

# TMCC160-EVAL MANUAL

TMCC160 TMCL Hardware Version 1.1 | Document Revision 1.0 • 2015-AUG-16

The TMCC160-EVAL is designed for evaluating all features of the TMCC160-LC motionCookie™. The integrated ARM Cortex-M4 microcontroller is used to control one PMSM/BLDC axis. The power MOSFETs are able to drive up to 10A (RMS) motor current. Several interfaces are supported on the evaluation board (see features).

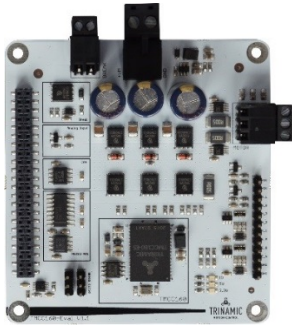


Figure 1: TMCC160-EVAL

## Features

- FOC torque-, velocity- and position-control for PMSM/BLDC 3-phase motors
- Encoder and hall sensor-based operation
- Up to 10A RMS nominal motor current
- Supply voltage: +7V... +24V DC operating voltage
- Interfaces: RS232, RS485, CAN, SPI™
- 2x reference switch inputs
- 1x analog input

## Applications

- Robotics
- Pump and Fan Applications
- Industrial Automation
- Medical
- Lab Automation

## Block Diagram

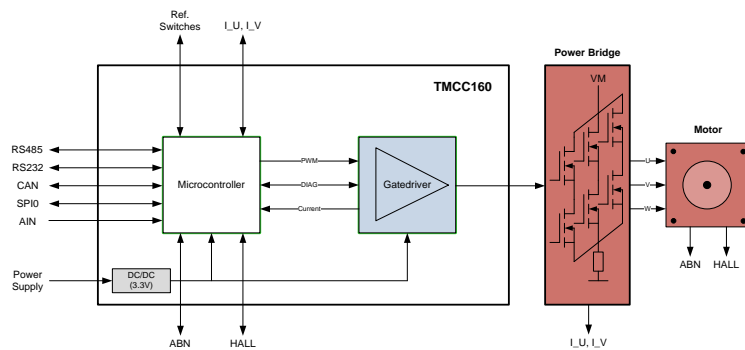


Figure 2: Simplified Block Diagram

## Order Code

| Order code   | Description   | Size         |
|--------------|---|--------------|
| TMCC160-EVAL | Evaluation board for TMCC160 single axis BLDC controller. | 85 x 79 x 34 |

Table 1: TMCC160 Order Code

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Read entire documentation; especially the Supplemental Directives.

## SUPPLEMENTAL DIRECTIVES

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### Read the entire documentation before you make use of this product:

- Ensure you meet the *Target User Requirements* on page [13](#).
- Read the *User Information and Directives* provided on page [13](#).
- Read the *ESD-Sensitivity Directives* provided on page [13](#).

**Keep this manual and all other applicable and related documents complete, legible and accessible to the specified user at all times.**

**Failure to observe the *Supplemental Directives* could result in damage to product and things; to property or persons; or economic loss.**

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**TRINAMIC is not liable for damages incurred as a result of improper use or disregard of the instructions provided in this *document*.**

**Please refer to our *User Information and Directives* for more details (page [13](#)).**

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**Contact**  
**TRINAMIC**  
**support team**

In case you encounter difficulties or need additional advice, please contact our support team via: [www.trinamic.com](http://www.trinamic.com). Thank you.



