Nokia Corporation

Date of Issue : Audust 1, 1997

R E F E R E N C E

Product Description : ANGULAR RATE SENSOR
Product Part Number : EWTZ9G (S4A)
Classification of Spec : REFERENCE
Advice Note : "This product has not been manufactured with any ozone depleting chemical controlled under the Montreal Protocol"

Matsushita Electronic Components Co., Ltd.
Resistor Division

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Engineering Section
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Contact Person: T. Shiotsu
Title : Engineer
Authorized by : K. Omoto
Title : Manager of Engineering

3rd Angle System Unit : mm Drawing Not to Scale

1. Part No.

EWTZ9G

2. Maximum Specific Values

No.	Item	Specification	Unit	Note
1	Input Voltage	-0.3 to 16	V	Between Vcc and Gnd.
2	Current Consumption	30	mA	No load
3	Operation Temp.	-30 to 80	℃	
4	Storage temp.	-40 to 85	℃	

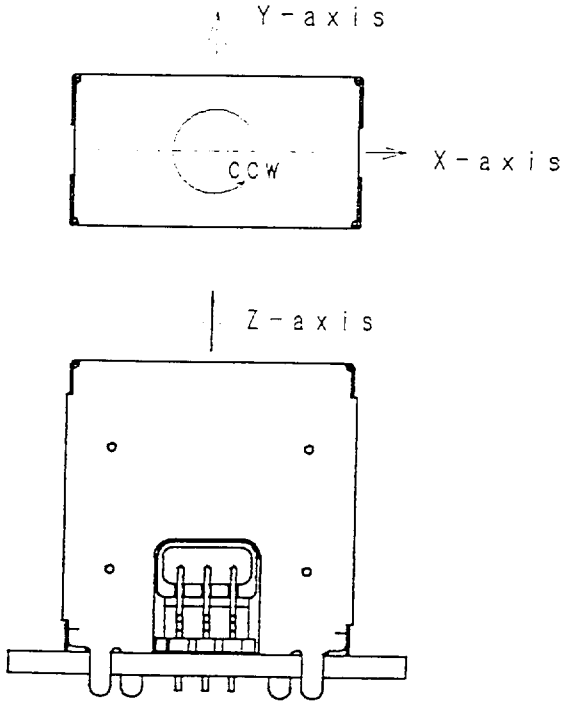
3. Dimensions and Mounting foot print

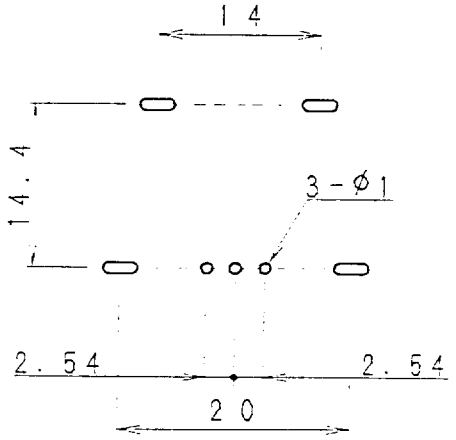
3-1 Dimensions

Appearance dimensions and terminal description are shown in the attached figure.

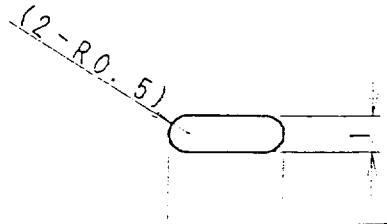
3-2 Mounting

Recommended slot dimensions
of the mating circuit board





Detail slot Dimension



Shield case to be clinched by more than two tabs on the board

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DRAW	May. 23. 97	T. Shiotsu	ANGULAR RATE SENSOR	ISSUE	REVISIONS	DATE
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APPROVAL	May. 23. 97	K. Omoto	EWTZ9G			

