



Operating instructions

3D camera

GB

O3D301

O3D303

O3D305

O3D311

O3D313

O3D353

O3D355

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1 Preliminary note

You will find instructions, technical data, approvals and further information using the QR code on the unit / packaging or at documentation.ifm.com.

1.1 Symbols used

- ✓ Requirement
- Instructions
- ▷ Reaction, result
- [...] Designation of keys, buttons or indications
- Cross-reference
-  Important note
Non-compliance may result in malfunction or interference.
-  Information
Supplementary note

1.2 Warnings

Warnings indicate the possibility of personal injury and damage to property. This enables safe product handling. Warnings are graded as follows:



WARNING

Warning of serious personal injury

- ▷ If the warning is not observed, fatal and serious injuries are possible.



CAUTION

Warning of minor to moderate personal injury

- ▷ If the warning is not observed, minor to moderate injuries are possible.

ATTENTION

Warning of damage to property

- ▷ If the warning is not observed, damage to property is possible.

1.3 Open source information



For more open source information see: documentation.ifm.com.

2 Safety instructions

- The unit described is a subcomponent for integration into a system.
 - The system architect is responsible for the safety of the system.
 - The system architect undertakes to perform a risk assessment and to create documentation in accordance with legal and normative requirements to be provided to the operator and user of the system. This documentation must contain all necessary information and safety instructions for the operator, the user and, if applicable, for any service personnel authorised by the architect of the system.
- Read this document before setting up the product and keep it during the entire service life.
- The product must be suitable for the corresponding applications and environmental conditions without any restrictions.
- Only use the product for its intended purpose (→ Intended use).
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property may occur.
- The manufacturer assumes no liability or warranty for any consequences caused by tampering with the product or incorrect use by the operator.
- Installation, electrical connection, set-up, operation and maintenance of the product must be carried out by qualified personnel authorised by the machine operator.
- Protect units and cables against damage.
- Store the product in its original packaging.

2.1 Safety symbols on the device

The following symbols are used on the device. Observe the instructions in order to avoid hazards:

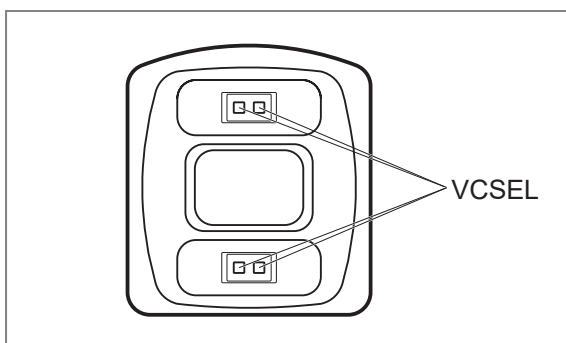


- Electric supply must correspond to IEC 61010-1, chapter 9.4 - Limited-energy circuits (→ [Electrical connection](#) □ 13).
- [Laser safety \(devices with VCSEL lighting\)](#) (→ □ 4)



- Device of protection class III. Only for operation in PELV circuits.

2.2 Laser safety (devices with VCSEL lighting)



Information on the lighting units of the device → Technical data at ifm.com.

Fig. 1: Device with 4 VCSEL lighting units

The device emits invisible laser radiation ($\lambda=850 \text{ nm} \pm 10 \text{ nm}$) of laser class 1 according to

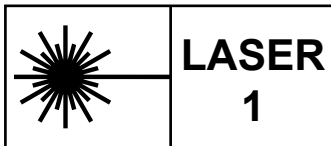
- IEC 60825-1:2014 and
 - EN 60825-1:2014 + AC:2017 + A11:2021 + A11:2021/AC:2022.
- Do not look directly into the switched-on light source. Glare or irritation can also occur in laser class 1.

- Ideally, install the device in such a way that no direct eye exposure to the light source is possible.

**WARNING**

If the device has been opened or damaged, laser safety is no longer guaranteed.

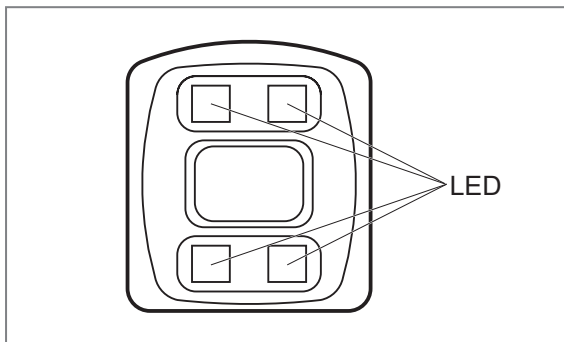
- ▷ Skin or eye damage may occur.
- The device may only be opened by the manufacturer.
- If the device is damaged, stop using it and disconnect it from the power supply.



Marking on the device:
CLASS 1 LASER PRODUCT
IEC 60825-1:2014
21 CFR 1040.10

USA

Complies with 21 CFR 1040.10 except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

2.3 Photobiological safety (devices with LED lighting)

Information on the lighting units of the device → Technical data at ifm.com.

Fig. 2: Device with 4 LED lighting units

The illumination LEDs emit invisible infrared light with a wavelength of 850 nm. The device complies with the Exempt Group according to EN 62471:2008.

- Do not look directly into the switched-on light source. Glare or irritation can also occur in Risk Group 0 (Exempt Group).
- Ideally, install the device in such a way that no direct eye exposure to the light source is possible.

2.4 Cyber security**ATTENTION**

Unprotected network environment.

The device does not include IT security measures according to IEC 62443.

- ▷ Unauthorised read or write access to data is possible.
- ▷ Unauthorised manipulation of the device function is possible.
- Check and restrict access options to the device.

3 Intended use

The device creates 3D images to detect the distance of objects.

The 3D distance data can be output via Ethernet and evaluated by the user.

3.1 Operating conditions

The device may only be used under the operating conditions specified in the data sheet.

The device safety is rated for use under the following operating conditions:

- Indoor use
- Altitudes up to 4000 m
- Relative air humidity up to max. 90 %, non condensing
- Pollution degree 3



Electromagnetic compatibility (EMC):

The unit is designed for use in industrial environments.

