

PCAN-Repeater DR

CAN Repeater for Decoupling
Bus Segments

User Manual



Document version 2.4.0 (2024-06-19)

PEAK
System

Relevant products

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

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Contents

1	Introduction	4
1.1	Properties at a Glance	4
1.2	Operation Requirements	5
1.3	Scope of Supply	5
2	Installation	6
2.1	CAN Ports	6
2.2	Power supply connection	6
2.3	Influence on Maximum Bus Length	7
2.4	CAN Termination	7
2.5	Transmission Limitation	9
3	Operation	11
3.1	Initial Steps	11
3.2	Status LEDs	12
3.3	Bus Load and Error Indication	12
4	Application Examples	14
4.1	Decoupling of Two Bus Segments	14
4.2	Implementation of a Long Stub Line	15
5	Technical Specifications	16
	Appendix A Operation in a CAN FD Bus	18
	Appendix B Dimension Drawing	19
	Appendix C Conformity	20
C.1	CE Certificate	20
C.2	UKCA Certificate	21
	Appendix D Disposal	22

1 Introduction

The PCAN-Repeater DR establishes a galvanic isolation of up to 5 kV within a High-speed CAN bus. The two CAN ports are decoupled from each other and from the power supply. All message traffic including error frames is forwarded 1 to 1 between both ports. The PCAN-Repeater DR behaves passively and is transparent from the perspective of the CAN bus. LEDs display the current bus status.

The PCAN-Repeater finds application in the realization of long stub lines or the galvanic isolation of two CAN bus segments. With its DIN rail casing and extended temperature range support, it is suitable for use in an industrial environment.

The PCAN-Repeater DR can be used in CAN FD buses with data bit rates up to 4 Mbit/s and nominal bit rates up to 1 Mbit/s. For operating the PCAN-Repeater DR in a CAN FD bus, there are notes in Appendix A on page 18.

Please note: Due to the CAN protocol, the maximum length of a CAN bus depends on the bit rate. Therefore, a bus cannot be extended with the PCAN-Repeater DR. The physical total length of the CAN bus is reduced with each built-in PCAN-Repeater DR according to its signal delay.

1.1 Properties at a Glance

- Two High-speed CAN ports (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

- └ Suitable for the use in CAN FD buses with data bit rates up to 4 Mbit/s and nominal bit rates up to 1 Mbit/s
- └ Connections for CAN and power supply via 4-pin screw terminal block (Phoenix)
- └ LEDs display CAN bus load and CAN errors (only for CAN 2.0 A/B)
- └ Each CAN port can be selectively terminated
- └ Galvanic isolation rated up to 5 kV according to IEC 60601-1, between both CAN ports and between CAN and power supply
- └ Plastic casing (width: 22.5 mm) for mounting on a DIN rail (IEC 60715 TH35)
- └ Voltage supply from 8 to 30 V
- └ Extended operating temperature range from -40 to +85 °C (-40 to +185 °F)

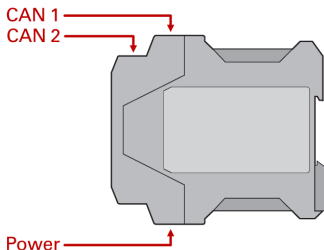
1.2 Operation Requirements

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

1.3 Scope of supply

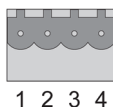
- └ PCAN-Repeater DR in DIN rail plastic casing
- └ 3 mating connectors (Phoenix, type: MSTB 2,5/4-ST BK) for power supply and CAN connectors

2 Installation



2.1 CAN Ports

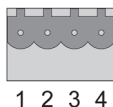
Both CAN ports CAN 1 and CAN 2 are located on the upper side of the casing.



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 to 30 V DC)
4	Shield (DIN rail potential)

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


2.3 Influence on Maximum Bus Length

The PCAN-Repeater DR has a transit delay of 115 ns. This corresponds to a cable length of 23 m which reduces the maximum bus length.

Due to the characteristics of the CAN protocol, the maximum bus length depends on the bit rate.

Bit rate	Maximum bus length	Bus length 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 determined on the basis of an idealized system and can differ from reality.

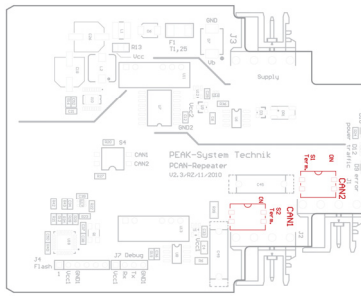
 **Note:** The PCAN-Repeater DR cannot be used to extend the length of a CAN bus beyond the maximum bus length.

2.4 CAN Termination

The termination for each CAN port 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 will arise. Both CAN bus segments that are coupled by the PCAN-Repeater DR must be fully terminated.


