USER MANUAL

GPStoCAN

Document version: 3.0
Firmware version: 2.0 or later
Published on: 21 October 2024

ECUMASTER

Contents

1. Device description

GPStoCAN V2 is a device designed to provide position information over the CAN bus. This module can use up to four concurrent navigation systems (GPS, GLONASS, BeiDou, Galileo) to provide position updates at a rate of 25 Hz. The position data can be used to measure lap times, estimate current lap times, create track maps, and analyze vehicle logs with respect to track position.

GPStoCAN V2 is available in two variants: **Basic (DT)** and **Autosport (AS)**. The key differences between the two versions are the type of connector and the CAN bus termination.

2. Specification

Specification		
General		
Operating supply voltage	6-22 V, immunity to transients according to ISO 7637	
Reverse polarity protection	Yes, internal up to 16 V	
Temperature range	-40 to +85 °C	
Enclosure	IP65, bespoke CNC machined aluminum	
Size and weight (DT version)	66×53×44 mm, 92 g	
Size and weight (AS version)	66×49×44 mm, 74 g	
Connector (DT version)	Plug: Deutsch DT06-4S	Socket: Deutsch DT15-4P
Connector (AS version)	Plug: Deutsch ASX602-06SN	Socket: Deutsch ASX202-06PN
CAN bus bitrate	1 Mbps (default), 500 kbps, 250 kbps, 125 kbps	
PC communication	Using USB to CAN interface (Ecumaster USBtoCAN, Peak, Kvaser)	
LED colors	Red – no position fix Green – position fix ready	
Navigation		
Supported systems	GPS, GLONASS, BeiDou, Galileo	
Supported antennas	Active	
Position update frequency	25 Hz	
IMU update frequency	100 Hz	
Velocity accuracy	0.05 m/s	

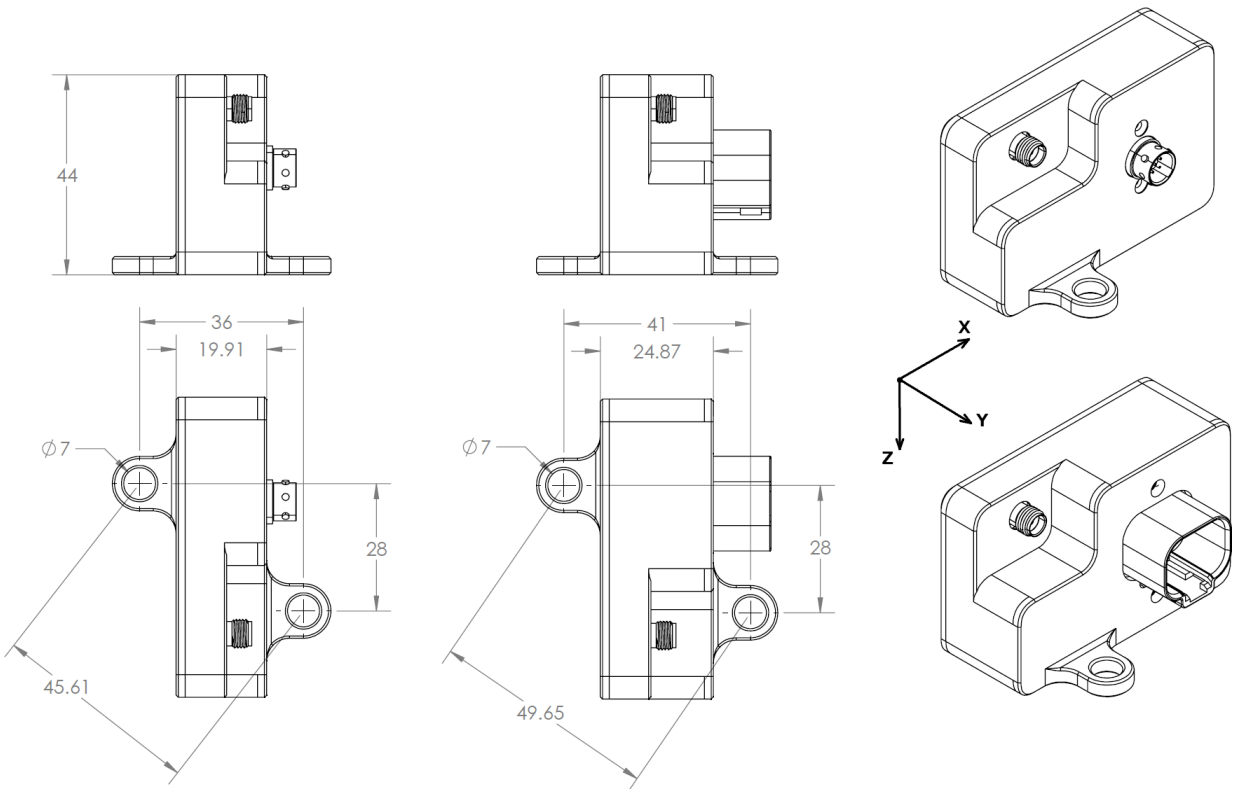
Velocity maximum	500 m/s
Velocity resolution	0.01 m/s
Velocity latency	< 20 ms
Position accuracy	2 m
Height accuracy	2.5 m
Heading accuracy	0.3°
Heading resolution	0.01°
Acquisition	Cold start: 24 sec Hot start: 2 sec

