Series SX402

Alphanumeric displays

with Profinet IO RT interface

Operating instructions

1   Contact

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2   Legal note

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3 Safety precautions

⚠ Bus errors may result in personal injury or material damage. Therefore it must be noted that the activation of the menu may cause a bus error.

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 is 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 is 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.

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.

Grounding

The devices are equipped with a ground connection for connection of the cable shielding to the functional ground (PE).

EMC measures

The devices comply with the EU Directive 2004/108/EC (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 connection of the cable shielding to the functional ground (PE) must be as short and low-impedance as possible.

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. 0.1µF/600 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.

4 Unit description

Model designation

This manual applies to units with the following model designation:

SX402-220/05/0G-001/0B-CP   SX402-420/05/0G-001/0B-CP

SX402-240/05/0G-001/0B-CP   SX402-220/09/0G-001/0B-CP

Start-up

To locate the device in the hardware catalog of the engineering tool the GSDML file must be installed. The file is on the data carrier included in delivery.

After installing the GSDML file the Profinet IO-device named NL51NDPL which is located in the hardware catalog is added to an existing Profinet IO-system.
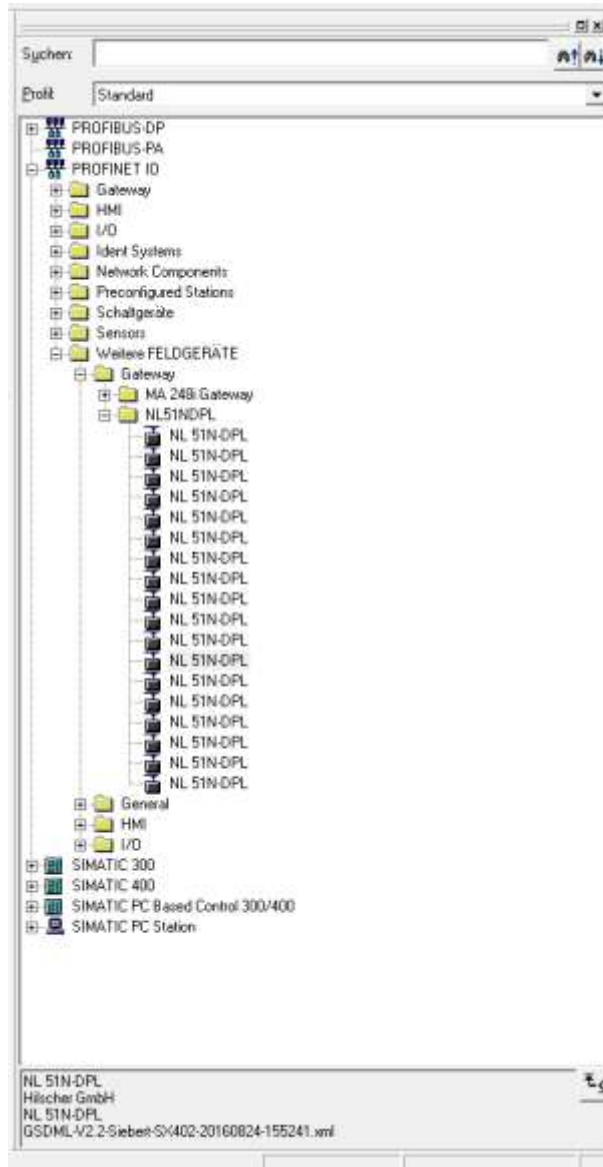
The output addresses of the device are defined (here: input address 2 and output address 40 … 47).

