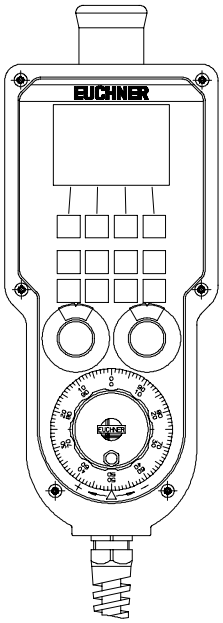
Pendant Station
with LCD - Display

HBLS 072725

Manual



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1. Equipment

Pendant housing	PA6 housing with reinforced fibreglass colour: blue-grey RAL 7031 hanging clip and magnetic clamp in the back
Front panel	plastic cover, RAL 7000 keypad can be labelled with insertion foil, selector switches can be labelled with transparent dials
Switching elements and LEDs	12 short stroke push-buttons with LED, 2 selector switches, 12 positions each, E-Stop with pull release to EN 418, 2 NC-contacts, 2 Enabling Push Buttons, 2 NO-contacts each, OR-wired
LCD-Display	with background-illumination Text mode: 8 lines, 15 characters/line Lens coverage: 62.6 x 43.5 mm Active area: 57.56 x 38.36 mm Contrast adjustment inside the pendant
Handwheel	100 detent positions per revolution 100 pulses per revolution Dial ∅ 65 mm
Connection	Lead, straight, 3.5 m, with circular metal connector, 23-pin
Environmental protection	IP 65 with plug connected
Weight	1700 g (3.75 lbs.)

2. Electrical Data

Operating temperature range	0 to +50 °C	(32 to 122 F)
Storage temperature range	-20 to +70 °C	(-4 to 158 F)
Humidity during operation, rel.	80%	
Humidity during storage, rel.	90%	

Operating voltage U_B DC 19,2V . . . 28,8V (DC 24V +/- 20%)

Operating current, max.	
without load	150 mA
all LEDs on	180 mA

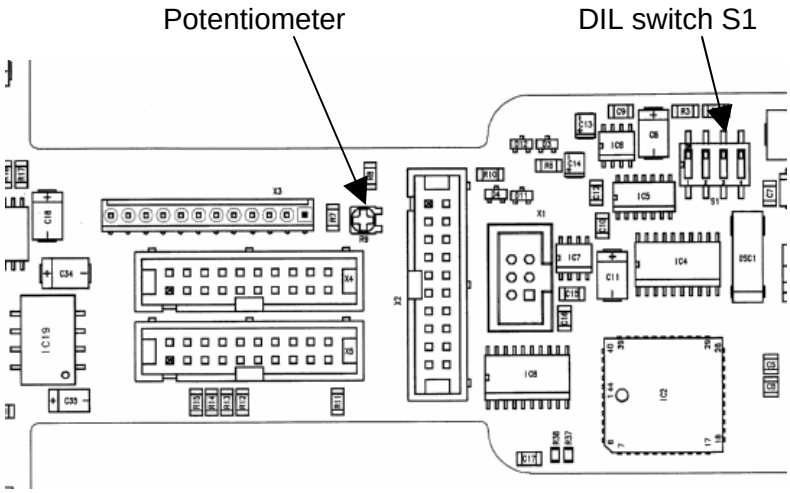
Handwheel

Operating voltage (internal)	DC 5V +/-5%
Output circuit	according to RS 422A
Outputs, galvanically isolated	A, /A, B, /B

