7.7 *Manufacturer Specific Objects, 0x5000 range*

0x5000 **Error_Reset**

Value	=	errors to clear (bit masked)
Type	=	i16 / rw
Default	=	0x0000
EEP	=	no
PDO	=	yes

This objects serves to reset certain error states. To reset a certain error, the particular bit has to be reset.

Bit	error state to be reset
0	digital input modules
1	digital output modules
2	analog input modules
3	analog output modules
4	-
5	-
6	-
7	-
8	faulty linearization table in EEPROM
9	EEPROM recently replaced or defect
10	EEPROM can not be written correct
11	EEPROM can not be read correct
12	CANopen can not be initialized correct
13	application error
14	IDs of slots are not clearly recognized
15	a new module configuration has been detected

Hint:

With object 0x5000 Error_Reset (ui16) the error bits of the ‘Additional Information’ can be reset. This is recommended, if an certain error is indicated through the particular status-objects and the device operates correct again. A recognized error is typically not reset by the device itself.

Writing the value 0xFFFF to object 0x5000|0x00 all error bits are reset, also recognized CAN bus communication errors are part of this.

0x5001 Alarm_Output

Value= mask to set the alarm output (RM 201)
Type = i16 / rw
Default = 0x0000
EEP = yes
PDO = no

This object determines, which errors should set the alarm output of the fieldbus coupler RM 201

Bit	Error type to activate the alarm relay
0	fault in digital input modules
1	fault in digital output modules
2	fault in analog input modules
3	fault in analog output modules
4	CAN bus error (Bus-Off)
5	CAN bus error (Life-Guarding)
6	CAN bus error (NMT-Error)
7	CAN transmission disturbed (incl. all messages)
8	faulty linearization table in EEPROM
9	EEPROM recently replaced or defect (*)
10	EEPROM can not be written correct
11	EEPROM can not be read correct
12	CANopen can not be initialized correct
13	application error
14	IDs of slots are not clearly recognized
15	a new module configuration has been detected (*)

Hint:

If the cause of trouble was identified and repaired, the particular error flag should be cleared by writing to the object 0x5000 Error_Reset. The alarm relay can be deactivated only by clearing the corresponding error flags. This is particular true for CAN bus interferences. To clear the error flags triggered by CAN bus errors, the object 0x5000 has to be written with the value 0xFFFF.

(*)
Bit 9 and Bit 15 have no significance, because in this cases the EEPROM is rewritten with the default values. The alarm-output-mask is also rewritten with the default value 0x0000, then.

0x5002 Slot_IDs[9]

Value	=	present device configuration identified via module-IDs
Type	=	ui8 / ro
Default	=	none
EEP	=	no
PDO	=	no

Every in/output-module has a definite module-ID. The subindexes 1 to 9 correspond with the plug-in positions 1 to 9. By read-out of the e.g. subindex 4 the actual utilized module type in position 4 is detected. Plug-in position 1 is the first in/output module slot next to the fieldbus coupler.

ID	I/O-Modules
0x00	no I/O module plugged
0x01	RM 251 / digital output, 24 V DC, 8 channel
0x02	RM 241 / digital input, sensor, 4 channel
0x04	RM 221-0 / analog input, standard, 4 channel, 12 bit, galvanic isolation, 4 x I
0x44	RM 221-1 / analog input, standard, 4 channel, 12 bit, galvanic isolation, 4 x U
0x84	RM 221-2 / analog input, standard, 4 channel, 12 bit, galvanic isolation, 2 x I; 2 x U
0x05	RM 231-0 / analog output, standard, 4 channel, 12 bit, spec. A: 4 x I; 4 x 0/10 V
0x45	RM 231-2 / analog output, standard, 4 channel, 12 bit, spec. C: 4 x I; 4 x -10/10 V
0x85	RM 231-1 / ana. output, stand., 4 ch., 12 bit, spec. B, 4 x I; 2 x 0/10 V; 2 x -10/10 V
0x06	RM 242 / digital input, 24 VDC, 8 channel
0x07	RM 252 / digital output, relay, 4 channel, change-over contact
0x08	RM 224-1 / analog input, temperature, 4 channel, 16 bit, full range
0x09	RM 243 / digital input, 230 V AC, 4 channel
0x0B	RM 222-0 / analog input, standard, 4 channel, 12 bit, with transducer supply, 4 x I
0x4B	RM 222-1 / analog input, standard, 4 channel, 12 bit, w. tr. sup., potentiometer, 4 x U
0x8B	RM 222-2 / analog input, standard, 4 channel, 12 bit, w. tr. sup. , pot., 2 x I and 2 x U
0x0E	RM 224-0 / analog input, T/C, 2 channel, galvanic isolation, 16 bit, full range
0x0F ...0x1B	Customer specific

8 Emergency Messages

8.1 *Start-Up Messages*

The modular I/O system RM 200 generates the appropriate error message for different error states. The transmission of an emergency message is possible in the ‘operational’ as well as in the ‘pre-operational’ mode. The device transmits the emergency message always with the identifier 0x080 + Node-ID. The error register, index 0x1001, subindex 0x00 contains always the latest error state. The Predefined Error Field, index 0x1003, subindex 0x00...0x0A contains the last 10 error states.

At start-up of the device the first emergency message is generated. If the device operates correct and the configuration has not changed the following emergency message is transmitted:

Identifier	1. Byte	2. Byte	3.Byte
0x80 + Node-ID	0x00	0x00	0x00

If the device configuration has changed, but operates correct, following emergency message is transmitted:

Identifier	1. Byte	2. Byte	3. Byte	4. Byte	5. Byte
0x80 + Node-ID	0x10	0x00	0x01	0x80	0x00

☞ Due to this event new default values are calculated and stored in the EEPROM of the RM 201. Attention: the former EEPROM data get overwritten.

8.2 *Meaning of Individual Bytes*

With an emergency message up to maximal 5 data bytes are sent. The bytes have the following meaning:

1. Byte: Error Code, high Byte
2. Byte: Error Code, low Byte
3. Byte: Error Register, Object 0x1001, see DS301, chapter 10.3
4. Byte: Additional Information 1 (high Byte) = ‘CPU’
5. Byte: Additional Information 2 (low Byte) = ‘Module’

Error Code:

0x0000: No Error
0x1000: Generic Error

Error Register:

Bit	Meaning
0	generic error
1	current
2	voltage
3	temperature
4	communication error
5	device profile specific
6	reserved
7	manufacturer specific

Additional Information 1 (CPU)

Bit	Meaning
0	faulty linearization table in EEPROM
1	EEPROM recently replaced or defect
2	EEPROM can not be written correct
3	EEPROM can not be read correct
4	CANopen can not be initialized correct
5	application error (data from EEPROM not suitable
6	IDs of slots are not clearly recognized
7	a new module configuration has been detected

Additional Information 2 (I/O-Module)

Bit	Meaning
0	Error occurred in digital input modules
1	Error occurred in digital output modules
2	Error occurred in analog input modules
3	Error occurred in analog output modules
4	Life-Guarding-Time-Out
5	
6	
7	

The object 0x1001 ‘Error Register’ always contains the latest occurred error.
To enable a closer investigation, the last 10 error states are saved in object 0x1003 ‘Predefined Error Field’. The latest error takes the highest position in the error register(Subindex 0x01). The ‘Predefined Error Field’ (32 bit value) has the following structure:
Example: An ul32 value of 0x12131415 in the Predefined-Error-Field means:
1. 12 = Additional Information 1 (high Byte) (CPU)
2. 13 = Additional Information 2 (low Byte) (Module)
3. 14 = Error Code, high Byte
4. 15 = Error Code, low Byte

8.3 *Reset of Error-Messages*

Via the object 0x5000 Error_Reset (ui16) the error bits of the ‘Additional Information’ can be cleared. This is recommended, if an certain error is indicated by the particular status-objects and the device operates correct again.

Writing the value 0xFFFF to object 0x5000|0x00 all error bits are cleared, also recognized CAN bus communication errors are included. CAN bus errors are only to be cleared together with all other errors through writing the value 0xFFFF to the object 0x5000.

For more informations see the description of the objects 0x5000 and 0x5001.

9 PDO-processing

9.1 *General*

All objects of the modular I/O system with the CANopen field bus coupler RM 201 can be addressed directly via an SDO data channel. This way any object can be read out and overwritten in the case of read/write entries. However, in general, communication via SDOs is used only for setting the parameters of the device. For example SDOs can be used to set the required temperature sensors for an analog input module RM 224-1. After the parameterization phase of the device, the process values of the decentral unit are of greatest importance. However, these process values can be exchanged between the devices far more effectively using PDOs rather than SDOs. To exchange data using PDOs a few presettings must be made. For example a valid identifier must be specified for every PDO. In addition, the relevant data of the decentral unit must be mapped in a PDO, i.e. they must be assigned to a PDO. The objects which can be mapped in such a PDO are identified in the object directory.