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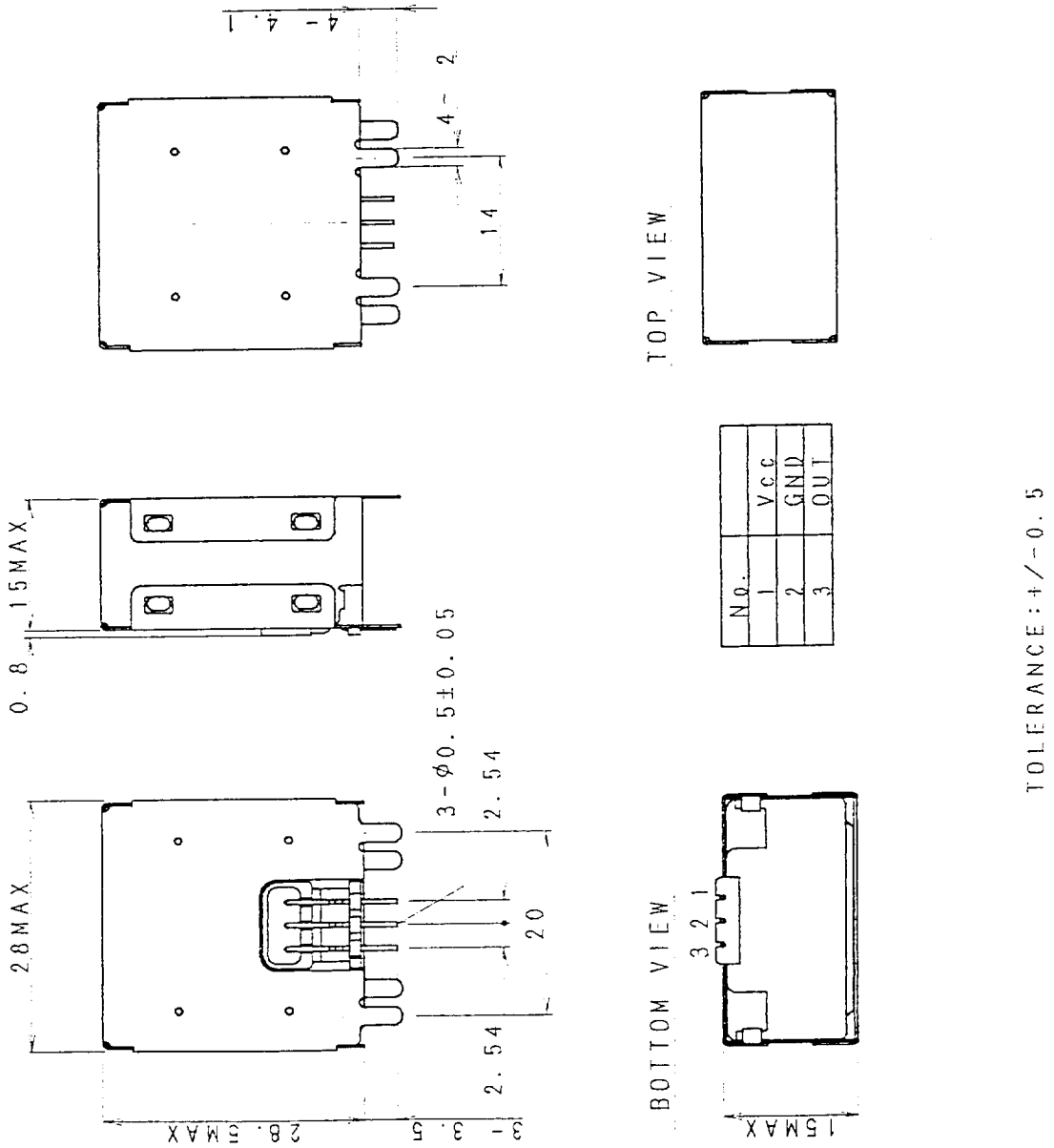

Shall be free from rust or stains that affect characteristics.

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3rd Angle System Unit : mm Drawing Not to Scale

4. Electric Characteristics

No.	Item	Conditions	Specification			Unit	Note
			MIN	TYP	MAX		
1	Operating Voltage		4.75	5.00	5.25	V	
2	Current Consumption	Vcc=5V	5.0		11.0	mA	
3	Minimum Output				0.3	V	
4	Maximum Output		Vcc-0.3			V	
5	Sensitivity	Ta=-30～80℃	22.50	25.00	27.50	mV/deg/s	
6	Sensitivity Drift	Ta=-30～80℃	-5.0		+5.0	%	Change from 25℃ value
7	Zero Point Output	Ta=-30～80℃	2.10	2.50	2.90	V	
8	Zero Point Drift	Ta=-30～80℃	-10.0		+10.0	%	Change from 25℃ value *See note(9)
9	Dynamic Range		-60.0		+60.0	deg/s	
10	Output Noise				10.0	mV_{p-p}	
11	Start Up Time				1.0	sec	
12	Zero point Stability	0-5min. from ON	-25.0		+25.0	mV	
		5-15min. from ON	-10.0		+10.0	mV	
13	Linearity	< 50 deg/sec	-0.5		+0.5	%	
		50～60 deg/sec	-5.0		+5.0	%	
14	Cross Axis Sensitivity		-5.0		+5.0	%	
15	Frequency Response	7 Hz	-7.0		-2.0	dB	
16	Temperature Dependence of Zero Point Output	During change of temp. (-30 → 80℃)	-50		+50	mV/7.5℃ ↑ A measuring interval of the inspection	*See note(8)
17	Operating Voltage Dependence of Zero Point Output		0.7		1.3		
18	Operating Voltage Dependence of Sensitivity		0.8		1.2		

