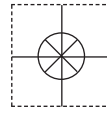
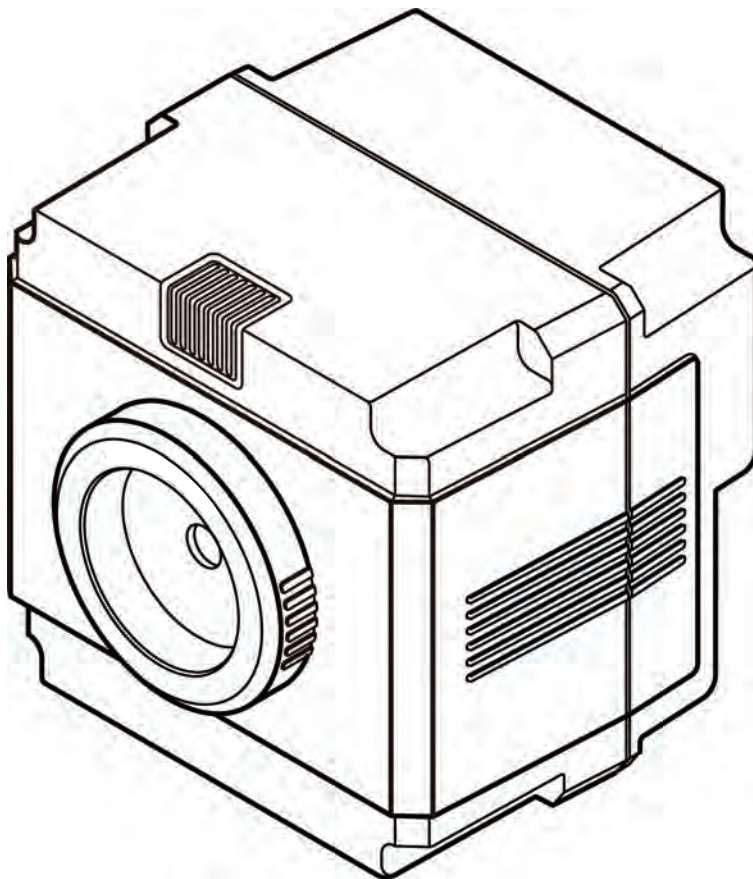


1 YEAR
WARRANTY



User's Guide



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MADE IN JAPAN

OSXL-101 Compact Thermal Image Sensor



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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

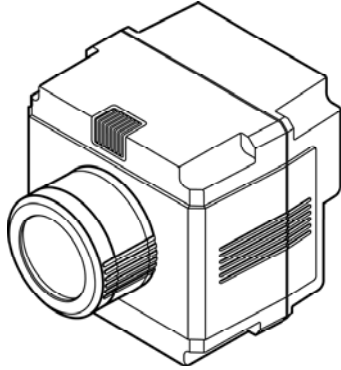
WARNING: These products are not designed for use in, and should not be used for, human applications.

Introduction

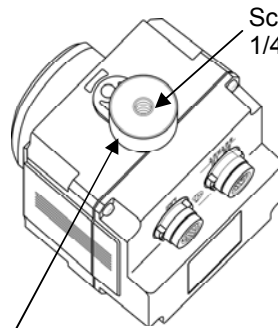
Thank you for purchasing a compact thermal image sensor. In order to use this product safely, please read this instruction manual completely before use and confirm the correct handling and instructions. In addition, please retain this instruction manual for future reference.

Before using

Please confirm the contents of packing. If something is missing, please contact to your nearest distributor.

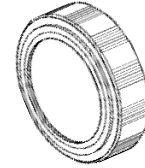


Thermal image sensor

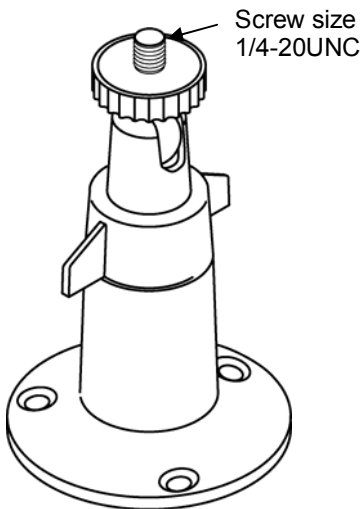


Screw size
1/4-20UNC

Mounting screw: 1 piece
This is attached to the sensor



Lens cap: 1 piece



Screw size
1/4-20UNC

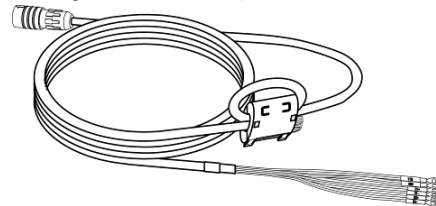
OSXL-100-MOUNT
Universal head: 1 piece



OSXL-100-LAN Custom Network Cable
(With a crossing cable and an RJ-45 terminal) 2.5m: 1 piece
* For direct connection to PC
(Refer to Page 6 for details.)



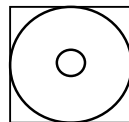
Connector cap: 1 piece



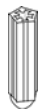
OSXL-100-PAC
Custom Power/Alarm Output Cable
(With O-tip terminals) 2.5m: 1 piece



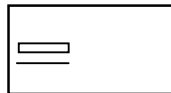
Screws for the universal
head: 3 pieces



CD-ROM: 1 piece
{ Application software
Instruction manuals (For the
sensor and the application
software)



Carl plugs for mounting
the universal head
into concrete: 3 pieces



Quick manual: 1 sheet

■ About this instruction manual



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- Unless otherwise specified in the guarantee clauses, we do not offer any guarantee about this product.
- We shall not be liable to a customer or a third party for any damages or indirect damages by using this product or by unpredictable defects of the product.


■ Safety precautions

- The safety precautions shown in this manual indicate the important contents about safety. Please be sure to understand and follow these precautions.
- In this manual, in order to use this product safely, the precautions are described with the following indications and marks.

	Warning	This indicates a potentially hazardous situation that, if not avoided, will result in death or serious injury.
	Caution	This indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury or cause property damage.

[Safety precautions]

	Warning
<ul style="list-style-type: none"> • Do not operate this product in a place where flammable gas or explosive gas exists. It is extremely dangerous to use this product under such environment. • In order to prevent an electric shock, make sure that the power source is turned off before connecting any wiring. • Stop using this product immediately, turn off the power source and contact to your nearest distributor if it is broken or there is smoke/abnormal odor from this product. Otherwise, it may cause fire. • Do not repair or modify this product. If it is modified, operation of this product will not be guaranteed. It may also cause fire/electric shock. 	

	Caution
<ul style="list-style-type: none"> • Avoid the use of this product in the following places. <ul style="list-style-type: none"> A place where ambient temperature varies widely A place where humidity is high A place where rain/water is splashed A place where there are dusts like sand or dirt A place where it is subjected to exposed in scorching heat or direct sunlight A place where it is subjected to radiation A place where strong electric circuit exists beside this product A place where there is any inductive interference A place where there is mechanical vibration/shock • If this product is wired with wrong polarity, it may cause trouble or fire. • Do not aim the sensor to a high temperature object like sun, or the imaging element may be damaged and it may cause trouble on this product. • In order to use this product safely, refer to "requirements" and handling methods mentioned in this manual or it may cause damage or malfunction to this product or cause damage also to other equipments. • Optical components have special coating. Be careful that these parts become easily dirty when they are dew-condensed. In addition, the infrared transmission is deteriorated under the dew condensation and a clear image is not provided. • If the body is affected by radiant heat, please use the radiant heat away from places affected. 	



