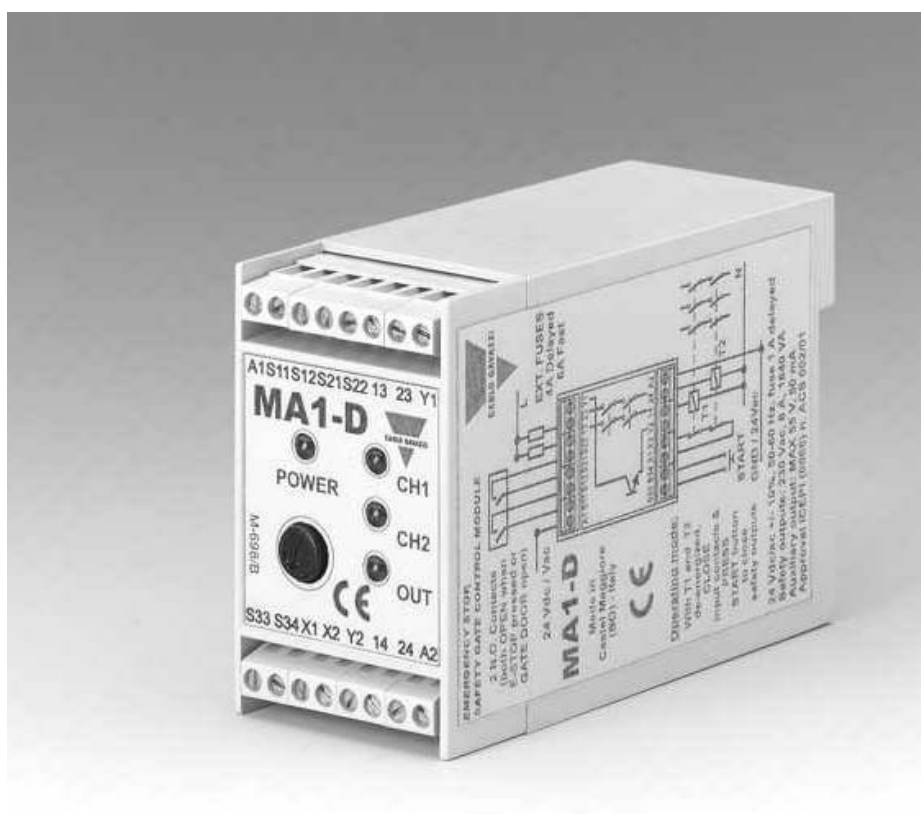


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# SAFETY MODULE MA1-D

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## USER MANUAL

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## 1. INTRODUCTION

This user manual must be read and understood completely, prior to carrying out any operation on the module, by personnel dealing with all the activities of the **MA1-D** safety module. It must be stored in a dry clean place close to where the module is used for easy consultation.

All the operations described in this manual must be carried out by carefully following all the indications given exclusively by specialised personnel.

Contact SAIET Elettronica and do not carry out any operations on the safety module, ensuring the safety of the operators, if there are any doubts over the contents of this manual, or if there is a fault or a malfunction.

The user of the module is responsible for the evaluation of the risks of the entire system. Based on the evaluation and on the standards in force in the country of use, the user decides with complete responsibility that the functions described in the user manual are suitable for use on his machine.

He must also ensure that the installation, the wiring and the regular inspections take place according to the requested risk reduction level.

The distance of the guard connected to the safety device from the dangerous area must be calculated on the basis of the machine stop time, including the device response time (see technical data: Response time), so that the operator cannot touch any moving parts.

Whenever the **MA1-D** safety module is improperly used, by not following only and all the indications of this manual or whenever these indications are partially, incorrectly or incompletely applied by personnel unspecialised and/or insufficiently informed on the contents of this manual and the machine safety directives, SAIET Elettronica is not responsible for the functioning of the **MA1-D** and its capacity to guarantee the operator's safety.

