TMC5161-EVAL Evaluation Kit

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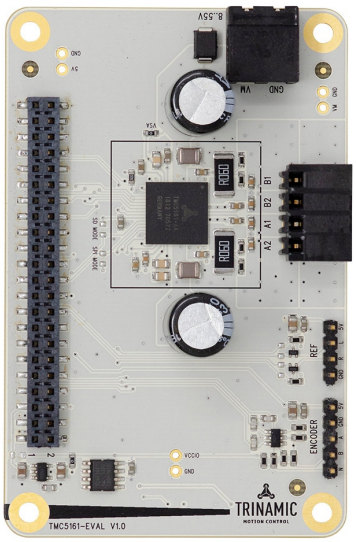
The TMC5161-EVAL is designed for evaluating all features of the TMC5161. The evaluation board is part of TRINAMICs user-friendly plug-in system for chip evaluation. Just connect the TMC5161-EVAL with Landungsbruecke, the associated base board. Therefore, use the dedicated connector board, called Eselsbruecke. Eselsbruecke offers test points for every connector pin.



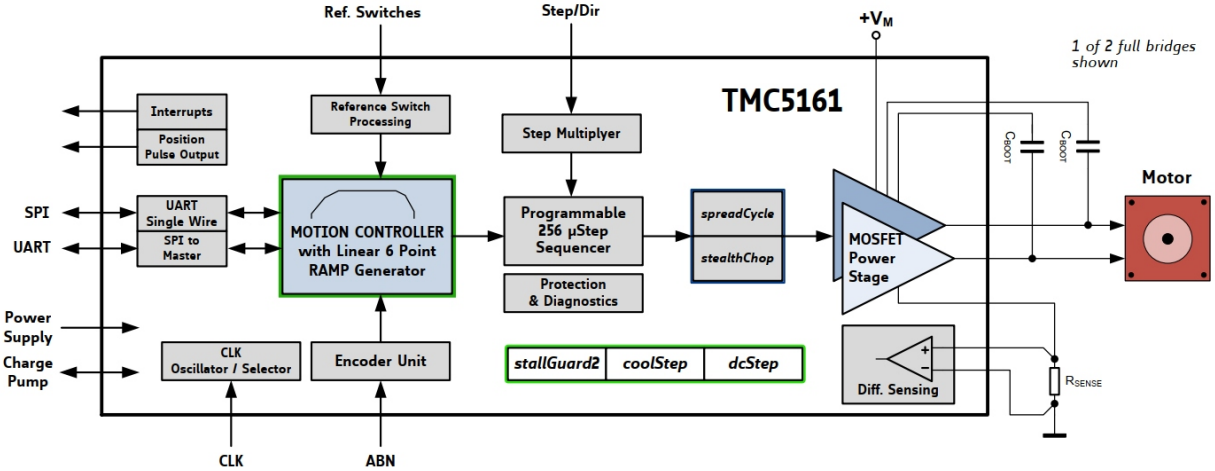
Features

- **2-phase** stepper motor up to 3.5A coil current (4.9A peak)
- **Supply Voltage** 8…55V DC
- **SPI & Single Wire UART**
- **Incremental Encoder Interface** and **2x Ref.-Switch Input**
- Integrated **SixPoint™** ramp motion controller
- **StealthChop™** silent PWM mode
- **SpreadCycle™** smart mixed decay
- **DcStep™** load dependent speed
- **StallGuard2™** load detection
- **CoolStep™** autom. current scaling

Applications

- Laboratory Automation
- Manufacturing
- Semiconductor Handling
- Robotics
- Factory Automation
- Test & Measurement
- Life Science
- Biotechnology
- Liquid Handling

Simplified Block Diagram



Read entire documentation.

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1 Getting Started

You need

- TMC5161-EVAL
- Landungsbruecke or Startrampe with latest firmware (We recommend the Landungsbruecke as it offers faster USB communication.)
- 1 x Eselsbruecke
- Stepper motor
- USB interface
- Power Supply
- Latest TMCL-IDE and PC
- Cables for interface, motors and power

Precautions

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

Connect together Landungsbruecke or Startrampe and the TMC5161 evaluation board using the Eselsbruecke as shown in figure 1.

