Evaluation Board User Guide

TMC5262-EVKIT

65V/4A_{RMS}+ Fully Integrated, Smart Stepper Motor Controller and Driver

General Description

The TMC5262-EVKIT is part of the TRINAMIC evaluation board system. The boards included in this kit, in combination with the TMCL-IDE, allow for an uncomplicated first evaluation of the TMC5262, while also providing full control of all its features.

The TMC5262 is a miniaturized, smart, high-power, single-axis stepper motor controller and driver IC with SPI and extensive diagnostic capabilities. Highest integration, high energy efficiency, and a small form factor enable miniaturized, scalable, and cost-effective motor drive solutions perfectly suited for Nema 17, Nema 23, and Nema 24 steppers.

StealthChop+ ensures noiseless operation and maximum efficiency, optimal motor torque control, and dampening of midrange motor resonances for a smoothly running motor with low mechanical vibrations. Combined with StallGuard+, CoolStep+, and µDcStep, this results in a highly efficient and versatile stepper motor driver. An unloaded Nema 17 motor automatically runs with as low as a few 10mA of supply current.

The TMC5262 combines a flexible, 8-point ramp generator for automatic positioning with a smart 256-microstep motor driver and two integrated 65V, 4.25A_{RMS}, 6A peak H-bridges plus nondissipative integrated current sensing (ICS). ICS eliminates bulky external sense resistors, resulting in space and power savings.

Abundant diagnostics include an on-chip scope interface for tuning and checking (RT-OCSI), temperature and voltage ADC, and a full set of protection functions such as short protection and thermal shutdown.

Features

- 4.5V to 65V DC Voltage Range
- Low $RDS_{(ON)}$ (HS+LS): 0.08Ω (typ) (T_A = 25°C)
- Current Ratings per H-Bridge (25°C, typ)
  - I_{RMS} = 4.25A_{RMS} (6A Full-Scale Sine Peak)
  - I_{MAX} = 9.0A (Bridge Peak Current)
- SPI for Configuration, Control, and Diagnostics
- Fully Integrated Lossless Current Sensing
- Eight-Point Motion Controller for Low Jerk
- Step and Direction Interface Option
- (Periodic) Position Compare Function
- Incremental Encoder and Reference Switch Input
- TriCoder Sensorless Standstill Steploss Detection and Full-Step Encoder
- Highest Resolution of 256 Microsteps
- Programmable Sine Wave Table to Match Motor
- StealthChop+ Silent and Smooth Motor Operation with Resonance Dampening
- SpreadCycle Highly Dynamic Motor Chopper
- StallGuard2, StallGuard+ Advanced Sensorless Load Detection
- CoolStep, CoolStep+ Current Control for Application Energy Savings up to 90%
- µDcStep Load Dependent Velocity Adaptation
- Integrated Motor Coil Resistance Measurement
- Passive Braking and Freewheeling Mode
- Chip Temperature and Supply Voltage Measurement
- Full Protection and Diagnostics
- Real-Time On-Chip Scope Interface (RT-OCSI)
- Overvoltage Protection Output

Table 1. TMC5262-EVKIT Contents

ITEM	DESCRIPTION
TMC5262-EVAL	TMC5262 Evaluation Board
Landungsbruecke	PC Interface Board
Eselsbruecke	Bridge Connection Board

***Ordering Information* appears at end of user guide.**

319-101146; Rev 1; 2/26

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Getting Started

Required Items

- TMC5262-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 the 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 that 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.