Note: (1) Initial adjustment error of sensitivity is
25.0 +/- 1.0 mV/deg/sec (25℃, at Shipping)
(2) Initial adjustment error of zero point output is
2.50 +/- 0.1 V (25℃, at Shipping)
(3) Polarity of the sensor output to the input is
CW input...Output Increase / CCW input...Output Decrease
(4) Conditions with no specification mean
Vcc = 5 +/- 0.005V, Ta = -30 to 80℃
(5) Operating Voltage Dependence of Zero Point Output is
$(V_{5.25} - V_{4.75}) / V_{5.00} * 10$ $V_{5.25}$: Zero Point Output at Vcc = 5.25 V
$V_{4.75}$: Zero Point Output at Vcc = 4.75 V
$V_{5.00}$: Zero Point Output at Vcc = 5 V

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(6) Operating Voltage Dependence of Sensitivity is
$(S_{5.25} - S_{4.75}) / S_{5.00} * 10$ $S_{5.25}$: Sensitivity at Vcc = 5.25 V
$S_{4.75}$: Sensitivity at Vcc = 4.75 V
$S_{5.00}$: Sensitivity at Vcc = 5 V

(7) Apply a 100 kΩ resistor and a 0.01 μF capacitor between output line and GND at the electric characteristics measurement.

(8) This value is specified according to Fukui Matsushita's measurement facilities.

(9) Zero Point Drift 1 % = 2.5V×1/100 = 0.025V ≒ 1 deg/sec
[See Definition of the word (14)]

<Definition of the words>

(1) Sensitivity
Measure the sensor with both ω (CW) and -ω (CCW) static rotation input, then divide the difference of the output by 2ω (deg/sec).

(2) Zero Point Output
Sensor output with no sensor movement

(3) Dynamic Range
Measurable angular rate range

(4) Minimum Output
Sensor output with 200 deg/sec CCW direction input

(5) Maximum Output
Sensor output with 200 deg/sec CW direction input

(6) Output Noise
Value multiplied $2\sqrt{2}$ on sensor's rms output value with no sensor movement

(7) Start Up Time
Interval time from power supply on until output signal gets stabilized into the output voltage zone specified in item 12; Zero Point Stability

(8) Zero Point Stability
Output signal change value with no sensor movement excluding noise of 100 msec or less

(9) Linearity
Define a line by least-squares method using five points including zero rotation input, maximum dynamic range and minimum dynamic range. Then divide the difference of the actual measured value and the line by the dynamic range.

(10) Cross axis Sensitivity
Divide sensitivity of X-axis and sensitivity of Y-axis by sensitivity of Z-axis, then multiply 100.

(11) Frequency Response
Rotate sensor in Z-axis (detecting axis) at 7 Hz. Divide the output signal change by input angular rate, then divide the sensitivity specified in item 5.

(12) Operating Voltage Dependence of Zero Point Output

$$= \frac{\text{Zero Point Output change ratio}}{\text{Operating Voltage change ratio}}$$

(13) Operating Voltage Dependence of Sensitivity

$$= \frac{\text{Sensitivity change ratio}}{\text{Operating Voltage change ratio}}$$

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(14) Zero point drift(%)

$$= \frac{\text{(Zero point voltage at Ta℃)-(Zero point voltage at 25℃)}}{\text{(Zero point voltage at 25℃)}} \times 100$$

