⚠ Safety Precautions (MEMS Angular Rate Sensors for Navigation/EWTS86N□/EWTS86K□)

1. Soldering

(1) Thickness of Solder Paste(Recommendation)	: 0.15 mm to 0.20 mm
(2) Flux	: Use non-corrosive rosin, and alcohol based solvent with little chemical reaction.
(3) Pre-heat	: Control the temperature on PWB to be under 180 °C and no longer than 120 s
(4) Reflow Soldering condition	: The Maximum temperature on PWB is 260 °C
(5) Atmospheric Temperature	: The atmospheric temperature should be under 300 °C
(6) Cooling	: To avoid deterioration of the sensor due to heat, immediately cool the sensor with blown air.
(7) Number of times it can be Reflow Soldered	: Once
(8) Hand soldering (recommendation)	: a) Use a 20 W or less soldering iron at less than 350 °C b) Soldering time: within 3 s

2. Washing

Do not wash.

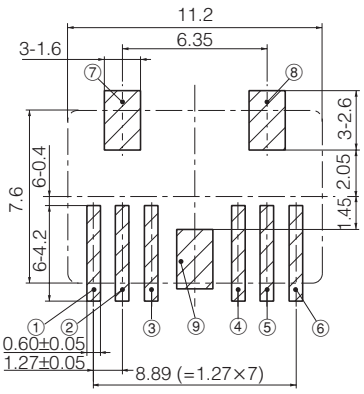
3. Handling

(1) Handle with care. Do not drop or apply any strong impact to the sensor this may degrade some performances.
(2) Do not store under the following conditions, they may degrade some performances and solderability.
a) Relative humidity of more than 85 %
b) Atmospheres of corrosive gas (Cl_2, H_2S, NH_3, NO_X, SO_2 etc.)
c) Long term storage of over 3 months after delivery
Do not store the package under severe load and stress.

4. Pattern layout of the circuit board

See the following recommended pattern design. (mm)

PART SIDE



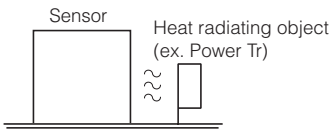
①	Vout
②	GND
③	GND
④	NC
⑤	NC
⑥	Vcc
⑦	GND
⑧	GND
⑨	GND

✻Recommendation item on the circuit composition
(1) Design a chip capacitor (approx. 0.01 µF to 0.1 µF) near the Vcc terminal and the signal terminal across the ground.
(2) Apply an electrolytic capacitor (approx. 47 µF to 100 µF) as a Vcc back up.

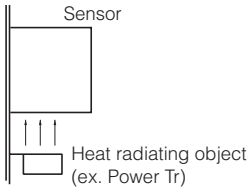
5. Layout

The sensor has a little zero point temperature drift due to surrounding conditions. Take this into consideration when determining 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 where it can be affected by heat convection.



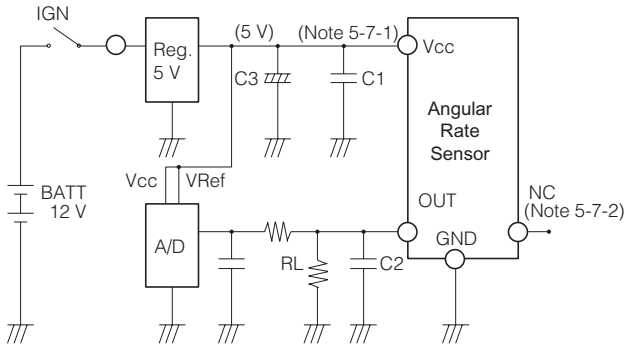
(3) Do not locate two or more sensors on the same PWB, otherwise periodical drift of zero point output may occur due to mutual interference by the vibration of each tuning fork in the sensor.

6. Vibration from outside

To prevent the PWB's (mounted sensor) from resonating with external vibration, please consider following these guides for the design of your PWB.
(1) Take into consideration the location of other parts which may cause vibration.
(2) Do not allow the screws, which fix the circuit board to become loose.

✻ Do a vibration test and carefully check the condition of the sensor attached to the unit.

