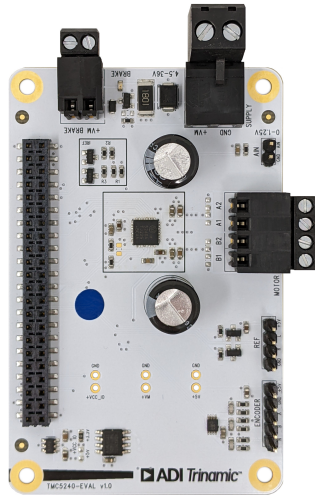


TMC5240-EVAL Evaluation Board

Document Revision V1.10 • 2022-NOV-17

The TMC5240-EVAL allows evaluation of the TMC5240 in combination with the TRINAMIC evaluation board system, or as stand-alone-board. It uses the standard schematic and offers several options in order to test different modes of operation. The TMC5240 is a Step/Dir Driver for Two-Phase Bipolar Stepper Motors up to 2.0A RMS (3.0A peak).

⚠ WARNING DO NOT CONNECT / DISCONNECT MOTOR WHILE POWER IS CONNECTED.



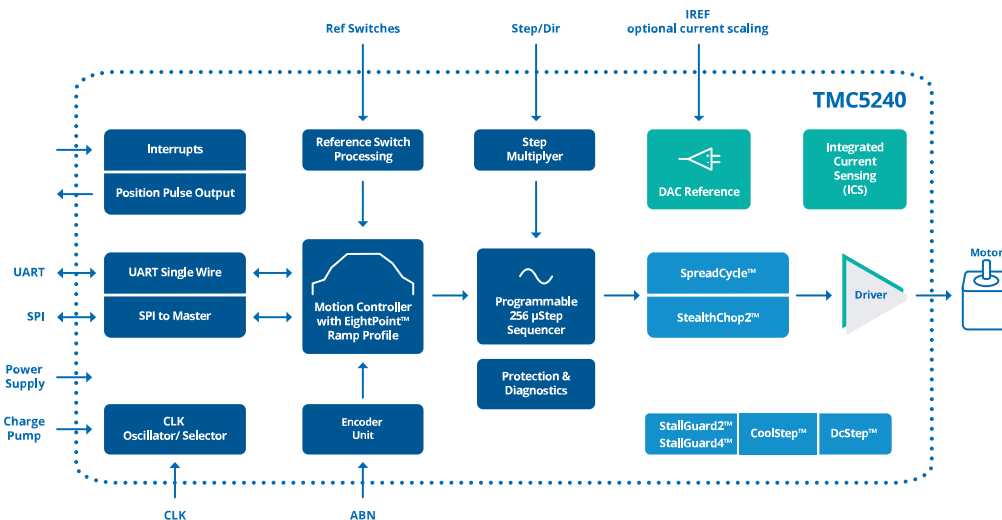
Features

- **2-phase** stepper motor up to 2.0A coil current (3.0A peak)
- **Supply Voltage** 4.5...36V DC
- SPI and Single Wire UART
- **Encoder Interface** and **2x Ref.-Switch Input**
- 1...256 microsteps
- Flexible wave table and phase shift to match motor
- **StealthChop2™** silent PWM mode
- **StallGuard4™** sensorless motor load detection

Applications

- Compatible Design Upgrade
- 3D Printers
- Printers, POS
- Office and home automation
- Textile, Sewing Machines
- CCTV, Security
- ATM, Cash recycler
- Antenna positioning
- HVAC

Simplified Block Diagram



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1 Order Codes

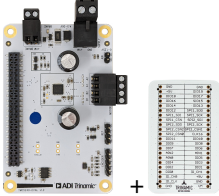
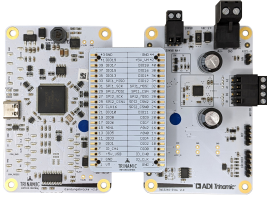
Order Code	Description	Size
TMC5240-EVAL	The evaluation board includes: - TMC5240-EVAL evaluation board - Eselsbruecke (bridge connector board) 	55mm x 85mm
TMC5240-EVAL-KIT	The kit includes: - TMC5240 evaluation board - Landungsbruecke (interface board to a PC) - Eselsbruecke (bridge connector board) 	140mm x 85mm

Table 1: TMC5240-EVAL Order Codes

2 Getting Started

You need

- TMC5240-EVAL
- Landungsbruecke with latest firmware
- Eselsbruecke bridge board
- Stepper motor (e.g. QMot line)
- USB interface
- Power Supply
- 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!