All dimensions in mm

X – front

Y – right

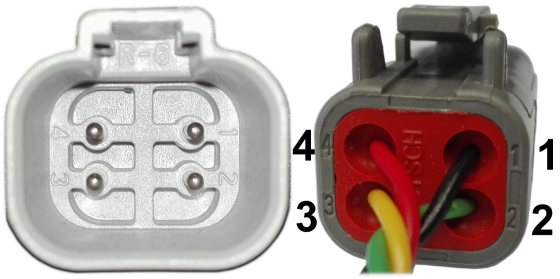
Z – down



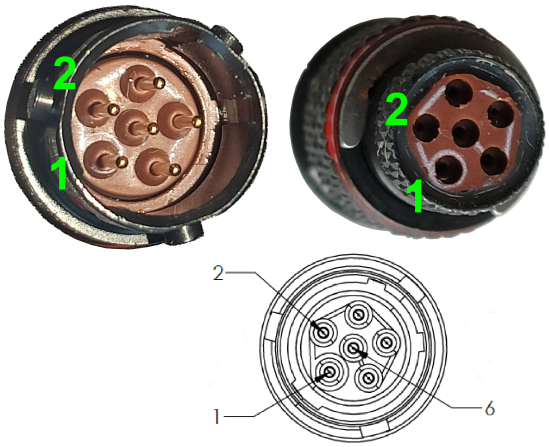
3. Installation

Pinout

DEUTSCH DT	
Pin	**Description**
1	Ground
2	CAN High
3	CAN Low
4	+12V (switched power supply)



