



Light curtains, Light grids and Light beams

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Why use light grids and light curtains?

Light grids and light curtains are production friendly safety components that causes no physical obstruction for the machine operator. Light barrier protection is also a good safety component to use when goods are to be passed in and out of a hazardous area.

How does a light grid/light curtain work?

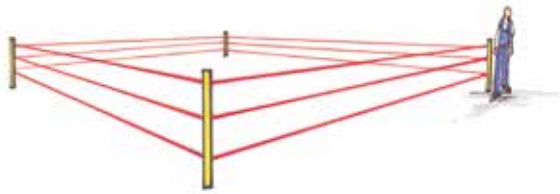
Both light grids and light curtains utilise optical transmitter and receiver units. From the transmitters beams of infrared light are sent to the receiver. When a light beam is interrupted a dual stop signal is given to the dangerous machines inside the light grid/curtain protected area.

What is the difference between a light curtain and a light grid?

A light curtain has several beams that are placed closely together whereas a light grid consists of only one, two, three or four light beams. The beams are closest on a light curtain that is used for finger detection. Then the resolution is 14 mm. For light grids the beams are normally placed at a relative distance of 300 to 500 mm. The choice between light grid or light curtain is often a question of available safety distance, reach and price. Light curtains are often chosen for short safe/minimum distances. Light grids are chosen for longer safe/minimum distances, long range up to 40 m and for a low price.



Light grids for long distances



Light grids with monitored by-passing during material transport



Light curtain for short safe/minimum distances



Light curtain to protect during cycle initiation



Light curtain as area protection



Light curtain for inner area limiting



What safety requirements are there for a light protection device?

High safety demands are stated in the standard EN 61496-1 which deals with light protection. The main demands are on a safe stopping function and that light from light sources other than the transmitter or other disturbances do not affect the safety function.

Depending on how the safety function is built up there are safety components of type 2 and 4 to choose between. Type 2 and 4 relates in principle category 2/PL c and category 4/PL e according to EN ISO 13849-1.

Type 4 which has the highest safety level, states that a fault is not allowed to affect the safety function and that the fault shall be detected by the outputs falling immediately or that they do not re-connect after being disconnected. Maximum allowed scattering angle for the light is $\pm 2.5^\circ$.

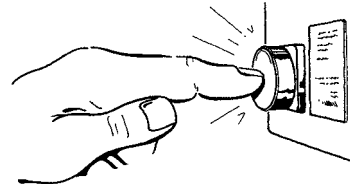
Type 2 states that a simple but monitored safety function is required, which means that the safety function shall be monitored through periodic tests which break the output when a fault occurs. Between the testing times there can though be faults which result in the safety component malfunctioning. The test function can either be built into the safety device or an external unit (e.g. the machine's control system) can initiate a test. Maximum allowed scattering angle for the light is $\pm 5^\circ$.

Light grids and light curtains are included among the products in the machine directive's appendix 4, which means that an external certifying procedure with an officially recognised institution is called for.

Reset – 3 alternatives

Supervised manual reset

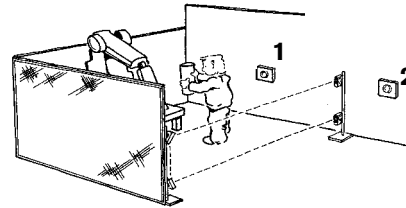
When a light curtain/grid is interrupted it will give a stop signal to dangerous machines within the hazardous area it protects and a reset-lamp can be lit. For a new start of the machine the light curtain/grid has to be reset. This is done with the reset button which is placed where the whole hazardous area can be supervised and can not be reached from within the area which it protects.. There are high requirements on the reset function - neither a short circuit nor a component fault shall give automatic reset. When the reset button has been set the outputs are activated and the reset-lamp is turned off.



Reset button with light indication.

7 Supervised time-reset

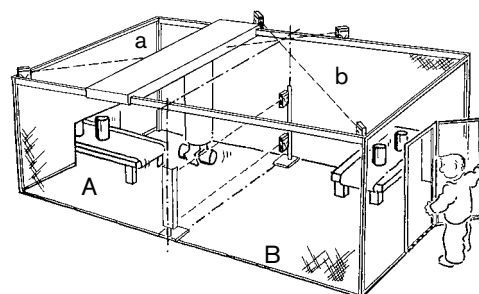
When supervised time-reset (pre-reset) is in use, its purpose is not to allow a reset from outside the protected area without first having confirmed that no-one is out of sight within the area. To reset the light beam (see figure) button 1 must first be pressed and afterwards button 2 within e.g. 5 seconds. This is especially important when one cannot see the entire area that is protected by the light beam.



Button 1 is pressed and afterwards, within a chosen time e.g. 5 seconds, button 2 is pressed for resetting the light beam.

Automatic reset

Automatic reset is used when the light beam is used for area monitoring. When the light beam is actuated this indicates that e.g. a robot is in the area. The robot is stopped if a person enters the same area e.g. through a gate. When the light beam is free again the control unit will be reset automatically.



A light beam b indicates that the robot is situated in area A. In this position it is possible to walk in through the gate to area B without stopping the robot.

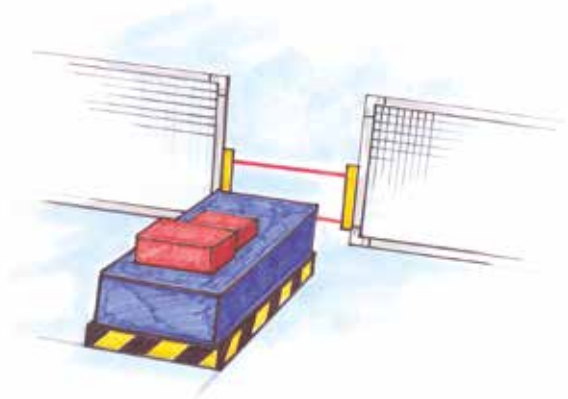
Muting (bypassing)

Bypassing may be needed for different reasons. One of the most common reasons for bypassing is during in and out feeding of material on a conveyor, Automated guided vehicle (AGV), etc. Another common application is bypassing while passing with a three-position device to the hazardous area.

Important aspects for bypassing is that it shall be safe, not be activated by mistake and be difficult to defeat. In other words it shall give a reliable bypassing when a loading carrier enters but not allow a human to pass. To achieve the highest safety level a dual and supervised bypassing system is needed (usually with at least two independent signals). If this is done with sensors, it is recommended they be of different kinds, because of the probability of them both malfunctioning for the same reason e.g. common cause failure. An example of a solution is to use a mechanical limit switch and a photo-cell sensor.

To avoid deliberate defeating/manipulation of the bypassing sensors/signals a safety relay or a safety-PLC is connected thereby monitoring that the sensors are both activated and deactivated in every bypassing cycle.

The number of variations in bypassing systems are almost infinite. This depends on the specific requirements of each plant/machine. For Focus II there are a number of bypassing possibilities prepared.



Automatic bypassing of light grid when an Automated guided vehicle passes.

Blanking

Blanking means permanent switching off of a number of beams in the detection zone of a light curtain. This is a function that is permitted and used when an object that is larger than the resolution of the light curtain is permanently located in the detection zone, without deactivating the safety outputs (OSSD). If the object is removed from the detection zone, the safety outputs are deactivated.

Blanking function has different tolerance settings that allow movement or vibration of the objects that obscure the detection zone.

One tolerance setting can be called "Floating blanking", that means that the part of the zone which is intentionally blocked can be moved around in the detection zone while the machinery is operating. Other beams are active and providing normal protection, but often with reduced resolution.

When a "blanking" function is used, it is very important that the light curtain provides protection and can detect objects, as small as a finger or hand, depending on the resolution, anywhere outside the zone that is rendered inactive because the object is there. Blanking may require an additional fixed guard and may require additional minimum distance to the dangerous movement.

It must not be possible to select the "blanking function" without using a key, tool or similar unlocking device.

Light curtain for short safety distance

A light curtain can be used in a machine or a production plant in the same way as a hatch. There is a great difference though when it comes to the risk situation. When one has a light curtain installed with a short minimum distance in front of a dangerous machine, there is a high risk for spontaneous engagement into the machine, often called after-grasp. If the dangerous machine movement does not stop during such an engagement, one has a small chance of avoiding injury.

Therefore it is of great importance that the whole chain in the stopping circuit is dual and supervised. Even valves and contactors which ultimately control dangerous movements normally have to be doubled up and supervised.

Regulations concerning safety distances are given in specific C-standards such as EN 692 for mechanical presses. If no specific C-standard is available, EN ISO 13855 is used.

Automatic machines

7

For light curtains on automatic machines there shall be a reset function which is active when the machine is set for automatic production whether or not it is a passable protection. After affected a light curtain, one must first use a reset function then the restart of the cycle shall be made with a separate starting device. The same reset applies for machines with semi-automatic drive.

Operator protection during manually serviced machines

Manually operated machines where one or more operators pick in and out parts between every cycle are the most risky light curtain applications. This because of the number of engagements into the machine's hazardous area is often several times per minute.

Light curtains on presses

Light curtains have traditionally been a common protection method among press applications and there has since long existed detailed information on the usage of light curtains on presses. (see next spread for "Cycle initiation with light curtain"). Only light curtains of type 4 are accepted on presses.

Reset

On the servicing side i.e. the side or sides where there is an operator that picks in and out parts, there shall be a separate reset function for the light curtain, usually a button. If there are several light curtains e.g. on the front and back there shall be one for each. If the light curtain is actuated during a dangerous movement the press shall not be able to restart without being reset. During engagement after the end of the cycle no reset is needed.



Hand resolution



Finger resolution

Cycle initiation with light curtain

Cycle initiation

Cycle initiation is a concept when the machine is designed so that a new cycle initiated by affecting the light curtain. A cycle is defined as the hand being placed in and taken out once. Usually it is possible to choose between one-cycle and two-cycle operation. During one-cycle a new action is started when the light curtain has been actuated once and during two-cycle when the light curtain has been actuated twice. The operator thereby operates the machine by the action of putting parts in and out.

On presses this "Cycle initiation" function is very common. But because the press starts without any particular command there are some risks involved and therefore many conditions have to be met before the machine operates.

Smaller presses which cannot be entered have certain regulations that means some limitations: The table height may not be lower than 750 mm, the stroking length may not be larger than 600 mm and the table depth may not be larger than 1000 mm. The light curtain shall have 30 mm or higher resolution. If the press is not started within approx. 30 seconds after the end of the cycle, a new cycle shall not be accepted without the light curtain being again manually reset. **NB.** For machines with cycle initiation, the installation of the light curtain must be in accordance with machine parameters and all relevant standards and regulations.

Installation of light curtain

The light curtain must be installed so no-one can reach a trapping/crushing risk without actuating the light curtain. The most important thing is that there are no gaps under, on the sides and over the top during cycle operation. The lower edge of the light curtain must therefore be slightly below the

Installation – correct and incorrect during cycle initiation



Correctly installed.

The operator cannot reach into the machine without actuating the light curtain.



Incorrect installation.

Gap below the light curtain. The operator can reach into the machine without actuating the light curtain.



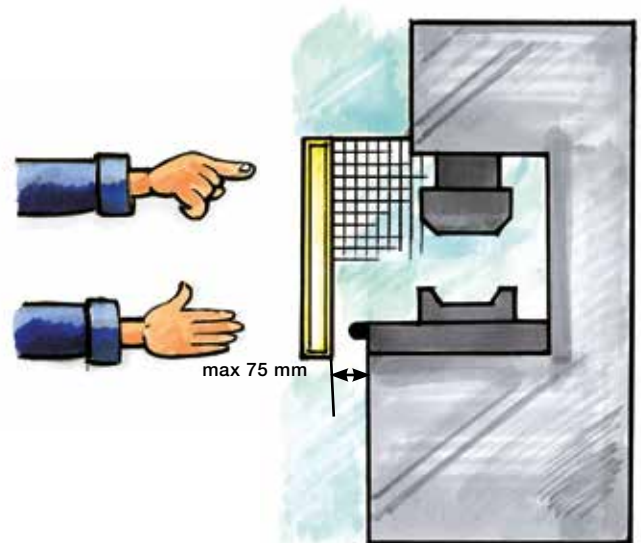
Incorrect installation.

Gap above the light curtain. The operator can reach into the machine without actuating the light curtain.



Correctly installed.

Light curtain complemented with a horizontal light curtain to detect the operator.



press table edge. Also if it is open above the light curtain the height must be adapted so that it is not possible to reach over the detection zone (see ISO 13855). Physical adjustment possibilities must be limited so that dangerous motions are placed out of reach.

Between the light curtains detection zone and mechanical parts there shall only be max 75 mm gap to prevent a person from standing there. In practise to achieve this demand and the required safety distance one usually has to complement with e.g. additional mechanical protection or additional horizontally positioned light curtains i.e. step-in light curtain. Another solution could be a lying or an angled light curtain.

Minimum distance for light protection according to EN ISO 13855

The distance 'S' is a minimum distance between a light curtain and a hazardous area. The distance shall prevent that a person is not able to reach a hazardous machine part before the machine movement has stopped. This is calculated with the formula from EN ISO 13855 - Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body.

$$S = (K \times T) + C$$

S = minimum distance in mm

K = body/part of body (e.g. hand) speed in mm/s

T = T1 + T2

where

T1 = the safety device's reaction time in seconds

T2 = the machine's reaction time in seconds

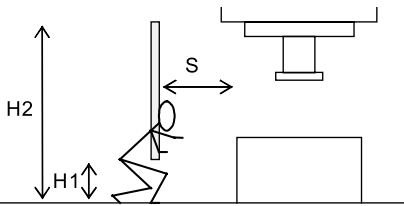
C = additional distance in mm based upon the body's intrusion towards the hazardous area before the safety device has been actuated.



