

INSTRUCTION MANUAL

AC VOLTMETER

AVM13
AVM15
AVM23
AVM25
AVM23R
AVM25R

The specifications of this product and the contents of this Instruction Manual are subject to change without prior notice.

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Printed in Japan.

Power Requirements of this Product

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.

(Revision should be applied to items indicated by a check mark ☒)

☐ Input voltage

The input voltage of this product is _____ VAC,
and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

The rating of this product's input fuse is _____ A, _____ VAC, and _____.

WARNING

- To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.
- Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

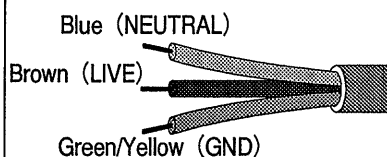
☐ AC power cable

The product is provided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

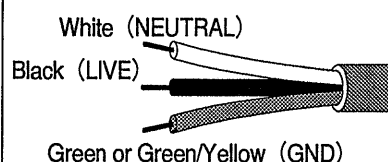
WARNING

- The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

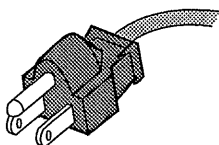
☐ Without a power plug



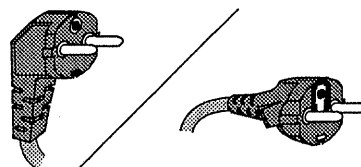
☐ Without a power plug



☐ Plugs for USA



☐ Plugs for Europe



☐ Provided by Kikusui agents

Kikusui agents can provide you with suitable AC power cable.
For further information, contact your Kikusui agent.

☐ Another Cable _____

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1. GENERAL

This instruction manual is applicable to the six models of AVM Series AC Voltmeters as shown in the following table:

Model	Pointers	Main scales	Sensitivity	Remote control of ranges	GND MODE selector
AVM13	Single pointer (1 CH)	1, 3 V rms	300 μ V rms	-	Without
AVM15	Single pointer (1 CH)	15, 50 dB	500 μ V rms	-	Without
AVM23	Dual pointers (2 CH)	1, 3 V rms	300 μ V rms	-	With
AVM25	Dual pointers (2 CH)	15, 50 dB	500 μ V rms	-	With
AVM23R	Dual pointers (2 CH)	1, 3 V rms	300 μ V rms	Available	With
AVM25R	Dual pointers (2 CH)	15, 50 dB	500 μ V rms	Available	With

These AC Voltmeters are capable of measuring AC voltages of 10 Hz - 500 kHz. The response characteristics of the pointers are of mean-value response. The scales are calibrated with root-mean-square values for sinusoidal waveform inputs. Range selection of the Dual-pointer Voltmeters (Models AVM23, AVM25, AVM23R, and AVM25R) can be made with the two channels directly linked together or with the two channels linked together providing a certain differential level between them, as well as it can be made independently for each of the two channels. Also, these models of voltmeters are incorporated with a GND MODE selector so that the circuit ground can be connected to or floated from the case ground.

Models AVM23R and AVM25R Voltmeters are capable of remote control of range selection. The remote control signal used for this purpose is a positive-logic TTL-level binary-coded signal with 4 bits per channel. The Remote Controllers which can be used for this purpose are RC01-AVM, RC02-AVM, RC01-ORC, and RC02-ORC. When the IF01-AVM (GP-IB interface) is used, digital data corresponding to pointer deflection can be sent to the CPU making use of the range selection control signal and DC output signal of the voltmeter.

All of the six models of Voltmeters are provided with an AC output terminal which delivers an output signal of approximately 0.1 V rms for full scale. Models AVM23R and AVM25R Voltmeters are provided with a DC output terminal which delivers an output signal of 1 V ($\pm 3\%$) for full scale.

2. SPECIFICATIONS

2.1 Specifications Common to All Models

- (1) Meter scales:
 - 1; Rms value of sinusoidal wave
 - 2; dBV value with reference to 1 V rms as 0 dB
 - 3; dBm value with reference to 1 mW, 600 Ω
- (2) Input terminals: BNC receptacles
- (3) Input impedance: Approx. 1 M Ω , with 55 pF or less in parallel
- (4) Accuracy: $\pm 3\%$ FS (at 1 kHz)
- (5) Frequency response:
 - 10 Hz - 500 kHz, $\pm 5\%$ with reference to response at 1 kHz
 - 20 Hz - 200 kHz, $\pm 3\%$ with reference to response at 1 kHz
- (6) Noise: Not greater than 4% FS

With input terminals shorted and GND MODE switch set to GND.

(7) AC output

Output voltage: Approx. 0.1 V rms (when at full scale and no load)

Output resistance: Approx. 600 Ω

Frequency response: 10 Hz - 500 kHz, $\begin{smallmatrix} +1 \\ -3 \end{smallmatrix}$ dB (with reference to response at 1 kHz, when no load)

Output terminals: BNC receptacles

- (8) Operating ambient temperature and humidity: 5°C to 35°C (41°F to 95°F), 85% or less

- (9) Power requirements: 90 V - 126 V, 194 V - 253 V,
selectable with plug; 50/60 Hz AC
- (10) Dimensions: 134 W x 180 H x 250 D mm
(5.28 W x 7.09 H x 9.84 D in.)
Maximum dimensions: 140 W x 250 H x 295 D mm
(5.51 W x 8.07 H x 11.61 D in.)
- (11) Accessories: Instruction manual ----- 1
Fuse, 0.1 A S.B ----- 1

2.2 Power Consumptions and Weights

AVM13, AVM15: Approx. 5VA, approx. 2.8 kg (6.2 lbs)

AMV23, AVM25, AVM23R, AVM25R: Approx. 8VA, approx. 3.1kg (6.8lbs)

2.3 Measuring Voltage Ranges

AVM	mV							V					
13 23 23R	0.3	1	3	10	30	100	300	1	3	10	30	100	
15 25 25R	0.5	1.5	5	15	50	150	500	1.5	5	15	50	150	
	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	dB

2.4 Maximum Allowable Input Overvoltages (DC + AC peak)

300 μ V - 100 mV ranges and 500 μ V - 150 mV ranges: 120 V

300 mV - 100 V ranges and 500 mV - 150 V ranges: 500 V

(AC components not higher than 1 kHz, application period not longer than 1 minute)

