Device description _V1.14

robusto control series robusto master RMC5xx

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This document was carefully created, in order to ensure the correctness and completeness of the documentation.
Since, in spite of all the care taken, errors can never be completely avoided, we are always grateful for advice and suggestions.

1 General

1.1 Preface

This manual contains texts, illustrations and explanations for the correct installation and operation. This manual must be read and considered before installation and employment of the devices.

This documentation is mainly directed towards qualified personnel to control and automation technology. They must be well acquainted with the current standards and guidelines.

If you have any questions about the installation, application and operation, please contact the *elrest* customer hotline:

Phone: 07021/92025-33

Fax: 07021/92025-59

E-Mail: hotline@elrest.de

or contact your responsible agency.

This manual is published subject to any changes. Changes can be made without reference.

1.2 Liability

The documentation was carefully compiled.

All examples and illustrations in this manual serve only as assistance for understanding the text. Changes without references can be made. We do not assume any liability for the correctness of the represented operations. No claims for the modification of products that have already been supplied may be made on the base of the texts, explanations and illustrations in this documentation. elrest Automationssysteme GmbH takes on no responsibility for an application of products, which refers to the represented examples (e.g. in eStudio demo).

elrest Automationssysteme GmbH assumes under no circumstances the liability or responsibility for damage, which resulted from an inappropriate installation, respectively an application of the devices or the accessories.

The staff must ensure that the installation and the application of the products according all of the safety requirements, laws, regulations and standards

In each case the national regulations and the valid safety regulations have to be considered.

Interferences and changes in the devices automatically render the warranty void.

1.3 Security regulations and safty precautions

This manual was provided for trained and competent personnel. The qualification is defined by the European guidelines for machines, low-voltages and EMV. The connection and the assembly of the devices can be carried out only via an electrical specialist, if the voltages are higher than the Safety Extra Low Voltage (SELV).

In each case the national regulations and the valid safety regulations have to be considered. Interferences and changes in the devices automatically render the warranty void.

Due to the large number of different applications for these devices, you must adapt yourself for your particular application.

If circuit components should fail, appropriate safety devices must ensure that the attached periphery is stopped.

Do not try to repair the devices themselves or exchange electrical parts. Please turn exclusively to the elrest service department. You can contact us on the elrest-hotline.

Consider the local, national standards and regulations during the installation and the employment of the devices.

The relevant regulations (VDE etc.) while handling electrical system are to be considered:

- To activate
- Prevent unintentional restart
- The unit must be deenergized
- Ground and short-circuiting
- No ground-loops.
- Cover or shield nearby live electric parts.

1.4 Copyright

The information, contained in this document, may be changed without advance NOTICE and represents no obligation on the part of elrest.

1.5 Symbolics

These manual different symbols are used for the emphasis of certain information. Hereby the service personnel receive necessary references to the safety and preventive measures. With each occurrence of the symbols the associated reference has to be read.

DANGER 	Indicates a directly threatening danger situation which may result in damage to persons or property.
WARNING 	Indicates a possibly arising danger, which may result in damage to persons or property.
	Indicates notes, thereby the handling gets easier.
DANGER 	Personal injury caused by electric current! Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.
DANGER 	Personal injury caused by electric current! Indicates a high-risk, imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING 	Warning of damage to persons Indicate a possible danger with moderate risk that can result in death or (severe) bodily injury if it is not avoided.
CAUTION 	Warning of damage to persons Indicates a low-risk, potentially hazardous situation which, if not avoided, could result in slight to moderate injury.
CAUTION 	Warning of damage to material Indicates a possible danger which can result in material damage, when it cannot be avoided.
ESD 	Damage to Property Caused by Electrostatic Discharge (ESD)! Indicates a potentially hazardous situation which, if not avoided, may result in damage to property

NOTICE 	Important Note! Indicates a potential malfunction which, if not avoided, however, will not result in damage to property.
INFORMATION 	Further information Refers to further information, which is not a substantial component of this documentation (e.g. Internet
 ST	(* comment to CoDeSys code lines *) a := a+1;

Table 1:Symbolics

1.6 Safety instructions

For installing and operating purposes of the relevant device to your system the following safety precautions shall be observed:

DANGER 	Don’t assembly the devices under voltage! Always switch off the power supply before assembling the device, eradicating defaults or carrying out maintenance operations.
DANGER 	Take note of the general regulations on prevention of accidents! Take note of the relevant regulations on prevention of accidents, e.g. the regulations during installation and commissioning of BGV A 3 "electrical installations and equipment" for mounting, installation and eradicating defaults.
DANGER 	Take note of connection in compliance with the standard! To avoid risks of the staff and the disturbances on the device, install the data- and the supply line conforming to standards. Take note of the correct assignment of connections.Observe the relevant EMC directives for your application.
ATTENTION 	Replace defective or damaged device! Replace defective or damaged device/module (e.g., in the event of deformed contacts), since the long-term functionality of fieldbus station involved can no longer be ensured.
ATTENTION 	Shield the devices from creeping and isolating materials! The components are not resistant against materials which have creeping and insulating properties such as: aerosols, silicones and triglycerides (found in some hand creams). If it cannot be excluded that this substances are in the environment of the device, incorporate the device in a cage which is resistant against the above-named substances. Always use proper tools and materials for the maintenance.

Table 2:Safty note

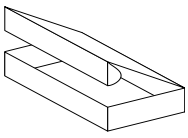
1.7 Before you start…

Before switching-on the supply voltage, please check definitely:

- The wiring
- Possible interference
- Free circulation around the heatsink

1.8 Storage, transport and packaging

The delivery has to be checked for completeness after the receipt. Possibly determined transport damages shall be notified to the shipping company and the manufacturer immediately. In the case of a possible temporary storage it is recommended to use the original packaging. The storage must be clean and dry. According the §BGB §446 and §448, the transfer of perils of the purchased product will pass to the buyer from invoicing. elrest does not assume any liability for the transport risk.If the carrier's liability of the transport enterprise does not cover the commodity value, it is incumbent on the buyer to conclude an additional transport insurance.



The devices are delivered in a suitable packing. To avoid damages please remove the packing before using the device. If the packing includes further accessories or descriptions, consider and keep them absolutely.

1.9 Warranty

A warranty claim presupposes a professional assembly and start-up, based on a valid assembly-, commissioning instruction and the operating instructions. The necessary assembly, start-up and maintenance work may be accomplished only by adept and authorized persons. See our EULA regulations too.

Manufacturer	**Trademark**	**Country of origins**
elrest Automationssysteme GmbH D-73230 Kirchheim unter Teck Leibnizstraße 10 Phone: +49 (0) 7021/92025-0 Fax: +49 (0) 7021/92025-29		Germany

1.10 Application area

The RMC501 and RMC503x processed digital and analog in- and outputs.

With its several communication interfaces (Ethernet, USB, CAN, RS232, RS485) the date exchange will be effected with further dedicated control systems.

1.10.1 Intended use

The devices are intended for the use in the ranges of the regulation, control and automatic control engineering.

Within all ranges, particularly when using inductive loads (e.g. engines and relay etc.), it must be guaranteed that arising voltage peaks don't exceed the maximum input voltages of the entrances and exits. If necessary, external predecting circuit parts must be installed.

The devices are exclusively intended for the installation in machines and plants. Start-up is forbidden until the conformity of the final product with the guideline 2006/42/EG „machine guideline "is determined.

With certain devices, external measures (e.g. a special power supply) can be necessary, in order to achieve the requiered interference immunity against surge). In this case, it will be pointed out at the respective device.

It will be applied accordingly to the appropriate device, if external measures are necessary for the minimization of the radiated interference.
Further the environment can affect the radiated interference.

Fulfils a device the "higher" engineer standards (e.g. EN 61000-6-3:2007 generic standard emission: Living quarters, business and industrial areas and small enterprises), it will be applied accordingly to the appropriate device (see to chapter „data sheets ").

WARNING 	Warning! This is a Class A product. In a domestic environment, it may cause radio interference, in which case the user may be required to take adequate measures. Designates a possibly arising danger, which can lead to a damage to property or person

1.10.2 Structure of the RMC5xx

Uniform structure of the robusto device:

- Robust aluminium heat sink housing
- Rail mounting
- Status LED for optical contol of the operating status
- RJ45 sockets for interface connection

1.10.3 Configuration

Ethernet communication level is available.

The selected configuration of the hardware must be accorded to the setting of the peripheral components. Malfunctions may otherwise occur, if no safty prompts are programmed in the application.

WARNING 	A RMC5xx device can only be (dis-)connected to the system in the power-off state of all system components.

2 Implementing

2.1 Mechanical installation

Safety notes at the workplace:

Before installating and starting up, the manual must be read and followed carefully. The relevant EN and VDE regulations are valid.

WARNING 	Before starting up, adapt the device to the room temperature. By condensation you are allowed to switch on the device only after it is completely dry. To prevent the device from overheating: - avoid direct sun contact to the device, - do not cover the vents - ensure sufficient air circulation

2.1.1 Clearance around the device

Ensure a minimum distance of 50mm around the device for sufficient ventilation.

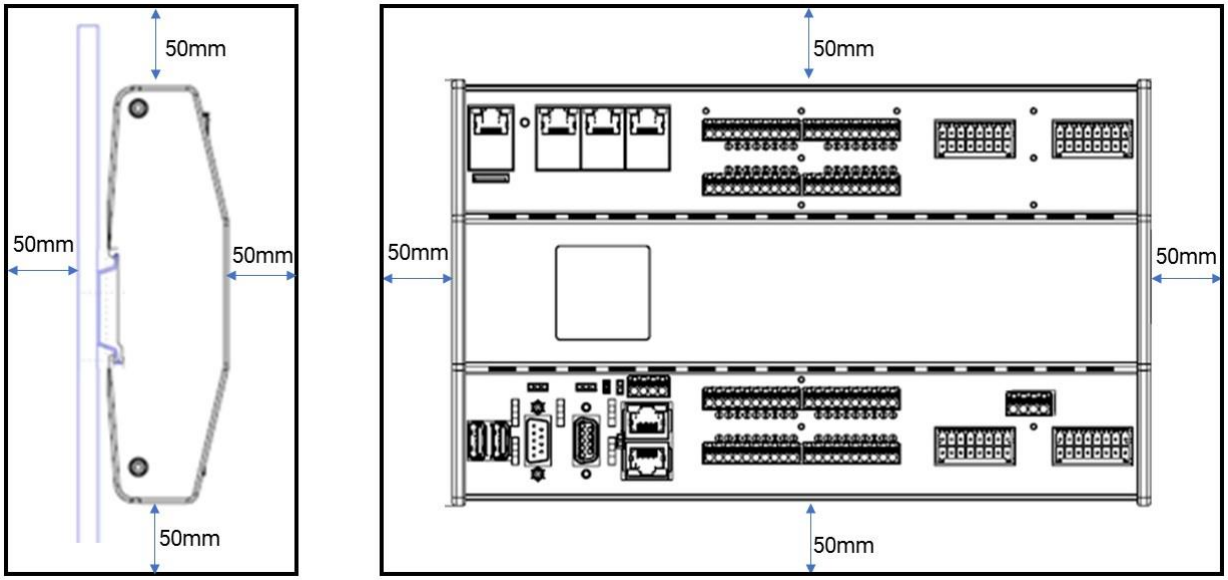


Figure 1:Clearence around the device

2.1.2 Required space

During installation, please ensure sufficient access to the device for the operator and maintenance work. Care must be taken for sufficient air ventilation.

2.1.3 Installation / Assembly

The valid local, and in particular, electrical safety regulations must be kept.

Safety notes at the workplace:

- The devices are intended for installation in switching cabinets
- The protection rating IP20 has to be warranted;
- The installation point has to be in a solid position with low vibration.

2.1.4 Assembly/Disassebly of the RMC5XX

The mounting position is horizontal.
According to the installation positions are the valid maximum ambient temperature have to be respected.

NOTICE 	**NOTICE the temperature range at a different mounting position!** In the chapter technical data is the range of temperature specified. It is valid for the recommended ambient working temperature. If the device will be mounted in a diffferent mounting position as recommended, the cooling will be affected. Please contact the elrest service for further information.

WARNING 	The RMC5XX is mounted on a 35 mm top hat rail acc. DIN EN 60715 The top hat rail must not be thicker than 1,5 mm. Bring the system into a safe, de-energized state before starting installation, disassembly or wiring of the device! THE TOP HAT RAIL MUST BE CONNECTED TO THE FUNCTION EARTH (FE). All communication interfaces of the RMC5xx device have additionally be connected to the function earth (FE) in the communication plug (if available). The cable screens of the communication interfaces must be connected by the mating connectors with the FE. The power supply (24 VDC) must be, in accordance with its requirements (e.g. amount of all driver outputs), adequately dimensioned and secured.

2.1.4.1 Mounting position

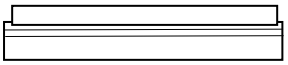
Device	Mounting position horizontal (standard)	Mounting position vertical	Mounting position desk
RMC5xx			
Operating temperature	50 °C	50°C	40 °C

Table 3:Mounting position

2.1.4.2 Connection functional earth

The functional earth of the RMCxxx has to be connected with the functional earth in the control cabinet. In this way, the device is included in the earthing concept of the control cabinet. The FE mounting bolt between the RJ45 sockets of X101 and X102 must be used.	
For the connection are particularly suited ultraflexible copper braiding tapes / ground strips, they are to be given preference over copper single conductor. A M3 screw with an installation depth of 6 mm has to be used for mounting.	

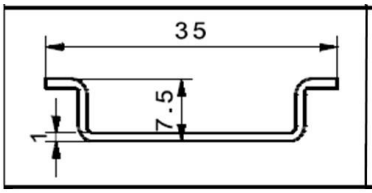
	The plug connectors constitute a solid and secure connection, so the device should be gripped at once with one hand if the plug is removed.

2.1.4.3

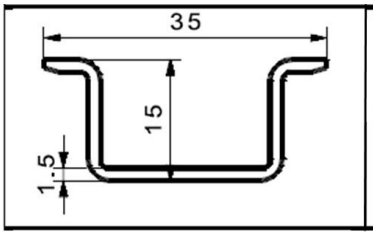
Top- hat rail:

The normed top-hat rail for the mechanical snap-on mounting may not be exceeded of maximum 1,5 mm.
Therefore the two below versions can be used.

Variante 1:

	35 x 7,5 x 1,0	18 x 5,2	Stahl verzinkt
			Edelstahl
		ungelocht	Stahl verzinkt
			Edelstahl

Variante 2:

	35 x 15 x 1,5	18 x 5,2	Stahl verzinkt
		ungelocht	Stahl verzinkt

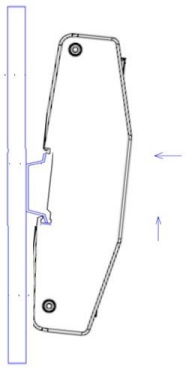
	Keep the RMC5XX over the top hat rail, so that the top hat rail applies in a right angle to the rear side of the device. Put the device into the top hat rail and push against the spring force of the splay, till the upper part of the profile snaps over the upper part of the top hat rail.
	Release the device; it must fit free and robust on the top hat rail. Check the best fit by easy attempts at movement of the device.

Figure 2:Assembly

Disassebly:

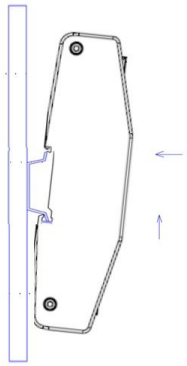
	All connecting plugs must be removed before the disassembly. For the disassembly push up the device, till the device can be tipped forward for the release
	Push the device against the spring force of the splay till it can released from the upper part of the top hat rail. In this moment the device is no longer kept from the top hat rail, it must be kept by you to avoid falling down. Lower the device and remove it from the top hat rail.

Figure 3:Disassembly

2.1.5 Cooling

Passive heat sink: Cooling is achieved via the robusto heat in the backside of the device.

2.1.6 Dimension drawing front view - RMC500

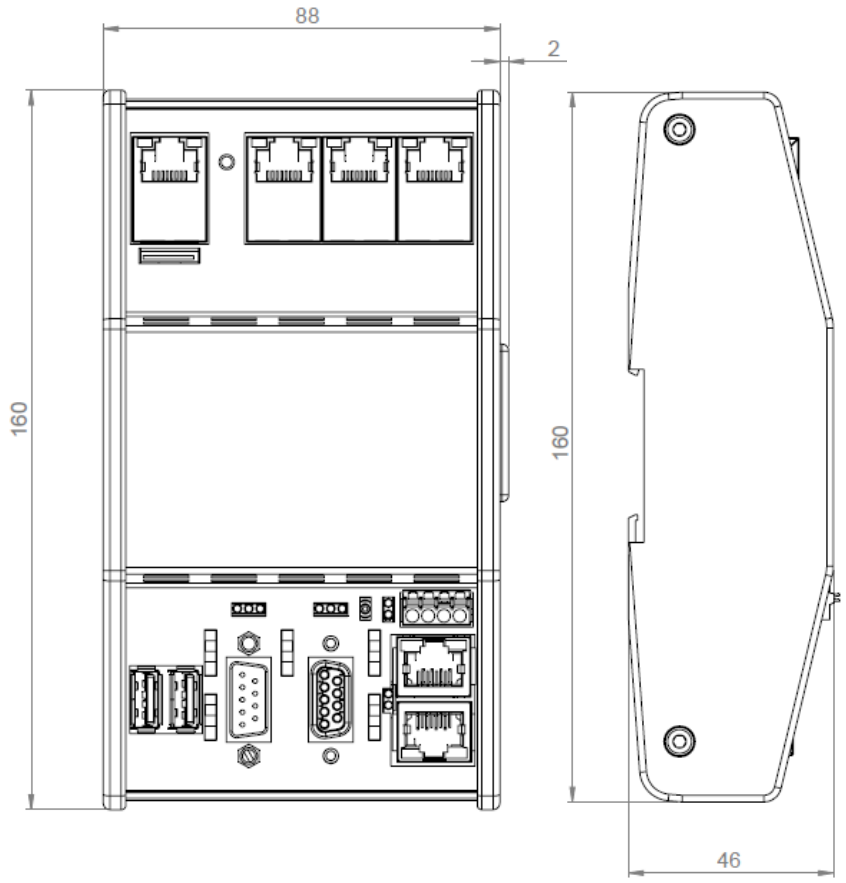


Figure 4:Front view - RMC500

2.1.7 Dimension drawing side view - RMC500

Figure 5:Side view - RMC500

2.1.8 Dimension drawing front view - RMC501

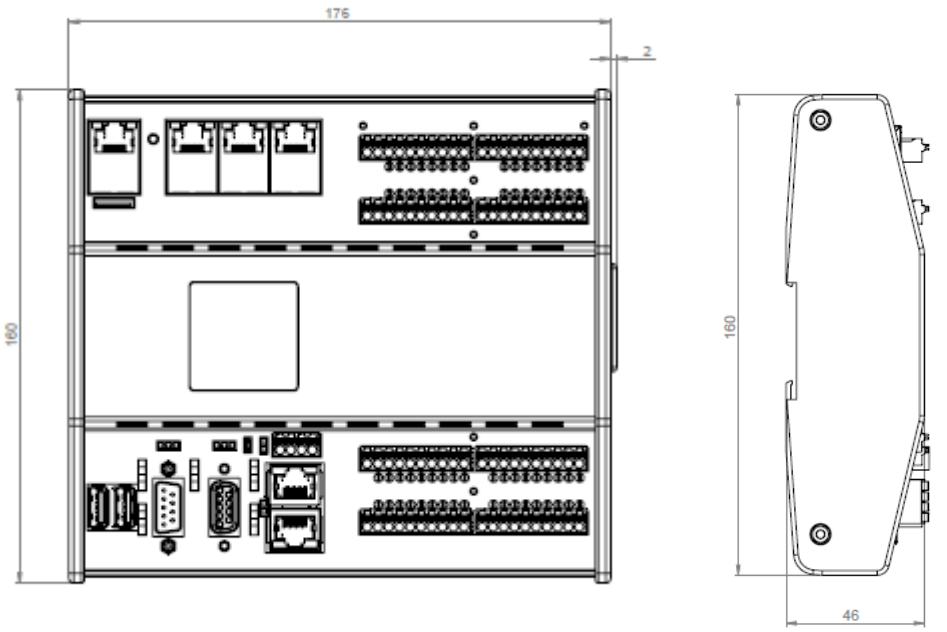


Figure 6:Front view - RMC501

2.1.9 Dimension drawing side view - RMC501

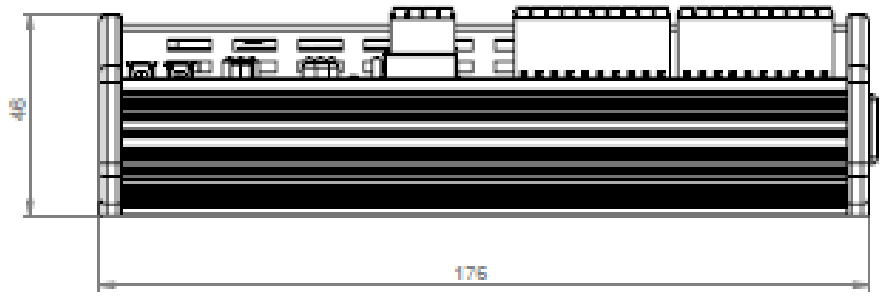


Figure 7:Side view - RMC501

2.1.10 Dimension drawing front view - RMC503

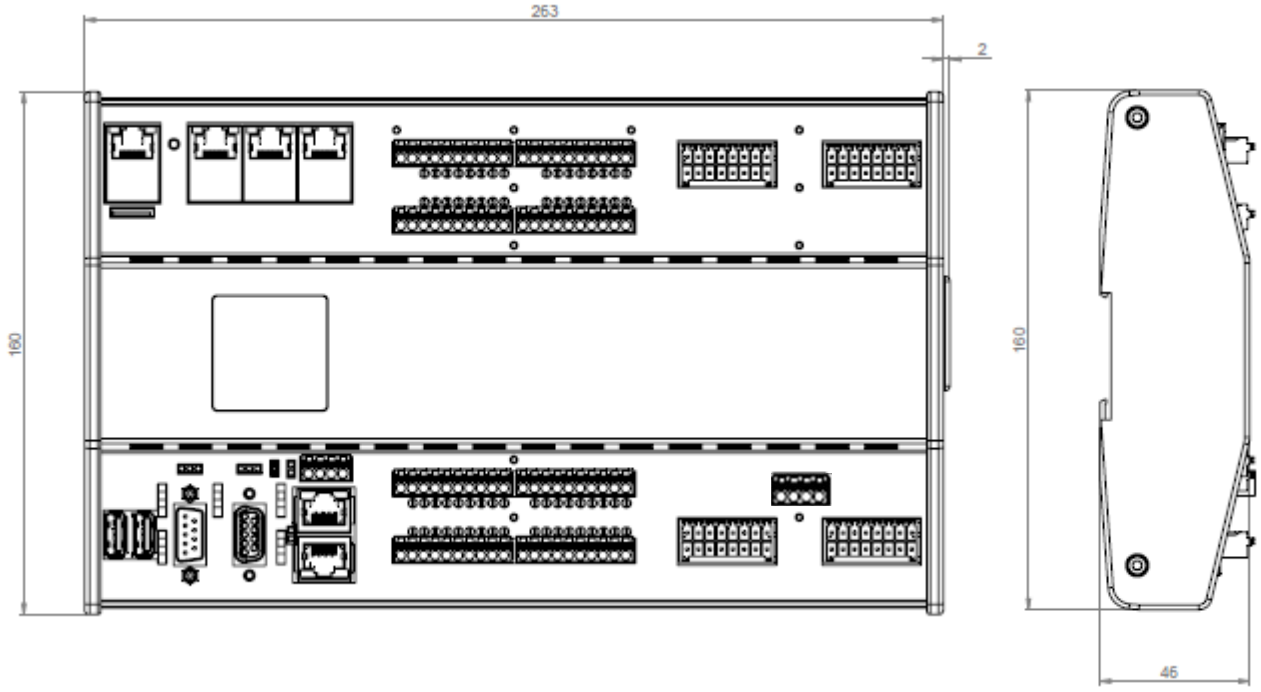


Figure 8:Front view - RMC503

2.1.11 Dimension drawing side view - RMC503

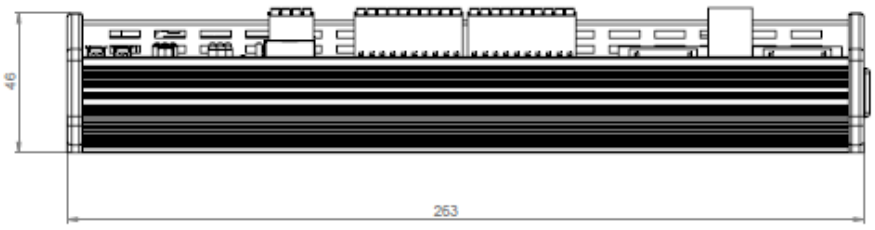


Figure 9:Side view - RMC503

2.2 Elektrical Installation

2.2.1 Supply voltage

Proceed with start-up generally as follows:

- Attach the supply voltage for the device RMC5xx to X109.
- Turn the power supply on.

WARNING

The supply voltage connection of the control component from the device has polarity protection.

If several connection points are available for the identical potential, than no potential difference between them is allowed. Otherwise, the resulted compensation currents can lead to irreversible damages of the device. Therefore, provide a suitable equipotential bonding!

For the 24 V – supplier ensure a reliable electrical isolation of the low voltage. Only use power supply units manufactured to the standards IEC 364 - 4 - 41 / HD 384.04.41 (VDE 0100 Part 410).

Only use power supply units in accordance with SELV and PELV specifications!

The supply voltage may be intermediate within the specified voltage range! Otherwise this may cause malfunction on the device. See the technical specifications for the supply voltage requirements.

High frequency radiation, from mobile phones for example, can cause unintentional operating situations.

2.2.1.1 Connectors for power supply

For the connectors only use the specified manufacturer types, unequal connectors can damage the pin connectors.

For the CAN interfaces can be used commercially connectors with good quality.

All plug connectors have to be plugged correctly, otherwise a contact resistance occurs.

⇨ Push open the plugs on several places Stecker an mehreren Stellen aufdrücken and hold for a few seconds until they lock.

WARNING	Never disconnect plugs when under load. Faulty or incorrect connection may cause malfunction on the device

2.2.2 EMC-compliant design

The basis for an interference-free operation is an EMC-compliant hardware construction of the system, as well as the use of interference-free cables**.** The guidlines for interference-free installation of your system are accordingly to the installation of the RMCxxx devices.

WARNING

For all signal connections are allowed only protected lines.

- All plug connectors must be screwed or locked;
- Signal lines and high-voltage cables are not allowed to lead both in the same cable duct;
- For malfunctions and damages caused by the use of unsuitable cable, no liability can be accepted;
- Unused signals (e.g. unused interfaces, battery connections, etc.) have to be adequate covered to avoid electrostatic influences (ETUC/ESD);
- Cables only plug in/off when the device is turned off.
- During the operation, all connected cables must be connected to a remote peer.

2.2.3 Connections to other elrest CANopen devices

For the CAN interfaces X110A (CAN0) and X110B (CAN1) can be used the the commercial RJ45-plugs (8- pol) of good quality.

Respect the correct polarity / pin order of „H“ / „L“ / „GND“-signals of the connected CAN kommumication interfaces.

Establish the connection as follows:

Article number: 25150.xxxx		
Master RMC5xx	Patch cable RJ-45 zu RJ-45	Slave RSCxxx
 Figure 10:Connections to other elrest CANopen devices		
The individual accessory components can be taken from the chapter „accessories“.		

2.2.4 EGB / ESD- guidelines

2.2.4.1 What means EGB/ ESD

Nearly all modern modules are equipped with highly integrated chips or components in MOS technology. These electronic components are very sensitive to overvoltage and therefore to electrostatic discharge.

The international abbreviation for ESD means Electrostatic Sensitive Device.

This symbol is on cabinets, subtracks, or packing boxes and indicates the use of electrostatically sensitive devices and thereby sensitivity by touching the devices:

EGB /ESD sensitive components may be damaged by energies and voltages that are below the limit of human perception. This kind of voltages occurs when somebody, which is not electrostatically discharged, touches a module/chip/component. In most of the cases, the components exposed to such overvoltages can not immediately be detected as defective. Only after long operating of the device may an error occur.

An installation that conforms to EMC requirements as well as the use of interferencefree cables represents a basic requirement in ensuring trouble-free operation.

The directives for interference-free installation of your device also apply for the installation of the HMI device.

2.2.4.2 Protective measures against static charge

The most plastics are hard chargeable and therefore must be kept away from ESDs!
Ensure that operators, work area, and packaging have proper grounding when working with ESDs!

2.2.4.3 Handling of ESD-Modules

Basically, the electronic boards should be touched only when it’s absolutely necessary. Never touch the chip connectors and live conductors of a flat electronic module.

Touch the electronic components **only**, if you are permanently grounded via the ESD wristband, ESD shoes, or shoes with protecting strip in constant touch with an ESD floor.

Discharge your body before touching any electronic module. For example, by touching electrically conductive and grounded material (e.g. grounded bare metal cabinet parts, water pipes…).

Electrostatic sensitive components or modules must not get in contact with materials which are chargeable including all standard types of plastic, desk top, and clothes with synthetical material and so on. Components must only be placed on conductive surfaces.(table witg ESD- layer, ESD conductive cellular material, ESD packaging, ESD container)

Do not place the components near visual displays and monitors or television sets. (Keep a minimum distance of 10 cm)

2.2.5 Guidelines

The conformity of the above specified products with the provisions of the Directive 2004/108/EG, 2006/95/EG und 2011/65/EG
is supported by the respect of the following standards:

2.2.5.1 Product standard

EN61131-2:2007
Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007

2.2.5.2 Immunity and interference

EN61000-6-2:2011
Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005, Corrigendum to DIN EN 61000-6-2 (VDE 0839-6-2):2006-03; German version CENELEC-Cor. :2005 to EN 61000-6-2:2005

EN61000-6-4:2011
Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments (IEC 61000-6-4:2006 + A1:2010); German version EN 61000-6-4:2007 + A1:2011

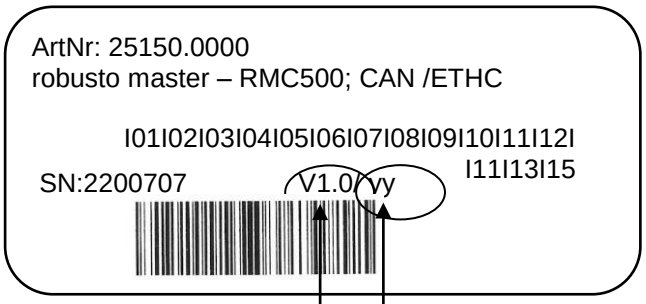
2.2.6 Label

Each device has on the left side an individual series label, which identifies the device.

