

MODEL GP-2001G, GP-2002G PIRANI VACUUM GAUGE INSTRUCTION MANUAL



This manual is applicable to the following gauges:

<u>Model</u>	<u>Serial No.</u>
GP-2001G	0001G and higher
GP-2002G	0001G and higher

Read this manual before operation and keep it at your hand for immediate reference.

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ULVAC, Inc.**

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Prior to Use

Thank you for purchasing this ULVAC product.

Upon receipt of the product, verify that is the correct model ordered and that it has not been damaged during transport.

 WARNING	<p>Read this instruction manual before installing, operating, inspecting, or maintaining the product and fully understand the safety precautions, specifications and operating procedures regarding the product.</p>
 WARNING	<p>The copyright of this instruction manual is held by ULVAC, Inc. You are prohibited from copying any portion of this instruction manual without the consent of ULVAC Inc. You are also prohibited from disclosing or transferring this instruction manual to third parties without the express written consent of ULVAC Inc.</p>
 CAUTION	<p>The contents described in this instruction manual are subject to change without prior notice because of changes in specifications or because of product improvements.</p>

Safety Symbols

 WARNING	<p>Safety symbols are used throughout this instruction manual to call the operator's attention to safety. The terminology used in safety symbols is classified below.</p>
 DANGER	<p>Indicate status of urgency of danger when failure to comply with DANGER results in serious personal injury or death The work ignoring this warning will lead to serious damage to human life or factory facility (including this equipment) at a high probability.</p>
 WARNING	<p>Indicate status of danger when failure to comply with WARNING results in serious worker's injury or death. The work ignoring this warning will cause possibility leading to serious damage to human life or factory facility (including this equipment)</p>
 CAUTION	<p>Indicate status of danger when failure to comply with WARNING results in minor injury or moderate damage. The work ignoring this warning will cause possibility leading to minor damage to worker or breakage to equipment or necessary to adjust.</p>
 Note	<p>Direct hazard is not existed, describe the necessity to know from the viewpoint of worker's safety or correct and safe operation of equipment</p>

Safety Cautions

For safe use of this vacuum gauge, carefully read this manual and comply with the warnings and cautions given in the manual.

 WARNING	<p><u>Turn OFF power.</u> If the vacuum gauge fails, immediately turn OFF the power. Use of a failed gauge may cause fire or electric shock. For repair, contact your local ULVAC representative or ULVAC JAPAN.</p>
 WARNING	<p><u>Turn OFF power.</u> If the vacuum gauge gets unusually hot or gives off smoke or unusual smell, immediately turn OFF the power. Otherwise, fire can result. For safety, contact your local ULVAC representative or ULVAC JAPAN.</p>
 WARNING	<p><u>Turn OFF power.</u> Before touching any terminal on the control rear panel or if there is a possibility of touching it, turn OFF the vacuum gauge power.</p>
 WARNING	<p><u>Turn OFF power.</u> Whenever mounting the gauge, unplug the power cable.</p>
 WARNING	<p><u>Check line voltage.</u> Prior to turning ON the power, make sure that the vacuum gauge operating voltage and the supply voltage are in agreement. Connection of incorrect power can cause damage to the vacuum gauge and fire.</p>
 WARNING	<p><u>Operating environment</u> Do not connect the sensor head to a test object of which pressure is in excess of atmospheric pressure. If the pressure in the sensor head exceeds atmospheric pressure, the sensor head will be damaged or it will pop out from the connector, causing injury to the surrounding, including human body. If the pressure exceeds atmospheric pressure, provide an isolation valve so that the pressure in the sensor head does not exceed atmospheric pressure.</p>
 CAUTION	<p><u>Don't disassemble.</u> Do not try to disassemble the vacuum gauge (controller, measuring unit, sensor head cable and sensor head).</p>
 CAUTION	<p><u>Don't modify.</u> Do not modify the vacuum gauge (controller, measuring unit, sensor head cable and sensor head). If it is modified, its functions are not warranted. Also fire or electric shock may result.</p>
 CAUTION	<p><u>Check connection.</u> For safety reasons, ground the GND terminal of the controller.</p>
 CAUTION	<p><u>Operating environment</u> Do not use the gauge in a place where it may be splashed with water. If it is splashed with water, failure, earth leakage or fire can result.</p>
 CAUTION	<p><u>Ventilation</u> Do not plug the air vents of the vacuum gauge controller. If the air vents are plugged, heat will be contained inside and the gauge may be damaged. The gauge will not indicate normal values either.</p>
 CAUTION	<p><u>Keep out foreign matter.</u> If foreign matter like metal fragments or combustibles are admitted into the vacuum gauge through the air vents or other openings, remove them. Otherwise, the vacuum gauge may be damaged.</p>
 CAUTION	<p><u>Operating conditions</u> Operate the vacuum gauge under the environment set forth in the specifications.</p>
 CAUTION	<p><u>Beware of impact</u> Do not give an impact to the sensor head.</p>

 CAUTION	<p><u>Repacking for transfer</u> If the vacuum gauge is to be shipped to other site, repack it in the same way as on delivery. If the vacuum gauge is shipped bare, it may be damaged.</p>
 CAUTION	<p><u>Discarding</u> When discarding the vacuum gauge, comply with your local regulations. Please note that any product supplied by our company can be disused only at the customer's responsibility and expense. And, the product in the meaning of this passage includes its appurtenances, annexed documents and / or media, etc. attached to, as well as the product in itself. Especially, a sensor head used in an atmosphere that can cause hazards to the human body must be disposed of by a specialist in disposal.</p>
 Note	<p><u>Maintenance</u> The electrical circuitry inside this unit uses aluminum electrolytic capacitors. In general, aluminum electrolytic capacitors possess an operating life and that operating life decreases the more the ambient temperature increases. To prevent damage to the device, we recommend maintenance at ULVAC about once every three years.</p>
 Note	<p><u>Lifetime of the parts (Connector-area)</u> In the connector-area such as a sensor head cable or GP-H, there is a life time. When a life time comes, displays are showing error or right pressure does not show. Even at the low number of plug-in and out, when a load at the inclination comes also the lifetime comes.</p>

Revision History

DATE	No.	Reason
Mar. 23, 2007	00	S/N:00001~ first version
Oct. 31, 2013	01	<ul style="list-style-type: none"> • Changed description of safety symbol. • Section 1.1, Changed accuracy description. • Section 1.1 and 1.2, Changes to accessories and options. • Section 1.2, WP-04 and WP-05 were discontinued. • Section 2.2.5, Added sensor head installation method to GP-H. • Section 4.1, Changed the overall operation diagram. • Chapter 6, Change fuse specification. • Chapter 7, Change warranty. • Chapter 8, Added certificate of Decontamination.
Nov. 19, 2014	02	<ul style="list-style-type: none"> • Added a note that the connector part has a limited life as a safety precaution. • Detailed option details. • Corrected an error.
Dec. 2, 2019	03	<ul style="list-style-type: none"> • Section 1.1, Added inrush current. • Section 1.2, Do not attach instruction manuals from standard accessories. • Section 1.3.5, Added option. • Corrected an error.

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1. GENERAL DESCRIPTION

The Model GP-200□G is a constant temperature type Pirani Vacuum gauge utilizing the thermal conduction of gas. The controller and measuring unit being separated from each other, measurement is less affected by the difference in the sensor head cable length. (No readjustment is required when the cable length is changed.)

The display is a large - sized 7-segment digital indicator (red LED) that can be easily read.

The DIN size has been employed and the weight has been reduced considerably from that of the predecessor models.

M3 terminal block is employed for easy connection with an external control system.

Pressure comparison values can be set at three places. The comparator output is delivered as transistor output (open collector).

Power voltage of Pirani Vacuum Gauge Model: GP-2001G and GP-2002G are specified below.

GP-2001G : AC 85~264 V 50/60 Hz

GP-2002G : DC 24 V

1.1. Specifications

Name	Pirani vacuum gauge
Measurable pressure range	0.4 to 3000 Pa
Measuring point	1 point
Display	7-segment digital Indicator (red LED) 0.0~3000.0 Pa
Display sampling time	100 msec
Measurement accuracy	4.0 × 10 ⁻¹ Pa ~ 1.0 × 10 ⁺¹ Pa : ±50% 1.0 × 10 ⁺¹ Pa ~ 5.1 × 10 ⁺¹ Pa : ±30% 5.1 × 10 ⁺¹ Pa ~ 7.6 × 10 ⁺² Pa : ±15% 7.6 × 10 ⁺² Pa ~ 1.0 × 10 ⁺³ Pa : ±30% 1.0 × 10 ⁺³ Pa ~ 2.7 × 10 ⁺³ Pa : ±50%
Recorder output signal	-1.5 to 11.5 VDC (maximum recorder output range) ① Lin 0 output 0 to 10 V: 0 to 3000 Pa ② Lin 1 output 0 to 10 V: 0 to 1000 Pa ③ Lin 2 output 0 to 10 V: 0 to 100 Pa
Zero correction input	No-voltage contact input Input current : 10mA
Setpoint output	3 points Transistor output (open collector) Rated load voltage : 24 VDC Max. Load current : 50 mA (saturation voltage:1V)
Interchangeability of sensor head	Within ± 3% at the filament resistance value (same type of sensor head)
Operating temperature range	10°C to 40°C
Power requirements	GP-2001G : AC 85~264 V 50/60 Hz GP-2002G : DC 24 V ± 10%
Power consumption	10 VA Inrush Current AC100V: 20A or less / 2ms or less AC200V: 8A or less / 2ms or less
Outside dimensions	48H×96W×151D(mm)
Weight	0.4 kg

1.2. Standard accessories

Quick manual	Paper	1 copy
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1.3. Option

1.3.1. Sensor head

Sensor head	WP-01/WP-03/WP-03/WP-16	WPB-10-034
Filament material	Pt	Pt
Other materials	BS/Ni-plating Ni, Kovar, Glass, SnSbCu	SUS304, Cu(Gasket) FeNiCo(Ni-plating), Al ₂ O ₃
Permitted leak ratio	$1 \times 10^{-8} \text{Pa} \cdot \text{m}^3/\text{s}$ max	$1 \times 10^{-8} \text{Pa} \cdot \text{m}^3/\text{s}$ max
Weight(g)	WP-01 : about 26, WP-02 : about 45 WP-03 : about 63, WP-16 : about 77	about 173
Internal volume(cm ³)	WP-01 : about 19, WP-02 : about 17 WP-03 : about 17, WP-16 : about 22	about 18
Pressure max※1	$< 2 \times 10^{-5} \text{Pa}(\text{abs})$	$< 2 \times 10^{-5} \text{Pa}(\text{abs})$
Bakeout※2	80°C max	250°C max

※1:The breakdown pressure of the flange and clamp are to be considered otherwise.