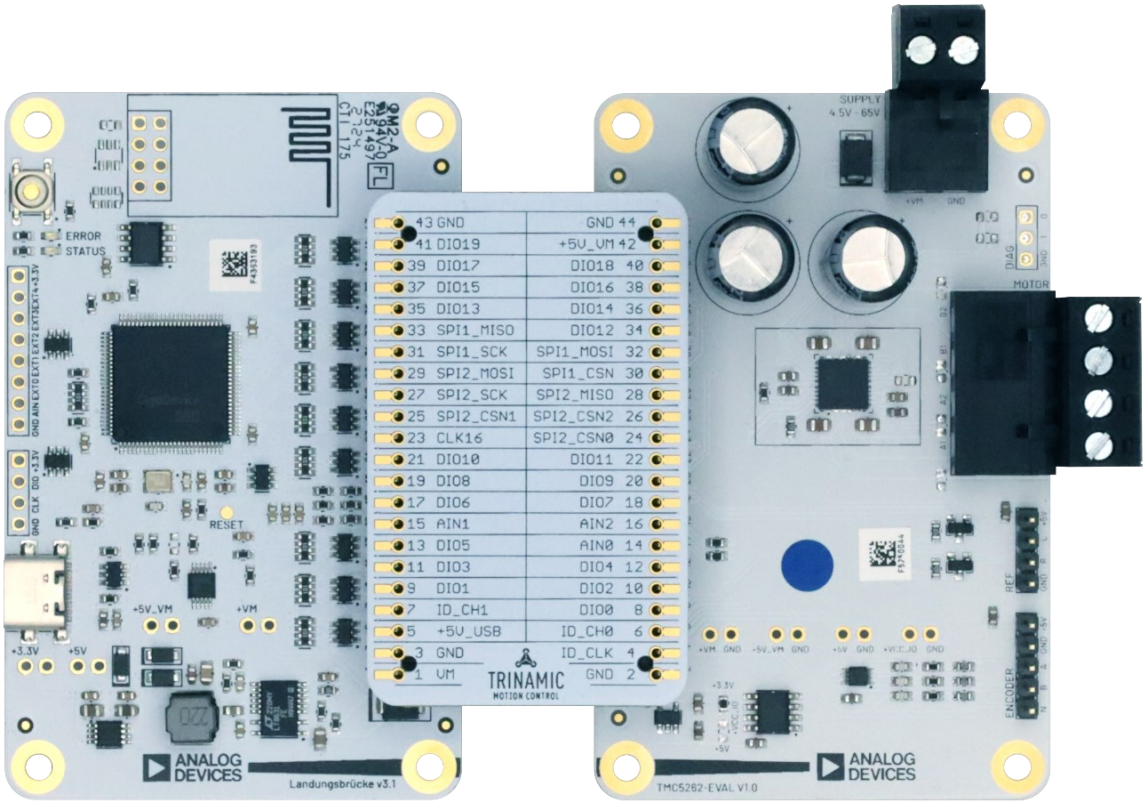


Figure 1. Assembled TMC5262-EVKIT

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Connecting the Peripherals

1. Interface the TMC5262-EVAL with the Landungsbruecke through the Eselsbruecke bridge board as shown in *Figure 1*. While connecting the boards, both the Landungsbruecke and the TMC5262-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 shorting of pins on the backside 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 to proceed to 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. The latest version can be downloaded from *TMCL-IDE*. Open the IDE, the board should be automatically detected, and it should appear 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*.