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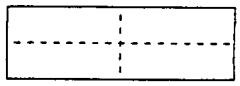
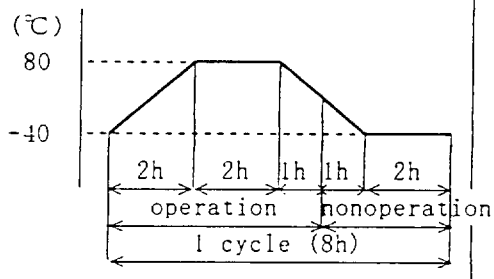
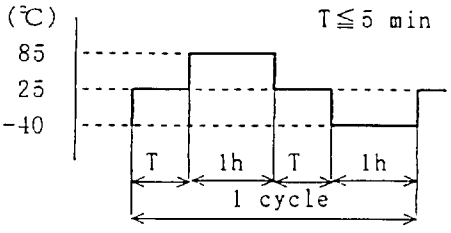
5. Reliability test items

No.	Item	Test Methods	Criteria
1	Performance & function	Test to be done under the following condition 5.25V 5.00V 4.75V  -30 25 80 (℃)	To satisfy 4. Electric characteristics
2	Cold soak	Soak in -40℃ for 72 hrs. Leave std temp and humidity for more than 2 hrs.	No distortion or crack in appearance. To satisfy 4. Electric characteristics
3	Cold operation	Operate in -30℃ for 72 hrs. Leave std temp and humidity for more than 2 hrs.	To satisfy 4. Electric characteristics during and after the test
4	Hot soak	Soak in 85℃ for 96 hrs. Leave std temp and humidity for more than 2 hrs.	No distortion or crack in appearance. To satisfy 4. Electric characteristics
5	Hot operation	Operate in 80℃ for 120 hrs. Leave std temp and humidity for more than 2 hrs.	To satisfy 4. Electric characteristics during and after the test.
6	Heat cycle	Soak in 30 cycles of the following schematic. Leave std temp and humidity for more than 2 hrs.  (℃) 80 -40 2h 2h 1h 1h 2h operation nonoperation 1 cycle (8h)	No distortion or crack in appearance. To satisfy 4. Electric characteristics during and after the test.
7	Heat shock	Soak in 25 cycles of the following schematic. Leave std temp and humidity for more than 2 hrs.  (℃) T≦5 min 85 25 -40 T 1h T 1h 1 cycle	No distortion or crack in appearance. To satisfy 4. Electric characteristics during and after the test.

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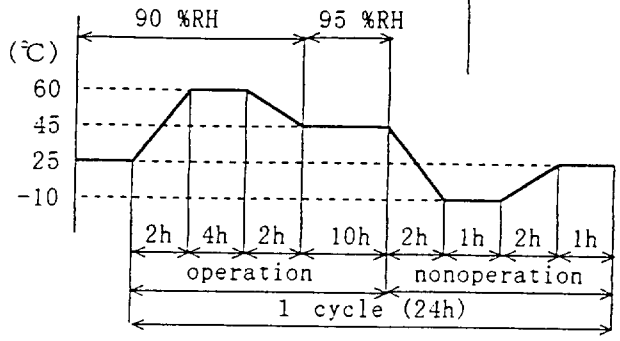
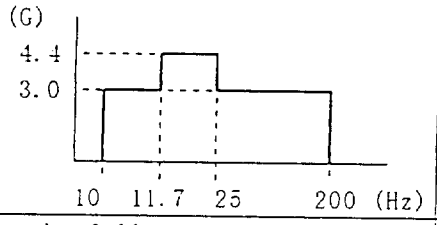
No.	Item	Test Methods	Criteria
8	Temp and Humidity cycle	After the heat shock, soak in 25 +/- 2℃, 65 +/- 20 %RH for 2.5 +/- 0.5 hrs. Then soak in 5 cycles of the following schematic with specified operation. 	To satisfy 4. Electric characteristics
9	Vibration durability	Soak in the following sweep vibration condition. Sweep term is 20 min. Test 18 cycles for each X, Y, Z direction. 	No destruction, loose or solder removal. No distortion or crack in appearance. To satisfy 4. Electric characteristics after the test.
10	Operating life	Apply the following angular rate in sensing direction. +/- 20 deg/sec, 5 Hz, 10 million cycles	To satisfy fundamental functions.
11	Impact (Sensor drop test)	1000 mm drop on a wood plate No direction One time	To satisfy fundamental functions.
12	Drop test (Shipping package)	Method: 1 corner, 2 edges 4 flat faces Once for each direction 650 mm drop for base flat drop 500 mm drop for others	To satisfy fundamental functions.

Note:

(1) Test room condition is standard temp. (20 +/- 15℃), standard humidity (65 +/- 20%) specified in JIS Z-8703, and the input voltage is 5V; unless specified.

(2) If temperature is not specified in the test conditions, start the tests after leaving the test pieces more than one hour in a standard temp. and humidity. If it is, start after leaving the test pieces more than one hour in the specified temperature conditions.

