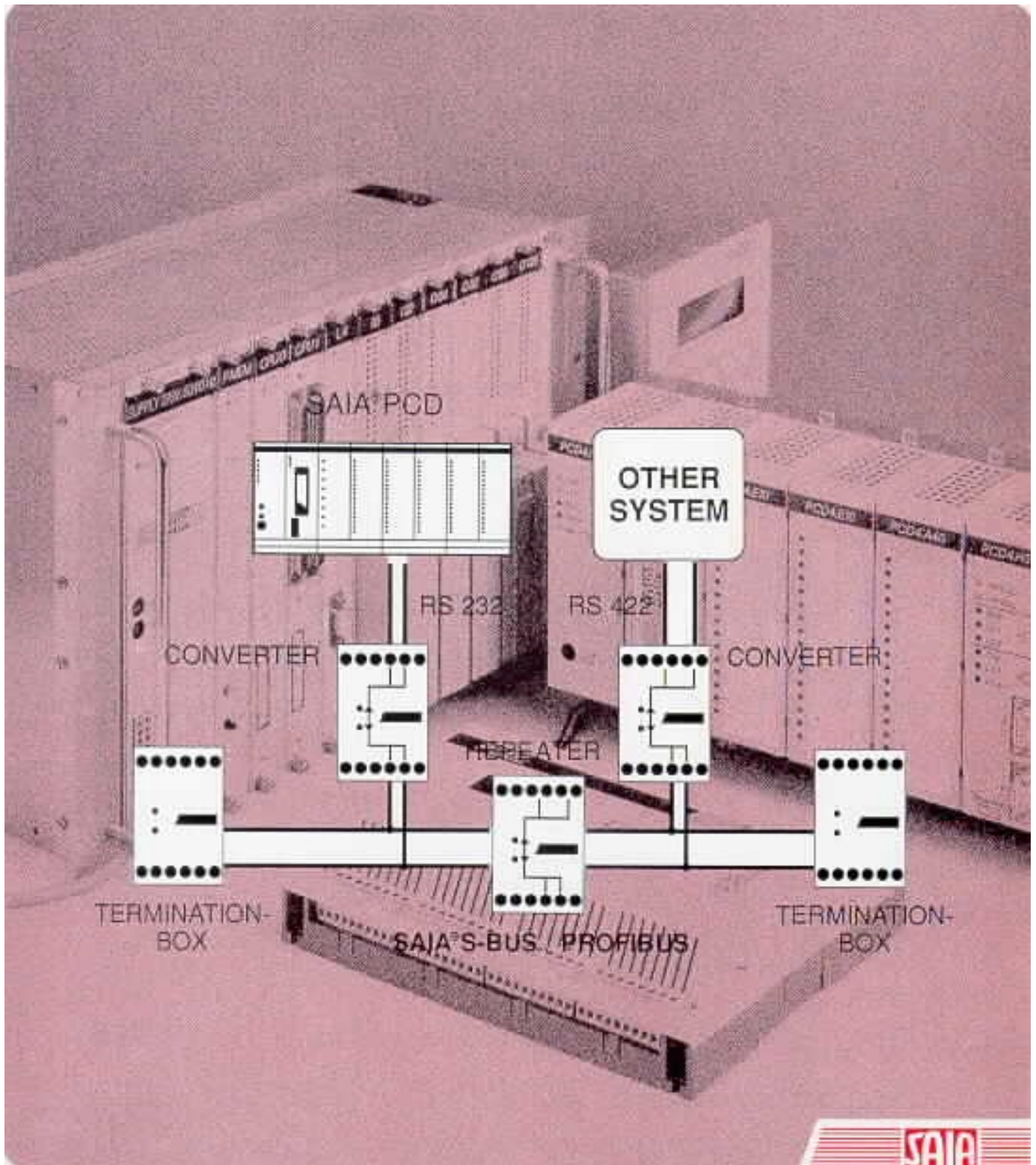


## SAIA® PCD Process Control Devices

## Installation Components for RS 485 networks for PCD series



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**SAIA® Process Control Devices**

# **Installation Components for RS 485 networks**

**for PCD series**

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Edition 26/740 E4 - 03.2000

Subject to technical changes

# Updates

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Manual : Installation Components for RS 485 networks - Edition E4

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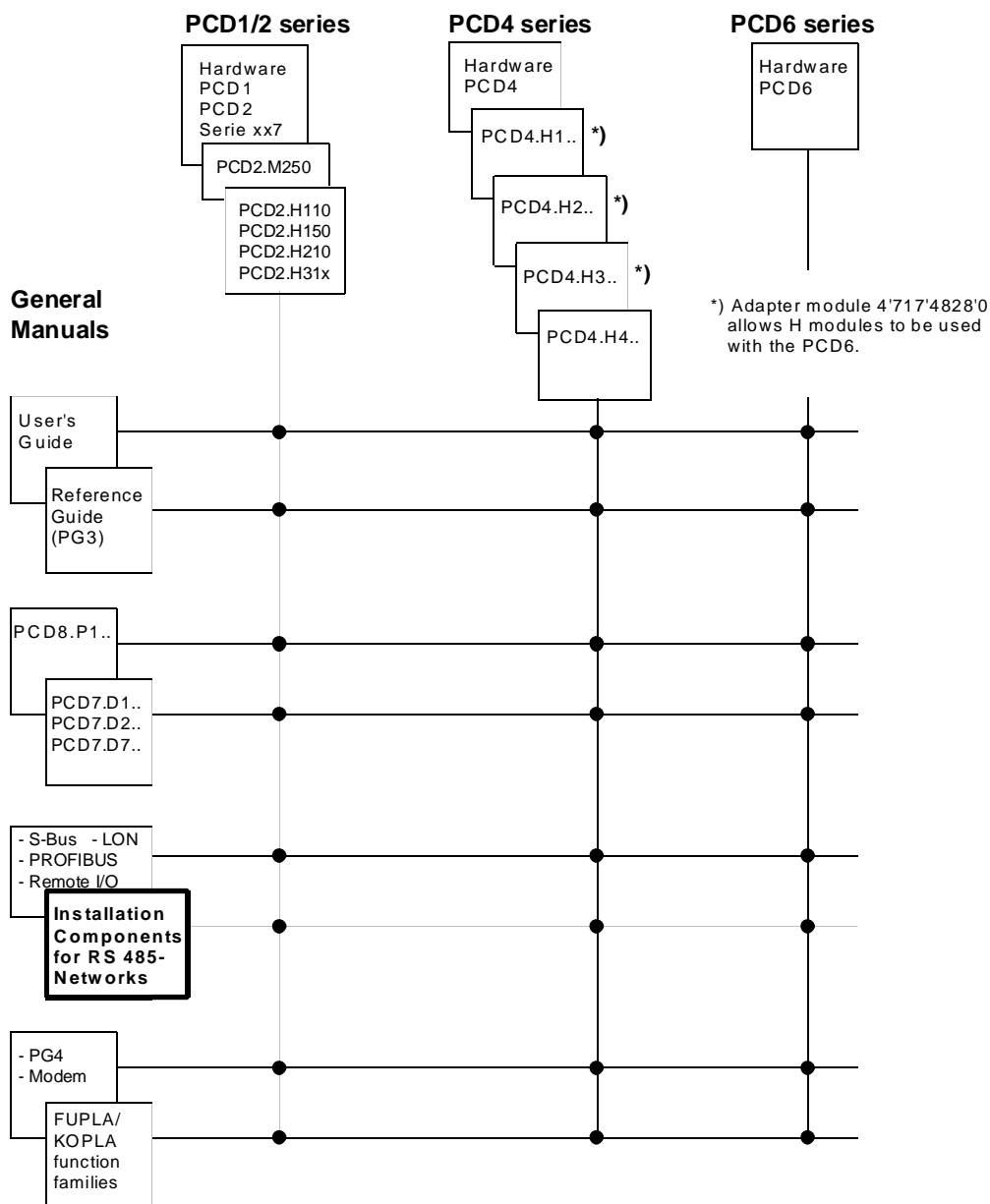
**Please note :**

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.

**Summary**



## 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, United Laboratories (UL), Det Norske Veritas, CE mark ...
- choice of high-quality componentry
- quality control checks at various stages of production
- in-circuit tests
- run-in (burn-in at 85°C for 48h)

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 Introduction

## 1.1 General description

For error-free operation of an RS485 network (SAIA® S-BUS, SAIA® LAN2, PROFIBUS) the principal requirement is perfect installation of the data transmission line. A small network is usually very tolerant of signal quality, i.e. any small installation in an office or laboratory will immediately show the expected results, even without a shielded line or the prescribed pull-up, pull-down and line termination resistors, and in the absence of any electrical isolation. If the same lack of care is applied to commissioning a larger, industrial installation, faults soon arise because of potential differences or inadequate signal levels.

The components described in this manual are provided as the best possible way of adapting an RS485 network to the task.

### Termination box

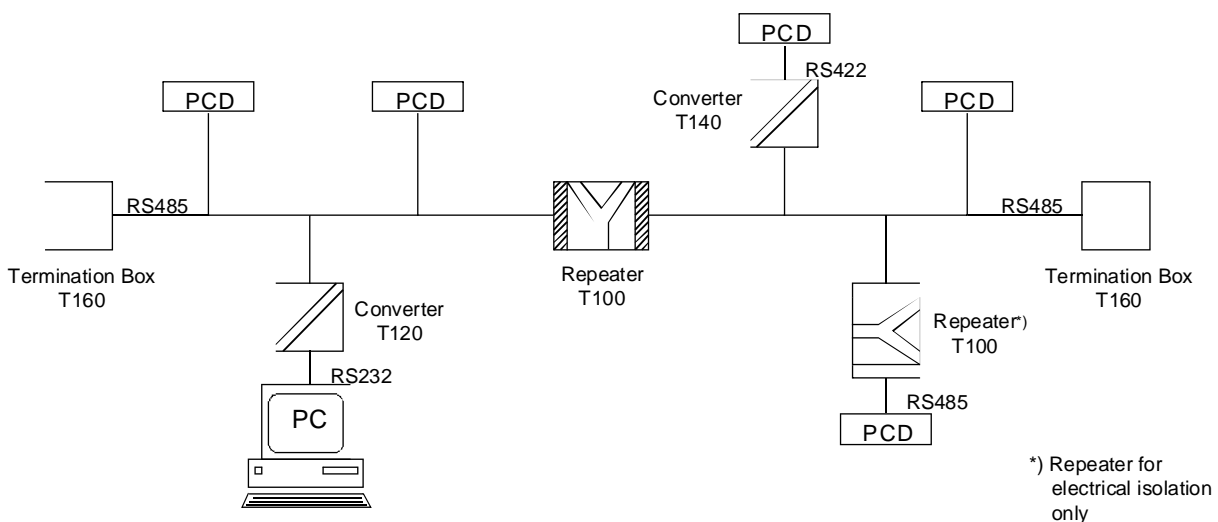
This very simple module is used to terminate the network correctly and to apply bias voltage to the signal lines with an electrically isolated supply and the correct off-load potential.

### Converter

The converters enable electrically isolated conversion from the RS232 or RS422 of a remote station to the RS485 2-wire bus and vice versa.

### Repeater

The repeater is used not only for the electrical isolation of individual line sections from each other, but also to reprocess signals travelling longer distances.



