TGR-T2 series

Multiray safety control unit,
safety level 2,
from 1 to 2 pairs of photocells

USER'S MANUAL

CE

The device conforms with the EC requirements in compliance with the following standards:

-Low Voltage Directive 73/23/EEC
-EMC Directive 89/336/EEC
-Machinery Directive 89/392/EEC
-IEC 61496-1: 1997
-FDIS IEC 61496-2: 1997
-DIN V VDE 0801: 1990 and
-amendment A1: 1994
-EN 50081-2: 1993
-EN 55022: 1994
-DIN EN 60204-1: 1993
-prEN 50178: 1996
-IEC 664-1: 1997

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INDEX

1 BEFORE USING THE DEVICE.

1.1 GENERAL INSTRUCTIONS.

Read this manual and the manual of safety PES (safety photoelectric switch) carefully and completely. Make sure the user information provided is understood before attempting to operate the safety PES.
Keep the manual in a secure and convenient location and confirm information if necessary.
To guarantee correct installation, carefully follow the instructions of this manual.

- Do not touch non-insulated cables, unless they have been disconnected from the power supply.
- Make sure that the cables connected to the control unit are not taut and that they do not hinder the movement of persons or objects.
- Before carrying out any outer operation, turn off the power.

Failure to do so may result in lethal or serious injury.

1.2 ROUTINE MAINTENANCE.

The following symbols are used for highlighted items in order to ensure safe and proper use of the TGR-T2. Highlighted items are critical for safe operation and must be heeded at all time.


NOTICE


WARNING

1.3 ROUTINE MAINTENANCE.

Be sure to conduct inspection regularly.
Please refer to sec.10 and the safety PES instruction manual.
Techno-GR refuses to accept any responsibility for damage to persons or object due to the incorrect use / installation of the control unit and safety PES.

2 GENERAL INFORMATION AND MAIN APPLICATIONS.

The multiray safety control unit of the TGR-T2 series has been produced to meet the need to protect persons in areas where it is necessary to guarantee the safety of the operator using machines, robots or in general automatic systems which are considered dangerous or subject to casual or undesired access to unsafe parts.
The system conforms with the requirements for safety devices of level 2 in compliance with what described in the latest international standards, that is to say IEC 61496 1-2.
This safety device is made up of a control unit protected by a plastic container so that it can be installed on a DIN/OMEGA guide; it has 16 removable screw terminals to which it is possible to connect from 1 to 2 pairs of photocells.

This version of the multi-ray safety barrier has the *'muting'* function, by means of this function it is possible to connect or disconnect one or more pair of photocells in order to allow - for instance - the material passage without stopping the machine. If the device has this function, an other function must be also possible: The *'override'* function. It represents the possibility to force the system, that is to say to close the output relays even with occupied rays in order to make it possible for the material which has gathered before the optical devices to proceed.
Both the *muting* and the *override* functions represent a system forcing; for this reason, to activate these functions some precautions limiting the reduction of the safety level have been added.
The *muting and override* function is available by simply connecting the LMS luminous warning light, supplied separately.

The presence of a limb or an object interrupting a beam causes the opening of the emergency exits and the consequent locking of the duly connected machine. It is necessary for the unit to be connected in the right position in comparison with the passage to be protected in such a way that there isn't any possibility to climb over.
Here is a list of the commonly used applications:

- ◊ Machines for the processing of wood, glass and ceramic products.
- ◊ Automatic warehouses.
- ◊ Conveying lines.
- ◊ Palletizers

The barrier has been planned with reference to the following standards:

IEC 61496-1: 1997.	Safety of machinery: electro-sensitive protective devices - General requirements and test.
FDIS IEC 61496-2: 1997.	Safety of machinery: electro-sensitive protective devices - Particular requirements for system using active opto-electronic devices.