The serial label includes the following information:

article number
article description
additional text

month of delivery
serial number index . year of delivery



The index Vx.x/yy splits in
x.x hardware status
yy software status

Figure 11:Label

WARNING	Note for devices with the index = „ PROTOTYPE”. Prototypes are used only for test purposes.

Currentunit version	Hardware	Software
Prototype: Prototypex/0.yy	Prototype	0.yy
Pilot series V0.x/yy	Pilot series	yy
Series V1.x/yy	Series	yy

3 System overview

3.1 Products

elrest- products

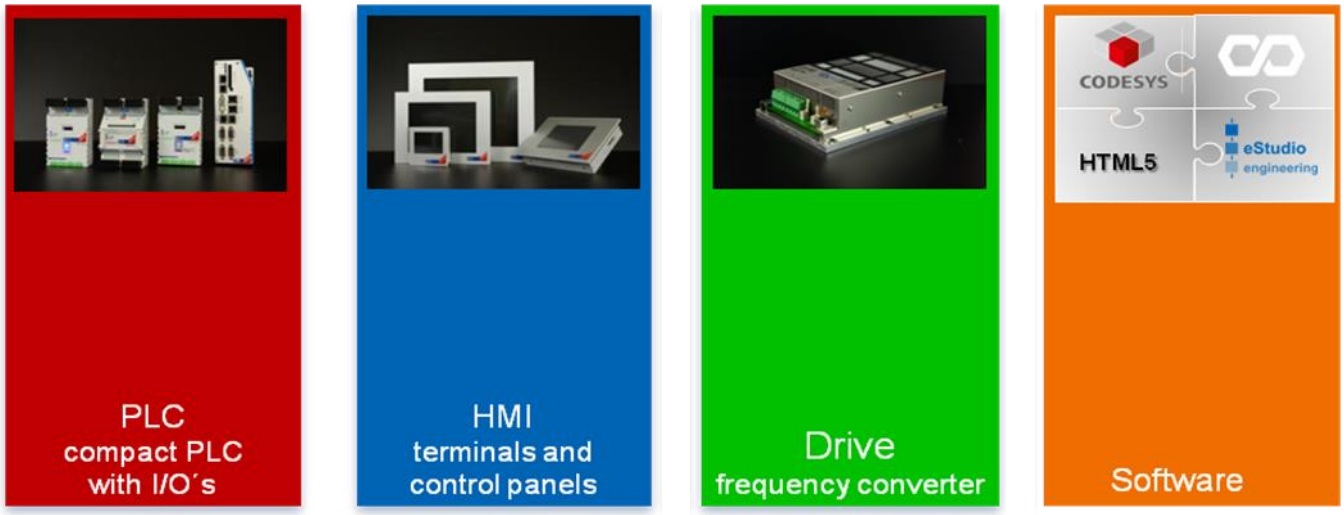


Figure 12:elrest products

combo robusto	visio terminal visio control	motion	Software

3.2 Communication interfaces

USB	Interface to all peripheral units as stick, keyboard, printer, a.s.o.
RS 232 RS 485	Serial interfaces RS232 and/or RS485. They can be operated with any desired UART protocols or with the prepared RTU-Modbus.
CAN	An open fieldbus interface to any CAN protocols e.g. Truck-Norm J1939-based
CANopen	CANopen is a Layer7 protocol for automation
Ethernet	With Ethernet can TCP-Modbus as UDP or TCP be used. on the base of socket functions can be additioned further protocols.

Table 4: Overview communication interfaces

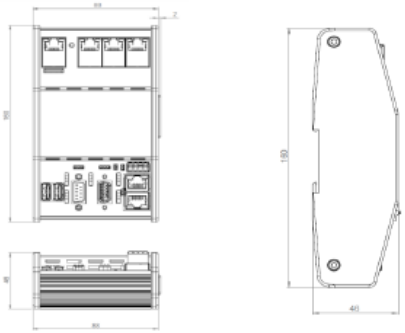
4 Device descriptions

4.1 Technical data RMC500

robusto control

Data sheet robusto master RMC500 *V1.10*

elrest® Wir steuern Ihren Erfolg



robusto control

• Ethernet Switch • Passive cooled CPU unit
• Universal design

Specification		
Processor		Cortex-A9, Single Core, 800 MHz
	optional	Cortex-A9, Dual Core, 800 MHz
Real-time clock		available, with goldcap buffered up to 4 weeks
Memory		1 GByte RAM, 4 GByte Flash
Memory expansion		via USB-Stick on the USB-Host interface
Memory expansion via µSD-card-socket	optional	with µSD card (max. 2 GB) or µSDHC card (max. 32 GB)
Speed class:		recommended: class 2 with 2 MB/s minimum speed
Buffering	optional	1 MByte retain data in flash
Software		
Operating system		Embedded Linux 4.00
PLC programming		CODESYS V3 (CS3)
HMI programming		CODESYS V3 WebVisu (WV)
Interface		
Ethernet		1 x 100/1000BASE-T, RJ45 3 x 10/100BASE-T, RJ45 with switch functionality
	optional	1 x 100/1000BASE-T, RJ45 1 x 10/100BASE-T, RJ45 2 x 10/100BASE-T, RJ45 with Profinet functionality
Serial interfaces		1 x D-Sub-9 plug (male) with multiple function: 1 x RS232 with galv. isolation, 2 x RS485 with galv. isolation, termination ON-OFF 1 x RS485 with galv. Isolation, D-Sub-9 socket (female); termination ON-OFF
Fieldbus interfaces		2 x CAN acc. ISO11898 with galv. isolation, 2x RJ45, 2 x termination ON-OFF
USB		2 x USB-2.0 hub device type A
NFC	optional	Short range wireless connectivity (smartphone)

Functions	
Operating mode switch	RUN-STOP-RESET
Profinet-RT Controller	Via CODESYS configurator
Profinet-RT Device	Via FPGA IP /IEC library
CANopen Master	Via IEC- library or CODESYS configurator
CANopen Slave	Via CODESYS configurator
Ethernet TCP-Modbus Client or Server	Via IEC- library
Modbus RTU Slave or Master	Via IEC- library
Order-No.:	
25150.0000	robusto master - RMC500
Environment/ mechanical values	
Supply voltage	24 VDC (-15% / +20%) SELV with polarity reversal
Power consumption (duration/start-up)	0,8 A / 1,0 A
Housing	robusto heat sink with device lid
Protection class	IP20, acc. EN 60529
Mounting	snap-in mounting on top-hat rail DIN EN 60715
Outside dimensions in mm (w x h x d)	88 x 160 x 46
Weight app.	430 g
Operating temperature	0°C…50°C (depending on position)
Storage temperature	-20°C... 70°C
Relative humidity for operation	10%...85% non-condensing
Relative humidity for storage	5%...85% non-condensing
Cooling	Passive heat sink
Diagnostic	
LED's	LEDs for operating- and status indication; LED Power

Standards	
Product standards	
EN61131-2:2007	Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007
Immunity and interference	
EN61000-6-2:2011	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005, Corrigendum to DIN EN 61000-6-2 (VDE 0839-6-2):2006-03; German version CENELEC-Cor. :2005 to EN 61000-6-2:2005
EN61000-6-3:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006 + A1:2010); German version EN 61000-6-3:2007 + A1:2011
Environment audit	
EN60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007); German version EN 60068-2-6:2008
EN60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:2008); German version EN 60068-2-27:2009
Accessory	
	Memory expansion with µSD-card Retain data 1 MByte
Applications	
	in many industries such as plastics, medical- and automation technology

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4.2 Technical data RMC501

robusto control

Data sheet robusto master RMC501 *V1.7*

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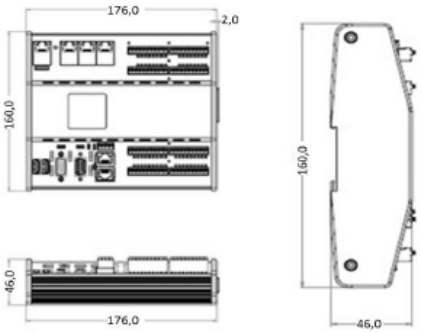

robusto control

• Ethernet Switch • Passive cooled CPU unit
• Universal design

Specification		
Processor		Cortex-A9, Single Core, 800 MHz
	optional	Cortex-A9, Dual Core, 800 MHz
Real-time clock		available, with goldcap buffered up to 4 weeks
Memory		1 GByte RAM, 4 GByte Flash
Memory expansion		via USB-Stick on the USB-Host interface
Memory expansion via µSD-card-socket	optional	with µSD card (max. 2 GB) or µSDHC card (max. 32 GB)
Speed class:		recommended: class 2 with 2 MB/s minimum speed
Buffering		1 MByte retain data in flash
Software		
Operating system		Embedded Linux 4.00
PLC programming		CODESYS V3 (CS3)
HMI programming		CODESYS V3 WebVisu (WV)
Interface		
Ethernet		1 x 100/100BASE-T, RJ45 3 x 10/100BASE-T, RJ45 with switch functionality
	optional	1 x 100/1000BASE-T, RJ45 1 x 10/100BASE-T, RJ45 2 x 10/100BASE-T, RJ45 with Profinet functionality
Serial interfaces		1 x D-Sub-9 plug (male) with multiple function: 1 x RS232 with galv. isolation, 2 x RS485 with galv. isolation, termination ON-OFF 1 x RS485 with galv. Isolation, D-Sub-9 socket (female); termination ON-OFF
Fieldbus interfaces		2 x CAN acc. ISO11898 with galv. isolation, 2x RJ45, 2 x termination ON-OFF
USB		2 x USB-2.0 hub device type A
NFC	optional	Short range wireless connectivity (smartphone)

Functions	
Operating mode switch	RUN-STOP-RESET
Profinet-RT Controller	Via CODESYS configurator
Profinet-RT Device	Via FPGA IP /IEC library
CANopen Master	Via IEC- library or CODESYS configurator
CANopen Slave	Via CODESYS configurator
Ethernet TCP-Modbus Client or Server	Via IEC- library
Modbus RTU Slave or Master	Via IEC- library
Order-No.:	
25150.0100	robusto master - RMC501
Environment/ mechanical values	
Supply voltage	24 VDC (-15% / +20%) SELV with polarity reversal
Power consumption (duration/start-up)	0,8 A / 1,0 A
Housing	robusto heat sink with device lid
Protection class	IP20, acc. EN 60529
Mounting	snap-in mounting on top-hat rail DIN EN 60715
Outside dimensions in mm (w x h x d)	approx. 176 x 160 x 46
Weight app.	1200 g
Operating temperature	0°C…50°C (depending on position)
Storage temperature	-20°C... 70°C
Relative humidity for operation	10%...85% non-condensing
Relative humidity for storage	5%...85% non-condensing
Cooling	Passive heat sink
Diagnostic	
LED's	LEDs for operating- and status indication; LED status for digital in- and outputs
Digital Inputs	
Number	32
Input voltage	24 VDC with galvanic isolation, EN61131-2 Typ 1
Frequency max.	1 kHz
Connection	4 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,5 mm²,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 714-110 and 714-140 
Digital Outputs	
Number	32
Output voltage	24 VDC with galvanic isolation
Output current	0,5 A
Total current (per DIN)	Current per group (8 outputs) max. 2 A
Ohmic load	At least 50 Ohm
Switching frequency Ohm/inductive	1 kHz
Short circuit	Current limiting up to 0,7 A per channel
Thermal Protection	Thermal protection of 120°C ; reconnecting of 100°C. additionally protection per group with a fuse of 5 A.
Connection	4 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,5 mm²,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 714-110 and 714-140 

Standards	
Product standards	
EN61131-2:2007	Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007
Immunity and interference	
EN61000-6-2:2011	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005, Corrigendum to DIN EN 61000-6-2 (VDE 0839-6-2):2006-03; German version CENELEC-Cor. :2005 to EN 61000-6-2:2005
EN61000-6-3:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006 + A1:2010); German version EN 61000-6-3:2007 + A1:2011
Environment audit	
EN60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007); German version EN 60068-2-6:2008
EN60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:2008); German version EN 60068-2-27:2009
Acessory	
	Memory expansion with µSD-card Retain data 1 MByte
Applications	
	in many industries such as plastics, medical- and automation technology

*Remark: The use of standard memory card (e.g. CF-cards is generally possible. Anyhow elrest GmbH does not take any responsibility thereby.

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4.3 Technical data RMC503

robusto control

Data sheet robusto master RMC503 *V1.9*

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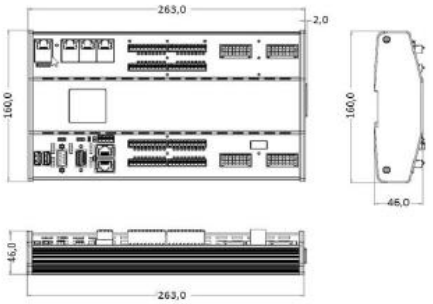

robusto control

• Ethernet Switch • Passive cooled CPU unit
• Universal design

Specification		
Processor		Cortex-A9, Single Core, 800 MHz
	optional	Cortex-A9, Dual Core, 800 MHz
Real-time clock		available, with goldcap buffered up to 4 weeks
Memory		1 GByte RAM,4 GByte Flash
Memory expansion		via USB-Stick on the USB-Host interface
Memory expansion via µSD-card-socket	optional	with µSD card (max. 2 GB) or µSDHC card (max. 32 GB)
Speed class:		recommended: class 2 with 2 MB/s minimum speed
Buffering		1 MByte retain data in flash
Software		
Operating system		Embedded Linux 4.00
PLC programming		CODESYS V3 (CS3)
HMI programming		CODESYS V3 WebVisu (WV)
Interface		
Ethernet		1 x 100/1000BASE-T, RJ45 3 x 10/100BASE-T, RJ45 with switch functionality
	optional	1 x 100/1000BASE-T, RJ45 1 x 10/100BASE-T, RJ45 2 x 10/100BASE-T, RJ45 with Profinet functionality
Serial interfaces		1 x D-Sub-9 plug (male) with multiple function: 1 x RS232 with galv. isolation, 2 x RS485 with galv. isolation, termination ON-OFF
		1 x RS485 with galv. Isolation, D-Sub-9 socket (female); termination ON-OFF
Fieldbus interfaces		2 x CAN acc. ISO11898 with galv. isolation, 2x RJ45, 2 x termination ON-OFF
USB		2 x USB-2.0 hub device type A
NFC	optional	Short range wireless connectivity (smartphone)

Functions	
Operating mode switch	RUN-STOP-RESET
Profinet-RT Controller	Via CODESYS configurator
Profinet-RT Device	Via FPGA IP /IEC library
CANopen Master	Via IEC- library or CODESYS configurator
CANopen Slave	Via CODESYS configurator
Ethernet TCP-Modbus Client or Server	Via IEC- library
Modbus RTU Slave or Master	Via IEC- library
Order-No.:	
25150.0300	robusto master - RMC503
Environment/ mechanical values	
Supply voltage	24 VDC (-15% / +20%) SELV with polarity reversal
Power consumption (duration/start-up)	0,8 A / 1,0 A
Housing	robusto heat sink with device lid
Protection class	IP20, acc. EN 60529
Mounting	snap-in mounting on top-hat rail DIN EN 60715
Outside dimensions in mm (w x h x d)	approx. 260 x 160 x 50,8
Weight app.	1200 g
Operating temperature	0°C…50°C (depending on position)
Storage temperature	-20°C... 70°C
Relative humidity for operation	10%...85% non-condensing
Relative humidity for storage	5%...85% non-condensing
Cooling	Passive heat sink
Diagnostic	
LED's	LEDs for operating- and status indication; LED status for digital in- and outputs
Digital Inputs	
Number	32
Input voltage	24 VDC with galvanic isolation, EN61131-2 Typ 1
Frequency max.	1 kHz
Connection	4 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,5 mm²,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 714-110 and 714-140 
Digital Outputs	
Number	32
Output voltage	24 VDC with galvanic isolation
Output current	0,5 A
Total current (per DIN)	Current per group (8 outputs) max. 2 A
Ohmic load	At least 50 Ohm
Switching frequency Ohm/inductive	1 kHz
Short circuit	Current limiting up to 0,7 A per channel
Thermal Protection	Thermal protection of 120°C ;reconnecting of 100°C. additionally protection per group with a fuse of 5 A.
Connection	4 x socket 10-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 … 1,5 mm²,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 714-110 and 714-140 

Analog Inputs

Number	16
Analog input types of sensors:	Ni1000 / Ni1000-TK5000 PT1000 2-wire PT100 2-wire TC TYP K (NI-CrNi), TC Typ L (Fe-CuNi), TC Typ S (Pt-RhPt) Voltage : 0...+ 10 VDC Current : 0...+ 20 mA Resistance : 0.. 200 kOhm, 0..500 Ohm
Conversion time:	100 ms of all analog channels

	Sensor range: up:	Sensor range: to:	Value range:	Resolution:	Resolution A/D converter:	Accurancy:
Range of measurement voltage	0(4) mA	20 mA	20 mA	± 0,0100 mA	± 0,0003 mA	± 0,0203 mA
Range of measurement current	0 mV	10 V	10 V	± 5,00 mV	± 0,19 mV	± 10,19 mV
Range of measurement temperature						
Pt100	-50°C	350°C	400°C	± 0,5000 K	± 0,0900 K	± 2,0000 K
Pt1000	-20°C	100°C	120°C	± 0,0500 K	± 0,0090 K	± 0,3706 K
Ni1000	-20°C	100°C	120°C	± 0,0500 K	± 0,0072 K	± 0,3639 K
Ni1000TK5000	-20°C	100°C	120°C	± 0,0500 K	± 0,0072 K	± 0,3639 K
TC TYP K (NI-CrNi)	-100°C	1300°C	1400°C	± 0,0200 K	± 0,0900 K	± 2,0000 K
TC Typ L (Fe-CuNi)	-100°C	900°C	1000°C	± 0,0200 K	± 0,0900 K	± 2,0000 K
TC Typ S (Pt-RhPt)	0°C	1600°C	1600°C	± 0,0200 K	± 0,0900 K	± 2,0000 K
Range of measurement resistance	0 Ω	200 kΩ	200 kΩ	200 Ω	± 3 Ω	± 4 kΩ
	0 Ω	500 Ω	550 Ω	0,01 Ω	± 0,156 mΩ	± 0,8 Ω

Input impedance	0(4)...20 mA	< 150 Ohm
	0...10 V	> 10 kOhm
Measuring current	Ni1000, PT1000, Ohm	< 1 mA
A/D-converter analog input	16-bit	
Processing time	100 ms of all analog channels	
Connection	2 x socket 8-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 ... 1,0 mm²,,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 713-1408 / female multipoint connector 713-1108	

Analog Outputs

Number	16
Analog output type of sensor:	Voltage : 0...+ 10 VDC
DA-converter analog output	12-bit
Resolution	± 5mV
Accuracy	± 10mV
Power load	< 10 mA
Processing time	100 ms of all analog channels
Connection	2 x socket 8-pole; contact spacing 3,5 mm, conductor crosssection up to 0,2 ... 1,0 mm²,,depending on the installation situation (see data sheet WAGO) 8 A WAGO: 713-1408 / female multipoint connector 713-1108 

Standards	
Product standards	
EN61131-2:2007	Programmable controllers - Part 2: Equipment requirements and tests (IEC 61131-2:2007); German version EN 61131-2:2007
Immunity and interference	
EN61000-6-2:2011	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005); German version EN 61000-6-2:2005, Corrigendum to DIN EN 61000-6-2 (VDE 0839-6-2):2006-03; German version CENELEC-Cor. :2005 to EN 61000-6-2:2005
EN61000-6-3:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006 + A1:2010); German version EN 61000-6-3:2007 + A1:2011
Environment audit	
EN60068-2-6	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007); German version EN 60068-2-6:2008
EN60068-2-27	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock (IEC 60068-2-27:2008); German version EN 60068-2-27:2009
Acessory	
	Memory expansion with µSD-card Retain data 1 MByte
Applications	
	in many industries such as plastics, medical- and automation technology

*Remark: The use of standard memory card (e.g. CF-cards is generally possible. Anyhow elrest GmbH does not take any responsibility thereby.

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4.3.1 Storage options

The flash storage will be subdivided in several partitions, like bootloader and operating system.
During the Linux update a backup will be created in a further partition.

Standard: 1GB-Flash:

There are 260 Mbyte available.

Option: 4GB-Flash:

There are 1,5 Gbyte available.

4.3.2 Dependence of the storage temperature to the humidity

There are relationships between the storage temperature and the humidity.
Field:

Example	Relative humidity	Ambient temperature max.	
1	85%	70°C	In conditions of relative humidity of more than 90% can the device be stored at a maximum temperature of 70 °C.
2	60%	60°C	In conditions of storage temperatur of 60 °C a maximum relative humidity of 60% is be allowed.

4.3.3 Dependence of the allowable operating temperature

All temperature measurements refer to an average occupancy of 50%

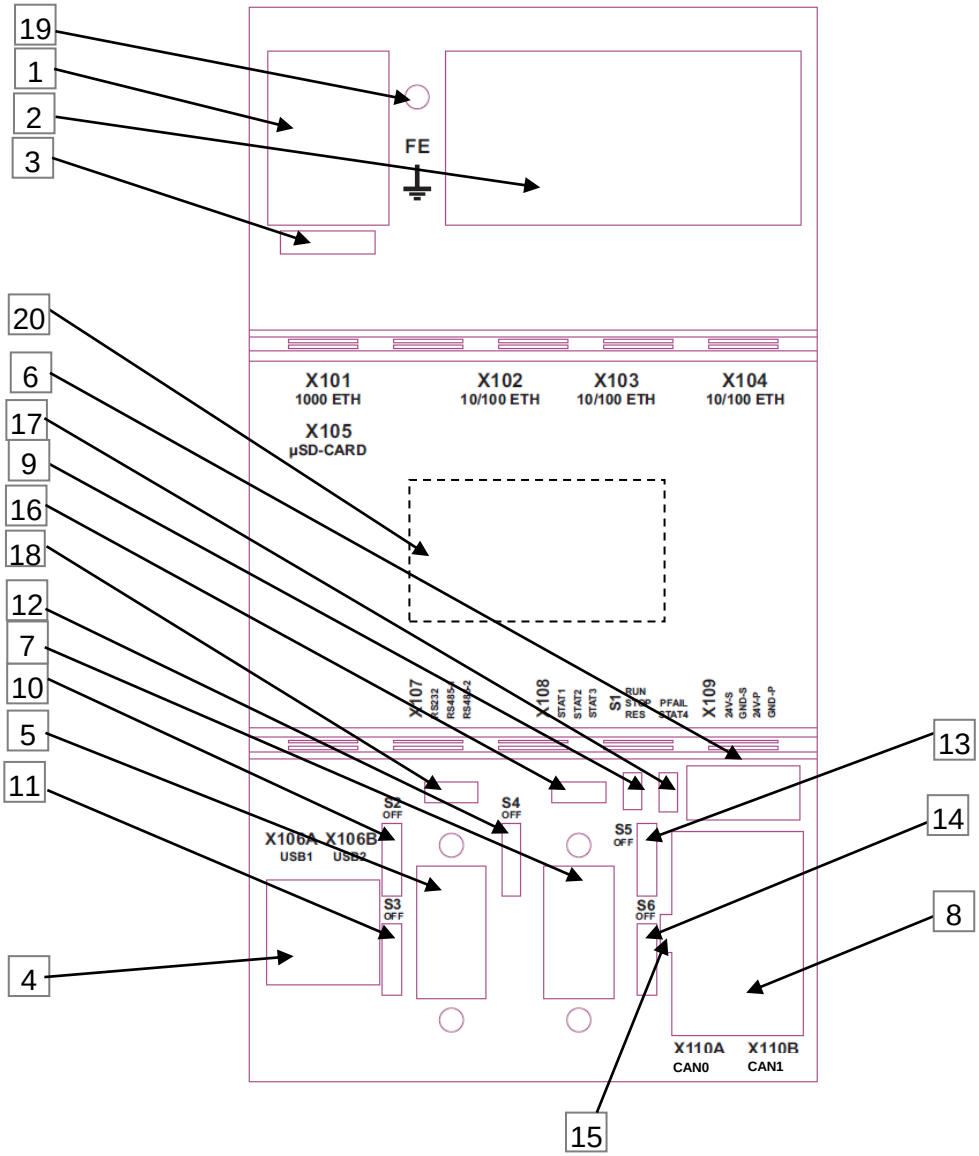
The internal temperature is because of self-heating higher than 20°C as the ambient temperature.
The allowable operating temperature may not be exceeded.
see data sheet RMC500

see data sheet RMC501

see data sheet RMC503

4.4 Frontview interfaces

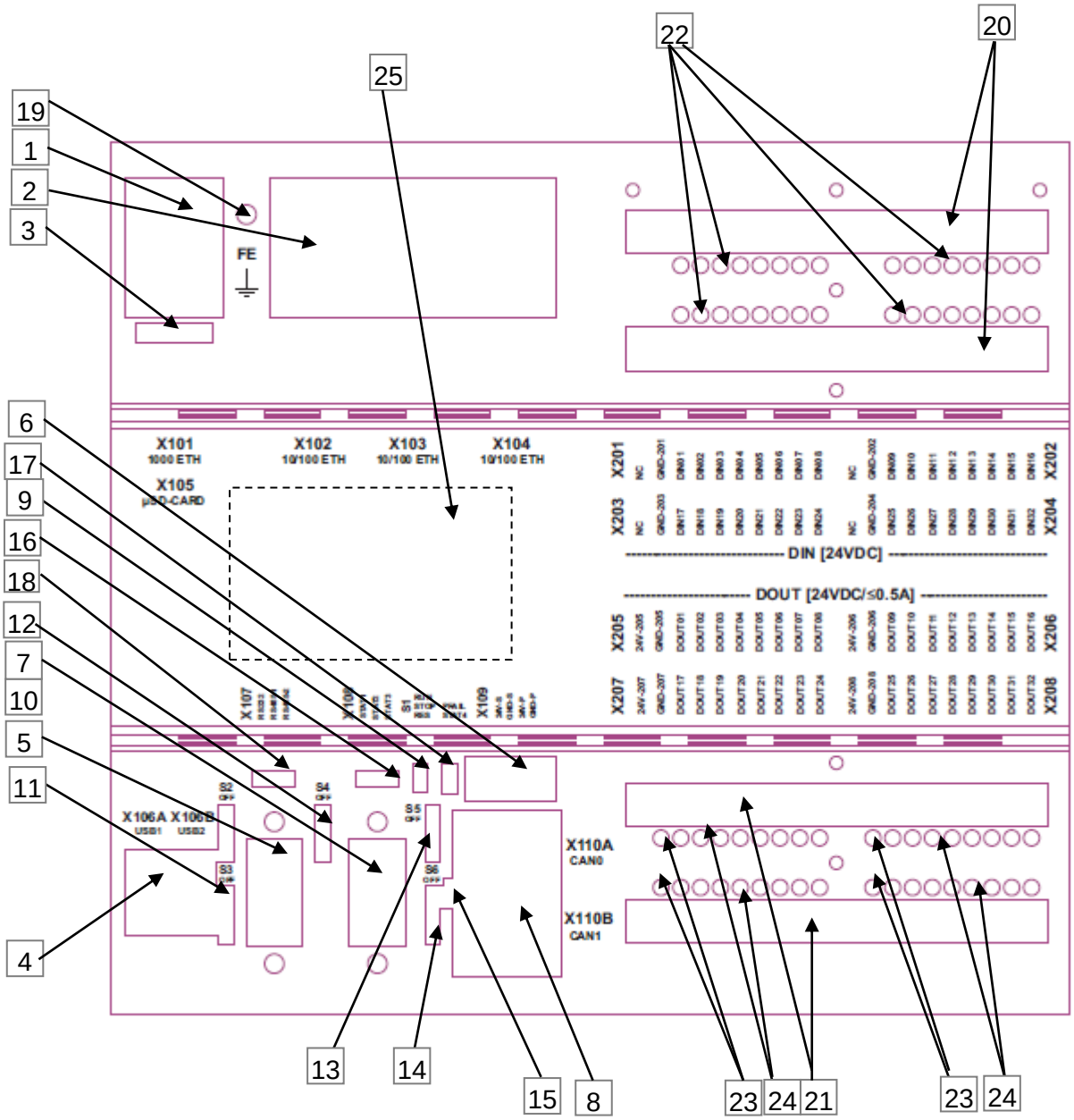
4.4.1 Frontview of the interfaces RMC500



No.	Chapter		Indication
1	X101 Gigabit Ethernet interface	X101	100/ 1000 BASE-T, RJ45
2	X102 – X104: Ethernet interface	X102-X104	3 x 10/100 BASE-T, RJ45 with switch functionality
3	X105 µSDHC Slot	X105	µSD-Card
4	X106: USB 2.0 host interface	X106A X106B	USB1; type A USB2; type A
5	X107 RS232 RS485	X107	Serial interface: 1 x RS232; DSUB9-male 2 x RS485
6	X109 Power supply	X109	System-power supply 24VDC ; WAGO 714-134 / 714-104
7	X108	X108	Fieldbus interface: 1 x RS485; female
8	X110 CAN	X110A X110B	CAN0; RJ45 CAN1; RJ45
9	S1 operating mode switch (BAS)	S1	Operating mode switch: RUN – STOP – RESET
10	S2, slide switch	S2	Bus termination RS485-1
11	S3, slide switch	S3	Bus termination RS485-2
12	S4, slide switch	S4	Bus termination RS485;
13	S5, slide switch	S5	Bus termination CAN0
14	S6, slide switch	S6	Bus termination CAN1
15	Status LEDs für CAN X110	Status LED (green / red)	Above:CAN0 Below: CAN1
16	3 LEDs: STAT1, STAT2, STAT3	Status LED ((green / red)	Left: STAT1 Middle: STAT2 Right: STAT3
17	PFAIL bicolor: STAT4:	Status LED (green / red) green	Above: PFAIL Below: STAT4 LED-idicator for powersupply LED for system status
18	LED for RS232 and RS485	Status LED (green / red)	Left: RS232 Middle: RS485-1 Right: RS485-2
19	Connection function earth	FE-bolt	Connectionpoint of the ground strip
20	NFC	optional	Near Field Communication
	Label	Device label	Serial label on the left side