Resolution for finger (≤ 14 mm) gives C = 0

NB If it is possible to reach the hazard zone by reaching over the light beam, an addition is made to the formula. In table 1 in EN ISO 13855 an alternative safety distance addition (C_{ro}) is given to the formula $S = (K \times T) + C$. The greatest value out of C and C_{ro} is to be used to prevent reaching the hazard zone by reaching over the light curtain/grid.

Minimum distances for vertical and horizontal installed light curtains according to EN ISO 13855



S = minimum distance in mm

H1 = the lower beam may not be situated higher than 300 mm above the ground

H2 = the upper beam may not be situated lower than 900 mm above the ground

For $S \leq 500$ mm the minimum distance for vertical installation is calculated with the following formula:

$$S = (2000 \times T) + 8 \times (d - 14)$$

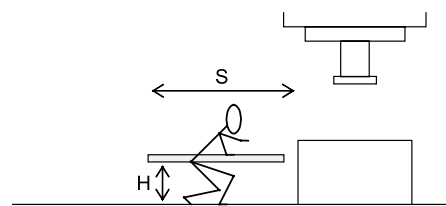
where d is the light curtain's resolution in mm.

K here is 2000 mm/s which represents the speed of the hand. The expression $(8 \times (d - 14))$ may never be less than 0. Minimum distance S is 100 mm.

If the minimum distance according to the formula above gets larger than 500 mm one can instead use:

$$S = (1600 \times T) + 8 \times (d - 14)$$

K is 1600 mm/s which represents the speed of the body. Minimum distance according to this formula is 500 mm.



S = minimum distance in mm

H = the light curtain detection zone must be positioned between 0 and 1000 mm above the floor

The minimum distance for horizontal installation is calculated with the following formula:

$$S = (1600 \times T) + (1200 - 0.4 \times H)$$

where H is the height of the detection zone above the reference plane, e.g. the ground

$(1200 - 0.4 \times H)$ may not be less than 850 mm. Depending on the resolution, d, that the light curtain has, there is a minimum height that the detection zone may be placed. This is calculated with:

$$H = 15 \times (d - 50)$$

H cannot be less than 0. With a resolution $d = 14$ or 30 mm one can therefore install the light curtain from $H = 0$ and up. The higher it is situated, the shorter the minimum distance gets. The highest permissible height H of the detection zone is 1000 mm.

When you use a horizontal light curtain as entry protection, the depth of the light curtain shall be at least 750 mm to prevent people from inadvertently stepping over it. The estimated minimum distance is measured from the machine's hazardous section to the outermost beam of the horizontal light curtain (seen from the machine).

Minimum distance for light beams according to EN ISO 13855

For light beams the minimum distance is calculated from the following:

$$S = (1600 \times T) + 850 \text{ mm}$$

NOTE! The additional distance will in most cases be more than 850 mm due to the possibility to reach over a light beam. (C_{ro})

The formula applies whether one installs 2,3 or 4 beams. It is the risk assessment that decides the number of beams that are to be chosen. The following possibilities must be considered.

- to crawl under the lowest beam;
- to reach over the top beam;
- to reach in between two beams;
- that the body passes in between two beams.

To fulfill the requirements the beams shall be installed at the following heights:

Number of beams	Height over the reference plane, e.g. ground
4	300, 600, 900, 1200
3	300, 700, 1100
2	400, 900

Minimum distances for new and old presses

New presses

For new CE-marked presses there are specific requirements from the standards EN 692 Machine tools – Safety – Mechanical presses – Safety and EN 693 Machine tools – Safety – Hydraulic presses.

The same requirements apply for vertical installation on presses as with vertical installation on other machines with the difference that C is given according to the following:

Resolution, d, (mm)	Minimum distance addition, C (mm)	Cycle initiation
≤ 14	0	Permitted
>14 - 20	80	
>20 - 30	130	
>30 - 40	240	Not permitted
>40	850	

Other manually serviced machines

The rules for presses may well be applied to other machines which function in a similar way and that have the same risk situation. There is no other standard which is as detailed on the usage of light curtains.

For cycle initiation the light curtains resolution, d, must be ≤ 30 mm. This applies to both old and new (CE-marked) presses.

Old presses

“NB” For old presses there are different rules for each country.

The formula that applies here is:

$$S = (2500 \times T) + C$$

The minimum distance addition C for different resolutions of the light curtain is given in the following table

Resolution, d, (mm)	Minimum distance addition, C (mm)
<16	0
16	70
20	110
25	130
30	140
35	240
40	270
45	300
50	330
55	360
>55	850

Safety Light Grids and Safety Light Curtains Focus II

Approvals:



Application:

- Optical protection in an opening or around a hazardous area

Features:

- Type 4 according to EN 61496
- Flexible assembly
- LED indication
- High protection class (IP65)
- Range 0.2-40 m
- Time reset
- Fixed / floating blanking
- Muting
- Single/Double Break funktion
- External Device Monitoring (EDM)
- Available with different resolutions
- Up to PL e according to EN ISO 13849-1



7

A light grid/light curtain with many possibilities

Focus II is a new version of our previous light grid/light curtain Focus. Features such as muting and override are standard in all Focus II light curtains and light grids. For light curtains, blanking and break functions are also standard. The optical sensors on Focus II also have variable coding. The Focus II units are light grids/curtains with safety functions intended for applications where it is of great importance to protect persons from a dangerous machine, robot or other automated systems where it is possible to access to a hazardous area.

Focus II creates a detection zone with infrared beams. If any beam is interrupted the safety mechanism is triggered and the dangerous machine is stopped. Focus II fulfills the requirements for non-contact safety equipment type 4 according to the international regulation standard EN 61496-1.

Units are available with safety heights between 150 and 2400 mm. All electronic control and monitoring functions are included in the light curtain profiles. External connection is made via a M12 connection at the end of the profile. Synchronization between transmitter and receiver is achieved optically. No electrical connection between the units is required. Control and monitoring of the beam transmission is carried out by two micro-processors which also give information on the status and alignment of the light curtain via several LEDs.

Muting and Override included in all Focus II

The "Muting" and "Override" functions are available on all Focus II light grids/curtains and is enabled directly when an indication lamp LMS is connected. Muting implies that one or more segments or the whole light curtain can be bypassed during in and out passage of material.

In the Focus II with muting enabled there is also an Override function which makes it possible to bypass the light grid/curtain i.e. activate the outputs if a machine start is necessary even if one or more light beams are interrupted. This is the case when the muting function is chosen and the A and B inputs are activated. If for example during the muting operation a loading pallet has stopped inside the detection zone after a voltage loss, the override function is used to enable the pallet to be driven clear.

Blanking

It is also possible to obtain the Focus II light curtains with blanking. Floating blanking is a tolerance setting that makes it possible to 'disconnect' a defined number of beams from the detection zone. The object is then free to move in the detection zone without the safety function being triggered. Other tolerance settings allows less movement of the interfering object. Blanking may require an additional fixed guard and may require additional minimum distance to the dangerous movement.

Safety outputs OSSD1 and OSSD2

Focus II has two PNP outputs - OSSD1 and OSSD2. If the load to be switched is alternating current or requires a higher current than 500 mA then one should use a safety relay e.g. RT9, Pluto PLC or the FRM-1 unit (converts the outputs to relay contacts) from ABB Jokab Safety. The FMC-Tina and Tina 10A/10B/10C converts the outputs to a dynamic signal for connection to Pluto or Vital. Pluto can also work directly with the OSSD-outputs.

Single/Double Break function

This function is used for presses when the operator prepares or picks out a detail. With the Single Break function the light curtain allows operation after entry and withdrawal out of the curtain. Similarly, the Double Break function allows operation after entry and withdrawal twice.

External Device Monitoring (EDM)

In all light grids and light curtains an EDM function is available which allows Focus II to test if the external control element responds correctly. A test channel is connected through the respective contactor, in order to detect any faults and thereby prevent a reset.

Reset

On every Focus II there are inputs for reset. The reset option is chosen through dual switches in the Focus II receiver. At delivery, Focus II is set to automatic reset.

- Automatic reset – When the detection zone is free the outputs are closed directly. (Setting when delivered).
- Manual reset – When the light field detection zone is free, the reset button has been actuated before the outputs are activated.
- Time reset – To reset the Focus II a pre-reset button must first be actuated and afterwards within 8 seconds a reset button outside the hazardous area must be actuated.

Focus II light curtain

Standard:

- Muting (bypassing) partly or completely
- Supervised output for muting lamp
- Override
- Manually supervised or automatic reset
- Time-reset
- Blanking
- Single/Double Break
- EDM

Focus II light grid

Standard:

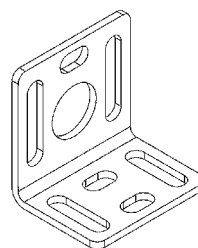
- Muting (bypassing) of one, two, three or four beams
- Supervised output for muting lamp
- Override
- Manually supervised or automatic reset
- Time-reset.
- EDM

Option:

- Light grids for tough environments with parallel beams of light for improved reliability.

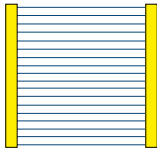
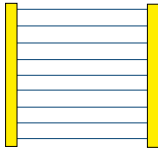
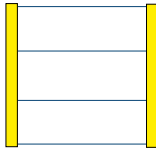
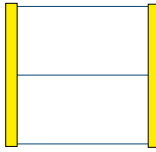
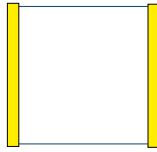


With the switches at the bottom of Focus II you can choose the function you desire.



JSM 66
2TLA022090R1300
JSM 66 Bracket for Focus II

Focus II light curtain/grid, Type 4 (FII-4) Summary

						
Model name	FII-4-14-zzzz	FII-4-30-zzzz	FII-4-K4-zzzz		FII-4-K3-800	FII-4-K2-500
Resolution	14	30				
Beam distance			300	400	400	500
Height (mm=zzzz)	150 300 450 600 750 900 1050 1200 1350 1500 1650 1800 1950 2100 2250 2400	150 300 450 600 750 900 1050 1200 1350 1500 1650 1800 1950 2100 2250 2400	900	1200	800	500
Range (m) SR LR	0.2-3 3-6	0.2-7 7-14	0.5-20 20-40		0.5-20 20-40	0.5-20 20-40
Reaction time off (ms)	18-103	14-47	13		13	13
Reaction time on (ms)	138-104	141-119	142		142	142
Manual reset	•	•	•		•	•
Automatic reset	•	•	•		•	•
Pre reset	•	•	•		•	•
Muting inputs	•	•	•		•	•
Muting lamp supervision	•	•	•		•	•
Override	•	•	•		•	•
Muting T/L/X	• / • / •	• / • / •	• / • / •		• / • / •	• / • / •
Blanking 3 types	• / • / •	• / • / •	- / - / -		- / - / -	- / - / -
Single/Double break	• / •	• / •	- / -		- / -	- / -
EDM	•	•	•		•	•
Dyn. Adaption to Vital/Pluto	☐	☐	☐		☐	☐

• Standard ☐ With Tina 10A/10B/10C or FMC-Tina

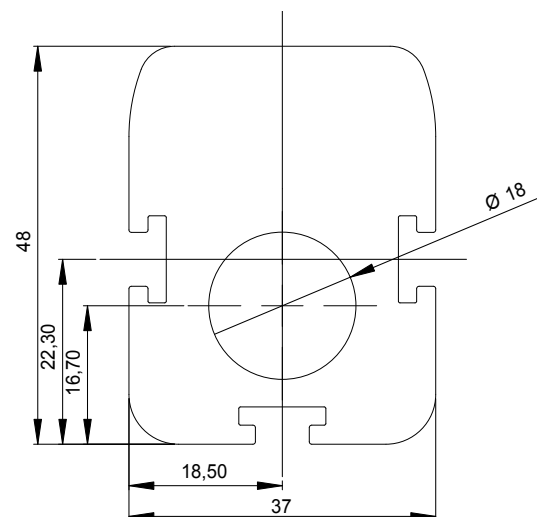
NOTE! For ordering data and article number see the product list. For more information see the manual on our home page.

