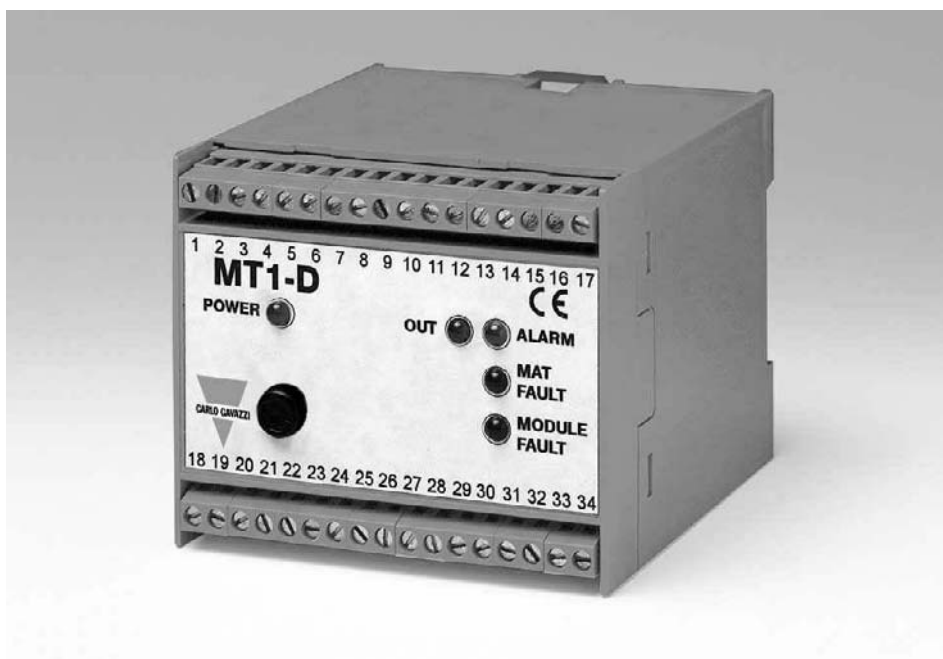

SAFETY MODULE MT1-D



USER MANUAL



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Contents

1. IDENTIFICATION DATA	.3
2. DESCRIPTION	.3
3. TECHNICAL DATA	.5
4. OUTPUT FEATURES	.6
5. INSTALLATION	.8
6. INSTALLATION PROCEDURE	.10
7. USAGE	.12
8. MT1-D MODULE USAGE WITH MAGNETIC SAFETY SENSORS	.14
9. MT1-D MODULE USAGE WITH SENSORS NOT MANUFACTURED BY SAJET ELETTRONICA	.16
10. REGULAR INSPECTIONS AND MAINTENANCE	.16
11. FAULT DIAGNOSIS	.17
12. REPAIRS	.17
13. DISASSEMBLY, PACKING, MOVING, TRANSPORT AND STORAGE	.19
14. SCRAPPING	.20
15. WARRANTY	.20

This “User Manual” must be read and understood completely by personnel dealing with the installation, installation procedure, usage, maintenance, storage and all other activities of the MT1-D mat control safety module. Contact SAIET Elettronica immediately if there are any doubts. The user must store this “User Manual” in a suitable and easily accessible place for easy consultation. All the

operations described below must be carried out by expert personnel. SAIET Elettronica reserves the right to make any changes or improvements without prior notice: any new versions annul and replace previous versions.

1. IDENTIFICATION DATA

Model	Mat control safety module (category 4) conforming to Machine Directive EC/98/37 according to EN 954-1, EN 292-1 and -2, EN 60204-1, EN 1760-1
Type	MT1-D

2. DESCRIPTION

The MT1-D safety module is the control unit of a surveillance system guarding access to potentially dangerous areas, to protect the operator from injuries and it controls the pressure sensing safety mats. It has been designed according to redundant and auto check criteria, so that if any fault occurs there is no loss of safety function. The malfunction is detected and signalled before others can take place, so that even if more faults occur there is no loss

of safety function.

The MT1-D safety module must be combined with a SM... pressure sensing safety mat, to carry out the **mat control** function. The entire system is in safety category 3 according to EN 954-1.

The main features of the MT1-D safety module are:

- Redundant and auto check circuit.
- Pressure sensing mat integrity control.

- 24 Vdc/ac power supply.
- 1 input (4 poles).
- 2 redundant safety outputs realised with force guided relays in series (2 N.O. contacts).
- 1 optocoupled non safety auxiliary output (NPN).
- 1 relay non-safety auxiliary output (1 N.O. contact).
- Module safety category: 4
- Module+mat safety category: 3
- Feedback circuit to control the relays contacts and force guided external contactors.
- Output contacts can be multiplied and amplified
- TEST push button can be connected (simulates pressure sensing mat operation)
- Automatic or manual start
- 5 warning led: POWER, OUT, ALARM, MAT FAULT, MODULE FAULT.

