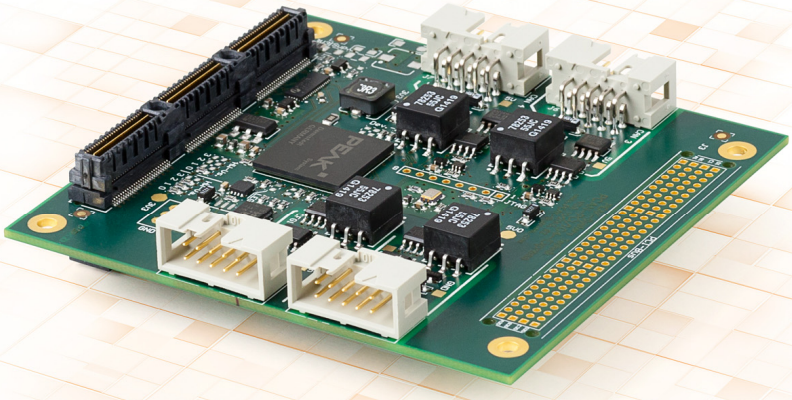
PCAN-PCI/104-Express

CAN Interface for PCI/104-Express

User Manual



Document version 2.7.0 (2019-03-11)

PEAK System

Relevant products

Product name	Model	Part number	S/N
PCAN-PCI/104-Express Single Channel opto-decoupled	One CAN channel	IPEH-003056	starting at 200
PCAN-PCI/104-Express Dual Channel opto-decoupled	Two CAN channels	IPEH-003057	starting at 250
PCAN-PCI/104-Express Quad opto-decoupled	Four CAN channels	IPEH-003058	

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

On request you can get the product versions with stack-through connectors for the PCI bus.

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Contents

1 Introduction

The PCAN-PCI/104-Express card enables the connection of one, two, or four CAN buses to a PCI/104-Express system. Up to four cards can be stacked together. The CAN bus is connected using a 9-pin D-Sub plug on the slot bracket supplied. There is a galvanic isolation of up to 500 Volts between the computer and the CAN sides. There are versions with one, two and four channels.

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.

Tip: At the end of this manual (Appendix C) you can find a Quick Reference with brief information about the installation and operation of the PCAN-PCI/104-Express card.

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
- Compliant with CAN specifications 2.0A (11-bit ID) and 2.0B (29-bit ID)
- Connection to CAN bus through D-Sub slot bracket, 9-pin (in accordance with CiA® 303-1)

- FPGA implementation of the CAN controller (SJA1000 compatible)
- NXP PCA82C251 CAN transceiver
- Galvanic isolation on the CAN connection up to 500 V, separate for each CAN channel
- Supplied only via the 5 V line
- 5-Volt supply to the CAN connection can be connected through a solder jumper, e.g. for external bus converter
- Extended operating temperature range from -40 to 85 °C (-40 to 185 °F)
- Optionally available: PCI-104 stack-through connector

Note: This manual describes the use of the PCAN-PCI/104-Express card with **Windows**. You can find device drivers for **Linux** and the corresponding application information on the provided DVD in the directory branch `Develop` and on our website under www.peak-system.com/linux.

1.2 System Requirements

- PC/104 stack with PCIe/104 connectivity to the host
- Operating system Windows 10, 8.1, 7 (32/64-bit) or Linux (32/64-bit)

1.3 Scope of Supply

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

- Device drivers for Windows 10, 8.1, 7 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
- Manual in PDF format

2 Installing the Software and the Card

This chapter covers the software setup for the PCAN-PCI/104-Express card under Windows and the installation of the card in the PC/104 stack.

Install the driver before you insert the card into the stack.

Do the following to install the driver:

1. Start `Intro.exe` from the supplied DVD.

   The navigation program starts.

2. Select in the main menu **Drivers** and click on **Install now**.
3. Confirm the message of the User Account Control related to "Installer database of PEAK Drivers".

   The driver setup starts.

4. Follow the program instructions.

Do the following to insert the card into the stack:

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

1. Shutdown the computer.
2. Disconnect the computer's power supply.
3. Insert the card into the stack next to the host or to another PCI/104-Express card.

   A maximum of 4 PCI/104-Express cards per stack is possible, either all on top or all beneath the host.
4. Plug a cable from the slot bracket to a 10-pin socket for each CAN connection.
5. Reconnect the power supply of the system.
6. Turn on the computer and start Windows.

