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VIPA Networking Solutions

PBR | 920-1CA50 | Manual

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PROFIBUS MultiRepeater A5

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Table of contents

1 General **4**
1.1 Copyright © VIPA GmbH 4
1.2 About this manual 5
1.3 Safety information 5

2 Product Description **7**
2.1 General 7
2.2 Product features 8
2.3 Application areas 9
2.4 Additional Benefits 9
2.5 Channel Structure 9
2.6 Grounding System 10
2.7 Cable lengths for PROFIBUS DP 10
2.8 Cable types for PROFIBUS DP 11
2.9 Status display 12

3 Installation Instructions **13**
3.1 Location 13
3.2 Position 13
3.3 Mounting 13
3.4 Power Supply 14
3.5 Backbone 14
3.6 Spur Segments 16
3.7 Termination 17
3.8 Baudrate switch 17

4 Technical data **19**

5 Glossary **21**

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1 General

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1.2 About this manual

Objective and contents

This manual describes the PROFIBUS MultiRepeater 920-1CA50 from VIPA. It contains a description of the construction, project implementation and usage.

Product	Order number	as of state: HW
PBMR-A5	920-1CA50	01

Target audience

The manual is targeted at users who have a background in automation technology.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

- communication and process control
- general control and automation tasks
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

DANGER!
This device is not certified for applications in

– in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

CAUTION!

The following conditions must be met before using or commissioning the components described in this manual:

- Hardware modifications to the process control system should only be carried out when the system has been disconnected from power!
- Installation and hardware modifications only by properly trained personnel.
- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal

National rules and regulations apply to the disposal of the unit!

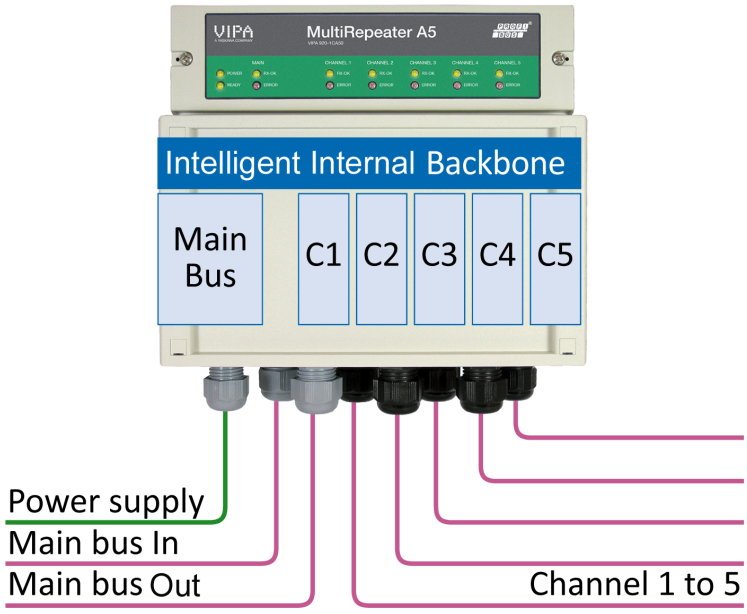
2 Product Description

2.1 General

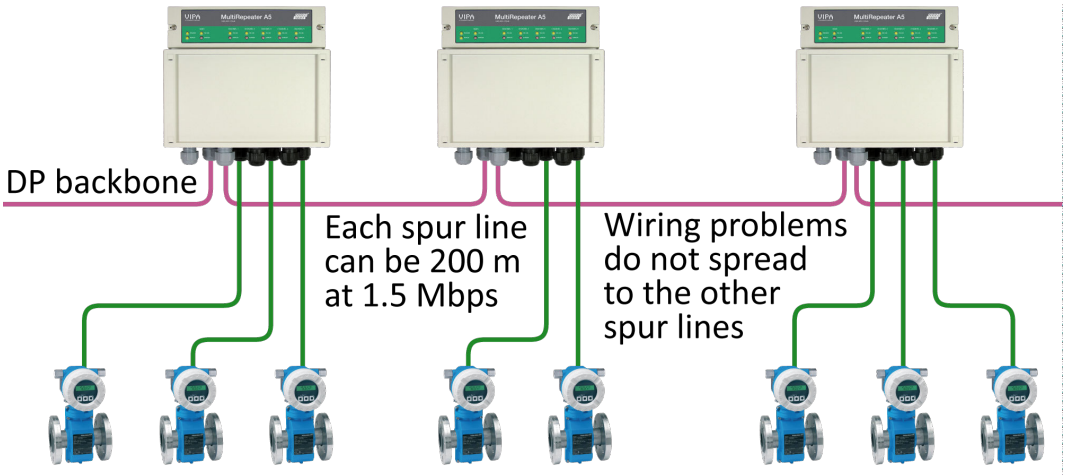
The PROFIBUS MultiRepeater A5 is advanced, flexible and robust network components for PROFIBUS DP installations, to implement long multi-device spur lines and backbone structures with star/tree segments.

