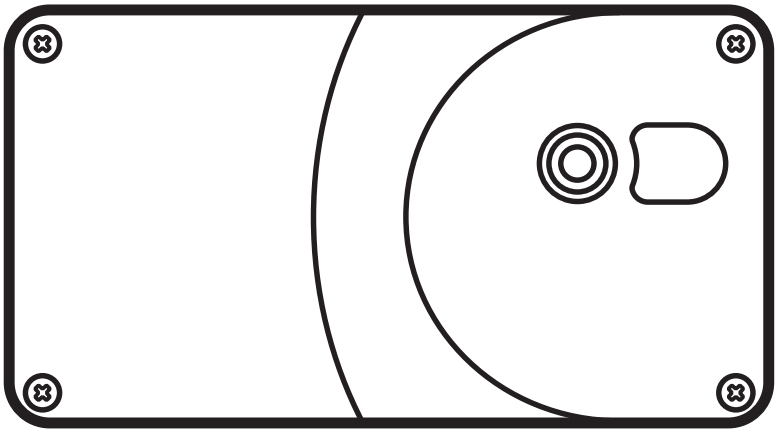
Operating instructions
3D camera
O3X1xx

UK



80268982 / 00 07 / 2017

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This device contains (maybe modified) open source software which is subject to special licensing terms.

For copyright information and licensing terms please refer to:

www.ifm.com/int/GNU

For software subject to the GNU General Public License or the GNU Lesser General Public License the source code can be requested against payment of the copying and shipping costs.

1 Preliminary note

This document is intended for specialists. These specialists are people who are qualified by their appropriate training and their experience to see risks and to avoid possible hazards that may be caused during operation or maintenance of the device. The document contains information about the correct handling of the device.

Read this document before use to familiarise yourself with operating conditions and installation. Keep this document during the entire duration of use of the device.

For a detailed description of the associated software please read the software manual and the interface description.

1.1 Explanation of symbols

▶ Instructions

> Reaction, result

[…] Designation of keys, buttons or indications

→ Cross-reference



Important note
Non-compliance may result in malfunction or interference.



Information
Supplementary note.

⚠ CAUTION

Warning of personal injury.
Slight reversible injuries may result.

NOTE

Warning of damage to property

2 Safety instructions

These instructions are part of the device. They contain texts and figures concerning the correct handling of the device and must be read before installation or use.

Note the safety instructions. Use the device in accordance with its designated use.

The installation and connection must comply with the applicable national and international standards. Responsibility lies with the person installing the device.

Only the signals indicated in the technical data or on the device label may be supplied to the connections or wires.

The device may only be opened by the manufacturer or by a person authorised by the manufacturer.

2.1 Laser protection class

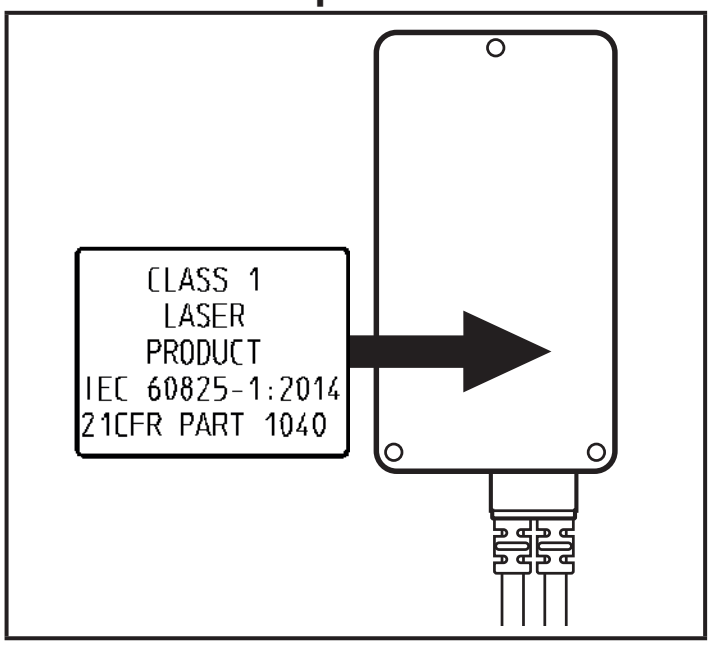
⚠ CAUTION

Use of controls or adjustments or procedures other than those specified herein may result in hazardous radiation exposure.

