REER

NORSTAT INC.

MODULAR SAFETY INTEGRATED CONTROLLER

MOSA:C

Modular Safety Integrated Controller

MOSAIC is certified to the highest level of safety required by the industrial safety standard.

- **SIL 3** - IEC 61508
- **SIL CL 3** - EN 62061
- **PL e** - ISO/EN 13849-1
- **Category 4** - ISO/EN 13849-1

Safety level:

SIL 3

SIL 3 – SILCL 3
PL e – Cat. 4

Mosaic MSC permits communication between the various units through a proprietary 5-way high-speed bus.

MOSAIC M1
Main unit
8 digital inputs
2 OSSD (2 pairs) output

&

MOSAIC MB
MBP - Profibus DP
MBD – DeviceNET
MBC – CANopen
MBEI - Ethernet IP
MBEC – EtherCAT
MBEP – PROFINET
MBU - Universal Serial Bus

MOSAIC MI8O2
Input / output expansion module
8 digital inputs
2 OSSD (2 pairs) output

MOSAIC MI8 – MI16
Digital input expansion modules
MI8 - 8 inputs
MI16 – 16 inputs

MOSAIC MI12T8
Expansion module 12 digital inputs
8 test outputs

New

MOSAIC MCT
Interface modules allowing the connection of remote expansions via MSC bus
MCT1 - 1 input or 1 output
MCT2 - 1 input and 1 output

MOSAIC

Mosaic MSC permits communication between the various units through a proprietary 5-way high-speed bus.

MOSAIC MCT
Interface modules allowing the connection of remote expansions via MSC bus
MCT1 - 1 input or 1 output
MCT2 - 1 input and 1 output

MOSAIC MO2 – MO4
Output expansion module.
MO2 - 2 OSSD safety outputs (pairs)
MO4 - 4 OSSD safety outputs (pairs)

MOSAIC MOR4
4 safety relays expansion module connectable to M1. The relay outputs, via the MSD software, can be configured as: 4 single-channel outputs (safety Category 1 or 2) or 2 bi-channel outputs (safety Category 4).

New

MOSAIC MR2 – MR4
Safety relay expansion modules.
MR2 - 2 relays – 2 NO + 1 NC
MR4 - 4 relays – 4 NO + 2 NC

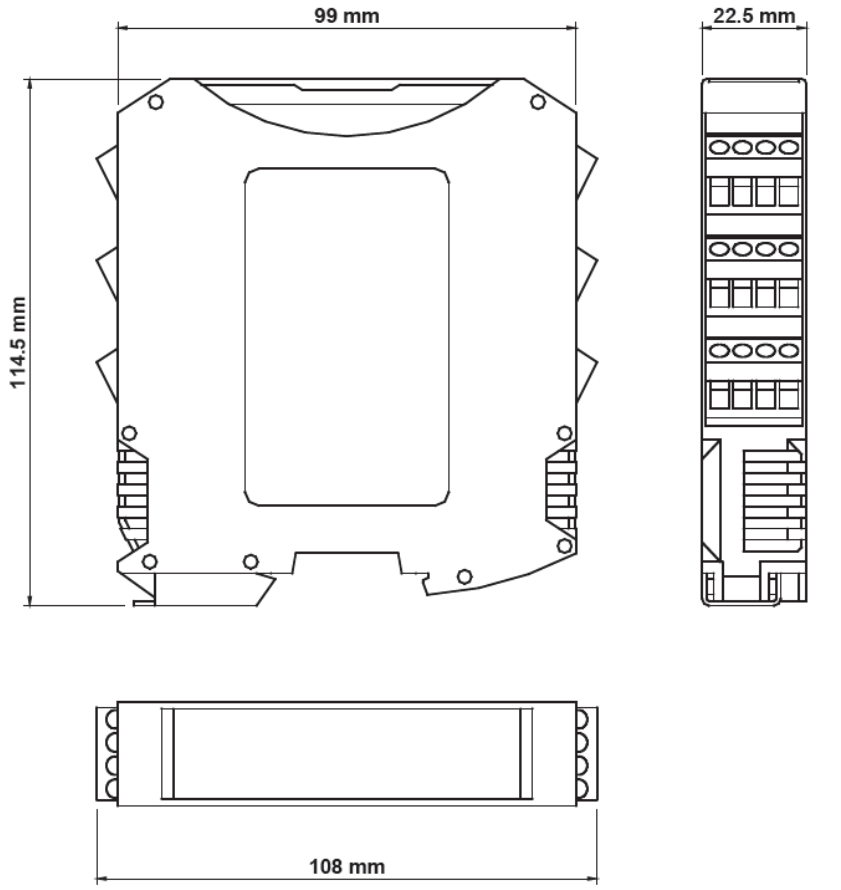
MOSAIC MV
Expansion module for safety speed control.
MV0 – Input for 1 or 2 NPN/NPN Proximity
MV1 - Input for 1 incremental encoder and 1 or 2 NPN/NPN Proximity
MV2 - Input for 2 incremental encoders and 1 or 2 NPN/NPN Proximity

New

Modules Dimension

Each single modules measures:

22,5 x 99 x 114.5 mm



Removable terminal blocks, screw contacts

Min and Max Expansion of the System

Minimum number of modules:

- **M1 used as stand-alone**
  1 module = **8 inputs**
  + **2 OSSD pairs**
  + **2 status outputs**

Max numbers of modules:

- **M1 + 14 expansions**
  15 modules = **128 inputs**
  + **16 OSSD pairs**
  + **32 status outputs**

(without MR2 e MR4 relay expansions)

Min and Max Expansion of the System

Roll Forming System Machinery

M1 Main Unit + 10 Expansion Module

M1 Main Unit stand alone

Marking /Cutting Laser System

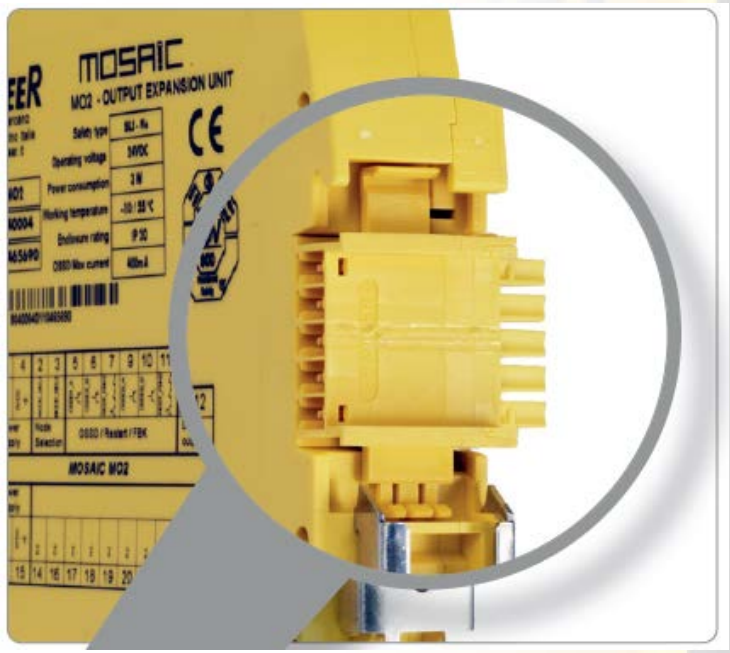
Mosaic Safety Communication

Mosaic MSC permits communication between the various units through a proprietary 5-way high-speed bus.

The MSC modular connectors can be used to connect the expansion units to M1 Master module.

The connectors are physically located on the back of each unit and are housed in the rail guide of the electrical Cabinet.

(except MR2 and MR4 safety relays units)

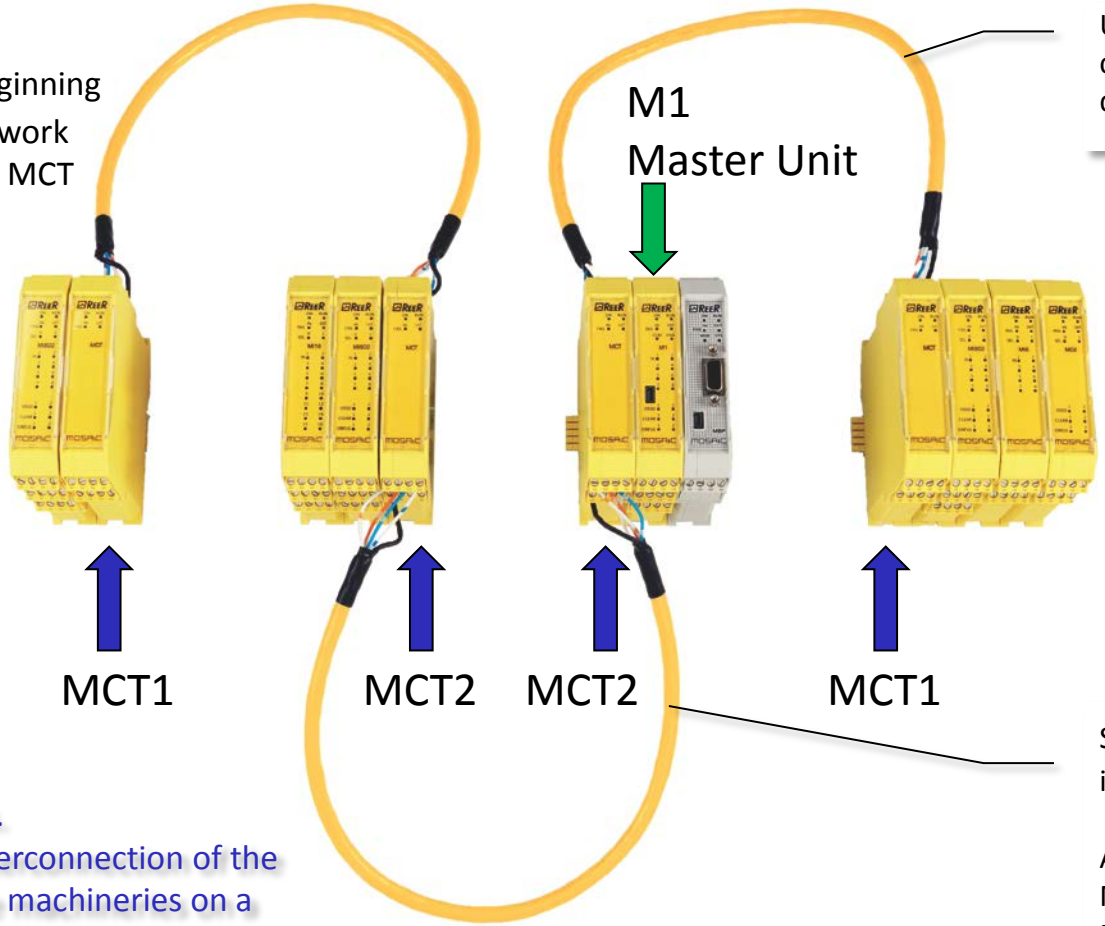


MCT - BUS expansion

Interface module allowing the connection of remote expansions via the MSC bus.

MCT1 - 1 connection (1 input or 1 output)*
MCT2 - 2 connections (1 input and 1 output)

* to be placed at the beginning or at the end of the network connected with a single MCT cable



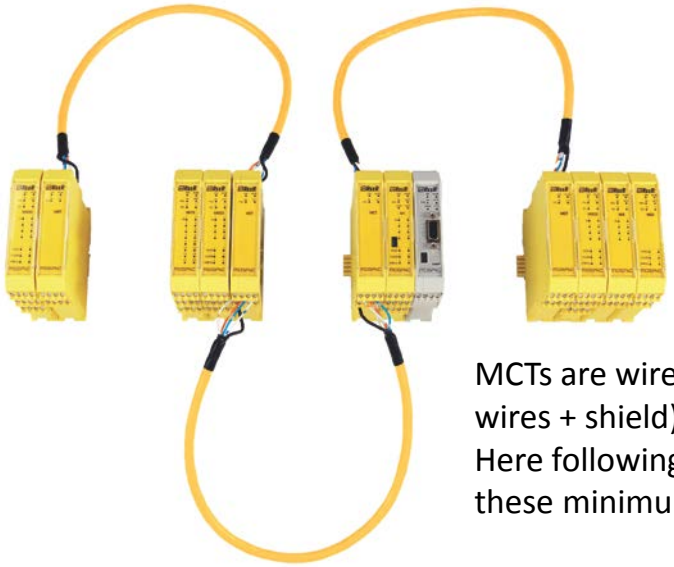
Up to 50 m for each connection (Total distance up to 250 m)

Specific RS485 serial interface shielded cable

Available Lengths:
MC25 - 25 m
MC50 - 50 m
MC100 - 100 m

Max. 5 MCT expansions.
Ideal solution for the interconnection of the safety functions of more machineries on a single production line.

MCT - BUS expansion



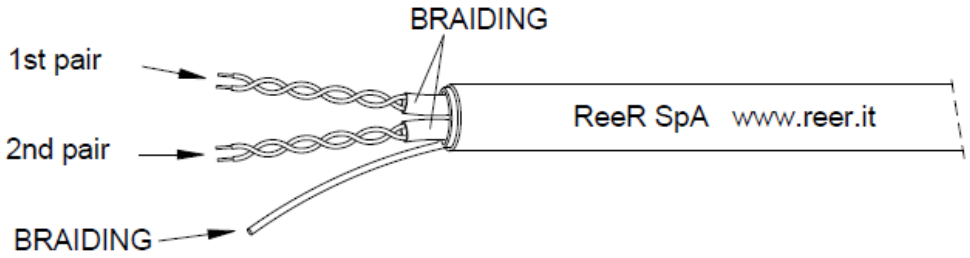
MCT1 and MCT2 are not counted as expansions

MCTs are wired using a shielded cable compatible with RS485 serial interface (4 wires + shield) via the connector block.
Here following the specification of our cable. In case of use of a different cable these minimum characteristics must be fulfilled.

Cable technical data

ELEMENT	DESCRIPTION/VALUE
CONDUCTORS	2 pairs of twistate conductors with braiding
NOMINAL IMPEDANCE	120 Ω
NOMINAL CAPACITANCE	< 42pF/m
NOMINAL RESISTANCE	< 95 mΩ/m

It is strongly recommended to use our custom cables MC25, MC50 and MC100



Mosaic Configuration Memory

Mosaic MCM is a proprietary removable memory card that can be used to save Mosaic configuration data and transfer it to a new device without using a PC.

The configuration in the MCM overwrites the configuration preset on M1.
This function can be disabled on M1 via the MSD (Mosaic Safety Designer) configuration software.

Overwrite operations are recorded in chronological order in the MOSAIC M1 LOG file.

