KENWOOD

2 CHANNEL AC VOLTMETER

VT-175

INSTRUCTION MANUAL

KENWOOD CORPORATION

CONTENTS

1. GENERAL

The Model VT-175 is dual-channel electronic voltmeter sets having two independent AC voltmeters in a single cabinet. Two-pointer meter allows easy dual measurements and inter-channel comparisons.

MODEL VT-175 is wideband, high sensitive voltmeter for use anywhere voltage measurements are made, with a remote control unit. The easy-to-use voltmeter provides frequency response as wide as 5Hz to 1MHz, measurable range from 1mV to 300V, and input impedance of 10MΩ.

2. FEATURES

a. Two power source circuits, positive and negative, are provided for very stable DC bias and recover from any overload in a very short time.

b. Small-sized compact construction is easy to carry and large-sized two-pointer meter is easy to read.

c. Four-scale dial plate and red and black pointers allow quick, and accurate voltage reading.

d. Number of adjusting trimmers are minimized with amplifiers that are precisely calculated in open loop gains and are negative feedbacked through metal-film resistors as accurate as 1%
Amplifier characteristics therefore are from secular change.

e. Input impedance is as high as 10 MΩ on all ranges and its parallel capacitance less than 45 pF

f. Indirect attenuator switching by relay and FET (field-effect transistor) switch provides higher reliability, signal-to-noise ratio, and inter-channel crosstalk than most previous direct method of rotary switch.

g. Ranges can be remotely selected using the RT-61 (option).

h. Two channel range setting can be made either individually or together (in interlocked manner).

i. A ground mode selector may float measuring circuit above ground.

3. SPECIFICATIONS

[Meter Section]

Measurable voltages :	1 mV–300V in 12 ranges : 1 mV, 3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 3 V, 10 V, 30 V, 100 V and 300 V. full scales.
dB :	−80～+50dB (0dB = 1 V).
dBm :	−80～+52dBm (0dBm = 1 mW, 600Ω).
Error :	Within ± 3% of full scale at 1kHz.
Frequency response :	± 10% at 5Hz～1MHz, ± 5% at 10Hz～500kHz and ± 3% at 20Hz～200kHz as ± 2% at 30Hz～100kHz referenced to 1kHz response.
Input impedance :	10MΩ ± 5%, with less than 45 pF parallel capacitance.
Durable input voltage :	500V (DC+AC peak) at 1V～300V range 100V (DC+AC peak) at 1mV～300mV range
Stability :	Within ± 0.5% of full scale for ± 10% line voltage fluctuation.

Residual voltage : Less than 20μV with input shorted on 1mV range.

Crosstalk, Individual : Less than −80dB with other input terminated with 600Ω

Inetrlock : Less than −50dB with other input terminated with 600Ω.

[Amplifier Section]

Gain : Approx. 60dB.

Output voltage : 1Vrms (Full scale) ±20%

Output impedance : 600Ω± 20%

Distortion : Less than 1% at full scale. (Rated by signal-to-noise ratio in 1mV and 1V ranges.)

Signal-to-noise ratio : Over 40dB at full scale.

Frequency response : Within ± 3dB at 5Hz～500kHz

[Environmental]

Coefficient : ± 0.08%/ °C

Temperature (within specification) : 10～40℃

(full operation) : 0～50°C

Relative humidity : Less than 80%

[Power Supply Section]

Line voltage : 100, 120, 220V AC ± 10%,
216 − 250V AC, 50/60Hz

Power consumption : Approx. 7W

[Dimensions] W×190(212)H×238(268)Dmm.
Values in ( ) include protrusions.

[Net weight] 3kg

[Accessories]

Power cable : 1pc.

Input cable : BNC cord, 2pcs.

Replacement fuse : 0.3A 2pcs.
0.5A 2pcs.

Instruction manual : 1copy.

