PCAN-Router DR

User Manual

PEAK
System

Relevant Product

Product Name	Model	Part Number
PCAN-Router DR	Industry	IPEH-002213

Imprint

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Contents

1   Introduction

The PCAN-Router DR has two High-speed CAN channels. Their bit rate is adjusted with a rotary switch on the device front. The module forwards the message traffic bi-directionally 1:1 between both connected CAN busses.

The ports of the PCAN-Router DR are isolated against each other and against the power supply with at least 500 V. Furthermore, CAN 1 has a separation voltage of up to 5 kV conforming with IEC 60601-1. With its DIN rail casing and the support of the extended temperature range, the module is suitable for use in an industrial environment.

Just like the PCAN-Router in the aluminum casing, the PCAN-Router DR can be freely programmed. A corresponding development package is included in the scope of supply.

1.1   Properties at a Glance

- NXP LPC21 series microcontroller (16/32-bit ARM CPU)
- 32 kbyte EEPROM
- Two High-speed CAN channels (ISO 11898-2)
    - Comply with CAN specifications 2.0 A/B
    - Bit rates from 5 kbit/s up to 1 Mbit/s, adjustable with a rotary switch
    - NXP PCA82C251 CAN transceiver
- Reset of the device with a push button
- Switchable termination for each CAN channel
- Status indication via LEDs for the module status, both CAN channels, and the power supply
- Connections for CAN, RS-232, and power supply via 4-pole screw-terminal strips (Phoenix)
- CAN 1 is isolated up to 5 kV against CAN 2, RS-232, and the power supply (compliant with IEC 60601-1)
- CAN 2 and RS-232 are isolated with 500 V against each other and against the power supply
- Plastic casing (width: 22.5 mm) for mounting on a DIN rail (DIN EN 60715 TH35)
- Voltage supply from 8 to 30 V
- Extended operating temperature range from -40 to +85 °C (-40 to +185 °F)
- RS-232 connector for serial data transfer (reserved for future use)
- New firmware can be loaded via CAN interface

1.2   Scope of Supply

- PCAN-Router DR in DIN rail plastic casing
- Mating connectors for both CAN channels, RS-232, and power supply (Phoenix Contact MSTB 2.5/4-ST BK - 1756298)

Download

- Windows development package with:
  - GCC ARM Embedded
  - Flash program
  - Programming examples
- Manual in PDF format

1.3   Prerequisites for Operation

- Power supply in the range of 8 to 30 V DC
- For uploading a new firmware via CAN:
  - CAN interface of the PCAN series for the computer (e.g. PCAN-USB)
  - Operating system Windows 11 (x64/ARM64), 10 (x86/x64)
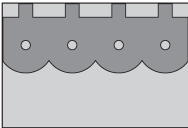
2 Connections and Operating Elements
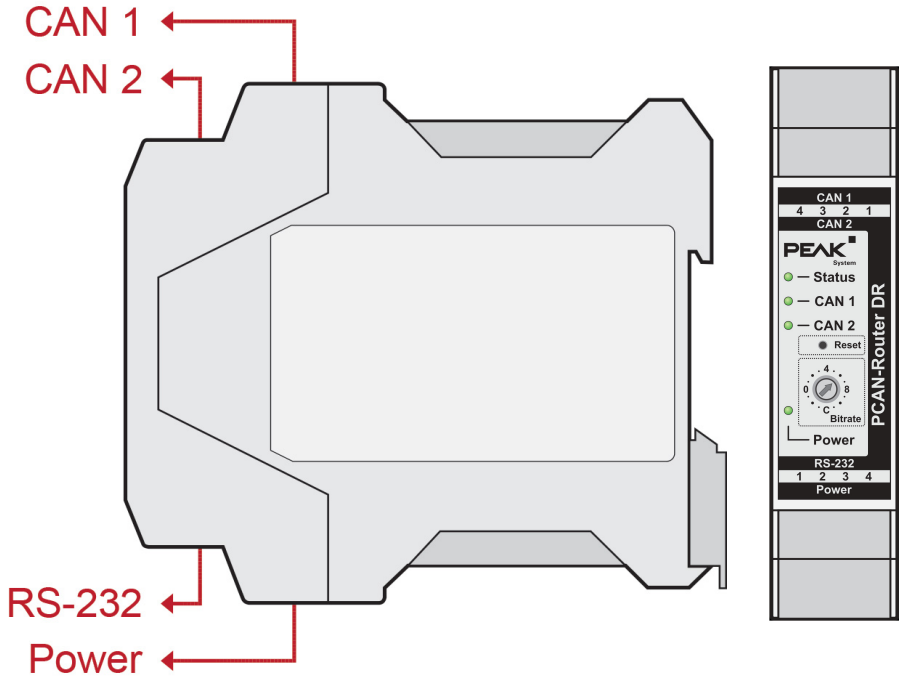
Connections and operating elements on the PCAN-Router DR
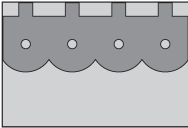
2.1   CAN 1/CAN 2

