YASKAWA

VIPA Networking Solutions

PBR | 920-1CB20 | Manual

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PROFIBUS MultiRepeater B2-R

www.vipa.com/en/service-support/manuals

VIPA CONTROLS

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1   General

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1.2 About this manual

Objective and contents

This manual describes the PROFIBUS MultiRepeater 920-1CB20 from VIPA. It contains a description of the construction, project implementation and usage.

Product	Order number	as of state: HW
PBMR-B2-R	920-1CB20	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 commis-sioning 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!**

1.4 Important Notices

> **CAUTION!**
> When the product is in use at an ambient temperature of 63 degrees Celsius or 145 degrees Fahrenheit, the housing of the device will be hot. **Do not touch the housing!**
>
> At normal operating temperatures of 25 degrees Celsius, the temperature of the housing will not exceed 35 degrees Celsius.

> **CAUTION!**
> When the product is in use at an ambient temperature of 63 degrees Celsius or 145 degrees Fahrenheit, the housing of the device will be hot. **Do not touch wires which are in contact with the housing!**

> **CAUTION!**
> When the product is in use at an ambient temperature of 63 degrees Celsius or 145 degrees Fahrenheit, the housing of the device will be hot. **Use wires suitable for these temperatures!**
>
> Hot housing warning located on the side of the housing. Make sure this warning is visible after wall installation. UL certification demands the warning to be visible during operation.
>
> To comply with UL certification regulations (UL60950-1) the power supply must be a Limited Power Source (LPS) or NEC Class 2 or CEC Class 2 that cannot exceed 100 Watt.
>
> According to UL60950-1, if a copper PROFIBUS cable is used outside, it is required to install surge protection that is suitable for PROFIBUS.
>
> To comply with UL certification regulations the device is to be used on altitudes under 2000 m.

2   Product Description

2.1   General

The PROFIBUS MultiRepeater B2-R is an advanced, flexible and robust network component for PROFIBUS DP installations, to create backbone structures and long multi-device star/tree segments.
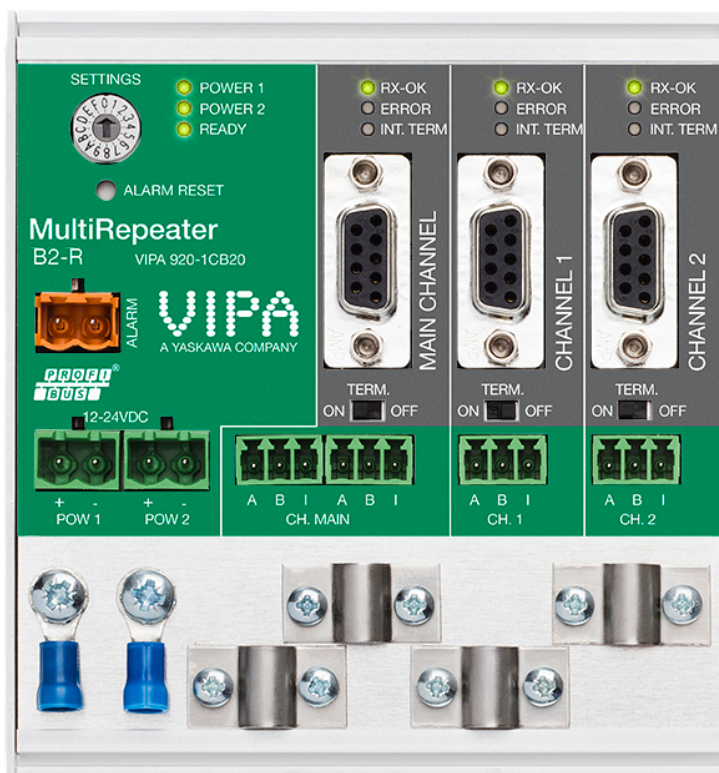

- PROFIBUS DP is a high speed communication bus that must comply with strict rules concerning spur lines, because of possible reflections that could lead to communication disturbances. If spur lines or star segments are required, costly investments in repeaters have to be done. When redundancy is enabled, the PROFIBUS MultiRepeater B2-R is transformed to a low cost extremely reliable redundant repeater solution.
- The innovative PROFIBUS MultiRepeater B2-R is the perfect component for such applications. It is an economic solution to realize reliable spur lines in high speed DP networks. They have the functionality of 2 galvanic isolated transparent repeaters (offering 3 segments). 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 PROFIBUS MultiRepeater B2-R refreshes a received message on one Channel and transfers it to the other Channels (chicken foot topology).
- Because the PROFIBUS MultiRepeater B2-R creates isolated segments, the devices can now be removed and added during operation. Also most electrical bus problems and EMC disturbances in a spur do not spread to the other segments. The intelligent logic and isolation circuits of the Repeaters 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 Repeaters are powered by a 12 to 24 DC Voltage. For troubleshooting, maintenance and commissioning the MultiRepeaters are equipped with LEDs on the outside, which indicate the status of each Channel (Data and Error).
- If bus redundancy is enabled, 2 segments will form a redundant pair which is completely compatible with the ABB RLM01. An alarm contact is linked to events based on the status of the power supply and the bus redundancy status.

