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# **Panelware PW35**

## **User's Manual**

Version: **1.00 (April 2007)**

Model number: -

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## **Chapter 1: General information**

## **Chapter 2: Technical data**

## **Chapter 3: Software**

## **Table index**

## **Figure index**

## Table of contents

<b>CHAPTER 1 • GENERAL INFORMATION .....</b>	<b>5</b>
1 Manual history .....	5
2 Safety notices .....	6
2.1 Intended use .....	6
2.2 Protection against electrostatic discharges .....	6
2.2.1 Packaging .....	6
2.2.2 Guidelines for proper ESD handling .....	6
2.3 Policy and procedures .....	7
2.4 Transport and storage .....	7
2.5 Installation .....	8
2.6 Operation .....	8
2.6.1 Protection against touching electrical parts .....	8
2.6.2 Programs, viruses, and dangerous programs .....	8
3 Organization of safety notices .....	9
4 Guidelines .....	9
5 Material number / serial number .....	9
6 Model number .....	10
6.1 Display units .....	10
6.2 Accessories .....	10
<b>CHAPTER 2 • TECHNICAL DATA .....</b>	<b>11</b>
1 General information .....	11
2 Operator panels .....	12
2.1 4PW035.E300-01 .....	12
2.2 4PW035.E300-02 .....	15
3 Mounting instructions .....	18
4 Components .....	20
4.1 LCD display .....	20
4.2 Membrane .....	21
4.2.1 Mylar keypad .....	22
4.3 Interfaces .....	23
4.3.1 Power supply .....	23
4.3.2 CAN interface .....	23
4.3.3 Number switches - 4PW035.E300-01 .....	24
4.3.4 X2X interface .....	24
4.3.5 Number switches - 4PW035.E300-02 .....	25
<b>CHAPTER 3 • SOFTWARE – 4PW035.E300-01 .....</b>	<b>26</b>
1 General information .....	26
2 Properties .....	26
3 Power-on .....	27
4 Interface description .....	27
4.1 CAN identifiers .....	27
4.2 Data format of the CAN object in the panel direction .....	27
<b>COMMAND SET .....</b>	<b>28</b>
1 General information .....	28
1.1 Transferring data: Panel -> PLC .....	28
1.2 Transferring data: PLC -> Panel .....	28
1.3 Command sequences .....	28
1.4 Syntax .....	28
2 Commands .....	29
2.1 Overview of commands .....	29
3 Data format of the CAN object in the PLC direction .....	62

## Table of contents

3.1	Key codes.....	62
3.2	Overview – Transferring data: Panel -> PLC .....	62
3.3	Key object data assignments .....	62
4	ASCII code table .....	63
5	Error handling .....	65
5.1	Error handling.....	65
6	Table index .....	66
7	Figure index .....	66

## Chapter 1 • General information

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### 1 Manual history

Version	Date	Change
1.00	4/30/2007	First edition.

Table 1: Manual history

## **2 Safety notices**

### **2.1 Intended use**

Programmable logic controllers (PLCs), operating and monitoring devices (industrial PCs, Power Panels, Mobile Panels, etc.), and B&R uninterruptible power supplies have been designed, developed, and manufactured for conventional use in industry. They were not designed, developed, and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical damage, or loss of any kind without the implementation of exceptionally stringent safety precautions. In particular, such risks and hazards include the use of these devices to monitor nuclear reactions in nuclear power plants, as well as flight control systems, flight safety, the control of mass transit systems, medical life support systems, and the control of weapons systems.

### **2.2 Protection against electrostatic discharges**

Electrical components that are vulnerable to electrostatic discharge (ESD) must be handled accordingly.

#### **2.2.1 Packaging**

- Electrical components with housing  
... Do not require special ESD packaging, but must be handled properly.  
(See "Electrical components with housing".)
- Electrical components without housing  
... Are protected by ESD-suitable packaging.

#### **2.2.2 Guidelines for proper ESD handling**

##### **Electrical components with housing**

- Do not touch the contacts of connectors on connected cables.
- Do not touch the contact tips on the circuit boards.

##### **Electrical components without housing**

In addition to "Electrical components with housing", the following also applies:

- Any persons handling electrical components or devices that will be installed in the electrical components must be grounded.
- Components can only be touched on the small sides or on the front plate.
- Components should always be stored in a suitable medium (ESD packaging, conductive foam, etc.).  
Metallic surfaces are not suitable storage surfaces!

## General information • Safety notices

- Electrostatic discharges should be avoided on the components (e.g. through charged plastics).
- A minimum distance of 10 cm must be kept from monitors and TV sets.
- Measurement devices and equipment must be grounded.
- Measurement probes on potential-free measurement devices must be discharged on sufficiently grounded surfaces before taking measurements.

### Individual components

- ESD protective measures for individual components are thoroughly integrated at B&R (conductive floors, footwear, arm bands, etc.).

The increased ESD protective measures for individual components are not necessary for our customers for handling B&R products.

### 2.3 Policy and procedures

Electronic devices are generally not failsafe. In the event of a failure on the programmable control system, operating or monitoring device, or uninterruptible power supply, the user is responsible for ensuring that other devices that may be connected, e.g. motors, are in a secure state.

Both when using programmable logic controllers and when using operating and monitoring devices as control systems in conjunction with a soft PLC (e.g. B&R Automation Runtime or comparable products) or a slot PLC (e.g. B&R LS251 or comparable products), the safety precautions applying to industrial control systems (e.g. the provision of safety devices such as emergency stop circuits, etc.) must be observed in accordance with applicable national and international regulations. The same applies for all other devices connected to the system, such as drives.

All tasks such as installation, commissioning, and maintenance are only permitted to be carried out by qualified personnel. Qualified personnel are persons who are familiar with the transport, mounting, installation, commissioning, and operation of the product and who have the appropriate qualifications (e.g. IEC 60364). National accident prevention guidelines must be followed.

The safety guidelines, connection descriptions (type plate and documentation), and limit values listed in the technical data are to be read carefully before installation and commissioning and must be observed.

### 2.4 Transport and storage

During transport and storage, devices must be protected from excessive stress (mechanical load, temperature, humidity, aggressive atmosphere, etc.).

## **2.5 Installation**

- Installation must take place according to the documentation, using suitable equipment and tools.
- Devices may only be installed without voltage applied and by qualified personnel.
- General safety regulations and nationally applicable accident prevention guidelines must be observed.
- Electrical installation must be carried out according to the relevant guidelines (e.g. line cross section, fuse, protective ground connection).

## **2.6 Operation**

### **2.6.1 Protection against touching electrical parts**

To operate programmable logic controllers, operating and monitoring devices, and uninterruptible power supplies, certain components must carry dangerous voltage levels of over 42 VDC. A life-threatening electrical shock could occur if you come into contact with these parts. This could result in death, severe injury, or material damage.

Before turning on the programmable logic controller, the operational and monitoring devices and the uninterruptible power supply, ensure that the housing is properly grounded (PE rail). The ground connection must be established when testing the operating and monitoring devices or the uninterruptible power supply, even when operating them for only a short time.

Before turning the device on, make sure that all voltage-carrying parts are securely covered. During operation, all covers must remain closed.

### **2.6.2 Programs, viruses, and dangerous programs**

The system is subject to potential danger each time data is exchanged or software is installed from a data medium (e.g. diskette, CD-ROM, USB flash drive, etc.), a network connection, or the Internet. The user is responsible for assessing these dangers, implementing preventative measures such as virus protection programs, firewalls, etc. and obtaining software from reliable sources.



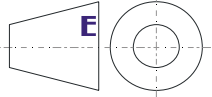
### 3 Organization of safety notices

The safety notices in this manual are organized as follows:

Safety notice	Description
<b>Danger!</b>	Disregarding the safety regulations and guidelines can be life-threatening.
<b>Caution!</b>	Disregarding the safety regulations and guidelines can result in severe injury or major damage to material.
<b>Warning!</b>	Disregarding the safety regulations and guidelines can result in injury or damage to material.
<b>Information:</b>	Important information for preventing errors.

Table 2: Organization of safety notices

### 4 Guidelines

	All dimension diagrams (e.g. dimension diagrams, etc.) are drawn according to European dimension standards.
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### 5 Material number / serial number

Each B&R device is assigned a unique serial number label with bar code, which allows the device to be clearly identified.

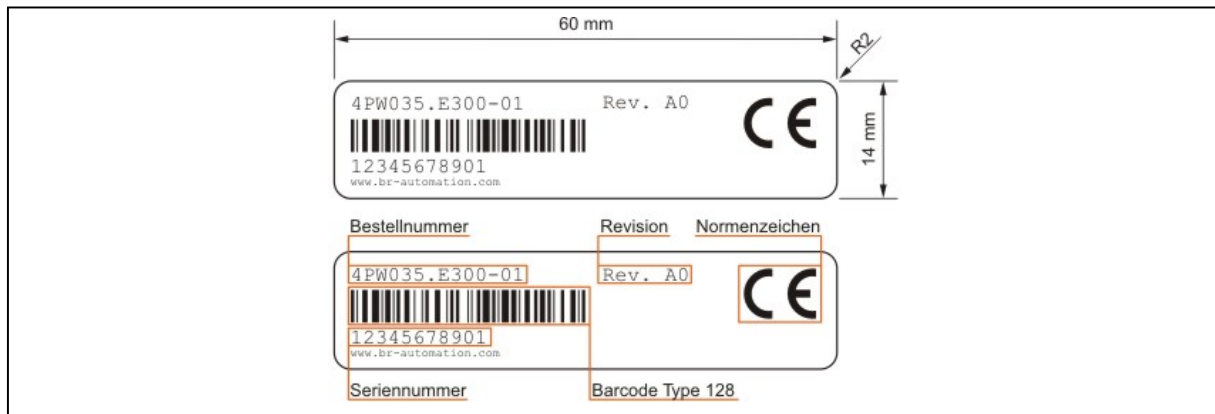


Figure 1: Serial number sticker design/dimensions

If you are a registered user on the B&R homepage ([www.br-automation.com](http://www.br-automation.com)), you can retrieve information regarding your products using your material number or serial number. You have access to the revision history for the B&R products you have purchased.

## 6 Model number

### 6.1 Display units

Model number	Description	Note
4PW035.E300-01	<b>Panelware Compact HMI</b> HMI terminal (escape sequences), LCD display, 160 x 80 pixels, background lighting, 26 keys, CAN interface, 24 VDC supply	
4PW035.E300-02	<b>Panelware Compact HMI</b> HMI terminal, LC display, 160 x 80 pixels, background lighting, 26 keys, X2X interface, 24 VDC supply	

**Table 3: Model number overview - Display units**

### 6.2 Accessories

Model number	Description	Note
0TB103.9	Plug 24V 5.08 3-pin screw clamps	Included in delivery
0TB103.91	Plug 24V 5.08 3-pin cage clamps	
0TB1108.8110	8-pin cage clamps	
4A0044.00-00	Set with printable legend strips	

**Table 4: Model number overview - Accessories**

## Chapter 2 • Technical data

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### 1 General information

Panelware PW35 (or just PW35 for short) devices are space-saving operator panels in a plastic housing. They are equipped with a 160 x 80 pixel LCD display. The display contrast can be adjusted using its buttons.

In addition, it comes with a 26-key membrane keypad, 10 of which are equipped with an LED indicator. The lower block of keys can be labeled using legend strips.

The 9-pin DSUB CAN interface is electrically isolated. The baud rate and node number can be set on the back side of the device.

The 8-pin X2X interface is also electrically isolated.

The functions listed above are integrated in a compact housing (153 x 120 x 46.1).



