

# RIPPLE CONTROL RECEIVERS

## FMX 500



*Ripple Control (RC) is used for organized control of real-time consumption of electricity in the network (tariff switching, blocking of appliance groups, control of public lighting etc.).*

*Application of small Ripple Control systems (MINI RC) makes it possible to optimize current consumption in closed distribution systems in industrial, agricultural and other companies and institutions and to obtain financial savings. The substantial advantage of both the RC and MINI RC systems is that command signals are transferred through the distribution power network that supplies the controlled appliances.*

### **FMX 500 RIPPLE CONTROL RECEIVER (RCR) FUNCTIONALITIES**

A digital filter with widely programmable parameters processes the received signal. A microprocessor evaluates received signals and controls all functionalities. Its behavior can be modified by changing data in the EEPROM.

The RCR can react to any well-known command code. The user can choose from a wide range of parameters of command codes, control frequency and filter width, sensitivity, different time functions and respond to outage and subsequent supply voltage recovery. RCRs can be programmed via communication adapters (either galvanically separated contact- or opto- interface) together with a PC equipped with any of Windows XP/7/8 or with operating system Windows Mobile. Every FMX 500 series stores data in its EEPROM used for modification of its behavior as well as identification and informative data. A special alphanumeric note or code, entered by the user, makes identification of all receivers easy and clear and, via a bespoke SW enables e.g. management of method and programming date of the receivers. The memory also stores the FMX 500 series number, production code, date of the last programming, total time of connection to the network and number of supply voltage outages.



**The combination of a modern microprocessor linked to an EEPROM and modifiable hardware has provided for a number of exceptional properties:**

- RCR programmability to respond up to three different RC systems, operating on common frequency in time multiplex;
- Individual commands can be executed either immediately or with a specific (fixed or variable) delay;
- Programmable response to receiving outages or to specific command outages;
- Programmable responses to power or real time outages and recoveries make possible to set the RCR relay to a programmed position in case of power outage or recovery, and in case of time functions being engaged, to continue these, start them over again or stop them, as requested;
- Programmable functionalities after power recovery;
- Real time back up in case of power outage for up to 64 hours (according to RCR type);
- Customer determined number of (exchangeable) relays, EEPROM and back-up time;
- Short pulse generation (in a 33 ms raster) by the output relay;
- Properties of switching programs can be set within wide limits. The following parameters can be set: number of switching programs, number of individual program changes, time step (min/sec) and the activation mode. Also, a learning function can be engaged to modify the control software;
- A learning function, with programmability of both signal property to be learned and conditions of its activation;
- Programmable RCR behavior setting / modification, includes the shape of input filter frequency characteristic, receiver sensitivity and command codes;
- Effective filtration of control signal interference pulses, with programmable parameters;
- Expanded number and programmability of logical relay characteristics;
- Number of control functions, allocated to each relay, is limited by used EEPROM capacity only;
- Simply defined various time functions that can be engaged, disengaged or synchronized by any command. Each relay can thus also work as a pulser, governed by specified command codes and remaining in either position as programmed, or as a timer, etc.;
- All time functions are synchronized via frequency of crystal-controlled oscillator ;
- Optional position of any relay after programming is finished;
- Repeated transmission discerning with appropriate programmable reaction;
- "Self-learning" function available, e.g. for public lighting or other control (proper function is maintained even if a RC transmitter outage occurs);
- Optional confirmations of output relay position. If the relay position is tampered the RCR will automatically switch to the correct position no later than in 12 minutes;
- Automatic received telegram monitoring in supporting PC. Time stamped monitored telegrams can be saved for later analysis;
- Verification of RCR functions by internal test execution;
- TEST button programmability;
- Optional RCR state recording into internal EEPROM;
- Telegram receiving can be interrupted after an execution pulse was received;
- Programmable delay for each command;
- Customer requested functionalities can be expanded or added as required.

