

G-TRAN Series Multi-Ionization gauge Sensor Unit Standard Type Model SH2-1 Serial Communications Type Model SH2-2 Specifications



Components Division, ULVAC, Inc.

http://www.ulvac.co.jp/

# 1. Specifications

The SH2-1/SH2-2 has the following modes:

- ① SH2 independent mode : Ionization gauge only
- ② SPU Combination mode : The Pirani vacuum gauge measuring unit (SPU)

and ionization gauge combination

③ SAU Combination mode : The pressure sensor (SAU) and the Pirani vacuum

gauge measuring unit (SWU10-R/SPU) and ionization gauge

combination

(d) SWU Combination mode: the Pirani vacuum gauge measuring unit (SWU10-R)

and ionization gauge combination

These four modes of usage can be selected.

\*SWU10-R and SPU cannot be used at the same time.

\*SAU works by connecting SWU10-R/SPU to SH2.

Name	Multi-ionization gauge		
Type name	Standard Type	Serial Communications Type	
Model	SH2-1	SH2-2	
Connectable sensors	Sensor for SH2		
	M-44, M-34 (NW16), M-45, M-35 (	NW25), M-46, M-36(UFC070): 1	
	SWU10-R Pirani vacuum gauge measurin	g unit: 1 (option)	
	SPU Pirani vacuum gauge measuring unit	: 1 (option)	
	SAU Pressure sensor unit: 1 (option)		
Measurement pressure	SH2 independent mode: $5x10^{-8}$ Pa to $1x10^{+1}$	Pa	
range (N <sub>2</sub> )			
Accuracy (N <sub>2</sub> )	SH2 independent mode: $5x10^{-8}$ Pa to $1x10^{+1}$	Pa: ±15%	
Repeatability (N <sub>2</sub> )	SH2 independent mode: $1 \times 10^{-6}$ Pa to $1 \times 10^{-1}$	Pa: ±2%	
Measurement gas type	Indicates pressure as sensitivity for N <sub>2</sub>		
Emission current	$1 \text{ mA} (1 \text{x} 10^{-3} \text{ Pa or lower}), 10 \text{ uA}$		
DEGAS	Electron bombardment - Emission current 1 mA, grid voltage approx. 330 V		
Sampling time	50ms, 5x moving average		
Analog output	Output voltage: 0 to 10 VDC, log output: 0.75 V/1 decade		
	Pressure conversion equation: P=10^{(V-7.25)/0.75+2}		
	V=7.25+0.75*(logP-2)		
	P: Pressure[Pa], V: Output Voltage[V]		
	* Also combined with the output voltage for setpoint adjustment		
	(SH2-1 only)		
Update time	50 ms		
Resolution	Approx 2.5 mV		
Output error	±20 mV		
Output impedance	1kΩ		
Control input signals	FIL ON/OFF, FIL 1/2, DEGAS ON/OFF		
	Operates with open collector input,		
	negative logic		
Control output signals	Sensor error, setpoint 1/2/3, emission		
	valid, filament current abnormality		
	Rating: 24 $V_{MAX}$ , 50 mA <sub>MAX</sub> , saturation		
	voltage 1 V		
Serial communications		RS-232C, RS-485	
Baud rate		9600/19200/38400 bps	