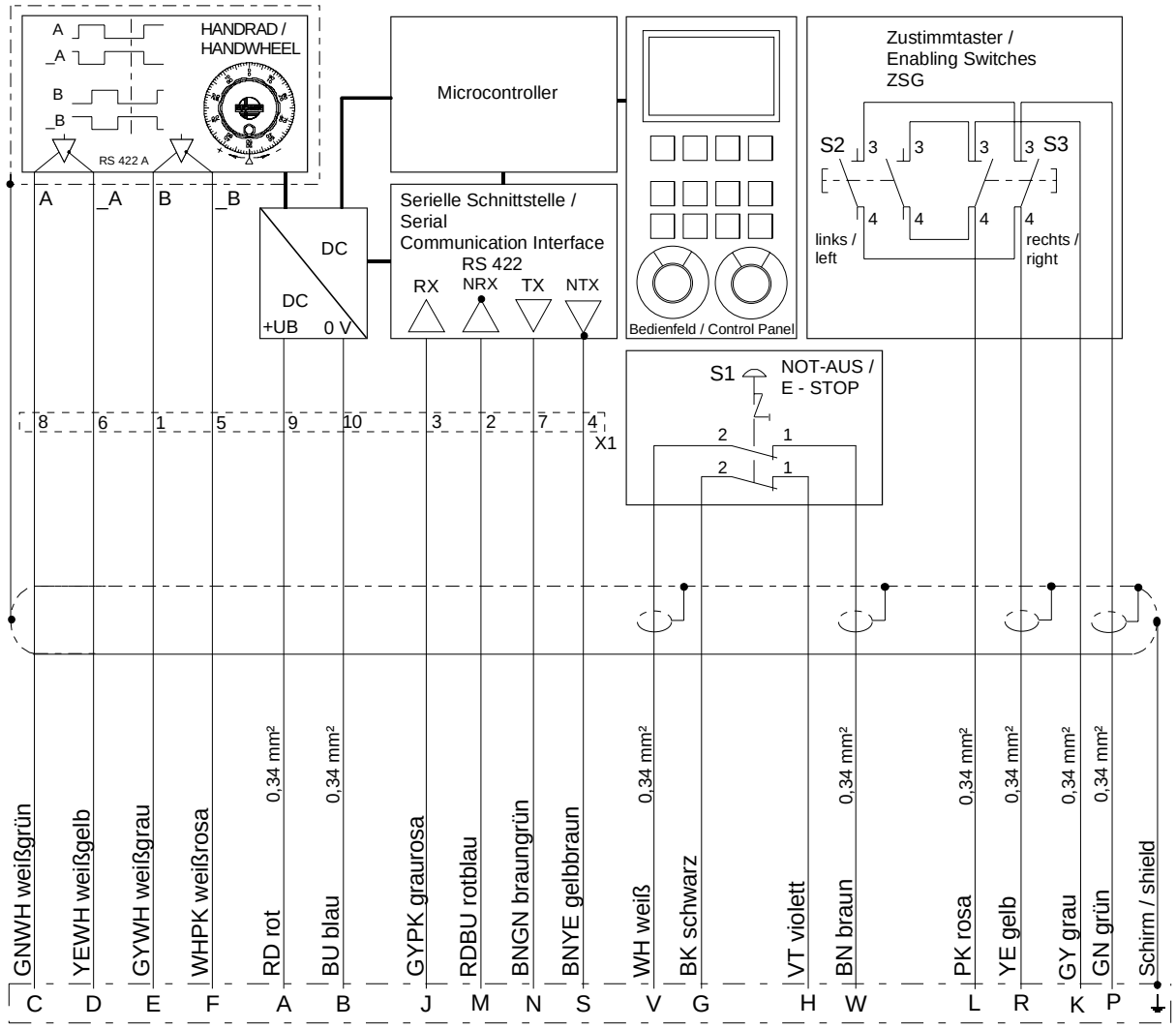
Serial data interface	RS 422A
Data format	8 Data bit + 1 Parity bit (even), 1 or 2 Stop bit
Baud rate	9600 or 19200 Baud, selectable via DIL switch
Transfer protocol	leant to procedure 3964R

	DIL switch S1				
	1	**2**	**3**	**4**	
19200 Baud	OFF	OFF	OFF	OFF	
9600 Baud	ON	OFF	OFF	OFF	default

Contrast LCD:
turning Potentiometer
clockwise = brighter

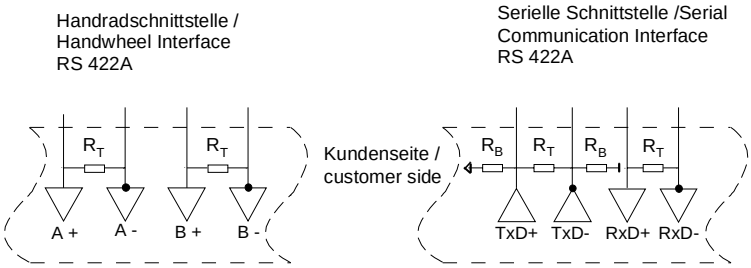


3. Wiring scheme



nicht belegt / not connected:
T,U,X,Y,Z; BNPK,BUWH,BNBU,RDWH,BNGY
nicht bezeichnete Adern /
wires without notes: 0,14 mm²

Schirm el. leitend mit Steckergehäuse verbunden /
shield electr. connected with connector housing



Abschlußwiderstände R_T und Zugwiderstände R_B bei Bedarf /
Termination resistors R_T and bias resitors R_B, if required

4. Power On / Initialising

Directly after Power On, the HBLS is in a non active state and a self test is executed.
During this time, the serial data interface is disabled.
The display shows the actual software version, built in.
Any changes of push buttons and selector switches are ignored.
First of all, the HBLS has to be initialised by the control.
This has to be done by requesting the actual states of the buttons and the selector switches, by performing the function status check.