## **OPERATING PRINCIPLE**

After its amplitude reduction by the input divider, the control signal is processed by the digital filter situated inside the microprocessor. All information, i. e. command code, control frequency, sensitivity, the way how the command code is evaluated and all requirements concerning time and self-learning functions and switching programs are stored in the EEPROM data memory. Memory content and thus also modification of all activities and properties of the RCR can easily be changed by the user in the programming mode. In this mode, the RCR communicates with the PC that is connected via a galvanically separated contact communication adapter or via an optical adapter linked to the RCR via a serial line. Correct RCR functions are checked on both program and circuit levels. Synchronization of the RCR and transmitter is performed by timing pulses derived from the mains power voltage 50 Hz. The RCR can be equipped, as per customer request, with one to four memory relays (optionally replaceable).

The SELFTEST function that can be activated by pushing the TEST button accessible after removing the terminal cover, serves for

functionality verification and for an easier check whether the RCR relay is connected to external circuits. This button function is programmable. During the SELFTEST function, checksum of the microprocessor memory content is carried out as well as correct communication with EEPROM memory is verified. If all is OK, the output relays will perform the planned action (e.g. periodical switching of the output relay selected or all relays are temporarily switched to defined positions, etc). After executing the SELFTEST, all relays are reset to initial positions. During SELFTEST execution, all other RCR functions are blocked (the same applies for the programming mode).

Programming or reading of EEPROM memory content of more RCRs from PC via the communication adapter can be accelerated if "mass programming" is used, activated by pressing the TEST button. The RCR first tests if such programming can be carried out and based on the test result, the RCR will either rewrite the EEPROM content or execute the TEST function. After the programming is done, output relays can be set to a programmable position. Programming using

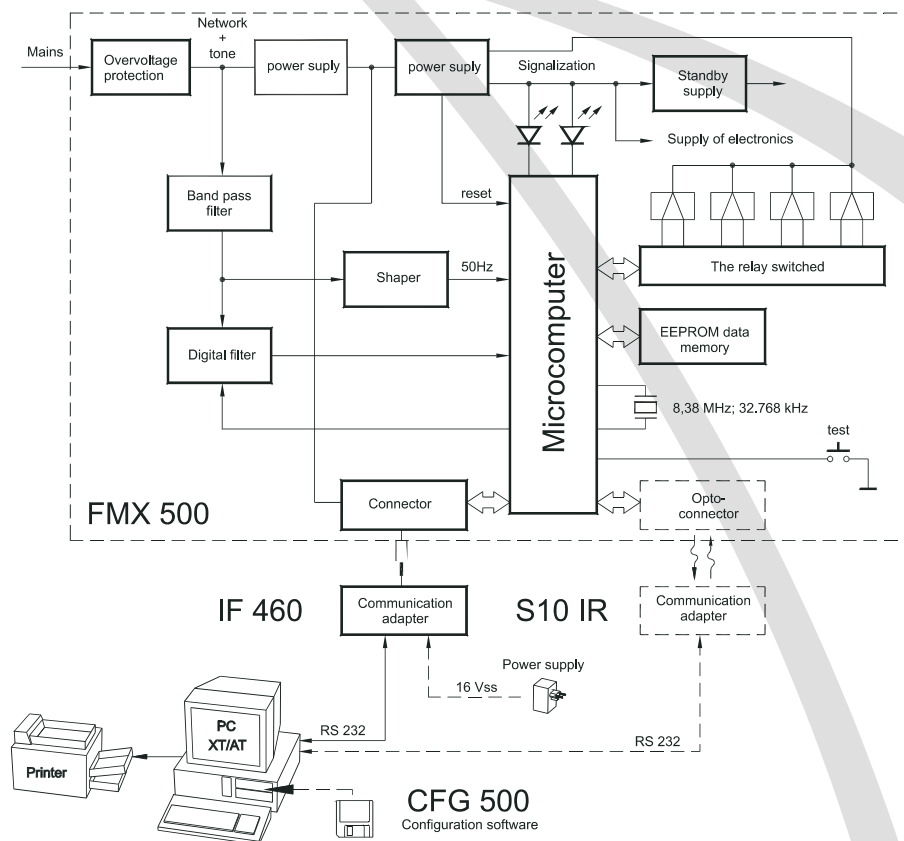
IF 500 contact adapter can be performed with power supply on or off. The communication adapter secures galvanic separation of the RCR and PC. During programming, the contact adapter can be used to power the receiver via the auxiliary power supply NZ 14. Programming via S 10 IR optical adapter can be made only if the RCR power supply is on. A security code protects optical communication from tampering and accidental changes of the ambient lighting. The innovated series FMX 529 xx2x is secured against reprogramming by activating this mode via pushing the TEST.