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(3) Tolerance of temperatures unless specified is +/- 2℃, tolerance of voltages unless specified is +/- 0.1V.

(4) The operation means to apply 5V input and rotate +/- 20 deg/sec at 2 Hz sinusoidal movement.

6. Request of handling the angular rate sensor

1. Soldering

(1) Flux application

Use non-corrosion rosin, and alcohol base solvent with little chemical reaction. Apply the flux thinly not to intrude into the sensor. In case of using a dip application, make sure the flux level.

(2) Pre-heat

Control the temperature under 100℃.

(3) Soldering condition (recommendation)

a) Solder material JIS Z 3238, H60A or H63A

b) Soldering temperature 250℃

c) Soldering time within 5 seconds

(4) Cooling

In order not to cause the sensor deterioration by the soldering heat, cool down by air blow immediately.

(5) Hand soldering (recommendation)

a) Soldering iron Use 20 watt or less soldering iron with 350℃ temperature conditioned

b) soldering time within 3 seconds

(6) Others

Make sure of clinching more than two tabs and soldering them before soldering the terminals.

2. Washing

If washing is necessary, refer to the following table.

Base solvent	Example	Available
Chloride base	Trichloroethane	OK
Fluorine base	Freon(TF, TES, TE)	OK
Water base		OK
Alcohol base	IPA, Ethanol	OK
Others	Gasoline	No

Do not apply ultrasonic washing

3. Handling

Handle with care. Do not drop or apply any strong impact on the sensor.

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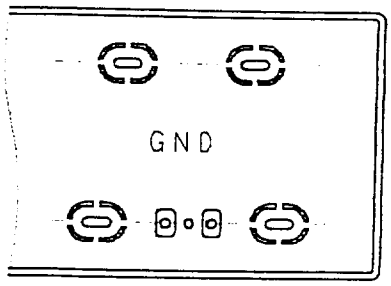
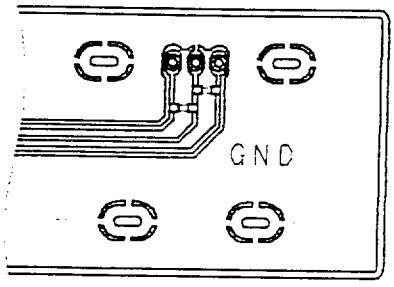
4. Pattern layout of the circuit board

See the following recommended pattern design. Double surface circuit board is recommended.

PART SIDE



SOLDER SIDE



(1) Design a full ground pattern under the sensor. The tabs are to be connected to the ground.
(2) Design a chip capacitor(approx. 0.01 - 0.1 μF) near the Vcc terminal and the signal terminal across the ground.
(3) Apply a electrolytic capacitor(approx. 47 - 100 μF) as a Vcc back up.

5. Layout

The sensor has a little zero point temperature drift by surrounding condition. Consider to determine the location of the sensor.
(1) Do not locate the sensor close to heat radiating objects such as power transistors.
(2) Do not locate the sensor to affect heat convection.
(3) Do not locate two or more sensors on the same PCB, otherwise periodical drift of zero point output may occur due to mutual interference by the vibration of each tuning fork of the sensor.

6. Vibration from outside

To prevent external vibration (Vibration outside the unit) from influencing the characteristics of sensor, please consider following points for design of PCB.
(1) Rigid glass epoxy circuit board is recommended. Locate the sensor near the screws which fix the circuit board. Design the resonance frequency so as to be 300Hz or more.
(2) Consider the location of other parts not to touch the sensor in out coming vibration condition.

