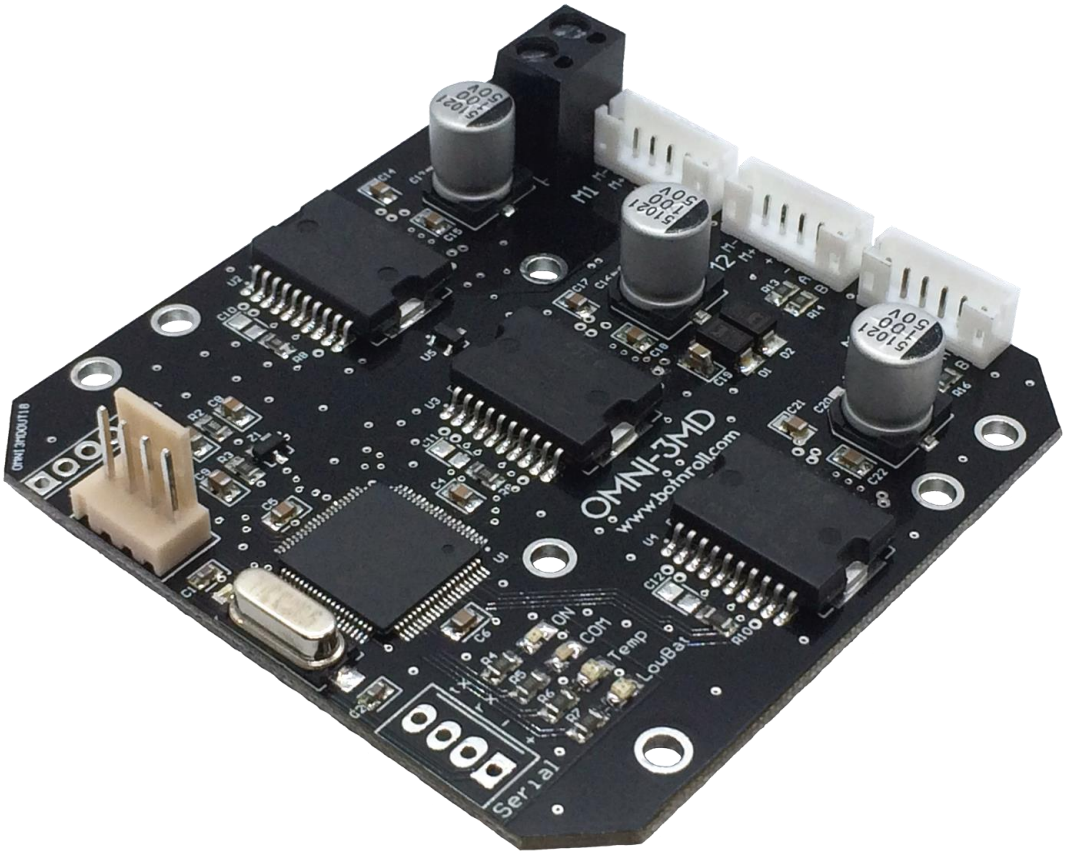
OMNI-3MD

3 Motor control board

Arduino Library Available



Hardware Manual

November 2018

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1 Index

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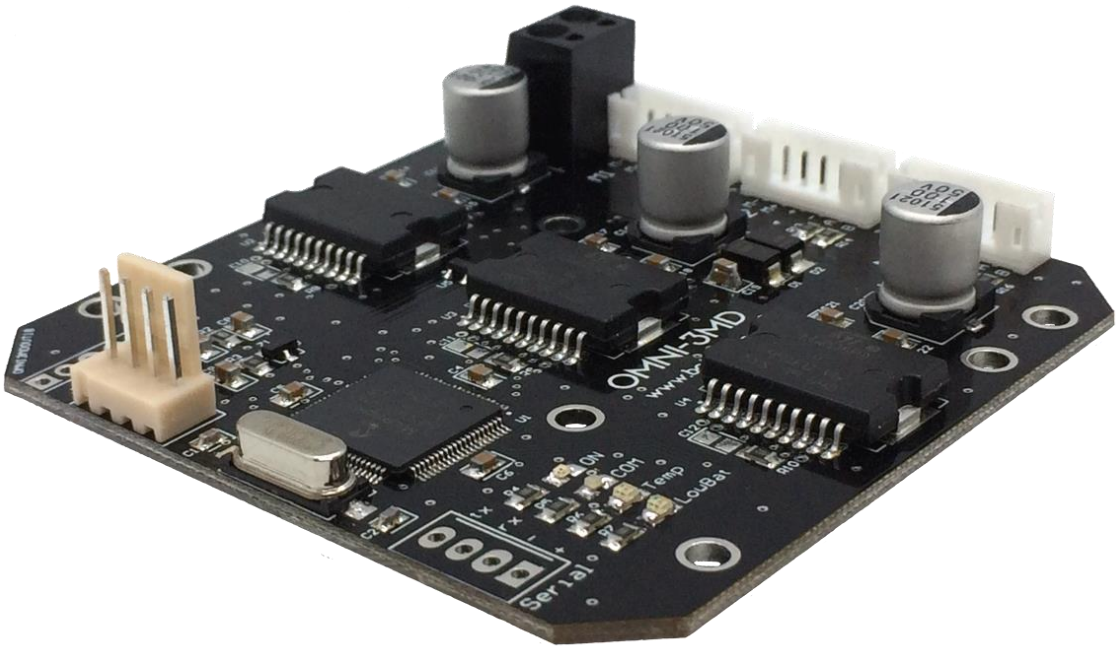
2 Specifications

- I2C bus Communication
- 3 DC motors closed loop PID control
- Motor power D3 DC motors closed loop control
- Rated motor power voltage: 8 to 50V DC
- Control voltage: 5V DC (I2C BUS)
- Rated maximum current per motor: peak of 14.2A with T(peak) smaller than 1ms
- Rated RMS current per motor: 5.2A
- Temperature monitoring and thermal cutting
- Battery voltage monitoring
- Compatible with Arduino UNO, MEGA and others
- 16bits Processor running at 40MHz
- Dimensions: 70mm x 70mm