9.2 *Default-Mapping*

Every fieldbus node of the RM 200 family can calculate default mapping independently for transmit and receive PDOs. With the calculated default mapping, all analog and digital in/outputs of a module can be addressed via a PDO, and Transmit PDOs can be requested via RTR. This way, extensive (depending on the size of the system) mapping calculations when planning the system, are no longer necessary. Due to this method, the cyclical data exchange required for example for PLCs is facilitated considerably using an RM 200 module, since no point to point connection in the form of an SDO must be made.

A module supports 5 receive and 10 transmit PDOs as standard. Of the 10 transmit PDOs, the first 5 can be requested via RTR.

An analog in/output module has up to 4 channels with a resolution of a maximum of 16 bits per channel. This results in 1 complete PDO with 8 bytes having to be made available for such type of module. Digital modules have a maximum of 8 in/outputs each with 1 bit. To map a digital module 1 byte, i.e. $1/8^{th}$ of a PDO is necessary so.

As the identifier range for PDOs is very limited - one usually assumes a maximum of 2 transmit and 2 receive PDOs - the following compromise must be made when calculating a default-mappping. The possible number of CANopen nodes should be reduced to 42. All CANopen nodes must have a node ID between 1 and 42.

Receive PDO-Identifier:

PDO1:	0x0200 (512)	+ Node-ID	(typically = digital outputs)
PDO2:	0x0300 (768)	+ Node-ID	(typically = analog outputs)
PDO3:	0x022A (554)	+ Node-ID	
PDO4:	0x032A (810)	+ Node-ID	
PDO5:	0x0254 (596)	+ Node-ID	
(PDO6:	0x0354 (852)	+ Node-ID)	not used

Transmit PDO-Identifier:

PDO1:	0x0180 (384)	+ Node-ID	(typically = digital inputs)
PDO2:	0x0280 (640)	+ Node-ID	(typically = analog inputs)
PDO3:	0x01AA (426)	+ Node-ID	
PDO4:	0x02AA (682)	+ Node-ID	
PDO5:	0x01D4 (468)	+ Node-ID	
PDO6:	0x02D4 (724)	+ Node-ID	can not be requested per RTC !

Note:
Unused PDOs can be deactivated by setting the MSB (Bit31) of the PDO identifier. When default mapping, unused PDOs are deactivated by means of the MSB of the PDO identifier.

9.2.1 Calculating the Default-Mapping for Receive-PDOs

9.2.1.1 Default-Mapping for Receive-PDOs (only digital outputs)

Fill Receive PDO1 with digital outputs starting from the field bus coupler (always 1 byte entries). When filling, only those slots which contain a digital output module, are taken into consideration. If more than 8 digital output modules have been plugged in, the ninth module is entered into the Receive PDO2

9.2.1.2 Default-Mapping for Receive-PDOs (only analog outputs)

The slots are searched for analog output modules starting from the field bus coupler. For every analog output module, a Receive PDO is set up starting at Receive PDO2. Receive PDO1 is deactivated for digital output. Hence, a PDO contains a maximum of 4 analog output modules each with 16 bit. As not more than 4 analog output modules are permitted, additional analog output modules are not taken into consideration during default mapping.

9.2.1.3 Default-Mapping for Receive-PDOs (digital and analog outputs)

In mixed operation mode, the maximum 8 digital output modules have sufficient space in the Receive-PDO1 (see 9.2.1.1). The analog output modules are mapped as described in 9.2.1.2, starting at the receive PDO2. A maximum total of 4 analog output modules can be taken into consideration in default mapping.

9.2.2 Calculation of the default mapping for transmit PDOs

9.2.2.1 Default mapping for transmit PDOs (only digital inputs)

Like 9.2.1.1 but for digital inputs.

9.2.2.2 Default mapping for transmit PDOs (only analog inputs)

Like 9.2.1.2 but for analog inputs.

With a combination of RM 221-x, RM 222-x, RM 224-1 and RM 224-0 one should bear in mind, that modules RM 224-0 have to be placed right from the modules RM 221-x, RM 222-x repectively RM 224-1. This procedure makes it easier to allocate the analog channels to the particular modules. Please note that the maximal possible number of 16 analog input channels per unit is not exceeded.

If the position of the module RM 221-0 and RM 224-0 are exchanged (slot 4: RM 224-0, slot 5: RM 221-0) then there is no change of the channel sequence. At first the modules with 4 channels are addressed, after that the modules with 2 channels.

9.2.2.3 Default mapping for transmit PDOs (digital and analog inputs)

Like 9.2.1.3 but for digital and analog inputs.

9.2.2.4 Transmit PDO6

The transmit PDO6 can not be requested per RTR. Typically this PDO is used for error diagnostic purpose.

The following default mapping is used:

1. object = 0x5202	uiDO_Module_Error	length = 2 Bytes
2. object = 0x5108	ucAI_Comp_Error	length = 1 Byte
3. object = 0x5107	uiAI_Channel_Error	length = 2 Byte
4. object = 0x5302	uiAO_Channel_Error	length = 2 Byte

If the transmit PDO6 is automatically sent after changes (default), by interpretation of one single PDO the error state of all digital and analog outputs and for all analog inputs is supervised.

9.3 *Transmission types*

The transmission types on sub-index 2 of the respective parameter index (0x1400 ... 0x1404 and 0x1800 ... 0x1809) can be set to a range between 0 and 255. The value 0 to 240 mean which ratio is used between SYNC telegram and PDO message. A 3 means that every 3 SYNC telegrams 1 PDO message is transmitted. A 0 means that the sampled input values are only sent in the case of changes once the SYNC has been received. Values between 1 and 240 mean that the PDO is transmitted once the required number of SYNC messages has been received. The COB-ID of the SYNC message is always specified via the index 0x1005. The values 241 to 251 are reserved. Types 252 and 253 are only intended for remote objects. In the case of type 252, the data is updated when the SYNC has been received, but it is not transmitted; in the case of 253 the data is updated when the remote request has been received. Types 254 and 255 stand for asynchronous PDOs, i.e. a PDO is transmitted as soon as at least one mapped value has changed.

PDO - Transmission Types						
Type No.		**cyclic**	**acyclic**	**synchronous**	**asynchronous**	**RTR only**
0			x	x		
1-240	(1)	x		x		
241-251				reserved		
252	(2)			x		x
253	(3)				x	x
254	(4)				x	
255	(5)				x	

(1) the type indicates the number of SYNC objects between two PDO transmissions
(2) data is updated (but not sent) immediately after reception of the SYNC
(3) data is updated at the reception of the RTR
(4) application event is device-specific
(5) application event is defined in the device profile

10 CAN Glossary

CAN ‘Controller Area Network’

CAN is a serial bus system which origins from the automobile industry. The signals are transmitted via twisted-pair wires. The noise immunity of CAN networks is especially high thanks to a number of provisions which have been taken e.g. CRC-Checks, use of differential signals, etc. CAN describes the physical bus concept incl. data link layer. The application layer, i.e. the protocol which is used is not described by CAN. Therefor one has to distinguish between CAN (physical bus) and CANopen (protocol, application layer).

CAL ‘CAN Application Layer’

CAL describes a collection of communication services. CAL specifies the application layer and not the physical bus like CAN. An exact description of CAL specifications can be found in the Draft Standards CiA DS 201...207. CAL is the basic concept for CANopen, but is useable without the CANopen-specification. A CAL device only needs to support the services it actually requires. Therefore the software of a CAL node may be simpler than of a CANopen-node. It has to be noticed that different manufacturers implement different services in their devices.

CANopen

CANopen describes the standardized use of communication services and establishes a communication profil. With CANopen, devices of different manufacturers can be used in one CAN network. Differences may be found in the number of supported communication objects. In contrast to PROFIBUS-DP, CANopen provides the advantage of real multi-master-capability.

CiA ‘CAN in Automation‘

The international association of manufacturers and applicators, CAN in Automation was founded in 1992. The registered association currently with more than 280 member corporations was and is a strong factor in the fast and wide distribution of CAN knowledge.

Address: Am Weichselgarten 26, D-91058 Erlangen
Tel. +49-9131-69086-0, Fax. +49-9131-69086-79
CiA-Homepage: http://www.can-cia.de

Device profiles

Specification of functions and interpretation of variables for the various device families.
The device profiles are described by ‘DS 4xx’ (Draft Standard).