- PROFIBUS DP is a high speed communication bus that has to comply with strict rules concerning spur lines, because of possible reflections that could lead to communication disturbances. If spur lines or star segments are required, costly investments in repeaters have to be done.
- A innovative component for such applications is the PROFIBUS MultiRepeater A5. These are perfect economic solutions to implement reliable spur lines in high speed DP networks. They have the functionality of 5 galvanic isolated transparent repeaters. This allows network structures with extended spur lines that individually can handle a maximum of 31 devices and a length equal to the main bus. The MultiRepeater refresh a received message on one Channel and transfer it to all the other Channels (chicken foot topology).
- Because the PROFIBUS MultiRepeater A5 creates isolated segments, the device can now be removed and added during operation. Also electrical bus problems and EMC disturbances in a spur do not spread to the other segments. The intelligent logic and isolation circuits of the MultiRepeaters do not change the bit width. This means the MultiRepeaters do not have limitations in serial placement. The logic also detects the transmission speed automatically.
- To assist the installation work, termination is integrated and can be switched on/off. The grounding concept is also selectable: direct or capacitive grounding. The MultiRepeaters are powered by a 10 to 32 DC Voltage (110/230V AC versions are also available). For troubleshooting, maintenance and commissioning the MultiRepeaters are equipped with a display on the outside, which indicate the status of each Channel (Data and Error).

2.2 Product features



- 5 Galvanic isolated channels (repeater segments)
- Transparent for all PROFIBUS DP protocols
- DP-RS485 specifications for each channel
- Cable redundancy for channel 1+2
- 9.6 Kbps to 12 Mbps
- 31 devices per channel
- 1200 m spur line length (depends on transmission speed)
- No limit in serial placement or cascading of MultiRepeaters
- No address required
- Integrated termination facilities (switches)
- Configurable grounding system (direct or capacitive)
- IP 65 classification



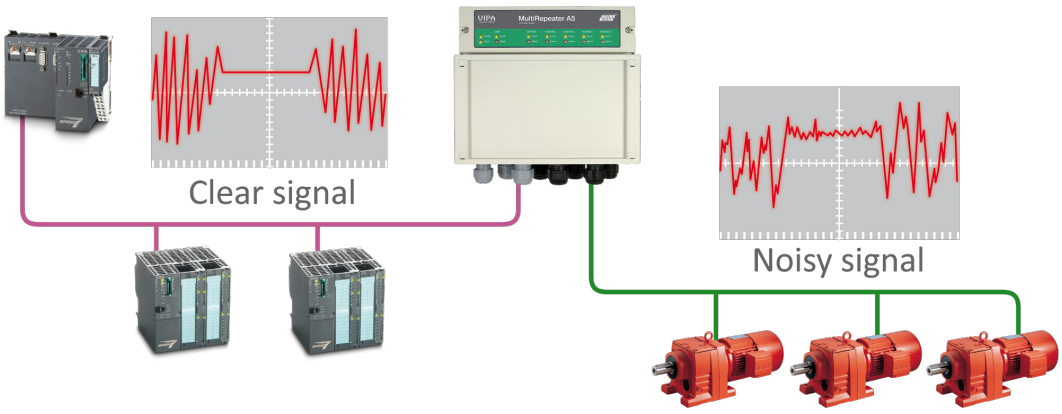
Long spur lines to instruments and the possibility to remove/insert them during operation. Short circuit protection on each spur line is automatically provided.

2.3 Application areas

- Dynamic spur lines to actuators, flow meters and pH analyzers
- Removable drives and motors
- Pull/Plug motor control centres (drawers)
- Roof mounted devices in tank farms
- Dirty and humid environments
- Barrier for non-galvanic isolated equipment
- Large star/tree structured networks
- Outdoor applications with device and cable stress