This product may cause radio interference in domestic areas.

- If required, take appropriate EMC screening measures.

4 Items supplied

- O3D3xx camera
 - 2 protective caps for electrical connections
 - Only for the aluminium devices O3D30x and O3D35x: spring washers for the installation
 - Only for O3D3x1: screwdriver for focus setting
-  Operating instructions, programming manual, software manual and software (firmware of the device and ifm Vision Assistant) available at documentation.ifm.com.
-  Information about available accessories at www.ifm.com

5 Function

The device is an optical 3D camera which measures the distance between the camera and the nearest surface point by point using the time-of-flight principle.

The device illuminates the scene with an infrared light source and calculates the distance by means of the light reflected from the surface.

The device supplies data which describes the captured scene three-dimensionally.

The device outputs the image data via an Ethernet interface.

Parameter setting of the device is also done via Ethernet.

2 switching outputs are provided to control external devices.

6 Installation

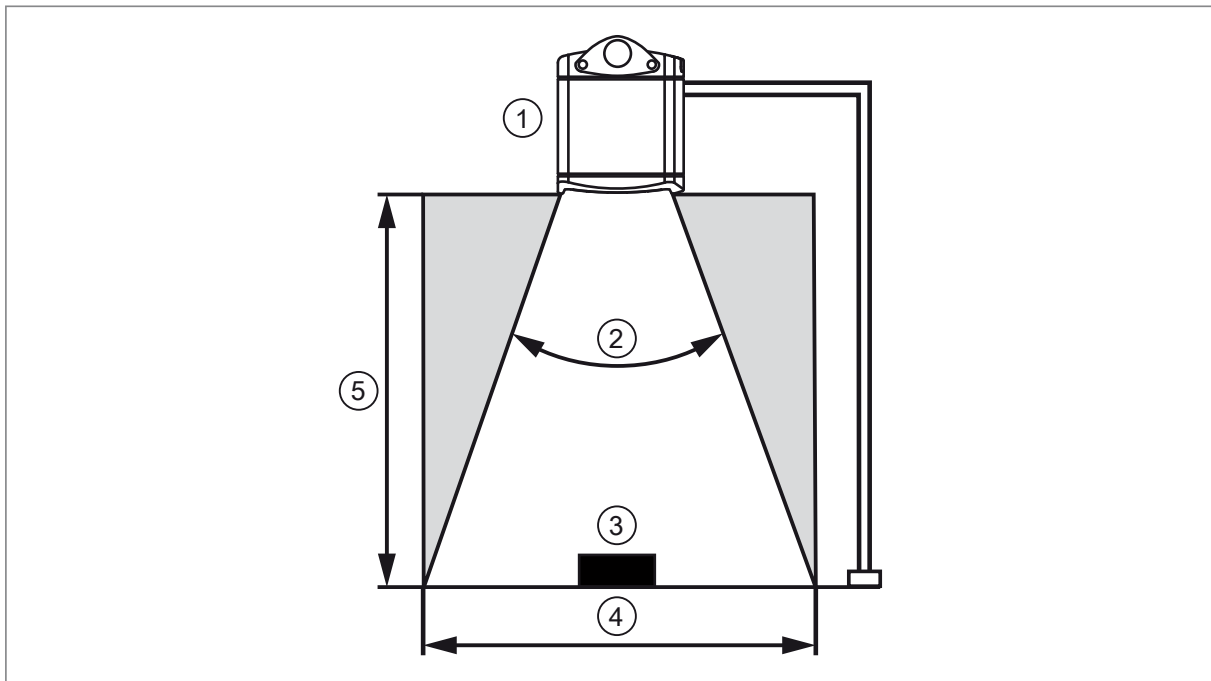


Fig. 3: Recommended installation structure

- 1: O3D3xx device
- 2: Angle of aperture
- 3: Object
- 4: Field of view
- 5: Distance between device and object

6.1 Installation location

- ▶ Install the device so that the object is completely in the field of view.
 - The size of the field of view depends on the device type → Technical data at ifm.com.
 - The size of the field of view also depends on the distance of the device to the object: With increasing distance the field of view becomes larger.
- ▶ Take tolerances into account when positioning the object.
- ▶ When determining the distance between device and object take the measuring range of the device into account (→ Technical data at ifm.com).
- ▶ Keep the distance between device and object as small as possible to increase the resolution.
- ▶ Avoid any strong ambient light and sunlight at the installation location.
An extraneous light level of over 8 klx (with solar spectrum) causes measurement errors. In fact, only the infrared component between 800 and 900 nm is of concern.
- ▶ Avoid installation in heavily polluted areas as the lens will become soiled even when orientated downwards.
- ▶ Avoid transparent panes between the device and the object, as even very clean glass panes reflect part of the light.



Measurement errors may occur if the instructions are not observed.

