

# *Introduction Murata Sensor Products*

**Murata Europe**  
Sensor Products





# Murata Sensors line-up

~Method/Principle~

**muRata**  
INNOVATOR IN ELECTRONICS



## Impact Detection



### Shock Sensor



Abnormal Vibration  
Pre-damage detection  
2mm SMD

## Gyroscope



### Acceleration & Gyro Combo



Reso.:  $\pm 0.02\text{dps}(\text{gyro})$   
15mm size

## Inclinometer



### Inclinometer



Reso.:  $\pm 0.001\text{deg.}$   
16mm size

## Rotation Detection



### Rotary Sensor



Contact  
Non-Contact  
Min 4mm size

## Actuation Device



### Piezo Actuator



Micro Actuation  
1mm size

## Acceleration



### Acceleration Sensor

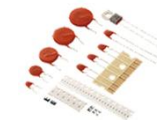


Reso.:  $\pm 0.5\text{mG}$   
8mm size

## Current Protection



### PTC Thermistor



10 to 500mA  
SMD & Lead

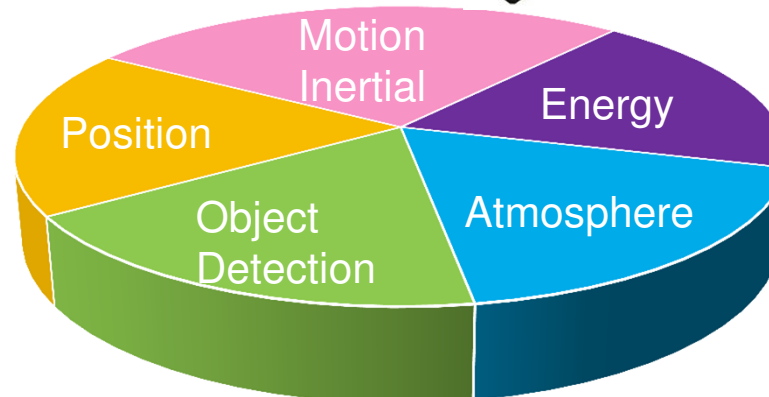
## Magnetic Detection



### MR Sensor



1-2 mT  
Min 1.5mm size



## Temperature



### NTC & PTC Thermistor



-40 to 150degC  
 $\pm 0.5\text{deg.C@25deg.C}$   
Min 0603 size

## Human Detection



### Infrared Sensor



Intrusion detection  
Wake-up of function  
3 to 8m (with lens)  
Lead

## Distance Ranging



### Ultrasonic Sensor



PAS,  
Intrusion detection  
SMD & Lead

## Room Air / GAS



### Barometric Pressure Sensor



Reso.:  $\pm 0.1\text{hPa}$   
2.6mm size

### CO2 Sensor



Reso.: 30ppm  
92mm size

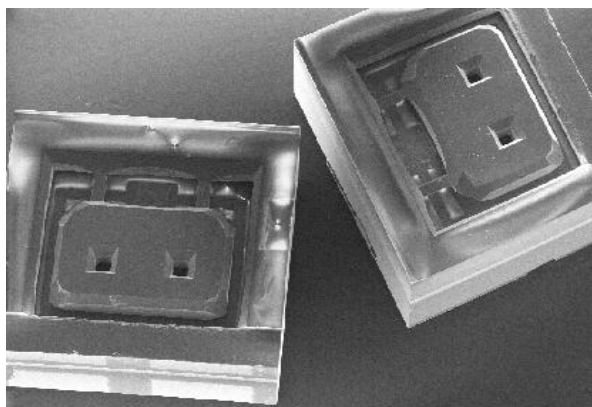
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## Ceramic based technology



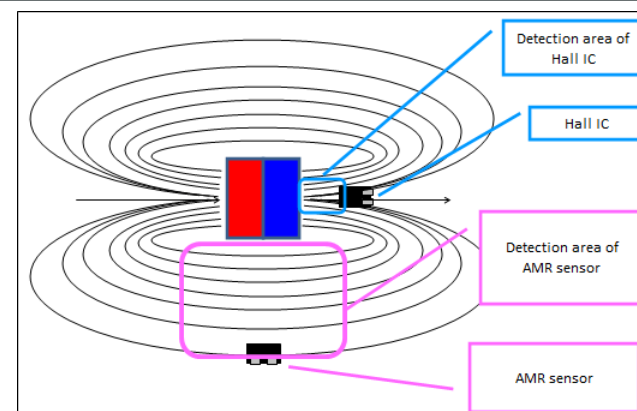
- ◆ Piezoelectric      Electric ↔ Mechanical force
- ◆ Pyroelectric      Infrared → Electric
- ◆ Semi conductive      Temp → Resistance

## Si-MEMS based technology



- ◆ 3D-MEMS

## Magnetics based technology



- ◆ Bulk MR
- ◆ AMR / Anisotropic Magneto Resistance



# Murata sensors for Consumers

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## Smartphone



- **NTC thermistor**  
+ Detect temperature on the heat spot



- **Barometric Sensor**  
+ Activity Detection  
+ Indoor Navigation

## Security



- **PIR Sensor**  
+ Detect suspicious person



- **Lead Thermistor**  
+ Fire detection

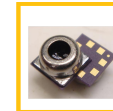
## Wearable



- **FTH Thermistor**  
+ Flat insulated surface detect temperature

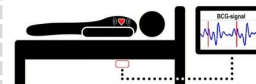


- **micro ES**  
+ Rotary encoder switch



- **Barometric Sensor (water proof)**  
+ Activity Detection

## Healthcare



- **Accelerometer Module**  
+ BCG detection

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# Murata sensors for Industry, Medical

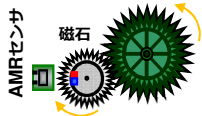
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## Industry



- **AMR Sensor**
- +Air cylinder position
- +Metering



- **FR**
- +Rotation Counter



- **Inclinometer**
- +Tilt detection



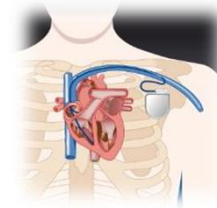
- **Inertial Sensor**
- +6DoF(Dimensions of Freedom)



- **3 axis Accelerometer**
- + Structure Health Monitoring
- + Acceleration detect

