INSTALLATION MANUAL

RXO
(T-Rx 500)

FSK 12

950604-000 EN -A0

Revision History

Version	Date	Reason
A0	2014-12-02	First released version

Applicable Documents

[App. 1] Requirement specification

[App. 2] Delivery interface manual

[App. 3] Delivery user manual

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1 Introduction

The Remotus T-Rx receivers are designed to provide flexible, powerful, and cost effective remote control for off-highway vehicles and mobile machines. They shall be used together with a suitable remote control transmitter from Åkerströms range of products. The receivers within Remotus T-Rx are characterized as other Åkerströms' products with ruggedness, durability, flexibility and reliability.

The T-Rx 500 has 24+2 outputs designed for controlling valves and other actuators. Also a serial data communication is available.

This manual only covers the general installation of the T-Rx 500 remote control receiver. For the total system functionality and in-/out-put function assignment consult the requirement specification, interface manual and user manual for the actual delivery.

The way the set of in-/out-puts are used for controlling the vehicle/machine (for instance for driving the engine and the brakes of the vehicle/machine or controlling other vehicle/machine assemblies) depends on the specific installation and is out of the scope of this document.

2 Symbols

Read all safety instructions throughout this manual and on safety signs attached to this equipment.

Failure to follow all safety instructions could result in death or serious injury.

The safety alert symbol is used to alert about potential personal injury hazards. To avoid hazards, obey all safety messages that follow this symbol. Inform all personnel that are working with the product.

The following safety alert symbols and signal words are used in this manual to inform the user of hazards.

Indicates a potentially risk of high voltage which, if not avoided, could result in death or serious injury or property damage.

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury or property damage.

!

Indicates a condition which, if not avoided, could result in damage to or poor functionality of the product.

3 Warnings regarding installation and maintenance work

This manual must be read and understood before installing and starting the radio remote control system to ensure safe and secure operation.

The installation and/or maintenance work must be carried out by a qualified and educated person in accordance with country installation rules and regulations. Only a correct installation can ensure the necessary level of safety during use.

Before any work on the receiver disconnect the power supply.

Disconnect voltage when working with installation wiring.
Voltage may be supplied from different power sources.

As the antenna installation may require work to be carried out on the vehicle/machine roof care should be taken to protect personnel from falling.

Read the User Manual before attempting to use the transmitter.

If testing of the installation also includes moving, make sure no personnel or equipment is in the area of moving objects.

Disconnect voltage when connecting/disconnecting connectors.
Voltage may be supplied from different power sources.

At high ambient temperatures, the receiver units' surface gets hot. Do not touch the surface. In these situations the receiver shall be installed out of reach.

4 Receiver overview

The T-Rx receiver consists of the following parts:

- One receiver T-Rx 500
- One antenna

4.1 Receiver T-Rx 500

Dimensions:	240x177x67.5 mm, connectors excluded
Weight:	1.6 kg
Power supply:	12 V DC nominal (6-16 V DC) max 0,35 A @12 V DC, outputs excluded 24 V DC nominal (10-21 V DC) max 0,175 A @12 V DC, outputs excluded
Ambient temperature:	-25 °C - +70 °C.
Degree of protection;	IP67

4.2 Antennas

The antenna connector is of type

- SMA for 400 and 800 MHz radio band
- Different antennas and connection cables are available

5 Installation preparation

The T-Rx 500 receiver can be operated within a wide ambient temperature range according to the technical specifications below. Due to the additional self-heating, proper derating or cooling is needed.

See chapter “13 Derating”.

Select a proper space on the vehicle/machine for the receiver.

- The receiver shall be installed on a flat surface
- The receiver shall be protected against weather conditions and excessive mechanical damage
- The receiver must be fixed with four screws M5 x L

! Do not install the receiver close to heat generating equipment. As the internal heating of the device electronics is dissipated via the housing, sufficient cooling must be ensured in case of “sandwich mounting”

! Be sure to connect the earth from loads close to the RXO receiver earth to avoid risk of EMC interference

! Do not install the receiver close to equipment likely to produce radio interference disturbance

! Do not install on a structure that is prone to vibration

Make sure that it is possible to install the necessary cabling between the receiver and

- the antenna. Maximum cable length 10 m
- the vehicle/machine control system

The antennas shall be installed on the vehicle/machine on a conductive surface. See chapter “6.5 Antenna installation”.