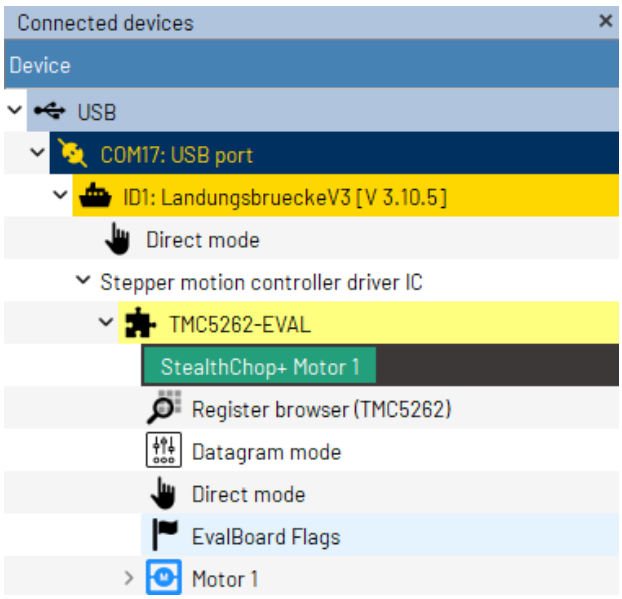


Figure 2. TMCL-IDE Device Tree

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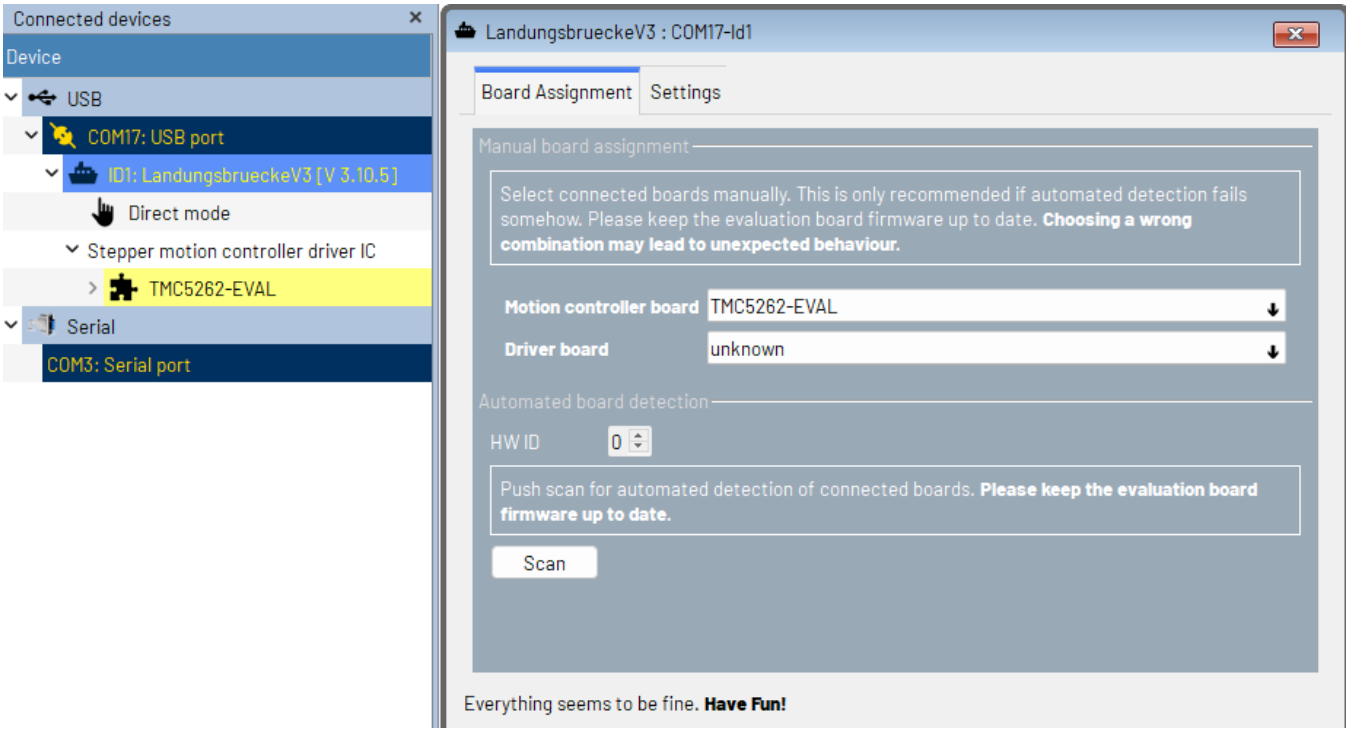


Figure 3. TMCL-IDE, Manual Selection of a Board

2. Turn on the power supply now.
3. A quick start guide to set up Stallguard2, StealthChop or µStep is available. Click the entry as shown in *Figure 4*. The wizard provides an uncomplicated guide to set up the TMC5262 with the connected motor.

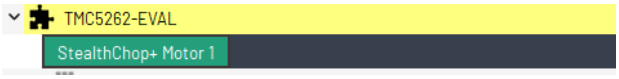


Figure 4. TMCL-IDE Wizard Pool Selection

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.

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Detailed Description of Hardware

Download the TMC5262-EVAL design files (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

