



OPERATION MANUAL  
OF  
GYROSTAR

Piezoelectric vibrating Gyroscope

MODEL : ENC-03M TYPE

January 13, 2004

PRODUCT ENGINEERING SECTION  
SENSOR MODULE DEPARTMENT  
CIRCUIT PRODUCTS DIVISION  
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## Introduction

This angular velocity sensor utilizes a Coriolis force that act on a vibrating object when an angular velocity is applied to it. Murata's unique ceramic bimorph vibrating unit is used as the sensor element unit, thereby enabling piezoelectric ceramics to be used for both excitation and detection. The use of this unit simplifies equipment structure and circuit configuration, thus making it possible to provide outstanding performance.

This sensor can be used for positional control and posture control of a moving object requiring precision and quick-response measurements.

## 1. Features

- Extremely small package, thin and lightweight
- Surface-mounted-device and reflow soldering can be used
- Quick response
- Low driving voltage, low current consumption

## Applications

- Detecting hand movement of camcorder and still camera
- Detecting the movement of Head-Mount-Display, aerial pointing-device, etc.
- Detecting vibrations in various vibration free table and isolators

## 2. Specifications

Characteristics	Symbol	Condition	MIN.	STD.	MAX.	Unit
Supply voltage	Vcc		+2.7	+3.0	+5.25	VDC
Current consumption	I <sub>sup</sub>	at Vcc = +3.0V	2.5	3.2	4.5	mA
Reference voltage	V <sub>ref</sub>	at -5 to +75 deg. C	+1.25	+1.35	+1.45	VDC
Static output (Bias)	V <sub>0</sub>	angular velocity = 0 at -5 to +75 deg. C	V <sub>ref</sub> -0.6	V <sub>ref</sub>	V <sub>ref</sub> +0.6	VDC
Scale factor	S <sub>v</sub>		-20%	0.67	+20%	mV/deg/s
Temp. coefficient of scale factor		Reference : T <sub>a</sub> at -5 to +75 deg.C	-20	-	+10	%FS
Resonance frequency - version ENC-03MA - version ENC-03MB	f <sub>a</sub> f <sub>b</sub>		- -	22.4 25.0	- -	kHz kHz
Linearity		in the maximum angular velocity range	-5	-	+5	%FS
Response		Phase delay : 90deg	DC to 50			Hz
Operating temp. range	T <sub>opr</sub>		-5	-	+75	deg C
Storage temp. range	T <sub>stg</sub>		-30	-	+85	deg C
Weight			-	0.4	-	g
Dimension		Refer to page 3	12.2 x 7.0 x 2.6 mm			

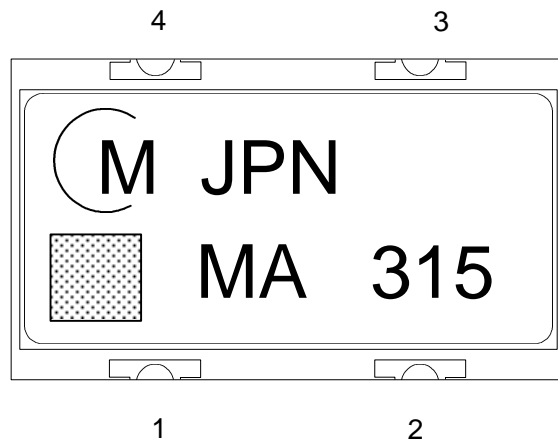
All typical values

Unless otherwise specified, ambient temperature T<sub>a</sub> = 25±5deg C, Vcc = +3.0 VDC.

Reference voltage (V<sub>ref</sub>) is grounded with capacitor of 4.7μF.

### 3. Terminal

Terminal	Symbols	Descriptions
1	Vref	Reference voltage (approx.+1.35V)
2	GND	Ground
3	Vcc	Supply voltage
4	OUT	Sensor output



### 4. Connection

1) Operation voltage is +2.7V to +5.25V.

Use a stabilized power supply free from surge and ripple voltages. Also, confirm proper power supply polarity before connecting sensor.

2) Output voltage is relative to the angular velocity.

$$\text{Output voltage} = V_0 + S_v \times w \text{ [V]}$$

$V_0$  :Static output [V] (at angular velocity is 0 [deg/s])

$S_v$  :Scale factor [mV/deg/s]

$w$  : Angular velocity [angular velocity range : -90 to +90 [deg/s]

3) Use a sensor output load resistance of 50 k ohm or more.

