Leuze

Original operating instructions

MSI-i/R

Modular safety interface

The Sensor People

We reserve the right to make technical changes
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1 About this document

These connecting and operating instructions contain information on the approved purpose and use of MSI safety interfaces.

⚠ ATTENTION!
 All information provided in the connecting and operating instructions, especially the Safety Notices, must be observed.

Safety and warning notices are marked with the  symbol.

These connecting and operating instructions must be kept in a safe place. It must be available during the mission time of the MSI safety interfaces.

Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use. Knowledge of these connecting and operating instructions is considered an element of proper use.

2 System overview and range of applications

2.1 General information

The Modular Safety Interface (MSI) serves as a link between one or more active optoelectronic protective devices (AOPD), type 2, type 3 or type 4, and the machine control. All MSI safety components include start/restart interlock and contactor monitoring functions that can be activated and deactivated. They are also equipped with a series of signal outputs and LED indicators as well as a diagnostic interface to a PC.

In addition, MSI-i/R offers a selection between protective mode only and several cyclic operating modes. During cyclic operation, the machine is controlled by means of the interruption and subsequent release of the protective field.Special safety regulations for cyclic operation are described in chapter 3.6 below.

Leuze electronic offers a range of additional MSI safety interfaces with standard and special function, e.g. muting (intentional suppression of the safety function) or cycle control (single cycle, two cycle).

All MSI safety modules are equipped with relay outputs.

2.2 Certifications

Europe
EC Type Examination TÜV SÜD

2.3 Terminology

AOPD	Active Optoelectronic Protective Device
Clear	Clearance of Cycles, Test
Diagn.	Diagnosis Function
EDM	External Device Monitoring Contactor monitoring
ESPE	Electro-sensitive Protective Equipment
Fault	Relay error
Locked	Start/Restart Interlock active
MSI Fault	MSI error
N.O.	Normally Open Contact
OSSD	Safety-related switching output
Reset	Start/Restart Interlock Initiator
RS 232	Interface RS 232
S1, S2	Safety input 1, 2
S1 & S2	Indication protective fields free/interrupted
Safety Switches	Safety Switches
Select	Selection of Cyclic Operation
State	Status
Test	Test Signal Outputs
T1, T2	Test signal output 1, 2

2.4 Nomenclature MSI-i/R

MSI	Modular Safety Interface
i	With protective mode, single cycle or two cycle control This version offers the following standard functions for either **1** AOPD, type 4, or up to **2** AOPDs, type 2: • Start/restart interlock • Contactor monitoring • Diagnostics function and the following special functions for 1 AOPD type 4 or 1 AOPD type 2: • Cycle control • Displays and status outputs for guard, protective and cyclic operation
/R	Relay output with the following functions: • Two safety-related normally open contacts, OSSD 1 and OSSD 2 • Status indicators and signal outputs

3 Safety

Before using the safety interface, a risk assessment must be performed according to valid standards (e.g. EN ISO 12100, EN ISO 13849-1, EN 62061). The result of the risk assessment determines the required safety level of the safety interface (see table in chapter 3.1.1). For mounting, operating and testing, document "MSI-i/R Modular Safety Interface" as well as all applicable national and international standards, regulations, rules and directives must be observed. Relevant and supplied documents must be observed, printed and handed to the affected personnel.

Before working with the safety interface, completely read and understand the documents applicable to your task.

In particular, the current version of the following national and international legal regulations apply for commissioning, technical tests and handling of safety sensors:

- Machinery Directive
- Low Voltage Directive
- Electromagnetic compatibility
- Use of Work Equipment Directive
- OSHA
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and employment protection act
- Product Safety Law (ProdSG)

NOTE
Local agencies can also provide safety-relevant information (e.g. occupational safety and health inspectorate, employer's liability insurance association, labor inspectorate, OSHA).

3.1 Intended use and foreseeable misuse

⚠ ATTENTION!
A running machine can cause severe injuries! ↳ Make certain that, during all conversions, maintenance work and inspections, the system is securely shut down and protected against being restarted.

3.1.1 Intended use

- The safety interface may only be used after it has been selected in accordance with the respectively applicable instructions and relevant standards, rules and regulations regarding labor protection and safety at work, and after it has been installed on the machine, connected, commissioned, and checked by a competent person.
- When selecting the safety interface it must be ensured that its safety-related capability meets or exceeds the required Performance Level PL_r ascertained in the risk assessment.

The following table shows the safety-related characteristic parameters of the MSI-i/R modular safety interfaces.

Type in accordance with EN 61496-1	Type 4
SIL in accordance with EN 61508	SIL 3
Performance Level (PL) in accordance with EN ISO 13849-1:2015	PL e
Category in accordance with EN ISO 13849-1:2015	Cat. 4
Mean probability of a dangerous failure per hour (PFH_d) as a function of the mean number of annual switching cycles of the relay n_{op}*	100% Load n_{op} = 4,800: 1.5 x 10^{-08} 1/h 60% Load n_{op} = 4,800: 1.2 x 10^{-08} 1/h 100% Load n_{op} = 28,800: 3.1 x 10^{-08} 1/h 60% Load n_{op} = 28,800: 1.5 x 10^{-08} 1/h 100% Load n_{op} = 86,400: 7.4 x 10^{-08} 1/h 60% Load n_{op} = 86,400: 2.1 x 10^{-08} 1/h
*n_{op} = mean number of annual actuations, see C.4.2 and C.4.3 of EN ISO 13849-1:2015 Use the following formula to calculate the mean number of annual actuations: $n_{op} = (d_{op} \cdot h_{op} \cdot 3600\ s/h) \div t_{Zyklus}$ In doing so, make the following assumptions with regard to the use of the component: h_{op} = mean operating time in hours per day d_{op} = mean operating time in days per year t_{cycle} = mean operating time between the start of two successive cycles of the component (e.g switching of a valve) in seconds per cycle	

- The safety interface is used in combination with one or more multiple light beam safety devices or safety light curtains to safeguard points of operation or danger zones.
- The control of the machine or system that is to be safeguarded must be electrically influenceable. A switch-off command initiated by an MSI must result in an immediate shutdown of the dangerous movement.
- The "Reset" acknowledgment button for unlocking the start/restart interlock must be mounted in such a way that the entire danger zone can be seen from its mounting location.
- Signal outputs (state output) must not be used for switching safety-relevant signals.
- The safety interface is designed for installation in a cabinet or a protective housing with a degree of protection of at least IP 54.
- The 24 V DC ±20% power supply must guarantee safe insulation from the mains voltage and be able to bridge a power outage period of 20 ms.
- Depending on external wiring, dangerous voltages may be present at the switching outputs. In addition to the power supply, these must be switched off and safeguarded against being switched back on prior to all work on the MSI-i/R.
- These operating instructions must be included with the documentation of the machine on which the protective device is installed so that they are available to the operator at all times.
- In the event of changes to the MSI-i/R, all warranty claims against the manufacturer of the safety interface are rendered void.
- The safety distance between the AOPD and the point of operation is to be maintained. It is calculated according to the formulas for machine-specific C standards or given in the general B1 standard EN ISO 13855. Both the reaction time of the test monitoring unit and the braking time of the machine must be taken into account.
- Two switching contacts must always be looped into the switch-off circuit of the machine. To prevent welding, relay switching contacts must be fused/protected externally according to the technical data.
- The safety interface must be exchanged after a maximum of 20 years. Repairs or the exchange of wear parts do not extend the mission time.
- The safety interface satisfies the requirements of safety category 4 acc. to EN ISO 13849-1:2015. If, however, an AOPD of a lower safety category is connected, the total category for the given path of the control cannot be higher than that of the connected AOPD.

