Operating instructions

Series SX402

Alphanumeric digital displays with Modbus RTU interface

Validity

The model designation of the units is:

SX402-220/05/0G-001/0B-M0	SX402-420/05/0G-001/0B-M0
SX402-240/05/0G-001/0B-M0	SX402-220/09/0G-001/0B-M0

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Chapter 1 | Dimensions

SX402-220/05/0G-001/0B-M0 (2 x 20 characters, character height 5 mm)
SX402-420/05/0G-001/0B-M0 (4 x 20 characters, character height 5 mm)

72

85 65

144

137

2...6 ca. 66

3

Panel cutout 138 x 66 mm

Rear view

Menu buttons

Screw terminal strip PE
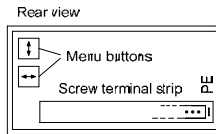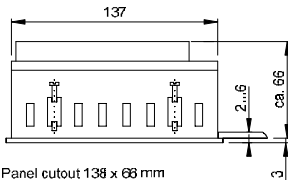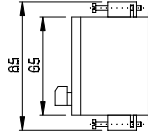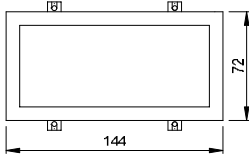
Dimensions in mm

SX402-240/05/0G-001/0B-M0 (2 x 40 characters, character height 4,7 mm)
SX402-220/09/0G-001/0B-M0 (2 x 20 characters, character height 9 mm)

72

85 65

240

233

2...6 ca. 66

3
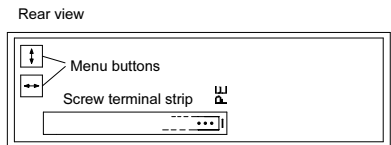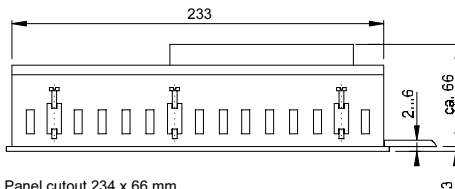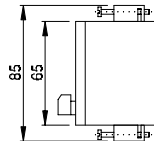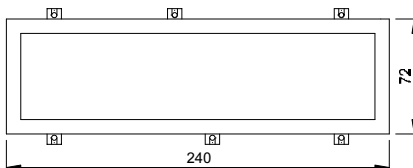
Panel cutout 234 x 66 mm

Rear view

Menu buttons

Screw terminal strip PE

Dimensions in mm

Principle circuit diagram
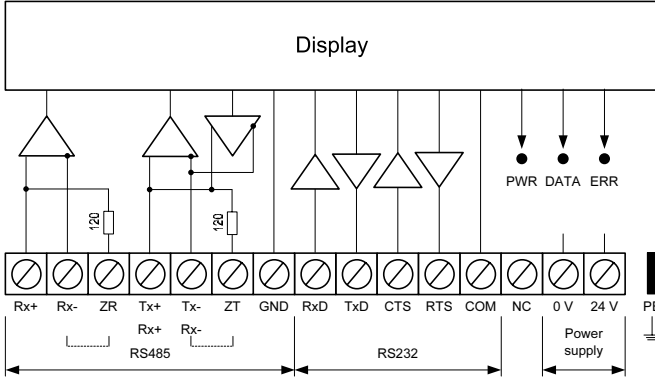
Parameterization | The parameterization of the unit is done by means of a menu in the menu display (see chapter 7).

Serial interface | The serial interface is located on the screw-type terminal. It has the formats RS485 and RS232.

The interface format is set in menu item 1 (see chapter 7).

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

The resistance in the clamps ZR and ZT is used to close the data line of the RS485 (see chapter 3).

The interface is determined for programming the device using a computer, for example for loading static texts in the text memory and for installing character sets by means of the PC tool 'DisplayManager' provided on data carrier (see chapter 8).

Status indicators | The status indicators (LEDs) are located on the back side of the display. They have the following function:

PWR   Operational readiness

DATA   Data are received

ERR   Communication error

Chapter 3 | **Modbus compatibility**

Modbus RTU | The displays are Modbus RTU Slaves (Remote Terminal Unit) in accordance with the *Modbus over serial line specification and implementation guide*. They support the Function Code 16 (0x10) Write Multiple registers in accordance with the *Modbus Application Protocol Specification*.

The indications in the above mentioned documentation are to be observed. Both documentations are available under www.modbus.org. and on the delivered data carrier.