FII-4-K4-zzzz D		FII-4-K3-800 D		FII-4-K2-500 D		FII-4-K2C-zzzz		FII-4-K2C-800		FII-4-K1C-500	
300	400	400		500		300	400	400		500	
900	1200	800		500		900	1200	800		500	
0.5-20 20-40		0.5-20 20-40		0.5-20 20-40		0.5-7		0.5-8		0.5-12	
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Technical data – Focus II

Article number	
Light curtains	
FII-4-14-150	2TLA022200R0000
FII-4-14-300	2TLA022200R1000
FII-4-14-450	2TLA022200R2000
FII-4-14-600	2TLA022200R3000
FII-4-14-750	2TLA022200R4000
FII-4-14-900	2TLA022200R5000
FII-4-14-1050	2TLA022200R6000
FII-4-14-1200	2TLA022200R7000
FII-4-14-1350	2TLA022200R8000
FII-4-14-1500	2TLA022200R9000
FII-4-14-1650	2TLA022201R0000
FII-4-14-1800	2TLA022201R1000
FII-4-14-1950	2TLA022201R2000
FII-4-14-2100	2TLA022201R3000
FII-4-14-2250	2TLA022201R4000
FII-4-14-2400	2TLA022201R5000
FII-4-30-150	2TLA022201R6000
FII-4-30-300	2TLA022201R7000
FII-4-30-450	2TLA022201R8000
FII-4-30-600	2TLA022201R9000
FII-4-30-750	2TLA022202R0000
FII-4-30-900	2TLA022202R1000
FII-4-30-1050	2TLA022202R2000
FII-4-30-1200	2TLA022202R3000
FII-4-30-1350	2TLA022202R4000
FII-4-30-1500	2TLA022202R5000
FII-4-30-1650	2TLA022202R6000
FII-4-30-1800	2TLA022202R7000
FII-4-30-1950	2TLA022202R8000
FII-4-30-2100	2TLA022202R9000
FII-4-30-2250	2TLA022203R0000
FII-4-30-2400	2TLA022203R1000
Light grids	
FII-4-K2-500	2TLA022204R0000
FII-4-K3-800	2TLA022204R1000
FII-4-K4-900	2TLA022204R2000
FII-4-K4-1200	2TLA022204R3000
FII-4-K2-500D	2TLA022204R4000
FII-4-K3-800 D	2TLA022204R5000
FII-4-K4-900 D	2TLA022204R6000
FII-4-K4-1200 D	2TLA022204R7000
FII-4-K1C-500	2TLA022204R8000
FII-4-K2C-800	2TLA022204R9000
FII-4-K2C-900	2TLA022205R0000
FII-4-K2C-1200	2TLA022205R1000
Supply voltage	24 VDC \pm 20%
Power consumption	
Transmitter	70 mA maximum
Receiver	100 mA maximum
Protective height	Light curtains: 150 mm - 2400 mm Light grids: 500 mm - 1200 mm
Object resolution	Light curtains: 14 mm and 30 mm

PFH _D	2.5x10 ⁻⁹
Light source	Infrared Emitting LEDs, Wavelength 880 nm
Enclosure	Housing: Aluminium painted yellow Front: Polycarbonate Connector: Polyamide End cap: Polyamide
Profile dimensions	37 x 48 mm
Protection class	IP65
Operating temperature	-10 to +55° C
Storage temperature	-25 to +70° C
Safety outputs (OSSD)	Two PNP safety outputs, each sourcing 500 mA 24 VDC. Short circuit protection.
Response time ON to OFF	Maximum: 13-103 ms (depending on model)
Connection transmitter	M12 5-pin male
Connection receiver	M12 8-pin male
Indication	LED's on transmitter and receiver indicating alignment, dirt, power supply and outputs
Safety level	
EN/IEC 61496	Type 4
EN ISO 13849-1	PL e/Cat. 4
IEC 61508	SIL 3
Conformity	EN ISO 12100-1:2010, EN ISO 13849-1:2008, EN 62061:2005, EN 60204-1:2007+A1:2009, EN 61496-1/AC:2010, EN 60664-1:2007, EN 61000-6-2:2005, EN 61000-6-4:2007



Focus II

Muting (bypassing)

Focus II muting types

- T-muting. Four NO muting sensors are used in two pairs (OR function), allowing bi-directional transport of material. Maximum muting time is 600 s. Muting A and Muting B need an activation time difference of 30 ms.
- L-muting. Two NO muting sensors works together with the light protection, allowing transport out from the hazardous area. Maximum muting time is 600 s. Muting A and Muting B need a activation time difference of 30 ms.
- X-muting. One NO and one NC muting sensor is like a cross through the light protection, allowing bi-directional transport of material. An alternative X-muting (only on Focus Light beams) with 2 NO muting sensor is also possible, but then with the condition of a 30 ms activation time difference on the muting sensors. Both solutions gives an infinite muting time.

Built-in muting for Focus II is available in three ways:

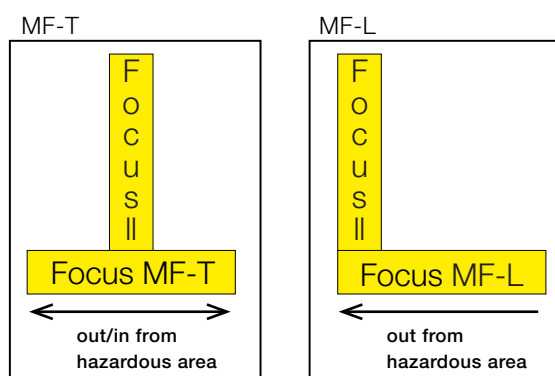
- Pre-made muting units MF-T and MF-L, which have integral photocells.
- Connection of muting sensors via a FMC.
- Separate connection of muting sensors (Mute R) directly to the Focus II receiver unit.

Muting-lamp

To the Focus II receiver unit it is also possible to directly connect a external muting-lamp. It is also possible to connect the muting-lamp via a FMC. During bypassing the muting-lamp is lit. Bypassing is only possible if the muting-lamp is functioning or a resistor of 220 Ohm is used in its place.

Muting with MF-T and MF-L units

MF-T and MF-L are muting units with integrated photocells built into a aluminum profile. They work with all Focus II light grid and curtain. No additional sensors are required because the muting units contain the required components. MF-T/MF-L is connected between the Focus II and the supervising unit (e.g safety relay, safety PLC). The cable between the Focus II and MF-T/MF-L is included with the muting unit.



MF-T

The muting unit MF-T consist of a transmitter unit and a receiver unit with four photocells A1, B1, B2 and A2. A1 and A2 are connected in parallel and B1 and B2 connected in parallel. In this way the unit is configured for installations where material is transported into and/or out of a hazardous area.

MF-L

The muting unit MF-L consist of a transmitter unit and a receiver unit with two photocells A1 and B1. The A1 and B1 sensor are actuated before the material is transported through the light grid/curtain. The light grid is an active part in upholding the muting function once A1 and B1 have been passed by the material. The light grid/curtain is being bypassed just as long as the material exiting. Unit MF-L is primarily intended for material transport out of a hazardous area.

MF-T Reflex

The muting unit MF-T Reflex consist of a transmitter/receiver side and a reflector unit. The active side contains four transmitters/receivers photocells. The MF-T Reflex works as the MF-T with a limited range (6m). These units, together with a light grid with one active and one passive side provides a good solution were electrical connections is only necessary on one side!

MF-L Reflex

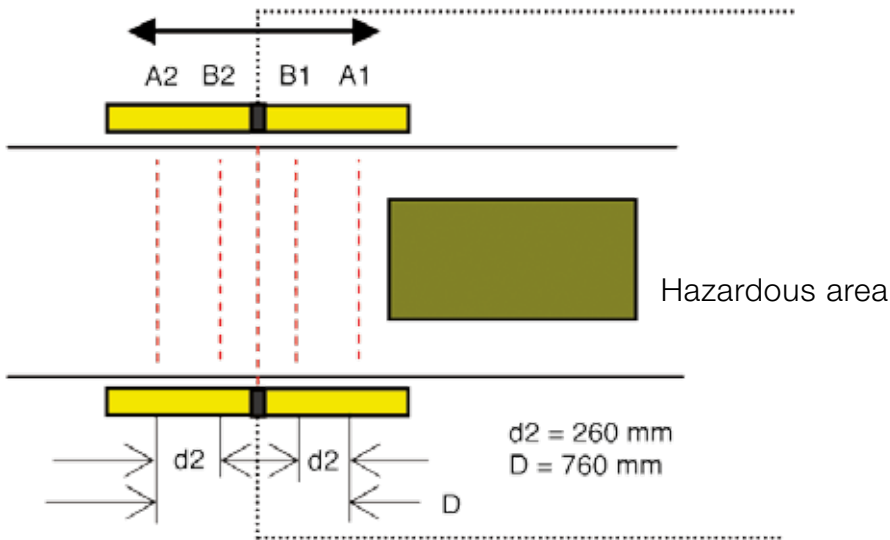
The muting unit MF-L Reflex consist of a transmitter/receiver unit and a reflector unit. The active side contains two transmitters/receivers photocells. The MF-L Reflex works as the MF-L with a limited range (6m). These units, together with a light grid with one active and one passive side provides a good solution were electrical connections is only necessary on one side!

Focus II

Muting with MF-T and MF-L

A solution with Focus Muting unit MF-T with integrated muting sensors.

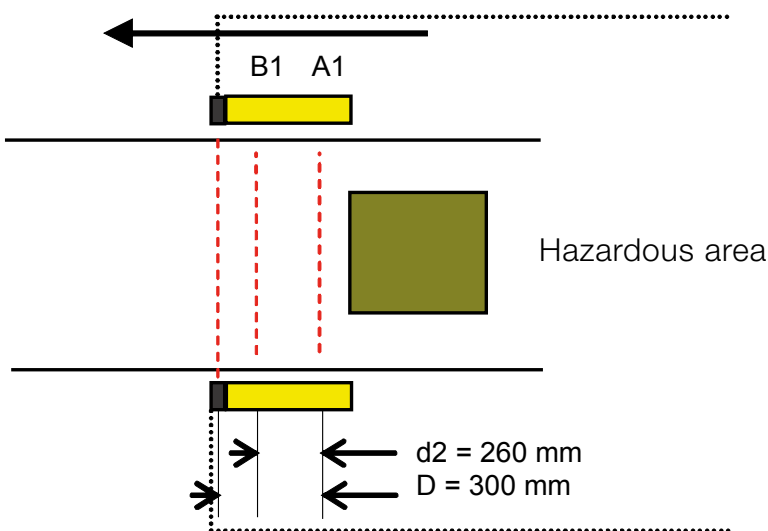
Possible direction of movement - in/out of hazardous area.



7

A solution with Focus Muting unit MF-L with integrated muting sensors

This solution shall only be used for movement out from a hazardous area.



NOTE! The muting sensors A and B must be placed so that the sensor A is always activated at least 30 ms before sensor B.

D: indicates the minimum length of the material that is to actuate the muting sensors that must be maintained during the passage through the light grid/curtain.

d2: indicates the measurement between the two/four pre-assembled muting sensors within the MF-L and MF-T.

Muting sensors – Mute R

Retro-reflective with polarizing filters

Approvals:



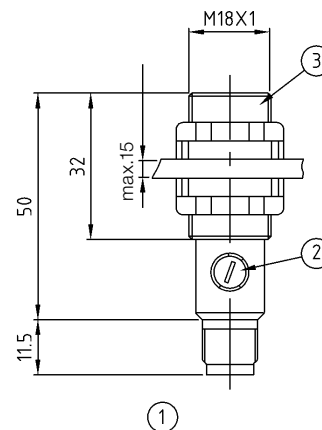
Features:

- Range adjustable
- Light reserve warning indicator
- Transistor output, PNP
- 1000 Hz switching frequency
- Short-circuit protection, reverse polarity protection and power-up output suppression
- Connector M12
- EMC tested according to IEC 801 and EN50081-1/EN 50082-2

Technical data

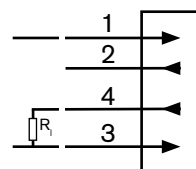
Article number	Mute R (FSTR-1)	2TLA022044R0000
Output	PNP, dark on	
Connection	Connector M12	
Range adjustment	Yes	
Range	0.15... 2.5 m (with reflector FZR 1)	0.15...5m (with reflector FZR 2A)
Light source	Visible-red, 660 nm, pulsed with polarizing filter	
Supply voltage	10...30 VDC	
Allowable ripple	± 10% of Us	
Current consumption (without load)	<15 mA	
Max. load current	100 mA	
Residual voltage	<1.6 V	
Max. switching frequency	1000 Hz	
Protection class	IP67	
Temperature (operating and storage)	-25 to +65° C	
Weight	approx. 15 g	

All technical data at 25° C and 24V.



1. Connector M12
2. Range adjustment and function indicator
3. Plastic housing

PNP output

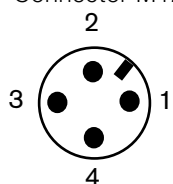


- 1 (+) Supply voltage 10...30 V
- 4 Dark-on output
- 3 (-) Supply voltage

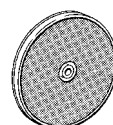
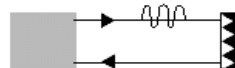
Dark-on output

The output is activated when an object interrupts the light.

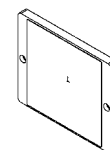
Connector M12



10...30 VDC
PNP
Dark-on output



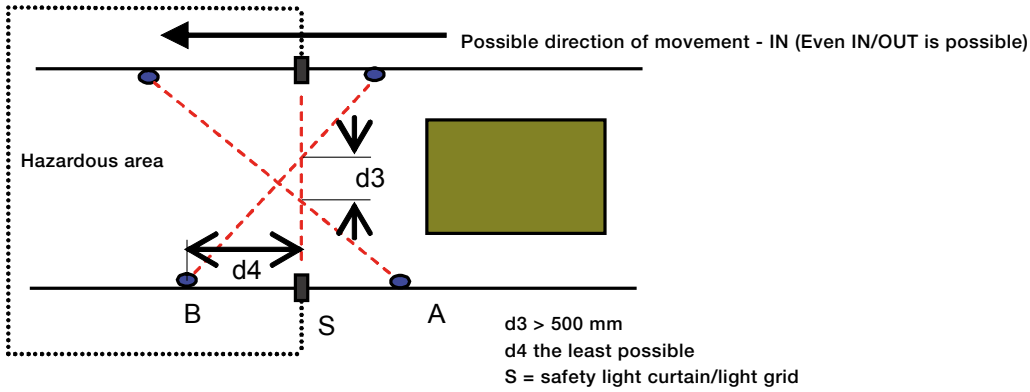
FZR 1 2TLA022044R0100
Reflector Ø 80 mm incl.screw MC6S M5 x 14 + Locking nut M5.



