Evaluation Board User Guide

TMC5222-EVKIT

16V/1.4ARMS Ultra Small Stepper Driver and Controller

General Description

The TMC5222-EVKIT is part of the ADI Trinamic™ evaluation board system. The boards included in this kit, in combination with the TMCL-IDE, allow for an uncomplicated first evaluation of the TMC5221/TMC5222, while also providing full control of all its features.

The TMC5221/TMC5222 are miniaturized, smart, high-performance single-axis stepper motor controller and driver ICs with serial communication interfaces and extensive diagnostic capabilities. Their high integration, high energy efficiency, and small form factor enable miniaturized and scalable systems for cost-effective solutions. StealthChop2™ ensures absolutely noiseless operation combined with maximum efficiency and the optimal motor torque control.

The TMC5221/TMC5222 combine a flexible 8-point ramp generator with reduced jerk for automatic positioning with a smart stepper motor driver based on a 256 microstep built-in indexer and two fully integrated 16V, 2.0A_{MAX} H-bridges plus nondissipative integrated current sensing (ICS), which eliminates bulky external sense resistors resulting in space and power savings.

Since the TMC5221 and TMC5222 share the same functionality except the communication Interface, a separate evaluation kit for TMC5221 is not available. Use TMC5222-EVKIT to evaluate the general functionality of each IC.

Features

- 2.1V to 16V DC Voltage Range
- Low $R_{DS(ON)}$ (HS + LS): 0.170Ω (typ, T_A = +25°C)
- Current Ratings (+25°C, typ)
  - Full-Scale Current I_{PEAK} = 2.0A_{MAX}
  - Full-Scale Current I_{RMS} = 1.4A_{RMS}
- Fully Integrated, Lossless Current Sensing (ICS)
- Eight-Point Motion Controller for Minimum Jerk
- Step/Direction Interface with MicroPlyer™ Step Interpolation
- I2C Interface
- Reference Switch Inputs
- TriCoder Sensorless Standstill Steploss Detection and Full-Step Encoder
- Highest Resolution with 256 Microsteps per Full Step
- StealthChop2 Silent Motor Operation
- SpreadCycle™ Highly Dynamic Chopper Mode
- StallGuard2™ and StallGuard4™ Sensorless Motor Load Detection
- CoolStep™ Current Control for Energy Savings up to 75%
- Passive Braking and Freewheeling Mode
- Bridge Disable, Reset, and Low-Power Mode
- Motor Phase and Chip Temperature Measurement
- Full Protection and Diagnostics

TMC5222-EVKIT Contents

ITEM	DESCRIPTION
TMC5222-EVAL	TMC5222 Evaluation Board
Landungsbruecke	PC Interface Board
Eselsbruecke	Bridge Connection Board

Documents Needed

TMC5221/TMC5222 data sheet

Software Needed

TMCL-IDE Evaluation Software

***Ordering Information* appears at end of data sheet.**

One Analog Way, Wilmington, MA 01887-2356, U.S.A. | Tel: 781.329.4700 | ©2024 Analog Devices, Inc. All rights reserved.

Downloaded from Arrow.com.

Getting Started

Required Items

- TMC5222-EVAL (included)
- Landungsbruecke board (included)
- Eselsbruecke board (included)
- A compatible motor (e.g., a Qmot Stepper motor)
- Power supply
- USB-C data cable
- 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 of 16V.
- 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.
- Do not touch the power stage section of the board during operation as it might get hot.

