Camera systems for mobile machines.

Industrial imaging

www.ifm.com/gb/o3m

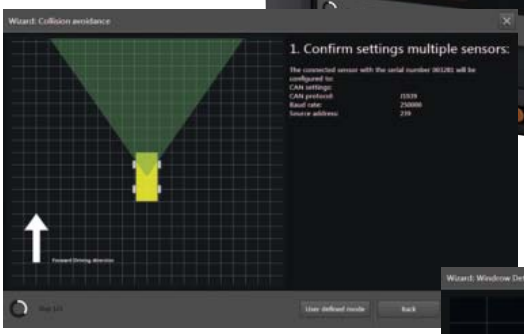
Future-oriented technology meets user-friendly handling

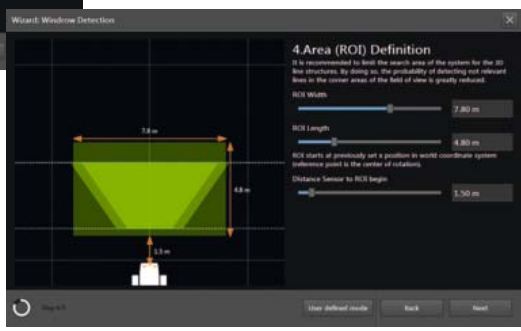
3D sensor system O3M

Augmented reality – 3D smart camera

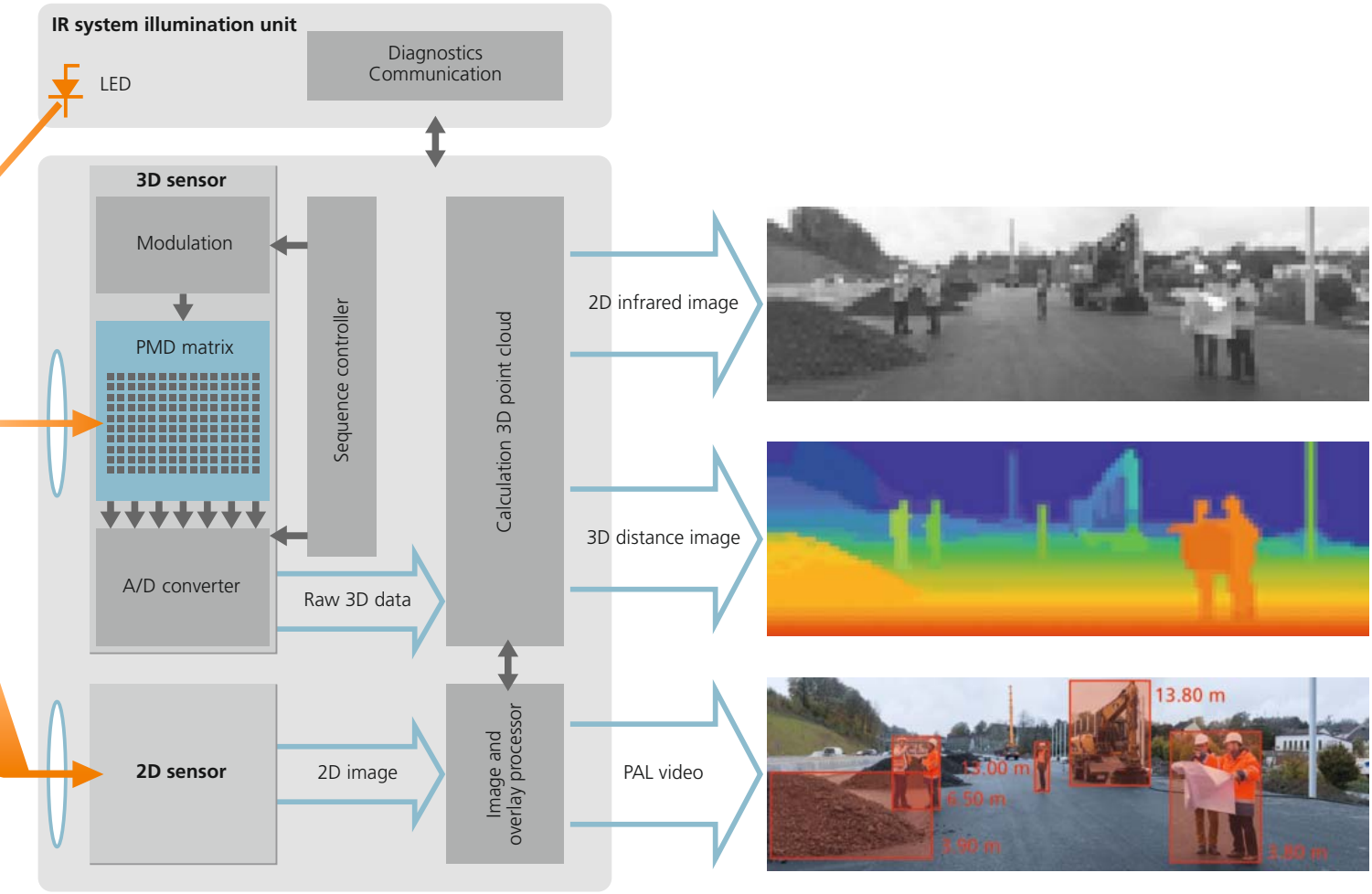
The function principle of ifm's PMD technology is based on time-of-flight (ToF). The scene is illuminated by modulated, invisible infrared light and the reflected light hits the PMD sensor. This sensor is also connected to the source of modulation. Each pixel of the PMD chip determines the distances to the scene due to the phase shift between the transmitted and the received signal.

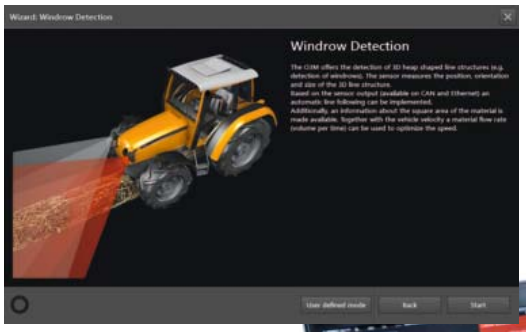
The integrated, active suppression of background illumination almost completely prevents saturation of the image sensor by extraneous light. That means that ifm's PMD 3D sensor can be operated in bright sunlight up to 120 klx. Simultaneously the optionally integrated camera provides a live image with superimposed real-time warning messages such as in dangerous situations or with imminent collisions. The sensor system places warning symbols, icons, line objects or texts into the image and combines them with the video signal. The command to display these objects can also be given directly by the machine control system via CAN bus. The analogue PAL video output supports conventional monitors and dialogue modules with video input and graphics capabilities.





Set up collision warning





Set up
line guidance

Easy set-up and handling

The 3D sensor system is set up and operated via ifm's user-friendly Vision Assistant. Its use ensures parameter setting of even complex configurations with several 3D sensor systems without profound previous knowledge. The preset wizards give support for many standard applications and intuitively guide to the best solution. At the same time the Vision Assistant enables checking of the setting in a monitoring mode during operation and even recording of all data for later replay.