DS 401:	digital and analog in/outputs, e.g. Modular I/O system RM 200
DS 402:	drives
DS 403:	HMI, control and monitor
DS 404:	MSR, measure-control-regulate
DS 405:	programmable devices
DS 406:	Encoder
DS 4xx:	additional device profiles are being worked on

SDO ‘Service Data Object’

SDOs serve the exchange of system parameters as are e.g. limit switch values, baud rate settings, PDO mappings, etc. SDOs are of great significance in the initializing phase of a CAN-Network, during the normal operation they play a minor role.

PDO ‘Process Data Object’

PDOs serve the exchange of process data e.g. setting and reading of analog or digital inputs, setting of outputs, etc. After the initializing phase of the CAN-networks PDOs serve the fast data transfer between the CAN bus participants. The contents of the messages is relatively high.

PDO-Mapping

PDO-Mapping means to link objects together to one CAN-message of 8 bytes maximum. The application engineer can “pack” the data relevant to him (e.g. digital outputs) in one PDO, i.e. he can map them and so guarantee a fast data exchange of relevant data. PDO mapping needs only to be carried out, if the default values of the PDOs do not comply with the requirements of the respective application.

Communication Objects

In addition to SDOs and PDOs other communication objects have been specified:

- boot-up:	specifies starting up the CAN network
- dyn. identifier distribution:	automatic identifier distribution per software
- node guarding/life guarding:	supervising the functionality of the CAN network
- synchronization:	synchronizing of input / output, e.g. for drives
- emergency:	emergency telegrams at failures

Node-ID

Each CAN device has its own node number by which it is identified. PDOs communicate with a COB-ID of ‘address + offset’ on the CAN bus. The ‘offset’ is equivalent to the allocated Node-ID of the respective device. This results in the necessity of allocating a unique node number to each device to avoid bus conflicts. Valid node numbers are 0 to 127, where 0 is reserved for the ‘Bus-Master’.

Baud Rate

CAN is a serial bus system where the data transmission rate is given in bits per second (baud). Valid baud rates are 10k, 20k, 50k, 100k, 125k, 250k, 500k, 800k and 1000 kBaud and are set e.g. with a BCD rotating switch. RM 201 automatically recognize the baud rate which means that it is not always necessary to set the baud rate manually.

EDS files ‘electronic data sheet’

EDS files describe a CANopen device and are required by the system configuration tools such as ProCANopen. They are part of the Engineering Sets 9407-999-103x1.

10.1 *Node States / Minimum Boot-Up*

The Minimum Boot-Up supports **four node states**. State transitions are either triggered automatically or by a command initiated by the NMT master.

(1) Initialization

In this state the node is initialized. Three sub-states can be distinguished:

- **Reset Application**

Before the automatic jump into the state ‘Reset Communication’, the manufacturer specific and device profile specific part of the object index are initialized with the default values. This state is also run through first after the node has been switched on.

- **Reset Communication**

Before the automatic jump into the state ‘Init’, the communication profile specific part of the object index is initialized with the default values.

- **Init**

In this state the rest of node initialization follows. Then the device automatically jumps into the state ‘Pre-Operational’.

(2) Pre-Operational

After ‘Initialization’, this state is achieved automatically. This state serves to parameterize the node. Node-guarding can be switched active or not active. SDO transfers are possible, PDO transfers are not supported. The SYNC telegram can be parameterized, but is not transmitted. The device can jump into every other state except ‘Init’.

(3) Operational

This is the normal operational state. Node-guarding can be activated or deactivated. SDO and PDO transfers are possible. If it has been parameterized beforehand, the node sends SYNC telegrams to the bus in this state. If the settings for the PDOs or SYNC telegrams are changed in the object index in this state, i.e. whilst operation, then to keep the data consistent, it must jump once into the state ‘Pre-operational’ or ‘Prepared’ until the new settings become valid. It can jump into every other state except ‘Init’.
Sometimes the jump to state ‘Operational’ is also called ‘start node’.

(4) Prepared / (Stopped)

In this state neither SDO or PDO transfers are possible, nor SYNC telegrams can be sent. If the node monitoring had been activated previously, it is the only service which is executed. It can jump into every other state except ‘Init’.
Sometimes the jump to state ‘Prepared’ is also called ‘stop node’.

11 Hardware / Technical data

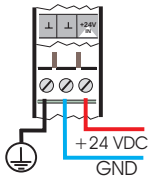
11.1 *Connections*

11.1.1 24 V/DC- supply

terminal 4,5 = GND mass
terminal 6 = +24 V/DC

The terminals 4 and 5 are internally connected.

The GND of the 24V power supply has to be connected to protective earth (PE).



11.1.2 CAN - connection

terminal 1 = CAN_H
terminal 2 = CAN_GND
terminal 3 = CAN_L

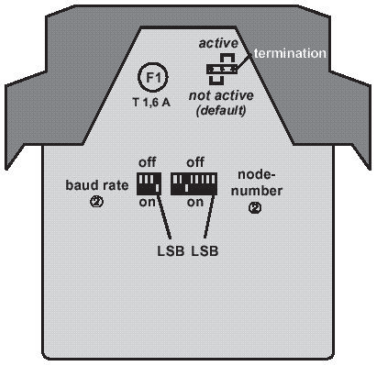
11.1.3 Alarm-relay

Change-over relay
terminal 7 = NC
terminal 8 = NO
terminal 9 = C

The maximum working voltage for a safe protective insulation according to EN 61010-1 is 150 V for pollution degree 2 and overvoltage category II.

11.1.4 Bus termination

A CAN-bus - termination resistance can be switched on via jumper.



11.2 *Replacement of the fuse on the RM 201*

If the green ‘Power’-Led does not light up with the connection of the voltage supply, the fuse should be checked.
The fuse on the RM 201 protects the 24V/DC supply voltage. With defectice I/O modules, bus boards or the coupler module a short-circuit of supply vlotage within the module is possible. The current is limited to max. 1.6 ampere by the fuse. After repairs of the error the defective fuse can be replaced by an identically type with 1.6 A / slow-acting.

11.3 *Transmit- / Receive - LED*

The yellow ‘Transmit- / Receive’ - LEDs light up during transmitting and receiving of CANopen messages.

11.4 *Alarm-LED*

The red ‘Alarm’-LED shows the state of the alarm relay.

11.5 *Technical Data RM 201*

Application: central unit of the modular fieldbus system

Power supply: +24 V DC (±10 %), max. power consumption 1750 mW (only RM 201)
The GND (⊥) of the 24 V DC supply has to be connected to protective earth.(PE)
The module supplies all I/O modules with the required voltages; the max. current consumption is 1.5 A (depending on the I/O modules used).

Microprocessor: SAB-C505C with 20 MHz

Memory:
- 32 kByte static RAM
- 64 kByte EPROM
- 8 kByte EEPROM

CAN-Bus:
- Full-CAN-Controller according to CAN-specification V2.0 A
- physical connection according to ISO 11898
- galvanic isolation via High-Speed-Opto-coupler
- Transmission data rate: 10, 20, 50, 100, 125, 250, 500, 800 and 1000 kBaud
- automatic baud rate scanning
- Range of node numbers: 0...127 (1...42 in use of default mappings)
- switchable termination resistance
- Process-Data-Objects (PDOs):
  - Receive ≤ 5
  - Transmit ≤ 10, max. 5 requestable per ‘Remote Transmit Request’

CAN-Protocol: The device operates according to the regulations DS301 and parts of DSP404 passed by the CiA as a CANopen slave.

Protection: The noise immunity of the CAN bus is considerably improved by a current-compensated choke.
The power supply connection is protected against external interferences such as voltage peaks by different EMC sources.

Alarm output: The module has an alarm relay output to release for example an emergency stop in case of defined events. These events can be parameterized via CANopen.
The max. working voltage for a safe protective insulation according to EN61010-1 with pollution degree 2 and overvoltage category II : 150 V
Relay: change-over, AC: Pmax = 750 W, 5 A
DC: Pmax = 120 W, 120 V, 5 A

LED displays:
- 1x ‘Transmit’ (yellow): transmission of a message via CANopen
- 1x ‘Receive’ (yellow): receipt of a CANopen message
- 1x ‘Power’ (green): state of the supply voltage
- 1x ‘Alarm’ (red): state of the alarm relays

Galvanic isolation: The power supply, CAN bus and logic areas are galvanic-isolated from each other (isolation voltage 500 V DC).