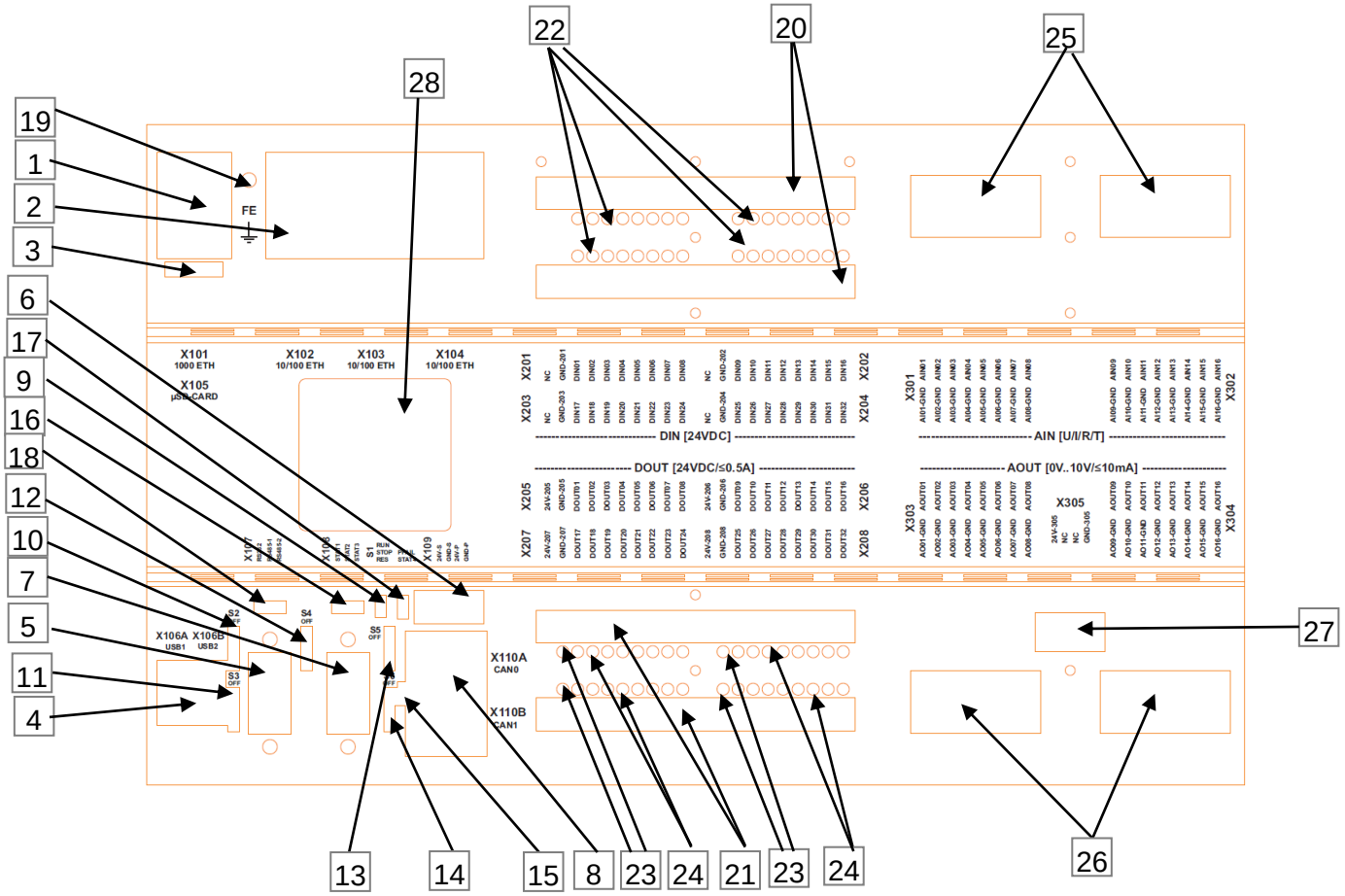
Table 5: Interface assignment RMC500

4.4.2 *Frontview of the interfaces RMC501*



No.	Chapter		Indication
1	X101 Gigabit Ethernet interface	X101	100/1000 BASE-T, RJ45
2	X102 – X104: Ethernet interface	X102-X104	3 x 10/100 BASE-T, RJ45 with switch functionality
3	X105 µSDHC Slot	X105	µSD-Card
4	X106: USB 2.0 host interface	X106A X106B	USB1; type A USB2; type A
5	X107 RS232 RS485	X107	Serial interface: 1 x RS232; DSUB9-male 2 x RS485
6	X109 Power supply	X109	System-power supply 24VDC ; WAGO 714-134 / 714-104
7	X108	X108	Fieldbus interface: 1 x RS485; female
8	X110 CAN	X110A X110B	CAN0; RJ45 CAN1; RJ45
9	S1 operating mode switch (BAS)	S1	Operating mode switch: RUN – STOP – RESET
10	S2, slide switch	S2	Bus termination RS485-1
11	S3, slide switch	S3	Bus termination RS485-2
12	S4, slide switch	S4	Bus termination RS485;
13	S5, slide switch	S5	Bus termination CAN0
14	S6, slide switch	S6	Bus termination CAN1
15	Status LEDs für CAN X110	Status LED (green / red)	Above:CAN0 Below: CAN1
16	3 LEDs: STAT1, STAT2, STAT3	Status LED (green / red)	Left: STAT1 Middle: STAT2 Right: STAT3
17	PFAIL bicolor: STAT4:	Status LED (green / red) green	Above: PFAIL Below: STAT4 LED-idicator for powersupply LED for system status
18	LED for RS232 and RS485	Status LED (green / red)	Left: RS232 Middle: RS485-1 Right: RS485-2
19	Connection function earth	FE-bolt	Connectionpoint of the ground strip
20	Digital Inputs X201 …X 204	X201, X202 X203, X204	Digital-inputs DIN01…DIN08 ; DIN09…DIN16 Digital-inputs DIN17…DIN24 ; DIN25…DIN32
21	Digital Outputs X205 … X 208	X205, X206 X207, X208	Digital-output DOUT01…DOUT08 ; DOUT09…DOUT16 Digital-output DOUT17…DOUT24 ; DOUT25…DOUT32
22	LEDs digital inputs	Status LEDs Digital-In	LED-indicator for aktive (24VDC) input; supply via input signal
23	LEDs digital output-supply	Status LEDs Digital-Output-supply	LED-indicator for the supply of the digital outputs
24	LEDs digital output	Status LEDs digital-out	LED-indicator for aktive (24VDC) output
25	NFC	optional	Near Field Communication
	Label	Device label	Serial label on the left side

4.4.3 Frontview of the interfaces RMC503



No.	Chapter		Indication
1	X101 Gigabit Ethernet interface	X101	100/1000 BASE-T, RJ45
2	X102 – X104: Ethernet interface	X102-X104	3 x 10/100 BASE-T, RJ45 with switch functionality
3	X105 µSDHC Slot	X105	µSD-Card
4	X106: USB 2.0 host interface	X106A X106B	USB1; type A USB2; type A
5	X107 RS232 RS485	X107	Serial interface: 1 x RS232; DSUB9-male 2 x RS485
6	X109 Power supply	X109	System-power supply 24VDC ; WAGO 714-134 / 714-104
7	X108	X108	Fieldbus interface: 1 x RS485; female
8	X110 CAN	X110A X110B	CAN0; RJ45 CAN1; RJ45
9	S1 operating mode switch (BAS)	S1	Operating mode switch: RUN – STOP – RESET
10	S2, slide switch	S2	Bus termination RS485-1
11	S3, slide switch	S3	Bus termination RS485-2
12	S4, slide switch	S4	Bus termination RS485;
13	S5, slide switch	S5	Bus termination CAN0
14	S6, slide switch	S6	Bus termination CAN1
15	Status LEDs für CAN X110	Status LED (green / red)	Oben:CAN0 Unten: CAN1
16	3 LEDs: STAT1, STAT2, STAT3	Status LED (green / red)	Left: STAT1 Middle: STAT2 Right: STAT3
17	PFAIL bicolor: STAT4:	Status LED (green / red) green	Above: PFAIL Below: STAT4 LED-idicator for powersupply LED for system status
18	LED for RS232 and RS485	Status LED (green / red)	Left: RS232 Middle: RS485-1 Right: RS485-2
19	Connection function earth	FE-bolt	Connection point of the ground strip
20	Digital Inputs X201… X 204	X201, X202 X203, X204	Digital-inputs DIN01…DIN08 ; DIN09…DIN16 Digital-inputs DIN17…DIN24 ; DIN25…DIN32
21	Digital Outputs X205…X 208	X205, X206 X207, X208	Digital-output DOUT01…DOUT08 ; DOUT09…DOUT16 Digital-output DOUT17…DOUT24 ; DOUT25…DOUT32
22	LEDs digital inputs	Status LEDs Digital-In	LED-indicator for aktive (24VDC) input; supply via input signal
23	LEDs digital output-supply	Status LEDs Digital-Output-supply	LED-indicator for the supply of the digital outputs
24	LEDs digital output	Status LEDs	LED-indicator for aktive (24VDC) output

		digital-out	
25	Analog Inputs X301 and X 302	X301 X302	Analog-input AIN01 / AI01-GND …AIN08 / AI08-GND Analog-input AIN09 / AI09-GND …AIN16 / AI16-GND
26	Analog Outputs X303 and X 304	X303 X304	Analog-output AOUT01 / AO01-GND …AOUT8 / AO08-GND Analog-output AOUT09 / AO09-GND …AOUT16 / AO16-GND
27	X305 power supply for analog in- and outputs	X305	Analog-power supply 24VDC ; WAGO 714-134 / 714-104
28	NFC	optional	Near Field Communication
	Label	Device label	Serial label on the left side

Table 7: Interface assignment RMC503

4.5 Pin assignment – Overview of the devices

Device	Components	Interface description
RMC500	Base	Interfaces chapter4.2
RMC501	Base + digital in- and outputs	Interfaces chapter4.2 Interfaces chapter4.3
RMC503	Base + digital in- and outputs + analog iIn-and outputs	Interfaces chapter4.2 Interfaces chapter4.3 Interfaces chapter4.4

4.6 Terminal assignment - RMC500

The interfaces for the RMC500 are listed below.

4.6.1 X101: Gigabit Ethernet interface

This interface is executed as a RJ45 socket.
The transmission rate is 100/1000 Mbit/s. The connections and the cables acc. CAT 5e and the guidelines for Ethernet interfaces.
The interface has two integrated LEDs.

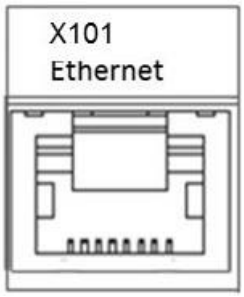
Interface X101	PIN	Allocation	Function
	1	BI_DA+	Bidirectional signal-pair DA+
	2	BI_DA-	Bidirectional signal-pair DA-
	3	BI_DB+	Bidirectional signal-pair DB+
	4	BI_DC+	DC+
	5	BI_DC-	Bidirectional signal-pair DC-
	6	BI_DB-	Bidirectional signal-pair r DB-
	7	BI_DD+	Bidirectional signal-pair DD+
	8	BI_DD-	Bidirectional signal-pair DD-

Figure 13: X101 Gigabit Ethernet allocation

4.6.1.1 Technical data

Gigabit- Ethernet	**1 x RJ-45**
Transmission medium at 100Base-TX	At least Twisted Pair SF-UTP, 100 Ω, CAT 5e, 100 m max. cable length
Transmission medium at 1000Base-T	At least Twisted Pair SF-UTP, 100 Ω, CAT 5e, 100 m max. cable length
Transmission rate	100/1000 Mbit/s
Protocols	DHCP, DNS, FTP, HTTP, HTTPS, SSH

4.6.2 X102 – X104: Ethernet interfaces

The interfaces are executed as a RJ45 socket with switch functionality.
The integrated 10/100 MBit Ethernet- switch supports Auto – MDI(X).
Each interface has two integrated LEDs.

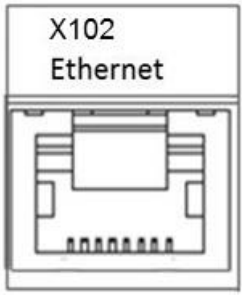
Interface X102 … X104	PIN	Allocation	Function
	1	TX+	Transmit Data +
	2	TX-	Transmit Data -
	3	RX+	Receive Data +
	4	n.c.	none
	5	n.c.	none
	6	RX-	Receive Data -
	7	n.c.	none
	8	n.c.	none

Figure 14: X102-X104 ethernet allocation

4.6.2.1 Technical data

Ethernet	**3 x RJ-45 (switched)**
Transmission medium	At least Twisted Pair SF-UTP, 100 Ω, CAT 5, 100 m max. cable length
Transmission rate	100 Mbit/s
Protocols	DHCP, DNS, FTP, HTTP, HTTPS, SSH

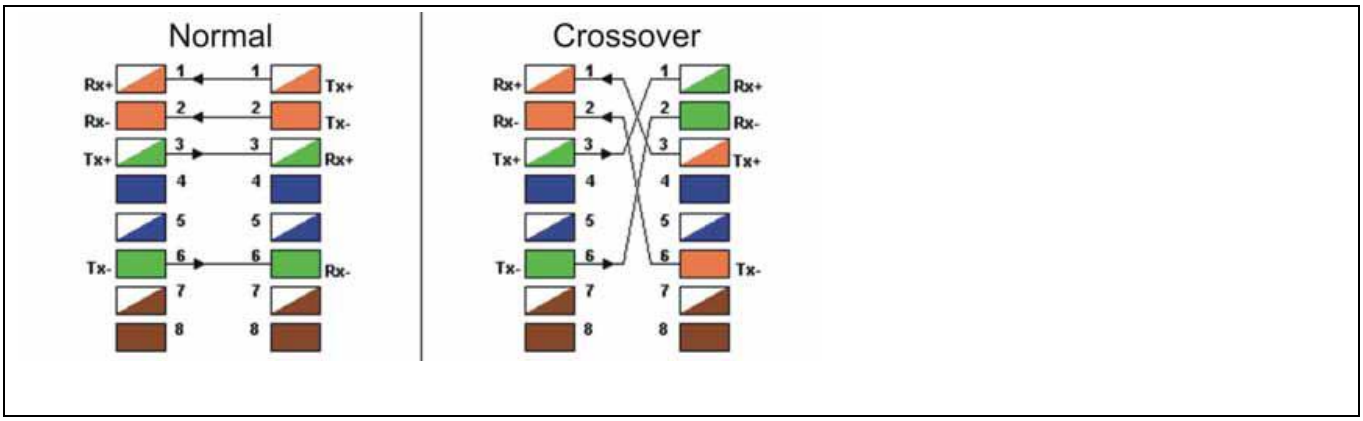


Figure 15: X102-X104 allocation X101, X102 … X104 RJ45

4.6.3 LEDs of the ethernet- interfaces X101 – X104

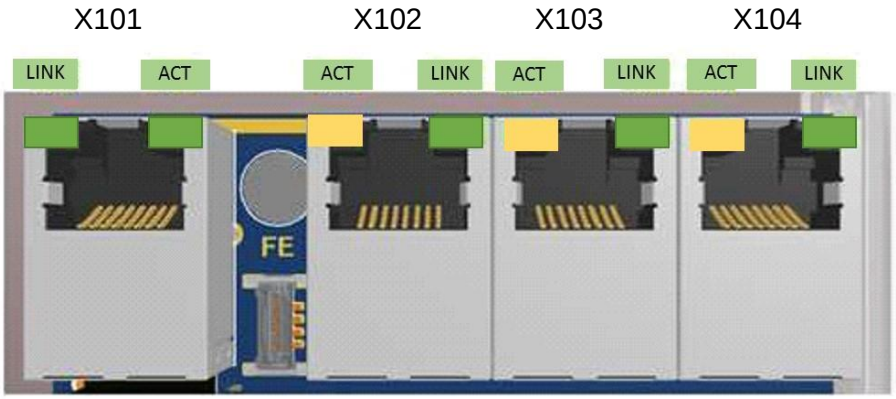


Abbildung 1: LEDs X101 - X104

LED	Color	Bedeutung
LINK	Green	Cable is connected
ACT X101	Green flashed	Communication is available
ACT X102- X104	Orange flashed	Communication is available

4.6.4 X106A and 106B: 2 x USB 2.0 host interface

The interfaces is executed as a USB 2.0-Host interface with Type A socket.
Power supply max. 500 mA for each interface.

The connection for this interface acc. the USB-specification, 2.0 High-Speed, max. transmission rate: 480 MBit/s.

The follwing table and illustration shows the pin assignment of this interface.

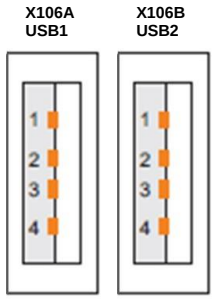
Interface X106	PIN	Allocation	Function
	1	USB_VCC1	USB + 5 VDC
	2	USB_N	USB data line D-
	3	USB_P	USB data line D+
	4	USB_GND	USB GND

Figure 16: X106 USB allocation

maximum memory size	file system	integrate	delete
-	FAT32	Automatically via: media/<VOLUME_NAME> and media/usb or media/usb2	automatically

NOTICE	A maximum of two USB storage media can be connected.

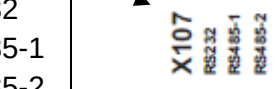
NOTICE	Accessing from CODESYS on removable storages like USB memory sticks should be done via a placeholder. Firstly the CODESYS program is getting portable and the CODESYS functions will be get back an error code, if the removable storages will be missing. For USB are the placeholders USB1 and USB2 available. The access will be taken place like: `hFile := SysFileOpen('$$USB1$$/test.txt', ACCESS_MODE.AM_READ, ADR(Result));`

4.6.5 X107: 1 x RS232, 2 x RS485

The interface is executed via a 9-pole D – Sub socket (male) and is galvanically isolated from the supply voltage of the device.
It's designed with RS232 and 2 x RS485

The UART RS232 suppots the following modi:

- Paritybits:
  Parity: none / even / odd
- Stopbits:
  Stop bit: one / two stop bits

NOTICE	**Printing** On the lid printing X107are the LED indicators for RS232 , RS485-1 and RS485-2		
	Printing: X107 RS232 RS485-1 RS485-2		LEDs: 1x RS232 X107 1 x RS485-1 X107 1 x RS485-2 X107

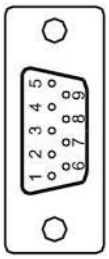
Interface X107	PIN	Allocation	Function
	1	RS485 2	Differential signal A2(+)
	2	RS232	Receive Data
	3	RS232	Transmit Data
	4	RS485 2	Differential signal B2 (-)
	5	RS232	ISO-GND-RS232
	6	RS485 2	ISO-GND-RS485-2
	7	RS485 1	Differential signal B1 (-)
	8	RS485 1	Differential signal A1 (+)
	9	RS485 1	ISO-GND-RS485-1

Figure 17: X107 RS232 and RS485 allocation

NOTICE	The delivery state ot the device is: RS232: COM1 RS485-1: COM2 RS485-2: COM3

WARNUNG	A RS232 interface is a pure point-to-point connection Wire or operate never more than two paricipants together! This may can have cause damage and/or malfunction of the unit.

	No terminating resistors are necessary. Connect only the needed pins for your application

RS232 witch crossed Pins:

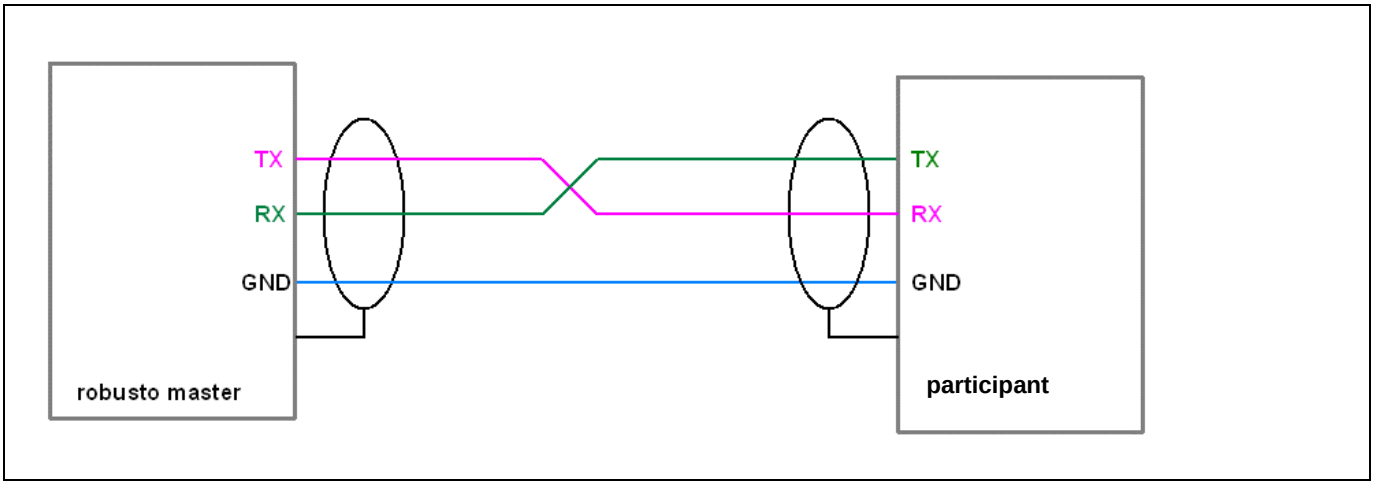


Figure 18: X107 structure RS232

WARNING	With an R-S232 interface point-to-point connection the pins TX and RX **have to be** crossed of both participants. (see upper oberes connection digram) TX1 ➔ RX2 ; RX1 ➔ TX2

4.6.5.1 Allocation of the RS485 interfaces

In the operating mode RS485 are terminating resistors on EACH bus end necessary.

If the device is connected at the beginnig or the end of a bus cable, the integrated terminating resistor of RMC5xx must be used!

For this purpose the slide switch S2 or S3 must be slid from "OFF" to the "ON" position. (Activated with a ball pen or a screwdriver, until a click is NOTICEable.)
In all other cases the terminating resistor hast o be inactive.

NOTICE	On the internefaces RS485-1 and RS485-2 is the configuration fix adjusted to 1 stopbit and one parity check.

Bus structure RS485 with a robusto master at the end andwith twisted pairs

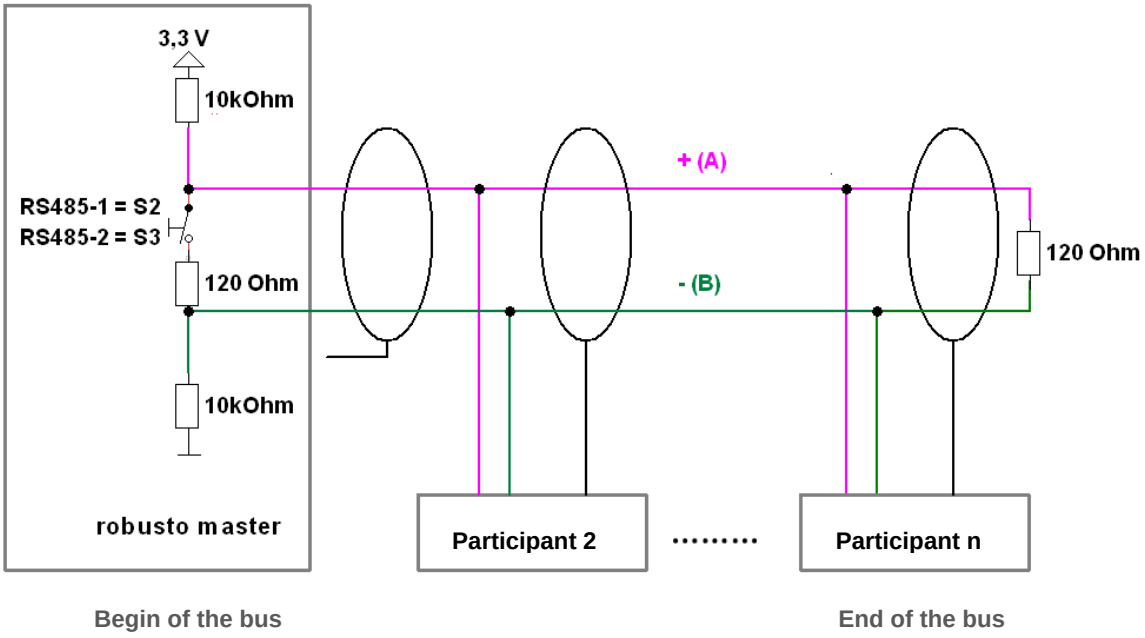


Figure 19: X107 structure RS485

4.6.6 X109: Power supply with two LED indicator lights

Figure 20: X109 pin header714-134

Figure 21: X109 female point connector 714-104

Power supply for the system -CPU:

The labels „24V-S“ und „GND-S“ mark the both pins in the 4-pole WAGO-plug (714-104) to supply the system CPU. The connector is predected against reverse. The cable length to the power supply may not exceed max. 3 m

Ensure a reliable electrical isolation of the low voltage for the 24 volt supply.
Only use power supply units manufactured to the standards IEC 364 - 4 - 41 / HD 384.04.41 (VDE 0100 Part 410). They must comply with the requirements of (SELV) in accordance with DIN EN 61131 for the supply.

Power supply of the peripherie-board:

The label „24-P“ und „GND-P“ mark the pins in the plug X109 via the interior structures of the peripherie units (ex. digital-IN / -OUT; analog-IN / -OUT) will be supplied.

The power outputs and the analog interfaces will be **not** supplied. Seperate, tailored to the IO performance requirements for power units should be used.

Power suppply X109	PIN	Allocation	Function
1 2 3 4 	1	24V-S	Power suppply system-CPU
	2	GND-S	Reference potential (ground)
	3	24V-P	Power suppply peripherie boards
	4	GND-P	Reference potential (ground)

Figure 22: X109 power supply allocation

4.6.7 Function earth (FE)

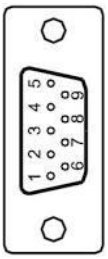
The housing has to be connected via the screw connection (on the lid), corresponding low-resistance, to the funktion earth (FE).

WARNING 	The RMC5XX has to be included via its functional earth (FE) in the earthing concept. • Connecting the top hat rail to FE • FE screw corresponding low-resistance connecting with FE • The cable screens of the communication ports, Ethernet, RS232 / 485 and CAN are connected with their respective mating plug to FE.

4.6.8 X108: RS485

This interface is a D-sub 9 socket, implemented as RS485 with galvanic isolation. and 2 control LEDs.

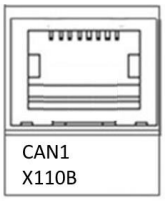
4.6.8.1 Allocation of the RS485 interface

Interface X108	PIN	Allocation	Function
 Figure 23: X108 allocation	1	Unused	None
	2	Unused	None
	3	RxD/TxD-P	A
	4	CNTR	Repeater control signal
	5	GND 5 V	Signal ground
	6	5 V	Power supply
	7	Unused	None
	8	RxD/TxD-N	B
	9	Unused	None

4.6.9 X110A und X110B: 2x CAN with termination

X110A CAN0:
This interface is lead out via a 8-pole RJ 45 plug, galvanically isolated from the supply voltage isolation. and linked with the termination switch S5.

X110B CAN1:
This interface is lead out via a 8-pole RJ 45 plug, galvanically isolated from the supply voltage isolation. and linked with the termination switch S6.

CAN0 X110A	CAN1 X110B	PIN	Belegung
 Figure 24: X108 allocation CAN 0 X110A interface	 Figure 25: X108 allocation CAN 0 X110B interface	1 2 3 4 5 6 7 8	CAN-L CAN-H GND (Signal Ground für CAN) NC NC NC NC NC

CAN with twisted pairs

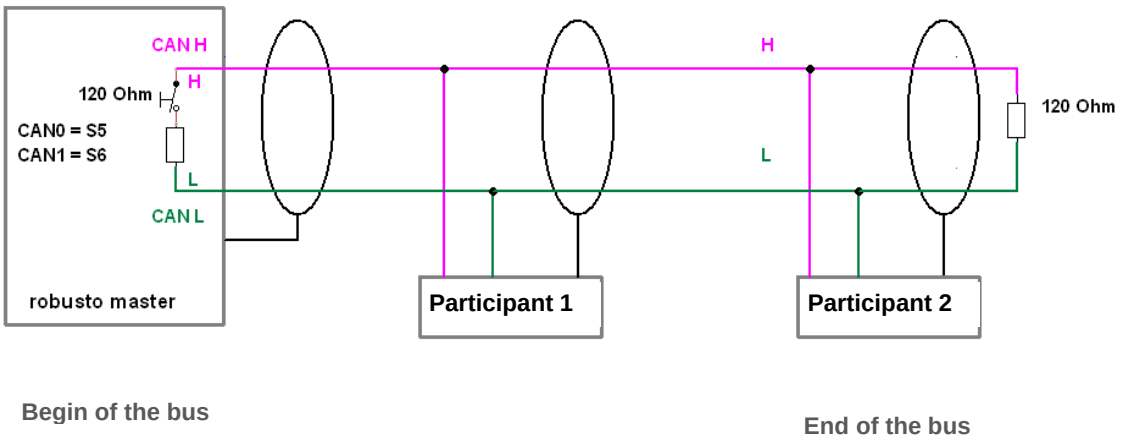


Figure 26: bus connection CAN

Tipp	Tip for the connector socket on the cable: Connect only the necessary pins for your application. Check, if an external terminal resistor is necessary, because of the complete bus structure. Usually are the termination resistors at the beginning and the end of the bus cable. The resistance value is characterised 120 Ohm.

NOTICE	For the CAN interfaces X110A (CAN0) and X110B (CAN1) can be used the the commercial RJ45-plugs (8- pol) of good quality. **Respect the correct polarity / pin order of „H“ / „L“ / „GND“-signals of the connected CAN kommumication interfaces**.

4.7 Terminal assignment RMC501

The interfaces of the RMC501 get together of:

- RMC500
- And the following interfaces

4.7.1 LEDs digital in

LED-indicator for active (24VDC) input; supply via input signal

Green: at the according DI is a positiv input signal.

4.7.2 LEDs digital out

LED indicator for supply of the 8-bits group

Yellow: supply is on. The status of all 8-bit groups wil be o.k. (no overcurrent, no excessive temperature)

LED-indicator for active (24VDC) output

Red: the according digital output will be driven.

4.7.3 X201 … X204: Digital inputs

Figure 27: digital I/O pin header 714-140

Figure 28: digital I/O female point connector 714-110

4 x socket 10-pole,
32 green LEDs for the indication of the acitive input of the four 8-bit groups.

All four 8bit- groups are galvanically isolated. The taken wiring of the GND-20x connections decides about the group formation.

WAGO: 714-140: Conductor crossection and contact spacing see data sheet WAGO.

