Distance sensors

Measurement from 20 mm to 250 m

Optical distance sensors

from Page 188

FT 25
- *Operating range (scanning distance) from 20 mm to 200 mm*
- *LED short-range distance sensors using the triangulation principle*
- *Miniature housing for simple integration*
- *Analogue output 0 … 10 V*

from Page 194

FT 50
- *Operating range (scanning distance) from 30 to 300 mm*
- *High absolute accuracy*
- *High measurement frequency*
- *Laser distance sensors using the triangulation principle*
- *High precision thanks to resolution of up to 7 µm*
- *RS485 and analogue interfaces*

from Page 194

FT 80
- *Operating range (scanning distance) from 250 mm to 750 mm*
- *High repeatability*
- *Laser distance sensors using the triangulation principle*
- *RS485 and analogue interfaces*

from Page 206

F 55 / F 90 / F 91 / F 92
- *Laser distance sensors using the time-of-flight principle*
- *Scanner versions up to measurement distance of 10 m*
- *Reflector versions up to 250 m range*
- *Wide choice of interfaces (serial and analogue)*

Rapid and precise measurement, accurate positioning, and detection of the most varied of materials – distance measurement is a central requirement in many areas of automation technology. Whether for checking the winding of coils with millimetre accuracy, the detection of double sheets, or the accurate positioning of storage and retrieval machines – distance sensors from SensoPart are reliable tools for many purposes in the following sectors:

- The automotive and supplier industries
- Mechanical engineering and special machine construction
- Assembly and handling
- The packaging industry
- Handling and warehousing systems
- The steel industry
- The textile and paper industries
- The wood industry

The technologies used are as varied as the applications.
Our optical sensors use the triangulation process for operating ranges below 1 m, and time-of-flight measurement for longer operating distances. Apart from optical sensors, ultrasonic sensors are also used for transparent or strongly reflective materials, in particular, and inductive sensors are employed for metal objects at close-range and in harsh operating conditions.

Monorail system with car bodies in the automotive industry

Car production
Positioning the body using distance sensors

from Page 226

FR 85 Rail Pilot

- *Distance sensors using the time-of-flight principle*
- *Specialised solution for anti-collision applications on monorails*
- *Cornering also possible*
- *Large aperture angle, thus long detection range*

Ultrasonic distance sensors from Page 594

- *Distance sensors using the ultrasonic time-of-flight principle*
- *Cubic and cylindrical housings*
- *Large portfolio for differing measurement ranges*
- *Reliable operation with all surfaces and colours – and especially with transparent objects*

Inductive distance sensors from Page 644

- *Long switching distances up to 10 mm with accurate linear measurement range*
- *Distance measurement on metals according to the inductive principle*
- *Various housings*
- *High accuracy and long linear measurement range*

Eyesight vision systems from Page 142

- *2D camera technology for measuring e.g. moulded and turned parts*
- *Versatile measurement tool for all dimensional accuracy tasks*
- *Image and result visualisation in inspection mode*

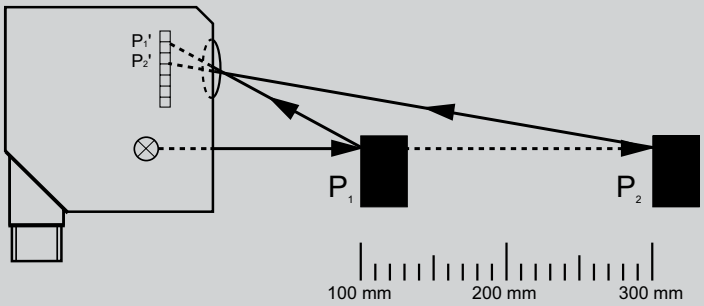
Distance sensors

System description

Distance measurement using triangulation

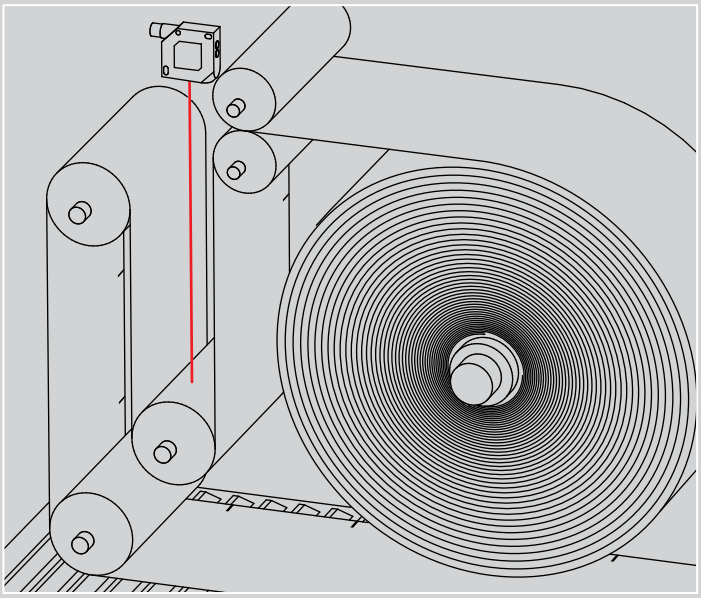
The measurement principle of optical triangulation is suitable for the precise determination of distances at close range. With the help of special receiver optics and a position-sensitive detector (e.g. a photodiode line), the sensor can determine the object distance regardless of its reflectivity (see illustration below). The colour and surface properties (e.g. highly reflective) thus have practically no effect on measurement accuracy.

The FT 50 RLA laser distance sensor provides a signal proportional to the distance, transmitted via the analogue output (e.g. 4 ... 20 mA) or a serial RS485 interface. The switching range of the digital outputs can be set to any zone within the operating range using teach-in.



The triangulation process: with the help of a line-shaped position-sensitive detector, the distance sensor measures the distance to the object regardless of the amount of light reflected.

The light reflected back from the object (P_1) hits the line at point P_1. The sensor determines the distance signal from this. The light correspondingly hits the detector at a different point (P_2) at object distance P_2.



Dancer roll control using the FT 50 RLA-220 laser distance sensor

Collision prevention sensors for monorails

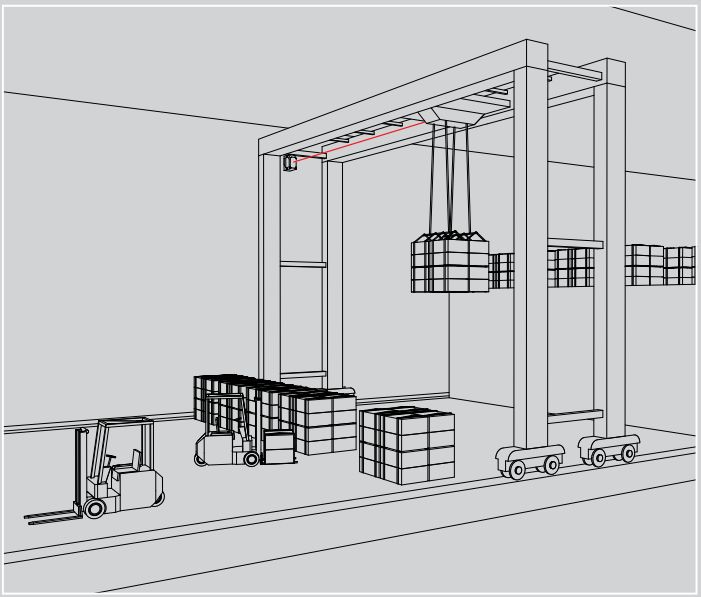
Collision prevention on monorail systems in car production is a special distance measurement task. The FR 85 series was specially developed for this application. These sensors provide excellent measurement results regardless of the reflectivity of the target object, and their comprehensive range of functions is impressive.

The FR 85 offers high measurement accuracy and immunity to ambient light because it is based on time-of-flight technology. A long measurement range (up to 6 m) and flexibly adjustable protection field geometries allow adaptation to the situation on site, even when cornering.

Distance measurement using time-of-flight

SensoPart uses time-of-flight technology to measure longer distances (up to 250 m). The sensor emits pulsed laser light that is reflected by the target object. The distance to the object is determined by the time taken between emission and reception of the light.

The use of pulsed light provides reliable background suppression and very high immunity to ambient light. The distance sensors of the F 90 series, using time-of-flight technology, measure distances of up to 250 m with a high level of accuracy. The sensors are particularly suitable for use on production lines and in handling and warehousing systems due to their reliable detection and long ranges or scanning distances.



Crane positioning with FR 92 distance sensor

Inductive analogue sensors

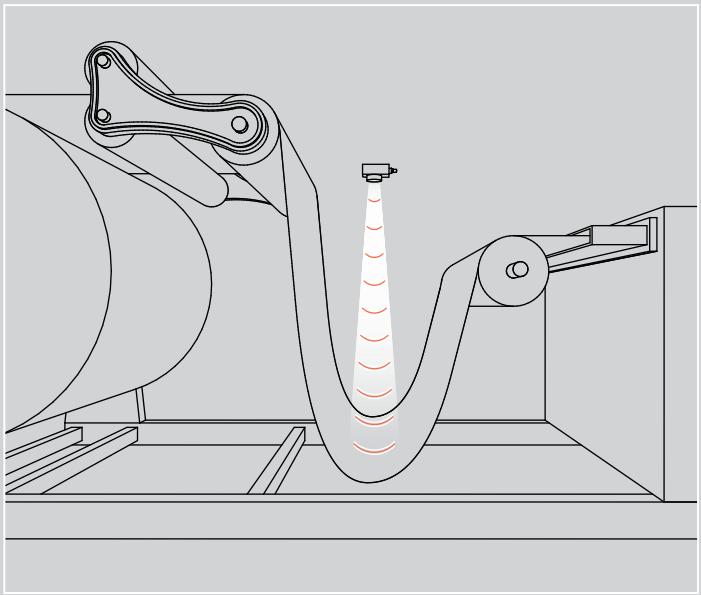
The reasonably priced solution for metallic objects. Compared to optical or ultrasonic sensors, inductive distance sensors have only limited ranges. They are still used under harsh conditions, in particular, as a result of their great robustness.

- Inductive distance sensors with analogue output of 4 … 20 mA
- Operating range of 0 … 6 mm to 4.5 … 12 mm
- Falling characteristic line on approach
- Robust metal housings

Ultrasonic sensors

Ultrasonic sensors are the right choice for materials with which optical systems cannot be reliably operated. Ultrasonic sensors work using the time-of-flight of sound. The sensor emits ultrasonic pulses. The target object reflects the sound. The sensor measures the time-of-flight of the pulse and calculates the distance value. This value is transmitted to the controller as a current or voltage signal.

- Operating ranges from 20 … 6000 mm
- Operating range and analogue output adjustable via teach-in
- Analogue output 0 … 10 V / 4 … 20 mA



Monitoring throughput with the UT 20 ultrasonic sensor

FT 25-RA – optical short-range distance sensors

The compact class for measurement and regulatory tasks

FT 25-RA for dancer roll regulation
The precise control of the FT 25-RA ensures a constant tension of the paper roll during unwinding.

TYPICAL FT 25-RA

- Operating range: 20 ... 80 mm / 30 ... 200 mm
- Distance sensor with 1 … 10 V analogue output
- Easily integratable ultra-compact ABS housing: 34 x 12 x 20 mm
- High precision and high repeatability – especially for control tasks
- Resolution: from 0.12 mm
- Two adjustable switching points as window mode for 2-point control
- Teach-in operation

In a miniature housing
The FT 25-RA is also suitable for limited installation spaces thanks to its compact dimensions of 34 x 12 x 20 mm³.

In addition to its analogue voltage output the small distance sensors also have a switching output and offer the possibility of defining a switching window by means of two switching points. Thanks to their simple operation, these sensors are suitable for straightforward measurement and control tasks at distances of up to 200 mm.

