



COMPACT

Sicherheits-Lichtvorhänge und -Lichtgitter

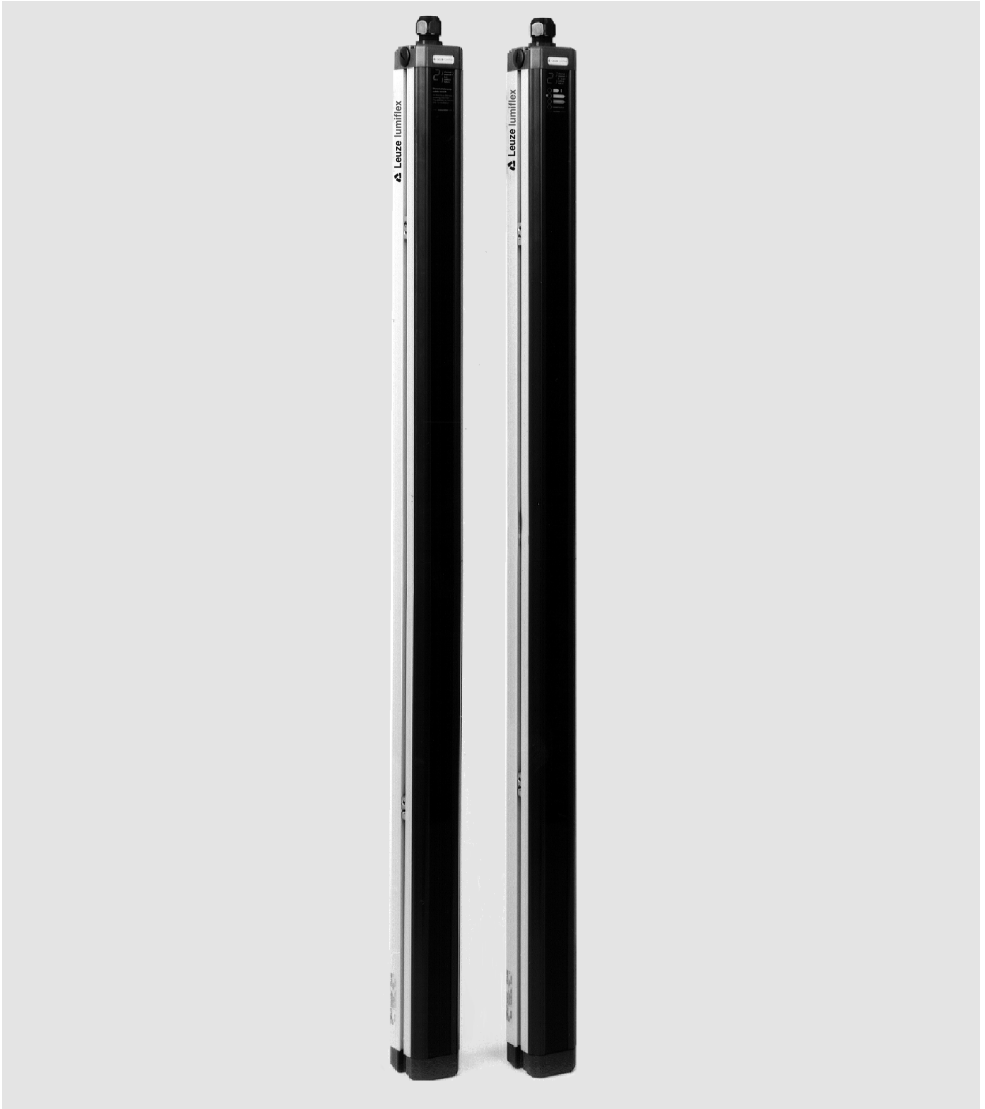
(der Baureihen C14, C30, C50, C90, C300/4, C400/3, C500/2, C301/4, C401/3 und C501/2)

Anschluß- und Betriebsanleitung

Safety Light Curtains and Light Grids


(Series C14, C30, C50, C90, C300/4, C400/3, C500/2, C301/4, C401/3 und C501/2)

Connecting and operating Instructions



Notes on connecting and operating instructions

These instructions contain information on the efficiency in the use of COMPACT safety light curtains and light grids in accordance with their intended applications. These instructions constitute a part of the scope of delivery.

Warning and safety notes are indicated by the symbol  .

The Leuze lumiflex GmbH + Co.KG is not liable for damage resulting from improper use.

Acquaintance with these instructions constitutes part of the knowledge required for proper use.

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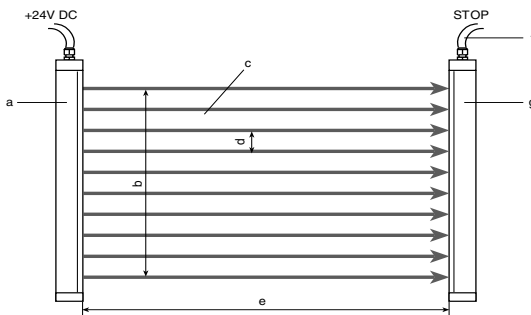
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1 System Overview and Scope of Applications

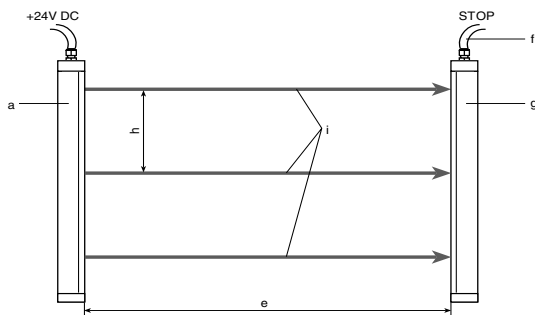
1.1 General

The COMPACT safety light curtains and light grids are active optoelectronic protection devices (AOPD) of the type 4 according to IEC 61496-1, -2 and EN 61496-1, -2. A two-dimensional protective field of infrared radiation is generated between transmitter and receiver. Penetrating this protective field will trigger the safeguarded machine to go into a safe mode before the person can enter a potentially hazardous area.

Parameters of COMPACT safety light curtains



Parameters of COMPACT safety light grids



- | | |
|------------------------------------------------------|----------------------------|
| a = transmitter | e = protected width, range |
| b = protected height | f = to machine control |
| c = sensing field | g = receiver |
| d = object sensitivity
(smallest detected object) | h = distance between beams |
| | i = number of beams |

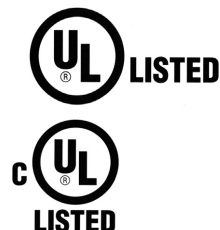
Fig. 1 The major parameters of an AOPD

1.2 Approvals

EU Prototype Testing (Europe)

TÜV PRODUCT SERVICE GMBH
Ridlerstraße 31
80339 Munich

IEC 61496-2 testing conducted by:
BIA
Berufsgenossenschaftliches Institut für
Arbeitssicherheit
Alte Heerstraße 111
53757 St. Augustin



North America

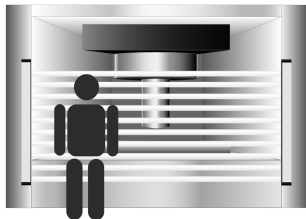
UL and C(UL)

1.3 Overview of Product Characteristics

- High immunity to ambient lighting, welding arcs and stroboscopic light by the application of patented evaluation procedures and special ASIC's for signal processing
- Interference-free operation of neighboring equipment by the selection of differing transmission channels
- Multiple evaluation procedures for environments with sources of extreme infrared impulsive disturbance
- Non-wear function through fail-safe semiconductor outputs
- Cascading of several units possible, e.g. hand protection and step-over protection
- Use of modern micro-controller engineering techniques
- Robust aluminium housing of small cross-section (52 x 55 mm, or 2 x 2.16 inch)
- Flexibility in add-on functions by connection to safety relays MSI-SR2/F or, for example, MSI-m/R (muting)
- Straight forward connections through plug-in terminal compartment
- Integrated self-diagnostics systems for quick on-site fault localisation and PC-supported diagnostic routines in the workshop

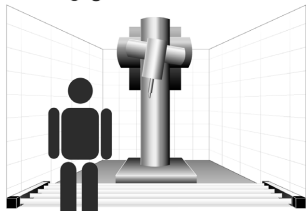
1.4 Equipment Variants and Scope of applications

The COMPACT is available in different models in order to provide an optimum price/performance ratio for differing applications. All models have one thing in common: the same engineering!



