

# ECUMASTER WheelSpeedToCAN

**Manual**  
Revision 1.0

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## 1. Copyright and trademarks

All trademarks, service marks, trade names, trade dress, product names and logos appearing on this document are the property of their respective owners.

## 2. Introduction

This document provides information about the ECUMASTER WheelSpeedToCAN module. In this document you will find the device description, specifications, available features and example use cases.

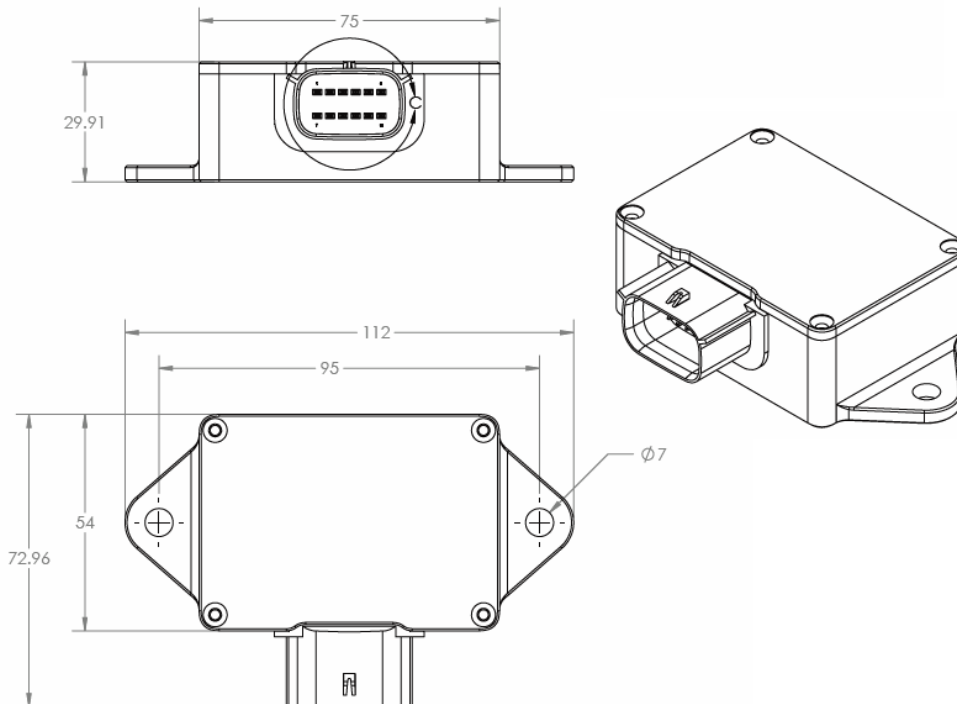
## 3. Description

The WheelSpeedToCAN device is designed to measure frequency-type signals from 4 separate sensors and send that data over CAN-bus. The module can measure signals from different types of sensors, or standard digital signals. Thanks to differential inputs and configurable pull up/down resistors, sensors can be connected directly to the device or parallel to a working ABS system.

## 4. Specification

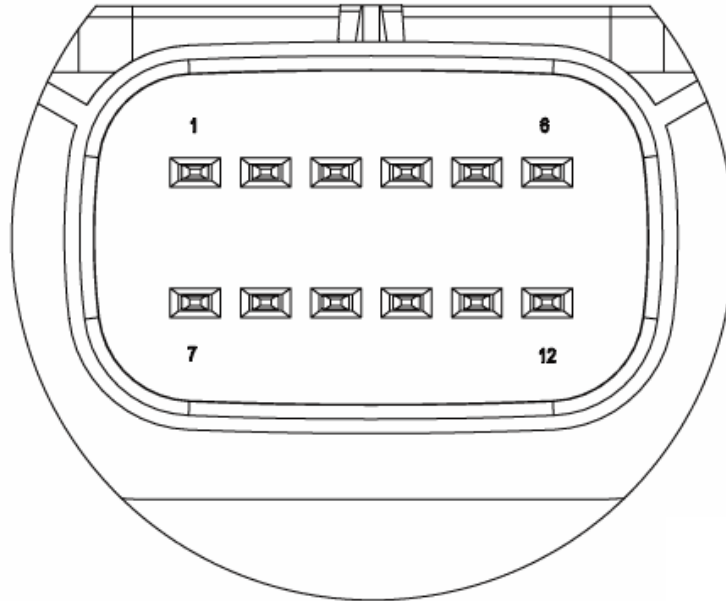
### 4.1. Mechanical drawings

(Dimensions in mm)



