

TMC5241 Smart, High-Performance Stepper Motor Controller and Driver IC

General Description

The TMC5241-EVKIT is part of the ADI-Trinamic evaluation board system. The boards included in this kit, in combination with the TMCL-IDE, allow an uncomplicated first evaluation of the TMC5241, while also providing full control of all its features.

The TMC5241 is a smart, high-performance, stepper motor controller and driver IC with serial communication interfaces (SPI, UART) and extensive diagnostic capabilities. It combines a flexible, jerk-optimized ramp generator for automatic target positioning. It also features the industry's most advanced stepper motor driver based on a 256-microstep, built-in indexer and fully integrated 65V, 3.0A_{MAX} H-bridges plus nondissipative integrated current sensing (ICS).

Features

- 4.5V to 65V DC Single-Supply Voltage Range
- Current Ratings per H-Bridge (25°C, typ):
 - $I_{RMS} = 2A_{RMS}$ (2.8A sine peak) at $V_S = 24V$
 - $I_{RMS} = 1.7A_{RMS}$ (2.4A sine peak) at $V_S = 48V$
- SPI and Single-Wire UART
- Encoder Interface and 2x Reference Switch Input
- Brake Output

Table 1. TMC5241-EVKIT Contents

ITEM	DESCRIPTION
TMC5241-EVAL	TMC5241-EVAL Board
Landungsbruecke	PC Interface Board
Eselsbruecke	Bridge Connection Board

Documents Needed

- TMC5241 Data Sheet

Software Needed

- TMCL-IDE Evaluation Software

[Ordering Information](#) appears at end of user guide.

Getting Started

Required Items

- TMC5241-EVAL (included)
- Landungsbruecke board (included)
- Eselsbruecke board (included)
- A compatible motor (e.g., a Qmot stepper motor)
- Power supply
- Cables to interface the motor, encoders, and power supply
- Latest [TMCL-IDE](#)
- Latest firmware for [TMC-EvalSystem](#)

Precautions

- Do not exceed the board's maximum rated supply voltage.
- Do not connect or disconnect the motor while the board is powered.
- Make sure the used board, cables, and motor are in a good state before using them.
- Mind the used power supply voltage. Voltages greater than 50V are considered dangerous in some countries.
- Do not touch the power stage section of the board during operation as it might get hot.

