

1 Features

- High-resolution feedback for smooth, precise motor control
- Optional Hall sensor emulation mode for motor controllers that only support hall sensors, such as the VESC Duet
- M3 mounting holes for simple installation into motors such as SIA155 and QS165 amongst other models
- Easy setup with VESC TOOL Desktop and Phone applications for fast integration alongside the possibility for deep customization
- Direct VESC integration via hardware timers, enabling accurate position and velocity measurement without additional conversion hardware
- Low computational load and sampled at the same time as the currents, making it work well for the entire RPM range
- PWM-output for resolving the position from a cold start before the index-pulse is found
- Input for a motor thermistor allows for only one connector to be wired to the controller
- I2C-interface for configuring the encoder resolution and hall sensor emulation pole pairs using VESC Tool

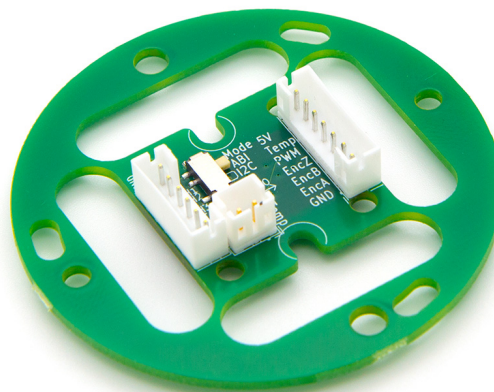


Figure 1: VESC ABI Encoder

2 Description

The VESC ABI Encoder is a rotary position sensor designed for seamless integration with VESC motor controllers. It provides two out-of-phase digital signals as well as an index-signal once per revolution. Using these signals, the VESC firmware calculates absolute rotor position and direction with exceptional accuracy and resolution. Using VESC Tool, the encoder can easily be configured using the example calibration script. The encoder PCB features mounting holes for M3 bolts and supports mounting for motors such as the SIA155 and QS165 amongst others. The outer ring can be cut off for mounting in more space-constrained applications

It is also possible use the encoder in hall sensor emulation mode. This can be configured using I2C and example configuration scripts are included with VESC Tool. VESC motor controllers and ESP-based peripherals can run I2C on most pins using LispBM, including the encoder/hall pins where the encoder normally is connected.

The encoder comes pre-configured in ABI + PWM-mode with 1024 pulses per revolution.

3 Specifications

3.1 Typical Operating Characteristics

Parameter	Min	Max	Unit
Input Voltage	4.5	5.5	V
Motor Speed	0	55,000	RPM

3.2 Recommended Operating Conditions

Parameter	Min	Max	Unit
Operating Temperature	-40	85	°C
Humidity	Non-condensing		-

3.3 Physical Properties

Parameter	Value	Unit
Length	57	mm
Width	57	mm
Height	10	mm
Mass	6	g

4 Pinout and Wiring

4.1 Pin Descriptions

Pin	Pin Name	Description
Thermistor 1		
1	GND	Ground Reference Pin
2	T1	Thermistor 1 input
ABI / PWM / I2C		
1	GND	Ground Pin
2	A / SDA	Signal A / SDA in I2C mode
3	B / SCL	Signal B / SCL in I2C mode
4	Z	Index Signal
5	PWM	PWM position output
6	Temp	Thermistor out
7	5V	5V input
Hall		
1	GND	Ground Pin
2	H1	Hall 1
3	H2	Hall 2
4	H3	Hall 3
5	Temp	Thermistor out
6	5V	5V input