Precautions for use

- This product is a precision instrument. Do not drop it or make a strong impact on it.
- Do not use it in water.
- Keep this product away from equipments generating strong static electricity and electromagnetic waves including TVs, microwave ovens and wireless applications, or it may cause malfunction or trouble on this product.
- Keep this product away from equipment generating strong high frequency or surge voltage, or it may cause malfunction or trouble on this product.
- Use neutral detergent for cleaning of this product and wipe it off lightly by rubbing with the cloth squeezed firmly. Do not use chemicals or bleaches including benzene, thinner and alcohol.
- Do not use or place this product in a place subjected to temperature of lower than -10°C or higher than 50°C , dew-condensation, or humidity of lower than 10%RH or higher than 80%RH.
- Do not use or place this product in a place subjected to direct sunshine, dusty, high temperature/high humidity or corrosive atmosphere.
- When any service including repairs is required, contact to your nearest distributor.
- Do not apply too much force on the custom power supply and Network cables. It may cause damage of the connection which may lead water immersion into the product, and may cause trouble on this product.

When you use accessories connected to this product, follow the instructions relating to regarding the safety in this manual. If you do not follow these instructions, safety of this product and the system will not be guaranteed.

Your extra consideration is required when this product is used in an application that may subject to life threatening to human or property damage. Pay extra attention to safety measures, avoid usage under extreme environment and build a fail-proof system.

Contents

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Outline of product

1. Configuration

The system consists of the thermal image sensor utilizing a thermopile array detector and the application software for displaying thermal images converted from the temperature data from the sensor..

The application software allows to connect up to 4 thermal image sensors and display thermal image from these sensors.

2. Features

- Built-in thermopile array detector with approximately 2256 pixels. Each pixel can measure temperature.
- Low cost, compact size and lightweight (150g) fixed-mount type thermal image sensor
- Robust and dust/splash-proof construction IP-65
- Data transmission to a PC via Ethernet (LAN), Thermal image display by the application software
- 2 built-in circuits of non-voltage contact outputs. The sensor can be used as a fixed-mount type alarm unit.

(When an alarm is activated, 1 image can be stored in the sensor.)

3. Functions

Alarm can be set from the application software or custom-made commands. The sensor provides non-voltage contact outputs when the alarm condition is met.

- ◆ Monitor mode (when the supplied application software is used)

The temperature data of the entire thermopile array can be obtained continuously from the PC.

- ◆ Capture mode (when the supplied application software is not used)

The temperature data in a single row of the thermopile array can be obtained at a time by a command from a master unit (e.g. PC or PLC).



When the capture mode is used, a series of communication command is required.

For the communication commands, contact to your nearest distributor.

4. Model/specification

OSXL-101-□□□

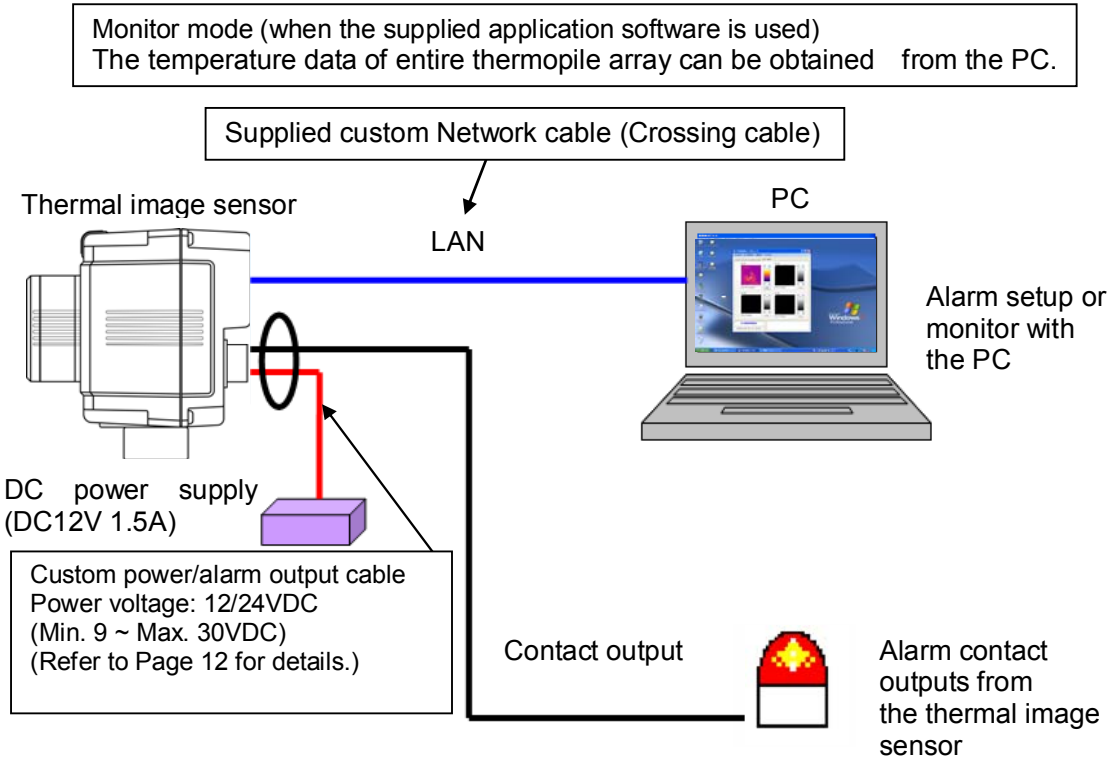
View angle	Blank: 60° (-20°C to 300°C)
	25: 25° (-20°C to 300°C)
	25H: 25° (100°C to 800°C)

Pixels	2256
--------	------

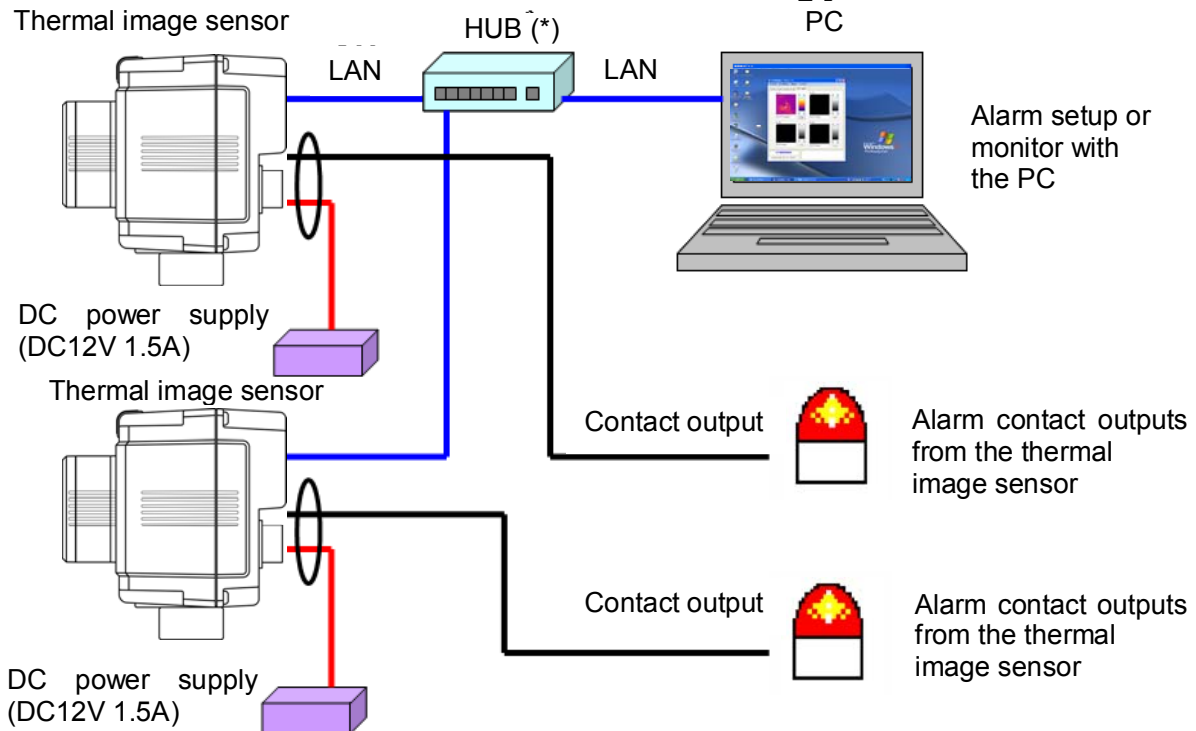
Output	Alarm + LAN
--------	-------------