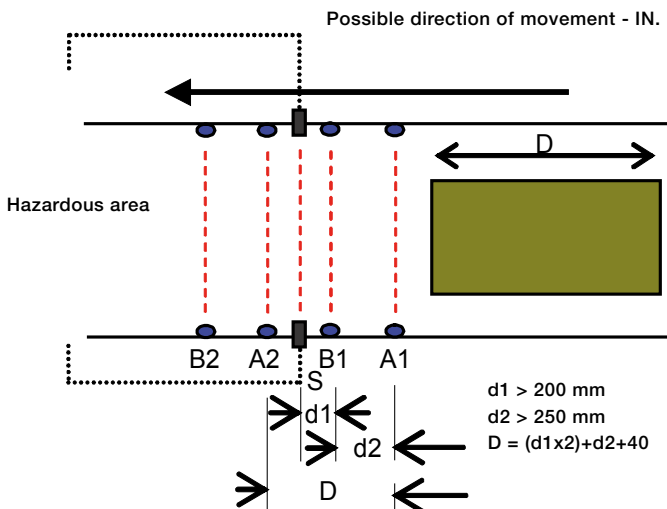
FZR 2A 2TLA022044R0400
Reflector 100 x 100 mm incl. screw MC6S M5 x 14 + Locking nut M5.

Muting with Mute R

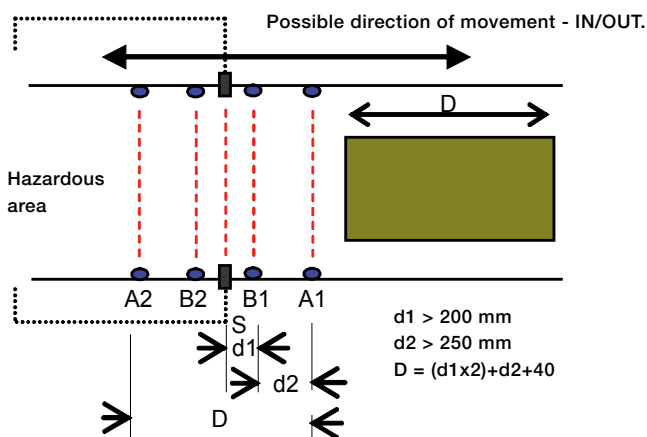
A solution with two sensors and one movement direction for material transport:



A solution with four sensors and one movement direction for material transport:



A solution with four sensors and two movement directions for material transport:



D: indicates the minimum length on the material that is to actuate the muting sensors that must be maintained during the passage through the light grid/curtain.

$d1$ must be as short as possible, and definitely less than 200 mm
 $d2$: indicates the distance between A1 and B1

Muting accessories FMC and FMI units



Approvals:



Application:

- FMC: Muting connection box
- FMI: Muting Indicator

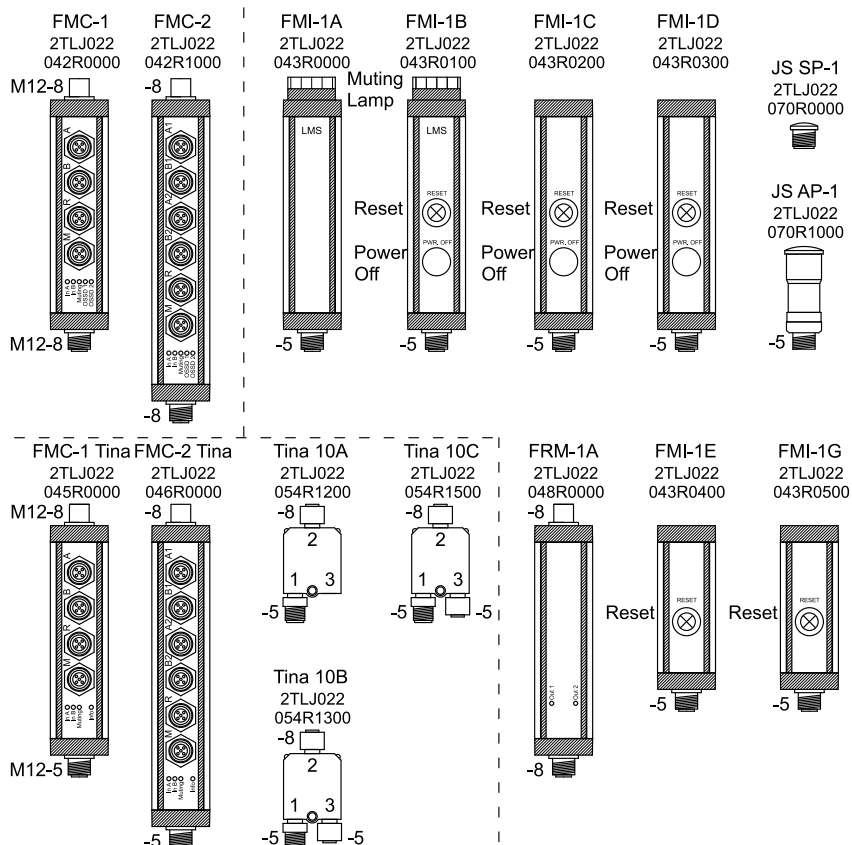
Features:

- Small
- Easy to connect

Various FMC, FMI, FRM- versions and Tina units

The Tina-versions have dynamic safety outputs for Vital/Pluto.

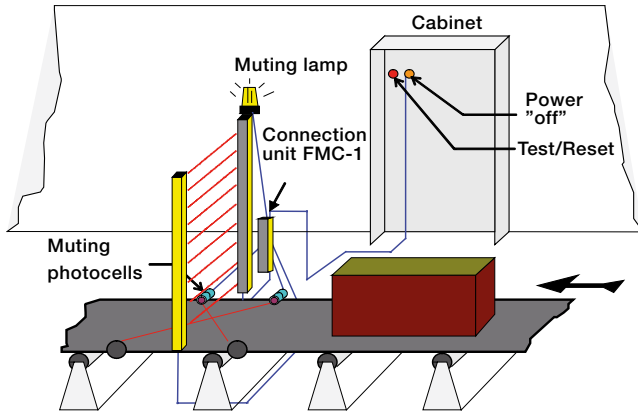
Model	Description
FMC-1(2)	with connectors for muting sensors (A+B), reset, power off and muting lamp (R) and muting lamp (M).
FMI-1A	with muting lamp only.
FMI-1B	with reset, power off and muting lamp.
FMI-1C	with reset and power off.
FMI-1D	with reset, power off and internal resistor for the muting lamp.
FMI-1E	as pre reset connected to connector A (A2) on FMC-1(2) (Tina).
FMI-1G	with reset, and internal resistor for the muting lamp.
FMC-1 (2) Tina	same as FMC-1(2) but connected to Vital or Pluto.
Tina 10A	adaptor unit for connecting Focus II to Vital or Pluto.
Tina 10B	simplified FMC-1(2) Tina including only the connector (R).
Tina 10C	simplified FMC-1(2) Tina including only power supply on con.no.3.
FRM-1A	translates the two OSSD outputs to relay outputs (and power supply).
JS SP-1	protection plug for not used connectors.
JS AP-1	adaptor for FMC units to use instead of FMI-1B or -1D on the (R) connector including muting resistor.



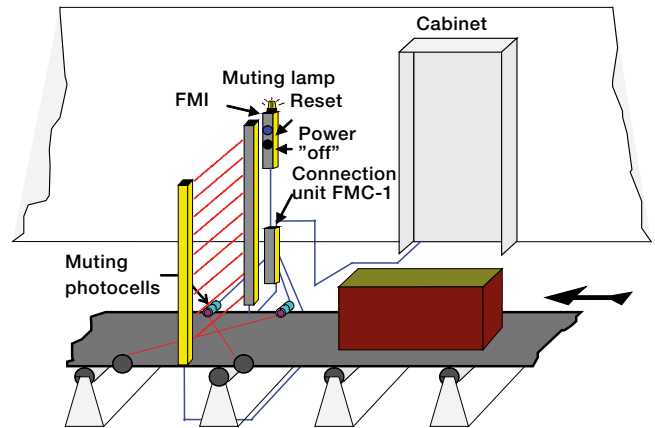
Muting with FMI and FMC

Connection of Focus II and muting components as FMC and FMI

Ex 1. Connection of light curtain with connection block FMC-1, test/reset button and switch for supply voltage placed in (by) the control cabinet.



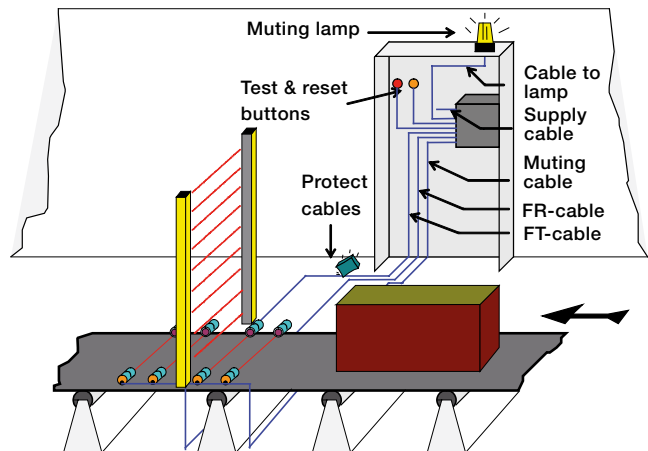
Ex 2. Connection of light curtain with connection block FMC-1. The Reset unit FMI must be placed out of reach from the hazardous area.



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Connection of Focus II and muting components directly to the control cabinet

- The TEST /RESET button shall be placed so the operator can see the protected area during reset, testing, and bypassing. It shall not be possible to reach the button from within the hazardous area.
- The LMS lamp for indication of muting and bypassing shall be placed so that it can be seen from all directions from where it is possible to access the hazardous area.
- If photocells are used as muting sensors then the sensor receivers shall be assembled on the light curtain's transmitter side to minimise the interference risk.
- The system is protected against dangerous functions caused by damage on the transmitter cable and/or the receiver cable. However, we recommend that the cables be protected so that physical damage to them can be minimised.

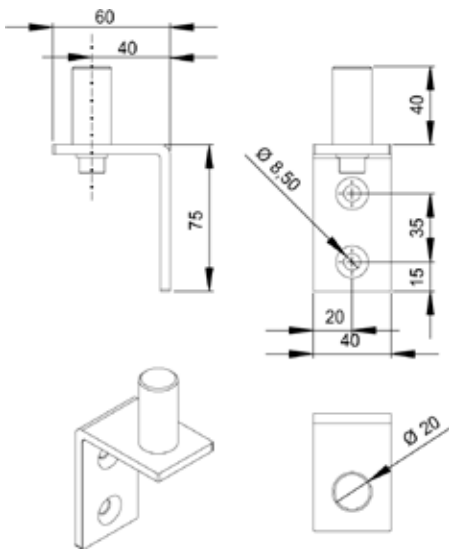


Accessories

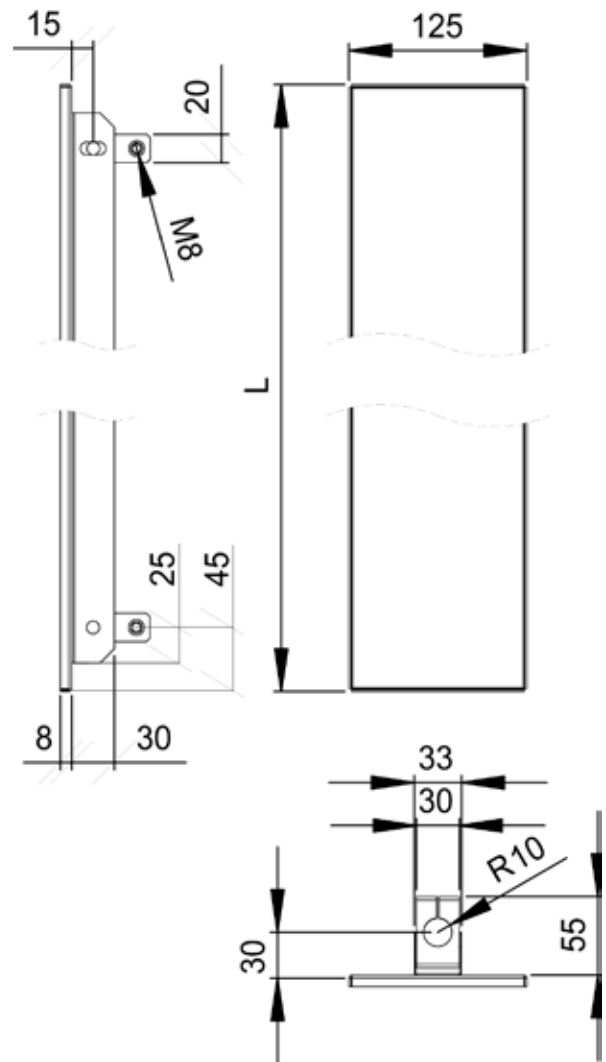
MFI mirrors for light curtain

Technical data – Mirrors

Type	Article No	Height mirror glass, mm	Height total, mm
MFI-300	2TLA022041R0200	356	361
MFI-450	2TLA022041R0300	506	511
MFI-600	2TLA022041R0400	653	658
MFI-750	2TLA022041R0500	796	801
MFI-900	2TLA022041R0700	953	958
MFI-1050	2TLA022041R1200	1103	1108
MFI-1200	2TLA022041R0800	1253	1258
MFI-1350	2TLA022041R1300	1403	1408
MFI-1500	2TLA022041R0900	1546	1551
MFI-1650	2TLA022041R1000	1703	1708
Bracket for MFI mirrors.	2TLA022041R2000		



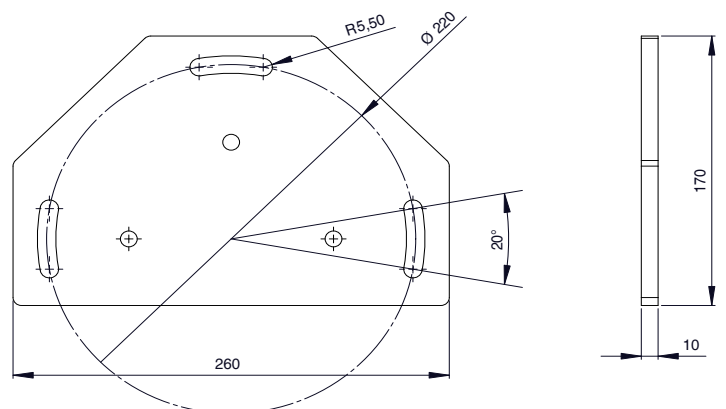
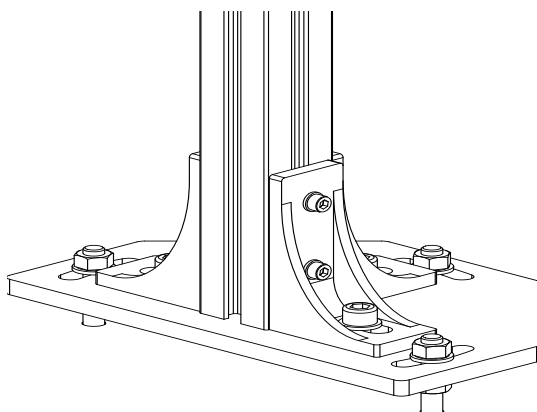
Bracket for MFI mirrors. 2 pcs needed for each mirror.



