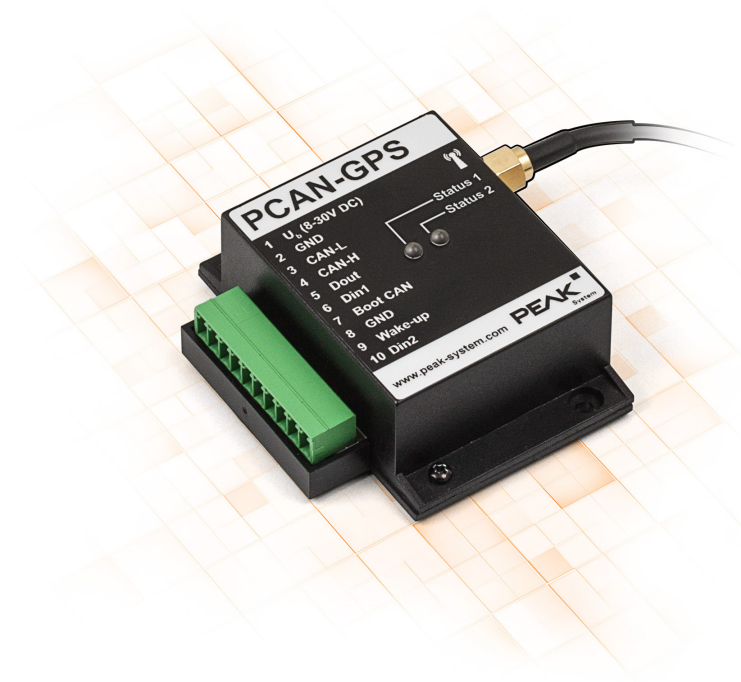
PCAN-GPS

Programmable Position Sensor Module with CAN Connection

User Manual



Document version 1.1.0 (2014-11-13)

PEAK System

Products taken into account

Product Name	Model	Part number
PCAN-GPS		IPEH-002110

PEAK-System Technik GmbH
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29

www.peak-system.com
info@peak-system.com

Document version 1.1.0 (2014-11-13)

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.

Using the supplied library and the Yagarto GNU ARM toolchain (contains the GNU Compiler Collection GCC for C and C++), custom firmware can be created and then transferred to the module via CAN. This gives a whole range of options for processing and routing of the arising sensor data.

On delivery, the PCAN-GPS is provided with a demo firmware that transmits the raw data of the sensors periodically on the CAN bus. The source code of the demo firmware as well as further programming examples that cover different tasks are 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, Galileo, 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 to 1 Mbit/s
- 2-KByte EEPROM in the microcontroller

- Internal microSD™ memory card slot, e.g. for logging position data (microSD™ memory card not in the scope of supply)
- Wake-up via CAN bus or a separate input
- 2 digital inputs (High-active)
- 1 digital output (Low-side switch)
- LEDs for status signaling
- Connection via a 10-pole screw terminal strip (Phoenix)
- Supply voltage from 8 to 30 V
- Extended operating temperature range from -40 to +85 °C (-40 to +185 °F) (with exception of the button cell)
- New firmware can be loaded via CAN interface

1.2 Scope of Supply

- PCAN-GPS in a plastic casing
- 10-pin screw terminal strip
- External antenna for satellite reception
- Windows development software (Yagarto GNU ARM toolchain, flash program)
- DVD with library, programming examples, and manual in PDF format

1.3 Prerequisites for Operation

- Power supply in the range of 8 to 30 V DC
- For updating the firmware via CAN:
  - CAN interface of the PCAN series for the computer (e.g. PCAN-USB)
  - Operating system Windows 8.1, 7, Vista (32/64-bit)

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 the technical specifications (on page 27) and the data sheets of the respective manufacturers (Appendix D on page 38).

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)
- Galileo (Europe)
- 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.

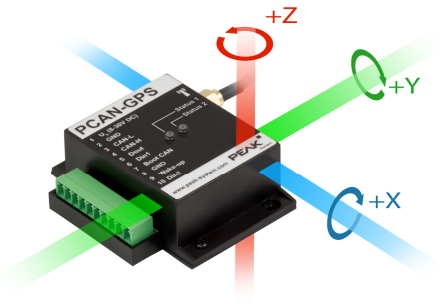
The use of **GPS and GLONASS** cannot happen simultaneously. On the one hand, the external antenna must match the respective system (the supplied one can receive both), on the other hand, the GNSS receiver must be switched.