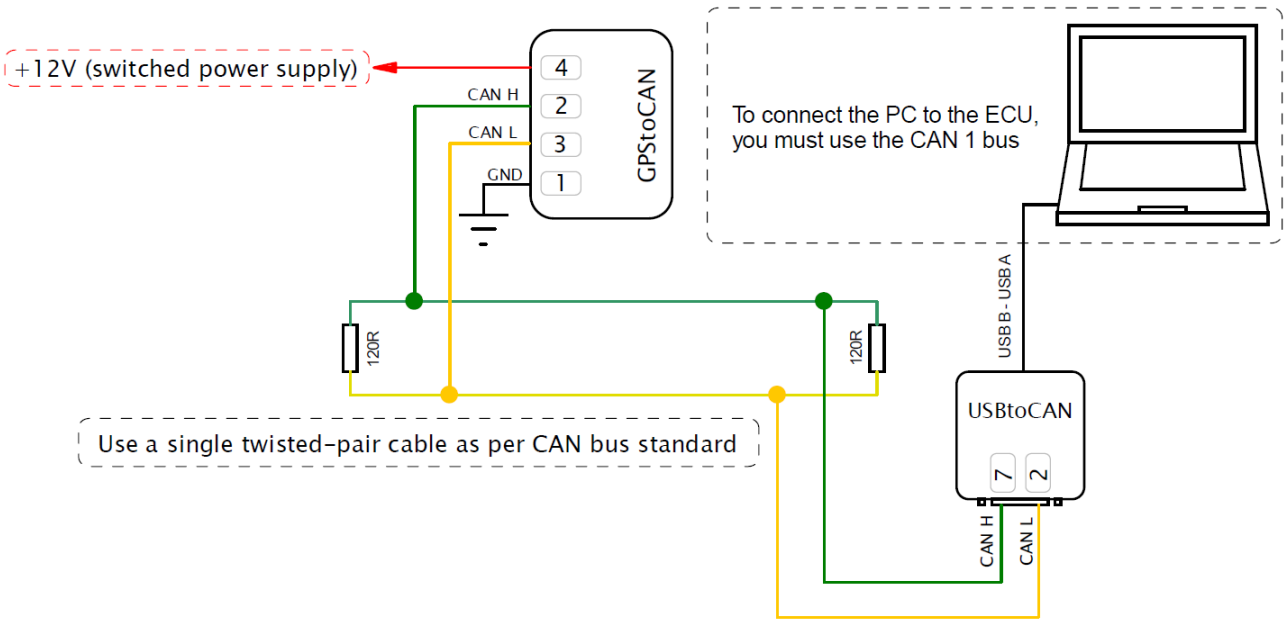
DEUTSCH AS	
Pin	**Description**
1	+12V (switched power supply)
2	CAN High
3	Short these pins together to add CAN termination resistor
4	
5	CAN Low
6	Ground



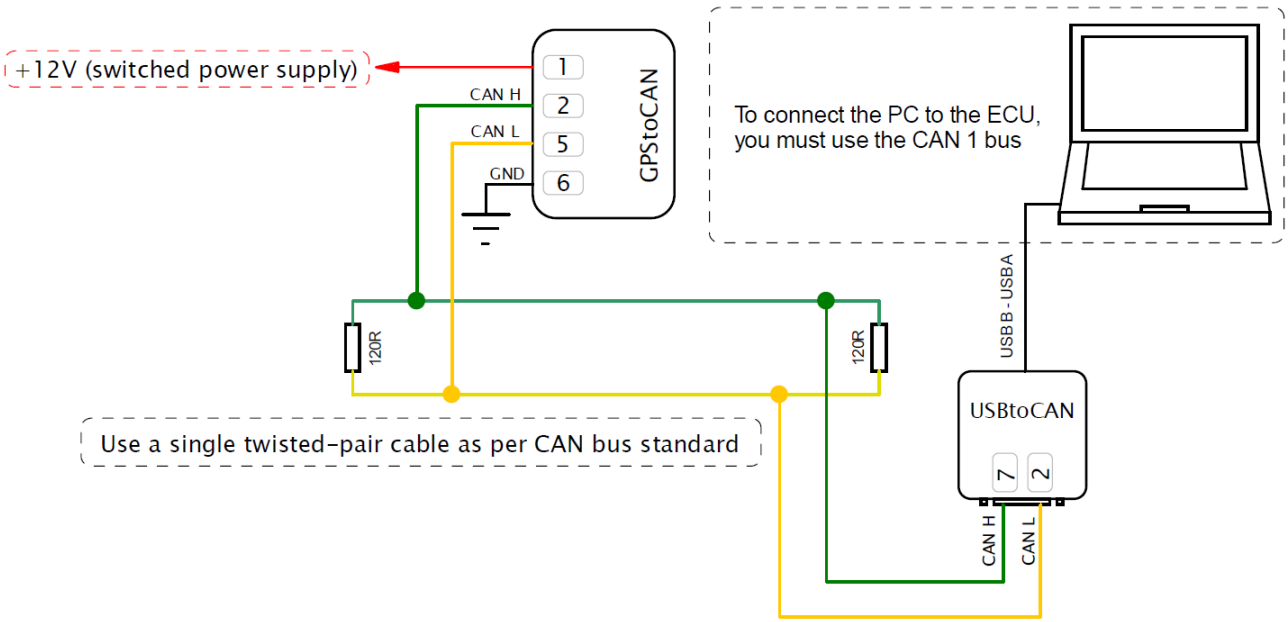
In the **DT** version, there is no internal termination resistor. In the **AS** version, a termination resistor is included, which can be activated by shorting Pin 3 and Pin 4.

