Infrared Thermosensor
ES1C

Achieve Superior Environmental Resistance and a Wide Measurement Range of 0 to 400°C.

- **Flexible placement with slim cylindrical shape and long focus with a distance of 500 mm and area diameter of 80 mm.**
- **The SUS body and silicon lens resist ambient operating temperatures of up to 70°C and resist dust and water to the equivalent of IP67.**
- **Fast measurement with high-speed response of 100 ms/90%.**
- **Strong resistance to noise with output of 4 to 20 mA.**

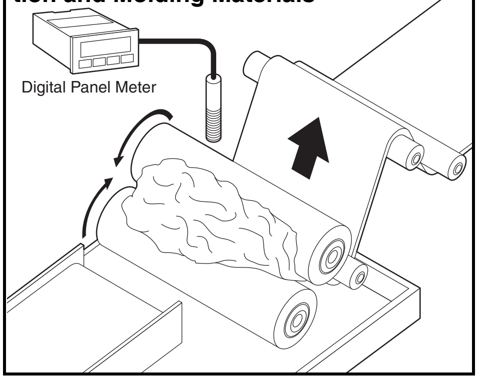
Refer to the *Safety Precautions* on page 6.

Ordering Information

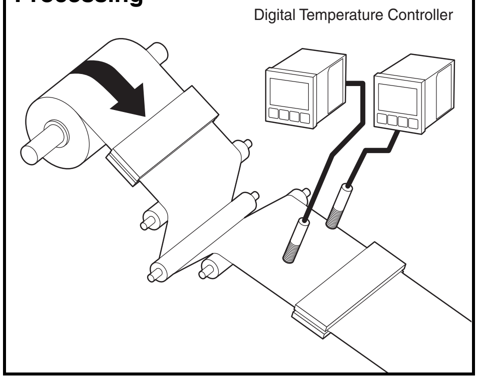
Specification (measuring temperature range)	Model
0 to 400°C	**ES1C-A40**

Application Examples

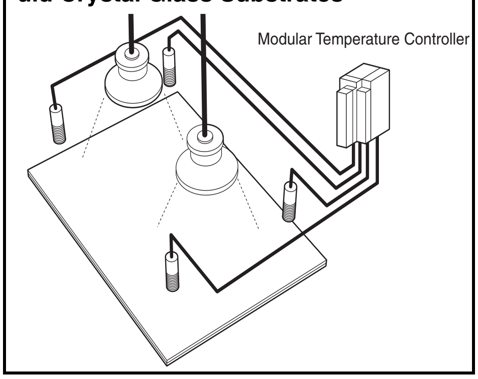
Checking Temperatures for Fabrication and Molding Materials



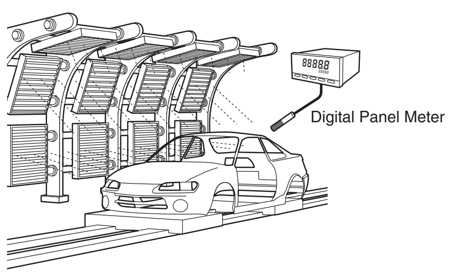
Quality Control in the Thermal Sheet Processing



Monitoring the Temperature of Liquid Crystal Glass Substrates



Checking the Drying Temperature in Baked Coatings



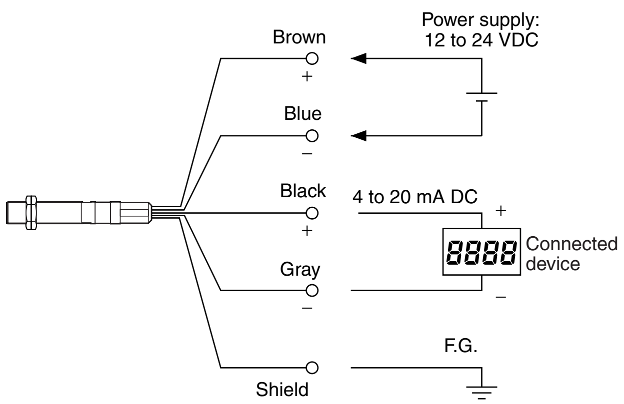
Do not use the ES1C in locations subject to rapid changes in ambient temperature.
Use a heat shield to suppress temperature changes if the ES1C is used in a location that is subject to rapid changes in ambient temperature due to radiating heat or hot air.