Translations:
Suchen	search
Profil	profile
Weitere Feldgeräte	Other field devices

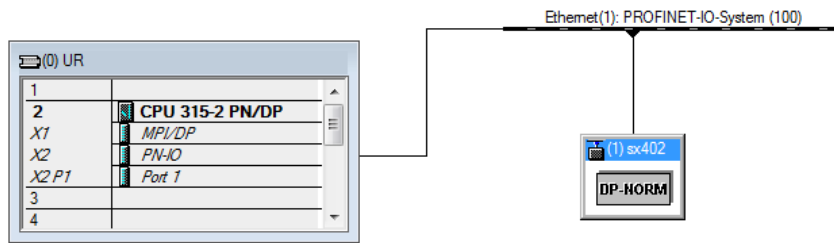| Steckplatz		Baugruppe	Bestellnummer	E-Adresse	A-Adresse	Diagnoseadresse	Kommentar
0		sx402	NL51N-DPL			2043*	
Interface 1		Interface 1				2042*	
Interface 1 - Port1		Interface 1 - Port1				2041*	
1		NL51N (PROFIBUS-DP)	MasterOrderNumber			2040*	
2		SX402	SlaveOrderNumber	2	40...47		

By assigning a name the device receives an IP address assigned by the controller and it is registered in the Engineering Tool. From this moment the display is manageable via the defined output addresses.

Translations:
Steckplatz   socket
Baugruppe   module
Bestellnummer   order no.
Diagnoseadresse   diagnostic address
Kommentar   comment

In OB100 the following settings must be made in accordance with the assigned data in the hardware configuration.

Translations:
Gerätenamen vergeben   assign device name
Gerätename   device name
Gerätetyp   type of device
Vorhandene Geräte   existing devices
Name zuweisen   assign name
Teilnehmer-Blinktest   flash test participant
Dauer   duration
Sekunden   seconds

German	English
Blinken ein	flashing on
Aktualisieren	update
Exportieren	export
Schließen	close
Hilfe	help
nur Geräte gleichen Typs anzeigen	only show devices of the same kind
nur Geräte ohne Namen anzeigen	only show devices without name

```
OB100 :  "Complete Restart"

Kommentar:


☐ Netzwerk 1 : Titel:

Initialize work DB for display
Settings done here MUST exactly match in hardware setup

        L     P#2.7
        T     "Display_WorkDb".RxHsAdr      DB1.DBD0

        L     P#40.0
        T     "Display_WorkDb".TxHsAdr      DB1.DBD4

        L     P#41.0
        T     "Display_WorkDb".TxDatAdr     DB1.DBD8

        L     8
        T     "Display_WorkDb".TxDatLen     DB1.DBW12

        L     1
        T     "Display_WorkDb".SrcDbNum     DB1.DBW14
```

From the PLC example (input byte 2 and output byte 40 …47)

1.   Handshake bit of input address (bit 7 in the input byte 2)

2.   Handshake bit of output address (bit 0 in the output byte 40)

3.   First user data byte (Handshake address +1) = output byte 40 +1

4.   Length of data package is always 8 byte

5.   Work data module (for the function) see example DB1

At the end the following values have to be entered in FC1:

```
⊟ Netzwerk 1 : Display handling and message generation

call display communication handler - check for transmit busy/ready
check inputs for rising / falling edge and generate dispaly messages if not
busy

///////////////        DISPLAY PREPARE      ///////////////////////////////

// ** call display communication handler DoRegular
      CALL  "Display_DoRegular"        FC51              -- Setup variables in SX40
       WorkDbNum:=W#16#1     ⬅
       RET_VAL  :=#DspDoRegRes          #DspDoRegRes      -- result of call to DoReg

// ** check if last message transmit complete
      L      #DspDoRegRes              #DspDoRegRes       -- result of call to DoReg
      L      W#16#0
      ==I
      SPBN  L299


//////////////////////////        TEXT CALL      ///////////////////////////////

// ** Text 1 call
      CLR


      U      E       0.0
      FP     M     199.0
      SPBN  L200

      L      2
      T      #SrcDbNum                 #SrcDbNum          -- temp var used during in
      SPA    L290


// ** Text 2 call
      CLR


L200: U      E       0.1
      FP     M     199.1
      SPBN  L299

      L      3
      T      #SrcDbNum                 #SrcDbNum          -- temp var used during in
      SPA    L290




////////////////        TEXT SEND TO DISPLAY     ///////////////////////////////

// ** Text send to display

L290: NOP    0
      CALL  "Display_StartTrans"       FC50              -- Handle message segmenta
       NumWorkDb:=W#16#1    ⬅
       NumSrcDb :=#SrcDbNum             #SrcDbNum         -- temp var used during in
       RET_VAL  :=#DspStartRes          #DspStartRes      -- result of call to Start
      SPA    L299
```

When calling the communication modules the work data block has to be entered.