2.5 Isolation of Circuit Ground from Case Ground [AVM23, 25, 23R, 25R]

- (1) Resistance: Approx. 100 k Ω (with GND MODE switch set to OPEN)
- (2) Allowable voltage: ± 15 V DC (with GND MODE switch set to OPEN)

2.6 DC Output [AVM23R, 25R]

- (1) Output voltage: 1 V $\pm 3\%$ (1 kHz, full scale, no load)
- (2) Output resistance: Approx. 600 Ω
- (3) Ripples: Not greater than 50 mVp-p (10 Hz, full scale, no load)
- (4) Output terminals: BNC receptacles

2.7 Remote Control of Range Selection [AVM23R, 25R]

- (1) Remote control terminal: Amphenol 57-40240 equivalent
- (2) Range selection signal: Positive-logic binary-coded signal

Range		mV							V		
AVM23R		0.3	1	3	10	30	100	300	1	3	10
AVM25R		0.5	1.5	5	15	50	150	500	1.5	5	15
DIO 0	DIO 4	0	1	0	1	0	1	0	1	0	1
DIO 1	DIO 5	0	0	1	1	0	0	1	1	0	0
DIO 2	DIO 6	0	0	0	0	1	1	1	1	0	0
DIO 3	DIO 7	0	0	0	0	0	0	0	0	1	1
R/L 1		0	0	0	0	0	0	0	0	0	0
Input 1	Input 2										

*GND1 *GND2

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1: H
0: L
x: Don't Care

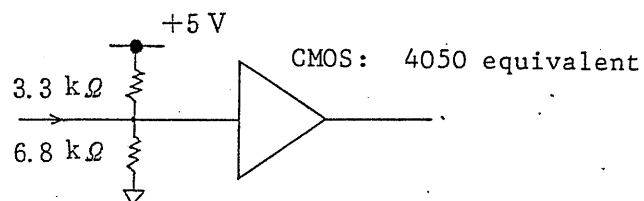
V						Set manually on front panel
30	100					
50	150					
0	1	0	1	0	1	x
1	1	0	0	1	1	x
0	0	1	1	1	1	x
1	1	1	1	1	1	x
0	0	0	0	0	0	1

(3) Electrical performance

Signal level: TTL

Maximum allowable voltage: +15 V DC, -0 V DC
(with respect to GND1 and GND2, respectively)

Equivalent circuit of input circuit



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3. NOTES BEFORE USE

3.1 Unpacking and Inspection

When the instrument is delivered to you, please immediately inspect it for any damage that might have been sustained when in transportation. If any sign of damage is found, immediately notify the transportation company and your Kikusui agent.

3.2 AC Line Voltage

The instrument can operate on an AC line voltage of 90 - 126 V or 194 - 253 V, 50/60 Hz AC. Either voltage can be selected with the voltage selector plug. Check that the plug is set in the correct position for the AC line voltage on which the instrument is going to be operated.

- * Also check that the fuse is the correct one for the AC line voltage. The fuse for the 90 - 120 V range is 0.2 A (regular) and that for the 194 - 253 V range is 0.1 A (S.B). Both fuses are of a tubular type.

Normally the instrument is shipped being set at the 90 - 126 V range and with a 0.2-A (regular) fuse. To operate it on a 194 - 253 V line voltage, change the setting of the plug and replace the fuse with the 0.1-A (S.B) fuse (supplied).

A 3P plug is provided at the end of the power cord. To connect the plug to a 2P AC line receptacle, use the AC Plug Adaptor (supplied) for 3P to 2P conversion.

- * Be sure to use the adaptor only for the 90 - 126 V range.

The casing of the instrument can be grounded by grounding the leadwire of the adaptor.

- * The uncovered metallic terminal on the rear panel of the instrument also is a ground terminal. It is most recommendable to securely ground this terminal before connecting the power plug to an AC line receptacle.

3.3 Operating Environments

Do not operate the instrument being exposed to direct sunlight and do not place it near a source of heat. Note that the longevity of the instrument will be badly shortened if it is operated in such adverse environments as dust, gases, chemicals, or vibration.

When operating the AVM23R or AVM25R in the remote-control range selection mode with an external device, pay attention to EMI (electromagnetic interferences) such as logic noise which may be radiated by the external device. To prevent interferences, lay the logic signal wires apart from the input terminals and separate power sources may be used.

3.4 Mechanical Zero Adjustment of Indicating Meter

Before turning on the instrument power, check that the pointer(s) of the indicating meter is at the zero point of the meter scale. If it has been deviated, adjust it accurately to the zero point. If the instrument power has been on, turn it off and allow 3 minutes or more of discharge time before starting mechanical zero adjustment.

3.5 GND MODE Switch [Dual-pointer Models]

The INPUT 1 circuit and the INPUT 2 circuit are mutually independent, and their circuit ground lines are floated from the case ground. The GND MODE switch selects between the OPEN mode (the circuit ground is floated from the case ground) and the GND mode (the circuit ground is connected to the case ground). When in the OPEN mode, the instrument can operate even with a potential difference between GND 1 ($\nabla 1$) and GND 2 ($\nabla 2$), provided that the potential difference is not greater than 30 V and their potentials with respect to the case ground is within ± 15 V. The GND mode can be used only when the GND 1, GND 2, and the case ground are at the same potential.

- * Never throw the GND MODE switch to the GND position when the instrument is operating in the OPEN mode with a potential difference between the GND 1 and the GND 2 or between the GND 1 or GND 2 and

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the case ground. If the switch is changed to the GND mode when in this state, an abnormally large current which can cause damage to the instrument may flow. Be sure to disconnect the cables of the measured points before changing this switch.

3.6 Circuit Ground and Case Ground (When GND MODE Switch Is Set To GND)

When the GND MODE switch of the dual-pointer voltmeter is set to the GND position, the circuit ground is connected to the case ground through a resistor of approximately 47 ohms. This mode, therefore, can be used when there is no potential difference between the circuit ground and the case ground.

- * The term "circuit ground" as used here means the potential of the outer conductor of the input terminal (BNC receptacle). The same applies to the output terminals. (For details, refer to description of output terminals in Section 4.)

