SAIA-Burgess Electronics

SWITCHES • MOTORS • CONTROLLERS

SAIA®PCD
Process Control Devices

PCD7.D160 and ..D170
Small industrial terminals
Manual

SAIA-Burgess Electronics Ltd.
Bahnhofstrasse 18
CH-3280 Murten (Switzerland)
http;//www.saia-burgess.com

BA: Electronic Controllers   Telephone   026 / 672 72 72
                               Telefax   026 / 672 74 99
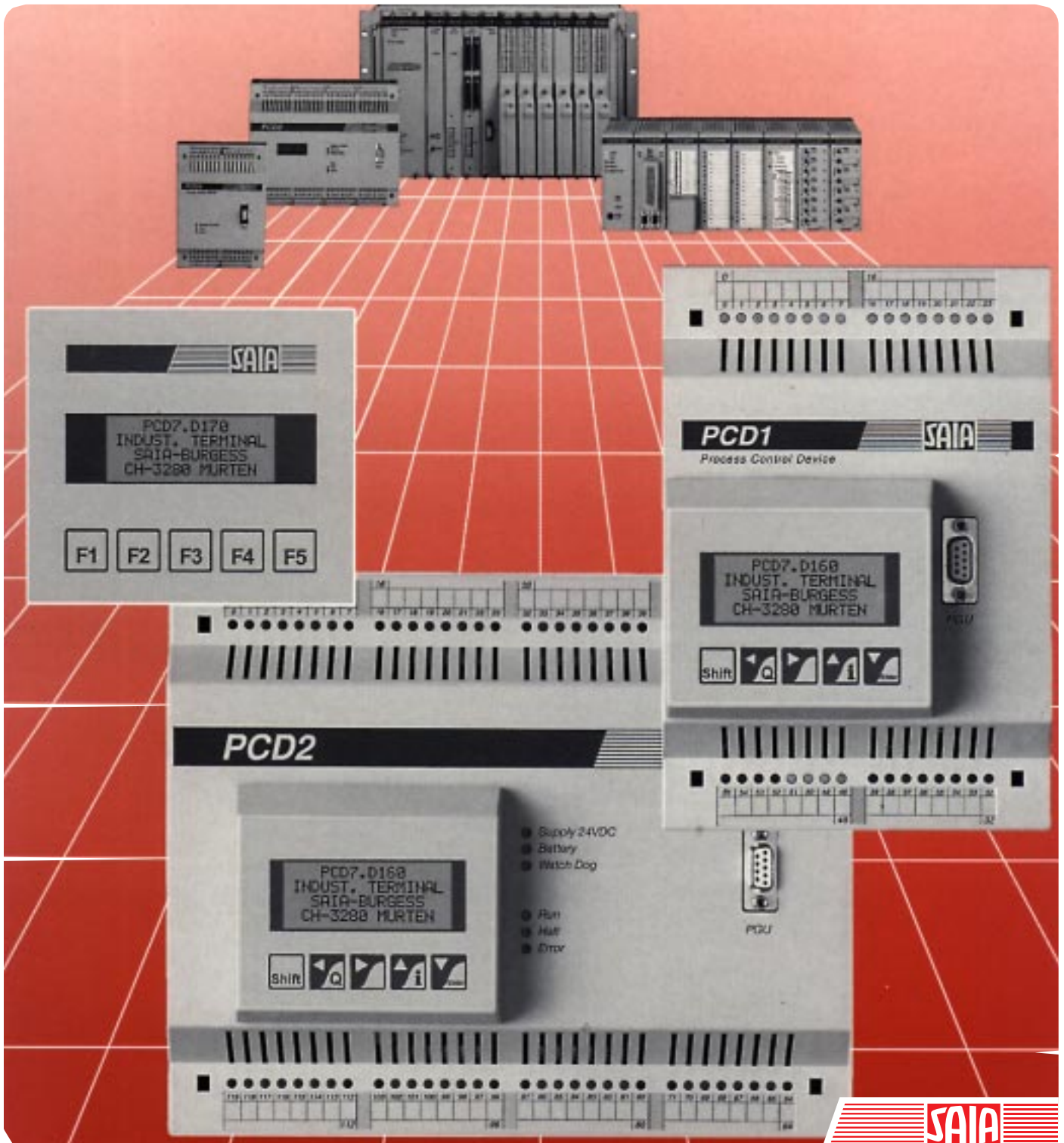
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Switzerland	SAIA-Burgess Electronics AG Freiburgstrasse 33 CH-3280 Murten ☎ 026 672 77 77, Fax 026 670 19 83	**France**	SAIA-Burgess Electronics Sàrl. 10, Bld. Louise Michel F-92230 Gennevilliers ☎ 01 46 88 07 70, Fax 01 46 88 07 99
Germany	SAIA-Burgess Electronics GmbH Daimlerstrasse 1k D-63303 Dreieich ☎ 06103 89 060, Fax 06103 89 06 66	**Nederlands**	SAIA-Burgess Electronics B.V. Hanzeweg 12c NL-2803 MC Gouda ☎ 0182 54 31 54, Fax 0182 54 31 51
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Italy	SAIA-Burgess Electronics S.r.l. Via Cadamosto 3 I-20094 Corsico MI ☎ 02 48 69 21, Fax 02 48 60 06 92	**Hungary**	SAIA-Burgess Electronics Automation Kft. Liget utca 1. H-2040 Budaörs ☎ 23 501 170, Fax 23 501 180

Representatives

Great Britain	Canham Controls Ltd. 25 Fenlake Business Centre, Fengate Peterborough PE1 5BQ UK ☎ 01733 89 44 89, Fax 01733 89 44 88	**Portugal**	INFOCONTROL Electronica e Automatismo LDA. Praceta Cesário Verde, No 10 s/cv, Massamá P-2745 Queluz ☎ 21 430 08 24, Fax 21 430 08 04
Denmark	Malthe Winje Automation AS Håndværkerbyen 57 B DK-2670 Greve ☎ 70 20 52 01, Fax 70 20 52 02	**Spain**	Tecnosistemas Medioambientales, S.L. Poligono Industrial El Cabril, 9 E-28864 Ajalvir, Madrid ☎ 91 884 47 93, Fax 91 884 40 72
Norway	Malthe Winje Automasjon AS Haukelivn 48 N-1415 Oppegård ☎ 66 99 61 00, Fax 66 99 61 01	**Czech Republic**	ICS Industrie Control Service, s.r.o. Modranská 43 CZ-14700 Praha 4 ☎ 2 44 06 22 79, Fax 2 44 46 08 57
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Suomi/ Finland	ENERGEL OY Atomitie 1 FIN-00370 Helsinki ☎ 09 586 2066, Fax 09 586 2046		

Australia	Siemens Building Technologies Pty. Ltd. Landis & Staefa Division 411 Ferntree Gully Road AUS-Mount Waverley, 3149 Victoria ☎ 3 9544 2322, Fax 3 9543 8106	**Argentina**	MURTEN S.r.l. Av. del Libertador 184, 4° "A" RA-1001 Buenos Aires ☎ 054 11 4312 0172, Fax 054 11 4312 0172

After sales service

USA	SAIA-Burgess Electronics Inc. 1335 Barclay Boulevard Buffalo Grove, IL 60089, USA ☎ 847 215 96 00, Fax 847 215 96 06

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SAIA® Process Control Devices

Manual

Small industrial terminals

PCD7.D160 and ..D170

Updates

Date	Chapter	Page	Description
15.11.2000	---	---	Small updates for the "Support Homepage"
15.11.2000	2	2-1	Correction : Tolerance of the supply voltage at U_n
15.11.2000	10	10-1 / 10-2	Serial interface RS 232 only possible with ..D170

Contents

Notes :

<table>
<tr>
<td>⚠ !</td>
<td>

Please note :

A number of detailed manuals are available to aid installation and operation of the SAIA® PCD. These are for use by technically qualified staff, who may also have successfully completed one of our "workshops".

To obtain the best performance from your SAIA® PCD, closely follow the guidelines for assembly, wiring, programming and commissioning given in these manuals. In this way, you will also become one of the many enthusiastic SAIA® PCD users.

If you have any technical suggestions or recommendations for improvements to the manuals, please let us know. A form is provided on the last page of this manual for your comments.

</td>
</tr>
</table>

Summary

PCD1/2 series

Hardware PCD1 PCD2 Serie xx7

PCD2.M250

PCD2.H110
PCD2.H150
PCD2.H210
PCD2.H31x

PCD4 series

Hardware PCD4

PCD4.H1.. ***)**

PCD4.H2.. ***)**

PCD4.H3.. ***)**

PCD4.H4..

PCD6 series

Hardware PCD6

*) Adapter module 4'717'4828'0 allows H modules to be used with the PCD6.

General Manuals

User's Guide

Reference Guide (PG3)

PCD8.P1..

- PCD7.D1..
- PCD7.D202
- **PCD7.D250**
- PCD7.D7..

- S-Bus
- LON
- PROFIBUS

Installation Components for RS 485- Networks

- PG4
- Modem

FUPLA/ KOPLA function families

Reliability and safety of electronic controllers

SAIA-Burgess Electronics Ltd. is a company which devotes the greatest care to the design, development and manufacture of its products:

- state-of-the-art technology

- compliance with standards

- ISO 9001 certification

- international approvals: e.g. Germanischer Lloyd, UL, Det Norske Veritas, CE mark ...

- choice of high-quality componentry

- quality control checks at various stages of production

- in-circuit tests

Despite every care, the excellent quality which results from this does have its limits. It is therefore necessary, for example, to reckon with the natural failure of components. For this reason SAIA-Burgess Electronics Ltd. provides a guarantee according to the "General terms and conditions of supply".

The plant engineer must in turn also contribute his share to the reliable operation of an installation. He is therefore responsible for ensuring that controller use conforms to the technical data and that no excessive stresses are placed on it, e.g. with regard to temperature ranges, overvoltages and noise fields or mechanical stresses.

In addition, the plant engineer is also responsible for ensuring that a faulty product in no case leads to personal injury or even death, nor to the damage or destruction of property. The relevant safety regulations should always be observed. Dangerous faults must be recognized by additional measures and any consequences prevented. For example, outputs which are important for safety should lead back to inputs and be monitored from software. Consistent use should be made of the diagnostic elements of the PCD, such as the watchdog, exception organization blocks (XOB) and test or diagnostic instructions.

If all these points are taken into consideration, the SAIA® PCD will provide you with a modern, safe programmable controller to control, regulate and monitor your installation with reliability for many years.

1. Overview

1.1 Application

SAIA's new small terminals take advantage of the high intelligence and ample memory of SAIA®PCD controllers and can therefore be used economically and to optimal effect with industrial control systems or in building automation.

- All SAIA terminals PCD7.D1.. and D2.. have a simple text display. Apart from the display size and number of keys, they are fully mutually compatible, which makes changing to a larger version problem free (request brochure 26/311 E).

- The texts to be displayed are stored in the PCD control device. This means that the same programming tool (PG1, PG3 or PG4) can be used as for the control program. In addition, access to text and variables is possible at any time via modem.

- The intelligent text output of PCD controllers allows variables to be edited as desired and output to the display in the necessary format.

- Of course, these terminals also bear the CE mark and have been developed and manufactured under quality rules to ISO 9001.

For intelligent terminals with graphics display also, please request brochure 26/325 E.

1.2 Quick guide to operating terminals PCD7.D160 and D170

The following chapters supply detailed descriptions of the broad functional possibilities provided by the D160/D170 terminal. In any practical application, probably only a small part of them will be used.

In order to give the beginner a brief guide to simple text output it is advisable, before studying all tests and instructions individually, to do one of the program examples from chapter 8 as a practical exercise. In this way it will be obvious how simple it is in practice to work with the PCD and the D160/D170 terminal.

1.3 Three types
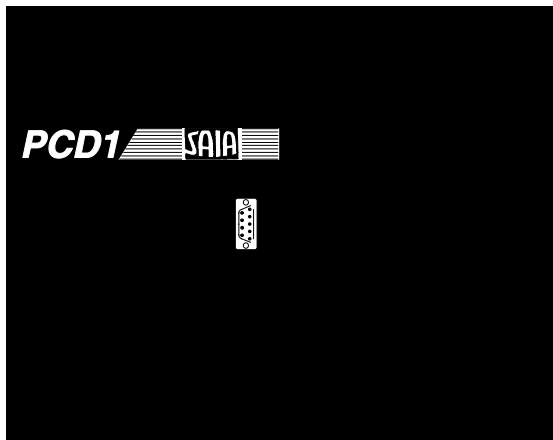
D160 on PCD1

D160 on PCD2

All types are identical regarding display (4 x 16 characters) number of keys (5) and all software functions.

Terminal sets ..D162 and ..D163 plug straight onto the cover of PCD1or PCD2 controllers. This combination results in an intelligent controller with the capacity for direct display and entry.
The type designation for the set varies according to the interface modul used (see ordering details and part 4.1).
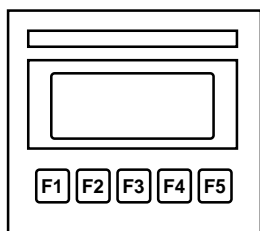
PCD7.D170

Terminal ..D170 is suitable for front-panel flush mounting with IP 65 protective system and has RS 232 interface which fits all PCD controllers.

1.4 Ordering details

Type	Description
	Small terminal set for direct mounting on PCD1 or PCD2, consisting of terminal with display of 4 x 16 characters.
PCD7.D162	... and ..F540 interface module
PCD7.D163	... and ..F550 interface module with additional RS 422/RS 485 interface and real time clock (only for PCD2)
PCD7.D170	Small terminal for external mounting (front panel flush mount) with display of 4 x 16 characters
	Interface connecting cable (shielded)
PCD7.K412	between ..D170 terminal and the PGU connector of PCD CPU's (9-pole D-type connector both ends), lenght 2.5 m
PCD7.K422	between ..D170 terminal (9-pole D-type connector) and the RS232 interface of the PCD1, PCD2 or PCD4 (wire ends free), lenght 2.5 m

Overview

Notes :

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2. Technical data

Type designation	PCD7.D162/..D163 [1]	PCD7.D170
Display		
Type	LCD with LED back-lighting	
Display dimensions (h x w)	4 x 16 characters 24 x 60 mm	4 x 16 characters 24 x 60 mm
Character size (h x w)	5 x 7 pixels + cursor 2.95 x 4.75 mm	5 x 7 pixels + cursor 2.95 x 4.75 mm
Contrast adjustment	software	software
Back-lighting	off/on	off/on
Character fonts	ASCII plus special characters for English, German,French and Scandinavian languages	
Keyboard		
Function keys, customizable	5	5
System / numeric keys	(5) [2]	(5) [2]
Memory		
Text and data	Entire text and data memory of PCD controller, i.e. from max. 128 Kbytes for PCD1 to max. 1 Mbytes for PCD6	
Interfaces		
to SAIA®PCD	plugged directly onto PCD1/2	RS 232 9-pole, D-type jack
Performance and programming		
Performance features	All performance features of PCD controllers are also available for terminals, such as: up to 8000 texts, data in any format, alarm handling, password protection, real time clock	
Programming software	Any SAIA®PCD programming tool (PG1, PG3 or PG4)	
General data		
Supply voltage at U_n	5 VDC from PCD1/2 bus	24 VDC, +30%/-20% 19 VAC, ±15%, full-wave rectified
Power consumption at U_n	300 mA or 100 mA [3]	100 mA
Interference immunity	CE mark according to EN 50 081-1 and 50 082-2	
Protective system (front)	IP 20	IP 65
Operating temperature	0...50°C	0...50°C
Storage temperature	-25..+70°C	-25...+70°C
Humidity (without condensation) DIN 40 040 class F	5...95%	5...95%

1) The ..D162 or ..D163 build-on terminals can also be ordered rady for connection, mounted on a PCD1 or PCD2
2) Software configuration on the 5 keys produces 5 function keys or, with a shift key, 8 key functions.
3) 100 mA with back-lighting switched off

Technical data

Notes :

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3. Dimensions

PCD7.D160
on
PCD1
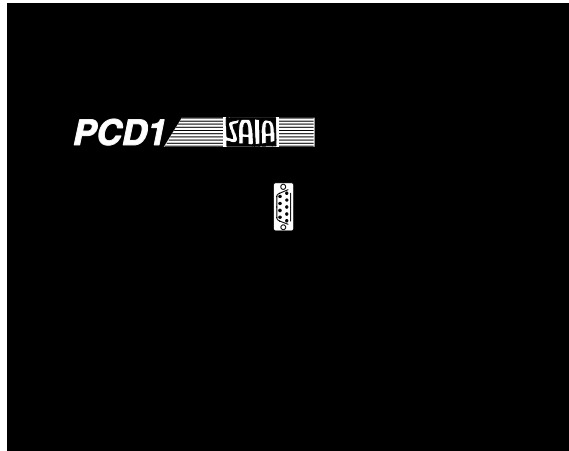
PCD7.D160
on
PCD2
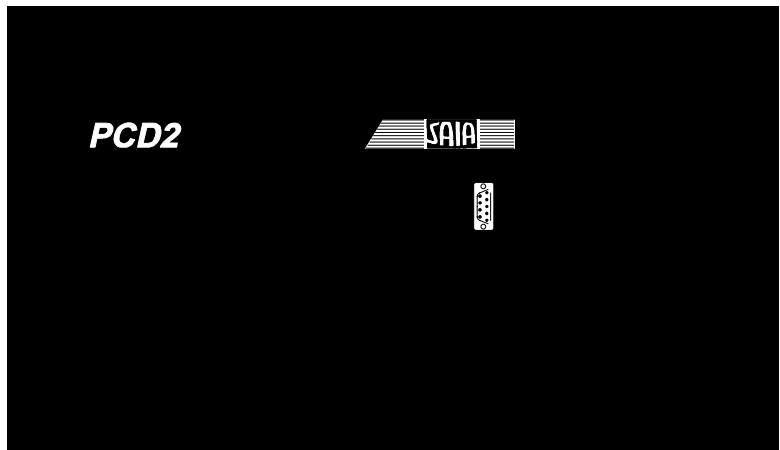
PCD7.D170

Dimensions

Notes :

© SAIA-Burgess Electronics AG
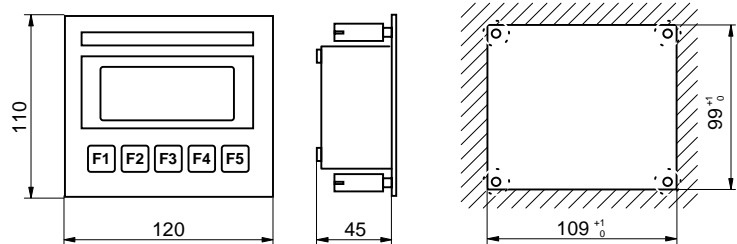
4. Hardware

Both models D160/D170 are identical as far as the display, keys and all software functions are concerned. Regarding hardware, they differ from each other in the following points:

- **Type D160** is plugged directly onto a PCD1 or PCD2 control device using an interface module

- **Type D170** (as D200/202) is designed for independent front-panel flush mounting, with its own 24V DC supply and a plug for an RS 232 connection.

