

INSTRUCTION MANUAL

HIGH VOLTAGE DIGITMETER

MODEL 149-05A

KIKUSUI ELECTRONICS CORPORATION

78.4.4

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1. GENERAL

Kikusui Model 149-05A High Voltage Digitalmeter measures AC and DC voltages of up to 5 kV, with a high accuracy.

As the meter input impedance is as high as 1000 M Ω , the meter is best suited for measurement of voltages of high source impedance circuits.

The meter is compact and light, but its measuring accuracy is high. Thus the meter can also be used conveniently as a portable calibration instrument or to calibrate voltage of a withstanding voltage tester.

2. SPECIFICATIONS

External dimensions: 135 W × 165 H × 270 D (mm)
(Maximum dimensions): 135 W × 190 H × 345 D (mm)
Weight(net): Approx. 3 kg
Power requirements: 100 V $\pm 10\%$, 50/60 Hz AC, approx. 15 VA

Measuring ranges

2.5 kV range: 0.500 ~ 2.999 kV
5 kV range: 3.00 ~ 5.00 kV

Measuring accuracies

*AC 2.5 kV range: $\pm(1\%$ of rdg + 0.1% of f.s)
*AC 5 kV range: $\pm(1\%$ of rdg + 0.2% of f.s)
DC 2.5 kV range: $\pm(0.5\%$ of rdg + 0.1% of f.s)
DC 5 kV range: $\pm(0.5\%$ of rdg + 0.2% of f.s)
*(for sine wave, at 50 ~ 60 Hz)
at 23°C $\pm 10^\circ\text{C}$

Maximum allowable input voltages

AC: 5.5 kV rms (sine wave, 50 ~ 60 Hz)
DC: ± 7 kV
Pulse: ± 7.7 kV peak

Display

Figures: Digital nixie tubes
Polarity: "-" sign for negative DC voltage
Overflow: When the value has exceeded "2.999",
the display is fixed at "3.000" and
the "OVER" mark is displayed.
Sampling rate: 8 samples/sec

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Type of voltmeter: Integration-type pulse-width modulation,
mean value response, sine wave rms value
calibration

