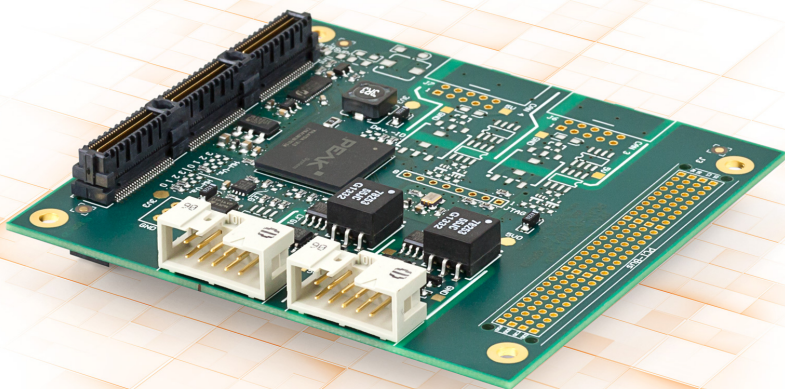


# PCAN-PCI/104-Express

## User Manual



# Relevant Products

Product name	Model	Part number
PCAN-PCI/104-Express Single Channel	One CAN channel	IPEH-003054
PCAN-PCI/104-Express Double Channel	Two CAN channels	IPEH-003055
PCAN-PCI/104-Express Single Channel opto-decoupled	One CAN channel, galvanic isolation for CAN connection	IPEH-003056
PCAN-PCI/104-Express Double Channel opto-decoupled	Two CAN channels, galvanic isolation for CAN connection	IPEH-003057
PCAN-PCI/104-Express Quad Channel opto-decoupled	Four CAN channels, galvanic isolation for CAN connection	IPEH-003058

The cover picture shows the product PCAN-PCI/104-Express Double Channel opto-decoupled. Other product versions have an identical form factor but vary in equipment.

## Imprint

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# 1 Introduction

The CAN interface PCAN-PCI/104-Express for a PC/104-Plus computer is available as a version with one, two, or four channels. The CAN bus is connected via a 9-pin D-Sub connector on the supplied slot bracket. Operation of up to four CAN interfaces plugged into each other is possible.

Opto-decoupled CAN interfaces only: Galvanic isolation up to 500 V for each CAN channel protects against the transmission of electrical interference peaks between the CAN channels and the computer.

The monitor software PCAN-View and the programming interface PCAN-Basic for the development of applications with CAN connection are included in the scope of supply.

Device drivers exist for different operating systems, so programs can easily access a connected CAN bus.



This manual describes the use of the CAN interface with **Windows**.  
Device drivers and application information for **Linux**:  
[www.peak-system.com/quick/DL-Driver-E](http://www.peak-system.com/quick/DL-Driver-E)



At the end of this manual you can find a Quick Reference with brief information about the installation and operation of the CAN interface.

# 1.1 Properties at a Glance

- PCI/104-Express card, 1 Lane (x1)
- Form factor PC/104
- Up to four cards can be used in one system
- 1, 2 or 4 High-speed CAN channels (ISO 11898-2)
- Bit rates from 5 kbit/s up to 1 Mbit/s
- Complies with CAN specifications ISO 11898-1 for CAN
- Connection to CAN bus through D-Sub slot brackets, 9-pin (in accordance with CiA® 303-1)
- FPGA implementation of the CAN controller (SJA1000 compatible)
- NXP PCA82C251 CAN transceiver
- Voltage supply for external devices via CAN connection can be connected through a solder jumper
- Galvanic isolation up to 500 V per CAN connection (opto-decoupled versions only)
- Extended operating temperature range from -40 to +85 °C (-40 to +185 °F)
- Optional available: PC/104-ISA stack-through connector

# 1.2 System Requirements

PC/104-Plus computer with

- PCIe/104 connectivity to the host
- Operating system Windows® 11 (64 bit), 10 (32/64 bit) or Linux (32/64-bit)

# 1.3 Scope of Supply

- CAN interface PCAN-PCI/104-Express
- Slot bracket with D-Sub connector(s) for the CAN bus (two for the four-channel version)

## Downloads

- Device drivers for Windows® 11 (64 bit), 10 (32/64 bit) and Linux (32/64-bit)
- CAN monitor PCAN-View for Windows
- Programming interface PCAN-Basic for developing applications with CAN connection
- Programming interfaces for standardized protocols from the automotive sector

# 2 Configuration

Before installing the CAN interface into a PC/104-Plus computer:

Check if you need the following configuration.

## 2.1 Voltage Supply of External Devices



**Attention!** The voltage supply for external devices is not protected separately. Therefore, turn off the computer before you connect and disconnect CAN cables or peripheral systems.

Optionally, an external voltage supply can be connected separately for each CAN channel via solder bridges at pin 9 on the D-Sub connector. This allows external devices to be supplied with a voltage of 5 V DC, for example bus converters (PCAN-TJA1054 for Low-Speed-CAN). Pin 9 is not connected at delivery.

