KENWOOD

DISTORTION METER

HM-250

INSTRUCTION MANUAL

KENWOOD CORPORATION

CONTENTS

A product of

KENWOOD CORPORATION

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1. GENERAL

The model HM-250 is a precision distortion meter. It features continuous measurement from 20Hz to 20kHz, 0.1% full scale and 0.01% (typ.) of residual distortion rate.

Pushbutton switches on the panel offer one-touch operation and simplified calibration regardless of measurement ranges. Automatic tuning is adopted in the basic wave reduction circuit to eliminate complicated adjustments, enabling easy-to-use automatic operation.

The HM-250 can also be used as a 10Hz-to-200kHz, 100V full scale highly-sensitive AC voltmeter.

2. FEATURES

a. Automatic tuning offers easy operation.
b. High sensitivity : 0.1% full scale (distortion meter)
   100V full scale (voltmeter)
c. One-touch calibration
d. Has "X" and "Y" axis outputs for waveform observation.
e. small-sized, lightweight and easy to install and move.

3. SPECIFICATIONS

[Distortion Rate Measurement]

Range of measurement :
0.1 to 100% / F.S. in 7 ranges, in 1–3 steps (distortion rate ≦ 30%)

Input level range : 100mV to 100V (with 100% calibration)
30mV or more (automatic tuning possible)

Basic wave freq. range :
20Hz to 20kHz in 3 ranges, with a fine control

Residual distortion rate : 0.01% (Typical)
(at 1kHz, SENSITIVITY Control : max)

Higher harmonics : (2nd to 5th) Within ±1dB at 20Hz to 10kHz basic frequency
Within ±2dB at 10Hz to 20kHz basic frequency
* (Higher harmonics ≦ 60kHz, distortion rate ≦ 30%)

Basic wave rejection ratio :
80dB or more

[AC Voltage Measurement]

Range of measurement :
100μV to 100V/F.S. in 1–3 steps

Indication accuracy : within ± 3% of full scale (at 1kHz)

Residual noise : 5% or less of meter full scale (in 0.1mV range with closed input)

Frequency response : ± 0.5dB from 20Hz to 20kHz
± 1dB from 10Hz to 200kHz
(with respect to 1kHz)

[Common Specification]

Meter indication system :
Average value detection, effective value indication (Calibration based on input sine wave)

X-out characteristics : Outputs basic wave components in DM mode.
Output voltage : Approx. 1Vrms (when tuned with 100% calibration)

Output impedance : Approx. 2.2kΩ, unbalance

Y-out characteristics : Outputs higher harmonics in DM mode.
Outputs input signals in VM and CAL modes.
Output voltage : Approx. 0.5Vrms (in meter F.S. mode)
Output impedance : Approx. 2.2kΩ, unbalance

Input impedance : Approx. 100kΩ, 100pF or less

Max. input voltage : At 0dB attenuation
120Vrms or less (≦60Hz)
200VDC or less
(AC peak value + DC) ≦ 200V
At 30 or 60dB attenuation
140Vrms or less
200VDC or less
(AC peak value + DC) ≦ 200V

[Environmental]

Operating temperature and humidity :
0 to 40℃, 10 to 90% RH
(No dew concentration)

Storage temperature and humidity :
−10 to 50℃, 10 to 80% RH
(No dew concentration)

[Power Requirements]