4. FUNCTIONAL CONTROLS

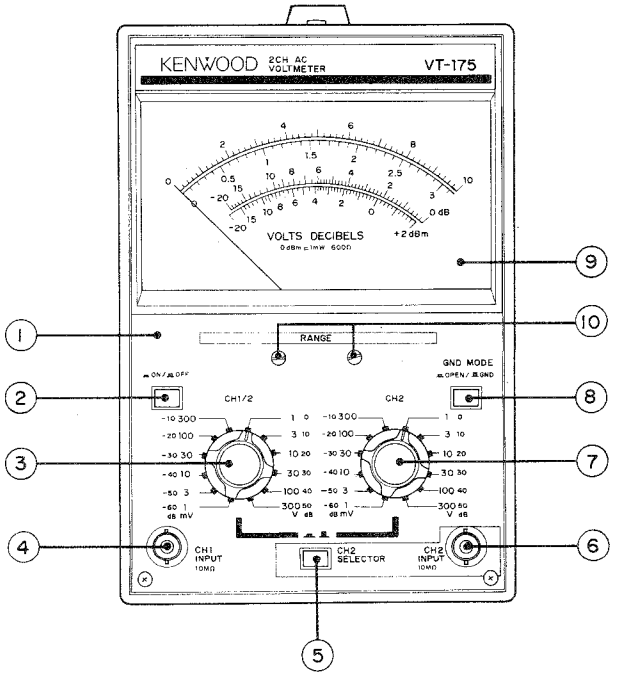

Figure 1 – Front Panel View

Front Panel (see Figure 1)

REFERENCE No.	IDENTIFICATION	DESCRIPTION
①		Power-on indicator (LED)
②	ON OFF	on-off switch
③	RANGE-CH 1/2	Channel 1 and 2 attenuator selector
④	INPUT 1	Channel 1 input connector
⑤	CH2 SELECTOR	Individual-interlock range setting selector
⑥	CH2 INPUT	Channel 2 input connector
⑦	RANGE-CH 2	Channel 2 attenuator selector
⑧	GND MODE	Negative input floating switch
⑨		Dual-pointer meter
⑩		Meter zero-adjust trimmer CH1(left), CH2(right)

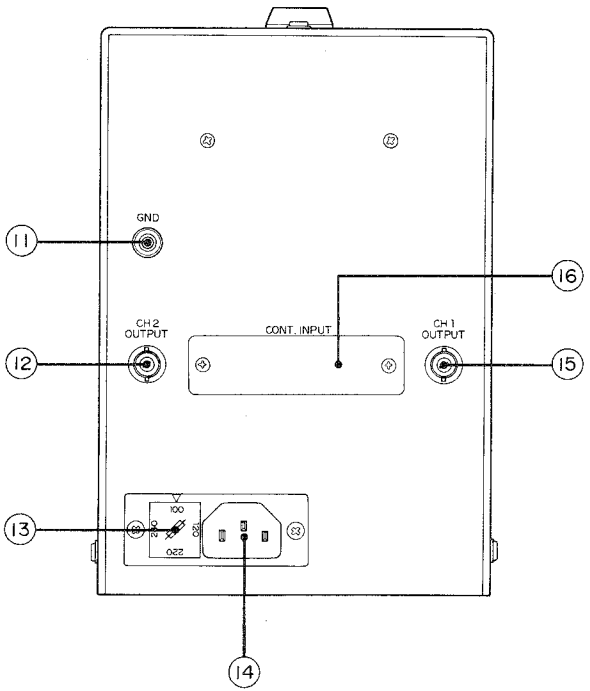

Figure 2 – Rear Panel View

Rear Panel (see Figure 2)

REFERENCE No.	IDENTIFICATION	DESCRIPTION
⑪	GND	Casing grounding post
⑫	CH2 OUTPUT	Channel 2 monitor output connector
⑬		Line voltage selector and fuse holder
⑭		Power cable connector
⑮	CH1 OUTPUT	Channel 1 monitor output connector
⑯	CONT. INPUT	Remote control mounting hole

5. OPERATION

• **Set-up**

(1) Press the ON/OFF Pushswitch② in. The Power-on indicator①, a light-emitting diode, will light, indicating that power has been applied.