- Cross-circuits between S1 and S2 are only detected by the MSI safety module if both time-delayed test signal outputs, T1 and T2, are used for the connected protective device(s) with relay output. AODPs of type 4 with safety-relevant transistor outputs and their own cross circuit monitoring can be directly connected to S1 and S2.

3.1.2 Foreseeable misuse

Any use other than that defined under the "approved purpose" or which goes beyond that use is considered improper use!

e.g.,

- Applications in explosive or easily flammable atmospheres

⚠ ATTENTION!	
	Such instances can jeopardize the health and lives of the personnel operating the machinery and/or may cause damage to property.

3.2 Competent personnel

Prerequisites for competent personnel:

- They have a suitable technical education.
- They know the rules and regulations for labor protection, safety at work and safety technology and can assess the safety of the machine.
- They know the instructions for the safety interface and the machine.
- They were instructed by the responsible individuals on the mounting and operation of the machine and of the safety interface.

3.3 Responsibility for safety

Manufacturer and operator must ensure that the machine and implemented safety interface function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- Safe machine construction
- Safe implementation of the safety interface
- Imparting all relevant information to the operating company
- Adhering to all regulations and directives for the safe commissioning of the machine

The operator of the machine is responsible for:

- Instructing the operating personnel
- Maintaining the safe operation of the machine
- Adhering to all regulations and directives for labor protection and safety at work
- Regular testing by competent personnel (see chapters 3 and 3.2)

3.4 Exemption of liability

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- Safety interface is not used as intended.
- Safety notices are not adhered to.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Proper function is not tested.
- Changes (e.g., constructional) are made to the safety interface.

3.5 Connection of E-STOP buttons

- It must be ensured that the EMERGENCY STOP function is always and immediately effective. **E-STOP buttons must not be connected at sensor inputs which provide for muting or cycle control functions! Since the MSI-i does not provide for additional sensor inputs without special functions, no E-STOP buttons must be connected.** If an E-STOP button is needed, the use of the extended version MSI-ix is recommended.

3.6 Additional safety notices for the special function "Cycle control"

- Special safety precautions must be followed for controlling protective devices. For example, it must be impossible to step behind the protective device on the side facing the point of operation. Stepping into or through the protective field would automatically cause the dangerous movement to be enabled!
- More specific regulations can be found in EN ISO 12100, Control guards. In addition, the european standard for Hydraulic Presses EN ISO 16092-3 contains restrictions on the minimum height of the press table and on the maximum dimensions of the access (window) opening. If these stipulations cannot be complied with, additional measures must be taken to reliably monitor the interior of the machine.

4 System design and functions

4.1 System design

Two microprocessors handle the redundant processing of the signal sequences within the intelligent modular safety interface MSI. The results of the two processors are continuously compared. If any deviations are found, the safety-related outputs are immediately switched off and the LED indicating an MSI failure lights up.

Sensor signals at inputs S1 and S2 are checked. Depending on which of the functions (as described below) are selected, when the protective fields of all connected AOPDs are free, the MSI outputs switch automatically to the ON state (without start/restart interlock) or remain in the OFF state until the reset button has been pressed and released (with start/restart interlock = standard operating mode).

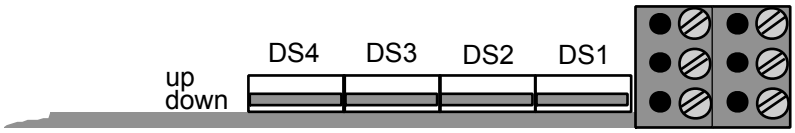
On the output side, the MSI-i/R is equipped with two positive-guided, normally open contacts.

The MSI safety interface comes in a 35 mm-wide slide-in housing that holds the MSI-i module and the output module. It is suitable for mounting on a grounded 35 mm standard rail.

4.2 DIP switch settings

4.2.1 MSI-i module DIP switch

To reset the DIP switches: cut off the voltage supply to the interface (see chapter "Safety Notices"), loosen the mounting tabs of the component with the **imprint "MSI-i"** and pull this module partly out of the housing:



Functions **only** in conjunction with external wiring, see Chapter 4.3:

DIP switch	DS4	DS3	DS2	DS1
Function	With-out	Lock	Contactor moni-toring	Cycle time limit
Up		Start interlock only	Static• - none••	30 min
Down		Start/restart interlock* - none**	Dynamic	30 sec

Factory setting: all switches down

* See chapter 4.3.1.1 – 4.3.1.3
** See chapter 4.3.1.4
• See chapter 4.3.1.2
•• See chapter 4.3.1.3 – 4.3.1.5

4.3 Operating modes and functions

MSI-i/R permits the following operating modes and functions:

- Protective function with the possibility of the following combinations of interlocking function and contactor monitoring function.
- Five operating modes can be selected by means of external wiring and the DIP switches DS2 and DS3 on the MSI-i module.
- Cycle operation as single cycle or two cycle operation with protective function. In cyclic operation, the AOPD connected at S1 controls the process. Special safety precautions are required and described in chapter 3.6, Safety Notices. **Start/restart interlock is a necessary precondition for cyclic operation.** Whenever cyclic operation is selected, terminal 13 must be connected to 24 V DC via a reset button! See more in chapter 4.3.3. A three-point key switch is used to select among the operating modes. Changes at this key switch may only be made by qualified personnel. If just one of the available operating modes is going to be required, we recommend permanently wiring this mode using a bridge.

4.3.1 Operating modes – interlocking and contactor monitoring functions

The following 5 combinations can be selected by externally wiring the MSI safety interface and/or by changing the settings of the DIP switches DS2 and DS3 in the MSI module:

OPERATING MODES			
Chapter	Type of locking	Type of contactor monitoring	Cyclic function
4.3.1.1	With start/restart interlock	With dynamic contactor monitoring	Possible
4.3.1.2	With start/restart interlock	With static contactor monitoring	Possible
4.3.1.3	With start/restart interlock	Without contactor monitoring	Possible
4.3.1.4	Without start/restart interlock	Without contactor monitoring	Not permitted
4.3.1.5	With start/without restart interlock	Without contactor monitoring	Not permitted

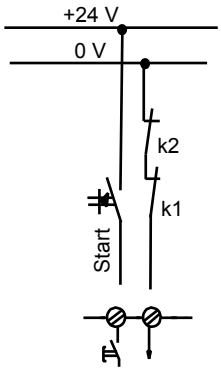
⚠ ATTENTION!

The MSI safety interface is factory-set for the operating mode "with start/restart interlock and dynamic contactor monitoring function". If this setting is changed, these functions (i.e. the appropriate safety level) must be guaranteed by other means.