4) Reference voltage (Vref) must be grounded with capacitor of 4.7μF or more.

### 5. Installation

ENC-03M is Surface-Mounted-device.

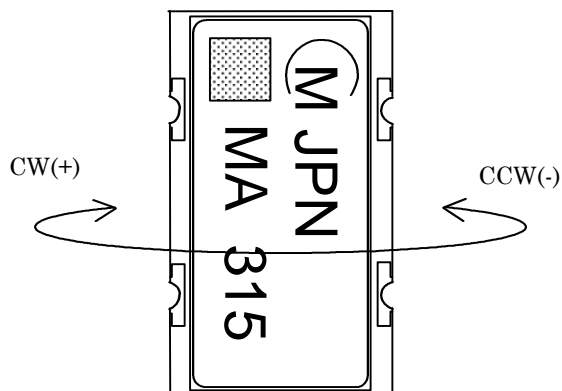
reflow soldering condition ( reference )

	temp. (deg. C)	time
pre-heat	150 – 180	90sec
Max. temp.	250	—

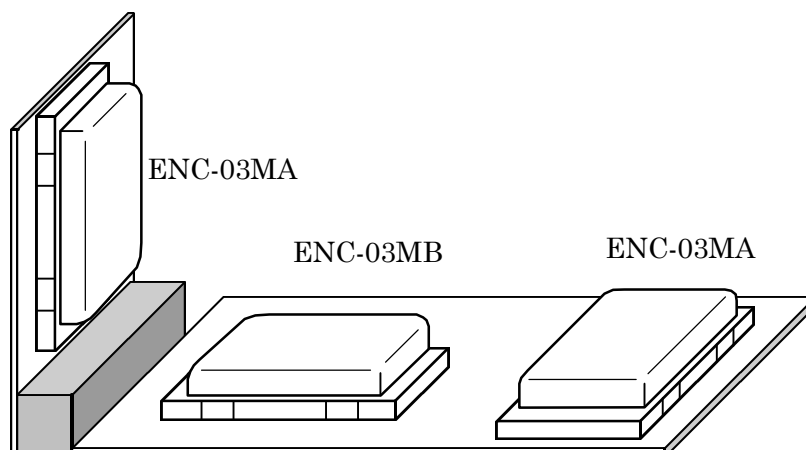
\* ENC-03M can not be mounted by flow-soldering.

## 6. Instruction for use

- 1) One sensor can detect one angular velocity along one axis. You need two sensors when you want to detect around 2 axes angular movement.
- 2) Install sensors in a direction that the rotating axis is parallel to long side of the sensor.



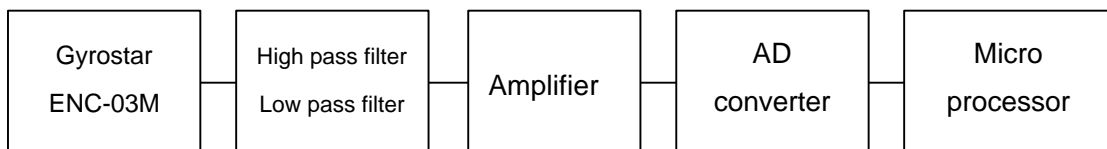
- 3) There are 2 types of sensors. One is the ENC-03MA and other is ENC-03MB. The ENC-03MA & ENC-03MB have the same specifications except for its resonant frequencies. When using same type of ENC-03Ms, output swell may occur due to adjacent resonant frequencies. It can be avoided by using different types.
- 4) When detecting just one axis, select model ENC-03MA or ENC-03MB. When detecting two axes, select models ENC-03MA and ENC-03MB. When detecting three axes, select 2 pcs of ENC-03MA and 1pc of ENC-03MB and follow the bellow guideline to avoid mutual interference:
  - Install one ENC-03MA on a separate PCB from the other installed ENC-03MA & MB.
  - Two devices are kept apart as far as possible.
  - Use acoustical material in order to isolate the sound wave as needed.