(2) Plug the signal calbes into the CH1 INPUT and CH2 INPUT connectors ④ and ⑥.

(3) CH2 SELECTOR⑤, with the switch released (▀), takes single mode in which Ranges CH1 and CH2 are changed over uging Attenuators CH1/2③ and CH2⑦, respectively.
With the switch pressed (▬), the SELECTOR takes inter lock mode in which both Ranges CH1 and CH2 are simultane-ously changed over using Attenuator CH1/2③. In the interlook mode, Attenuator CH2⑦ is no longer operable to select a Range.
Select either single or interlook mode according to your particular measurement.

(4) Set the RANGE-CH1/2 selector③ and the RANGE-CH2 selector⑦ to "300V." To measure an AC voltage superimposed on a DC voltage, be sure to set the selectors to the positions before connecting the cables to points to be measured. ´ erwise, the DC voltage causes a high surge, which could burn voltmeter.

(5) GND MODE⑧ is effected with the switch released (▀), in which both CH1 and CH2 are connected to the grounding terminal of the casing, taking GND state. with the switch pressed (▬), the grounding of CH1 and CH2 is floated to OPEN state in which you move the earth point to the signal source side. Normally use the device in the GND state.

(6) Connect the cables to points to be measure.

(7) Turn the selectors ③ and ⑦ for proper ranges until each Meter pointer switngs over one third of the fullscale.

(8) OUTPUTs CH2 ⑫ and CH1 ⑮ provide output signals by amplifying input signals in such a degree as the signal amplitude of a meter full-scale becomes 1 Vrms no matter which range is set.

(9) Read the Meter.

(1) Voltage Scales

See Figure 3

There are two black voltage scales : a scale Ⓐ graduated 0 to 10 and a scale Ⓑ 0 to 3. When the RANGE selector ③ is at "1V", for example, the division 10 on the scale Ⓐ indicates 1V. At the "300 mV" position, the division 3 on the scale Ⓑ indicates 300 mV. Similarly, the other RANGE selector positions show their full scale values.

(2) dB Scale

In general, the dB values are expressed in dBV which is a unit referenced by 0dB equal to 1 V. The division 10 at the scale Ⓐ corresponds to 0 dB on the dB scale, which is a voltage ratio scale. Since the RANGE selector has 12 range positions in steps of 10 dB, the voltage ratio of 1 mV to 300V is 110 dB attenuation. Assume a reference voltage level on the scale Ⓐ be 1V with the RANGE selector at "1V," a given voltage can be read as low as −60dB (1mV) by turning the selector downward. Further, as the scale A allows reading to −20dB (0.1mV), you can continuously measure the voltage ratio as high as −80dB (0.1mV to 1V). The read of −80dB means a signal-to-noise ratio of around 10dB. Also, the dB scale allows continuous measuring up to +50dB (1 to 300V) by turning the selector upward.

(3) dBm Scale

In general, voltmeters have a reference level division of 0dBm equal to 0.775V (1mW power) induced across a 600Ω resistance load. Therefore, the dBm scale is available to measure a power level referenced to 0 dBm, with the impedance of the given power circuit being 600Ω pure resistance. Where measured across specific resistance loads, for example, 10kΩ, other than the 600Ω load, the levels are sometimes expressed in dBs.

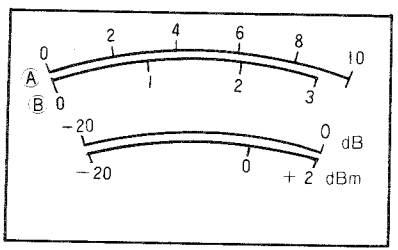

Figure 3 – Meter Scale Graduation

- **How to Use Remoto Control**

The RT–61 option, a remarkable feature of the VT–175, provides a remote control capability. To use the option, remove the case and the rear-panel blind plate, install the connector supplied with the RT–61, then plug the RT–61 into the 16-pin connector on the print circuit board. For details, refer to the RT–61 Instruction Manual.