## 4.2. Connector description

Pin	Description
1	Sensor 1 positive
2	Sensor 1 negative
3	Sensor 2 positive
4	Sensor 2 negative
5	Sensor 3 positive
6	Sensor 3 negative
7	+12V
8	Ground
9	CAN Low
10	CAN High
11	Sensor 4 positive
12	Sensor 4 negative



## 4.3. Specification 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	112x73x30mm, 112g
Connector	Molex MX120G 12P
CAN-bus bitrate	1Mbps, 500kbps, 250kbps, 125kbps
PC communication	Using USB to CAN interface (ECUMASTER USBtoCAN, PEAK, Kvaser)
INPUTS	
Input type	Differential (2 pins per input)
Differential voltage measurement range	0-7V
Max combined frequency	50kHz
Configurable pull up/down	None, 1k at positive input to 5V, 140, 220 or 390R at positive input to ground, 140, 220 or 390R at negative input to supply voltage (12V)
Configurable gain	Normal or double
Configurable logic threshold	Yes

## 5. PC connection

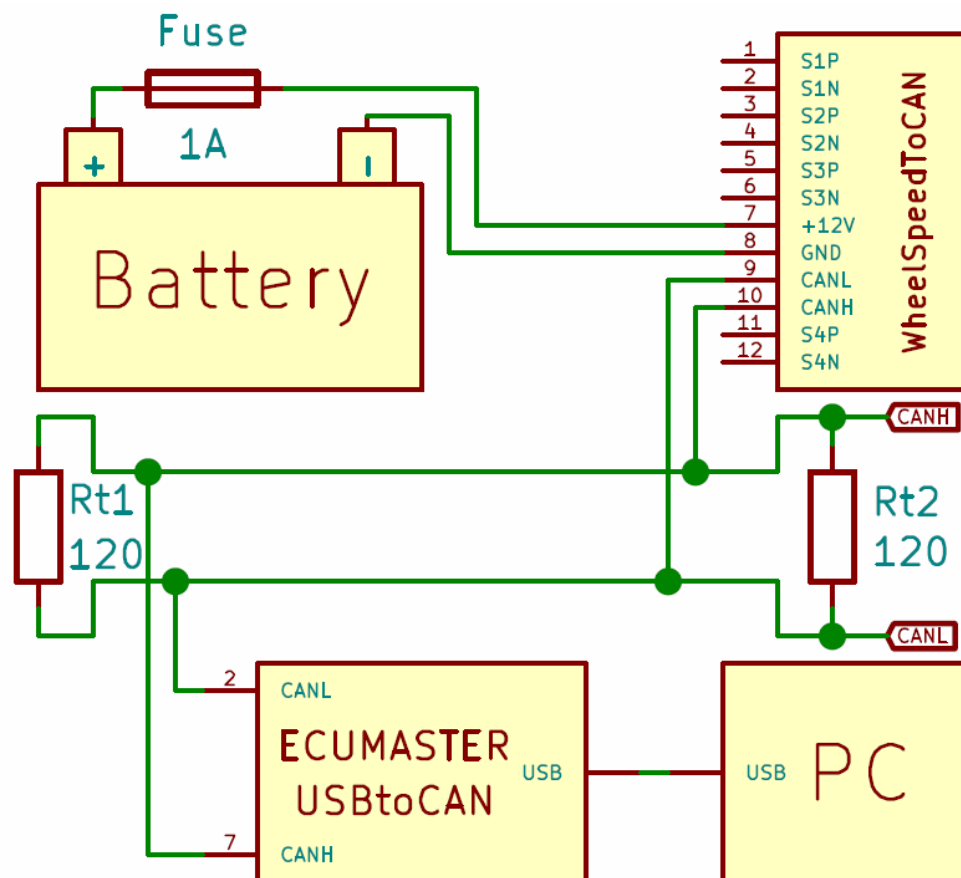
Communication with PC software is done using CAN-bus. This requires a special interface which converts CAN-bus communication to USB 2.0. Interface is an independent device and must be purchased separately. Supported interfaces:

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

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

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

Byte	Channel	Data type	Range	Multiplier	Divider	Offset	Unit
<b>Output ID (default: 0x663)</b>							
0	Sensor1 output	16bit unsigned	0-65535	1	1	0	-
2	Sensor2 output	16bit unsigned	0-65535	1	1	0	-
4	Sensor3 output	16bit unsigned	0-65535	1	1	0	-
6	Sensor4 output	16bit unsigned	0-65535	1	1	0	-
<b>Diagnostics ID (default: 0x420)</b>							
0	S1 input voltage	8bit unsigned	0-8.4	100	3035	0	V
1	S2 input voltage	8bit unsigned	0-8.4	100	3035	0	V
2	S3 input voltage	8bit unsigned	0-8.4	100	3035	0	V
3	S4 input voltage	8bit unsigned	0-8.4	100	3035	0	V
4	S1 comparator voltage	8bit unsigned	0-3.3	1	77	0	V
5	S2 comparator voltage	8bit unsigned	0-3.3	1	77	0	V
6	S3 comparator voltage	8bit unsigned	0-3.3	1	77	0	V
7	S4 comparator voltage	8bit unsigned	0-3.3	1	77	0	V
<b>Diagnostics ID+1 (default: 0x421)</b>							
0	S1 comparator min	8bit unsigned	0-3.3	1	77	0	V
1	S2 comparator min	8bit unsigned	0-3.3	1	77	0	V
2	S3 comparator min	8bit unsigned	0-3.3	1	77	0	V
3	S4 comparator min	8bit unsigned	0-3.3	1	77	0	V
4	S1 comparator max	8bit unsigned	0-3.3	1	77	0	V
5	S2 comparator max	8bit unsigned	0-3.3	1	77	0	V
6	S3 comparator max	8bit unsigned	0-3.3	1	77	0	V
7	S4 comparator max	8bit unsigned	0-3.3	1	77	0	V

Diagnostics ID+2 (default: 0x422)							
0	S1 frequency	16bit unsigned	0-6553.5	1	10	0	Hz
2	S2 frequency	16bit unsigned	0-6553.5	1	10	0	Hz
4	S3 frequency	16bit unsigned	0-6553.5	1	10	0	Hz
6	S4 frequency	16bit unsigned	0-6553.5	1	10	0	Hz
Diagnostics ID+3 (default: 0x423)							
0	S1 period	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S2 period	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
Diagnostics ID+4 (default: 0x424)							
0	S3 period	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S4 period	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
Diagnostics ID+5 (default: 0x425)							
0	S1 low time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S2 low time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
Diagnostics ID+6 (default: 0x426)							
0	S3 low time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S4 low time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
Diagnostics ID+7 (default: 0x427)							
0	S1 high time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S2 high time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
Diagnostics ID+8 (default: 0x428)							
0	S3 high time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs
4	S4 high time	32bit unsigned	0-4.29*10 <sup>8</sup>	1	10	0	µs

Channels description:

(X is sensor number from 1 to 4)

**SensorX output** – value representing wheel speed, created by modifying “SX frequency” raw value using “Multiplier/Divider” settings

**SX input voltage** – sensor voltage at input pins

**SX comparator voltage** – voltage at internal comparator input, comparator switches between high and low states depending on “Logic threshold” setting

**SX comparator min** – minimum voltage at internal comparator input

**SX comparator max** – maximum voltage at internal comparator input

**SX frequency** – sensor signal frequency

**SX period** – sensor signal period

**SX low time** – sensor signal low time

**SX high time** – sensor signal high time

## 6.2. Settings

Device settings can be changed using the ECUMASTER Light Client software and connection interface.

