Evaluation Board User Guide

TMC2262-EVKIT

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

General Description

The TMC2262-EVKIT is part of the TRINAMIC evaluation board system. The boards included in this kit, in combination with the TMCL-IDE, allow for easy first evaluation of the TMC2262, while also providing full control of all its features.

The TMC2262 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 TMC2262 combines 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
- Step and Direction Interface
- Incremental Encoder
- 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 and CoolStep+ Current Control for Application Energy Savings up to 90%
- µDcStep Load Dependent Velocity Adaptation
- 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. TMC2262-EVKIT Contents

ITEM	DESCRIPTION
TMC2262-EVAL	TMC2262 Evaluation Board
Landungsbruecke	PC Interface Board
Eselsbruecke	Bridge Connection Board

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

319-101165; Rev 0; 5/26

One Analog Way, Wilmington, MA 01887-2356, U.S.A. | Tel: 781.329.4700

Getting Started

Required Items

- TMC2262-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.
- Ensure to use the appropiate protection while working with high voltages. In some countries, voltages higher than 50V are considered dangerous.
- Do not touch the power stage section of the board during operation as it can get hot.

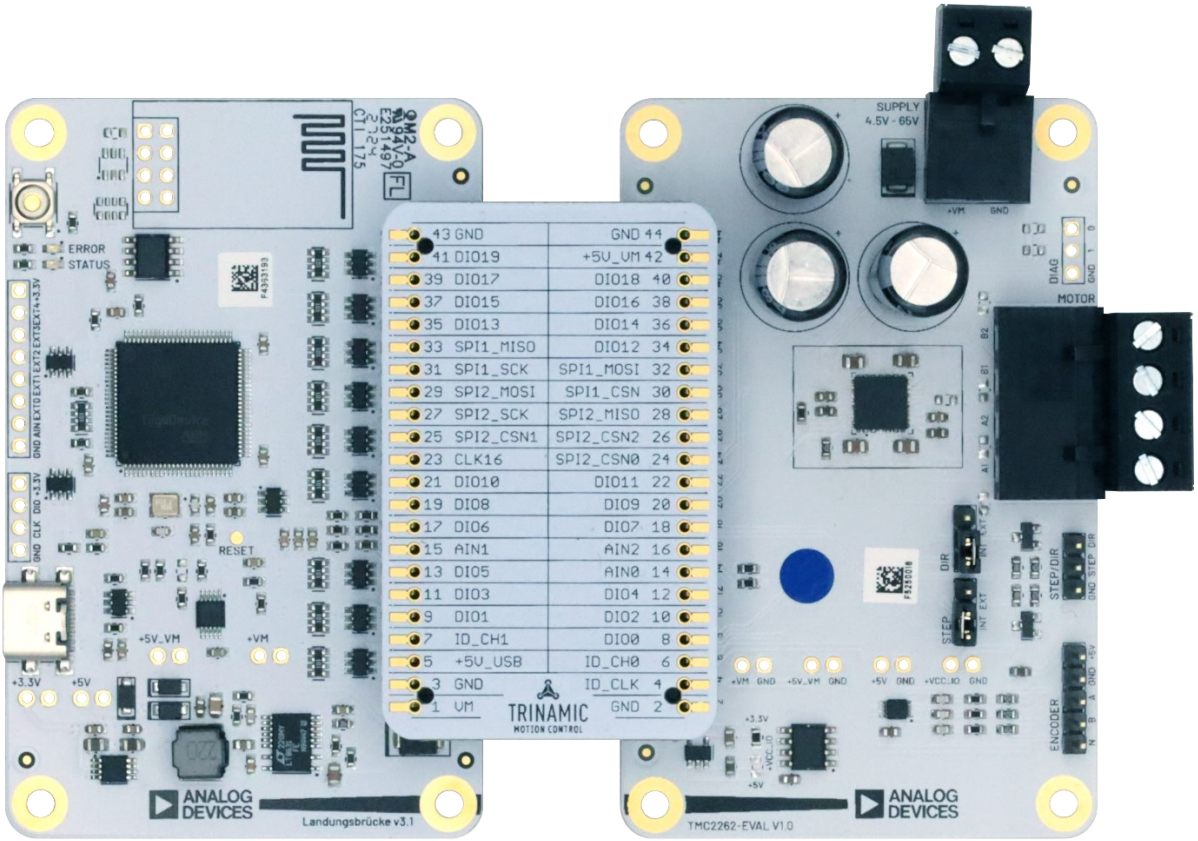


Figure 1. Assembled TMC2262-EVKIT

Connecting the Peripherals

1. Interface the TMC2262-EVAL with the Landungsbruecke through the Eselsbruecke bridge board as shown in *Figure 1*. While connecting the boards, both the Landungsbruecke and the TMC2262-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*). Ensure the polarity is correct, and check the power supply is off before connecting it to the board.