2.2 Product features
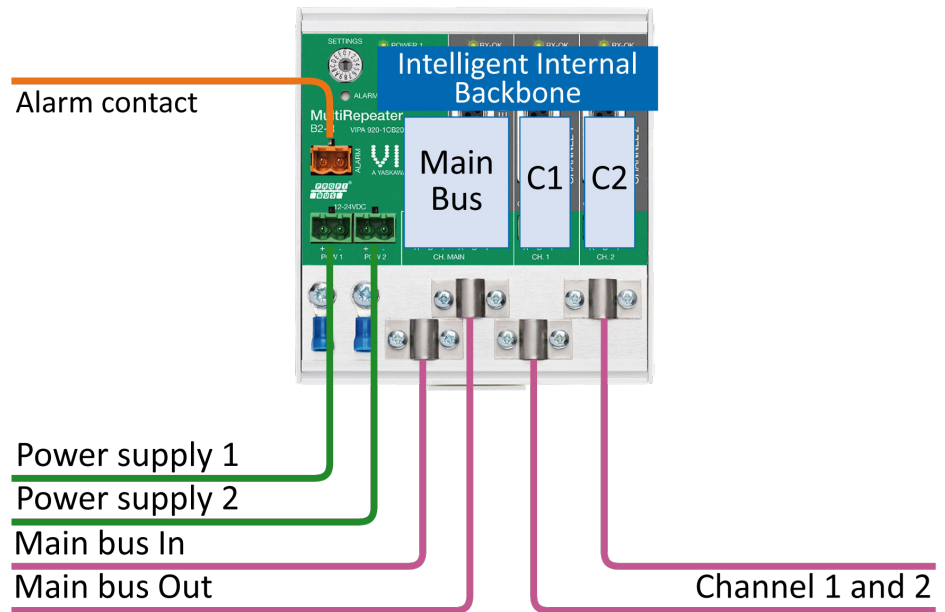
- ■ 2 Galvanic isolated outgoing channels (repeater segments)
- ■ Transparent for all PROFIBUS DP protocols
- ■ DP-RS485 specifications for each channel
- ■ Cable redundancy for channel 1+2
- ■ 9.6 Kbps to 12 Mbps
- ■ 31 devices per channel
- ■ 1200 m spur line length (depends on transmission speed)
- ■ Redundant power supply
- ■ No limit in serial placement or cascading of MultiRepeaters
- ■ Alarm contact, with manual reset button
- ■ No address required
- ■ Integrated termination facilities (switches)
- ■ Configurable grounding system (direct or capacitive)
- ■ IP 20 classification
- ■ Increased temperature range
- ■ DNV / offshore Certification (request pending, to be removed on approval)
- ■ UL approval (request pending, to be removed on approval)