The two other values marked are data blocks which contain the texts to be send.

To be able to send the texts from DB2 and DB3 to the display a positive flank has to be set on input E0.0 or E0.1
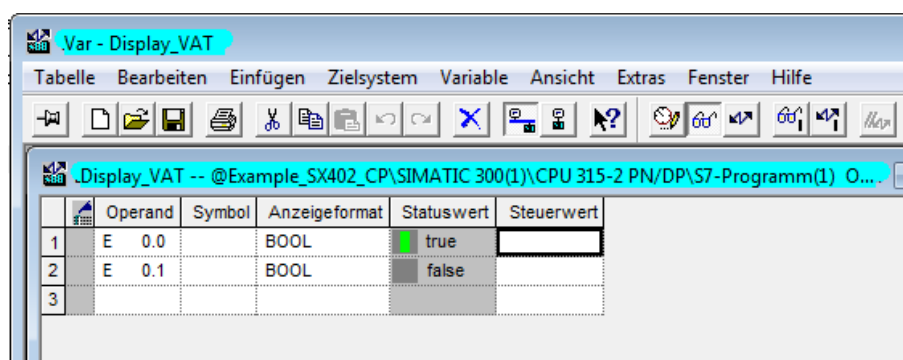
6   Control

⚠️ Bus errors may result in personal injury or material damage. Therefore it must be noted that resetting the unit with the command $0 and activating the menu can cause a bus error.

Handshake

Due to the system the data transmission in the Profinet is cyclical. Data located in the input or output area of the master are exchanged cyclically between master and slave. Therefore new data must be characterized as 'new' by a handshake. The data transfer is only done once, whereas the cyclic repetition is ignored.

The handshake labels new data for the display (send handshake) and checks the readiness to receive of the display (busy check).

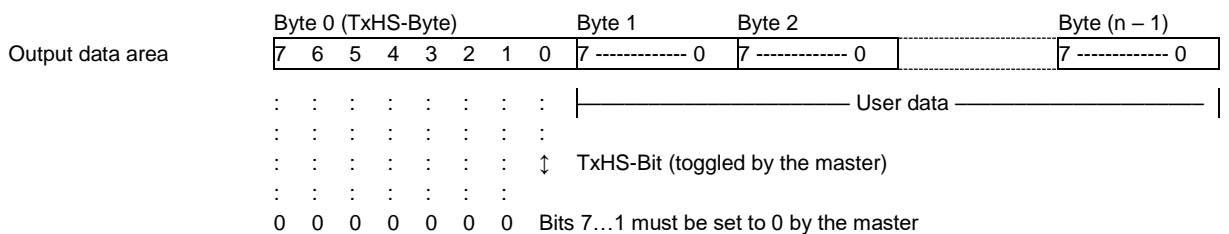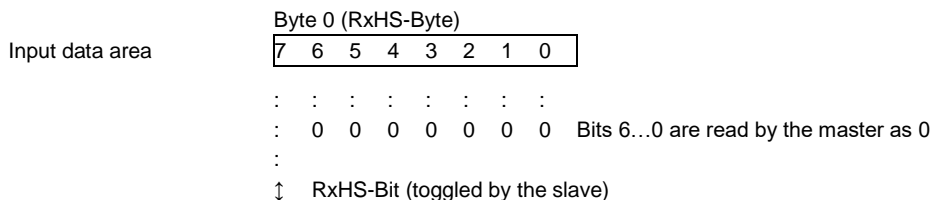For the send handshake, bit 0 (TxHS bit) has been reserved in the first byte of the output data area (TxHS byte). Bits 7...1 must be set to 0 by the master.