## 1.2 Summary of types

---

Description	Type	Current consumption
Repeater	PCD7.T100	65 mA
Converter RS232 to RS485	PCD7.T120	55 mA
Converter RS422 to RS485	PCD7.T140	55 mA
Termination Box	PCD7.T160	30 mA

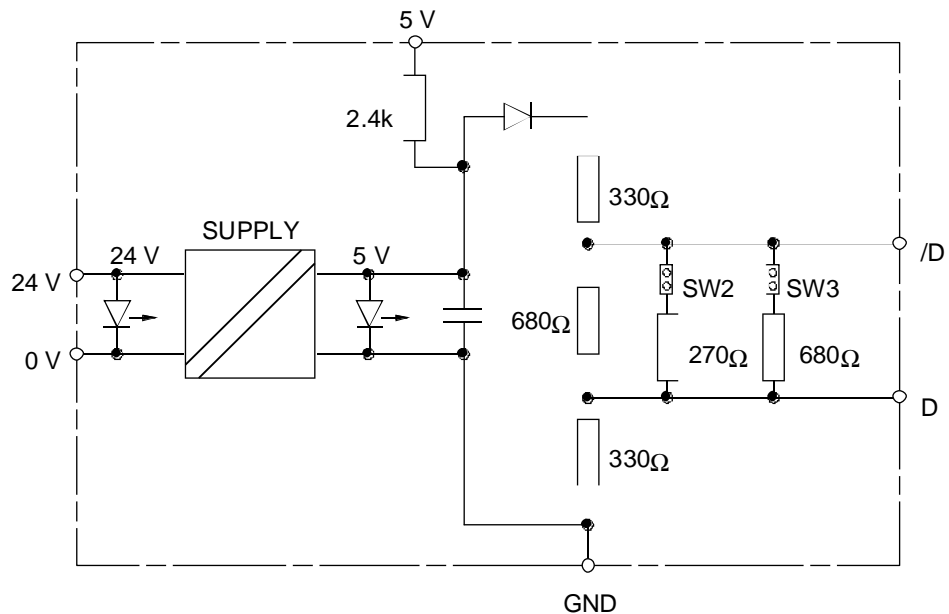
## 2 Termination box PCD7.T160

### 2.1 Description of function

For the safe use of an RS485 network, and for ease of service, it is important to install the line termination resistors separately and and to arrange them clearly. The termination box is provided for this purpose where, depending on the physical properties and length of the line, a suitable line termination resistors can be set by a DIL switch. An electrically isolated supply provides bias voltage at the necessary off-load potential for signal lines D and /D.

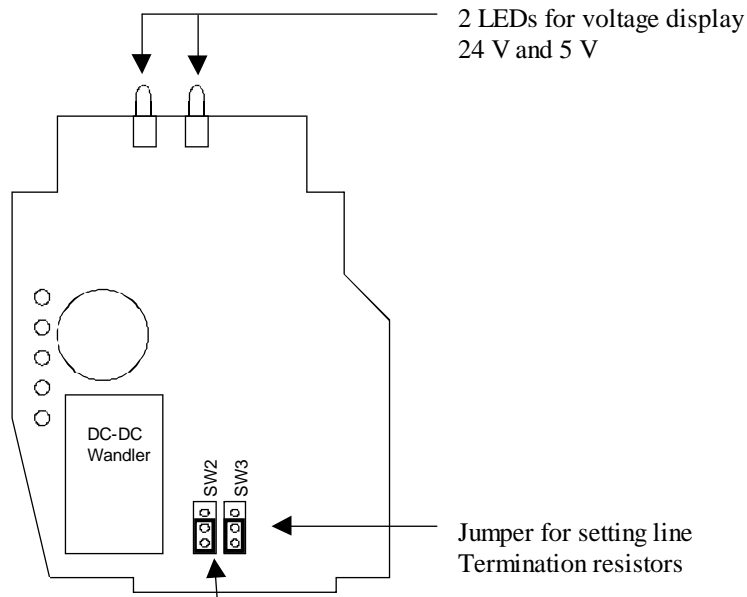
The termination box can be used for SAIA<sup>®</sup> LAN2, SAIA<sup>®</sup> S-Bus or for PROFIBUS FMS/DP. For PROFIBUS, the termination box can be used with all baudrate until 12 Mbit/s

### 2.2 Block diagram



*Block diagram for PCD7.T160 termination box*

## 2.3 Printed circuit board, jumper positions



## 2.4 Settings

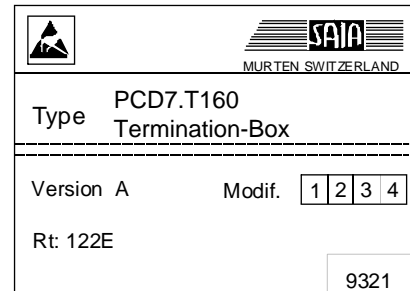
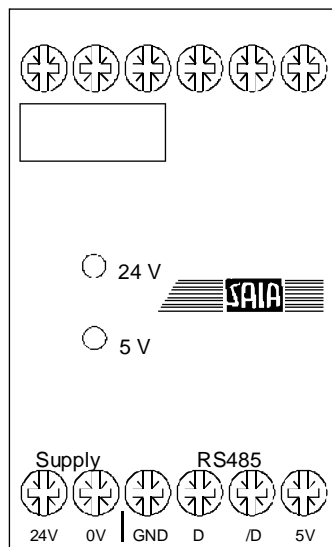
Selected resistance R	680Ω	340Ω	193Ω	150Ω *)	open	close
Resultant line termination resistance RT	335Ω	224Ω	149Ω	122Ω		

\*) factory setting

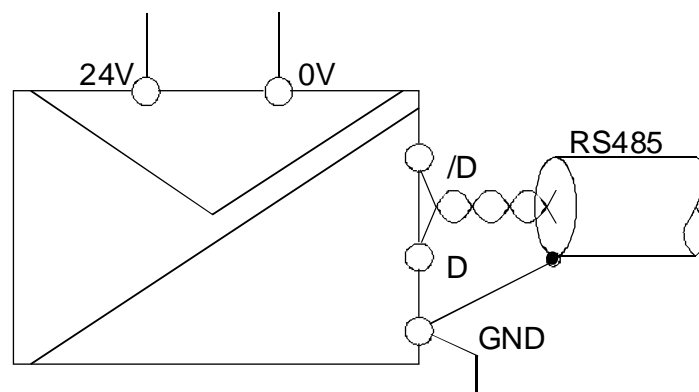
The factory setting of the termination resistors is 122Ω. This setting is suitable for almost all cases and should not be changed.

If in practice there are a lot of telegram repetitions, a try with other termination resistors can be done.

## 2.5 Front panel and name plate



## 2.6 Connection



- Notes:
- Terminals "0V" and "GND" are electrically isolated.
  - The "5V" terminal is used solely to enable control measurement with a standard voltmeter.

Notes

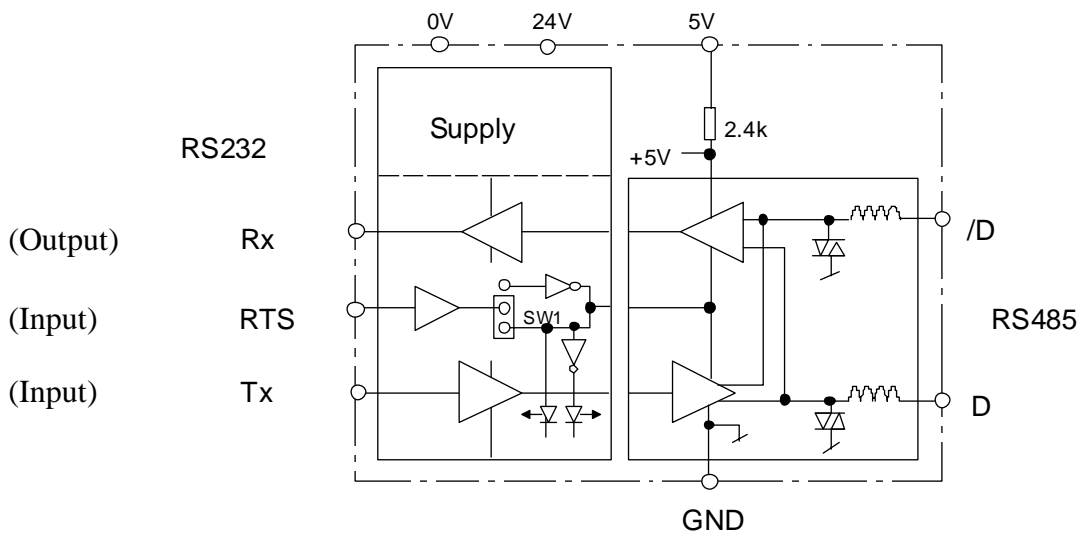
### 3 Converters PCD7.T120 and PCD7.T140

#### 3.1 Description of function

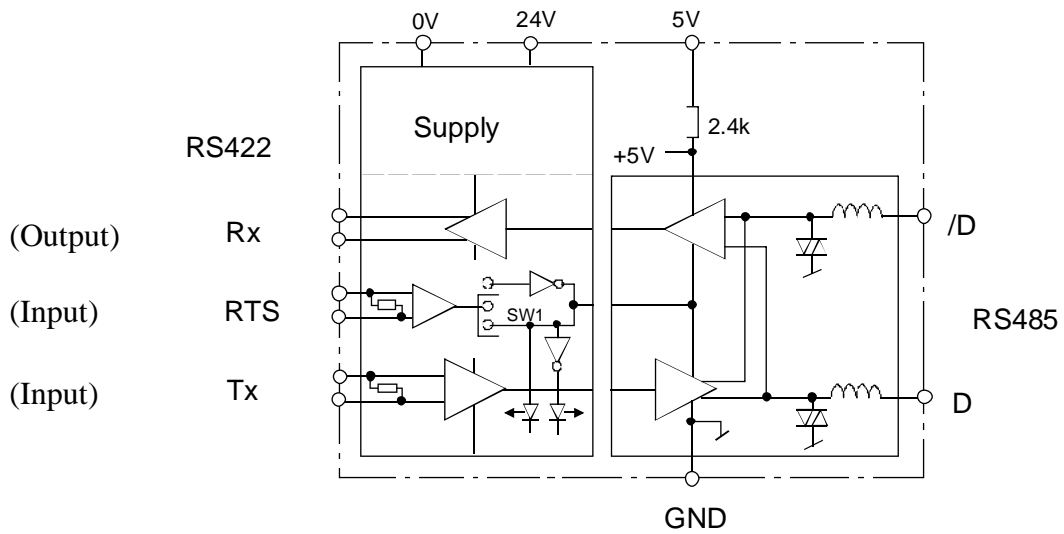
The converters enable communications to change over from RS232 (for PCD7.T120) or from RS422 (for PCD7.T140) to RS485. Switching from receive to send is controlled externally by means of the RTS signal. The RS485 connection is electrically isolated from any other potential. These converters do not have line termination resistors on the RS485 side. It is possible to preset RTS signal polarity with a jumper.

Converters are used exclusively for S-Bus networks.

#### 3.2 Block diagrams



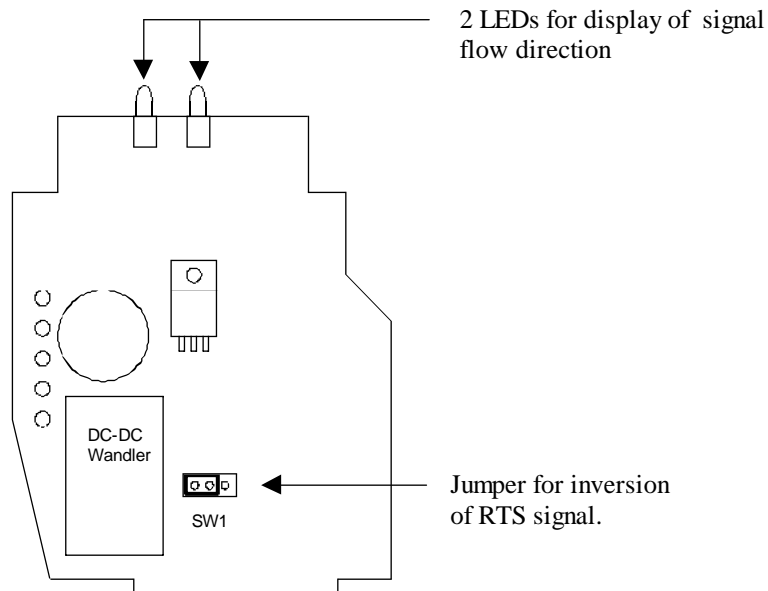
Block diagram of PCD7.T120 converter (RS232 to RS485)



The RS422 inputs are Terminated with 150Ω

Block diagram of PCD7.T140 converter (RS422 to RS485)

### 3.3 Printed circuit board, jumper positions





### 3.4 Settings



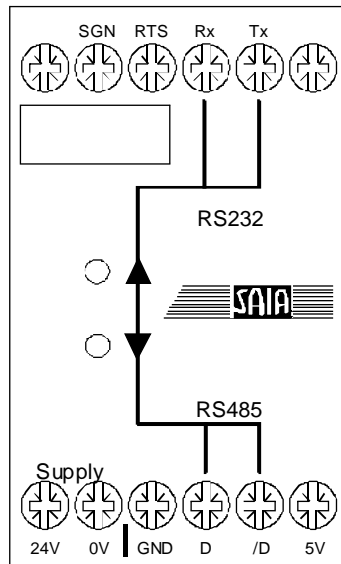
if RTS is H: send  
if RTS is L: receive