6.2 Installing the device

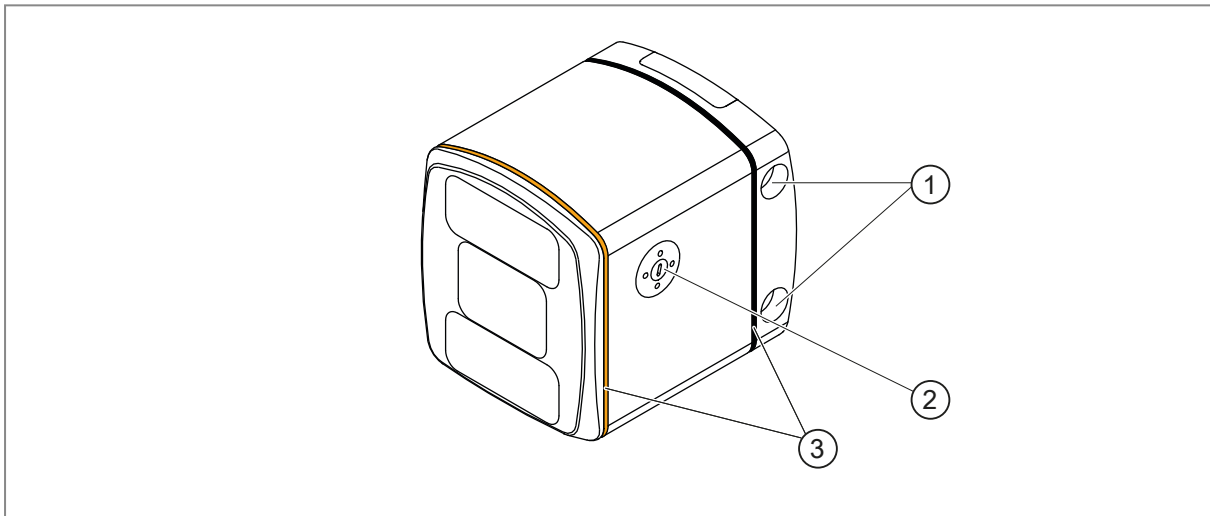


Fig. 4: Installation

- 1: Drill holes for installation
- 2: Focus adjustment screw (only for device type O3D3x0)
- 3: Seals on the device

ATTENTION

Mechanical overload of the seals on the device

- ▷ The IP protection rating specified in the data sheet cannot be guaranteed.
- ▶ Do not apply force to the seals of the device.
- ▶ Provide for a recess in the fixture (for example a groove).
- ▶ Use spacers.

- ▶ Install the device via the drill holes with two M5 screws or using a mounting set.
- Hole dimensions for the M5 screws → Technical data sheet at ifm.com.
- Information about available mounting accessories at ifm.com.
- ▶ Mount the device with focus adjustment screw so that the screw is freely accessible with a screw driver.
- ▶ Use strain reliefs for all cables connected to the device.

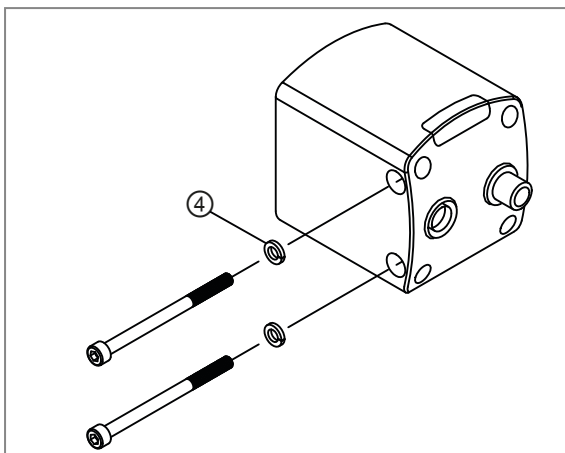


Fig. 5: Installation with spring washers

- ▶ Install the devices with aluminium housing (O3D30x and O3D35x) with the enclosed spring washers.
Maximum tightening torque: 3 Nm.

6.3 Surface temperature

ATTENTION

High surface temperature of the device

- ▷ The device can heat up depending on the operating mode, the set parameters and the heat dissipation to the environment.
The difference between the device's surface temperature and the ambient temperature must not exceed 25 degrees (according to IEC61010-2-201).
- ▶ Use the parameter setting software to adjust the operating mode and parameters.
- ▶ Reduce the surface temperature with heat-dissipating measures.
- ▶ Use a contact protection for the device.

The surface temperature of the device depends on the type of installation and the parameter settings for [maximum background distance], [exposure time] and [frame rate] in the ifm Vision Assistant software.

The typical warning thresholds for the individual parameter settings are shown in the following diagrams (→ [Warning thresholds](#) □ 11).

If the warning threshold is exceeded during normal installation:

- ▶ Take heat-dissipating measures (→ [Heat-dissipating installation](#) □ 12).

If the warning threshold is exceeded despite heat-dissipating installation:

- ▶ Install a contact protection without restricting the convection (air circulation).

6.3.1 Warning thresholds

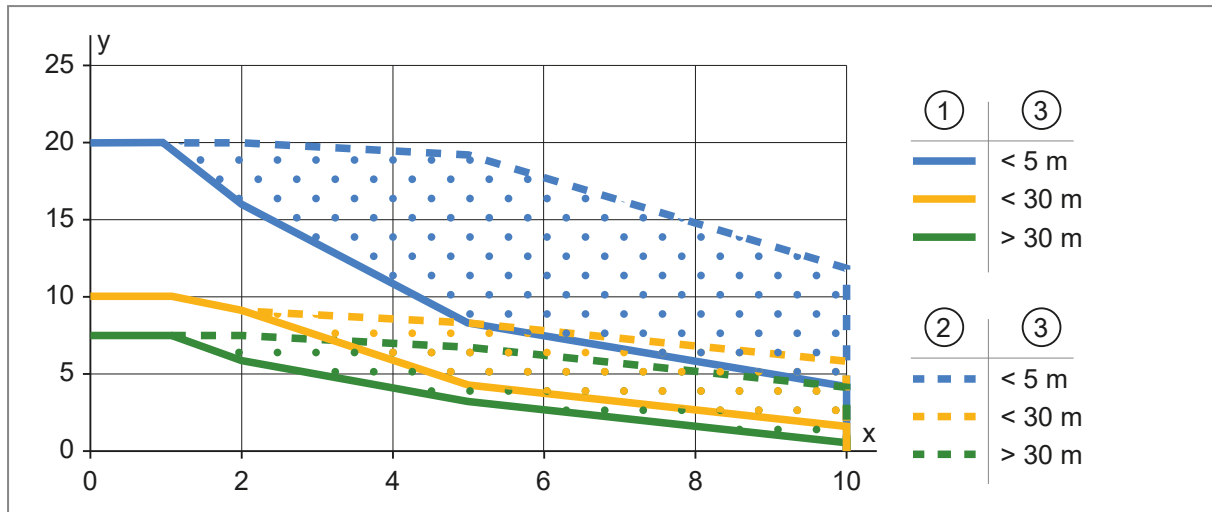


The diagrams are valid for the following operating modes: one exposure time, moderate exposures, high exposures.

In the event of moderate and high exposures the typical warning thresholds must be determined via the sum of the exposure times. The exposure times are indicated in the ifm Vision Assistant software.



Information on the lighting units of the device → Technical data at ifm.com.