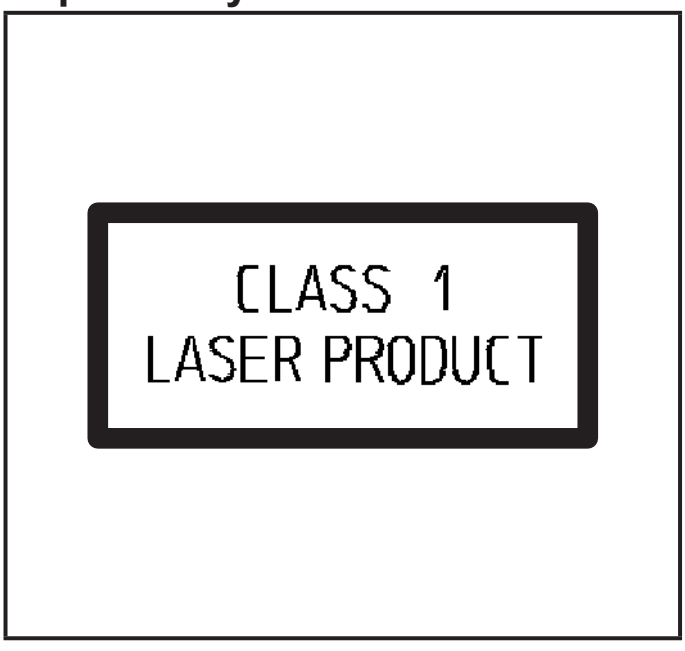


Invisible laser light; CLASS 1 LASER PRODUCT.
IEC 60825-1 : 2014
Complies with 21 CFR 1040 except for deviations
pursuant to Laser Notice No. 50, dated June 2007.

Position of the product label



Explanatory label



3 Functions and features

The O3X1xx 3D camera is an optical 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. This distance data can be output via Ethernet and evaluated by the user. Parameter setting of the device is also done via Ethernet.

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

- Indoor use
- Altitudes up to 2000 m
- Relative air humidity up to max. 90%, non condensing
- Pollution degree 3

Because of the requirements for electromagnetic interference emissions, the device is intended for use in industrial environments. The device is not designed for use in domestic areas.

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

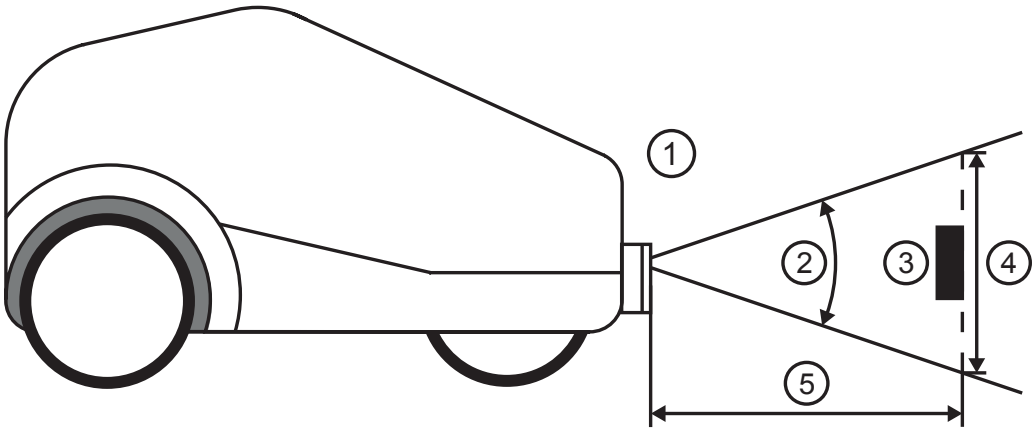
4 Items supplied

- O3X1xx 3D camera
- Operating instructions

▶ In the event of incomplete or damaged items supplied please contact ifm electronic.

The device is supplied without installation / connection accessories.

5 Installation



(1): Device, installed horizontally
(2): Angle of aperture
(3): Object
(4): Field of view
(5): Distance between device and object

UK

5.1 Select installation location

Observe the following instructions for the selection of the installation location:

▶ The object ③ must be in the field of view ④.

> The size of the field of view is indicated in the data sheet. The size of the field of view depends on the distance of the device to the object ⑤: With increasing distance the field of view becomes larger.

▶ Avoid direct reflections from the floor.

▶ Take tolerances into account when positioning the object.

▶ When determining the distance between device and object ⑤ take the measuring range of the device into account.

> The measuring range is indicated in the data sheet of the sensor.

▶ Select a distance as small as possible between device and object ⑤.

> If the distance is as small as possible, the object is detected with the maximum 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 transparent panes between the device ① and the object ③.

> Transparent panes reflect part of the light even if a very clean glass pane is used.

If the instructions are not observed, measurement errors may occur.

5.2 Additional device installation guidance

NOTE

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). Take the following measures:

▶ Reduce surface temperature (→ 5.2.1).

▶ Adapt operating mode and parameters.

5.2.1 Reduce surface temperature

Reduce the surface temperature with the following measures:

▶ Mount the device on heat-conductive metal parts.

> A large-surface contact of the device with metal parts increases heat dissipation (e.g. conventional aluminium heat sinks or profiles).

▶ Reduce obstructions around the device. Reduce the density of objects mounted near the device.

> Obstructions around the device and a high installation density may have a negative impact on convection (air movement).

▶ Reduce exposure time, frame rate or max. background distance.

> The surface temperature decreases if the parameters are reduced.

5.3 Install device

Observe the following instructions when installing the device:

▶ Install the device with 3 x M3 screws.

The hole dimensions are indicated in → "12 Scale drawing".

