Manuals+ — User Manuals Simplified.

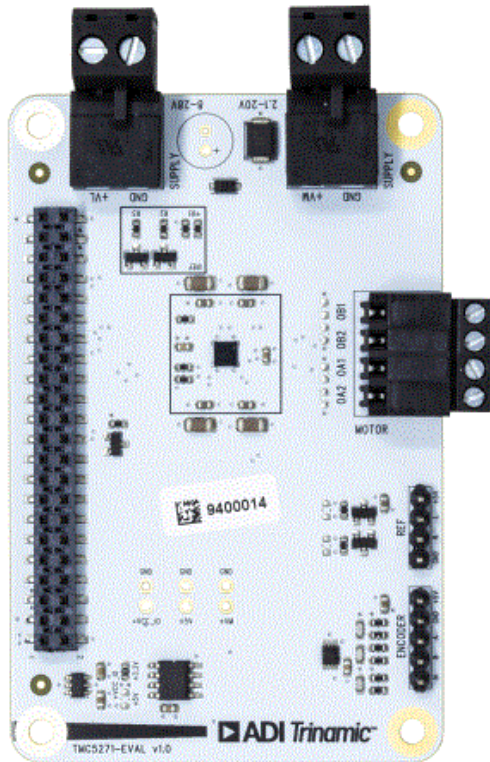# Trinamic TMC5271-EVAL Evaluation Board User Guide

Contents

Trinamic TMC5271-EVAL Evaluation Board

Product Information

The TMC5271-EVAL is an evaluation board for stepper motors. It is designed to provide a platform for testing and evaluating the TMC5271 motor driver. The board includes various features such as detection and full step encoder, simplified block diagram, and onboard connectors.

Applications

- Motor testing and evaluation
- Stepper motor control system development

Features

- Detection and Full-Step Encoder
- Simplified Block Diagram
- Onboard Connectors
- Current scaling IREF-Pins
- TMCL-IDE Integration

Order Codes

Order Code	Description
TMC5271-EVAL-KIT	The kit includes: – TMC5271 evaluation board – Landungsbruecke (interface board to a PC) – Eselsbruecke (bridge connector board) Size 140mm x 85mm

Product Usage Instructions

Getting Started

To get started with the TMC5271-EVAL, follow these steps:

1. Make sure that the latest version of the TMCL-IDE 3. X is installed. You can download the TMCL-IDE from the Trinamic website **www.trinamic.com/support/software/tmcl-ide/**.

2. Open the TMCL-IDE and connect the Landungsbruecke via USB to your computer. If you are using Windows 8 or higher, no driver is needed. For Windows 7 machines, the TMCL-IDE will automatically install the driver.

3. Verify that the Landungsbruecke is using the latest firmware version. You can check the firmware version in the connected device tree. If a newer firmware version is available, you can download it from the Trinamic website: **www.trinamic.com/support/eval-kits/details/landungsbruecke/**.

Once you have completed these steps, you are ready to start using the TMC5271-EVAL board for testing and evaluating your stepper motor applications.

TMC5271-EVAL Evaluation Board

Document Revision V1.00 • 2023-MAY-23
The TMC5271-EVAL allows evaluation of the TMC5271 in combination with the TRINAMIC evaluation board system or as a stand-alone board. It uses the standard schematic and offers several options in order to test different modes of operation. The TMC5271 is a Step/Dir Driver for Two-Phase Bipolar Stepper Motors up to 1.6 A (RMS) (2.24 A (PEAK)).

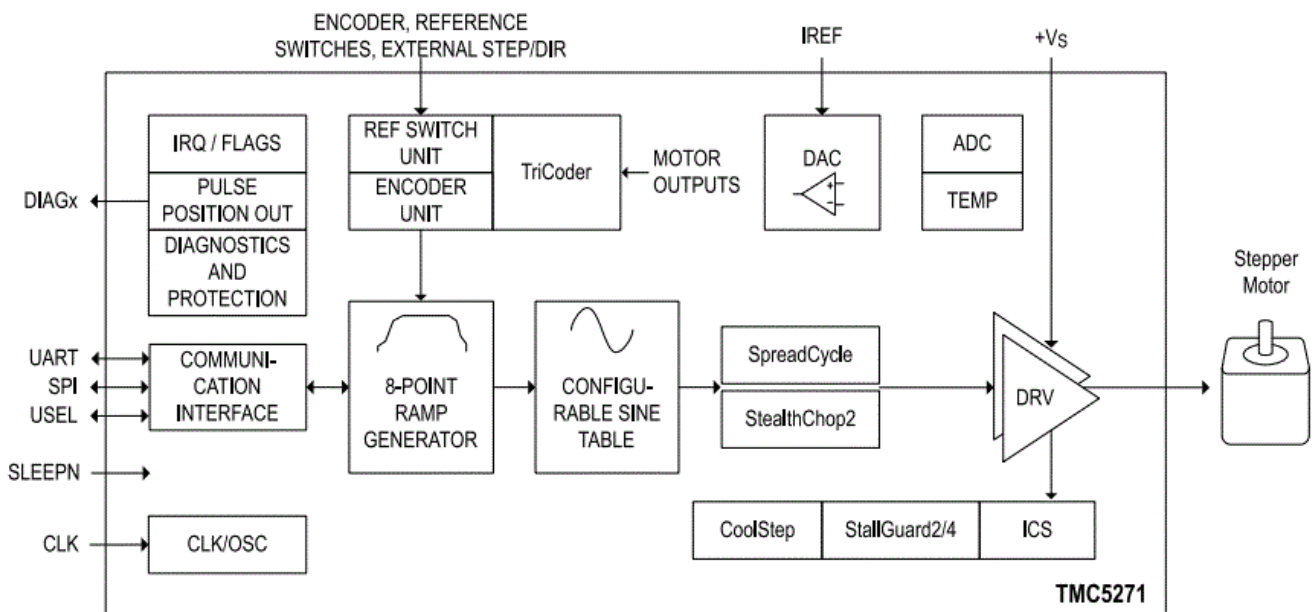**WARNING** DO NOT CONNECT / DISCONNECT THE MOTOR WHILE POWER IS CONNECTED.
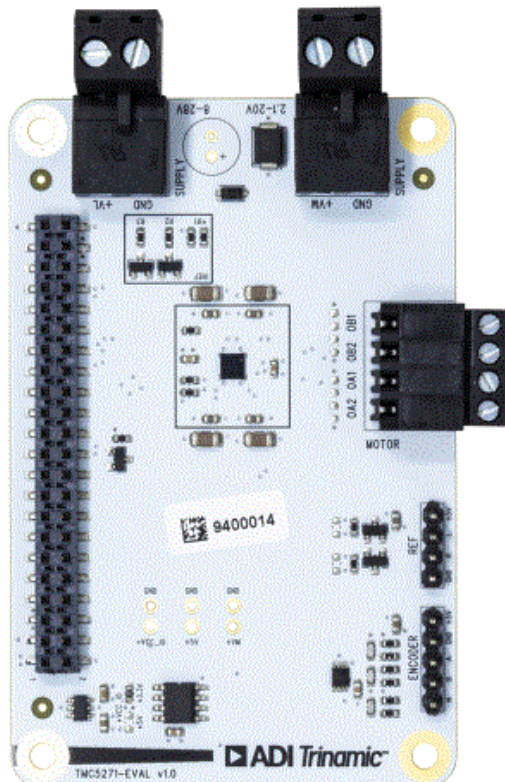
Features

