

## Vibration Sensors **D7S**

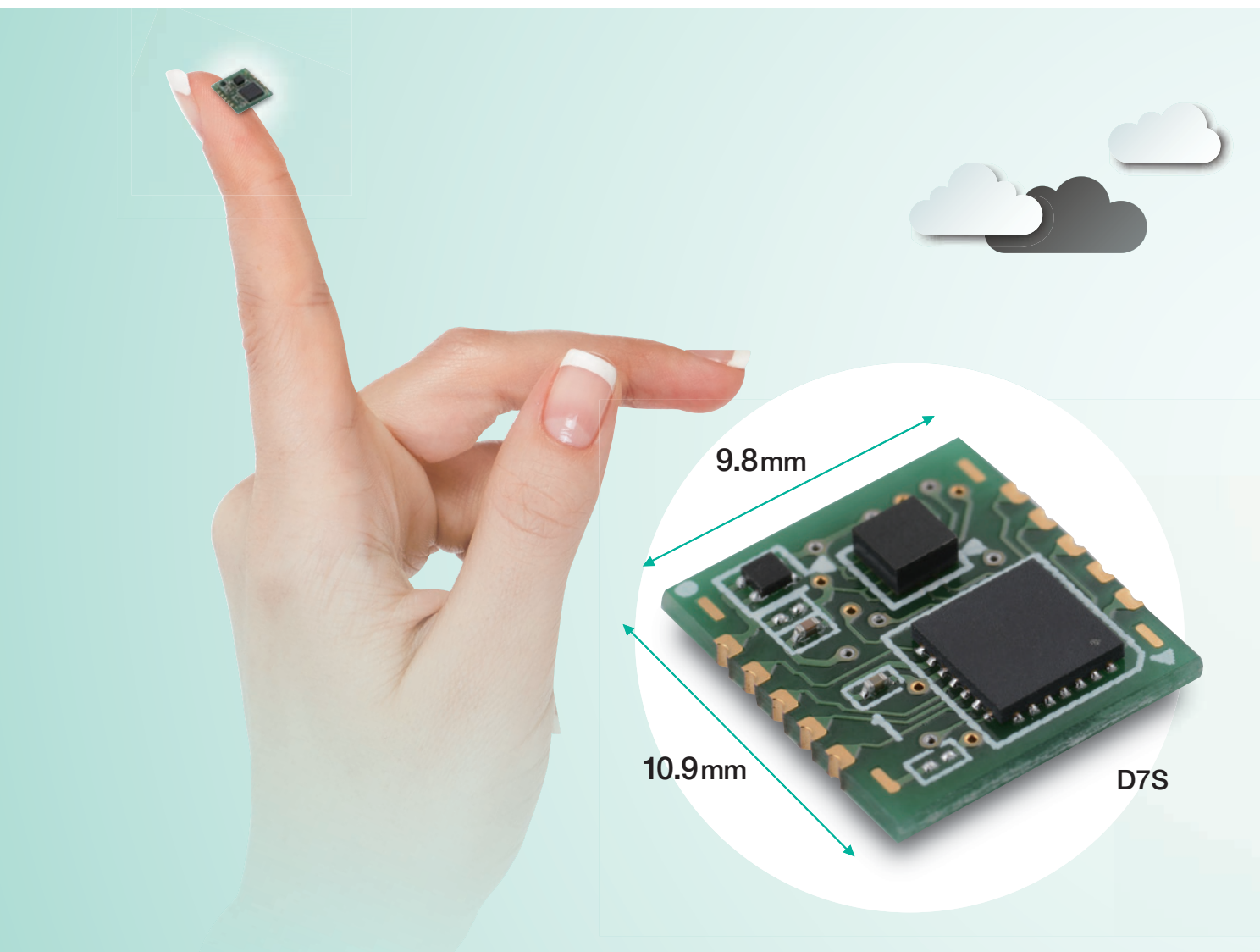


The World's Smallest Class Size,  
High-precision Seismic Sensor.  
IoT Friendly.