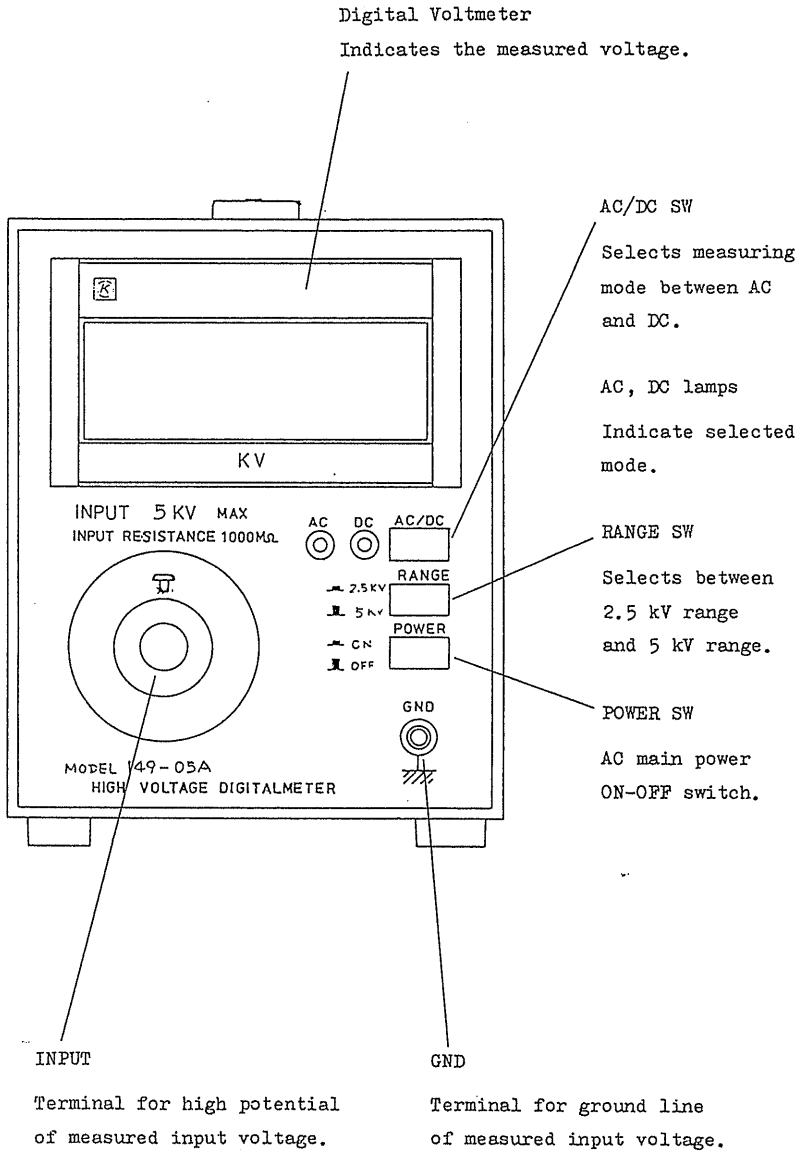
Input resistance: 1000 MΩ $\pm 2\%$

Ambient temperature and humidity: 5°C ~ 35°C, 75% RHmax.

Accessories: High voltage test cord 1 set

3. OPERATION METHOD

3.1 Explanation of Front Panel



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3.2 Explanation of Rear Panel

RATIO ADJ: Semi-fixed resistor for adjustment of voltage dividing ratio. Do not disturb the calibrated state, except when re-calibration is required.

GND terminal: For grounding the casing to the earth.

3.3 Measuring Method

- (1) Connect the AC power cord to an AC power line outlet of the correct voltage, and turn-ON the POWER switch. Allow more than 15 minutes of stabilization period.
- (2) Connect the metallic GND terminal of the rear panel to a good earth ground. Note that, unless the GND terminal is securely connected to the earth, a hazardously high voltage will be induced on the casing when the ground line from the measured voltage source is disconnected accidentally. Be sure to check the earth ground when using this instrument.
- (3) Securely connect the GND terminal of the front panel to the low line of the measured voltage source using the GND cord (supplied).
- (4) Insert the end of the HIGH VOLTAGE cord (supplied) for a sufficient length in the INPUT terminal on the front panel, and securely fix the cord with the vinyl screw (supplied). Note that serious hazards can be caused if the HIGH VOLTAGE cord is accidentally disconnected while in measurement.
- (5) Set the RANGE selector switch to suit the measured voltage.

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- (6) Set the AC/DC selector switch in accordance with the measured voltage. The meter will not be damaged even if a voltage is measured with a wrong setting of this selector switch, although the meter does not indicate the correct voltage.
- (7) Turn-ON the power of the measured voltage signal source after connecting the HIGH VOLTAGE cord to the INPUT terminal of the meter. The meter will digitally indicate the measured voltage.

3.4 Notes in Use

- (1) As afore-mentioned, be sure to connect securely both high voltage line and ground line between the meter and the measured voltage source. Note that, if the ground line is accidentally disconnected while the high voltage is being applied, electric shock hazards may be caused or the meter may be seriously damaged. Do not use other cord than the supplied one .
- (2) The meter input impedance is very high (1000 M Ω). When the voltage source impedance is substantially high, however, errors can be caused. In such a case, make correction calculation as follows:

$$E = E_o \left(1 + \frac{r_o}{1000 \text{ M}\Omega} \right)$$

where, E: True voltage
E_o: Meter reading
r_o: Source impedance of measured voltage

In most cases the value of source impedance (r_o) is unknown. In such cases, use the above equation as follows:

When $r_o \cong 10 \text{ M}\Omega$ for example,

$$E_o < E \cong 1.01 \times E_o$$

As above, when the source impedance is lower than $10 \text{ M}\Omega$, the error caused impedance-wise is less than 1%. Measurement can be done with an accuracy of this error plus meter accuracy.

