

GENERAL CATALOG

BUILT-IN SENSORS



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Selector Chart



Equipment sensors for improved comfort and convenience, safety and energy conservation

Acceleration

Acceleration Sensors

Acceleration Sensor

Made possible by leading-edge MEMS technology, this acceleration sensor is ideal for automotive and mobile devices




Product name	Acceleration detection range	Characteristics
2-axis GS2  1-axis GS1 	$\pm 2g$ $\pm 1.5g$	<ul style="list-style-type: none"> High precision and high sensitivity. High reliability: Detection errors due to temperature fluctuation reduced to a minimum. Product lineup covers range of operating voltage and acceleration detection.

Brightness

Light Sensors

Light Sensor

Making us more comfortable with energy efficient devices...Environmentally friendly, cadmium-free





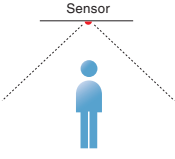





Product name	Peak sensitivity wave length	Characteristics
Light Sensor NaPiCa    <small>Chip type SMD type Through-hole type</small>	$580nm$ $560nm$ (Chip type)	<ul style="list-style-type: none"> Cadmium-free. Built-in optical filter for spectral response similar to that of the human eye. Photocurrent is proportional to illumination. (linear output). Chip type that achieves miniaturization

Motion

Motion Sensors

Motion Sensor

Motion sensors that always detect your slightest movement






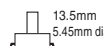



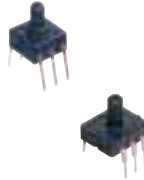

Product name	Detection method	Type	Characteristics			
MP Motion Sensor NaPiOn     <small>Standard type Slight motion detection type Spot type 10m detection type</small>	Detecting the heat (infrared rays) of the human body and other objects. 	Standard type Black lens White lens	<ul style="list-style-type: none"> Built-in amplifier for easy use. Detects even slight motion of a person. Digital output and analog output (with adjustable sensitivity) are available. Ideal for battery driven devices, a low current consumption type ($46\mu A$ typ.) has also been added to the lineup. <p style="text-align: right;">*Digital output type only.</p>			
		Slight motion detection type Black lens White lens				
		Spot type Black lens White lens				
		10m detection type Black lens White lens				
		MA Motion Sensor      <small>Thin short type (V type) Short type (H type) Middle type (H type) Long type (H type) Long type (V type)</small>		Built-in oscillation circuit type Detection distance 5 to 200cm 1.969 to $78.74inch$	<ul style="list-style-type: none"> The sensors are ready for immediate use by simply connecting to a DC power supply. The built-in oscillation circuit removes the need to input a start signal. Can be used with a number of different supply voltages. 1) 5V DC type 2) Free-ranging type (6.5 to 27V DC) 	
				External trigger type Detection distance 5 to 200cm 1.969 to $78.74inch$		

Pressure

Pressure Sensors

Pressure Sensors

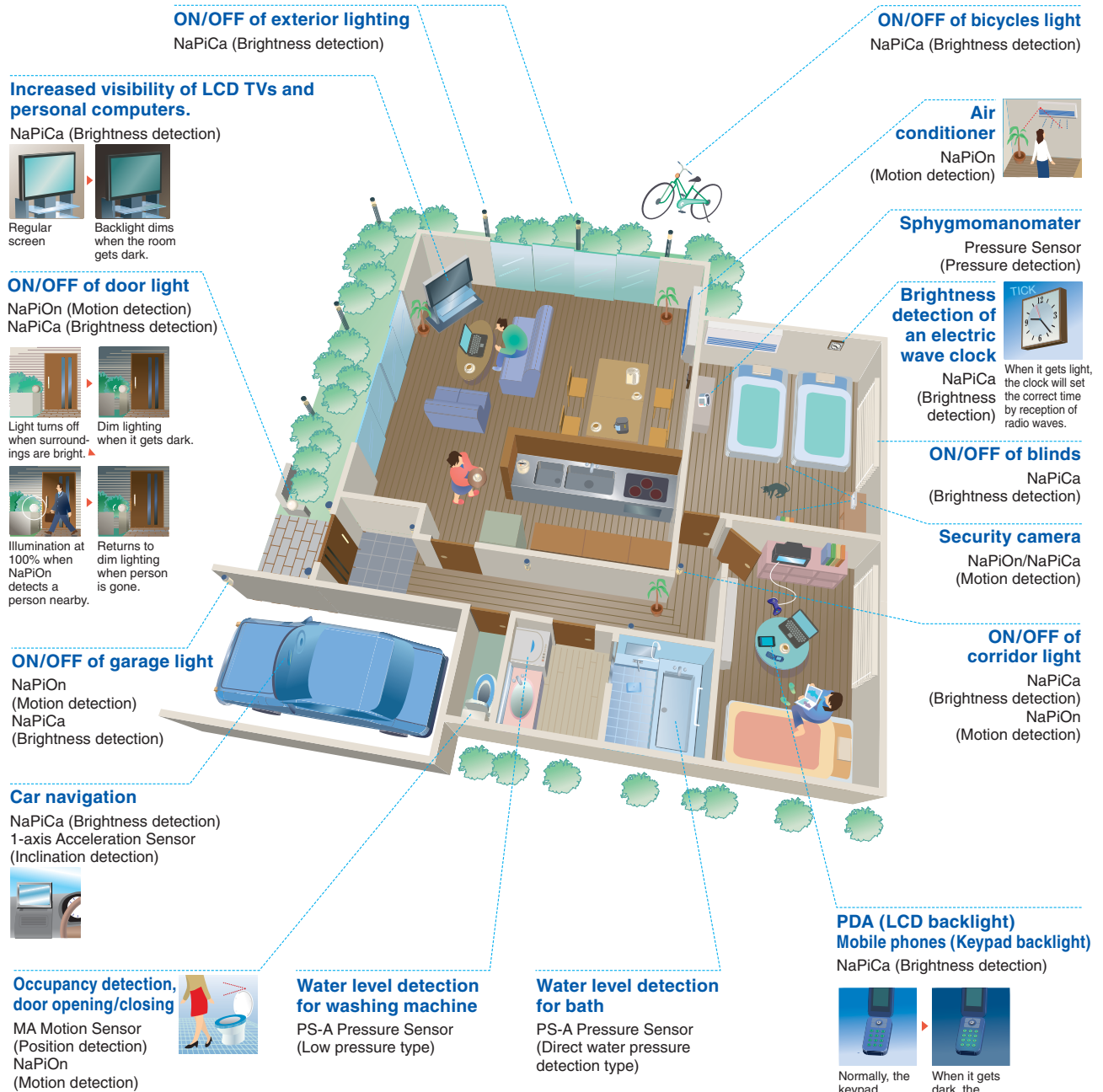
A wide range of rated pressure, including minute pressures

Product name	Pressure medium	Type (*Without glass base type)	Terminal direction	Pressure inlet hole length	Characteristics
PS-A Pressure Sensor 	Air	Rated pressure	Opposite the pressure inlet direction 	 3mm  5mm	<ul style="list-style-type: none"> ● Compact pressure sensor with built-in amplification and temperature compensation circuit ● Low pressure type ideal for water level detection applications added to lineup.
		<Low pressure type> 6kPa		 5mm 3mm dia.  13.5mm 5.45mm dia.	
PS-A Pressure Sensor (Direct water pressure detection type) 	Air Water	-19.6 to 49kPa		 8mm  6mm dia.	<ul style="list-style-type: none"> ● Not only air, now water pressure can be detected directly.
PS Pressure Sensor PF Pressure Sensor 	Air	Rated pressure	Opposite the pressure inlet direction 	—	<ul style="list-style-type: none"> ● Ultra-miniature Base area 7.2 (W) x 7.2 (D) mm .283 (W) x .283 (D) inch ● A wide range of rated pressure, including a minute pressure.
		Bridge resistance 4.9, 14.7, 34.3, *49.0, 98.1, 196.1, 343.2, 490.3, 833.6, 980.7 kPa *40kPa 98.1, 980.7kPa (PS only)			

Recommended Applications

Built-in sensor contributes to energy savings, safety, and comfort

Providing sensors for various aspects of our lives



Acceleration

Acceleration Sensors

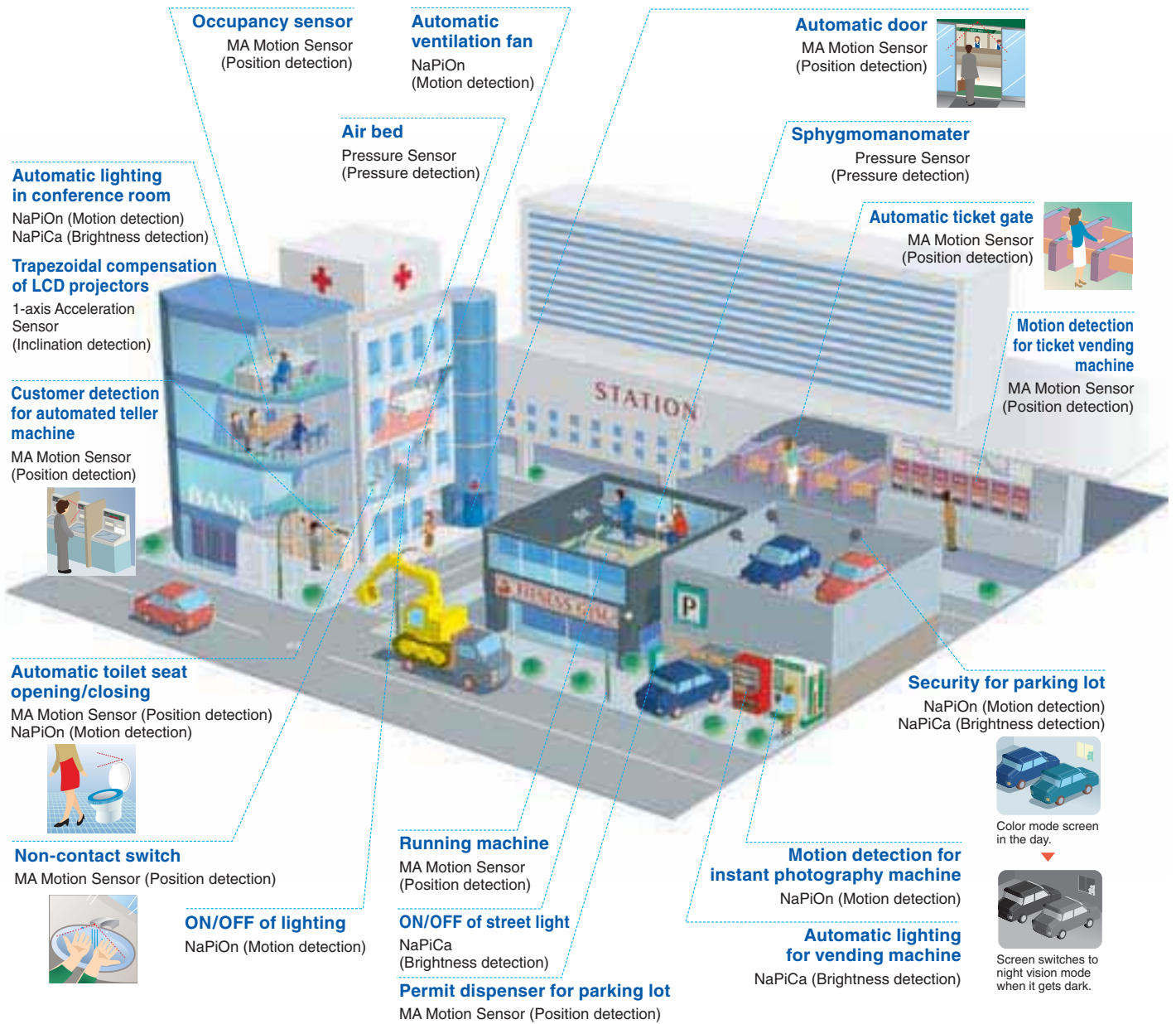
2-axis GS2 1-axis GS1

Brightness

Light Sensors

NaPiCa

SMD type Through-hole type Chip type



Motion

Motion Sensors

NaPiOn

Standard type Slight motion detection type Spot type 10 m detection type

Thin short type (V type) Short type (H type)

Middle type (H type) Long type (H type) Long type (V type)

Pressure

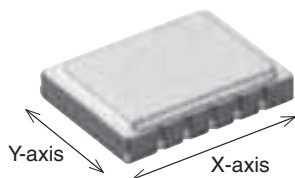
Pressure Sensors

PS-A

PS-A (Low pressure type) PS PF

PS-A (Direct water pressure detection type)

New



↔ : Direction of acceleration detection

FEATURES

- High precision and high reliability:**
Offset temperature characteristics $\pm 38\text{mg}$ (Typical value)
- High sensitivity: 1 to 1.333V/g**
(VDD=5V)
- Product lineup covers range of operating voltage and acceleration detection.**

TYPICAL APPLICATIONS

- Car electronics**
 - Car navigation system (inclination detection)
 - Event data recorder
 - Car security systems (Theft prevention using slope and vibration detection)
- Equipments for shipping and special vehicles**
 - Devices for shipping, construction equipment, agricultural machinery, and vehicles for persons with special needs
- Other applications**
 - Theft prevention for all types of equipment and devices
 - Measuring instruments (levels, gauges)

Compliance with RoHS Directive

ORDERING INFORMATION

AGS 2 1 1

Number of detectable axis (Method)

2: 2-axis Acceleration Sensor (Electrostatic capacitance type)

Package type/Size

1: Ceramic package/6.2 x 8.5 mm

Detection sensitivity

1: 1 V/g

3: 1.333 V/g

6: 0.6 V/g

8: 0.8 V/g

Operation power supply voltage/Output type

3: 3 V DC/Analog output

5: 5 V DC/Analog output

Type

1: Built-in ASIC

TYPES

Product name	Operation power supply voltage	Acceleration detection range	Detection sensitivity	Part number
New 2-axis Acceleration sensor GS2	3V DC	$\pm 2\text{g}$	0.6V/g	AGS21631
		$\pm 1.5\text{g}$	0.8V/g	AGS21831
	5V DC	$\pm 2\text{g}$	1V/g	AGS21151
		$\pm 1.5\text{g}$	1.333V/g	AGS21351

Standard packing: Carton: 1,000 pcs.

MAXIMUM RATING

Item	Unit	Standard value			Remarks
		min.	typ.	max.	
Max. applied voltage	V	-0.3	—	7	Ta=25°C 77°F
Storage temperature range	°C °F	-40 -40	—	85 185	
Operation temperature range	°C °F	-40 -40	—	85 185	
Anti-shock characteristic	g	5,000	—	—	

ELECTRICAL CHARACTERISTICS

Item	Unit	Standard value												Remarks
		min.				typ.				max.				
		AGS 21151	AGS 21351	AGS 21631	AGS 21831	AGS 21151	AGS 21351	AGS 21631	AGS 21831	AGS 21151	AGS 21351	AGS 21631	AGS 21831	
Acceleration detection range ^{Note 1)}	g	-2	-1.5	-2	-1.5	—				2	1.5	2	1.5	
Operation power supply voltage	V	4.75		2.85		5		3		5.25		3.15		-40 to +85°C -40 to +185°F
Current consumption	mA	—		—		2		1.8		5		5		0g, Ta=25°C 77°F
Sensitivity	V/g	0.975	1.3	0.585	0.78	1	1.333	0.6	0.8	1.025	1.366	0.615	0.82	Ta=25°C 77°F
Offset voltage (0 g)	V	2.44	2.42	1.464	1.452	2.5		1.5		2.56	2.58	1.536	1.548	Ta=25°C 77°F
Temperature sensitivity characteristic	%	-2				—				2				-40 to +85°C -40 to +185°F
Offset voltage temperature characteristic	mg	-55				—				55				-40 to +85°C -40 to +185°F
Other axis sensitivity ^{Note 2)}	%	-5				—				5				Ta=25°C 77°F
Non-linearity ^{Note 3)}	%FS	-1				—				1				Ta=25°C 77°F
Turn-on time ^{Note 4)}	ms	—				10				—				0g, Ta=25°C 77°F C1=220nF, C2=27nF
Frequency response ^{Note 5)}	Hz	DC				—				60				-3dB point, C2=27nF

Notes: 1. The acceleration unit "g" means 9.8 m/s².

2. VDD typical value of each part number when nothing is specified.

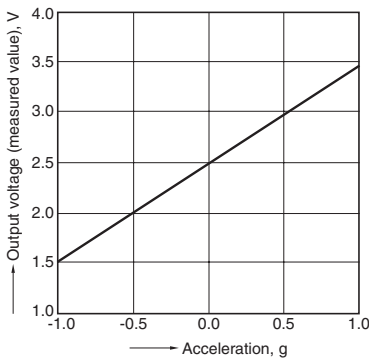
3. Maximum error from linear output that connects +2 g and -2 g output.

4. "C1" is a ceramic capacitor installed between the VDD and GND terminals. "C2" is a ceramic capacitor installed between the Vout (X) and Ext-Cap (X) terminals. "C3" is a ceramic capacitor installed between the Vout (Y) and Ext-Cap (Y) terminals.

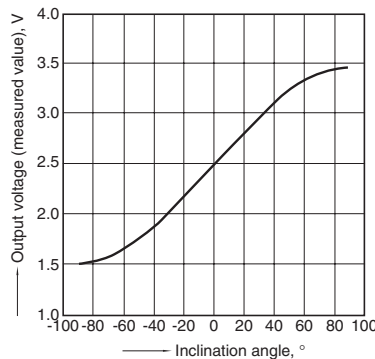
5. The frequency characteristics can be changed depending on the C2 and C3 capacitance value. Please refer to "Recommended circuit diagram" on the following page. Note that the maximum frequency response is 60 Hz.

REFERENCE DATA

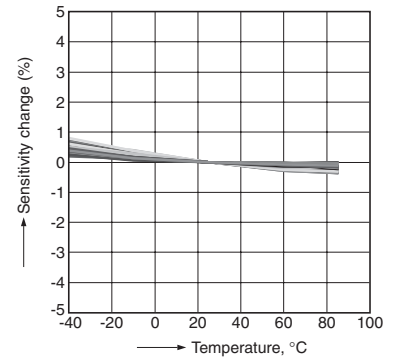
1. Output characteristics



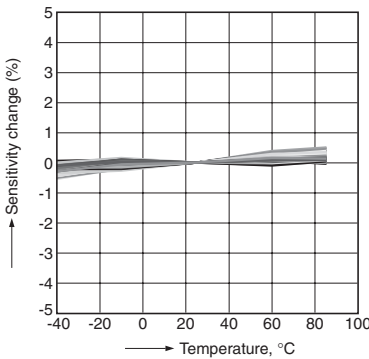
2. Inclination angle - Output voltage characteristics



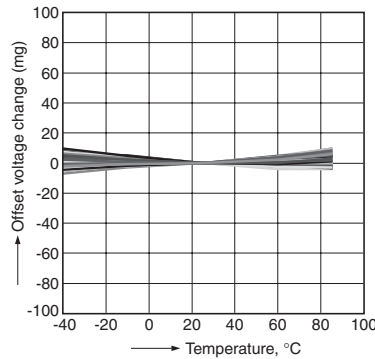
3-1 Sensitivity temperature characteristics X-axis (VDD=5V)



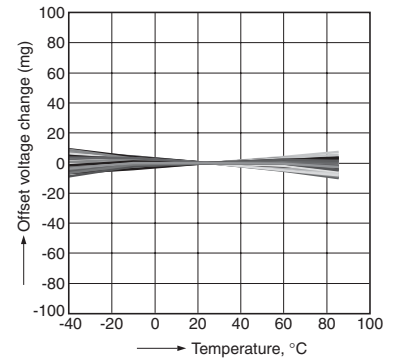
3-2 Sensitivity temperature characteristics Y-axis (VDD=5V)



4-1 Offset voltage temperature characteristics X-axis (VDD=5V)

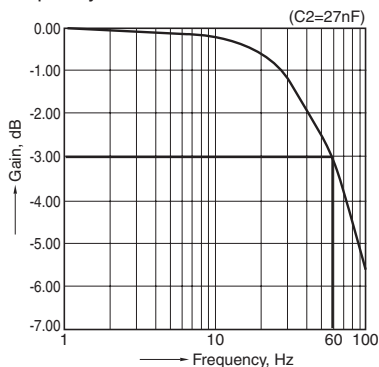


4-2 Offset voltage temperature characteristics Y-axis (VDD=5V)



GS2 Sensor (AGS2)

5. Frequency characteristics

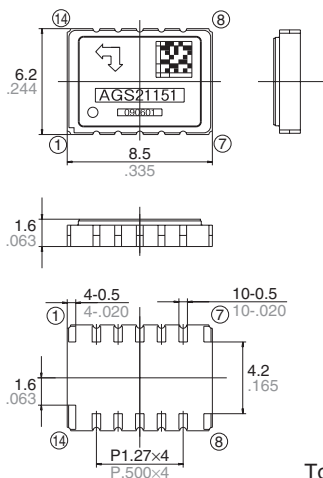


Note: The frequency characteristics can be changed depending on the C2 capacitance value. Please refer to "Recommended circuit diagram" on the following page.

DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

CAD Data

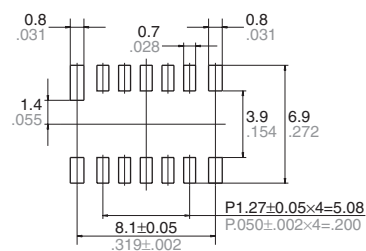


Terminal layout			
①	NC	⑧	NC
②	GND	⑨	VDD
③	NC	⑩	Ext-Cap (Y)
④	Vout (X)	⑪	Vout (Y)
⑤	Ext-Cap (X)	⑫	NC
⑥	GND	⑬	NC
⑦	NC	⑭	NC

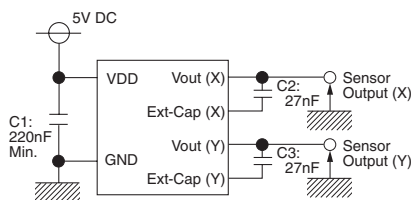
Leave terminal "NC (No. 1, 3, 7, 8 and 12 to 14)" unconnected.
The No. 2 and No. 6 terminals are connected internally.

Tolerance: $\pm 0.2 \pm .008$

Recommended PC board pad



RECOMMENDED CIRCUIT DIAGRAM

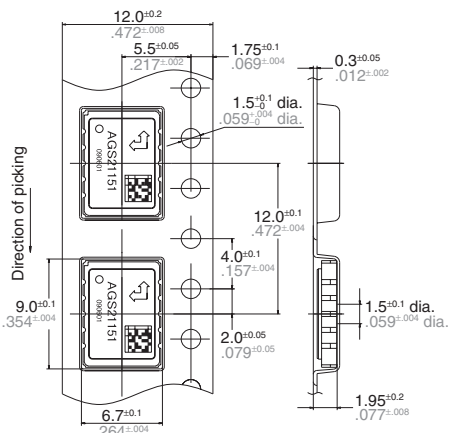


The frequency characteristics value can be changed depending on the C2 and C3 capacitance value.
-3dB bandwidth is expressed in the formula below.

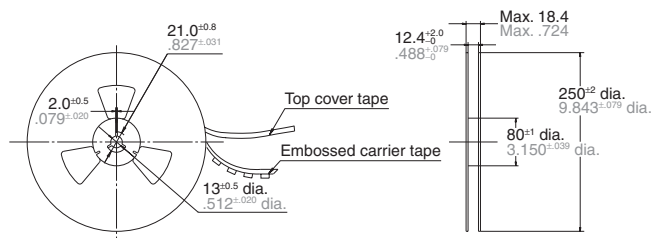
$$f_{-3dB} = \frac{1}{2\pi \times (100k\Omega) \times (C2 \text{ or } C3)}$$

PACKING FORMAT (Tape and reel) (mm inch)

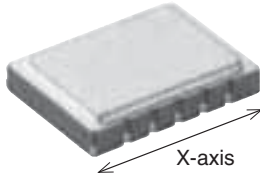
Tape dimensions



Dimensions of tape reel



For NOTES, see Page 14.



↔ : Direction of acceleration detection

FEATURES

- High precision and high reliability:**
Offset temperature characteristics
 $\pm 47\text{mg}$ (Typical value)
- High sensitivity: 1 to 1.333V/g**
(VDD=5V)

TYPICAL APPLICATIONS

- Car navigation system
- Projectors (trapezoidal compensation)
- Elevators, Medical caregiving devices (inclination detection)

Compliance with RoHS Directive

ORDERING INFORMATION

	AGS	1	1		5	1
Number of detectable axis (Method) 1: 1-axis Acceleration Sensor (Electrostatic capacitance type)		1	1			
Package type/Size 1: Ceramic package/6.2 x 8.5 mm						
Detection sensitivity 1: 1 V/g 3: 1.333 V/g						
Operation power supply voltage/Output type 5: 5 V DC/Analog output					5	
Type 1: Built-in ASIC						1

TYPES

Product name	Operation power supply voltage	Acceleration detection range	Detection sensitivity	Part number
1-axis Acceleration sensor GS1	5V DC	$\pm 2\text{g}$	1V/g	AGS11151
		$\pm 1.5\text{g}$	1.333V/g	New AGS11351

Standard packing: Carton: 1,000 pcs.

MAXIMUM RATING

Item	Unit	Standard value			Remarks
		min.	typ.	max.	
Max. applied voltage	V	-0.3	—	7	Ta=25°C 77°F
Storage temperature range	°C °F	-40 -40	—	85 185	
Operation temperature range	°C °F	-40 -40	—	85 185	
Anti-shock characteristic	g	5,000	—	—	

ELECTRICAL CHARACTERISTICS

Item	Unit	Standard value						Remarks
		min.		typ.		max.		
		AGS11151	AGS11351	AGS11151	AGS11351	AGS11151	AGS11351	
Acceleration detection range ^{Note 1)}	g	-2	-1.5	—	—	2	1.5	
Operation power supply voltage	V	4.75		5		5.25		-40 to +85°C -40 to +185°F
Current consumption	mA	—		5		7		0g, Ta=25°C 77°F
Sensitivity	V/g	0.97	1.293	1	1.333	1.03	1.373	Ta=25°C 77°F
Offset voltage (0 g)	V	2.4		2.5		2.6		Ta=25°C 77°F
Temperature sensitivity characteristic	%	-4		—		4		-40 to +85°C -40 to +185°F
Offset voltage temperature characteristic	mg	-70		—		70		-40 to +85°C -40 to +185°F
Other axis sensitivity ^{Note 2)}	%	-5		—		5		Ta=25°C 77°F
Non-linearity ^{Note 3)}	%FS	-1		—		1		Ta=25°C 77°F
Turn-on time ^{Note 4)}	ms	—		10		—		0g, Ta=25°C 77°F C1=220nF, C2=27nF
Frequency response ^{Note 5)}	Hz	DC		60		—		-3dB point, C2=27nF

Notes: 1. The acceleration unit "g" means 9.8 m/s².

2. VDD=5 V when there is no indication.

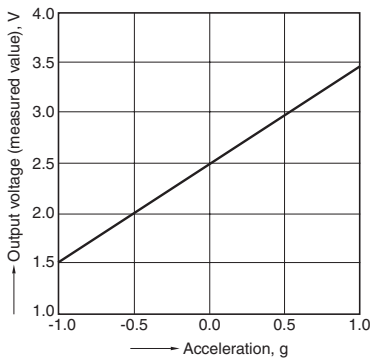
3. Maximum error from linear output that connects +2 g and -2 g output.

4. "C1" is a ceramic capacitor installed between the VDD and GND terminals. "C2" is a ceramic capacitor installed between the Vout and Ext-Cap terminals.

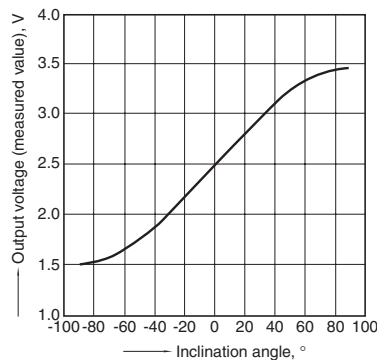
5. The frequency characteristics can be changed depending on the C2 capacitance value. Please refer to "Recommended circuit diagram" on the following page. Note that the maximum frequency response is 200 Hz.

REFERENCE DATA

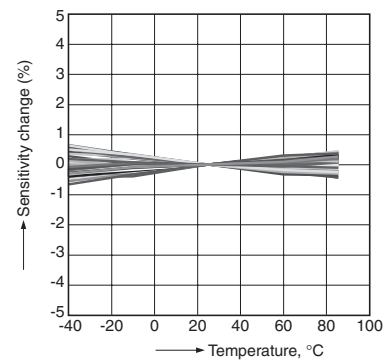
1. Output characteristics



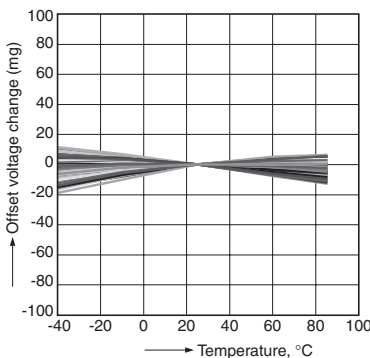
2. Inclination angle - Output voltage characteristics



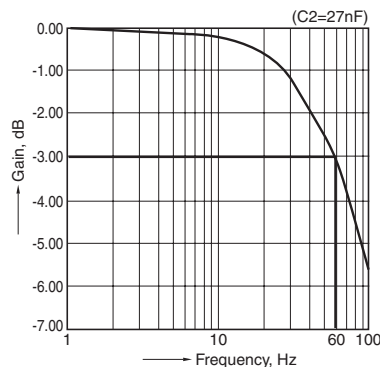
3. Sensitivity temperature characteristics (VDD=5V)



4. Offset voltage temperature characteristics (VDD=5V)



5. Frequency characteristics (C2=27nF)

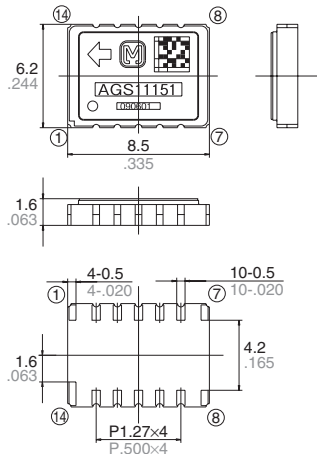


Note: The frequency characteristics can be changed depending on the C2 capacitance value. Please refer to "Recommended circuit diagram" on the following page.

DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

CAD Data

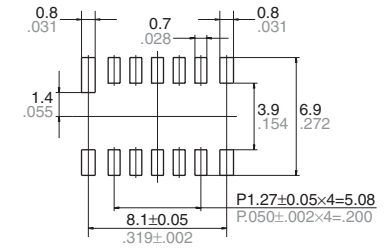


Tolerance: $\pm 0.2 \pm .008$

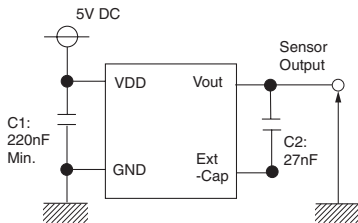
Terminal layout			
①	NC	⑧	NC
②	GND	⑨	VDD
③	NC	⑩	NC
④	Vout	⑪	NC
⑤	Ext-Cap	⑫	NC
⑥	GND	⑬	NC
⑦	NC	⑭	NC

Leave terminal "NC (No. 1, 3, 7, 8 and 10 to 14)" unconnected.
The No. 2 and No. 6 terminals are connected internally.

Recommended PC board pad



RECOMMENDED CIRCUIT DIAGRAM

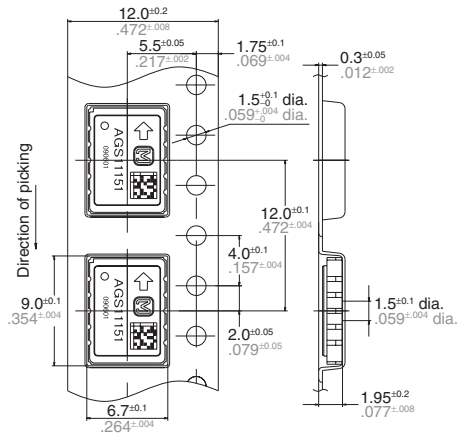


The frequency characteristics value can be changed depending on the C2 capacitance value.
-3dB bandwidth is expressed in the formula below.

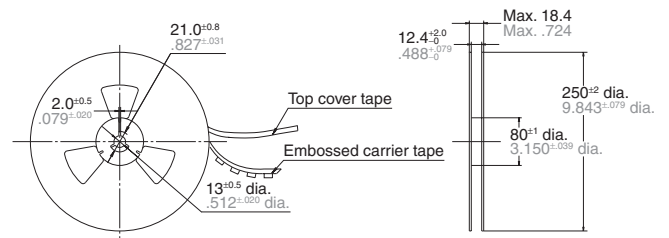
$$f_{-3dB} = \frac{1}{2\pi \times (100k\Omega) \times C2}$$

PACKING FORMAT (Tape and reel) (mm inch)

Tape dimensions



Dimensions of tape reel



NOTES

1. To ensure reliability, please verify quality under conditions of actual use.

2. Mounting

Use lands on the PC boards to which the sensor can be securely fixed.

- Malfunctioning may occur if much noise is present in the power supply used for this product. In order to prevent, in particular, superimposed noise, please install the recommended capacitor between the sensor input terminals (between VDD and GND) closest to the sensor (a position within 20 mm of the pattern circuit length). However, please reselect an ideal capacitor after performing tests on the actual equipment.

- Since the top surface (where the part number is visible) of the sensor is GND, please make sure that the metallic parts of other components do not come into contact.

3. Soldering

- Take steps to minimize the effects of external heat. Damage and changes to characteristics may occur due to heat deformation.

- Use a non-corrosive resin type of flux.

1) Manual soldering

- Set the soldering tip from 350 to 400°C (662 to 752°F (30 to 60W)), and solder for no more than 3 seconds.

- Please note that output may change if the pressure is applied on the terminals when the soldering.

- Thoroughly clean the soldering iron.

2) Reflow soldering

- The recommended reflow temperature profile conditions are given below.

- We recommend the screen solder printing method as the method for cream solder printing.

- Please refer to the recommended PC board pad for the PC board foot pattern.

- Self alignment may not always work as expected; therefore, please carefully adjust the position of the terminals and pattern.

- The profile temperature is the value measured on the PC board near the terminals.

- When doing reflow soldering on the back of the PC board after performing sensor reflow, please fix the sensor with adhesive and so on.

3) Solder reworking

- Finish reworking in one operation.

- For reworking of the solder bridge, use a soldering iron with a flat tip. Please do not add more flux when reworking.

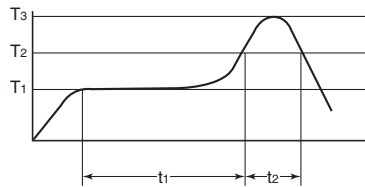
- Please use a soldering iron that is below the temperature given in the specifications in order to maintain the correct temperature at the tip of the soldering iron.

4) Too much temperature on the terminals will cause deformation and loss in effectiveness of the solder. Therefore, please avoid dropping and careless handling of the product.

5) When cut folding the PC board after mounting the sensor, take measures to prevent stress to the soldered parts.

6) The sensor terminals are designed to be exposed, so contact of the terminals with metal shards and the like will cause output errors. Therefore, please be careful and prevent things such as metal shards and hands from contacting the terminals.

7) To prevent degradation of the PC board insulation after soldering, please be careful not to get chemicals on the sensor when coating.



T ₁	150 to 180°C	302 to 356°F
T ₂	230°C	446°F
T ₃	Max. 250°C	482°F
t ₁	60 to 120 sec.	
t ₂	With in 30 sec.	

4. Connections

- Please perform connections correctly in accordance with the terminal connection diagram. In particular, be careful not to reverse wire the power supply as this will cause damage or degrade to the product.

- Do not connect "NC" terminals that are not used. This can cause malfunction of the sensor.

5. Cleaning

- Avoid ultrasonic cleaning since this may cause breaks or disconnections in the wiring.

6. Environment

- Please avoid using or storing the sensor in a place exposed to corrosive gases (such as the gases given off by organic solvents, sulfurous acid gas, hydrogen sulfides, etc.) which will adversely affect the performance of the sensor.

- When installing the sensor, you must provide a capacitor as shown in the recommended circuit diagram.

- Since the internal circuitry may be destroyed if an external surge voltage is supplied, provide an element which will absorb the surges.

- Malfunctioning may occur if the product is in the vicinity of electrical noise such as that from static electricity, lightning, a broadcasting station, an amateur radio, or a mobile phone.

- Please do not use the sensor in a location where it may be sprayed with water, etc.

- Avoid using the sensor in an environment where condensation may form.

Furthermore, its output may fluctuate if any moisture adhering to it freezes.

- Avoid using the sensor where it will be susceptible to ultrasonic or other high-frequency vibration.

7. Other handling precautions

To assure reliability, check the sensor under actual loading conditions. Avoid any situation that may adversely affect its performance.

- This product may malfunction if dropped on its own before it is installed. Do not use if this happens.

- Caution is required because differences in the acceleration detection range and the method of connection can lead to accidents.

- The actual acceleration should be within the rated acceleration range. Damage may occur if it is outside of this range.

- This product may become damaged if exposed to static electricity. Therefore, please be careful, as follows, when handling.

(1) Since plastic containers easily hold a charge, please do not use them for storage or transport.

(2) Please store or transport the product in an environment that hinders the occurrence of static electricity (for example, places with 45% to 60% humidity) and protect the product using electrically conductive packaging.

(3) Implement static electricity prevention measures once the product packaging has been opened.

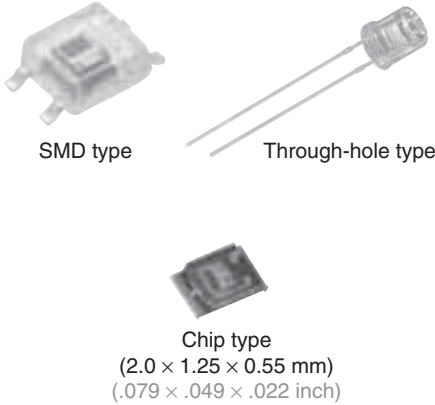
- Any personnel handling the sensor should wear electrostatic clothing and be body grounded.

- Place an electrically conducting board on the work surface and ground any devices used such as measuring instruments and jigs.

- Use a soldering iron with a low leak current or else ground the tip.

- Make sure that customer equipment used for device assembly is grounded.

(4) Since the internal circuitry may be destroyed if an external surge voltage is supplied, provide an element which will absorb the surges. (Surge toleration: power supply voltage of absolute maximum rating)



FEATURES

1. Built-in optical filter for spectral response similar to that of the human eye.
2. Photocurrent is proportional to illumination. (linear output)
3. Uses environmentally friendly silicon chips.

TYPICAL APPLICATIONS

SMD and Through-hole types

1. Brightness detection for LCD backlight control for LCD devices (LCD TVs, car navigation systems, and mobile PCs).
2. Brightness detection for circuits in residential lighting, lighting for security, and automatic lighting for bicycle.
3. Household appliances (day/night energy savings for air conditioners and electric hot water pots, etc.)
4. Brightness detection for wall clocks (radio clocks).

Chip type

1. Brightness detection for LCD backlight control for compact mobile devices (mobile phones and PDAs).
2. Brightness detection for controlling the keypad backlight in mobile phones.

Compliance with RoHS Directive

TYPES

Type (shape)	Photo current	Part No.	
		Tape and reel package	Baggage package
SMD type	260 μ A*	AMS104Y	—
Through-hole type		AMS302T	AMS302
Chip type	20 μ A*	AMS402Y	—

Standard packing: Tape and reel package SMD type: Carton: 3,000 pcs.; Case: 3,000 pcs.
 Tape and reel package Through-hole type: Carton: 2,000 pcs.; Case: 2,000 pcs.
 Baggage package Through-hole type: Carton: 500 pcs.; Case: 1,000 pcs.
 Tape and reel package Chip type: Carton: 3,000 pcs.; Case: 3,000 pcs.

Notes: *Ev = 100 lx (Ev: Brightness, Fluorescent lamp is used as light source)
 Tape and reel package is standard packaging style for SMD and chip types. ("Y" and "T" at end of part number indicate packaging type.)

RATINGS

1. Absolute maximum ratings (Measuring condition: ambient temperature: 25°C 77°F)

Item	Symbol	AMS104/AMS302	AMS402	Remarks
Reverse voltage	V_R	-0.5 to 8 V	-0.5 to 6 V	—
Photocurrent	I_L	5 mA	1 mA	—
Power dissipation	P	40 mW	6 mW	—
Operating temperature	T_{opr}	-30 to +85°C -22 to +185°F	-30 to +85°C -22 to +185°F	Non-condensing at low temperatures
Storage temperature	T_{stg}	-40 to +100°C -40 to +176°F	-40 to +100°C -40 to +176°F	Non-condensing at low temperatures

2. Recommended operating condition

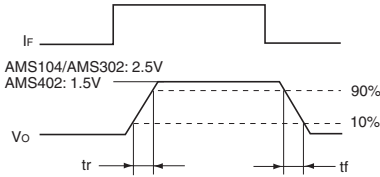
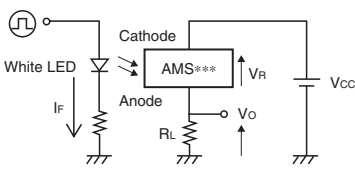
Item	Symbol	AMS104/AMS302	AMS402	Remarks
Reverse voltage	Minimum	1.5 V	1.5 V	—
	Maximum	6 V	5.5 V	

Light Sensor (AMS1, 3, 4)

3. Electrical and optical characteristics (Measuring condition: ambient temperature: 25°C 77°F)

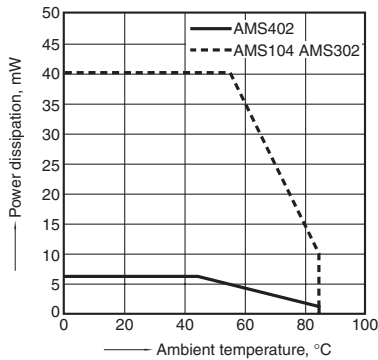
Item	Symbol	AMS104/AMS302	AMS402	Condition	
Peak sensitivity wavelength	λ_p	580 nm	560 nm	—	
Photocurrent 1	Minimum	9.1 μA	0.7 μA	AMS104/AMS302: $V_R = 5\text{ V}$, $E_V = 5\text{ lx}^{*1}$ AMS402: $V_R = 3\text{ V}$, $E_V = 5\text{ lx}^{*1}$	
	Typical	13 μA	1 μA		
	Maximum	16.9 μA	1.3 μA		
Photocurrent 2	Minimum	182 μA	14 μA	AMS104/AMS302: $V_R = 5\text{ V}$, $E_V = 100\text{ lx}^{*1}$ AMS402: $V_R = 3\text{ V}$, $E_V = 100\text{ lx}^{*1}$	
	Typical	260 μA	20 μA		
	Maximum	338 μA	26 μA		
Photocurrent 3	Typical	I_{L3}	500 μA	35 μA	AMS104/AMS302: $V_R = 5\text{ V}$, $E_V = 100\text{ lx}^{*2}$ AMS402: $V_R = 3\text{ V}$, $E_V = 100\text{ lx}^{*2}$
Dark current	Maximum	I_D	0.3 μA	0.05 μA	AMS104/AMS302: $V_R = 5\text{ V}$, $E_V = 0\text{ lx}$ AMS402: $V_R = 3\text{ V}$, $E_V = 0\text{ lx}$
Switching time	Rise time	Typical	t_r	8.5 ms	AMS104/AMS302: $V_{CC} = 5.0\text{ V}$, $V_O = 2.5\text{ V}$, $R_L = 5\text{ k}\Omega$ AMS104/AMS302: $V_{CC} = 3.0\text{ V}$, $V_O = 1.5\text{ V}$, $R_L = 5\text{ k}\Omega$
	Fall time	Typical	t_f	8.5 ms	

Notes: *1. Fluorescent lamp is used as light source. E_V = Brightness
*2. CIE standard illuminant 'A' is used as light source.
*3. Measuring method for switching time.



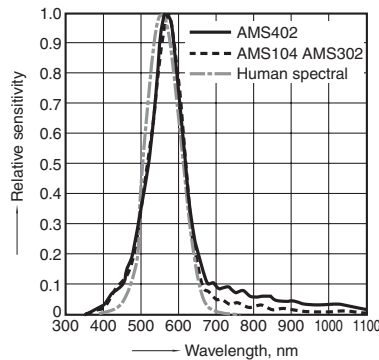
REFERENCE DATA

1. Power dissipation vs. ambient temperature characteristics



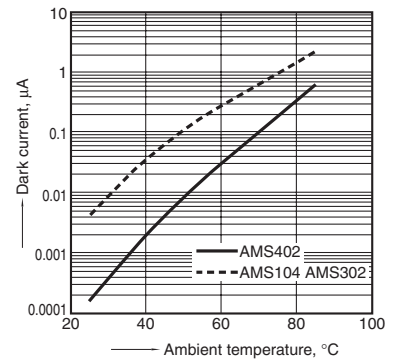
2. Relative sensitivity vs. wavelength characteristics

Reverse voltage: 3V (AMS402), 5V (AMS104, AMS302)
Ambient temperature: 25°C 77°F



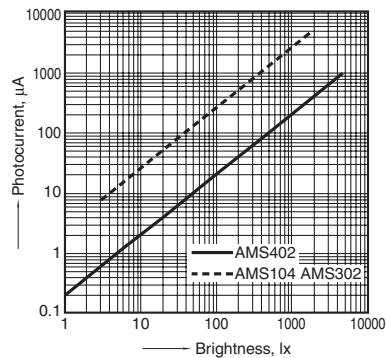
3. Dark current vs. ambient temperature characteristics

Reverse voltage: 3V (AMS402), 5V (AMS104, AMS302)



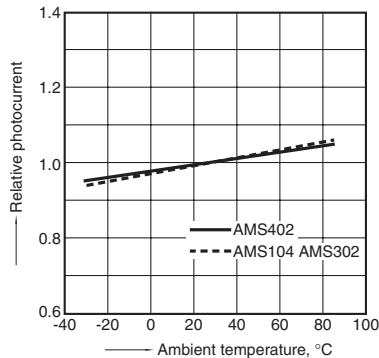
4. Photocurrent vs. brightness characteristics

Light source: Fluorescent lamp
Reverse voltage: 3V (AMS402), 5V (AMS104, AMS302)
Ambient temperature: 25°C 77°F



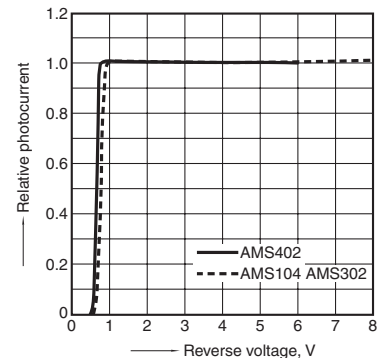
5. Relative photocurrent vs. ambient temperature characteristics

Light source: Fluorescent lamp, Brightness: 100 lx
Reverse voltage: 3V (AMS402), 5V (AMS104, AMS302)



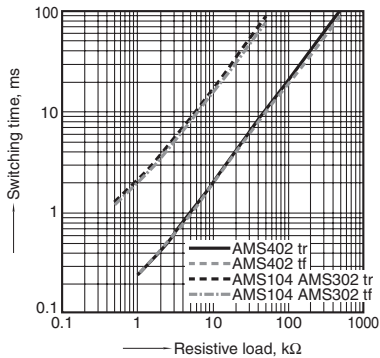
6. Relative photocurrent vs. reverse voltage characteristics

Light source: Fluorescent lamp, Brightness: 100 lx
Ambient temperature: 25°C 77°F



7. Switching time vs. resistive load characteristics

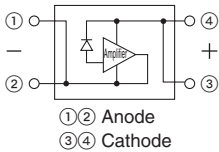
Light source: White LED
 Power voltage: 3V (AMS402), 5V (AMS104, AMS302)
 Resistive load voltage: 1.5V (AMS402),
 2.5V (AMS104, AMS302)
 Ambient temperature: 25°C 77°F



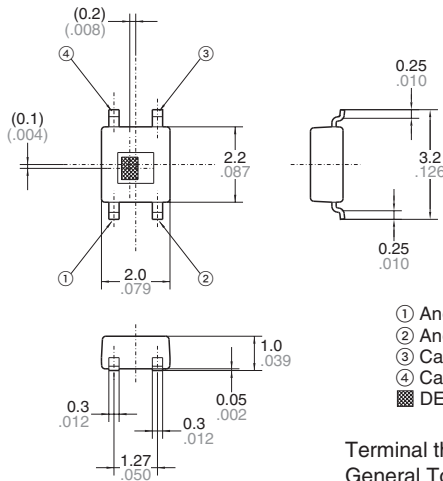
DIMENSIONS (mm inch)

1. SMD type

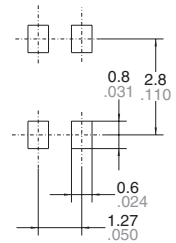
CAD Data



The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

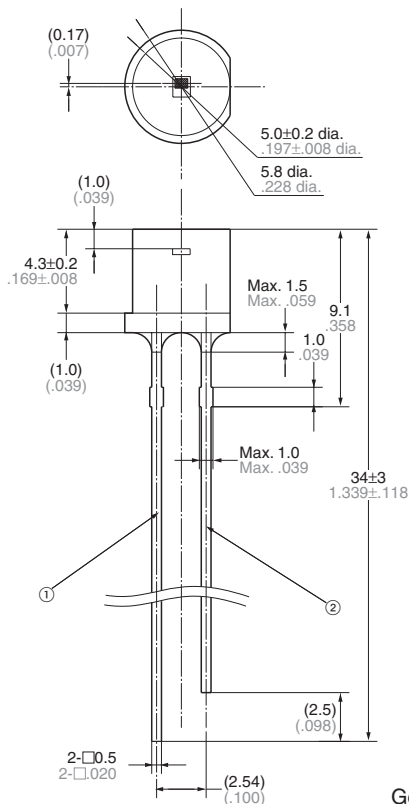
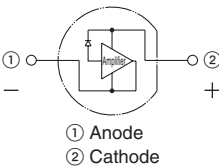
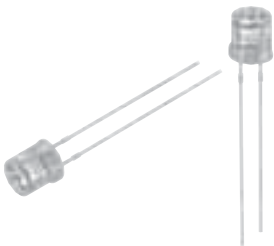


Recommended mounting pad
 (Top view)



2. Through-hole type

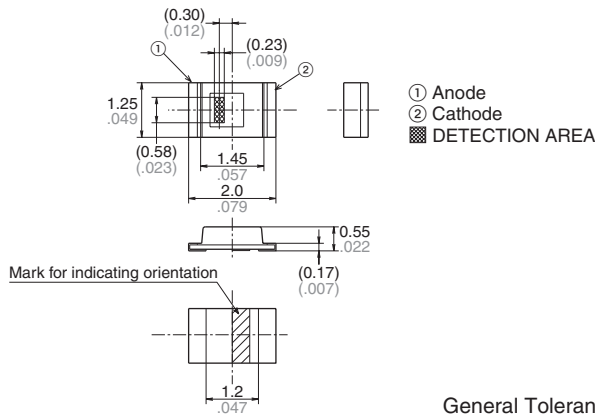
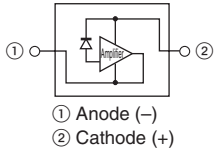
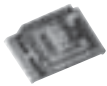
CAD Data



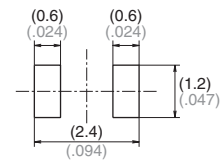
Light Sensor (AMS1, 3, 4)

3. Chip type

CAD Data



Recommended mounting pad
(Top view)



General Tolerance: $\pm 0.1 \pm .004$

SAFETY PRECAUTIONS

Be sure to obey the following in order to prevent injuries and accidents.

- Do not use the sensors under conditions that exceed the range of its specifications. It may cause overheating, smoke, or fire.

- Connect terminals correctly by verifying the pin layout with the specifications diagram or other instructions. Erroneous connections may lead to unexpected operating errors, overheating, smoke, or fire.

- For an important and serious application in terms of safety, add protection circuit or any other protection method.

CAUTIONS FOR USE

1. Applying stress that exceeds the absolute maximum rating

If the voltage or current value for any of the terminals exceeds the absolute maximum rating, internal elements will deteriorate because of the excessive voltage or current. In extreme cases, wiring may melt, or silicon P/N junctions may be destroyed.

Therefore the design should ensure that the absolute maximum ratings will never be exceeded, even momentarily.

2. Deterioration and destruction caused by discharge of static electricity

This phenomenon is generally called static electricity destruction. Static electricity generated by various factors flows through the terminal and occurs to destroy internal elements. To prevent problems from static electricity, the following precautions and measures should be taken when using your device.

- 1) Person handling sensor should wear anti-static clothing and should be grounded through protective resistance of 500 kΩ to 1 MΩ.
- 2) A conductive metal sheet should be placed over the work table. Measuring instruments and jigs should be grounded.
- 3) When using soldering irons, either use irons with low leakage current, or ground the tip of the soldering iron. (Use of low-voltage soldering irons is also recommended.)

4) Devices and equipment used in assembly should also be grounded.

5) When packing printed circuit boards and equipment, avoid using high-polymer materials such as foam styrene, plastic, and other materials which carry an electrostatic charge.

6) When storing or transporting sensor, the environment should not be generated static electricity (for instance, the humidity should be between 45 and 60%), and sensor should be protected using conductive packing materials.

3. Just after supplying voltage, please note that current in the sensor will be not constant until internal circuit stability.

4. Storage

The sensors are transparent plastic packages. They are sensitive to moisture and come in moisture-proof packages. Observe the following cautions when storing.

- 1) After the moisture-proof package is unsealed, take the sensors out of storage as soon as possible (within 1 week \leq 30°C 86°F/60% R.H.).
- 2) If the devices are to be left in storage for a considerable period after the moisture-proof package has been unsealed, it is recommended to keep them in another moisture-proof bag containing silica gel (within 3 months at the most).

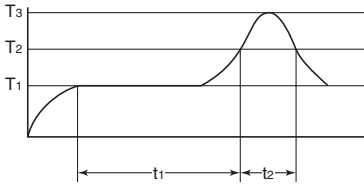
3) Storage under extreme conditions will cause soldering degradation, external appearance defects, and deterioration of the characteristics. The following storage conditions are recommended:

- Temperature: 0 to 30°C 32 to 86°F
 - Humidity: Less than 60% R.H. (Avoid freezing and condensing)
 - Atmosphere: No harmful gasses such as sulfurous acid gas, minimal dust.
- *When mounting with solder, if thermal stress is applied to sensors that have absorbed moisture, the moisture will vaporize, swelling will occur, and the inside of the package will become stressed. This may cause the package surface to blister or crack. Therefore, please take caution and observe the soldering conditions in the following section.

5. Recommended soldering conditions

<SMD/Chip type>

- 1) Recommended condition
- (1) IR (Infrared reflow) soldering method



$T_1 = 150 \text{ to } 180^\circ\text{C } 302 \text{ to } 356^\circ\text{F}$

$T_2 = 230^\circ\text{C } 446^\circ\text{F}$

$T_3 = 250^\circ\text{C } 482^\circ\text{F}$ or less

$t_1 = 60 \text{ to } 120 \text{ s}$ or less

$t_2 = 30 \text{ s}$ or less

- (2) Soldering iron method

Tip temperature: $350 \text{ to } 400^\circ\text{C } 662 \text{ to } 752^\circ\text{F}$

Wattage: 30 to 60 W

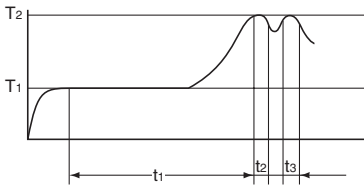
Soldering time: within 3 s

*We don't recommend soldering iron method for chip type.

- 2) Do not do flow soldering.

<Through-hole type>

- 1) Recommended condition
- (1) Double wave soldering method



$T_1 = 120^\circ\text{C } 248^\circ\text{F}$

$T_2 = 260^\circ\text{C } 500^\circ\text{F}$ or less

$t_1 = 120 \text{ s}$ or less

$t_2 + t_3 = 6 \text{ s}$ or less

- (2) Soldering iron method

Tip temperature: $350 \text{ to } 400^\circ\text{C } 662 \text{ to } 752^\circ\text{F}$

Wattage: 30 to 60 W

Soldering time: within 3 s

2) The soldered position on leads should not be closer than 3mm .118inch to the molding resin of this sensor.

6. Notes for mounting

1) Temperature rise in the lead portion is highly dependent on package size. If multiple different packages are mounted on the same board, please check your board beforehand in an actual product, ensuring that the temperature of the solder area of the sensor terminals falls within the temperature conditions of item 5.

2) If the mounting conditions exceed the recommended solder conditions in item 5, resin strength will fall and the mismatching of the heat expansion coefficient of each constituent material will increase markedly, possibly causing cracks in the package, disconnections of bonding wires, and the like. For this reason, please inquire with us about whether this use is possible.

7. Cleaning solvents compatibility

We recommend dip cleaning with an organic solvent for removal of solder flux etc. If you cannot avoid using ultrasonic cleansing, please ensure that the following conditions are met, and check beforehand for defects.

- Frequency: 27 to 29 kHz
- Ultrasonic power: No greater than $0.25\text{W}/\text{cm}^2$
- Cleaning time: No longer than 30 s
- Cleanser used: Asahiklin AK-225
- Other: Submerge in solvent in order to prevent the PCB and sensors from being contacted directly by the ultrasonic vibrations.

Note: Applies to unit area ultrasonic power for ultrasonic baths.

8. Transportation

Extreme vibration during transport will warp the lead or damage the sensor. Handle the outer and inner boxes with care.

9. Avoid using the sensor in environments containing excessive amounts of steam, dust, corrosive gas, or where organic solvents are present.

10. Lead forming and cutting of through-hole type

- 1) Lead forming must be done at normal temperature before soldering
- 2) The bent and cut position on leads should not be closer than 3mm .118inch to the base of leads.
- 3) Lead forming and cutting must be done while fixing the base of leads.
- 4) Avoid mounting with stress at the base of leads.

11. The following shows the packaging format

- 1) SMD type tape and reel (mm inch)

Type	Tape dimensions	Dimensions of tape reel
Light sensor NaPiCa SMD type AMS104Y		

Light Sensor (AMS1, 3, 4)

2) Through-hole type tape and reel (mm inch)

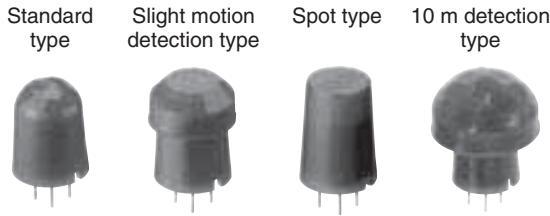
Type	Tape dimensions	Symbol	Symbol	Dimensions	Remarks
Acceleration sensors Light sensors NaPiCa Through-hole type AMS302T	<p>Note: Zigzag tape style is used.</p>	Feed hole pitch	P ₀	12.7±0.3 .500±.012	
		Product interval pitch	P	12.7±1.0 .500±.039	
		Product distance	P ₂	6.35±1.3 .250±.051	
		Product bottom distance	H	20.5±1.0 .807±.039	
		Lead interval	F	2.54±0.5 .100±.020	
		Product slant	Δh	0±1.0 0±.039	
		Product tilt	Δp	0±1.0 0±.039	
		Tape width	W	18.0 ^{+1.0} _{-0.5} .709 ^{+0.039} _{-.020}	
		Holding tape width	W ₀	13.0±0.3 .512±.012	
		Feed hole position	W ₁	9.0 ^{+0.75} _{-0.5} .354 ^{+0.030} _{-.020}	
		Holding tape distance	W ₂	0 to 0.5 0 to .020	
		Feed hole diameter	D ₀	3.8±0.2 .150±.008	
		Tape thickness	t	0.5±0.2 .020±.008	Included holding tape thickness
		Defective product cutoff position	L	Max.: 11.0 .433	

3) Chip type tape and reel (mm inch)

Type	Tape dimensions	Dimensions of tape reel
Pressure sensors Light sensor NaPiCa Chip type AMS402Y		

Light Sensor NaPiCa terminology

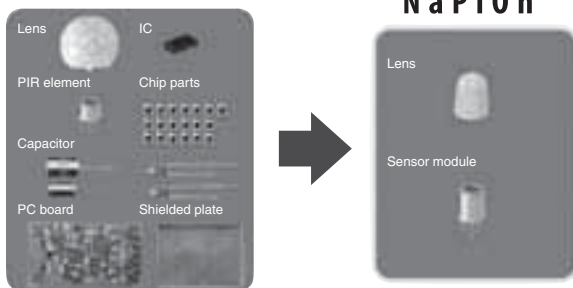
Term	Symbol	Explanation
Reverse voltage	V _R	The applied voltage between the cathode and anode.
Photocurrent	I _L	The current that flows between the cathode and anode when light is applied.
Power dissipation	P	The electric power loss that occurs between the cathode and anode.
Operating temperature	T _{opr}	The workable ambient temperature range at which normal operation is possible under the condition of a prescribed allowable loss.
Storage temperature	T _{stg}	The ambient temperature range at which the sensor can be left or stored without applying voltage.
Peak sensitivity wavelength	λ _p	The wavelength of light at which sensitivity is at its maximum.
Dark current	I ₀	The current between the cathode and anode when reverse voltage is applied during darkness.
Rise time	t _r	Time required for the output waveform to rise from 10% to 90% when light is applied.
Fall time	t _f	Time required for the output waveform to fall from 90% to 10% when light is cut.