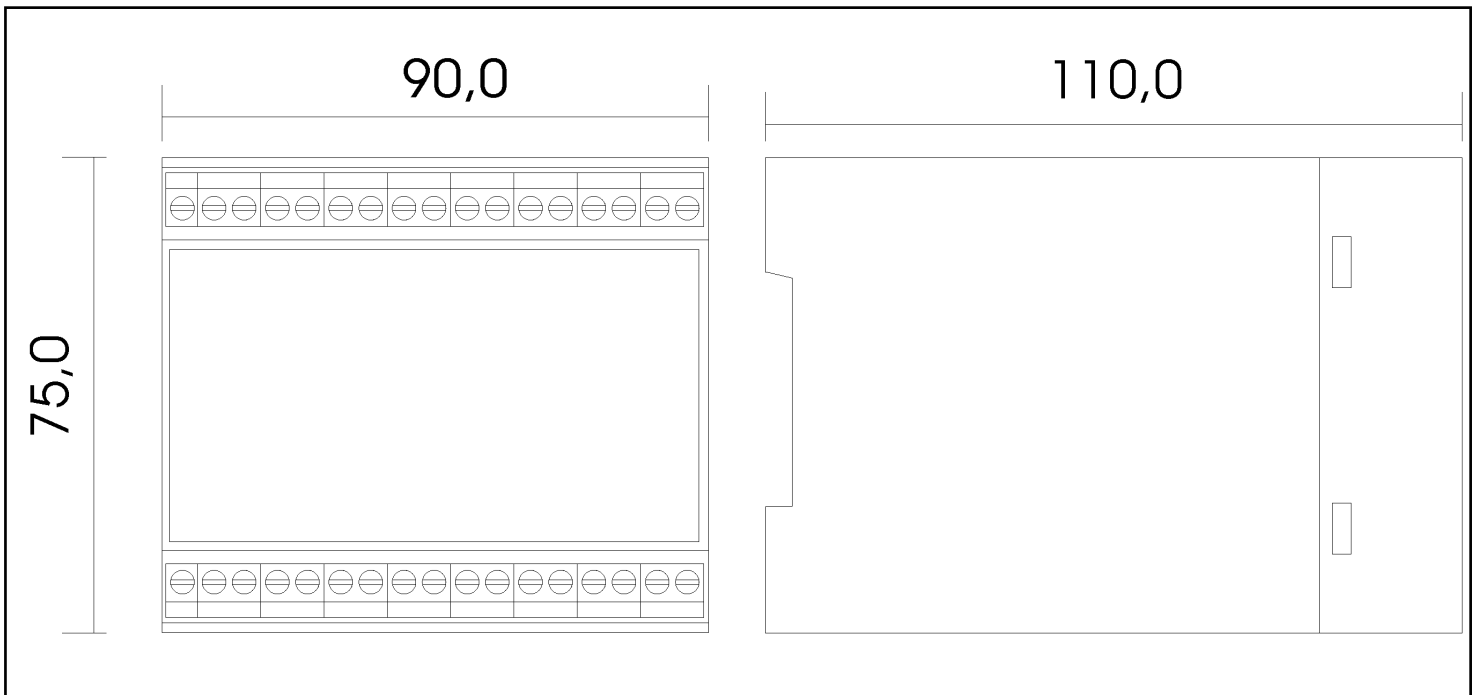


Fig. 1 – MT1-D safety module dimensions

3. TECHNICAL DATA

Supply voltage	24 Vac \pm 10% 50 \div 60 Hz, 24 Vdc \pm 10%
Maximum current consumption	200 mA (@ 24 Vdc)
Inputs	4 poles
START procedure (module) (inputs activated \Rightarrow safety outputs closed)	\leq 800 ms
Response time (module) (inputs not activated \Rightarrow safety outputs open)	\leq 60 ms
Mat + module response time (mat operated \Rightarrow safety outputs open)	\leq 150 ms
Module safety category	4
Module+mat safety category	3
Led warning	Yes
Short circuit protection: power supply inputs	Fuse 1 A 250 V delayed PTC 150 mA
Maximum mat surface that can be checked	Unlimited with SM..safety mat
Pressure sensing mat maximum resistance	4 k Ω (1)
Housing	ABS, 34 terminals, with DIN rail fixing
Protection degree	IP30
Operating temperature	0 \div 55°C
Storage temperature	-25 \div +55°C
Operating/storage humidity	30 \div 95 %
Cable section that can be connected to the terminals	0.2 \div 4 mm ² (rigid) 0.2 \div 2.5 mm ² (flexible)
Dimensions	75 x 90 x 105 mm
Weight	400 g

(1) : this resistance value includes both the resistance from the mat and the resistance from the output cable.

4 OUTPUT FEATURES

- **Redundant safety outputs realised with force guided relays (2 N.O. contacts)**

Function	Contacts closed: safety outputs enabled Contacts open: safety outputs disabled
Maximum switching voltage	230 Vca
Maximum switching current	4 A
Maximum switching power	1200 VA (ohmic load)
Mechanical life	$>10^7$ switchings
Electrical life	$>10^5$ switchings

Note: a fuse in series must be connected externally to every output contact, to avoid the safety outputs contacts welding.

- **Optocoupled non safety auxiliary output (NPN)**

Function	Transistor excited: safety outputs enabled Transistor not excited: safety outputs disabled
Insulation voltage	2500 Vrms
Maximum phototransistor collector current	50 mA
Maximum phototransistor collector-emitter voltage	55 V

Note: the optocoupled auxiliary output status coincides with the safety outputs status; it can be used for non-safety secondary warnings or controls.

- **Redundant non-safety auxiliary relay output (1 N.O. contact)**

Function	Contact closed: mat not pressed and OK Contact open: mat pressed or faulty (interrupted)
Maximum switching voltage	250 Vca
Maximum switching current	1.25 A
Maximum switching power	62.5 VA (ohmic load)
Mechanical life	$>10^7$ switchings
Electrical life	$>10^5$ switchings

Note: the auxiliary relay output signals the operation and the fault (interruption) of the pressure sensing mat; it can be used for non-safety secondary warnings or controls.

- **Luminous LED warnings**

System status	OUT LED (green)	ALARM LED (yellow)	MAT FAULT LED (red)	MODULE FAULT LED (red)
Mat OK and not pressed	ON	OFF	OFF	OFF
Mat OK and pressed	OFF	ON	OFF	OFF
Mat faulty (interrupted)	OFF	OFF	ON	ON
Module faulty	OFF	OFF	OFF	ON

5. INSTALLATION

Prior to installation ensure that the label on the left hand side of the safety module is intact. If it is not, SAIET Elettronica does not guarantee the safety module's correct functioning.

Ensure also that there are no evident traces of damage to the safety module due to transport and moving operations and carefully read the following "User Manual" completely. If there are any doubts do not install and contact SAIET Elettronica immediately.

The installation must be carried out when the machine is not powered and not during storms with lightning. The safety module must be installed on the machine's electrical board, in a dry place fixed on the special DIN rail. The machine must operate in temperature and humidity conditions according to the safety module technical data.

The following must also be carried out:

- 1) connect a fuse in series to every output safety contact to avoid them welding;
- 2) do not exceed the maximum electrical ratings admissible for the safety outputs and auxiliary outputs connections (see "Technical Data");

3) feedback the N.C. contacts of the external force guided contactors.