The **MA1-D** module does not require internal maintenance: if it is tampered or if the case is opened, the module loses its safety functions and the guarantee is annulled.

## 2. PACKAGE CONTENTS

The package contains :

- 1 safety module model **MA1-D**
- 1 1A, 250V spare fuse
- 1 user manual

If any anomalies are found with the package, its contents or with the safety module do not install and contact SAJET Elettronica.

## 3. CERTIFICATION

<i>BODY</i>	ICEPI srl
<i>DATE</i>	16/11/01
<i>CERTIFICATE</i>	ACS-002/01

## 4. REFERENCE STANDARDS

<i>STANDARD</i>	<i>YEAR</i>
EN 954-1	1998
EN 292-1	1991
EN 292-2	1991
EN 60204-1	1998
EN 418	1992
EN 1088	1995

## 5. CONTROL UNIT FUNCTIONS

The **MA1-D** control unit is designed to control emergency stop (E-STOP) devices and guards controls.

<i>FUNCTION</i>	<i>PROTECTION DEVICE</i>
<b>Emergency Stop (E-STOP)</b>	E-STOP pushbutton with two positive mode actuation contacts with locking (2 closed contacts with the pushbutton not pressed ⇒ safety condition)
<b>Guards controls</b>	Two mechanical limit switches, or a two independent channels coded magnetic sensor (2 closed contacts with the guard closed ⇒ safety condition)(*)

(\*) According to the indications of the EN 1088 Standard

## 6. TECHNICAL DATA

<b>GENERAL FEATURES</b>	<b>VALUES</b>
Supply voltage	24 Vac $\pm$ 10% 50 $\div$ 60 Hz, 24 Vdc $\pm$ 10%
Current consumption	100 mA (@24Vdc, without load)
Power consumption	$\leq$ 7 VA
Input	4 terminals inputs (2 contacts voltage free)
Safety category (EN 954-1)	Up to 4 (depending on the application)
Emergency stop category (EN 60204-1)	0
Short circuit protection	Delayed 1A 250V fuse
Housing	ABS (NORYL) Flammability class VO-UL94
Connection terminals	16 terminals in PA 6.6 Flammability class VO-UL94
Fixing	OMEGA-DIN EN 50022 guide
Degree of protection: Safety module	IP30
Installation location minimum	IP54
Electromagnetic compatibility	EN 50081-1; EN 50082-2
Operating temperature	0 $\div$ 55°C
Storage temperature	-25 $\div$ 55°C
Relative operating humidity	30 $\div$ 95%
Relative storage humidity	30 $\div$ 95%
Section of cables to be connected to the terminals	0.2 $\div$ 4 mm <sup>2</sup> (rigid) 0.2 $\div$ 2.5 mm <sup>2</sup> (flexible)
Dimensions	75 x 45 x 110 mm
Weight	240 g

<b>TIMINGS</b>	<b>VALUES</b>
Response time (guard open/E-STOP pushbutton pressed $\Rightarrow$ safety output open)	$\leq 25$ ms
START procedure delay (START pushbutton pressed $\Rightarrow$ safety output closed)	$\leq 150$ ms
Contemporaneity (in closing) between the two input channels	$\leq 200$ ms

<b>OPTOCOUPLED AUXILIARY OUTPUT (*)</b>	<b>VALUES</b>
Maximum phototransistor collector current	50 mA
Maximum phototransistor collector / emitter voltage	55 V

(\*) The optocoupled auxiliary output status coincides with the safety output status; it can only be used for non-safety secondary warnings or controls.