Compliance with RoHS Directive

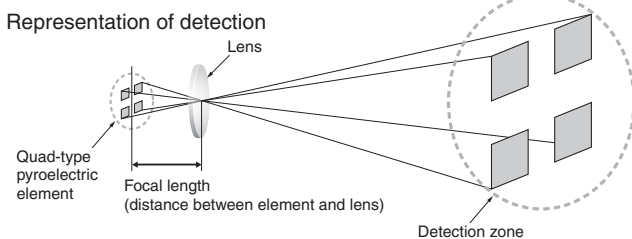
FEATURES

1. **NaPiOn** pyroelectric sensor modules contain the necessary functions in a small package (TO-5). These miniature, high-performance infrared human detection sensors take the trouble out of circuit design and mounting.



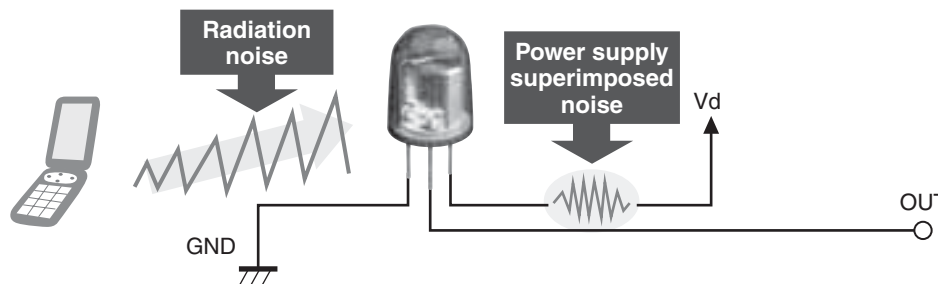
2. Ideal for small-movement detection thanks to quad-type pyroelectric element.

The quad-type pyroelectric element contained in **NaPiOn** has four receptors. Since the detection zone within the detection range is so precise, even small movements can be detected.



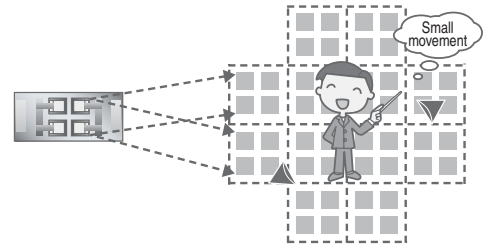
5. Excellent noise resistance (radiation noise, power supply noise)

The entire **NaPiOn** circuitry is enclosed in a metal package, which means it has extremely high electromagnetic shielding capabilities. With proven resistance against power supply noise, it is also resistant against power supply superimposed noise.



3. Lenses can be miniaturized because the pyroelectric element is small

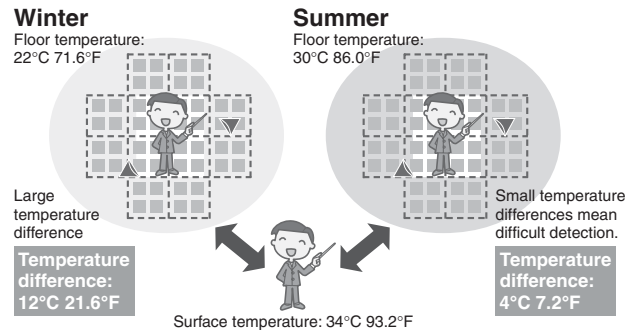
A short focal length is all that's required even when detecting at the same distance, because the size of the **NaPiOn** pyroelectric element is so small. This means that high precision is maintained even though the lens is small and the sensor itself has been miniaturized.



4. Small temperature differences also detected.

NaPiOn detects the temperature difference between the detection target and its surroundings, and the lowest required temperature difference to the background is 4°C 7.2°F.

This means that temperature differences can be accurately detected not only in winter, when the temperature differences are large, but also in summer, when temperature differences are slight.



MP Motion Sensor (AMN2, 3, 4)

TYPICAL APPLICATIONS

1. Home appliance market: Air conditioner, air purifier and fan heater
2. Construction equipment: lighting, automatic switches
3. Commercial equipment: vending machines, facilities for designated smoking areas

4. Anti-crime device market: crime prevention sensor, simple anti-crime devices, surveillance cameras

ORDERING INFORMATION

Output type		AMN			1		
2: Analog output	4: Low current consumption (digital output)						
3: Digital output							
Detection performance							
1: Standard detection type	3: Spot detection type						
2: Slight motion detection type	4: 10m detection type						
Feature							
1: PC board mounting type							
Operating voltage							
1: 5V DC	2: 3V DC						
Lens color							
1: Black	2: White						

PRODUCT TYPES

Detection performance	Output type		Digital output	Low current consumption type Digital output	Analog output
	Lens color				
Standard detection type	Black		AMN31111	AMN41121	AMN21111
	White		AMN31112	AMN41122	AMN21112
Slight motion detection type	Black		AMN32111	AMN42121	AMN22111
	White		AMN32112	AMN42122	AMN22112
Spot detection type	Black		AMN33111	AMN43121	AMN23111
	White		AMN33112	AMN43122	AMN23112
10m detection type	Black		AMN34111	AMN44121	AMN24111
	White		AMN34112	AMN44122	AMN24112

Standard packing: Carton: 50 pcs.; Case: 1,000 pcs.

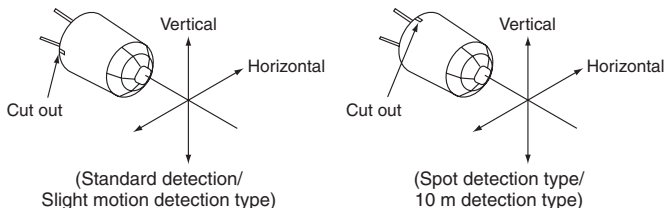
RATING

1. Detection performance

Items		Standard detection type	Slight motion detection type	Spot detection type	10m detection type	Conditions of objects to be detected
Rated detection distance Note 1)		Max. 5m 16.404ft	Max. 2m 6.562ft	Max. 5m 16.404ft	Max. 10m 32.808ft	1. Detectable difference in temperature between the target and background is more than 4°C 7.2°F. 2. Movement speed 1) Digital output type • Standard detection type/Spot detection type/ 10m detection type: 0.8 to 1.2 m/s • Slight motion detection type: 0.5 m/s 2) Analog output and low current consumption types • Standard detection type/Spot detection type/ 10m detection type: 0.5 to 1.5 m/s • Slight motion detection type: 0.3 to 1.0 m/s 3. Detection object = human body (size is 700mm × 250mm 27.559inch × 9.843inch, but for the slight motion detection type the size is 200mm × 200mm 7.874inch × 7.874inch)
Detection range	Horizontal Note 2)	100°	91°	38°	110°	
	Vertical Note 2)	82°	91°	22°	93°	
Detection zone Note 3)		64 zones	104 zones	24 zones	80 zones	

Notes: 1. Depending on the difference in temperature between the background and detection target and the speed at which the target moves, these sensors may be capable of detection beyond the detection distances stated above. Nevertheless, they should be used within the prescribed detection distances. For further details, refer to the detection range diagram on page 24.

2.



3. Regarding of detection zone, please refer to "DETECTION PERFORMANCE" on page 24.

2. Absolute maximum ratings (Measuring condition: ambient temperature = 25°C 77°F) (Common to All types)

Items	Absolute maximum ratings
Power supply voltage	-0.3 to 7 V DC
Usable ambient temperature	-20 to 60°C -4 to +140°F (No freezing and condensing at low temperature.)
Storage temperature	-20 to 70°C -4 to +158°F

3. Electrical characteristics (Common to All types)

1) Digital output

Items	Symbol	Electrical characteristics *() is low current consumption type	Measured conditions *() is low current consumption type
Rated operating voltage	Minimum	3.0 V DC (2.2 V DC)	
	Maximum	6.0 V DC (3.0 V DC)	
Rated consumption current (Standby) Note	Typical	170 μA (46 μA)	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Iout = 0
	Maximum	300 μA (60 μA)	
Output current (when detecting)	Maximum	Iout	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Vout ≥ Vdd-0.5
Output voltage (when detecting)	Minimum	Vout	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Open when not detecting
Circuit stability time	Typical	7 s	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V)
	Maximum	30 s	

Note: The current which is consumed during detection consists of the standby consumed current plus the output current.

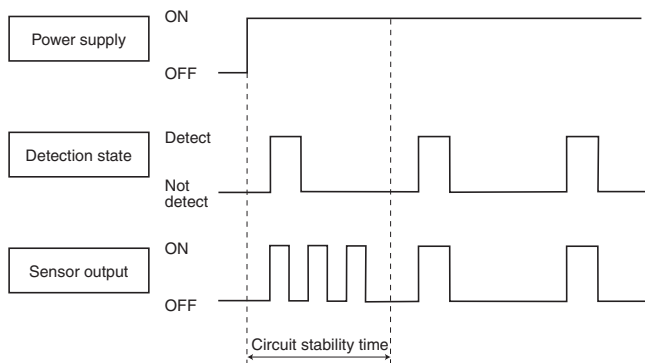
2) Analog output

Items	Symbol	Specified value	Measured conditions
Operating voltage	Minimum	4.5 V DC	
	Maximum	5.5 V DC	
Consumption current	Typical	170 μA	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Iout = 0
	Maximum	300 μA	
Output current	Maximum	Iout	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V)
Output voltage range	Minimum	0 V	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V)
	Maximum	Vdd	
Output offset average voltage	Minimum	2.3 V	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Steady-state output voltage when not detecting
	Typical	2.5 V	
	Maximum	2.7 V	
Steady-state noise	Typical	155 m Vp-p	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V)
	Maximum	300 m Vp-p	
Detection sensitivity	Minimum	Vh or Vl	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V) Temperature difference with background: 4°C 39.2°F Please refer to conditions of other detection objects.
Circuit stability time	Maximum	Twu	Ambient temperature = 25°C 77°F Operating voltage = 5V (3V)

Note: To set to the same detection performance as the digital output type, set the output voltage to the offset voltage (2.5V) ±0.45V (i.e. 2.95V or more and 2.05V or less).

TIMING CHART

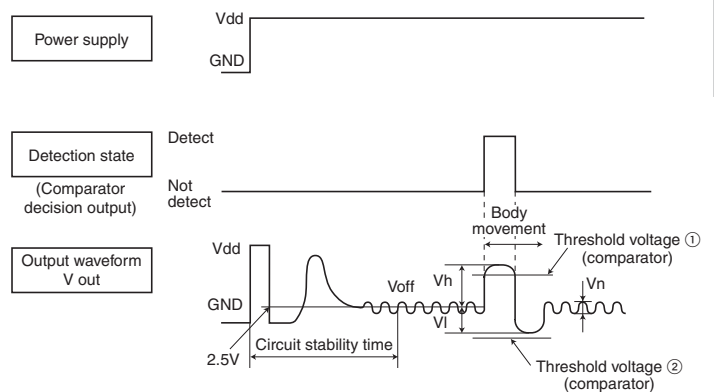
1. Digital output



Note: Circuit stability time: 30s max.

While the circuitry is stabilizing after the power is turned on, the sensor output is not fixed in the "on" state or "off" state. This is true regardless of whether or not the sensor has detected anything.

2. Analog output

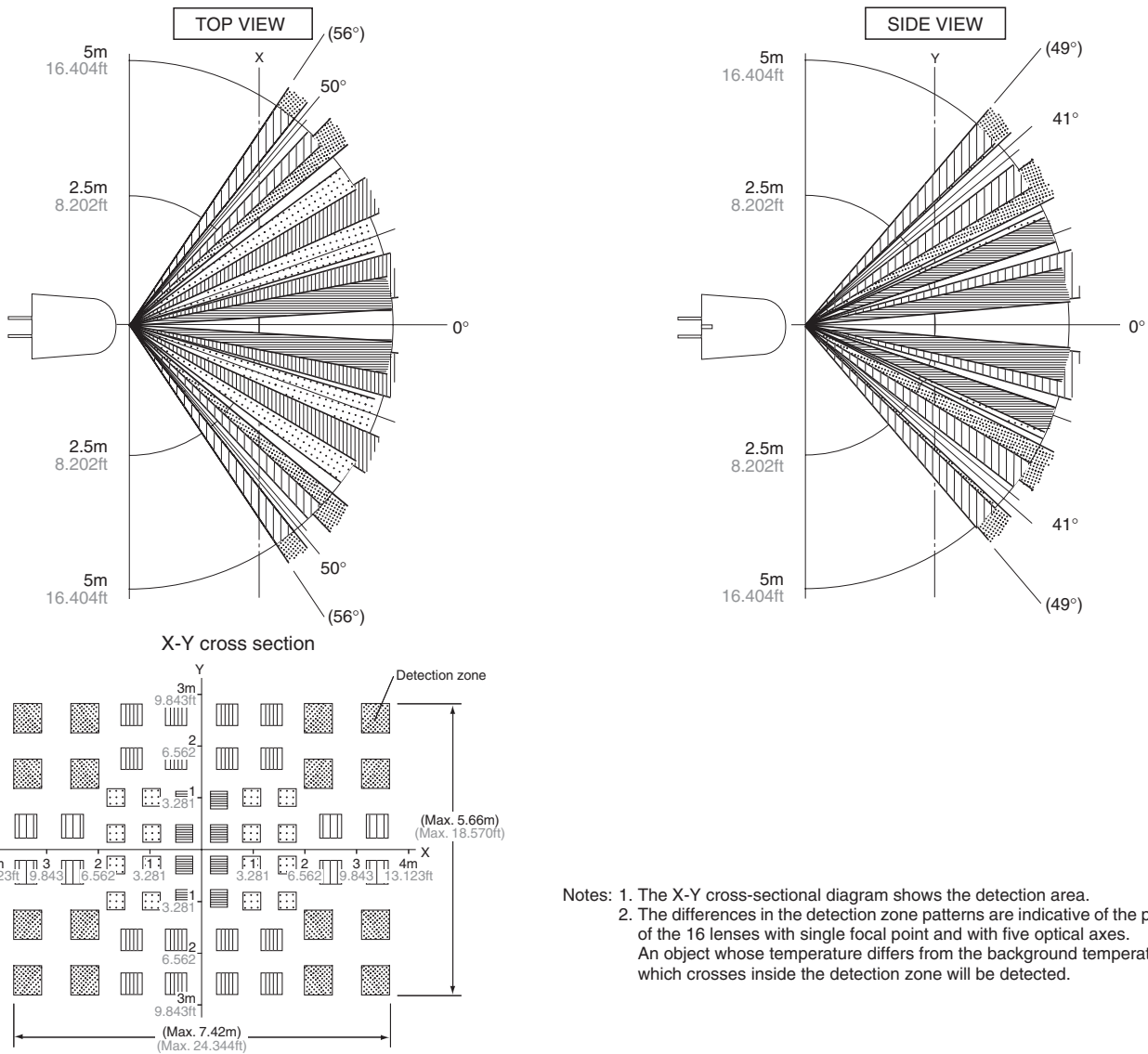


Note: Circuit stability time: 45s max.

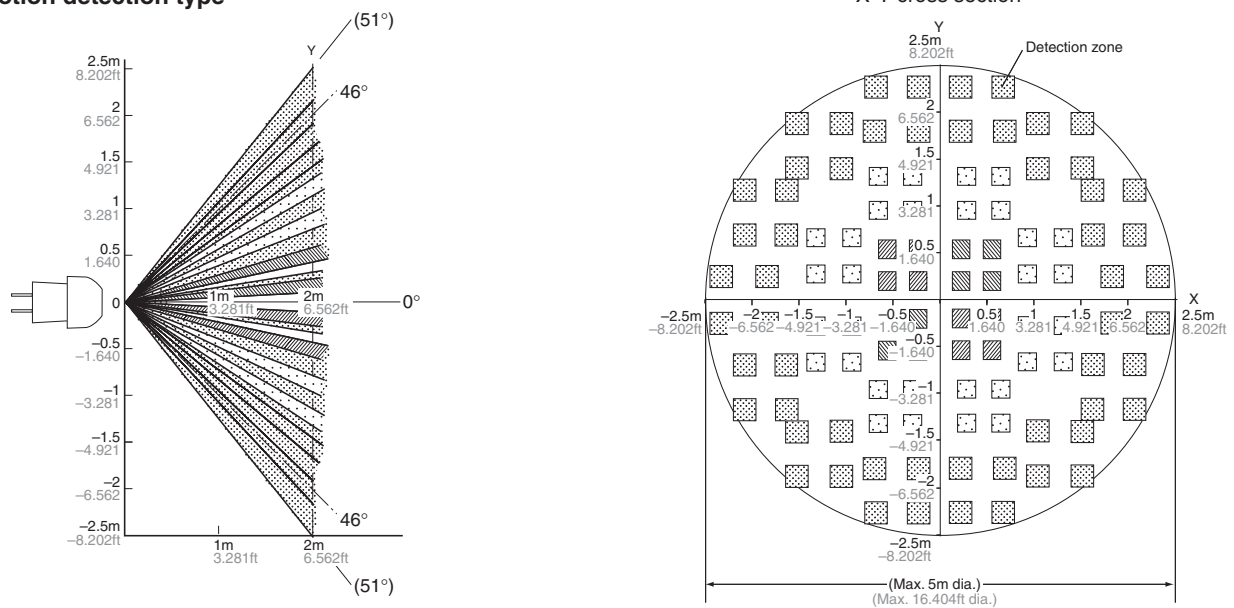
While the circuitry is stabilizing after the power is turned on, the sensor output is not fixed in the "on" state or "off" state. This is true regardless of whether or not the sensor has detected anything.

DETECTION PERFORMANCE

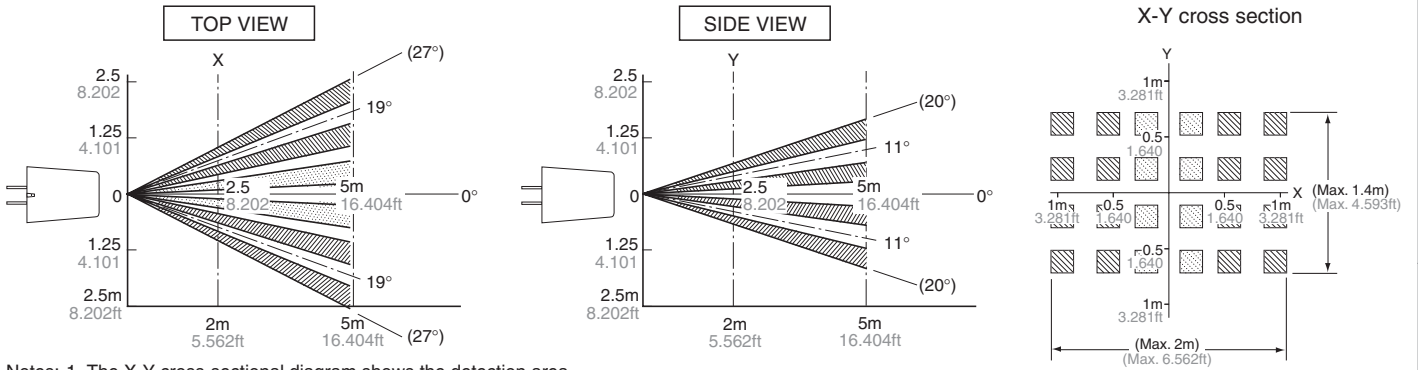
1. Standard detection type



2. Slight motion detection type

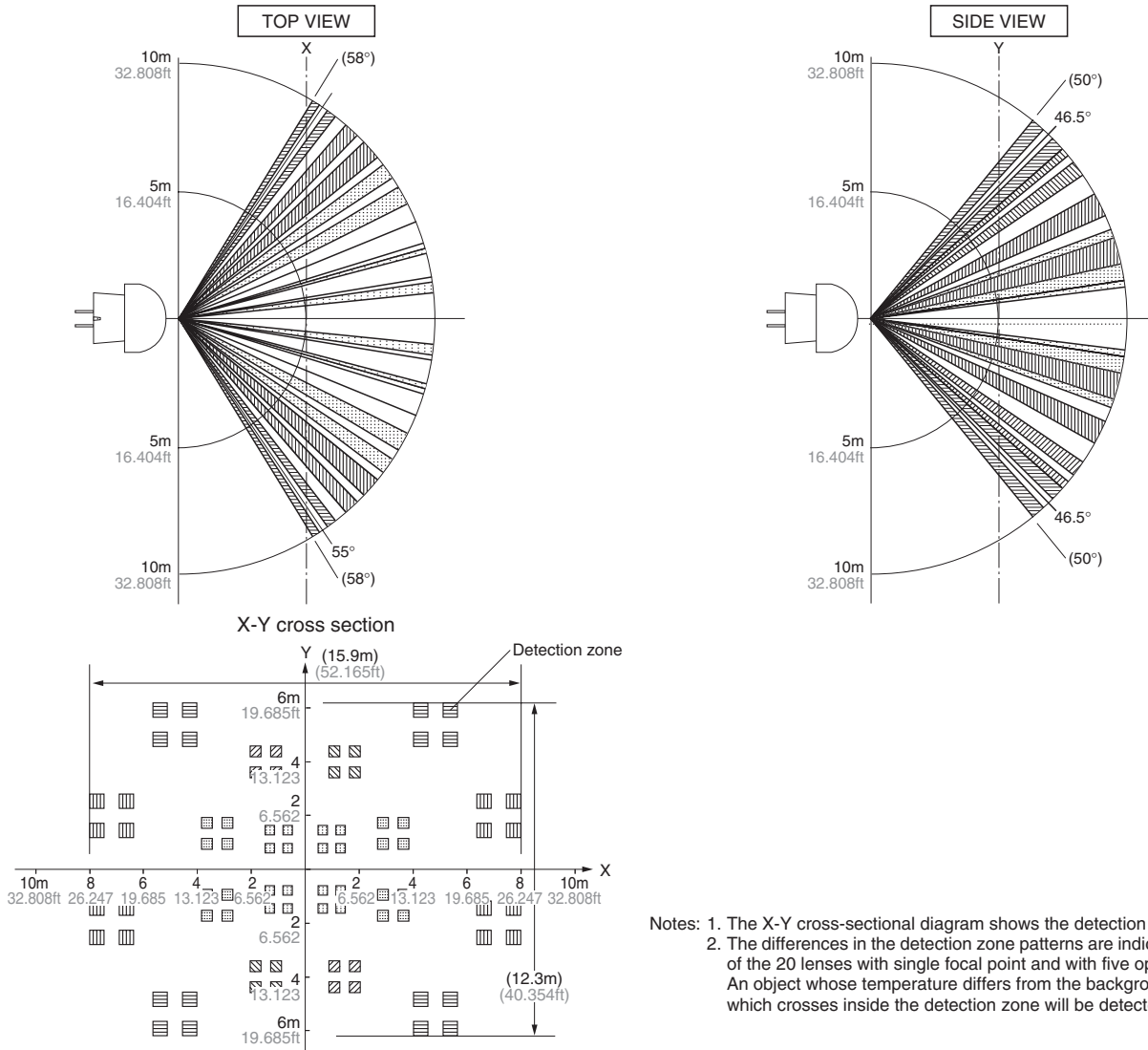


3. Spot detection type



Notes: 1. The X-Y cross-sectional diagram shows the detection area.
 2. The differences in the detection zone patterns are indicative of the projections of the 6 lenses with single focal point and with two optical axes.
 An object whose temperature differs from the background temperature and which crosses inside the detection zone will be detected.

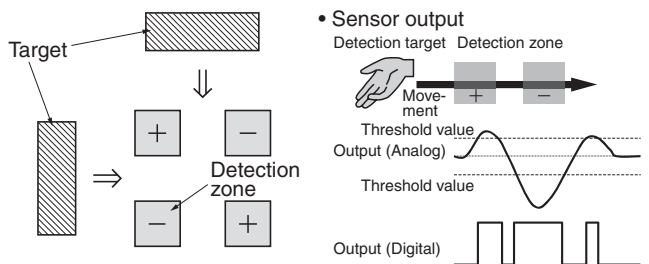
4. 10m detection type



Notes: 1. The X-Y cross-sectional diagram shows the detection area.
 2. The differences in the detection zone patterns are indicative of the projections of the 20 lenses with single focal point and with five optical axes.
 An object whose temperature differs from the background temperature and which crosses inside the detection zone will be detected.

5. Notes regarding the detection zone

The detection zone has the polarity shown in the diagram on the right.
 When targets enter both the + and - zones with the same timing, the signals are cancelled each other, thus in this case there is a possibility that the object cannot be detected at the maximum specified detection distance.



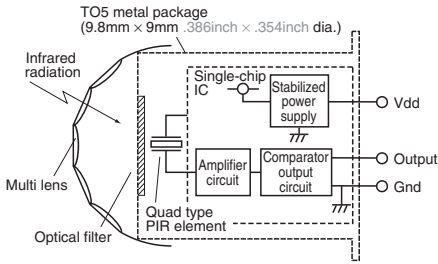
• Sensor output
 Detection target Detection zone
 Movement
 Threshold value
 Output (Analog)
 Threshold value
 Output (Digital)
 *Threshold value: Level at which digital output turns on.

MP Motion Sensor (AMN2, 3, 4)

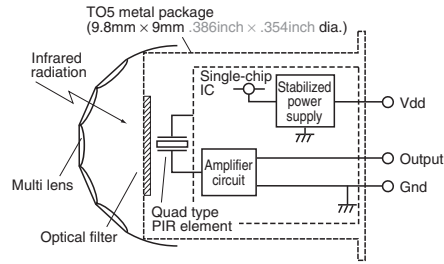
HOW TO USE

1. Block diagram output circuit

1) Block diagram of the digital output circuit

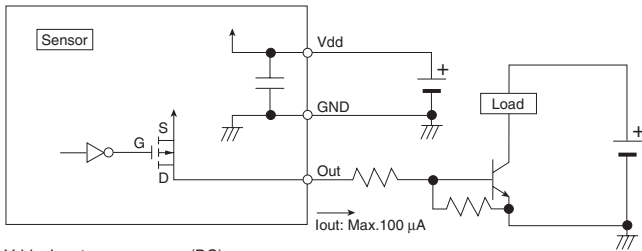


2) Block diagram of the analog output circuit



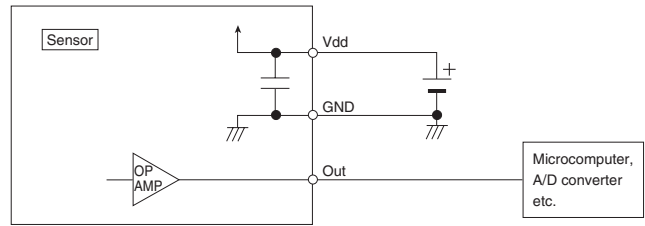
2. Wiring diagram

1) Digital output



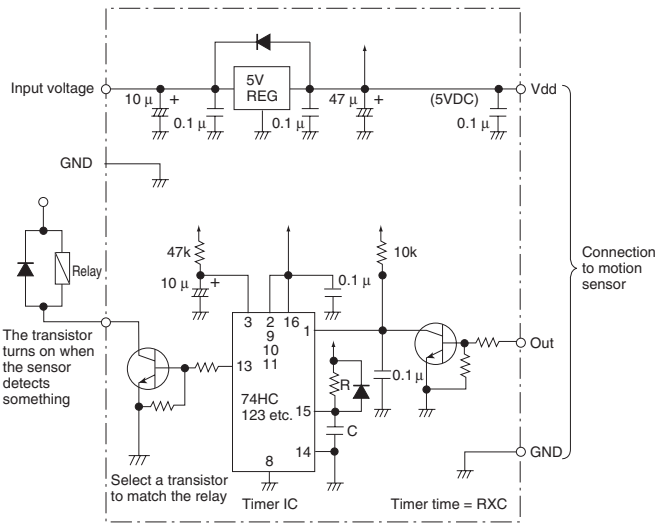
Vdd: Input power source (DC)
GND: GND
Out: Output (Comparator)

2) Analog output

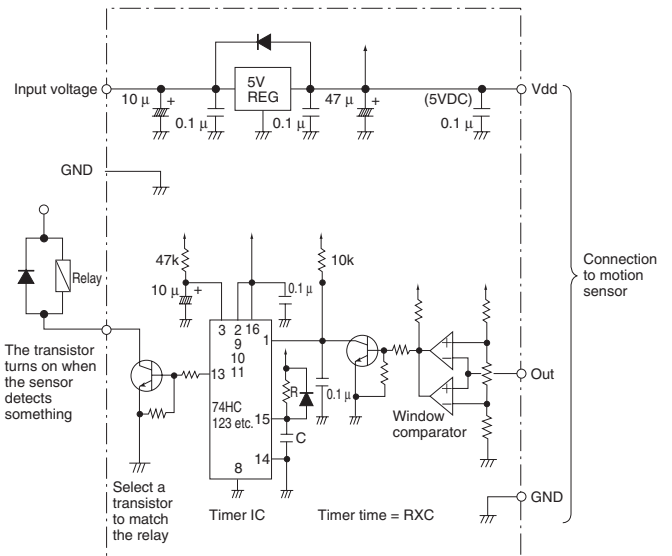


3. Timer circuit example

1) Digital output



2) Analog output



Note: This is the reference circuit which drives the MP motion sensor. Install a noise filter for applications requiring enhanced detection reliability and noise withstanding capability.

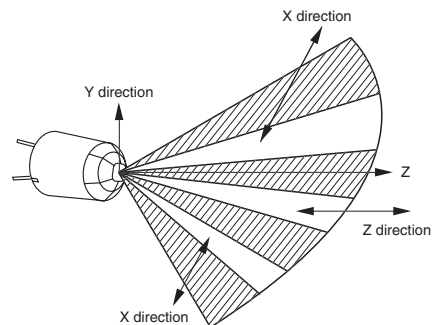
Differences in the specifications of electronic components to which the units are connected sometimes affect their correct operation; please check the units' performance and reliability for each application.