\*) factory setting

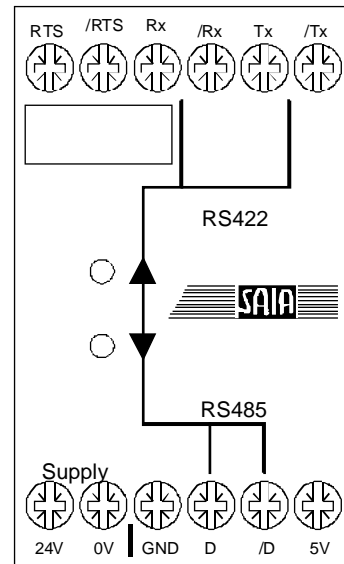


if RTS is H: receive  
if RTS is L: send

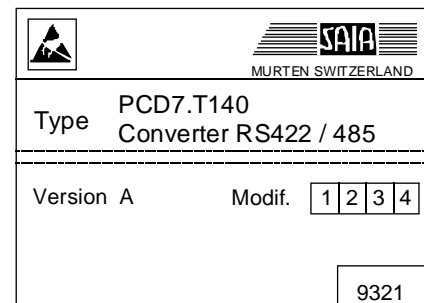
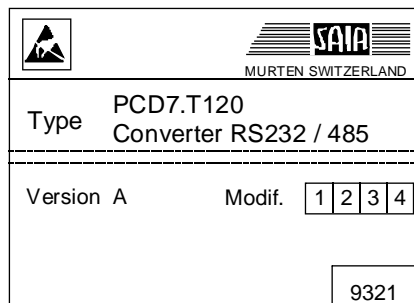
### 3.5 Front panels and name plates



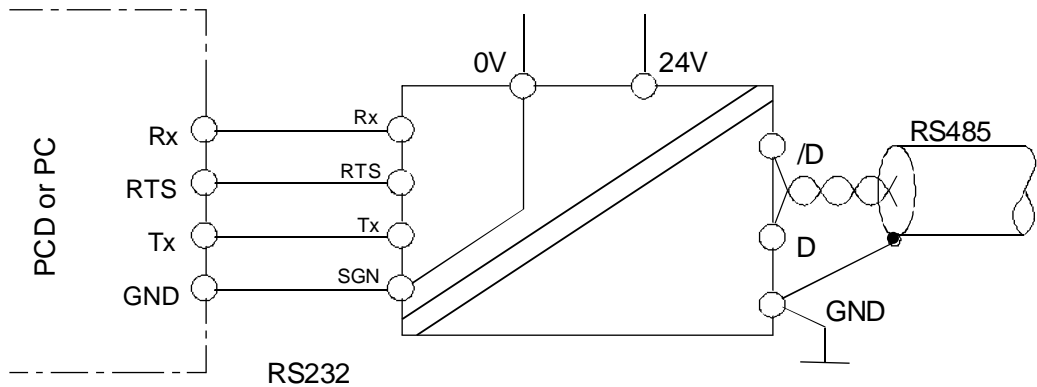
PCD7.T120



PCD7.T140

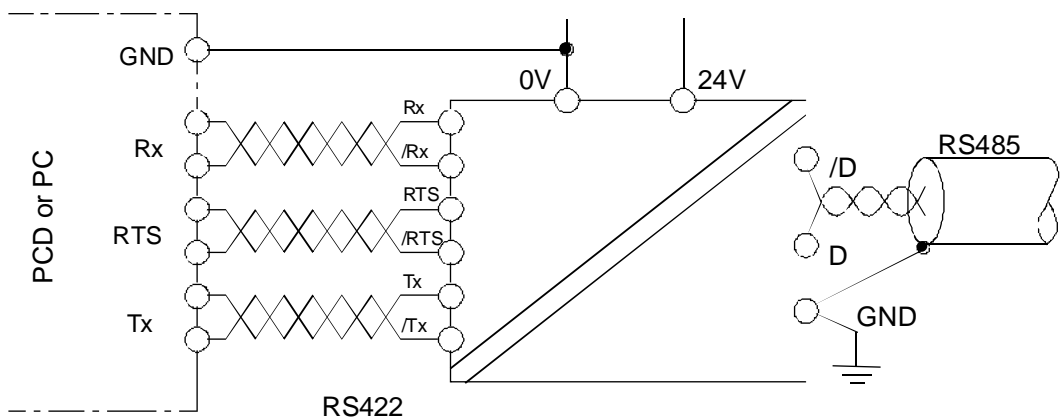


### 3.6 Connection



*PCD7.T120*

As the connection diagram shows, terminals "0V" and "SGN" have the same potential.



*PCD7.T140*

The "+5V" terminal is used for test purposes only. If necessary, the internal supply can be checked with a voltmeter.

## 4 Repeater PCD7.T100

---

### 4.1 Description of function

---

The repeater is used for decoupling the RS485 communications network. This serves two purposes: the reprocessing of transmission signals and the electrical isolation of individual sections of the line.

Signal reprocessing is necessary

- if total length of bus cable exceeds

for 0.3 kBit/s	to 187.5 kBit/s	1200 m
	to 500 kBit/s	400 m
	to 1500 kBit/s	200 m
	to 12 Mbit/s	100 m

- if more than 32 remote stations participate in a network

For details see chapter 6.

Electrical isolation is necessary

- if the reference ground in the area of the installation shows excessive potential differences (a few volts)
- if the installation's reference ground is excessively charged with stray current.

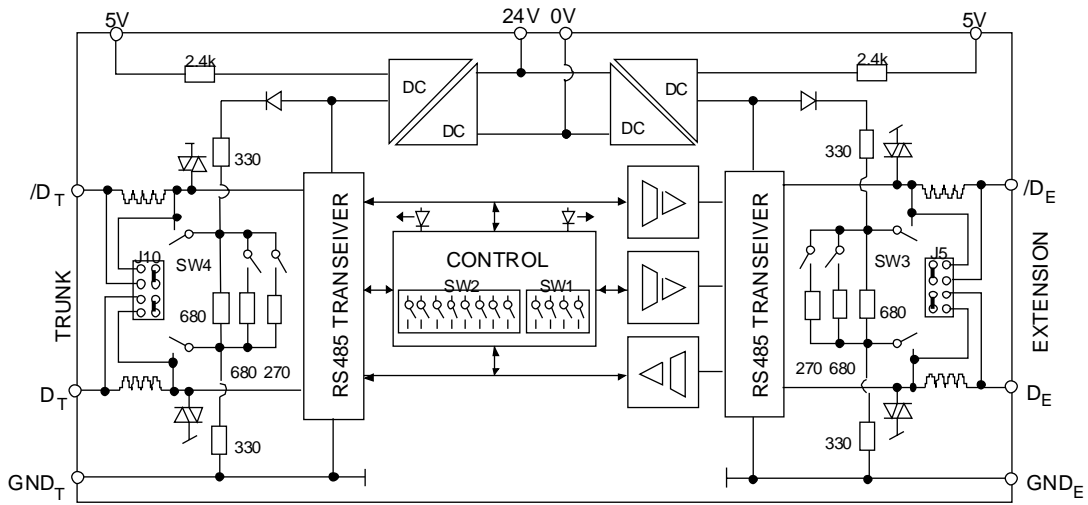
With the RS485, only one line is available for sending and receiving information. The direction of data flow must therefore be recognized and controlled by the repeater independently. Complete transmission of the characters is ensured by monitoring the rest period. Rest period monitoring is dependent on transmission speed and the transmission protocol. This rest period must be set with DIL switches on the module.

The repeater can be used with SAIA<sup>®</sup> LAN2, SAIA<sup>®</sup> S-Bus and PROFIBUS FMS/DP. For PROFIBUS, a baudrate higher than 500 kBit/s is not allowed.

The maximum number of repeaters which can be used in sequence in the signal way is limited:

- 7 repeaters for LAN2
- 7 repeaters for S-Bus
- 3 repeaters for PROFIBUS

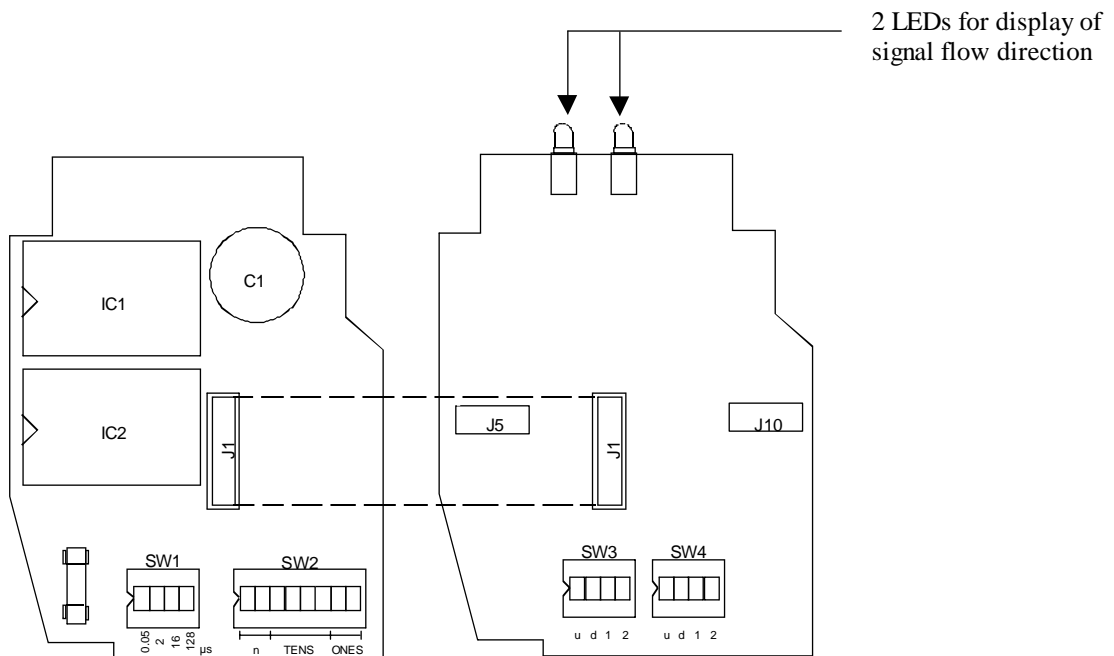
## 4.2 Block diagram



*Detailed block diagram of the PCD7.T100 repeater*

The "5V" terminals are used for test purposes only. If necessary, internal supplies can be checked with a voltmeter.

## 4.3 Printed circuit boards, DIL switches, jumper positions



DIL switch and jumper functions are described in the next section.