2.4 Additional Benefits

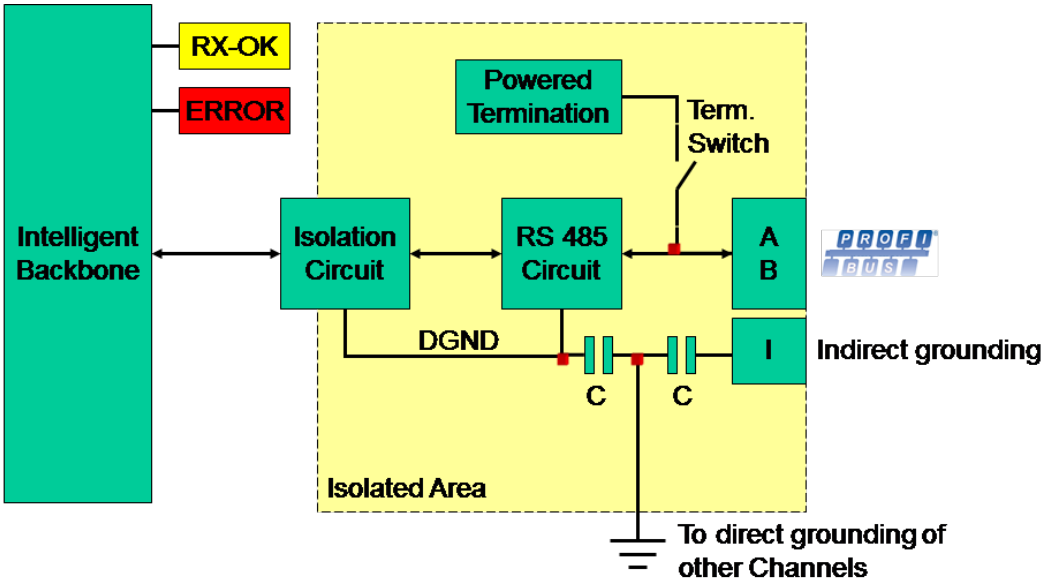
- Hot slave insertion and removal during operation
- Short circuit protection on each Channel
- Compact and robust construction
- Status and error display (per Channel)
- Suitable for all DP cables
- Conveniently arranged networks
- Easy extendable installations
- On-board DB9 female connector on each channel for maintenance activities
- Cost Savings



Because of the isolation and intelligence the PROFIBUS-Multi-Repeater provides, it can be used as a barrier for electrically sensitive segments. This keeps the backbone and other Channels clean.

2.5 Channel Structure

Each channel is electrically isolated and internally connected to the transparent intelligent backbone. The termination is switchable and powered by the MultiRepeater. The shielding of the PROFIBUS cable can be directly grounded or indirectly grounded.



2.6 Grounding System

The PROFIBUS MultiRepeater can be grounded by 3 methods:

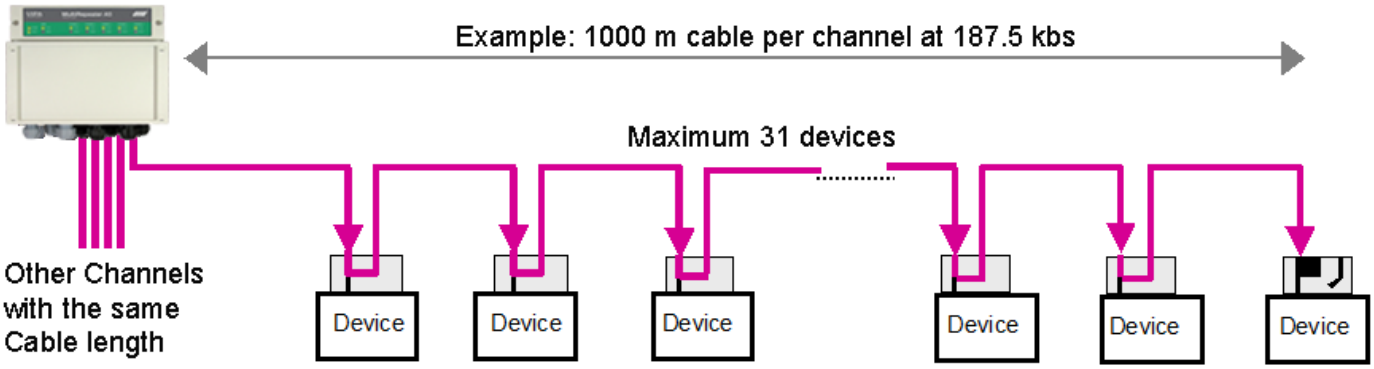
- Direct grounding on the Ground Rail
- Indirect grounding (through a capacitor)
- Combination of direct and indirect

The power supply must be grounded directly on the Ground Rail. The shielding of the PROFIBUS cables can be directly or indirectly grounded. If you do not want to ground all or some cables to the common ground, i.e. compensating current, the cable shielding must be connected to pin "I" which stands for Indirect grounding. A capacitor with a parallel high value resistor will separate the 2 potentials, ensuring protection of the signal against non-DC disturbances. If by accident on 1 channel the Direct Grounding is connected with the Indirect Grounding, the connection to the Direct Grounding bypasses the capacitor in the Indirect Ground connection. The current on the shield will flow to Direct Ground.

2.7 Cable lengths for PROFIBUS DP

The cables on the channels and the main channel must comply with the PROFIBUS DP cable specifications for RS485.