Panasonic Electric Works, Ltd. accepts no responsibility for damages resulting from the use of this circuit.

4. Installation

Install the sensor so that people will be entering from the X direction shown below.

(If persons approach the sensor from the Z direction, detection distance will be shortened.)



DIMENSIONS (mm inch)

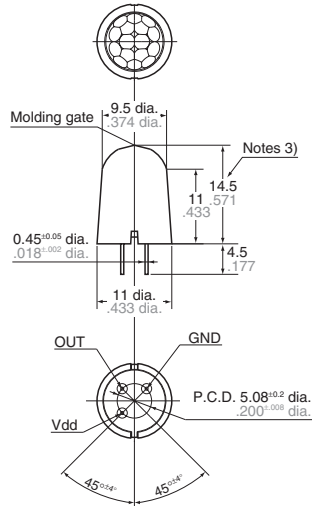
The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

1. Standard detection type

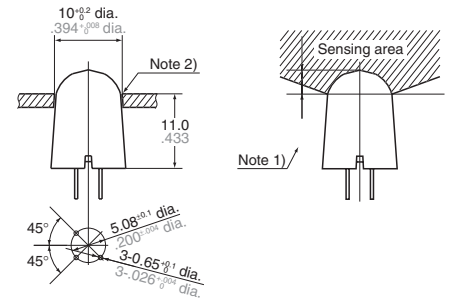
CAD Data



General tolerance $\pm 0.5 \pm .020$



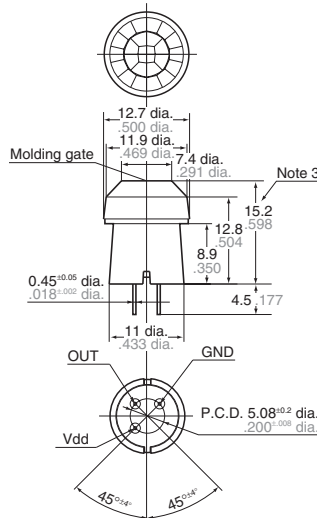
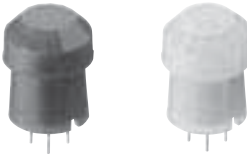
Recommended panel mounting hole



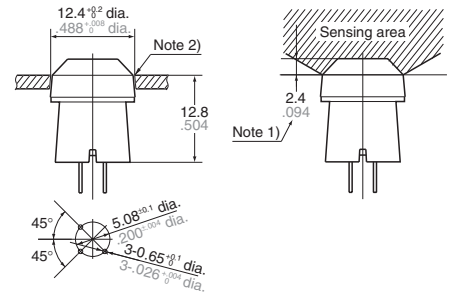
- Notes: 1. In order to ensure proper detection, install it with the lens exposed at least 3.5mm .138inch.
2. As for panel mounting hole, tapering or making a large size hole should be done.
3. The height dimension does not include the remaining molding gate.

2. Slight motion detection type

CAD Data



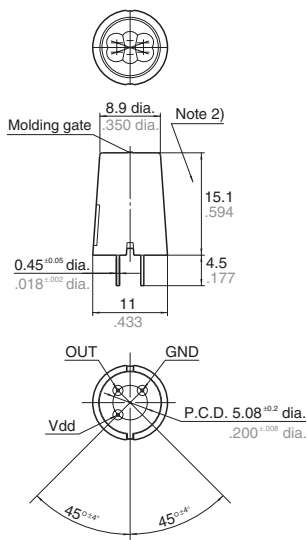
Recommended panel mounting hole



- Notes: 1. In order to ensure proper detection, install it with the lens exposed at least 2.4mm .094inch.
2. As for panel mounting hole, tapering or making a large size hole should be done.
3. The height dimension does not include the remaining molding gate.

3. Spot detection type

CAD Data



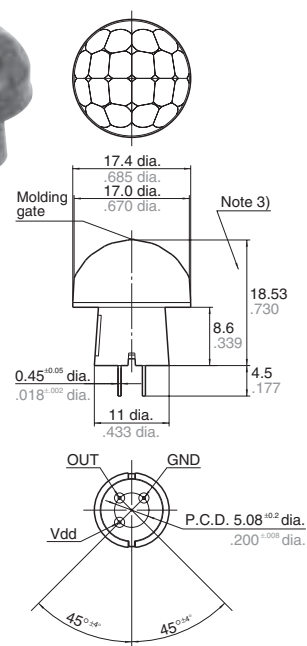
Recommended panel mounting hole



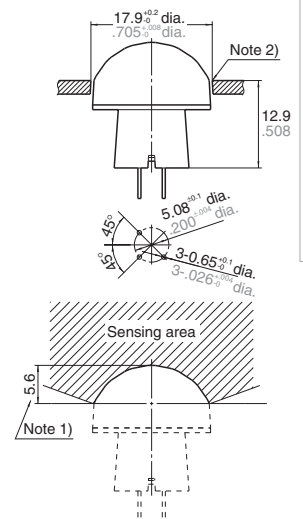
- Notes: 1. As for panel mounting hole, tapering or making a large size hole should be done.
2. The height dimension does not include the remaining molding gate.

4. 10m detection type

CAD Data



Recommended panel mounting hole



- Notes: 1. In order to ensure proper detection, install it with the lens exposed at least 5.6mm .220inch.
2. As for panel mounting hole, tapering or making a large size hole should be done.
3. The height dimension does not include the remaining molding gate.

NOTES

1. Checkpoints relating to principle of operation

MP motion sensors are passive infrared sensors which detect changes in the infrared rays. They may fail to detect successfully if a heat source other than a human being is detected or if there are no temperature changes in or movement of a heat source. Care must generally be taken in the following cases. The performance and reliability of the sensors must be checked out under conditions of actual use.

1) Cases where a heat source other than a human being is detected.

- (1) When a small animal enters the detection range.
- (2) When the sensor is directly exposed to sunlight, a vehicle's headlights, an incandescent light or some other source of far infrared rays.
- (3) When the temperature inside the detection range has changed suddenly due to the entry of cold or warm air from an air-conditioning or heating unit, water vapor from a humidifier, etc.

2) Cases where it is difficult to detect the heat source

- (1) When an object made of glass, acrylic or other subject which far infrared rays have difficulty passing through is located between the sensor and what is to be detected.
- (2) When the heat source inside the detection range hardly moves or when it moves at high speed; for details on the movement speed, refer to the section on the performance ratings.

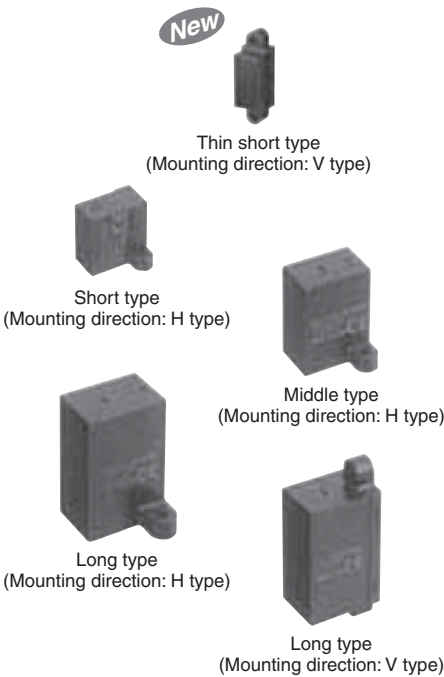
2. When the detection area becomes larger

When the difference between the ambient temperature and body temperature is large (more than 20°C 68°F), detection may occur in isolated areas outside the specified detection range.

3. Other handling cautions

- 1) Be careful not to allow dust or dirt to accumulate on the lens as this will adversely affect the detection sensitivity.
- 2) The lens is made of a soft material (polyethylene).
Avoid applying a load or impact since this will deform or scratch the lens, making proper operation impossible and causing a deterioration in its performance.
- 3) The sensor may be damaged if it is exposed to static with a voltage exceeding $\pm 200\text{V}$. Therefore, do not touch its terminals directly, and exercise adequate care in the handling of the sensor.
- 4) When the leads are to be soldered, solder them by hand for less than 3 seconds at a temperature of less than 350°C 662°F at the tip of the soldering iron. Avoid using a solder bath since this will cause a deterioration in the sensor's performance.
- 5) Do not attempt to clean the sensor. Cleaning fluid may enter inside the lens area causing a deterioration in performance.
- 6) When using the sensors with cables, it is recommended that cables which are shielded and as short as possible be used in order to safeguard against the effects of noise.

For Cautions for Use, see Page 39.



Compliance with RoHS Directive

FEATURES

- 1. Now even more miniature.**
The new thin type cuts 35% from the thickness of the previous short type. Device installing is now easier than ever.
- 2. Certain detection unaffected by the reflectance of the object**
The sensor can provide stable detection that is not affected by the condition (color or material of the clothing) or parts (skin, hair, etc.) of the object being monitored. (Reflectance 18% to 90%). Excellent performance even when the detection surface is dirty.
- 3. Only connecting DC power supply for operating**
Built-in oscillation circuit type obviates the hitherto existing need for start signal input.
- 4. Use in adjacent positions is possible**
These sensors can be located in adjacent positions, because the timing of the external trigger signals can be adjusted so that the beam frequency of each adjacent sensor will not interfere with the other.

APPLICATIONS

- 1. Water-based product market**
 - Automatic lighting of wash basin units
 - Toilets
 - Automatic water flow from faucets
- 2. Stores and financial instructions**
 - Automatic doors
 - Automatic lighting
 - Cash dispensing machines
 - Automatic teller machines
 - Visitor detecting sensors
- 3. Amusement market**
 - Automatic lighting for game display
- 4. Medical field**
 - Non-contact switch

ORDERING INFORMATION

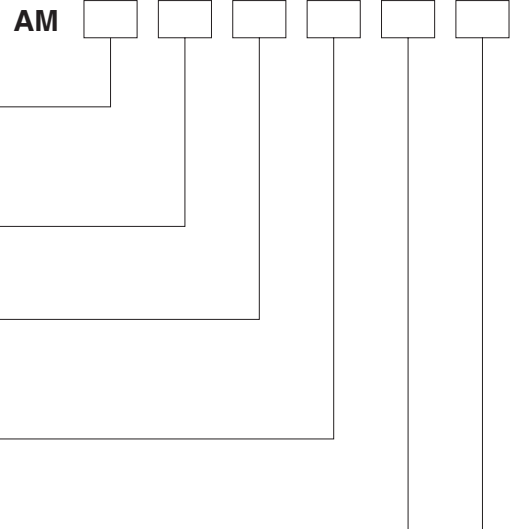
A: Thin short type MA Motion sensor
B: MA Motion sensor

Detection distance type (shape)
1: Short type
2: Middle type
3: Long type

Triggering function
1: External triggering type
4: Built-in oscillation circuit type (Internal trigger)

Classification by output method & mounting direction
0: NPN open collector/H type
5: NPN open collector/V type
6: PNP open collector/V type

Operating voltage
2: Free-ranging power type (6.5 to 27V DC)
9: 5V DC type (4.5 to 6.5V DC)



Part No.	cm inch																			
	02	03	04	05	06	07	08 (Middle type does not need 08)	09	10 (Short type does not need 10)	11	12	13	14	15	16	17	18	19	20 (Long type does not need 20)	
Thin short type	—	—	—	5 1.969	—	—	—	—	10 3.937	—	—	—	—	15 5.906	—	—	—	—	—	
Short type	—	—	—	5 1.969	6 2.362	7 2.756	8 3.150	9 3.543	10 3.937	—	—	—	—	—	—	—	—	—	—	
Middle type	20 7.874	30 11.811	40 15.748	50 19.685	60 23.622	70 27.559	80 31.496	—	—	—	—	—	—	—	—	—	—	—	—	
Long type	—	30 11.811	40 15.748	50 19.685	60 23.622	70 27.559	80 31.496	90 35.433	100 39.37	110 43.307	120 47.244	130 51.181	140 55.118	150 59.055	160 62.992	170 66.929	180 70.866	190 74.803	200 78.74	

MA Motion Sensor (AMA1, AMB1, 2, 3)

PRODUCT TYPES

1. Detection distance type (distance limited)

1) Thin short type (V type)

Operating voltage	Output method	Rated detection distance	Built-in oscillation circuit type		External triggering type	
			Part No.		Part No.	
4.5 to 6.5 V DC	NPN open collector output	5 cm 1.969 inch	AMA145905		AMA115905	
		10 cm 3.937 inch	AMA1459		AMA1159	
		15 cm 5.906 inch	AMA145915		AMA115915	
	PNP open collector output	5 cm 1.969 inch	AMA146905		AMA116905	
		10 cm 3.937 inch	AMA1469		AMA1169	
		15 cm 5.906 inch	AMA146915		AMA116915	

Standard packing: Carton: 20 pcs.; Case: 200 pcs.

Note: If you plan to use multiple sensors side-by-side, or you wish to keep the current consumption small, inquire for details about external trigger type, which is suitable for such applications.

2) Short type (H type)

Rated operating voltage	Rated detection distance	Mounting direction: H type			
		Short type			
		Built-in oscillation circuit type		External triggering type	
		Part No.		Part No.	
4.5 to 6.5 V DC	5 cm 1.969 inch	AMB140905		AMB110905	
	6 cm 2.362 inch	AMB140906		AMB110906	
	7 cm 2.756 inch	AMB140907		AMB110907	
	8 cm 3.150 inch	AMB140908		AMB110908	
	9 cm 3.543 inch	AMB140909		AMB110909	
	10 cm 3.937 inch	AMB1409		AMB1109	
6.5 to 27 V DC	5 cm 1.969 inch	AMB140205		AMB110205	
	6 cm 2.362 inch	AMB140206		AMB110206	
	7 cm 2.756 inch	AMB140207		AMB110207	
	8 cm 3.150 inch	AMB140208		AMB110208	
	9 cm 3.543 inch	AMB140209		AMB110209	
	10 cm 3.937 inch	AMB1402		AMB1102	

Standard packing: Carton: 20 pcs.; Case: 200 pcs.

Note: If you plan to use multiple sensors side-by-side, or you wish to keep the current consumption small, inquire for details about external trigger type, which is suitable for such applications.

3) Middle type (H type)

Rated operating voltage	Rated detection distance	Mounting direction: H type			
		Middle type			
		Built-in oscillation circuit type		External triggering type	
		Part No.		Part No.	
4.5 to 6.5 V DC	20 cm 7.874 inch	AMB240902		AMB210902	
	30 cm 11.811 inch	AMB240903		AMB210903	
	40 cm 15.748 inch	AMB240904		AMB210904	
	50 cm 19.685 inch	AMB240905		AMB210905	
	60 cm 23.622 inch	AMB240906		AMB210906	
	70 cm 27.559 inch	AMB240907		AMB210907	
	80 cm 31.496 inch	AMB2409		AMB2109	
	6.5 to 27 V DC	20 cm 7.874 inch	AMB240202		AMB210202
30 cm 11.811 inch		AMB240203		AMB210203	
40 cm 15.748 inch		AMB240204		AMB210204	
50 cm 19.685 inch		AMB240205		AMB210205	
60 cm 23.622 inch		AMB240206		AMB210206	
70 cm 27.559 inch		AMB240207		AMB210207	
80 cm 31.496 inch		AMB2402		AMB2102	

Standard packing: Carton: 20 pcs.; Case: 200 pcs.

Note: If you plan to use multiple sensors side-by-side, or you wish to keep the current consumption small, inquire for details about external trigger type, which is suitable for such applications.

MA Motion Sensor (AMA1, AMB1, 2, 3)

4) Long type

Rated operating voltage	Rated detection distance	Mounting direction: H type		Mounting direction: V type	
		Long type			
		Built-in oscillation circuit type	External triggering type	Built-in oscillation circuit type	External triggering type
		Part No.	Part No.	Part No.	Part No.
4.5 to 6.5 V DC	30 cm 11.811 inch	AMB340903	AMB310903	AMB345903	AMB315903
	40 cm 15.748 inch	AMB340904	AMB310904	AMB345904	AMB315904
	50 cm 19.685 inch	AMB340905	AMB310905	AMB345905	AMB315905
	60 cm 23.622 inch	AMB340906	AMB310906	AMB345906	AMB315906
	70 cm 27.559 inch	AMB340907	AMB310907	AMB345907	AMB315907
	80 cm 31.496 inch	AMB340908	AMB310908	AMB345908	AMB315908
	90 cm 35.433 inch	AMB340909	AMB310909	AMB345909	AMB315909
	100 cm 39.370 inch	AMB340910	AMB310910	AMB345910	AMB315910
	110 cm 43.307 inch	AMB340911	AMB310911	AMB345911	AMB315911
	120 cm 47.244 inch	AMB340912	AMB310912	AMB345912	AMB315912
	130 cm 51.181 inch	AMB340913	AMB310913	AMB345913	AMB315913
	140 cm 55.118 inch	AMB340914	AMB310914	AMB345914	AMB315914
	150 cm 59.055 inch	AMB340915	AMB310915	AMB345915	AMB315915
	160 cm 62.992 inch	AMB340916	AMB310916	AMB345916	AMB315916
	170 cm 66.929 inch	AMB340917	AMB310917	AMB345917	AMB315917
	180 cm 70.866 inch	AMB340918	AMB310918	AMB345918	AMB315918
190 cm 74.803 inch	AMB340919	AMB310919	AMB345919	AMB315919	
200 cm 78.740 inch	AMB3409	AMB3109	AMB3459	AMB3159	
6.5 to 27 V DC	30 cm 11.811 inch	AMB340203	AMB310203	AMB345203	AMB315203
	40 cm 15.748 inch	AMB340204	AMB310204	AMB345204	AMB315204
	50 cm 19.685 inch	AMB340205	AMB310205	AMB345205	AMB315205
	60 cm 23.622 inch	AMB340206	AMB310206	AMB345206	AMB315206
	70 cm 27.559 inch	AMB340207	AMB310207	AMB345207	AMB315207
	80 cm 31.496 inch	AMB340208	AMB310208	AMB345208	AMB315208
	90 cm 35.433 inch	AMB340209	AMB310209	AMB345209	AMB315209
	100 cm 39.370 inch	AMB340210	AMB310210	AMB345210	AMB315210
	110 cm 43.307 inch	AMB340211	AMB310211	AMB345211	AMB315211
	120 cm 47.244 inch	AMB340212	AMB310212	AMB345212	AMB315212
	130 cm 51.181 inch	AMB340213	AMB310213	AMB345213	AMB315213
	140 cm 55.118 inch	AMB340214	AMB310214	AMB345214	AMB315214
	150 cm 59.055 inch	AMB340215	AMB310215	AMB345215	AMB315215
	160 cm 62.992 inch	AMB340216	AMB310216	AMB345216	AMB315216
	170 cm 66.929 inch	AMB340217	AMB310217	AMB345217	AMB315217
	180 cm 70.866 inch	AMB340218	AMB310218	AMB345218	AMB315218
190 cm 74.803 inch	AMB340219	AMB310219	AMB345219	AMB315219	
200 cm 78.740 inch	AMB3402	AMB3102	AMB3452	AMB3152	

Standard packing: Carton: 20 pcs.; Case: 200 pcs.

Note: If you plan to use multiple sensors side-by-side, or you wish to keep the current consumption small, inquire for details about external trigger type, which is suitable for such applications.

RATING

1. Detection performance

1) Thin short type (Measuring conditions: ambient temp.: 25°C 77°F; operating voltage: 5 V DC)

Items		Thin short type			Measured conditions
		5 cm 1.969 inch	10 cm 3.937 inch	15 cm 3.937 inch	
Rated detection distance	Minimum	45 mm	90 mm	135 mm	with a standard reflection board*1
	Typical	1.772 inch 50 mm	3.543 inch 100 mm	5.315 inch 150 mm	
	Maximum	1.969 inch 55 mm 2.165 inch	3.937 inch 110 mm 4.331 inch	5.906 inch 165 mm 6.496 inch	
Measuring tolerance	Typical	10%	25%	35%	Reflection rate: 90 to 18%
Usable ambient brightness (Resistance to ambient light)*2	Brightness of sensor surface	30,000 lx			See the drawing (Fig. 1) on the next page.
	Brightness of reflection surface	30,000 lx			

Notes: *1. Ambient brightness: 500 lx

*2. Install so that light from direct light sources does not enter the sensor (within 30° of the sensor light beam).

Indicates brightness detectible enough for sensor operation.

MA Motion Sensor (AMA1, AMB1, 2, 3)

2) Short type (Measuring conditions: ambient temp.: 25°C 77°F; operating voltage: 5 V DC type 5V, Free-ranging power type 24V DC)

Items		Short type*1						Measured conditions
		5 cm 1.969 inch	6 cm 2.362 inch	7 cm 2.756 inch	8 cm 3.150 inch	9 cm 3.543 inch	10 cm 3.937 inch	
Rated detection distance	Minimum	45 mm 1.772 inch	54 mm 2.126 inch	63 mm 2.480 inch	72 mm 2.835 inch	81 mm 3.189 inch	90 mm 3.543 inch	with a standard reflection board
	Typical	50 mm 1.969 inch	60 mm 2.362 inch	70 mm 2.756 inch	80 mm 3.150 inch	90 mm 3.543 inch	100 mm 3.937 inch	
	Maximum	55 mm 2.165 inch	66 mm 2.598 inch	77 mm 3.031 inch	88 mm 3.465 inch	99 mm 3.898 inch	110 mm 4.331 inch	
Measuring tolerance	Typical	10%		15%	20%		25%	Reflection rate: 90 to 18%
Usable ambient brightness (Resistance to ambient light)*2	Brightness of sensor surface	30,000 lx						See the drawing (Fig. 1) on the next page.
	Brightness of reflection surface	30,000 lx						

Notes: *1. After receipt of order, average rated detection distance to 15 cm 5.906 inch is possible. Please inquire.

*2. Install so that light from direct light sources does not enter the sensor (within 30° of the sensor light beam).

3) Middle type (Measuring conditions: ambient temp.: 25°C 77°F; operating voltage: 5 V DC type 5V, Free-ranging power type 24V DC)

Items		Middle type*1						Measured conditions	
		20 cm 7.874 inch	30 cm 11.811 inch	40 cm 15.748 inch	50 cm 19.685 inch	60 cm 23.622 inch	70 cm 27.559 inch		80 cm 31.496 inch
Rated detection distance	Minimum	190 mm 7.480 inch	285 mm 11.220 inch	380 mm 14.961 inch	475 mm 18.701 inch	570 mm 22.441 inch	665 mm 26.181 inch	760 mm 29.921 inch	with a standard reflection board
	Typical	200 mm 7.874 inch	300 mm 11.811 inch	400 mm 15.748 inch	500 mm 19.685 inch	600 mm 23.622 inch	700 mm 27.559 inch	800 mm 31.496 inch	
	Maximum	210 mm 8.268 inch	315 mm 12.402 inch	420 mm 16.535 inch	525 mm 20.669 inch	630 mm 24.803 inch	735 mm 28.937 inch	840 mm 33.071 inch	
Measuring tolerance	Typical	3%			5%		10%		Reflection rate: 90 to 18%
Usable ambient brightness (Resistance to ambient light)*2	Brightness of sensor surface	30,000 lx						See the drawing (Fig. 1) on the next page.	
	Brightness of reflection surface	30,000 lx							

Notes: *1. After receipt of order, average rated detection distance to 110 cm 43.307 inch is possible. Please inquire.

*2. Install so that light from direct light sources does not enter the sensor (within 30° of the sensor light beam).

4) Long type (Measuring conditions: ambient temp.: 25°C 77°F; operating voltage: 5 V DC type 5V, Free-ranging power type 24V DC)

Items		Long type								Measured conditions	
		30 cm 11.811 inch	40 cm 15.748 inch	50 cm 19.685 inch	60 cm 23.622 inch	70 cm 27.559 inch	80 cm 31.496 inch	90 cm 35.433 inch	100 cm 39.37 inch		110 cm 43.307 inch
Rated detection distance	Minimum	285 mm 11.220 inch	380 mm 14.961 inch	475 mm 18.701 inch	570 mm 22.441 inch	665 mm 26.181 inch	760 mm 29.921 inch	855 mm 33.661 inch	950 mm 37.402 inch	1045 mm 41.142 inch	with a standard reflection board
	Typical	300 mm 11.811 inch	400 mm 15.748 inch	500 mm 19.685 inch	600 mm 23.622 inch	700 mm 27.559 inch	800 mm 31.496 inch	900 mm 35.433 inch	1000 mm 39.37 inch	1100 mm 43.307 inch	
	Maximum	315 mm 12.402 inch	420 mm 16.535 inch	525 mm 20.669 inch	630 mm 24.803 inch	735 mm 28.937 inch	840 mm 33.071 inch	945 mm 37.205 inch	1050 mm 41.339 inch	1155 mm 45.472 inch	
Measuring tolerance	Typical	3%					5%			Reflection rate: 90 to 18%	
Usable ambient brightness (Resistance to ambient light)*	Brightness of sensor surface	30,000 lx								See the drawing (Fig. 1) on the next page.	
	Brightness of reflection surface	30,000 lx									

Items		Long type								Measured conditions	
		120 cm 47.244 inch	130 cm 51.181 inch	140 cm 55.118 inch	150 cm 59.055 inch	160 cm 62.992 inch	170 cm 66.929 inch	180 cm 70.866 inch	190 cm 74.803 inch		200 cm 78.74 inch
Rated detection distance	Minimum	1140 mm 44.882 inch	1235 mm 48.622 inch	1330 mm 52.362 inch	1425 mm 56.102 inch	1520 mm 59.842 inch	1615 mm 63.583 inch	1710 mm 67.323 inch	1805 mm 71.063 inch	1900 mm 74.803 inch	with a standard reflection board
	Typical	1200 mm 47.244 inch	1300 mm 51.181 inch	1400 mm 55.118 inch	1500 mm 59.055 inch	1600 mm 62.992 inch	1700 mm 66.929 inch	1800 mm 70.866 inch	1900 mm 74.803 inch	2000 mm 78.74 inch	
	Maximum	1260 mm 49.606 inch	1365 mm 53.740 inch	1470 mm 57.874 inch	1575 mm 62.008 inch	1680 mm 66.142 inch	1785 mm 70.275 inch	1890 mm 74.409 inch	1995 mm 78.543 inch	2100 mm 82.677 inch	
Measuring tolerance	Typical	5%	10%			15%				Reflection rate: 90 to 18%	
Usable ambient brightness (Resistance to ambient light)*	Brightness of sensor surface	30,000 lx								See the drawing (Fig. 1) on the next page.	
	Brightness of reflection surface	30,000 lx									

Note: * Install so that light from direct light sources does not enter the sensor (within 30° of the sensor light beam).

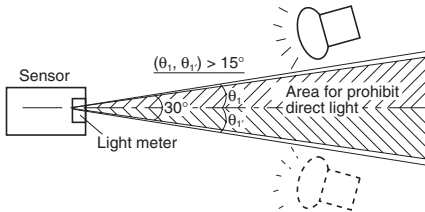
- For thin short type:
Standard reflection board: 150 mm 5.906 inch square area, 90% reflection rate.
- For short type:
Standard reflection board: 100 mm 3.937 inch square area, 90% reflection rate.
- For middle type:
Standard reflection board: 200 mm 7.874 inch square area, 90% reflection rate.
- For long type:
Standard reflection board: 500 mm 19.685 inch square area, 90% reflection rate.

Notes: 1. Detecting an object within the maximum preset detection distance.

$$2. \text{Distance deviation} = \frac{a-b}{a} \times 100 (\%)$$

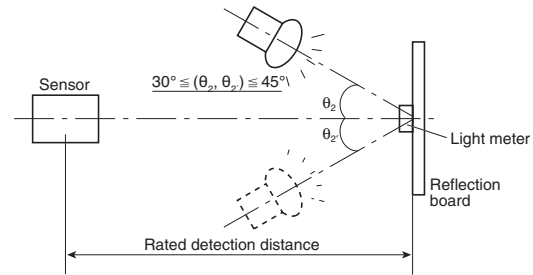
(a: detection distance of detection target with reflectance of 90%.
b: detection distance of standard detection target with reflectance of 18%.)

<Fig. 1>
[Brightness of sensor surface]



Note: Light from direct light sources (sunlight, strobe light, inverter illumination, reflected light from glass or mirrors etc.) that enters the sensor from within the prohibited range can cause the sensor to operate erroneously.

[Brightness of reflection surface]



2. Absolute maximum rating (Measuring condition: ambient temp.: 25°C 77°F)

Items	Type	Absolute maximum rating			
		Built-in oscillation circuit type		External triggering type	
		5 V DC type	Free-ranging power type	5 V DC type	Free-ranging power type
Power supply voltage		-0.3 to 8 V DC	-0.3 to 30 V DC	-0.3 to 8 V DC	-0.3 to 30 V DC
Output dielectric strength		30 V		30 V	
Output flow current		100 mA		10 mA*	
Usable ambient temperature		-25 to +75°C +5 to +131°F (No freezing)		-25 to +75°C +5 to +131°F (No freezing)	
Storage temperature		-30 to +85°C -4 to +176°F		-30 to +85°C -4 to +176°F	

Note: * Thin short type is only: 100 mA

3. Electrical characteristics

(Measuring conditions: ambient temp.: 25°C 77°F; operating voltage: 5 V DC type =5V DC, free-ranging power type =24V DC)

1) Built-in oscillation circuit type

Items	Symbol	Thin short type*		Short type	Middle type	Long type	Measured conditions	
		NPN output type	PNP output type					
Rated operating voltage	Minimum	5V DC type: 4.5V/Free-ranging power type: 6.5V						
	Typical	—						
	Maximum	5V DC type: 6.5V/Free-ranging power type: 27V						
Average current consumption (I _{out} = 0 mA)	No detection	Minimum	—					
		Typical	4.5mA	5V DC type: 4.5mA/Free-ranging power type: 5.6mA				
		Maximum	6.2mA	5V DC type: 6.2mA/Free-ranging power type: 7.8mA				
	Detection	Minimum	—					
		Typical	7.0mA	11.0mA	5V DC type: 7.0mA/Free-ranging power type: 9.1mA			
		Maximum	11.2mA	15.2mA	5V DC type: 11.2mA/Free-ranging power type: 14.2mA			
Measuring cycle	Minimum	T	8ms/cycle					
Output characteristics	Remain voltage	Maximum	V _r	1 V DC	1.2 V DC	1 V DC	I _t = 100 mA	
	Leakage current	Maximum	I _l	5μA		3μA	V = 30V	

Note: * The thin short type is only available for 5V DC.