- 2-phase stepper motor up to 1.6 A (RMS) coil current (2.24 A (PEAK))
- Supply Voltage 2.1. . . 20 V DC
- SPI and Single Wire UART

- Encoder Interface and Ref.-Switch Input
- 1…256 micro steps
- StealthChop2 silent PWM mode
- StallGuard4 sensorless motor load detection
- TriCoder Sensorless Standstill Steploss Detection and Full Step Encoder
    - Small printing devices
    - Lab and office automation
    - Space constrained applications

Applications

- Wearables
- Personal portable devices
- Optical systems, lens control
- CCTV, Security
- Insulin pumps
- Liquid handling

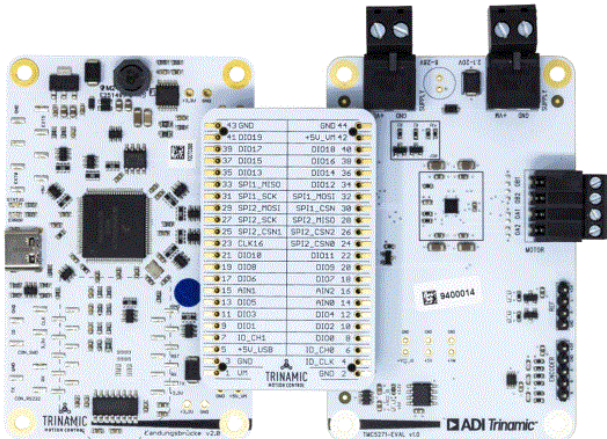## Simplified Block Diagram

Order Codes

Order Code	Description	Size
TMC5271-EVAL-KIT	The kit includes: – **TMC5271 evaluation board** – **Landungsbruecke** (interface board to a PC) – **Eselsbruecke** (bridge connector board) 	140mm x 85mm

Table 1: TMC5271-EVAL Order Codes

Getting Started

You need

- TMC5271-EVAL
- Landungsbruecke with latest firmware
- Eselsbruecke bridge board
- Stepper motor (e.g. QMot line)
- USB interface
- Power Supply (2x if VCC < 8 V wished. See 3.1)
- Latest TMCL-IDE V3.5 (or higher)
- Cables for interface, motors, and power

Precautions

- Do not mix up connections or short-circuit pins.
- Avoid bundling I/O wires with motor wires.
- Do not exceed the maximum rated supply voltage!
- Do not connect or disconnect the motor while powered!
- START WITH POWER SUPPLY OFF!
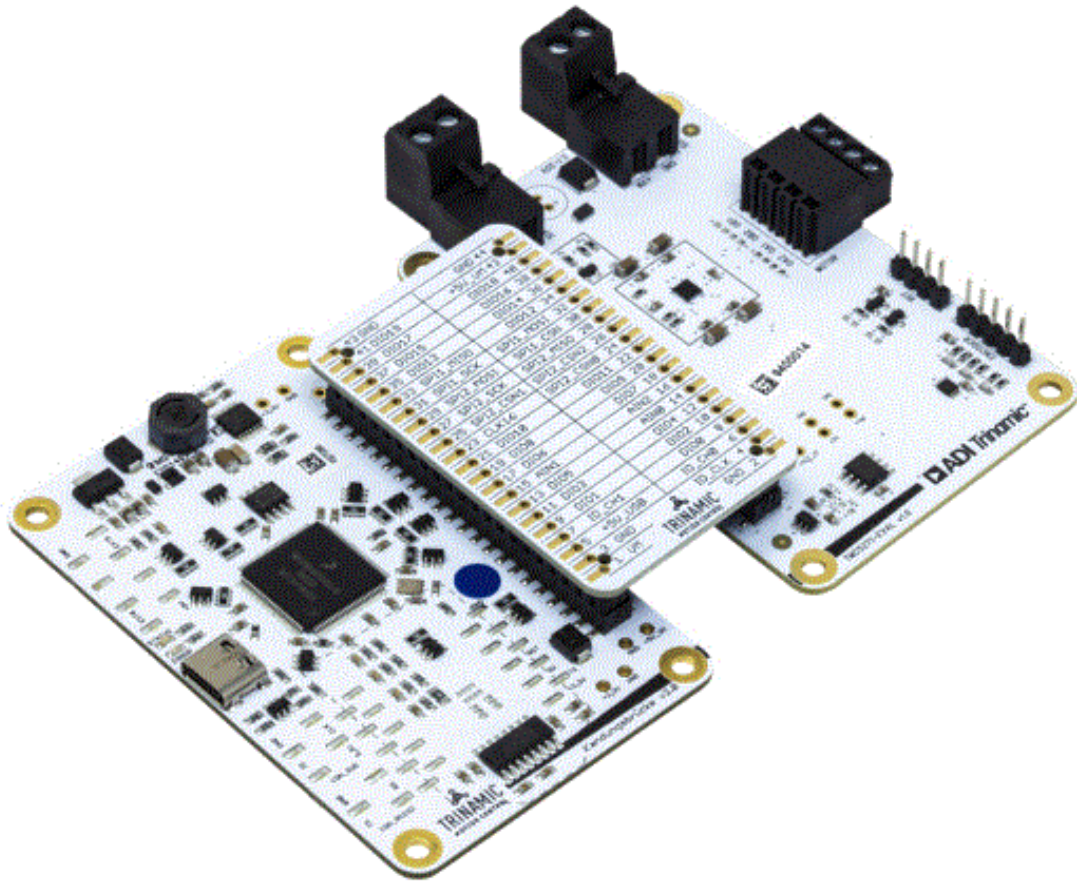
Figure 1: Getting started

