TMC5031-EVAL Evaluation Board

Document Revision V1.0 • 2020-OCT-02

The TMC5031-EVAL allows evaluation of the TMC5031-LA 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.

Features

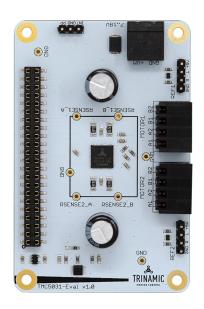
1.1A coil current

controller

SPI Interface

Guard2™

1...256 microsteps



Applications

- Battery operated equipment
- Printers, POS
- Miniature 3D Printers
- Toys
- Office and home automation
- CCTV, Security
- HVAC
- Mobile medical devices
- Lab automation

• Two 2-phase stepper motors up to

• Integrated **SixPoint**[™] ramp motion

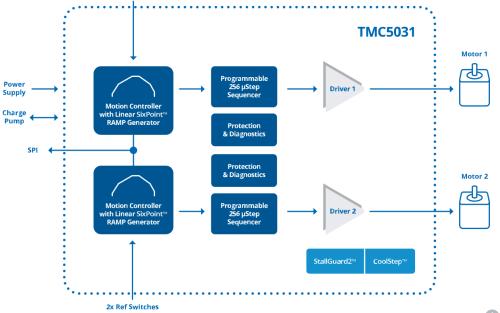
• Supply Voltage 7...18V DC

• 2x Ref.-Switch Inputs per axis

· Stall detection using sensorless Stall-

SpreadCycle[™] smart mixed decay





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1 Getting Started

You need

- TMC5031-EVAL
- Landungsbruecke or Startrampe with latest firmware (We recommend the Landungsbruecke as it offers faster USB communication.)
- Eselsbruecke bridge board
- 2x Stepper motor (e.g. QMot line)
- USB interface
- Power Supply
- Latest TMCL-IDE V3.0 and PC
- 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!

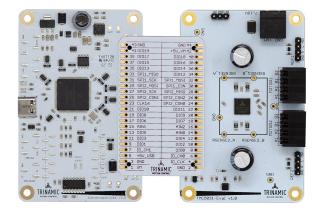


Figure 1: Getting started



1.1 First Start-Up

- 1. Make sure that the latest version of the TMCL-IDE 3.0 is installed. The TMCL-IDE can be downloaded from www.trinamic.com/support/software/tmcl-ide/.
- Open the TMCL-IDE and connect the Landungsbruecke 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 is using the latest firmware version. The firmware version is shown in the connected device tree.

🚴 TMCL-IDE 3.0					
<u>File Tools Options Views H</u> elp					
Connected devices ×					
Device					
✓ 🛶 USB					
🗸 🏹 COM6: USB port					
🗸 📥 ID1: Landungsbruecke [V 3.01]					
🖢 Direct mode					

Figure 2: Firmware Version

- 4. The TMCL-IDE 3.0 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.

-	: VC1-Id 1	📥 Landungsbruecke : VC1-Id 1 🔤
Board Assignment	Settings	Board Assignment Settings
Automated board	detection	Reset
	tomated detection of connected boards. Please ion board firmware up to date.	You can reset the board settings to defaults here. Form most Trinamic chips It's a matter of firmware to restore defaults.
Scanning.	Scan	Please note that the default settings are not neccessarily the chip reset settings. The default
		O Motion controller board only
Manual board ass	ignment	Power driver board only Reset boards to defaults
	boards manually. This is only recommended if ction fails somehow. Please keep the evaluation	Both
board firmware u	up to date. Choosing a wrong combination nexpected behaviour.	Driver Enable
Motion controlle	er Driver	Please disable drivers before plug/unplug a motor to a driver board. Otherwhise the driver may be damaged!
none	a none a	Enable drivers
Diagnostics		Diagnostics
	to be fine. Have Fun!	Diagnostics Everything seems to be fine. Have Fun!
	to be fine. Have Fun!	
Everything seems t	to be fine. Have Fun!	Everything seems to be fine. Have Fun!
Everything seems t		Everything seems to be fine. Have Funt
Everything seems t	0.0V on Controller): none	Everything seems to be fine. Have Funt Information Motor Supply: 0.0V

Figure 3: Landungsbruecke Dialogue

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2 Hardware Information

All design files for our evaluation boards are available for free. We offer the original ECAD files (Eagle, Altium, or PADS), Gerber data, the BOM, and PDF copies. 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 TMC5031-EVAL homepage.

