PCAN-GPS

User Manual

PEAK
System

Relevant Product

Product name	Part number
PCAN-GPS	IPEH-002110

Imprint

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Contents

1 Introduction

The PCAN-GPS is a programmable sensor module for position and orientation determination. It has a satellite receiver, a magnetic field sensor, an accelerometer, and a gyroscope. The sampled data can be transmitted on a CAN bus and logged on the internal memory card. The data processing is performed by a microcontroller of the NXP LPC4000 series.

The behavior of the PCAN-GPS can be programmed freely for specific applications. The firmware is created using the included development package with GNU compiler for C and C++ and is then transferred to the module via CAN. Various programming examples facilitate the implementation of own solutions.

On delivery, the PCAN-GPS is provided with a standard firmware that transmits the raw data of the sensors periodically on the CAN bus. The source code of the standard firmware as well as further programming examples are included in the scope of supply.

1.1   Properties at a Glance

- NXP LPC4000 series microcontroller (ARM Cortex-M4)
- Receiver for navigation satellites u-blox MAX-7W
  (GPS, GLONASS, QZSS, and SBAS)
- Bosch BMC050 electronic three-axis magnetic field sensor and
  three-axis accelerometer
- Gyroscope STMicroelectronics L3GD20
- High-speed CAN channel (ISO 11898-2) with bit rates
  from 40 kbit/s up to 1 Mbit/s
- Complies with CAN specifications 2.0 A/B
- On-chip 4 kByte EEPROM
- microSD™ memory card slot
- Wake-up by CAN bus or by separate input
- 2 digital inputs (High-active)
- 1 digital output (Low-side driver)
- LEDs for status signaling
- Connection via a 10-pole terminal strip (Phoenix)
- Voltage supply from 8 to 30 V
- Extended operating temperature range from -40 to +85 °C
  (with exception of the button cell)
- New firmware can be loaded via CAN interface

1.2   Scope of Supply

- PCAN-GPS in plastic casing with
    - Mating connector: Phoenix Contact FMC 1.5/10-ST-3.5 - 1952348
    - External antenna for satellite reception

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 the 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 Description of the Sensors

This chapter describes the characteristics of the sensors that are used in the PCAN-GPS in short form and gives instructions for use.

For additional information about the sensors, see chapter 8 *Technical Data* and the data sheets of the respective manufacturers in Appendix E *Data Sheets*.

2.1 Receiver for Navigation Satellites (GNSS)

The u-blox MAX-7W receiver is designed for the following global navigation satellite systems (GNSS):

- GPS (USA)
- GLONASS (Russia)
- QZSS (Japan)
- SBAS (supplementary)

To receive a satellite signal, an external antenna must be connected to the SMA socket . Both passive and active antennas are suitable. An active antenna is included.

The use of GPS and GLONASS cannot happen simultaneously. On the one hand, the external antenna must match the respective system (the supplied one can receive both), on the other hand, the GNSS receiver must be switched.

For a faster position fix after turning on the PCAN-GPS, the internal RTC and the internal backup RAM can be supplied by the button cell. This requires a hardware modification (see section 4.2 *Buffer Battery for GNSS*).

2.2 Gyroscope

The STMicroelectronics L3GD20 gyroscope is a three-axis angular rate sensor. It returns the rotational speed around X, Y, and, Z axis.
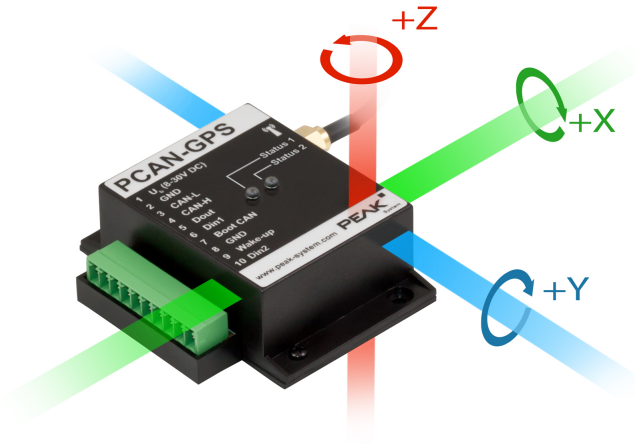
Gyroscope axes in relation to the PCAN-GPS casing
Z: yaw, X: roll, Y: pitch

The covered rotation angle can be determined by integration over time.

There are two sensor-internal filters for limitation and damping of output values. They are implemented by configurable high-pass and low-pass.