Interface | The interface RS485 is to be used for Modbus interfacing.

Do not use the interface RS232 for Modbus interfacing. It is determined for programming the device using a computer, for example for loading static texts in the text memory and for installing character sets by means of the PC tool 'DisplayManager' provided on data carrier (see chapter 8).

Parity and baud rate are set in menu items 3 and 4 (see chapter 7).

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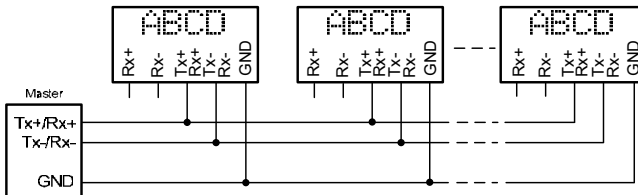
Control via RS485 4 wire bus (Optional Four-Wire Modbus Definition) as described as follows is optionally possible.

Setting in menu item 1: RS485.4
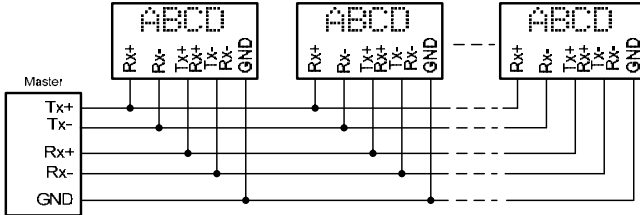
Data lines | To achieve the highest possible interference immunity, the data lines of the RS485 have to be terminated on both ends. The resistance necessary for this is available in the display and these can be connected to the screw-type terminal with a wire link (see chapter 2, simplified diagram, clamps ZR, ZT).

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.

Text types | The displays can display dynamic and static texts.

Dynamic texts can be changed while the unit is running. They are generated from within the process and sent to the display as data telegram.

Static texts cannot be changed while the unit is running. They are compiled using the PC tool 'DisplayManager' delivered on data carrier and loaded in the text memory via the serial interface RS232. After that, they can be opened via their text number.

Control types | Not only do the units allow a standard control, they also offer a selective line control.

Standard control (see chapter 5) has optimized applications in which single texts can be displayed. Longer texts are written in several lines of the display due to the automatic line break. When the text contains more characters than can be displayed, it will be automatically displayed in paging mode.

The individual line selection (see chapter 6) is optimized for applications in which several texts independent of one another should be shown in different lines and each line should be considered as an individual display. The lines can be selected individually. The control commands only refer to the activated line. The automatic line break and paging functions are not active.

Register address | The unit is controlled via Function Code 16 (10_h) Write Multiple Registers with the following register addresses:

Control	Online texts	Static texts	
Standard	0000_h	5000_h	see chapter 5
Selective line line 1	1000_h	6000_h	see chapter 6
Selective line line 2	2000_h	7000_h	see chapter 6
Selective line line 3	3000_h	8000_h	see chapter 6
Selective line line 4	4000_h	9000_h	see chapter 6

Commands | The control of the devices is done using commands according to the following command table. In the description, the numbers in [ ] refer to the corresponding lines in the command table.

Individual commands are transferred without additional data in one Modbus telegram. These commands are marked with ↵ (↵ is not a character).

Commands for text manipulation

Online-Text	`cc...↵`	Send any character (`cc…` = characterband with any content)	[1]
Deleting text	`$E↵`	Clearing text that is shown on the display/line	[2]

Commands for text formatting

Line break	`$C`	Forced line break	[3]
Flashing	`$F1`	Flashing of following characters on	[4]
	`$F0`	Flashing of following characters off	[5]
Character set	`$M1`	Standard character set	[6]
	`$M2`	User-defined character set	[7]

Commands for text formatting (cont.)

Bar graph	`$Gnnn`	Bar graph display (nnn = number of columns, always enter in three numeric digits, e. g. $G040)	[8]
$ character	`$$`	Display of the '$' character in the text	[9]

Commands for display options

Flashing	`$F1↵`	Flashing of the entire display on	[10]
	`$↵F0`	Flashing of the entire display off	[11]
Reset	`$0↵`	Restarting the display	[12]

Chapter 5 | **Standard control**

Display online text | In order to display a dynamic text, the characters (**cc**…) are sent to the display via a data string to the register address 0000$_h$ [1]. Any text in the display is cleared when a fixed text is called up.

