

PCAN-Repeater DR

CAN Repeater for the Decoupling of Bus Segments

User Manual



Relevant products

Product Name	Model	Part number
PCAN-Repeater DR	Industry	IPEH-004038

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1 Introduction

The PCAN-Repeater DR establishes a connection between two High-speed CAN buses with galvanic isolation of up to 5 kV. Both CAN channels are decoupled from each other and from the power supply. All message traffic including error frames is forwarded 1:1 between both channels, if necessary, in one direction only. The PCAN-Repeater DR behaves passively and is transparent from the perspective of the CAN bus. LEDs display the current bus status. With its DIN rail casing and extended temperature range support, this module is suitable for use in an industrial environment.

Due to the properties of the CAN protocol, the maximum distance of two nodes on a CAN bus depends on the bit rate. Therefore, a CAN bus cannot be extended with the PCAN-Repeater DR. The maximum distance of two nodes is decreased with each interposed PCAN-Repeater DR according to its transit delay.

For operating the PCAN-Repeater DR in a CAN FD network, there are notes in Appendix C on page 21.

1.1 Properties at a Glance

- Two High-speed CAN channels (ISO 11898-2)
- Bit rates from 5 kbit/s up to 1 Mbit/s
- Compliant with CAN specifications 2.0A (11-bit ID) and 2.0B (29-bit ID)
- NXP CAN transceiver PCA82C251
- Connections for CAN and power supply via 4-pin screw terminal block (Phoenix)
- LEDs display CAN bus load and CAN errors

- └ Switchable termination for each CAN channel
- └ Galvanic isolation rated up to 5 kV according to IEC60601-1, between both CAN channels and between CAN and power supply
- └ Listen-only mode for CAN channel 1 or CAN channel 2 can be switched selectively
- └ Plastic casing (width: 22.5 mm) for mounting on a DIN rail (IEC 60715 TH35)
- └ Supply voltage from 8 to 30 V
- └ Extended operating temperature range from -40 to +85 °C (-40 to +185 °F)

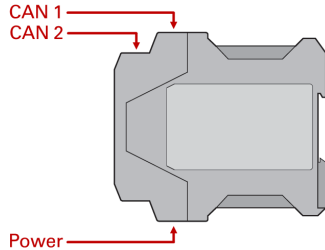
1.2 Operation Requirements

- └ Power supply in the range of 8 to 30 V DC

1.3 Scope of Supply

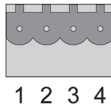
- └ PCAN-Repeater DR in DIN rail plastic casing
- └ 3 mating connectors (Phoenix, type: MSTB 2,5/4-ST BK) for power supply and CAN connectors
- └ Manual in PDF format

2 Installation



2.1 CAN Connectors

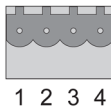
Both CAN connectors CAN 1 and CAN 2 are located on the upper side of the casing.



Pin	Assignment
1	CAN-High
2	CAN-Low
3	CAN-GND
4	CAN-Shield ¹

2.2 Power supply connection

The connection for the power supply is located on the lower side of the casing.



Pin	Assignment
1	GND
2	not connected
3	Vbat (8 - 30 V DC)
4	Shield (DIN rail potential)

¹ Capacitive connection (5 kV) to supply shield (DIN rail potential)

2.3 Influence on Maximum Node Distance

The PCAN-Repeater DR has a transit delay of 115 ns. This corresponds to a cable length of 23 m which reduces the maximum distance between two nodes on both sides of the PCAN-Repeater DR.

Due to the properties of the CAN protocol, the maximum distance of two nodes on a CAN bus depends on the bit rate. The following table shows the maximum distance of two nodes on the CAN bus at different bit rates.

Bit rate	Maximum distance	Maxim. dist. with repeater
1 Mbit/s	40 m	17 m
500 kbit/s	110 m	87 m
250 kbit/s	240 m	217 m
125 kbit/s	500 m	Using these bit rates, the transit delay of a repeater can be disregarded.
50 kbit/s	1.3 km	
20 kbit/s	3.3 km	
10 kbit/s	6.6 km	
5 kbit/s	13.0 km	

The listed values have been calculated on the basis of an idealized system and can differ from reality.




Note: The PCAN-Repeater DR cannot be used to extend the length of a CAN bus beyond the maximum distance of two nodes.

