ECUMASTER
GPStoCAN

Manual

Revision 1.0

Contents

1. Copyright and trademarks

2. Introduction

This document provides information about the ECUMASTER GPStoCAN module including a device description, specifications, available features and use cases.

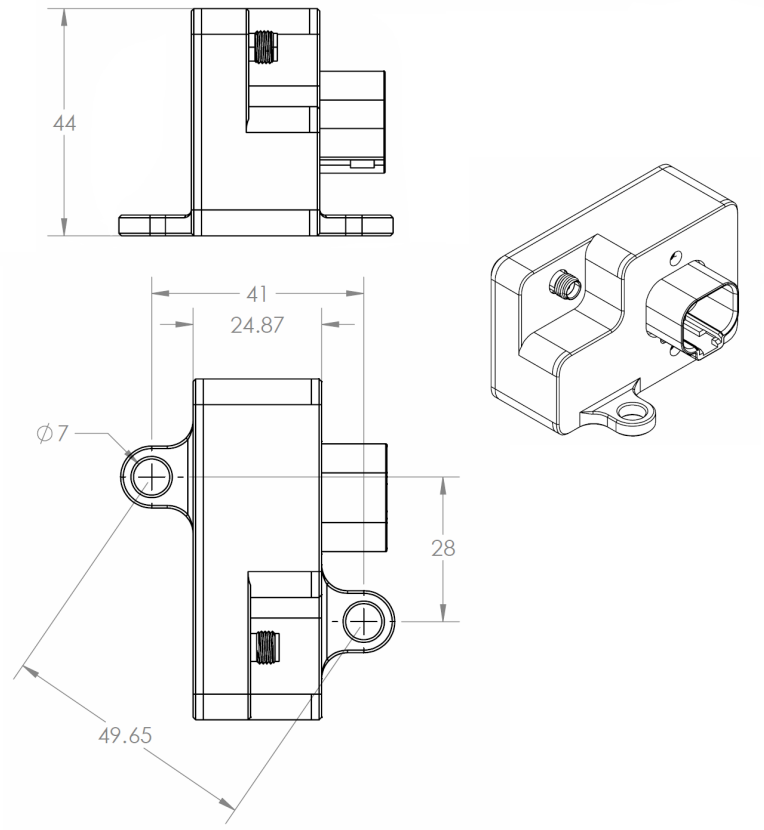
3. Description

GPStoCAN is a device designed to provide position information over CAN BUS. This module can use combination of different navigation systems (GPS, GLONASS, BeiDou, Galileo) as well as IMU (Inertial Measurement Unit) to provide position updates at a rate of 20Hz. Position data can be used to measure lap times, estimate current lap time, draw track maps and analyze vehicle logs with respect to track position.

4. Specifications

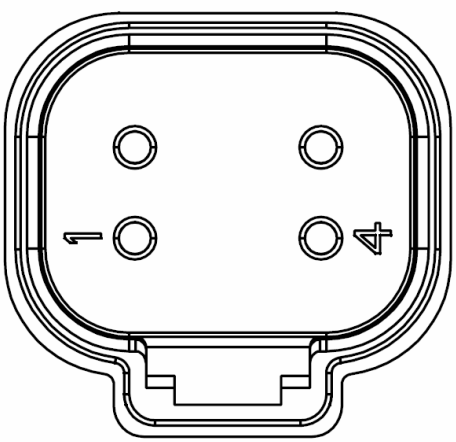
4.1. Mechanical drawings

(Dimensions in mm)



4.2. Connector description

Pin	Description
1	Ground
2	CAN High
3	CAN Low
4	+12V



4.3. Specifications table

GENERAL	
Operating supply voltage	6-22V, immunity to transients according to ISO 7637
Reverse polarity protection	Yes, internal up to 16V
Temperature range	-40 to +85°C
Enclosure	IP65, bespoke CNC machined aluminium
Size and weight	66x53x44mm, 92g
Connector	DEUTSCH DT15-4P
CAN-bus bitrate	1Mbps, 500kbps, 250kbps, 125kbps
PC communication	Using USB to CAN interface (ECUMASTER USBtoCAN, PEAK, Kvaser)
NAVIGATION	
Supported systems	GPS, GLONASS, BeiDou, Galileo
Position update frequency	20Hz
Supported antennas	Active
Acquisition	Cold starts: 26 sec Aided starts: 3 sec Reacquisition: 1 sec