Three-dimensional detection of scenes Automatic detection of objects

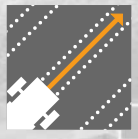
3D sensor system O3M

Real-Time 3D

Augmented reality – now in real 3D

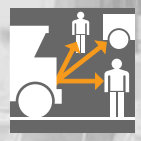
The PMD 3D sensor from ifm detects scenes and objects three-dimensionally with only one image capture.
This avoids the motion blur that can occur with line scanners. ifm's award-winning patented PMD technology forms the basis for a sensor system that can cope with the harsh operating conditions of mobile machines. Besides the robust and compact design the 3D sensor system is especially designed for outdoor applications with changing light conditions or bright sunlight. The ifm 3D sensor has no moving components in contrast to other sensors such as laser scanners. Therefore it is particularly robust and not subject to wear.
The so far unique combination of PMD 3D sensor and 2D camera with integrated overlay function allows a completely new perception. Overlay of customer-specific symbols, warning messages, texts and even drawings of complex, geometric shapes is supported by the new 3D smart camera system. The request for overlay can either be event-controlled or directly triggered by the machine control system via CAN bus.

Area surveillance



Line guidance

Distance monitoring



Object recognition

Reflector tracking

Positioning help

Collision warning

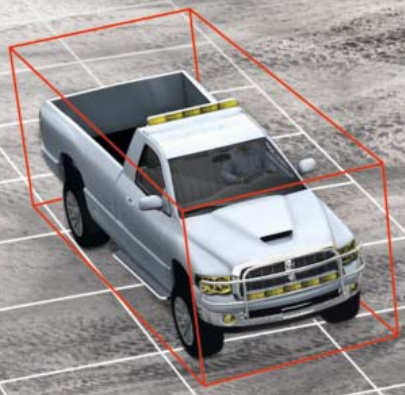
Construction machines	**Area surveillance in harsh environments**	*6 - 7*
Agriculture and forestry	**Automation solutions for agricultural machinery**	*8 - 9*
Transport and logistics	**Collision warning and position determination**	*10 - 13*
Transport and logistics	**Automation solutions and area surveillance in port areas**	*14 - 17*
Transport and logistics	**Height and distance monitoring in airport areas**	*18 - 19*
Overview of articles / Technical data	**3D sensor system O3M** **Heavy-duty universal camera O2M**	*20 - 27*

Area surveillance in harsh environments

Construction machines

Collision warning

The integrated, automatic object recognition detects up to 20 stationary or moving objects in the path of a construction vehicle. By comparing the current speed, the motion vector and fixed parameters such as the braking distance, the collision probability is calculated by the 3D sensor and transferred to the machine control system via CAN bus or Ethernet and then signalled to the driver.

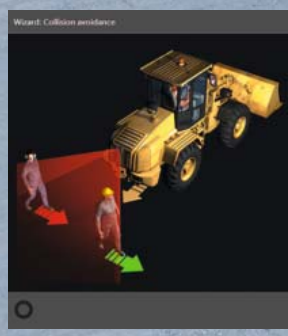


3D smart camera:
IIntegrated camera with overlay function to provide a live image and real-time warning messages.

Enormous far sightedness:
The 3D sensor that is optimised for long ranges even detects moving reflective objects at a distance of up to 35 metres.

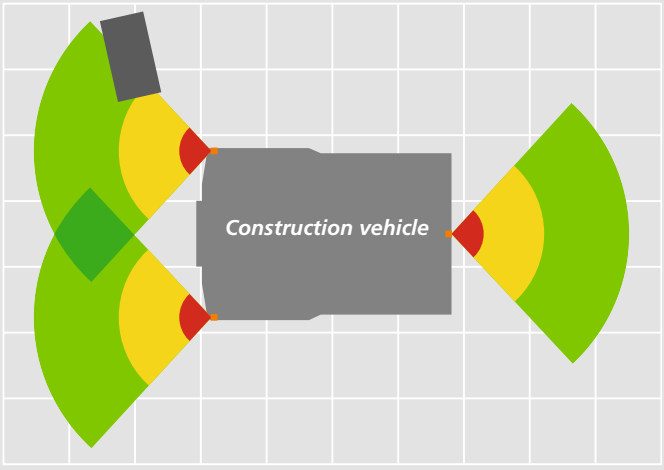
Integrated evaluation:
All 3D calculations are made in the powerful sensor system and the results are provided via the CAN bus or the Fast Ethernet connection.

Simply convenient:
The parameters of the system are set via the easy-to-handle "ifm vision assistant" for Windows. Ready-to-use function blocks are available for the CODESYS software for machine integration.



Distance monitoring

For simple distance functions the integrated distance monitoring provides up to 64 adjustable regions of interest (ROIs), i.e. individual regions whose distances are to be monitored. Rear area monitoring can be implemented or automation or assistance tasks can be solved.



Learn more at www.ifm.com/gb/o3m-ca

Automation solutions for agricultural machinery

Agriculture and forestry

For the harshest environments:

Since the sensor does not have any moving components, it is virtually free of wear. Its high ambient temperature range of -40 to 85 °C is the basis for universal use.

Resistant to extraneous light:

The PMD technology ensures high repeatability of the measured data even in difficult ambient light conditions or with direct sunlight.

Communicative:

Interfaces such as CAN with J1939 or CANopen and Fast Ethernet are integrated as standard. Self-diagnostic functions from the sensor to the IR system illumination unit continually monitor the system status.

Reliable and fast:

With a highly developed algorithm from the automotive sector and a frame rate of up to 50 frames / second the sensor allows fast and reliable calculation of the 3D information.

Line guidance

A highly developed algorithm with generic recognition of linear contours provides the machine driver with a selection of recognised lines and their guidance. With interrupted contours the data is interpolated. This ensures that guidance does not stop in case of smaller interruptions. An offset function ensures fine adjustment between vehicle and the line to be followed.

Besides the actual line guidance, the volume flow of the harvested material can be determined at the same time so that the speed of the tractor unit or harvester can be adapted to match the quantity of material.

Windrow recognition

The mobile 3D sensor assumes windrow recognition and provides the information for automatic steering to the machine control system.

At the same time the quantity of material [m³/s] is determined to avoid overloading or underloading of the baler.

Grape harvesting machine

To relieve the driver and to protect the plants the 3D sensor transmits all relevant data for automatic steering along the grape row to the machine control system.

Learn more at www.ifm.com/gb/o3m-lg

Area surveillance on machines and vehicles

Transport and logistics

Integrated camera:
An additional camera in the 3D sensor system provides the machine operator with a user-friendly overview.

Continuously reliable:
Thanks to the specially modulated infrared light a continuously high recognition rate can be achieved even with reflective material of different intensity. All that with a minimum response time of only 40 ms.

High coverage:
The range of up to 15 m in typical environments and up to 35 m on reflective objects ensures universal use.

Goal-oriented:
Object distances and dimensions are automatically provided in a clear grid using the selectable world coordinate system.
The ground recognition integrated in the algorithm ensures high unambiguity of object recognition.

Area surveillance

With more than 1,000 individual distance values the 3D sensor recognises objects in the detection range and signals this to the machine control system depending on the distance to the machine.

Waste disposal vehicle

Automatic recognition of dangerous situations such as during reversing or placing of containers.

The integrated logic functions allow to solve applications without additional complex programming.