3 OPERATION.

The control electronic system is fitted inside the control unit. The 'core' of the device is made up of a microprocessors. By means of the suitable hardware, it continuously control and check the connected photocells. No interference among the photocells is possible as they are controlled sequentially; it will be thus possible to install one or two adjacent photocells. When one or more rays are interrupted, the electronic system opens the output relays signalling which photocells have triggered by means of LEDs which can be seen on the container.
The control-unit can work in two different modes (please refer to par. 7 page 14) which he can carry out the following operations:

- TEST button: if pressed during normal operation, it checks if all the system, comprising the barrier and the machinery, is efficient. Pressing the button (opening the contact) basically simulates the interruption of one or more safety rays and it is possible to check that the machinery stops in the time and way set. If perssed after a failure detection of the unit (see the table of error code), reset the system.
- START button: It is used to start the system which has been just powered - in case you are in a condition of manual reset - and to start it again when it has locked after a relay triggering (if you are in a condition of manual reset) or after an error which can be reset (see table relating to the error codes).

Two types of different operating modes are also available:

1. Automatic restoring, that is to say after the triggering caused by the detection of an object: The barrier starts to work again normally when the object is removed.
2. Manual reset by means of the START button so that the return to the normal operating mode takes place only after the object has been removed and the button has been pressed.

During the unit working, no operation set by means of the user interface involves functions which can influence the system safety.

4 PRECAUTIONS AND INSTALLATION CRITERIA.

The safety products used must be suitable for the required application, and other influences must be also taken into account such as a room temperature, electromagnetic interference, intense light sources etc.
Please refer to the manual for specification or contact the manufacturer for details.

4.1 CALCULATION OF THE MINIMUM INSTALLATION DISTANCE.

The safety distance 'S' must be sufficient to guarantee that the dangerous area cannot be reached by the operator up to the moment in which the machine with moving part stops. The safety distance must be calculated according EN999 (European Standards. Safety of Machinery – The positioning of protective equipment in respect of approach speeds of part of the human body)
Using EN 999 formula:

$$S = (K * T) + C$$

S = safety distance.
T = T1 + T2
whereas T1 = machine response time in seconds.
T2 = unit response time in seconds including Safety sensor response time.
K = 1600 mm/s (speed of the body approaching the dangerous area).
C = additional distance depend on resolution of SLC and applicable standard

1) Multiple separate beams (EN999, clause 6.1.4)

K = 1600 mm/s
C = 850 mm

Heights recommended in EN999	4 Beams	3 Beams	2 Beams
Heights of 1st ray	300 mm	300 mm	400 mm
Heights of 2nd ray	600 mm	700 mm	900 mm

2) Single height beam (EN999, clause 6.1.5)

WHERE THE RISK ASSESSMENT ALLOWS THE USE OF A SINGLE BEAM, THE FOLLOWING VALUES CAN BE USED

K = 1600 mm/s
C = 1200 mm

The height of beam from the ground or reference plan: 750mm (EN 999)

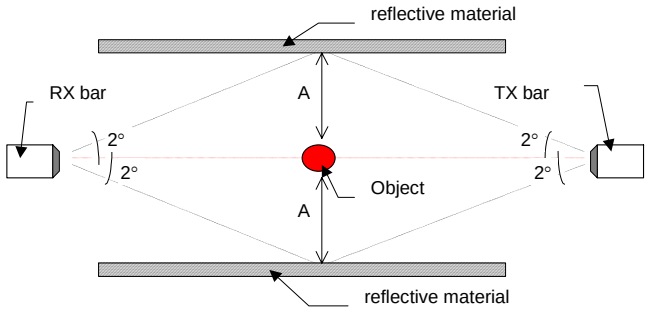
WARNING.

Always maintain the safety distance between the safety PES and a hazardous part of a machine.

4.2 REFLECTIVE SURFACES.

In case that reflective surface exist, the distance must be sufficient to avoid the possibility of passive reflections.

<Top View>



Distance between emitter and receiver (detection distance L)	Minimum installation distance D
0.3 to 3m	0.27 m
3m or more	L x tan 2° = L x 0.034 (m)

WARNING.

Do not install the safety PES in a location affected by shiny surface reflections.

