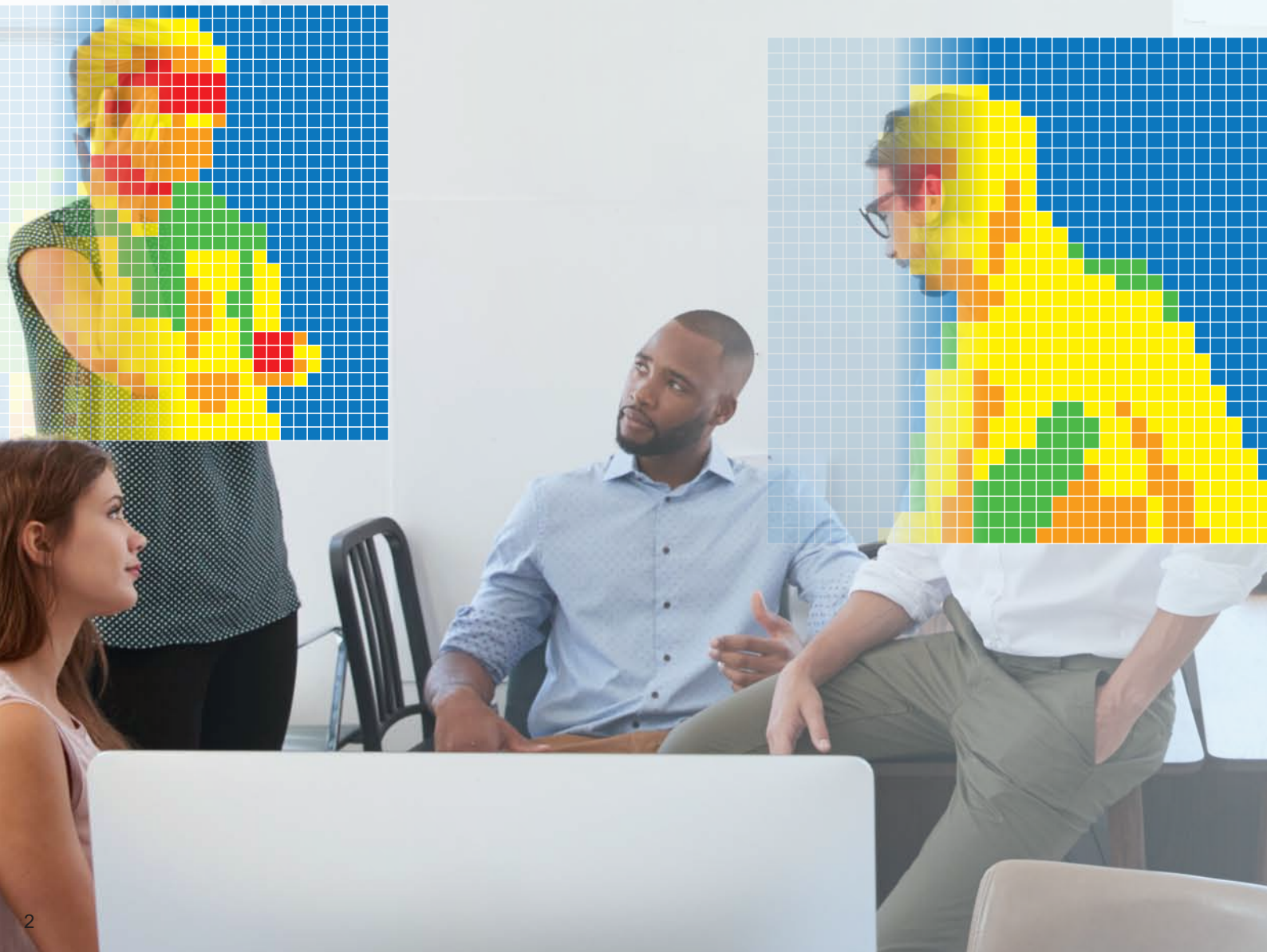
D6T

MEMS Thermal Sensors

Contactless measurement with OMRON D6T Thermal Sensors Able to detect the slightest temperature changes

Contactless Measurement OMRON MEMS Thermal Sensors are able to detect the slightest temperature changes

MEMS Thermal (IR sensor) measures the surface temperature of objects without touching them when the thermopile element absorbs the amount of radiant energy from the object.



1

Low noise

Market performance of over 6 million units*1 with a stable temperature output*2

*1: According to OMRON's research as of March 2022.
*2: Refer to the Noise Equivalent Temperature Difference (NETD) on page 12.

2

Easy connection

Direct temperature value output allows easy software design

3

Number of elements and temperature lineup

Variation of the number of elements (1 to 1024) x temperature range (-40 to 200°C)

1

High Precision

Market performance of over 6 million units*1 with a stable temperature output*2

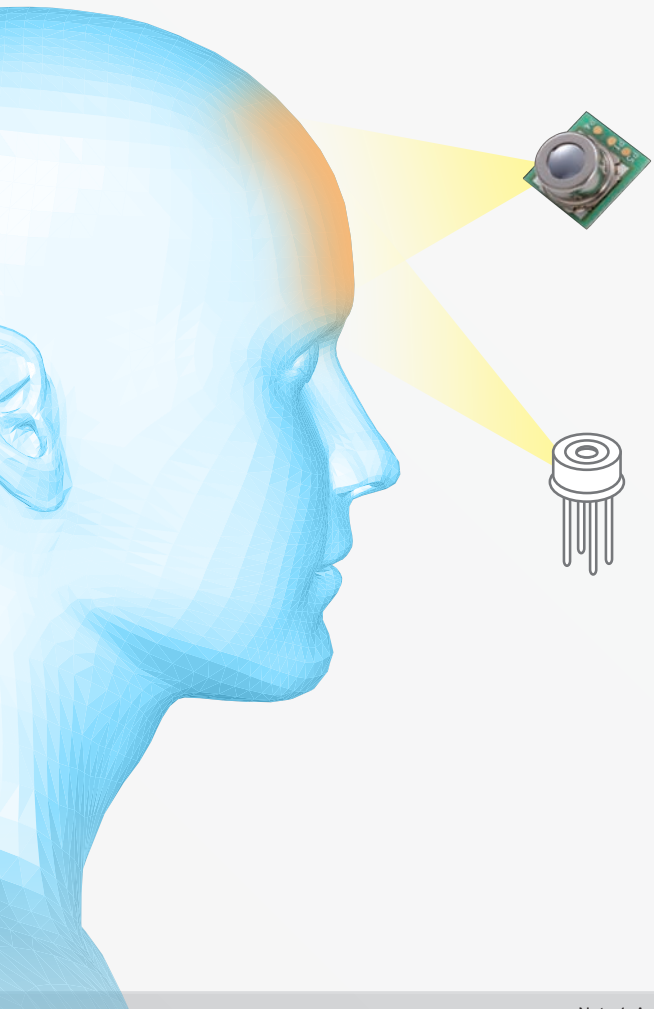
*1: According to OMRON's research as of March 2022.
*2: Refer to the Noise Equivalent Temperature Difference (NETD) on page 12.