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 is detected automatically, and it appears in the *Device* tree, as shown in *Figure 2*. If the board is not automatically detected, select it manually by following the steps shown in *Figure 3*.

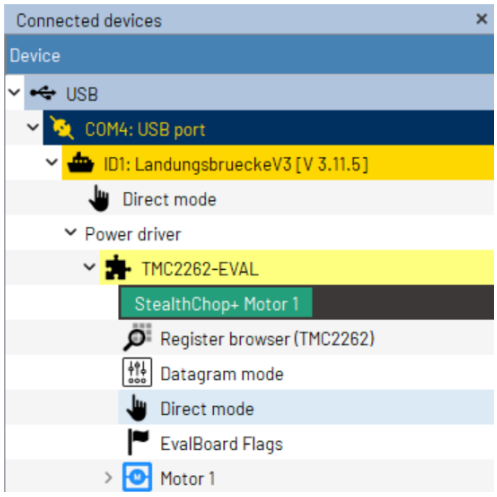


Figure 2. TMCL-IDE Device Tree

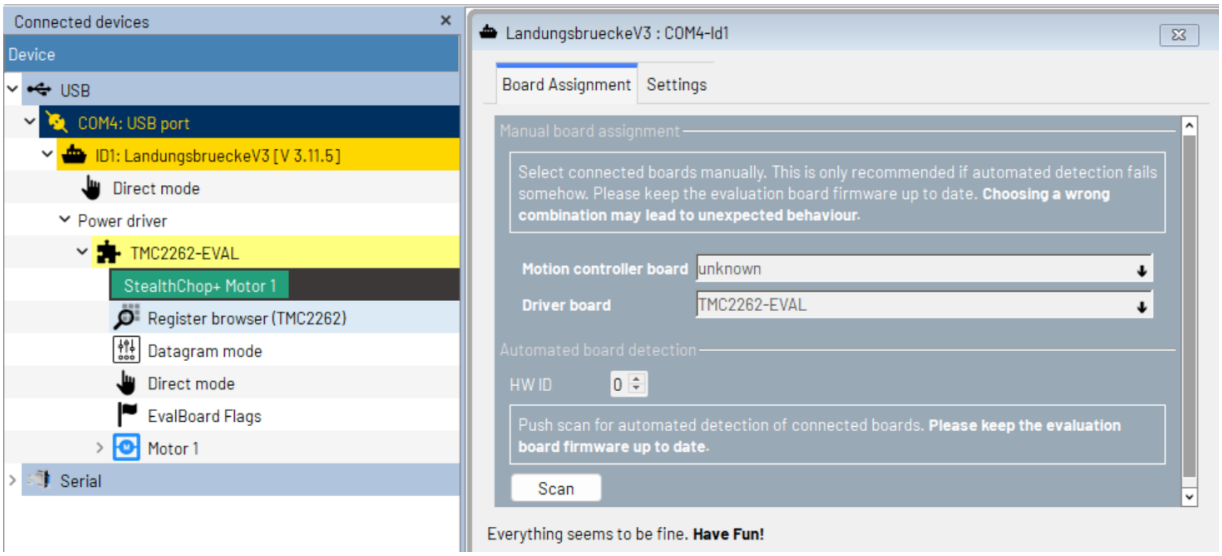


Figure 3. TMCL-IDE, Manual Selection of a Board

2. Turn on the power supply.
3. A quick start guide to set up basic motor parameters, StealthChop+ and CoolStep+ is available. Click the entry as shown in *Figure 4*. The wizard provides an easy guide to set up the TMC2262 with the connected motor.