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## Medical

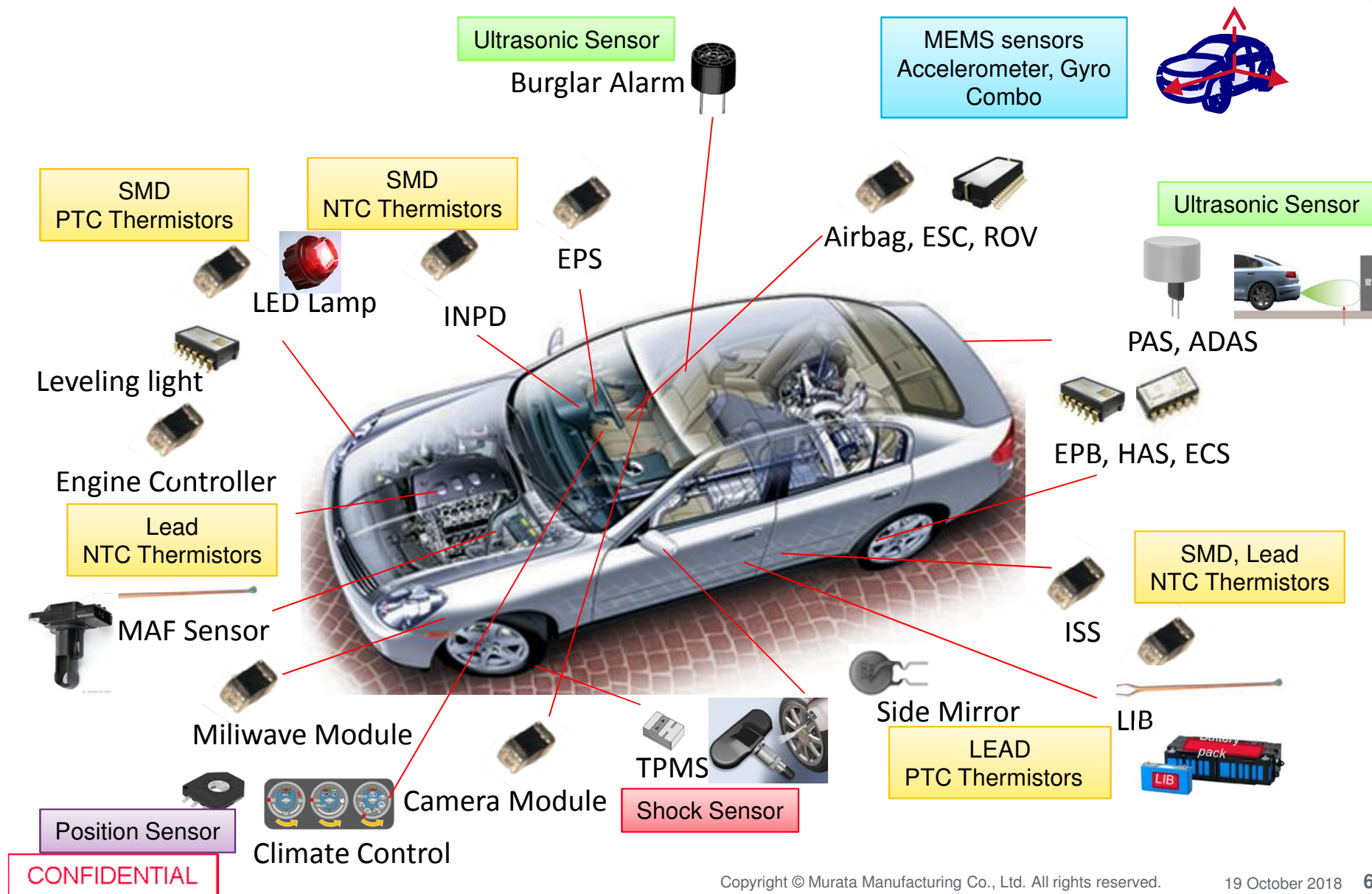


- **MEMS element**
- +Acceleration detect for pace maker



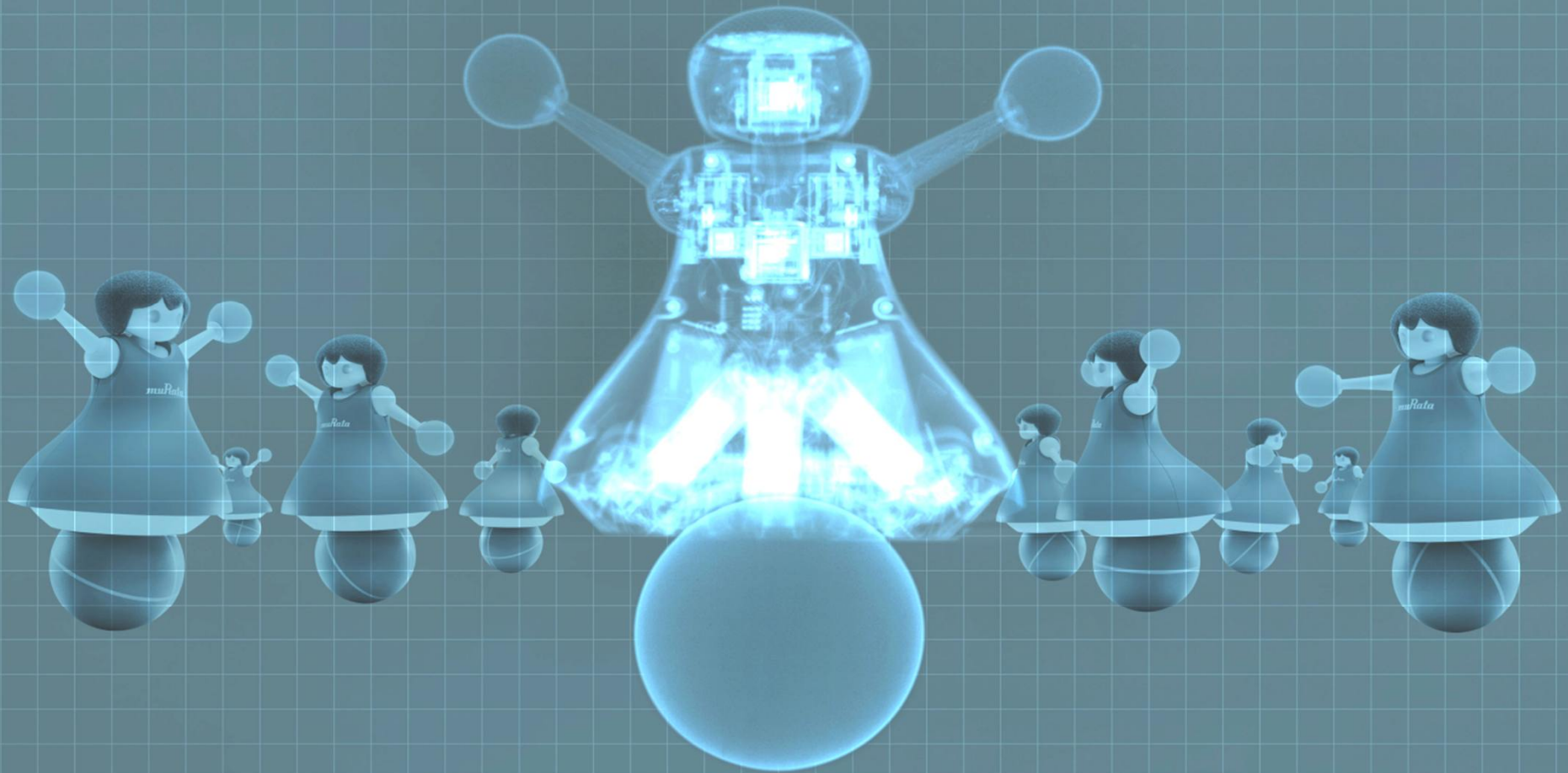


# Murata sensors for Automotive





# *MEMS Sensor*



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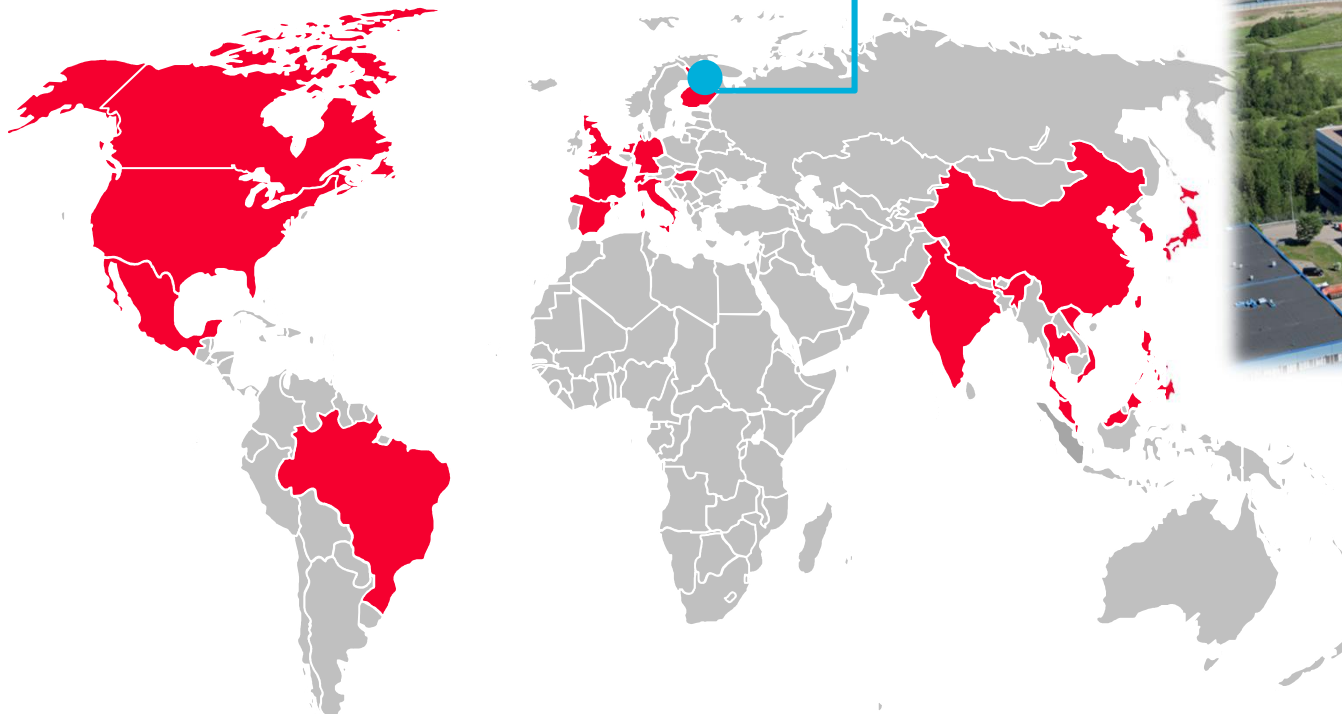


# Murata Electronics Oy: Murata's MEMS Technology Center in Finland

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- Part of Murata since 2012
- Global leader in low-g MEMS sensors for automotive and medical applications
- Over 900 employees
- In-house 3D MEMS technology



*In red all countries where Murata has factories, R&D centers and sales offices.*

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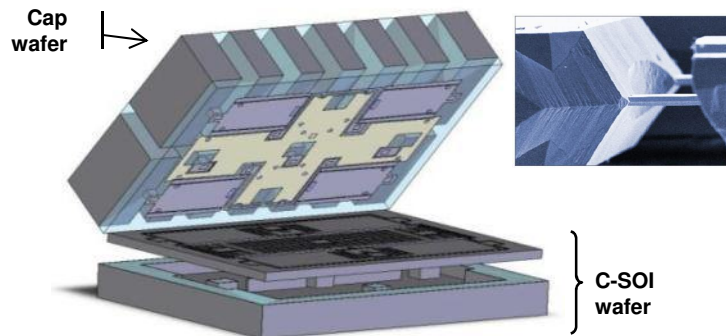




# What is 3D MEMS



- Unique, proprietary technology
- Combination of bulk and surface micro-machining process technology
- Shaping three-dimensional structure of silicon, encapsulation, and contacts for easy mounting and assembly
- Advanced sensor element can be made of a tiny piece of silicon, capable of measuring e.g. acceleration or angular rate in three orthogonal directions



## Advantages

### Robust

Single crystal silicon

Wafer level bonding

- Si is an ideal elastic material
- No plastic deformation, up to 70,000g
- Hermetical seal, tailored gas damping
- Proven reliability over 20 years
- Low noise

### Low power

Capacitive sensing

- Direct measurement of deflection
- No energy consuming measurement principle
- High accuracy and stability as well as easy diagnostics by using a limited number of capacitors

### Small size

Real 3D structures

- Highest signal per silicon surface area
- Zero point stability
- Enables 3D sensing elements
- Low temperature dependence

### Versatile

Customised sensors

- Flexible 2-chip solution enables tunable sensitivity and frequency response for various applications
- Application specific packaging

## Key benefits

- Sensitive sensors, Low g-ranges, High performance
- High impact strength, Enables low power, Enables low noise



## Accelerometers & Inclinometers



**SCA3300**



**SCA8x0/21x0/3100**



**T-series**



**Inertial  
Measurement Unit  
(IMU)**

High performance analogue and digital accelerometers and inclinometers for safety critical automotive and industrial as well as healthcare applications

## Gyroscopes and Combined Sensors



**SCC2000**



**SCC1300**



**SCR1100**

Gyros only or combined with accelerometers with excellent product features for automotive, industrial and healthcare applications

## Acceleration and Pressure Sensing Elements



Ideal for implantable medical devices, thanks to the inherent accuracy, reliability, small size and capacitive principle for low power solution

## Patient Monitoring Devices



**SCA10H**



**SCA11H**

Continuous contactless patient monitoring



# Main markets & applications



We contribute to safer driving, higher quality of life and increased efficiency

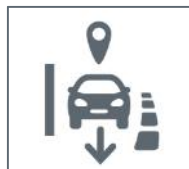
## AUTOMOTIVE



**#1 in acceleration sensors for automotive active safety systems**



Electronic Stability Control (ESP/ESC)



Advanced Driver Assistance Systems (ADAS)



Hill Start Assistance (HSA)



Electronically Controlled Suspension (ECS)



Transmission Control (TCM)



Electric Parking Brake (EPB)

## HEALTHCARE & MEDICAL



**#1 in activity monitoring in Cardiac Rhythm Management**

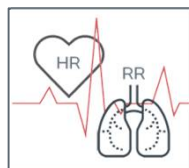


Pacemakers and ICDs



Surgery tables and medical imaging

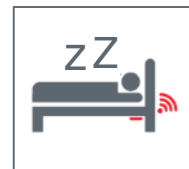
Patient monitoring solutions



Vital signs



Bed occupancy



Sleep quality, stress, relaxation

## INDUSTRIAL



**Wide range of sensing solutions across industries**



Construction tools and systems



Heavy machines



Structural health monitoring



Weight scales



Airplane instrument systems



Robotics



# SCA3300 Product Concept

## 3-axis low-g accelerometer

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- High performance 3-axis accelerometer
- Ground breaking stability and performance
- Suitable for inclination measurement and industrial acceleration measurements
- Low noise, excellent bias stability
- Industry proven technology with significantly improved performance
- Automotive Qualified with advanced self diagnostics