Past problem

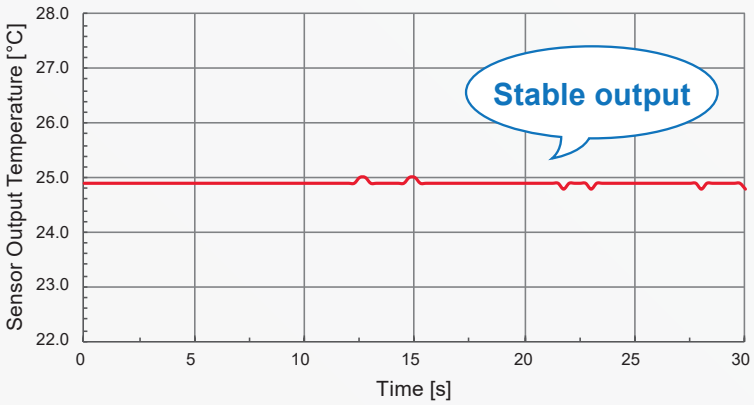
Output was unstable in applications requiring high precision

Solution!

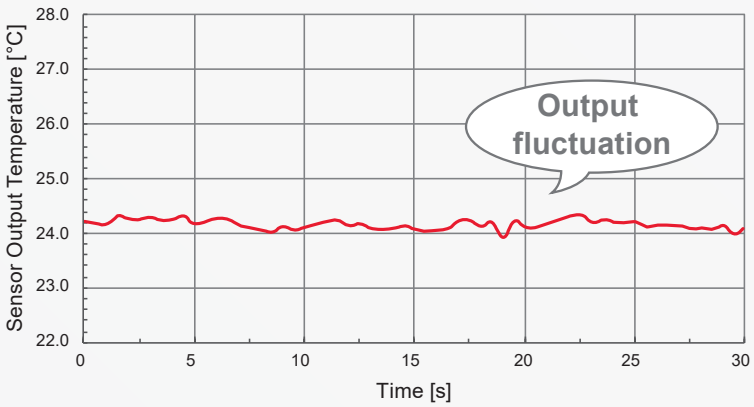
Stable temperature output



OMRON D6T-1A-01



Standard Equivalent Product



Note 1. According to OMRON's evaluation method (30-second continuous measurement with a blackbody furnace at 25°C)
Note 2. However, product specifications are not guaranteed.

-High Precision- Why?

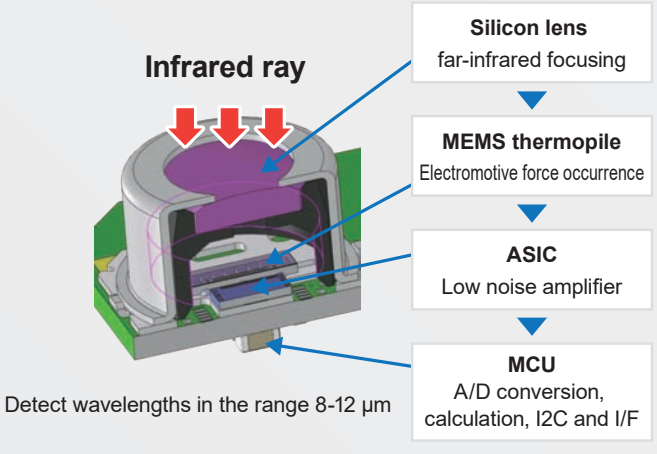
Achieves a low NETD*1 through the combination of ASIC and MEMS

OMRON's unique digital filter and process optimization help reduce the noise of ASIC, thus achieving a low NETD*1.

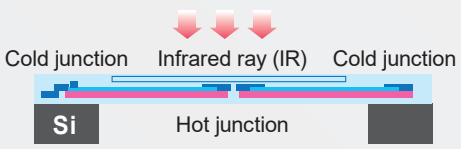
*1: Refer to the Noise Equivalent Temperature Difference (NETD) on page 12.

Product Structure

MEMS technology allows combining thermopile elements and ASICs into one package, resulting in ultra-compact footprint and high precision.



☐MEMS thermopile detection principle



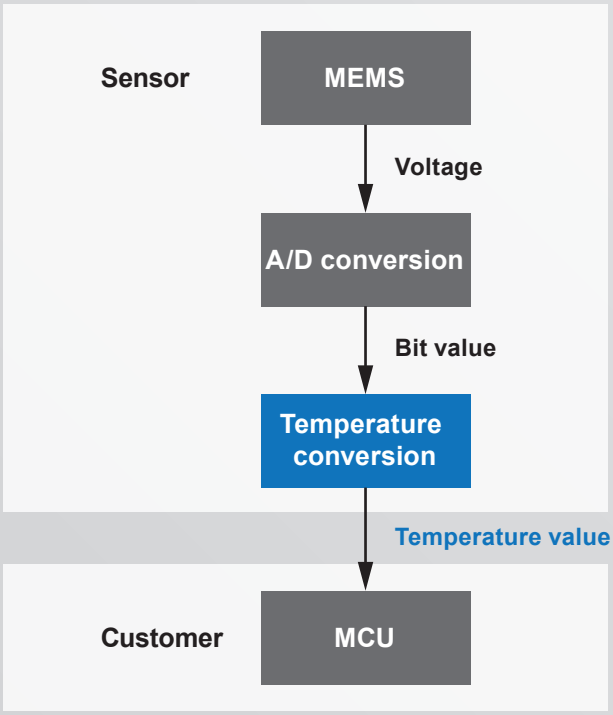
The sensor utilizes the seebeck effect in which thermoelectric force is generated due to the temperature difference that occurs across the junction points of two different types of metal.