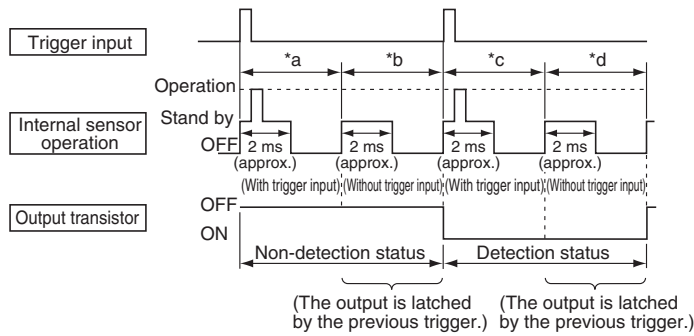
MA Motion Sensor (AMA1, AMB1, 2, 3)

2) External triggering type (trigger conditions: trigger pulse width = 20μs and trigger synchronization = 5ms)

Items	Symbol	Thin short type Note 1		Short type	Middle type	Long type	Measured conditions
		NPN output type	PNP output type				
Rated operating voltage	Minimum	5V DC type: 4.5V/Free-ranging type: 6.5V					
	Typical	—					
	Maximum	5V DC type: 6.5V/Free-ranging type: 27V					
Average current consumption	Without trigger input	Output OFF	Minimum	—			Note 2: *b
			Typical	0.1m	5V DC type: 0.1mA/Free-ranging type: 1.0mA		
			Maximum	0.3m	5V DC type: 0.3mA/Free-ranging type: 1.8mA		
		Output ON	Minimum	—			
			Typical	2.6mA	6.7mA	5V DC type: 0.5mA/Free-ranging type: 1.4mA	
			Maximum	6.6mA	9.6mA	5V DC type: 3.4mA/Free-ranging type: 4.5mA	
	With trigger input	Output OFF	Minimum	—			Note 2: *a
			Typical	2.2mA	5V DC type: 2.2mA/Free-ranging type: 3.1mA		
			Maximum	6.2mA	5V DC type: 6.2mA/Free-ranging type: 7.2mA		
		Output ON	Minimum	—			
			Typical	4.2mA	6.2mA	5V DC type: 2.4mA/Free-ranging type: 3.3mA	
			Maximum	8.2mA	12.5mA	5V DC type: 8.2mA/Free-ranging type: 9.3mA	
Measuring cycle (Trigger interval)	Minimum	Tt	5ms/cycle				
External trigger	Pulse width	Minimum	Tw	20μs			Half off the distance period
		Maximum		1/2Tt			
	Level	Maximum	V _{TL}	0.8V			
		Minimum	V _{TH}	3V			
Response performance: time from trigger pulse fall to detection output	Maximum	Tr	5ms				
Output characteristics	Remain voltage	Maximum	Vr	1 V DC	1.2 V DC	1 V	I = 10 mA
	Leakage current	Maximum	II	5μA		3μA	V = 30 mA

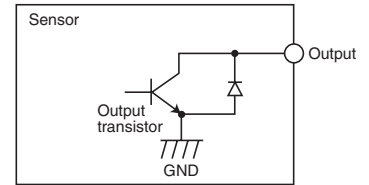
Notes: 1. The thin short type is only available for 5V DC.
 2. The ratio between the 4 operating modes (*a to *d) depends on the external trigger period and detector time, and the current consumption corresponds with this varying ratio.

4. The output transistor is open collector.
 The output transistor is turned ON by the sensor detection status and turned OFF by its non-detection status.



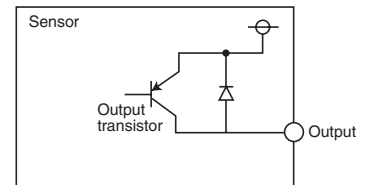
3. A high level is established in the open state due to pull-up by the internal circuit. (Refer to the connector wiring diagram.)

Detection status:
output transistor ON
 Non-detection status:
output transistor OFF



(NPN output types of the AMA series and all of AMB series)

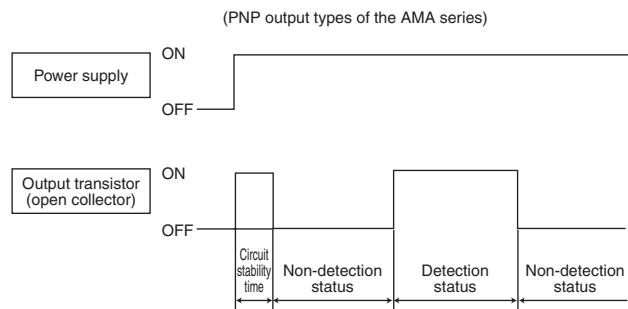
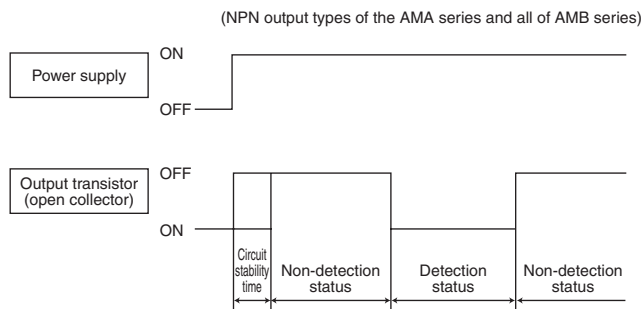
Detection status:
output transistor ON
 Non-detection status:
output transistor OFF



(PNP output types of the AMA series)

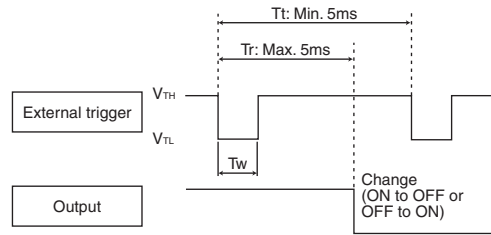
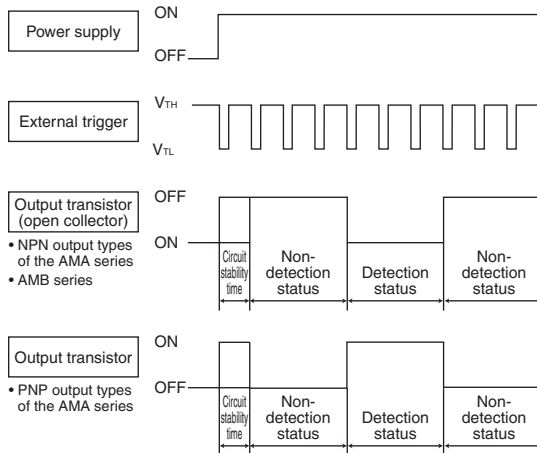
TIMING CHART

1. Built-in oscillation circuit type



Notes: 1. Circuit stability time : Max. 12 ms
 2. During the time taken for the circuit to stabilize after the power is turned on, the ON/OFF status of the output transistor is not determined by whether the sensor is in the detection status or non-detection status.

2. External triggering type

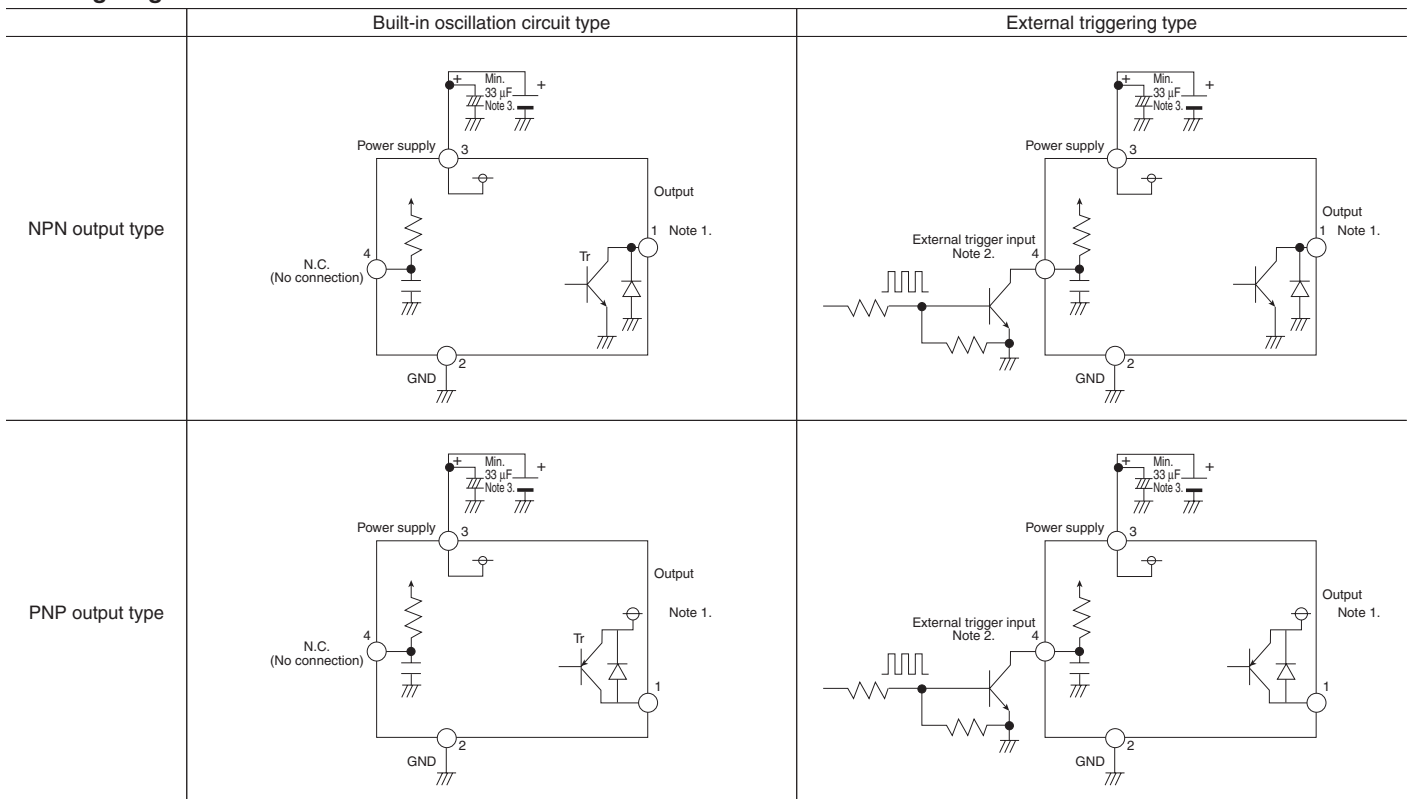


Note: The sensor recognizes at the $V_{TH} \rightarrow V_{TL}$ edge of an external trigger that the external trigger has been input.

- Notes: 1. Circuit stability time: Max. 12 ms
 2. During the time taken for the circuit to stabilize after the power is turned on, the ON/OFF status of the output transistor is not determined by whether the sensor is in the detection status or non-detection status.

HOW TO USE

1. Wiring diagram of connector



- Notes: 1. The output transistor has an open collector structure.
- Detection status: Output transistor ON (connected to GND)
 - Non-detection status: Output transistor OFF (open state)
2. The status of the external trigger input is as follows:
- Open at the high level
 - GND (less than 0.8V) at the low level
- Under no circumstances must a high-level voltage be applied.
3. To maintain the power supply superimposed noise performance, be certain to connect a capacitor (33 μ F or more) to the sensor power supply input terminal in order to stabilize the power supply voltage.

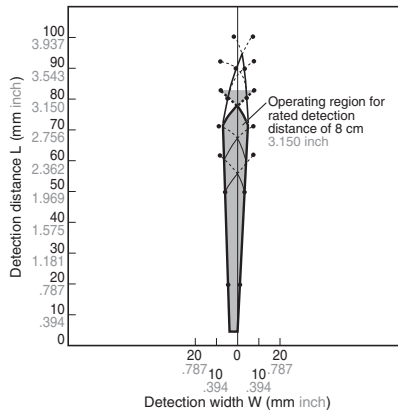
MA Motion Sensor (AMA1, AMB1, 2, 3)

REFERENCE DATA

Operating region characteristics

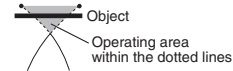
• How to interpret the graph

Example: Operating area of the Short Type with rated detection distance of 8 cm 3.150 inch.



Operating area within the dotted lines

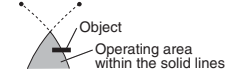
Objects that enter the entire area are detected.



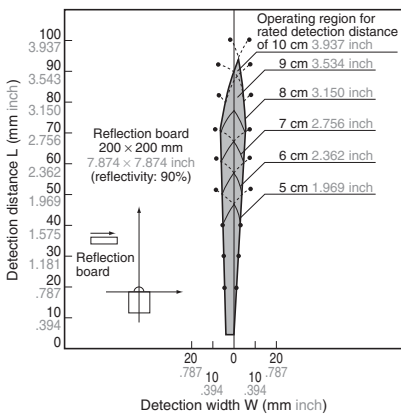
Note: If only part of the object is in the detection area, it is not detected.

Operating area within the solid lines

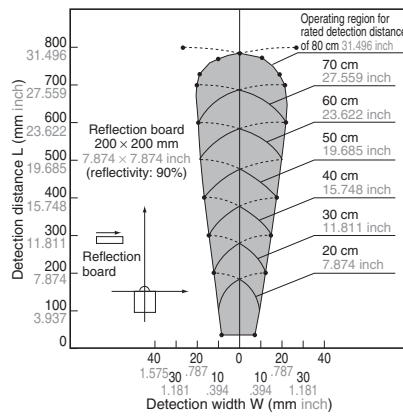
Objects that even partially enter the area are detected.



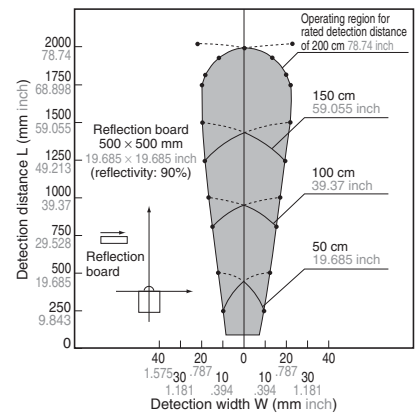
1.-(1) Thin short type (AMA14□□□□□) Short type (AMB14□□□□□)



1.-(2) Middle type (AMB24□□□□□)



1.-(3) Long type (AMB34□□□□□)



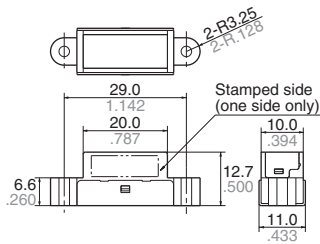
DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

(Common to the Built-in oscillation circuit type and External triggering type)

1. Thin short type (V type)

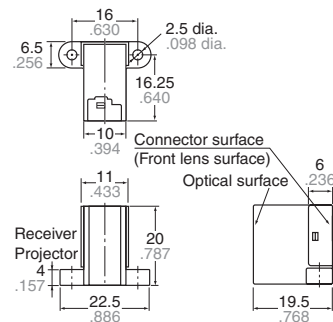
CAD Data



*Rear side connector protrusion: Max. 0.4mm

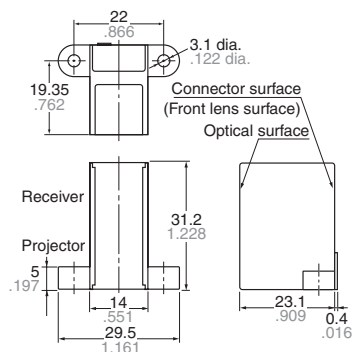
2. Short type (H type)

CAD Data



3. Middle type (H type)

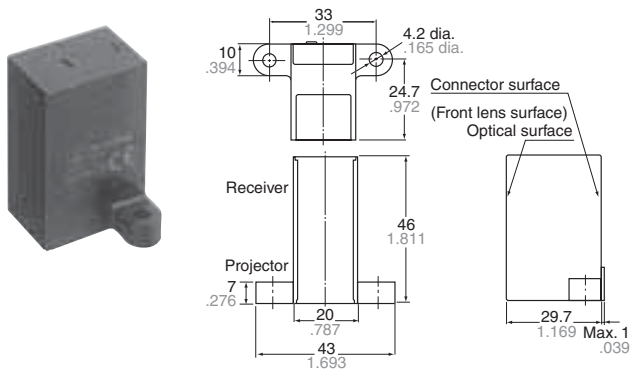
CAD Data



MA Motion Sensor (AMA1, AMB1, 2, 3)

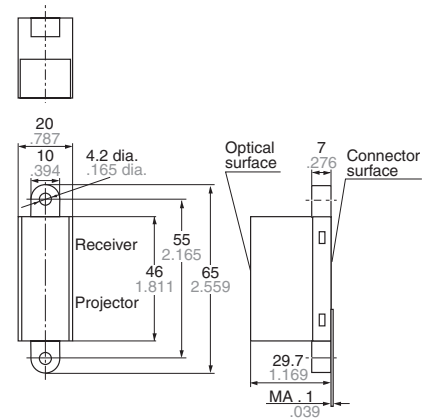
4. Long type (H type)

CAD Data



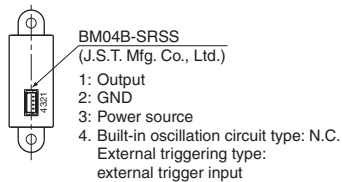
5. Long type (V type)

CAD Data

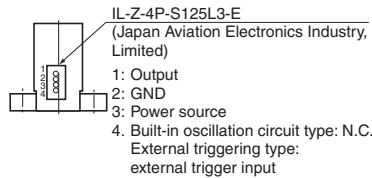


WIRING DIAGRAM (Connector surface view)

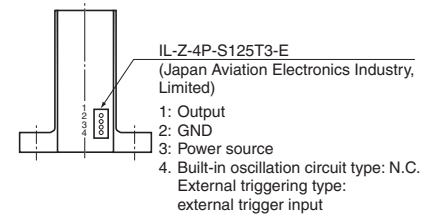
1. Thin short type (V type)



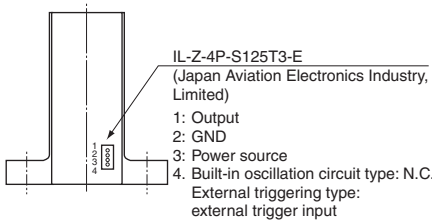
2. Short type (H type)



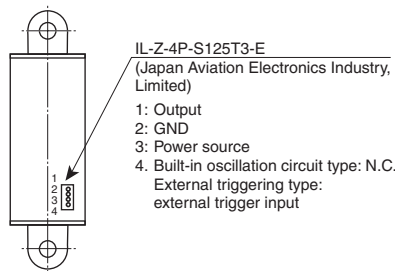
3. Middle type (H type)



4. Long type (H type)



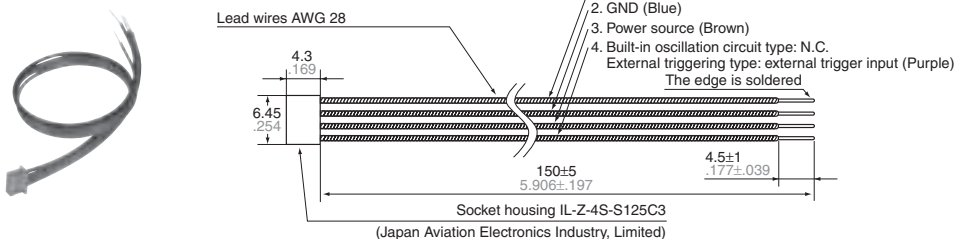
5. Long type (V type)



OPTIONS (mm inch)

1. Connector with cable (for Short, Middle and Long type)

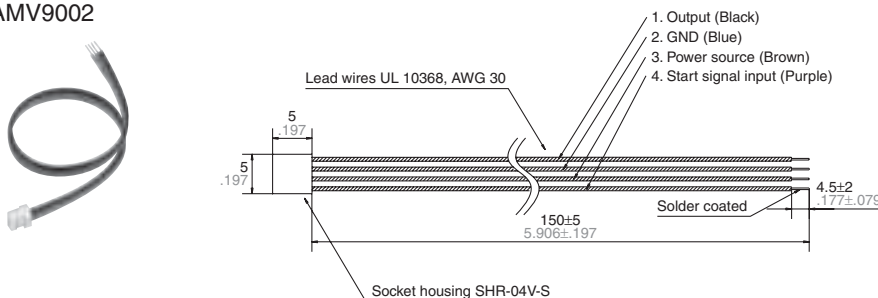
AMV9001



Note: Mistaken cable assembly can cause damage to the internal circuits, so please check the power cord before switching ON. (Particular care must be taken as to avoid reverse connection of the power.)

2. Connector with cable (for Thin short type)

AMV9002



NOTES

1. Environment

1) Avoid using the sensor in environments containing excessive amounts of steam, dust, corrosive gas, or where organic solvents are present.

2) When the sensor is used in noisy environments, connect a capacitor (minimum 33 μ F) across its power input terminals.

2. Wiring

1) Check all wiring before applying power. Incorrect wiring may damage the internal circuit (in particular, check that the connection to the power supply is not reversed.)

2) Avoid excessive removing and replacing of the connector.

3. Detector surface (Optical surface)

1) Keep the detector surface clean. Excessive dust or dirt on the detector surface will deteriorate the sensing performance.

2) Do not allow condensation or freezing to occur on the surface of the sensor. If condensation or freezing does occur at low temperatures, the sensor may not detect objects correctly.

3) This product is designed to detect the existence of human body. The sensor will not detect objects consisting of a low reflective material (e.g., an object coated with black rubber, etc.) or of a highly reflective material (e.g., mirror, glass, coated paper, etc.)

4) The front surface of the lens and case are made of polycarbonate resin and can withstand water, alcohol, oils, salts and weak acids. Other fluids such as alkalines, aromatic hydrocarbons and halogenated hydrocarbons may melt or swell the lens and case, please do not have such fluids touch the lens and case.

5) If you use the sensor with a cover or filter connected to the front of the sensor, the sensor may detect the cover itself, the detection distance can change, and unstable operation can result.

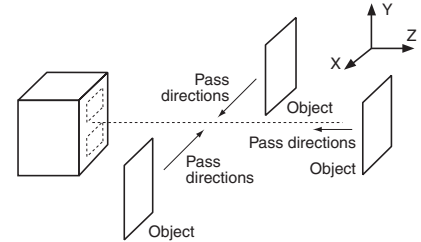
6) When multiple sensors are to be used side by side, please verify that there will be no mutual interference by installing them with the proper spacing, depending on the type as shown below.

Model number	Sensor spacing
AMB1 series	5 cm 1.969 inch
AMA1 series	8 cm 3.150 inch
AMB2 series	10 cm 3.937 inch
AMB3 series	20 cm 7.874 inch

7) To protect the inner circuit, wiring should be max. 3 m 9.843 ft..

4. Recommended installation procedure

Install the sensor so that it is orientated correctly in relation to the pass directions of the target objects as shown in the figure below.



* → stands for pass direction of the target object.

For the general precautions, refer to "NOTES FOR USING MOTION SENSOR (Common)" on next page.

NOTES FOR USING MOTION SENSOR (Common)

SAFETY PRECAUTIONS

Head the following precautions to prevent injury or accidents.

- Do not use these sensors under any circumstances in which the range of their ratings, environment conditions or other specifications are exceeded. Using the sensors in any way which causes their specifications to be exceeded may generate abnormally high levels of heat, emit smoke, etc., resulting in damage to the circuitry and possibly causing an accident.

- Before connecting a connector, check the pin layout by referring to the connector wiring diagram, specifications diagram, etc., and make sure that the connector is connected properly. Take note that mistakes made in connection may cause unforeseen problems in operation, generate abnormally high levels of heat, emit smoke, etc., resulting in damage to the circuitry.

- Do not use any motion sensor which has been disassembled or remodeled.
- Protection circuit recommended
The possible failure mode is either open or short of the output transistor. An excess heat is the cause for short mode failure. For any important and serious application in terms of safety, add protection circuit or any other protection method.

NOTES FOR MOTION SENSOR

1. Ambient operating conditions

- Temperature: Refer to the absolute maximum ratings for the temperature of each individual sensor.
- Humidity: 15% to 85% RH (No freezing nor condensation at low temperature)
- Atmospheric pressure: 86 to 106 kPa
- Because the humidity range differs depending on the ambient temperature, the humidity range indicated below should be used. Continuous operation of the switch is possible within this range, but continuous use near the limit of the range should be avoided. This humidity range does not guarantee permanent performance.

In general, degradation of electronic devices accelerates when they are operated under conditions of high temperature or high humidity. Before use, confirm the reliability of the sensors under the expected operating conditions.

5) The sensors do not have a water-proof or dust-proof construction. Depending on the ambient operating conditions, some means of providing protection from water and dust and preventing the formation of ice and condensation must be provided prior to using the sensors. If a sensor is used with a cover installed, the initial detection performance specifications may not be able to be met. Confirm the operation under the actual operating conditions.

3. Concerning power supply-superimposed noise

1) Use a regulated power supply as the power supply. Otherwise, power supply-superimposed noise may cause the sensors to malfunction. The levels of noise which the sensor can withstand is given below.

MA motion sensors: ± 200 V (50ns, 1 μ s wide square waves)

MP motion sensors: ± 20 V (50ns, 1 μ s wide square waves)

2) To maintain the power supply noise performance, be certain to connect a capacitor (33 μ F or more) to the sensor power supply input terminal in order to stabilize the power supply voltage.

4. Drop damage

If the sensor is dropped, damage can occur resulting in incorrect operation. If dropped, be sure to do a visual check of the exterior for noticeable damage and check the operation characteristics for faulty operation.

5. Concerning the circuit sides

Since the circuit sides given in this catalog are not protected in terms of circuit design, check out the performance and reliability of the circuits prior to using the sensors.

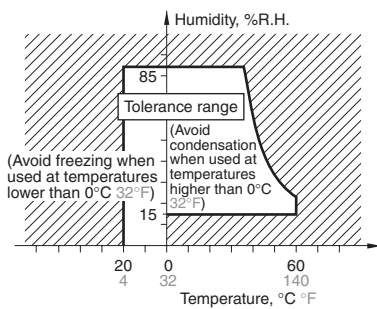
2. Concerning external surge voltages

Since the internal circuitry may be destroyed if an external surge voltages is supplied, provide an element which will absorb the surges. The levels of the voltage surges which the sensor can withstand is given below.

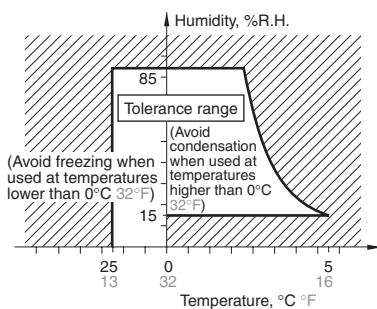
MA motion sensors: 500 V ($\pm 1.2 \times 50\mu$ s unipolar full-wave voltage)

MP motion sensors: Within the supply voltage given in the absolute maximum ratings.

<MP Motion Sensor>



<MA Motion Sensor>





<Low pressure type>

Compliance with RoHS Directive

FEATURES

1. Contains built-in amplification and temperature compensation circuit. Circuit design and adjustment of characteristics are not required by users.

2. High-level precision and high reliability realized.

- Overall accuracy is $\pm 1.25\%$ FS (Standard type)

- Overall accuracy is $\pm 4\%$ FS (Economy type)

- Overall accuracy is $\pm 2.5\%$ FS (Low pressure type)

3. Compact pressure sensor unit that saves space.

Same size and as previous PS pressure sensor.

- Footprint 7.0 mm (W) x 7.2 mm (D)

- 10.4 mm (W) x 10.4 mm (D) (Low pressure type)

TYPICAL APPLICATIONS

(Please evaluate under actual conditions before using.)

- Industrial use (pressure switches and pneumatic devices, etc.)

- Medical use (blood pressure monitors, oxygen concentrators, air beds, etc.)

- Other pneumatically operated pressure devices

Low pressure type

1. Water level detection for household appliances

Washing machines and dishwashers.

2. Air pressure control

Clean rooms and separate rooms for smokers.

3. Medical applications

Respiratory equipment monitoring, etc.

ORDERING INFORMATION

ADP5 1

<Terminal profile>

1: DIP terminal



<Rated pressure>

0: ± 100 kPa

1: -100 kPa

2: 25 kPa

3: 50 kPa

4: 100 kPa

5: 200 kPa

6: 500 kPa

7: 1,000 kPa

A: 40 kPa

B6: 6 kPa (Low pressure type)

<Pressure inlet hole>

0: length 3 mm, diameter 3 mm

1: length 5 mm, diameter 3 mm

2: length 13.5 mm, diameter 5.45 mm





<Type>

Nil: Standard type (with glass base)

1: Economy type (without glass base)

Note: Some part numbers may not be available depending on the combination. Please refer to the Table of Product Types on the next page.

PRODUCT TYPES

Pressure	Pressure inlet hole length	Terminal	Part No.			
			3mm	5mm	Low pressure type	
					5mm	13.5mm
			DIP terminal 	DIP terminal 	DIP terminal 	DIP terminal 
Standard type (with glass base)	±100kPa		ADP5100	ADP5101	—	—
	−100kPa		ADP5110	ADP5111	—	—
	25kPa		ADP5120	ADP5121	—	—
	50kPa		ADP5130	ADP5131	—	—
	100kPa		ADP5140	ADP5141	—	—
	200kPa		ADP5150	ADP5151	—	—
	500kPa		ADP5160	ADP5161	—	—
	1,000kPa		ADP5170	ADP5171	—	—
Economy type (without glass base)	40kPa		—	ADP51A11	—	—
Low pressure type	6kPa		—	—	ADP51B61	ADP51B62

Standard packing: Carton: 100 pcs.; Case: 1,000 pcs.

RATING

1. Standard type

Item	Standard type (with glass base)								Remarks	
Type of pressure	Gauge pressure									
Pressure medium	Air								Note*1	
Rated pressure	Unit: kPa	±100	−100	25	50	100	200	500	1,000	
Max. applied pressure	Twice the rated pressure								1.5 times the rated pressure	
Drive voltage	5±0.25V DC									
Temperature compensation range	0 to 50°C 32 to 122°F									
Offset voltage	2.5±0.05		0.5±0.05V						Note*2	
Rated output voltage	4.5±0.05 (when +100kPa)		4.5±0.05V						Note*2	
Overall accuracy	±1.25%FS								Note*2 Note*3	
Current consumption	Max. 10mA									
Output impedance	Approx. 50Ω									
Source current	Max. 0.2mA									
Sink current	Max. 2mA									

- Notes: 1. Please consult us for pressure media other than air.
 2. Indicates output when drive voltage is 5 V. Although output fluctuates due to fluctuations in the drive voltage, this is not included.
 3. Overall accuracy indicates the accuracy of the offset voltage and rated output voltage at temperatures between 0 to 50°C 32 to 122°F (Low pressure type: 0 to 70°C 32 to 158°F). (FS=4V)
 4. Overall accuracy indicates accuracy after adjusting auto offset to zero.