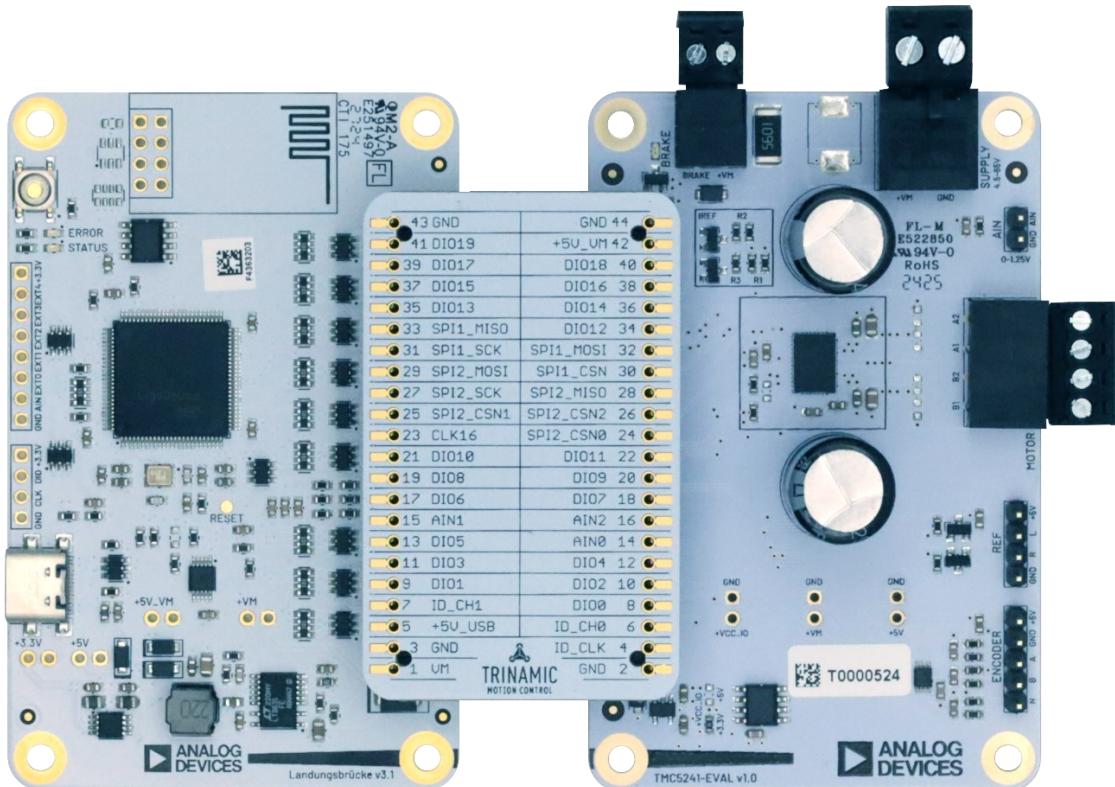


Figure 1. Assembled TMC5241-EVKIT

Connecting the Peripherals

1. Interface the TMC5241-EVAL with the Landungsbruecke through the Eselsbruecke bridge board as shown in [Figure 1](#). While connecting the boards together, both the Landungsbruecke and the TMC5241-EVAL must not be powered. Make sure that every pin in the connector is connected to its corresponding header. The working area is nonconductive to prevent the shorting of pins on the back side of the boards.
2. Plug the selected motor to connector J203, which is labelled as **MOTOR** on the board's silkscreen ([Figure 5](#)). Observe the correct order of the A1, A2, B1, and B2 motor phases.
3. (Optional) Plug the ABN encoder to pin header J204, which is labelled as **ENCODER** on the board's silkscreen ([Figure 5](#)).
4. Connect the Landungsbruecke board to the computer through a USB cable.
5. Plug the power supply cable to connector J202, which is labelled as **SUPPLY** on the board's silkscreen ([Figure 5](#)). Make sure the power supply is off before connecting it to the board and the polarity is correct.

Note: Voltages above 50V are considered dangerous in some countries. Keep the work area clean and do not touch the board while powered on. Keep in mind that the power stage section of the board can get hot during operation.

The board is now ready for the next steps. Continue with the following section, but do not turn on the power supply yet.

TMCL-IDE Quick Start

1. Make sure the latest version of the TMCL-IDE is installed on the computer; download the latest version from [TMCL-IDE](#). Open the IDE; the board is automatically detected and appears in the **Device** tree, as shown in [Figure 2](#). If the board is not automatically detected, manually select it by following the steps shown in [Figure 3](#).