▶ Use strain reliefs for all cables connected to the device.

6 Electrical connection

Observe the following instructions before electrical installation.

NOTE

The device must be connected by a qualified electrician. Observe the electrical data in the data sheet.

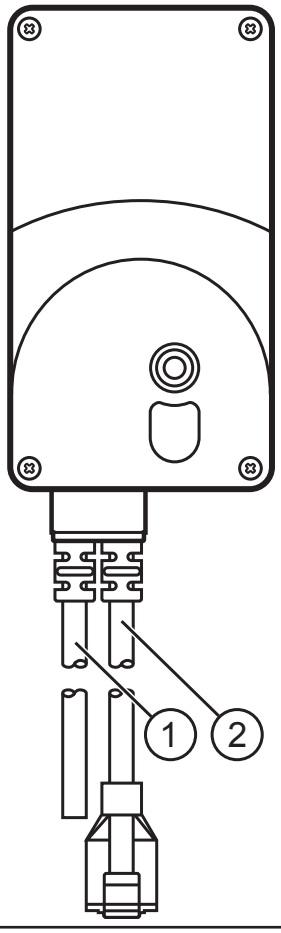
Device of protection class III (PC III).

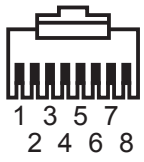
The electrical supply must only be made via PELV circuits.

For cable lengths > 30 m use an additional protection against surge voltages to IEC 6100-4-5.

Disconnect power before connecting the device.

6.1 Wiring



(1) Power supply		
2 cables, open ends		
	red	U+ (24 V)
	black	GND
(2) Ethernet		
RJ45 Ethernet connector		
	1	TD +
	2	TD -
	3	RD +
	4	not connected
	5	not connected
	6	RD -
	7	not connected
	8	not connected

6.2 Use of several devices

It is possible that the devices interfere if they are not optically separated and expose simultaneously.

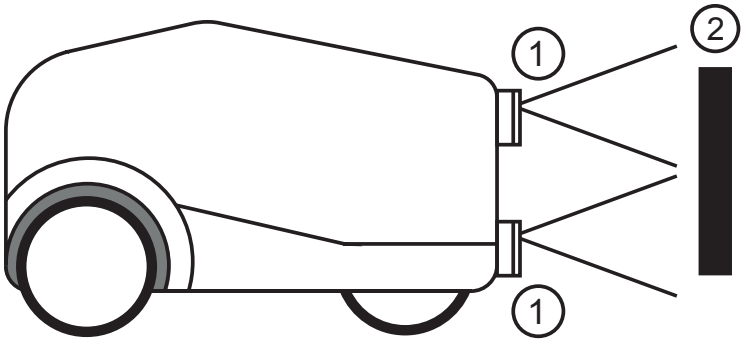
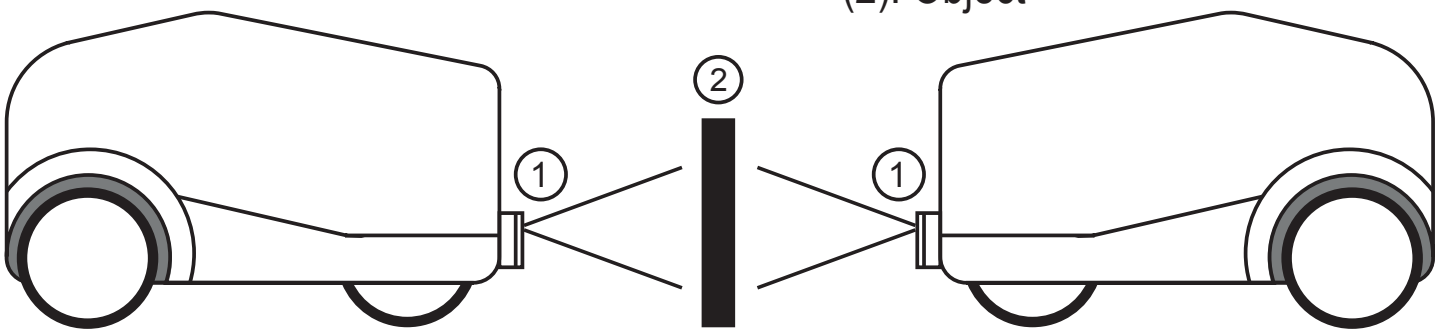


Fig. left: 2 devices installed on a robot.

Fig. below: 2 robots with 1 device each are opposite each other.

(1): Device, installed horizontally

(2): Object



Reduce the measurement error with the following measures:

▶ Trigger devices one after the other with software trigger via the process interface.

An internal process considerably reduces possible interference. Nevertheless measurement errors and minor tolerances may occur.

7 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.