## 4.4 Settings

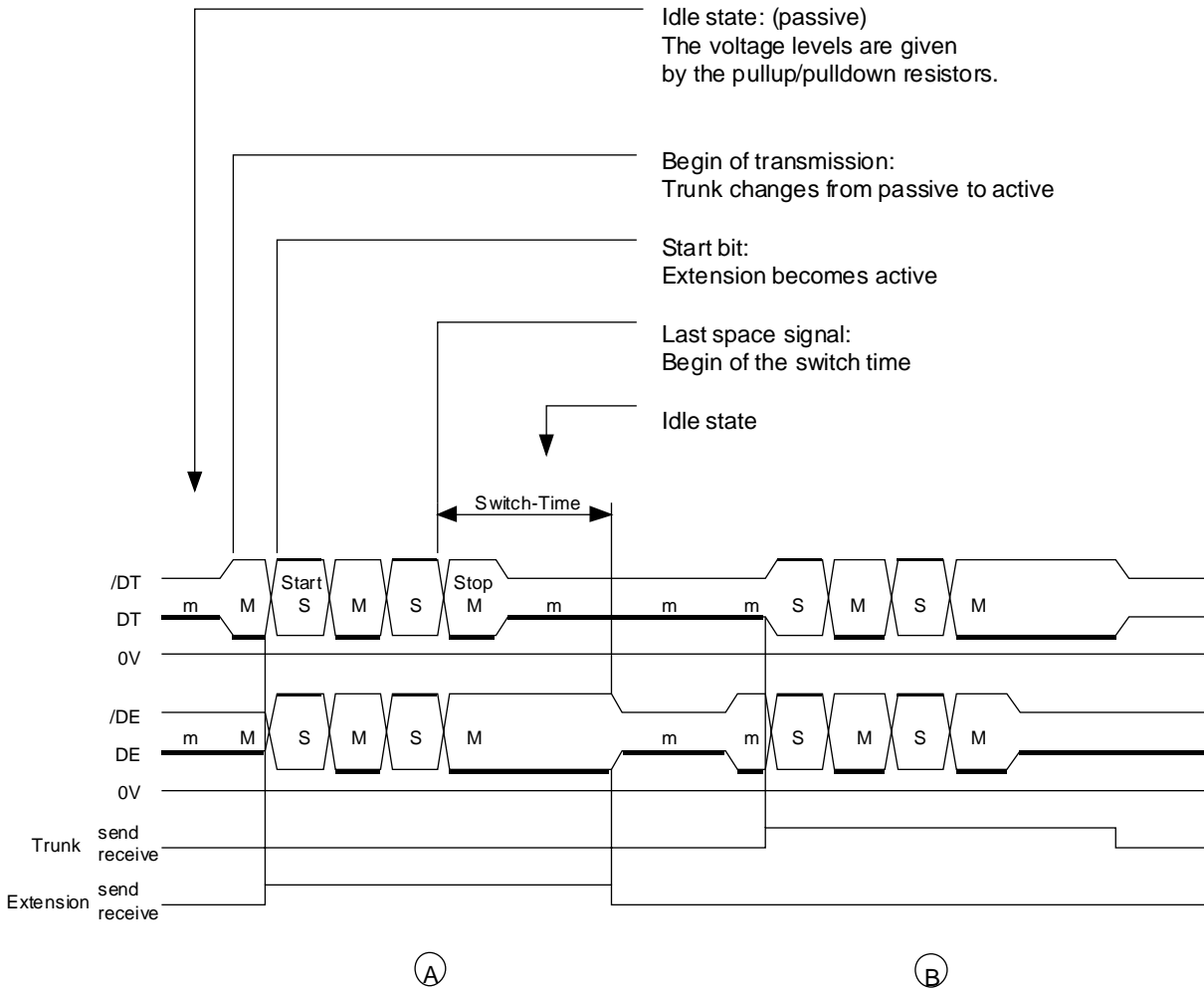
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The rest period is set using the 2 DIL switches SW1 and SW2 according to the following table.

Baudrate	Timebase	Setting		Switch-Time
		SW1	SW2	
110 Bit/s	128 $\mu$ s	000X	XX 000X XX	88.1 ms
150 Bit/s	128 $\mu$ s	000X	XX 0XXO OX	65.5 ms
300 Bit/s	128 $\mu$ s	000X	XO 0XXO OX	32.7 ms
600 Bit/s	128 $\mu$ s	000X	OO 0XXO OX	16.4 ms
1200 Bit/s	16 $\mu$ s	00XO	XX 0XXO OX	8.2 ms
2400 Bit/s	16 $\mu$ s	00XO	XO 0XXO OX	4.1 ms
4800 Bit/s	16 $\mu$ s	00XO	OO 0XXO OX	2.0 ms
<sup>1)</sup> 9600 Bit/s	2 $\mu$ s	0X00	XX 0XXO OX	1024 $\mu$ s
19200 Bit/s	2 $\mu$ s	0X00	XO 0XXO OX	512 $\mu$ s
38400 Bit/s	2 $\mu$ s	0X00	OO 0XXO OX	256 $\mu$ s
50000 Bit/s	2 $\mu$ s	0X00	OO XOXO OO	200 $\mu$ s
76800 Bit/s	2 $\mu$ s	0X00	OO XXOO OX	128 $\mu$ s
93750 Bit/s	2 $\mu$ s	0X00	OO OXOO XX	104 $\mu$ s
LAN2: 62.5 kBit/s	2 $\mu$ s	0X00	OO OXOO XX	104 $\mu$ s
187.5 kBit/s	0.125 $\mu$ s	X000	XX XOXO OX	54 $\mu$ s
250.0 kBit/s	0.125 $\mu$ s	X000	XO 000X OO	40 $\mu$ s
500.0 kBit/s	0.125 $\mu$ s	X000	OO 000X OO	20 $\mu$ s

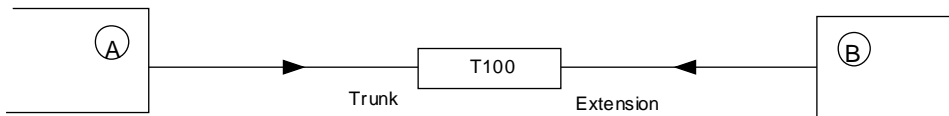
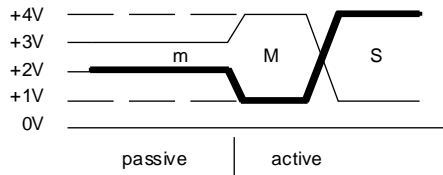
1) factory setting

## 4.5 Impulse diagram



m = Mark passive  
M = Mark active  
S = Space active

Voltage levels:



The line termination resistors for both subnetworks are set at DIL switches SW3 and SW4:

SW3 (extension side) and SW4 (trunk side)

u	d	1	2	U (/D)	U (D)	Rm	Rt	
o	o	-	-					open
x	x	o	o	3.54 V	1.15 V	680 Ω	335 Ω	
x	x	x	o	3.15 V	1.55 V	340 Ω	224 Ω	
x	x	o	x	2.88 V	1.82 V	193 Ω	149 Ω	
x	x	x	x	2.78 V	1.91 V	150 Ω	122 Ω	1)

x = Switch closed (on)

o = Switch open (off)

- = not relevant

Rm = Middle resistor

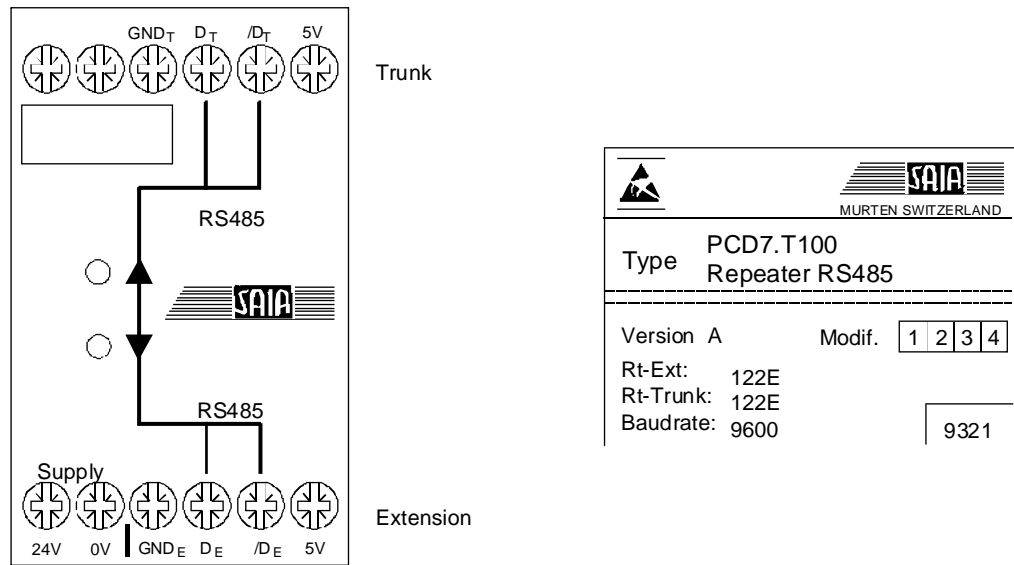
Rt = Termination resistance =  $R_m // (R_u + R_d)$

u = R up / d = R down

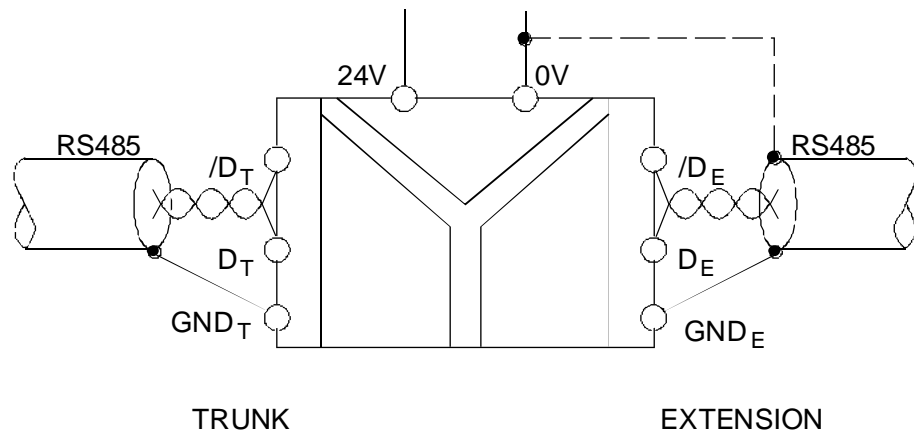
For higher frequencies (from approx. 100 kHz), jumpers J5 and J10 can be used to bypass filter inductances.

1) factory setting

## 4.6 Front panel and name plate



## 4.7 Connection



**Please note:** Terminals "GND<sub>T</sub>", "GND<sub>E</sub>" and "0V" are electrically isolated from each other. To prevent interference, it is recommended that "GND<sub>E</sub>" is connected to "0V" of the power supply.



## 5 Common data

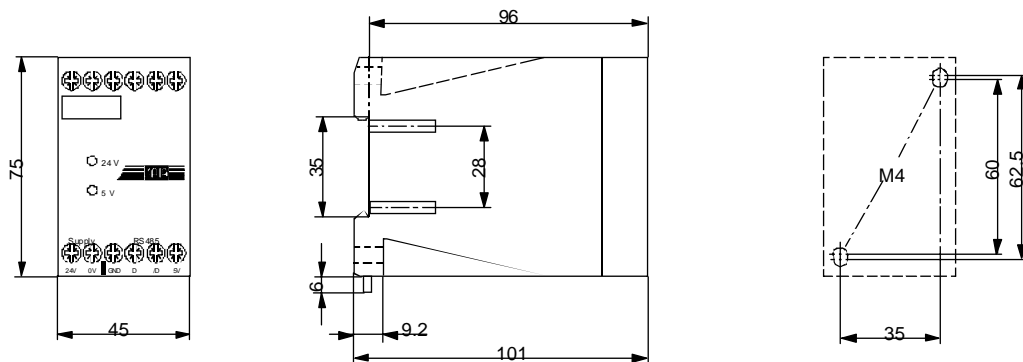
### 5.1 Supply

Supply voltage:	24 VDC +20%/-15% smoothed or 19 VAC ±15% from transformer full-wave rectified
Supply current:	< 100 mA

### 5.2 Mechanical description

Housing:	Surface mount housing with covered terminals
Front panel:	Plastic cover directly printed with designations of functions and terminals
Fastening:	Rapid fastening on 35mm top hat rail or using M4 screws
Terminals:	12 screw terminals for 2 x 1.5 mm <sup>2</sup> (multiwire with end ferrule) AWG 13 to AWG 20
Protective class:	Housing IP 40, terminals IP 20
Weight:	approx. 200g

### 5.3 Dimension diagrams



## 5.4 Operating conditions

---

Voltage for electrical isolation:	500V
Ambient temperature:	-20°C to 55°C
Climatic conditions:	Class E, DIN 40040
Resistance to interference, IEC 801-4:	1 kV with coupling tongs and shielded communications lines 4 kV directly on supply lines
Shake resistance:	Operating safety 4g; mechanical strength 5g; to IEC 68-2-6, test FC in 3 levels at 10...500 Hz for 6 hours
Impact resistance:	50 g; to IEC 68-2-27, 3 impacts in each level

## 5.5 Storage conditions

---

Temperature:	-20°C to +85°C
Humidity:	0 - 95% relative humidity without condensation

## 5.6 Standards

---

EIA RS485, RS422, RS232

## 6 Installation of a network

### 6.1 Single segment networks

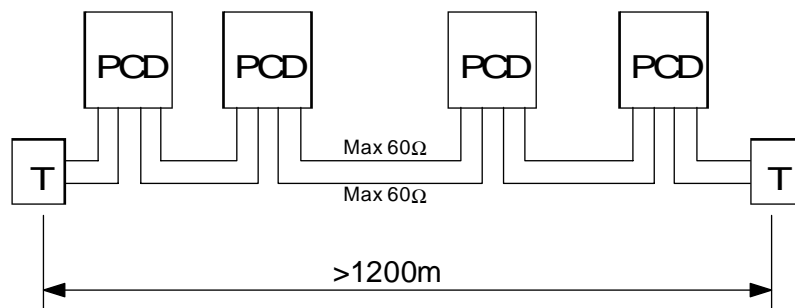
One segment contains max. 32 participating stations.