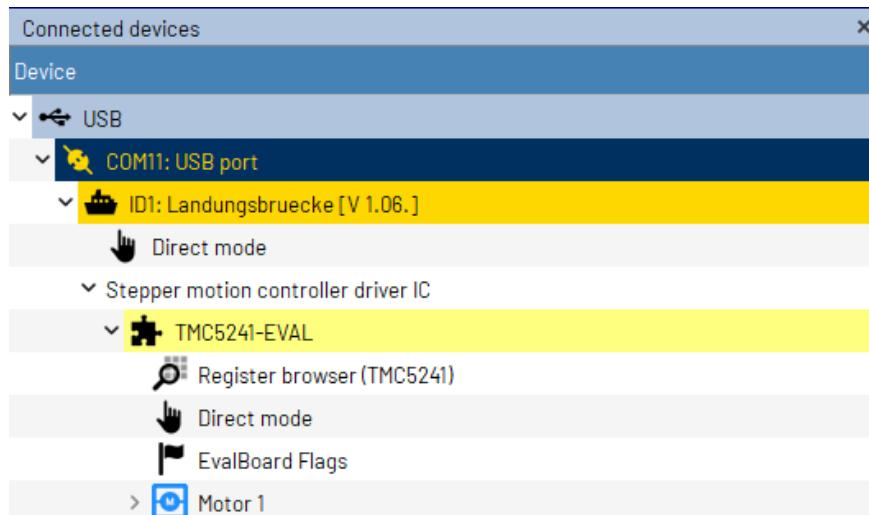


Figure 2. TMCL-IDE Device Tree

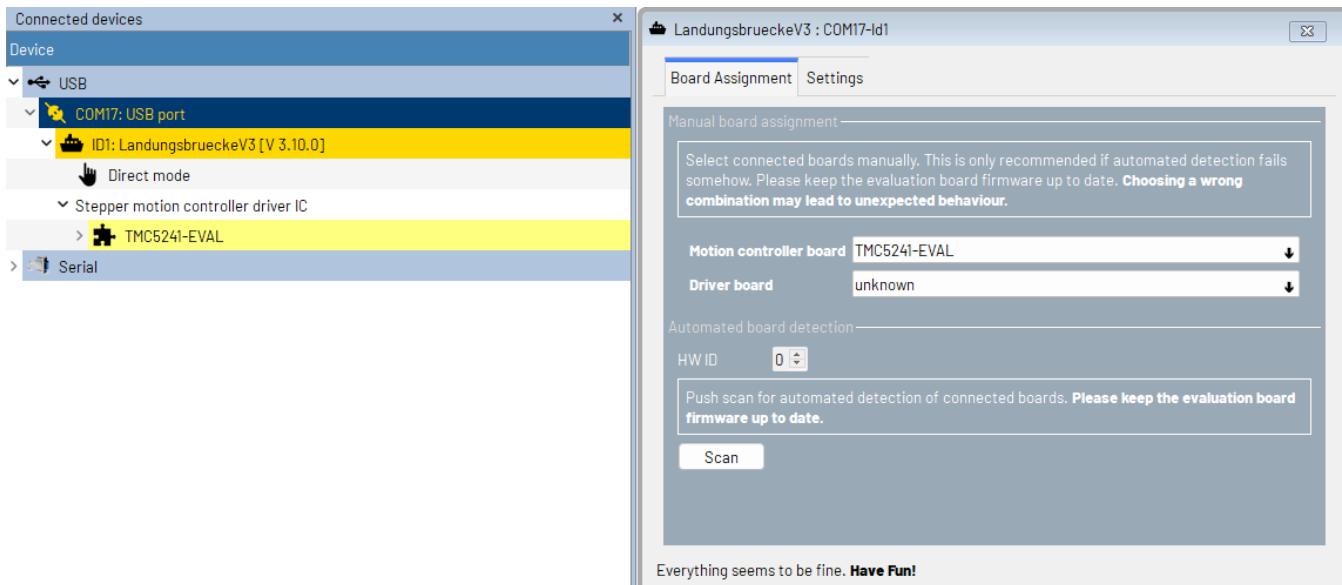


Figure 3. TMCL-IDE, Manual Selection of a Board

2. Turn on the power supply now.
3. A step-by-step guide to set up Stallguard2, StealthChop or μ Step is available. Click **Tools** on the menu bar, and select **Wizard Pool** as shown in [Figure 4](#). The wizard provides a simple guide to set up the TMC5241 with the connected motor.

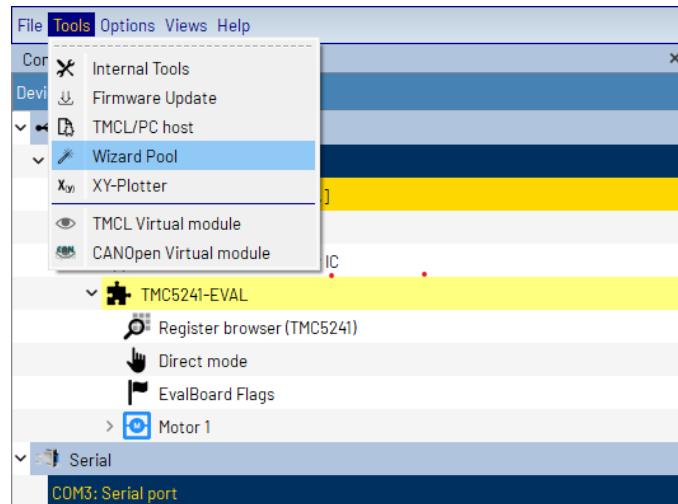


Figure 4. TMCL-IDE Wizard Pool Selection

4. Once the wizard launches, follow the steps provided.

For further instructions and clarifications on how to use the IDE, see the **TMCL-IDE Manual**, which can be accessed by clicking **Help** on the menu bar.

Detailed Description of Hardware

Download the above and use them as a reference alongside this section of the user guide. These files include a BOM, component placement drawings, schematics, and fabrication files.