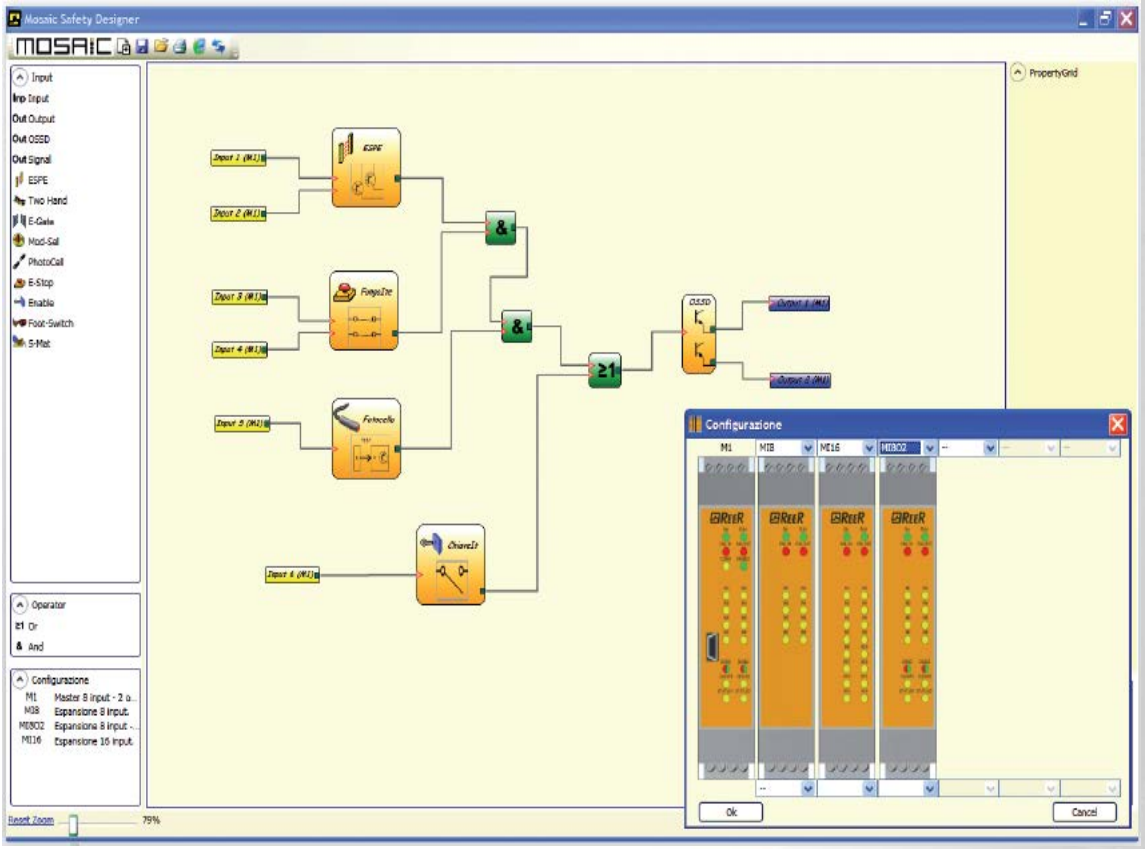
MCM is an accessory and can be ordered separately

MOSAIC M1 rear view

Mosaic Safety Designer

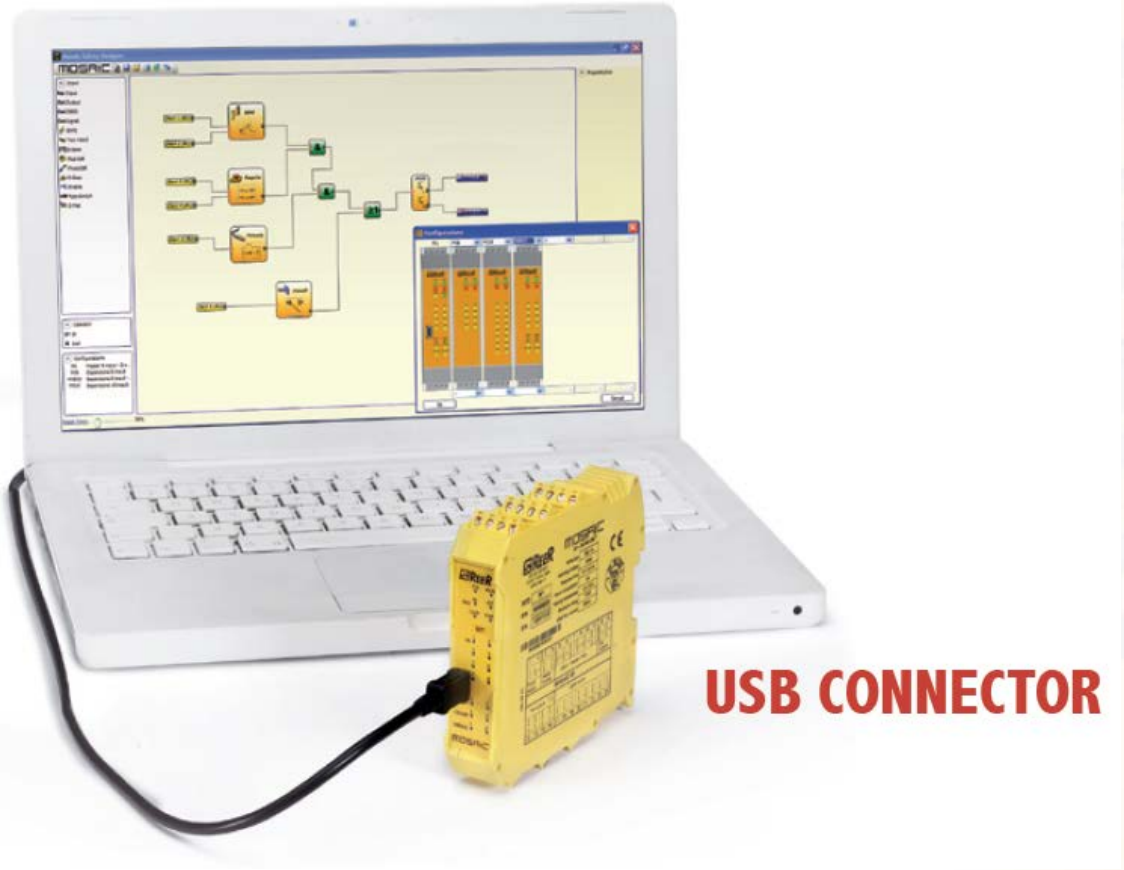
Mosaic Safety Designer - MSD

- is the MOSAIC configuration software
- is an user-friendly configuration tool thanks to its graphic interface
- is included in each M1 box – with no extra fees.



Software Configuration

MSD – Configuration software



Mosaic master M1 has a 2.0 USB port for the connection to a Personal Computer where the MSD (Mosaic Safety Designer) configuration software is installed.

PASSWORD

Level 1 Password

- Alphanumerical max 8 characters. This is a maintenance password which allows only to view the LOG file, the system set up and the use of the real time monitoring.
- The knowledge of this password does not enable the operator to perform the download of a new project or the upload of a preloaded one.

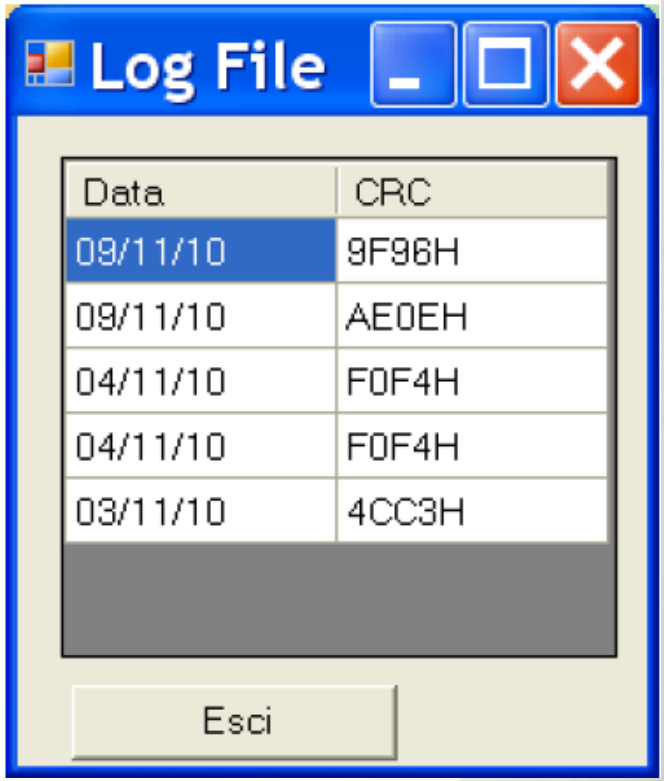
Level 2 Password

- Alphanumerical max 8 characters.
  This is the designer password.
  It allows to load, modify, save and upload (from PC to Mosaic) a project configuration.
- **The upload from Mosaic to a PC of a preloaded project is now possible**.

Log File

A Log File with date of creation of the project and related checksum (CRC 4-digit hexadecimal identification) is stored in the M1.

The Log File can be visualized using the icon in the tool bar (Level 1 Password).



MSD Project Report

ReeR S.p.A.

Project Report generated by Mosaic Safety Designer version 1.1.9

Project Name: Project User:
Name Company: Company
Date: 16/11/2011 18.22.09
Schematic CRC: 9CEFH

Mosaic: Configuration
Module M1 (Configured Firmware version: >= 0.4)
Module MO2 Node 0

Mosaic: Project Safety Information's

PFHd (according to IEC 61508): 9,22E-009 (1/h)
MTTFd (according to EN ISO 13849-1): 100 years
DCavg (according to EN ISO 13849-1): 97.61 %

Resources used

INPUT: 38% (3/8)

Timing: 0% (0/8) Counters: 0% (0/8)
DFF: 0% (0/8) Restart: 0% (0/8)
MUTING: 0% (0/4)
Total number blocks: 22% (7/32)

OSSD: 75% (3/4) STATUS: 75% (3/4)

Electrical diagram

Sensor (E-GATE 01)
Functional Block 1
Filter (ms): 3 Reset Type: Automatic
StartUp Test: False In1 -> Test1
DC = 90% (according to EN ISO 13849-1)
Connections: M1 INPUT1/Terminal17

Mosaic Safety Designer

MONITOR I/O

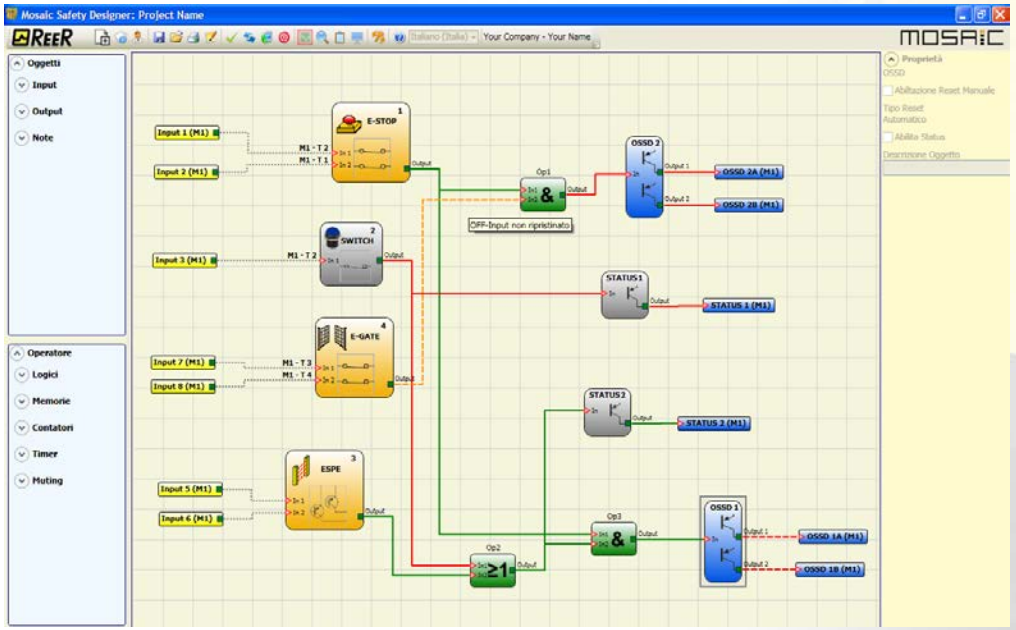
The I/O MONITOR allows the real-time monitoring of all the I/Os of a Mosaic system and the diagnostic information about a working system.

Monitor

Modulo	blocco	Tipo	INPUT	Stato	Diagnostica ingressi	Modulo	OSSD	Stato	Diagnostica OSSD	Modulo	Status	Stato	OutTest	Diagnostica OutTest
M1	1	E-Stop	IN1	ON		M1	OSSD1	ON		M1	STATUS1	OFF	M1 T1	
			IN2			M1	OSSD2	OFF		M1	STATUS2	ON	M1 T2	
M1	2	Switch	IN3	OFF									M1 T3	
			X										M1 T4	
M1	3	ESPE	IN5	ON										
			IN6											
M1	4	E-Gate	IN7	OFF										
			IN8											