Key applications:

- Dancer roll regulation, sag monitoring
- Determining the roll diameter of an unwinding machine
- Stacking height measurement, double layer detection and height measurements in the wood processing, packaging- and handling industry
- Distance measurement and positioning on robot grippers in „pick & place“ applications

FT 25-RA / FT 20 RA – Product Overview			
	Operating range	Special features	Page
FT 25-RA	20 … 80 mm / 30 ... 200 mm	Small housing with long range	190
FT 20 RA	20 … 80 mm	Small housing	192

FT 25-RA

Miniature distance sensor

PRODUCT HIGHLIGHTS

- Miniature housing with measurement ranges up to 200 mm for an easy integration and high flexibility
- High linearity and high repeatability for precise control tasks
- Almost surface independant detection on homogeneous object surfaces
- Invertible analogue characteristic
- Window mode e.g. for two-step controls separately adjustable

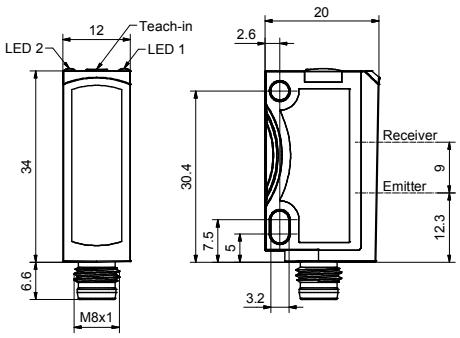
Optical data			Functions	
Measurement range	20 … 80 mm[1]	30 … 200 mm[1]	Indicator LED, green	Operating voltage indicator
Resolution	0.12 mm (12-bit)	0.68 mm (12-bit)	Indicator LED, yellow	Switching output indicator
Linearity	± 0.4 mm[2]	± 2 mm[2]	Measurement range adjustment	Via Teach-in button
Repeatability	< 0.4 mm[2, 3]	< 1 mm[2, 3]	Adjustment possibilities	Analogue measurement range Q_A Invertible analogue characteristic Switching output Q (window mode) N.O./N.C. via teach-in button
Type of light	LED, red, 632 nm	LED, red, 632 nm	Default settings	See Table

Electrical data		Mechanical data	
Operating voltage, $+U_B$	13 … 30 V DC	Dimensions	34 x 20 x 12 mm
No-load current, I_0	≤ 30 mA	Enclosure rating	IP 67 / IP 69K[4]
Output current, le Q	≤ 100 mA	Material, housing	ABS
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection (Q)	Material, front screen	PMMA
Protection Class	2	Type of connection	See Selection Table
Power On Delay	< 300 ms	Ambient temperature: operation	-20 … +60 °C[5]
Switching output, Q	PNP/NPN (See Selection Table)	Ambient temperature: storage	-20 … +80 °C
Output function	N.O./N.C.	Weight (metal plug device)	10 g
Max. capacitive load Q	10 nF	Resistance to vibrations and impacts	EN 60947-5-2
Switching frequency, f (ti/tp 1:1) Q	≤ 1000 Hz		
Response time Q	500 µs		
Analogue output Q_A	1 … 10 V / max. 3 mA		
Response time Q_A	400 µs (FT 25-RA-60) 3.4 ms (FT 25-RA-170)		
Warm-up time	10 min.		
Temperature drift	< 0.1 mm/K (FT 25-RA-60) < 0.2 mm/K (FT 25-RA-170)		

[1] Reference material: 6…90 % reflectivity [2] Reference material grey, 18 % reflectivity [3] At constant ambient conditions [4] With connected IP 67 / IP 69K plug [5] UL: -20°C...+50 °C

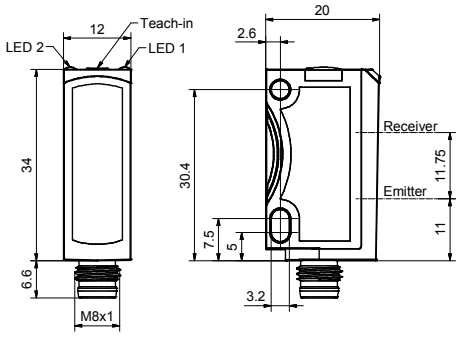
Measurement range	Analogue output	Switching output	Type of connection	Part number	Article number
20 ... 80 mm	1 ... 10 V	PNP	Metal plug, M8x1, 4-pin	FT 25-RA-60-PSU-M4M	604-41000
20 ... 80 mm	1 ... 10 V	NPN	Metal plug, M8x1, 4-pin	FT 25-RA-60-NSU-M4M	604-41001
30 ... 200 mm	1 ... 10 V	PNP	Metal plug, M8x1, 4-pin	FT 25-RA-170-PSU-M4M	604-41002
30 ... 200 mm	1 ... 10 V	NPN	Metal plug, M8x1, 4-pin	FT 25-RA-170-NSU-M4M	604-41003

Plug connection (20 ... 80 mm)



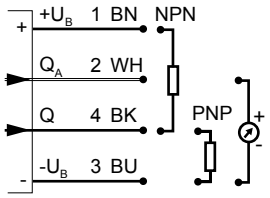
153-00839

Plug connection (30 ... 200 mm)



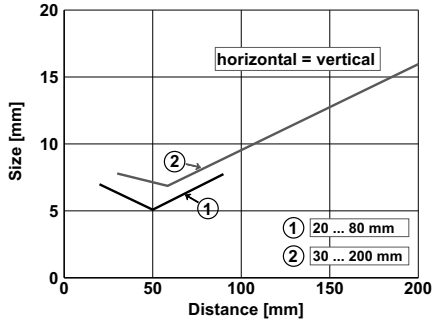
153-00837

Connection, 4-pin



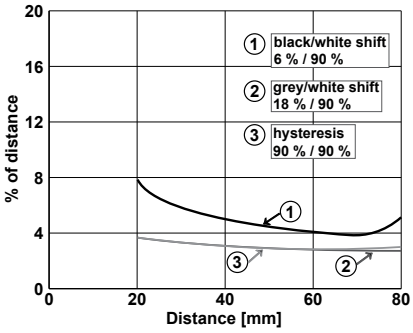
154-00543

Light spot size



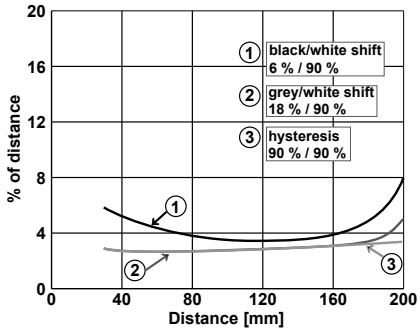
155-01663

Scanning properties FT 25-RA-60



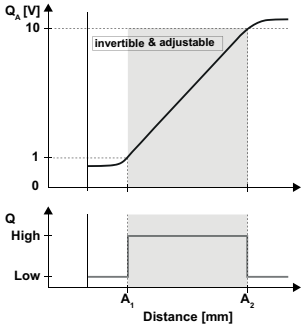
155-01666

Scanning properties FT 25-RA-170



155-01667

Characteristic output and analogue curves



155-01661

155-01681

Default settings

	FT 25-RA-60	FT 25-RA-170
Analogue output Q$_A$ (1 ... 10 V)	20 ... 80 mm	30 ... 200 mm
Switching output Q (A1 ... A2), N.O.	20 ... 80 mm	30 ... 200 mm

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 20 RA

Distance sensor

PRODUCT HIGHLIGHTS

- Operating range 20 … 80 mm
- Analogue output 0 … 10 V
- Simple teach-in
- Adjustable switching window (switch on/off points) for e.g. two-point control
- Red light (660 nm)

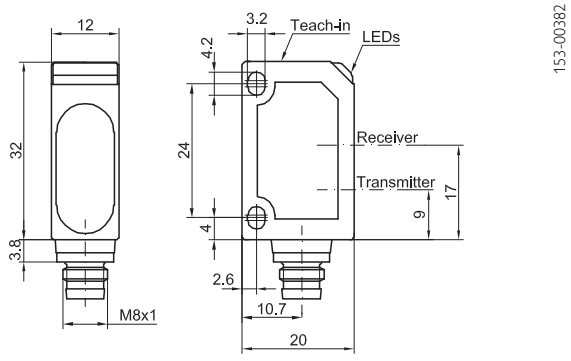
Optical data		Functions	
Operating range	20 … 80 mm[1]	Indicator LED, green	Operating voltage indicator
Measurement range	60 mm	Indicator LED, yellow	Switching output indicator
Type of light	LED, red, 660 nm	Scanning distance adjustment	Via Teach-in button
Resolution	≈ 2 % distance (measurement value)		
Linearity	< 1 %		

Electrical data		Mechanical data	
Operating voltage, $+U_B$	15 … 30 V DC	Dimensions	32 x 20 x 12 mm
No-load current, I_0	≤ 30 mA	Enclosure rating	IP 67[2]
Output current, Ie	≤ 100 mA	Material, housing	ABS
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection (Q)	Material, front screen	PMMA
		Type of connection	See Selection Table
Protection Class	2	Ambient temperature: operation	-20 … +60 °C
Switching output, Q	PNP	Ambient temperature: storage	-20 … +80 °C
Output function	N.O./N.C.	Weight (metal plug device)	10 g
Analogue output	0 … 10 V / max. 3 mA	Weight (cable device)	40 g
Limit frequency, analogue output	≤ 200 Hz		
Load	≥ 10 kΩ		
Switching frequency, f (ti/tp 1:1)	≤ 1000 Hz		
Response time	500 µs		

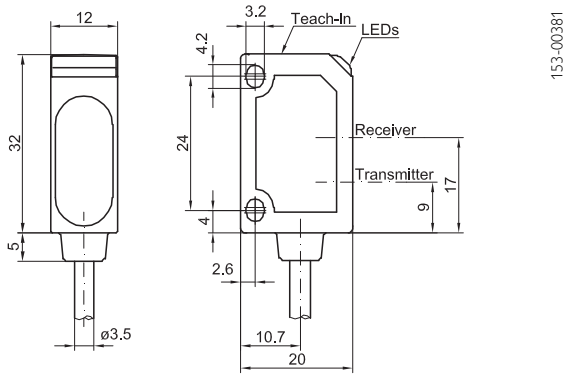
[1] Reference material: Kodak white, 90 % [2] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M8, 4-pin	FT 20 RA-60-F-M4	554-11000
Cable, 2 m, 4-wire	FT 20 RA-60-F-K4	554-11001

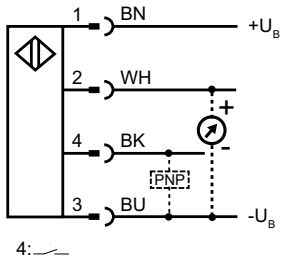
Plug connection



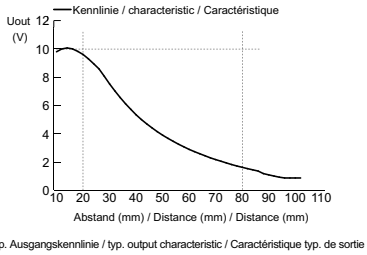
Cable connection



Connection, 4-pin



Characteristic output curve



Typ. Ausgangskennlinie / typ. output characteristic / Caractéristique typ. de sortie

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 50 / FT 80 – laser distance sensors

Precise and rapid measurement with many extras

Independent of reflectivity
These highly precise triangulation sensors are predestined for the detection of differing materials thanks to their high contrast-independence.

TYPICAL FT 50 / FT 80

- Laser distance sensors with a variety of measurement ranges
- Shape and colour of the target object is largely irrelevant
- High accuracy and resolutions up to 7 µm
- Rapid response time up to 1 kHz
- Intelligent teach-in user concept
- 2 switching outputs
- Analogue output: 4 … 20 mA / 0 … 10 V
- Variants with serial interface for measuring differences and thicknesses in master/slave mode
- ABS housing with rotatable plug

These distance sensors are particularly easy to commission thanks to their fixed operating distances. Voltage rises linearly with increasing distance.

Regardless of the reflectivity of the target object, these sensors provide excellent measurement results and their comprehensive range of functions is impressive.

The optional serial interface allows user-friendly configuration via PC, providing visualisation of measurement values.

FT 50 / FT 80 – Product Overview				
	Housing dimensions	Operating range	Special features	Page
FT 50 RLA-20	50 x 17 x 50 mm	40 … 60 mm	Analogue output	196
FT 50 RLA-40	50 x 17 x 50 mm	45 … 85 mm	Analogue output	198
FT 50 RLA-70 -100 -220	50 x 17 x 50 mm	30 … 100 mm 70 … 170 mm 80 … 300 mm	Analogue output, switching outputs, simple teach-in of measurement ranges; RS485 interface	200
FT 80 RLA-500	83 x 25 x 65 mm	250 … 750 mm	Analogue output, switching outputs, RS485 interface; M12 8-pin	204

FT 50 RLA 20

Distance sensor

PRODUCT HIGHLIGHTS

- High resolution and small laser light spot
- Operating range: 40 … 60 mm
- Small, easily visible laser light spot
- No adjustments necessary
- Resolution: 7 µm / 40 µm
- Analogue output: 0 … 10 V
- Device plug rotatable through 270°

Optical data	
Operating range	40 … 60 mm[1]
Measurement range	20 mm
Type of light	Laser, red, 670 nm
Laser Class (DIN EN 60825-1:2008-5)	2
Resolution	40 µm / 7µm (see Selection Table)
Linearity	< 1 %
Light spot size	< 1 mm bei 50 mm
Repeatability	< 0.1 mm / 0.05 mm (see Selection Table)

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, red	Contamination indicator
Scanning distance adjustment	Fixed setting

Electrical data	
Operating voltage, $+U_B$	18 … 28 V DC
No-load current, I_0	≤ 35 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Analogue output	0 … 10 V / max. 3 mA
Limit frequency	400 Hz / 40 Hz (see Selection Table)
Temperature drift	10 µm / K
Rise time (10 to 90 %)	3 ms / 30 ms (see Selection Table)
Fall time (90 to 10 %)	2 ms / 20 ms (see Selection Table)

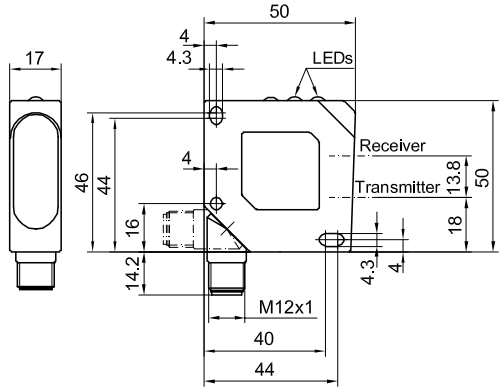
Mechanical data	
Dimensions	50 x 50 x 17 mm
Enclosure rating	IP 67[2]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	0 … +45 °C
Ambient temperature: storage	-20 … +60 °C
Weight (plug device)	40 g
Weight (cable device)	260 g
Vibration and impact resistance	EN 60947-2

