

DIGITAL PANEL METER MODEL AP-301 Series INSTRUCTION MANUAL



Caution

- (1) The application of voltage or current exceeding its maximum allowable value to the input terminals may result in instrument damage.
- (2) The supply of power out of its allowable range may cause fire, electric shock or instrument failure.
- (3) The content of this manual may subject to change without prior notice for product improvement.
- (4) The manual is carefully prepared. However, if any question arises, or any mistake, omission or suggestion is found in the content of this manual, contact your nearest our sales agent.
- (5) After read this manual, please keep it as anytime can see.

1.OUTLINE

The AP-301 Series digital panel meter is thin and light meter uses only 3-1/2 digits. The meter uses a 5V power supply driving and has large LED(Light Emitting Diode)numeric display elements (Height:14.2mm)which are easy to see in spite of the small case. The display has holding and blanking functions and can show a maximum value of 1999. The circuit largely consists of an independently developed LSI, which is more reliable than hybrid integrated circuit.

1 to 5V input, boards for external set screws, a terminal for a mother board fixture, a power source isolation board and other options can be provided as required by the customer.

2.SPECIFICATIONS

●DC Voltage Measurement

Model and Range Codes	Measuring Range	Max. Resolution	Input Impedance	Max. allowable Input Voltage
AP-301-11	$\pm 199.9\text{mV}$	$100\mu\text{V}$	$100\text{M}\Omega$	$\pm 100\text{V}$
AP-301-12	$\pm 1.999\text{V}$	1mV	$100\text{M}\Omega$	$\pm 100\text{V}$
AP-301-13	$\pm 19.99\text{V}$	10mV	$10\text{M}\Omega$	$\pm 250\text{V}$
AP-301-14	$\pm 199.9\text{V}$	100mV	$10\text{M}\Omega$	$\pm 500\text{V}$

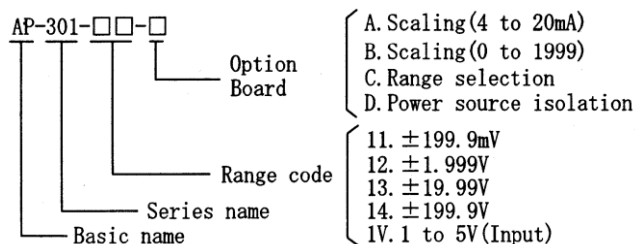
Accuracy: $\pm (0.1\% \text{ of rdg} + 1\text{digit}) (23^\circ\text{C} \pm 5^\circ\text{C}, 35 \text{ to } 85\% \text{ RH})$

●Specification: DC Voltage Measurement

Model and Range Codes	Measuring Range	Display	Input Impedance	Max. allowable Input Current
AP-301-1V	1 to 5V	0 to 1999	Approx $1\text{M}\Omega$	$\pm 100\text{V}$

Accuracy: $\pm (0.1\% \text{ of rdg} + 1\text{digit}) (23^\circ\text{C} \pm 5^\circ\text{C}, 35 \text{ to } 85\% \text{ RH})$

●Model Configuration



3.COMMON SPECIFICATIONS

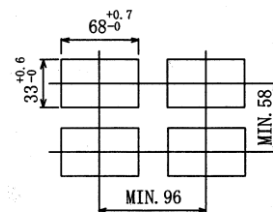
Measurement Function	: DC Voltage measurement
Operation Method	: Dual slope integration
Input Circuit	: Single-ended type
Input Bias Current	: 50pA (Typical)
Sampling speed	: Approx. 2.5 times/sec.
Normal Mode Noise	: 40dB (NMR) (Typical) (50Hz/60Hz)
Rejection Ratio	
Max. Number of Display	: 1999
Digit	
Overrange Alarm	: For input signal exceeding maximum display; 1999 flashes for each digit.
Display	: LED (Light emitting diode), Numeric elements, Height 14.2mm
Polarity	: Automatic polarity selection.
Polarity Display	: When input signal is negative, "−" sign is displayed
External Control	: <ul style="list-style-type: none"> • Started with HOLD terminal and 0V terminal shorted at (0V). • Started with BL terminal and 0V terminal shorted at (0V) • Any point can be set, decimal terminals $10^1, 10^2$ and 10^3 and 0V terminal shorted.
Operating temperature/humidity	: $0 \text{ to } 50^\circ\text{C}$ $35 \text{ to } 85\% \text{RH}$ (Nodew-Condense)
Power supply	: DC; $5\text{V} \pm 5\%$
Power Consumption	: 400mW
Dimensions	: 72mm (W) \times 36mm (H) \times 29mm (D) DIN size
Weight	: Approx. 35g
Dielectric strength	: Input terminal (LO)/common for AC1500V 1 minute
Insulation resistance	: DC 500V more than $100\text{M}\Omega$ at above terminals
Accessories	: Instruction manual, Connector