Voltage & frequency : 100/120/220/240V AC ±10% (max. 250V), 50/60Hz

Power consumption : Approx. 5W

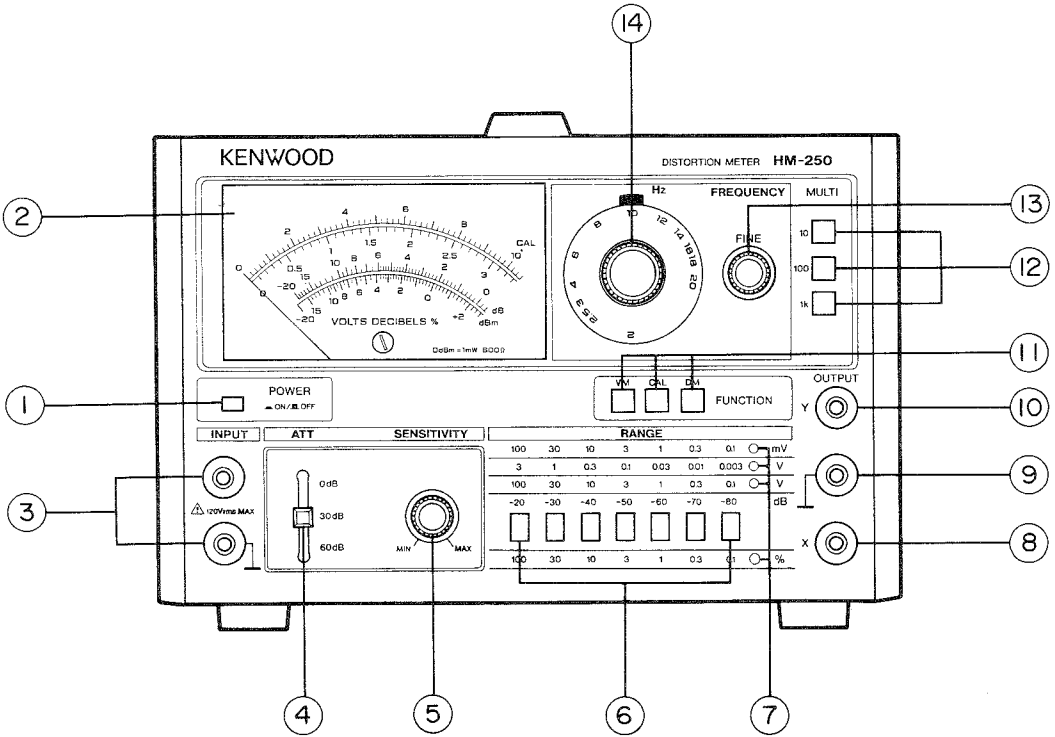
[Dimensions] 212W × 133H × 272Dmm

Max.dimensions : 212W × 156H × 288Dmm

[Weight] Approx. 3.7kg

[Accessories] Signal cable (with banana-alligator clips, 1 meter) : 1
Instruction manual : 1
Power cable : 1

4. PANEL EXPLANATION



① Power Switch (▬ ON/ ▬ OFF)
A push-button type switch that turns the power source on and off. Pressing the switch turns the power on. Pressing it again turns the power off.

② Meter
Indicates measured values.

③ INPUT Terminal
Input signals to be measured into this thrminal.

④ ATT (dB) Switch
Attenuates input signals. Three attenuation levels are available : 0, 30 and 60dB.

⑤ SENSITIVITY control
Controls the calibration level.

⑥ RANGE selector switch
Selects the meter range. 7 ranges are available in 1–3 steps.

⑦ Measurement range indicator lamps
Indicate the mode selected with the FUNCTION switch ⑪ and the meter range selected with the ATT switch ④.

⑧ X–OUTPUT terminal
This terminal outputs basic wave in the DM mode. Used together with the Y–OUTPUT terminal for easy frequency adjustment by displaying Lissajous waveforms on an oscilloscope.

⑨ ⏚
GND terminal of this meter.

⑩ Y–OUTPUT terminal
This terminal outputs higher harmonics in the DM mode, or it outputs the input signal in the VM or CAL mode. In the DM mode, the terminal is used the same way as the X-OUTPUT terminal.

⑪ FUNCTION selector switch
Selects any of the following three measurement modes :
VM : AC voltmeter mode
CAL : Calibration mode
DM : Distortion meter mode

⑫ MULTI Switch
Selects 10, 100, or 1kHz range.
Set the FREQUENCY dial to ×10, ×100 or ×1000 position for each range.

⑬ FINE adjustment
A knob for frequency fine adjustment.

⑭ FREQUENCY (Hz) adjustment
A dial for frequency rough adjustment.

5. PRECAUTION FOR USE

a. Do not apply excessively high voltage to the input terminal.
b. Do not apply voltage to the output terminal.
c. Do not press any pushbutton twice or more.
d. The supply voltage should be within the rating voltage ±10% (Max. 250V).
e. Use the meter at an ambient temperature from 15 to 35℃. Do not place the meter close to a heat generating object.
f. Do not apply excessive force to the meter, dial, input terminal, etc.
g. Wipe dirt off the panel, etc. with soft cloth. Use weak neutral detergent for dirt if it cannot be wiped off with cloth only.
h. If power supply contains pulse noise, a higher value may be indicated or monitor waveform may be influenced.

6. OPERATING PROCEDURE

◎ Power ON
connect the attached power cable to the meter and a wall socket. Press the POWER switch ① and power is supplied to the meter.

◎ Prior to applying input signal
Excessive input signal may damage this meter. Before applying input signal, set the switches as follows :
ATT switch ④ : 60 (dB)
RANGE switch ⑥ : Press the left button.
In the VM mode, the full scale of this meter is 100V under the above setting.

Note : The following table shows the relationship between the maximum input voltages and settings of the ATT switch ④. If applied voltage is higher than specified in the following table, the meter is damaged. Never apply a voltage higher than specified.

