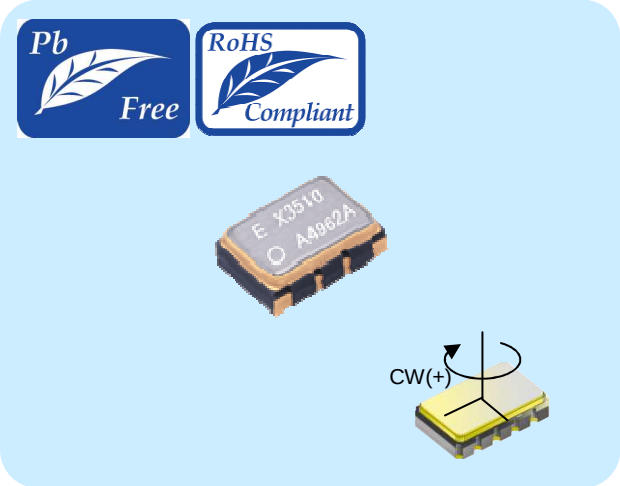
High-Performance, Low-Power Yaw Rate Gyro Sensor : XV-3510CB

Features

- High-Performance, High-Stability
- Rate range : ±100 °/s
- Low current consumption
  - ➢ 2.2mA Typ.
- Low Noise Density
  - ➢ 0.004 (°/s) /$\sqrt{Hz}$ @10Hz
- Small size
- Pb free.
- Complies with EU RoHS directive.



Applications

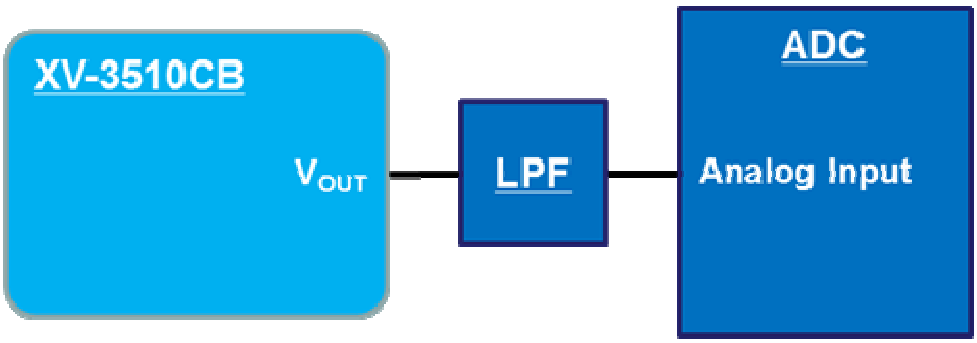
- Optical Image Stabilization
- Motion tracking
- Platform stabilization etc.

Description

The XV-3510CB is a high-performance low-power yaw rate gyro sensor. Using EPSON's proprietary quartz-based MEMS(QMEMS) process, XV-3510CB delivers superior stability and noise in an ultra-small package.

XV-3510CB offers wide environmental capability by hermetically sealed ceramic package.

Simplified Application Diagram



SEIKO EPSON CORPRATION
Document No.: XV-3510CB_E Ver. 1.00
Date: Jul. 3rd 2012

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/Transportation vehicles and related (automobiles, aircraft, trains, vessels, etc.)
/Medical instruments to sustain life
/Submarine transmitters
/Power stations and related
/Fire work equipment and security equipment
/Traffic control equipment /and others requiring equivalent reliability.

- The manual does not guarantee the specification of product.