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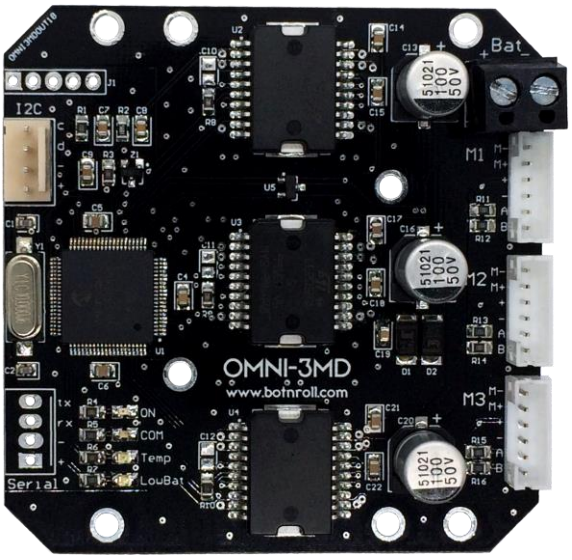
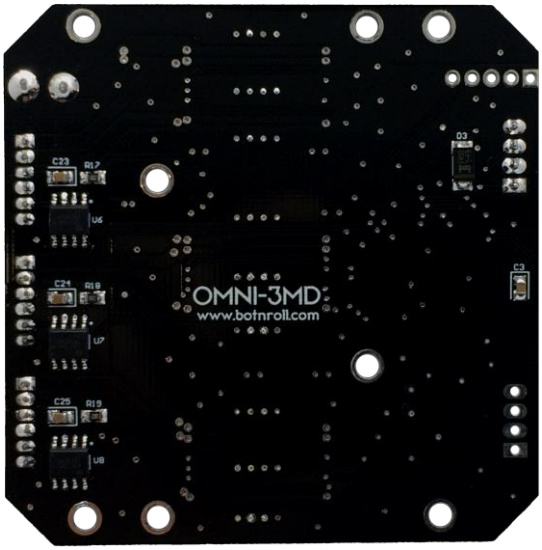
3 General Overview

The OMNI-3MD control board is an I2C *SLAVE* device able to drive 3 DC motors from 8V to 50V and currents up to 5.6A RMS per motor. Using *encoders*, it can drive the motors in a PID control closed loop. A 16bits dsPIC processor running at 40MHz enables several different motor drives, namely:

- 3 motors omnidirectional drive (concentric, with the same distance to the centre and spaced 120º) with PID control.
- 2 motors differential drive with PID control using International System of Units (SI).
- Linear drive of 1, 2 or 3 motors with/without PID control.
- Positional drive of 1, 2 or 3 motors with PID control.