Component Placement Drawing

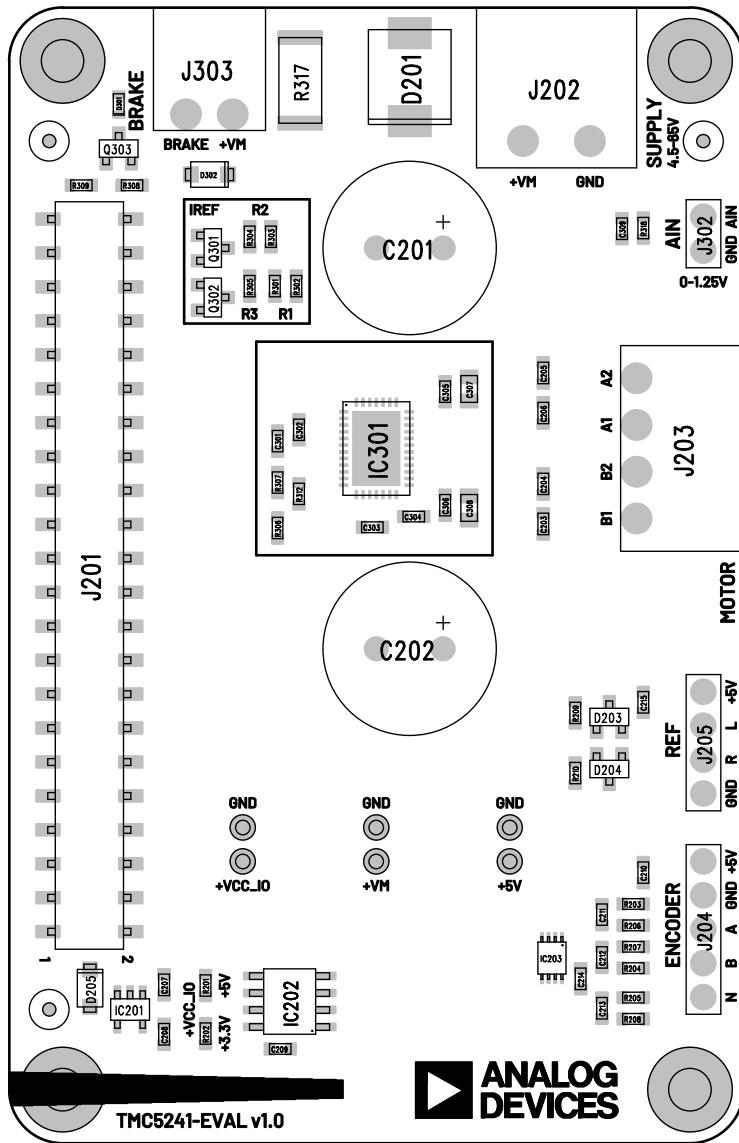


Figure 5. TMC5241-EVAL Component Placement and Silkscreen

Onboard Connectors and Pin Headers

The TMC5241-EVAL has one power, one motor connector, and three pin headers. These can be found in the component placement drawing in [Figure 5](#) and are described in detail in [Table 2](#).

Table 2. TMC5241-EVAL Available Connectors

REFERENCE DESIGNATOR	CONNECTOR TYPE	DESCRIPTION
J201	2.54mm female pin header 22x2 (W+P 46-3492-44-3-00-10-PPTR)	Main IO connector to interface with the Landungsbruecke through the Eselsbruecke bridge board. Figure 6 provides a detailed view of this connector.
J202	Terminal block 2 position (Molex 395221002)	Connector for the main power supply input.
J203	Terminal block 4 position (Molex 395221004)	Connector for the A1, A2, B1, and B2 phases of the motor.
J204	2.54mm pin header 5x1	Connector for the ABN encoder. This connector is always referenced to 5V and includes 4.7kΩ pull-up resistors on all its inputs. The input signals get translated into the appropriate IO level.
J205	2.54mm pin header 4x1	Connector for the reference switch inputs. This connector is referenced to VCC_IO and includes 4.7kΩ pull-up resistors on all its inputs.
J302	2.54mm pin header 5x1	Connector for general-purpose analog input signals. Input range 0 to 1.25V.
J303	Terminal block 2 position (Molex 395021002)	Connector for the brake. This connector is rated for up to 8A.

Additional Connectors

In addition to the connectors shown in [Table 2](#), some unpopulated THM test points are available in the TMC5241-EVAL. See the component placement drawing in [Figure 5](#). The additional connectors are described in [Table 3](#).

Table 3. TMC5241-EVAL Additional Connectors

REFERENCE DESIGNATOR	CONNECTOR TYPE	DESCRIPTION
PTH205 and PTH206	Unpopulated THM test point. These are placed 2.54mm apart from each other. So, a standard pin header can also be mounted.	Test points for the main supply voltage and ground. They are labeled +VM and GND on the board's silkscreen.
PTH207 and PTH208	Unpopulated THM test point. These are placed 2.54mm apart from each other. So, a standard pin header can also be mounted.	Test points for the 5V line and ground. They are labeled +5V and GND on the board's silkscreen.
PTH209 and PTH210	Unpopulated THM test point. These are placed 2.54mm apart from each other. So, a standard pin header can also be mounted.	Test points for the selected IO supply voltage and ground. They are labeled +VCC_IO and GND on the board's silkscreen.

Landungsbruecke Connector

[Figure 6](#) shows the Landungsbruecke connector section of the TMC5241-EVAL schematics. Level-shifted control signals are interfaced through the Landungsbruecke (e.g., the DRV_ENABLE, SLEEP, and CLK input pins). The UART and SPI communication signals are linked through this connector, too.