Learn more at www.ifm.com/gb/o3m-as

Collision warning and position determination

Transport and logistics

Truck positioning on a loading bay

To protect the logistic facilities the driver is informed as soon as he has reached the ideal discharge position at the bay.

Continuously reliable:
Thanks to the specially modulated infrared light a continuously high recognition rate can be achieved even with reflective material of different intensity. All that with a minimum response time of only 40 ms.

High coverage:
The range of up to 15 m in typical environments and up to 35 m on reflective objects ensures universal use.

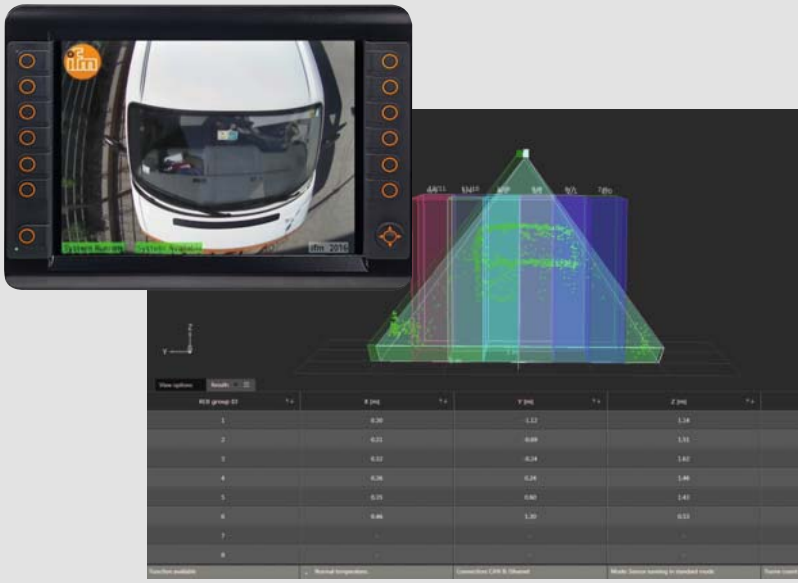
Goal-oriented:
Object distances and dimensions are automatically provided in a clear grid using the selectable world coordinate system. The ground recognition integrated in the algorithm ensures high unambiguity of object recognition.

Driver assistance during reversing

To prevent accidents the hazardous area behind the fork lift is detected in 3D and the driver is informed in time by a warning message before a possible collision. Simultaneously the machine control system can get a command to lower the speed, for example.

Position determination of transport vehicles

For simple position determination the integrated distance monitoring provides up to 64 adjustable regions of interest (ROIs), i.e. individual regions whose distances are to be monitored.
This ensures, for example, position determination of a transport vehicle underneath a loading point.



Learn more at www.ifm.com/gb/o3m-dm

Automation solutions and area surveillance in port areas

Transport and logistics

Fast reaction:

The 2 x 32-bit processor architecture ensures very fast and reliable calculation of the 3D data with up to 50 frames / second directly in the sensor system.

No interference:

Automatic suppression of background illumination ensures reliable recognition even with full solar radiation of 120 klx.

Reliable parallel operation:

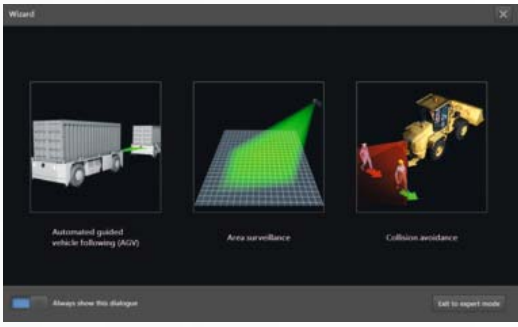
The reliable operation of several 3D sensor systems in the same area is guaranteed by an adjustable frequency change method. This may be random or preset.

Automatic detection of reflectors:

By detecting highly reflective objects these can be classified and evaluated as reflectors. Even simple safety vests suffice for this recognition.

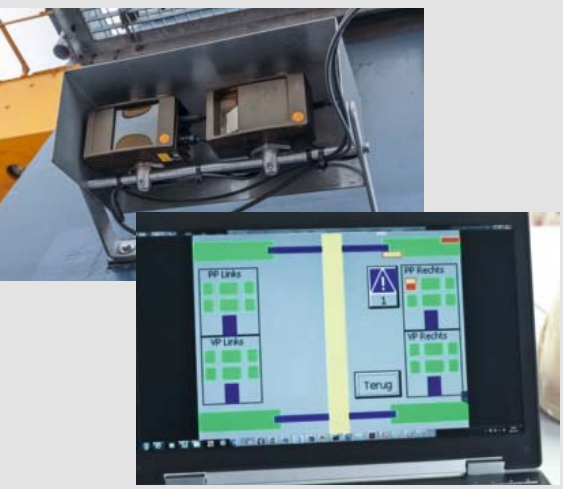
Automatic vehicle tracking with collision warning

A special classification of reflective objects is used as basis for automatic tracking of the vehicle ahead. The proven and highly-developed algorithm from the automotive sector is relied on.
For example, the minimum and maximum distance to the vehicle ahead is set or recognition is limited to a certain arrangement of reflectors via various parameters. An additional collision warning ensures that obstacles are reliably detected and signalled to the machine control system in two stages. Interference by direct solar radiation or other 3D sensor systems is automatically suppressed.