# Compact & High-precision Seismic Sensors

- Reducing Secondary Disasters from Earthquakes -



## What Is an SI Value?

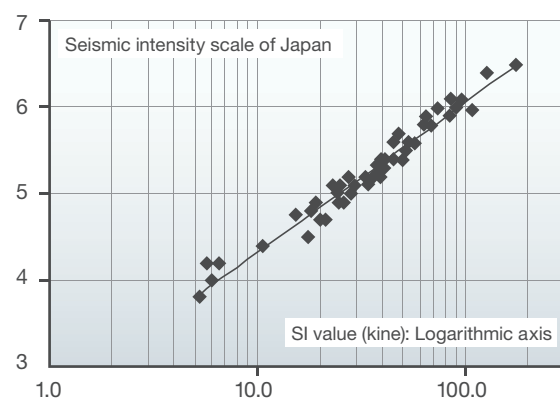
The SI value (or spectral intensity) is equivalent to the magnitude of the destructive energy imposed by seismic motion on structures.

The SI value, which is the average value of the integrated velocity response spectrum, is an index that expresses the destructive force of seismic motion and is highly correlated with the damage to structures.

SI value  
formula

$$SI = \frac{1}{2.4} \int_{0.1}^{2.5} Sv(T, h) dT$$

Relationship between SI Value and  
Measured Seismic Intensity Equivalent Value



New earthquake detection sensors with high detection precision and low electricity consumption through 3-axis acceleration sensors and a unique SI value calculation algorithm. Superior cost performance.

### Ultra Compact

## The Best for Embedding in Equipment

The D7S can be embedded in essentially any device thanks to its ultra-small size and ultra-low consumption to contribute to package downsizing.

### High Precision

## Rejects Impulse Vibration Noise

Spectral intensity (SI) high-precision earthquake indicator, which correlates highly with damage to structures.

### IoT Friendly

## Earthquake Maps and Rescue Maps

Internal memory and I<sup>2</sup>C interface enable the creation of original applications.

### Comparison of SI Values and Acceleration

As an index, the SI value has a higher correlation with the seismic intensity scale of Japan than the maximum acceleration does. This makes it possible to make judgments that accurately reflect structural damage.

|   | Maximum acceleration       | Seismic intensity scale of Japan   | SI value   |
|---|----------------------------|--|--|
| Overview  | Maximum acceleration value | Calculated from the acceleration   | Average value of the shaking velocity  |
| Calculation load  | Small                      | Large  | Small to medium  |
| Correlation with structural damage                                  | △                          | ◎  | ◎  |
| Correlation with the Japan Meteorological Agency's earthquake level | △                          | Empirical formula set by the Japan Meteorological Agency   | ○  |
| Others  |                            | Introducing this measurement method involves cost because Japan Meteorological Agency certification is required. | The SI value correlates highly with the measured seismic intensity and can be calculated easily, so it is used by major gas companies and railroads too. |



## Application Examples

The world's smallest class of Seismic Sensors supports a wide range of applications.

The D7S is ideal for embedding in equipment.

### Industry

Semiconductors, FPD, Machine Tools, Control Panels, Incinerators, Printers



## Examples of Vibration Sensor Applications

With their high detection accuracy, these Sensors help with measures to prevent secondary damage after earthquakes in a variety of settings.

### Emergency Actions

#### Preventing Secondary Damage

Shutting Off and Stopping Hazardous Devices

- Semiconductors
- Chemical plants
- Distribution panels

Earthquake

Earthquake ends.



## Society

Electricity Meters, Gas Meters,  
Chemical Plants, Expressways, Bridges,  
Tunnels, Railroads



## Homes

Distribution Panels, Fire-prevention Systems,  
Home Appliances (Heaters, Gas Stoves)

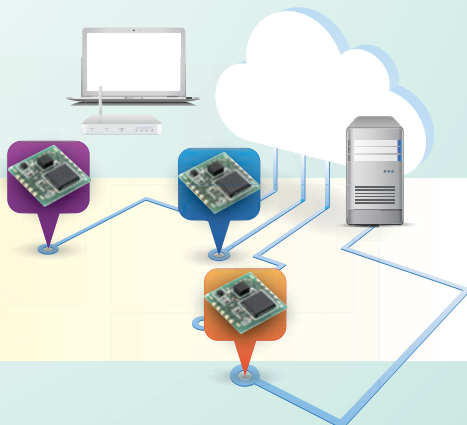


## Rescue

### Determining Damage

Mapping seismic intensity and building collapse information  
Vibration Sensor communications enable the collection of  
earthquake information to map damage conditions by area.