<b>SAFETY OUTPUTS</b>	<b>VALUES / FEATURES</b>
Function	<b>Open contacts:</b> safety outputs disabled (danger or fault detected or lack of power condition) <b>Closed contacts:</b> safety outputs enabled (safety condition for the operator)
Maximum switching voltage	230 Vac, 300 Vdc
Maximum switching current	8 A
Maximum switching power (ohmic load)	1840 VA
Contacts protection	External fuse: delayed 4 A / fast 6 A
Mechanical life	$> 10^7$ switching
Electrical life (with maximum load)	$> 10^5$ switching
Torque setting on connection terminals	0.5 Nm

LED WARNINGS	VALUES	
	ON	OFF
POWER	module powered	module not powered
CH1	contact on channel S21-S22 closed	contact on channel S21-S22 open
CH2	contact on channel S11-S12 closed	contact on channel S11-S12 open
OUT	safety outputs closed	safety outputs open

## 7. INSTALLATION

### 7.1 Warnings

- The safety module **MA1-D** must be installed following the standards in force in the country of use, when the machine is not powered and with no dangers for the operator, on the machine's electrical board in a dry and clean place, fixed on the special DIN rail.
- Install the module in an electrical board with a minimum protection degree equal to IP54.
- Ensure that close to the module installation point there are no conductors, cables or free materials that can come into contact with the module.
- To avoid interference due to coupling, run the limit switches connecting conductors separately from the power conductors.

- Ensure that the machine can operate in temperature and humidity conditions according to the technical data of this manual.
- Avoid installation during storms.
- Do not dispose of the packaging in the environment.

### 7.2 Wiring

It is recommended to use conductors with section and length adequate to the currents and distances 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.

The safety module **MA1-D** can be connected and used with mechanical limit switches or with coded magnetic sensors (complying with standard EN 1088), or with two channels E-STOP pushbuttons.

In any case two independent contacts must be connected to the module's inputs, which must be:

- **both open** (equivalent to an open circuit) in case of a dangerous situation for the operator (guard open and/or E-STOP pushbutton pressed), or
- **both closed** (equivalent to a short circuit) in case of an absence of a dangerous situation for the operator (guard closed and/or E-STOP pushbutton not pressed).

Opening even just one input contact leads to a safety condition

forcing the safety outputs into an opening status (open circuit) and avoiding their closure.

Closing both inputs enables the machine to start, in the manual START configuration, whilst it starts the machine in the automatic START configuration.

The user is completely responsible for choosing the device to connect to the **MA1-D** module, evaluating the risks and deciding the device that with the module will guarantee the requested safety category.