	Byte 0 (TxHS-Byte)	Byte 1	Byte 2		Byte (n – 1)
Output data area	7 6 5 4 3 2 1 0	7 ------------- 0	7 ------------- 0		7 ------------ 0

```
:  :  :  :  :  :  :  :      |———————————— User data ———————————— |
:  :  :  :  :  :  :  :
:  :  :  :  :  :  :  ↕   TxHS-Bit (toggled by the master)
:  :  :  :  :  :  :
0  0  0  0  0  0  0   Bits 7…1 must be set to 0 by the master
```

For the busy check, bit 7 (RxHS bit) has been reserved in the only byte of the input data area (RxHS byte). Bits 6…0 are read by the master as 0.

	Byte 0 (RxHS-Byte)
Input data area	7 6 5 4 3 2 1 0

```
:  :  :  :  :  :  :  :
:  0  0  0  0  0  0  0   Bits 6…0 are read by the master as 0
:
↕   RxHS-Bit (toggled by the slave)
```

Flow chart

After the transfer to DATA-EXCHANGE (display has been parameterized and Profinet has been recognized) the display will set the RxHS bite to the starting value of 0. The master will also set the TxHS bite to 0 during the transfer to the DATA-EXCHANGE.

The display is ready to receive as soon as the RxHS bit has the same value as the TxHS bit sent last. Now the master can send new data to the display. The master marks new data by inverting the TxHS bit (toggle). The new data is written in the user data if the TxHS byte is unchanged. The TxHS bit will be toggled into TxHS-Byte only after this has been done. After a short time, the display signals again readiness to receive by setting the RxHS bit equal to the TxHS bit received last.

```
        ┌─────────────────────┐
        │    Entry of state   │
        │   DATA-EXCHANGE     │
        └─────────┬───────────┘
                  │
        ┌─────────▼───────────┐
        │    TxHS Bit:= 0     │
        └─────────┬───────────┘
                  │
        ┌─────────▼───────────┐  No
        │ New data to display?├──────┐
        └─────────┬───────────┘      │
                  │                  │
        ┌─────────▼───────────┐  No  │
        │ RxHS Bit == TxHS Bit?├─────┤
        └─────────┬───────────┘      │
                  │                  │
        ┌─────────▼───────────┐      │
        │ Generate new data block│   │
        └─────────┬───────────┘      │
                  │                  │
        ┌─────────▼───────────┐      │
        │   Write data block  │      │
        │  (excluding TxHS Byte)│    │
        │   to output bytes   │      │
        └─────────┬───────────┘      │
                  │                  │
        ┌─────────▼───────────┐      │
        │   Toggle TxHS Bit   │      │
        │   in TxHS Byte      │      │
        └─────────┬───────────┘      │
                  └──────────────────┘
```
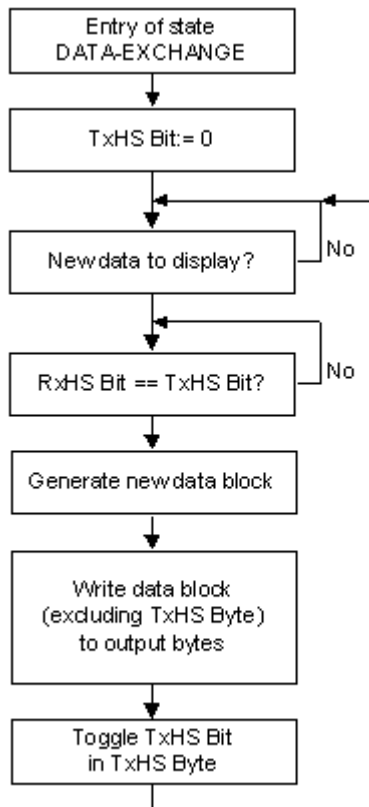
Data segmentation

The system requires the number of output bytes to be limited. This may require the division of a new data telegram into several segments. In accordance with the handshake method described above, each individual segment contains a send handshake byte (TxHS byte), and the maximum number of bytes it can contain is that configured in the output data area.