It is recommended to keep the safety module power supply separate, in galvanic terms, from the machine capacity section and to keep the safety module connection cables separate from the capacity loads supply cables.

The use of spark quenching circuits (diodes, Zener diodes, RC circuits, varistors, etc.), in parallel to the external contactors reel increases the electrical life of the safety outputs contacts.

Never, under any circumstance, connect spark quenching circuits in parallel to safety output contacts: the safety function would no longer be guaranteed.

It is recommended to use conductors with section adequate to the currents involved, ensuring that the conductors are not excessively tight, that their positioning avoids potential cuts or squashing and that they are not in the way of people or things. Before connecting ensure that the pressure sensing mat functions correctly.

Carry out the connections as follows:

Power supply

1 and 34 = +24 V_{cc/ca}

Pressure sensing mat inputs

2 = pin 4 pressure sensing mat connector

3 = pin 2 pressure sensing mat connector

4 = pin 3 pressure sensing mat connector

5 = pin 1 pressure sensing mat connector

Inputs for the contactors or force guided external relays feedback

20 and 21 = force guided external contactors N.C. contacts

Redundant relay safety outputs

15 and 32 = 1st redundant safety output (N.O. contact)

16 and 33 = 2nd redundant safety output (N.O. contact)

Non-safety optocoupled auxiliary output

12 = NPN phototransistor collector optocoupled auxiliary output

13 = NPN phototransistor emitter optocoupled auxiliary output

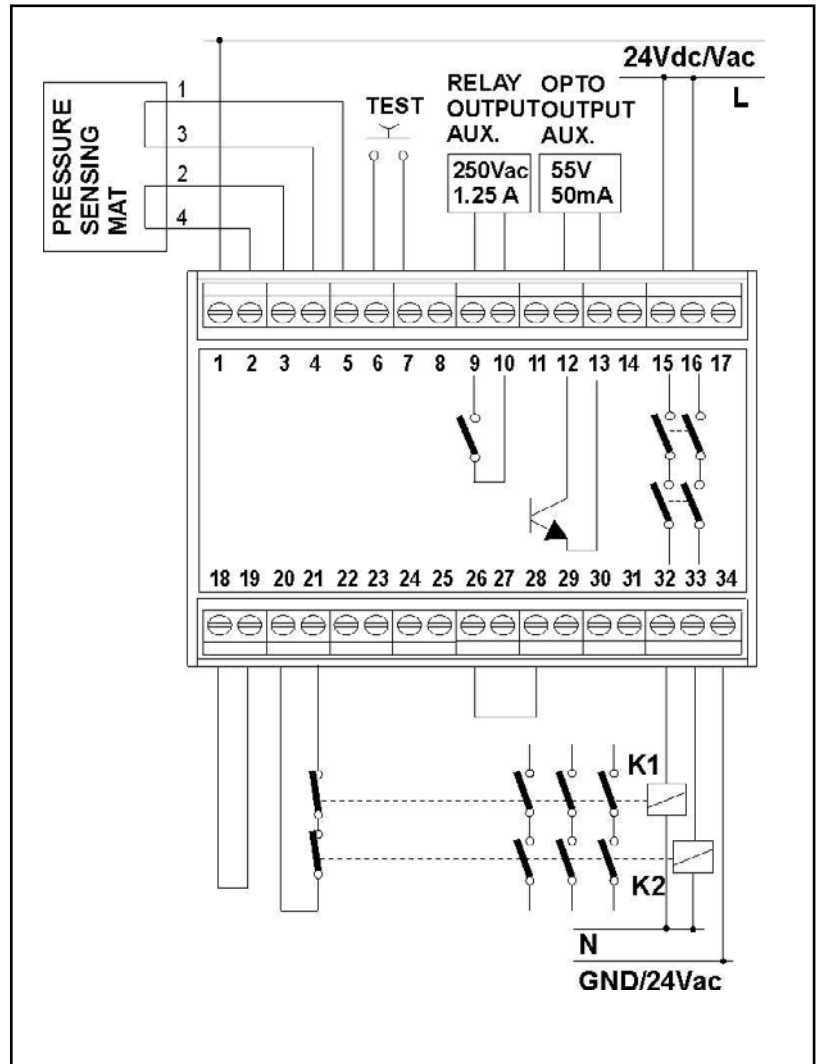


Fig 2 –MT1-D module connections with manual start not to EN 1760-1 standard

Non-safety relay auxiliary output

9 and 10 = auxiliary output pressure sensing mat pressed or faulty (interrupted) (N.O. contact)

TEST pushbutton

6 and 7 = TEST push button (N.O. contact)

START pushbutton

18 and 19 = to be short-circuited for the automatic START;

see fig. 2 for the manual START not to EN 1760-1 standard;

see fig. 3 for the manual START to EN 1760-1 standard

Configuration jumpers

26 and 28 = to be short-circuited

Terminals not used

8, 11, 14, 17, 22, 23, 24, 25, 27, 29, 30, 31

It is recommended to carry out the machine “Installation procedure” at the end of the installation.

In case of an incorrect installation, SAJET Elettronica does not guarantee the correct functioning of the safety module.

6. INSTALLATION PROCEDURE

At the end of the installation, the safety module installation procedure must be carried out (in the manual START version, the START push button must also be pressed).