Easy area monitoring in ports

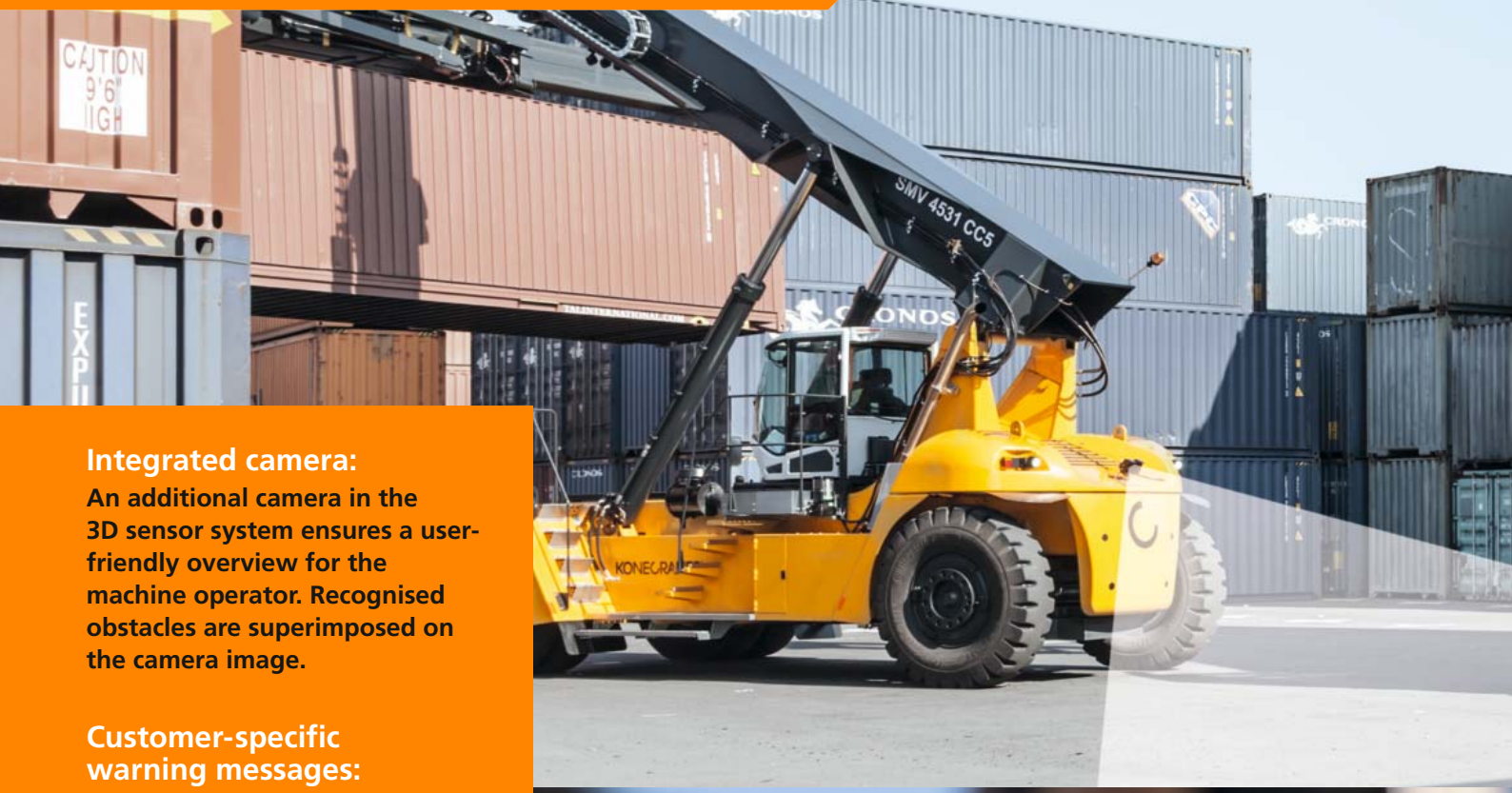
The integrated functions in the 3D sensor are especially suited for monitoring the rails of a gantry crane. The sensor detects an obstacle on the rails or extending into the path and signals this to the crane driver in time. The crane is stopped automatically in critical situations.



Learn more at www.ifm.com/gb/o3m-sd

Automation solutions and area surveillance in port areas

Transport and logistics



Integrated camera:
An additional camera in the 3D sensor system ensures a user-friendly overview for the machine operator. Recognised obstacles are superimposed on the camera image.

Customer-specific warning messages:
The overlay function of the 3D smart camera also allows overlay of graphics and texts by the machine control system via CAN bus.

No interference:
Automatic suppression of background illumination ensures reliable recognition even with full solar radiation of 120 klx.

Reliable parallel operation:
The reliable operation of several 3D sensor systems in the same area is guaranteed by an adjustable frequency change method. This may be random or preset.

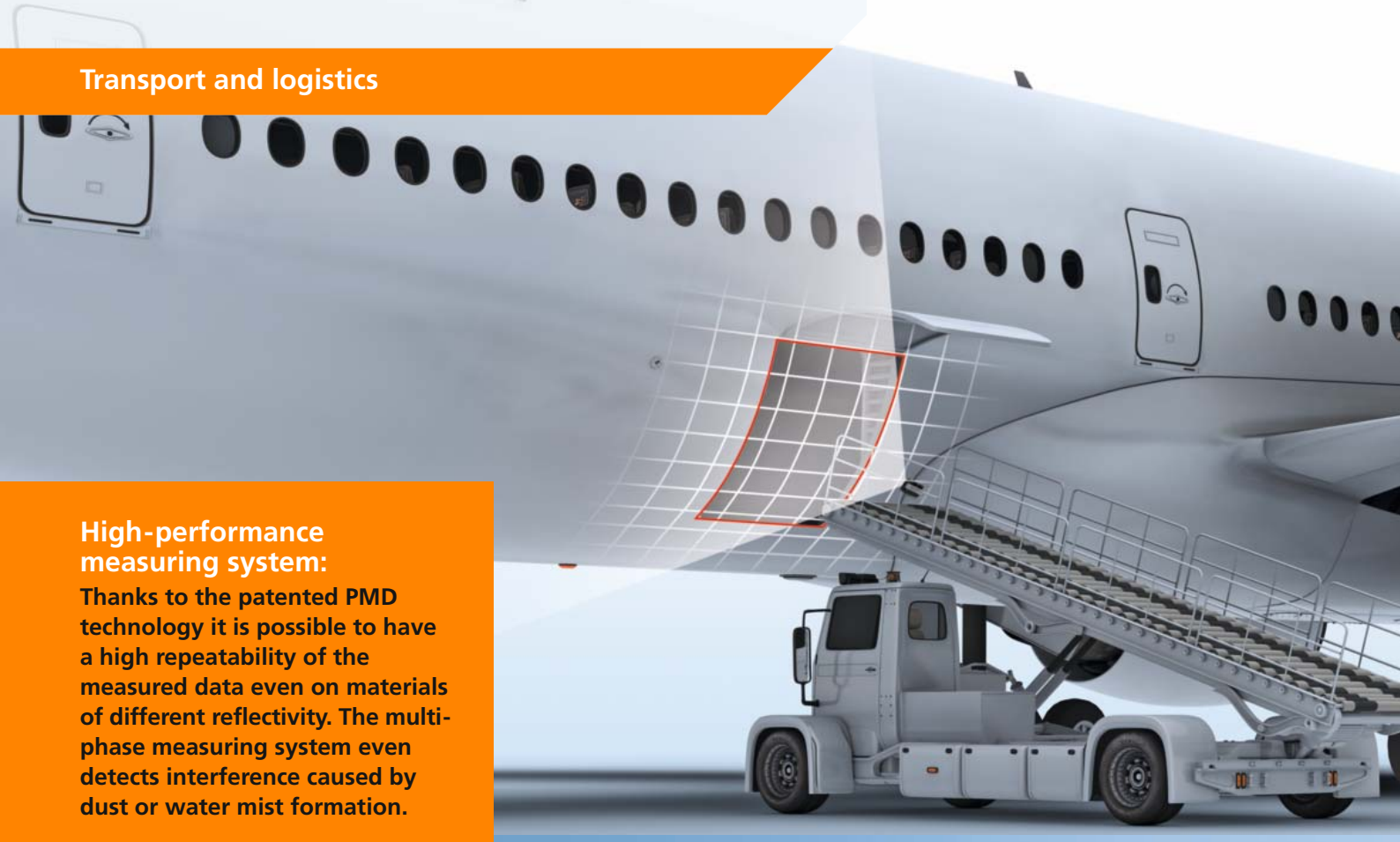
Collision warning

The integrated, automatic object recognition detects up to 20 stationary or moving objects in the path of a reach stacker. On the basis of the current speed, the moving vector and fixed parameters, for example the braking distance, the collision probability is calculated by the 3D sensor. It is transferred to the machine control system via CAN bus or Ethernet and signalled to the driver. In a live image provided by the integrated camera the recognised obstacles are highlighted.

Learn more at www.ifm.com/gb/o3m-ca

Height and distance monitoring in airport areas

Transport and logistics



High-performance measuring system:

Thanks to the patented PMD technology it is possible to have a high repeatability of the measured data even on materials of different reflectivity. The multi-phase measuring system even detects interference caused by dust or water mist formation.