Figure 2: Panelware PW35

## 2 Operator panels

### 2.1 4PW035.E300-01



Figure 3: Front view - 4PW035.E300-01



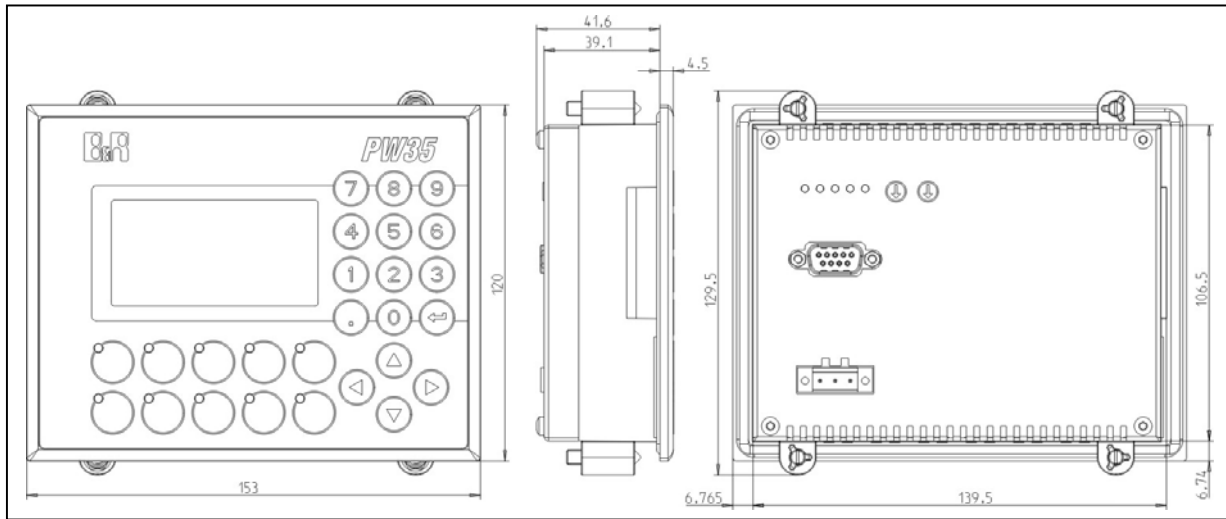
Figure 4: Rear view - 4PW035.E300-01

**Technical data**

<b>Features</b>		<b>4PW035.E300-01</b>
Display		
Type		LCD b/w
Resolution		160 x 80 pixels
Background lighting		LED
Lifespan		100,000 hours
Character set		European / Cyrillic
CAN interface		
Electrical isolation		Yes
Design		9-pin DSUB
Distance		Max. 1000 m bus length
Max. baud rate		
Up to 60 m		500 kBit/s
Up to 200 m		250 kBit/s
Up to 1000 m		50 kBit/s
Keys		
Total keys		26 Keys, 10 with LEDs
System keys		Number block
		Control keys
Label		10 keys with legend strips
<b>Electrical characteristics</b>		
Power supply		
Rated voltage		24 VDC ± 25%
Rated current		Typ. 90 mA / max. 120 mA
Power consumption		Max. 6 W
<b>Environmental conditions</b>		
Ambient temperature		
Operation		0 °C .. + 50 °C
Storage		-20 °C .. +60 °C
Relative humidity		
Operation		10 to 90%, non-condensing
Storage		5 to 95%, non-condensing
<b>Mechanical characteristics</b>		
Protection type		IP65 (front side)
Outer dimensions (W x H x D)		153 x 120 x 46.1
Weight		0.5 kg

**Table 5: Technical data - 4PW035.E300-01**

## Dimensions



**Figure 5: Dimensions - 4PW035.E300-01**

Installation cutout: 141 mm x 108 mm (max. 4.5mm plate thickness)

2.2 4PW035.E300-02



Figure 6: Front view - 4PW035.E300-02



Figure 7: Rear view - 4PW035.E300-02

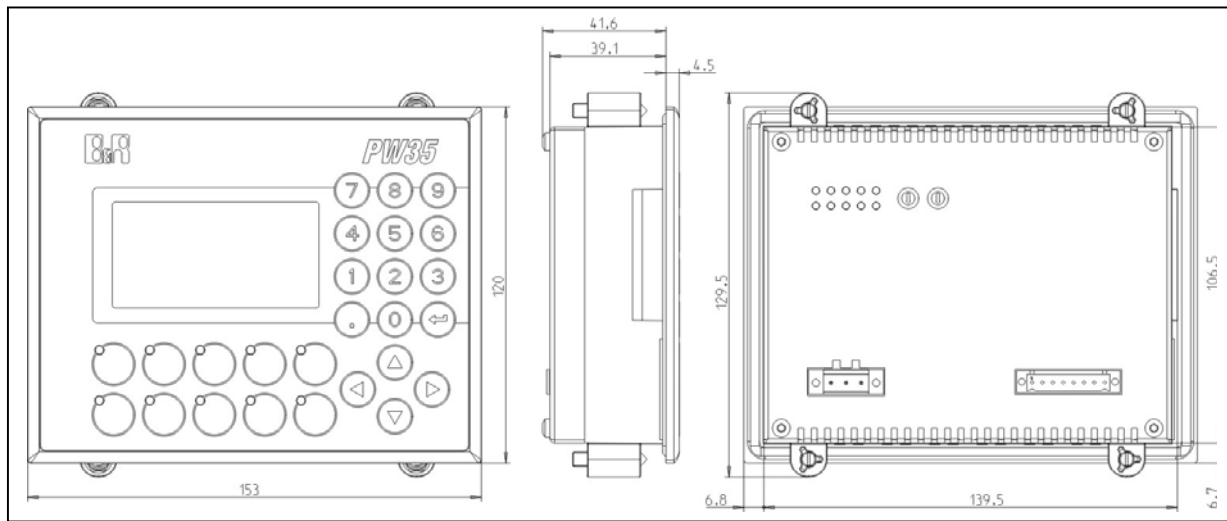
**Technical data**

<b>Features</b>	<b>4PW035.E300-02</b>
Display Type Resolution Background lighting Lifespan Character set	LCD b/w 160 x 80 pixels LED 100,000 hours European / Cyrillic
X2X Interface Type Electrical isolation Design Distance between 2 stations Internal bus supply	X2X slave Yes 8-pin multipoint connector 100 m Yes
Keys Total keys System keys  Label	26 Keys, 10 with LEDs Number block Control keys 10 keys with legend strips
<b>Electrical characteristics</b>	
Power supply Rated voltage Rated current Power consumption	24 VDC $\pm$ 25% Typ. 90 mA / max. 120 mA Max. 6 W
<b>Environmental conditions</b>	
Ambient temperature Operation Storage	0 °C .. + 50 °C -20 °C .. +60 °C
Relative humidity Operation Storage	10 to 90%, non-condensing 5 to 95%, non-condensing
<b>Mechanical characteristics</b>	
Protection type Outer dimensions (W x H x D) Weight	IP65 (front side) 153 x 120 x 46.1 0.5 kg

**Table 6: Technical data - 4PW035.E300-02**



## Dimensions



**Figure 8: Dimensions - 4PW035.E300-02**

Installation cutout: 141 mm x 108 mm (max. 4.5mm plate thickness)

### 3 Mounting instructions

Please note the following mounting instructions:

- 1) The Panelware PW35 device must be mounted with the four retaining clips included in delivery.
- 2) In order to guarantee proper air circulation, allow a distance of at least 20 mm (above and below) between the ventilation slots and all other objects.

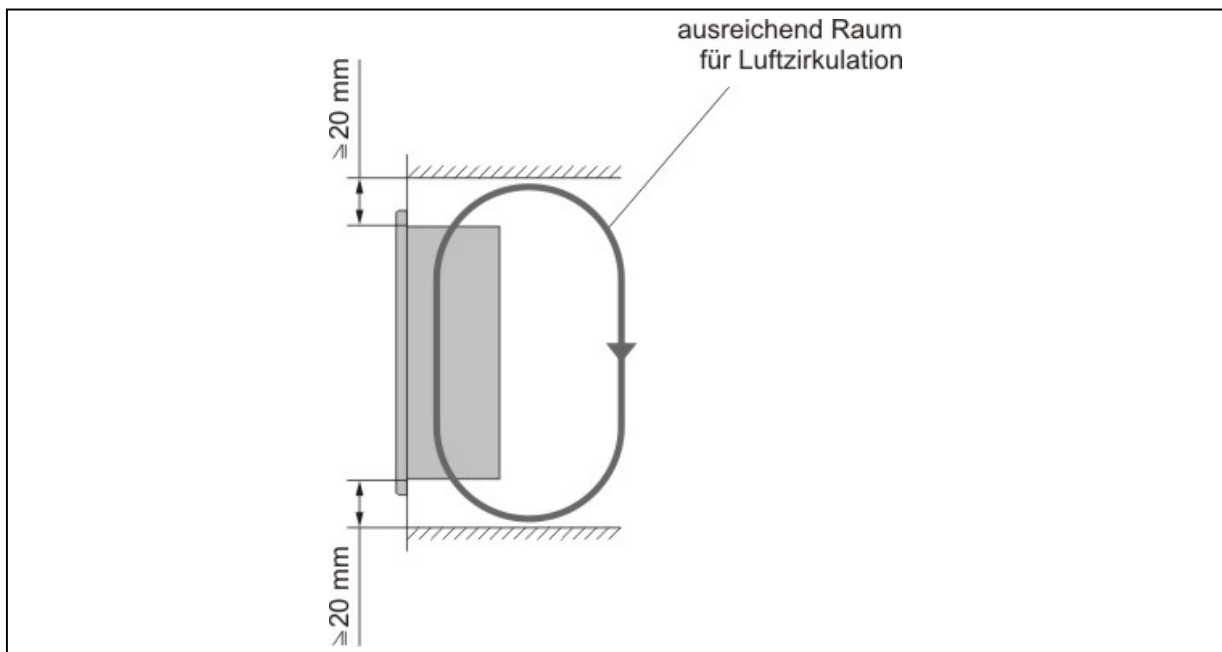
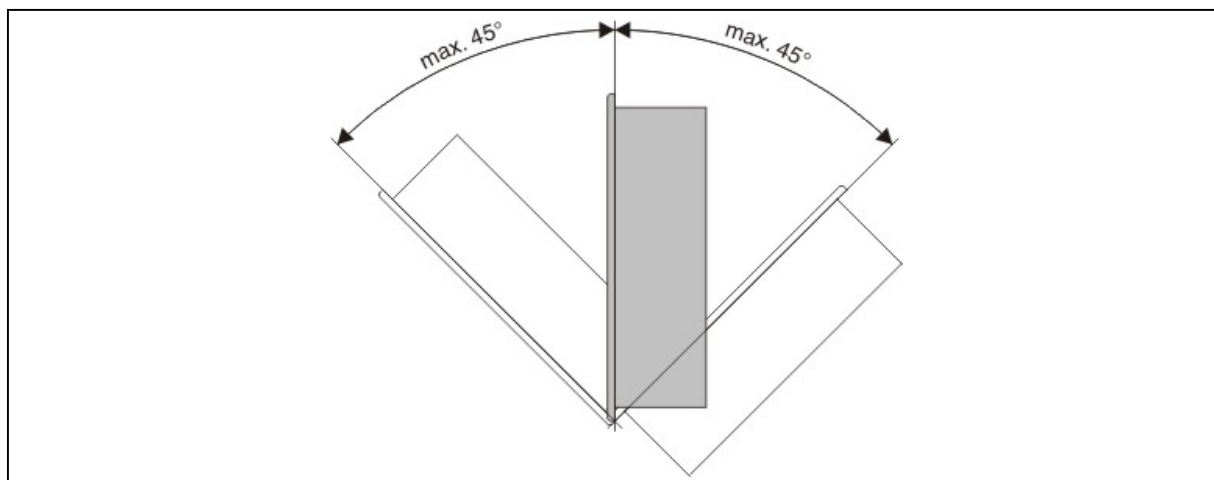


Figure 9: Space for air circulation

## Technical data • Mounting instructions

3) The Panelware PW35 can be mounted up to a maximum angle of  $\pm 45^\circ$ .