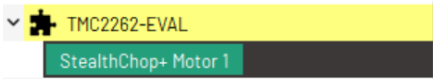


Figure 4. TMCL-IDE Wizard Pool Selection

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

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

Detailed Description of Hardware

Download the TMC2262-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

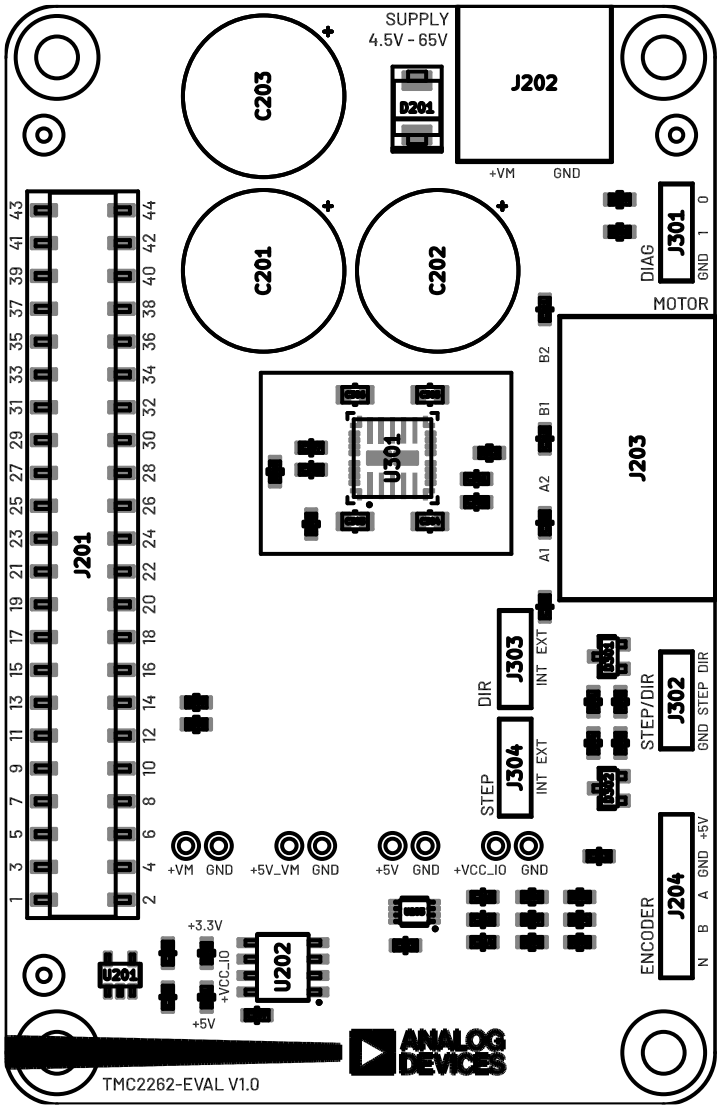


Figure 5. TMC2262-EVAL Component Placement and Silkscreen

Onboard Connectors and Pin Headers

The TMC2262-EVAL has one power, one motor connector, and five pin headers. These can be found in the component placement drawing in *Figure 5* and are described in detail in *Table 2*.

Table 2. TMC2262-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. A detailed view of this connector is given in *Figure 6*.
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.
J301	2.54mm pin header 3x1	Connector for DIAG output.
J302	2.54mm pin header 3x1	Connector for the external STEP/DIRECTION input. This connector is referenced to VCC_IO and includes 4.7kΩ pull-down resistors on all its inputs.
J303	2.54mm pin header 3x1	Jumper selection for DIRECTION input between INTERNAL (Landungsbruecke Connector) and EXTERNAL (J302)
J304	2.54mm pin header 3x1	Jumper selection for STEP input between INTERNAL (Landungsbruecke Connector) and EXTERNAL (J302)

Additional Connectors

In addition to the connectors shown in *Table 2,* some unpopulated THM test points are available in the TMC2262-EVAL. See the component placement drawing in *Figure 5*. The additional connectors are described in *Table 3*.

Table 3. TMC2262-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.

Landungsbruecke Connector

The Landungsbruecke connector section of the TMC2262-EVAL schematics is shown in *Figure 6*. Control signals are interfaced through the Landungsbruecke, (e.g., the nDRV_EN, nSLEEP, and CLK input pins). The SPI communication signals are linked through this connector, too.