Ratings and Characteristics

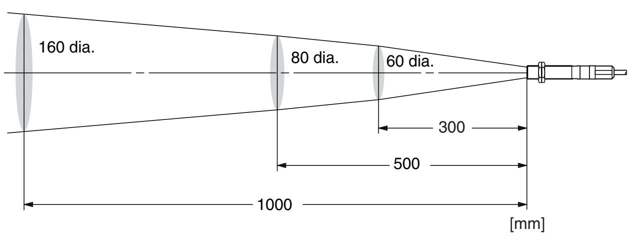
Item		ES1C
Power supply voltage		12 to 24 VDC
Operating voltage range		90% to 110% of rated voltage
Current consumption		70 mA max.
Measuring temperature range		0 to 400°C
Measurement accuracy		0 to 200°C: ±2°C, 201 to 400°C: ±1% PV (emissivity: 0.95)
Influence of EMS	Radiated electromagnetic field immunity	±10°C max.
	Imunity Conducted Disturbance	±10°C max.
Response time		100 ms/90%
Reproducibility		±1% of reading value
Measurement wavelength		8 to 14 µm
Light-receiving element		Thermopile
Emissivity		0.95 fixed
Current output		4 to 20 mA DC, Load: 250 Ω max.
Ambient temperature range		Operating: 0 to 70°C, Storage: –20 to 70°C (with no icing or condensation)
Ambient humidity range		Operating and storage: 35% to 85%
Vibration resistance (destruction)		1.5-mm amplitude at 10 to 55 Hz for 2 hours each in the X, Y, and Z directions
Weight		180 g
Degree of protection		Equivalent to IP67
Applicable safety standards		CE Marking (See note.)

Note: EN61326-1 : Industrial electromagnetic environment (EN/IEC 61326-1 Table 2)

Connections



Measurement Range

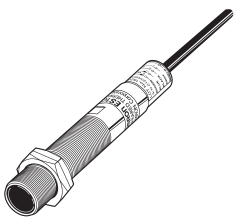


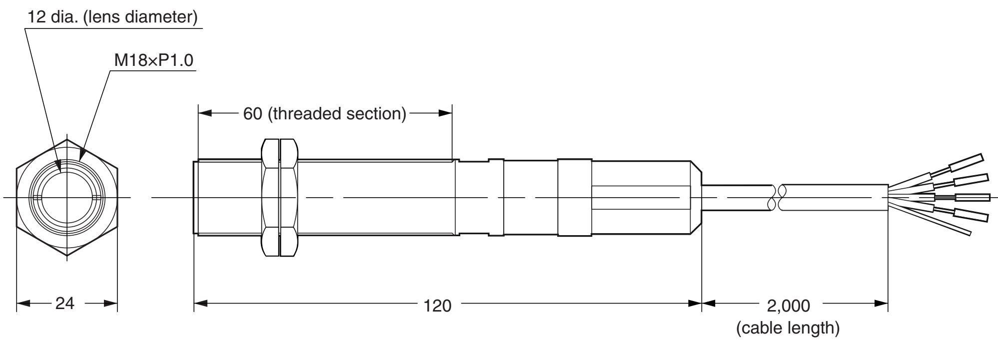
Note: The measurement range is the measurement diameter for an optical response of 90%. Make sure that the actual object to be measured is sufficiently larger than the measurement diameters in the above figure.

Dimensions

(Unit: mm)

ES1C

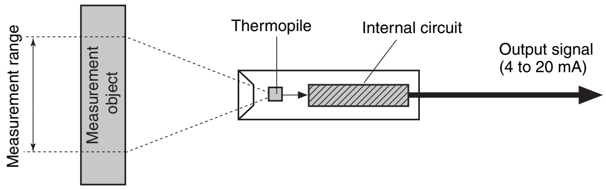




Characteristics of Infrared Thermosensors

1. Principles of Infrared Thermosensors

The ES1C uses thermopile light-receiving elements to receive the specific wavelengths (8 to 14 µm) in the infrared range radiated from the measurement range of the measurement object, converts the received light into an output signal in the internal circuits, and outputs a current that corresponds to the measured temperature.



2. Measurement Error due to Emissivity

The ES1C outputs a current of 4 to 20 mA for measurement object temperatures of 0 to 400°C at a emissivity of 0.95. If the emissivity of the measurement object is less than 0.9, the effects of the ambient temperature will cause measurement error. Glossy metal surfaces generally have an extremely low emissivity, and so operation is easily affected by the ambient temperature, and it is difficult to measure the temperature of the measurement object. (Refer to the emissivities that are given on page 5.)