4.1 The D160 build-on terminal

4.1.1 Mechanical features and assembly instructions D162 and D163
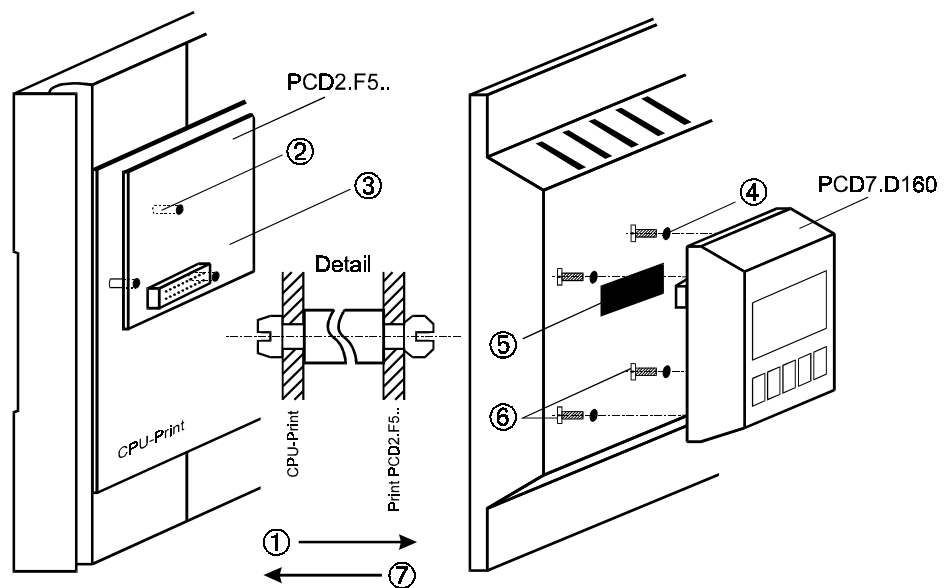
① Remove cover
② insert supports onto main board (see "Detail"). Older modules do not have all 3 holes on the main board.
③ Plug PCD7.F5.. interface module into connector and snap into supports.
④ Push through or drill out ready-positioned screw holes Ø 3mm from back of cover.

⑤ For PCD2: press red window out of cover
  For PCD1: spec. cover 4'104'7338'0 can be ordered.
⑥ Tighten the D160 terminal with the 4 screws.
⑦ Carfully place cover on lower part.

The cover, including the terminal, can be removed and replaced, even while the PCD1 is powered up and running.

We solve all listed problems for you when you order configured PCD1 or PCD2 systems with ready-assembled terminals (see part 4.1.2).

4.1.2 Which combinations are possible?

PCD1/2 base unit	Cover	**PCD7.D162** terminal set with F540 interface module (standard without RTC and interface no.3)	**PCD7.D163** terminal set with F550 interface module (with RTC and interface no.3
PCD1.M110	Special 4'104'7338'0	√ a)	(√) but no other interface available
PCD1.M120	Special 4'104'7338'0	√ b)	(√) but no other interface available
PCD2.M110	Standard	√ c)	√ d) with RTC but no other interface available
PCD2.M120	Standard	√ e)	√ f) additional interface no. 3 (RS422/485) and real time clock available

*) From production 9701 on, blind holes are in the cover. They can be pushed or drilled through.
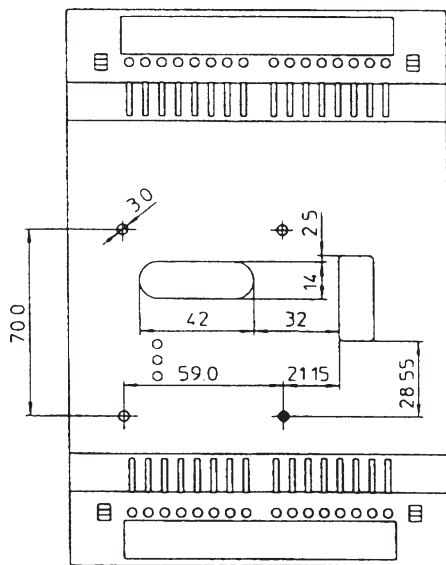
This type of PCD1 cover can be obtained by ordering item number 4'104'7338'0 .

We solve all listed assembly problems for you when you order configured PCD1 or PCD2 systems with ready-assembled terminals.

Combination	Configured type
a) PCD1.M110 with set D162	P30-5
b) PCD1.M120 with set D162	P35-5
c) PCD2.M110 with set D162	P10-5
d) PCD2.M110 with set D163	P10-6
e) PCD2.M120 with set D162	P20-5
f) PCD2.M120 with set D163	P20-6

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Drawings to represent preceding table

PCD1.M110
with **PCD7.D162** terminal set

F540

Terminal
D160

PGU connector
no. 0 (RS232)

no. 1 (RS485)

PCD2.M110
with **PCD7.D162** terminal set

F540

Terminal
D160

PGU connector
no. 0 (RS232)

(A)

Socket (A) for
any PCD7.F1..
interface module
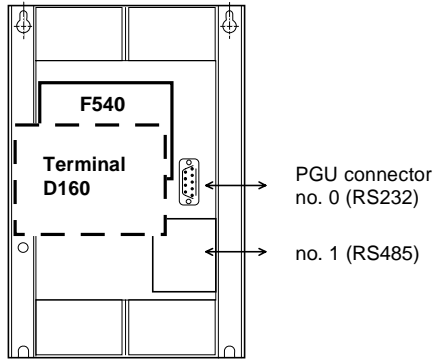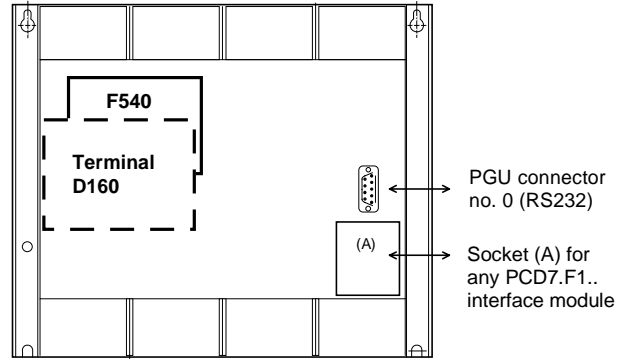
PCD1.M120
with **PCD7.D162** terminal set

F540

Terminal
D160

(A)

PGU connector
no. 0 (RS232)

Socket (A) for
any PCD7.F1..
interface module
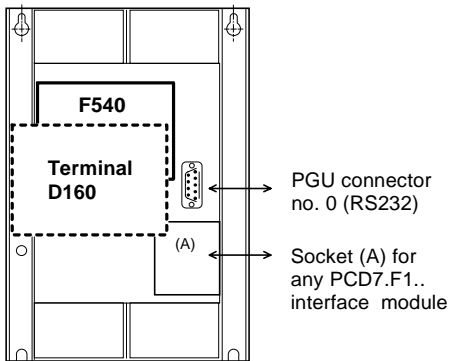
PCD2.M120
with **PCD7.D163** terminal set

Interface
no. 3 (RS422/485)

F550 (B)

incl. RTC

Terminal
D160

(A)

PGU connector
no. 0 (RS232)

Socket (A) for
any PCD7.F1..
interface module
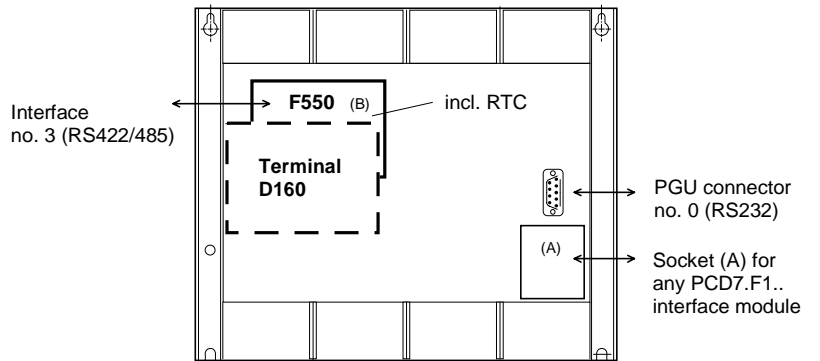
4.1.3 Communications of terminal D160 to PCD1/PCD2

As shown in the previous section, communication takes place via the interface module with **port no. 2** of the PCD1 or PCD2 controller.

The communications parameters of both devices (D160 and PCD1/2) must match (see section 5.3.1 Setup mode). Regarding handshaking, the terminal requires **"RTS/CTS"** (which is the default setting). This corresponds to **MC1** mode in the PCD1/2 SASI text.

4.1.4 Power supply of D160

This is provided from the **internal +5V supply of the PCD1/2**. For all additional modules plugged onto the base unit, only limited power is available.

PCD1   750 mA
PCD2   1100 mA   (including expansion unit)

The power consumption of the D160 resp. D162/D163 with interface module F540/F550 is dependent on the back lighting of the display. From +5V it amounts to

- 300 mA with back lighting
- 100 mA without back lighting

Please note these values in connection with the rest of the equipment for the PCD1/2. Further details can be obtained from the PCD1/2 manual under the "Power supply" chapter.

4.2 D170 front-panel terminal

4.2.1 Power supply / connections
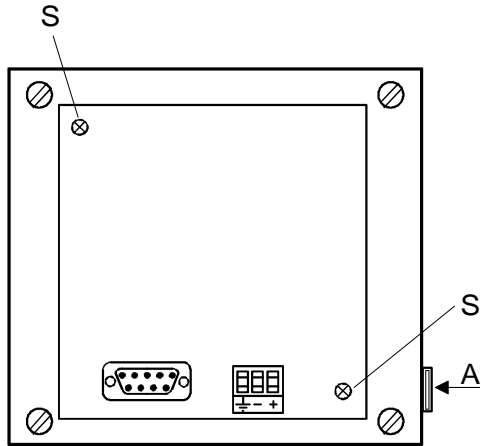
Power supply via plug-in screw terminals for wires of max. 2.5 mm^2 (flexible wires with ferrules max. 1.5 mm^2).

19...32 VDC smoothed or 19 VAC ± 15 % full wave rectified with reverse battery protection.

24 VDC

⚠ A good earth connection is imperative for perfect operation! Moreover, whenever the cover has been removed, cover screw S must be screwed back tightly to restore a good connection to frame ground.

The labelling strip for the 5 keys is pushed in at position A. Depending on the setup (shift key No/Yes) the strip is selectable with F-labelling or with shift function. On the back of the strip, a user-specific label can also be applied.

Power supply with full wave rectified AC

PCD7.D170

electronic cutout

Overvoltage limiter

reverse battery protection

noise filter

smoothing

External supply

+18VDC

AC 50/60Hz

19VAC

0V (-)
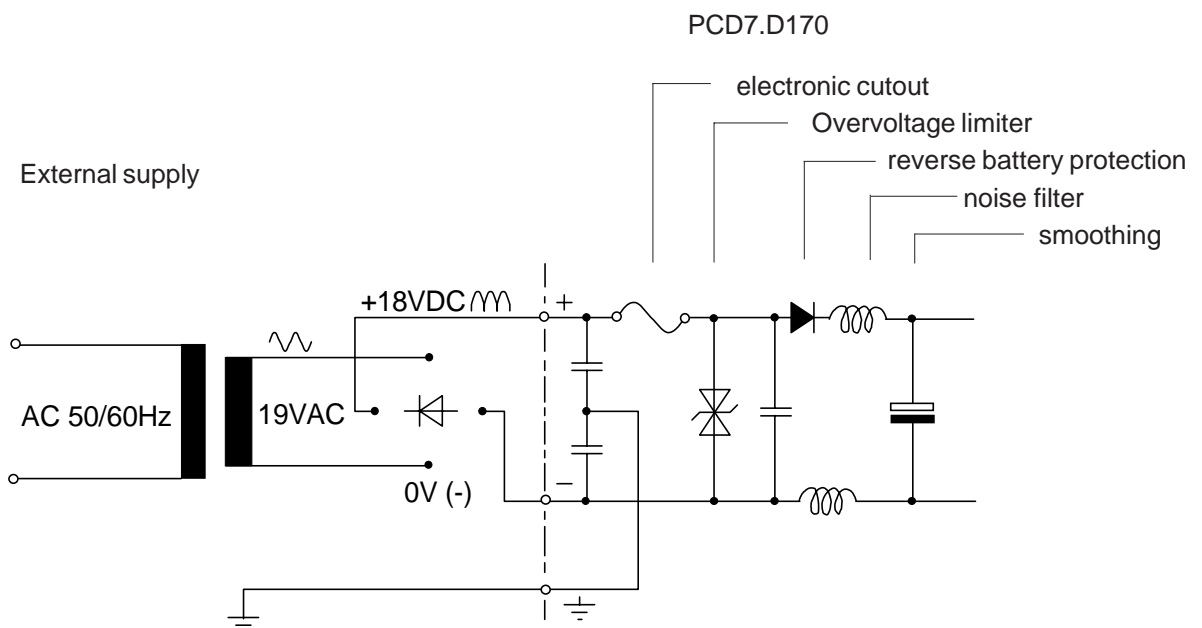
4.2.2 Serial interface RS232 from terminal ..D170

9-pole D-type jack (female)
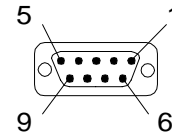
Without RTS/CTS handshaking

Instructions apply for all PCD communications channels:

- At the terminal, RTS must be connected with CTS.

- Up to 9600 Baud it is possible to work under PCD communications mode MC0.