! Do not install the antennas close to equipment likely to produce radio interference disturbance

6 Installation

The installation shall be carried out by qualified personal.

Ensure compliance to national and vehicle/machine depending installation regulations.

Over current protection for the receiver power supply and interface circuit is not provided with this enclosure. Over current protection must be provided as part of the installation.

6.1 *Functional diagram*

The receiver functional diagram shows how to connect the equipment, see document attached to the specific delivery.

6.2 *Mechanical installation*

The receiver shall be installed on a flat surface or similar construction. Make sure that the structure may support the load of the receiver.

If possible the cable entry of the interface connector should be mounted pointing downwards. Mount the receiver using the mounting slots on each receiver end block as shown in Figure 1 below.

Fasten the receiver with four M5 screws. Fasten the screws with a torque of 2 Nm.

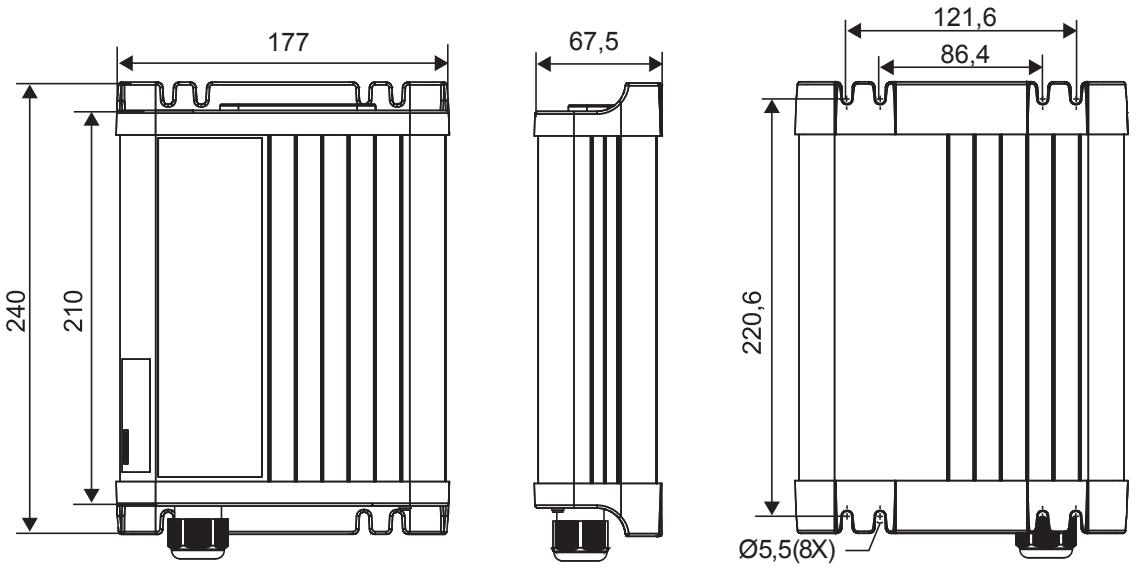

Figure 1. Receiver mounting dimension

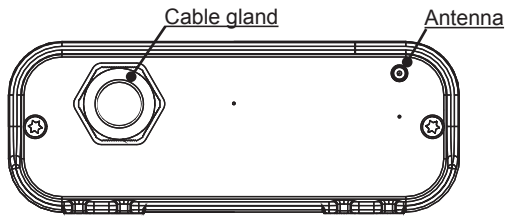

Figure 2. Receiver front side

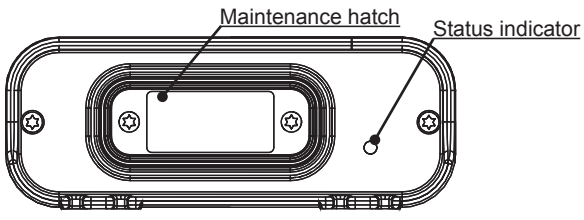

Figure 3. Receiver back side

6.2.1 Connecting earth to receiver housing

To ensure the receiver against electrical interference the housing shall be connected to ground. If a proper connection is not achieved by the fastening screws an additional earth cable shall be connected to one of the fastening screws of the receiver. Recommended wire size 2.5 mm^2.