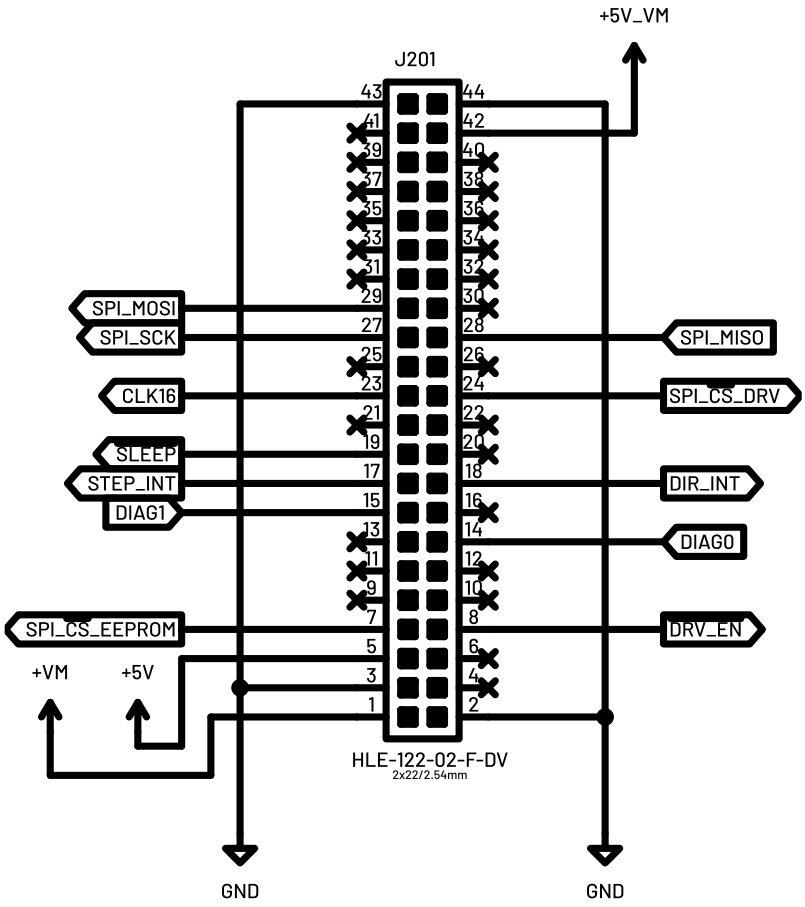


Figure 6. TMC2262-EVAL Schematics Detail of the Landungsbruecke Connector

V_{CCIO} Selection

The TMC2262-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 TMC2262-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 board, simply unmount R202 and mount it back at R201. For reference, see *Figure 7* and the TMC2262-EVAL design files.