[1] Reference material: Kodak grey, 18 % [2] With connected IP 67 plug

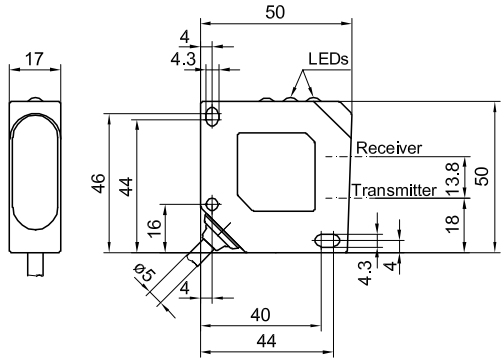
Resolution	Repeatability	Rise time	Fall time	Limit frequency	Type of connection	Part number	Article number
40 µm	< 0.1 mm	3 ms	2 ms	400 Hz	Plug, M12x1, 4-pin	FT 50 RLA-20-F-L4S	574-41005
7 µm	< 0.05 mm	30 ms	20 ms	40 Hz	Plug, M12x1, 4-pin	FT 50 RLA-20-S-L4S	574-41007
40 µm	< 0.1 mm	3 ms	2 ms	400 Hz	Cable, 6 m, 4-wire	FT 50 RLA-20-F-K5	574-41004
7 µm	< 0.05 mm	30 ms	20 ms	40 Hz	Cable, 6 m, 4-wire	FT 50 RLA-20-S-K5	574-41006

Version: 07/2015. Subject to changes; diagrams similar

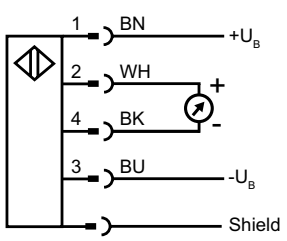
Plug connection



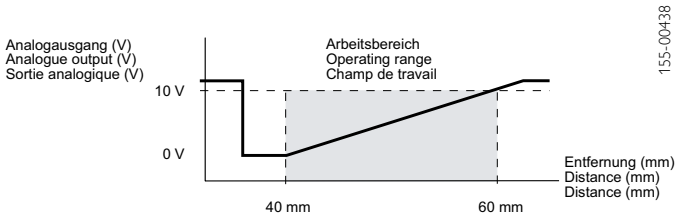
Cable connection



Connection, 4-pin



Characteristic output curve



Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 50 RLA 40

Distance sensor

PRODUCT HIGHLIGHTS

- High resolution and small light spot
- Operating range: 45 … 85 mm
- Laser red light (670 nm)
- Small, easily visible light spot
- No adjustments necessary
- Resolution: 0.02 mm / 0.08 mm
- Analogue output: 0 … 10 V
- Device plug rotatable through 270°

Optical data		Functions	
Operating range	45 … 85 mm[1]	Indicator LED, green	Operating voltage indicator
Measurement range	40 mm	Indicator LED, red	Contamination indicator
Type of light	Laser, red, 670 nm	Scanning distance adjustment	Fixed setting
Laser Class (DIN EN 60825-1:2008-5)	2		
Resolution	80 µm / 20 µm (see Selection Table)		
Linearity	< 1 %		
Light spot size	< 0.8 mm at 65 mm		
Repeatability	< 0.2 mm / 0.1 mm (see Selection Table)		

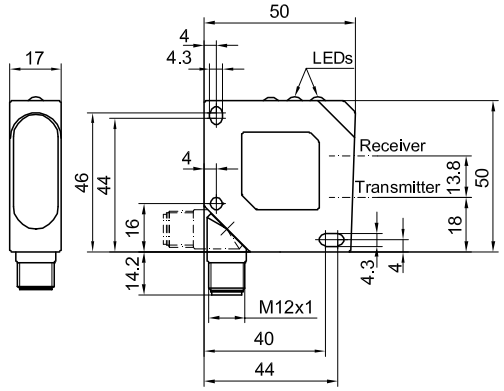
Electrical data		Mechanical data	
Operating voltage, $+U_B$	18 … 28 V DC	Dimensions	50 x 50 x 17 mm
No-load current, I_0	≤ 35 mA	Enclosure rating	IP 67[2]
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q	Material, housing	ABS, impact-resistant
		Material, front screen	PMMA
Protection Class	2	Type of connection	See Selection Table
Analogue output	0 … 10 V (max. 3 mA)	Ambient temperature: operation	0 … +45 °C
Limit frequency	400 Hz / 40 Hz (See Selection Table)	Ambient temperature: storage	-20 … +60 °C
Temperature drift	18 µm / K	Weight (plug device)	40 g
Rise time (10 to 90 %)	3 ms / 30 ms (See Selection Table)	Weight (cable device)	260 g
Fall time (90 to 10 %)	2 ms / 20 ms (See Selection Table)	Vibration and impact resistance	EN 60947-2

[1] Reference material: Kodak grey, 18 % [2] With connected IP 67 plug

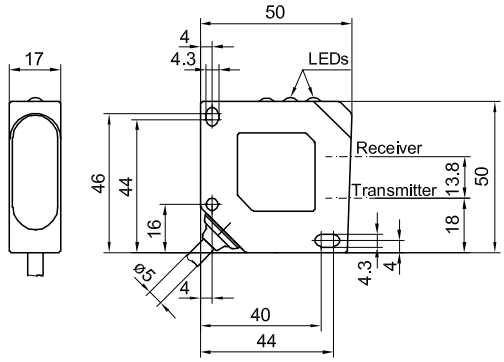
Resolution	Repeatability	Rise time	Fall time	Limit frequency	Type of connection	Part number	Article number
80 µm	< 0.2 mm	3 ms	2 ms	400 Hz	Plug, M12x1, 4-pin	FT 50 RLA-40-F-L4S	574-41001
20 µm	< 0.1 mm	30 ms	20 ms	40 Hz	Plug, M12x1, 4-pin	FT 50 RLA-40-S-L4S	574-41003
80 µm	< 0.2 mm	3 ms	2 ms	400 Hz	Cable, 6 m, 4-wire	FT 50 RLA-40-F-K5	574-41000
20 µm	< 0.1 mm	30 ms	20 ms	40 Hz	Cable, 6 m, 4-wire	FT 50 RLA-40-S-K5	574-41002

Version: 07/2015. Subject to changes; diagrams similar

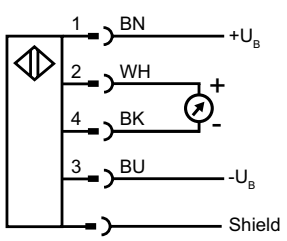
Plug connection



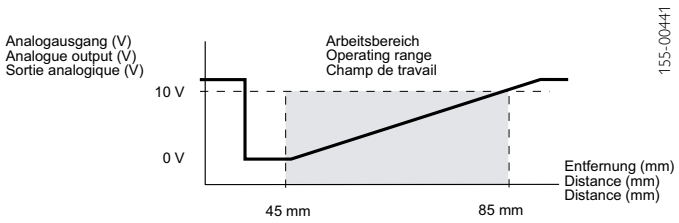
Cable connection



Connection, 4-pin



Characteristic output curve



Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 50 RLA 70 / 100 / 220

Distance sensor

PRODUCT HIGHLIGHTS

- Precise distance measurement
- Largely independent of target object reflectivity (highly reflective and glossy objects)
- High long-term stability and low temperature effects
- High resolution
- Very high update rate of analogue output (response time)
- One switching output, one analogue output 4 ... 20 mA
- Simple adjustment via teach-in button

Optical data	
Operating range	30 … 100 mm / 70 … 170 mm / 80 … 300 mm[1]
Measurement range	70 mm, 100 mm, 220 mm
Type of light	Laser, red, 650 nm
Laser Class (DIN EN 60825-1:2008-5)	2
Resolution	< 0.1 % of operating range end-value[2] (see Selection Table)
Linearity	< 0.25 % of operating range end-value (see Selection Table)
Repeatability	< 0.25 % of measurement value

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input
Adjustment possibilities	N.O. / N.C. via Teach-in button and control input Button lock via control input

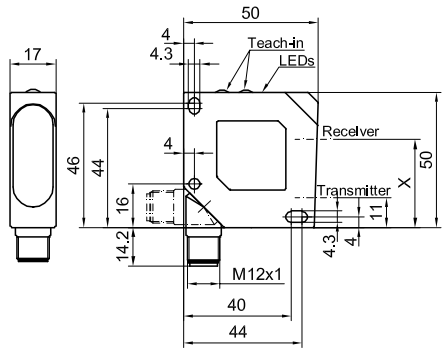
Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC
No-load current, I_0	≤ 40 mA
Output current, Ie	≤ 100 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Power On Delay	< 300 ms
Switching output, Q	PNP
Output function	N.O. / N.C.
Max. capacitive load, Q	< 100 nF
Analogue output	4 … 20 mA
Temperature drift	< 0.02 % of operating range end-value / K
Load	≤ 500 Ω (recommended)
Switching frequency, f (ti/tp 1:1)	≤ 1 kHz (speed mode) ≤ 10 Hz (averaging mode)
Response time	0.4 ms (speed mode) 40 ms (averaging mode)
Control input, IN	When High ($+U_B$) = laser disable When Low ($-U_B$) = button lock When open = free-running

Mechanical data	
Dimensions	50 x 50 x 17 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +60 °C
Ambient temperature: storage	-20 … +80 °C
Weight	43 g
Vibration and impact resistance	EN 60947-2

[1] Reference material: Kodak grey, 18 % [2] Smallest measurable change [3] With connected IP 67 plug

Operating range	Measurement range	Resolution	Linearity	Type of connection	Part number	Article number
30 … 100 mm	70 mm	0.1 mm	0.25 mm	Plug, M12x1, 5-pin	FT 50 RLA-70-PL5	574-41027
70 … 170 mm	100 mm	0.17 mm	0.42 mm	Plug, M12x1, 5-pin	FT 50 RLA-100-PL5	574-41032
80 … 300 mm	220 mm	0.3 mm	0.75 mm	Plug, M12x1, 5-pin	FT 50 RLA-220-PL5	574-41029

Plug connection



153-00716

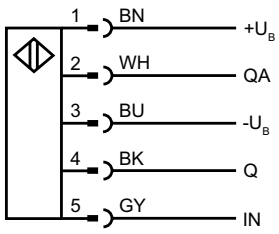
Type

FT 50 RLA 70
FT 50 RLA 100
FT 50 RLA 220

X (distance, receiver)

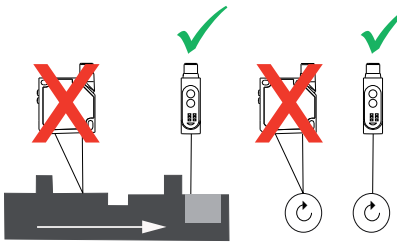
29.4 mm
32.5 mm
32.5 mm

Connection, 5-pin

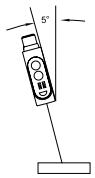


154-00176

Installation



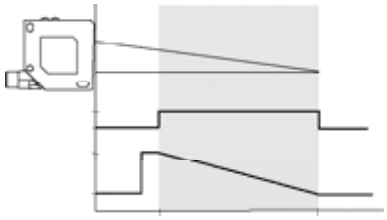
155-00270



155-00274

Characteristic analogue curve

Operating range (default setting)



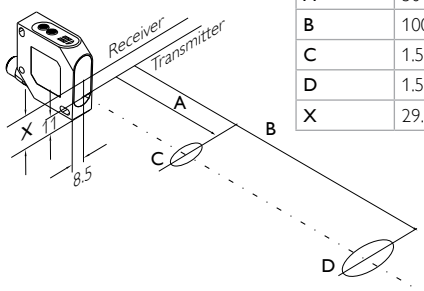
OK LED (green)
(Good Target)

Analogue output
(invertible)

FT 50 RLA 70	30 mm	100 mm
FT 50 RLA 100	70 mm	170 mm
FT 50 RLA 220	80 mm	300 mm

155-00271

Light spot geometry



FT 50 RLA	70 …	100 …	220 …
A	30	70	80
B	100	170	300
C	1.5 x 3	1.5 x 3.5	1.5 x 3.5
D	1.5 x 3.25	1.7 x 3.9	2 x 4.5
X	29.4	32.5	32.5

155-00269

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 50 RLA 70 / 100 / 220

Distance sensor with RS485 interface

PRODUCT HIGHLIGHTS

- Largely independent of target object reflectivity (highly reflective and glossy objects)
- RS485 interface for parameterisation and measurement value output
- High resolution
- Rapid response time
- 2 switching outputs, 1 analogue output 4 ... 20 mA
- High long-term stability and low temperature effects

Optical data	
Operating range	30 … 100 mm / 70 … 170 mm / 80 … 300 mm[1]
Measurement range	70 mm, 100 mm, 120 mm
Type of light	Laser, red, 650 nm
Laser Class (DIN EN 60825-1:2008-5)	2
Resolution	< 0.1 % of operating range end-value (0.1 mm / 0.17 mm/ 0.3 mm)[2]
Linearity	< 0.25 % of operating range end-value (0.25 mm / 0.42 mm / 0.75 mm)
Repeatability	< 0.25 % of measurement value

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input
Adjustment possibilities	N.O. / N.C. via Teach-in button and control input Button lock via control input
Default settings	Max. scanning distance and N.O.