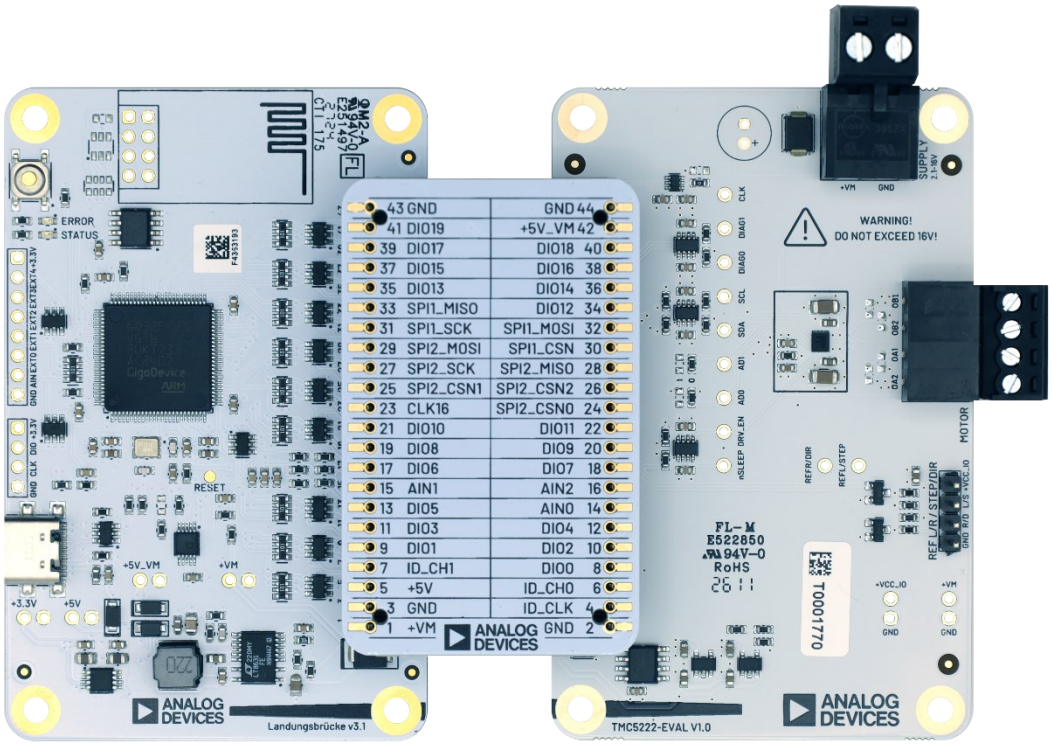


Figure 1. Assembled TMC5222-EVKIT

Downloaded from Arrow.com.

Connecting the Peripherals

1. Interface the TMC5222-EVAL with the Landungsbruecke board through the Eselsbruecke bridge board as shown in *Figure 1*. Before connecting the boards together, ensure both the Landungsbruecke and the TMC5222-EVAL are not 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, labelled as *MOTOR* on the board's silkscreen (*Figure 4*). Observe the correct order of the A1, A2, B1, and B2 motor phases.
3. Connect the Landungsbruecke board to the computer through a USB cable.
4. Plug the power supply cable to connector J202, labelled as *SUPPLY* on the board's silkscreen (*Figure 4*). Make sure the power supply is off and the polarity is correct before connecting it to the board.

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.

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

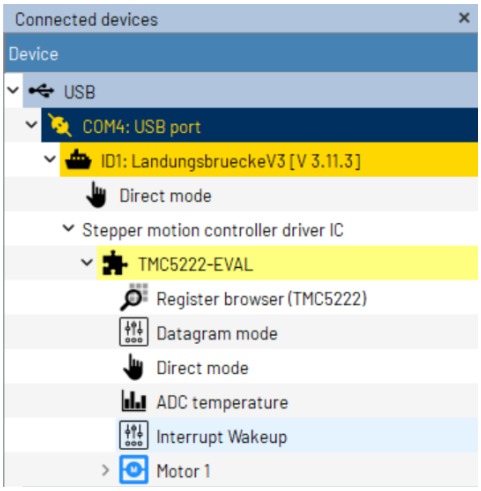


Figure 2. TMCL-IDE Device Tree

Downloaded from Arrow.com.

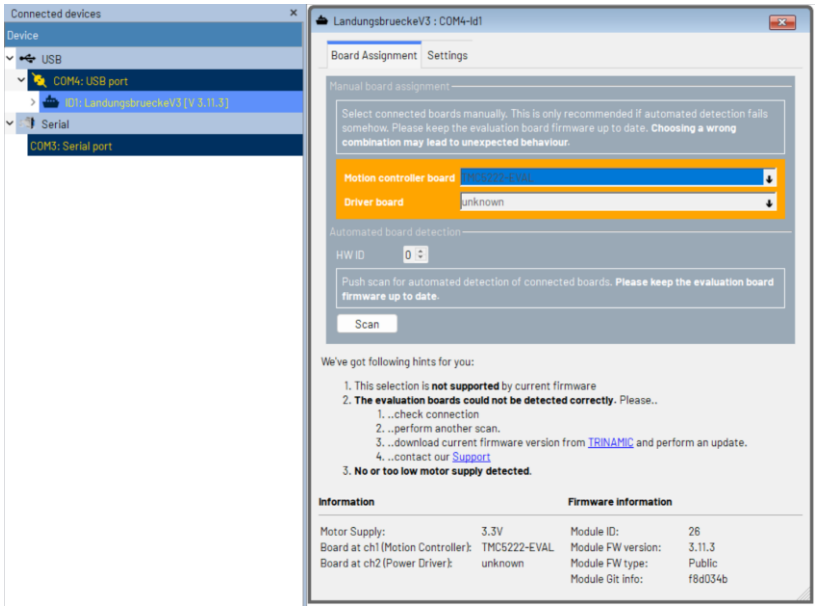


Figure 3. TMCL-IDE, Manual Selection of a Board

3. (Optional) 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.
4. The board is now ready to turn on the power supply.