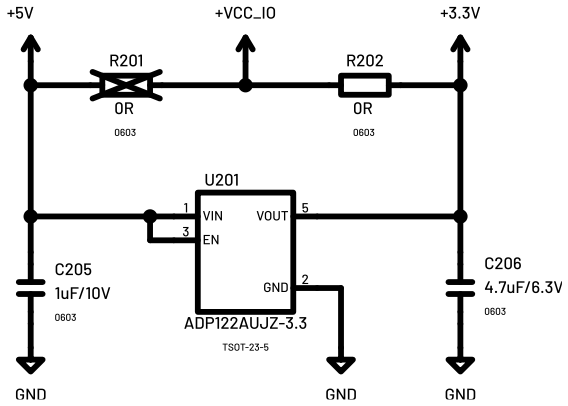


Figure 7. TMC2262-EVAL Schematics Detail of the IO Supply Circuit

Ordering Information

PART	TYPE
TMC2262-EVKIT	Evaluation Kit

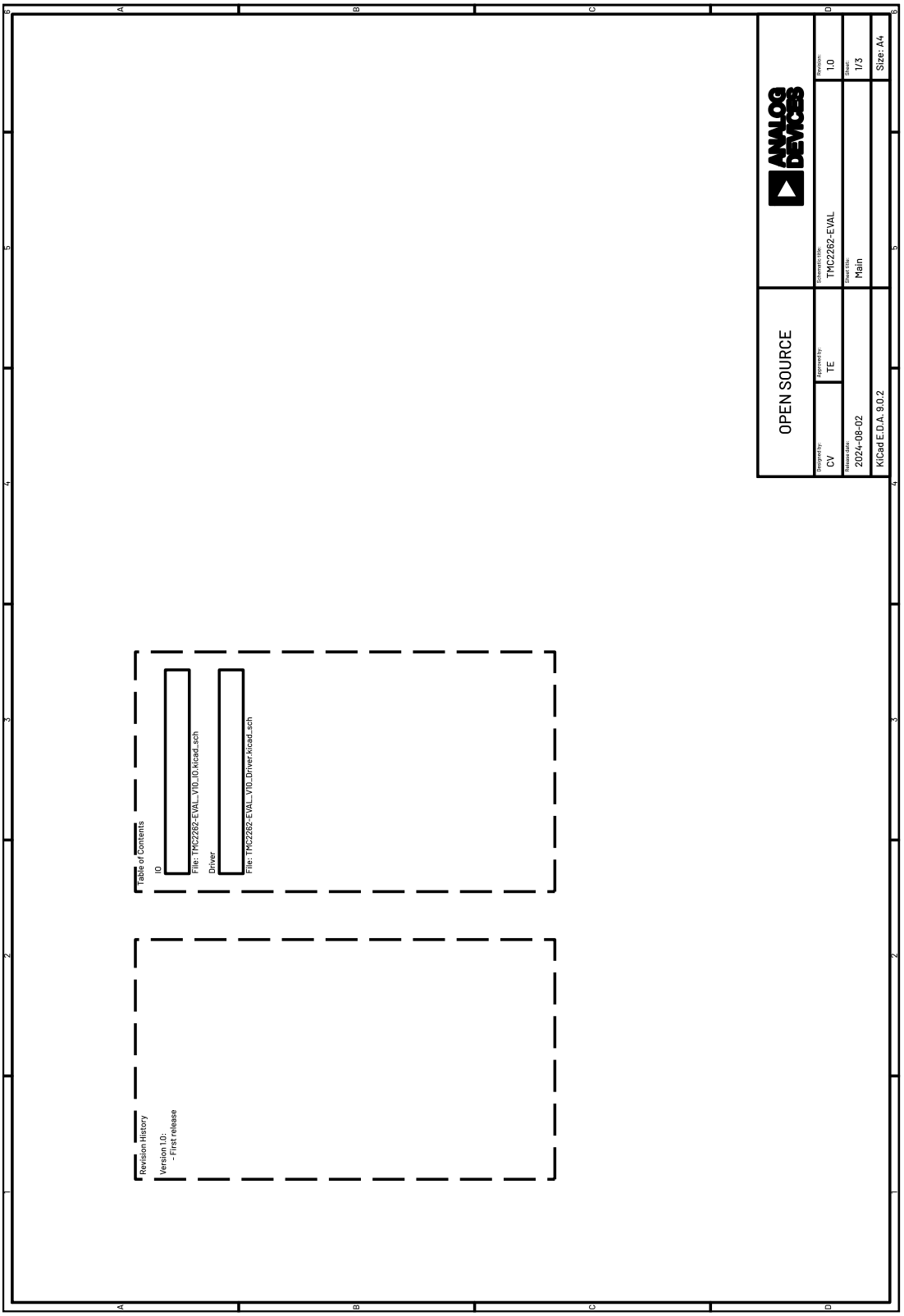
#Denotes RoHS compliance.