1.1. SH2-1/SH2-2 Specifications

LED display	POWER/ERROR: Power, error		
	SPU: Pirani vacuum gauge SWU10-R/SPU status indicator		
	SAU: Pressure sensor SAU status indicator		
	FIL: Ionization gauge filament status		
	indicator		
	SET1/2/3: Setpoint 1/2/3		
Sensor material	M-44/M-45/M-46 Filament 1: Ir/Y <sub>2</sub> O <sub>3</sub> -coa	ted, Filament 2: Ir/Y <sub>2</sub> O <sub>3</sub> -coated	
	M-34/M-35/M-36 Filament 1: Ir/Y <sub>2</sub> O <sub>3</sub> -coa	ted, Filament 2: Tungsten	
	Others : PtC-Mo, SUS304, W, Kovar glas	ss, Kovar/Ni plating	
Gauge head withstand	$2x10^{+5}$ Pa (absolute pressure)		
pressure	*Take the withstand pressure for flanges, c	lamps, and other components into	
	account separately.		
Gauge head internal	M-44: 17cm <sup>3</sup> , M-45: 19cm <sup>3</sup> , M-46: 17cm <sup>3</sup>		
volume	M-34: 17cm <sup>3</sup> , M-35: 19cm <sup>3</sup> , M-36: 17cm <sup>3</sup>		
Operating temperature	10 to 50°C		
range			
Bake out temperature	Sensor head : 150 °C (when controller is dise	connected)	
	Flange part of sensor : 80 °C		
	(Temperature Surround controller is less tha	n 50 °C only when mounting	
	position is horizontal.)		
	*The specification and accuracy of this gauge is not guaranteed when this		
	sensor head is heating.		
Operating humidity	15% to 80% RH (no condensation)		
range			
Storage temperature	$-20 \text{ to } 65^{\circ}\text{C}$ (when unpowered, no condensation)		
IP code	IP30		
Power supply voltage	20 to 28 VDC (ripple, noise 1% or less)		
	*Power supply voltage at SH2 connector end		
	Normal operation : about 8W		
	At the time of degas : 19 W or less		
	At power-on : 6A or lower, 4ms or less		
Corresponding	CE standard, UKCA standard		
standard	Validated with SPU, SAU connected		
	Display cable 40m		
	SH2-SWU10-R/SPU unit cable 0.5m*		
	SH2-SAU unit cable 0.5m*		
	*When using a unit cable of 0.5m or longer	r, consider noise separately.	
Overvoltage category	Category I: Connected to a circuit that implements measures to limit excessive		
	overvoltage to a sufficiently low	level	
I/O connector	D-sub 15-pin 2.6 mm screws		
Sensor weight	Controller: Approx. 530 g, Gauge head (M-3	84): 80 g	
External dimensions	144 x 75 x 62 mm (approximate, controller s	section)	

1.2. SPU combination mode key specifications

Measurement pressure	$5x10^{-8}$ Pa to $1x10^{+4}$ Pa
range	When pressure falling: Automatically switches from Pirani vacuum gauge to
	ionization gauge at $2x10^{+0}$ Pa(SPU)
	When pressure rising: Automatically switches from ionization gauge to Pirani
	vacuum gauge at $3x10^{+0}$ Pa(SPU)
	* Ionization gauge measurements can be forced off with the control signal
Accuracy	Refer to the accuracy for each sensor.
	In the overlapping pressure region of 3 Pa to 0.4 Pa, the measured pressure for
	the Pirani vacuum gauge and ionization gauge is adjusted and output.
	* Measurements on the Pirani vacuum gauge and the ionization gauge are
	dependent on the gas type.
	Be particularly aware of the difference in pressure readings when the
	gauges switch.
POWER/ERROR	Blue on: Operating normally
LED state	Red on : SH2-1/2, SPU power supply abnormality, etc.
Control input signals	FIL ON/OFF, FIL 1/2, DEGAS ON/OFF
	Operates with open collector input, negative logic
	* When the FIL ON/OFF signal is low input, the ionization gauge is FIL OFF

# 1.3. SAU combination mode key specifications

Measurement pressure	$5x10^{-8}$ Pa to $1x10^{+5}$ Pa	
range	When pressure falling: Automatically switches from the pressure sensor to	
	Pirani vacuum gauge at 1x10 <sup>+4</sup> Pa(SAU)	
	When pressure falling: Automatically switches from Pirani vacuum gauge to	
	ionization gauge at 2x10 <sup>+0</sup> Pa(SWU10-R/SPU)	
	When pressure rising: Automatically switches from ionization gauge to Pirani	
	vacuum gauge at 3x10 <sup>10</sup> Pa(SWU10-R/SPU)	
	When pressure rising: Automatically switches from Pirani vacuum gauge to pressure sensor at $1 \times 10^{+4}$ Pa(SAU)	
	* Ionization gauge measurements can be forced off with the control signal	
Accuracy	Refer to the accuracy for each sensor.	
	In the overlapping pressure region of 3 Pa to 0.4 Pa, the measured pressure for	
	the Pirani vacuum gauge and ionization gauge is adjusted and output.	
	* The pressure sensor measures at gauge pressure and the Pirani sensor	
	measures as absolute pressure, so a margin of error occurs from altitude and air pressure.	
	* Measurements on the Pirani vacuum gauge and the ionization gauge are	
	dependent on the gas type. Be particularly aware of the difference in	
	pressure readings when the gauges switch.	
POWER/ERROR	Blue on: Operating normally	
LED state	Red on : SH2-1/2, SWU10-R/SPU or SAU power supply abnormality, etc.	
Control input signals	FIL ON/OFF, FIL 1/2, DEGAS ON/OFF	
	Operates with open collector input, negative logic	
	* When the FIL ON/OFF signal is low input, the ionization gauge is FIL OFF	