First Start-Up

1. Make sure that the latest version of the TMCL-IDE 3.X is installed. The TMCL-IDE can be downloaded from **www.trinamic.com/support/software/tmcl-ide/**.
2. Open the TMCL-IDE and connect the Landungsbruecke via USB to the computer. For Windows 8 and higher no driver is needed, on Windows 7 machines the TMCL-IDE installs the driver automatically.
3. Verify that the Landungsbruecke is using the latest firmware version. The firmware version is shown in the connected device tree. The newest firmware can be downloaded from **www.trinamic.com/support/eval-kits/details/landungsbruecke/.**
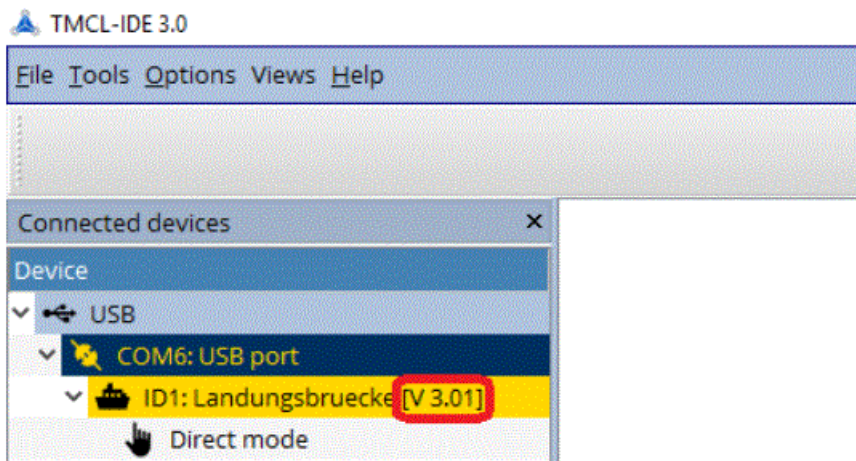
Figure 2: Firmware Version

4. The TMCL-IDE 3.X needs room to show all important information and to provide a good overview. Therefore, arrange the main window related to your needs. We recommend using full screen. For evaluation boards, it is essential to have access to the registers. Therefore open up the Register Browser (left side). For a better view click top right on the normal icon to get a maximized register browser window.

5. The TMCL-IDE includes a dialogue for diagnostic tasks. Further, the dialogue provides an overview of the connected motion controller and driver chips. A window pops up immediately after connecting the evaluation kit the first time. The window shows the actual status of the connections. The second tab of the dialogue offers the possibility to choose basic settings or to reset the module to factory defaults.
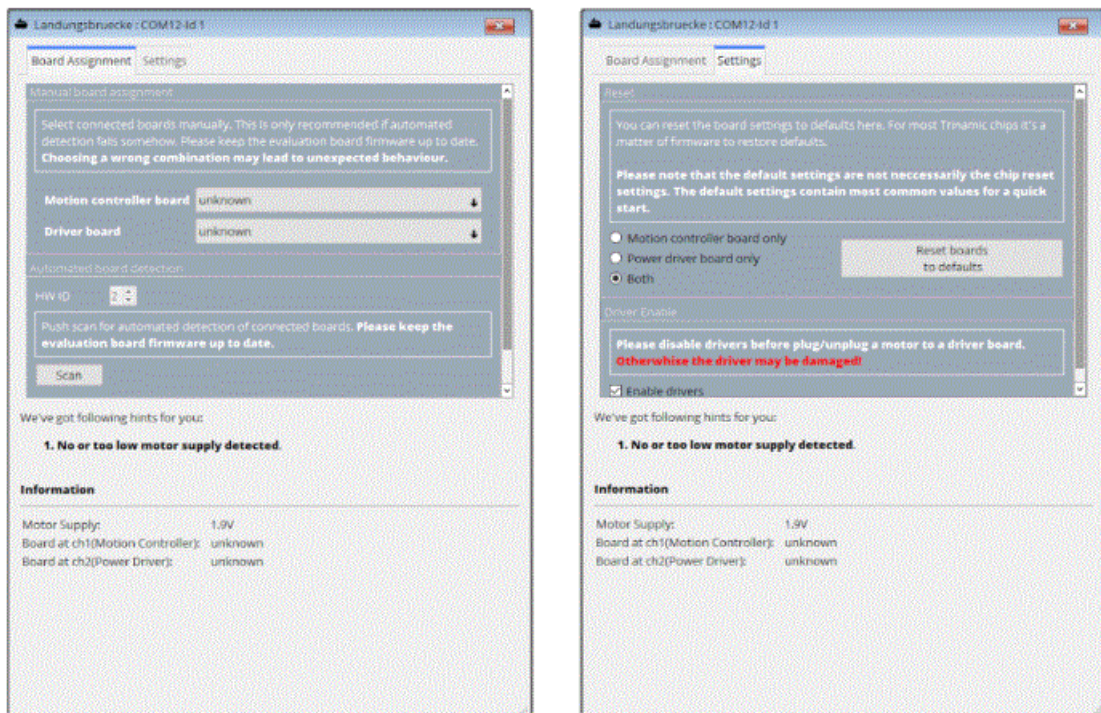
Figure 3: Landungsbruecke Dialogue

Hardware Information

- All design files for our evaluation boards are available for free. We offer the original ECAD files, Gerber data, the BOM, and PDF copies. Typically, the ECAD files are in KiCAD format. Some (older) evaluation boards may

only be available in Eagle, Altium, or PADS format.

