

MEMS Rate Sensor specification			
	Sensor Device Development Department Development Section	Approved by	Confirmed by
		Issued by	

1 Scope

This product specification is applied to “Rate sensor” used for car-navigation systems. Please contact us before using any of the products in the applications not described above.

2 Part number

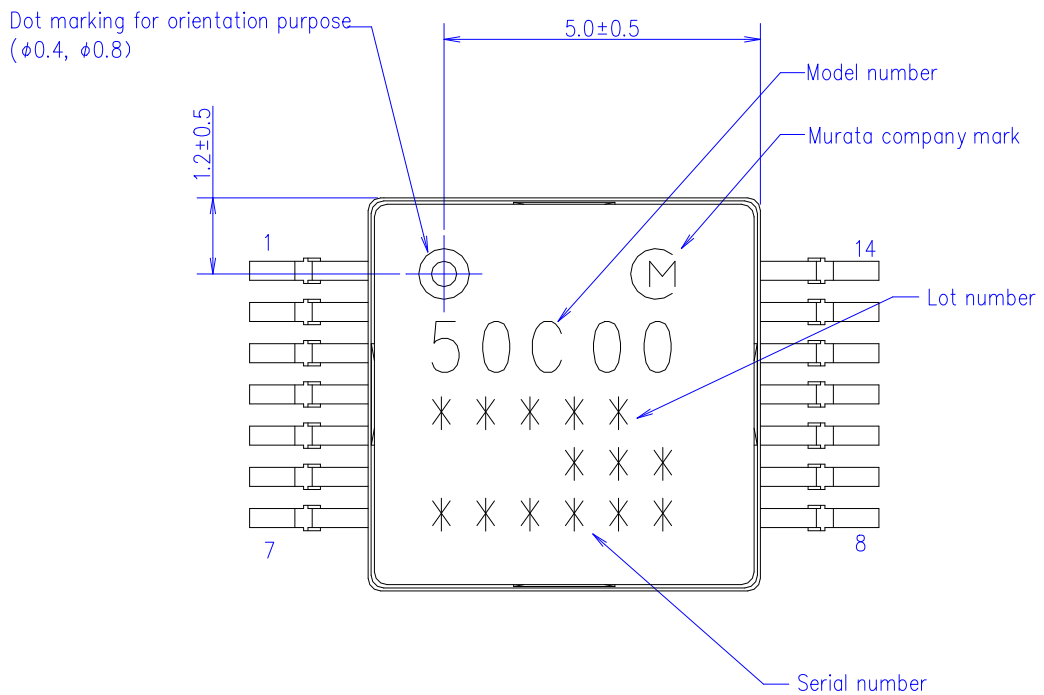
Customer part number :
Murata part number : MEV-50C-R

3 Configuration, external dimension, and structure

3-1 Structurally characteristics

External dimension : Refer to <Appendix drawing 1> (P. 15/15)

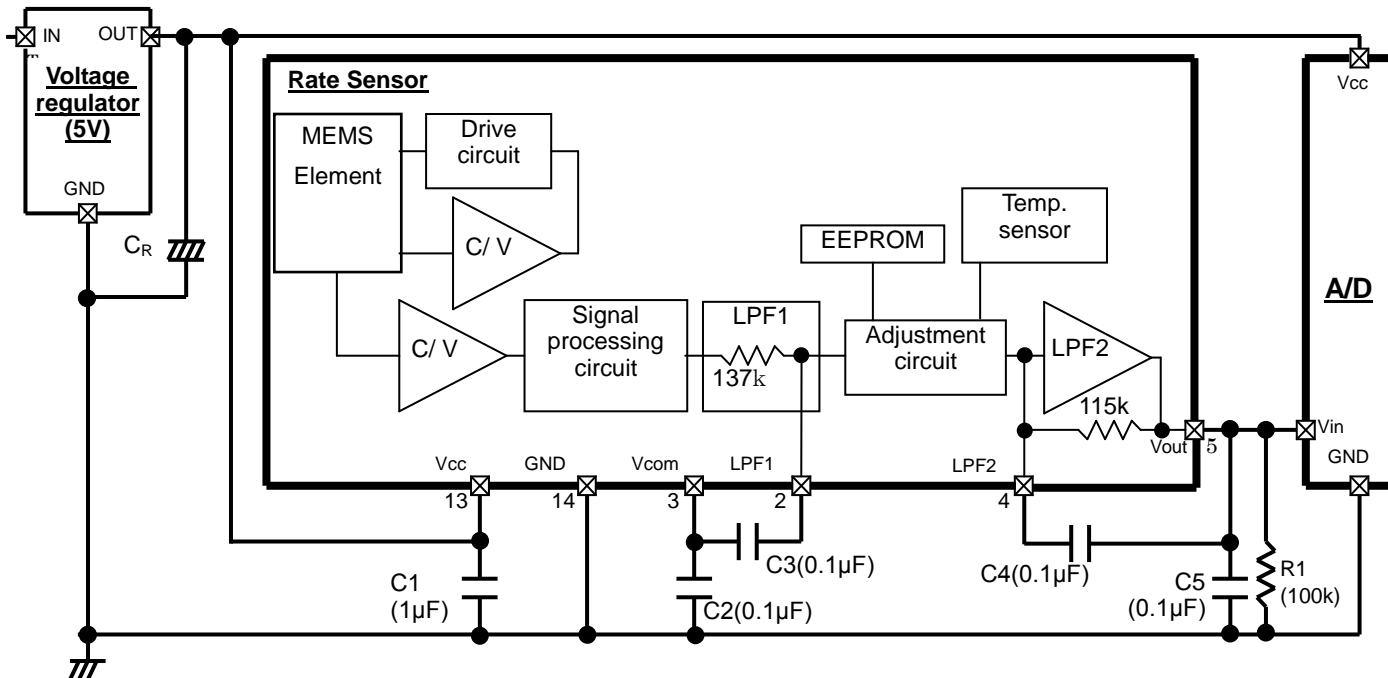
3-2 Marking (Unit: mm)



Specification

3-3 Weight
0.3g MAX.