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC
No-load current, I_0	≤ 40 mA
Output current, Ie	≤ 100 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q (not Type S1)
Protection Class	2
Power On Delay	≤ 300 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O. / N.C.
Analogue output	4 … 20 mA
Temperature drift	< 0.02 % of operating range end-value / K
Load	≤ 500 Ω
Switching frequency, f (ti/tp 1:1)	≤ 1000 Hz
Response time	≥ 0.4 ms (when mean value formation = off) / 4 ms / 40 ms to end-value
Serial interface	See Selection Table

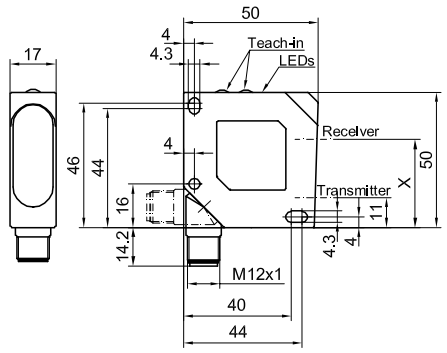
Mechanical data	
Dimensions	50 x 50 x 17 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +60 °C
Ambient temperature: storage	-20 … +80 °C
Weight	43 g
Vibration and impact resistance	EN 60947-2

[1] Reference material: Kodak grey, 18 % [2] Smallest measurable change [3] With connected IP 67 plug

Scanning distance	Measurement range	Resolution	Linearity	Serial interface	Type of connection	Part number	Article number
30 … 100 mm	70 mm	0,1 mm	0,25 mm	–	Plug, M12x1, 8-pin	FT 50 RLA-70-L8	574-41018
30 … 100 mm	70 mm	0,1 mm	0,25 mm	RS485	Plug, M12x1, 8-pin	FT 50 RLA-70-S1L8	574-41019
70 … 170 mm	100 mm	0,17 mm	0,42 mm	RS485	Plug, M12x1, 8-pin	FT 50 RLA-100-S1L8	574-41033
80 … 300 mm	220 mm	0,3 mm	0,75 mm	–	Plug, M12x1, 8-pin	FT 50 RLA-220-L8	574-41014
80 … 300 mm	220 mm	0,3 mm	0,75 mm	RS485	Plug, M12x1, 8-pin	FT 50 RLA-220-S1L8	574-41015

Version: 07/2015. Subject to changes; diagrams similar

Plug connection

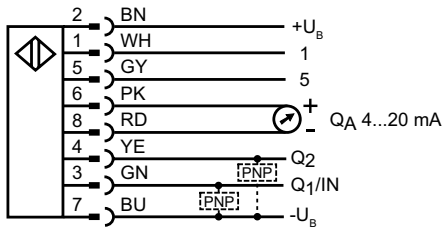


153-00716

Type	X (distance, receiver)
FT 50 RLA 70	29,4 mm
FT 50 RLA 100	32,5 mm
FT 50 RLA 220	32,5 mm

6

Connection, 8-pin

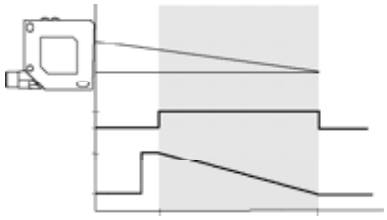


154-00127

Type	Pin 1	Pin 5
FT 50 RLA -S1L8.	RS485 Y/A	RS485 Z/B
FT 50 RLA -L8.	–	–

Characteristic analogue curve

Operating range (default setting)



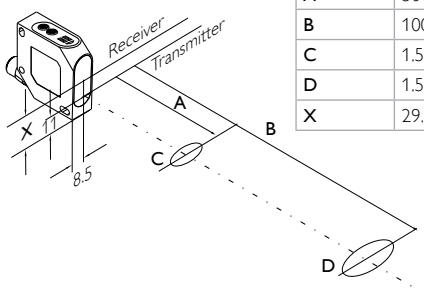
OK LED (green)
(Good Target)

Analogue output
(invertible)

FT 50 RLA 70	30 mm	100 mm
FT 50 RLA 100	70 mm	170 mm
FT 50 RLA 220	80 mm	300 mm

155-00271

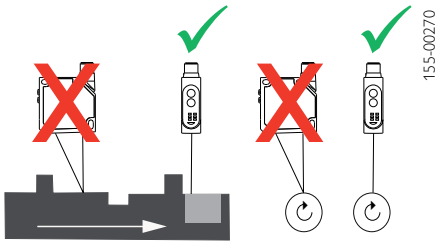
Light spot geometry



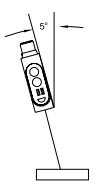
FT 50 RLA	70 …	100 …	220 …
A	30	70	80
B	100	170	300
C	1.5 x 3	1.5 x 3.5	1.5 x 3.5
D	1.5 x 3.25	1.7 x 3.9	2 x 4.5
X	29.4	32.5	32.5

155-00269

Installation



155-00270



155-00274

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

FT 80 RLA

Distance sensor with RS485 interface

PRODUCT HIGHLIGHTS

- Long operating distance
- 2 switching outputs + analogue output: 4 … 20 mA
- High resolution (0.1% of measurement range)
- Type S1 with serial Bus interface (RS485 half-duplex)
- Adjustable via Teach-in; Type S1 also via software
- Wide range of functions

Optical data	
Operating range	250 … 750 mm[1]
Measurement range	500 mm
Type of light	Laser, red, 650 nm
Laser Class (DIN EN 60825-1:2008-5)	2
Resolution	< 0.1 % of measurement range end-value
Linearity	< 0.25 % of measurement range end-value

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Indicator LED, red	State indicator
Scanning distance adjustment	Via Teach-in button and control input
Adjustment possibilities	Button lock via control input
Default settings	Max. scanning distance and N.O.

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC
No-load current, I_0	≤ 40 mA
Output current, Ie	≤ 100 mA
Protective circuits Temperature drift	Reverse-polarity protection, U_B / short-circuit protection, Q (not Type S1)
Protection Class	2
Power On Delay	≤ 300 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O. / N.C.
Analogue output	4 … 20 mA
Temperature drift	< 0.02 % of operating range end-value / K
Load	≤ 500 Ω (recommended)
Switching frequency, f (ti/tp 1:1)	≤ 1000 Hz
Response time	≥ 0.4 ms (when mean value formation = off) / 4 ms / 40 ms to end-value
Serial interface	See Selection Table

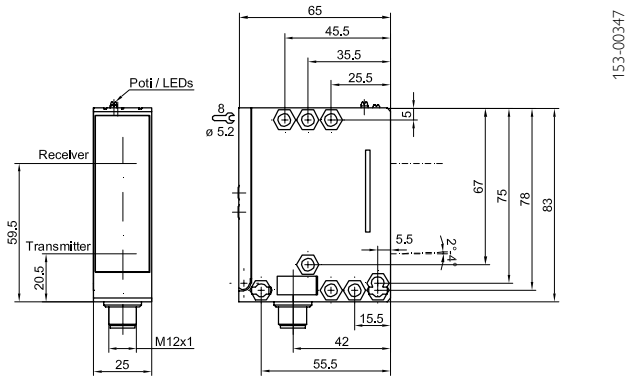
Mechanical data	
Dimensions	83 x 65 x 25 mm
Enclosure rating	IP 67[2]
Material, housing	PBT
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +60 °C
Ambient temperature: storage	-20 … +80 °C
Weight	107 g

[1] Reference material: Kodak grey, 18 % [2] With connected IP 67 plug

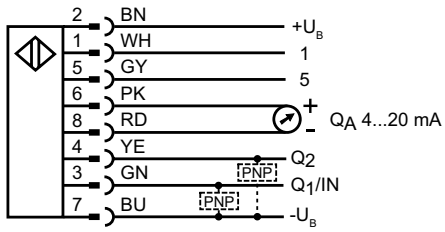
Scanning distance	Measurement range	Resolution	Linearity	Serial interface	Type of connection	Part number	Article number
250 … 750 mm	500 mm	0,1 mm	0,25 mm	–	Plug, M12x1, 8-pin	FT 80 RLA-500-L8	574-41020
250 … 750 mm	500 mm	0,1 mm	0,25 mm	RS485	Plug, M12x1, 8-pin	FT 80 RLA-500-S1L8	574-41024

Version: 07/2015. Subject to changes; diagrams similar

Plug connection



153-00347

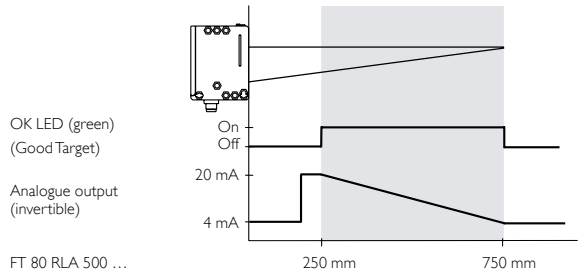
Connection, 8-pin	Type	Pin 1	Pin 5
	FT 80 RLA 500 -S1L8. FT 80 RLA 500 -L8.	RS485 Y/A not connected	RS485 Z/B not connected

154-00127

6

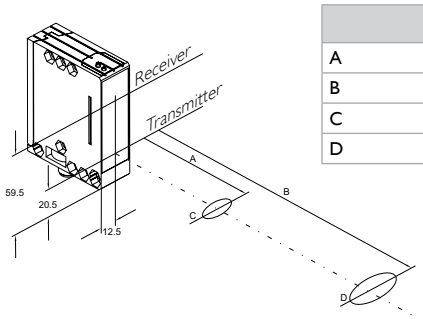
Characteristic analogue curve

Operating range (default settings)



155-00143

Light spot geometry



	FT 80 RLA 500 …
A	250 mm
B	750 mm
C	1.9 mm x 1.2 mm
D	2.7 mm x 1.9 mm

155-00157

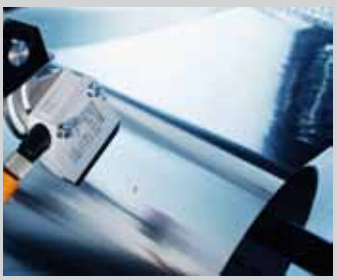
Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

F 55 / F 90 / F 91 / F 92 –
Laser distance sensors for long distances

Far-sighted with time-of-flight technology

Indicator
The distance is directly Indicatored in mm by the F 90 and F 91 devices, and can even be directly read off from the device in the dark – thanks to the Indicator's background illumination.



Coil diametre
The FT 55-RLA measures the distance to the coil surface in order to activate roll changes.

TYPICAL F 55 / F 90 / F 91 / F 92

- Laser distance sensor using time-of-flight technology
- Largely independent of target object's colour and properties
- Operating range: scanner up to 10 m, with reflector up to 250 m
- Variants with analogue output and switching output
- Interfaces for maximum compatibility, SSI-compatible, RS422 (PROFIBUS and DeviceNet via gateway)
- High repeatability and high measurement rates
- Compact housings from 50 x 50 x 23 mm

With a reflector these devices can achieve ranges of up to 250 m (FR 90 ILA).
Ranges of up to 10 m can be achieved with the scanner versions (FT 90 ILA).

Pilot laser
Correct adjustment of the F 90 at long distances is considerably simplified by using the pilot laser. This can be switched off so that no-one is irritated by it during running operation.

Long ranges of up to 250 m are no problem with time-of-flight technology – and ideal in handling and warehousing systems.