2 Easy connection

Direct temperature value output allows easy software design

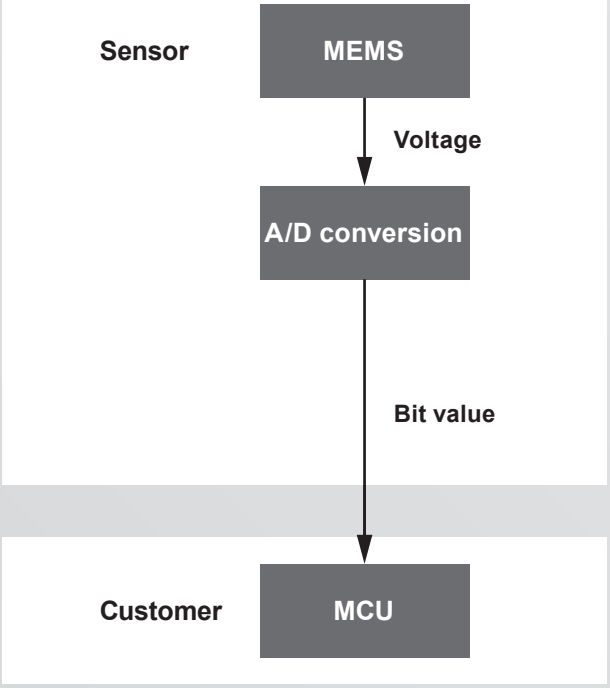
OMRON D6T

Temperature value output



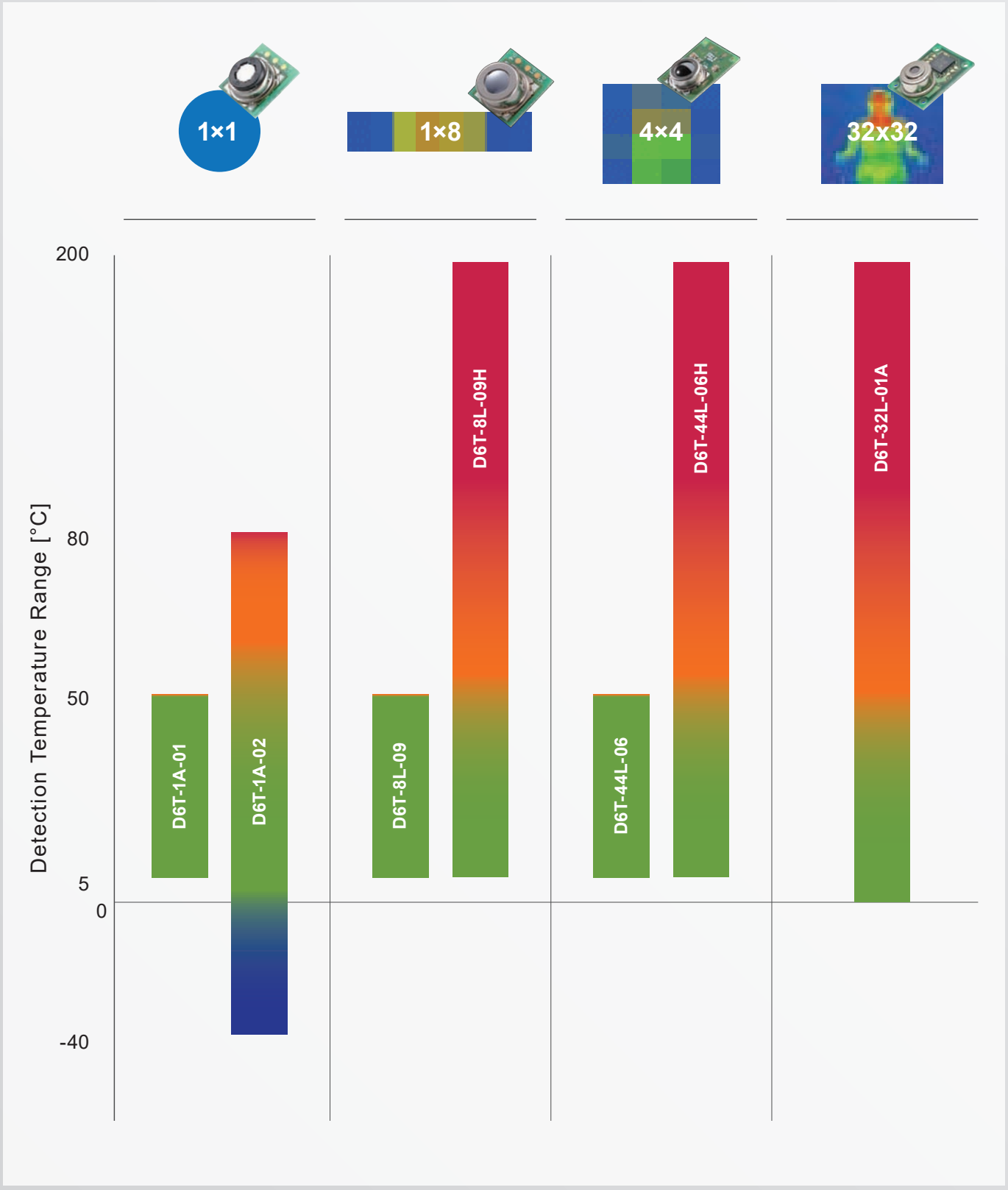
CAN packaged thermal sensor from a competitor

Bit value output



3 Number of elements and temperature lineup

Variation of the number of elements (1 to 1024) and the temperature range (-40 to 200°C)



Example Applications

The sensors can be used in a wide range of applications, depending on the temperature measurement range.

-40°C

Refrigerator Interior & Room Temperature Detection

Able to detect temperature from a long distance

Home appliances (refrigerators & air conditioners)

Recommended Models


1×1


1×8


4×4


32×32

Human Presence Detection

Able to detect stationary human presence

Air conditioners & lighting systems

Recommended Models


1×1

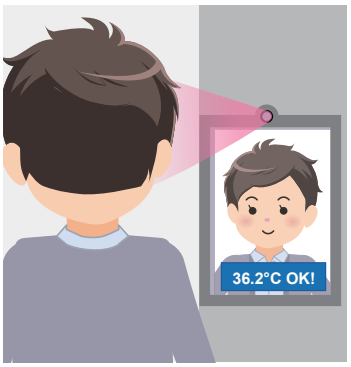

1×8


4×4


32×32

Screening of Humans with Fever

Contributes to automated non-contact temperature detection



Room-Entry Management Equipment

Recommended Models


1×1


1×8


4×4


32×32

200°C

Abnormal High Temperature Monitoring

Contributes to prevention of fires due to overheating

Transformers & distribution boards

Recommended Models


1×1


1×8


4×4

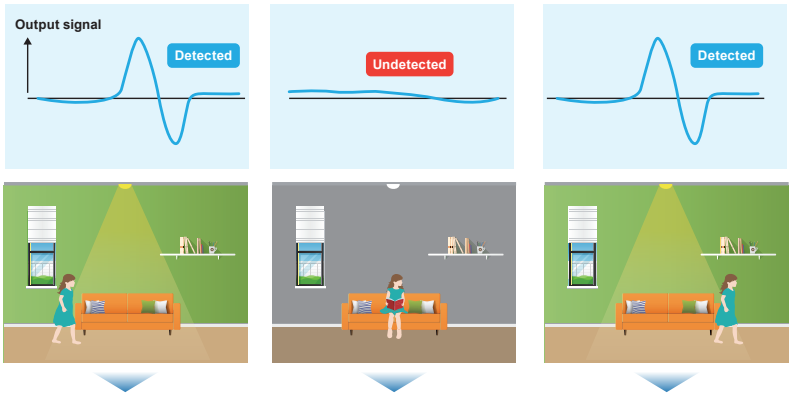

32×32

Comparison with Pyroelectric Sensor

Both the pyroelectric sensor and non-contact MEMS thermal sensor can detect even the slightest amount of radiant energy from objects such as infrared radiation and convert them into temperature readings. However, unlike pyroelectric sensor that relies on motion detection, non-contact MEMS thermal sensor is able to detect the presence of stationary humans (or objects).