3-4 Circuit diagram



Connecting part information

Symbol	Function
C _R	If ripple of power supply affects the sensor output, please set the appropriate capacitor (C _R) for the purpose of smoothing the power supply. C _R should better be mounted as closely as possible to the Voltage regulator.
C1	For noise elimination purpose to Vcc (Voltage Power Supply). C1 should better be mounted as closely as possible to the Sensor.
C2	For noise elimination purpose to Vcom (Reference Supply). C2 should better be mounted as closely as possible to the Sensor.
C3	Used along with the built-in resistor of 137k±20% ohm for LPF1 (Low Pass Filter 1) C3 should better be mounted as closely as possible to the Sensor.
C4	Used along with the Built-in resistor of 115k±20% ohm for LPF2 (Low Pass Filter 2) C4 should better be mounted as closely as possible to the Sensor.
C5	A load capacitor to Vout (Rate signal Output)
R1	A load resistor to Vout (Rate signal Output)
A/D	10M ohm of input impedance recommended (1M ohm or more is needed.)

Specification

Recommendable part number

Symbol	Part Number (Vendor) and spec.
C1	GRM188R71C105K (MURATA) or similar / Tol.:±10%
C2~C5	GRM155R11C104K (MURATA) or similar / Tol.:±10%
R1	MCR01MZPJ104 (ROHM) or similar / Tol.:±5%

Condition of signal terminal

Symbol	Condition
Vout	Max. load capacitance:2 μ F / Min. load resistance:50k ohm. (To GND or To Vcc) Connect 0.1 μ F capacitor to GND
Vcom	Connect 0.1 μ F capacitor to GND

4 Operating conditions and characteristics

4-1 Operating conditions (Ratings)

4-1-1 Absolute maximum ratings

Item	Rating value		Unit	Remarks
	MIN.	MAX.		
Supply voltage (Vcc)	-0.3	6.5	V	
Storage temp. range	-40	95	°C	

Note 1) All values are based on GND potential.

Note 2) Do not use the sensor of deviating from the above mentioned ratings.

4-1-2 Recommended operating conditions

Item	MIN.	TYP.	MAX.	Unit
Dynamic range	-70		+70	deg/s
Supply voltage	4.75	5.00	5.25	V
Current consumption	2		8	mA
Operating temp. range	-40		85	°C

Note 3) Non-load condition to the sensor output

4-2 Characteristics

4-2-1 Electrical characteristics

(Unless otherwise specified, ambient temperature Ta = 25+/-5°C, Vcc = 5.0 +/- 0.01VDC.)

(All values are under the condition of "Circuit diagram" described in 3-4.)

Specification

Item	Symbol	Test method or condition	Characteristic value			Unit
			MIN.	TYP.	MAX.	
Scale factor	Sv	-40~+85°C	23.25	25.00	26.75	mV/(deg/s)
Temp. coefficient scale factor		-40~+85°C Reference : Ta			4	%
Zero point output	V0	-40~+85°C	2.20	2.50	2.80	V
Temp. drift		-40~+85°C			6	deg/s
Temp. drift gradient		-40~+85°C			0.5 1.0	(deg/s)/2°C (deg/s)/8°C
Start up drift		0.5s~5minutes 0.5s~15minutes			0.4 0.8	deg/s deg/s
Startup time		After the power on, monitor a time that zero point output has been within +/-12.5mV against zero point output value of being steady.			0.5	s
Output noise					10	mV(p-p)
Linearity-error		Within maximum dynamic range			0.5	%FS
Cross axis sensitivity		On each X, Y axis	-5		+5	%
Frequency response (Frequency vs. Gain)		Gain at 7Hz	-4		-1	dB
Ratiometric for zero point output		4.75~5.25V	0.8		1.2	-
Ratiometric for scale factor		4.75~5.25V	0.8		1.2	-

Note 4) Frequency Response is defined under the condition of C3, C4 = 0.1+/-10%. (C3, C4 are described in "3-4. Circuit diagram".)

Note 5) "Zero point output" and "Scale factor" are proportional to Vcc.

4-2-2 Vibration resistant characteristic

This is the specification of "acceleration sensitivity under the vibrational condition" of the sensor when mounted on the PCB. Unless otherwise specified, ambient temperature Ta = 25+/-5°C, Vcc = 5.0 +/- 0.01VDC, under the condition of "Circuit diagram" described in 3-4.

Item	Condition	Spec.			Unit
		MIN	TYP	MAX	
Acceleration sensitivity under the vibrational condition	Frequency : 10~2000Hz Acceleration : 2.2G(21.56m/s ²) 3 directions(X,Y,Z)			1.0	deg/s

Specification

Note 6) Resonance on PCB or vibration machine during above frequency is not allowed.