With its cut-off frequency (3 dB level), the high-pass defines the minimum angular velocity needed for transmission. With the lowpass in contrast, it is possible to affect the transmission of faster rotation angles. Typical values for output can be distinguished from intermittent fast movements. The selected filter characteristic is always to be considered together with the output data rate (ODR).
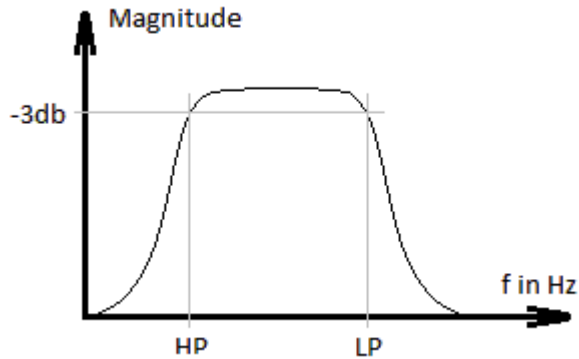
Filter curve of high-pass and low-pass

2.3   Acceleration and Magnetic Field Sensor

The acceleration and magnetic field sensor Bosch Sensortec BMC050 is used to determine the position in a magnetic field (such as the earth's magnetic field) and the acceleration along three axes.
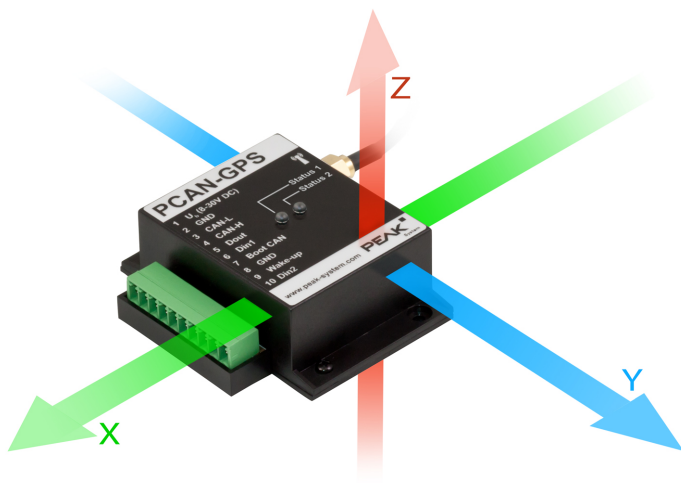
Axes of the acceleration and magnetic field sensor
in relation to the PCAN-GPS casing

There are three configurable control lines to adjust the function to the respective application:

- Data Ready MAG
- Interrupt_MAG
- Interrupt_ACC1

Interrupt_ACC2 is not connected to the microcontroller. All connected interrupt lines of the sensor are provided with pull-up resistors.

Since both functions of the sensor are independent of each other, also the corresponding interrupt functions are not linked. The interrupt for the acceleration sensor can be configured from seven functionalities, its timing validity can be adjusted. The functional scope of the magnetic field sensor interrupt comprises four sources.

The offset compensation of the acceleration sensor is done via the addition of a correction value which is copied from the EEPROM. This requires a conversion of an 8-bit value (Public Register) to a 10-bit value (Internal Register) (see table). With one of the four compensation methods, the correction value can be checked and readjusted.

Bit in Public Register	Compensation value for measuring range			
	±2 G	±4 G	±8 G	±16 G
8 (msb): sign	±	±	±	±
7	500 mG	500 mG	500 mG	500 mG
6	250 mG	250 mG	250 mG	250 mG
5	125 mG	125 mG	125 mG	125 mG
4	62.5 mG	62.5 mG	62.5 mG	62.5 mG
3	31.3 mG	31.3 mG	31.3 mG	31.3 mG
2	15.6 mG	15.6 mG	15.6 mG	-
1 (lsb)	7.8 mG	7.8 mG	-	-

The correction value can be determined with four methods. A target value (± 1 G in X/Y/Z) is given in this process. The methods determine the necessary offset of the measured value until it reaches the target value. The offset appears in the Public Register and may be transferred to EEPROM.

- **Slow compensation:** Over several steps (8 or 16), the correction value is gradually adjusted (4 lsb) to reach the target value.
- **Fast compensation:** The correction value is calculated from the average of 16 measurements and the target value.
- **Manual compensation:** The user specifies a correction value.
- **Inline calibration:** The calculated correction value is stored in the EEPROM.

