VESC RMCORE

1 Features

- ESP32-C3 microcontroller with integrated 2.4 GHz Wi-Fi and Bluetooth Low Energy (BLE) for wireless configuration and real-time monitoring.
- Preloaded with VESC Express firmware for seamless integration with VESC controllers, supporting telemetry, diagnostics, and wireless firmware updates.
- 4 switched outputs capable of driving up to 1.5A each and 4 analog inputs capable of reading 0V to 6V.
- CAN-bus interface for reliable, high-speed communication between multiple devices such as motor controllers, BMS units, and other CAN-enabled peripherals.
- Wide input voltage range from 3 V to 15 V for compatibility with various power sources including batteries and regulated supplies.
- Can be powered directly from USB for convenience during configuration, development, and bench testing.
- Compact form factor measuring only 23.5 mm × 35.5 mm and lightweight at just 6.4 g, ideal for applications where space and weight are critical.
- Two onboard fully programmable RGB LEDs.

2 Suggested Applications

- Handlebar-mounted IO-expander for scooters and ebikes. Throttle, brake switches, display and headlight can all be connected to it, only requiring 4 cables to the motor controller: 12V, GND, CANH and CANL.
- Custom wired or wireless remote control.

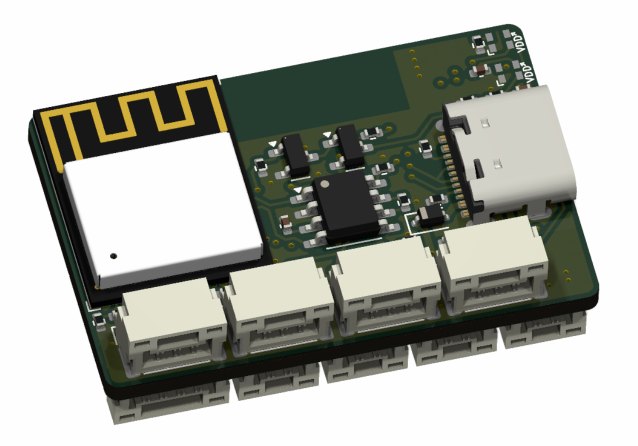

Figure 1: VESC Rmcore

3 Description

The VESC Rmcore is a small PCB with 4 analog inputs, 4 switched outputs, USB and CAN-bus. It can be used as a CAN-connected or wireless IO-expander for connecting peripherals such as throttles, brake switches, buttons, lights and indicators. All functions can be scripted in LispBM from VESC Tool while connected over USB or wirelessly using WiFi or Bluetooth 5.

Contents

4 Specifications

4.1 Recommended Operating Conditions

Parameter	Min	Max	Unit
Input Voltage	3.0	15.0	V
Operating Temperature	-40	85	°C
Humidity		Non-condensing	-

4.2 Physical Properties

Parameter	Value	Unit
Length	23.5	mm
Width	35.5	mm
Height	10.2	mm
Mass	6.4	g

5 Pinout and Wiring

5.1 Pin Descriptions

The VESC Rmcore has a several JST-GH connectors for which the pin functions and limits are described in Table 2. Figure 2 shows where the connectors are and what the pin numbers are.

Pin	Name	Function	Limits	CPU Pin
CAN & Power[1]				
1	VBUS	Bus Voltage	3V-15V 1.5A	-
2	CANH	CAN High	±60V	-
3	CANL	CAN High	±60V	-
4	GND	Ground	-	-
Out 1				
1	SW1	Low-Side Switch	1.5A	GPIO5
2	VBUS	Bus Voltage	1.5A	-
Out 2				
1	SW1	Low-Side Switch	1.5A	GPIO6
2	VBUS	Bus Voltage	1.5A	-
Out 3				
1	SW1	Low-Side Switch	1.5A	GPIO7
2	VBUS	Bus Voltage	1.5A	-
Out 4				
1	SW1	Low-Side Switch	1A	GPIO8
2	VBUS	Bus Voltage	-	-
In 1				
1	5V-SW	Switched 5V[2]	5V 1A	-
2	ADC	Analog In[3]	6V	ADC0 / GPIO0
3	GND	Ground	1A	-
In 2				
1	5V-SW	Switched 5V[2]	5V 1A	-
2	ADC	Analog In[3]	6V	ADC1 / GPIO1
3	GND	Ground	1A	-
In 3				
1	5V-SW	Switched 5V[2]	5V 1A	-
2	ADC	Analog In[4]	6V	ADC3 / GPIO3
3	GND	Ground	1A	-
In 4				
1	5V-SW	Switched 5V[2]	5V 1A	-
2	ADC	Analog In[4]	6V	ADC4 / GPIO4
3	GND	Ground	1A	-

