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**Operating instructions**

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**C9302-M0**

**Control computer for XC-Boards<sup>®</sup>  
with Modbus RTU Interface**

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**Important information**

Read these operating instructions before starting the unit. They provide you with important information on the use, safety and maintenance of the units. This helps you to protect yourself and prevent damage to the unit.



Information intended to help you to avoid death, bodily harm or considerable damage to property are highlighted by the warning triangle shown here; it is imperative that this information be properly heeded.

The operating instructions are intended for trained professional electricians familiar with the safety standards of electrical technology and industrial electronics.

Store these operating instructions in an appropriate place.

The manufacturer is not liable if the information in these operating instructions are not complied with.

**Safety**

Components inside the units are energized with electricity during operation. For this reason, mounting and maintenance work may only be performed by professionally-trained personnel while observing the corresponding safety regulations.

The repair and replacement of components and modules may only be carried out by the manufacturer for safety reasons and due to the required compliance with the documented unit properties.

The units do not have a power switch. They are operative as soon as the operating voltage is applied.

**Intended use**

The units are intended for use in industrial environments. They may only be operated within the limit values stipulated by the technical data.

When configuring, installing, maintaining and testing the units, the safety and accident-prevention regulations relevant to use in each individual case must be complied with.

Trouble-free, safe operation of the units requires proper transport, storage, installation, mounting and careful operation and maintenance of the units.

**Mounting and installation**

The attachment options for the units were conceived in such a way as to ensure safe, reliable mounting.



The user must ensure that the attachment hardware, the unit carrier and the anchoring at the unit carrier are sufficient to securely support the unit under the given surrounding conditions.

The units are to be mounted in such a way that they can be opened up while mounted. Sufficient space for the cables must be available in the unit near the cable infeed.

Sufficient space is to be kept clear around the units to ensure air circulation and to prevent the build-up of heat resulting from use. The relevant information must be heeded in the case of units ventilated by other means.



When the housing fasteners are opened, the front frame of the housing hinges out upward or downward (depending on the unit version) automatically.

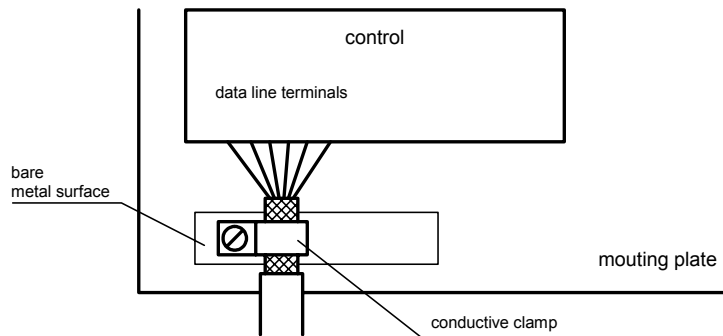
## Grounding

All devices are equipped with a metal housing. They comply with safety class I and require a protective earth connection. The connecting cable for the operating voltage must contain a protective earth wire of a sufficient cross section (DIN VDE 0106 part 1, DIN VDE 0411 part 1).

## EMC measures

The devices comply with the EU Directive 89/336/EEC (EMC Directive) and provide the required interference immunity. Observe the following when connecting the operating voltage and data cables:

- Use shielded data cables.
- The data and operating voltage cables must be laid separately. They may not be laid together with heavy-current cables or other interference-producing cables.
- The cable thickness must be properly assessed (DIN VDE 0100 Part 540).
- The cable lengths inside the units are to be kept as short as possible to prevent interference. This applies especially to unshielded operating voltage cables. Shielded cables are also to be kept short due to any interference which might be emitted by the shielding.
- Neither excessively long cables nor cable loops may be placed inside the units.
- The connection of the cable shielding to the functional ground (PE) must be as short and low-impedance as possible. It should be made directly to the mounting plate over a large area with a conductive clip:



- The cable shielding is to be connected at both cable ends. If equipotential bonding currents are expected due to the cable arrangement, electrical isolation is to be performed on one side. In this case, capacitive connection (approx.  $0.1\mu\text{F}/600\text{ V AC}$ ) of the shielding on the isolated side must occur.