- If communication is at 19,200 Baud, handshaking with XON/XOFF is required (PCD communications mode MC2).

a) D170 terminal to PGU connector of PCD

Terminal PCD7.D170			cable		PCD processor module at PGU socket interface 0	
TxD	2				2	RxD
RxD	3				3	TxD
SGND	5				5	SGND
CTS	7				7	RTS
RTS	8				8	CTS
PGND	1			*)	1	PGND
Shield / housing						Shield / housing

*) optional connection
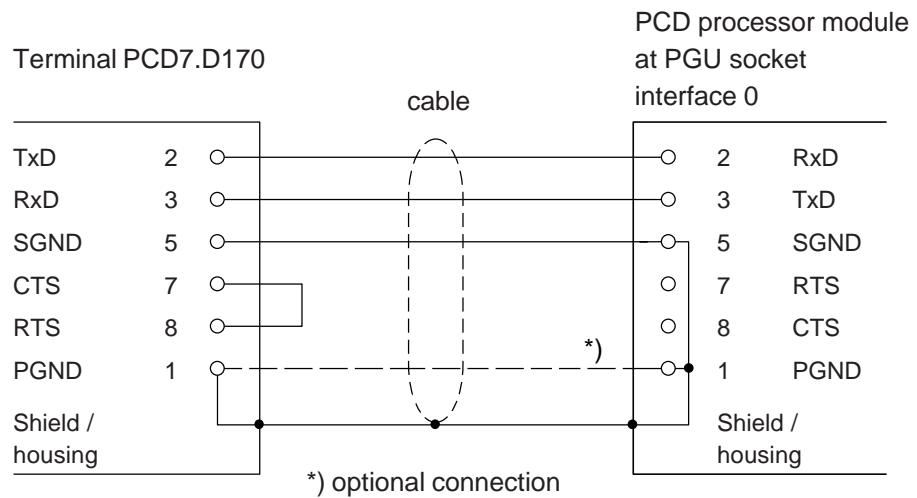
For terminal D170 select in setup mode under handshaking "None" or "XON/XOFF".
PCD7.K412 cable can be used for this connection (see chapter 10).

b) D170 terminal to PCD processors, channels 1 to 3

Terminal
PCD7.D170

PCD processor module

		PCD7. F120	PCD2. F5..	PCD4. C120 *)	PCD4. C130 *)
cable					
TxD 2	RxD	12	32	11	31
RxD 3	TxD	11	31	10	30
SGND 5					
CTS 7	RTS	Channel 1	Channel 2	Channel 1	Channel 3
RTS 8	CTS				
PGND 1					
Shield / housing	GND	10 (-)	30 (-)	GND (-)	GND (-)
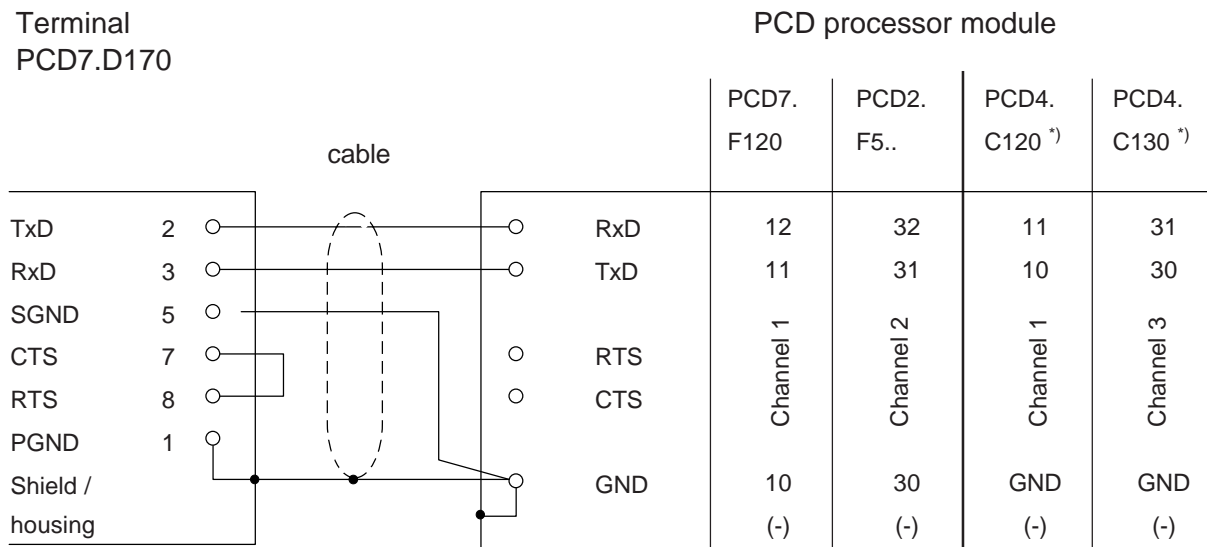
For terminal D170 select in setup mode under handshaking "None" or "XON/XOFF".
PCD7.K422 cable can be used for this connection (see chapter 10).

With RTS/CTS handshaking

The corresponding PCD communications channel must be assigned with MC1 mode. Default the terminal is already in pos. "RTS/CTS".

Terminal
PCD7.D170

PCD processor module

		PCD7. F120	PCD2. F5..	PCD4. C120 *)	PCD4. C130 *)
cable					
TxD 2	RxD	12	32	11	31
RxD 3	TxD	11	31	10	30
SGND 5					
CTS 7	RTS	13	33	14	34
RTS 8	CTS	14	34	15	35
PGND 1					
Shield / housing	GND	10 (-)	30 (-)	GND (-)	GND (-)
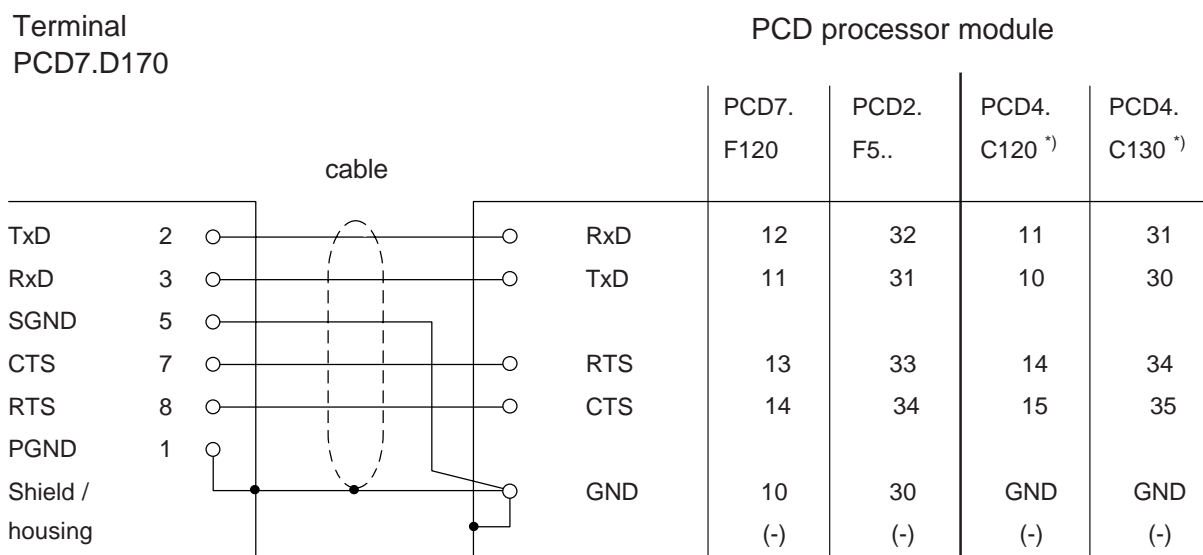
*) Regarding bus module PCD4.C340, please refer to PCD4 manual 26/734 part 3.4.

Notes :

5. Operation

5.1 Power-up tests

When the D160/D170 starts up, this display is shown:

```
 SAIA-BURGESS
CH-3280 MURTEN
PCD7.D1x  V001
POWER-UP TEST
```

The power-up tests are executed, and the D160/D170 is initialized. This takes about 2 seconds. The user program should not send commands to the terminal during this period, because they will be ignored. The user program can use the "poll" command, described in section 6.4, to determine when the terminal is ready to accept commands, or can simply delay for short period.

The selftest contains 6 steps :
- CPU-Test
- LCD-Test
- RAM-Test
- EPROM-Checksum Test
- Display-Test
- EEPROM-Checksum Test

If any test fails, the D160/D170 attempts to indicate the failure on the display and the microprocessor is halted. The tests are automatically repeated after about 1.5 seconds, when the watchdog timer resets the terminal.

5.2 The keyboard

The 5 keys can operate either as straight function keys F1 to F5, or as shift-keys with dual functions (see also chapters entitled "Setup" and "Control commands").
According to the mode selected, appropriate strip labels can be inserted.

Mode without Shift-function   F1   F2   F3   F4   F5

Key	Dec	Hex	ASCII	Notes
F1	65	41	'A'	
F2	66	42	'B'	
F3	67	43	'C'	
F4	68	44	'D'	
F5	69	45	'E'	

Mode with Shift-function   Shift   Q   ▶   i   E

Key	Dec	Hex	ASCII	Notes
Shift	-	-	-	*)
←	8	08	BS	Left arrow
→	6	06	ACK	Right arrow
↑	11	0B	VT	Up arrow
↓	5	05	ENQ	Down arrow
Shift+← (Q)	113	71	'q'	Quit
Shift+→	112	70	'p'	User key
Shift+↑ (i)	(105)	(69)	(i)	No code output but change to "Setup/Test" mode. If "Setup/Test" mode is blocked, the character 'i' is output. *)
Shift+↓ (E)	13	0D	CR	Enter (carriage return)

*)   If the shift-function mode is being used, access to "Setup/Test" mode should be blocked. This prevents any risk of the user unintentionally entering that mode. An additional key combination (total 8) is also available to the programmer. See chapter 6.4 "Disable and Enable Setup/Test mode".

                                       Issue 02.97

5.3 Setup/Test mode

This mode is entered by pressing **F1**+**F4** [*)] resp. **Shift**+**i** . Setup/Test mode can be entered when the D160/D170 is on or off line, all data received from the host is ignored until the mode is exited.

Mode without Shift-function: Mode with Shift-function:

```
SETUP/TEST MODE
F4/5 scroll menu
F1 exec, F2 exit
Setup mode
```

```
SETUP/TEST MODE
↑/↓  scroll menu
↵  exec, Q  exit
Setup mode
```

Pressing the F4/F5 key or the up or down arrow key steps through the Setup/Test mode menu:

Setup mode   Configures the D160/D170

Default setup   Restores factory default setup

Demo display   Demonstration display

Hardware tests   Runs hardware tests continuously

Display test   Tests the LCD display

Keyboard test   Tests the keyboard

Once the desired menu item is selected, pressing F1 resp. ↵ executes.

To exit Setup/Test mode, press **"F2"** or **"Q"**.

⚠ Note 1:   If the host computer is sending data to the D160/D170 when the operator enters Setup/Test mode, characters may be lost, which can cause the display to become corrupted on return to normal operation.

[*)] Note 2: If mode without Shift-function is selected (default), the character of the first depressed key is sent out by the serial interface.

5.3.1 Setup mode

This displays and configures the setup data by the keyboard in the non-volatile EEPROM. The first screen shows a help text:

Mode without Shift-function: Mode with Shift-function:

```
SETUP MODE
F4/5 scroll menu
F3   change data
F1 ok , F2 abort
```

```
SETUP MODE
↑/↓  scroll menu
←/→ change data
↵  ok , Q  abort
```

Pressing any key displays the first item in the menu:

```
SETUP MODE

Baudrate:
9600
```

Pressing the up or down arrow key resp. F4 or F5 steps through the menu of configurable items. Press the left or right arrow key resp. F3 (only one direction) to change the selected item's setting.

Baudrate	110, 150, 300, 600, 1200, 2400, 4800 [9600], 19200
Data bits	[8] (can not be modified)
Parity	[Even], Odd, None, Low, High
Stop bits	[1] (can not be modified)
Handshaking	None, [RTS/CTS], XON/XOFF
Echo key to display	[No], Yes
Page/scroll mode	[Page], Scroll
Auto line feed	[No], Yes
Key auto-repeat "2 speed"	[No], Yes
Character set	[D100 compatible], English, French, German, Scandinavian
Backlight	[Off], On
Contrast	0...7 [4]
Shift key	[No], Yes

[ ] Factory default settings are shown in square brackets. Each item is described in detail below.

Once all settings are correct, press F1 resp. ↵ to store the data to the non-volatile EEPROM memory. To abort, discarding any changes, press **"F2"** or **"Q"**.All features except the baudrate, data bits, parity, stop bits and handshaking can also be controlled from the host computer by sending an escape sequence to the D160/D170. These are described in section 6.1.

Communication parameter   (Baudrate, Data bits, Parity and
                                          Stop bits)

These settings define the communications protocol
   1 Start bit
   8 Data bits
   1 Party bit (or none)
   1 Stop bit

Parity "High" can also be used as second stop bit.

Handshaking   [None]

With handshaking, the data flow between communications partners
can be controlled. Since the D160/D170 has a receive buffer of 256
characters, handshaking is not generally required.

At 19,200 Baud, however, handshaking should always be used (either
with RTS/CTS or XON/XOFF).

The D160 always requires RTS/CTS handshaking, regardless of baud
rate.

RTS/CTS :   This handshaking takes place via hardware, using the
                 appropriate control lines (PCD mode MC1).
                 If "None" is selected, pins 8 and 7 (RTS/CTS) on the
                 D170 should be short-circuited (PCD mode MC0)

XON/XOFF :   handshaking uses the XOFF (17 decimal, 11H) and
                 XON (19 decimal, 13H) characters to disable (XOFF)
                 and enable (XON) transmission. Pins 7 and 8 of the
                 D170 plug must be connected together and SAIA°
                 PCD is assigned in mode MC2.

Echo (Echo key to display)   [No]

When a key is pressed in "Echo=Off" mode (the default), the ASCII
code is transmitted directly to the host computer and is not displayed.
The user program in the host computer must echo the character back to
the D160/D170 for it to be displayed. When a key is pressed in
"Echo=Yes" mode, the character is automatically written to the display
at the current cursor position, and it is also transmitted to the host.

Page/scroll mode   [Page]

Page mode :   The cursor moves from the last line to the first line
                     when the D160/D170 receives a line feed character.
                     The display is not altered.

Scroll mode: If the cursor is on the last line when a line feed is
                     received, then the display scrolls up one line and the
                     cursor remains on the last line, which is now blank, in
                     the same column. If the line feed was caused by a
                     carriage return character, with "auto line feed" set to
                     "Yes", then the cursor is also moved to the start of
                     the line.

Auto line feed   [No]

When the D160/D170 receives a carriage return character (13 decimal,
0DH), it moves the cursor to the start of the current line. If "auto line
feed" is set to "Yes", then the cursor also moves to the next line down
automatically.

Key auto-repeat   [No]

Keys can be made to repeat at a rate of 8 per second if the key is held
depressed for more than 0.7 seconds. The auto-repeat feature has these
settings:

No   No keys repeat (default)
Yes   All keys repeat, with 2-speed signalling, see below

"2 speed" signalling mode is for use by host programms that have
stepping up/down controls, which are stepped by pressing up/down
keys. With auto-repeat on, key codes are sent at a rate of 8 per second if
the key is held down for 0.7 sec. The same occurs with the 2 speed
feature, but after holding the key down for 3 seconds a special "start
second speed" character (30 decimal) is sent to the host to indicate 2
speed mode, followed by more repeated key codes at the same 8-per-
second rate. When the key is released an "end 2 speed" character (31
decimal) is sent to indicate that the key has been released.
When the host's program receives the up/down key code, it should
increment/decrement the associated value. If the host receives a "start
second speed" character it should step the value by two (or more) and
also for each additional up/down key code received and stop when the
"end 2 speed" character is received (or any character which is not the
same repeated up/down key code).

For example, if "A" is pressed, with "All keys, 2 speed" auto-repeat, this is the sequence of events:

Time (secs.)   0   0,7   3   n

Code sent: A   AAAAA . . . AAAA 30AA . . . AA 31

Key released,
sends 31 decimal.

Start second speed mode after 3 secs,
sends 30 decimal, "A" still repeats at 8
per second.

Start repeat at 8 per sec.

"A" key pressed, single A sent.
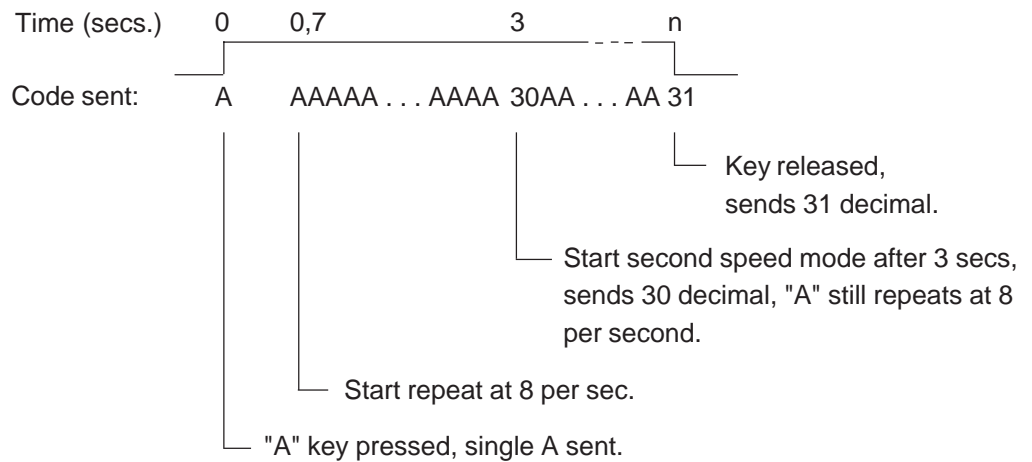
Character set   [D100]

Five character sets are available. Each character set has the same characters for those with codes 32 to 127 decimal (20H to 7FH), but extended ASCII characters with codes 128 to 255 decimal (80H to FFH) are selected according to the character set. (see section 7).

Backlight   [On]

The display's LED backlight can be turned on and off if required. The backlight is normally off. The backlight can be turned off and on (blinked) to provide a visual indication of an alarm etc. using escape sequences sent by the host computer.

Contrast   [7]

The contrast of the LCD display (it's blackness) can be adjusted in 8 steps by selecting a value between 0 and 7. 0 is the lightest, 7 is the darkest.

Shift-key mode   [No]

Since this terminal only has 5 keys, operation with or without the shift function is possible, depending on requirements (see chapter 5.2, Keyboard).

5.3.2 Default setup

This restores the factory default setup, and writes it into the non-volatile EEPROM. The factory default settings are as follows:

Baudrate	9600
Data bits	8
Parity	Even
Stop bits	1
Handshaking	RTS/CTS
Echo key to display	No
Page/scroll mode	Page
Auto line feed	No
Key auto-repeat	No
Character set	D100 compatible
Backlight	Off
Contrast	4 (medium)
Shift key	No

5.3.3 Demo display

This is for use when showing the D160/D170 at an exhibition, when it is not connected to a host computer. The display shows some information about the unit. Press F1+F4 resp. Shift+i to exit.

```
  <PCD7.D1x0>
INDUST. TERMINAL
  SAIA-BURGESS
 CH-3280 MURTEN
```

5.3.4 Hardware tests

This runs the power-up tests in a continuous loop, which can be used for detecting intermittent faults when the D160/D170 is in the field. The tests run until an error occurs, which displays a text and the D160/D170 is reset by the watchdog timer and the tests are repeated. The only way to exit the tests is to power the terminal off and on.