**Figure 10: Panelware PW35 installation angle**

## 4 Components

### 4.1 LCD display

The Panelware PW35 is equipped with a 160 x 80 pixel LCD display. This display comes with LED background lighting (white). The display contrast can be adjusted using its buttons.

Procedure:

The display is selected by pressing Enter. While holding this key, the contrast can be adjusted by pressing the Up or Down key.

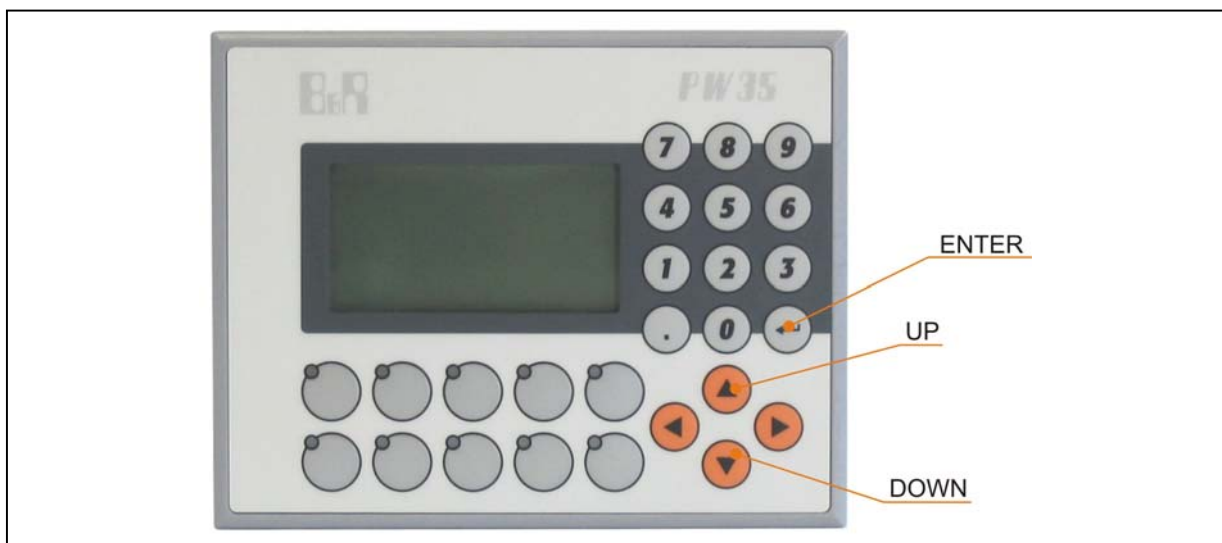


Figure 11: Contrast setting

The contrast setting made in this way is placed in nonvolatile memory and becomes the default value.

### Information:

The key codes for the Up and Down keys are not sent to the controller as long as Enter is being pressed. For this reason, it is not possible to use the key combinations Enter+Up or Enter+Down in the application project.

## 4.2 Membrane

### Information:

The following characteristics, features, and limit values only apply to these individual components and can deviate from those for the entire device. For the entire device in which these individual components are used, refer to the data given specifically for the entire device.

The Mylar conforms to DIN 42115 (section 2). This means it is resistant to exposure to the following chemicals for a 24-hour period with no visible signs of damage:

Ethanol Cyclohexanol Diacetone alcohol Glycol Isopropanol Glycerin Methanol Triacetin Dowanol DRM/PM	Formaldehyde 37%-42% Acetaldehyde Aliphatic hydrocarbons Toluene Xylene White spirits	1.1.1.Trichloroethane Ethyl acetate Diethyl ether N-Butyl acetate Amyl acetate Butylcellosolve Ether
Acetone Methyl ethyl ketone Dioxan Cyclohexanone MIBK Isophorone	Formic acid < 50% Acetic acid < 50% Phosphoric acid < 30% Hydrochloric acid < 36% Nitric acid < 10% Trichloroacetic acid < 50% Sulphuric acid < 10%	Sodium hypochlorite < 20% Hydrogen peroxide < 25% Potassium carbonate Washing agents Fabric conditioner Ferric chloride Ferrous chloride (FeCl <sub>2</sub> ) Ferrous chloride (FeCl <sub>3</sub> ) Dibutyl phthalate Diethyl phthalate Sodium carbonate
Ammonia < 40% Caustic soda < 40% Potassium hydroxide Alkali carbonate Bichromate Potassium Acetonitrile Sodium bisulphate	Cutting oil Diesel oil Linseed oil Paraffin oil Blown castor oil Silicon oil Turpentine oil substitute Universal brake fluid Aviation fuel Petrol Water Sea water Decon	

**Table 7: Chemical resistance of the mylar**

The Mylar conforms to DIN 42115 section 2 for exposure to glacial acetic acid for less than one hour without visible damage.

#### 4.2.1 Mylar keypad

The Panelware PW35 is equipped with a Mylar keypad with 26 keys, 10 of which are lit with LEDs (yellow). The labels for the right-hand key block are permanent. The labels for the left-hand key block can be changed (using legend strips). Special laser-printable legend strips (model number 4A0026.00-000) are available for this.

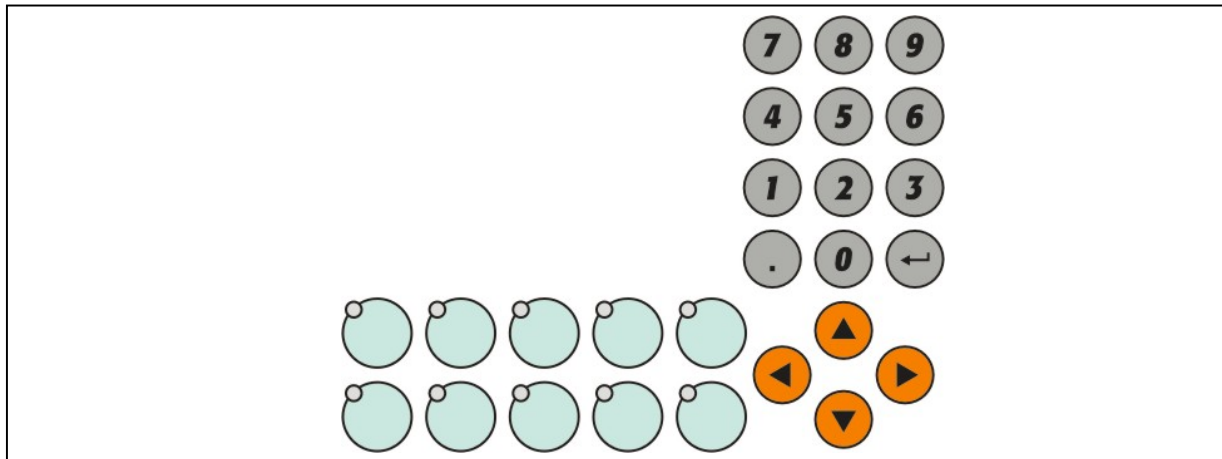


Figure 12: Mylar keypad

#### Keys and LED codes

Keys and LEDs are present in the matrix as follows (LED codes correspond to the accompanying key codes). The codes below are shown in hexadecimal.

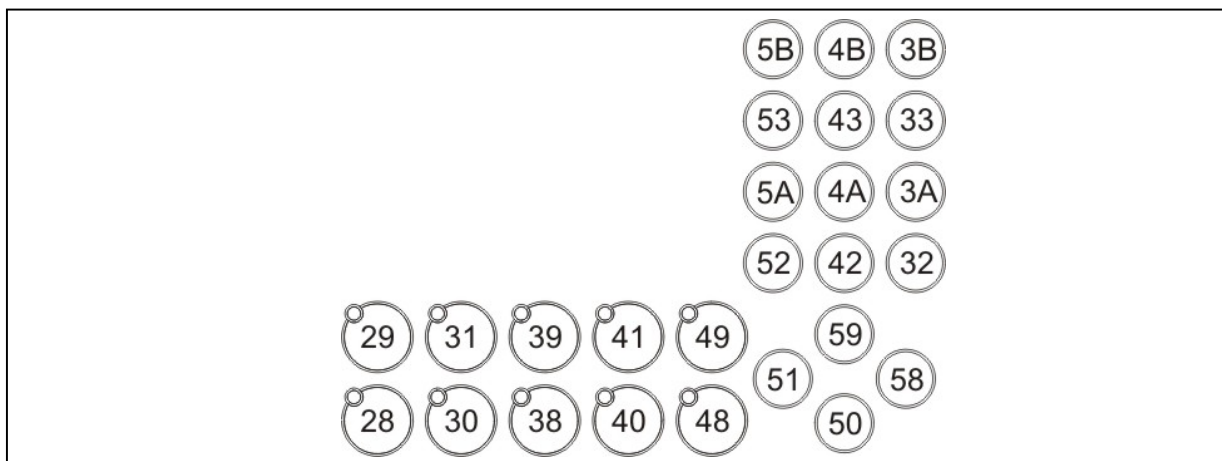


Figure 13: Key and LED codes

## 4.3 Interfaces

### 4.3.1 Power supply

The Panelware 35 is supplied with 24 VDC via a 3-pin terminal block. This 24 VDC is supplied to the panel by a 3-pin contact socket. The supply is protected against surges, bursts, ESD, and radiation. The connection to the ground should be as short as possible.


Power supply		
Connection	Description	
1	+24 VDC	
2	Ground	
3	GND	

Figure 14: Power supply

### 4.3.2 CAN interface

The 4PW035.E300-01 is equipped with a CAN interface. The baud rate and node number can be set with the number switches. These number switches are accessible from the opening in the housing.

The 9-pin DSUB CAN interface is electrically isolated.


Power supply		
Connection	Description	
1	NC	
2	CAN_L	
3	CAN_GND	
4	NC	
5	NC	
6	NC	
7	CAN_H	
8	NC	
9	NC	

Figure 15: CAN interface

### 4.3.3 Number switches - 4PW035.E300-01

The baud rate and CAN node number are set with the hex switches. Each hex switch has a value range of 4 bits. The first two bits of the SW1 hex switch is used to configure the baud rate. The second two bits of the SW1 hex switch are used in conjunction with the four bits of the SW0 hex switch to specify the CAN node number.

Number switches - 4PW035.E300-01			
SW1	SW0	Baud# (kbit/s)	Node#
0	1 .. F	250	1 .. 15
1	0 .. F	250	16 .. 31
2	0	250	32
4	1 .. F	125	1 .. 15
5	0 .. F	125	16 .. 31
6	0	125	32
8	1 .. F	20	1 .. 15
9	0 .. F	20	16 .. 31
A	0	20	32
C	1 .. F	500	1 .. 15
D	0 .. F	500	16 .. 31
E	0	500	32



Figure 16: Number switches - 4PW035.E300-01

### 4.3.4 X2X interface

The 4PW035.E300-02 is equipped with an X2X interface. The station number can be set using the number switches. These number switches are accessible from the opening in the housing.

The 8-pin interface is electrically isolated.