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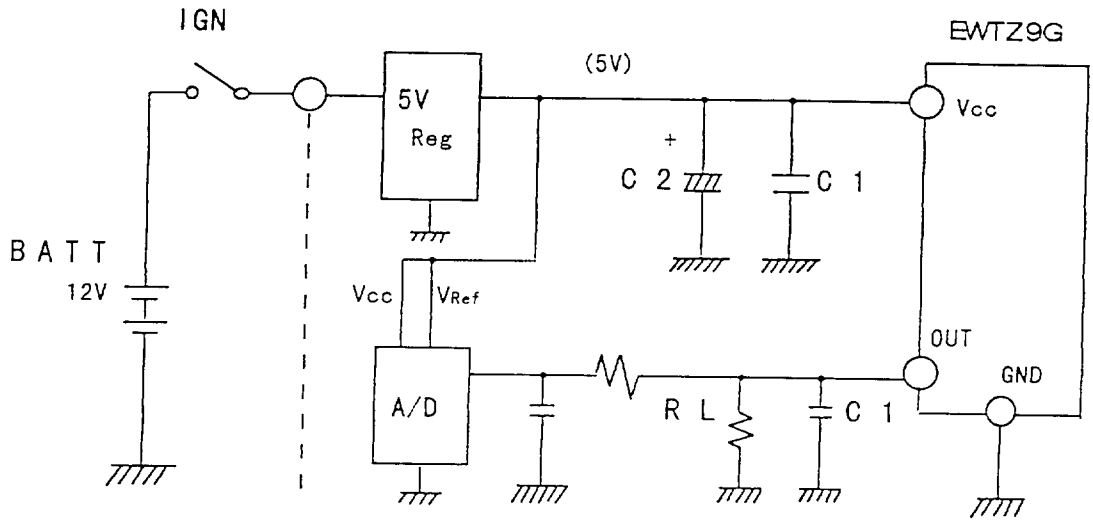
(3) Do not allow the screws which fix the circuit board to become loose.
Do vibration test and check carefully with the condition of sensor attached to the unit.

7. Recommended circuit



(1) Make sure to use 100 kΩ load resistor(RL).
(2) Since the sensor does not have a power supply back up, insert a back up capacitor if power supply unit is far away or power voltage comes through connectors. in case of intermittent power break, vibration of the tuning fork stops and it takes one second to reboot.
(3) Reverse voltage or over voltage more than 16V may destroy the sensor.
(4) When the sensor signal goes to an A/D converter, use the same 5V power supply both for the sensor and for A/D converter.
(5) EMC characteristics depend on whether the shield-case is power-grounded or case-grounded. The choice needs to be determined after evaluating the assembled set.

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7. Request in using the product

Prudential attention has been paid to the quality of this sensor. As a failure mode, however, zero point output and sensitivity error, instability or the like may occur. For a single failure of the product, study the influence on the whole set in advance.

1. This specification guarantees the quality of the Angular Rate Sensor as a single unit. In using the sensor, make sure to check and evaluate it as installed on your product.
2. We cannot guarantee any troubles caused by using this product not in accordance with this specification.
3. If it is expected that serious damage may be caused to human life or the like by a trouble of this product in traffic transportation means (trains, automobiles, traffic signal equipment), medical equipment, air space equipment, electric heaters, combustion or gas equipment, rotating equipment, warning or crime prevention equipment, nuclear equipment, work equipment or the like, give careful consideration to fail-safe design for purposes of safety by studying the following.
   (1) Provision of a protection network or apparatus for safety of a system
   (2) Provision of a redundant network or the like for safety of a system so that a single failure causes no danger
4. If questions arise about the safety of this product, let us know soon and make technical studies.
5. A preservative term of this sensor is less than 6 months. Please do not do keep it in high humidity.
   Please maintain a drying conditions when it is kept longer than 6 months.
   If not, the metallic case or the pin will corrode and soldering becomes bad.

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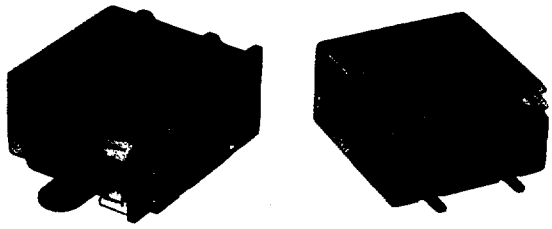
Compact Angular Rate Sensors, On Boad / Direct Coupler Type
小形角速度センサ
オンボードタイプ/ダイレクトカプラータイプ

Type: **EWTS4□□ (On Boad)**
EWTS4P□ (Direct Coupler)



This angular rate sensor utilizes CORIOLIS force generated by a vibrating tuning fork. This sensor consists of sensing and driving elements, tuning fork driving circuit and the signal processing circuit. The tuning fork is composed of two metal pieces, a connecting block and four piezo-electric elements. A compact and reliable angular rate sensor has been realized.