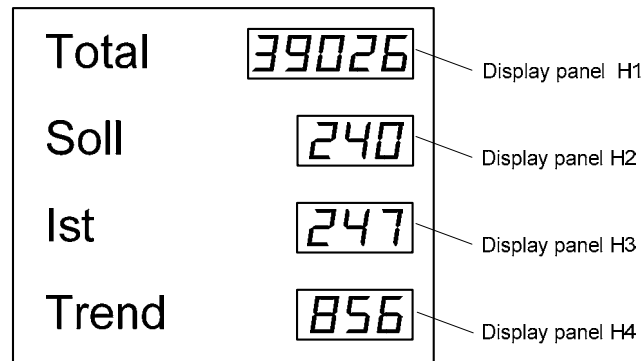
## Disposal

Units or unit parts which are no longer needed are to be disposed of in accordance with the regulations in effect in your country.

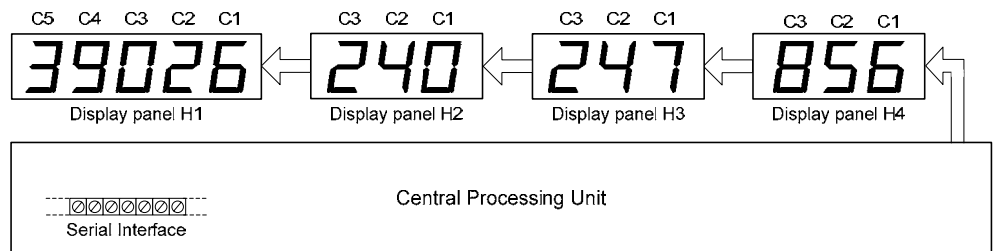
XC-Board®

The control computer C9302-M0 serves for the activation of numeric or alphanumeric display fields in XC-Boards® via a Modbus-RTU interface.

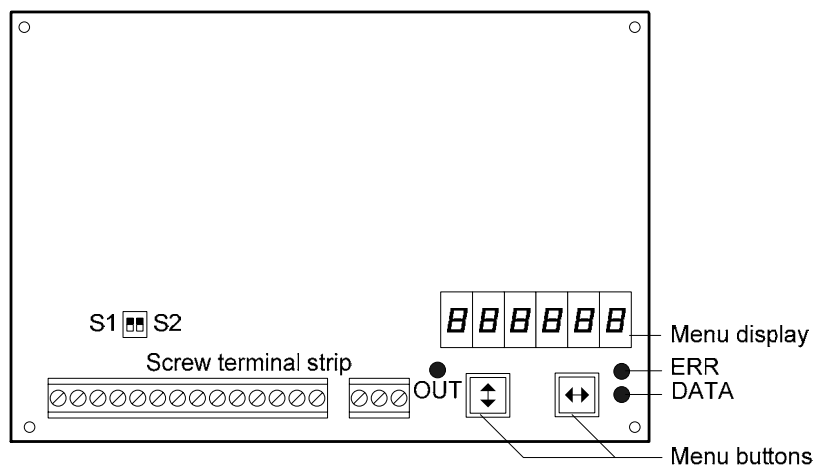
The following picture shows an example for an XC-Board® with four display fields:



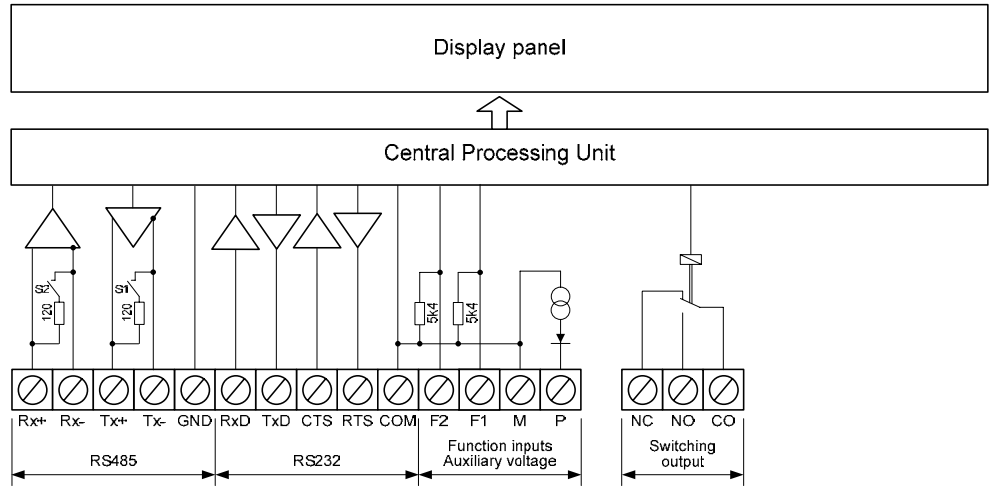
The electrical structure of the XC-Boards® is documented in the included logic diagram. The following picture shows the general structure of the XC-Boards®:



Central Processing Unit



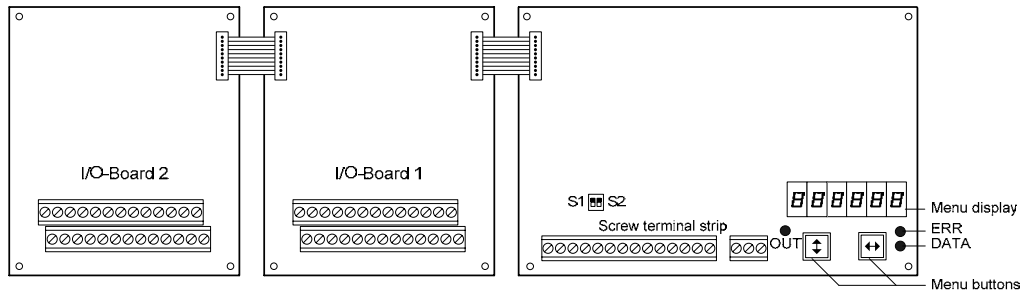
Principle circuit diagram



Relay cards

Optionally, up to two relay cards with 8 relays each (type C9210) can be connected to the control computer, for example, for activating optical and acoustic signal transmitters.

The following picture shows the control computer with two relay cards:



Parameterization

The parameterization of the unit is done by means of a menu in the menu display (see chapter 3).

**⚠** Bus errors may result in personal injury or material damage. Therefore it is to observe that activating the menu may cause a bus error.

Serial Interface

The serial interface is located on the screw-type terminal strip of the control computer. It has the formats RS485 and RS232 (see notes on configuration chapter 4).

The interface format is set in menu item 1 (see chapter 3).

The interface RS485 is to be used for Modbus interfacing. It is galvanically isolated from all other electric circuits.

The switches S1 (Tx) and S2 (Rx) serve for locking the data lines of the RS485 (see chapter 4).

The RS232 interface is determined for testing and not to be used as Modbus interface.




Function inputs	<p>The function inputs allow, independently of commands via the Modbus interface, a reduction of the brightness and the flashing of the display (see chapter 2). It is located on the screw type terminal of the control computer.</p> <p>The function inputs are PLC-compatible and are designed for the following signal voltages:</p> <p>Signal voltage: L = -3.5...+5 V (open input = L) H = +18...30 V (active H), M = reference potential</p>
Auxiliary voltage	<p>The units supply terminal P with an auxiliary voltage galvanically isolated from the operating voltage (24 V <math>\pm</math>25%, max. 50 mA, M = reference potential). It can be used as H signal.</p>
Menu display	<p>The menu display represents a menu for unit parameterization (see chapter 3).</p> <p>In normal operation, <i>Online</i> is shown in the menu display.</p>
Menu buttons	<p>The menu can be operated by means of the menu buttons (see chapter 3).</p>
Switching output	<p>The devices dispose of a switching output (relay) with potential-free change-over contact (NC, NO, CO).</p>
Status indicators	<p>The status indicators (LED) of the central processing unit have the following function:</p> <p>DATA Data reception ERR Communication error OUT Switching output is active</p>

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## Chapter 3

## Control

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 Bus errors may result in personal injury or material damage. Therefore it is to observe that activating the menu may cause a bus error.

