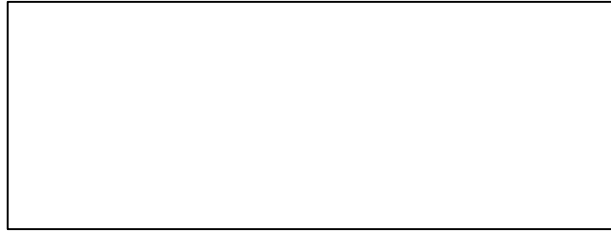

RC-TRS

Radio Remote Control System

User's Manual



Write the System Number of your Radio Remote Control Equipment here and keep it as a reference for technical support.

Using the radio Control is forbidden for anybody who has not read and fully understood this manual. Special attention should be given to the safety instructions herein contained.

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The technical features of the Radio Control as described in this Manual may be subsequently modified without notice with the sole purpose of improving the equipment to better satisfy the user.

Changes or modifications not expressly approved by TECNORD could voice the user's authority to operate the equipment

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1 SAFETY

1.1 Safety of the Radio Control System

The Radio Control System has been equipped with electronic and mechanical safety devices. Processing control signals sent by other transmitters is impossible as the transmission codes are totally unique for each system.

1.2 Safety Information

The use of the Radio Control applied to any machinery allows the operator greater freedom of movement within the working area, improved handling accuracy whilst improving both the efficiency and the safety of the operator. However, all these benefits do require a certain attention from the operator and the staff in charge of maintenance.

The correct and safe use of the Radio Control requires the operator to visually follow the remote-controlled machine.

It is therefore compulsory that anyone using the transmitting unit stops the Radio Control by pushing the Emergency stop push-button during the break times.

The maintenance staff should check that the receiver unit is not powered during the control operations, the change of the battery or the periodic or extraordinary maintenance operations in general.

Each Radio Control should be checked at least once a year. Any repair should be made at authorized centers or centers that Tecnord has recommended or directly at the Tecnord service and spare parts center. Any use of no-original spare parts or tampering by non-authorized staff immediately cancels all the warranty rights.

1.3 Authorized Operators

IMPORTANT !

Always verify the operating instructions of your machine in order to be aware of any further important information to be observed. When placing the transmitter away during the breaks, the **user must** make sure that no unauthorized people can use it by pushing the Emergency Stop push-button and locking it in a safe place. In this way, any abusive operations by unauthorized third parties will be prevented. The **user must** be able to have access to all of the operating instructions that are necessary for the smooth operation of the machine to be controlled. The user must also read and be sure to have clearly understood each section of this manual before using the Radio Control.

1.4 Safety Measures to be taken within the working area

The user should ensure that the working area in which the Radio Control will be used is free from any risks for the movement or other potential safety risks. For example, the user should verify that the working area is free from any obstacles or dangerous situations that could jeopardize the possibility of operating in total safety.

1.5 Protection Devices

All of Tecnord's industrial Radio Controls have been fitted with an Emergency Stop push-button on the control board of the transmitting unit.

Several other protection devices exist in the Radio Control system which automatically intervene whenever:

- There is a radio interference in the working area that affects the frequency range of the Tecnord Radio Remote Control;
- The action range of the transmitting unit is exceeded.

In the event of the above the Radio Control immediately activates the Emergency Stop, and interrupts any outgoing signal of the receiving unit whilst maintaining, whenever possible, continuous and constant radio contact between the transmitter and receiver.

1.6 How to react and behave in case of an Emergency

WARNING !

In any Emergency situation, immediately push the red EMERGENCY STOP Push-Button (also called: EMERGENCY STOP PUSH). Then, follow the instructions in the machine operating manual.

2 RC-TRS SYSTEM'S COMPONENTS

A Tecnord's RC-TRS Remote Control System includes the following parts:

- TRANSMITTING UNIT (RC-TRS-TX)
- RECEIVING UNIT (RC-TRS-RX)
- SERVICE CABLE
- BATTERIES (INCLUDED IN THE TRANSMITTING UNIT)
- HARNESS