※2:Bakeout temperature is a temperature of the sensor unit. Please remove the electronics(GP-H) or the conversion cable(GP-BH).

※3:WP-04 and WP-05 discontinued producing in August, 2012.

1.3.2. Measuring unit

Measuring unit	GP-H		GP-BH (Conversion cable 2m)
Sensor head	WP-01, WP-02	WP-03, WP-16	WPB-10-034
Weight	35g		GP-BH: 0.13kg Conversion cable: 0.2kg
remarks	GP-H for WP-01/WP-02 and WP-03/WP-16 are different.		

1.3.3. Sensor head cable

Sensor head cable	2、5、10、15、20、30、50、100m
Weight(kg)	0.2/0.4/0.7/1.0/1.3/1.9/3.9/7.7

1.3.4. Supply cable 3m (only GP-2001G)

※The plug specification of supply cable is AC125V / 7A.

1.3.5. Others

JCSS calibration certificate	Only combination with sensor unit
General proofreading test	Only combination with sensor unit
Inspection certificate	
Calibration certificate	

 CAUTION	<p>This gauge is based on the measurement of thermal conductance and the indicated value may change depending on the type of the sensor head. Some sensor heads may require change of the circuitry or structure of the measuring unit. Therefore, if the type of the sensor head is changed after delivery of the gauge, re-adjustment will be required. Factory adjusted conditions (type of sensor head) are inscribed on the measuring unit GP-H. Check them before operation.</p>
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1.4. Description of Components

1.4.1. Front panel

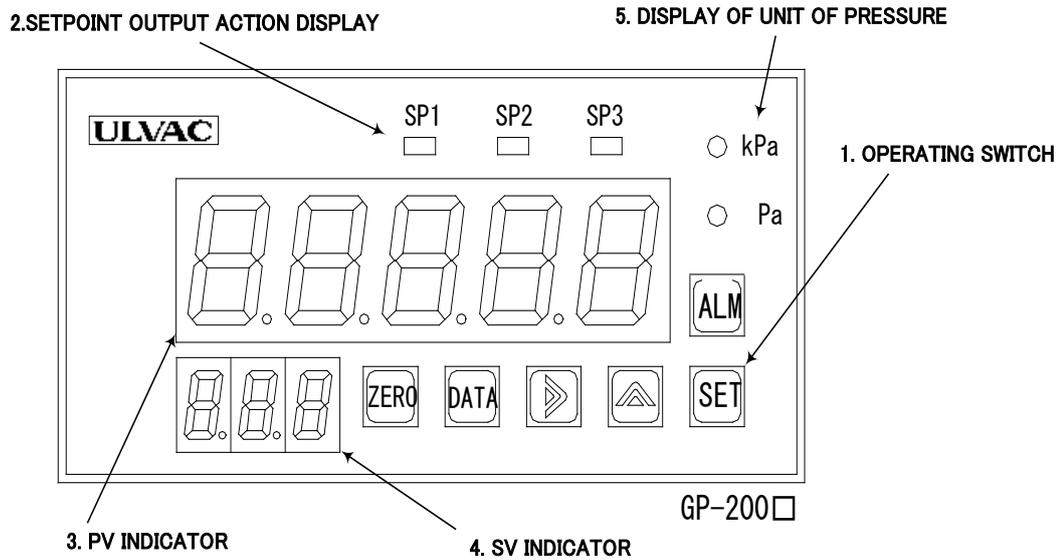


Fig. 1-1 Front Panel of GP-200□G

(1) Operation switch

ALM	Used to display and change the comparison set value (setpoint)
ZERO	Used to set and cancel the zero point correction function
DATA	Used to change data
▶	Used to shift the decimal place of data when changing data.
▲	Used to change data
SET	Used to finalize data, etc.

Refer to section 4 for the operating procedure.

(2) Comparison (setpoint) output action display

The green LED comes on when the comparison output is ON.

(3) PV indicator

Main indicator that displays the comparison set value and set value for output adjustment, in addition to the current measurement value. If the measurement value exceeds the scale limit or if the sensor head filament has blown out, "-----" will blink on the display.

(4) SV indicator

An auxiliary indicator that explains the contents of the PV indicator. Nothing is displayed or in normal measuring condition. "OFF" is displayed when the comparison set value is displayed or in the output adjustment setting.

(5) Display of unit of pressure

The LED for the selected unit of pressure comes on.

1.4.2. Rear Panel

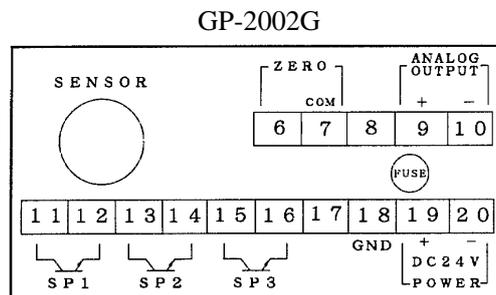
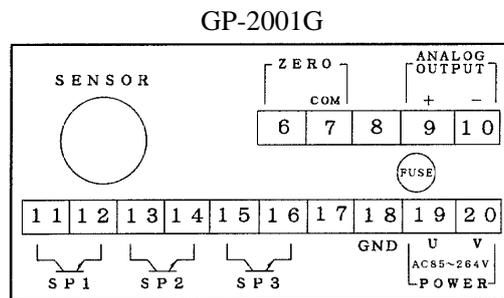
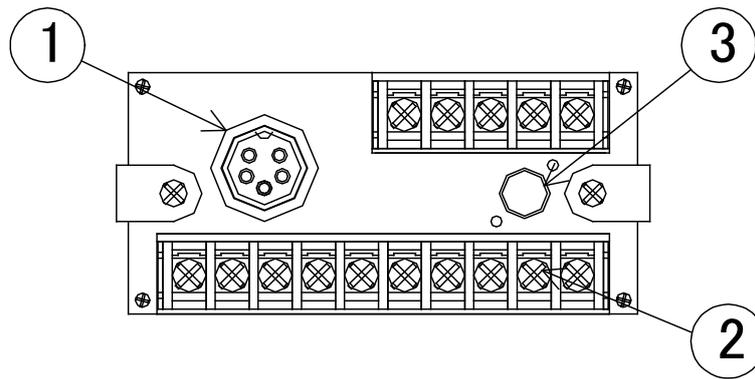


Fig. 1-2 Rear Panel of GP-200□G

- (1) Sensor head cable connector
A connector to which the supplied sensor head cable is to be connected.
- (2) Terminal block for input / output
Terminal block for connecting input/output such as connection of input power, zero point correcting function input, comparison (setpoint) output, recorder output, etc. A 3mm-dia. solderless terminal is best suited to connection.
When connecting the input / output wiring, do not make mistake in wiring. Also cover the solderless terminal with insulating covering so that adjacent terminals are not shorted.
- (3) Fuse
The fuse protects the power supply. Normally, it does not blow out. If it blows out, contact your local ULVAC service center or representative for repair without taking any action.

2. INSTALLING THE PIRANI VACUUM GAUGE

 WARNING	Turn OFF power Whenever mounting the vacuum gauge, unplug the power cable.
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2.1. Preliminary Operation

- Unpack the vacuum gauge and check quantities.
- Check components for possible damage.

2.2. Installation

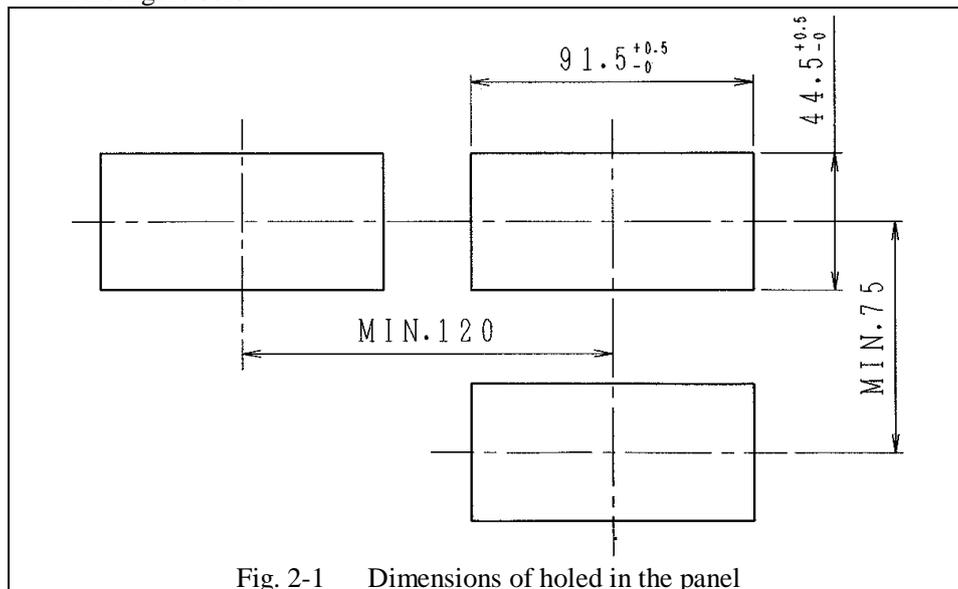
2.2.1. Installing the controller

 CAUTION	Ventilation Do not plug the air vents of the vacuum gauge controller. If the air vents are plugged, heat will be contained inside and the gauge may be damaged. The vacuum gauge will not indicate a normal value either.
 CAUTION	Keep out foreign matter If foreign matter like metal fragments or combustibles are admitted into the vacuum gauge through the air vents or other openings, remove them. Otherwise, the vacuum gauge may be damaged.
 CAUTION	Operating environment Do not use the vacuum gauge in a place where it may be splashed with water. If it is splashed with water, failure, earth leakage or fire can result.
 CAUTION	Check connection For safety reasons, ground the GND terminal of the controller.

Secure a space for cable connection on the batch.

1) Panel

- This instrument is the panel mounting type.
- Board thickness : 1.0~4.0mm
- Panel cut : 91.5 × 44.5mm
- If the instruments are mounted side by side, provide a spacing between controllers as shown in the figure below.



- 2) How to mount
 - a) Remove the metal fitting from the controller.
 - b) Fit the controller into the front panel.
 - c) Attach the metal fittings in the original position from the back of the panel.