The total length of the bus is dependent on transmission speed and line section:

Line section:		0.22 mm <sup>2</sup>	0.5 mm <sup>2</sup>
Max. length of one segment:	up to 93,75 kBit/s	1200m	1200m
	up to 187,5 kBit/s	600m	1200m
	up to 500 kBit/s	200m	400m
	up to 1500 kBit/s		200m
	up to 12 MBit/s		100m

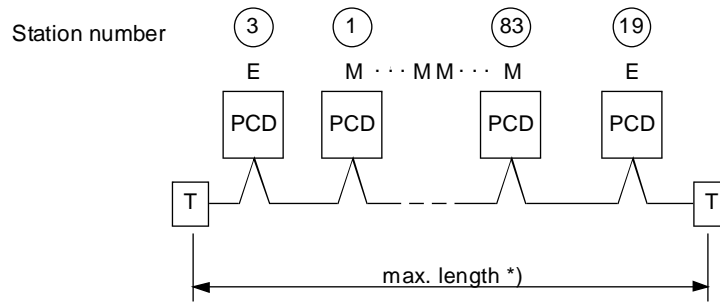
- For S-BUS (only if the baudrate is less then 93,75 kBit/s):

The distance in a segment can be >1200m (up to 11km) if the resistor of both wires is less then 120Ω.



To avoid reflections at the ends of the line, each segment must be terminated at the physical start and end. Bias voltage is also applied to the lines at an equilibrium rest potential. Both measures are achieved either by termination boxes (T160) or directly by the termination circuit in the participating station.

The value of the line termination is normally 150Ω.

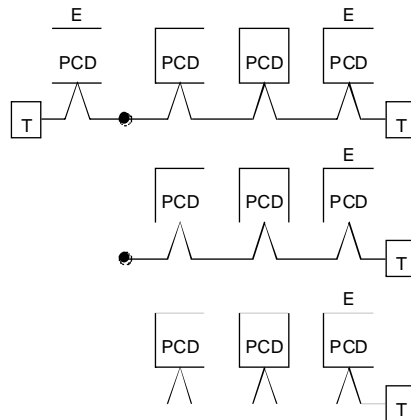


\*) Here "max. length" refers to the physical length of the line and NOT to the distance between end-stations.

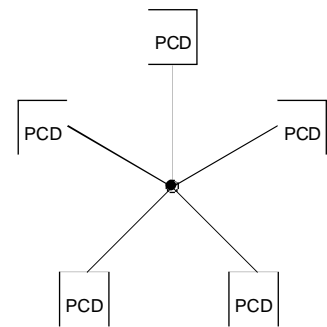
E = End station, M = Middle station, T = Termination Box PCD7.T160

Stations can be numbered between 0 and 254 as desired (PROFIBUS stations can be numbered between 0 and 128). Any segment may contain max. 32 stations. The same station number can only be used once within an RS485 network. A master station, e.g. in an S-Bus network, can be located in any position.


Stations at the two ends of the bus are called end stations (E), while those between the end stations are called middle stations. Each end of the bus must be terminated either with its own termination box (T160) or by the built-in termination circuit. Networks may not be branched out without special provisions.



Branched network



Star network



Networks of this kind are NOT allowed, as each segment can only have two end stations with the corresponding termination circuit.

## 6.2 Multi-segment networks

The insertion of repeaters in-line can be used to expand the network.

There are 3 structures: the line structure, the tree structure and the star structure.

It should be noted that a repeater always counts as one station, even if it does not have a station number.

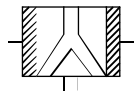
The repeater can be used with SAIA® LAN2, SAIA® S-Bus and PROFIBUS FMS/DP.

The maximum number of repeaters which can be used in sequence in the signal way is limited:

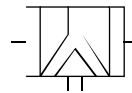
- 7 repeaters for LAN2
- 7 repeaters for S-Bus
- 3 repeaters for PROFIBUS

Each individual segment must be terminated at both ends. This is carried out by the repeater termination circuits, which can be either switched in or switched out.

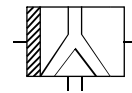
Symbol for a repeater in the following drawings:



Line termination resistors active both sides

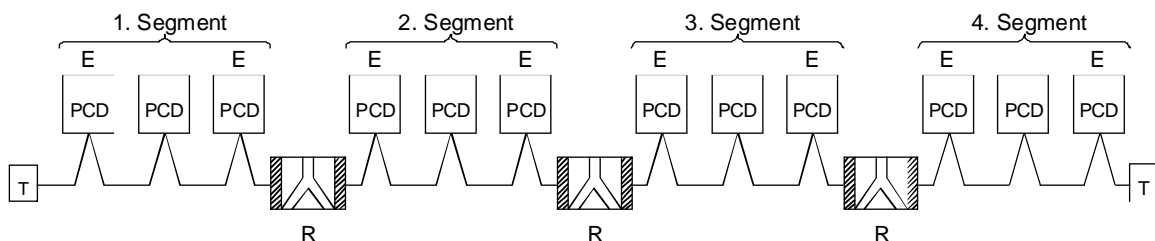


Line termination resistors inactive both sides

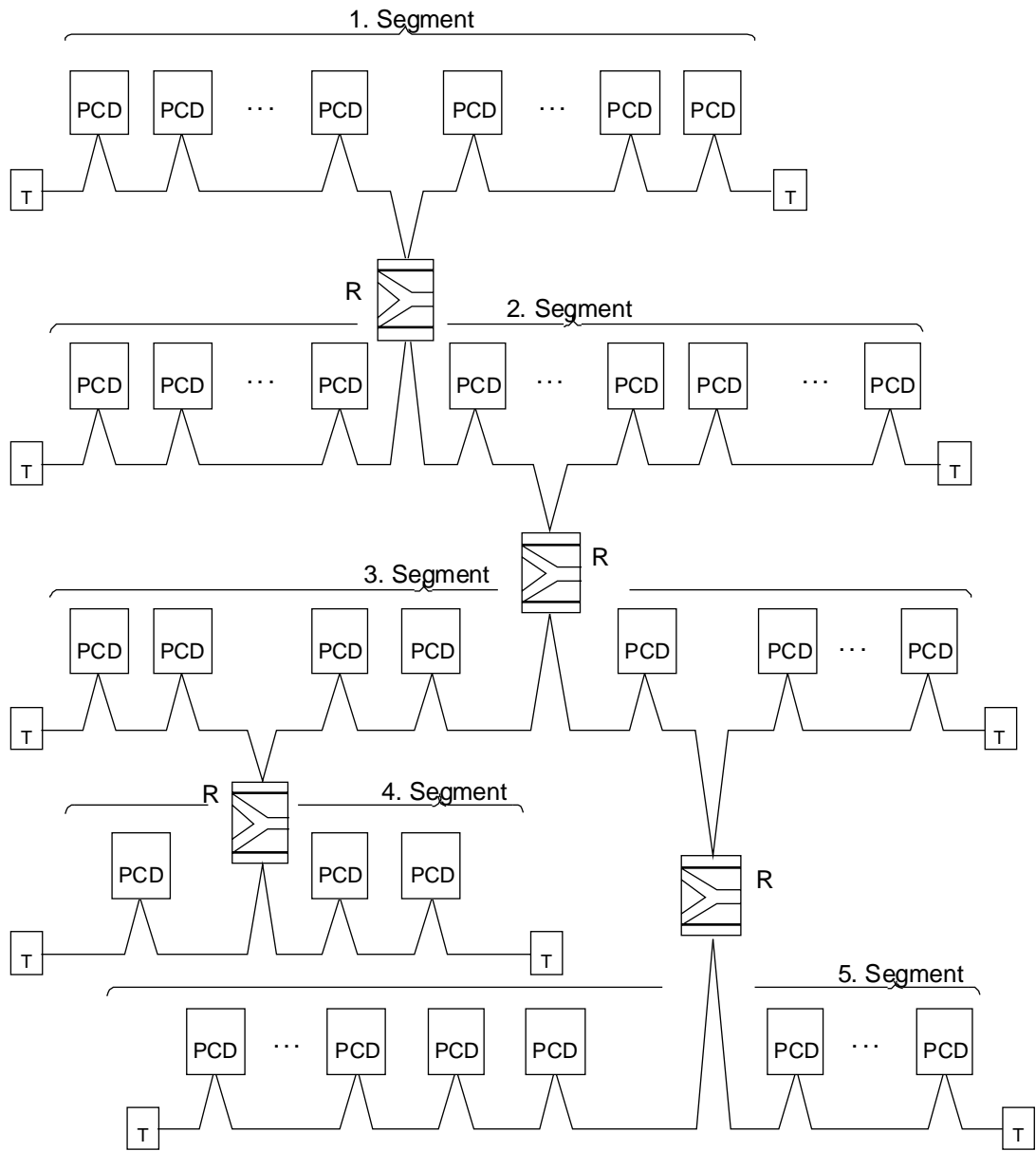


Line termination resistors active left, inactive right

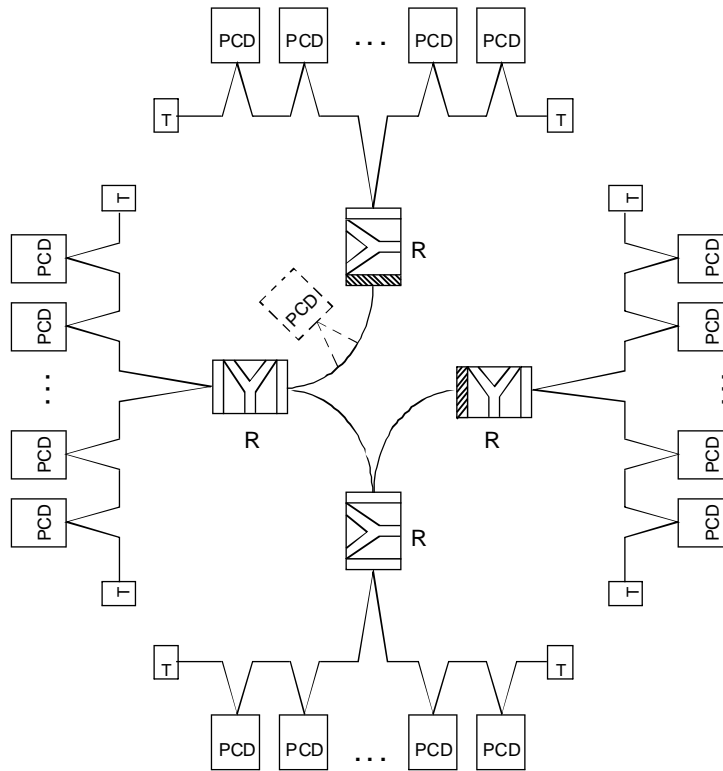
The line structure



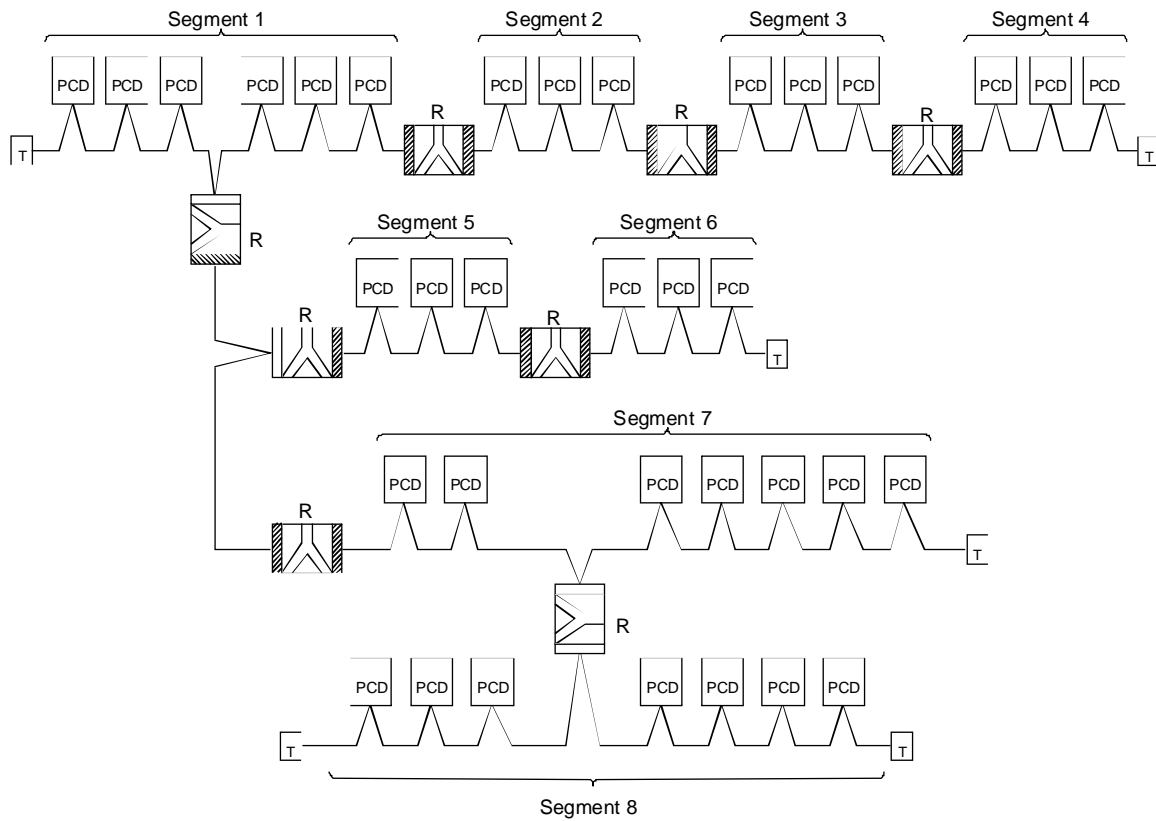
The tree structure



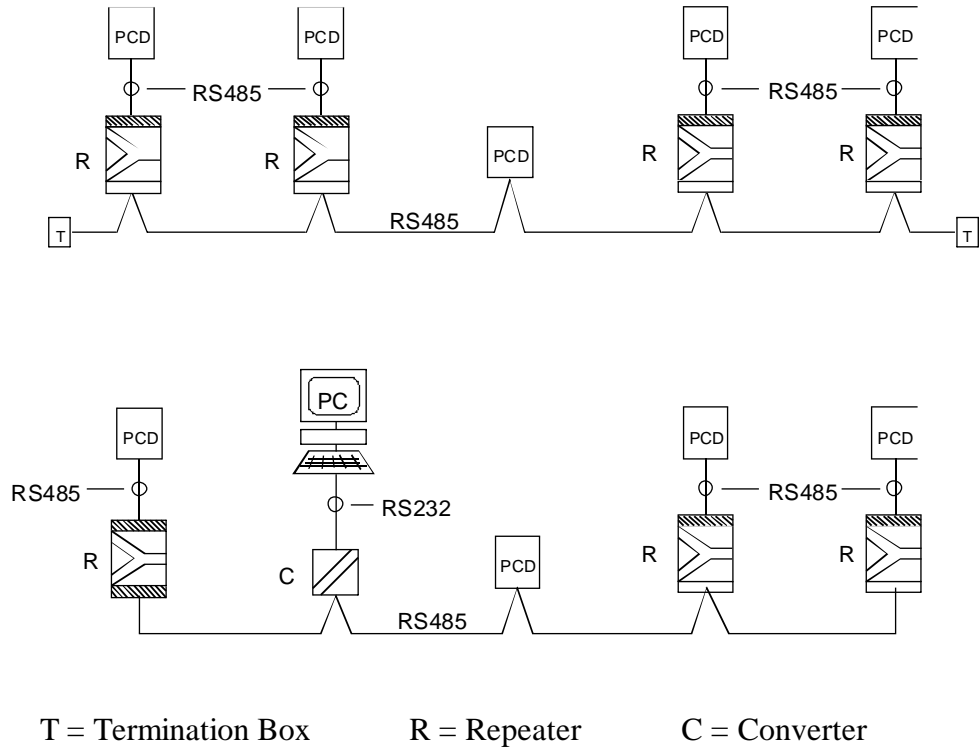
The Star structure



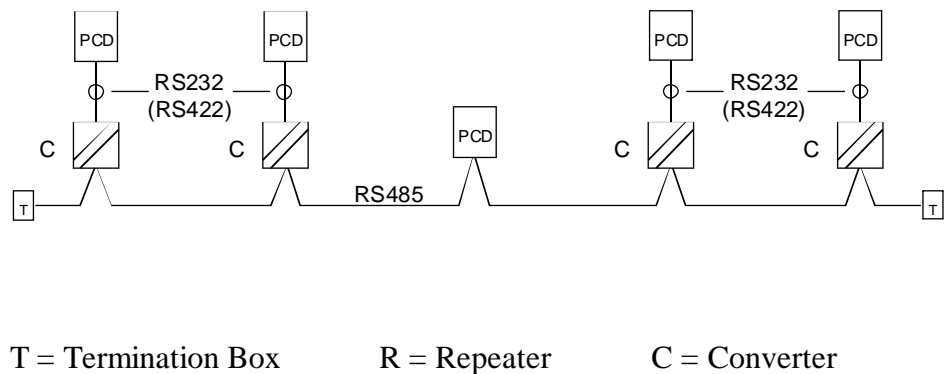
A combined structure (for S-Bus or SAIA® LAN2)



Repeaters can also be used purely to provide electrical isolation for individual stations:



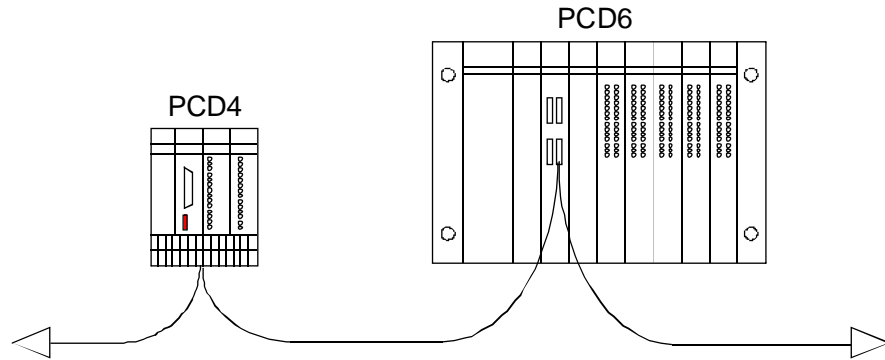
Another solution is to use converters instead of repeaters. The converters also have electrical isolation. On the PCD side it is possible to use the normal RS232 interfaces, e.g. the PGU port which is always present.



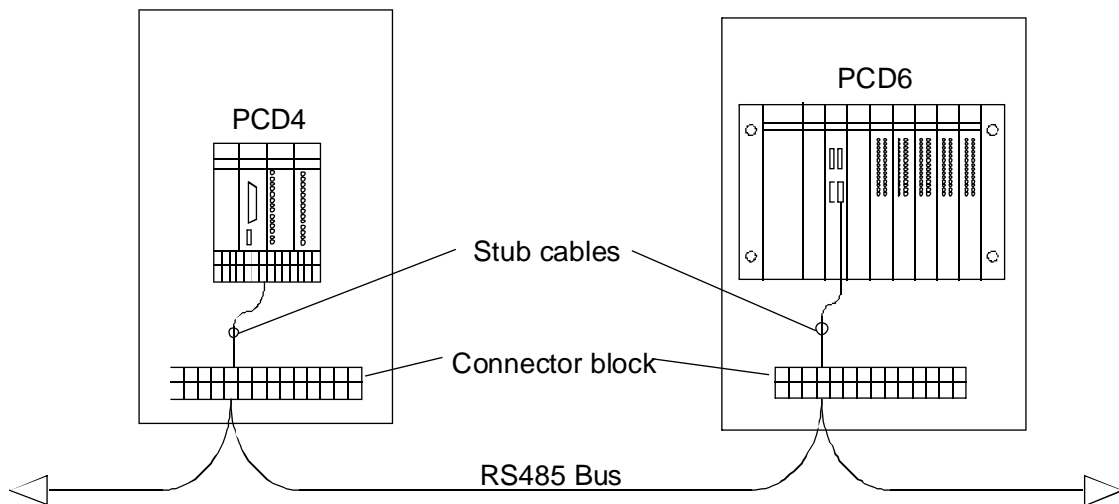


### 6.3 Stub cables

Basically, bus lines should run directly to the connector or the participating station terminal.



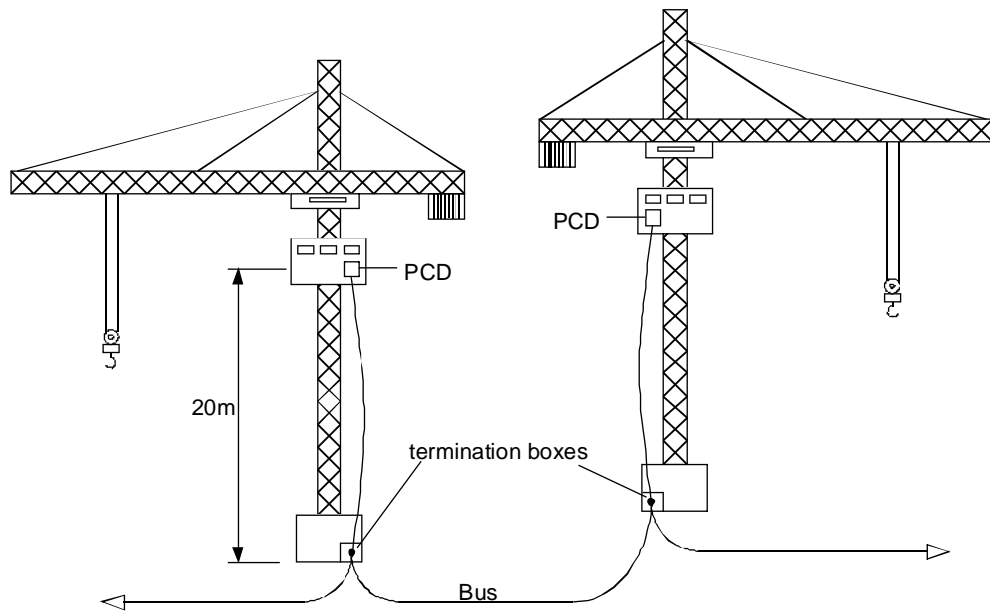
For technical reasons, in a control box the bus is often wired to a connector block, with a stub cable running from it to, for example, the PCD.



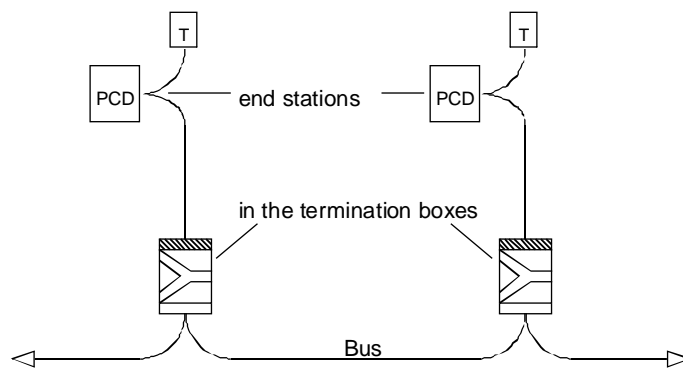
There is a limit to the length of this stub cable!

For a shielded line the maximum lengths are:

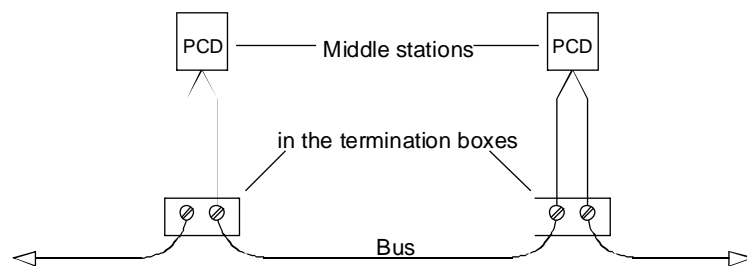
Bit rate Kbit/S	Length of stub cable. Total per segment in metres
9.6	6.6
19.2	6.6
93.75	6.6
187.5	6.6
500	6.6
1500	6.6
3000	0
6000	0
12000	0



Extreme cases with stub lines like the above are NOT allowed, unless repeaters and termination boxes are used as in the drawing below:



Of course, the PCUs can also be treated as middle stations:



There is no electrical isolation here, with S-Bus or LAN2.  
Also, the length of the former stub cable is added twice to the total length of the RS485 bus.