If there is a potential difference between the circuit ground and case ground, damage may be caused to the instrument. Pay attention to this especially when the GND terminal (uncovered metallic terminal) on the rear panel is used. Also pay attention so that the case of instrument is not contacted with that of other instrument which has a potential.

- * Following the above description, similarly handle single pointer models.

3.7 Remote Control Connector [AVM23R, 25R]

The remote control connector is used for remote control of the voltmeter with the following models of devices.

- RC01-AVM (8-point preset, single channel)
- RC02-AVM (8-point preset, dual channels)
- RC01-ORC (8-point preset, with scanning, for single channel)
- RC02-ORC (8-point preset, with scanning, for dual channels)
- IF01-AVM (GP-IB interface)

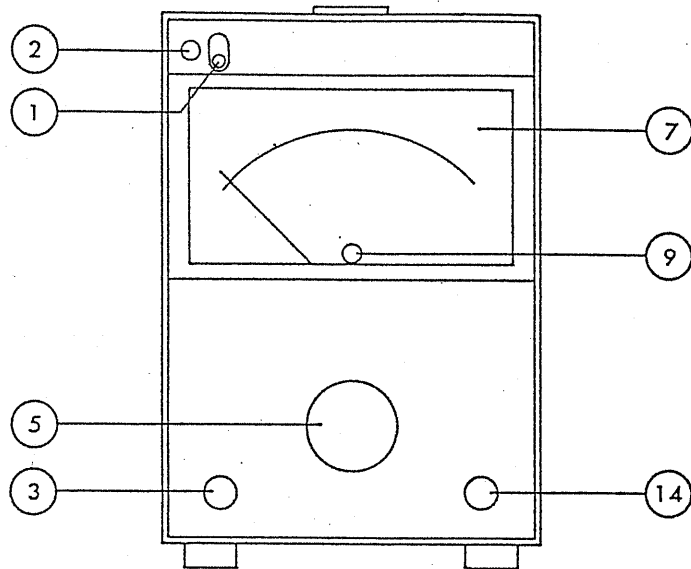
Further description of the remote control connector is given at a later part of this instruction manual. For the use of the remote control terminal in special conditions, please contact your Kikusui agent.

3.8 Others

The specifications are subject to change without notice.

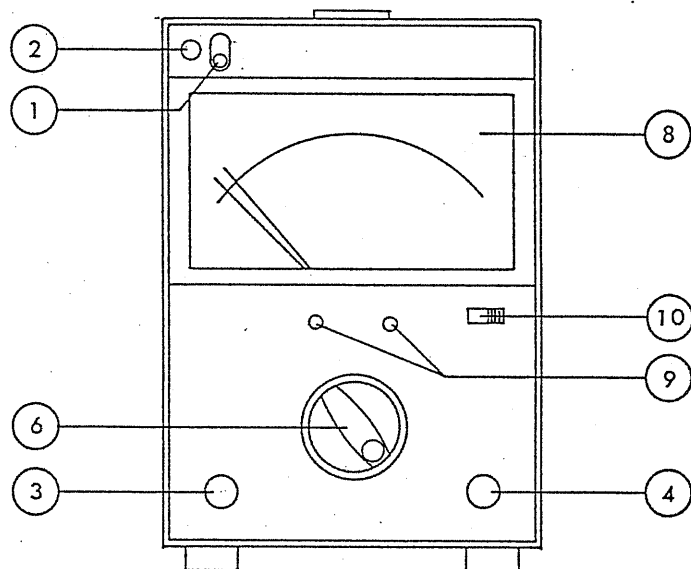
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AVM 13, 15



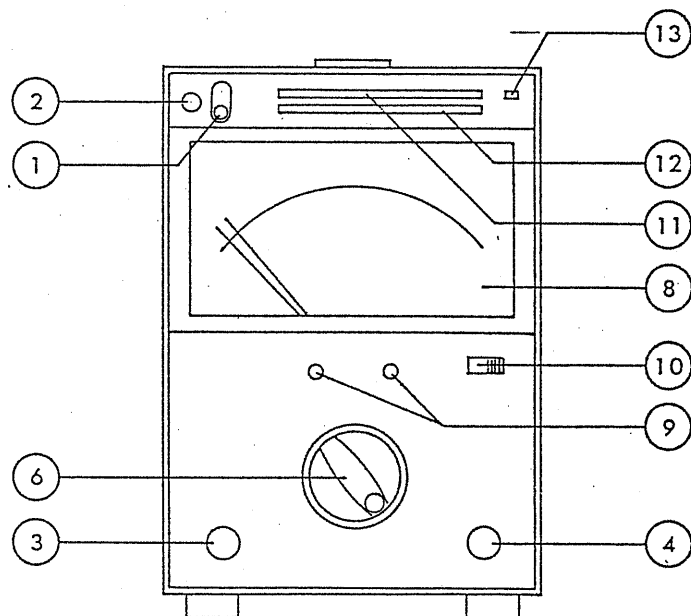
(1)

AVM 23, 25



(2)

AVM 23R, 25R

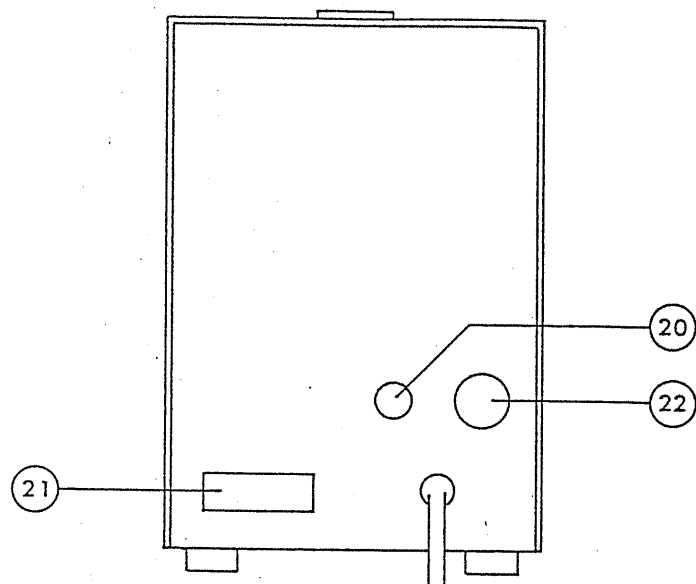


(3)