3 Connectors
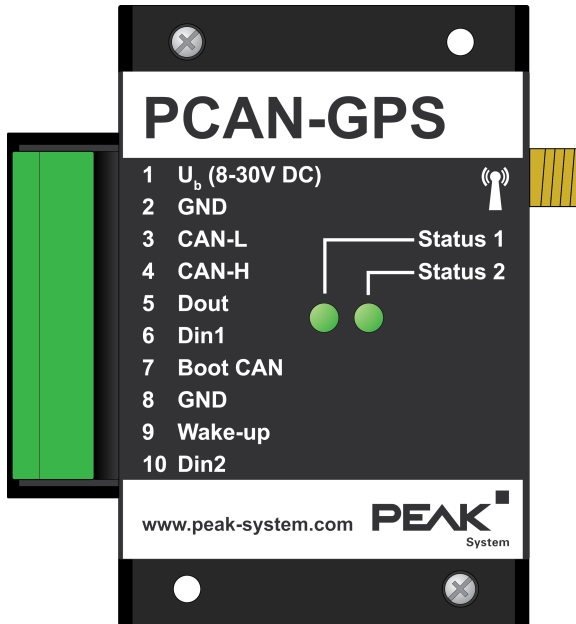
PCAN-GPS with 10 connector pins
and 2 status LEDs

3.1 Spring Terminal Strip
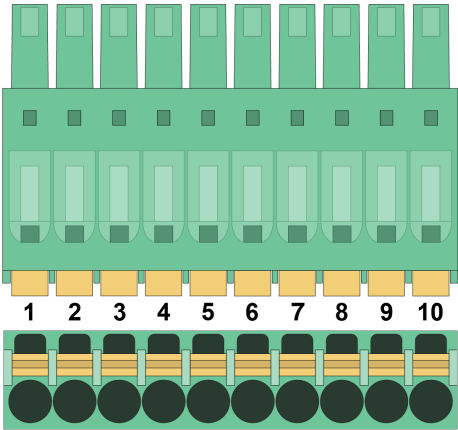
Spring terminal strip with 3.5 mm pitch
(Phoenix Contact FMC 1.5/10-ST-3.5 - 1952348)

Terminal	Identifier	Function
1	U_b	Power supply 8 - 30 V DC, e.g. car terminal 30, reverse-polarity protection
2	GND	Ground
3	CAN_L	Differential CAN signal
4	CAN_H	
5	DOut	Digital output, Low-side switch
6	DIn1	Digital input, High-active (internal pull-down), inverting
7	Boot CAN	CAN bootloader activation, High-active
8	GND	Ground
9	Wake-up	External wake-up signal, High-active, e.g. car terminal 15
10	DIn2	Digital input, High-active (internal pull-down), inverting

3.2 SMA Antenna Connector

An external antenna must be connected to the SMA socket ⊺ for the reception of satellite signals. Both passive and active antennas are suitable. For an active antenna, a supply of 3.3 V with at most 50 mA can be switched through the GNSS receiver.

The scope of supply of the PCAN-GPS provides an active antenna that is suitable for the navigation satellite systems GPS and GLONASS.

3.3 microSD™ Slot (internal)

For the recording of, for example, status and location information, a microSD™ memory card of the types SD and SDHC can be used. Memory cards are not included in the scope of supply. The maximum capacity is 32 GByte.

Freely available source code exists for the implementation of the FAT32 file system in custom firmware.

> **ℹ** **Note:** The microSD™ connectivity in the PCAN-GPS module is not suitable for recording large data flows, such as the CAN traffic.

In order to insert a memory card, open the casing of the PCAN-GPS module by loosening the two fixing screws.

4 Hardware Configuration

For special applications, several settings can be done on the circuit board of the PCAN-GPS by using solder bridges:

- Coding solder bridges for polling by the firmware
- Buffer battery for satellite reception

4.1 Coding Solder Jumpers

The circuit board has three coding solder bridges to assign a permanent state to the corresponding input bits of the microcontroller. The three positions for coding solder bridges (ID 0 - 2) are each assigned to one port of the microcontroller LPC4074FBD80 (µC). A bit is set (1) if the corresponding solder field is open.

The status of the ports is relevant in the following cases:

- The loaded firmware is programmed so that it reads the status at the corresponding ports of the microcontroller. For example, the activation of certain functions of the firmware or the coding of an ID is conceivable here.
- For a firmware update via CAN, the PCAN-GPS module is identified by a 3-bit ID which is determined by solder jumpers. A bit is set (1) when the corresponding solder field is open (default setting: ID 7, all solder fields open).

Solder field	ID0	ID1	ID2
Binary digit	001	010	100
Decimal equivalent	1	2	4

See chapter 7 *Firmware Upload* for more information.

Activate coding solder bridges:

> ⚠️ **Risk of short circuit!** Soldering on the PCAN-GPS 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.

1. Unscrew the two screws.
2. Remove the cover under consideration of the antenna connection.
3. Pull out the circuit board.
4. Solder the solder bridge(s) on the board according to the desired setting.

Solder field	Port status
▭	High
🔴	Low
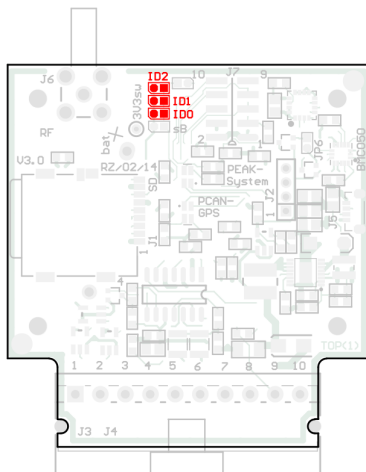
Solder fields 0 to 2 for the ID on the board

5. Replace the circuit board and put the housing cover back in place according to the recess of the antenna connector.
6. Screw the two screws back into their original positions.

4.2 Buffer Battery for GNSS

The receiver for navigation satellites (GNSS) needs about half a minute until the first position fix after switching on the PCAN-GPS module. To shorten this period, the button cell can be used as a buffer battery for a quick start of the GNSS receiver. However, this will shorten the life of the button cell.

**Activate quick start via buffer battery:**

> ⚠️ **Risk of short circuit!** Soldering on the PCAN-GPS 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.

1. Unscrew the two screws.
2. Remove the cover under consideration of the antenna connection.
3. Pull out the circuit board.