The segments are sent in succession to the display in accordance with the handshake. The display evaluates the data after receipt of a message termination.

Surplus output bytes have to be filled with 00_h if less data than that that has been configured in the output data area is being sent to the display. It does not matter whether the data is being segmented or not. Data bytes containing 00_h are ignored by the display.

Functional building block

We will send you a sample program for Siemens S7 as a data medium for the control of a display and a functional building block for the implementation of the handshake.

Data evaluation

The data is evaluated according to the command table shown below. In the description, the numbers in [ ] refer to the corresponding lines in the command table.

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.

Commands with ↵ require a telegram ending (<CR>, <LF> or <CR/LF>).

In line [1] `cc...` stands for a character chain of any desired content.

Commands for text manupulations

Display text	`cc...↵`	Send any desired characters	[1]
Delete text	`$E↵`	Delete text in the display	[2]

Commands for text formatting

Line break	`$C`	Forced line break	[3]
Flashing	`$F1`	Flashing of following characters on	[4]
	`$F0`	Flashing of following characters off	[5]
Bar graph	`$Gnnnn`	Bar graph display (nnn = number of columns, always enter in four numeric digits, e.g. $G0040)	[6]
Character $	`$$`	Display of the character '$' in the text	[7]

Commands for display options

Flashing	`$F1↵`	Flashing of the whole display on	[8]
	`$F0↵`	Flashing of the whole display off	[9]
Reset	`$0↵`	Restart of the display	[10]

Display text

To display a text, its characters (cc…) are sent to the display as a data telegram [1]. Any text in the display is cleared when a new text is received.

Delete text

Any text in the display is cleared with the `$E↵` command [2]. Afterwards the following will appear on the display ⠿ .

Line break

If a 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 `$F1↵` command activates the flashing of the entire display [8]. The `$F0↵` command deactivates the flashing of the entire display [9].

Bar graph

The `$Gnnn` command activates the bar graph display [31]. `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 [6].

Character $

The command for displaying the '$' character is `$$` [7].

Reset

The command `$0↵` restarts the unit [10].

⚠️ Bus errors in Profinet systems may result in personal injury or material damage. Therefore it is to observe that a bus error at the Profinet may occur if you reset the display with the command $0 while the display is in operation.

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.

7   Individual line selection

Application

The activation of the devices as described in chapter "Control" is optimized for applications in which individual texts are shown in the display. 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 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.

Commands

The individual line selection is carried out by means of commands according to the following command table. In the description of the commands, the numbers in [ ] refer to the corresponding lines in the command table.

The commands beginning with **$Lx** select an individual line. **x** is the line number (1 … 4).

Commands with ↵ require a telegram ending (<CR>, <LF> or <CR/LF>).

In line [11] **cc...** stands for a character chain of any desired content.

Commamnds for text manipulations

Display text	`$Lxcc...↵`	Send any desired characters	[11]
Delete text	`$Lx$E↵`	Delete the text in the line x	[12]
Flashing	`$Lx$F1↵`	Flashing of the entire line x on	[13]
	`$Lx$F0↵`	Flashing of the entire line x off	[14]

Menu

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

In normal operation, status messages appear in the menu display.

Menu operation

To start the menu, press both menu buttons simultaneously (approx. 1 sec.) until the first menu item appears in the menu display. It is now possible to 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 key [↕] 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 key [↔] and keep it pressed

To exit the menu shortly press the key [↕] in menu item U. Depending on the setting in menu item U the settings made are either saved (set) or not saved (escape) or the factory settings are reset (default).

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

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

In the menu mode the control of the display is not possible.

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	
P	Paging	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
U	Saving	Saving parameters* (Set)	U	Set
		Not saving parameters (Escape)	U	Esc
		Resetting to the default settings (Default)	U	Def

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. Sign ⁖ then illuminates on the display.

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 on 2, 5 or 10 seconds in menu item P.