Ensure that there are no dangerous situations for the operators before starting the machine. Carry out *all the following operations* to check the integrity of the module and that

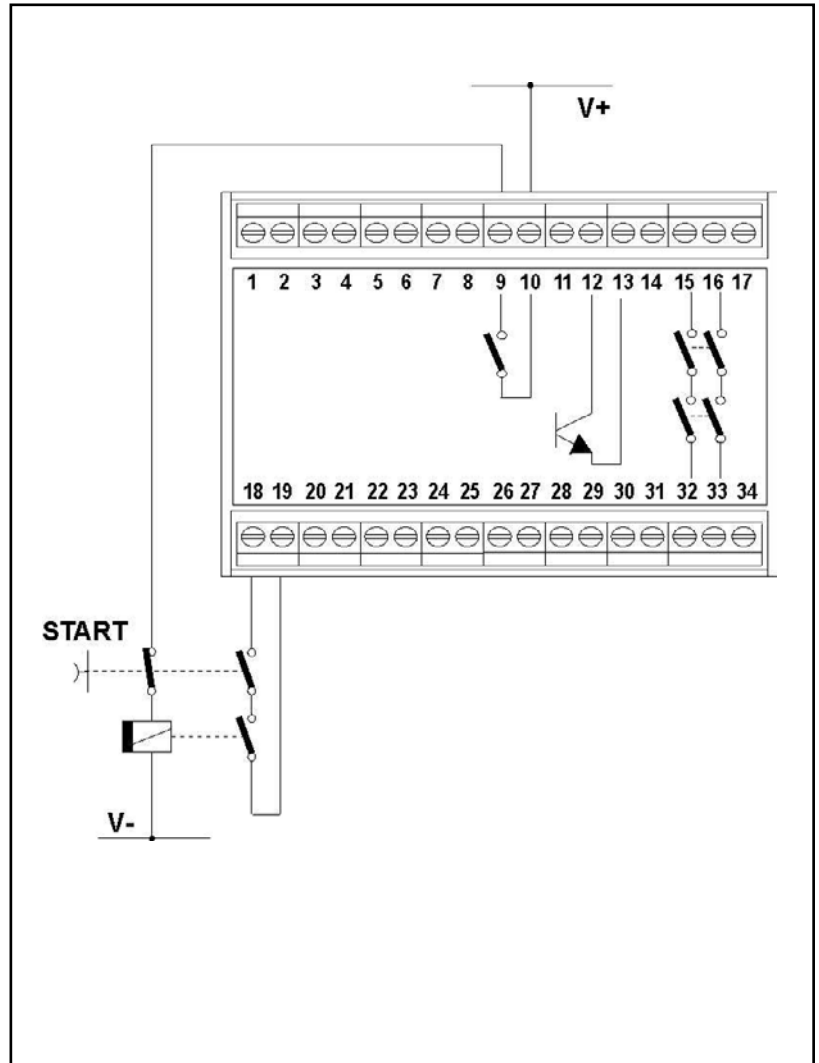


Fig. 3 – Manual START to EN 1760-1 standard

the wiring is correct:

- **Check the correct assembly of the command devices**

Check that the pressure sensing mat has been installed correctly.

- **System installation procedure**

1) Connect the power supply to the terminals 1 and 34 with the mat pressed ⇒ the POWER and ALARM LED light up;

2) Release the pressure sensing mat (and press the START push button) ⇒ the safety outputs are enabled, the OUT LED lights up and the ALARM LED switches off.

• **Safety function check**

1) Press the pressure sensing mat ⇒ the safety outputs are disabled, the OUT LED switches off and the ALARM LED lights up;

2) To restart the module, release the pressure sensing mat (and press the START button) ⇒ the safety outputs are enabled, the OUT LED lights up and the ALARM LED switches off.

• **Feedback circuit complete functioning control**

1) Disconnect the terminal 20 (or 21) conductor and press the pressure sensing mat ⇒ the safety outputs are disabled, the OUT LED switches off and the ALARM LED lights up.

2) Release the pressure sensing mat (and press the START push button) ⇒ the safety outputs are disabled and the ALARM LED switches off.

3) Reconnect the disconnected conductor with the pressure sensing mat released (and press the START push button) ⇒ the safety outputs are enabled and the OUT LED lights up.

• **Pressure sensing mat integrity check circuit complete functioning control**

1) Disconnect one of the pressure sensing mat conductors (terminals 2, 3, 4 or 5), with the pressure sensing mat released ⇒ the safety outputs are disabled, the OUT LED switches off and the MAT FAULT and MODULE FAULT LED light up.

2) Reconnect the conductor with the pressure sensing mat released (and press the START push button) ⇒ the safety outputs are enabled, the OUT LED lights up and the MAT FAULT and MODULE FAULT LED switch off.

The release of the pressure sensing mat restarts the system only when the force guided relays N.C. contacts inside the module and the external force guided contactors are closed and, in the manual START version, the START push button is pressed. In this way a check is carried out on the integrity of the module's internal relays and the external force guided contactors.

It is recommended to also check the correct functioning of the TEST pushbutton (if connected) and of the safety and auxiliary outputs.

Note: one safety module can control more than one pressure sensing mat, but if there are any faults, it is no longer able to detect which pressure sensing mat is faulty.

In case of an incorrect installation procedure, SAIET Elettronica does not guarantee the correct functioning of the safety module.

7. USAGE

Fig.2 shows the connection diagram of the MT1-D safety module with manual START not to EN 1760-1 standard. For the automatic START, terminals 18 and 19 of the module must be jumped. The EN 1760-1 standard requires that to START the module there must firstly be a recognition of the mat release and then of the START pushbutton being pressed. In this case the START pushbutton must

be connected to two contacts (one N.O. and one N.C.) and to a relay with a de-excitation delay of a few dozen ms (see Fig.3).

Fig. 4 shows the connection diagram of two pressure sensing mats in series to a single module: the maximum total resistance (due to the surface of the mats and to the output cables) must be of 4 K Ω .