Warning thresholds for devices with aluminium housing:

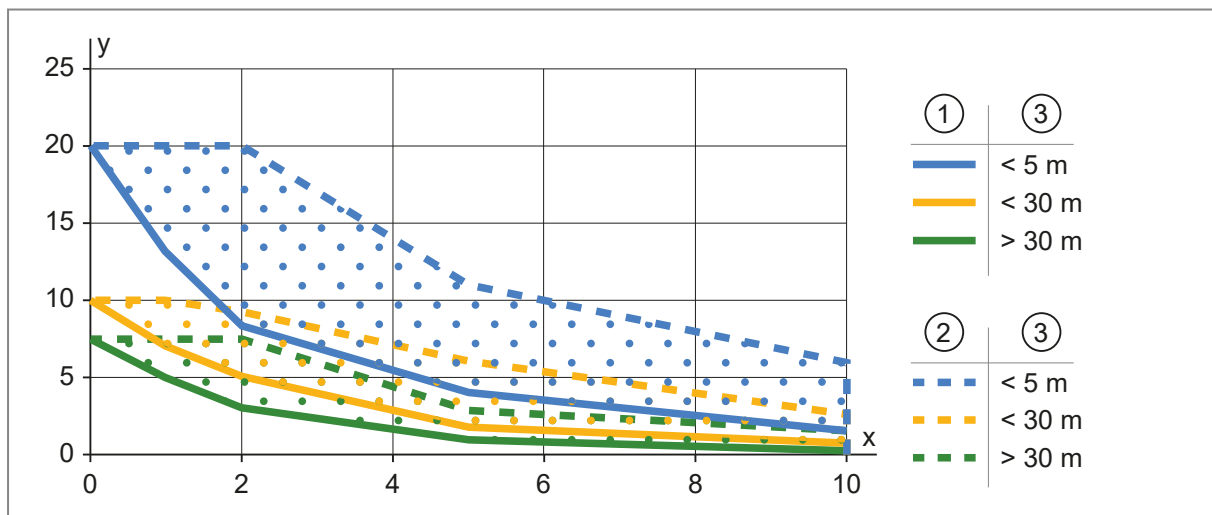
x: Exposure time in ms

y: Frame rate in fps

① Warning threshold for normal installation

② Warning threshold for heat-dissipating installation

③ [Maximum background distance]

Warning thresholds for devices with stainless steel housing:

x: Exposure time in ms

y: Frame rate in fps

① Warning threshold for normal installation

② Warning threshold for heat-dissipating installation

③ [Maximum background distance]

6.3.2 Heat-dissipating installation

With the following measures the surface temperature can be reduced:

- Install the device on heat-conductive metal parts (e.g. aluminium) with large-surface contact.
- When mounting on metal parts, use a heat conductor → Accessories at ifm.com.
- Reduce structures around the device and the density of objects to increase convection (air movement).
- Install one or two heat sinks on the device → Accessories at ifm.com.
- Reduce the settings in the ifm Vision Assistant for the following parameters: [Exposure time], [Frame rate], [Maximum background distance].

7 Electrical connection

The device must be connected by a qualified electrician.

► Disconnect power before connecting the device.



Protection class III device (IEC 61010-2-201 chap. 6.5.2.101.4).

The electrical supply must

- be provided only by PELV circuits (IEC 61010-2-201 chap. 3.111),
- not exceed 35 V DC during operation,
- not exceed 60 V DC in the event of a single fault and
- not exceed the permitted operating voltage of the device (see data sheet).

The separation of external circuits must comply with IEC 61010-2-201, Figure 102.



WARNING

Unsuitable power supply

- ▷ Electric shock may cause serious injury or death.
- Use a PELV power supply within the specified voltage range.

Use energy-limited circuits for the electrical supply (IEC 61010-1 chap. 9.4). The energy of the circuit can be limited at an operating voltage of 24 V by an overcurrent protection device. The overcurrent protection device must switch off a current of 8.3 A in maximum 120 s. Observe the specific tripping characteristic. Possible overcurrent protection devices:

- fuse or
- non-adjustable and non-self-reclosing electromechanical device.

Separate the circuit from other, non-energy-limited circuits by at least basic insulation.

ATTENTION

No suitable energy limitation of the circuit

- ▷ Fire hazard in case of a malfunction.
- Use energy-limited circuit according to IEC 61010-1 chap. 9.4.



The device may only be connected to internal Ethernet networks that do not leave the building. It must not be connected to TNV circuits.

ATTENTION

Use an additional protection against surge voltages according to IEC 61000-4-5 if the connection cable is longer than 30 m.

ATTENTION

The unit can be damaged by insufficiently tightened M12 connectors.

- ▷ The IP rating indicated in the data sheet is only guaranteed if the M12 connectors are firmly screwed.
- Firmly screw the M12 connectors to the unit.
- Cover the unused sockets with protective caps (E73004). Tightening torque: 0.6...0.8 Nm.
- Use strain reliefs for cables connected to the unit.



If the device is permanently used in wet areas, the nut of the M12 industrial Ethernet connection cable (e.g. E11898) may corrode.