4.HANDLING

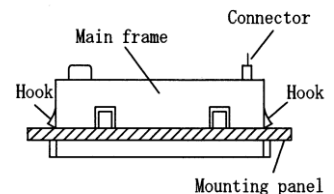
4-1 Mounting

1) Panel mounting

Make a rectangular cutout as shown in Fig.1, insert the instrument from the front into the mainframe panel as shown in Fig.2. (Specify the panel thickness 1.0 to 4.0mm)



[Fig.1] Panel Cutout



[Fig.2] Upper Side

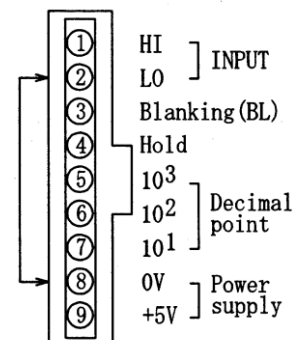
2) Removing from the panel

Push the instrument to the panel, holding the hook (Fig.2) with the thumb and middle finger.

4-2 Connector Connection

Insert the provided connector into the rear of the panel meter.

- The input LO and power supply 0V are connected outside to start operation.

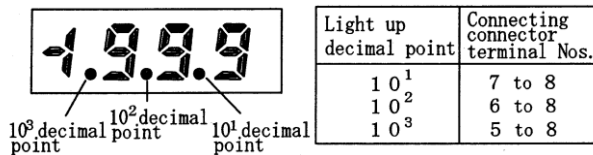


1) Power Connection

Connect the power to connector terminals 8 and 9. Use $5V \pm 5\%$ DC power. (Since the meter is not provided with a power switch it is ready to start as soon as power is connected.) There is not a fuse inside the mainframe, so if one is necessary for safety, use a 0.2A fuse externally.

2) Decimal Point setting

Since the decimal point is not connected prior to shipment, any decimal-point can be set on site by the customer by connecting the connector terminals below.



3) Input connection

Connect an input signal (DC voltage) between HI (1) and LO (2). The circuit is on line whenever the output LO is connected with an outside power source 0V terminal. Ground the one-point earth with the input signal (LO) and power source (0V) wires.

4) Hold and external start

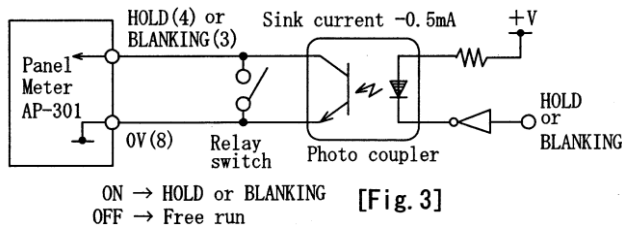
The displayed value can be held by shorting the HOLD terminal (NO. 4) with the COM terminal (NO. 8), or by setting the HOLD terminal to level "0". Measurement also starts by opening these terminals or by setting the HOLD terminal to level "1" at the necessary timing. The minimum time required to measure a value once is about 400ms.

In addition, since the input terminal (LO) and power terminal (0V) in this meter are not separated and insulated, use a mechanical contact such as a relay or switch for external control as much as possible. When controlling with a TTL or transistor, add an external circuit as shown Fig. 3.

5) Blanking

By shorting the BL terminal (NO. 3) and 0V terminal (NO. 8), the numeric displays can be turned OFF, and this is recommended when power saving is required. Also, when controlling with a TTL or transistor, use a mechanical contact for external control and add an external circuit as shown in Fig. 3.

(Level "0" 0 to 1.5V, Level "1" 3.5 to 5V)



• Calibration procedures are as follows.

(1) Remove the front bezel.

(2) Connect the power to the meter for a warm up of 20 minutes or more prior to adjustment.

(3) Zero adjustment

• 11 to 14 range

Check to ensure that the display shows 000 by shorting terminals HI and LO.