Table 2: Pin-functions of the VESC Rmcore

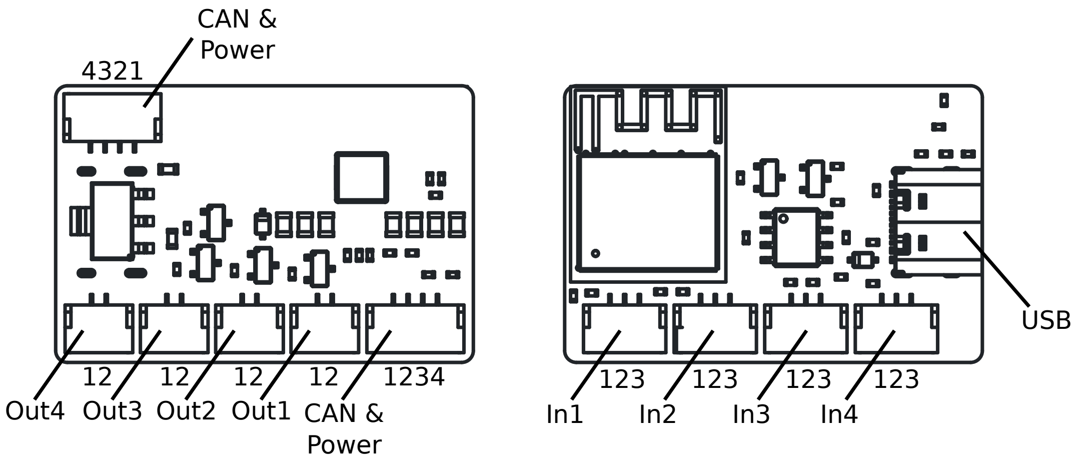

Figure 2: Connector locations and pin numbers on the VESC Rmcore.

5.2 LispBM Scripting

The VESC Rmcore does not come with any default functionality and at this time there are no ready-to-use packages available for it, so the intended application has to be implemented using LispBM scripting from VESC Tool. The first step is to power the device, which can be done from USB or from the power input on the CAN & Power connector. Once the device has power, a connection to it can be made from VESC Tool over USB, WiFi or CAN-bus. Further instructions on how to establish a VESC Tool connection can be found at `https://www.vesclabs.com/category/getting-started/`

Once VESC Tool is connected, all scripting can be done from the LispBM Scripting page. On the bottom tab bar of that page many examples can be found to get started and complete documentation for all functions and extensions can be found at `https://github.com/vedderb/bldc/blob/master/lispBM/README.md`

The following script is a simple example of how to read and map all analog inputs, control the LEDs and write to some of the outputs

```
(def adc-thr 0.0)
(def adc-brake 0.0)
(def adc-lever1 0.0)
(def adc-lever2 0.0)

(def val-thr 0.0)
(def val-brake 0.0)
(def val-lever1 0.0)
(def val-lever2 0.0)

(def ledbuf (rgbled-buffer 2 0 1))

@const-start

(defun clamp01 (v)
    (cond
        ((< v 0.0) 0.0)
        ((> v 1.0) 1.0)
        (t v)
))
```

[1]Both CAN & Power connectors are connected in parallel internally and any of them can be used. The reason there are two is to make it easier to daisy-chain boards.

[2]This 5V line is switched with a MOSFET and disabled by default. It can be enabled by writing 1 to GPIO10.