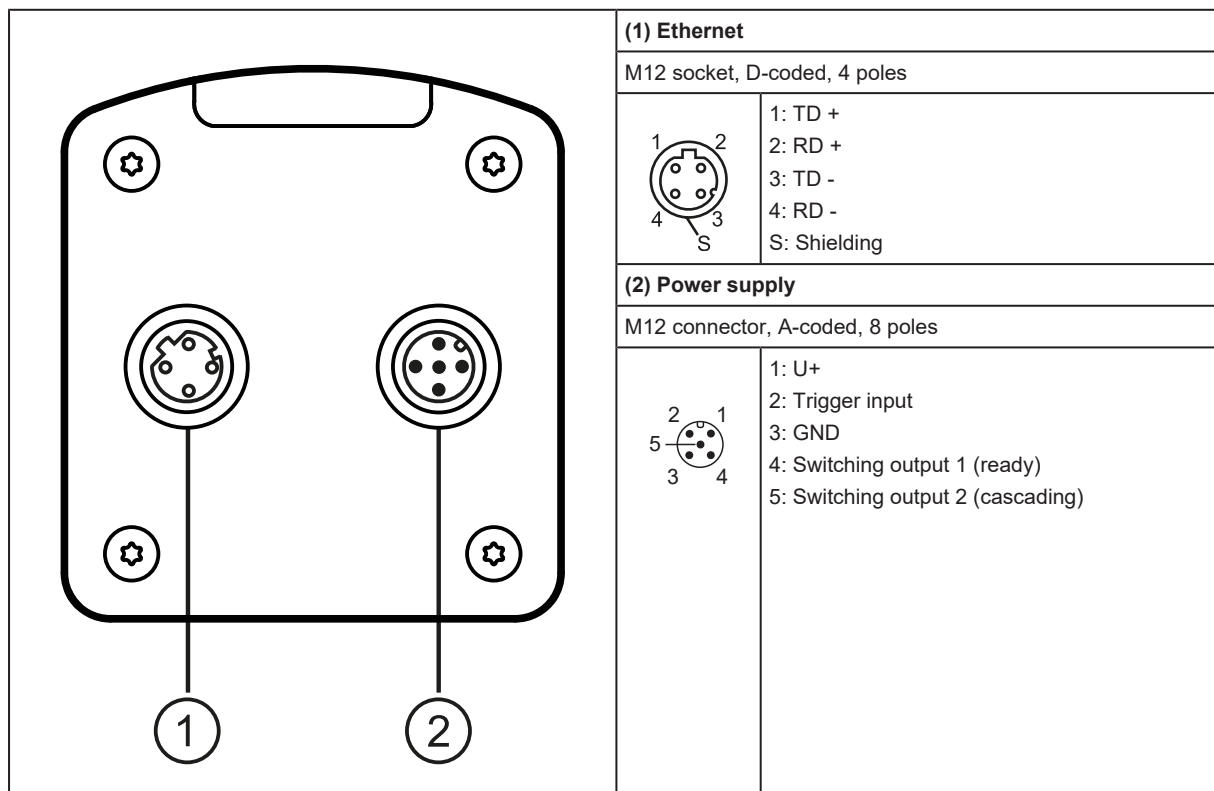
► Use a connection cable with a high-grade stainless steel nut.



For the scope of validity cULus:

Minimum temperature rating of the cable to be connected to the field wiring terminals: 70 °C.

7.1 Wiring



ATTENTION

Moisture penetration

- If the Ethernet connection is not used, moisture can enter the device through the unprotected Ethernet connection.
- Cover the unused Ethernet connection with the protective cap E73004.
- Tighten the protective cap applying 0.6..0.8 Nm.



The behaviour of the switching inputs and outputs can be set with the ifm Vision Assistant software.

The setting PNP or NPN always applies to all switching inputs and outputs. When installing actuators and sensors make sure that the setting is correct (e.g. photoelectric sensors for triggering).

The switching outputs can also be operated as pulse outputs which reset their switching signal after an adjustable time.

7.1.1 Pin 1 / 3 (24 V / GND)

The permissible voltage range is indicated in the data sheet of the sensor.

7.1.2 Pin 2 (trigger input)

The image capture of the device can be triggered with a switching signal via the trigger input.

The following trigger edges can be used:

- falling edge triggers image capture
- rising edge triggers image capture
- falling and rising edges trigger image capture



Further possibilities to trigger the device:

- process interface command (→ 13.2)
- continuous image capture with fixed frame rate.

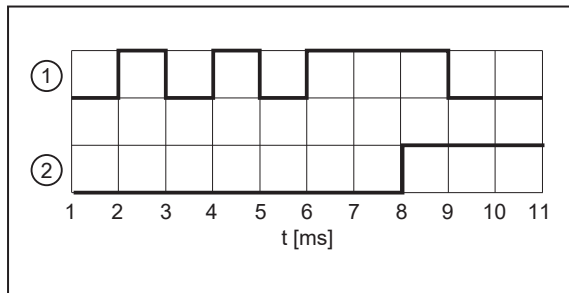


Fig. 6: Internal debouncing

1: trigger input

2: image capture

The trigger input can be debounced internally (preset: internal debouncing deactivated). Internal debouncing prevents several short pulses from triggering. The pulse must be at least 2 ms long to be recognised as a trigger.

Depending on the electrical installation, debouncing is not necessary.



A trigger delay can be set.

7.1.3 Pin 4 / 5 (ready / cascading)

The electrical data of the switching outputs 1 and 2 (ready / cascading) is indicated in the data sheet.

The switching outputs provide the following device status set as default:

- Switching output 1: “Ready for trigger”
- Switching output 2: “Image capture finished”



“Switching output switched” means that the respective device status has occurred.

Depending on the setting the device status can have one of the following values:

- “Ready for trigger”
The device signals that a new image can be captured. Only with this device status are trigger operations processed. For the continuous image capture the status “Ready for trigger” is not output.
- “Image capture finished”
The device signals that the image capture is finished. The device status can be used for cascading devices.
- “Evaluation finished”
The device signals that image processing is finished. At that moment the switching outputs are already updated. The image data is transmitted via Ethernet.
- “Error”
The device signals an internal error. Detailed information about errors can be requested via Ethernet.