In an application like this, select a location with a high emissivity, or use Black spray or Black tape as necessary.

Setting and Adjusting the Connected Device

This section describes an example of making settings and adjustments when a Digital Temperature Controller and Digital Panel Meter are connected.

1. Mounting

- Select a location with a high emissivity for the object to be measured. If required, use Black spray or Black tape.
- Secure the Thermosensor with the enclosed lock nuts. Use a tightening torque of 20 N·m max.
- Mount the Thermosensor so that it is perpendicular to the object to be measured.
- Mount the Thermosensor in a location that is not subject to ambient temperatures above 70°C, to direct hot air, etc.

2. Setting the Connected Device

Make the settings so that 0.0 to 400.0°C is displayed for an output of 4 to 20 mA for the ES1C.

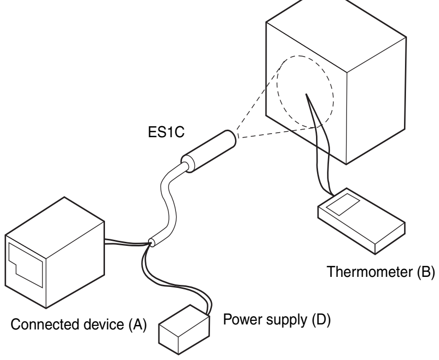
E5□N-□L Digital Temperature Controller (Analog Input)		K3GN-ND□ Digital Panel Meter (DC Input)	
Input type	0 (4 to 20 mA)	Input type	Analog
Scaling upper limit	4,000	Analog range scaling input value 1	4 to 20 4.00
Scaling lower limit	0	Scaling display value 1 scaling input value 2	0 20.00
Decimal point position	1	Scaling display value 2	4,000
		Decimal point position	0000.0

✻ For details, refer to the User's Manual for the connected device.

3. Adjusting the Connected Device

Error may occur due to the emissivity of the measurement environment or measurement object. There are two easy methods that can be used to adjust the error: simple shifting and two-point shifting, as described in the following section.

Setup for Adjustment



● Adjustment Example for the E5□N-L (Analog Input) ✻

✻ E5□N Series have been discontinued at the end of March 2017.

① Shift Method

1. Measuring the Temperature of the Measurement Object

Use the thermometer (B) to measure the actual temperature when using the measurement object (C).

2. Shifting the Display Value of the Connected Device

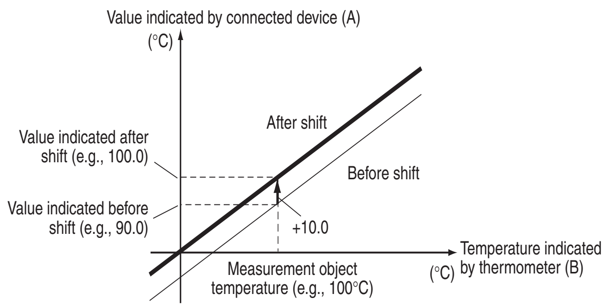
Adjust the settings of the connected device after checking the following value:

Temperature B (thermometer) − Temperature A (connected device)

If temperature B minus temperature A is 10.0, adjust the settings so that measurement value of the connected device is +10.0.

- Scaling upper limit = 4,000 to 4,100
- Scaling lower limit = 0 to 100

(The setting for the decimal point position is 1, and so the scaling set value will be increased by 100 for a displayed value of +10.0.)



② Two-point Shift

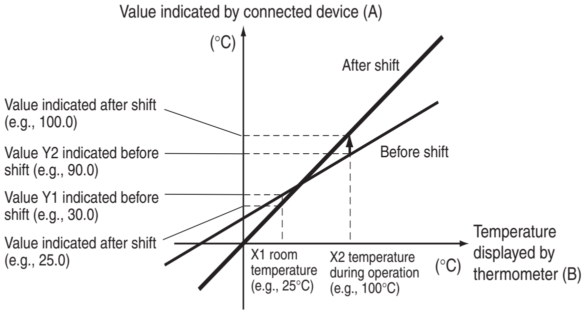
1. Measuring the Temperature of the Measurement Object

Set the temperature of the measurement object to room temperature and to the temperature during operation, and check the values indicated by the connected device (A) and the temperatures of the measurement object (B).