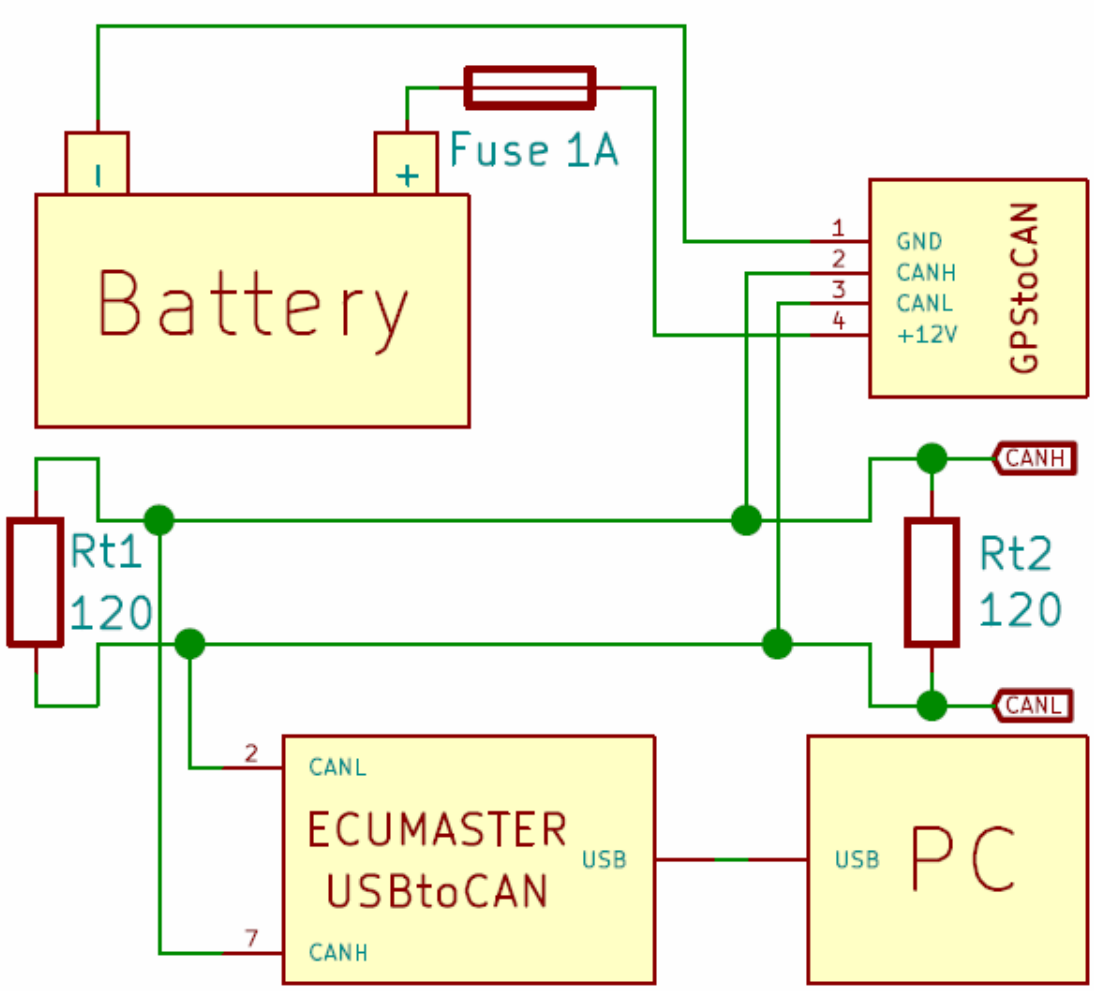
5. PC connection

Communication with PC software is done using CAN-bus. This requires a special interface which converts CAN-bus communication to USB 2.0. Interface is an independent device and must be purchased separately. Supported interfaces:

- ECUMASTER USBtoCAN (driver and manual here)
- PEAK-System
- Kvaser

ECUMASTER Light Client is the configuration software for many ECUMASTER products as well as tool for CAN-bus monitoring. Light Client can be used to check available devices on the CAN-bus, display channel values, change CAN-bus bitrate and device specific properties. Monitoring of CAN-bus is possible thanks to list of frames grouped by ID, saving traffic trace file and sending custom messages on the CAN-bus.
Software can be downloaded from: http://www.ecumaster.com/lcbeta.html

Wiring diagram:



6. Software features

6.1. Channels

Channels are different data values that are sent over CAN-bus. Channels are sent as raw values, which means that obtaining a value with the correct unit requires some calculations.

$$Value[unit] = \frac{Value[raw] * Multiplier}{Divider} + Offset$$

The table below describes how each channel is positioned inside the CAN frame and how to obtain the correct value. All values are Big Endian.