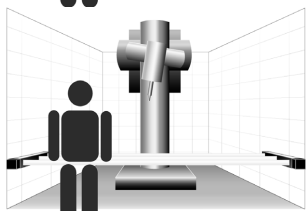
COMPACT light curtains of series C30 and C14 for hand and finger protection at danger points

Resolution: 14 mm (finger) and 30 mm (hand)
 Protected range: series C14: 0.3 - 6 m, series C30: 0.8 - 18 m
 Protected heights: 150, 225, 300, 450, 750, 900, 1050, 1200, 1350, 1500, 1650, 1800 mm (1950, 2100, 2250 mm on request)



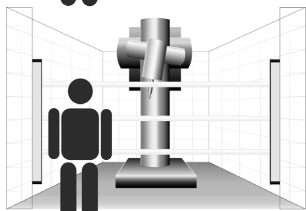
COMPACT light grids of series C50 safeguarding danger areas close to the ground (height: from 0 mm on)

Resolution: 50 mm (lower leg)
 Protected range: 0.8 - 18 m
 Protected heights: 450, 600, 750, 900, 1050, 1200, 1350, 1500, 1650, 1800, 2100, 2400, 2700, 3000 mm



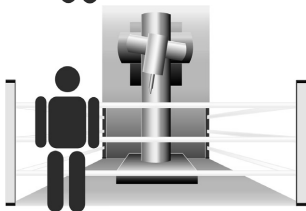
COMPACT light grids of series C90 safeguarding danger areas at a height of 600 - 1000 mm

Resolution: 90 mm (upper leg)
 Protected range: 0.8 - 18 m
 Protected heights: 750, 900, 1050, 1200, 1350, 1500, 1650, 1800, 2100, 2400, 2700, 3000 mm



COMPACT light grids of series C500/2. C400/3, C300/4 safeguarding access

Dist. betw. beams: 500, 400, and 300 mm according to EN 999
 Protected range: 0.8 - 18 m
 number of beams: 2, 3, and 4 beams according to EN 999



COMPACT light grids of series C501/2. C401/3, C301/4 safeguarding access to large areas

Dist. betw. beams: 500, 400, and 300 mm according to EN 999
 Protected range: 6 - 60 m
 number of beams: 2, 3, and 4 beams according to EN 999

Fig. 2 COMPACT equipment variants and their scope of applications

1.5 Deflection Mirrors

A hazard location or a danger area can be guarded on more than one front by employing deflection mirrors. The maximum possible width of the protection zone is reduced for each mirror accordingly as shown in the following table. The use of more than two mirrors is not to be recommended because of the difficulties associated in the alignment.

COMPACT Series	Reduction in the Range per Mirror
C14	1 m
C30, C50, C90, C300/4, C400/3, C500/2	2,3 m
C301/4, C401/3, C501/2	10 m

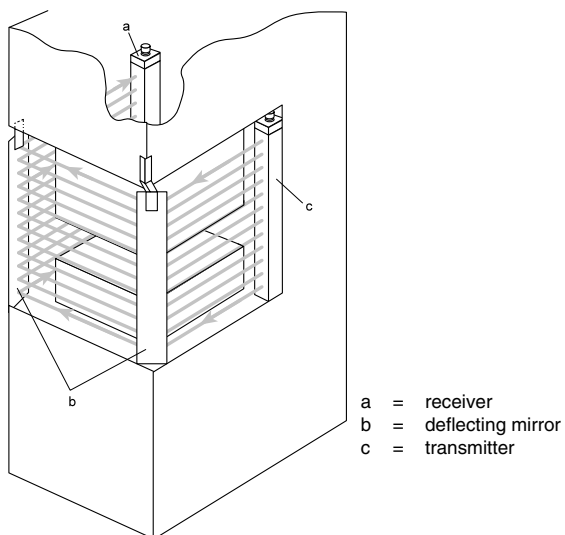


Fig. 3 Guarding several fronts of a hazard location by means of deflecting mirrors

2 Notes on Safety

2.1 General Hazards for Non-observance of Notes on Safety



Care is exercised in accordance with recognised codes of engineering practice in the development and production of Leuze lumiflex products. The protection function of the equipment can however be impaired if the units are not used in accordance with their intended application or are not used properly. Such instances can cause hazards for the health and life of the personnel operating the machinery. Safety light curtains and light grids do not provide protection against injuries resulting from flying objects.

2.2 Use according to Intended Applications



COMPACT equipment type	Use according to intended application
Light curtain, series C14	Finger protection
Light curtain, series C30	Hand protection
Light grid, series C50 and C90	Horizontal guard over areas of danger, detection of a person
Light grid, series C300/4, C400/3, C500/2, C301/4, C401/3, C501/2	Vertical guard against access to areas of danger, detection of a person

For use in the foodstuffs industry and in explosion-endangered areas, the COMPACT is not suitable in its standard design. Special housings on request.

2.3 Operating Conditions



Applicable regulations (e. g. machinery-specific C-Standards in the EU or the OSHA and ANSI standards in the USA) apply for the use and installation of COMPACT safety light curtains and light grids. The appropriate authorities for the country in question are available for answering questions regarding safety engineering. In general, compliance with the following operating is required:

- The COMPACT units shall be installed such that access from above, beneath or behind the protected field is ruled out. If this is not assured, then additional protection measures must be installed



Fig. 4 Access from above, beneath or behind must be ruled out

- Intervention in the controls of the machine by electrical means must be possible so as to enable immediate termination of potentially hazardous states in each working phase.
- The safety clearance between hazard location and protection zone must be sufficiently large enough such that the potentially hazardous state is terminated before the person has reached the hazard location (refer to 4.1).
- The mechanical and electrical installation shall be carried out by trained and qualified personnel. The switching outputs of the COMPACT (OSSD's) shall be connected as two-channel outputs to the shutoff path for the potentially hazardous condition (refer to 5.1 and 5.2).

3 Design and Function

3.1 System Overview

The COMPACT equipment consists of transmitter and receiver. The transmitter consists of the control electronics and a modular arrangement of IR-radiation sources which are sequentially triggered in quick succession and send out coded infrared pulses. The receiver consists of a control and evaluation assembly with the switching outputs and modular IR reception elements which are evaluated in synchronisation with the transmitter. The synchronisation is realised by optical means. Interconnection of both components by a cable is not necessary. The control assemblies are identical for all COMPACT models, the IR transmitter and reception modules differ however in their radiation range and optical characteristics. Each component is housed in a robust aluminium profile casing of standard design and is powered by 24 V DC.

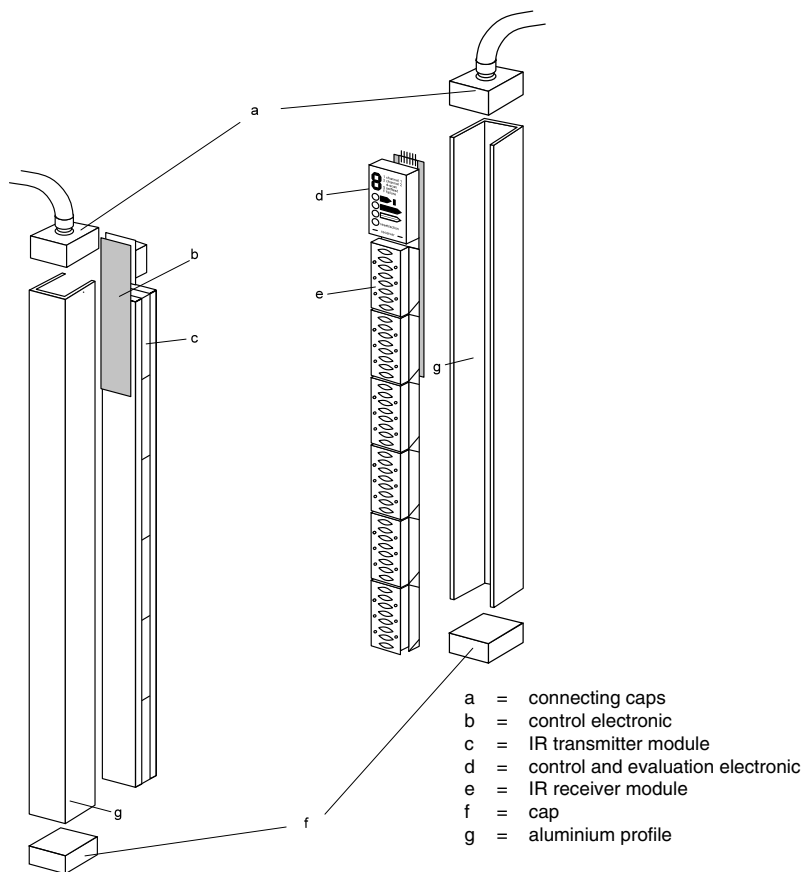


Fig. 5 COMPACT System design

3.2 Operating Mode

The COMPACT works in the operating mode „Protection operating mode without restart disable“. Reception of all light planes switches the output voltage at the OSSD's to +24 V. Interruption of one or more light planes shuts off the output voltage at the OSSD's within the response time for the system. The OSSD's automatically revert to +24 V as soon as the planes of light are free again. Additional functions such as restart disable and protection control can be realised by the safety relays MSI-SR2/F or MSI-SR2 or directly from a fail-safe PLC (refer to Chapter 5.2). For additional intelligent functions like single break/double break or muting the modular safety interfaces of the MSI series can be connected.

3.3 Cascading

COMPACT basic and follower equipment can be connected in succession in order to realise linked protection zones. Units of different resolution can thereby be combined with up to 240 planes of light (e.g. a basic unit 1650 mm with 14 mm resolution as finger protection and a follower unit with 450 mm and 50 mm resolution as step-over protection), see Table 2, Page 78. The follower units are available starting at a protection height of 150 mm and in graduations of 150 mm.