7. Recommended Circuit



(1) C1, C2 : Design chip capacitors with good high frequency characteristics of about 10000 pF so they are as close to the terminals of the sensor as possible in parallel, as a measure against EMS.
(2) RL : Make sure to use 100 kΩ load resistor(Recommendation).
(3) C3 : Since the sensor does not have a power supply back up, insert a back up capacitor if the power supply unit is far away or power voltage comes through connectors. (If there already are back-up capacitors for sharing the power voltage with A/D converter or microcomputer, this is unnecessary.)
(4) When the sensor signal goes to an A/D converter, use the same 5 V power supply both for the sensor and for A/D converter.
(5) NC terminal of the sensor does not connect to your PWB.

8. Limited Warranty

(1) Customer acknowledges that the Angular Rate Sensor ("Product") delivered to Customer by Panasonic Electronic Devices Co., Ltd. ("PED") is designed and manufactured by PED, or its affiliates, only for the purpose of incorporation into Customer's car navigation system (hereinafter called "Purpose"). Accordingly, Customer understands that PED, or its affiliates, shall only guarantee the performance of the Product under this Product Specification for information (this "Specification") to the extent such Product is used by Customer for the Purpose defined in this paragraph.
(2) Customer agrees that it shall, at its sole cost and responsibility, test and evaluate the performance of Customer's system which incorporates the Product (hereinafter called "System").
(3) Customer acknowledges that some failure mode, such that Product does not comply with this Specification in terms of Zero Point Output and/or Sensitivity or shows any unstable performance, should be observed depending on the characteristics of the System, or the environment at which such System is installed. Therefore, Customer shall design the System taking into account such influences.
(4) Customer agrees that PED shall not be responsible for any loss or damage due to defective Product, including, but not limited to, economic loss, bodily injury or property damage, as far as Customer utilizes the Product for any purpose other than the Purpose defined in the above paragraph 8-1. Therefore, Customer shall ensure the "fail-safe" design of the System, if it deems necessary, to mitigate any such loss or damage.

⚠ Safety Precautions (MEMS Angular Rate Sensors for Rollover detection/EWTS64N□)

1. Soldering

(1) Thickness of Solder Paste(Recommendation)	: 0.15 mm to 0.20 mm
(2) Flux	: Use non-corrosive rosin, and alcohol based solvent with little chemical reaction.
(3) Pre-heat	: Control the temperature on PWB to be under 180 °C and no longer than 120 s
(4) Reflow Soldering condition	: The Maximum temperature on PWB is 260 °C
(5) Atmospheric Temperature	: The atmospheric temperature should be under 300 °C
(6) Cooling	: To avoid deterioration of the sensor due to heat, immediately cool the sensor with blown air.
(7) Number of times it can be Reflow Soldered	: Once
(8) Hand soldering (recommendation)	: a) Use a 20 W or less soldering iron at less than 350 °C b) Soldering time: within 3 s

2. Washing

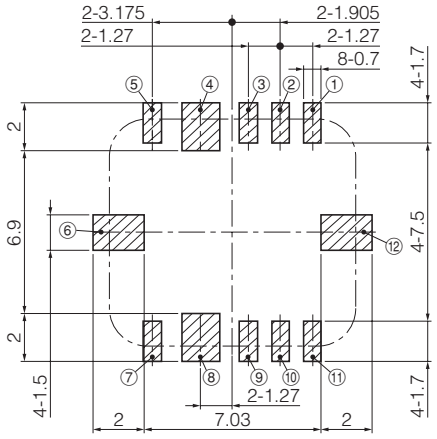
Do not wash.

3. Handling

(1) Handle with care. Do not drop or apply any strong impact to the sensor this may degrade some performances.
(2) Do not store under the following conditions, they may degrade some performances and solderability.
a) Relative humidity of more than 85 %
b) Atmospheres of corrosive gas (Cl_2, H_2S, NH_3, NO_X, SO_2 etc.)
c) Long term storage of over 3 months after delivery
Do not store the package under severe load and stress.

4. Pattern layout of the circuit board

See the following recommended pattern design. (mm)



①	Vcc
②	DIAG
③	NC
④	GND
⑤	CHECK
⑥	GND
⑦	GND
⑧	GND
⑨	NC
⑩	NC
⑪	SIG
⑫	GND

5. Layout

The sensor has a slight zero point temperature drift due to surrounding conditions. Locate the sensor with care of the following items.

(1) Do not locate the sensor close to heat radiating objects such as power transistors.

(2) Do not locate the sensor where it will be effected by heat convection.

6. The application method of a coating agent.

Please apply by the spray system about a coating agent. (Recommendation)

Dip coating of a coating agent is disapproval.