[3]This input has a voltage divider with two 10k resistors and a 100nF capacitor for filtering. The measured voltage on the ADC will be half of the voltage on the pin.

[4]This input has a voltage divider with two 10k resistors (no filtering capacitor). The measured voltage on the ADC will be half of the voltage on the pin.

```
(defun map-range-01 (v min max) (clamp01 (/ (- (to-float v) min) (- max min))))

(defun main () {
        ; LED and ADC enable
        (gpio-configure 10 'pin-mode-out)
        (gpio-write 10 1)

        ; Out 1 and Out 2
        (gpio-configure 5 'pin-mode-out)
        (gpio-configure 6 'pin-mode-out)

        ; RGB LEDs on PCB
        (rgbled-init 2)
        (rgbled-color ledbuf 0 (color-make 0.2 0 0))
        (rgbled-color ledbuf 1 (color-make 0 0.2 0.0))
        (rgbled-update ledbuf)

        ; Analog inputs
        (gpio-configure 0 'pin-mode-analog)
        (gpio-configure 1 'pin-mode-analog)
        (gpio-configure 3 'pin-mode-analog)
        (gpio-configure 4 'pin-mode-analog)

        ; Thread that blinks the on-board RGB LEDs
        (loopwhile-thd 150 t {
                (rgbled-color ledbuf 0 (color-make 0.5 0 0))
                (rgbled-color ledbuf 1 (color-make 0.0 0 0))
                (rgbled-update ledbuf)
                (sleep 0.5)
                (rgbled-color ledbuf 0 (color-make 0.0 0 0))
                (rgbled-color ledbuf 1 (color-make 0.0 0.5 0))
                (rgbled-update ledbuf)
                (sleep 0.5)
        })

        ; Thread that toggles Out 1 and Out 2
        (loopwhile-thd 150 t {
                (gpio-write 5 0)
                (gpio-write 6 1)
                (sleep 0.8)
                (gpio-write 5 1)
                (gpio-write 6 0)
                (sleep 0.8)
        })

        ; Thread that reads and maps the ADCs to a few configurable
        ; ranges typical for many hall-sensor based throttles. Enable
        ; "Poll All" in VESC Tool to see and plot them.
        (loopwhile-thd 150 t {
                (setq adc-thr (get-adc 0))
                (setq adc-brake (get-adc 1))
                (setq adc-lever1 (get-adc 3))
                (setq adc-lever2 (get-adc 4))

                (setq val-thr (map-range-01 adc-thr 0.42 2.1))
                (setq val-brake (map-range-01 adc-brake 0.43 2.1))
                (setq val-lever1 (map-range-01 adc-lever1 0.4 2.05))
                (setq val-lever2 (map-range-01 adc-lever2 0.4 2.1))

                (sleep 0.025)
        })
})

(image-save)
(main)
```

6 Device Installation

6.1 Installation Warnings

- **Installation must be performed by qualified personnel** with experience in high-voltage battery systems and VESC-based motor controllers.
- **Read and fully understand all instructions, datasheets, and safety warnings** before beginning installation.
- **Gather all necessary tools and materials** including the device, wiring harnesses, connectors, insulation materials, and personal protective equipment.
- **Ensure the motor controller and motor system are prepared and properly arranged** with correct wiring paths and secure mounting.
- **Securely mount the device using threadlock** in a location protected from vibration, moisture, dust, and direct heat sources.
- **Do not install the device in locations exposed to water, condensation, or flammable materials.**
- **Install motor temperature sensors as required,** in order for the motor protection to ramp down the current smoothly when the motor is about to overheat.
- **Only use manufacturer-specified connectors and cables** to ensure safe and reliable connections.
- **Verify correct polarity for all connections.** Incorrect wiring can cause irreversible damage to the device, battery pack, or connected equipment. **Double-check the wiring diagram before proceeding.**
- **Insulate all exposed terminals and wiring** to prevent accidental short circuits or electric shock.
- **Keep metal objects and tools away from the device and power terminals during installation** to avoid accidental bridging of electrical contacts.
- **Tidy up and secure all cables** with cable ties or routing guides to prevent movement and wear.
- **Do not drill, cut, or modify the device enclosure or circuit board.** Unauthorized modifications may void the warranty and compromise safety or functionality.
- **Double-check all connections and wiring against the provided diagrams** before applying power to the system.
- **When powering up the system for the first time, do so in a controlled environment with appropriate protective equipment.** Be prepared to disconnect power immediately if any abnormal behaviour is observed.