For vehicles, ground refers to vehicle body.

Do not install the receiver on a vehicle/machine with positive grounding.

If the receiver is installed on an industrial truck the receiver must be mounted isolated from the frame. In the antenna cabling a DC block must be used.

Åkerströms can provide one suitable DC block 944498-000.

The insulation resistance between the receiver and the frame shall be at least 1000 Ω multiplied by the nominal voltage of the truck system according to EN 1175-1 + A1, Safety of industrial trucks - Electrical requirements - Part 1: General requirements for battery powered trucks.

6.3 Connections and switches on the MAIN board

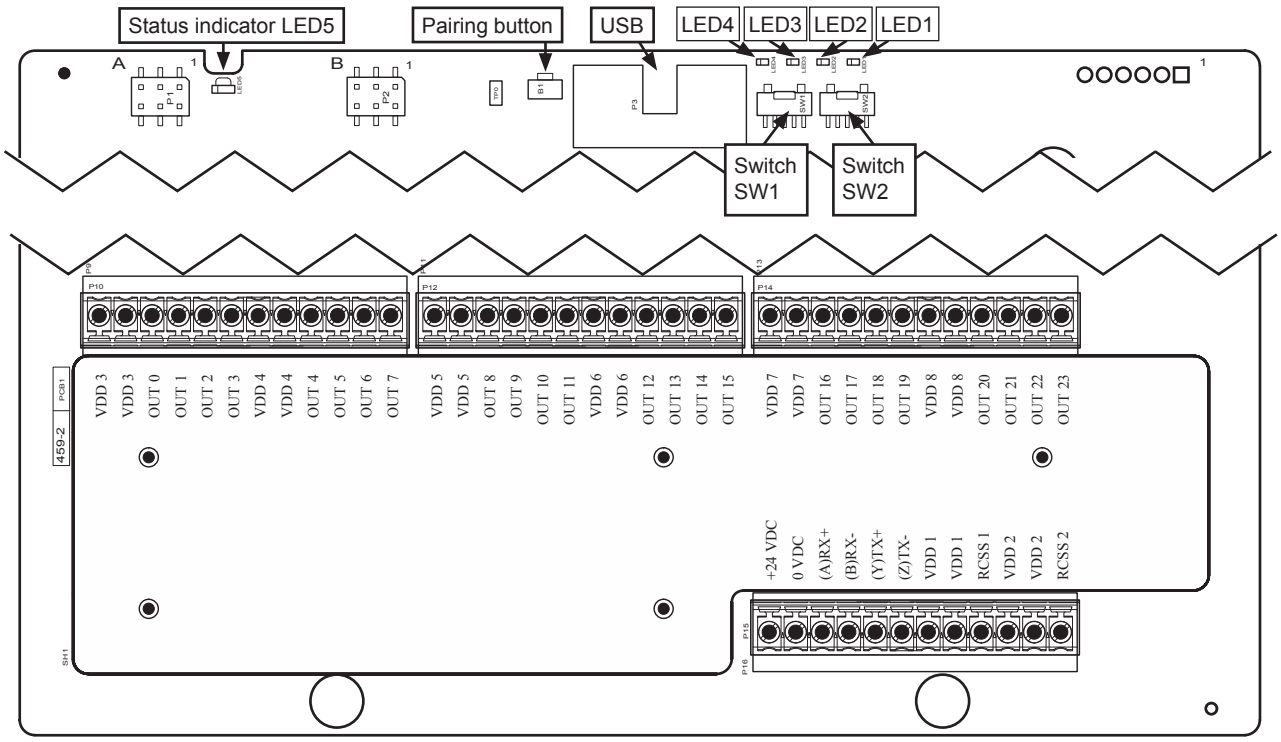

Figure 4. Connections, switches, interface terminals and LED on the MAIN board

6.4 Cable installation

Do not mix SELV and NON SELV signals in the same cable.