The CAN connectors are located on the upper side of the casing.

CAN Connector (Phoenix)	Pin	Function
	1	CAN_High
	2	CAN_Low
	3	CAN GND
1 2 3 4	4	CAN Shield
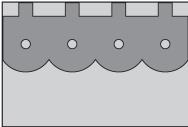
2.2   RS-232

The RS-232 connector is located on the lower side of the casing.

CAN Connector (Phoenix)	Pin	Function
	1	GND
	2	RxD
	3	not connected
1 2 3 4	4	TxD

2.3   Power Supply

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

CAN Connector (Phoenix)	Pin	Function
	1	GND
	2	not connected
	3	V_{bat} (8 - 30 V)
	4	Shield

2.4   Galvanic Isolation of the Connections
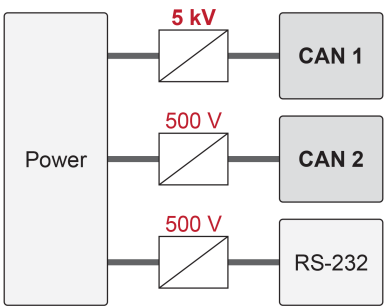
Galvanic isolation

The ports of the PCAN-Router DR are isolated against each other and against the power supply with at least 500 V. Furthermore, CAN 1 has a separation voltage of up to 5 kV conforming with IEC 60601-1.

2.5   Rotary Switch

The rotary switch of the PCAN-Router DR can be used to set the CAN bit rate and activate the CAN bootloader. The selected bit rate applies to both CAN channels.

The setting for the bit rate is explained in section 3.1 *Configure Bit Rate*.

The activation for the CAN bootloader is explained in section 3.2 *Activate CAN Bootloader*.

2.6   Reset Push Button
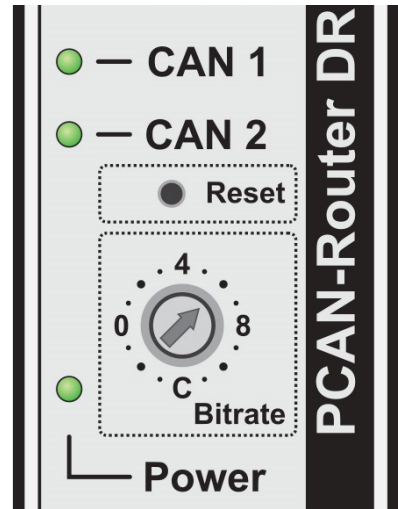
The reset button is located behind a small hole on the front of the PCAN-Router DR. The reset button can be used to restart the PCAN-Router DR.

The application is explained in section 4.2 *Restart*.

3 Hardware Configuration

3.1 Configure Bit Rate

Using the rotary switch of the PCAN-Router DR, the CAN bit rate can be adjusted. The selected bit rate applies to both CAN channels. At delivery, the switch is set to C (500 kbit/s). A changed setting takes effect after the reset of the PCAN-Router DR. Performing a reset is described in section 4.2 *Restart*.