Note 7) Measurement errors, such as output noise, angular velocity unexpectedly generated by vibration machine, should not be considered to be acceleration sensitivity.
Only DC voltage level, which does not contain the measurement errors, should be specified.

5 Environmentally-resistant characteristics

5-1 Operating condition:

Inputting the supply voltage: 5.0 +/- 0.1VDC between Vcc and GND

5-2 Environmental characteristics

5-2-1 Low temperature exposing test

Exposing the product in -40°C thermostatic chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

5-2-2 Low temperature operating test

Operating the product in -40°C thermostatic chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

5-2-3 High temperature exposing test

Exposing the product in +95°C thermostatic chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

5-2-4 High temperature operating test

Operating the product in +85°C thermostatic chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

5-2-5 High temperature and High humidity exposing test

Exposing the product in +85°C and 85%RH thermo-hygrostat chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

5-2-6 High temperature and High humidity operating test

Operating the product in +85°C and 85%RH thermo-hygrostat chamber during 1000hours.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

Specification

5-2-7 Heat shock test

Exposing the product in below heat shock test profile during 1000cycles.

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect

- Heat shock test profile (1cycle)
Temperature (Time): 85°C (30min.) ⇔ -40°C (30min.)

5-2-8 Static electricity test (Human Body Model :HBM)

Inputting test voltage on each terminal of the product in below condition

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

- Vtest=+/-1kV, C=100pF, R=1500 ohm

5-2-9 Static electricity test (Machine Model : MM)

Inputting test voltage on each terminal of the product in below condition

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

- Vtest=+/-200V, C=200pF, R=0 ohm

5-3 Mechanical characteristics

5-3-1 Vibration test

Inputting vibration onto the product in below condition

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

- Frequency: 10~500Hz
- Acceleration: 98m/s²(10G) , Maximum swing: 1.5mm
- Sweeping period: 11min. (log sweep)
- Test cycle: 24 cycles to each X,Y,Z direction

5-3-2 Shock test

Inputting shock onto the product in below condition

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

- Acceleration: 14700 m/s²(1500G)
- Operating time: 0.5ms (Half sine wave)
- Number of shocks: 3 times for each 6 directions of X, Y, Z axis.

5-3-3 Operation endurance test

Under operating the product, inputting angular rate toward the detecting rotation

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.

- Angular rate: +/-20deg/s
- Frequency: 2Hz
- Operating time: 1000hours

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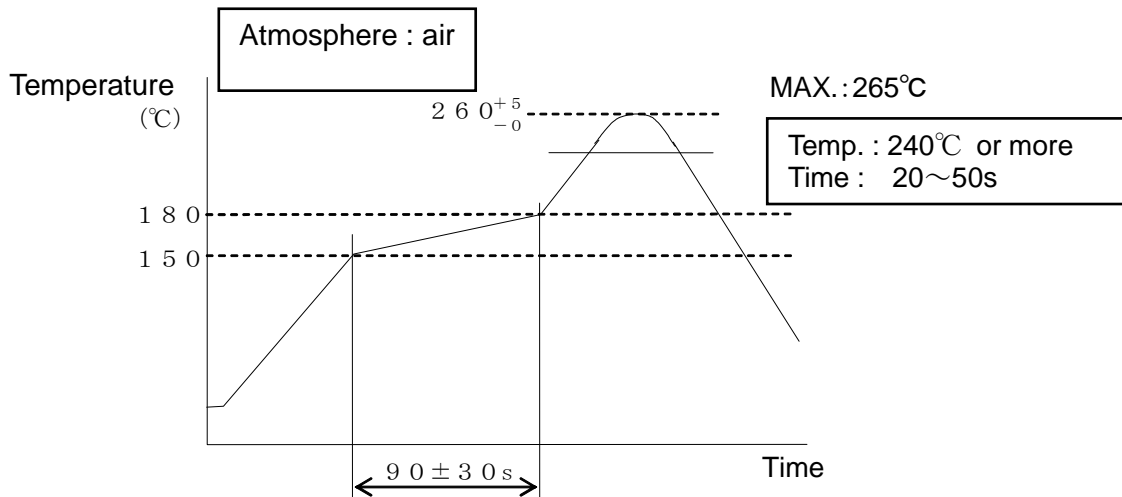
5-4 Mounting characteristics

5-4-1 Durability for reflow soldering profile

Reflowing the product in the profile as follows (Reflow cycle: 3cycles)

After testing, being placed at ambient conditions for 2 hours or more, then to be measured

Judgment criteria: To satisfy "4-2-1 Electrical characteristics", No appearance defect.



5-4-2 Solderability

Terminals are immersed by flux, then immersing the product into soldering bath

Checking the solderability of the terminals. Conditions are as follows.

