Evaluation Board User Guide

MAX22512EVKIT

Evaluating the MAX22512 IO-Link Device Transceiver with Integrated Cortex-M0 and AFE

General Description

The MAX22512 evaluation kit (EV kit) is designed to evaluate the MAX22512 IO-Link device transceiver with integrated Arm® Cortex®-M0 and analog front end (AFE).

The MAX22512 EV kit includes three integrated regulators (5V, 3.3V, and 1.8V) with a flexible power scheme that allows the device to be used in many applications. The EV kit is designed to allow the user to test and optimize the power structure for any design.

The MAX22512 EV kit features suite of peripherals for high performance and flexibility. Peripherals include a high-speed comparator, a 6-bit DAC, a 13-bit ADC, four variable resistors, and twelve GPIO pins. All peripherals and associated pins are available on easy-to-access headers.

The MAX22512 EV kit includes two methods to program the IC: using on-board serial EEPROM or programming through the serial debug (SWD) interface.

Sample code is available for use with the EV kit and can be downloaded from the Analog Devices' website.

Features

- Fully-featured evaluation board for the MAX22512
- Access to all peripherals and AFE
- Enables quick prototyping

Ordering Information appears at end of data sheet.

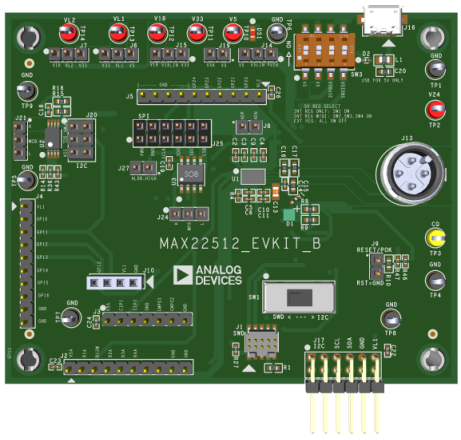
Quick Start

Required Equipment

- MAX22512 EV kit
- 24V, 500mA supply
- PC with Windows® operating system
- 24V/500mA supply or IO-Link master to provide power
- I²C controller with Pmod™ connector (Analog Devices recommends the *USB2PMB2* board)
- SWD debugger with 10-pin connector (examples in this document use the Arm Keil® ULINK-ME or ULINK2TM debug unit)
- Multimeter
- MAX22512/MAX22522 EEPROM programming GUI

Note: In the following sections, software-related items are identified by bolding. Text in bold refers to items directly from the EV kit software.

Evaluation Board Image



319-101175; Rev 0; 6/26

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

Procedure

The EV kit is fully assembled and tested. To start evaluating with the MAX22512 EV kit, perform the following steps:

1. Ensure that the jumpers on the EV kit appear as shown in *Table 1.*
2. Connect the 24V supply to the V_{24} test point (TP2). Connect the ground return of the supply to the GND test point (TP1). **Optional:** Connect an IO-Link master to the MAX22512 EV kit using the J13 M12 connector. Then turn on the channel connected to the device to power the EV kit and skip to step 4.
3. Turn on the 24V supply.
4. Verify that the green power indicator LED (DS1) at the top of the board is on. The MAX22512 EV kit comes preprogrammed with a basic IO-Link communication script. Verify that the blue D1 LED is also blinking.
5. Using the multimeter, verify that the voltage on the V5 test point (TP10) is 5V, the voltage on the V33 test point (TP11) is 3.3V, and the voltage on the V18 test point (TP12) is 1.8V. VL1 (TP13) and VL2 (TP14) are also set to 3.3V.
6. If an IO-Link master is connected to the MAX22512 EV kit, enable IO-Link communication between the master and device and verify that the MAX22512 EV kit is correctly identified by the IO-Link master.

For more details on programming the device, see the *Programming the MAX22512 EV Kit* section.

Table 1. Jumper Connection Guide

JUMPER	DEFAULT CONNECTION	FEATURE
J6	**1-2***	V_{L1} = V_{33} (3.3V).
	2-3	V_{L1} = V_5 (5V).
J7	1-2	V_{L2} = V_{18} (1.8V).
	2-3*	V_{L2} = V_{33} (3.3V).
J9	Open	$\overline{RESET}$/POK is high (pulled up to V_{L1}).
	Closed*	$\overline{RESET}$/POK is low (GND).
J14	**1-2***	V_{5LIN} = PV24.
	2-3	V_{5LIN} = V_5. Connect an external 5V supply to the V_5 test point (TP10) for normal operation.
J15	**1-2***	V_{18LIN} = V_{33}.
	2-3	V_{18LIN} = V_{18}. Connect an external 1.8V supply to the V_{18} test point (TP12) for normal operation.
J19	Open	V_{5A} is not connected to V_5. Connect an external 5V supply to V_{5A} for normal operation.
	Closed*	V_{5A} = V_5.
J21	1-2, 3-4, 5-6	M24128 serial EEPROM is connected to the MAX22512.
	Open*	M24128 serial EEPROM is not connected to the MAX22512.
J25	**1-2, 3-4, 5-6, 7-8, 9-10, 11-12***	CAV25M01 serial SPI EEPROM is connected to the MAX22512.
	Open	CAV25M01 serial SPI EEPROM is not connected to the MAX22512.
SW1	**Left (SWD)***	SWDEN is high.
	Right (I2C)	SWDEN is low.
SW3	**1: ON 2, 3, 4: OFF***	V_5 is powered using the internal regulator. For other configurations, see the *Power* section.
	1: OFF 2, 3, 4: ON	V_5 is powered using the internal regulator with the external transistor, Q1. For other configurations, see the *Power* section.
	1, 2, 3, 4: OFF	Internal regulator is disabled. Set V_{5LIN} = V_5 and connect an external 5V to the V_5 test point.