2. Economy type

Item	Economy type (without glass base)								Remarks	
Type of pressure	Gauge pressure									
Pressure medium	Air								Note*1	
Rated pressure	Unit: kPa	40								
Max. applied pressure	Twice the rated pressure									
Drive voltage	3±0.15V DC									
Temperature compensation range	5 to 45°C 41 to 113°F									
Offset voltage	0.3±0.09V								Note*2	
Span voltage	2.4±0.03V								Note*2	
Overall accuracy	±4%FS								Note*2 Note*3	
Current consumption	Max. 3mA									
Output impedance	20Ω (typ.)									
Source current	Max. 0.15mA									
Sink current	Max. 1.5mA									

- Notes: 1. Please consult us for pressure media other than air.
 2. Indicates output when drive voltage is 3 V. Although output fluctuates due to fluctuations in the drive voltage, this is not included.
 3. Overall accuracy indicates the accuracy of the offset voltage and rated output voltage at temperatures between 5 to 45°C 41 to 113°F (Low pressure type: 0 to 70°C 32 to 158°F). (FS=4V)

PS-A (ADP5)

3. Low pressure type

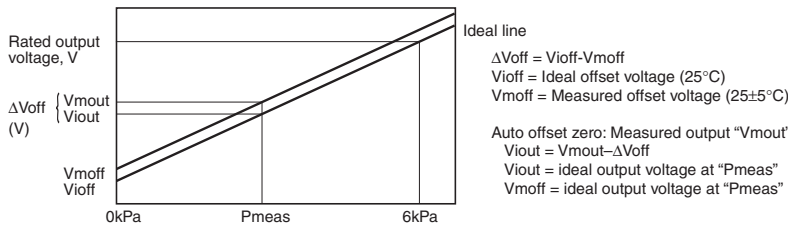
Item	Low pressure type	Remarks
Type of pressure	Gauge pressure	
Pressure medium	Air	Note*1
Rated pressure	6	
Max. applied pressure	Twice the rated pressure	
Drive voltage	5±0.25V DC	
Temperature compensation range	0 to 70°C 32 to 158°F	
Offset voltage	0.5V	Note*2
Span voltage	4.0V	Note*2
Overall accuracy	±2.5%FS	Notes*2, *3 and *4
Current consumption	Max. 10mA	
Output impedance	Approx. 50Ω	
Source current	Max. 0.2mA	
Sink current	Max. 2.0mA	

Notes: 1. Please consult us for pressure media other than air.

2. Indicates output when drive voltage is 5 V. Although output fluctuates due to fluctuations in the drive voltage, this is not included.

3. Overall accuracy indicates the accuracy of the offset voltage and span voltage at temperatures between 0 to 70°C 32 to 158°F (FS=4V)

4. Overall accuracy indicates accuracy after adjusting auto offset to zero.



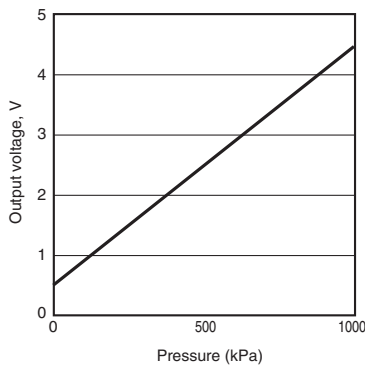
5. Where no particular temperature is indicated, the specification is for use at 25°C 77°F.

REFERENCE DATA

1. Standard and Economy types

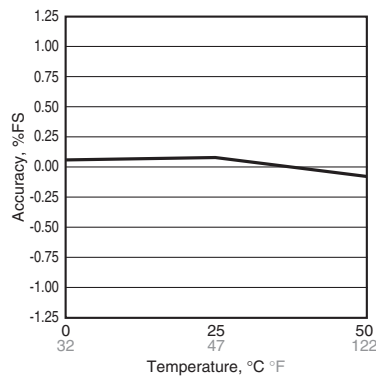
1.-(1) Output voltage

ADP5170
 Drive voltage: 5V DC
 Temperature: 25°C 77°F
 Applied pressure: 0 to +1,000kPa



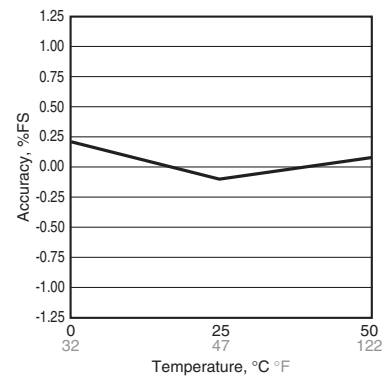
1.-(2) Overall accuracy (Offset voltage)

ADP5170
 Drive voltage: 5V DC
 Temperature: 0 to 50°C 32 to 122°F
 Applied pressure: 0kPa



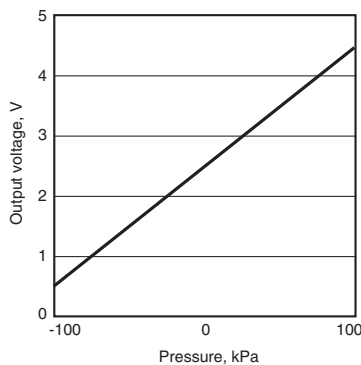
1.-(3) Overall accuracy (Rated output voltage)

ADP5170
 Drive voltage: 5V DC
 Temperature: 0 to 50°C 32 to 122°F
 Applied pressure: +1,000kPa



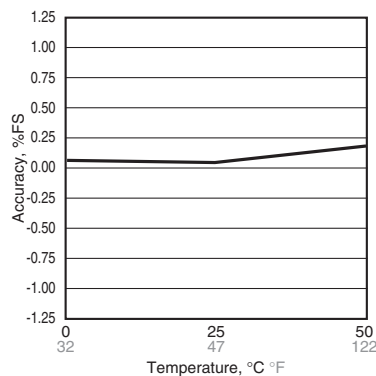
2.-(1) Output voltage

ADP5100
 Drive voltage: 5V DC
 Temperature: 25°C 77°F
 Applied pressure: -100 to +100kPa



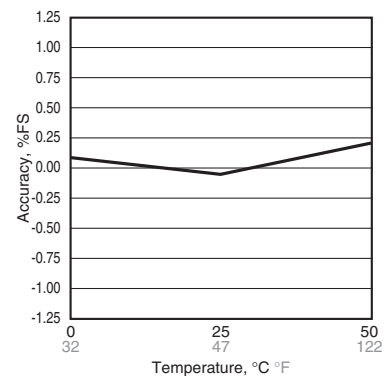
2.-(2) Overall accuracy (Offset voltage)

ADP5100
 Drive voltage: 5V DC
 Temperature: 0 to 50°C 32 to 122°F
 Applied pressure: 0kPa



2.-(3) Overall accuracy (Rated output voltage)

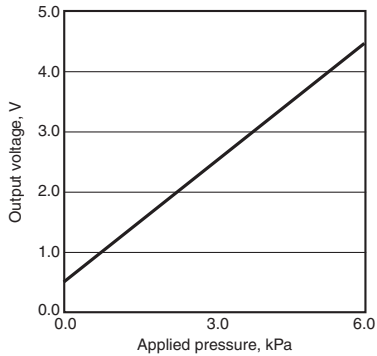
ADP5100
 Drive voltage: 5V DC
 Temperature: 0 to 50°C 32 to 122°F
 Applied pressure: +100kPa



2. Low pressure type

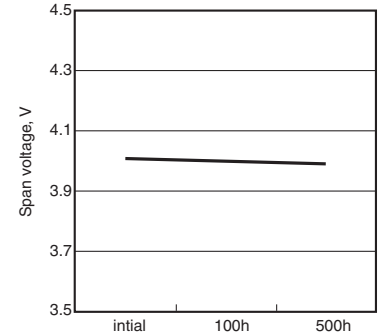
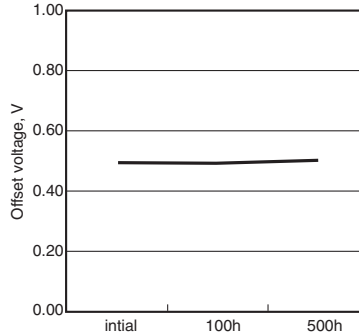
1. Output voltage

ADP51B61
 Drive voltage: 5V
 Temperature: 25°C 77°F
 Applied pressure: 0 to 6kPa



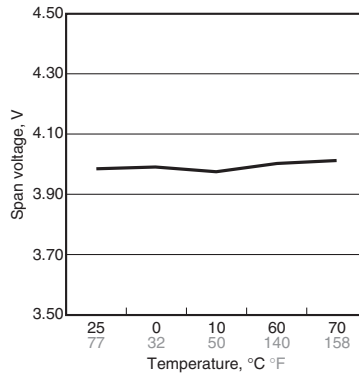
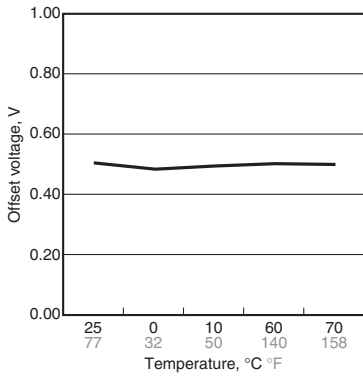
2. THB (high temperature high humidity bias test)

ADP51B61
 Within 85°C 185°F and 85% RH
 5 V applied between No. 2 (Vdd) and No. 3 (GND)
 Applied pressure: 0kPa



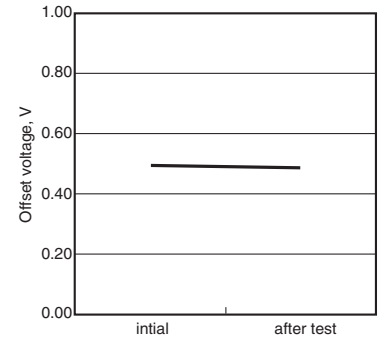
3. Ambient temperature characteristics

Ambient temperature: 25°C 77°F → 0°C 32°F → 10°C 50°F → 60°C 140°F → 70°C 158°F



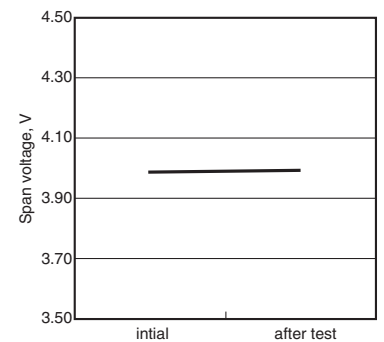
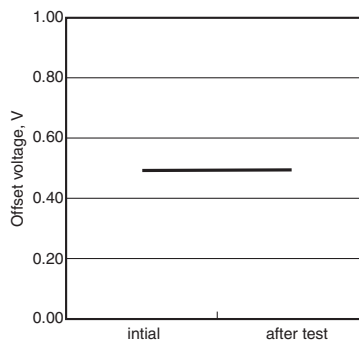
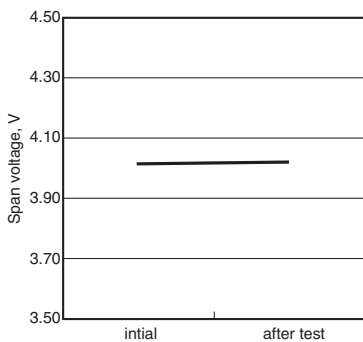
4. Shock test

ADP51B61
 Shock applied:
 981 m/s² 3 times in x, y and z directions
 Applied pressure: 0kPa



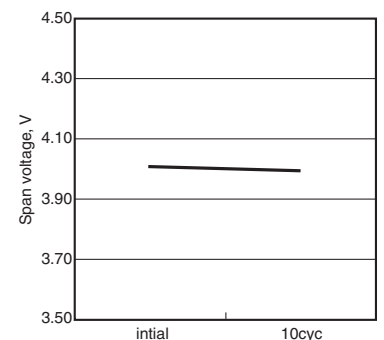
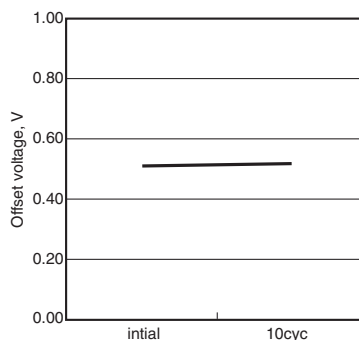
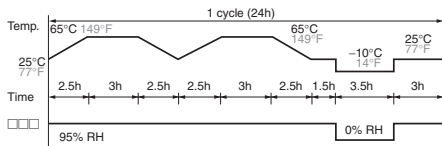
5. Vibration test

ADP51B61
 Vibration applied: 10 to 55 Hz, amplitude: 1.5mm, x, y and z directions, 2 hrs each
 Applied pressure: 0kPa



6. Temperature/humidity cycle test

ADP51B61
 Exposed to 10 cycles in the temperature and humidity conditions given below.
 Applied pressure: 0kPa



PS-A (ADP5)

3. Evaluation test

Classification	Tested item	Tested condition	Result
Environmental characteristics	Storage at high temperature	Temperature: Left in a 85°C 185°F constant temperature bath; Time: 100 hrs.	Passed
	Storage at low temperature	Temperature: Left in a -20°C -4°F constant temperature bath; Time: 100 hrs.	Passed
	Humidity resistance	Temperature/humidity: Left at 40°C 104°F, 90% RH; Time: 100 hrs.	Passed
	Temperature cycle	Temperature: -20°C to 85°C -4°F to 185°F; 1 cycle: 30 min.; Times of cycle: 100	Passed
Endurance characteristics	High temperature/high humidity operation	Temperature/humidity: 40°C 104°F, 90% RH; Operation times: 10 ⁶ , rated voltage applied	Passed
Mechanical characteristics	Vibration resistance	Double amplitude: 1.5 mm .059 inch; Vibration: 10 to 55 Hz; Applied vibration direction: X, Y, Z 3 directions; Times: 2 hrs each	Passed
	Dropping resistance	Dropping height: 75 cm 29.528 inch; Times: 2 times	Passed
	Terminal strength	Pulling strength: 9.8 N {1 kgf}, 10 sec.; Bending strength: 4.9 N {0.5 kgf}, left and right 90° 1 time	Passed
Soldering resistance	Soldered in DIP soldering bath	Temperature: 230°C 446°F; Time: 5 sec.	Passed
	Temperature (DIP)	Temperature: 260°C 500°F; Time: 10 sec.	Passed

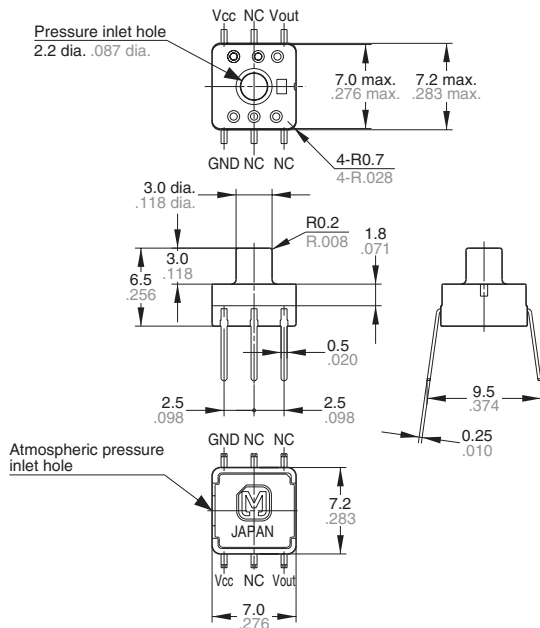
DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

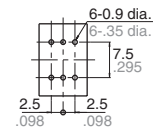
1. DIP terminal (Pressure inlet hole: 3mm) ADP51*0

General tolerance: $\pm 0.3 \pm 0.12$

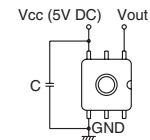
CAD Data



Recommended PC board pattern (TOP VIEW 2:1)



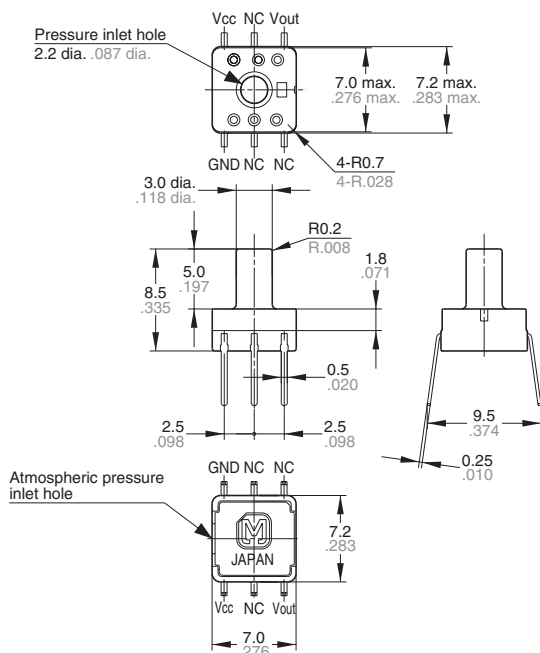
Terminal connection diagram



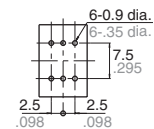
Terminal No.	Name
1	Vcc (Power supply [+])
2	NC (No connection)
3	Vout (Output)
4	NC (No connection)
5	NC (No connection)
6	GND (Ground)

2. DIP terminal (Pressure inlet hole: 5mm) ADP51*1/ADP51A11

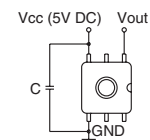
CAD Data



Recommended PC board pattern (TOP VIEW 2:1)



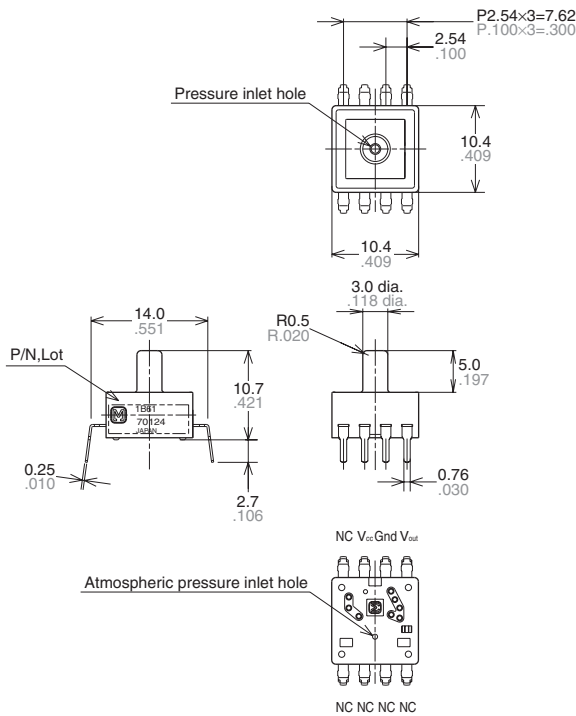
Terminal connection diagram



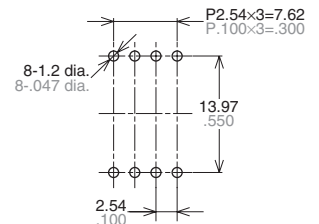
Terminal No.	Name
1	Vcc (Power supply [+])
2	NC (No connection)
3	Vout (Output)
4	NC (No connection)
5	NC (No connection)
6	GND (Ground)

3. Low pressure type (Pressure inlet hole length: 5mm) ADP51B61

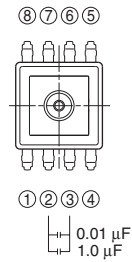
CAD Data



Recommended PC board pattern



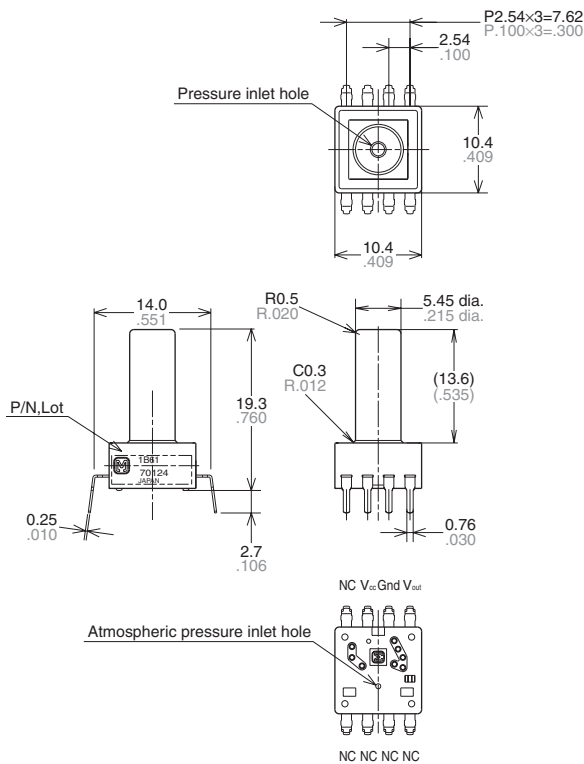
Terminal connection diagram



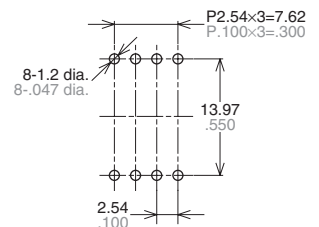
Terminal No.	Name
1	NC (No connection)
2	V _{cc} (Power supply [+])
3	GND (Ground)
4	V _{out} (Output)
5	NC (No connection)
6	NC (No connection)
7	NC (No connection)
8	NC (No connection)

4. Low pressure type (Pressure inlet hole length: 13.5mm) ADP51B62

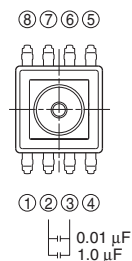
CAD Data



Recommended PC board pattern



Terminal connection diagram



Terminal No.	Name
1	NC (No connection)
2	V _{cc} (Power supply [+])
3	GND (Ground)
4	V _{out} (Output)
5	NC (No connection)
6	NC (No connection)
7	NC (No connection)
8	NC (No connection)

NOTES

1. Mounting

Use lands on the printed-circuit boards to which the sensor can be securely fixed.

2. Soldering

Due to its small size, the thermal capacity of the pressure sensor DIP type is low.

Therefore, take steps to minimize the effects of external heat.

Damage and changes to characteristics may occur due to heat deformation.

Use a non-corrosive resin type of flux.

Since the pressure sensor DIP type is exposed to the atmosphere, do not allow flux to enter inside.

1) Manual soldering

- Set the soldering tip from 260 to 300°C 500 to 572°F (30W), and solder for no more than 5 seconds.

- Please note that output may change if the pressure is applied on the terminals when the soldering.

- Thoroughly clean the soldering iron.

2) DIP soldering (DIP terminal type)

- Please keep the DIP solder bath temperature no higher than 260°C 500°F. When soldering, heat should be applied no longer than five seconds.

- When mounting onto a PCB of low thermal capacity, please avoid DIP soldering as this may cause heat deformation.

3) Solder reworking

- Finish reworking in one operation.

- For reworking of the solder bridge, use a soldering iron with a flat tip. Please do not add more flux when reworking.

- Please use a soldering iron that is below the temperature given in the specifications in order to maintain the correct temperature at the tip of the soldering iron.

4) Too much force on the terminals will cause deformation and loss in effectiveness of the solder. Therefore, please avoid dropping and careless handling of the product.

5) Please control warping of the PCB within 0.05 mm of the sensor width.

6) When cut folding the PCB after mounting the sensor, take measures to prevent stress to the soldered parts.

7) The sensor terminals are designed to be exposed, so contact of the terminals with metal shards and the like will cause output errors. Therefore, please be careful and prevent things such as metal shards and hands from contacting the terminals.

8) To prevent degradation of the PCB insulation after soldering, please be careful not to get chemicals on the sensor when coating.

9) Please consult us regarding the use of lead-free solder.

3. Connections

1) Please perform connections correctly in accordance with the terminal connection diagram. In particular, be careful not to reverse wire the power supply as this will cause damage or degrade to the product.

2) Do not connect terminals that are not used. This can cause malfunction of the sensor.

4. Cleaning

1) Since the pressure sensor chip is exposed to the atmosphere, do not allow cleaning fluid to enter inside.

2) Avoid ultrasonic cleaning since this may cause breaks or disconnections in the wiring.

5. Environment

1) Please avoid using or storing the pressure sensor chip in a place exposed to corrosive gases (such as the gases given off by organic solvents, sulfuric acid gas, hydrogen sulfides, etc.) which will adversely affect the performance of the pressure sensor chip.

2) To ensure resistance to power supply superimposed noise, you must provide a capacitor at the power supply input terminal of the sensor in order to stabilize the power supply voltage. We recommend to provide 0.1 μF and 1,000 pF capacitor in parallel. Please confirm the noise resistance with the actual equipment and choose adequate capacitor.

3) Since the internal circuitry may be destroyed if an external surge voltages is supplied, provide an element which will absorb the surges.

4) Malfunctioning may occur if the product is in the vicinity of electrical noise such as that from static electricity, lightning, a broadcasting station, an amateur radio, or a mobile phone.

5) Since this pressure sensor chip does not have a water-proof construction, please do not use the sensor in a location where it may be sprayed with water, etc.

6) Avoid using the pressure sensors chip in an environment where condensation may form.

Furthermore, its output may fluctuate if any moisture adhering to it freezes.

7) The pressure sensor chip is constructed in such a way that its output will fluctuate when it is exposed to light.

Especially when pressure is to be applied by means of a transparent tube, take steps to prevent the pressure sensor chip from being exposed to light.

8) Avoid using the pressure sensor chip where it will be susceptible to ultrasonic or other high-frequency vibration.

6. Quality check under actual loading conditions

To assure reliability, check the sensor under actual loading conditions. Avoid any situation that may adversely affect its performance.

7. Other handling precautions

1) That using the wrong pressure range or mounting method may result in accidents.

2) The only direct pressure medium you can use is dry air. The use of other media, in particular, corrosive gases (organic solvent based gases, sulfuric acid based gases, and hydrogen sulfide based gases, etc.) and media that contains moisture or foreign substances will cause malfunction and damage. Please do not use them.

3) The pressure sensor chip is positioned inside the pressure inlet. Never poke wires or other foreign matter through the pressure inlet since they may damage the chip or block the inlet. Avoid use when the atmospheric pressure inlet is blocked.

4) Use an operating pressure which is within the rated pressure range. Using a pressure beyond this range may cause damage.

5) Since static charge can damage the pressure sensor chip, bear in mind the following handling precautions.

(1) When storing the pressure sensor chips, use a conductive material to short the pins or wrap the entire chip in aluminum foil. Plastic containers should not be used to store or transport the chips since they readily become charged.

(2) When using the pressure sensor chips, all the charged articles on the bench surface and the work personnel should be grounded so that any ambient static will be safely discharged.

6) Based on the pressure involved, give due consideration to the securing of the pressure sensor DIP type and to the securing and selection of the inlet tube. Consult us if you have any queries.

Pressure sensor
Built-in amplifier and
compensating circuit

PS-A PRESSURE SENSOR
 Direct water pressure
 detection type

New



FEATURES

1. Not only air, now water pressure can be detected directly.
*For other media, please inquire.
2. Linear output achieved for both positive and negative pressure.
3. Standalone type
 One-touch connection using connector
4. Low power consumption contributes to energy savings.

TYPICAL APPLICATIONS

- Water heaters (water level detection)
- Industrial water pressure monitoring

Compliance with RoHS Directive

ORDERING INFORMATION

	ADPW	1	1
PS-A Direct water pressure detection type			
Shape			
1: Standalone type			
Installation hole: 4.5mm dia., 40mm pitch			
Pipe shape: 6mm dia., No O-ring groove			
Compatible plug: XMP-04V			
Rated pressure			
1: Negative pressure -19.6kPa			
Positive pressure 49.0kPa			
* Please inquire about pressure ranges.			

RATING

1. Use conditions and Absolute maximum ratings

Item	ADPW11	Remarks
Type of pressure	Gauge pressure	
Pressure medium	Air and water	Note*1
Max. applied pressure	-90 to 350kPa	
Max. applied voltage	7.0 V	
Ambient temperature range	-10 to 80°C 14 to 176°F	
Storage temperature range	-20 to 85°C -4 to 185°F	

Note: *1. Please consult us for other pressure media.

* When the pressure medium is a liquid, the maximum pressure it can withstand may be exceeded due to shock pressure (water hammer), etc., caused by sudden changes in pressure. Please only use after sufficiently verifying in the actual environment under actual conditions.

PS-A (ADPW)

2. Electrical characteristics

Item	ADPW11	Remarks
Rated pressure	-19.6 to 49kPa	
	-2 to 5m	Converts to water level
Drive voltage	5.0±0.25V	
Power consumption	16mW (typ.)	Note*2 and *3
Offset voltage	2.0±0.06V	Note*2 and *3
Rated output voltage for positive pressure	4.5±0.12V	Note*2 and *3
Rated output voltage for negative pressure	1.0±0.084V	Note*2 and *3
Rated span voltage for positive pressure	2.5±0.06V	Note*2 and *3
Rated span voltage for negative pressure	1.0±0.024V	Note*2 and *3
Non linearity	±0.5%FS	Note*2, *3 and *5
Pressure hysteresis	±0.3%FS	Note*2, *3 and *5
Offset voltage temperature characteristics	30mV	Note*3 and *4
Sensitivity temperature characteristics	±2.0%FS	Note*3, *4 and *5
Output impedance	15Ω (typ.)	Note*2

Notes: *2. Indicates output when temperature is 25°C 77°F.

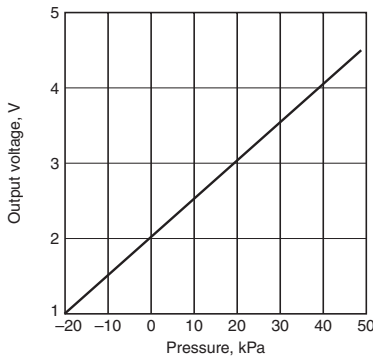
*3. Indicates output when drive voltage is 5 V. Although output fluctuates due to fluctuations in the drive voltage, this is not included.

*4. Indicates from output value at 25°C 77°F and the change of output at 0 and 50°C 32 to 122°F.