Pretreatment : PCT 105°C, 100% (1.22×105Pa)×4h

Flux : IPA / Rosin = 75 / 25

Composition of solder : Sn-3Ag-0.5Cu

Temperature : 245 +/- 5°C

Immersing time : 3 +/- 0.3s

Immersing rate : 20~25 mm/s

Immersing depth : 2mm or more from solder surface

Judgment criteria : 95% or more of the terminals are wet

6 Packing style

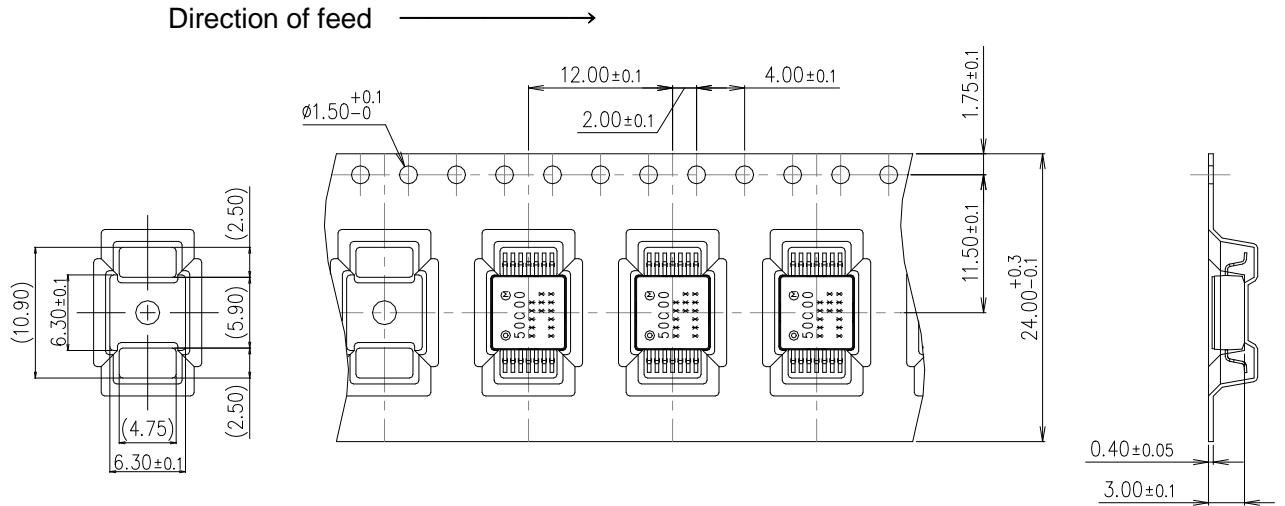
•A carrier shall contain 200 pcs of products. Carrier is made of plastic reel (φ330mm).

•Packing parts information are as follows.

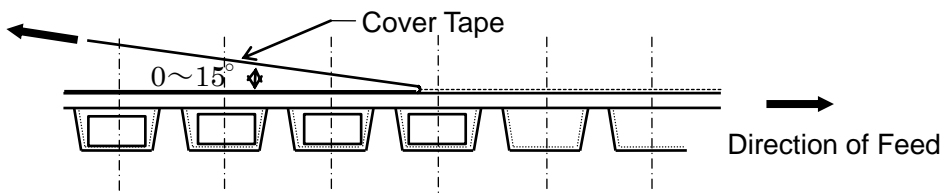
Packing parts	Explanation
Carrier	Conductive PS reel (φ330mm)
Embossed tape	Conductive A-PET
Cover tape	PET or Olefin series resin
Moisture Barrier Bag (MBB)	Aluminum
Desiccant	
Humidity Indicator Card (HIC)	JEDEC compliant

Specification

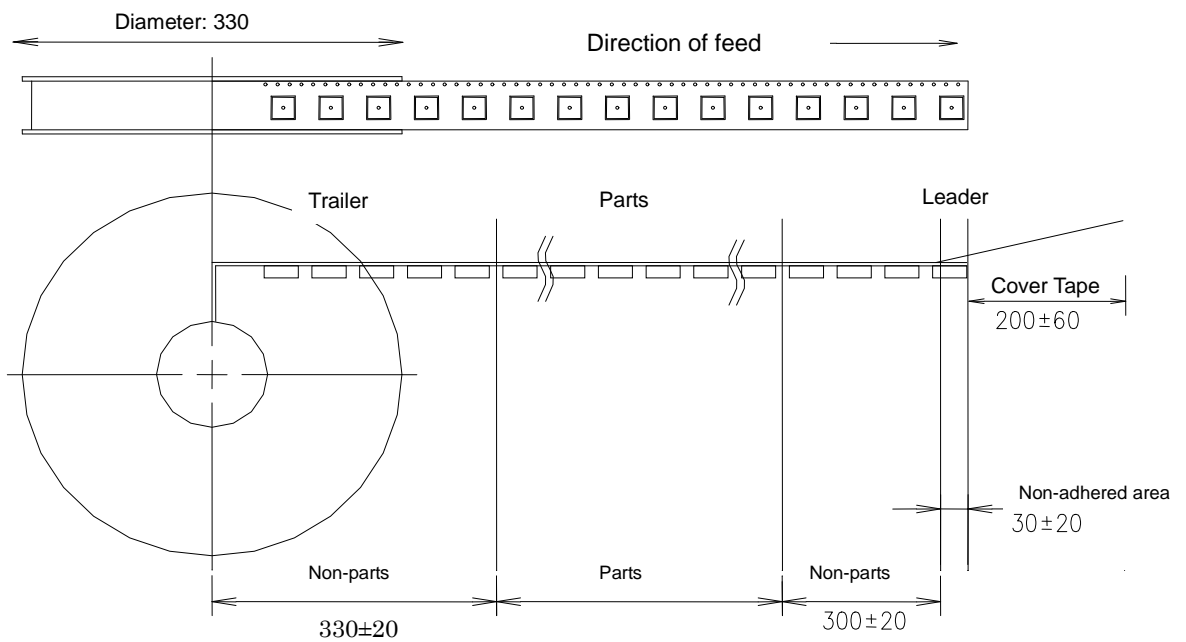
- Dimension of embossed tape (unit: mm)



Peeling strength : 0.1 to 1.3N (300+/-10mm / min.)



