No. SK00-7011-EI-004-07

ULVAC

MODEL GP-1000G
(Pa/Torr)

PIRANI VACUUM GAUGE

INSTRUCTION MANUAL

This manual is for the following vacuum gauges.
Serial Nos.T7000G and higher

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

ULVAC , Inc.

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	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.
⚠WARNING	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.
⚠CAUTION	The contents described in this instruction manual are subject to change without prior notice because of changes in specifications or because of product improvements.

Safety Symbols

⚠WARNING	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.

⚠DANGER	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.
⚠WARNING	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)
⚠CAUTION	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.
✔ Note	Direct hazard is not existed, describe the necessity to know from the viewpoint of worker's safety or correct and safe operation of equipment

Safety Cautions

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

	**Turn OFF power.** 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, Inc., JAPAN.
	**Turn OFF power.** 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, Inc., JAPAN.
	**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.
	**Turn OFF power.** Whenever mounting the gauge, unplug the power cable.
	**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.
	**Operating environment** 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.
	**Don't use cables above rating.** The rating of the supplied power cable is 125 V 7 A. If the power exceeds the rating, use another power cable. Use above the rating will damage the gauge.
	**Don't disassemble.** Do not try to disassemble the vacuum gauge (controller, measuring unit, sensor head cable and sensor head).
	**Don't modify.** 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.
	**Check connection.** For safety reasons, ground the GND terminal of the controller.
	**Operating environment** 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.
	**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 gauge will not indicate normal values either.
	**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 conditions** Operate the vacuum gauge under the environment set forth in the specifications.
⚠CAUTION	**Beware of impact** Do not give an impact to the sensor head.
⚠CAUTION	**Repacking for transfer** 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.
⚠CAUTION	**Discarding** 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.
⚠CAUTION	**Connection** The contact output capacity is 100VAC/0.5A, 24VDC/1A (resistance load). If power higher than this is opened/closed, do not use the contact of the vacuum gauge, but use a large capacity switch in conjunction.
✔ Note	**Maintenance** Aluminum electrolytic capacitor and relays is used for the electric circuit in the sensor controller. Generally, the life expectancy of the aluminum electrolytic capacity is limited and the higher the surrounding temperature, the shorter the life. It is recommended to replace the aluminum electrolytic capacitor and relays once every five years or at the time or repair or overhaul to prevent components from being damaged.
✔ Note	**Lifetime of sensor head cable and connector** Female connector is used in the sensor head cable and detection unit. This female connector has a lifetime. A large current load may cause a fire in the connector connection area. Avoid the frequent insert/remove of connector to prevent a heavy load and loosens of the connector connection.

Contents

1. OVERVIEW

The Model GP-1000G is a constant temperature type Pirani vacuum gauge utilizing heat conduction of gas. The measurable pressure range is 0.4 to 2700 Pa.

Pressure can be set at two points and its comparator output can be taken out as setpoint (transfer type).

Also functional check of the sensor head can be made (the sensor head is not burnt out).

Digital output (BCD output) and RS232C are provided as standard.

The controller and measuring unit being separated from each other, it is not necessary to make re-adjustment when the sensor head cable length is changed.

Changes in pressure indications due to change of the sensor head ambient temperature have been reduced by incorporating a 2-point temperature compensation circuit.

1.1. Specifications

Name	Pirani vacuum gauge
Model	GP-1000G
Measurable range	4.0×10^{-1}Pa ～ $2.7\times10^{+3}$Pa （3.0×10^{-3}Torr ～ $2.0\times10^{+1}$Torr）
Measurement point	One
Display	2 digits mantissa part, 1 digit exponent part
Display sampling time	200 msec
Measurement accuracy	4.0×10^{-1} Pa(3.0×10^{-3}Torr) ～ $1.0\times10^{+1}$ Pa(7.6×10^{-2}Torr) : ±50% $1.0\times10^{+1}$ Pa(7.6×10^{-2}Torr) ～ $5.1\times10^{+1}$ Pa(3.8×10^{-1}Torr) : ±30% $5.1\times10^{+1}$ Pa(3.8×10^{-1}Torr) ～ $7.6\times10^{+2}$ Pa($5.7\times10^{+0}$Torr) : ±15% $7.6\times10^{+2}$ Pa($5.7\times10^{+0}$Torr) ～ $1.0\times10^{+3}$ Pa($7.6\times10^{+0}$Torr) : ±30% $1.0\times10^{+3}$ Pa($7.6\times10^{+0}$Torr) ～ $2.7\times10^{+3}$ Pa($2.0\times10^{+1}$Torr) : ±50%
Recorder output	(1) Linear output $1.0\times10^{+3}$ Pa f.s. 0 to 10 V (2) Linear output $1.0\times10^{+2}$ Pa f.s. 0 to 10 V (3) Dummy log output Each range 2 V (4) Dummy log output Each range 1 V (5) Non-linear output 0 to 10 V
BCD output	TTL level Open collector
Input signal	Ar/N_2 changeover input: TTL level
Output signal	Error signal, Setpoint signals(three) Relay contact output (transfer type) Relay load: 100VAC/0.5A, 24VDC/1A (resistance load) Mechanical service life: 5million operations Electrical service life: 100,000 operations
Communication	RS-232C
Sensor head inter-changeability	Within ± 3% in filament resistance value (sensor head of the same type)
Operating temperature range	10°C to 40°C
Operating humidity range	15% to 80 % （No condensation）
Power requirements	100 to 240 VAC
Power consumption	10 VA Inrush Current AC100V: 25A or less / 2ms or less AC200V: 20A or less / 2ms or less
Outside dimensions	50W × 238D × 99H (mm)
Weight	Controller : 1.0 kg Measuring unit (GP-H) : 35g

CE standard	Tested Norms EMC Emmission EN61000-6-4:2007 EN61326-1：2006 EN61000-3-2：2006 EN61000-3-3：1995 + A1: 2001 + A2:2005 Immunity EN61000-6-2:2005 EN61326-1：2006 Basic Standards Electrostatic discharge immunity test (ESD) EN61000-4-2：1995 + A1:1998 + A2:2001 Radiated, radio-frequency, electromagnetic field immunity test EN61000-4-3：2006 Electrical fast transient / burst immunity test (BURST) EN61000-4-4：2004 Surge immunity test (Surge) EN61000-4-5：2006 Immunity to conducted disturbances, induced by radio-frequency fields EN61000-4-6：2007 Power frequency magnetic field immunity test EN61000-4-8：1993 + A1:2001 Voltage dips, short interruptions and voltage variations immunity test EN61000-4-11：2004 ※

※ During the test with 5000ms the EUT tune off and on automatically.

1.2. Standard Accessories

Power cable *1 This controller side：PLUG TYPE B Outlet side：IEC60320-C13	3m long	1pc
Input/output connector	D-sub 37 socket (M2.6 screw)	1 pc
Quick manual	(This manual)	1 copy
Instruction manual	CD	1 pc

*1: The rating of the supplied power cable is 125 V 7 A. If the power exceeds the rating, use another power cable. Use above the rating will damage the gauge.

1.3. Option

1.3.1. Sensor head

Sensor head	WP-01, WP-02, WP-03., WP-16	WPB-10, WPB-10-034
Connecting flange	WP-01: ϕ 18 port, WP-02: ϕ 15 port WP-03:R3/8, WP-16(NW16)	WPB-10:UFC034 WPB-10-034:UFC034
Filament material	Pt	Pt
Other materials	BS/Ni-plating Ni、Kovar、Glass、SnSbCu	SUS304、Cu(Gasket) FeNiCo(Ni-plating)、Al_2O_3
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	$< 2 \times 10^{+5}$Pa(abs)	$< 2 \times 10^{+5}$Pa(abs)
Bakeout※2	80℃ max	250℃ 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).

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, WPB-10-034
Weight	35g	GP-BH: 0.13kg Conversion calbe: 0.2kg

*Because of its circuitry, the indication of this vacuum gauge varies with the type of sensor head. Therefore, if the type of sensor head is changed after delivery, re-adjustment will be required. Before operation, check the conditions at the time of shipment from the factory (type of sensor head) that are indicated on the measuring unit.

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. Others

Test results certificate	
Calibration certificate	Calibration certificate, JCSS Calibration certificate

1.4. Description of Components
1.4.1. Front panel

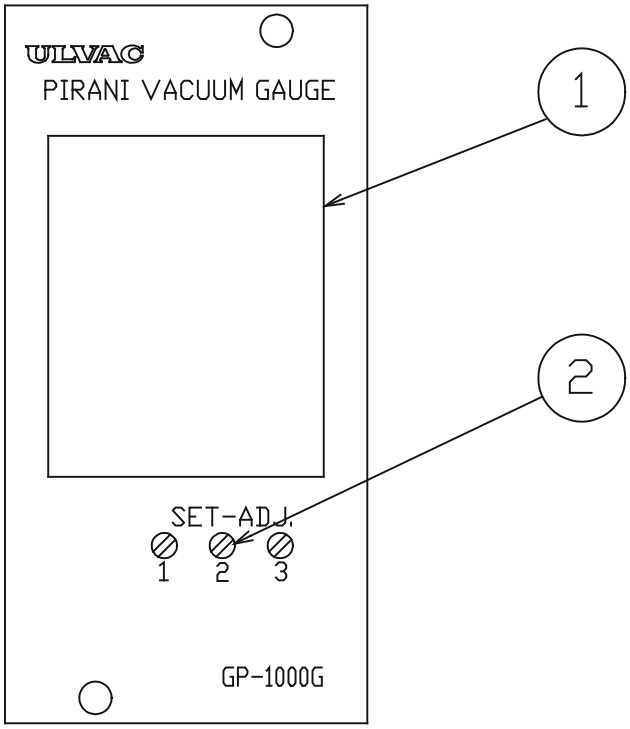


Fig. 1-1 Front panel of controller

① LCD display panel
Pressure indicator.
Displays the indicated pressure value, unit of pressure, set pressure value of each setpoint and relay status of each setpoint.
Refer to 1.3.3 "LCD panel" for more information.

② Setpoint ADJ.
Sets the pressure for pressure setting signal.
The setpoint relay action is described in 3.4 "Relay Setpoint Output".