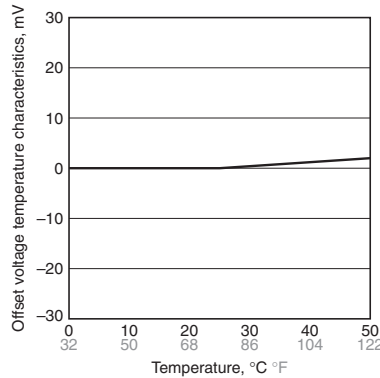
*5. Full scale (FS) indicates 0 to 49 kPa.

REFERENCE DATA

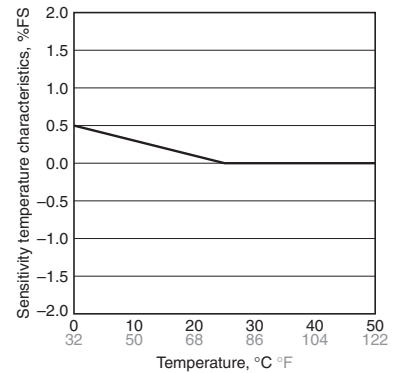
1.-(1) Output characteristics



1.-(2) Offset voltage temperature characteristics



1.-(3) Sensitivity temperature characteristics

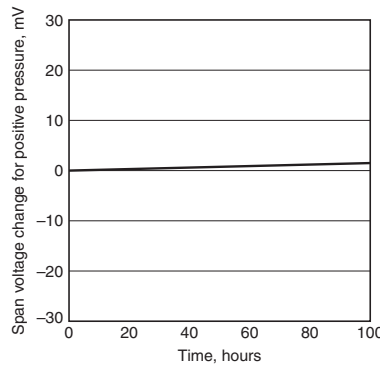
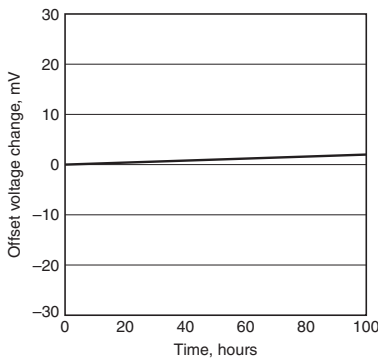


2. THB (high temperature high humidity bias test)

Within 85°C 185°F and 85% RH

5 V applied between No. 2 (VDD) and No. 3 (GND)

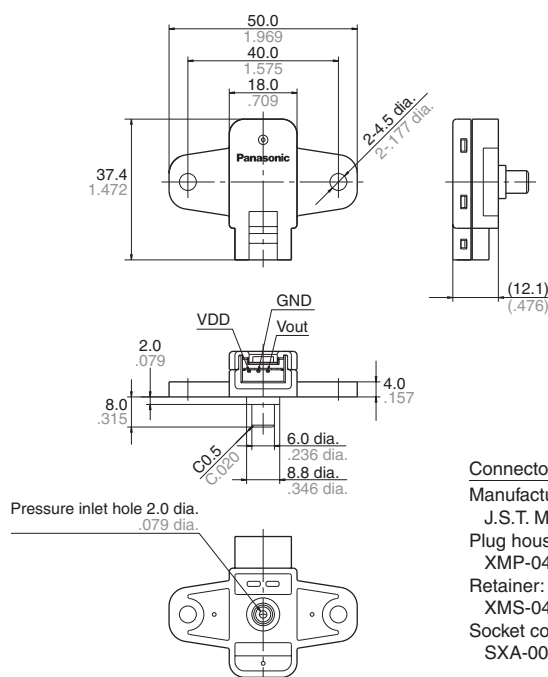
Applied pressure: 0kPa



DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net> ac

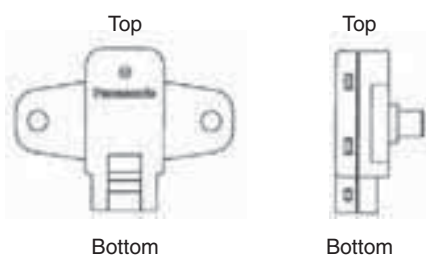
CAD Data



NOTES

1. Installation direction

1) Influenced by the weight of the filled oil, the offset voltage will shift depending on the installation direction. This product should be installed in the recommended orientation shown below in order to achieve detection results it was designed for.



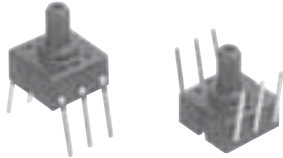
2) Air tightness may be compromised due to the case breaking or loosening if the screws are not tightened properly. Please make sure the proper torque is used when tightening the screws during sensor installation.

2. Environment

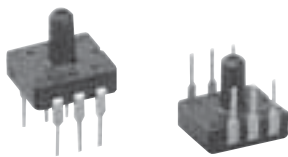
- 1) Please avoid using or storing the pressure sensor chip in a place exposed to corrosive gases (such as the gases given off by organic solvents, sulfuric acid gas, hydrogen sulfides, etc.) which will adversely affect the performance of the pressure sensor chip.
- 2) Avoid use in environments susceptible to condensation and freezing.
- 3) The connector on this product is not water proof. Please make sure there is no problem with the installation environment before installing.
- 4) When using with cable wiring, we recommend using shielded cables and keeping them as short as possible in order to prevent noise from leaking in.
- 5) Since the internal circuitry may be destroyed if an external surge voltages is supplied, provide an element which will absorb the surges.
- 6) Please note that noise entering the power supply may cause malfunction and breakdown.
- 7) Static electricity can damage this product. Please take sufficient cautions when handling.

3. Other handling precautions

- 1) Oil has been placed inside the pressure intake opening in order to protect the pressure sensor chip and sensor chip. Do not insert foreign objects, such as a needle, into the pressure intake opening. Doing so may cause damage to the sensor chip or cause oil to leak.
- 2) As a rule, please do not use this product if it has been dropped. If you still intend to use it, please verify functionality first.
- 3) Use an operating pressure which is within the rated pressure range. Using a pressure beyond this range may cause damage.
- 4) Avoid using the pressure sensor where it will be susceptible to ultrasonic or other high-frequency vibration.
- 5) To assure reliability, check the sensor under actual loading conditions. Avoid any situation that may adversely affect its performance.



PS pressure sensor



PF pressure sensor

FEATURES

- 1. Ultra-miniature size (for PS pressure sensor)**
 - 2. High-level precision and linearity: Overall accuracy is $\pm 1.25\%$ FS (standard type)**
 - 3. Impressive line-up of models**
 - Taking their place alongside the standard $5k\Omega$ bridge resistance models are those with a $3.3k\Omega$ resistance which is optimally suited to 5V drive circuits.
 - Economy model (no glass base) gives outstanding value for consumer appliances
- 40 kPa (0.4 kgf/cm²) and 49 kPa (0.5 kgf/cm²) units are also available.

TYPICAL APPLICATIONS

(Please evaluate under actual conditions before using.)

- Industrial use (pressure switches and pneumatic devices, etc.)
- Medical use (blood pressure monitors, oxygen concentrators, air beds, etc.)
- Other pneumatically operated pressure devices

Compliance with RoHS Directive

ORDERING INFORMATION

ADP

<Product name>

- 1: PF pressure sensor
- 4: PS pressure sensor

<Terminal profile and direction>

- 1: DIP terminal (Direction opposite the pressure inlet direction)



- 2: DIP terminal (Pressure inlet direction)



<Rated pressure>

- 0: 4.9 kPa
- 1: 14.7 kPa
- 2: 34.3 kPa
- 3: 49.0 kPa
- 4: 98.1 kPa
- 5: 196.1 kPa
- 6: 343.2 kPa
- 7: 490.3 kPa
- 8: 833.6 kPa
- 9: 980.7 kPa
- A: 40.0 kPa

<Type>

- 1: Standard type (With glass base)
- 2: Economy type (Without glass base)

<Bridge resistance>

- Nil: PF $5k\Omega$
- 0: PS $5k\Omega$
- 3: $3.3k\Omega$

Note: Some part numbers may not be available depending on the combination. Please refer to the Table of Product Types.

TYPES

1. DIP terminal

Brige resistance		Part No.							
		PS pressure sensor				PF pressure sensor			
		5kΩ		3.3kΩ		5kΩ		3.3kΩ	
Pressure	Terminal								
		DIP terminal: Direction opposite the pressure inlet direction	DIP terminal: Pressure inlet direction	DIP terminal: Direction opposite the pressure inlet direction	DIP terminal: Pressure inlet direction	DIP terminal: Direction opposite the pressure inlet direction	DIP terminal: Pressure inlet direction	DIP terminal: Direction opposite the pressure inlet direction	DIP terminal: Pressure inlet direction
Standard type (with glass base)	4.9kPa	ADP41010	ADP42010	—	—	ADP1101	ADP1201	—	—
	14.7kPa	ADP41110	ADP42110	—	—	ADP1111	ADP1211	—	—
	34.3kPa	ADP41210	ADP42210	—	—	ADP1121	ADP1221	—	—
	49.0kPa	ADP41310	ADP42310	—	—	ADP1131	ADP1231	—	—
	98.1kPa	ADP41410	ADP42410	ADP41413	ADP42413	ADP1141	ADP1241	—	—
	196.1kPa	ADP41510	ADP42510	—	—	ADP1151	ADP1251	—	—
	343.2kPa	ADP41610	ADP42610	—	—	ADP1161	ADP1261	—	—
	490.3kPa	ADP41710	ADP42710	—	—	ADP1171	ADP1271	—	—
	833.6kPa	ADP41810	ADP42810	—	—	ADP1181	ADP1281	—	—
980.7kPa	ADP41910	ADP42910	ADP41913	ADP42913	ADP1191	ADP1291	—	—	
Economy type (without glass base)	40.0kPa	—	—	ADP41A23	ADP42A23	—	—	ADP11A23	ADP12A23
	49.0kPa	ADP41320	ADP42320	—	—	ADP1132	ADP1232	—	—

Standard packing: Carton: 100 pcs.; Case: 1,000 pcs.

RATING

Type	Standard type (With glass base)								Economy type (Without glass base)		
Type of pressure	Gauge pressure										
Pressure medium	Air*2										
Rated pressure	Unit: kPa	4.9	14.7	34.3 to 343.2	490.3	833.6	980.7	98.1*3	980.7*3	40.0	49.0
Max. applied pressure	Twice the rated pressure					1.5 times the rated pressure		Twice the rated pressure	1.5 times the rated pressure	Twice the rated pressure	
Bridge resistance	5000±1000Ω						3300±700Ω		3300±600Ω	5000±1000Ω	
Ambient temperature	-20 to 100°C -4 to 212°F (no freezing or condensation)								-5 to +50°C +23 to +122°F	-20 to +100°C -4 to +212°F	
Storage temperature	-40 to 120°C -40 to 248°F (no freezing or condensation)								-20 to +70°C -4 to +158°F	-40 to +120°C -40 to +248°F	
Standard temperature	25°C 77°F						30°C 86°F		25°C 77°F		
Temperature compensation range	0 to 50°C 32 to 122°F						0 to 60°C 32 to 140°F		5 to 45°C 41 to 113°F	0 to 50°C 32 to 122°F	
Drive current (constant current)	1.5 mA DC						1.0 mA DC		1.5 mA DC		
Output span voltage	40±20 mV	100±40 mV					65±25 mV		43.5±22.5 mV	85±45 mV	
Offset voltage	±20 mV										
Linearity	±0.7%FS	±0.5%FS	±0.3%FS	±0.5%FS	±0.6%FS		±1.0%FS		±0.3%FS		
Pressure hysteresis	±0.6%FS	±0.4%FS	±0.2%FS	±0.4%FS			±1.0%FS		±0.7%FS		
Offset voltage-temperature characteristics*4	±15%FS	±5.0%FS					±3.5%FS		±10%FS	±8%FS	
Sensitivity-temperature characteristics*4	±10%FS	±2.5%FS								±1.3%FS	±2.5%FS

- Notes: *1. Unless otherwise specified, measurements were taken with a drive current of ±0.01 mA and humidity ranging from 25% to 85%.
 *2. Please consult us if a pressure medium other than air is to be used.
 *3. For PS pressure sensor only
 *4. This is the regulation which applies within the compensation temperature range.
 *5. Please consult us if the intended use involves a negative pressure.

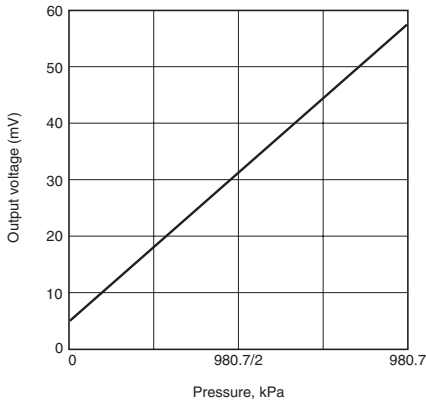
REFERENCE DATA

[PS pressure sensor]

1. Characteristics data

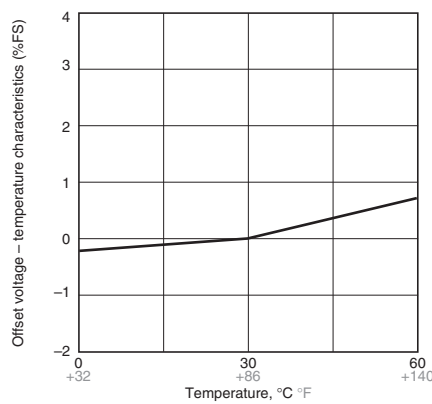
1.-(1) Output characteristics

ADP41913
Drive current: 1.0 mA; temperature: 30°C 86°F



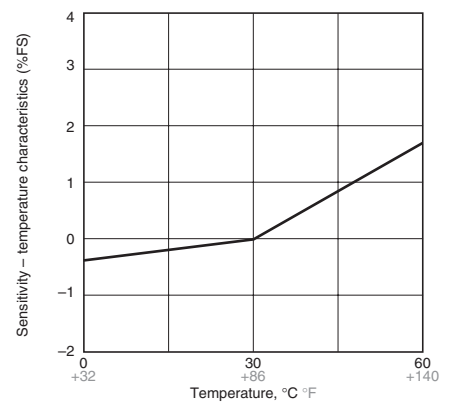
1.-(2) Offset voltage – temperature characteristics

ADP41913
Drive current: 1.0 mA; rating $\pm 3.5\%$ FS



1.-(3) Sensitivity – temperature characteristics

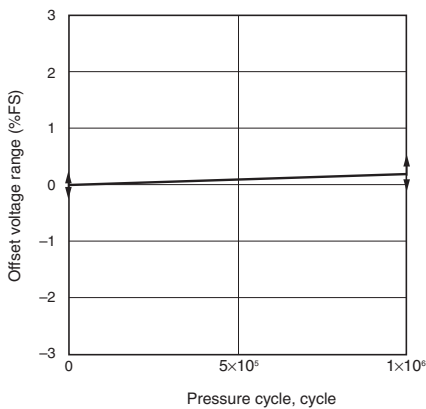
ADP41913
Drive current: 1.0 mA; rating $\pm 2.5\%$ FS



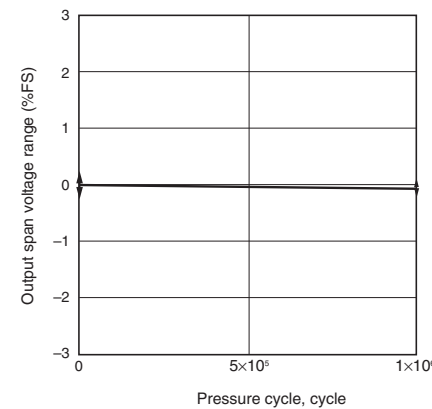
2. Pressure cycle range (0 to rated pressure)

Tested sample: ADP41913, temperature: 100°C 212°F, No. of cycle: 1×10^6

Offset voltage range



Output span voltage range



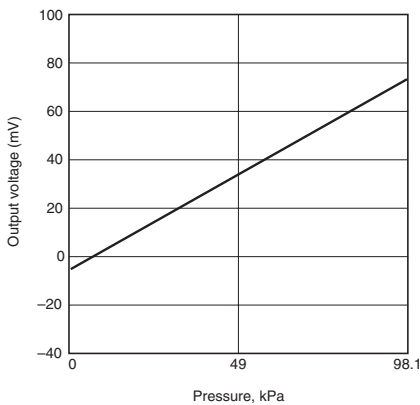
Even after testing for 1 million times, the variations in the offset voltage and output span voltage are minimal.

[PF pressure sensor]

1. Characteristics data

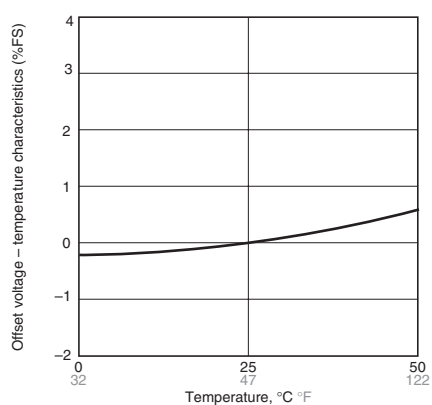
1.-(1) Output characteristics

ADP1141
Drive current: 1.5 mA; temperature: 25°C 77°F



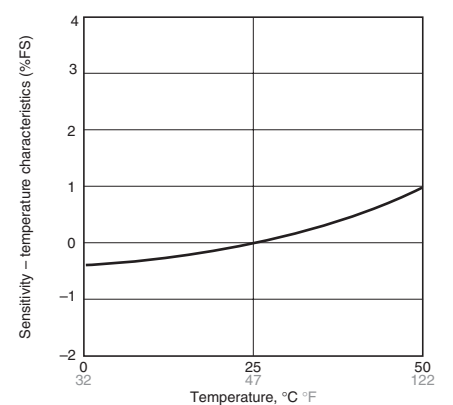
1.-(2) Offset voltage – temperature characteristics

ADP1141
Drive current: 1.5 mA; rating $\pm 5\%$ FS



1.-(3) Sensitivity – temperature characteristics

ADP1141
Drive current: 1.5 mA; rating $\pm 2.5\%$ FS

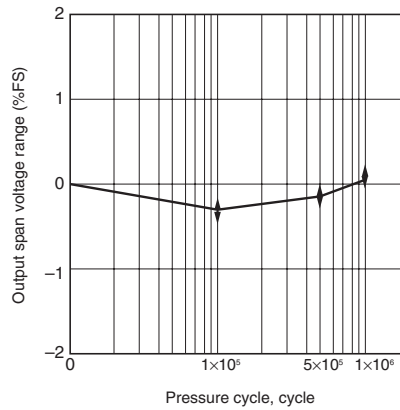
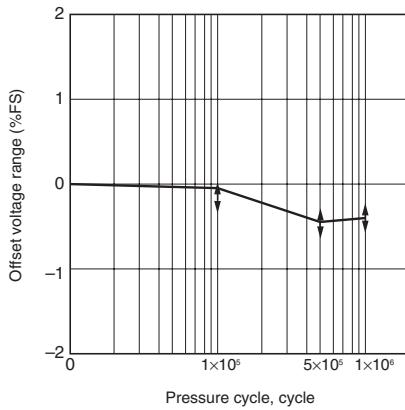


2. Pressure cycle range (0 to rated pressure)

Tested sample: ADP1131, temperature: 25°C 77°F

Offset voltage range

Output span voltage range



Even after testing for 1 million times, the variations in the offset voltage and output span voltage are minimal.

Evaluation test

Classification	Tested item	Tested condition	Result
Environmental characteristics	Storage at high temperature	Temperature: Left in a 120°C 248°F constant temperature bath Time: 1,000 hrs.	Passed
	Storage at low temperature	Temperature: Left in a -40°C -40°F constant temperature bath Time: 1,000 hrs.	Passed
	Humidity	Temperature/humidity: Left at 40°C 104°F, 90% RH Time: 1,000 hrs.	Passed
	Temperature cycle	Temperature: -40°C to 120°C -40°F to 248°F 1 cycle: 30 min. Times of cycle: 100	Passed
Endurance characteristics	High temperature/high humidity operation	Temperature/humidity: 40°C 104°F, 90% RH Operation times: 10 ⁶ , rated voltage applied	Passed
Mechanical characteristics	Vibration resistance	Double amplitude: 1.5 mm .059 inch Vibration: 10 to 55 Hz Applied vibration direction: X, Y, Z 3 directions Times: 2 hrs each	Passed
	Dropping resistance	Dropping height: 75 cm 29.528 inch Times: 2 times	Passed
	Terminal strength	Pulling strength: 9.8 N {1 kgf}, 10 sec. Bending strength: 4.9 N {0.5 kgf}, left and right 90° 1 time	Passed
Soldering resistance	Soldered in DIP soldering bath	Temperature: 230°C 446°F Time: 5 sec.	Passed
	Temperature	Temperature: 260°C 500°F Time: 10 sec.	Passed

Note: For details other than listed above, please consult us.

Acceleration sensors

Light sensors

Motion sensors

Pressure sensors

Information

PS (ADP4)/PF (ADP1)

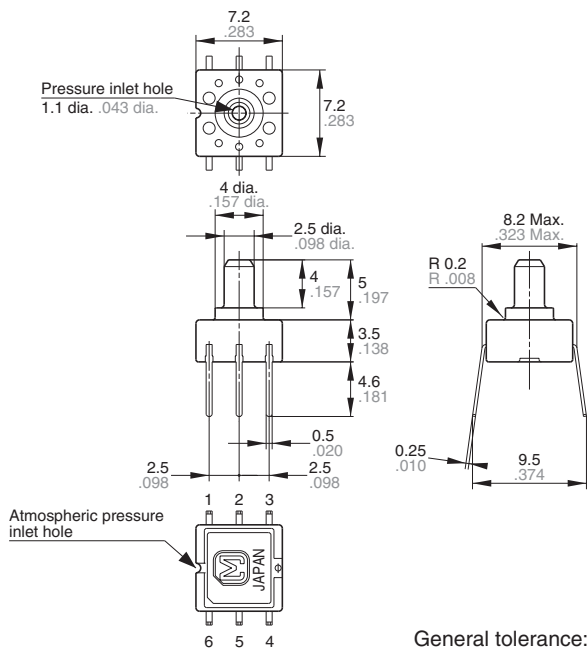
DIMENSIONS (mm inch)

The CAD data of the products with a **CAD Data** mark can be downloaded from: <http://panasonic-electric-works.net/ac>

[PS pressure sensor]

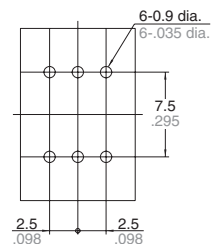
1. Terminal direction: DIP terminal Direction opposite the pressure inlet direction ADP41□□□

CAD Data

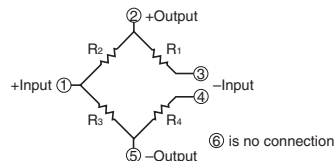


General tolerance: $\pm 0.3 \pm .012$

Recommended PC board pattern (BOTTOM VIEW)



Terminal connection diagram

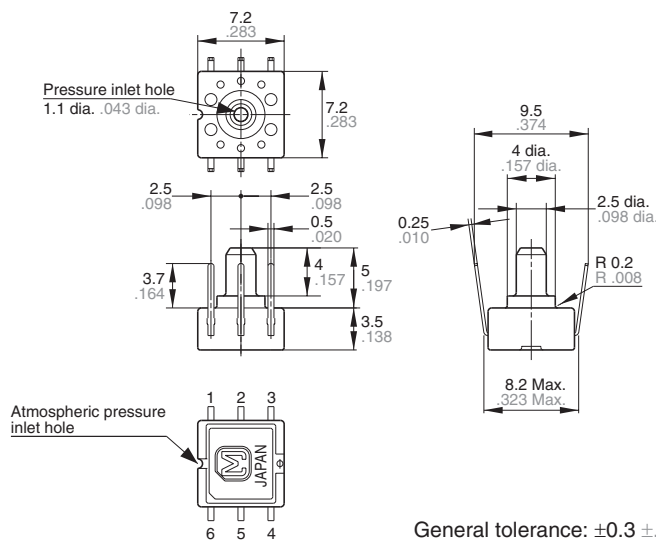


Terminal No.	Name
1	Power supply (+)
2	Output (+)
3	Power supply (-)
4	Power supply (-)
5	Output (-)
6	No connection

Note: Leave terminal 6 unconnected.

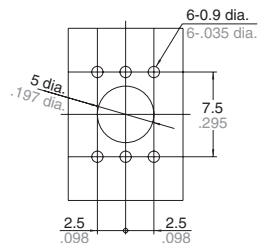
2. Terminal direction: DIP terminal Pressure inlet direction ADP42□□□

CAD Data

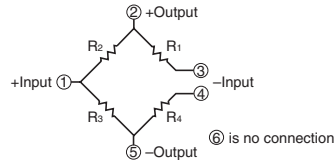


General tolerance: $\pm 0.3 \pm .012$

Recommended PC board pattern (BOTTOM VIEW)



Terminal connection diagram



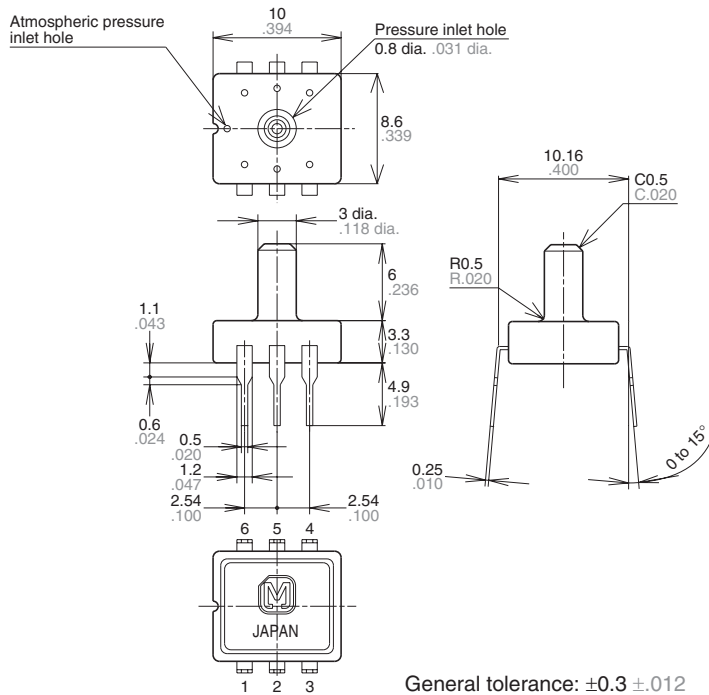
Terminal No.	Name
1	Power supply (+)
2	Output (+)
3	Power supply (-)
4	Power supply (-)
5	Output (-)
6	No connection

Note: Leave terminal 6 unconnected.

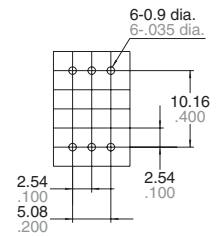
[PF pressure sensor]

1. Terminal direction: Direction opposite the pressure inlet direction ADP11□□ (□)

CAD Data

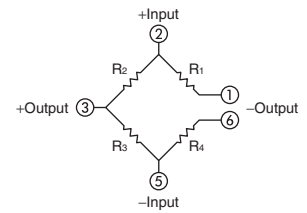


Recommended PC board pattern (BOTTOM VIEW)



Tolerance: $\pm 0.1 \pm .004$

Terminal connection diagram

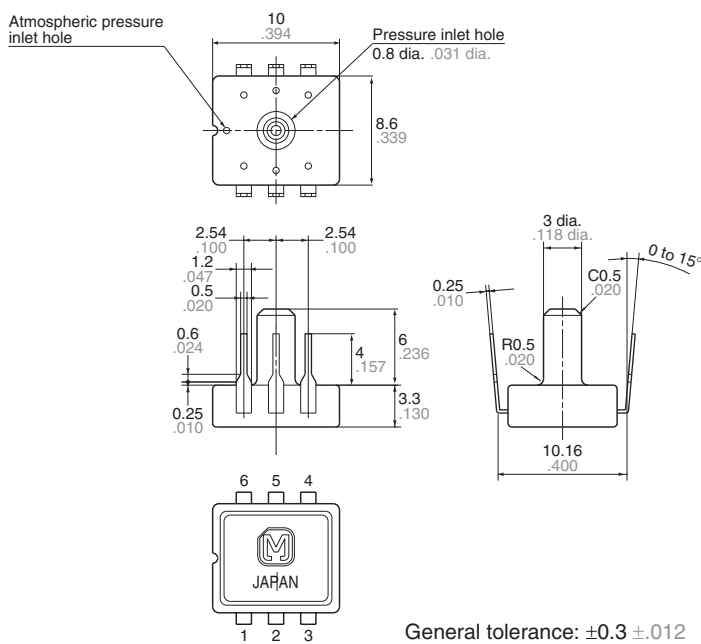


Terminal No.	Name
1	Output (-)
2	Power supply (+)
3	Output (+)
4	No connection
5	Power supply (-)
6	Output (-)

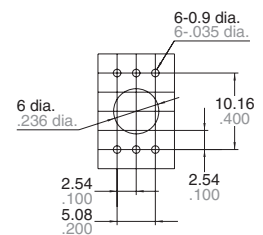
Note: Leave terminal 4 unconnected.

2. Terminal direction: Pressure inlet direction ADP12□□ (□)

CAD Data

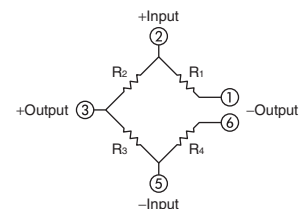


Recommended PC board pattern (BOTTOM VIEW)



Tolerance: $\pm 0.1 \pm .004$

Terminal connection diagram



Terminal No.	Name
1	Output (-)
2	Power supply (+)
3	Output (+)
4	No connection
5	Power supply (-)
6	Output (-)

Note: Leave terminal 4 unconnected.

NOTES

1. Mounting

Use lands on the PC boards to which the sensor can be securely fixed.

2. Soldering

Due to its small size, the thermal capacity of the pressure sensor DIP type is low.

Therefore, take steps to minimize the effects of external heat.

Damage and changes to characteristics may occur due to heat deformation.

Use a non-corrosive resin type of flux.

Since the pressure sensor DIP type is exposed to the atmosphere, do not allow flux to enter inside.

1) Manual soldering

- Set the soldering tip from 260 to 300°C 500 to 572°F (30W), and solder for no more than 5 seconds.

- Please note that output may change if the pressure is applied on the terminals when the soldering.

- Thoroughly clean the soldering iron.

2) DIP soldering (DIP terminal type)

- Please keep the DIP solder bath temperature no higher than 260°C 500°F. When soldering, heat should be applied no longer than five seconds.