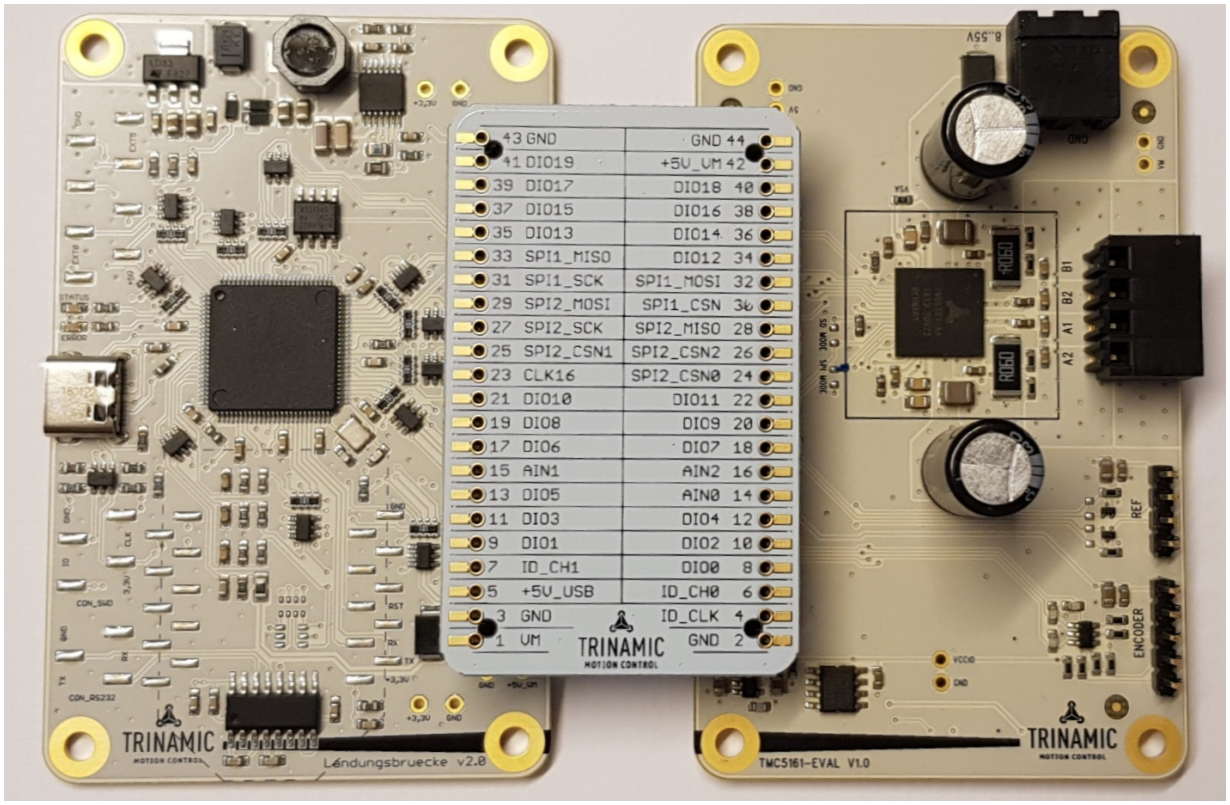

Figure 1: Getting started

NOTICE The Landungsbruecke operates on USB Power Supply. All other voltages are generated from V_M. Kit works only, when V_M is applied.

1.1 First Start-Up

1. Make sure that the latest version of the TMCL-IDE 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 or Startrampe via USB to the computer. For Windows 8 and higher is no driver needed, on Windows 7 machines the TMCL-IDE is installing the driver automatically.

3. Verify that the Landungsbruecke or Startrampe is using the latest firmware version. The firmware version is shown in the connected device tree.

