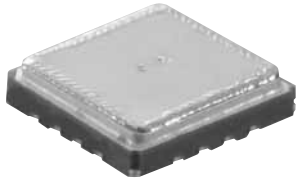


Ultra-small devices
PIMITES
[pi:mittels]

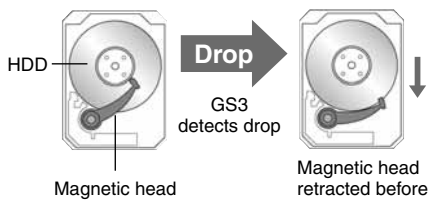


RoHS Directive compatibility information
<http://www.nais-e.com/>

APPLICATIONS

● Built-in ASIC Type

1. Protection of HDD parts against drops, free drop detection



FEATURES

● Built-in ASIC Type

1. Ultra-compact size
4.6 (L) × 4.6 (W) × 1.3 mm (H) (typ.)
2. Excellent ability to withstand dropping due to high anti-shock properties
5,000 g
3. Independent detection possible of acceleration and inclination on X, Y, and Z axes.

● Element Type

1. Ultra-compact size
4.6 (L) × 4.6 (W) × 1.0 mm (H) (typ.)
2. High anti-shock characteristic
5000g
3. Functioning 6-axis motion sensor in connection with "AK8971N" 3-axis electronic compass of Asahi Kasei Microsystems Corporation.

2. Inclination detection in gaming devices



3. Other applications

- Posture detection of mobile terminals, operation simplification, and vertical/
- Vibration and inclination detection for security devices
- Robot posture detection
- Vibration detection for household appliances

● Element Type

1. Mobile phone GPS navigation (Posture detection)



2. Other mobile phone applications

- Games
- Simplification of key operation
- HDD drop protection
- LCD horizontal/vertical switching
- Pedometers, etc.

ORDERING INFORMATION

AGS 6 1 3

Number of detectable axis (Method)
6: 3-axis Acceleration Sensor (Piezo resistance method)

Package type/Size
1: Ceramic package/4.6 x 4.6 mm

Acceleration detection range
2: ±2 g
3: ±3 g

Operation power supply voltage/Output type
3: 3 V DC/Analog output

Type
1: Built-in ASIC type
3: Element type

AGS6

PRODUCT TYPES

Product name	Operation power supply voltage	Type	Acceleration detection range	Part number
3-axis Acceleration sensor GS3	3 V DC	Built-in ASIC type 1	±2g	AGS61231
		Built-in ASIC type 2	±3g	AGS61331
		Element type	±3g	AGS61333

Note: Please consult us regarding packaging.

MAXIMUM RATING

1. Built-in ASIC type (AGS61231/AGS61331)

Item	Unit	Standard value			Remarks
		min.	typ.	max.	
Maximum allowable voltage	V	-0.3	—	6.5	Ta=25°C
Storage temperature range	°C	-40	—	85	
Operation temperature range	°C	-20	—	70	
Anti-shock characteristic	g	5,000	—	—	

2. Element type (AGS61333)

Item	Unit	Standard value			Remarks
		min.	typ.	max.	
Maximum allowable voltage	V	-0.3	—	6.5	Ta=25°C
Storage temperature range	°C	-40	—	85	
Operation temperature range	°C	-30	—	85	
Anti-shock characteristic	g	5,000	—	—	