Two LED diodes are used for a visual check of work and operation states of the RCR. The yellow LED shows basic RCR states, i. e. supply of direct or alternating voltage and receiving of a telegram, the red LED

shows internal RCR states and, in connection with the configuration software, its meaning can be programmed.

When a new RCR is to be installed with no connection to a PC, its real time can be set using an RPC 500 adapter. This contains a real time back up circuit and after its plugging into the FMX 550 / 590 it is possible to compare adapter real time with RCR time (a tolerance of 1 sec thru 60 min can be set to indicate disagreement) and copy adapter real time to the RCR. The RPC adapter is fed from the RCR and that is why the RCR must be connected to the power supply during its real time setting. RPC 500 adapter real time is checked and/or set when it communicates with the PC (CFG 500 parametrization program) to which it is connected via RPC communication adapter (refer to accessories list).

## FMX 500 BLOCK DIAGRAM



## DESIGN

Basic types of the FMX 500 series are FMX 510 and FMX 520. Other types are design modifications of these basic types. They have either the same or very similar circuits and are software compatible.

### FMX 510

Basic type of this series. This RCR uses a case with 12 terminals, equipped with 1 to 4 relays. The RCR can be installed into a switchboard using three M5 bolts on an A-base. The A-base is 82 mm wide and 125 mm high (+10 ÷ 21 mm with an attachment). It can also be installed to a DIN rail after breaking off side blinds and adding a latch. Output relays 1 to 3 are replaceable. Load of output relays depending on design is up to 40 A. Both the contact programming connector and TEST button are accessible only after removing the terminal cover. Sealing points protect the RCR inside from tampering.

### FMX 520

Basic type of this series. FMX 510 RCR description applies. Optical interface is added for communication via optical head.

### FMX 550

This module is to be built into the poly-phase electricity meter ZPA EMU 300.4U (H), ZE 310.DU or ZE 310.DM with a standard optical interface. It has a separate panel that can be easily inserted into the meter compartment and is covered with the meter box. K2 and K3 relay contacts (with switching current of up to 8 A) are led to terminals that are accessible only after removing the terminal box cover. K1 and K4 relays used for switching the meter rates are optocoupler based in the FMX 552 type. Both the contact programming connector and TEST button are accessible only after removing the meter cover. The module is completely (except for the power supply) galvanically separated from the meter.

### FMX 560

This module is to be built into a single-phase electricity meter ZE 110. DK with a standard optical interface. It comprises a printed circuit board with output relays and is covered together with the electricity meter. K2 and K3 relay contacts (with switching current of up to 8 A) are led to terminals that are accessible only after removing the terminal box cover. K1 and K4 relays used for switching the meter rates are optocoupler based. The TEST button is accessible only after removing the meter cover. The module is completely (except for the power supply) galvanically separated from the meter.

## FMX 590

This RCR has no optical interface, uses an individual box and can be connected into the switch board via detachable terminals. There are one or two output relays K1 and K2 in the RCR (with switching current of up to 6 A). Both the contact programming connector and the TEST

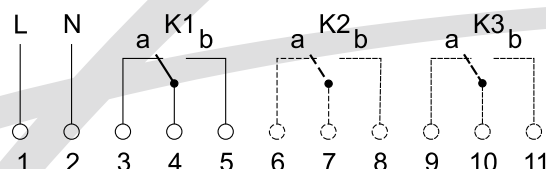
button are accessible only after removing the RCR cover. Sealing points protect the RCR inside from tampering.

For available modifications of all said types and with design and dimensions see below.