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# 1.1 Connector Overview

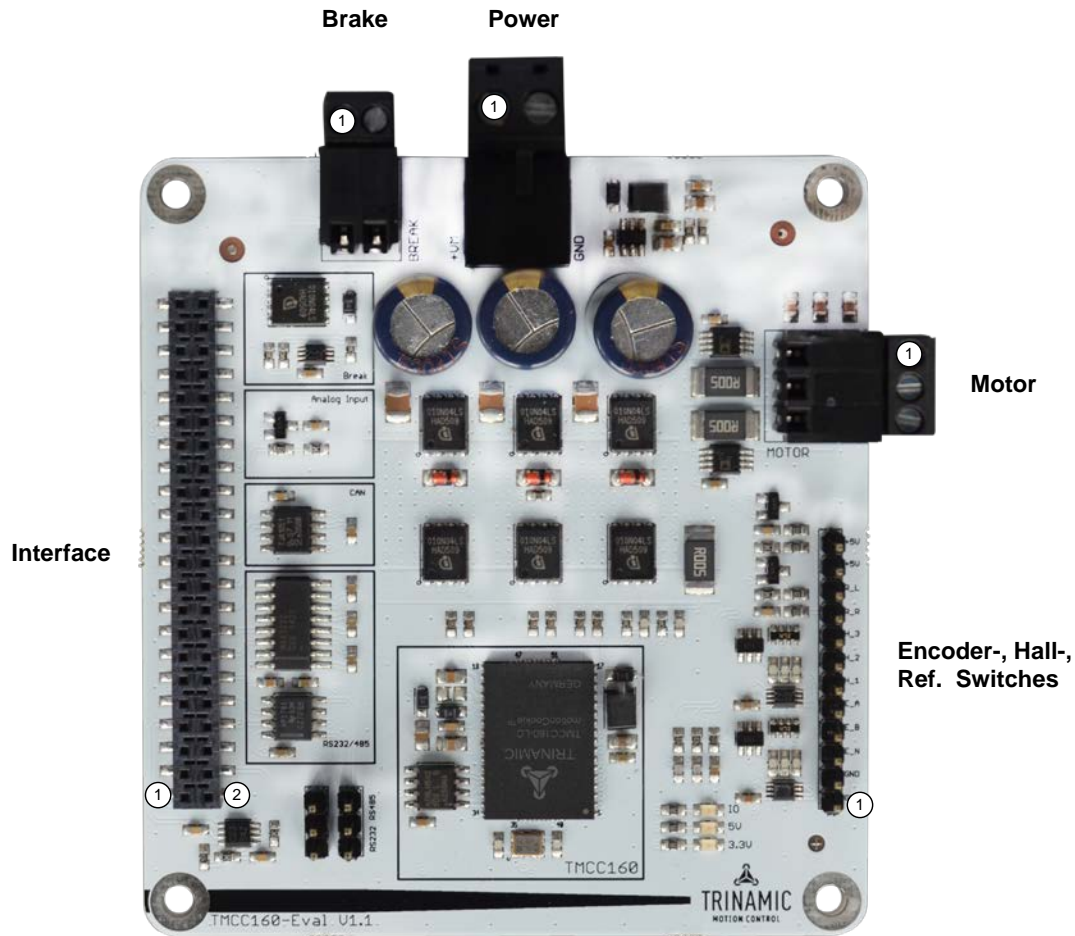


Figure 3: TMC160-EVAL Connectors

| TMCC160-EVAL Connectors               |   |   |
|---------------------------------------|---|---|
| Label (Key)                           | Connector Type  | Mating Connector Type   |
| <b>Power</b>                          | RIA 330-02, 2 pol., 5mm pitch, shrouded header        | RIA 349-2, screw type terminal block, pluggable, centerline 5 mm / 0.197 inches, wire entry parallel to plug direction    |
| <b>Brake</b>                          | RIA 182-02, 2 pol., 3.5mm pitch, header               | RIA 169-02, screw type terminal block, pluggable, centerline 3.5 mm / 0.138 inches, wire entry parallel to plug direction |
| <b>Motor</b>                          | RIA 182-03, 3 pol., 3.5mm pitch, header               | RIA 169-03, screw type terminal block, pluggable, centerline 3.5 mm / 0.138 inches, wire entry parallel to plug direction |
| <b>Encoder-, Hall-, Ref. Switches</b> | Standard male 12 pin connector, one row, 2.54mm pitch | Standard female 12 pin connector, one row, 2.54mm pitch   |



| TMCC160-EVAL Connectors |   |   |
|-------------------------|---|---|
| Label (Key)             | Connector Type  | Mating Connector Type   |
| Interface               | 2 x 22 pol., 2.54mm pitch, pluggable female connector 2 x 22 pol., 2.54mm pitch, pluggable male connector | 2 x 22 pol., 2.54mm pitch, pluggable female connector 2 x 22 pol., 2.54mm pitch, pluggable male connector |