Pyroelectric sensor

Converts temperature readings only when detecting "temperature changes in the radiant energy" in its field of view.



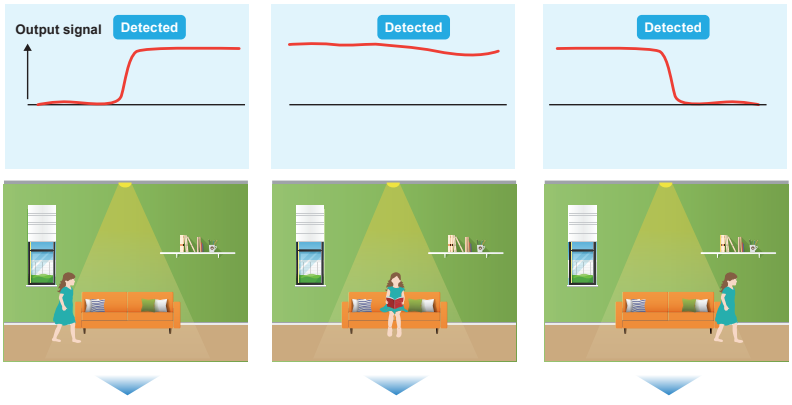
Able to detect human (object) motion

Unable to detect stationary human (object) presence

Able to detect human (object) motion

MEMS thermal sensor (thermopile)

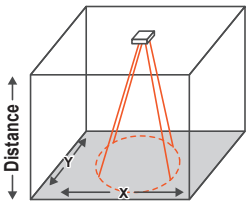
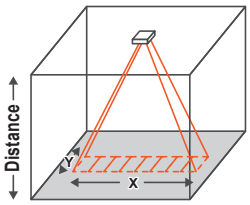
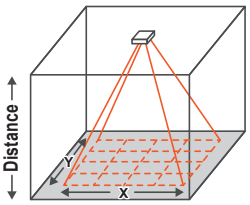
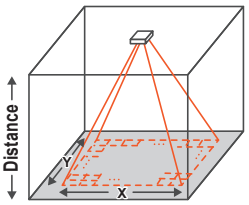
Converts temperature readings by "continuously detecting the temperature of radiant energy" in its field of view



Able to detect both stationary and motion state of humans (objects).

Viewing Angle and Measurement Area

Choose your preferred sensor viewing angle to meet your application needs.

Model	D6T-1A-01	D6T-1A-02	D6T-8L-09	D6T-8L-09H	D6T-44L-06	D6T-44L-06H	D6T-32L-01A
Appearance							
Number of elements	1(1x1)		8(1x8)		16(4x4)		1024(32x32)
Viewing angle X-direction Y-direction	X = 58.0° Y = 58.0°	X = 26.5° Y = 26.5°	X = 54.5° Y = 5.5°		X=44.2° Y=45.7°		X=90.0° Y=90.0°
Size of measurement area							
Distance 10 cm	X = 11 cm Y = 11 cm	X = 4.7 cm Y = 4.7 cm	X = 10 cm Y = 1.0 cm		X = 8.1 cm Y = 8.4 cm		X = 20 cm Y = 20 cm
Distance 50 cm	X = 55 cm Y = 55 cm	X = 24 cm Y = 24 cm	X = 52 cm Y = 4.8 cm		X = 41 cm Y = 42 cm		X = 100 cm Y = 100 cm
Distance 1 m	X = 111 cm Y = 111 cm	X = 47 cm Y = 47 cm	X = 103 cm Y = 10 cm		X = 81 cm Y = 84 cm		X = 200 cm Y = 200 cm
Distance 2 m	X = 222 cm Y = 222 cm	X = 94 cm Y = 94 cm	X = 206 cm Y = 20 cm		X = 162 cm Y = 169 cm		X = 400 cm Y = 400 cm
Distance 3 m	X = 333 cm Y = 333 cm	X = 141 cm Y = 141 cm	X = 309 cm Y = 30 cm		X = 244 cm Y = 253 cm		X = 600 cm Y = 600 cm

Note1: The sizes of measurement areas indicated above are for reference only.

Note2: The size of the measurement area changes according to sensor mounting angle

MEMS Non-Contact Thermal Sensor for Contactless Measurement

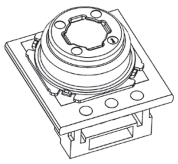
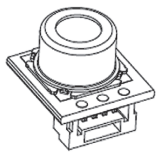
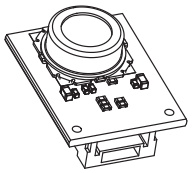
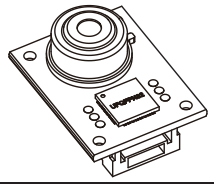
- **Achieves a low NETD*1 through the combination of ASIC and MEMS**
- **Direct temperature value output allows easy software design**
- **Variation of the number of elements (1 to 1024) and the temperature range (-40 to 200°C)**

*1. Refer to the Noise Equivalent Temperature Difference (NETD) on page 12.

Refer to *Safety Precautions* on page 18.

Ordering Information

Thermal Sensors

Element type	Model	Shape
1×1	**D6T-1A-01**	
	D6T-1A-02	
1×8	**D6T-8L-09**	
	D6T-8L-09H	
4×4	**D6T-44L-06**	
	D6T-44L-06H	
32×32	**D6T-32L-01A**	

Accessories (Sold separately)

Type	Model
Cable Harness	**D6T-HARNESS-02**

Model Number Legend

D6T-□-□ □
(1) (2) (3)

(1) Number of elements
1A : 1 (1 × 1)
8L : 8 (1 × 8)
44L : 16 (4 × 4)
32L : 1024 (32 × 32)

(2) Viewing angle
01 : X direction, Y direction=58.0°
02 : X direction, Y direction=26.5°
09 : X direction=54.5°, Y direction=5.5°
06 : X direction=44.2°, Y direction=45.7°
01A : X direction, Y direction=90°

(3) Special Functions
H : High-temperature type
Non-display : Standard sensor

Others

Evaluation of MEMS thermal sensors can be performed by connecting thermal sensor and harness to the platform.
However, please connect the communication signal voltage of the platform at 5.0 V, which is Vcc of thermal sensors.

Platform	Harness for connection (D6T - Platform)	Sample Source Code
For Raspberry Pi *1	**D6T-HARNESS-02**	https://github.com/omron-devhub/d6t-2jcieev01-raspberrypi
For Arduino *2		https://github.com/omron-devhub/d6t-2jcieev01-arduino
For ESP32 Feather *3		https://github.com/omron-devhub/d6t-2jcieev01-arduino

*1. Raspberry Pi is a registered trademark of the Raspberry Pi Foundation.
*2. Arduino is a registered trademark of Arduino LLC and Arduino SRL.
*3. Feather is a registered trademark of Adafruit Industries LLC.