Adjustment plate

JSM 70, 2TLA040001R1500.

Plate for easy adjustment on uneven floors.



Light protection stand Bjorn



Application:

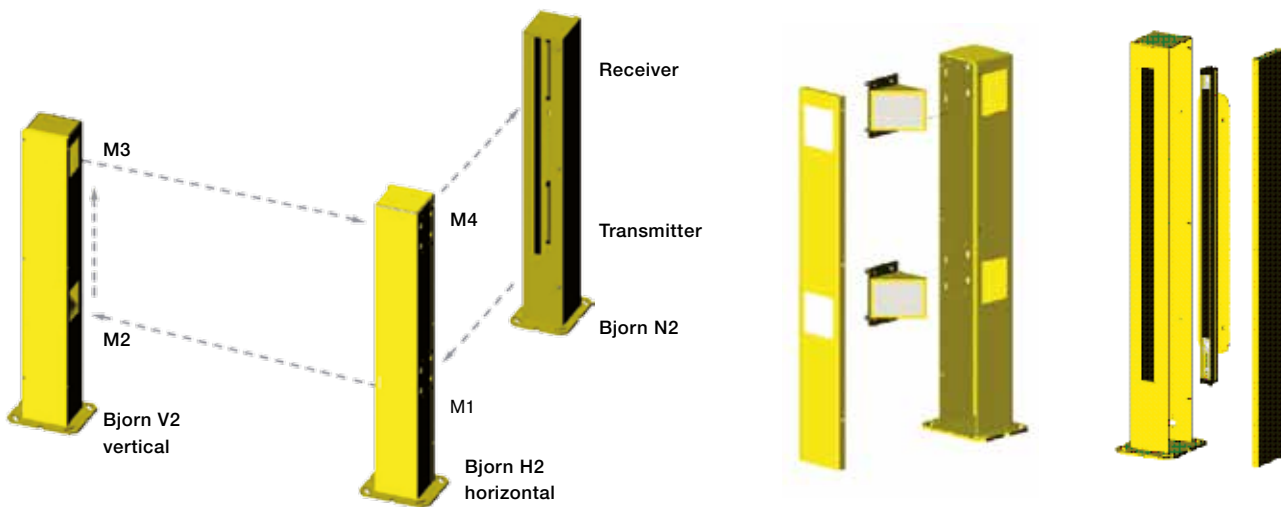
- Protects light curtain, light grids and mirror

Features:

- Robust
- Adjustable

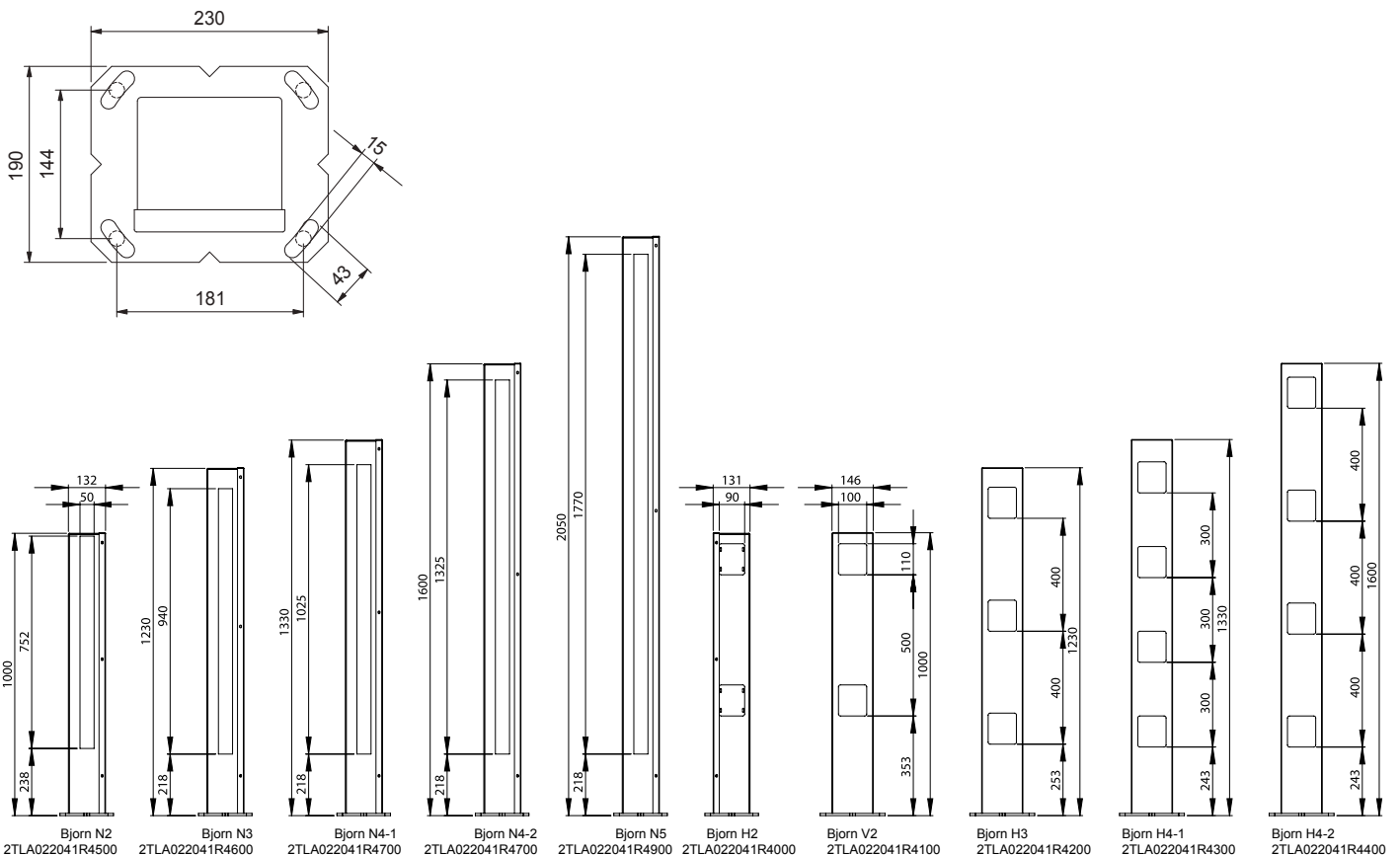
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Bjorn is a very stable and flexible stand system in which Focus II safety light grids/curtains and mirrors are mounted in the stand. The fixings for the mirrors in the stand can be turned to provide either vertical or horizontal angles. The robust material of the Bjorn protects Focus II units from direct collisions, and thus prevents unnecessary material damage and halts in production.



Technical data – Bjorn

Article number	
Bjorn H2	2TLA022041R4000
Bjorn V2	2TLA022041R4100
Bjorn H3	2TLA022041R4200
Bjorn H4-1	2TLA022041R4300
Bjorn H4-2	2TLA022041R4400
Bjorn N2	2TLA022041R4500
Bjorn N3	2TLA022041R4600
Bjorn N4-1	2TLA022041R4700
Bjorn N4-2	2TLA022041R4800
Bjorn N5	2TLA022041R4900
H = Horizontal reflection V = Vertical reflection N = For the light guard unit	
Colour	Yellow powder-coated (RAL 1018)
Material	3 mm steel
Dimensions	
Cross section	146 mm x 130 mm
Foot	230 mm x 190 mm
Weight	
N2	14 kg/piece
H2, V2	15 kg/piece
N3	17 kg/piece
H3, N4-1	18 kg/piece
H4-1	20 kg/piece
N4-2:	22 kg/piece
H4-2	24 kg/piece
N5	27 kg/piece
Mirror reduction	~10 % per mirror



Protection against water and dust

WET



Application:

- Protection in severe environments

Features:

- Adjustable
- IP68

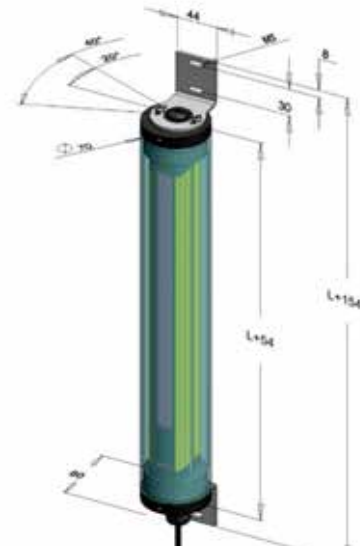
7

Technical data – WET

Article number	
WET-150 FII	2TLA022038R4000
WET-300 FII	2TLA022038R4100
WET-450 FII	2TLA022038R4200
WET-600 FII	2TLA022038R4300
WET-750 FII	2TLA022038R4400
WET-900 FII	2TLA022038R4500
WET-1050 FII	2TLA022038R4600
WET-1200 FII	2TLA022038R4700
WET-1350 FII	2TLA022038R4800
WET-1500 FII	2TLA022038R4900
WET-1650 FII	2TLA022038R5000
WET-1800 FII	2TLA022038R5100
WET-K-500 FII	2TLA022038R5200
WET-K-800 FII	2TLA022038R5300
WET-K-900 FII	2TLA022038R5400
WET-K-1200 FII	2TLA022038R5500
WET-L FII	2TLA022038R5600
WET-T FII	2TLA022038R5700
Colour	Transparent plastic
Length including lid	light curtain/light grid + 54 mm
Material	
Tube	PC
Lid	PEHD-300
Angle bracket	Stainless steel
Max. ambient temperature	+55°C
Installation adjustment	± 20°
Protection rating	IP68 (IP69K)

WET is used for protection against water (or dust) where extreme washing conditions are encountered. The protective encapsulation rating (IP68) now enables Focus II light curtains and light grids to be used for such applications as the food industry where the use of high pressure washing for cleaning machinery often occurs.

WET, with Focus II light curtains or light grids, is pre-assembled complete with cabling, on request. During installation on a machine a WET unit can be adjusted by ± 20° with the accompanying angle bracket.



Blanking programmer BP-1



Application:

- Program blanking

Features:

- Easy to connect
- Can stay fitted during operation

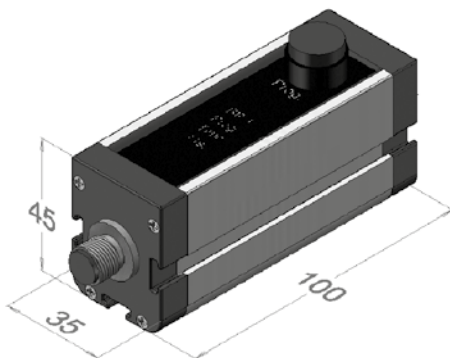
Technical data – BP-1 Blanking programmer

Article number	
BP-1 Blanking programmer	2TLA022090R2300
Colour	yellow and black

Programming blanking is made easy by using the Blanking programmer BP-1. The BP-1 is easily connected between the receiver unit of the light curtain and the cable otherwise connected to the receiver. The blanking object is placed in the light curtain detection zone and the button on the BP-1 is then pressed. 11 seconds later blanking is programmed for the object.

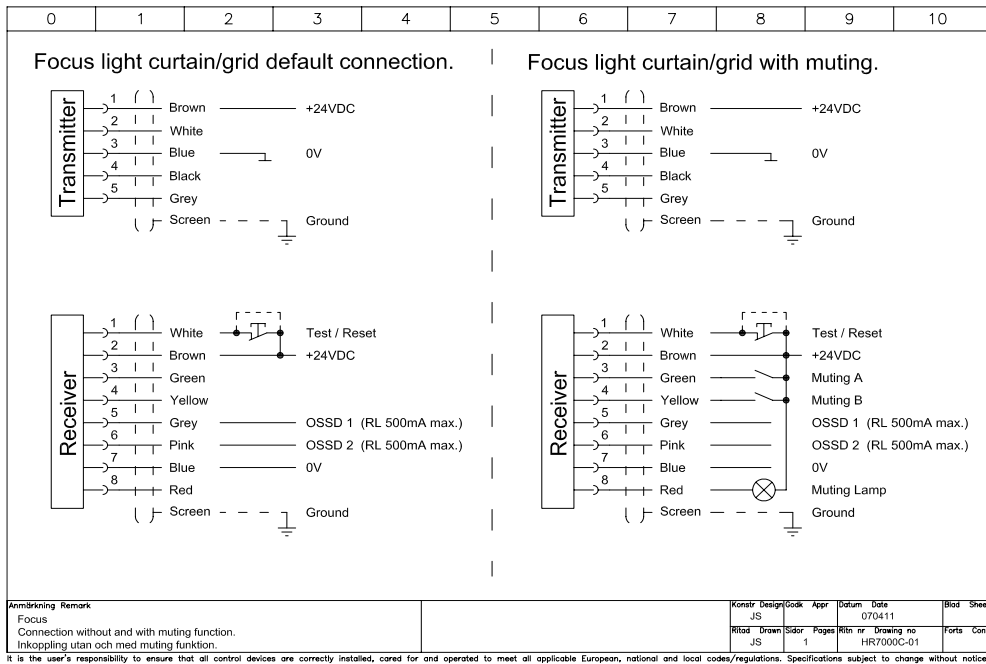
If the object needs to be changed a new programming is needed.