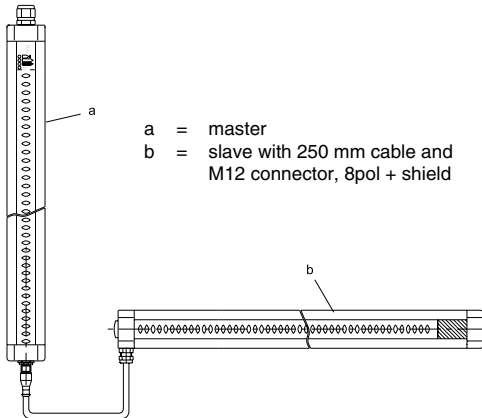


Fig. 6 Cascading of basic and follower units over plug-in cable connection

3.4 Display Elements

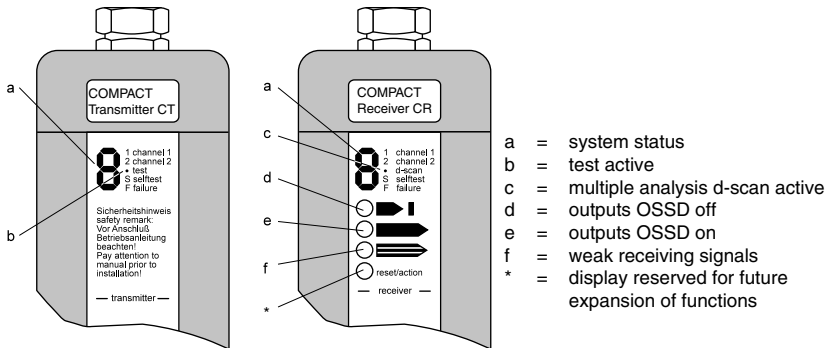


Fig. 7 Display elements in transmitter and in receiver

3.5 Selectable System Functions

The COMPACT is equipped with functions for the prevention of mutual interference and for an increased suppression of interference for operation in environments where there are sources of extreme infrared pulses, such as welding arcs.

These functions are optional and can be activated by means of DIP switches. The switches are mounted on the circuit boards in the plug-in terminal caps. In the event that the unit has to be replaced, then the set equipment parametrisation is retained in the terminal cap for that position and does not need to be set again.

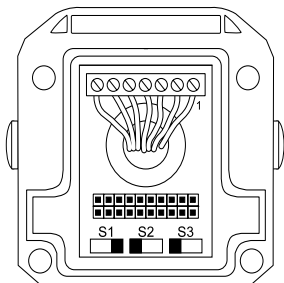


Fig. 8 Selection of function by means of DIP switches on the terminal circuit boards for the transmitter and receiver.

- S1 = pnp status output or RS-485 interface
 contamination status pnp
- RS-485 pour diagnostic PC

NOTE: The possibility of options is only for the receiver. For the transmitter S1 always has to be in the position shown above.

- S2 = transmission channel
 channel 1
- channel 2

NOTE: The same channel has to be set always for the transmitter and receiver.

- S3 = task
 standard
- d-scan

NOTE: d-scan can only be selected at the receiver. S3 is not connected at the transmitter.



Switching over to d-scan increases the device's response time and thus also the safety distance required!
 (see identification plate: response time and/or chart 1, page 77).

Switch 3 at the transmitter board has no function. Switches are preset according to the figure.

3.5.1 Different Transmission Channels to Prevent Mutual Interference

Two differing transmission channels can be set by means of the DIP switch S2 in order to prevent functional disturbance from mutual interference by two neighboring units. The selected transmission channel 1 or 2 is indicated in the transmitter and receiver displays.

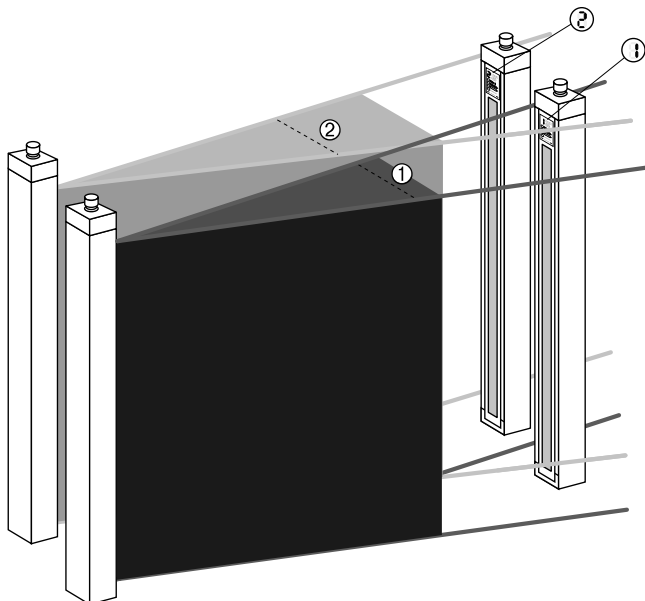


Fig. 9 Differing transmission channels prevent mutual interference

3.5.2 Multiple Evaluation Procedure for Environments with Sources of Extreme Infrared Pulses

High immunity to interference is already realised by the component technology used in the COMPACT in combination with a special software algorithm for the suppression of interference. For applications in environments of extreme disturbance from interfering light, e.g. from many welding robots, the multiple scanning mode **d-scan** can be set by means of the DIP switch S3. The response time of the unit is thereby increased to the value which is indicated on the type plate and in Table 1 (Chapter 8, Technical data and dimensions).

3.5.3 Contamination and Fault Signal Output

A short-circuit-proof signal output for „weak signals or fault“ can be connected by means of the DIP switch S1 to the connecting terminal 6 in place of the RS-485 interface. The pnp output carries +24 V, and is switched to high resistance in the case of contamination or a fault.

3.5.4 Test Input

The COMPACT is equipped as AOPD Type 4 with a permanent self-monitoring function, which automatically detects faults in the system as well as cross-circuits and short-circuits to the output cables. An external signal is not required for this. In order to test connected circuits for follower protection devices, an external control (e.g. combination of protection devices) can switch off the OSSD outputs by means of a test signal and thereby test the drop in the switching devices (refer to Chapter 5.4 in this context). If this test function is not required, then the connecting terminal 3-4 of the transmitted shall be bridged by a jumper (already set by factory).

3.6 Fail-safe Semiconductor Outputs

Both switching outputs OSSD1 and OSSD2 of the receiver are active-monitored pnp semiconductor outputs for switching earthed loads up to 0.3 A. The outputs are HIGH-active and carry the voltage $U_{\text{OSSD}} = U_{\text{supply}} - 2,7 \text{ V}$ for an uninterrupted protection zone. U_{OSSD} amounts to max. 2 V for an interrupted protection zone.

In order to monitor the safe function of the outputs, they are switched OFF cyclically every 140 μs (Channel 1) and every 80 μs (Channel 2). A cross-circuit between the output cables 3 and 4 of the COMPACT receiver is detected immediately after signal changing of the outputs from OFF to ON by the self monitoring system. Then both outputs are switching to OFF as long as the cross-circuit exists. In case of a short-circuit of an output to + 24 V the other OSSD output will be switched to OFF as long as the short-circuit exists. Short-circuits to +24 V and 0 V are well as cross-circuits between OSSD1 and OSSD2 are indicated and do not lead to a destruction of the outputs (refer to Chapter 5.2 for circuits).

The semiconductor outputs are equipped with a fast de-energising function. Radio interference suppression circuits are not necessary. The fast de-energising function reduces the release time to a fraction in comparison with the conventional actuation of relays with recovery diodes. In total, this leads to a shorter reaction time of the protective fixture.

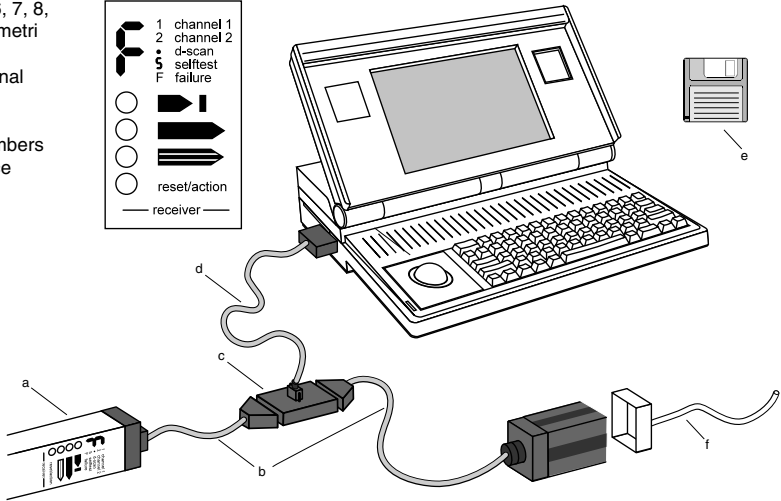
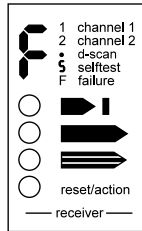
3.7 Diagnostic Function

Transmitter and receiver are equipped with extensive self-diagnostic functions. An „F“ is indicated in the 7-segment display for a discrepant unit in the event of a component failure. This enables the quick on-site identification of defective components (refer to Chapter 6.2). A PC can be connected to the serial RS-485 interface for visualizing the light axes during alignment or for locating problems in the workshop. An adapter for converting from RS-485 to RS-232 is available as an optional accessory. The adapter is connected to the receiver power cable by means of a cable set suited to the connector type. The serial interface of the PC must permit a transmission rate up to 57.6 kBaud.

The diagnostics software required for visualization can be run on Windows 3.1 and higher. Software, RS-485/RS-232 interface converter and diagnostics cable set are available as accessories.

F + fault number 6, 7, 8, or 9 (blinking symmetrically)
= fault in the external circuit

F + other fault numbers
= fault in the device



- a = COMPACT receiver
- b = diagnostics cable set suited to the connector type
- c = RS-485/232 converter
- d = RS-232 serial cable
- e = COMPACT diagnostics software
- f = Receiver connector cable for machine control

Fig. 10 Straightforward light axis visualization and on-site fault diagnostics, PC-supported diagnostics in the workshop

4 Installation

4.1 General Installation Procedures



Attention shall be paid to the general notes on safety given in Chapter 2.

Principally, all units shall be installed such that the hazard location can be reached only by the interruption of at least one plane of light and sufficient clearance is maintained between hazard location and the protection zone.