X2X interface	
Connection	Description
1	X2X
2	X2X $\bar{L}$
3	X2X\
4	SHLD
5	X2X
6	X2X $\bar{L}$
7	X2X\
8	SHLD



Figure 17: X2X interface



#### 4.3.5 Number switches - 4PW035.E300-02

The baud rate and X2X node number are set with the hex switches.

Number switches - 4PW035.E300-01		
SW1	SW0	Node#
0	1 .. F	1 .. 15
1	0 .. F	16 .. 31
2	0 .. F	32 .. 47
3	0 .. F	48 .. 63
4	0 .. F	64 .. 79
5	0 .. F	80 .. 95
6	0 .. F	96 .. 111
7	0 .. F	112 .. 127
8	0 .. F	128 .. 143
9	0 .. F	144 .. 159
A	0 .. F	160 .. 175
B	0 .. F	176 .. 191
C	0 .. F	192 .. 207
D	0 .. F	208 .. 223
E	0 .. F	224 .. 239
F	0 .. F	240 .. 255



Figure 18: Number switches - 4PW035.E300-02

## **Chapter 3 • Software – 4PW035.E300-01**

---

### **1 General information**

#### **Operation**

The Panelware PW35 reads ASCII characters, ESC sequences, and CSI sequences on CAN using the CAN ID set by the node numbers, processes the commands accordingly, and sends key codes (with or without a repeat function), "key release" codes, and status messages to the configured CAN ID + 1.

The Panelware PW35 does not have any memory for user programs.

The background lighting of the display switches off after a configured time of 1 to 98 minutes (default: 1 min 30 sec). Pressing a certain key or the <ESC><r> command sequence switches the background lighting back on.

### **2 Properties**

- Display control and other parameters using ASCII characters, ESC sequences, and CSI sequences
- Key codes with configurable repeat rate (key repeat frequency)
- LEDs on/off, blinking, and fast blinking
- Configurable minimum waiting time (minimum time that must pass between two CAN frames), e.g. if the controller cannot process keystrokes fast enough
- Possible to connect up to 32 panels on one CAN bus (node numbers configurable with HEX switches)
- Baud rates: 250 kB, 20 kB, 125 kB, 500 kBaud, configurable with HEX switches
- Configurable life signs for monitoring the panel function and connection
- Graphic display (font sizes 1x1 and 2x2)
- Blinking and inverse display of characters (inverse only from Automation Studio)
- European character set (like PP35)

- Background lighting on display automatically switched off after a programmed time
- Contrast setting: with keyboard

### 3 Power-on

When powered on, the panel switches all LEDs on for 1 seconds and sends a reset code (0x90) to the CAN bus.

The version number, the node number configured with the hex switches, and the current baud rate are shown on the display. If an invalid node number was set, this status is shown as "Node number: --, baud rate --" on the display and the panel goes into service mode. For another configured node number to become effective, another power-on must be performed to reset.

The following are default settings:

- No key repeat
- No life signs
- Delay time between CAN frames: 10 ms
- Background lighting on for 1 minute 30 seconds
- Cursor at the top left of the display (1/1), not visible

### 4 Interface description

CAN bus: 11-bit identifier with 20 kBaud, 125 kBaud, 250 kBaud, and 500 kBaud. See "Description of components" – "Number switches" for configuring node numbers and the baud rate.

#### 4.1 CAN identifiers

Panel direction – Calculating the CAN ID for commands to the panel:

$\text{CAN ID} = 1054 + (\text{node number} - 1) * 16$

PLC direction – Calculating the CAN ID for key objects:

$\text{CAN ID} = 1054 + (\text{node number} - 1) * 16 + 1$

#### 4.2 Data format of the CAN object in the panel direction

Every command does not have to be sent in a separate CAN frame. If a command is only sent in part to the panel, it waits for its completion (timeout: approx. 2 sec.). The "open" command sequence is cancelled with <ESC> or an invalid parameter, and "SYNTAX ERROR" (0x97) is sent to the sender ID.

# Command set

---

## 1 General information

### 1.1 Transferring data: Panel -> PLC

Information that is sent to a PLC from the B&R operator panel has a basic length of 1 byte. The data transferred is either key codes or (error) messages. The format used to transfer the key codes can be configured using control sequences (commands) from the PLC.

In addition, the PLC can request a status string from the panel that contains information about the panel configuration.

The formats (of key codes or status strings) sent from the panel are described under the respective commands. See also "3.2 Overview – Transferring data: Panel -> PLC"

### 1.2 Transferring data: PLC -> Panel

The commands that can be sent from the PLC to the panel are explained in detail in Chapter 2, "Commands".

### 1.3 Command sequences

Most commands consist of sequences that are put together as follows:

1. Control characters
2. Characters that specify the command
3. Possible parameters

Either the ASCII characters <ESC> (dec. 27, hex. 1B) or <CSI> (dec. 155, hex. 9B) are used. The panel begins with the execution of the command only when the number of specified parameters is absolutely complete.

If the timeout of 2 sec. expires, error code 0x97 is sent to the PLC.

### 1.4 Syntax

The following syntax is used for the description of commands and control sequences:

**<x> ..** Characters between the "less than" and "greater than" signs corresponds to the characters in the ASCII table:

Alphanumeric characters:	<a>, <A>, <0>, <9>, etc.
Other characters:	<!>, <#>, <ß>, etc.
Control characters:	<CSI>, <CR>, <ESC>, etc.

**xxx ...** Numeric values that are not shown in parentheses are interpreted as decimal or hexadecimal ASCII values.

**(x) ....** Parameters for the respective command.

## Command set

## 2 Commands

### 2.1 Overview of commands

ASCII	Hex.	Dec.	Command
<b>Key commands</b>			
<ESC> <T> (Nr) (M)	1B 54 (Nr) (M)	27 84 (Nr) (M)	Configure key mode
<ESC> <w> (ww)	1B 77 (w1) (w0)	27 119 (w1) (w0)	Configure delay time
<ESC> <f> (ff)	1B 66 (f1) (f0)	27 102 (f1) (f0)	Configure repeat rate
<b>LED commands</b>			
<ESC> <e> (No)	1B 65 (No)	27 101 (No)	Turn on LED
<ESC> <a> (No)	1B 61 (No)	27 97 (No)	Turn off LED
<ESC> <l> (No)	1B 6C (No)	27 108 (No)	Slow-blinking LED
<ESC> <s> (No)	1B 73 (No)	27 115 (No)	Fast-blinking LED
<ESC> <H> (No) <d>	1B 48 (No) Att	27 72 (No) Att	Turn on local echo
<b>Cursor commands</b>			
<CSI> <D>	9B 44	155 68	Cursor left
<CSI> <C>	9B 43	155 67	Cursor right
<CSI> <A>	9B 41	155 65	Cursor up
<CSI> <B>	9B 42	155 66	Cursor down
<CSI> <H>	9B 48	155 72	Cursor home
<CSI> <f>	9B 66	155 102	Cursor home
<CSI> <E>	9B 45	155 69	Cursor at end
<CSI> (zz) <;> (ss) <H>	9B (z1) (z0) 3B (s1) (s0) 48	155 (z1) (z0) 59 (s1) (s0) 72	Position cursor
<CSI> (zz) <;> (ss) <f>	9B (z1) (z0) 3B (s1) (s0) 66	155 (z1) (z0) 59 (s1) (s0) 102	Position cursor
<CR>	0D	13	Carriage return
<LF>	0A	10	Line feed
<b>Write / Delete commands</b>			
(z)=32...255	0...FF	(z)	Write characters
<CSI> <e>	9B 65	155 101	Insert character
<DEL>	7F	127	Delete character
<CSI> <P>	9B 50	155 80	Delete character
<CSI> <X>	9B 58	155 88	Delete character without advancing
<BS>	08	8	Backspace
<CSI> <L>	9B 4C	155 76	Insert line
<CSI> <M>	9B 4D	155 77	Delete line
<CSI> <K>	9B 4B	155 75	Delete line from cursor position
<CSI> <2> <J>	9B 32 4A	155 50 74	Clear screen
<CSI> <5> <m>	9B 35 6D	155 53 109	Switch on blinking mode
<CSI> <0> <m>	9B 30 6D	155 48 109	Turn off all attributes
<CSI> <7> <m>	9B 37 6D	155 55 109	Switch on inverse mode
<ESC> <N> (x) (y) (l)	1B 4E (x1) (x0) (y1) (y0) (l1) (l0)	27 78 (x1) (x0) (y1) (y0) (l1) (l0)	Show X characters blinking
<ESC> <Q> (x) (y) (l)	1B 51 (x1) (x0) (y1) (y0) (l1) (l0)	27 81 (x1) (x0) (y1) (y0) (l1) (l0)	Show X characters normally
<ESC> <O> (x) (y) (l)	1B 4F (x1) (x0) (y1) (y0) (l1) (l0)	27 79 (x1) (x0) (y1) (y0) (l1) (l0)	Show X characters inversely
<ESC> <#> <1>	1B 23 31	27 35 49	Select 1x1 font size
<ESC> <#> <2>	1B 23 32	27 35 50	Select 2x2 font size
<b>Graphic commands</b>			
<ESC> <G/C> <p> (xxx) (yyy)	1B 47/43 70 (x2) (x1) (x0) (y2) (y1) (y0)	27 71/67 112 (x2) (x1) (x0) (y2) (y1) (y0)	Toggle point
<ESC> <G/C> <h> (xxx) (yyy) (lll)	1B 47/43 68 (x2) (x1) (x0) (y2) (y1) (y0) (l2) (l1) (l0)	27 71/67 104 (x2) (x1) (x0) (y2) (y1) (y0) (l2) (l1) (l0)	Draw / Delete horizontal line

Table 8: Overview of commands

## Command set

<ESC> <G/C> <v> (xxx) (yyy) (lll)	1B 47/43 76 (x2) (x1) (x0) (y2) (y1) (y0) (l2) (l1) (l0)	27 71/67,118 (x2) (x1) (x0) (y2) (y1) (y0) (l2) (l1) (l0)	Draw / Delete vertical line
<ESC> <G/C> <f> (xxx) (yyy) (bbb) (hhh) (sss)	1B 47/43 66 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0) (s2) (s1) (s0)	27 71/67 102 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0) (s2) (s1) (s0)	Draw / Delete border
<ESC> <G/C> <r> (xxx) (yyy) (bbb) (hhh)	1B 47/43 72 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0)	27 71/67 114 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0)	Draw / Delete rectangle
<ESC> <G> <b> (xxx) (yyy) (bbb) (lll) (fff)	1B 47 (b) (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (l2) (l1) (l0) (f2) (f1) (f0)	27 71 (b) (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (l2) (l1) (l0) (f2) (f1) (f0)	Draw bar
<ESC> <C> <b> (xxx) (yyy) (bbb) (lll)	1B 43 (b) (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (l2) (l1) (l0)	27 71 (b) (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (l2) (l1) (l0)	Delete bar
<b>Additional commands</b>			
<ESC> <h> (hh)	1B 68 (h1) (h0)	27 104 (h1) (h0)	Modify brightness
<ESC> <b> (t1) (t0)	1B 62 (t1) (t0)	27 98 (t1) (t0)	Set time for background lighting
<ESC> <r>	1B 72	27 114	Reset time for background lighting
<ESC> <S>	1B 53	27 83	Query status
<ESC> <E>	1B 45	27 69	Query extended status
<CSI> <i> (zz)	9B 69 (z1) (z0)	155 105 (z1) (z0)	Query display contents of a line
<ESC> <R>	1B 52	27 82	Reset
<ESC> <Y> (zzz)	1B 59 (z2) (z1) (z0)	27 89 (z2) (z1) (z0)	Configure minimum delay
<ESC> <F>	1B 46	27 70	Query matrix
<ESC> <1>	1B 31	27 49	Query HEX switch position
<ESC> <p> <l> (zzz)	1B 70 6C (t2) (t1) (t0)	27 112 108 (t2) (t1) (t0)	Set time for life signs
<b>New commands</b>			
<ESC> <G> <b> (xxx) (yyy) (bbb) (hhh)	1B 47 62 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0)	27 71 98 (x2) (x1) (x0) (y2) (y1) (y0) (b2) (b1) (b0) (h2) (h1) (h0)	Draw bitmap

Table 9: Overview of commands

## Key commands

### Configure key mode

#### Description:

This command is used to define the key mode for individual or all keys.