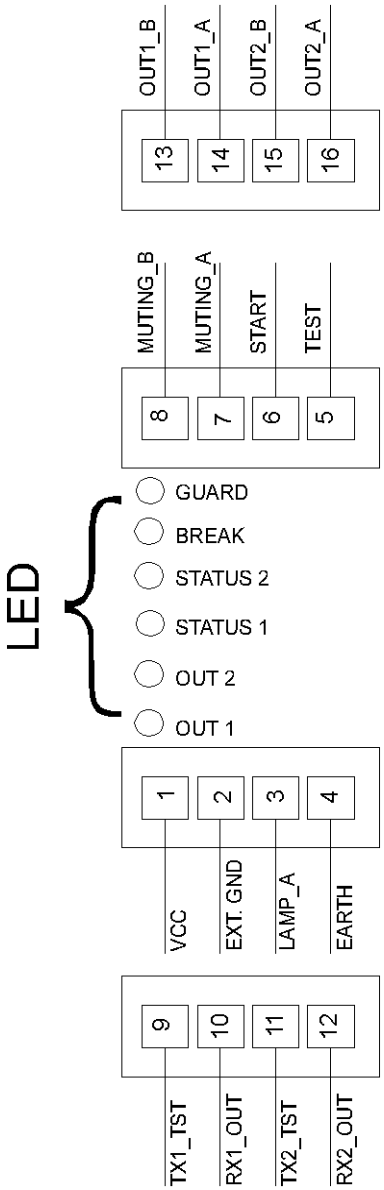
5 CONNECTIONS.

5.1 REFERENCES ON THE TERMINAL BOARD.

Here is a table reporting the function and the connection to be carried out for each number which is present on the label near the terminal board:

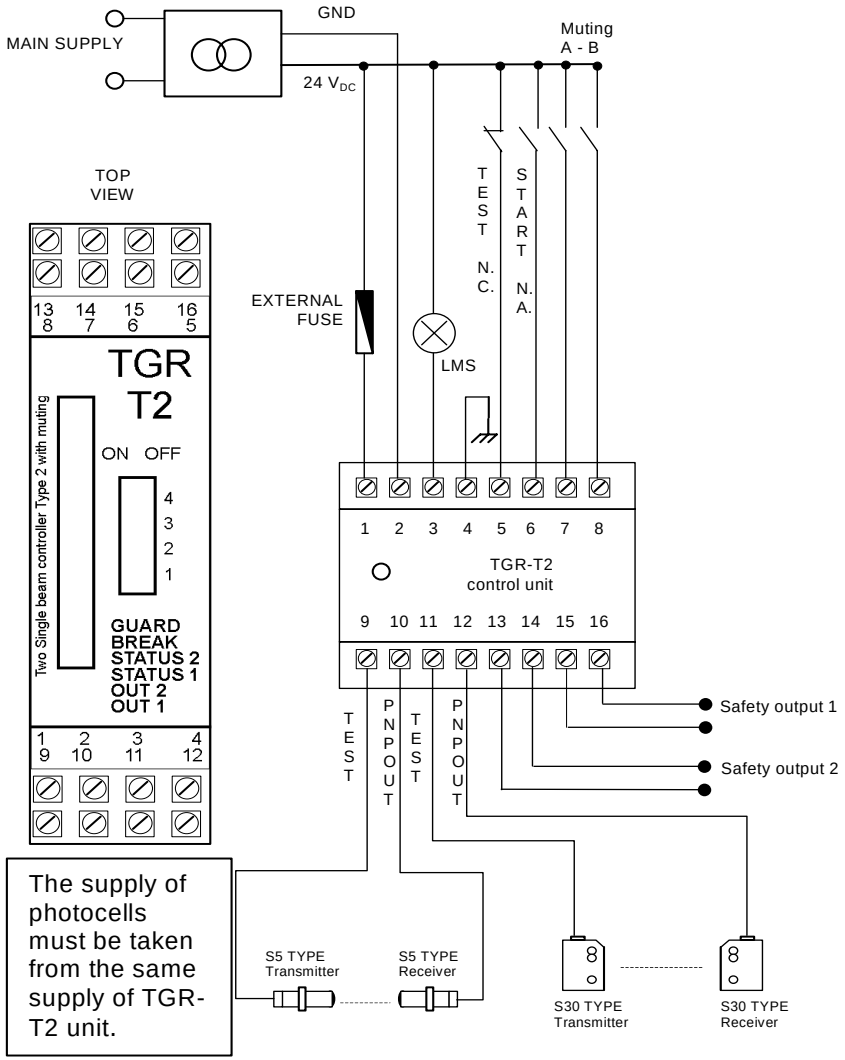
TERMINAL	OUTER CONNECTION
1 - 2	Connect to the 24 Vdc power supply, 1 to 24Vcc and 2 to 0Vcc
3	Connect the muting signaller LMS.
4	Connect to the ground of plant.
5	TEST button; connect a normally closed button (N.C.)
6	START button; connect a normally open button (N.O.)
7	Input of the muting A sensor. Connect to the N.O. contact of the muting sensor (photocell, proximity switch, other).
8	Input of the muting B sensor. Connect to the N.O. contact of the muting sensor (photocell, proximity switch, other).
9	Connect the photocells test input of transmitters TX1. Black wire (pin 4 of connector) In case of photocell S30 with terminal board, connect these terminals with terminal 3 of the photocell.
10	Connect to the PNP output of the receivers RX1, black wire. (pin 4 of connector). In case of photocell S30 with terminal board, connect these terminals with terminal 6 of the photocell.
11	Connect the photocells test input of transmitters TX2. Black wire (pin 4 of connector) In case of photocell S30 with terminal board, connect these terminals with terminal 3 of the photocell.
12	Connect to the PNP output of the receivers RX2, black wire. (pin 4 of connector).In case of photocell S30 with terminal board, connect these terminals with terminal 6 of the photocell.
13 - 14	(OUT1) safety output 1 with N.O. contact.
15 - 16	(OUT2) safety output 2 with N.O. contact.