Rotary Switch	Switch Position	Bit Rate
	0 (left)	5 kbit/s
	1	10 kbit/s
	2	20 kbit/s
	3	33.3 kbit/s
	4 (top)	47.6 kbit/s
	5	50 kbit/s
	6	83.3 kbit/s
	7	95.2 kbit/s
	8 (right)	100 kbit/s
	9	125 kbit/s
	A	200 kbit/s
	B	250 kbit/s
	C (bottom)	500 kbit/s
	D	800 kbit/s
	E	1 Mbit/s
	F	CAN-Bootloader

3.2 Activate CAN Bootloader

With rotary switch position F the CAN bootloader is activated after a reset. This allows you to transfer a self-created firmware to the PCAN-Router DR via CAN. The upload procedure is described in detail in chapter 6 *Firmware Upload*.
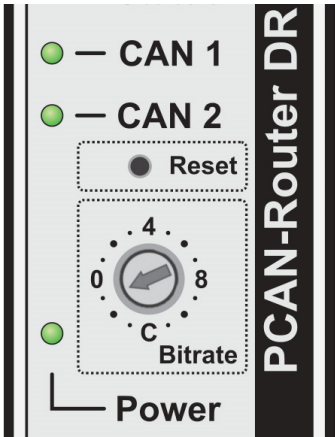
Rotary switch position F for activation of the CAN bootloader

When the CAN bootloader is activated, the LEDs indicate the following states:

LED	Status
Status	off
CAN 1	orange blinking
CAN 2	orange on

3.3   Internal Termination

The termination for each CAN channel can be separately activated with switches on the board. At delivery, the termination is switched off. A High-speed CAN bus (ISO 11898-2) must be terminated on both cable ends with 120 Ω. Otherwise, malfunctions may arise.

> We recommend to do termination at the CAN cabling, for example with the terminating resistors PCAN-Term (IPEK-003002) or PCAN-MiniTerm (IPEK-003002-Mini). Thus, CAN nodes can be flexibly connected to the bus.

Activate internal termination:

> **Attention!** Electrostatic discharge (ESD) can damage or destroy components on the card. Take precautions to avoid ESD.

1. Disconnect the power supply to the PCAN-Router DR.

2. Using a slotted screwdriver, lightly press into the recesses of the latches on the top and bottom of the housing.
   The latches are unlocked.
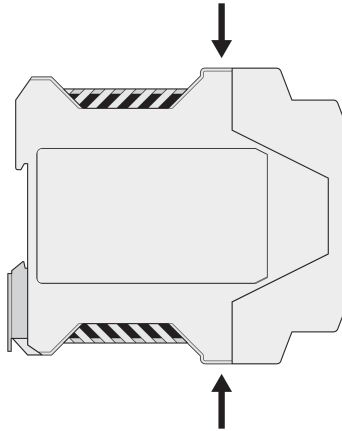
Side view PCAN-Router DR

3. Pull out the front of the housing together with the circuit board.
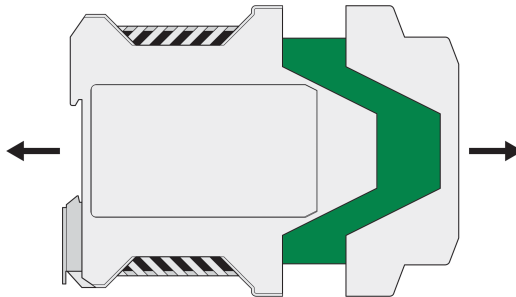
Open housing with the circuit board

4. Make the desired setting(s).

The following figure shows the positions of the switches term. CAN-1 and term. CAN-2. The table below contains the possible settings.

> **ℹ Note:** Notice that both switches of each switch block have to be set to On to activate the internal termination.
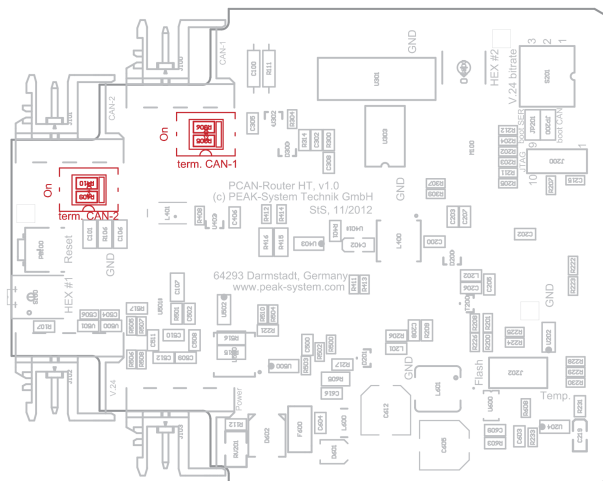
Switch on the circuit board for the termination of the CAN channels

CAN Connector	Switching Block	Off (default)	Active
CAN 1	term. CAN-1	No internal termination	120 Ω between CAN_L and CAN_H
CAN 2	term. CAN-2	No internal termination	120 Ω between CAN_L and CAN_H

5. Re-insert the board with the housing front into the guide slot of the housing.
6. Push both halves of the housing together until the snap locks engage with a clicking sound.