- 5) Do not install sensors near vibration source such as actuator or buzzer. It may have an affect on sensor output when vibrating frequency or their harmonic component is near by resonant frequency of gyro.
- 6) Temperature variation will have an affect on the sensor output in bias, scale factor. Sensors should be mounted where ambient temperature would not be likely to change.
- 7) Do not install sensors under the shock. Strong shock may have an affect on sensor output. If it would be needed, shock absorbing countermeasure should be taken.
- 8) Do not install sensors under the vibration. Strong vibration may have an affect on sensor output. If it would be needed, vibration proof countermeasure should be taken.
- 9) Precision electronic parts, such as ICs, are used. It is necessary to take anti-static precautions when handling.
- 10) Do not use sensors under the condition that condensations in likely to form on it.
- 11) Do not wash the sensors, as it is not waterproof.
- 12) Do not touch terminals by naked hand.
- 13) Do not disassemble the sensors.

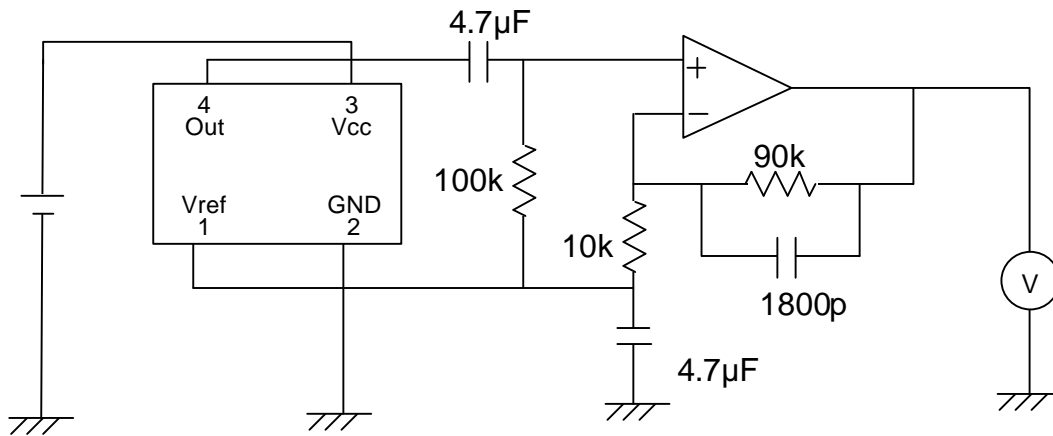
## 7. Usage

A referential simplified block diagram is shown in the illustration.



- 1) Positive voltage(+) and negative voltage(-) are obtained in the clockwise and counterclockwise directions, respectively, with the static output as a reference.
- 2) Low-frequency components should be cut by HPF (Hi-Pass-Filter) in order to cancel bias drift, and high-frequency component should be cut out by LPF(Low-Pass-Filter) in order to eliminate output noise. Cut-off frequency will affect measurement accuracy. Please choose a proper cut-off frequency according to the application.