ATT Setting	Max. Input Voltage *
0 (dB)	120 VAC rms or less, 200 VDC or less
30 (dB)	140 VAC rms or less, 200 VDC or less
60 (dB)	140 VAC rms or less, 200 VDC or less

* (AC peak value + DC) ≦ 200V

Table 1 Maximum Input Voltage

6–1 AC Voltage Measurement

Depending on the settings of the ATT and RANGE switches, this meter measures input voltage from 0.1mV to 100V. If the ATT switch is set to 0dB, the upper scale of the RANGE switch 0.1mV to 100mV is selected. If the ATT switch is set to 30dB, the mid scale 0.003V to 3V is selected. If the ATT switch is set to 60dB, the lower scale 0.1V to 100V is selected. If the level of input signal is unknown, select the lowest sensitivity range as described in the previous paragraph.

The impedance of the input terminal is 100kΩ. The maximum input voltage is as shown in Table 1. Adjust the ATT and RANGE switches so that the meter reads a value from 1/3 of the full scale and the full scale.

(1) How to read voltage

Three meter ranges are available for AC voltage measurement. The right lamp indicates a selected range. The numbers above the pressed RANGE switch in the row indicated by the lamp show the selected range.

In the example shown in Fig. 1, the 0.1V range is selected. Division 10 on the meter corresponds to 0.1V. The ATT switch and the measurement range indicator lamp correspond to each other in the vertical direction.

Note : If the level of input signal is unknown, be sure to set the ATT and meter range to the minimum sensitivity, then apply input signal.

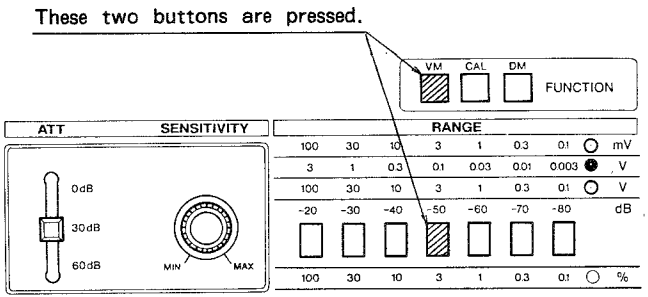


Fig. 1

(2) How to read dB value

Numbers below the RANGE switches ⑥ indicate dB values. Numbers −20dB to −80dB correspond to the voltages when the ATT switch ④ is set to 0dB. In other ATT settings, dB values corresponding to the voltages are obtained by adding the setting (number) of the ATT to the number of dB scale.

In other words, 0dB on the meter in each setting can be obtained by adding the dB value of a pressed RANGE switch to the dB value of the ATT switch. In the example shown in Fig. 1, 0dB on the meter is −20dB (−50dB + 30dB = −20dB).

Note : The input impedance of this meter is 100kΩ. If impedance of the input signal source is high, use care for errors (due to load effect).

6–2 Measurement of Distortion Rate

(1) How to set calibration level

For measuring distortion rate, input signal must be calibrated to a constant level. This is called calibration operation, which is performed as follows on this meter using the ATT (dB) and SENSITIVITY ⑤ (calibration level control) :

1. Press the CAL button of the FUNCTION ⑪.
2. Adjust the ATT (dB) and SENSITIVITY so that the meter reads the full scale value (at the CAL position).

If the level of input signal is between 0.1 to 3V, set the ATT (dB) to 0dB. It it is between 3 to 100V, set the ATT (dB) to 30dB. The level between 0 to 30dB can be adjusted continuously with the SENSITIVITY ⑤. For distortion rate measurement, do not set the ATT ④ to 60dB.

(2) Tuning

Distortion rate measurement requires tuning of the notch filter for removing the basic waves. This meter provides automatic tuning. However, rough adjustment shall be carried out manually.

1. Press the leftmost button (100%) of the RANGE ⑥.
2. Press the DM (distortion rate measurement) button of the FUNCTION ⑪.
3. Set the MULTI (frequency range selector) switch ⑫ in accordance with the basic frequency. The frequency ranges are as follows :

   10 : 20Hz to 200Hz

   100 : 200Hz to 2kHz

   1k : 2kHz to 20kHz
4. Adjust the FREQUENCY dial ⑭ (frequency rough adjustment) and FINE knob ⑬ (frequency fine adjustment) to decrease the value indicated on the meter. When the value indicated on the meter lowers below 15%, increase the meter range sensitivity to read indication. The numbers in the lowest row (with lamp ON) indicate the range for distortion rate measurement.