Downloaded from Arrow.com.

Detailed Description of Hardware

Component Placement Drawing

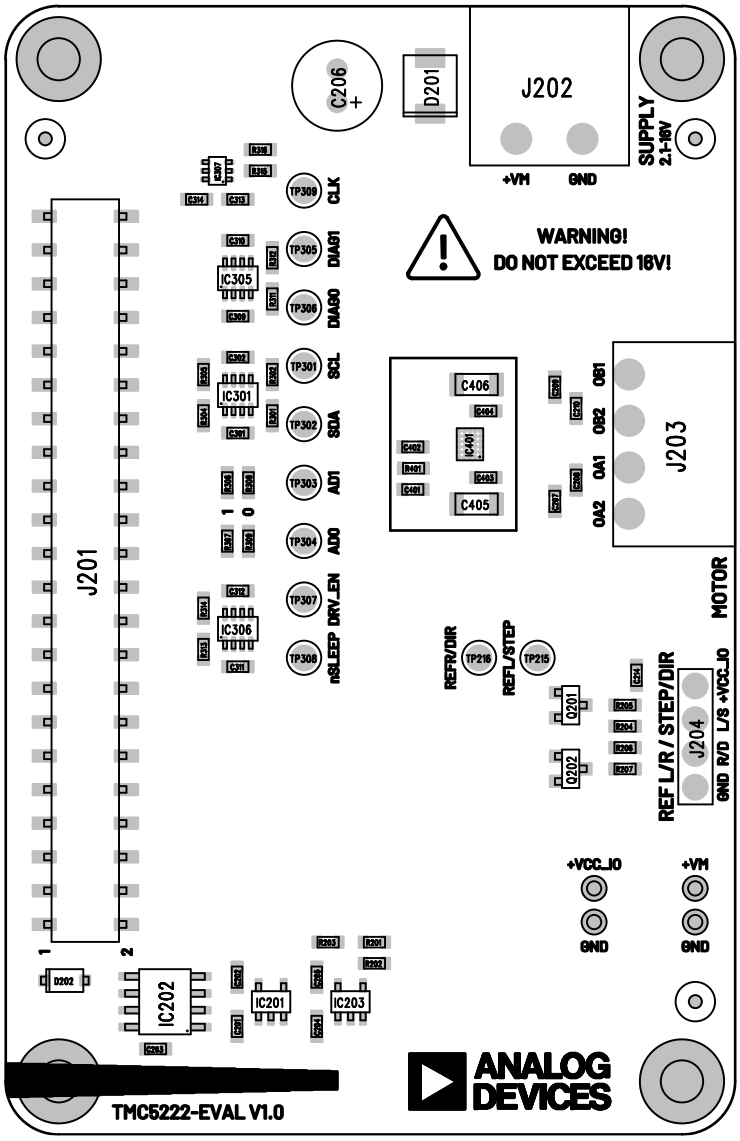


Figure 4. TMC5222-EVAL Component Placement and Silkscreen

Downloaded from Arrow.com.

Onboard Connectors and Pin Headers

The TMC5222-EVAL has one power, one motor connector, and two pin headers, which are found in the component placement drawing in *Figure 4* and described in *Table 1*.

Table 1. TMC5222-EVAL Available Connectors

REFERENCE DESIGNATOR	CONNECTOR TYPE	DESCRIPTION
J201	2.54mm pin header socket 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 5*.
J202	Terminal block header, 2 positions (Molex 395221002)	Connector for the main power supply input.
J203	Terminal block header, 4 positions (Molex 395221004)	Connector for the A1, A2, B1, and B2 phases of the motor.
J204	2.54mm pin header 4x1	Connector for the reference switch inputs (or with different configuration STEP/DIR). This connector is always referenced to VCC_IO and includes 2.2kΩ pull-up resistors on all its inputs.

Additional Connectors

In addition to the connectors shown in *Table 1*, some unpopulated THM test points are available in the TMC5222-EVAL. See the component placement drawing in *Figure 4*. The additional connectors are described in *Table 2*.

Table 2. TMC5222-EVAL Additional Connectors and Test Points

REFERENCE DESIGNATOR	CONNECTOR TYPE	DESCRIPTION
PTH205 and PTH206 (Labels +VM and GND)	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 (Labels +VCC_IO and GND)	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.

Downloaded from Arrow.com.

Landungsbruecke Connector

The Landungsbruecke connector section of the TMC5222-EVAL schematics is shown in *Figure 5*. The TMC5222 work with V_{CC_IO} voltages between 1.1V and 2V, while Landungsbruecke uses 3.3V level. Level-shifted control signals are interfaced through the Landungsbruecke connector, the DRV_EN_LB, and SLEEPN_LB input pins, as well as the CLK_LB input pin. The serial communication signals are also interfaced through this connector.