The connections must be carried as follows:

- Pin 1 pressure sensing mat A connector to safety module terminal 5
- Pin 3 pressure sensing mat A connector to pin 1 pressure sensing mat B connector

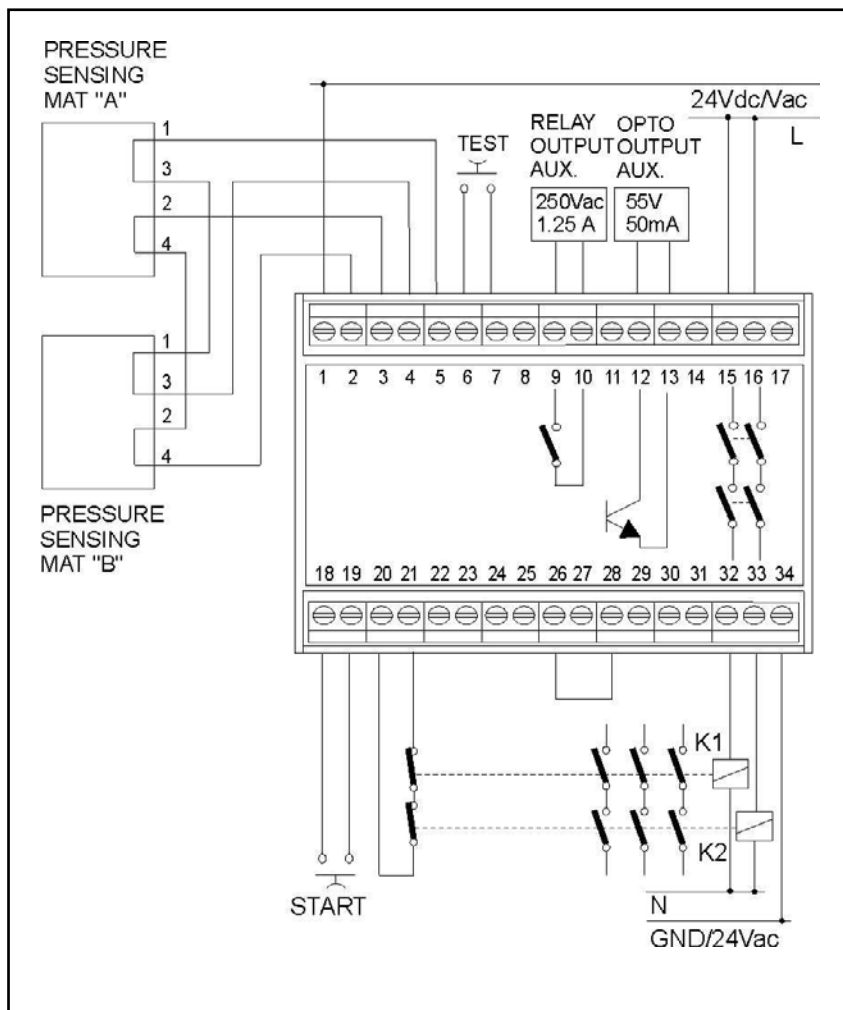


Fig. 4 – Diagram for the connection of two pressure sensing mats to a single MT1-D module

- Pin 3 pressure sensing mat B connector to safety module terminal 4
- Pin 2 pressure sensing mat A connector to safety module terminal 3
- Pin 4 pressure sensing mat A connector to pin 2 pressure sensing mat B connector
- Pin 4 pressure sensing mat B connector to safety module terminal 2

In case more than 2 safety output contacts are required (multiplication of the output contacts) or a current capacity greater than the one set out in the “Technical Data” (Output contacts amplification), the force guided external relays N.C. contacts must feedback to the module to be controlled.

The other possible configurations must be compatible with the safety category requested by the machine, on the basis of its risk evaluation.

Once the pressure sensing mat has been installed, the machine stop time must be controlled to ensure that the machine stop time is much less than the operator access to the machine time, once the pressure sensing mat has been operated.

If the safety module does not reduce sufficiently the machine risks (established by the risks evaluation), the user must adopt other safety measures such as: individual protection devices, grills, fixed guards, interlocked mobile guards, photoelectric safety barriers, two-hand devices control, bumpers, acoustic and luminous signals, barriers to physically stop access of part or of the whole body of the operator to the dangerous zone, etc. Only expert personnel must have access to the machine on which the safety module is fitted. Once the safety function has been triggered (pressure sensing mat operation), eliminate the cause of danger and ensure that the dangerous condition for the operators is no longer present, prior to restarting the machine. An improper use of the safety module can lead to a dangerous situation for the operator.

In case of incorrect installation procedure SAJET Elettronica does not guarantee the correct functioning of the safety module.

8. MT1-D MODULE USAGE WITH MAGNETIC SAFETY SENSORS

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The output of one or more SMS-03 magnetic safety sensors can also be connected to the MT1-D module, if one wants to also control the opening of the mobile guards, and remain in safety category 3. Fig. 5 shows a connection diagram for a SM.. pressure sensing mat and an SMS-03 magnetic safety sensor and CLS magnet connected to a MT1-D module. If one wants to control more than one mobile guard, the SMS-03 magnetic sensors must be connected in series with each other (see fig. 6 relative to the 2 guard's control).

3

Ensure that the machine stop time is much less than the operator access to the machine time, once the guard is opened.

Refer to the relative "User Manual" for the installation and use of the SMS-03 magnetic sensors and the CLS magnet.

It is recommended to regularly check the correct functioning of the SMS-03 magnetic sensors and the CLS magnets by opening all the guards and checking the machine alarm condition.

The MT1-D module fault conditions for this application are as follows:

System status	OUT LED (green)	ALARM LED (yellow)	MAT FAULT LED (red)	MODULE FAULT LED (red)
Mat OK and not pressed, guards closed	ON	OFF	OFF	OFF
Mat OK and pressed, guards closed	OFF	ON	OFF	OFF
Mat OK and not pressed, guards open	OFF	OFF	ON	ON
Mat OK and pressed, guards open	OFF	OFF	ON	ON
Mat faulty (interrupted), guards open or closed	OFF	OFF	ON	ON
Module faulty	OFF	OFF	OFF	ON