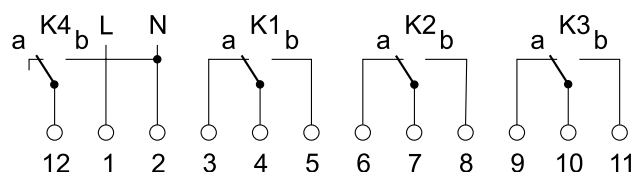
### TYPE IDENTIFICATION FMX 5XX

	FMX 5 # #	# # # #
<b>Design</b>		
Without Optical Interface	1	
With Optical Interface	2	
<b>Number of Relays</b>		
One Relay Exchangeable	1	
Two Relays Exchangeable	2	
Three Relays Exchangeable	3	
Relays 1+3 Exchangeable, Relay 4 Fixed	4	
One Exchangeable Relay Assembled, Two Free Positions for Exchangeable Relays	9	
<b>Duration of Real Time Backup</b>		
Backup Time 64 Hours		5
Non-removable battery backup time		9
<b>Connection of Receiver</b>		K
<b>Connection of Receiver</b>		A
<b>Connection of Receiver</b>		B
<b>HW + SW Design</b>		
Standard Design		0 3
With Remote Data Parametrization		0 5
According to Order		0 6
Permanent Resistance max. 500 V		0 7
Standard Version Upgrade		2 3
Standard Design Innovated 40 A		2 4
Testing Version		9 9

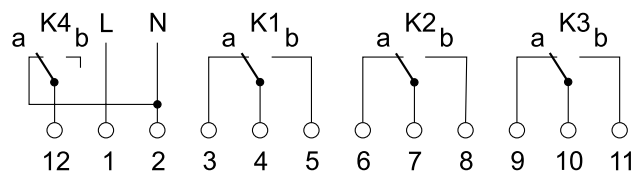
#### Connection K



#### Connection A



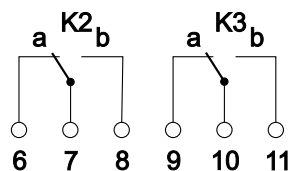
#### Connection B



### TYPE IDENTIFICATION FMX 552

	FMX 5 5 2	# # # #
<b>Number of Relays</b>		
Two Relays and Two Optocouplers for Internal Tariff Switching	2	
<b>Duration of Real Time Backup</b>		
Backup Time 64 Hours		5
<b>Connection of Receiver</b>		K
<b>HW + SW Design</b>		
Standard Design		0 1
With Remote Data Parametrization		0 5
According to Order		0 6
Testing Version		9 9

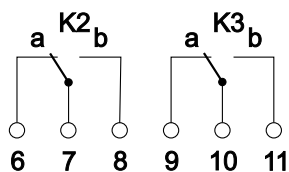
#### Connection K



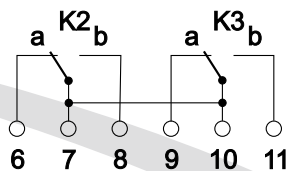
### TYPE IDENTIFICATION FMX 562

FMX 5 6 2	# # # #
<b>Number of Relays</b> Two Relays and Two Optocouplers for Internal Tariff Switching	2
<b>Duration of Real Time Backup</b> Backup Time 64 Hours	5
<b>Connection of Receiver</b>	K
<b>Connection of Receiver</b>	P
<b>HW + SW Design</b>	
Standard Design	0 3
With Remote Data Parametrization	0 5
According to Order	0 6
Testing Version	9 9

#### Connection K



#### Connection P

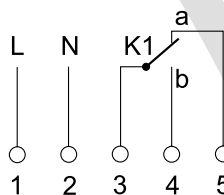


Module FMX 560 is not separately salable, it is fitted in electricity meters ZE 110 series only.