Temperature range:
- Storage temperature: -20 ... +70 °C
- Ambient temperature: 0 ... +50 °C

Humidity:
- 75% rel. humidity, no condensation

Shock sensitivity: DIN 40046 IEC68-2-69

EMC:
- DIN EN 50081 Part 2
- DIN EN 50082 Part 2

Electrical connections: screw-/plug-in-terminals, line cross-section max. 2.5 mm²

Class of protection: IP 20

Dimensions: 99 x 17.5 x 114.5 mm (h x w x d)

Weight: 100 g

Housing: Polyamid PA 6.6, combustibility class V0 according to UL 94

Assembly: plugged-in and locked in front of base module

Usage position: vertical

Subject to technical alterations !

12 Appendix

12.1 *Definitions*

AVS	Abbr. for power supply
Basic module	Unit for installation of the modules of the RM 200 - system (RM 211, RM 212, RM 213)
CANopen	Protocol based on CAN-Bus, specified by user organization CiA
CiA	CAN in Automation user organization
EEP	Abbr. for EEPROM
Fail Safe	Behaviour of an output value if communication to bus master fails
ID	Abbr. for ident number
I/O	Abbr.for input / output
HW	Abbr. for hardware
Coupler	(Fieldbus-)Coupler to connect the selected fieldbus; main module of the RM 200 system
LSB	Least significant bit
MSB	Most significant bit
Octet	8 continuous bits
PDO	Abbr. for Process Data Object
RC-combination	Combination from resistance and capacity
RS485	Standardized two wire connection, half duplex, (EIA RS 485)
SDO	Abbr. for Service Data Object
SW	Abbr. for software
SYNCH	Synchronization message
TC	Abbr. for thermocouple

12.2 *FAQ - RM 200 Modules - General*

❑ Execeeding measuring range

In order to achieve the highest possible resolution in the specified measuring range, the RM 200 modules only have very small limits for exceeding the measuring range, for example, only some 70 µA with the current input modules RM 221-0 and RM 222-0. A larger deviation will set the Fail bit.

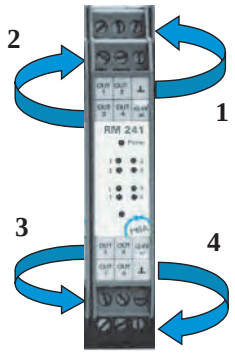
❑ Error detection for RM 251

The digital output module RM 251 can detect an open or short-circuited input for **two adjacent outputs.** This is indicated by both LEDs blinking under the following conditions:
Open circuit detection: Supply voltage is connected and at least one output “Low”, or no supply voltage and both outputs “Low”.
Short circuit detection: Supply voltage is connected and at least one output “High”, or no supply voltage and both outputs “High”.
After a disturbance, set error flags can only be reset if the outputs return to the status they had when the fault was detected. If the object “Fault_Mode” (0x6206) is used to reset an error flag, the output value must also be re-written. Alternatively, the error flag can be reset by overwriting the datum “Error_Reset” (0x5000) with the value 0x0002.
Recommendation for KS 98+ (only uses the short circuit detection): Set the “Fmode” behaviour on error for output Out_i to “none” = disabled.

❑ Lower limit for thermocouple

With the temperature module RM 224-1, the lowest possible limit with thermocouple measurement depends on the CJC measurement value. Therefore, the enclosed data sheet specifies two values for the lowest limit (0 °C and 50 °C), which can be also defined in the Engineering of the KS 98plus.

❑ Assignment of terminal descriptions to terminals



❑ Calculation of cycle time for CANopen coupler module RM 201 (worst case)

The calculation of the internal cycle time depends on the number of inserted (analog) modules and the external load on the CANbus. Main internal times of the RM 200:

– digital signals (1 to 9 modules): ≤ 10 ms
– 4-channel analog module (per module): ≤ 50 ms
– 2-channel analog module (per module): ≤ 20 ms

Examples:
A) 4 x RM 224-1 (4 channels TC/Pt100) + 4 x RM 231-0 (4 channels AO) + 1x RM 242 (8 DI) : ≤ **400 ms**
B) 9 x RM 242 (8 DI) : ≤ **10 ms**

❑ Sensor break RM 224-1

Starting delivering in June 2000, all the modules are fitted with break detection for all 3 leads.
Exception: If the equalizing lead (e.g. pin 3) breaks, no error is detected, but the input value goes to a defined value of less than –150 °C.

❑ **Upscale / downscale**
With the analog input modules (RM 221-x, RM 222-x, RM 224-x) it is possible to configure upscale (max. value) or downscale (min. value) action per channel when an error is detected. The default setting is upscale.

❑ **Output hold**
With analog output modules (RM 231-x) it is possible to configure “output hold” (last value) or zero (fail safe) per channel when a bus error is detected.

❑ **Spike detection**
The CAN coupler software has been fitted with a spike detection function, which eliminates freak values. Furthermore, the function has been modified so that no fail signal is generated when a spike is detected.

12.3 *FAQ - RM 200 Modules and KS98+*

❑ **Identification RM 221 and RM 222**
Previously, the current input module with transmitter supply RM 222-0 identified itself to the CAN coupler module as a RM 221-0 (current input without transmitter supply). This error can be remedied by means of an exchange in the KS 98 Engineering (no functional difference).
Beginning with software Version 4.1.101 of the KS 98plus, the identification of the RM 221-0 instead of the expected RM 222-0 will be accepted.

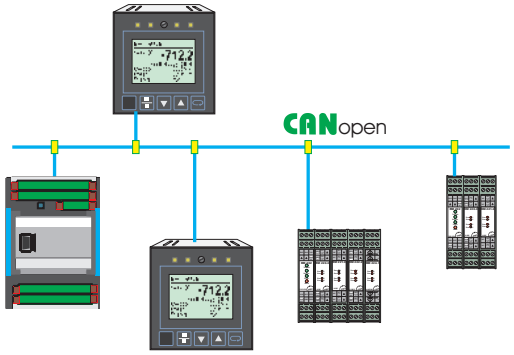
❑ **KS 98plus and changed address for RM 201**
If the address of an RM 201 module is changed in an automation system with a KS 98plus after the KS 98-Engineering has been uploaded, but no change is made in the module’s position in the RM basic module, proceed as follows for the KS 98plus (software Version 4.3):

1. Disconnect supply voltage, and remove or install a RM 200 module.
2. Reconnect the supply voltage, and wait until the node initialization has been completed.
3. Disconnect the supply voltage, and remove or install a RM 200 module. Reconnect supply voltage.

From KS 98plus Version V4.4 onwards, a CAN node reset for a new RM 200 node can be carried out in this case, in order to read a changed configuration or address from the RM 200 node.

In the menu “Status CAN bus” the entry ”Node Reset” has been added. The sub-menu displays all available RM 200 nodes. A reset can then be initiated for the selected node.

12.4 *Connection between RM 200 and KS98+ with CANopen interface*

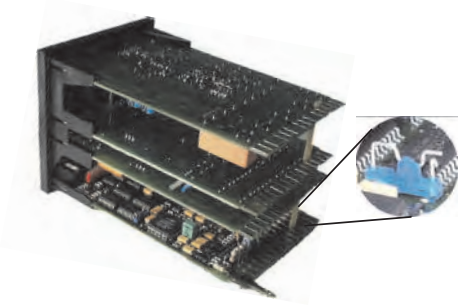


The additional CANopen interface extends the multifunction unit functionality of KS98+already in the basic version by

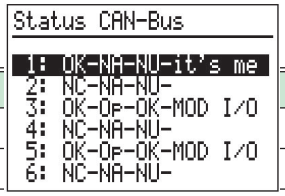
- Extension of the number of local I/O by means of the modular PMA RM 200 I/O system
- connection of PMA multi-temperature controllers KS800 / KS 816 with CANopen interface
- on-site data exchange with other KS98+ units (cross crommunication)

These functions are available only in KS98+ versions from operating version 5.

BUS terminating resistor
Both ends (first and last unit) of the CANopen bus must be fitted with a bus terminating resistor. For this purpose, the bus terminating resistor provided in each KS98+ can be used.
With the S.I.L. switch closed, the terminating resistor is connected.
By default , the S.I.L. switch is open (see opposite).