Ratings, Specifications, and Functions

Ratings

Item / Model	D6T-1A-01	D6T-1A-02	D6T-8L-09	D6T-8L-09H	D6T-44L-06	D6T-44L-06H	D6T-32L-01A
Power supply voltage	4.5 to 5.5 VDC						
Storage temperature range	-20 to 80°C	-40 to 80°C	-20 to 80°C (with no icing or condensation)		-10 to 60°C		-20 to 80°C
Operating temperature range	0 to 60°C	-40 to 80°C	0 to 60°C (with no icing or condensation)		0 to 60°C		-10 to 70°C
Storage humidity range	95% max.	95% max.	95% max. (with no icing or condensation)		85% max.		95% max.
Operating humidity range	20% to 95%	20% to 95%	20% to 95% (with no icing or condensation)		20% to 85%		20% to 95%

Characteristics

Item	Model	D6T-1A-01	D6T-1A-02	D6T-8L-09	D6T-8L-09H	D6T-44L-06	D6T-44L-06H	D6T-32L-01A
View angle *1	X direction	58.0°	26.5°	54.5°		44.2°		90°
	Y direction	58.0°	26.5°	5.5°		45.7°		90°
Object temperature output accuracy *2	Accuracy 1	±1.5°C max. Measurement conditions: Vcc = 5.0 V (1) Tx = 25°C, Ta = 25°C (2) Tx = 45°C, Ta = 25°C (3) Tx = 45°C, Ta = 45°C						Within ±3.0°C Measurement conditions: Vcc = 5.0 V Tx = 25°C, Ta = 25°C Central 16x16-pixel area
	Accuracy 2	±3.0°C max. Measurement conditions: Vcc = 5.0 V (4) Tx = 25°C, Ta = 45°C						Within ±5.0°C Measurement conditions: Vcc = 5.0 V Tx = 80°C, Ta = 25°C Central 16x16-pixel area
Current consumption		3.5 mA typical		5 mA typical				19 mA typical

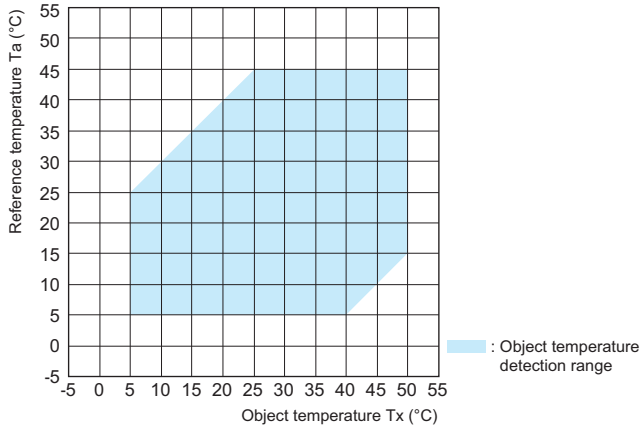
Functions

Item / Model	D6T-1A-01	D6T-1A-02	D6T-8L-09	D6T-8L-09H	D6T-44L-06	D6T-44L-06H	D6T-32L-01A
Object temperature detection range *2	5 to 50°C	-40 to 80°C	5 to 50°C	5 to 200°C	5 to 50°C	5 to 200°C	0 to 200°C
Ambient temperature detection range *2	5 to 45°C	-40 to 80°C	5 to 45°C	5 to 45°C	5 to 45°C	5 to 45°C	0 to 80°C
Output specifications	Digital values that correspond to the object temperature (Tx) and reference temperature (Ta) are output from a serial communications port.						
Output form (Object temperature detection)	Binary code (10 times the detected temperature (°C))			Binary code (5 times the detected temperature (°C))	Binary code (10 times the detected temperature (°C))		
Output form (Reference temperature inside the sensor)	Binary code (10 times the detected temperature (°C))						
Communications form	I2C compliant						
Temperature resolution (NETD) *3	0.02°C (Data update cycle 100 msec)	0.06°C (Data update cycle 100 msec)	0.03°C (Data update cycle 250 msec)	0.03°C (Data update cycle 250 msec)	0.06°C (Data update cycle 300 msec)	0.06°C (Data update cycle 300 msec)	0.33°C *4 (Data update cycle 200 msec)

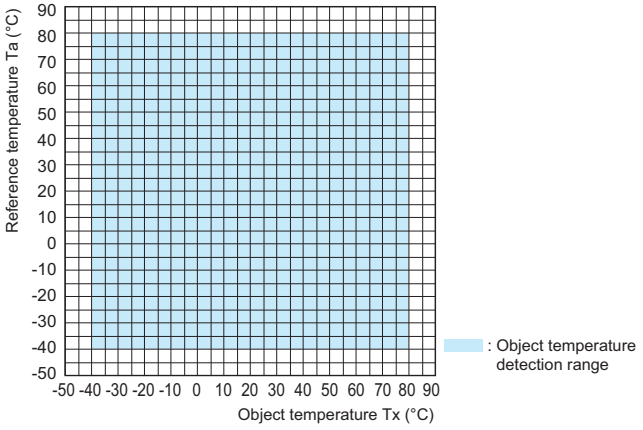
*1. Refer to *Field of View Characteristics*.
*2. Refer to *Object Temperature Detection Range*.
*3. Reference data
*4. Taken to be the average value of the central 4 pixels.