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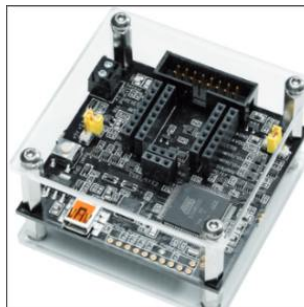


# Murata's MEMS EVAL BOARD Enables Fast Evaluation with SCA3300

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- MEMS Evaluation Unit with SCA3300 Sensor Board:
  - Java based Graphical User Interface (Windows, Linux)
  - Sensor output in graphical format
  - Data logging with time stamps
  - Data rate and average calculation configuration options
  - Powered from PC USB port
- MEMS EVAL BOARD (black PCB) supports majority of Murata Electronics' sensors



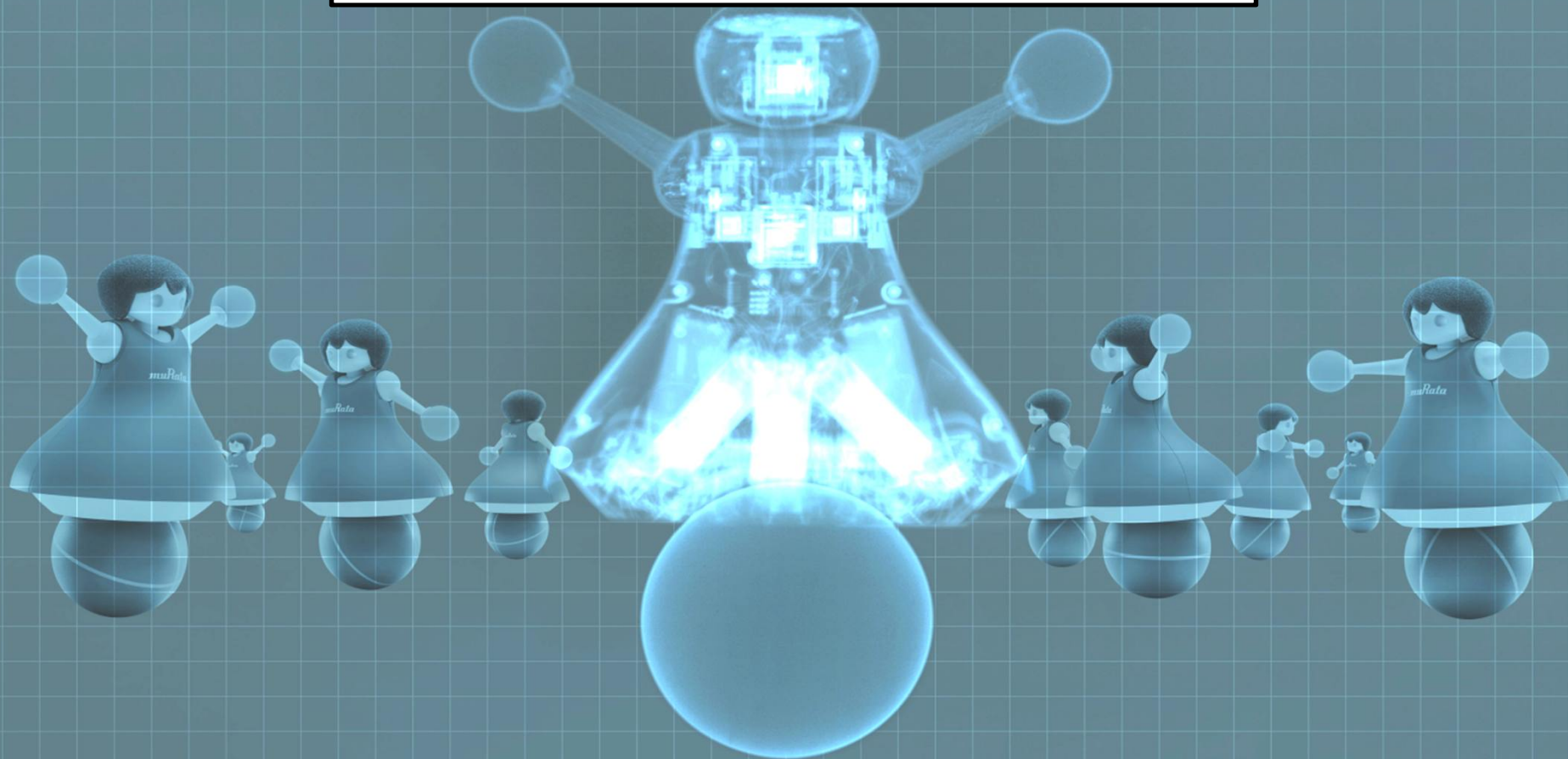
Interface Board, Order code:  
MEMS EVAL BOARD



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# Temperature Sensor (**NTC** Thermistor)





# NTC thermistor

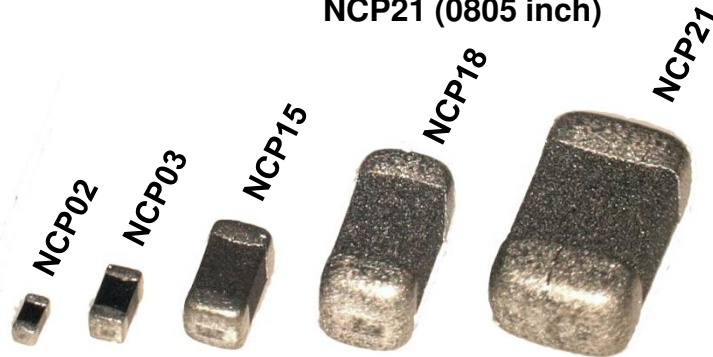
**NTC**= Negative Temperature Coefficient

**muRata**  
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## Part number

NCP02 (01005 inch)  
NCP03 (0201 inch)  
NCP15 (0402 inch)  
NCP18 (0603 inch)  
NCP21 (0805 inch)



## Features

- ◆ **Variety line-up, easy to select smaller size**  
(smaller size : 0201, 01005 inch size)
- ◆ **Available tighter tolerance products**  
(Resistance Tolerance : +/-1%, +/- 0.5%)
- ◆ **UL / cUL certificated products**  
(0201, 0402, 0603, 0805 inch size)
- ◆ **NCP R-T simulation software available**

<http://ds.murata.co.jp/software/sim surfing/en-us/index.html>

## Application

- Temperature detection or compensation for Digital Appliances
- Temperature detection for rechargeable batteries
- Temperature compensation for crystal oscillator



- Temperature compensation of LCD
- Temperature compensation in general use of electric circuits



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# Leaded Thermistor Lineup for Consumer, Automotive

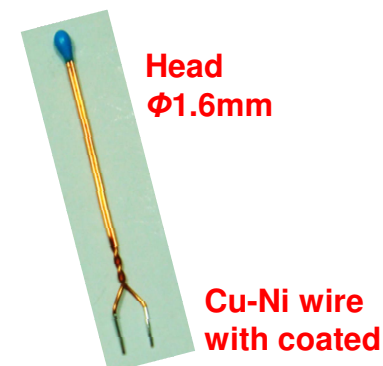
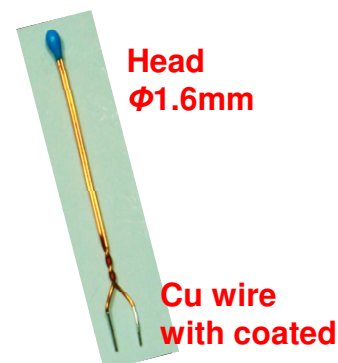
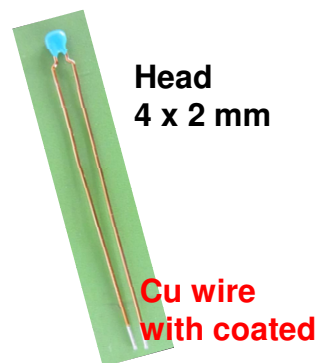
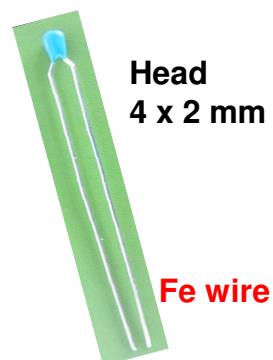
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**New!!**

Series & wire material	NXR series Fe (Non-insulated)	NXR series Cu (Insulated)	NXF series Cu (Insulated)	NXF series Cu-Ni (Insulated)
MP Schedule	on sale	on sale	on sale	Starting Sep-2017
Sample	available	available	available	available

Appearance



Length	10-45mm	25-45mm	25-150mm	25-50mm
Resistance characteristic	R25 +/- 1% (2, 10, 47, 100kohm)	R25 +/- 1% (2, 10, 47, 100kohm)	R25 +/- 1% (2, 10, 47, 100kohm)	R25 +/- 1% (2, 10, 47, 100kohm)
Thermal response	very good	good	Excellent	Superexcellent

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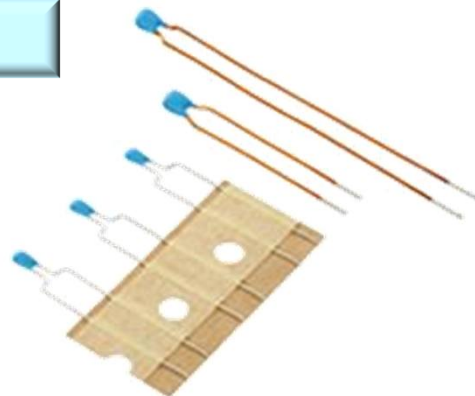
# Leaded NTC Thermistor (NXR Series)

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## Appearance

10~45mm  
25~45mm(Insulated)  
(5mm STEP)



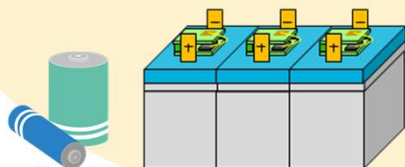
## Features

- ◆ muRata's chip NTC(NCP15) inside
- ◆ High accuracy and High sensibility
- ◆ Self-standing

## Application

- Suitable for Temp.sensing on various applications

● EV  
BMS, LED...etc.