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 3.2 on page 15).

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.



X: roll

Y: pitch

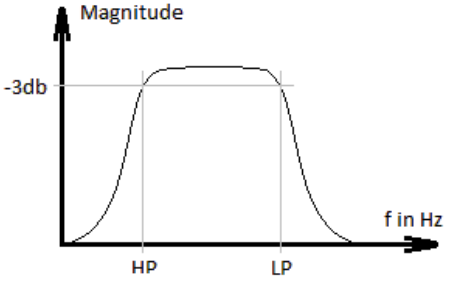
Z: yaw

Gyroscope axes in relation to the PCAN-GPS casing

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.

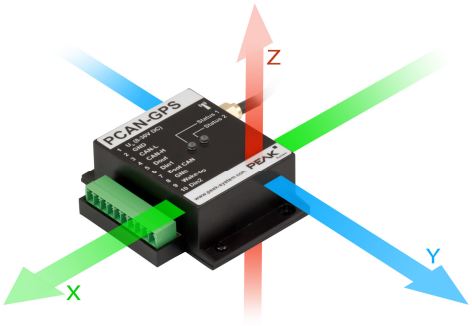
With its cut-off frequency (3 dB level), the high-pass defines the minimum angular velocity needed for transmission. With the low-pass in contrast, it is possible to affect the transmission of faster rotation angles. Typical values for output can be distinguished from intermittent fast movements. The 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, and

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 Hardware Configuration

Basic settings can be made on the circuit board of the PCAN-GPS module by using solder jumpers. On delivery, there are the following presets:

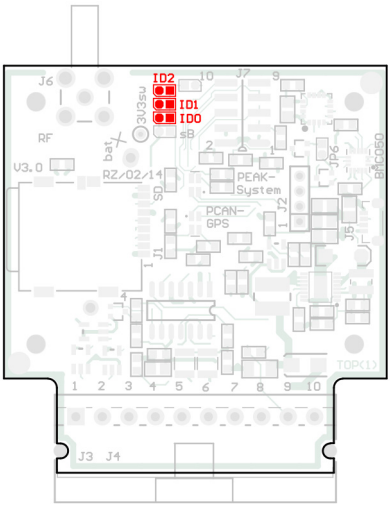
- 3 coding solder jumpers: all open
- Buffer battery for satellite reception: not connected

These settings need to be adjusted only if necessary. On delivery, you can operate the PCAN-GPS module without changing the hardware configuration.

Attention! Electrostatic discharge (ESD) can damage or destroy components on the PCAN-GPS circuit board. Take precautions to avoid ESD when handling the circuit board.

3.1 Coding Solder Jumpers

The three solder fields for coding solder jumpers (ID0, ID1, ID2) are each assigned to one port of the LPC4074 microcontroller (µC).



Solder fields for coding solder jumpers on the circuit board

Solder field is …	Status at the port
bridged	Low
open	High

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).

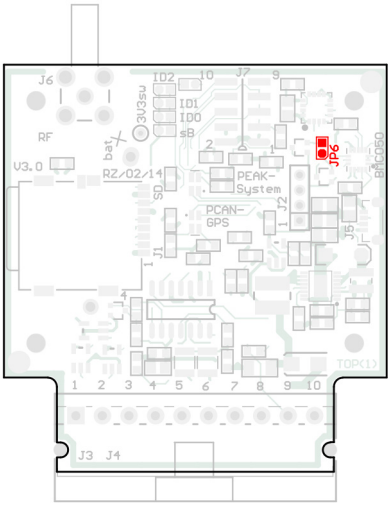
Solder field	ID0	ID1	ID2
Binary digit	001	010	100
Decimal equivalent	1	2	4

See also chapter 7 *Firmware Update* on page 22.

3.2 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.

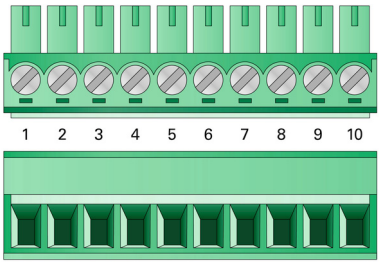
On solder field JP6, a solder bridge must be set that connects the button cell with the GNSS receiver.



Solder field JP6 on the circuit board

4 Connectors

4.1 Screw Terminal Strip



Screw terminal strip with 3.5 mm pitch
(Phoenix Contact MC 1,5/10-ST-3,5 - 1840447)

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

4.2 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.