The current output is limited to

- 100 mA without galvanic isolation.
- 50 mA with galvanic isolation.

The lower current output of the versions with galvanic isolation is due to an intermediate DC/DC converter.

## 2.1.1 Activate voltage supply



**Risk of short circuit!** Soldering on the CAN interface may only be performed by qualified electrical engineering personnel.

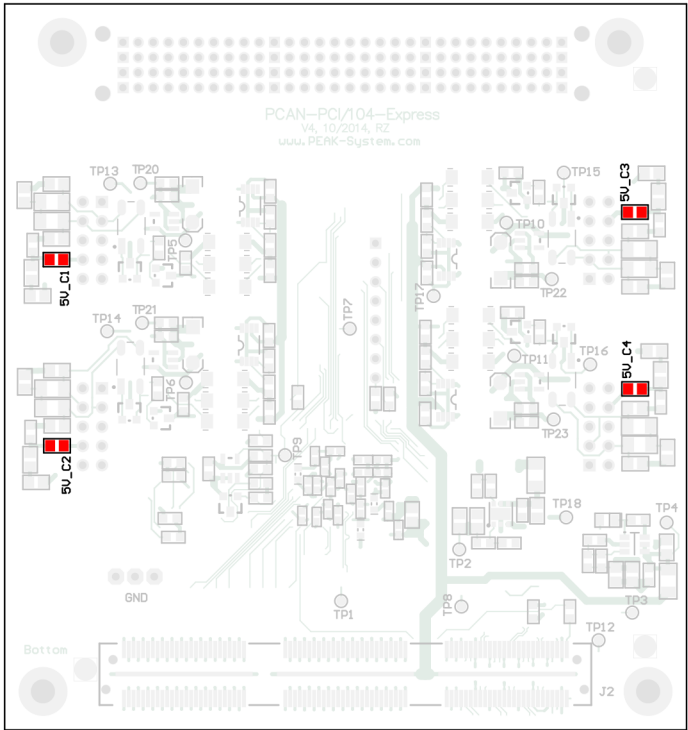


**Attention!** Electrostatic discharge (ESD) can damage or destroy components on the card. Take precautions to avoid ESD.

The solder fields for the power supply of external devices are located on the bottom side of the bottom side of the CAN interface. The following picture shows the solder field positions on the fourchannel card. The solder fields for the single and dual channel versions are located in the same positions.

Set the solder bridge(s) on the card according to the desired settings.





**5-Volt supply via D-Sub plug**

D-Sub connector	Solder field	Without (Standard)	PIN 9
CAN 1	5V_C1		
CAN 2	5V_C2		
CAN 3	5V_C3		
CAN 4	5V_C4		

# 3 Installation

This chapter covers the software setup for the CAN interface PCAN-PCI/104-Express under Windows and the installation of the CAN interface into the PC/104 computer.

**Note:** For installation on Linux, see Appendix D *Linux*.

Install the driver before you install the CAN interface.

## 3.1 Install Device Driver Setup

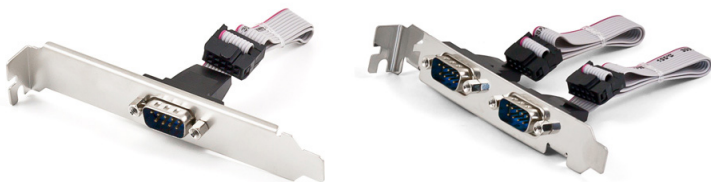
1. Download the device driver setup from our website:  
[www.peak-system.com/quick/DL-Driver-E](http://www.peak-system.com/quick/DL-Driver-E)
2. Unpack the file `PEAK-System_Driver-Setup.zip`
3. Double-click the file `PeakOemDrv.exe`  
The driver setup starts.
4. Follow the program instructions.

## 3.2 Install CAN interface



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

1. Connect one cable per CAN connection from the slot bracket to a 10-pin socket on the CAN interface.



2. Shut down the computer.
3. Disconnect the computer's power supply.
4. Plug the CAN interface directly onto the host or onto another PCI/104 Express card of the PC/104 computer.  
A maximum of four PCI/104-Express cards per stack is possible, either all on top or all beneath the host.
5. Install the slot bracket.
6. Reconnect the computer power supply.
7. Turn on the computer and start Windows.

Windows detects the new hardware and completes the driver installation.

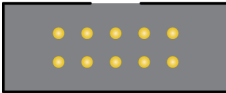

### 3.3 Check Operational Readiness

1. Open the Windows Start menu.
2. Type *Peak Settings* and press .  
The window *PEAK Settings* appears.
3. Select *CAN Hardware*.  
The connected CAN interface is displayed.