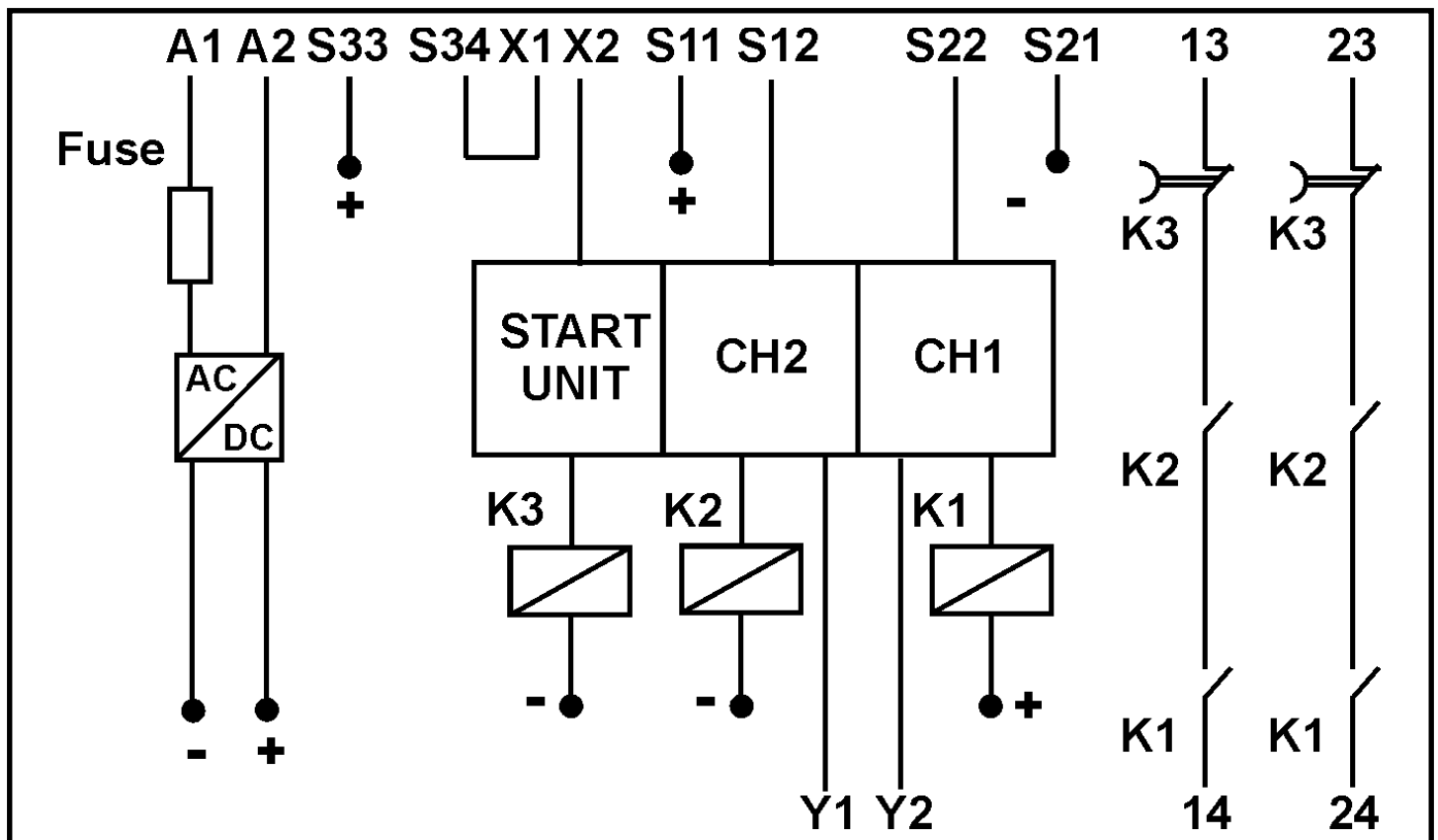


Fig 1 – MA1-D module block diagram.