7.1 Set parameters of the device

The device parameters can be set in two ways:

- Software ifm Vision Assistant (→ see software manual)
- ifm3Dlib (third-party product, → https://github.com/lovepark/ifm3d)
  Programming example for ifm3Dlib: (→ "8 Programming example")
- ROS (third-party product, → https://github.com/lovepark/ifm3d-ros)

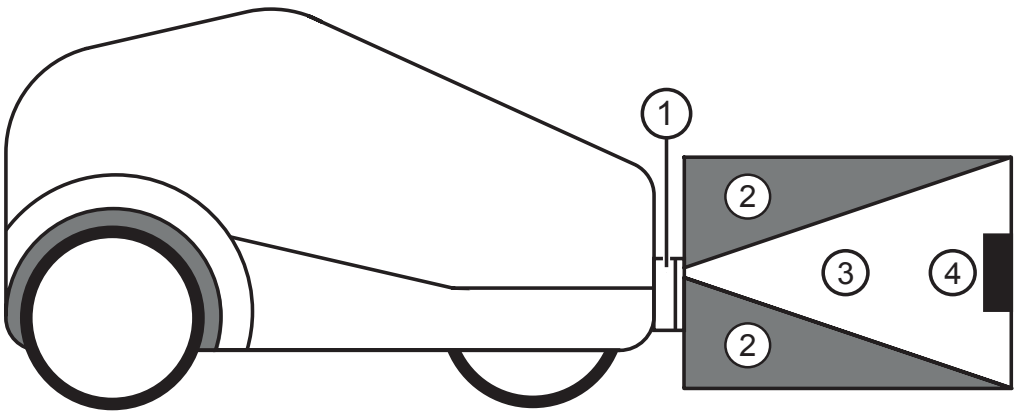
The software ifm Vision Assistant and detailed information about the measuring principle of the device are described in the software manual.

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

The library ifm3Dlib and the wrapper ROS are programmed by ifm electronic. Both packages are available for Linux under Apache License Version 2.0.

7.2 Optimum object detection

The conditions which lead to a high detection rate of objects are described below.



(1): Device, installed horizontally
(2): Unambiguous range
(3): Field of view
(4): Object

Optimum detection of an object ④ is given if the following conditions are met:

- Object is positioned in the field of view ③.
- Object is the nearest visible object to the device ①.
- Unambiguous range ② is clear from objects (obstructions etc.).
- Lens window of the device is free from soiling.

If the conditions are not met, measurement errors may occur.

7.3 Install ifm Vision Assistant

▶ Unzip the ifm Vision Assistant zip file on the hard disk.

> The unzipped ifm Vision Assistant folder contains all necessary files. Installation is not necessary. Administrator rights are not necessary.

The ifm Vision Assistant software is only available for Windows operating systems.

The ifm Vision Assistant software is available free of charge on our website:

www.ifm.com

7.4 Connect O3X1xx to ifm Vision Assistant

7.4.1 Required Ports

To connect the ifm Vision Assistant, the following ports must be enabled:

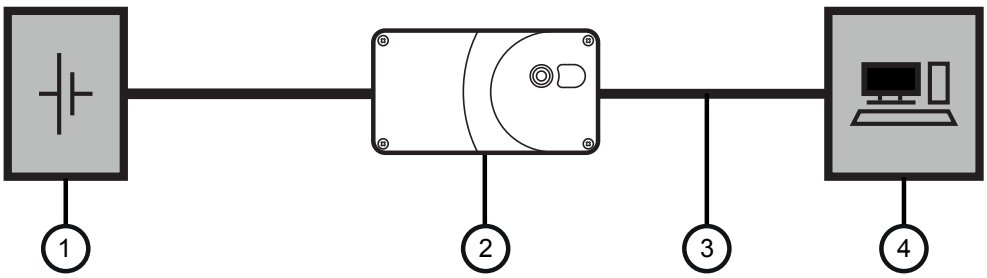
- UDP: 3321
- TCP: 50010
- TCP / HTTP: 80 and 8080

Firewalls and routers available in the network must enable the ports for the ifm Vision Assistant.

7.4.2 Hardware

▶ Connect device to the voltage supply.

▶ Connect device to the Ethernet interface of the PC using the Ethernet cable.



(1): Power supply 24 V

(2): Device

(3): Ethernet cable

(4): PC

7.4.3 Connect device automatically

1. Start the "ifmVisionAssistant" application.
2. Click on .

> The ifm Vision Assistant searches for connected devices via Ethernet.

> All devices found are shown in a list for selection.

3. Click on the button of the device found.

> Connecting to device.

If ifm Vision Assistant does not find a device:

▶ Check hardware connection and current supply (→ "7.4.2 Hardware").

▶ For troubleshooting connect the Ethernet cable of the device directly to the PC.

▶ Connect device manually (→ "7.4.4 Connect device manually").

7.4.4 Connect device manually

1. Start the "ifmVisionAssistant" application.
2. Click on .
3. Click on the button [Manual connection].
4. In the list "Select type of sensor" select the device type [O3X1XX manual connection].
5. Enter the IP address of the device in the field "Enter IOP address".

   The default IP address is "192.168.0.69".

6. Click on the button [Connect].

7.5 Monitoring screen

When a connection to the device has been established, ifm Vision Assistant opens the monitoring screen.

In the monitoring screen the device runs in the operating mode. The current application can be monitored but not interrupted or changed.