4.2 ABI-Mode Wiring Diagram

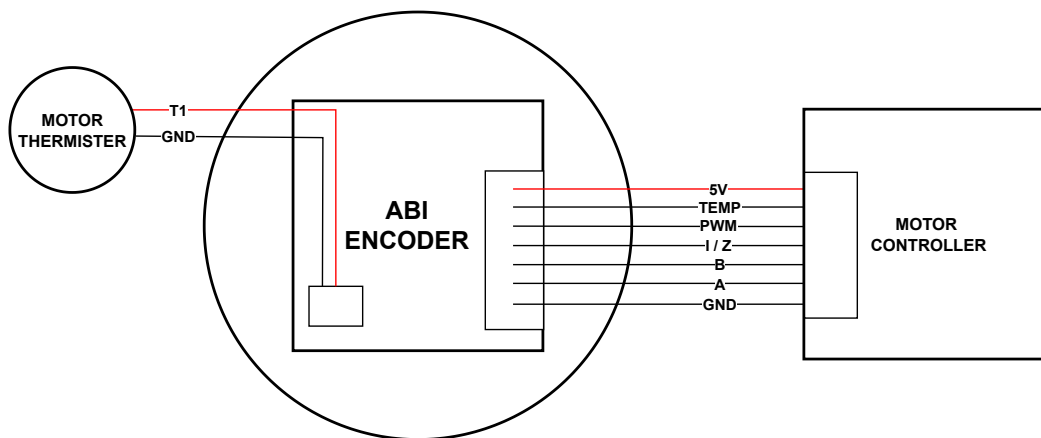


Figure 2: VESC ABI Encoder wired to a Motor Controller and Motor Thermistor in ABI + PWM mode. Note that the PWM-output from the encoder should be connected to the PPM/PWM input on the motor controller.

5 Device Installation

5.1 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.

5.2 Installation Guidelines

- The motor shaft must have a magnet installed at end of the shaft.
- The encoder should be aligned with centre of the magnet and positioned 0.5mm - 2.5mm away.
- The connectors should be facing out away from the motor.
- The encoder should be secured using the M3 mounting holes.
- The outer ring of the PCB can be trimmed to fit into smaller spaces but **do not cut or sand the inside square of the PCB.**
- Ensure that the mode-switch on the encoder is set to ABI.

6 Configuring the Device

6.1 Configuration Warnings

- **Double-check all wiring connections** before powering on the device. Incorrect wiring can cause damage to the device, battery cells, any connected devices or pose a fire risk.
- **Always install the latest version of VESC Tool from the official website** to ensure compatibility with your hardware and access to the newest features, bug fixes, and safety updates. Download the installer from vesc-project.com/vesc_tool and follow the on-screen instructions. After installation, update your device firmware if prompted to ensure optimal performance.
- **Do not exceed the recommended voltage limits** for this device, your specific battery or motor system. Setting incorrect voltage thresholds can result in overvoltage errors or undervoltage cutoffs, potentially damaging the system.
- **Do not exceed the recommended current limits** for this device, your specific battery or motor system. Setting incorrect current thresholds can result in overheating or excessive stress on components, which may lead to failure or dangerous conditions.
- **Ensure the motor and any moving parts connected to it are free from obstruction and lifted off the ground before powering on the device.** This prevents unexpected movement that could cause injury, damage, or interference with calibration and configuration procedures
- **Avoid configuring the device in wet or humid environments.** Moisture can cause short circuits and damage sensitive electronic components.
- **If you are unsure about any configuration step, consult the datasheet or seek professional assistance.** Improper configuration can void warranties and lead to hazardous conditions.
- **Wear appropriate personal protective equipment (PPE),** such as safety glasses and gloves, when working with high-voltage systems.

6.2 Connecting the Controller to VESC Tool

Once the encoder has been installed and wired to the the controller, the controller can be connected to VESC Tool via USB, Wi-Fi, Bluetooth, or CAN. For instructions on how to connect with and navigate VESC Tool please visit: <https://www.vesclabs.com/category/getting-started/>.

1. Connect the controller to VESC Tool using one of the mentioned methods.
2. Ensure the controller with the encoder connected has been selected from the list of CAN devices if you have connected through another device via CAN.

6.3 Configuring the Motor Settings in ABI-mode

1. Navigate to the **“General Motor Settings”** section from the menu on the left of the screen on desktop, or by swiping across the screen on a mobile device.
2. Select the **“Sensors”** tab at the top of the screen.
3. Set **“Sensor Port Mode”** to **“PWM + ABI”**.
4. Set **“Encoder counts”** to **“1024”**.
5. Press the **“Write Motor Configuration”** button to write the new configuration to the controller.

6.4 Verify the Configuration is Correct

1. Navigate to the **“Realtime Data”** section from the menu on the left of the screen on desktop, or by swiping across the screen on a mobile device.
2. Select the **“Rotor Position”** tab at the top of the screen.
3. Select the **“Encoder”** button.
4. Slowly spin the motor and verify that the value shown matches the position of the motor.
5. To verify that both PWM and ABI work, the sensor port mode can be set to only PWM and only ABI one at a time while checking that the rotor position updates as expected when turning the motor.

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.