5.3.5 Display test

This is a comprehensive test of the LCD display, the character set and the LCD controller's internal RAM. **Press any key** to exit.

5.3.6 Keyboard test

This displays a "map" of the keyboard, with a digit for each key. If the key is not pressed, the digit will be "0", when the key is pressed the digit should be "1". It also shows the character assigned to the last key which was pressed, enclosed in square brackets.

Mode without Shift-function: Mode with Shift-function:

```
 KEYBOARD TEST
 F1+F3 to exit
 Last Key:[F1]
  10000
```

```
 KEYBOARD TEST
 Shift+→ to exit
 Last Key:[RA]
  00100
```

Press **F1+F3** resp. **Shift**+→ to exit the keyboard test.

Notes :

6. Commands

Single control characters or two, three or four character "escape sequences" are transmitted to the D160/D170 using the PCD's STXT (send text) or STXD (transmit character) instructions.

⚠	Note:	Some escape sequences use the '@' character. If using a SAIA° PCD port running in MODE C, the PCD interprets an '@' character as the start of an indirect addressing control string. So when using MODE C, enter each '@' character as '@@', so the PCD intreprets it as a single '@' character.

6.1 Configuration (by the serial interface)

The configuration of the D160/D170 can be modified by sending a series of special commands. The configuration remains active until the D160/D170 is powered off and on, whereupon the configuration defined from "setup mode" is restored.
All required commands can be included in a single PCD Text and transmitted to the D160/D170 in one go.

Echo key to display

See section 5.3.1 for details.

Command	ASCII	Decimal	Hex
Echo off	ESC @ 0	27 64 48	1B 40 30
Echo on	ESC @ 1	27 64 49	1B 40 31

Page and scroll mode

See section 5.3.1 for details.

Command	ASCII	Decimal	Hex
Scroll mode	ESC @ 4	27 64 52	1B 40 34
Page mode	ESC @ 5	27 64 53	1B 40 35

Auto line feed after carriage return

See section 5.3.1 for details.

Command	ASCII	Decimal	Hex
Auto line feed on	ESC @ 2	27 64 50	1B 40 32
Auto line feed off	ESC @ 3	27 64 51	1B 40 33

Key auto-repeat

See section 5.3.1 for details.

Command	ASCII	Decimal	Hex
Auto-repeat off	ESC A	27 65	1B 41
Auto-repeat on for all keys, "2 speed"	ESC D	27 68	1B 44

Keyboard with "Shift" function

See section 5.3.1 for details.

Command	ASCII	Decimal	Hex
Shift function off	ESC G	27 71	1B 47
Shift function on	ESC F	27 70	1B 46

Character set

Five character sets are available, as described in section 7.

Command	ASCII	Decimal	Hex
D100 compatible	ESC @ F	27 64 70	1B 40 46
English	ESC @ 6	27 64 54	1B 40 36
French	ESC @ 7	27 64 55	1B 40 37
German	ESC @ 8	27 64 56	1B 40 38
Scandinavian	ESC @ E	27 64 69	1B 40 45

Backlight and contrast see part 6.3

6.2 Cursor control

Cursor up/down/left/right

The cursor can be moved one place up, down, left or right with a single-character command. If the cursor is moved off the display, it wraps around automatically.

Command	ASCII	Decimal	Hex
Cursor up	CTRL+K	11	0B
Cursor down	CTRL+E	5	05
Cursor left	CTRL+H	8	08
Cursor right	CTRL+F	6	06

Cursor positioning

Apart from the cursor address code (16 dec. or 10H), this function also requires X and Y addresses to position the cursor. Add an offset of 32 dec. or 20H to both addresses. If either of the addresses is incorrect, the cursor is not moved.

Example (sequence: 16 dec., Code X, Code Y) :

Cursor position	Decimal command	Hex command
Column 1, Line 1	16 32 32	10 20 20
Column 4, Line 2	16 35 33	10 23 21
Column 16, Line 4	16 47 35	10 2F 23

Code X → Y Code ↓		<32> ∨ 1	<33> ∨ 2	<34> ∨ 3	<35> ∨ 4	<36> ∨ 5	<37> ∨ 6	<38> ∨ 7	<39> ∨ 8	<40> ∨ 9	<41> ∨ 10	<42> ∨ 11	<43> ∨ 12	<44> ∨ 13	<45> ∨ 14	<46> ∨ 15	<47> ∨ 16
<32>	1	x															
<33>	2				x												
<34>	3																
<35>	4																x

Note: To place the cursor in x-pos. 36 (equal ASCII $), please enter in each PCD text <36><36>.

Example: Text xxxx "... 16 **36 36** 34 ..."
                                    X-Pos. Y-Pos.

Cursor home

This single-character command moves the cursor to the first column of the first line.

Command	ASCII	Decimal	Hex
Cursor home	CTRL+Z	26	1A

Cursor on/off

These two-character commands turn the cursor on and off.

Command	ASCII	Decimal	Hex
Cursor on	ESC W	27 87	1B 57
Cursor off	ESC T	27 84	1B 54

Line feed

Line feed moves the cursor down one line. If the cursor was on the last line, this scrolls the display if in scroll mode, or the cursor moves to the first line if in page mode. The column position is not changed.

Command	ASCII	Decimal	Hex
Line feed	LF	10	0A

Carriage return

Carriage return moves the cursor to the start of the current line. If "auto line feed after carriage return" is selected, a line feed is also done as described above.

Command	ASCII	Decimal	Hex
Carriage return	CR	13	0D

Delete character

Delete removes the character to the left of the cursor (changes it to a space), and moves the cursor left one place. If at the start of a line, the cursor is moved to the end of the preceding line. Delete stops at the home position.

Command	ASCII	Decimal	Hex
Delete (backspace)	DEL	127	7F

6.3 Display control

Clear display

Clear display sets all the characters on the display to spaces, and moves the cursor to the home position.

Command	ASCII	Decimal	Hex
Clear display	CTRL+L	12	0C

Save display/Restore display

These commands save and restore the contents of the display and the cursor position and state (visible/not visible). Ten save/restore areas are provided, numbered 0 to 9. Restoring from a display area that was not previously saved will produce unexpected results.

Command	ASCII	Decimal	Hex
Save display 'n'	ESC @ S n	27 64 83 n	1B 40 53 n
Restore display 'n'	ESC @ R n	27 64 82 n	1B 40 52 n

Where 'n' is '0'..'9' (48..57 decimal, 30H..39H)

Backlight off/on

The display's LED backlight can be turned off if required. The backlight is normally always on, and is required to make the text visible. The backlight can be turned off and on (blinked) to provide a visual indication of an alarm etc.

Command	ASCII	Decimal	Hex
Backlight off	ESC O	27 79	1B 4F
Backlight on	ESC L	27 76	1B 4C

Display contrast

The contrast of the LCD display (it's blackness) can be adjusted by sending a contrast value between 0 and 7, where 0 is lightest and 7 is darkest.

Command	ASCII	Decimal	Hex
Light	ESC @ D 0	27 64 68 48	1B 40 44 30
Medium contrast	ESC @ D 4	27 64 68 52	1B 40 44 34
Dark	ESC @ D 7	27 64 68 55	1B 40 44 37

6.4 Miscellaneous commands

Lock keyboard/Unlock keyboard

These commands enable or disable the keyboard. When locked, all key depressions are ignored.

Command	ASCII	Decimal	Hex
Lock keyboard	ESC N	27 78	1B 4E
Unlock keyboard	ESC Q	27 81	1B 51

Restart warm/Restart cold

"Restart warm" resets the D160/D170 and restores the customer setup. It is the same as a power-up reset.
"Restart cold" initializes the setup to the factory defaults listed in section 5.3.2.

Command	ASCII	Decimal	Hex
Restart warm	ESC H	27 72	1B 48
Restart cold	ESC @ G	27 64 71	1B 40 47

Disable and Enable Setup/Test mode

Once the D160/D170 has been configured, you may want to prevent unautorized users changing the setup. This can be done with the escape sequence below, which disables or enables the Shift+i key combination. If desabled, Shift+i is also restored by powering the D160/D170 off and on, or by sending a "Restart" command.

Command	ASCII	Decimal	Hex
Disable Setup/Test	ESC @ H	27 64 72	1B 40 48
Enable Setup/Test	ESC @ I	27 64 73	1B 40 49

Note: If the shift-function mode is being used, access to "Setup/ Test" mode should be blocked. This prevents any risk of the user unintentionally entering that mode. An additional key combination (total 8) is also available to the programmer. See also chapter 5.2.

Demonstration display and hardware tests

These commands execute the tests described in sections 5.3.3 to 5.3.7. The "poll" command can be used determine when test has been completed.

Command	ASCII	Decimal	Hex
Demonstration display	ESC J	27 74	1B 4A
Display test	ESC @ A	27 64 65	1B 40 41
Keyboard test	ESC @ 9	27 64 57	1B 40 39
Hardware tests	ESC @ C	27 64 67	1B 40 43

Poll

To determine if the D160/D170 is connected and is ready to receive commands, the "poll" message can be sent. If the D160/D170 is ready, it returns an "SOH" response character (1 decimal, 01H). If not ready there will be no response.
It can also be used to check that the D160/D170 is still operational. If it fails, the user program could take the necessary action to alert the operator that the D160/D170 terminal is not responding.

Command	ASCII	Decimal	Hex
Poll	ESC @ B	27 64 66	1B 40 42

6.5 Command summary

Command	ASCII	Decimal	Hex
Configuration:			
Echo off	ESC @ 0	27 64 48	1B 40 30
Echo on	ESC @ 1	27 64 49	1B 40 31
Auto line feed on	ESC @ 2	27 64 50	1B 40 32
Auto line feed off	ESC @ 3	27 64 51	1B 40 33
Scroll mode	ESC @ 4	27 64 52	1B 40 34
Page mode	ESC @ 5	27 64 53	1B 40 35
D100 character set	ESC @ F	27 64 70	1B 40 46
English	ESC @ 6	27 64 54	1B 40 36
French	ESC @ 7	27 64 55	1B 40 37
German	ESC @ 8	27 64 56	1B 40 38
Scandinavian	ESC @ E	27 64 69	1B 40 45

Note: To output the character "@", please enter in each PCD text "@@" !

Command	ASCII	Decimal	Hex
Auto-repeat off	ESC A	27 65	1B 41
Auto-repeat on, all keys, "2 speed"	ESC D	27 68	1B 44
Keyboard with shift-function on	ESC F	27 70	1B 46
Keyboard with shift-function off	ESC G	27 71	1B 47
Cursor control:			
Cursor up	CTRL+K	11	0B
Cursor down	CTRL+E	5	05
Cursor left	CTRL+H	8	08
Cursor right	CTRL+F	6	06
Cursor home	CTRL+Z	26	1A
Cursor on	ESC W	27 87	1B 57
Cursor off	ESC T	27 84	1B 54
Line feed	LF	10	0A
Carriage return	CR	13	0D
Delete (backspace)	DEL	127	7F
Cursor positioning	ASCII	CTRL+P ' '+X ' '+Y	
	Decimal	16 32+X 32+Y	
	Hex	10 20+X 20+Y	
Display control:			
Clear display	CTRL+L	12	0C
Save display 'n'	ESC @ S n	27 64 83 n	1B 40 53 n
Restore display 'n'	ESC @ R n	27 64 82 n	1B 40 52 n
Backlight off	ESC O	27 79	1B 4F
Backlight on	ESC L	27 76	1B 4C
Display light	ESC @ D 0	27 64 68 48	1B 40 44 30
Medium contrast	ESC @ D 4	27 64 68 52	1B 40 44 34
Display dark	ESC @ D 7	27 64 68 55	1B 40 44 37

Note: To output the character "@", please enter in each PCD text "@@" !

```
Command                    ASCII        Decimal        Hex

Miscellaneous commands:

Lock keyboard              ESC N        27 78          1B 4E
Unlock keyboard            ESC Q        27 81          1B 51
Restart warm               ESC H        27 72          1B 48
Restart cold               ESC @ G      27 64 71       1B 40 47
Disable Setup/Test         ESC @ H      27 64 72       1B 40 48
Enable Setup/Test          ESC @ I      27 64 73       1B 40 49
Demonstration display      ESC J        27 74          1B 4A
Display test               ESC @ A      27 64 65       1B 40 41
Keyboard test              ESC @ 9      27 64 57       1B 40 39
Hardware tests             ESC @ C      27 64 67       1B 40 43
Poll                       ESC @ B      27 64 66       1B 40 42
 (D160/D170 responds with SOH)
```

> Note: To output the character "@", please enter in each PCD text "@@" !

Notes :

7. Character sets

The character set determines which special characters are displayed. The D160/D170 has eight programmable characters which are programmed according to the selected character set.

7.1 First ASCII-table (32...127 dec)

The characters 20..7F hex (32..127 decimal) are the same for all character sets:

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
32	20	SP	48	30	0	64	40	@	80	50	P	96	60	`	112	70	p
33	21	!	49	31	1	65	41	A	81	51	Q	97	61	a	113	71	q
34	22	"	50	32	2	66	42	B	82	52	R	98	62	b	114	72	r
35	23	#	51	33	3	67	43	C	83	53	S	99	63	c	115	73	s
36	24	$	52	34	4	68	44	D	84	54	T	100	64	d	116	74	t
37	25	%	53	35	5	69	45	E	85	55	U	101	65	e	117	75	u
38	26	&	54	36	6	70	46	F	86	56	V	102	66	f	118	76	v
39	27	'	55	37	7	71	47	G	87	57	W	103	67	g	119	77	w
40	28	(	56	38	8	72	48	H	88	58	X	104	68	h	120	78	x
41	29	)	57	39	9	73	49	I	89	59	Y	105	69	i	121	79	y
42	2A	*	58	3A	:	74	4A	J	90	5A	Z	106	6A	j	122	7A	z
43	2B	+	59	3B	;	75	4B	K	91	5B	[	107	6B	k	123	7B	{
44	2C	,	60	3C	<	76	4C	L	92	5C	\	108	6C	l	124	7C		
45	2D	-	61	3D	=	77	4D	M	93	5D	]	109	6D	m	125	7D	}
46	2E	.	62	3E	>	78	4E	N	94	5E	^	110	6E	n	126	7E	→
47	2F	/	63	3F	?	79	4F	O	95	5F	_	111	6F	o	127	7F	DEL

7.2 Extended ASCII-table (128...255 dec)

Extended ASCII characters 128..255 decimal (80..FF hex) are slightly different, depending on the selected character set. IBM extended ASCII character codes have been used (except for the "D100 compatible" character set). This allows the characters to be entered directly into TEXTs in the PCD's user program, using a PC-based ASCII text editor such as EDIT or IBM's Personal Editor (PE).
In the following diagrams, ASCII characters which are left blank display as a space.

Note:	The displayed character shapes in the extended ASCII characters may not be exactly as shown due to differences between the D160/D170 and IBM PC character shapes.

7.2.1 D100 compatible

This is the same as the original D100 character set.