7.6 Application

In the window "Application" the application of the connected device is shown and the "Image Settings" are set.

▶ Click on .

> The window "Application" opens.

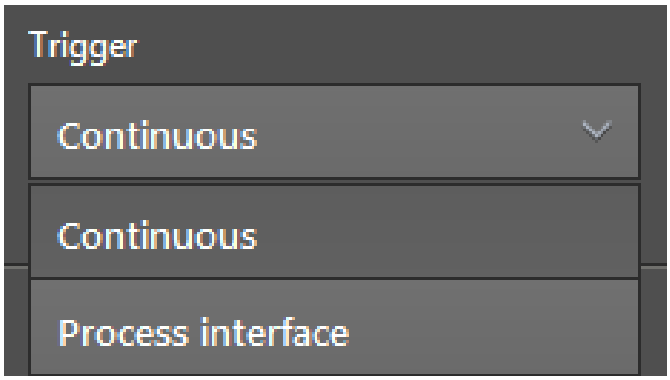
When you change from the monitoring screen to the window "Application", you have to confirm that the evaluation (the operating mode) of the device stops.

The button  saves the image settings in the application.

The button  exits the application.

7.6.1 Set trigger source

The trigger source is set in the list "Trigger"

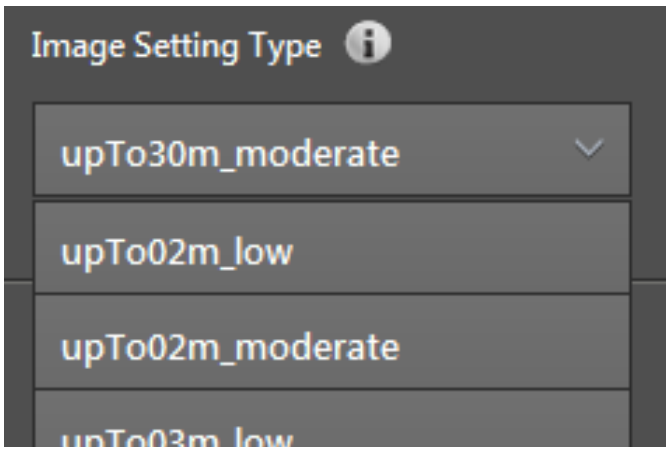


The following trigger sources can be set:

Trigger source	Description
Continuous	The trigger source "Continuous" displays the current image repetition rate in the window "Image settings". The image repetition rate is changed in the input box "Target Framerate". The max. possible image repetition rate depends on the exposure mode and the exposure time.
Process interface	The device is controlled via the process interface (e.g. PC).

7.6.2 Set capture mode

The capture mode is set in the list "Image Setting Type". In the capture mode the characteristics of an image capture are set.



The capture mode "upTo30m_moderate" is preset:

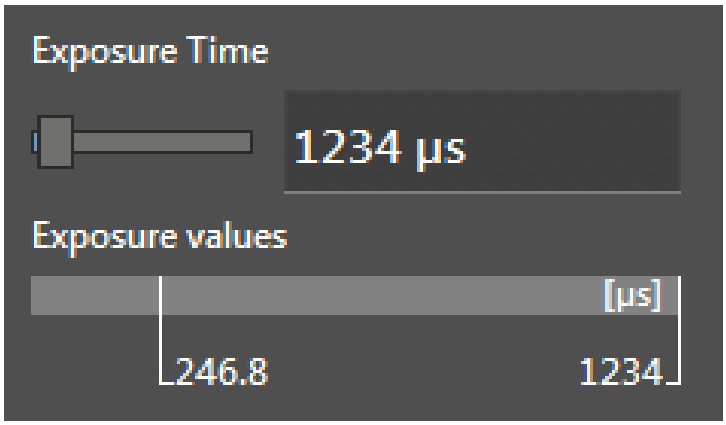
upTo30m_moderate	
upTo30m_	• Unambiguous range "30 m" • 2 measurement frequencies
_moderate	• 2 exposure times

The capture mode consists of:

upTo30m_	• Length of the unambiguous range • 1 measurement frequency: unambiguous range < "7m" • 2 measurement frequencies: unambiguous range >= "7m"
_moderate	• 2 exposure times
_low	• 1 exposure time