5. Acknowledge Push-button and Selector Switch Status change

Every status change of push-buttons and selector switches will be transmitted to the PLC.

When pushing two or more buttons at the same time, only the first will be transmitted. If one button remains pushed, another button will be ignored, and the status will not be changed.

5.1 Push-button Status change

PLC	HBLS		
	Byte 1	STX	(02H)
Byte 1 DLE			
	Byte 2	Push-button byte	(see table)
	Byte 3	DLE	
	Byte 4	ETX	(03H)
	Byte 5	BCC	
Byte 2 DLE			

Push-button Table

Button pushed	*Push-button Byte*
Push-button 1	31H
Push-button 2	32H
Push-button 3	33H
Push-button 4	34H
Push-button 5	35H
Push-button 6	37H
Push-button 8	38H
Push-button 9	39H
Push-button 10	3AH
Push-button 11	3BH
Push-button 12	3CH
No button pushed	30H

Push-button Layout

1	2	3	4
5	6	7	8
9	10	11	12

5.2 Selector Switch Status change

Selector Switch W1	*Byte*	*Selector Switch W2*	*Byte*
Position 1	41H	Position 1	51H
Position 2	42H	Position 2	52H
Position 3	43H	Position 3	53H
Position 4	44H	Position 4	54H
Position 5	45H	Position 5	55H
Position 6	46H	Position 6	56H
Position 7	47H	Position 7	57H
Position 8	48H	Position 8	58H
Position 9	49H	Position 9	59H
Position 10	4AH	Position 10	5AH
Position 11	4BH	Position 11	5BH
Position 12	4CH	Position 12	5CH

Selector Switch Layout

W1	W2

6. Status Check

The actual status is requested from the pendant through the PLC.

The PLC can request the status of the selector switches and push-buttons at any time, it is recommended to do this after receiving a NAK, this will “reset” the HBLS.

a.) PLC is requesting actual status from the pendant

HBLS		PLC		
		Byte 1	STX	(02H)
Byte 1	DLE			
		Byte 2	Status Word	(23H)
		Byte 3	DLE	(10H)
		Byte 4	ETX	(03H)
		Byte 5	BCC	
Byte 2	DLE			

b.) Pendant is sending actual status immediately

PLC		HBLS		
		Byte 1	STX	(02H)
Byte 1	DLE			
		Byte 2	Pushb.-Byte	(see table)
		Byte 3	Selec1-Byte	(see table)
		Byte 4	Selec2-Byte	(see table)
		Byte 5	DLE	(10H)
		Byte 6	ETX	(03H)
		Byte 7	BCC	
Byte 2	DLE			

Status request

Status Word 23H

Push-button 1...12, Selector Switch 1, Selector Switch 2

The control has to receive the whole string of the status information, before sending a new STX.

example:

wrong:										!									
pendant HBLS	NAK			DLE					DLE	STX									
control PLC			STX		#	DLE	ETX	BCC		STX									

right:										!									
pendant HBLS	NAK			DLE					DLE	STX		Pushb	Selec1	Selec2	DLE	ETX	BCC		STX
control PLC			STX		#	DLE	ETX	BCC			DLE							DLE	

7. LED on/off

The LEDs can be switched on/off or set up to flash separately.

The PLC tells the pendant which LED has to be switched on or off.

HBLS		PLC		
		Byte 1	STX	(02H)
Byte 1	DLE			
		Byte 2	LED-Byte	(see table)
		Byte 3	DLE	(10H)
		Byte 4	ETX	(03H)
		Byte 5	BCC	
Byte 2	DLE			

LED	*on*	*off*	*flashing*
LED 1	31H	41H	51H
LED 2	32H	42H	52H
LED 3	33H	43H	53H
LED 4	34H	44H	54H
LED 5	35H	45H	55H
LED 6	36H	46H	56H
LED 7	37H	47H	57H
LED 8	38H	48H	58H
LED 9	39H	49H	59H
LED 10	3AH	4AH	5AH
LED 11	3BH	4BH	5BH
LED 12	3CH	4CH	5CH
all LEDs	30H	40H	50H

LED Layout

1	2	3	4
5	6	7	8
9	10	11	12

8. Data Transfer

8.1 Protocol 3964 R

The protocol of the serial interface is leant to the procedure 3964 R.

The data transfer starts by sending the STX character. The receiver has to respond within 128 ms with the DLE character. The transmitter will then send the information.

The connection will not be made if the receiver responds with NAK, a character <> DLE, an incorrect character, or if the response isn't in the proper time frame. The receiver will stop the data transfer after 3 unsuccessful attempts, and will then send a failure message (HBLS will show situation with all LEDs flashing).