4 Operation

The PCAN-Router DR is activated by applying the supply voltage to the respective connectors. More information about the connections can be found in chapter 2 *Connections and Operating Elements*. The firmware in the flash memory is subsequently run.

On delivery, the PCAN-Router DR is supplied with an standard firmware which forwards CAN messages 1:1 between the two channels. The bit rate selected at the rotary switch is used. An incoming CAN message causes a change between green and orange of the LED status indication for the respective CAN channel.

Information on firmware can be found in chapter 15 *Creating Own Firmware*.

4.1   First Steps

1. Mount the PCAN-Router 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.

3. If the bit rate is different from the default 500 kbit/s, set the bit rate with the rotary switch (see section 3.1 *Configure Bit Rate*).
    The new bit rate takes effect after reset (see section 4.2 *Restart*).

4. Connect the PCAN-Router DR to a power supply (8 to 30 V DC).

The PCAN-Router DR now forwards the CAN messages one on one.

4.2 Restart

For a restart, the reset button can be pressed with a paper clip, for example. Alternatively, the voltage supply can be disconnected and reconnected.
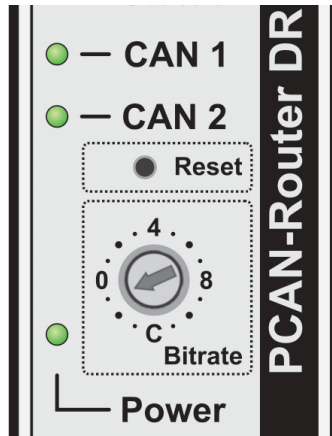
4.3   Signal Delay

The signal delay at forwarding of a CAN message consists of a fixed processing time of the microcontroller of about 30 μs and a variable delay depending on message length and bit rate.

For example, the signal delay of a CAN message with an 11-bit ID and eight data bytes at 500 kbit/s is approximately 260 μs.

4.4   Status LEDs

A standard firmware is pre-installed on delivery. Therefore, the LEDs CAN 1 and CAN 2 light up between green and red on incoming and outgoing CAN messages.

The LEDs can indicate the following states:

LED	Status	Meaning
Status	Off	No CAN communication
	Green blinking	Operational
	Red flashing	Reset
CAN 1/CAN 2	Green blinking	Data is transmitted
	Red flashing	Communication error (error frames)
Power	Green on	Power supply is present

Additionally, they light up orange when the bootloader is activated. Additional LED functions can be programmed with your own firmware. More details can be found in the programming examples supplied.

5 Creating Own Firmware

With the help of the PEAK-DevPack development package, you can program your own application-specific firmware for PEAK-System programmable hardware products. For each supported product, examples are included.

On delivery the PCAN-Router DR is supplied with the standard firmware which forwards CAN messages 1:1 between both CAN channels.

System requirements:

- Computer with operating system Windows 11 (x64), 10 (x86/x64)
- CAN interface of the PCAN series to upload the firmware to your hardware via CAN

Download of the development package:

www.peak-system.com/quick/DLP-DevPack

Content of the package:

- `Build Tools Win32\`
  Tools for automating the build process for Windows 32-bit
- `Build Tools Win64\`
  Tools for automating the build process for Windows 64-bit
- `Compiler\`
  Compilers for the supported programmable products
- `Debug\`
  - OpenOCD and configuration files for hardware which supports debugging
  - VBScript `SetDebug_for_VSCode.vbs` to modify the example directories for the Visual Studio Code IDE with Cortex-debug
  - Detailed information about debugging in the enclosed documentation of the PEAK-DevPack Debug Adapter

- `Hardware\`

  Sub directories with firmware examples for supported hardware. Use the examples for starting your own firmware development.
- `PEAK-Flash\`

  Windows software for uploading the firmware to your hardware via CAN
- `LiesMich.txt` and `ReadMe.txt`

  Short documentation how to work with the development package in German and English
- `SetPath_for_VSCode.vbs`

  VBScript to modify the example directories for the Visual Studio Code IDE

Creating your own firmware:

1. Create a folder on your computer. We recommend using a local drive.

2. Unzip the development package `PEAK-DevPack.zip` completely into the folder. No installation is required.

3. Run the script `SetPath_for_VSCode.vbs`. This script will modify the example directories for the Visual Studio Code IDE. Afterwards, each example directory has a folder called `.vscode` containing the needed files with your local path information.