5. Basic configuration

5-1. Connection with 1 Thermal Image Sensor to PC (Monitor mode)

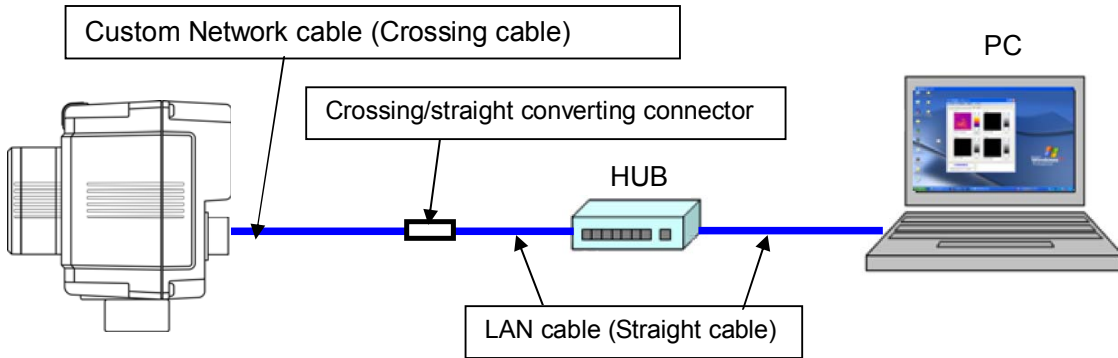


5-2. Connection of multiple Thermal Image Sensors (Example: 2 units)

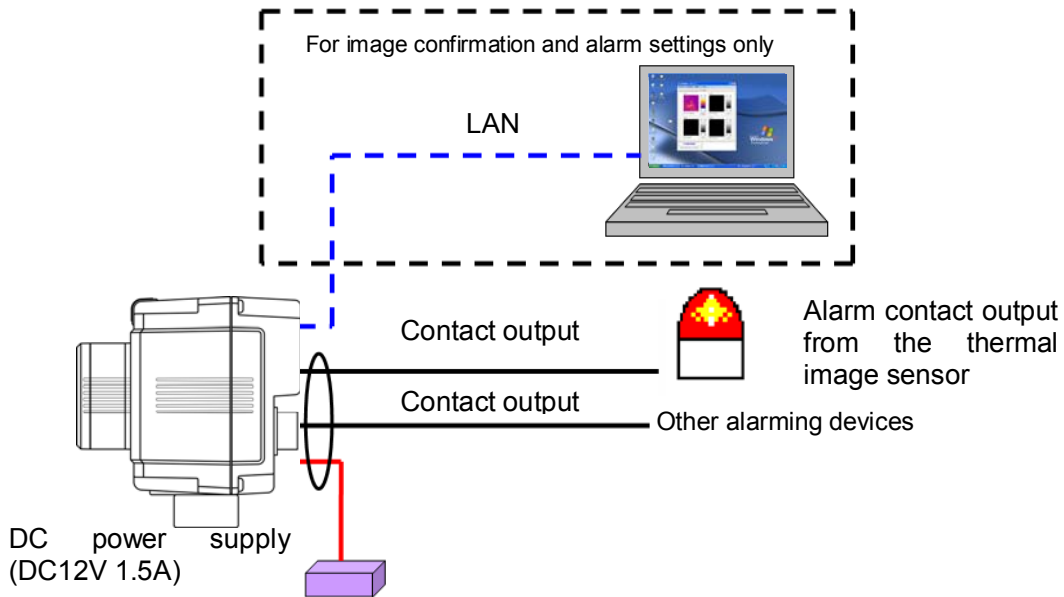


⚠ * If a HUB without automatic crossing/straight converting function is used, a straight cable is needed. Connect a crossing/straight converting connector between the custom Network cable and a HUB. (Refer to Page 3.)

◆ Connection example of HUB (without automatic crossing/straight converting function)