Contents

1. Electrical characteristics
   1) Absolute maximum ratings ····· P. 4
   2) Operating conditions ····· P. 4
   3) Characteristics ····· P. 4 ~ P.5

2. Outline
   1) Outline dimensions and Pin information ····· P. 5
   2) Pin map and Function of terminals ····· P. 5
   3) Soldering pattern ····· P. 6

3. Detection direction ····· P. 6

4. Reference circuit ····· P. 7

5. Solder heatproof ····· P. 8

6. Terminology ····· P. 9 ~ P.10

7. Handling precaution ····· P. 11 ~ P.12

8. Contact ····· P. 13

1. Electrical characteristics

1) Absolute maximum ratings

Parameter	Symbol	Unit	Standard			Note
			Min.	Typ.	Max	
Supply voltage	V_{DD}	V	-0.3		4.0	V_{SS}=GND=0V
Storage temperature	T_{STG}	℃	-40		+85	

2) Operating conditions

Parameter	Symbol	Unit	Standard			Note
			Min.	Typ.	Max	
Supply voltage	V_{DD}	V	2.7		3.3	V_{SS}=GND=0V
Operating temperature	T_{OPR}	℃	-20		+80	
Output current	I_{VO}	μA	-100		+100	
POR *1)	tPU	msec.	0.01		100	V_{DD}:0%->90%

*1) POR: Power on reset circuit

This sensor has the POR built-in.

Prevent malfunction of POR circuit, please put up V_{DD} within 100msec. of start-up time.
And please do not put up at middle of V_{DD} range.

3) Characteristics

V_{DD} = 2.7 ～ 3.3V , V_{SS} = GND = 0V , Ta = -20～+80 ℃

Parameter	Symbol	Unit	Standard			Note
			Min.	Typ.	Max	
Drive frequency	fd	kHz		46.5		Frequency symbol : A
	fd	kHz		50.3		Frequency symbol : B
	fd	kHz		54.1		Frequency symbol : C
Difference frequency	df	kHz		0.8		
Scale factor	So	mV/(°/s)	2.85	3.00	3.15	
Scale factor variation with temp.	Spt	%	-3		+3	V_{DD}=3V, Ta=+25 ℃
Bias	V_0	mV	Vr - 30	Vr	Vr + 30	Ta=+25 ℃
Bias variation with temp.	V_{0t}	mV	-25		+25	V_{DD}=3V, Ta=+25 ℃
Reference voltage	Vr	mV	1410	1430	1450	Ta=+25 ℃
Reference voltage variation with temp.	Vrt	mV	-15		+15	V_{DD}=3V, Ta=+25 ℃
Rate range	I	°/s	-300		300	
Non linearity	NI	%FS	-0.5		+0.5	Ta=+25 ℃
Phase delay	ϕ_{20}	°		9		20 Hz phase delay angle
Bandwidth	BW	Hz		200		Phase delay 90°

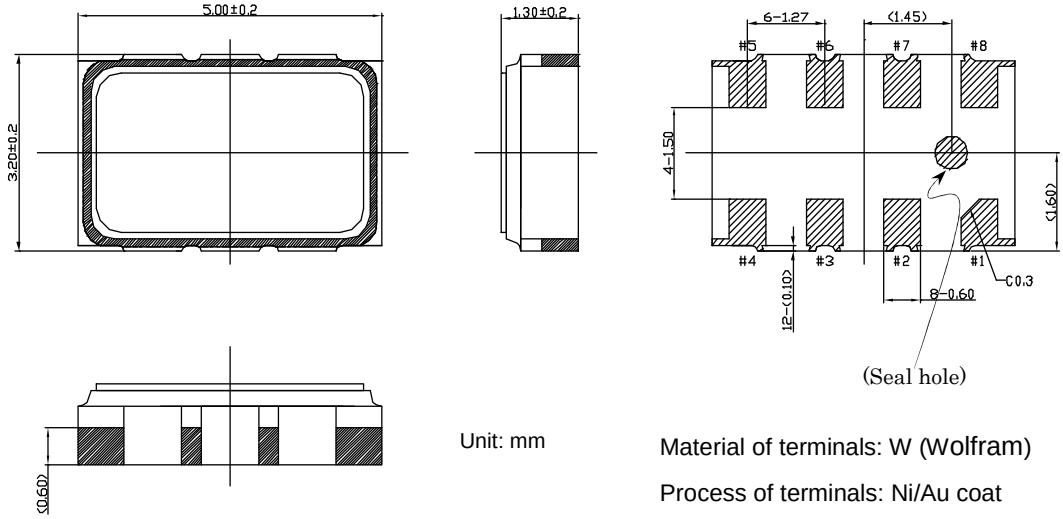
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Document No.: XV-3510CB_E Ver.1.00
Date: Jul. 3rd 2012