4.1.1 Clearance

The clearance S is calculated in accordance with EN 999 according to the following formula:

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

where:

S Minimum clearance between the protection zone and the hazard location in mm

K Rate of approach by the body or the person in mm/ms

T Overtravel time of the machine + the response time of the optoelectronic protection device (AOPD) in ms

C Allowance in mm, which depends on the detection capacity d of the AOPD

Depending on the differing applications (e.g. hand and finger protection, access protection), there are differing approach rates K and allowances C applicable in accordance with EN 999. The following installation procedures take the formula into account to be used in each application case.

4.1.2 Distance from Reflective Surfaces

Reflective surfaces within the 4° transmission and reception cone can lead to reflections and hence to a non-detection of bodies. It is for this reason that a minimum distance (**a**) must be maintained between the optical plane of the COMPACT and such reflective surfaces as polished parts of machines and receptacles for material. The greater the distance between transmitter and receiver, the greater is the distance (**a**) which has to be maintained. The following diagrams illustrate the correct installation and this distance (**a**) as a dependency of the width of the protection zone.

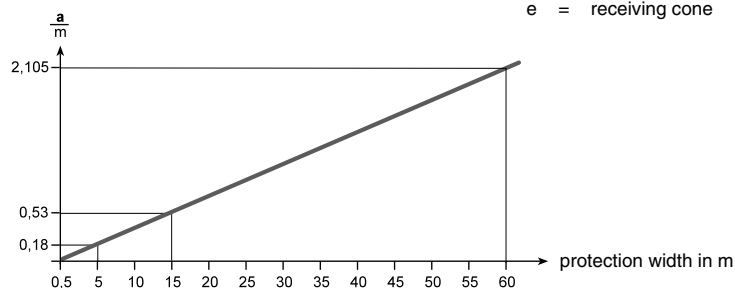
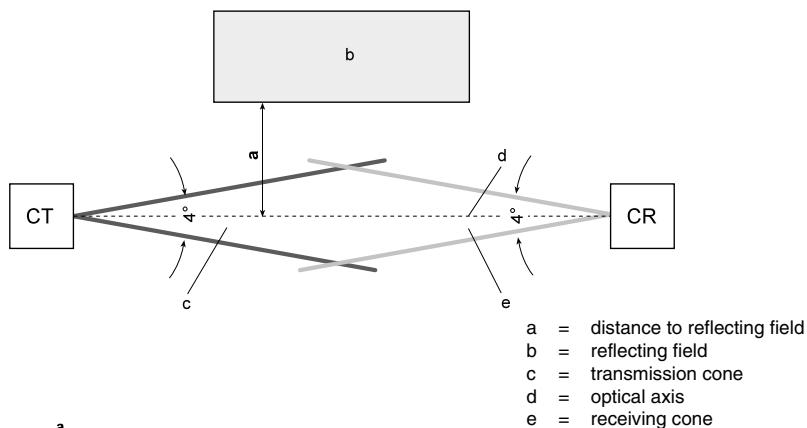


Fig. 11 Sufficiently large distance (**a**) from reflective surfaces must be assured.
 $a \text{ [m]} = 0.035 \times \text{protection zone width [m]} + 0.005 \text{ m}$

4.1.3 Prevention of Mutual Interference

Radiation from the transmitter and receiver is in the form of divergent cones with an angle of 4° . The diameter of the radiated light beam thus increases with increasing distance and irradiates the receiver accordingly. Mutual interference and hence functional disturbance can result if a second receiver is positioned within this range.

Two differing transmission channels can be set by means of the DIP switch S2 in order to prevent this. The units can be mounted in opposite directions or be separated by appropriate shielding.

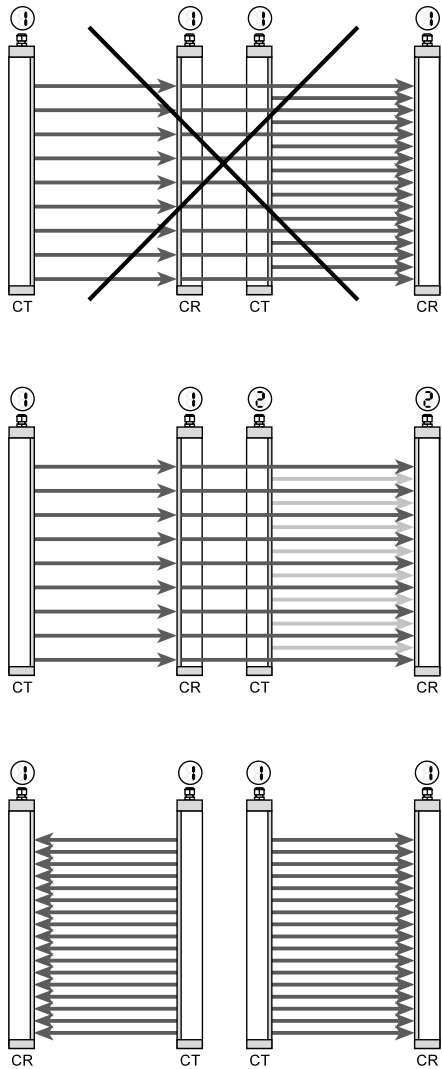


Fig. 12 Prevention of mutual interference by the selection of different transmission channels or by mounting in opposite directions

4.2 Mounting Procedures for COMPACT Light Curtains (Series C14 and C30)



With the COMPACT light curtains for finger and hand protection, it shall be observed that access to the protection zone is not possible from above, below or around, as well as from stepping over the curtain, by the incorporation of additional mechanical safeguards or by cascading the COMPACT units.

The minimum clearance for protection is calculated as follows:

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

where:

- S** Minimum clearance between protection zone and hazard location, in mm ($S_{\min} \geq 100$ mm)
- K** Accessing rate 2 mm/ms
- T** Overtravel time of the machine + the response time of the optoelectronic protection device (AOPD), in ms
- C** 8 (d - 14 mm), not less than 0 however
- d** Detection capacity (resolution) of the AOPD, in mm

If this calculation gives a value for S which is greater than 500 mm, then the calculation shall be repeated for $K = 1.6$ mm/ms. In this case the value of S_{\min} may not be less than 500 mm.

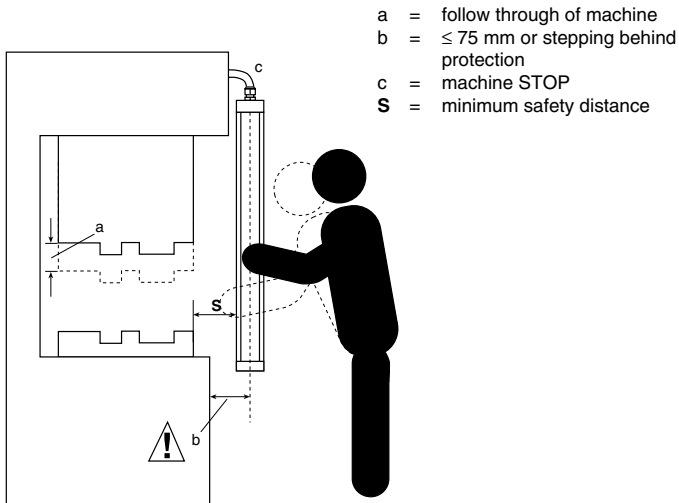


Fig. 13 Light curtain for hand or finger protection at hazard location

4.3 Mounting Procedures for COMPACT Light Grids for Vertical Access Protection (Series C300/4, C400/3, C500/2, C301/4, C401/3 and C501/2)



The installation of COMPACT light grids shall ensure that hazard locations cannot be accessed by crawling under, between, reaching over the planes of light, or by reaching through the planes of light. The number of planes of light and the spacing between these depend on the risk assessment as well as machinery-specific regulations such as e.g. EN 775. The EN 999 proposes the following variants:

Number of beams	Height above the reference plane, e.g. ground in mm	COMPACT series
4	300, 600, 900, 1200	C300/4 respectively C301/4
3	300, 700, 1100	C400/3 respectively C401/3
2	400, 900	C500/2 respectively C501/2

The minimum clearance is calculated as follows:

$$S = (1.6 \text{ mm/ms} \times T) + 850 \text{ mm}$$

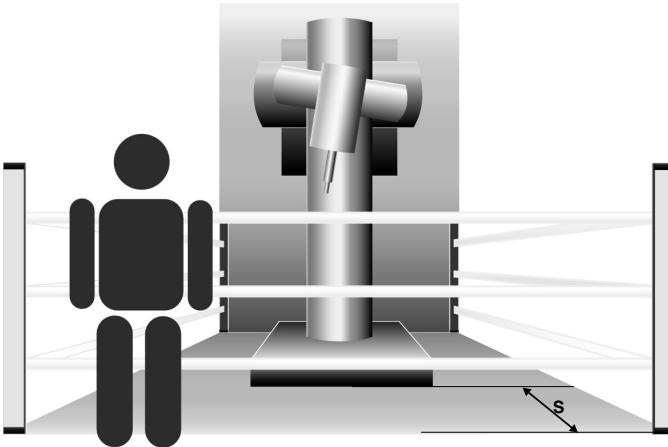


Fig. 14 Safety distance safeguarding access, vertical arrangement

4.4 Installation Specifications for COMPACT Light Grids for Danger Area Safe-guard, Horizontal Arrangement (Series C50 and C90)