4. Solder the solder bridge(s) on the board according to the desired setting.
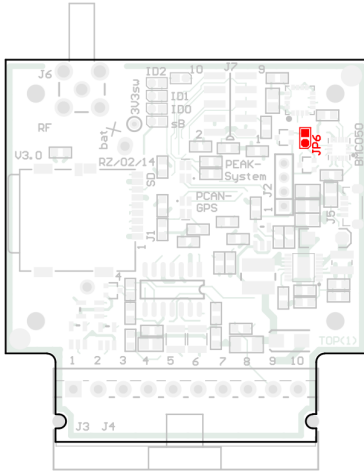
Solder field JP6 on the circuit board

Solder field	Port status
	Default: quick start of the GNSS receiver is not activated.
	Quick start of the GNSS receiver is activated.

5. Replace the circuit board and put the housing cover back in place according to the recess of the antenna connector.

6. Screw the two screws back into their original positions.

5 Operation

5.1 Starting PCAN-GPS

The PCAN-GPS is activated by applying the supply voltage to the respective ports (see section 3.1 *Spring Terminal Strip*). The firmware in the flash memory is subsequently run.

At delivery, the PCAN-GPS is provided with a standard firmware. At a CAN bit rate of 500 kbit/s, it periodically transmits the raw values determined by the sensors. In Appendix D *CAN Messages of the Standard Firmware* is a list of the used CAN messages.

5.2 Status LEDs

The PCAN-GPS has two status LEDs that can be green, red, or orange. The status LEDs are controlled by the running firmware.

LEDs in CAN bootloader mode

If the PCAN-GPS module is in CAN bootloader mode which is used for firmware updates (see chapter 7 *Firmware Upload*), the two LEDs are in the following state:

LED	Status	Description
Status 1	orange, quickly blinking	CAN bootloader mode active
Status 2	orange	

LEDs when using the standard firmware

When using the standard firmware, the LED Status 1 shows the reception status of GNSS data and the LED Status 2 shows the status of the CAN communication.

LED	Status	Description
Status 1	orange	Initial state
	orange, blinking (0.5 Hz)	At least one NMEA data frame with a valid CRC has been received.
	green, blinking (0.5 Hz)	A valid time stamp was received from the navigation satellites.
	green, quickly blinking (2 Hz)	The u-blox module has a fix and can determine its position.
Status 2	green and orange, quickly blinking	CAN messages are received.

5.3   Sleep Mode

The PCAN-GPS can be set into sleep mode via a specific CAN message. The voltage supply is turned off for a majority of the electronic components in the PCAN-GPS and the current consumption is reduced to 60 µA at 12 V. The sleep mode can be ended via various wake-up events. More about this in the following section 5.4 *Wake-up*.

> **Tip:** In the supplied example application, the sleep mode is activated by a specific CAN message with the CAN ID 0x651. To do this, the lowest bit in the first data byte must be set in order to activate the sleep mode.

5.4   Wake-up

If the PCAN-GPS is in sleep mode, a wake-up signal will be required for the device to turn on again. The following subsections show the possibilities.

5.4.1 Wake-up Externally by High Level

Via pin 9 of the connector strip (see section 3.1 *Spring Terminal Strip*), a high level (at least 1.3 V) can be applied over the entire voltage range in order to turn on the PCAN-GPS.

> ℹ️ **Note:** As long as a voltage is present at the wake-up pin, it is not possible to turn off the PCAN-GPS.

5.4.2 Wake-up via CAN Message

When receiving any CAN message, the PCAN-GPS will turn on again.

6 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.

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. Start 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-GPS\Examples\03_Timer`.

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

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

8. Prepare your hardware for firmware upload like described in section 7.2 *Preparing Hardware*.

9. Use the PEAK-Flash tool to upload your firmware to the device via CAN.

   The tool is either started via the menu *Terminal > Run Task > Flash Device* or from the subdirectory of the development package. Section 7.3 *Firmware Transfer* describes the process. A CAN interface of the PCAN series is required.

6.1   Library

The development of applications for the PCAN-GPS is supported by the library `libPCAN-GPS-*.a` (* stands for version number), a binary file. You can access all resources of the PCAN-GPS 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.

7 Firmware Upload

The microcontroller in the PCAN-GPS is equipped with new firmware via CAN. The firmware is uploaded via a CAN bus with the Windows software PEAK-Flash.

7.1 System Requirements

- CAN interface of the PCAN series for the computer, for example PCAN-USB
- CAN cabling between the CAN interface and the module with correct termination at both ends of the CAN bus with 120 Ohm each.
- Operating system Windows 11 (x64/ARM64), 10 (x86/x64)
- If you want to update several PCAN-GPS modules on the same CAN bus with new firmware, you must assign an ID to each module. See section 4.1 *Coding Solder Jumpers*.

7.2 Preparing Hardware

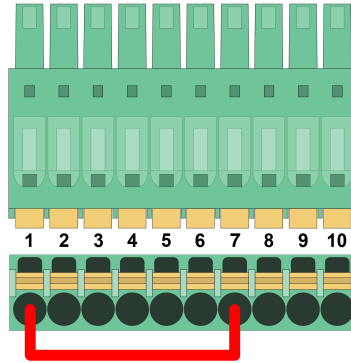For an upload of new firmware via CAN, the CAN bootloader must be activated in the PCAN-GPS.