- Creating suitable restrictions for traffic and train operation



## Restoration

- Disaster map creation

## Prevention



# D7S

## Vibration Sensor

### Helps Prevent Fire and Other Secondary Disasters after an Earthquake. The World's Smallest Class Size Seismic Sensor.

- Using the SI value, which has a high correlation with the seismic intensity scale that indicates the magnitude of an earthquake, provides higher-precision judgment of seismic intensity scales.
- The 3-axis acceleration Sensor and OMRON's unique SI value calculation algorithm achieve surface-mountable compact modules and low power consumption.
- Higher degree of freedom for incorporation into devices and prolonged operation on battery power.
- Shutoff output terminal (INT1) operates equivalent to a conventional mechanical vibration sensor and ensures compatibility with mechanical vibration sensors.
- I<sup>2</sup>C interface is able to obtain earthquake-related information from the Sensor with communications from external devices.



RoHS Compliant



Refer to the *Safety Precautions* on page 9.

## Ordering Information

| Type                                 | Appearance | Power supply voltage | Model          | Minimum packing unit * |
|--------------------------------------|------------|----------------------|----------------|------------------------|
| Surface-mounting<br>Vibration Sensor |            | 2.1 to 5.5 V         | D7S-A0001      | 1,000 pcs.             |
|                                      |            |                      | D7S-A0001-R100 | 100 pcs.               |

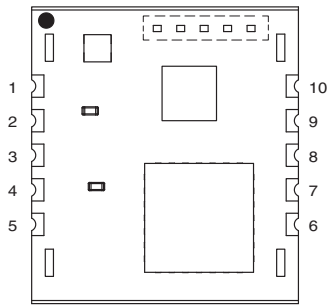
\* Products are packed with embossed tape.

## Characteristics/Performance

| Item                         | Model | D7S-A0001   |
|------------------------------|-------|---|
| Power Supply Voltage         |       | 2.1 to 5.5 V  |
| Current consumption          |       | During standby: 90 $\mu$ A or less<br>Processing (average): 300 $\mu$ A or less |
| Operating Temperature        |       | -30 to 70°C (with no condensation or icing)                                     |
| Storage Temperature          |       | -40 to 80°C (with no condensation or icing)                                     |
| Ambient Humidity             |       | 25% to 95% (with no condensation or icing)                                      |
| Storage Humidity             |       | 25% to 95% (with no condensation or icing)                                      |
| Acceleration Detection Range |       | -2,000 to 2,000 gal   |
| Shutoff Output (INT1)        |       | Output at seismic intensity level 5 or higher.                                  |
| Communications Interface     |       | I <sup>2</sup> C  |
| Dimensions                   |       | 10.9 × 9.8 mm   |
| Installation angle           |       | ±5°   |