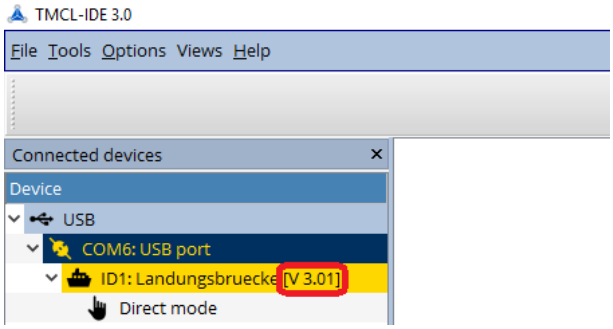

Figure 2: Firmware Version

4. The TMCL-IDE (V3.0 and upwards) 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.

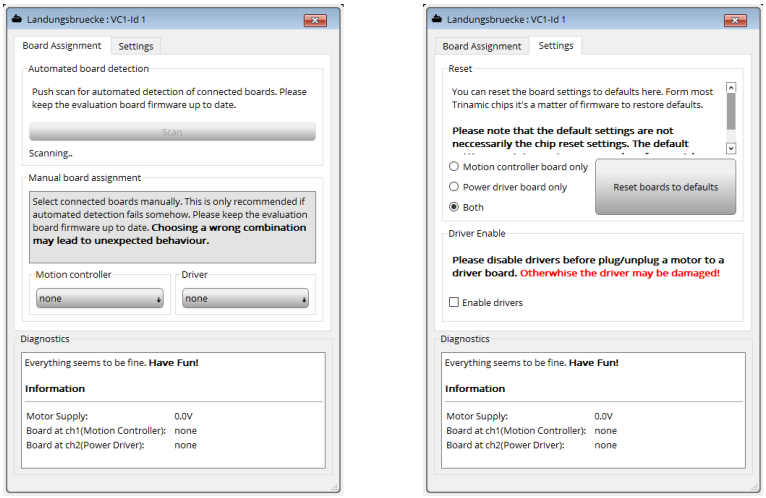

Figure 3: Landungsbruecke Dialogue

5. The TMC5161-EVAL provides 2 optional solder jumpers for the IC pins SD_MODE and SPI_MODE as highlighted in red in Figure 4. They are not assembled by default. They allow to use the TMC5161 in different modes:

- Full Featured Motion Controller & Driver (default for TMC5161-EVAL)
- Step & Direction Driver with Configuration
- Simple Step & Direction Driver with standalone pin-configuration

For detailed information on these modes please check the TMC5161 datasheet.