After the installation of the equipment, the installed cables must be bound together in pairs (e.g. by using a cable tie) very close to the terminal blocks (see Figure 5). This is important if a cable become loose. The cable should not be able to end up in an unsuitable location of the receiver. Fasten with a torque of 0.4-0.5 Nm.

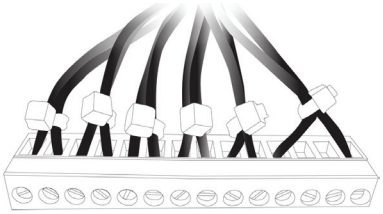

Figure 5. Installation of cables

6.4.1 Connecting power supply

The power supply is nominal 12/24 V DC, range 6-32 V DC. The input power supply wiring must be sufficiently fused, and if necessary it must be possible to disconnect manually from the DC mains supply.

Description	Terminal name	Fuse
Supply voltage receiver/analogue interface	VDD	max. 10 AT
Supply voltage output RCSS1	VDD 1	max. 10 AT
Supply voltage output RCSS2	VDD 2	max. 10 AT
Supply voltage output Digital 0-3	VDD 3	max. 10 AT
Supply voltage output Digital 4-7	VDD 4	max. 10 AT
Supply voltage output Digital 8-11	VDD 5	max. 10 AT
Supply voltage output Digital 12-15	VDD 6	max. 10 AT
Supply voltage output Digital 16-19	VDD 7	max. 10 AT
Supply voltage output Digital 20-23	VDD 8	max. 10 AT
Ground	GND	

Both RCSS supply lines must be connected for correct functionality of the receiver.

6.4.1.1 Receiver supply

The maximum current consumption is 0.35 A at 12 V DC and 0.175 A at 24 V DC.

The fuse for the input power supply shall be max 10AT, and of slow blow characteristic and high breaking capacity.

If a switch is used for selecting Remote/Manual control the receiver and analogue interface supply (VDD) shall not be connected to the switch together with the supply for other outputs (VDD 1 - VDD 8).

6.4.1.2 RCSS Interface supply

The receiver has two safety outputs, RCSS1 and RCSS2. They shall be connected to the machine safety circuit in such a way that either one of them can stop the machine independently.

The current consumption on each RCSS feeding point is depending on the controlled devices connected to the output, but shall not exceed 3 A. The fuse for each RCSS feeding point shall be max10 AT, and of slow blow characteristic and high breaking capacity.

6.4.1.3 Digital Interface supply

Each feeding point supports four outputs. The current consumption on each feeding point is depending on the controlled devices connected to the outputs, but shall not exceed 3A/output or in all 4 A within the group. The fuse for each feeding point shall be max 10AT, and of slow blow characteristic and high breaking capacity.

6.4.2 Serial interface cabling

For the RS422/485 interface screened cables shall be used. The screen shall be connected to ground.

6.4.2.1 Serial port setup

Is described in the specific delivery documentation. Customized serial protocols on demand.

6.4.3 Connecting output interface to control equipment

The interface of the receiver consists of:

2	RCSS (Remote Control Safety Stop) outputs
24	Digital outputs
1	RS422 or RS485 interface

6.4.3.1 Connector pin assignment

6.4.3.1.1 RCSS outputs

Supply line terminal	Function output terminal
VDD 1	RCSS 1
VDD 2	RCSS 2

6.4.3.1.2 Digital outputs

Supply line terminal	Function output terminal
VDD 3	OUT 0-3
VDD 4	OUT 4-7
VDD 5	OUT 8-11
VDD 6	OUT 12-15
VDD 7	OUT 16-19
VDD 8	OUT 20-23

6.4.3.1.3 RS422/485 interface

RS422	RS485
Function output terminal	Function output terminal
Rx+	A (Jumper)
Rx-	B (Jumper)
Tx+	Y
Tx-	Z
GND	GND

6.5 *Antenna installation*

The antenna should be installed on a conductive surface with a minimum size of 50 x 50 cm. The surface shall be electrically connected to vehicle/machine chassis. The maximum allowed cable length between receiver and the antenna is 10 meters.