Display static text | A static text can be selected with a formatted data string to the register address 5000$_h$. Any text in the display is cleared when a fixed text is called up.

The data string is a data word with the following format:

High Byte								Low Byte							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
FL	X	X	X	X	X	X	X	———————— text number ————————							

:
0 Flashing of the entire display off
1 Flashing of the entire display on

Deleting text | The command **$E↵** as a data string to the register address 0000$_h$ will delete the text that is on the display. [2]. Afterwards the following will appear on the display ⸫. This is only for dynamic texts.

Line break | If the text contains more characters than can be displayed in one line, a line break is inserted automatically at the end of the line, and the text is continued in the next line. A line break can also be forced at a certain place in the text, for example for correct hyphenation [3] using the command **$C**.

Flashing | Including **$F1** in the data string causes the following characters to flash [4]. **$F0** command in the data telegram deactivates the flashing of the following characters [5].

The command **$F1↵** as a data string to the register address 0000$_h$ will activate the flashing for the entire display [10]. The command **$F0↵** as a data string to the register address 0000$_h$ will deactivate the flashing for the entire display [11].

If a static text with set Bit FL is selected in the first byte of the data string (High Byte) and sent to the register address 5000$_h$ the flashing of the addressed display has then been activated. If the Bit FL has been deleted the flashing of the addressed display has been deactivated.

Character set | The character set for all characters can be chosen in the text. The command **$M1** in the data string causes all following characters to be displayed in standard character sets [6]. The command **$M2** in the data string

causes all following characters to be displayed in user defined character sets [7]. Characters will be displayed in the standard character set if no user defined character set has been installed.

Bar graph | The `$Gnnn` command in the data string is used for activating the bar graph display [8]. `nnn` stands for the number of illuminating columns, i.e. the length of the bar graph and must always be three digits, e. g. $G040.

**Character $** | The command for displaying the '$' character is `$$` [9].

Reset | The command `$0↵` as a data string to the register address 0000$_h$ causes the unit to re-start [12]. This is only for dynamic texts.

Paging | If a text contains more characters than can be shown in the display, it is automatically displayed in paging mode. The page change interval can be set between 2, 5 or 10 seconds in menu item P (see chapter 7).

Initial text | After power-on, ⋗ is displayed to signalize that the unit is ready for operation. If an initial text is to appear in the display instead (e.g. 'System operational'), this text is to be saved in the text memory with text number 0, and displaying of the initial text is to be set in menu item A (see Chapter 7).

Display online text | In order to visualize a dynamic text, the characters (**cc**…) are sent to one of the following register addresses as a data string [1]:

1000$_h$ send a dynamic text to line 1
2000$_h$ send a dynamic text to line 2
3000$_h$ send a dynamic text to line 3
4000$_h$ send a dynamic text to line 4

Any text contained in the addressed line will be deleted upon receipt of a new text. The texts in the other lines will not be deleted.

The displays SX402-220/xx/0G-001/0B-M0 and SX402-240/xx/0G-001/0B-M0 ignore commands sent to lines 3 and 4.

Display static text | A static text is selected in one of the lines with a formatted data string in one of the following register addresses.

6000$_h$ select static text in line 1
7000$_h$ select static text in line 2
8000$_h$ select static text in line 3
9000$_h$ select static text in line 4

The data string is a data word with the following format:

		High Byte								Low Byte					
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0

FL X   X   X   X   X   X   X |————— text number ————— |
  :
  0 Flashing of the entire display off
  1 Flashing of the entire display on

Any text contained in the addressed line will be deleted upon receipt of a new text. The texts in the other lines will not be deleted.

The displays SX402-220/xx/0G-001/0B-M0 and SX402-240/xx/0G-001/0B-M0 ignore commands sent to lines 3 and 4.

Deleting text | The command **$E↵** as a data string to the register addresses 1000$_h$, 2000$_h$, 3000$_h$ or 4000$_h$ will delete the text of the addressed line [2]. Afterwards the following will appear on the display ⋄. This is only for dynamic texts.

Flashing | Including `$F1` in the data string causes the following characters to flash [4]. `$F0` command in the data string deactivates the flashing of the following characters [5].

The command `$F1↵` as a data string to the register addresses 1000$_h$, 2000$_h$, 3000$_h$ or 4000$_h$ will activate the flashing of the addressed line [10]. The command `$F0↵` as a data string to one of the register addresses 1000$_h$, 2000$_h$, 3000$_h$ or 4000$_h$ will deactivate the flashing of the addressed line [11].