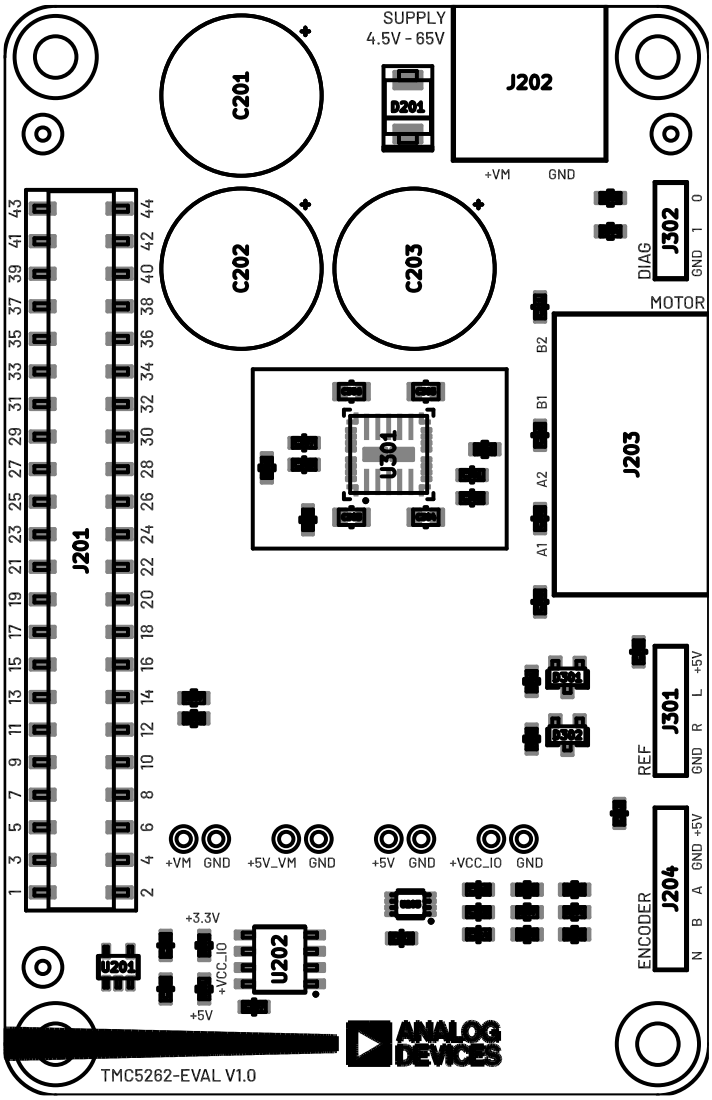


Figure 5. TMC5262-EVAL Component Placement and Silkscreen

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Onboard Connectors and Pin Headers

The TMC5262-EVAL has one power, and 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. TMC5262-EVAL Available Connectors

REFERENCE DESIGNATOR	CONNECTOR TYPE	DESCRIPTION
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.
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. A detailed view of this connector is given in *Figure 6*.
J301	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.
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.
J302	2.54mm pin header 3x1	Connector for DIAG output.

Additional Connectors

In addition to the connectors shown in *Table 2,* some unpopulated THM test points are available in the TMC5262-EVAL. See the component placement drawing in *Figure 5*. The additional connectors are described in *Table 3*.

Table 3. TMC5262-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 could also be mounted.	Test points for the main supply voltage and ground. They are labeled as +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 could also be mounted.	Test points for the 5V_VM line and ground. They are labeled as +5V_VM 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 could also be mounted.	Test points for the 5V line and ground. They are labeled as +5V and GND on the board's silkscreen.
PTH211 and PTH212	Unpopulated THM test point. These are placed 2.54mm apart from each other, so a standard pin header could also be mounted.	Test points for the selected IO supply voltage and ground. They are labeled as +VCC_IO and GND on the board's silkscreen.

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Landungsbruecke Connector

The Landungsbruecke connector section of the TMC5262-EVAL schematics is shown in *Figure 6*. Level-shifted control signals are interfaced through the Landungsbruecke, (e.g., the nDRV_EN, nSLEEP, and CLK input pins). The UART and SPI communication signals are linked through this connector, too.