! Do not paint the antennas. Paint might considerable reduce the radio coverage area.

The maximum allowed length of the antenna cables is 10 meters.
The connectors on the receiver are of type SMA for radio band 400MHz and 800MHz.
Install the antenna cables separated from high voltage or high current cables/devices.

If the antenna is installed outdoors, there is a risk that dangerous voltages may enter the antenna cable. To minimize this risk a DC block shall be used. DC blocks are coaxial components that prevent the flow of low and direct current (DC) frequencies while offering minimum interference to RF signals. Suitable models have capacitors in series with both the inner and outer conductors.

Åkerströms can provide one suitable DC block 944498-000.

7 Wiring plan example

Definitions

R/M	Remote/manual mode changeover switch
Stop Device	Device that sets the controlled object in a safe state

7.1 *Receiver power and RCSS*

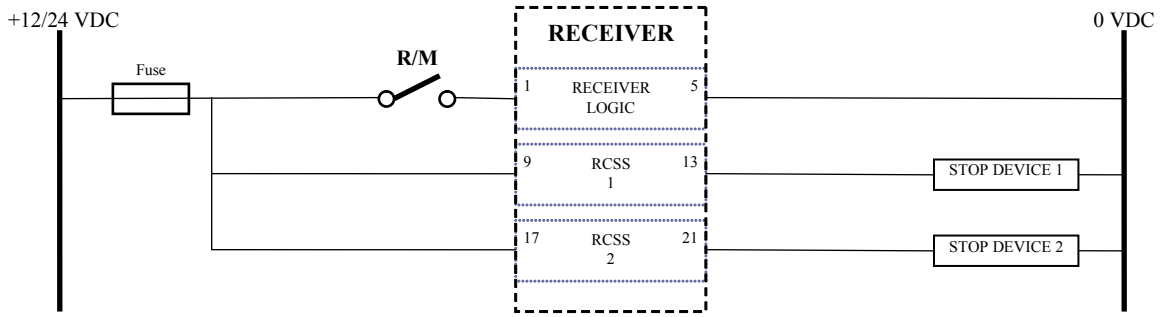

Figure 6. Wiring example for Receiver power and RCSS

! Both RCSS1 and RCSS2 must be fed with power (pin 9 and 17)
RCSS1 and RCSS2 outputs may not be tied together

! Always use a separate switch for switching the receiver ON/OFF
To reach full safety both RCSS1 and RCSS2 shall be used