4. Launch Visual Studio Code. The IDE is available free of charge from Microsoft: https://code.visualstudio.com.

5. Select the folder of your project and open it. For example:
   `d:\PEAK-DevPack\Hardware\PCAN-Router_DR\Examples\
   01_ROUTING`

   You can edit the C code and use the menu *Terminal > Run Task* to call *make clean*, *make all*, or to compile a single file.

6. Create your firmware with *make all*. The firmware is the `*.bin` in the `out` subdirectory of your project folder.

7. Prepare your hardware for firmware upload like described in section 6.2 *Preparing the Hardware*.

8. Use the PEAK-Flash tool to upload your firmware to the PCAN-Router DR via CAN.

    The tool is either started via the menu *Terminal > Run Task > Flash Device* or from the subdirectory of the development package. Chapter 6.2 *Preparing the Hardware* describes the process. A CAN interface of the PCAN series is required.

5.1 Library

The development of applications for the PCAN-Router DR is supported by the library `libPCAN-RouterDRGNU*ys.a` (* stands for version number), a binary file. You can access all resources of the PCAN-Router DR by means of this library. The library is documented in the header files (`*.h`) which are located in the `inc` subdirectory of each example directory.

6 Firmware Upload

The PCAN-Router DR is equipped with new firmware via CAN and the Windows program PEAK-Flash. For this, the bootloader must be activated via the rotary switch on the front of the PCAN-Router DR.

6.1 System Requirements

- CAN interface of the PCAN series for the computer, for example PCAN-USB
- CAN cabling between the CAN interface and the PCAN-Router DR with correct termination at both ends of the CAN bus with 120 Ohm each.
- Operating system Windows 11 (x64/ARM64), 10 (x86/x64)

6.2 Preparing the Hardware

For uploading new firmware via CAN, the CAN bootloader must be activated in the PCAN-Router DR. This is done with the help of the rotary switch on the front of the PCAN-Router DR.

Activate CAN bootloader:

1. Note the current setting of the rotary switch and then turn it to F (one notch below 0).

2. Restart the PCAN-Router DR by pressing the reset button with a paper clip, for example, or briefly interrupting the power supply.

   The change of the rotary switch is now active.

3. The active CAN bootloader is displayed as follows:

LED	Status
Status	off
CAN 1	orange blinking
CAN 2	orange on

4. Continue with section 6.3 *Firmware Transfer*.

6.3 Firmware Transfer

The firmware is uploaded via a CAN bus using the Windows software PEAK-Flash and is only possible with the CAN 1 connector. This must be connected to the computer alone.

Transfer firmware with PEAK-Flash:

The software PEAK-Flash is included in the development package, which can be downloaded via the following link: www.peak-system.com/quick/DLP-DevPack

1. Open the zip file and extract it to your local storage medium.

2. Run the `PEAK-Flash.exe`.
   The main window of PEAK-Flash appears.
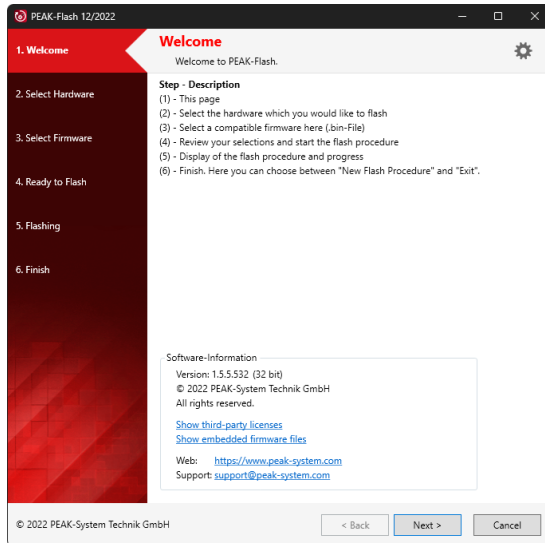
3. Click the button *Next*.