If a static text with set Bit FL is selected in the first byte of the data string (High Byte) and sent to the register addresses 6000$_h$, 7000$_h$, 8000$_h$ or 9000$_h$, the flashing of the addressed display has then been activated. If the Bit FL has been deleted the flashing of the addressed display has been deactivated.

Character set | The character set for all characters can be chosen in the text. The command `$M1` in the data string causes all following characters to be displayed in standard character sets [6]. The command `$M2` in the data string causes all following characters to be displayed in user defined character sets [7]. Characters will be displayed in the standard character set if no user defined character set has been installed.

Bar graph | The `$Gnnn` command in the data string is used for activating the bar graph display [8]. `nnn` stands for the number of illuminating columns, i.e. the length of the bar graph and must always be three digits, e. g. $G040.

**Character $** | The command for displaying the '$' character is `$$` [9].

Chapter 7 | Parameterization

Menu display | The parameterization of the devices is carried out in a menu of the display. 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 display. Now, you can navigate in the menu as follows:

Next menu item:	Shortly press key [↕]
Page menu items forward:	Press key [↕] long
Previous menu item:	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 setting 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, except for menu item 1, 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.

Control of the displays 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	Display
1	Serial Interface	RS232	1 232
		RS485 (4-wire bus)	1 485.4
		RS485 (2-wire bus)	1 485.2
		RS232 Programming operation	1 Prog

Menu item		Settings	Display	
3	Parity	No parity*	3	None
		odd parity	3	Odd
		even parity*	3	Even
4	Baud rate	1200	4	1200
		2400	4	2400
		4800	4	4800
		9600	4	9600
		19200*	4	19.2
		38400	4	38.4
9	Address	Address 1	9	00
		↓	↓	
		Address 247	9	247
A	Initial text	Not displaying initial text*	A	>
		Displaying initial text	A	Txt0
F	Character set	Standard character set*	F	Std
		User-defined character set	F	User
P	Paging interval	2 seconds *	P	2
		5 seconds *	P	5
		10 seconds *	P	10
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

Menu item	Settings	Display
U Saving	Saving parameters* (Set)	U Set
	Not saving parameters (Escape)	U Esc
	Resetting to the default settings (Default)	U Def

Serial Interface | Select in menu item 1 between the interface formats which are available in the unit (RS485 und RS232).

The interface format RS485 should be used for Modbus control (see chapter 2).

Do not use the interface RS232 for Modbus interfacing. It is determined for programming the device using a computer, for example for loading static texts in the text memory and for installing character sets by means of the PC tool 'DisplayManager' provided on data carrier (see chapter 8).

In the interface format RS232, the RTS/CTS handshake is always active.

Parity and baud rate are set in menu items 3 and 4.

Programming operation | If the interface RS232 is connected to a PC for programming the device, for example, for loading static texts or for installing character sets, in menu item 1, the setting Prog has to be selected.

Then, the parameter of the interface RS232 is set firmly as follows: 9600 bauds, 8 data bits, no parity, 1 stop bit, RTS/CTS handshake, CR/LF protocol, no addressing

In the programming mode, the display will be temporarily dark.

After finishing the programming operation, the interface parameters selected in the menu items 3 and 4 are automatically reset.

Addressing | The individual slave address can be set in menu item 9 from 1 to 247.

Time-out | In menu item T, it is possible to set whether a time-out occurs, and if so, after what time. Time-out means that the display is cleared if it has not received a data telegram after a defined time period. The following symbol appears then on the display ⁝⁝.

Initial text | After power-on, ⁝⁝ is displayed to signalize that the unit is ready for operation. If an initial text is to appear in the display instead (e.g. 'System

operational'), this text is to be stored in the text memory with text number 0, and displaying of the initial text is to be set in menu item A.

Paging Interval | If a text contains more characters than can be shown in the display, it is automatically displayed in paging mode. The page change interval can be set between 2, 5 or 10 seconds in menu item P.

Character set | In menu item F, you can set the default character set used to display the texts.

The standard character set is installed in the displays (setting Std). You can access the user defined characters with the setting $User$. If no user defined character set is installed, all the characters are shown in the standard character set.

The PC tool „DisplayManager" is included in the delivery of the displays. The tool is used to install user defined character sets. The tool is also used to install character sets, to save character sets to data media and to read back installed character sets.