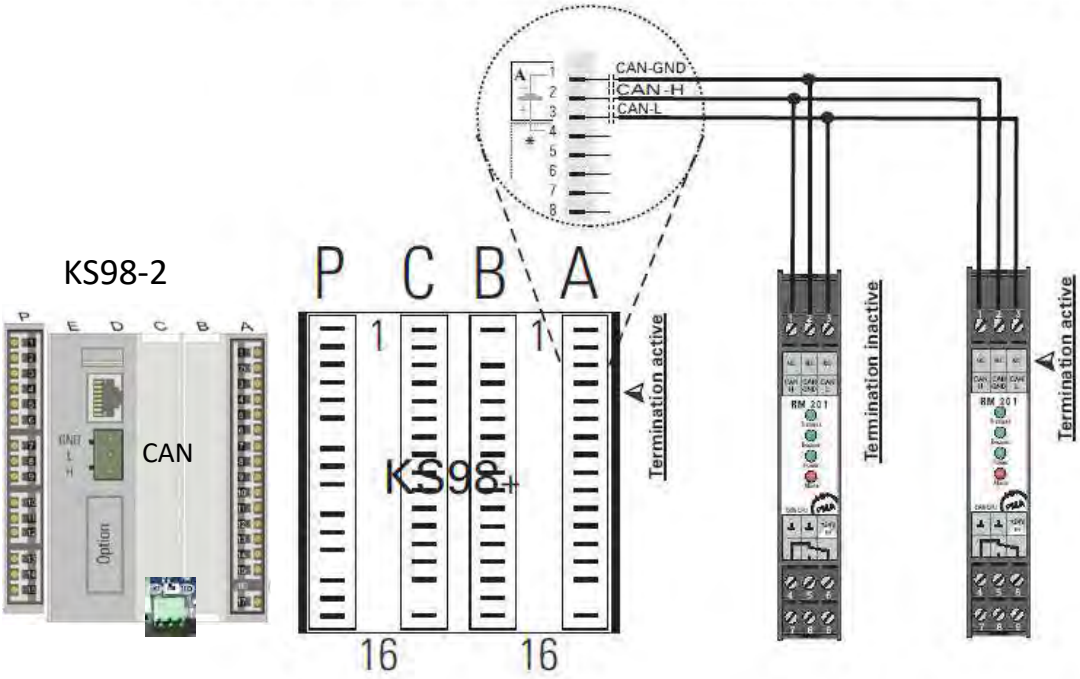
Status display : CAN bus status



Character	Value	Signification	
1, 2	1...42	Node number	
3, 4	:	Separator	
5, 6	NC	NoCheck:	Node existence so far unchecked / node not provided.
	Ck	Check:	Check for node existence is busy.
	NR	NoResponse:	No response from this node. However, node is required.
	OK	Ready:	Node has responded and was identified.
	ES	EmStart:	Node has output an emergency message.
7, 10, 13	-	Separator	
8, 9	NA	NotAvailable:	Node status is unknown.
	PO	PreOperation:	Node is in status PreOperational.
	Er	Error:	Node is in error condition.
	Op	Operational:	Node is in operational condition.
11, 12	NU	NotUsed:	Node is not required by an own lib function.
	Wa	Waiting:	Lib function waits for identification of this node
	Pa	Parameter setting:	Lib function is busy setting the node parameters
	OK	Ready:	Lib function has finished parameter setting
14...21	String	Determined node name	

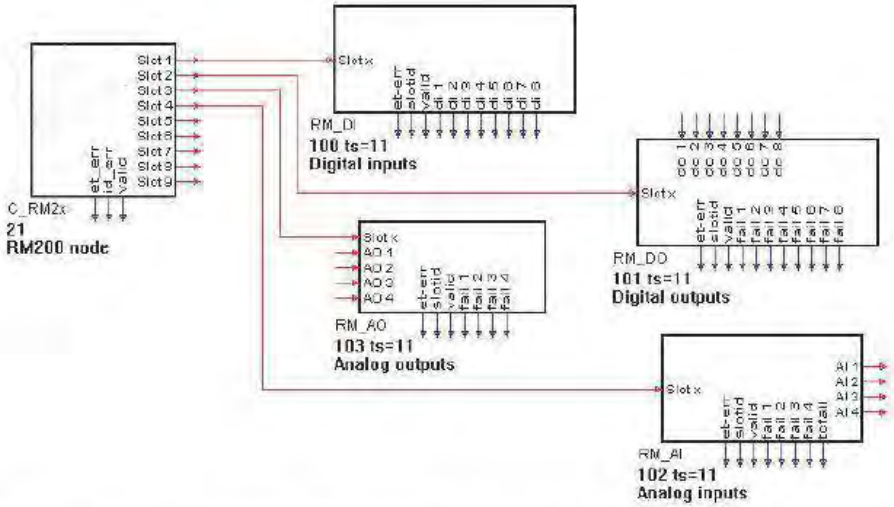
12.4.1 Cable connection KS98+ and RM 200 modules

The following figure shows the example of a cable connection between a KS98+ and two RM 201 nodes .



12.4.2 Partial engineering for communication with a RM 200 node.

Data access to the RM 200 nodes is performed by using predefined function blocks in KS98 engineering.



Further details on KS98+ engineering see operating manual 9407-040-44311.

CANopen Coupler Module RM 201

Safety Instructions

ESD !

- contains electro-statically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

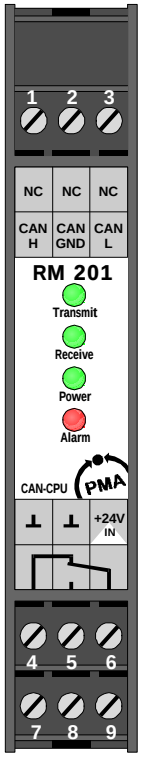
Maintenance / Repair

Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Pin Assignment



Pin	Assignment	
	NC	
	NC	
	NC	
1	CAN H	CAN-Bus
2	CAN GND	
3	CAN L	
4	GND	Power supply
5	GND	
6	+24 V IN	
7		Alarm relay
8		
9		
Art.-No.	9407-738-20101	

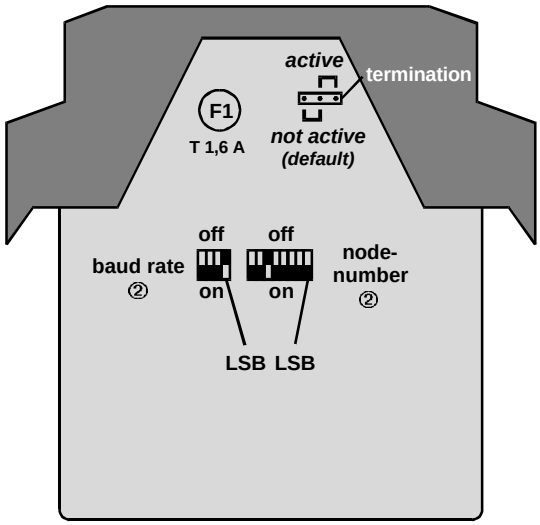
DIP switches / Jumper

4 Bit DIP switch

DIP ①	Baud rate
0000	10 kBit
0001	20 kBit ②
0010	50 kBit
0011	100 kBit
0100	125 kBit
0101	250 kBit
0110	500 kBit
0111	800 kBit
1000	1000 kBit
1001	Auto Scan
4321	Switch-Pos.

8 Bit DIP switch

DIP ①	Node-No.
0000 0000	invalid
0000 0001	1
0000 0010	2
0000 0011	3
...	...
0010 0000	32 ②
...	...
0111 1110	126
0111 1111	127
8765 4321	Switch-Pos.



① The positions of the switches are shown in binary-code. The number at the right position corresponds to the LSB (DIP-switch-position 1), the number at the left position corresponds to the MSB (DIP-switch-position 4 or 8). To use the default-mapping of the modular fieldbus-system in full effect a node number ≤ 42 should be chosen.

② Factory settings

Art.-Nr.: 9499-040-58841 ◆ 22.02.01

PMA Prozeß- und Maschinen-Automation GmbH ◆ Postfach 310229 ◆ 34058 Kassel ◆ Deutschland
http://www.pma-online.de ◆ E-Mail: mailbox@pma-online.de

Technical Data RM 201

Application: central unit of the modular fieldbus system

Power supply: +24 V DC (±10 %), max. power consumption 1750 mW (only RM 201)
The GND (⊥) of the 24 V DC supply has to be connected to the protective earth(PE).
The module supplies all I/O modules with the required voltages; the max. current consumption is 1.5 A (depending on the I/O modules used).

Microprocessor: SAB-C505C with 20 MHz

Memory:
- 32 kByte static RAM
- 64 kByte EPROM
- 8 kByte EEPROM

CAN-Bus:
- Full-CAN-Controller according to CAN-specification V2.0 A (CAN-specification V2.0 B on request)
- physical connection according to ISO 11898
- galvanic isolation via High-Speed-Opto-coupler
- Transmission data rate: 10, 20, 50, 100, 125, 250, 500, 800 and 1000 kBaud
- automatic baud rate scanning
- Range of node numbers: 0...127 (1...42 in use of default mappings)
- switchable termination resistor
- Process-Data-Objects (PDOs):
  - Receive ≤ 5
  - Transmit ≤ 10, max. 5 requestable per 'Remote Transmit Request'

CAN-Protocol: The device operates according to the regulations DS301 and parts of DSP404 passed by the CiA as a CANopen slave.