When light grids, horizontal arrangement are being mounted to safeguard danger areas, make sure that the height of the sensing field does not exceed 1000 mm above the ground. If H exceeds 300 mm (200 mm if children are present), an undetected approach underneath the sensing field is possible. This must be taken into account when the risk is assessed. The lowest admissible height for grid assembly depends on the AOPDs resolution, to ensure that the human leg or foot can be recognized without failure. The minimum safety distance is calculated as follows:

$$S = (1.6 \text{ mm/ms} \times T) + C$$

$$C = 1200 \text{ mm} - 0.4 \times H$$

(with H = height of the sensing field above reference plane $C_{\min} = 850 \text{ mm}$)

Assembly height:

$$H_{\max} = 1000 \text{ mm}$$

$$H_{\min} = 15 (d - 50 \text{ mm}) \text{ with } d = \text{resolution of the AOPD}$$

The admissible height for grid assemblies of the COMPACT light grids by using this calculation is:

COMPACT Series	Height of the Sensing Field above Reference Plane from ... to
C50	0 mm ... 1000 mm
C90	600 mm ... 1000 mm

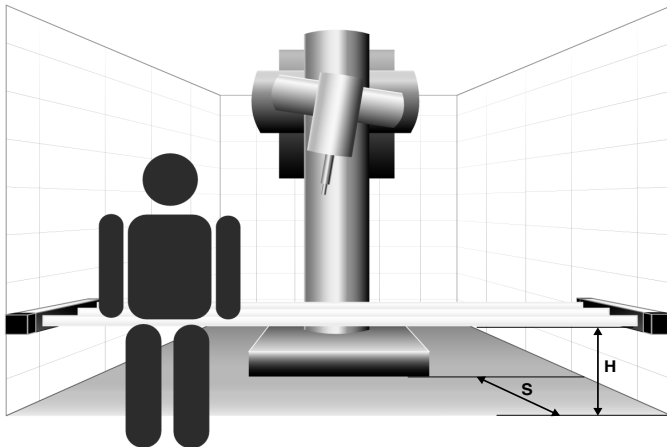


Fig. 15 Clearance and installation height for horizontal protection against dangerous areas

4.5 Mechanical Installation

The units are mounted using M6 T-slot nuts with an M6 thread, which is inserted from the side into the longitudinal grooves. The M6 T-slot nuts can be freely adjusted and allow the unit to be aligned along the longitudinal axis. These nuts are fitted with a retainer spring to prevent the elements from accidentally slipping when the screws are being tightened and in order to make the mounting easier. Two different types of mounting brackets are available for installation:

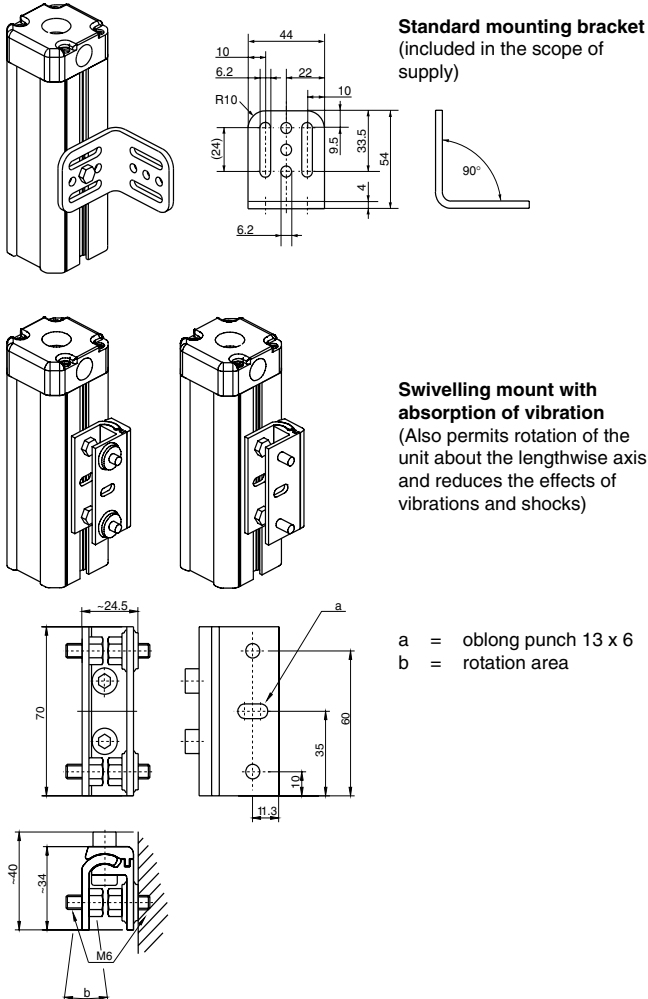


Fig. 16 Mechanical mounting for COMPACT light curtains and light grids

5 Electrical Installation

5.1 Installation Regulations



Attention shall be paid to the general notes of safety given in Chapter 2. The electrical installation shall be performed by experienced and qualified personnel. The OSSD outputs of the COMPACT are principally to be connected as two-channel outputs to the safety engineering section of the machinery controls. When connecting relays, attention must be paid to ensure that relays or contactors with reliable network separation are used.

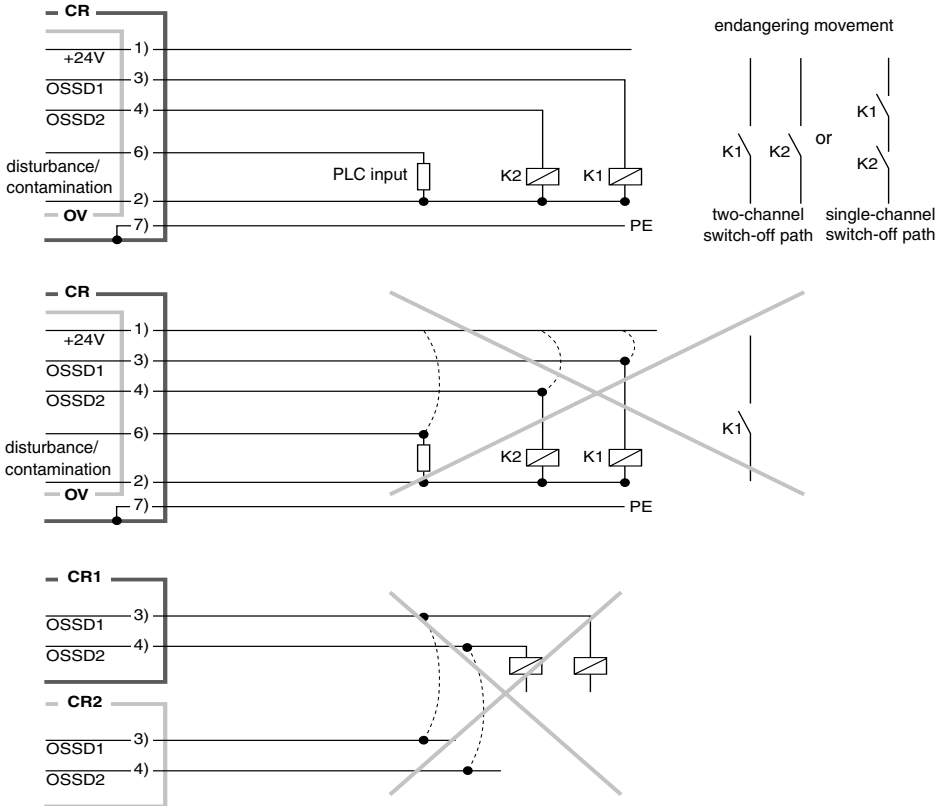


Fig. 17 Caution! Do not make any connections in parallel and do not apply any external voltages to OSSD outputs

5.2 Power Supply

The power supply to transmitter and receiver shall be 24 V DC \pm 20 %. The maximum power consumption of COMPACT equipment including 2 x 0.3 A on-load current, amounts to 0.9 A. The power supply shall meet the requirements of prEN 60204 and exhibit a safe mains separation as well as bridging short-term mains failures of up to 20 ms.

5.3 Connecting Cables

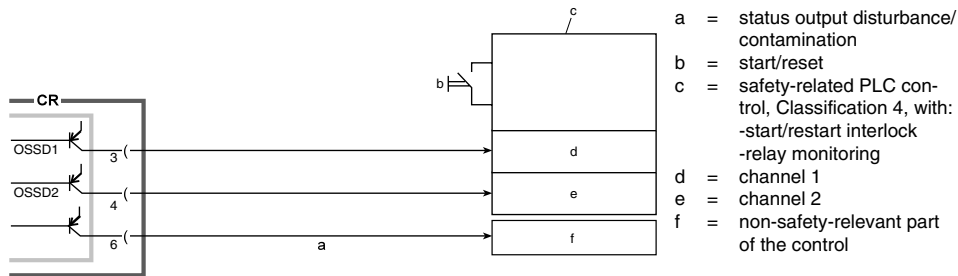
Transmitter and receiver shall be connected to the machinery controls by means of 7-pole connecting cables with a maximum conductor cross-section of 1.0 mm². The routing of the cables shall be separate from supply lines. If power circuits and/or interface sources are close by, it might be necessary to use shielded lines. The screen shall be connected at both ends. For differences in the potential between switching cabinet and installation location of the COMPACT, the screen can be connected to the switching cabinet ground over a plastic-foil capacitor in accordance with the dielectric strength (e. g. x2-capacitors with 47 nF, 250 V AC).

5.4 Examples of Connections

The COMPACT can be integrated in a number of ways to the user controls. The COMPACT can be connected directly to these controls if the safety engineering control system of the machine is equipped with such disable and surveillance functions as „Start/restart disable“ and „Protection control“ necessary for interconnection (see Fig. 18.1, page 68).