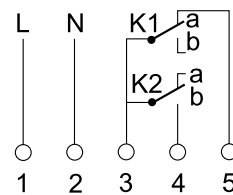
### TYPE IDENTIFICATION 59X

FMX 5 9 #	# # # #
<b>Number of Relays</b> One Relay Exchangeable	1
Two Relays Exchangeable	2
<b>Duration of Real Time Backup</b> Backup Time 64 Hours	5
<b>Connection of Receiver</b>	K
<b>Connection of Receiver</b>	J
<b>Connection of Receiver</b>	B
<b>Connection of Receiver</b>	V
<b>Connection of Receiver</b>	G
<b>Connection of Receiver</b>	L
<b>HW + SW Design</b>	
Standard Design	0 1
With Remote Data Parametrization	0 5
According to Order	0 6
Testing Version	9 9

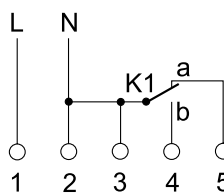
#### Connection K (1 relay)



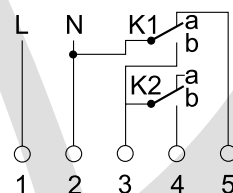
#### Connection K (2 relays)



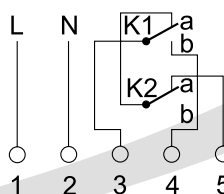
#### Connection J



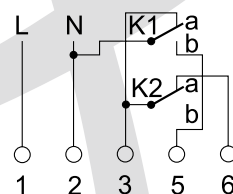
#### Connection B



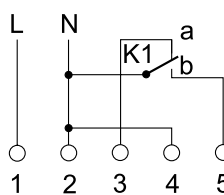
#### Connection V



#### Connection G



#### Connection L



## TECHNICAL DATA

RCR Fulfils Requirements of Standards	EN 62054-11
Nominal Supply Voltage $U_n$	230 V or 120 V
Permissible Allowance	$0.75 U_n$ up to $1.15 U_n$
Nominal Frequency $f_n$ of Nominal Supply Voltage $U_n$	50 Hz
Permissible Allowance $f_n$	-5 Hz up to +2 Hz
Resistance of Terminals	Standard design 460 V Version FMX 51x xx07 and FMX 52x xx07 max. 500 V; 50 Hz
Overvoltage Withstand Strength	8 kV 1.2/ 50 $\mu$ s
Active Input	Max. 2 W
Apparent Input	Max. 12 VA capacitive
Control Frequency $f_s$	Programmable from 167 up to 2100 Hz
Pass Band Width	Programmable from 1 up to 6 % $f_s$
Setting Range $U_f$	Programmable from 0.35 up to 2.1 % $U_n$
Command Code	Selectable by programming
Time Between Command Codes	Min. 1 s
Ambient Operating Temperature	-40 °C up to +70 °C
Number of Output Relays Uncoupled	One to four
Tripping Voltage $U_c$	250 V
FMX 510, 520 Switching Current $I_c$ (1st, 2nd, 3rd Relay)	Permanently 25 A $\cos \varphi = 1$
FMX 510, 520 Switching Current $I_c$ (4th Relay)	Permanently 6 A $\cos \varphi = 1$
FMX 550, 560 Switching Current $I_c$ per Relay	Permanently 8 A $\cos \varphi = 1$
FMX 590 Switching Current $I_c$ per Relay	Permanently 6 A $\cos \varphi = 1$
Max. Total $I_{tot}$ FMX 510, 520 for 1 to 4 Relays	75 A $\cos \varphi = 1$
Electric Service Life of Output Relay (max. Load)	Min. $3 \times 10^4$ cycles ON/OFF
Electric Service Life of Output Relay (max. 6 A)	Min. $2 \times 10^6$ cycles ON/OFF
Lifetime When in Permanent Operation	Expected longer than 20 years
Insulation Protection	IP 51 (type FMX 529 - IP 53)
Electrical Insulation Strength Mains/Outputs	Min. 2 kV
Electrical Insulation Resistance Mains/Outputs	Min. 20 M $\Omega$
Outlet of Relay Contact	Depends on design (see type tables)
Number of Terminals in Terminal Box	Depends on design (see type tables)
Attachable Wires FMX 510, 520	2 x 1 or 1 x 1.5 to 6 mm <sup>2</sup> Cu rigid conductor
Attachable Wires FMX 550, 560, 590	2 x 1.5 or 1 x 1.5 to 2.5 mm <sup>2</sup> Cu rigid conductor
Maximum Tightening Torque of the Screws	1 Nm
Working Position	Vertical and lateral
Mounting Options	To panel of distribution board To cover of meter terminal box To DIN rail 35 mm Permanent
Operation Type	
Weight	Depends on design, ranging from 0.3 kg to 0.6 kg