Protection: The noise immunity of the CAN bus is considerably improved by a current-compensated choke.
The power supply connection is protected against external interferences such as voltage peaks by different EMC sources.

Alarm output: The module has an alarm relay output to release for example an emergency stop in case of defined events. These events can be parameterized via CANopen.

Alarm relay: max. working voltage for a safe protective insulation according to EN61010-1 with pollution degree 2 and overvoltage category II: 150 V
change-over-contact rating: AC: Pmax = 750 W, 5 A
DC: Pmax = 120 W, 120 V, 5 A

LED displays:
- 1x 'Transmit' (yellow): transmission of a message via CANopen
- 1x 'Receive' (yellow): receipt of a CANopen message
- 1x 'Power' (green): state of the supply voltage
- 1x 'Alarm' (red): state of the alarm relays

Galvanic isolation: The power supply, CAN bus and logic areas are galvanic-isolated from each other (isolation voltage 500 V DC).

Temperature range:
- Storage temperature: -20 ... +70 °C
- Ambient temperature: 0 ... +50 °C

Humidity: ≤ 75% rel. humidity, no condensation

Shock sensitivity: DIN 40046 IEC68-2-69

EMC:
- DIN EN 50081 Part 2
- DIN EN 50082 Part 2
- DIN EN 61326

CE

Electrical connections: screw-/plug-in-terminals, line cross-section max. 2.5 mm²

Class of protection: IP 20

Dimensions: 99 x 17.5 x 114.5 mm (h x w x d)

Weight: 100 g

Housing: Polyamid PA 6.6, combustibility class V0 according to UL 94

Assembly: plugged-in and locked in front of base module

Usage position: vertical

Subject to technical alterations !

Basic Modules RM 211 / RM 212 / RM 213

Safety Instructions

ESD !

- contains electro-statically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

Maintenance / Repair

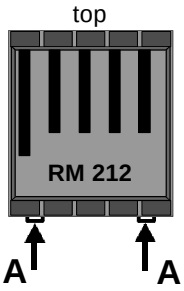
Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Mounting on DIN-Rail

The basic modules are intended for DIN-rail mounting according to EN 50022. The mounting is carried out by locking the metal ledge (**A**) on the back side below. For dismantling a basic module the metal ledge (**A**) must be released.



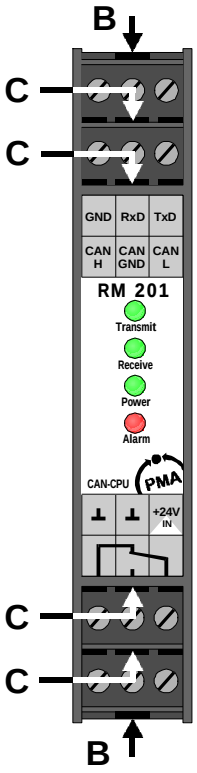
Installation / Removal the Modules

Module installation into a basic module: Slide in the module at the respective place. Listen to the 'click' for proper enganging.

The installation of the modules **RM 201** or **RM 202** (fieldbus coupler) always must be placed at the absolutely left position. All other modules can be installed at any position.

For removing: Release the two ledges (**B**) and pull out the module.

To keep the specified protection degree (IP20) emty slots must be protected by slot covers RM 214.

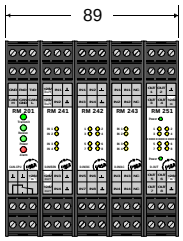


Screw-/ Plug-in-Terminals

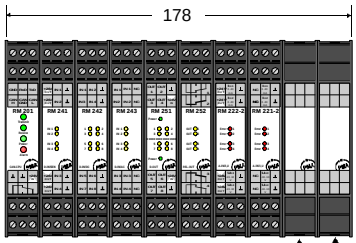
The screw-/plug-in-terminals can be plugged in from above or below into the module housing (audible locking). Removing the screw-/plug-in-terminals takes place by levering out at position (**C**), e.g. with a screwdriver.

Due to contact-voltage proof not connected terminals should remain in the respective places.

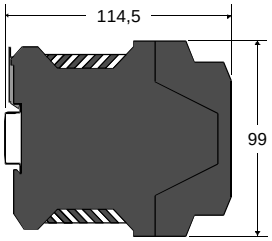
RM 211
9407-738-21101



RM 212
9407-738-21201



RM 213
9407-738-21301



side view

slot cover
RM 214
9407-738-21401

Subject to technical alterations!

Analog Input Module RM 221 / 222

Safety Instructions

ESD !

- contains electro-statically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

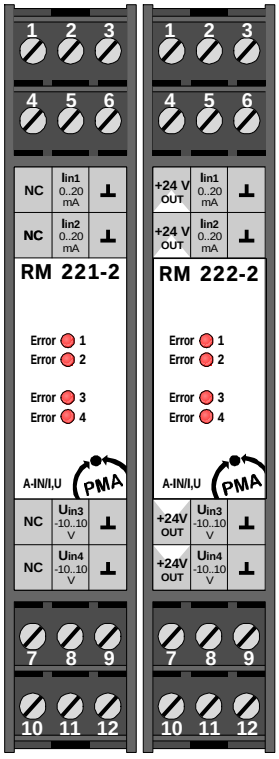
Maintenance / Repair

Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Pin Assignment



RM 221 RM 222

Pin	RM221-0	RM221-1	RM221-2	RM222-0	RM222-1	RM222-2
1				24 V OUT	5/24 V OUT	24 V OUT
2	0...20 mA	-10...10 V	0...20 mA	0...20 mA	-10...10 V	0...20 mA
3	GND	GND	GND	GND	GND	GND
4				24 V OUT	5/24 V OUT	24 V OUT
5	0...20 mA	-10...10 V	0...20 mA	0...20 mA	-10...10 V	0...20 mA
6	GND	GND	GND	GND	GND	GND
7				24 V OUT	5/24 V OUT	5/24 V OUT
8	0...20 mA	-10...10 V	-10...10 V	0...20 mA	-10...10 V	-10...10 V
9	GND	GND	GND	GND	GND	GND
10				24 V OUT	5/24 V OUT	5/24 V OUT
11	0...20 mA	-10...10 V	-10...10 V	0...20 mA	-10...10 V	-10...10 V
12	GND	GND	GND	GND	GND	GND
Art.-Nr.	9407-738-22101	9407-738-22111	9407-738-22121	9407-738-22201	9407-738-22211	9407-738-22221
	4x I	**4x U**	**2x I, 2x U**	**4x I**	**4x U**	**2x I, 2x U**
	without transducer supply			with transducer supply		

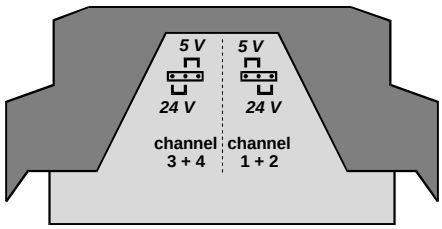
Remark:

The -10...+10 V input can be switched to the range 0...+10 V via software.

The 0...20 mA input can be switched to the range 4...20 mA via software.

For 2 channels each the transducer supply can be switched from 24 V DC to controlled 5 V DC, so that there is a 5 V DC supply with max. 20 mA available for potentiometric transmitters.