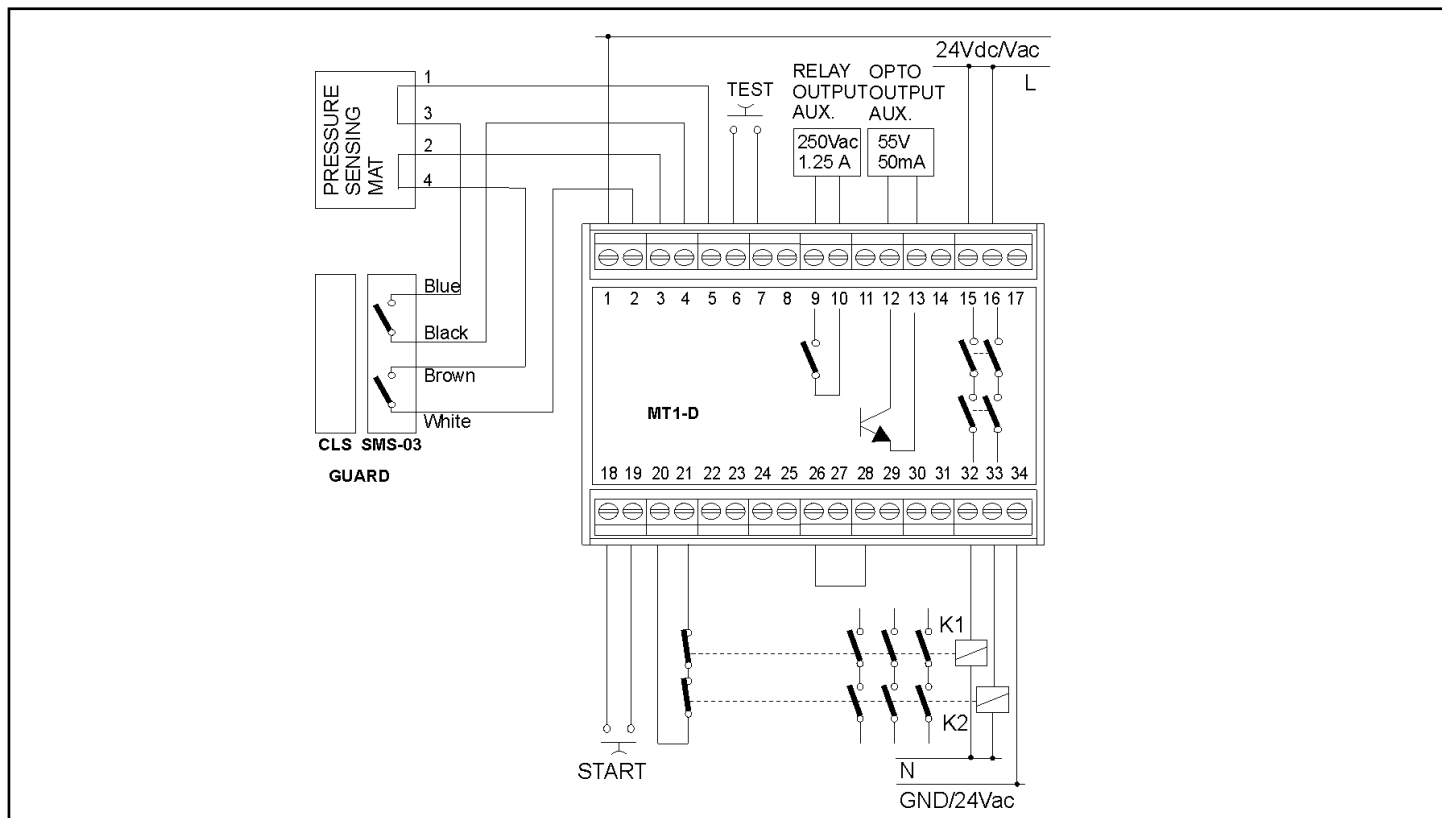


Fig. 5 - Diagram for the connection of a pressure sensing mat SM.. and a SMS-03 magnetic safety sensor to a MT1-D module.