Object Temperature Detection Range

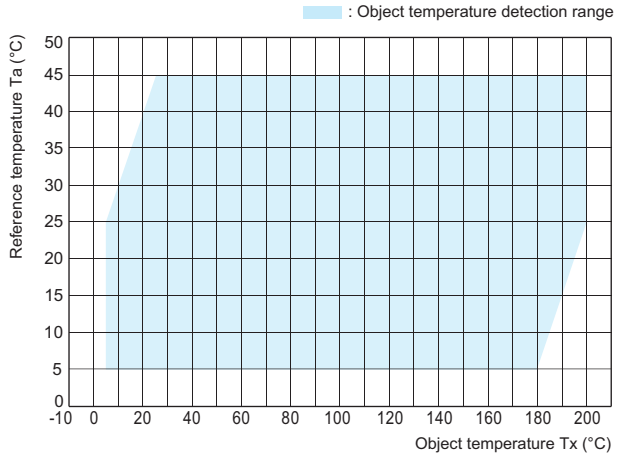
D6T-44L-06, D6T-8L-09, D6T-1A-01



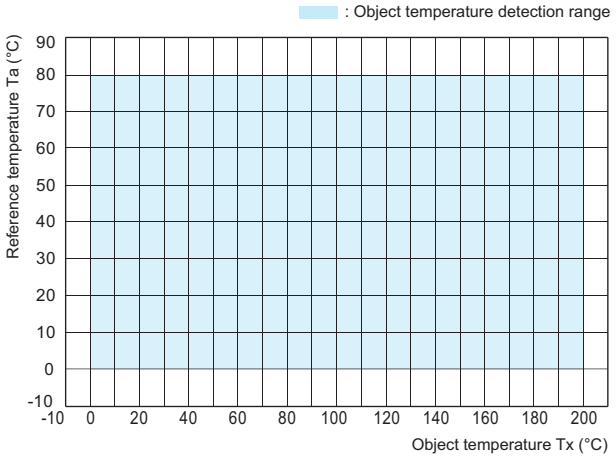
D6T-1A-02



D6T-44L-06H, D6T-8L-09H



D6T-32L-01A

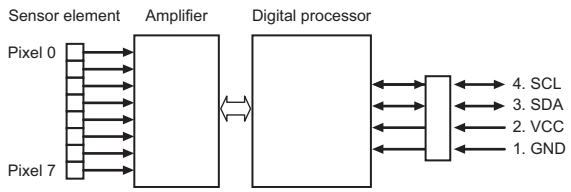


Connections

Thermal Sensor Configuration Diagram

<D6T-8L-09>

<D6T-8L-09H>



Note: The D6T-44L-06 has pixels 0 to 15.
The D6T-44L-06H has pixels 0 to 15.
The D6T-1A-01 has pixel 0.
The D6T-1A-02 has pixel 0.
The D6T-32L-01A has pixel 0 to 1023.

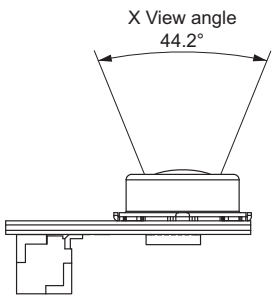
Terminal Arrangement

Terminal	Name	Function	Remarks
1	GND	Ground	
2	VCC	Positive power supply voltage input	
3	SDA	Serial data I/O line	Connect the open-drain SDA terminal to a pull-up resistor.
4	SCL	Serial clock input	Connect the open-drain SCL terminal to a pull-up resistor.

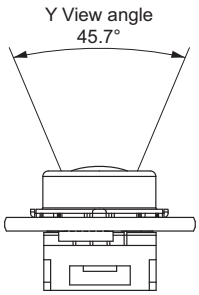
Field of View Characteristics

D6T-44L-06
D6T-44L-06H

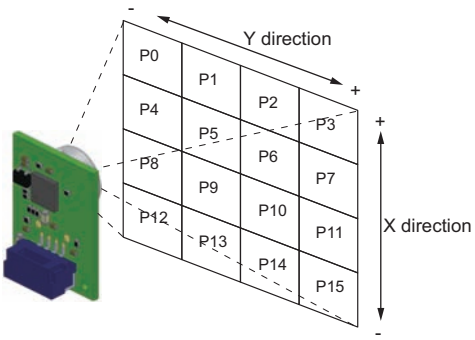
Field of View in X Direction



Field of View in Y Direction



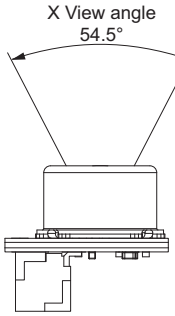
Detection Area for Each Pixel



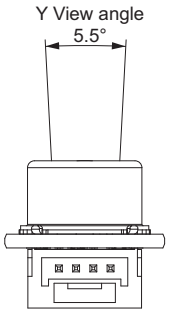
Note: Definition of view angle: Using the maximum sensor output as a reference, the angular range where the Sensor output is 50% or higher when the angle of the Sensor is changed is defined as the View angle.

D6T-8L-09
D6T-8L-09H

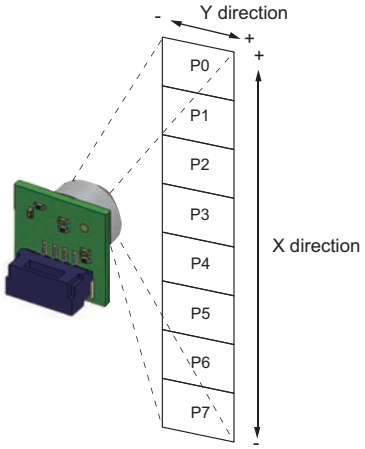
Field of View in X Direction



Field of View in Y Direction



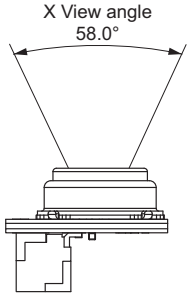
Detection Area for Each Pixel



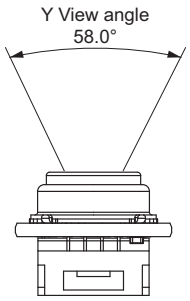
Note: Definition of view angle: Using the maximum Sensor output as a reference, the angular range where the Sensor output is 50% or higher when the angle of the Sensor is changed is defined as the view angle.

D6T-1A-01

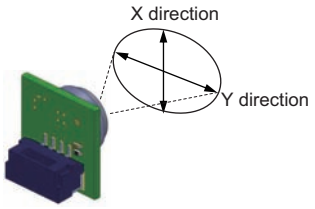
Field of View in X Direction



Field of View in Y Direction

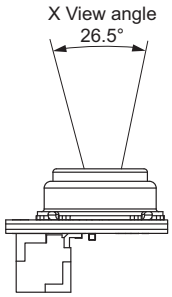


Detection Area for Each Pixel

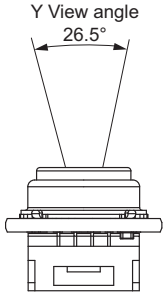


D6T-1A-02

Field of View in X Direction



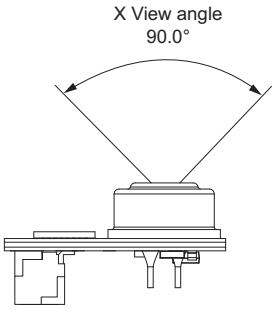
Field of View in Y Direction



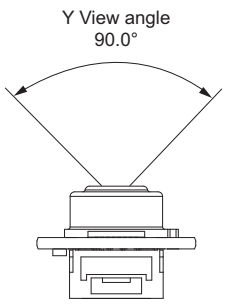
Note: Definition of view angle: Using the maximum Sensor output as a reference, the angular range where the Sensor output is 50% or higher when the angle of the Sensor is changed is defined as the view angle.

D6T-32L-01A

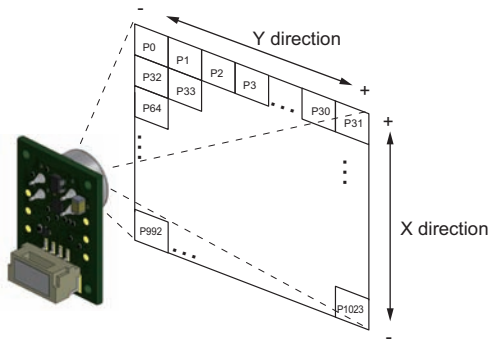
Field of View in X Direction



Field of View in Y Direction



Detection Area for Each Pixel



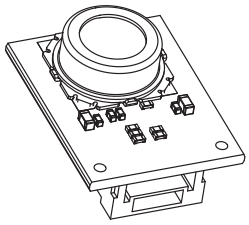
Note: Definition of view angle: Using the maximum Sensor output as a reference, the angular range where the Sensor output is 50% or higher when the angle of the Sensor is changed is defined as the view angle.