Table 2: TMC5031-EVAL Connectors

This connector fits for commercially available power supply units for e.g. 24V DC.

| Power Connector |       |                                  |
|-----------------|-------|----------------------------------|
| Pin             | Label | Description                      |
| 1               | GND   | System GND                       |
| 2               | +VM   | Power supply input +7V .. 24V DC |

Table 3: Power Connector

| Brake Connector |       |                              |
|-----------------|-------|------------------------------|
| Pin             | Label | Description                  |
| 1               | Brake | Open collector brake output. |
| 2               | +VM   | Power supply output          |

Table 4: Brake Connector

| Motor Connector |       |              |
|-----------------|-------|--------------|
| Pin             | Label | Description  |
| 1               | W     | Motor coil W |
| 2               | V     | Motor coil V |
| 3               | U     | Motor coil U |

Table 5: Motor Connector

| Encoder-, Hall-, Ref. Switches Connector |        |         |                                     |
|--|--------|---------|-------------------------------------|
| Pin                                      | Label  | Pull-up | Description                         |
| 1  | GND    | -       | System GND                          |
| 2  | GND    | -       | System GND                          |
| 3  | ENC_N  | 4k7     | Encoder index channel input.        |
| 4  | ENC_B  | 4k7     | Encoder quadrature channel B input. |
| 5  | ENC_A  | 4k7     | Encoder quadrature channel A input. |
| 6  | HALL_1 | 4k7     | Hall signal 1 input.                |
| 7  | HALL_2 | 4k7     | Hall signal 2 input.                |
| 8  | HALL_3 | 4k7     | Hall signal 3 input.                |
| 9  | REF_R  | 3k3     | Right reference switch input.       |



| Encoder-, Hall-, Ref. Switches Connector |       |     |  |
|--|-------|-----|--|
| 10                                       | REF_L | 3k3 | Left reference switch input.             |
| 11                                       | +5V   | -   | Supply output for encoder-, hall-sensors |
| 12                                       | +5V   | -   | Supply output for encoder-, hall-sensors |

Table 6: Encoder-, Hall-, Reference Switches Connector

| Interface Connector |          |   |
|---------------------|----------|---|
| Pin                 | Label    | Description   |
| 1                   | +VM      | Power supply.   |
| 2                   | GND      | System GND.   |
| 3                   | GND      | System GND.   |
| 4                   | ID_CLK   | STARTRAMPE: clock pulse test point.   |
| 5                   | -        | Not used.   |
| 6                   | ID_CH0   | ID channel 0. Not used with TMCC160-EVAL.   |
| 7                   | ID_CH1   | ID channel 1. Used for automatic module detection.                                    |
| 8                   | ENABLE   | TMCC160 enable signal. Use open collector output only to switch enable signal to GND. |
| 9                   | -        | Not used.   |
| 10                  | RS485_B- | Negative differential RS485 interface signal.   |
| 11                  | -        | Not used.   |
| 12                  | RS485_A+ | Positive differential RS485 interface signal.   |
| 13                  | -        | Not used.   |
| 14                  | RS232_TX | RS232 interface output.   |
| 15                  | -        | Not used.   |
| 16                  | RS232_RX | RS232 interface input.  |
| 17                  | -        | Not used.   |
| 18                  | CAN_H    | CAN high interface signal.  |
| 19                  | -        | Not used.   |
| 20                  | CAN_L    | CAN low interface signal.   |
| 21                  | -        | Not used.   |
| 22                  | AIN      | 10V analog input.   |
| 23                  | -        | Not used.   |
| 24                  | -        | Not used.   |
| 25                  | -        | Not used.   |
| 26                  | -        | Not used.   |
| 27                  | -        | Not used.   |
| 28                  | -        | Not used.   |
| 29                  | -        | Not used.   |
| 30                  | CSN      | SPI interface chip select signal. Low active.   |
| 31                  | SCLK     | SPI interface clock signal.   |
| 32                  | MOSI     | SPI interface master out slave in signal.   |
| 33                  | MISO     | SPI interface master in slave out signal.   |
| 34                  | -        | Not used.   |
| 35                  | -        | Not used.   |
| 36                  | -        | Not used.   |
| 37                  | -        | Not used.   |