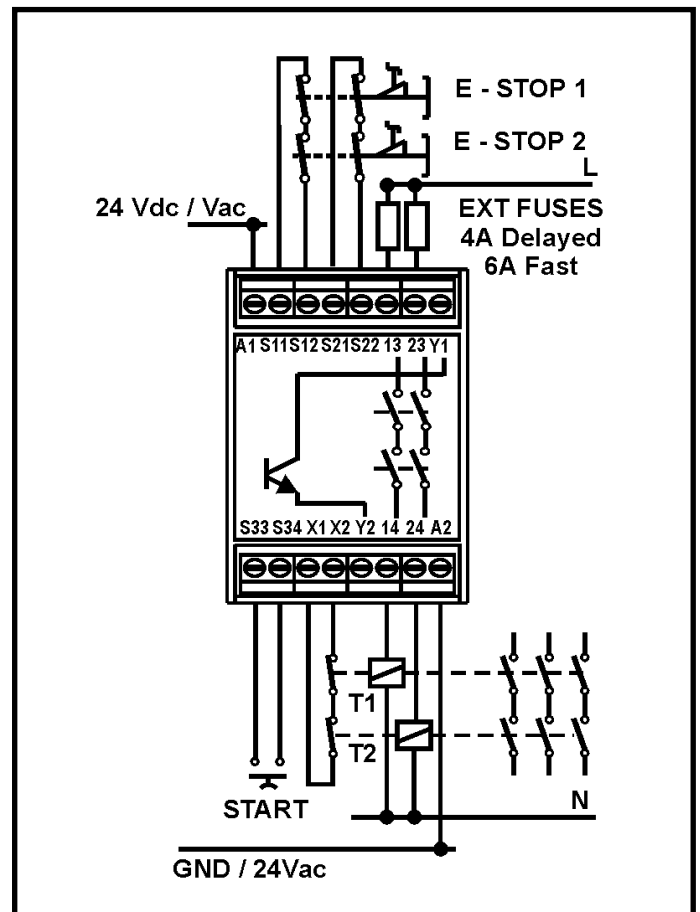
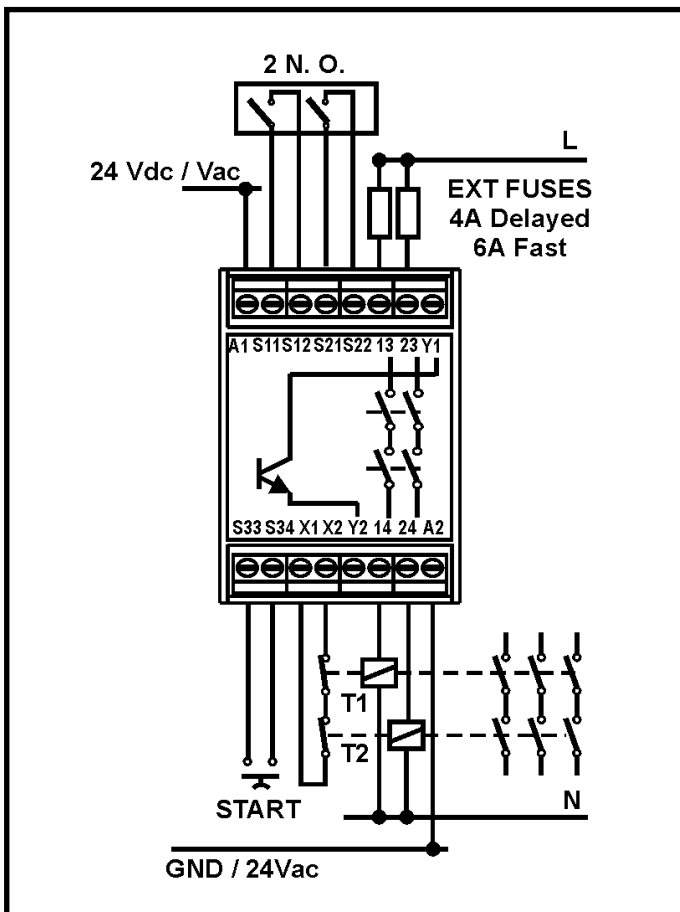
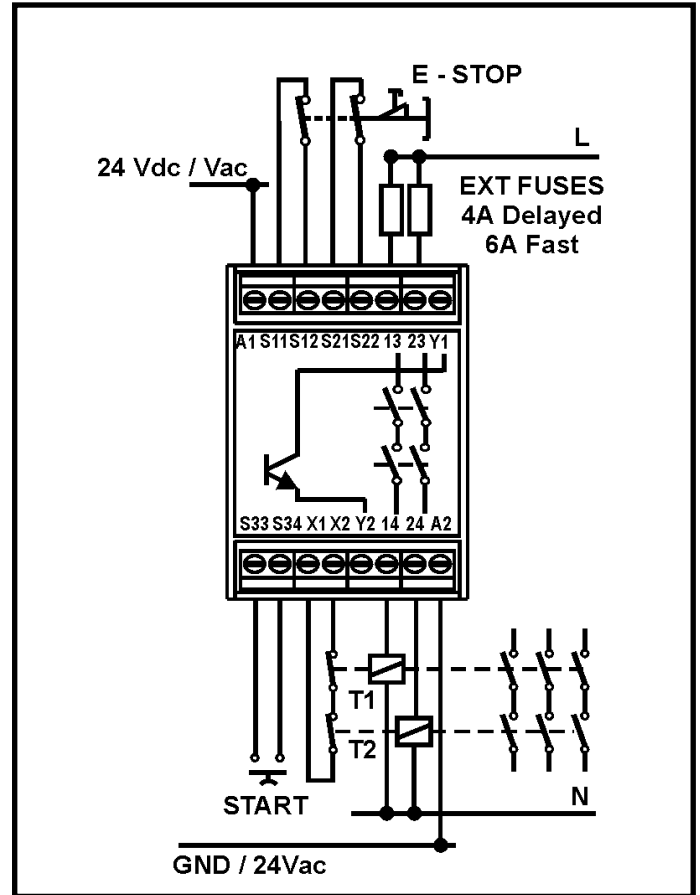
<b>TERMINAL</b>	<b>FUNCTION / CONNECTION</b>
<b>A1</b> ( <i>Power supply</i> )	+24 Vdc / 24 Vac
<b>A2</b> ( <i>Power supply</i> )	GND / 24 Vac
<b>S11-S12</b> ( <i>Input</i> )	<b>First channel</b> (E-STOP pushbutton/limit switch/sensor contact): <i>CLOSED</i> with E-STOP pushbutton not pressed/guard closed ⇒ machine start enabled condition <i>OPEN</i> with E-STOP pushbutton pressed/guard open ⇒ machine start disabled condition
<b>S21-S22</b> ( <i>Input</i> )	<b>Second channel</b> (E-STOP pushbutton/limit switch/sensor contact) <i>CLOSED</i> with E-STOP pushbutton not pressed/guard closed ⇒ machine start enabled condition; <i>OPEN</i> with E-STOP pushbutton pressed/guard open ⇒ machine start disabled condition
<b>X1-X2</b> ( <i>Inputs for external contactors or relay feedback</i> )	N.C. contacts of force guided external contactors
<b>13-14</b> ( <i>Redundant safety outputs</i> )	<b>First safety output</b> (OPEN in case of danger or of fault detected or lack of power; CLOSED in safety condition)
<b>23-24</b> ( <i>Redundant safety outputs</i> )	<b>Second safety output</b> (OPEN in case of danger or of fault detected or lack of power; CLOSED in safety condition)
<b>Y1</b> ( <i>Non safety auxiliary output</i> )	Optocoupled output phototransistor collector
<b>Y2</b> ( <i>Non safety auxiliary output</i> )	Optocoupled output phototransistor emitter
<b>S33-S34</b> ( <i>START</i> )	START pushbutton (to be short circuited in case of automatic START)(*)