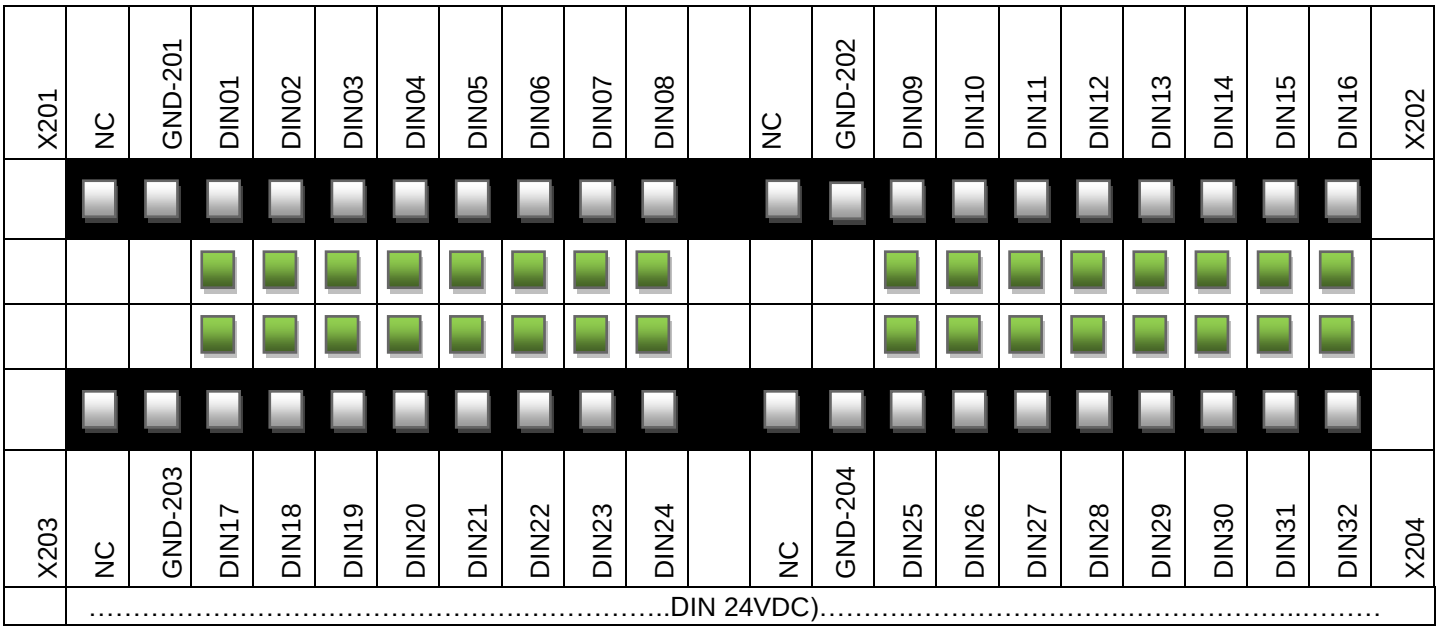


Figure 29: digital inputs allocation

4.7.4 X205 – 208:Digital outputs

4 x socket 10-pole,
4 x yellow LEDs for the status display of the power supply, for each of the 8-bit groups
32 red LEDs for the outputs for the indication of the acitive output.

WAGO-714-140: Conductor crossection and contact spacing see data sheet WAGO.

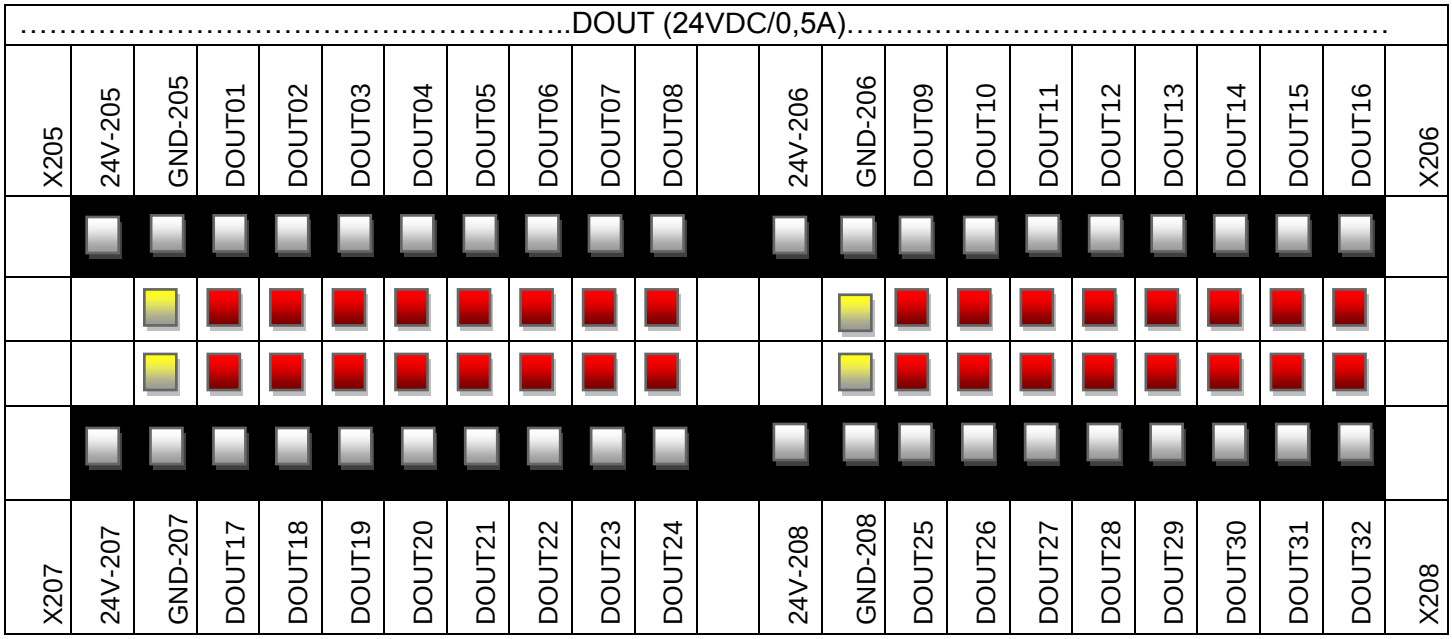


Figure 30:digital outputs allocation

4.8 Terminal assignment RMC503

The interfaces of the RMCC503 get together of:

- RMC500
- RMC501
- And the following interfaces

4.8.1 X301 and 302: Analog inputs

Figure 31: analog I/O pin header
WAGO 713-1408

Figure 32: analog I/O female multipoint connector
WAGO 713-1108

2 x 8 x 2-pole

WAGO:713-1408: Conductor crossection and contact spacing see data sheet WAGO.

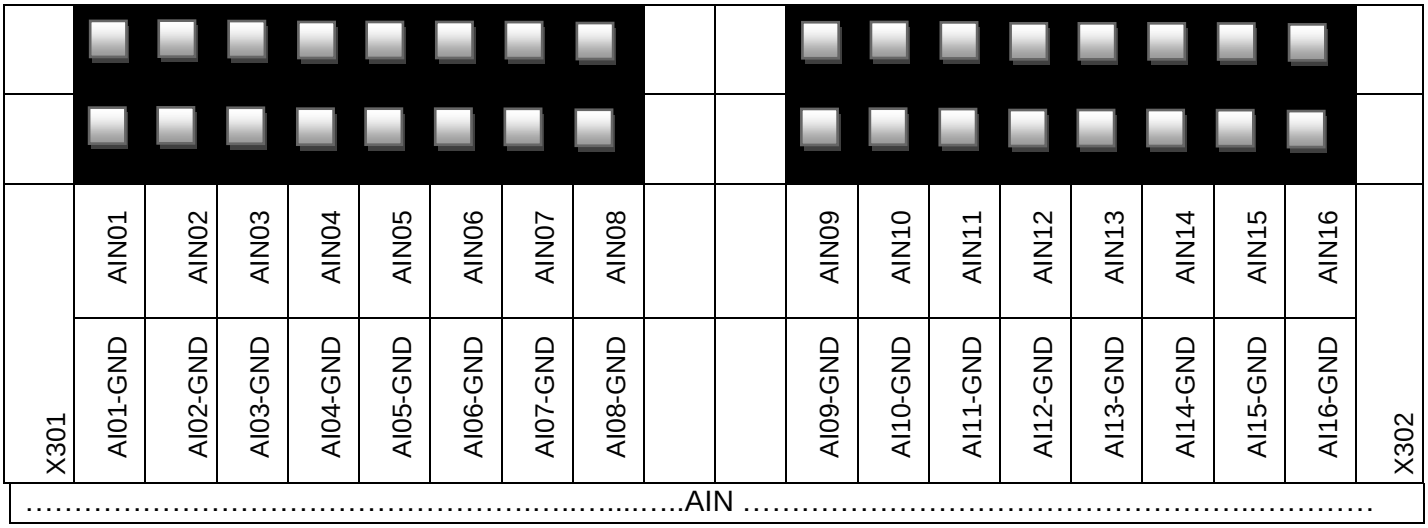


Figure 33: analog intputs allocation

4.8.2 X303 – X304: Analog outputs

 	2 x female multipoint connector 8 x 2-pole 713-1408: Conductor crossection and contact spacing see data sheet WAGO.

The respective analog ground must be used that the interference capacitor will be effected.

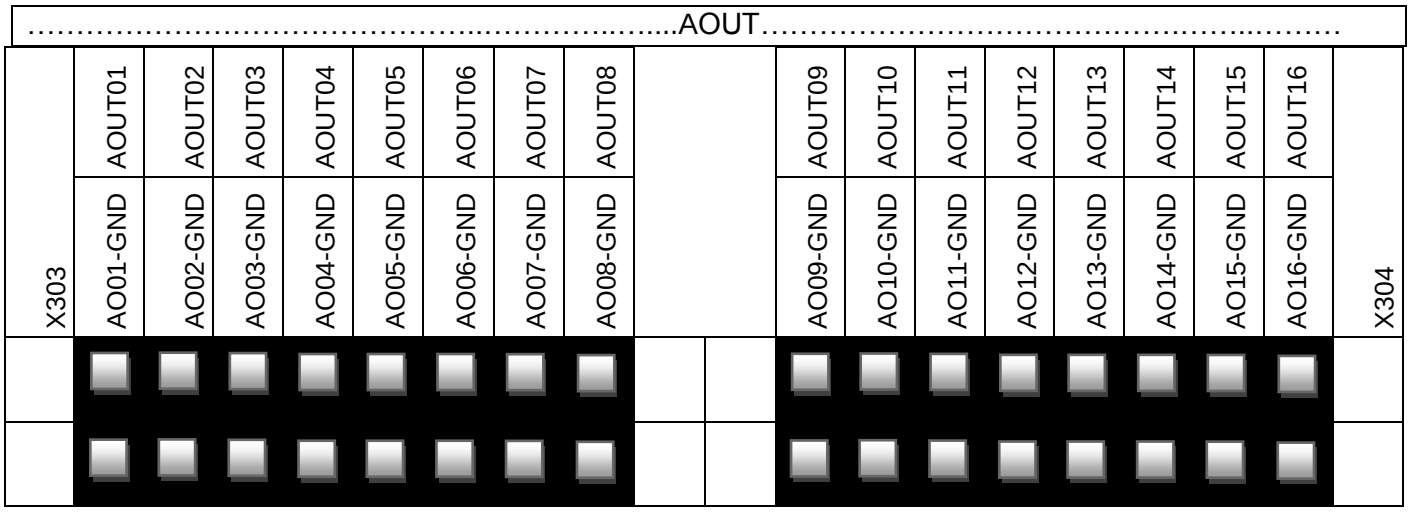


Figure 34: analog outputs allocation

NOTICE	
	It must be ensured, that the plugs will be carefully put on, otherwise the contact resistance will be changed. Otherwise possible faulty measurements or malfunktions are the concequences.

4.8.3 X305 Power supply for analog in- and outputs

Figure 35: X305 pin header 714-134

Figure 36: X305 female multipoint connector 714-104

Power supply for the AIO's:
The labels „24V-305" and „GND-305" marks the both pins in the 4-poled WAGO-plug for supplying the analog in- and outputs. The connector is protected against polarity.
WAGO: 714-104 The cable length to the power supply may not exceed 3m, and the conductor crossection amounts 0,75 … 1,5 mm².(AWG 19 …14)

Conductor crossection and contact spacing see data sheet WAGO.

Ensure a reliable electrical isolation of the low voltage for the 24 volt supply.
Use only produced powersupplies acc. IEC 364-4-41 or HD 384.04.41 (VDE 0100, part 410). They must fulfil the requirements to SELV acc. LPS acc. DIN EN 60950-1.

Power supply X305	PIN	Allocation	Function
1 2 3 4 	1	24 V-305	Power supply AIN / AOUT
	2	NC	NOT CONNECTED
	3	NC	NOT CONNECTED
	4	GND-305	reference potential (ground)

4.9 X105: memory card slot - µSD slot

The robusto master devices are equipped with a slot for µSD and µSDHC, located above left side of the device, below X101. A cover flap nonexits.
There is no push / pull function by entering the card, because the slot is vertical on the device.

It can be used:
µSD cards from 8 MB to 2 GB and
µSDHC cards from 4 GB to 32 GB See Accessories

Attention 	By using there is no warranty on function, power and also defects. **Recommendation:** Card manufacturer: "Sandisc industrial", has been tested and approved by elrest Power class: Class 2 with 2 MB/s minimum speed

Maximum memory size	File System	Including	Remove
32 GByte	FAT32	Automatically via: media/<VOLUME_NAME>	Via the application

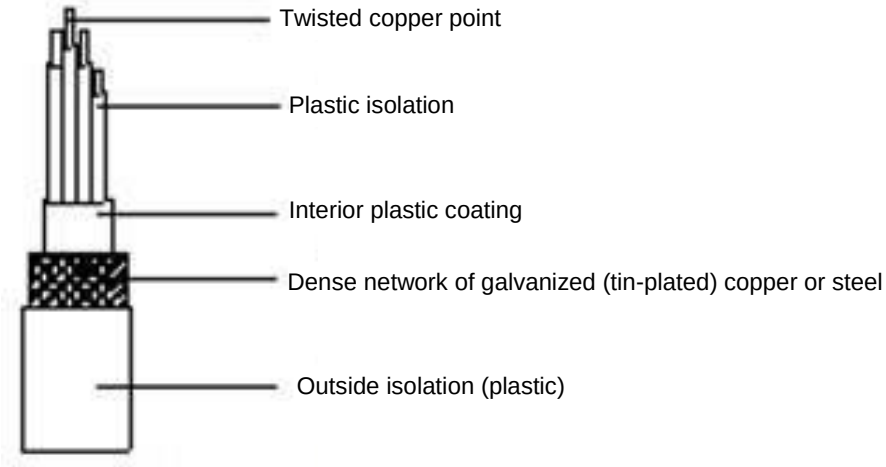
NOTICE	Accessing from CODESYS on removable storages like SD cards should be done via a placeholder. Firstly the CODESYS program is getting portable and the CODESYS functions will be get back an error code, if the removable storages will be missing. For the SD cards is the placeholder SD available. The access will be taken place like: `hFile := SysFileOpen('$$USB1$$/test.txt', ACCESS_MODE.AM_READ, ADR(Result));`

4.10 Adviced cable types for the interfaces

In the following table are the important characteristics summarized for the connection of the interfaces.

This overview has been made to help you to select the optimal cables. Depending on interface type are several cables listed, because it depends on the customer- specific construction situation, the distance to the components and the kind of transmission.

Specification fort he shielded cables



Signal conductor:	connecting lines or cable for signal- and measurements like target ore actual values a.s.o. Cable for analog signs (cores of strands) Cable for digital signs (cores of strands)
Twisted conductor:	Two-vired conductors with up to 25 mindestens 25 strandings per metre.
Shielding for sgnal conductor:	Wire mesh of tinned copper with not less than 85% cover

Interfaces	Description	Manufacturer data:
Analog I/O	LiYCY shielded control cable , geschirmte Steuerleitung, fine stranded wire ; PVC grey	Lapp-Article number:  0034602: 2 x 0,5 mm²; Dm = 5,6 mm
Digital I/O	LiYCY(TP) twisted-pair (TP) data line, fine stranded wire consisting of bare copper wires; copper mesh, tin- plated	Lapp-Article number:  0035810: 2 x 2 x 0,5 mm²; Dm = 7,9 mm 0035811: 3 x 2 x 0,5 mm²; Dm = 8,7 mm 0035812: 4 x 2 x 0,5 mm²; Dm = 9,4 mm 0035813: 6 x 2 x 0,5 mm²; Dm = 11,1 mm 0035814: 8 x 2 x 0,5 mm²; Dm = 13,1 mm 0035816: 12 x 2 x 0,5 mm²; Dm = 14,9 mm
RS232	Max 15m length or 2700pF cable capacitance Max. cable length of the point-to-point connection: - 2400 Bit/s = max 900 m - 4800 Bit/s = max 300 m - 9600 Bit/s = max 150 m - 19200 Bit/s= max 15 m -	Lapp-Article number: See digital I/O
RS485 RS232	Fine-wired / multi wired with tin-plated, copper branding; the bit rates are resulted a maximum lenghs of a bus segment: - 9,6-93,75 kBit/s = max 1200 m - 187,5 kBit/s = max 1000 m - 500 kbit/s = max 400 m	Lapp-Article number:  2170203: 1 x 2 x 0,22 mm²; Dm = 5,7mm 2170204: 2 x 2 x 0,22 mm²; Dm = 7,1mm 2170205: 3 x 2 x 0,22 mm²; Dm = 7,2mm 2170803: 1 x 2 x 0,22 mm²; Dm = 5,7mm (UL/CSA)
CANopen	Strand, blank, finely stranded with copper shielding.	
Industrial Ethernet Cat.5e	Industrial Ethernet cable Cat.5e for fixed installation, PUR, flexible, 2- and 4-paired - 2 paired: 10/100 Mbit/s for Ind.Ethernet - 4 paired: 10/100/1000 Mbit/s for Ind.Ethernet - suitable for EtherCAT and EtherNet/IP Appl. - Conductor isolation of foam-skin - 2- or 4- paired version - Flexible finely stranded copper conductor - Braided pairs enables a largely	Lapp-Article number:  2170280: 2 x 2 x AWG24/1; Dm = 6,1mm 2170296: 4 x 2 x AWG24/1; Dm = 6,3mm PUR outer shealth, halogen free 2170281: 2 x 2 x AWG24/1; Dm = 6,1mm

	interference-free operation (decoupling) - SF/UTP: Braiding of tinned copper wires and aluminium-clad foil as overall shielding - Outer shealth as PUR- or LSZH-execution - Color: water blue (RAL 5021)	2170297: 4 x 2 x AWG24/1; Dm = 6,3mm
Industrial Ethernet Cat.5e Patchkabel RJ45	Industrial Ethernet Patchcord, Cat.5e, plug RJ45, PUR, flexible, 2- and 4-paired - 2 paired: 10/100 Mbit/s for Ind.Ethernet - 4 paired: 10/100/1000 Mbit/s for Ind.Ethernet - suitable for EtherCAT and EtherNet/IP Appl. - Conductor isolation of foam-skin - 2- or 4- paired version - Flexible finely stranded copper conductor - Braided pairs enables a largely interference-free operation (decoupling) - Gesamtschirmung mit Kupfergeflecht und kunststoffkaschierte Aluminiumfolie - Outer shealth in PUR execution - Color: water blue (RAL 5021)	Lapp-Article number:  2171115: 2 x 2 x AWG26; L=1m 2171117: 2 x 2 x AWG26; L=3m 2171118: 2 x 2 x AWG26; L=5m 2171119: 2 x 2 x AWG26; L=10m 2171501: 4 x 2 x AWG26; L=1m 2171503: 4 x 2 x AWG26; L=3m 2171504: 4 x 2 x AWG26; L=5m 2171505: 4 x 2 x AWG26; L=10m
USB 2.0 Type-A	Anschlüsse: USB 2.0 Typ A beidseitig Stecker > USB 2.0 Typ A Buchse - USB-A plug usable on both sides - Wirecross-section: 28 AWG power and data line - Contacts: gold-plated color: black	 DELOCK 83370: 28AWG, 1m DELOCK 83371: 28AWG, 2m DELOCK 83372: 28AWG, 3m DELOCK 83373: 28AWG, 5m
Power supply	24VDC-power supply 1,0 mm² H05V-K HAR, connection and control cable PVC, 300/500 V, wiring, machines and switching cabinets, flame-retardant Class 5/Feindrähtig, fine stranded fixed installation, ring/coil	Lapp-Article number:  **0,5 mm² , Dm=2.1 - 2.5mm** 4510001: green/ yellow 4510011: black 4510021: blue 4510031: brown 4510041: red

		0,75 mm² , Dm=2.2 - 2.7mm 4510002: green/ yellow 4510012: black 4510022: blue 4510032: brown 4510042: red **1,0 mm² , Dm=2.4 - 2.8mm** 4510003: green/ yellow 4510013: black 4510023: blue 4510033: brown 4510043: red

Tabelle 1 : Kabelspezifikationen für die Schnittstellen

4.11 S1 operating switch mode (BAS)

	The switch has 3 positions:	RUN STOP RESET

Tasks with the operating switch mode:

- The processing of IEC applications can be controlled,
- Settings on the device.
- To release a reset on the device.

The following table shows the functions of the operating switch modes.

Final state or action	Position BAS	Expiry	Description	Status display LED
<u>In the operation:</u>				
Run	RUN		All IEC applications will be processed and can be stopped or started via CODESYS.	STAT3 lights green
Stop	STOP		All existing IEC applications will be stopped at the end of cycle and can't be started again CODESYS.	STAT3 lights red

Reset CODESYS Warm start	RESET	From > 1 till < 2 s	All IEC applications will be resetted via ‚Reset Warm'.	STAT3 off
Reset	RESET	> 4 s	Retain-Data will be saved and the IEC-applications will be closed. The a device rest will be executed.	STAT3 lights red
Switch on the power –supply and PoR (power on reset):				
	RUN		An existing boot project will be loaded and the application will be stated. No boot-project	STAT3 lights green flashes red
	STOP		An existing boot project will **not** be loaded and the application will **no**t be sterted. For loading the boot project, the device has to be disconnected of the power-supply and be started in the RUN modus.Via CODESYS IDE can be loaded a new project on the controller and a new boot project will be generated.	STAT3 lights red

In service-menue: Is the BAS in the position STOP, if the device will be switched on, the LED STAT3 will be flashing red for two seconds. If during this time the BAS will be set in the position RESET for > 1 s, the service menue will be active. The LED STAT3 will be goes out.				
	RESET	> 1 s	Actual menue item will be excecuted.	STAT3 lights green
	RUN	> 1 s	Step in the next menue item The possible menue points will be describe in the following table.	Via the STAT LEDs will be show the aktual menue item.
	STOP	> 3 s	The service-menue will be left. Now the BAS kann be put during 3 s in the position, which should be take into account when starting CODESYS.	STAT3 lights green

Table 8: Functions operating mode switch

Menue item	Description	Status LED
Fix IP address	Via this menue item can be set temporarily with the first Ethernet port (X101) the standard IP-Adresse (192.168.1.254 and active till the next restart.	STAT2 lights green
Delete retain-data	Via this menue item the retain data can be deleted	STAT2 lights red

Table 9: Function menue items

4.12 S2 –S6 operating switch mode

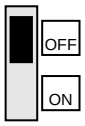
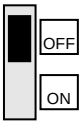
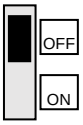
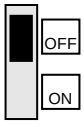
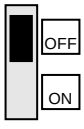
Position	Name		Dedicated interface	Function
	S2	Bus termination for RS485-1: Position up: **120-Ohm OFF** Position down: **120-Ohm ON**	X107	Terminating resistor will be switched
	S3	Bus termination for RS485-2 Position up: **120-Ohm OFF** Position down: **120-Ohm ON**	X107	Terminating resistor will be switched
	S4	Bus termination for RS485 Position up: **120-Ohm OFF** Position down: **120-Ohm ON**	X108	Terminating resistor will be switched
	S5	Bus termination for CAN0: Position up: **120-Ohm OFF** Position down: **120-Ohm ON**	X110A CAN0	Terminating resistor will be switched
	S6	Bus termination for CAN1 Position down: **120-Ohm OFF** Position down: **120-Ohm ON**	X110B CAN1	Terminating resistor will be switched

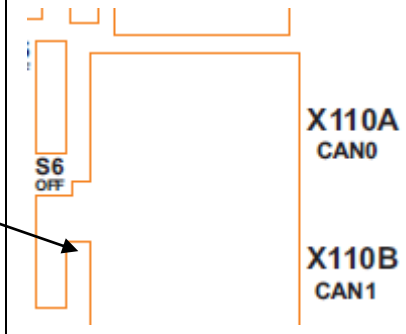
Figure 37:S2 –S6 operating switch mode

4.13 LEDs

4.13.1 Status LEDs for CAN X110

green Send
red Receive

The LEDs are above S6 (slide switch)



4.13.2 Power and status LED for the power supply X109

Above: PFAIL1 x bicolor:

In the starting torque the LED lights up as approx.16,5 V; power entry green.
In the stop torque changes the LED from green to red as approx.15,5 V.

Below: STAT4 1x green

Flashes green during the run-up phase of the device. (approx.12 s)

Afterwards the LED shows the state of the device.

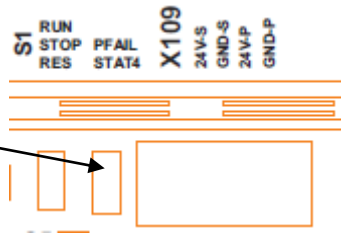
Flashes green:	FPGA can't be initializesed
Signs statically green:	System OK
Off	boot incorrect

Below: STAT4 1x green

Flashes green during the run-up phase of the device. (approx.12 s)

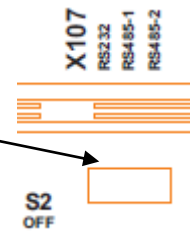
Afterwards the LED shows the state of the device.

Flashes green:	FPGA can't be initializesed
Signs statically green:	System OK
Off	boot incorrect

The LEDs are on the left side of X109	

4.13.3 LEDs for X107: RS232 / RS485-1 /RS485-2

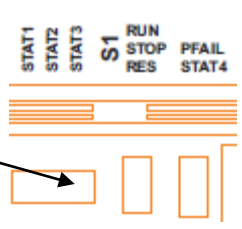
Left: RS232: Middle: RS485-1 Right: RS485-2
Green: Send
Red: Receive

Die LEDs are above S2 (slide switch)	

4.13.4 3 LEDs: STAT1, STAT2, STAT3

The LEDs STAT1-STAT3 shows the status of the device. The LEDs can display the following states.
The function of the LEDS will be described in another chapter.

Farbe	Zustand
No colour	off
green	lights
green	flashes
green	flashes fast
yellow	lights
yellow	flashes
yellow	flashes fast
red	lights
red	flashes
red	flashes fast

Die LEDs are next to S1 (side switch)	

5 Software

5.1 General informationen

Further information can be downloaded from our homepage:

With the link Kunden Login you can get directly to the download area:

- Enter user name and password 
- Public 

- If nonexistent, please contact our support.

5.1.1 USB-Update

The device software can be updated via the USB stick. Normally, it will be published as a device specific archive („Update package“). In case of doubt please contact the elrest support.

Step	Description
1	The update will be published as an archive file. Please copy the content of the archive to an empty USB stick. This may only contains one primary partition, type FAT32.
2	After copy, please safely remove the USB stick. (Windows-function „eject“).
3	Disconnect the device from the supply voltage.
4	Connect the USB stick to the USB port.
5	Place the operating mode switch in the position STOP
6	Connect the power supply to the device. Booting will be indicated through rapid flashing of the LED STAT4.
7	As soon as the update is started, the LEDs STAT1, STAT2, STAT3 flashes slowely green. Please don’t disconnect the voltage, and the USB memory stick may not be removed. See warning above. The process may can take 2 - 5 minutes, depending on the size.
8	The update will be successfully finished, if the LEDs STAT1, STAT2, STAT3 light up permanently. The result of the update process will be shown as follows: • Permanently green flashes: The process was successful • Permanently red flashes: The process was failed. During the update the LEDs possibly can shortly be switched of. **The update process, however, will not be completed until the LEDs STAT1, STAT2, STAT3 light up permanently.**

9	The update has failed, if the LEDs STAT1, STAT2, STAT3 flashes permanently red.
10	If the update is completed (permanently green or red lightning of the LEDs STAT1, STAT2, STAT3), the USB stick can be removed and the operating mode switch set in the original position. The actually devices software is after a reboot of the device available.

WARNING 	• Do not switch off the device during the update. Do not remove the USB stick during the process. Non-observance of these instructions may lead to malfunction of device and loss of warranty. • The update-package is device-specific. The recording of an incorrect package may cause to a malfunction of the device and and a chargeable repair. In case of doubt, please contact our elrest support.

5.1.2 Boot time

The boot time amounts approx. 20 sec from switching the supply voltage on till the CODESYS runtime.

5.1.3 Retains memory optional

Max. 1 MB can be stored in the "retain area".

5.1.3.1 Buffering of retain-data (optional)

In the event of a mains failure > 5 ms the retain data will be saved in CODESYS as a file. Then the system event ‚PowerFail'will be triggered, CODESYS will be finished and a reset will be implemented. It is not assured that the remaining lifetime of the device will be fully processed the system event and completely exited CODESYS.

When CODESYS will be closed, the retain data will be stored again into a further file. After starting CODESYS, the data will be checked, if the reatain data will be stored correctly.In this case, this file will be used to intialize the retain data.Otherwise the previous saved file.

NOTICE 	The predotype ensures a save buffering of the retain data only from a switch-off time > 200 ms.

5.1.4 Access rights

In the system are different users, which are assigned allways a user group. The access rights of the device are based via this group.