Wiring diagrams

DT version



AS version



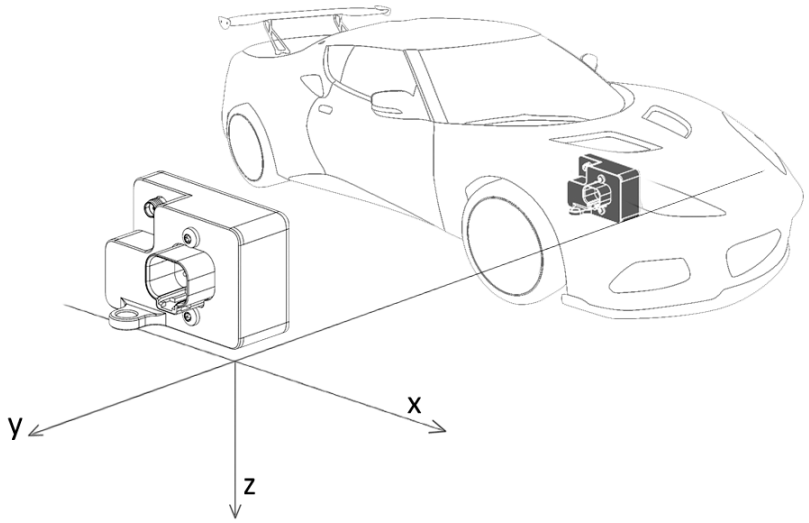
Mounting

The ideal mounting position is in the middle of the vehicle, attached to the vehicle frame using the included rubber dampers, and oriented as shown below. Acceleration in the directions shown gives positive values:

X – front

Y – right

Z – down



The GPStoCAN V2 module must be mounted with the rubber dampers in a vertical orientation (Z-axis pointing down). Mounting the module to a vertical plane with the dampers oriented horizontally can cause issues with the IMU, as bumps in the road could significantly move the module up and down relative to the vehicle.

Antenna connection

The GPStoCAN V2 module is designed to work with active antennas. The ideal antenna placement is on a large metal surface (roof, hood, trunk) with a clear view of the sky. The most common way to mount the antenna is on the roof using the magnetic base.

The antenna wire should be routed away from any harnesses carrying high currents or voltages (such as the engine harness). Rapidly changing currents or voltages can generate noise in the antenna wire and interfere with the GNSS signal.

4. PC connection

Communication with the PC software is done via CAN bus, which requires a special interface to convert CAN bus communication to USB 2.0. This interface is an independent device and must be purchased separately.

Supported interfaces:

- Ecumaster USBtoCAN (driver and manual: https://www.ecumaster.com/products/usb-to-can/)
- PEAK-System
- Kvaser

5. Light Client description

Ecumaster Light Client is the configuration software for many Ecumaster products and also serves as a 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 modify device specific properties. CAN bus monitoring is made possible through a list of frames grouped by ID, the ability to save traffic trace files, and the option to send custom messages on the CAN bus.
The software and manual can be downloaded from: https://www.ecumaster.com/products/light-client/

Properties

Device properties can be changed using the Ecumaster Light Client software and the connection interface. Each property is described below:

Ecumaster output:

- **Enable** – enable Ecumaster CAN frames output
- **Output CAN ID** – base frame ID for Ecumaster output

Format M output:

- **Enable** – enable format M CAN frames output
- **Output CAN ID** – base frame ID for format M output

High rate IMU output:

- **Enable** – enable high rate IMU CAN frames output
- **Output CAN ID** – base frame ID for high rate IMU output

Navigation config:

- **Navigation systems** – selected navigation systems to use in positioning

Static hold config:

- **Enable** – enable static hold, this option holds position constant and speed equal to 0 until distance or speed threshold is exceeded
- **Distance threshold** – threshold in meters for static hold to deactivate
- **Speed threshold** – threshold in kilometers per hour for static hold to deactivate

Channels

Channels represent different data values sent over the CAN bus. These channels are transmitted as raw values, meaning that obtaining a value with the correct unit requires some calculations.

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

The tables below describe how each channel is positioned within CAN frames and how to obtain the correct values. All values are in Big Endian format.

Ecumaster format output:

Channels description:

Latitude – latitude position in degrees

Longitude – longitude position in degrees

Speed – ground speed in kilometers per hour

Height – height above mean sea level in meters

Satellites number – number of currently visible satellites

GPS frame index – increments cyclically from 0 to 15 for each position frame

Empty frame index – increments cyclically from 0 to 15 for each empty frame

GPS status – position fix status:

- 1 - “NoFix” - no position fix acquired
- 3 - “GPS-2D” - position is fixed in 2D space using GNSS satellites
- 4 - “GPS-3D” - position is fixed in 3D space using GNSS satellites

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(referenced to the vehicle frame)

X, Y, Z acceleration – longitudinal, lateral and vertical acceleration (referenced to the vehicle frame)

UTC year, month, day – UTC date from navigation satellites

UTC hour, minute, second, millisecond – UTC time from navigation satellites

Format M output:

Channels description:

Latitude (M) – latitude position in degrees

Longitude (M) – longitude position in degrees

Time (M) – time in HHMMSS.sss format

Speed (M) – ground speed in kilometers per hour

Altitude (M) – height above mean sea level in meters

Date (M) – date in DDMMYY format

Valid (M) – position data valid:

- -1 - “Warning” - position data may be invalid
- 0 - “Unknown” - position data is unknown
- 1 - “Valid” - position data is valid

True course (M) – direction of vehicle motion in degrees

Satellites (M) – number of currently visible satellites

FAA mode (M) – duplicate of ‘Fix quality 2’ field, see below

Fix quality (M) – fix quality status:

- -1 - “Unknown” - unknown fix quality
- 0 - “Invalid” - not enough satellites, invalid fix quality
- 1 - “GPS” - standard GPS signal position fix

High rate IMU output:

Channels description: **HR X, Y, Z ang rate** – high rate angular velocity around longitudinal, lateral and vertical axis **HR X, Y, Z accel** – high rate longitudinal, lateral and vertical acceleration

6. CAN Stream

The default CAN bus bitrate of the device is **1 Mbps**.

Ecumaster format output:

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Ecumaster output ID (default: 0x400)							
0	Latitude	32bit signed	-90 – 90	1	10^7	0	°
4	Logitude	32bit signed	-180 – 180	1	10^7	0	°
Ecumaster output ID+1 (default: 0x401)							
0	Speed	16bit signed	-1179 – 1179	36	1000	0	km/h
2	Height	16bit signed	-32768 – 32767	1	1	0	m
5	Satellites number	8bit unsigned	0 – 72	1	1	0	-
6 (0)	GPS frame index	4bit unsigned	0 – 16	1	1	0	-
6 (4)	Empty frame index	4bit unsigned	0 – 16	1	1	0	-
7 (0)	GPS status	3bit unsigned	1 – 5	1	1	0	-
Ecumaster output ID+2 (default: 0x402)							
0	Heading motion	16bit unsigned	0 – 360	1	1	0	°
2	Heading vehicle	16bit unsigned	0 – 360	1	1	0	°
4	X angle rate	16bit signed	-250 – 250	1	100	0	°/s
6	Y angle rate	16bit signed	-250 – 250	1	100	0	°/s
Ecumaster output ID+3 (default: 0x403)							
0	Z angle rate	16bit signed	-250 – 250	1	100	0	°/s
2	X acceleration	16bit signed	-4 – 4	1	100	0	g
4	Y acceleration	16bit signed	-4 – 4	1	100	0	g
6	Z acceleration	16bit signed	-4 – 4	1	100	0	g
Ecumaster output ID+4 (default: 0x404)							
0	UTC year	8bit unsigned	0 – 255	1	1	2000	-