本センサは一定振幅で振動する音叉に生じる「コリオリ力」を利用したもので，小形・低消費電力・耐久性に優れたセンサです。
構成は，音叉片の上部を音叉振動面に対して直角に折り曲げた金属音叉部と，専用ICにより構成される制御回路基板よりなっております。

■ Features
- Compact, Low-hight 28.5 mm, Low-profile 15 mm (36 mm of installation paies)
- Chassis installatior's being possible
- 5 V operating voltage (Ratio-metric output)

■ 特　長
- 小形，低背 28.5mm，薄形 15mm（取付ピッチ36mm）
- シャーシ取付可能
- 電源電圧 5V 対応（出力電圧は電源電圧に比例）

■ Recommended Applications
- Detection of moving direction for car-navigation
- Orientation controls in industrial equipment
- Multi navigation systems

■ 主な用途
- カーナビゲーション用進行方向検出
- 各種産業用機器姿勢制御
- マルチナビシステム

■Ratings　定　格

● Electrical Characteristics　電気的特性

Items 項目	Specifications 規格
Operating Temperature Range 使用温度範囲	–30 to +80°C
Supply Voltage Range 電源電圧範囲	5±0.25 V
Zero Point Voltage(–40to+80 °C) 0点電圧（–40～80℃）	2.5±0.4 V
Sensitivity 感度	25 mV/deg/s
Frequency Response(7 Hz) 周波数応答性（7Hz）	> –7 dB
Output Voltage Range 出力電圧範囲	0.3 to 4.7 V
Output Noise 出力ノイズ	< 10 m Vp-p

● Environmental Characteristics　環境特性

Items 項目	Specifications 規格
Low Temperature Operation 低温作動	–30 °C for 72 h
High Temperature Operation 高温作動	+80 °C for 120 h
Heat shock ヒートショック	–40 to +85 °C for 25 cycles
Heat and Damp Cycling Test 温湿度サイクル	–10 to +60 °C at 90% RH for 5 cycles
Life(Operating Durability) 作動耐久	2 Hz, 1×10^7 cycles