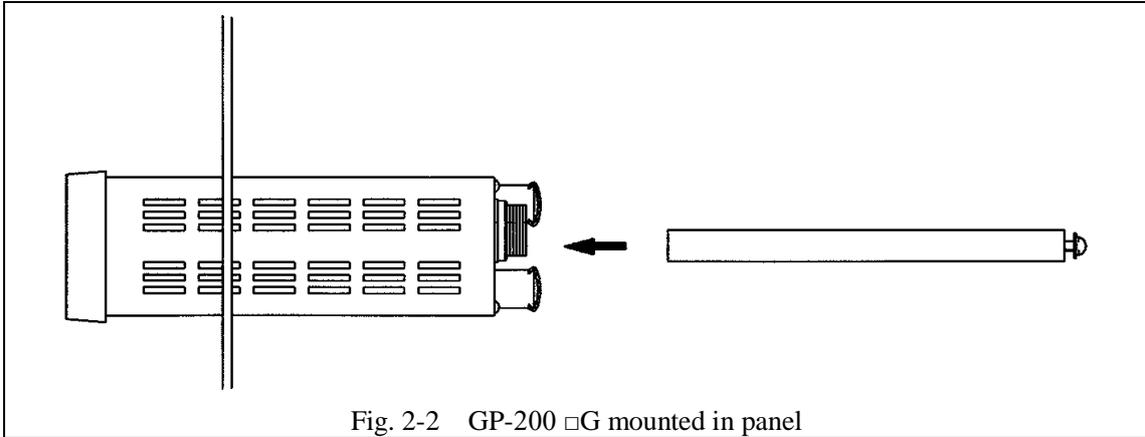


Fig. 2-2 GP-200 □G mounted in panel

2.2.2. Installing the sensor head

 WARNING	<p><u>Operating environment</u> Do not connect the sensor head to a test object of which pressure is in excess of atmospheric pressure. If the pressure in the sensor head exceeds atmospheric pressure, the sensor head will be damaged or it will pop out from the connector, causing injury to the surrounding, including human body. If the pressure exceeds atmospheric pressure, provide an isolation valve so that the pressure in the sensor head does not exceed atmospheric pressure.</p>
 CAUTION	<p><u>Beware of impact</u> Do not give an impact to the sensor head.</p>
 CAUTION	<p><u>Check wiring</u> Check that there are no mistakes with the wiring before turning the power on. There is a risk of damage and fire if wired incorrectly.</p>
 CAUTION	<p><u>Check wiring</u> Ensure that the power supply cable (crimping terminal section) does not touch other conductive components on the control, etc.</p>
 CAUTION	<p><u>Check power supply voltage</u> Before turning on the power supply, check that the vacuum gauge operating voltage and the supply voltage are the same. If the wrong power supply is mistakenly connected, there is a risk of damage to the vacuum gauge and a risk of fire.</p>

Install the sensor head to the vacuum gauge port of a vacuum system.

- (1) Measuring position
 - This gauge measures the static pressure in the position where the sensor head is connected. If there is gas flow or an outgas source or an intense electron or ion generating source, the measurement value will be affected. So select the measuring position carefully. Note that if the sensor head is subjected to vibration, heat radiation, high intensity magnetic field or intense radiation, correct pressure measurement may not be made.
 - Because of its principles of operation, the Pirani vacuum gauge indication is affected by the ambient temperature of the sensor head. Be careful that the ambient temperature deviates considerably from the calibrating temperature (about 25°C).

- (2) Installing the sensor head
- Install the vacuum gauge in such a manner that the sensor head mounting opening plane is parallel with gas flow. See to it that gas does not enter the sensor head in the form of beam.
 - The vacuum gauge filament is as thin as 25 microns in diameter. Avoid use in a place where vibration is at a high level, if possible. Be careful in selecting the installation place and handling the sensor because major cause of filament burnout is mechanical impact. Be careful in selecting the place of installation and in handling.
 - To install the sensor head, use an O-ring that releases little outgas. Use of a material that releases much outgas like rubber pipe or grease can be a cause of error.

2.2.3. Installing the supply cable

 WARNING	Turn OFF power. Before touching any terminal on the control rear panel or if there is a possibility of touching it, turn OFF the vacuum gauge power.
 WARNING	Check line voltage. Prior to turning ON the power, make sure that the vacuum gauge operating voltage and the supply voltage are in agreement. Connection of incorrect power can cause damage to the vacuum gauge and fire.
 CAUTION	Check connection. For safety reasons, ground the GND terminal of the controller.

Connect the power cable to the connecting terminal block No.19 and 20 on the rear panel using a solderless terminal. Before connection, check the polarity of the power to the GP-2002G. Also ground pin No.18, which is a grounding terminal.

2.2.4. Electrical connection

 CAUTION	Check line voltage. Prior to turning ON the power, make sure that the vacuum gauge operating voltage and the supply voltage are in agreement. Connection of incorrect power can cause damage to the vacuum gauge and fire.
 CAUTION	Check connection. For safety reasons, ground the GND terminal of the controller.
 CAUTION	Operating conditions Operate the vacuum gauge under the environment set forth in the specifications.

Make electrical connection after installing components.

Fix the cable by taking care not to exert undue force to the connection between the sensor head and sensor head cable and the connection between the controller and sensor head cable.

Lay the sensor head cable away from power lines, if possible. Noise may occur.

Moving the sensor head cable will generate frictional electricity between conductor and insulator, which can cause an error at a low pressure.

Avoid installation of the vacuum gauge in a high temperature or high humidity place.

Securely fasten the connector fixing screw.

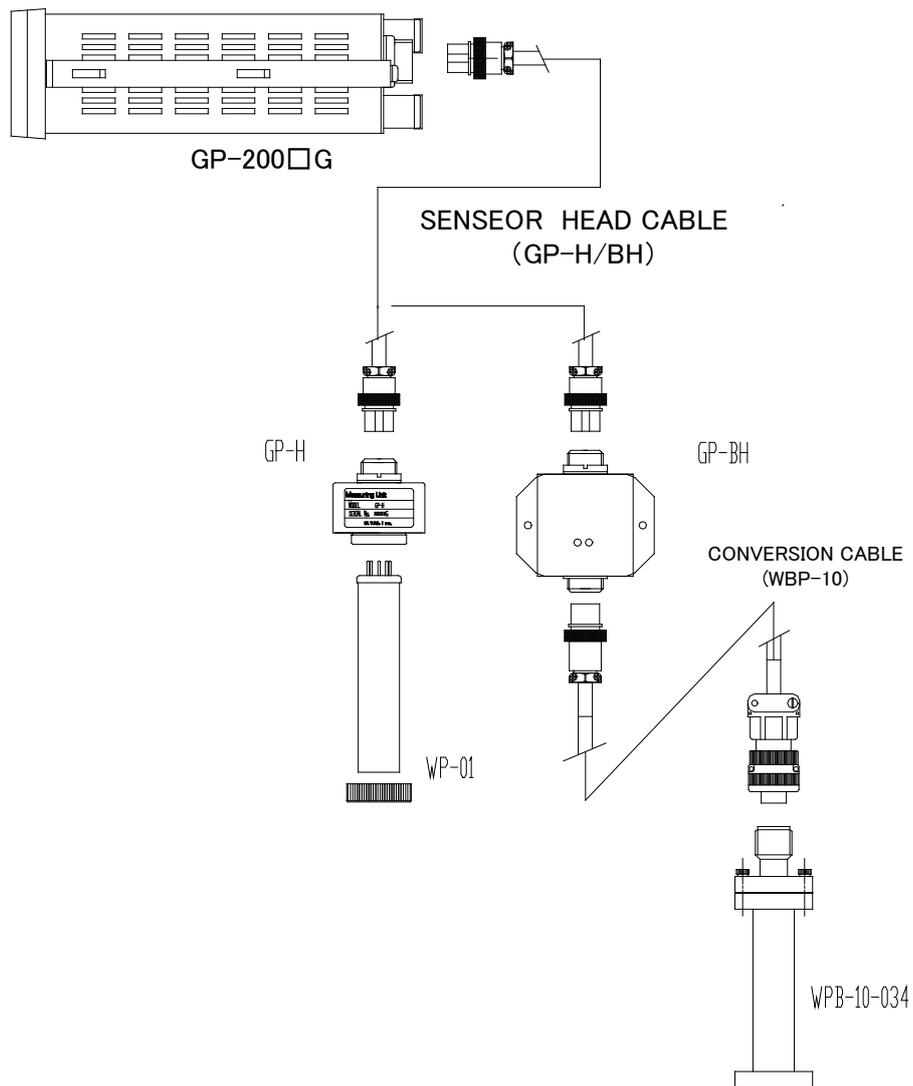


Fig. 2-3 GP-200□G overall connection diagram

2.2.5. A sensor head installation method to GP-H

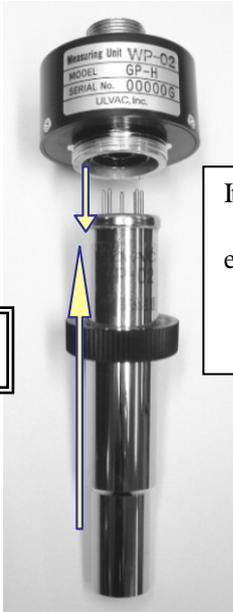
CAUTION Screw for fixation
The installation methods of a screw for fixation are different by a sensor head.

① Install a screw for fixation that is attached to GP-H to a sensor head. By the kind of the sensor head, installation methods are different

For sensor head WP-01, 02



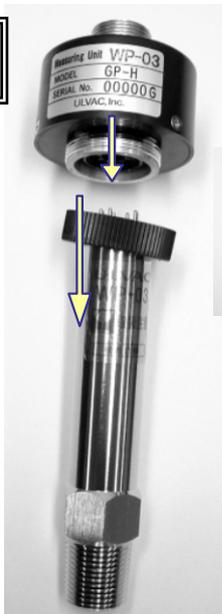
For sensor head WP-03, 16



It is inserted a screw for fixation by the vent side of the sensor head.



② Tighten a screw for fixation in the main body of GP-H, and please fix it.



Insert a screw for fixation from the connector side of the sensor head. Please insert it diagonally like a figure.