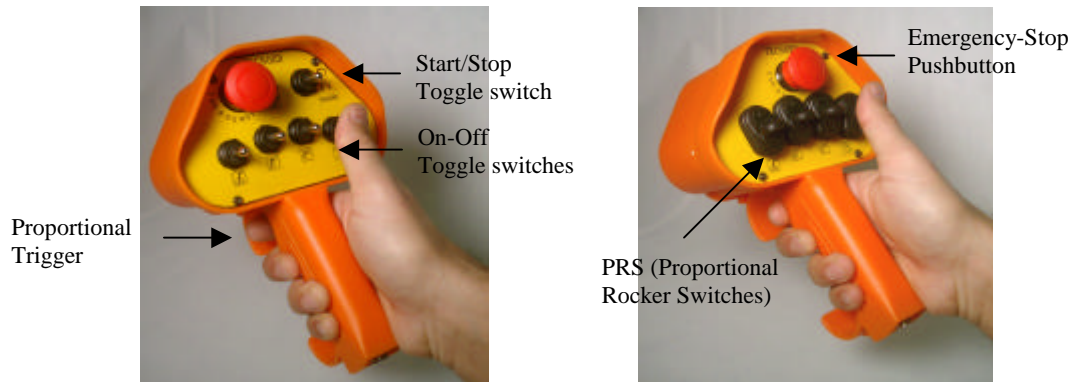
The following parts can be provided as an option:

- BATTERY CHARGE CABLE WITH PLUG FOR IN-VEHICLE CIGARETTES-LIGHTER

All the above mentioned parts are also available as spare parts.

2.1 RC-TRS -TX Control Configurations

RC-TRS transmitters (RC-TRS-TX) can be provided in several control configurations, dependign on customer's requirements. Basically, control configurations differ in the number and type of actuators. The figures below show the available actuators, while the next table outlines the actuators available in the various control configurations.



Types of actuators available in the RC-TRS-TX transmitters.

CONTROL CONFIGURATION	On-Off switches	Start/Stop switch	Proportional trigger	PRS	Emergency-Stop
RC-TRD-4F	4	No	No	-	Yes
RC-TRD-5F	5	No	No	-	Yes
RC-TRD-6F	6	No	No	-	Yes
RC-TRD-7F	7	No	No	-	Yes
RC-TRR-4F	4	No	Yes	-	Yes
RC-TRR-5F	5	No	Yes	-	Yes
RC-TRR-6F	6	No	Yes	-	Yes
RC-TRR-7F	7	No	Yes	-	Yes
RC-TRE-4S	4	Yes	Yes	-	Yes
RC-TRE-5S	5	Yes	Yes	-	Yes
RC-TRE-6S	6	Yes	Yes	-	Yes
RC-TRM-4F	4	No	No	4	Yes
RC-TRM-5F	5	No	No	5	Yes
RC-TRM-6F	6	No	No	6	Yes
RC-TRM-4S	4	Yes	No	4	Yes
RC-TRM-5S	5	Yes	No	5	Yes
RC-TRM-6S	6	Yes	No	6	Yes

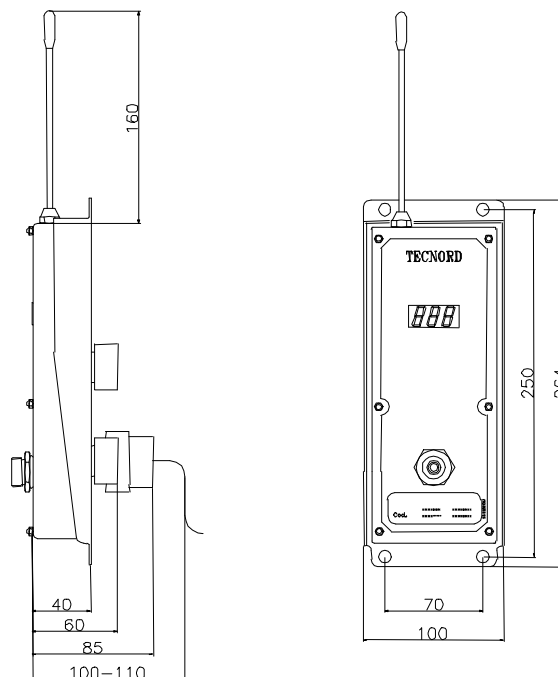
Housing and panel colours, as well as the panel printouts, are customizable.

3 INSTALLATION

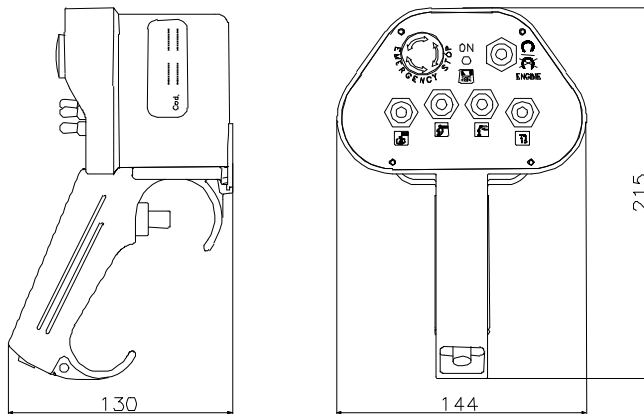
WARNING !