Function Code	<p>The displays are Modbus RTU Slaves (Remote Terminal Unit) in accordance with the <i>Modbus over serial line specification and implementation guide</i>. They support the <i>Function Code 16 (0x10) Write Multiple Registers</i> in accordance with the <i>Modbus Application Protocol Specification</i> (see 'www.modbus.org').</p>																
Slave address	<p>The slave address can be set in menu item 9 from 1 to 247.</p>																
Display fields	<p>The addressing of the display fields occurs with the high byte of the start address.</p> <table border="0"> <tr> <td>Display field H1</td> <td>Start address 0x01xx</td> </tr> <tr> <td>Display field H2</td> <td>Start address 0x02xx</td> </tr> <tr> <td>Display field H3</td> <td>Start address 0x03xx</td> </tr> <tr> <td>Display field H4</td> <td>Start address 0x04xx</td> </tr> <tr> <td>Display field H5</td> <td>Start address 0x05xx</td> </tr> <tr> <td>Display field H6</td> <td>Start address 0x06xx</td> </tr> <tr> <td>Display field H7</td> <td>Start address 0x07xx</td> </tr> <tr> <td>Display field H8</td> <td>Start address 0x08xx</td> </tr> </table>	Display field H1	Start address 0x01xx	Display field H2	Start address 0x02xx	Display field H3	Start address 0x03xx	Display field H4	Start address 0x04xx	Display field H5	Start address 0x05xx	Display field H6	Start address 0x06xx	Display field H7	Start address 0x07xx	Display field H8	Start address 0x08xx
Display field H1	Start address 0x01xx																
Display field H2	Start address 0x02xx																
Display field H3	Start address 0x03xx																
Display field H4	Start address 0x04xx																
Display field H5	Start address 0x05xx																
Display field H6	Start address 0x06xx																
Display field H7	Start address 0x07xx																
Display field H8	Start address 0x08xx																

Data format The data format for the interpretation of the Modbus data is configured with the low byte of the start address.

Start address Data format INTEGER Start address 0xxx00 UI16 (16 bit unsigned integer)  
 Start address 0xxx10 SI16 (16 bit signed integer)  
 Start address 0xxx20 UI24 (24 bit unsigned integer)  
 Start address 0xxx30 SI24 (24 bit signed integer)

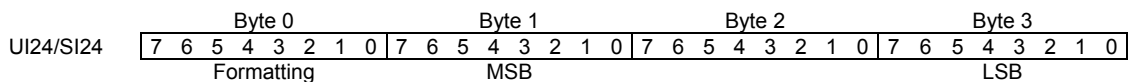
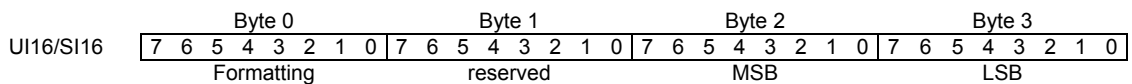
Data format ASCII Start address 0xxx40

Examples Data should be displayed in the format UI16 in display field H1. The start address is then 0x0100.

Data should be displayed in the format ASCII in display field H2. The start address is then 0x0x0240.

INTEGER data format Data transmission is carried out with 4 bytes per display field.

Byte 0 contains the formatting of the device and the control of the switching output. The following bytes are displayed in INTEGER data format.



- : : : : : : : :
  - : : : : : 0 0 0 No decimal point
  - : : : : : 0 0 1 Decimal point digit C2
  - : : : : : 0 1 0 Decimal point digit C3
  - : : : : : 0 1 1 Decimal point digit C4
  - : : : : : 1 0 0 Decimal point digit C5
  - : : : : : 1 0 1 Decimal point digit C6
  - : : : : : 1 1 0 Decimal point digit C7
  - : : : : : 1 1 1 Decimal point digit C8
  - : : : : : :
  - : : : : : 0 Deactivate switching contact (relay OFF)
  - : : : : : 1 Activate switching contact (relay ON)
  - : : : : : :
  - : : : : : 0 Normal brightness of all display fields
  - : : : : : 1 Reduced brightness of all display fields (only devices with LED display)
  - : : : : : :
  - : : : : : 0 Flashing off
  - : : : : : 1 Flashing on (only devices with LED display)
  - : : : : : :
  - 0 0 Retrace blanking of all display fields off
  - 0 1 Retrace blanking of all display fields on
  - 1 0 reserved
  - : : : : : :
  - 0 0 Red character color
  - 0 1 Green character color
  - 1 0 Orange character color
  - : : : : : :
  - 1 1 Display test of all display fields
- MSB: Most Significant Byte (highest value byte)
- LSB: Least Significant Byte (lowest value byte)
- For devices with single colored LED displays or LRD® display
- For devices with selectable LED colors

Depending on the data format, the maximum value ranges are the following:

UI16	0...65535	SI16	-32768...32767
UI24	0...16777215	SI24	-8388608...8388607

If the transferred value exceeds the value range, then the following will appear on the display: ▯ (upper range) or ▮ (lower range).