7.2 Wiring examples

7.2.1 Trigger image capture with proximity switch

The device can be triggered externally:

- via Ethernet
- via a proximity switch connected to the trigger input

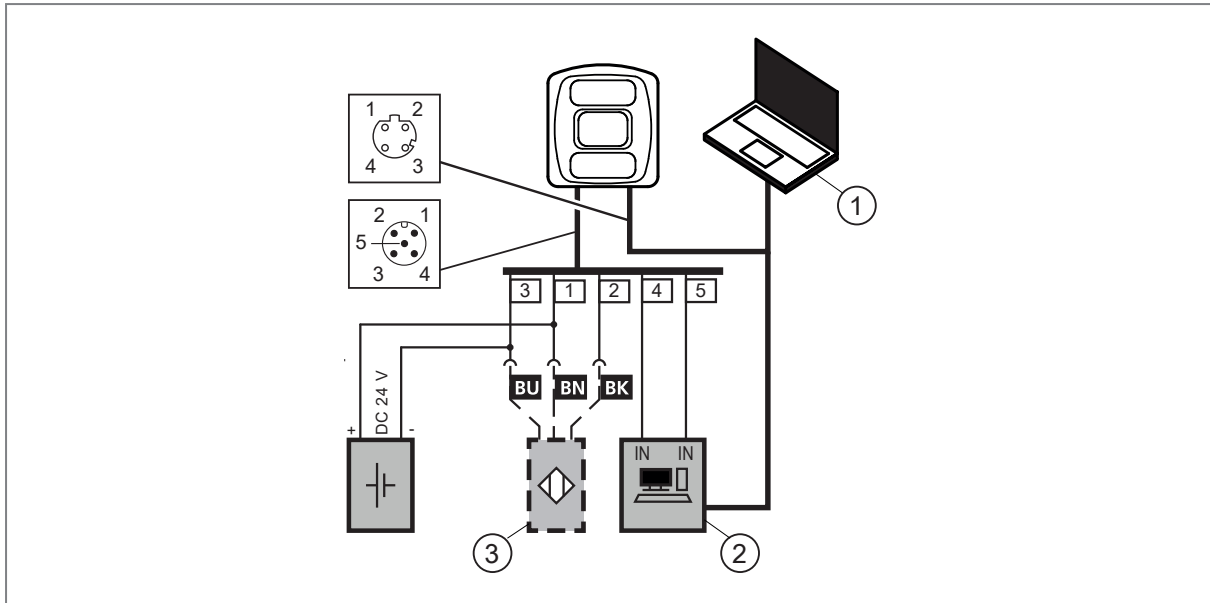


Fig. 7: Wiring of the device with a proximity switch

- 1: Notebook (parameter setting)
 2: Industrial PC (evaluate / trigger)
 3: Proximity switch

7.2.2 Several devices next to each other

Devices installed next to each other can cause measurement errors due to simultaneous exposure.

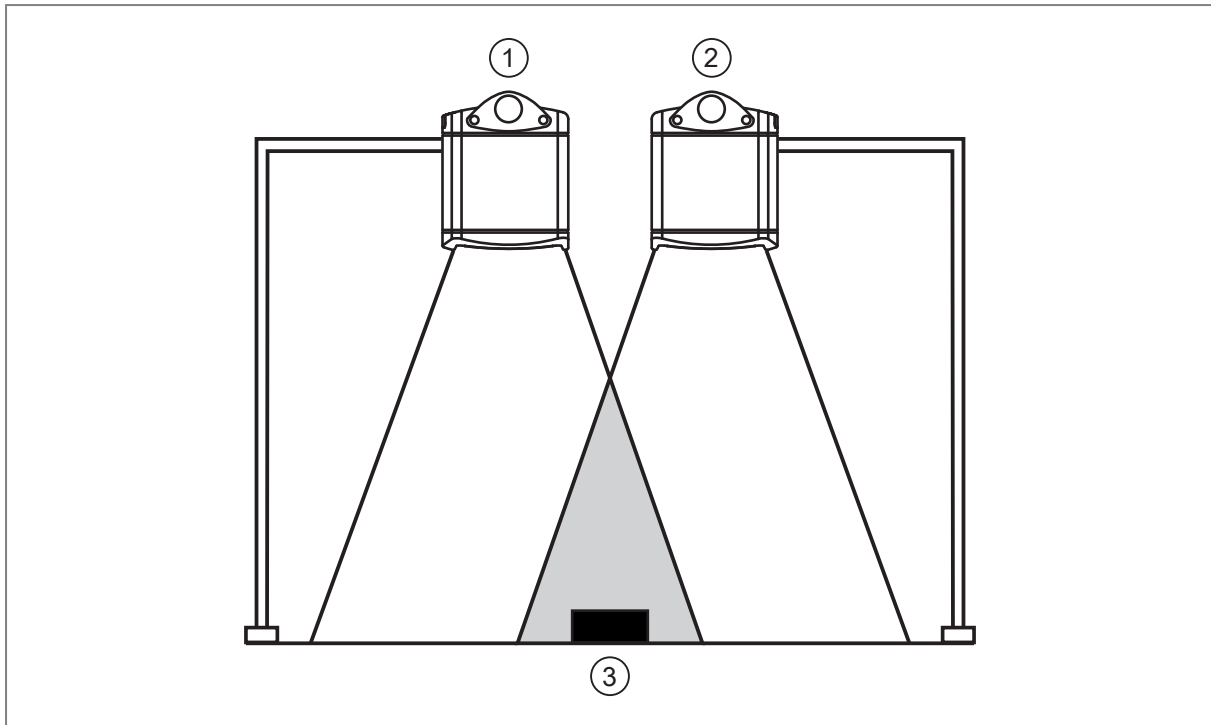


Fig. 8: Overlapping of fields of view

- 1: Device 1
- 2: Device 2
- 3: Object

The resulting measurement errors can be avoided in two ways:

1. Cascade sensors via HW trigger

During cascading a controller triggers the image capture of device 1.

After completion of the image capture, device 1 automatically triggers device 2. At the same time, pin 5 of device 1 provides the device status "Image capture finished". Device 2 signals the end of the sequence to the industrial controller.