ELECTRICAL CHARACTERISTICS

1. Built-in ASIC type (AGS61231/AGS61331)

Part number	Axis	Unit	AGS61231			AGS61331			Remarks
			Standard value			Standard value			
			min.	typ.	max.	min.	typ.	max.	
Acceleration detection range	X, Y, Z	g	-2	—	2	-3	—	3	
Operation power supply voltage	—	V	2.7	3.0	3.6	2.7	3.0	3.6	-20 to 70°C
Current consumption	—	mA	—	1.7	2.5	—	1.7	2.5	Ta=25°C
Sensitivity	X, Y, Z	V/g	0.47	0.5	0.53	0.313	0.333	0.353	Ta=25°C
Temperature sensitivity characteristic	X, Y, Z	%	-9	—	9	-9	—	9	-20 to 70°C
Offset voltage (0 g)	X, Y, Z	V	1.41	1.5	1.59	1.44	1.5	1.56	Ta=25°C
Offset voltage temperature characteristic	X, Y, Z	%FS	-12	—	12	-8	—	8	-20 to 70°C
Other axis sensitivity	X, Y, Z	%	-6	—	6	-6	—	6	Ta=25°C
Non-linearity ^{Note 3)}	X, Y, Z	%FS	-2	—	2	-2	—	2	Ta=25°C
Turn-on time ^{Note 4)}	X, Y, Z	ms	—	20	—	—	20	—	0g, Ta=25°C, C1=C2=0.1μF, Cx,Cy, Cz=33nF
Frequency response ^{Note 5)}	X, Y, Z	Hz	DC	50	—	DC	50	—	-3dB point, Cx, Cy, Cz=33nF

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

2. VDD=3 V when there is no indication.

3. Maximum error from linear output that connects +2 g and -2 g output (Built-in ASIC type 1) or +3 g and -3 g output (Built-in ASIC type 2).

4. "C1" is a capacitor installed between the VDD and GND terminals. "C2" is a capacitor installed between the AGND and GND terminals.

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

6. The specifications above are subject to change without notice.

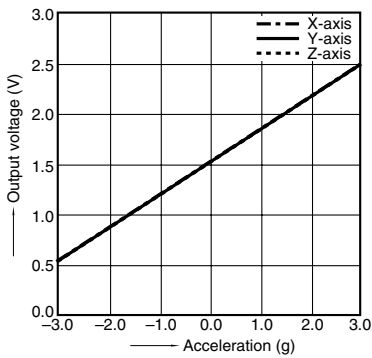
2. Element type (AGS61333)

Item	Unit	Standard value			Remarks
		min.	typ.	max.	
Acceleration detection range	g	-3	—	3	
Operation power supply voltage	V	2.0	3.0	5.0	-30 to 85°C
Sensor resistance Note 3)	kΩ	8	9.5	11	0g, Ta=25°C
Sensitivity	mV/g	0.6	—	2.3	Ta=25°C
Temperature sensitivity characteristic	%/°C	-0.8	—	0.8	-30 to 85°C
Offset voltage (0 g)	mV	-20	—	20	Ta=25°C
Offset voltage temperature characteristic	%FS/°C	-1.5	—	1.5	-30 to 85°C
Other axis sensitivity	%	-6	—	6	Ta=25°C
Non-linearity Note 4)	%FS	-2	—	2	Ta=25°C
Frequency response	Hz	DC	200	—	±1dB point

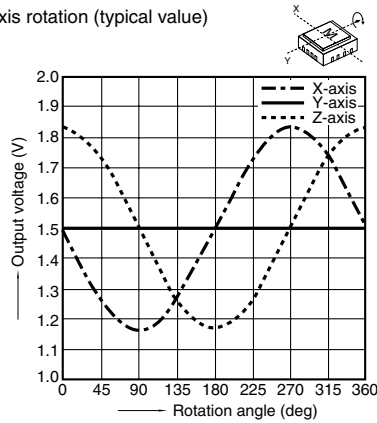
- Notes: 1. The acceleration unit “g” means 9.8 m/s².
 2. VDD=3 V when there is no indication.
 3. Resistance value between VDD and GND terminals.
 4. Maximum error from linear output that connects +3 g and -3 g output.
 5. The specifications above are subject to change without notice.

REFERENCE DATA (Typical value for AGS61331)

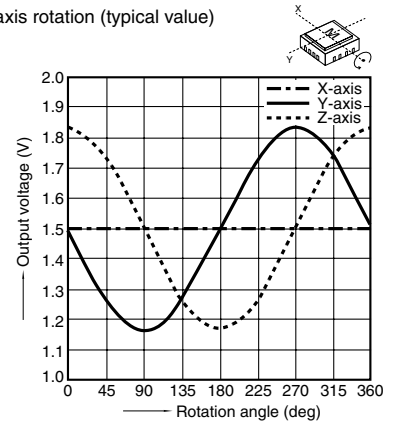
1. Output characteristics



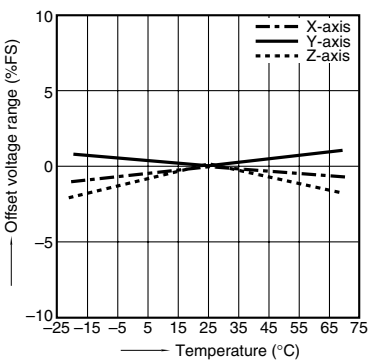
2. Inclination angle - Output voltage characteristics
 Y-axis rotation (typical value)