The TMC5222-EVAL V_{CC_IO} voltage used for TMC5222 is selectable by R201 between 1.2V and 1.8V. See the *Schematics* section.

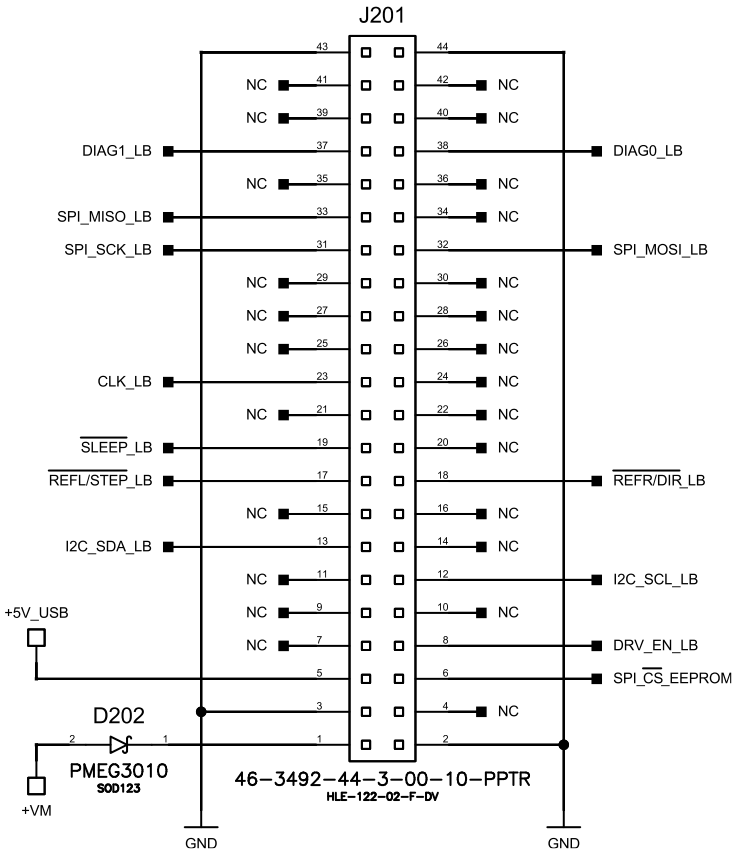


Figure 5. TMC5222-EVAL Schematics Detail of the Landungsbruecke Connector

Downloaded from Arrow.com.

Ordering Information

PART	TYPE
TMC5222-EVKIT	Evaluation Kit

#Denotes RoHS compliance.

Downloaded from Arrow.com.