- When mounting onto a PCB of low thermal capacity, please avoid DIP soldering as this may cause heat deformity.

3) Solder reworking

- Finish reworking in one operation.

- For reworking of the solder bridge, use a soldering iron with a flat tip. Please do not add more flux when reworking.

- Please use a soldering iron that is below the temperature given in the specifications in order to maintain the correct temperature at the tip of the soldering iron.

4) Too much force on the terminals will cause deformation and loss in effectiveness of the solder. Therefore, please avoid dropping and careless handling of the product.

5) Please control warping of the PCB within 0.05 mm of the sensor width.

6) When cut folding the PCB after mounting the sensor, take measures to prevent stress to the soldered parts.

7) The sensor terminals are designed to be exposed, so contact of the terminals with metal shards and the like will cause output errors. Therefore, please be careful and prevent things such as metal shards and hands from contacting the terminals.

8) To prevent degradation of the PCB insulation after soldering, please be careful not to get chemicals on the sensor when coating.

9) Please consult us regarding the use of lead-free solder.

3. Cleaning

1) Since the pressure sensor chip is exposed to the atmosphere, do not allow cleaning fluid to enter inside.

2) Avoid ultrasonic cleaning since this may cause breaks or disconnections in the wiring.

4. Environment

1) Please avoid using or storing the pressure sensor chip in a place exposed to corrosive gases (such as the gases given off by organic solvents, sulfuric acid gas, hydrogen sulfides, etc.) which will adversely affect the performance of the pressure sensor chip.

2) Since this pressure sensor chip does not have a water-proof construction, please do not use the sensor in a location where it may be sprayed with water, etc.

3) Avoid using the pressure sensors chip in an environment where condensation may form.

Furthermore, its output may fluctuate if any moisture adhering to it freezes.

4) The pressure sensor chip is constructed in such a way that its output will fluctuate when it is exposed to light. Especially when pressure is to be applied by means of a transparent tube, take steps to prevent the pressure sensor chip from being exposed to light.

5) Avoid using the pressure sensor chip where it will be susceptible to ultrasonic or other high-frequency vibration.

5. Quality check under actual loading conditions

To assure reliability, check the sensor under actual loading conditions. Avoid any situation that may adversely affect its performance.

6. Other handling precautions

1) That using the wrong pressure range or mounting method may result in accidents.

2) The only direct pressure medium you can use is dry air. The use of other media, in particular, corrosive gases (organic solvent based gases, sulfuric acid based gases, and hydrogen sulfide based gases, etc.) and media that contains moisture or foreign substances will cause malfunction and damage. Please do not use them.

3) The pressure sensor chip is positioned inside the pressure inlet. Never poke wires or other foreign matter through the pressure inlet since they may damage the chip or block the inlet. Avoid use when the atmospheric pressure inlet is blocked.

4) Use an operating pressure which is within the rated pressure range. Using a pressure beyond this range may cause damage.

5) Since static charge can damage the pressure sensor chip, bear in mind the following handling precautions.

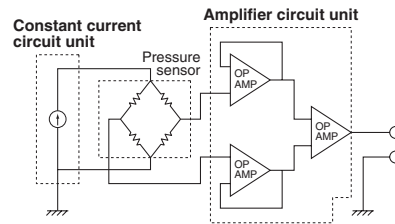
(1) When storing the pressure sensor chips, use a conductive material to short the pins or wrap the entire chip in aluminum foil. Plastic containers should not be used to store or transport the chips since they readily become charged.

(2) When using the pressure sensor chips, all the charged articles on the bench surface and the work personnel should be grounded so that any ambient static will be safely discharged.

6) Based on the pressure involved, give due consideration to the securing of the pressure sensor DIP type and to the securing and selection of the inlet tube. Consult us if you have any queries.

APPLICATION CIRCUIT DIAGRAM (EXAMPLE)

The pressure sensor is designed to convert a voltage by means of constant current drive and then, if necessary, it amplifies the voltage for use. The circuit shown below is a typical example of a circuit in which the pressure sensor is used.



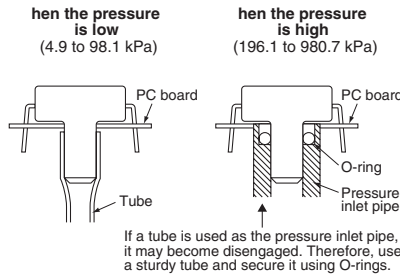
MOUNTING METHOD

The general method for transmitting air pressures differs depending on whether the pressure is low or high.

• Checkpoints for use

- (1) Select a pressure inlet pipe which is sturdy enough to prevent pressure leaks.
- (2) Fix the pressure inlet pipe securely so as to prevent pressure leaks.
- (3) Do not block the pressure inlet pipe.

Methods of transmitting air pressures



Glossary of Common Terms for Pressure Sensors

EXPLANATION OF TERMS

1. Pressure object

This is what can be used to activate the pressure sensor.
(The Panasonic Electric Works pressure sensor can be used with gas.)

2. Rated pressure

The pressure value up to which the specifications of the pressure sensor are guaranteed.

3. Maximum applied pressure

The maximum pressure that can be applied to the pressure sensor, after which, when the pressure is returned to below the rated pressure range, the specifications of the pressure sensor are guaranteed.

4. Temperature compensation range

The temperature range across which the specification values of the pressure sensor are guaranteed.

5. Drive current (voltage)

The supply current (voltage) required to drive a pressure sensor.

6. Output span voltage

The difference between the rated output voltage and the offset voltage. The output span voltage is also called the full-scale voltage (FS).

7. Offset voltage

The output voltage of a pressure sensor when no pressure is applied.

8. Rated pressure output voltage

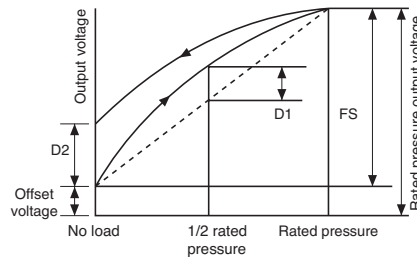
Output voltage when rated pressure is applied.

9. Linearity

When the pressure is varied from no load to the rated pressure, the linearity is the amount of shift between the straight line that joins the no-load voltage value and the rated pressure voltage value (expressed as the ratio of the amount of shift (D1) at half of the rated pressure value with respect to the full scale voltage (FS)).

10. Output hysteresis

The ratio of the difference (D2) in the no-load output voltages when the pressure is varied from no load to the rated pressure then reduced back to no load, with respect to the full scale voltage (FS).

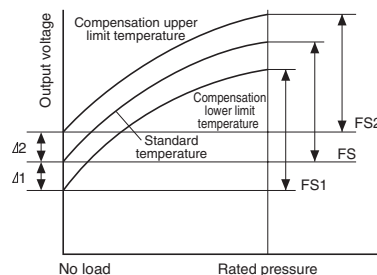


11. Offset voltage temperature characteristic

The variation of the offset voltage with changes in ambient temperature. The difference between the offset voltage at the standard temperature and the offset values at the compensation lower limit temperature (low temperature) (D1) and compensation upper limit temperature (high temperature) (D2) are obtained, and the offset voltage temperature characteristic is expressed as the ratio of the larger of these two differences (absolute) with respect to the full scale voltage (FS).

12. Temperature sensitivity characteristic

The variation of the sensitivity with changes in ambient temperature (variation in full scale (FS)). The difference between the full scale voltage at the standard temperature (FS) and the full scale values at the compensation lower limit temperature (low temperature) (FS1) and compensation upper limit temperature (high temperature) (FS2) are obtained, and the offset voltage temperature characteristic is expressed as the ratio of the larger of these two differences (FS1 - FS and FS2 - FS (absolute)) with respect to the full scale voltage (FS).

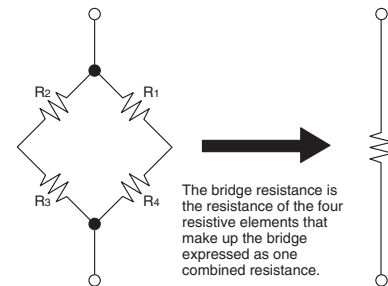


13. Bridge resistance

Refers to the resistance value of a piezoresistance formed on a monolithic silicon substrate.

For example, the values of the resistances R1 to R4 in the bridge are typically 5kΩ each.

When the resistances of the resistive elements R1 to R4 that comprise the bridge are 5kΩ each, the equivalent composite resistance of the bridge is 5kΩ (3kΩ bridges are also available).



14. Overall accuracy

Accuracy of offset voltage and rated pressure output voltage within the temperature compensation range.

ISO14001 Certificate of approval

Since the establishment of the "Matsushita Electric Works Global Environmental Charter" (previous company name) in 1992, we are set to unite in a concerted effort toward making Panasonic Electric Works a company capable of sustainable development by striking the right balance between our commitments to the environment, the economy, and society. Regarding environmental conservation, we are fully committed to reducing the transfer and waste of chemical substances. In energy-related efforts, we are developing technologies to create energy-saving products, and for natural resources, we are working to eliminate industrial waste and developing recycling technologies.

Our goal is peaceful co-existence with our global society.

Panasonic Electric Works Global Environmental Charter

■ Responsibilities of industry

- To provide products and services useful to society
- To fulfill social responsibilities
- To pursue corporate logic

■ Harmonization with the global environment

- Conservation of the global environment
- Protection of resources

■ Harmonization with society

- Contributing to local communities
- Contributing to the global community



ISO9001 Certificate of approval

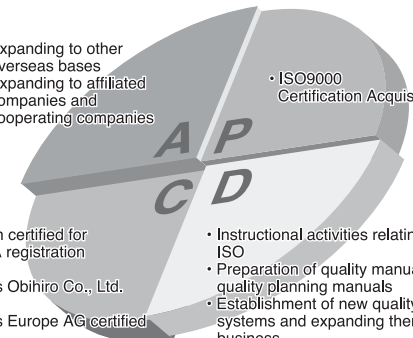
Our Switching Device Division, which handles from development to production and marketing, has been approved for certification of the ISO9001 quality assurance standards established by the International Standards Organization (ISO).

On October, 1993, this achievement was officially registered by the certification organizations UKAS of the United Kingdom and RVA of the Netherlands.



The Necessity and Pursuit of ISO Certification

- Expanding to other overseas bases
- Expanding to affiliated companies and cooperating companies
- ISO9000 Certification Acquisition



- Switching Device Division certified for ISO9001 UKAS and RVA registration (October, 1993)
- Panasonic Electric Works Obihiro Co., Ltd. certified for ISO9001
- Panasonic Electric Works Europe AG certified for ISO9001
- Panasonic Electric Works Automation Controls (Beijing) Co., Ltd. certified for ISO9001
- Panasonic Electric Works (Thailand), Ltd. certified for ISO9001
- Panasonic Electric Works, Mexicana S.A. de C.V. certified for ISO9001
- Instructional activities relating to ISO
- Preparation of quality manuals and quality planning manuals
- Establishment of new quality systems and expanding them to business operations
- Upgrading internal quality monitoring

ISO/TS16949 Certificate of approval

Our Switching Device Division has been accredited for ISO/TS16949, covering our quality management system for an entire spectrum of automotive products ranging from mechanical to semiconductor relays. ISO/TS16949 is a standard based on ISO9001 that adds items necessary for the automobile industry.

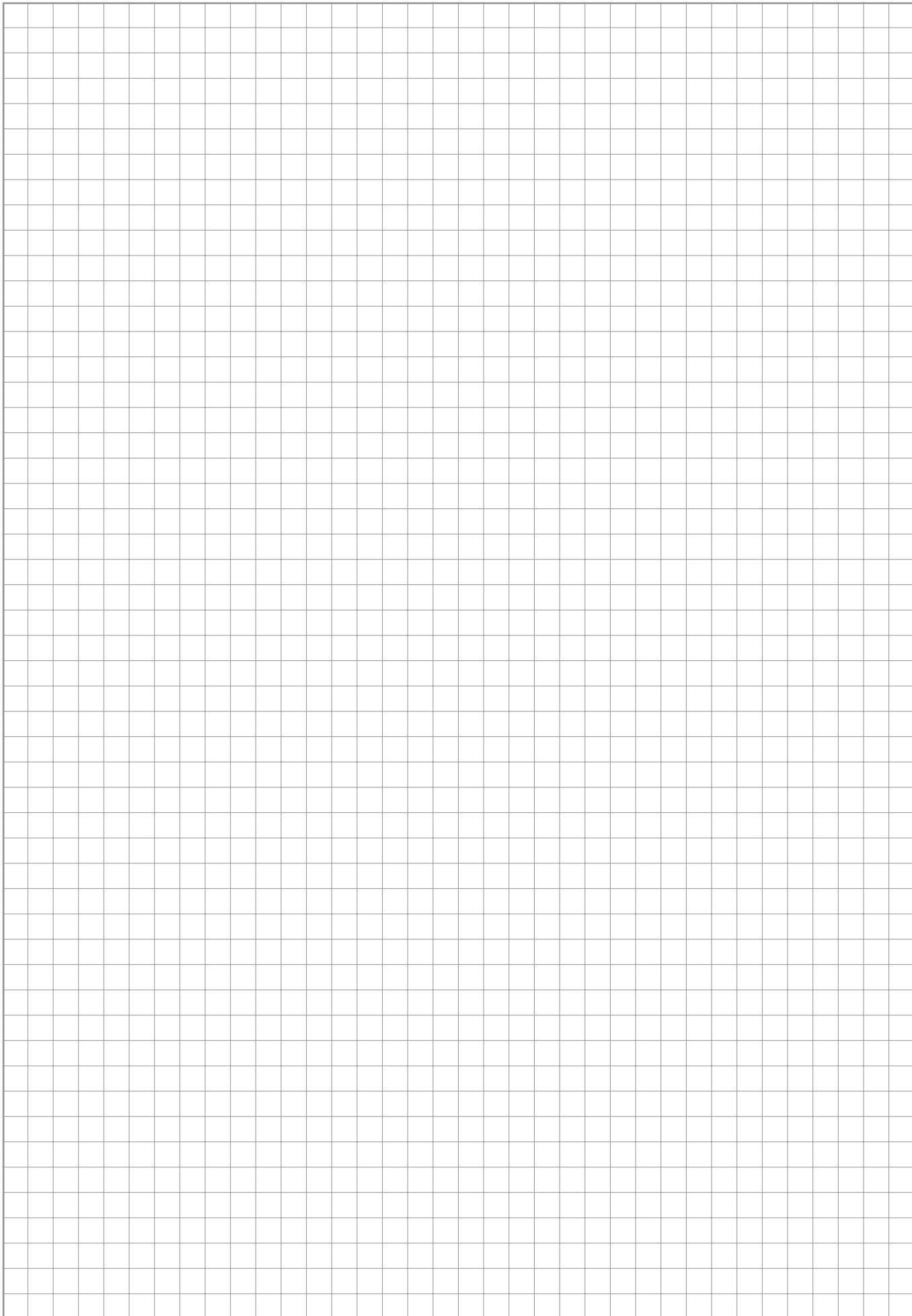
It calls for a comprehensive quality management system that includes CS, cost performance, ongoing improvement, and many other aspects of quality management.

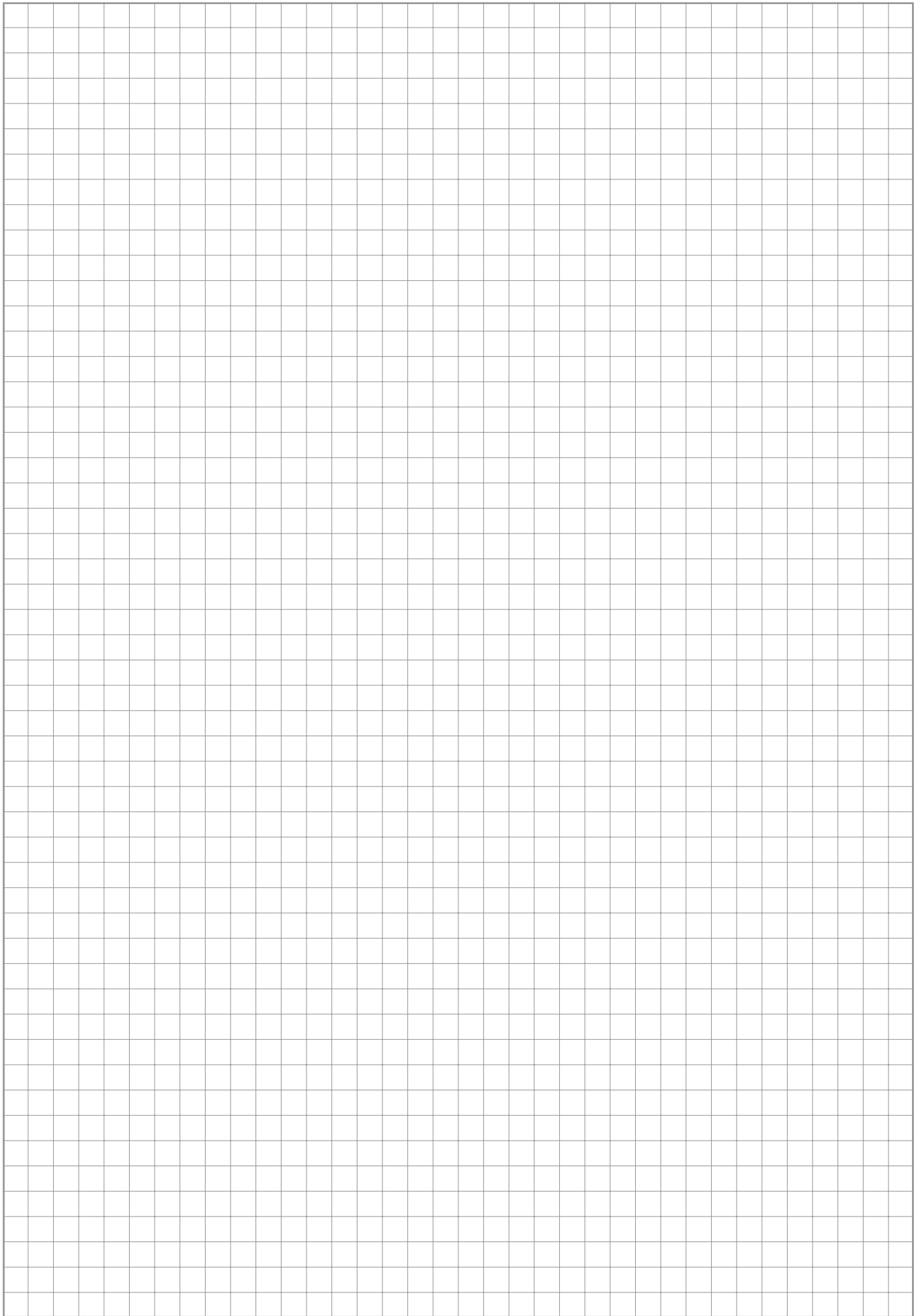
■ Certification Status

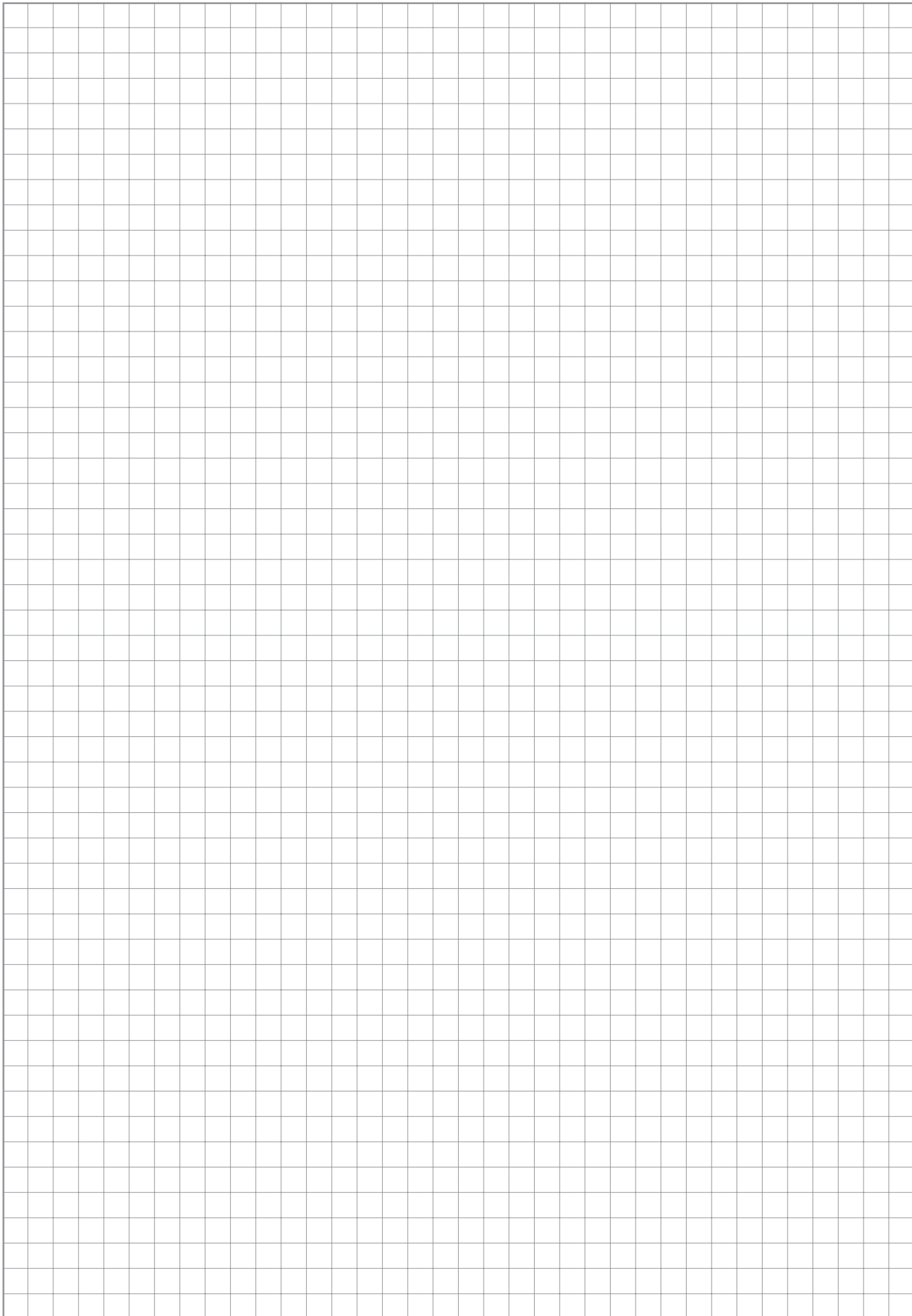
- Switching Device Division approved
- Panasonic Electric Works Obihiro Co., Ltd. approved
- Panasonic Electric Works, (Thailand) Ltd. approved
- Panasonic Electric Works, Mexicana S.A. de C.V. approved
- Panasonic Electric Works, Europe AG, German Factory approved

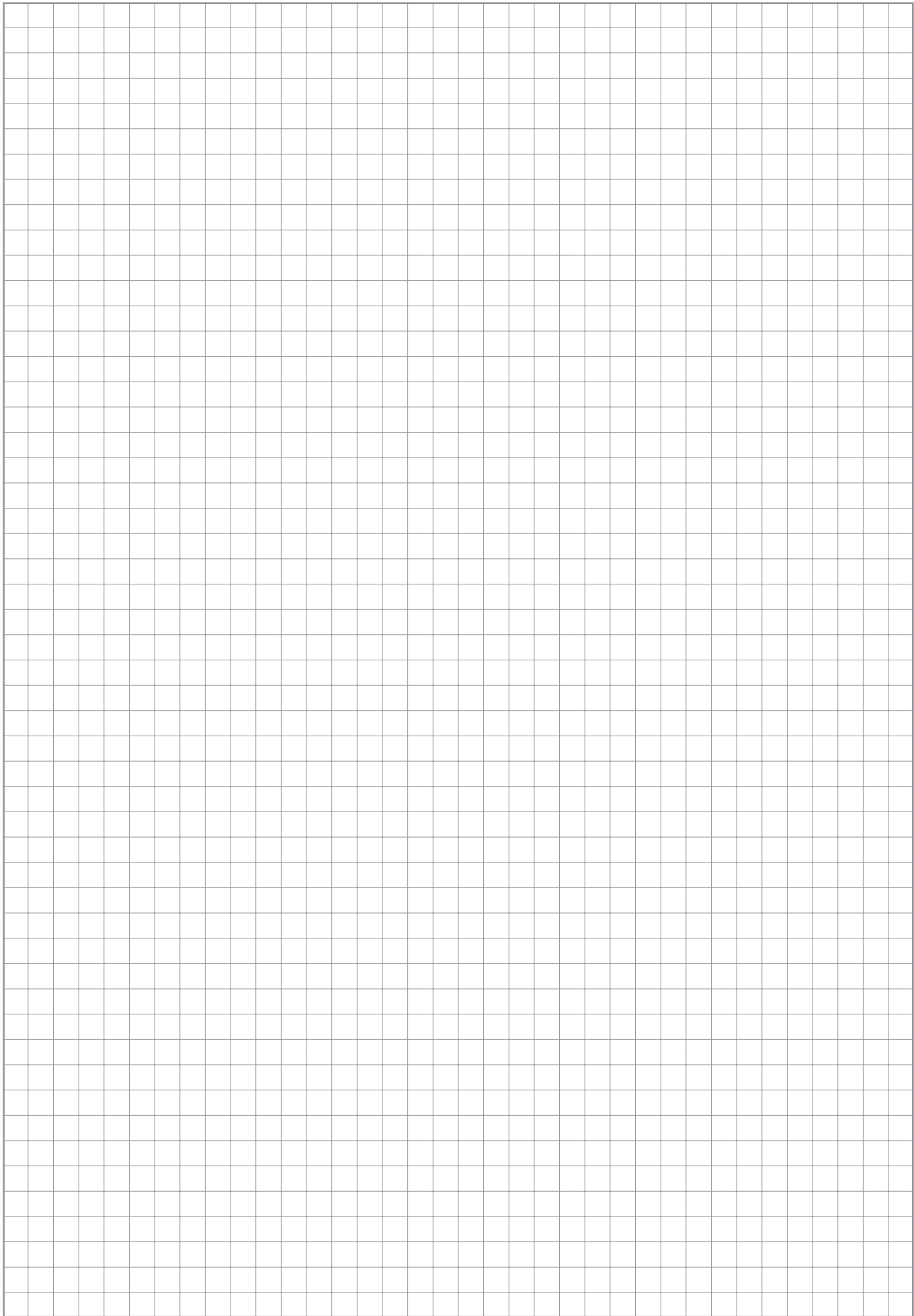
Advantages

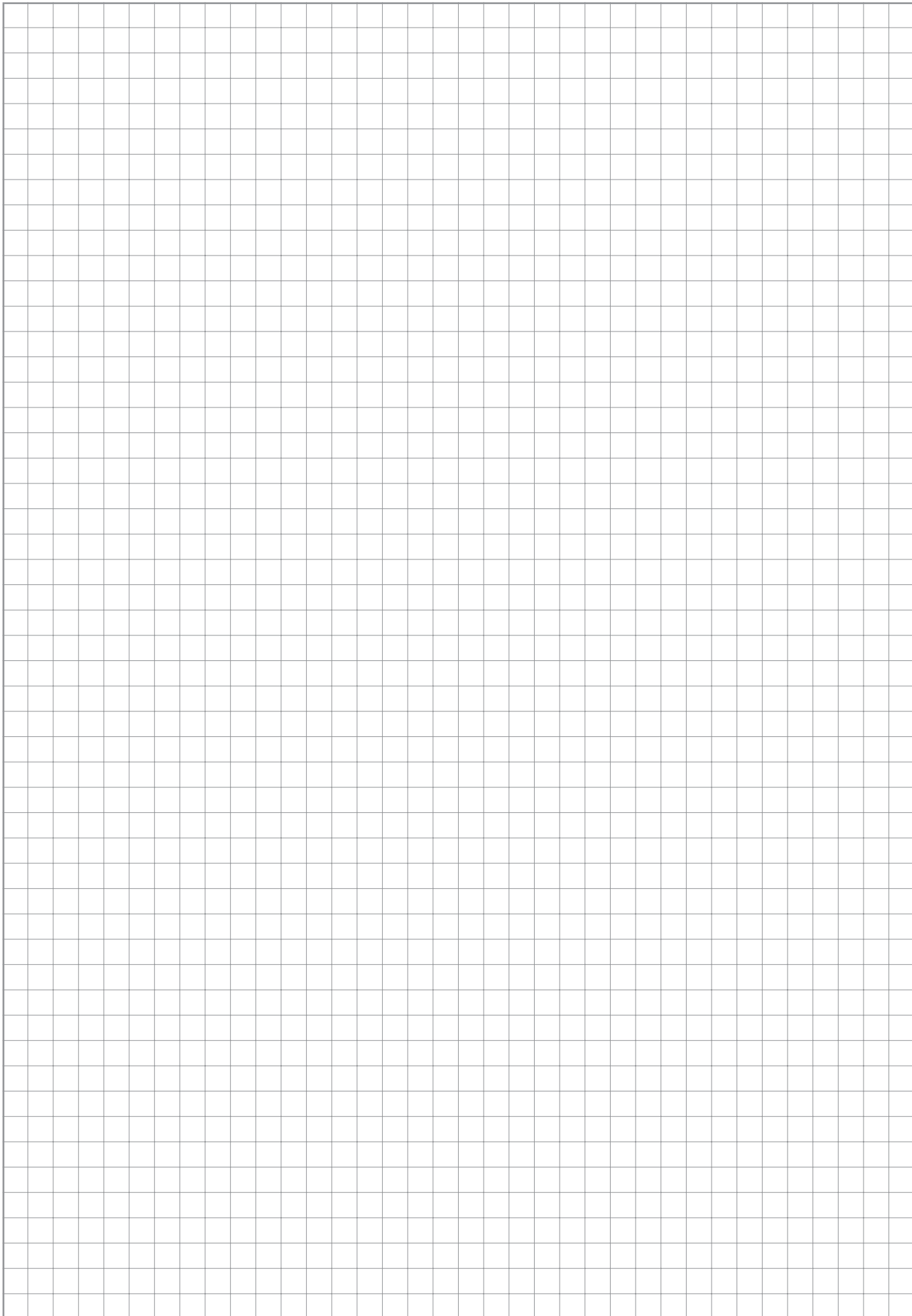
- Strengthening and upgrading quality assurance organizational structures applicable on an international basis
- Technology can be accumulated and disseminated through documentation and records
- Leads to improved reliability of the manufacturer's quality and improved CS (customer satisfaction)











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