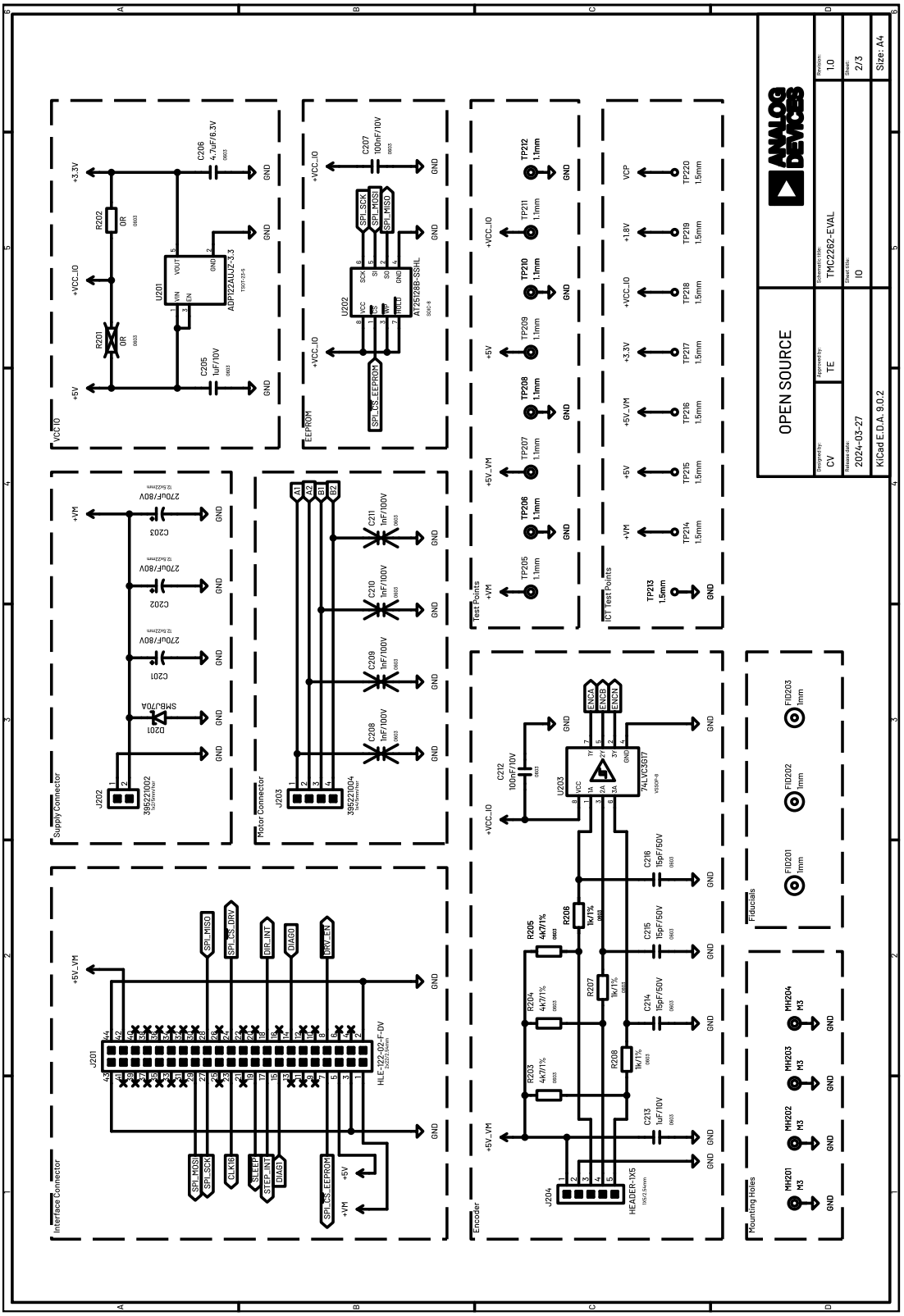
Appendix

TMC2262-EVKIT Bill of Materials

QTY	PART	PACKAGE	MANUFACTURER	MANUFACTURER PN
3	C201–C203	CAP+,270UF,20%,80V,ALUM,TH	PANASONIC CORP	EEUFS1K271
3	C205, C213, C302	CAP+,1UF,10%,10V,X5R,0603	AVX Corporation	0603ZD105KAT2A
1	C206	CAP+,4.7UF,10%,6.3V,X7R,0603	SAMSUNG GROUP	CL10B475KQ8NQNC
2	C207, C212	CAP+,100NF,10%,10V,X7R,0603	KEMET CORPORATION	C0603C104K8RACAUTO
3	C214–C216	CAP+,15PF,5%,50V,C0G/NP0,0603	AVX Corporation	06035A150KAT2A
1	C301	CAP+,22NF,10%,100V,X7R,0603	KEMET CORPORATION	C0603C223K1RACTU
4	C303–C306	CAP+,1UF,10%,100V,X7R,0805	AVX Corporation	08051C105K4T2A
1	C307	CAP+,100NF,10%,16V,X7R,0603	AVX Corporation	0603YC104K4Z2A
1	C308	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,SERIES,30V,0.2A,SOT-23-3	ON SEMICONDUCTOR CORPORATION	BAT54S
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
4	J302–J304	HEADR+,VERT,3POS,2.54MM,TH	WURTH ELECTRONIK GROUP	61300311121
5	R202, R308, R309	RES#,0 OHM,0.1W,0603	ASJ COMPONENTS	CR16-000-ZL
8	R203–R205, R302, R303, R305	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
2	R301, R304	RES#,1.5K OHM,1%,0.1W,0603,AUTO	PANASONIC CORP	ERJ-3EKF1501V
1	R310	RES#,12K OHM,1%,0.1W,0603	ASJ COMPONENTS	CR16-1202-FK
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 DRVR+,STEP,4.5V-65V,SPI,FCQFN-30	ANALOG DEVICES INC.	TMC2262AFV+