Robust sensors:

The protection ratings IP 67 and IP 69K and a wide temperature range of -40 to 85 °C ensure universal use in different applications.

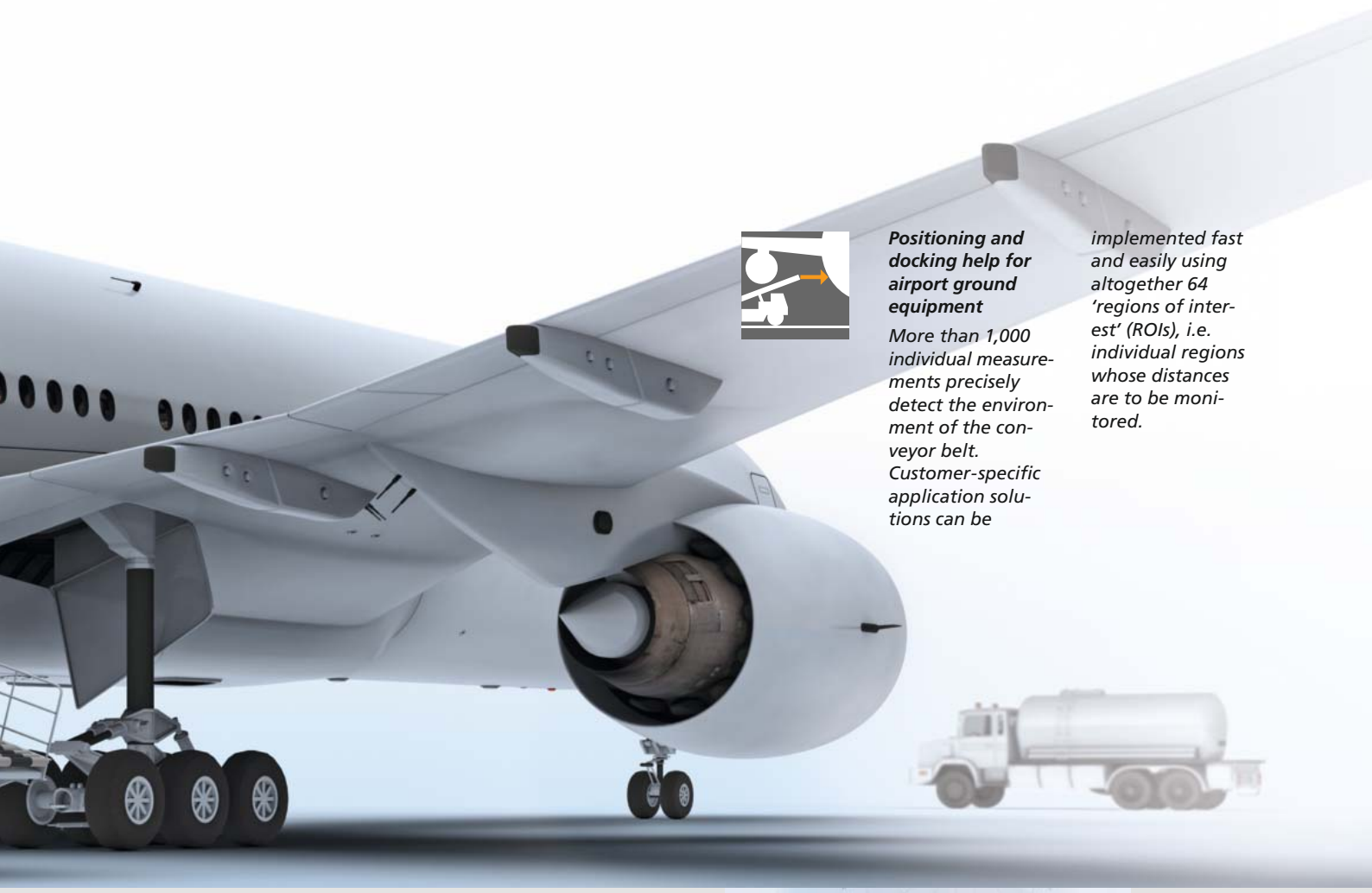
High reliability:

Integrated self-diagnostic functions from the sensor to the IR system illumination unit always ensure comprehensive information of the machine control system about the current function status of the 3D sensor. In case of damage, interference or heavy soiling the sensor system can give corresponding signals in time.

Height monitoring for tankers

The integrated distance function 'minimum distance' can monitor up to 64 selectable points above the tanker simultaneously.

The driver can, for example, be supported when he positions the tanker underneath the aeroplane wing or is informed if the wing is lowered.

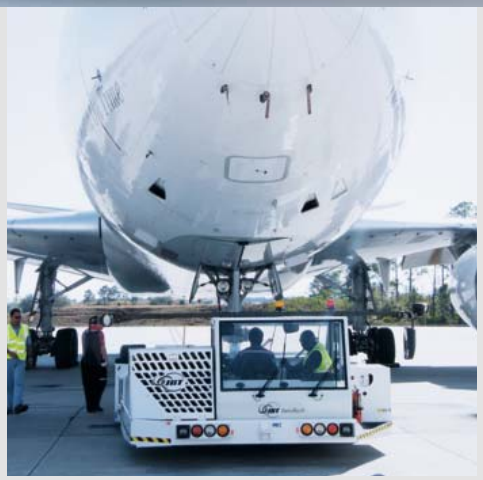


Positioning and docking help for airport ground equipment

More than 1,000 individual measurements precisely detect the environment of the conveyor belt. Customer-specific application solutions can be implemented fast and easily using altogether 64 'regions of interest' (ROIs), i.e. individual regions whose distances are to be monitored.

Simple distance monitoring

The integrated function 'minimum distance' can also be used for simple area monitoring. It informs the driver when a minimum distance has been reached and simultaneously it signals where this next distance is in the recognition field.



Assistance for aircraft tractors

Thanks to easy monitoring of a pre-defined area the 3D sensor can either provide an end position message or even a contour image of the nose wheel to the machine control system.

Learn more at www.ifm.com/gb/o3m-sd

Technical data and accessories

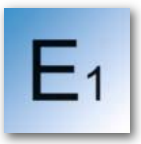
3D sensor system O3M

PMD 3D sensor O3M

Type	Horizontal x vertical angle of aperture [°]	Order no.	Suitable illumination	Order no.
Mobile 3D sensor without data preprocessing[1)]	70 x 23	**O3M150**	IR system illumination unit	**O3M950**
Mobile 3D sensor with integrated 2D camera[1)]	70 x 23 (3D) 90 (2D)	**O3M250**	IR system illumination unit	**O3M950**
Mobile 3D sensor without data preprocessing[1)]	95 x 32	**O3M160**	IR system illumination unit	**O3M960**
Mobile 3D sensor with integrated 2D camera[1)]	95 x 32 (3D) 120 (2D)	**O3M260**[3)]	IR system illumination unit	**O3M960**
Mobile 3D smart sensor[2)]	70 x 23	**O3M151**	IR system illumination unit	**O3M950**
Mobile 3D smart sensor with integrated 2D/3D overlay	70 x 23 (3D) 90 (2D)	**O3M251**	IR system illumination unit	**O3M950**
Mobile 3D smart sensor[2)]	95 x 32	**O3M161**	IR system illumination unit	**O3M960**
Mobile 3D smart sensor with integrated 2D/3D overlay	95 x 32 (3D) 120 (2D)	**O3M261**[3)]	IR system illumination unit	**O3M960**