V_{DD} = 2.7 ～ 3.3V , V_{SS} = GND , Ta = -20～+80 ℃

Parameter	Symbol	Unit	Standard			Note
			Min.	Typ.	Max	
Cross axis	CS	%	-5		+5	Ta=+25 ℃
Start up time	Tsta	ms		150	300	V_{DD}=3.0V, Ta=+25 ℃
Current consumption	Iop	mA		2.2	2.9	Vout,V_{REF} No Load
Bias output load regulation	V_{load1}	mV	-2		+2	Iload = ±100μA
Reference voltage load regulation	V_{load2}	mV	-2		+2	Iload = ±100μA
Noise density	rN	(°/s) $/\sqrt{Hz}$		0.004		@10Hz

2. Outline

2-1) Outline dimensions and Pin information



Unit: mm

Material of terminals: W (Wolfram)

Process of terminals: Ni/Au coat

2-2) Pin map and Function of terminals

Pin No.	Pin name	I/O	Function
1	N.C.	-	Please do not connect this pin.
2	N.C.	-	Please do not connect this pin.
3	N.C.	-	Please do not connect this pin.
4	GND	-	GND Output
5	V_{OUT}	O : Output	Output angular rate
6	V_{REF}	O : Output	Output reference voltage
7	N.C.	-	Please do not connect this pin.
8	V_{DD}	-	Power supply

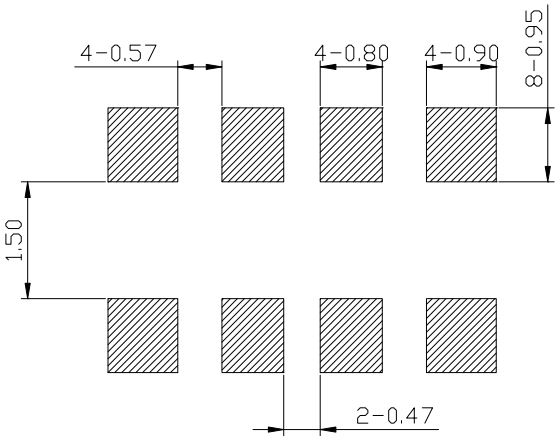
Caution for circuit connection

1. Supply power voltage between pin 4 and 8.
2. Sensor output can be picked up between pin 4 and 5.
3. Pin 6 is an output voltage reference of +1.43V

2-3) Soldering pattern

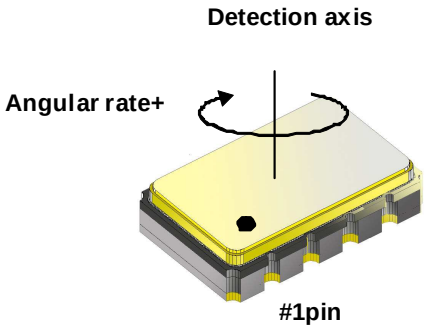
A solder pattern example is shown as below. For your actual design, please optimize the pattern to meet your design considerations such as mounting density, soldering reliability, ease of mounting, etc.

Please mount the device so that solder doesn't adhere to any portion of the seal hole (package underside).