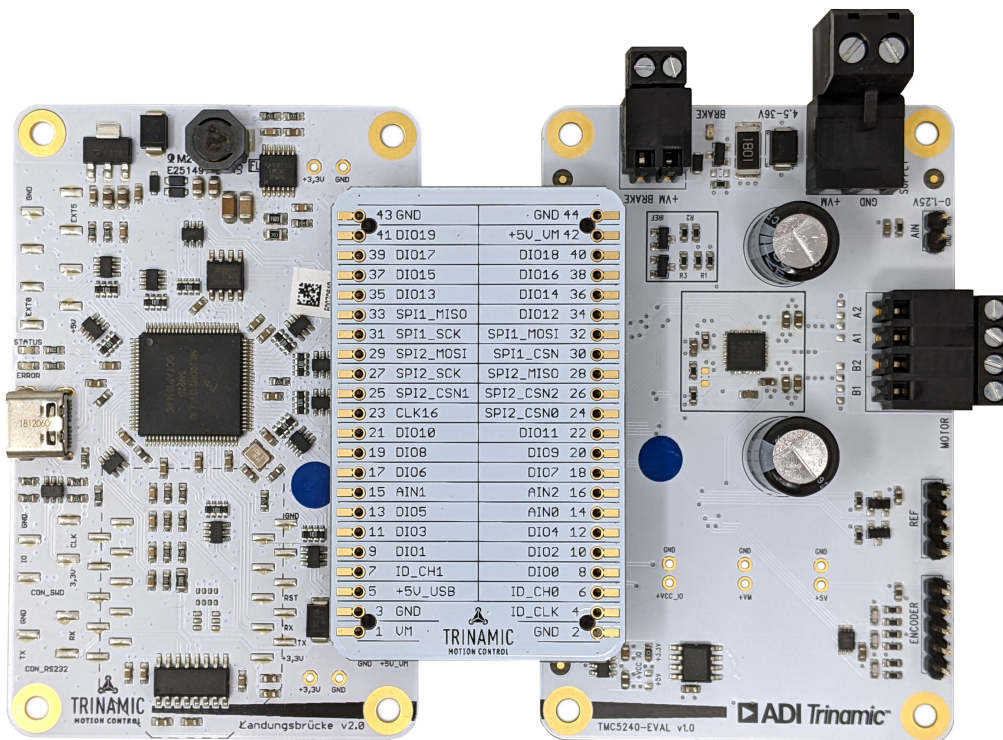


Figure 1: Getting started

2.1 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 is installing 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/.

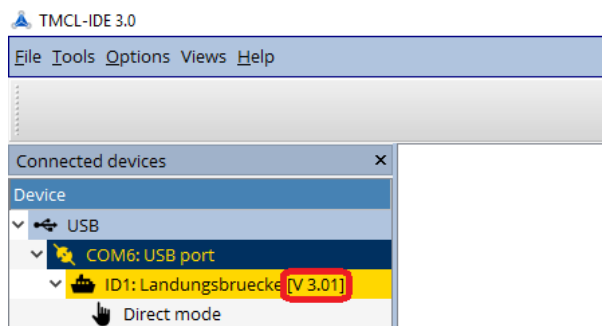


Figure 2: Firmware Version

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.