8   Status messages

Fault messages

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

| Fault message	Cause	Rectification
Syntax_ERROR	An incorrect command was sent to the display	The command has to be corrected
OVER_FLOW	Too many characters have been sent to the display	Correct the data telegram

9 Character table

Character set

	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	æ	Æ	ô	ö	ò	û	ù	ÿ	Ö	Ü	¢	£	¥	₧	ƒ
A	á	í	ó	ú	ñ	Ñ	ª	º	¿	⌐	¬	½	¼	¡	«	»
B	░	▒	▓	│	┤	╡	╢	╖	╕	╣	║	╗	╝	╜	╛	Ë
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	β	Γ	π	Σ	σ	μ	τ	Φ	θ	Ω	δ	∞	ø	ε	∩
F	≡	±	≥	≤	⌠	⌡	÷	≈	°	∙	·	√	ⁿ	²	■	

11   Technical data

Dimensions
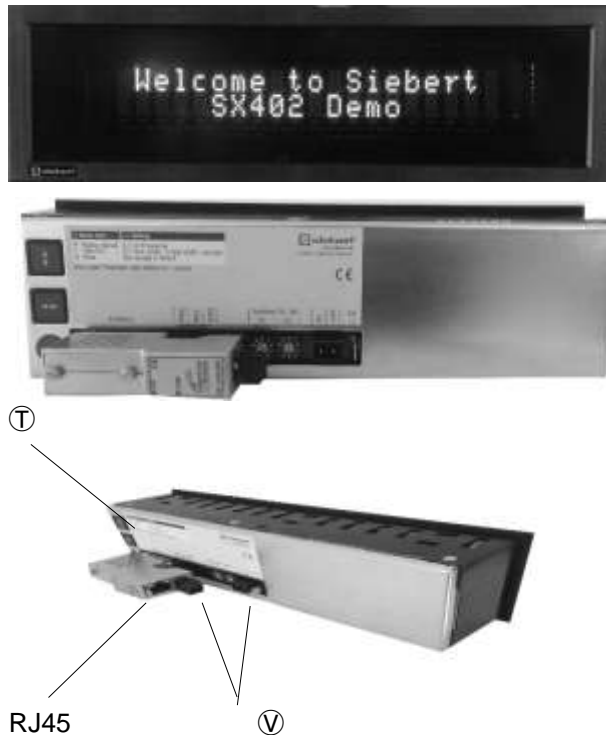
Symbol	Description
Ⓣ	Menu buttonsr
Ⓥ	Power supply voltage
RJ45	Profinet interface

SX402-220/05/0G-001/0B-CP/x
SX402-420/05/0G-001/OB-CP
Dimensions (W x H x D) 144 x 72 x 97 mm
Panel cut out (W x H) 138 x 66 mm

SX402-240/05/0G-001/0B-CP/x
SX402-220/09/0G-001/0B-CP
Dimensions (W x H x D) 240x 72 x 97 mm
Panel cut out (W x H) 234 x 66 mm

Unit properties

Display range	SX402-220/xx/0G-001/0B-K0	2 x 20 characters
	SX402-420/xx/0G-001/0B-K0	4 x 20 characters
	SX402-240/xx/0G-001/0B-K0	2 x 40 characters
Character height	SX402-220/05/0G-001/0B-K0	approx. 5 mm
	SX402-420/05/0G-001/0B-K0	approx. 5 mm
	SX402-240/05/0G-001/0B-K0	approx. 4,7 mm
	SX402-220/09/0G-001/0B-K0	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. 15 VA	
Connecting technology	Profinet, RJ45 socket	
Power supply	Plug-in screw-terminal strip, Capacity of terminals 0.08…2.5 mm²	
Operating temperature	0...50 °C	
Storage temperature	20...70 °C	
Humidity	max. 95 % (non-condensing)	
Weight	SX402-220/05/0G-001/0B-K0	approx. 650 g
	SX402-420/05/0G-001/0B-K0	approx. 650 g
	SX402-240/05/0G-001/0B-K0	approx. 800 g
	SX402-220/09/0G-001/0B-K0	approx. 800 g
Text length	max. 200 characters including formatting	