1.4.2. Rear panel

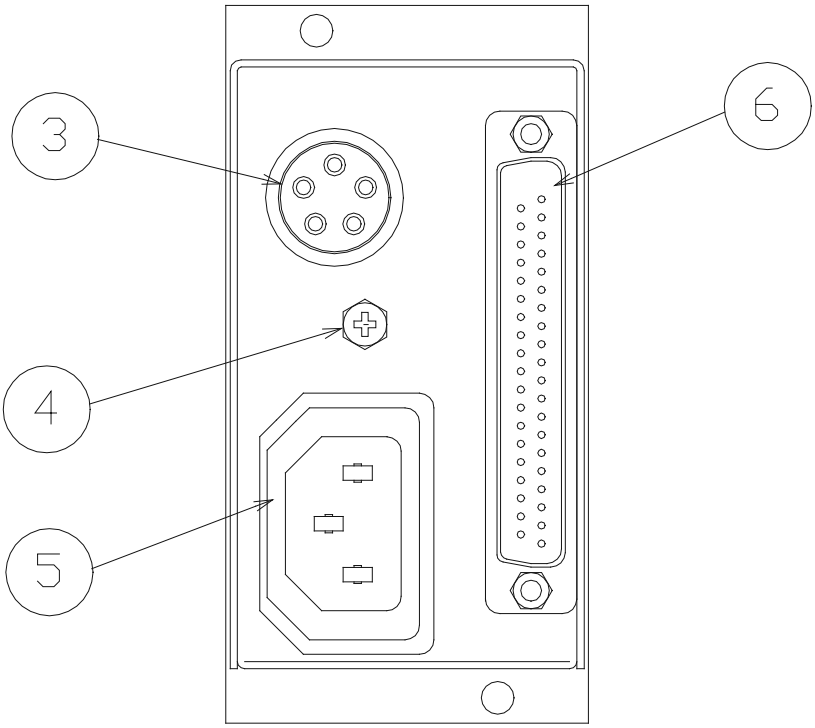


Fig. 1-2 Rear panel of controller

③ Sensor head cable connector
Connector for connecting the sensor head cable. Connect the supplied sensor head cable.

④ Ground terminal
Ground terminal for this gauge. Attach M3 solderless terminal before use. Analog ground, digital ground and frame ground are common.

⑤ Power inlet connector
Connector for connecting 3-core power cord with grounding terminal.

⚠CAUTION	**Don't use cables above rating.** The rating of the supplied power cable is 125 V 7 A. If the power exceeds the rating, use another power cable. Use above the rating will damage the gauge.
⚠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.

⑥ Input/output signal connector
Recorder outputs, relay setpoint outputs (setpoint), BCD outputs and Ar/N_2 changeover inputs are outputted from this connector.
Refer to Table. 4-1 "I/O Connectors" for more information.

1.4.3. LCD panel

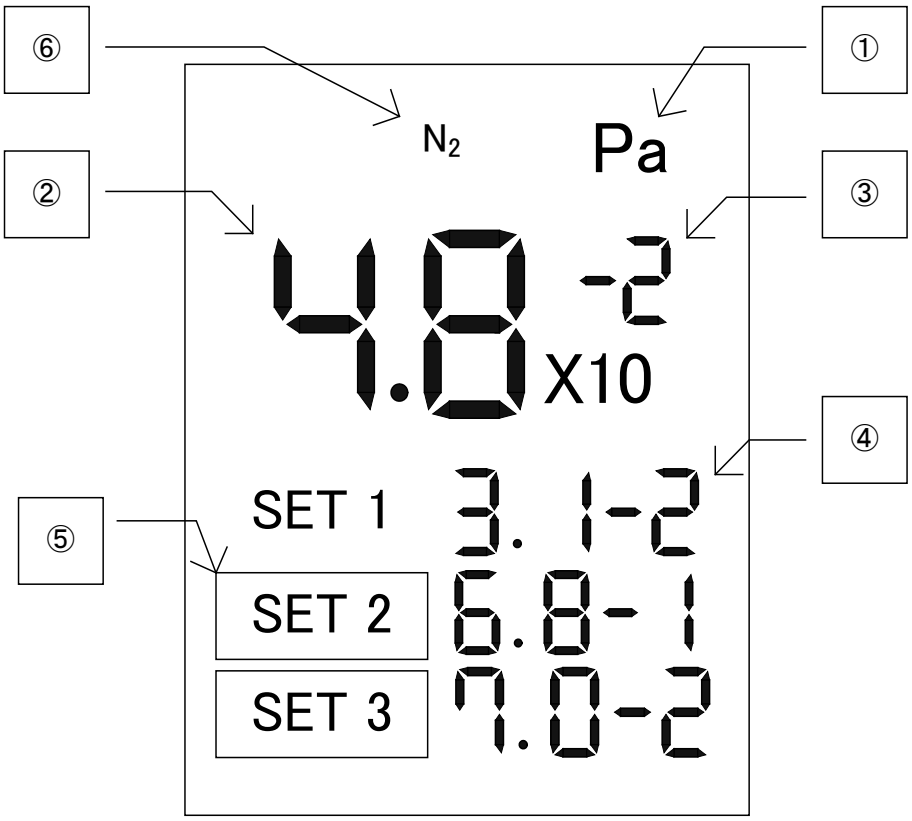


Fig. 1-3 LCD panel

① Unit of pressure
Indicates the measured pressure in Pa or Torr.

② Pressure mantissa part
Indicates the mantissa part of the measured pressure.

③ Pressure exponent part
Indicates the exponent part of the measured pressure.

④ Setpoint pressure set value
Indicates the pressure set value of each setpoint.

⑤ Setpoint relay status
Indicates the relay status of each setpoint.
When the setpoint relay is actuated, a frame will be displayed around "SET□".

⑥ N_2/Ar gas display
Indicates N_2 or Ar.
Refer to 3.2 "How to Set the DIP Switch" for changeover.

2. INSTALLING THE PIRANI VACUUM GAUGE

⚠WARNING	**Turn OFF power.** Whenever mounting the vacuum gauge, unplug the power cable.

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.

Fig. 13-1 shows the panel cut drawing.
If the controllers are mounted side by side, provide a spacing 30mm between controllers.
Secure a space for cable connection on the batch.

2.2.2. Installing the sensor head

⚠WARNING	**Operating environment** 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.
⚠CAUTION	**Beware of impact** Do not give an impact to the sensor head.

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 materiel that releases much outgas like rubber pipe or grease can be a cause of error.

2.2.3. Electrical connection

⚠CAUTION	**Don't use cables above rating.** The rating of the supplied power cable is 125 V 7 A. If the power exceeds the rating, use another power cable. Use above the rating will damage the vacuum gauge.
⚠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.

Plug the power cable to a 100 VAC outlet.

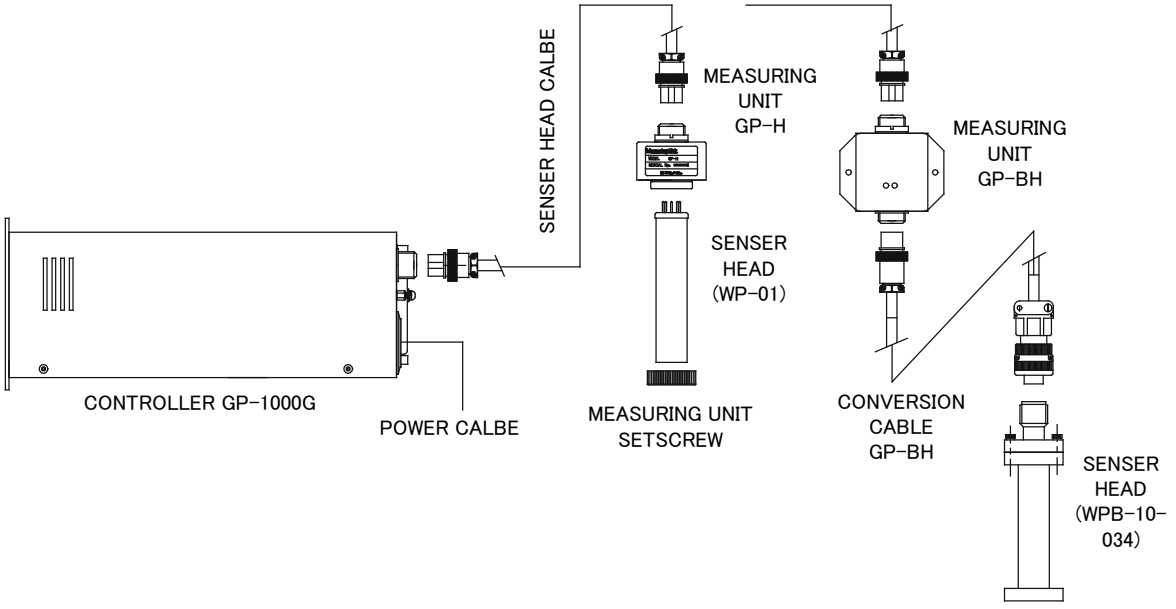


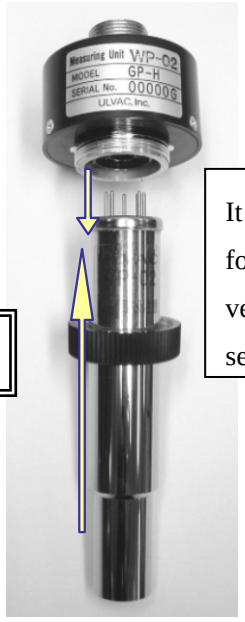
Fig. 2-1 GP-1000G overall connection diagram

2.2.4. 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.

①Install 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

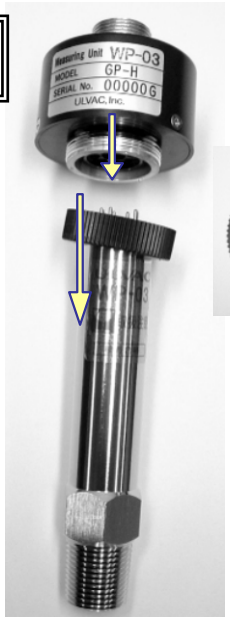
For sensor head WP-01, 02



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.