● Climate Temp.  
Sensor



● White goods



● Fire Alarm



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# Leaded NTC Thermistor (NXF Series)

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## Appearance

25,30 ~150 mm  
(10mm STEP)



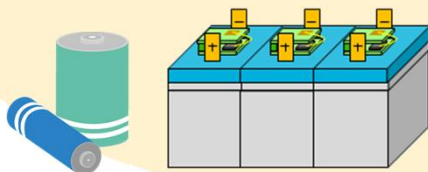
## Features

- ◆ Small sensing head
- ◆ High accuracy and High sensibility
- ◆ Flexible lead

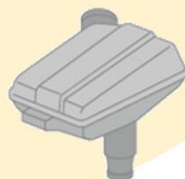
## Application

- Suitable for Temp.sensing on various applications

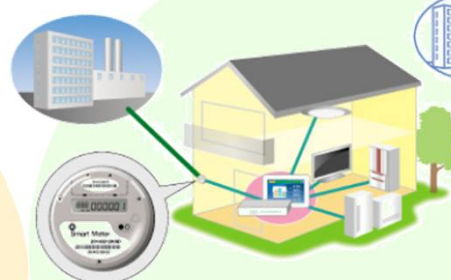
● EV  
BMS, LED...etc.



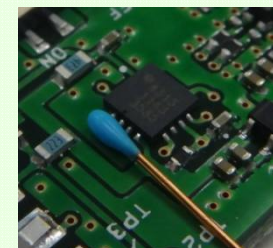
● MAF, MAP Sensor



● Sensors  
for Healthcare



● Temperature Sensors  
for narrow space



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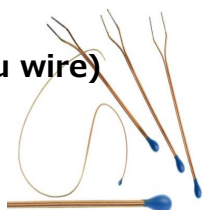
# Leaded NTC Thermistor (**NXFT** series / quick temp. response)

**muRata**  
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## **NXFT series (Cu wire)**

Small head &  
flexible insulated wire



**New!!**

## **NXFT series (with Cu-Ni wire)**

Small head &  
flexible insulated wire

**Fastest thermal response**



## Target applications



**Fire Detector**

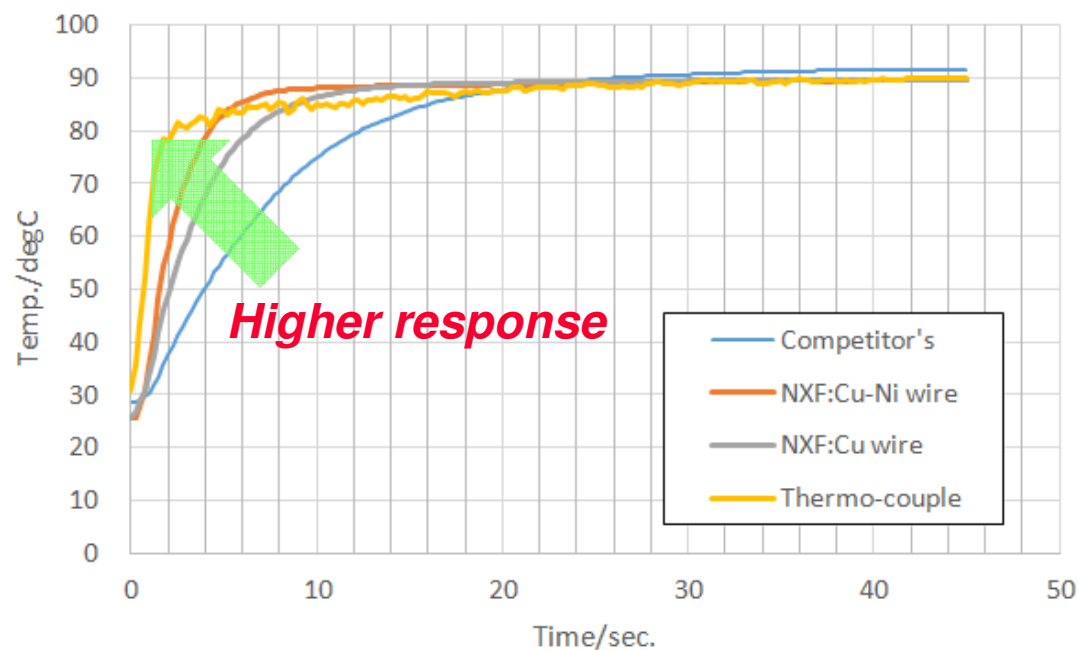
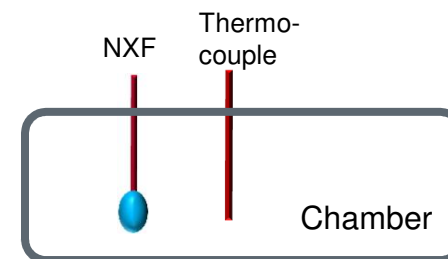


**Smart Heating**

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## **Test condition:**

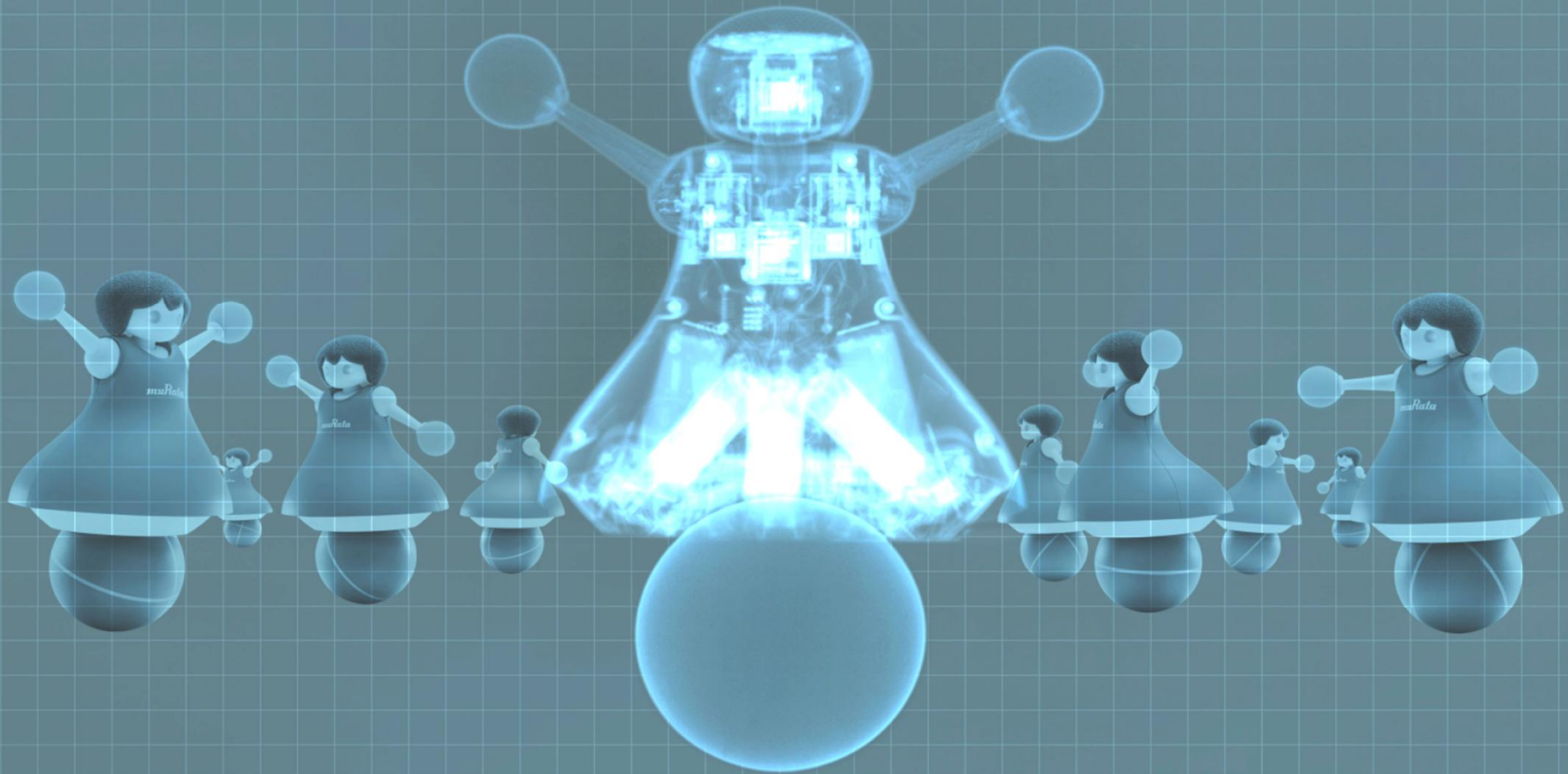
From 25C to 90C @Air



***New NXFS can control temperature finely***



## *Pyro Infra-Red (PIR) Sensor*







# PIR Sensor -Lead Type- (IRA-Series)

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## Part number

### Dual Type

•IRA-S210ST01

### Quad Type

•IRA-S510ST01



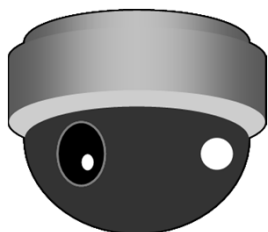
Size: 9φ  
TO-5(Standard)

## Features

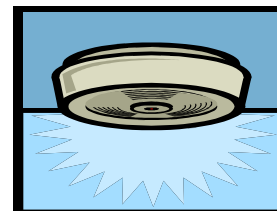
- Excellent S/N ratio
- High stability against ambient temperature change
- Excellent immunity characteristic to electromagnetic waves