4.3 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 (not included). The maximum capacity is 32 GByte.

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

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.

5 Operation

5.1 Starting PCAN-GPS

The PCAN-GPS is activated by applying the supply voltage to the respective ports (see chapter 4.1 *Screw Terminal Strip* on page 16). The firmware in the flash memory is subsequently run.

At delivery, the PCAN-GPS is provided with a demo firmware. At a CAN bit rate of 500 kbit/s, it periodically transmits the raw values determined by the sensors. In Appendix C on page 33, there 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.

If the PCAN-GPS module is in **CAN bootloader mode** which is used for a firmware update (see chapter 7 on page 22), the two LEDs are in the following state:

- Status 1 (left): orange, quickly blinking
- Status 2 (right): orange

6 Software

This chapter covers the installation of the Yagarto GNU ARM toolchain and gives notes about the software library and the firmware examples.

Software, source code, and additional information are included on the supplied DVD in the following directory branch:

`/Develop/Microcontroller hardware/PCAN-GPS/`

6.1 Installing the GNU ARM Toolchain

To compile the code examples and the custom firmware code under Windows, install Yagarto on your computer. Yagarto is a collection of tools to develop applications for ARM processors and microcontrollers on Windows platforms. The collection includes the GNU GCC compiler for C and C++, Make, and further tools. Further information about Yagarto: www.yagarto.de

System requirement: operating system Windows 8.1, 7, Vista (32/64-bit)

Do the following to install Yagarto:

1. From the directory branch on the provided DVD mentioned above, change to the `Compiler` subdirectory.

   The directory contains the two installation programs `yagarto-*.exe` and `yagarto-tools-*.exe`.

2. Execute the first installation program and follow its instructions.

If you don't want to use the default destination folder, make sure that your customized path doesn't contain any spaces. Otherwise compile operations will not work later.

3. Afterwards, execute the second installation program and follow its instructions.

In the system environment, the installation programs create search paths for the executable files. These new search paths are effective only for programs and command prompts that are started afterwards.

6.2 Library

The development of applications for the PCAN-GPS module is supported by the library `libPCAN-GPS-GNU*.a` (`*` stands for version number), a binary file. You can access the resources of the module by means of this library. The library is documented in the header files (`*.h`). The files are located in each example directory.

6.3 Firmware Examples (Compiling)

On the DVD, the `Examples` subdirectory contains source code for several firmware examples that you can use and test directly and that you can reuse for custom firmware.

At delivery, the PCAN-GPS module is provided with the `DeliveryFirmware`. At a CAN bit rate of 500 kbit/s, it periodically transmits the raw values determined by the sensors. In Appendix C on page 33, there is a list of the used CAN messages.

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

Do the following to compile a firmware example under Windows:

1. From the provided DVD, copy the subdirectory of the desired example from the `Examples` directory to the local hard disk.
2. Open a **command prompt** by using the Windows Start menu. Alternatively you can press the key combination ⊞ + R and enter `cmd.exe` as program to be executed.
3. At the command prompt change to the previously copied directory.
4. Execute the following command in order to clean-up the target directories (i.e. `.out`) from files that have been generated earlier:

   ```
   make clean
   ```

5. Execute the following command to compile the example firmware:

   ```
   make all
   ```

   If the compiler has finished without errors (“Errors: none”), you can find the firmware file with the extension `.bin` in the subdirectory `.out`. This file is then used for a firmware update on the PCAN-GPS module.

7 Firmware Update

The microcontroller in the PCAN-GPS module is equipped with new firmware via CAN. The scope of supply includes the Windows program PCAN-Flash to transfer the firmware from the computer to the PCAN-GPS module.

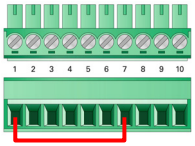
7.1 System Requirements

- CAN interface of the PCAN series for the computer (e.g. PCAN-USB)
- CAN cabling between the CAN interface and the PCAN-GPS module with proper termination (120 Ω on each end of the CAN bus)
- Operating system Windows 8.1, 7, Vista (32/64-bit)
- If you want to update several PCAN-GPS modules connected to the same CAN bus, you must assign a unique ID to each module. See section 3.1 *Coding Solder Jumpers* on page 14.

7.2 Preparing Hardware and Software

Perform the following steps for preparation of the hardware:

1. Switch the off the PCAN-GPS module by disconnecting it from the power supply.
2. Establish a connection between "+U_b" (terminal 1) and "Boot CAN" (terminal 7) of the module.