5.1.4.1 The following users defined:

User	Password (standard)	User group
Administrator	Administrator	Administrators
Developer	Developer	Developers
Service	Service	Services
Supervisor	Supervisor	Supervisors
User	User	Users
Guest	Guest	Guests

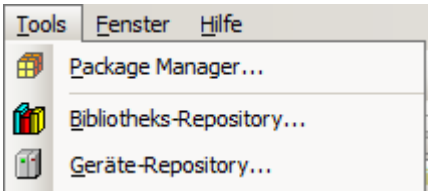
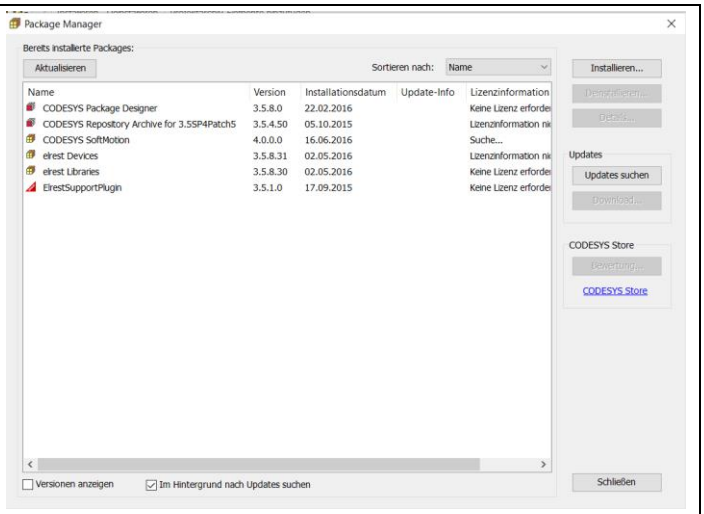
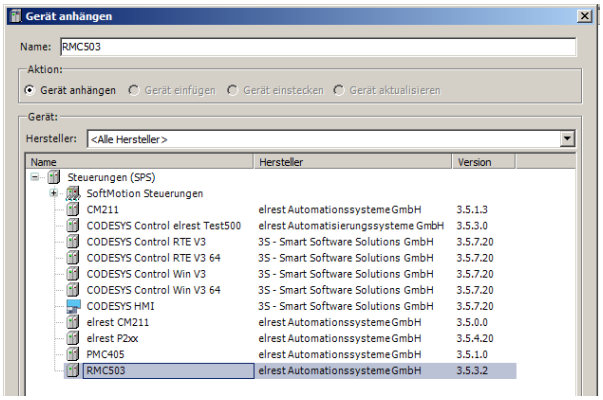
NOTICE	
	More users can be create

5.1.4.2 The following user groups are defined:

User group	WBM Login	Password for	SSH access	FTP access
Administrators	X	Alle	X	X
Developers	X	Developers	X	X
Services	X	Service	X	X
Supervisors	X	Supervisors	X	X
Users	X	Users		
Guests	X	Guests		

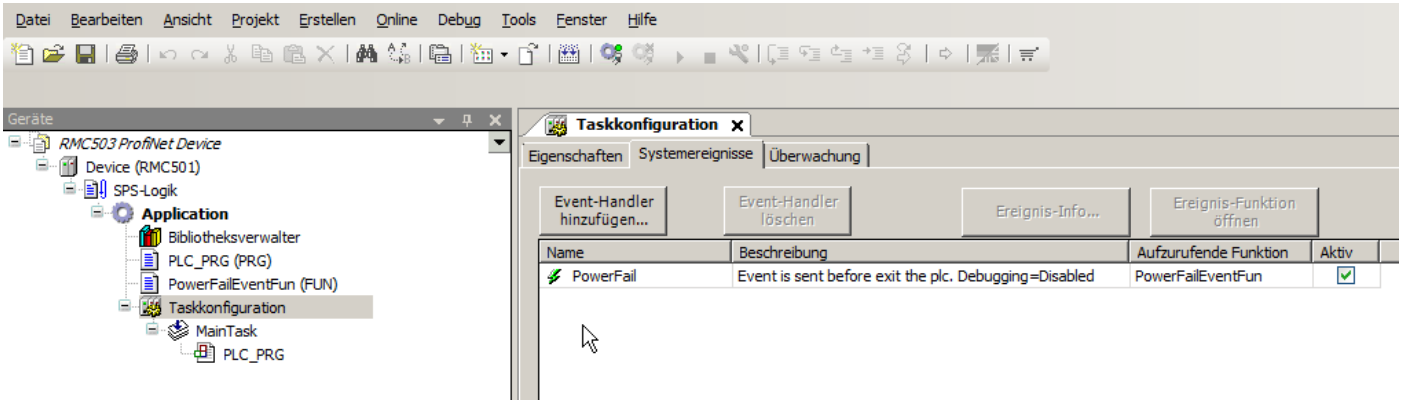
5.2 CODESYS

5.2.1 Integrate in CODESYS IDE

The device description has to be installed the CODESYS IDE.	
The installation of all elrest device descriptions can be occured via the elrest Package „elrest Devices_V_x_x_x_x.package“ and the package manager. Individuals device descriptions can be installed in the devic repository.See example RMC503 below:	
Select „install…“ and „navigate“ to the location of the file RMC503.devdesc.xml on your PC. Now, the device is available for the choice in CODESYS.	

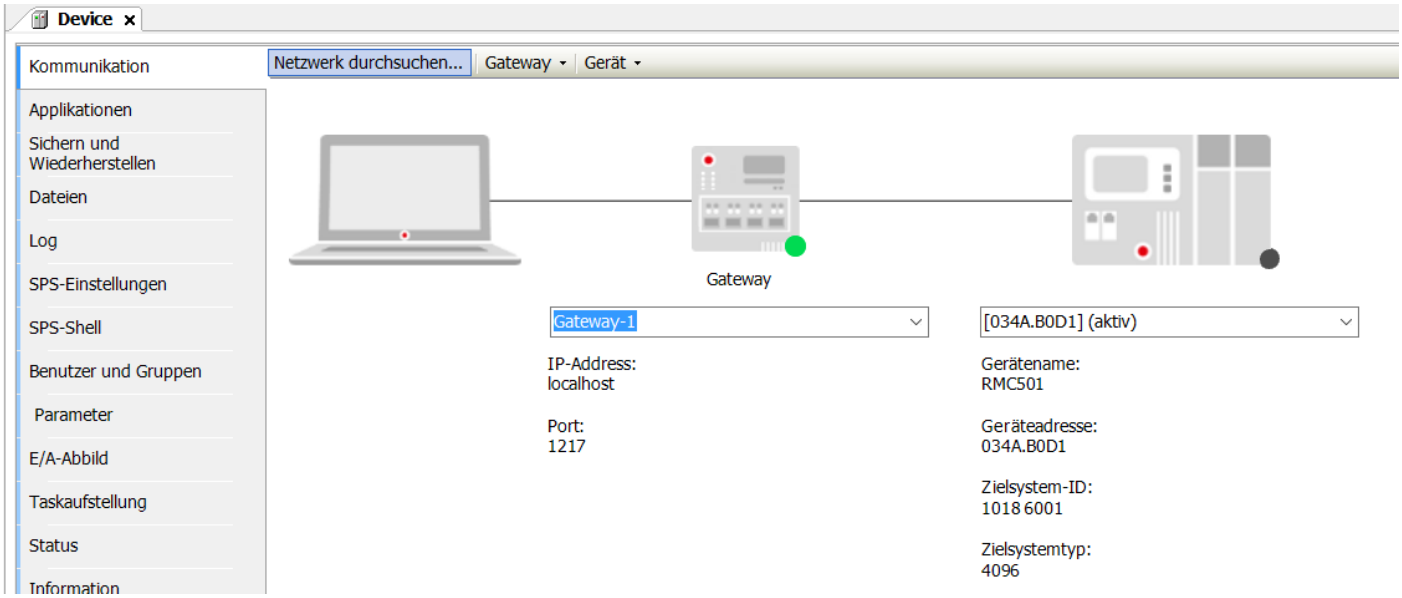
5.2.2 System event „PowerFail“

At recognition of a „PowerFail“, the system event „„PowerFail“ will be triggered. The allocated function in the event handler, see example below „PowerFailEventFun, will then be activated. In the function „PowerFailEventFun “, the individual program code of the IEC programmer will be started.

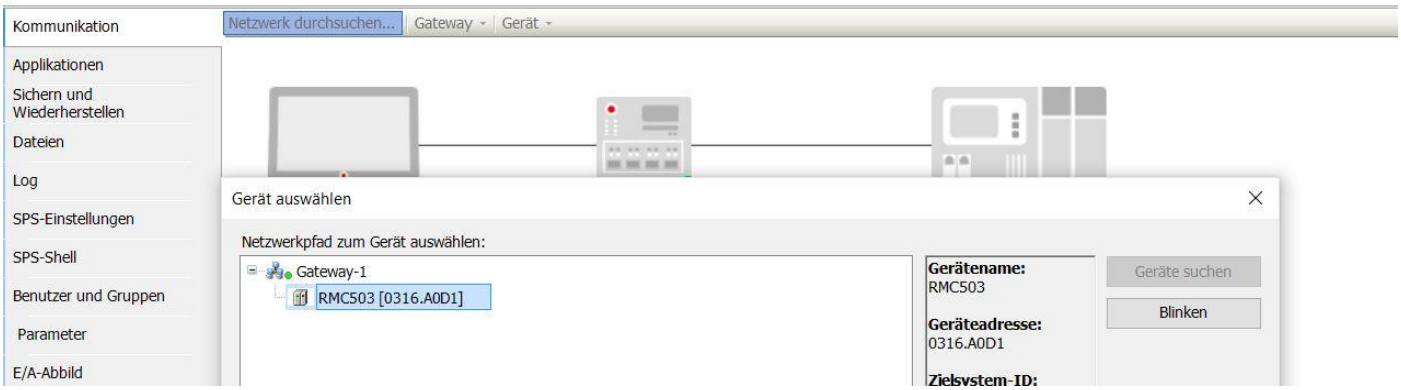


5.2.3 CODESYS communication

For a communication between CODESYS IDE and the device, it must be choosen an active connection in the communication editor.



After the choice „ searching network ..“ a list of the available device will be displayed.
For a better identification of the devices can be used the button „flashing“. If you
By activating this button, the led STAT3 flashes for 5 seconds on the choosen device.



5.2.4 CODESYS fielbusses

The devices support the CODESYS filedbus configuration for CANopen master, CANopen slave and. ProfiNet master and ProfiNet slave.

The field busses will be configured in the CODESYS DIE and executed on the device.

As a further communication contains the CODESYS runtime system an OPC UA Server, which will be parametrized via the symbol configuration in the CODESYS IDE.

5.2.5 File access

A file access can get out of the IEC Code just relative to files underneath this directory. ‚/home/plc_v3/PlcLogic‘ oder über Platzhalter erfolgen.

For example the file 'test.txt' in the root '/home/plc_v3/PlcLogic' can be open with

```
hFile := SysFileOpen('.\test.txt', AM_WRITE_PLUS, ADR(Result));
```

The file 'test.txt' can be opened on a USB stick with:

```
hFile := SysFileOpen('$$USB1$$/test.txt', ACCESS_MODE.AM_READ, ADR(Result));
```

5.2.6 Installation of the analog channel types:

NOTICE	The ELA-IO.Library scales analog in- and output values. If the ELA-IO.Library will be used for the EA access, the scaled display and value ranges can be removed from the manual.

Analog outputs

Type	Enumeration	Measuring range	Display range
AOUT_0_10VOLT_NORMED	54	0 ... 10Volt	0..10000
AOUT_AI08_OFF	55	0	none

Analog inputs

Type	Enumeration	Measuring range	Display range
AIN_0_10Volt	0	0 ... 10Volt	0..10,00
AIN_0_20MA	3	0 ... 20mA	0,0..20,0
AIN_4_20mA	7	4 … 20mA	0,0..20,0
AIN_Pt100_2WIRE	21	-50 ... 350°C	-50,0..350,0

AIN_Pt1000_2WIRE	24	-20 ... 100°C	-20,0..100,0
AIN_NI1000_2WIRE	29	-20 ... 100°C	-20,0..100,0
AIN_TC TYP K (NI-CrNi)	15	-100 ... 1300°C	-100,0..1300,0
AIN_TC Typ L (Fe-CuNi)	16	-900 ... 1000°C	-900,0..1000,0
AIN_TC Typ S (Pt-RhPt)	19	0 ... 1600°C	-0,0..1600,0
AIN_200KOHM	105	0 ... 200KOhm	0..200,00
AIN_500OHM	103	0 ... 500Ohm	0..500,00
AIN_NTC_68KOHM	106	-20 ... 100°C	-20,0..100,0
AIN_NI1000_TK5000	108	-20 ... 100°C	-20,0..100,0

Error messages:

Type	Software correction of saturation		Display range
	Short circuit	Wire breakage	
AIN_Pt100_2WIRE	0 x 7FFE	0 x 7FFF	-50,0..350,0
AIN_Pt1000_2WIRE	0 x 7FFE	0 x 7FFF	-20,0..100,0
AIN_NI1000_2WIRE	0 x 7FFE	0 x 7FFF	-20,0..100,0
AIN_200KOHM	-	0 x 7FFF	0..200,00
AIN_500OHM	-	0 x 7FFF	0..500,00
AIN_NTC_68KOHM	0 x 7FFE	0 x 7FFF	-20,0..100,0
AIN_NI1000_TK5000	0 x 7FFE	0 x 7FFF	-20,0..100,0

Messages:

0 x 7FFA Incorrect calibration
0 x 7FFF Wire breakage („OPEN“)
0 x 7FFE Short circuit

General:
0 x 7FFD Wrong sensor type

For further questions please contact our application department.
Service and Support

5.2.7 IEC libaries

5.2.7.1 Device settings

For making settings out of the IEC code there is the libary system parameter available.

5.2.8 Example for the handling of the COM Ports

Required libraries:

1. SysCom 3.5.5.0
2. SysTypes2 3.5.0.0
3. CmpErrors 3.3.1.14

```
PROGRAM SERIELL_PRG
VAR
  DoSend                : BOOL  := FALSE;                    // Manuelles Auslösen des Senden
  DoClose               : BOOL  := FALSE;                    // Manuelles Auslösen des COM-Port Schliessen
  COMRS485              : BOOL  := TRUE;                     // Sende- & Empfangsumschaltung soll
verwendet werden

  RtsIecHandle          : RTS_IEC_HANDLE;
  ComSettings           : COM_Settings;                      // COM- Einstellungen
  ComSettingsEx         : COM_SettingsEx;                    // Erweiterte COM- Einstellungen
  pComSettingsEx        : POINTER TO BYTE := 0;              // nötig für Aktivieren der der Sende-und
Emfangsumschaltung

  SendBuffer            : STRING(1024):= 'ABCDEFG1234567890'; // Sendepuffer
  RecvBuffer            : STRING(1024);                      // Empfangspuffer
  COMSTATE              : INT;                               // Schrittkette, 0= Öffnen, 1
=lesen/Schreiben, 2= Schliessen
  CntSendChar           : UDINT;                             // Anzahl der gesendeten Zeichen
  CntRecvChar           : UDINT;                             // Anzahl der empfangenen Zeichen
  RtsIecResult          : ARRAY[0..FUN_MAX] OF RTS_IEC_RESULT;// Ergebnis von COM- Funktionen
END_VAR

VAR CONSTANT
  OK                    : BYTE := 0;                         // Rückgabewert für "OK"
  OPEN                  : BYTE := 0;                         // Index für Öffnen
  WRITE                 : BYTE := 1;                         // Index für Schreiben
  READ                  : BYTE := 2;                         // Index für Lesen
  FUN_MAX               : BYTE := 2;                         // Maximalwert der "Enumeration"
END_VAR


CASE COMSTATE OF
  0:// Initialisierung
    //
================================================================================================================
========
    // VOREINSTELLUNGEN
    //
================================================================================================================
========
    ComSettings.sPort        := SYS_COMPORT3;           // COM- Port
    ComSettings.ulBaudrate   := SYS_BR_9600;            // Baudrate
    ComSettings.byParity     := SYS_NOPARITY;           // Parität
    ComSettings.byStopBits   := SYS_ONESTOPBIT;         // Stopbits
    ComSettings.ulTimeout    := SYS_NOWAIT;             // Waitstait
  (*ComSettings.ulBufferSize := 1024;                   // Kann ignoriert werden, wird vom Betriebssystem fix
gesetzt *)
    ComSettingsEx.byByteSize := 8;                      // Anzahl der verwendeten Bit's im Byte
    COMRS485                 := TRUE;                   // Sende- & Empfangsumschaltung aktivieren TRUE =
RS485 , FALSE = RS232
```

```
    // Einschalten der RS485 - Automatisches Umschalten Sende-/Empfang
    pComSettingsEx := ADR(ComSettingsEx.bRtsControl);   // Ermittle die Adresse von RtsControl
    IF COMRS485 = TRUE
    THEN
      pComSettingsEx^:=3;                               // RS485 : Setze den Wert=3 über Pointerzugriff
      ELSE
       pComSettingsEx^:=0;                              // RS232 : Setze den Wert=0 über Pointerzugriff
              END_IF

    //
================================================================================================================
========
    // OEFFNE COM-PORT
    //
================================================================================================================
========
    RtsIecHandle := SysComOpen2( ADR( ComSettings ), ADR( ComSettingsEx ), ADR( RtsIecResult[OPEN] ) );
    IF ( RtsIecResult[OPEN] =  OK                 ) AND
       ( RtsIecHandle       <> RTS_INVALID_HANDLE ) AND
       ( RtsIecHandle       <> 0                  )
    THEN
       COMSTATE := 1;          // COM- Port erfolgreich geöffnet. Weiter zum nächsten Schritt
              END_IF
  1://
================================================================================================================
========
    // LESEN UND SCHREIBEN
    //
================================================================================================================
========

     // Lesen - Achtung hiermit werden nur die Zeichen gelesen die mit diesem PLC- Zyklis empfangen werden.
     //         Eine nachgeschaltete Logik für mehrzyklischen Empfang und Erkennung des Telegrammende ist
notwendig.
     CntRecvChar := SysComRead( RtsIecHandle, ADR(RecvBuffer), SIZEOF(RecvBuffer), 0, ADR( RtsIecResult[READ]
) );

     // Schreiben
     IF DoSend = TRUE
     THEN
       CntSendChar := SysComWrite( RtsIecHandle, ADR(SendBuffer), LEN(SendBuffer), 0, ADR(
RtsIecResult[WRITE] ) );

       IF ( RtsIecResult[WRITE] =  OK  ) // Abfrage auf Erfolg
       THEN
        DoSend:= FALSE;
       END_IF
     END_IF

  2://
================================================================================================================
========
    // SCHLIESSE COM-PORT
    //
================================================================================================================
========
    IF DoClose = TRUE
    THEN
      IF RtsIecHandle <> 16#FFFFFFFF AND RtsIecHandle <> 16#0
      THEN
        SysComClose(hCom := RtsIecHandle);
        RtsIecHandle := 0;
      END_IF
      DoSend := FALSE;
    END_IF
END_CASE
```

5.2.9 Example for the handling of CAN-LAYER 2

- The send module sends cyclic, and in case of data change a CAN-telegram.
- The receiver module receives telegrams other participants and serves for node controlling

Required libraries:
CAN05 3.5.3.0

```
PROGRAM CAN
VAR
 CanNo                  : BYTE          := 0;     // CAN-Controller 0/1
 BaudRate               : WORD          := 125;   // Baudrate in Kb
 CanRecvByteStdFbInst   : CanReceiveByte;
 CanSendByteStdFbInst   : CanSendByte;
 CanState               : INT;                    // Schrittkette, 0= Init, 1= Senden und Empfangen

 DataOut                : ARRAY [0..7] OF BYTE;   // Datenschnittstelle nach extern : Zu übertragende Daten
 DataIn                 : ARRAY [0..7] OF BYTE;   // Datenschnittstelle nach extern : Empfangene Daten
 RecvByte               : ARRAY [0..7] OF BYTE;   // Empfangsdaten
 SendByte               : ARRAY [0..7] OF BYTE;   // Sendedaten
 NodeID                 : BYTE:= 1;               // Eigene Knotennummer
 OwnNodeID              : BYTE:= 2;               // Knotennummer des Kommunikationspartner
 SendTelegramm          : BOOL:= FALSE;           // Auslösevariable für das Senden
 tLastSend              : TIME;                   // Zeitmerker für das Senden
 CountOfWrite           : DWORD;                  // Zähler für das Senden
 CountOfWriteOld        : DWORD;                  // Hilfszähler für das Senden
 CountOfRead            : DWORD;                  // Zähler für das Empfangen
 CountOfReadOld         : DWORD;                  // Hilfszähler für das Empfangen
 StayInLoop             : BOOL  :=TRUE;           // Hilfsvariable für die While-Schleife
 RecvID                 : DWORD;                  // Empfangs
 RecvLength             : BYTE;                   // Länge der Empfangsdaten
 tEnterRecvLoop         : TIME;                   // Zeitmerker Empfangseintritt (Für Timeout)
 tRecvTelegramm         : TIME;                   // Zeitmerker für empfangenes Telegramm
 RemoteNodeOK           : BOOL;                   // Kommunikationspartner verbunden
 i                      : INT;                    // Hilfsvariable für FOR- Schleife
END_VAR
VAR CONSTANT
END_VAR


CASE CanState OF
  0://
================================================================================================================
========
    // INITIALISIERUNG
    //
================================================================================================================
========
    CanInitialize(CanNo:=CanNo, BaudRate:= Baudrate , Extendend29bit:= FALSE ); // Can parametrieren
    CanState := 1;                                                              // In nächsten Schritt.

  1://
================================================================================================================
========
    // SENDEN
    // An den Teilnehmer "NodeID" wird ein Telegramm gesendet, bei Datenänderung, spätestens jedoch alle
500ms.
    //
================================================================================================================
========

    // Rücksetzten Senden
    SendTelegramm := FALSE;

    // Auslösen Senden
    IF TIME()- tLastSend >= T#500MS       // Das letzte Telegramm wurde vor >= 500ms versandt
    THEN
```

```
      SendTelegramm := TRUE;              // Senden Aufgrund Delta T
      ELSE
        FOR i:= 0 TO 7 DO
          IF DataOut[i] <> SendByte[i]    // Sendedaten haben sich geändert
          THEN
            SendTelegramm := TRUE;        // Senden Aufgrund Datenänderung
            EXIT;
          END_IF;
        END_FOR
      END_IF

      // Sendedaten umkopieren
      IF SendTelegramm = TRUE
      THEN
        FOR i:= 0 TO 7 DO
          Sendbyte[i] := DataOut[i];
        END_FOR
      END_IF;

      // Instanz- Input
      CanSendByteStdFbInst.CanNo      := CanNo;               // CAN-Controller 0 oder 1
      CanSendByteStdFbInst.SendID     := 16#180 + NodeID;     // Erzeuge Identifier
      CanSendByteStdFbInst.CycleTime  := 0;                   // Zyklisches Senden alle 0ms
      CanSendByteStdFbInst.Length     := 8;                   // 8 Byte Senden
      CanSendByteStdFbInst.Hold       := NOT SendTelegramm;   // Sperre Senden wenn SendTelegramm = FALSE
      CanSendByteStdFbInst.Byte0      := SendByte[0];
      CanSendByteStdFbInst.Byte1      := SendByte[1];
      CanSendByteStdFbInst.Byte2      := SendByte[2];
      CanSendByteStdFbInst.Byte3      := SendByte[3];
      CanSendByteStdFbInst.Byte4      := SendByte[4];
      CanSendByteStdFbInst.Byte5      := SendByte[5];
      CanSendByteStdFbInst.Byte6      := SendByte[6];
      CanSendByteStdFbInst.Byte7      := SendByte[7];
      // Instanzaufruf
      CanSendByteStdFbInst ();

      // Instanz- Output
      CountOfWrite := CanSendByteStdFbInst.CountOfWrite;

      IF CountOfWrite <> CountOfWriteOld          // Telegramm wurde versendet
      THEN
        CountOfWriteOld := CountOfWrite;          // Kopiere den Zählerstand
        tLastSend       := TIME();                // Merke
      END_IF

      //
================================================================================================================
========
      // EMPFANGEN
      //
      //
================================================================================================================
========

      // Instanz- Input
      CanRecvByteStdFbInst.CanNo :=  CanNo;       // Can- Controller mit welchem gearbeitet werden soll

      tEnterRecvLoop             := TIME();       // Speichere Zeitpunkt des Einsprung in die While-Schleife
für einen Timeout
      StayInLoop                 := TRUE;         // Bedingung zum Verweilen in der While-Schleife = TRUE

      WHILE (StayInLoop             =  TRUE ) AND // Nächster Durchlauf notwendig um zu prüfen ob Telegramm in
Empfangspuffer
            (TIME()-tEnterRecvLoop  <= T#2MS)     // maximal jedoch 2 Milisekunden
      DO

      // Instanzaufruf
      CanRecvByteStdFbInst();

      // Instanz- Output
      RecvID          := CanRecvByteStdFbInst.RecvID;
```

```
    CountOfRead     := CanRecvByteStdFbInst.CountOfRead;
    RecvLength      := CanRecvByteStdFbInst.Length;
    RecvByte[0]     := CanRecvByteStdFbInst.Byte0;
    RecvByte[1]     := CanRecvByteStdFbInst.Byte1;
    RecvByte[2]     := CanRecvByteStdFbInst.Byte2;
    RecvByte[3]     := CanRecvByteStdFbInst.Byte3;
    RecvByte[4]     := CanRecvByteStdFbInst.Byte4;
    RecvByte[5]     := CanRecvByteStdFbInst.Byte5;
    RecvByte[6]     := CanRecvByteStdFbInst.Byte6;
    RecvByte[7]     := CanRecvByteStdFbInst.Byte7;

    IF CountOfRead <> CountOfReadOld            // Telegramm empfangen
    THEN
      CountOfReadOld := CountOfRead;            // Kopiere den Empfangs- Zählerstand
      StayInLoop     := TRUE;                   // Bleibe in Schleife um weitere Telegramme zu empfangen

      IF RecvID - 16#180 = OwnNodeID            // Telegramm ist für diese Steuerung
      THEN
        FOR i := 0 TO RecvLength-1
        DO
          DataIn[i]:= RecvByte[i];              // Kopiere die Emfangsdaten ins Ziel
        END_FOR
        tRecvTelegramm := TIME();               // Merke Zeitpunkt des Empfangstelegramm
      END_IF
      ELSE
        StayInLoop   := FALSE;                  // Kein Telegramm empfangen
    END_IF
    END_WHILE

  // Kommunikationsüberwachung
  RemoteNodeOK := (TIME()- tRecvTelegramm <= T#1500MS); // TRUE= Telegramm erhalten, FALSE = 1,5 Sekunden
kein Telegramm erhalten

END_CASE
```

5.2.10 Web visualization

The CODESYS version on the decice supports the CODESYS web visulization. It based on HTML5 and and can be performed therefore on each browser, which supports the HTML5 innovation Canvas. For calling the Web visualization, please give in the address bar the following address:

http://<IP Adresse>:<Portnummer>/webvisu.htm
z.B. http://192.168.1.254/webvisu.htm

On delivery state is used port 80 for the Web visualization, so the specification of the port can be renounced.
The used port csn be set in the WBM.

NOTICE	
	Web visualization and WBM use the same port!

5.3 WBM

Via the WBM (Web Based Management) can considered and changed the most important parameters. The setting of the WBM can occurs of any browser, only the precondition is, that the HTML5 innovation WebSockets will be supported.

Das WBM can launched with the following address:
http://<IP Adresse>:<Portnummer>/wbm

Example http://192.168.1.254/wbm

Automically be forwarded to: http://192.168.1.254/wbm/index.html

On delivery state is used port 80 for the Web visualization, so the specification of the port can be renounced.

5.3.1 User Login

Various users can log in, they don‘t different in the access rights.

Find this information in the chapter “access rights”

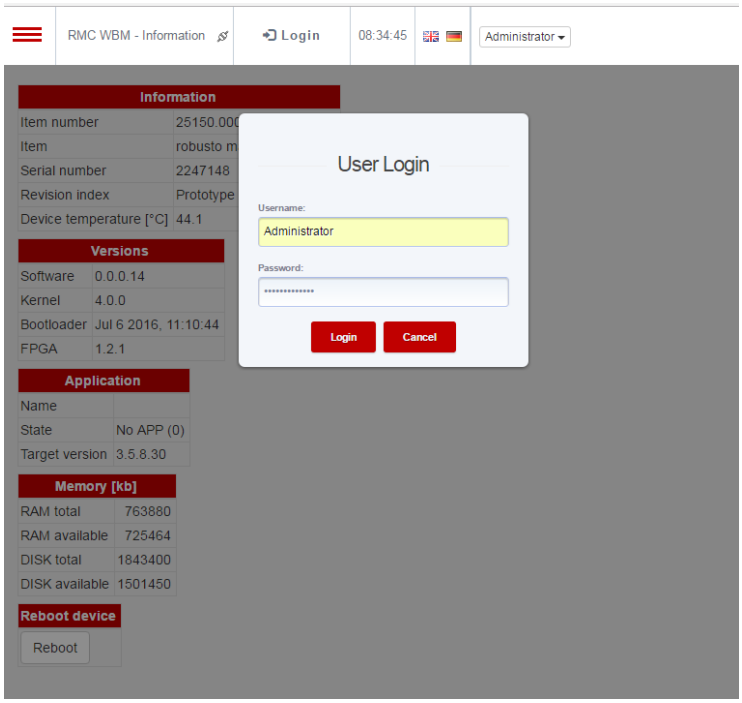


Figure 38: User Login

5.3.2 User Logout

At top right the logged in user will be displayed. By clicking on the button, the menu item „Logout“ appears.

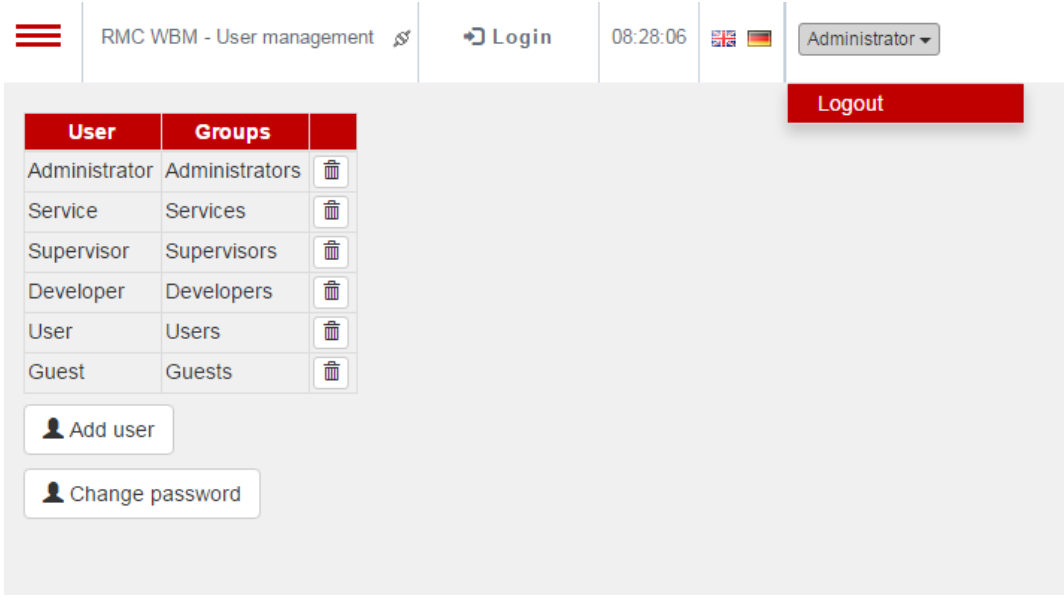
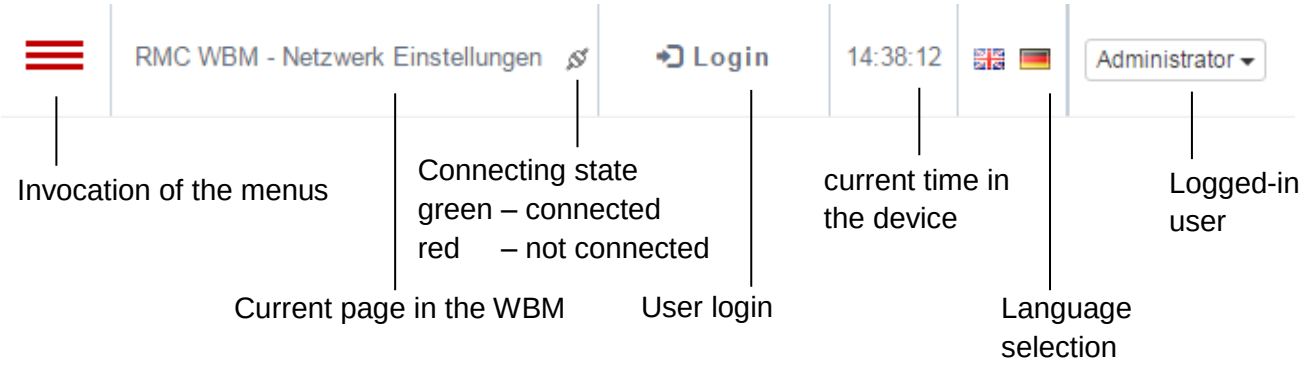


Figure 39: User Login/ Logout

5.3.3 *Title bar*

The title bar of the WBM shows information which can initiate tasks.