## Application

### ★Security Alarm



### ★Sensor Light

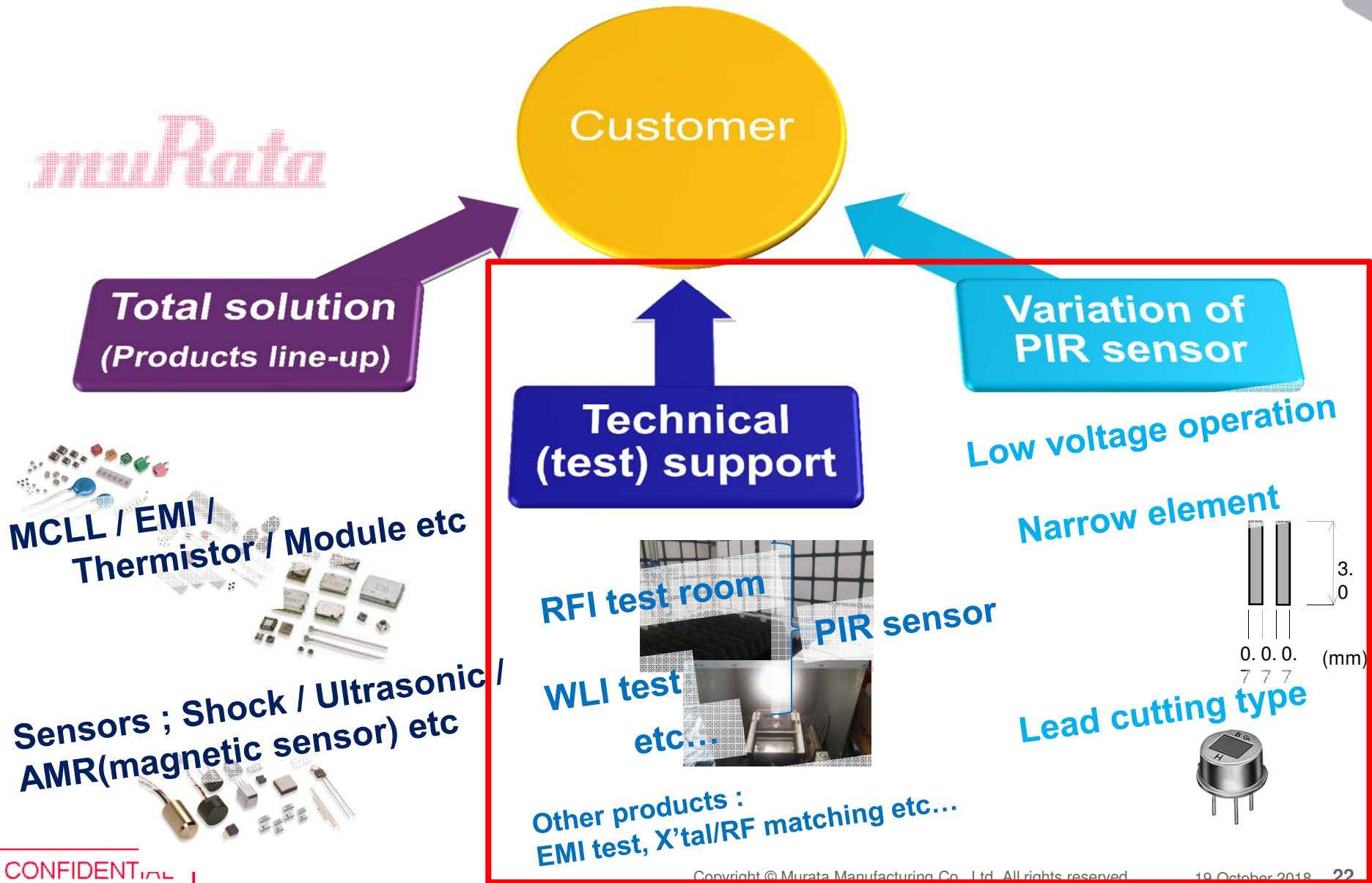


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# Design-in activity of PIR-sensor ~ **Murata Strong Benefit** ~

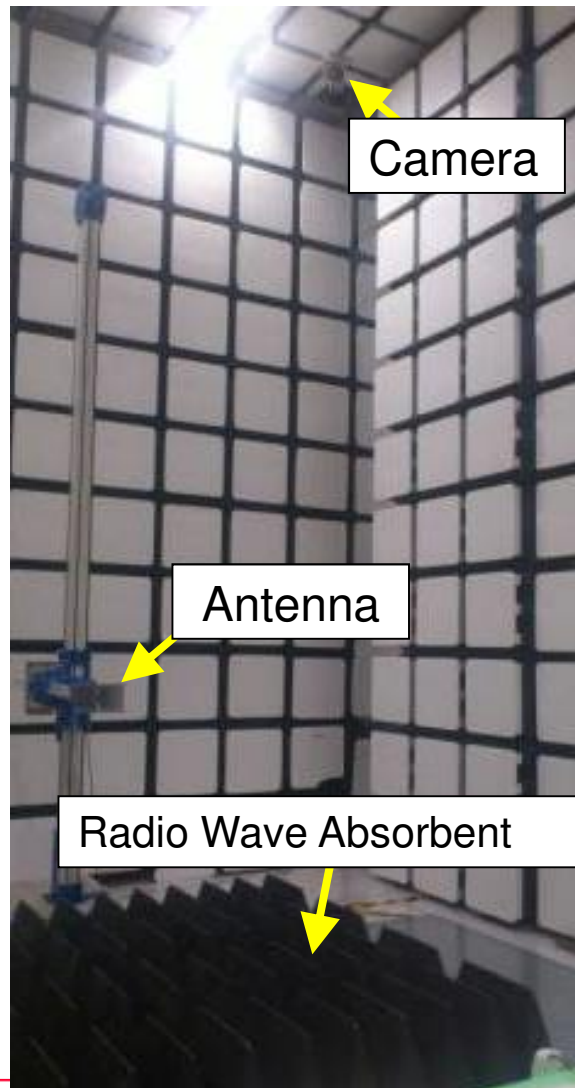
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## Test condition of RFI (RFI Test Room)



Camera

Antenna

Radio Wave Absorbent

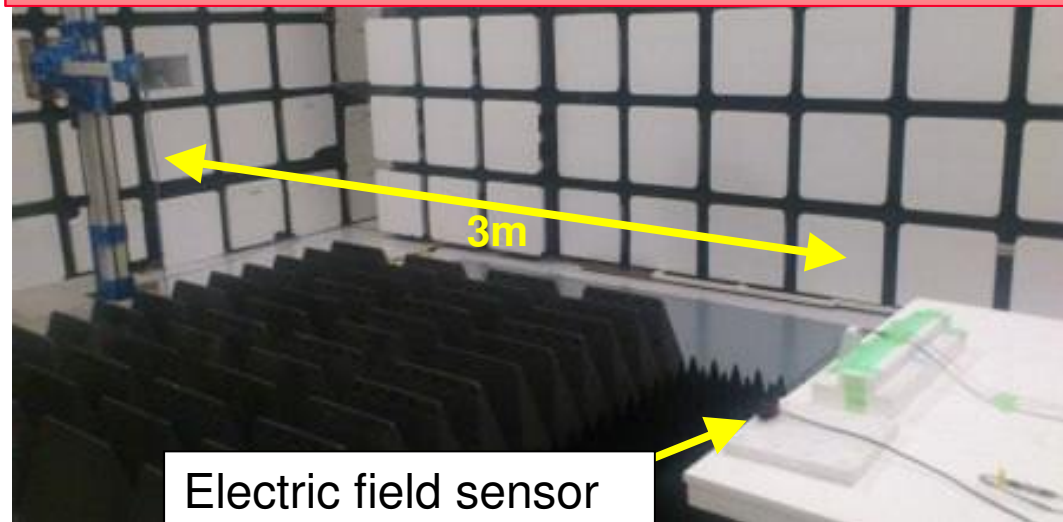
- Murata's test site condition and method, based on IEC61000-4-3 requirement.

Size of the room :  $5.9 \times 6.9\text{m}$

Height of the room :  $6.75\text{m}$

Height of the Antenna :  $1.5\text{m}$

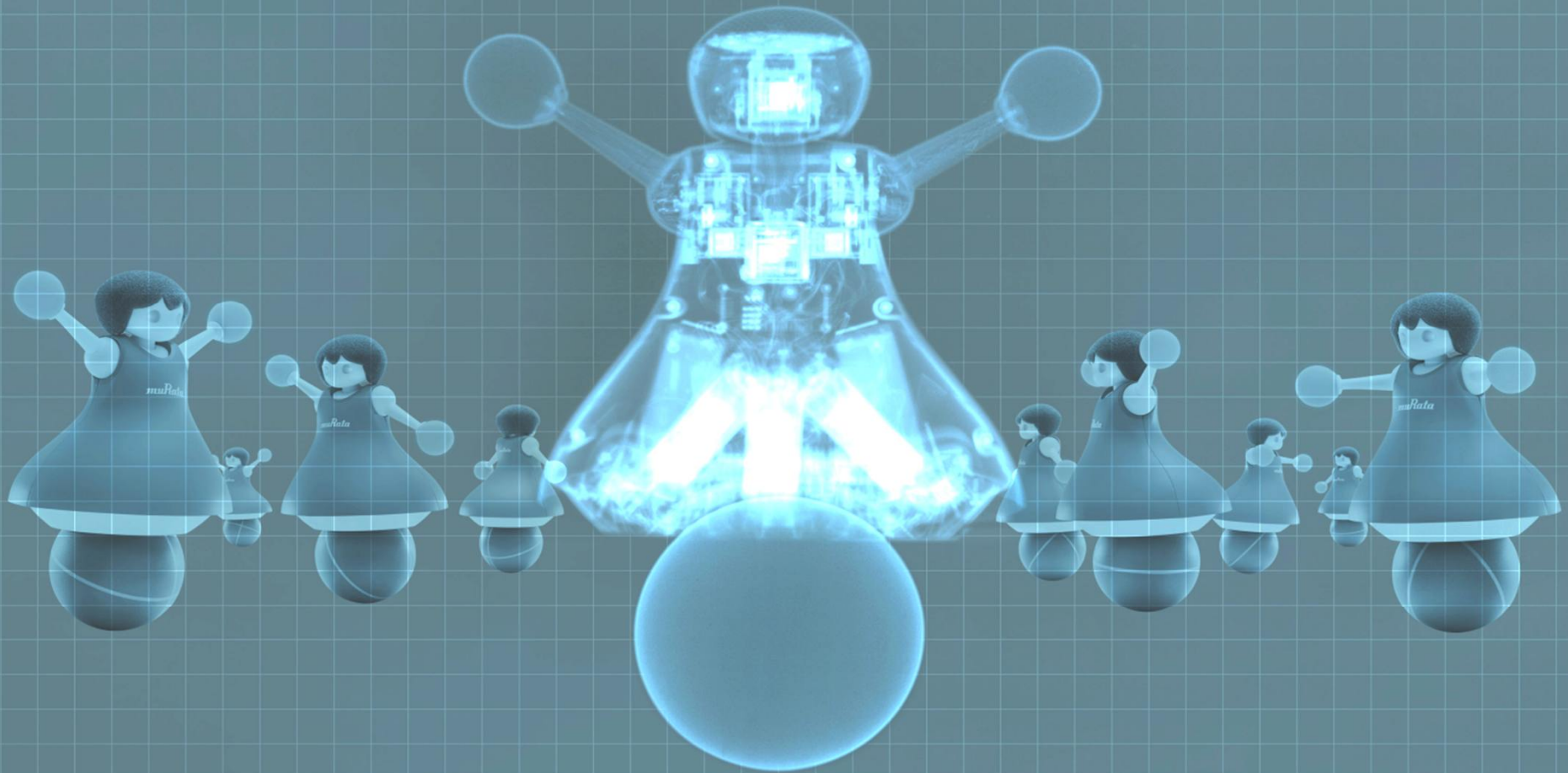
We can do the RFI test ***up to 6 GHz***