TEXT VISUALIZATION

GRAPHIC VISUALIZATION

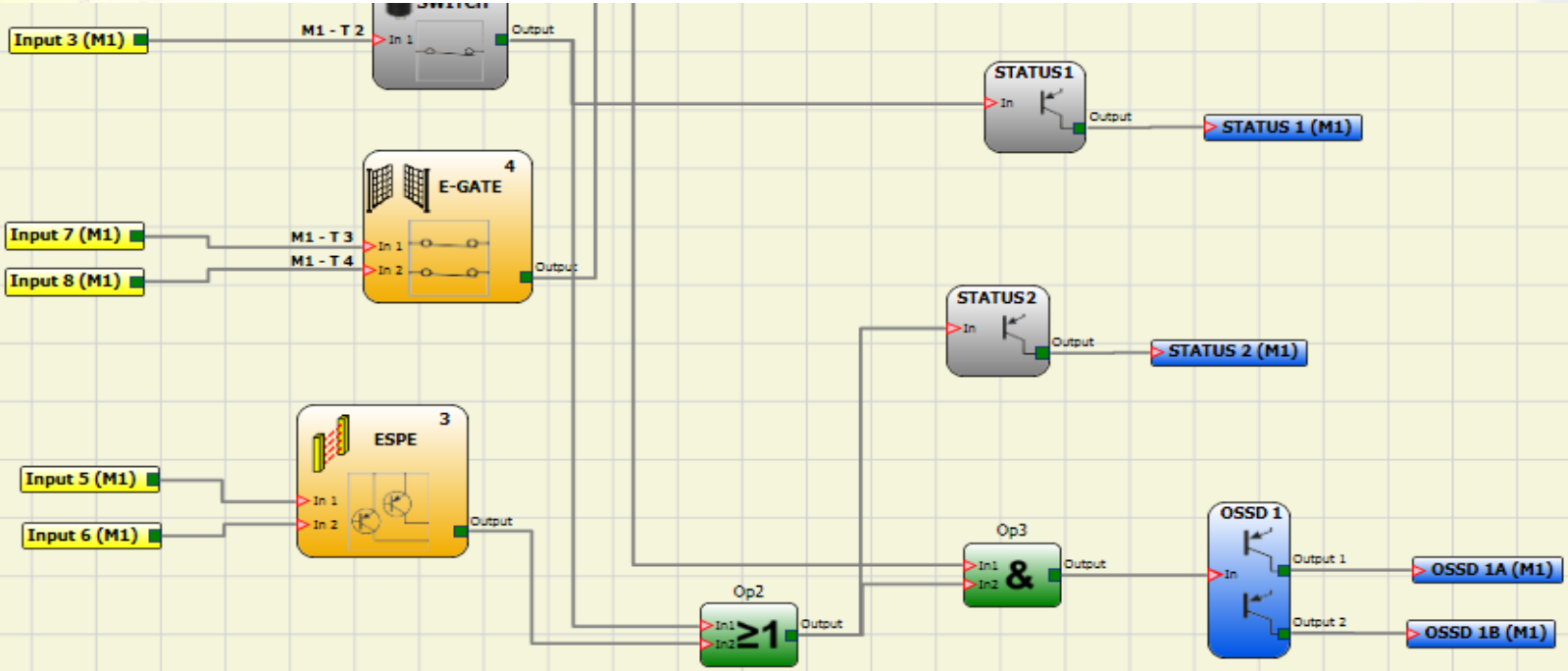


REER

Mosaic Safety Designer

TEXT VISUALIZATION

MONITOR I/O



Monitor

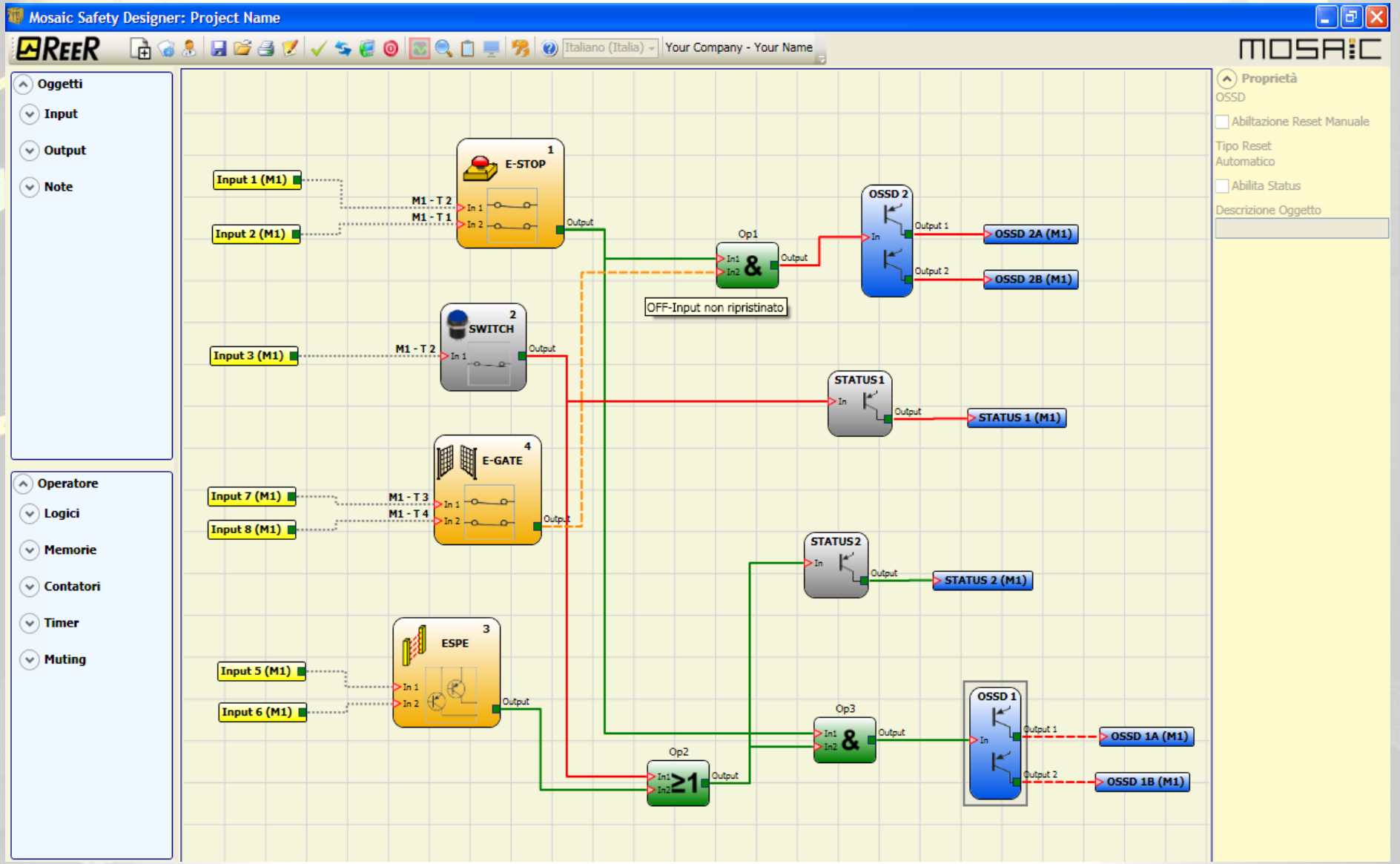
Modulo	blocco	Tipo	INPUT	Stato	Diagnostica ingressi	Modulo	OSSD	Stato	Diagnostica OSSD	Modulo	Status	Stato	OutTest	Diagnostica OutTest
M1	1	E-Stop	IN1	ON		M1	OSSD1	ON		M1	STATUS1	OFF	M1 T1	
			IN2			M1	OSSD2	OFF		M1	STATUS2	ON	M1 T2	
M1	2	Switch	IN3	OFF									M1 T3	
			X										M1 T4	
M1	3	ESPE	IN5	ON										
			IN6											
M1	4	E-Gate	IN7	OFF										
			IN8											

REER

Mosaic Safety Designer

GRAPHIC VISUALIZATION

MONITOR I/O



Advantages of Mosaic solution

Compared to the safety circuitries made by “traditional” electromechanical safety relays, Mosaic has many remarkable advantages such as:

- **Reduces the number of devices** and wires and, therefore, the overall size;
- **Speeds up** the control panel **construction**;
- Provides the logic configuration through a **quick and simple SW programming.** Machine designers are always able to easily change the logic of the configuration;
- Makes it **easy to add or remove safety function blocks** at any stage of the machine designing.

Advantages of Mosaic solution

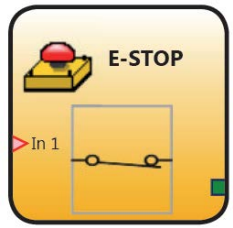
- Is able to check the logic configuration of the application during the designing phase through the **VALIDATION** function as well as to test it during the installation through the **MONITOR** function.
- Allows **tamper-proof system** configurations as:
  - ✓ detection of any attempts of by-passing the safety devices, always possible with traditional safety relays, through specific tests (i.e. **mandatory test of the safety device** at the machine start-up)
  - ✓ **Protection against unauthorized changes** to the project through a 2-level password

Advantages of Mosaic solution

- The logic is made through a graphic interface. **No more laborious wirings are needed** as they are with traditional solution when it is necessary to wiring the outputs of the safety relays.
- A lower number of electromechanical components also means a better Performance Level and, therefore, a **higher Safety Level.**
- The project report provides the actual values of **PFH, DCavg and MTTFd** according to EN 13849-1 and EN 62061.

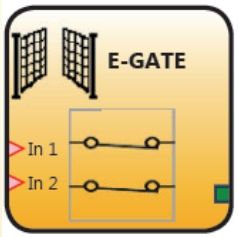
MSD – Configuration Software

FUNCTION BLOCKS – INPUT OBJECTS



E STOP (emergency stop)

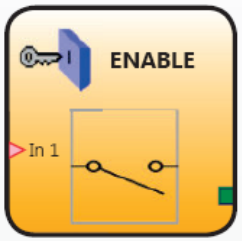
Verifies an emergency stop device inputs status. If the emergency stop button has been pressed (contacts open) the output is 0.
If not the output is 1.



E-GATE (safety gate device)

Verifies a mobile guard or safety gate device input status.

If the mobile guard or safety gate is open, the output is 0. Otherwise the output is 1.



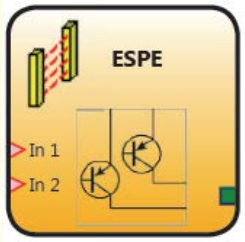
ENABLE (enable key)

Verifies a manual key device Input status.

If the key is not turned the output is 0. Otherwise the output is 1.

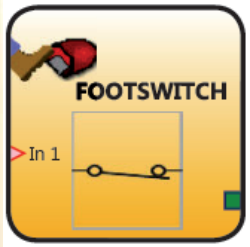
MSD – Configuration Software

FUNCTION BLOCKS - INPUT OBJECTS



ESPE (optoelectronic safety light curtain / laser scanner)

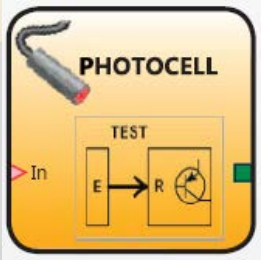
Verifies an optoelectronic safety light curtain (or laser scanner) inputs state. If the area protected by the light curtain is occupied (light curtain outputs at LOW level) the output is 0.
Otherwise, with the area clear and outputs to 1 the output of this function block is 1.



FOOTSWITCH (safety pedal)

Verifies the status of the inputs of a safety pedal device. If the pedal is not pressed the output is 0.

Otherwise the output is 1.



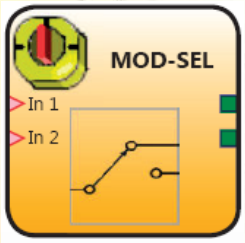
PHOTOCELL (safety photocell)

Verifies the status of the inputs of an optoelectronic safety photocell. If the beam of the photocell is occupied (photocell output FALSE) the output is 0. Otherwise with the beam clear the output is 1.

Test outputs must be used.

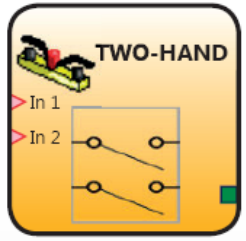
MSD – Configuration Software

FUNCTION BLOCKS – INPUT OBJECTS



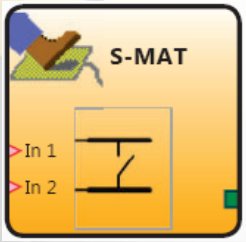
MOD-SEL (safety selector)

Verifies the status of the inputs from a mode selector (up to 4 inputs): if only one input is 1 the corresponding output is also 1. In all other cases, and thus when all inputs are 0 or more than one input is 1 all the outputs are 0.



TWO-HAND (bi-manual control)

Verifies the status of the inputs of a two hand control switch. Only if both the press-buttons are pressed within 500 ms the output is 1. Otherwise the output is 0.



S-MAT (safety mat or safety edge)

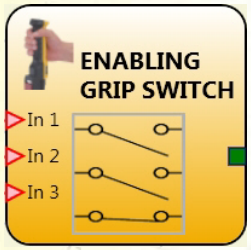
verifies the status of the inputs of a safety mat. If a person stands on the mat the output is 0. Otherwise, with the mat clear, the output is 1.

Test outputs must be used.

Can't be used with 2-wire mats and termination resistance mats.

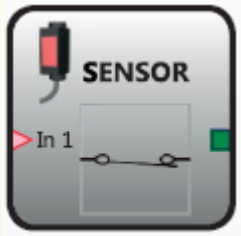
MSD – Configuration Software

FUNCTION BLOCKS – INPUT OBJECTS



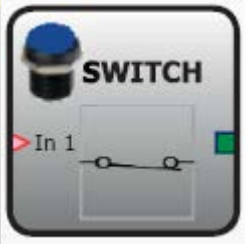
ENABLE GRIP SWITCH

Verifies the status of the inputs of a enable grip switch. If the enable grip switch is completely pressed or completely released the output is 1. Otherwise the output is 0



SENSOR

Verifies the status of the input of a sensor (not a safety sensor). If the beam of the sensor is occupied (sensor output FALSE) the output is 0. Otherwise, with the beam clear the output is 1.



SWITCH

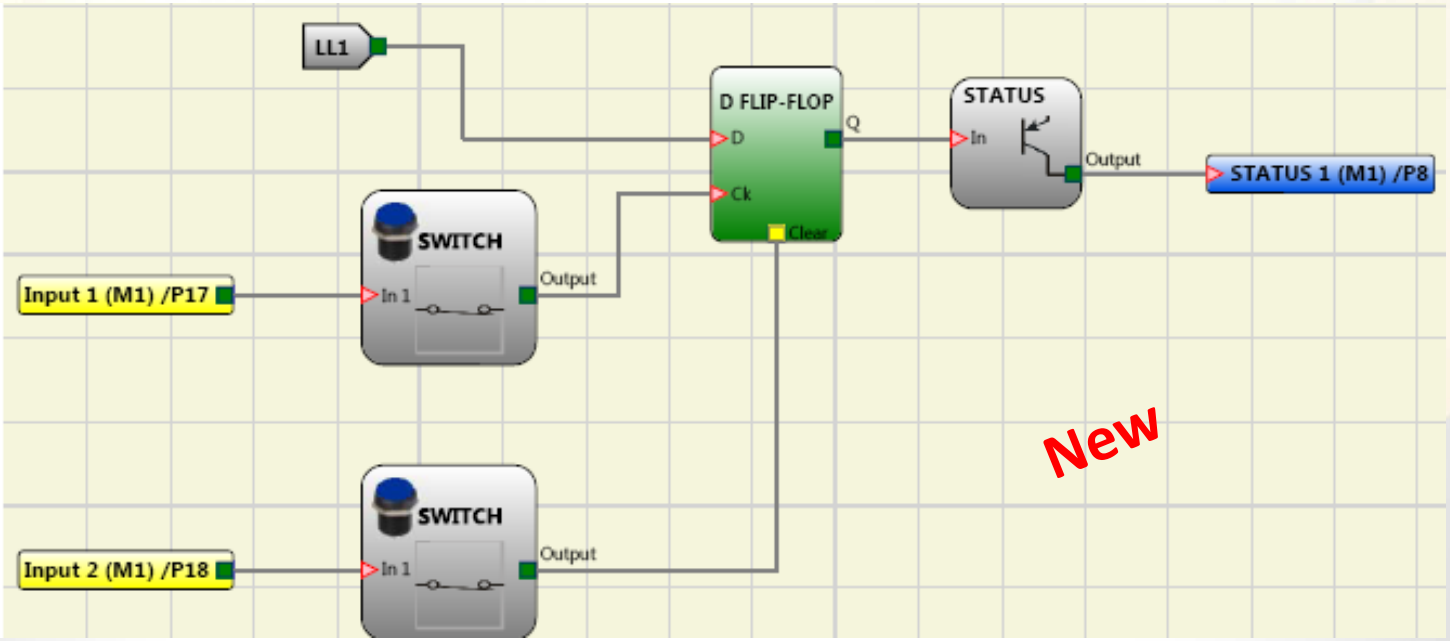
Verifies the input status of a pushbutton or switch (NOT SAFETY SWITCHES). If the pushbutton is pressed the output is 1.
Otherwise, the output is 0.