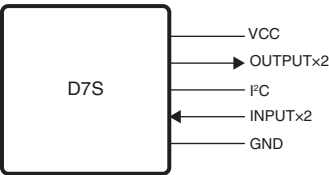
Connections

● Terminal Arrangement

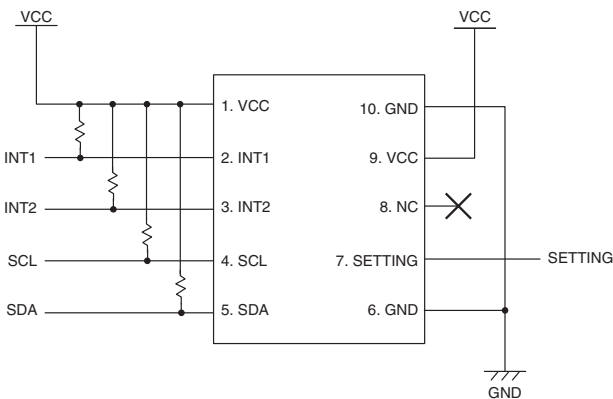


| No. | Signal  | Function                       | Direction | Description  |
|-----|---------|--------------------------------|-----------|--|
| 1   | VCC     | Power supply voltage           | ---       |  |
| 2   | INT1    | Shutoff output                 | OUT       | An open-drain output.<br>Goes active (ON) when the shutoff judgment condition and collapse detection condition are met.                      |
| 3   | INT2    | Processing notification output | OUT       | An open-drain output.<br>Goes active (ON) during earthquake calculations, offset acquisition, and self-diagnostic processing.                |
| 4   | SCL     | I <sup>2</sup> C clock         | IN        | Pull up the voltage to VCC even when you do not use I <sup>2</sup> C.  |
| 5   | SDA     | I <sup>2</sup> C data          | IN/OUT    | Pull up the voltage to VCC even when you do not use I <sup>2</sup> C.  |
| 6   | GND     | Power supply ground            | ---       |  |
| 7   | SETTING | Initial setting input          | IN        | Changes the Sensor to Initial Installation Mode for an input from an external device.<br>Normal Mode: High<br>Initial Installation Mode: Low |
| 8   | NC      | Not connected                  | ---       | Completely floating and cannot be connected to another line.   |
| 9   | VCC     | Power supply voltage           | ---       |  |
| 10  | GND     | Power supply ground            | ---       |  |

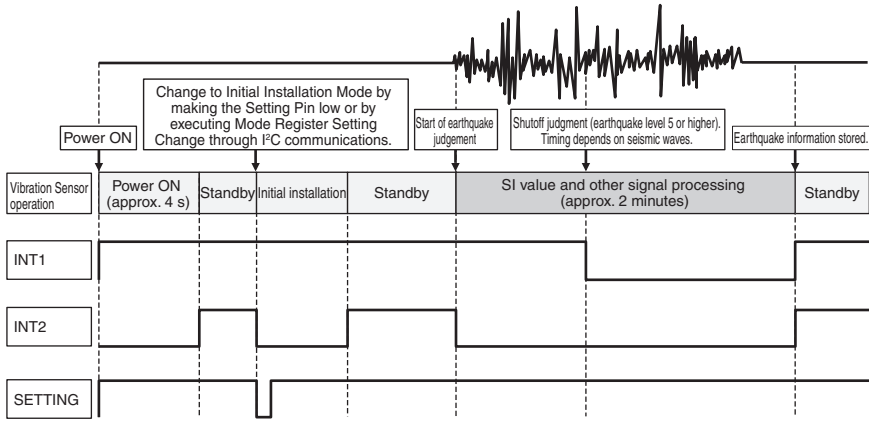
● Block Diagram



● Circuit Diagrams



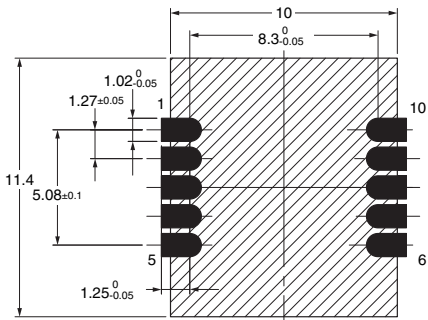
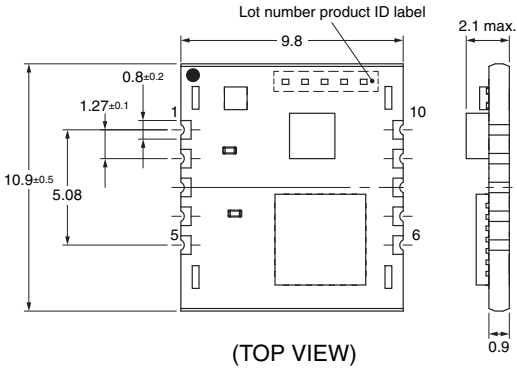
● Operation Chart



Dimensions (Unit: mm)

D7S-A0001

Recommended Mounting Pattern (TOP VIEW)



Note. Do not mount other components or place wiring patterns in the area marked with diagonal lines.

**Recommended Mounting Conditions**  
Peak mounting temperature: 245°C min. (260°C max.)  
Reflow time: 64 to 80 s (220°C)  
Reflow repetitions: Up to 2



## Safety Precautions

### Caution

This Sensor is a precision device. Do not drop it or subject it to excessive shock or force. Doing so could break it or change its characteristics. Do not use the Sensor if it has been dropped.