RM 222



PMA Prozeß- und Maschinen-Automation GmbH ◆ Postfach 310229 ◆ 34058 Kassel ◆ Germany
http://www.pma-online.de ◆ E-Mail: mailbox@pma-online.de

Technical Data RM 221 / RM 222

Application:	4 analog standard-signal inputs with the measuring ranges: 0..20 mA or 4..20 mA and 0..10 V or -10..10 V ● RM 221: with differential inputs ● RM 222: with supply for transducers and potentiometric transmitters
Configuration:	The 4 inputs can be designed for any combination of current or voltage measurement by the respective assembling of the module. Standard: 4x current, 4x voltage or 2x current / 2x voltage The desired measuring range is parameterized via the fieldbus.
Power supply:	The module is supplied with 24 V DC and 5 V DC via the bus board.
Power consumption:	● RM 221: 24 V: 1.2 W, 5 V : 125 mW ● RM 222: 24 V: 1.0 W, 5 V : 200 mW (without load at transducer supply)
Overload protection:	Fuse in combination with suppressor diode
A/D-converter:	● Process: 'successive-approximation' ● Resolution: 12 bit, approx. 2.5 or 5.0 mV / 1 digit or approx. 4.1 or 5.1 µA / digit
Input impedance:	● RM 221: current input typ. 75 Ω, voltage input typ. 390 kΩ ● RM 222: current input typ. 75 Ω, voltage input typ. 730 kΩ
Total error:	● RM 221: I: 0.755% U: 0.15% (of full range without differential voltage error) ● RM 222: I: 0.26% $U_{[0...10]}$: 0.28% $U_{[-10...+10]}$: 0.45%
Characteristic curve deviation:	● RM 221: I: 0.055% U: 0.05% (of full range without differential voltage error) ● RM 222: I: 0.1% $U_{[0...10]}$: 0.05% $U_{[-10...+10]}$: 0.09%
Deviation by temperature:	● RM 221: I: 0.14%/10K U: 0.02%/10K ● RM 222: I: 0.016%/10K $U_{[0...10]}$: 0.055%/10K $U_{[-10...+10]}$: 0.073%/10K
Differential error: (only RM 221)	RM 221: I: 0.55% of full range with max. common mode rejection of 30 VDC RM 221: U: <1 digit of full range with max. common mode rejection of 30 VDC
Galvanic isolation:	The logic-part is galvanically isolated from the inputs. The module version 'differential inputs' (RM 221) also has an isolation between the power supply and the inputs. (Isolation voltage 500 V DC) The inputs are not isolated from each other.
Transducer supply: (only RM 222)	● The module version 'with transducer supply' (RM 222) provides each input with 24 V DC(10%), with a max. current of 25 mA. Condition: voltage supply of 24 V DC (±10 %), connected to the fieldbus coupler. ● For 2 channels each the transducer supply can be switched from 24 V DC to controlled 5 V DC(±2 %), so that there is a 5 V DC supply with max. 20 mA (total) available for potentiometric transmitters.
Cycle times:	100 ms
Filter:	● Analog: low pass 2. order, cutoff frequency = 305 Hz ● Digital: low pass 1. order (parameterizable average processing via fieldbus)
LED-Displays:	Errors are displayed directly on the module with 4 red LEDs.
Ambient Temperature:	● Operation: 0 ... +50 °C ● Storage: -20 ... +70 °C
Humidity:	≤ 75% humidity, no condensation
Shock sensitivity:	DIN 40046 IEC60068-2-6
EMC:	● DIN EN 50081 part 2 ● DIN EN 50082 part 2 ● DIN EN 61326 CE
Electrical connection:	screw-/plug-in-terminals, line cross-section max. 2.5 mm²
Class of protection:	IP 20
Dimensions:	99 x 17.5 x 114.5 mm (h x w x d)
Weight:	51 g / 53 g (RM 221/ RM 222)
Housing:	Polyamid PA 6.6, combustibility class V0 according to UL 94
Montage:	plugged-in and locked in front of base module
Usage position:	vertical

Subject to technical alterations!

Analog Input Module RM 224-0

Safety Instructions

ESD !

- contains electrostatically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

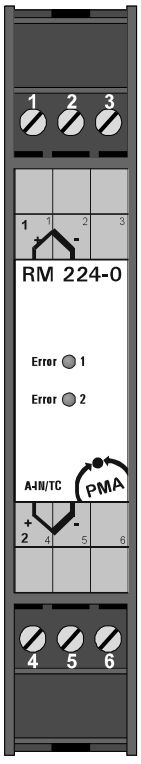
Maintenance / Repair

Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Pin Assignment



Pin	Assignment	
1	+	Input 1
2	-	
3	NC	
4	+	Input 2
5	-	
6	NC	
Art.-No.	9407-738-22401	

Art.-No.: 9499-040-59741 ◆ 03.09.01

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Technical Data RM 224-0

Application: 2 galvanically isolated inputs for the direct connection of thermocouples (type J, K, L, E, T, S, R, B, N, W)

Resolution: 16 bits / successive approximation

Measuring range: -9.835... +76.357 mV

Temperature ranges:

	Measuring range	Resolution	Error
Thermocouple type J:	-210.0 °C ... +1200.0 °C	0.03 K	≤ 1 K
Thermocouple type K:	-2700 °C ... +1370.0 °C	0.04 K	≤ 1 K
Thermocouple type L:	-200.0 °C ... +900.0 °C	0.03 K	≤ 1 K
Thermocouple type E:	-270.0 °C ... +1000.0 °C	0.02 K	≤ 1 K
Thermocouple type T:	-270.0 °C ... +400.0 °C	0.04 K	≤ 1 K
Thermocouple type S:	-50.0 °C ... +1760.0 °C	0.13 K	≤ 2 K
Thermocouple type R:	-50.0 °C ... +1760.0 °C	0.12 K	≤ 2 K
Thermocouple type B: 1)	+25.0 °C ... +1820.0 °C	0.15 K	≤ 2 K
Thermocouple type N:	-196.0 °C ... +1299.6 °C	0.04 K	≤ 1 K
Thermocouple type W: 2)	0.0 °C ... +2299.3 °C	0.09 K	≤ 1 K

1) specification applies above 400°C 2) W5Re/W26Re

Unit °C, °F, K selectable via software / number of post decimal places = 1

Cold junction compensation: additional error ≤0.15% of the respective measuring range

Linearization: Linearity error negligible

Differential input: yes

Input resistance: ca. 1 MΩ

Sensor current: ca. 0.5 µA (sensor breakage detection)

Overflow of measuring range: Alarm message if value overflows 160 digits

Overload-protection: Overload-protected by varistors (5 V/ 0.4 J)

Filter:
- Analog: Low-pass, $f_{cut-off}$ < 10 Hz
- Digital: Low-pass of 1st order (adjustable averaging process)

Configuration: The type of the used thermocouple is selected via the fieldbus.

Power supply: The module is supplied with necessary voltages via the bus board.

Power consumption: max. 1400 mW

Cycle times: Each channel is scanned with 50 ms. Filters for the input values can be parameterized via the fieldbus.

LED-Displays: Errors are indicated for each channel via 2 LEDs.

Galvanic isolation: The logic-part is galvanically isolated from the inputs. Additionally, there is a galvanic isolation between the power supply and the inputs. The inputs are also galvanically isolated from each other.

Ambient temperature:
- Operation: 0... +50 °C
- Storage: -20... +70 °C
- Effect: ≤0.05% / 10 K

Climatic Application Class: KUF DIN 40040 (≤ 75% rel. humidity, no condensation)

Shock sensitivity: DIN 40046 IEC68-2-69

EMC:
- DIN EN 50081 Part 2
- DIN EN 50082 Part 2
- HF-effect: ≤0.1%

CE

Electrical connections: Screw-/plug-in terminal blocks, line cross-section max. 2.5 mm²

Class of protection: IP 20 of the completely equipped device

Dimensions: 99 x 17.5 x 114.5 mm (h x w x d)

Weight: 68 g

Housing: Material: Polyamid PA 6.6, combustibility class V0 according to UL 94

Assembly: plugged-in and locked from the front of base module

Usage position: vertical

Subject to technical alterations!

Analog Input Module RM 224-1

Safety Instructions

ESD !

- contains electrostatically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

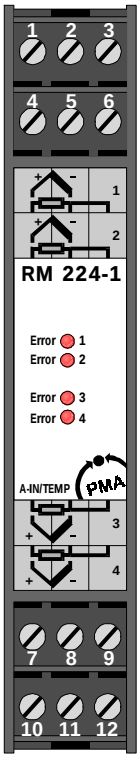
Maintenance / Repair

Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Pin Assignment



Pin	Assignment	
1	+	Input 1
2	-	
3		
4	+	Input 2
5	-	
6		
7	+	Input 3
8	-	
9		
10	+	Input 4
11	-	
12		
Art.-No.	9407-738-22411	

Technical Data RM 224-1

Application: 4 analog inputs for the direct connection of RTD (Pt 100) or thermocouples (T/C) (Type J, K, L, E, T, S, R, B, N, W)

Resolution: 16 bit / successive approximation

Measuring range: -9.835 ... +76.357 mV (Thermocouple) / 18.49 Ω ... 390.26 Ω (RTD, Pt100)

Temperature ranges:

	Measuring range	Resolution	Error
Pt100:	-200.0°C ... +850.0°C	0.02 K	≤ 1 K
Thermocouple type J:	-210.0°C / -120.0°C ... +1200.0°C	0.03 K	≤ 1 K
Thermocouple type K:	-270.0°C / -130.0°C ... +1370.0°C	0.04 K	≤ 1 K
Thermocouple type L:	-200.0°C / -120.0°C ... +900.0°C	0.03 K	≤ 1 K
Thermocouple type E:	-270.0°C / -130.0°C ... +1000.0°C	0.02 K	≤ 1 K
Thermocouple type T:	-270.0°C / -130.0°C ... +400.0°C	0.04 K	≤ 1 K
Thermocouple type S:	-50.0°C / +12.0°C ... +1760.0°C	0.13 K	≤ 2 K
Thermocouple type R:	-50.0°C / +13.0°C ... +1760.0 °C	0.12 K	≤ 2 K
Thermocouple type B: **1)**	+25.0°C / +50.0°C ... +1820.0 °C	0.15 K	≤ 2 K
Thermocouple type N:	-196.0°C / -109.0°C ... +1299.6 °C	0.04 K	≤ 1 K
Thermocouple type W: **2)**	0.0°C / +50.0°C ... +2299.3 °C	0.09 K	≤ 1 K

1) specification applies above 400C ° **2)** W5Re/W26Re

The measuring ranges are related to terminal temperature 0°C / 50°C.