Electric field sensor



# AMR Sensor



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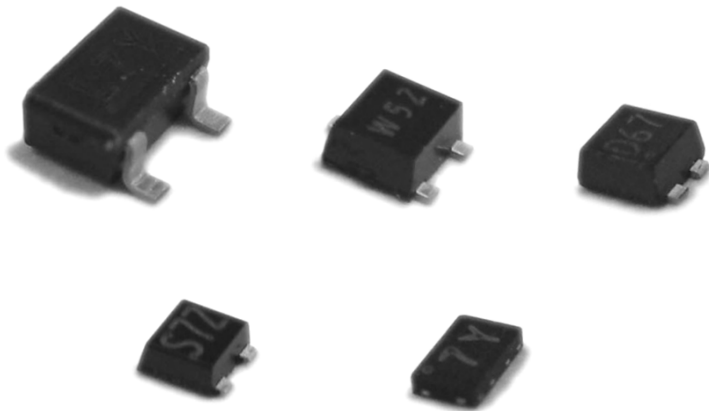


# Feature of AMR sensor

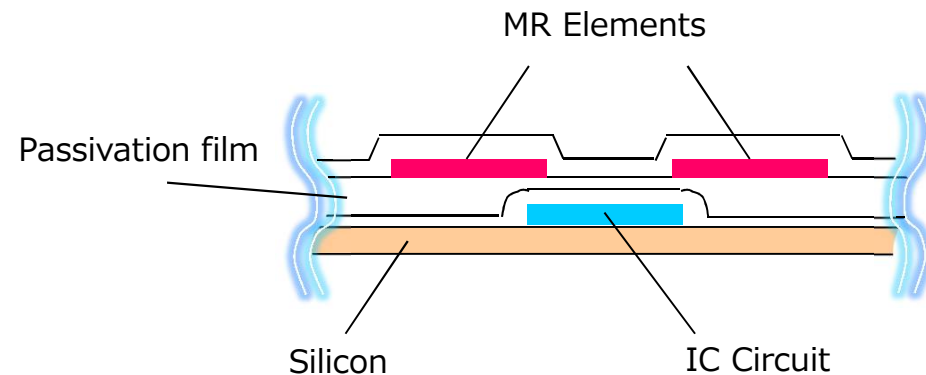


- **AMR** sensor is a sensing device utilizing Magneto Resistance effect
- Ferromagnetic NiFe alloy thin film is deposited over the IC circuit.

**AMR** = Anisotropic Magneto Resistance

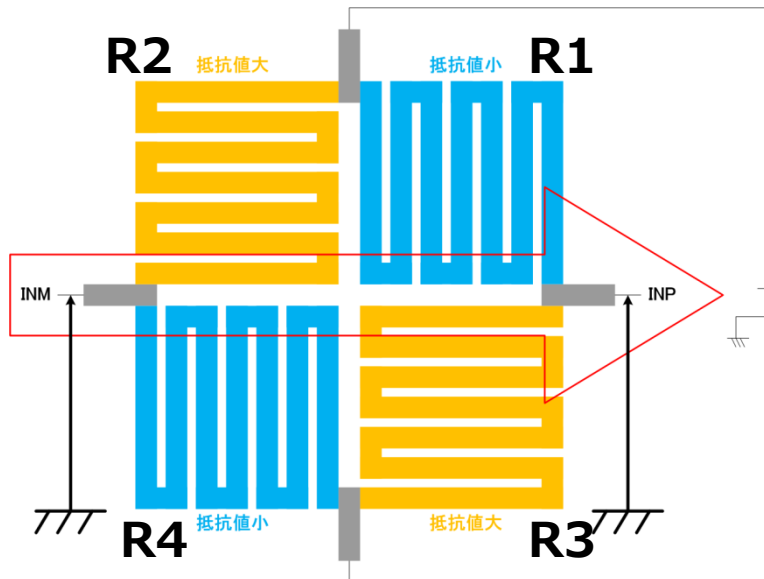


Chip Internal Image

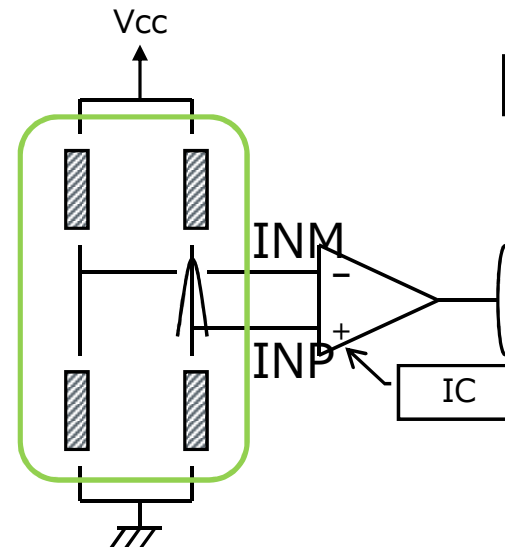




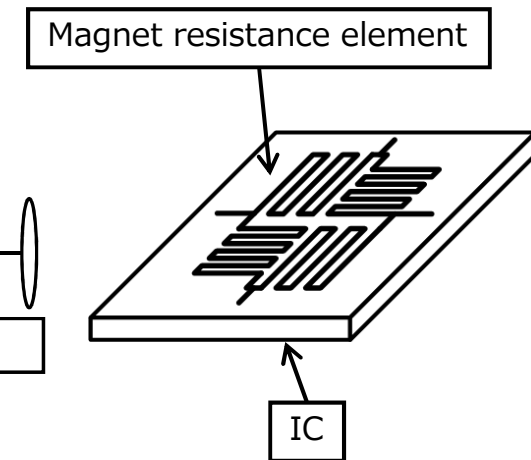
# AMR sensor principle



【Magnet resistance element】



【Circuit block】



【 Structure image 】

AMR sensor's magnetic resistance are formed overlap on IC  
So our AMR sensor become 1 chip that include magnetic resistance and ASIC  
When magnetic field is applied, resistance value of R1 and R4 are changed.  
Then, Voltage occur between INP and INM.



# AMR Sensor

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## Part number



**MRMS2\*\*** (2.8x2.9x1.1 mm)

**MRMS5\*\*** (1.45x1.45x0.55 mm)

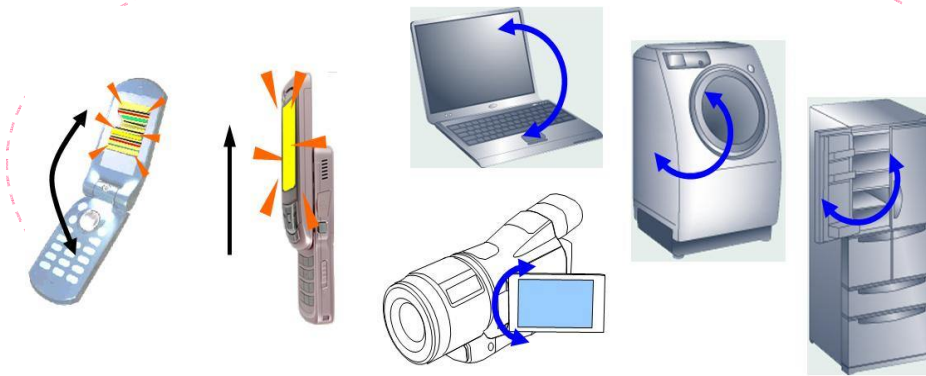
**MRUS7\*\*** (1.5x1.8x0.8 mm)

## Features

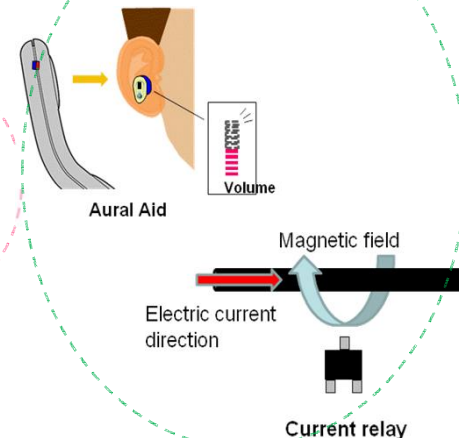
- High sensitivity
- Low current consumption (e.g. 3 $\mu$ A)
- Abundant variation (Package, Sensitivity, Supply voltage)
- Excellent immunity characteristic to electromagnetic waves
- Cost effective

## Application

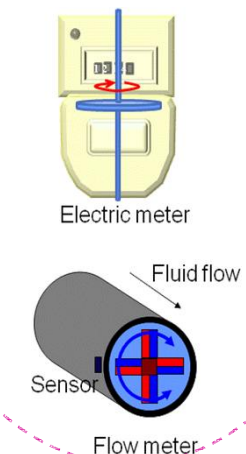
### ★ Magnetic switch: Opening and closing switch



### ★ Magnetic switch: Other

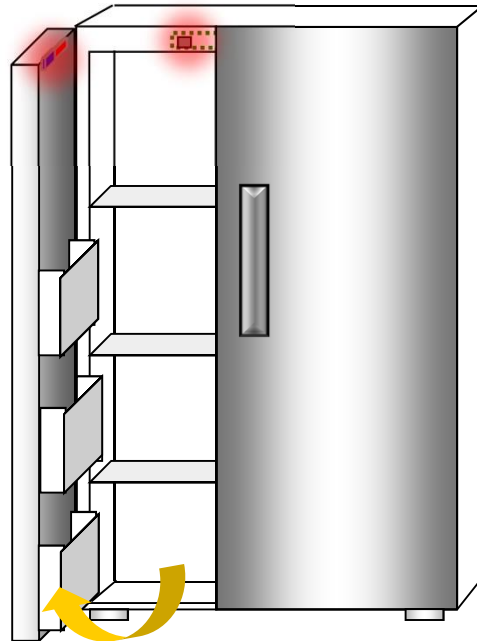


### ★ Rotational sensor

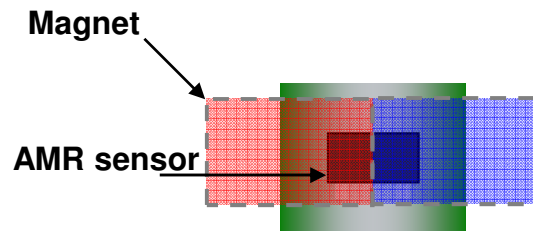


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# Position/ Refrigerator Door



Front view



## Recommended P/N

- MRMS205A-001

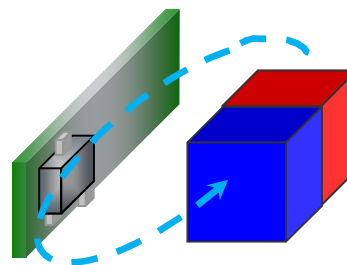
## Why the application needs sensor?