2.4 CAN Termination

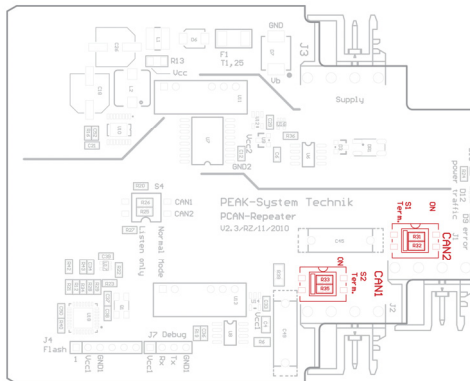
The termination for each CAN channel can be separately activated with switches on the board. At delivery, the termination is switched on.

A High-speed CAN bus (ISO 11898-2) must be terminated on both cable ends with 120 Ohms. Otherwise, malfunctions may arise.

▶ Proceed as follows to change the termination setting:

 **Important note:** Before opening the PCAN-Repeater DR, disconnect it from the power supply.

1. Open the plastic casing by slightly pushing the latches on the front above the CAN connectors and at the bottom behind the power connector, e.g. with a flat tip screwdriver.
2. Pull out the circuit board including the front part of the casing.



Positions S1 and S2 of the switch blocks for the termination of the CAN channels

3. Change the termination settings for the CAN channels using the switches on the circuit board (switch blocks S1 and S2).

For a CAN channel, both switches of a switch block must have the same setting.

4. For the assembly of the PCAN-Repeater DR, slide the board including the front part back into the plastic casing and press the casing together (the latches click in).

2.5 Listen-only Mode

The listen-only mode can be activated for CAN channel 1 or CAN channel 2. If the listen-only mode is activated for CAN channel 1, the nodes on this bus can receive messages from CAN channel 2, but no data (including acknowledge) is transmitted from CAN channel 1 to channel 2.

At delivery, the PCAN-Repeater DR has the listen-only mode switched off.



Note: The listen-only mode may only be activated for a single CAN channel. If both CAN channels have the listen-only mode activated, the complete message transmission is blocked.

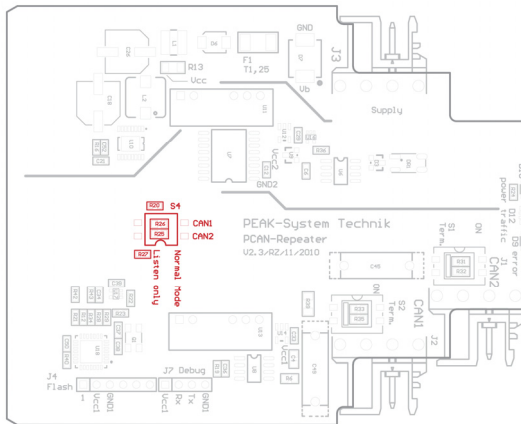


Proceed as follows to change the listen-only mode setting:



Important note: Before opening the PCAN-Repeater DR, disconnect it from the power supply.

1. Open the plastic casing by slightly pushing the latches on the front above the CAN connectors and at the bottom behind the power connector, e.g. with a flat tip screwdriver.
2. Pull out the circuit board including the front part of the casing.



Position S4 of the switch block for the listen-only mode

3. Activate the listen-only mode for a CAN channel with the switch on the circuit board (switch block S4).
4. For the assembly of the PCAN-Repeater DR, slide the board including the front part back into the plastic casing and press the casing together (the latches click in).

3 Operation

3.1 Initial Steps


- ▶ To integrate the PCAN-Repeater DR into your CAN network, proceed as follows:
1. Mount the PCAN-Repeater DR at the appropriate position on the DIN rail by hanging it in at the top of the rail and snapping it to the bottom.
 2. Connect each of the two CAN ports with the corresponding CAN network. Make sure that both CAN buses use the same bit rate.
 3. Connect the PCAN-Repeater DR to a power supply (8 - 30 V DC).

The PCAN-Repeater DR now forwards the CAN messages 1 to 1.

For operating the PCAN-Repeater DR in a CAN FD network, there are notes in Appendix C on page 21.

3.2 Status LEDs

LED	Status	Meaning
Error	Red flashing once	Communication error (error frames)
Traffic	Orange on	Bit rate detection is executed or a bit rate could not be detected
	Off	No CAN communication
	Green slow blinking (2 Hz)	Bus load up to 19 %
	Green quick blinking (4 Hz)	Bus load 20 to 49 %
	Orange slow blinking (2 Hz)	Bus load 50 to 79 %
	Orange quick blinking (4 Hz)	Bus load 80 to 100 %
Power	Green on	Power supply is present

 **Note:** The status indication by the Error and the Traffic LEDs always refer to the CAN bus being connected to CAN channel 1 (relevant for the listen-only mode).