OMNI-3MD front view



OMNI-3MD back view

The OMNI-3MD control board communicates using I2C bus and the use of commands allow access to all features of the OMNI-3MD control board.

A set of LEDs displays the user information about the status of the OMNI-3MD main parameters.

On board dedicated circuits measure the battery, temperature and voltage, allowing the user to monitor these parameters.

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A calibration routine acquires automatically the necessary parameters for the closed loop PID control related with the *encoders*.

The user is able to configure several parameters in order to adjust the system to its requirements, like PID control parameters and acceleration ramp.

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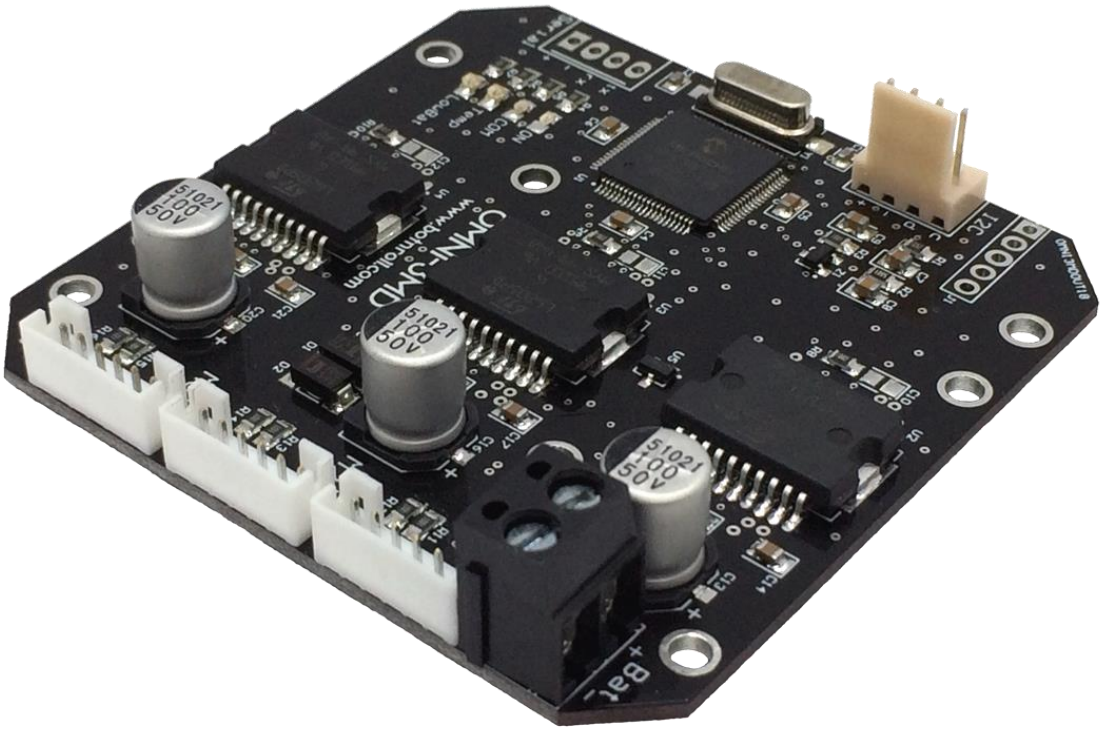
4 Power supply

For a proper use of the OMNI-3MD control board, it is required to use two distinct power supplies:

- The **I2C bus** to power the control circuit.
- The **Bat** connector for the motors power supply.