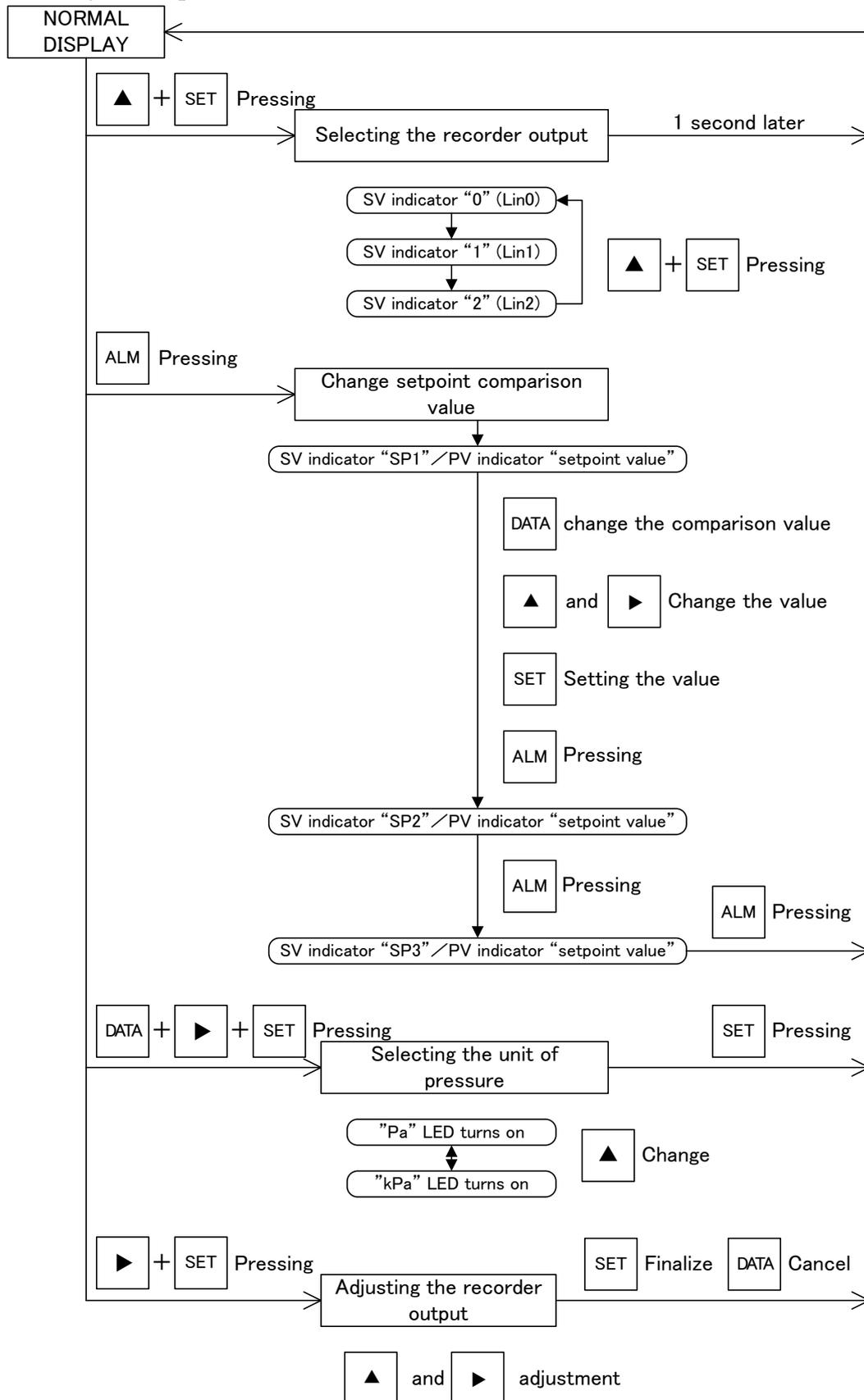
3. OPERATING PROCEDURE

3.1. Cautions in Handling

- (1) When power is applied to this gauge, it starts measurement after a delay of approx. three seconds. However, temperature drift or other problem due to power application is likely. So wait for more than one minute after applying power to the sensor head until the indication is stabilized.
- (2) For precision measurement, wait for more than 30 minutes after turning ON power until the sensor head temperature is in equilibrium. In a series of measurements, more stabilized measurement can be made by keeping the power to the sensor head ON during the measurements.
- (3) If the sensor head is exposed to chemically active gas or highly adsorbing gas, its characteristics may change.
In such a case, repeat pumping (flushing) operation after filling the vacuum chamber with nitrogen gas, inert gas or dry air with power applied to the sensor head.
The previous characteristics may be restored.
Even with these types of gas, however, avoid the flushing operation by blowing gas into the opening of the sensor head.
If there is no prospect of the characteristics being restored by this flushing operation, replace the sensor head.
- (4) The Pirani gauge is sensitive to all types of gases, but the sensitivity differs depending on the types of gas.
This gauge indicates pressure by assuming that the gas is nitrogen gas.

4. OPERATING PROCEDURE

4.1. Summary of the operation method



4.2. Selecting the Recorder Output

The recorder (analog) output signals of this gauge include Lin1 and Lin2, which can be selected.

Lin0	0 to 3000 Pa : 0 to 10 V
Lin1	0 to 1000 Pa : 0 to 10 V
Lin2	0 to 100 Pa : 0 to 10 V

- (1) Pressing the [▲] and [SET] switches simultaneously displays “0”, “1” or “2” on the SV indicator for one second. Select the desired output.
* Default setting: Lin1

4.3. Selecting the Unit of Pressure

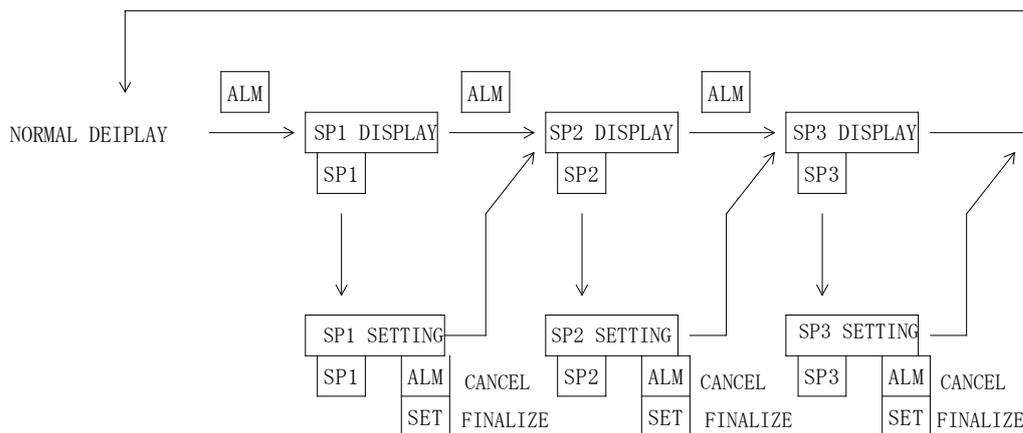
This gauge permits selection of “Pa” or “kPa” at the unit of pressure.

- (1) Pressing the [DATA], [▶] and [SET] switches simultaneously sets up the unit changeover mode.
- (2) Press the [▲] switch to select the desired unit of pressure.
- (3) Pressing the [SET] switch finalizes the unit and sets up the normal measurement mode.
* Default setting: “Pa”.

4.4. Display and Change of Setpoint Comparison Value

This gauge has three setpoint outputs (SP1, SP2, SP3), permitting independent setting of comparison value.

The comparison value can be arbitrarily set between 0.0 and 3000.0 Pa.

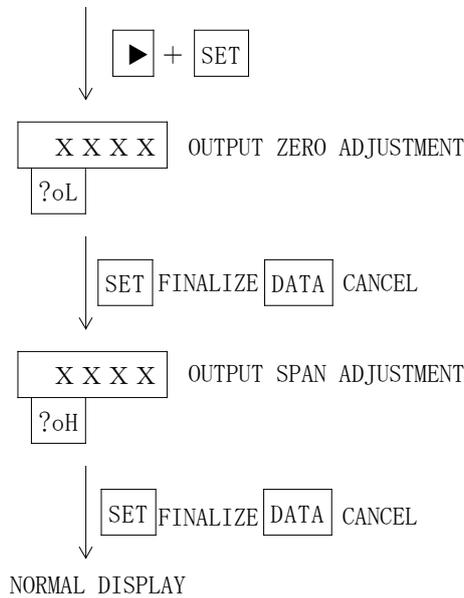


- (1) The comparison value setting mode and the normal measurement mode can be changed over from one to the other by pressing the [ALM] switch on the front panel. Select the required indicator while watching the SV indicator.
(Example) To display and change the comparison value of SETPOINT, press [ALM] switch once to display “SP1” on the SV indicator.
- (2) To change the comparison value, press the [DATA] switch, and the one of the displayed decimal places will blink. Move this blinking place to the decimal place to be changed by pressing the [▶] switch. When the decimal place is determined, press the [▲] switch to display the desired numeric value.
In the same matter, set all the decimal places to the desired value using the [▶] and [▲] switches. Here, pressing the [SET] switch completes the change of the comparison value.
- (3) Upon completion of the display and change of the comparison value, press the [ALM] switch to restore the blank state (measurement status) in while nothing is displayed on the SV indicator.

4.5. Adjusting the Recorder Output

Adjustment has been completed before shipment from factory. If the correlation between the displayed value and the output value cannot be obtained, make adjustment by using the following procedure.

NORMAL DISPLAY



Data can be set with the [▲] switch and ± of the data can be selected with the [▶] switch. If “-“ is displayed in the “?” portion on the SV indicator shown in the figure above, each press on the [▲] switch decrements the value by one and, if the display is blank, the value is incremented by one.

The data setting range with the [▲] switch is ±1500 and the output adjustment range is approx. ±20% both in zero and span adjustment. (The numeric values displayed in this mode are not directly related to the actual recorder output value. Make adjustment while measuring the output using a voltmeter.)

4.6. Recorder output

The recorder outputs of this gauge include Lin1 and Lin2, which can be selected. Both outputs are correlated with pressure in linear function.

Lin 0	0 to 3000 Pa	: 0 to 10 V
Lin 1	0 to 1000 Pa	: 0 to 10 V
Lin 2	0 to 100 Pa	: 0 to 10 V

The maximum value of the recorder output is approx. 11.5 volts.

If the recorder output voltage and measured value (indicated value) are not correlated with each other, refer to 4.5 “Adjusting the Output Voltage.”

The ripple of the recorder output is approx. 10 mV (p-p).