| Interface Connector |       |                |
|---------------------|-------|----------------|
| Pin                 | Label | Description    |
| 38                  | -     | Not used.      |
| 39                  | -     | Not used.      |
| 40                  | -     | Not used.      |
| 41                  | -     | Not used.      |
| 42                  | -     | Not used.      |
| 43                  | GND   | System ground. |
| 44                  | GND   | System ground. |

Table 7: Interface Connector

## 1.2 LEDs

The **TMCC160-EVAL** has three LEDs. Two of them indicate the digital 3.3V (LED1) and 5V (LED2) power supply. The third LED is connected with the brake chopper output pin. Whenever the brake chopper is active LED3 is on.




Figure 4: LEDs



### 1.3 RS232, RS485 Interface Switch

TMCC160-EVAL board supports RS232 or RS485 interface. To switch between both two jumpers have to be configured as described in the table below.

| RS232, RS485 Interface Switch   |     |   |
|---|-----|---|
| Connector   | PIN | Description   |
|  | 1-2 | If pin 1 and 2 of the interface switch is connected, RS485 interface is active. |
|   | 2-3 | If pin 2 and 3 of the interface switch is connected, RS232 interface is active. |

*Table 8: RS232, RS485 Interface Switch*





## 2 Operational Ratings of TMCC160-EVAL

The operational ratings shown below should be used as design values. The maximum power supply current depends on the used motors and the supply voltage.

**AREAS OF SPECIAL CONCERN**

**!** Do not exceed the maximum values during operation! Otherwise the driver will be damaged!

| General Operational Ratings of the Module |   |     |      |     |      |
|---|---|-----|------|-----|------|
| Symbol                                    | Parameter   | Min | Type | Max | Unit |
| +VM                                       | Power supply voltage for operation                                    | 7   | 24   | 28  | V    |
| V <sub>AIN</sub>                          | 10V analog input voltage (24V compatible)                             |     | 10   | 24  | V    |
| V <sub>ENC_x</sub>                        | Encoder input signals   | 0   | 5    | 5.1 | V    |
| V <sub>HALL_x</sub>                       | Hall sensor input signals   | 0   | 5    | 5.1 | V    |
| V <sub>REF_x</sub>                        | Reference input signals   | 0   | 5    | 5.1 | V    |
| I <sub>Motor</sub>                        | Motor coil current [RMS]  |     | 10   |     | A    |
| I <sub>SUPPLY</sub>                       | Power supply current  |     |      | 10  | A    |
| T <sub>ENV</sub>                          | Environment temperature at rated current (no forced cooling required) |     | 20°C |     | °C   |

Table 9: General Operational Ratings of the Module



## 3 Getting Started

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### Follow guidelines provided in this chapter:

- Disconnect power supply.
- Read safety instructions.
- Follow configuration guidelines.

**Failure to observe could result in damage to product and things; to property or persons; or economic loss.**

---

### Preparations

#### You need:

- TMCC160-EVAL
- RS232, RS485, CAN interface
- PMSM/BLDC motor
- TMCL-IDE V3. And PC
- Cables for interface, motor, and power supply
- Nominal supply voltage +24V DC (+7...+24V DC)

### Before You Connect the Devices

---

## CAUTION

### Minor injuries or unintended system behavior through incorrect handling!

- Do NOT connect or disconnect the motor while still powered.
  - Do NOT mix up connections and short-circuit pins.
  - Do NOT bound I/O wires with motor wires.
  - Do NOT exceed the maximum power supply of +28 DC.
- 

**Connect all devices according to specification and user manual instructions in order to ensure safe handling and correct system behavior.**



## Start-up Preparations

The following actions have to be carried out prior to start-up:

### Action 1:

- Download the TMCL-IDE 3.0 from [www.trinamic.com](http://www.trinamic.com) and install it.