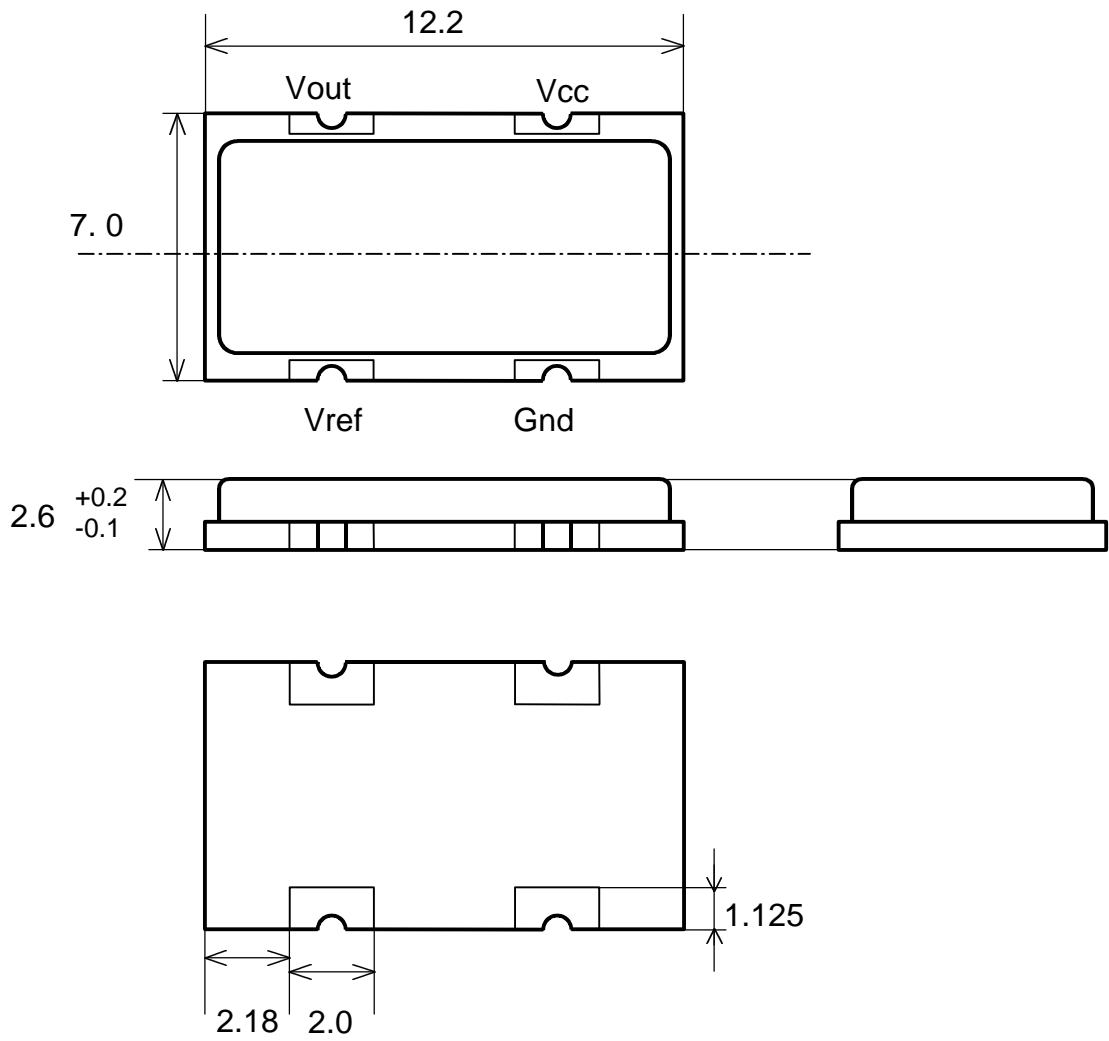
- 3) Usually an A/D converter of 8 bits or more is used. Resolution of A/D converter will affect measurement accuracy. Please choose a proper resolution according to the application.
- 4) The sampling frequency used for measurement should be 50 times/sec minimum. Sampling frequency will affect measurement accuracy. Please choose a proper sampling frequency according to the application.
- 5) Please choose a proper amplification factor according to the application.
- 6) Typical circuit



The cut-off frequency of HPF is approx. 0.3Hz and of LPF is approx. 1kHz.