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 TMC5031-LA data sheet. The register browser of the TMCL-IDE provides help-ful 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.

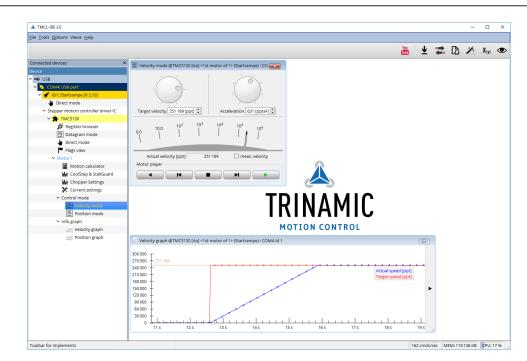


Figure 4: Driving the motor in velocity mode (TMCL-IDE provides similar view for TMC5031-EVAL)

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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.

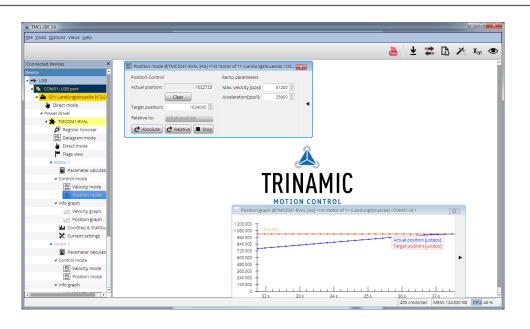


Figure 5: Driving the motor in position mode (TMCL-IDE provides similar view for TMC5031-EVAL)



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.

Parameter calculator @TMC26x: COM24-Id 1				
TMCL axis parameters		Motor parameters		
Velocity [pps]:	64000 🖨			
Acceleration [pps]:	65535 🜲	Full steps / rev.:	200 🗘	
Microsteps: 8 (2:	56x) 🔸			
Physical units				
Fullstep Frequency [pps]:	250.00000 🗘	Acceleration fullsteps [pps ²]:	255.99609 🜩	
Revolutions per sec.:	1.25000 🗘	Acceleration [RPS ²]:	1.27998 🔹	
Revolutions per minute:	75.00000 🗘	Acceleration [RPM/S]:	76.79883 🔹	
Time to reach velocity [s]:	0.97658			
Fullsteps to reach velocity:	122.07218			
Microsteps to reach velocity:	31250.47684			

Figure 6: 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.

actual motor current vs. time: 17 stallGuard value vs. time: 160 velocity: 65 535	32 102 30 960 28 892 26 832
Region 1	Region 2 24 768 22 704 20 640
stallGuard2 coolStep TMCL	
stallGuard2 coolStep TMCL	Run current: 17 [031] 🖨
stall guard threshold:	Standby current: 5 [031] 🗘
stall velocity threshold: 0 [pps] 보	
Restart motor:	

Figure 7: CoolStep™ & StallGuard2™ window

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

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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.

coolStep & stallGuard					
actual motor current vs. time: 17 stallGuard value vs. time: 160 velocity: 65 535					
stallGuard2 cools			12 64		
		יי איזער איי איי איי איי איי איי איי איי איי אי	12 64		
stallGuard2 cools	5tep TMCL				

Figure 8: 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.



coolStep & stallGuard					
actual motor current vs. time: 11 22 1021 stallGuard value vs. time: 192 30 960 velocity: 65 25 26 24 768 22					
122 704 135 76 14 448 10 320 12 64 10 320 12 128 12 64 10 320 5 15 12 128 2 64 10 320 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 10 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0 5 0					
Current minimum:	0 - 1/2	Threshold speed:	200 [pps] 🜲		
Current down step:	0 - slow 🕴	Deactivation threshold speed:	0		
Current up step:	0 - tiny +	Slow run current:	0		

Figure 9: 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 Stall-Guard4[™] 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
1.0	2020-OCT-02	LH	Initial release.

Table 1: Document Revision



Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Trinamic: TMC5031-EVAL-KIT