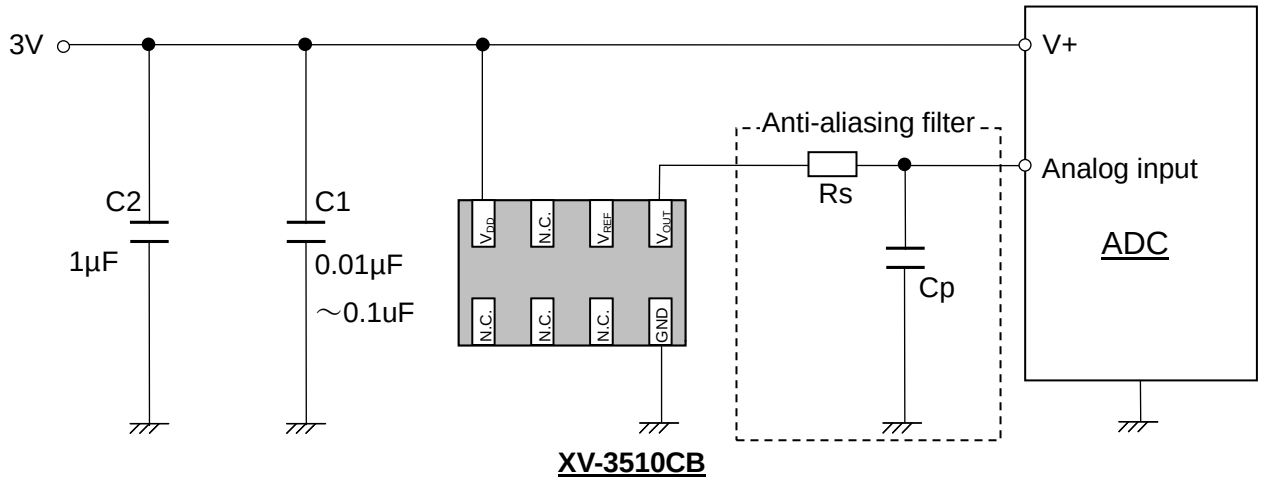
3. Detection direction

The detection direction is shown as in the following figure. Please mount carefully to meet your design requirement for detect direction.