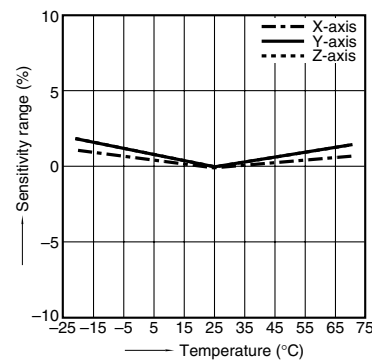
X-axis rotation (typical value)



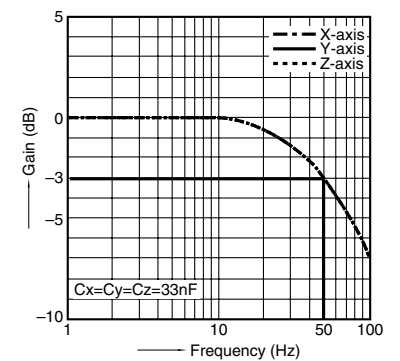
3. Offset voltage temperature characteristics (Typical value)



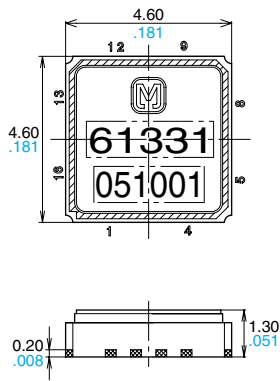
4. Sensitivity temperature characteristics



5. Frequency characteristics
 -3dB bandwidth: 50 Hz



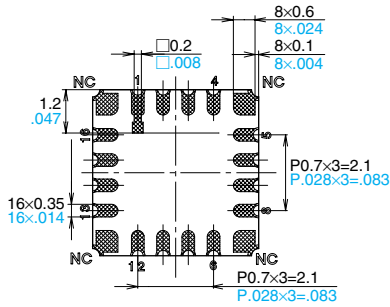
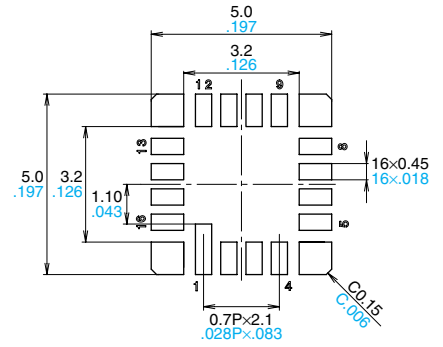
Note: The frequency characteristics can be changed depending on the Cx, Cy and Cz capacitance value. Please refer to “Recommended circuit diagram” on the following page.



Terminal No.	Abbreviation	Terminal No.	Abbreviation
1	ZO	9	NC
2	AGND	10	NC
3	VDD	11	GND
4	NC	12	XC
5	NC	13	XO
6	NC	14	YC
7	GND	15	YO
8	NC	16	ZC

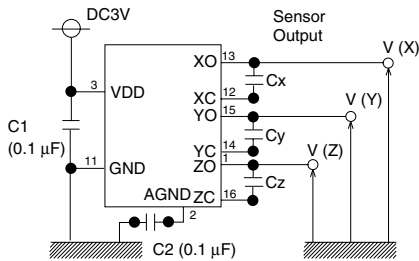
Leave terminal "NC (No. 4 to 6 and 8 to 10)" unconnected.
The No. 7 and No. 11 terminals are connected internally.