#### Command:

Syntax	<ESC>	<T>	(No)	(M)
Hex.	1B	54	(No)	(M)
Dec.	27	84	(No)	(M)

**Parameters:** (Nr) ... Key number

(No)	Description
31	All keys are configured with the specified mode (M).
28 – 5B hex. 40 – 91 dec.	The key (No) is configured with the specified mode (M).

(M) ... Mode

(M)	Description
<w>	Wait repeat
<r>	Repeat
<s>	Single
<t>	Toggle

**Default:** "Single" mode is configured for all keys after a reset or power-on.

### Configure delay time

#### Description:

This command defines the delay time for all keys that are operated in "Wait repeat" mode.

#### Command:

Syntax	<ESC>	<w>	(w)	
Hex.	1B	77	(w1)	(w0)
Dec.	27	119	(w1)	(w0)

**Parameters:** (w) ... The delay time in tenths of a second can be in the following range:

(w) = <0><1>....<5><0>

**Default:** The delay time is configured to 1 s (<1><0>) after a reset or power-on.

## Key commands

### Configure repeat rate

#### Description:

This command is used to define the key repeat rate for all keys.

#### Command:

Syntax	<ESC>	<f>	(f)	
Hex.	1B	66	(f1)	(f0)
Dec.	27	102	(f1)	(f0)

**Parameters:** (f) ... The repeat rate (hertz) can be in the following range:  
(f)=00 means no key repeat.

	Description
<b>Syntax</b>	(f)=<f1> <f0>.....<f1> <f0>
<b>Char.</b>	(f)=<0> <0>.....<2> <5>
<b>Dec.</b>	(f)=<48> <48>.....<50> <53>
<b>Hex.</b>	(f)=<30> <30>.....<32> <35>

**Default:** The repeat rate is turned off by default after a reset or power-on.



## LED commands

### Turn on LED

#### Description:

This command can be used to turn on individual or all LEDs. In addition, the local echo of the selected LED(s) is turned off.

#### Command:

Syntax	<ESC>	<e>	(No)
Hex.	1B	65	(No)
Dec.	27	101	(No)

**Parameters:** (No) ... LED number (same as the key number)

(No)	(No) hex.	Description
31	1F	All LEDs are turned on using the method described above. The local echo for all LEDs is turned off.
40 - 72	28 - 48	The selected LED (No) is turned on and the local echo is turned off.

**Note:** See "Keys and LED codes" on page 22.

### Turn off LED

#### Description:

This command can be used to turn off individual or all LEDs. In addition, the local echo of the selected LED(s) is turned off.

#### Command:

Syntax	<ESC>	<a>	(No)
Hex.	1B	61	(No)
Dec.	27	97	(No)

**Parameters:** (No) ... LED number (same as the key number)

(No)	(No) hex.	Description
31	1F	All LEDs are turned off. The local echo for all LEDs is turned off.
40 - 72	28 - 48	The selected LED (No) is turned on and its local echo is turned off.

**Note:** See "Keys and LED codes" on page 22.

## LED commands

### Slow-blinking LED

#### Description:

This command makes individual or all LEDs blink slowly (1 Hz). In addition, the local echo of the selected LED(s) is turned off.

#### Command:

Syntax	<ESC>	<l>	(No)
Hex.	1B	6C	(No)
Dec.	27	108	(No)

**Parameters:** (No) ... LED number (same as the key number)

(No)	(No) hex.	Description
31	1F	All LEDs begin blinking slowly using the method described above. The local echo for all LEDs is turned off.
40 - 72	28 - 48	The selected LED (No) begins blinking slowly and the local echo is turned off.

**Note:** See "Keys and LED codes" on page 22.

### Fast-blinking LED

#### Description:

This command makes individual or all LEDs blink quickly (2 Hz). In addition, the local echo of the selected LED(s) is turned off.

#### Command:

Syntax	<ESC>	<s>	(No)
Hex.	1B	73	(No)
Dec.	27	115	(No)

**Parameters:** (No) ... LED number (same as the key number)

(No)	(No) hex.	Description
31	1F	All LEDs begin blinking quickly using the method described above. The local echo for all LEDs is turned off.
40 - 72	28 - 48	The selected LED (No) begins blinking quickly and the local echo is turned off.

**Note:** See "Keys and LED codes" on page 22.

## LED commands

### Turn on local echo

#### Description:

This command turns on the local echo for individual or all LEDs. "Local echo" means that a key's LED is controlled simultaneously when the key is pressed. It can either blink slowly or quickly as long as the key is pressed depending on the specified attribute. When the key is released, the LED goes dark. This allows the user to receive an optical signal when a key is pressed without loading down the PLC (since this procedure takes place internally in the panel).

#### Command:

Syntax	<ESC>	<H>	(No)	(Att)
Hex.	1B	48	(No)	(Att)
Dec.	27	72	(No)	(Att)

**Parameters:** (No) ... LED number (same as the key number)

(No)	(No) hex.	Description
31	1F	The local echo for all LEDs is turned on.
40 - 72	28 - 48	The local echo for the selected LED (No) is turned on.

(Att) ... Attribute

(Att)	Description
<d>	LED constantly lit if the key is pressed.
<s>	LED blinks quickly (2 Hz) lit if the key is pressed.
<l>	LED blinks slowly (2 Hz) lit if the key is pressed.

**Default:** The local echo for all keys is turned off by default after a reset or power-on.

**Note:** See "Keys and LED codes" on page 22.

## Information:

If the command "Turn on local echo" is received, all LEDs are turned off.

## Cursor commands

### Cursor left

**Description:**

Moves the cursor one position to the left. This command is ignored if the cursor is located in the first position of a line.

**Command:**

Syntax	<CSI>	<D>
Hex.	9B	44
Dec.	155	68

### Cursor right

**Description:**

Moves the cursor one position to the right. This command is ignored if the cursor is located in the last position of a line.

**Command:**

Syntax	<CSI>	<C>
Hex.	9B	43
Dec.	155	67

### Cursor up

**Description:**

Moves the cursor one position up in the same column. This command is ignored if the cursor is located in the uppermost line.

**Command:**

Syntax	<CSI>	<A>
Hex.	9B	41
Dec.	155	65

### Cursor down

**Description:**

Moves the cursor one position down in the same column. This command is ignored if the cursor is located in the lowermost line.

**Command:**

Syntax	<CSI>	<B>
Hex.	9B	42
Dec.	155	66

## Cursor commands

### Cursor home

**Description:**

The cursor is moved to the first position of the first line.

**Command:**

Syntax	<CSI>	<H>
Hex.	9B	48
Dec.	155	72

or:

Syntax	<CSI>	<f>
Hex.	9B	66
Dec.	155	102

### Cursor at end

**Description:**

The cursor is moved to the last position of the last line.

**Command:**

Syntax	<CSI>	<A>
Hex.	9B	42
Dec.	155	66

## Cursor commands

### Position cursor

#### Description:

The cursor must be positioned by pixels. An invalid position (outside of the display) causes the command to be ignored.

#### Command:

Syntax	<CSI>	(x)		<;>	(y)		<H>
Hex.	9B	(x1)	(x0)	3B	(y1)	(y0)	48
Dec.	155	(x1)	(x0)	59	(y1)	(y0)	72

or:

Syntax	<CSI>	(x)		<;>	(y)		<f>
Hex.	9B	(x1)	(x0)	3B	(y1)	(y0)	66
Dec.	155	(x1)	(x0)	59	(y1)	(y0)	102

**Parameters:** (x0) ... Byte 0 x-position (beginning with 0 to 160 dec. or A0 hex.)  
(x1) ... Byte 1 x-position (always 0 since the display size lies beneath it)  
(y0) ... Byte 0 y-position (beginning with 0 to 80 dec. or 50 hex.)  
(y1) ... Byte 1 y-position (always 0 since the display size lies beneath it)

## Information:

For the 1x1 font size, the character size is 6x8. For this reason, the display can write max. 26 characters in the X direction (156 pixels from a max. of 160) and 10 characters in the Y direction (80 pixels from a max. of 80).

For the 2x2 font size, the character size is 12x16. For this reason, the display can write max. 13 characters in the X direction (156 pixels from a max. of 160) and 5 characters in the Y direction (80 pixels from a max. of 80).

### Carriage return

#### Description:

The cursor is moved to the first position of the current line.

#### Command:

Syntax	<CR>
Hex.	0D
Dec.	13

## Cursor commands

### Line feed

**Description:**

The cursor is moved to same column in the next line.

**Command:**

Syntax	<LF>
Hex.	0A
Dec.	10

## Write / Delete commands

### Write characters

#### Description:

If the panel receives a printable ASCII character (ASCII no. 16 – 126, 128 – 154 and 156 – 255 in the extended character set), it will be shown immediately on the display at the current cursor position. The cursor is then advanced automatically to the right. The old character is overwritten. If the cursor is already at the last position of a line, the cursor remains unchanged.

#### Command:

Syntax	(z)
Hex.	(z)
Dec.	(z)

(z) ... Printable ASCII character 16 – 126, 128 – 154 and 156 – 255

### Insert character

#### Description:

Inserts a space at the current cursor position and moves all of the characters to the right of the cursor one position to the right. The original last character is moved from the window and deleted. The cursor position remains the same.

#### Command:

Syntax	<CSI>	<e>
Hex.	9B	65
Dec.	155	101

### Delete character

#### Description:

Deletes the character over the cursor. The characters to the right of the cursor are moved one position to the left. A space is inserted into the "free" last position. The cursor position remains the same.

#### Command:

Syntax	<DEL>
Hex.	7F
Dec.	127

or:

Syntax	<CSI>	<P>
Hex.	9B	50
Dec.	155	80



## Write / Delete commands

### Delete character without advancing

**Description:**

Deletes the character over the cursor. The cursor's position stays the same.

**Command:**

Syntax	<CSI>	<X>
Hex.	9B	58
Dec.	155	88

### Backspace

**Description:**

Deletes the character to the left of the cursor; the cursor moves one position to the left. All characters after the cursor position are moved one position to the left. A space is inserted in the last column of the line that becomes free. This command is ignored if the cursor is located in the first position of a line.

**Command:**

Syntax	<BS>
Hex.	08
Dec.	8

### Insert line

**Description:**

Shifts all lines underneath the cursor down, including the line currently containing the cursor. The original last line is moved from the window and deleted. A blank line is inserted at the cursor's position. The cursor's position stays the same.

**Command:**

Syntax	<CSI>	<L>
Hex.	9B	4C
Dec.	155	76

### Delete line

**Description:**

Deletes the entire line containing the cursor. The lines under the cursor are all moved up one line. A blank line is inserted at the last line. The cursor position remains the same.

**Command:**

Syntax	<CSI>	<M>
Hex.	9B	4D
Dec.	155	77

## Write / Delete commands

### Delete line from cursor position

**Description:**

Deletes the character over the cursor and the rest of the characters up to the end of the line. The cursor position remains the same.