For sensor head WP-03, 16



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) Start measurement more than one minute after power is turned ON and the indication is stabilized.

(2) The relay set point sometimes actuated in a moment after three seconds when power is turned ON.

(3) For precision measurement, wait for at least 10 minutes until temperature equilibrium of the sensor head is established after power is turned ON. Do not turn OFF the power when a sequence of measurements is being made.

(4) If the sensor head is exposed to a chemically active gas or highly adsorptive gas, its characteristics may change.
In such a case, fill the chamber with nitrogen or inert gas, with the sensor head energized with power, and then evacuate it. Repeat this purging operation. The sensor head may be restored to the condition before the characteristics changed. At this time, do not blow gas toward the opening plane of the sensor head even if the gas is inert or dry air.
If there is no prospect of the characteristics being restored by purging operation, replace the sensor head.

(5) The Pirani vacuum gauge is sensitive to all types of gas, but its sensitivity varies with the type of gas.
Refer to 7.2 "Types of Measured Gas and Indications".

3.2. How to Set the DIP Switch

JSW1 : Sets the unit of pressure,Pa or Torr. The pressure display changes simultaneously with the changeover, allowing direct reading of the pressure.
"ON": Torr "OFF": Pa

JSW2 : N_2/Ar gas setting switch.
"ON" : N_2 gas sensitivity "OFF": Ar gas sensitivity.

JSW3 : Sets each range 2V or 1V of dummy log output.
"ON" : each range 2V "OFF": each range 1V
* This setting is not related in the linear output, the non-linear output.

JSW4 : Sets the full scale of linear output, dummy log and non-Linear output
*Sets the full scale of linear output
"ON": 1.0×10^3 Paf.s. "OFF": 1.0×10^2 Paf.s.
*Sets dummy log output or non-linear output
"ON": dummy log output "OFF": non-linear output

JSW5 : Sets dummy log output/non-linear output/linear output of recorder output.
"ON" : dummy log output or non-linear output "OFF": linear output

JSW6, 7 : Sets the baud rate of RS-232C.

JSW8 : Used in system setting. Used on OFF.

Table. 3-1 Setting dip switch

JSW	ON	OFF
1	Torr	Pa
2	N_2	Ar
3	Each range 2V of dummy log	Each range 1V of dummy log
4	Linear output $1.0 \times 10^{+3}$ Pa f.s.	Linear output $1.0 \times 10^{+2}$Pa f.s.
	Dummy log output	Non-Linear output
5	Dummy log output or Non-Linear output	Linear output
6 7	See the table below	
8	–	–

Table. 3-2 Setting recorder output

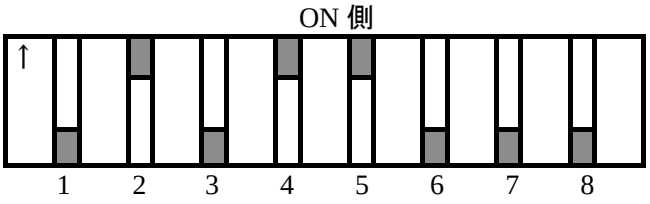
JSW	Each range 2V Dummy LOG output	Each range 2V Dummy LOG output	Non-Linear output	Linear output $1.0 \times 10^{+3}$Pa f.s.	Linear output $1.0 \times 10^{+2}$Pa f.s.
3	ON	OFF	-	-	-
4	ON	ON	OFF	ON	OFF
5	ON	ON	ON	OFF	OFF

*: JSW3 is only dummy log output.

Table. 3-3 Setting baud rate for RS-232C

JSW	Baud rate(bps)			
	9600	4800	2400	1200
6	OFF	OFF	ON	ON
7	OFF	ON	OFF	ON

Table. 3-4 Factory set as shown above



3.3. Display of Pressure out of Measurement Pressure Range

(1) Pressure out of the measurement pressure range is displayed as follows.
   1) When pressure is lower than 4.0×10^{-1} Pa : Displayed as 0.0×10^{-1} Pa
   2) When pressure is higher than 2.7×0^{3} Pa : Blinks at 2.7×10^{3} Pa

(2) The following display appears if the sensor head filament burns out.
   Pressure indicator corresponding to the burnt-out sensor head blinks at $E.E \times 10^{E}$.

3.4. Relay Setpoint Output

3.4.1. Setpoint

The setpoint relay output is actuated (reversed) when the measured pressure value is lower than the set pressure value.

What is meant by "Pressure is higher or lower" is as follows.

2.0×10^{1} [Pa] is lower than, or

8.0×10^{1} [Pa] is higher than

5.0×10^{1} [Pa].

The table below gives the relay action.

Table. 3-5 Setpoint relay setpoint output table

Power	Measured pressure(Pa)	Set pressure(Pa)	Relay setpoint output	
			COM-NC	COM-NO
OFF			CLOSE	OPEN
ON	$2.0 \times 10^{+1}$	$5.0 \times 10^{+1}$	OPEN	CLOSE
ON	$8.0 \times 10^{+1}$	$5.0 \times 10^{+1}$	CLOSE	OPEN

When the setpoint relay is actuated, a frame is displayed around "SET" on the LCD display panel.

Normally	When actuated
SET1 $5.0 \times 10^{+1}$	SET1 $5.0 \times 10^{+1}$

* The relay setpoint is not actuated for about three seconds after power is turned ON even if the measured pressure is lower than the set pressure. But after three seconds, the relay setpoint is actuated in a moment.

* The relay setpoint is not actuated under setpoint adjustment, and just after adjustment.

3.4.2. Error

The error relay setpoint output is actuated (reversed) when the sensor head filament has burnt out.

The table below gives the relay action.

Table. 3-6 Error Relay Setpoint Outputs

Power	Sensor head filament	Relay setpoint output	
		COM-NC	COM-NO
OFF		CLOSE	OPEN
ON	Burnout	OPEN	CLOSE
ON	Normal	CLOSE	OPEN

The relay setpoint is not actuated for about three seconds after power is turned ON even if the sensor head filament has burnt out.

4. EXTERNAL INPUTS/OUTPUTS

4.1. External Input/Output Connector Assignment

Pa/Torr, N_2/Ar can be changed over by external inputs.
Refer to Table. 4-1 "I/O Connectors" for the input terminals.
For changeover, input TTL level Lo/Hi or relay setpoint SHORT/OPEN.
For external changeover of Pa/Torr, turn OFF JSW1 of the DIP switch.
For external changeover of Ar/N_2, turn OFF JSW2 of the DIP switch.
For exchange of external signals is used the OUTPUT connector on the rear panel.

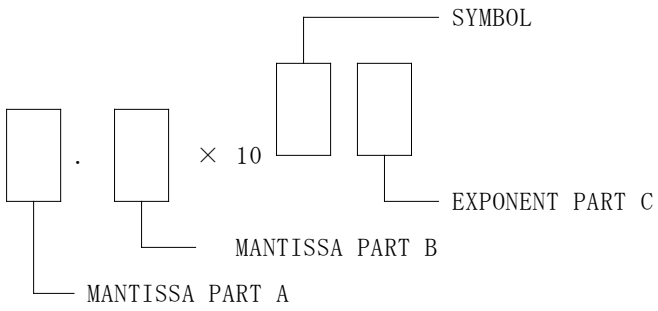
Table. 4-1 I/O Connectors

Pin No.	Signal	PinNo.	Signal
1	REC OUT (+)	20	REC OUT (–)
* 2	Ar/N_2 (INPUT)	21	Mantissa part A 1 (OUTPUT)
	• N_2 Lo/SHORT	22	Mantissa part A 2 (OUTPUT)
	• N_2 Hi/OPEN	23	Mantissa part A 4 (OUTPUT)
3		24	Mantissa part A 8 (OUTPUT)
4	GND	25	Mantissa part B 1 (OUTPUT)
5	Symbol +/– (OUTPUT)	26	Mantissa part B 2 (OUTPUT)
	• + Lo	27	Mantissa part B 4 (OUTPUT)
	• – Hi	28	Mantissa part B 8 (OUTPUT)
6	Strobe	29	RS-232C SD
7	Exponent part C 1 (OUTPUT)	30	RS-232C RD
8	Exponent part C 2 (OUTPUT)	31	
9	Exponent part C 4 (OUTPUT)	32	SETPOINT-1 NO
10	Exponent part C 8 (OUTPUT)	33	SETPOINT-1 COM
11		34	SETPOINT-1 NC
12		35	ERROR NO
* 13	Pa／Torr	36	ERROR COM
	・Torr Lo/SHORT		
	・Pa Hi/OPEN		
14	SETPOINT-2 NO	37	ERROR NC
15	SETPOINT-2 COM		
16	SETPOINT-2 NC		
17	SETPOINT-3 NO		
18	SETPOINT-3 COM		
19	SETPOINT-3 NC		

* Pa/Torr, Ar/N_2 changeover function is effective only when the DIP switch is OFF.
Refer to 3.2 "How to set the DIP Switch".

4.2. BCD Output

Digital signals of pressure values are outputted from the I/O connector on the rear panel of the controller.
Refer to Table. 4-1 "I/O Connectors".
The relationship between mantissa parts A, B and C is as shown below.



The above are outputs during measurement.

The following are outputs at other displays.