Windows detects the new hardware and completes the driver installation.

Do the following to check the operational readiness:

1. Open the Windows Start menu.
2. Type `peakcpl` and press Enter.

The information window for PEAK hardware appears. The plug-in card must be displayed in the table on the **CAN Hardware** tab.

3 Connecting the CAN Bus

3.1 Connection over D-Sub connector

A High-speed CAN bus (ISO 11898-2) is connected to the 9-pin D-Sub connector. The pin assignment corresponds to the specification CiA® 303-1.

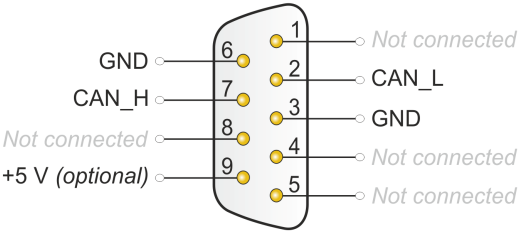

Figure 1: Pin assignment High-speed CAN

Low power devices (e.g. bus converters) can be supplied directly with 5 volts over pin 9 of the CAN connector. Pin 9 is not in use at the delivery state. For more information see the next section 3.2.

The pin assignment between the D-Sub port and the 10-pin connector on the PCAN-PCI/104-Express card is as follows:

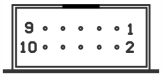

Figure 2: Numbering at the 10-pin connector on the board

Pin	Assignment	Assignment D-Sub
1	not connected	1
2	GND	6
3	CAN_L	2
4	CAN_H	7
5	GND	3
6	not connected	8
7	not connected	4
8	+5 V (optional)	9
9	not connected	5
10	not connected	

Tip: You can connect a CAN bus with a different transmission standard via a bus converter. PEAK-System offers different bus converter modules (e.g. PCAN-TJA1054 for a Low-speed CAN bus according to ISO 11898-3).

3.1.1 Slot Bracket with D-Sub Connectors

Figure 3: Single channel slot bracket

Figure 4: Dual channel slot bracket

To connect a CAN bus to the PCAN-PCI/104-Express card, use the supplied slot brackets. After you have connected the cables from the slot bracket with the 10-pin sockets, you can connect the CAN buses with the D-Sub sockets.

3.2 Voltage Supply of External Devices

External devices with low power consumption (e.g. bus converters) can be directly supplied via the CAN connector (independently for each connector on the Dual- and Four Channel models). With a solder bridge per CAN channel on the PCAN-PC/104-Express board, a 5-Volt supply can optionally be routed to pin 9 of the D-Sub connector. The current output is limited to 50 mA.

➡ Do the following to activate the voltage supply:

⚠ **Risk of short circuit!** Solder with great care to avoid unwanted short circuits on the card.

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

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

Figure 5 shows the solder field positions on the card. The table below contains the possible settings.

Note: The pin labels for the CAN connector are related to the 9-pin D-Sub connector being connected via a cable to a socket on the card.

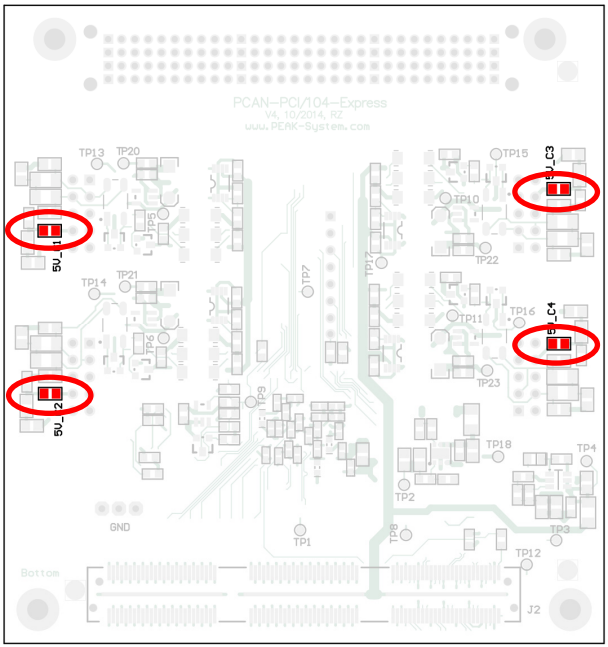

Figure 5: Positions of the soldering fields on the bottom of the PCAN-PCI/104-Express Quad card,
upper position left CAN channel 1 and right CAN channel 3,
lower position left CAN channel 2 and right CAN channel 4

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

Risk of short circuit! The 5-Volt supply is not protected separately. Therefore, turn off the computer before you connect and disconnect CAN cables or peripheral systems.