Baudrate (kbit/s)	9.6	19.2	45.45	93.75	187.5	500	1500	3000	6000	12000
Segment length (m)	1200	1200	1200	1200	1000	400	200	100	100	100
Segment length (feet)	3940	3940	3940	3940	3280	1310	656	328	328	328

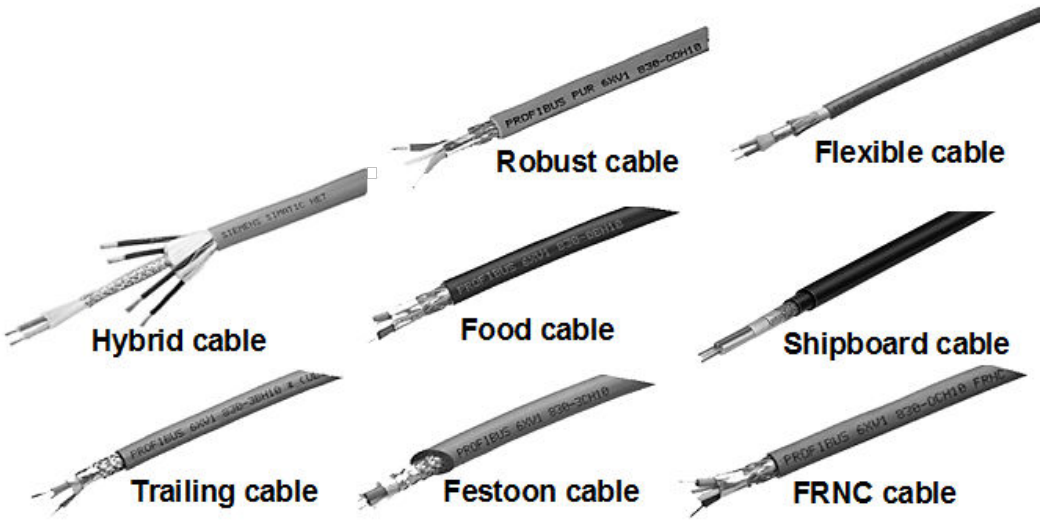


2.8 Cable types for PROFIBUS DP

The cable type must comply with the PROFIBUS DP cable specifications for RS485.

Parameter	Value
Wires	2 (twisted)
Impedance	135 ... 165 Ohm (3 to 20 MHz)
Capacity	< 30 pF/m
Loop resistance	< 110 Ohm/km
Wire diameter	> 0.64 mm
Wire area	> 0.32 mm^2

The PROFIBUS MultiRepeater can handle cables based on multiple protection sheaths with an overall cable diameter between 6 ... 12 mm.



2.9 Status display

The Status LEDs on the PROFIBUS MultiRepeater 920-1CA50 are very useful for diagnostics.

	OFF	Blinking	ON
POWER	Power is not switched on or an internal failure	Power supply not stable or an internal failure	Power supply OK
Main READY	Power is not switched on or an internal failure	Trying to detect the transmission speed, but has not locked it yet	The transmission speed has been detected
Main RX-OK	No communication detected on the Main Channel	1 or more devices communicating on the Main Channel	1 or more devices communicating on the Main Channel
Main ERROR	No problem has been detected	Problem in the cabling has been detected (Main Channel)	Problem in the cabling has been detected (Main Channel)
Channel RX-OK	There is no communication detected (on this Channel)	1 or more devices communicating (on this Channel)	1 or more devices communicating (on this Channel)
Channel ERROR	No problem has been detected	Problem in the cabling has been detected (on this Channel)	Problem in the cabling has been detected (on this Channel)

3 Installation Instructions

3.1 Location

The PROFIBUS MultiRepeater A5 can be installed everywhere in a non-hazardous area that complies with IP 65 (DIN 40 050) and the specified temperature range of -40 ... +75° Celsius.