(1) When 0.0×10^{-1} Pa is displayed : 0.0×10^{-1}
When 0.0×10^{-3} Torr is displayed : 0.0×10^{-3}

(2) When 2.7×10^{3} Pa is displayed by blinking : $F.F \times 10^{+F}$
When $2.0 \times 10^{+1}$ Torr is displayed by blinking : $F.F \times 10^{+F}$

(3) When $E.E \times 10^{E}$ is displayed by blinking : $E.E \times 10^{+E}$

4.3. Strobe Signal

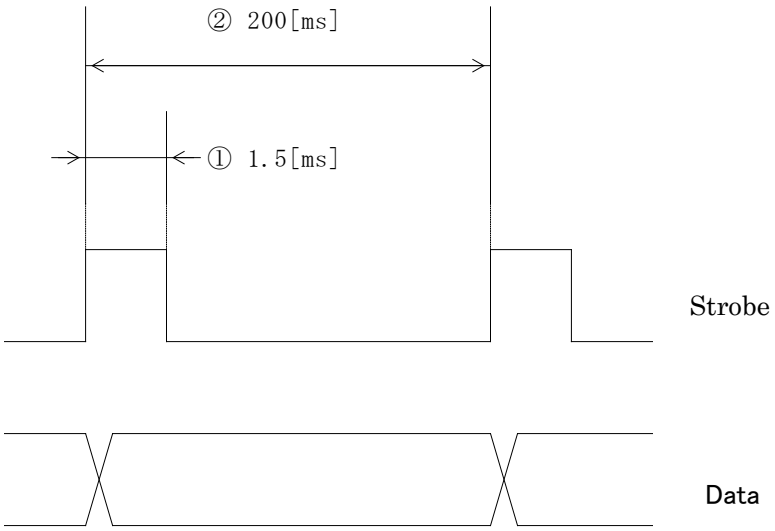


Fig. 4-1 Strobe signal output

① Duration of strobe signal
The duration from the rise to fall of the strobe signal is 1.5 [ms].
② Interval of strobe signal
The interval of strobe signals is 200 [ms].

The BCD outputs and strobe signals are TTL level open collector outputs.
The maximum rating of the output terminal is 80 VDC 50 mA.
Following figure shows the equivalent circuit.

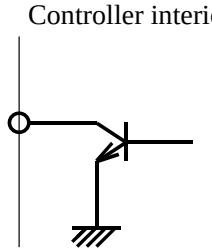


Fig. 4-2 Equivalent circuit

5. RECORDER OUTPUTS

Recorder outputs DC [V] can be taken out from the recorder output terminal (pin 1, pin 20) of the I/O connector on the rear panel of the controller.
The following three outputs are available by setting the DIP switch.
Refer to 3.2 "How to Set the DIP Switch".

(1) Linear output $1.0 \times 10^{+3}$ Paf.s. [No. 4: ON, No. 5: OFF]
(2) Linear output $1.0 \times 10^{+2}$ Paf.s. [No. 4: OFF, No. 5: OFF]
(3) Dummy log output (each range 2V) [No. 3: ON, No. 4: ON, No. 5: ON]
(4) Dummy log output (each range 1V) [No. 3: OFF, No. 4: ON, No. 5: ON]
(5) Non-Linear output [No. 4: OFF, No. 5: ON]

5.1. Linear Output $1.0 \times 10^{+3}$ Pa($1.0 \times 10^{+1}$Torr)f.s.

The output is 0 to 10 V and is delivered linearly to the pressure indication.
The relationship between the pressure indication and recorder output voltage is as shown below.

Table. 5-1 Pressure-Recorder Output Voltage: Linear $1.0\times10^{+3}$Pa($1.0\times10^{+1}$Torr)f.s.

with Pa display

Pressure (Pa)	Voltage (V)	Pressure (Pa)	Voltage (V)
$1.0 \times 10^{+0}$	0.01	$1.0 \times 10^{+2}$	1.0
$2.0 \times 10^{+0}$	0.02	$2.0 \times 10^{+2}$	2.0
$4.0 \times 10^{+0}$	0.04	$4.0 \times 10^{+2}$	4.0
$8.0 \times 10^{+0}$	0.08	$8.0 \times 10^{+2}$	8.0
$1.0 \times 10^{+1}$	0.10	$9.9 \times 10^{+2}$	9.9
$2.0 \times 10^{+1}$	0.20	$1.0 \times 10^{+3}$	10.0
$4.0 \times 10^{+1}$	0.40		
$8.0 \times 10^{+1}$	0.80		
$9.9 \times 10^{+1}$	0.99		

with Torr display

Pressure (Torr)	Voltage (V)	Pressure (Torr)	Voltage (V)
1.0×10^{-2}	0.01	$1.0 \times 10^{+0}$	1.0
2.0×10^{-2}	0.02	$2.0 \times 10^{+0}$	2.0
4.0×10^{-2}	0.04	$4.0 \times 10^{+0}$	4.0
8.0×10^{-2}	0.08	$8.0 \times 10^{+0}$	8.0
1.0×10^{-1}	0.10	$9.9 \times 10^{+0}$	9.9
2.0×10^{-1}	0.20	$1.0 \times 10^{+1}$	10.0
4.0×10^{-1}	0.40		
8.0×10^{-1}	0.80		
9.9×10^{-1}	0.99		

Convert pressure using the following equation.

(Pa): $P = (1\times10^{+3}) \times V \ / \ 10 \quad \Leftrightarrow \quad V = 10\times P \ / \ (1\times10^{+3})$
P: Pressure (Pa) V: Output voltage (V)

(Torr): $P = (1\times10^{+1}) \times V \ / \ 10 \quad \Leftrightarrow \quad V = 10 \times P \ / \ (1\times10^{+1})$
P: Pressure (Torr) V: Output voltage (V)

Voltage values on order of several mV are low in accuracy because the recorder output is 12-bit DAC.
If a linear output of 10^{-1} to 10^{+0}Pa (10^{-3} to 10^{0-2} Torr) range is required, use the $1.0 \times 10^{+2}$ Pa($1.0\times10^{+0}$Torr) full scale.
Linear signals of pressure of $1.0 \times 10^{+3}$Pa ($1.0\times10^{+1}$Torr) or higher Pa cannot be outputted.
The following voltages are outputted in other statuses.

When 0.0×10^{-1} Pa(0.0×10^{-3}Torr) is displayed : 0.0 V
When $2.7 \times 10^{+3}$ Pa($2.0\times10^{+1}$Torr) is displayed by blinking : 10.0 V
When $E.E \times 10^{E}$ is displayed by blinking : 10.0 V

5.2. Linear Output $1.0 \times 10^{+2}$ Paf.s.

The output is 0 to 10 V and is delivered linearly to the pressure indication.
The relationship between the pressure indication and recorder output voltage is as shown below. (with Pa display)

Table. 5-2 Pressure-Recorder Output Voltage: Linear $1.0\times10^{+2}$Pa($1.0\times10^{+0}$Torr) f.s.

with Pa display

Pressure (Pa)	Voltage (V)	Pressure (Pa)	Voltage (V)
4.0×10^{-1}	0.04	$1.0 \times 10^{+1}$	1.0
5.0×10^{-1}	0.05	$2.0 \times 10^{+1}$	2.0
8.0×10^{-1}	0.08	$4.0 \times 10^{+1}$	4.0
1.0×10^{-1}	0.10	$8.0 \times 10^{+1}$	8.0
$2.0 \times 10^{+0}$	0.20	$9.9 \times 10^{+1}$	9.9
$4.0 \times 10^{+0}$	0.40	$1.0 \times 10^{+2}$	10.0
$8.0 \times 10^{+0}$	0.80		
$9.9 \times 10^{+0}$	0.99		

with Torr display

Pressure (Torr)	Voltage (V)	Pressure (Torr)	Voltage (V)
3.0×10^{-3}	0.03	1.0×10^{-1}	1.0
4.0×10^{-3}	0.04	2.0×10^{-1}	2.0
8.0×10^{-3}	0.08	4.0×10^{-1}	4.0
1.0×10^{-2}	0.10	8.0×10^{-1}	8.0
2.0×10^{-2}	0.20	9.9×10^{-1}	9.9
4.0×10^{-2}	0.40	$1.0 \times 10^{+0}$	10.0
8.0×10^{-2}	0.80		
9.9×10^{-2}	0.99		

Convert pressure using the following equation.

(Pa): $P = (1\times10^{+2}) \times V \ / \ 10 \quad \Leftrightarrow \quad V = 10 \times P \ / \ (1\times10^{+2})$

P: Pressure (Pa) V: Output voltage (V)

(Torr): $P = (1\times10^{+0}) \times V \ / \ 10 \quad \Leftrightarrow \quad V = 10 \times P \ / \ (1\times10^{+0})$

P: Pressure (Torr) V: Output voltage (V)

Voltage values on order of several mV are low in accuracy because the recorder output is 12-bit DAC.
If a linear output in the 10^{+2} Pa(10^{+0} Torr) range is required, use the $1.0 \times 10^{+3}$ Pa($1.0 \times 10^{+1}$ Pa) full scale.
The following voltages are outputted in other statuses.

When 0.0×10^{-1} Pa(0.0×10^{-3}Torr) is displayed : 0.0 V
When $2.7 \times 10^{+3}$ Pa($2.0\times10^{+1}$Torr) is displayed by blinking : 10.0 V
When E.E $\times 10^{E}$ is displayed by blinking : 10.0 V

5.3. Dummy Log Output Each Range 1V

The recorder output is 1 V per pressure range within the output range of 0 to 4.27 V and the scale range is linear. The relationship between the output indication and the recorder output voltage is as shown in the table below.

Table. 5-3 Pressure-Recorder Output Voltage: Dummy Log output Each Range 1V

with Pa display

Pressure (Pa)	Voltage (V)	Pressure (Pa)	Voltage (V)
0.0×10^{-1}	0.00	$1.0 \times 10^{+1}$	2.10
4.0×10^{-1}	0.40	$2.0 \times 10^{+1}$	2.20
5.0×10^{-1}	0.50	$4.0 \times 10^{+1}$	2.40
6.0×10^{-1}	0.60	$8.0 \times 10^{+1}$	2.80
8.0×10^{-1}	0.80	$9.9 \times 10^{+1}$	2.99
$1.0 \times 10^{+0}$	1.10	$1.0 \times 10^{+2}$	3.10
$2.0 \times 10^{+0}$	1.20	$2.0 \times 10^{+2}$	3.20
$4.0 \times 10^{+0}$	1.40	$4.0 \times 10^{+2}$	3.40
$8.0 \times 10^{+0}$	1.80	$8.0 \times 10^{+2}$	3.80
$9.9 \times 10^{+0}$	1.99	$9.9 \times 10^{+2}$	3.99
		$1.0 \times 10^{+3}$	4.10
		$2.7 \times 10^{+3}$	4.27

with Torr display

Pressure (Torr)	Voltage (V)	Pressure (Torr)	Voltage (V)
0.0×10^{-3}	0.00	1.0×10^{-1}	2.10
3.0×10^{-3}	0.03	2.0×10^{-1}	2.20
4.0×10^{-3}	0.40	4.0×10^{-1}	2.40
6.0×10^{-3}	0.60	8.0×10^{-1}	2.80
8.0×10^{-3}	0.80	9.9×10^{-1}	2.99
1.0×10^{-2}	1.10	$1.0 \times 10^{+0}$	3.10
2.0×10^{-2}	1.20	$2.0 \times 10^{+0}$	3.20
4.0×10^{-2}	1.40	$4.0 \times 10^{+0}$	3.40
8.0×10^{-2}	1.80	$8.0 \times 10^{+0}$	3.80
9.9×10^{-2}	1.99	$9.9 \times 10^{+0}$	3.99
		$1.0 \times 10^{+1}$	4.10
		$2.0 \times 10^{+1}$	4.20

The dummy log outputs of the recorder can be converted into pressure by using the following equation.