3.3 Cabling

3.3.1 Termination

A High-speed CAN bus (ISO 11898-2) must be terminated with 120 ohms at 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 PCAN-PCI/104-Express card does not have an internal termination. Use the adapter on a terminated CAN bus.

3.3.2 Example of a Connection

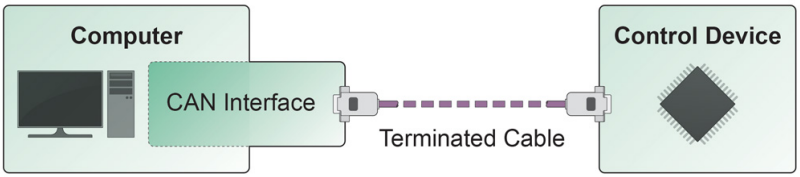

Figure 6: Simple CAN connection

This example shows a connection between the PCAN-PC/104-Express card and a control unit. The connection cable is terminated with 120 ohms at both ends.

3.3.3 Maximum Bus Length

High-Speed-CAN networks may have bit rates of up to 1 Mbit/s. The maximum bus length depends primarily on the bit rate.

The following table shows the maximum possible CAN bus length at different bit rates:

Bit rate	Bus length
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	13.0 km

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

4 Software and API

This chapter covers the provided software PCAN-View and the programming interface PCAN-Basic.

4.1 Monitor Software PCAN-View

PCAN-View is simple Windows software for viewing, transmitting, and logging CAN and CAN FD messages.

Note: This chapter describes the use of PCAN-View with a CAN adapter.

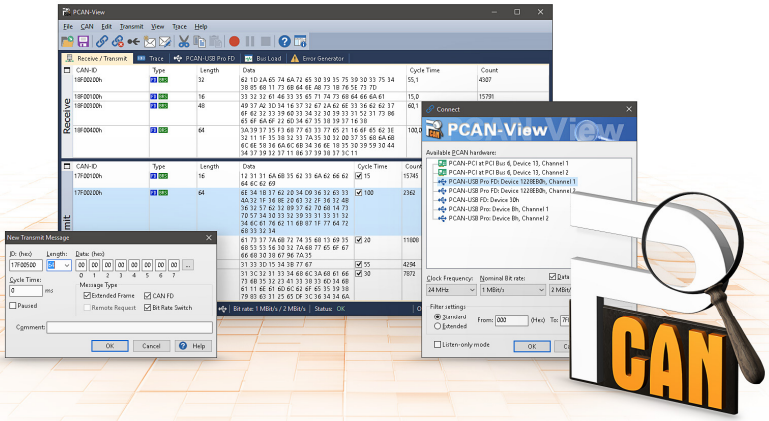

Figure 7: PCAN-View for Windows

Do the following to start and initialize PCAN-View:

1. Open the Windows Start menu and select **PCAN-View**.

   The **Connect** dialog box appears.

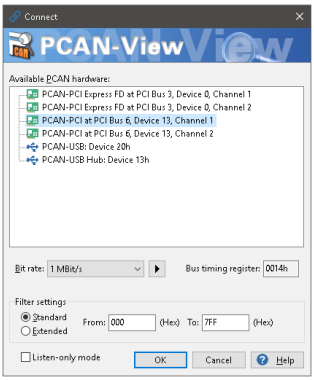

Figure 8: Selection of the hardware and parameters

2. Select an interface from the list.
3. From the drop-down list, select the **Bit rate** that is used by all nodes on the CAN bus.

Tip: You can create custom bit rates by using the button (▸).

4. Under **Filter settings** you can limit the range of CAN IDs to be received, either for standard frames (11-bit IDs) or for extended frames (29-bit IDs).
5. Activate the **Listen-only mode** if you do not actively participate in the CAN traffic and just want to observe. This also avoids an unintended disruption of an unknown CAN environment (e.g. due to different bit rates).
6. Confirm the settings in the dialog box with **OK**. The main window of PCAN-View appears (see Figure 9).