F 55 / F 90 / F 91 / F 92 – Product Overview

	Operating distance	Functional principle	Special features	Page
FT 55-RLAP	0,1 … 5 m	Scanning on object	Compact design, high flexibility	208
FT 90 ILA	0.5 … 10 m	Scanning on object	2 switching outputs, RS422 interface, SSI-compatible, switchable red-light pilot laser	210
FT 91 ILA	0.5 … 6 m	Scanning on object	2 switching outputs, RS422 interface, SSI-compatible, switchable red-light pilot laser	212
FT 92 ILA/RLA	0.2 … 6 m	Scanning on object	2 switching outputs, 1 analogue output, switchable red-light pilot laser	214
FR 55-RLAP	0,3 … 70 m	Reflector	1 analogue output 4 ... 20 mA, 2 switching outputs, compact design, high flexibility	216
FR 55-RLP	0,3 … 70 m	Reflector	2 switching outputs, compact design, high flexibility	218
FR 90 ILA	0.5 … 250 m	Reflector	2 switching outputs, RS422 interface, SSI-compatible, switchable red-light pilot laser	220
FR 91 ILA	0.5 … 50 m	Reflector	2 switching outputs, RS422 interface, SSI-compatible, switchable red-light pilot laser	222
FR 92 ILA	0.2 … 30 m	Reflector	2 switching outputs, 1 analogue output, switchable red-light pilot laser	224

FT 55-RLAP

Distance sensor for large distances – Time-of-flight technology

PRODUCT HIGHLIGHTS

- For measurement and control tasks with all object surfaces at long scanning distances
- Stable and precise distance measurement even with tilted objects and with bright, highly reflective or shiny backgrounds
- Compact design for an easy integration
- High flexibility thanks to invertible analogue characteristic (Q_A) and window mode (Q)
- Easy installation and operation via external teach-in
- Clearly visible laser light spot (laser class 1) for an easy alignment and full eye safety

Optical data		Functions	
Measurement range	0.1 ... 5 m (see Selection Table)[1]	Indicator LED 2, green	Operating voltage indicator
Resolution	< 5 mm (12-bit)	Indicator LED 2, yellow	Status indicator analogue output
Linearity	± 30 mm[1, 2]	Indicator LED 1 yellow	Switching output indicator
Repeatability	1.2 mm[1, 2, 3]	Measurement range adjustment	Via Teach-in button or control input
Hysteresis	20 mm	Adjustment possibilities	Analogue measurement range Q_A Invertible analogue characteristic Switching output Q (window mode) N.O. / N.C. and Auto-Detect / NPN / PNP via teach-in and control line Button lock via control input
Type of light	Laser, red 655 nm		
Laser class (DIN EN 60825-1:2008-5)	1	Default settings	See Selection Table

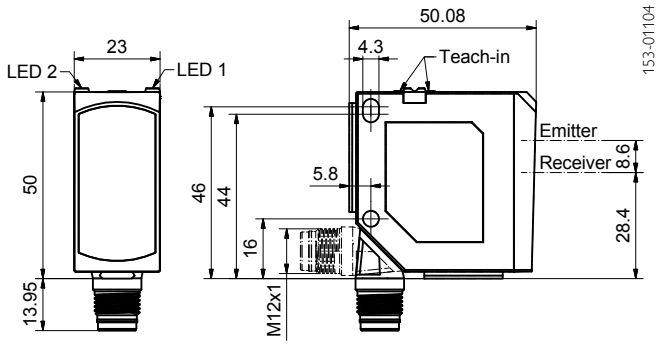
Electrical data			
Operating voltage $+U_B$	18 … 30 V DC	Response time Q	2 ms
No-load current I	≤ 60 mA	Load	≤ 500 Ohm (4 ... 20 mA) ≥ 4 k Ohm (0 … 10 V)
Output current Ie Q	≤ 100 mA	Analogue output Q_A	4 … 20 mA / 0 … 10 V
Protection circuits	Reverse polarity protection U_B / short-circuit protection (Q)	Update rate Q_A	2 ms
Protection class	2	Temperature drift	< 2 mm / K
Power On Delay	< 5 s	Warm-up time	20 min.
Switching output Q	Auto-Detect (PNP/NPN)[4]	Control input IN	$+U_B$ = Teach-in $-U_B$ = Button locked Open = normal operation
Output function	N.O. / N.C.		
Switching frequency f (ti/tp 1:1)	≤ 250 Hz		

Mechanical data			
Dimensions	50 x 50.1 x 23 mm	Ambient temperature: operation	-40 … +60 °C[6]
Enclosure rating	IP 67 & IP 69K[5]	Ambient temperature: storage	-40 … +80 °C
Material, housing	ABS	Weight (plug device)	42 g
Material, front screen	PMMA	Resistance to vibration and impacts	EN 60947-5-2
Type of connection	See Selection Table		

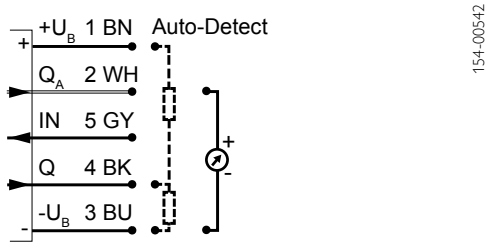
[1] Reference material 90 % reflectivity [2] At 50 Hz [3] For 1 σ, see diagram for further values [4] Auto-Detect: Automatic selection of PNP or NPN by the sensor, PNP or NPN can be fixed
[5] With connected IP 67 / IP 69K plug [6] Up to +50 °C with current output 4 ... 20 mA

Measurement range[1]	Analogue output	Switching output	Type of connection	Part Number	Article number
0.1… 5 m	4 … 20 mA	Auto-Detect	Plug, M12x1, 5-pin	FT 55-RLAP-5-PNSI-L5	622-21018
0.1 … 5 m	0 … 10 V	Auto-Detect	Plug, M12x1, 5-pin	FT 55-RLAP-5-PNSU-L5	622-21021

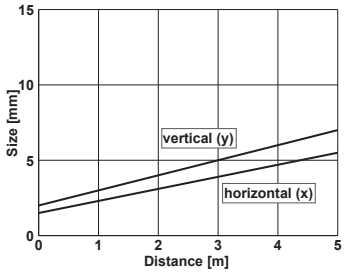
Plug connection



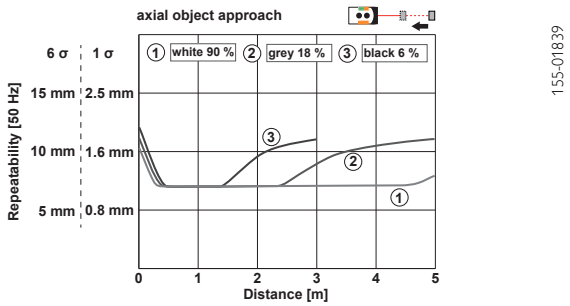
Connection, 5-pin, Auto-Detect



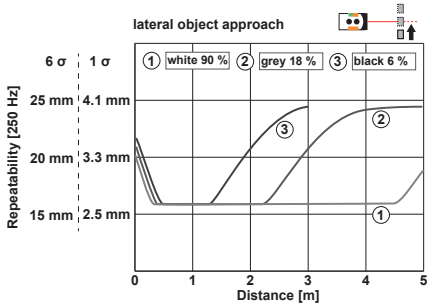
Light spot size



Repeatability[1] (50 Hz)

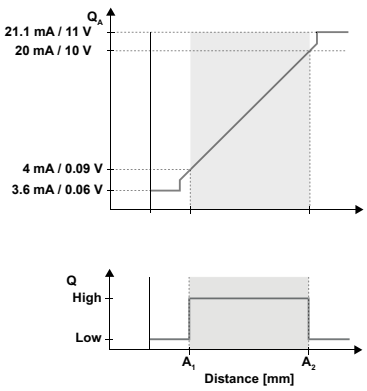


Repeatability[1] (250 Hz[2])



[1] At constant ambient conditions [2] Automatic adjustment to 50 Hz at constant distance

Characteristic analogue curve



Reference material	Measurement range
White (90 %)	0.1 … 5 m
Grey (18 %)	0.1 … 5 m
Black (6 %)	0.1 … 3 m

Default setting[3]

Analogue output Q$_A$ (4…20 mA / 0,09 … 10 V)	0.3 … 3 m
Switching output Q (A$_1$…A$_2$), N.O., Auto-Detect	0.3 … 3 m

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4

[3] The specified precision is achieved by teaching the distances

FT 90 ILA

Distance sensor

PRODUCT HIGHLIGHTS

- Long scanning distance (up to 10 m on white objects)
- High repeatability
- High measurement rates
- Open interfaces ensure maximum compatibility (SSI-compatible, RS422)
- Profibus and DeviceNet via gateway
- Switchable red-light pilot laser
- 2 switching outputs

Optical data	
Operating range	0.5 … 10 m[1]
Measurement range	9.5 m
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Resolution	0.1 mm or 0.125 mm
Linearity	± 8 mm
Repeatability	± 4 mm

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[2]
Output current, Ie	≤ 100 mA
Plausibility output, Qp	50 mA
Service output, Qs	50 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Power On Delay	≤ 12 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O.
Analogue output	4 … 20 mA
Temperature drift	< ± 5 mm absolute
Serial interface	RS422 or SSI-compatible (GREY / BINARY) adjustable
Bus interface	Profibus or DeviceNet, each via gateway (accessory)
Cable length / m	< 25 / < 50 / < 100 / < 200 / < 400
Cycle rate	< 500 kHz / < 400 kHz / < 300 kHz / < 200 kHz / < 100 kHz

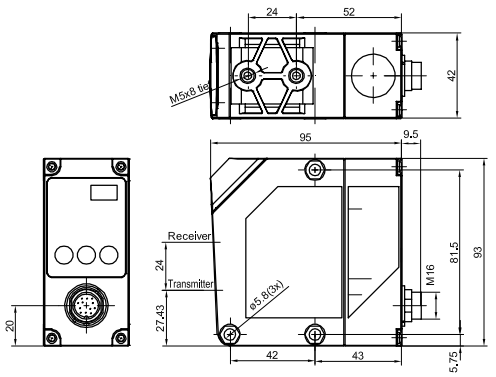
Mechanical data	
Dimensions	93 x 93 x 42 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +50 °C (-20 … +50 °C in continuous operation)
Ambient temperature: storage	-30 … +75 °C
Weight	230 g
Vibration and impact resistance	EN 60947-5-2

[1] Reference material: Kodak white, 90 % [2] 10 % ripple, within U_B [3] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M16x1, 12-pin	FT 90 ILA-S2-Q12	591-91000

Version: 07/2015. Subject to changes; diagrams similar

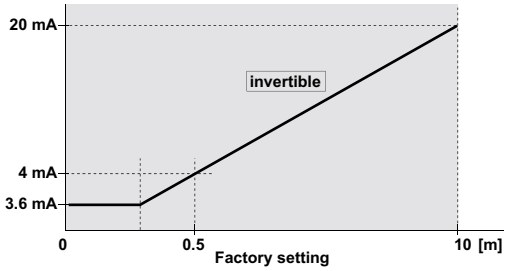
Plug connection



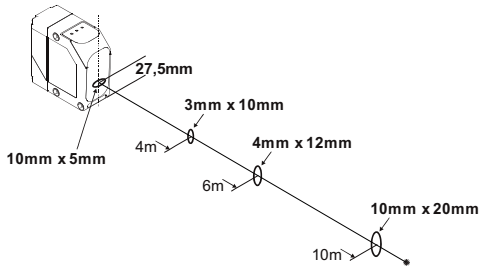
Connection, 12-pin

Pin	Name	Cable Type 1 (12-pin) colour	Cable Type 2 (5-pin) colour	Description
A	TX+	White		RS422: transmission data / SSi: Data+
B	Q1	Brown	Black	Switching output, Q1
C	RX+	Green		RS422: receiver data / SSI: clock+
D	analog	Yellow		Analogue output 4 … 20 mA (only FT9X)
E	Qs	Grey	Orange	Service output, Qs
F	Qp	Pink		Plausibility output, Qp
G	U_B	Red	Brown	U_B + 18 … 30 V
H	RX-	Black		RS422: receiver data / SSI: clock
J	NC	Violet		
K	TX-	Grey/pink		RS422: transmitter data / SSI: Data-
L	Q2	Red/blue	White	Switching output, Q2
M	CND	Blue	Blue	0 V (GND)

Characteristic analogue curve



Light spot geometry



Scanning distance

White 90 %	0.5 … 10 m
Grey 10 %	0.5 … 7 m
Black 6 %	0.5 … 3 m

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FT 91 ILA

Distance sensor

PRODUCT HIGHLIGHTS

- Long scanning distance (up to 10 m on white objects)
- High repeatability
- High measurement rates
- Open interfaces ensure maximum compatibility (SSI-compatible, RS422)
- Profibus and DeviceNet via gateway
- Switchable red-light pilot laser
- 2 switching outputs

Optical data	
Operating range	0.5 … 6 m[1]
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Resolution	0.1 mm or 0.125 mm
Linearity	± 10 mm
Repeatability	± 5 mm

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[2]
Output current, Ie	≤ 100 mA
Plausibility output, Qp	50 mA
Service output, Qs	50 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Power On Delay	≤ 12 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O.
Analogue output	4 … 20 mA
Temperature drift	< 0.5 mm / K
Serial interface	RS422 or SSI-compatible (GREY / BINARY) adjustable
Bus interface	Profibus or DeviceNet, each via gateway (accessory)
Cable length / m	< 25 / < 50 / < 100 / < 200 / < 400
Cycle rate	< 500 kHz / < 400 kHz / < 300 kHz / < 200 kHz / < 100 kHz

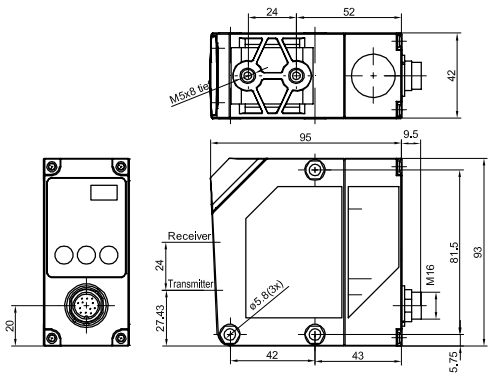
Mechanical data	
Dimensions	93 x 93 x 42 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +50 °C (-20 … +50 °C in continuous operation)
Ambient temperature: storage	-30 … +75 °C
Weight	230 g
Vibration and impact resistance	EN 60947-5-2

[1] Reference material: Kodak white, 90 % [2] 10 % ripple, within U_B [3] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M16, 12-pin	FT 91 ILA-S2-Q12	591-91003