6.2 Mechanical Dimensions

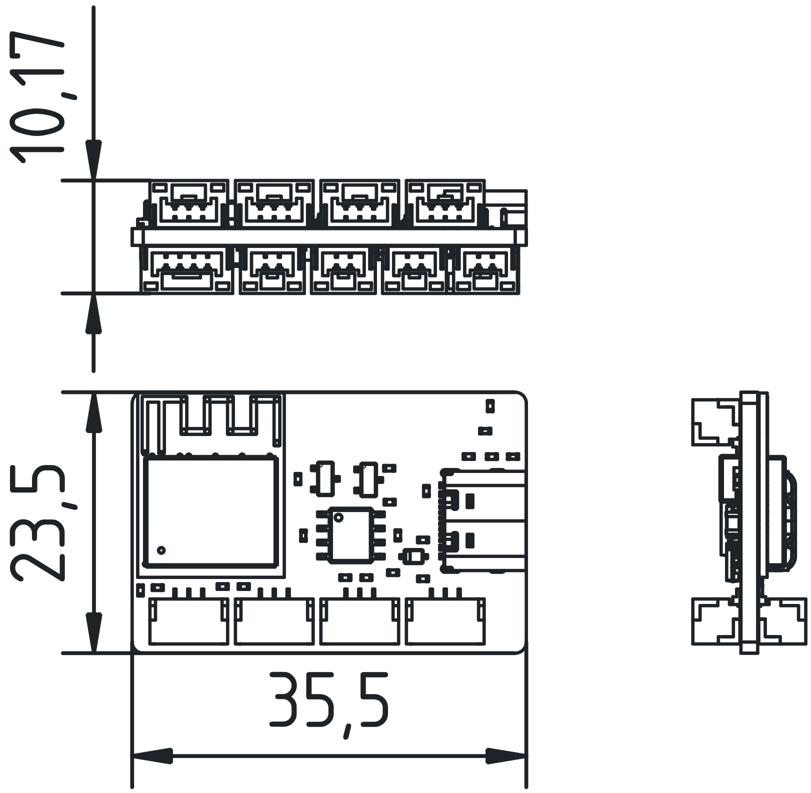

Figure 3: VESC Rmcore Dimensions shown in mm.

7 Product Warranty

7.1 Warranty Coverage

Please find the warranty information regarding VESC Labs products using the following link:
`https://www.vesclabs.com/warranty-and-returns-policy/`

8 Compliance & Regulatory Information

8.1 CE Marking

This product meets the requirements of all applicable EU directives and regulations and complies with the essential health, safety, and environmental protection requirements as set out in relevant legislation. It is CE marked in accordance with:

- **Directive 2014/30/EU** – Electromagnetic Compatibility (EMC)
- **Directive 2014/35/EU** – Low Voltage Directive (LVD)
- **Directive 2011/65/EU** – Restriction of Hazardous Substances (RoHS)

8.2 UKCA Marking

This product is compliant with UK regulations and bears the UKCA marking, confirming its conformity with the applicable statutory requirements in Great Britain. It meets the relevant provisions of:

- Electrical Equipment (Safety) Regulations 2016
- Electromagnetic Compatibility Regulations 2016
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

8.3 WEEE Directive (2012/19/EU)

This product is compliant with the Waste Electrical and Electronic Equipment (WEEE) Directive. It should not be disposed of with unsorted municipal waste and must be collected separately for proper treatment and recycling. Please contact your local distributor or relevant waste authority for information on recycling options and collection facilities.