- Only a qualified and specialized technician should install the receiver of a radio control to the electrical system of a machine (see item 4, Maintenance) who is acquainted with both the electrical circuit of the machine and the radio control technical features.
- During the entire installation stage both the transmitter and the receiver must be turned off.
- All of the regulations on the health of the staff working within the installation area, together with any local regulations in force, and those on fire prevention must be observed.
- TECNORD declines all responsibility, neither does it grant any guarantee whatsoever for any damage caused to things or persons due to the improper or careless use of this equipment or due to the non-observance of any regulation or that, which has been indicated in the operating instructions.

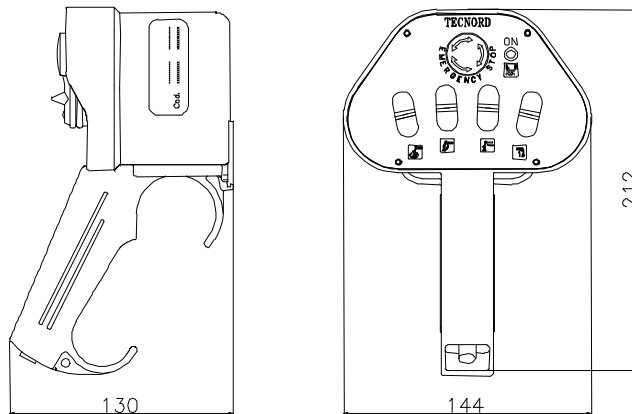
3.1 RC-TRS -RX sample drawing



3.2 RC-TRS -TX sample drawings



TRE control configuration



TRM control configuration

3.3 Positioning the receiver

WARNING !

When positioning the receiver, check that the outside antenna is not being screened by large metallic surfaces.

For the Radio Control to operate smoothly, it is necessary that the receiver should be installed in such a position as to allow the maximum reception of radio waves from the antenna. The metallic parts of the machine to be controlled that surround the receiver create a barrier that interferes with reception

In most cases, the receiver can be housed on any side of the machine or, if necessary, for installations on vehicles even inside the glass cabin. It is also necessary to place the receiver where it is accessible and safe to work both for those who carry out the installation of the electrical connections and for those who will do the future maintenance.

Make sure to keep the display visible to the user in order to ease the diagnostics of the equipment during operations.

Should such an installation be performed on board mobile machinery or on a vehicle, then you should attach rubber bumpers. These rubber bumpers will prevent strong vibrations from the machine to the receiver.

3.4 Outside electrical connections

Outside electrical connections are:

- Power Supply
- Input / Output connections

For safety reasons it is recommended to install on the controlled machine a supply disconnecting device in order to cut off the receiver's power supply when necessary. This supply disconnecting device should comply with the directive EN60947-3, cat. AC-23B or DC-23B. The following requirements apply to the supply disconnecting device:

- isolate all live conductors of the electrical equipment from the supply and have one OFF and one ON position only, that shall clearly marked with the "0" and "1" symbols respectively
- have a visible gap or a position indicator which cannot indicate OFF until all contacts are actually open
- have an external operating handle, which shall be easily accessible to the operator, and must be located between 0,6m and 1,9m above the servicing level. The device must be provided with means permitting it to be locked in the "off" position.

The receiver unit (RC-TRS-RX) makes available the contacts for the insertion of a safety push-button in series with the power supply in order to carry on a "category 0 Emergency Stop" function.

Each function that is activated on the transmitter unit (RC-TRS-TX) activates a dedicated output, or a combination of more outputs, on the receiver unit (RC-TRS-RX), depending on the configuration of the machine to be operated.

4 OPERATION

4.1 The radio transmission and servicing system

Tecnord's RC-TRS Radio Control System allows for the operating machines to be controlled in general by means of electro-magnetic waves. It is made up of a portable transmitter unit (RC-TRS-TX) held by the operator and of a receiver unit (RC-TRS-RX) that is usually installed on the machine to be controlled.