[1)] Synchronous output of the 2D IR image and the 3D distance image as input information for customer-specific image processing
[2)] Incl. application wizards, see table page 22
[3)] Types O3M260 / O3M261 available as of 2nd quarter of 2017

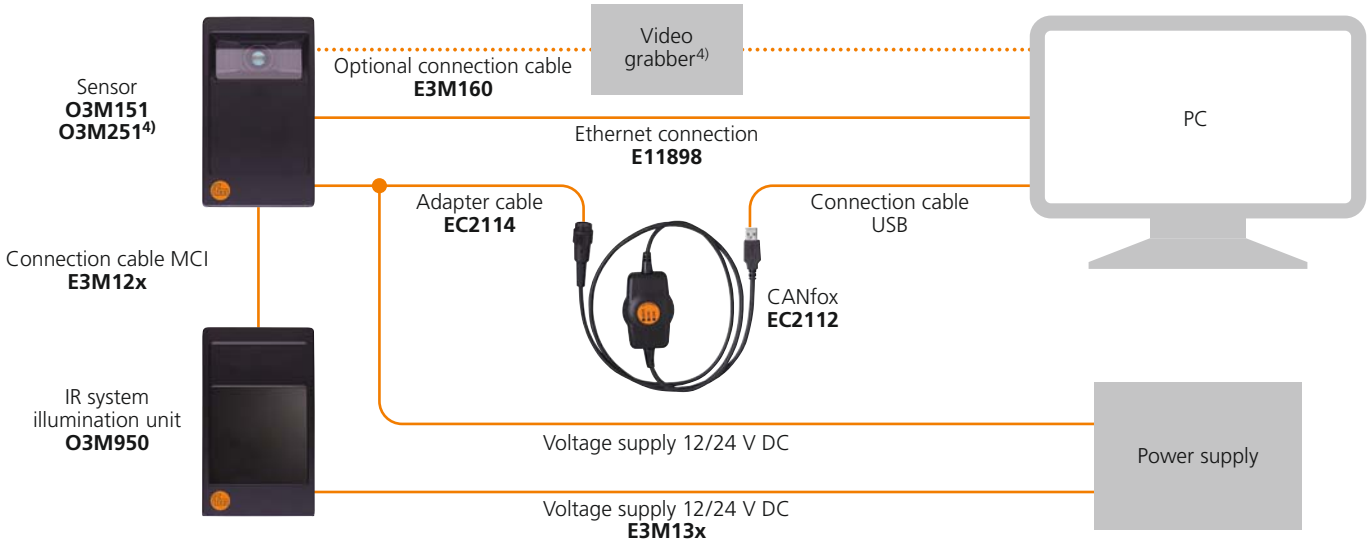
Technical data		
Type of sensor		PMD 3D chip
Pixel resolution	[Pixel]	64 x 16
Illumination		IR system illumination 850 nm (wave length)
max. frame rate	[Hz]	25 / 33 / 50
Connection		M12 connector
Protection rating / protection class		IP 67 / IP 69K, III
Operating voltage	[V DC]	9...32
Ambient temperature	[°C]	-40...85



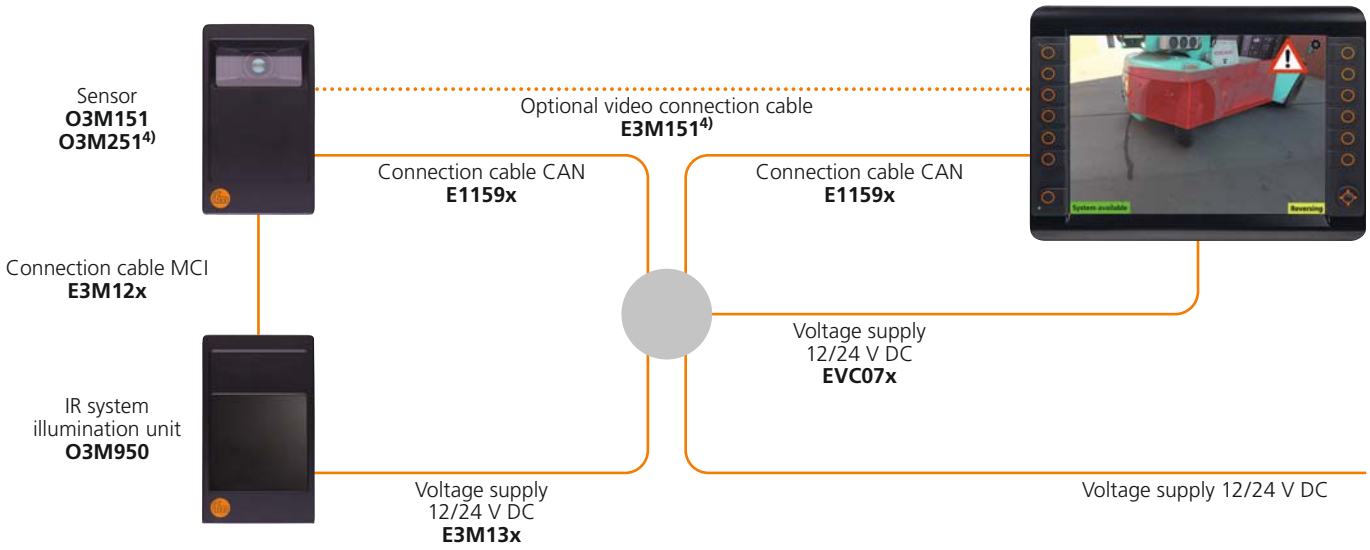
Further technical data devices with 2D camera		
Sensor type		1/4" 4:3 VGA CMOS image sensor colour
PAL resolution	[Pixel]	640 x 480

Note:
The 3D sensors of the O3M series can be used for example as driver assistance for collision warning or for area monitoring. They are photoelectric systems whose function may be impaired by heavy soiling, for example. This system does not meet the requirements of IEC 61496 for electro-sensitive protective equipment and must not be used for implementing a safety function for operator protection. The 3D sensors of the O3M series can be used to assist the machine operator. The machine operator is, however, always fully responsible.

Wiring for parameter setting



Wiring for installation



[4)] Type O3M251 provides an additional analogue video output

Learn more at www.ifm.com/gb/o3m

Technical data and accessories

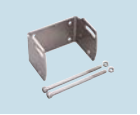
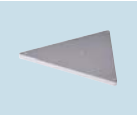
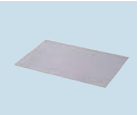
3D sensor system O3M

Application wizards Types O3M151 / O3M161

Application wizards available in the ifm Vision Assistant	Application examples
Collision warning as driver assistance	Monitoring the area behind the construction vehicles and fork lifts, monitoring the blind spots, recognition of collisions when moving forwards, collision recognition with dockside cranes.
Area surveillance for mobile or stationary machinery	Area surveillance on drilling rigs, waste disposal vehicles and cranes.
Automatic following for driverless transport vehicle	Automatic tracking of transport vehicles ahead and keeping safety distances.
Line guidance	Automatic windrow recognition and calculation of the volume flow, automatic steering of a grape harvester.