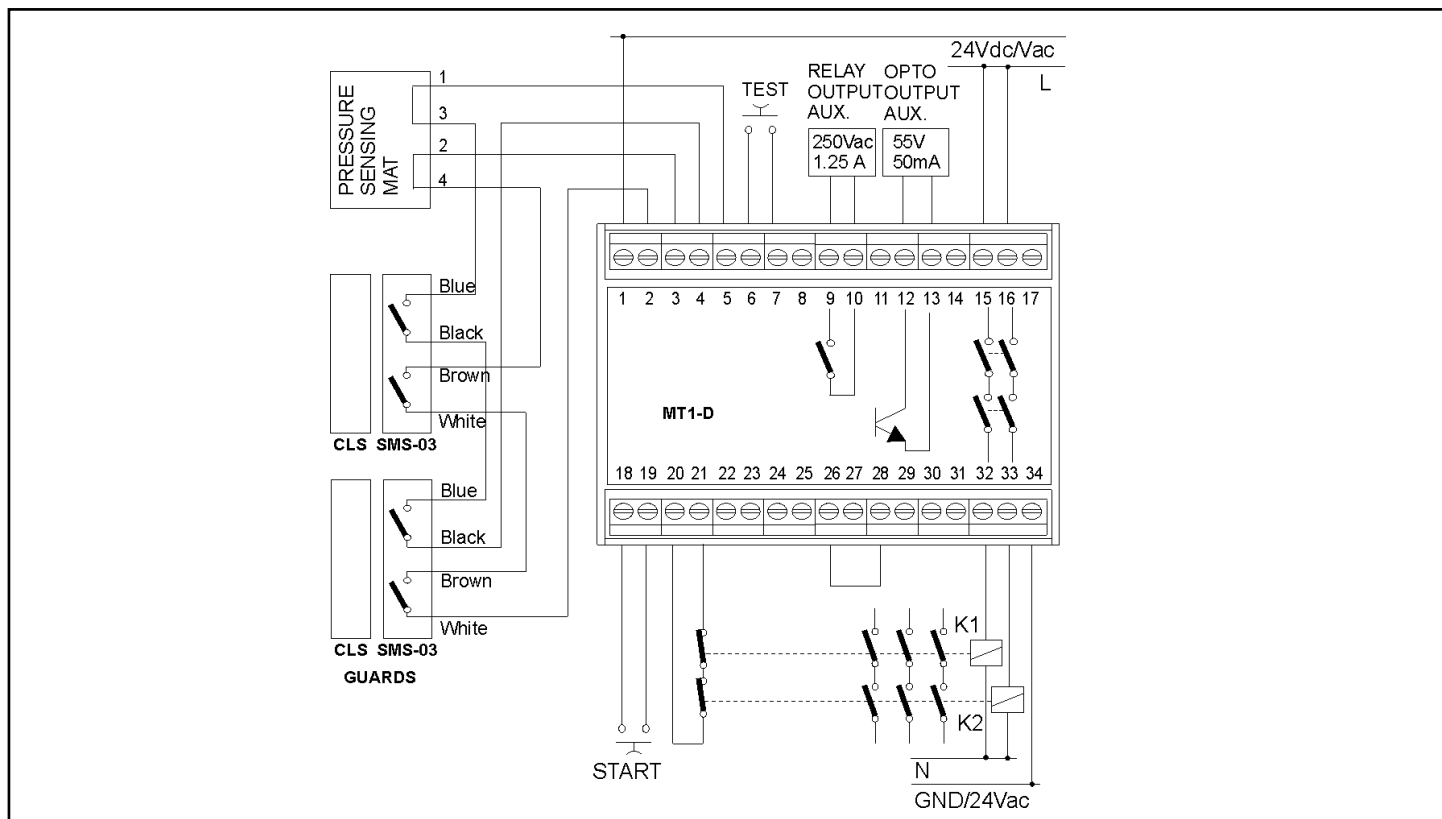


Fig. 6 – Diagram for the connection of a SM..pressure sensing mat and two SMS-03 magnetic safety sensors to a MT1-D module.

9. MT1-D MODULE USAGE WITH SENSORS NOT MANUFACTURED BY SAIET ELETTRONICA

The MT1-D safety module can be used with other sensors (mats, platforms, etc.) not manufactured by SAIET Elettronica, as long as they adhere to certain features. A sensor connected to the MT1-D module must have the following features:

- 1) 4 wires configured as 2 pairs (1-3 and 2-4);
- 2) a resistance per layer R_{1-3} , $R_{2-4} \leq 2k\Omega$ and a closing resistance R_{1-3} , $R_{2-3} > 10M\Omega$ if not operated or $< 4 k$ if operated.

3) a response time of $\leq 75ms$.

For sensors with different response times, contact SAIET Elettronica.

10. REGULAR INSPECTIONS AND MAINTENANCE

Carry out regular inspections to check the integrity of the safety module, the command devices and the pressure sensing mat. The frequency of the inspections depends on the typology of the machine on which the safety module is installed and therefore is part of the machine risks evaluation.

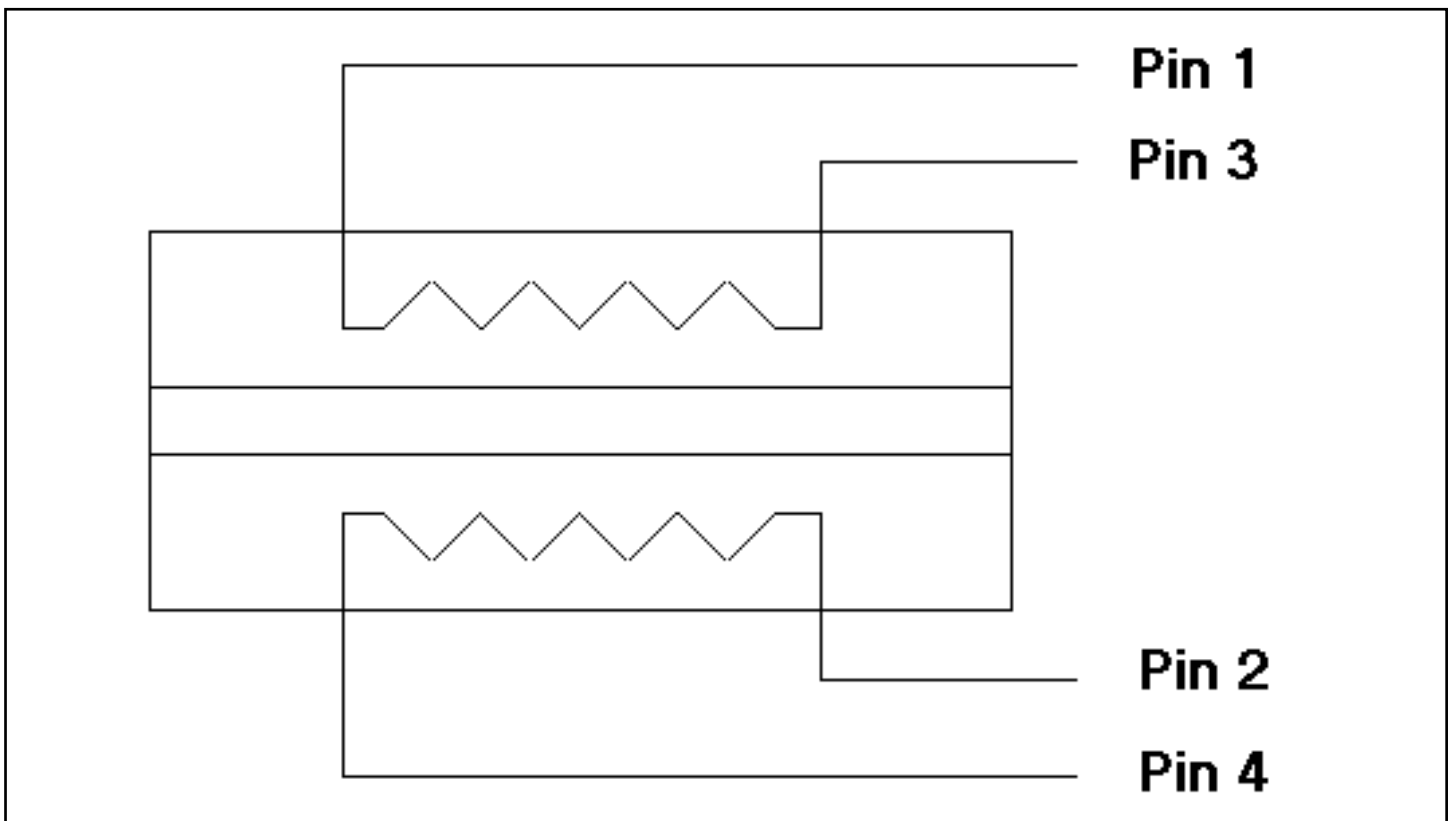


Fig. 7 – Sensor diagram

It is recommended to carry out the inspections at least weekly. Regular inspections consist of carrying out an inspection of the wiring, of the installation and the integrity of the safety module, of its command devices and of the pressure sensing mat and in repeating all the operations listed in the safety module “Installation procedures” section.