## ASCII data format

For the data transmission, the number of bytes depends on the number of digits of the display field.

Byte 0 contains the formatting of the device and the control of the switching output. The following bytes are displayed in ASCII data format (C8...C1).

Display field with one digit	Byte 0 Format.	Byte 1 C1								
Display field with 2 digits	Byte 0 Format.	Byte 1 C2	Byte 2 C1	Byte 3*						
Display field with 3 digits	Byte 0 Format.	Byte 1 C3	Byte 2 C2	Byte 3 C1						
Display field with 4 digits	Byte 0 Format.	Byte 1 C4	Byte 2 C3	Byte 3 C2	Byte 4 C1	Byte 5*				
Display field with 5 digits	Byte 0 Format.	Byte 1 C5	Byte 2 C4	Byte 3 C3	Byte 4 C2	Byte 5 C1				
Display field with 6 digits	Byte 0 Format.	Byte 1 C6	Byte 2 C5	Byte 3 C4	Byte 4 C3	Byte 5 C2	Byte 6 C1	Byte 7*		
Display field with 7 digits	Byte 0 Format.	Byte 1 C7	Byte 2 C6	Byte 3 C5	Byte 4 C4	Byte 5 C3	Byte 6 C2	Byte 7 C1		
Display field with 8 digits	Byte 0 Format.	Byte 1 C8	Byte 2 C7	Byte 3 C6	Byte 4 C5	Byte 5 C4	Byte 6 C3	Byte 7 C2	Byte 8 C1	Byte 9*

\*will be ignored

Byte 0								
7	6	5	4	3	2	1	0	
:	:	:	:	:	:	:	:	
:	:	:	:	0	0	0	No decimal point	
:	:	:	:	0	0	1	Decimal point digit C2	
:	:	:	:	0	1	0	Decimal point digit C3	
:	:	:	:	0	1	1	Decimal point digit C4	
:	:	:	:	1	0	0	Decimal point digit C5	
:	:	:	:	1	0	1	Decimal point digit C6	
:	:	:	:	1	1	0	Decimal point digit C7	
:	:	:	:	1	1	1	Decimal point digit C8	
:	:	:	:	:	:	:	:	
:	:	:	:	0	Deactivate switching contact (relay OFF)			
:	:	:	:	1	Activate switching contact (relay ON)			
:	:	:	:	:	:	:	:	
:	:	:	:	0	Normal brightness of all display fields			
:	:	:	:	1	Reduced brightness of all display fields (only devices with LED display)			
:	:	:	:	:	:	:	:	
:	:	:	:	0	Flashing off			
:	:	:	:	1	Flashing on (only devices with LED display)			
:	:	:	:	:	:	:	:	
0	0	Retrace blanking of all display fields off						For devices with single colored LED displays or LRD <sup>®</sup> display
0	1	Retrace blanking of all display fields on						
1	0	reserved						
:	:	:	:	:	:	:	:	
0	0	Red character color						For devices with selectable LED colors
0	1	Green character color						
1	0	Orange character color						
:	:	:	:	:	:	:	:	
1	1	Display test of all display fields						