Lin 0	
Pressure (Pa)	Output Voltage(V)
0.0	0.00
1.0	0.00
10.0	0.03
100.0	0.33
1000.0	3.33
3000.0	10.00
----.-	11.5

Lin 1	
Pressure (Pa)	Output Voltage(V)
0.0	0.00
1.0	0.01
10.0	0.10
100.0	1.00
1000.0	10.00
3000.0	11.5
----.-	11.5

Lin 2	
Pressure (Pa)	Output Voltage(V)
0.0	0.00
1.0	0.10
10.0	1.00
100.0	10.00
1000.0	11.5
3000.0	11.5
----.-	11.5

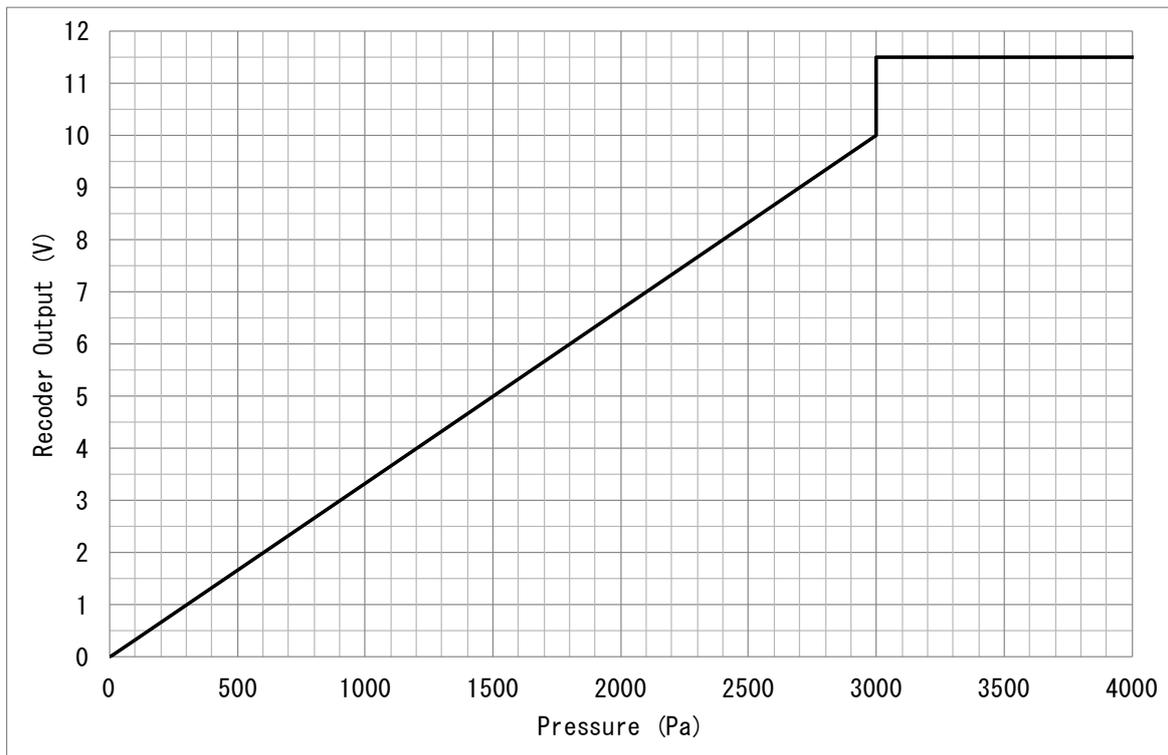


Fig. 4-1 Lin0 Output

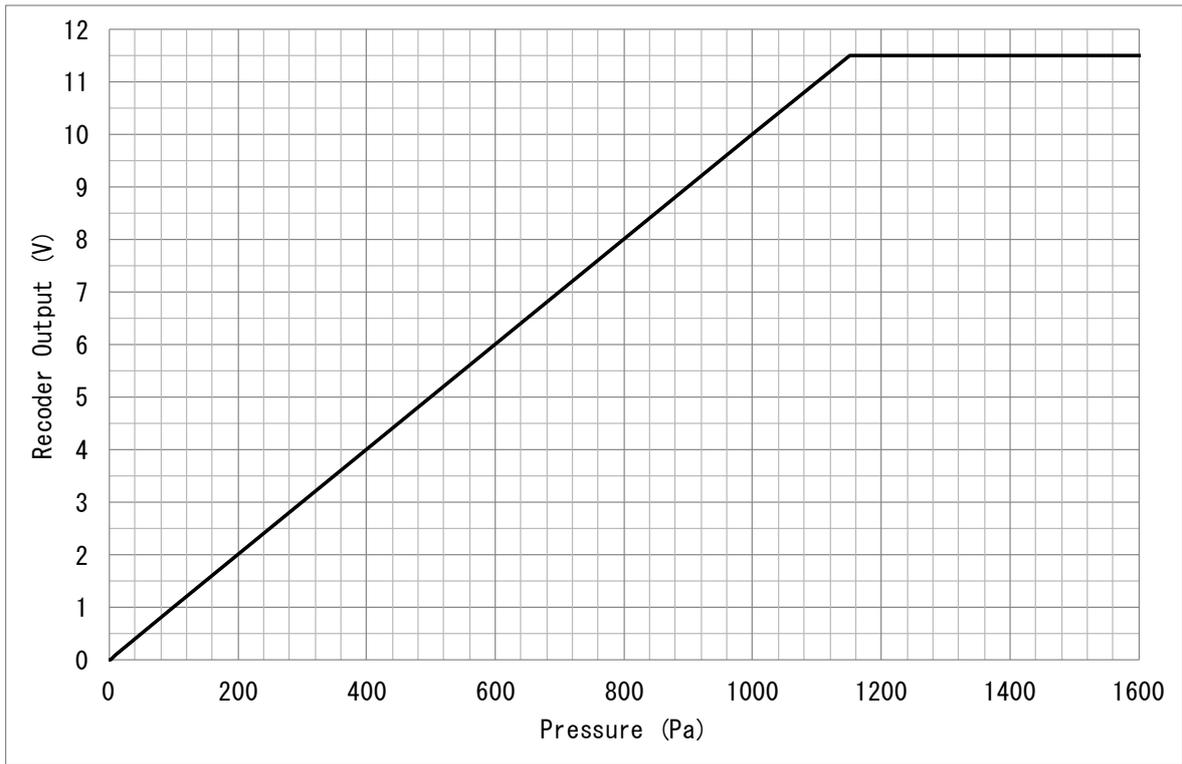


Fig. 4-2 Lin1 Output

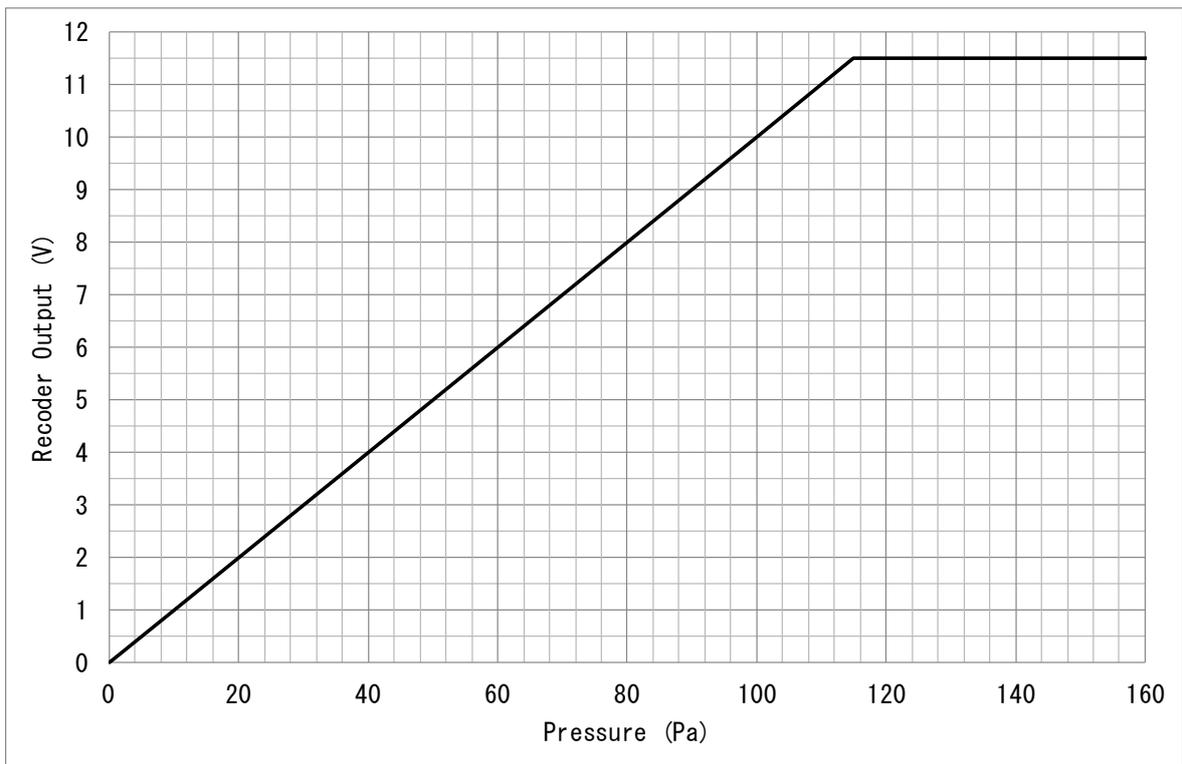


Fig. 4-3 Lin2 Output

4.7. Setpoint Output

The setpoint output turns ON (continuity) the transistor output (open collector) if the measured value is smaller than the set comparison value and the status is maintained continuously for more than 0.5 second.

When the setpoint output is turned ON, the LED (green) that displays the comparison output action on the front panel also light up.

The load of the setpoint output to be used is:

Rated load voltage: 24 VDC
Maximum load current: 50 mA

* The setpoint output is not turned ON for approx. three seconds after power is turned ON regardless of the measured value.

4.8. Zero Resetting Function

This is a function of resetting the indicated value (PV display value) and the analog output to zero when a zero signal is inputted or when the reset switch on the front panel is pressed.

Use it when the measured pressure is sufficiently lower than “0.1 Pa” but the gauge does not indicate “0.0 Pa”.

This function can be used when the original indicated value (the value when the zero reset function is canceled) is below “6.0 Pa”, but use it at below “1.0 Pa” considering the characteristics of the Pirani gauge.

When it is necessary to make zero resetting at a pressure higher than “1.0 Pa”, replace the sensor head, recalibrate the vacuum gauge or take other actions because the sensor head contamination is responsible.

(1) Setting and canceling the zero reset value from the zero input terminal.

Shorting the zero input terminals on the rear panel of the gauge sets the zero reset value, and opening them cancels it.

The zero reset function of this gauge gives priority to the zero input terminal on the rear panel. Even when the zero reset function has been used with the front panel switch, the setting will be invalid and the zero reset value from the zero input terminal will be set. If zero resetting is done from the zero input terminal, it will be impossible to clear it from the front panel switch.