Maintenance also includes a regular cleaning of the safety module, the pressure sensing mat, its command devices and conductors: dust and other substances must be removed from the module and it must be dried of liquids or any condensation. Refer to the relative “User Manual” to clean the pressure sensing mat. These cleaning operations must be carried out whilst the machine and module are rigorously not powered. There must be a regular inspection of the other safety measures integrated to the safety module such as: individual protection devices, grills, fixed guards, interlocked mobile guards, photoelectric safety barriers, two-hand devices control, bumpers, acoustic and luminous signals, barriers to physically stop access of part or the whole body of the operator to the dangerous zone, etc.

SAIET Elettronica does not guarantee the correct functioning of the safety module if the regular inspections and/or maintenance are

not carried out according to the stated frequency.

11. FAULT DIAGNOSES

A list of possible safety module faults is listed below, along with the respective solution. This list sets out the most common faults that can occur on the safety module and is by no means exhaustive.

It is recommended to contact a SAIET Elettronica service centre for faults inside the safety module.

If any repairs are carried out inside the safety module by unauthorised personnel, SAIET Elettronica does not guarantee the correct functioning of the safety module.

12. REPAIRS

Repairs not concerning the safety module must be carried out with the machine and module not powered, without using makeshift solutions (e.g. Lower quality replacement parts) that could compromise the safety of the machine. A visual inspection of the integrity of the safety module and its command devices must be carried out following any repair carried out on a command device or on part of the machine or following rewiring and all the operations listed in the “Installation procedure” section must be repeated.

EVENT: Green POWER LED off ⇒ safety module not functioning	
CAUSE	SOLUTION
<ol style="list-style-type: none"> 1. Module not powered 2. incorrect wiring 3. power supply conductor interrupted 4. power supply voltage out of range 5. broken fuse 6. internal module fault 	<ol style="list-style-type: none"> 1. power up the module 2. check the wiring 3. replace the power supply conductor 4. reset correct power supply 5. replace the fuse 6. contact a SAIET Elettronica service centre
EVENT: Broken fuse	
CAUSE	SOLUTION
<ol style="list-style-type: none"> 7. incorrect wiring 8. power supply conductor squashed 9. power supply voltage out of range 10. internal module fault 	<ol style="list-style-type: none"> 7. check the wiring 8. replace the power supply conductor 9. reset correct power supply 10. contact a SAIET Elettronica service centre
EVENT: Red MAT FAULT LED and red MODULE FAULT LED on	
CAUSE	SOLUTION
<ol style="list-style-type: none"> 11. pressure sensing mat not connected 12. incorrect wiring 13. pressure sensing mat cable interrupted 14. pressure sensing mat faulty 15. internal module fault 	<ol style="list-style-type: none"> 11. connect the pressure sensing mat 12. check the wiring 13. replace pressure sensing mat cable 14. replace pressure sensing mat 15. contact a SAIET Elettronica service centre
EVENT: Red MODULE FAULT LED on	
CAUSE	SOLUTION
<ol style="list-style-type: none"> 16. internal module fault 	<ol style="list-style-type: none"> 16. contact a SAIET Elettronica service centre

EVENT: Yellow ALARM LED on	
CAUSE	SOLUTION
17. pressure sensing mat faulty 18. incorrect wiring 19. floor surface uneven 20. pressure sensing mat cable squashed 21. TEST pushbutton faulty (in short circuit) 22. TEST pushbutton conductor squashed 23. internal module fault	17. replace the pressure sensing mat 18. check wiring 19. clean floor surface thoroughly 20. replace sensing mat cable 21. replace TEST pushbutton 22. replace TEST pushbutton conductor 23. contact a SAIET Elettronica service centre
EVENT: Red MAT FAULT LED, red MODULE FAULT LED and yellow ALARM LED on	
CAUSE	SOLUTION
24. no jumper between terminals 26 and 28 of the module 25. internal module fault	24. make the required jumper 25. contact a SAIET Elettronica service centre

Do not carry out any repair operation inside the CARLO GAVAZZI safety module. In case of faults inside the safety module contact SAIET Elettronica specialised personnel.

In case of any repairs carried out inside the safety module by unauthorised personnel, SAIET Elettronica does not guarantee the correct functioning of the safety module.

13. DISASSEMBLY, PACKING, MOVING, TRANSPORT AND STORAGE

Disassembly must be carried with the machine and safety module unpowered.

The safety module is individually packed with protections that can absorb any knocks. The safety module must be moved and transported avoiding violent knocks and it must be maintained within storage temperature and humidity parameters (see “Technical Data”). The dimensions

and the weight of the safety module are set out in the Technical data. *If the case containing the safety module arrives damaged and/or open, contact SAIET Elettronica immediately as SAIET Elettronica will not guarantee the correct functioning of the safety module.*

The safety module must be stored in a suitable place at a temperature and humidity within storage parameters set out in the technical data.

In case of incorrect disassembly, packing, moving, transport and storage SAIET Elettronica will no longer guarantee the correct functioning of the safety module.

14. SCRAPPING

Scrapping must be carried out according to the laws in force in the country of use. The safety module does not use or produce noxious substances which must be subsequently disposed. Destroy the relative safety module identification plate and any documents attached to it, so as to avoid any confusion with other safety modules or with future versions of the same safety module.

15. WARRANTY

The warranty is applied according to the terms set out in the purchase contract. Specify clearly the fault experienced. The warranty is applied for manufacturing defects and faults that occur within the warranty period, excluding faults arising from transport, storage and use outside the product's technical specifications.



SAIET Elettronica reserves the right to make improvements or changes without prior notice.