- Types of interlocking functions
  The "start interlock function" ensures that when the system is switched on or when the supply voltage returns, even if the protective field is free, the safety-related output contacts (OSSDs) do not automatically go into ON state, but only after the reset button has been pressed and released. The "start/restart interlock function" prevents the OSSDs from automatically entering the ON state when the protective fields of one or more of the connected AOPDs are released again after an interruption. Here as well, the reset button must be pressed and released to initiate the system. Cyclic operation and muting are not permissible if there is no locking (and hence no reset button) since the start button is also used to perform the function of the cyclic and muting reset.
- Types of contactor monitoring
  The function "dynamic contactor monitoring" monitors the contactors and relays connected downstream from the MSI safety interface. Each time before the OSSDs switch to the ON state, a check is made of whether the subsequent circuit elements have closed and reopened. If they have not, the OSSDs of the MSI safety interface remain in the OFF state. If the function "static contactor monitoring" is selected, a check is made of whether the subsequent switching elements are in an open state. If they are, the start/restart interlock can be unlocked.

4.3.1.1 Operating mode: with start/restart interlock – with dynamic contactor monitoring

External wiring requirements:



Terminal 13 "Reset"	Connected to 24 V DC supply via a start button
Terminal 14 "EDM"	Connected to 0 V via feedback contacts of the positive-guided downstream relay

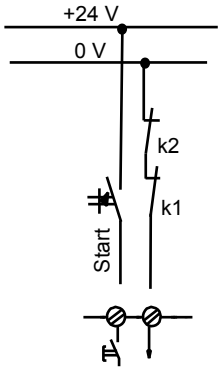
Required DIP switch settings in the MSI module (chapter 4.2):

DS3 down	DS2 down (factory setting on delivery)

Start/restart interlock is no longer active when the protective fields of all connected AOPDs are free, the downstream relays have returned to their original state, and the reset button is pressed and released.

4.3.1.2 Operating mode: with start/restart interlock – with static contactor monitoring

External wiring requirements:



Terminal 13 "Reset"	Connected to 24 V DC supply via a start button
Terminal 14 "EDM"	Connected to 0 V via feedback contacts of the positive-guided downstream relay

Required DIP switch settings in the MSI module (chapter 4.2):

DS3 down	DS2 up

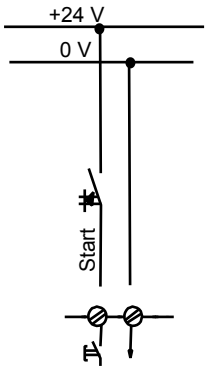
In this operating mode, if the protective fields are free, a check is made of whether the downstream switching elements have returned to their original state. If so, a release is issued by pressing and releasing the reset button.

⚠ ATTENTION!

The dynamic monitoring of the downstream relays, which may be required in order to maintain the safety category, must be performed by other means.

4.3.1.3 Operating mode: with start/restart interlock – without contactor monitoring

External wiring requirements:



Terminal 13 "Reset"	Connected to 24 V DC supply via a start button
Terminal 14 "EDM"	Connected to 0 V

Required DIP switch settings in the MSI module (chapter 4.2):

DS3 down	DS2 up

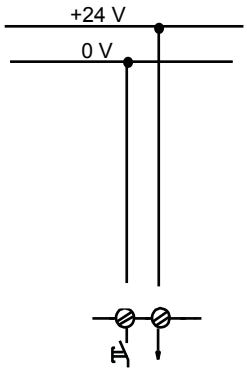
⚠ ATTENTION!

The monitoring of the downstream switching elements, which may be required in order to maintain the safety category, must be performed by other means.

4.3.1.4 Operating mode: without start/restart interlock – without contactor monitoring

Cyclic operation is not permissible in this operating mode!

External wiring requirements:



Terminal 13 "Reset"	Connected to 0 V
Terminal 14 "EDM"	Connected to 24 V DC

Required DIP switch settings in the MSI module (chapter 4.2):

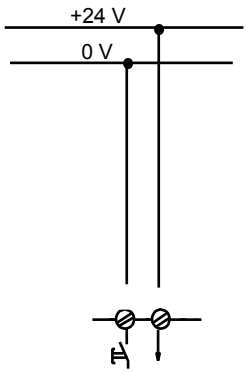
DS3 down	DS2 up

⚠ ATTENTION!	
	After the supply voltage is applied, the OSSDs immediately go into the ON state if all of the protective fields of the connected AOPDs are free. The start/restart interlock function and the monitoring of the downstream switching elements, which may be required in order to maintain the safety category, must be performed by other means.

4.3.1.5 Operating mode: with start/without restart interlock – without contactor monitoring

Cyclic operation is not permissible in this operating mode!

External wiring requirements:



Terminal 13 "Reset"	Connected to 0 V
Terminal 14 "EDM"	Connected to 24 V DC
Required DIP switch settings in the MSI module (chapter 4.2):	
DS3 up	DS2 up

After the supply voltage is applied, the OSSDs remain in the OFF state even if all of the protective fields of the connected AOPDs are free.

⚠ ATTENTION!	
	When the protective fields of all connected AOPDs are initially free, the OSSDs first enter the ON state when the protective field of the AOPD connected at S1 (for type 4: S1 and S2) is interrupted and released. Only then do the rest of the connected AOPDs respond to the interruption and release of their own protective fields by switching the OSSDs directly to the OFF and ON states. The restart interlock function and the monitoring of the downstream switching elements, which may be required in order to maintain the safety category, must be performed by other means.

4.3.2 Protective mode, test function

If the protective fields are free, it is possible to simulate an interruption of the protective field of the AOPD connected at S1 via the "Clear" input. During this procedure, the safety-related outputs will switch to the OFF state. Test is activated if 24 V DC at pin 20 is disconnected via a normally closed contact.

If operating mode "Start interlock only" (as in Chapter 4.3.1.5) is selected, the "Clear" input also serves as remote start for the AOPD connected at S1 (for type 4: at S1 and S2). In this case, it is no longer necessary to initiate the first start by interruption the protective field.

4.3.3 Cycle operation as single cycle or two cycle operation with protective function

Special safety precautions must be taken when the protective device is used to control the machine. These are described in Safety Notices, chapter 3.6.

At terminal 21 "Select" you can choose the operating modes "Protective mode", "single cycle operation" or "two cycle operation". Start/restart interlock is a necessary precondition for cyclic operation, which means that terminal 13 must always be connected to 24 V DC via the start button. There are some options available with regard to contactor monitoring. It can be performed either dynamically or statically, or it can be dispensed with completely if the requirements for maintaining the safety category are fulfilled by other means.

Cyclic operation:

The start interlock ensures that the OSSDs remain in the OFF state after the supply voltage has been switched on. The display "start/restart interlock" (symbol: lock) is constantly lit.

The following applies for single cycle operation:

When the start button is pressed, the readiness for cyclic operation is achieved, and the display "start/ restart interlock" emits a single blink which is repeated in short intervals. The MSI safety interface waits in this state for an intervention by the operating personnel of at least 300 ms into the protective field of the AOPD connected to S1. After release of the protective field, the OSSDs switch to the ON state.