Flashing	<p>If in byte 0 bit 5 is set, the respective display field flashes.</p> <p>Flashing of all display fields can also be activated by application of the H signal to functional input F1 (priority compared to the bit 5 in byte 0).</p> <p>For units provided with an LRD® display flashing is not possible.</p>
LED color	<p>The LED color can be set in byte 0 bit 7 and bit 6. (only for displays that have selectable LED colors).</p>
Blanking	<p>If in byte 0 bit 6 is set, all display fields are blank (priority over flashing). This is not possible for displays with selectable LED colors.</p>
Brightness	<p>If in byte 0 bit 4 is set, the brightness of all display fields will be reduced.</p> <p>The brightness of the display can also be reduced with an H signal applied to functional input F2 (priority compared to the bit 4 in byte 0).</p> <p>For units provided with an LRD® display brightness reduction is not possible.</p>
Decimal point	<p>In the menu items A1...A8, the decimal point can be set for each display (for numeric display fields only).</p> <p>The decimal point can also be activated by setting bits 2...0 in byte 0. You must select setting 0 (no fixed decimal point) in the respective menu item (A1...A8).</p> <p>If a decimal point has been set in the menu points A1...A8, this decimal point will have priority.</p> <p>Units with a LRD® display have no decimal points.</p>
Leading zero suppression	<p>In menu item C1...C8 you can set if leading zeros are to be displayed or suppressed (for numeric display fields only). If leading zeros should be suppressed for units with LRD® display and fixed decimal point (e.g. self-adhesive foil), the corresponding position must be set in menu item A1...A8.</p>
Display test	<p>In menu item F, you can set whether a short-time display test is automatically carried out in all display fields after power-on.</p> <p>The display test can also be activated by setting bits 7 and 6 in byte 0.</p> <p>The display test has priority over flashing and blanking.</p>
Switching output	<p>The devices dispose of a switching output (relay) with potential-free change-over contact (NC, NO, CO).</p> <p>The switching output can be activated by setting bit 3 in byte 0 in the setting OFF in menu item r.</p> <p>When setting 1, 2 or 4 in menu item r, setting bit 3 in byte 0 causes a wiping pulse at the switching output with a duration of 1, 2 or 4 seconds.</p> <p>When setting A1, A2 or A4 in menu item r, every data string causes a wiping pulse at the switching output with a duration of 1, 2 or 4 seconds.</p> <p>The wiping function is suitable, for example, for activating optical and acoustic signal transmitters.</p> <p>The status indicator OUT of the control computer is lighted with active switching output.</p>
Power-on reset	<p>After power-on, minus signs are displayed to signalize that the unit is ready for operation. If a display test has been preselected in menu item F, it will run beforehand.</p>



Character set for numeric display fields


20/2B	2D	30	31	32	33	34	35	36	37	38	39	2C/2E
	-	0	1	2	3	4	5	6	7	8	9	.
41/61	42/62	43	44/64	45/65	46/66	47/67	48	49	4A/6A	4C/6C	50/70	55
A	b	C	d	E	F	G	H	I	J	L	P	U
59/79	5F	63	68	69	4E/6E	4F/6F	52/72	54/74	75	58/78	other	
Y	-	c	h	i	n	a	r	t	u	o	=	

Character set for alphanumeric display fields

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
2		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{		}	~	Δ
8	€	ç	è	é	â	ã	ä	å	ç	ê	ë	è	é	í	î	ï
9	Ê	ë	Ê	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö	ö
A	ä	í	ó	ü	ñ	ñ	.	.	¿	ª	¼	½	¾	í	∞	∞
B	∞	∞	∞	†	†	†	†	†	†	†	†	†	†	†	†	†
C	À	É	Ê	Ë	Ì	Í	Î	Ï	Ð	Ñ	Ò	Ó	Ô	Õ	Ö	Ø
D	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ	Ɔ
E	α	β	γ	π	Σ	σ	ρ	τ	ϑ	ε	Ω	δ	*	*	*	*
F	≡	±	∞	∞	.	.	÷	∞	°	.	.	.	.	.	?	.

## Chapter 4 Parameterization

Menu The parameterization of the devices is carried out in a menu of the menu display.

 Bus errors may result in personal injury or material damage. Therefore it is to observe that activating the menu may cause a bus error.

In normal operation, **Online** is shown in the menu display.

Menu operation To reach the menu, press both menu buttons simultaneously (approx. 1 sec.) until an audible signal is heard and menu item 01 appears in the menu display. Now, you can navigate in the menu as follows:

Next setting	Shortly press key [↕]
Page menu items forward	Press key [↕] long
Previous setting	Double click on key [↕]
Page menu items backward	Double click on [↕] and keep it pressed
Next setting	Shortly press key [↔]
Page settings forward	Press key [↔] long
Previous setting	Double click on key [↔]
Page settings backward	Double click on [↔] and keep it pressed

The menu ends in menu item U with the button [↕]. The settings made are either saved (set), not saved (escape) or the factory settings are reset, depending on the setting selected in menu item U.