- ▶ Proceed as follows to change the termination settings:
1. Before opening the PCAN-Repeater DR, disconnect it from the power supply.
 2. 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.
 3. Pull out the circuit board including the front part of the casing.



Switch blocks S1 and S2 for the termination of the CAN ports


4. Change the termination settings for the CAN ports using the switches on the circuit board (switch blocks S1 and S2). For a CAN port, both switches of a switch block must have the same setting.
5. 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 Transmission Limitation

 **Note:** Use this function only for special purposes. An in-depth understanding of CAN bus communication is required.

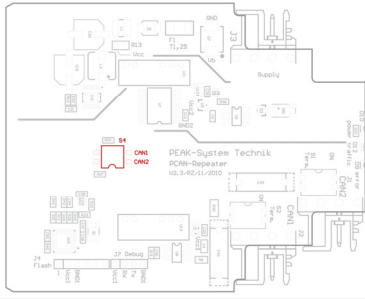
On delivery of the PCAN-Repeater DR, CAN communication is done in both directions without limitation.

The transmission of CAN signals can be completely blocked in one direction. This allows to observe a CAN bus segment without physical interference.

 **Note:** CAN nodes on the observing CAN bus segment must not transmit. Therefore, you must activate the listen-only mode for each of those CAN nodes. Background: If transmission is limited to one direction, no collision detection can take place between both CAN bus segments.

 Proceed as follows to change the setting for the transmission direction:

1. Before opening the PCAN-Repeater DR, disconnect it from the power supply.
2. 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.
3. Pull out the circuit board including the front part of the casing.



Switch block S4 for setting the transmission direction

- Set the transmission direction with switch block S4 according to the following table.

Switch block S4	Transmission direction		Remark
	CAN 1	CAN 2	
1 <input type="checkbox"/> NO CAN1 2 <input type="checkbox"/> NO CAN2	↔		Default setting (recommended)
1 <input type="checkbox"/> NO CAN1 2 <input type="checkbox"/> NO CAN2	→		CAN 2 is observer (only for special purposes)
1 <input type="checkbox"/> NO CAN1 2 <input type="checkbox"/> NO CAN2	←		CAN 1 is observer (only for special purposes)
1 <input type="checkbox"/> NO CAN1 2 <input type="checkbox"/> NO CAN2	✘		No communication!

- 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 bus, 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 bus segment. Make sure that the same bit rate is used on both CAN bus segments.
 3. Connect the PCAN-Repeater DR to a power supply (8 to 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 bus, there are notes in Appendix A on page 18.

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 **Error** and **Traffic** LEDs only work with CAN 2.0 data traffic.

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 at CAN 2.0 data traffic.

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

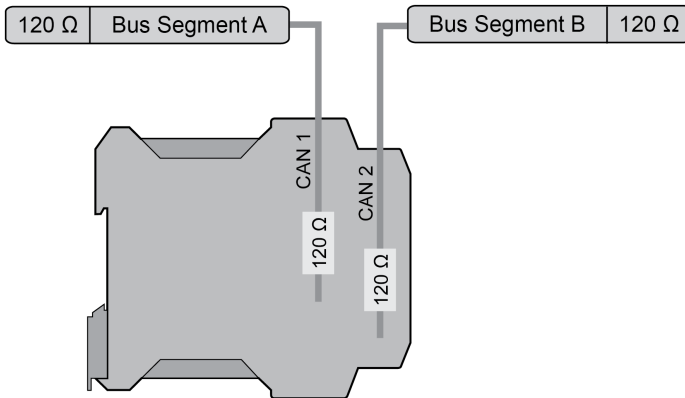
This section describes two application examples for the PCAN-Repeater DR:

- 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

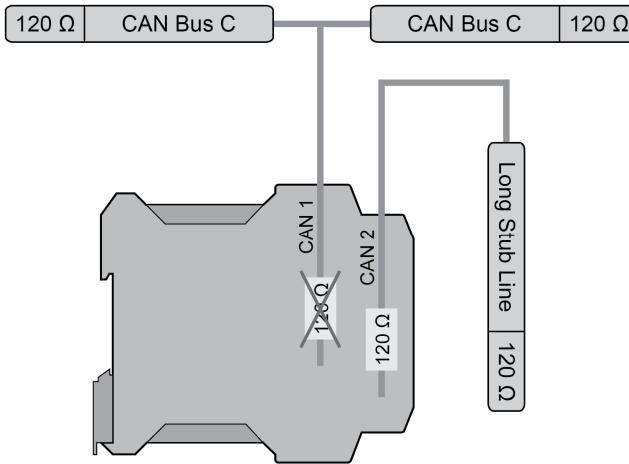


The PCAN-Repeater DR is used to establish a galvanic isolation between two bus segments (A and B).