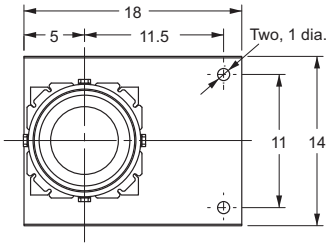
Dimensions

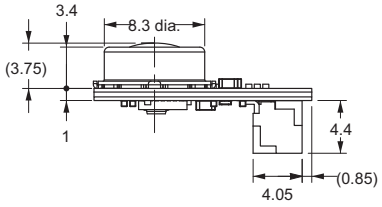
CAD Data Please visit our CAD Data website, which is noted on the last page. (Unit: mm)

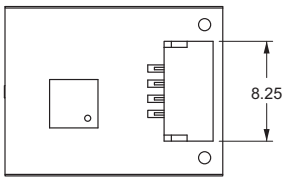
D6T-44L-06
D6T-44L-06H

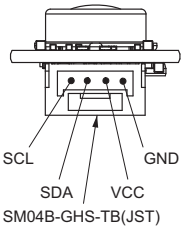
CAD Data



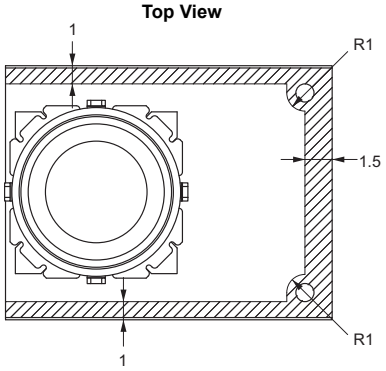




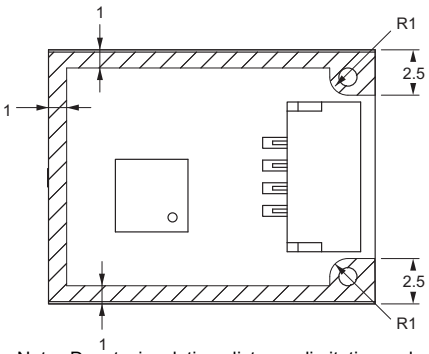




Supporting and Mounting Area (Shaded Portion)
Top View



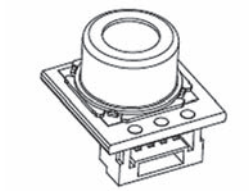
Bottom View

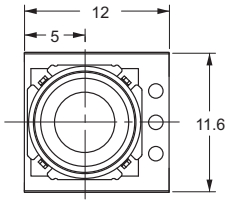


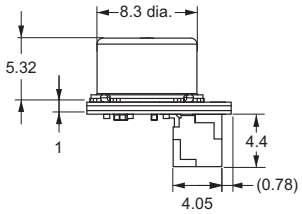
Note: Due to insulation distance limitations, do not allow metal parts to come into contact with the Sensor.

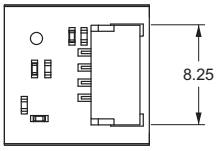
D6T-8L-09
D6T-8L-09H

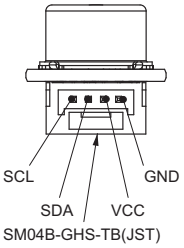
CAD Data



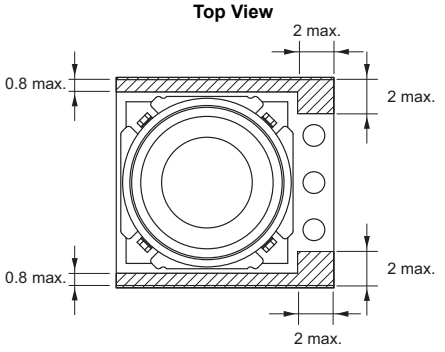




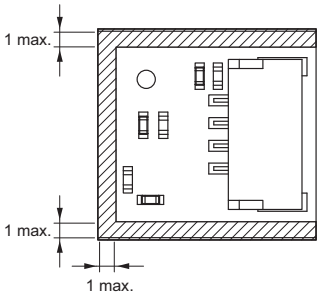




Supporting and Mounting Area (Shaded Portion)
Top View



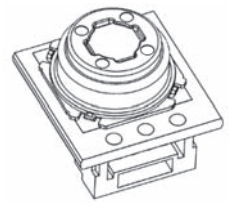
Bottom View

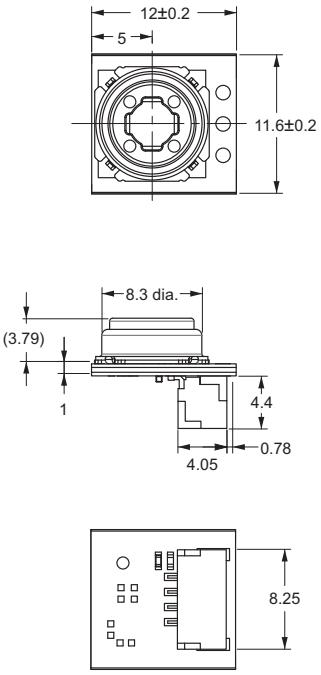


Note: Due to insulation distance limitations, do not allow metal parts to come into contact with the Sensor.

Note: Unless otherwise specified, a tolerance of ±0.3 mm applies to all dimensions.

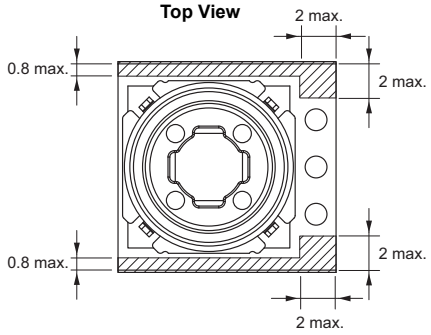
D6T-1A-01
D6T-1A-02



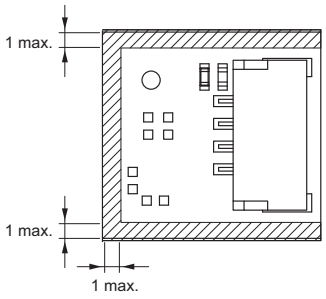


CAD Data

Supporting and Mounting Area (Shaded Portion) Top View

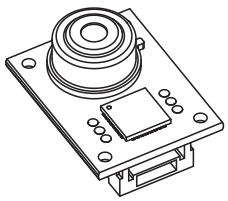


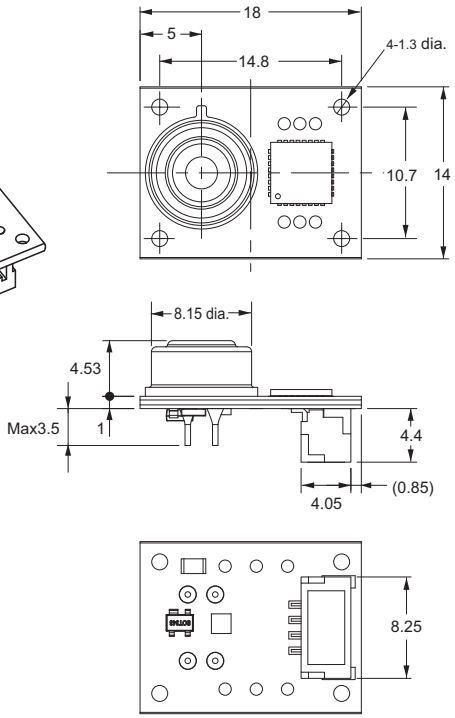
Bottom View



Note: Due to insulation distance limitations, do not allow metal parts to come into contact with the Sensor.