1.4. SWU combination mode key specifications

Measurement pressure	$5x10^{-8}$ Pa to $1x10^{+5}$ Pa
range	When pressure falling: Automatically switches from Pirani vacuum gauge to
	ionization gauge at 2x10 <sup>+0</sup> Pa(SWU10-R)
	When pressure rising: Automatically switches from ionization gauge to Pirani
	vacuum gauge at 3x10 <sup>+0</sup> Pa(SWU10-R)
	* Ionization gauge measurements can be forced off with the control signal
Accuracy	Refer to the accuracy for each sensor.
	In the overlapping pressure region of 3 Pa to 0.4 Pa, the measured pressure for
	the Pirani vacuum gauge and ionization gauge is adjusted and output.
	* Measurements on the Pirani vacuum gauge and the ionization gauge are
	dependent on the gas type.
	Be particularly aware of the difference in pressure readings when the
	gauges switch.
POWER/ERROR	Blue on: Operating normally
LED state	Red on : SH2-1/2, SWU10-R power supply abnormality, etc.
Control input signals	FIL ON/OFF, FIL 1/2, DEGAS ON/OFF
	Operates with open collector input, negative logic
	* When the FIL ON/OFF signal is low input, the ionization gauge is FIL OFF

# 1.5. Accessory

Multi-ionization gauge SH2-1/2 unit	1pc
Sensor for SH2 M series*	1pc
Quick Manual	1paper

\* Only when you order at the same time as SH2, it will be attached to SH2 and delivered.

\* The sensor model is the one you specified when ordering.

1.6. Separately ordered products

Sensor for SH2	M-44(N	W16), M-45(NW25), M-46(UFC070)
	M-34(N	W16), M-35(NW25), M-36(UFC070)
Connector for SH2	D-sub 15	5-pin connector (socket, 2.6 mm screws) *unwired
Calibration certificate	General	calibration test report, JCSS calibration certificate
Inspection report		
Traceability certificate		
Display unit	1CH	Model ISG1 (24 VDC power supply)
	4CH	Model IM1R1 (24 VDC power supply)
		Model IM2R1 (100 VAC power supply)
Display cable	Cable co	nnecting SH2 and display unit
	2 m, 5 m	n, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 40 m
Pirani vacuum gauge sensor unit	SWU10-	R/SPU
Sensor for SWU10-R SWP series	SWP-16	, SWP-25, SWP-CF16, SWP-P15, SWP-P18,
	SWP-R1	./8, SWP-1S
Sensor for SPU WP series	WP-01,	WP-02, WP-03, WP-16
Unit cable GUC-P	Cable co	nnecting SH2 and SWU10-R/SPU 0.5m, 1m, 2m
Pressure sensor	SAU	
	*Require	es SWU10-R or SPU for operation.
Unit cable GUC-A	Cable co	onnecting SH2 and SAU 0.5m, 1m, 2m
	*he conr	nector that connects this unit cable and SAU are
	connecte	ed by a cable of about 0.5m.