6. APPLICATIONS

The basic use of your voltmeter is to measure sinusoidal wave voltages as an AC voltmeter. In addition, it provides a wide variety of applications as described below.

Amplifier Gain Measurement

Voltmeter is capable of measuring an amplifier gain, which is a signal magnification from point A to B in Figure 4 with a signal generator connected to the amplifier input. If the measured signal levels at points A and B are a and b dB, respectively, then the gain is (b–a) dB.

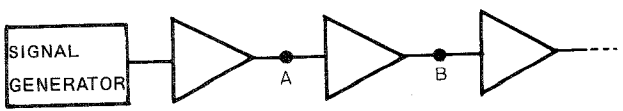

Figure 4 – Amplifier Gain Measurement

Also the method is applicable for measuring an open loop gain of each amplifier circuit with the negative-feedback signal leaves applied. Further, the method can be used for measu) the frequency responses of given

circuits by changing the signal generator frequency. Voltmeter is capable of directly reading a gain between two points as having two independent voltmeters. As an example, let us calculate the open loop gain (from point A to B) of the negative-feedback amplifier shown in Figure 5. Assume that the measured level at point A be +1.5dB on the −60dB range of the channel 1 and that of point B −4dB on the +10dB range of the channel 2. The gain from point A to B is then

(+10dB − 4dB) − (−60dB + 1.5dB) = 64.5dB.

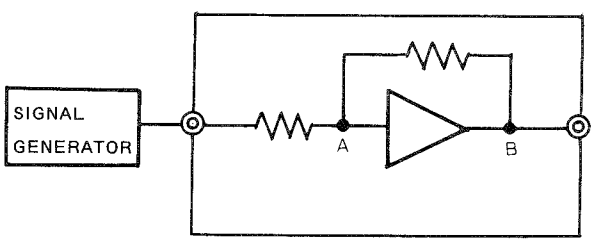

Figure 5 − Negative Feedback Amplifier Gain Measurement

Voltage Calculations of Some Special Waveforms

An voltmeter of absolute-mean value indication type, reads root-mean-square values of sinusoidal wave inputs. Also it deflects the pointers in proportion to the absolute-mean value of a given input wave.

If the form factor (= root-mean-square value/absolute-mean value) of the input wave and the crest factor (= peak value/root-mean-square value) are known; then the root-mean-square value and peak value can be calculated as follows.

Assume the Meter read x.

- Absolute-mean value = $\frac{2\sqrt{2}}{\pi}$ x ≒ 0.9x
- Root-mean-square value = (Absolute-mean value) × (Form factor).
- Peak value = (Root-mean-square value) × (Crest factor).

For rectangular waves, their form factor and crest factor are unity (1).

- Aboslute-mean value = $\frac{2\sqrt{2}}{\pi}$ x ≒ 0.9x
- Root-mean-square value = 0.9x.
- Peak value = 0.9x.

For sawtooth waves, their form factor is $2/\sqrt{3}$ and the crest factor $\sqrt{3}$.

- Absolute-mean value= $\frac{2\sqrt{2}}{\pi}$ x ≒ 0.9x.
- Root-mean-square value= $\frac{2\sqrt{2}}{\pi} \times \frac{2}{\sqrt{3}}$ x = $\frac{4\sqrt{2}}{\pi\sqrt{3}}$ x ≒ 1.04x
- Peak value= $\frac{4\sqrt{2}}{\pi\sqrt{3}} \times \sqrt{3}$ x = $\frac{4\sqrt{2}}{\pi}$ x ≒ 1.8x.

Ways To Better Dual-Channel Voltmeter Operation

The two input channels and two meter pointers arranged specifically in Voltmeter are most useful for measuring an electronic equipment having two signal sources. For example, Voltmeter is far more convenient for measuring stereo left and right channel characteristics than using two units units of usual single-channel voltmeter.