Frequency adjustment is facilitated by connecting the X ⑧ and Y ⑩ OUTPUT terminals of this meter to an oscilloscope as shown in Fig. 2 and observing Lissajous waveforms on the oscilloscope.

Note that automatic tuning is deactivated if the meter range is set to 100 or 30%.

The scale on the FREQUENCY dial is for rough adjustment and is not accurate.

The FINE knod enables fine adjustment of ±10% for 20 divisions on the FREQUENCY dial and ±1% for 2 divisions. Set the FINE knob to the center usually.

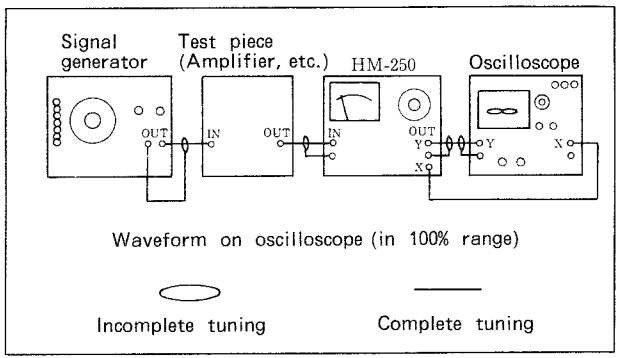


Fig. 2 Lissajous Waveform Monitoring

(3) Measurement of signal level to distortion rate characteristics

Tuning is needless for signals at the same frequency with different level. Measurement can be performed in a short time as follows :

1. Press the CAL button of the FUNCTION ⑪.
2. Adjust the meter to its full scale with the ATT (dB) ④ and SENSITIVITY ⑥.
3. Press the DM button of the FUNCTION.
4. Set the meter range again, if necessary, and read indication.
5. Repeat operations 1 to 4 above.

If the frequency has been changed, tuning is required. Follow the instructions below :

1. Press the CAL button of the FUNCTION.
2. Adjust the meter to its full scale with the ATT (dB) and SENSITIVITY.
3. Set the meter range to 100%.
4. Press the DM button of the FUNCTION.
5. Set the meter indication to a value below 15% with the MULTI, FREQUENCY and FINE.
6. Boost the sensitivity of the meter and read its indication.
7. Repeat operations 1 to 6 above.

(4) Analyzing higher harmonics using Lissajous waveform

Observing Lissajous curve formed by the comparison of distortion (higher harmonics) and the basic waves enables simple analysis of higher harmonics. Fig. 3 shows an example.

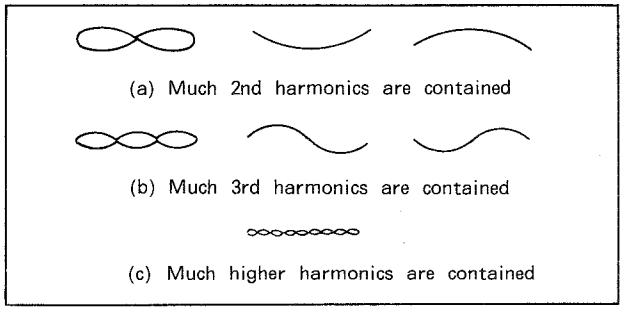


Fig. 3 Higher Harmonics Analysis using Lissajous Waveform

6–3 Usage as Band-Pass Filter

The X OUTPUT terminal outputs signals through a band-pass filter. Usage of this terminal is the same as described in paragraph 6–2 Distortion Rate Measurement above. The X OUTPUT terminal is invalid for AC voltage measurement. The meter range shall be set to 100% or 30%.

To set the center frequency of the band-pass filter, maximize the level of intended signal while observing the level of the signals output from the X terminal. At this time, adjust the signal level properly through calibration described in 6–2–(1) to avoid saturation of the internal circuit.

The selectivity of the band-pass filter Q is approx. approx. 5.

Q=(center frequency)/(band width at −3dB point)

6–4 Outputs

Details of the X and Y outputs of this meter are as follows :

X output : Outputs the basic wave (for distortion rate measurement)
Approx. 1Vrms when tuned to 100% calibration.

Y output : Outputs higher harmonics (for distortion rate measurement) or input signal (for AC voltage measurement).
Approx. 0.5Vrms at the full scale of the meter.

The impedance of the both outputs is approx. 2.2kΩ. Using the Y OUTPUT terminal enables the user to use this meter as a low noise amplifier. Its gain varies depending on the meter range settings.

It is 74dB (5000 times) in the 0.1mV range, or −46dB (0.005 time) in the 100V range. Note that the Y output signals a certain crossover distortion.

Note : If signals are applied to the X or Y OUTPUT terminal, the meter is damaged. Never apply signals to these terminals.