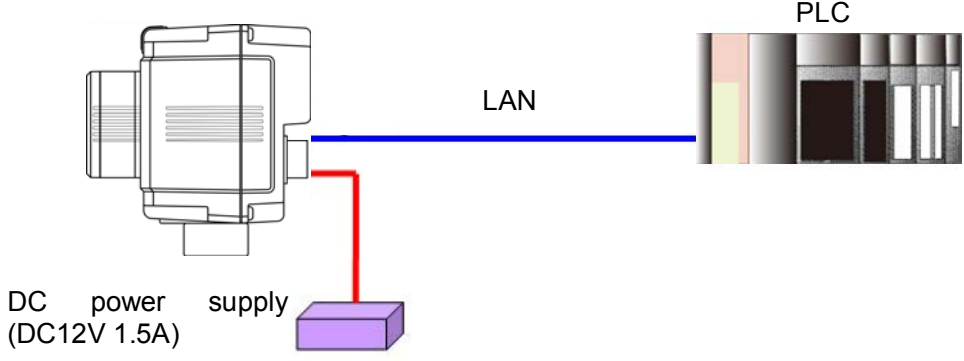


5-3. Stand alone usage of the thermal image sensor



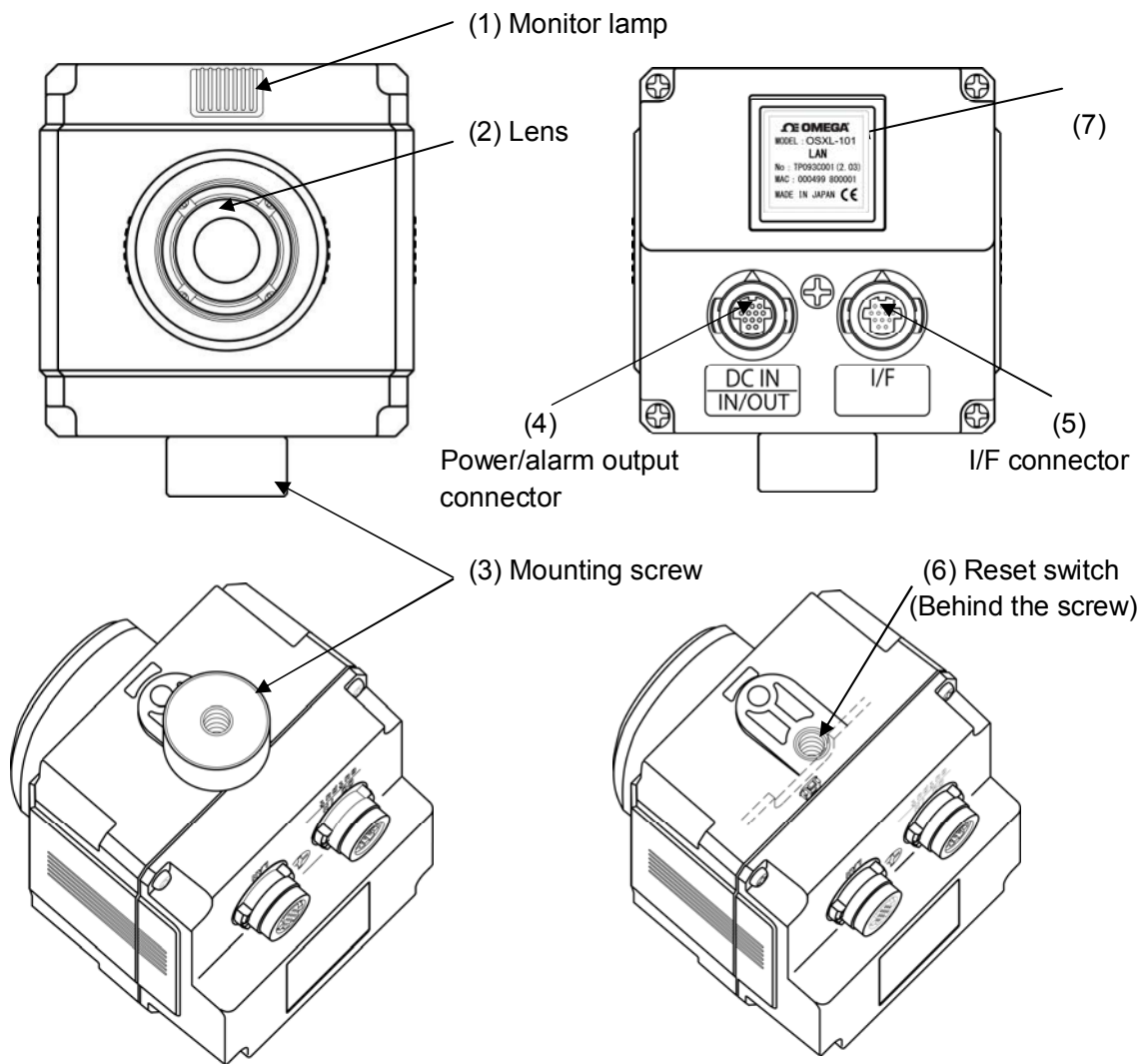
5-4. Connection to PLC (Capture mode)

Capture mode (when the supplied OMEGA application software is not used)
 The temperature data in a single row of the thermopile array can be obtained at a time by a command from a master unit (e.g. PC or PLC).



⚠ When the capture mode is used, a series of communication commands are required. For the communication commands, contact to your nearest distributor.

Names and functions



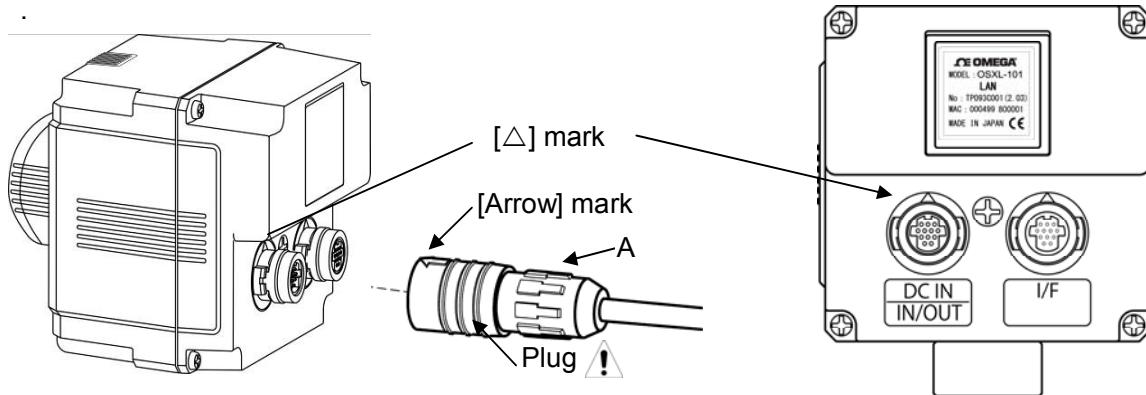
No	Name	Function
(1)	Monitor lamp	The state of alarm and the condition of the sensor is indicated with colors of blue, red and purple. (Refer to Page 8.)
(2)	Lens	For forming image of radiation energy from a measurement object on the detecting element
(3)	Mounting screw	For mounting the sensor on a tripod (1/4-20UNC)
(4)	Power/alarm output connector	For connecting custom power/alarm output cable
(5)	I/F connector	For connection of custom Network cable
(6)	Reset switch	To initialize the sensor to factory default (The switch is located behind the mounting screw.) (Refer to Page 11 for details.)
(7)	Mfg nameplate	Serial No., MAC address, etc. are shown.

■ Connection

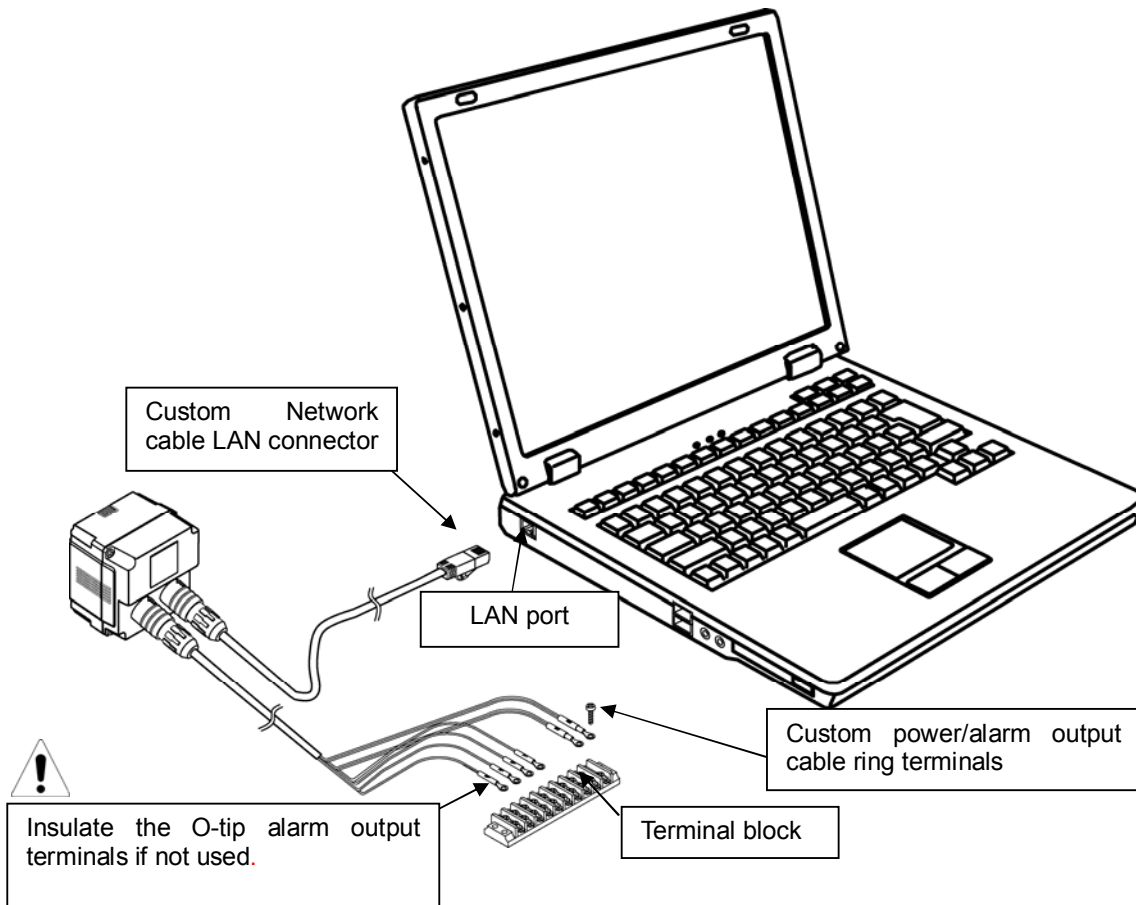
- Connect the custom power/alarm output cable and the custom Network cable to this product. Connect them to align the marks of [△] back of this product and [Arrow] on the cable connectors.