PLC/DCS1 — Adress X
PLC/DCS2 — Adress X+1

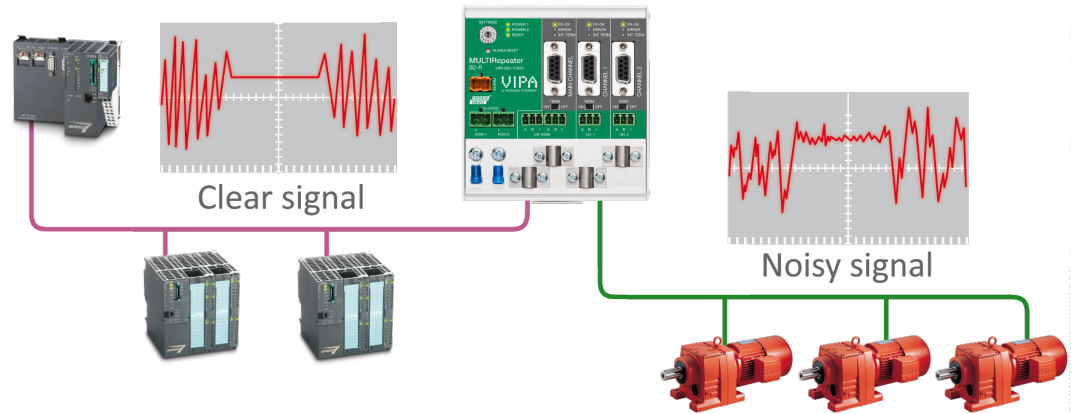MultiRepeater B2-R

Line redundancy

MultiRepeater B2-R
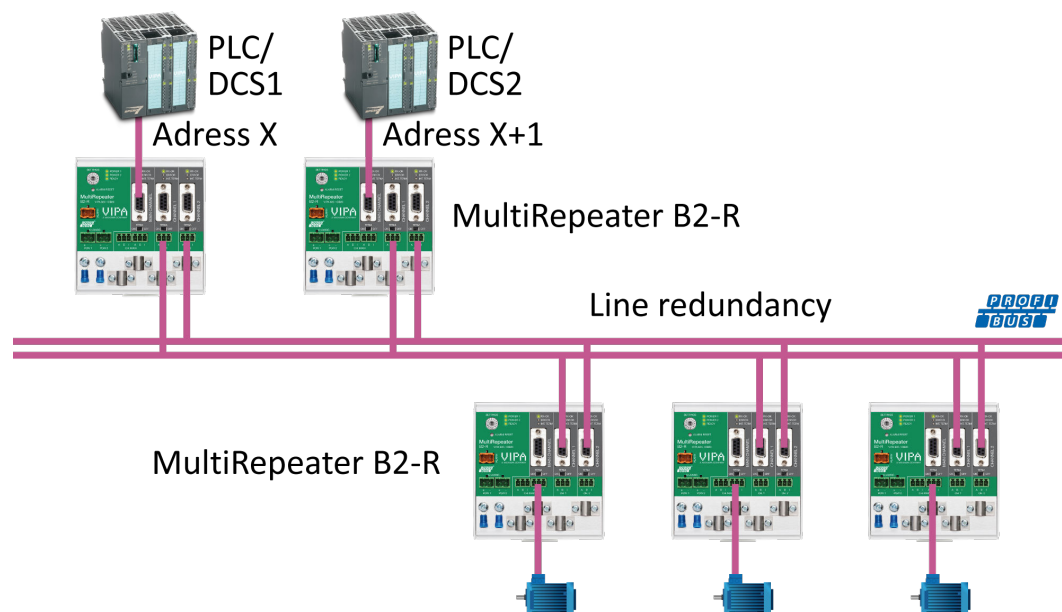
If bus redundancy is enabled, 2 segments will form a redundant pair. Short circuit protection on each spur line is automatically provided.

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
- Barrier for non-galvanic isolated equipment
- Networks with requirement for High Availability/uptime
- Large star/tree structured networks

2.4 Additional Benefits

- Create a redundant path to other Repeaters
- 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 MultiRepeater 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.
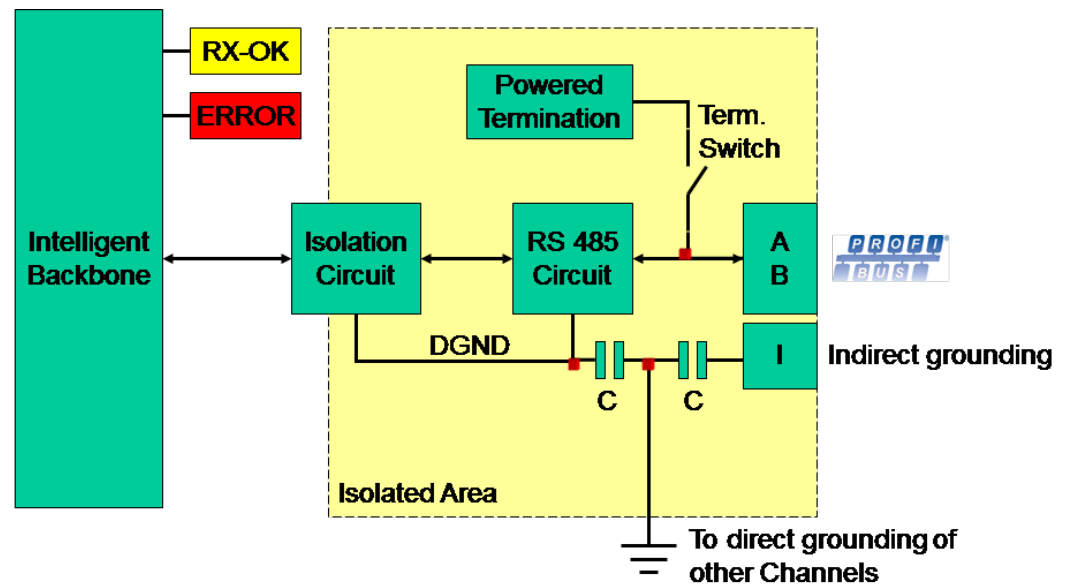
2.6 Grounding System