Each function originated from several devices or control actuators of the transmitter is transformed into a serial command that is coded and transmitted through a high-frequency carrier. The receiver captures the information output from the transmitter, decodes the messages and sends the controls to the machine by means of electronic power switches controlled by a microprocessor and a dedicated harness.

The information sent from the transmitter is contained in a message commonly named "telegram". This telegram consists of an identifier, a command field and a redundancy field for error control. The identifier, or matching code, contains the identification elements to match the transmitter with its coupled receiver. The command field contains all the information relevant to the commands that the machine should carry out. The error control redundancy fields allow the receiver to discard messages that are found modified by disturbs on the radio link.

As the matching code is unique for each TX/RX pair, each RC-TRS-TX transmitter can control through radio waves only its coupled RC-TRS-RX receiver, which is labeled with the same System Number.

4.2 Use of Batteries

Tecnord's Radio Control System is equipped with batteries for operating the Transmitter. Rechargeable NiMH batteries are supplied with the RC-TRS-TX transmitter and guarantee a long operating time.

The working voltage of the transmitter is constantly controlled. Should it fall below a threshold value, the corresponding indication is activated (green led blinking) each time the transmitter is put into operation. From this moment, the transmitter can continue to operate, but it is recommended to recharge the batteries as soon as possible.

Batteries are protected against short -circuit. For additional safety and ease of use, they have a dedicated location in the RC-TRS-TX transmitter.

4.3 The battery charger and re -chargeable batteries

The RC-TRS-TX transmitter unit is equipped with a battery charger circuit; therefore it is not necessary to remove the batteries for the charging operation, and is possible to operate the machine during the battery charging procedure.

In order to charge the batteries, connect the RC-TRS-TX transmitter to its RC-TRS-RX receiver unit through the service cable supplied with the equipment. As an option, a different battery charger cable can be provided, which allows the charge to be carried out from a vehicle's cigarette's lighter plug.

The charging phase for a completely discharged battery can last up to three hours, and it is continuously controlled by the microprocessor. When the battery charger states that charging is complete, it automatically disconnects, therefore avoiding overcharge phenomena that could reduce batteries life.

WARNING !

Use TECNORD original spare parts only!

If not, there is the danger of an explosion. Chemical substances that leak or parts that detach themselves can cause irreparable damage.

4.4 Control Elements

Tecnord manufactures a family of Industrial Radio Controls suitable for just as many applications. Furthermore, Industrial Radio Controls are designed according to the specific requests of the Customer or the User.

Tecnord's Radio Remote Control Equipment are designed as complete systems for controlling an operating machine's functions. Each Radio Control System can be fitted with many different control elements according to the machine to be controlled, as well as provided with standard controls for its operation, stopping, acoustic warning, start switch, warning led etc.

Push buttons, switches, selectors, joysticks and special control accessories complete the radio control. Their type and number are features of each "control configuration".

Configurations "D", "R", "E":	up to 6 toggle-switches with 3 positions (1 stable + 2 temporary) for the function's selection, 1 proportional trigger available for speed control
Configuration "M":	up to 6 PRS (Proportional Rocker Switches) for the control of more independent proportional functions

For a better diagnosis of the machine's operating status, the RC-TRS-RX receiver is equipped with a display on which is possible to make system information available.

4.5 Visual Check

WARNING !

Always check the sound condition on the transmitter before operating.

- Are all the safety devices in the correct position and in good condition?
- Are there any broken parts?
- Are all of the rubber protections and the actuator covers sound?
- Are all of the connecting plugs and cables sound?

WARNING !

Never work with a Radio Control with any of the above-mentioned damage! Always remove any of the above-mentioned faults before starting to work!

4.6 Safety Control and Start-up of the Radio Control

WARNING !

Important checks on some of the functions mentioned below are required for the first start-up of the Radio Control!

- Verify that the transmitter battery casing on the RC-TRS-TX unit also houses a rechargeable battery.
- Release the Emergency Stop Push Button on the RC-TRS-TX unit, if pressed.
- Now, your Radio Control is ready to work. Activate any function on the transmitter unit and verify whether the machine stops when the same function is released should you release it or re-set it to zero.

- Now check that the Emergency Stop function works exactly as described by the manufacturer of the machine by applying the following procedure:
 1. Start any of the functions of the transmitter and verify that the function is activated by the receiver and keep it running
 2. Push the Emergency push button on the transmitter
 3. Verify that the function carried out stops immediately and that no other functions can be then operated from the transmitter
 4. Was the safety control successful and does the Emergency Stop function work perfectly?
 5. Now release all the control elements
 6. Release the Emergency stop push button, your radio control is now ready to operate in total safety

WARNING !