⚠ To avoid misconnections, the custom Network cable is designed not to connect to the power/alarm output connector of this product. Similarly, the custom power/alarm output cable cannot be connected to the LAN connector of this product.

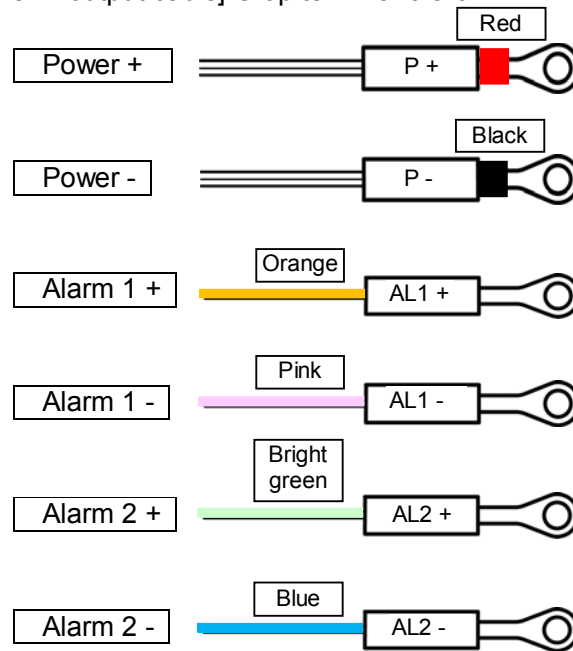
⚠ The connections are a quick-disconnect locking type. Insert the plug until it clicks. To unplug, hold the sliding part (that has the [Arrow] marking on) and pull it outward. If the "A" part is pulled, and the plug may be damaged.



- Plug the connector of the custom Network cable to the Ethernet port of a master unit (PC, etc.) and connect the O-tip terminals of the custom power/alarm output cable to the terminal block of 12VDC Power Supply.



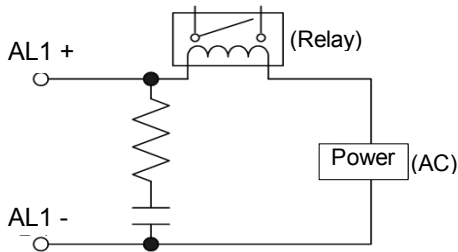
[Details of custom power/alarm output cable] O-tip terminal 0.5-3.7



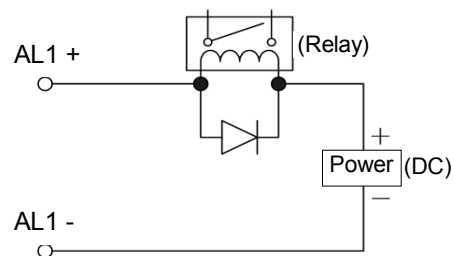
[Example of contact output circuit]

⚠ Use the contact output with a protection device (e.g. fuse) for preventing malfunction.

[Alarm 1, w/ AC current]

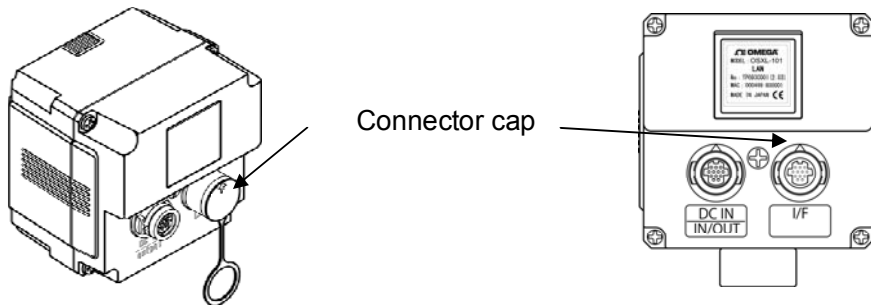


[Alarm 1, w/ DC current]



Output capacity (Per 1 contact)	Max. output load voltage	125V (Peak AC)
	Max. continuous load current	60mA (Peak AC)
	Peak load current	240mA (100ms/1 shot)
	Max. output loss	180mW

- If the custom Network cable is not used (When using the thermal image sensor stand alone) Cover the supplied connector cap to the connector marked with [LAN] back of this product.



⚠ If you don't cover the connector with the cap, the waterproofing performance cannot be satisfied. (It may cause water immersion.)

Installation

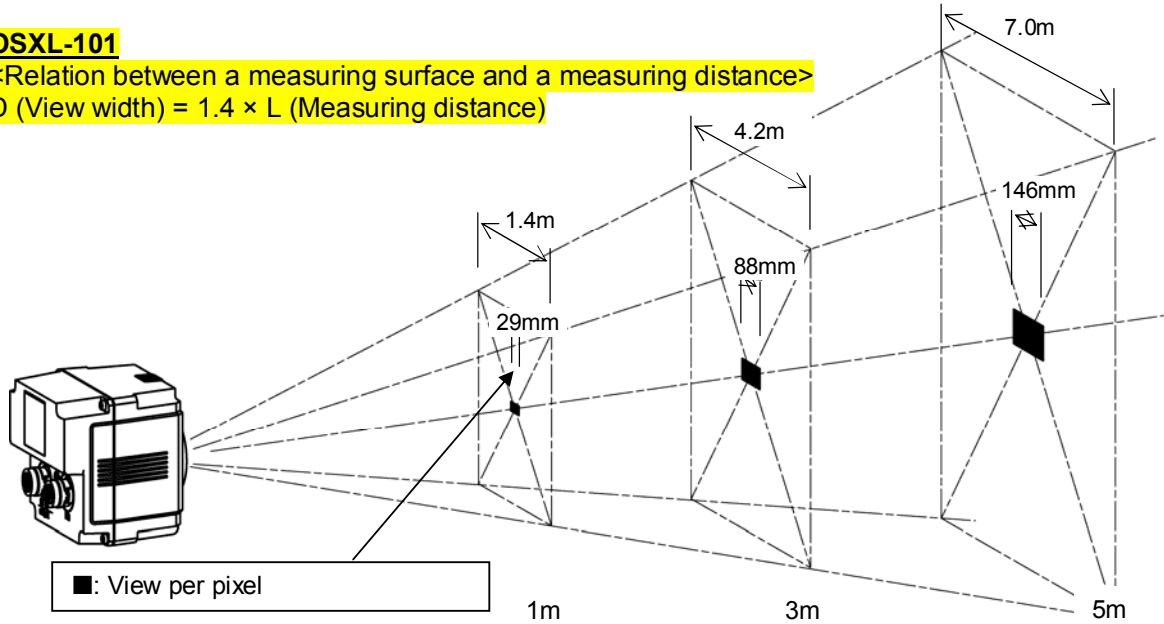
By referring the figure below, install the thermal image sensor at the measuring distance that a measuring object can be imaged at the center of screen as large as possible.