Recommended PC board pad



Tolerance: $\pm 0.15 \pm 0.006$

RECOMMENDED CIRCUIT DIAGRAM FOR BUILT-IN ASIC TYPE



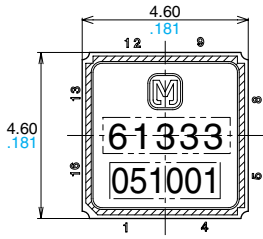
The frequency characteristics value can be changed depending on the Cx, Cy and Cz capacitance value. -3dB bandwidth is expressed in the formula below.

$$f_{-3dB} = \frac{1}{2\pi \times (100k\Omega) \times C(x,y,z)}$$

Selection example of Cx, Cy and Cz

Cx, Cy, Cz	Bandwidth
33nF	50Hz
8.2nF	200Hz

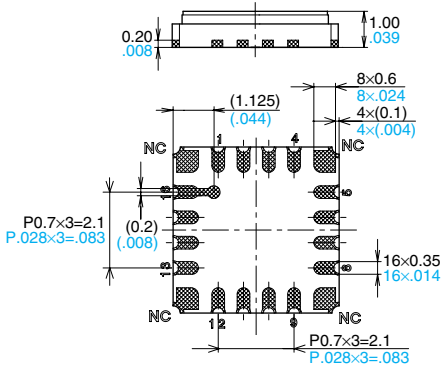
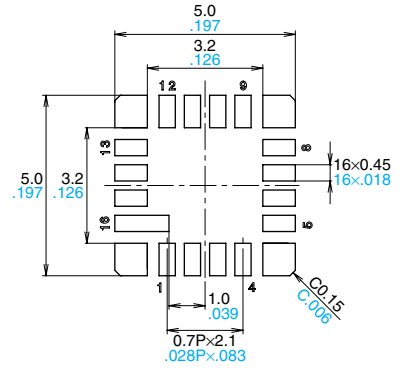
DIMENSIONS FOR ELEMENT TYPE



Terminal No.	Abbreviation	Terminal No.	Abbreviation
1	NC	9	NC
2	NC	10	NC
3	NC	11	NC
4	NC	12	NC
5	XN	13	XP
6	YP	14	YN
7	VDD	15	ZP
8	ZN	16	GND

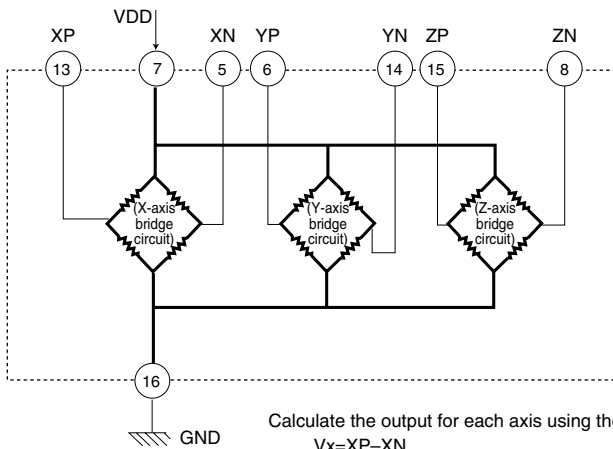
Note: Leave terminal "NC (No. 1 to 4 and 9 to 12)" unconnected.

Recommended PC board pad



Tolerance: $\pm 0.15 \pm 0.006$

BLOCK DIAGRAM FOR ELEMENT TYPE



Calculate the output for each axis using the formulas below.

$$V_x = XP - XN$$

$$V_y = YP - YN$$

$$V_z = ZP - ZN$$

NOTES

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

1. Mounting

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

2. 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 260 to 300°C (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) 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 PCB 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.

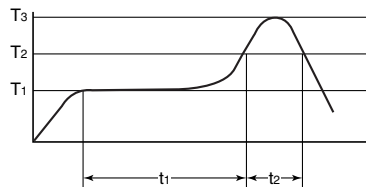
- Please use a soldering iron that is below the temperature given in the specifications in order to maintain the correct temperature at the tip of the soldering iron.

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.



T₁ = 150 to 180°C 302 to 356°F
 T₂ = 230°C 446°F
 T₃ = Max. 240°C 464°F
 t₁ = 60 to 120 sec.
 t₂ = With in 30 sec.

3. 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 terminals that are not used. This can cause malfunction of the sensor.

4. Cleaning

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

5. 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 voltages 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.

6. Other handling precautions

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

- 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.

- Static electricity can damage the sensor. Be very careful when handling.