Activating CAN-Bootloader:

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

1. Disconnect the PCAN-GPS from the power supply.
2. Establish a connection between **Boot** and the power supply **U_b**.

Connection at the spring terminal strip
between terminals 1 and 7

   Because of that, a High level is later applied to the **Boot** connection.
3. Connect the CAN bus of the module with a CAN interface connected to the computer. Pay attention to the proper termination of the CAN cabling (2 x 120 Ohm).
4. Reconnect the power supply.
   Due to the High level at the **Boot** connection, the PCAN-GPS starts the CAN bootloader. This can be determined by the status LEDs:

LED	Status	Description
Status 1	orange, quickly blinking	CAN bootloader mode active
Status 2	orange	

7.3 Firmware Transfer

A new firmware version can be transferred to the PCAN-GPS. The firmware is uploaded via a CAN bus using the Windows software PEAK-Flash.

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.
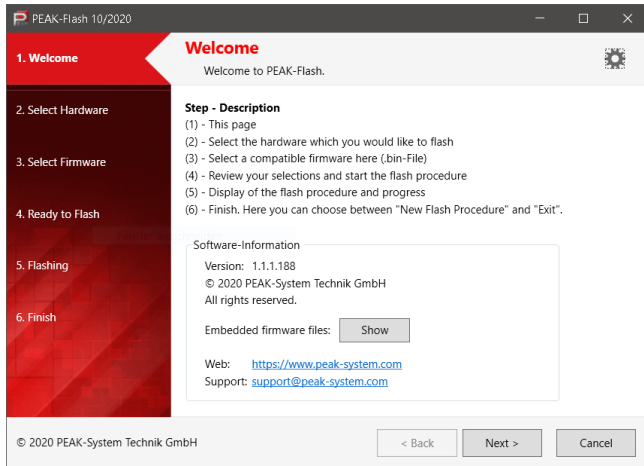
3. Click the button *Next*.

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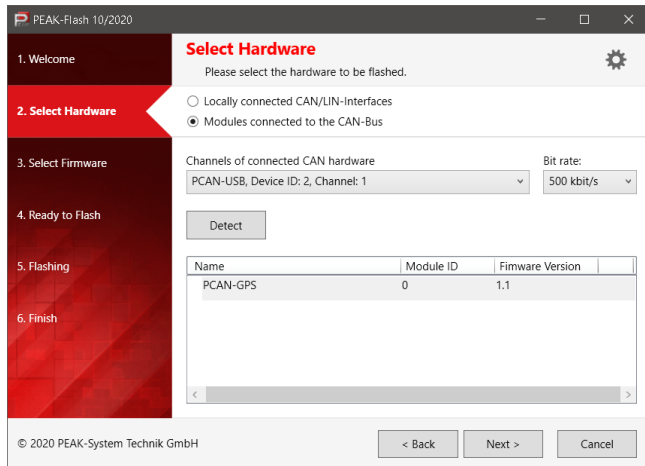
4. Click on the *Modules connected to the CAN bus* radio button.

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-GPS 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.
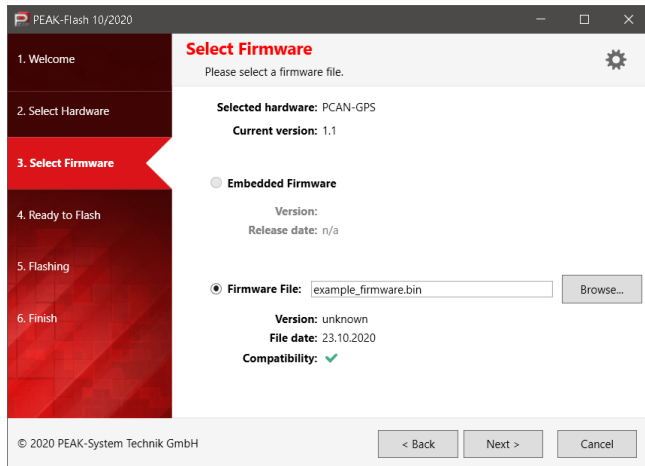
9. Select the F*irmware File* radio button and click *Browse*.

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-GPS.

    The *Flashing* dialog appears.

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

14. You can exit the program.

15. Disconnect the PCAN-GPS from the power supply.

16. Remove the connection between **Boot** and the power supply **U$_b$**.

17. Connect the PCAN-GPS to the power supply.

You can now use the PCAN-GPS with the new firmware.

8 Technical Data

Power supply		
Supply voltage	8 to 30 V DC	
Current consumption	Normal operation	8 V: 100 mA
		12 V: 60 mA
		24 V: 30 mA
		30 V: 25 mA
	Sleep mode	60 µA
Button cell for RTC (and GNSS if required)	Type CR2032, 3 V, 220 mAh, Operating time without power supply of the PCAN-GPS: approx. 570 days **Note:** Observe the operating temperature range for used button cell.	