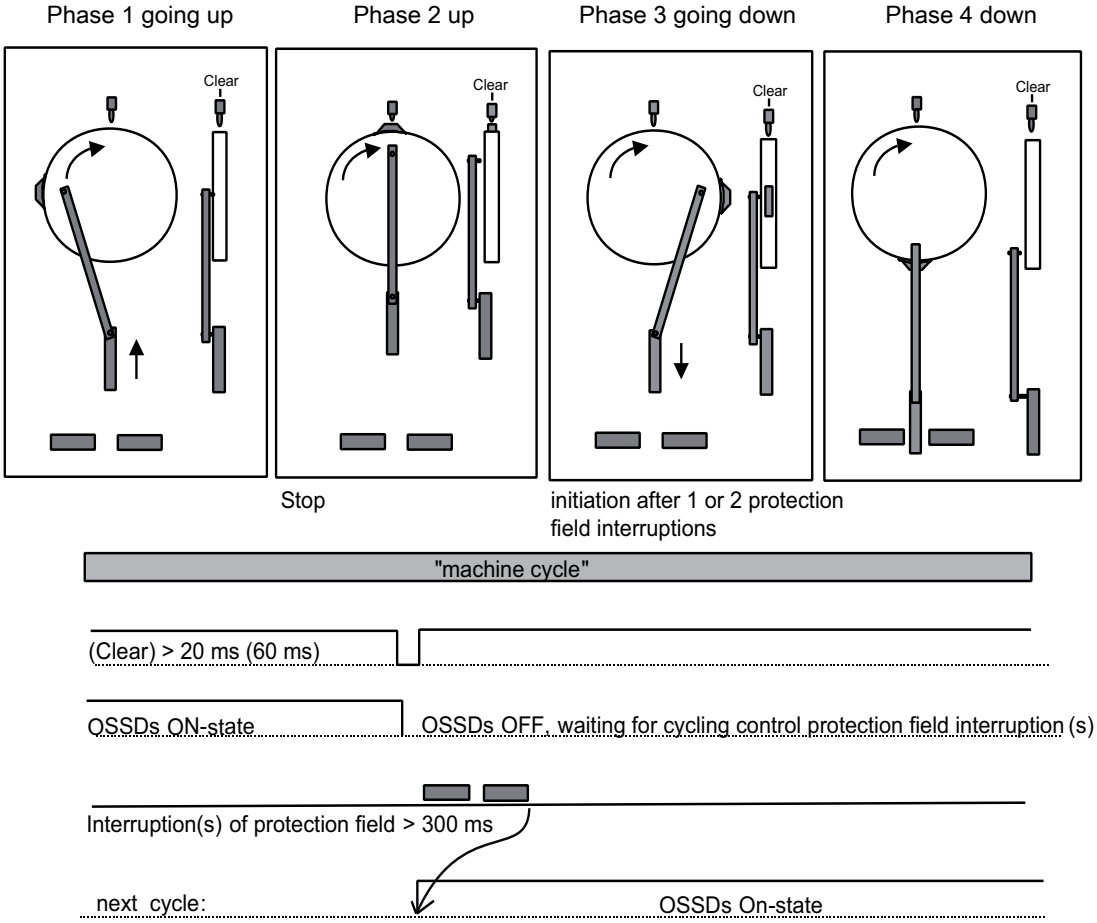
The following applies for two cycle operation:

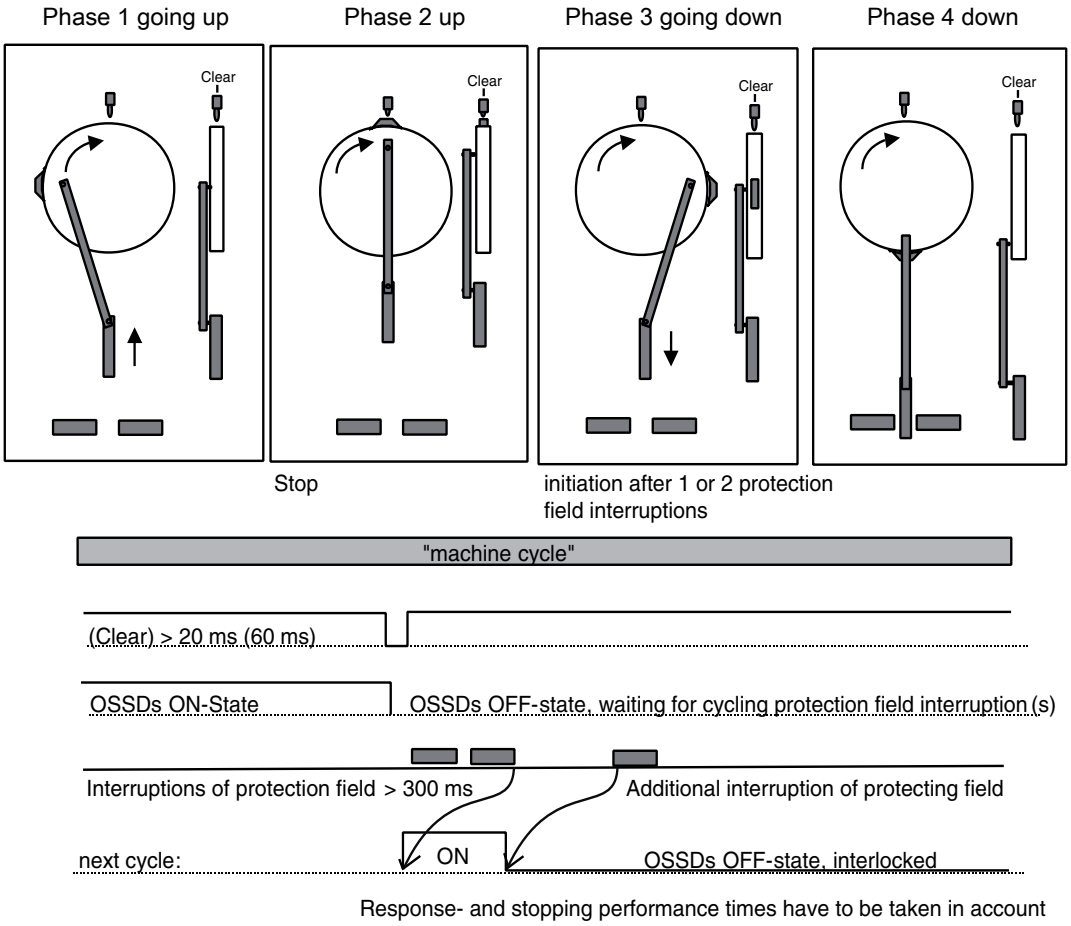
When the start button is pressed, the readiness for cyclical operation is achieved, and the display "start/ restart interlock" emits a double blink which is repeated in short intervals. After the first intervention by the operating personnel of at least 300 ms into the protective field of the AOPD connected to S1, the display emits a single flash which is repeated in short intervals. The MSI safety interface waits for the second controlling intervention into the protective field. Following another intervention and re-release of the protective field, the OSSDs switch to the ON state.