   The *Select Hardware* window appears.
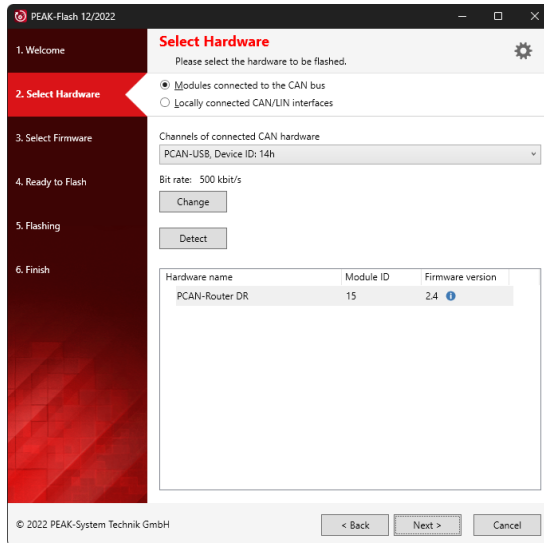
4. Click on the *Modules connected to the CAN bus* radio button.

5. In the drop-down menu *Channels of connected CAN hardware*, select a CAN interface connected to the computer.

6. In the drop-down menu *Bit rate*, select the nominal bit rate 500 kbit/s.

7. Click on *Detect*.

   In the list, the PCAN-Router DR appears together with the Module ID and Firmware version. If not, check whether a proper connection to the CAN bus with the appropriate nominal bit rate exists.

8. Click *Next*.

   The *Select Firmware* window appears.
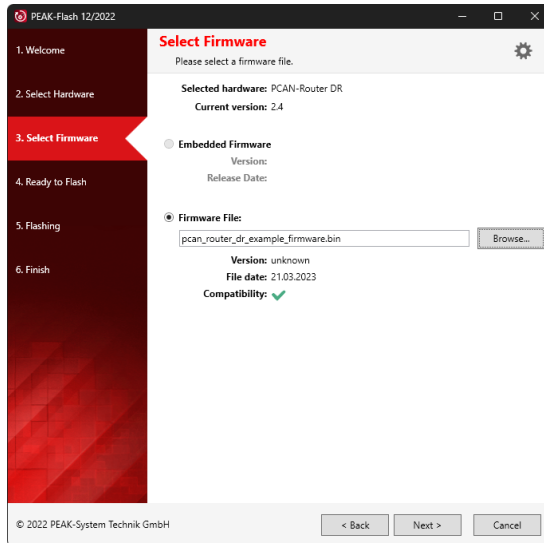
9. Select the *Firmware File* radio button and click *Browse*.

10. Select the corresponding file (`*.bin`).

11. Click *Next*.

    The *Ready to Flash* dialog appears.

12. Click *Start* to transfer the new firmware to the PCAN-Router DR.
    The *Flashing* dialog appears.

13. After the process is complete, click *Next*.

14. You can exit the program.

15. Turn the rotary switch to the previously noted position or to another required position.

16. Restart the PCAN-Router DR.

You can now use the PCAN-Router DR with the new firmware.

7 Technical Data

Connectors	
Power	Phoenix connector 4-pin[1]
CAN channel 1 and 2	2 x Phoenix connector 4-pin[1]
RS-232	Phoenix connector 4-pin[1]

[1] Phoenix connector, type MSTB 2.5/4-ST BK, order no. 1756298

CAN		
Protocols	CAN 2.0 A/B	
Physical transmission	ISO 11898-2, High-speed-CAN	
Transceiver	NXP PCA82C251	
CAN bit rates	Nominal: 5 kbit/s to 1 Mbit/s	
Controller	Internal CAN controller	
Supported clock frequencies	60 MHz	
Supported bit timing values		Nominal
	Prescaler (BRP)	1 to 1024
	Time Segment 1 (TSEG1)	1 to 16
	Time Segment 2 (TSEG2)	1 to 8
	Synch. Jump Width (SJW)	1 to 4
Galvanic isolation	CAN 1 is isolated up to 5 kV against CAN 2, RS-232, and the power supply (compliant with IEC 60601-1) CAN 2 and RS-232 are isolated with 500 V against each other and against the power supply	
Internal termination	Switchable for each CAN channel, disabled at delivery	
Listen-only mode	Programmable; not activated at delivery	
Signal delay for CAN message routing	About 260 µs for CAN messages with an 11-bit ID and eight data bytes at a nominal bit rate of 500 kbit/s	