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 par-

allel 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

Example: 1000m cable at 187.5 Kbps

Max 31 devices

Other channels with the same cable length
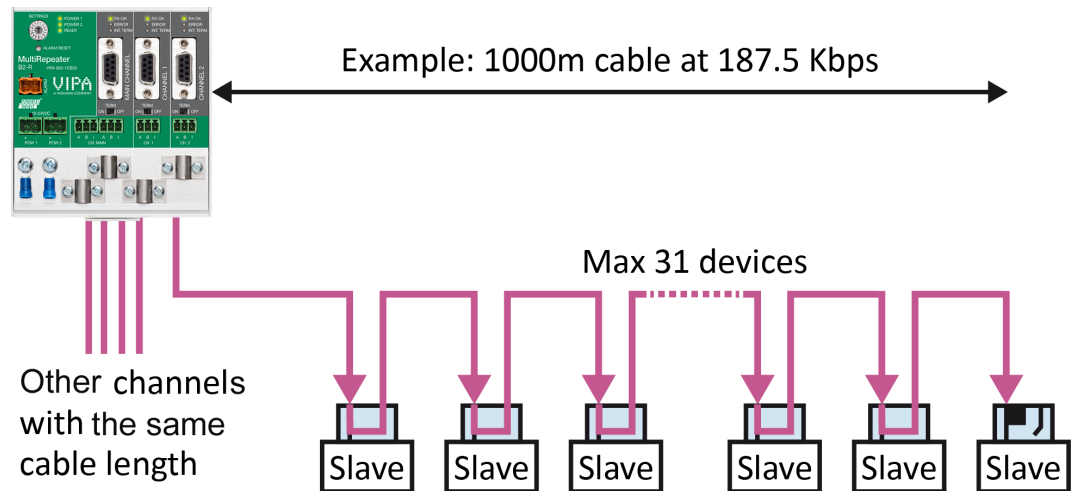
2.8 Cable types for PROFIBUS DP

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.
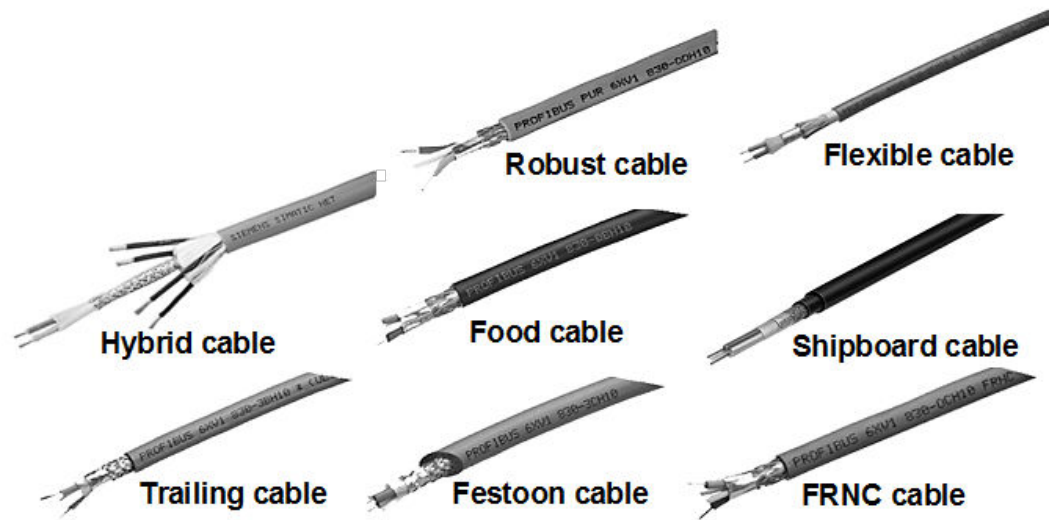
2.9 Status display

The Status LEDs on the PROFIBUS MultiRepeater 920-1CB20 are very useful for diagnostics.

	OFF	Blinking	ON
POWER 1 / 2	Power is not switched on or an internal failure	Power supply not stable, redundant power supply interrupted or an internal failure	Power supply OK
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)
INT. TERM	Termination for this channel is OFF	Internal failure	Termination for this channel is ON

3   Installation Instructions

3.1 Location

The PROFIBUS MultiRepeater B2-R can be installed everywhere in a non-hazardous area that complies with IP 20 (DIN 40 050) and the specified temperature range of -25 ... +70° Celsius or -13 ... +158° Fahrenheit.