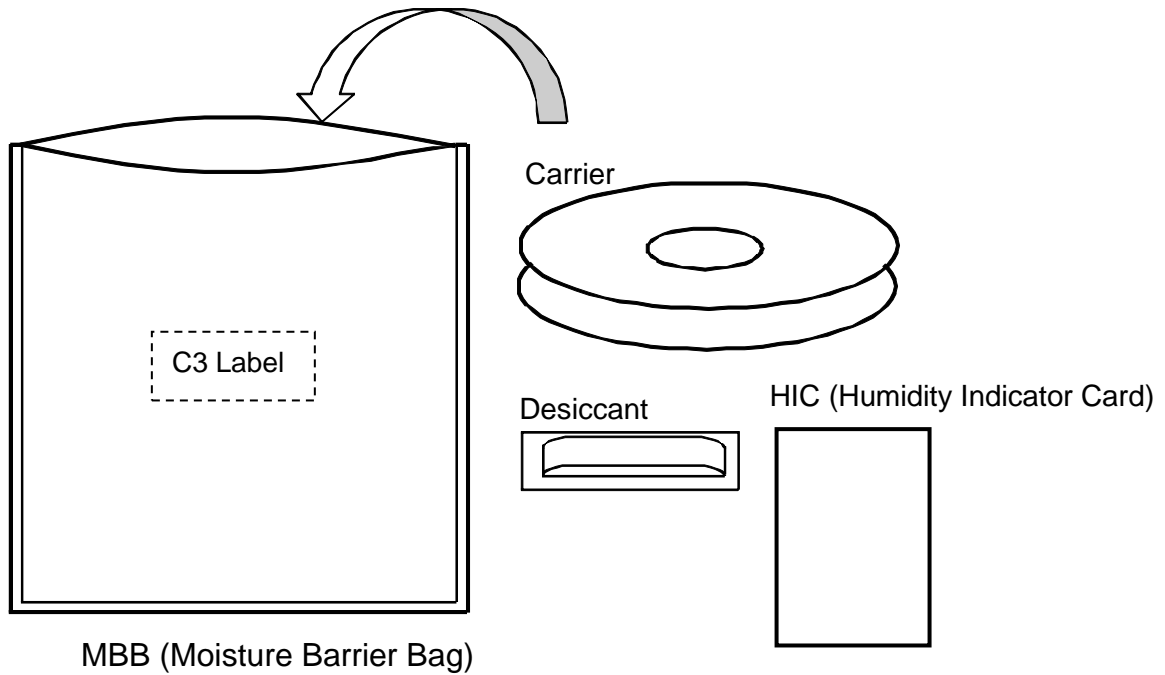
- Dimension of carrier (unit: mm)



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• Moisture barrier information

Carriers which contain the products with embossed tape, desiccant and HIC are packed in a MBB. Then, the MBB is sealed by thermocompression bonding.



• Shipping style

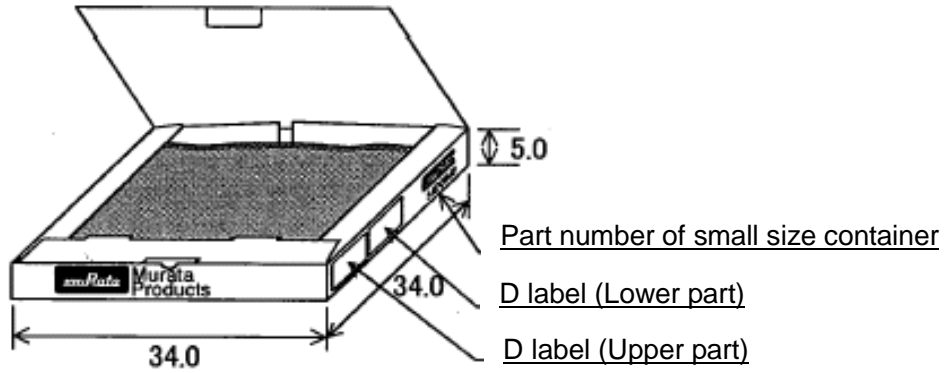
Shipping style is 3 types, and the type is selected by qty. of carrier.