TMC2262-EVKIT Schematic




OPEN SOURCE
ANALOG DEVICES
Designed by: CV
Approved by: TE
Release date: 2024-03-27
Schematic title: TMC2262-EVAL
Sheet title: IO
Revision: 1.0
Sheet: 2/3
Size: A4
KiCad E.D.A. 9.0.2
VCC IO
EEPROM
Test Points
GT Test Points
Supply Connector
Motor Connector
Encoder
Fiducials
Mounting Holes
Interface Connector
U201 ADP122AUJZ-3.3
U202 AT25128B-SSHL
U203 74LVC3G17
J201 HLE-122-02-F-DV
J202 39522102
J203 39522104
J204 HEADER-1X5
D201 SMBJ70A
R201 0R
R202 0R
R203 4k7/1%
R204 4k7/1%
R205 4k7/1%
R207 1k/1%
R208 1k/1%
C201 270UF/80V
C202 270UF/80V
C203 270UF/80V
C205 1uF/10V
C206 4.7uF/6.3V
C207 100nF/10V
C208 1nF/100V
C209 1nF/100V
C210 1nF/100V
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C212 100nF/10V
C213 1uF/10V
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C215 15pF/50V
C216 15pF/50V
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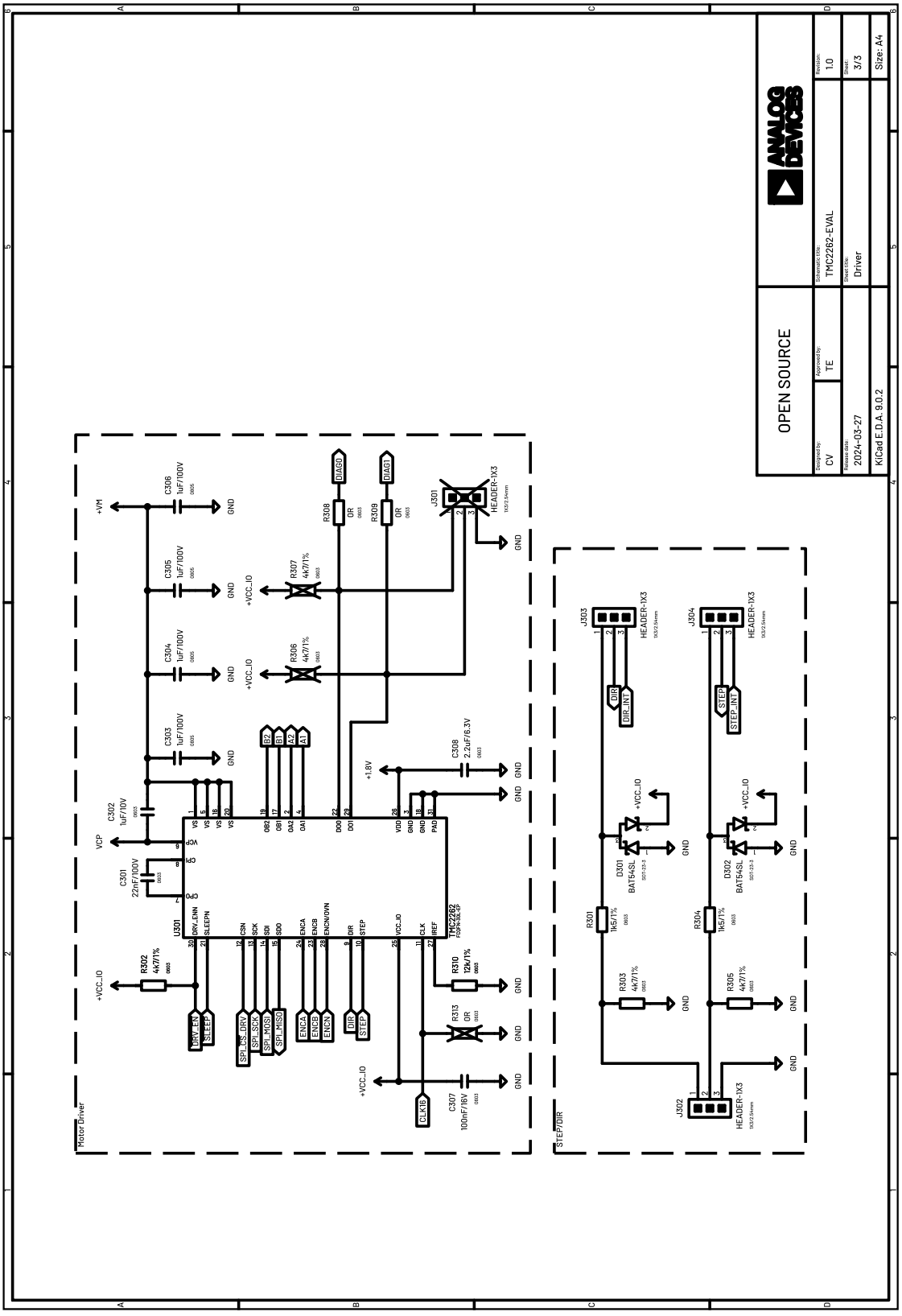
TP206 1.1mm
TP207 1.1mm
TP208 1.1mm
TP209 1.1mm
TP210 1.1mm
TP211 1.1mm
TP212 1.1mm
TP213 1.5mm
TP214 1.5mm