- (3) Use the instrument within the specified ambient temperature and humidity range.
- (4) Calibrate the meter once a year or more frequently.
- (5) If the meter is used in dusty atmosphere or the meter is used continuously for a long time with a high voltage being applied to it, dust may be collected on the high voltage terminal section -- causing input resistance degradation or voltage dividing ratio disturbance. Clean at appropriate intervals the high voltage section and the internal insulators using a clean, dry cloth. To gain access to the internal components, remove the casing after undoing the screws at the four corners of the rear panel.
- (6) With the 2.5 kV RANGE, voltages up to 2.999 kV can be measured. If a voltage higher than this is applied, the readout is fixed at "3.000" and the "OVER" mark is displayed. In this case, switch the range to the 5 kV RANGE.
- (7) The AC/DC converter of this meter is a mean-value response system and is calibrated with the rms value of sine wave. Note, therefore, that errors may be caused if the measured voltage waveform is largely different from sine wave.

4. CALIBRATION

For meter calibration, turn-ON instrument power and allow more than 30 minutes of stabilization period and, then, proceed as follows referring to Fig. 4-1.

4.1 Calibration of Digital Voltmeter

- (1) Remove the front cover of the digital voltmeter (indicating meter).
- (2) Remove the case after removing the four clamping-screws at the four corners of the rear panel.
- (3) Apply to the "A" point of Fig. 4-2 the voltages as mentioned in the subsequent paragraphs.
- (4) Zero adjustment

Apply a reference voltage of 10 mV $\pm 1\%$ and so adjust the "+" ZERO ADJ semi-fixed resistor that the readout indicates "+10". Next, apply a reference voltage of -10 mV $\pm 1\%$ and so adjust the "-" ZERO ADJ semi-fixed resistor that the readout indicates "-10".

- (5) "+" full scale adjustment

Apply a reference voltage of 2.999 V $\pm 0.02\%$ and so adjust the "+" FULL SCALE ADJ semi-fixed resistor that the readout indicates "+2.999".

- (6) "-" full scale adjustment

Apply a reference voltage of -2.999 V $\pm 0.02\%$ and so adjust the "-" FULL SCALE ADJ semi-fixed resistor that the readout indicates "-2.999".

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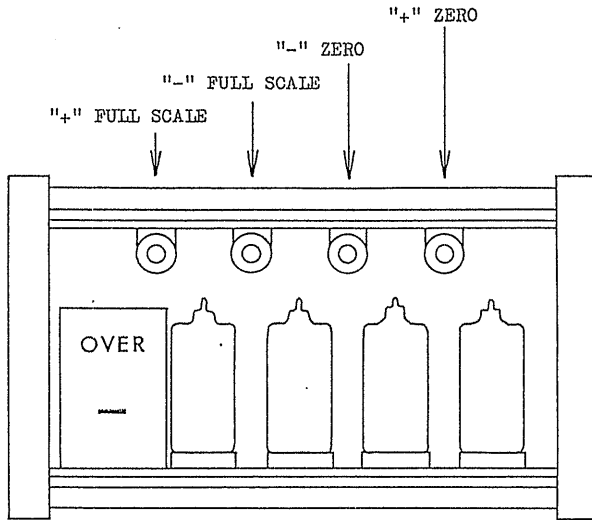