5.2 PIN OVERVIEW



5.3 WIRING EXAMPLE.

Here is a connection example of the control unit **TGR-T2** relating to a mixed configuration in which all the available models of photocells have been used.



Please, note especially what follows:

- All models can be connected in all the possible combinations for a maximum of two pairs of sensors with at least one pair connected. In the following paragraph you can find the codes of the available models which can be used in the wished configuration.
- The transformer which is necessary to power the system must conform to standard EN 60742 (double insulation) or with equal insulation, for instance VDE 0551.
- It is necessary to protect the control unit with an outer fuse having a nominal interruption current equal to 1 A.
- The TEST and START pushbuttons must be positioned in such a way that the operator can see the protected area when he restarts, or carries out a *test* or *override* operation.
- The LMS must be positioned in a place where it can be seen from any operative point.
- Read the paragraph relating to the *muting* function and its use for the positioning of the activation sensors of this function.
- Both safety contacts OUT1 and OUT2 must be connected. If the machine has a single locking circuit, the two normally opened contacts must be connected in series.
- Photocells of the type S5-5 and S10-5 are delivered with wired cable or standard M12 connector and the wiring on the control unit is indicated according to the cable colour, or to the male connector pin number.
- Photocells of the type S30-5 are available also in the version with terminal board; in this case, it is necessary to carry out the connections by respecting the same symbols present both on the terminal board of the control until and on the photocell one.
- The connection cables of the photocells, of *muting* request, *start* and *test* must be masked with minimum section 22AWG. The screen braids must be all earthed towards the control unit side.