The unit can stay fitted during operation if required.

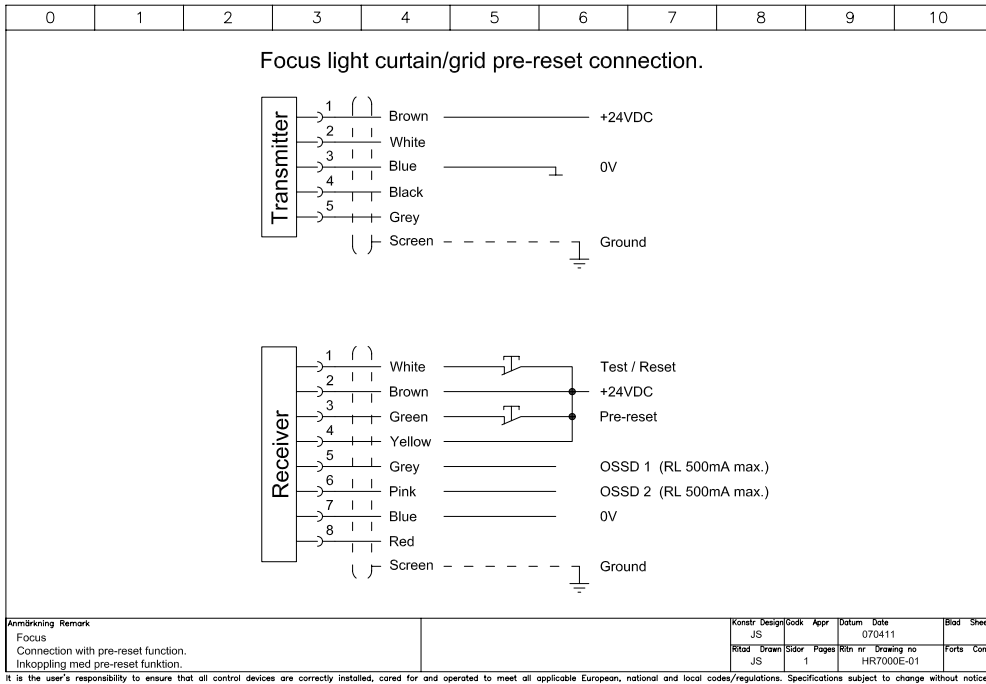


Connection examples

HR7000C-01 Focus II - Connection without and with muting function

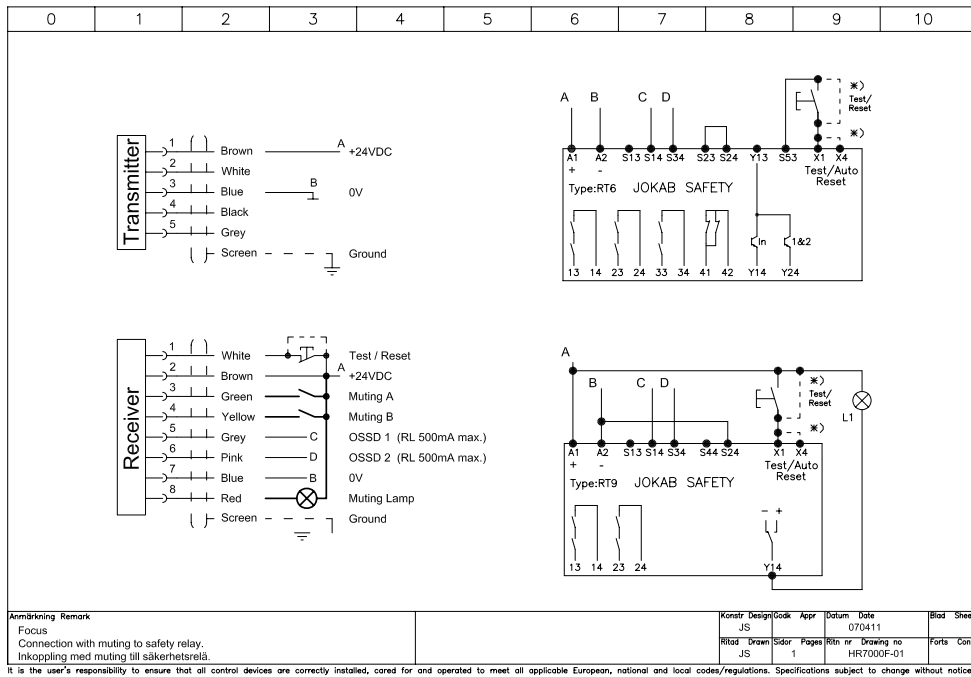


HR7000E-01 Focus II - Connection with pre-reset function

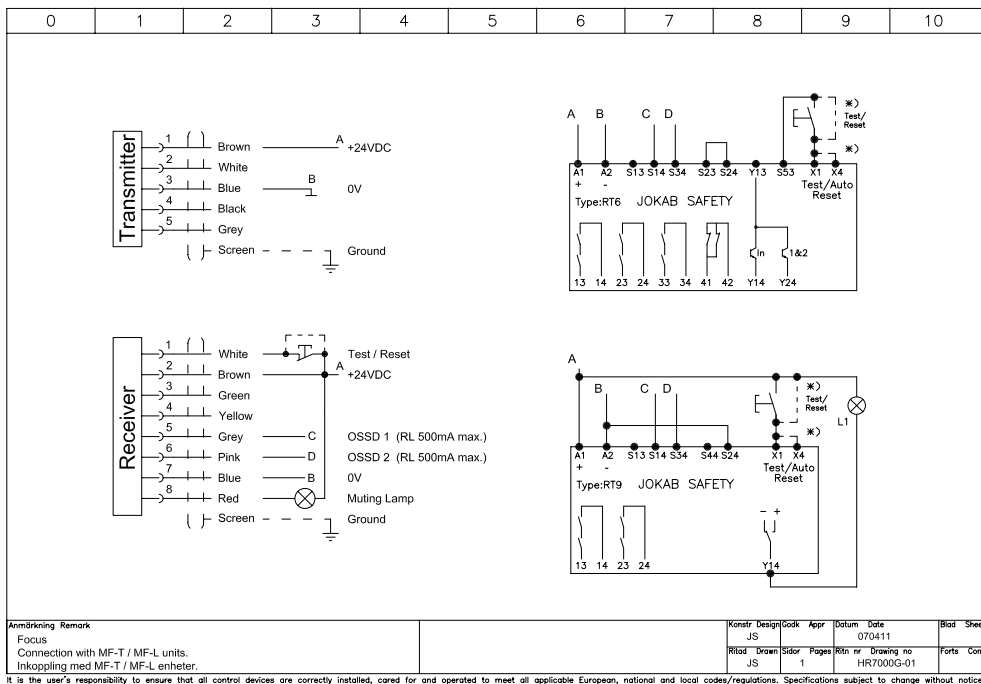


Connection examples

HR7000F-01 Focus II - Connection with muting to safety relay

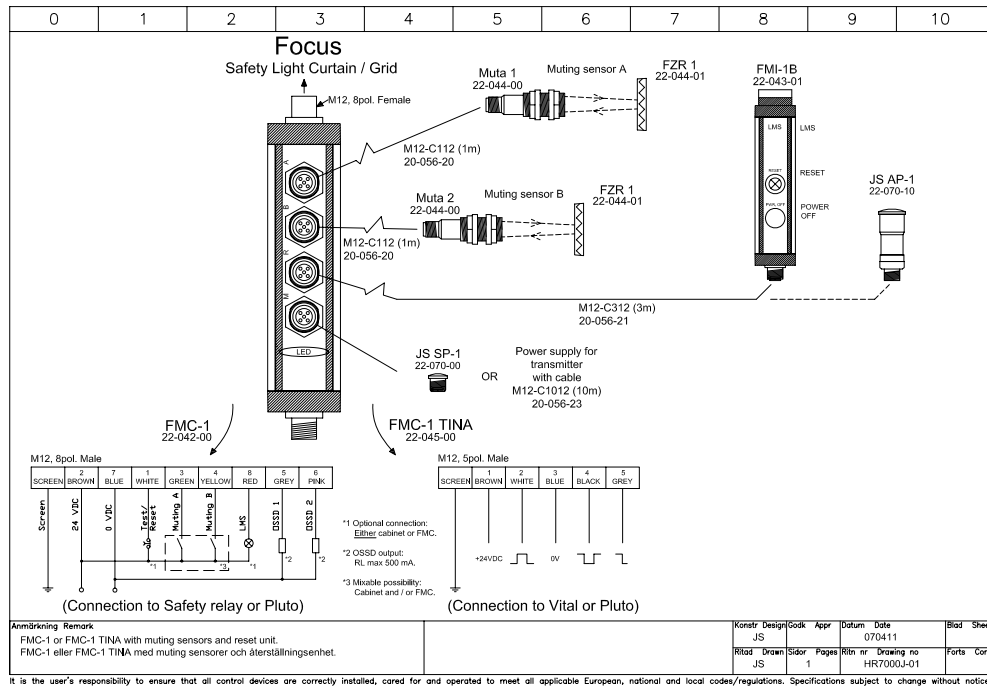


HR7000G-01 Focus II - Connection with MF-T/MF-L units

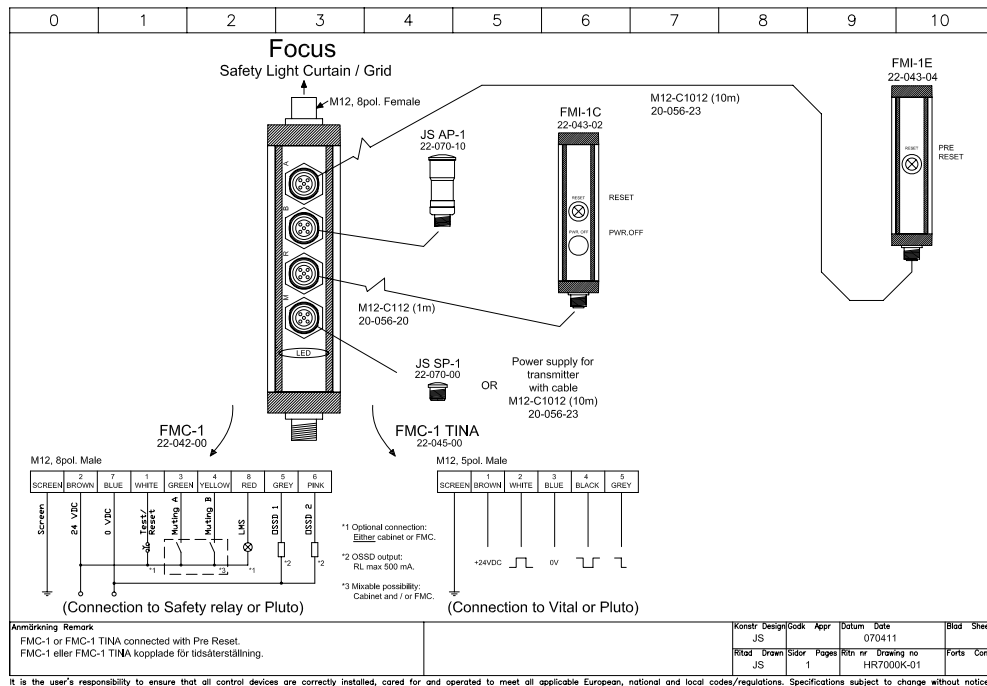


Connection examples

HR7000J-01 FMC-1 or FMC-1 Tina with muting sensors and reset unit

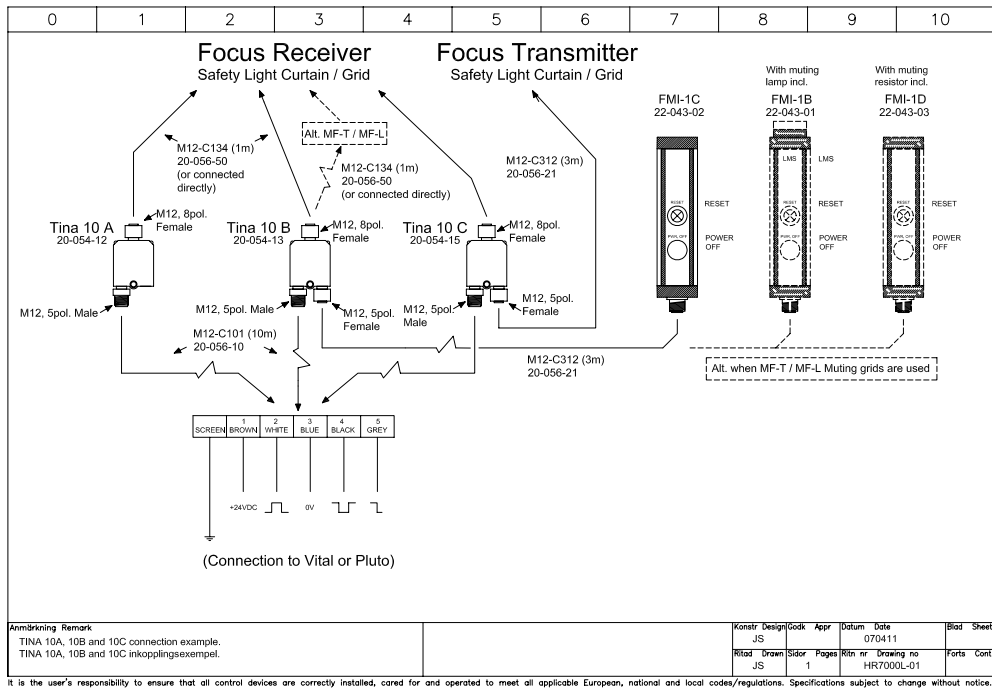


HR7000K-01 FMC-1 or FMC-1 Tina connected with Pre-Reset



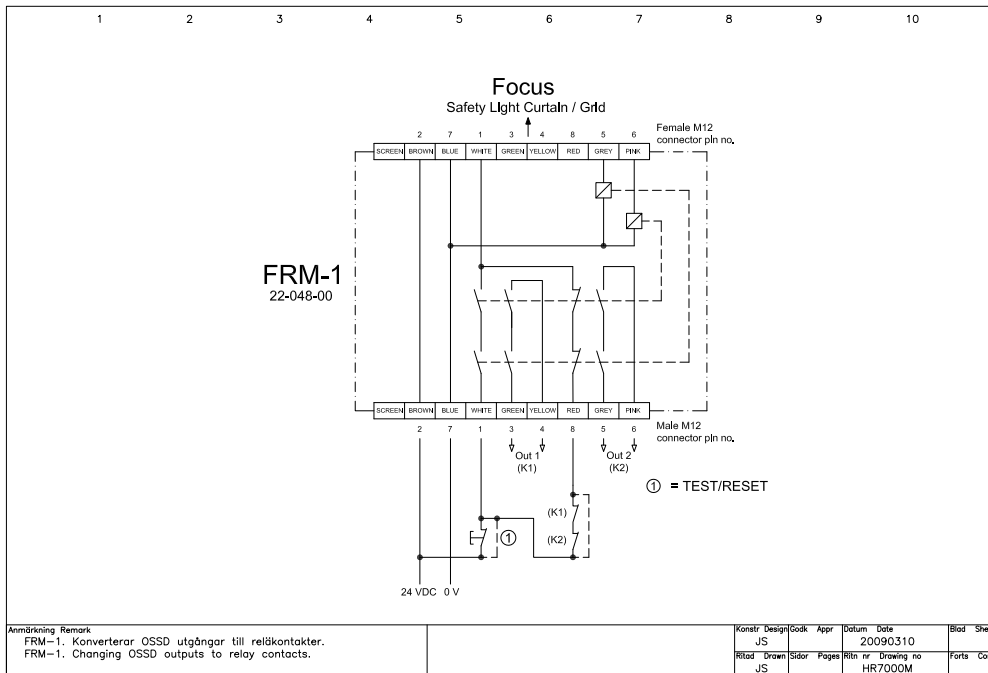
Connection examples

HR7000L-01 Tina 10A, 10B and 10C connection example



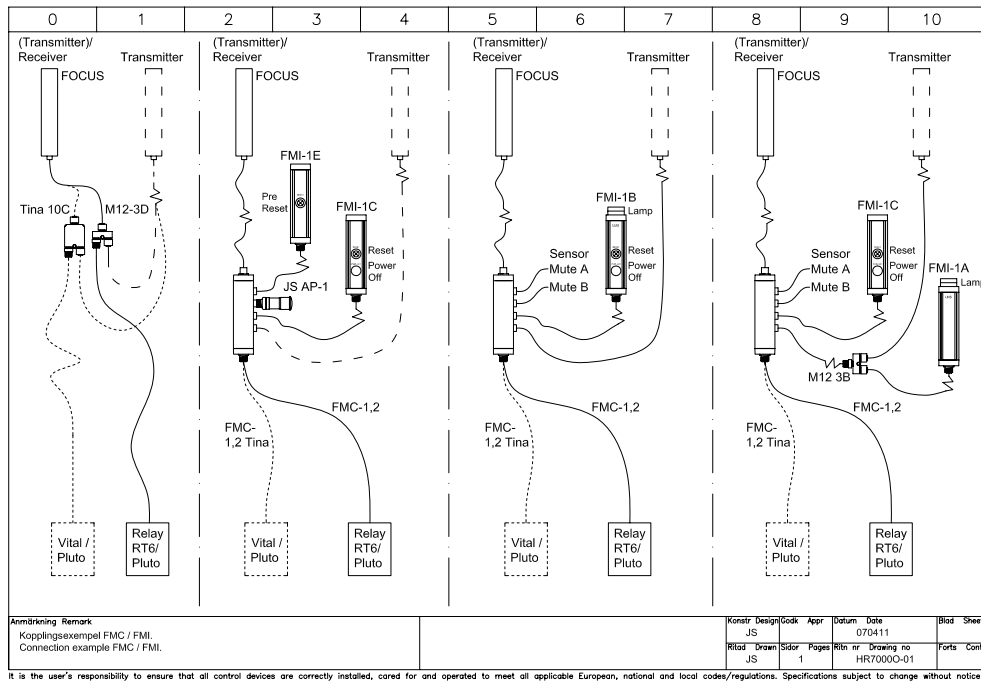
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HR7000M FRM-1 - Changing OSSD outputs to relay contacts