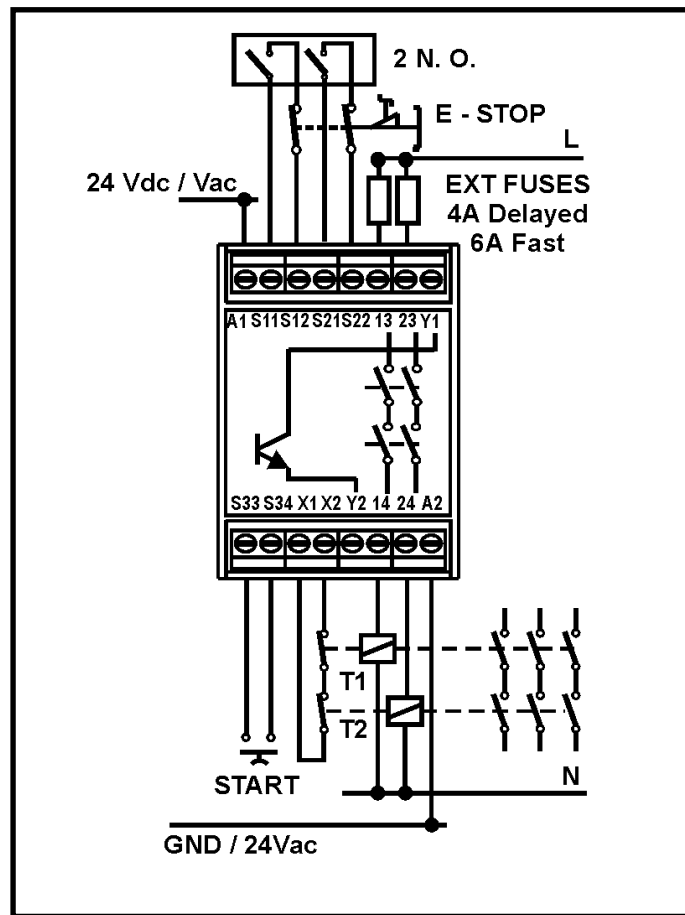
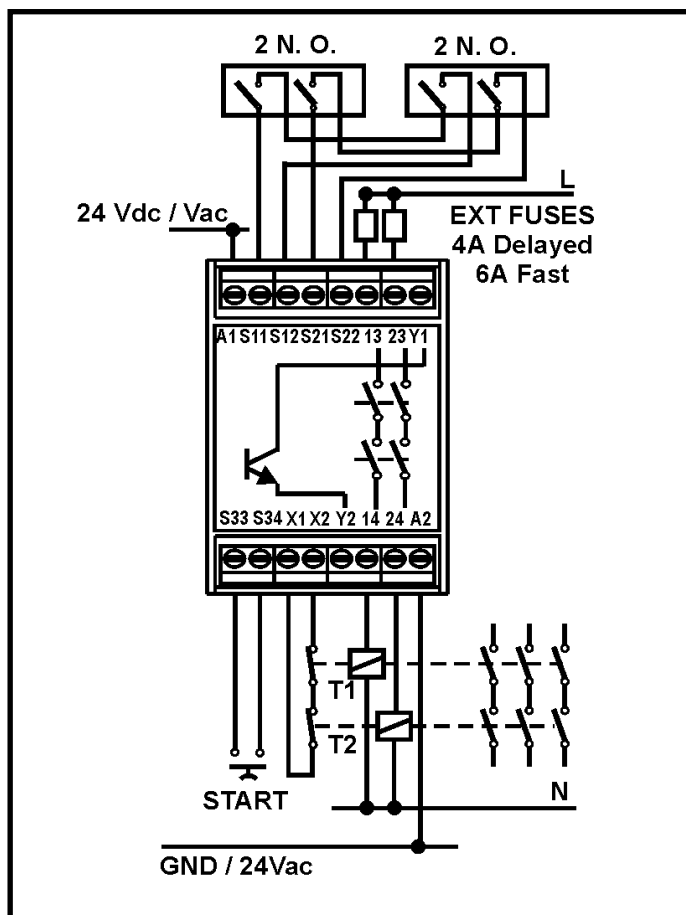
(\*) *The START pushbutton is not monitored, so that if the pushbutton gets welded the machine start is no longer manual but becomes automatic.*