Cyclic operation time monitoring

A time monitoring function prevents other controlling interruptions of the protective field after a period of 30 s following the "readiness" state or the last controlling interruption of the protective field. After this period, the start/restart interlock function is automatically actuated, and the yellow LED illuminates continuously. By a press of the start button, "readiness" may be restored. This function safeguards against the unintentional and unexpected initiation of a processing cycle after a longer standstill. In justified cases only, and if this does not create any additional danger to the operating personnel, the time monitoring function can be switched to 30 min via the DIP switch DS1. See chapter 4.2.1.

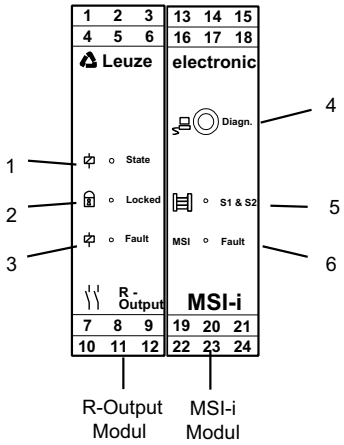
4.3.4 Cycle control, schematic illustration





4.4 Indicators

A number of LEDs of various colors indicate the operating state of the MSI modular safety interface. It is also possible to show the indicators and input/output states on the PC monitor using the integrated RS 232 interface and diagnostic connector.



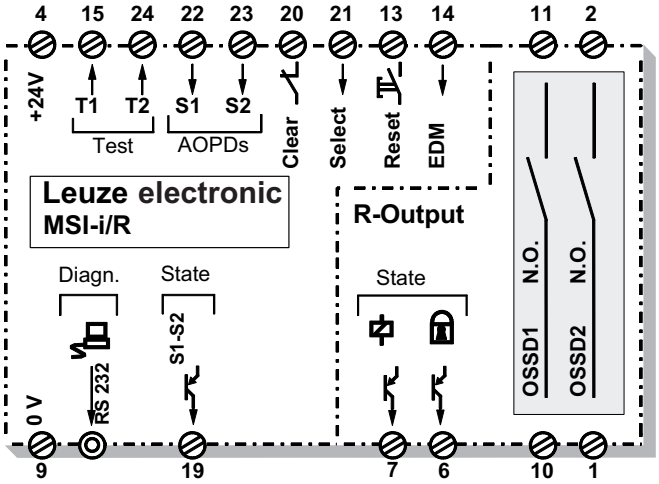
Output /R					
Position	Display/function	Icon	Status	LED	Color
1	Switching state Safety output	Relay	On Off	On On	Green Red
2	Start/restart interlock - Wait for 2 cycles - Wait for 1 cycle	Lock	Locked Locked Locked Not locked	On Flashes 2x Flashes 1x Off	Yellow Yellow Yellow
3	Error in output module	Relay	Error No error	On Off	Red

MSI-i module					
Position	Display/function	Icon	Status	LED	Color
4	Diagnosis, RS 232 See signal outputs	Socket Diagn.	N/A	N/A	N/A
5	Protective field	AOPDs S1 & S2	Protective field free Not free	On Off	Green
6	MSI error	MSI Fault	Error No error	On Off	Red

4.5 Signal outputs

ATTENTION!

Signal outputs are not allowed to be used as safety-related signals in release circuits (see also chapter Safety Notices, Operating conditions and approved purpose).



Output /R				
Terminal	Signaling function	Icon	Status	Signal output
6	Start/restart interlock - Wait for 2 cycles - Wait for 1 cycle	Lock	Locked Locked Locked Not locked	Active high Pulse 2x Pulse 1x Active low

7	Switching state Safety output	Relay	ON OFF	Active high Active low

MSI-i module				
Terminal	Signaling function	Icon	Status	Signal output
Front socket	Diagnosis, RS 232 2.5 mm connector	–	–	Connection to PC with diagnosis program
19	Protective field(s)	S1 - S2	Free Not (all) free	Active high Active low

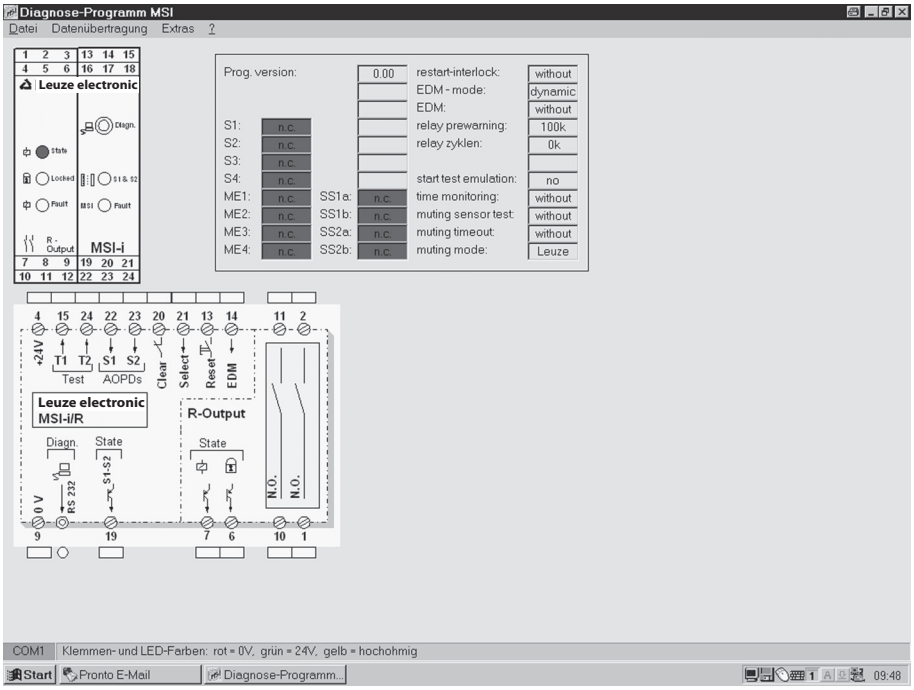
4.6 Diagnostics function

Requirements for running the diagnosis system: a standard PC or laptop operating under Windows (Version 3.1 or higher) and the MSI software, Version 01, as well as a serial connection cable and a 2.5 mm jack plug.

- Simultaneous display of all input and output states as well as all LED displays on the MSI

With its diagnosis interface, the intelligent modular safety interface MSI offers a convenient way to visualize all of the input and output states simultaneously on the monitor. The connection diagram as well as display fields in different colors can be shown via the connection terminals. A graphic representation of the MSI front design with the display elements as described in chapter 4.4 also appears on the screen.

Example:



This enables the sequences at individual screw terminals to be tracked without the use of additional measuring instruments. The diagnostics function is equipped with online help and can be operated in either English or German.

5 Electrical connection

5.1 Installation instructions

⚠ ATTENTION!
The general Safety Notices in chapter 3 must be observed. The electrical installation may only be performed by trained specialists and if there is no voltage applied.

⚠ ATTENTION!
In the R/Rx versions, it is possible that high voltages may be applied at the output contacts. A de-energized state is achieved only when the 24 V DC supply voltage as well as the supply lines to the switching contacts are safely switched off and secured against being switched on again.