TP215 1.5mm
TP216 1.5mm
TP217 1.5mm
TP218 1.5mm
TP219 1.5mm
TP220 1.5mm
FID201 1mm
FID202 1mm
FID203 1mm
MH201 M3
MH202 M3
MH203 M3
MH204 M3
SPI_MISO
SPI_DIS_DRV
DIR_INT
DIAG0
DRV_EN
SPI_MOSI
SPI_SCK
CLKIN
SLEEP
STEP_INT
DIAG1
SPI_DIS_EEPROM
ENCA
ENCB
ENCN
+3.3V
+5V
+VM
+VCC_IO
+5V_VM
GND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Approved by: TE
Release date: 2024-03-27
KiCad E.D.A. 9.0.2
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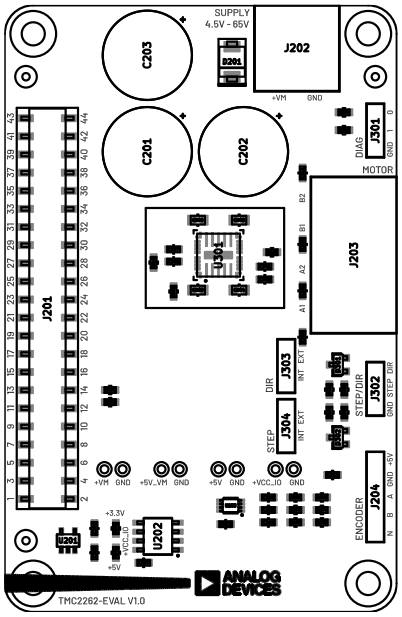
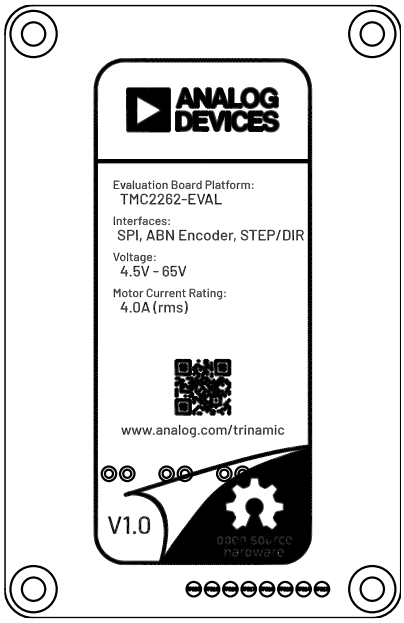
Sheet title: Driver
Revision: 1.0
Sheet: 3/3
Size: A4
Motor Driver
STEP/DIR
U301
TMC2262
TSSOP38E-EP
J301
HEADER-1X3
J302
HEADER-1X3
J303
HEADER-1X3
J304
HEADER-1X3
+VM
+VCC_IO
+1.8V
VCP
GND
DIAG0
DIAG1
DRV_ENN
SLEEPN
SPI_SSS_DRV
SPI_SCK
SPI_MOSI
SPI_MISO
ENCA
ENCB
ENCN
DIR
STEP
CLK16
DIR_INT
STEP_INT
BAT54SL

TMC2262-EVKIT PCB Layout



TMC2262-EVKIT Component Placement Guide—Top Silkscreen



TMC2262-EVKIT Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/26	Initial release	—

Notes