7.2 Single/multiple fuses

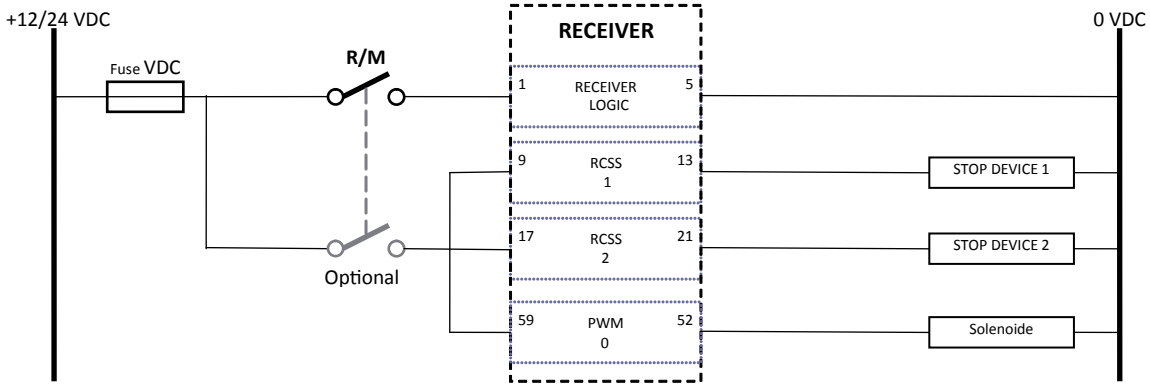

Figure 7. Wiring example for Single fuse

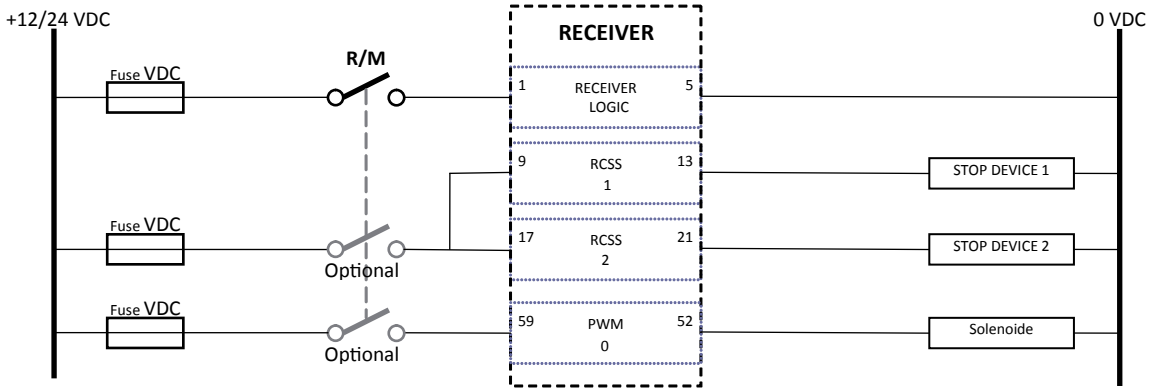

Figure 8. Wiring example for multiple fuses

7.3 Control devices in parallel with receiver

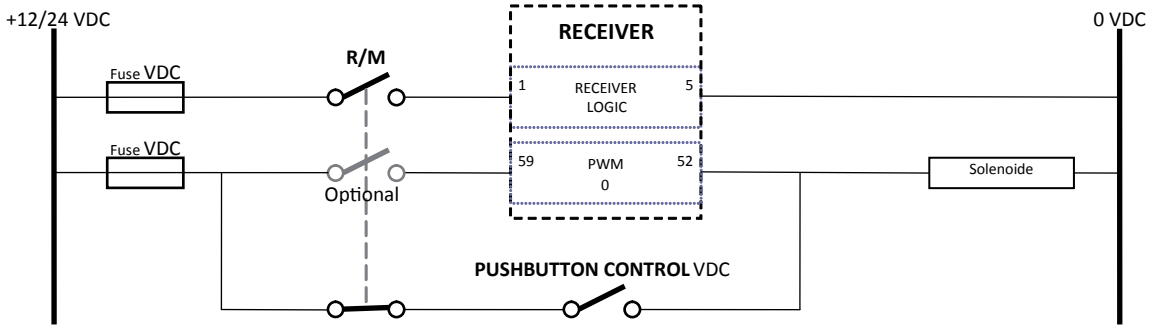

Figure 9. Wiring example for Control devices in parallel with receiver

! **If an external push button or other device is connected in parallel with the receiver it shall always have the same feeding point and if necessary also be connected to the R/M switch.**

8 Acceptance tests

8.1 T-Rx 500

Check that the installed receiver is intended for use on the vehicle/machine where it is installed.

8.2 Radio frequency

Check that the used radio frequency is allowed to use.

8.3 Assembly

8.3.1 Receiver

Check that the receiver is fixed firmly.

Check that the receiver is not mounted close to heat generating equipment.

Check that the antennas are of a type intended for use on this kind of vehicle/machine and installed according to manufactures installation manual.

8.3.2 Electrical grounding

Check that the case of the receiver is properly connected to the vehicle/machine chassis.