Shipping container type

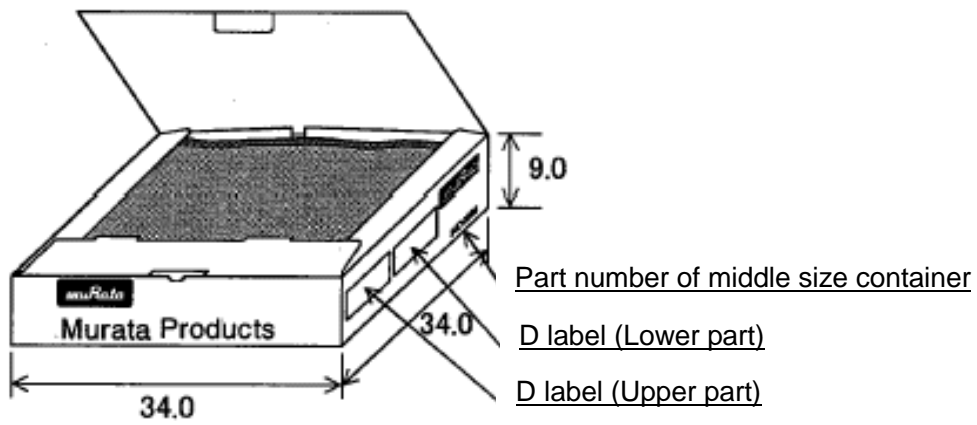
Carrier	Container type	Carrier qty.
φ330mm	1	1
same as above	2	2
same as above	3	3

Specification

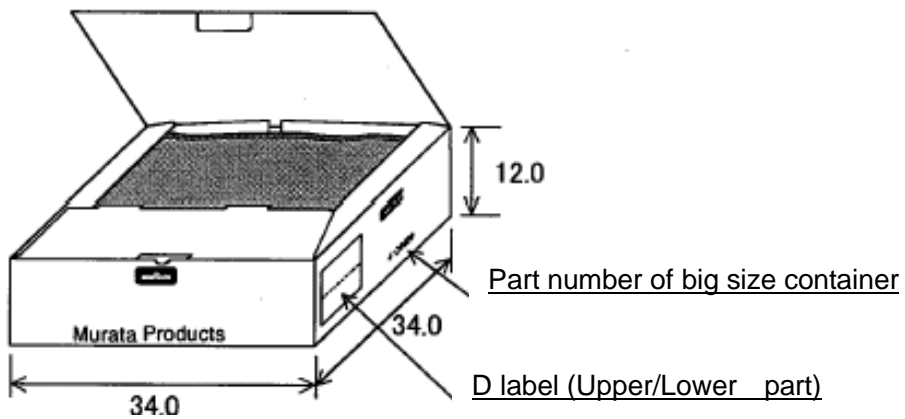
(Type1)



(Type2)



(Type3)



Unit:cm

Specification

7 ⚠ CAUTION

7-1. Limitation of Application

Do NOT use our product for the applications listed below which require especially high reliability for the prevention of defects that might directly cause damage to the third party's life, body or property.

- | | |
|---|--|
| (1) Automotive control equipment | (11) Data-processing equipment |
| (2) Aircraft, Avionics equipment | (12) Applications of similar complexity and/or reliability requirements to the applications listed in the above. |
| (3) Aerospace equipment | |
| (4) Under sea equipment | |
| (5) Power plant control equipment | |
| (6) Medical equipment | |
| (7) Traffic signal equipment | |
| (8) Disaster prevention / crime prevention equipment | |
| (9) Safety device / system | |
| (10) Military equipment (regardless of directly/indirectly) | |

7-2. Fail-safe

Be sure to provide an appropriate fail-safe function on your product to prevent may be caused by the abnormal function or the failure of our product.

8 CAUTION of application

8-1 CAUTION of handling

- ① When carrying or handling the product, please take care not subject the product to heavy shock by way of drop etc. It may cause the destruction of inside the sensor or performance defect. When carrying the product, we recommend it with the condition of packing style.
- ② Precision electronic parts, such as ICs, are used for the sensor; therefore, it is necessary to take anti-static precautions when handling.
- ③ Do not disassemble. It may affect the characteristics.
- ④ Do not touch the terminal of the sensor directly by hand. It may affect the solderability or break down the inner circuit by static electrical charge.
- ⑤ Do not wash the product. It may cause characteristics error of the sensor.
- ⑥ Do not apply Ultrasonic wave over 12kHz to the product. It may cause characteristics error of the sensor.

8-2 CAUTION of storage and evaluation

- ① Please note the following precaution regarding application or storage condition. It may affect the characteristics of the sensor.
 - 1) Do not subject the sensor to shocks that exceed the rated limit.
 - 2) Do not install or store the sensor in a location where water may splash directly on it or where dew condensation may occur.