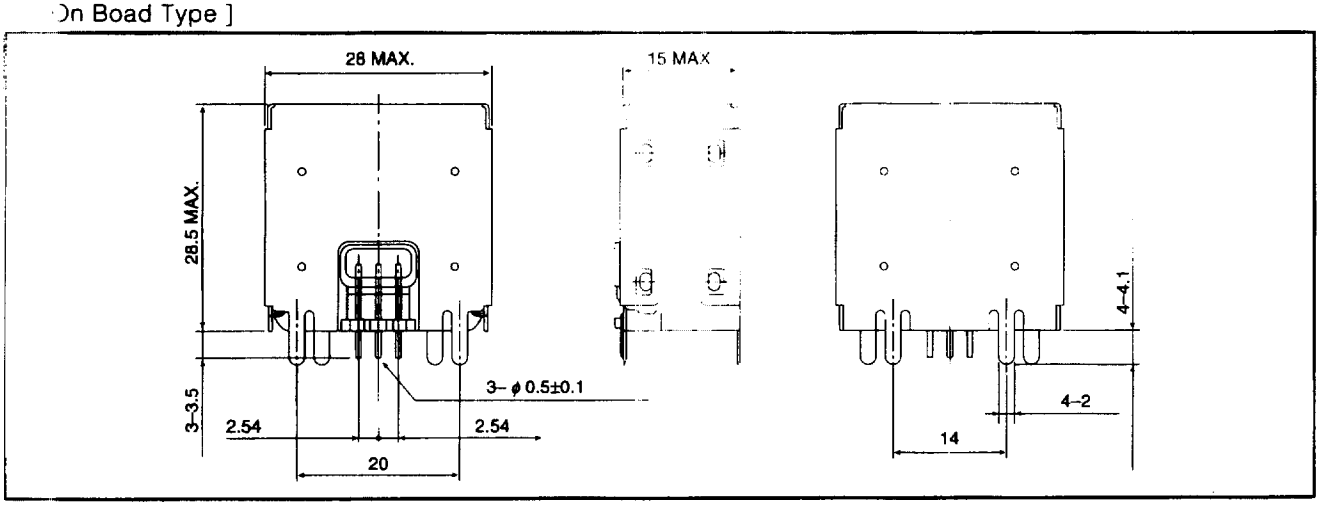
NEW

Panasonic

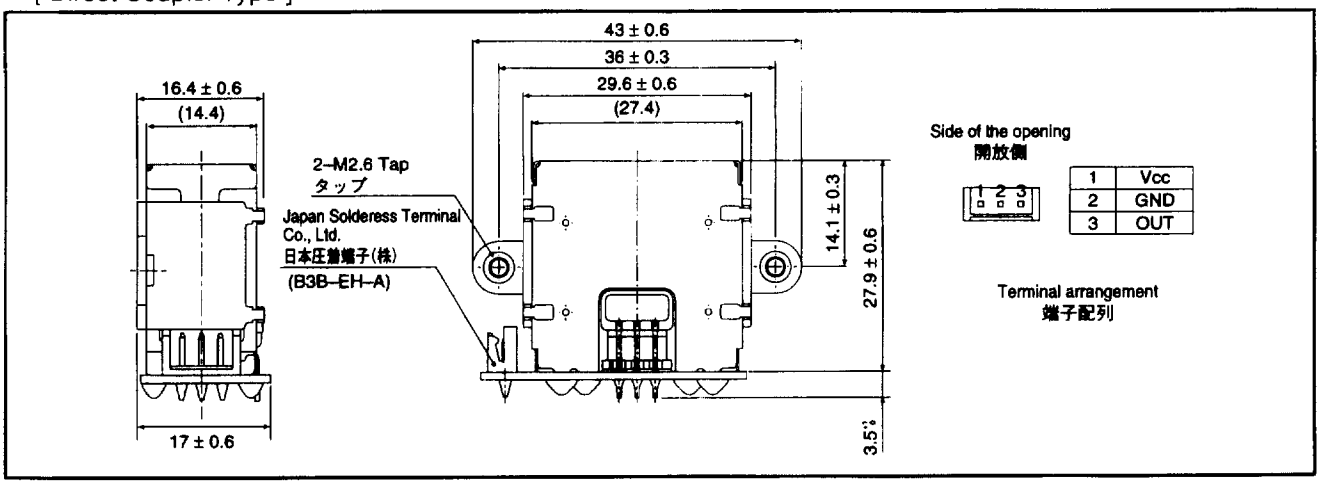
Compact Angular Rate Sensors, On Boad / Direct Coupler Type
小形角速度センサオンボードタイプ/ダイレクトカプラータイプ

■ mensions in mm (not to scale) 形状寸法

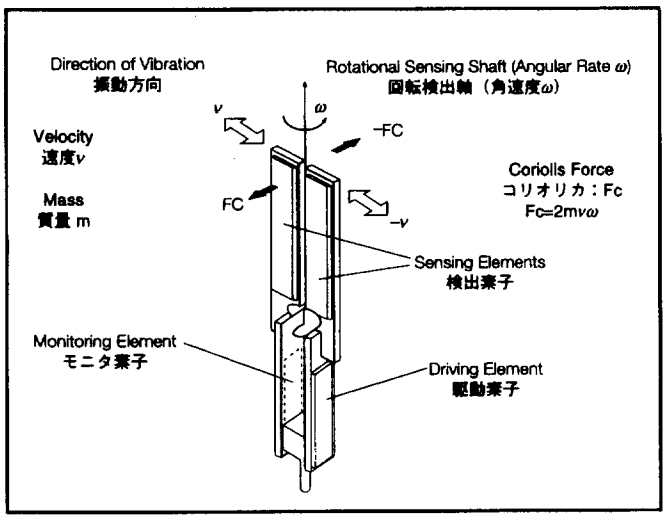
On Boad Type]



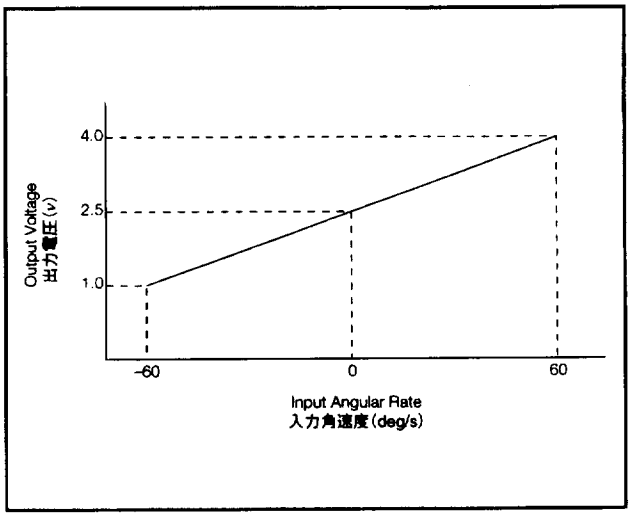
[Direct Coupler Type]



■ Detection Principle 検出原理



■ Output Characteristics 出力特性



Information : as of September 1997. Validity : till August 1999

記載内容：1997年9月現在， 有効期限：1999年8月

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