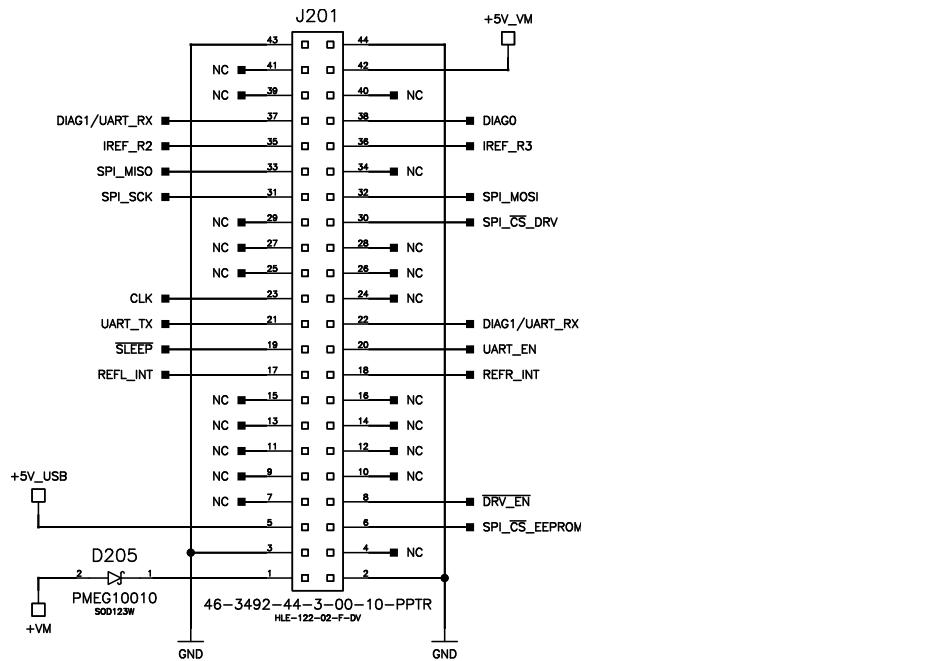


Figure 6. TMC5241-EVAL Schematics Detail of the Landungsbruecke Connector

Vccio Selection

The TMC5241-EVAL allows to select the input/output (IO) supply voltage as either 3.3V or 5V by mounting a 0Ω resistor on either R201 and R202. By default, the TMC5241-EVAL comes with R202 to supply 3.3V.

Note that using an IO supply voltage of 3.3V is mandatory when the Landungsbruecke board is used as the main controller. However, if an IO supply voltage of 5V is needed for a standalone operation without the Landungsbruecke, simply unmount R202 and mount it back at R201. For reference, see the schematics detail in [Figure 7](#) and the [TMC5241-EVAL design files](#).

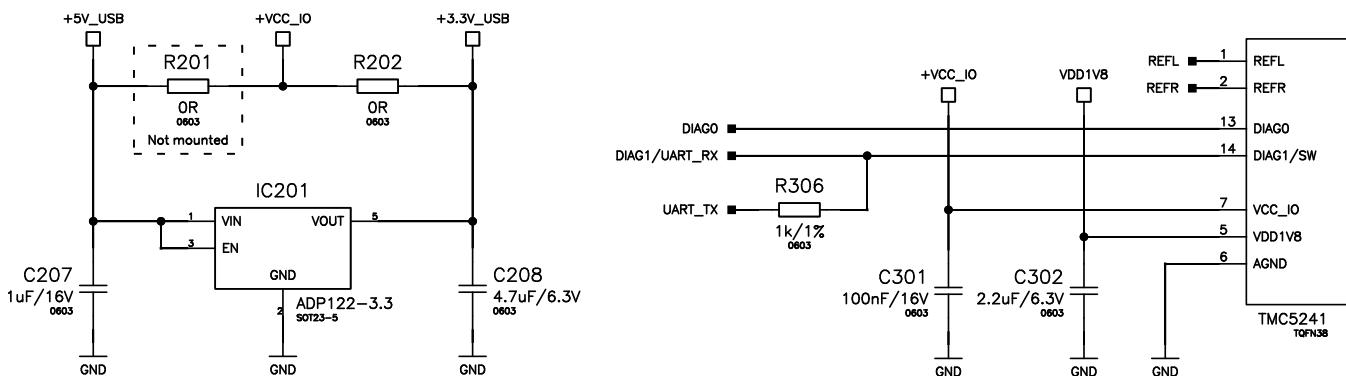


Figure 7. TMC5241-EVAL Schematics Detail of the IO Supply Circuit with Reduced Pin Count at TMC5241

Current Selection

The TMC5241 supports output current range selection through an external reference resistor. For solderless evaluation of this feature, a changeable resistor is present on TMC5241-EVAL. With two control signals from the Landungsbruecke connector, multiple resistors can be placed in parallel, like shown in [Figure 8](#).

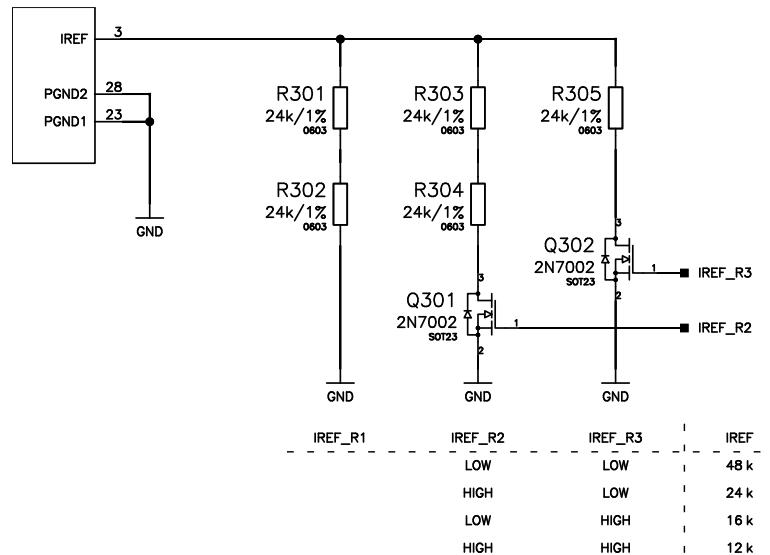


Figure 8. TMC5241-EVAL Reference Resistor Selection Circuit with Reduced Pin Count at TMC5241