⚠ ATTENTION!
Coded plug-in terminal blocks allow a connection cross-section of up to 2.5 mm^2. The supply voltage must be externally fused against overcurrent with a fuse of 2.5 A mT. The switching contacts must also be externally fused against overcurrent with a maximum of 4 A gG. This prevents the safety-related contacts from welding together if the current load is too high!

5.2 Power supply requirements

⚠ ATTENTION!
The supply voltage of 24 V DC must guarantee safe mains separation and be able to bridge a voltage dip of 20 ms at full load. The functional earth connection of the MSI is established when snapped onto the grounded metal mounting rail via the rear clamping device. ↳ The supply line for the supply voltage must be externally fused against overcurrent with a maximum of 2.5 A mT.

5.3 Connecting AOPDs, type 4 or type 2

The examples below show possibilities for connecting and combining AOPDs of various safety categories and with various output features (relays, safety-oriented transistor outputs, cross circuit monitoring within and outside the AOPD).

AOPDs of type 4 with transistor outputs and cross circuit monitoring function can be connected directly to the safety inputs S1 and S2. See example 1.

AOPDs of type 4 with relay outputs must be connected so that the odd-numbered test signal T1 is directed via the non-delaying contacts to an odd-numbered sensor input (T1 => S1) and vice versa (T2 => S2). See example 2.

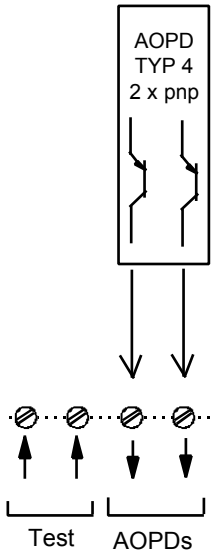
AOPDs of type 2 are periodically tested using the time-delayed test signals T1 or T2. The even-numbered test signal must be directed to an odd-numbered safety input via the time-delaying sensor (T2 => S1) and vice versa (T1 => S2). The sensor response time to a test request must be in a range of 2 to 18 ms. See example 3.

All available safety inputs must be occupied! In case no components are connected, the remaining sensor input must be connected to the corresponding test signal using bridges. In doing so, please note that the even-numbered test signal must be connected to the even-numbered sensor input via the non-delaying bridge (T2 => S2) and vice versa (T1 => S1). See example 4.

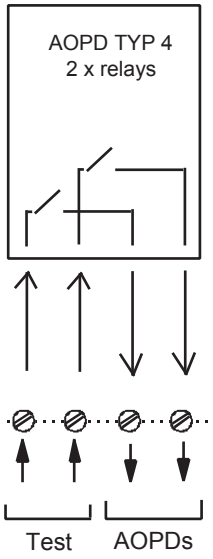
If type 2 AOPDs are connected:

- According to EN 61496-1, only a maximum of PL c or SIL CL 1 can be achieved!
- When cables are laid without protection, an error detection time of up to 10 s is possible.

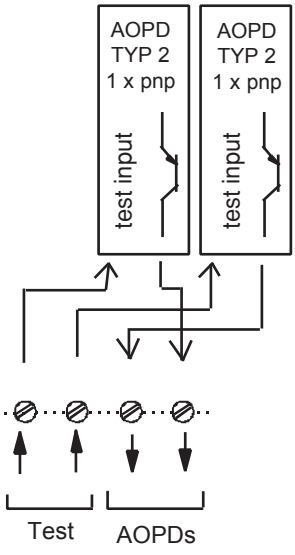
Example 1
1 AOPD of type 4 with 2 safety-related transistor outputs and internal cross circuit monitoring function.



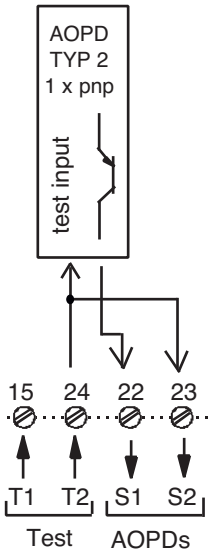
Example 2
1 AOPD of type 4 with 2 relay outputs; cross circuit monitoring of the interconnection cable by using the test signals T1 and T2.



Example 3
2 AOPDs of type 2 with one safety-related transistor output each; cross circuit monitoring between the supply lines of both AOPDs.



Example 4
1 AOPD of type 2 with one safety-related transistor output.



5.4 Connecting to the machine control

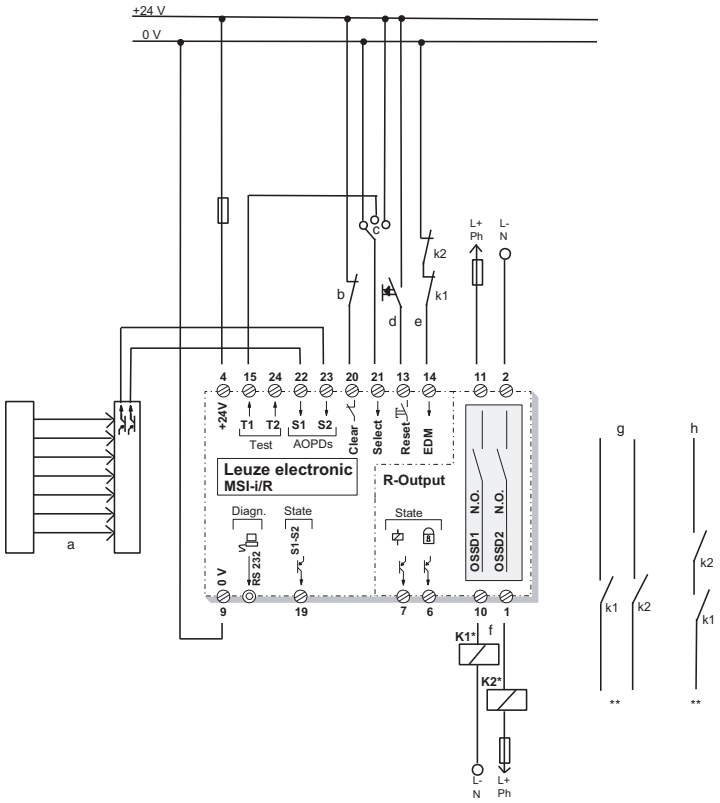
⚠ ATTENTION!	
	The safety-related parts of the controls comprise more than the MSI-i/R described above. They also include successive control elements and even power transmission elements which must be safely and promptly shut down. Special attention must be given here to the adherence to the required safety category. Important information on this topic can be found in EN ISO 13849-1:2015.

⚠ ATTENTION!	
	Essential prerequisites for safe operation are the abilities to electrically influence the interruption of the dangerous movement and to bring the machine to a standstill as quickly as possible. These factors, as well as the reaction times of AOPDs and the MSI, must be taken into consideration when calculating the safety distance. The reaction times depend on the type of AOPD selected (see chapter 7, Technical data). Other parameters, such as access speed or additional distance to be added to the safety distance, are dependent on the respective applications and the resolution of the used AOPD. European standard EN ISO 13855 includes calculation formulas and examples for various arrangements.

Before starting the next cycle, the MSI cycle control must be reset automatically. A normally closed contact between 24 V DC and terminal 20 (Clear) must be interrupted for a minimum duration according to the technical data. This causes all fed-in cycles to be cleared. The output contacts enter the OFF state when the cycle clearance procedure is performed.