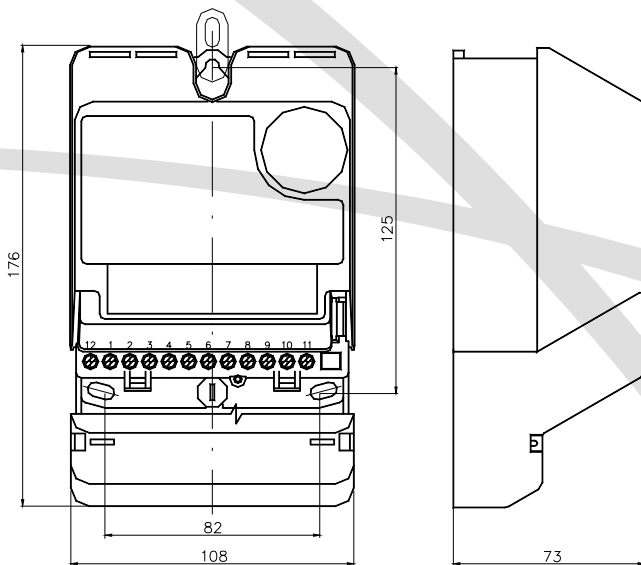
## ACCESSORIES LIST

Accessories are not a part of FMX 500 receivers and must be ordered separately:

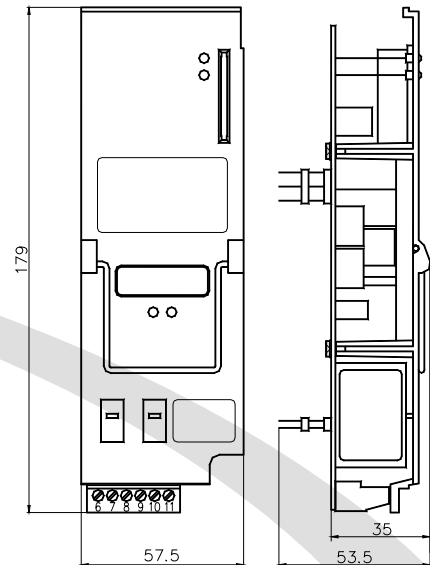
- **CFG 500** Parametrization programme for PC;
- **EMTools** Parametrization programme for Windows Mobile;
- **Programming guide**;
- **IF - U** Galvanically separated parametrization adapter for connecting the FMX 500 / 590 RCR with PC;
- **NZ 14** Power Supply for RCRs not hooked to mains during parametrization or for RPC 500/590 during real time setup from PC;
- **RC - U** Universal adapter for checking and real time setting of the FMX 500 / 590 RCR;
- **RPC 500** Adapter for real time setup of RC-U from PC via printed circuit board Version U1;
- **RPC 590** Adapter for real time setup of RC-U from PC via printed circuit board Version U2;
- **S 10 IR** Communication adapter for interconnecting the FMX 500 RCR optical interface with PC;
- **S 10 BT** Communication sensor for interconnecting the FMX 500 RCR with EMTools;
- **Cable IF** 460/CANON 25 Pins, length 2m;
- **Cable IF** 460/CANON 9 Pins, length 2m;
- **Gruner Relay** for RCRs with replaceable relays;
- **Connecting Comb with Cover Customizable terminal number and arrangement**;
- **Customer Plate** Used for customer data.