Ordering Information

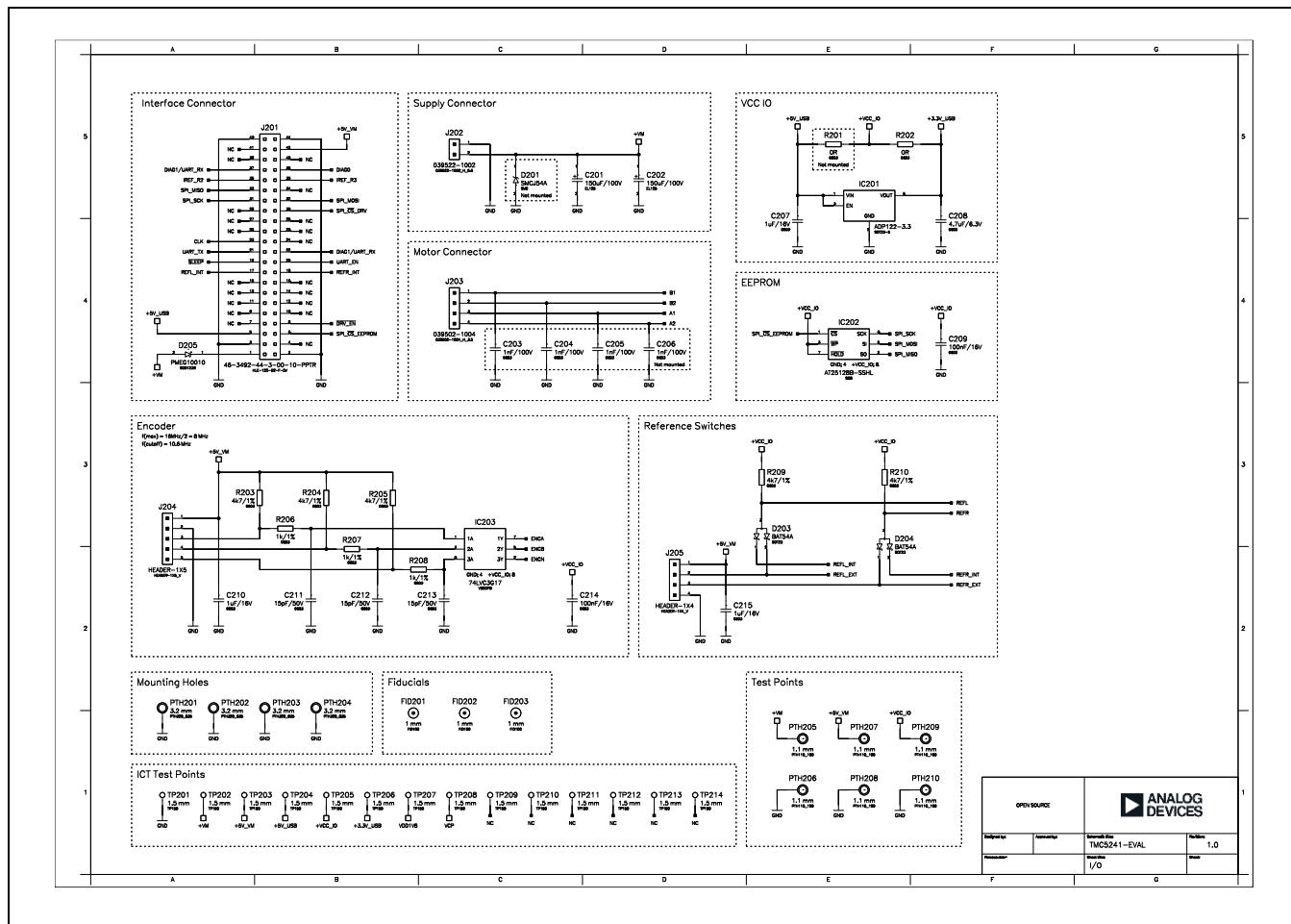
PART	TYPE
TMC5241-EVKIT	Evaluation Kit

#Denotes RoHS compliance.