Connectors	
Spring terminal strip	10-pole, 3.5 mm pitch (Phoenix Contact FMC 1.5/10-ST-3.5 - 1952348)
Antenna	Sub-Miniature-A (SMA) Supply for active antenna: 3.3 V, max. 50 mA
Memory card	micoSD™ slot internally for cards up to 32 GByte, types SD and SDHC

CAN	
Protocols	CAN 2.0 A/B
Physical transmission	ISO 11898-2 (High-speed CAN)
CAN bit rates	40 kbit/s to 1 Mbit/s
Transceiver	NXP TJA1041T, wake-up-capable
Internal termination	None
Listen-only mode	Programmable; not activated at delivery

Receiver fornavigation satellites (GNSS)

Type	u-blox MAX-7W
Receivable navigation systems	GPS, GLONASS, QZSS, SBAS **Note:** The standard firmware uses GPS.
Connection to microcontroller	Serial connection (UART 2) with 9600 Baud 8N1 (default) Input for synchronization pulses (ExtInt) Output of timing pulses (default: 1/s)
Operating modes	Continuous mode Power-save mode
Antenna type	active or passive
Protective circuit antenna	Monitoring of the antenna current on short circuit with error message **Note:** The OPEN detection of the u-blox MAX-7W is not enabled.
Maximum update rate of navigation data	10 Hz
Maximum number of satellites received at the same time	56
Sensitivity	max. -161 dbm (tracking and navigation)
Time to first position fix after cold start (TTFF)	approx. 30 s
Accuracy of the position values	GPS: 2.5 m GPS with SBAS: 2 m GLONASS: 4 m
Supply for active antenna	3.3 V, max. 50 mA, switchable

Antenna for satellite reception

Type	taoglas Ulysses AA.162
Center frequency range	1574 to 1610 MHz
Receivable systems	GPS, GLONASS
Operating temperature range	-40 to +85 °C (-40 to +185 °F)
Size	40 x 38 x 10 mm
Cable length	approx. 3 m
Weight	59 g
Special feature	Integrated magnet for mounting

Gyroscope

Type	STMicroelectronics L3GD20
Connection to microcontroller	SPI
Axes	roll (X), pitch (Y), yaw (Z)
Measuring ranges	±250, ±500, ±2000 dps (degrees per second)
Data format	16 bit, two's complement
Output data rate (ODR)	95 Hz, 190 Hz, 380 Hz, 760 Hz
Filter possibilities	Configurable high-pass and low-pass
Power saving modes	Sleep (2 mA), Power-down (5 µA)

Acceleration and magnetic field sensor

Type	Bosch Sensortec BMC050	
Connection to microcontroller	SPI	
Accelerometer		
Measuring ranges	±2, ±4, ±8, ±16 G	
Data format	10 bit, two's complement	
Filter possibilities	Low-pass with 1 kHz to 8 Hz bandwidth	
Operating modes	Power off, Normal, Suspend, Low-Power	
Correction options	Offset compensation	
Magnetic field sensor		
Sensitivity	X, Y:	±1000 µT
	Z:	±2500 µT
Data format	X, Y:	13 bit, two's complement
	Z:	15 bit, two's complement
Output data rate (ODR)	2 to 30 measurements per second	
Operating modes	Power off, Suspend, Sleep, Active	

Digital inputs

Count	2 (terminals 6 and 10)
Switch type	High-active (internal pull-down), inverting
Max. input frequency	3 kHz
Max. voltage	30 V
Switching thresholds	High: $U_{in} \geq 3$ V Low: $U_{in} \leq 2.2$ V
Internal resistance	133 kΩ

Digital output

Count	1 (terminal 5)
Type	Low-side driver
Max. voltage	30 V
Max. current	0.5 A
Short-circuit current	1.5 A

Microcontroller

Type	NXP LPC4074FBD80
Clock frequency quartz	12 MHz
Clock frequency internally	max. 120 MHz (programmable via PLL)
Firmware upload	via CAN (PCAN interface required)

Measures

Size	68 x 57 x 25.5 mm (W x D x H) (without SMA connector)
Weight	Circuit board: 33 g (incl. button cell and mating connector) Casing: 17 g

Environment

Operating temperature	-40 to +85 °C (-40 to +185 °F) (except button cell) Button cell (typical): -20 to +60 °C (-5 to +140 °F)
Temperature for storage and transport	-40 to +85 °C (-40 to +185 °F) (except button cell) Button cell (typical): -40 to +70 °C (-40 to +160 °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 System

This declaration applies to the following product:

Product name:	**PCAN-GPS**
Item number(s):	**IPEH-002110**
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
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, 19 January 2023

Uwe Wilhelm, Managing Director

Appendix B   UKCA Certificate

UK Declaration of Conformity

.PEAK
System

This declaration applies to the following product:

Product name:	**PCAN-GPS**
Item number(s):	**IPEH-002110**

Manufacturer:

PEAK-System Technik GmbH
Otto-Röhm-Straße 69
64293 Darmstadt
Germany

UK authorized representative:

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

UKCA

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
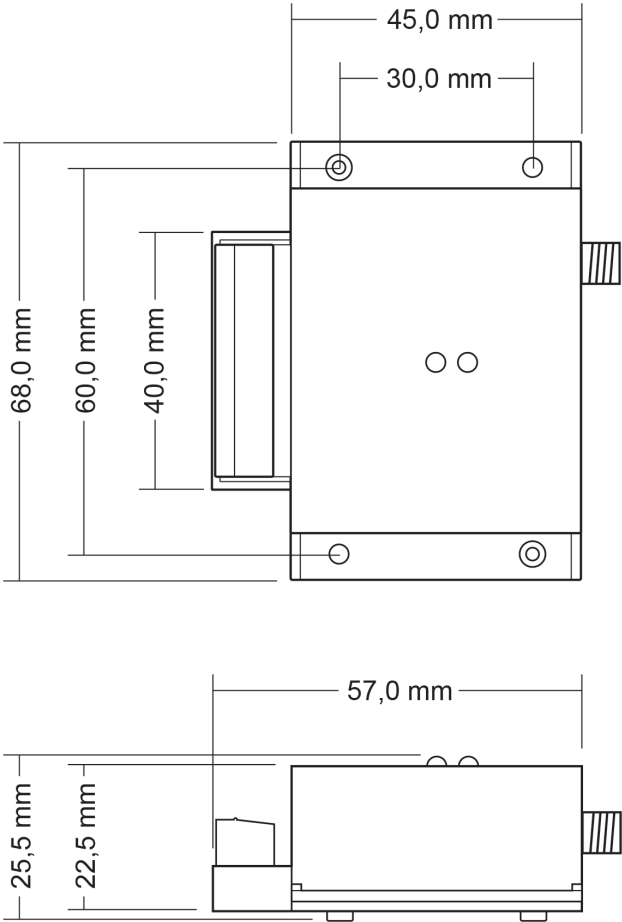
Electromagnetic Compatibility Regulations 2016

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, 19 January 2023

Uwe Wilhelm, Managing Director

Appendix C   Dimension Drawing

Appendix D CAN Messages of the Standard Firmware

The following two tables apply to the standard firmware which is provided with the PCAN-GPS at delivery. They list the CAN messages that, on the one hand, are transmitted periodically by the PCAN-GPS (600h to 640h) and, on the other hand, can be used to control the PCAN-GPS (650h to 657h). The CAN messages are sent in **Intel** format.

> 💡 **Tip:** For users of the PCAN-Explorer, the development package contains an example project that is compatible with the standard firmware.
>
> **Download link to the development package:**
> www.peak-system.com/quick/DLP-DevPack
>
> **Path to the example project:**
> ```
> PEAK-DevPack\Hardware\PCAN-GPS\Examples\
> 00_Delivery_Firmware\PCAN-Explorer Example Project
> ```

D.1 CAN Messages from the PCAN-GPS

CAN ID	Start bit	Bit count	Identifier	Values
600h	BMC_Acceleration (Cycle time 75 ms)			
	0	16	Acceleration_X	Conversion to mG: raw value * 3.91
	16	16	Acceleration_Y	
	32	16	Acceleration_Z	
	48	8	Temperature	Conversion to °C: raw value * 0.5 + 24
	56	2	VerticalAxis	0 = undefined 1 = X Axis 2 = Y Axis 3 = Z Axis
	58	3	Orientation	0 = flat 1 = flat upside down 2 = landscape left 3 = landscape right 4 = portrait 5 = portrait upside down
601h	BMC_MagneticField (Cycle time 75 ms)			
	0	16	MagneticField_X	Conversion to µT: raw value * 0.3
	16	16	MagneticField_Y	
	32	16	MagneticField_Z	
610h	L3GD20_Rotation_A (Cycle time 50 ms)			
	0	32	Rotation_X	Floating-point number[1], unit: degree per second
	32	32	Rotation_Y	
611h	L3GD20_Rotation_B (Cycle time 50 ms)			
	0	32	Rotation_Z	Floating-point number[1], unit: degree per second

[1]   Sign: 1 bit, fixed-point part: 23 bits, exponent: 8 bits (according to IEEE 754)

CAN ID	Start bit	Bit count	Identifier	Values
620h	GPS_Status (Cycle time 100 ms)			
	0	8	GPS_AntennaStatus	0 = INIT 1 = DONTKNOW 2 = OK 3 = SHORT 4 = OPEN[2]
	8	8	GPS_NumSatellites	
	16	8	GPS_NavigationMethod	0 = INIT 1 = NONE 2 = 2D 3 = 3D
	24	8	GPS_TalkerID	0 = GPS 6 = GLONASS
	32	8	GPS_SatellitesInView	
	40	1	TimeValid	
	41	1	DateValid	
	42	1	PositionValid	
621h	GPS_CourseSpeed (Cycle time 100 ms)			
	0	32	GPS_Course	Floating-point number[1], unit: degree
	32	32	GPS_Speed	Floating-point number[1], unit: km/h
622h	GPS_PositionLongitude (Cycle time 100 ms)			
	0	32	GPS_Longitude_Minutes	Floating-point number[1]
	32	16	GPS_Longitude_Degree	
	48	8	GPS_IndicatorEW	0 = INIT 69 = East 87 = West

[2] The OPEN detection of the u-blox MAX-7W is not enabled.