5.3.4 *Select menue*

The selection menu opens by staying with the mouse above left the menue symbol, or clicking on this.

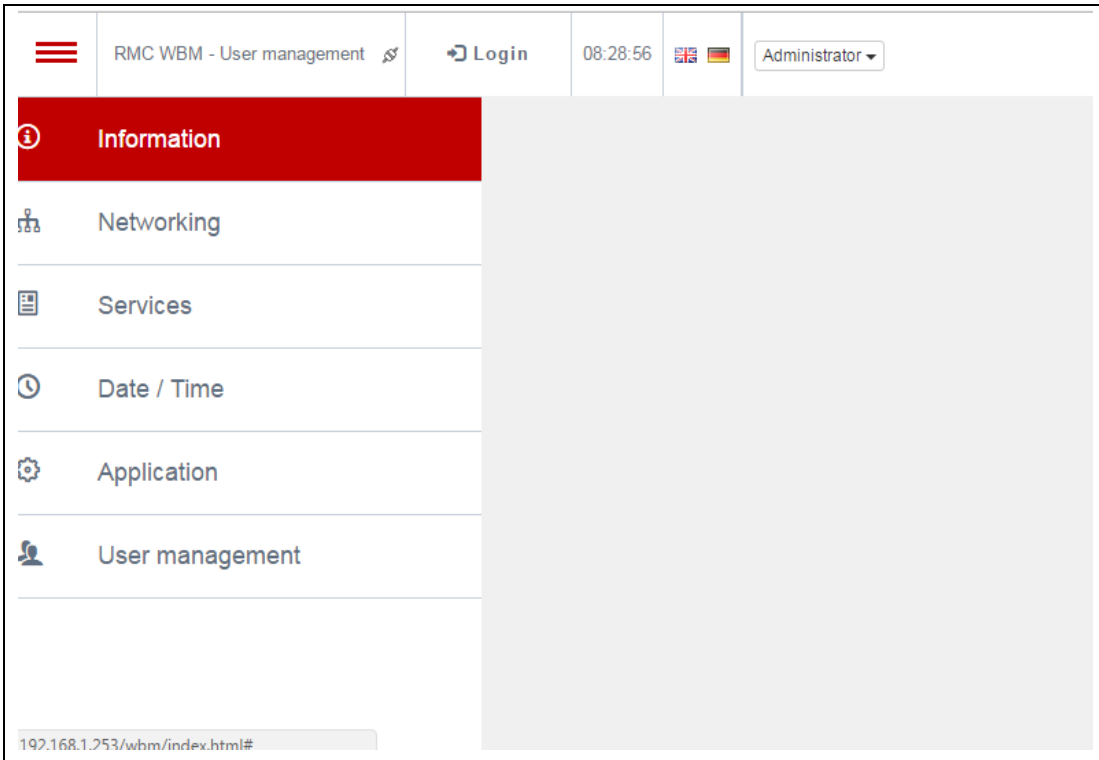


Figure 40:WBM menue

5.3.5 *RMC Web Based Management – information*

Various information about the device can be retrieved here, and execute a device reset**.**

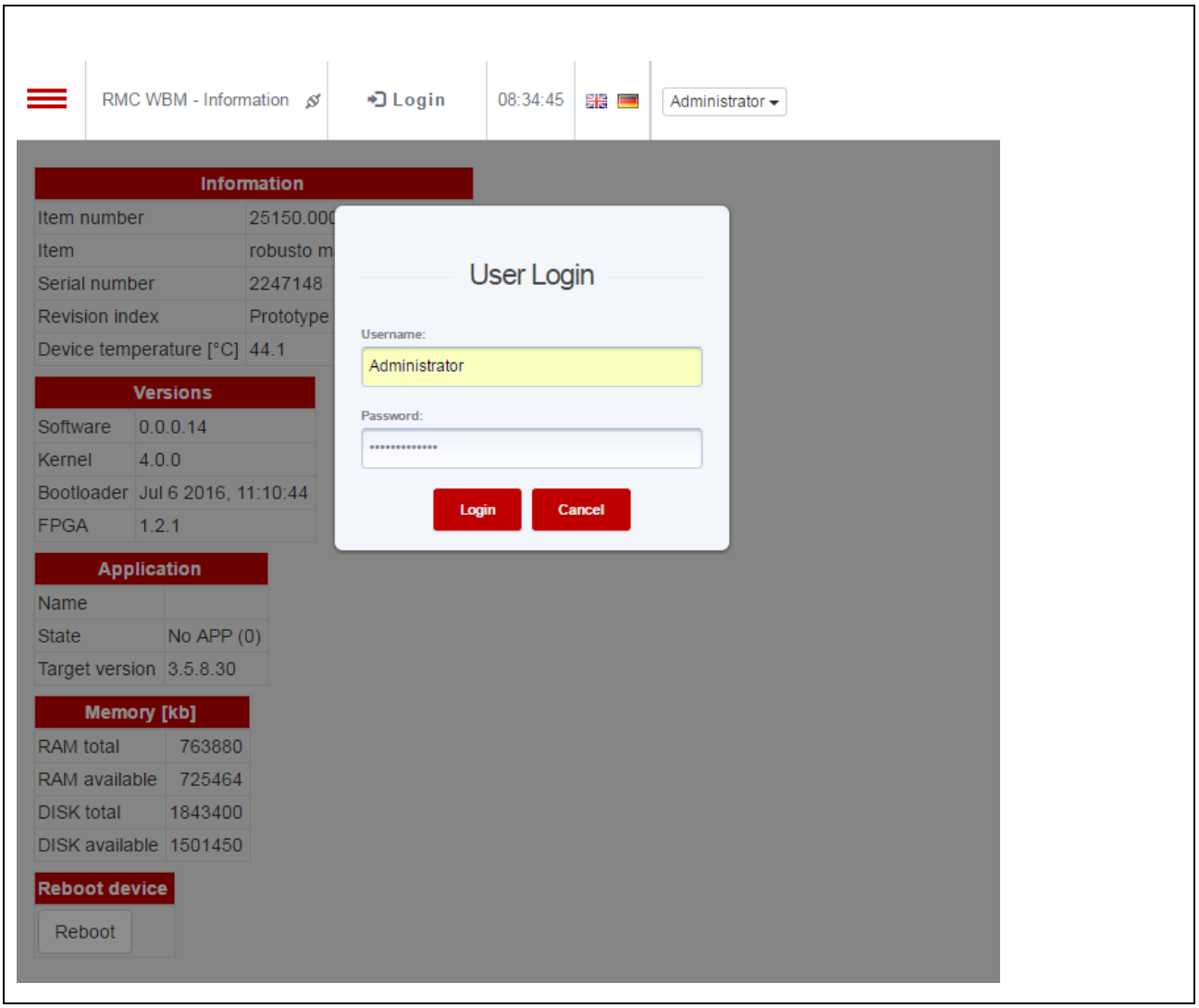


Figure 41: RMC - information

5.3.6 RMC Web Based Management – network settings

Specific informations about the network can be called, and also appropriate various settings to the networks and the FTP server

The factory settings of the device are as follows:

IP address 192.168.1.254

Subnet mask 255.255.255.0

Gateway 192.168.1.1

Promiscuous Mode OFF

Multicast Mode ON

NOTICE	
	Promiscuous Mode: In this mode the device only reads the inteded data for this device Multicast Mode: The multicast mode enables in IP network packages simultaneous, real time transmission to multiple receivers.

5.3.6.1 Netzwerk settings

The following network settings are global and refers to both network

They will be entered above in “Network1.

Domain name

DNS Server 1

DNS Server 2

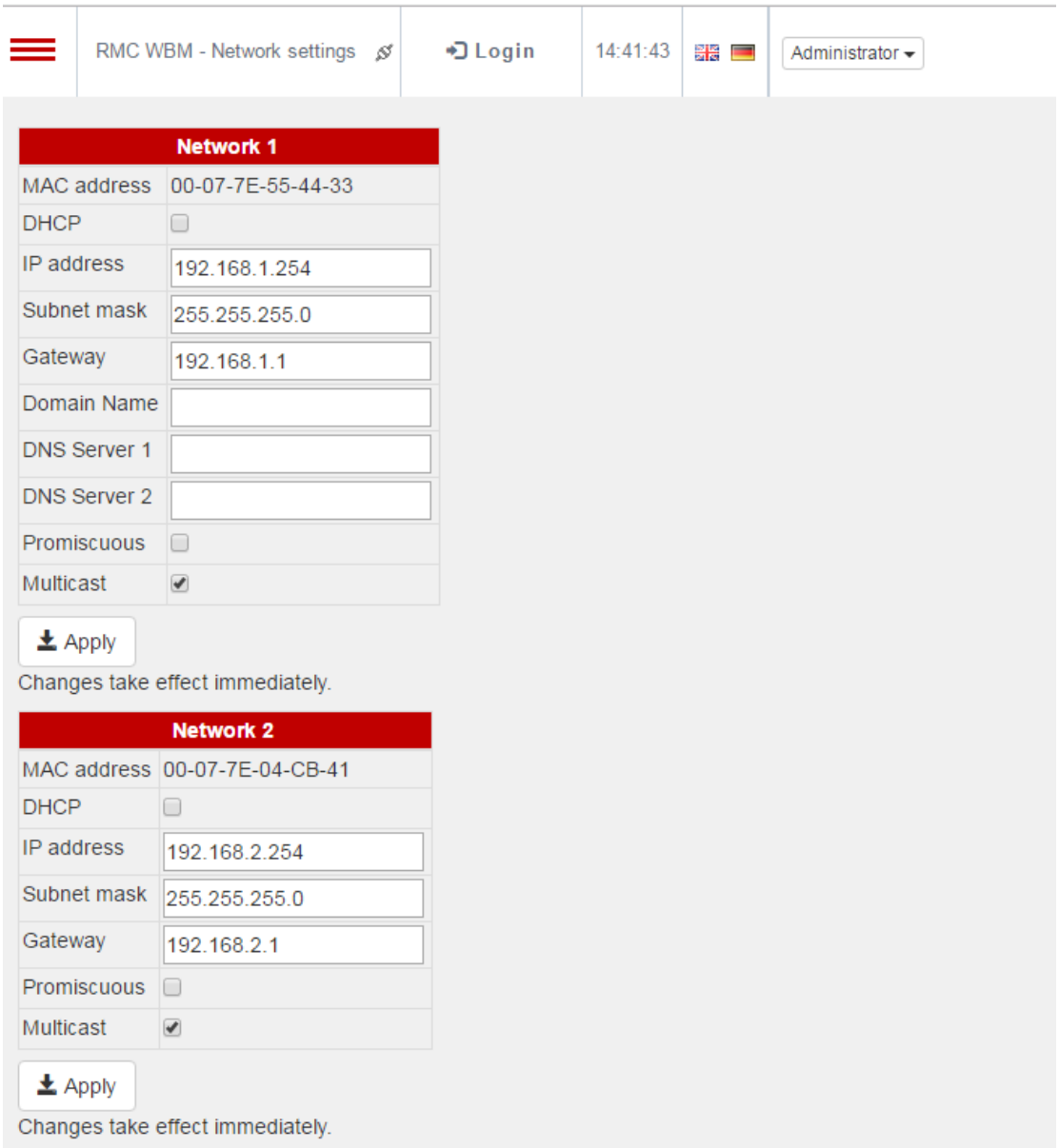


Figure 42: RMC– network settings with adapters

5.3.7 *RMC Web Based Management – Services*

On this page can be made settings for the network services and the watchdog. The server FTP, SSH, Telnet require from the client an authentification about user and password.
The acces date remove from chapter „access rights“
By using of MySQL in conjunction with PHP5 and HTML-pages, the webserver Lighttpd and the data base system MySQL can be activatd.
The default directory for the die MySQL data bases is located on the system unter */var/lib/mysql*. Here are the data bases included the internal tables for the database user and the acces rights. A change of the directory will be required a final configuration. Otherwise it will be created with the comand. *mysql_install_db* and create with the help of mysql console the user and the rights.
Via default there is a MySQL user *root* with the password *root*. The password can be changed via the mysql console.

Option MySQL external:

Via default is the option switched off
OFF means:

- The MySQL server can not be accessed from outside (from other PCs), only localhost. Default.
- The file /etc/mysql/my.cnf is configured as follows: bind-address = 127.0.0.1
- Only programmes which runs on the RMC can connect to the server.

ON means:

- The MySQL server can be accessed from outside via the TCP Port 3306. (this means other PCs or or network users can be connected to the server.
- The file /etc/mysql/my.cnf is configured as follows: bind-address = 0.0.0.0

The watchdog can be acktivated / deactivated. Optionally the time can be specified within the watchdog has to be reset. (>= 20 seconds). If the system will be hanged on and the watchdog will „Hängt“ das System und der Watchdog is no longer, reboot the device.

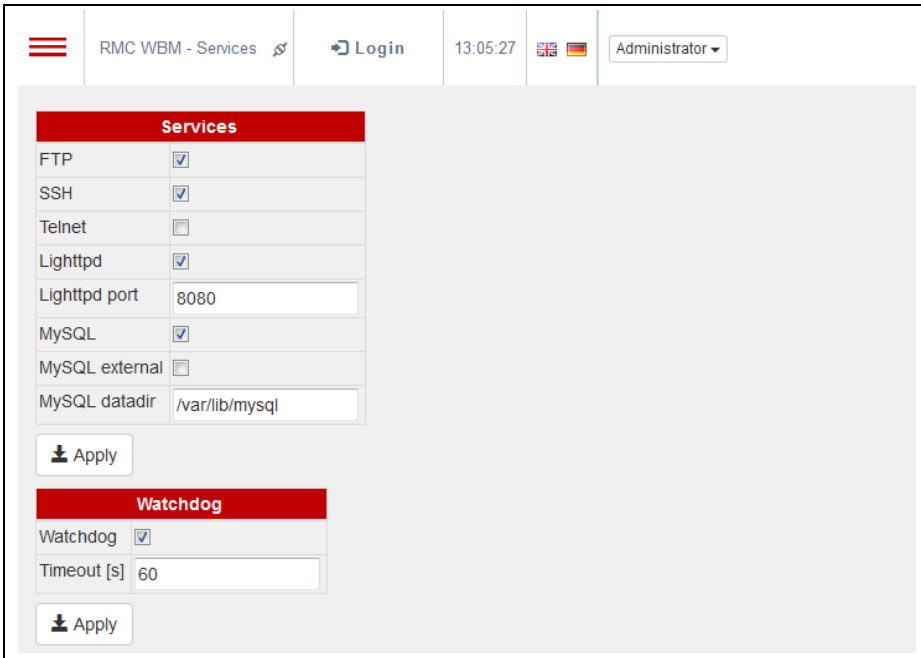


Figure 43:RMC– services

5.3.8 RMC Web Based Management – date/ time settings

On this page can theNTC Client beconfigured and be set data, time and timezone.

Synchrnization of the time with a time-server can be made with the Network Time Protocol (NTP). NTP uses the connectioness transport protocol UDP.

NOTICE	
	• The NTP client will be no longer synchronized, if the diffrence of the time >= 1000 seconds. • The update interval in the range of 64 up to 1024 seconds will be determined dynamically. • The maximum input for the clock is the year 2037.

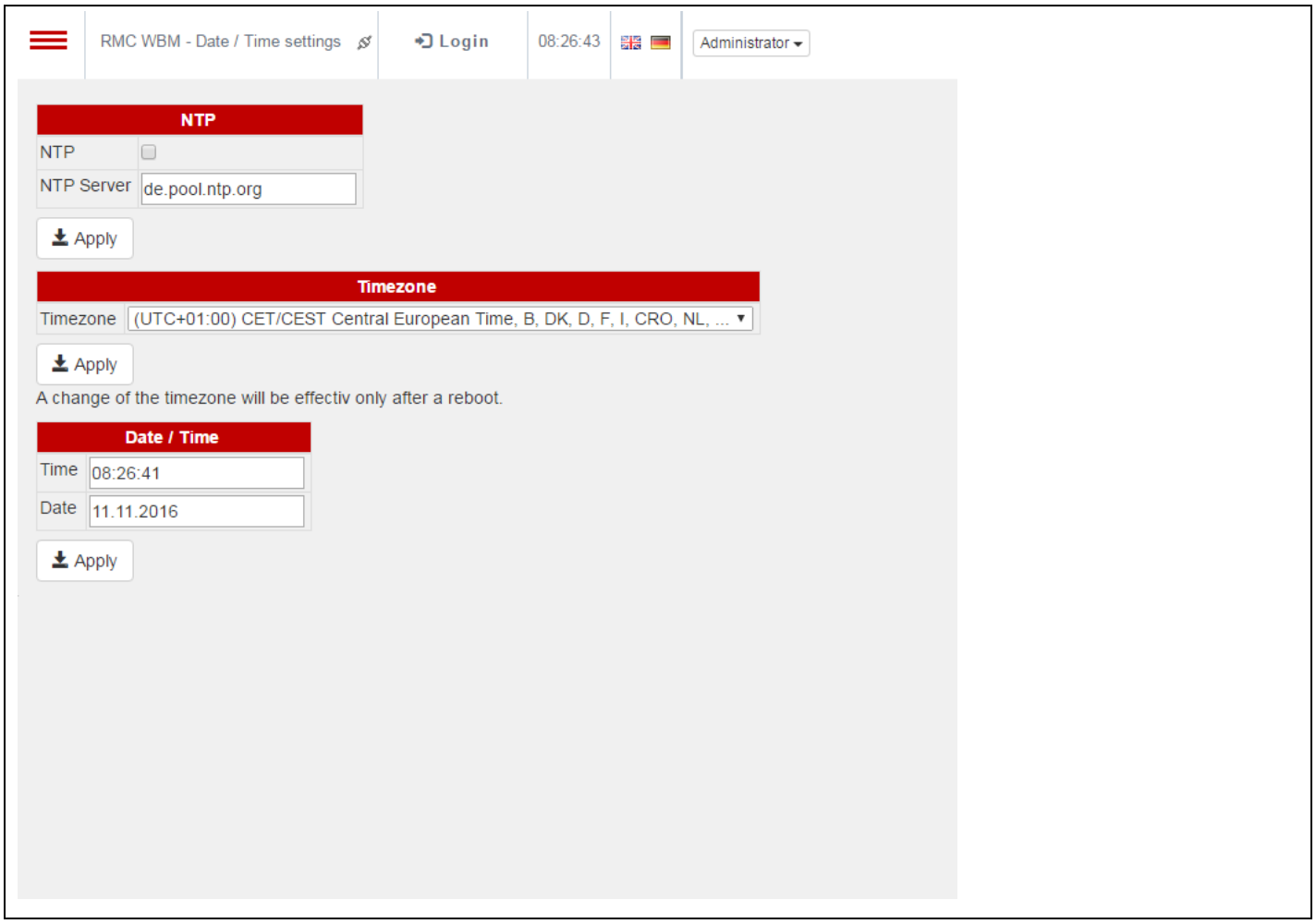


Figure 44: RMC– date/ time settings

5.3.8.1 Data / time

A change of the tie zone will be affected after a reset.

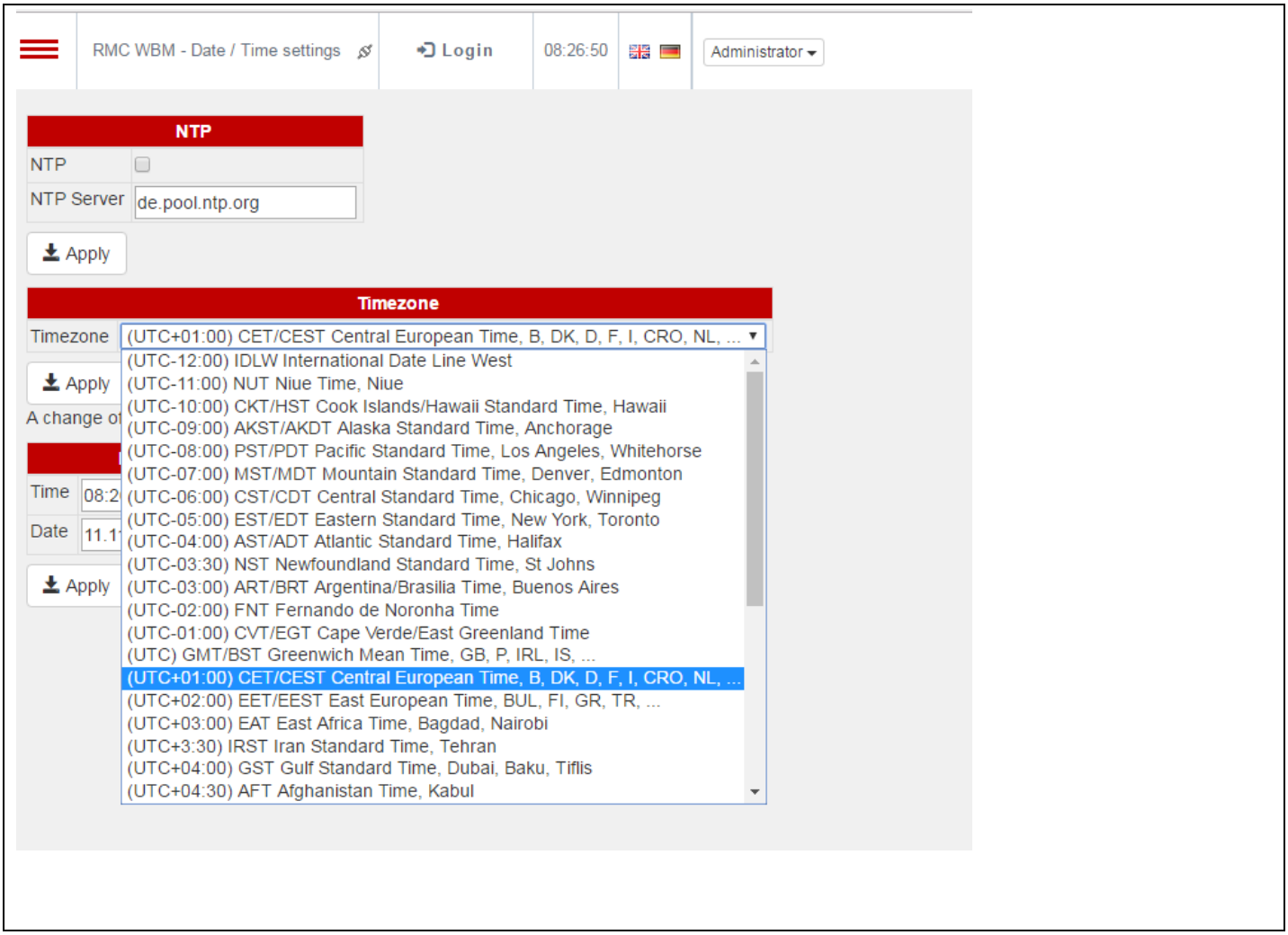


Figure 45: WBMB date/ time

5.3.9 *RMC Web Based Management – application settings*

The port number of the web server can be set. The web server has in the delivery state the HTTP Port 80 and the HTTPS Port 443.

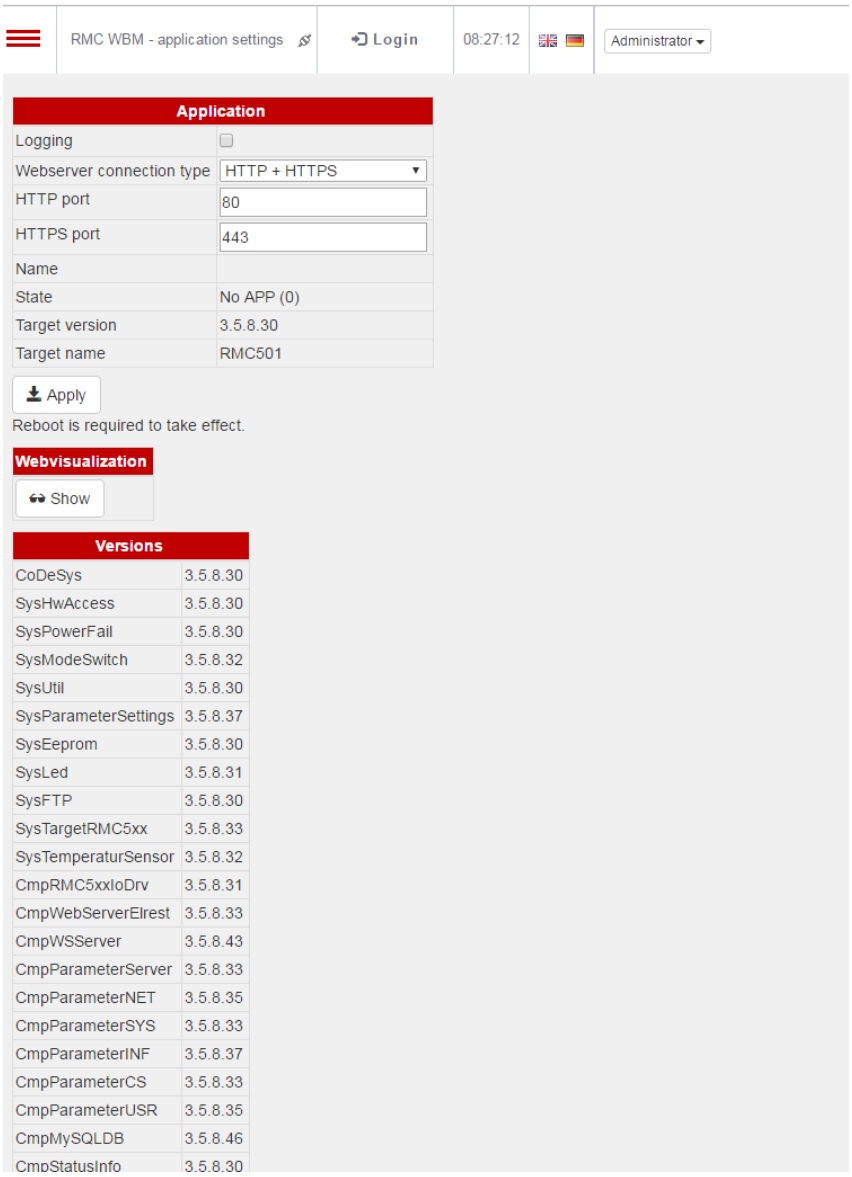


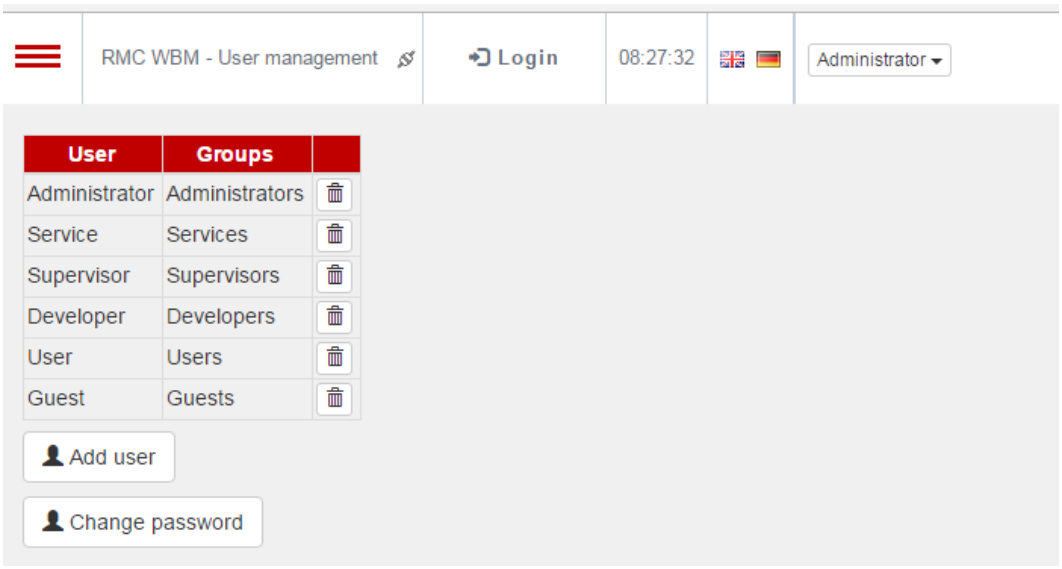
Figure 46: WBM application

Webserver connection type:	HTTP_ONLY	only http (unecrypted)
	HTTPS_ONLY	only https (ecrypted)
	HTTP_AND_HTTPS	boths
	REDIRECT_HTTP_TO_HTTPS	diversion from http to https

Webserver port:	Port for http
Webserver secure port	Port for https

5.3.10 RMC Web Based Management - User management

Via the menu item “User management” can be new users added, users deleated or the password ca be changed.



5.3.10.1 Add user

Users can be added by clicking the button “Add user”. The corresponding dialogue will be opened. Each user must be assigned a group. The user has the defined access rights of this group.