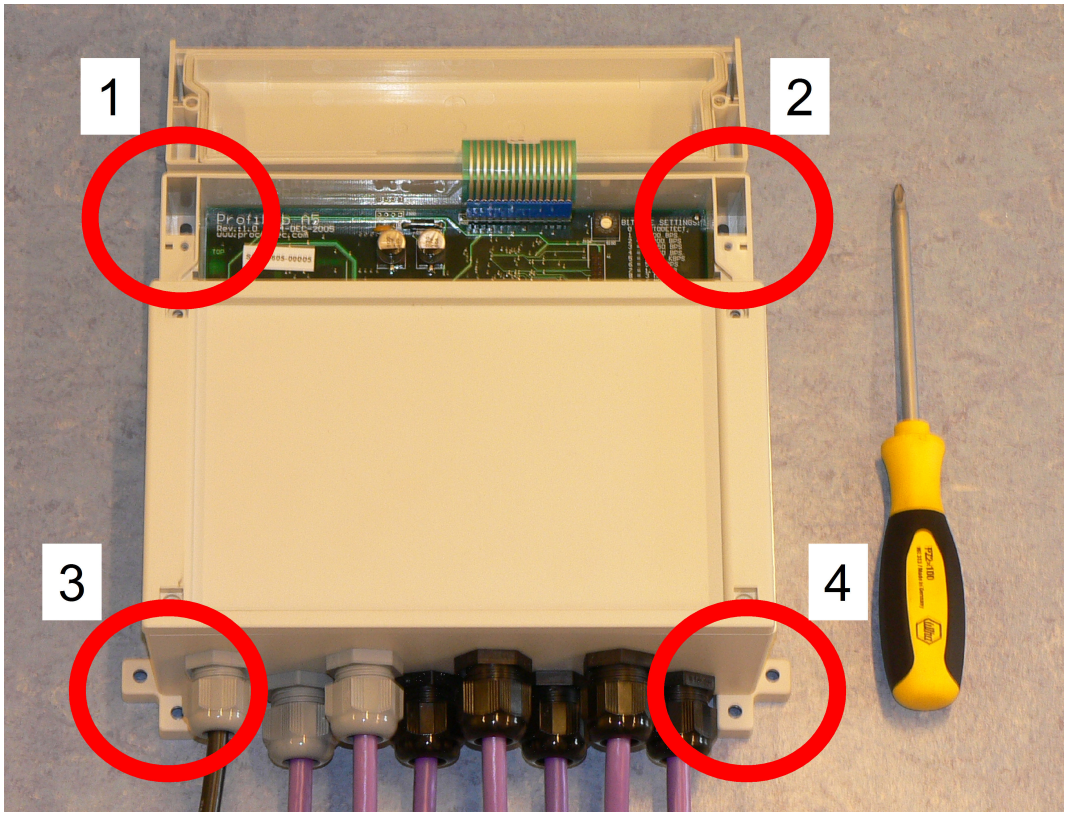
3.2 Position

Der PROFIBUS MultiRepeater A5 can be installed in every position, but it is recommended to install it with the cable glands pointing down to create a more reliable protection against moist and dust (water compartment and glands). In this position it is also easier to read the status display.

3.3 Mounting

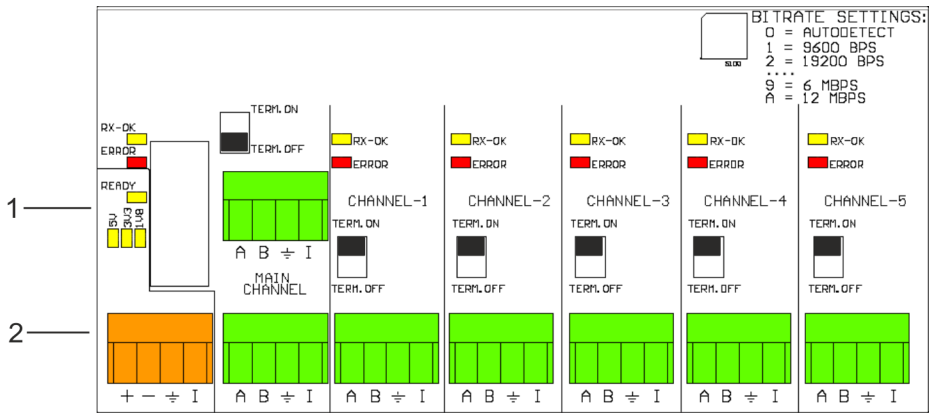
The PROFIBUS MultiRepeater has 4 mounting holes for 4 ... 5 mm screws. To reach the holes on position 1 and 2, the top lid has to be removed.

It is recommended to mount the MultiRepeater A5 with at least 4 suitable screws/bolts in position 1, 2, 3 and 4. Be careful with the flat cable that connects the lid with the PCB.



3.4 Power Supply

The 4-pin screw type power connector is located on the bottom left of the PCB:



1 Power LEDs
3 Power connector

The power supply must comply with the following specifications:

- Voltage: 10 - 32V DC
- Current: min. 130 mA
- Wire diameter: < 2.5 mm^2
- Cable thickness: 5 to 10 mm

Procedure

To connect the 24V supply to the 4-pin screw-type terminal, proceed as follows:

1. Strip the insulation from the cable or the conductors for the 24V power supply.
2. Secure the crimp terminals in the screw-type terminal.
   There is a grounding point that can be used.

To connect the power supply, you need a 3 mm screwdriver.