CAN ID	Start bit	Bit count	Identifier	Values
623h	GPS_PositionLatitude (Cycle time 100 ms)			
	0	32	GPS_Latitude_Minutes	Floating-point number[1]
	32	16	GPS_Latitude_Degree	
	48	8	GPS_IndicatorNS	0 = INIT 78 = North 83 = South
624h	GPS_PositionAltitude (Cycle time 100 ms)			
	0	32	GPS_Altitude	Floating-point number[1]
625h	GPS_Delusions_A (Cycle time 100 ms)			
	0	32	GPS_PDOP	Floating-point number[1]
	32	32	GPS_HDOP	
626h	GPS_Delusions_B (Cycle time 100 ms)			
	0	32	GPS_VDOP	Floating-point number[1]
627h	GPS_DateTime (Cycle time 100 ms)			
	0	8	UTC_Year	
	8	8	UTC_Month	
	16	8	UTC_DayOfMonth	
	24	8	UTC_Hour	
	32	8	UTC_Minute	
	40	8	UTC_Second	
630h	IO (Cycle time 25 ms)			
	0	1	Din1_Status	
	1	1	Din2_Status	
	2	1	Dout_Status	
	3	1	SD_Present	
	4	1	GPS_PowerStatus	
	5	3	Device_ID	

CAN ID	Start bit	Bit count	Identifier	Values
640h	RTC_DateTime (Cycle time 500 ms)			
	0	8	RTC_Sec	
	8	8	RTC_Min	
	16	8	RTC_Hour	
	24	8	RTC_DayOfWeek	0 = Monday 1 = Tuesday 2 = Wednesday 3 = Thursday 4 = Friday 5 = Saturday 6 = Sunday
	32	8	RTC_DayOfMonth	
	40	8	RTC_Month	
	48	16	RTC_Year	

D.2 CAN Messages to the PCAN-GPS

CAN ID	Start bit	Bit count	Identifier	Values
650h	Out_IO (1 Byte)			
	0	1	Dout_Set	
	1	1	GPS_SetPower	
651h	Out_PowerOff (1 Byte)			
	0	1	Device_PowerOff	
652h	Out_Gyro (1 Byte)			
	0	2	Gyro_SetScale	0 = ±250 °/s 1 = ±500 °/s 2 = ±2000 °/s
653h	Out_BMC_AccScale (1 Byte)			
	0	3	Acc_SetScale	1 = ±2 G 2 = ±4 G 3 = ±8 G 4 = ±16 G
654h	Out_SaveConfig (1 Byte)			
	0	1	Config_SaveToEEPROM	

CAN ID	Start bit	Bit count	Identifier	Values
655h	Out_RTC_SetTime (8 Bytes)			
	0	8	RTC_SetSec	
	8	8	RTC_SetMin	
	16	8	RTC_SetHour	
	24	8	RTC_SetDayOfWeek	0 = Monday 1 = Tuesday 2 = Wednesday 3 = Thursday 4 = Friday 5 = Saturday 6 = Sunday
	32	8	RTC_SetDayOfMonth	
	40	8	RTC_SetMonth	
	48	16	RTC_SetYear	
656h	Out_RTC_TimeFromGPS (1 Byte)			
	0	1	RTC_SetTimeFromGPS	**Note:** The data from GPS does not contain the day of week.
657h	Out_Acc_FastCalibration (4 Bytes)			
	0	2	Acc_SetCalibTarget_X	0 = 0 G 1 = +1 G 2 = -1 G
	8	2	Acc_SetCalibTarget_Y	
	16	2	Acc_SetCalibTarget_Z	
	24	1	Acc_StartFastCalib	

Appendix E   Data Sheets

The data sheets of components of the PCAN-GPS are enclosed to this document (PDF files). You can download the current versions of the data sheets and additional information from the manufacturer websites.

- Antenna taoglas Ulysses AA.162:
    PCAN-GPS_UserManAppendix_Antenna.pdf
    www.taoglas.com
- GNSS receiver u-blox MAX-7W:
    PCAN-GPS_UserManAppendix_GNSS.pdf
    www.u-blox.com
- Gyroscope STMicroelectronics L3GD20:
    PCAN-GPS_UserManAppendix_Gyroscope.pdf
    www.st.com
- Acceleration and magnetic field sensor Bosch Sensortec BMC050:
    PCAN-GPS_UserManAppendix_MagneticFieldSensor.pdf
    www.bosch-sensortec.com
- Microcontroller NXP LPC4074 (User Manual):
    PCAN-GPS_UserManAppendix_Microcontroller.pdf
    www.nxp.com

Appendix F   Disposal

The PCAN-GPS and the battery it contains must not be disposed of in household waste. Remove the battery and dispose of the battery and the PCAN-GPS properly in accordance with local regulations.

The following battery is included in the PCAN-GPS:

- 1 x button cell CR2032 3.0 V