Given that the output voltage value is A and A – (value below decimal point of A) is B, pressure P will be as shown below.

With Pa display	With Torr display
$P = 10 \times (A - B) \times 10^{-1+B}$	$P = 10 \times (A - B) \times 10^{-3+B}$

If the output voltage is 2.58 V, for example, A = 2.58 and B = 2.

Hence, P (Pa) = $10 \times (2.58 - 2) \times 10^{-1+2} = 5.8 \times 10^{+1}$ Pa

Hence, P (Torr) = $10 \times (2.58 - 2) \times 10^{-3+2} = 5.8 \times 10^{-1}$ Torr

Other states are displayed as follows.

When 2.7×10^{3} Pa ($2.0 \times 10^{+1}$Torr)is displayed by blinking : 9.4 V

When $E.E \times 10^{E}$ is displayed by blinking : 10.0 V

(A-B) value may show as below 0.1 due to fluctuation in output voltage or margin of error. In such case, we would highly recommend rounding up the value to 0.1 for the actual calculation.

5.4. Non-Linear Output

Non-Linear output is compatible with S-range output of GP-2G/2GRY and GP-2A/2ARY.
The relationship between the pressure indication and recorder output voltage is as shown below.

Table. 5-4 Pressure-Recorder Output Voltage: Non-Linear output

with Pa display

Pressure (Pa)	Voltage (V)	Pressure (Pa)	Voltage (V)
4.0×10^{-1}	0.15	$1.0 \times 10^{+2}$	4.00
$2.0 \times 10^{+0}$	0.35	$2.0 \times 10^{+2}$	5.31
$5.0 \times 10^{+0}$	0.65	$4.0 \times 10^{+2}$	6.70
$1.0 \times 10^{+1}$	1.10	$6.0 \times 10^{+2}$	7.46
$2.0 \times 10^{+1}$	1.70	$8.0 \times 10^{+2}$	7.94
$4.0 \times 10^{+1}$	2.53	$1.0 \times 10^{+3}$	8.29
$6.0 \times 10^{+1}$	3.13	$2.0 \times 10^{+3}$	9.17
$8.0 \times 10^{+1}$	3.63	$2.7 \times 10^{+3}$	9.49

with Torr display

Pressure (Torr)	Voltage (V)	Pressure (Torr)	Voltage (V)
3.0×10^{-3}	0.15	$1.0 \times 10^{+0}$	4.52
1.0×10^{-2}	0.27	$2.0 \times 10^{+0}$	5.91
5.0×10^{-2}	0.83	$3.0 \times 10^{+0}$	6.70
1.0×10^{-1}	1.30	$4.0 \times 10^{+0}$	7.26
2.0×10^{-1}	2.02	$6.0 \times 10^{+0}$	7.94
4.0×10^{-1}	2.97	$8.0 \times 10^{+0}$	8.36
6.0×10^{-1}	3.62	$1.0 \times 10^{+1}$	8.65
8.0×10^{-1}	4.12	$2.0 \times 10^{+1}$	9.40

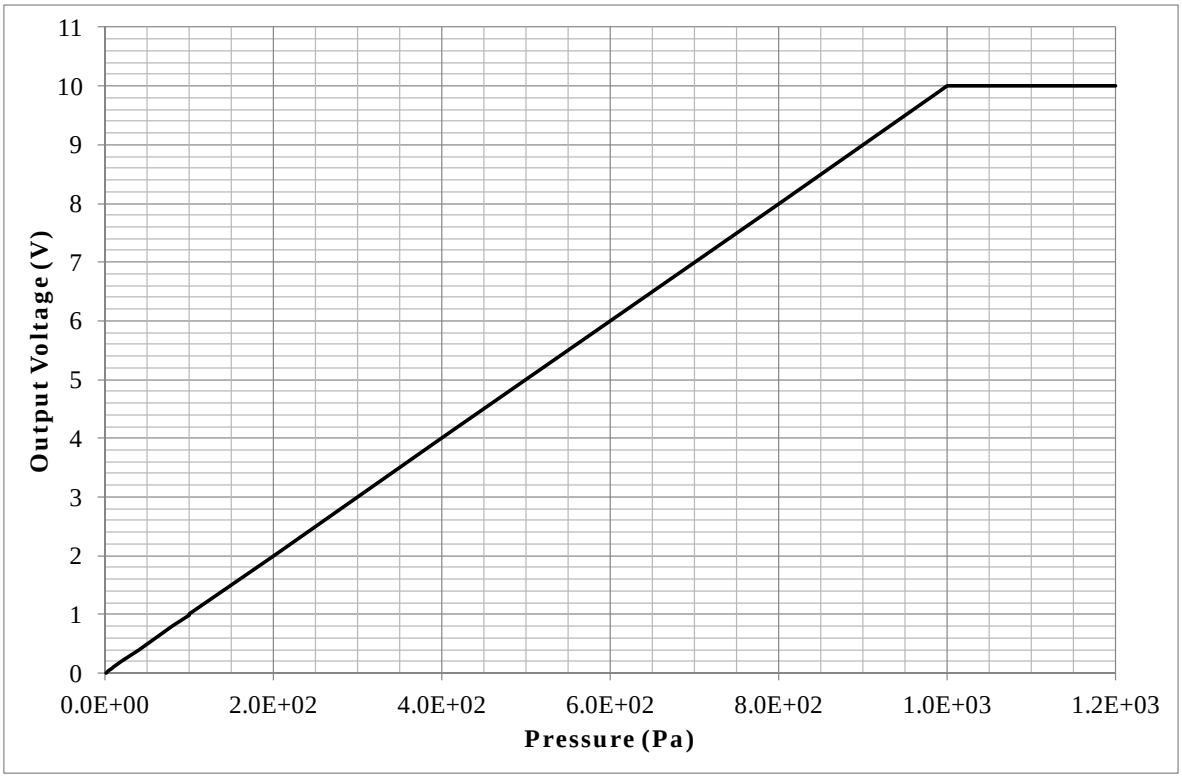


Fig. 5-1　Recorder output voltage graph (Linear output $1.0\times10^{+3}$Pa f.s.)

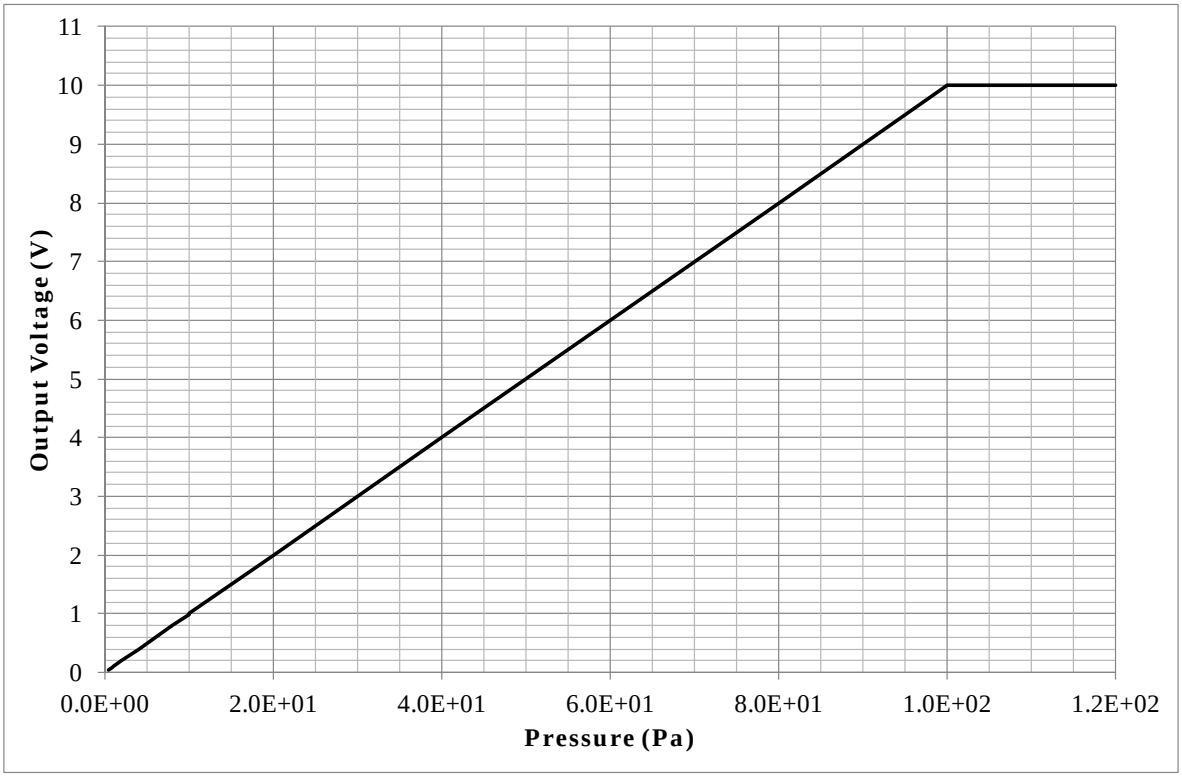


Fig. 5-2　Recorder output voltage graph (Linear output $1.0\times10^{+2}$Pa f.s.)