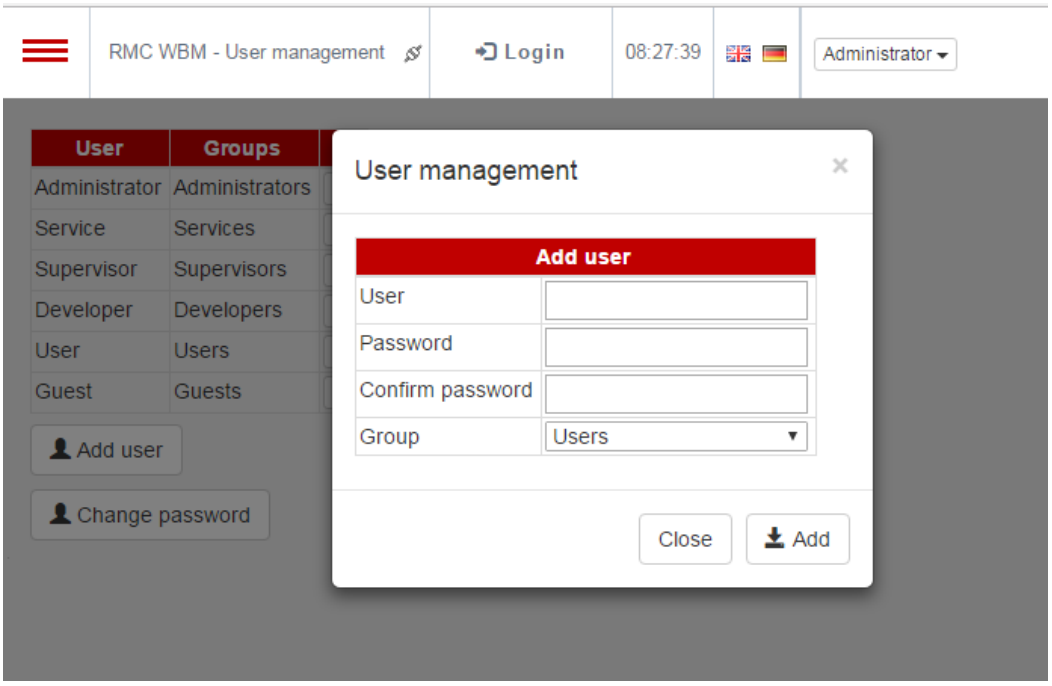
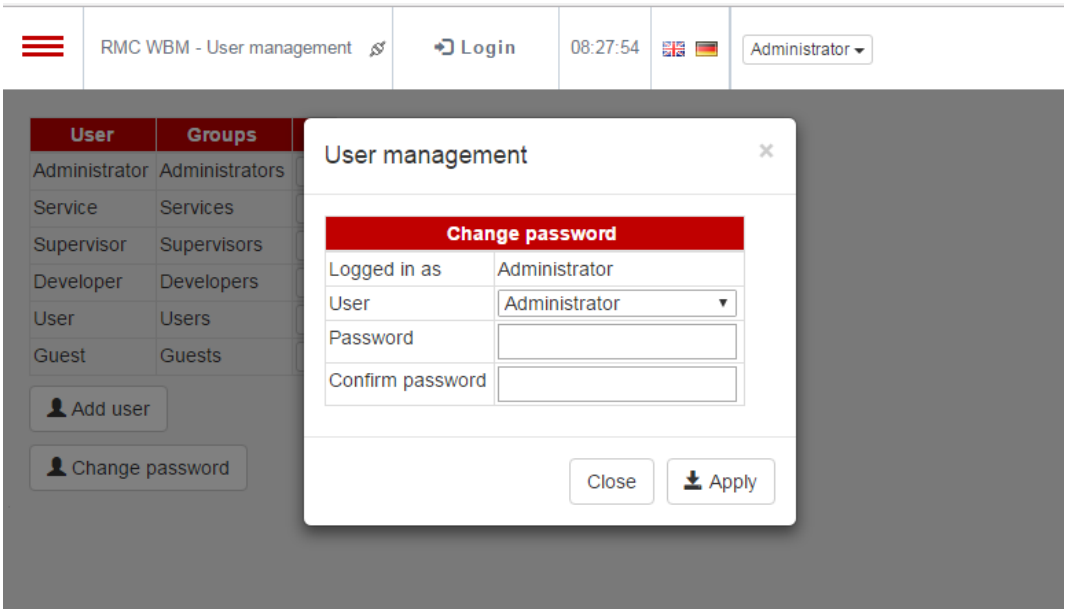


Figure 47: Add user

5.3.10.2 Change password

Each user can change its own password via the button “Change password”. Users of the group “Administrator” can also change the password of other users.

Find this information in the chapter “access rights”



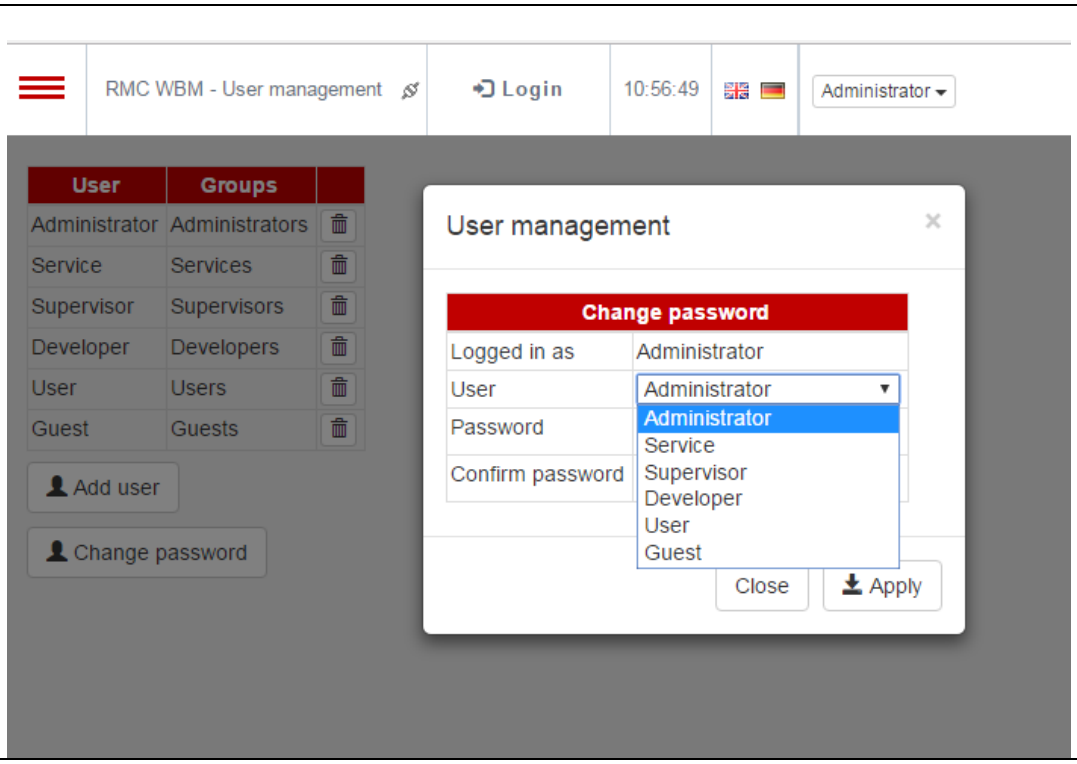


Figure 48: WBM change password

6 Maintenance and service

6.1 Maintenance

6.1.1 General

Please ensure you observe and check the following points:

- The ambient conditions must be assured.I
- Is the housing temperature unusually high?

6.1.1.1 Device temperature

WARNING 	**The device temperature** of the robusto RMC5XX during the operation should not be lower than 0°C and not higher than 50 °C (dependimng on position). Otherwise all warranty claims will be terminated and the device can be destroyed.

6.2 Device failure

The RMCxxx device was tested before delivery and has left our premises in good order and conditions. Should an error occur, on our webside „service/ redelivery“ you can fill out the RMA form and send us. We'll attend to it directly and answer as soon as possible.

6.3 Accessories

Designation	Artikle number	Description	
Patch cable RJ45 zu RJ45	commercial	Connection to further slaves. (CAN devices)	
µSDHC Card up to 32GB permitted		„Sandisc industrial“	 symbol. illustration
µSD Card max. 2 GB		„Sandisc industrial“	

7 Troubleshooting

7.1 Service and Support

Hotline

For additional support and information contact our hotline with the following times:

Mon-Fri: 8.00- 12.00 and 13.00 - 16.30

Phone: +49 (0) 7021 / 92025-33

Besides, you can of course always contact us by mail or fax.

Fax.: +49 (0) 7021 / 92025-29
e-mail: support@elrest.de

Training und Workshops

We offer education or project-based workshops for the elrest products.

Please contact our sales deparment for further information.

Phone: +49 (0) 7021/92025-0
Fax: +49 (0) 7021/92025-29
E-mail: vertrieb@elrest.de

8 List of figures

9 List of tables

10 History

Date	*Name*	*Chapter*	*Changing*
09.03.2016	Hm	1.0	Created
04.05.2016	Hm	1.1	WBM, new screenshots
10.05.2016	Hm	1.2	USB update
30.06.2016	Hm	1.3	Current screenshots; Ethernet interface; updates SW and HW
20.07.2016	Hm	1.4	Udates SW and HW
09.08.2016	Hm	1.5	Profinet-RT; changes and updates
15.08.2016	Hm	1.6	DB (no buzzer)
19.09.2016	Hm	1.7	UART RS232: Modi; USB Update Step 1, RS485, Gigabit Ethernet interface
11.11.2016	Hm	1.8	Screenshots, software updated
08.12.2016	Hm	1.9	Access from CODESYS to removable data media Connection storage media
31.01.2017	Hm	1.10	File access, New Screen Shots
27.02.2017	Hm	1.11	RMC503 Update data sheet: Resistance Accurancy
31.01.2017	Hm	1.12	RMC503 Update data sheet: temerature sensor
19.05.2017	Hm	1.13	Update data Sheet; Ethernet interface: LEDs

E602030.-1.13

11 Annex resistance tables

11.1.1 Resistance characteristics for the temperature sensor NTC-10K

For the RMC5xx is the mesuring range from -20°C…100°C.

°C	0	1	2	3	4	5	6	7	8	9
-20	97,604	92,094	86,930	82,088	77,544	73,280	69,328	65,515	61,981	58,659
-10	55,535	52,595	49,829	47,225	44,773	42,462	40,284	38,231	36,294	34,467
0	32,742	31,114	29,576	28,123	26,750	25,451	24,223	23,062	21,963	20,922
10	19,936	19,003	18,118	17,280	16,485	15,731	15,016	14,338	13,693	13,082
20	12,501	11,949	11,424	10,925	10,451	10,000	9,571	9,163	8,774	8,404
30	8,051	7,715	7,395	7,090	6,800	6,522	6,258	6,005	5,765	5,535
40	5,315	5,105	4,905	4,714	4,531	4,356	4,189	4,029	3,876	3,729
50	3,589	3,455	3,327	3,204	3,086	2,973	2,865	2,762	2,662	2,567
60	2,476	2,388	2,304	2,223	2,146	2,071	2,000	1,931	1,865	1,802
70	1,741	1,683	1,626	1,572	1,520	1,470	1,422	1,376	1,331	1,288
80	1,247	1,207	1,169	1,132	1,097	1,062	1,029	0,997	0,967	0,937
90	0,909	0,881	0,855	0,829	0,804	0,780	0,757	0,735	0,714	0,693
100	0,673	0,635	0,635	0,617	0,599	0,582				

11.1.2 Resistance characteristics for the temperature sensor NI1000

For the RMC5xx is the mesuring range from -20°C…100°C.

°C	0	1	2	3	4	5	6	7	8	9
-20	892,960	898,190	903,430	908,680	913,340	919,220	924,510	929,820	935,140	940,470
-10	945,820	951,170	956,550	961,930	967,330	972,740	978,170	983,600	989,060	994,520
0	1000,000	1005,490	1011,000	1016,510	1022,050	1027,590	1033,150	1038,720	1044,310	1049,900
10	1055,520	1061,140	1066,780	1072,430	1078,090	1083,770	1089,460	1095,170	1100,890	1106,620
20	1112,360	1118,120	1123,900	1129,680	1135,480	1141,290	1147,120	1152,960	1158,810	1164,680
30	1170,560	1176,450	1182,360	1188,280	1194,210	1200,160	1206,130	1212,100	1218,090	1224,090
40	1230,110	1236,140	1242,190	1248,250	1254,320	1260,410	1266,510	1272,620	1278,750	1284,890
50	1291,050	1297,220	1303,410	1309,610	1315,820	1322,050	1328,290	1334,550	1340,820	1347,100
60	1353,400	1359,720	1366,050	1372,290	1378,750	1385,120	1391,510	1397,910	1404,330	1410,760
70	1417,210	1423,670	1430,150	1436,640	1443,150	1449,670	1456,210	1462,760	1469,330	1475,950
80	1482,510	1489,130	1495,760	1502,400	1509,070	1515,740	1522,440	1529,140	1535,870	1542,610
90	1549,370	1556,140	1562,930	1569,730	1576,550	1583,390	1590,240	1597,110	1604,000	1610,900
100	1617,830	1624,760	1631,720	1638,690	1645,670	1652,680	1659,700	1666,740	1673,790	1680,870

11.1.3 Resistance characteristics for the temperature sensor NI1000TK5000

For the RMC5xx is the mesuring range from -20°C…100°C.

°C	0	1	2	3	4	5	6	7	8	9
-20	913,480	917,720	921,960	926,210	930,470	934,740	939,020	943,310	947,610	951,920
-10	956,240	960,570	964,910	969,260	973,620	977,990	982,370	986,770	991,170	995,580
0	1000,000	1004,430	1008,870	1013,330	1017,790	1022,260	1026,750	1031,240	1035,750	1040,270
10	1044,790	1049,330	1053,880	1058,440	1063,010	1067,590	1072,180	1076,780	1081,390	1086,020
20	1090,650	1095,300	1099,960	1104,620	1109,300	1113,990	1118,700	1123,410	1128,130	1132,870
30	1137,620	1142,370	1147,140	1151,920	1156,720	1161,520	1166,340	1171,160	1176,000	1180,850
40	1185,710	1190,590	1195,470	1200,370	1205,280	1210,200	1215,130	1220,070	1225,030	1230,000
50	1234,980	1239,970	1244,970	1249,990	1255,020	1260,060	1265,110	1270,180	1275,250	1280,340
60	1285,450	1290,560	1295,690	1300,830	1305,980	1311,140	1316,320	1321,510	1326,710	1331,920
70	1337,150	1342,390	1347,640	1352,910	1358,180	1363,470	1368,780	1374,090	1379,420	1384,770
80	1390,120	1395,490	1400,870	1406,260	1411,600	1417,090	1422,530	1427,970	1433,430	1438,910
90	1444,390	1449,900	1455,410	1460,940	1466,480	1472,030	1477,600	1483,180	1488,770	1494,380
100	1500,010	1505,640	1511,290	1516,950	1522,630	1528,320	1534,030	1539,750	1545,480	1551,220

11.1.4 Resistance characteristics for the temperature sensor PT100

For the RMC5xx is the mesuring range from -50°C…350°.

°C	0	1	2	3	4	5	6	7	8	9
-50	-2,431	-1,865	-1,818	-1,770	-1,722	-1,674	-1,626	-1,578	-2,055	-2,008
-40	-1,961	-1,913	-1,865	-1,818	-1,770	-1,722	-1,674	-1,626	-1,578	-1,530
-30	-1,482	-1,433	-1,385	-1,336	-1,288	-1,239	-1,190	-1,142	-1,093	-1,044
-20	-0,995	-0,946	-0,896	-0,847	-0,798	-0,749	-0,699	-0,650	-0,600	-0,550
-10	-0,501	-0,451	-0,401	-0,351	-0,301	-0,251	-0,201	-0,151	-0,101	-0,050
0	0,000	0,050	0,101	0,151	0,202	0,253	0,303	0,354	0,405	0,456
10	0,507	0,558	0,609	0,660	0,711	0,762	0,814	0,865	0,916	0,968
20	1,019	1,071	1,122	1,174	1,226	1,277	1,329	1,381	1,433	1,485
30	1,537	1,589	1,641	1,693	1,745	1,797	1,849	1,902	1,954	2,006
40	2,059	2,111	2,164	2,216	2,269	2,322	2,374	2,427	2,480	2,532
50	2,585	2,638	2,691	2,744	2,797	2,850	2,903	2,956	3,009	3,062
60	3,116	3,169	3,222	3,275	3,329	3,382	3,436	3,489	3,543	3,596
70	3,650	3,703	3,757	3,810	3,864	3,918	3,971	4,025	4,079	4,133
80	4,187	4,240	4,294	4,348	4,402	4,456	4,510	4,564	4,618	4,672
90	4,726	4,781	4,835	4,889	4,943	4,997	5,052	5,106	5,160	5,215
100	5,269	5,323	5,378	5,432	5,487	5,541	5,595	5,650	5,705	5,759
110	5,814	5,868	5,923	5,977	6,032	6,087	6,141	6,196	6,251	6,306
120	6,360	6,415	6,470	6,525	6,579	6,634	6,689	6,744	6,799	6,854
130	6,909	6,964	7,019	7,074	7,129	7,184	7,239	7,294	7,349	7,404
140	7,459	7,514	7,569	7,624	7,679	7,734	7,789	7,844	7,900	7,955
150	8,010	8,065	8,120	8,175	8,231	8,286	8,341	8,396	8,452	8,507
160	8,562	8,618	8,673	8,728	8,783	8,839	8,894	8,949	9,005	9,060
170	9,115	9,171	9,226	9,282	9,337	9,392	9,448	9,503	9,559	9,614
180	9,669	9,725	9,780	9,836	9,891	9,947	10,002	10,057	10,113	10,168
190	10,224	10,279	10,335	10,390	10,446	10,501	10,557	10,612	10,668	10,723
200	10,779	10,834	10,890	10,945	11,001	11,056	11,112	11,167	11,223	11,278
210	11,334	11,389	11,445	11,501	11,556	11,612	11,667	11,723	11,778	11,834
220	11,889	11,945	12,000	12,056	12,111	12,167	12,222	12,278	12,334	12,389
230	12,445	12,500	12,556	12,611	12,667	12,722	12,778	12,833	12,889	12,944
240	13,000	13,056	13,111	13,167	13,222	13,278	13,333	13,389	13,444	13,500
250	13,555	13,611	13,666	13,722	13,777	13,833	13,888	13,944	13,999	14,055
260	14,110	14,166	14,221	14,277	14,332	14,388	14,443	14,499	14,554	14,609
270	14,665	14,720	14,776	14,831	14,887	14,942	14,998	15,053	15,109	15,164
280	15,219	15,275	15,330	15,386	15,441	15,496	15,552	15,607	15,663	15,718
290	15,773	15,829	15,884	15,940	15,995	16,050	16,106	16,161	16,216	16,272
300	16,327	16,383	16,438	16,493	16,549	16,604	16,659	16,715	16,770	16,825
310	16,881	16,936	16,991	17,046	17,102	17,157	17,212	17,268	17,323	17,378
320	17,434	17,489	17,544	17,599	17,655	17,710	17,765	17,820	17,876	17,931
330	17,986	18,041	18,097	18,152	18,207	18,262	18,318	18,373	18,428	18,483
340	18,538	18,594	18,649	18,704	18,759	18,814	18,870	18,925	18,980	19,035
350	19,090	19,146	19,201	19,256	19,311	19,366	19,422	19,477	19,532	19,587

11.1.5 Resistance characteristics for the temperature sensor PT1000

For the RMC5xx is the mesuring range from -20°C…100°C.

°C	0	1	2	3	4	5	6	7	8	9
-20	921,599	925,530	929,461	933,390	937,317	941,244	945,169	949,093	953,016	956,938
-10	960,859	964,778	968,696	972,613	976,529	980,444	984,358	988,270	992,181	996,091
0	1000,000	1003,908	1007,814	1011,720	1015,624	1019,527	1023,429	1027,330	1031,229	1035,128
10	1039,025	1042,921	1046,816	1050,710	1054,603	1058,495	1062,385	1066,274	1070,162	1074,049
20	1077,935	1081,820	1085,703	1089,585	1093,467	1097,347	1101,225	1105,103	1108,980	1112,855
30	1116,729	1120,602	1124,474	1128,345	1132,215	1136,083	1139,950	1143,817	1147,681	1151,545
40	1155,408	1159,270	1163,130	1166,989	1170,847	1174,704	1178,560	1182,414	1186,268	1190,120
50	1193,971	1197,821	1201,670	1205,518	1209,364	1213,210	1217,054	1220,897	1224,739	1228,579
60	1232,419	1236,257	1240,095	1243,931	1247,766	1251,600	1255,432	1259,264	1263,094	1266,923
70	1270,751	1274,578	1278,404	1282,228	1286,052	1289,874	1293,695	1297,515	1301,334	1305,152
80	1308,968	1312,783	1316,597	1320,411	1324,222	1328,033	1331,843	1335,651	1339,458	1343,264
90	1347,069	1350,873	1354,676	1358,477	1362,277	1366,077	1369,875	1373,671	1377,467	1381,262
100	1385,055	1388,847	1392,638	1396,428	1400,217	1404,005	1407,791	1411,576	1415,360	1419,143

11.1.6 Characteristic curves for the temperature sensor TC TYP K (NI-CrNi

For the RMC5xx is the mesuring range from -100°C…1300°C.

°C	0	1	2	3	4	5	6	7	8	9
-100	-3,553	-3,523	-3,492	-3,461	-3,430	-3,399	-3,368	-3,337	-3,305	-3,274
-90	-3,242	-3,211	-3,179	-3,147	-3,115	-3,082	-3,050	-3,018	-2,985	-2,953
-80	2,920	-2,887	-2,854	-2,821	-2,788	-2,754	-2,721	-2,687	-2,654	-2,620
-70	-2,586	-2,552	-2,518	-2,484	-2,450	-2,416	-2,381	-2,347	-2,312	-2,277
-60	-2,243	-2,208	-2,173	2,137	-2,102	-2,067	-2,032	-1,966	-1,961	-1,925
-50	-1,889	-1,853	-1,817	-1,781	-1,745	-1,709	-1,673	-1,636	-1,600	-1,563
-40	-1,527	-1,490	-1,453	-1,416	-1,379	-1,342	-1,305	-1,268	-1,231	-1,193
-30	-1,156	-1,118	-1,081	-1,043	-1,005	-0,968	-0,930	-0,892	-0,854	0,816
-20	-0,777	-0,739	-0,701	-0,662	-0,362	-0,585	0,547	-0,508	-0,469	-0,431
-10	-0,392	-0,353	-0,314	-0,275	-0,236	-0,197	-0,157	-0,118	-0,079	-0,039
0	0,000	0,039	0,079	0,119	0,158	0,198	0,238	0,277	0,317	0,357
10	0,397	0,437	0,477	0,517	0,557	0,597	0,637	0,677	0,718	0,758
20	0,798	0,838	0,879	0,919	0,960	1,000	1,041	1,081	1,122	1,162
30	1,203	1,244	1,285	1,325	1,366	1,407	1,448	1,489	1,529	1,570
40	1,611	1,652	1,693	1,734	1,776	1,817	1,858	1,899	1,940	1,981
50	2,022	2,064	2,105	2,146	2,188	2,229	2,270	2,312	2,353	2,394
60	2,436	2,477	2,519	2,560	2,601	2,643	2,684	2,726	2,767	2,809
70	2,850	2,892	2,933	2,975	3,016	3,058	3,100	3,141	3,183	3,224
80	3,266	3,307	3,349	3,390	3,432	3,473	3,515	3,556	3,598	3,639
90	3,681	3,722	3,764	3,805	3,847	3,888	3,930	3,971	4,012	4,054
100	4,095	4,137	4,178	4,219	4,261	4,302	4,343	4,384	4,426	4,467
110	4,508	4,549	4,590	4,632	4,673	4,714	4,755	4,796	4,837	4,878
120	4,919	4,960	5,001	5,042	5,083	5,124	5,164	5,205	5,246	5,287
130	5,327	5,368	5,409	5,450	5,490	5,531	5,571	5,612	5,652	5,693
140	5,733	5,774	5,814	5,855	5,895	5,936	5,976	6,016	6,057	6,097
150	6,137	6,177	6,218	6,258	6,298	6,338	6,378	6,419	6,459	6,499
160	6,539	6,579	6,619	6,659	6,699	6,739	6,779	6,819	6,859	6,899
170	6,939	6,979	7,019	7,059	7,099	7,139	7,179	7,219	7,259	7,299
180	7,338	7,378	7,418	7,458	7,498	7,538	7,578	7,618	7,658	7,697
190	7,737	7,777	7,817	7,859	7,897	7,937	7,977	8,017	8,057	8,097
200	8,137	8,177	8,216	8,256	8,296	8,336	8,376	8,416	8,456	8,497
210	5,537	8,577	8,617	8,657	8,697	8,737	8,777	8,817	8,857	8,898
220	8,938	8,978	9,018	9,058	9,099	9,139	9,179	9,220	9,260	9,300
230	9,341	9,381	9,421	9,462	9,502	9,543	9,583	9,624	9,664	9,705
240	9,745	9,786	9,826	9,867	9,907	9,948	9,989	10,029	10,070	10,111
250	10,151	10,192	10,233	10,274	10,315	10,355	10,396	10,437	10,478	10,519
260	10,560	10,600	10,641	10,682	10,723	10,764	10,805	10,846	10,887	10,928
270	10,969	11,010	11,051	11,093	11,134	11,175	11,216	11,257	11,298	11,339
280	11,381	11,422	11,463	11,504	11,546	11,587	11,628	11,669	11,711	11,752
290	11,793	11,835	11,876	11,918	11,959	12,000	12,042	12,083	12,125	12,166
300	12,207	12,249	12,290	12,332	12,373	12,415	12,456	12,498	12,539	12,581
310	12,623	12,664	12,706	12,747	12,789	122,831	12,872	12,914	12,955	12,997
320	13,039	13,080	13,122	13,164	13,205	13,247	13,289	13,331	13,372	13,414
330	13,456	13,497	13,539	13,581	13,623	13,665	13,706	13,748	13,790	13,832
340	13,874	13,915	13,957	13,999	14,041	14,083	14,125	14,167	14,208	14,250
350	14,292	14,334	14,376	14,418	14,460	14,502	14,544	14,586	14,628	14,670
360	14,712	14,754	14,796	14,838	14,880	14,922	14,964	15,006	15,048	15,090
370	15,132	14,174	15,216	15,258	15,300	15,342	15,384	15,426	15,468	15,510
380	15,552	15,594	15,636	15,679	15,721	15,763	15,805	153,847	15,889	15,931
390	15,974	16,016	16,058	16,100	16,142	16,184	16,227	16,269	16,311	16,353
400	16,395	16,438	16,480	16,522	16,564	16,607	16,649	16,691	16,733	16,776
410	16,818	16,86	16,902	16,945	16,987	17,029	17,072	17,114	17,156	17,199
420	17,241	17,283	17,326	17,368	17,41	17,453	17,495	17,537	17,580	17,622
430	17,664	17,707	17,749	17,792	17,834	17,876	17,919	17,961	18,004	18,046
440	18,088	18,131	18,173	18,216	18,258	18,301	18,343	18,385	18,428	18,47
450	18,513	18,555	18,598	18,640	18,683	18,725	18,768	18,810	18,853	18,895
460	18,938	18,980	19,023	19,065	19,108	19,150	19,193	19,235	19,278	19,320
470	193,363	19,405	19,448	196,490	19,533	196,576	19,618	19,661	19,703	17,746

°C	0	1	2	3	4	5	6	7	8	9
480	19,788	19,831	19,873	19,916	19,959	20,001	20,044	20,086	20,129	20,172
490	20,214	20,257	20,299	20,342	20,385	20,427	20,470	20,512	20,555	20,598
500	20,640	20,683	20,725	20,768	20,811	20,853	20,896	20,938	20,981	21,024
510	21,066	21,109	21,152	21,194	21,237	21,28	21,322	21,365	21,407	21,450
520	21,493	21,535	21,578	21,621	21,663	21,706	21,749	21,791	21,834	21,876
530	21,919	21,962	22,004	22,047	22,090	22,132	22,175	22,218	22,260	22,303
540	22,346	22,388	22,431	22,473	22,516	22,559	22,601	22,644	22,687	22,729
550	22,772	22,815	22,857	22,900	22,942	22,985	23,028	23,070	23,117	23,156
560	23,198	23,241	23,284	23,326	23,369	23,411	23,454	23,497	23,539	23,582
570	23,624	23,667	23,710	23,752	23,795	23,837	23,880	23,923	23,965	24,008
580	24,050	24,093	24,136	24,178	24,221	24,263	24,306	24,348	24,391	24,434
590	24,476	24,519	24,561	24,604	24,646	24,689	24,731	24,774	24,817	24,859
600	24,902	24,944	24,987	25,029	25,072	25,114	25,157	25,199	25,242	25,284
610	25,327	25,369	25,412	25,454	25,497	25,539	25,582	25,624	25,666	25,709
620	25,751	25,794	25,836	25,879	25,921	25,964	26,006	26,048	26,091	26,133
630	26,176	26,218	26,260	26,303	26,345	26,387	26,430	26,472	26,515	26,557
640	26,599	26,642	26,684	26,726	26,769	26,811	26,853	26,896	26,938	26,980
650	27,022	27,065	27,107	27,149	27,192	27,234	27,276	27,318	27,361	27,403
660	27,445	27,487	27,529	27,572	27,614	27,656	27,698	27,740	27,783	27,825
670	27,867	27,909	27,951	27,993	28,035	28,078	28,120	28,162	28,204	28,246
680	28,288	28,330	28,372	28,414	28,456	28,498	28,540	28,593	28,625	28,667
690	28,709	28,751	28,793	28,835	28,877	28,919	28,961	29,002	29,044	29,086
700	29,128	29,170	29,212	29,254	29,296	29,338	29,380	29,422	29,464	29,505
710	29,547	29,589	29,631	29,673	29,715	29,756	29,798	29,840	29,882	29,924
720	29,965	30,007	30,049	30,091	30,132	30,174	30,216	30,257	30,299	30,341
730	30,383	30,427	30,466	30,508	30,549	30,591	30,632	30,674	30,716	30,757
740	30,799	30,840	30,882	30,924	30,965	31,007	31,048	31,090	31,131	31,173
750	31,214	31,256	31,297	31,339	31,380	31,422	31,463	31,504	31,546	31,587
760	31,629	31,670	31,712	31,753	31,794	31,856	31,877	31,918	31,960	32,001
770	32,042	32,084	32,125	32,166	32,207	32,249	32,290	32,331	32,372	32,414
780	32,455	32,496	32,537	32,578	32,619	32,661	32,702	32,743	32,784	32,825
790	32,866	32,907	32,948	32,990	33,031	33,072	33,113	33,154	33,195	33,236
800	33,277	33,318	33,359	33,400	33,441	33,482	33,523	33,564	33,604	33,645
810	33,686	33,727	33,768	33,809	33,850	33,891	33,931	33,972	34,013	34,054
820	34,095	34,136	34,176	34,217	34,258	34,299	34,339	34,380	34,421	34,461
830	34,502	34,543	34,583	34,624	34,665	34,705	34,746	34,787	34,827	34,868
840	34,909	34,949	34,990	35,030	35,071	35,111	35,152	35,192	35,233	35,273
850	35,314	35,354	35,395	35,435	35,476	35,516	35,557	35,597	35,637	35,678
860	35,718	35,758	35,799	35,839	35,880	35,920	35,960	36,000	36,041	36,081
870	36,121	36,162	36,202	36,242	36,282	36,323	36,363	36,403	36,443	36,483
880	36,524	36,564	36,604	36,644	36,684	36,724	36,764	36,804	36,844	36,885
890	36,925	36,965	37,005	37,045	37,085	37,125	37,165	37,205	37,245	37,285
900	37,325	37,365	37,405	37,445	37,484	37,524	37,564	37,604	37,644	37,684
910	37,724	37,764	37,803	37,843	37,883	37,923	37,963	38,002	38,042	38,082
920	38,122	38,162	38,201	38,241	38,281	38,320	38,360	38,400	38,439	38,479
930	38,519	38,558	38,598	38,638	38,677	38,717	38,756	38,796	38,836	38,875
940	38,915	38,954	38,994	39,033	39,073	39,112	39,152	39,191	39,231	39,270
950	39,310	39,349	39,388	39,428	39,467	39,507	39,546	39,585	39,625	39,664
960	39,703	39,743	39,782	39,821	39,861	39,900	39,939	39,979	40,018	40,057
970	40,096	40,136	40,175	40,214	40,253	40,262	40,332	40,710	40,410	40,449
980	40,488	40,527	40,566	40,605	40,645	40,684	40,723	40,762	40,801	40,840
990	40,879	40,918	40,957	40,996	41,035	41,074	41,113	41,115	41,191	41,230
1000	41,269	41,308	41,347	41,385	41,424	41,463	41,502	41,541	41,580	41,619
1010	41,657	41,696	41,735	41,774	41,813	41,851	41,890	41,929	41,968	42,006
1020	42,045	42,084	42,123	42,161	42,200	42,239	42,277	42,316	42,355	42,393
1030	42,432	42,470	42,506	42,548	42,586	42,625	42,663	42,702	42,740	42,779
1040	42,817	42,856	42,894	42,933	42,971	43,010	43,048	43,087	43,125	43,164

°C	0	1	2	3	4	5	6	7	8	9
1050	43,202	43,240	43,279	43,317	43,356	43,394	43,432	43,471	43,509	43,547
1060	43,585	43,624	43,662	43,700	43,739	43,777	43,815	43,853	43,891	43,930
1070	43,968	44,006	44,044	44,082	44,121	44,159	44,197	44,235	44,273	44,311
1080	44,349	44,387	44,425	44,463	44,501	44,539	44,577	44,615	44,653	44,691
1090	44,729	44,767	44,805	44,843	44,881	44,919	44,957	44,995	45,033	45,070
1100	45,108	45,146	45,184	45,222	45,260	45,297	45,335	45,373	45,411	45,448
1110	45,486	45,524	45,561	45,599	45,637	45,675	45,712	45,750	45,787	45,825
1120	45,863	45,900	45,938	45,975	46,013	46,051	46,088	46,126	46,163	46,201
1130	46,238	46,275	46,313	46,350	46,388	46,425	46,463	46,500	46,537	46,575
1140	46,612	46,649	46,687	46,724	46,761	46,799	46,836	46,873	46,910	46,948
1150	46,985	47,022	47,059	47,096	47,134	47,141	47,208	47,245	47,282	47,319
1160	47,356	47,393	47,430	47,468	47,505	47,542	47,579	47,616	47,653	47,689
1170	47,726	47,763	47,800	47,837	47,874	47,911	47,948	47,985	48,021	48,058
1180	48,095	48,132	48,169	48,205	48,242	48,279	48,316	48,352	48,389	48,426
1190	48,462	48,499	48,536	48,572	48,609	48,645	48,682	48,718	48,755	48,792
1200	48,828	48,865	48,901	48,937	48,974	49,010	49,047	49,083	49,120	49,156
1210	49,192	49,229	49,265	49,301	49,338	49,374	49,410	49,446	49,483	49,519
1220	49,555	49,591	49,627	49,663	49,700	49,736	49,772	49,808	49,844	49,880
1230	49,916	49,952	49,988	50,024	50,060	50,096	50,132	50,168	50,204	50,240
1240	50,276	50,311	50,347	50,383	50,419	50,455	50,491	50,526	50,562	50,598
1250	50,633	50,669	50,705	50,741	50,776	50,812	50,847	50,883	50,919	50,954
1260	50,990	51,025	51,061	51,096	51,132	51,167	51,203	51,238	51,274	51,309
1270	51,344	51,380	51,415	51,450	51,486	51,521	51,556	51,592	51,627	51,662
1280	51,697	51,733	51,768	51,803	51,838	51,873	51,908	51,943	51,979	52,014
1290	52,049	52,084	52,119	52,154	52,189	52,224	52,259	52,294	52,329	52,364
1300	52,398	52,433	52,468	52,503	52,538	52,573	52,608	52,642	52,677	52,712

11.1.7 Characteristic curves for the temperature sensor TC Typ L (Fe-CuNi)

For the RMC5xx is the mesuring range from -100°C…900°C.