7.6.3 Set exposure time

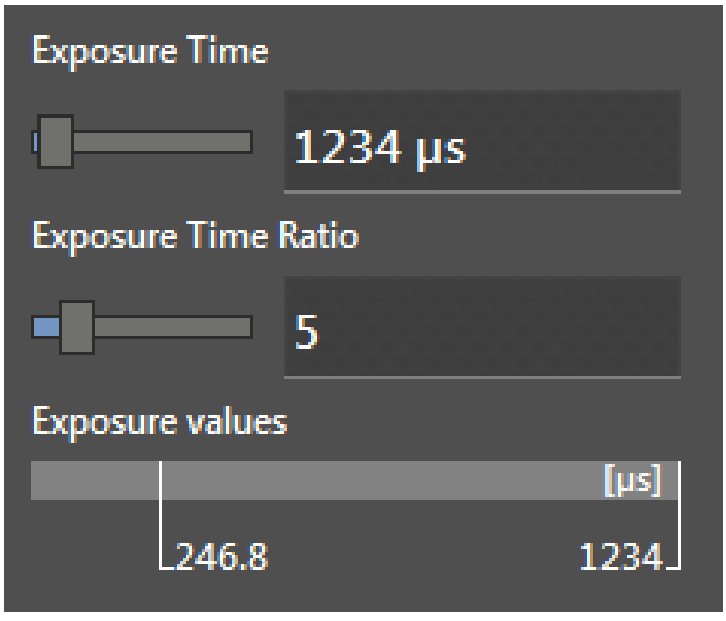
If an "Image Setting Type" is set for 1 exposure time, the following settings are available:



The single exposure is intended for scenes with low dynamics.

The exposure time is set in µs. The value is changed with the slider bar or entered in the box.

If an "Image Setting Type" is set with 2 exposure times, the following settings are available:



The double exposure is intended for scenes with high dynamics.

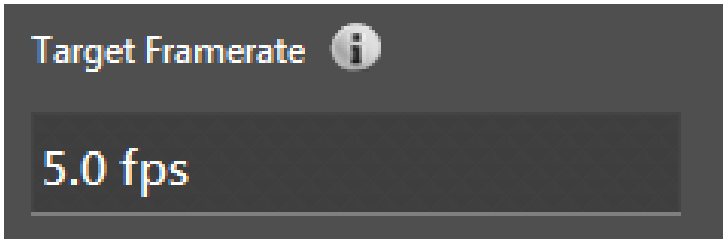
The exposure time is set in µs.

The longer exposure time is changed with the slider bar "Exposure Time" or entered in the box.

The shorter exposure time is changed with the slider bar "Exposure Time Ratio" or entered in the box.

7.6.4 Set image repetition rate

The image repetition rate to be reached by the device is set in the field "Target Framerate". The "Target Framerate" is set in fps.

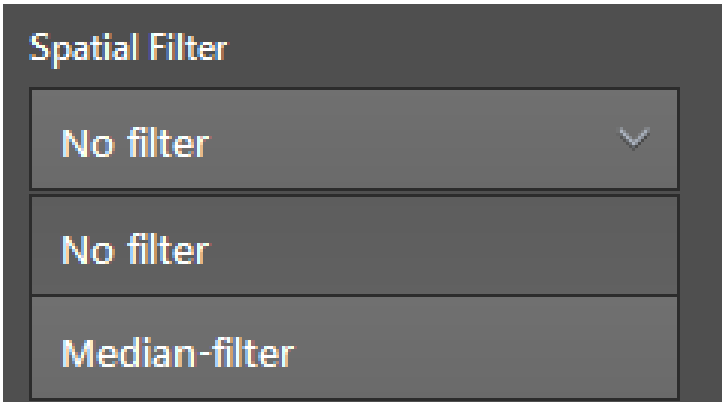


The maximum image repetition rate depends on the selected capture mode and the exposure time.

7.6.5 Set the filter

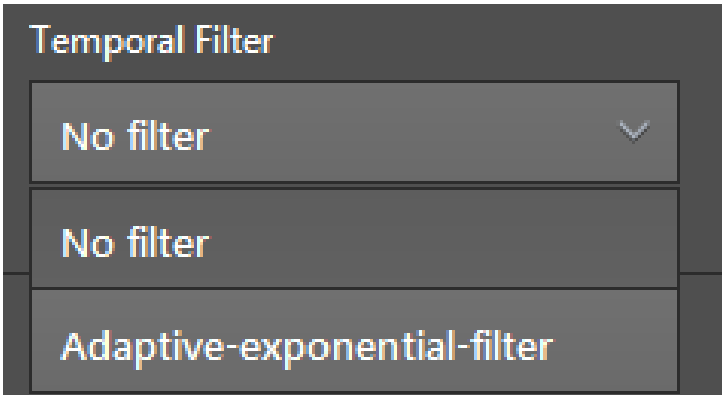
The filters "Spatial Filter" and "Temporal Filter" optimise the repeatability.

The list "Spatial Filter" contains the following filters:



Filter	Description	Characteristics
Median filter	Each pixel is replaced by the median of the neighbouring pixels.	Good edge preservation

The list "Temporal Filter" contains the following filters:



Filter	Description
Adaptive exponential filter	A weighted average across successive images is calculated. Newer images have more weight than older images. The filter can only be used with the trigger source "Continuous".

7.7 Device configuration

The general settings of the connected device, the network and the NPT function are set in the window "Device setup".

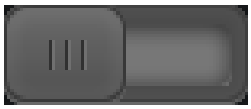
▶ Click on .

> The window "Device setup" opens.

When you change from the monitoring screen to the window "Device configuration", you have to confirm that the evaluation (the operating mode) of the device stops.

7.7.1 General

General settings of the connected device are set in the window "General".