Figure 1. External views of Front Panels

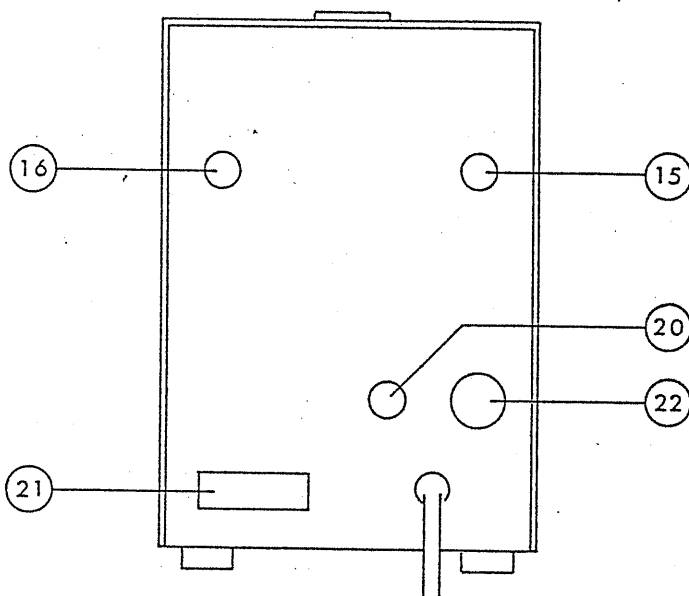
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AVM 13, 15



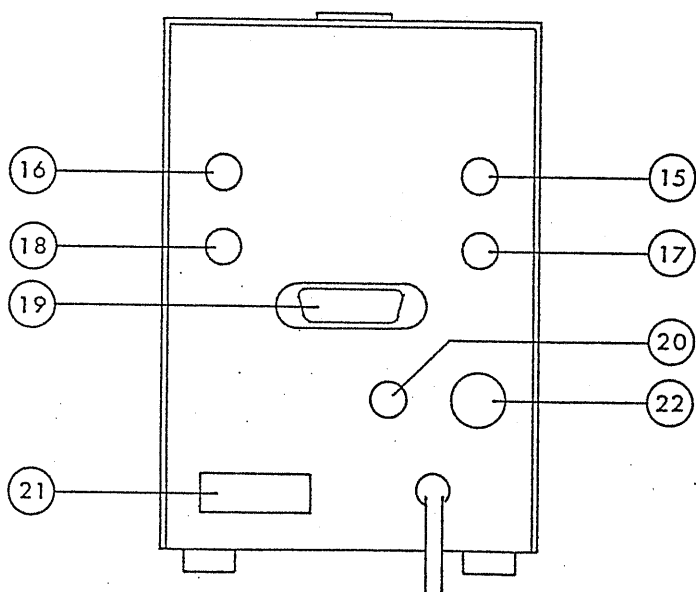
(1)

AVM 23, 25



(2)

AVM 23R, 25R

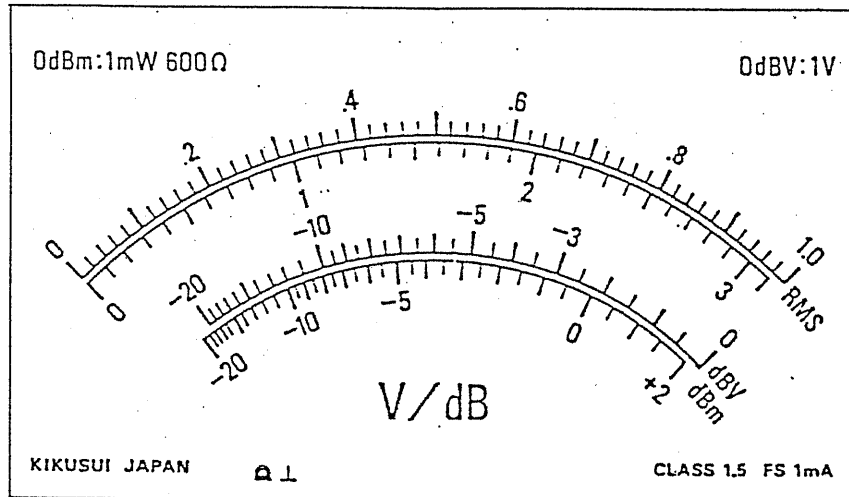


(3)

Figure 2. External views of rear panels

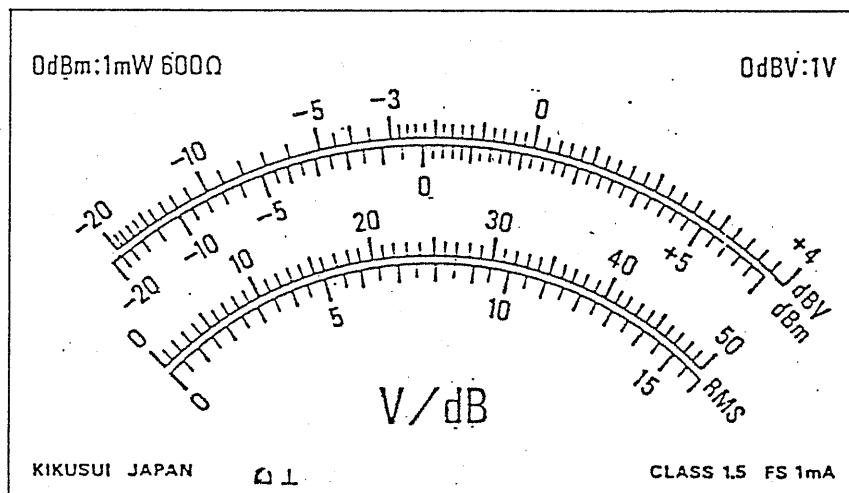
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AVM 13, AVM 23, AVM 23 R



(1)

AVM 15, AVM 25, AVM 25 R



(2)

Figure 3. Meter Scales

4. OPERATION METHOD

4.1 Description of Front Panel Items (See Figure 1.)

- ① POWER switch
- ② POWER indicator lamp (LED)
- ③ INPUT terminal (INPUT 1 for dual-pointer voltmeter)

To connect the input signal to be measured.