# 4 Connecting the CAN Bus

## 4.1 Connection over D-Sub Connector

After the slot bracket has been connected to the CAN interface a CAN bus can be connected to the D-Sub connector. The pin assignment of the D-Sub connector corresponds to the specification CiA<sup>®</sup> 303-1:

10-pin connector on CAN interface	D-Sub plug on slot bracket, 9-pin	
9 7 5 3 1	1 2 3 4 5	
		
10 8 6 4 2	6 7 8 9	<b>Assignment</b>
2	6	GND
3	2	CAN_Low
4	7	CAN_High
5	3	GND
8	9	+5 V (optional)
1, 6, 7, 9, 10	1, 4, 5, 8	None

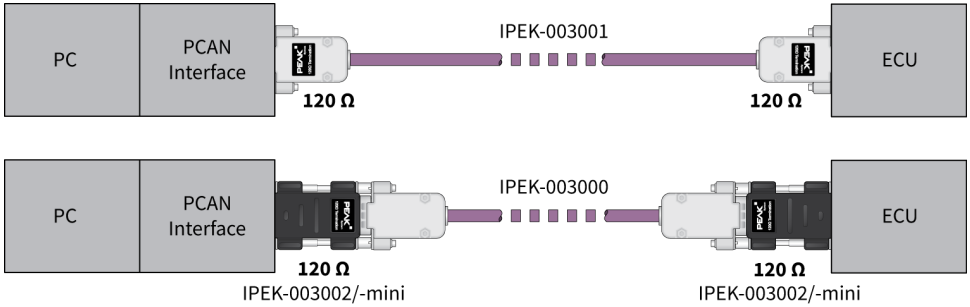
## 4.2 Cabling

### 4.2.1 Termination

The High-speed CAN bus (ISO 11898-2) must be terminated with 120  $\Omega$  on both ends. The termination prevents interfering signal reflections and ensures the proper operation of the transceivers of the connected CAN nodes (CAN interfaces, control devices).

The CAN interface PCAN-PCI/104-Express does not have an internal termination. Use the CAN interface on a terminated CAN bus.

## 4.2.2 Example of a Connection



This example shows a connection between the PCAN Interface and a control unit (ECU). The upper example shows a connection with a cable which is terminated with 120 Ω at both ends. At the lower example the connection is made with termination adapters.

### 4.2.3 Maximum Bus Length

The maximum bus length depends primarily on the bit rate:

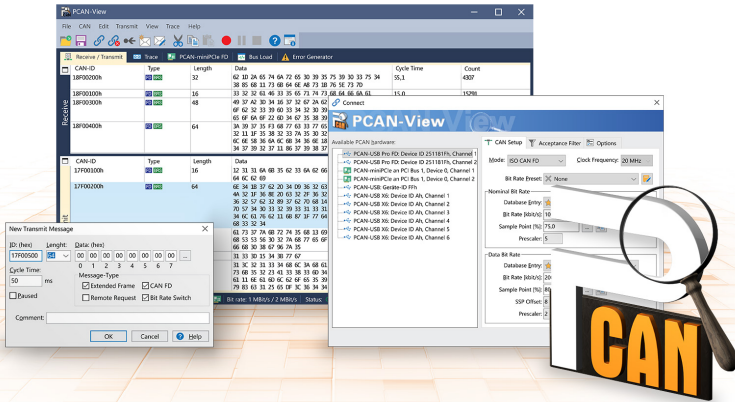
Nominal bit rate	Buslength
1 Mbit/s	40 m
500 kbit/s	110 m
250 kbit/s	240 m
125 kbit/s	500 m
50 kbit/s	1.3 km
20 kbit/s	3.3 km
10 kbit/s	6.6 km
5 kbit/s	13 km

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

## 4.3 Example Application under Windows

As an example application for accessing the CAN interface, run the CAN monitor PCAN-View from the Windows Start menu.

# 5 CAN Monitor PCAN-View



The CAN monitor PCAN-View is a Windows software for viewing, sending, and recording CAN and CAN FD messages. The software is installed with the installation of the device driver package under Windows.

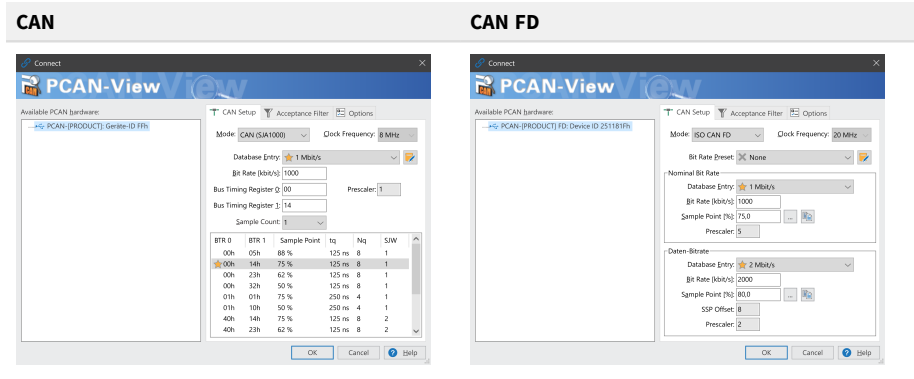
In the following the initialization of a CAN interface is described as an example.