When the receiver responds within allotted time frame with the DLE character, the data of the transmitter buffer will be sent to the receiver. The receiver itself is expecting the data within 128 ms. If the data is not sent within this time, the receiver will send the NAK character. The transmitter will then try to send the telegram again. The transmitter will stop the data transfer after 3 unsuccessful attempts, and will then send a failure message (HBLS will show situation with all LEDs flashing).

After sending the content of the buffer, the transmitter will add the DLE and ETX character as an acknowledgement. In addition to this, the transmitter will send the BCC character (**B**lock **C**heck **C**haracter).
The receiver will respond within 128 ms with the DLE character to confirm the successful data transmission, or will send the NAK character if an unsuccessful transmission has occurred.

8.2 Character Definition

data format: 8 BIT, value range 0x00 ... 0xFF (00H ... FFH)

The value range has following chapters:

0x00 0x1F : common control characters
0x30 0x3C : push buttons change
0x41 0x4C : selector switch W1 status change
0x51 0x5C : selector switch W2 status change
0x30 0x3C : LED on
0x40 0x4C : LED off
0x50 0x5C : LED flashing
0x20 0x7F : control characters and instructions for the LCD (identified with 0x6C)
0x80....0xFF.: LCD character set (see chapter *Character Set*)

Control characters:

STX	0x02	Start of Text Beginning of the character sequence
ETX	0x03	End of Text End of the character sequence
DLE	0x10	Data Link Escape Data transfer direction change
NAK	0x15	Negative Acknowledge
BCC	0x00 ... 0xFF	Block Check Character

8.3 BCC Block Check Character / equal to 3964R

The BCC (Block Check Character) is generated by calculation.
All the characters in a string have to be exclusive OR'd with each.
The resulted BCC character is added as the final character.

STX	Data Block	DLE	ETX	BCC

calculation:

1. character of the data block
XOR 2. character of the data block
XOR - - -
XOR last character of the data block
XOR DLE
XOR ETX

= BCC

simplification:

The 2 control characters, ETX and DLE are always present. You can collect them (03 XOR 10 = 13) and calculate the data block separately. The result of the data block is afterwards exclusive OR'd with the constant value 13H.

BCC = (XOR Data Block) XOR (13H).

8.4 Examples of BCC-Calculation

***example 1**, LED 7 switching ON:*

Byte 1		
Byte 2	LEDBYTE	(37H = LED 7 ON)
Byte 3	DLE	(10H)
Byte 4	ETX	(03H)
Byte 5	BCC	

37 XOR **10** = 27

27 XOR **03** = 24

BCC = 24

simplified variation:
Data Block, existing of 1 character: 37 XOR 13 = 24

***example 2**, display text* Euchner*:*

Example of a data block, which displays the text Euchner *at the actual cursor position: 0x6C 0xA5 0xD5 0xC3 0xC8 0xCE 0xC5 0xD2*

Byte 1		
Byte 2	LCD mode byte (6CH)	
Byte 3 ... 9	A5H, D5H, C3H, C8H, CEH, C5H, D2H	
Byte 10	DLE	(10H)
Byte 11	ETX	(03H)
Byte 12	BCC	(created by bytes 1 to 11)

6C XOR **A5** = C9

C9 XOR **D5**= 1C

1C XOR **C3** = DF

DF XOR **C8** = 17

17 XOR **CE** = D9

D9 XOR **C5** = 1C

1C XOR **D2** =CE

CE XOR 10 = DE

DE XOR **03** = DD

BCC = DD

simplified variation:
Data Block existing of

6CH, XOR A5H, XOR D5H, XOR C3H, XOR C8H, XOR CEH, XOR C5H, XOR D2H = CE

CE XOR 13 = DD

9. Priorities at data collision (PLC has higher priority)

The PLC transmitter has a higher priority, and the HBLS transmitter has a lower priority.

In case of a collision, which means the HBLS recognises an incoming STX character from the PLC while sending its own STX to the PLC **at the same time**, the data, intended to transfer to the PLC will be interrupted and the data from the PLC will be handled first. When completed, the data transfer from the HBLS to the PLC will be repeated.