3.3 Bus Load and Error Indication

In order to be functional, the bus load and the error indication (LEDs Traffic and Error) require the use of standard bit rates.

Bus load and error indication

Supported CAN bit rates (kbit/s)	1000, 800, 500, 250, 200, 125, 100, 95.2, 83.3, 50, 47.6, 33.3, 20
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Behavior of the indicator function:

- The used CAN bit rate is detected automatically. The supported transmission rates are tried out. During the detection phase, the Traffic LED is lit orange. The duration of this process depends on the CAN traffic and on the bit rate being used on the CAN bus (200 successive CAN messages must have been detected faultlessly).

- └ The indication function does not influence the transmission of CAN messages.
- └ If the indication function detects a significantly increased error rate, it assumes that the bit rate has changed and re-executes the bit rate detection.
- └ After switching off the PCAN-Repeater DR and switching it on again later, the indication function uses the last detected bit rate.

4 Application Examples

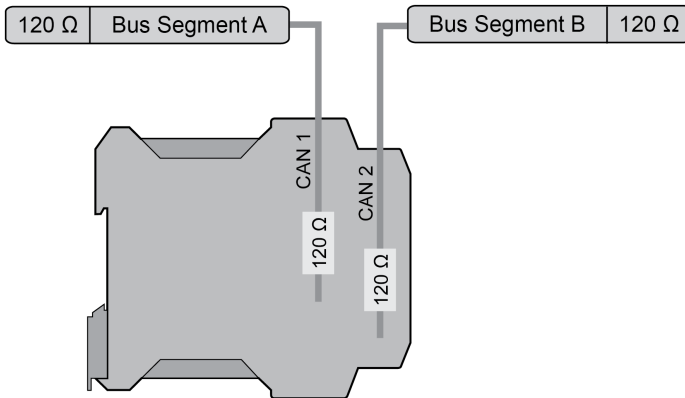
This section describes two application examples for the PCAN-Repeater DR:

- Decoupling of Two Bus Segments (below)
- Implementation of a Long Stub Line (on page 15)



Note: The PCAN-Repeater DR cannot be used to extend the length of a CAN bus beyond the maximum distance of two nodes.

4.1 Decoupling of Two Bus Segments



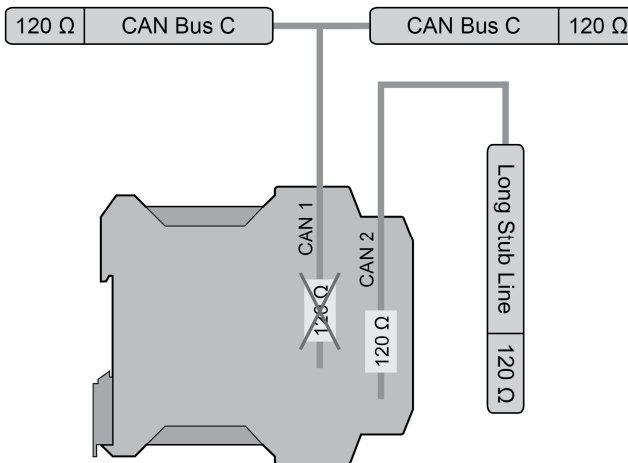
The PCAN-Repeater DR is used to establish a galvanic isolation between two bus segments (A and B).

Both new bus segments must each be terminated with two 120-Ohm resistors. As the PCAN-Repeater DR has already an activated

internal termination (120 Ohms) on each CAN channel, no further action is required during installation.

If the bus segment B is only used for monitoring of the CAN traffic on segment A, the listen-only mode can be activated for CAN channel 2 (see section 2.5 on page 9). Thus, segment B has no influence on segment A.

4.2 Implementation of a Long Stub Line



The PCAN-Repeater DR is used to implement a long stub line.

Normally, a CAN bus must have a line structure. Stub lines (connections for nodes within the CAN line) may only be short in order to avoid a star structure that can affect high-frequency electronic signals.

Since a fully terminated CAN bus C is assumed, the internal termination for CAN channel 1 must be deactivated (activated on delivery, see section 2.4 on page 8). Because the PCAN-Repeater DR

forms one end of the long stub line, the termination on CAN channel 2 remains activated.

If the CAN stub is only used for monitoring of the CAN traffic on CAN bus C, the listen-only mode can be activated for CAN channel 2 (see section 2.5 on page 9). Thus, the CAN nodes on the stub line have no influence on CAN bus C.