- Please check schematics for Jumper settings and input/output connector description.
- The files can be downloaded from the evaluation boards' website directly at our homepage: TRINAMIC Eval Kit homepage.

Note If files are missing on the website or something is wrong please send us a note.

Power connector

- The TMC5271-EVAL has the option to use two power inputs. You need to use both if you want to use the
- TMC5271 at low voltages. This is necessary as the Landungsbruecke needs a minimum voltage of 8 V via the Eselsbruecke connector to operate correctly.
- Connector J202 (right in figure 5) is the main connector to power the TMC5271-EVAL-KIT. If the TMC5271 should be evaluated at voltages below 8 V a second supply needs to be attached via J203 (left in figure 5). Please refer to Chapter 3.1.2 in this case.
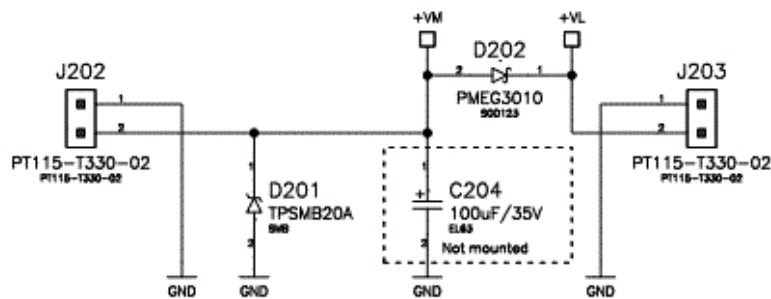
Figure 4: Schematic drawing for power connectors
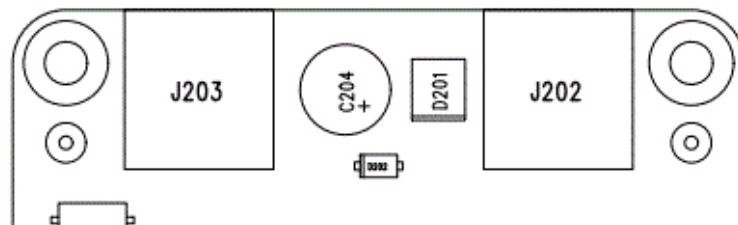
Figure 5: Power connector placement and labeling. J203 (left) and J202 (right)

Single supply
A single supply is achieved by using the connectors in the following voltage range:

- +VM (J202) = 8. . . 20 V
- +VL (J203) = do not use

Dual supply
By using two supplies, the full voltage range of TMC5271 can be used.

- +VM (J202) = 2.1. . . 20 V
- +VL (J203) = 8. . . 28 V

Voltage selection

In case the TMC5271 VIO should be used with +5 V instead of +3.3 V there is a solder selection near the EEPROM. This selection should be changed if an external electronic with 5 V levels is connected. Using the TMC5271-EVAL with Landungsbruecke, the VCCIO must be set to +3.3 V (default).

NOTICE Don't bridge both selections at the same time. This might disturb the onboard voltage regulator. Leave at +3.3 V (default) in combination with Landungsbruecke.
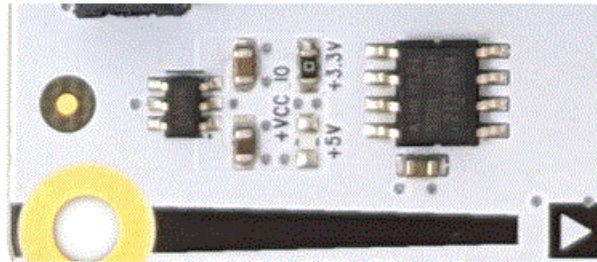
Figure 6: +VCC IO selection near the EEPROM

Onboard Connectors

- The TMC5271-EVAL has 6 onboard connectors. The following table contains information on the connector type and mating connectors.
- The connector pinning and signal names can be derived from the board design and schematic files available here: TRINAMIC TMC5271-EVAL homepage

#	Connects to…	Connector	Type		Description
1	2x Power Supply	**METZ CONNECT 31330102**			Connects a battery or power supply to the evaluation board. Mating cable for example **METZ CONNECT 31349102**
2	1x Motor	**METZ CONNECT 31182104**			Connects the motor to the TMC5271 output. Mating connector **METZ CONNECT 31169104**
3	1x ENCODER	Standard header	5x	2.54mm	Use to connect ABN encoder to board.
4	1x REF	Standard header	4x	2.54mm	Use to connect reference switches to the board.
5	Landungsbruecke	46-3492-44-3-00-10-PPTR from **W+P Series 3492**			Main I/O and digital supply connector to connect to Trina Mic's Landungsbruecke or Star-trampe controller boards via the Eselsbruecke connector or to connect to an own controller board.

Table 3: TMC5271-EVAL connectors

Landungsbruecke Connector

NOTICE

All signals are connected to the TMC5271 directly, without any additional protection. Please consult the TMC5271 datasheet for electrical ratings.

Figure 7: Pin assignment on Landungsbruecke connector

Current scaling IREF-Pins

The IREF pin of TMC5271 is connected to a resistance network as shown in figure 8. IREF of TMC5271 is connected to the upper rail. This feature is targeted for a quick change of the reference resistor via the TMCL-IDE.

IREF_R1	IREF_R2	IREF_R3	IREF
	LOW	LOW	60 k
	HIGH	LOW	20 k
	LOW	HIGH	15 k
	HIGH	HIGH	10 k

Figure 8: Pin assignment and logic table for IREF (upper rail)

IREF_R2	IREF_R3	R_REF [Ω]	Max. TMC5271 FS current [A]
LOW	LOW	60 k	0.27
HIGH	LOW	20 k	0.80
LOW	HIGH	15 k	1.07
HIGH	HIGH	10 k	1.60

Table 5: IREF selection and their resulting current setting

Evaluation Features in the TMCL-IDE

This chapter gives some hints and tips on using the functionality of the TMCL-IDE, e.g., how to use the velocity mode or some feature-based tools.