(1) Frequency response

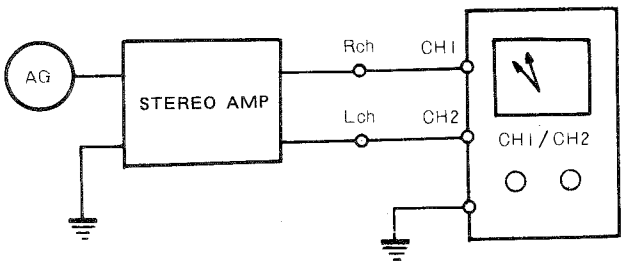

Figure 6 – Stereo Amplitier Frequency Response Measurement

CH2 SELECTOR swich to pressed (interlock position) as most stereo amplifiers are not deviated vertually in the left and right channel levels. Set the GND MODE switch to "GND." If the given stereo amplifier output has no connector common to the left and right channels, then turnt he switch to "OPEN" and connect the GND post on the rear panel of voltmeter to that of the stereo amplifier.

(2) Crosstalk characteristic

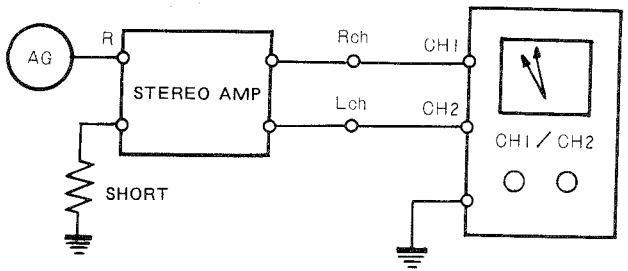

Figure 7 – Stereo Amplifier Crosstalk Measurement

Crosstalk measurement is needed if there is a large difference between the left and right channel output levels. CH2 SELECTOR Pushbutton to release(individual position). Set the RANGE-CH1/2 selector and RANGE-CH2 selector to proper posi-tions for ease of read. Set the GND MODE switch for no adverse effect by hum as explained in above Example (1), the "Frequency response"

7. MAINTENANCE

Replacing the fuse (see Figure 8)

REPLACING FUSE

When a fuse goes out, the device is no longer operable. If gone out, check for a trouble cause, remedy it, remove the cap of the fuse holder on the rear panel using a minus screw driver and take it out and replace the fuse with a new one.

When replacing fuse, be sure to check the capacity of a new fuse for a specified value as follows:

AC 100V, 120V : 0.5A

AC 220V, 240V : 0.3A

CHANGEOVER OF VOLTAGE IN SWITCHING REGULATOR

Remove the fuse holder on the rear side of the device set, using a minus surew driver, adjust your preferred voltage indication with ▼ mark and plug the holder in. For changing 100V or 120V to 220V or 240V, change the fuse of 0.5A to that of 0.3A.

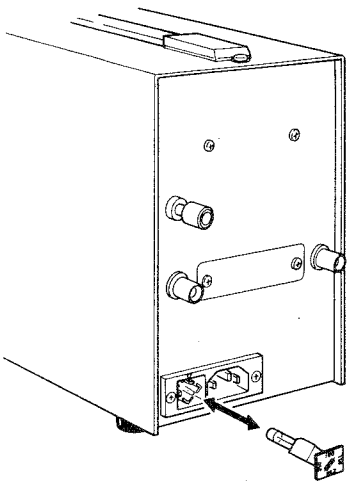

Figure 8 – Replacing the fuse

8. ALIGNMENT

Voltmeter was presicely aligned at the factory. However it can be aligned through the adjust holes located on the side with leaving is housed in the casing, if required. In realignment, first adjust the line to the rated voltage, use a precisely calibrated measuring instruments, and proceed as follows.

Preset Controls on Side Panel (see Figure 9)

The following controls, placed on the Main PC board, are to be preset on the right-hand side panel.