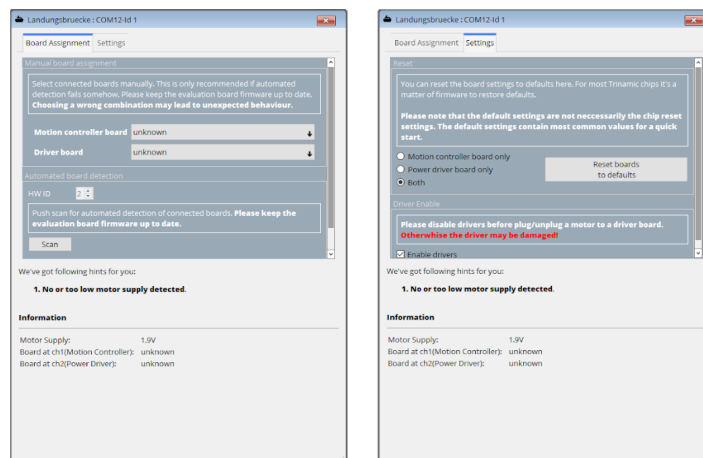


Figure 3: Landungsbruecke Dialogue

3 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.

3.1 Voltage selection

In case the TMC5240 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 a external electronic with 5 V levels is connected.

Using the TMC5240-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.

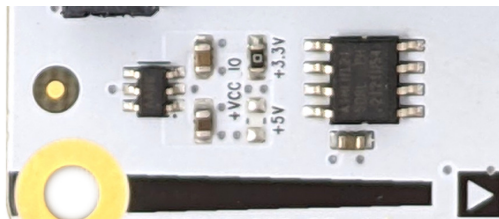


Figure 4: +VCC IO selection near the EEPROM

3.2 Onboard Connectors

The TMC5240-EVAL has 7 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 TMC5240-EVAL homepage](#)

#	Connects to...	Connector Type	Description
1	Power Supply	METZ CONNECT 31330102	Connects a battery or power supply to the evaluation board. Mating cable for example METZ CONNECT 31349102
2	Brake	METZ CONNECT 31182102	Connects a brake resistor to the TMC5240 output. Mating connector METZ CONNECT 31169102
3	Motor	METZ CONNECT 31182104	Connects the motor to the TMC5240 output. Mating connector METZ CONNECT 31169104
4	Landungsbruecke	46-3492-44-3-00-10-PPTR from W+P Series 3492	Main I/O and digital supply connector to connect to Trinamic's Landungsbruecke or Startrampe controller boards via the Eselsbruecke connector or to connect to an own controller board.
5	ENCODER	Standard header 5x 2.54mm	Use to connect ABN encoder to board.
6	REF	Standard header 4x 2.54mm	Use to connect two external reference switches.
7	AIN	Standard header 2x 2.54mm	Use to input external analog signal.

Table 3: TMC5240-EVAL connectors

3.2.1 Landungsbruecke Connector

NOTICE All signals are connected to the TMC5240 directly, without any additional protection. Please consult the TMC5240 datasheet for electrical ratings.

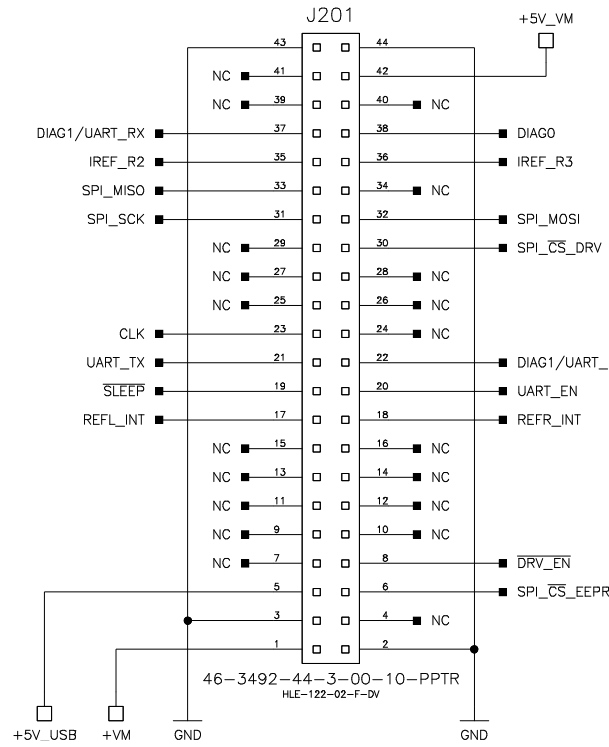


Figure 5: Pin assignment on Landungsbruecke connector

3.2.2 Current scaling IREF-Pins

The IREF pin of TMC5240 is connected to a resistance network as shown in figure 6. IREF of TMC5240 is connected to the upper rail.