Note

In order to achieve good settings please refer to descriptions and flowcharts in the TMC5271 data sheet. The registered browser of the TMCL-IDE provides helpful information about any currently selected parameter. Beyond that, the data sheet explains concepts and ideas that are essential for understanding how the registers are linked together and which setting will fit for which kind of application. To get more familiar with the evaluation kit at the beginning of your examinations, drive the motor using velocity mode and/or positioning mode first. Beyond this, the direct mode function can be used. This way, TMCL commands can be sent to the evaluation board system.

Current Settings

To configure the current settings for the TMC5271-EVAL, open the TMC5271 Current Settings tool by clicking the appropriate entry in the tool tree. This tool usually includes settings to control the IC registers and select the reference resistor via Landungsbruecke. It is recommended to use this tool first. Newer generations of ICs provide a wide range of current settings. Therefore the tool might look different or support other functionalities.
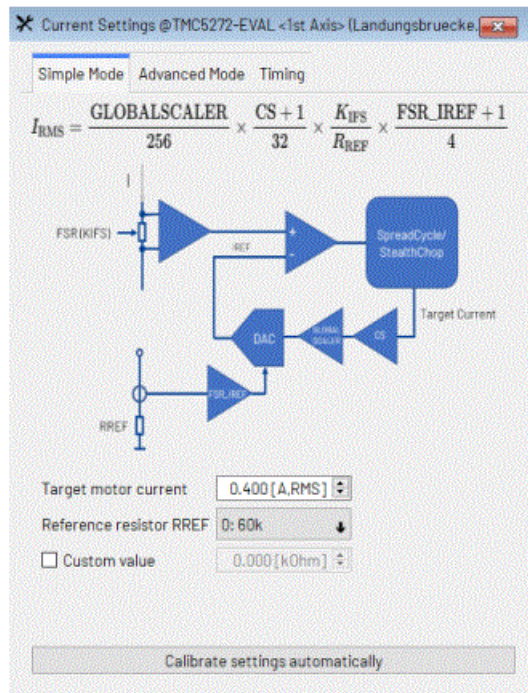

Figure 9: Configuring current settings of a TMC5272 within Simple Mode (similar for other ICs).
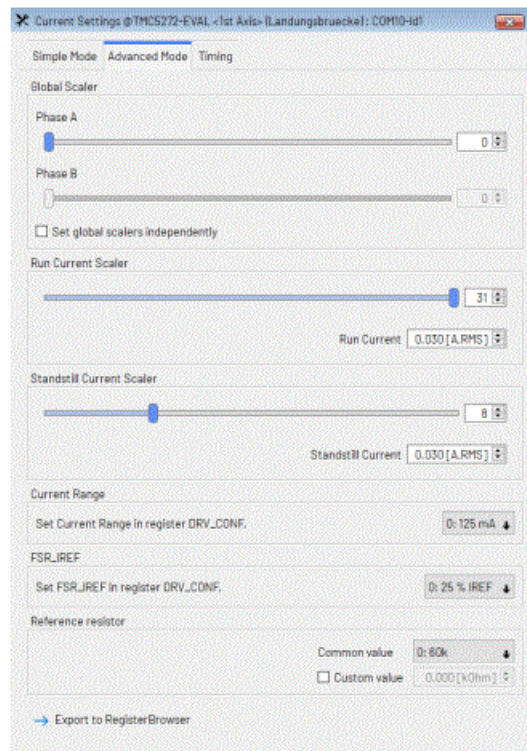

Figure 10: Configuring current settings of a TMC5272 within Advanced Mode (similar for other ICs).

Velocity Mode
To move the motor in velocity mode, open the velocity mode tool by clicking the appropriate entry in the tool tree. In the velocity mode tool you can enter the desired velocity and acceleration and then move the motor using the arrow buttons. The motor can be stopped at any time by clicking the stop button. Open the velocity graph tool to get a graphical view of the actual velocity. You might have to change the desired run and hold currents in the Current Settings tool before.

Note In order to get a more accurate graphical velocity view, close the register browser window when using the velocity graph.
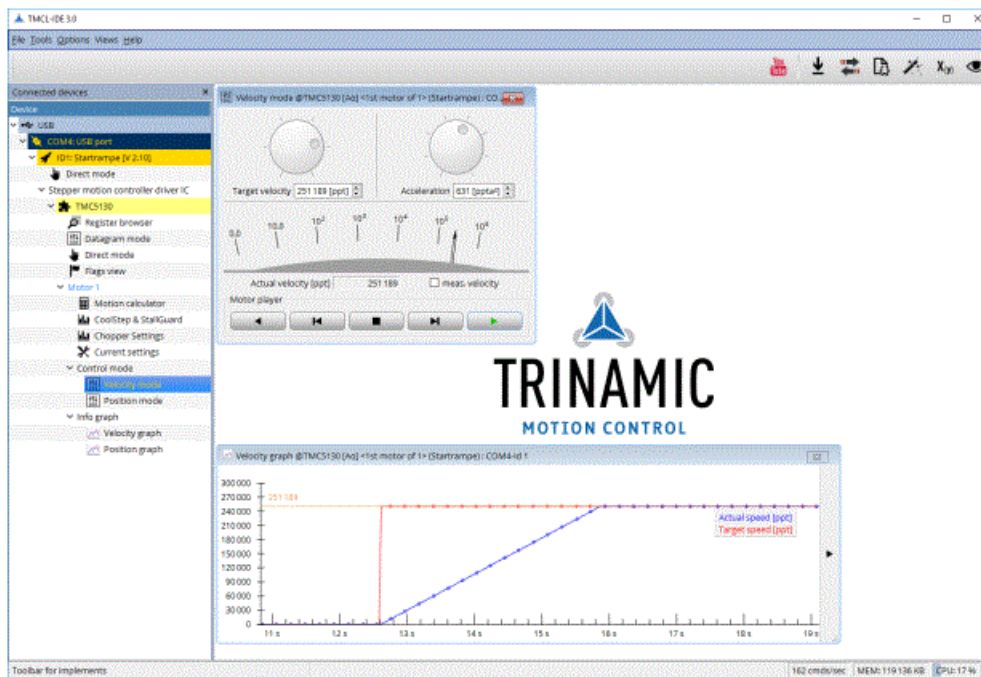
Figure 11: Driving the motor in velocity mode (TMCL-IDE provides similar view for TMC5271-EVAL)