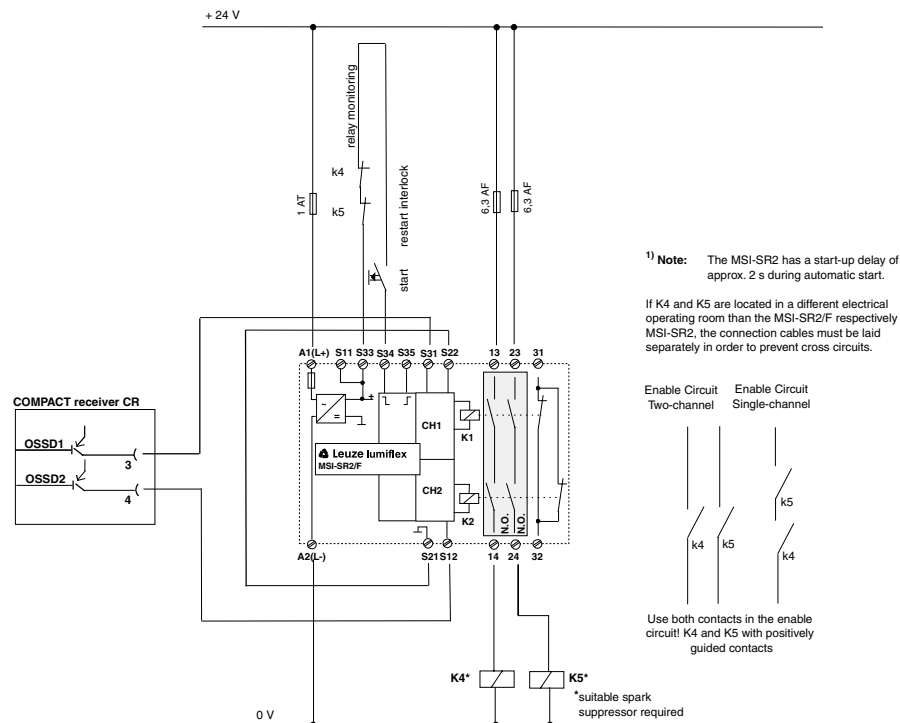
If these functions are not included in the machinery controls, then the COMPACT can be connected either by means of the Modular safety interfaces MSI-SR2/F or MSI-SR2 with the selectable functions „manual start“ or „automatic start“ can be connected (see Fig. 18.2, page 68). The MSI modular safety interfaces, such as the MSI m/R, are required in order to perform special functions such as cyclical control or muting (see Fig. 18.3, page 69). Refer to the appropriate connection and operating instructions when making the connections.

The following examples of connections demonstrate the principle of the connection of the COMPACT into the user controller in compliance with Safety Category 4.



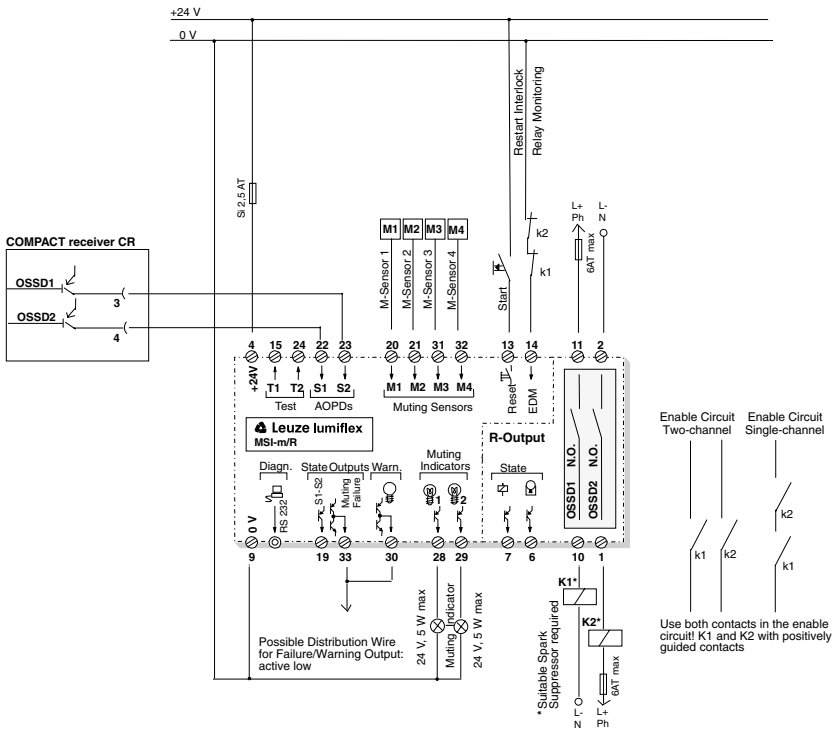
NOTE: Use bridge 3-4 in the transmitter for the pluggable COMPACT version!

Fig. 18.1 Integration of the COMPACT into the safety engineering section of the user controls in accordance with EN 954-1, Safety Category 4, connecting to a fail safe PLC category 4.



NOTE: Use bridge 3-4 in the transmitter for the pluggable COMPACT version!

Fig. 18.2 Integration of the COMPACT into the safety engineering section of the user controls in accordance with EN 954-1, Safety Category 4, connection to the modular safety interfaces MSI-SR2/F or MSI-SR2¹⁾



NOTE: Use bridge 3-4 in the transmitter for the pluggable COMPACT version!

Fig. 18.3 Integration of the COMPACT into the safety engineering section of the user controls in accordance with EN 954-1, Safety Category 4, connecting to the modular safety interface MSI-m/R (muting)

5.5 Connecting Techniques

The basic COMPACT model is fitted with a plug-in terminal connector compartment with PU cable feedthroughs. The terminal caps can be removed after loosening the screws. The connecting cables are routed through the PU glands and connected to the threaded terminals in accordance with the wiring diagram. The maximum conductor cross-section is 1.0 mm².

- a = connecting pins
- b = switches for adjusting parameters
- c = pin receptacles
- d = indicator screw plug PG 9
- e = PG 13,5

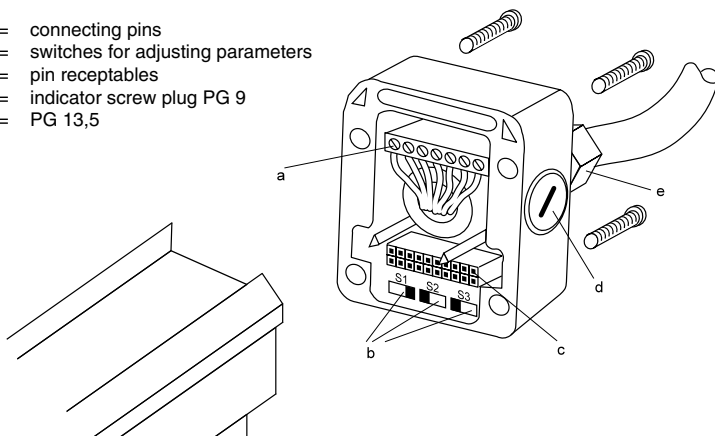
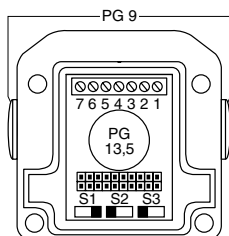


Fig. 19 The terminal caps can be removed once the screws have been loosened.

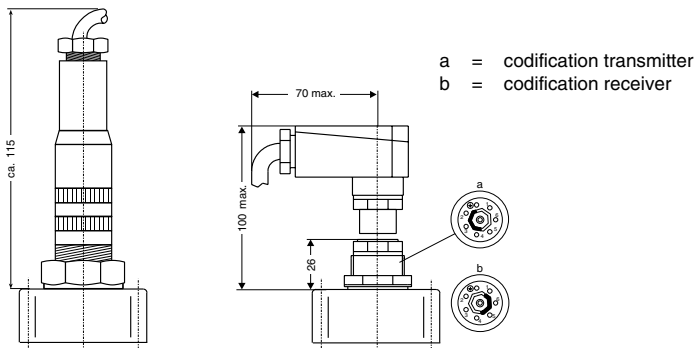
One option which is available is to use terminal caps with connector inserts (DIN 43651, 6-pin + PE) and matching cable sockets in straight or angled or with Brad-Harrison-Min connection and matching cable versions.



Terminal assignment		
Clamp, Connector	Transmitter CT	Receiver CR
1	+ 24 V	+ 24 V
2	0 V	0 V
3	Test out <input type="checkbox"/> Jumper has been	OSSD1
4	Test in <input type="checkbox"/> factory-set already *)	OSSD2
5	- RS-485	- RS-485
6	+ RS-485 (S1 <input type="checkbox"/>)	select: + RS-485 (S1 <input type="checkbox"/>) or pnp contamination and disturbance output (S1 <input type="checkbox"/>)
7	PE, shield	PE, shield

Fig. 20 Pluggable connecting cap with screw terminals (included in the scope of supply)

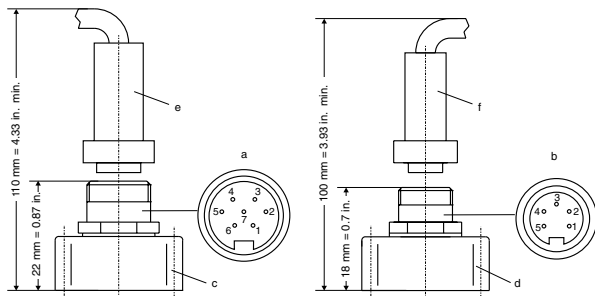
*) Jumper only factory-set in connecting cap of transmitter with PG 13.5. In case of pluggable devices the jumper has to be set externally.