4.1.1 Receive/Transmit Tab

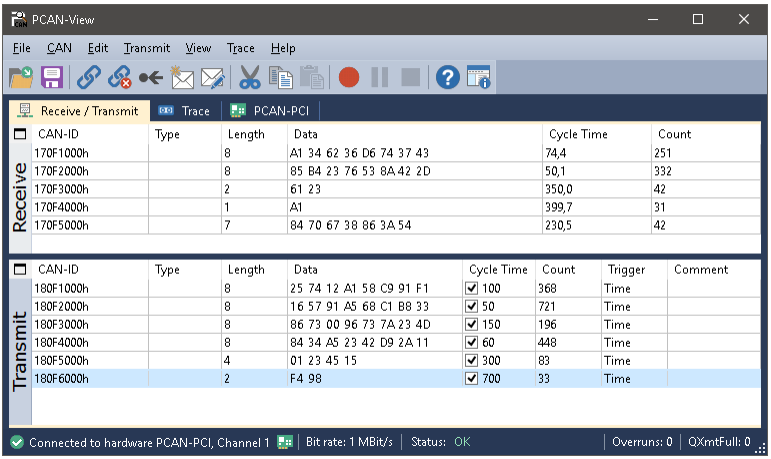

Figure 9: Receive/Transmit tab

The **Receive/Transmit** tab is the main element of PCAN-View. It contains two lists, one for received messages and one for the transmit messages. The CAN data format is hexadecimal by default.

- Do the following to transmit a CAN message with PCAN-View:

1. Select the menu command **Transmit** > **New Message** (alternatively or Ins).

   The **New Transmit Message** dialog box appears.

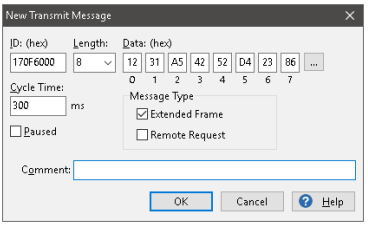

Figure 10: Dialog box new transmit message

2. Enter the **ID**, the data **Length,** and the CAN message **Data**.

Note: With the program version 4 of PCAN-View, the DLC field was renamed to **Length**. Latter reflects the actual data length.

3. 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.
4. Confirm the entries with **OK**.

   The created transmit message appears on the **Receive/Transmit** tab.
5. You trigger selected transmit messages manually with the menu command **Transmit** > **Send** (alternatively Space bar). The manual transmission for CAN messages being transmitted periodically is carried out additionally.

Tip: Using the menu command **File** > **Save** the current transmit messages can be saved to a list and loaded for reuse later on.

4.1.2 Trace Tab

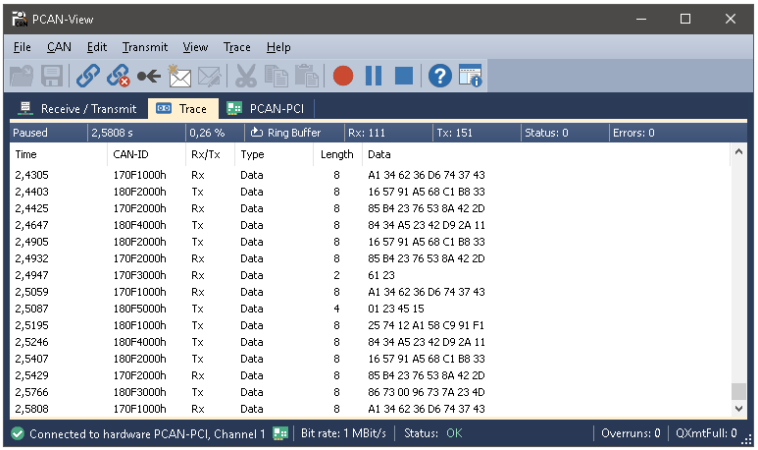

Figure 11: Trace tab

On the **Trace** tab, the data tracer (data logger) of PCAN-View is used for logging the communication on a CAN bus. During this process the messages are cached in the working memory of the PC. Afterwards they can be saved to a file.

The Tracer runs either in linear or in ring buffer mode. The linear buffer mode stops the Tracer as soon as the buffer is full. The ring buffer mode overwrites the oldest messages by new ones as soon as the buffer is full.