## DIMENSIONAL SKETCHES

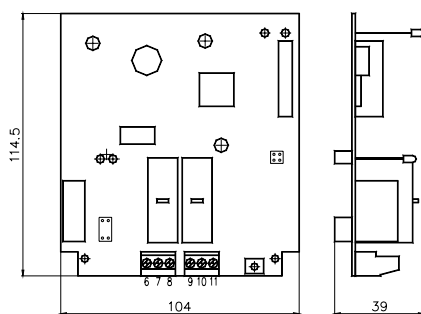
FMX 51x, FMX 52x



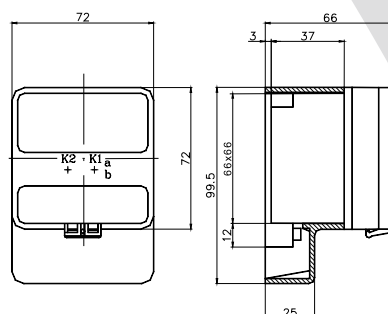
FMX 55x



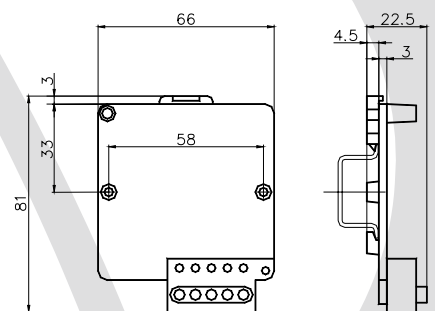
Module FMX 56x



FMX 59x



Platform for Mounting of FMX 590 to DIN bar



## ORDERING

The order has to clearly specify RCR required properties and quantity requested:

- number of RCRs;
- type designation (e. g. FMX 5xx - xxxx) and type plate data.

If so agreed with the manufacturer, the following RCRs can be supplied:

- RCRs compatible, programmed according to customer requirements;
- With customer requested type and customer plate design (e.g. bar code, logo, TLG, program number);
- To serve local authorities, public lighting, electrical engineering companies, etc., programmed for governing of public lighting including night switch-off intervals, if so required.

## INSTALLATION

The RCR installation and commissioning are subject to the requirements of internal instructions and regulations of distribution companies or those set forth by the approved design documentation. During installation, it is necessary to observe valid standards and safety work regulations including inspection activities.

## WARNING

When the cover is open and the device is connected to low voltage network, very dangerous voltage (which can be lethal) is present on the live parts of the RCR.

## CARE AND MAINTENANCE

The RCR is a maintenance-free product with established minimum operation service-life of 15 years. For possible cleaning of the outside surface from dust and other impurities, the manufacturer does not recommend using organic solvents, aggressive chemicals and abrasive cleaning agents. It is necessary to comply with the required storage temperatures; a failure to comply with them can result in shortening the service-life of the electrical components. Furthermore, the product shall be protected against wet and humid conditions. The RCR is designed for internal use, ie. it may only be used in places providing additional protection against the effects of external environment (e.g. inside a building or in a cabinet). Precipitations, humidity and liquids including minerals cause corrosion of electric circuits if the product becomes wet. The device may not be placed on and dried by placement on a source of heat or inserted into a source of heat (e.g. microwave oven, classic oven or radiator / heater). The product can be overheated and some of its parts could explode. It may not be exposed to excessive heat; it can result in deformation of covers. The device is not kept in cold premises, especially with the follow-up repeated warming (to the nominal operation temperature). Humidity can condensate in the device and damage electronic components or isolation properties of the product can deteriorate.

## SERVICE

The service shall be ensured by the company: ZPA Smart Energy a.s., Komenského 821, 541 01 Trutnov, Czech Republic, Trademark Smart Energy, Tel. + 420 499 907 111, E-mail zpa@zpa.cz, www.zpa.cz .

## TRANSPORT

For the preparation, the device shall be packed either in the original package, in which it was delivered by the manufacturer, or in such package, which cannot cause damage resulting from handling or transport.

## WARNING OF THE MANUFACTURER

The product is capable of safe operation. The manufacturer has issued the Declaration of conformity according to Section 13 of Act 22/97 Coll.