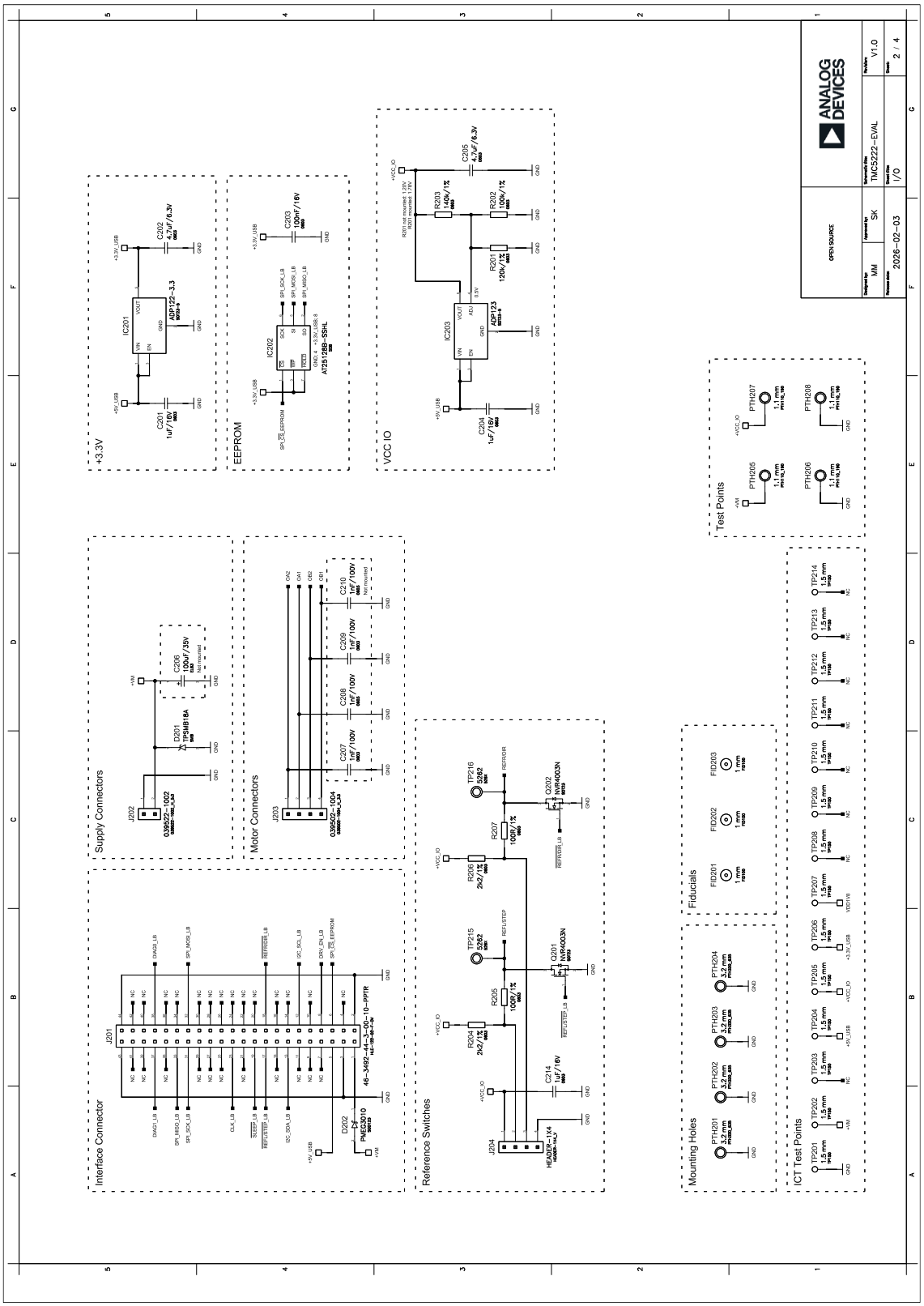
Appendix

Bill of Materials

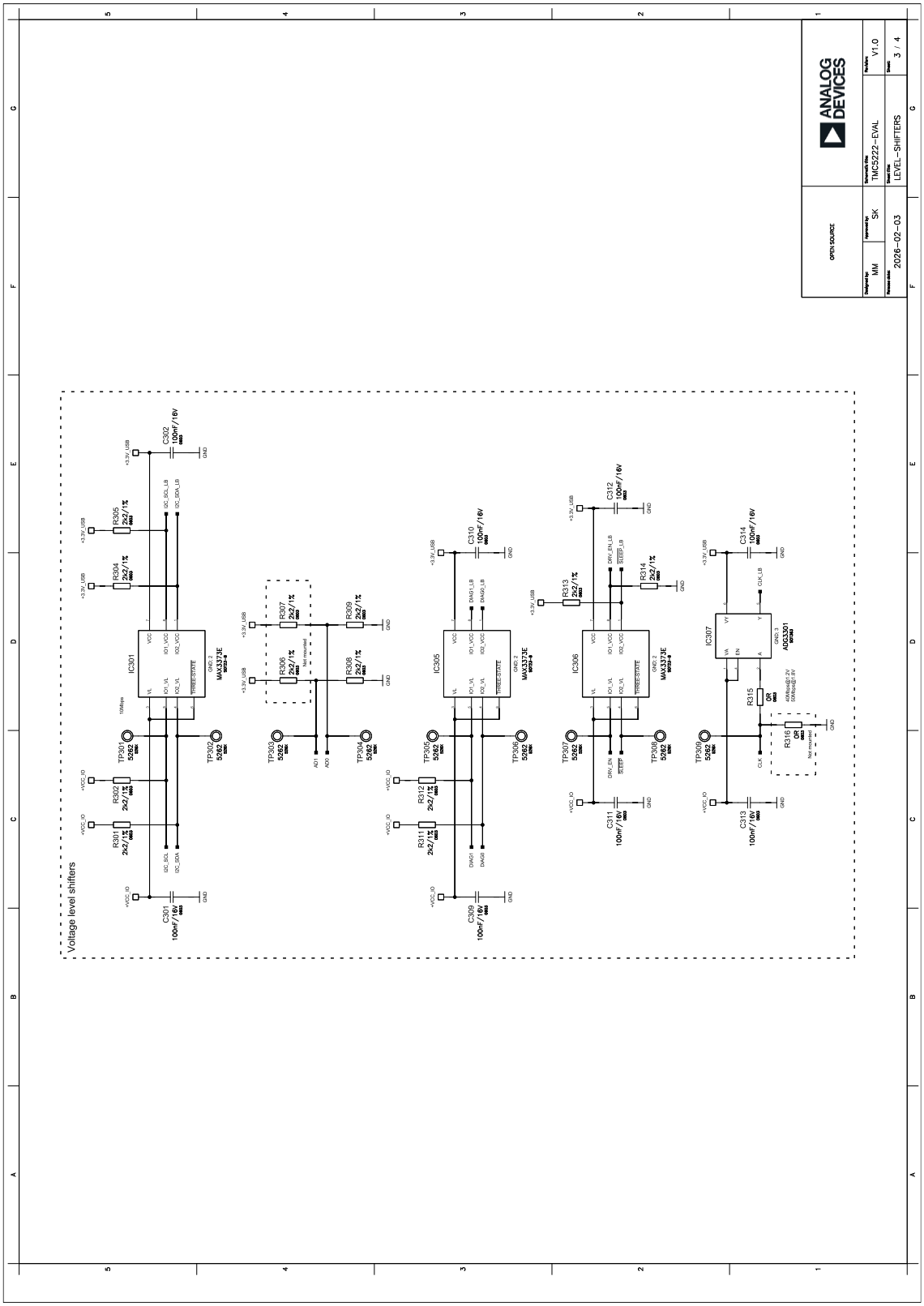
PART	QTY	DESCRIPTION
C201, C204, C214	3	1µF/16V
C202, C205	2	4.7µF/6.3V
C203, C301, C302, C309–C314, C402	10	100nF/16V
C401	1	2.2µF/6.3V
C403, C404	2	100nF/35V
C405, C406	2	10µF/35V
D201	1	TPSMB18A
D202	1	PMEG3010
IC201	1	ADP122-3.3
IC202	1	AT25128B-SSHL
IC203	1	ADP123
IC301, IC305, IC306	3	MAX3373E
IC307	1	ADG3301
IC401	1	TMC5222AWV+
J201	1	46-3492-44-3-00-10-PPTR
J202	1	039522-1002
J203	1	039502-1004
J204	1	HEADER-1X4
Q201, Q202	2	NVR4003N
R201	1	120kΩ/1%
R202	1	100kΩ/1%
R203	1	140kΩ/1%
R204, R206, R301, R302, R304, R305, R308, R309, R311–R314	12	2.2kΩ/1%
R205, R207	2	100Ω/1%
R315	1	0Ω
R401	1	60.4kΩ