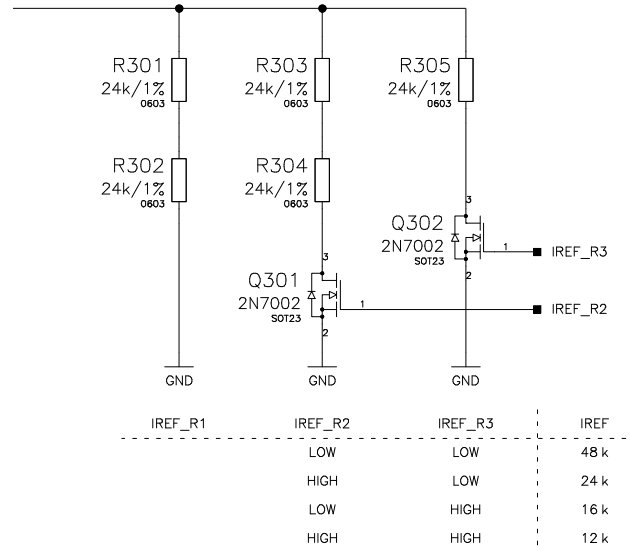


Figure 6: Pin assignment and logic table for IREF (upper rail)

IREF_R2	IREF_R3	R_REF [Ω]	Max. TMC5240 FS current [A]
LOW	LOW	48 k	0.75
HIGH	LOW	24 k	1.50
LOW	HIGH	16 k	2.25
HIGH	HIGH	12 k	3.00

Table 5: IREF selection and their resulting current setting

4 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 TMC5240 data sheet. The register browser of the TMCL-IDE provides helpful information about any currently selected parameter. Beyond that, the data sheet explains concepts and ideas which are essential for understanding how the registers are linked together and which setting will fit for which kind of application. For getting more familiar with the evaluation kit in 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.

4.1 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 *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.

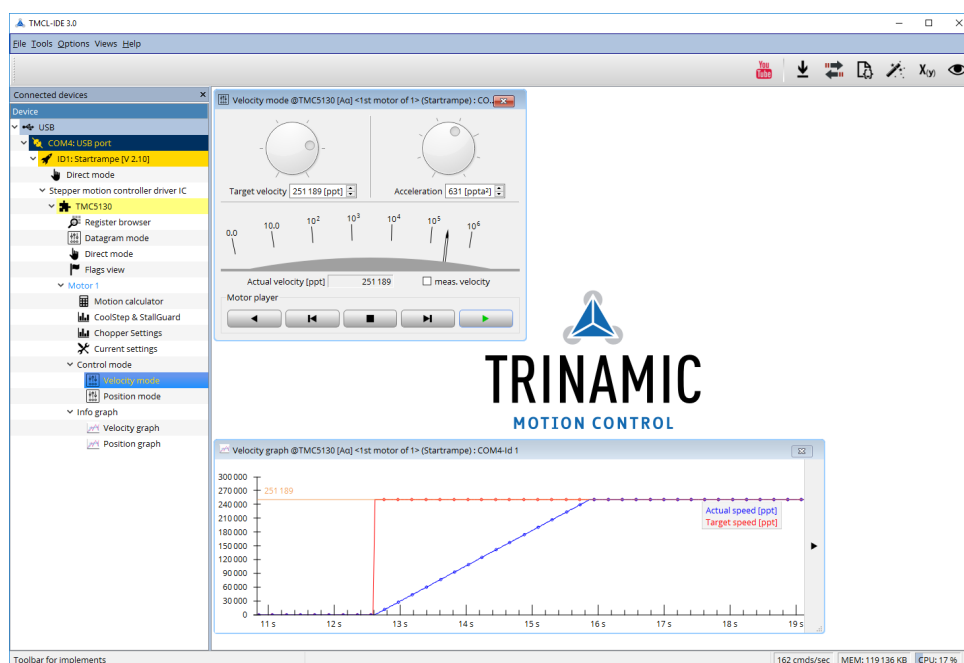


Figure 7: Driving the motor in velocity mode (TMCL-IDE provides similar view for TMC5240-EVAL)

4.2 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 adjusted 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.