6 ALIGNMENT PROCEDURE.

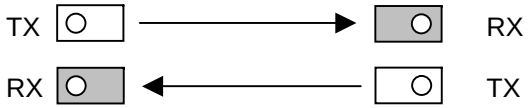
After having carried out the correct mechanical assembly and the correct connections as described in the previous paragraphs, it is necessary to align the pairs of photocells. Follow the operative modes as follows:

- Turn off the power supplying the control unit.
- Open the TEST pushbutton.
- Power the control unit.
- Align the photocells by observing the LEDs on the control unit: If the alignment of the relevant pair of photocell is correct, the LED is turned on.
- After the alignment, turn off the power supplying the control unit, close the TEST pushbutton and re-power the control unit again.
- Wait for the control unit to carry out the initial tests.
- At the end of this operation, the unit indicate the right alignment whit the guard led green on.
- Carry out all the checks described in the final checks and in the routine maintenance operations.

During aligning operations or normal working, check that the photocells connected to the same or other units do not interfere which each other, modifying their mutual position, for instance by positioning some pairs of transmitters on the other receiver side.

NOTICE

The control unit can detect the mutual interference between safety PESs. The control unit forces the output contact to open, when it detects external disturbance light including mutual interference light.
The safety PESs should be installed the following way to avoid mutual interference.
- The safety PESs are installed with sufficient distance.
- Emitters and receivers of safety PES are installed alternately as follows:



7 OPERATING PROCEDURES.

7.1 DIP-SWITCHES CONFIGURATION.

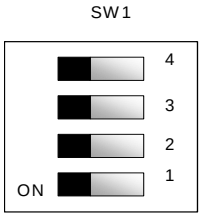
The configuration indicated in the table must be selected on the *dip-switch* available in the front label.

4	function
X	not used

3	function
Off	muting A-B act on the sensor couples 1 and 2.
On	muting A-B act on the sensor couple 1.

2	function
Off	muting 60 s
On	muting ∞ s

1	function
Off	manual restoring
On	automatic restoring



The control-unit is manufactured from the factory with the following configuration:

- Automatic restoring, all two optics in *muting*, the maximum duration of the *muting* is of sixty seconds.

7.2 CONFIGURATION OF THE NUMBER OF PHOTOCELLS.

In case you use only a pair of photocells, operate as follows:
Turn off the power and short the terminal 11-12.

At least one pair of photocells must be connected, otherwise the control unit is locked.

7.3 MUTING FUNCTION.

7.3.1 DESCRIPTION.

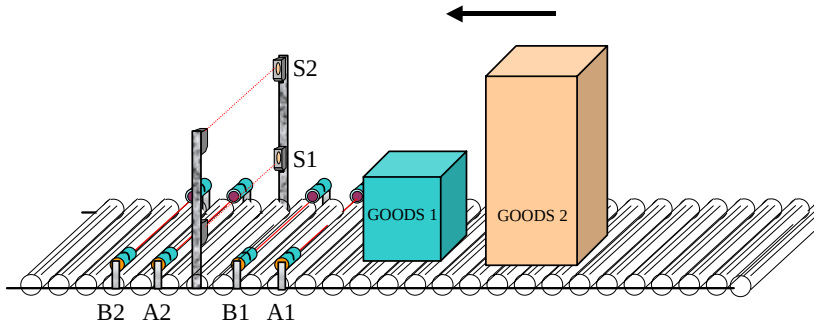
As mentioned in the introduction, the *muting* function can be enabled with any unit by simply connecting the LMS muting indicator when the unit is switched off.
This presence of this indicator is recognised everytime the unit is powered on. If its presence is detected, the unit will enable the *muting* function and if its presence is not detected the unit will ignore any request for *muting*. It is important to note that if the *muting* indicator is connected when the TGR-T2 is connected to the power supply, it will not be recognised and the *muting* function will not be enabled. Once enabled, if the indicator develops a fault or is removed without first disconnecting the unit's power supply, it will signal an error as described in section 8.

To disenable the *muting* function, therefore, the unit's power supply must be turned on without the LMS muting indicator connected.
In brief: this function, present on all units, is enabled and disenabled by means of the following simple procedure:
- Disconnect the unit's power supply.
- Connect the appropriate LMS and the muting sensors
- Restore the unit's power supply.

Bypass the muting function as follows.
- Disconnect the unit's power supply.
- Disconnect the LMS device and the muting sensors
- Restore the unit's power supply.