1. Remove the antenna cables from the receiver.
2. Measure the resistance between the receiver case and the vehicle/machine chassis.
3. Measure the resistance between antenna base and the vehicle/machine chassis.
4. Reconnect the antenna cables to the receiver

8.4 Supply voltage

Check that the power supply to the receiver is nominal 12 or 24 V DC and inside the allowed range of 6-32 V DC.

8.5 Functional test

For information how to use the transmitter see the User Manual.

8.5.1 Turn on the receiver

Check that the led “STATUS” on the receiver is flashing green.

8.5.2 Connections receiver- vehicle/machine control system

Make sure that the moving of the vehicle/machine is interlocked before this test.

1. Activate the transmitter to be used with the receiver.
2. Check that the functions commanded from the transmitter affects the intended functions on the vehicle/machine control system.

8.5.3 Radio coverage area

1. Activate the system.
2. Check that the driver with an activated system may keep the system activated within the expected area.

9 Acceptance test recommendations

As the way the set of outputs is used for controlling the vehicle/machine (for instance for driving the engine and the brakes of the vehicle/machine or controlling other vehicle/machine assemblies) depends on the specific installation and is out of the scope of the T-Rx 500 receiver no vehicle/machine functionality tests are described in this test plan.

However the following general test recommendations should be considered:

- Test that each RCSS output will generate a stop.
- Test that all commands performed on the transmitter performs the expected response on the controlled vehicle/machine.

10 Decommissioning of equipment

The receiver shall be treated as electronic waste and disposed of according to legal regulation or law. Contact therefore your local environmental authority or your waste disposal company.

10.1 Removal of receiver

Before decommissioning contact the remote control integrator to check if any modification is necessary on the vehicle/machine control unit/control equipment when removing the remote control.

Disconnect and remove all cabling between the receiver and the control unit/equipment on the vehicle/machine. Disconnect and remove the antenna cabling to the receiver. If also the antennas are removed be sure to secure the vehicle/machine chassis against water leakage.

Remove the receiver unit from the vehicle/machine.

11 Indication

Status indication

Status indication

See “Figure 3. Receiver back side”

Bicolored LED

Mode	Event	Status LED	
Status OK	Not connected	Fast GREEN	50/50 ms
	CONNECTED, RCSS=ON	Slow GREEN	30/970 ms
	CONNECTED, RCSS=OFF	Medium GREEN	50/250 ms
ERROR	Receiver internal error	Steady RED	
	Transmitter internal error	Fast RED	50/50 ms
	No supply power	Off	

12 Technical data

Technical data	
Housing	Aluminum with flange fastening
Dimensions (H x W x D)	240x177x67.5 mm, connectors excluded
Weight	1,6 kg
Protection	IP67
Working temperature	-25 - +70 °C
Storage temperature	-40 - +85 °C
Connector	Pluggable screw terminals
Interface	24 on/off outputs
Operating voltage	12/24 V DC nominal, range 6-32 V DC
Current consumption	<350 mA (without external load at 12 V DC) <175 mA (without external load at 24 V DC)
Relay Reaction times:	
Reaction time on STOP function	Maximum 550 ms
Safety Parameters for STOP function	ISO13849-1:2006 category 3 PL d
Device monitoring	Under/over-voltage monitoring Watchdog function Checksum management of data and program code during runtime Task counter management during runtime Extensive diagnostics on RCSS outputs during runtime
Process monitoring	Dual channel architecture
Type designation	RXO

Electromagnetic Compatibility Immunity			
ISO 7637-2-2004		12 V	24 V
	Pulse 1	-75 V	-450 V
	Pulse 2a	37 V	
	Pulse 2b	+ 10 V	+20 V
	Pulse 3a supply lines	-112 V	-150 V
	Pulse 3b supply lines	+75 V	+150 V
	Pulse 4	-6 V	-12 V
ISO 10605:2001	Powered up	Contact 8 kV	
		Air 15 kV	
	Unpowered	Contact 6 kV	
		Air 15 kV	