*11 to 14 range does not have zero adjuster of zero point adjustment VR2.

• 1V range

Apply a voltage of +1V, DC to the input and then turn the zero adjuster VR2 until the display shows 000.

(4) Span adjustment

• 11 to 14 range

Apply voltage with a +polarity to the input corresponding to the fullscale (1900), then turn the span adjuster VR until the display shows 1900.

Next, apply voltage with a - polarity to check that the display shows the value of $1900 \pm 0.1\%$ of rdg +1digit.

Note: When the input is a - polarity, if the - sign is not required, remove the front bezel and disconnect the jumper wire (J1) on the left of the maximum significant digit in the numeral display.

The display will then show the absolute value with no "- " sign.

• 1V range

Apply a voltage of +4.9V, DC to the input and then turn the span adjuster VR1 until the display shows 1950.

6. Warranty

This meter is warranted for a period of one year from date of delivery. Any defect which occurs in this period and is undoubtedly caused by Watanabe Electric Industry faults will be remedied free of charge.

This warranty does not apply to the meter showing abuse or damage which has been altered or repaired by others except as authorized by Watanabe Electric Industry.

7. After-sale service

This meter is delivered after being manufactured, tested and inspected under strict quality control.

However, if any problem does occur, contact your nearest Watanabe Electric Industry sales agent or Watanabe Electric Industry directly giving as much information on problem as possible.

5. MAINTENANCE AND INSPECTION

5-1 Caution

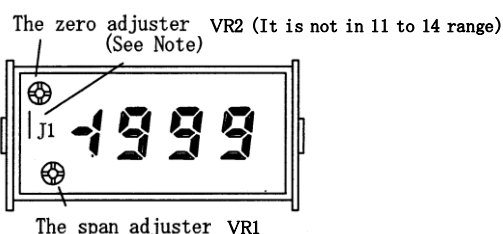
Store the meter where ambient temperature is between -10°C and $+70^\circ\text{C}$, and humidity is less than 60%. When used in a dusty environment pull the meter out of the mainframe, and clear it, as an accumulation of dust may lead to a rise in temperature and a reduction in equipment life.

Also, since the mainframe case and the bezel are made of plastic, do not wipe stains off with volatile liquids such as thinners.

5-2 Calibration

• In order to assure the initial accuracy over a long period of time, it is recommended that the meter be calibrated periodically. When doing so, use standard equipment with an accuracy of 0.01% or better.

Proofreading is $23^\circ\text{C} \pm 5^\circ\text{C}$, please carry out by the ambient conditions of RH 35 to 85%.



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OPTIONAL BOARDS FOR MODEL AP-301 SERIES INSTRUCTION MANUAL

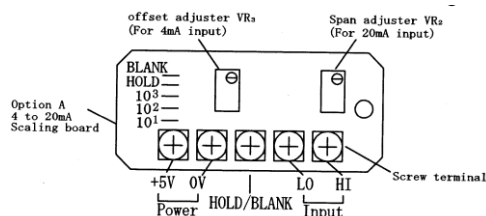


Caution

- (1) The application of voltage or current exceeding its maximum allowable value to the input terminals may result in instrument damage.
- (2) The supply of power out of its allowable range may cause fire, electric shock or instrument failure.
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Temperature coefficient	: Offset displayed-value TYP. ± 0.1 -digit/ $^{\circ}\text{C}$ Max. ± 0.5 -digit/ $^{\circ}\text{C}$
Operating temperature	: 0 to 50°C
Power supply	: 5V DC $\pm 5\%$
Power consumption	: 600mW (TYP) (When connected to the AP-301)
Weight	: Approx. 27g (Board only)
Accessories	: Instruction manual Tapping screw 1 pc. Nameplate

3-2 Input/output terminal connection diagram



1. Outline

This is an external screw terminal mounting board used especially for the AP-301, with this optional board mounted on the AP-301, such a function as meter scaling, range selection or power isolation becomes available.

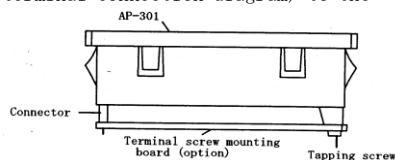
The following 4 types of option: A, B, C and D are available.