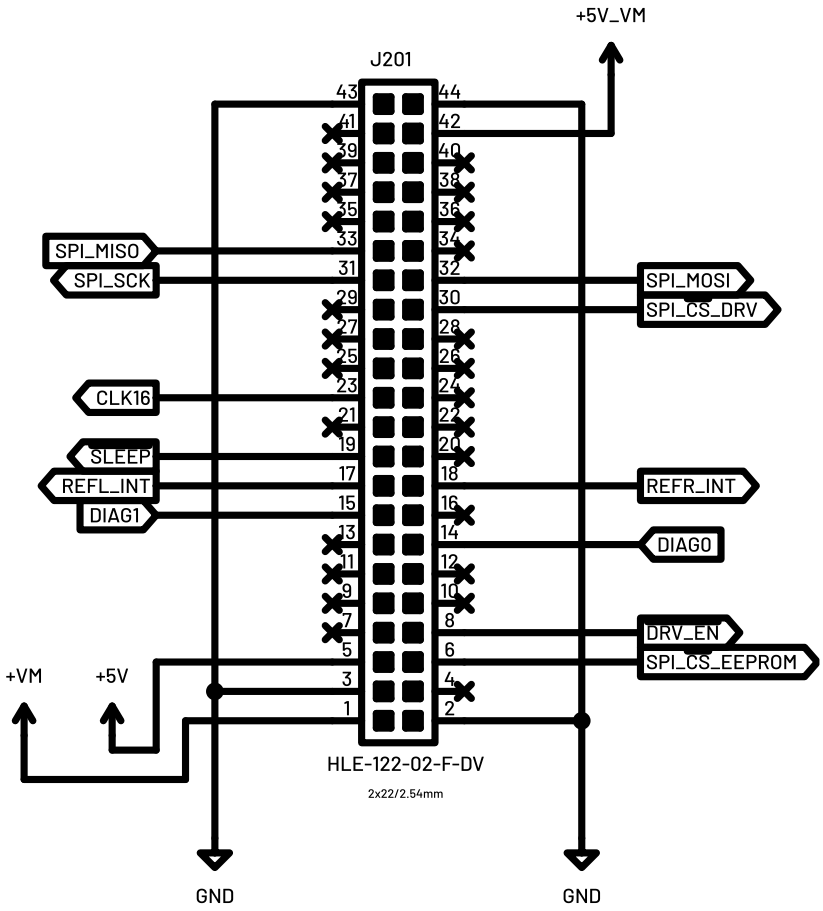


Figure 6. TMC5262-EVAL Schematics Detail of the Landungsbruecke Connector

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V_{CCIO} Selection

The TMC5262-EVAL includes the ability to select the input/output (IO) supply voltage to either 3.3V or 5V, which is accomplished by mounting a 0Ω resistor on R201 or R202. By default, the TMC5262-EVAL R202 is connected to the 3.3V supply.

Using a 3.3V IO supply voltage is required when the Landungsbruecke board is employed as the main controller. However, if a 5V IO supply voltage is needed for a standalone operation without the Landungsbruecke, simply unmount R202 and mount it back at R201. For reference, see *Figure 7* and the TMC5241-EVAL design files.

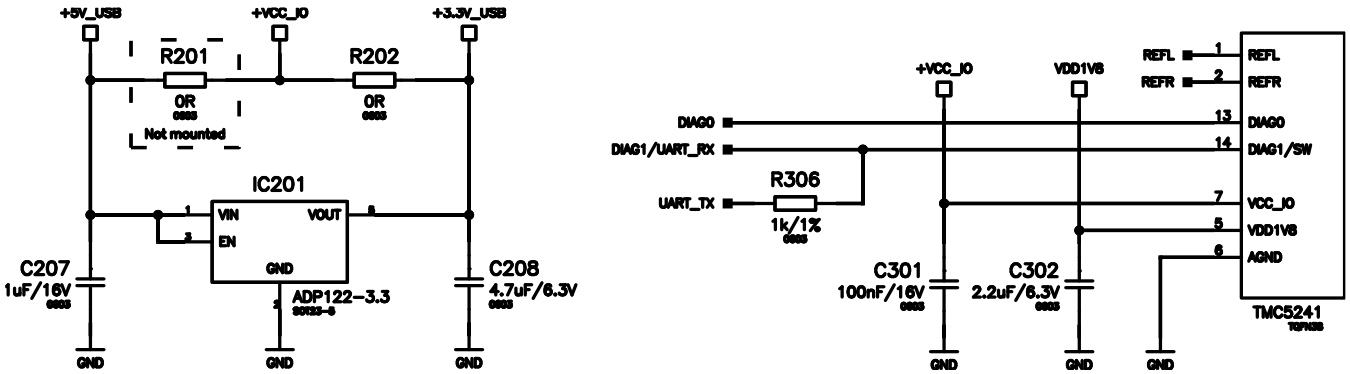


Figure 7. TMC5262-EVAL Schematics Detail of the IO Supply Circuit with a Reduced Pin Count at TMC5262

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Ordering Information

PART	TYPE
TMC5262-EVKIT	Evaluation Kit

#Denotes RoHS compliance.