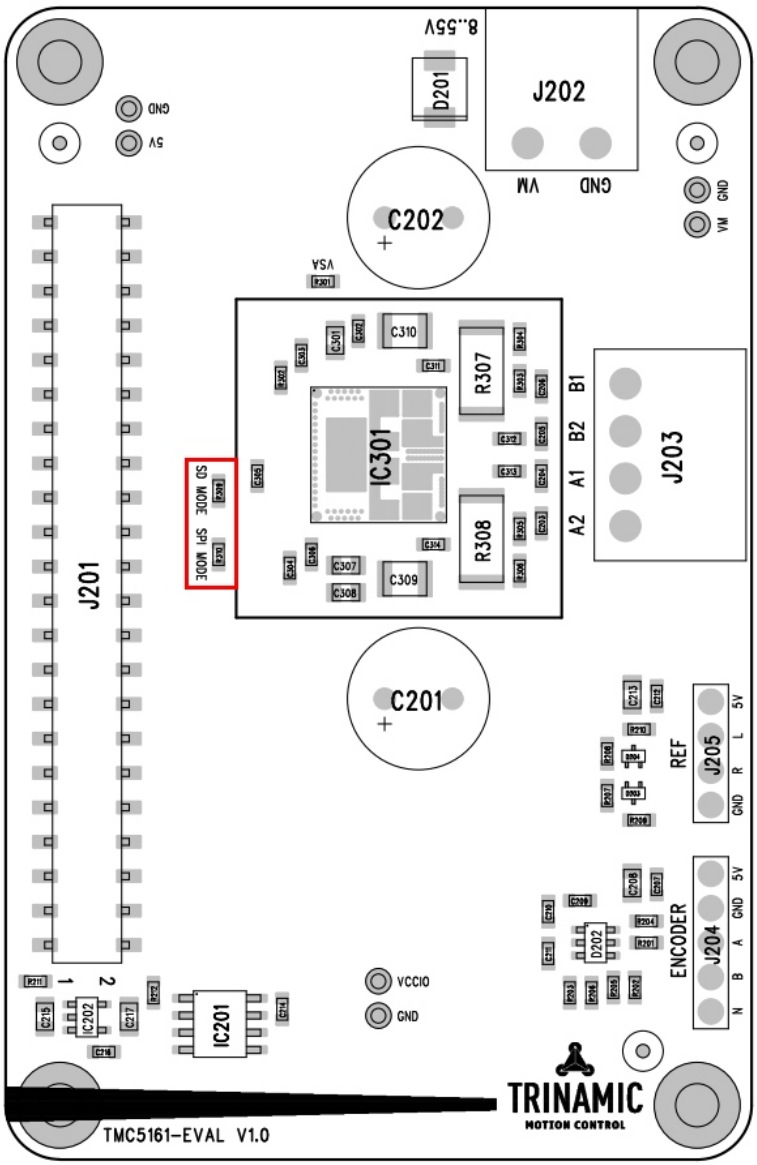

Figure 4: Solder Jumpers on TMC5161-EVAL

2 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 https://www.trinamic.com/support/eval-kits/.

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

3 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 TMC5161 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.

3.1 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.

Note

In order to get a more accurate graphical velocity view, close the register browser window when using the velocity graph.

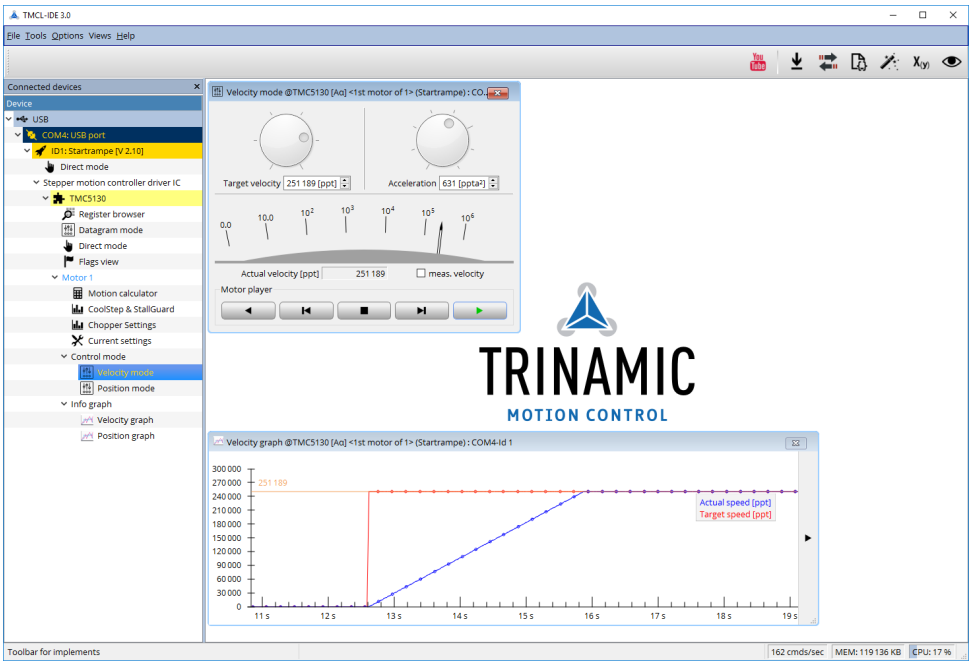

Figure 5: Driving the motor in velocity mode (TMCL-IDE provides similar view for TMC5161-EVAL)

3.2 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.

Note In order to get a more accurate graphical position view, close the register browser window when using the position graph.