Field	Button	Description
Name	–	Set the name of the device
Description	–	Set the description of the device
Password protection	 On  Off (standard)	Activate or deactivate the password protection. When the password protection is activated, the windows "Application" and "Device Configuration" can only be accessed when the password has been entered.
	Input box	Editable field to enter a password
Settings	[Export]	Exports a copy of the settings and application on the PC (→ "7.7.2 Export settings").
	[Import]	Imports a copy of the settings and application from the PC to the device (→ "7.7.3 Import settings").

Field	Button	Description
Firmware update	[Update]	Installs a firmware update (→ "7.7.4 Install firmware update"). The current version of the firmware is shown next to the button.
Factory settings	[Reset]	Resets the factory settings and deletes all current settings.
Reboot	[Reboot]	Reboots the device.
Save		Saves the settings.
Cancel		Rejects the settings.

7.7.2 Export settings

The settings of the ifm Vision Assistant can be exported for the firmware update or the exchange of the device.

1. Click on the button [Export].

> The "Save as" window appears.

2. Enter "File name" for the export.

The exported settings have the file extension ".o3x1xxcfg".

7.7.3 Import settings

The exported settings of the ifm Vision Assistant can be imported.

1. Click on the button [Import].

> The file selection window is displayed.

2. Select file for the import.

The current settings are overwritten during the import. The settings have the file extension ".o3x1xxcfg".

7.7.4 Install firmware update

With the ifm Vision Assistant the firmware of the device can be updated.

Settings saved in the device get lost by the firmware update. Create a backup copy of the settings before updating the firmware:

- ▶ Export settings before updating the firmware.
- ▶ Import settings after updating the firmware.

Firmware updates are available on our website: www.ifm.com

Update the firmware:

1. Click on the button [Update].
2. Acknowledge message window with [OK].

> The file selection window is displayed.

3. Select firmware file.

   The firmware file has the file extension ".swu".

4. Click on the button [Open].

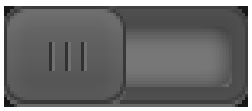
> Firmware update is executed. After successful firmware update the message "Firmware update successful" is displayed.

The ifm Vision Assistant re-establishes the connection to the device again.

In the event of problems with the firmware update:
(→ "11.1 Error messages during firmware updates")

7.7.5 Network

The network settings of the connected device are set in the window "Network".

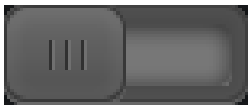
Field	Button	Description
DHCP	 On  Off (standard)	Switch DHCP on or off. When DHCP is switched on, the device gets the network settings from the network.
IP address	Input box	Set IP address of the device. The default setting is "192.168.0.69".
Subnet mask	Input box	Set the subnet mask of the network. The default setting is "255.255.255.0".
Gateway	Input box	Set the gateway of the network. The default setting is "192.168.0.201".
MAC address	MAC address	The MAC address of the device is displayed.
Save		Saves the network settings.
Cancel		Rejects the network settings.

The ifm Vision Assistant re-establishes the connection to the device after the network settings have been saved.

7.7.6 NTP

The real-time clock (Network Time Protocol) is set in the window "NTP".

A real-time clock which can be synchronised via NTP is integrated in the device. If several devices are used, it is ensured via NTP that the real-time clocks of the devices run synchronously.

Field	Button	Description
Activate NTP	 On  Off (standard)	Switch NTP on or off. When NTP is on, the device gets the date and the time from the network.
NTP server	green	The set NTP server answered to the last request.
NTP server	red	The set NTP server did not answer to the last request.
NTP server	grey	The set NTP server has not yet been requested.
NTP server	IP address	IP address of the set NTP server.
Add server		Adds the NTP server.
Delete		Deletes the NTP server.
Max. number of requests	input box	Set maximum number of requests. If the NTP server does not reply within the set number if requests, the NTP server will be ignored in future.
Currently set device time	Date and time	Display of the date and time saved last in the device.

Field	Button	Description
Save		Saves the network settings.
Cancel		Rejects the network settings.

8 Programming example

Preferably use the ifm3Dlib for access to the device under Linux. The library has been tested and is the reference implementation for C++.

The library is supported by ifm electronic and the company Lovepark Robotics. The Apache-2 licence does not allow commercial use.