Detailed information about using PCAN-View can be found in the program window under the menu item *Help*.

# 5.1 CAN interface initialize

1. Open the program *PCAN-View* via the Windows Start menu.

Depending on the CAN interface the *Connect* dialog is displayed with or without settings for CAN FD.

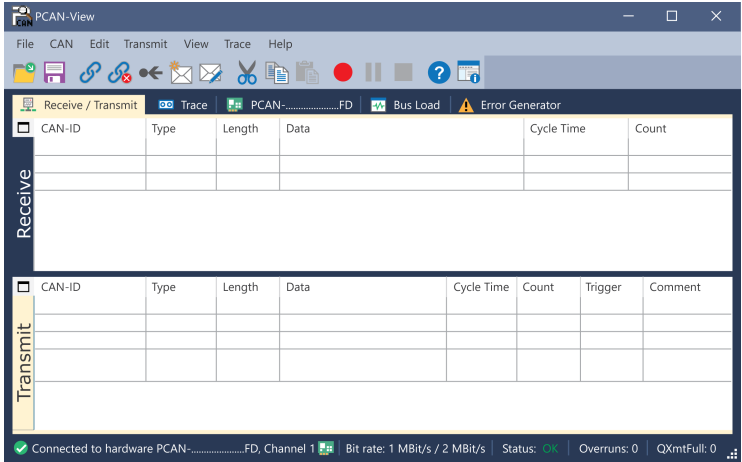


CAN interface	List entry in Available Hardware
USB Interface, 1-channel	see example above
USB Interface, 2-channel	<ul style="list-style-type: none"> <li>PCAN-USB Pro FD: Device ID 251181Fh, Channel 1</li> <li>PCAN-USB Pro FD: Device ID 251181Fh, Channel 2</li> </ul>
PCIe Interface, 2-channel	<ul style="list-style-type: none"> <li>PCAN-PCI Express at PCI Bus 1, Device 0, Channel 1</li> <li>PCAN-PCI Express at PCI Bus 1, Device 0, Channel 2</li> </ul>

2. If there are several CAN interfaces, select the desired interface. For multiple channels, select the desired channel from the list.
3. Enter the *bit rate(s)* and other settings according to the connected CAN bus.



- Confirm the entries with *OK*. The main window appears and displays the *Receive / Transmit* tab.



- For initializing another channel or CAN interface, open another instance of *PCAN-View*.

## 5.2 Transmit CAN message

1. Select the menu command *Transmit / New Message*.

Depending on the CAN interface, the dialog box *New Transmit Message* is displayed with or without settings for CAN FD.

### CAN CAN FD

New Transmit Message

ID: (hex) Length: Data: (hex)

000 8 00 00 00 00 00 00 00 ...

0 1 2 3 4 5 6 7

Cycle Time: 0 ms

Paused

Message-Type

Extended Frame

Remote Request

Comment:

OK Cancel Help

New Transmit Message

ID: (hex) Length: Data: (hex)

000 8 00 00 00 00 00 00 00 ...

0 1 2 3 4 5 6 7

Cycle Time: 0 ms

Paused

Message-Type

Extended Frame  CAN FD

Remote Request  Bit Rate Switch

Comment:

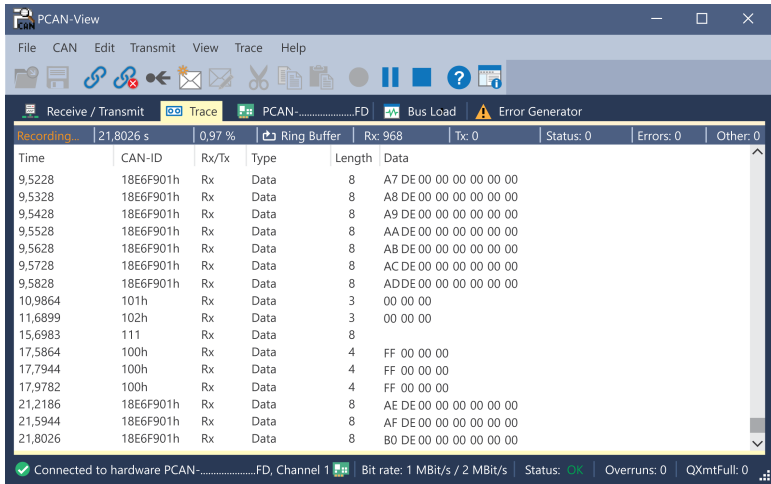
OK Cancel Help

1. Enter the *ID*, *Length* and *Data* of the message. Other settings can be made according to the connected CAN bus.
2. Enter a value into the *Cycle Time* field to choose manually or periodically message transmission.  
Enter a value greater than 0 to transmit periodically.  
Enter the value 0 to transmit only manually.
3. Confirm the entries with *OK*.  
The created transmit message appears on the *Receive / Transmit* tab.
4. To send the message manually, select the menu command *Transmit > Send* or press the space bar.  
The manual transmission process is performed additionally for periodically transmitted CAN messages.