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 port, no further action is required during installation.

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 on the CAN line) may only be short in order to avoid a star structure. A star structure can affect the high-frequency electronic signals on the CAN bus.

Since a fully terminated CAN bus C is assumed, the internal termination for CAN port 1 must be deactivated (activated on delivery, see section 2.4 on page 7). Because the PCAN-Repeater DR forms one end of the long stub line, the termination on CAN port 2 remains activated.

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 to 1 Mbit/s
Transceiver	NXP PCA82C251
Galvanic isolation	Up to 5 kV DC or 3.5 kV AC (in accordance with IEC 60601-1), between both CAN ports and between CAN and power supply
Termination	120 Ohm, switchable for each CAN port, activated on delivery
Transit delay	115 ns (corresponds to about 23 m cable length)

Power supply

Supply voltage	8 to 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 19
Weight	96 g

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

Environment

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

Conformity

RoHS	EU Directive 2011/65/EU (RoHS 2) + 2015/863/EU DIN EN IEC 63000:2019-05
EMC	EU Directive 2014/30/EU DIN EN 61326-1:2022-11 Extended interference immunity: IEC 61000-4-6 (10 V eff.) IEC 61000-4-3 (20 V/m)

Appendix A Operation in a CAN FD Bus

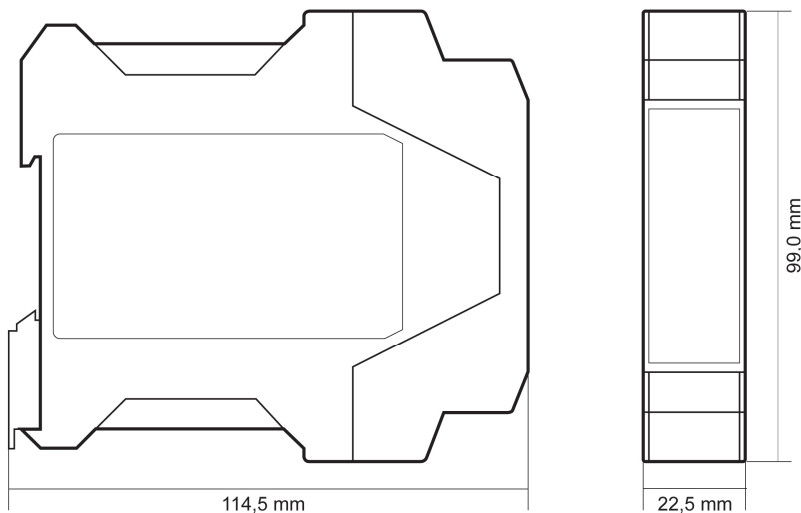
The circuit logic in the PCAN-Repeater DR does not distinguish between different CAN protocols. It transmits CAN traffic bitwise. That's why CAN FD frames are also transmitted correctly.

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 ports.

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

- └ The data bitrate of CAN FD frames may be up to 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 are not detected.

Appendix B Dimension Drawing



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

Appendix C Conformity

C.1 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 Leydheckerstraße 10 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) + 2015/863/EU (amended list of restricted substances)		
DIN EN IEC 63000:2019-05		
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016); German version of EN IEC 63000:2018		
EU Directive 2014/30/EU (Electromagnetic Compatibility)		
DIN EN 61326-1:2022-11		
Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2020); German version of EN IEC 61326-1:2021		
Darmstadt, 7 June 2024		
		
Uwe Wilhelm, Managing Director		

C.2 UKCA Certificate

<h3>UK Declaration of Conformity</h3>		
This declaration applies to the following product:		
Product name:	PCAN-Repeater DR	
Item number(s):	IPEH-004038	
Manufacturer:	UK authorized representative:	
PEAK-System Technik GmbH Leydheckerstraße 10 64293 Darmstadt Germany	Control Technologies UK Ltd Unit 1, Stoke Mill, Mill Road, Sharnbrook, Bedfordshire, MK44 1NN, UK	
	We declare under our sole responsibility that the mentioned product is in conformity with the following UK legislations and the affiliated harmonized standards:	
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012		
DIN EN IEC 63000:2019-05 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016); German version of EN IEC 63000:2018		
Electromagnetic Compatibility Regulations 2016		
DIN EN 61326-1:2022-11 Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements (IEC 61326-1:2020); German version of EN IEC 61326-1:2021		
Darmstadt, 7 June 2024		
		
Uwe Wilhelm, Managing Director		

Appendix D Disposal

The PCAN-Repeater DR must not be disposed of with household waste after decommissioning. Dispose of this electronic device in accordance with local regulations.

The PCAN-Repeater DR does not contain a battery for separate disposal.