	Value indicated by connected device (A)	Temperature of measurement object (B)
Room temperature	Y1	X1
Temperature during operation	Y2	X2

2. Shifting the Indicated Value

Use the following formula to calculate the upper limit and lower limit of input scaling after the shift from the values Y1 and Y2 indicated by the connected device and temperatures X1 and X2 of the measurement object.



(1) Scaling upper limit after shift (°C)

$$= \frac{X2 - X1}{Y2 - Y1}(400 - Y1) + X1$$

(2) Scaling lower limit after shift (°C)

$$= \frac{X2 - X1}{Y2 - Y1}(0 - Y1) + X1$$

Change the values to the scaling upper and lower limits from the result considering the decimal point position. For example, if the scaling upper limit after shift is 487.5 (°C) and the scaling lower limit after shift is –12.5 (°C), the decimal point position of the connected device will be set to the first decimal position, and so the scaling upper limit will be set to 4,875 and the scaling lower limit to –125.

● Adjustment Example for the K3GN

① Shift Method

1. Measuring the Temperature of the Measurement Object

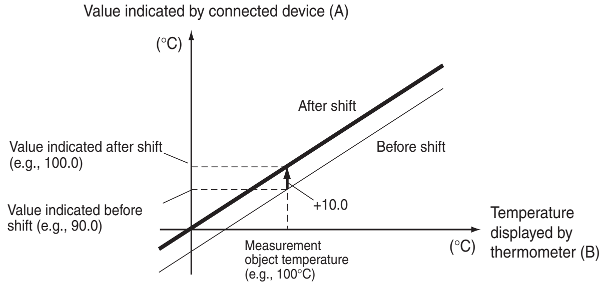
Use a thermometer (B) to measure the actual temperature when using the measurement object (C).

2. Shifting the Display Value

Adjust the settings of the connected device after checking the following value:
Temperature B (thermometer) − Temperature A (connected device)
If temperature B minus temperature A is 10.0, adjust the settings so that measurement value of the connected device is +10.0.

- Scaling display value 1 = 0 to 100
- Scaling display value 2 = 4,000 to 4,100

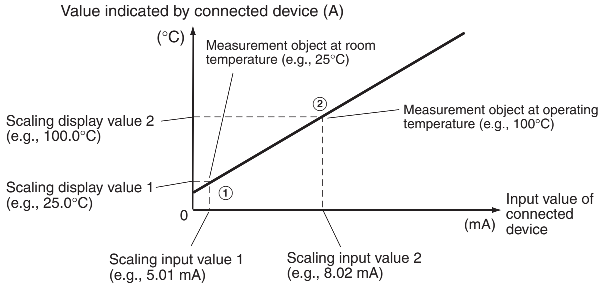
(The setting for the decimal point position is 0000.0, and so the scaling set value will be increased by 100 for a displayed value of +10.0.)



② Two-point Shift

Use the teaching function of the K3GN to make adjustments using the ES1C's actual analog input value and the actual temperature. Set one of the two teaching points to room temperature and the other to the actual temperature of the measurement object during operation.

1. Move the K3GN to the initial setting level.
2. Set the temperature of the object to be measured to room temperature and set scaling input value 1 using teaching. Next, set the temperature (B) of the thermometer to scaling display value 1. (Point ① in the following figure. The decimal point position for the K3GN is set to the first decimal position, and so set 250 for 25.0°C.)
3. Next, set the measurement object to the actual operating temperature and set scaling input value 2 and scaling display value 2 in step 2. (A value of 1,000 is set to specify 100.0°C for point ② in the following graph.)



Emissivities

	Item	Emissivity	Item	Emissivity
Metals	Aluminum		Iron oxide	0.78 to 0.82
	Pure aluminum, high-gloss aluminum	0.04 to 0.06	Red rusted iron	0.69
	Aluminum oxide	0.76	Gray oxidized lead	0.28
	Commercially available aluminum sheets	0.09	Mercury	0.09 to 0.12
	Brass		Molybdenum filament	0.10 to 0.20
	High-gloss sheets of pure brass	0.10	Nickel	
	Brass oxide	0.56 to 0.64	Glossy	0.07
	Glossy chrome	0.08 to 0.36	Nickel oxide	0.90
	Chrome oxide	0.81	Platinum	
	Copper		Glossy platinum sheets	0.05 to 0.10
	Glossy	0.05	Platinum wire rods	0.07 to 0.18
	Copper oxide	0.78	Glossy pure silver	0.03 to 0.28
	Bronze with uneven surface	0.55	Stainless steel	
	Glossy pure gold	0.02 to 0.03	Glossy	0.07
	Iron and steel (except stainless)		Rolled stainless steel	0.45
	Glossy iron	0.14 to 0.38	Glossy tin	0.06
	Glossy cast iron	0.21	Etched tungsten filament	0.03 to 0.35
	Glossy wrought iron	0.28	Zinc	
	Oxidized dull-colored wrought iron	0.94	Commercially available glossy pure zinc	0.05
	Rusty iron sheet	0.69	Galvanized sheets	0.21
	Glossy steel	0.07	Zinc oxide	0.11 to 0.28
	Thin rolled steel sheets	0.66	Titanium oxide	0.40 to 0.60
	Unpolished steel sheets	0.94 to 0.97		