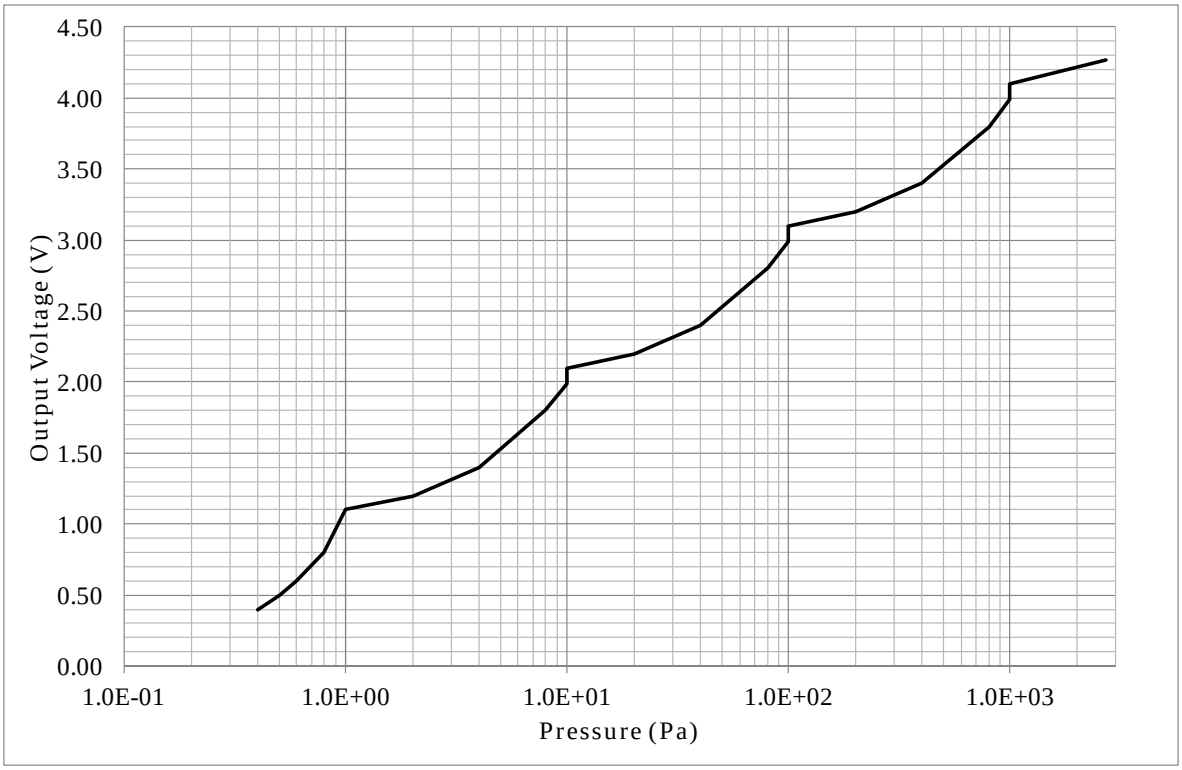


Fig. 5-3 Recorder output voltage graph (Dummy LOG output)

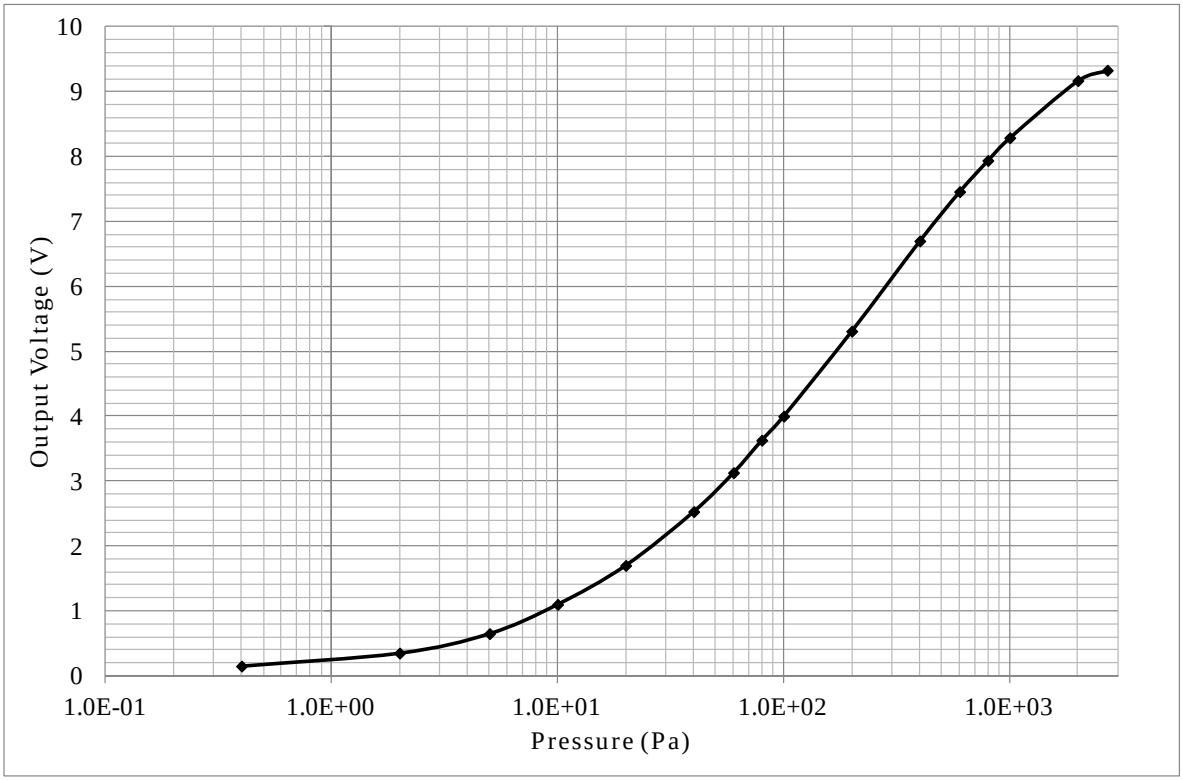


Fig. 5-4 Recorder output voltage graph (Non-Linear output)

6. HOW TO USE COMMUNICATION (RS-232C)

6.1. Specifications

(1) System : Half duplex
(2) Data bit length : 8 bits
(3) Stop bit length : 1 stop bit
(4) Parity : None
(5) Code : ASCII
(6) Baud rate : Selectable from 1200, 2400, 4800 and 9600.
Refer to 3.2 "How to Set the DIP Switch" for the setting.
(7) Command transmitting interval : recommended interval: 0.2seconds or more
This controller has updated pressure data every 0.2 seconds.

6.2. Connecting the Communication Cable

Use the I/O connector (D-sub 37-pin) on the rear panel of the controller.
The table below shows the connection.

Table. 6-1 RS-232C Communication Cable Connection

I/O connector			Signal direction	PC-side standard connector pin No. (Dsub-9P)
Pin No.	Symbol	Meaning		
29	SD	Send data	→	3
30	RD	Receive data	←	2
4	SG	Signal ground		5

*: The communication cable is not supplied with the gauge.

6.3. Communication Commands

Table. 6-2 RS-232C Commands

Command	Answer		Meaning
	OK	NG	
'CO' + CR	'OK' + CR	'?' + CR	Remote command [1]
'CF' + CR	'E' + CR	'?' + CR	Local (communication reset) command
'KN' + CR	'OK' + CR	'?' + CR	N_2 sensitivity designation
'KA' + CR	'OK' + CR	'?' + CR	Ar sensitivity designation
'P0' + CR	'XXXX' + CR[2]	'?' + CR	Loads the pressure value
'P1' + CR	'XXXX' + CR	'?' + CR	Loads the setpoint 1 value
'P2' + CR	'XXXX' + CR	'?' + CR	Loads the setpoint 2 value
'P3' + CR	'XXXX' + CR	'?' + CR	Loads the setpoint 3 value
'RL' + CR	'XXXX' + CR SET1,SET2,SET3,ERR OR	'?' + CR	Relay, setpoint output status 1: ON, 0: OFF[3]
'ER' + CR	'X' + CR	'?' + CR	Error output 1: Error, 0: Normal

1) Communication cannot be activated except in the remote status.
2) 'ab ± c' when pressure is $a.b \times 10^{\pm c}$
3) 1 (ON) is outputted when pressure is lower than the relay setpoint set value or when in error.

6.4. Action

(1) If the filament has burnt out and the display $E.E \times 10^{E}$ is blinking, '?' will be returned against pressure value loading.
(2) If the pressure display is blinking (scale over), '++++' will be returned.
(3) If framing error or overrun error occurs, 'e0' will be returned.
(4) If anything except command is inputted, '?' + CR will be returned.
(5) If nothing is returned when a command is sent, send the command again.
(6) To change over the baud rate setting, set it with the power turned OFF and turn it ON again.

7. APPENDIX

7.1. 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 To [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 To [K] is the temperature of the vessel wall.

$$Q = \alpha\Lambda (T - To) P \quad \text{.....} \qquad (1)$$

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.

$$\alpha = \frac{Tg - To}{T - To} \quad \text{.....} \qquad (2)$$

where, T is the filament temperature, To is the temperature of gas molecule before collision and Tg 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.

7.2. 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.