Cancelling the menu without saving the settings made is possible by pressing both menu buttons longer (approx. 1 sec.) or will occur automatically if 60 seconds pass without a menu button being pressed.

Once the menu is closed, the unit behaves in the same manner as when the operating voltage was applied.

In the menu mode the character  $\bar{\text{E}}$  appears in all display fields. Control of the display is not possible in menu mode.

## Menu table

The menu items are displayed in the following menu table. The factory settings are marked with an \*. Individual menu items or settings can be suppressed in another menu item, depending on the unit version or setting.

Menu item	Settings	Menu display
1 Interface	RS232 (not for Modbus interfacing)	1 232
	RS485	1 485
	RS485 (4-wire bus)	1 4854
	RS485 (2-wire bus)	1 4852
3 Parity	No parity*	3 nonE
	odd parity	3 odd
	even parity*	3 EuEn
4 Baud rate	1200	4 1200
	2400	4 2400
	4800	4 4800
	9600	4 9600
	19200*	4 192
9 Address	Address 1	9 001
	Address 2	9 002
	↓	↓
	Address 247	9 247
R Switching output	No wiping pulse*	r OFF
	Wiping pulse 1 sec	r 1
	Wiping pulse 2 sec	r 2
	Wiping pulse 4 sec	r 4
	Automatic wiping pulse 1 sec	r R1
	Automatic wiping pulse 2 sec	r R2
	Automatic wiping pulse 4 sec	r R4
T Time-out	No time-out *	t 0
	Time-out after 2 s	t 2
	Time-out after 4 s	t 4
	Time-out after 8 s	t 8
	Time-out after 16 s	t 16
	Time-out after 32 s	t 32
	Time-out after 64 s	t 64
	Time-out after 128 s	t 128

<b>Menu item</b>	<b>Settings</b>	<b>Menu display</b>
A1 Decimal point display field H1	No decimal point*	<i>A 1 0</i>
	Decimal point digit C1	<i>A 1 1</i>
	Decimal point digit C2	<i>A 1 2</i>
	↓	↓
	Decimal point digit C8	<i>A 1 8</i>
A2 Decimal point display field H2	No decimal point*	<i>A 2 0</i>
	Decimal point digit C1	<i>A 2 1</i>
	Decimal point digit C2	<i>A 2 2</i>
	↓	↓
	Decimal point digit C8	<i>A 2 8</i>
↓	↓	↓
A8 Decimal point display field H8	No decimal point*	<i>A 8 0</i>
	Decimal point digit C1	<i>A 8 1</i>
	Decimal point digit C2	<i>A 8 2</i>
	↓	↓
	Decimal point digit C8	<i>A 8 8</i>
C1 Leading zeros display field H1	Leading zeros not displayed*	<i>C 1 00</i>
	Leading zeros displayed	<i>C 1 0000</i>
C2 Leading zeros display field H2	Leading zeros not displayed*	<i>C 2 00</i>
	Leading zeros displayed	<i>C 2 0000</i>
↓	↓	↓
C8 Leading zeros display field H8	Leading zeros not displayed*	<i>C 8 00</i>
	Leading zeros displayed	<i>C 8 0000</i>
F Display test	No display test at power-on *	<i>F ----</i>
	Display test at power-on	<i>F 8888</i>
U Saving	Saving parameters* (Set)	<i>U 5E1</i>
	Not saving parameters (Escape)	<i>U ESC</i>
	Resetting to the default settings (Default)	<i>U dEF</i>



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**Chapter 5** **Notes on configuration**


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**Interface**

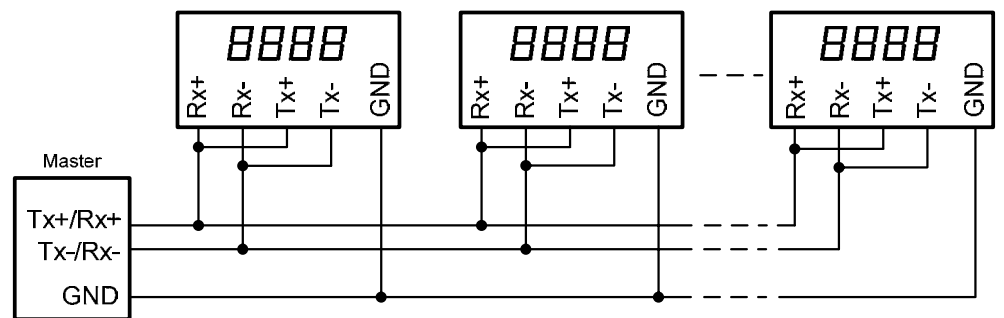
The interface RS485 is to be used for Modbus interfacing. The RS232 interface is determined for testing and not to be used as Modbus interface.