Connecting cap with straight cable socket (description "G")

Connecting cap with angled cable socket (description "W")

Fig. 21 Connecting cap with cable socket, straight or angled DIN 43651 with crimp connection



- a = connector 7-poles front view
- b = connector 5-poles front view
- c = receiver connecting cap
- d = transmitter connecting cap

Pin	Colour	Function
1	black/white	+24 V DC
2	black	0 V DC
3	white	OSSD1
4	red	OSSD2
5	orange	-RS485
6	blue	+RS485
7	green	PE

Pin	Colour	Function
1	white	+24 V DC
2	red	0 V DC
3	green	test out
4	orange	test in
5	black	PE

Fig. 22 Connecting cap for transmitter and receiver with Brad Harrison-Min connection (description "BH")

6 Commissioning

6.1 Functional Check

The correctness of the connections and the supply voltage (+24 V DC \pm 20 %) shall be checked before switching the equipment on for the first time.

The LED's and the 7-segment displays indicate the system status of transmitter and receiver when the supply voltage is turned on:

7-segment display	System status transmitter	System status receiver
8.(only in the instant of being turned on)	Hardware reset	Hardware reset
S (for approx. 1 s)	Self-test running	Self-test running
1 or 2	Normal operation, channel 1 or channel 2 set	Normal operation, channel 1 or channel 2 set
. (decimal point turned on)	Test input open, testing activated	Multiple scanning d-scan set
F	Discrepancy in unit or circuitry	Discrepancy in unit or circuitry

Receiver LED's	System status
Green illuminated	OSSD's on, adequate reception of light at all light planes
Green + orange illuminated	OSSD's on, weak reception of light at one or more light planes => Perform fine adjustment of transmitter and receiver
Red illuminated	OSSD's off, at least one plane of light interrupted or transmitter tester input open (decimal point in transmitter display illuminated)
Yellow illuminated (This function is only available together with a future intelligent interface.)	Safety sequencing circuit signals „Operator invention required“ => - Operate command unit Start/Restart, or - Unit waiting for insertion or removal of workpiece for activated clocked control.

6.2 Notes on Rectification of Faults

Operating faults are often attributable to simple causes which can easily be rectified. The following table provides remedies for these.

Symptom	Measures for fault rectification
7-segment displays and LED's are not illuminated	Check the 24 V DC power supply
7-segment display not illuminated at one component	Check the supply voltage, Check the connecting cable, Replace the unit if necessary
F and 6 blinking (receiver)	External short circuit at OSSD1 to 0 V, or cross circuit, or connecting cable respectively device interchanged
F and 7 blinking (receiver)	External short circuit at OSSD1 to +24 V, or cross circuit
F and 8 blinking (receiver)	External short circuit at OSSD2 to 0 V, or cross circuit
F and 9 blinking (receiver)	External short circuit at OSSD2 to +24 V, or cross circuit
8. permanently illuminated	Hardware fault, replace unit
F glows continuously, interrupted by the fault number	Fault determined in the unit, replace unit (detailed fault code is outputted via the serial interface)
The decimal point of the transmitter's 7-segment display glows (testinput active)	Jumper 3-4 in the transmitter end cap is missing or endcap of transmitter and receiver have been exchanged

7 Cleaning

The cover disks in the transmitter and receiver must be cleaned regularly, depending on the amount of dirt. Illumination of the „weak reception signal“ message in the display of the receiver indicates when cleaning is necessary at the latest.

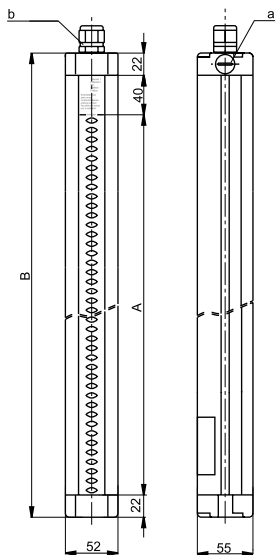
For the cleaning of the Plexiglass cover disks, we recommend a mild detergent. The plexiglass cover disks are highly resistant to dilute acids and alkalis, and against organic solvents to a limited extent.

8 Technical Data and Dimensions

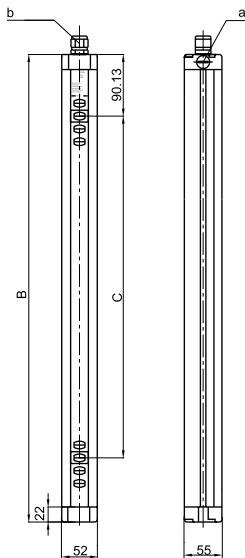
Safety classification	Category 4 according to EN 61496-1, -2 and/or IEC 61496 -1,-2 (self-monitoring)
Protected height	150...1800 mm for series C14 and C30 (1950, 2100, 2250 mm on request) 450...3000 mm for series C50 750...3000 mm for series C90
Protected width, Range	0.3...6 m for series C14 0.8...18 m for series C30, C50, C90, Cxx0 6.0...60 m for series Cxx1
Resolution (object sensitivity)	14 mm, 30 mm, 50 mm, 90 mm, and/or whole person with 2, 3, or 4 beams
Response time (from interrupting the sensing field to switching off the OSSDs)	Response time increases in proportion to number of beams Series C14: 7...39 ms (d-scan 10...78 ms) Series C30: 7...20 ms (d-scan 10...39 ms) Series C50: < 17 ms (d-scan 33 ms) Series C90: < 13 ms (d-scan 20 ms) exact Response time see Table 1, page 77
Switch on-delay time (after the release of the sensing field)	0.5 ms after the release of the sensing field. As an reaction of an interruption of the sensing field, the OSSDs remain switched off in minimum 100 ms, even if the interruption is shorter.
Enclosure rating	IP 65
Ambient temperature	0 ... +55 °C
Supply voltage	24 V DC +/- 20 % External supply unit with safe disconnecting function from the supply and 20 ms mains failure bridging
Current consumption	Transmitter: 75 mA Receiver: 180 mA (without load)
Safety outputs (OSSD)	2 fail-safe pnp-outputs with cross circuit monitoring, $U_{amin} = U_{vers} - 2.7 V$ surge current (100 ms) = 0.4 A permanent current at 35 °C = 0.3 A permanent current at 55 °C = 0.22 A max. capacity load per output = 0.3 µF (0.1 µF for channel 2)
Contamination and disturbance output	pnp output short circuit-proof, 70 mA max
Interface for safety and diagnosis	RS-485, 57,6 Kbaud max
Test input transmitter	closed circuit operation, minimum length of opening equal to 50 ms

Electrical connection	via PG 13.5 and/or PG 9, screw terminals and plug-in connection device, alternatively via plug according to DIN 43651 or Brad Harrison-Min
Connection cable	Transmitter: 7 pole, max 1.0 mm ² Receiver: 7 pole, max 1.0 mm ² (if necessary shielded)
Length of circuit	max 100 m at 1,0 mm ²
Type of operation	protective operation without restart interlock
Synchronization Transmitter/receiver	optical synchronization, 2 transmission channels can be selected
Suppression of infra-red interfering light	2 methods can be selected Standard: high suppression d-scan: very high suppression response time increases according to measurement table (exact response time see Table 1, page 77).
Measurements	cross section 55 x 52 mm length depending on protected height 234 ... 3084 mm
Air humidity	15 ... 95 %
Storage temperature	-25 ... +70 °C

Series C14, C30, C50, C90

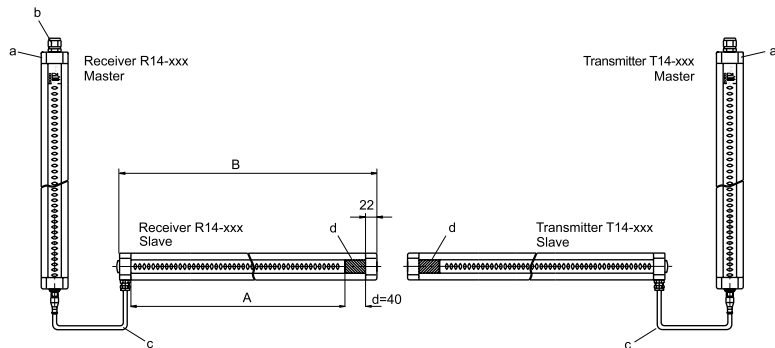


Series C30x/4, C40x/3, C50x/2



- a = PG 9, bilateral
- b = PG 13.5

Fig. 23 Dimensions for standard version



- a = connecting cap PG 9, bilateral
- b = PG 13.5
- c = cable (length 250 mm) with M12 connector
- d = no active sensing field

Fig. 24 Dimensions for cascaded basic unit - follower unit

Table 1: Dimensions, weight and response times for COMPACT safety light grids and light curtains:

Series C14, C30, C50, C90

Protect. height Meas. A [mm]	Meas. B [mm]	Weight CT+CR [kg]	Response time [ms] n = standard; d = d-scan							
			C14		C30		C50		C90	
			n	d	n	d	n	d	n	d
150	234	1,2	7	10	7	10				
225	309	1,7	10	15	10	15				
300	384	2,1	13	20	7	10				
450	534	3,0	10	20	10	15	10	15		
600	684	3,7	13	26	13	20	7	10		
750	834	4,6	17	33	9	17	9	13	9	13
900	984	5,5	20	39	10	20	10	15	10	15
1050	1134	6,4	23	46	12	23	12	18	6	9
1200	1284	7,3	26	52	13	26	13	20	7	10
1350	1434	8,2	30	59	15	30	8	5	8	11
1500	1584	8,6	33	65	17	33	9	17	9	13
1650	1734	10,0	36	72	18	36	9	18	9	14
1800	1884	10,9	39	78	20	39	10	20	10	15
2100	2184	12,7					12	23	12	18
2400	2484	14,5					13	26	13	20
2700	2784	16,3					15	30	8	15
3000	3084	18,1					17	33	9	17

Series C30x/4, C40x/3, C50x/2

Type	Meas. B [mm]	Meas. C [mm]	Number of beams	Weight [kg]	Response time [ms] n = standard; d = d-scan	
					n	d
C30x/4	1134	300	4	2,3	5	8
C40x/3	984	400	3	2,0	5	8
C50x/2	684	500	2	1,3	5	8

The response time of master and slave devices consists of the sum of the partial response times.