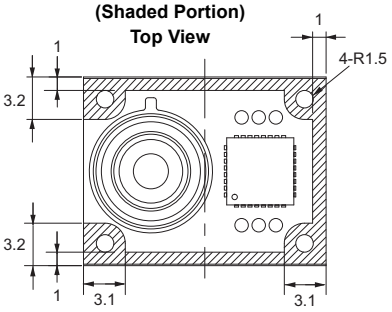
D6T-32L-01A



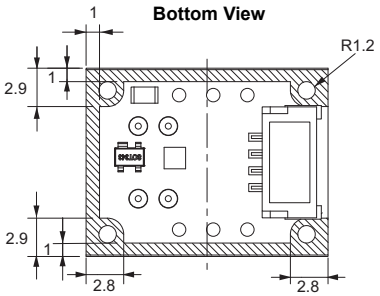


CAD Data

Supporting and Mounting Area (Shaded Portion) Top View



Bottom View



Note: Due to insulation distance limitations, do not allow metal parts to come into contact with the Sensor.

D6T-HARNESS-02 (Optional - sold separately)

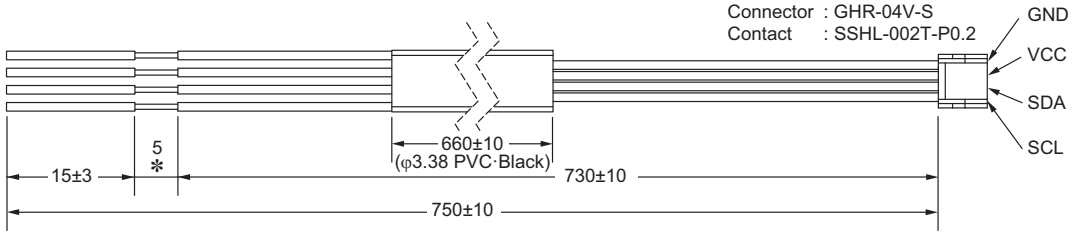
CAD Data

Cable :UL1061.AWG#28
UL Tube : T-105-2 No.8
Connector : GHR-04V-S
Contact : SSHL-002T-P0.2

Cable Color

GND → BLACK Wire
VCC → RED Wire
SDA → BLUE Wire
SCL → YELLOW Wire

✻ Length of Cable removed sheath.



Note: Unless otherwise specified, a tolerance of ±0.3 mm applies to all dimensions.

Safety Precautions

Precautions for Correct Use

● Installation

- The sensor may not achieve the characteristics given in this datasheet due to the ambient environment or installation location. Before using the Sensor, please acquire an adequate understanding and make a prior assessment of Sensor characteristics in your actual system.

● Operating Environment

- Do not use the Sensor in locations where dust, dirt, oil, and other foreign matter will adhere to the lens. This may prevent correct temperature measurements.
- Do not use the Sensor in any of the following locations.
  - Locations where the Sensor may come into contact with water or oil
  - Outdoors
  - Locations subject to direct sunlight.
  - Locations subject to corrosive gases (in particular, chloride, sulfide, or ammonia gases).
  - Locations subject to extreme temperature changes
  - Locations subject to icing or condensation.
  - Locations subject to excessive vibration or shock.

● Noise Countermeasures

- The Sensor does not contain any protective circuits. Never subject it to an electrical load that exceeds the absolute maximum ratings for even an instance. The circuits may be damaged. Install protective circuits as required so that the absolute maximum ratings are not exceeded.
- Keep as much space as possible between the Sensor and devices that generates high frequencies (such as high-frequency welders and high-frequency sewing machines) or surges.
- Attach a surge protector or noise filter on nearby noise-generating devices (in particular, motors, transformers, solenoids, magnetic coils, or devices that have an inductance component).
- In order to prevent inductive noise, separate the connector of the Sensor from power lines carrying high voltages or large currents. Using a shielded line is also effective.
- If a switching requlator is used, check that malfunctions will not occur due to switching noise from the power supply.

● Handling

- This Sensor is a precision device. Do not drop it or subject it to excessive shock or force. Doing so may damage the Sensor or change its characteristics. Never subject the connector to unnecessary force. Do not use a Sensor that has been dropped.
- Take countermeasures against static electricity before you handle the Sensor.
- Turn OFF the power supply to the system before you install the Sensor. Working with the Sensor while the power supply is turned ON may cause malfunctions.
- Secure the Sensor firmly so that the optical axis does not move.
- Install the Sensor on a flat surface. If the installation surface is not even, the Sensor may be deformed, preventing correct measurements.
- Do not install the Sensor with screws. Screws may cause the resist to peel from the board. Secure the Sensor in a way that will not cause the resist to peel.
- Always check operation after you install the Sensor.
- Use the specified connector (GHR-04 from JST) and connect it securely so that it will not come off. If you solder directly to the connector terminals, the Sensor may be damaged.
- Make sure to wire the polarity of the terminals correctly. Incorrect polarity may damage the Sensor.
- Never attempt to disassemble the Sensor.
- Do not use the cable harness to the other product.

MEMO

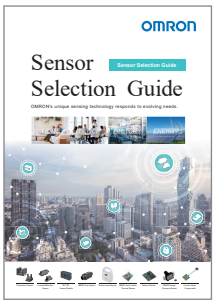
Information of Related Products

D6T
MEMS Thermal Sensor
User's Manual

Catalog No.
A284-E1

D6F
MEMS Flow Sensor

Catalog No.
X211-E1



Sensor Selection Guide

Catalog No.
Y232-E1

Please check each region's Terms & Conditions by region website.

OMRON Corporation
Device & Module Solutions Company

Regional Contact

Americas
https://components.omron.com/us

Europe
https://components.omron.com/eu

Asia-Pacific
https://components.omron.com/ap

China
https://components.omron.com.cn

Korea
https://components.omron.com/kr

Japan
https://components.omron.com/jp

Cat. No. A274-E1-10
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