3.2 Position

Der PROFIBUS MultiRepeater B2-R can be installed in every position, but it is recommended to install it with the cables pointing down. In this position it is also easier to read the status LEDs.

3.3 Mounting

The PROFIBUS MultiRepeater can be mounted on 35 mm DIN rail with a minimum width of 167 mm. Mounting brackets are available for mounting the Repeater directly on a wall.
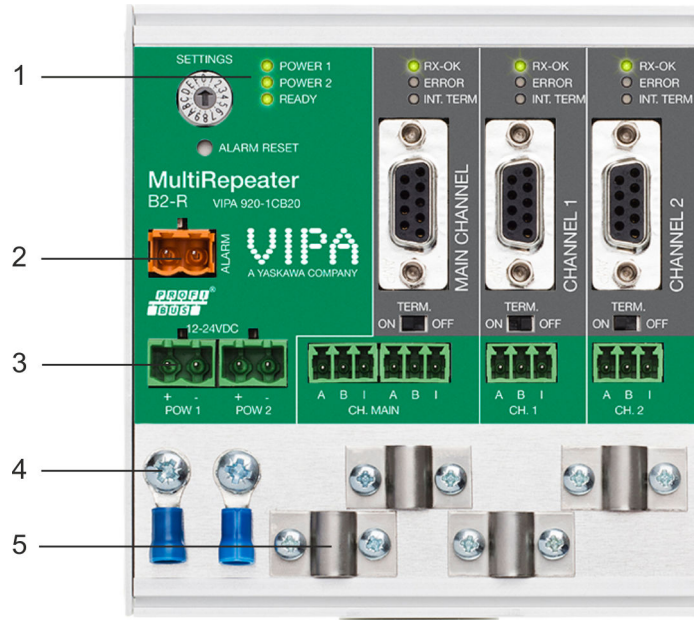
The supplied rubber studs need to be placed on the back of the housing of the Repeater for extra fixation. This is to prevent the product to potentially slide off the DIN rail.

3.4 Power Supply

The two 2-pin screw type power connectors are located on the left of the PROFIBUS MultiRepeater B2-R:

1 = **+** (left)

2 = **-** (right)

1   Power LEDs
2   Alarm contact
3   Power connector
4   Grounding points
5   Grounding points

Redundancy

Both power connectors are linked 1-on-1 to the internal power supply of the Repeater. If one power supply fails, the other takes over without delay time. When redundancy is not required, it is sufficient to use one power connector. Please note that when using only one power supply, a voltage of max. 0.25 V will exist on the other unconnected power connector.
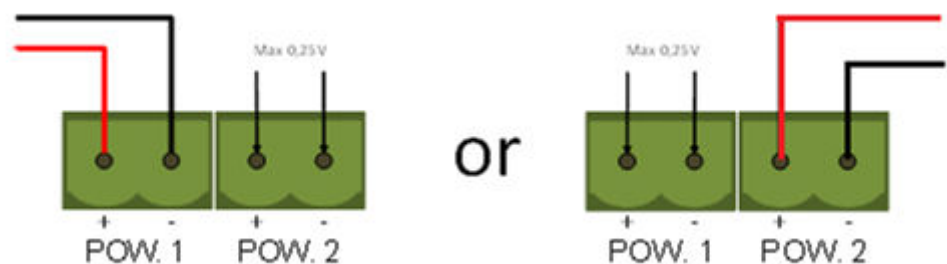
If only one power supply is used, the alarm contact is closed. If two power sources are connected, the contact is open. As soon as one of the power supplies fails, the contact will close and the Power Indicator LED will blink.

The power supply must comply with the following specifications:

- Limited Power Source (LPS) or NEC Class 2 or CEC Class 2
- Voltage: 12 - 24 V DC
- Current: min. 275 mA
- Wire diameter: < 2.5 mm²

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

1. ▸ Strip the insulation from the cable or the conductors for the 24V power supply.

2. ▸ Add cable crimp terminals/wire ferrules to the conductors.

3. ▸ Secure the crimp terminals in the screw-type terminal.

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:

■ LEDs should be blinking in a circular animation for a short time.
■ The "POWER" LED of the respective power connector (1, 2 or both) is ON.
■ The "READY" LED is ON or Blinking, depending on baud rate lock.