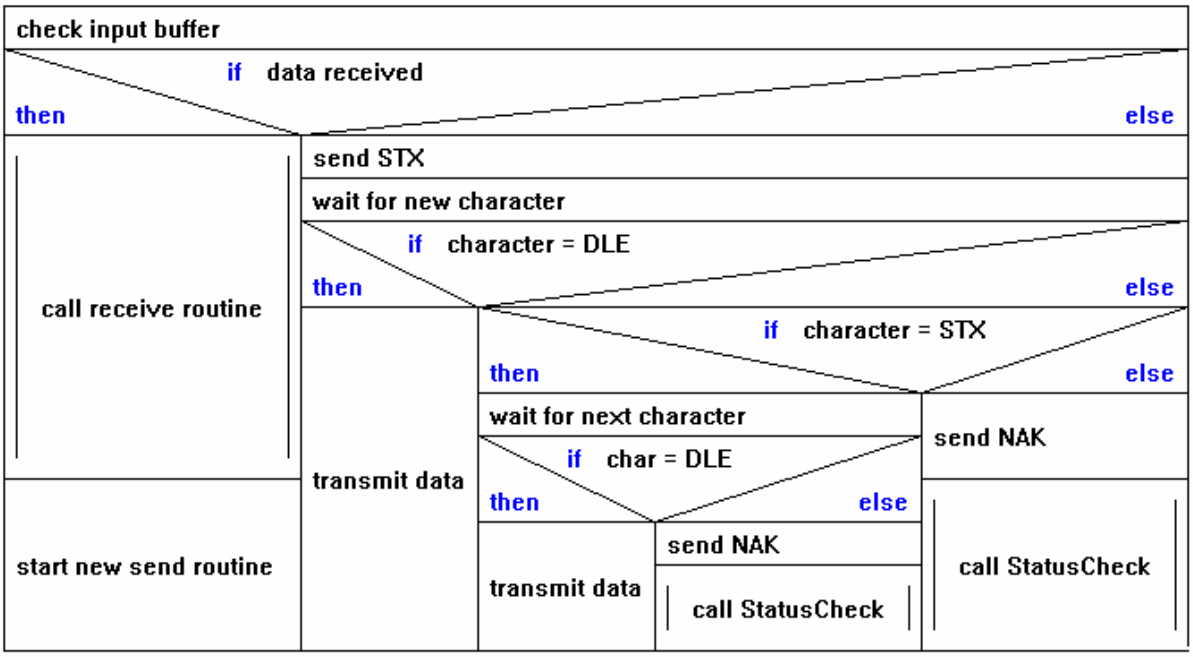
Example of possible collisions:

HBLS is sending push button changed	STX	DLE	??
PLC is sending “LED 1 ON”	STX	DLE	??

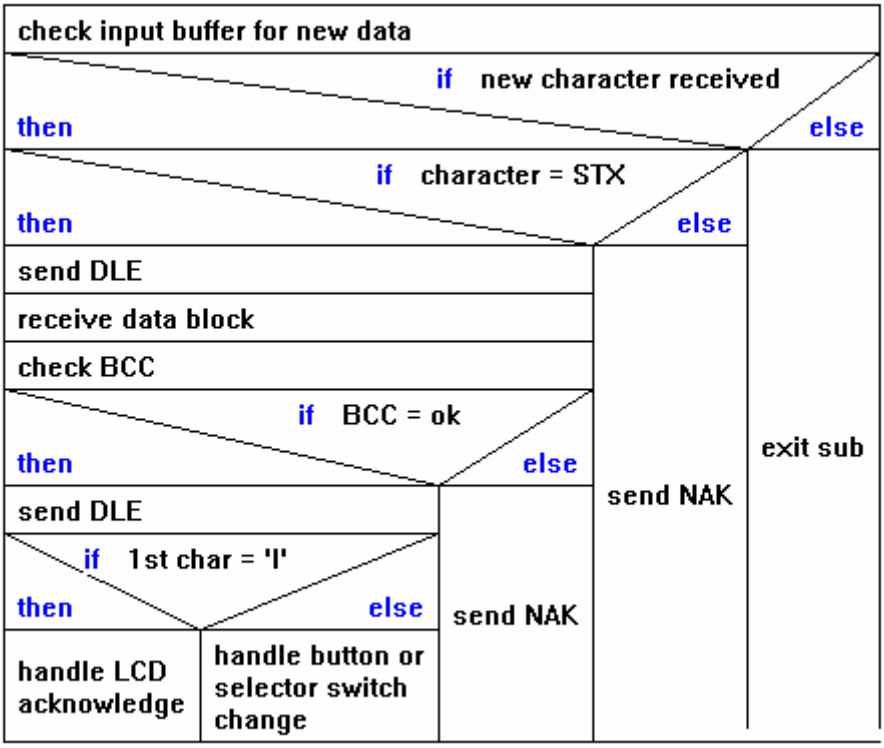
Solution:

HBLS is sending push button changed	STX	DLE					DLE	STX
PLC is sending “LED 1 ON”	STX		31H	DLE	ETX	BCC		

send Data to HBLS



receive data



StatusCheck

send Status Request (#)
wait for status information
evaluate status

10. LC-Display

The LCD operates in text mode.