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Output ID (default: 0x400)							
0	Latitude	32bit signed	-214 – 214	1	10^7	0	°
4	Longitude	32bit signed	-214 – 214	1	10^7	0	°
Output ID+1 (default: 0x401)							
0	Speed	16bit signed	-32768 – 32767	1	1	0	cm/s
2	Height	16bit signed	-32768 – 32767	1	1	0	m
4	Noise	8bit unsigned	0 – 255	1	1	0	-
5	Satellites number	8bit unsigned	0 – 255	1	1	0	-
6	Frame index	8bit unsigned	0 – 255	1	1	0	-
7 (0)	GPS status	3bit unsigned	0 – 7	1	1	0	-
7 (3)	Fusion mode	2bit unsigned	0 – 3	1	1	0	-
Output ID+2 (default: 0x402)							
0	Heading motion	16bit unsigned	0 – 655.35	1	100	0	°
2	Heading vehicle	16bit unsigned	0 – 655.35	1	100	0	°
4	X angle rate	16bit signed	-327 – 327	1	100	0	°/s
6	Y angle rate	16bit signed	-327 – 327	1	100	0	°/s
Output ID+3 (default: 0x403)							
0	Z angle rate	16bit signed	-327 – 327	1	100	0	°/s
2	X acceleration	16bit signed	-327 – 327	1	100	0	g
4	Y acceleration	16bit signed	-327 – 327	1	100	0	g
6	Z acceleration	16bit signed	-327 – 327	1	100	0	g

Channels description:

Latitude – current latitude position in degrees
Longitude – current longitude position in degrees
Speed – current speed in centimeters per second
Height – current height above mean sea level in meters
Noise – satellite signal noise, lower is better
Satellites number – number of currently visible satellites
Frame index – position frame index number, increases cyclically from 0 to 255
GPS status – position fix status:

- 1 - “NoFix” - no position fix acquired
- 2 - “IMU” - position is fixed using inertial measurement unit only
- 3 - “GPS-2D” - position is fixed in 2D space using GNSS satellites
- 4 - “GPS-3D” - position is fixed in 3D space using GNSS satellites
- 5 - “GPS+IMU” - position is fixed in 3D space using GNSS satellites and IMU

Fusion status – IMU status:

- 0 - “Initialization” - initialization and calibration of inertial sensors
- 1 - “Fusion” - inertial sensors are used to create position fix
- 2 - “Suspended” - temporary error of inertial sensors
- 3 - “Disabled” - sensors disabled due to hardware error

Heading motion – direction of vehicle motion in degrees
Heading vehicle – direction in which vehicle front is heading in degrees
X, Y, Z angle rate – angular velocity around longitudinal, lateral and vertical axis
X, Y, Z acceleration – longitudinal, lateral and vertical axis acceleration

6.2. Settings

Device settings can be changed using the ECUMASTER Light Client software and connection interface. Each setting is described below:

CAN ID – output data CAN frame ID

7. Device mounting

7.1. Mounting method and location

GPStoCAN module can be mounted in any orientation since the inertial sensors will be calibrated automatically. Device should be mounted using vibration dampers to reduce inertial sensors noise and to increase the precision of position calculation.

7.2. Inertial measurement unit calibration

IMU will calibrate automatically after first start. Calibration is always working in the background and making corrections based on vehicle dynamics. The first calibration is using sensor data when the vehicle is idling, driving in a straight line and in corners to find the axes of the vehicle. The unit will also self-calibrate if the module is moved to different position where axes are not properly aligned.

Position fix type is indicated by the LED on the back of the device:
Red – there is no position fix currently
Blue – position fix using GNSS satellites or IMU
Green – position fix using GNSS satellites and IMU

7.3. Antenna connection

The GPStoCAN module is designed to work with active antennas. The antenna should be mounted with a clear view of the sky and as close as possible close to the GPStoCAN module. The most common way to mount the antenna is to put it on the roof (using the magnetic base), placing it exactly above GPS device.

8. Document revision history

Revision	Date	Changes
1.0	14-06-2019	- official release, minor corrections
0.1	20-08-2018	- initial release