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
128	80		144	90		160	A0		176	B0	
129	81		145	91		161	A1	□	177	B1	
130	82		146	92		162	A2		178	B2	
131	83		147	93		163	A3		179	B3	
132	84		148	94		164	A4		180	B4	
133	85		149	95		165	A5		181	B5	
134	86		150	96		166	A6		182	B6	
135	87		151	97		167	A7		183	B7	
136	88		152	98		168	A8		184	B8	
137	89		153	99		169	A9		185	B9	
138	8A		154	9A		170	AA		186	BA	
139	8B		155	9B		171	AB		187	BB	
140	8C		156	9C		172	AC		188	BC	
141	8D		157	9D		173	AD		189	BD	
142	8E		158	9E		174	AE	∃	190	BE	
143	8F		159	9F		175	AF		191	BF	

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
192	C0		208	D0		224	E0	α	240	F0	
193	C1		209	D1		225	E1	ä	241	F1	
194	C2		210	D2		226	E2	ß	242	F2	
195	C3		211	D3		227	E3		243	F3	
196	C4	Ä	212	D4		228	E4	ä	244	F4	Ω
197	C5	Å	213	D5		229	E5	å	245	F5	
198	C6	Æ	214	D6	Ö	230	E6	æ	246	F6	ö
199	C7		215	D7		231	E7		247	F7	π
200	C8		216	D8	Ø	232	E8		248	F8	Ø
201	C9		217	D9		233	E9		249	F9	
202	CA		218	DA		234	EA		250	FA	
203	CB		219	DB	□	235	EB	x	251	FB	
204	CC		220	DC	Ü	236	EC	Φ	252	FC	ü
205	CD		221	DD		237	ED		253	FD	
206	CE		222	DE		238	EE		254	FE	
207	CF		223	DF	□	239	EF	Ö	255	FF	■

7.2.2 English

The English character set has a '£' sign and additional box drawing characters: ⌐ ¬ └ ┘ │ — ┬ ┴

Dec Hex ASC	Dec Hex ASC	Dec Hex ASC	Dec Hex ASC
128 80	144 90	160 A0	176 B0
129 81 ü	145 91	161 A1	177 B1
130 82	146 92	162 A2	178 B2
131 83	147 93	163 A3	179 B3 │
132 84 ä	148 94 ö	164 A4 ñ	180 B4
133 85	149 95	165 A5	181 B5
134 86	150 96	166 A6	182 B6
135 87	151 97	167 A7	183 B7
136 88	152 98	168 A8	184 B8
137 89	153 99	169 A9 ←	185 B9
138 8A	154 9A	170 AA →	186 BA
139 8B	155 9B ¢	171 AB	187 BB
140 8C	156 9C £	172 AC	188 BC
141 8D	157 9D ¥	173 AD	189 BD
142 8E	158 9E	174 AE	190 BE
143 8F	159 9F	175 AF	191 BF ¬

Dec Hex ASC	Dec Hex ASC	Dec Hex ASC	Dec Hex ASC
192 C0 └	208 D0	224 E0 α	240 F0
193 C1 ┴	209 D1	225 E1 ß	241 F1
194 C2 ┬	210 D2	226 E2 Γ	242 F2
195 C3	211 D3	227 E3 π	243 F3
196 C4 —	212 D4	228 E4 Σ	244 F4
197 C5	213 D5	229 E5 σ	245 F5
198 C6	214 D6	230 E6 µ	246 F6 ÷
199 C7	215 D7	231 E7	247 F7
200 C8	216 D8	232 E8	248 F8 °
201 C9	217 D9 ┘	233 E9 θ	249 F9 •
202 CA	218 DA ⌐	234 EA Ω	250 FA
203 CB	219 DB ■	235 EB	251 FB √
204 CC	220 DC	236 EC ∞	252 FC
205 CD	221 DD	237 ED	253 FD
206 CE	222 DE	238 EE ∈	254 FE ■
207 CF	223 DF	239 EF	255 FF

7.2.3 French

The French character set includes: é â à ê è î ô ù

Dec	Hex	ASC		Dec	Hex	ASC		Dec	Hex	ASC		Dec	Hex	ASC
128	80			144	90			160	A0			176	B0	
129	81	ü		145	91			161	A1			177	B1	
130	82	é		146	92			162	A2			178	B2	
131	83	â		147	93	ô		163	A3			179	B3	
132	84	ä		148	94	ö		164	A4	ñ		180	B4	
133	85	à		149	95			165	A5			181	B5	
134	86			150	96			166	A6			182	B6	
135	87			151	97	ù		167	A7			183	B7	
136	88	ê		152	98			168	A8			184	B8	
137	89			153	99			169	A9	←		185	B9	
138	8A	è		154	9A			170	AA	→		186	BA	
139	8B			155	9B	¢		171	AB			187	BB	
140	8C	î		156	9C			172	AC			188	BC	
141	8D			157	9D	¥		173	AD			189	BD	
142	8E			158	9E			174	AE			190	BE	
143	8F			159	9F			175	AF			191	BF	

Dec	Hex	ASC		Dec	Hex	ASC		Dec	Hex	ASC		Dec	Hex	ASC
192	C0			208	D0			224	E0	α		240	F0	
193	C1			209	D1			225	E1	ß		241	F1	
194	C2			210	D2			226	E2	Γ		242	F2	
195	C3			211	D3			227	E3	π		243	F3	
196	C4	–		212	D4			228	E4	Σ		244	F4	
197	C5			213	D5			229	E5	σ		245	F5	
198	C6			214	D6			230	E6	μ		246	F6	÷
199	C7			215	D7			231	E7			247	F7	
200	C8			216	D8			232	E8			248	F8	°
201	C9			217	D9			233	E9	θ		249	F9	•
202	CA			218	DA			234	EA	Ω		250	FA	
203	CB			219	DB	▐		235	EB			251	FB	√
204	CC			220	DC			236	EC	∞		252	FC	
205	CD			221	DD			237	ED			253	FD	
206	CE			222	DE			238	EE	∈		254	FE	■
207	CF			223	DF			239	EF			255	FF	

7.2.4 German

The German character set includes: ä ö ü Ä Ö Ü "(opening) and " (closing)

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
128	80		144	90		160	A0		176	B0	
129	81	ü	145	91		161	A1		177	B1	
130	82		146	92		162	A2		178	B2	
131	83		147	93		163	A3		179	B3	
132	84	ä	148	94	ö	164	A4	ñ	180	B4	
133	85		149	95		165	A5		181	B5	
134	86		150	96		166	A6		182	B6	
135	87		151	97		167	A7		183	B7	
136	88		152	98		168	A8		184	B8	
137	89		153	99	Ö	169	A9	←	185	B9	
138	8A		154	9A	Ü	170	AA	→	186	BA	
139	8B		155	9B	¢	171	AB		187	BB	
140	8C		156	9C		172	AC		188	BC	
141	8D		157	9D	¥	173	AD		189	BD	
142	8E	Ä	158	9E		174	AE	"	190	BE	
143	8F		159	9F		175	AF	"	191	BF	

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
192	C0		208	D0		224	E0	α	240	F0	
193	C1		209	D1		225	E1	ß	241	F1	
194	C2		210	D2		226	E2	Γ	242	F2	
195	C3		211	D3		227	E3	π	243	F3	
196	C4	–	212	D4		228	E4	Σ	244	F4	
197	C5		213	D5		229	E5	σ	245	F5	
198	C6		214	D6		230	E6	µ	246	F6	÷
199	C7		215	D7		231	E7		247	F7	
200	C8		216	D8		232	E8		248	F8	°
201	C9		217	D9		233	E9	θ	249	F9	•
202	CA		218	DA		234	EA	Ω	250	FA	
203	CB		219	DB	■	235	EB		251	FB	√
204	CC		220	DC		236	EC	∞	252	FC	
205	CD		221	DD		237	ED		253	FD	
206	CE		222	DE		238	EE	∈	254	FE	■
207	CF		223	DF		239	EF		255	FF	

7.2.5 Scandinavian

The Scandinavian character set includes: å Ä Å æ Æ Ö Ü ¢

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
128	80		144	90		160	A0		176	B0	
129	81	ü	145	91	æ	161	A1		177	B1	
130	82		146	92	Æ	162	A2		178	B2	
131	83		147	93		163	A3		179	B3	
132	84	ä	148	94	ö	164	A4	ñ	180	B4	
133	85		149	95		165	A5		181	B5	
134	86	å	150	96		166	A6		182	B6	
135	87		151	97		167	A7		183	B7	
136	88		152	98		168	A8		184	B8	
137	89		153	99	Ö	169	A9	←	185	B9	
138	8A		154	9A	Ü	170	AA	→	186	BA	
139	8B		155	9B	¢	171	AB		187	BB	
140	8C		156	9C		172	AC		188	BC	
141	8D		157	9D	¥	173	AD		189	BD	
142	8E	Ä	158	9E		174	AE		190	BE	
143	8F	Å	159	9F		175	AF		191	BF	

Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC	Dec	Hex	ASC
192	C0		208	D0		224	E0	α	240	F0	
193	C1		209	D1		225	E1	ß	241	F1	
194	C2		210	D2		226	E2	Γ	242	F2	
195	C3		211	D3		227	E3	π	243	F3	
196	C4	–	212	D4		228	E4	Σ	244	F4	
197	C5		213	D5		229	E5	σ	245	F5	
198	C6		214	D6		230	E6	μ	246	F6	÷
199	C7		215	D7		231	E7		247	F7	
200	C8		216	D8		232	E8		248	F8	°
201	C9		217	D9		233	E9	θ	249	F9	•
202	CA		218	DA		234	EA	Ω	250	FA	
203	CB		219	DB	■	235	EB		251	FB	√
204	CC		220	DC		236	EC	∞	252	FC	
205	CD		221	DD		237	ED		253	FD	
206	CE		222	DE		238	EE	∈	254	FE	■
207	CF		223	DF		239	EF		255	FF	

8. User program examples for PCD

8.1 Hardware configuration

All examples are based on the following hardware configuration.

PCD1
with built on terminal set D162
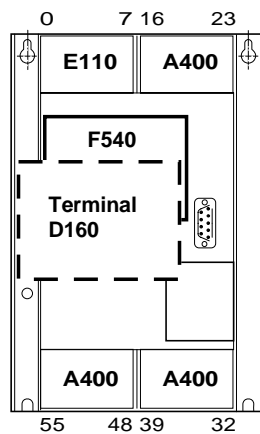
PCD2
with external terminal D170
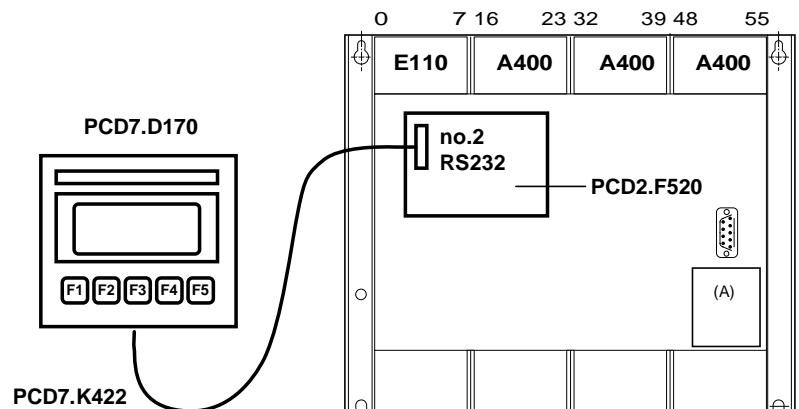
Hardware PCD1 :	PCD1.M110 or M120 with built on terminal set PCD7.D162, consisting of PCD7.D160 and PCD2.F540
Hardware PCD2 :	PCD2.M120 or M130 with interface module PCD2.F520, terminal PCD7.D170, cable PCD7.K422 (without RTS/CTS)
Serial interface :	no. 2

Terminal setup
- for PCD1   :   Backlight   On
- for PCD2   :   Handshaking   None (MC0)
                    Backlight   On

8.2 Single text transmission

When the switch connected to input 0 is switched on a simple text is transmitted to the terminal.

8.2.1 The user program is structured in BLOCTEC.
8.2.2 The user program is structured in GRAFTEC.

8.3 Transmission of several texts

When the switches connected to input 0, 1 and 2 are switched on the following texts are transmitted to the terminal:

Input 0 : a simple text is displayed.
Input 1 : a text containing the state of the inputs 4 and 5 is displayed.
Input 2 : a text containing the state of the inputs 6 and 7 is displayed.

8.3.1 The user program is structured in BLOCTEC.
8.3.2 The user program is structured in GRAFTEC.

8.4 Recognition of a pressed key with a following action

When one of the function keys F1, F2, F3 or F4 is pressed the following texts are transmitted.

Key F1 : a simple text is displayed
Key F2 : a text containing the state of the inputs 0 to 7 and outputs 16 to 23 is displayed.
Key F3 : a text containing the the BCD value of the switches connected to the inputs 0... 7 is displayed.
Key F4 : a text containing the date, week and time is displayed.

By pressing the key F4 the date, week and time is transmitted only once to the terminal. If a value should be displayed cyclically (for instance to refresh the time) then the following points should be noted to get a stable display:

- Switch off the cursor
- Don't send the control code "12" (clear screen) at the beginning of the text.

8.4.1 The user program contains jumps.
8.4.2 The user program is structured in BLOCTEC.
8.4.3 The user program is structured in GRAFTEC.

8.5 Modifying numerical parameters

Guided by a menu the contents of a register and counter can be modified by the terminal.

Conditions:
- The register can contain either positive or negative values using the format with a fixed decimal point.
- The counter may contain only positive values without decimal point.

To realise that function the universal function block **MODIFY** had been developed.
The complete description of that function block can be found attached to the listing of the demonstration program.

```
; ╔══════════════════════════════════════════════════════════════════╗
; ║                                                                    ║
; ║   User program example 8.2.1 for the industrial terminal PCD7.D160/170 ║
; ║   ================================================================ ║
; ║   The program is structured in BLOCTEC                             ║
; ║                                                                    ║
; ║   File  :      NDEMO21.SRC                                         ║
; ║                                                                    ║
; ║   Creation:   16.01.97        U.Jäggi / Th. Hofer                  ║
; ║                                                                    ║
; ╚══════════════════════════════════════════════════════════════════╝
```

```
TEXT    1       "<12>"                          ; Clear display
                "<27><84>"                      ; Cursor off
                *    INDUSTRIAL    "
                "CONTROL-TERMINAL"
                " PCD7.D160/170   "
                "################"


TEXT    100     "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"  1)


        ;---------------
        ; Coldstart
        ;---------------
        XOB             16
        SASI            2               ; Assignation interface no. 2
                        100             ; Text 100
        EXOB
        ;---------------
        ; Mainprogram
        ;---------------
        COB             0
                        0
        STH     I       0
        DYN     F       0
        ANL     O       22              ; Text busy flag
        CPB     H       0               ; Send text
        ECOB


        PB              0               ; Send text
        STXT            2               ; Interface 2
                        1               ; Text 1
        EPB
```