(2) Setting the zero reset value using the front panel switch.

- 1) Hold down the [ZERO] switch on the front panel for more than two seconds.
- 2) The value “oN” on the SV indicator.
- 3) Holding down the [SET] switch when the SV indicator is “oN” (for 10 seconds) sets the zero reset value.

(3) Canceling the zero reset setting using the front panel switch.

- 1) Hold down the [ZERO] and [DATA] switches on the front panel simultaneously for more than two seconds.
- 2) “oFF” on the SV indicator.
- 3) Pressing the [SET] switch when “oFF” is indicating (for 10 seconds) cancels the zero resetting.

5. APPENDIX

5.1. Principles of Operation

When a cold gas molecule collides with a high temperature solid, it receives energy from the solid, is heated and flies away, collides with a low temperature portion and returns to the original state. The high temperature portion loses energy for the energy the cold gas molecule has obtained. This is the mechanism of thermal conduction of gas and is called transport phenomenon of energy by gas molecule.

In a pressure region (molecular flow region) in which collision of gas molecules is small, the amount of energy carried by gas is proportional to the frequency of gas molecules colliding with the high temperature portion. Thus it is also proportional to pressure.

Pressure can be measured by utilizing this principle.

Here, the following relationship holds between T and T_0 [K] and the energy Q [J] carried away by filament per unit area in unit time, given that T is the temperature of the sensor head filament and T_0 [K] is the temperature of the vessel wall.

$$Q = \alpha A (T - T_0) P \dots\dots\dots (1)$$

In this equation, A is a coefficient referred to as free molecule thermal conductivity [$m^3 \cdot K^{-1}$] and its value varies with the type of gas. " α " is a coefficient that corrects the imperfectness of exchange of amount of energy at the time of collision of gas molecules and is referred to as an accommodation coefficient, which is defined as follows.

$$\alpha = \frac{T_g - T_0}{T - T_0} \dots\dots\dots (2)$$

where, T is the filament temperature, T_0 is the temperature of gas molecule before collision and T_g is the temperature of gas molecule after collision. If the exchange of energy on the filament surface is perfect, $\alpha = 1$.

The value α has complex properties that change with geometrical roughness, presence or absence of adsorption layer, heat history, type of gas, temperature and others and is not yet fully explored. The value α directly affects the accuracy and stability of the vacuum gauge.

The constant temperature type Pirani gauge supplies the energy lost by collision of gas molecules from the heated filament and maintains the filament temperature constant all the time. The ULVAC Pirani gauge is this type of gauge.

This type of gauge is less susceptible to change of α and more advantageous over other types of Pirani vacuum gauges in terms of small change in α , stability and responsibility.

5.2. Types of Gas Measured and Indication

As briefly explained in "7.1 Principles of Operation", the indication of the Pirani vacuum gauge changes with the type of gas measured.

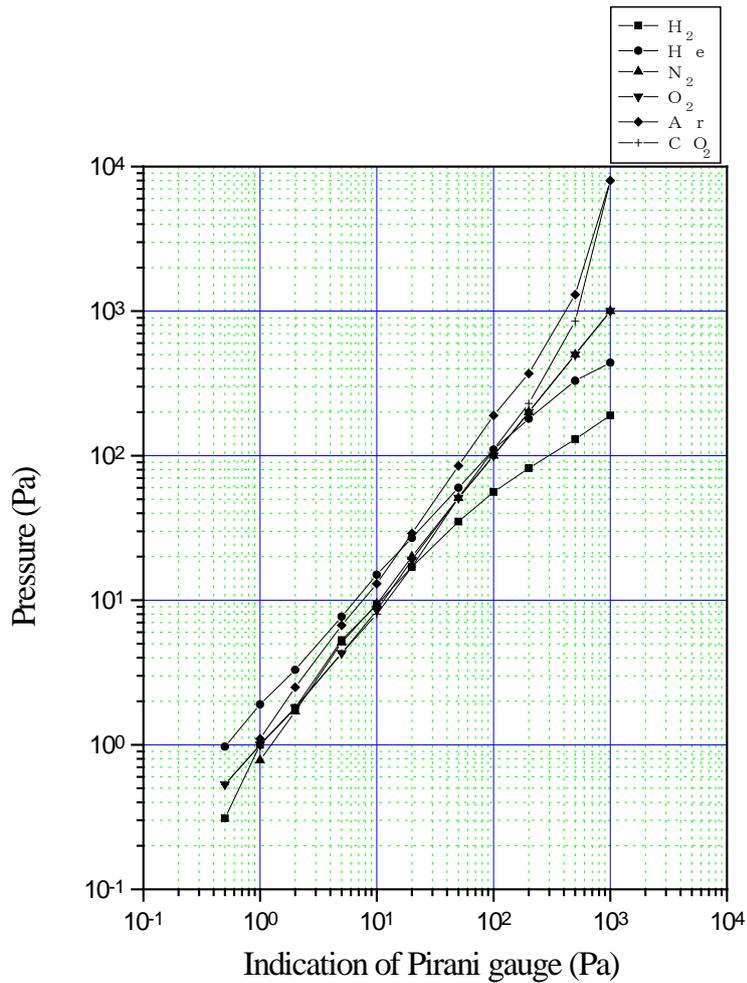
In the molecular flow region, Λ (free molecule thermal conductivity) is given by the following equation.

$$\Lambda = \frac{C_v + (R / 2)}{\sqrt{2\pi MRT'}} \dots\dots\dots (3)$$

where, M is molecular weight, R is a gas constant. T' is the average temperature of T and T_0 , and C_v is specific heat at constant volume. This equation shows that it is dependent on C_v and is in inverse proportion to $\sqrt{MT'}$. In a high pressure region, the number of molecules that carry heat energy increases, while the free path of molecule becomes short, so that the amount of transport per molecule decreases in effect and the change of the indication due to the type of gas measured becomes complex.

Since the Pirani gauge measurement region is an intermediate region between molecular flow and viscosity flow, the difference in indication due to the type of gas is not simple and is difficult to express by an equation.

For your reference, Fig. 5-1 shows the relationship between the indication and pressure when representative gases are measured.



Indication of Pirani gauge (Pa)	Absolute pressure of Gas (Pa)										
	H ₂	He	N ₂	O ₂	Ar	CO ₂	CO	SF ₆	CCl ₂ F ₂	CCl ₄	NH ₃
0.5	3.1E-1	9.7E-1	-	5.3E-1	-	5.3E-1	5.9E-1	3.7E-1	7.4E-1	2.0E-1	4.3E-1
1	1.0	1.9	7.8E-1	1.0	1.1	1.0	1.2	8.2E-1	1.1	6.0E-1	8.2E-1
2	1.8	3.3	1.7	1.8	2.5	1.8	2.3	1.7	2.0	1.2	1.6
5	5.3	7.7	5.1	4.3	6.7	4.3	5.3	4.7	4.1	2.9	3.7
10	9.3	1.5E+1	9.4	8.5	1.3E+1	8.0	1.1E+1	9.8	7.4	5.6	7.2
20	1.7E+1	2.7E+1	2.0E+1	1.9E+1	2.9E+1	1.7E+1	2.1E+1	2.1E+1	1.5E+1	1.2E+1	1.9E+1
50	3.5E+1	6.0E+1	5.1E+1	5.1E+1	8.5E+1	5.1E+1	5.2E+1	4.0E+1	4.0E+1	3.7E+1	4.5E+1
100	5.6E+1	1.1E+2	1.0E+2	1.0E+2	1.9E+2	1.1E+2	1.1E+2	9.0E+1	9.6E+1	1.2E+2	8.0E+1
200	8.2E+1	1.8E+2	2.0E+2	2.0E+2	3.7E+2	2.3E+2	2.1E+2	2.4E+2	3.3E+2	-	1.3E+2
500	1.3E+2	3.3E+2	5.0E+2	5.0E+2	1.3E+3	8.5E+2	5.3E+2	2.0E+3	-	-	3.5E+2
1000	1.9E+2	4.4E+2	1.0E+3	1.0E+3	8.0E+3	8.0E+3	1.0E+3	-	-	-	5.9E+2

(Fron 12)

Remarks: Sensor head: WP-01, Controller: GP-2T.
 The absolute pressure was measured by a diaphragm gauge.
 The indication of the Pirani gauge was calibrated with dry air.