Accessories

Type	Description	Order no.
	CAN/RS232 USB Interface CANfox	**EC2112**
	Adapter cable set for CANfox	**EC2114**
	Operating software for vision sensors	**E3D300**
	Weather protective cover, stainless steel black	**E3M101**
	U-shaped bracket, suitable for sensor or illumination unit, stainless steel black	**E3M102**

Type	Description	Order no.
	U-shaped bracket, suitable for sensor or illumination unit, stainless steel	**E3M100**
	Mounting set for clamp mounting, Ø 14 mm, stainless steel / high-grade stainless steel	**E3M103**
	Reflector triangular, 200 mm	**E3M140**
	Reflective tape triangular, self-adhesive, 200 mm	**E3M141**
	Reflective tape 210 x 297 mm, self-adhesive	**E3M142**

Connection technology

Type	Description	Order no.
	TPU connection cable, connection sensor / system illumination unit, 0,25 m	**E3M120**
	MCI connection cable, connection sensor / system illumination unit, 1 m	**E3M121**
	MCI connection cable, connection sensor / system illumination unit, 2 m	**E3M122**
	MCI connection cable, connection sensor / system illumination unit, 3 m	**E3M123**
	M12 socket, voltage supply system illumination unit, 2 m, PUR cable, 4 poles	**E3M131**
	M12 socket, voltage supply system illumination unit, 5 m, PUR cable, 4 poles	**E3M132**
	M12 socket, voltage supply system illumination unit, 10 m, PUR cable, 4 poles	**E3M133**
	M12 video connection cable, connection sensor / display PDM360, 5 m	**E3M151**
	M12 video connection cable, connection sensor / display PDM360, 11 m	**E3M152**
	M12 video connection cable, connection sensor / display PDM360, 16 m	**E3M153**
	M12 video connection cable, connection sensor / display PDM360, 21 m	**E3M154**

Type	Description	Order no.
	M12 socket, CAN bus, 2 m, PUR cable, 5 poles	**E11596**
	M12 socket, CAN bus, 5 m, PUR cable, 5 poles	**E11597**
	Ethernet, cross-over patch cable, 2 m, PVC cable, M12 / RJ45	**E11898**
	Ethernet, cross-over patch cable, 10 m, PVC cable, M12 / RJ45	**E12204**
	Ethernet, cross-over patch cable, 20 m, PVC cable, M12 / RJ45	**E12205**
	Ethernet, cross-over patch cable, 2 m, PVC cable, M12 / RJ45, angled / straight	**E12226**
	M12 video extension cable, 5 m	**E3M159**
	M12 video adapter cable / Cinch plug for connection of a video grabber, 1 m	**E3M160**
	Video adapter cable M12 socket to M16 connector, for connection to MultiViewBox, 1 m	**E3M161**

Technical data and accessories

Heavy-duty universal camera O2M

Camera with analogue video output O2M

Type	Angle of aperture [°]	Mirror function	Order no.
CMOS camera	78	–	**O2M200**
CMOS camera	78	integrated	**O2M201**
CMOS camera	115	–	**O2M202**
CMOS camera	115	integrated	**O2M203**

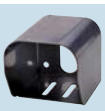
Technical data		
Type of sensor		1/4" 4:3 VGA CMOS image sensor colour
PAL resolution	[Pixel]	680 x 480
Image repetition rate	[fps]	25
Connection		Connection cable 0.5 m with M16 connector
Protection rating / protection class		IP 68 / IP 69K
Operating voltage	[V DC]	8...32
Ambient temperature	[°C]	-40...85
Lens heating		automatical

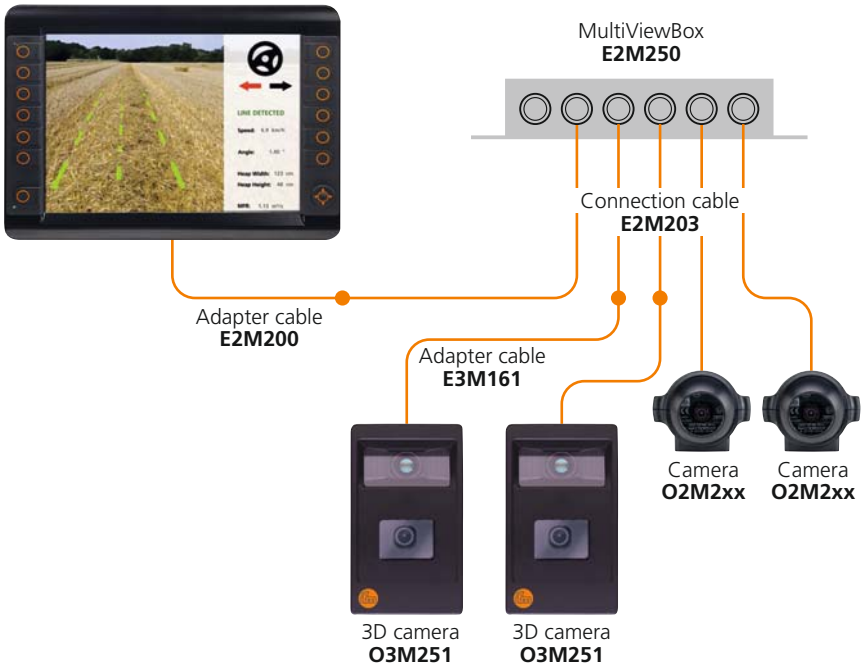
MultiViewBox

Type	Description	Order no.
	Video splitter, visualises up to 4 camera images (PAL) on a conventional monitor or a process and dialogue module	**E2M250**
	M16 connection cable, 3.85 m, 8 poles, for the voltage supply of the E2M250 MultiViewBox, open cable end	**E2M251**
	M16 socket, wirable, 8 poles, for the voltage supply of the E2M250 MultiViewBox	**E2M252**

Technical data	
Video signal	PAL, 720 H x 576 V (active 680 x 480)
Inputs	4
Connection	M16 connectors

Accessories

Type	Description	Order no.
	Protective metal cover, stainless steel	**E2M212**
	Dome fixture	**E2M211**
	Vibration damper set	**E2M213**
	Replacement fixture	**E2M210**



Connection technology

Type	Description	Order no.
	Adapter cable, M12 connector to M16 socket, black, PVC cable. To connect a camera to the PDM NG	E2M200
	Adapter cable, M12 connector to M16 socket, black, PVC cable. For connection of two cameras to the PDM NG	E2M201
	Connection cable, M16 connector to M16 socket, 5 m black, PVC cable	E2M203
	Connection cable, M16 connector to M16 socket, 11 m black, PVC cable	E2M204
	Connection cable, M16 connector to M16 socket, 16 m black, PVC cable	E2M205
	Connection cable, M16 connector to M16 socket, 21 m black, PVC cable	E2M206