A data carrier with the PC tool „DisplayManager" is included in the delivery of the devices. It serves for creating texts and user defined character sets. For details please refer to the menu item „Help" or to the operating manual of the PC tool.

In the programming mode, the display will be temporarily dark.

In order to use the PC tool, the display must be connected to a PC in the following way. In menu item 1 setting Pro3 is to be selected. The handshake cables RTS and CTS should also be connected.

```
PC (RS232)                                  SX402
9 pin D Sub socket                          screw-type terminal

1
2 ──────────────────────────────────────── TxD
3 ──────────────────────────────────────── RxD
4
5 ──────────────────────────────────────── COM
6
7 ──────────────────────────────────────── CTS
8 ──────────────────────────────────────── RTS
9
```

Serious faults due to improper operation or faulty operating conditions are indicated in the display. The following messages are possible:

Fault message	Cause	Elimination
NO_TEXT	The text called up is not saved in the fixed text memory.	The text is to be loaded into the fixed text memory.
SYNTAX_ERROR	A faulty command was sent to the display.	The command must be corrected (see command table in chapter 7).
Time-out	An error occurred when loading static texts or user defined character sets.	The connection and the interface parameters of the PC tool must be corrected.
OVER_FLOW	Too many characters have been sent to the display or the interface parameters are incorrect.	The data telegram has to be corrected or the interface parameters of the communication partners must be adapted.
SERIAL_ERROR	Faulty data has been sent.	Correct the interface parameter of the master and the display or choose the correct setting: to program the display use the setting Pro3 and for the Modbus setting 485.2 or 485.4.

	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	{	¦	}	~	△
8	€	Ü	é	â	ä	à	å	ç	ê	ë	è	ï	î	ì	ä	å
9	É	※	※	ô	ö	ò	û	ù	ÿ	Ö	Ü	⊗	£	⊗	×	ƒ
A	á	í	ó	ú	ñ	Ñ	ª	º	▓	⌐	¬	½	¼	¡	«	»
B	░	▒	▓	│	┤	╡	╢	╖	╕	╣	║	Ŗ	═	¢	¥	è
C	А	Б	В	Г	Д	Е	Ж	З	И	Й	К	Л	М	Н	О	П
D	Р	С	Т	У	Ф	Х	Ц	Ч	Ш	Щ	Ъ	Ы	Ь	Э	Ю	Я
E	α	ß	Γ	π	Σ	σ	µ	τ	Φ	θ	Ω	δ	∞	φ	ε	∩
F	≡	±	≥	≤	⌠	⌡	÷	≈	°	∙	·	√	ⁿ	²	▬	ƒ

The characters 00_h to 1F_h are replaced by blanks.

The characters 00$_h$ to 1F$_h$ are replaced by blanks.

Display range	SX402-220/xx/0G-001/0B-M0	2 x 20 characters
	SX402-420/xx/0G-001/0B-M0	4 x 20 characters
	SX402-240/xx/0G-001/0B-M0	2 x 40 characters
Character height	SX402-220/05/0G-001/0B-M0	approx. 5 mm
	SX402-420/05/0G-001/0B-M0	approx. 5 mm
	SX402-240/05/0G-001/0B-M0	approx. 4,7 mm
	SX402-220/09/0G-001/0B-M0	approx. 9 mm
Display color	green	
Protection type	IP65 (front)	
Operating voltage	24 V DC ±15 %, galvanically isolated, protected against reversed polarity	
Power consumption	approx. 7 VA	
Connection	Pluggable screw-type terminal strip clamping range 0,08…2,5 mm²	
Operating temperature	0...50 °C	
Storage temperature	-20...70 °C	
Relative humidity max. 95 % (non-condensing)		
Weight	SX402-220/05/0G-001/0B-M0	approx. 450 g
	SX402-420/05/0G-001/0B-M0	approx. 450 g
	SX402-240/05/0G-001/0B-M0	approx. 600 g
	SX402-220/09/0G-001/0B-M0	approx. 450 g
	SX402-240/05/0G-001/0B-M0	approx. 600 g
	SX402-220/09/0G-001/0B-M0	approx. 600 g
Fixed text memory	Capacity	16 KBytes
	Number of texts	max. 128 (static texts)
Text length	The text length of static texts is not limited but must not exceed the capacity of the text memory. Dynamic texts can have a length of 200 characters at the most; formatting is included in the 180 characters.	