Fig. 5-1 Indications of various types of gas

5.3. Change of Indication with Ambient Temperature

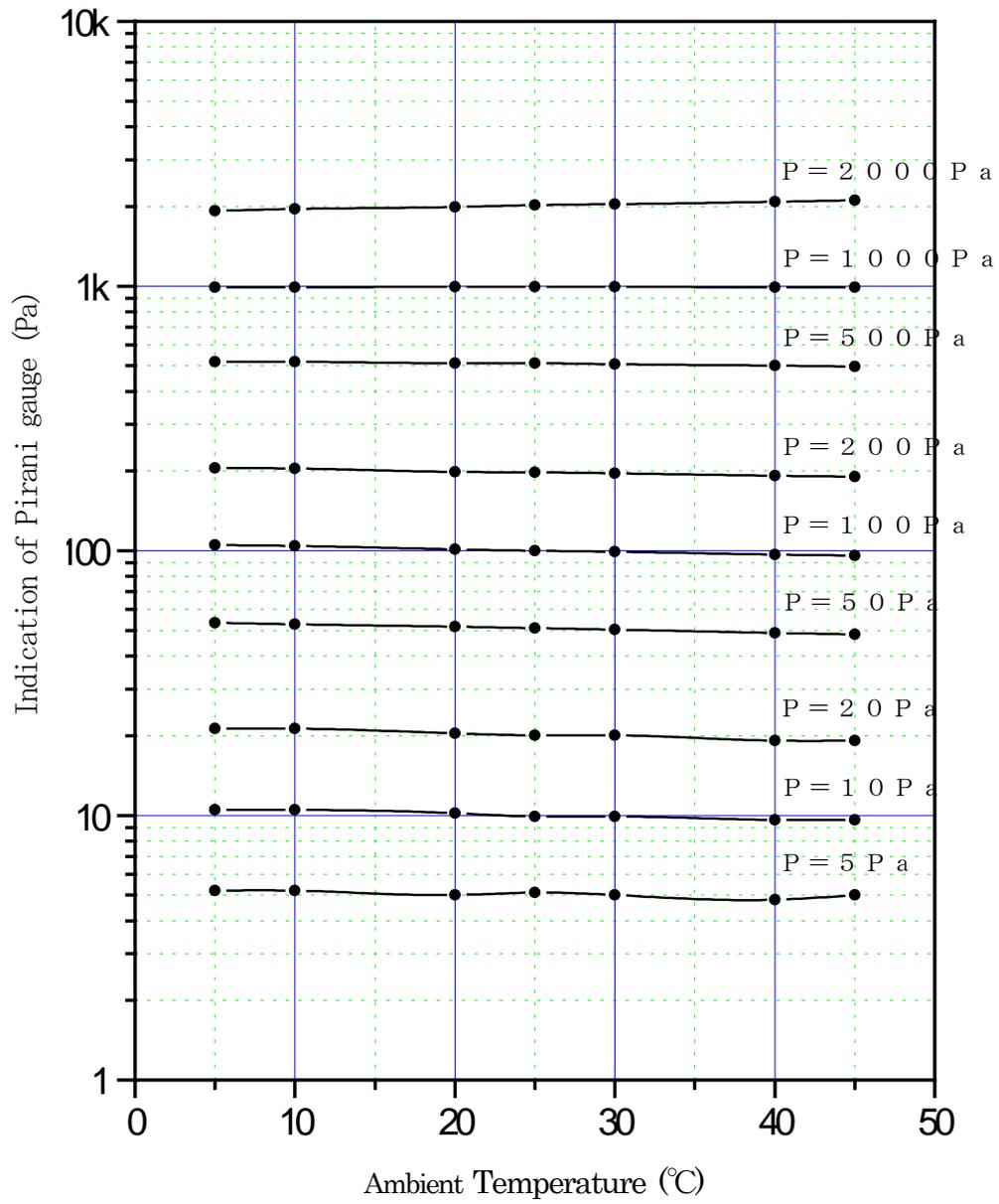


Fig. 5-2 Change of Indications with Ambient Temperature

6. TROUBLESHOOTING

Symptom: No Display When Power is Applied

Possible cause	Corrective action
<ul style="list-style-type: none"> • Within 3 second after power is applied • Fuse blown out 	1) Normal 1) Replace the fuse Vendor : Littelfuse Part Number: 37008000410 Current : 800mA * The fuse used in this instrument does not blow out under normal conditions. If the cause is unknown (for example, the power line was struck by lightning), do not replace it by yourself, but contact your local ULVAC representative for replacement.
<ul style="list-style-type: none"> • The power cord is disconnected. 	1) Check the power cord for connection.
<ul style="list-style-type: none"> • The line voltage is below the specified range. 	1) Check the line voltage by a circuit tester.

Symptom: The PV display is “----” and does not change when pressure has lowered.

Possible cause	Corrective action
<ul style="list-style-type: none"> • Pressure is still higher than the measurement range. (atmospheric pressure, for example) 	1) Normal

Symptom: The PV display remains “----”, and the SV display remains “OFF”.

Possible cause	Corrective action
<ul style="list-style-type: none"> • The sensor head filament has burnt out. 	1) Check the filament for continuity referring to Fig. 10-4 Sensor head filament connection diagram. The filament resistance value is about 13 ohms under atmospheric pressure. Replace the sensor head if the filament has burnt out. Do not energize the filament with a current of 10mA or more. Its life will be shortened.
<ul style="list-style-type: none"> • The sensor head filament is disconnected or in poor contact. 	1) Check the sensor head cable referring to Fig. 10-5 Sensor head cable.
<ul style="list-style-type: none"> • The sensor head, measuring unit and sensor head cable are not connected to the controller. 	1) Securely connect the sensor head, measuring unit and sensor head cable.

Symptom: The display remains at 0.0 Pa and does not change though the pressure has increased.

Possible cause	Corrective action
<ul style="list-style-type: none"> • Pressure is still below the measurement range. 	1) Normal
<ul style="list-style-type: none"> • ZERO adjustment function is setting. 	1) Normal Reset ZERO adjustment function. Refer to section 4.8

Symptom: The PV display does not “-----” when atmospheric pressure is being measured.

Possible cause	Corrective action
<ul style="list-style-type: none"> The type of sensor head differs from the specified one. 	1) Change the sensor head with the specified type. Or re-adjust and re-calibrate the one in use.
<ul style="list-style-type: none"> Gas under measurement is not nitrogen or air. 	1) Normal
<ul style="list-style-type: none"> Gas under measurement is nitrogen or air, but contains much moisture and oil. 	1) Normal
<ul style="list-style-type: none"> The sensor head is contaminated or the sensor head filament has worn out. 	1) Replace the sensor head.
<ul style="list-style-type: none"> Air temperature at the location where the sensor head or controller is installed is high. (This gauge has been adjusted at 25°C.) 	1) Change the place of installation. (Install in a clean, well ventilated place not blown with draft.)

Symptom: Pressure display does not show a constant value.

Possible cause	Corrective action
<ul style="list-style-type: none"> The pressure is changing. 	1) Normal
<ul style="list-style-type: none"> The type of sensor head differs from the specified one. 	1) Change it with the specified one. Or re-adjust and re-calibrated the one currently in use.
<ul style="list-style-type: none"> The sensor head is contaminated or the sensor head filament has worn out. 	1) Replace the sensor head.
<ul style="list-style-type: none"> Leak in the sensor head or area where it is installed. 	1) If there is a leak in the sensor head, replace it. If there is a leak elsewhere, stop it.
<ul style="list-style-type: none"> Poor contact of the sensor head cable or increased resistance of wire rod due to corrosion or other. 	1) Check the sensor head cable referring to Fig. 10-5 Sensor head cable.

7. WARRANTY

This product was shipped after rigid company inspection. However, in case any failure occurs under ULVAC's responsibility, such as defect in manufacturing and damage during transportation, Buyer shall inform ULVAC, Inc. or the local ULVAC representatives. ULVAC will repair or exchange it at free of charge.

Warrantable Items: Vacuum gauge (controller)

Duration of guarantee: One (1) year after shipping date from ULVAC

Warranty scope

- 1) Domestic business in Japan: Product, which has damage, caused by a failure on delivery.
- 2) Direct export transaction: Product, which has damage, caused by a failure on delivery. The warranty scope shall conform to the new INCOTERMS.
- 3) Products not satisfying meet the standard specifications although the product is used under the normal service conditions such as temperature range and power etc.

Response procedure

- 1) Domestic business in Japan: ULVAC send a replacement or Buyer return the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. If field service is required, Buyer shall ask ULVAC, Inc. or the local ULVAC representatives.
- 2) Direct export transaction: ULVAC send a replacement or Buyer return the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. Return charge shall be paid by Buyer.

Disclaimer

- 1) Failure occurred after expiration of warranty period
- 2) Failure caused by force majeure, such as fire, storm and flood damage, earthquake, lightning strike, war etc
- 3) Failure occurred due to carelessness handling or faulty usage
- 4) Products remodeled, disassembled or repaired without ULVAC's acceptance
- 5) Failure occurred under abnormal environment, such as intense electromagnetic field, radiation, high-temperature, high-humidity, flammable gases, corrosive gases, dust etc.
- 6) Failure occurred by noise
- 7) Product deficiency or secondary damage occurred to Buyer, from law suit to ULVAC by third party for patent infringement.
- 8) Sensor head being used (expiration of life, measurement error, etc.)
- 9) Sensor head cable being used (cable burnout due to improper installation, poor contact, etc.)

Others

- 1) In case, special agreement or memorandum for specifications is made individually, the descriptions are prior to this article "13 Product Warranty".
- 2) Buyer shall inform ULVAC when this product is exported out of Japan. In the meantime, Buyer shall take necessary procedures according to Foreign Exchange and Foreign Trade Law.
- 3) As for the question and consultation, Buyer shall check the model and serial number and ask the local representative or ULVAC, Inc.
- 4) The content of this document is subject to change without notice in future.

8. CHINA ROHS DECLARATION



This mark is applied to the electronic information product sold in the People's Republic of China. The figure at the center of the mark is the validity date of environmental protection. This product does not influence the environment, the human body and the property during the period reckoning the manufacturing date as long as the caution for safe use regarding the products are observed.

*The environmental protection validity date is not the product warranty period.

Table. 8-1 Making format for names and contents of hazardous substances or elements

Name of parts	Hazardous substances or elements					
	Pb	Hg	Cd	Cr ⁶⁺	PBB	PBDE
Printed Circuit Board	×	○	○	○	○	○
Chassis	○	○	○	○	○	○
Connector	○	○	○	○	○	○
AC-DC Converter	○	○	○	○	○	○
Label	○	○	○	○	○	○
Detection Unit	○	○	○	○	○	○
Gauge Head	×	○	×	○	○	○
Cable	○	○	○	○	○	○

○: indicating that content of the hazardous substance or element in all homogeneous materials of the part does not exceed the requirements for concentration limits specified by SJ/T11363-2006.
 ×: indicating that content of the hazardous substance or element in, at least one kind of, homogeneous materials of the part exceeds the requirements for concentration limits specified by SJ/T11363-2006. Producer may further explain the technical excuse to the items marked with “X” perspecific conditions here.

9. CERTIFICATE OF DECONTAMINATION

ULVAC

Form: A003S1268-04

ULVAC Components / Certificate of Decontamination

This is a certificate of decontamination for repair and inspection request of ULVAC Components. All material must be certified as decontaminated and this certificate must be submitted to your closest local ULVAC service center or sales office prior to shipment.

Please consult with your closest local ULVAC service center or sales office if our components are used with toxic gases or contaminated with reactive products or substances produced by reaction.

Product model:

Model:

Serial No.:

Application:

Remarks:

Contaminant (Check an applicable box.)

- I guarantee that above returned item(s) is not contaminated with harmful substances.
- Above returned item(s) is contaminated with the following harmful substances.

	Name of contaminant (molecular formula)	Characteristics
1		
2		
3		
4		
5		

To: ULVAC, Inc

Attn: _____

Date: / / (YYYY/MM/DD)

Your company

Division

Contact

Phone

Fax

E-mail

Please pack returned item(s) carefully before shipment. Any accident occurred during transportation to us caused by contaminant is under your responsibility. It is also to be understood that ULVAC may decline to repair returned item(s) depending on the type of contaminant and degree of contamination, and return it to you.

To be filled in by ULVAC	Received by	
Request for MSDS: Yes/No		
ULVAC job No.		