## 5.3 Additional Tabs

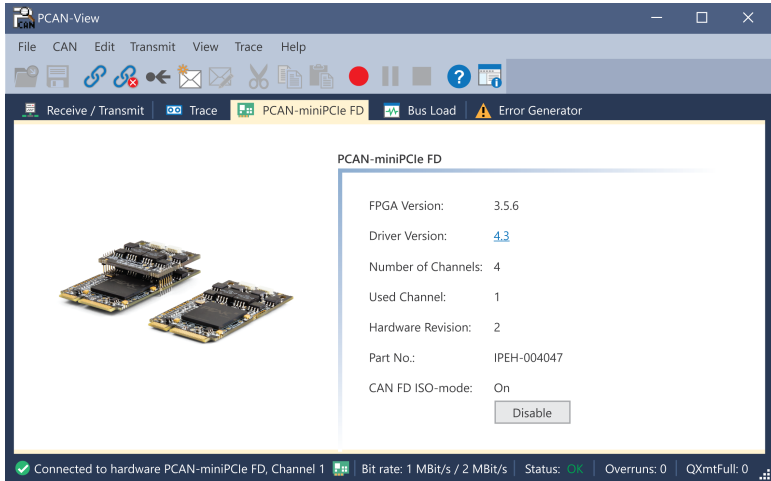
Depending on the CAN interface, additional tabs are available.

### 5.3.1 Trace Tab



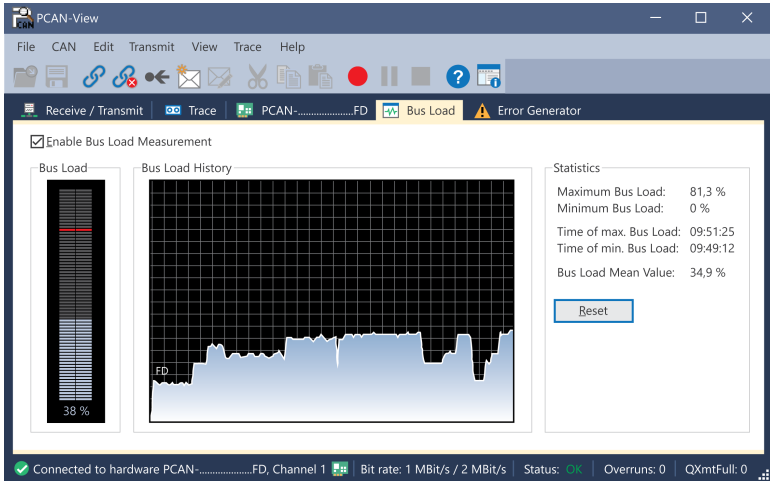
The tracer (data logger) records the communication of the CAN bus in linear or ring buffer mode. The trace data can be saved to a file.

## 5.3.2 CAN interface Tab



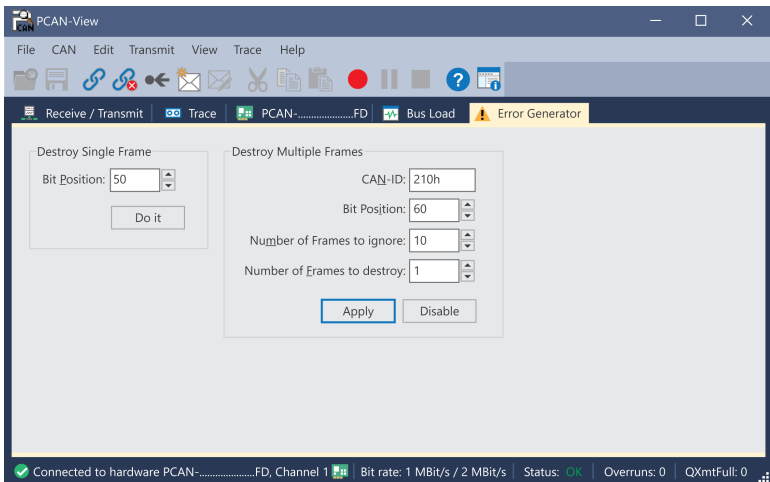
The *CAN interface* tab shows information about the hardware and the used Windows device driver. In this case exemplary for the PCAN-miniPCIe FD. Depending on the CAN interface, a hardware ID can be determined to distinguish several interfaces of the same type. For interfaces with CAN FD a transmission according to "ISO" or "Non-ISO" can be set as default of the hardware.