7. Vibration from outside

If the PWB with the sensor is resonant to frequencies caused by external vibrations, take the following items into consideration.

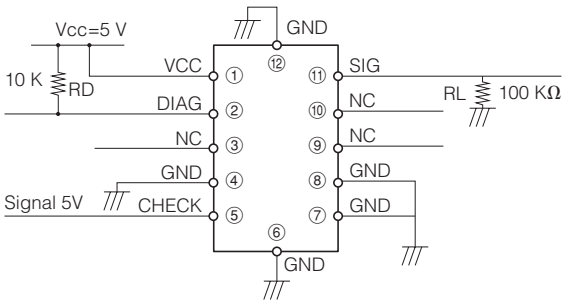
(1) Rigid glass-epoxy circuit board is recommended. Locate the sensor close to the mounting screws of the PWB. (Since tuning fork part has a resonating point (detuning frequency) between 500 to 900Hz, vibration evaluation in actual use is necessary.)

(2) Locate other parts so that they will not touch the sensor directly due to external vibration.

(3) Do not allow the mounting screws in the circuit board to become loose.

✻ Perform a vibration test and carefully check the condition of the sensor attached to the unit.

8. Recommended circuit



(1) Be sure to use 100 kΩ load resistors.

(2) The sensor does not have a power-supply backup capacitor. Insert a backup capacitor in the power supply line close to the sensor when power supply is far or the power is supplied through connectors. In case of instant power break, vibration of the tuning fork stops and takes 0.5 second to reboot.

(3) Reverse voltage or over-voltage of more than 6.3 V may destroy the sensor.

(4) When the sensor signal goes to an A/D converter, use the same 5 V power supply for both the sensor and the A/D converter.

(5) EMC characteristics depend on whether the shield-case is power grounded or case grounded. Choose which one after evaluating the assembled set.

9. Limited Warranty

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

(1) Install the following systems for a failsafe design to ensure safety if these products are to be used in equipment where a defect in these products may cause the loss of human life or other significant damage, such as damage to vehicles (automobile, train, vessel), traffic lights, medical equipment, aerospace equipment, electric heating appliances, combustion/gas equipment, rotating equipment, disaster/crime prevention equipment, nuclear apparatus, and machine tools.

· Systems equipped with a protection circuit and a protection device

· Systems equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault

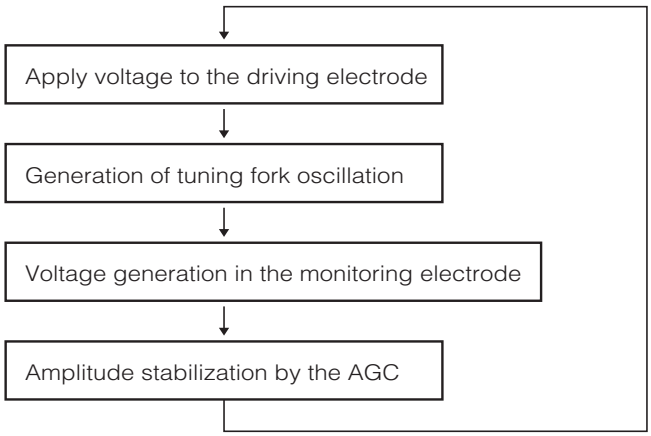
(2) If questions about the safety of this product arise, please do not hesitate to contact our company and be sure to perform the technical assessment.

■ Operating principle

- This is a sensor to detect the revolution speed w (° / s) of objects
- The sensing element is the bimorph quartz tuning fork and MEMS silicone based tuning fork
- The control circuit consists of (1) Driving Circuit and (2) Detecting Circuit