1) MC0 for D170 with cable K422 !

```
;┌─────────────────────────────────────────────────────────────────────┐
;│                                                                       │
;│   User program example 8.2.2 for the industrial terminal PCD7.D160/170│
;│   ================================================================    │
;│   The program is structured in GRAFTEC                                │
;│                                                                       │
;│   File  :     NDEMO22.SRC                                             │
;│                                                                       │
;│   Creation:   16.01.97        U.Jäggi / Th. Hofer                     │
;│                                                                       │
;└─────────────────────────────────────────────────────────────────────┘


TEXT    1       "<12>"                              ; Clear display
                "<27><84>"                          ; Cursor off
                "    INDUSTRIAL    "
                "CONTROL-TERMINAL"
                " PCD7.D160/170    "
                "################"

TEXT    100     "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"

        ;---------------
        ; Coldstart
        ;---------------
        XOB             16
        SASI            2                   ; Assignation interface no. 2
                        100                 ; Text 100
        EXOB
        ;---------------
        ; Mainprogram
        ;---------------
        COB             0
                        0
        CSB             0
        ECOB
        ;---------------
```

```
        SB      0

          |<───────────────1
          |                │
        ┌─┴─┐  ┌───┐       │
        ║ 0 ╟──┤NOP│       │
        └─┬─┘  └───┘       │
       (0)┼(Input 0="1")   │
        ┌─┴─┐  ┌─────────┐ │
        │ 1 ├──┤Send Text│ │
        └─┬─┘  └─────────┘ │
       (1)┼(=1)            │
          └────────────────0

        ESB
```

```
     SB      0
;---------------
IST      0                        ;NOP
EST
;---------------
ST      1                         ;Send Text
STXT            2
                1
EST
;---------------
TR      0                         ;Input 0="1"
STH     I       0
DYN     F       0
ANL     O       22                ; Text busy
ETR
;---------------
TR      1                         ;=1
ETR
;---------------
ESB
```

```
;┌─────────────────────────────────────────────────────────────────┐
;║                                                                   ║
;║   User program example 8.3.1 for the industrial terminal PCD7.D160/170 ║
;║   ======================================================================= ║
;║   The program is structured in BLOCTEC                            ║
;║                                                                   ║
;║   File  :      NDEMO31.SRC                                        ║
;║                                                                   ║
;║   Creation:   16.01.97        U.Jäggi / Th. Hofer                ║
;║                                                                   ║
;└─────────────────────────────────────────────────────────────────┘


TEXT    1         "<12>"                              ; Clear display
                  "<27><84>"                          ; cursor off
                  "Main menu   : I0<10><13>"
                  "Display status   "
                  "Input 4,5   : I1"
                  "Input 6,7   : I2"

TEXT    2         "<12>"
                  "Status <10><13>"
                  "Input  4 :$i0004<10><13>"
                  "Input  5 :$i0005<10><13>"
                  "Main menu  I0"

TEXT    3         "<12>"
                  "Status <10><13>"
                  "Input  6 :$i0006<10><13>"
                  "Input  7 :$i0007<10><13>"
                  "Main menu  I0"

TEXT    100       "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"
```

```
;---------------
; Coldstart
;---------------
XOB           16
SASI          2                    ; Assignation interface no. 2
              100                  ; Text 100
EXOB
;---------------
; Mainprogram
;---------------
COB           0
              0
;---------------
STH    I      0
DYN    F      0
ANL    O      22                   ; Text busy flag
CFB    H      0                    ; Send text
              1                    ; Text 1
;---------------
STH    I      1
DYN    F      1
ANL    O      22                   ; Text busy flag
CFB    H      0                    ; Send text
              2                    ; Text 2
;---------------
STH    I      2
DYN    F      2
ANL    O      22                   ; Text busy flag
CFB    H      0                    ; Send text
              3                    ; Text 3
ECOB


FB            0                    ; Send text
STXT          2                    ; Interface 2
       =      1                    ; Textnumber
EFB
```

```
; ╔══════════════════════════════════════════════════════════════╗
; ║                                                                ║
; ║   User program example 8.3.2 for the industrial terminal PCD7.D160/170 ║
; ║   ============================================================ ║
; ║   The program is structured in GRAFTEC                         ║
; ║                                                                ║
; ║   File   :     NDEMO32.SRC                                     ║
; ║                                                                ║
; ║   Creation:   16.01.97          U.Jäggi / Th. Hofer           ║
; ║                                                                ║
; ╚══════════════════════════════════════════════════════════════╝
;
```

```
TEXT    1        "<12>"                                  ; Clear display
                 "<27><84>"                              ; Cursor off
                 "Main menu   : I0<10><13>"
                 "Display status  "
                 "Input 4,5   : I1"
                 "Input 6,7   : I2"

TEXT    2        "<12>"
                 "Status <10><13>"
                 "Input  4 :$i0004<10><13>"
                 "Input  5 :$i0005<10><13>"
                 "Main menu  I0"

TEXT    3        "<12>"
                 "Status <10><13>"
                 "Input  6 :$i0006<10><13>"
                 "Input  7 :$i0007<10><13>"
                 "Main menu  I0"

TEXT    100      "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"
```

```
;---------------
; Coldstart
;---------------
XOB             16
SASI            2                       ; Assignation interface no. 2
                100                     ; Text 100
EXOB
;---------------
; Mainprogram
;---------------
COB             0
                0
CSB             0
ECOB


SB      0
```
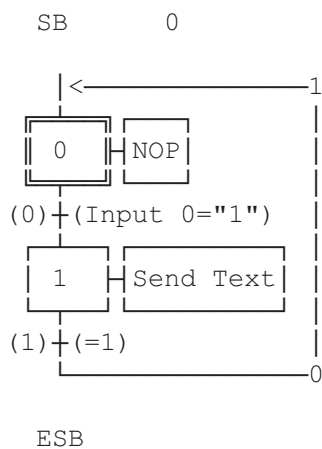


```
ESB
```

```
SB      0
;---------------
IST     0                           ;NOP
EST
;---------------
ST      1                           ;Text 1
STXT            2
                1
EST
;---------------
ST      2                           ;Text 2
STXT            2
                2
EST
;---------------
ST      3                           ;Text 3
STXT            2
                3
EST
;---------------
TR      0                           ;Input 0 = "1"
STH     I       0
DYN     F       0
ANL     O       22                  ; Text busy
ETR
;---------------
TR      1                           ;Input 1 = "1"
STH     I       1
DYN     F       1
ANL     O       22                  ; Text busy
ETR
;---------------
TR      2                           ;Input 2 = "1"
STH     I       2
DYN     F       2
ANL     O       22                  ; Text busy
ETR
;---------------
TR      3                           ;=1
ETR
;---------------
TR      4                           ;=1
ETR
;---------------
TR      5                           ;=1
ETR
;---------------
ESB
```

```
;╔══════════════════════════════════════════════════════════════════════╗
;║                                                                        ║
;║   User program example 8.4.1 for the industrial terminal PCD7.D160/170 ║
;║   ==================================================================== ║
;║   The program contains jumps                                           ║
;║                                                                        ║
;║   File  :      NDEMO41.SRC                                             ║
;║                                                                        ║
;║   Creation:   16.01.97        U.Jäggi / Th. Hofer                      ║
;╚══════════════════════════════════════════════════════════════════════╝


TEXT    1        "<12>"                              ; Clear display
                 "<27><84>"                          ; Cursor off
                 "Main menu      F1<10><13>"
                 "I/O 0..23      F2<10><13>"
                 "BCD-Value      F3<10><13>"
                 "Date/Time      F4"

TEXT    2        "<12>"                              ; Clear display
                 "Input Status          "
                 "I0..7   : $I0000<10><13>"
                 "O16..23 : $O0016<10><13>"
                 "Main menu  F1"

TEXT    3        "<12>"                              ; Clear display
                 "BCD-Value I0..7"
                 "---------------"
                 "Value  : $R0010<10><13>"
                 "Main menu  F1"

TEXT    4        "<12>"                              ; Clear display
                 "Date : $D<10><13>"
                 "Week : $W<10><13>"
                 "Time : $H<10><13>"
                 "Main menu  F1"

TEXT    100      "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"


; Symboldefinitions
;=====================================
; Diagnostic outputs serial interface
;-------------------------------------
RBSY    EQU      O      16               ; Receiver Busy
RFUL    EQU      O      RBSY+1           ; Receive Buffer Full
RDIA    EQU      O      RBSY+2           ; Receiver Diagnostic
TBSY    EQU      O      RBSY+3           ; Transmitter Busy
TFUL    EQU      O      RBSY+4           ; Transmit Buffer Full
TDIA    EQU      O      RBSY+5           ; Transmitter Diagnostic
XBSY    EQU      O      RBSY+6           ; Text Busy
NEXE    EQU      O      RBSY+7           ; Not Executed
;-------------------------------------
; Function/Program blocks
;-------------------------------------
READ    EQU      FB     0               ; Read character
SEND    EQU      FB     1               ; Send text
COMPARE EQU      PB     0               ; Compare received character
;-------------------------------------
; Register
;-------------------------------------
RBUF_R  EQU      R      1000
```

```
        ;-------------------------------
        ; Coldstart
        ;-------------------------------
        XOB             16
        SASI            2                       ; Assignation interface no. 2
                        100                     ; Text 100
        LDL     T       10                      ; Wait on D160
                        25
        STL     T       10
        JR      L       -1
        STXT            2                       ; Interface 2
                        1                       ; Text 1
        SOCL            1                       ; nötig weil Kabel für MC1-Mode
                        0
        EXOB
        ;-------------------------------
        ; Main program
        ;-------------------------------
        COB             0
                        0
        STH     O       RBSY                    ; Receiver busy
        ANL     O       XBSY                    ; Text busy
        JR      L       END                     ; If RBSY = low then do nothing
        SRXD            2                       ; Interface 2
                R       RBUF_R                  ; Receive buffer register
        ;-----------------------------------  Compare received character
        CMP     R       RBUF_R
                K       65                      ; F1
        ACC     Z
        JR      L       F2
        STXT            2                       ; Interface 2
                        1                       ; Text 1
        JR              END
        ;-------------------------------
F2:     CMP     R       RBUF_R
                K       66                      ; F2
        ACC     Z
        JR      L       F3
        STXT            2                       ; Interface 2
                        2                       ; Text 2
        JR              END
        ;-------------------------------
F3:     CMP     R       RBUF_R
                K       67                      ; F3
        ACC     Z
        JR      L       F4
        STXT            2                       ; Interface 2
                        3                       ; Text 3
        JR              END
        ;-------------------------------
F4:     CMP     R       RBUF_R
                K       68                      ; F4
        ACC     Z
        JR      L       END
        STXT            2                       ; Interface 2
                        4                       ; Text 4
        JR              END
        ;---------------------------------; Read BCD-Value
END:    DIGI            4
                I       0
                R       10
        ;-------------------------------
        ECOB
```
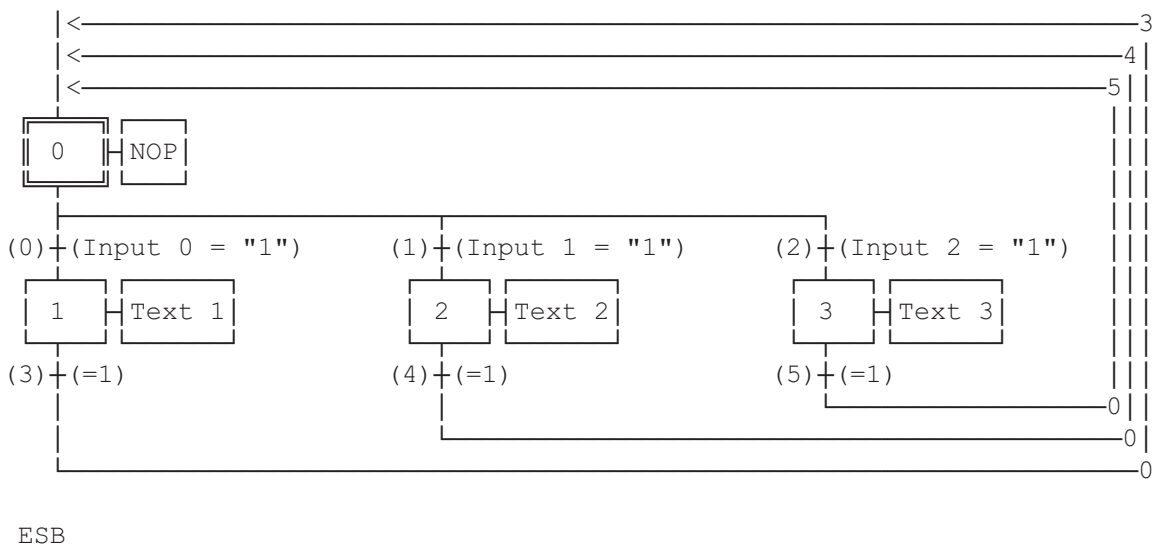
```
;╔═══════════════════════════════════════════════════════════════════╗
;║                                                                     ║
;║   User program example 8.4.2 for the industrial terminal PCD7.D160/170 ║
;║   =================================================================== ║
;║   The program is structured in BLOCTEC                              ║
;║                                                                     ║
;║   File :      NDEMO42.SRC                                           ║
;║                                                                     ║
;║   Creation:   16.01.97         U.Jäggi / Th. Hofer                  ║
;╚═══════════════════════════════════════════════════════════════════╝

TEXT    1        "<12>"                              ; Clear display
                 "<27><84>"                          ; Cursor off
                 "Main menu     F1<10><13>"
                 "I/O 0..23     F2<10><13>"
                 "BCD-Value     F3<10><13>"
                 "Date/Time     F4"

TEXT    2        "<12>"                              ; Clear display
                 "Input Status       "
                 "I0..7   : $I0000<10><13>"
                 "O16..23 : $O0016<10><13>"
                 "Main menu  F1"

TEXT    3        "<12>"                              ; Clear display
                 "BCD-Value I0..7"
                 "---------------"
                 "Value  : $R0010<10><13>"
                 "Main menu  F1"

TEXT    4        "<12>"                              ; Clear display
                 "Date : $D<10><13>"
                 "Week : $W<10><13>"
                 "Time : $H<10><13>"
                 "Main menu  F1"

TEXT    100      "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"

; Symboldefinitions
;===================================
; Diagnostic outputs serial interface
;-------------------------------------
RBSY    EQU     O       16              ; Receiver Busy
RFUL    EQU     O       RBSY+1          ; Receive Buffer Full
RDIA    EQU     O       RBSY+2          ; Receiver Diagnostic
TBSY    EQU     O       RBSY+3          ; Transmitter Busy
TFUL    EQU     O       RBSY+4          ; Transmit Buffer Full
TDIA    EQU     O       RBSY+5          ; Transmitter Diagnostic
XBSY    EQU     O       RBSY+6          ; Text Busy
NEXE    EQU     O       RBSY+7          ; Not Executed
;-------------------------------------
; Function/Program blocks
;-------------------------------------
READ    EQU     FB      0               ; Read character
SEND    EQU     FB      1               ; Send text
COMPARE EQU     PB      0               ; Compare received character
;-------------------------------------
; Register
;-------------------------------------
RBUF_R  EQU     R       1000
```

```
          ;-------------------------------
          ; Coldstart
          ;-------------------------------
          XOB           16
          SASI          2                   ; Assignation interface no. 2
                        100                 ; Text 100
          LDL     T     10                  ; Wait on D160
                        25
          STL     T     10
          JR      L     -1
          CFB           SEND
                        1
          EXOB
          ;-------------------------------
          ; Main program
          ;-------------------------------
          COB           0
                        0
          STH     O     RBSY                ; Receiver busy
          ANL     O     XBSY                ; Text busy
          CFB     H     READ                ; Read character
                  R     RBUF_R              ; Receive buffer register
          CPB     H     COMPARE             ; Compare received character
          ;-----------------------------; Read BCD-Value
          DIGI          4
                  I     0
                  R     10
          ;-------------------------------
          ECOB
```

```
        PB              COMPARE         ; Compare received character
        ;-----------------------------; Key = F1 ?
        CMP     R       RBUF_R
                K       65              ; F1
        ACC     Z
        CFB     H       SEND            ; Send text
                        1               ; Text 1
        ;-----------------------------; Key = F2 ?
        CMP     R       RBUF_R
                K       66              ; F2
        ACC     Z
        CFB     H       SEND            ; Send text
                        2               ; Text 2
        ;-----------------------------; Key = F3 ?
        CMP     R       RBUF_R
                K       67              ; F3
        ACC     Z
        CFB     H       SEND            ; Send text
                        3               ; Text 3
        ;-----------------------------; Key = F4 ?
        CMP     R       RBUF_R
                K       68              ; F4
        ACC     Z
        CFB     H       SEND            ; Send text
                        4               ; Text 4
        ;-----------------------------
        EPB


        ;=============================
        FB              READ            ; Read character
        SRXD            2               ; Interface 2
                =       1
        EFB
        ;-----------------------------
        FB              SEND            ; Send text
        STXT            2               ; Interface 2
                =       1               ; Textnumber
        EFB
```

```
;  ╔══════════════════════════════════════════════════════════════════╗
;  ║                                                                    ║
;  ║   User program example 8.4.3 for the industrial terminal PCD7.D160/170 ║
;  ║   ==================================================================== ║
;  ║   The program is structured in GRAFTEC.                            ║
;  ║                                                                    ║
;  ║   File  :     NDEMO43.SRC                                          ║
;  ║                                                                    ║
;  ║   Creation:  16.01.97        U.Jäggi                               ║
;  ║                                                                    ║
;  ╚══════════════════════════════════════════════════════════════════╝
;


TEXT    1       "<12>"                                ; Clear display
                "<27><84>"                            ; Cursor off
                "Main menu     F1<10><13>"
                "I/O 0..23     F2<10><13>"
                "BCD-Value     F3<10><13>"
                "Date/Time     F4"

TEXT    2       "<12>"                                ; Clear display
                "Input Status        "
                "I0..7   : $I0000<10><13>"
                "O16..23 : $O0016<10><13>"
                "Main menu  F1"

TEXT    3       "<12>"                                ; Clear display
                "BCD-Value I0..7"
                "--------------"
                "Value  : $R0010<10><13>"
                "Main menu  F1"

TEXT    4       "<12>"                                ; Clear display
                "Date : $D<10><13>"
                "Week : $W<10><13>"
                "Time : $H<10><13>"
                "Main menu  F1"

TEXT    100     "UART:9600,8,E,1;MODE:MC1;DIAG:O16,R100"

; Symboldefinitions
;=======================================
; Diagnostic outputs serial interface
;---------------------------------------
RBSY    EQU     O       16              ; Receiver Busy
RFUL    EQU     O       RBSY+1          ; Receive Buffer Full
RDIA    EQU     O       RBSY+2          ; Receiver Diagnostic
TBSY    EQU     O       RBSY+3          ; Transmitter Busy
TFUL    EQU     O       RBSY+4          ; Transmit Buffer Full
TDIA    EQU     O       RBSY+5          ; Transmitter Diagnostic
XBSY    EQU     O       RBSY+6          ; Text Busy
NEXE    EQU     O       RBSY+7          ; Not Executed
;---------------------------------------
; Register
;---------------------------------------
RBUF_R  EQU     R       1000
```

```
          ;------------------------------
          ; Coldstart
          ;------------------------------
          XOB             16
          SASI            2                    ; Assignation interface no. 2
                          100                  ; Text 100
          LDL     T       10                   ; Wait on D160
                          25
          STL     T       10
          JR      L       -1
          STXT            2                    ; Text 1 (menu text)
                          1
          EXOB
          ;------------------------------
          ; Main program
          ;------------------------------
          COB             0
                          0
          CSB             0
          ;-----------------------------; Read BCD-Value
          DIGI            4
                  I       0
                  R       10
          ;------------------------------
          ECOB
```
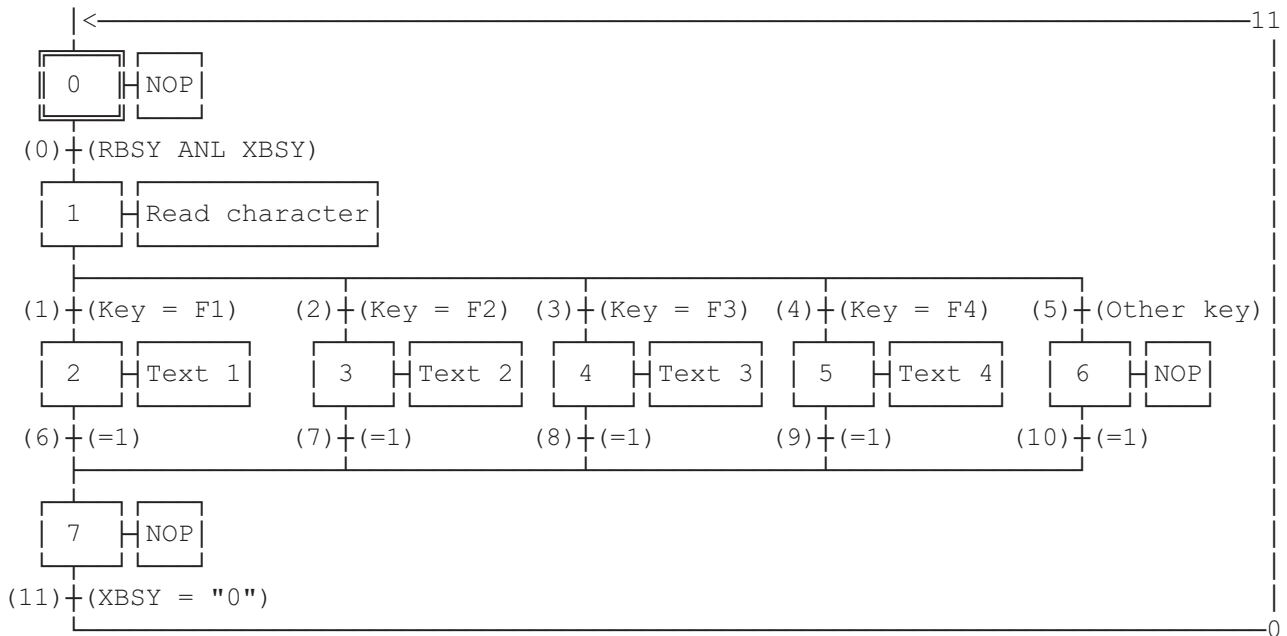
```
  SB      0

      |<------------------------------------------------------------11
      |                                                             |
    ┌┌──┐ ┌───┐                                                     |
    ║ 0 ║ ┤NOP│                                                     |
    └└──┘ └───┘                                                     |
  (0)┼(RBSY ANL XBSY)                                               |
    ┌───┐ ┌─────────────┐                                          |
    │ 1 │ ┤Read character│                                         |
    └───┘ └─────────────┘                                          |
      |                                                             |
  (1)┼(Key = F1)   (2)┼(Key = F2)  (3)┼(Key = F3)  (4)┼(Key = F4)  (5)┼(Other key)|
    ┌───┐ ┌──────┐    ┌───┐ ┌──────┐  ┌───┐ ┌──────┐  ┌───┐ ┌──────┐  ┌───┐ ┌───┐ |
    │ 2 │ ┤Text 1│    │ 3 │ ┤Text 2│  │ 4 │ ┤Text 3│  │ 5 │ ┤Text 4│  │ 6 │ ┤NOP│ |
    └───┘ └──────┘    └───┘ └──────┘  └───┘ └──────┘  └───┘ └──────┘  └───┘ └───┘ |
  (6)┼(=1)         (7)┼(=1)       (8)┼(=1)         (9)┼(=1)        (10)┼(=1)       |
      |                                                             |
    ┌───┐ ┌───┐                                                     |
    │ 7 │ ┤NOP│                                                     |
    └───┘ └───┘                                                     |
  (11)┼(XBSY = "0")                                                 |
      |                                                             |
      |-------------------------------------------------------------0

  ESB
```

```
        SB      0
        ;-------------------------------
        IST     0                       ;NOP
        EST
        ;-------------------------------
        ST      1                       ;Read character
        SRXD            2
            R       RBUF_R
        EST
        ;-------------------------------
        ST      2                       ;Text 1
        STXT            2               ; send
                        1               ; text 1
        EST
        ;-------------------------------
        ST      3                       ;Text 2
        STXT            2               ; send
                        2               ; text 2
        EST
        ;-------------------------------
        ST      4                       ;Text 3
        STXT            2               ; send
                        3               ; text 3
        EST
        ;-------------------------------
        ST      5                       ;Text 4
        STXT            2               ; send
                        4               ; text 4
        EST
        ;-------------------------------
        ST      6                       ;NOP
        EST
        ;-------------------------------
        ST      7                       ;NOP
        EST
        ;-------------------------------
```
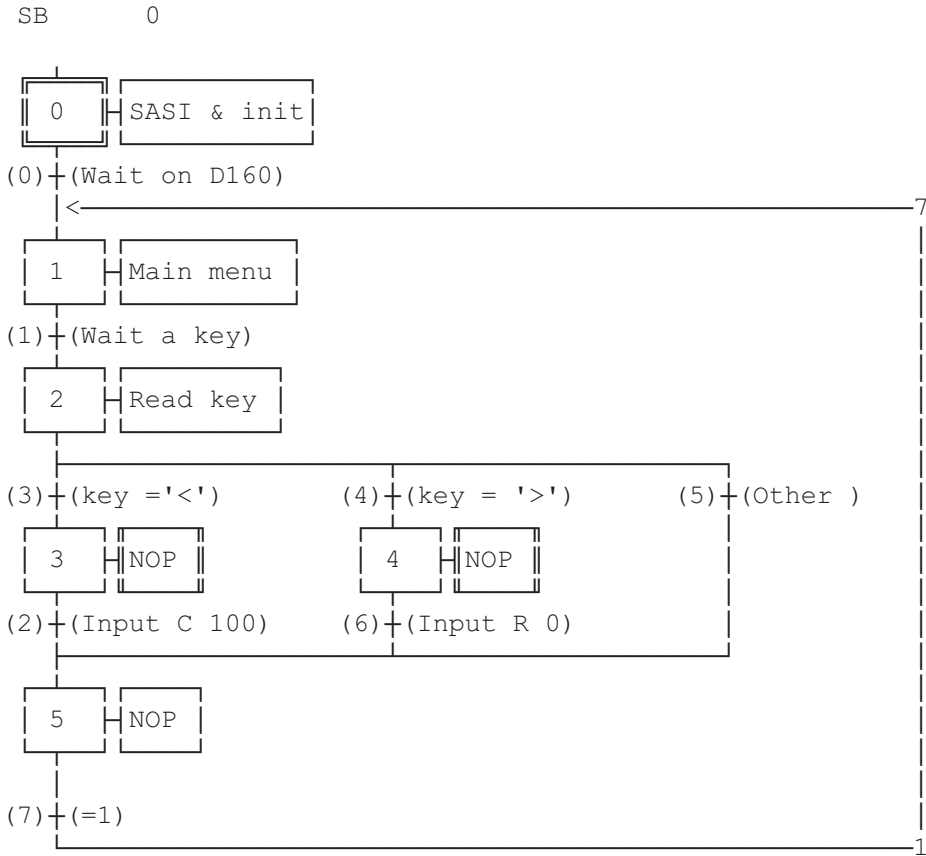
```
       TR      0                           ;RBSY ANL XBSY
       STH     O      16                   ; Receiver busy
       ANL     O      22                   ; Text busy
       ETR
       ;------------------------------
       TR      1                           ;Key = F1
       CMP     R      RBUF_R
               K      65                    ; F1
       ACC     Z
       ETR
       ;------------------------------
       TR      2                           ;Key = F2
       CMP     R      RBUF_R
               K      66                    ; F2
       ACC     Z
       ETR
       ;------------------------------
       TR      3                           ;Key = F3
       CMP     R      RBUF_R
               K      67                    ; F3
       ACC     Z
       ETR
       ;------------------------------
       TR      4                           ;Key = F4
       CMP     R      RBUF_R
               K      68                    ; F4
       ACC     Z
       ETR
       ;------------------------------
       TR      5                           ;Other key
       ETR
       ;------------------------------
       TR      6                           ;=1
       ETR
       ;------------------------------
       TR      7                           ;=1
       ETR
       ;------------------------------
       TR      8                           ;=1
       ETR
       ;------------------------------
       TR      9                           ;=1
       ETR
       ;------------------------------
       TR      10                          ;=1
       ETR
       ;------------------------------
       TR      11                          ;XBSY = "0"
       STL     O      22                   ; Text busy
       ETR
       ;------------------------------
       ESB
```

```
;┌──────────────────────────────────────────────────────────────────┐
;│                                                                    ║
;│   User program example 8.5 for the industrial terminal PCD7.D160/170 ║
;│   ================================================================ ║
;│                                                                    ║
;│   Modifying numerical parameters                                   ║
;│                                                                    ║
;│   File  :    DEMO160.SRC                                           ║
;│                                                                    ║
;│   Creation:  03.02.97        N. Bovigny                            ║
;│                                                                    ║
;└──────────────────────────────────────────────────────────────────┘
;
RBSY_F          EQU     O 16                           ; Receiver Busy
PUBL    RBSY_F                                         ; Receiver Busy
XBSY_F          EQU     O 22                           ; Text Busy
PUBL    XBSY_F                                         ; Text Busy
IN_BUSY         EQU     O 32                           ; Input Busy
PUBL    IN_BUSY                                        ; Input Busy
SIGN            EQU     O 33                           ; Sign input
                DOC     R 0
R_X             EQU     R 1
R_Y             EQU     R 2
EDIT_R          EQU     R 3
KEY             EQU     R 10
                DOC     R 99
DIAG_R          EQU     R 3999                         ; Diagnostic register
                DOC     T 0
                DOC     T 1
                DOC     C 0
                DOC     C 99
                DOC     C 100
K_INC2          EQU     K 10
PUBL    K_INC2
K_INC3          EQU     K 100
PUBL    K_INC3
K_INC4          EQU     K 1000
PUBL    K_INC4
X_INIT          EQU     TEXT 0
X_PR1           EQU     TEXT 1                         ; Prompt 1
X_PR2           EQU     TEXT 2                         ; Prompt 2
X_PR3           EQU     TEXT 3
X_SASI          EQU     TEXT 3999
CHAN_N          EQU     2
PUBL    CHAN_N
DOC             COB 0
MODIFY          EQU     FB 0
PUBL    MODIFY
```

```
      SB      0


         ┌──┐ ┌──────────┐
         ║ 0 ╟┤ SASI & init│
         └──┘ └──────────┘
     (0)─┤(Wait on D160)
         │┌◄─────────────────────────────────────7
         │                                        │
         ┌──┐ ┌──────────┐                        │
         │ 1 ╟┤ Main menu │                        │
         └──┘ └──────────┘                        │
     (1)─┤(Wait a key)                            │
         ┌──┐ ┌──────────┐                        │
         │ 2 ╟┤ Read key  │                        │
         └──┘ └──────────┘                        │
                                                  │
     (3)─┤(key ='<')       (4)─┤(key = '>')       (5)─┤(Other )   │
         ┌──┐ ┌────┐           ┌──┐ ┌────┐            │           │
         │ 3 ╟┤NOP ║           │ 4 ╟┤NOP ║            │           │
         └──┘ └────┘           └──┘ └────┘            │           │
     (2)─┤(Input C 100)   (6)─┤(Input R 0)           │           │
         │                                           │           │
         ┌──┐ ┌────┐                                             │
         │ 5 ╟┤NOP │                                             │
         └──┘ └────┘                                             │
         │                                                       │
     (7)─┤(=1)                                                   │
         └───────────────────────────────────────────────────────1


      ESB



         ;----------------------
         ; Mainprogram
         ;----------------------
         COB     0                 ; Main program
                 0

         CSB     0                 ; Call communication SB

         ECOB
         ;========================

         SB      0
         ;----------------------
         IST     0                 ; SASI & init
                 O 0               ; Wait on D160
         SASI    CHAN_N
                 X_SASI

$SASI
TEXT  X_SASI  "UART:9600,8,E,1;"
              "MODE:MC1;"                    ; MC0 for D170 with cable K422
              "DIAG:",RBSY_F.T,",",DIAG_R.T
$ENDSASI
```

```
        ACC     H
        SOCL    CHAN_N
                0
        LDL     T 0
                25
        LDL     C 100
                0
        LDL     R 0
                0
        EST     ;0
        ;-----------------------
        ST      1                       ; Main menu
                I 0                     ; Wait on D160
                I 7                     ; =1
                O 1                     ; Wait a key
        STXT    CHAN_N                  ; send the main
                X_INIT                  ; menu

TEXT  X_INIT  "<ESC>D<ESC>@@H<FF>"
                "<<>Edit Cnt 100<CR><LF>"
                "<>> Edit Reg 0<CR><LF><LF>"
                " Press a key"

        LDL     R_X             ; X_position
                32
        LDL     R_Y             ; Y_position
                35
        EST     ;1
        ;-----------------------
        ST      2                       ; Read key
                I 1                     ; Wait a key
                O 3                     ; key = '<'
                O 4                     ; key = '>'
                O 5                     ; Other
        SRXD    2                       ; read key
                KEY
        EST     ;2
        ;-----------------------
        ST      3                       ; NOP
                I 3                     ; key = '<'
                O 2                     ; Input C 100
        EST     ;3
        ;-----------------------
        ST      4                       ; NOP
                I 4                     ; key = '>'
                O 6                     ; Input R 0
        EST     ;4
        ;-----------------------
        ST      5                       ; NOP
                I 2                     ; Input C 100
                I 6                     ; Input R 0
                I 5                     ; Other
                O 7                     ; =1
        EST     ;5
        ;-----------------------
```

```
        TR      0                       ; Wait on D160
                I 0                     ; SASI & init
                O 1                     ; Main menu
        STL     T 0
        ETR     ;0
        ;-----------------------
        TR      1                       ; Wait a key
                I 1                     ; Main menu
                O 2                     ; Read key
        STH     RBSY_F                  ; wait a key
        ETR     ;1
        ;-----------------------
        TR      2                       ; Input C 100
                I 3                     ; NOP
                O 5                     ; NOP
        ACC     H
        RES     SIGN                    ; sign input not allowed
TEXT  X_PR1   "Cnt 100:$%07d$",edit_r.04T
        CFB     MODIFY                  ; Call FB Modify
                X_PR1                   ; Input Text
                R_X                     ; X Position
                R_Y                     ; Y Position
                C 100                   ; Counter to be modified
                EDIT_R                  ; Editing register
                SIGN                    ; Sign input
        STL     IN_BUSY
        ETR     ;2
        ;-----------------------
        TR      3                       ; key = '<'
                I 2                     ; Read key
                O 3                     ; NOP
        CMP     KEY                     ; if key = '<'
                K 8
        ACC     Z
        ETR     ;3
        ;-----------------------
        TR      4                       ; key = '>'
                I 2                     ; Read key
                O 4                     ; NOP
        CMP     KEY                     ; if key = '>'
                K 6
        ACC     Z
        ETR     ;4
        ;-----------------------
        TR      5                       ; Other
                I 2                     ; Read key
                O 5                     ; NOP
        ETR     ;5
        ;-----------------------
```

```
        TR      6                   ; Input R 0
                I 4                 ; NOP
                O 5                 ; NOP
        ACC     H
        SET     SIGN                ; Sign input not allowed
TEXT  X_PR2  "Reg 0:$%06.1d$",edit_r.04T," "
        CFB     MODIFY              ; Call FB MODIFY
                X_PR2               ; Input text
                R_X                 ; X position
                R_Y                 ; Y position
                R 0                 ; Register to be modified
                EDIT_R              ; Editing register
                SIGN                ; Sign input
        STL     IN_BUSY
        ETR     ;6
        ;-----------------------
        TR      7                   ; =1
                I 5                 ; NOP
                O 1                 ; Main menu
        ETR     ;7

        ESB     ;0
```