Downloaded from Arrow.com.

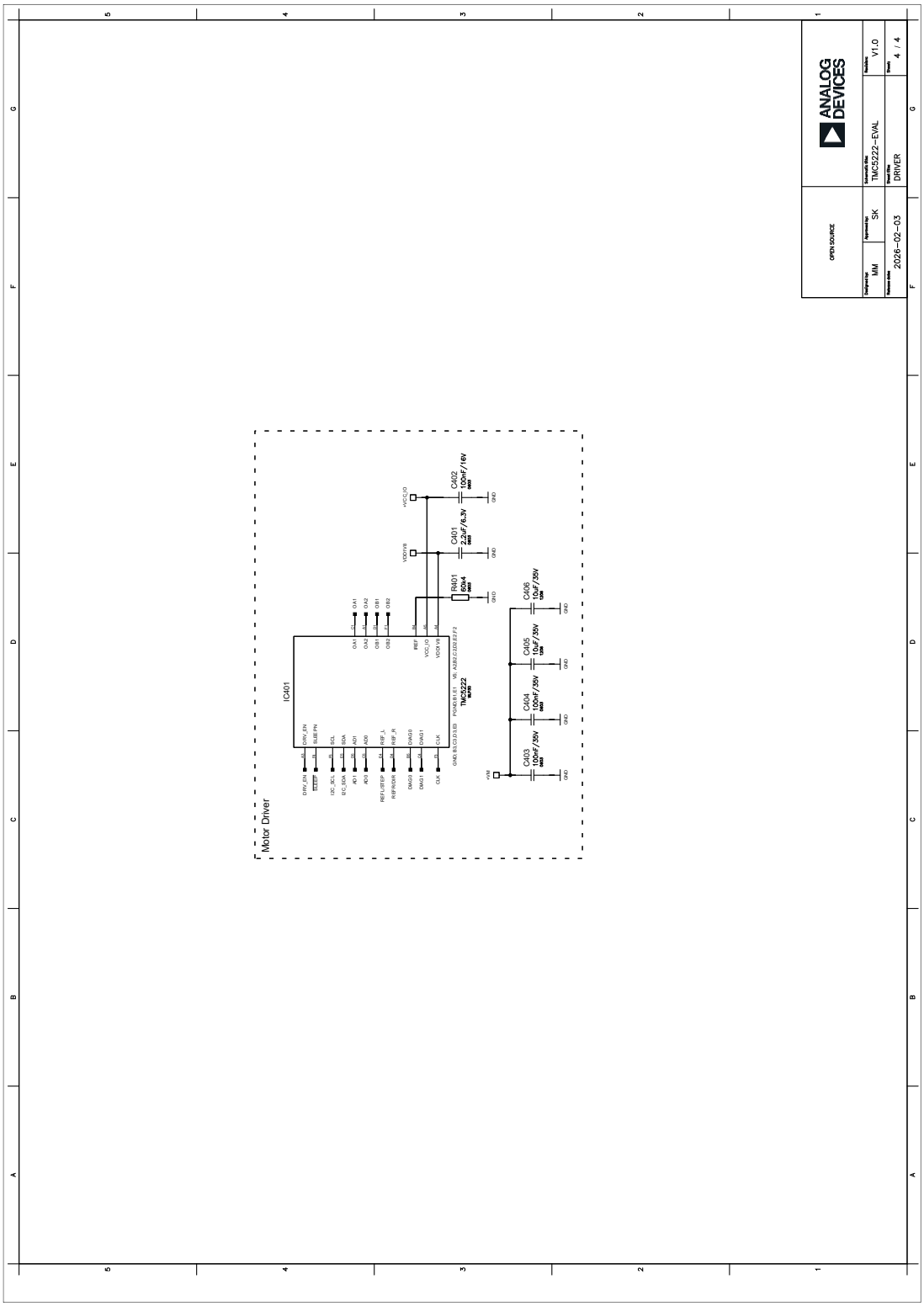
Schematics



Downloaded from Arrow.com.



Downloaded from Arrow.com.



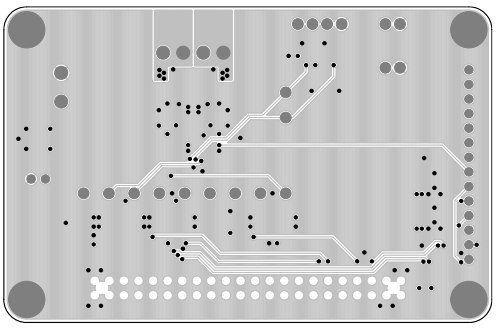
Downloaded from Arrow.com.

Mechanical Dimensions

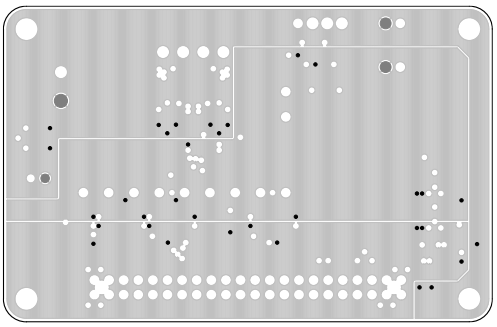


Downloaded from Arrow.com.