Each setting is described below:

### Output:

**Output ID** – output data CAN frame ID

**Update frequency** – CAN frames sending frequency

**Multiplier** – sensor frequency raw value is multiplied by this value to create output data

**Divider** – sensor frequency raw value is divided by this value to create output data

### Diagnostics:

**Diagnostics ID** – diagnostic data CAN frame ID

**Diagnostics enable** – enable sending diagnostic data

### Sensor input:

**Logic threshold** – voltage threshold for comparator to switch between high and low state

**Double gain enable** – enable double gain of input signal

**Pull up/down** – select different pull up/down configurations

## 7. Sensor inputs

### 7.1. Description

Sensor inputs are differential inputs with the ability to monitor voltage, control gain, change logic threshold, measure timing and switch between different pull up/down configurations. This flexibility allows you to connect almost any frequency sensor or digital signal found in vehicles.

### 7.2. Sensor Types

Three major types of frequency sensors are VR (Variable reluctance), MR (Magnetoresistive) and HALL (Hall effect). ABS systems mostly use MR sensors, but other types can also be found.

#### Sensor types description:

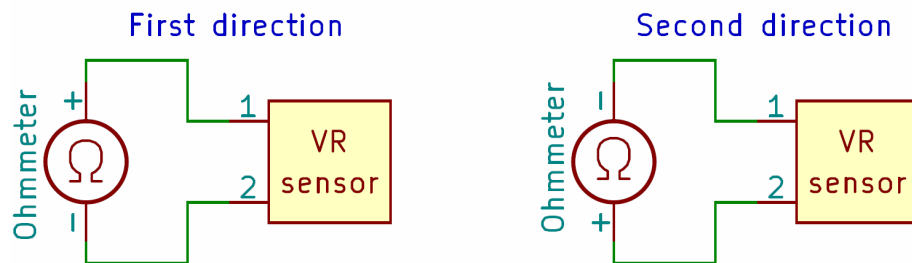
**VR sensor** – consists of a wire coil on a permanent magnet or ferromagnetic core. This coil is directly connected to 2 pin connector. Changes in the magnetic field around the coil generate voltage which will be measured. Output voltage is similar to sine wave symmetrical with respect to ground. The main disadvantage is that signal voltage is proportional to frequency, which creates problem with measuring slow signals.

**MR sensor** – consists of material that changes resistance due to a magnetic field. Inside the sensor is electronic circuitry that behaves like a current source, which is connected to a 2 pin connector. This current source outputs 2 different current values (typ. 7 and 14mA) depending on the magnetic field. Output voltage is measured across external resistor connected in series with the sensor.

**HALL sensor** – consists of conductor using hall effect and electronics for signal conditioning. Connector is a 3 pin with power supply (typ. 5V), ground and open collector output which requires a pull up resistor. Output signal is square wave from 0V to pull up voltage.

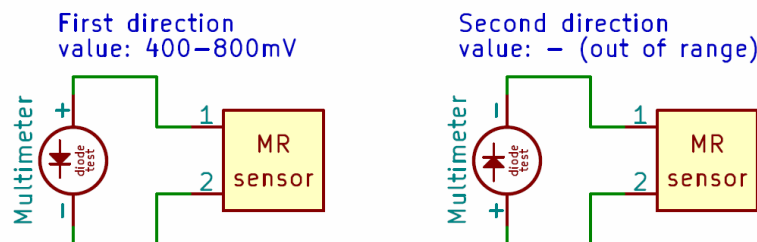
Sensor type identification:

**VR sensor** – can be checked using ohmmeter. Coil resistance can be in the range of a few hundred to a few thousand ohms. Measure resistance between the 2 pins in both directions. If values are the same and in the plausible range there is high chance it is a VR sensor.



Both measurements have to show the same value between few hundreds and few thousands ohms.

**MR sensor** – these sensors have polarity, so positive and negative pins have to be identified. Some sensors have markings on a connector case (like a “+” sign). If there are no markings, polarity can be checked using your multi-meter diode test. These sensors are protected against reverse polarity with a diode. Use diode test in both directions and the direction which shows diode voltage out of range is the correct one.



First measurement shows value between 400 and 800mV, which means this is direction with protection diode. Second measurement shows value out of range so this is the correct polarization. In this case pin 1 is negative and pin 2 positive.

**HALL sensor** – there is no special identification needed since this sensor has 3 pins, compared to both previous sensors which are 2 pin. Pinout description must be found for your specific sensor.