7.3.2 *INSTALLATION CRITERIA*

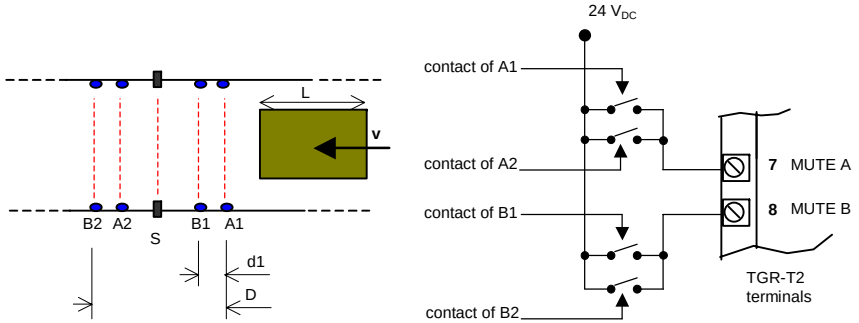
1. The *muting* sensors must recognise the material (namely pallets, vehicles, etc.) in all its length.
2. The sensors must be arranged in such a way that the material is recognised even when it must be lifted for the relevant processing.
3. In case of different transport speeds in the *muting* area, always bear in mind their influence on the *muting* total duration.
4. All the safety photocells and the *muting* sensors must be arranged in such a way that the previous material has already passed the last *muting* sensor before the new material has reached the first sensors.



In the previous figures, an installation example of a protection arranged on a conveyor is drawn. The protection photocells **S** are connected to the TGR-T2 control unit and are temporaneously cut-out at the package passage by means of the *muting* **A1**, **A2**, **B1** and **B2** activation sensors.
Sensors **A** and **B** are optical, mechanical, proximity, etc. sensors with closed contact in the presence of the object to be detected.

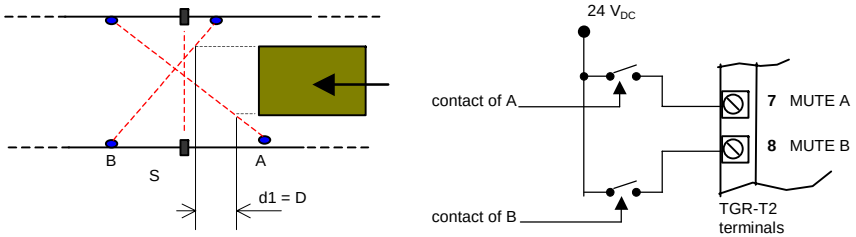
Typical application with four *muting* sensors:

Muting sensor connection:



Application with two muting sensors, passage permitted only for package 1:

Muting sensor connection:



D: minimum distance so that the *muting* sensors keep active the request; it depends on the parcel length: D < L.

d_1: necessary maximum distance so that the muting request is accepted; it depends on the parcel speed:

$$d_{max}\ [cm] = v[m/s] * 3[s] * 100$$

This distance must not allow to activate both sensors and the *muting* with the accidental passage of a person.

To allow the muting function only for the first photocells it's necessary to set the unit with the dip-switch number 3 in ON.
To allow the muting function for both the photocells the dip-switch number 3 must be setted OFF.

- The TEST and START pushbuttons must be positioned in such a way that the operator can see the protected area when he carries out start, *test* or *override* operations.
- The LMS active *muting* signalling must be positioned in a place where it can be seen from any operative point.
- If the *muting* sensors are installed very near the protection photocells , it is necessary to install the sensor receivers on the photocell sender side to avoid interference.
- The system is anyway protected from possible failures due to the cable damage; it is necessary to prepare the wiring of all connections so as to avoid damage to the connection cables.
- The control unit must be located in a cabinet with protection degree of at least IP54.