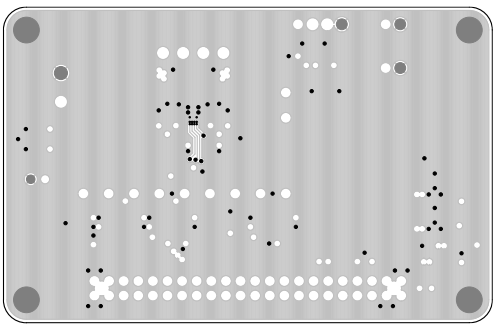
PCB Layout



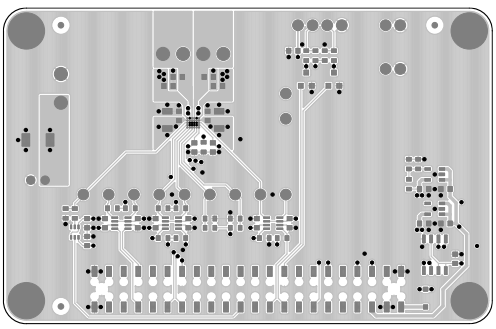
TMC5222-EVKIT Silkscreen—Bottom Layer



TMC5222-EVKIT Silkscreen—Inner Layer 2



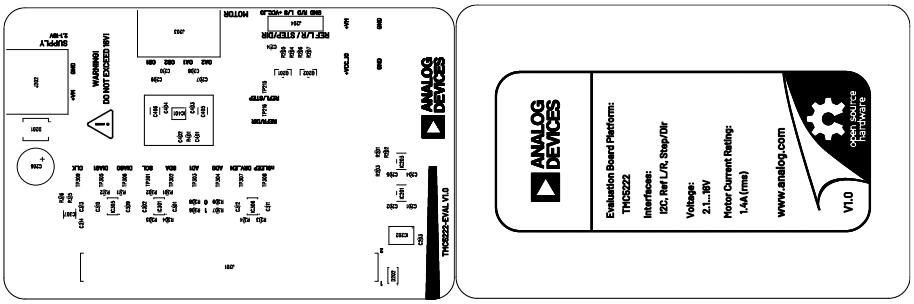
TMC5222-EVKIT Silkscreen—Inner Layer 1



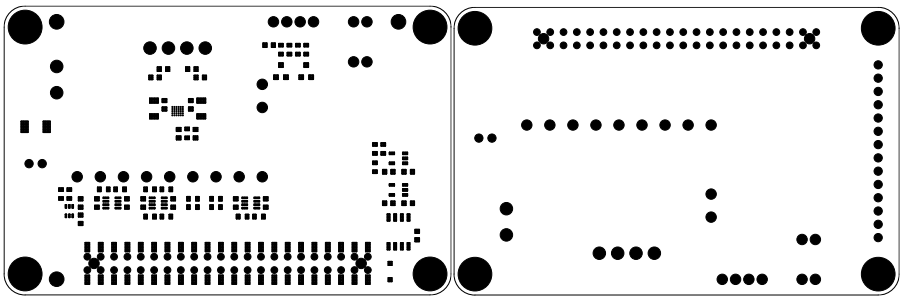
TMC5222-EVKIT Silkscreen—Top Layer

Downloaded from Arrow.com.

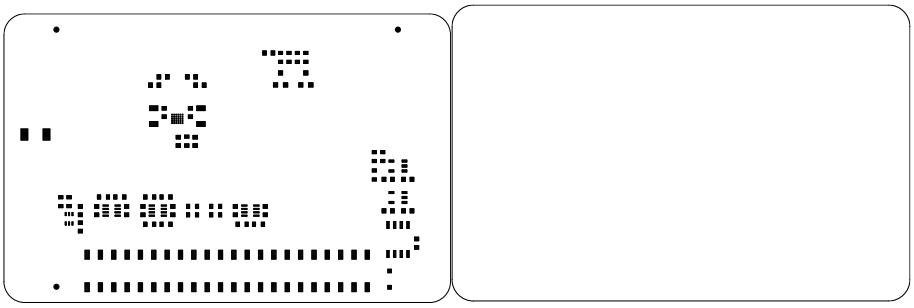
Additional Fabrication Layers



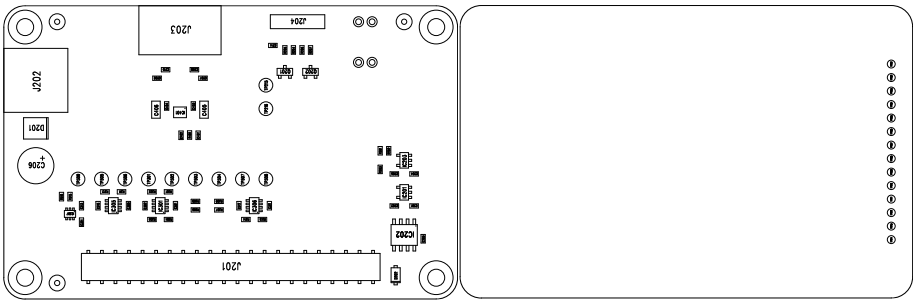
TMC5222-EVKIT Silkscreen



TMC5222-EVKIT Soldermask



TMC5222-EVKIT Pastemask



TMC5222-EVKIT Assembly Drawing

Downloaded from Arrow.com.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/26	Initial release	—
1	8/26	Corrected part number in *General Description* and *Documents Needed* sections	1

Downloaded from Arrow.com.

Notes

ALL INFORMATION CONTAINED HEREIN IS PROVIDED “AS IS” WITHOUT REPRESENTATION OR WARRANTY. NO RESPONSIBILITY IS ASSUMED BY ANALOG DEVICES FOR ITS USE, NOR FOR ANY INFRINGEMENTS OF PATENTS OR OTHER RIGHTS OF THIRD PARTIES THAT MAY RESULT FROM ITS USE. SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE. NO LICENSE, EITHER EXPRESSED OR IMPLIED, IS GRANTED UNDER ANY ADI PATENT RIGHT, COPYRIGHT, MASK WORK RIGHT, OR ANY OTHER ADI INTELLECTUAL PROPERTY RIGHT RELATING TO ANY COMBINATION, MACHINE, OR PROCESS, IN WHICH ADI PRODUCTS OR SERVICES ARE USED. TRADEMARKS AND REGISTERED TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE OWNERS. ALL ANALOG DEVICES PRODUCTS CONTAINED HEREIN ARE SUBJECT TO RELEASE AND AVAILABILITY.

Downloaded from Arrow.com.