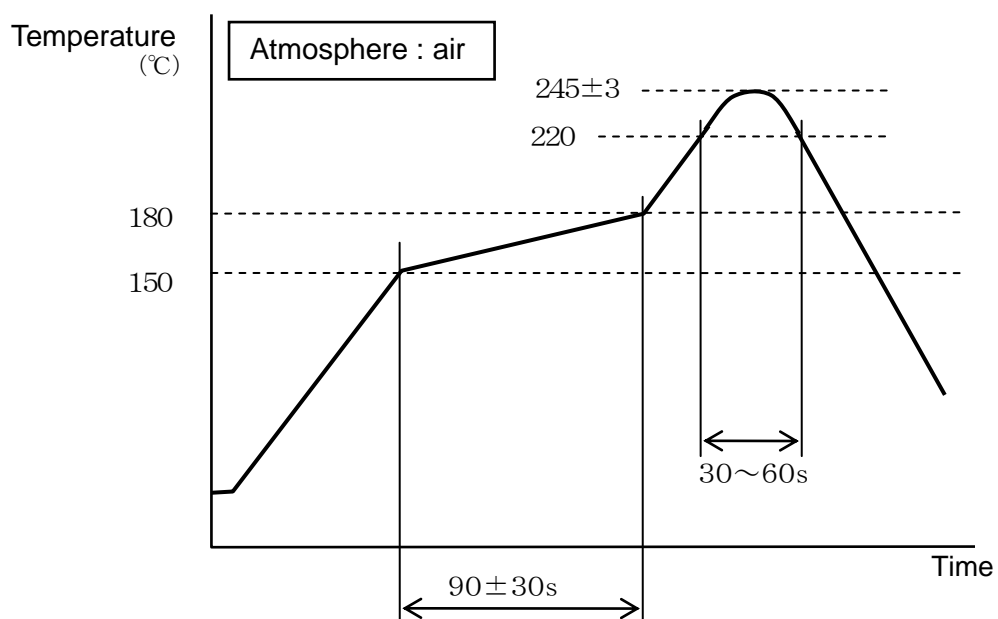
Specification

- 3) Do not install or store the sensor in a location in which it is likely to be exposed to salt water or corrosive vapor.
- ② When reflow-soldering the sensor onto PCB more than once, the mounted sensor may fall down from the PCB when 2nd reflow is carried out. Please take care and have an action for it. The spec. of "Durability for reflow soldering profile" is described in No.5-4-1.
 - ③ Mount all terminals by soldering. Furthermore, please do not connect NC terminals to any circuits nor signal lines in <Appendix drawing 1>. If connected, it may result in operation error or degradation to EMI (Electro Magnetic Interference) performance.
 - ④ Please make sure not having resonance onto the PCB by external vibration. Please fix the PCB robustly not having bend or distortion. Furthermore, please make sure to check "vibration resistant characteristic" of the sensor when mounted on PCB in advance.
 - ⑤ Do not use or store the product in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. And avoid exposure to shock, dewfall, sunshine or dust condition. Store the product where the temperature and relative humidity do not exceed -10 to 40 degrees centigrade and 15 to 90% with "packing style". Solder the products within 6 months from delivery.
 - ⑥ Do not damage the MBB by sting, throw or drop and so on. It may influence on the moisture-proof property of the packing.

8-3 Caution for mounting the product

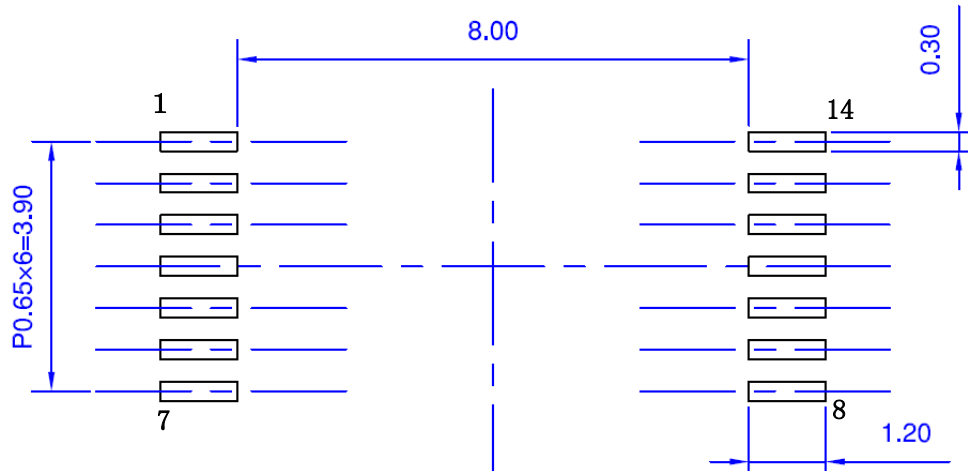
"Recommendable composition of solder" and the "reflow soldering profile" are as follows.

- ① Recommendable composition of solder : Sn-3Ag-0.5Cu (lead-free solder)
- ② Thickness of a solder-print mask : 0.15mm
- ③ Reflow soldering profile (Sn-3Ag-0.5Cu lead-free solder is assumed.)



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④ Recommendable pad pattern (unit: mm)



Terminal information is described in <Appendix drawing 1>, P15/15.

- ⑤ Maximum cycle of reflow soldering : 3cycles
- ⑥ If soldering iron is needed, use iron (3mm diameter or less, 45W max.) that temperature of iron should be 380°C or less with 5 seconds or less at each terminals. The maximum number of times of soldering is 1 time per 1 terminal.
Please be careful not to touch the soldering iron to the product body directly.
- ⑦ In case of using the solder other than the recommendable one, please estimate the mounting condition and mounting reliability in advance.
- ⑧ Flow soldering is not applicable.
- ⑨ The product may have an influence on its reliability when heat stress of reflow is added with some moisture inside the product. Take care below points after unsealing Moisture Barrier Bag (MBB).
1. After unsealing the MBB, mount the product within 168 hours under the condition of 5~30°C, 60%RH.
 2. Desiccant and Humidity Indicator Card (HIC) are enclosed in the MBB. When "10% detection area" of the HIC changes from blue to lavender (pink), or exceed the timelimit of item 1, please do "Baking treatment (125°C, 24hours)" to the product before mounting.
 3. "Adhesive tape", "Embossed tape" and "Carrier" are not heat-resistant. Therefore, the baking treatment with "taping packed condition" is not applicable. When doing the baking treatment, please do not forget to transfer the product from the carrier to the tray which is conductive and heat-resistant.