MSD – Configuration Software

FUNCTION BLOCKS – INPUT OBJECTS

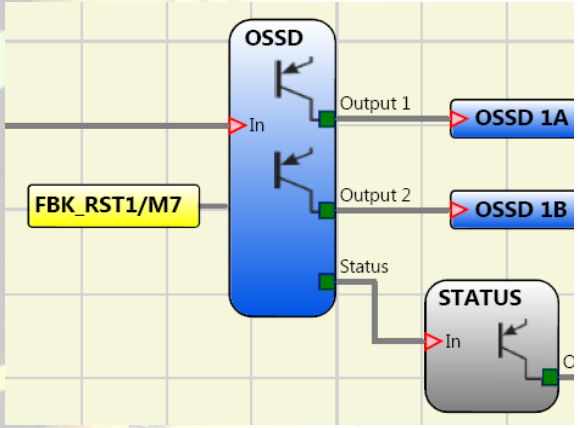
INPUT FIXED TO LOGIC LEVEL 0 (LOW)

INPUT FIXED TO LOGIC LEVEL 1 (HIGH)



MSD – Configuration Software

FUNCTION BLOCKS - OUTPUT OBJECTS

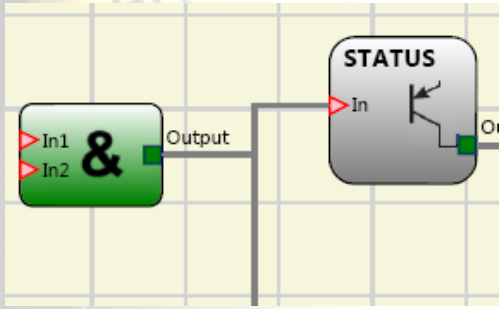


OSSD (safety outputs)

PNP safety static outputs.
The 2 outputs cannot operate independently.

Each OSSD pair can work in both AUTO/Manual restart mode and can perform the EDM of external relays using the dedicated RESTART_FBK input.

Each OSSD pair can be set for giving information about the output status.



STATUS (signal output)

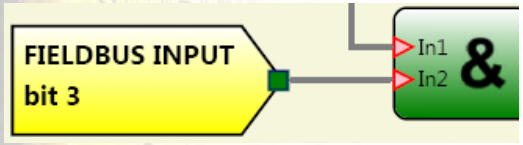
It is possible to monitor any point on the diagram by connecting it to the input of this block. The output returns 24Vdc if the input is 1 or 0Vdc if the input is 0.

(STATUS is not a safety output)

It is possible to connect the Status to the OSSD status signal to have a signal output of the REAL OSSD output status, including the restart signal effect.

MSD – Configuration Software

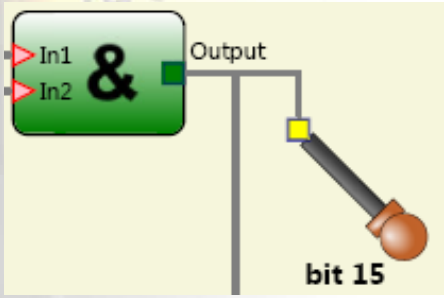
FUNCTION BLOCKS
FIELDBUS INPUT / OUTPUT



FIELDBUS INPUT

It allows to receive signals (up to 8 bits) from the machine control unit via the field-bus module.

The signal is connected directly into the diagrams without using any input block.



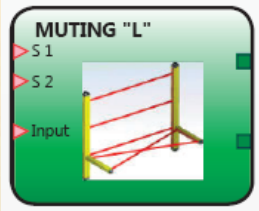
FIELDBUS PROBE OUTPUT

It allows to send signals (up to 16 bits) to the machine control unit via the field-bus module.

The signal is connected directly into the diagrams without using any output block.

MSD – Configuration Software

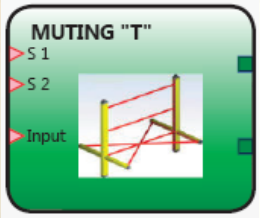
FUNCTION BLOCKS - MUTING OPERATORS



MUTING “L” with 2 Muting sensors – only for one-way openings

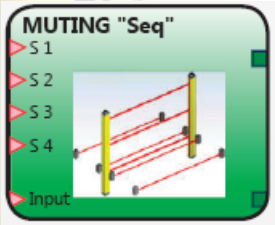
The MUTING operator with “L” logic performs muting of the input signal through sensor inputs S1 and S2.

Muting closes when the input signal rises.



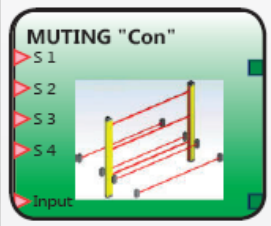
MUTING “T” with 2 Muting sensors for two-way openings

The MUTING operator with “T” logic performs muting of the input signal through sensor inputs S1 and S2.



MUTING ”T” “Sequential” with 4 Muting sensors for two-way openings

The MUTING operator with "Sequential" logic performs muting of the input signal through sensor inputs S1, S2, S3 and S4.

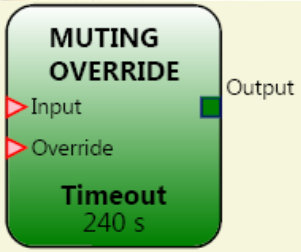


MUTING “T” “Concurrent” with 4 Muting sensors for two-way openings

The MUTING operator with "Concurrent" logic performs muting of the input signal through sensor inputs S1, S2, S3 and S4.

MSD – Configuration Software

FUNCTION BLOCKS – MUTING OVERRIDE



MUTING OVERRIDE

OVERRIDE function is necessary when the machine stops with the material still in the guarded gate, due to some wrong muting sequence.

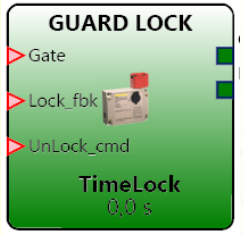
OVERRIDE command forces the output high allowing to remove the material obstructing the gate.

Two different ways of operation are available:

1. Manual action with hold to run
2. Automatic with pulse command

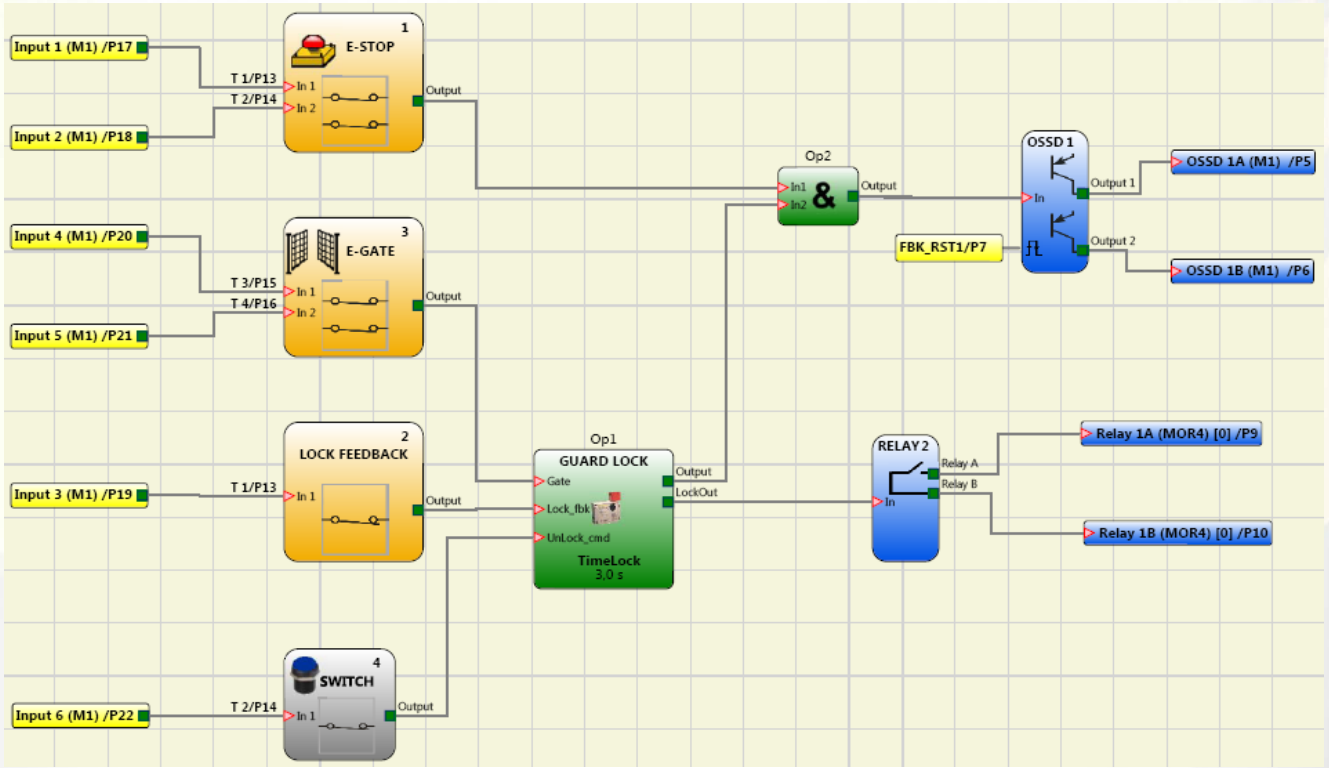
MSD – Configuration Software

FUNCTION BLOCK – GUARD LOCK



GUARD LOCK allows the use with different types of locks.

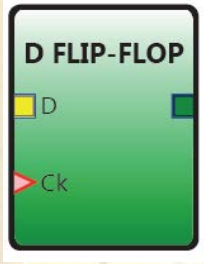
NEW



MSD – Configuration Software

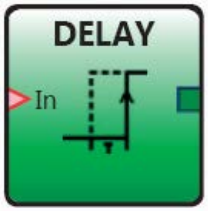
FUNCTION BLOCKS - MEMORY OPERATORS

Are used if you decide to save any data (TRUE or FALSE) from other project components.

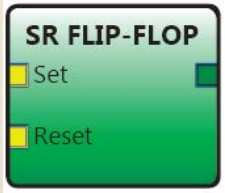


D FLIP FLOP

COUNTER

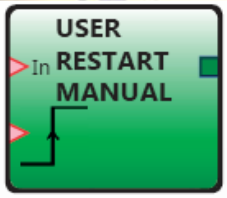


DELAY

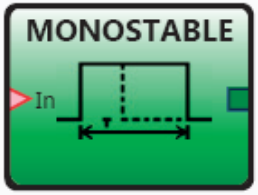


SR FLIP FLOP

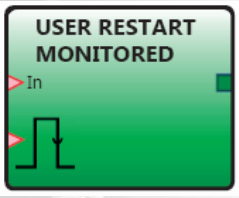
CLOCKING



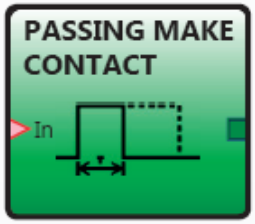
MANUAL RESTART



MONOSTABILE



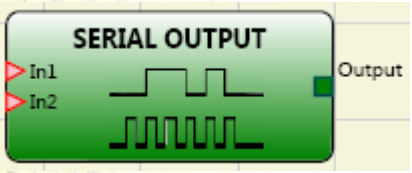
MONITORED RESTART



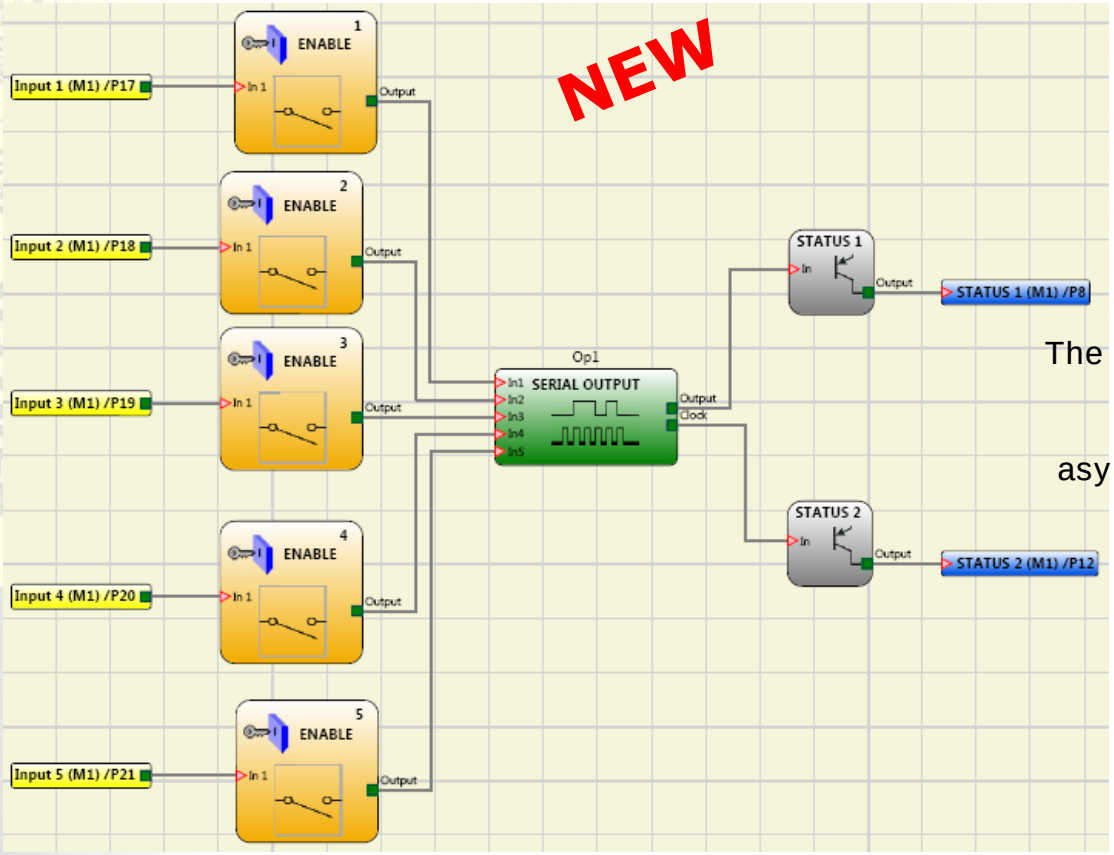
PASSING MAKE CONTACT

MSD – Configuration Software

FUNCTION BLOCK – SERIAL OUTPUT



Returns as output the status of max 8 inputs through a simulated serial line. Max number of serial output blocks: 4.