## 6.4 Physical properties of the network

The RS485 network uses twisted and shielded two-core wire. The wave resistance should be in the range 100 to 130Ω at  $f > 100$  kHz, the cable capacity should be  $< 100$  pF/m and the core section should be at least  $0.22 \text{ mm}^2$  (AWG 24). However, a section of  $0.5$  (AWG 20) or preferably  $0.75 \text{ mm}^2$  (AWG 18) is recommended. Maximum signal loss allowed is 6 dB.

Recommendations for proven bus cable:

For S-Bus:

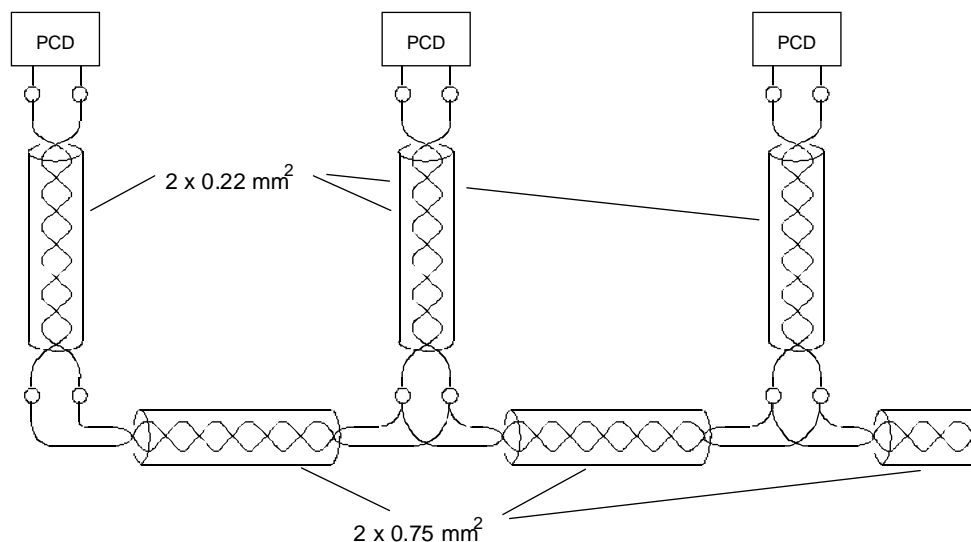
Manufacturer	Type:
- CABLOSWISS	1 x 2 x AWG24
- Kromberg & Schubert	371'502

For PROFIBUS:

(Volland AG, Rümlang, Switzerland, offering the following cable types:)

- Cable for static installation:  
Unitronic bus L2/F.I.P.                      Volland ref. 2170221
- Cable for highly flexible installation:  
Unitronic bus FD P L2/F.I.P                Volland ref. 2170222

Experience has shown that it is difficult to solder 2 x 2 cables whose section is  $0.75 \text{ mm}^2$  to a 9-pole D-type connector. The "main" bus should therefore be wired to terminals, as shown in the drawing below, from which a more manageable cable runs as a short stub cable to the PCD. For maximum length of stub cable see section 6.3.

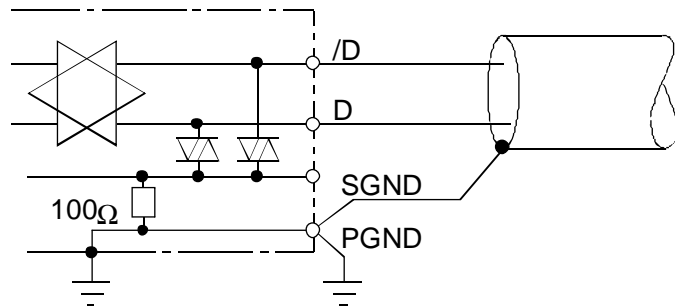


When connecting the bus, strict care should be taken not to mix up the data lines D and /D, i.e. always connect D to D and /D to /D.

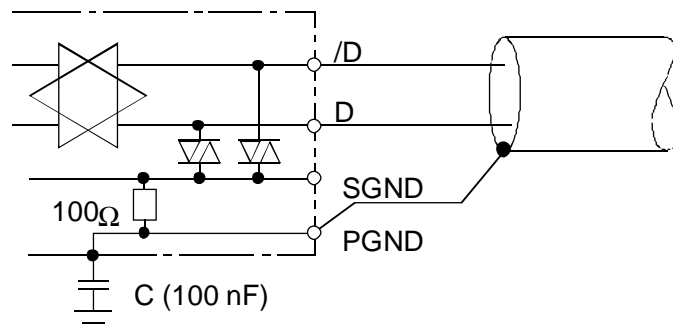
## 6.5 Grounding plans

The following rules are to be applied:

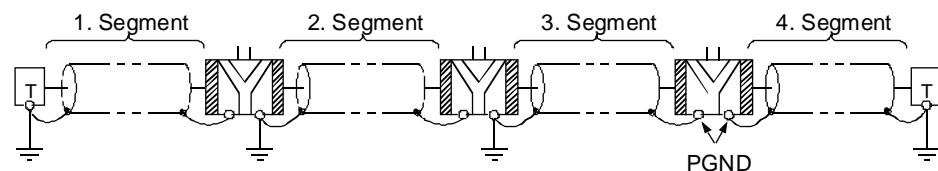
- 1) The shield of the RS485 bus cable must be connected to PGND resp. GND on each device.
- 2) The 0V resp. the minus terminal of a PCD must be wired directly (3a) or by a capacitor (3b) to earth ( $\perp$ ).
- 3a) Internal in the device, the SGND and the PGND should be connected together (direct or via  $100\Omega$ )



- 3b) In the case of a not earthed installation, a resistor of  $100\Omega$  must be put between SGND and PGND. The PGND must be wired to earth.



- 4) In the case of the repeater, all shields must be connected to PGND. The shield of the bus cable must be wired to earth on one side only.



Explanations:

PGND or GND	Protective Ground	Shield
SGND	Signal Ground	
$\perp$	Ground, Earth	

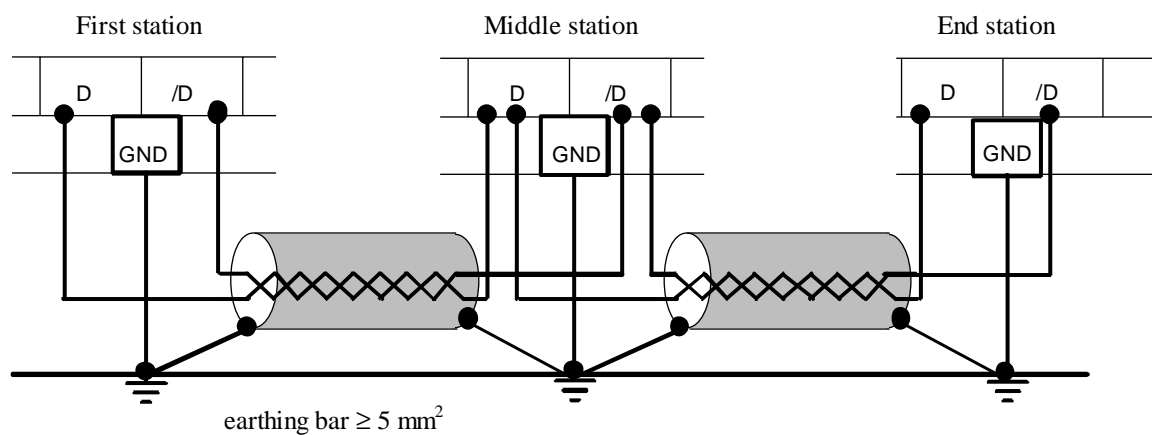
### 6.5.1 Network structure with tied potential

In this case, the grounding of all participating stations on the bus is rigidly tied, i.e. there can be no differences in earth potential between the different stations. The upper limit for permissible deviation is a static value of 3V, or a dynamic value of 1V.

BEFORE designing the installation, it is necessary to clarify exactly whether the requirements on differences in earth potential are met throughout the WHOLE network, or can be achieved with justifiable expense.

If these requirements can only be achieved in parts of the network (in the same room, on the same floor, in the same building) a mixed layout may be envisaged with electrical isolation between the separate parts.

The basic structure of a network with tied potential is shown in the following drawing.




On BOTH SIDES of each section, shielding must be laid along the earthing bar or potential equalization line. The earth connection (GND) should run to the same point.

The equalization line runs parallel to the RS485 bus cable and should have an adequate section ( $\geq 5 \text{ mm}^2$ ).

### 6.5.2 Network structure with separate potential

Individual segments can be installed with electrical isolation, as can individual, some or all stations.

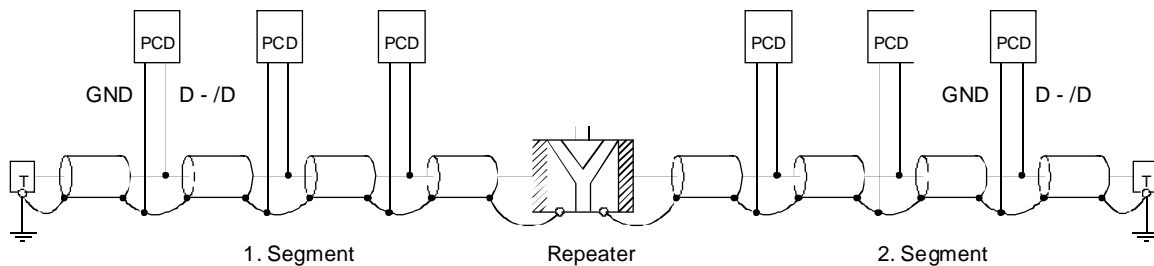
Electrical isolation is achieved by optoelectronic couplers, supplied from electrically isolated power supplies. Strict care should be taken during installation not to make any electrical connections between the individual groups.



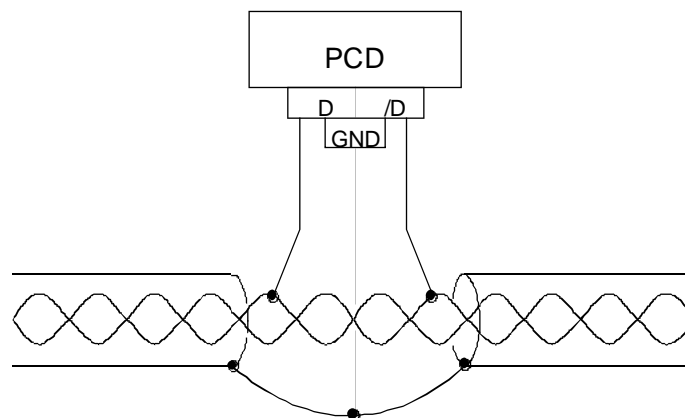
Bus cable shielding should only be earthed on one side of a segment!

Electrical isolation of segments is achieved with the PCD7.T100 repeater. Electrical isolation of individual stations is provided either by the repeater also, or by a PCD7.T120/T140 converter. See also section 6.2.