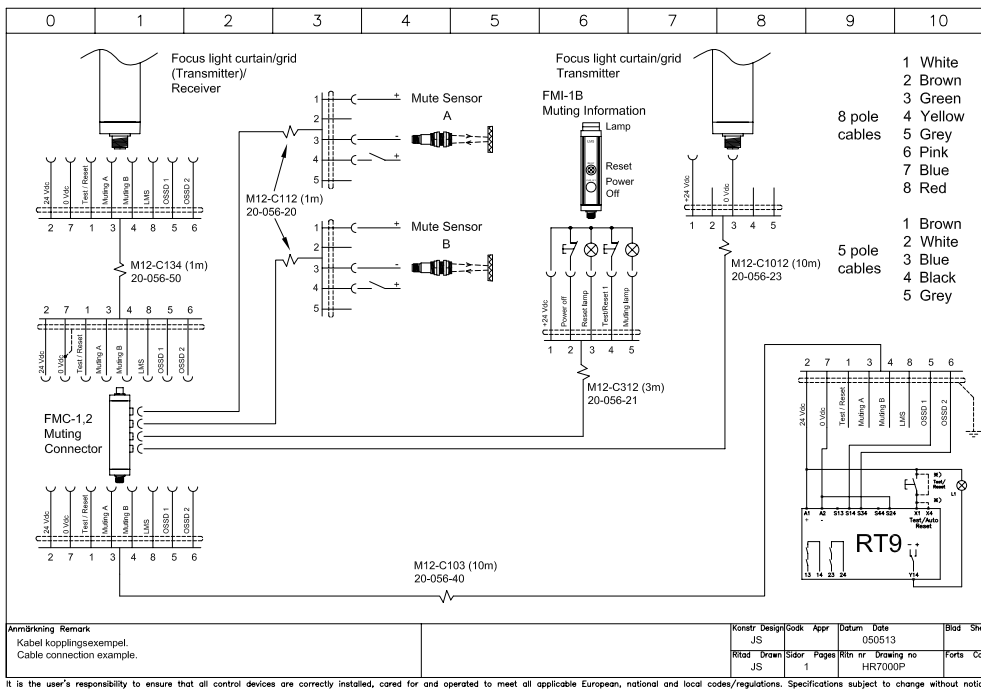


Connection examples

HR7000-01 Connection example FMC/FMI

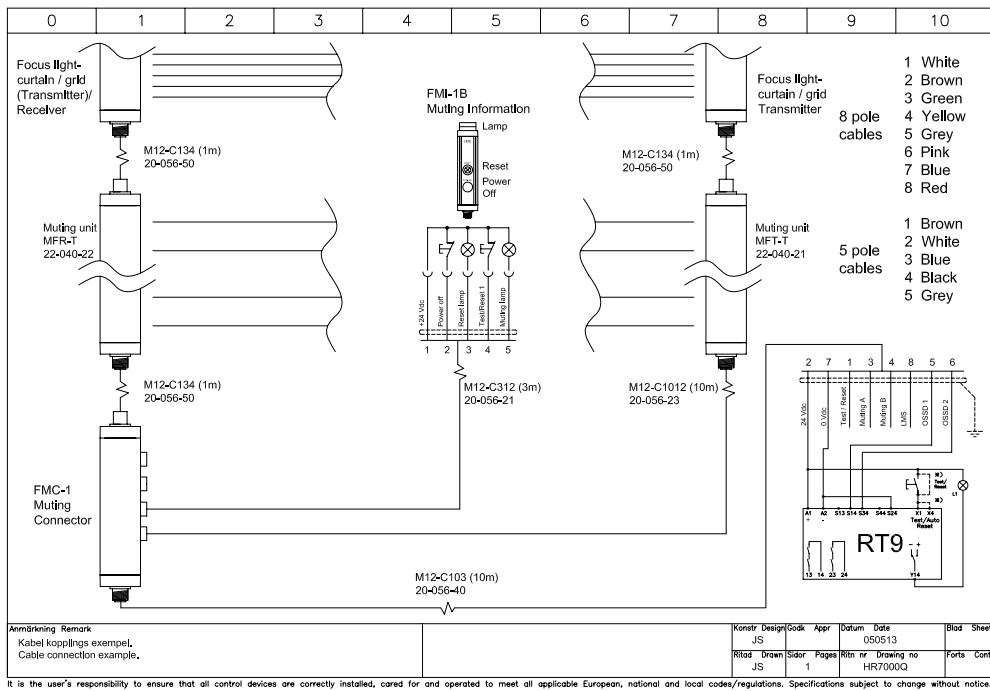


HR7000P Cable connection example

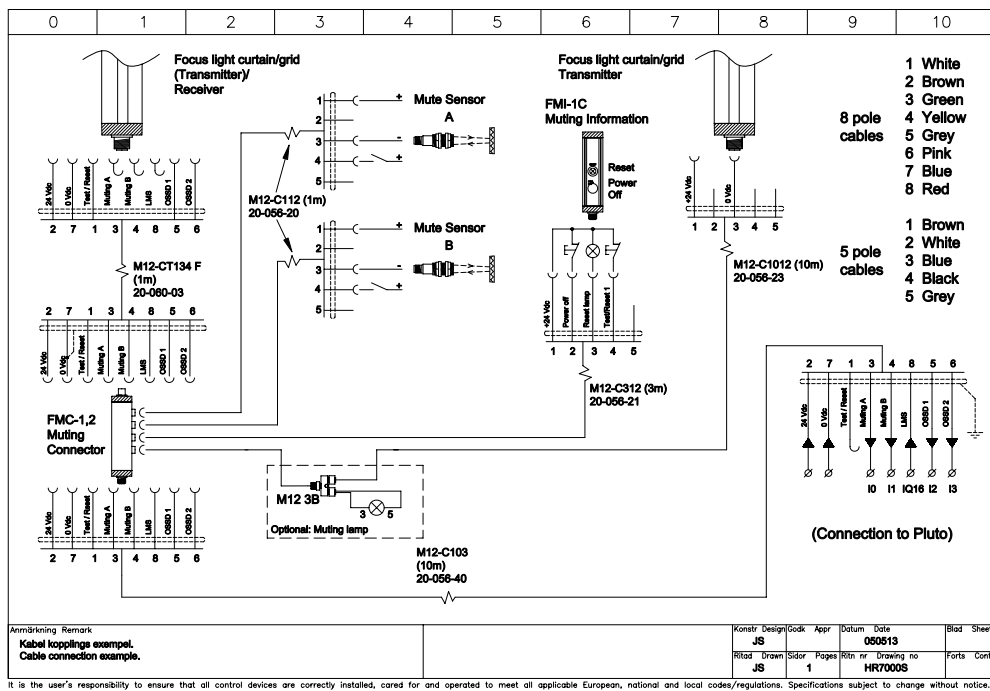


Connection examples

HR7000Q Cable connection example



HR7000S Focus II; Muting with the aid of Pluto, FMC and a transfer cable



Safety Light Beam Spot



Approvals:



Application:

- Photoelectric guarding of an entrance or around a risk area

Features:

- Safety level Type 4 according to EN 61496
- Versatile mounting
- LED indication
- IP67
- 10 m or 35 m range
- Bypassing possibility
- Light beam, emergency stop and Eden in the same safety circuit together with Vital/Pluto achieves PL e according to EN ISO 13849-1

A light beam for the highest safety level

The light beam is available in two versions Spot 10 for distances up to 10 m and Spot 35 for up to 35 m. The light beams can be mounted at different heights and be angled around a machine using our mirrors and brackets.