3.5 Grounding of the power
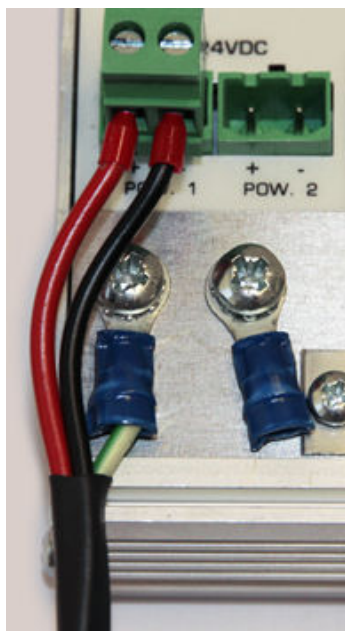
ⓘ   *It is recommended to use a power supply with a ground lead (3-wire).*

1. ▸ Connect the ground lead of the power lead to the Ground Rail of the PROFIBUS MultiRepeater.

**2.** ▸ Connect the Ground Rail to the common ground with a separate ground lead.

3.6 Alarm contact

The PROFIBUS MultiRepeater features a potential-free relay contact. This alarm contact can be used to monitor the power supplies. Example applications are: Connect a LED tower, alarm buzzer, SMS server or use it as a digital signal for the PLC.

■ If only one power supply is used, the alarm contact is closed. If two power sources are connected, the contact is open. As soon as one of the power supplies fails, the contact will close and the Power Indicator LED will blink.
■ In the case of an interrupted power supply you can reset the contact by pressing the *[Reset]* button. The contact will open and the LEDs will stop blinking.
■ The maximum power to be connected to the alarm contact is 24 VDC. The maximum switching current is 500 mA.

3.7 Backbone

➤ Connect the DP backbone cable to the bottom-left connector of the main channel. If the Repeater is not the last device on the bus segment, connect the Bus-Out cable to the right connector of the main channel. The second method is to place a PROFIBUS standardized plug with an In/Out cable on the DB9 connector.
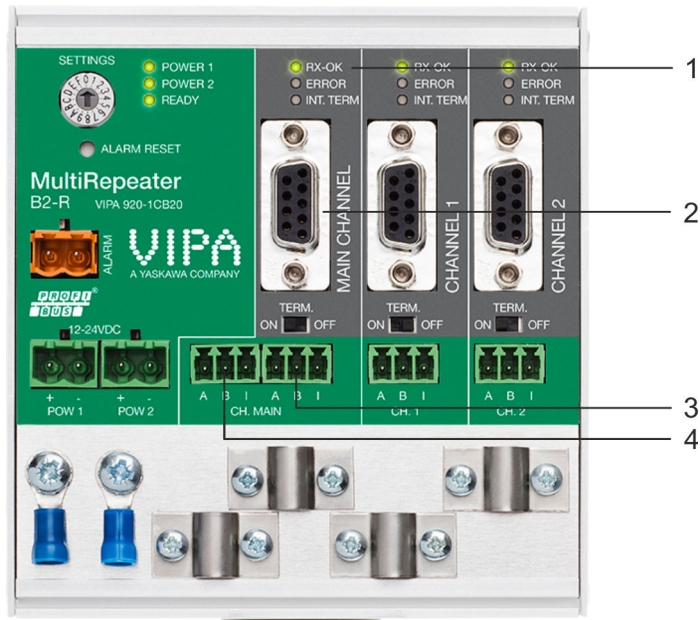
1   Communication status LED
2   D9 Bus In/Out connector
3   Bus Out connector
4   Bus In connector

Pin layout of the screw terminals

Pin	Wiring
A	Green wire
B	Red wire
I	Indirect 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.

3.8 Spur Segments

➤ Connect the spur segments to the connectors of the channels. The second method is to place a PROFIBUS standardized plug on the DB9 connector of the specific Channel.

1   Communication status LEDs
2   Channel connector channel 1
3   Channel connector channel 2
4   Channel connector channel 2
5   Channel connector channel 1

Pin layout of the screw terminals

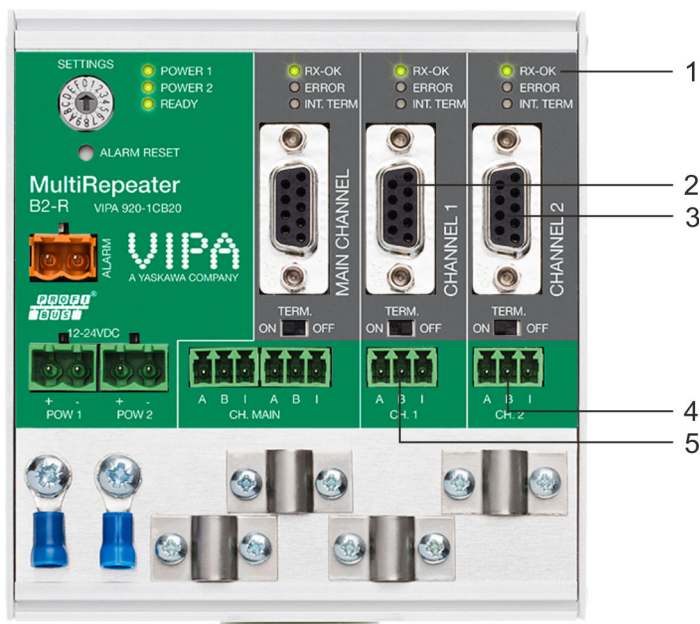| Pin	Wiring
A	Green wire
B	Red wire
I	Indirect cable shielding