### Result:

The TMCL-IDE then opens automatically.

### Action 2:

- **Step 1:** Connect one of the supported interfaces to the TMCC160-EVAL board.
- **Step 2:** Connect a PMSM/BLDC motor with hall- or encoder sensor to the specific connectors.
- **Step 3:** Connect the +24V power supply to the TMCC160-EVAL board
- **Step 4:** Turn power ON. The green LEDs one and two should turn ON
- **Step 5:** Start TMCL-IDE V3.0 and select connected interface.

### Result:

Now, all your connections have been established in order to start up the system,

### NOTE:

→ *Default interface settings:*

*RS232: 115.200 kbit/s*

*RS485: 115.200 kbit/s*

*CAN: 1Mbit/s*

## Graphic Overview: Getting Started

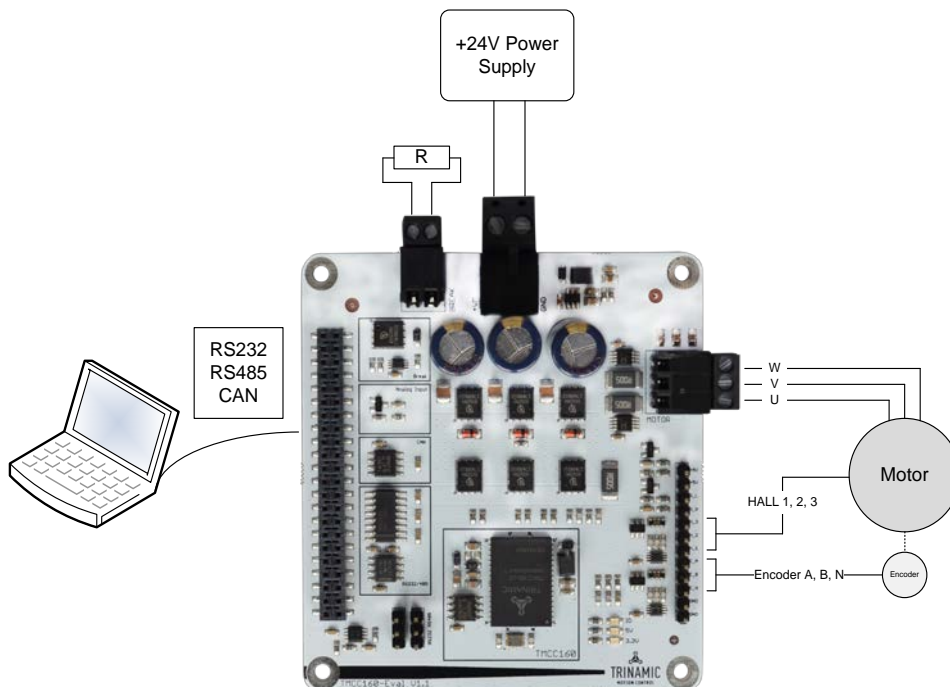


Figure 5: Graphic Overview: Getting Started



## TMCC160-EVAL Size and Mounting Holes

The board dimensions are 85mm x 79mm. Maximum component height (above PCB level) without mating connectors is 32mm. There are four mounting holes suitable for M3 screws.