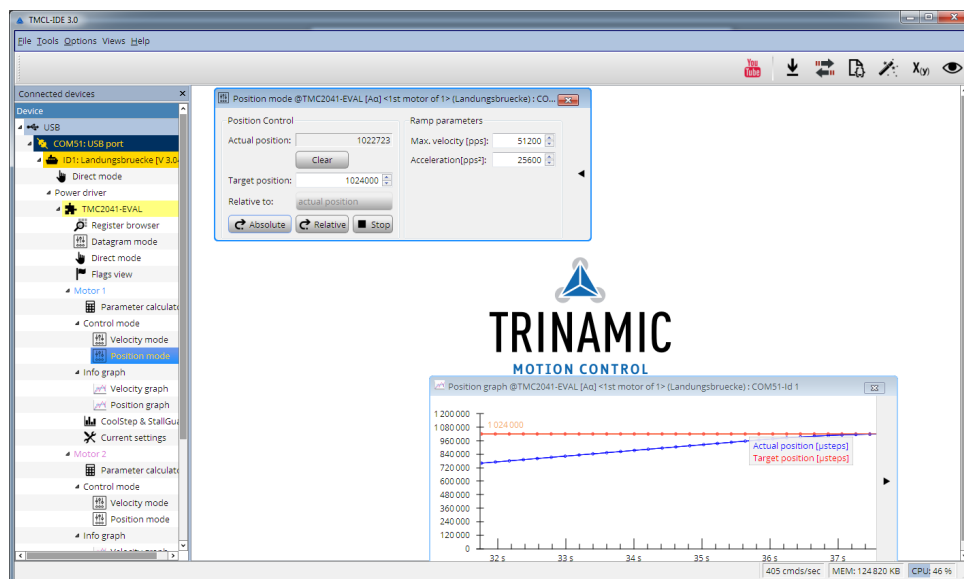


Figure 8: Driving the motor in position mode (TMCL-IDE provides similar view for TMC5240-EVAL)

4.3 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.

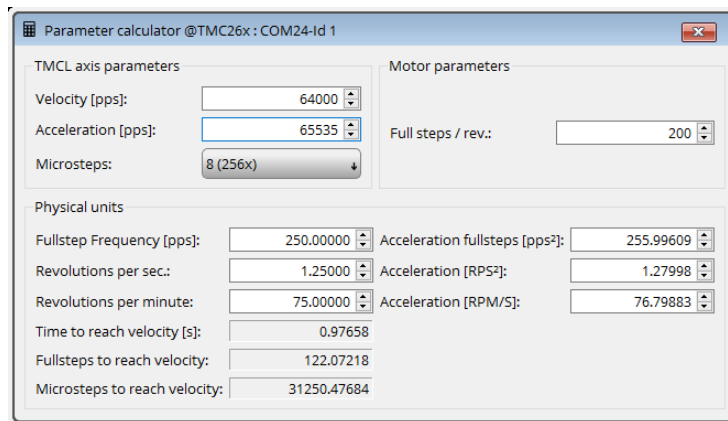


Figure 9: TMCL IDE v3.0.20.0 Parameter calculator

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 it so 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.

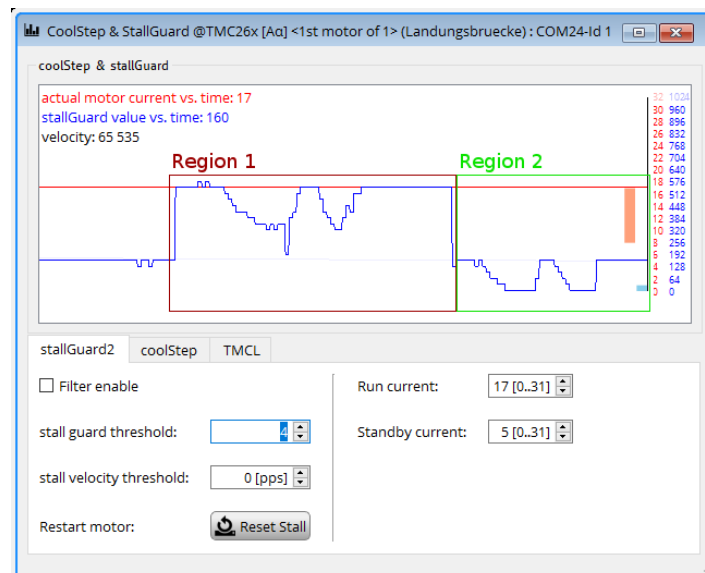


Figure 10: CoolStep™ & StallGuard4™ window

With optimal StallGuard4™ settings you can optionally activate CoolStep™.