Electromagnetic Compatibility Emission		
2009/19/EG / ECE Regulations No. 10 Revision3:2008	30 – 1000 MHz	
ISO 11452-1 /-5	20 – 100 MHz	60 V/m
ISO 11452-1 /-2	100 – 2000 MHz	30 V/m
ISO 7637-2:2004	+75 / -100 V	

Immunity to Environmental Conditions	
IEC 60526:2001	IP67

Outputs

Possible Configurations

Number	Type	
4	PWM	Positive switching 0 -3 A, 50-400 Hz
or	Digital	High side 3 A
20	Digital	3 A
2	RCSS	3 A

Asynchronous interface

Number	Type	
1	RS422	
or	RS485	

Interface characteristics		
RCSS 1-2	Short-circuit and overload protected	
	Voltage	User supplied 12/24 V DC nominal
	Current	Max 3A
PWM outputs 0-3 **Can be configured as...**	► **PWM output positive switching**	
	Short-circuit and overload protected	
	Switching Voltage	User supplied 12/24 V DC nominal
	Switching current	Max 3A
	Resolution	12 bits
	Switching frequency	50-400 Hz
	► **Digital output**	
	Short-circuit and overload protected	
	Voltage	User supplied 12/24 V DC nominal
	Current	Max 3A
Digital outputs 4-23	Short-circuit and overload protected	
	Voltage	User supplied 12/24 V DC nominal
	Current	Max 3A

Interface characteristics		
Serial interface	►RS422	
	Protocol	On request
	Baud rate	1,2 / 4,8 / 9,6 / 19,2 Kbits/s
	Termination	470 Ω on receive
	►RS485	
	Protocol	On request
	Baud rate	1,2 / 4,8 / 9,6 / 19,2 Kbits/s
	Termination	470 Ω

13 Derating

The maximum possible total output current of the T-Rx 500 receiver is more than 30 A. As the internal switch losses in the receiver generates heat the maximum output current can not be used over the whole specified temperature range.

13.1 Convection cooling

If a T-Rx 500 receiver is located in free, quasi-stationary air (convection cooling) the maximum allowed output current must be reduced according to Figure 10.

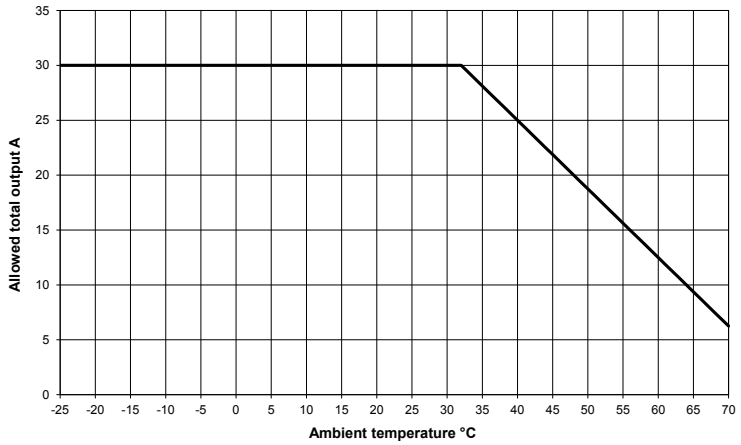

Figure 10. Convection cooling. Maximum allowed output current versus ambient temperature

13.2 Output current calculation

To calculate the maximum used current load use the following table. Insert values referring to estimated most hectic 30 minutes period usage of receiver outputs.

Output	C Nominal current of controlled equipment Ampere	T Average On time %	Average current load $\frac{CxT}{100}$
RCSS1		100	
RCSS2		100	
OUT0			
OUT1			
OUT2			
OUT3			
OUT4			
OUT5			
OUT6			
OUT7			
OUT8			
OUT9			
OUT10			
OUT11			
OUT12			
OUT13			
OUT14			
OUT15			
OUT16			
OUT17			
OUT18			
OUT19			
OUT20			
OUT21			
OUT22			
OUT23			
Total used output current during 30 minutes hectic period =			

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