4.1.3 PCAN-PCI/104-Express Tab

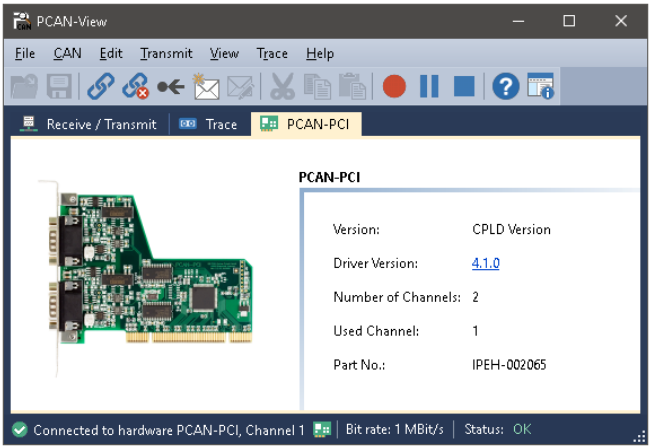

Figure 12: PCAN-PCI tab (example)

The **PCAN-PC/104-Plus** tab contains some detailed information about the hardware and driver.

4.1.4 Status Bar

Figure 13: Display of the status bar

The status bar shows information about the current CAN connection, about error counters (Overruns, QXmtFull) and shows error messages.

You can find further information about the use of PCAN-View in the help which you can invoke in the program via the **Help** menu or with the F1 key.

4.2 Linking Own Programs with PCAN-Basic

Figure 14: PCAN-Basic

On the provided DVD, you can find files of the PCAN-Basic programming interface in the directory branch `Develop`. This API provides basic functions for linking own programs to CAN and CAN FD interfaces by PEAK-System and can be used for the following operating systems:

- Windows 10, 8.1, 7 (32/64-bit)
- Windows CE 6.x (x86/ARMv4)
- Linux (32/64-bit)

The API is designed for cross-platform use. Therefore software projects can easily ported between platforms with low efforts. For all common programming languages examples are available.

Beginning with version 4, PCAN-Basic supports the new CAN FD standard (CAN with Flexible Data Rate) which is primarily characterized by higher bandwidth for data transfer.

4.2.1 Features of PCAN-Basic

- API for developing applications with CAN and CAN FD connection
- Access to the CAN channels of a PCAN-Gateway via the new PCAN-LAN device type
- Supports the operating systems Windows 10, 8.1, 7 (32/64-bit), Windows CE 6.x, and Linux (32/64-bit)
- Multiple PEAK-System applications and your own can be operated on a physical channel at the same time
- Use of a single DLL for all supported hardware types
- Use of up to 16 channels for each hardware unit (depending on the PEAK CAN interface used)
- Simple switching between channels of a PEAK CAN interface
- Driver-internal buffer of 32,768 messages per CAN channel
- Precision of time stamps on received messages up to 1 µs (depending on the PEAK CAN interface used)
- Supports PEAK-System's trace formats version 1.1 and 2.0 (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
- Extended system for debugging operations
- Multilingual debugging output

- Output language depends on operating system
- Debugging information can be defined individually

Tip: An overview of the API functions is located in the header files. You can find detailed information about the PCAN-Basic API on the provided DVD in the text and help files (file name extensions `.txt` and `.chm`).

4.2.2 Principle Description of the API

The PCAN-Basic API is the interface between the user application and device driver. In Windows operating systems this is a DLL (Dynamic Link Library).

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

1. Initialization
2. Interaction
3. Completion

Initialization

A 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. Depending on the type of the CAN hardware, up to 16 CAN channels can be opened at the same time. 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. Additional settings can be made, e.g. setting up message filters to confine to specific CAN IDs or setting the CAN controller to listen-only mode.

When receiving CAN messages, events are used for an 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.

4.2.3 Notes about the License

Device drivers, the interface DLL, and further files needed for linking are property of the PEAK-System Technik GmbH and may be used only in connection with a hardware component purchased from PEAK-System or one of its partners. If a CAN hardware component of third-party suppliers should be compatible to one of PEAK-System, then you are not allowed to use or to pass on the driver software of PEAK-System.

If a third-party supplier develops software based on the PCAN-Basic and problems occur during the use of this software, consult the software provider.