RS-232	
Bit rate max.	115200 Baud
Signal level max.	±14 V
Galvanic isolation	RS-232 is isolated - with 500 V against CAN 2 and the power supply - with 5 kV against CAN 1

Power Supply	
Operating voltage	8 to 30 V DC
Supply type	External supply
Current consumption	Max. 223 mA, typ. 110 mA at 12 V without load
Protection	±1 kV surge protection -60 V reverse polarity protection ±4 kV ESD protection
Microcontroller backup supply	none
Power saving modes	none

Microcontroller	
CPU	LPC2194 (based on Arm® ARM7TDMI-S CPU)
Clock frequency	60 MHz
Voltages	Core: 1.8 V; I/O: 3.3 V
RAM	128 kByte SDRAM
Firmware upload	Via CAN (PCAN interface required)

Measures	
Size	22.5 x 99 x 114.5 mm (W x H x D)
Weight	101 g

Environment	
Operating temperature	-40 to +85 °C (-40 to +185 °F)
Temperature for storage and transport	-55 to +125 °C (-67 to +257 °F)
Relative humidity	15 to 90 %, not condensing
Ingress protection (IEC 60529)	IP20

Conformity	
RoHS 2	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

Appendix A   CE Certificate

EU Declaration of Conformity

.PEAK
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This declaration applies to the following product:

Product name:	**PCAN-Router DR**
Item number(s):	**IPEH-002213**
Manufacturer:	PEAK-System Technik GmbH Leydheckerstraße 10 64293 Darmstadt Germany

CE   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, 15 May 2024

Uwe Wilhelm, Managing Director

Appendix B UKCA Certificate

UK Declaration of Conformity

.PEAK
System

This declaration applies to the following product:

Product name:	**PCAN-Router DR**
Item number(s):	**IPEH-002213**

Manufacturer:

PEAK-System Technik GmbH
Leydheckerstraße 10
64293 Darmstadt
Germany

UK authorized representative:

Control Technologies UK Ltd
Unit 1, Stoke Mill,
Mill Road, Sharnbrook,
Bedfordshire, MK44 1NN, UK

UK CA

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

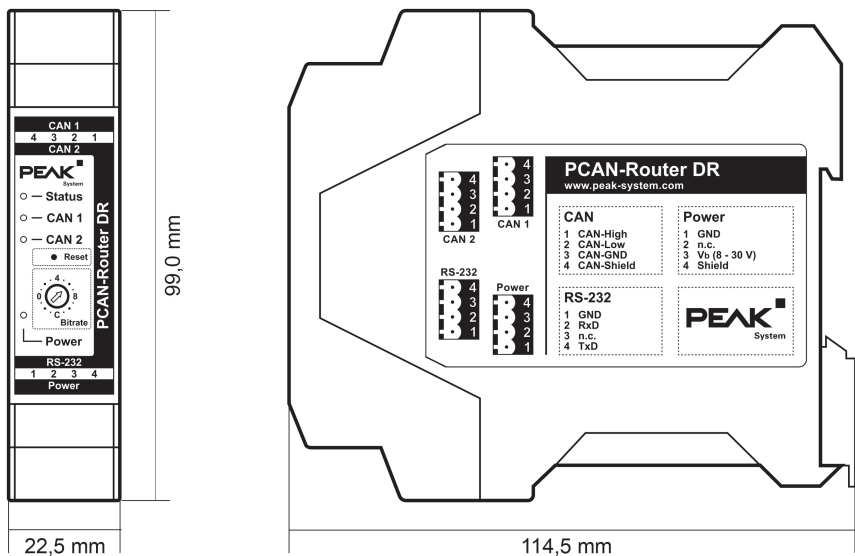**Electromagnetic Compatibility Regulations 2016**

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, 15 May 2024

Uwe Wilhelm, Managing Director

Appendix C   Dimension Drawings

99,0 mm

22,5 mm

114,5 mm

PCAN-Router DR
www.peak-system.com

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

Power
1 GND
2 n.c.
3 Vb (8 - 30 V)
4 Shield

RS-232
1 GND
2 RxD
3 n.c.
4 TxD

Appendix D Disposal

The PCAN-Router DR must not be disposed of in household waste. Dispose of the PCAN-Router DR properly in accordance with local regulations.