Connection at the screw terminal strip
between terminals 1 and 7

This measure later applies the “Boot CAN” connection with a High level.

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 Ω).

- Perform the following steps for preparation of the software:

1. On the supplied DVD, change to the following directory: `/Develop/Microcontroller hardware/PCAN-GPS/`
2. Copy the subdirectory `PcanFlash` to the local hard disk.

   The contained Windows software that copies the Firmware via CAN (`PcanFlash.exe`) can only be started from a data carrier that is writable.

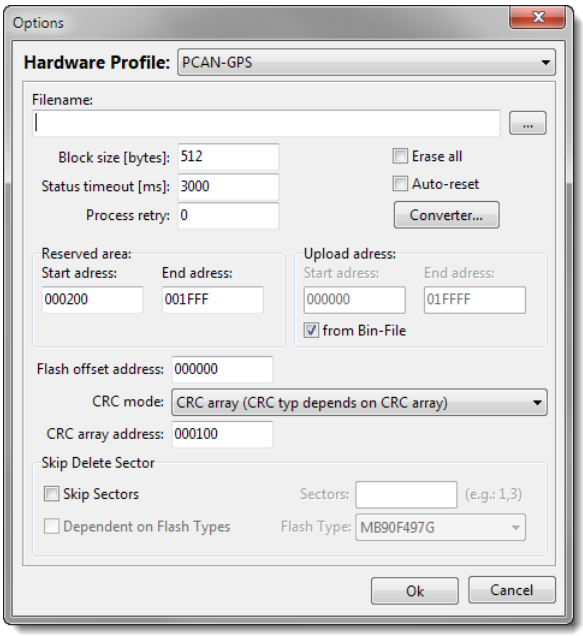
7.3 Sending the Firmware

- The process of sending new firmware to the PCAN-GPS module is as follows:

1. Ensure that a connection is established between the “U_b” and the “Boot CAN” terminals of the module (details: see above).
2. Switch on the module by applying a supply voltage.

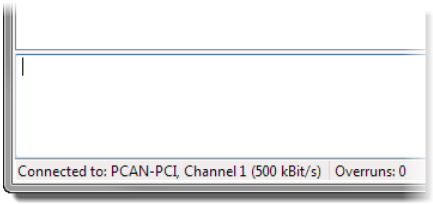
Due to the High level at the "Boot CAN" connection, the module starts the CAN bootloader. This is indicated by the two LEDs: both orange, the left one quickly blinking.

3. Run the program `PcanFlash.exe` under Windows from the local hard drive.
4. Click on the (Options) button in order to call up the dialog box.
5. From the **Hardware Profile** dropdown list, select the **PCAN-GPS** entry.



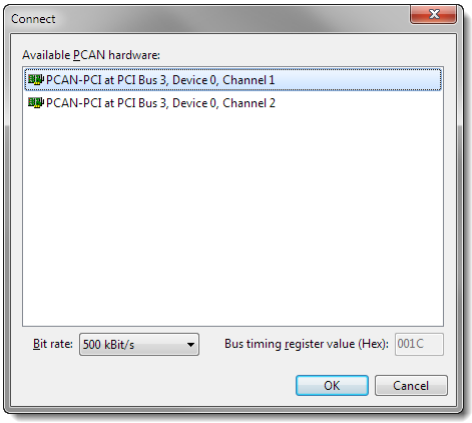
6. Click on the ... button next to the **File name** field in order to select the desired firmware file (`*.bin`) to be send.
7. Click on the **OK** button.

8. Make sure that the PCAN-Flash program is connected with 500 kbit/s to the available CAN interface at the computer.



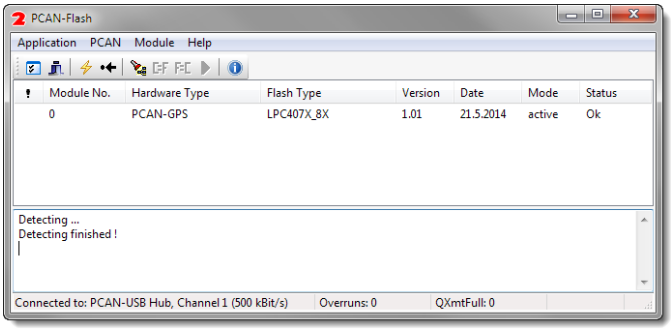
PCAN-Flash: Display of a connection in the status bar on the bottom.