4.4 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 below picture by default.

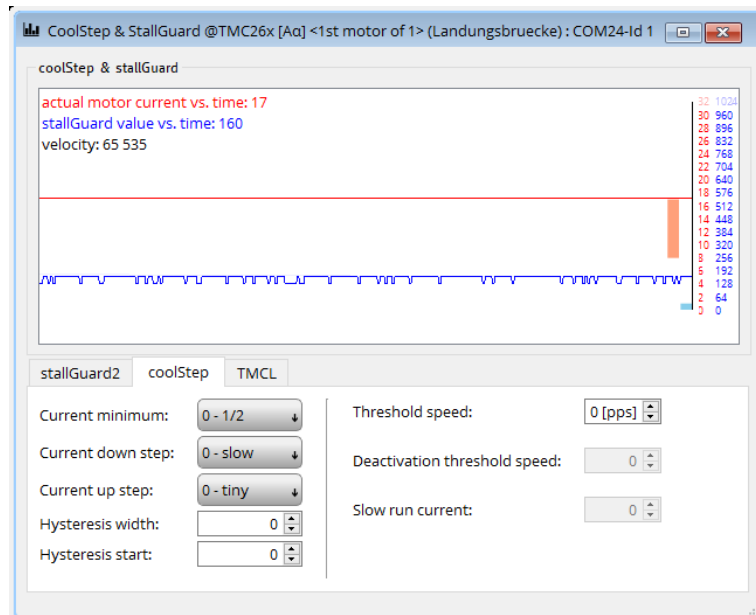


Figure 11: CoolStep™ & StallGuard2™ (or StallGuard4™) window

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.

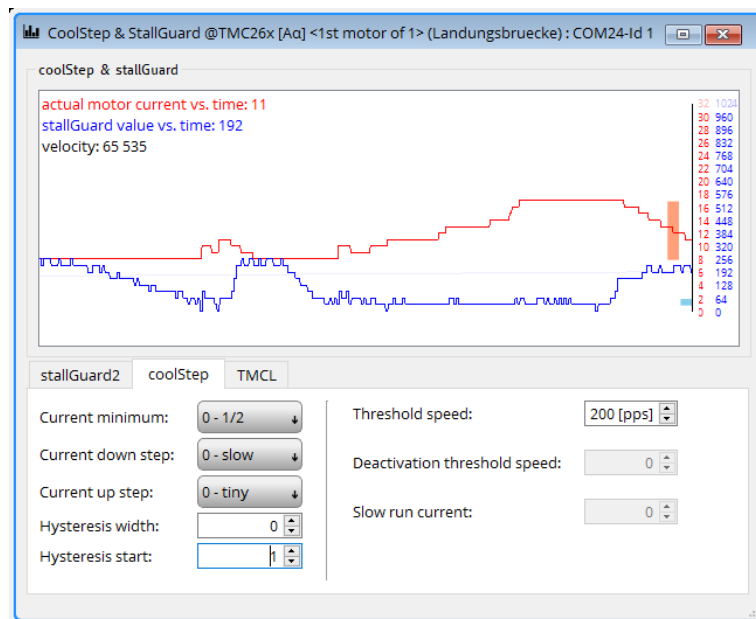


Figure 12: CoolStep™ & StallGuard2™ (or StallGuard4™) window

The above values activate CoolStep™ but the values can be fine tuned to make CoolStep™ work reliable and in a 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 the 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 load gets released from the motor shaft.
- **Current up step:** This setting defines the step height when hitting the lower StallGuard2™ or StallGuard4™ threshold (Hysteresis start).
- **Hysteresis width:** This setting defines the area of the StallGuard2™ or StallGuard4™ threshold (Hysteresis end).
- **Hysteresis start:** This setting defines the switching point, related to the StallGuard2™ or StallGuard4™ value, to boost up the current by one step.