Do not install the sensor where subjected to vibration/shock or inductive ambient.

OSXL-101

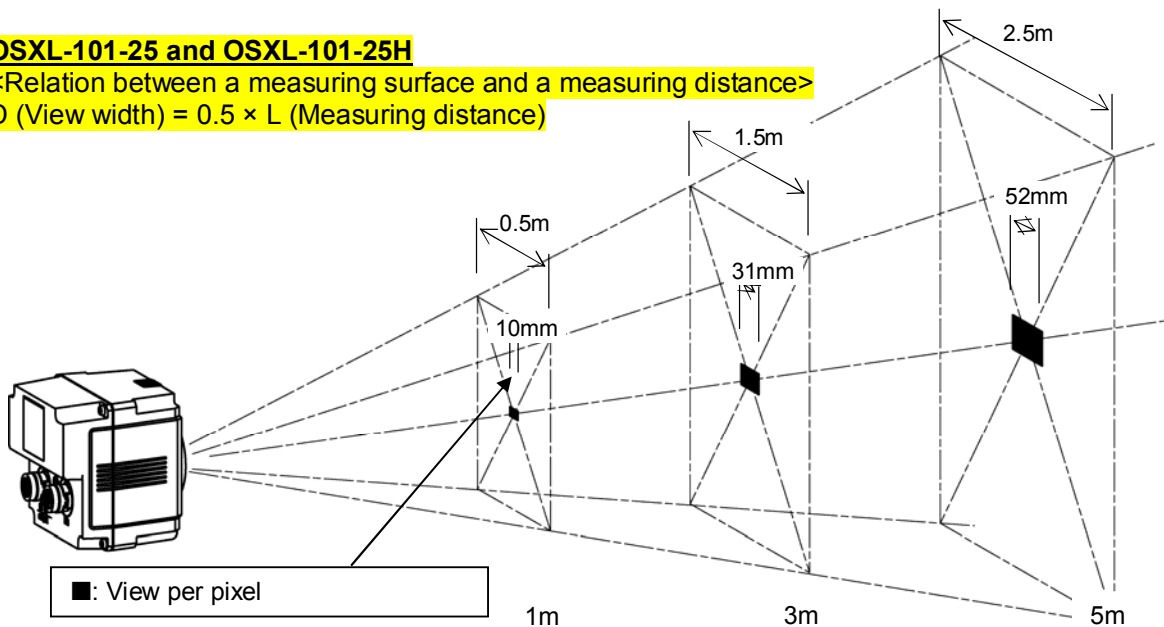
<Relation between a measuring surface and a measuring distance>
 D (View width) = $1.4 \times L$ (Measuring distance)



For accurate measurements, 8 x 8 pixels or more for a target is recommended.

OSXL-101-25 and OSXL-101-25H

<Relation between a measuring surface and a measuring distance>
 D (View width) = $0.5 \times L$ (Measuring distance)



For accurate measurements, 5 x 5 pixels or more for a target is recommended.

■ Operation

- Install the supplied application software to your personal computer.
(For the details, refer to the instruction manual for the application software.)
- For more accurate measurements, wait 30 minutes after power-on until this product is stabilized.
- Use this product with noiseless and stable power source.


■ Monitor lamp

The state of product is indicated by 3 colors on the LED indicator; blue, purple and red.

Item		Color	Specification
Mode is not set (Factory Default)		Blue	Lit once for 3 seconds
Alarm values are not set		Blue	Lit once for 3 seconds
Alarm being monitored		Blue	Lit continuously
Set to Captured Mode		Purple	Lit continuously
Reboot is required after all settings have completed		Purple	Lit for 3 seconds twice
Alarm is activated		Red	Lit continuously
Abnormal State	Abnormal internal memory	Red	Lit once for 3 seconds * Refer to Page 14 Troubleshooting.
	Abnormal internal temperature	Red	Lit once for 3 seconds * Refer to Page 14 Troubleshooting.

■ Operation mode

1. Monitor mode: When OMEGA application software is used
The temperature data is sent continuously to a master unit (e.g. PC) by a command from the software.(The frame rate of the thermal image on the software is 3fps without any Alarm activated.)
The alarm set on the sensor can provide a non-voltage contact output while sending the temperature data.(The frame rate goes down to 1fps or less with the alarm set on the sensor.)
2. Capture mode: Without OMEGA application software
The temperature data in a single row of the thermopile array can be obtained at a time by a command from a master unit.

 When Capture mode is used, a series of communication commands are required.
For the communication commands, contact to your nearest distributor.

Alarm output

1. Specifications

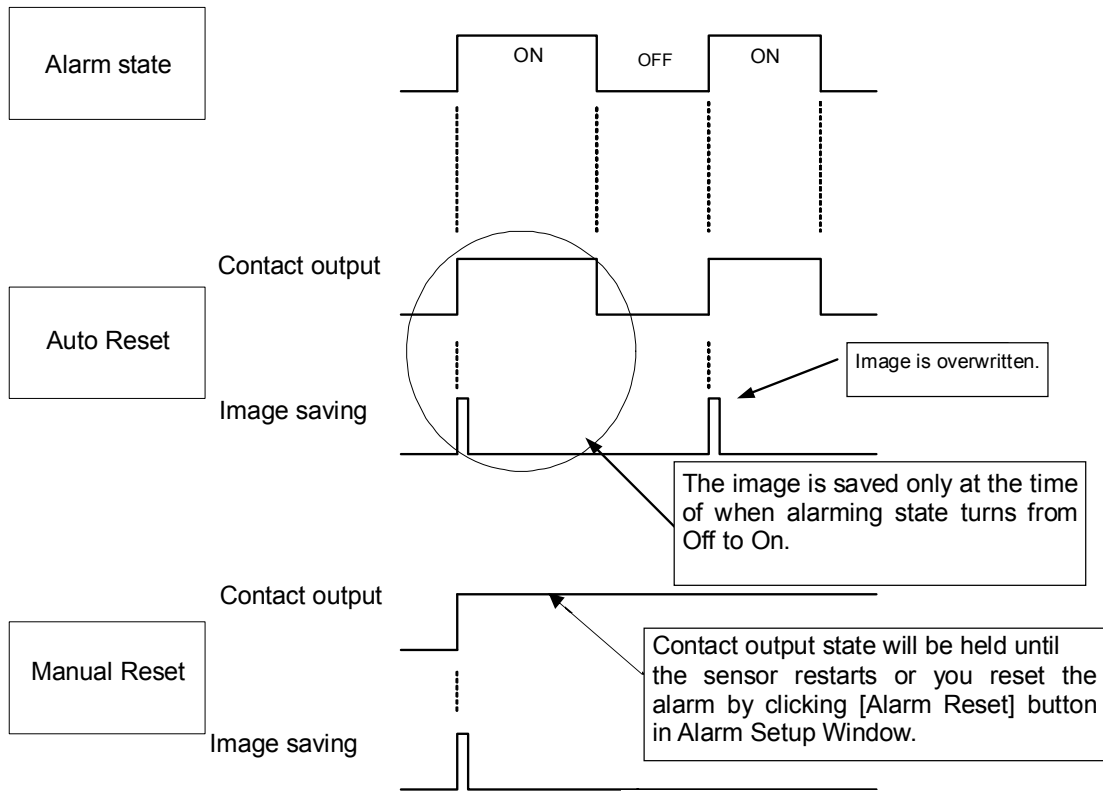
Item	Specification
Alarm area	1 area
Alarm set value	2 values in a specified area
Setting resolution	1 degree (°C/°F)
Alarm activation condition	When consecutive 4 frames have satisfied the alarm condition
Alarm reset condition	When the measured temperature returns from the alarm set value in 4 images continuously
Output Control	Auto Alarm Reset/Manual Alarm Reset
Resetting condition of alarm output manual reset	<ul style="list-style-type: none"> • Rebooting of the thermal image sensor • Command from a PC
Alarm Output	Non-voltage contact output
Number of outputs	2 points [Alarm name: AL1 (alarm 1), AL2 (alarm 2)]
Output logic	Output logic selectable (N.O/N.C)
Alarm condition	Selectable (high-limit, low-limit)
Alarm condition when power is off	Opened