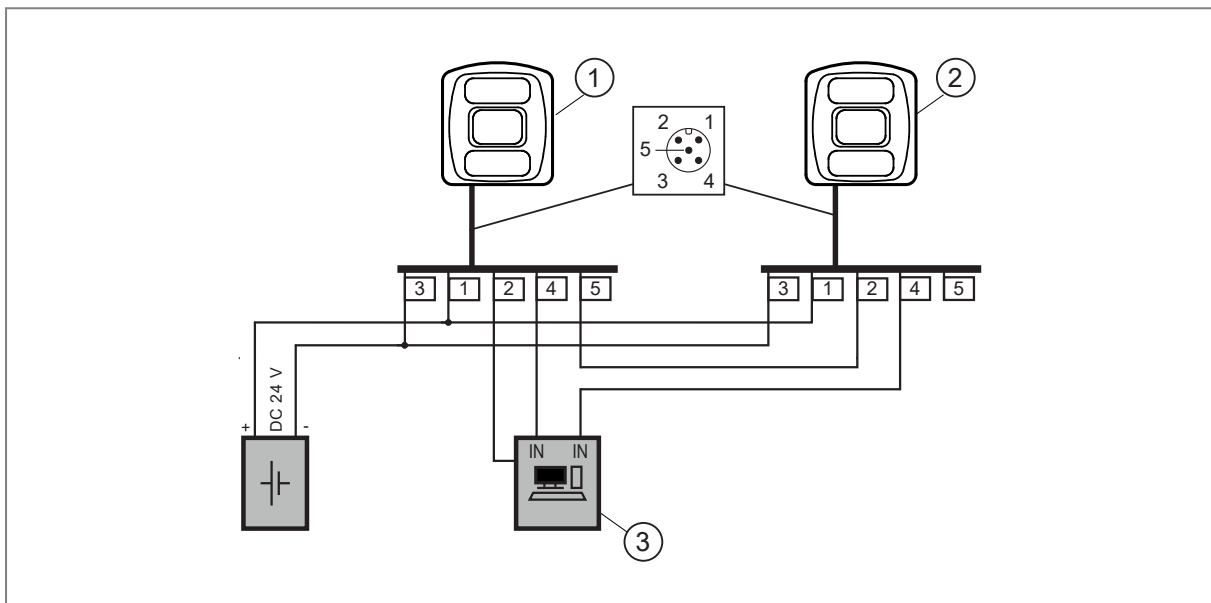


Fig. 9: HW trigger

- 1: Device 1
- 2: Device 2
- 3: Industrial PC (evaluate / trigger)

2. Use different frequency channels

With the ifm Vision Assistant software each device can be assigned its own frequency channel. The different frequency channels reduce the occurrence of measurement errors.

8 Operating and display elements

Via the LED indicators 1 - 4 the device signals the current operating status.

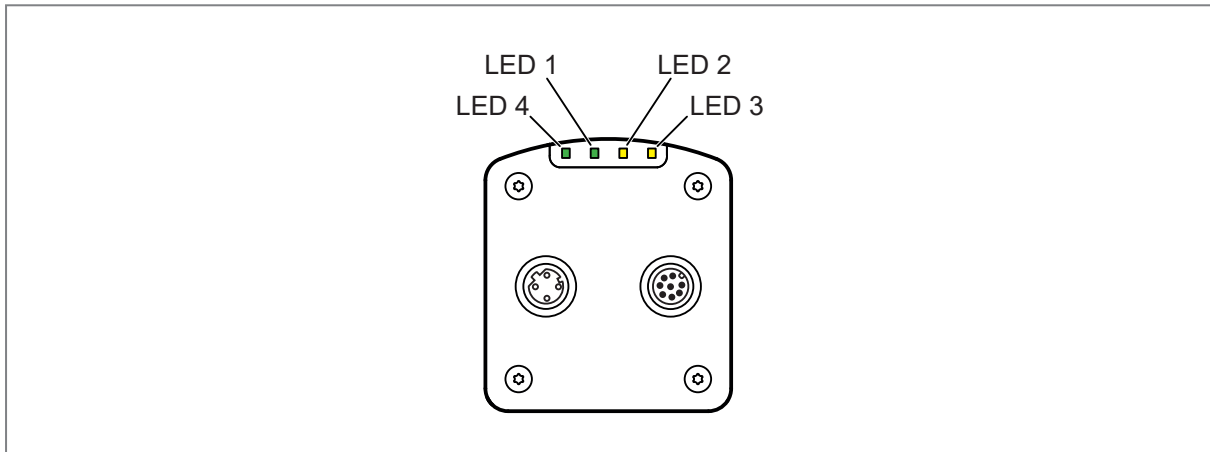
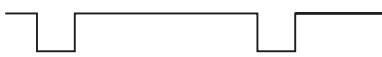
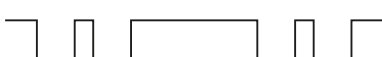


Fig. 10: Indicators of the device

LED 4 (Ethernet)	LED 1 (Power)	LED 2 (OUT 1)	LED 3 (OUT 2)	Description
	On			The device is ready for operation, supply voltage applied
	Flashes at 0.5 Hz			No parameters set or parameter setting was not loaded into the device. On  Off
	Flashes 2x at 0.5 Hz			The device is in the parameter setting mode. On  Off
		On		Switching output 1 switched.
		Flashes at 8 Hz		Switching output 1 shorted
			On	Switching output 2 switched.
			Flashes at 8 Hz	Switching output 2 shorted
On				Ethernet connected.
Flashes				Ethernet transmitting data.
Off				Ethernet not connected.
		Flashes at 8 Hz	Flashes at 8 Hz	The device signals an internal error.
		Flashes at 2 Hz	Flashes at 2 Hz	The device signals a recoverable error. The error information can be read via Ethernet.
	Running light ⇒			Device booting.
	Running light ⇐			The device carries out a firmware update.

9 Set-up

After power on, the device is put into operation. After 15 seconds, the device is in the evaluation mode where saved applications are executed. The indicators signal the current operating status (→ [Operating and display elements](#) 19).

Up to 32 applications can be saved on the device. Typically, an application contains the following parameters:

- Image capture: e.g. triggering of the image capture, exposure time, image processing filter
- Interface: Ethernet, switching outputs

The respective application can be activated with the ifm Vision Assistant software or via process interface commands.

9.1 Set parameters of the device

The parameters of the device can be set in the following ways:

- ifm Vision Assistant software (www.visionassistant.ifm)
- ifm3Dlib (<https://github.com/ifm/ifm3d>)
 - Programming example for ifm3Dlib
- ROS (<https://github.com/ifm/ifm3d-ros>)
- XML-RPC commands



Using the ifm Vision Assistant software and detailed information about the measuring principle of the device are described in the software manual.

The software manual is available on our website: documentation.ifm.com.



The library ifm3Dlib and the wrapper ROS are available for Linux under Apache License Version 2.0.