Position Mode

- To move the motor in position mode, open the position mode tool by clicking the appropriate entry in the tool tree. In the position mode tool you can enter a target position and then start positioning by clicking the Absolute or Relative Move button. The speed and acceleration used for positioning can also be ad-justed here.
- Open the position graph tool to get a graphical view of the actual position. You might have to change the desired run and hold currents in Current Settings tool before

Note In order to get a more accurate graphical position view, close the register browser window when using the position graph.
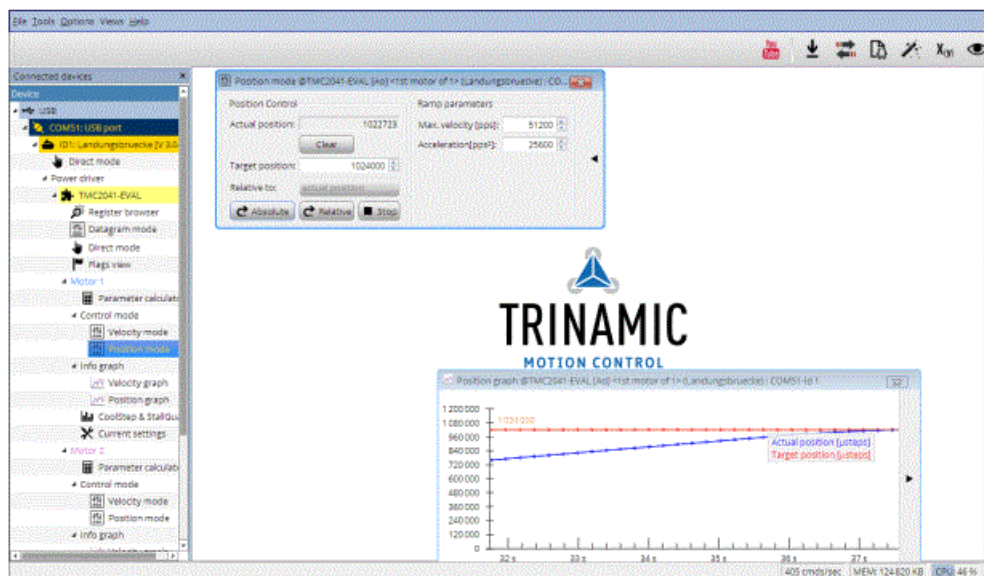
Figure 12: Driving the motor in position mode (TMCL-IDE provides similar view for TMC5271-EVAL)

StallGuard4 Tuning

To tune StallGuard4 properly you need to set the current for the motor first, e.g. 1A RMS. After that you specify the velocity to run the motor with. This could be 75 rpm as in this example. You can use the TMCL IDE to calculate the velocity with the "Parameter calculator" tool shown in the list on the left when connecting the board.
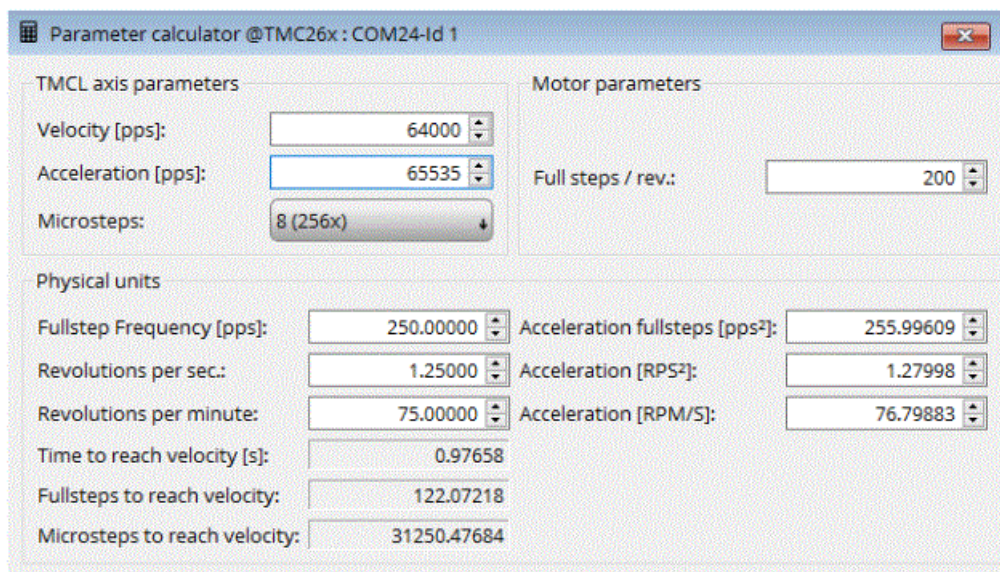