# 1.7. Connection with External Devices

SH2-1 Standard Type (D-sub 15-pin (pin) M2.6mm screws)

Terminal number*	Sensor	Function
1	Power supply	Power supply to drive this unit
2	Sensor error	Outputs the pressure protection signal or a signal during an error such as when there is a filament break
3	Setpoint 1	Outputs a signal during setpoint 1 operation
4	Emission valid	Outputs a signal when emission current is normal
5	FIL ON/OFF	Input a signal to turn the filament on or off * FIL ON signal in SH2 independent mode * FIL OFF signal in combination mode
6	FIL 1/2	Input a signal when selecting FIL 2
7	FIL power monitor	Outputs a signal when the FIL power exceeds the threshold
8	Pressure signal/setpoint setting output	Outputs the pressure signal and the setpoint setting output
9	Power supply GND	Ground for the power supply that drives this unit
10	Signal GND	Output signal ground
11	Setpoint 2	Outputs a signal during setpoint 2 operation
13	DEGAS ON/OFF	Input a signal during DEGAS ON
14	Setpoint 3	Outputs a signal during setpoint 3 operation
15	Signal GND	Output signal ground
Case	FG	Frame ground

SH2-2 Serial Communications Type (D-sub 15-pin (pin) M2.6mm screws)

Terminal number <sup>*</sup>	Sensor	Function
1	Power supply	Power supply to drive this unit
4	RS-232C RxD	RS-232C RxD
5	Terminal resistance for RS-485	Terminal resistance for RS-485, connect with pin 13
6	RS-232C TxD	RS-232C TxD
8	Analog output	Outputs the pressure signal
9	Power supply GND	Ground for the power supply that drives this unit
10	RS-485-	RS-485-
12	RS-485+	RS-485+
13	RS-485 (for terminal resistance connection)	Terminal resistance for RS-485, connect with pin 5
14	RS-232C GND	RS-232C ground
15	GND	Output signal ground
Case	FG	Frame ground

2. Analog Output (SH2-1/SH2-2)

This unit outputs the measured pressure as a 0 to 10 VDC voltage signal. I/O connector: pin 8 (analog output+) - pin 15 (GND)

#### 2.1. Pressure conversion equation

Convert the analog output to pressure with the following equation.

 $P = 10^{4} (V - 7.25) / 0.75 + k \} \quad \Leftrightarrow \quad V = 7.2$ 

$$V = 7.25 + 0.75 \times (\log P - k)$$

P: Pre	ssure V: Output voltage [	V] k : Pressure unit dependent
	Puressure Unit	k (Pressure unit dependent)
	Pa	2
	Torr	-0.1249
	mbar	0

2.2. SH2 independent mode analog output

The analog output that can occur in several states during measurements is shown in Table 2-1.

Operating state	Analog output voltage
Filament off	9.9 V or higher
During normal measurements	Voltage corresponding to the measured pressure 027 to 6.5 V
SH2 error (Errors such as a filament break)	9.9 V or higher
Abnormal power supply voltage, sensor malfunction, etc.	0.1 V or less

Table 2-1 Analog output states

2.3. SPU combination mode analog output

The analog output that can occur in several states during measurements is shown in Table 2-2.

Table 2-2 Measurement value output states

	1
Operating state	Analog output voltage
During normal measurements	Voltage corresponding to the measured pressure 0.27 to 8.75 V
1x10 <sup>+4</sup> Pa or higher	8.75 V
SH2 error	Voltage corresponding to the measured by SPU
(Errors such as a filament break)	5 V to 8.75V
Ionization gauge FIL OFF	Voltage corresponding to the measured by SPU 5 V to 8.75V
SPU error (Errors such as a filament break)	9.9 V or higher
Power supply voltage abnormality, sensor unit fault, etc.	0.1 V or less

\* Error is output even if SPU error. However, the ionization gauge error is cleared by turning FIL off.

2.4. SAU combination mode analog output

The analog output that can occur in several states during measurements is shown in Table 2-3.

Table 2-3 Analog output states

Operating state	Analog output voltage
During normal measurements	Voltage corresponding to the measured pressure 0.27 to 9.5 V
Atmospheric pressure or higher	9.5 V or higher
SH2 error (Errors such as a filament break)	When SWU10-R is connected: SWU10-R/SAU measurement pressure range 4.25V to 9.5V When SPU is connected: SPU/SAU measurement pressure range 5V to 9.5V
Ionization gauge FIL OFF	When SWU10-R is connected: SWU10-R/SAU measurement pressure range 4.25V to 9.5V When SPU is connected: SPU/SAU measurement pressure range 5V to 9.5V
SWU10-R/SPU error	Voltage corresponding to the measured by SAU
(Errors such as a filament break)	8.677 V to 9.5V
SAU error	9.9 V or higher
Power supply voltage abnormality, sensor unit fault, etc.	0.1 V or less

\* Error is output even if a SAU or SWU10-R/SPU error.