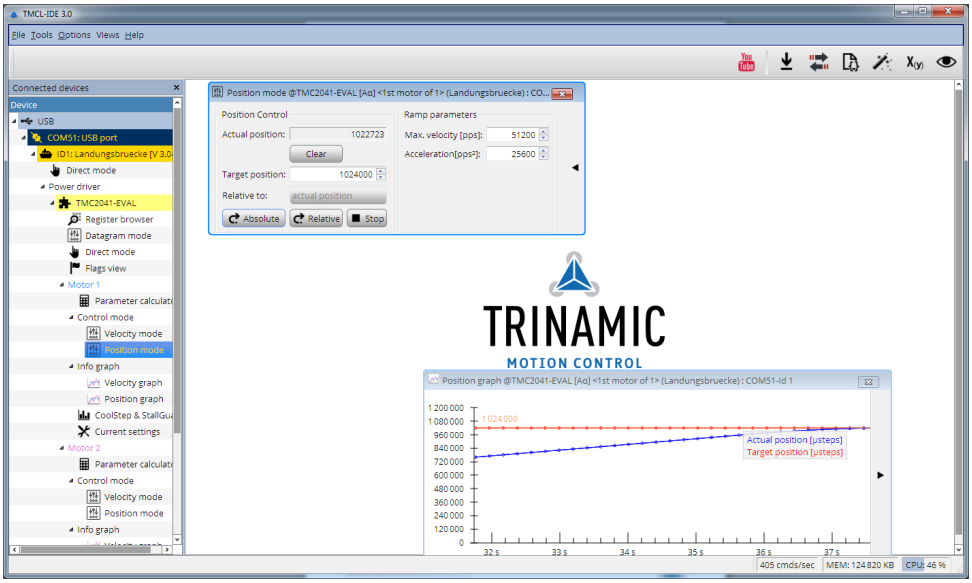

Figure 6: Driving the motor in position mode (TMCL-IDE provides similar view for TMC5161-EVAL)

3.3 StallGuard2™ Tuning

To tune StallGuard2™ 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.

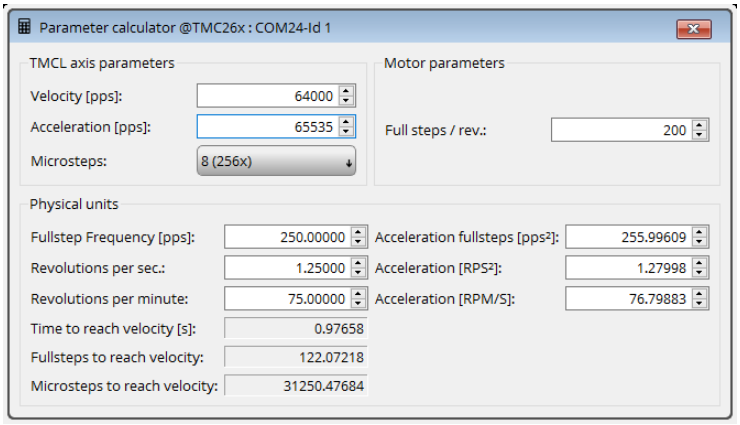

Figure 7: TMCL IDE v3.0.20.0 Parameter calculator

In the TMCL IDE you can use the CoolStep™ & StallGuard2™ graph where the StallGuard2™ value is shown in blue. There are two parameters that need tuning for proper StallGuard2™ use. StallGuard2™ 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.

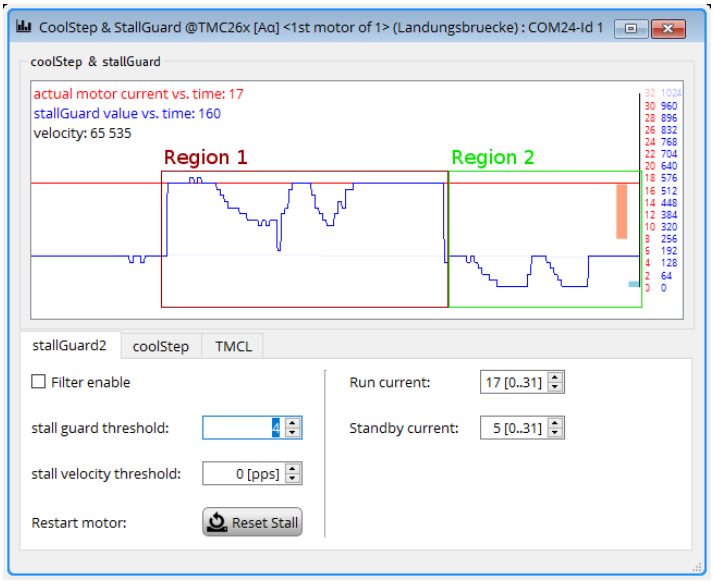

Figure 8: CoolStep™ & StallGuard2™ window

With optimal StallGuard2™ settings you can optionally activate CoolStep™.