### 7.3 Installation examples

The applications display the configurations of E-STOP pushbutton/s not pressed and of guard/s open.

**NOTE:** The external relays T1 and T2 showed in the examples, must be **force guided** relays, so that the module can check their status with a feedback on the X1 and X2 terminals. If a non-force guided relay is used, the module is no longer able to guarantee the detection of any faults to the T1 and/or T2 relays increasing the risk of injury for the operator.





## 8. INSTALLATION PROCEDURE

The installation procedure of the safety module must be repeated every time it is installed and every time the wiring is changed and at regular intervals by carrying out *in sequence all* the steps described below without any type of condition dangerous for the operators.

### STEP 1: Check of the wirings and of the assembly

The inspection includes the visual control, the integrity control, the correct positioning on the machine control, the correct installation control and the correct functioning of all the devices (E-STOP pushbuttons, safety limit switches, START

pushbutton, external contactors) that control or are controlled by the **MA1-D** safety module as well as the correct tightening of the cables and that they are not squashed or excessively pulled.

### STEP 2: Activation

- Connect the power supply to the terminals **A1** and **A2** and check that the safety outputs are open, the **POWER** LED is on and the **CH1**, **CH2** and **OUT** LED are off.
- Unlock the E-STOP pushbutton, close the guard and check that the safety outputs are open, the **POWER**, **CH1** and **CH2** LED are on and the **OUT** LED is off.

- Press the **START** pushbutton and check that the safety outputs are closed and the **POWER**, **CH1**, **CH2** and **OUT** LED are on.

### **STEP 3: Safety function check**

- Press the E-STOP pushbutton/open the guard and check that the safety outputs open, that the **POWER** LED is on and the **CH1**, **CH2** and **OUT** LED are off.
- Unlock the E-STOP pushbutton/close the guard; press the **START** pushbutton and check that the safety outputs are closed, that the **POWER**, **CH1**, **CH2** and **OUT** LED are on.
- Check that the safety outputs do not close just by unlocking the E-STOP pushbutton / closing the guard without pressing the **START** pushbutton.

Repeat all the step 3 operations for each sensor, E-STOP pushbutton or limit switch connected to the input terminals.

### **STEP 4: Feedback circuit check**

- Disconnect the conductor relative to terminal X1 (or X2), unlock the E-STOP pushbutton/close the guard, press the **START** pushbutton and check that the safety outputs are open, the **POWER**, **CH1** and **CH2** LED are on and the **OUT** LED is off.

- Reconnect the disconnected conductor and press the **START** pushbutton, checking that the safety outputs are closed, the **POWER**, **CH1**, **CH2** and **OUT** LED are on.

### **STEP 5: Safety outputs and optocoupled auxiliary output check**

Check that both the safety outputs are closed and that the optocoupled auxiliary output functions correctly during each STEP described above.

## **9. USAGE PRECAUTIONS**

With automatic **START** configuration, S33-S34 terminals must be short-circuited. The safety outputs close immediately after unlocking the E-STOP pushbutton/closing the guard.

It is recommended to connect a fuse in series to the safety outputs to reduce the risk of the safety outputs contacts welding (see outputs technical data).

Never, in any situation, connect spark quenching unit circuits in parallel to safety outputs contacts: the safety function would no longer be guaranteed.

Never, in any circumstance, exceed the electrical ratings indicated in the technical data table of this manual.

If the safety module does not reduce sufficiently the machine risks, the user must employ other protection measures to prevent the operator's physical access to the danger zone.

The condition of safety outputs open points out the presence of a fault or a dangerous condition for the operator. If the module opens its safety outputs the cause must be found. Once every cause of danger for the operators has been eliminated, the machine can be restarted.

The **MA1-D** module must be used for safety functions along with safety devices that conform to the standards applicable to such devices.

The **MA1-D** safety module can constitute, with the input device, a category 4 system according to the EN 954-1 standard, if it is used according to this manual's indications with one of the following devices connected to the input terminals:

- SAIET Elettronica mod. SMS-03 sensor and CLS coded magnetic unit, or
- 2 mechanical safety limit switches, or
- two channels coded magnetic sensor with requirements conforming to EN 1088 standard,

or

- E-STOP pushbutton with two positive opening independent channels with lock.

## **10. REGULAR INSPECTIONS AND MAINTENANCE**

The integrity of the safety module and of all the parts connected to it must be checked regularly.

*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 carried out by the person responsible for such evaluations.*

**Operator safety can be compromised by the lack of regular inspections or maintenance, or if they are carried out incorrectly, or by non specialised personnel, or at lower intervals than prescribed.**

Regular inspections consist of carrying out an inspection of the wiring, of the installation and of the integrity of the safety module, of its command and actuating devices and in repeating *all the operations* listed in the **INSTALLATION PROCEDURE** section.

Maintenance also includes a regular cleaning of the safety module (dust and other substances must be removed from the module and it must be dried of liquids or any condensation) and of all integrated command or actuating devices connected, that must be carried out whilst the machine and module are rigorously not powered.

**NOTES**



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