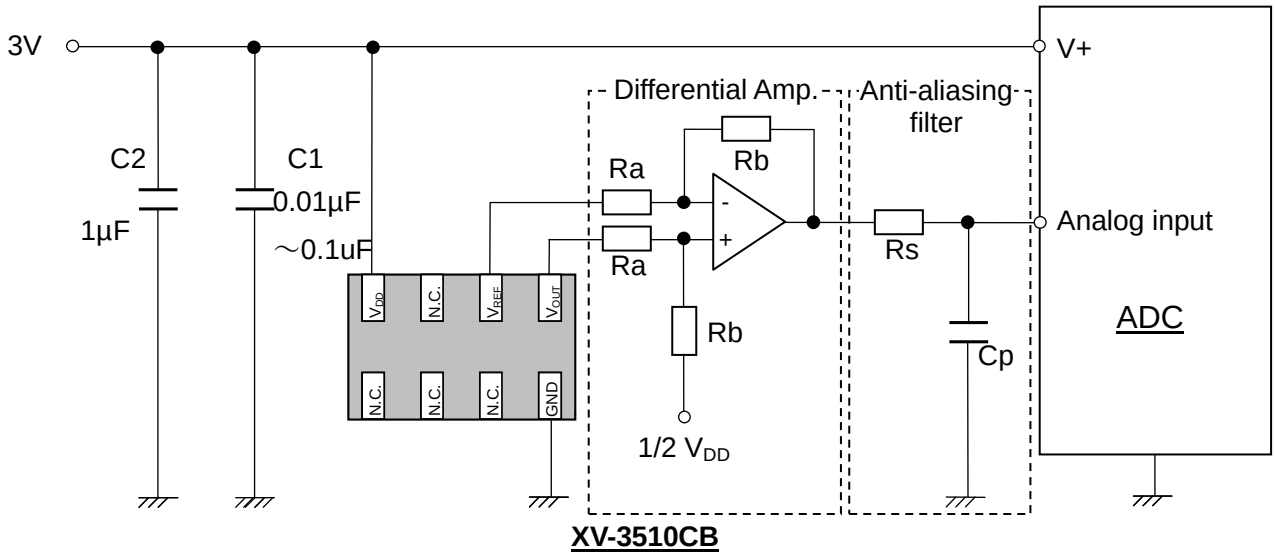


4. Reference circuit

Reference circuit 1



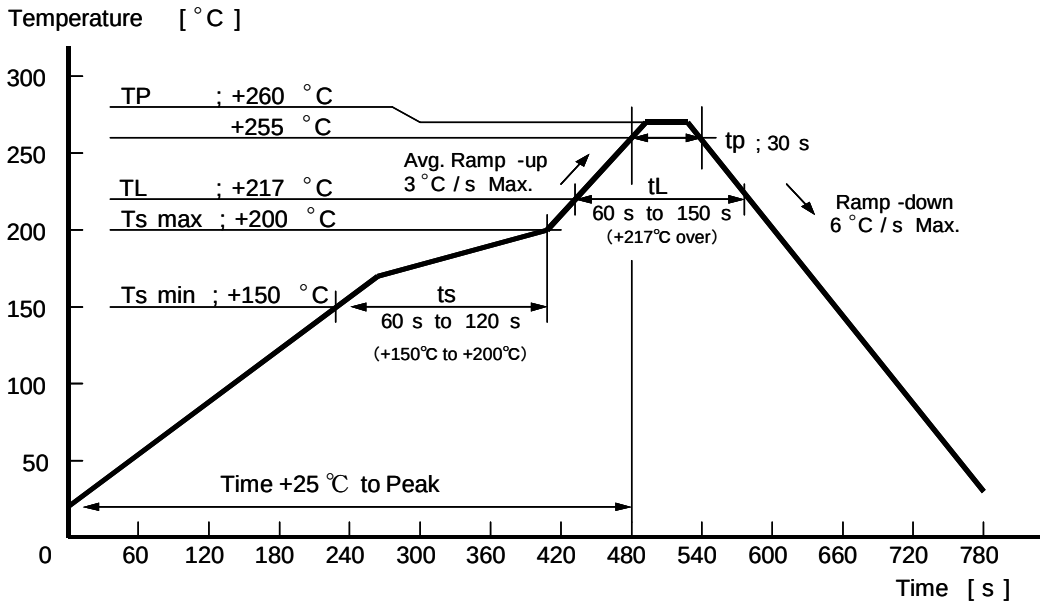
Reference circuit 2



- When the gyroscope is digitalized by ADC, it is required to put an appropriate Low Pass Filter to set the sensor bandwidth and act as an anti-aliasing filter. This will minimize noise and ensure signals are below the Nyquist frequency for the ADC sampling. The filter cut-off frequency is typically determined by the desired sensor bandwidth, and the sampling rate of the ADC must be atleast 2 times the sensor bandwidth (to meet Nyquist criterion).
- To make the output of gyro sensor stable, please ensure the output load value does not exceed 100pF maximum and 100kΩ minimum.

5. Solder heatproof

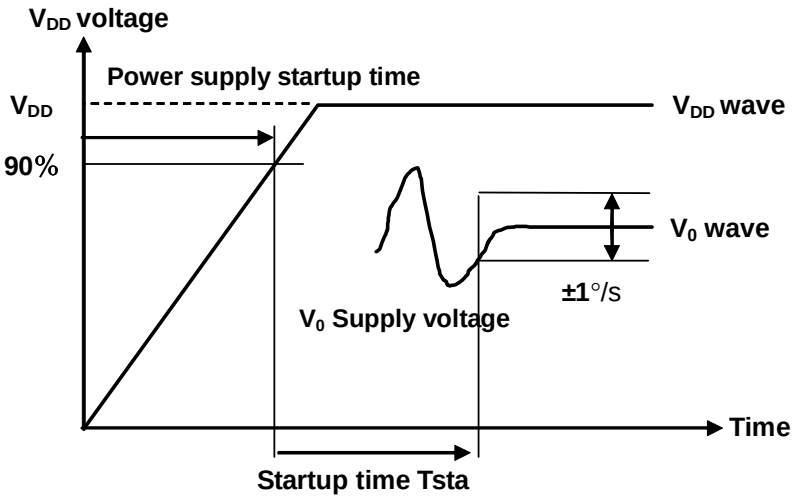
The resistance to soldering heat was qualified in accordance with the IPC/JEDEC J-STD-020D.1 following profile.