- To switch on/off the light and save power
- To change the operating mode

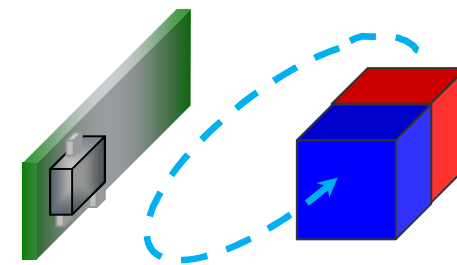
## Similar Applications

- Security door and window sensor etc.

Side view

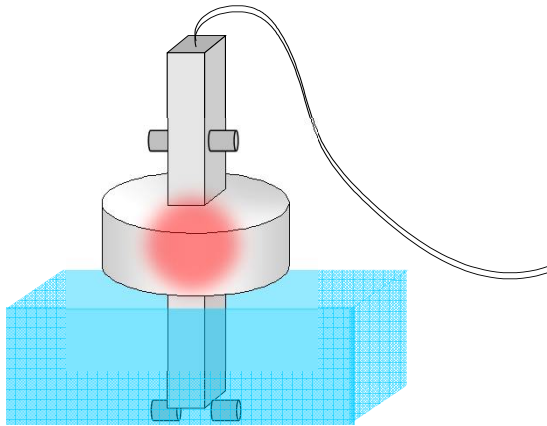


**Hon** (Closed)



**Hoff** (Open)

# Position/ Fluid Level



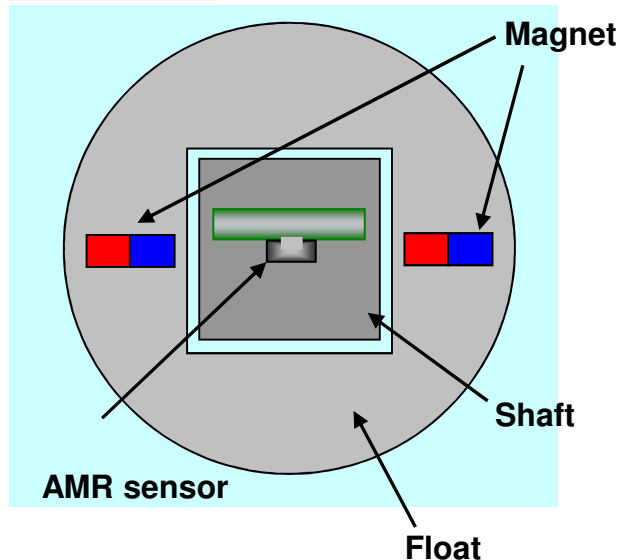
## Typical P/N

- MRMS201A-001

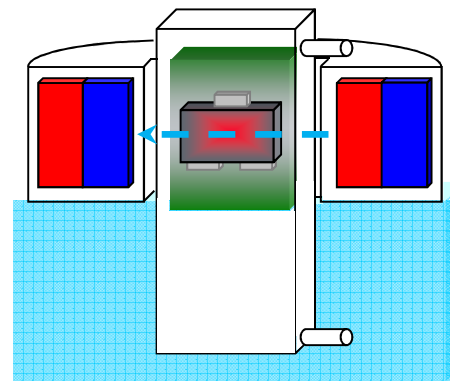
## Why the application needs sensor?

- To check the fluid level.

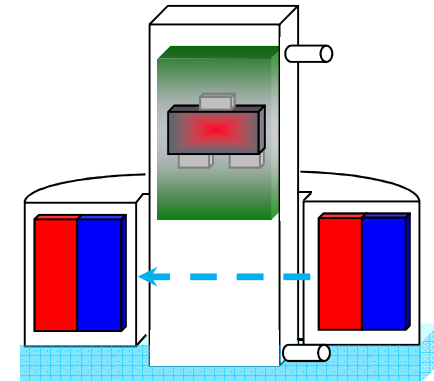
Top view



Front view



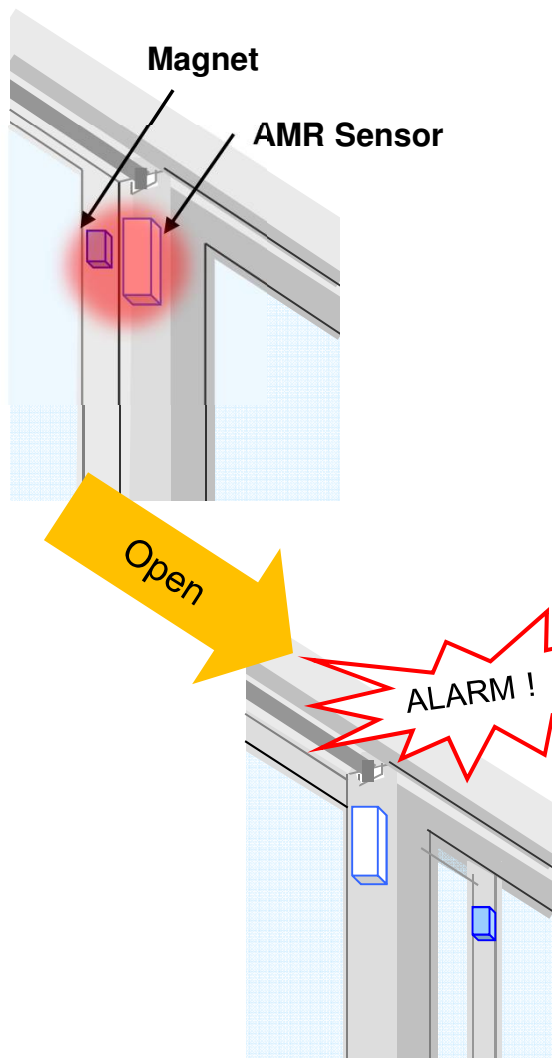
**Hon** (Full level)



**Hoff** (Empty level)



# Position/ Window Security



## Typical P/N

- MRMS201A-001
- MRMS205A-001

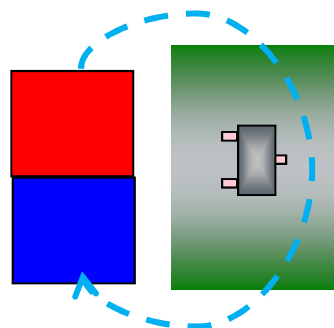
## Why the application needs sensor?

- To sound the alarm when window is opened and AMR sensor switches off.

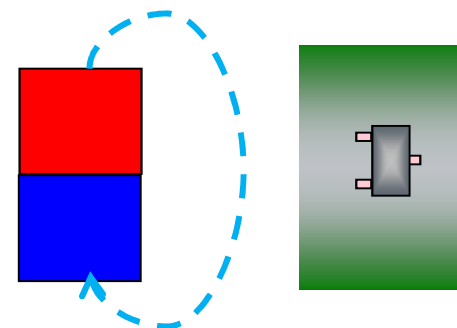
## Similar Applications

- Security door sensor, Commercial door chime etc.

### Front view

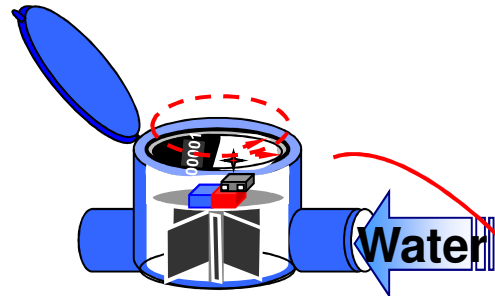


**Hon** (Closed)

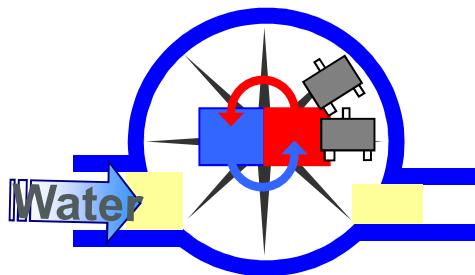
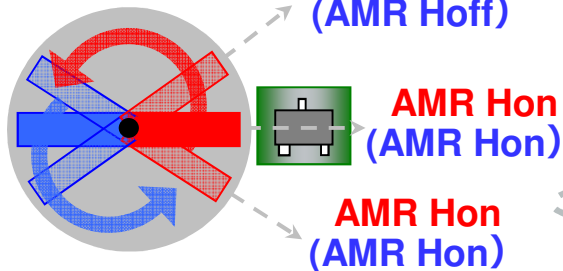


**Hoff** (Open)

# Rotation/ Water Meter



**Top view**



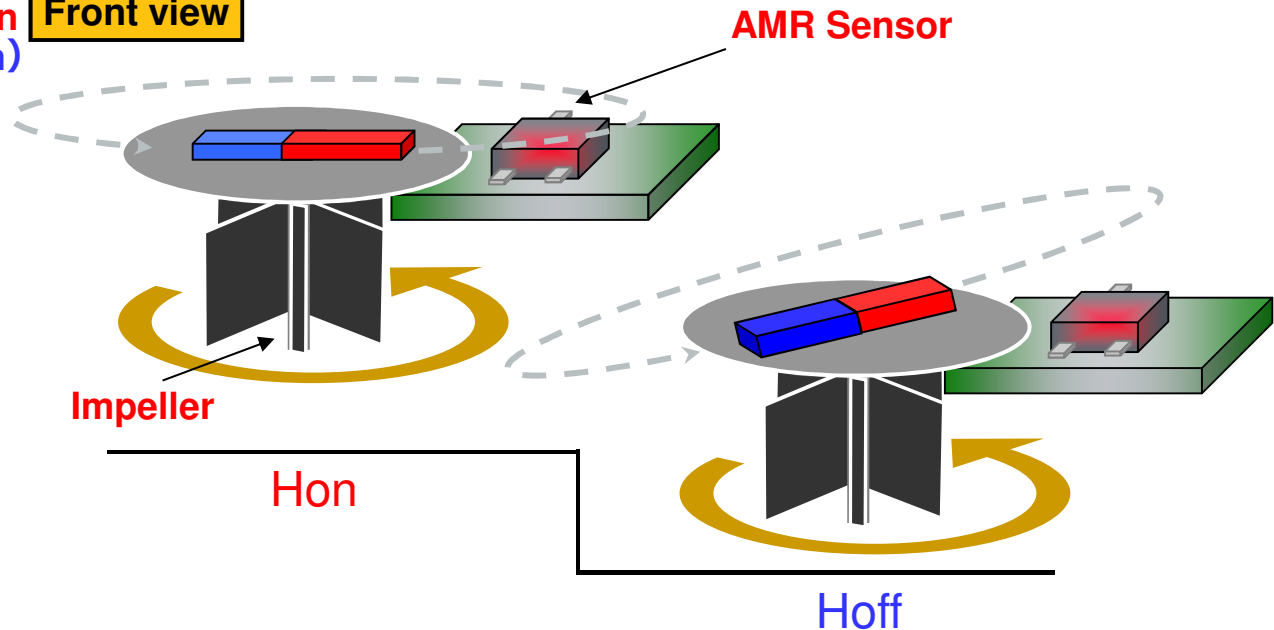
## Typical P/N

- MRMS201A-001/MRMS205A-001
- MRMS511X-001

## Why the application needs sensor?

- Use of 2 sensors enables normal and reverse flow detection.