Testing

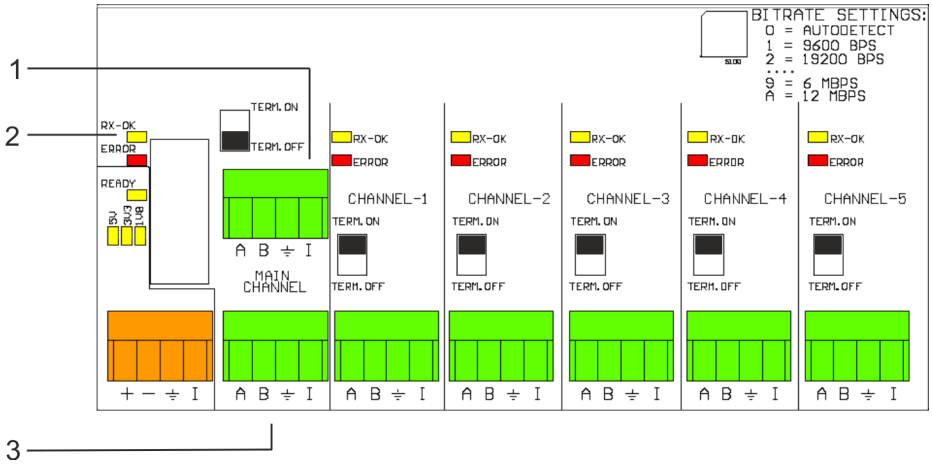
If the power is switched on it can be diagnosed by the following indicators on the PCB:

- All the LEDs should be shortly blinking.
- The "READY" LED is ON or Blinking
- The Power LEDs are ON (5V, 3V3 and 1V8).

It is recommended to use a power supply with a ground lead (3-wire).

3.5 Backbone

Connect the DP backbone cable to the bottom connector of the Main-Channel. If the MultiRepeater is not the last device on the bus segment, connect the Bus-Out cable to the top connector of the Main-Channel.



1 Communication status LED
3 Bus-Out Connector
4 Bus-In Connector

Pin layout of the screw terminals

Pin	Wiring
A	Green wire
B	Red wire
I	Cable shielding
Shield	Cable shielding

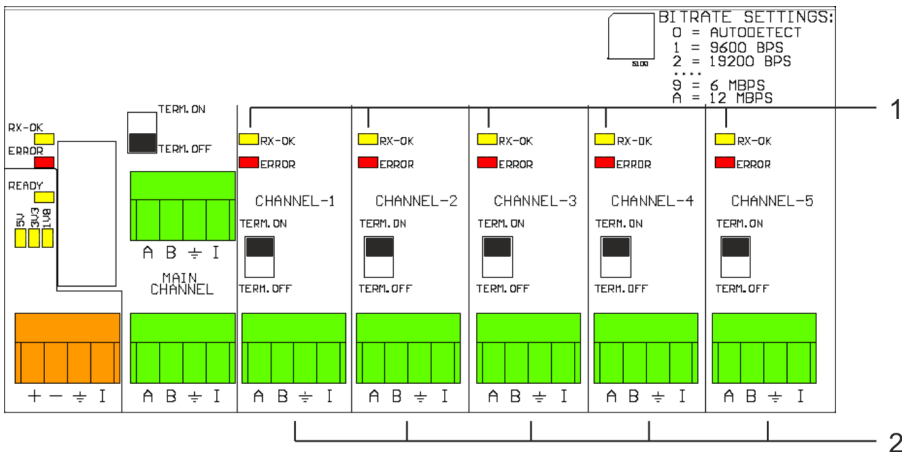
Connecting the indirect cable shielding is not required when the ground clips are used.

Test

If the Main-Channel recognizes valid PROFIBUS messages from one or more connected devices, the "RX-OK" LED of the Main Channel should be blinking.

3.6 Spur Segments

Connect the spur segments to the connectors of Channel 1 to 5.



1 Communications status LEDs
2 Channel connector

Pin layout of the screw terminals

Pin	Wiring
A	Green wire
B	Red wire
I	Cable shielding
Shield	Cable shielding

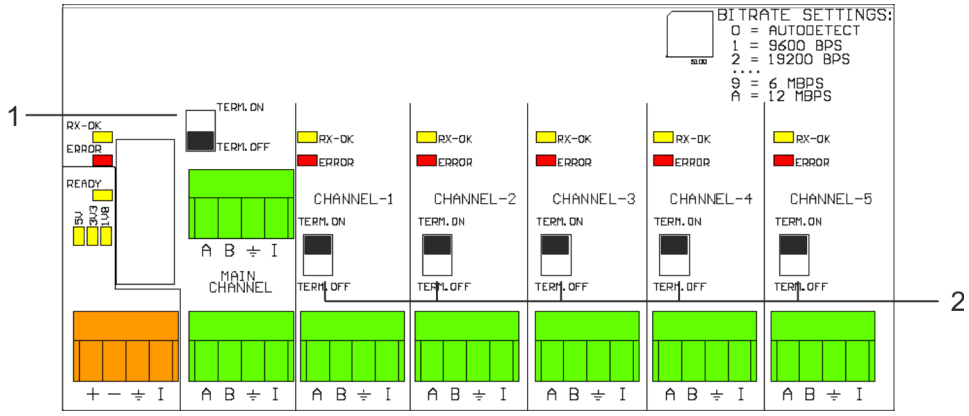
Testing

If a Channel recognizes valid PROFIBUS messages from one or more connected devices, the "RX-OK" LED of the Channel should be blinking.