6. Terminology

1. Method for startup time measurement

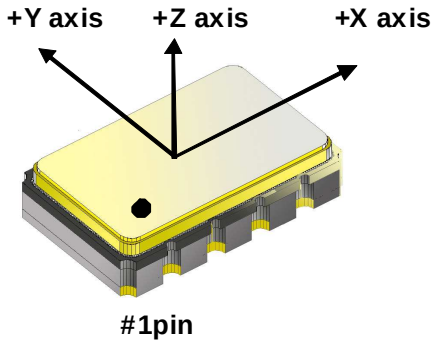
On condition that the supply voltage is rising from 0 % to 90 % within 40 ms, startup time measurement is done by measuring the time from when the power supply is ON until Voutput is in a quiescent state stabilized in ±1 °/s of zero-point voltage



2. Cross axis

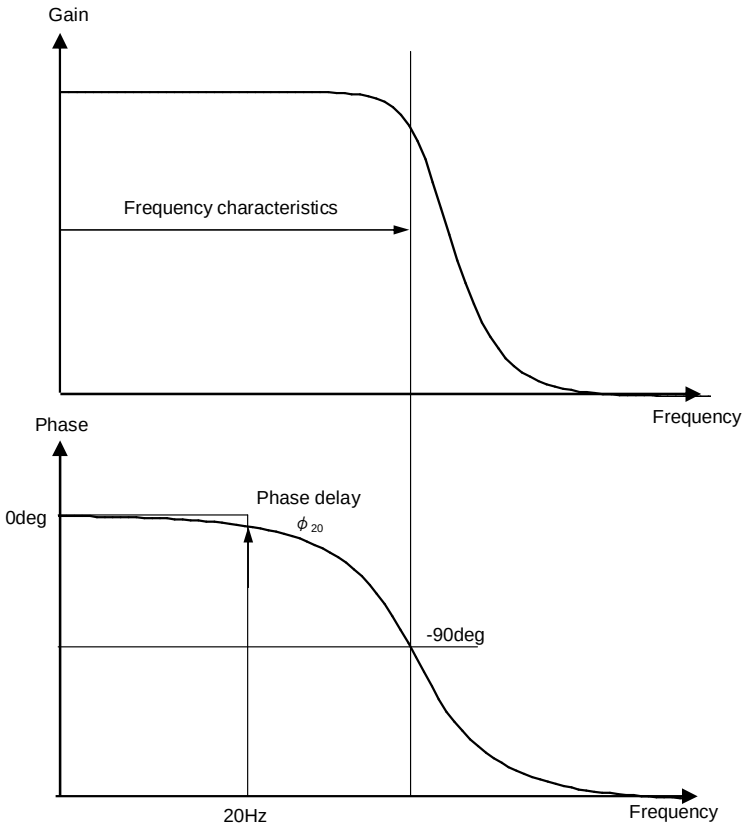
Cross axes sensitivity is the value of X axis or Y axis sensitivity divided by Z axis sensitivity.

The X, Y, Z directions are as follows.



3. Band width of output

The figure shows the relationship of frequency characteristics and phase delay.



4. Drive frequency and resonant difference frequency

Drive frequency is the sensor element oscillation frequency to detect Coriolis force. (Drive Mode)

Resonant difference frequency is the frequency offset between Drive Mode and Detect Mode[*1)].

[*1)] Detect Mode is the sensor element oscillation frequency to convert the Coriolis force into electric signal.

5. Detected signal

This sensor detects angular rate of rotary motion. It can detect only one axis motion. So if you want to detect two or more axes of motion, you need two or more sensors.