The PLC transfers style attributes and content of the displayed message.

Frequently used messages will be transferred to the HBLS during an initialising routine and stored in the data memory (RAM). These messages can then be displayed by a short command.

Command to the LCD:

PLC:	STX		LCD Data block	DLE	ETX	BCC	
LCD:		DLE					DLE

Acknowledge:

PLC:		DLE					DLE
LCD:	STX		LCD Acknowledge block	DLE	ETX	BCC	

Each data block, which includes a command for the LCD (in contrast to push-buttons or selector switches) has to have a LCD identifier byte as the first sign:

Hex 0x6C / ASCII "small-l".

A data block can include several commands with a maximum length of 128 Bytes.

LCD Acknowledge block:

After being adapted, each command has to be acknowledged with the LCD Acknowledge block. During this procedure, the HBLS is able to handle push buttons and LED commands. A further LCD data block can only be sent after the LCD Acknowledge block.

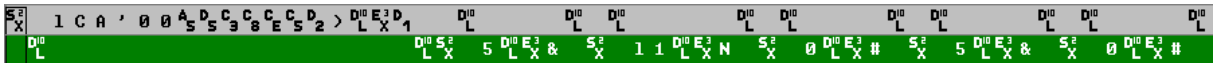
The acknowledge block includes the LCD identifier byte and an additional Status-Byte.

Status-Bytes:	0x31	command okay
	0x32	no defined text selected
	0x33	no defined area selected
	0x34	illegal parameter

Hint: After a status check (request the actual status), the LCD Acknowledge block is no longer sent.

example 1:
LCD data block - LCD acknowledge block

example 2:
LCD data block - push button 5 activated - LCD acknowledge block – push button released



example 3:
push button 6 activated - LCD data block - LED 5 ON - LCD acknowledge block - push button released

The typical delay time between the reception of the LCD string and the LCD acknowledge block is 20 ms.
Therefore, a push button change, happening during the transmission of a LCD string can be surely recognised by the PLC. Even a LED can be turned ON or OFF during this time delay.

example 4:
status request –
status information: no push button activated, selector switch left 02, selector switch right 03

It is not allowed to break a string, which is already in process.
Before sending a new string, it is necessary to check the input (receiver) buffer for a STX, pending from the HBLS.

10.1 Functions

10.1.1 Cursor Functions

Command Byte	Description	Parameter
0x21	cursor to the next character	
0x22	cursor to the previous character	
0x23	cursor to the next line	
0x24	cursor to the previous line	
0x25	cursor to the LCD home position	
0x26	cursor to the beginning of a line	
0x27	cursor to a defined position	line (0x30..0x37), column (0x30..3F)

Example of a data block, which first places the cursor at the display home position and then at line 2, column 3:

0x6C 0x25 0x27 0x32 0x33

10.1.2 Character displaying

In order to display a character at the actual cursor position, it has to be written in the data block. The cursor will then be set to the next position (except at the end of the display).

Example of a data block, which displays the text Euchner *at the actual cursor position:*

0x6C 0xA5 0xD5 0xC3 0xC8 0xCE 0xC5 0xD2

A text can also be displayed with different attributes by using Command-Bytes as shown in the following table.

Command Byte	Description	Parameter
0x40	Inverse on, all following characters will be displayed inverse	
0x41	Inverse out	
0x42	Flash on, all following characters will be displayed flashing	
0x43	Flash off	

Example of a data block which displays the text Euchner *inverse at the actual cursor position:*

0x6C ***0x40*** *0xA5 0xD5 0xC3 0xC8 0xCE 0xC5 0xD2* ***0x41***

Attributes will be kept set up unless they are set back.

10.1.3 Delete Commands

Command Byte	Description	Parameter
0x28	Delete at actual cursor position	
0x29	Delete up to line end	
0x2A	Delete up to display end	
0x2B	Delete whole display	
0x2C	Delete part of the screen	Start-line, -column, End-line, -column

Cursor will be moved to the next position with the command ”Delete at actual cursor position”.

Example of a data block, which deletes the text beginning from the actual cursor position until the end of the line:

0x6C 0x29

Example of a data block, which deletes the display from column 2, line 3 to column 12, line 6:

0x6C 0x2C 0x32 0x33 0x3C 0x36

10.1.4 Text Commands

The user can define up to 200 different messages, including their screen position, and display them with a short command. The text can have a maximum of 30 characters. End of text in a data block has to be marked with the LF-sign (0x0A).
The text can be changed at any time. If you define an already existing text as new, the old text will be overwritten. If you want to display a text which has not been defined, the Status Byte 0x32 has to be sent with the acknowledge protocol.
Additional LCD commands are allowed within an already defined text, so longer commands can be called through that short command (macro).