**Command:**

Syntax	<CSI>	<K>
Hex.	9B	4B
Dec.	155	75

### Clear screen

**Description:**

Deletes the entire display and sets the cursor at the first position.

**Command:**

Syntax	<CSI>	<2>	<J>
Hex.	9B	32	4A
Dec.	155	50	74

### Switch on blinking mode

**Description:**

All subsequent printable characters are output with the attribute **blinking**. This command applies until it is disabled with "Turn off all attributes".

**Command:**

Syntax	<CSI>	<5>	<m>
Hex.	9B	35	6D
Dec.	155	53	109

## Write / Delete commands

### Turn off all attributes

#### Description:

Turns off the attributes for all additional characters that are output, i.e. **blinking and inverted** display is disabled.

#### Command:

Syntax	<CSI>	<0>	<m>
Hex.	9B	30	6D
Dec.	155	48	109

See also:      Switch on blinking mode

### Switch on inverse mode

#### Description:

Displays subsequent printable characters inversely.

#### Command:

Syntax	<CSI>	<7>	<m>
Hex.	9B	37	6D
Dec.	155	55	109

See also:      Switch on blinking mode  
                 Turn off all attributes

## Write / Delete commands

### Show X characters blinking

#### Description:

The coordinates and the length of the text to be blinking must be specified by pixel.

#### Command:

Syntax	<ESC>	<N>	(x)		(y)		(l)	
Hex.	1B	4E	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)
Dec.	27	78	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)

**Parameters:** (x0) ... Byte 0 x-position (beginning with 0 to 160 dec. or A0 hex.)

(x1) ... Byte 1 x-position (always 0 since the display size lies beneath it)

(y0) ... Byte 0 y-position (beginning with 0 to 80 dec. or 50 hex.)

(y1) ... Byte 1 y-position (always 0 since the display size lies beneath it)

(l0) ... Byte 0 of the length (beginning with 0 to 160 dec. or A0 hex.)

(l1) ... Byte 0 of the length (always 0 since the display size lies beneath it)

## Information:

For the 1x1 font size, the character size is 6x8. For this reason, the display can write max. 26 characters in the X direction (156 pixels from a max. of 160) and 10 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 6, and the display size should not be exceeded.

For the 2x2 font size, the character size is 12x16. For this reason, the display can write max. 13 characters in the X direction (156 pixels from a max. of 160) and 5 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 12, and the display size should not be exceeded.

## Write / Delete commands

### Show X characters normally

#### Description:

The coordinates and the length of the text to be shown normally must be specified by pixel.

#### Command:

Syntax	<ESC>	<Q>	(x)		(y)		(l)	
Hex.	1B	51	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)
Dec.	27	81	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)

**Parameters:** (x0) ... Byte 0 x-position (beginning with 0 to 160 dec. or A0 hex.)

(x1) ... Byte 1 x-position (always 0 since the display size lies beneath it)

(y0) ... Byte 0 y-position (beginning with 0 to 80 dec. or 50 hex.)

(y1) ... Byte 1 y-position (always 0 since the display size lies beneath it)

(l0) ... Byte 0 of the length (beginning with 0 to 160 dec. or A0 hex.)

(l1) ... Byte 0 of the length (always 0 since the display size lies beneath it)

## Information:

For the 1x1 font size, the character size is 6x8. For this reason, the display can write max. 26 characters in the X direction (156 pixels from a max. of 160) and 10 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 6, and the display size should not be exceeded.

For the 2x2 font size, the character size is 12x16. For this reason, the display can write max. 13 characters in the X direction (156 pixels from a max. of 160) and 5 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 12, and the display size should not be exceeded.

## Write / Delete commands

### Show X characters inversely

#### Description:

Turns on the **inverse** attribute beginning from the specified cursor position for the line (l), column (c), and number (x) of characters. This allows the end of lines to be exceeded.

#### Command:

Syntax	<ESC>	<O>	(x)		(y)		(l)	
Hex.	1B	4F	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)
Dec.	27	779	(x1)	(x0)	(y1)	(y0)	(l1)	(l0)

**Parameters:** (x0) ... Byte 0 x-position (beginning with 0 to 160 dec. or A0 hex.)

(x1) ... Byte 1 x-position (always 0 since the display size lies beneath it)

(y0) ... Byte 0 y-position (beginning with 0 to 80 dec. or 50 hex.)

(y1) ... Byte 1 y-position (always 0 since the display size lies beneath it)

(l0) ... Byte 0 of the length (beginning with 0 to 160 dec. or A0 hex.)

(l1) ... Byte 0 of the length (always 0 since the display size lies beneath it)

## Information:

For the 1x1 font size, the character size is 6x8. For this reason, the display can write max. 26 characters in the X direction (156 pixels from a max. of 160) and 10 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 6, and the display size should not be exceeded.

For the 2x2 font size, the character size is 12x16. For this reason, the display can write max. 13 characters in the X direction (156 pixels from a max. of 160) and 5 characters in the Y direction (80 pixels from a max. of 80). The length should be divisible by 12, and the display size should not be exceeded.

### Select 1x1 font size

#### Description:

All subsequent characters are output in the default size.

#### Command:

Syntax	<ESC>	<#>	<1>
Hex.	1B	23	31
Dec.	27	35	49

## Write / Delete commands

### Select 2x2 font size

**Description:**

All subsequent characters are output in the larger (doubled) size.

**Command:**

Syntax	<ESC>	<#>	<2>
Hex.	1B	23	32
Dec.	27	35	50

## Graphic commands

### Graphic commands

Graphic commands only have an effect on graphic-capable displays. Graphic elements are drawn without consideration of the existing display contents. If a character is output, the entire area that would be covered by the drawing operation is cleared, and the drawn pixels are displayed. A normal character is 8 pixels high and 6 pixels wide. This results in an existing line being overwritten by a character, interrupting the line.

#### Example:

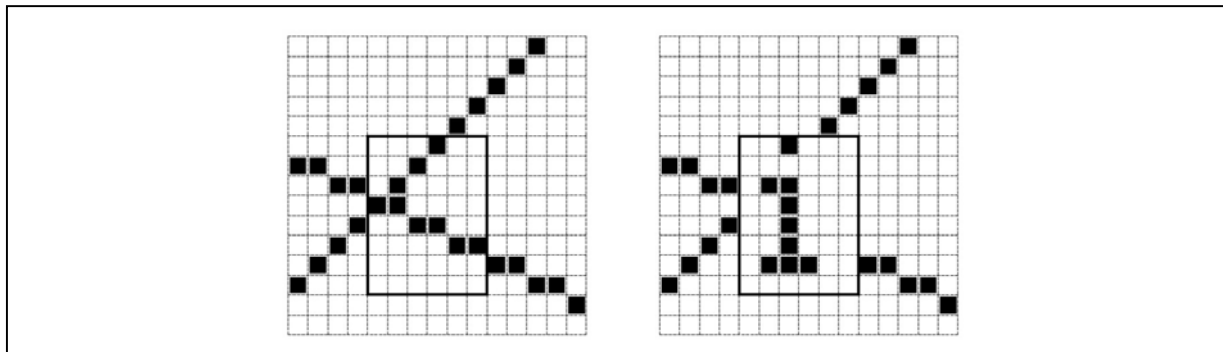


Figure 19: Graphic commands

Graphic commands basically begin with the code <ESC> <G> if the object should be drawn or the code <ESC> <C> if the object should be deleted.

The position of the graphic element is defined using (X,Y) coordinates.

**x** ... Horizontal coordinate  
**y** ... Vertical coordinate

The upper left point on the display has the coordinates x=0 and y=0.

The parameters for the coordinates are each three digits and encoded in ASCII (each coordinate consists of three bytes). The maximum value of each depends on the size of the display.

The following codes are used in the graphic commands:

**(xxx)** ..... X coordinate of the upper left corner of the object  
**(yyy)** ..... Y coordinate of the upper left corner of the object  
**(bbb)** ..... Width of a bar horizontally to the direction of extension  
                    Width of a rectangle always in the X direction (horizontal)  
**(hhh)** ..... Height of a rectangle always in the Y direction (vertical)  
**(fff)** ..... Fill level of a bar (number of active pixels)  
**(lll)** ..... Length of a line or bar  
**(sss)** ..... Line thickness of a rectangle

All coordinates and parameters are monitored to guarantee that the entire object has room on the display. If the object cannot be completely displayed, it is not drawn and an error message (\$97) is output.



## Graphic commands

### Toggle point

#### Description:

Sets or deletes the pixel at the selected position.

#### Command:

Syntax	<ESC>	<G/C>	<p>	(xxx)			(yyy)		
Hex.	1B	47/43	70	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)
Dec.	27	71/67	112	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)

Parameters: <G> ... Set

<C> ... Delete

(xxx) ... X coordinate of the pixel

(yyy) ... Y coordinate of the pixel

Permitted values:      <0><0><0>to<9><9><9>      Char.  
                         <48><48><48>to<57><57><57>      Dec.  
                         <30><30><30>to<39><39><39>      Hex.

### Draw / Delete horizontal line

#### Description:

Draws or deletes a horizontal line with the specified length at pixel position (x/y).

#### Command:

Syntax	<ESC>	<G/C>	<h>	(xxx)			(yyy)			(lll)		
Hex.	1B	47/43	68	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(l2)	(l1)	(l0)
Dec.	27	71/67	104	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(l2)	(l1)	(l0)

Parameters: <G> ... Set

<C> ... Delete

(xxx) ... X coordinate of the line's leftmost pixel

(yyy) ... Y coordinate of the line's leftmost pixel

(lll) ... Length of the line in pixels

Permitted values:      <0><0><0>to<9><9><9>      Char.  
                         <48><48><48>to<57><57><57>      Dec.  
                         <30><30><30>to<39><39><39>      Hex.

## Graphic commands

### Draw / Delete vertical line

#### Description:

Draws or deletes a vertical line with the specified length at pixel position (x/y).

#### Command:

Syntax	<ESC>	<G/C>	<v>	(xxx)			(yyy)			(lll)		
Hex.	1B	47/43	76	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(l2)	(l1)	(l0)
Dec.	27	71/67	118	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(l2)	(l1)	(l0)

Parameters: <G> ... Set

<C> ... Delete

(xxx) ... X coordinate of the line's leftmost pixel

(yyy) ... Y coordinate of the line's leftmost pixel

(lll) ... Length of the line in pixels

Permitted values:	<0><0><0>to<9><9><9>	Char.
	<48><48><48>to<57><57><57>	Dec.
	<30><30><30>to<39><39><39>	Hex.

### Draw / Delete border

#### Description:

Draws or deletes a rectangle with the specified size, width, height, and line thickness at pixel position (x/y).

#### Command:

Syntax	<ESC>	<G/C>	<f>	(xxx)			(yyy)			(bbb)		
Hex.	1B	47/43	66	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)
Dec.	27	71/67	102	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)

(hhh)			(sss)		
(h2)	(h1)	(h0)	(s2)	(s1)	(s0)
(h2)	(h1)	(h0)	(s2)	(s1)	(s0)

Parameters: <G> ... Set

<C> ... Delete

(xxx) ... X coordinate of the upper left corner of the rectangle

(yyy) ... Y coordinate of the upper left corner of the rectangle

(bbb) ... Width of the rectangle (horizontal) in pixels

(hhh) ... Height of the rectangle (vertical) in pixels

(sss) ... Line thickness of a rectangle

Permitted values:	<0><0><0>to<9><9><9>	Char.
	<48><48><48>to<57><57><57>	Dec.
	<30><30><30>to<39><39><39>	Hex.