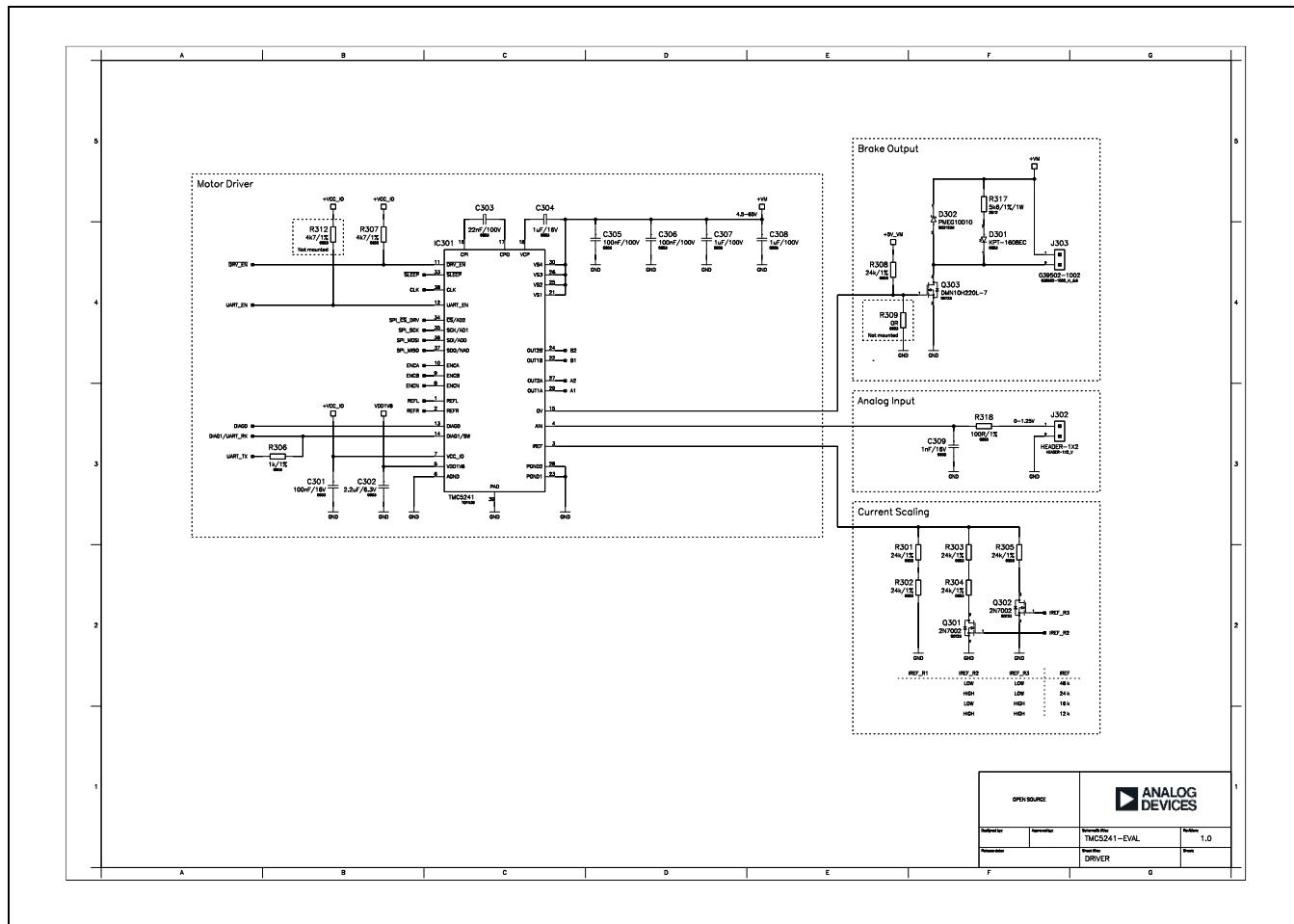
TMC5241-EVKIT Bill of Materials

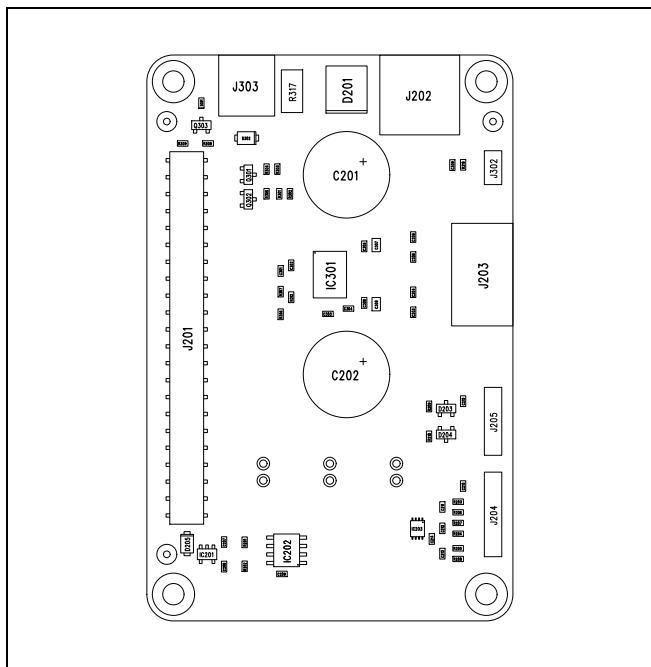
PART	QTY	PACKAGE	MANUFACTURER	MANUFACTURER PN
C201, C202	2	EL125	Panasonic	EEU-FS2A151
C203-C206	4	0603	Kemet	C0603C102K1RACTU
C207, C210, C215, C304	4	0603	Kemet	C0603C105K4RACTU
C208	1	0603	Samsung	CL10B475KQ8NQNC
C209, C214, C301	3	0603	Yageo	CC0603KRX7R7BB104
C211-C213	3	0603	Kemet	C0603C150K5GACTU
C302	1	0603	Yageo	CC0603KRX7R5BB225
C303	1	0603	Kemet	C0603C223K1RACTU
C305, C306	2	0603	Taiyo Yuden	HMK107B7104KA-T
C307, C308	2	0805	AVX	08051C105K4T2A
C309	1	0603	Yageo	CC0603KRX7R7BB102
D201	1	SMC	Bourns	SMCJ54A
D203, D204	2	SOT23	Diodes Incorporated	BAT54A-7-F
D205, D302	2	SOD123W	Nexperia	PMEG10010ELRX
D301	1	0603	Kingbright	KPT-1608EC
IC201	1	SOT23-5	Analog Devices	ADP122AUJZ-3.3-R7
IC202	1	SO8	Atmel	AT25128B-SSH
IC203	1	VSSOP8	Nexperia	74LVC3G17DC,125
IC301	1	TQFN38	Analog Devices	TMC5241ATU+
J201	1	HLE-122-02-F-DV	W+P	46-3492-44-3-00-10-PPTR
J202	1	039522-1002_H_5.0	Molex	395221002
J203	1	039502-1004_H_3.5	Molex	395021004