2. Image storage

The image data can be stored when alarm is activated.

Item	Content
Number of storage	1 image An image can be stored by AL1 or AL2 (to be specified).
Storage medium	Built-in EEPROM
Storage data	Temperature data (without time stamp)
Storage timing	Every time when the alarm is activated/when the first alarm is activated only Selectable by a PC (Refer to Page 10.)
Reading of stored data	Can be retrieved from a PC
Erasing of stored data	Automatic erasing or erasing by a command with the alarm setting from a PC

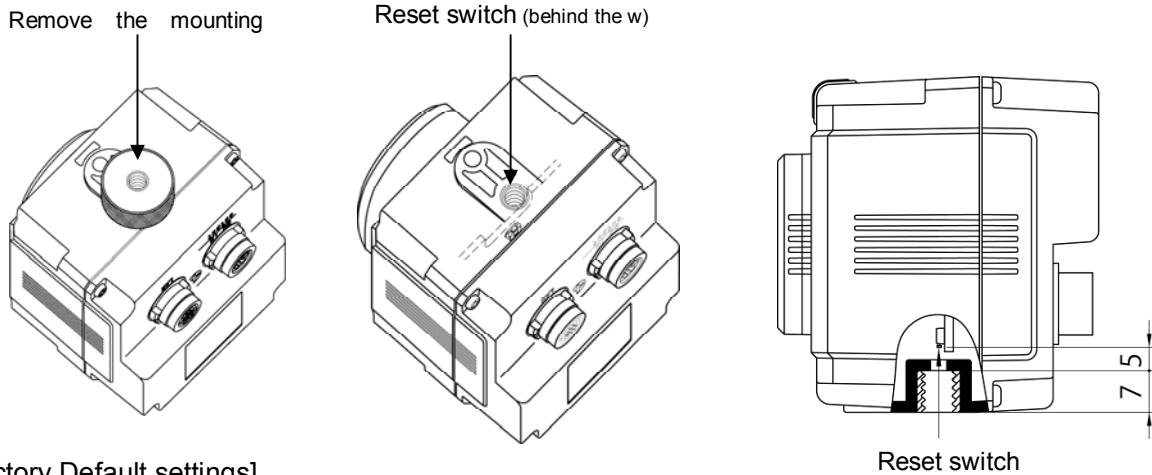
- Alarm output and storing image



■ About reset switch

In case of an error, etc. at the LAN environment settings, the set values can be reset to the default values as shipped from factory by removing the mounting screw and then pushing the reset switch.

! Turn the power on while pushing the reset switch for 1 second continuously. Resetting to the default values becomes effective (The violet monitor lamp flashes 2 times.) By re-power-on, the set values are reset to the default values at the shipment from factory. Usually do not push the reset switch.



[Factory Default settings]

Items	Specifications
IP address	192.168.1.254
Subnet mask	255.255.255.0
Gateway address	0.0.0.0 (Invalidation)
Sensor number	1
UDP port address	50828 (fixed) *1
Emissivity	1.00 (all pixels)
Alarm setting	Alarm invalid

! *1 If you use UDP port on your PC and the UDP port address that you are using is overlapping with this address, change the UDP address that you are using.

[MEMO]

■ Specifications

	Items	Specifications	
Thermal image specifications		OSXL-101	OSXL-101-25, OSXL-101-25H
	Detecting element	Thermopile array with 48 x 47 pixels	
	Measurement wavelength	Center wavelength 10μm	
	Measurement view angle	60° x 60°	25° x 25°
	Temperature measurement range	-20°C to 300°C	-20°C to 300°C (OSXL-101-25) 100°C to 800°C (OSXL-101-25H)
	Temperature resolution	0.5°C (at 100°C black body)	
	Accuracy ratings (Ambient temperature 25 ± 2°C)	±2% of measured value or ±3°C, whichever is greater	±1% of measured value or ±3°C, whichever is greater
	Focus	Fixed focus	
	Flame rate	3fps (1fps or slower if alarm function is enabled)	
	Emissivity correction	0.10 ~ 1.00 (0.01 increment)	
	Radius resolution	21.8mrad	9.1mrad
	Reproducibility	0.3°C in the measurement range	
	General specifications	Working temperature range	-10°C to 50°C
Working humidity range		10 to 80%RH (no dew condensation)	
Storage temperature range		-20°C to 60°C	
Housing		IP65 (with custom cable connection or connector cap, and mounting screw mounted)	
External dimensions		W62 x H62 x D59	W62 x H62 x D69.7
Weight (sensor unit)		About 150g	About 160g
Material		Polycarbonate Resin Color: Black	
Conforming standard		Influence within 2% of measurement range under the environment of CE (EN61326-1/Class B)	Influence within 3% of measurement range under the environment of CE (EN61326-1/Class B)
mounting screw size		1/4-20UNC	
Power specifications	Power supply	12 to 24VDC (Min. 9 to Max. 30VDC)	
	Current consumption *1	Max. 2.5VA at 12VDC	
	Inrush current *1	Max. 1A at 12VDC (When power supply S8VM-01512 made in Omron is used)	
	Connection	Custom-connector connection	
	Connector name	[DC IN/IN/OUT]	



*1 The inrush current should be considered for the selection of power source.

Items		Specifications		
Contact output specifications		OSXL-101	OSXL-101-25, OSXL-101-25H	
	Number of contact output	2 Outputs		
	Kind of contact	No-voltage contact output		
	Cable terminal names	AL1, AL2		
	Contact Rating (per contact)	Max. output load voltage	125V (Peak AC)	
		Max. continuous load current	60mA (Peak AC)	
		Peak load current	240mA (100ms/1 shot)	
		Max. output loss	180mW	
Connection	Custom-connector connection			
Connector name	[DC IN/IN/OUT]			
Ethernet specifications	Interface standard	10BASE-T/100BASE-TX		
	Data/Protocol	Data communication by UDP [Measured temperature data → To a master unit (PC, etc.) Setting data ← From a master unit (PC, etc.)]		
	Setting data	IP address/alarm setting information, etc.		
	DHCP	Not supported		
	Thermal image sensor IP address	192.168.1.254 (default at shipment)		
	Thermal image sensor subnet mask	255.255.255.0		
	Default gateway	0 or FFFF (Not set)		
	Connection	Custom-connector connection		
	Connector name	[I/F]		

■ Accessory (sold separately)

- NEMA 4 stainless steel industrial enclosure: OSXL-100-PE
- Replacement LAN Cable: OSXL-100-LAN
- Replacement Power/Alarm Cable: OSXL-100-PAC
- Replacement Mounting Stand: OSXL-100-MOUNT
- Replacement Power Supply: OSXL-100-PS

■ Minimum requirements for the OMEGA application software

Compatible PC: DOS/V computers with PC/AT compatible

- * The LAN port is required.
- * Display resolution: 800 x 600 pixels or more recommended
- * .NET Framework 2.0 or later has been installed and runs correctly.