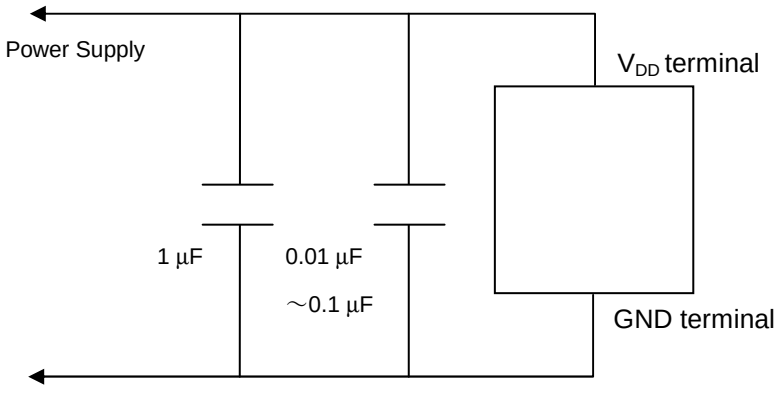
6. Reference output

Reference output pin (V_{REF}) outputs 1.43V stable voltage.

7. Handling precaution

Quartz parts are precision parts. Please handle carefully paying attention to the next points

1. This crystal product is designed in consideration of shock resistance. However, it may be destroyed by the conditions of severe shock. In case the product is dropped, and too much shock is experienced by the product, please be sure to check the characteristic to confirm normal operation.
2. If too much shock is generated when a crystal product is mounted, it will lead to change or degradation of the characteristics. (In the case of product absorption, catching, and substrate mounting) Therefore, please set up the conditions such that shock is reduced as small as possible. Please be sure to test the product before use in your company, and check that there is no change in the characteristics. Please confirm similarly at the time of condition change. Please be careful after mounting that the crystal product does not collide with a machine object or other substrates at the time of mounting.
3. This product contains circuits that protect from static electricity destruction. However, if static electricity is excessive the IC may break. Therefore, the packing material and container carrying the product should use a conductive material. Moreover, any soldering iron and measurement circuit should use precaution against static electricity.
4. Ultrasonic washing may lead to destruction of the crystal which cannot be guaranteed by our company. When ultrasonic washing is unavoidable in your company, be sure to test and confirm operation of product before use in your company.
5. Reflow is to 2 times. The condition for use of soldering iron to correct for soldering mistake should be 350 °C or less and for less than 3 seconds.
6. We recommend the substrate be designed by the recommended soldering pattern.
7. Please do not use the product in an environment where a short-circuit can be generated between terminals from moisture and condensation.
8. Please connect bypass capacitor near the power supply terminal. Please connect 0.1uF and 10uF capacitors in parallel.



9. If the product has noise of the same frequency as drive frequency, it is necessary to remove the noise using a suitable filter circuit.
10. This sensor is designed not to interfere easily even if multiple sensors are operated closely and simultaneously. However, in some cases, the sensors may interfere mechanically or electrically by vibration of circuit board or common impedance of power supply. Please check them before use.

If several sensors in same drive frequency are used, parts creating same noise as drive frequency of sensors are used on the same board or with the same power supply, the interference may be occurred.
Please use the sensors that drive frequencies are different and make the design of circuit, board layout avoiding the interference with noise. Please also check whether you do not have any problem with the practical condition.

11. This sensor is designed not to interfere easily even if multiple sensors are operated closely and simultaneously. However , in some cases, the sensors may interfere by vibration circuit board or common impedance of power supply. Please check them before use.
12. Please use sensors that have different drive frequency, when two sensors are used on the same PCB or same power supply to avoid cross interference.
13. Please confirm the influence of vibration absorption when there is an excessive vibration coupling to the sensor. Other high voltage level signal line may cause irregular output. Please take care to design output traces as short as possible, and keep high voltage level signal sources away from this device.
14. Please keep the gyro sensor within normal operating temperature and normal moisture. Refer to the packing standard document for the management method of proper packing state.
15. This product supplied (and any technical information furnished, if any) by SEIKO EPSON CORPORATION shall not be used for the development and manufacture of weapons of mass destruction or for other military purposes. Making available such products and technology to any third party who may use such products or technologies for the said purposes are also prohibited.
16. The products listed here are designed as components or parts for electronics equipment in general consumer use. We do not expect that any of these products would be incorporated or otherwise used as a component or part for the equipment which requires extra high reliability, such as satellite, rocket and other space systems, and medical equipment with the functional purpose of maintaining life

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