Fig. 4-1

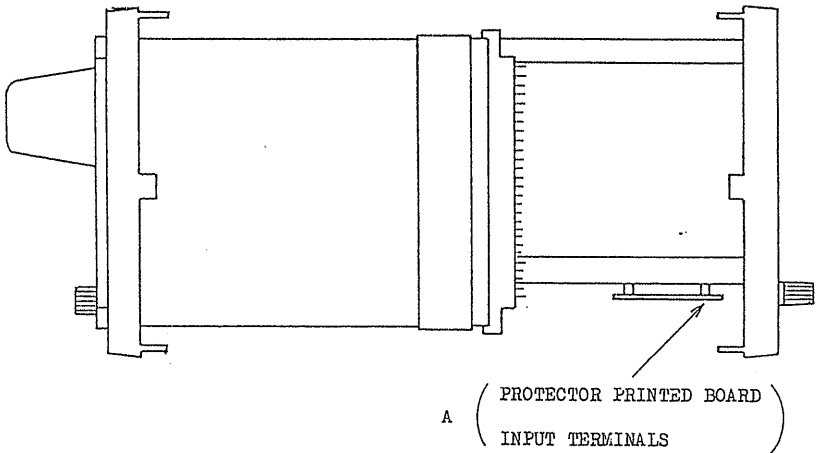


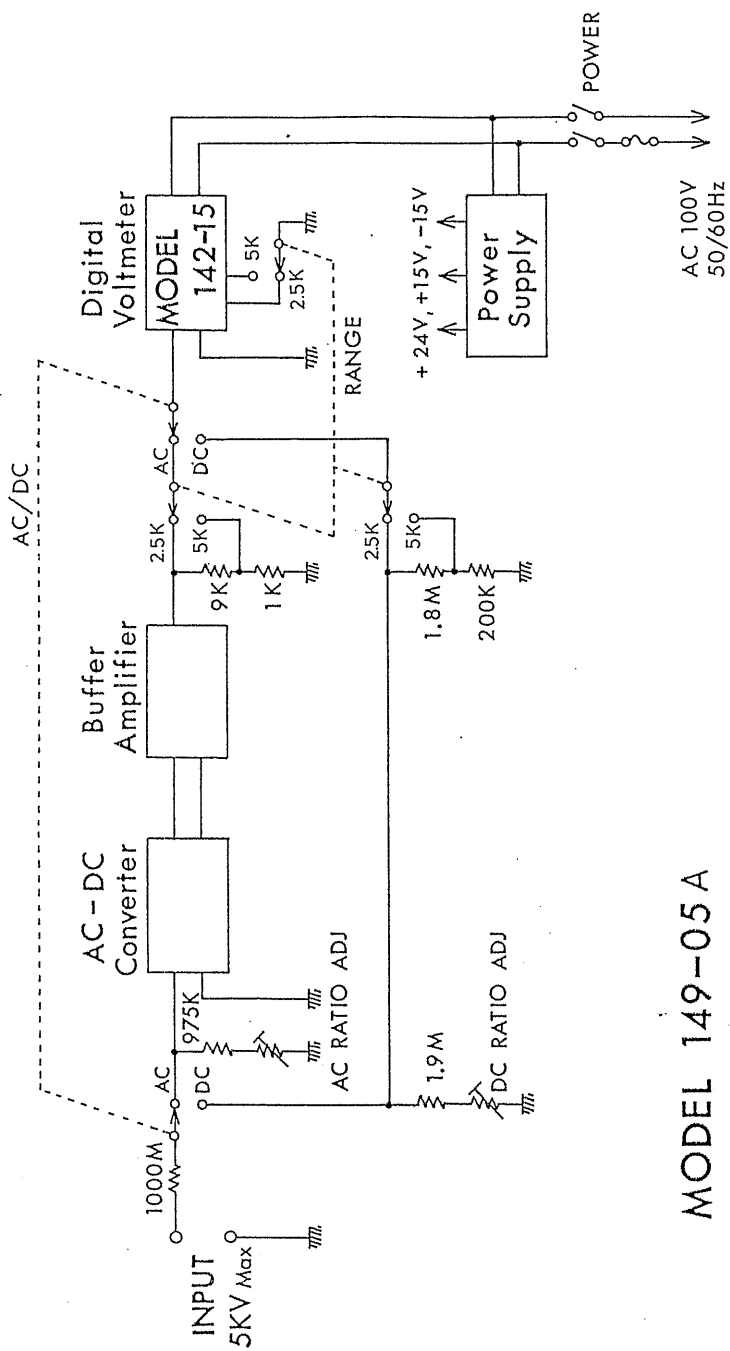
Fig. 4-2

4.2 Calibration of High-voltage Dividing Ratio

- (1) After the calibration of the digital voltmeter is complete, place the meter in the casing and allow more than 15 minutes of stabilization period.
- (2) Set the RANGE selector switch in the 2.5 kV position and the AC/DC switch in the AC position. Apply a reference voltage of 1.5 kV $\pm 0.1\%$ AC.
- (3) So adjust the AC RATIO ADJ semi-fixed resistor on the rear panel that digital voltmeter reads 1.500 kV.
- (4) Keeping the RANGE selector switch in the same position, turn the AC/DC switch to the DC position. Apply a reference voltage of 2.999 kV $\pm 0.05\%$ DC.
- (5) So adjust the DC RATIO ADJ semi-fixed resistor that the digital voltmeter reads 2.999 kV.

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Block diagram



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: ALL RESISTORS ARE IN OHMS.