3.4 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.

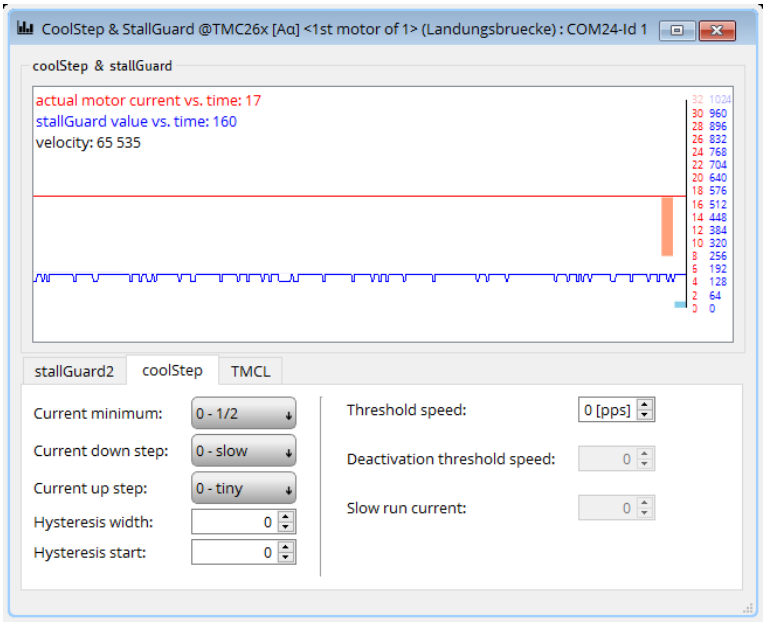

Figure 9: CoolStep™ & StallGuard2™ (or StallGuard4™) window

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.

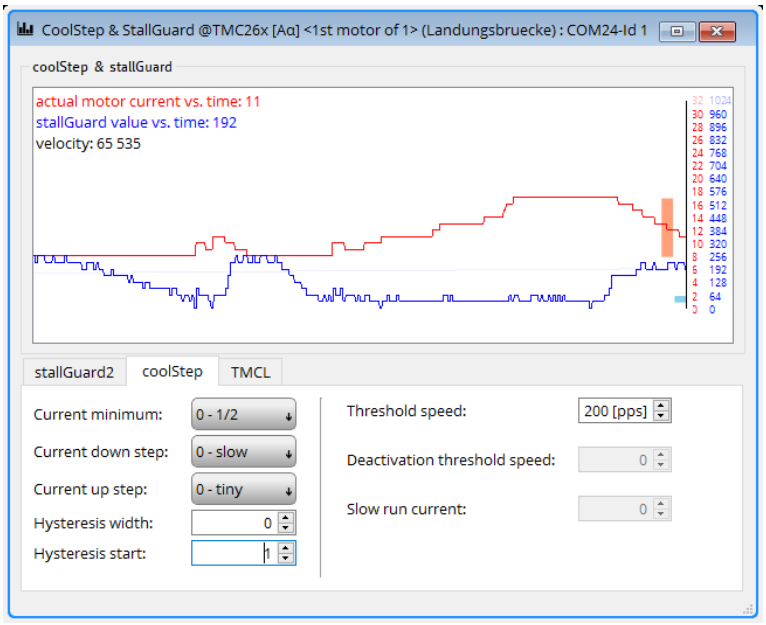

Figure 10: CoolStep™ & StallGuard2™ (or StallGuard4™) window

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 Revision History

4.1 Document Revision

Version	Date	Author	Description
1.00	2018-DEC-17	SK	Initial release.
1.01	2019-MAY-08	OM	Added sections for CoolStep™ and StallGuard™

Table 1: Document Revision