The XML-RPC commands are described in a separate programming manual: documentation.ifm.com.

9.1.1 Programming example

Preferably use ifm3Dlib for access to the unit under Linux. The library has been tested and is the reference implementation for C++. The Apache-2 licence allows commercial use.

The short C++ example below shows how to address the unit with ifm3Dlib.

```
auto cam = ifm3d::Camera::MakeShared();
auto fg = std::make_shared<ifm3d::FrameGrabber>
    (cam, (ifm3d::IMG_AMP|ifm3d::IMG_RDIS|ifm3d::IMG_CART));
auto img = std::make_shared<ifm3d::ImageBuffer>();
if (! fg->WaitForFrame(img.get(), 1000))
{
    std::cerr << "Timeout waiting for camera!" << std::endl;
    return -1;
}
pcl::io::savePCDFileASCII("point_cloud.pcd", *(img->Cloud()));
imwrite("amplitude.png", img->AmplitudeImage());
imwrite("radial_distance.png", img->DistanceImage());
```

In the example, a data set is retrieved from the unit. The amplitude image and the radial distance from the data set are saved as a PNG file. The Cartesian coordinates are saved as a PCL file.



Detailed examples are available online at: <https://github.com/ifm/ifm3d-examples>

9.2 Detect object

Optimum detection of an object is given if the following conditions are met:

- The object is positioned in the field of view
- The object is the nearest visible object to the sensor
- The zone of influence is clear from objects (obstructions etc.)
- The front pane of the device is free from soiling

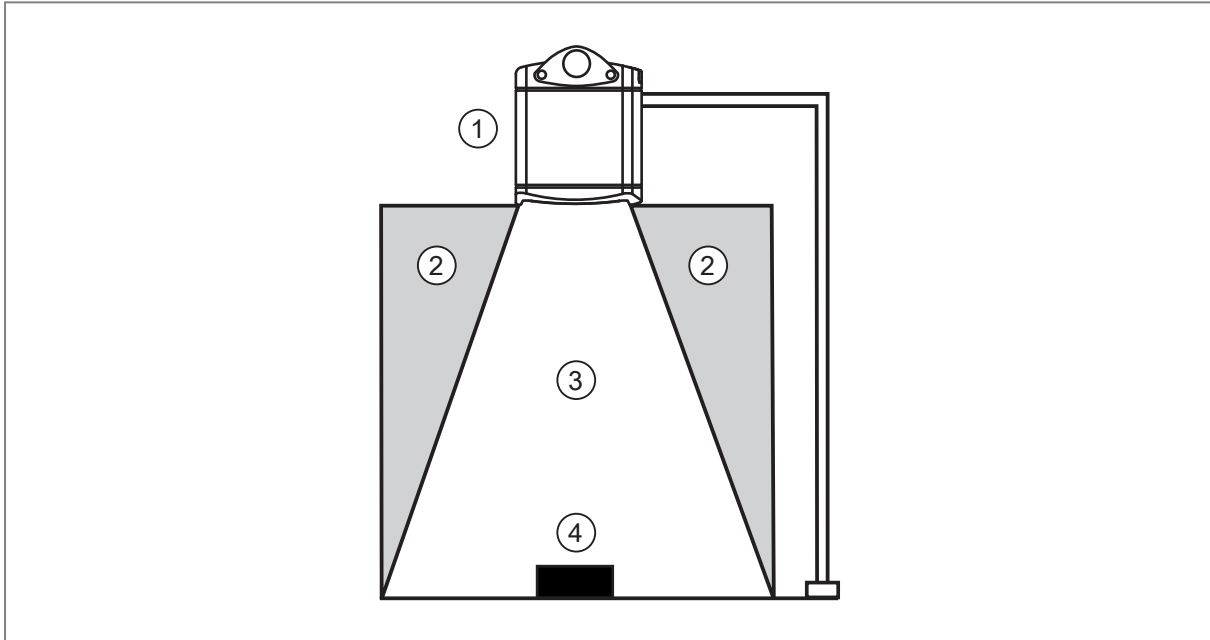


Fig. 11: Detect object

- 1: Device
- 2: Zone of influence
- 3: Field of view
- 4: Object



Measurement errors may occur if the instructions are not observed.

10 Troubleshooting

If the device behaves unexpectedly or incorrectly:

- ▶ Download and install the latest firmware and ifm Vision Assistant versions. Download at documentation.ifm.com.
- ▶ Read the error messages via the process interface.

If the problems persist:

- ▶ Contact the ifm support. Contact at www.ifm.com.

11 Maintenance, repair and disposal

- ▶ Do not open the device.
 - ▷ The device does not contain any components which can be maintained by the user. The device must only be repaired by the manufacturer.
- ▶ After use, dispose of the unit in an environmentally friendly way in accordance with the applicable national regulations.



WARNING

If the device has been opened or damaged, laser safety is no longer guaranteed.

- ▷ Skin or eye damage may occur.
- ▶ The device may only be opened by the manufacturer.
- ▶ If the device is damaged, stop using it and disconnect it from the power supply.

Cleaning the device:

Soiling reduces the contrast and the recognition performance.

- ▶ Keep the front pane free from soiling.
- ▶ Use a clean and lint-free cloth for cleaning.
- ▶ Use glass cleaner as cleaning agent.



If the instructions are not observed, scratches on the front pane may cause measurement errors.

11.1 Update firmware

The firmware of the device can be updated using the ifm Vision Assistant software.



Data loss due to firmware update

- ▷ Some parameters saved in the sensor get lost when the firmware is updated. A backup of the parameters can be created with the ifm Vision Assistant.
 - ▶ Export parameters before updating the firmware.
 - ▶ Import parameters after updating the firmware.

11.2 Replace device



Data loss due to device replacement

- ▷ The parameters stored in the device are lost through the replacement. A backup of the parameters can be created with the ifm Vision Assistant.
 - ▶ Export parameters before updating the firmware.
 - ▶ Import parameters after updating the firmware.



- ▷ Backing up the parameters has an additional benefit: With the backup, several devices can be quickly equipped with identical parameters.