Figure 13: TMCL IDE v3.0.20.0 Parameter calculator

In the TMCL IDE, you can use the CoolStep & StallGuard4 graph where the StallGuard4 value is shown in blue. There are two parameters that need tuning for proper StallGuard4 use. StallGuard4 Threshold (SGT), will need to be tuned by raising or lowering the SGT value. The goal of SGT is to have it hit 0 before a stall occurs. If the SGT is too high, a step loss will occur and you need to lower it. In the picture, you see two regions. In the first region, the SGT value was too high. It was set to 10 and with loading the motor you can see the value does not reach 0. In the second region, the SGT value was set to 4 which results in hitting the 0 axis just short before the motor stalls.
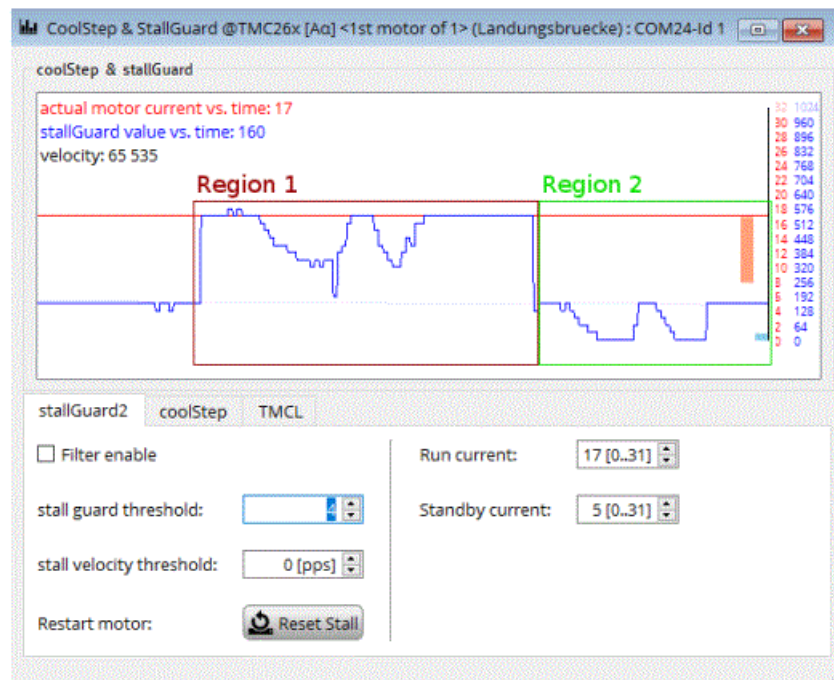
Figure 14: CoolStep & StallGuard4 window

With optimal StallGuard4 settings, you can optionally activate CoolStep.

CoolStep Tuning
With the TMCL IDE and the EVAL-KIT, you have a powerful tool to find your CoolStep to run your motor most energy efficient and cool. To tune it, please open the CoolStep & StallGuard2 or StallGuard4 window you'll find on the left of the IDE when you have connected the EVAL board. On the CoolStep tab, you will see the below picture by default.
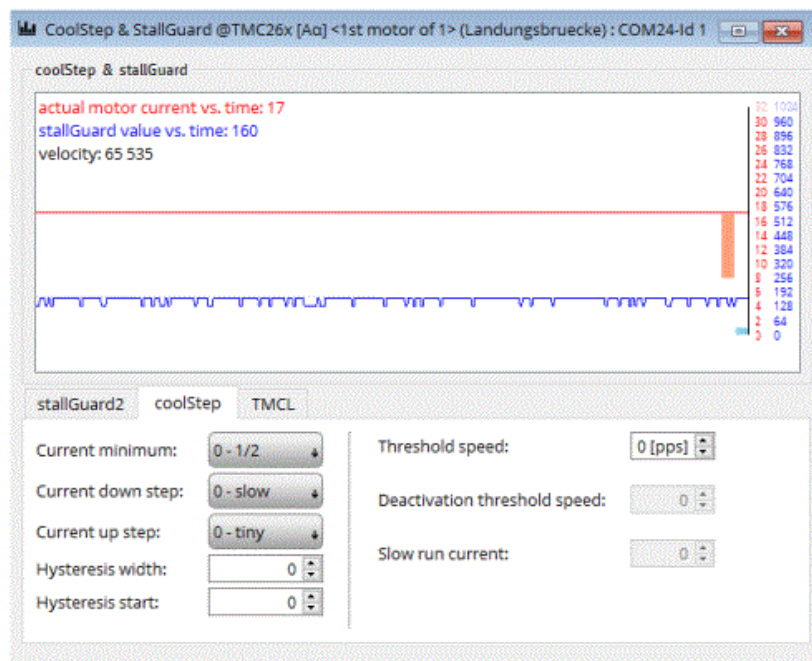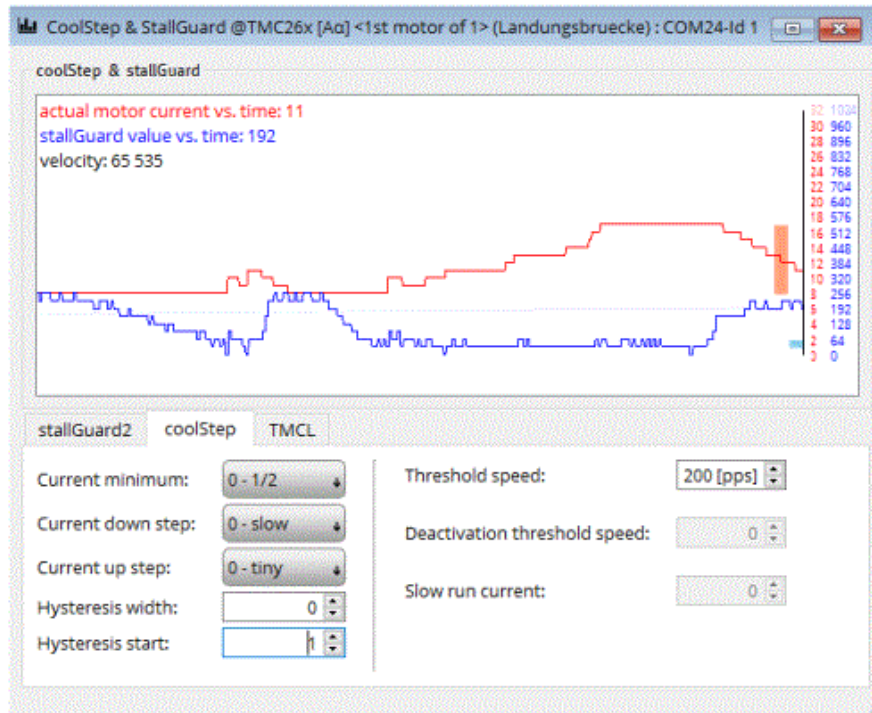

Figure 15: CoolStep & StallGuard2 (or StallGuard4) window

CoolStep will get activated as soon as you change the "Hysteresis start" value higher than 0 and enter a "Threshold speed" value higher than 0.

Figure 16: CoolStep & StallGuard2 (or StallGuard4) window

The above values activate CoolStep but the values can be fine tuned to make CoolStep work reliably and in the way as you need it in your application. For that, it is important to understand what each setting is doing.