However, the ionization gauge error is cleared by turning FIL off.

2.5. SWU combination mode analog output

The analog output that can occur in several states during measurements is shown in Table 2-4 Measurement value output states.

Table 2-4 Measurement value output sta	ates
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Operating state	Analog output voltage				
During normal measurements	Voltage corresponding to the measured pressure 0.27 to 9.5 V				
$1 \times 10^{+5}$ Pa or higher	9.5 V				
SH2 error	Voltage corresponding to the measured by SWU10-R				
(Errors such as a filament break)	4.25 V to 9.5V				
Ionization gauge FIL OFF	Voltage corresponding to the measured by SWU10-R 4.25 V to 9.5V				
SWU10-R error (Errors such as a filament break)	9.9 V or higher				
Power supply voltage abnormality, sensor unit fault, etc.	0.1 V or less				

\* Error is output even if SWU10-R error. However, the ionization gauge error is cleared by turning FIL off.

# 2.6. Simple conversion tables

Pressure (Pa)	Analog output (V)	Values after the decimal point	Voltage difference
5.0E-08	0.274	1.0E-N	0.000
1.0E-07	0.500	1.5E-N	0.132
1.0E-06	1.250	2.0E-N	0.226
1.0E-05	2.000	2.5E-N	0.298
1.0E-04	2.750	3.0E-N	0.358
1.0E-03	3.500	3.5E-N	0.408
1.0E-02	4.250	4.0E-N	0.452
1.0E-01	5.000	4.5E-N	0.490
1.0E+00	5.750	5.0E-N	0.524
1.0E+01	6.500	5.5E-N	0.555
1.0E+02	7.250	6.0E-N	0.584
1.0E+03	8.000	6.5E-N	0.610
1.0E+04	8.750	7.0E-N	0.634
1.0E+05	9.500	7.5E-N	0.656
		8.0E-N	0.677
		8.5E-N	0.697
		9.0E-N	0.716
		9.5E-N	0.733
		10.0E-N	0.750

To find the analog output voltage when the pressure is 5E+1 Pa.

From the left table, voltage when 1E+1 Pa: 6.5 V

From the right table, voltage when 5E-N Pa: 0.524  $\rm V$ 

Therefore, 6.5 V + 0.524 V = 7.024 V.

# 3. Control Signals

3.1. Control output signals (SH2-1 Standard Type only) Photocoupler rating: 30 V<sub>MAX</sub>, 50 mA<sub>MAX</sub>, 70 mW



Figure 3-1 SH2-1 output signal internal circuit diagram

3.2. Control input signals (SH2-1 only)



Figure 3-2 SH2-1 input signal internal circuit diagram

# 4. Using Serial Communications (SH2-2 Serial Communications Type)

4.1. Serial communications specification

1					
RS-485	RS-232C				
2-w	vire				
Half d	uplex				
Asynch	ronous				
ASCI	I code				
Data bit length 8 bits					
Stop b	it 1 bit				
No p	arity				
Maximum cable length 1200 m*	Maximum cable length 15 m				
Maximum connections 32	Maximum connections 1				
(including host)					
9600/19200/38400 bps	9600/19200/38400 bps				

\*Please check a specification of remote host and an environmental noise if you use the cable of 4m or more.

- 4.2. Settings
- 4.2.1. Wiring diagram
- 4.2.1.1. RS-232C wiring diagram

The digram below shows an example RS-232C connection. The host side is D-sub 9-pin

Sensor	r pin #		Host	pin #
RxD	4		2	RxD
TxD	6		3	TxD
GND	11	]	5	GND

#### 4.2.1.2. RS-485 no terminal resistance (example)

For RS-485 wiring, the diagram below describes the National Instruments USB Serial Interface USB-485 as an example.