Command Byte	Description	Parameter
0x48	Text definition	Text-number, line, column, text
0x49	Display defined text	Text-number

Text-numbers: from 0x31 (Text 1) to 0xF9 (Text 200).

Example of a data block, which defines text no. 5 (EUCHNER) in line 4, column 0:

0x6C 0x48 0x35 0x34 0x30 0xA5 0xD5 0xC3 0xC8 0xCE 0xC5 0xD2 0x0A

Example of a data block, which displays text no. 5:

0x6C 0x49 0x35

Example of a data block, which displays text no. 5 flashing:

0x6C 0x42 0x49 0x35 0x43

Example of a data block, which defines a text with additional commands (delete display, place cursor at beginning, inverse output of EUCO):

0x6C 0x48 0x36 0x30 0x30 0x2B 0x2A 0x40 0xA5 0xB5 0xA3 0xAF 0x41 0x0A

10.1.5 Area Commands

With one short command, the user can define up to 32 areas, which can be deleted, inverted or displayed flashing. The actual attribute will not be changed.

Command Byte	Description	Parameter
0x4A	Definition of area	Area-number, start-line, start-column, end-line, end-column
0x4B	Delete defined area	Area-number
0x4C	Inverse displayed area	Area-number
0x4D	Flashing displayed area	Area-number
0x4E	Inv. and flashing displayed area	Area-number
0x4F	Standard displayed area	Area-number

Area-numbers: from 0x31 (area 1) to 0x51 (area 32).
If a non-defined area will be called, a acknowledge protocol with 0x33 will be sent.

Example of a data block, which defines the area-no. 22 from line 4, column 0 to line 6, column 10:

0x6C 0x4A 0x46 0x34 0x30 0x36 0x3A

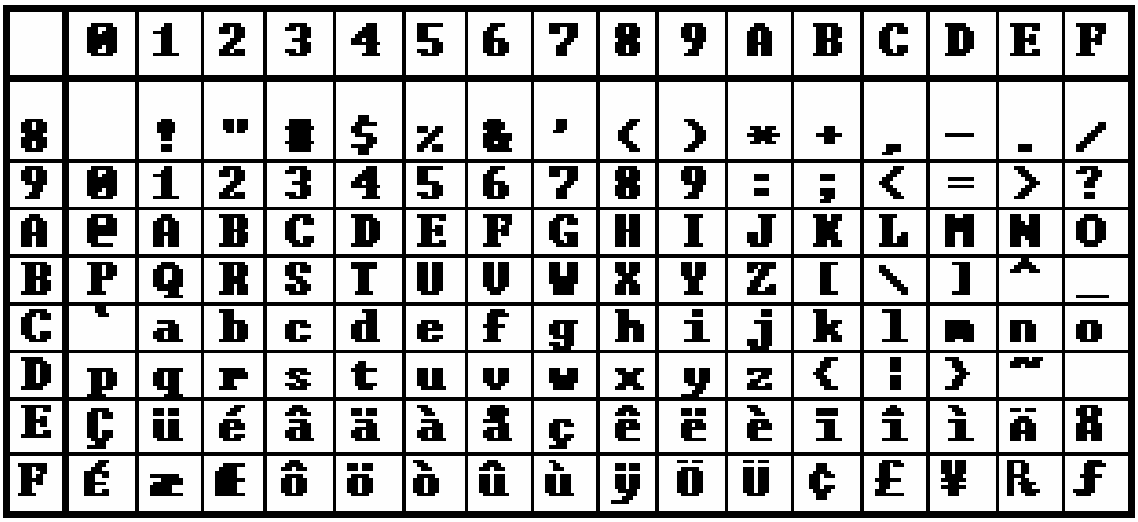
Example of a data block, which deletes area-no. 22:

0x6C 0x4B 0x46

Example of a data block, which displays area-no. 22 flashing:

0x6C 0x4D 0x46

10.2 Character Set



10.3 Command Overview

Command Byte	Description	Parameter
0x21	cursor to the next character	
0x22	cursor to the previous character	
0x23	cursor to the next lower line	
0x24	cursor to the upper line	
0x25	cursor to the LCD home position	
0x26	cursor to the beginning of the line	
0x27	cursor to a defined position	line (0x30...37), column(0x30..3F)
0x28	Delete at actual cursor position	
0x29	Delete up to line end	
0x2A	Delete up to display end	
0x2B	Delete whole display	
0x2C	Delete part of the screen	Start-line, -column, End-line, -column
0x40	Inverse on, all following characters will be displayed inverse	
0x41	Inverse off	
0x42	Flash on, all following characters will be displayed flashing	
0x43	Flash off	
0x48	Text definition	Text-number, line, column, text
0x49	Display defined text	Text-number
0x4A	Definition of area	Area-number, Start-line, Start-column, End-line, End-column
0x4B	Delete defined area	Area-number
0x4C	Inverse displayed area	Area-number
0x4D	Flashing displayed area	Area-number
0x4E	Inverse and Flashing displayed area	Area-number
0x4F	Standard displayed area	Area-number

11. Installation

To ensure, the EMC protection requirements are fulfilled, the connecting cable has to be shielded.