* Do not apply an input voltage exceeding the specified maximum allowable input overvoltage (DC+AC peak) as follows:

300 μ V - 100 mV	}	ranges: 120 V max. (1 kHz or lower, within 1 minute)
500 μ V - 150 mV		

300 mV - 100 V	}	ranges: 500 V max. (1 kHz or lower, within 1 minute)
500 mV - 150 V		

- ④ INPUT terminal

This terminal is for INPUT 2 for dual-pointer models only.
Its functions are identical with those of INPUT 1 terminal.

- ⑤ RANGE switch

To select the measuring range by switching an attenuator in 10-dB steps.

- ⑥ RANGE switches

To select the measuring ranges by switching attenuators in 10-dB steps. The black knob is for INPUT 1 and the red knob for INPUT 2. The two switches moves in gang or independently, as set by the lock button.

* Of the AVM23R and 25R, the set ranges are indicated by RANGE indicator lamps (LED's) ⑪ and ⑫. When the REMOTE lamp ⑬ is on, these RANGE switches remain idle.

- ⑦ Indicating meter

To indicate the measured value. The meter has voltage scales and decibel scales. For details, see Figure 3.

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⑧ Indicating meter

This indicating meter is identical with that of ⑦ except that this indicating meter has two pointers. The black pointer is for INPUT 1 and the red pointer is for INPUT 2.

⑨ ZERO adjustment

Mechanical zero adjustment of the indicating meter.

⑩ GND MODE switch

The INPUT 1 circuit and the INPUT 2 circuit are mutually independent. When the GND MODE switch is set to the OPEN position, the circuit ground lines (outer conductors of BNC terminals) are electrically floated from the case through a resistor of approximately 100 k Ω for each channel and the voltmeter can measure two signals mutually independently.

When the GND MODE switch is set to the GND position, each of the circuit ground lines is connected to the case through a resistor of approximately 47 Ω which is sufficiently low as compared with the input resistance (approximately 1 M Ω).

⑪ RANGE indicator lamps (LED's)

To indicate the selected range of INPUT 1. The selected range is indicated regardless of whether in the local or in the remote mode of operation.

⑫ RANGE indicator lamps (LED's)

Identical with those of ⑪, except that these lamps are for INPUT 2.

⑬ REMOTE CONTROL STATUS indicator lamp (LED)

This lamp lights when range selection operation is made via the remote control connector ⑭. When operated in this mode, the RANGE switch ⑥ of AVM23R and AVM25R remains idle.

⑭ OUTPUT terminal

This AC output terminal delivers a signal proportional to the voltmeter indication. The signal is approximately 0.1 V rms for the full scale indication of the voltmeter at each range

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and the signal is employed to monitor the measured voltage or to use the voltmeter as an amplifier. For the single-channel voltmeters, the OUTPUT terminal is provided on the front panel.

- * Do not apply any external voltage signal to the OUTPUT terminal. If an output voltage signal is applied to this terminal, the voltmeter may be damaged.
- * The outer conductor of the OUTPUT terminal is connected to the circuit ground (the outer conductor of the input terminal) via a resistor of approximately 10 ohms. Therefore, the outer conductor of the OUTPUT terminal must not be connected in common with that of the INPUT terminal. That is, the signal to be measured must not be connected between the HOT line (the inner conductor of the input BNC receptacle) and the outer conductor of the OUTPUT terminal.

4.2 Description of Rear Panel Items (See Figure 2.)

⑮ OUTPUT terminal

This AC output terminal delivers a signal proportional to that of INPUT 1. Its function is identical with that of ⑭. The outer conductor of the OUTPUT terminal is not at the same potential with that of the outer conductors of the BNC receptacles of the OUTPUT terminals ⑯, ⑰ and ⑱, and therefore the former outer conductor must not be connected to the latter conductors as is the case of ⑭.

- * The output voltage is approximately 0.1 V rms for the full scale indication of the voltmeter at each range.

⑯ OUTPUT terminal

This AC output terminal delivers a signal proportional to that of INPUT 2. Its function is identical with that of ⑮.

⑰ OUTPUT terminal

This DC output terminal delivers a signal proportional to that of INPUT 1. The signal is approximately 1 V $\pm 3\%$ (at 1 kHz)

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for the full scale indication of the voltmeter at each range. The requirements regarding the outer conductor of the BNC terminal are identical with that of (14).

* By applying the output signal of this OUTPUT terminal to the analog input terminal (A5 - A8) of GP-IB Interface of IF01-AVM, the voltage measured by this voltmeter can be converted into digital data and fed to GP-IB. For details, refer to Section 4.6 "Remote Control of Range Selection."

(18) OUTPUT terminal

This DC output terminal delivers a signal proportional to that of INPUT 2. Its function is identical with that of (17).

(19) REMOTE CONTROL connector

This connector (Amphenol 57-40240 equivalent) is used for remote control of range selection of the voltmeter. When the voltmeter is locally operated with its front panel controls, the connector pins should be kept open (the connector should be disconnected).

(20) GND terminal

The ground terminal of the voltmeter casing.

(21) AC LINE VOLTAGE SELECTOR plug

To select the AC line voltage on which the voltmeter is to be operated. Align the arrowhead mark to the voltage range indication. Be sure to disconnect the power cord plug from the line power receptacle before changing the setting of the plug. Change the power fuse also in conformity with the AC line voltage. (For details, refer to Section 3.2.)

(22) Fuse holder

The fuse rating is 0.2 (regular) amperes for 90 - 126 V or 0.1 (S.B) ampere for 194 - 253 V.

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4.3. Measuring Procedure

- (1) Turn on the POWER switch. The POWER indicator lamp (LED) will light.

- * The meter pointer may deflect irregularly. The same may occur also when the POWER switch is turned off.

- (2) Set the range switch to the maximum input range (100 V for AV13, 23 or 23R, or 150 V for AV15, 25 or 25R).
- (3) Apply the signal to be measured to the INPUT terminal.
- (4) Turn counterclockwise the RANGE switch to the position where the pointer deflect with the maximum deflection angle without overscale.

- * The range switch has no rotation stoppers.

- * Note that the pointer may transientially deflect overscale when ranges are changed.