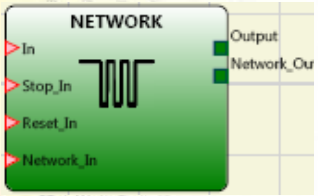
The serial output can be synchronous (1 clock + 1 data output)
or
asynchronous (1 Manchester coding data output)

REER

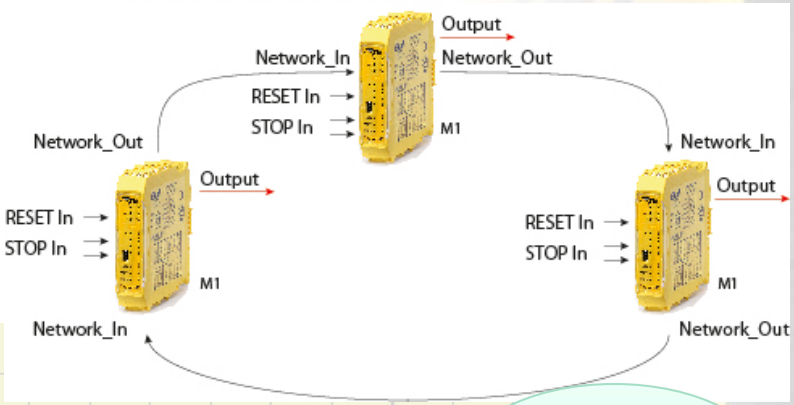
Mosaic Safety Designer

MSD – Configuration Software

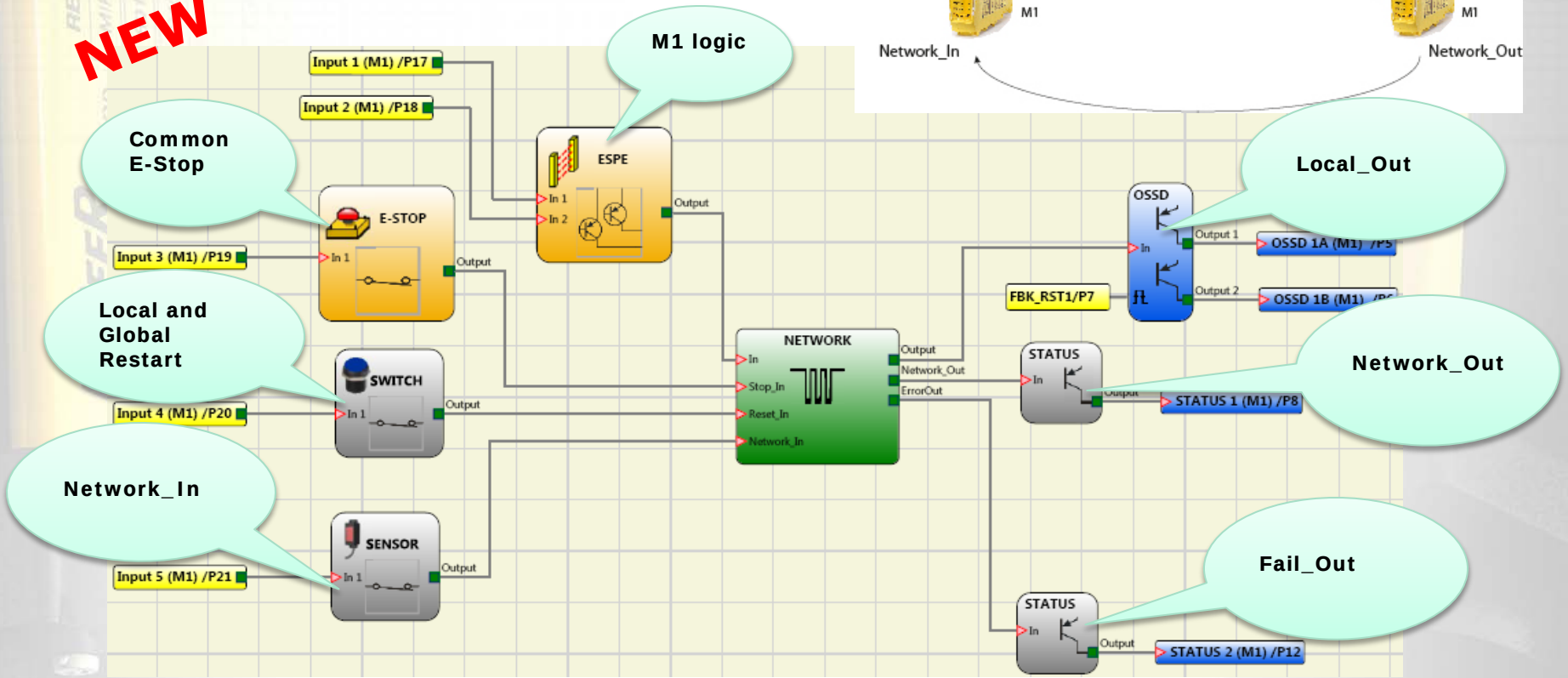
FUNCTION BLOCK – NETWORK



Is a serial connection (Loop) of several Masters (M1) with different and independent logics linked through a common E-Stop

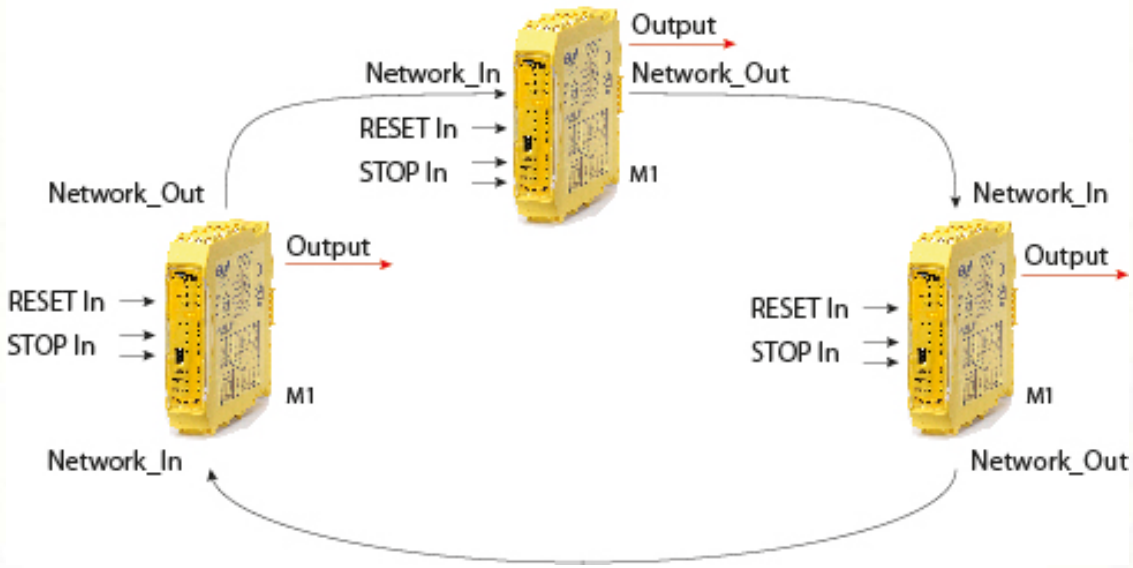


NEW



MSD – Configuration Software

FUNCTION BLOCK – NETWORK



- Each E-Stop halts the whole Network
- The Network can be restarted from any point of the loop
- The machine where the fault has occurred must be locally restarted
- It is possible to set up through the MSD which machines, besides the one that has generated the fault, must be always locally restarted (i.e. when the machine is not clearly visible from other points of the network).

MOSAIC MOR4

Intelligent Expansion units with 4 internal safety relay outputs

NEW

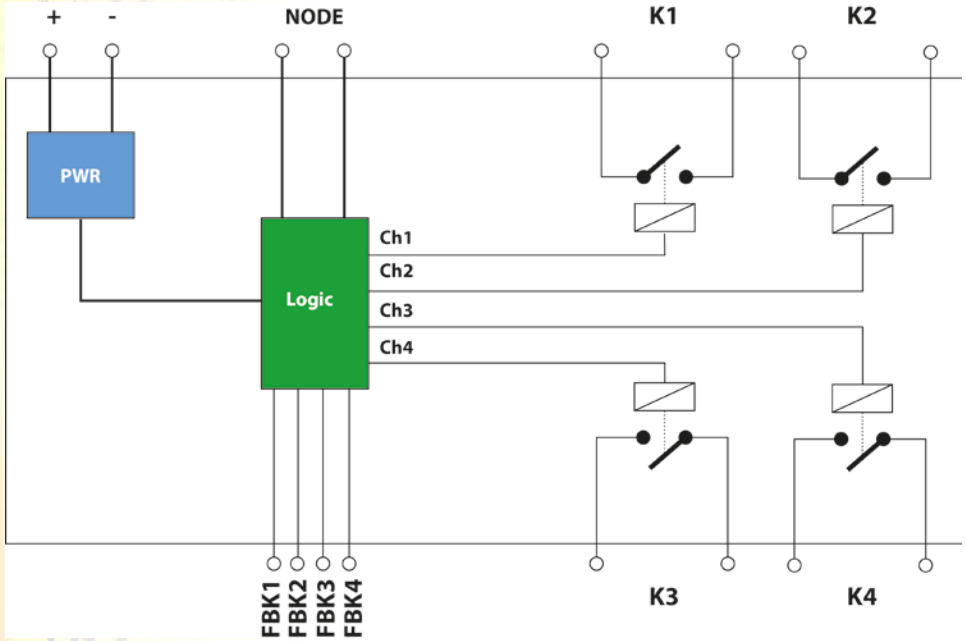
- Connectable to M1 through MSC Bus
- 4 internal safety relays with NO contacts 6A 250 Vac
- It is possible to select via MSD 2 different configurations:
  - 4 independent single channel outputs
  - 2 dual channel outputs
- 4 external contactors feedback
- Single channel LED signaling

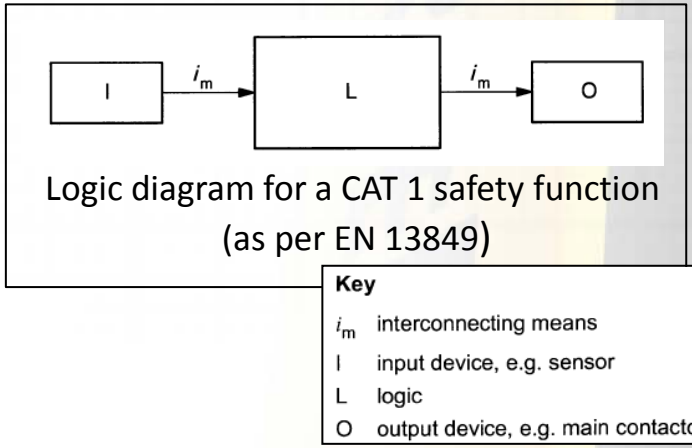
two versions available

MOR4	4 relay outputs + 4 feedback inputs
MOR4 S8	4 relay outputs + 4 feedback inputs + 8 status outputs

MOR4 Configuration

4 indipendent channels – Safety category 1





Logic diagram for a CAT 1 safety function (as per EN 13849)

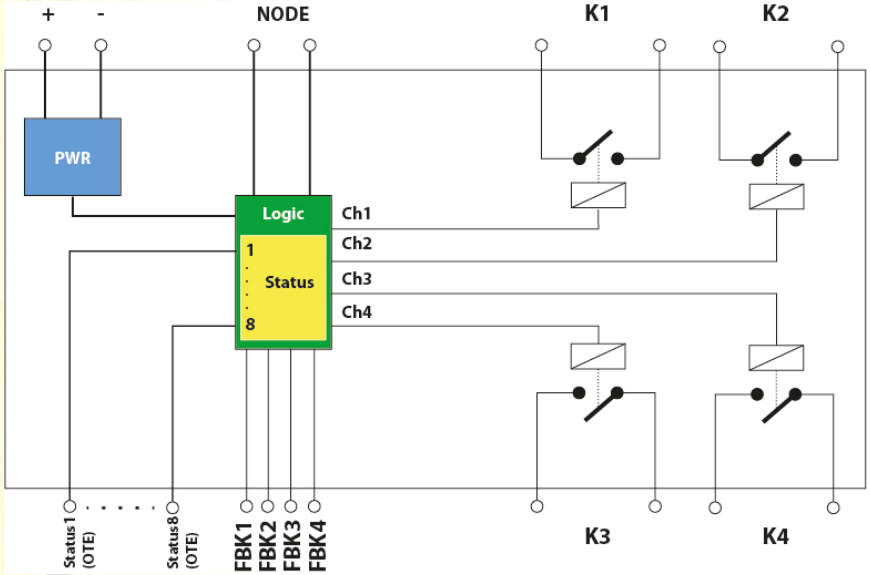
Key

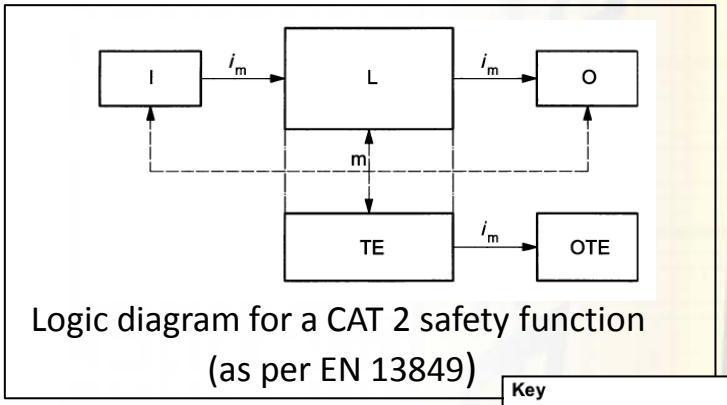
i_m	interconnecting means
I	input device, e.g. sensor
L	logic
O	output device, e.g. main contactor

- Internal relays are monitored
- EDM (check of FBK 1-4) not used (not requested for CAT1)
- Each output can be set as AUTO/MANUAL RESTART

MOR4 Configuration

4 independent channels – Safety category 2





Logic diagram for a CAT 2 safety function (as per EN 13849)

Key

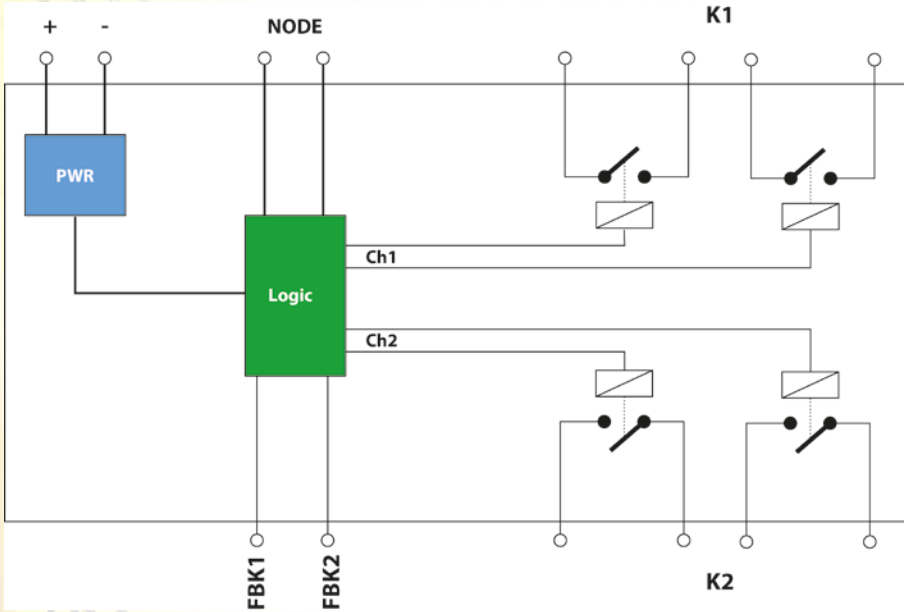
i_m	interconnecting means
I	input device, e.g. sensor
L	logic
m	monitoring
O	output device, e.g. main contactor
TE	test equipment
OTE	output of TE

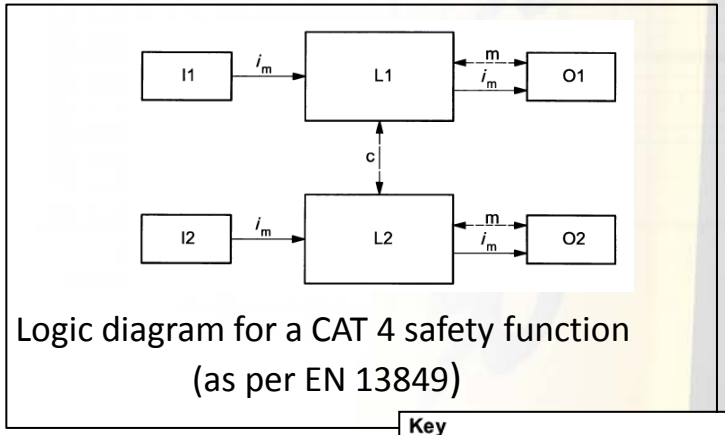
- In this configuration the OTE output is enabled (Output Test Equipment), mandatory for signaling dangerous faults as per the requirement of EN 13849 for CAT2.
- Internal relays are monitored
- EDM can be selected using the MSD software:
  - If EDM is NOT selected, the related output can be set as AUTO/MANUAL RESTART.
    This configuration is possible ONLY if the internal relay directly interrupt the load without any external devices.
  - If EDM is selected, the related output can be set only as AUTOMATIC. Anyway the MANUAL RESTART can be obtained using logical operator and an extra input.