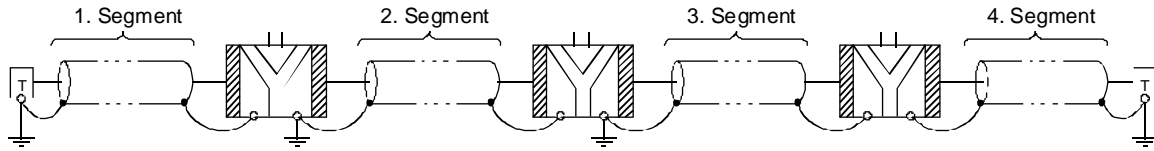
The following drawing shows the basic structure of a network with 2 electrically isolated segments:



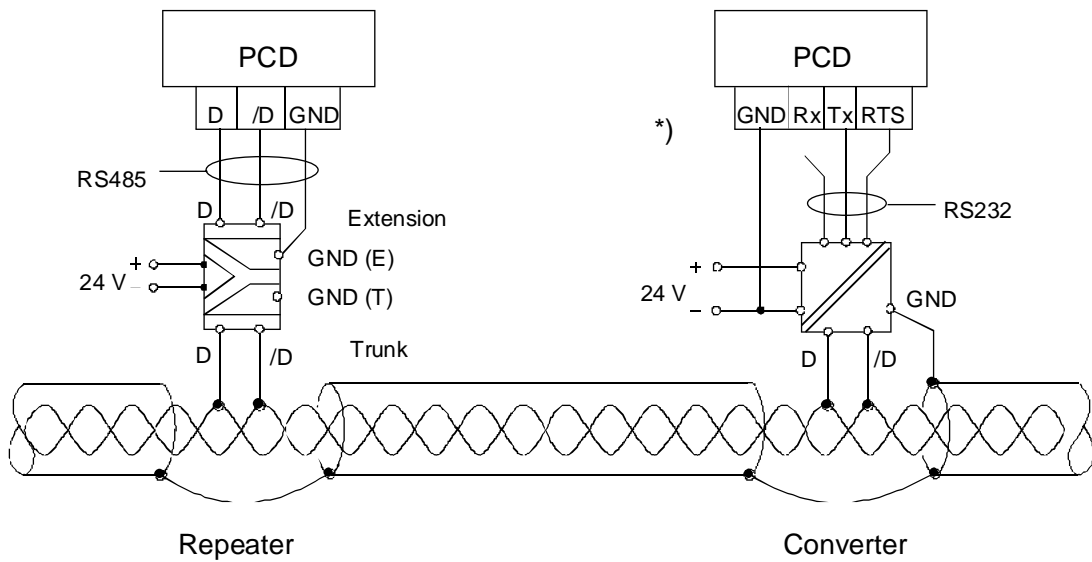
The earth connection (GND) of each individual PCD should be connected to the shielding.



If a network consists of several segments, the middle segments should be earthed ON ONE SIDE at a repeater, so that each segment is connected to earth at a single point.



If individual stations must be electrically isolated from the bus, they should be wired up as follows:



\*) Within the PCD, the "GND" terminal is connected with the minus of the PCD supply.

## 6.6 Attributes and components for individual networks

---

SAIA<sup>®</sup> S-Bus, SAIA<sup>®</sup> LAN2 and PROFIBUS RS485 networks, which are used in connection with the SAIA<sup>®</sup> PCD, have to some extent their own components and attributes, such as repeaters, line termination resistors, electrical isolation, etc. These are explained below.

### 6.6.1 SAIA<sup>®</sup> S-Bus

SAIA<sup>®</sup> S-Bus is connected to the standard interfaces of the PCD processor modules. For direct bus connection an RS485 interface is used. There is normally no electrical isolation of these RS485 interfaces in any of the PCD family! If an electrical isolation is required then use the module PCD7.F150 (PCD1, 2, 4 and 6).

SAIA<sup>®</sup> S-Bus is described in detail in the manual 26/739.

- For the PCD6, processor module PCD6.M300, channel 1..4 or processor PCD6.M540, channel 1 should be selected. S-Bus connection is via D-type connectors at the front of the processor module.
- For the PCD4, bus module PCD4.C130, channel 1 or bus module PCD4.C340, channel 1, 2, 3 with PCD7.F110/F150 and a CPU of the type M125, M145, M240, M340 or M445 should be used. Connection is to the bus module screw terminals. A line termination resistance of 120 Ohm and pull-up/pull-down resistors can be selected with jumpers on the bus module terminals.
- For the PCD2, it is possible to use the standard PGU interface, channel 0, and either interface no. 1 with the PCD7.F110/150 add-on module, or interface no 3 with the PCD2.F520/530 add-on module. Connection is via screw terminals.
- For the PCD1, it is possible to use the standard PGU interface, channel 0, and either interface no. 1 with the PCD7.F110/150 add-on module.

The often required galvanic separation in industrial installations can be achieved for the PCD2 and for the PCD4 (PCD4 together with the bus module PCD4.C340) with the plug-in interface module PCD7.F150 or with the repeater PCD7.T100.

Details on the individual interfaces and processors can be obtained from the appropriate hardware manuals.



### 6.6.2 SAIA<sup>®</sup> LAN2

The SAIA<sup>®</sup> LAN2 is a PCD-specific multimaster network with its own processor modules. LAN2 processors are not electrically isolated from the bus.

- For the PCD6, the simple PCD6.T100 LAN2 processor and PCD6.T110 LAN2 processor are offered as station and repeater. Bus connection is via 9-pole, D-type connectors at the front of the modules. Both processors have jumper selectable line termination resistors. The PCD6.T110 has built-in pull-up/pull-down resistors. For details see the PCD6 hardware manual.
- For the PCD4, the PCD4.M340 processor should be used. Bus connection here is via the screw terminals on each bus module. Every processor has line termination, pull-up and pull-down resistors which can be set individually. For details see the PCD4 hardware manual.
- The PCD2 cannot be connected to SAIA<sup>®</sup> LAN2.

### 6.6.3 PROFIBUS

PROFIBUS processors are always electrically isolated from the bus.

PROFIBUS DP is described in detail in the manual 26/765 and PROFIBUS FMS is described in detail in the manual 26/742.

#### PROFIBUS FMS

- For the PCD4, processor module PCD4.M445 is offered. PROFIBUS connection is via a separate 9-pole, D-Sub connector at the front of the module.
- The PROFIBUS FMS connection for PCD2 and PCD6.M300 is realised with the pluggable module PCD7.F700. For the PCD2, the wiring is done by the terminal 30 to 39. For PCD6.M300 the connection is via the 9 pole D-SUB connector of the port 3.

#### PROFIBUS DP

- The PROFIBUS DP connection for PCD1, PCD2 and PCD6.M300 is realised with the pluggable modules:
  - PCD7.F750 for DP-master.
  - PCD7.F770 / 772 / 774 for DP-slave

For the PCD2, the wiring is done by the 6 pole connector on the F7xx module.

For PCD6.M300 the connection is via the 9 pole D-SUB connector of the port 3.

Notes

## 7 Commissioning a network

---

Once a network has been constructed, it must be commissioned. This is carried out in 2 phases:

- 1) Setting and checking all line termination, pull-up and pull-down resistors. Checking that the bus line is passable, then application of supply voltages and measurement of equilibrium rest potentials at all participating stations. These tests are referred to as the static tests.
- 2) Checking communications connections between all stations or between the master and slave stations using a simple, propositional test program. This is the dynamic test.

### 7.1 Static tests

---

Before connection of participating stations, termination boxes, converters and repeaters, the bus lines must be checked for passability and mixed wires. It is important that no line termination, pull-up or pull-down resistors should be connected for these tests.

All participating stations, termination boxes, converters and repeaters are then connected in the manner described above. It is highly recommended that a list should be made of the configurations of each individual component in the installation. This will avoid the necessity, at a later date, of opening each individual housing to establish jumper positions or DIL switch settings. For this purpose, individual components should be identified on the front panel marking plate.

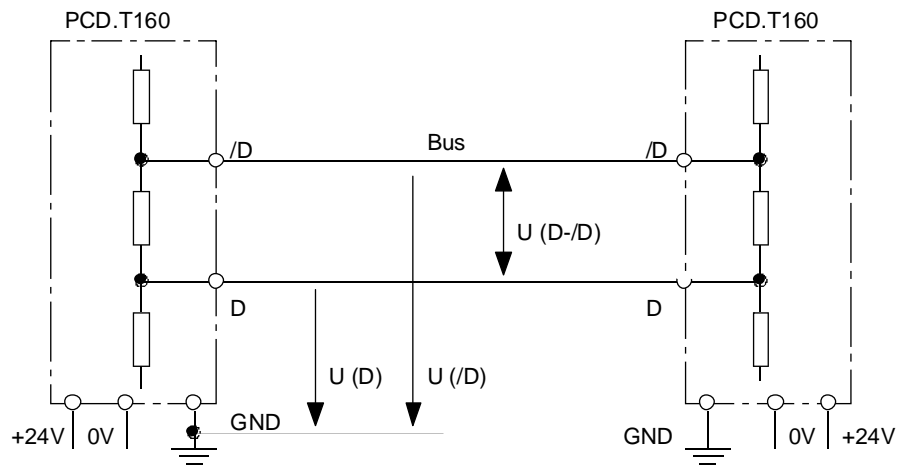
Once the network is completely installed and all installation components have been configured, the supply voltages are switched on. However, during this phase no communication of any kind should take place on the bus.

At the terminals of each station, a voltmeter is used to measure off-load voltages between the bus lines on the one hand and, on the other hand, between the individual bus lines and the reference ground. As mentioned often before, each bus segment should be terminated on both sides. The line termination resistance to select depends on the physical length of the bus. The values are given here once again:

The factory setting of the termination resistors is 122Ω. This setting is suitable for almost all cases and should not be changed.

If in practice there are a lot of telegram repetitions, a try with other termination resistors can be done.

The same values should be chosen for both sides of the bus!



Voltages measured should correspond to the following table:

Line termination resistance	U (D)	U (/D)	U (D-/D)
335 Ω	1.15 V	3.54 V	2.39 V
224 Ω	1.55 V	3.15 V	1.60 V
149 Ω	1.82 V	2.88 V	1.06 V
122 Ω	1.91 V	2.78 V	0.87 V

Tolerance: approx. ± 0.1 V

If these voltages deviate outside the limits of tolerance, errors are present, which must be identified and removed.

Possible sources of errors:

- Short circuits
- Transposed D and /D lines
- Line termination resistances not the same
- Additional passive line termination resistors
- No supply
- Supply on one side only
- ...

## **7.2 Dynamic tests**

---

SAIA<sup>®</sup> S-Bus is a single-master - multi-slave network, i.e. all actions are initiated by the master station. During commissioning the master station sends a sequence of short, propositional write and read telegrams to each individual station in the network. In each case checks must be made to establish whether the actions have been correctly executed on the basis of individual telegrams.

The simplest form of test telegram is to set some of the slave station outputs. These outputs can be checked visually or a read telegram can be returned to the master station for evaluation. The same can of course also be done with flags and register values, although this demands greater use of devices for the visual check. It is also possible to change and read back the status of a slave station, instead of its elements.

Telegram structuring and additional advice on commissioning can be found in the S-Bus manual. In particular, the possibilities for registering repeat telegrams should be exploited, as they are a measure of the network's transmitting quality.

An S-Bus analyser is available. This analyser is a software running under DOS on an IBM-PC. The description is part of the package. The PC should be equipped with 2 serial ports RS232. A special cable for the 2 serial ports and the connection to the S-Bus is part of this equipment.

### 7.2.1 SAIA<sup>®</sup> LAN2

SAIA<sup>®</sup> LAN2 is a multi-master network, i.e. each station can send telegrams to all other stations and can also receive telegrams from all other stations. During commissioning, a full check would be to transmit both read and write telegrams from each station to all the others and the effects of each telegram would have to be checked. In the case of a network with 16 stations, this would result in 240 telegrams! It is for the operator of the installation to judge whether all stations should be checked in all directions or whether, for example, only the two end stations should send telegrams to all the other stations.

Telegram structuring and additional advice on commissioning can be found in the PCD6 and PCD4 hardware manuals. In particular, the possibilities for constructing repeat telegrams should be exploited, as they are a measure of the network's transmitting quality.

### 7.2.2 PROFIBUS

The same rules apply by analogy as for S-Bus und LAN2.

Commissioning rules specific to PROFIBUS will be drawn up in due course and added here.

A PROFIBUS-Analyser in form of a add on PCMCIA card and a software package for the IBM-PC is available.

### 7.2.3 Connection of non SAIA devices

On SAIA devices, the signal lines are named D, /D resp. Rx, /Rx and Tx, /Tx. Non SAIA devices are often named like D- und D+ resp. +Rx, -Rx and +Tx, -Tx. This can cause some confusions.

Normally, the following symbols are used:

SAIA		Non SAIA devices
D	→	D-
/D	→	D+
Rx	→	-Rx
/Rx	→	+Rx
Tx	→	-Tx
/Tx	→	+Tx

Recommendation from the practice:

If the installation seems to be correct, but it is not possible to transfer any telegrams, try to change the data lines !

Notes



From :

Company :

Department :

Name :

Address :

Tel. :

Date :

Send back to :

SAIA-Burgess Electronics Ltd.

Bahnhofstrasse 18

CH-3280 Murten (Switzerland)

<http://www.saia-burgess.com>

BA : Electronic Controllers

Installation Components for

RS 485 networks

If you have any suggestions concerning the SAIA<sup>®</sup> PCD, or have found any errors in this manual, brief details would be appreciated.

**Your suggestions :**