Function block: MODIFY

for the modification of values with D160/D170 terminals.

```
                              ┌──────────────────────────┐
                              │          ┌───────────────┤
                              │          │   MODIFY      │
                              │          └───────────────┤
          INP_TXT──┤=1        │                          │
          X_POS  ──┤=2        │                          │
          Y_POS  ──┤=3        │                          │
          PARAM  ──┤=4        │                          │
          EDIT_R ──┤=5        │                          │
          SIGN   ──┤=6        │                          │
          CHAN_N ──┤          │                          │
          RBSY_F ──┤          │                          │
          XBSY_F ──┤          │               4=├── PARAM │
          IN_BUSY──┤          │                 ├── IN_BUSY│
                              │                          │
                              ├──────────────────────────┤
                              │Index modified : no        │
                              ├──────────────────────────┤
                              │Execution time : 0.1/0.5ms │ 1)
                              ├──────────────────────────┤
                              │Used FB levels : 1         │
                              ├──────────────────────────┤
                              │Program lines  : 132       │
                              └──────────────────────────┘
```
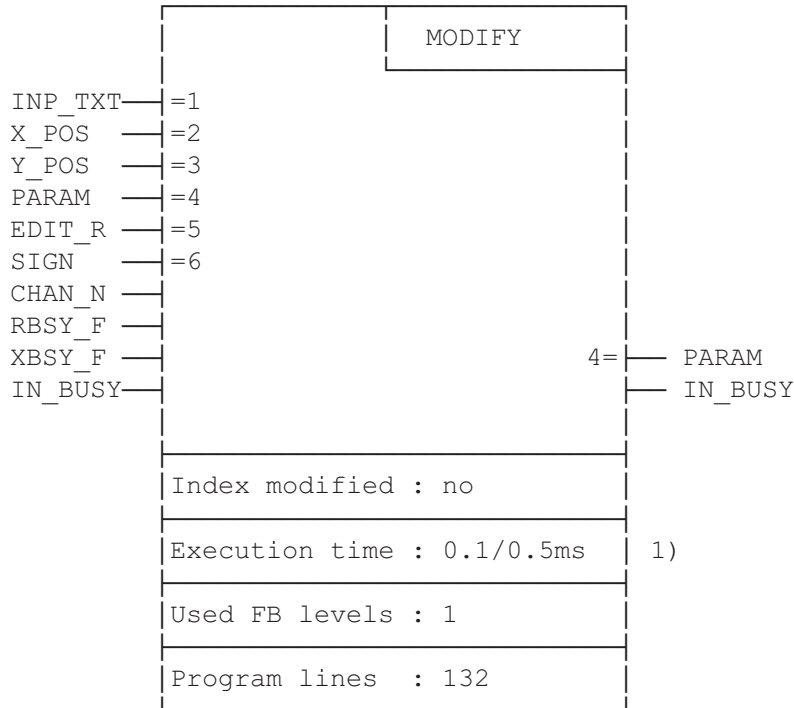
1)   0.1ms :   no key depressed
     0.4ms :   arrow key "left" depressed (PCD2)

Function description

This function block can be used to modify the contents of a PCD
register or counter with the PCD7.D160/D170 terminal. It requires
the terminal to have first been set up in "**with shift function**" mode.

The values of registers and counters displayed can be modified using
the arrow keys. The stepping rate has several speeds so that large
changes can be made quickly. When decrementing a register value it
can go below zero into the negative range.

Procedure during programming

To allow modification of displayed values, the FB must be processed
cyclically (preferably in a Graftec transition or in a cyclical program)
until the BUSY flag becomes 0.