OTE: Normally ON. In case of fault of internal feedback or EDM => OFF. This permits to inform the machine logic, with the scope of stopping the dangerous movement or at least signaling the fault to the user. OTE output is a logical signal and can be sent to a logical block inside the MSD as well as to a STATUS output.

MOR4 Configuration

2 independent double channels – Safety category 4





Logic diagram for a CAT 4 safety function (as per EN 13849)

Key	
i_m	interconnecting means
c	cross monitoring
I1, I2	input device, e.g. sensor
L1, L2	logic
m	monitoring
O1, O2	output device, e.g. main contactor

- Internal relays are monitored
- Each output can be set as AUTOMATIC only. The MANUAL RESTART can be obtained using logical operator and an extra input.
- Any logic output OTE (not required) is used only for the error message (must be OFF).

The combination of Category plus DCavg adopted is shown in one of the seven columns of fig. 5 of ISO 13849-1. Calculated $MTTF_d$ determines which part of the column has to be considered. Corresponding PL is shown on the left of the table.

Getting the CAT. 2 configuration permits to step into the PL d !

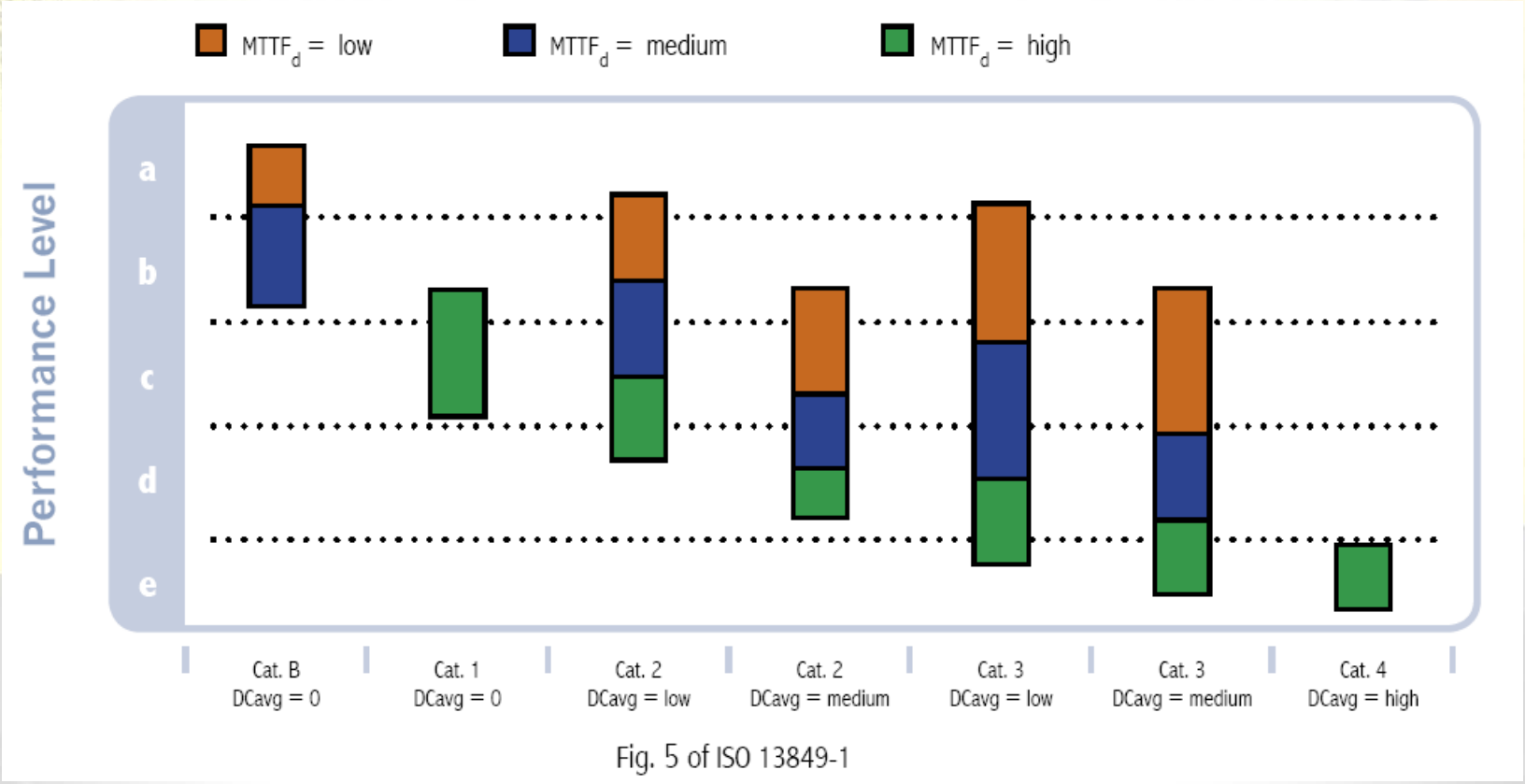


Fig. 5 of ISO 13849-1

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MOSAIC

Safety speed monitoring

MOSAIC MV

Expansion module for safety speed monitoring

- Safety speed monitoring (up to PLe) for:
  - ✓ zero speed control,
  - ✓ max speed,
  - ✓ speed range and direction
- Up to 4 logically selectable speed thresholds (freely configurable via MSD) for each logical output (axis)
- Each module includes two logical outputs configurable via MSD and is therefore able to control up to two independent axes
- RJ-45 (1 for MV1, 2 for MV2) connectors for encoders and terminal blocks for proximity switches
- Max input frequency (encoders): 500 KHz (300 KHz for HTL)
- Max input frequency (proximity): 5 KHz

New

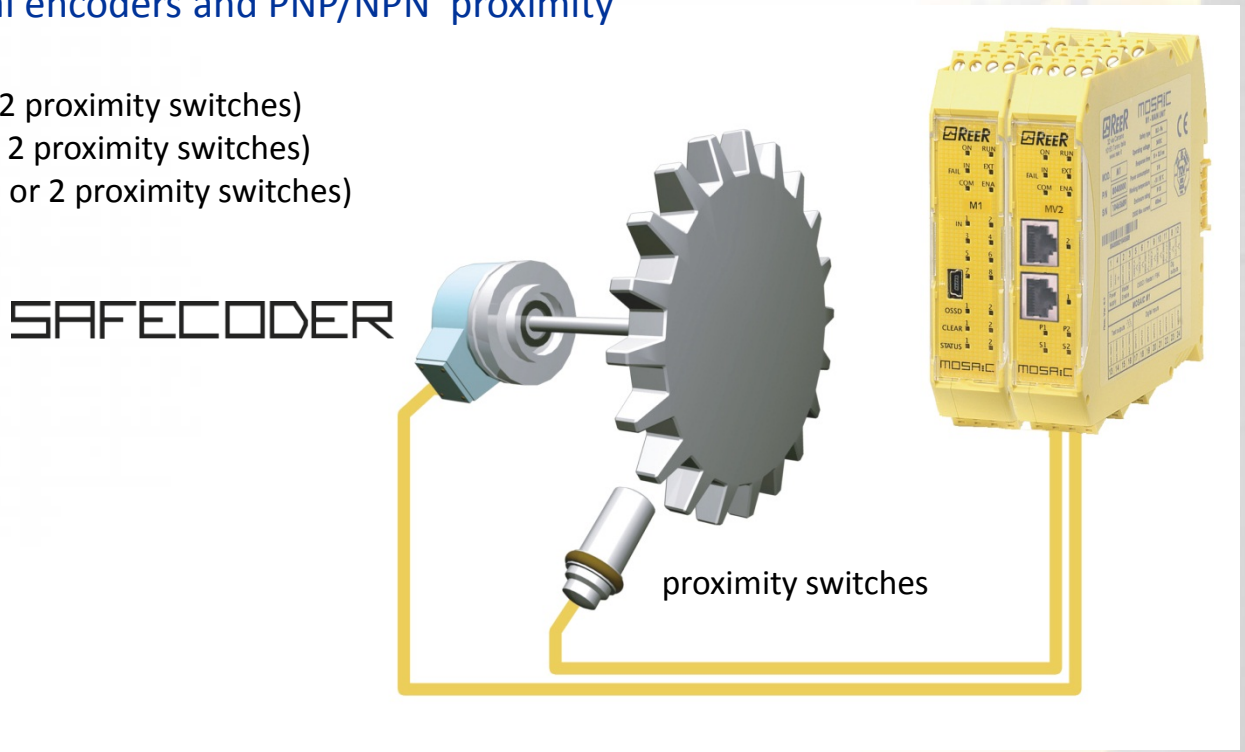
MOSAIC MV

MV0 - Input for PNP/NPN proximity switches

(1 or 2 proximity switches)

MV1 - Input for incremental encoders and PNP/NPN proximity switches

- MV1T (1 TTL encoder + 1 or 2 proximity switches)
- MV1H (1 HTL encoder + 1 or 2 proximity switches)
- MV1S (1 sin/cos encoder + 1 or 2 proximity switches)



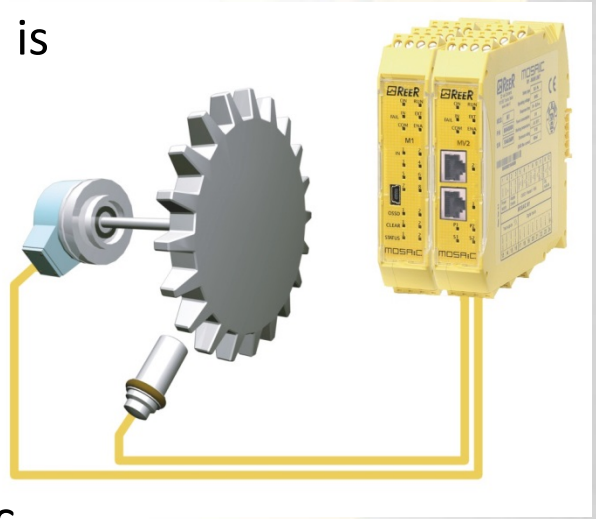
MV2 - Input for incremental encoders and PNP/NPN proximity switches

- MV2T (1 or 2 TTL encoders + 1 or 2 proximity switches)
- MV2H (1 or 2 HTL encoders + 1 or 2 proximity switches)
- MV2S (1 or 2 sin/cos encoders + 1 or 2 proximity switches)

SOME EXAMPLES

Zero speed control: verifies that the dangerous device is actually standstill so that gates can be unlock to permit safe access of the operator to the hazardous area.

Maximum speed control: verifies that the safety speed is not exceeded. This allows to safely work during maintenance or system adjustment procedures.



Prevention of damage to parts of the machine due to excessive speed during the working process.

Combination of max speed and zero speed in automatic machines, when different speeds are necessary for the processing of different materials with different tools.

MSD – Configuration Software

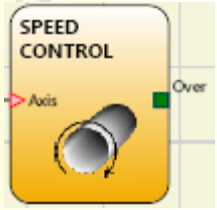
FUNCTION BLOCKS – SPEED CONTROL

STAND STILL

Verifies the speed of a device generating an output 1 (TRUE) when the speed is 0.
If the speed is different from 0 generates an output 0 (FALSE).

STAND STILL AND SPEED CONTROL

Verifies the speed of a device generating an output 1 (TRUE) when the speed is 0.
If the speed is different from 0 generates an output 0 (FALSE).
Moreover, this block verifies the speed of a device generating an output Over = 0 (FALSE) when the speed is over a defined threshold.



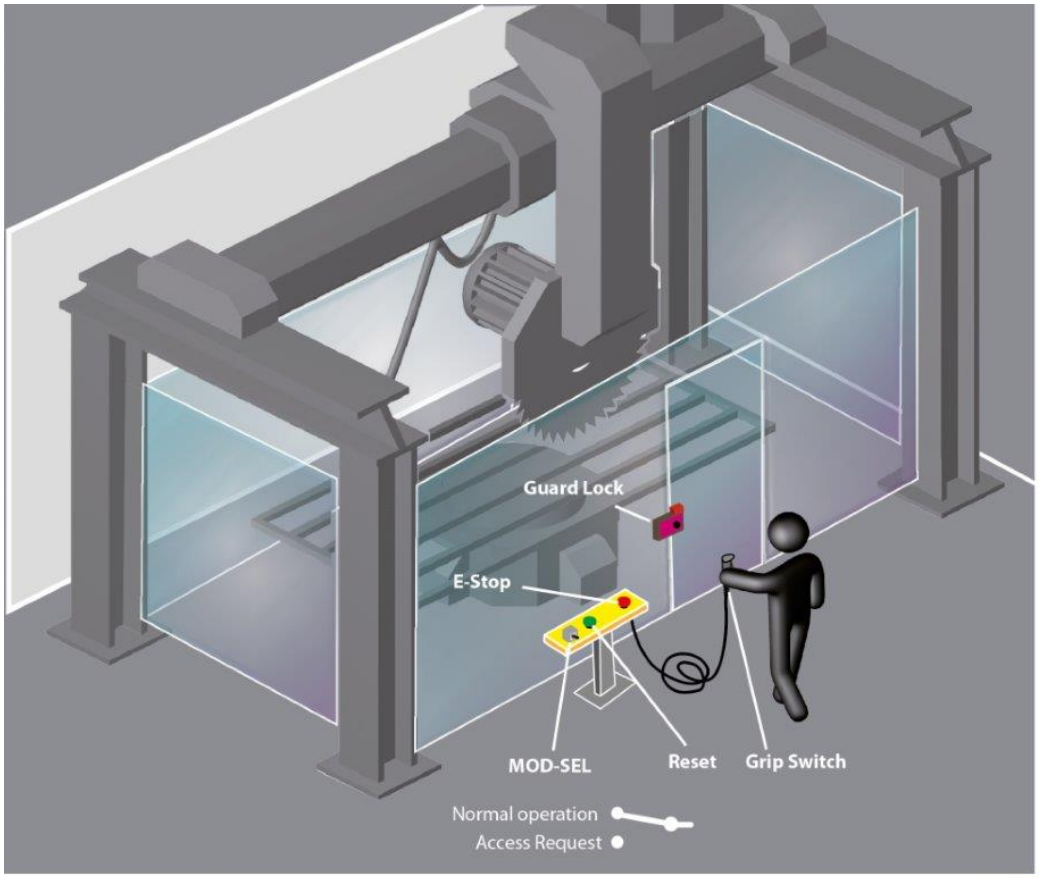
SPEED CONTROL

Verifies the speed of a device generating an output Over = 0 (FALSE) when the speed is over a defined threshold.