Sensor p	oin #	Host	
DS /851	12	 4	RxD+
K3-40J+	12	8	TxD+
DS 185	10	5	RxD-
КЗ-403-	10	 9	TxD-
GND	15	1	GND

4.2.1.3. RS-485 with terminal resistance (example)

For RS-485 wiring, the diagram below describes the National Instruments USB Serial Interface USB-485 as an example.

When there are many RS-485 connections, when the total length of the connection cables is over 15 m, or when there are frequent communications errors, attach a terminal resistor to the terminal device.

Sensor pin #		Host	
RS-485+	12	4	RxD+
K5-405+	12	8	TxD+
PS 485	10	5	RxD-
ND-40J-	10	 9	TxD-
GND	15	 1	GND
Terminal resistor	5		
RS-485+	13		

#### 4.3. Basic data format

The basic data format for sending and receiving data is described below.

:	AD0	AD1	CMD	D0		Dn	SH	SL	СНКН	CHKL	CR
	:	Col	on		I	I	I.			I	
	AL	D0 Dev	vice addre	ss, upper	4 bits (up	percase c	character	s: 0 to 9)			
	AL	D1 Dev	vice addre	ss, lower	4 bits (up	percase c	character	s: 0 to 9)			
	CM	1D Cor	nmand (ca	ase sensit	ive)						
	D	0 Dat	a <4 bits>	· (upperca	ase charac	ters: 0 to	9, A to I	F)			
	D	n Dat	a <4 bits>	· (upperca	ase charac	eters: 0 to	9, A to I	F)			
	SI	H Stat	us upper 4	4 bits							
	SL Status lower 4 bits										
	CHKH Checksum upper 4 bits (upper case characters: 0 to 9, A to F)										
	CHKL Checksum lower 4 bits (upper case characters: 0 to 9, A to F)										
	C	R Car	riage retu	rn							
	Com	mands are	e compose	d of upp	er case an	d lower c	ase alpha	anumeric	character	s.	

> The checksum is an exclusive OR (XOR) of AD0 to SL. Convert with hexadecimal ASCII codes.

### 4.3.1. Command list

Command	Description	Command	Description
D	Read measurement value, status	1R	Read setpoint 1 setting
ATM	Adjust atmospheric pressure	2R	Read setpoint 2 setting
SR	Read status	1W	Write setpoint 1 setting
SW	Write status	2W	Write setpoint 2 setting
FIL	Check filament current value	ERR	Check error details
Т	Model, software version		

# 4.4. Command (example)

4.4.1. Read measurement value, status

	Command		AD0	AD1	D	CHKH	CHKL	CR
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Sensor -> PC response format

:	AD0	AD1	D	Х	•	Х	Х	Е	±	Х	Х	SH	SL	СНКН	CHKL	CR
The measured pressure value goes in "X.XXE±XX".																
	E	vomnla 1	. 20		02			2 00	w 10+	3						

Example 1:	3.00E+03	$\rightarrow$	5.00X10
Example 2:	5.00E+00	$\rightarrow$	$5.00 \times 10^{+0}$
Example 3:	4.00E-01	$\rightarrow$	4.00x10 <sup>-1</sup>

► "E.EEE+EE" response: Sensor error

> "F.FFE+FF" response: SH2 independent mode only, over measurement range, filament off

▶ For status "SH" and "SL", see the separate section.

### 5. Warranty

This product has been shipped after undergoing an extensive in-house inspection. However, in the event a failure occurs that ULVAC Inc. is responsible for, such as a manufacturing defect or accident during shipment, please inquire with the Components Division of ULVAC Inc. or the nearest sales office or dealer regarding repairs. The product will be repaired or replaced at no charge.

#### Subject to warranty

- 1) Pressure sensor unit
- 2) Gauge head immediately after delivery

### Duration of guarantee

Within 1 year from the date of delivery.

#### Warranty range

- 1) Products damaged by problems during delivery, shipping.
- 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 that do not meet key specifications even when used within the conditions in the key specifications including measurement pressure, operating temperature range, and power supply used.

#### Response procedure

- 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.
- 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 in use (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.

# 6. Related drawings