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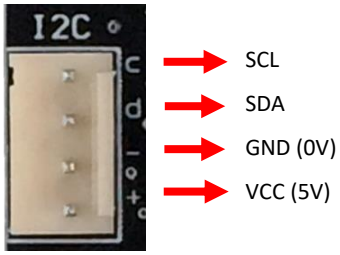
5 Electrical connections

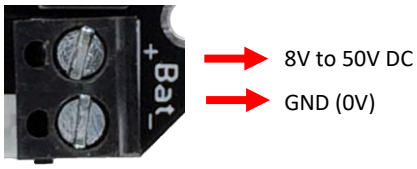
5.1. I2C

I2C electric connections to communicate and power the control circuit:



5.2. Bat

Motors power supply:

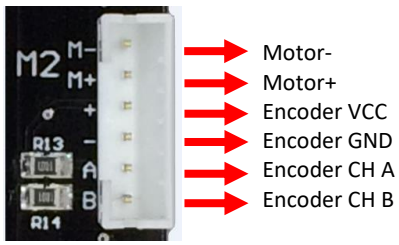


5.3. M1

Motor 1 and Encoder 1 electric connection

5.4. M2

Motor 2 and Encoder 2 electric connection:



5.5. M3

Motor 3 and Encoder 3 electric connection

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6 LEDs

Four LEDs allow the user to monitor the OMNI-3MD main parameters.

6.1. LED ON

Green LED: indicates the power status of the control circuit. When the green LED is on it indicates the OMNI-3MD is powered thru the I2C BUS.

6.2. LED COM

Yellow LED: monitors the I2C bus activity; “blinks” for every I2C stream properly received. The LED goes on when a valid command is received and goes off after performing the instruction of the stream. This LED remains on during the OMNI-3MD calibration process.

6.3. LED Temp

Red LED: monitors the OMNI-3MD temperature. When the temperature exceeds 80ºC the motors power is cut and the LED goes on. When the temperature is below 60ºC the motors power supply is automatically restored and the LED goes off.

6.4. LED LowBat

Red LED: monitors the voltage of the conector “Bat”. The LED lights when the battery voltage is below the minimum configured voltage that is defined by the user.

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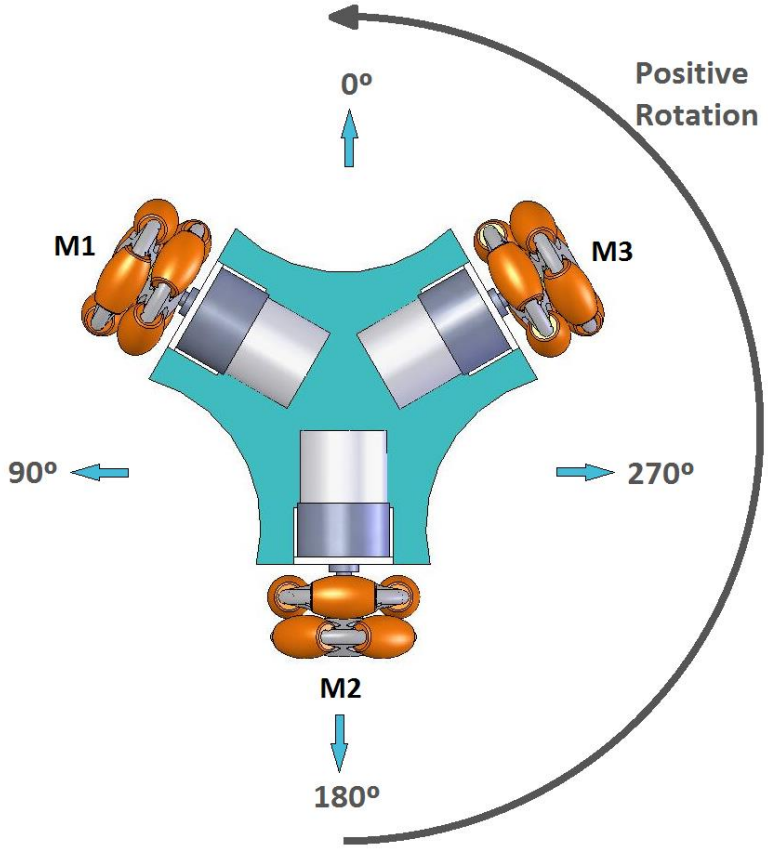
7 Driving modes

The OMNI-3MD control board allows driving the 3 motors in several different modes. The use of *encoders* allow moving the motors in closed loop control based on PID. Some driving modes are only possible to perform if the motors have *encoder*s coupled.

7.1. Three motors Omnidirectional Driving

The omnidirectional driving allows a platform to move in any direction. Consider the following image for guidance where it is pictured a robot top view.