10. RELATED DRAWINGS

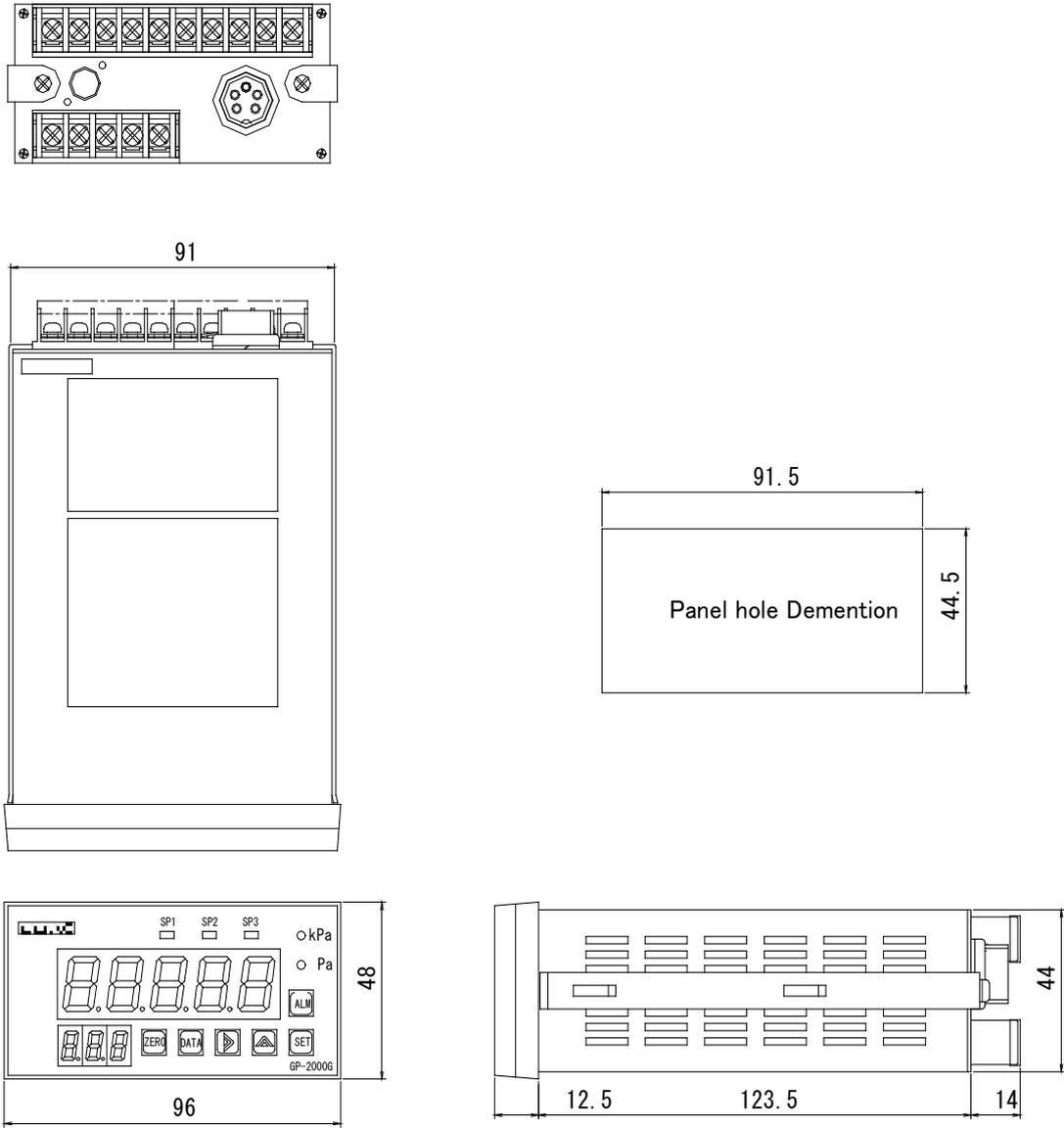


Fig. 10-1 Dimensional drawing for GP-200□G

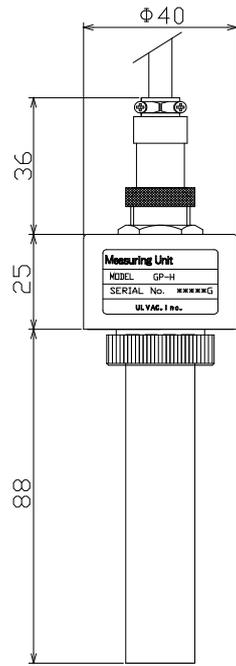


Fig. 10-2 Dimensional drawing for measuring unit GP-H

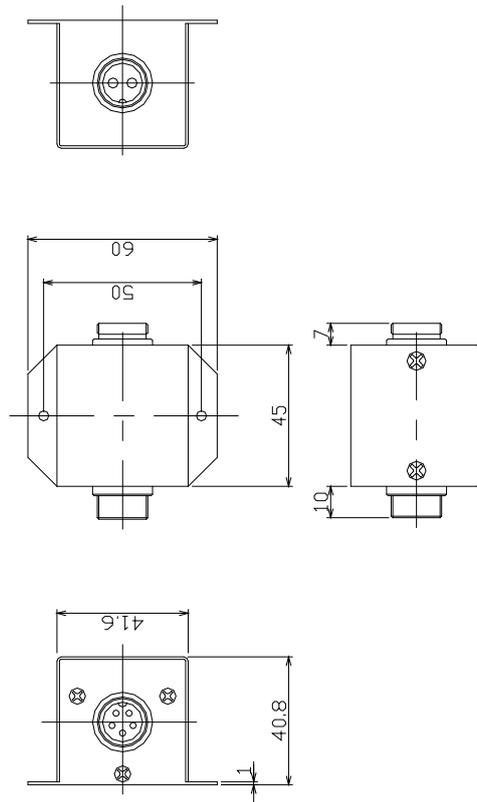


Fig. 10-3 Dimensional drawing for measuring unit GP-BH

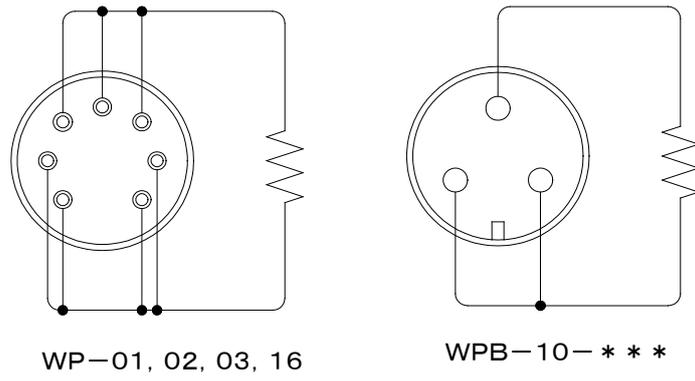
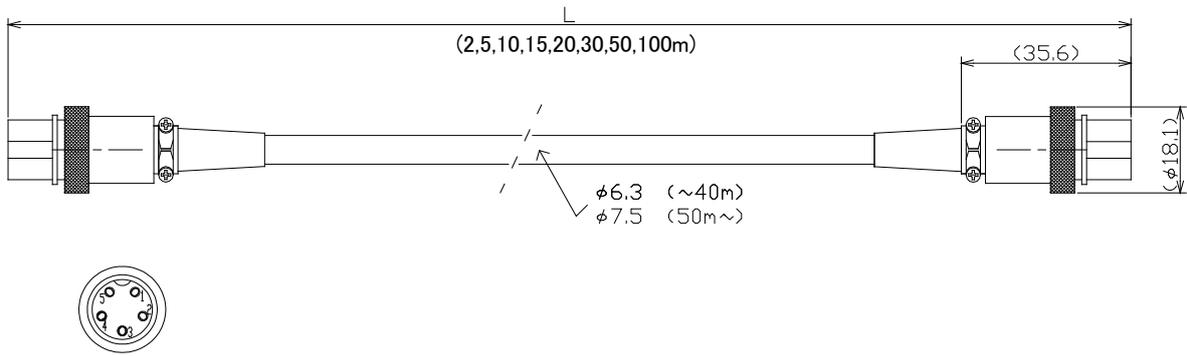
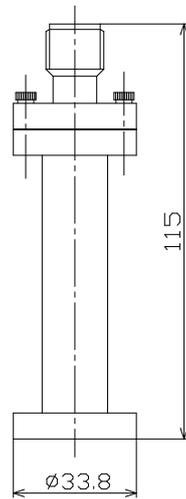
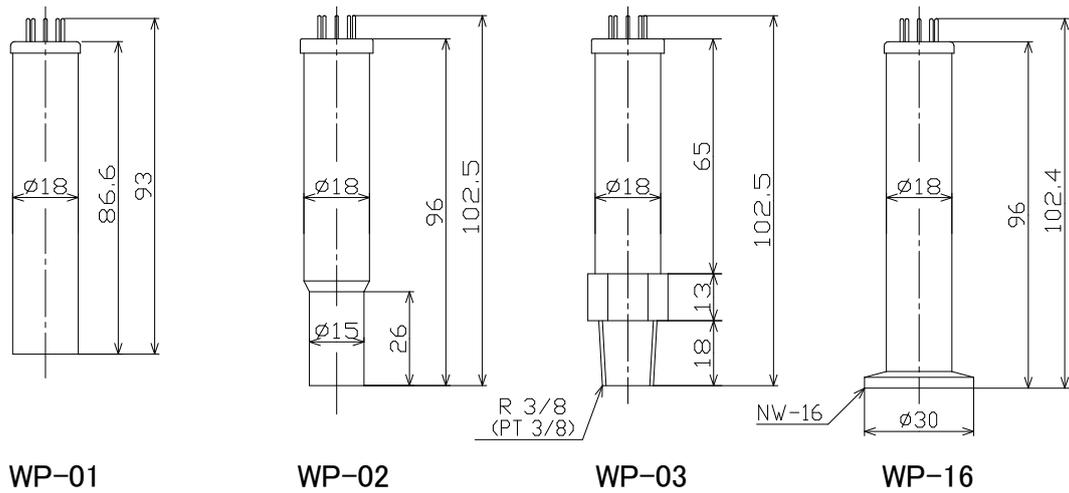


Fig. 10-4 Sensor head filament connection diagram



Pin No.	Use
1	+5 V
2	+15 V
3	V+
4	V-
5	AG
Cover	FG

Fig. 10-5 Sensor head cable



Sensor head model	Mounting port size (dia.)	Filament material	Case material
WP-01	φ 18	Pt (φ 25μ)	BS (Ni plating)
WP-02	φ 15 (18)	Pt (φ 25μ)	BS (Ni plating)
WP-03	φ 3/8	Pt (φ 25μ)	BS (Ni plating)
WP-16	NW-16 (φ 30)	Pt (φ 25μ)	BS (Ni plating)
WPB-10-034	UFC-034	Pt (φ 25μ)	SUS304

Fig. 10-6 Sensor heads compatible with GP-200□G