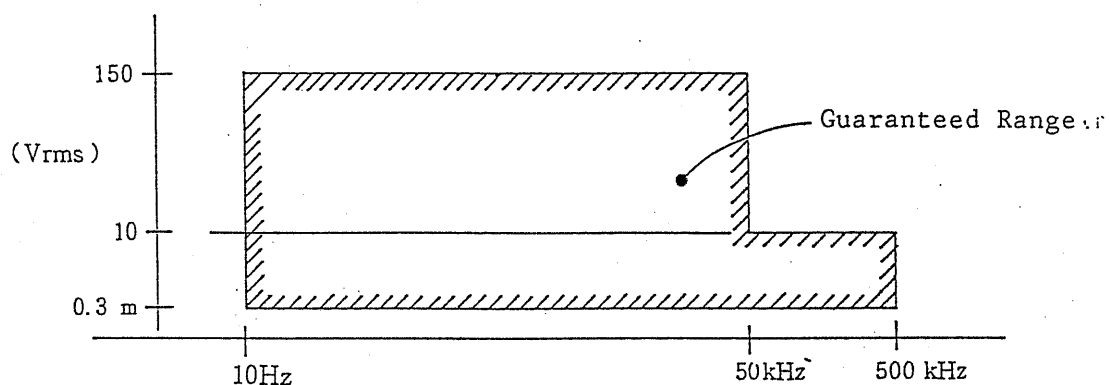
- * When in the remote control mode of range selection, the selected range is indicated by the RANGE indicator lamps (LED's).

- (5) Read the value on the scale corresponding to the range setting.
- (6) For the operation method of the GND MODE switch of the dual-pointer voltmeters, refer to Section 3.5 and Section 4.1 10 . Note that, when operated in the OPEN state, a resistance of approximately 100 k Ω and a stray capacitance of approximately 350 pF are connected in parallel between the circuit ground and the case ground.

4.4 Frequency Range for Guaranteed Accuracy

The frequency range for which the measuring accuracy is guaranteed differs by the input voltage as illustrated in the following.

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4.5 Signal Waveforms and Indication Errors

The indicating meter is of a mean-value response type and its scales are calibrated in rms values. It is calibrated with reference to the ratio between the mean value and the rms value of a pure sinusoidal waveform with very less distortions. When input signals with distortions (harmonics) are measured, indication errors are caused as shown in the following table:

Input signal	Rms value	Meter indication
Fundamental frequency only	100	100
(Fundamental frequency) + (10% 2nd harmonic frequency)	100,5	100
(Fundamental frequency) + (20% 2nd harmonic frequency)	102	100 - 102
(Fundamental frequency) + (50% 2nd harmonic frequency)	112	100 - 110
(Fundamental frequency) + (10% 3rd harmonic frequency)	100,5	96 - 104
(Fundamental frequency) + (20% 3rd harmonic frequency)	102	94 - 108
(Fundamental frequency) + (50% 3rd harmonic frequency)	112	90 - 116

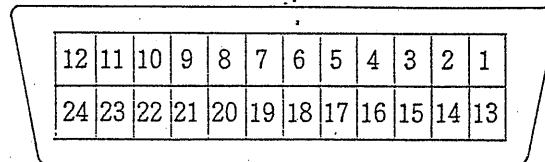
* As measured with fundamental frequency at 1 kHz

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4.6 Remote Control of Range Selection [AVM23R, 25R]

4.6.1 Pin Layout of Remote Control Connector

REMOTE



Amphenol 57-40240
receptacle

No.	Name	I/O	No.	Name	I/O
1	DIO 0	Input	13	DIO 4	Input
2	DIO 1	Input	14	DIO 5	Input
3	DIO 2	Input	15	DIO 6	Input
4	DIO 3	Input	16	DIO 7	Input
5	DEVICE 0	Output	17	D GND	-
6	DEVICE 1	Output	18	D GND	-
7	DEVIDE 2	Output	19	D GND	-
8	VALID	Input	20	D GND	-
9	R/L 1	Input	21	NC	-
10	R/L 2	Input	22	NC	-
11	+5V 2	Output	23	GND 2	-
12	+5V 1	Output	24	GND 1	-

4.6.2 Description of Signals

The signals for the remote control connector pins are explained in this section. The numbers enclosed in the brackets are the pin numbers.

(1) DIO 0 - 3 [1 - 4]: Level signals, GND 1 system

DIO 4 - 7 [13 - 16]: Level signals, GND 2 system

The signals of DIO 0 - 3 are for range selection of INPUT 1 and the signals of DIO 4 - 7 are for that of INPUT 2. These signals are positive-logic binary-coded signals with their bits assigned as shown in the following table.

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* As explained later, the ground system of DIO 0 - 3 and that of DIO 4 - 7 are mutually independent as the ground systems of INPUT 1 and INPUT 2 are mutually independent.

Range		mV							V		
AVM23R		0.3	1	3	10	30	100	300	1	3	10
AVM25R		0.5	1.5	5	15	50	150	500	1.5	5	15
DIO 0	DIO 4	0	1	0	1	0	1	0	1	0	1
DIO 1	DIO 5	0	0	1	1	0	0	1	1	0	0
DIO 2	DIO 6	0	0	0	0	1	1	1	1	0	0
DIO 3	DIO 7	0	0	0	0	0	0	0	0	1	1
R/L 1		0	0	0	0	0	0	0	0	0	0
Input 1	Input 2										

•GND1 •GND2

1: H
0: L
×: Don't Care

Becomes effective
when R/L 1 is "L".

V						Manual operation with panel controls
30	100					
50	150					
0	1	0	1	0	1	×
1	1	0	0	1	1	×
0	0	1	1	1	1	×
1	1	1	1	1	1	×
Q	0	0	0	0	0	1

(2) DEVICE 0 - 2 [5 - 7]: Level signals, GND 1 system

These bits are used to notify the properties (status) of the voltmeter to the external controller. Normally, these bits are not used. When the voltmeter is shipped, all of these bits are set open.

(3) R/L 1 [9]: Level signal, GND 1 system

This bit selects between the remote control mode of range selection with an external device or the local control mode of range selection with the front panel controls of the voltmeter..

- * If this pin is kept open, the voltmeter operates in the local mode. When in the local mode, data of DIO 0 - 7 is ignored.
- * When in the remote mode, the REMOTE lamp on the front panel lights and the RANGE switch remains idle. Range selection is dictated by the DIO 0 - 7 signals.
- * R/L 2 [10] is not used by these voltmeters. Keep this pin in the open state.