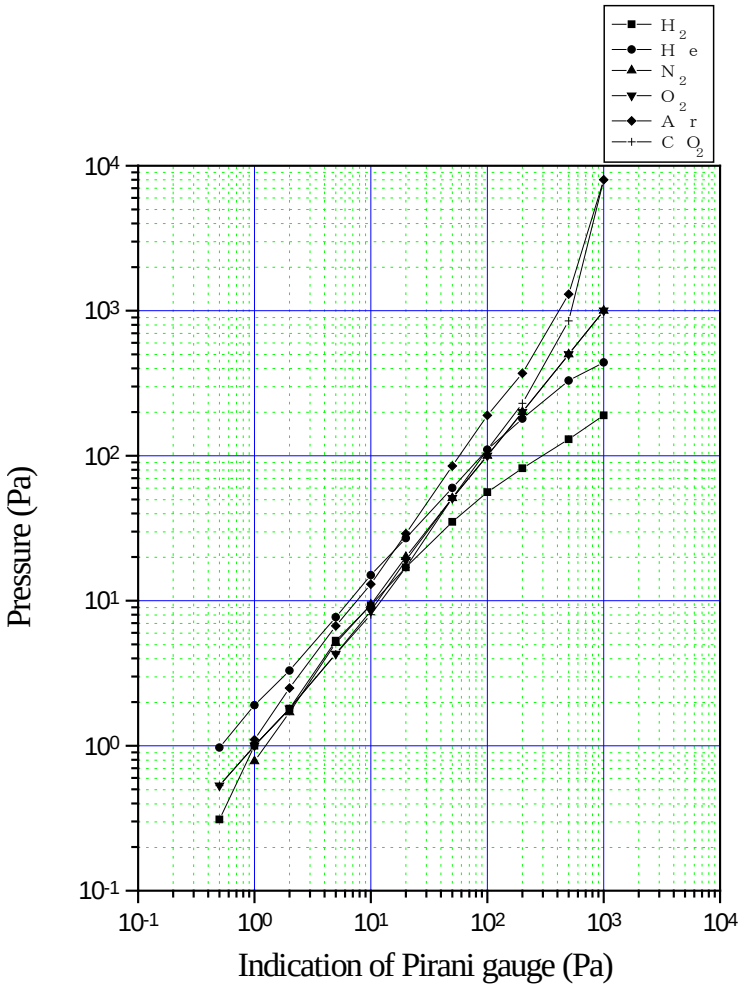
In the molecular flow region, A (free molecule thermal conductivity) is given by the following equation.

$$\Lambda = \frac{C\nu + (R/2)}{\sqrt{2\pi MRT'}} \quad \text{.....} \qquad (3)$$

where, M is molecular weight, R is a gas constant. T' is the average temperature of T and To, and Cν is specific heat at constant volume. This equation shows that it is dependent on Cν 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. 7-1 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	$CC1_2F_2$	$CC1_4$	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. 7-1 Indications of various types of gas

7.3. Change of Indication with Ambient Temperature

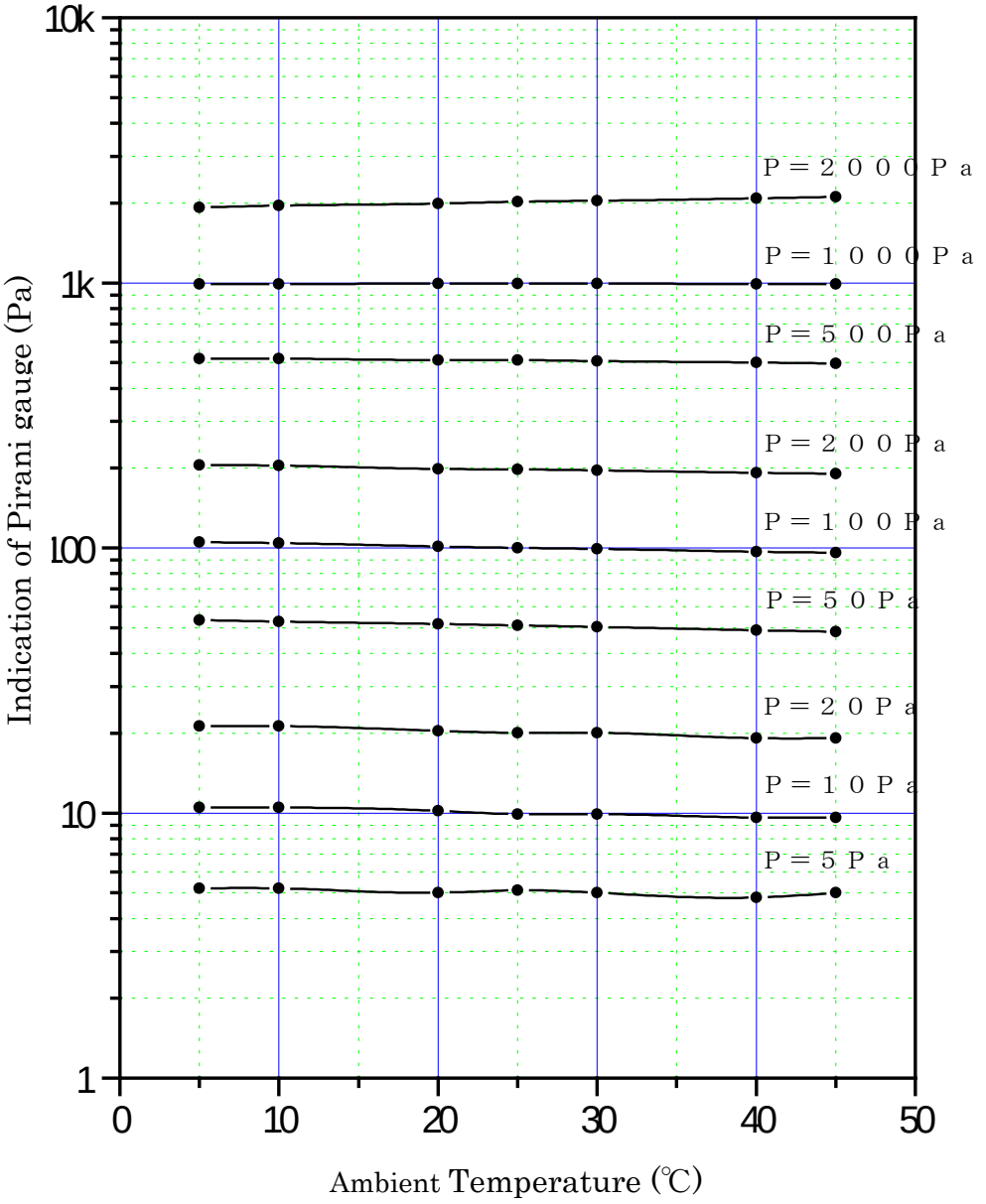


Fig. 7-2 Change of Indications with Ambient Temperature

8. TROUBLESHOOTING

Symptom: No display appears on the front panel when power is turned ON.

Possible cause	Corrective action
• The power cord is disconnected. • The line voltage is below the specified range.	1) Check the power cord for connection. 1) Check the line voltage by a circuit tester.

⚠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.

Symptom: The display is blinking at $2.7 \times 10^{+3}$Pa and does not change when pressure has lowered.

Possible cause	Corrective action
• Pressure is still higher than the measurement range. (atmospheric pressure, for example)	1) Normal

Symptom: The display remains blinking at $E.E \times 10^{E}$.

Possible cause	Corrective action
• The sensor head filament has burnt out.	1) Check the filament for continuity referring to Fig. 13-5 "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 10 mA or more. Its life will be shortened.
• The sensor head filament is disconnected or in poor contact.	1) Check the sensor head cable referring to Fig. 13-6 "Sensor head cable connection diagram".
• 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 0.0×10^{-1} Pa and does not change though the pressure has increased.

Possible cause	Corrective action
• Pressure is still below the measurement range.	1) Normal

Symptom: The display does not blink at $2.7 \times 10^{+3}$ Pa when atmospheric pressure is being measured.

Possible cause	Corrective action
• 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.
• Gas under measurement is not nitrogen or air.	1) Normal
• Gas under measurement is nitrogen or air, but contains much moisture and oil.	1) Normal
• The sensor head is contaminated or the sensor head filament has worn out.	1) Replace the sensor head.
• 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
• The pressure is changing.	1) Normal
• 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.
• The sensor head is contaminated or the sensor head filament has worn out.	1) Replace the sensor head.
• 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.
• 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. 13-6 "Sensor head connection diagram".

9. 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

Warrantee 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 warrantee scope shall confirm 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 damnification 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.

10. CE DECLATION OF CONFORMITY

ULVAC

CE DECLARATION OF CONFORMITY

Tested unit:	GP-1000G	
Manufacturerd by :	Ulvac Inc. 2500 Hagisono, Chigasaki Kanagawa, 253-8543 Japan	
Tested Norms:	EMC Emmission:	EN 61000-6-4:2007 EN 61326-1:2006 EN 61000-3-2:2006 EN 61000-3-3:1995 + A1:2001 + A2:2005
	Immunity:	EN 61000-6-2:2005 EN 61326-1:2006

The standard above refers to following basic standards:

EN 61000-4-2:1995 + A1: 1998 + A2: 2001	Electrostatic discharge immunity test (ESD)
EN 61000-4-3:2006	Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4:2004	Electrical fast transient / burst immunity test (BURST)
EN 61000-4-5:2006	Surge immunity test (Surge)
EN 61000-4-6:2007	Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8:1993 + A1:2001	Power frequency magnetic field immunity test
EN 61000-4-11:2004	Voltage dips, short interruptions and voltage variations immunity test

Confirmation :

The tested instrument conforms to all regulations concerning electromagnetic disturbance (EMF) as per the above listed regulations.

Signature:	Kiyokazu Yanagisawa
Date:	September 25, 2008
Name:	Kiyokazu Yanagisawa
Title:	General Manager Components Division, ULVAC Inc.

11. 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. 11-1 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.

12. 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 Request for MSDS: Yes/No	Received by	
ULVAC job No.		