6 Connection examples

The connection example below shows one wiring suggestion for the MSI-i/R.



Connection example MSI-i/R with one AOPD type 4

a	=	AOPD type 4 with protective and control function
b	=	Machine contact for cycle clearance (normally closed contact)
c	=	Actuation mode selector switch (protection = 0 V, single cycle = T1, two cycle = 24 V)
d	=	Command device for release (start/restart interlock)
e	=	Feedback circuit for contactor monitoring
Pin 19	=	Signal output "sensor state"
Pin 7	=	Signal output "switching state of safety output "
Pin 6	=	Signal output "interlock state"
f	=	Safety-related switching outputs (OSSDs)
g	=	Two-channel release circuit
h	=	One-channel release circuit
*	=	Use suitable spark extinction circuits
**	=	Always use both contacts in the release circuit. Only use sequential contactors with positive-guided contacts.

All available safety inputs must be occupied!
See chapter 5.3.

7 Technical data and order guide

7.1 MSI-i

Version, type Modular Safety Interface	MSI-i
Type in accordance with EN 61496-1	Type 4
SIL in accordance with EN 61508	SIL 3
Performance Level (PL) in accordance with EN ISO 13849-1:2015	PL e
Category in accordance with EN ISO 13849-1:2015	Cat. 4
Mean probability of a dangerous failure per hour (PFH_d) as a function of the mean number of annual switching cycles of the relay n_{op}*	100% Load n_{op} = 4,800: 1.5×10^{-08} 1/h 60% Load n_{op} = 4,800: 1.2×10^{-08} 1/h 100% Load n_{op} = 28,800: 3.1×10^{-08} 1/h 60% Load n_{op} = 28,800: 1.5×10^{-08} 1/h 100% Load n_{op} = 86,400: 7.4×10^{-08} 1/h 60% Load n_{op} = 86,400: 2.1×10^{-08} 1/h
Number of cycles until 10% of the components have a failure to danger ($B10_d$)	400,000: 100% of the max. switching current of loading cases AC1, DC1, AC15, DC13 2,500,000: 60% of the max. switching current of loading cases AC1, DC1, AC15, DC13 20,000,000: 20% of the max. switching current of loading cases AC1, DC1, AC15, DC13
Mission time (T_M)	20 years
Connectable safety sensors at S1 and S2	1 AOPD of type 4, type 3 or up to 2 AOPDs of type 2 (all in acc. with EN 61496-1)
Test outputs T1 and T2, test interval Test impulse duration, time-delayed Reaction time, AOPD of type 2 on test request	200 ms 24 ms each 2 to 18 ms
Available functions	Start/restart interlock Contactor monitoring Protective mode, single cycle and two cycle operation
Minimum duration for cycle feed-in	300 ms
Control input Start/restart interlock (reset)	Potential-free normally open contact (button or key switch)
Control input Contactor monitoring (EDM)	Feedback of positive-guided contacts of sequential contactors (see connection diagram)
Control input Cyclic operation selection (Select)	Operating mode key switch or bridge for permanent operating mode
Control input Cycle clearance (Clear) For AOPDs of type 4 with transistor output For AOPDs of type 4 with relay output For AOPDs of type 2	Normally closed contact to 24 V DC in the machine cycle At least 20 ms break time At least 60 ms break time At least 60 ms break time

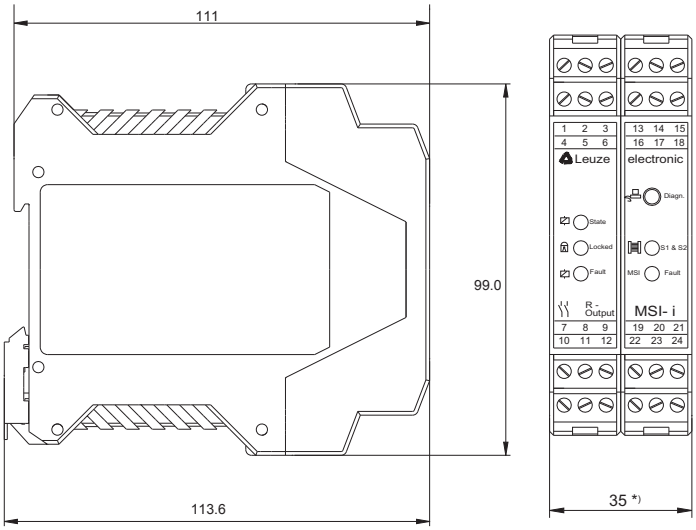
Signal output State of protective fields S1 and S2	pnp – switching output All protective fields free Active high, 24 V DC, 100 mA max. Not all free Active low
Safety outputs (Technical data, see below)	Relay outputs Via /R output
Supply voltage	24 V DC, ± 20%, external power supply unit (PELV) with safe mains separation and equalization for 20 ms voltage dip required
Current consumption	Approx. 200 mA without external load
External fuse (power supply)	2.5 A mT
Housing Degree of protection	IP 20; installation in switch cabinet or housing with degree of protection of at least IP 54 Mounting on 35 mm standard top-hat rail
Protection class	III
Ambient temperature, operation	0 … + 55 °C
Ambient temperature, storage	-25 … + 70 °C
Relative humidity	93 % max.
Connection technology (GS-ET-20: 2014)	Pluggable, coded screw terminals Cable cross section min., rigid, flexible: 0.14 mm² Cable cross section max., rigid, flexible: 2.5 mm² Cable cross section AWG/kcmil, min./max.: 26/14 Cable cross section UL AWG/kcmil: 30-12
Dimensions	See dimensional drawing
*n_{op} = mean number of annual actuations, see C.4.2 and C.4.3 of EN ISO 13849-1:2015 Use the following formula to calculate the mean number of annual actuations: $n_{op} = (d_{op} \cdot h_{op} \cdot 3600\ s/h) \div t_{Zyklus}$ In doing so, make the following assumptions with regard to the use of the component: h_{op} = mean operating time in hours per day d_{op} = mean operating time in days per year t_{cycle} = mean operating time between the start of two successive cycles of the component (e.g switching of a valve) in seconds per cycle	

7.2 /R output

OSSD safety outputs Switching voltage/switching current	2 safety-related normally open contacts, 60 V DC, 250 V AC, 5 A max. Minimum switching current 20 mA
Safety outputs protection class	II
Rating voltage for safety outputs	Overvoltage category 3 / 300 V AC
OSSD external fuse (EN 60269-1)	4 A gG D-fuse
Contact currents (EN 60947-5-1)	AC15, 3 A DC13, 2 A
OSSD reaction time MSI (without AOPD)	For AOPD type 4, transistor output 22 ms For AOPD type 4, relay output 64 ms For AOPD type 2 64 ms For safety switches (electro-mechanical) 64 ms

OSSD restart delay time	> 100 ms
OSSD-suitable spark extinction via the coils of the downstream relays	Required
Do not use "Status of switching outputs" signal output for safety circuit!	pnp switching output OSSDs ON state: Active high, 24 V DC, 100 mA max. OSSDs OFF state: Active low
Signal output "State of start/restart interlock"	pnp switching output in protective mode Locked: Active high, 24 V DC, 100 mA max. Not locked: Active low
	pnp switching output 1 cycle Locked: Impulse 1x, active high, 24 V DC, 100 mA max. Active low Not locked:
	pnp switching output 2 cycles Locked: Impulse 2x, active high, 24 V DC, 100 mA max. Active low Not locked:

7.3 Dimensioned drawing



*) Stringing together without distance possible

7.4 Order guide

Type	Order no.
MSI-i/R	549902

MSI diagnostic software	549930
Diagnostics cable 3 m	549953
Diagnostics cable 5 m	549955
/R output assembly (replacement part)	509210

8 EC Declaration of Conformity

Leuze

EU-/EG-KONFORMITÄTS-ERKLÄRUNG

Hersteller:

Produktbeschreibung:
Modulares Sicherheits-Interface
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Serien Nr. siehe Typenschild

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsrechts-vorschriften der Union:

Angewandte EU-/EG-Richtlinie(n):
2006/42/EG (*1)
2014/30/EU

EU/EC DECLARATION OF CONFORMITY

Manufacturer:
Leuze electronic GmbH + Co. KG
In der Braike 1, PO Box 1111
73277 Owen, Germany

Description of product:
Modular Safety Interface
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Serial no. see name plate

This declaration of conformity is issued under the sole responsibility of the manufacturer.

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Applied EU/EC Directive(s):
2006/42/EC (*1)
2014/30/EU

DECLARATION UE/CE DE CONFORMITE

Constructeur:

Description de produit:
Module d'nterface de sécurité
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
numéro de série voir plaque signalétique

La présente déclaration de conformité est établie sous la seule responsabilité du fabricant.

L'objet de la déclaration décrit ci-dessus est conforme à la législation d'harmonisation de l'Union applicable:

Directive(s) UE/CE appliquées:
2006/42/CE (*1)
2014/30/UE

Angewandte harmonisierte Normen / Applied harmonized standards / Normes harmonisées appliquées:

EN ISO 13849-1:2015 (*1)
EN 60204-1:2006+AC:2010+A1:2009
EN ISO 13849-2:2012
EN 62061:2005
+AC:2010+A1:2013+A2:2015

Angewandte technische Spezifikationen / Applied technical specifications / Spécifications techniques appliquées:

EN 61496-1:2013+AC2015 (*1)

Notified Body
(*1) TUEV SUED Product Service GmbH, Certification Body, Ridlerstraße 65, D-80339 Munich, NB 0123, Z10 068636 0038 Rev. 00
Dokumentationsbevollmächtigter ist der genannte Hersteller, Kontakt: quality@leuze.de.
Authorized for documentation is the stated manufacturer, contact: quality@leuze.de.
Autorisé pour documentation est le constructeur déclaré, contact: quality@leuze.de

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30.06.2020
Datum / Date / Date

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Leuze electronic GmbH + Co. KG, Sitz Owen, Registergericht Stuttgart, HRA 230712
Persönlich haftende Gesellschafterin Leuze electronic Geschäftsführungs-GmbH,
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LEO-ZQM-148-07-FO

Leuze

DICHIARAZIONE DI CONFORMITÀ UE/CE

Fabbricante:

Descrizione del prodotto:

Interfaccia di sicurezza modulare
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Numero di serie vedi etichetta del tipo

La responsabilità per l'emissione della presente dichiarazione di conformità è esclusivamente a carico del fabbricante.

Il summenzionato oggetto della dichiarazione è conforme alle norme armonizzate applicabili dell'Unione:

Direttiva(e) UE/CE applicata(e):

2006/42/CE (*1)
2014/30/UE

DECLARACIÓN DE CONFORMIDAD UE/CE

Fabricante:

Leuze electronic GmbH + Co. KG
In der Braike 1, PO Box 1111
73277 Owen, Germany

Descripción del producto:

Interfaz de seguridad modular
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Número de serie ver etiqueta de tipo

El único responsable de la expedición de esta declaración de conformidad es el fabricante.

El objeto de la declaración arriba descrito cumple la legislación comunitaria de armonización pertinente:

Directiva(s) UE/CE aplicada(s):

2006/42/CE (*1)
2014/30/UE

DECLARAÇÃO DE CONFORMIDADE UE/CE

Fabricante:

Descrição do produto:

Interface de segurança modular
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Número de série veja etiqueta de tipo

A responsabilidade pela emissão desta declaração de conformidade é exclusivamente do fabricante.

O objeto da declaração descrito acima cumpre os regulamentos legais de harmonização aplicáveis da União Europeia:

Diretiva(s) UE/CE aplicada(s):

2006/42/CE (*1)
2014/30/UE

Norme armonizzate applicate / Normas harmonizadas aplicadas / Normas harmonizadas aplicadas:

EN ISO 13849-1:2015 (*1)
EN 60204-1:2006+AC:2010+A1:2009

EN ISO 13849-2:2012

EN 62061:2005
+AC:2010+A1:2013+A2:2015

Specifiche tecniche applicate / Especificaciones técnicas aplicadas / Especificações técnicas aplicadas:

EN 61496-1:2013+AC2015 (*1)

Notified Body
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El apoderado de la documentación es el nombrado fabricante, contacto: quality@leuze.de.
O responsável pela documentação é o fabricante especificado, contato: quality@leuze.de.

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LEO-ZQM-148-07-FO

Leuze

EU/EC 符合性声明

制造商:

产品介绍:

模块化安全接口
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
序列号请参见类型标签

制造商对于本一致性声明的签发承担唯一的责任。

本声明的上述适用对象符合欧盟的统一立法规定:

应用的 EU/EC 指令:

2006/42/EC (*1)
2014/30/EU

EU/EC 준수선언서

제조업체:

Leuze electronic GmbH + Co. KG
In der Braike 1, PO Box 1111
73277 Owen, Germany

제품 설명:

모듈 식 보안 인터페이스
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
일련 번호 유형 라벨 참조

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적용된 EU/EC 지침:

2006/42/EU (*1)
2014/30/EU

EU-/EG-VERKLARING VAN OVEREENSTEMMING

Fabrikant:

Productbeschrijving:

Modulaire beveiligingsinterface
MSI (-s, -sx), (-i, -ix), (-m, -mx), (-mE, -mxE)
Serienummer zie typeplaatje

De verantwoordelijkheid voor het opstellen van deze comformiteitsverklaring ligt uitsluitend bij de fabrikant.

Het hierboven gespecificeerde voorwerp van de verklaring voldoet aan de van toepassing zijnde geharmoniseerde wettelijke voorschriften van de Europese Unie:

Toegepaste EU-/EG-richtlijn(en):

2006/42/EG (*1)
2014/30/EU

应用统一标准 / 적용 조화 표준 / Toegepaste geharmoniseerde normen:

EN ISO 13849-1:2015 (*1)
EN 60204-1:2006+AC:2010+A1:2009

EN ISO 13849-2:2012

EN 62061:2005
+AC:2010+A1:2013+A2:2015

应用技术规范 / 응용 기술 사양 / Toegepaste technische specificaties:

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Gevolmachtigde voor de documentatie is de genoemde fabrikant, contact: quality@leuze.de.

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