Dialogue module PDM360 NG

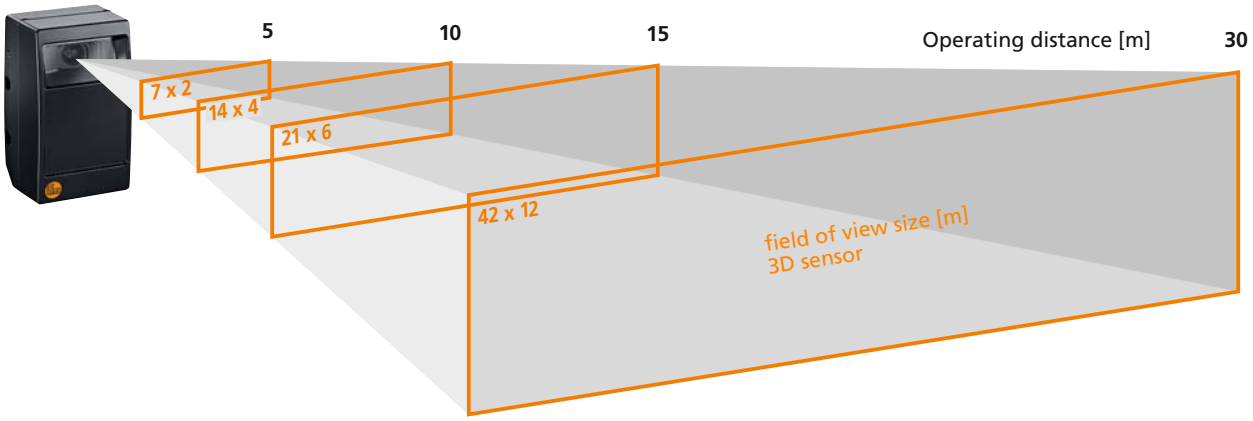
Type	Description	Order no.
	7" colour display, 9 function keys, navigation key, 2 x analogue video input, touch screen	CR1082
	7" colour display, 9 function keys, navigation key, 2 x analogue video input	CR1085
	7" colour display, 8 function keys, 2 x analogue video input	CR1083
	7" colour display, 9 function keys, encoder, 2 x analogue video input	CR1084
	12" colour display, 13 function keys, navigation key, 2 x analogue video input	CR1200
	12" colour display, 13 function keys, navigation key, 2 x analogue video input, touch screen	CR1201

Learn more at www.ifm.com/gb/o2m

Overview
Operating distance / field of view size

3D sensor system O3M

Type O3M150 / O3M151 / O3M250 / O3M251 angle of aperture 70° x 23°



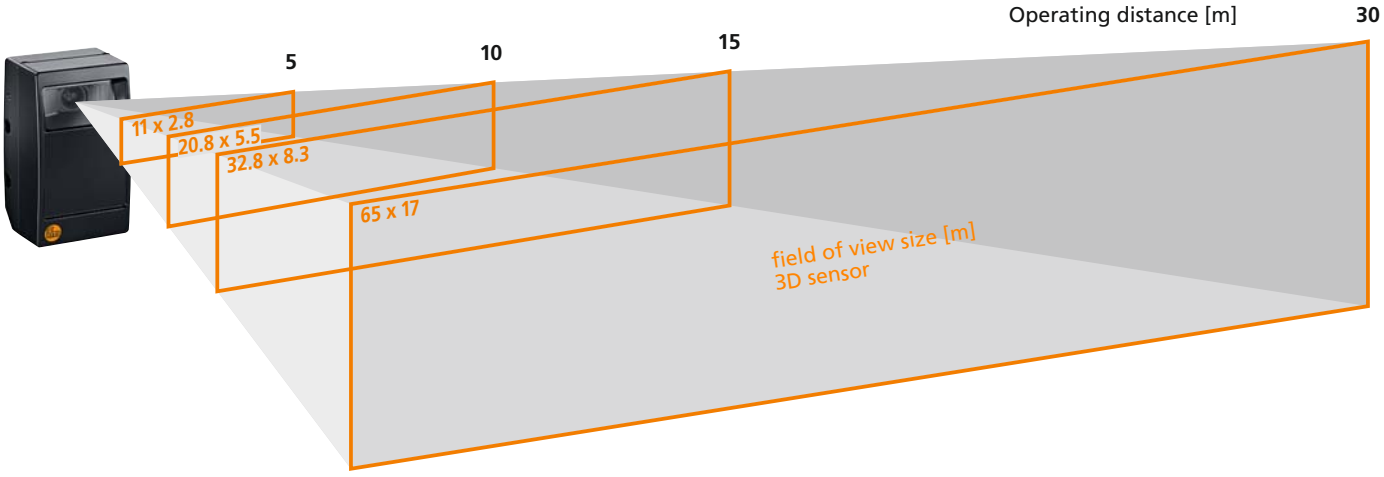
Type O3M151 / O3M251 measurement accuracy

Software version	Object type	Operating conditions	Measuring range for object recognition [m]	Typ. measuring range for ROI [m]	Typ. measurement accuracy [cm]
OD object recognition	vehicle	sunny (~120 kLux)	0.25...30	–	–
		cloudy (~20 kLux)	0.25...40	–	–
		darkness	0.25...50	–	–
OD object recognition	person[5)]	sunny (~120 kLux)	0.25...12	–	–
		cloudy (~20 kLux)	0.25...16	–	–
		darkness	0.25...20	–	–
OD object recognition	highly reflective object (e.g. high visibility vest)	sunny (~120 kLux)	1...40	–	–
		cloudy (~20 kLux)	1...60	–	–
		darkness	1...80	–	–
DI / BF distance image basic functions		sunny (~120 kLux)	–	0.25...12	± 15
		cloudy (~20 kLux)	–	0.25...15	± 10
		darkness	–	0.25...30	± 5

[5)] The term person is only to be understood as a reference for size

Note:
The 3D sensors of the O3M series can be used for example as driver assistance for collision warning or for area monitoring. They are photoelectric systems whose function may be impaired by heavy soiling, for example. This system does not meet the requirements of IEC 61496 for electro-sensitive protective equipment and must not be used for implementing a safety function for operator protection. The 3D sensors of the O3M series can be used to assist the machine operator. The machine operator is, however, always fully responsible.

Type O3M160 / O3M161 / O3M260[3] / O3M261[3] angle of aperture 95° x 32°



Type O3M161 / O3M261[3] measurement accuracy

Software version	Object type	Operating conditions	Measuring range for object recognition [m]	Typ. measuring range for ROI [m]	Typ. measurement accuracy [cm]
OD object recognition	vehicle	sunny (~120 kLux)	0.25...21	–	–
		cloudy (~20 kLux)	0.25...30	–	–
		darkness	0.25...35	–	–
OD object recognition	person[5]	sunny (~120 kLux)	0.25...9	–	–
		cloudy (~20 kLux)	0.25...12	–	–
		darkness	0.25...15	–	–
OD object recognition	highly reflective object (e.g. high visibility vest)	sunny (~120 kLux)	1...29	–	–
		cloudy (~20 kLux)	1...42	–	–
		darkness	1...55	–	–
DI / BF distance image basic functions		sunny (~120 kLux)	–	0.25...8	± 15
		cloudy (~20 kLux)	–	0.25...11	± 10
		darkness	–	0.25...21	± 5

[3] Types O3M260 / O3M261 available as of 2nd quarter of 2017

[5] The term person is only to be understood as a reference for size

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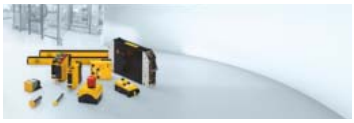

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