(4) VALID [8]: L active pulse signal, GND 1 system

Not used in these voltmeters.

- * This pin is not a spare pin. Do not use it as a junction pin for signal connection.

(5) +5V 1 [12]: Supply voltage, GND 1 system

+5V 2 [11]: Supply voltage, GND 2 system

These pins are for the DC supply voltages for the remote controller. The voltages are +4 V to +4.5 V, typically. The current ratings are 10 mA. The voltages are supplied with mutually different ground systems.

+5V 1 - GND 1, +5V 2 - GND 2

- * Do not short between +5V 1 and GND 1 or between +5V 2 and GND 2 since such will cause troubles.
- * The remote controllers which can be used for this purpose are as follows:

RC01-AVM, RC02-AVM, RC01-ORC, RC02-ORC

(6) GND 1 [24]: Ground of INPUT 1, GND 1 system

GND 2 [23]: Ground of INPUT 2, GND 2 system

These pins are for the circuit ground lines of the voltmeter, for INPUT 1 and INPUT 2 respectively and mutually independently.

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* It is allowable to short between GND 1 and GND 2. Note, however that, if these pins are shorted, the circuit ground lines of INPUT 1 and INPUT 2 are shorted, and setting of the GND MODE switch to the OPEN position becomes meaningless. Pay attention especially when measuring signals of points with respect to GND 1 ($\nabla 1$) and GND 2 ($\nabla 2$) which are at different potentials.

* The internal remote control signals also are mutually independent between GND 1 system GND 2 system.

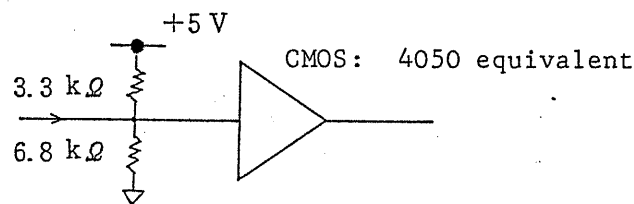
(7) D GND [17 - 20]: Ground, GND 1 system

These pins are for ground lines for remote control logic signals. These pins are not used for these voltmeters.

(8) NC [21, 22]: Spare pins

4.6.3 General Precautions

(1) The electrical signal level is TTL. The maximum allowable application voltage is +15 VDC, -0 VDC (with respect to GND 1, GND 2). An equivalent input circuit is as follows:



* From an external device, drive with an open-collector.

(2) Avoid causing potential difference between GND 1 and GND 2 whenever avoidable. Pay attention not to inject noise between GND 1 and GND 2 when they are mutually isolated (the GND MODE switch is set in the OPEN state). The maximum allowable potential difference between GND 1 and GND 2 is ± 15 VDC (when the GND MODE switch is set in the OPEN state).

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- (3) The cable connected to the remote control connector should not be longer than 2 meters. When using a shielded cable (a cable having a shielding wire connected to the metallic sections of the cable connectors), disconnect the shielding wire from one of the cable connectors. Unless this disconnection is made, the case ground of the voltmeter may be extended to other device connected to the voltmeter and, consequently, the circuit ground lines of INPUT 1 and INPUT 2 may be shorted to the case ground of the voltmeter.
- (4) When nothing is connected to the remote control connector, this state means that all pins are in the "H" state, the voltmeter is in the LOCAL mode and range selection can be made with the RANGE switch on the front panel. (The REMOTE indicator lamp (LED) goes off.)

4.6.4 Response Speed of Voltmeters When in Remote Control Mode

(1) DC Output

Simple response (fixed range) 	Approx. 0.5 sec	Time to reach 99% of FS
	Approx. 0.3 sec	Time to reach 97% of FS
Range selection response (+40 dB → -20 dB)	Approx. 0.8 sec	Time to reach 99% of FS
	Approx. 0.6 sec	Time to reach 97% of FS
Input removal FS → 0 (fixed range) 	Approx. 0.6 sec	Time to reach 1/100 of FS
	Approx. 0.4 sec	Time to reach 3/100 of FS

* As measured with 1 kHz signal

* Ripples (at full scale)

At 40 Hz: Approx. 4 mVp-p

At 20 Hz: Approx. 8 mVp-p

At 10 Hz: Approx. 20 mVp-p

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(2) Meter Pointer

The response speed of the meter pointer is approximately 1 second in either case of simple response, range select response or input removal response (FS $\rightarrow$ 0).

- * Be sure to take this response time into consideration when delivering the DC output of the voltmeter to other device using the IF01-AVM (GP-IB Interface) or other device.
- * The throughput rate of the voltmeter is regarded to be 1.5 seconds or over.

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5. MAINTENANCE

5.1 Meter Cover

The transparent front cover of the meter has been processed for electric-charge-free layer. Do not rub it strongly with a cloth. When the electric-charge-free feature has become degraded in a long course of use, dilute an electric-charge-free agent (such as used for clothing) with water and apply it on the transparent front cover by wiping it with a soft cloth soaked with the diluted agent.

5.2 Adjustment and Calibration

The voltmeters have been designed for long-term stabilized operation and are shipped after being accurately calibrated. However, to ensure high measuring reliability (accuracy, especially), it is most recommendable to calibrate the voltmeters at every six months.

5.2.1 Notes for Adjustment and Calibration

- (1) Calibrate each voltmeter in ambient temperature within $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($73.4^{\circ}\text{F} \pm 41^{\circ}\text{F}$).
- (2) Before turning on the voltmeter power, check that the pointer has been accurately adjusted to the mechanical zero point. If it has been shifted from the zero point, accurately adjust it to the zero point. If the voltmeter power has been on, allow a discharge time of 3 minutes or over before performing this mechanical zero adjustment.
- (3) After turning on the voltmeter power, allow a warm-up time of 5 minutes or over before starting calibration.
- (4) The minimum requirements of the instruments used for calibration are as shown in the following table. Allow sufficient warm-up time before starting calibration.