J204	1	HEADER-1X5_V	Würth	61300511121
J205	1	HEADER-1X4_V	Würth	61300411121
J302	1	HEADER-1X2_V	Würth	61300211121
J303	1	039502-1002_H_3.5	Molex	395021002
Connect to J202	1		Molex	395200002
Connect to J203	1		Molex	395000004
Connect to J303	1		Molex	395000002
Q301, Q302	2	SOT23	Nexperia	2N7002P,215
Q303	1	SOT23	Diodes Incorporated	DMN10H220L-7
R201, R309	2	0603	Panasonic	ERJ-3GEY0R00V
R202	1	0603	Panasonic	ERJ-3GEY0R00V
R203-R205, R209, R210, R307	6	0603	Panasonic	ERJ-3EKF4701V
R206-R208, R306	4	0603	Panasonic	ERJ-3EKF1001V
R301-R305, R308	6	0603	Panasonic	ERJ-3EKF2402V
R312	1	0603	Panasonic	ERJ-3EKF4701V
R317	1	2512	TE Connectivity	CRGCQ2512F5K6
R318	1	0603	Panasonic	ERJ-3EKF1000V

TMC5241-EVKIT Schematic

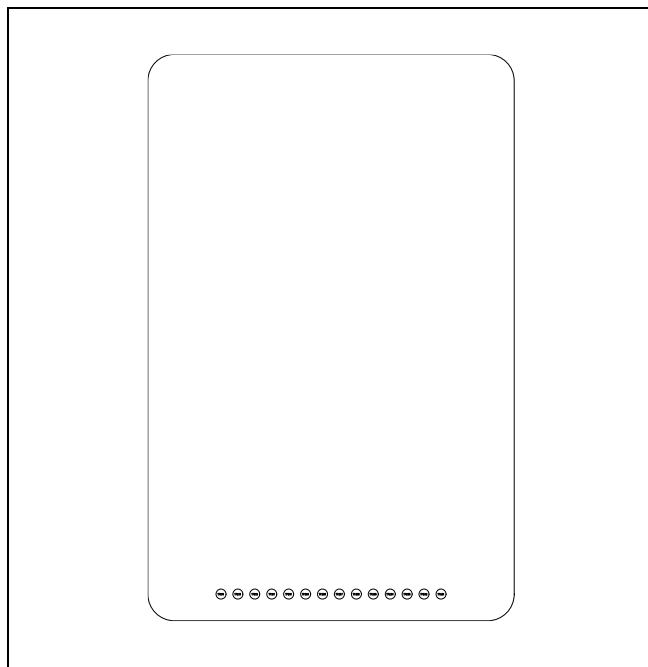


TMC5241-EVKIT Schematic (continued)



TMC5241-EVKIT PCB Layout

TMC5241-EVKIT Component Placement Guide—Top Silkscreen



TMC5241-EVKIT Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/25	Initial release	—

Notes

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