TMC5262-EVKIT Bill of Materials

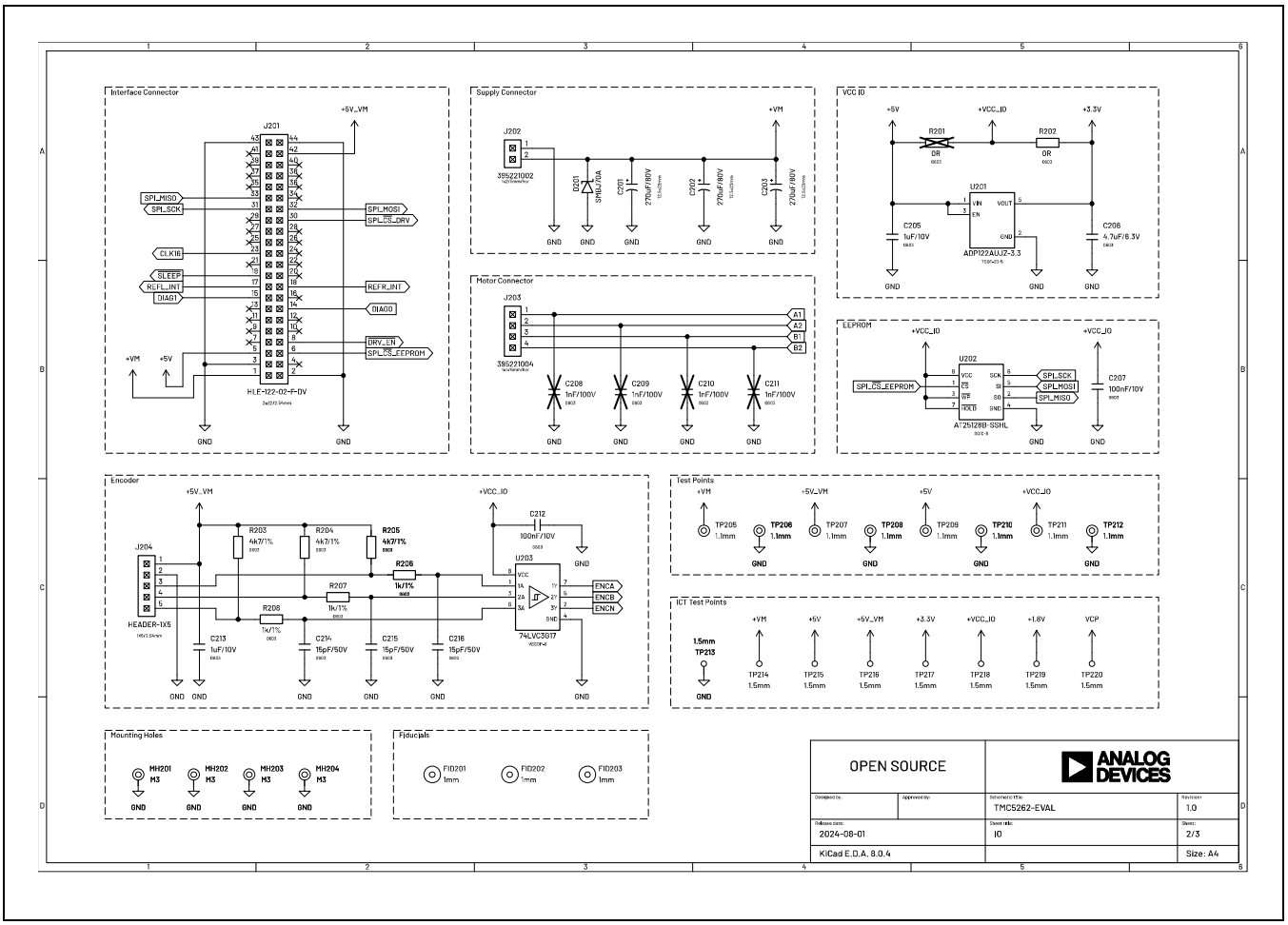
QTY	PART	PACKAGE	MANUFACTURER	MANUFACTURER PN
3	C201, C202, C203	CAP+,270UF,20%,80V,ALUM,TH	PANASONIC CORP	EEU-FS1K271LB
4	C205, C213, C302, C308	CAP+,1UF,10%,10V,X5R,0603	AVX Corporation	0603ZD105KAT2A
1	C206	CAP+,4.7UF,10%,6.3V,X7R,0603	SAMSUNG GROUP	CL10B475KQ8NQNC
3	C207, C212, C307	CAP+,100NF,10%,10V,X7R,0603	KEMET CORPORATION	C0603C104K8RACAUTO
3	C214, C215, C216	CAP+,15PF,5%,50V,C0G/NP0,0603	AVX Corporation	06035A150KAT2A
1	C301	CAP+,22NF,10%,100V,X7R,0603	KEMET CORPORATION	C0603C223K1RACTU
4	C303, C304, C305, C306	CAP+,1UF,10%,100V,X7R,0805	AVX Corporation	08051C105K4T2A
1	C309	CAP+,2.2UF,10%,6.3V,X7R,0603	YAGEO CORPORATION	CC0603KRX7R5BB225
1	D201	TVS#,113V,5.3A,DO-214AA	DIODES INCORPORATED	SMBJ70A-13-F
2	D301, D302	SCHTY+,ARY2,COM AND,30V,0.2A,SOT-23-3	DIODES INCORPORATED	BAT54A-7-F
1	J201	RCPT+,VERT,SHRD,44P,2R,2.54MM,SMD	W+P PRODUCTS GMBH	3492-44-3-00-10-PPTR
1	J202	HEADR+,R/A,SHRD,2POS,5.0MM,TH	MOLEX LLC	395221002
1	J203	HEADR+,R/A,SHRD,4POS,5MM,TH	MOLEX LLC	395221004
1	J204	HEADR+,VERT,5POS,2.54MM,TH	BINDER GROUP	087-1-005-S-XS0-1260
1	J301	HEADR+,VERT,4POS,2.54MM,TH	BINDER GROUP	087-1-004-0-S-XS0-1260
3	R202, R306, R307	RES#,0 OHM,0.1W,0603	ASJ COMPONENTS	CR16-000-ZL
6	R203, R204, R205, R301, R302, R303	RES#,4.7K OHM,1%,0.1W,0603,AUTO	PANASONIC CORP	ERJ-3EKF4701V
3	R206, R207, R208	RES#,1K OHM,1%,0.1W,0603,AUTO	TT ELECTRONICS PLC	ASC0603-1K0FT5
1	R308	RES#,12K OHM,1%,0.1W,0603	ASJ COMPONENTS	CR16-1202-FK