Version: 07/2015. Subject to changes; diagrams similar

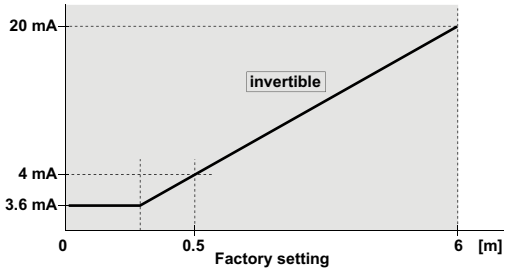
Plug connection



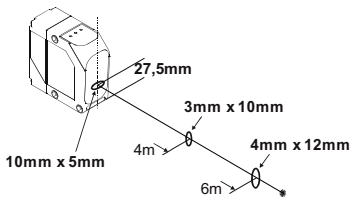
Connection, 12-pin

Pin	Name	Cable Type 1 (12-pin) colour	Cable Type 2 (5-pin) colour	Description
A	TX+	White		RS422: transmission data / SSi: Data+
B	Q1	Brown	Black	Switching output, Q1
C	RX+	Green		RS422: receiver data / SSI: clock+
D	analog	Yellow		Analogue output 4 … 20 mA (only FT9X)
E	Qs	Grey	Orange	Service output, Qs
F	Qp	Pink		Plausibility output, Qp
G	U_B	Red	Brown	U_B + 18 … 30 V
H	RX-	Black		RS422: receiver data / SSI: clock
J	NC	Violet		
K	TX-	Grey/pink		RS422: transmitter data / SSI: Data-
L	Q2	Red/blue	White	Switching output, Q2
M	CND	Blue	Blue	0 V (GND)

Characteristic analogue curve



Light spot geometry



Scanning distance

White 90 %	0.5 … 6 m
Grey 10 %	0.5 … 4 m
Black 6 %	0.5 … 2 m

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FT 92 ILA / IRLA

Distance sensor

PRODUCT HIGHLIGHTS

- Long scanning distance and range
- High repeatability
- High measurement rates
- Very good price/performance ratio
- Switchable red-light pilot laser
- 2 PNP switching outputs
- 1 analogue output: 4 … 20 mA
- All outputs in measurement range freely adjustable
- Standard M12 plug

Optical data	
Scanning distance	0.2 … 6 m[1]
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Repeatability Fast/Slow	< ± 15 / 10 mm[2]
Linearity	≤ ± 40 mm[2]

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	2 x switching output indicator
Indicator LED, orange	Operating mode
Indicator LED, red	Menu Indicator
Scanning distance adjustment	Via Teach-in button
Default settings	Max. scanning distance and N.O.

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[3]
No-load current, I_0	≤ 125 mA
Output current, Ie	≤ 100 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection (Q)
Protection Class	2
Power On Delay	< 300 ms
Switching output, Q_1 / Q_2	PNP / NPN 100 mA (see Selection Table)
Analogue output	4 … 20 mA
Temperature drift	≤ 1.2 mm / K
Load	≤ 500 Ω

Mechanical data	
Dimensions	95 x 93 x 42 mm
Enclosure rating	IP 67[4]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-20 … +50 °C
Ambient temperature: storage	-40 … +80 °C
Weight	200 g
Vibration and impact resistance	EN 60947-5-2

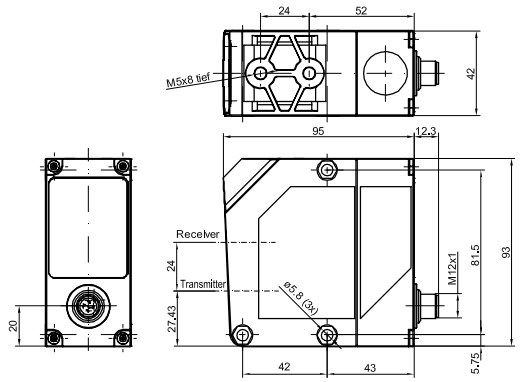
[1] With RL250 reflector [2] Data apply after a minimum switch-on time of 30 min [3] 10 % ripple, within U_B [4] With connected IP 67 plug

Switching output	Type of connection	Part number	Article number
PNP	Plug, M12, 5-pin	FT 92 ILA-PSL5	591-91005
NPN	Plug, M12, 5-pin	FT 92 ILA-NSL5	591-91008
PNP	Plug, M12, 5-pin	FT 92 IRLA-PSL5[5]	591-91013

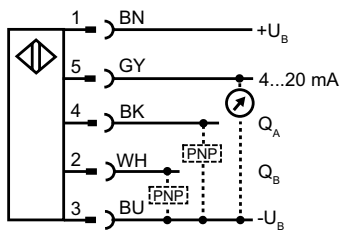
[5] Pilot laser (red) on permanently

Version: 07/2015. Subject to changes; diagrams similar

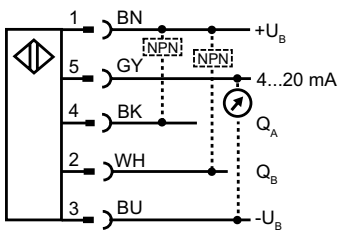
Plug connection



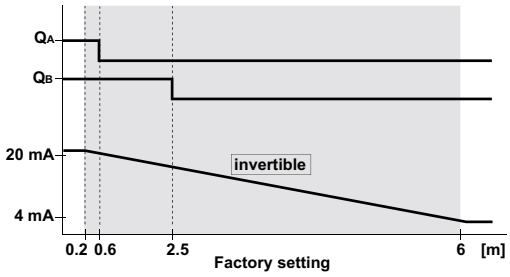
Connection, 5-pin (PNP)



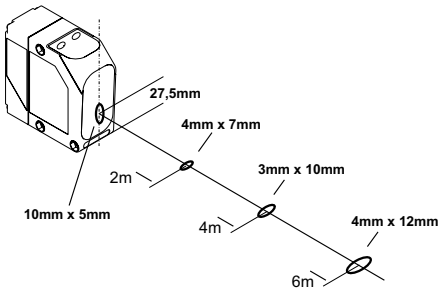
Connection, 5-pin (NPN)



Characteristic analogue curve



Light spot geometry



Scanning distance

White 90 %	0.2 … 6 m
Grey 18 %	0.2 … 6 m
Black 6 %	0.2 … 2.5 m

Accessories

Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FR 55-RLAP

Distance sensor with a reflector for large distances – Time-of-flight technology

PRODUCT HIGHLIGHTS

- Sensor with large range for anticollision and positioning applications
- High flexibility thanks to adjustable analogue characteristic (Q_A)
- 4 distance positions with 2 switching outputs, adjustable via window function
- Q_1/Q_2 switchable to $Q_1/\overline{Q}_1$ as antivalent outputs
- Compact design for an easy integration
- Easy installation and operation via external teach-in
- Clearly visible laser light spot (laser class 1) for a precise alignment and full eye safety
- Laser can be switched off via control line

Optical data		Functions	
Measurement range	0.3 ... 70[1]	Indicator LED 1, green	Operating voltage indicator
Resolution	8 µA	Indicator LED 1, yellow	Switching output indicator
Linearity	± 0.5 %[1, 2]	Indicator LED 2 yellow	Switching output indicator
Repeatability Q	1.5 mm[3]	Measurement range adjustment	Via Teach-in button or control input
Hysteresis	60 mm	Adjustment possibilities	Analogue measurement range Q_A Invertible analogue characteristic Switching output Q (window mode) N.O. / N.C. / antivalent $Q_1/\overline{Q}_1$ and Auto-Detect / NPN / PNP via teach-in and control line Button lock via control input
Type of light	Laser, red 655 nm		
Laser class (DIN EN 60825-1:2008-5)	1	Default settings	See Selection Table

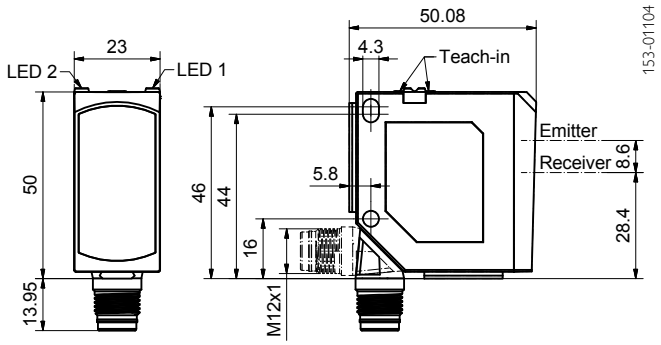
Electrical data			
Operating voltage $+U_B$	18 … 30 V DC	Response time Q	10 ms
No-load current I_0	≤ 60 mA	Load	≤ 500 Ohm (4 ... 20 mA)
Output current le Q	≤ 100 mA	Analogue output Q_A	4 … 20 mA
Protection circuits	Reverse polarity protection U_B / short-circuit protection (Q)	Update rate Q_A	10 ms
		Temperature drift	< 1 mm / K
Protection class	2	Warm-up time	20 min.
Power On Delay	< 5 s	Control input IN 1 und IN 2	$+U_B$ = Teach-in $-U_B$ = Button locked Open = normal operation
Switching output Q	Auto-Detect (PNP/NPN)[4]		
Output function	N.O. / N.C. / antivalent $Q_1/\overline{Q}_1$	Control input IN 3	$+U_B$ = Laser off $-U_B$ = Laser on offen = Laser on
Switching frequency f (ti/tp 1:1)	≤ 50 Hz		

Mechanical data			
Dimensions	50 x 50.1 x 23 mm	Ambient temperature: operation	-30 … +60 °C
Enclosure rating	IP 67 & IP 69K[5]	Ambient temperature: storage	-40 … +80 °C
Material, housing	ABS	Weight (plug device)	42 g
Material, front screen	PMMA	Resistance to vibration and impacts	EN 60947-5-2
Type of connection	See Selection Table		

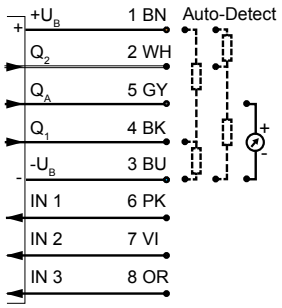
[1] Reference material: RF250 reflector [2] Of set measuring range [3] For 1 σ, the set measuring range is < 20 m, for futher values see diagram [4] Auto-Detect: Automatic selection of PNP or NPN by the sensor, PNP or NPN can be fixed [5] With connected IP 67 / IP 69K plug

Measurement range[1]	Analogue output	Switching output	Type of connection	Part Number	Article number
0.3 … 70 m	4 … 20 mA	2 x Auto-Detect	Plug, M12x1, 8-pin	FR 55-RLAP-70-2PNSI-L8	621-11026

Plug connection

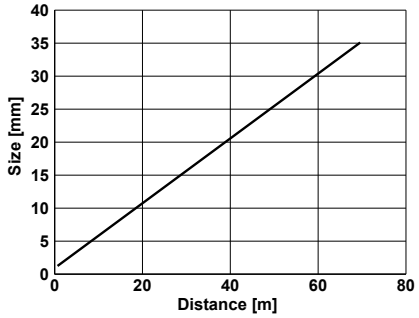


Connection, 5-pin, Auto-Detect

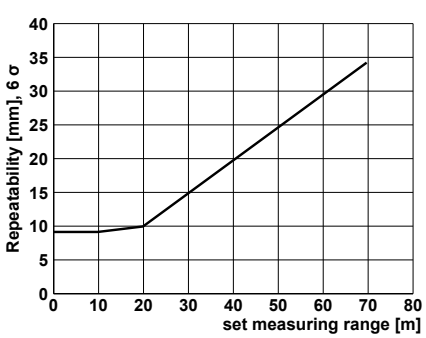


Colour assignment in accordance to 60947-5-2/IEC=2007

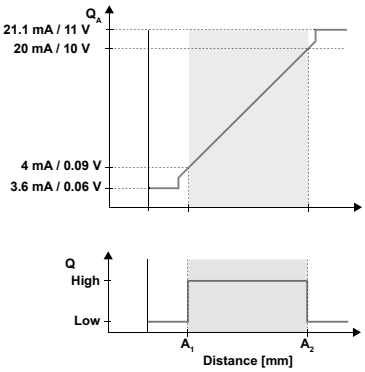
Light spot size



Repeatability Q, Q_A



Characteristic analogue curve



[1] At constant ambient conditions

Default setting	Measurement range
Analogue output Q_A (4…20 mA)	2 … 6 m
Switching output Q (A_1…A_2), N.O., Auto-Detect	2 … 6 m
Switching output Q_2 (A_1…A_2), N.O., Auto-Detect	2 … 6 m

Accessories	
Mounting angle MA F 55 (579-50007)	From Page A-4
Further brackets	From Page A-4
Connection cables (C L8FG-S-2m-PUR / 902-51830)	From Page A-34
Further connection cables	From Page A-34
Reflective foil RF 250 (599-91009)	From Page A-18
Further reflectors	From Page A-18

FR 55-RLP

Distance sensor with a reflector for large distances – Time-of-flight technology

PRODUCT HIGHLIGHTS

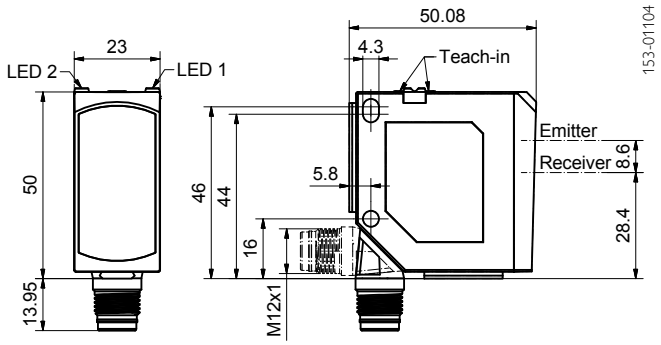
- Sensor with large range for anticollision and positioning applications
- 4 distance positions with 2 switching outputs, adjustable via window function
- Q_2 can be switched to Q_1 as antivalent output, e.g. for wire breakage monitoring
- Compact design for an easy integration
- Easy installation and operation via external teach-in
- Clearly visible laser light spot (laser class 1) for a precise alignment and full eye safety