8.1 ifm3Dlib

Below a short C++ example how to address the device with imf3Dlib.

```
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 the device transmits the data set. The amplitude image and the radial distance from the data set is saved as PNG file. The Cartesian coordinates are saved as PCL file.

A detailed example is available on the web at: https://github.com/lovepark/ifm3d/blob/master/modules/examples/ex-file_io.cpp

9 Maintenance, repair and disposal

Observe the following instructions:

- ▶ Do not open the device as it does not contain any components which can be maintained by the user. The device must only be repaired by the manufacturer.
- ▶ Dispose of the device in accordance with the national environmental regulations.

9.1 Cleaning

Observe the following instructions before cleaning the device:

- ▶ Use clean and lint-free cloth.

If the instructions are not observed, scratches on the lens window may cause measurement errors.

9.2 Replace device

The parameters are lost when a device is replaced. Create a backup copy of the parameters before replacing the device:

- ▶ Export the parameters of the old device before replacement.
- ▶ Import the parameters into the new device after replacement.

With the export and import of parameters several devices can be quickly provided with the same parameters.

10 Approvals/standards

The EU declaration of conformity is available at:

www.ifm.com

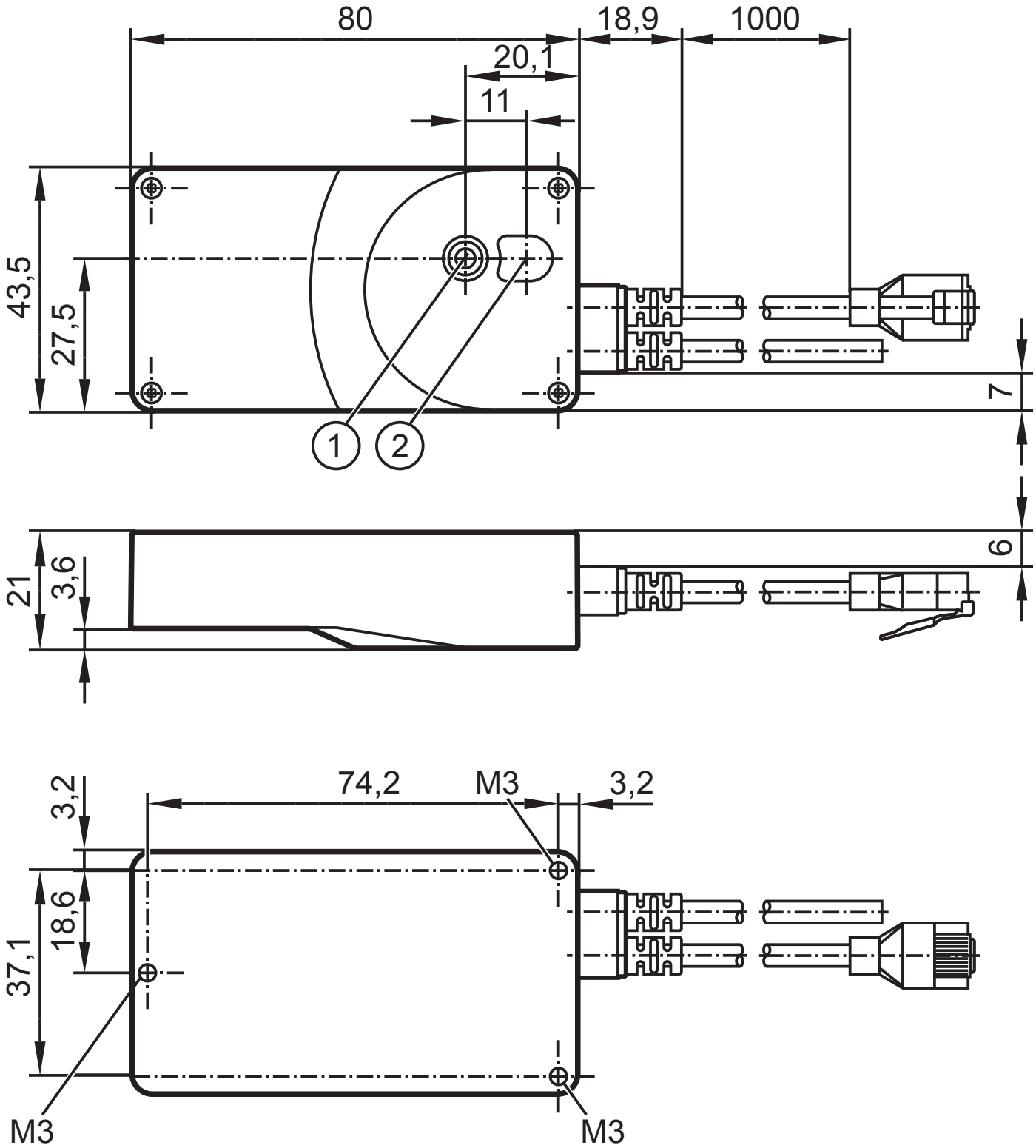
11 Error messages

11.1 Error messages during firmware updates

The firmware update can fail displaying one of the following error messages:

Error message	Solution
FW update not possible Firmware update is not supported with dynamic IP address. Change the device to a static configuration before	▶ Change network settings of the device to a static IP address. > After saving the settings the ifm Vision Assistant tries to establish the connection automatically.
Firmware update failed Failed to boot recovery mode. [120001] Firmware update failed Installation of firmware update failed. [120003] Firmware update failed Failed to transfer file to device. [120002]	1. Reboot ifm Vision Assistant. 2. Click on  . > The ifm Vision Assistant searches for connected devices via Ethernet. 3. Click on the button of the device found. > The message "Recovery mode running" is displayed. 4. Click on the message "Install another firmware". 5. Install firmware update (→ "7.7.4 Install firmware update").

12 Scale drawing



①: Lens

②: Illumination unit