**Front view**

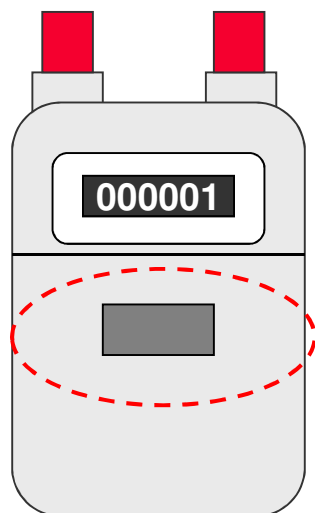


# Rotation/ Gas Meter

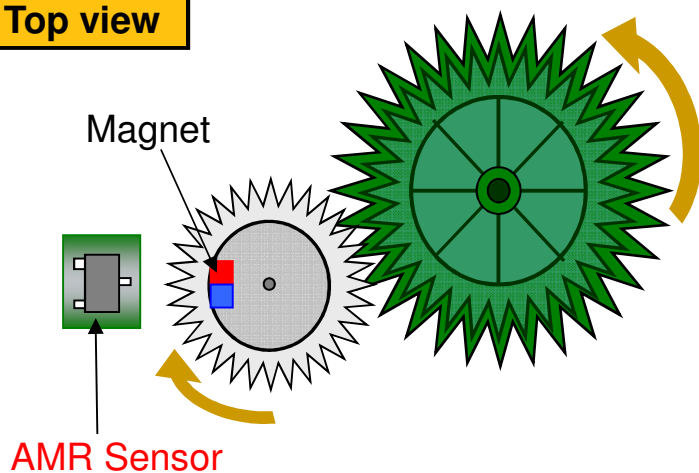


## Typical P/N

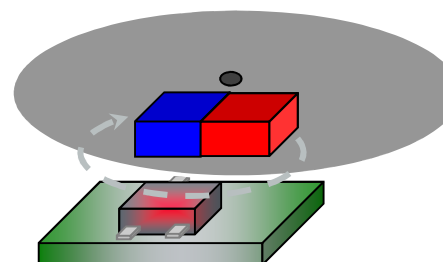
MRMS201A-001/MRMS205A-001  
MRMS511X-001



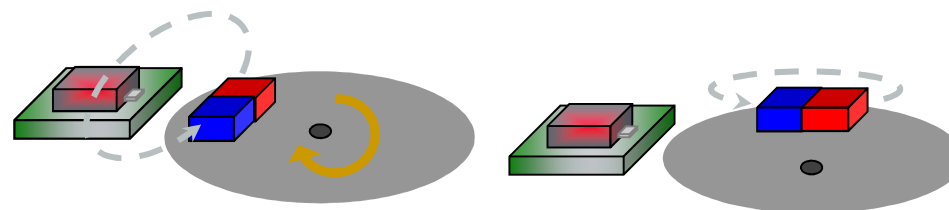
Top view



Side view



Front view



Hon

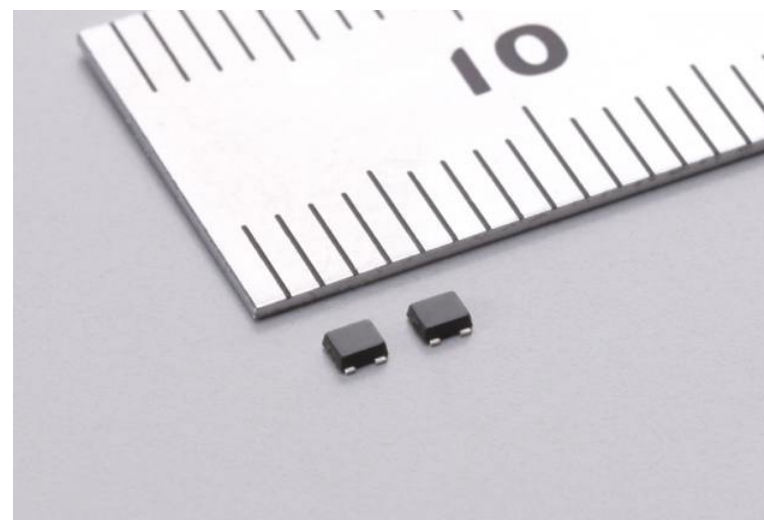
Hoff

# Murata AMR Makes 3D Magnetic Field Detection Come True


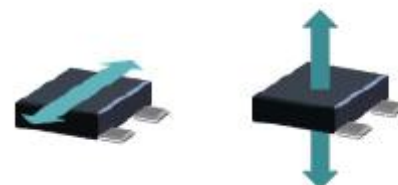


## World's First 360° Sensing with Uniform Sensitivity in All Directions

Murata offers a revolutionary sensing solution! 3-dimensional magnetic field detection that usually requires multiple sensors is now possible with single sensor.



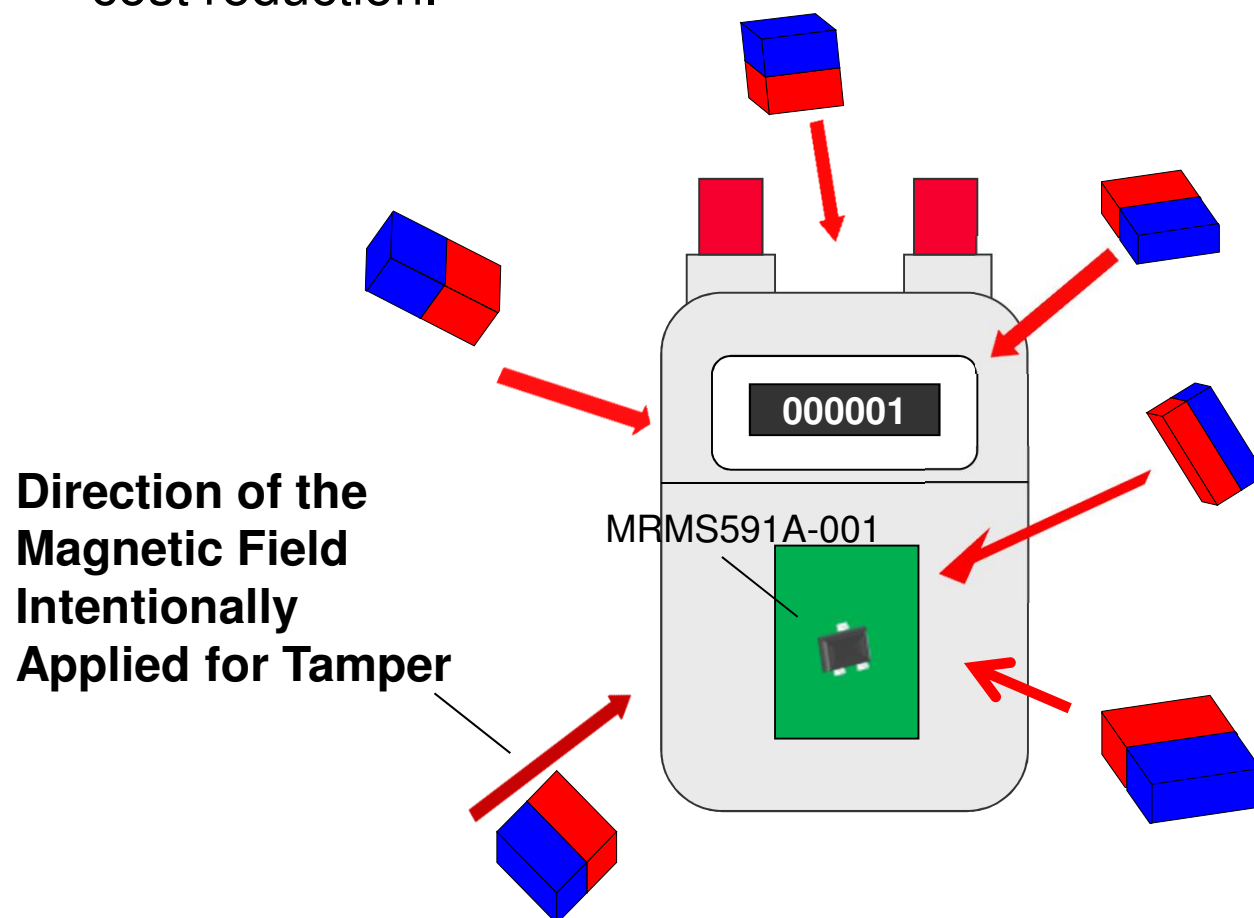
1.45 mm × 1.45mm × 0.55mm)

	3D Sensing MRMS591A-001	Conventional
Detecting magnetic field	Multi direction 	Only one direction 

# Anti Tampering / Meters

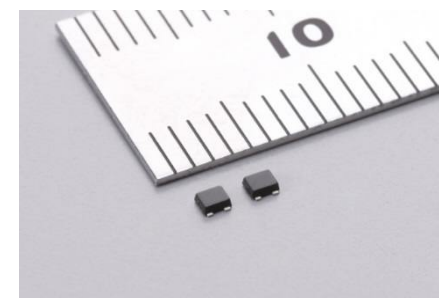


Single sensor detects interfering magnetic field from all direction.  
Remarkable sensing capability contributes to achieve compact design and cost reduction.



## Typical P/N

MRMS591A-001







**Thank you.**