°C	0	1	2	3	4	5	6	7	8	9
-100	-4,750	-4,710	-4,660	-4,620	-4,580	-4,540	-4,500	-4,450	-4,410	-4,370
-90	-4,330	-4,280	-4,240	-4,200	-4,150	-4,110	-4,060	-4,020	-3,980	-3,930
-80	-3,890	-3,840	-3,800	-3,750	-3,710	-3,660	-3,620	-3,570	-3,530	-3,480
-70	-3,440	-3,390	-3,350	-3,300	-3,250	-3,210	-3,160	-3,120	-3,070	-3,020
-60	-2,980	-2,930	-2,880	-2,840	-2,790	-2,740	-2,700	-2,650	-2,600	-2,560
-50	-2,510	-2,460	-2,410	-2,360	-2,320	-2,270	-2,220	-2,170	-2,120	-2,080
-40	-2,030	-1,980	-1,930	-1,880	-1,830	-1,780	-1,730	-1,680	-1,630	-1,580
-30	-1,530	-1,480	-1,430	-1,380	-1,320	-1,270	-1,220	-1,170	-1,120	-1,070
-20	-1,020	-0,970	-0,920	-0,870	-0,810	-0,760	-0,710	-0,660	-0,610	-0,560
-10	-0,510	-0,460	-0,410	-0,360	-0,310	-0,250	-0,200	-0,150	-0,100	-0,050
0	0,000	0,050	0,100	0,160	0,210	0,260	0,310	0,360	0,420	0,470
10	0,520	0,570	0,630	0,680	0,730	0,780	0,840	0,890	0,940	1,000
20	1,050	1,100	1,160	1,210	1,260	1,310	1,370	1,420	1,470	1,530
30	1,580	1,630	1,690	1,740	1,790	1,840	1,900	1,950	2,000	2,060
40	2,110	2,160	2,220	2,270	2,330	2,380	2,430	2,490	2,540	2,600
50	2,650	2,700	2,760	2,810	2,870	2,920	2,970	3,030	3,080	3,140
60	3,190	3,240	3,300	3,350	3,410	3,460	3,510	3,570	3,620	3,680
70	3,730	3,780	3,840	3,890	3,950	4,000	4,050	4,110	4,160	4,220
80	4,270	4,320	4,380	4,430	4,490	4,540	4,600	4,650	4,710	4,770
90	4,820	4,870	4,930	4,980	5,040	5,090	5,150	5,200	5,260	5,320
100	5,370	5,420	5,480	5,530	5,590	5,640	5,700	5,750	5,810	5,870
110	5,920	5,970	6,030	6,080	6,140	6,190	6,250	6,300	6,360	6,420
120	6,470	6,530	6,580	6,640	6,690	6,750	6,810	6,860	6,920	6,970
130	7,030	7,090	7,140	7,200	7,250	7,310	7,370	7,420	7,480	7,530
140	7,590	7,650	7,700	7,760	7,810	7,870	7,930	7,980	8,040	8,090
150	8,150	8,210	8,260	8,320	8,370	8,430	8,490	8,540	8,600	8,650
160	8,710	8,770	8,820	8,880	8,930	8,990	9,050	9,100	9,160	9,210
170	9,270	9,330	9,380	9,440	9,490	9,550	9,610	9,660	9,720	9,770
180	9,830	9,890	9,940	10,000	10,050	10,110	10,170	10,220	10,280	10,330
190	10,390	10,450	10,500	10,560	10,631	10,670	10,730	10,780	10,840	10,890
200	10,950	11,010	11,060	11,120	11,170	11,230	11,290	11,340	11,400	11,450
210	11,510	11,570	11,620	11,680	11,730	11,790	11,850	11,900	11,960	12,010
220	12,070	12,130	12,180	12,240	12,290	12,350	12,410	12,460	12,520	12,570
230	12,630	12,690	12,740	12,800	12,850	12,910	12,970	13,020	13,080	13,130
240	13,190	13,250	13,300	13,360	13,410	13,470	13,530	13,580	13,640	13,690
250	13,750	13,810	13,860	13,920	13,970	14,030	14,090	14,140	14,200	14,250
260	14,310	14,370	14,420	14,480	14,540	14,590	14,650	14,710	14,760	14,820
270	14,880	14,940	14,990	15,050	15,100	15,160	15,220	15,270	15,330	15,380
280	15,440	15,500	15,550	15,610	15,660	15,720	15,780	15,830	15,890	15,940
290	16,000	16,060	16,110	16,170	16,220	16,280	16,340	16,390	16,450	16,500
300	16,560	16,620	16,670	16,730	16,780	16,840	16,900	16,950	17,010	17,060
310	17,120	17,180	17,230	17,290	17,340	17,400	17,460	17,510	17,570	17,620
320	17,680	17,740	17,790	17,850	17,900	17,960	18,020	18,070	18,130	18,180
330	18,240	18,300	18,350	18,410	18,460	18,520	18,580	18,630	18,690	18,740
340	18,800	18,860	18,910	18,970	19,020	19,085	19,140	19,190	19,250	19,300
350	19,360	19,420	19,470	19,530	19,580	19,640	19,700	19,750	19,810	19,850
360	19,920	19,980	20,030	20,090	20,140	20,200	20,260	20,310	20,370	20,420
370	20,480	20,540	20,590	20,650	20,700	20,760	20,820	20,870	20,930	20,980
380	21,040	21,100	21,150	21,210	21,260	21,320	21,380	21,430	21,490	21,540
390	21,600	21,660	21,710	21,770	21,820	21,880	21,940	21,990	22,050	22,100
400	22,160	22,220	22,270	22,330	22,380	22,440	22,500	22,550	22,610	22,660
410	22,720	22,780	22,830	22,890	22,950	23,000	23,060	23,120	23,180	23,230
420	23,290	23,350	23,400	23,460	23,520	23,570	23,630	23,690	23,740	23,800
430	23,860	23,920	23,970	24,030	24,090	24,140	24,200	24,260	24,320	24,370
440	24,430	24,490	24,540	24,600	24,660	24,710	24,770	24,830	24,890	24,940
450	25,000	25,060	25,110	25,170	25,230	25,280	25,340	25,400	25,460	25,510
460	25,570	25,630	25,680	25,740	25,800	25,850	25,910	25,970	26,030	26,080
470	26,170	26,200	26,250	26,310	26,370	26,420	26,480	26,540	26,600	26,650
480	26,710	26,770	26,820	26,880	26,940	26,990	27,050	27,110	27,170	27,220
490	27,280	27,340	27,390	27,450	27,510	27,560	27,620	27,680	27,740	27,790

°C	0	1	2	3	4	5	6	7	8	9
500	27,850	27,910	27,970	28,020	28,080	28,140	28,200	28,260	28,310	28,370
510	28,430	28,490	28,550	28,600	28,660	28,720	28,780	28,840	28,890	28,950
520	29,010	29,070	29,130	29,180	29,240	29,300	29,360	29,420	29,470	29,530
530	29,590	29,650	29,710	29,760	29,820	29,880	29,940	30,000	30,050	30,110
540	30,170	30,230	30,290	30,340	30,400	30,460	30,520	30,580	30,630	30,690
550	30,750	30,810	30,870	30,920	30,980	31,040	31,100	31,160	31,210	31,270
560	31,330	31,390	31,450	31,500	31,560	31,620	31,680	31,740	31,790	31,850
570	31,910	31,970	32,030	32,080	32,140	32,200	32,260	32,320	32,370	32,430
580	32,490	32,550	32,610	32,660	32,720	32,780	32,840	32,900	32,960	33,020
590	33,080	33,140	33,200	33,260	33,320	33,380	33,430	33,490	33,550	33,610
600	33,670	33,730	33,790	33,850	33,910	33,970	34,020	34,080	34,140	34,200
610	34,260	34,320	34,380	34,440	34,500	34,560	34,610	34,670	37,730	34,790
620	34,850	34,910	34,970	35,030	35,090	35,150	35,200	35,260	35,320	35,380
630	35,440	35,500	35,560	35,620	35,680	35,740	35,800	35,860	35,920	35,980
640	36,040	36,100	36,160	36,220	36,280	36,340	36,400	36,460	36,520	36,580
650	36,640	36,700	36,760	36,820	36,880	36,950	37,010	37,070	37,130	37,190
660	37,250	37,300	37,360	37,420	37,480	37,550	37,610	37,670	37,730	37,790
670	37,850	37,910	37,970	38,040	38,100	38,160	38,220	38,280	38,350	38,410
680	38,470	38,530	38,590	38,660	38,720	38,780	38,840	38,900	38,970	39,030
690	39,090	39,150	39,220	39,280	39,340	39,410	39,470	39,530	39,590	39,660
700	39,720	39,780	39,850	39,910	39,970	40,040	40,100	40,160	40,220	40,290
710	40,350	40,410	40,480	40,540	40,600	40,670	40,730	40,800	40,860	40,930
720	40,980	41,040	41,110	41,170	41,230	41,300	41,360	41,430	41,490	41,560
730	41,620	41,690	41,750	41,820	41,880	41,950	42,010	42,080	42,140	42,210
740	42,270	42,340	42,400	42,470	42,530	42,600	42,660	42,730	42,790	42,860
750	42,920	42,990	43,050	43,120	43,180	43,250	43,310	43,380	43,440	43,510
760	43,570	43,640	43,700	43,770	43,830	43,900	43,970	44,030	44,100	44,160
770	44,230	44,300	44,360	44,430	44,490	44,560	44,630	44,690	44,760	44,820
780	44,890	44,960	45,020	45,090	45,150	45,220	45,290	45,350	45,420	45,480
790	45,550	45,620	45,680	45,750	45,820	45,890	45,950	46,020	46,090	46,150
800	46,220	46,290	46,350	46,420	46,490	46,560	46,620	46,690	46,760	46,820
810	46,890	46,960	47,030	47,090	47,160	47,230	47,300	47,370	47,430	47,500
820	47,570	47,640	47,710	47,770	47,840	47,910	47,980	48,050	48,110	48,180
830	48,250	48,320	48,390	48,460	48,530	48,600	48,660	48,730	48,800	48,870
840	48,940	49,010	49,080	49,150	49,220	49,290	49,350	49,420	49,490	49,560
850	49,630	49,700	49,770	49,840	49,910	49,980	50,040	50,110	50,180	50,250
860	50,320	50,390	50,460	50,530	50,600	50,670	50,740	50,810	50,880	50,950
870	51,020	51,090	51,160	51,230	51,300	51,370	51,440	51,510	51,580	51,650
880	51,720	51,790	51,860	51,930	52,000	52,080	52,150	52,220	52,290	52,360
890	52,430	52,500	52,570	52,640	52,710	52,790	52,860	52,930	53,000	53,070
900	53,140									

11.1.8 Characteristic curves for the temperature sensor TC Typ S (Pt-RhPt)

For the RMC5xx is the mesuring range from 0°C…1600°C.

°C	0	1	2	3	4	5	6	7	8	9
0	0,000	0,005	0,011	0,016	0,022	0,027	0,033	0,038	0,044	0,050
10	0,055	0,061	0,067	0,072	0,078	0,084	0,090	0,095	0,101	0,107
20	0,113	0,119	0,125	0,131	0,137	0,143	0,149	0,155	0,161	0,167
30	0,173	0,179	0,185	0,191	0,197	0,204	0,210	0,216	0,222	0,229
40	0,235	0,241	0,248	0,254	0,260	0,267	0,273	0,280	0,286	0,292
50	0,299	0,305	0,312	0,319	0,325	0,332	0,338	0,345	0,352	0,358
60	0,365	0,372	0,378	0,385	0,392	0,399	0,405	0,412	0,419	0,426
70	0,433	0,440	0,446	0,453	0,460	0,467	0,474	0,481	0,488	0,495
80	0,502	0,509	0,516	0,523	0,530	0,538	0,545	0,552	0,559	0,566
90	0,573	0,580	0,588	0,595	0,602	0,609	0,617	0,624	0,631	0,639
100	0,646	0,653	0,661	0,668	0,675	0,683	0,690	0,698	0,705	0,713
110	0,720	0,727	0,735	0,743	0,750	0,758	0,765	0,773	0,780	0,788
120	0,795	0,803	0,811	0,818	0,826	0,834	0,841	0,849	0,857	0,865
130	0,872	0,880	0,888	0,896	0,903	0,911	0,919	0,927	0,935	0,942
140	0,950	0,958	0,966	0,974	0,982	0,990	0,998	1,006	1,013	1,021
150	1,029	1,037	1,045	1,053	1,061	1,069	1,077	1,085	1,094	1,102
160	1,110	1,118	1,126	1,134	1,142	1,150	1,158	1,167	1,175	1,183
170	1,191	1,199	1,207	1,216	1,224	1,232	1,240	1,249	1,257	1,265
180	1,273	1,282	1,290	1,298	1,307	1,315	1,323	1,332	1,340	1,348
190	1,357	1,365	1,373	1,382	1,390	1,399	1,407	1,415	1,424	1,432
200	1,441	1,449	1,458	1,466	1,475	1,483	1,492	1,500	1,509	1,517
210	1,526	1,534	1,543	1,551	1,560	1,569	1,577	1,586	1,594	1,603
220	1,612	1,620	1,629	1,638	1,646	1,655	1,663	1,672	1,681	1,690
230	1,698	1,707	1,716	1,724	1,733	1,742	1,751	1,759	1,768	1,777
240	1,786	1,794	1,803	1,812	1,821	1,829	1,838	1,847	1,856	1,865
250	1,874	1,882	1,891	1,900	1,909	1,918	1,927	1,936	1,944	1,953
260	1,962	1,971	1,980	1,989	1,998	2,007	2,016	2,025	2,034	2,043
270	2,052	2,061	2,070	2,078	2,087	2,096	2,105	2,114	2,123	2,132
280	2,141	2,151	2,160	2,169	2,178	2,187	2,196	2,205	2,214	2,223
290	2,232	2,241	2,250	2,259	2,268	2,277	2,287	2,296	2,305	2,314
300	2,323	2,332	2,341	2,350	2,360	2,369	2,378	2,387	2,396	2,405
310	2,415	2,424	2,433	2,442	2,451	2,461	2,470	2,479	2,488	2,497
320	2,507	2,516	2,525	2,534	2,544	2,553	2,562	2,571	2,581	2,590
330	2,599	2,609	2,618	2,627	2,636	2,646	2,655	2,664	2,674	2,683
340	2,692	2,702	2,711	2,720	2,730	2,739	2,748	2,758	2,767	2,776
350	2,786	2,795	2,805	2,814	2,823	2,833	2,842	2,851	2,861	2,870
360	2,880	2,889	2,899	2,908	2,917	2,927	2,936	2,946	2,955	2,965
370	2,974	2,983	2,993	3,002	3,012	3,021	3,031	3,040	3,050	3,059
380	3,069	3,078	3,088	3,097	3,107	3,116	3,126	3,135	3,145	3,154
390	3,164	3,173	3,183	3,192	3,202	3,212	3,221	3,231	3,240	3,250
400	3,259	3,269	3,279	3,288	3,298	3,307	3,317	3,326	3,336	3,346
410	3,355	3,365	3,374	3,384	3,394	3,403	3,413	3,423	3,432	3,442
420	3,451	3,461	3,471	3,480	3,490	3,500	3,509	3,519	3,529	3,538
430	3,548	3,558	3,567	3,577	3,587	3,596	3,606	3,616	3,626	3,635
440	3,645	3,655	3,664	3,674	3,684	3,694	3,703	3,713	3,723	3,732
450	3,742	3,752	3,762	3,771	3,781	3,791	3,801	3,810	3,820	3,830
460	3,840	3,850	3,859	3,869	3,879	3,889	3,898	3,908	3,918	3,928
470	3,938	3,947	3,957	3,967	3,977	3,987	3,997	4,006	4,016	4,026
480	4,036	4,046	4,056	4,065	4,075	4,085	4,095	4,105	4,115	4,125
490	4,134	4,144	4,154	4,164	4,174	4,184	4,194	4,204	4,213	4,223
500	4,233	4,243	4,253	4,263	4,273	4,283	4,293	4,303	4,313	4,323
510	4,332	4,342	4,352	4,362	4,372	4,382	4,392	4,402	4,412	4,422
520	4,432	4,442	4,452	4,462	4,472	4,482	4,492	4,502	4,512	4,522
530	4,532	4,542	4,552	4,562	4,572	4,582	4,592	4,602	4,612	4,622
540	4,632	4,642	4,652	4,662	4,672	4,682	4,692	4,702	4,712	4,722
550	4,732	4,742	4,752	4,762	4,772	4,782	4,793	4,803	4,813	4,823
560	4,833	4,843	4,853	4,863	4,873	4,883	4,893	4,904	4,914	4,924
570	4,934	4,944	4,954	4,964	4,974	4,984	4,995	5,005	5,015	5,025
580	5,035	5,045	5,055	5,066	5,076	5,086	5,096	5,106	5,116	5,127
590	5,137	5,147	5,157	5,167	5,178	5,188	5,198	5,208	5,218	5,228
600	5,239	5,249	5,259	5,269	5,280	5,290	5,300	5,310	5,320	5,331
610	5,341	5,351	5,361	5,372	5,382	5,392	5,402	5,413	5,423	5,433
620	5,443	5,454	5,464	5,474	5,485	5,495	5,505	5,515	5,526	5,536
630	5,546	5,557	5,567	5,577	5,588	5,598	5,608	5,618	5,629	5,639
640	5,649	5,660	5,670	5,680	5,691	5,701	5,712	5,722	5,732	5,743
650	5,753	5,763	5,774	5,784	5,794	5,805	5,815	5,826	5,836	5,846

°C	0	1	2	3	4	5	6	7	8	9
660	5,857	5,867	5,878	5,888	5,898	5,909	5,919	5,930	5,940	5,950
670	5,961	5,971	5,982	5,992	6,003	6,013	6,024	6,034	6,044	6,055
680	6,065	6,076	6,086	6,097	6,107	6,118	6,128	6,139	6,149	6,160
690	6,170	6,181	6,191	6,202	6,212	6,223	6,233	6,244	6,254	6,265
700	6,275	6,286	6,296	6,307	6,317	6,328	6,338	6,349	6,360	6,370
710	6,381	6,391	6,402	6,412	6,423	6,434	6,444	6,455	6,465	6,476
720	6,486	6,497	6,508	6,518	6,529	6,539	6,550	6,561	6,571	6,582
730	6,593	6,603	6,614	6,624	6,635	6,646	6,656	6,667	6,678	6,688
740	6,699	6,710	6,720	6,731	6,742	6,752	6,763	6,774	6,784	6,795
750	6,806	6,817	6,827	6,838	6,849	6,859	6,870	6,881	6,892	6,902
760	6,913	6,924	6,934	6,945	6,956	6,967	6,977	6,988	6,999	7,010
770	7,020	7,031	7,042	7,053	7,064	7,074	7,085	7,096	7,107	7,117
780	7,128	7,139	7,150	7,161	7,172	7,182	7,193	7,204	7,215	7,226
790	7,236	7,247	7,258	7,269	7,280	7,291	7,302	7,312	7,323	7,334
800	7,345	7,356	7,367	7,378	7,388	7,399	7,410	7,421	7,432	7,443
810	7,454	7,465	7,476	7,487	7,497	7,508	7,519	7,530	7,541	7,552
820	7,563	7,574	7,585	7,596	7,607	7,618	7,629	7,640	7,651	7,662
830	7,673	7,684	7,695	7,706	7,717	7,728	7,739	7,750	7,761	7,772
840	7,783	7,794	7,805	7,816	7,827	7,838	7,849	7,860	7,871	7,882
850	7,893	7,904	7,915	7,926	7,937	7,948	7,959	7,970	7,981	7,992
860	8,003	8,014	8,026	8,037	8,048	8,059	8,070	8,081	8,092	8,103
870	8,114	8,125	8,137	8,148	8,159	8,170	8,181	8,192	8,203	8,214
880	8,226	8,237	8,248	8,259	8,270	8,281	8,293	8,304	8,315	8,326
890	8,337	8,348	8,360	8,371	8,382	8,393	8,404	8,416	8,427	8,438
900	8,449	8,460	8,472	8,483	8,494	8,505	8,517	8,528	8,539	8,550
910	8,562	8,573	8,584	8,595	8,607	8,618	8,629	8,640	8,652	8,663
920	8,674	8,685	8,697	8,708	8,719	8,731	8,742	8,753	8,765	8,776
930	8,787	8,798	8,810	8,821	8,832	8,844	8,855	8,866	8,878	8,889
940	8,900	8,912	8,923	8,935	8,946	8,957	8,969	8,980	8,991	9,003
950	9,014	9,025	9,037	9,048	9,060	9,071	9,082	9,094	9,105	9,117
960	9,128	9,139	9,151	9,162	9,174	9,185	9,197	9,208	9,219	9,231
970	9,242	9,254	9,265	9,277	9,288	9,300	9,311	9,323	9,334	9,345
980	9,357	9,368	9,380	9,391	9,403	9,414	9,426	9,437	9,449	9,460
990	9,472	9,483	9,495	9,506	9,518	9,529	9,541	9,552	9,564	9,576
1000	9,587	9,599	9,610	9,622	9,633	9,645	9,656	9,668	9,680	9,691
1010	9,703	9,714	9,726	9,737	9,749	9,761	9,772	9,784	9,795	9,807
1020	9,819	9,830	9,842	9,853	9,865	9,877	9,888	9,900	9,911	9,923
1030	9,935	9,946	9,958	9,970	9,981	9,993	10,005	10,016	10,028	10,040
1040	10,051	10,063	10,075	10,086	10,098	10,110	10,121	10,133	10,145	10,156
1050	10,168	10,180	10,191	10,203	10,215	10,227	10,238	10,250	10,262	10,273
1060	10,285	10,297	10,309	10,320	10,332	10,344	10,356	10,367	10,379	10,391
1070	10,403	10,414	10,426	10,438	10,450	10,461	10,473	10,485	10,497	10,509
1080	10,520	10,532	10,544	10,556	10,567	10,579	10,591	10,603	10,615	10,626
1090	10,638	10,650	10,662	10,674	10,686	10,697	10,709	10,721	10,733	10,745
1100	10,757	10,768	10,780	10,792	10,804	10,816	10,828	10,839	10,851	10,863
1110	10,875	10,887	10,899	10,911	10,922	10,934	10,946	10,958	10,970	10,982
1120	10,994	11,006	11,017	11,029	11,041	11,053	11,065	11,077	11,089	11,101
1130	11,113	11,125	11,136	11,148	11,160	11,172	11,184	11,196	11,208	11,220
1140	11,232	11,244	11,256	11,268	11,280	11,291	11,303	11,315	11,327	11,339
1150	11,351	11,363	11,375	11,387	11,399	11,411	11,423	11,435	11,447	11,459
1160	11,471	11,483	11,495	11,507	11,519	11,531	11,542	11,554	11,566	11,578
1170	11,590	11,602	11,614	11,626	11,638	11,650	11,662	11,674	11,686	11,698
1180	11,710	11,722	11,734	11,746	11,758	11,770	11,782	11,794	11,806	11,818
1190	11,830	11,842	11,854	11,866	11,878	11,890	11,902	11,914	11,926	11,939
1200	11,951	11,963	11,975	11,987	11,999	12,011	12,023	12,035	12,047	12,059
1210	12,071	12,083	12,095	12,107	12,119	12,131	12,143	12,155	12,167	12,179
1220	12,191	12,203	12,216	12,228	12,240	12,252	12,264	12,276	12,288	12,300
1230	12,312	12,324	12,336	12,348	12,360	12,372	12,384	12,397	12,409	12,421
1240	12,433	12,445	12,457	12,469	12,481	12,493	12,505	12,517	12,529	12,542
1250	12,554	12,566	12,578	12,590	12,602	12,614	12,626	12,638	12,650	12,662
1260	12,675	12,687	12,699	12,711	12,723	12,735	12,747	12,759	12,771	12,783
1270	12,796	12,808	12,820	12,832	12,844	12,856	12,868	12,880	12,892	12,905
1280	12,917	12,929	12,941	12,953	12,965	12,977	12,989	13,001	13,014	13,026
1290	13,038	13,050	13,062	13,074	13,086	13,098	13,111	13,123	13,135	13,147
1300	13,159	13,171	13,183	13,195	13,208	13,220	13,232	13,244	13,256	13,268
1310	13,280	13,292	13,305	13,317	13,329	13,341	13,353	13,365	13,377	13,390
1320	13,402	13,414	13,426	13,438	13,450	13,462	13,474	13,487	13,499	13,511
1330	13,523	13,535	13,547	13,559	13,572	13,584	13,596	13,608	13,620	13,632
1340	13,644	13,657	13,669	13,681	13,693	13,705	13,717	13,729	13,742	13,754
1350	13,766	13,778	13,790	13,802	13,814	13,826	13,839	13,851	13,863	13,875

°C	0	1	2	3	4	5	6	7	8	9
1360	13,887	13,899	13,911	13,924	13,936	13,948	13,960	13,972	13,984	13,996
1370	14,009	14,021	14,033	14,045	14,057	14,069	14,081	14,094	14,106	14,118
1380	14,130	14,142	14,154	14,166	14,178	14,191	14,203	14,215	14,227	14,239
1390	14,251	14,263	14,276	14,288	14,300	14,312	14,324	14,336	14,348	14,360
1400	14,373	14,385	14,397	14,409	14,421	14,433	14,445	14,457	14,470	14,482
1410	14,494	14,506	14,518	14,530	14,542	14,554	14,567	14,579	14,591	14,603
1420	14,615	14,627	14,639	14,651	14,664	14,676	14,688	14,700	14,712	14,724
1430	14,736	14,748	14,760	14,773	14,785	14,797	14,809	14,821	14,833	14,845
1440	14,857	14,869	14,881	14,894	14,906	14,918	14,930	14,942	14,954	14,966
1450	14,978	14,990	15,002	15,015	15,027	15,039	15,051	15,063	15,075	15,087
1460	15,099	15,111	15,123	15,135	15,148	15,160	15,172	15,184	15,196	15,208
1470	15,220	15,232	15,244	15,256	15,268	15,280	15,292	15,304	15,317	15,329
1480	15,341	15,353	15,365	15,377	15,389	15,401	15,413	15,425	15,437	15,449
1490	15,461	15,473	15,485	15,497	15,509	15,521	15,534	15,546	15,558	15,570
1500	15,582	15,594	15,606	15,618	15,630	15,642	15,654	15,666	15,678	15,690
1510	15,702	15,714	15,726	15,738	15,750	15,762	15,774	15,786	15,798	15,810
1520	15,822	15,834	15,846	15,858	15,870	15,882	15,894	15,906	15,918	15,930
1530	15,942	15,954	15,966	15,978	15,990	16,002	16,014	16,026	16,038	16,050
1540	16,062	16,074	16,086	16,098	16,110	16,122	16,134	16,146	16,158	16,170
1550	16,182	16,194	16,205	16,217	16,229	16,241	16,253	16,265	16,277	16,289
1560	16,301	16,313	16,325	16,337	16,349	16,361	16,373	16,385	16,396	16,408
1570	16,420	16,432	16,444	16,456	16,468	16,480	16,492	16,504	16,516	16,527
1580	16,539	16,551	16,563	16,575	16,587	16,599	16,611	16,623	16,634	16,646
1590	16,658	16,670	16,682	16,694	16,706	16,718	16,729	16,741	16,753	16,765
1600	16,777	16,789	16,801	16,812	16,824	16,836	16,848	16,860	16,872	16,883