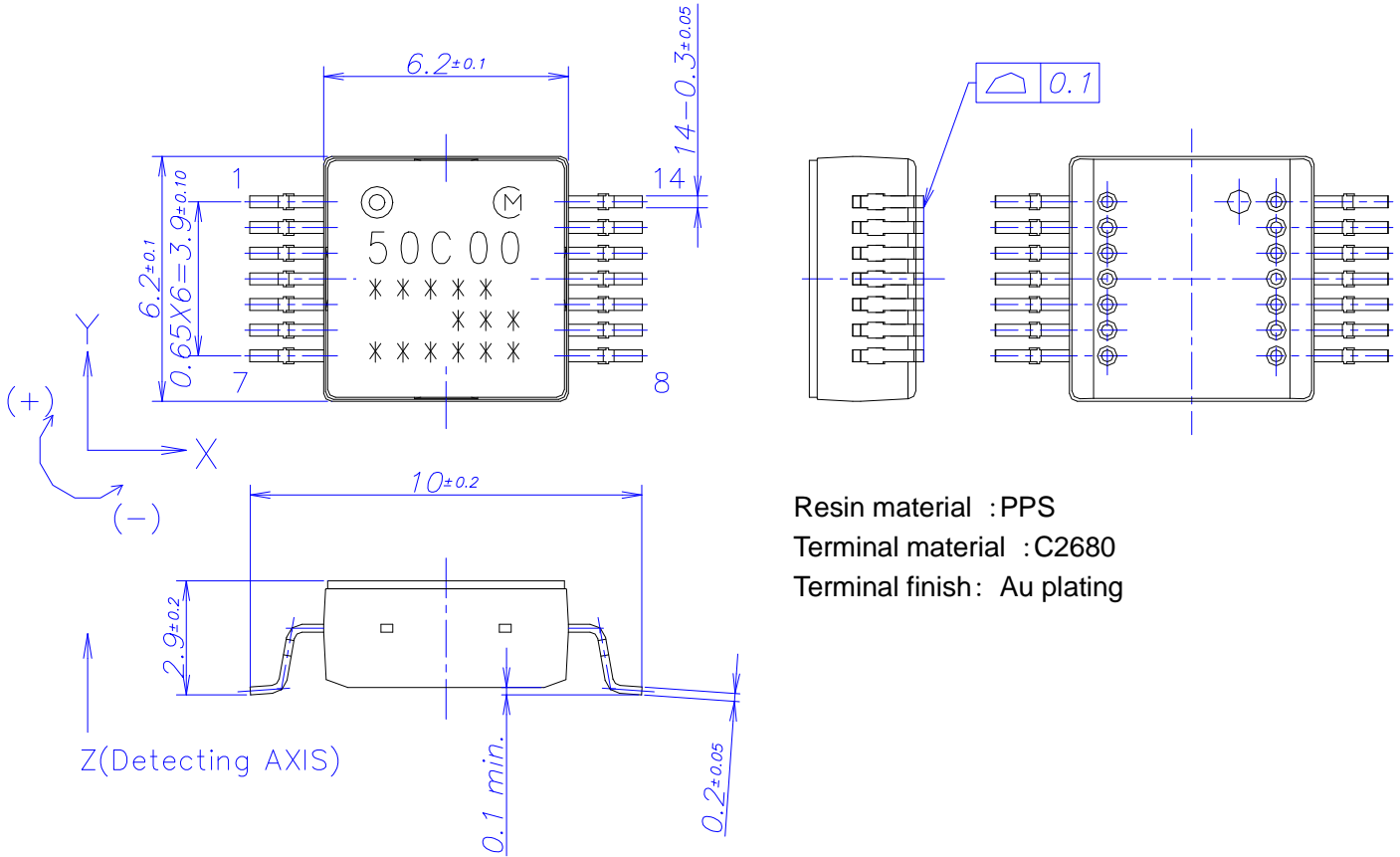
Specification

9  Note

1. Please make sure that your product has been evaluated and confirmed against your specifications when our product is mounted to your product.
2. All the items and parameters in this approval sheet for product specification have been prescribed on the premise that our product is used for the purpose, under the condition and in the environment agreed upon between you and us. You are requested not to use our product deviating from such agreement.
3. Please return one duplicate of this approval sheet for product specification to us upon approval. If the duplicate is not returned by 3 months after our submission, this approval sheet for product specification will be deemed to have been approved by you.
4. We consider it not appropriate to include other terms and conditions for transaction warranty in product specifications, drawings or other technical documents. Therefore, if your technical documents as above include such terms and conditions as warranty clause, product liability clause, or intellectual property infringement liability clause, we will not be able to accept such terms and conditions unless they are based on the governmental regulation or they are stated in a separate contract agreement.

Specification

<Appendix drawing 1> External dimension (unit: mm)



Resin material : PPS
 Terminal material : C2680
 Terminal finish : Au plating

Terminals

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	NC	No Connect.	8	NC	No Connect.
2	LPF1	Low Pass Filter 1	9	NC	No Connect.
3	Vcom	System Ground	10	NC	No Connect.
4	LPF2	Low Pass Filter 2	11	NC	No Connect.
5	Vout	Rate Signal Output	12	NC	No Connect.
6	NC	No Connect.	13	Vcc	Voltage Power Supply
7	NC	No Connect.	14	GND	Analog Ground