Should any fault or problem be noticed during the initial starting, turn the machine off immediately. Never operate the machine unless the Emergency Stop Button functions properly. Serious danger exists for both people and things from the non-observance of this extremely important regulation. Any operation not conforming to this basic operating rule may lead to the loss of both the operating permit and your warranty.

4.7 Functions operation

Two possible types of electronic control exist that can be operated from the Radio Control, the digital and analog also named ON-OFF and Proportional respectively. The ON-OFF control determines either the activation or deactivation of an output stage within the receiver when the transmitter activates this control. Usually, these are commands that can be sent from push-buttons, switches, selectors or digital joysticks.

The Proportional control is a function determining a variable output in either current or voltage in a way which is directly proportional to the position of an analog actuator on the transmitter, be it proportional trigger, a potentiometric joystick or a simple potentiometer. Tecnord manufactures different types of proportional controls for several models of solenoid valves, servo controls or other devices. The transmission technology remains unchanged, while the proportional output stage of the receiver is designed for the different requirements of the command to be carried out.

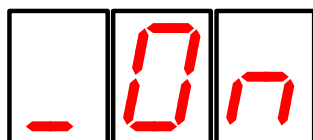
4.8 Diagnostics

The RC-TRS Radio Control System allows diagnostics on both the RC-TRS-TX transmitter unit and the RC-TRS-RX receiver unit.

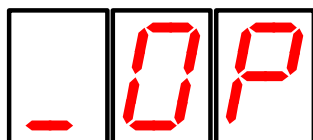
The RC-TRS-TX has an internal buzzer and a green led located on the control panel. The buzzer emits a short beep each time the transmitter is turned on activating the radio-frequency carrier. The green led lights when any function is activated: when the "low battery" condition is entered, the green led blinks during operations.

The RC-TRS-RX receiver is equipped with a 7-segments led display. Upon power-on, the receiver performs a short self-diagnosis cycle, during which some indications about the current software release are displayed.

During the normal operating mode the receiver's display helps in the diagnosis of the current operations status through the following indications:



Machine ready (waiting for command)

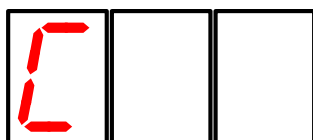


Operation in progress (at least one function is active)



Open circuit found on an output

the display also shows the name of the output where the fault has been found



Short circuit found on an output

the display also shows the name of the output where the fault has been found

Example of fault diagnostics:



Open circuit on output 3B

4.9 Operating problems

Repairs and checks following failure of the Radio Control equipment must be carried out according to the instructions below so that the system maintains all of its original features. In the event of malfunctions, check that the machine provided with Radio Control operates properly with traditional control systems (such as, for example, cable control, fixed panel etc.).

Verify that in the area you are operating in with your Radio Control no other Radio equipment has started working and is operating on the same radio frequency. Also verify that you are operating the transmitter with its own coupled receiver.

If the outputs of the receiver unit are not energized when commands have been transmitted and the machine cannot therefore carry out any operation, then check the state of the receiver's power supply fuse, check the wiring connections to find out if any of the wires is not properly connected or is out of its housing or coupling.

The non-operation of the RC-TRS system may depend on either the transmitter or the receiver. The table located in the following paragraph may help in the diagnosis of the most common causes of malfunction.

4.10 Troubleshooting table

Tecnord's Radio Control Systems implement a microprocessor technology in both the RC-TRS-TX and RC-TRS-RX units. Each system is subject to a quality assurance test at the manufacturer's plants before being delivered to the customer. However, should a failure subsequently occur, a swift diagnosis is possible and hence a quick reset of the Radio Control through the technical assistance service.

FAILURE	POSSIBLE CAUSE	ACTION
No reaction of the RC-TRS-RX when turned on	Batteries are completely discharged	Recharge batteries
The RC-TRS-RX display doesn't turn on	Interruption of the receiver's power supply	Turn the main switch on. Verify the connections. Measure the voltage input to the receiver unit
No reaction of the receiver to the activation of any function on the transmitter	The Emergency Stop pushbutton is pressed	Release the Emergency Stop pushbutton
	(In control configurations with proportional trigger) the proportional trigger has been pressed before activating the on-off function	Release all the actuators, activate first the on-off actuator of the function, and then use the proportional trigger for speed regulation
	The function is inhibited by blocks such as limit switches etc.	Activate only the functions that are allowed in the current machine's state
	Loss of radio communication	Verify that you are in the Radio Control's operating range Make sure that no other Radio Controls are operating on the same frequency in the same area Make sure that the receiver is not shielded by metal enclosures
Batteries short operating time	Batteries damaged or at the end of life	Replace batteries with Tecnord's original spare parts
Open or short circuit indication on one output	Wiring problems	Verify the connections the involved output