### 5.3.3 Bus Load Tab



The *Bus Load* tab displays the current bus load, its time history and statistical information of the connected CAN channel.

### 5.3.4 Error Generator Tab



Via the *Error Generator* tab the communication on the CAN bus in test environments or during the development of CAN buses can be disturbed in a controlled way by 6 consecutive dominant bits. This is a violation of the CAN protocol on the CAN bus which must be recognized as an error by the connected CAN nodes.



**Note:** The Error Generator should only be used by experienced users and in the development environment. For further information, please contact our customer support: [support@peak-system.com](mailto:support@peak-system.com)

You can destroy CAN frames with the error generator by one of two methods:

- once after activation
- repeatedly at specific intervals related to a CAN ID

## Destroy Single CAN Frame

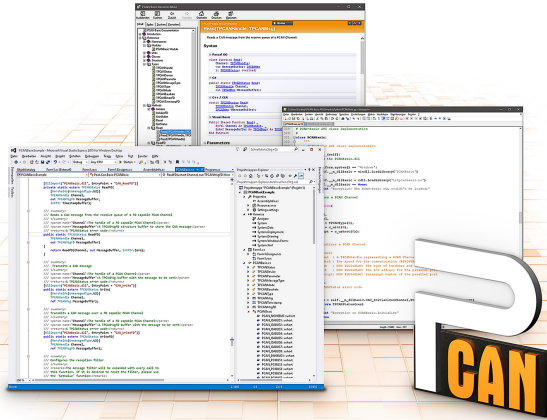
The *Destroy Single Frame* area refers to the next CAN frame that is recognized by the plug-in card after activation.

1. Enter the *Bit Position* where in the CAN frame the error is to be generated. The bit position must start after the identifier. The count includes the stuff bits.
2. Execute the destroy action with *Do it*.  
The next received or transmitted CAN frame will be destroyed at the selected bit position.

## Destroy Multiple CAN Frames

1. Enter the *CAN ID* of the CAN frame that is intended to be destroyed multiple times. The following specifications refer to this ID.
2. Enter the *Bit Position* where in the CAN frame the error is to be generated. The bit position must start after the identifier. The count includes the stuff bits.
3. If CAN messages are to be sent unharmed before being destroyed, specify the *Number of Frames to ignore*.
4. Determine the *Number of Frames to destroy*.
5. Confirm the entries with *Apply* to activate the error generator.
6. Stop destroying further CAN frames with *Disable*.

# 6 API PCAN-Basic



The intended use of PCAN-Basic requires compliance with the license rights. Read the license agreement for end users at:

<https://www.peak-system.com/quick/eula>

The programming interface (API) PCAN-Basic provides basic functions for the connection of own programs to the CAN interface of PEAK-System. PCAN-Basic is the interface between the program and the device driver. In Windows operating systems this is a DLL (Dynamic Link Library) and in Linux operating systems an SO (Dynamic Shared Object). PCAN-Basic is designed to be cross-operating system compatible. Software projects can be ported between supported systems with little effort.

With the installation of the device driver package under Windows the DLL files of the API PCAN-Basic are placed in the system folder. Examples for all common programming languages as well as libraries and help files are available as download package at: [www.peak-system.com/quick/DL-Develop-E](http://www.peak-system.com/quick/DL-Develop-E)



For Linux a download of the API is available under this link. For a use of PCAN-Basic another driver package with chardev driver is needed, because an access under SocketCAN is not possible. The "Driver Package for Proprietary Purposes", the user manual, and further information about the implementation can be found at [www.peak-system.com/linux](http://www.peak-system.com/linux)

## 6.1 Features of PCAN-Basic

- Thread-safe API for developing applications with CAN and CAN FD connections
- Supports CAN specifications ISO 11898-1 for CAN and CAN FD
- Supports the operating systems:
  - Windows® 11 (64 bit), 10 (32/64 bit)
  - Linux (32/64-bit)
- Multiple PEAK-System applications and your own can be operated on a physical channel at the same time
- Single DLL (Win) / SO (Linux) for all supported hardware types
- Use of up to 16 channels for each hardware type
- Simple switching between channels
- Access to the CAN channels of a PCAN-Gateway via the PCAN-LAN device type
- Driver-internal buffering under Windows of up to 32,768 CAN messages per CAN channel
- Precision of time stamps on received messages up to 1  $\mu$ s (depending on the PEAK CAN interface used)
- Supports PEAK-System's trace formats v1.1 for CAN and v2.0 for CAN FD applications
- Access to specific hardware parameters, such as Listen-only mode
- Notification of the application through Windows events when a message is received
- Support of CAN error frames
- Confirmation of physical transmission by CAN echo frames
- Extended system for debugging operations

- Multilingual debugging output
- Output language depends on operating systems
- Debugging information can be defined individually

## 6.2 Principle Description of the API

The sequence of accessing the CAN interface is divided into three phases:

### Initialization

A CAN channel must be initialized before using it. This is done by the simple call of the function `CAN_Initialize` for CAN and `CAN_InitializeFD` for CAN FD. Per CAN interface type the API allows the simultaneous use of up to 16 CAN channels. After a successful initialization the CAN channel is ready. No further configuration steps are required.