13. RELATED DRAWINGS

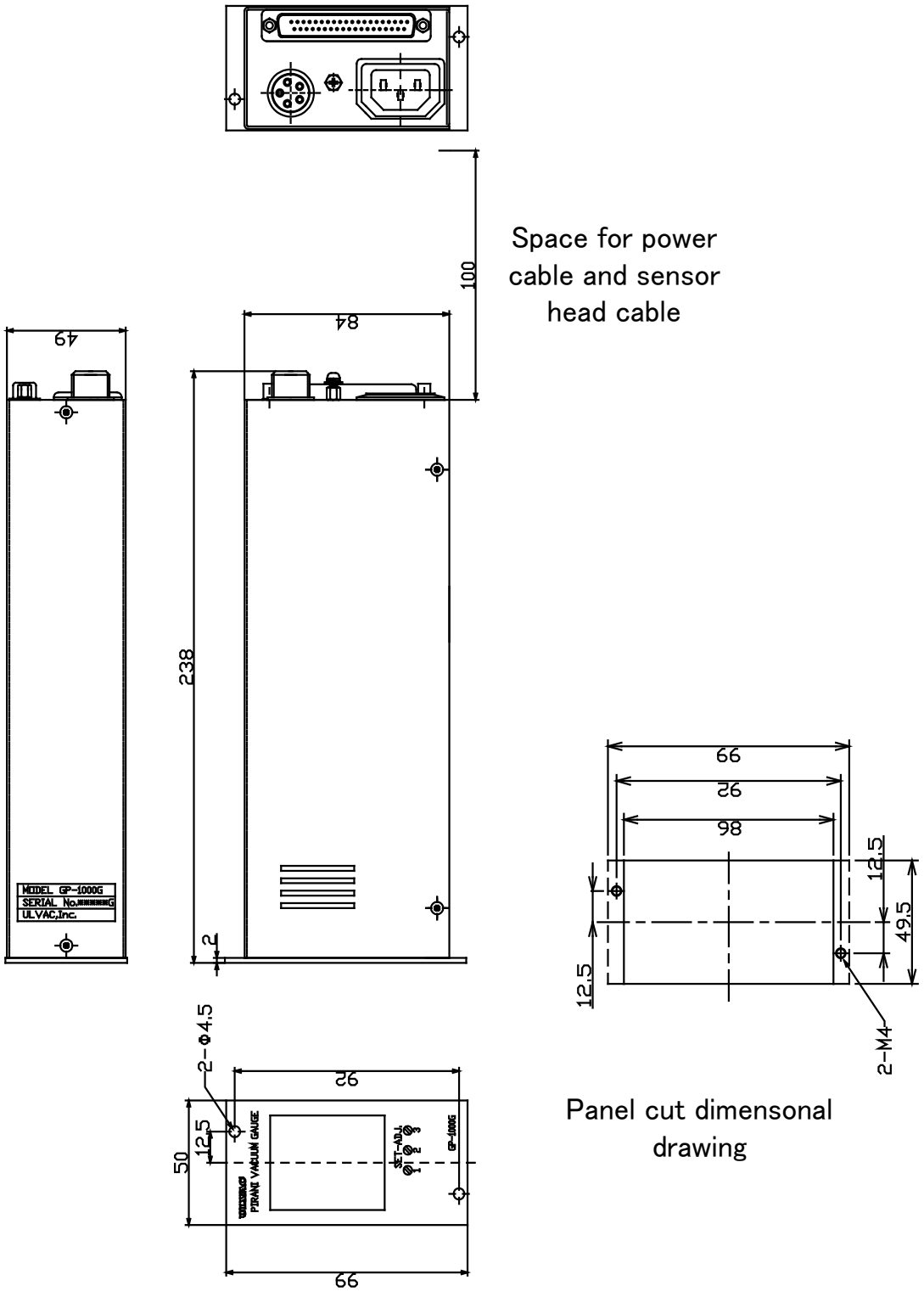


Fig. 13-1 Dimensional drawing for GP-1000G

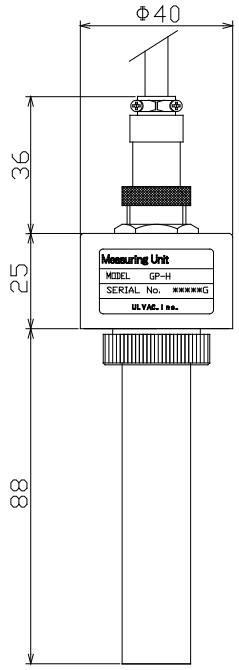


Fig. 13-2 Dimensional drawing for measuring unit GP-H

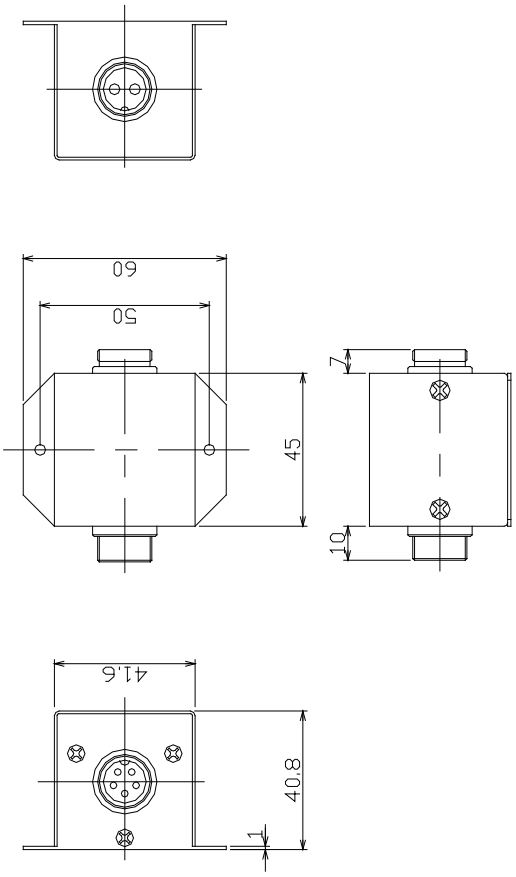
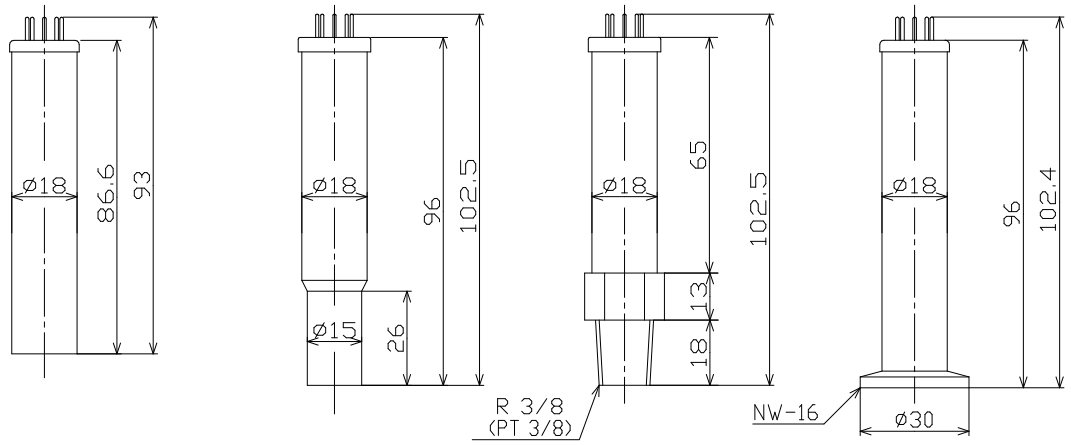
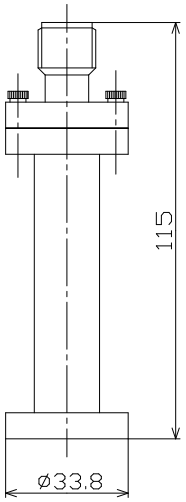


Fig. 13-3 Dimensional drawing for measuring unit GP-BH



WP-01　　WP-02　　WP-03　　WP-16



WPB-10-034

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. 13-4　Sensor heads compatible with GP-1000G

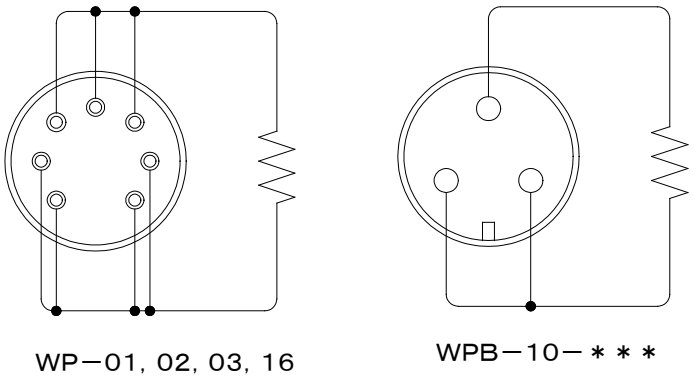
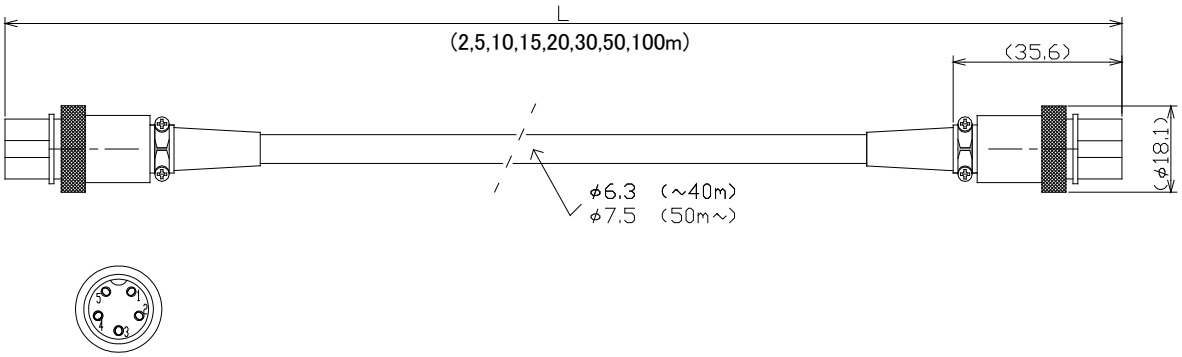


Fig. 13-5　Sensor head filament connection diagram



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

Fig. 13-6　Sensor head cable

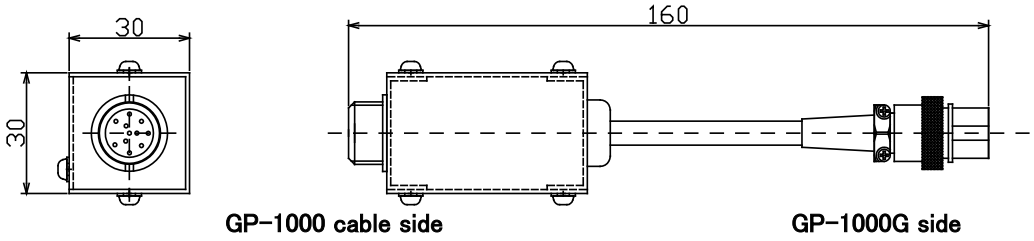


Fig. 13-7　Conversion connector from GP-1000 to GP-1000G