5 MAINTENANCE

Tecnord's RC-TRS Radio Control System does not require any special maintenance. However, some precautions are necessary in order to ensure that the equipment is both efficient and safe. Each radio control must be checked at least once a year. The staff in charge of maintenance must check that the receiver is not powered on during the checks and the inspection inside the transmitter.

Dust and other material from the working environment as well as dirt can deposit on the transmitter and receiver units. Remove it so that the buttons, joysticks and actuators in general, including the emergency stop push button, are always clean and therefore in good working order.

Each control unit has been designed so that all that the above causes the least amount of problems possible to the smooth operation of the Radio Control. However, careful periodical maintenance by the user will certainly prolong its life span.

The inner inspection of the transmitter should be carried out in a dry and damp-free place. As well as removing all traces of dirt and drying any condensation with warm air, the checking of the connections of the different wires and terminal boards of interconnections, as well as the dean condition of the electrical contacts of all of the control actuators is also highly recommended.

WARNING!

In the event of the possible oxidation of the electrical contacts, never use any type of anti-oxidant spray or similar product. Instead, contact your service center to immediately replace these parts. These problems can be caused by the particular environmental conditions in which the radio control operates. Using chemical products on the actuators could cause irreparable damage to the mechanical and electronic parts.

The duration and the capacity of the batteries depend on many elements such as the operating temperature, the charging and discharging cycles, but basically on how often the radio control is used. It is highly recommended to always use the battery charge until the "low battery" indication aactivates, and to replace it at least every 2 years.

Besides the regular checks on the interconnections and the firm tightening of the terminal boards for the output controls, it is recommended to check that the seal of the transmitter unit cover is in good condition and that it is watertight. After 2/3 years of operation, it is suggested to check the smooth operation of the electronic and electro-mechanical parts, their response to commands and their drop out speed. Special layers of resin-based insulating paint and with anti-oxidant properties protect the electronic parts of the Radio Control system; hence they do not require any maintenance. It is, however, necessary to check the various interconnections between the different modules.

6 DISPOSAL

WARNING !

Avoid environmental pollution.

Electrical devices and their parts are dangerous waste. This specially applies to batteries and rechargeable accumulators. Engage a specialized company for their disposal.

7 TECHNICAL DATA

7.1 Transmitter (RC -TRS -TX)

Working frequency:	from 434,050 to 434,650 MHz (European version) from 458,525 to 459,175 (USA – Canada version) 25 kHz Channel step
Available transmission channels:	25 (European version) 11 (USA – Canada version)
RF output power:	< 10 mW e.r.p.
Antenna:	Fixed internal – Lambda/4
Power Supply:	4.8 V _{DC}
Battery:	Rechargeable (NiMH)
Operating time:	10 – 12 hours
Battery charger:	Built-in (into the RC-TRS-TX) battery charge through the service cable (standard supply)
Numero comandi simultanei possibili:	All
Operating range:	about 100 m
Diagnostics:	green led
Housing material:	Fiber enforced Polycarbonate
Weight:	< 0,7 kg (with batteries)
Environmental protection:	IP 65

7.2 Receiver (RC -TRS -RX)

Working frequency:	from 434,050 to 434,650 MHz (European version) from 458,525 to 459,175 (USA – Canada version) 25 kHz Channel step
Available receive channels:	25 (European version) 11 (USA – Canada version)
Sensitivity:	- 120 dBm
Antenna:	External – Lambda/4
Power Supply:	From 8,5 to 30 V _{DC}
Output power:	On/Off outputs: Max 5A Proportional outputs: Max 1A Voltage analog outputs: 0 – 5V
Housing material:	Stainless steel
Weight:	< 1 kg
Environmental protection:	IP 65
Response time for active emergency:	< 45 ms
Response time for passive emergency:	< 250 ms

7.3 Communication Protocol

Transmission speed:	4800 bit/s
Hamming distance:	≥ 3
Matching code:	65536 combinations available
Error check:	parity on each single character vertical checksum on message horizontal checksum on message
Auxiliary channel:	RS-485, available using the standard supplied service cable