## Graphic commands

### Draw / Delete rectangle

#### Description:

Draws or deletes a filled-in rectangle with the specified size, width, and height at pixel position (x/y).

#### Command:

Syntax	<ESC>	<G/C>	<r>	(xxx)			(yyy)			(bbb)		
Hex.	1B	47/43	72	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)
Dec.	27	71/67	114	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)

(hhh)		
(h2)	(h1)	(h0)
(h2)	(h1)	(h0)

**Parameters:** <G> ... Set  
<C> ... Delete  
(xxx) ... X coordinate of the upper left corner of the rectangle  
(yyy) ... Y coordinate of the upper left corner of the rectangle  
(bbb) ... Width of the rectangle (horizontal) in pixels  
(hhh) ... Height of the rectangle (vertical) in pixels

Permitted values:      <0><0><0>to<9><9><9>      Char.  
                         <48><48><48>to<57><57><57>      Dec.  
                         <30><30><30>to<39><39><39>      Hex.

## Graphic commands

### Draw bar

#### Description:

Draws a bar (rectangular form) whose extension direction derives from the bar type. The width of the rectangular form always refers horizontally to the extension direction, whereas the length specifies the max. extension direction. The bar is black according to the fill level; the remaining part is white.

#### Command:

Syntax	<ESC>	<G>	(b)	(xxx)			(yyy)			(bbb)		
Hex.	1B	47	(b)	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)
Dec.	27	71	(b)	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)

(lll)			(fff)		
(l2)	(l1)	(l0)	(f2)	(f1)	(f0)
(l2)	(l1)	(l0)	(f2)	(f1)	(f0)

**Parameters:** <G> ... Set

(xxx) ... X coordinate of the upper left corner of the rectangle

(yyy) ... Y coordinate of the upper left corner of the rectangle

(bbb) ... Width of the rectangle (horizontal) in pixels

(lll) ... Length of the bar

(fff) ... Fill level of the bar (number of active pixels)

Permitted values:      <0><0><0>to<9><9><9>      Char.  
                              <48><48><48>to<57><57><57>      Dec.  
                              <30><30><30>to<39><39><39>      Hex.

(b) ... Bar type

(b)	Description
<e>	Bar extending from left to right. The lower left corner is used as the reference point (x/y).
<w>	Bar extending from right to left. The upper left corner is used as the reference point (x/y).
<n>	Bar extending from bottom to top. The lower left corner is used as the reference point (x/y).
<s>	Bar extending from top to bottom. The upper right corner is used as the reference point (x/y).

## Graphic commands

### Delete bar

#### Description:

Deletes a bar (rectangular form) whose extension direction derives from the bar type. The width of the rectangular form always refers horizontally to the extension direction, whereas the length specifies the max. extension direction. The bar is black according to the fill level; the remaining part is white.

#### Command:

Syntax	<ESC>	<C>	(b)	(xxx)			(yyy)			(bbb)		
Hex.	1B	43	(b)	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)
Dec.	27	67	(b)	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)

(lll)		
(l2)	(l1)	(l0)
(l2)	(l1)	(l0)

**Parameters:** <C> ... Delete

(xxx) ... X coordinate of the upper left corner of the rectangle

(yyy) ... Y coordinate of the upper left corner of the rectangle

(bbb) ... Width of the rectangle (horizontal) in pixels

(lll) ... Length of the bar

Permitted values:      <0><0><0>to<9><9><9>      Char.  
                              <48><48><48>to<57><57><57>      Dec.  
                              <30><30><30>to<39><39><39>      Hex.

(b) ... Bar type

(b)	Description
<e>	Bar extending from left to right. The lower left corner is used as the reference point (x/y).
<w>	Bar extending from right to left. The upper left corner is used as the reference point (x/y).
<n>	Bar extending from bottom to top. The lower left corner is used as the reference point (x/y).
<s>	Bar extending from top to bottom. The upper right corner is used as the reference point (x/y).

## Additional commands

### Modify brightness

#### Description:

The brightness of the background lighting can be configured on this display.

#### Command:

Syntax	<ESC>	<h>	(hh)	
Hex.	1B	68	(h1)	(h0)
Dec.	27	104	(h1)	(h0)

**Parameters: (hh)** ... Brightness is specified as a percent. Most display modules have only a small number of brightness levels; for this reason, entering different values often results in the same brightness.

Permitted values: <0><0> to <9><9>

### Set time for background lighting

#### Description:

It's advantageous to take care of the light membrane due to its reduced lifespan on LCD displays. Turning the background lighting off after a certain time in which there is no action on the panel (keystroke) protects the membrane and increases its lifespan. This command is used to configure this time. In addition, this command can be used to also explicitly turn the lighting on or off.

#### Command:

Syntax	<ESC>	<b>	(tt)	
Hex.	1B	62	(t1)	(t0)
Dec.	27	98	(t1)	(t0)

**Parameters: (tt)** ... Time in minutes

(tt) Char.	Dec.	Hex.	Description
<0><0>	<48><48>	<30><30>	Turns off the lighting. In this case, the lighting will not be turned back on when a key is pressed.
<0><1>to <9><8>	<48><49>to <57><57>	<30><31>to <39><39>	Length of the lighting after the last keystroke or screen command in minutes.
<9><9>	<57><57>	<39><39>	The lighting is turned on and remains on until turned back off again with (tt)=(0)(0). If a time is set for the background lighting, then the lighting will shut off after the specified time.

## Additional commands

### Reset time for background lighting

#### Description:

With this command, the application software can re-enable the background lighting (e.g. when an alarm state occurs) without the operator's having to press a key. After this command is received, the background lighting is enabled for the configured time (like with a keystroke). If the time is permanently on (00) or permanently off (99), this sequence has no effect.

#### Command:

Syntax	<ESC>	<r>
Hex.	1B	72
Dec.	27	114

### Query status

#### Description:

This command can be used for the PLC to request a so-called "status string" from the panel. This string contains information about the panel configuration and the hex switch settings.

#### Command:

Syntax	<ESC>	<S>
Hex.	1B	53
Dec.	27	83

#### Structure of the sent string:

	Start	0 ..... 1 ..... 2 ..... 3 ..... 0123456789012345678901234567890123456789	End
Status string	<DC2>	Version: x.y                      Status: abcdefgh	<DC4>
Hex.	12	According to the ASCII table	14
Dec.	18	According to the ASCII table	20

**Version:**     x ...    Operating system version number

                 y ...    Operating system edition number

**Status:**     a ...    Display code (3 – 160x80 graphics display)

                 b ...    Always outputs the C character [C as in CAN]

                 cc ...    CAN node number [1 to 32]

                 d ...    Baud rate: Corresponds to the 2 highest bits of the first hex switch  
                                 0 ... 250 KBaud, 1 ... 125 KBaud, 2 ... 20 KBaud, 3 ... 500 KBaud

                 e ...    Number of connected key modules

                 f ...    0

                 g ...    0

                 h ...    0

## Additional commands

### Query extended status

#### Description:

This command can be used for the PLC to request an "extended status string" from the panel. This string contains additional information about the panel being used.

#### Command:

Syntax	<ESC>	<E>
Hex.	1B	45
Dec.	27	69

## Information:

This string is 20 characters long. To differentiate status string characters from keystrokes, the ASCII characters <DC2> are sent in front of the string and <DC4> after it.

	Start	0 ..... 1 ..... 01234567890123456789	End
Status string	<DC2>	aabbccddeexxxxxxxxxx	<DC4>
Hex.	12	According to the ASCII table	14
Dec.	18	According to the ASCII table	20

**Status:**

- aa ...** Number of lines: 10
- bb ...** Number of characters (characters per line): 26
- c ...** Information about whether the display is graphics-capable
  - 0 ..... Not graphics-capable
- dd ...** Height of a 1x1 character in pixels: 08
- ee ...** Width of a 1x1 character in pixels: 06
- x ...** Available for future expansions



## Additional commands

### Query display contents of a line

#### Description:

This command requests the panel to send the contents of the specified lines on the display to the PLC. Attributes like blinking characters and graphic elements are ignored.

#### Command:

Syntax	<CSI>	<i>	(zz)	
Hex.	9B	69	(z1)	(z0)
Dec.	155	105	(z1)	(z0)

Parameters: (zz) ... Line number

Permitted values: <0><1> to <1><0> 1x1 characters  
<0><5> 2x2 characters

	Start	ASCII string (length is display dependent)	End
Status string	<DC2>	.....	<DC4>
Hex.	12	According to the ASCII table	14
Dec.	18	According to the ASCII table	20

### Reset

#### Description:

The system resumes the state it was in when it was turned on.

#### Command:

Syntax	<ESC>	<R>
Hex.	1B	52
Dec.	27	82

## Additional commands

### Configure minimum delay

#### Description:

This command can be used to configure the time that must pass between two CAN frames being sent to the PLC. The maximum delay time is 999 ms and can be configured in steps of 1 ms. The default delay time is set to 10 ms since the panel sends a reset code after the initialization phase. The panel can only receive data and commands after the reset code has been sent. This value ensure that a receiving task on the PLC in task class 1 (10 ms) can receive all data. Without this delay time, a data packet would be sent every millisecond in the worst case.

#### Command:

Syntax	<ESC>	<Y>	(zzz)
Hex.	1B	59	(z2)(z1)(z0)
Dec.	27	89	(z2)(z1)(z0)

**Parameters:** (zzz) ... Delay time in 1 ms steps

Permitted values:	<0><0><0>to<9><9><9>	Char.
	<48><48><48>to<57><57><57>	Dec.
	<30><30><30>to<39><39><39>	Hex.

Setting the minimum delay time to 000 results in a maximum transfer rate.

## Additional commands

### Query matrix

#### Description:

This command can be used to send an entire map of the key matrix with the release code via the CAN bus. If a key is pressed, a pressed code appears instead of the release code at this position.

#### Command:

Syntax	<ESC>	<1>
Hex.	1B	46
Dec.	27	70

#### CAN frame structure:

Example: Key matrix with 16 keys, release code for all keys

160 161 162 163 164 165 166 167  
168 169 170 171 172 173 174 175

Example: Key matrix with 16 keys. When the command is executed, the first and third keys are pressed. (pressed code of both keys)

32 161 34 163 164 165 166 167  
168 169 170 171 172 173 174 175

### Query HEX switch position

#### Description:

This command can be used to output the position of both hex switches via the CAN bus.

#### Command:

Syntax	<ESC>	<1>
Hex.	1B	31
Dec.	27	49

#### CAN frame structure:

Switch 0	Switch 1
Value	Value

## Additional commands

### Set time for life signs

#### Description:

A life sign can be enabled so that the controller can monitor whether the panel is still working. The Panelware PW35 device periodically sends a CAN frame with the contents "00" in at set intervals.

#### Command:

Syntax	<ESC>	<p>	<l>	(t2)	(t1)	(t0)
Hex.	1B	70	6C	(t2)	(t1)	(t0)
Dec.	27	112	108	(t2)	(t1)	(t0)

**Parameters:** (ttt) ... Time in 10 millisecond steps from 10...2550 ms  
000....Life sign off

Permitted value range:	<0><0><0>to<2><5><5>	Char.
	<48><48><48>to<50><53><53>	Dec.
	<30><30><30>to<32><35><35>	Hex.

## New commands

### Draw bitmap

#### Description:

Outputs a bitmap with the specified size (bbb) and (hhh) (in pixels) at the specified coordinates (xxx) and (yyy) (in pixels). The bitmap data (in bytes) follows the command.