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1	U201	VREG+,LIN,FIX,3.3V,0.3A,TSOT-23-5	ANALOG DEVICES INC.	ADP122AUJZ-3.3-R7
1	U202	EEPROM+,128Kb,SPI,20MHZ,SO-8	MICROCHIP TECHNOLOGY INC.	AT25128B-SSHL-B
1	U203	BUFFR+,74LVC,NNVRT,5.5V,PSHPUL,3,VSSOP-8	NEXPERIA	74LVC3G17DC,125
1	U301	MTR CTRL+,STEP,4.5V-65V,SPI,FCQFN-30	ANALOG DEVICES INC.	TMC5262AFV+
1	Plug for J202	PLUG#,VERT,SCREW,2POS,5MM	MOLEX	395200002
1	Plug for J203	PLUG#,VERT,SCREW,4POS,5MM	MOLEX	395200004
4	C208, C209, C210, C211	CAP+,1NF,10%,100V,X7R,0603 (DO NOT MOUNT)	KEMET CORPORATION	C0603C102K1RACTU
1	J302	HEADR+,VERT,3POS,2.54MM,TH (DO NOT MOUNT)	WURTH ELECTRONIK GROUP	61300311121
2	R201, R311	RES#,0 OHM,0.1W,0603 (DO NOT MOUNT)	ASJ COMPONENTS	CR16-000-ZL
2	R304, R305	RES#,4.7K OHM,1%,0.1W,0603,AUTO (DO NOT MOUNT)	PANASONIC CORP	ERJ-3EKF4701V