Instrument	Performance
DC electronic voltmeter	Accuracy: $\pm 0.2\%$ or better Measuring range: 1 mV - 10 V Input impedance: 1 M Ω or over
Electronic voltmeter calibrator	Accuracy: $\pm 0.2\%$ or better Output voltage: 1 mV - 150 V (sine wave, 400 Hz or 1 kHz)
Sine wave generator	Frequency: 10 Hz - 1 MHz Output voltage: 1 mV - 3 V Output impedance: 50 Ω

- (5) To remove the case, remove the two screws on the top of the casing and the four screws on the sides of the case and, then, slowly pull up the case. The controls (semi-fixed potentiometers) and test points are laid out as shown in Figures 4 and 5.

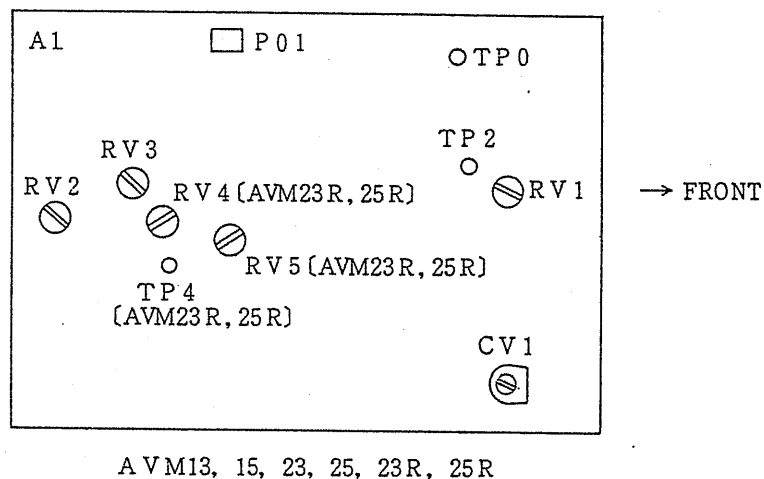


Figure 4 A1

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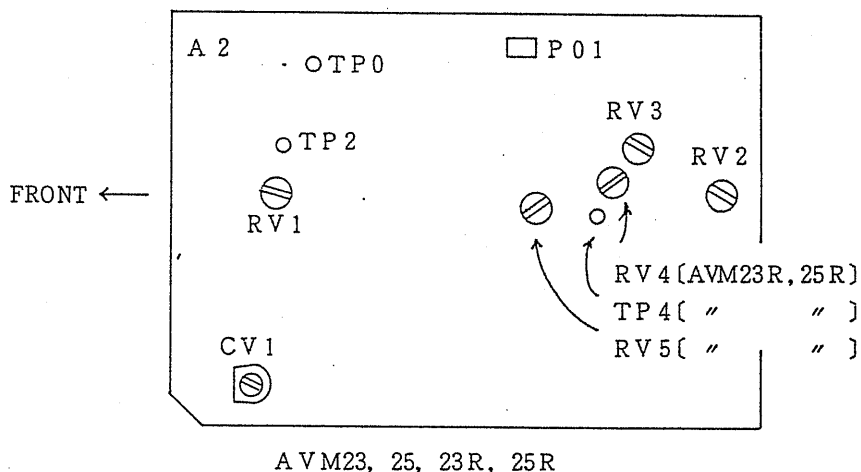


Figure 5 A2 (Dual-pointer models only)

* Abbreviations used in the following table

A: Setting at front panel of voltmeter

B: Type and setting of calibration instrument

C: Adjustment or calibration point

D: Measuring point

E: Reference or range of adjustment

Models of 1, 3 scales: Models of Figure 3-(1) [AVM13, 23, 23R]

Models of 15, 30 scales: Models of Figure 3-(2) [AVM15, 25, 25R]

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	A	B	C	D	E	Remarks
Offset adjustment	100V range for models of 1, 3 scales 150V range for models of 15, 50 scales A1 P0 1 A2 P0 1 Short between two pins	DC electronic voltmeter	A1 RV1	A1 TP2 A1 TP0	±5 mVDC	* A1 TP0 and A2 TP0 are circuit ground.
			A2 RV1	A2 TP2 A2 TP0		
		-	A1 RV2	Meter (Black)	Zero scale	* (Black) and (red) are colors of pointers of dual-pointer voltmeter.
			A2 RV2	Meter (Red)		
Meter indication calibration	100mV range for models of 1, 3 scales 50mV range for models of 15 - 50 scales	DC electronic voltmeter	A1 RV4	A1 TP4 A1 TP0	±5 mVDC	* AVM23R AVM 25R Offset adjustment of DC output
			A2 RV4	A2 TP4 A2 TP0		
		Electronic voltmeter calibrator Output 100 mVrms	A1 RV3	Meter (Black)	1.0 scale Full scale	INPUT 1
			A2 RV3	Meter (Red)		INPUT 2
		Electronic voltmeter calibrator 50 mVrms	A1 RV3	Meter (Black)	50 scale Full scale	INPUT 1
			A2 RV3	Meter (Red)		INPUT 2
	1V range for models of 1, 3 scales	Sine wave generator 100 kHz, 1 Vrms	A1 CV1	Meter (Black)	1.0 scale Full scale	INPUT 1
			A2 CV1	Meter (Red)		INPUT 2
Frequency response adjustment						At input terminal of voltmeter, Terminate generator output with 50-ohm register.

	A	V	C	D	E	Remarks
	500mV range for models of 15 - 50 scales	Sine wave generator 100 kHz, 500 mVrms	A1 CV1	Meter (Black)	50 scale Full scale	INPUT 1
			A2 CV1	Meter (Red)		INPUT 2
DC output adjustment	1V range for models of 1, 3 scales 500mV range for models of 15 - 50 scales	Sine wave generator 1 kHz Voltage for full-scale deflection	A1 RV5	A1 TP4 A1 TP0	+1 VDC ±10 mV	INPUT 1
			A2 RV5	A2 TP4 A2 TP0		INPUT 2
						AVM23R AVM25R

5.3 Others

For part of the range selector circuit, small relays are used. In order to maintain the operation stability of the contacts of the relays, apply an overvoltage to the input terminal at appropriate time intervals. The overvoltage applied for this purpose should be approximately 10 Vrms when the voltmeter is set at the maximum sensitivity range.

- * Precaution: Do not apply a voltage higher than the maximum allowable input overvoltage.

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