5 Technical Specifications

Connectors	
PC/104 stack	PCIe/104, PCI Express x1 (1 Lane) Stack-through PCI/104-Bus, equipped with contact strip on request
CAN	D-Sub (m), 9 pins Pin assignment according to specification CiA® 303-1

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (standard format) and 2.0B (extended format)
Bit rates	5 kbit/s - 1Mbit/s
Controller	FPGA implementation (SJA1000 compatible)
Transceiver	NXP PCA82C251
Galvanic isolation	up to 500 V separate for each CAN channel
Supplying external devices	D-Sub Pin 9; 5 V, max. 50 mA Not assigned at delivery
Internal termination	none

Power supply		
Supply voltage	5 V	
Current consumption (max.)	Single Channel: Dual Channel: Four Channel:	360 mA 420 mA 550 mA

Measures		
Size	90.2 x 95.9 mm (W x L) See also dimension drawing in Appendix B on page 29	
Weight	Single Channel: Dual Channel: Four Channel:	44 g 50 g 56 g

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

Conformity	
EMV	Directive 2014/30/EU DIN EN 55024:2016-05 DIN EN 55032:2016-02
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-PCI/104-Express

Item number(s): IPEH-003056/57/58

Manufacturer: PEAK-System Technik GmbH
Otto-Roehm-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)

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 55024:2016-05
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
Electromagnetic compatibility of multimedia equipment - Emission Requirements (CISPR 32:2015);
German version EN 55032:2015

Darmstadt, 22 February 2019

Uwe Wilhelm, Managing Director

Appendix B Dimension Drawing

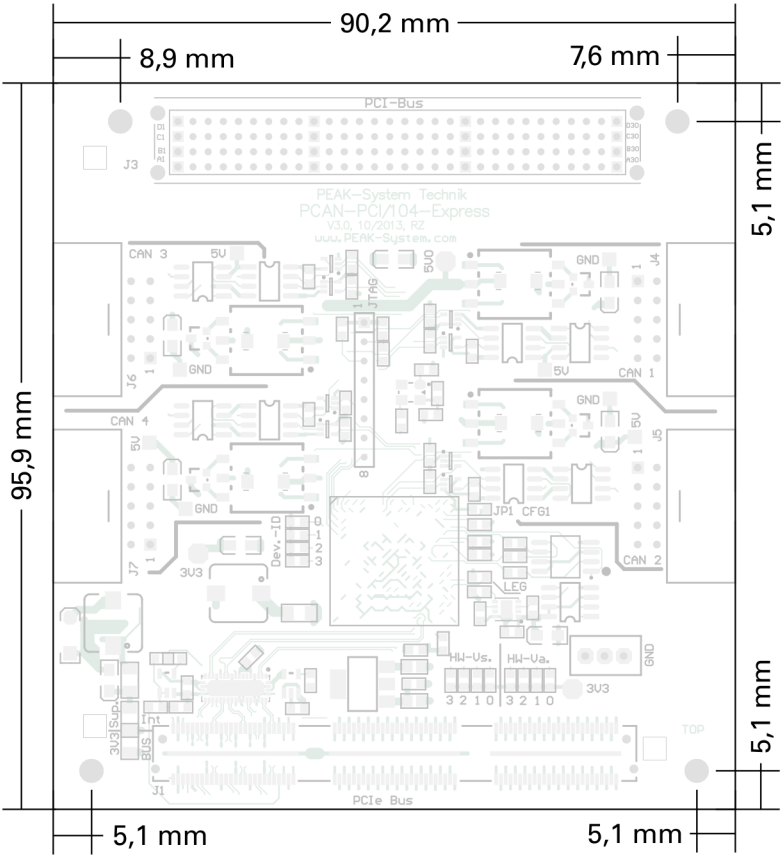

Figure 15: Dimension drawing PCAN-PCI/104-Express

Appendix C Quick Reference

Software/Hardware Installation under Windows

Install the driver from the supplied DVD, before you insert the plug-in card in the PC/104 stack.

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 `peakcpl` and press Enter.
An information window for PEAK Hardware opens. The plug-in card must be displayed in the table on the **CAN Hardware** tab.

Getting Started under Windows

Run the CAN monitor PCAN-View from the Windows Start menu as a sample application for accessing the PCAN-PC/104-Express card. For initialization of the card select the CAN connection and the CAN bit rate.

High-speed CAN connector (D-Sub, 9 pins)