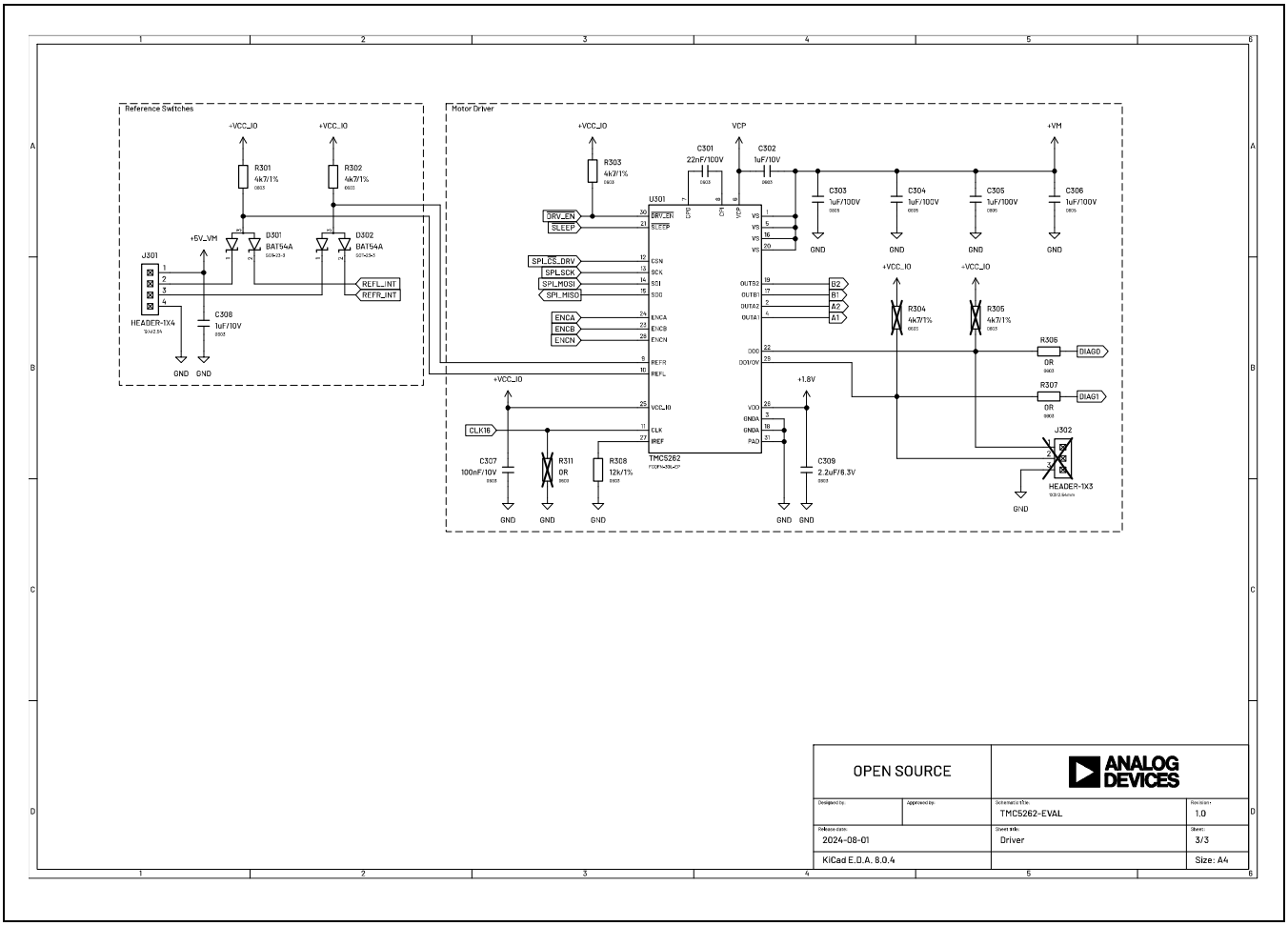
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TMC5262-EVKIT Schematic



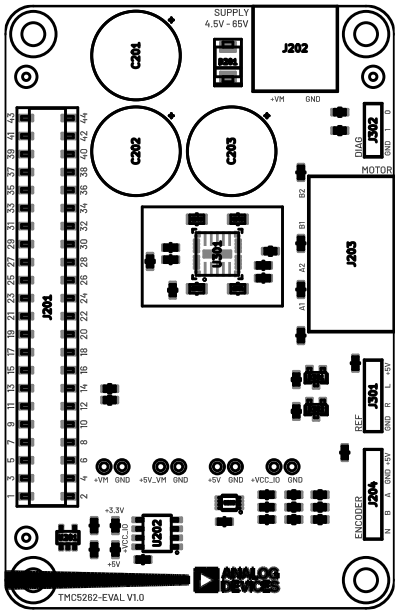
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TMC5262-EVKIT Schematic (continued)

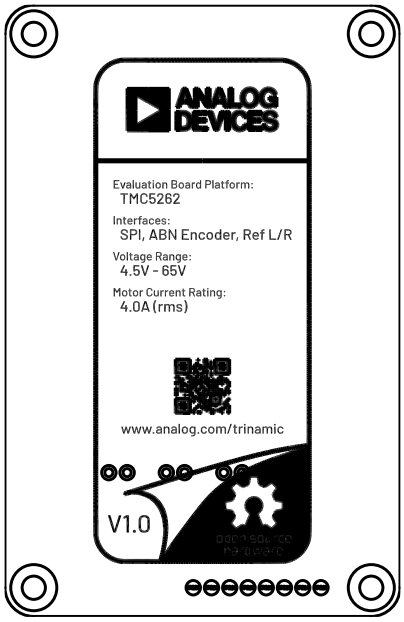


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TMC5262-EVKIT PCB Layout



TMC5262-EVKIT Component Placement Guide—Top Silkscreen



TMC5262-EVKIT Component Placement Guide—Bottom Silkscreen

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/25	Initial release	—
1	2/26	Updated part to TMC5262-EVAL throughout doucment Corrected orderable part number to TMC5262-EVKIT Corrected reference to design files download in Detailed Description of Hardware	1, 2, 5–8 2, 9, 11–13 5

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Notes

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