Compatible OS: Windows 2000 (SP4 or later)/XP/Vista/7

- * Windows XP or later recommended
- * .NET Framework 2.0 or later required
- *64-bit not supported

⚠ Precautions (For maintaining measurement accuracy)

Pay attention to the followings for maintaining the measurement accuracy.

- Vibration and shock
Vibration and shock causes not only a damage to the thermal image sensor in a long term but in stability of the measurement. When vibration is present, anti-vibration/shock absorber may be required between the thermal image sensor and a mounting plate or between the mounting bracket and a mounting plate.
- Inductive condition
The thermal image sensor is designed to be inductivity-resistant. However, it is recommended to keep the sensor from induction heaters or power lines as much as possible.
- IR energy path between measuring targets and the sensor
Avoid places where water drops, dusts, smoke, steam, etc. can be present between the thermal image sensor and a measurement surface. If it is impossible to avoid such places, consider utilizing an air purge system or equivalent system. The optional protective case is recommended.
- Disturbances causing higher temperature indication
Avoid places where high temperature heat source such as sunlight, light/flame of incandescent electric lamps is not reflecting on a measurement surface and the thermal image sensor. If such condition is present, cover the area with an opaque object.

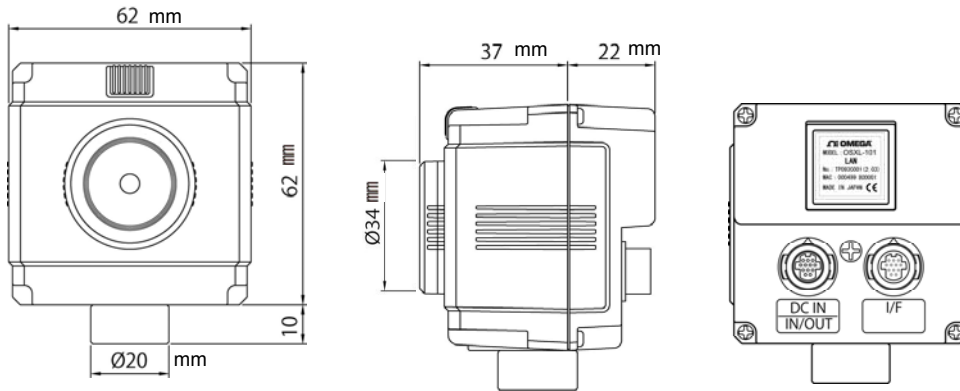
■ Troubleshooting

If you are experiencing difficulties with the sensor or noticing an abnormality on its operation, refer to the followings. If the difficulties or abnormality is still present, contact to your nearest distributor.

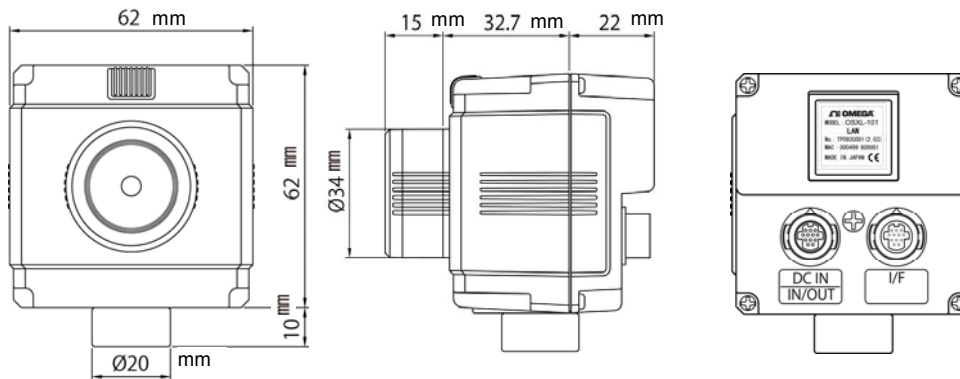
Symptoms	Causes	Measures
Indicator lamp is not lit	The custom power cable is not connected properly.	Connect the custom power cable properly.
	The power for equipment is not turned on.	Turn the power for the equipment.
No Communications	The custom Network cable is not connected correctly.	Connect the custom Network cable properly.
	The application software is not installed.	Install the software. Refer to the instruction manual for the application software.
	The IP address has not been set.	Refer to the instruction manual for the application software.
Image/temperature value abnormally fluctuates.	Strong static electricity, electromagnetic wave or high frequency may be present around the sensor.	Keep this product away from an equipment generating strong static electricity or electromagnetic wave.
Indicator lamp is red	Alarm is activated (Not abnormal)	Automatic reset: Resets automatically. Manual reset: Resets by re-boot or a command from a master unit (PC, etc.).
Indicator lamp flashes red once	Internal memory abnormality	Contact to your nearest distributor.
Indicator lamp flashings red twice	Internal temperature abnormality	Use this product within its operating temperature range. Contact to your nearest distributor.

External dimensions

1. Thermal image sensor (OSXL-101)

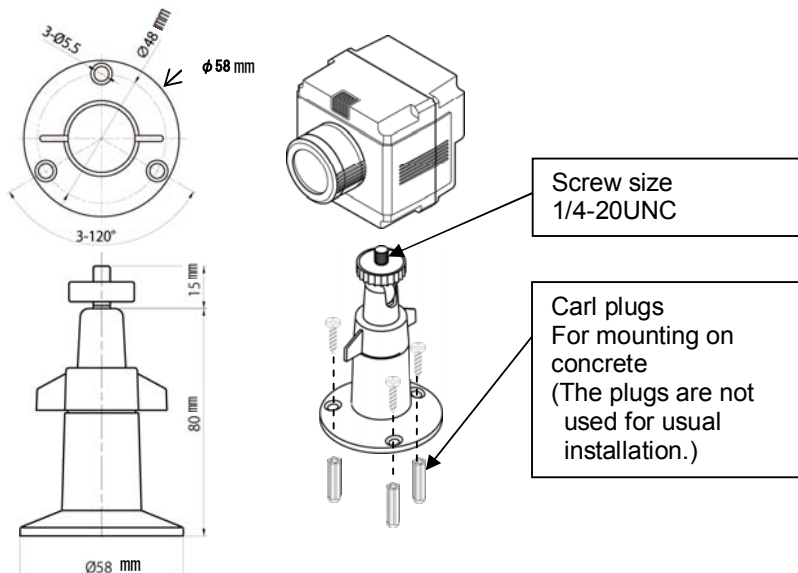


1. Thermal image sensor (OSXL-101-25, OSXL-101-25H)



2. Universal head

When the thermal image sensor is installed with the universal head, mount the mounting bracket with 3 pieces of screws through the 3 holes on the bracket. If the universal head needs to be mounted on concrete surface, drill holes with 6.5mm ϕ and 25mm depth on the concrete and push the Carl plugs into the holes, and then mount the universal head.



WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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