The user defines a text "INP_TXT", which contains the register value to be displayed in the appropriate format. FB parameters include the following definitions:
- the text
- position on display
- serial interface
- register or counter to be displayed and modified
- an input register
- permission for negative values.

Further programming instructions:
- The terminal must be in "Shift keys: Yes" mode.
- Setup must include the selection of "Key auto-repeat: All keys, 2 speed".
- At run-time, access to setup must be blocked (ESC @ H)

Symbol	Description	Type	Format	Values	Definition
INP_TXT	Input text	X	Text		Parameter
PARAM	Input parameter(R or C)	R/C	Integer	Whole range R or C	Parameter
EDIT_R	Edit register	R	Integer	Whole range R	Parameter
X_POS	Cursor X-position	R	Integer	32..47	Parameter
Y_POS	Cursor Y-position	R	Integer	32..35	Parameter
SIGN	Negative values accepted	F/I/O	Binary	1 = yes / 0 = no	Parameter
CHAN_N	Serial channel number	K	Integer	0..3	Extern
RBSY_F	Receive busy flag	F/O	Binary	0/1	Extern
XBSY_F	Text busy flag	F/O	Binary	0/1	Extern
IN_BUSY	Input busy flag	F/O	Binary	0/1	Extern
K_INC2	Value for modification speed 2	K	Integer	Recommded value : 10	Extern
K_INC3	Value for modification speed 3	K	Integer	Recommded value : 100	Extern
K_INC4	Value for modification speed 4	K	Integer	Recommded value : 1000	Extern

Key: Parameters   These elements are directly transmitted as parameters when the FB is called.
        External   These elements are not transmitted as parameters and must be defined as public in the main program.

Explanation of FB I/Os

Input text "INP_TXT":
This text is called when the FB is called for the first time and at each key depression. It must always contain the register to be modified (EDIT_R), including the appropriate output format. However, this text is not allowed to contain any control commands (strings) for the terminal. Positioning of the input text takes place automatically via the FB parameters X_POS and Y_POS.

Example:
TEXT   INP_TEXT   "Register:$%06.1$",REG.04T
n.b.: REG is an independent register (no FB parameters)

Position of cursor "X_POS and Y_POS":
It defines the position of the first character in the input text.

"SIGN":
This flag controls whether negative values are allowed.
"SIGN" = 0   Lower limit of value is 0.
"SIGN" = 1   Negative values are allowed.
n.b.: - For counters (C) "SIGN" must be = 0.
       - The zero limit is only monitored during decrementing. This
         value can be negative if the register in the input text already
         contains a negative value.

Serial channel number "CHAN_N":
Defines the serial channel number. This number must be assigned in the SASI instruction before calling the FB.

Serial channel diagnostic flags "RBSY_F" and "XBSY_F":
Addresses for the RBSY_F and XBSY_F flags must agree with the diagnostic flag addresses defined by the SASI instruction.

Input busy flag "IN_BUSY":
The input busy flag IN_BUSY must initially be zero otherwise the FB will not function correctly.
Reset the IN_BUSY flag in XOB 16.
The flag is set high the first time the FB is called. The flag is reset again when a carriage return is received.

Resources used internally

The FB uses 2 registers and 2 flags internally for its work. These are defined locally as symbols and may only be used here. In each case it is only necessary to define the lower of the two addresses.

Symbol	Description	Type	Default value	Definition
WORK_R	Base address of the 2 registers	R	2000	Local
WORK_F	Base address of the 2 flags	F	2000	Local

Key assignment

Key codes can be changed for specific applications by re-assigning the symbols. The following list shows the symbols and default codes, as output by the D160 and D170 terminals

Symbol	Description	Default code	Definition
K_CR	Key 'E' (carriage return) Confirms the modification of the value	K 13	Local
K_QUIT	Key 'Q' (quit) Ends or ignors the modification	K 113	Local
K_UP	Arrow up ($\uparrow$) Increments the value	K 11	Local
K_DOWN	Arrow down ($\downarrow$) Decrements the value	K 5	Local
K_LEFT	Arrow left ($\leftarrow$) Decrements with speed 3 and 4	K 8	Local
K_RIGHT	Arrow right ($\rightarrow$) Increments with speed 3 and 4	K 6	Local
K_2ON	Speed 2 on	K 30 [1]	Local
K_2OFF	Speed 3 off	K 31 [1]	Local

1) These codes are sent by the terminal automatically when a key is depressed for longer than 3 seconds, or when it is released again.

Use of arrow keys to modify values

When the FB is called for the first time, the input text is displayed. The IN_BUSY flag is set to 1 and the contents of the PARAM register are copied to the EDIT_R register. It is now possible to modify the value displayed on the terminal with the arrow keys.

For the ↑ and ↓ keys, modification is by one unit per key depression. If the key is held down for longer than 0.7 seconds, the function repeats automatically. After 3 seconds the speed increases to steps of 10 (speed 2).

With the ← and → keys, the modification factor is 100 (speed 3). Here too the modification is repeated after 0.7 seconds, and the speed increasing to steps of 1000 after 3 seconds (speed 4).

Modification speeds 2 to 4 can be changed against the default values with symbols K_INC.

The input is terminated by depressing the "E" key (with shift). The input can be ignored by depressing the "Q" key.

The IN_BUSY flag is then set to 0. During entry, the PARAM register is not modified. It only adopts the new value when the "E" key is pressed.

9. Comparison of terminals PCD7.D202 and ..D160/..D170

Criterion	D202	D170	D160
Front panel colour	light grey	light grey	light grey
Front panel protection system	IP 65	IP 65	IP 20
Mounting position	Front panel flush mount	Front panel flush mount	Built onto PCD1/2
Supply	24 VDC	24 VDC	5 V from PCD1/2 bus
Display	4 x 20 character, LCD with LED backlight	4 x 16 character, LCD with LED backlight	4 x 16 character, LCD with LED backlight
Backlight at power-up	on	off	off
Character set	ASCII + special characters for Eng/Ger/Fr/Scand.	ASCII + special characters for Eng/Ger/Fr/Scand.	ASCII + special characters for Eng/Ger/Fr/Scand.
Keyboard	25 keys	5 keys with 5 or 8 functions	5 keys with 5 or 8 functions
Labelling strip	4 function keys only	All 5 keys	All 5 keys
LEDs	4 + 4	none	none
Serial interface	RS232, 9-pole connector	RS232, 9-pole connector	Port 2 of PCD1/2
Baud rate	110.. 19200 bps	110.. 19200 bps	110.. 19200 bps
Data bits	8 or 7	8	8
Stop bits	1 or 2	1	1
Default handshaking	None (MC0)	RTS/CTS (MC1)	RTS/CTS (MC1)
Usable cable	PCD7.K412 and K422	PCD7.K412 and K422	-
Instructions:			
- Display contrast	0...15	0...7	0...7
- Shift mode	permanent	no/yes	no/yes

Comparison of terminals PCD7.D202 and ..D160/..D170

Notes :

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10. Interface connection cables RS 232

The cables are double shielded with metallized connectors, in 2.5 m
standard lengths.

Type PCD7.K412:   For interface RS 232
                        without handshaking RTS/CTS

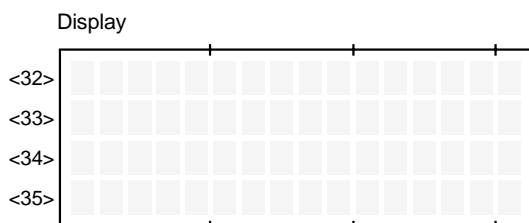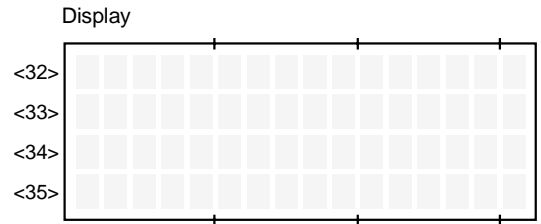Connection between terminal ..D170 and PGU socket (channel 0) of all
PCD processor modules.

Terminal PCD7.D170   **PCD processor module**
                                                    at PGU socket
                                                    (interface 0)

| **9-pole,** **D-type connector** (male) | **Cable RS 232** | **9-pole,** **D-type connector** (male) |

TxD	2		2	RxD
RxD	3		3	TxD
SGND	5		5	SGND
CTS	7		7	RTS
RTS	8		8	CTS

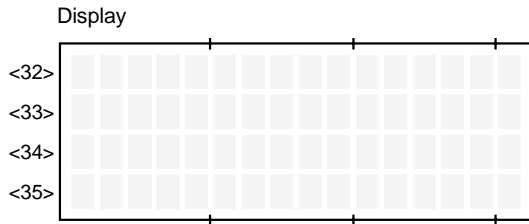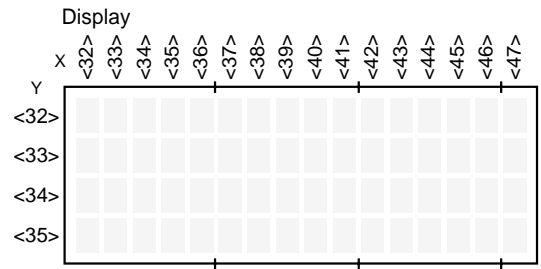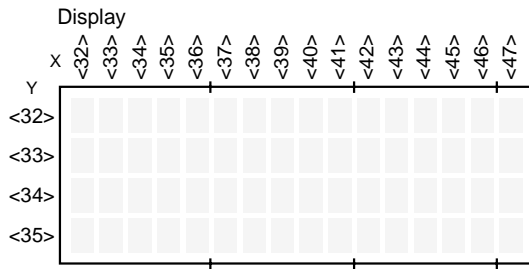Shield / housing   Shield / housing
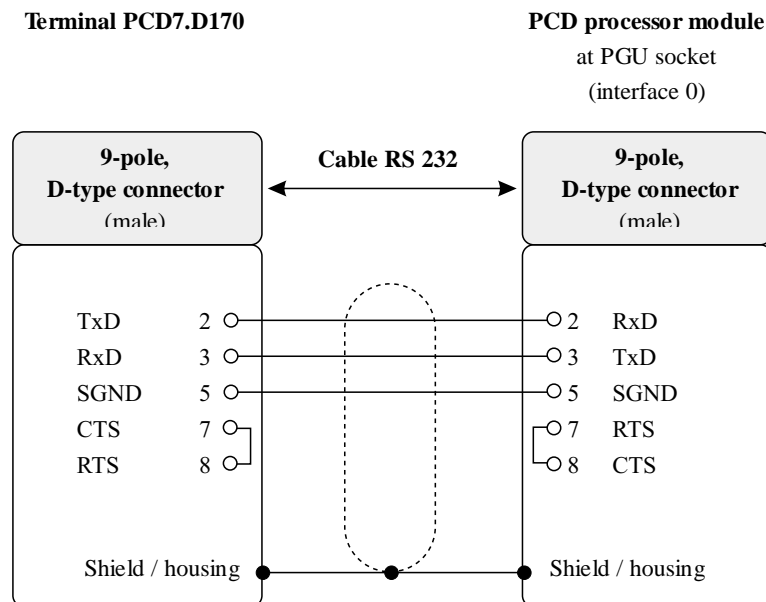
Type PCD7.K422:   For interface RS 232
without handshaking RTS/CTS

Connection between terminal ..D170 and processor module or bus module of the series PCD1, PCD2 or PCD4. Free cable ends (with sleeves).

Display

X   <32> <33> <34> <35> <36> <37> <38> <39> <40> <41> <42> <43> <44> <45> <46> <47>

Y

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Display

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Display

X   <32> <33> <34> <35> <36> <37> <38> <39> <40> <41> <42> <43> <44> <45> <46> <47>

Y

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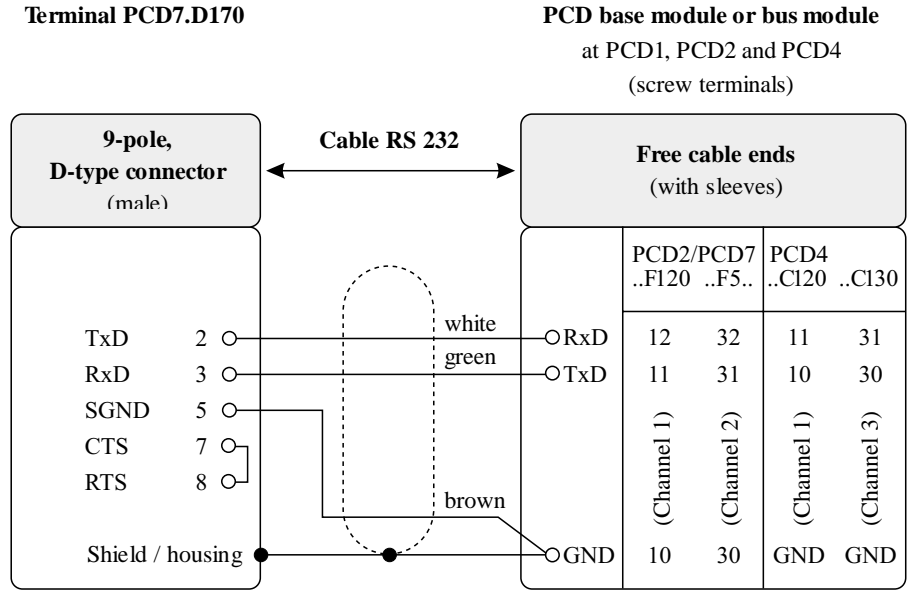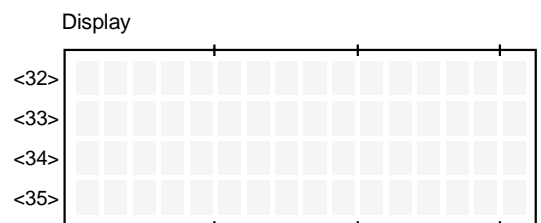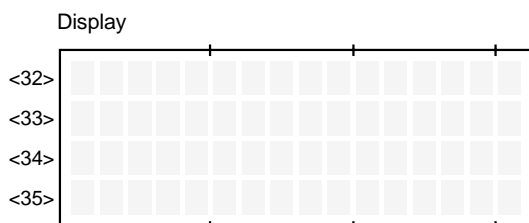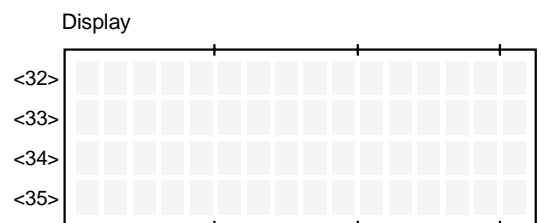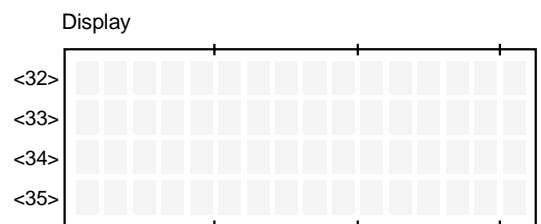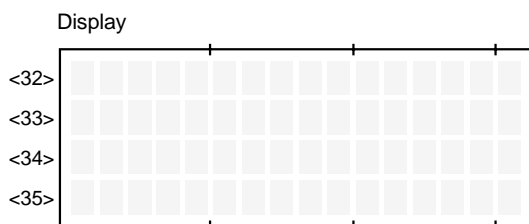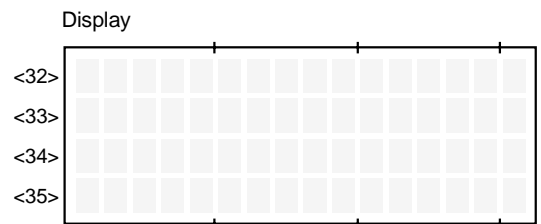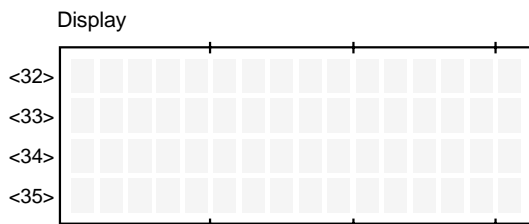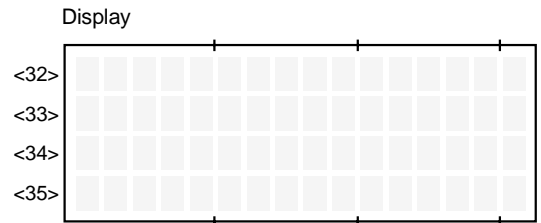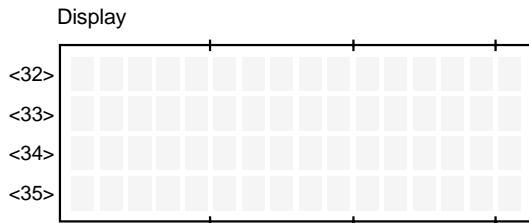
Displays

Notes :

From :

Company :
Department :
Name :
Address :

Tel. :

Date :

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SAIA-Burgess Electronics Ltd.
Bahnhofstrasse 18
CH-3280 Murten (Switzerland)
http://www.saia-burgess.com

BA : Electronic Controllers

Small industrial terminals
PCD7.D160 and ..D170

If you have any suggestions concerning the SAIA$^{\circledR}$ PCD, or have found any errors
in this manual, brief details would be appreciated.

Your suggestions :