ENC-03M type

## 8. Dimension



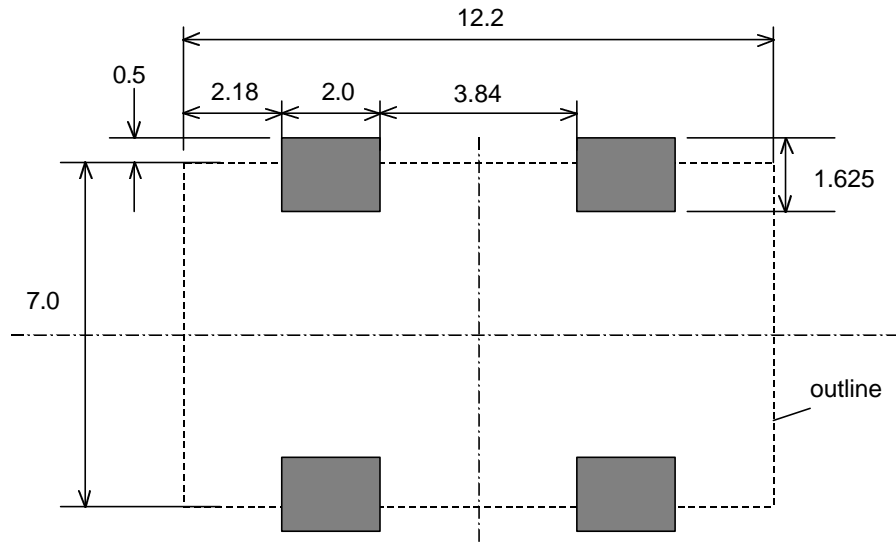
tolerance: +/-0.2

in mm

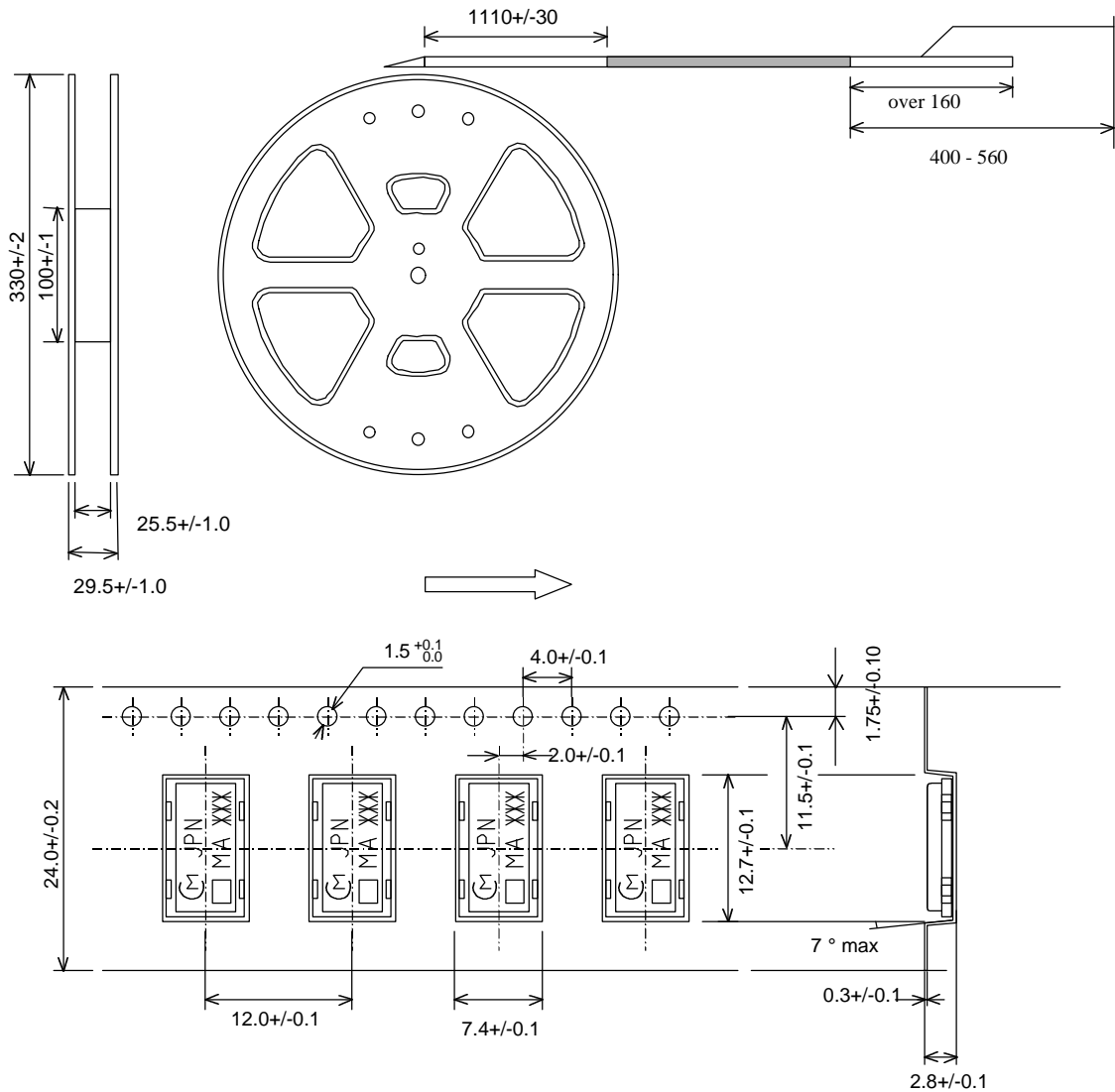


ENC-03M type

land pattern (reference)



Package (reel and embossed tape)



 Note

1) Please contact us before using our products for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property.

(1) Aircraft equipment (2) Aerospace equipment (3) Undersea equipment

(4) Medical equipment (5) Transportation equipment (vehicles, trains, ships, etc.)

(6) Traffic signal equipment (7) Disaster prevention / crime prevention equipment

(8) Data-processing equipment (9) Applications of similar complexity or with reliability requirements comparable to the applications listed in the above.

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