- A Scaling (4 to 20mA)
- B Scaling (0 to 1999 display)
- C Range selection
- D Power isolation

2. Operation

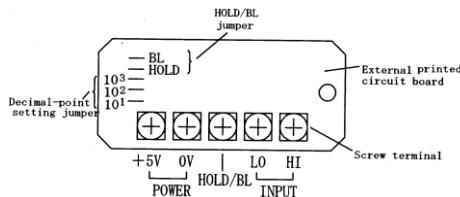
2-1 Mounting of optional board on AP-301

As shown in the following Fig., match the AP-301 connector with the optional board connector, then fix the board to the AP-301 using the attached tapping screw. In addition, stick the attached nameplate (screw terminal connection diagram) to the top of the AP-301 case.



2-2 Hold (HOLD)/Blanking (BL) jumper setting

Select either HOLD or BL. Connect the jumper wire to either HOLD or BL to be used.



2-3 Decimal-point setting

Prior to factory shipment, it is so set that all decimal point in the 10^1 , 10^2 , and 10^3 digits are lit. Therefore, disconnect the jumper wire corresponding to the relevant digit which is not to be used.

3. MODEL AP-301-11-A (Scaling: 4 to 20mA)

The AP-301-11 can be used as a scaling meter with an input of 4 to 20mA with the optional board mounted on the AP-301-11. This optional board is power-isolated. The input terminal (LO) is floated from the power terminal (0V).

(Dielectric strength: $\pm 300\text{V DC}$)

3-1 Specifications

Measuring range	: 4 to 20mA
Display	: offset ± 1000 , Fullscale 100 to 1999
Internal resistance	: 25Ω
Max. allowable input current	: $\pm 100\text{mA}$
Accuracy	: $\pm 0.2\%$ rdg. ± 2 digits ($23^{\circ}\text{C} \pm 5^{\circ}\text{C}$)

3-3 HOLD

When the HOLD and LO terminals are shorted, the displayed value just after their shorting is held.

The input (LO) and power (0V) terminals on this optional board are DC-isolated. However, the HOLD terminal is not isolated.

3-4 Blanking (BL)

The numeric displayed-value can be erased by shorting the BLANK terminal with the LO terminal.

The input (LO) and power (0V) terminals on this optional board are DC-isolated. However, the BLANK terminal is not isolated.

3-5 Scaling setting

Adjustment procedure

For this adjustment, a standard equipment with an accuracy of more than 0.01% is required. Adjust the meter in the following order.

- (1) First, connect the power, then warm up the meter for more than 10 min.
- (2) Offset adjustment
Apply a current of 4mA to the input terminals, then set the display unit to the desired value by turning the offset adjuster (VR3).
- (3) Span adjustment
Apply a current of 20mA to the input terminals, then set the display unit to the desired value by turning the span adjuster (VR2).
- (4) Setting width:
Offset variable width ± 1000
Fullscale variable width 100 to 1999
(Offset adjustment value < Span adjusted-value)

4. MODEL AP-301-□□-B (Scaling: 0 to 1999 display)

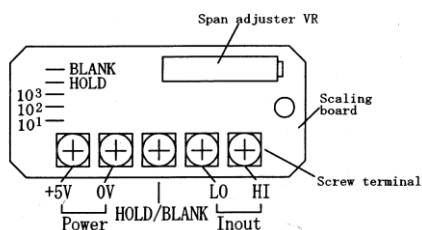
The fullscale displayed-value can be varied from 0 to 1999 with the optional board mounted on the AP-301-12.

Three types of range code: "12", "13" and "14" are available depending on the measured voltage.

4-1 Specifications

Model and Range Codes	Measuring Range	Display	Input Impedance	Max. allowable Input Voltage
AP-301-12-B	$\pm 1.999\text{V}$	0 to ± 100 to 1999	Approx $1\text{M}\Omega$	$\pm 100\text{V}$
AP-301-13-B	$\pm 19.99\text{V}$	0 to ± 100 to 1999	Approx $1\text{M}\Omega$	$\pm 250\text{V}$
AP-301-14-B	$\pm 199.9\text{V}$	0 to ± 100 to 1999	Approx $1\text{M}\Omega$	$\pm 500\text{V}$

4-2 Input/output terminal connection diagram



4-3 HOLD

When the HOLD terminal is shorted with the 0V terminal. The displayed value just after their shorting is held.
The input (LO) and power (0V) terminals on the optional board are not DC-isolated.