Optical data		Functions	
Measurement range	0.3 ... 70[1]	Indicator LED 1, green	Operating voltage indicator
Repeatability Q	1.5 mm[2]	Indicator LED 1, yellow	Switching output indicator
Hysteresis	60 mm	Indicator LED 2 yellow	Switching output indicator
Type of light	Laser, red 655 nm	Measurement range adjustment	Via Teach-in button or control input
Laser class (DIN EN 60825-1:2008-5)	1	Adjustment possibilities	Switching output Q (window mode) N.O. / N.C. / antivalent Q_1/Q_1 and Auto-Detect / NPN / PNP via teach-in and control line Button lock via control input
		Default settings	See Selection Table
Electrical data			
Operating voltage $+U_B$	18 … 30 V DC	Response time Q	10 ms
No-load current I_0	≤ 60 mA	Temperature drift	< 1 mm / K
Output current Ie Q	≤ 100 mA	Warm-up time	20 min.
Protection circuits	Reverse polarity protection U_B / short-circuit protection (Q)	Control input IN	$+U_B$ = Teach-in $-U_B$ = Button locked Open = normal operation
Protection class	2		
Power On Delay	< 5 s		
Switching output Q	Auto-Detect (NPN / PNP)[3]		
Output function	N.O. / N.C. / antivalent $Q_1/\overline{Q}_1$		
Switching frequency f (ti/tp 1:1)	≤ 50 Hz		
Mechanical data			
Dimensions	50 x 50.1 x 23 mm	Ambient temperature: operation	-30 … +60 °C
Enclosure rating	IP 67 & IP 69K[4]	Ambient temperature: storage	-40 … +80 °C
Material, housing	ABS	Weight (plug device)	42 g
Material, front screen	PMMA	Resistance to vibration and impacts	EN 60947-5-2
Type of connection	See Selection Table		

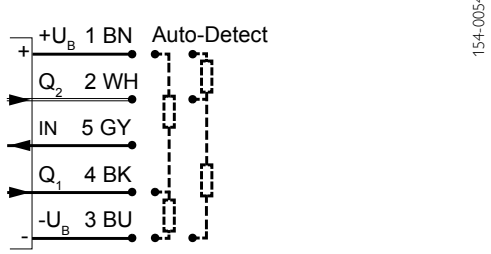
[1] RF250 reflector [2] For 1 σ, the set measuring range is < 20 m, for futher values see diagram [3] Auto-Detect: Automatic selection of PNP or NPN by the sensor, PNP or NPN can be fixed
[4] With connected IP 67 / IP 69K plug

Measurement range[1]	Switching output	Type of connection	Part Number	Article number
0.3… 70 m	2 x Auto-Detect	Plug, M12x1, 5-pin	FR 55-RLP-70-2PNS-L5	621-11027

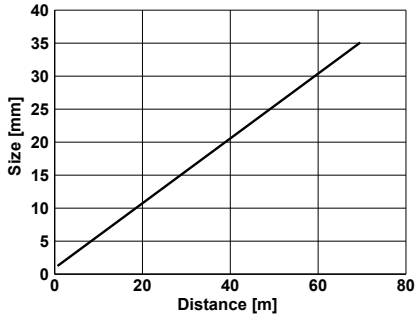
Plug connection



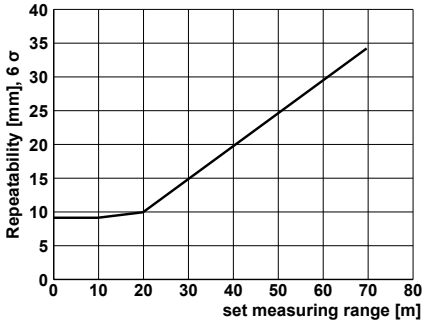
Connection, 5-pin, Auto-Detect



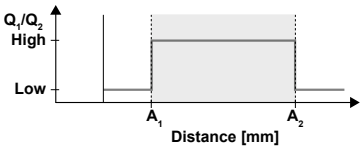
Light spot size



Repeatability[1] Q_1 / Q_2



Switching output Q_1 / Q_2



[1] At constant ambient conditions

Default setting	Measurement range
Switching output Q_1 (A_1…A_2), N.O., Auto-Detect	2 … 6 m
Switching output Q_2 (A_1…A_2), N.O., Auto-Detect	2 … 6 m

Accessories	
Mounting angle MA F 55 (579-50007)	From Page A-4
Further brackets	From Page A-4
Connection cables	From Page A-34
Reflective foil RF 250 (599-91009)	From Page A-18
Further reflectors	From Page A-18

FR 90 ILA

Reflector distance sensor

PRODUCT HIGHLIGHTS

- Long range of up to 250 m on specified reflector
- High repeatability
- High measurement rates
- Ideal for precise positioning tasks
- Open interfaces ensure maximum compatibility (SSI-compatible, RS422)
- Profibus and DeviceNet via gateway
- Switchable red-light pilot laser
- 2 switching outputs

Optical data	
Scanning distance	0.5 … 250 m
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Resolution	0.1 mm or 0.125 mm
Linearity	± 3 mm (from 2 m)
Repeatability	< ± 2 mm
Light spot	20 x 20 mm[1]

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input

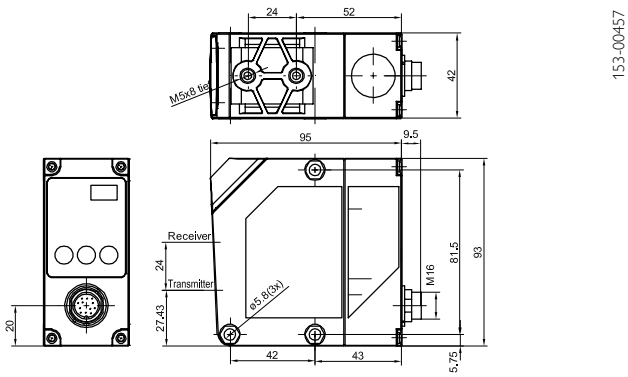
Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[2]
Output current, Ie	≤ 100 mA
Plausibility output, Qp	50 mA
Service output, Qs	50 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Power On Delay	≤ 12 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O.
Temperature drift	< ± 5 mm absolute
Serial interface	RS422 or SSI-compatible (GREY / BINARY) adjustable
Bus interface	Profibus or DeviceNet each via gateway (accessories)
Cable length / m	< 25 / < 50 / < 100 / < 200 / < 400
Cycle rate	< 500 kHz / < 400 kHz / < 300 kHz / < 200 kHz / < 100 kHz

Mechanical data	
Dimensions	93 x 93 x 42 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +50 °C (-20 … +50 °C in continuous operation)
Ambient temperature: storage	-30 … +75 °C
Weight	230 g
Vibration and impact resistance	EN 60947-5-2

[1] At scanning distance of 10 m [2] 10 % ripple, within U_B [3] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M16x1, 12-pin	FR 90 ILA-S2-Q12	591-91001

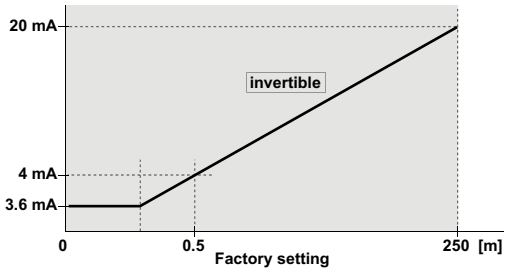
Plug connection



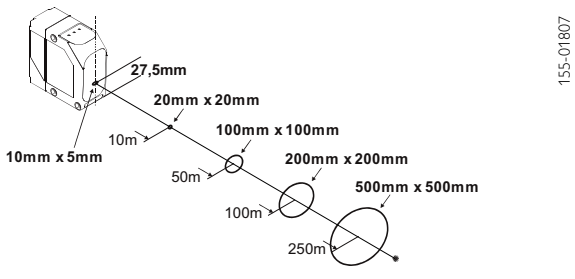
Connection, 12-pin

Pin	Name	Cable Type 1 (12-pin) colour	Cable Type 2 (5-pin) colour	Description
A	TX+	White		RS422: transmission data / SSi: Data+
B	Q1	Brown	Black	Switching output, Q1
C	RX+	Green		RS422: receiver data / SSI: clock+
D	analog	Yellow		Analogue output 4 … 20 mA (only FT9X)
E	Qs	Grey	Orange	Service output, Qs
F	Qp	Pink		Plausibility output, Qp
G	U_B	Red	Brown	U_B + 18 … 30 V
H	RX-	Black		RS422: receiver data / SSI: clock
J	NC	Violet		
K	TX-	Grey/pink		RS422: transmitter data / SSI: Data-
L	Q2	Red/blue	White	Switching output, Q2
M	CND	Blue	Blue	0 V (GND)

Characteristic analogue curve



Light spot geometry



Accessories

Reflectors	From Page A-18
Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FR 91 ILA

Reflector distance sensor

PRODUCT HIGHLIGHTS

- Long range of up to 50 m on specified reflector
- High repeatability
- High measurement rates
- Very good price/performance ratio
- Open interfaces ensure maximum compatibility (SSI-compatible, RS422)
- Profibus and DeviceNet via gateway
- Switchable red-light pilot laser
- 2 switching outputs

Optical data	
Scanning distance	0.5 … 50 m
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Resolution	0.1 mm or 0.125 mm
Linearity	± 5 mm (from 2 m)
Repeatability	< ± 4 mm
Light spot	20 x 20 mm[1]

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Scanning distance adjustment	Via Teach-in button and control input

Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[2]
Output current, Ie	≤ 100 mA
Plausibility output, Qp	50 mA
Service output, Qs	50 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection, Q
Protection Class	2
Power On Delay	≤ 12 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O.
Temperature drift	< 0.5 mm / K
Serial interface	RS422 or SSI-compatible (GREY / BINARY) adjustable
Bus interface	Profibus or DeviceNet, each via gateway (accessories)
Cable length / m	< 25 / < 50 / < 100 / < 200 / < 400
Cycle rate	< 500 kHz / < 400 kHz / < 300 kHz / < 200 kHz / < 100 kHz

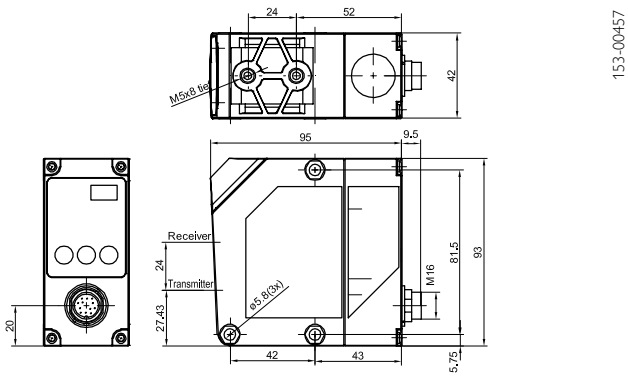
Mechanical data	
Dimensions	95 x 93 x 42 mm
Enclosure rating	IP 67[3]
Material, housing	ABS, impact-resistant
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-10 … +50 °C
Ambient temperature: storage	-30 … +75 °C
Weight	230 g
Vibration and impact resistance	EN 60947-5-2

[1] At scanning distance of 10 m [2] 10 % ripple, within U_B [3] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M16, 12-pin	FR 91 ILA-S2-Q12	591-91002

Version: 07/2015. Subject to changes; diagrams similar

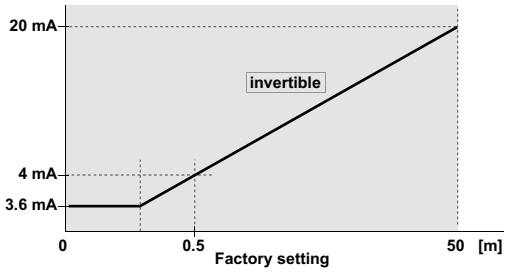
Plug connection



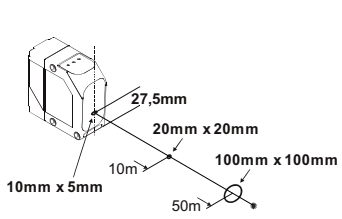
Connection, 12-pin

Pin	Name	Cable Type 1 (12-pin) colour	Cable Type 2 (5-pin) colour	Description
A	TX+	White		RS422: transmission data / SSi: Data+
B	Q1	Brown	Black	Switching output, Q1
C	RX+	Green		RS422: receiver data / SSI: clock+
D	analog	Yellow		Analogue output 4 … 20 mA (only FT9X)
E	Qs	Grey	Orange	Service output, Qs
F	Qp	Pink		Plausibility output, Qp
G	U_B	Red	Brown	U_B + 18 … 30 V
H	RX-	Black		RS422: receiver data / SSI: clock
J	NC	Violet		
K	TX-	Grey/pink		RS422: transmitter data / SSI: Data-
L	Q2	Red/blue	White	Switching output, Q2
M	CND	Blue	Blue	0 V (GND)

Characteristic analogue curve



Light spot geometry



Accessories

Reflectors	From Page A-18
Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FR 92 ILA

Reflector distance sensor

PRODUCT HIGHLIGHTS

- Long scanning distance and range (scanning up to 6 m on white objects, with reflector up to 30 m)
- High repeatability
- High measurement rates
- Switchable red-light pilot laser
- Simple teach-in

Optical data	
Scanning distance	0.2 … 30 m[1]
Type of light	Infrared, 905 nm (measurement laser) Laser, red, 650 nm (pilot laser)
Laser Class (DIN EN 60825-1:2008-5)	1 (measurement laser) 2 (pilot laser)
Repeatability Fast/Slow	≤ ± 10 / 5 mm[2]
Linearity	≤ ± 60 mm[2]

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, yellow	Switching output indicator
Indivator LED, orange	Operating mode
Indicator LED, red	Menu Indicator
Scanning distance adjustment	Via Teach-in button
Default settings	Max. scanning distance and N.O.