### Interaction

For receiving and transmitting messages the functions `CAN_Read` and `CAN_Write` as well as `CAN_ReadFD` and `CAN_WriteFD` are available depending on the initialization mode. Additional settings can be made, such as setting up message filters to confine to specific CAN IDs or setting the CAN controller to Listen-only mode.

For the receiving CAN messages, events can be configured for automatic notification of an application (client). This offers the following advantages:

- The application no longer needs to check for received messages periodically (no polling).
- The response time at reception is reduced.

### Completion

To end the communication the function `CAN_Uninitialize` is called in order to release the reserved resources for the CAN channel, among others. In addition the CAN channel is marked as "Free" and is available to other applications.

# 7 Technical Data

## Connections

	Connection side	Connection type
CAN slot bracket	CAN-bus	D-Sub (m), 9-pin
	CAN interface	10-pin connector
PCIe/104	PCIe/104, PCI Express x1 (1 Lane); Stack-through PCI/104-Bus, optionally equipped with contact strip on request	

## CAN (FD)

Protocols on OSI layer 2	CAN according to ISO 11898-1		
Physical transmission, OSI layer 1	ISO 11898-2 (High-speed CAN)		
Transceiver	NXP PCA82C251		
CAN bit rates	5 kbit/s to 1 Mbit/s		
Controller	FPGA implementation (SJA1000 compatible)		
Time stamp resolution	1 $\mu$ s		
Galvanic isolation	Single Channel		without
	Double Channel		without
	Single Channel	opto-decoupled	up to 500 V, separate for each CAN connector
	Double Channel	opto-decoupled	up to 500 V, separate for each CAN connector
Power supply external devices at D-Sub pin 1 and/or pin 9 (not assigned at delivery)	Single Channel		5 V, max. 100 mA
	Double Channel		5 V, max. 100 mA
	Single Channel	opto-decoupled	5 V, max. 50 mA
Internal Termination	Double Channel	opto-decoupled	5 V, max. 50 mA
	Quad Channel	opto-decoupled	5 V, max. 50 mA
Internal Termination	none		

## Power supply

Supply voltage	5 V DC	
Max. current consumption without power supply for external devices	Single Channel	360 mA
	Double Channel	420 mA
	Single Channel	opto-decoupled 360 mA
	Double Channel	opto-decoupled 420 mA
	Quad Channel	opto-decoupled 550 mA

## Measures

Size absolute (W x L x H)	90.2 x 95.9 x 21.8 mm	
Weight	Single Channel	42 g
	Double Channel	47 g
	Single Channel	opto-decoupled 44 g
	Double Channel	opto-decoupled 50 g
	Quad Channel	opto-decoupled 56 g
	Slot bracket	Single Channel 25 g
	Slot bracket	Double Channel 40 g

## Environment

Operating temperature	-40 to +85 °C (-40 to +185 °F)
Temperature for storage and transport	-40 to +125 °C (-40 to +257 °F)
Relative humidity	15 to 90 %, not condensing

## Conformity

RoHS	Directive 2011/65/EU (RoHS 2) + 2015/863/EU DIN EN IEC 63000:2019-05;VDE 0042-12:2019-05
EMV	Directive 2014/30/EU EN 55024:2016-05;VDE 0878-24:2016-05 EN 55032:2016-02;VDE 0878-32:2016-02

# Appendix A CE Certificate

## EU Declaration of Conformity



This declaration applies to the following product:

Product name: PCAN-PCI/104-Express  
Item number(s): IPEH-003054/55/56/57/58  
Manufacturer: PEAK-System Technik GmbH  
Otto-Röhm-Straße 69  
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; VDE 0042-12:2019-05**

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances (IEC 63000:2016); German version EN 63000:2018

**EU Directive 2014/30/EU (Electromagnetic Compatibility)**

**DIN EN 55024:2016-05; VDE 0878-24:2016-05**

Information technology equipment – Immunity characteristics – Limits and methods of measurement (CISPR 24:2010 + Cor.:2011 + A1:2015); German version EN 55024:2010 + A1:2015