7.4 OVERRIDE.

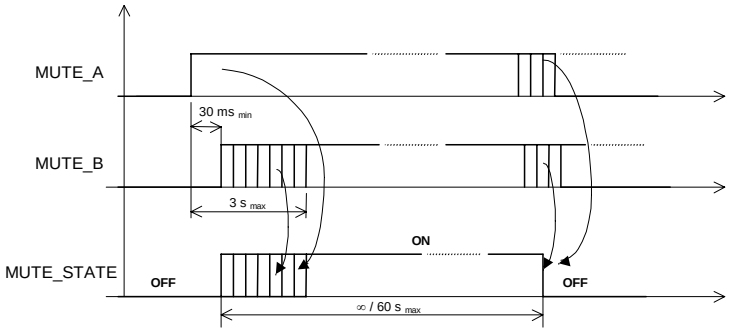
This function makes it possible to force a muting condition, if it is necessary to start the machine despite one or more rays have been interrupted by the material. The aim is that of removing from the protected area the material, which has possibly gathered before the photocells for instance because of a failure of the machine cycle.
Let's suppose that a pallet has stopped before one or more used optical devices; the conveyor belt cannot be started again because the control unit - after having detected one or more interrupted rays - will not close the output relays, thus making it impossible to free the controlled area.
By starting the override function, it will be possible to carry out this operation.

7.5 STARTING THE OVERRIDE FUNCTION.

- Switch off the device.
- Make sure that the TEST e START buttons are connected. (N.C. for the TEST button, N.O. for the START button).
- Switch on the device.
- Within 10 seconds, press together the test and reset buttons and keep pressing. (At each switching on operation, a test is carried out to check that the buttons are not locked).
- The override function has been activated. The muting lamp blinks to signal the barrier disconnection.
- The maximum duration of the override function amounts to 60 seconds after that the unit is connected again even if the buttons are pressed. Obviously, if the buttons are released before this time has elapsed, the override function will be immediately stopped.

7.6 MUTING RESTRICTIONS (muting function).

a) The request of *muting* must occur according to the correct time sequence; it is necessary to activate input MUTE_A at first and then input MUTE_B. The request of this last one must arrive within a maximum time of 3 seconds. If not the *muting* request will not be activated. A wrong sequence on the entrances of *muting* does not activate this function.
b) Since when the *muting* state is active, an object can remain for a period of time not longer than 60 s., otherwise the *muting* function is switched off. This mechanism is optional and can be deactivated when the barrier is set up with the dip-switch.
c) For all the cases in which the *muting* function is automatically disabled because of *time-out*, the request must be cut-out and re-activated to generate the following *muting* state.



It is not possible to carry out a *muting* request, if the barrier is in the opened relay state.

8 LED DIAGNOSTIC.

The user can be informed of the unit operative state by means of four LEDs.

The LED state has the following meaning:

- GREEN LEDS OUT: if switched on, the related photocells work regularly and no object is interposed; the relays are closed.
- GREEN LED STATUS: if switched on all the unit test are correctly passed, if blinking an error occurs.
- RED LED BREAK : if switched on, the unit has detected an object or an error - which can be possibly recovered by pressing the reset button - has occurred; in this condition, the relays are opened.
- GREEN LED GUARD: if switched on in green, the barrier is working regularly and there are no interposed obstacles; in this condition, the relays are closed.

The TGR-T2 has inside an easy diagnosis with the four green leds to detect the most common errors or failure that can be presents:

- One led flashing:
  Probable error in a photocells pair.

- Two leds flashing:
  Probable incorrect setting of numbers of beams connected

- Tree leds flashing:
  Probable fail in muting lamp connection

- Four leds flashing:
  Probable internal error.

All this error are resettable by the TEST pushbutton if the error condition can be removed.

THE TWO LED OUT 1 AND OUT 2 CAN BRING INDICATIONS ONLY IF THE OPTICAL BEAMS ASSOCIATED TO THE LED FLASHING ARE FREE. IF THE BEAMS ARE INTERRUPTED THE LEDS CAN ONLY BE OFF.

9 FINAL CHECKS.

Check that the area protected by the beams is free from any obstacle; check the correct triggering of the safety relay opening by interrupting the protection rays (red LED switched on, controlled machine stopped). CAUTION! If the red LED switches on and off, check the correct mechanical assembly.