This driving mode implies the usage of omnidirectional wheels coupled to three motors with *encoders*, preferably identical, concentric, with the same distance to the mobile platform centre and assembled with 120º degrees between them. Motors connection to OMNI-3MD must follow the image above. M1, M2 and M3 motors must connect to the OMNI-3MD using the connectors with the same ID.

Performs omnidirectional movement communicating the direction, linear velocity and angular velocity. The OMNI-3MD control board performs all the required mathematics calculations and

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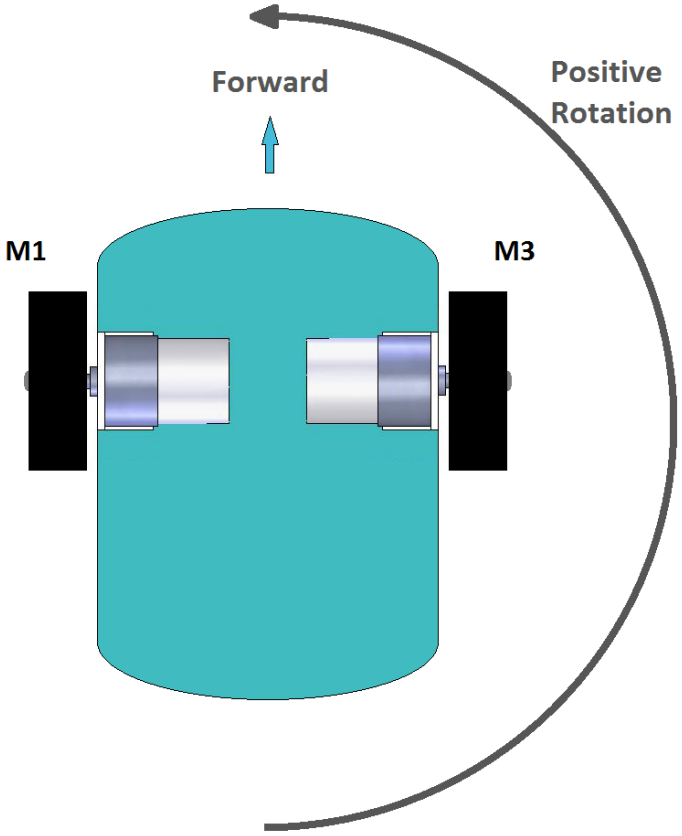
proceeds to its omnidirectional driving with PID control. The encoders counting can be read by the user whenever required using the *encoders* reading command.

7.2. Two motors Differential Driving using International System of Units (SI)

On the differential driving a platform moves using two motors with *encoders*, placed with 180º between them, connected to M1 and M3. Consider the following image for guidance where a robot top view is pictured.



For linear driving using International System of Units (SI) the command to be sent includes the linear velocity in m/s and angular velocity in rad/s. Before performing the movement it is required to configure the robot/system parameters necessary for the correct movement calculation. The parameters to bear in mind are: radius from the axe of rotation, wheel radius, wheel gearbox ratio and encoder pulses per 1 motor rotation (PPR) in quadrature. The enconders counting can be read by the user whenever required using the *encoders* reading command.

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7.3. Normal 1, 2 or 3 motors linear driving

There are two ways/commands to use this driving mode:

- Linear drive of one motor sending a command with the motor number and its velocity.
- Linear drive of 3 motors simultaneously sending a command with velocity for the 3 motors.

The use of *encoders* on the linear drive allows motor PID closed loop control.

7.4. Three motors positional driving

The driving mode demands the use of *encoders* for positioning the motors in a predefined value between -32768 and 32767 from a positioning variable. To each motor is associated a counter with a configurable *prescaler* and a *preset* position system. The user must configure the *prescaler* of each counter with the value that better serves his application. There are 1, 10, 100, 1000, 10000 *prescalers values* available.

In order to perform the positional drive of a certain motor, the counter is initialized with the *preset* value between -32768 and 32767. Then, the user must indicate the motor to be used, the required stop value, the velocity and direction of movement. The motor will stop when the required position is reached. The stop can be carried out with or without torque (torque retention). The movement in CW (*clockwise*) direction will increment the encoders counting. On the CCW (*counter-clockwise*) direction the counter will be decremented. The *overflow* counter must be managed by the user. The enconders value can be read by the user whenever required using the *encoders* reading command.

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