- Current minimum: The current minimum setting will be the lowest current when CoolStep is activated. With 1A RMS the current will either be reduced to a quarter or to half of this current when no or less force is applied to the motor shaft.
- Current down step: Current down steps defines the speed of the current to drop down after the load gets released from the motor shaft.
- Current up step: This setting defines the step height when hitting the lower StallGuard2 or Stall-Guard4 threshold (Hysteresis start).
- Hysteresis width: This setting defines the area of the StallGuard2 or StallGuard4 threshold (Hys-teresis end).
- Hysteresis start: This setting defines the switching point, related to the StallGuard2 or StallGuard4 value, to boost up the current by one step.

ADC Tool
The TMC5271 has integrated ADC registers. The values can be read out and displayed with the ADC Tool. Configurations for them are available as well.
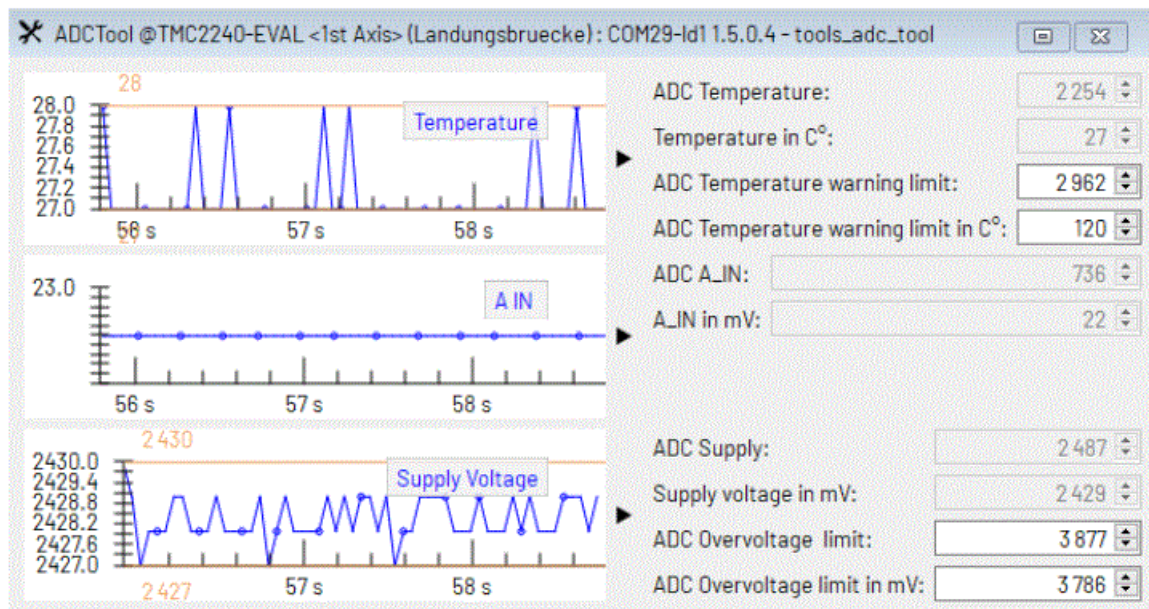
Figure 17: Configuring and read out the ADC registers of a TMC2240 (similar for other ICs).

Sinus Tool

The TMC5271 has the ability to change the waveform of the motor current to match the motor characteristic. The necessary values can be read out and displayed with the Sinus Tool. Graphs show the resulting waveform. The Phase shift functionality can optimize the parameter for the connected motor automatically.

Figure 18: Configuring and read out the sinus and phase shift registers of a TMC5272 (similar for other ICs).

TriCoder Tool

The TMC5271 supports TriCoder functionality to detect motor movements within standstill. This tool pro-vides the basic settings to setup and enable this function.
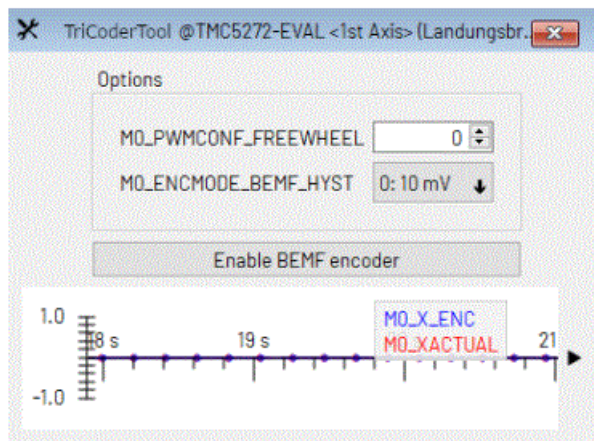
Figure 19: Setting up the TriCoder for TMC5272 (similar for other ICs).

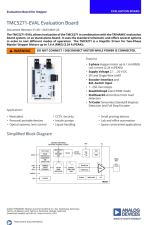## Revision History

Document Revision

Version	Date	Author	Description
1.00	2023-MAY-23	FV	Initial release.

Table 6: Document Revision

Documents / Resources

Trinamic TMC5271-EVAL Evaluation Board [pdf] User Guide
TMC5271-EVAL Evaluation Board, TMC5271-EVAL, Evaluation Board, Board

References

- **31182104 Metz Connect, Stiftleiste, Wire-to-Board, 3.5 mm | Farnell DE**
- **31169104 METZ CONNECT USA Inc. | Steckverbinder, Verbindungen | DigiKey**
- **31330102 METZ CONNECT USA Inc. | Steckverbinder, Verbindungen | DigiKey**
- **31349102 METZ CONNECT USA Inc. | Steckverbinder, Verbindungen | DigiKey**
- **ADI Trinamic Support | Analog Devices**
- **Landungsbrücke Eval System | Design Center | Analog Devices**

- ▶ **[ESELSBRUECKE Evaluation Board | Analog Devices](#)**
- ▶ **[LANDUNGSBRUECKE Evaluation Board | Analog Devices](#)**
- ▶ **[ADI Trinamic Support | Analog Devices](#)**
- ▶ **[TMCL-IDE | Design Center | Analog Devices](#)**
- **[User Manual](#)**

- ▶ **[ESELSBRUECKE Evaluation Board | Analog Devices](#)**
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- ▶ **[TMCL-IDE | Design Center | Analog Devices](#)**
- **[User Manual](#)**