3.7 Termination

The termination of the main channel has been set to OFF by default. If the MultiRepeater is the last/first device on the segment, the termination must be set to ON.

The termination of the channels have been set to ON by default, because it is assumed that the new segment is started at the MultiRepeater.

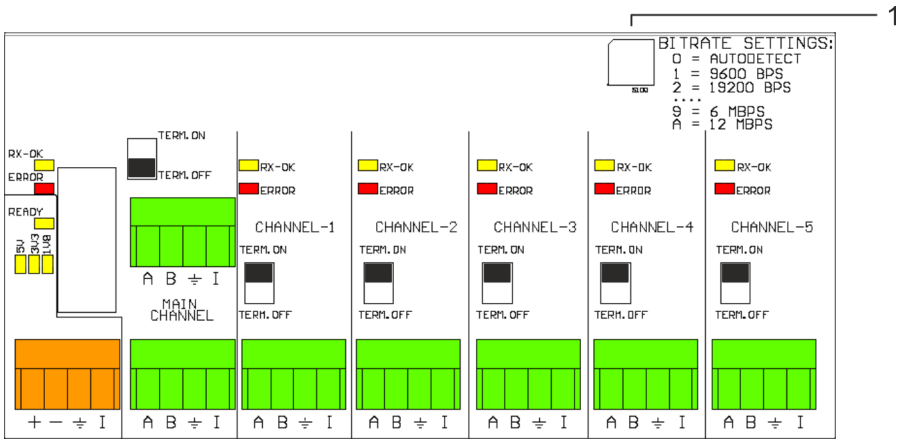


1 Termination of the main channel (default OFF)
2 Termination of the channels (default ON)

> *Don't forget to switch the termination ON at the other end of the segment and make sure it is powered continuously.*

3.8 Baudrate switch

The PROFIBUS MultiRepeater A5 recognizes the transmission speed by default. If it is required that the MultiRepeater is locked to a certain transmission speed, the baudrate switch should be set to the required value.



1 Baudrate switch

To set the rotary switch, use a 3 mm screwdriver.

Switch values

0 = Auto detect (default)

1 = 9.6 kbps

2 = 19.2 kbps

3 = 45.45 kbps

4 = 93.75 kbps

5 = 187.5 kbps

6 = 500 kbps

7 = 1500 kbps

8 = 3000 kbps

9 = 6000 kbps

A = 12000 kbps

B ... F = Auto detect

4 Technical data

Order no.	920-1CA50	
Dimensions and weight		
Dimensions L x H x D (mm) with screws Weight	213 x 210 x 95 mm	
Weight	Approx. 800 g	
Mounting screws	4 to 5 mm	
Ambient conditions		
Operating temperature	-40 ... +75 °C	
Isolation class	IP 65 (DIN 40 050)	
Protocol specifications		
Supported Protocols	DP-V0, DP- V1, DP-V2, FDL, MPI, FMS, PROFIsafe, PROFIdrive and any other FDL based protocol.	
Transmission speed	9.6 kbps to 12 Mbps (including 45.45 kbps)	
Transmission speed detection	Auto detect (default) or selectable with rotary switch	
Transmission speed switch	0 = Normal repeating (Auto detect) (default) 1 = 9.6 kbps 2 = 19.2 kbps 3 = 45.45 kbps 4 = 93.75 kbps 5 = 187.5 kbps 6 = 500 kbps 7 = 1500 kbps 8 = 3000 kbps 9 = 6000 kbps A = 12000 kbps B...F = Auto detect	
Transmission speed detection time	< 10 s (if it is set to auto detect)	
Data delay time	At baudrate:	Normal mode:
	9.6 - 93.75 kbps	≤1.25 Tbit
	187.5 - 500 kbps	≤1.3 Tbit
	1.5 Mbps	≤1.4 Tbit
	3 Mbps	≤1.6 Tbit
	6 Mbps	≤2.0 Tbit
	12 Mbps	≤3.0 Tbit
Delay time jitter	Max. ¼ bit time	
PROFIBUS cable specifications		
Cable lengths	1200 m at 9.6 kbps to 93.75 kbps	
	1000 m at 187.5 kbps	

Order no.	920-1CA50
	400 m at 500 kbps
	200 m at 1.5 Mbps
	100 m at 3 Mbps to 12 Mbps
Cable thickness	6 to 12 mm
Wire diameter	< 2.5 mm^2
Wire type	Stranded or Solid core
Number of devices	Maximum 31 per Channel (including MultiRepeaters, OLMs, Laptops/ PCs, etc)
Termination	Integrated and switchable. Powered according to IEC 61158 (390/220/390 Ohm) ■ All Channels (default: ON) ■ Main-Channel (default: OFF)
Cascading depth	No limits
Redundancy	No
Power supply specifications	
Nominal supply voltage	10 to 32 V DC
Current consumption	130 mA at 24 V power supply (all Channels fully loaded)
Power dissipation	Max. 4.1 W
Reverse polarity protection	Yes
Cable thickness	5 to 10 mm
Wire diameter	< 2.5 mm^2
Others	
MTBF	Not available