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

Testing

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

3.9   Termination

The termination of the main channel has been set to OFF by default. If the MultiRepeater is the last 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.
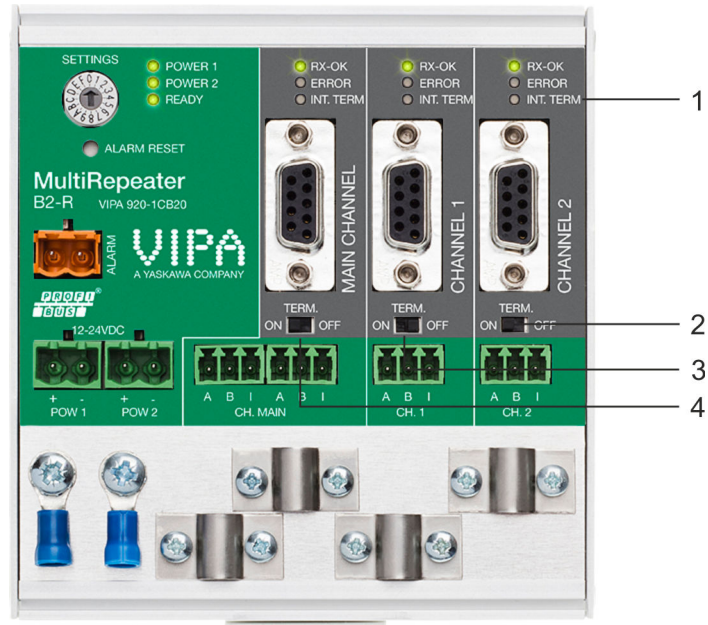
1   Termination LEDs
2   Termination of the channels (default ON)
3   Termination of the channels (default ON)
4   Termination of the main channel (default OFF)

The termination LED of the corresponding Channel is activated when the termination switch is set to ON.

> *When the DB9 connector is used and the cable starts at the MultiRepeater, it is recommended to use the termination on the DB9 plug and NOT the MultiRepeater. This way, the connector can be removed while maintaining termination on the bus.*

3.10   Baudrate switch

The PROFIBUS MultiRepeater B2-R 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.
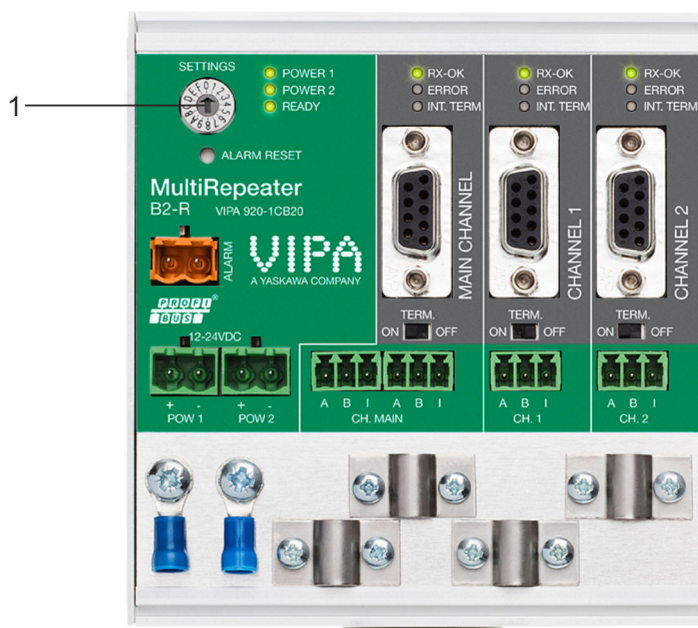
1   Baudrate switch

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

Switch values

0 = 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 = Robust repeating, Auto detect

C = Robust repeating, redundancy on channel 1 and 2

D .. F = Reserved for future use

Please note that the position of the rotary switch is only sampled during start-up. Changing the position of the switch will not have effect during operation.

The auto baudrate detect feature will search for the correct baud rate within 10 seconds of receiving the first telegram. This baud rate lock will be lost after 50 seconds of incorrect or no message reception.