Unit: °C, °F, K selectable by software / number of decimal places= 1

Cold junction compensation: additional error ≤0.4% of the respective measuring range (after a warming-up phase of the device of max. 20 minutes)

Linearization: Linearity error negligible

Differential input: ● Pt100: no ● T/C: high resitiv at mass (ca. 1 MΩ)

Input resistance: ca. 1 MΩ (T/C)

Sensor current: ● Pt100: ca. 1 mA (short-circuit protected) ● T/C: ca. 5 µA (sensor breakage detection)

Overflow / underflow of measuring range: Alarm message if value overflows 160 digits

Open/Break sensor Detection: Short-circuit and interruption with Pt100 sensors are detected as well as interruptions with thermocouples.
! With a break of the compensation line (Pt100) a temperature of ≤ -150C° is indicated. !

Overload-protection: Overload-protected by varistors (5 V/ 0.4 J)

Filter:
- Analog: Low-pass, $f_{cut\text{-}off}$ < 10 Hz
- Digital: Low-pass of 1st order (adjustable averaging process)

Configuration: The inputs may be configured via the fieldbus for application with a RTD (Pt100) or thermocouples.

Power supply: The module is supplied with necessary voltages via the bus board.

Power consumption: max. 1200 mW

Cycle times: Each channel is scanned with at least 100 ms. Filters for the input values can be parameterized via the fieldbus.

LED-Displays: Errors are indicated for each channel via the 4 LEDs .

Galvanic isolation: The logic-part is galvanically isolated from the inputs. Additionally, there is a galvanic isolation between the power supply and the inputs, while the inputs are not galvanically isolated from each other.

Ambient temperature: ● Operation: 0... +50 °C ● Storage: -20... +70 °C ● Effect: ≤0.05% / 10 K

Humidity: ≤ 75% relative humidity, no condensation

Shock sensitivity: DIN 40046 IEC68-2-69

EMC:
- DIN EN 50081 part 2 CE
- DIN EN 50082 part 2
- HF-effect: ≤1% RTD (Pt100); ≤5% (T/C)

Electrical connections: Screw-/plug-in terminal blocks, line cross-section max. 2.5 mm²

Class of protection: IP 20, in the completely equipped device

Dimensions: 99 x 17,5 x 114,5 mm (h x w x d)

Weight: 95 g

Housing: Material: Polyamid PA 6.6, combustibility class V0 according to UL 94

Assembly: plugged-in and locked in from the front of base module

Usage position: vertical

Subject to technical alterations!

Analog Output Module RM 231

Safety Instructions

ESD !

- contains electrostatically sensitive components
- Original packing protects against electrostatic discharge (ESD)
- Transporting only in the original packing
- during mounting rules for protection against ESD must be followed

Connections

- Wiring must be conform to local standards (e.g. VDE 0100 in Germany) !
- Input leads must be kept separate from signal and mains leads !
- The protective earth must be connected to the relevant terminal (in the instrument carrier) !
- The cable screening must be connected to the terminal for grounded measurement !
- Usage of twisted and screened input leads prevent stray electric interference !
- Connections must be made according to the connecting diagrams !

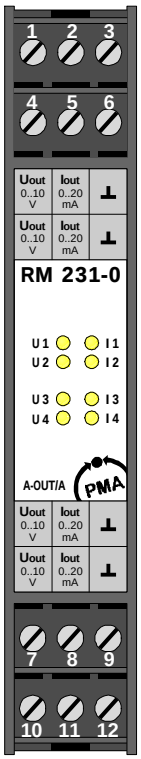
Maintenance / Repair

Instrument needs no particular maintenance.
When opening the instrument live parts or terminals can be exposed.
Before carrying out the instrument must be disconnected from all voltage sources.
The instrument contains electrostatically sensitive components.
The following work may be carried out only by trained, authorized persons.

Fuse tripped:

- Cause must be determined and removed !
- Only fuses of the same type and current rating as the original fuse must be used.
- Using repaired fuses or short-circuiting the fuse socket is inadmissible !

Anschlußbelegung



Pin	RM 231-0	RM 231-1	RM 231-2	
1	0...10 V	0...10 V	-10...10 V	Output 1
2	0...20 mA	0...20 mA	0...20 mA	
3	GND	GND	GND	
4	0...10 V	0...10 V	-10...10 V	Output 2
5	0...20 mA	0...20 mA	0...20 mA	
6	GND	GND	GND	
7	0...10 V	-10...10 V	-10...10 V	Output 3
8	0...20 mA	0...20 mA	0...20 mA	
9	GND	GND	GND	
10	0...10 V	-10...10 V	-10...10 V	Output 4
11	0...20 mA	0...20 mA	0...20 mA	
12	GND	GND	GND	
Art.-No.	9407-738-23101	9407-738-23111	9407-738-23121	

Remark: The outputs -10...+10 V can be switched to the range 0...+10 V via software.

The outputs 0...20 mA can be switched to the range 4...20 mA via software.

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Technical Data RM 231

Application: 4 analog norm-signal outputs with 0(4)...20 mA and 0...10 V or -10...10 V

Standard versions:

	RM 231-0	RM 231-1	RM 231-2
0(4)...20 mA	4x	4x	4x
0...10 V	4x	2x	--
-10...10 V	--	2x	4x

Resolution: The used DA-converters have a resolution of 12 bit.

Scaling:
- Starting-value: 0 mA = 0 / 4 mA = 4000 / 0 V = 0 / -10 V = -10000
- End-value: 20 mA = 20000 / 10 V = 10000

Configuration: The desired output signal can be modified by the used fieldbus.
The non active output signal (current or voltage) may not be used.

Power supply: The module is supplied with the necessary voltages via the bus board.

Power consumption: max. 3310 mW

Output impedance:
- Current output: working resistance max. 500 Ω
- Voltage output: max. current delivery 10 mA

Cycle times: The maximum cycle time for describtion of the 4 outputs is 50 ms.

Total error:
- 0...10 V = 0.25% full scale
- -10...10 V = 0.6% f. s.
- 0...20 mA = 0.63% f. s.

Protection: All outputs are short-circuit proof.

LED-Display: Each of the 4 output channels is provided with 1 yellow LED for the current output and 1 yellow LED for the voltage output.

These LEDs display the selection (current or voltage) for each output.
Errors are displayed by blinking LEDs.

Galvanic isolation: The logic part is galvanic isolated from the outputs. Additional there is a galvanic isolation between the power supply and the outputs.
(Testing voltage 2 kV DC, Isolation voltage 500 V DC)
The outputs are not isolated from each other.

Temperature range:
- Ambient temperature: 0 ... +50 °C
- Storage temperature: -20 ... +70 °C

Humidity: ≤ 75% humidity, no condensation

Shock sensitivity: DIN 40046 IEC68-2-69

Influence factors:
- Temperature: 0.01 % / 10 K
- Burden: 0...10 V = 0.01% / mA
  -10...10 V = 0.025% / mA
  0...20 mA = 0.1% / 100 Ohm
- Auxiliary energy: neglible 24 V DC ± 10%

EMC:
- DIN EN 50081 part 2
- DIN EN 50082 part 2

CE

Electrical connection: screw-/plug-in-terminals, line cross-section max. 2.5 mm²

Class of protection: IP 20

Dimensions: 99 x 17.5 x 114.5 mm (h x w x d)

Weight: 88 g

Housing: Polyamid PA 6.6, combustibility class V0 according to UL 94

Assembly: plugged-in and locked in front of base module

Usage position: vertical

Subject to technical alterations!