4-4 Blanking (BL)

The numeric displayed-value can be erased by shorting the BLANK terminal with the 0V terminal.

Use this function when power saving is required.

4-5 Scaling setting

• For this adjustment, standard equipment with an accuracy of more than 0.01% is required. Adjust the meter in the following order.

- (1) First, connect the power, then warm up the meter for more than 10 min.
- (2) Offset
Fixed to 0
- (3) Span adjustment
Apply the desired voltage to the input terminals, then set the display unit to the desired value by turning the span adjuster (VR).
- (4) Setting width:
Fullscale variable width: 100 to 1999

5. MODEL AP-301-□□-C(Range selection)

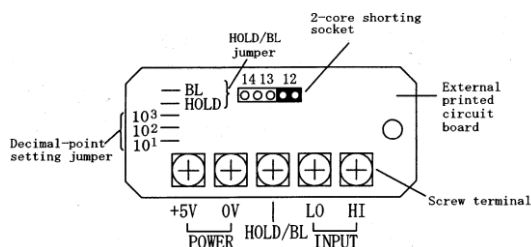
Any measuring range from range cord "12" to range cords "13" and "14" can be easily changed with the optional board mounted on the AP-301-12.

5-1 Specifications

• DC voltage measurement

Model and Range Codes	Measuring Range	Highest resolution	Input Impedance	Max. allowable Input Voltage
AP-301-12-C	$\pm 1.999V$	1mV	Approx 1M Ω	$\pm 100V$
AP-301-13-C	$\pm 19.99V$	10mV	Approx 1M Ω	$\pm 250V$
AP-301-14-C	$\pm 199.9V$	100mV	Approx 1M Ω	$\pm 500V$

5-2 Input/output terminal connection diagram



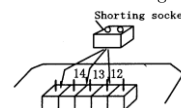
5-3 Range selection

Set the 2-core shorting socket as shown in the following diagram.

For range cord "12" : To No. 12

For range cord "13" : To No. 13

For range cord "14" : To No. 14



When the range is changed, calibrate the meter in accordance with "Item 6-2" in the instruction manual for the AP-301.

5-4 HOLD

When the HOLD and 0V terminals are shorted, the displayed value just after their shorting is held.

The input (LO) and power (0V) terminals are not DC-isolated.

5-5 Blanking(BL)

The numeric displayed-value can be erased by shorting the BLANK and 0V terminals. Use this function when power saving is required.

6. MODEL AP-301-□□-D(Power isolation)

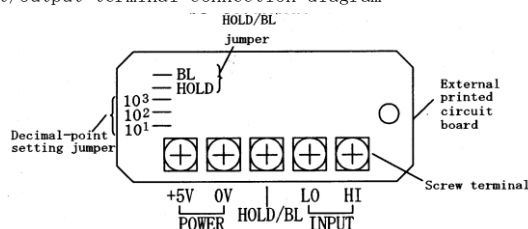
This optional board can be mounted on the AP-301 with any of range cords from "11" to "14".

This board is power-isolated.

The input terminal (LO) is floated from the power terminal (0V).
(Dielectric strength: $\pm 300V$ DC)

Three types of power supply: +7.5 DC (6 to 9V), +12V DC(10 to 14V) and +24V DC (19 to 29V) are available in addition to +5V DC (4.75 to 5.25V).

6-1 Input/output terminal connection diagram



6-2 HOLD

When the HOLD and 0V terminals are shorted, the displayed value just after their shorting is held.

The input (LO) and power (0V) terminals on the optional boards are DC-isolated.

The HOLD terminal is isolated.

(Dielectric strength: $\pm 300V$ DC)

6-3 Blanking (BL)

The numeric displayed-value can be erased by shorting the BLANK terminal with the 0V terminal.

The input (LO) and power (0V) terminals on the optional board are DC-isolated.

The BLANK terminal is isolated.

(Dielectric strength: $\pm 300V$ DC)

7. Warranty

This board is warranted for a period of one year from date of delivery. Any defect which occurs in this period and is undoubtedly caused by Watanabe Electric Industry faults will be remedied free of charge.

This warranty does not apply to the board showing abuse or damage which has been altered or repaired by others except as authorized by Watanabe Electric Industry.

8. After-sale service

This board is delivered after being manufactured, tested and inspected under strict quality control.

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