Interface parameter Parity and baud rate are set in menu items 3 and 4 (see chapter 3).

**Connection**

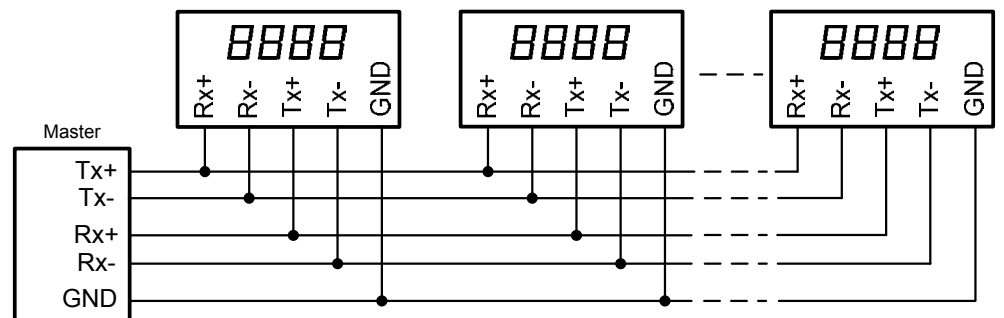
Control via RS485 2-wire bus (two-wire Modbus definition) as described as follows is recommended by *Modbus over serial line specification and implementation guide*.

Setting in menu item 1: RS485.2

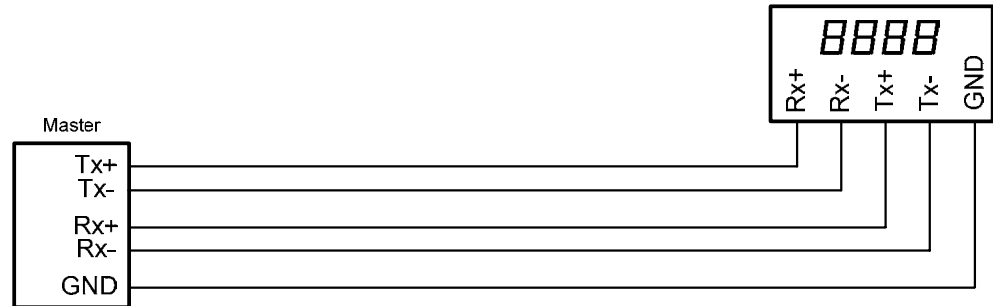


Control via RS485 4 wire bus (Optional Four-Wire Modbus Definition) as described as follows is optionally possible.

Setting in menu item 1: RS485.4



If the Modbus only consists of one master and one display as described as follows, in menu item 1 setting RS485 can also be selected.



#### Data lines

To achieve the highest possible interference immunity, the data lines of the RS485 have to be terminated on both ends. The required resistors are provided in the unit and can be connected on the screw terminal strip with the jumpers S1 (Tx) and S2 (Rx) (see chapter 2, block diagram).

The polarization of the data lines must be ensured by means of the master.

For the data lines, you always have to ensure that:

- Shielded twisted-pair cables of sufficiently large cross-section are used.
- The shielding is connected on both line ends.
- For the signal ground (GND) use a wire pair short-circuited on both ends in the data cable. The shielding may not be used as the signal ground.
- A twisted core pair is used each for Tx+ and Tx- and for Rx+ and Rx-. Non-observance of this instruction causes the protective function of the twisted-pair cable to be lost.
- Improperly terminated data lines cause faults during data transfer.

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## Chapter 6

### Technical data

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#### Ambient conditions

Operating temperature           0...55 °C  
 Storage temperature-30...85 °C  
 Relative humidity max. 95 % (non-condensing)