#### Command:

Syntax	<ESC>	<G>	<b>	(xxx)			(yyy)			(bbb)		
Hex.	1B	47	62	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)
Dec.	27	71	98	(x2)	(x1)	(x0)	(y2)	(y1)	(y0)	(b2)	(b1)	(b0)

(hhh)		
(h2)	(h1)	(h0)
(h2)	(h1)	(h0)

**Parameters:** <G> ... Set

(xxx) ... X coordinate of the upper left corner of the object

(yyy) ... Y coordinate of the upper left corner of the object

(bbb) ... Width in pixels

(hhh) ... Height in pixels (vertical)

Permitted values:	<0><0><0>to<9><9><9>	Char.
	<48><48><48>to<57><57><57>	Dec.
	<30><30><30>to<39><39><39>	Hex.

### 3 Data format of the CAN object in the PLC direction

#### 3.1 Key codes

The panel can send the following 1-byte messages to the PLC. The table on the following page lists all 1-byte data that can be sent from the panel to the PLC.

Exception:

The responses to the "Query status" and "Query extended status" commands are not listed in the table.

#### 3.2 Overview – Transferring data: Panel -> PLC

Hex.	Dec.	Description
0	0	Life sign
1 – F	1 – 15	"t on" codes (key pressed code)
11	17	<XON> (reserved for software handshake, not used)
12	18	<DC2> (start of string)
13	19	<XOFF> (reserved for software handshake, not used)
14	20	<DC4> (end of string)
15 – 1E	21 – 30	Not used
1F	31	Used for reading the rotational encoder start-of-frame
20 – 7E	32 – 126	"t on" codes (key pressed code)
80	127	Used to fill in the key matrix
81 – 8F	129 – 143	"t off" codes (key release code)
90	144	Panel reset (after turning on or from controller command)
91 – 96	145 – 150	Not used
97	151	Command sequence aborted (e.g. timeout, <ESC> from the PLC, unknown command sequence, unknown parameter)
98	152	Not used
99	153	CAN controller reset
9A – 9F	154 – 159	Not used
A0 – FE	160 - 254	"t off" codes (key release code)

**Table 10: Data transfer overview**

#### 3.3 Key object data assignments

**Key code:**

No key pressed, life sign	0 (0x00)
Key pressed	40...91 or hex: 28...5B see Key / LED matrix
Key released	Key code + 128 (highest-value bit set)

Key numbers are the same as the accompanying LED numbers. When pressing one or more keys, each newly pressed key is identified by sending the key code. When the key is released, the key code +128 (hex 80) is sent. When pressing more than one key in repeat mode, all pressed codes are sent as repeats. When the key is released, 1x the release code is sent.

## Command set

If several keys are pressed within a key scan cycle (16 ms) or other messages (e.g. unknown command sequences 0x97) are issued on the CAN bus, then the key codes can also be in the second, third, or last (eighth) byte of the CAN message.

The CAN frames are always filled from front to back (byte 0...byte 7).

## 4 ASCII code table

Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen
000	\$00		032	\$20		064	\$40	À	096	\$60	`
001	\$01		033	\$21	!	065	\$41	A	097	\$61	a
002	\$02		034	\$22	"	066	\$42	B	098	\$62	b
003	\$03		035	\$23	#	067	\$43	C	099	\$63	c
004	\$04		036	\$24	\$	068	\$44	D	100	\$64	d
005	\$05		037	\$25	%	069	\$45	E	101	\$65	e
006	\$06		038	\$26	&	070	\$46	F	102	\$66	f
007	\$07		039	\$27	'	071	\$47	G	103	\$67	g
008	\$08		040	\$28	(	072	\$48	H	104	\$68	h
009	\$09		041	\$29	)	073	\$49	I	105	\$69	i
010	\$0A		042	\$2A	*	074	\$4A	J	106	\$6A	j
011	\$0B		043	\$2B	+	075	\$4B	K	107	\$6B	k
012	\$0C		044	\$2C	,	076	\$4C	L	108	\$6C	l
013	\$0D		045	\$2D	-	077	\$4D	M	109	\$6D	m
014	\$0E		046	\$2E	.	078	\$4E	N	110	\$6E	n
015	\$0F		047	\$2F	/	079	\$4F	O	111	\$6F	o
016	\$10	à	048	\$30	0	080	\$50	P	112	\$70	p
017	\$11	á	049	\$31	1	081	\$51	Q	113	\$71	q
018	\$12	â	050	\$32	2	082	\$52	R	114	\$72	r
019	\$13	ã	051	\$33	3	083	\$53	S	115	\$73	s
020	\$14	ä	052	\$34	4	084	\$54	T	116	\$74	t
021	\$15	å	053	\$35	5	085	\$55	U	117	\$75	u
022	\$16	ä	054	\$36	6	086	\$56	V	118	\$76	v
023	\$17	ë	055	\$37	7	087	\$57	W	119	\$77	w
024	\$18	ö	056	\$38	8	088	\$58	X	120	\$78	x
025	\$19	ü	057	\$39	9	089	\$59	Y	121	\$79	y
026	\$1A	ü	058	\$3A	:	090	\$5A	Z	122	\$7A	z
027	\$1B		059	\$3B	;	091	\$5B	[	123	\$7B	{
028	\$1C	í	060	\$3C	<	092	\$5C	¥	124	\$7C	¿
029	\$1D	l	061	\$3D	=	093	\$5D	]	125	\$7D	}
030	\$1E	ß	062	\$3E	>	094	\$5E	^	126	\$7E	̄
031	\$1F	ç	063	\$3F	?	095	\$5F	_	127	\$7F	

Table 11: ASCII code table

## Command set

Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen	Dez.	Hex.	Zeichen
128	\$80	Ç	160	\$A0	í	192	\$C0	В	224	\$E0	Э
129	\$81	Ü	161	\$A1	ó	193	\$C1	Г	225	\$E1	Ђ
130	\$82	é	162	\$A2	Ġ	194	\$C2	ë	226	\$E2	П
131	\$83	ă	163	\$A3	ă	195	\$C3	И	227	\$E3	Х
132	\$84	ă	164	\$A4	î	196	\$C4	Э	228	\$E4	Ф
133	\$85	ă	165	\$A5	ț	197	\$C5	И	229	\$E5	Ψ
134	\$86	ø	166	\$A6	€	198	\$C6	Й	230	\$E6	Ω
135	\$87	Ç	167	\$A7	ı	199	\$C7	К	231	\$E7	α
136	\$88	è	168	\$A8	ç	200	\$C8	Л	232	\$E8	Σ
137	\$89	ş	169	\$A9	€	201	\$C9	М	233	\$E9	Υ
138	\$8A	è	170	\$AA	ł	202	\$CA	Н	234	\$EA	δ
139	\$8B	ñ	171	\$AB	ı	203	\$CB	П	235	\$EB	ε
140	\$8C	ı	172	\$AC	ñ	204	\$CC	Т	236	\$EC	ζ
141	\$8D	ı	173	\$AD	ś	205	\$CD	Ч	237	\$ED	η
142	\$8E	ä	174	\$AE	ž	206	\$CE	Ш	238	\$EE	θ
143	\$8F	Ä	175	\$AF	ž	207	\$CF	Ъ	239	\$EF	°
144	\$90	É	176	\$B0	Б	208	\$D0	Ы	240	\$F0	ι
145	\$91	æ	177	\$B1	И	209	\$D1	ь	241	\$F1	κ
146	\$92	Æ	178	\$B2	Э	210	\$D2	Ә	242	\$F2	λ
147	\$93	ò	179	\$B3	И	211	\$D3	Ю	243	\$F3	μ
148	\$94	ö	180	\$B4	Й	212	\$D4	Я	244	\$F4	ν
149	\$95	ø	181	\$B5	Л	213	\$D5	Д	245	\$F5	ξ
150	\$96	û	182	\$B6	П	214	\$D6	У	246	\$F6	π
151	\$97	ú	183	\$B7	У	215	\$D7	Ш	247	\$F7	ρ
152	\$98	Ş	184	\$B8	Ф	216	\$D8	А	248	\$F8	σ
153	\$99	Ü	185	\$B9	Ч	217	\$D9	О	249	\$F9	τ
154	\$9A	Ü	186	\$BA	Ш	218	\$DA	Ц	250	\$FA	υ
155	\$9B		187	\$BB	Ъ	219	\$DB	Ч	251	\$FB	φ
156	\$9C	£	188	\$BC	Ы	220	\$DC	Г	252	\$FC	ψ
157	\$9D	ă	189	\$BD	Э	221	\$DD	Д	253	\$FD	ω
158	\$9E	ö	190	\$BE	Ю	222	\$DE	Ө	254	\$FE	ε
159	\$9F	ă	191	\$BF	Я	223	\$DF	А	255	\$FF	■

Table 12: ASCII code table



## 5 Error handling

A panel should be completely tested before it is finally installed in a switching cabinet, control desk, or machine.

### 5.1 Error handling

#### Visual inspection

The device should definitely be visually inspected before switching it on:

- Check the mechanical connection.
- If necessary, check the position of the number switch (node number, baud rate).

#### Commissioning

A first test is carried out when connecting the panel with the 24 V supply. In this case, all LEDs should briefly light, and the following message should appear on the display:

```
CAN-PANEL  
FW-Version: xx.xx  
CAN#: NodeNr: -- / Baud rate: ---kBaud  
Waiting for data ...
```

If this message appears on the display, then the processor, display, and internal power supply are OK. If the node number and baud rate settings are valid, then they will be displayed in place of "--".

- Display stays dark: Is the current supplied really between 18 and 30 VDC?
- The contrast of the display can be adjusted with the 7 and 8 (or 7 and 9) keys.
- Although the welcome message as listed above is shown, the display doesn't respond to any commands from the CAN interface:

Does the CAN identifier match the configured node number; is the correct baud rate set?

Is the right CAN cable being used? -> See CAN bus specification

#### Starting the application

Error-free functionality of the CAN interface on the Panelware PW35 device cannot be completely determined with the procedure listed above.

To test a panel completely, an entire application can be started to test its functionality before the device is mounted.

## Figure index

### 6 Table index

Table 1: Manual history .....	5
Table 2: Organization of safety notices .....	9
Table 3: Model number overview - Display units.....	10
Table 4: Model number overview - Accessories.....	10
Table 5: Technical data - 4PW035.E300-01 .....	13
Table 6: Technical data - 4PW035.E300-02.....	16
Table 7: Chemical resistance of the mylar .....	21
Table 8: Overview of commands .....	29
Table 9: Overview of commands .....	30
Table 10: Data transfer overview.....	62
Table 11: ASCII code table .....	63
Table 12: ASCII code table .....	64

### 7 Figure index

Figure 1: Serial number sticker design/dimensions.....	9
Figure 2: Panelware PW35 .....	11
Figure 3: Front view - 4PW035.E300-01 .....	12
Figure 4: Rear view - 4PW035.E300-01 .....	12
Figure 5: Dimensions - 4PW035.E300-01 .....	14
Figure 6: Front view - 4PW035.E300-02 .....	15
Figure 7: Rear view - Rückansicht 4PW035.E300-02 .....	15
Figure 8: Dimensions - 4PW035.E300-02 .....	17
Figure 9: Space for air circulation .....	18
Figure 10: Panelware PW35 installation angle.....	19
Figure 11: Contrast setting.....	20
Figure 12: Mylar keypad.....	22
Figure 13: Key and LED codes .....	22
Figure 14: Power supply .....	23
Figure 15: CAN interface.....	23
Figure 16: Number switches - 4PW035.E300-01 .....	24
Figure 17: X2X interface .....	24
Figure 18: Number switches - 4PW035.E300-02 .....	25
Figure 19: Graphic commands.....	48