In robust repeating mode, only messages starting with a valid PROFIBUS start delimiter are repeated (SD1, SD2, SD3, SD4 and Short Acknowledge). In Normal mode, every bit is transferred immediately onto the other channels.

3.11   Channel Redundancy

▶ To use the Redundancy option of the PROFIBUS MultiRepeater 920-1CB20, set the rotary switch to the "C" position. This enables the two channels (1 and 2) to be one redundant path to another Repeater or to any other supporting product.
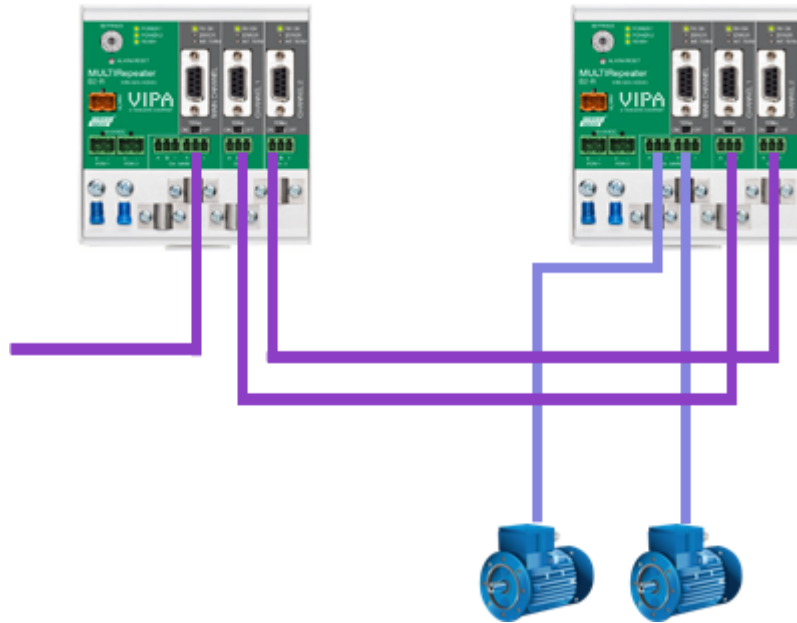
The telegrams are transferred onto both redundant channels. The logic inside the Repeater determines which telegram is used to be transferred onto the other channels. A message received by a redundant channel is repeated on all other channels, except the other redundant channel. A message received by a normal channel is repeated on all other channels.

When one redundant cable breaks, the other cable ensures safe delivery of the telegram. In this event the built-in alarm contact will close. The red "ERROR" LED will blink with an interval of 100 ms. When the redundant path is fixed, press the *[ALARM RESET]* push-button to reset the alarm.

4 Technical data

Order no.	920-1CB20		
Dimensions and weight			
Dimensions L x H x D (mm) with screws Weight	102 x 111 x 32 mm		
Weight	Approx. 320 g		
Ambient conditions			
Operating temperature	-25 ... +70 °C		
	-13 ... +158 °Fahrenheit		
Isolation class	IP 20 (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 = Robust repeating (auto detect)		
	C = Robust repeating, redundancy on channel 1 and 2		
	D ... F = Same as 0		
Transmission speed detection time	< 10 s (if it is set to auto detect)		
Data delay time	At baudrate:	Normal mode:	Robust mode:
	9.6 - 93.75 kbps	≤1.7 Tbit	≤13.25 Tbit
	187.5 - 500 kbps	≤1.8 Tbit	≤13.30 Tbit
	1.5 Mbps	≤1.9 Tbit	≤13.40 Tbit
	3 Mbps	≤2.2 Tbit	≤13.60 Tbit
	6 Mbps	≤3.0 Tbit	≤14.00 Tbit
	12 Mbps	≤4.0 Tbit	≤15.00 Tbit
Delay time jitter	Max. ¼ bit time		
PROFIBUS cable specifications			

Order no.	920-1CB20
Cable lengths	1200 m at 9.6 kbps to 93.75 kbps
	1000 m at 187.5 kbps
	400 m at 500 kbps
	200 m at 1.5 Mbps
	100 m at 3 Mbps to 12 Mbps
Cable thickness	10 mm (when the ground rail is used)
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	Yes
Power supply specifications	
Nominal supply voltage	12 to 24 V DC
Redundant power supply	Yes
Current consumption	Min 275 mA at 12 V power supply (all Channels fully loaded)
Reverse polarity protection	Yes
Cable thickness	10 mm (when the ground rail is used)
Wire diameter	< 2.5 mm^2
Alarm contact	
Voltage	Max. 24 V DC
Current	0.5 A
Others	
MTBF	T.b.d.

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 $\rightarrow$ Tbit = 83 ns
	1,5 Mbps $\rightarrow$ 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.