### 7.3. Wiring and configuration

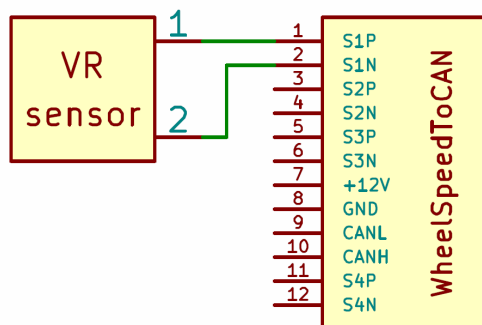
#### VR sensor:

These sensors have to be connected directly to positive and negative input pins (direction does not matter).

Setting information:

- Logic threshold – has to be as low as possible without creating too much noise
- Double gain enable – more gain will allow you to measure slower signals with low amplitude, but can also create more noise
- Pull up/down – choose “None”, as VR sensors do not require pull-up or pull-down resistors

VR can be connected in any direction since it has no polarization.



#### MR sensor:

There are 2 possible wiring configurations for this sensor.

Power supply is typically car battery voltage (12V).

First method: Power supply → Sensor → Resistor → Ground.

In this case we measure voltage between the sensor negative pin and ground.

Negative pin from the sensor must be connected to positive input and ground must be connected to negative input.

Second method: Power supply → Resistor → Sensor → Ground.

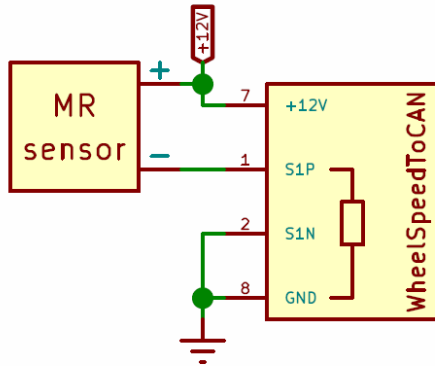
In this case we measure voltage between the power supply and the sensor positive pin.

Power supply must be connected to the positive input and sensor positive pin must be connected to the negative input.

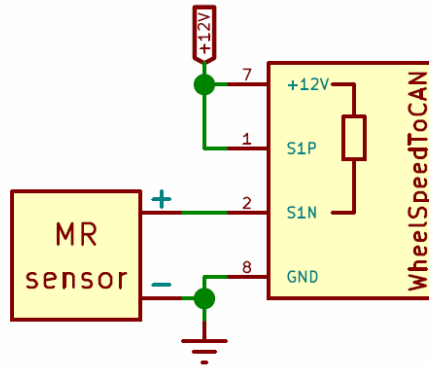
Setting information:

- Logic threshold – check min/max voltage channels and use a value between them
- Double gain enable – can be used to get proper signal range
- Pull up/down – for the first method, a pull down on the positive pin can be used instead of an external resistor. Similarly pull up on the negative pin can be used for the second method

First case



Second case

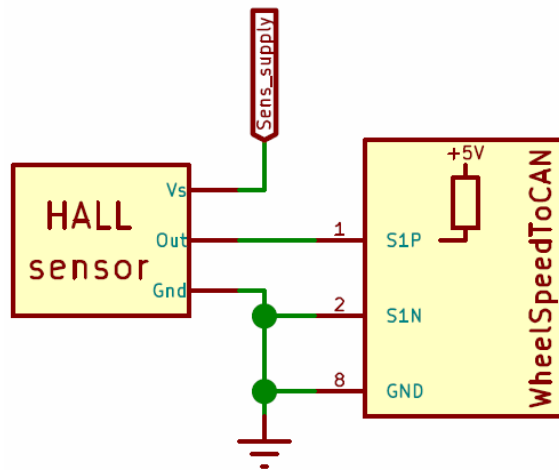


HALL sensor:

Output from sensor must be connected to the positive input and ground to the negative input.

Setting information:

- Logic threshold – check min/max voltage channels and use a value between them
- Double gain enable – not needed
- Pull up/down – pull up to 5V can be used instead of an external resistor



## 8. Document revision history

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