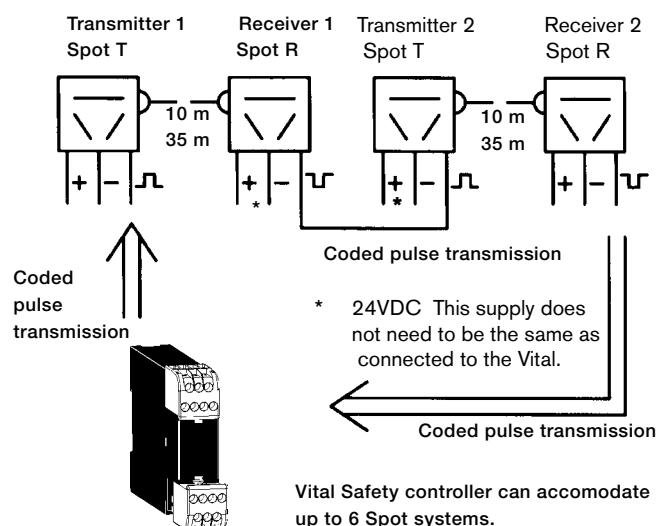
Spot and Vital/Pluto in combination fulfils the requirements for PL e according to EN ISO 13849-1 and type 4 according to EN 61496. Several light beams, Eden sensors and emergency stops can be connected in series achieving the high safety level for the safety circuit. A number of solutions for bypassing of light beams for material transport are available.

For indication there are LED's on the transmitter and on the receiver which indicate 'contact' between transmitter and receiver and safety status. The 'contact' information is available via the light beam receiver connection cables.

Function

The Spot light beam is supervised by the Vital safety controller or by the Pluto safety-PLC. A unique coded signal is sent out from the control unit to the transmitter (Spot T). The signal which comes back from the receiver (Spot R) is then compared in the Vital/Pluto. If the correct coded signal is received the Vital/Pluto switches the necessary safety output contacts to permit dangerous machine movements. Coding guarantees that no output signals can be produced by light from other sources, interference or faults in components in the transmitter or receiver. The light beam is dynamically

supervised which means that if the signal stops pulsating at the correct frequency it is immediately detected. By means of coding, the dynamic signal can pass between up to 6 pairs of transmitters and receivers, with only one pair needing to be electrically connected to a Vital.



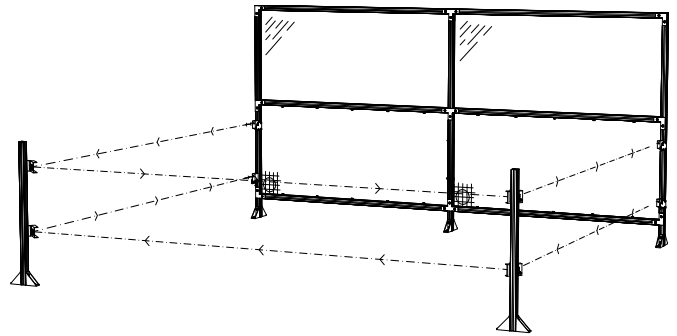
Spot Mounting and alignment

Safety distance

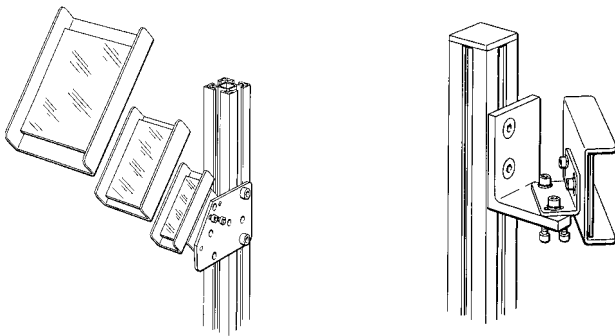
The basic principle is that dangerous machine movements should be stopped before a person reaches the dangerous area, which should be at least 850 mm from the light beams. When determining the correct safety distance the stopping time of the machine and the risk level must be taken into account (see also EN ISO 13855).

Accessories and Mounting

The Spot light beam can be mounted using a variety of brackets, posts and mirrors.



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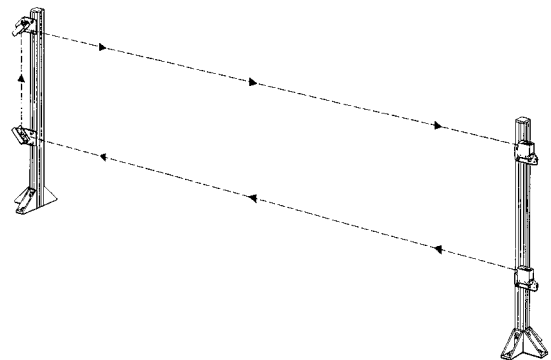
Different sizes of mirrors, mounting brackets and profiles are available.

NOTE! Every mirror reduces the sensing distance of the beam by approx. 20%.

Alignment

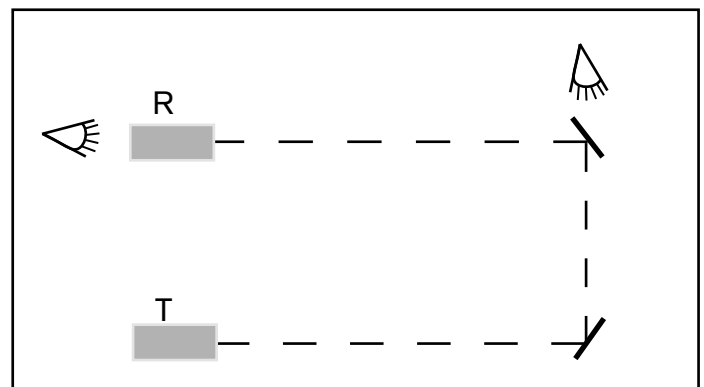
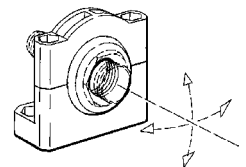
When aligning the light beam, look towards the transmitter. In the lens will be seen a strong red light. When this light is seen from the receiver (via mirrors if fitted) the light beam is basically aligned. The LED on the receiver is on when the receiver is aligned with the transmitter. By moving the transmitter up/down and left/right the best alignment can be found.

When vertically mounting, (as shown in the diagram) the receiver should be mounted above the transmitter as this will simplify the alignment and minimise the risk of extraneous light disturbance. In exceptional light disturbance environments the received light can be adjusted by a screw on the rear of the Spot 35 receiver. On Spot 10 this adjustment can be made on the transmitter.



JSM64

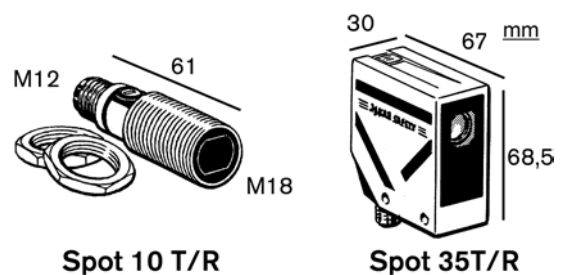
Pivot M18 bracket for Spot 10 or MUTE R (FSTR1) for example



Technical data - Spot

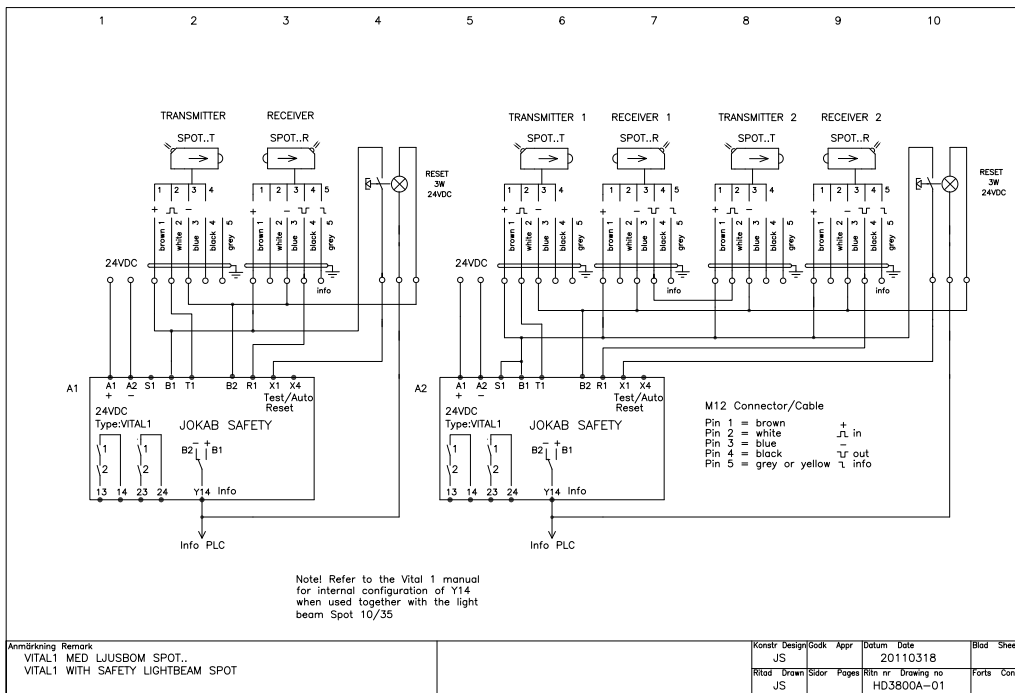
Article number	
Spot 10 T/R	2TLA020009R0600
Spot 35 T/R	2TLA020009R0500
Safety level	
EN/IEC 61496	Type 4 with Vital/Pluto
EN ISO 13849-1	PL e/Cat. 4
PFH_D	1.14x10 ⁻⁸
Power supply	
	17 – 27 VDC, ripple ±10%
Current consumption	
Transmitter	< 25 mA
Receiver	< 15 mA
Output currents	
Info. output	10 mA max.
Dynamic signal out	30 mA max.
Light source	
	Red visible light, 660 nm, <±2°
Optical power	
Spot 10	< 0.1 mW
Spot 35	< 0.2 mW
LED indication	
Green LED on transmitter (power)	Power supply OK
Green LED on receiver status	
On	Alignment OK, safety circuit closed
Flashing	Alignment OK, earlier safety circuit open
Off	Beam interrupted, safety circuit open
Protection class	
	IP67
Range	
Spot 10	0 - 10 m
Spot 35	0 - 35 m
Range adjustment	
Spot 10	Trim pot. on transmitter
Spot 35	Trim pot. on receiver
Installation	
Spot 10	2xM18 nuts (provided)
Spot 35	Either via mounting holes in the casing or with angle bracket JSM63 (provided)
Operating temperature range	
	-25°C – +65°C
Cable connection	
	M12 fixed connector
Casing Material	
Spot 10	Steel housing with polyacryl lens protection.
Spot 35	Polyamide housing with polyacryl lens protection.
Colour	
Spot 10	Steel grey
Spot 35	Yellow/black
Weight	
Spot 10	2 x 21 g
Spot 35	2 x 100 g

Connections	
Transmitter:	
Brown (1)	+24 VDC
White (2)	Dynamic signal in
Blue (3)	0 VDC
Receiver:	
Brown (1)	+24 VDC
White (2)	0 VDC
Blue (3)	0 VDC
Black (4)	Dynamic signal out
Grey (5)	Info output
	24 VDC when LED is green or flashing (tolerance -2 VDC)
	0 VDC when LED is off (tolerance +2 VDC)
Conformity	
	EN ISO 12100:2010, EN ISO 13849-1:2008, EN 62061:2005, EN 61508:2010, EN 60204-1:2006+A1:2009, EN 61496-1:2004+A1:2008, EN 60664-1:2007, EN 61000-6-2:2005, EN 61000-6-4:2007
Certifications	
	TÜV Nord, cCSAus



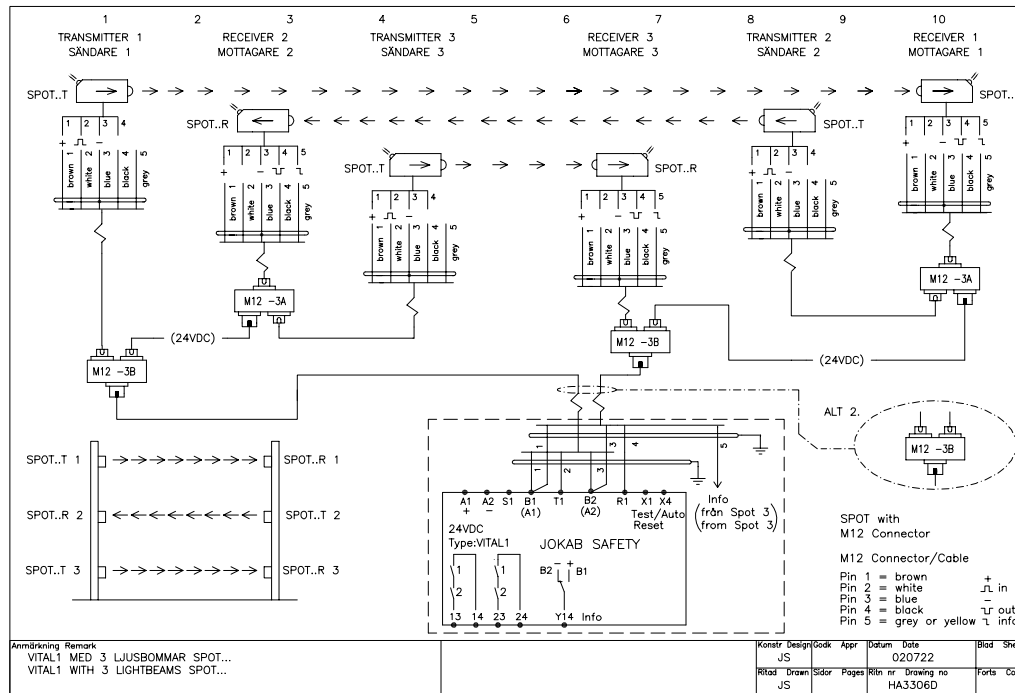
Connection examples

HD3800A-01 Connection of Spot T/R to Vital1



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HA3306D Vital 1 with 3 lightbeams Spot



*For more connection examples see chapters for Vital or Pluto