Despite this fact, the manufacturer warns about the risk, however, of a possible danger resulting from incorrect handling or incorrect use of the product:

- Installation and maintenance must be performed by a competent person with the applicable electrotechnical qualification that shall acquaint the operator with the conditions of safe operation.
- The product may not be used for other purposes that it is produced for.
- The product may not be wilfully modified contrary to the type design.
- The product may not be operated with different voltage, current and frequency than it was produced or expertly modified for.
- The product must be located and secured so that manipulation by persons without electro technical qualification, especially children, is hindered or, as the case may be, disabled.
- Before each new commissioning, e.g. after a repair, maintenance etc., Ingress Protection and all measures for securing safety must be renewed / restored within the full range and revision shall be realized by a revision technician.
- During the operation, it is necessary to ensure that in the area where the product is installed there is no danger of fire or explosion in case of creation of gases, vapours of flammable liquids and occurrence of flammable dust.
- Each handling of the product by a competent person, with the exception of measurement with insulated tips of a measuring device, must be realized without voltage.
- The product may not be operated in the conditions and environment, which do not guarantee safe operation (e.g. location on flammable base, cover from flammable material, imperfect Ingress Protection against penetration of foreign particles or, as the case may be, against water or other liquids).
- The product must be placed and operated in an indoor environment, ie. in places providing additional protection against the effects of external environment (eg. in the building or in a locker).
- The product may not be operated in the premises with bigger oscillation and vibrations that it is specified in this Service and technical manual.

If the user does not respect any of the aforesaid warnings and if a failure occurs in causal relationship with such incompliance, responsibility of the manufacturer for defect shall not be established. A failure to comply with the recommended storage and operation conditions of equipment identified by the manufacturer in the paragraph Care and maintenance can have a negative impact on service-life of the equipment.

More useful information follows, to facilitate proper usage of the device as well as to provide general knowledge on it.

## RESPONSIBILITY

The owner of the product (generally the utility company) shall be responsible for ensuring that all the persons engaged in work and handling with the device:

- Are competent and qualified in compliance with national regulations
- Have read and understood the applicable parts in the Technical specification
- Strictly comply with safety regulations and operation data in individual chapters

Furthermore, the owner of the product bears the following responsibilities:

- For protection of persons
- For prevention of damage to material
- For training of staff

## SAFETY REGULATIONS

The following safety regulations shall be complied with in all circumstances:

- The wires, to which the device is connected, may not be alive during the installation or during the replacement. Hot contacts are dangerous to life. That is why the applicable fuses of the power supply should be removed and stored in a safe place so that they could not be replaced by a person without responsibility without awareness of the others until the work is finished.
- Local safety regulations shall be complied with. The installation of products must be realized exclusively by an expert, qualified and trained person.
- During the installation, the device must be kept firmly; otherwise it could cause injury if it falls.
- Product may not be installed, which fell down, even if they do not show any visible marks of damage. They must be returned for repeated testing either to the responsible repair department or directly to the manufacturer. Internal damage may cause functional failures or a short circuit.
- The device may not be, in any way, cleaned under running water or by means of high-pressure equipment. Penetration of water can cause a short circuit.

## LIQUIDATION

On the basis of the data identified in the certificate ISO 14001, the components used in the product are separable to a great extent and, therefore, they can be accepted for the applicable liquidation or recycling. At the end of its service-life, the device shall be handed over to specialized firms that are engaged in the separation of used materials and their follow-up recycling. Unused device shall be liquidated ecologically and in compliance with the Waste Act.

The product does not include any radioactive, carcinogenic or other materials having a negative impact on human health or the environment. All plastic materials can be recycled.

Packing boxes can be recycled and at the end of the service-life, they shall be submitted to specialized companies as a source of secondary raw materials or energy.

### Liquidation and legal regulations concerning protection of the environment

For the liquidation of the product it is necessary, without exception, to comply with local regulations for the protection of the environment.

Components	Liquidation
Printed circuit boards, LED	Electronic waste. Liquidation in compliance with local regulations
Battery	Dangerous waste. Liquidation in compliance with local regulations
Metal parts	Sort out and hand over to the waste collection centre for liquidation in compliance with local regulations
Plastic components	Sort out and hand over for liquidation or re-granulation in compliance with local regulations