Table 2: Number of light axes of the C14, C30, C50 and C90 series

COMPACT				Number of Light Axes
			C90-150	2
		C50-150		4
	C30-150			8
			C90-750	10
	C30-225	C50-450	C90-900	12
			C90-1050	14
C14-150	C30-300	C50-600	C90-1200	16
			C90-1350	18
		C50-750	C90-1500	20
			C90-1650	22
C14-225	C30-450	C50-900	C90-1800	24
			C90-2100	28
C14-300	C30-600	C50-1200	C90-2400	32
		C50-1350	C90-2700	36
	C30-750	C50-1500	C90-3000	40
		C50-1650		44
C14-450	C30-900	C50-1800		48
	C30-1050	C50-2100		56
C14-600	C30-1200	C50-2400		64
	C30-1350	C50-2700		72
C14-750	C30-1500	C50-3000		80
	C30-1650			88
C14-900	C30-1800			96
C14-1050				112
C14-1200				128
C14-1350				144
C14-1500				160
C14-1650				176
C14-1800				192

The table shows how many light axes are included in the particular COMPACT alternatives. A combination of master and slave may not exceed 240 light axes.

9 Selection and Notes on Ordering

9.1 Selection of a COMPACT Safety Light Curtain or Light Grid

1. Consult the applicable regulations for the application in question (e.g. machine-specific C-Standards of the EU, or OSHA and ANSI standards in the USA), observe the notes on safety given in Chapter 2.
2. Define the protection target and select the appropriate COMPACT model accordingly (e.g. finger protection at a hazard location => C14, refer to Chapters 1.4 and 2.2 for this)
3. Calculate the clearance according to the Chapter 4.
4. Determine the width for the protection zone; curtains on more than one front can be realised by using deflection mirrors (refer to 1.5).
5. Determine the protection height = height of the area to be protected or the depth for horizontal applications (take reaching over, reaching under, crawling under etc. into consideration).
6. Select the equipment type and the ordering number from the selection table.

Types for light curtains C14 and C30 and light grids C50 and C90

Example: CT14A-1050M/W

Ca bbA-dddd e/f

- C** : COMPACT
a : T = Transmitter, R = Receiver
bb : Object sensitivity, resolution [mm]
A : Only at plugable connection with akkalit front plates (resistant to welding)
dddd : Protected height [mm]
e : Only for cascade connections M = master, S = Slave
f : W = plugable design with angled cable socket, DIN 43651
G = plugable design with straight cable socket, DIN 43651
BH = plugable design with „Brad-Harrison-Min“ connection

Order numbers

Type	C14 bb = 14	C30 bb = 30	C50 bb = 50	C90 bb = 90
CTbb-150 CRbb-150	561101 564101	561301 564301		
CTbb-225 CRbb-225	561102 564102	561302 564302		
CTbb-300 CRbb-300	561103 564103	561303 564303		
CTbb-450 CRbb-450	561104 564104	561304 564304	561504 564504	
CTbb-600 CRbb-600	561106 564106	561306 564306	561506 564506	
CTbb-750 CRbb-750	561107 564107	561307 564307	561507 564507	561907 564907
CTbb-900 CRbb-900	561109 564109	561309 564309	561509 564509	561909 564909
CTbb-1050 CRbb-1050	561110 564110	561310 564310	561510 564510	561910 564910
CTbb-1200 CRbb-1200	561112 564112	561312 564312	561512 564512	561912 564912
CTbb-1350 CRbb-1350	561113 564113	561313 564313	561513 564513	561913 564913
CTbb-1500 CRbb-1500	561115 564115	561315 564315	561515 564515	561915 564915
CTbb-1650 CRbb-1650	561116 564116	561316 564316	561516 564516	561916 564916
CTbb-1800 CRbb-1800	561118 564118	561318 564318	561518 564518	561918 564918
CTbb-2100 CRbb-2100			561521 564521	561921 564921
CTbb-2400 CRbb-2400			561524 564524	561924 564924
CTbb-2700 CRbb-2700			561527 564527	561927 564927
CTbb-3000 CRbb-3000			561530 564530	561930 564930

Order numbers for pluggable designs:

Type of Plug	Order Number
W	57...
G	55...
BH	58...

For cascaded connections the masters designated with the following character M (example: C14-1050M). The slave is designated with an S (example: C30-300S).

Type for light grid C500, C400, C300, C501, C401, C301

Example : CR500A/2/BH

Ca bbhA/k/f

- C** : COMPACT
- a** : T = Transmitter, R = Receiver
- bb** : Beam center to center distance [cm]
- A** : Only at pluggable connection with akkalit front plates (resistant to welding)
- h** : Range (0 = 18 m, 1 = 60 m)
- k** : Number of beams (1, 2, 3, or 4)
- f** : W = pluggable design with angled cable socket, DIN 43651
 G = pluggable design with straight cable socket, DIN 43651
 BH = pluggable design with „Brad-Harrison-Min“ connection

Order numbers

Type	Order No.
CT 500/2 CR 500/2	567502 568502
CT 400/3 CR 400/3	567403 568403
CT 300/4 CR 300/4	567304 568304
CT 501/2 CR 501/2	567512 568512
CT 401/3 CR 401/3	567413 568413
CT 301/4 CR 301/4	567314 568314

9.2 Scope of Delivery and Accessories

- 1 COMPACT transmitter CT ...
- 1 COMPACT receiver CR ...
- 4 mounting brackets with fittings
- 1 instructions for connecting and operating

The scope of delivery of a COMPACT in the plug-in version „G“ or „W“ includes the appropriate connection sockets. The connection cables of the „BH“ version must be ordered separately as an accessory.

Accessories:

COMPACT accessory	Order number
Swivelling mounted with vibration damping ¹⁾	560300
Mounting brackets with screws ²⁾	560120
Mounting column UDC-1000	549810
Mounting column UDC-1300	549813
Connecting cable „Brad Harrison“ transmitter - 4 m - 12 m - 20 m	150791 150792 150794
Connecting cable „Brad Harrison“ receiver - 4 m - 12 m - 20 m	150781 150782 150783
Laser alignment aid LA- 78C/R	560020
Laser alignment aid LA- 78C/R-UDC (for mounting columns UDC)	560030
Deflection mirror S150...2000/150	on request
Deflection mirror columns UMC UMC-1000 UMC-1300 UMC-1002 UMC-1303 UMC-1304 UMC-1600 UMC-1900	549710 549713 549702 549703 549704 549716 549719
Safety relais module MSI-SR2 Safety relais module MSI-SR2/F Safety interface module MSI (muting, cyclical control)	549911 549915 on request

COMPACT accessory	Order number
RS-485/RS-232 converter for diagnosis interface	520030
RS-232 serial cable	426500
Set of cables for diagnosis	
C/PG	520050
C/W	520052
C/G	520051
C/BH	520053

- 1) 2 pieces for transmitter, 2 pieces for receiver necessary
- 2) included in scope of delivery (standard mount)



EC-Declaration of Conformity

according to Machinery Directive 98/37/EC, Annex II C

We herewith declare, Leuze lumiflex GmbH + Co. KG
Liebigstr. 4
82256 Fürstenfeldbruck

that the following described safety components in our delivered version complies with the appropriate basic safety and health requirements of the Machinery Directive 98/37/EC based on its design and type, as brought into circulation by us. In case of alteration of the safety components, not agreed upon by us, this declaration will lose its validity.

Description of the safety component: **safety light curtain / safety light grid**

Safety component type: **COMPACT C14, C30, C50, C90, C300/4, C400/3, C500/2
C301/4, C401/3, 501/2**

Serial number: see type plate

Safety category: AOPD type 4

Safety function: Active Opto-electronic Protective Device

Applicable directives and standards: Machinery Directive 98/37/EC
EMC Directive 89/336/ECC
Low-Voltage Directive 73/23/ECC
DIN EN 60204-1:1998
IEC 61496-1:1998
IEC 61496-1:1997
DIN EN 954-1:1997
DIN V VDE 0801:1990 and modification A1:1994

Notified body according to annex VII: **TÜV PRODUCT SERVICE GmbH**
Zertifizierstelle
Ridlerstraße 31
D-80339 München


Charged to do: EC - type examination
Examination certificate no. **U9903 22795 014**

Technical report no.: LM 50437, (latest valid revision)

CE-marking: The compliance with the directives 73/23/EWG and
89/336/EWG is certified by the CE-mark.

Fürstenfeldbruck, May 27th 2002


ppa. Dr. Holger Lehmitz
Manager product unit
Safety at work


ppa. Werner Lehner
Manager product management