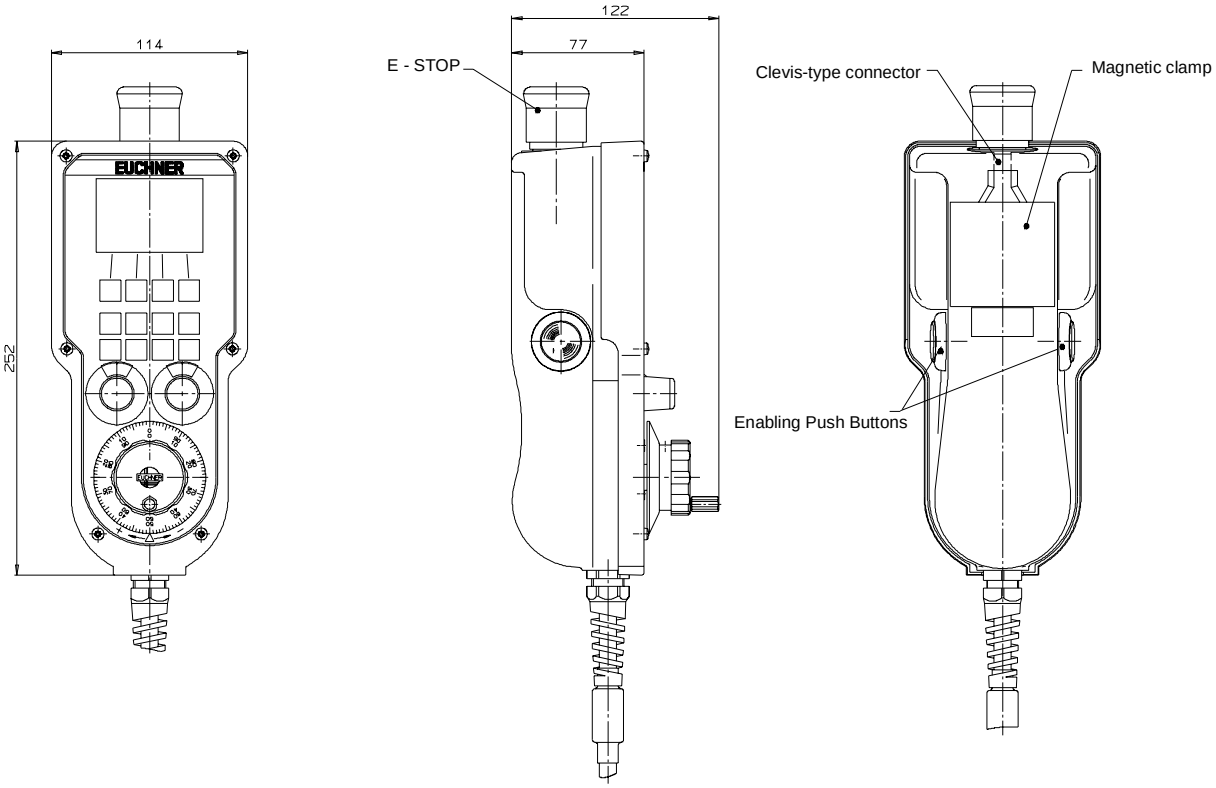
The shield of the mounted cable of the HBLS is el. connected to the connector housing.

The user has to fit a metal flange connector and its case has to be grounded.
All extending lines (serial communication interface, counter modules, enabling switches, E-Stop) have also to be shielded and grounded at a central grounding point at the control.

Suitable RS 422-receiver circuits are necessary for the transmission of the handwheel signals A; /A and B; /B (e.g. 75176).
It is not permitted to use TTL level signals (only A and B, without /A or /B).

The serial communication interface requires an RS 422A transmitter circuit and an RS 422A receiver circuit.
For the correct choice of the wire diameters, the whole cable length is to be calculated.

12. Mechanical Dimensions



13. Ordering Table

Pendant Station HBLS
with lead 3.5m, straight
and circular metal connector, 23-pin — Euchner ID. No.: 072725

Manual, Demo- and test software — available on the Internet:

www.euchner.de