**DIN EN 55032:2016-02; VDE 0878-32:2016-02**

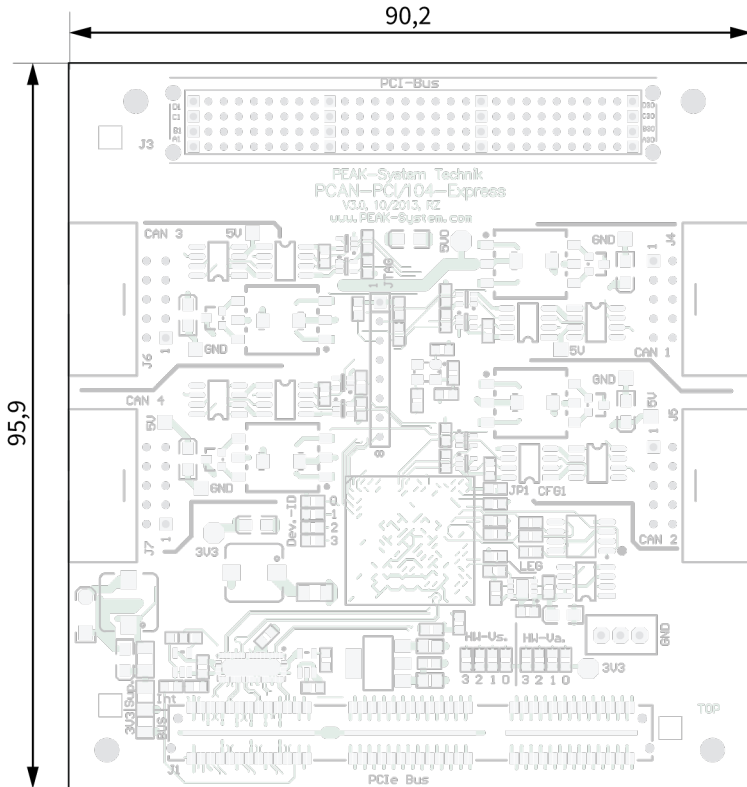
Electromagnetic compatibility of multimedia equipment - Emission Requirements (CISPR 32:2015); German version EN 55032:2015

Darmstadt, 9 March 2022

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

Uwe Wilhelm, Managing Director

# Appendix B Dimension Drawings



Dimensions in mm.

# Appendix C Quick Reference

## Software/Hardware Installation under Windows

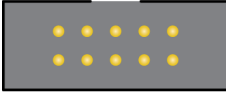

Download the device drivers installation package from our website [www.peak-system.com/quick/DL-Driver-E](http://www.peak-system.com/quick/DL-Driver-E). Install the driver before you install the CAN interface.

The new hardware is detected at the next Windows start and the driver is initialized. Check the operational readiness. Open the Windows Start menu. Type *Peak Settings* and press **Enter**. The window *PEAK settings* appears. The connected CAN interface is displayed under *CAN Hardware*.

## Getting Started under Windows

Run the CAN monitor PCAN-View from the Windows Start menu as a sample application for accessing the CAN interface. For initialization of the CAN interface select the desired CAN channel and CAN bit rate.

## Pin assignment

10-pin connector on CAN interface	D-Sub plug on slot bracket, 9-pin	
9 7 5 3 1	1 2 3 4 5	
		
10 8 6 4 2	6 7 8 9	Assignment
2	6	GND
3	2	CAN_Low
4	7	CAN_High
5	3	GND
8	9	+5 V (optional)
1, 6, 7, 9, 10	1, 4, 5, 8	None

# Appendix D Linux

Depending on the Kernel version, device drivers for the CAN interfaces from PEAK-System are already included in the operating system. The CAN interfaces are treated as network devices (SocketCAN, netdev). You can find the documentation for SocketCAN under: <https://www.kernel.org/doc/Documentation/networking/can.txt>

The command `grep PEAK_ /boot/config-`uname -r`` lists the available drivers. The following table shows the PCAN-Interfaces and from which kernel version they are supported.

PCAN-Interface			Kernel version
PCAN-PCI	PCAN-PCI Express	PCAN-miniPCI	≥ 3.2
PCAN-PC/104-Plus	PCAN-PCI/104-Express		
PCAN-USB	PCAN-USB Pro	PCAN-ExpressCard	≥ 3.4
PCAN-PCI Express	PCAN-miniPCle		≥ 3.7
PCAN-PCI/104-Express			≥ 3.7
PCAN-USB FD	PCAN-USB Pro FD		≥ 4.0
PCAN-Chip USB			≥ 4.11
PCAN-PCI Express FD			≥ 4.12
PCAN-PCI/104-Express FD	PCAN-miniPCle FD	PCAN-Chip PCle FD	≥ 4.12
PCAN-M.2			
PCAN-Chip PCle			≥ 4.3
PCAN-USB X6			≥ 4.9

Whether the required driver for the PCAN-Interface is present and loaded can be checked with the following command: `lsmod | grep ^peak check`. If the initialization was successful, the response line starts with `peak_usb` or `peak_pci`.

If the required drivers are not listed, install the "Driver Package for Proprietary Purposes". The download, the user manual for the driver, and the corresponding "Implementation Details" can be found under: [www.peak-system.com/linux](http://www.peak-system.com/linux)

This driver package is also needed to use the APIs based on the chardev driver, for example PCAN-Basic, libpcan, or libpcanfd.