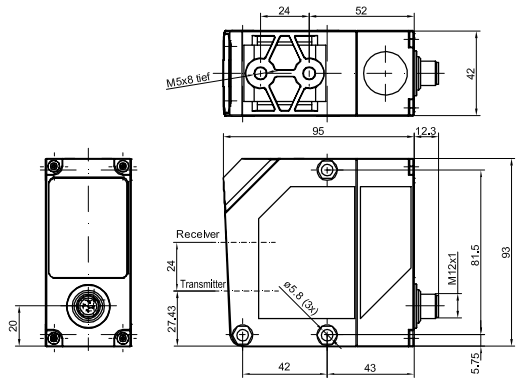
Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[3]
No-load current, I_0	≤ 125 mA
Output current, Ie	100 mA
Max. voltage drop at switching output	≤ 2.4 V
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection (Q)
Protection Class	2
Power On Delay	< 300 ms
Response time fast / slow	30 ms / 65 ms
Switching output, Q_1 / Q_2	PNP
Output function	N.O.
Analogue output	4 … 20 mA
Temperature drift analogue	3 mm / K
Temperature drift switching output	1.5 mm / K

Mechanical data	
Dimensions	95 x 93 x 42 mm
Enclosure rating	IP 67[4]
Material, housing	ABS
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	-20 … +50 °C
Ambient temperature: storage	-40 … +80 °C
Weight	200 g
Vibration and impact resistance	EN 60947-5-2

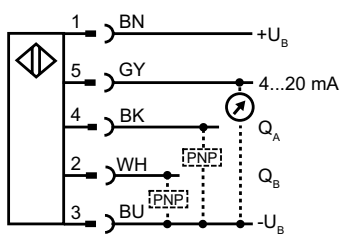
[1] With RL250 reflector [2] Data apply after a minimum switch-on time of 30 min [3] 10 % ripple, within U_B [4] With connected IP 67 plug

Type of connection	Part number	Article number
Plug, M12, 5-pin	FR 92 ILA-PSL5	591-91006

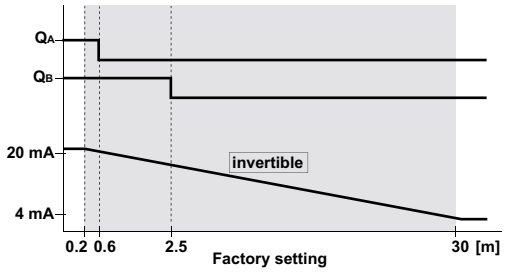
Plug connection



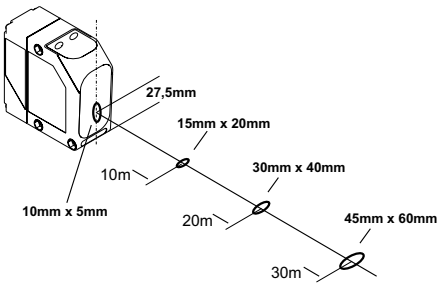
Connection, 5-pin



Characteristic output and analogue curves



Light spot geometry

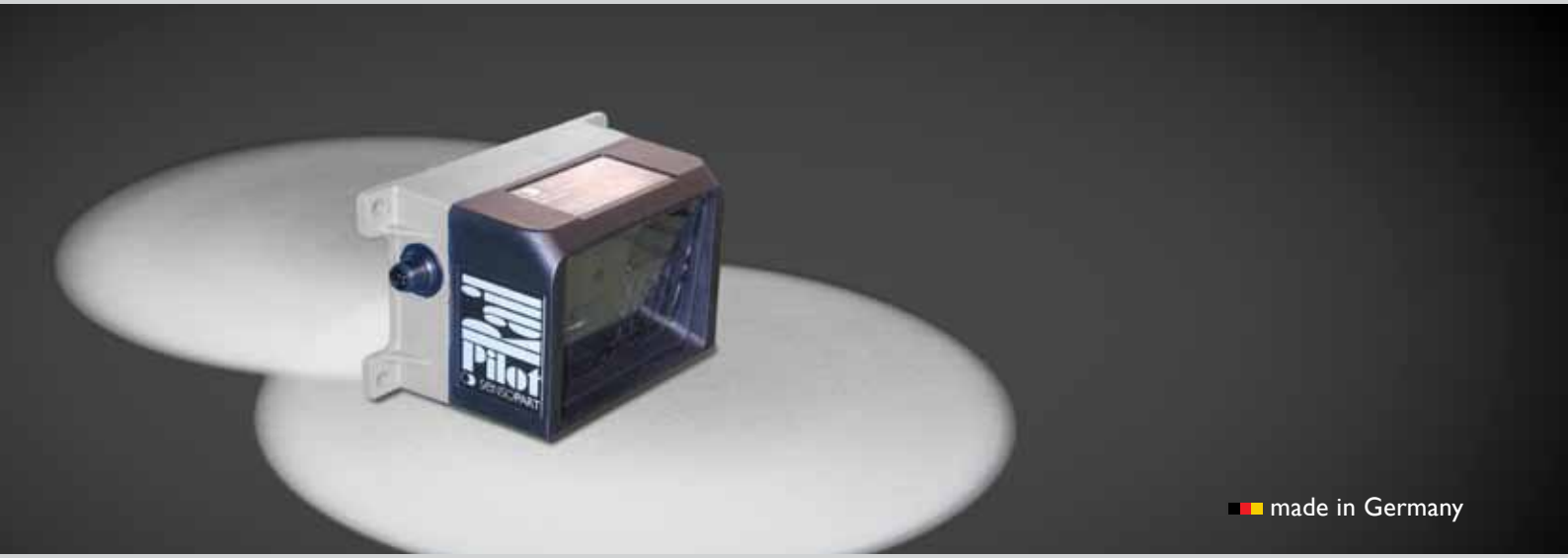


Accessories

Reflectors	From Page A-18
Connection cables	From Page A-34
Brackets	From Page A-4
AS F 90 Aligning aid	From Page A-4
MSP F 90 A Fine adjustment	From Page A-4
Converters and adapter cables	From Page A-38

FR 85 Rail Pilot – optical collision protection sensors

Safe movement on monorail systems



Monorail system with car bodies in the automotive industry

TYPICAL FR 85 RAIL PILOT

- Laser photoelectric reflex switches for preventing collisions on monorail systems
- Operating range: 0 … 6 m
- Typical measurement accuracy: ± 10 cm
- Large optics aperture angle and thus long detection range
- 1 input and 2 PNP outputs
- RS485 interface
- Detection range adjustable externally
- Reliable suppression of foreign objects (girders, pillars)
- ABS housing: 145 x 85 x 80 mm

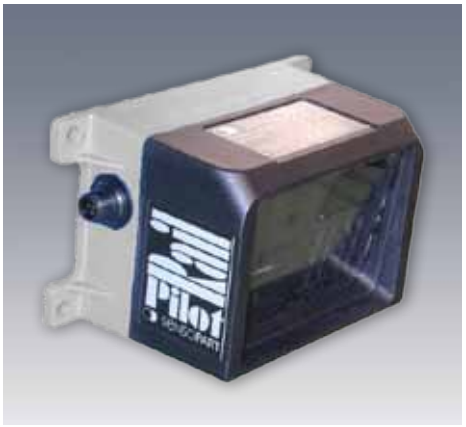
The sensor's task is to prevent collisions between vehicles on monorail systems. The Rail Pilot achieves this reliably. The distances to be maintained, and the braking distances of the monorail vehicles, depend on the load transported and on the speed – this is taken into account by means of flexibly adjustable switching distances.

Even constantly changing objects in the vicinity of the vehicles and sensors have no effect on the reliable functioning of collision prevention.

FR 85 Rail Pilot – Product Overview			
	Operating range	Special features	Page
FR 85 Rail Pilot	0 … 6 m	RS485 interface or PNP switching outputs	228

FR 85 Rail Pilot

Distance sensor for collision prevention



PRODUCT HIGHLIGHTS

- Measurement range: 0 … 6 m
- Wide detection cone
- Switching point accuracy ± 10 cm
- 2x2 detection zones
- 1 input
- 2 PNP outputs
- RS485 interface
- Detection zone adjustable externally
- Reliable suppression of foreign objects (girders, pillars)

Optical data	
Scanning distance	0 … 6 m[1]
Type of light	Infrared, 905 nm
Laser Class (DIN EN 60825-1:2008-5)	1
Repeatability	± 100 mm

Functions	
Indicator LED, green	Operating voltage indicator
Indicator LED, red	Switching output indicator
Scanning distance adjustment	Via control wire

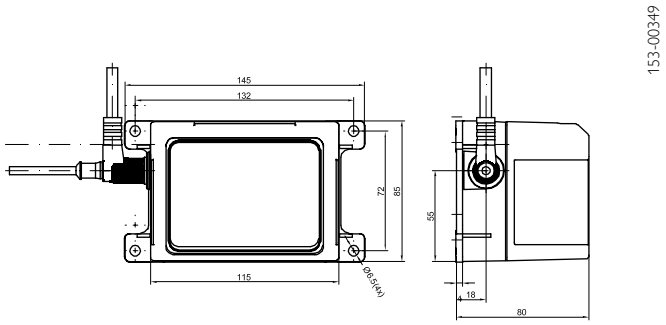
Electrical data	
Operating voltage, $+U_B$	18 … 30 V DC[2]
No-load current, I_0	≤ 200 mA
Output current, Ie	≤ 200 mA
Protective circuits	Reverse-polarity protection, U_B / short-circuit protection (Q)
Protection Class	2
Power On Delay	< 300 ms
Switching output, Q	See Selection Table
Output function	See Selection Table
Serial interface	RS485 / R = 1 KΩ[3]
Control input E1 / banking	Close and remote switching $-U_B$ (low) Q1 = switching point 1; Q2 = switching point 2 $+U_B$ (high) Q1 = switching point 3; Q2 = switching point 4

Mechanical data	
Dimensions	145 x 85 x 80 mm
Enclosure rating	IP 54[4]
Material, housing	ABS
Material, front screen	PMMA
Type of connection	See Selection Table
Ambient temperature: operation	0 … +50 °C
Ambient temperature: storage	-20 … +70 °C
Weight	340 g

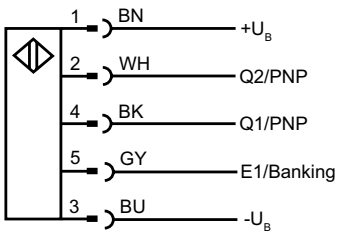
[1] Reference material: R10/2 reflector [2] 10 % ripple, within U_B [3] Type FR85 … S1L5 [4] With connected IP 54 plug

Interface	Baud rate	Suitable for control	Type of connection	Part number	Article number
RS485	57,6 kB	Lenze / DETO	Plug, M12x1, 5-pin	FR 85-2 ILLG-S1L5	529-11008
RS485	62,5 kB	LJU	Plug, M12x1, 5-pin	FR 85-2 ILLG-S1L5-62,5 kB	529-11014
2 switching points Q (PNP) N.C.	-	-	Plug, M12x1, 5-pin	FR 85-2 ILLG-POL5	529-11010

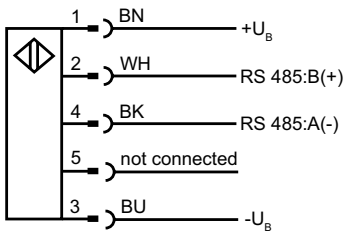
Plug connection



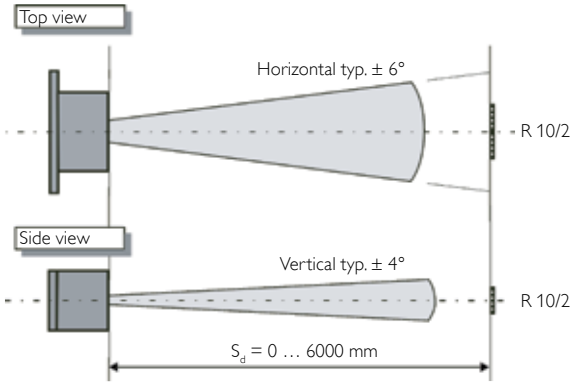
Connection, 5-pin: FR 85-2 ILLG-POL5



Connection, 5-pin: FR 85-2 ILLG-S1L5



Detection cone



Reflector	Article number
R10 / 2 (2xR10)	904-51636
Reflective foil	904-51548

Accessories	
Reflectors	From Page A-18
Connection cables	From Page A-34
Setup Box FR 85-2 ILLX 533-11016	From Page A-38