4.5 ADC Tool

The TMC5240 has integrated ADC registers. The values can be read out and displayed with the ADC Tool. Configurations for them are available as well.

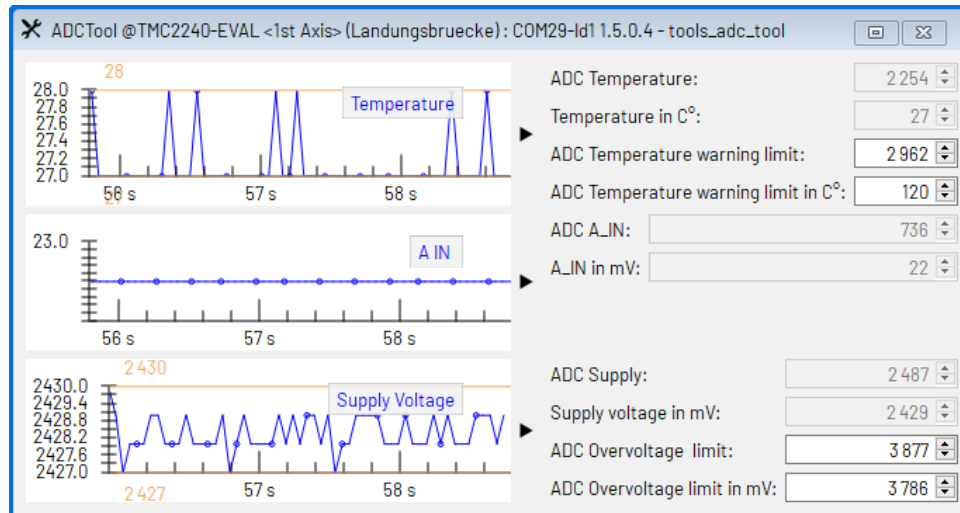


Figure 13: Configuring and read out the ADC registers of a TMC2240 (similar for other ICs).

4.6 Sinus Tool

The TMC5240 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.

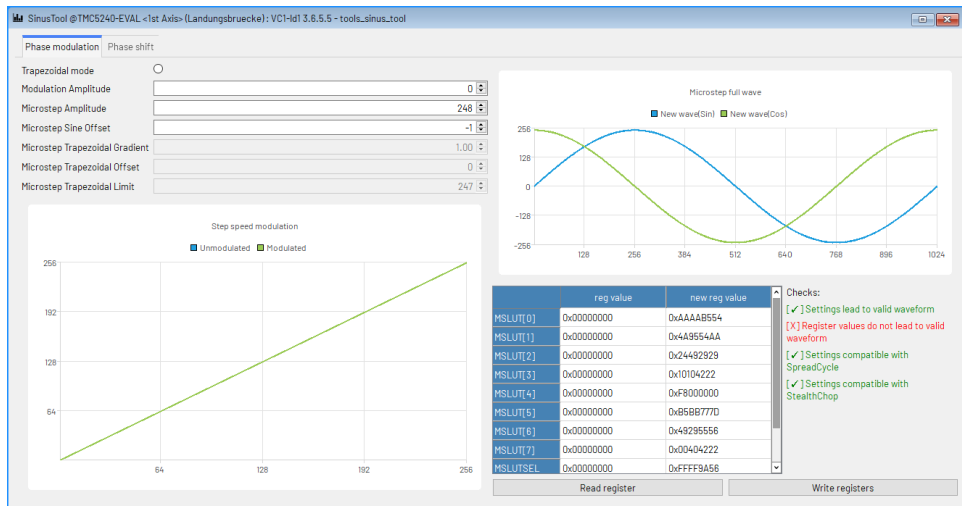


Figure 14: Configuring and read out the sinus and phase shift registers of a TMC5240 (similar for other ICs).

5 Revision History

5.1 Document Revision

Version	Date	Author	Description
1.00	2022-AUG-24	FV	Initial release.
1.10	2022-NOV-17	FV	Fixed short spec. Clarified IREF values and chapter Voltage selection. Added SinusTool.

Table 6: Document Revision