5 Glossary

Address	Unique number of a device connected to the network. With PROFIBUS this can be 0 to 126. 127 is a broadcast address.
Analyzer	Software tool to observe the protocol traffic. Combi-Analyzers can also inspect the signal quality. Other term: Bus Monitor
Backbone	The primary bus cable. Most of the time only the control systems, MultiRepeaters and fiber optic couplers are connected to this cable. The field devices are connected behind the MultiRepeaters and fiber optic couplers.
Bit Time (Tbit)	The bit time Tbit is the time, which elapses during the transmission of one bit. It depends on the baudrate and is calculated as follows Tbit = 1 (bit) / baudrate (bps). Examples: 12 Mbps → Tbit = 83 ns 1,5 Mbps → Tbit = 667 ns
Busparameters	Settings that define the timing behaviour on the bus. They are defined in the master. Examples: Tslot, MaxTSDR.
C	Capacitance
DGND	Digital Ground
DIN	German Institute for Standardization (www.din.de)
DP-V0	DP-V0 is the basic stage of the PROFIBUS DP communication protocol. DP-V0 devices (master and slaves) perform the following basic functionalities: ■ Cyclic exchange of I/O data between controlling and slave devices ■ Device, Identifier (module) and Channel related Diagnosis ■ Parameterization of DP-slaves ■ Configuration of DP-slaves
DP-V1	DP-V1 is the first stage of extension of PROFIBUS DP after DP-V0. DP-V1 devices shall comply with the following features: ■ Device related diagnosis is replaced by status and alarms. ■ The first three octets of the user parameterization data are now standardized ■ Optionally these devices may support: – Acyclic communication (MS1, MS2) – If alarms are used, MS1 shall be supported
DP-V2	DP-V2 is the second stage of extension of PROFIBUS DP after DP-V1. DP-V2 devices shall comply with the following features: ■ Data Exchange Broadcast (DxB) for slave to slave communication (publisher/subscriber principle). ■ Isochronous Mode (time tick synchronized operating slaves, e.g. drives) ■ Up- and/or download of Load Region Data (domains) ■ Clock Control (synchronization within slaves) and Time Stamping ■ Redundancy
EMC (Electromagnetic Compatibility)	The extent to which an electric or electronic device will tolerate electrical interference from other equipment (immunity), and will interfere with other equipment. Within the European Community as well as in other countries it is regulated by law that electric and electronic components and equipment comply with basic standards such as IEC 61000-6-2 or IEC 61326 or corresponding individual product standards.
Hub	A Hub refreshes a signal and passes the information on to all nodes which are connected to the Hub. Data frames which were received on one port are transferred to all the other ports (chicken foot topology).

MPI	Multiple Protocol Interface. Protocol defined by Siemens which uses the layer 1 and 2 of PROFIBUS (FDL).
PCB	Printed Circuit Board
PROFIBUS DP	Acronym for "PROFIBUS for Decentralized Peripherals". Specification of an open fieldbus system with the following characteristics: ■ Polling master-slave-system (cyclic communications, MS0) ■ Flying masters with robin round token passing coordination (MM) ■ Connection based (MS1) and connectionless (MS2, MS3) acyclic communication between masters and slaves Options (e.g.): – Data exchange broadcast (DXB), i.e. slave to slaves communication – Isochronous mode of slaves – Clock synchronization – Redundancy PROFIBUS DP is standardized within IEC 61158 and IEC 61784, communication profile families 3/1 and 3/2 The term "PROFIBUS DP" also is a synonym for the RS485 based deployments within factory automation.
Repeater	Active physical layer device that receives and retransmits all signals over a different port to increase the distance and number of devices for which signals can be correctly transferred for a given medium.
Spur line	A cable attached to a bus segment with a T-connection . Spurs are not recommended with PROFIBUS DP. They are prohibited with 12 Mbps and PROFIsafe operations.
Stub line	See Spur line
Termination	A (powered) resistor network at both ends of a segment to prevent reflections (with PROFIBUS DP the termination must be powered).
Topology	In a communications network, the pattern of interconnection between network nodes; e.g. bus, ring, star configuration.
PI	PROFIBUS International. The International PROFIBUS Organization based in Karlsruhe.
PNO	PROFIBUS user Organization. The German PROFIBUS Organization based in Karlsruhe.
Drop Cable	See Spur line
Reflection	Part of the original signal that is transmitted back along the cable. It corrupts the original signal.