WINDOW SPEED CONTROL

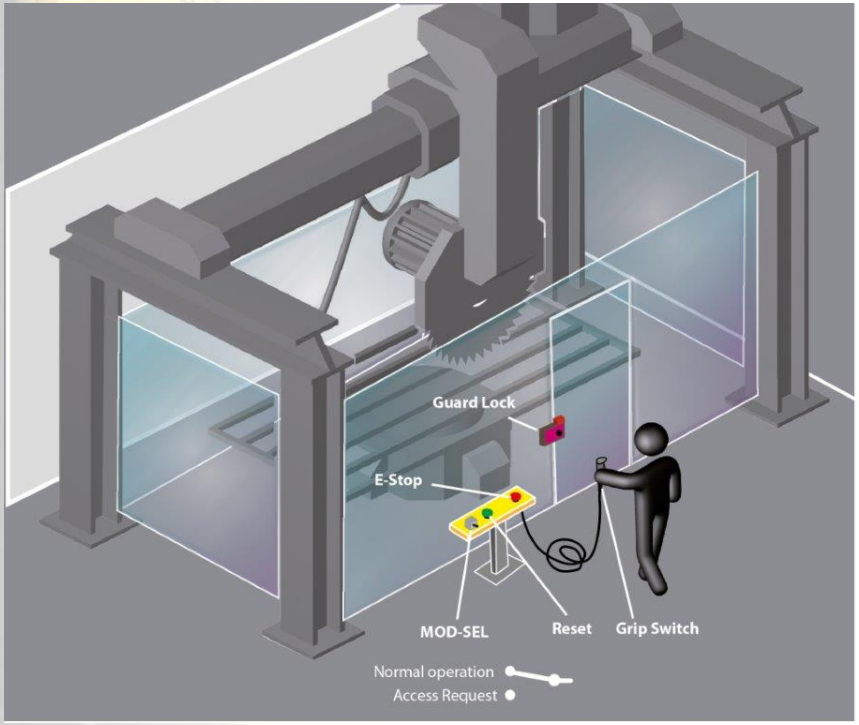
Verifies the speed of a device generating an output 1 (TRUE) when the speed is within a defined threshold.

SPEED CONTROL - EXAMPLE



In this example the positioning of the workpiece is allowed only when the tool is completely stopped.
As long as the tool is working at the normal speed the GUARD LOCK is locked and the access to the hazardous area is not allowed.

SPEED CONTROL - EXAMPLE

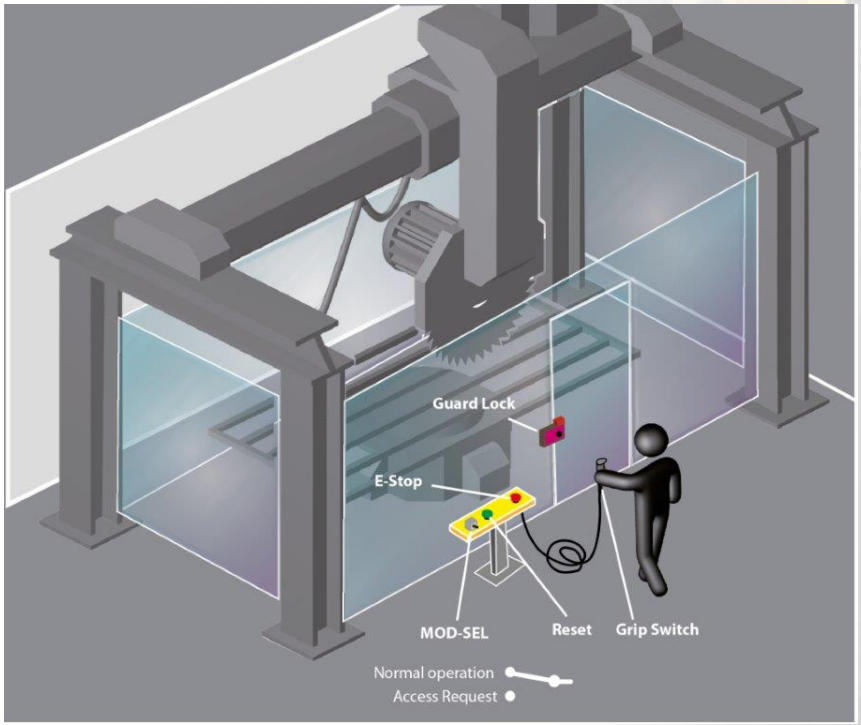


Access to the hazardous area is allowed either when the working cycle is over or when the operator switches the MOD SEL to “Access Request”. In the second case, the GARD LOCK is unlocked with a 4 seconds delay, that is the time needed to permit to the machine to completely stop the tool (time measured during the risk assessment). At this point the operator can safely access the hazardous area.

If the tool has to be kept moving for maintenance reasons as the operator is inside the hazardous area this is possible through the Grip Switch. The speed monitoring device detects whether the speed of the tool is under a defined threshold set through the MSD. If the threshold is exceeded or the Grip Switch is released the machine is immediately stopped.

SPEED CONTROL - EXAMPLE

Furthermore, during the working cycle the same speed monitoring device can detect when the speed of the tool is over a defined threshold and immediately stop the machine to avoid damages to the nearby operators and to the tool itself.



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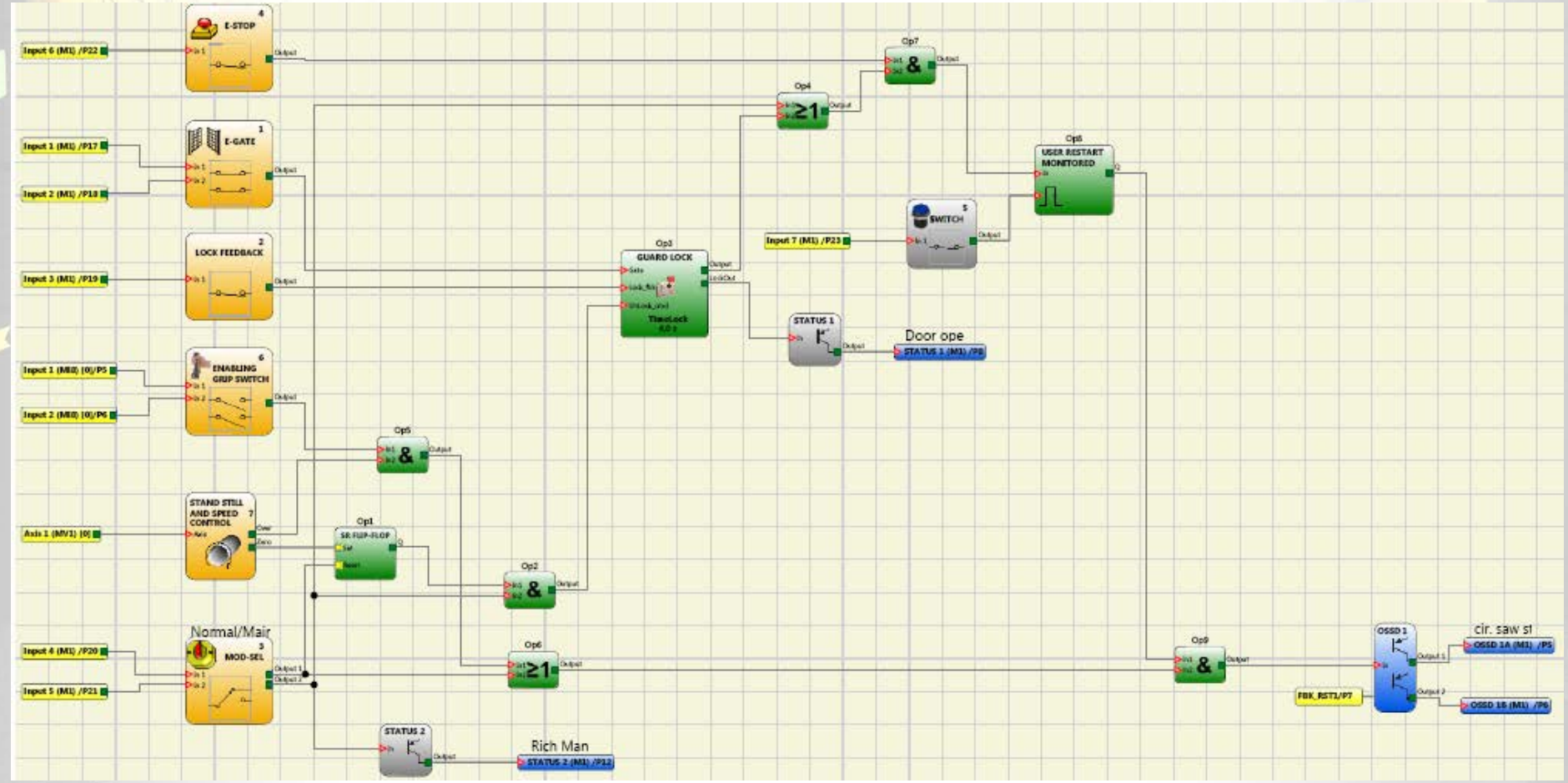
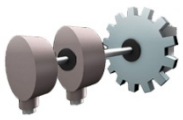
MSD – Configuration Software

SPEED CONTROL - EXAMPLE



MOSAIC MV

Encoder		Proximity Switches		MV		Safety level
	1 Sin/Cos Safety Encoder	--	+		MV1 expansion module	=	SIL 3 – PL e
	1 TTL or 1 HTL or 1 Sin/Cos Encoder	+ 	1 Proximity switch	+		MV1 expansion module	=	Cat. 3 DC 90% up to SIL 3 – PL e
	--		2 Proximity switches **	+		MV1 expansion module	=	Cat. 3 DC 90% up to SIL 3 – PL e
	2 TTL or 2 HTL or 2 Sin/Cos Encoder	--	+		MV2 expansion module	=	Cat. 3 DC 90% up to SIL 3 – PL e
	1 TTL or 1 HTL or 1 Sin/Cos Encoder *	--	+		MV1 expansion module	=	up to SIL 1 – PL c

* Encoders in safety application must comply with additional requirements

** See proximity switches installation example

Additional requirements

In order to build and use machinery complying with safety standards, an encoder without its own PFHd (safety encoder certified) requires the following information from the manufacturer of the encoder:

- ❑ MTTF value of the encoder
- ❑ fault table (table D.16) filled in with comments included in the standard EN 61800-5-2
- ❑ declarations of "fault exclusion" for the loss of the mechanical connection (see next).

The Safety encoder complies with all the above additional requirements.

Standard encoders without the above additional requirements cannot be used in Safety applications.

Fault exclusion

Fault considered	Fault exclusion	Remarks
Loss of attachment during standstill: • sensor housing from motor chassis • sensor shaft from motor shaft	Preparing **FMEA** (Failure mode and effects analysis) and prove longterm integrity of mechanical fixings.	Effect: output signal equals standstill. If fault exclusion is claimed, the design of the sensor housing to chassis and sensor shaft to motor shaft mounting usually withstands an overstress factor of approximately 20, and specific maintenance information should be provided.
Loss or loosening of attachment during motion: • sensor housing from motor chassis • sensor shaft from motor shaft	Preparing **FMEA** (Failure mode and effects analysis) and prove longterm integrity of mechanical fixings.	Possible effects: • Static offset of sensor shaft • Dynamic slip of sensor shaft • Wrong output signal/zero speed signal If fault exclusion is claimed, the design of the sensor housing to chassis and sensor shaft to motor shaft mounting usually withstands an overstress factor of approximately 20, and specific maintenance information should be provided.

Source from table D16 in the safety standard EN 61800-5-2

Encoders in safety applications

Once you have obtained the necessary data from the manufacturer of the encoder and controller, you will have to determine:

- **The safety categorie provided**
- **The DCavg /diagnostic coverage on the potential dangerous failures that can be detected**
- **The di MTTFd value of the safety function**

These elements make it possible to calculate the PL security level achieved.

EN ISO 13849-1

ISO 13849-1 simplifies calculation by providing a table based on Markov modeling in which average probability of dangerous failure per hour is pre-calculated for various Category combinations and range values of $MTTF_d$ and DCavg which are in turn obtained using tables.

Denotations of $MTTF_d$	Range of $MTTF_d$
Low	3 years ≤ MTTFd < 10 years
Medium	10 years ≤ MTTFd < 30 years
High	30 years ≤ MTTFd < 100 years

Denomination DCavg	Range of values DC / DCavg
None	DC < 60%
Low	60% ≤ DC < 90%
Medium	90% ≤ DC < 99%
High	99% ≤ DC

The combination of Category plus DCavg adopted is shown in one of the seven columns of fig. 5 of ISO 13849-1. Calculated $MTTF_d$ determines which part of the column has to be considered. Corresponding PL is shown on the left of the table.

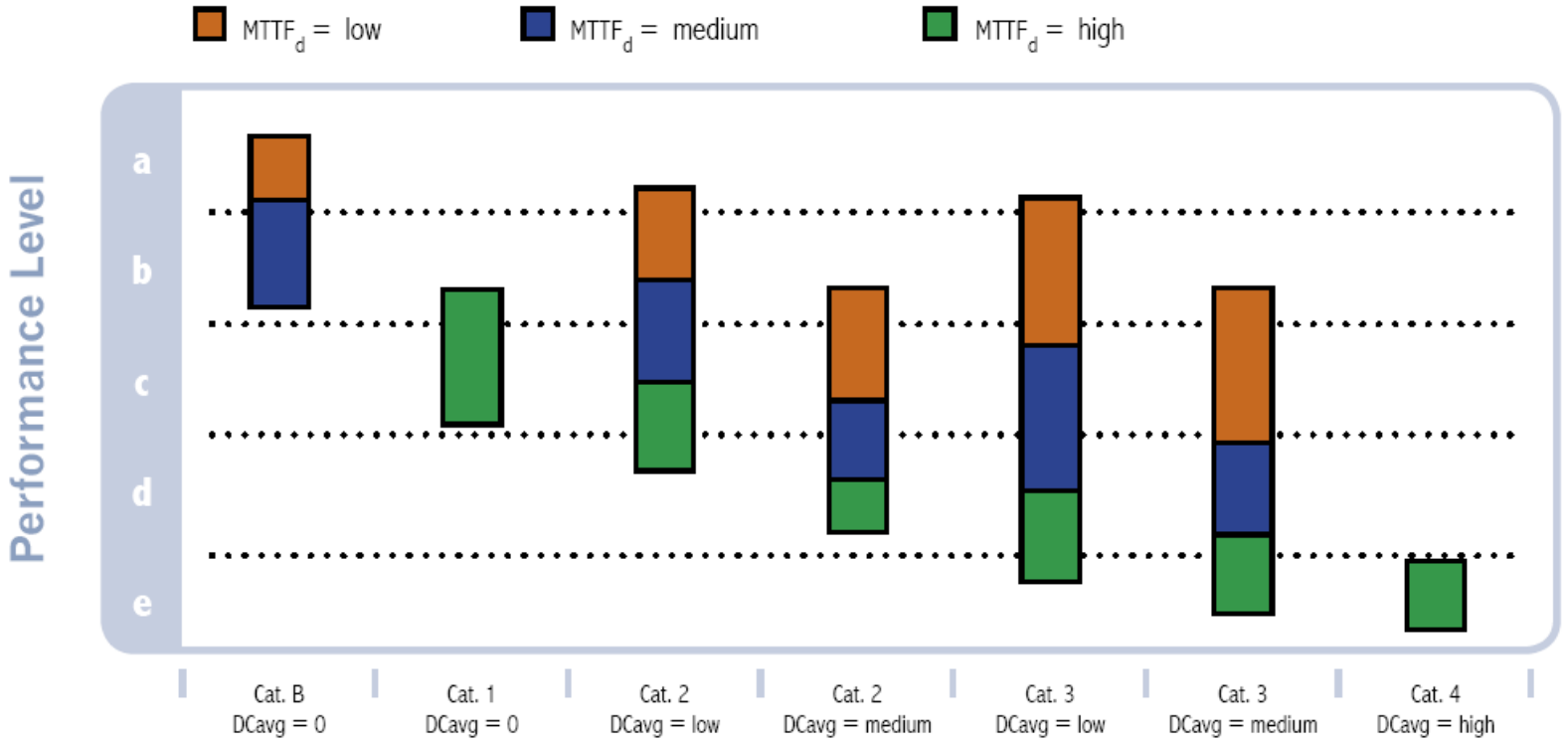
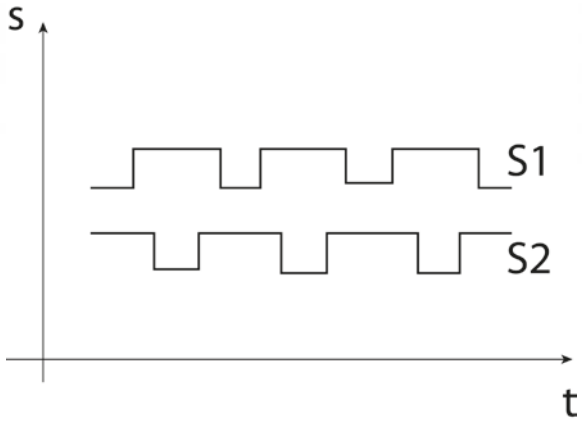