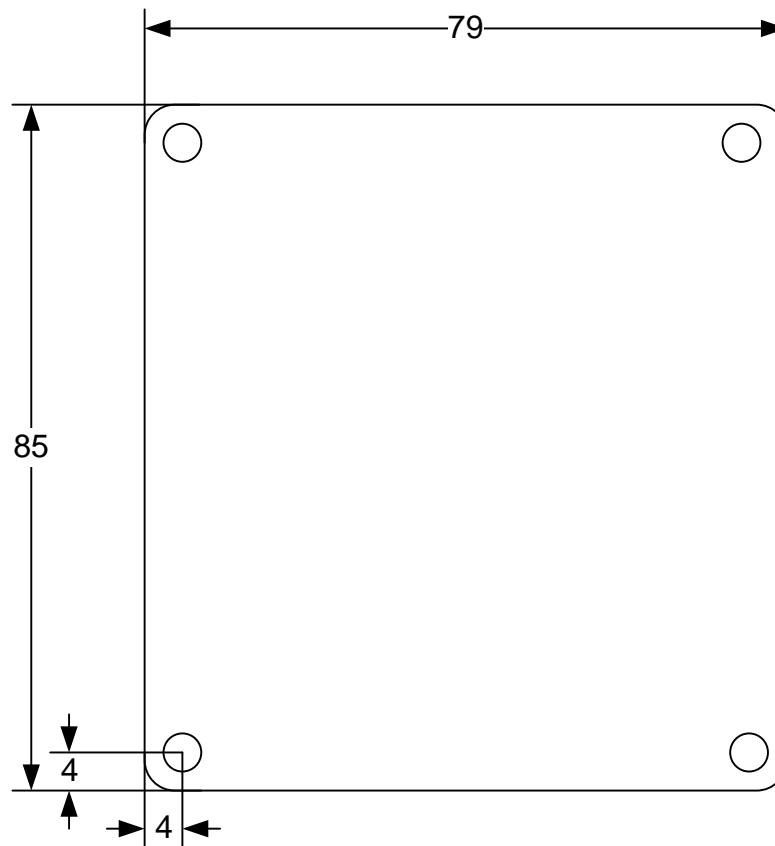
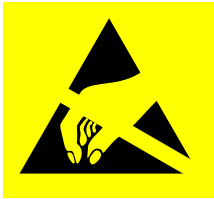


Figure 6: TMCC160-EVAL Dimensions



## USER INFORMATION AND DIRECTIVES

### ESD-DEVICE INSTRUCTIONS



**This product is an ESD-sensitive CMOS device. It is sensitive to electrostatic discharge.**

- Provide effective grounding to protect personnel and machines.
- Ensure work is performed in a non-static environment.
- Use personal ESD control footwear and ESD wrist straps, if necessary.

**Failure to do so can result in defects, damages and decreased reliability.**

#### Producer Information

The producer of the product TMCC160 is TRINAMIC GmbH & Co. KG in Hamburg, Germany; hereafter referred to as TRINAMIC. TRINAMIC is the supplier; and in this function provides the product and the production documentation to its customers

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#### Target User

The documentation provided here, is for programmers and engineers only, who are equipped with the necessary skills and have been trained to work with this type of product.

The *Target User* knows how to responsibly make use of this product without causing harm to himself or others, and without causing damage to systems or devices, in which the user incorporates the product.

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**TMCC160-EVAL  
Document Info**

**This EVALBOARD User Manual contains only one document, which is the document "EVALBOARD User Manual. Section: Hardware". It is made available to you by TRINAMIC Motion Control GmbH & Co. KG in Hamburg, Germany.**

To access other *Datasheets/User Manuals* pertaining to TMCC160, please visit the TMCC160 product page at [www.trinamic.com](http://www.trinamic.com).

**Related  
Documents**

**The TMCC160 DATASHEET User Manual is related to this product.**

**Collateral  
documents**

**This product documentation comes with additional tool kits, firmware and/or other items, as provided on the specified product page on our company website.**

- i** They are made available to you for your convenience but are not part of the *TMCC160- EVALBOARD User Manual* documentation.



## REVISION HISTORY

### Hardware Product Revision History (HW V.)

| Version | Date        | Description      |
|---------|-------------|------------------|
| 1.1     | 2015-OCT-16 | Initial version. |

Table 10: Hardware Revision History

### ▶ Hardware Document Revision History (DC Rev.)

| Version | Date        | Author/s | Description      |
|---------|-------------|----------|------------------|
| 1.00    | 2015-OCT-16 | JM/JP/SV | Initial version. |
| 1.01    | 2016-JAN-04 | JP       | Format Edits.    |

Table 11: Document Revision History

#### **NOTE:**

→ Please refer to associated documentation available on product webpage at [www.trinamic.com](http://www.trinamic.com).

## REFERENCES

### Related Documents and Tools

[TMCC160]      TMCC160 Datasheet (please refer to <http://www.trinamic.com>)



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**CLOSING NOTE**

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