	Item	Emissivity	Item	Emissivity
Non-metals	Asbestos	0.93 to 0.94	Water	0.92 to 0.96
	Bricks		Ice	0.96 to 0.98
	Red, unpolished	0.93	Snow	0.83
	Fireclay	0.75	Glass	0.85 to 0.95
	Carbon		Ceramics	0.90 to 0.94
	Filament	0.53	Marble	0.94
	Soot film	0.84 to 0.95	Fluorite	0.30 to 0.40
	Paint, lacquer, varnish		Gypsum	0.80 to 0.90
	Coated lacquer	0.80 to 0.95	Plaster	0.89 to 0.91
	White enamel	0.91	Brick (red)	0.93 to 0.95
	Black lacquer	0.96 to 0.98	Fibers	0.90
	Aluminum paint	0.27 to 0.67	Cloth (black)	0.98
	16-color oil-based paint	0.92 to 0.96	Skin (human)	0.98
	Glazed porcelain	0.92	Leather	0.75 to 0.80
	Opaque crystals (quartz)	0.68 to 0.92	Charcoal (powder)	0.96
	Asphalt	0.90 to 0.98	Rubber (black)	0.94
	Concrete	0.94	Plastic	0.85 to 0.95
	Cement	0.96	Lumber	0.90
	Sand	0.90	Paper	0.70 to 0.94
	Dirt	0.92 to 0.96		

Note: Operation will be easily affected by the ambient temperature if the emissivity of the measurement object is lower than 0.9. Glossy metal surfaces generally have an extremely low emissivity, and it is difficult to measure the temperature of the measurement object. Use Black spray or Black tape.

Safety Precautions

⚠ CAUTION

A malfunction in the product may occasionally result in property damage to connected equipment or devices. To maintain safety in the event of malfunction of the product, take appropriate safety measures, such as installing a monitoring device on a separate line.

Precautions for Safe Use

(1) This Product is designed for indoor use only. Do not use the Product outdoors or in any of the following locations.
- Locations directly subject to heat radiated from heating equipment.
- Locations subject to splashing liquid or oil atmosphere.
- Locations subject to direct sunlight.
- Locations subject to dust or corrosive gases (in particular, sulfide or ammonia gases).
- Locations subject to intense temperature changes.
- Locations subject to icing or condensation.
- Locations subject to excessive vibration or shock.

(2) Use and store the Product within the rated ambient temperature and humidity. If there is heating equipment in the vicinity of the Product, heat radiated from the equipment will cause the temperature inside the Product to rise and shorten its service life. In such a case, use forced cooling by fans or other means of air ventilation.

(3) Be sure to wire properly with correct polarity of terminals.

(4) 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). If a noise filter is used on the power supply, check the voltage and current, and attach the noise filter as near as possible to the Product. Allow as much space as possible between the product and devices that generates high frequencies (such as high-frequency welders and high-frequency sewing machines) or surges.

(5) Use the product within the rated load and power supply.

(6) The current output and power supply are not isolated. Be sure that unwanted currents do no occur with the connected device.

(7) Do not measure glossy surfaces.

(8) Do not let the Product touch the object to be measured.

(9) Do not touch the lens.

(10) Do not allow charged objects in the vicinity of the Product.

Warranty and Application Considerations

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

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Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

Take all necessary steps to determine the suitability of the product for the systems, machines, and equipment with which it will be used.

Know and observe all prohibitions of use applicable to this product.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Disclaimers

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Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON *Warranty and Limitations of Liability.*

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons. Consult with your OMRON representative at any time to confirm actual specifications of purchased product.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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