Fig. 5 of ISO 13849-1

Proximity switches in safety applications

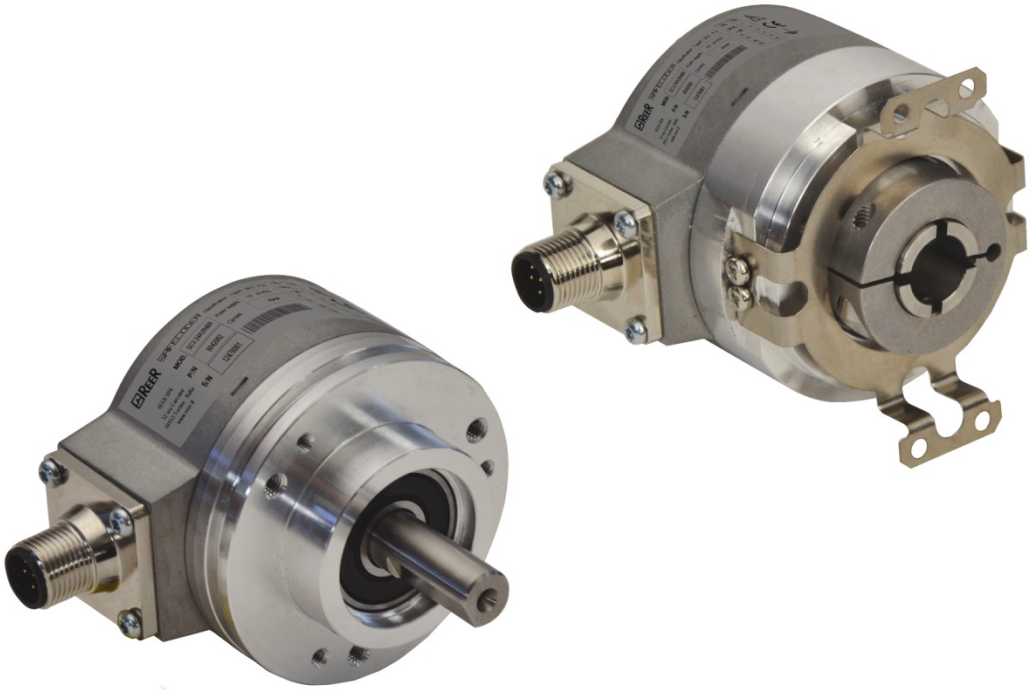
Example of Requirements and installation

- 2 proximity switches
- “PNP" type proximity switches may be used (N/O contact, switching to positive).
- At least one of proximity switches must be always activated.
- The proximity switches must be fitted so that the recorded signals overlap. See below:



NOTE: Appropriate installation measures should be taken to prevent a foreign body coming between the signal input device and the proximity switch.

SAFECODER



Safety Incremental Encoder

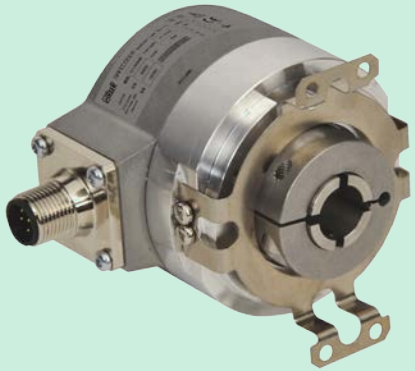
SAFECODER

Safety Level

SIL 3

SIL 3 – SILCL 3
PL e – Cat. 4

ReeR Safety Incremental Encoder

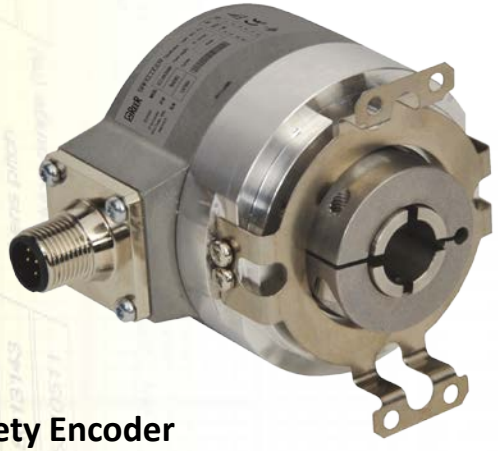
Model	Description	Code	Characteristics
	Incremental encoder shaft version	SC3 24A2048R	**24** – 24 VDC **A** – Shaft version Ø 10mm with key **2048** – Pulse rate **R**- Radial M12 connector
		SC3 05A2048R	**05** - 5 VDC **A** - Shaft version Ø 10mm with key **2048** – Pulse rate **R**- Radial M12 connector
	Incremental encoder hollow shaft version	SC3 24D2048R	**24** - 24 VDC **D** – Hollow Shaft version Ø 12mm **2048** – Pulse rate **R**- Radial M12 connector
		SC3 05D2048R	**05** - 5 VDC **D** – Hollow Shaft version Ø 12mm **2048** – Pulse rate **R**- Radial M12 connector

SAFECODER

Technical Characteristics

- Incremental encoder for use in safety-related applications up to SIL3
- Incremental SinCos tracks
- Certified by BGIA - Institute for Occupational Safety and Health
- 5 or 24 V DC power supply
- Current consumption – Max. 45 mA (24 V DC) / Max. 70 mA (5 V DC)
- Shaft or Hollow Shaft versions
- 2048 pulse rate
- M12 Connector with shielded cables up up to 50 m

Safety Encoder Vs Economical Encoder



Safety Encoder

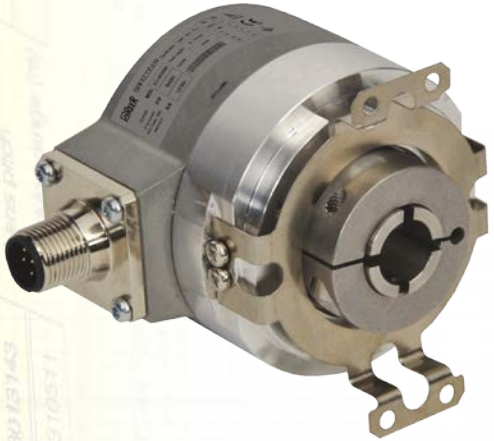
- Certified by BGIA
- Safety-Lock
- High rotational speed
- - 40° + 90° temperature range
- IP67
- High shaft load capacity
- Shock and vibration resistant
  - ✓ Shock resistance according EN 60068-2-27 - 2500 m/s², 6 ms
  - ✓ Vibration resistance according EN 60068-2-6 - 100 m/s², 55 ... 2000 Hz
- Materials
  - ✓ shaft / hollow shaft: stainless steel
  - ✓ Flange: aluminium
  - ✓ Housing: zinc die-cast housing

SAFECODER

Economical Encoder

- No certification
- Standard mechanical fixing
- - 20° + 70° temperature range
- IP67
- Shock and vibration resistant
  - ✓ Shock resistance acc. to EN 60068-2-27 1000 m/s², 6 ms
  - ✓ Vibration resistance acc. to EN 60068-2-6 100 m/s², 10 ... 2000 Hz
- Materials
  - ✓ shaft / hollow shaft stainless steel
  - ✓ housing, flange PPA, 40% CF
  - ✓ (carbon fibre)

SAFECODER



M1 MV

ONE SAFECODER + MOSAIC = SIL 3

SAFECODER together with Mosaic comprise a SIL 3 certified safety function for speed monitoring

NORSTAT INC.

REER

MOSA:IC

Modular Safety Integrated Controller

REER 50 1959-2009

MOSAIC

MOSAIC is the new modular and configurable safety controller of REER.

This new safety device is capable of monitoring several safety sensors and commands at the same time. These can be safety light curtains, safety photocells, emergency stops, safety mats, magnetic or mechanic switches, two-hand controls, etc.

Thanks to MOSAIC's modular and expandable structure, it is possible to adapt its I/O configuration and functionality to the demands of each application. This makes MOSAIC a highly versatile and flexible safety controller.

MOSAIC has solid state and/or relay outputs. They can be instantaneous or delayed.

MAIN FEATURES

- Configurable safety controller
- Safety level: SIL 3, PLe, Cat. 4
- Easy and intuitive graphic configuration software (MSD - Mosaic Safety Designer)
- Compact design:
  - single module dimensions 22.5 x 99 x 114.5 mm
- Max 72 inputs and 8 OSSD pairs
- Max 7 expansion units in addition to Master M1
- M1 stand alone main unit:
  - 8 safety inputs, 2 OSSD pairs with separate EDM and Start/Restart
  - configurable via PC through USB interface
- MI802 expansion unit:
  - 8 safety inputs, 2 OSSD pairs with separate EDM and Start/Restart
- MI8 and MI16 expansion units:
  - with 8 and 16 safety inputs
- MO2 and MO4 expansion units:
  - with 2 and 4 OSSD pairs with separate EDM and Start/Restart
- MR2 and MR4 relay units:
  - with 2 and 4 guided contacts safety relays
- MB expansion units for connection to the most common industrial Fieldbus systems:
  - PROFIBUS DP, DeviceNet, CANopen
- Communication between units via proprietary high speed bus (MSC - Mosaic Safety Communication)
- Simple diagnostics via led signaling and configuration software
- Memory card configuration storage (MCM - Mosaic Configuration Memory)

MSC

Mosaic Safety Communication

MSC allows communication between units via a proprietary high speed bus.

Safety level:

Cat. 4

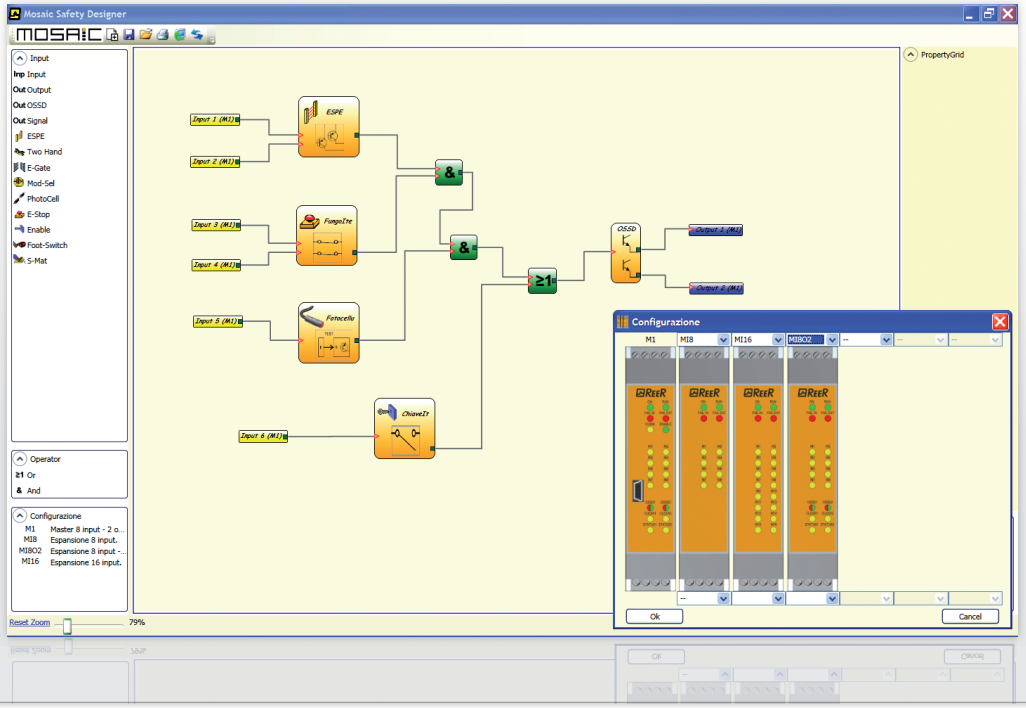
SIL 3 – SILCL 3
PL e – Cat. 4

Mosaic Safety Designer (MSD) software is a user-friendly configuration tool which makes the programming of MOSAIC possible in just a few simple steps. By clicking on the functional icons it is easy to 'Drag&Drop' and configure any safety functions.

Thanks to an accurate functional test incorporated into the Mosaic Safety Designer (MSD) software, configuration errors are detected immediately. This also helps to guarantee that configuration errors cannot lead to an unsafe situation and valuable time is not lost during the commissioning of the machine.

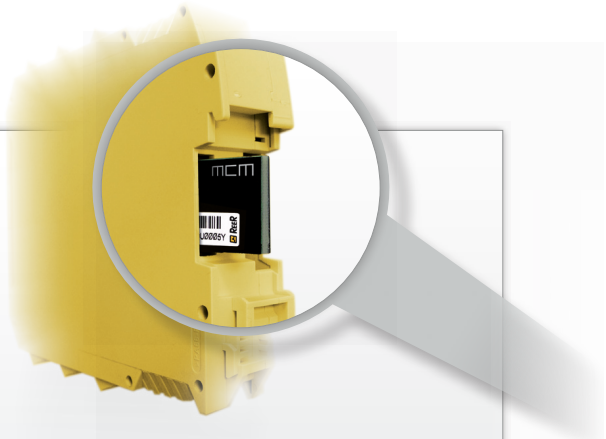
In addition, the multi-level password management of Mosaic Safety Designer (MSD) gives further security against non-authorized access to the configuration software.

MSD
Mosaic Safety Designer



MCM
Mosaic Configuration Memory

MCM is a memory card which can be used to save the configuration data for copying to a new MOSAIC safety controller as and when required.



REER

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