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Ecumaster output ID (default: 0x400)							
1	UTC month	8bit unsigned	1 – 12	1	1	0	-
2	UTC day	8bit unsigned	1 – 31	1	1	0	-
3	UTC hour	8bit unsigned	0 – 23	1	1	0	-
4	UTC minute	8bit unsigned	0 – 59	1	1	0	-
5	UTC second	8bit unsigned	0 – 60	1	1	0	-
6	UTC millisecond	16bit unsigned	0 – 65535	1000	65536	0	-

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Ecumaster output ID+4 (default: 0x404)							
0	UTC year	8bit unsigned	0 – 255	1	1	2000	-
1	UTC month	8bit unsigned	1 – 12	1	1	0	-
2	UTC day	8bit unsigned	1 – 31	1	1	0	-
3	UTC hour	8bit unsigned	0 – 23	1	1	0	-
4	UTC minute	8bit unsigned	0 – 59	1	1	0	-
5	UTC second	8bit unsigned	0 – 60	1	1	0	-
6	UTC millisecond	16bit unsigned	0 – 65535	1000	65536	0	-

Format M output:

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Format M output ID (default: 0x680)							
0	Latitude (M)	32bit signed	-90 – 90	1	10^7	0	°
4	Longitude (M)	32bit signed	-180 – 180	1	10^7	0	°
Format M output ID+1 (default: 0x681)							
0	Time (M)	32bit signed	0 – 235959999	1	1	0	-
4	Speed (M)	16bit unsigned	0 – 1800	1	10	0	km/h

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
Format M output ID (default: 0x680)							
6	Altitude (M)	16bit signed	-32768 – 32767	1	10	0	m
Format M output ID+2 (default: 0x682)							
0	Date (M)	24bit unsigned	0 – 311299	1	1	0	-
3	Valid (M)	8bit signed	-1 – 1	1	1	0	-
4	True course (M)	16bit signed	-250 – 250	1	10	0	°
7	Satellites (M)	8bit unsigned	0 – 255	1	1	0	-
Format M output ID+3 (default: 0x683)							
4	FAA mode (M)	8bit signed	-1 – 1	1	1	0	-
5	Fix quality (M)	8bit signed	-1 – 1	1	1	0	-

High rate IMU output:

Byte (bit)	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
High rate IMU output ID (default: 0x408)							
0	HR X ang rate	16bit signed	-250 – 250	1	100	0	°/s
2	HR Y ang rate	16bit signed	-250 – 250	1	100	0	°/s
4	HR Z ang rate	16bit signed	-250 – 250	1	100	0	°/s
High rate IMU output ID+1 (default: 0x409)							
0	HR X accel	16bit signed	-4 – 4	1	100	0	g
2	HR Y accel	16bit signed	-4 – 4	1	100	0	g
4	HR Z accel	16bit signed	-4 – 4	1	100	0	g

7. Document history

Revision	Date	Changes
1.0	2023.04.03	Official release
2.0	2023.08.23	Updated for firmware 2.x Corrected the IMU update frequency to 200 Hz
3.0	2024.10.04	Document layout updated to follow the Ecumaster standard format The structure and text have been refined and improved for better readability and clarity