If not, click the (Connect) button in order to change the selection in the according dialog box.



9. Click the (Detect) button in order to detect the PCAN-GPS module connected to the CAN bus.

   An entry for the PCAN-GPS module appears in the main window.



10. Select the entry for the PCAN-GPS module.
11. Click the ▶ (Program) button in order to start sending the new firmware to the converter.

    Observe the status indication at the bottom of the window. The process was successful if the last message to appear is “Flashing of module(s) finished!”.
12. Disconnect the power supply from the module.
13. At the module, disconnect “Boot CAN” from “U_b”.

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

8 Technical Specifications

Power supply	
Supply voltage	8 - 30 V DC
Current consumption normal operation	8 V: 100 mA 12 V: 60 mA 24 V: 30 mA 30 V: 25 mA
Current consumption sleep	60 µA
Button cell for RTC (and GNSS if required)	3 V, type CR2032 Note: Observe the operating temperature range for used button cell.

Connectors	
Screw terminal strip	10-pole, 3.5 mm pitch (Phoenix Contact MC 1,5/10-ST-3,5 - 1840447)
Antenna	Sub-Miniature-A (SMA) Supply for activa antenna: 3.3 V, max. 50 mA
Memory card	micoSD™ slot internally for cards up to 32 GByte, types SD and SDHC

CAN	
Specification	ISO 11898-2, High-speed CAN 2.0A (Standard format) and 2.0B (Extended format)
Bit rates	40 kbit/s - 1 Mbit/s
Transceiver	NXP TJA1041T, wake-up-capable
Termination	none

Receiver for navigation satellites (GNSS)	
Type	u-blox MAX-7W
Receivable navigation systems[1]	GPS, GLONASS, Galileo, QZSS, SBAS
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
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)	about 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 - 1610 MHz
Operating temperature range	-40 - +85 °C (-40 - +185 °F)
Size	40 x 38 x 10 mm
Cable length	about 3 m
Weight	59 g
Special feature	Integrated magnet for mounting

[1] The demo firmware uses GPS.

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 bits, 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 bits, two's complement
Filter possibilities	Low-pass with 1 kHz - 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 bits, two's complement Z: 15 bits, two's complement
Output data rate (ODR)	2 - 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
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 LPC4074
Clock frequency quartz	12 MHz
Clock frequency internally	max. 120 MHz (programmable by PLL)

Measures	
Size	45 x 68 x 26 mm (without SMA connector) See also dimension drawing Appendix B on page 32
Weight	Circuit board: 33 g (incl. button cell and mating connector) Casing: 17 g

Environment	
Operating temperature	-40 - +85 °C (-40 to +185 °F) (except button cell) Button cell (typical): -20 - +60 °C (-5 to +140 °F)
Temperature for storage and transport	-40 - +85 °C (-40 to +185 °F) (except button cell) Button cell (typical): -40 - +70 °C (-40 to +160 °F)
Relative humidity	15 - 90 %, not condensing
EMC	EN 61326-1:2013-07 EC directive 2004/108/EG
Ingress protection (IEC 60529)	IP20

Appendix A CE Certificate

PCAN-GPS IPEH-002110 – EC Declaration of Conformity
PEAK-System Technik GmbH

Notes on the CE Symbol CE

The following applies to the "PCAN-GPS" product with the item number(s) IPEH-002110.

EC Directive This product fulfills the requirements of EU EMC Directive 2004/108/EC (Electromagnetic Compatibility) and is designed for the following fields of application as for the CE marking:

Electromagnetic Immunity/Emission
DIN EN 61326-1, publication date 2013-07
Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements (IEC 61326-1:2012);
German version EN 61326-1:2013