NOTE. ***This check must be repeated each time you move or mechanically re-align the photocells.***

10 ROUTINE MAINTENANCE OPERATIONS.

Here is a list of checks recommended to the user to be carried out periodically by skilled workers:

- Check that the unit locks by inserting an object detecting the single elements of each photocell.
- By opening the *test* contact, check that the safety relays are opened (red LED switched on and machine under test stopped).
- Make sure that the access to the machine dangerous areas is not possible from any non-protected area and that the minimum distance from the beam dangerous parts is not lower than the one calculated with reference to the formula reported at paragraph 4.1.
- Check that it is not possible for a person to stop between the beams and the dangerous parts of the machine.
- Make sure that there is no outer damage to the unit and/or the outer electrical connections.
- Make sure that the response time - including the unit and the machine ones - does not exceed the established limits.

The frequency of these operations depends on the special applications and operative conditions according to which the unit is working.

11 GENERAL INFORMATION AND USEFUL DATA.

Safety MUST be part of our consciousness.
The safety devices are useful only if installed correctly by respecting the indications reported on the standards.
If you believe not to have the sufficient competence to correctly install the safety devices apply to our advisory service or request the installation.
We recommend to leave free space on the cover side to allow a possible easy access to the inner parts.

Trouble that cause voltage interruption on power supply may cause temporary openings of the outputs that are not damaging in any case the safety work of the unit.

The guarantee is complete for a period of 12 months starting from the delivery date of the device.
Defects which are clearly due to damage caused by an incorrect use, accidental causes or catastrophic events are not covered by the guarantee.

In case of failure, send the barrier to:

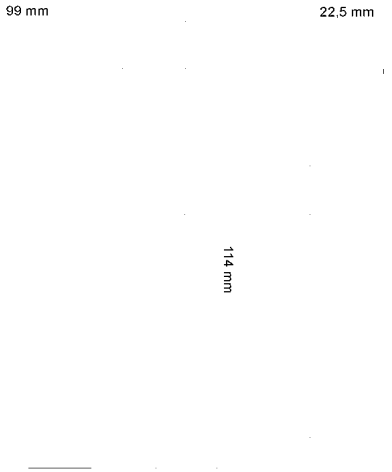
TECHNO-GR via Torino, 13/15
10046 Poirino (TO) - ITALY
Tel. +39 011 9452041
FAX. +39 011 9452090

always indicating the detected failure and the operational period.

12 TECHNICAL DATA.

- Voltage: 24 Vdc ± 10%
- Electrical input: 420 mA max.
- Combinable photocells: Omron E3FS serie
  Technogr S5-5 – S10-5 – S30-5 serie
-
- Number of photocells: two pairs max
- Wire range: size AWG 16 – 24 Solid/Stranded
- Wire type: 60/75 °C copper (Cu) conductor only
- Torque on terminals: 0.9 N*m
- Indicators: 5 green LEDs, 1 red LED
- Resolution with static test rod: S5-5, S10-5: 15mm – S30-5: 20mm
- Resolution with dynamic test rod: S5-5, S10-5, S30-5: 53mm (measured with velocity of 1.6 m/s)
- Response time: ≤ 30 ms
- Working temperature: -10 a + 55 °C
- Moisture: from 15% to 95% (not condensing)
- Output contacts: 2 NA, 115 Vac 2.5 A max
- Operative distance: according to the type of photocell
  S5-5 8m
  S5-10 8m
  S30-5 50m
- Outer controls: *start* control, *test*, *muting* and *override*
- Container: plastic container for installation on a din/omega guide
- Protection class of control unit: IP 20
- Protection class of photocells: IP 67
- Protection class of the cabinet containing the control-unit: IP54 at least
- Weight: control unit: 300 g
- Features of fuses *muting* signalling lamp: internal re-settable fuse 315mA 60V
- *Muting* signalling: LMS

13 OVERALL DIMENSIONS.



Control unit
TGR-T2