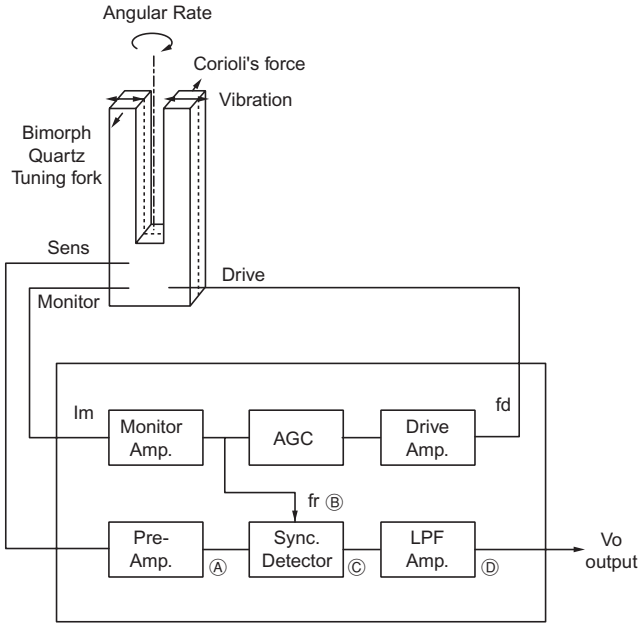
(1)Driving Circuit

It generates the particular frequency of the tuning fork through the following oscillation loop. In order to stabilize the sensitivity, the amplitude is controlled by the AGC

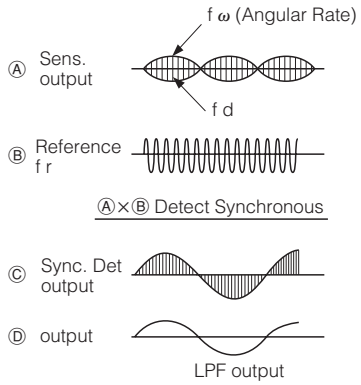


(2)Detection Circuit

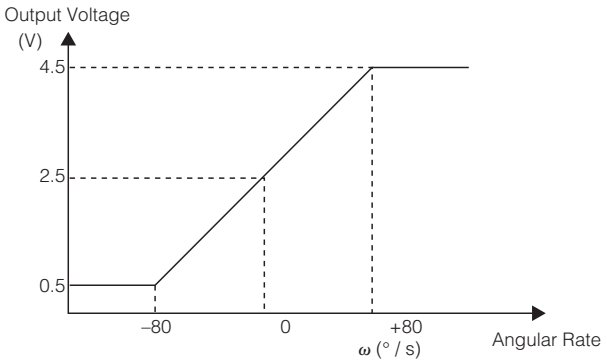
Applying angular rate to the sensor, the tines of tuning fork are twisted by CORIOLIS force and generate waves as shown in Fig 1 below. This is equivalent to the signal which is amplitude - modulated by the angular rate signal fω, using the driving frequency fd as the carrier waves. Thus the angular rate signal is extracted by the synchronized detection using driving frequency fr as base signal



[Signal Procesing]



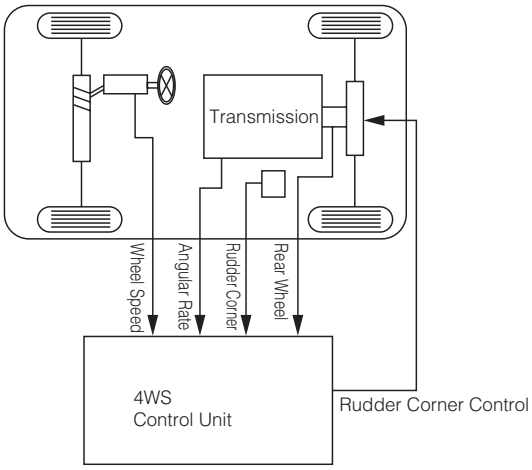
[Output Characteristic]



The maximum and minimum outputs, and the maximum detection angular rate vary with applications.

■ An Example of Applications

(Automobile 4 WS Controls)



- In some applications such as automobiles, power source lines may pick up inrush surges, a protection circuit shall be built in the control circuit
- If it is used in the conditions of a wide temperature range and the zero-point drift is not negligible, the drift correction by the digital filter (LPF) shall be executed

■ Explanation of terms

- CORIOLIS force

  In a rotating coordinate system (the angular rate: ω), when a object moving at a certain speed, apparent force generated at right angle against the moving direction.

  It can be expressed by the formula,

  $$\text{CORIOLIS force} = 2 \cdot \omega \cdot v \cdot \omega$$

  Where, m : the mass of the rotating object

  v : the velocity of the object

  ω : the angular rate in the rotating coordinate system
- Zero point voltage

  The output voltage at zero angular rate (static condition)
- Response Time

  The delay time of the output signal of Angular Rate Sensor against the input angular rate signal

■ Explanation of part numbers

1	2	3	4	5	6	7	8	9	10	11	12
E	W	T	S								
Product Code				Type	Custom Code					Reference	

5th	Type
8	for car navigation etc.
6	for rollover detection Type