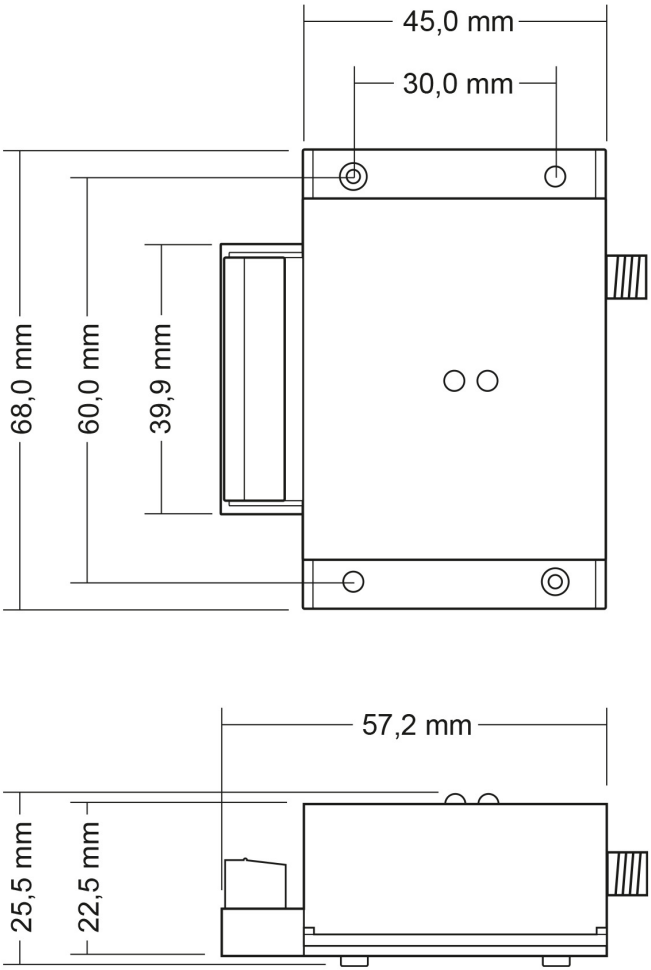
Declarations of Conformity In accordance with the above mentioned EU directives, the EC declarations of conformity and the associated documentation are held at the disposal of the competent authorities at the address below:

PEAK-System Technik GmbH
Mr. Wilhelm
Otto-Roehm-Strasse 69
64293 Darmstadt
Germany

Phone: +49 (0)6151 8173-20
Fax: +49 (0)6151 8173-29
E-mail: info@peak-system.com

Signed this 12th day of November 2014

Appendix B Dimension Drawing



The dimension drawing is not shown in actual size.

Appendix C CAN-Messages of the Demo Firmware

The two tables apply to the demo 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).

Tip: For users of the PCAN-Explorer 5, the provided DVD contains an example project suitable for the demo firmware in the following directory branch:
`/Develop/Microcontroller hardware/PCAN-GPS/`

C.1 CAN Messages from the PCAN-GPS

CAN ID	Start bit	Bit count	Identifier	Values
600h	BMC_Acceleration			
	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

CAN ID	Start bit	Bit count	Identifier	Values
601h	BMC_MagneticField			
	0	16	MagneticField_X	Conversion to µT: raw value * 0.3
	16	16	MagneticField_Y	
	32	16	MagneticField_Z	
610h	L3GD20_Rotation_A			
	0	32	Rotation_X	Floating-point number[2], unit: degree per second
	32	32	Rotation_Y	
611h	L3GD20_Rotation_B			
	0	32	Rotation_Z	Floating-point number[2], unit: degree per second
620h	GPS_Status			
	0	8	GPS_AntennaStatus	0 = INIT 1 = DONTKNOW 2 = OK 3 = SHORT 4 = OPEN
	8	8	GPS_NumSatellites	
	16	8	GPS_NavigationMethod	0 = INIT 1 = NONE 2 = 2D 3 = 3D
621h	GPS_CourseSpeed			
	0	32	GPS_Course	Floating-point number[2], unit: degree
	32	32	GPS_Speed	Floating-point number[2], unit: km/h
622h	GPS_PositionLongitude			
	0	32	GPS_Longitude_Minutes	Floating-point number[2]
	32	16	GPS_Longitude_Degree	
	48	8	GPS_IndicatorEW	0 = INIT 69 = East 87 = West

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

CAN ID	Start bit	Bit count	Identifier	Values
623h	GPS_PositionLatitude			
	0	32	GPS_Latitude_Minutes	Floating-point number[2]
	32	16	GPS_Latitude_Degree	
	48	8	GPS_IndicatorNS	0 = INIT 78 = North 83 = South
624h	GPS_PositionAltitude			
	0	32	GPS_Altitude	Floating-point number[2]
625h	GPS_Delusions_A			
	0	32	GPS_PDOP	Floating-point number[2]
	32	32	GPS_HDOP	
626h	GPS_Delusions_B			
	0	32	GPS_VDOP	Floating-point number[2]
627h	GPS_DateTime			
	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			
	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			
	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	

C.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

CAN ID	Start bit	Bit count	Identifier	Values
654h Out_SaveConfig (1 byte)				
	0	1	Config_SaveToEEPROM	
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 D 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 sesnor 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