### Precautions for Correct Use

#### ● Operating Environment

- Do not use the Sensor in locations with volatile, flammable, or corrosive gas (organic solvent vapor, sulfite gas, chlorine, sulfide gas, ammonia gas, etc.) or other toxic gases. They may cause the Sensor to break down.
- Do not use the Sensor in locations subject to fresh water, salt water, water drops, or splattering oil.
- Do not use the Sensor in an environment where condensation or icing may occur. Moisture freezing on the Sensor may cause output to fluctuate or may cause the Sensor to break down.
- Do not use the Sensor in locations subject to direct sunlight. Doing so may cause the Sensor to break down.
- Do not use the Sensor in locations subject to direct radiant heat from heating equipment. Doing so may cause the Sensor to break down.
- Do not use the Sensor in locations with severe temperature changes. Doing so may cause the Sensor to break down.
- Do not use the Sensor in environments with excess mechanical stress. Doing so may cause the Sensor to malfunction or break down.
- Do not use the Sensor in locations with large vibration or shock. These may cause the Sensor to break down.
- Do not use the Sensor in locations with strong electrical or magnetic fields. These may cause the Sensor to break down.

#### ● Countermeasures against Noise

- The Sensor does not contain any protective circuits. Never allow the electrical load to exceed the absolute maximum ratings. Such loads may damage the circuits. If required, install protective circuits so that absolute maximum ratings are not exceeded.
- Allow as much space as possible between the Sensor and devices that generate surges or high frequencies (such as high-frequency welders and high-frequency sewing machines). Attach a surge protector or noise filter on nearby noise-generating devices (in particular, motors, transformers, solenoids, magnetic coils, or other devices that have an inductance component).
- Wire the Sensor away from high-voltage and large-current power lines in order to prevent inductance noise. It is also helpful to separate conduits and ducts and to use shielded cables.
- When using a switching regulator, power supply switching noise may cause malfunctions, so check this before use.

#### ● Handling

- Static electricity can destroy the Sensor. Take countermeasures including grounded work benches, floors, and other charged objects and workers.
- Do not handle the Sensor in locations with excessive vapor, dust, dirt, etc.
- Do not hold the Sensor with pliers, tweezers, or similar tools, and do not subject components to damage or excessive shock due to inadequate adjustment of the mounter.
- When placing components near the edge of the PCB or near a connector, make sure that stress is not applied to the Sensor when the device is assembled or when the connector is connected or disconnected.
- Do not apply any external force to components after soldering until everything has cooled off and do not allow mechanical stress due to PCB warping or other factors.
- Under some usage conditions, ultrasound may cause the Sensor to resonate and be destroyed. OMRON cannot specify the detailed conditions under which the Sensor will be used, so we assume no responsibility if the Sensor is used in environments where ultrasound is used. If the Sensor must be used in an environment with ultrasound, check its performance in the actual environment beforehand.
- Stress due to plastic hardening may change Sensor characteristics. Do not mold seal the Sensor after mounting.
- When applying a moisture preventing coating or other coating after mounting the Sensor, select a coating with minimal stress and check operation carefully.
- Do not attempt to disassemble or modify the Sensor.
- Do not use the Sensor in safety devices or for applications in which Sensor operation would directly affect human life.
- Carefully read the precaution in the *Instruction Manual* before using the Sensor.
- In addition, if you use the Sensor under conditions other than those in these specifications, check Sensor operation under those conditions beforehand.

#### ● Shipping and Storage

- Do not store the Sensor in locations with harmful corrosive gas (organic solvent vapor, sulfite gas, sulfide gas, etc.)
- The Sensor is not drip proof, so do not store it anywhere that water might get on it.
- Store the Sensor within appropriate temperature and humidity ranges.
  - \* Before storing the Sensor in an environment other than the environment recommended by OMRON, evaluate the results in the actual storage environment and judge whether or not storage there is appropriate.
- Do not store the Sensor in locations with excessive vapor, dust, dirt, etc.



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Тел: +7 (812) 336 43 04 (многоканальный)

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