IDENTIFICATION	DESCRIPTION
TC101	First Attenuator preset trimmer capacitor
VR101	First Attenuator preset variable resistor
VR102	Meter Amplifier gain preset variable resistor

1. Before turning the ON/OFF switch "ON," adjust the Meter zero-adjust screws (right for channel 1 and left for channel 2) on the front panel until the pointers correctly indica "0".

2. Set the CH2 SELECTOR pushbatton to release (individual position).
3. Connect a voltmeter calibrator 1 kHz (or 400 Hz) output to the INPUT connector④.
4. Set the RANGE-CH 1/2 selector③ on your VT-165 to the "30 mV" range and set the voltmeter calibrator output voltage to 30 mV.
5. Adjust VR102 until the pointer swings to the fullscale.
6. In turn, set the RANGE-CH1/2 selector③ to the "10V" range and set the voltmeter calibrator output voltage to 10V.
7. Adjust VR101 until the pointer swings to the full-scale.
8. Disconnect the voltmeter calibrator and connect a wideband signal generator to the CH1 INPUT connector④.

9 Set the signal generator frequency to 1 kHz and set the RANGE-CH 1/2 selector ③ on voltmeter to the "1V" range.

10. Adjust the signal generator output level until the pointer swings to the fullscale.
11. Change the signal generator frequency from 1 kHz to 50 kHz.
12. Adjust TC101 until the pointer swings to the full-scale.
13. Repeat Steps 3 through 10.
14. For channel 2 alignment, similary proceed with Steps 3 through 13.

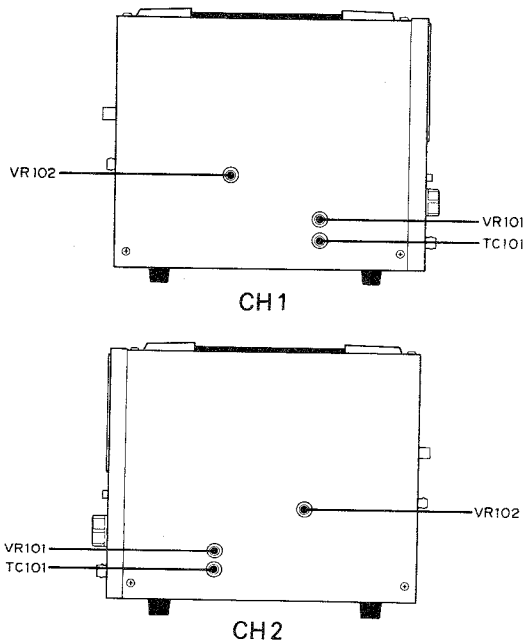

Figure 9 – Pres. Controls on Side Panel

9. CAUTIONS FOR USE

1. Your voltmeter will work just when the ON/OFF switch is pressed in. For accurate measurements, wait around five minutes for warm-up.
2. Avoid placing your voltmeter where magnetic field and electric field are too strong.
3. The input signal cable other than supplied should be low-capacitance shielded cable, or coaxial cable. For measurements at higher than audio frequencies, terminate the input connectors with 50Ω or 600Ω, resistor.
4. The continuous maximum input voltage allowable for your voltmeter is 100V (DC+ACpeak) with the RANGE selector at "−60dB" to "−10 dB". Full care should be observed in measuring high voltages.
5. Be careful of a line noise and similar small noises as your voltmeter is a highly sensitive voltmeter.
6. Do not leave your VT-175 at any of high temperature and humidity places for a long period of time.
7. As having two channel independent voltmeter, your voltmeter is involved in selection of grounding point on some equipment udner measurement. Set the GND MODE switch to "OPEN" and connect the GND post of your voltmeter to a point where noise effect is minimized.
8. The ON/OFF switch of this unit is designed to act on the secondary side of the power transformer. The primary side of the transformer remains energized even if the ON/OFF switch is set to OFF. Therefore, if the unit is to be unused for a long time, the power cord should be unplugged from the receptacle outlet.

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