5 Technical specifications

Connectors	
CAN	2 x Phoenix connector 4-pin ²
Power	Phoenix connector 4-pin ²

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (Standard format) and 2.0B (Extended format)
Bit rates	5 kbit/s - 1 Mbit/s
Transceiver	NXP PCA82C251
Galvanic isolation	Up to 5 kV DC or 3.5 kV AC, between both CAN channels and between CAN and power supply
Termination	120 Ohm, switchable for each CAN channel, activated on delivery
Listen-only mode	Switchable for CAN channel 1 or 2
Transit delay	115 ns (corresponds to about 23 m cable length)

Power supply	
Supply voltage	8 - 30 V DC
Current consumption	70 mA at 9 V 30 mA at 24 V

Measures	
Size	22.5 x 99 x 114.5 mm (W x H x D) See also dimension drawing in Appendix B on page 20
Weight	96 g

² Phoenix Contact type MSTB 2,5/4-ST BK - 1756298

Environment

Operating temperature	-40 - +85 °C (-40 - +185 °F)
Temperature for storage and transport	-40 - +100 °C (-40 - +212 °F)
Relative humidity	15 - 90 %, not condensing
Ingress protection (IEC 60529)	IP20

Conformity

EMV	Directive 2014/30/EU DIN EN 61326-1:2013-07 Extended interference immunity: IEC61000-4-6 (10 V eff.) IEC61000-4-3 (20 V/m)
Safety	IEC 60601-1
RoHS 2	Directive 2011/65/EU DIN EN 50581 VDE 0042-12:2013-02


Appendix A CE Certificate

EU Declaration of Conformity



This declaration applies to the following product:

Product name: PCAN-Repeater DR
Item number(s): IPEH-004038
Manufacturer: PEAK-System Technik GmbH
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

 We declare under our sole responsibility that the mentioned product is in conformity with the following directives and the affiliated harmonized standards:

EU Directive 2011/65/EU (RoHS 2)

DIN EN 50581 VDE 0042-12:2013-02

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances;
German version EN 50581:2012

EU Directive 2014/30/EU (Electromagnetic Compatibility)

DIN EN 61326-1:2013-07

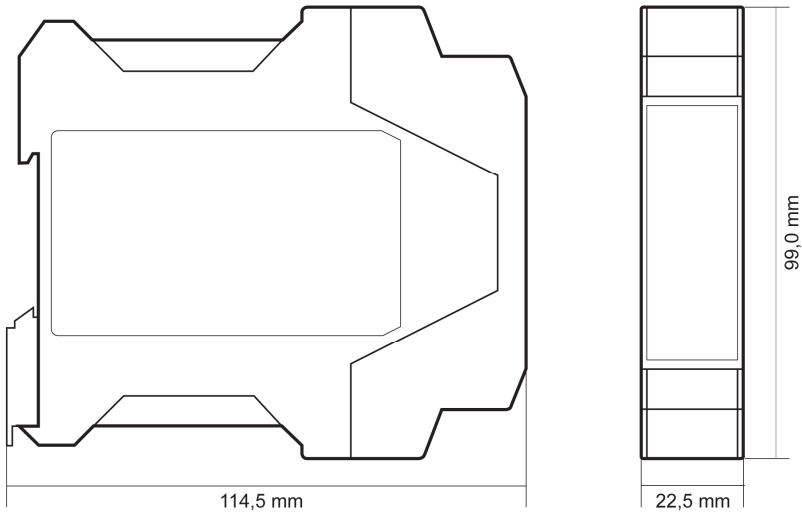
Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2012);
German version EN 61326-1:2013

Darmstadt, 22 February 2019

A handwritten signature in black ink, appearing to read "Uwe Wilhelm".

Uwe Wilhelm, Managing Director

Appendix B Dimension Drawing



The figure does not show the actual size of the product.

Appendix C Operation in a CAN FD Network

The circuit logic in the PCAN-Repeater DR does not distinguish between different CAN protocols. That's why CAN FD frames are also transmitted correctly.

In addition, a CAN 2.0 controller with activated listen-only mode is implemented that is used for bus load and error detection, but it cannot interpret CAN FD frames. However, this does not have any influence on the CAN and CAN FD communication between both CAN channels.

If you are using the PCAN-Repeater DR in a CAN FD network, note the following:

- └ The data bitrate of CAN FD frames can be set to a maximum of 4 Mbit/s.
- └ The Error status LED flashes red on CAN FD frames (e.g. in mixed operation with CAN 2.0 frames).
- └ Alternatively, the Traffic status LED is lit orange, because CAN FD bitrates cannot be detected.