Default options are bold.

Detailed Description of Hardware

Power

The MAX22512 EV kit has three power supply inputs: V_{24} (24V), V_5 (5V), and V_{18} (1.8V). *Table 2* shows a summary of available settings for each of these supplies.

Connect an external 24V power supply to the V_{24} and GND pins to power the device from a bench supply. Alternatively, connect an IO-Link master to the MAX22512 EV kit and power the device over the IO-Link cable. The V_{24} supply is required for IO-Link communication but does not need to be present when testing only peripheral functions. To test the device without V_{24}, set V_{5LIN} = V_5 and connect an external 5V supply to the V5 test point or connect a USB power source using the J16 connector.

The MAX22512 EV kit requires a 5V supply for normal operation. Set SW3 Channel 1 on (and all other channels off) and set V_{5LIN} = PV24 (J14 1-2) to use the internal 5V regulator. For larger loads, use an external transistor to generate the required 5V on V_5. Set the SW3 Channel 2, Channel 3, and Channel 4 on (Channel 1 is off) and connect V_{5LIN} = PV24 (J14 1-2) for this configuration. To use an external 5V supply, disable the internal regulator (SW3 Channel 1 is off) and the external transistor (Channel 2, Channel 3, and Channel 4 are off on SW3), set V_{5LIN} = V_5 (J14 2-3), and apply 5V to the V_5 test point.

The MAX22512 EV kit features an internal 3.3V regulator when V_5 = 5V. Connect to the V_{33} test point (TP11) to access this supply.

In addition to the 24V and 5V supplies, the MAX22512 EV kit requires a 1.8V supply on the V_{18} pin. To use the internal 1.8V regulator, connect the V_{18LIN} input to the V_{33} supply by setting J15 to 1-2. To bypass the internal regulator, connect V_{18LIN} = V_{18} (J15 2-3) and connect an external 1.8V supply to the V_{18} test point.

Table 2. V_5, V_{33}, and V_{18} Power Supply Settings

SUPPLY (V)	SWITCH SW3				LIN INPUT	NOTES
	CH1	CH2	CH3	CH4		
24	X	X	X	X	X	Apply 24V supply to V5 test point (TP2). 24V is required to IO-Link communication.
5	On	Off	Off	Off	V_{5LIN} = PV24	5V internal regulator enabled.
	Off	On	On	On	V_{5LIN} = PV24	5V internal regulator with external transistor for larger loads.
	Off	Off	Off	Off	V_{5LIN} = V_5	5V internal regulator disabled. Connect an external 5V to V_5 test point (TP10).
3.3	X	X	X	X	X	3.3V internal regulator. V_{33} is always on.
1.8	X	X	X	X	V_{18LIN} = V_{33}	1.8V internal regulator enabled.
	X	X	X	X	V_{18LIN} = V_{18}	1.8V internal regulator disabled. Connect an external 1.8V supply to the V_{18} test point (TP12).

X = Don't care.

IO-Link Communication (V_{24}, C/Q, and GND)

Connect the MAX22512 EV kit to an IO-Link master using the 4-pin M12 connector (J13). Power the EV kit from this connection when the device is connected to an IO-Link master.

$\overline{\text{RESET}}$/POK Input/Output

The $\overline{\text{RESET}}$/POK input/output is pulled up to V_{L1} by default. Place a shunt on J9 to pull $\overline{\text{RESET}}$/POK low and put the device in reset. Remove R46 and place a 0Ω resistor on R47 to pull-up $\overline{\text{RESET}}$/POK to V_{L2}, if required.

AFE and Peripheral Connections/Headers

GPIOs

Bank 1 GPIO pins (GPIO1_x) are accessible on the J4 header along the left-side of the board.

GPIO1_0 can also be used to drive the red LED (D1). Place a 0Ω resistor on the R8 pad to connect GPIO1_0 for this functionality. Remove R9 when GPIO1_0 is used to drive the LED.

GPIO1_1 and GPIO1_2 are also routed to J22 to connect to the on-board I2C serial EEPROM. These pins are also routed to the J10 connector for use with an I2C display.

Bank 2 GPIO pins (GPIO2_x) are accessible on the J5 header.

GPIO2_0 is used to drive the red LED (D1) by default. Remove R9 when GPIO1_0 is used to drive the LED.

GPIO2_1 to GPIO2_4 are also routed to J25 to connect to the on-board SPI serial EEPROM. J25 connections are in-place by default.

Comparators and DACs

The comparator inputs (CIP1, CIN2) and outputs (CMPO1, CMPO2) are accessible on the J3 header.

Variable Resistors

Variable resistor pins (R1A, R12W, R2A, R3A, and R4A) are accessible on the J2 header at the bottom of the board. Enable and set the variable resistors in the register.

Programming the MAX22512 EV Kit

Programming the MAX22512 EV Kit through the SWD Interface

The MAX22512 EV kit can be programmed tested using a standard serial debugger connected to the SWD interface (J1). To program the device through the SWD interface, use the following steps (the serial debugger used in this example is the KeilTM ULINK-METM or UNLINK2TM):

1. Connect the serial debugger controller to the J1 header, as shown in *Figure 1*.
2. Ensure that SW1 is in the SWD position.

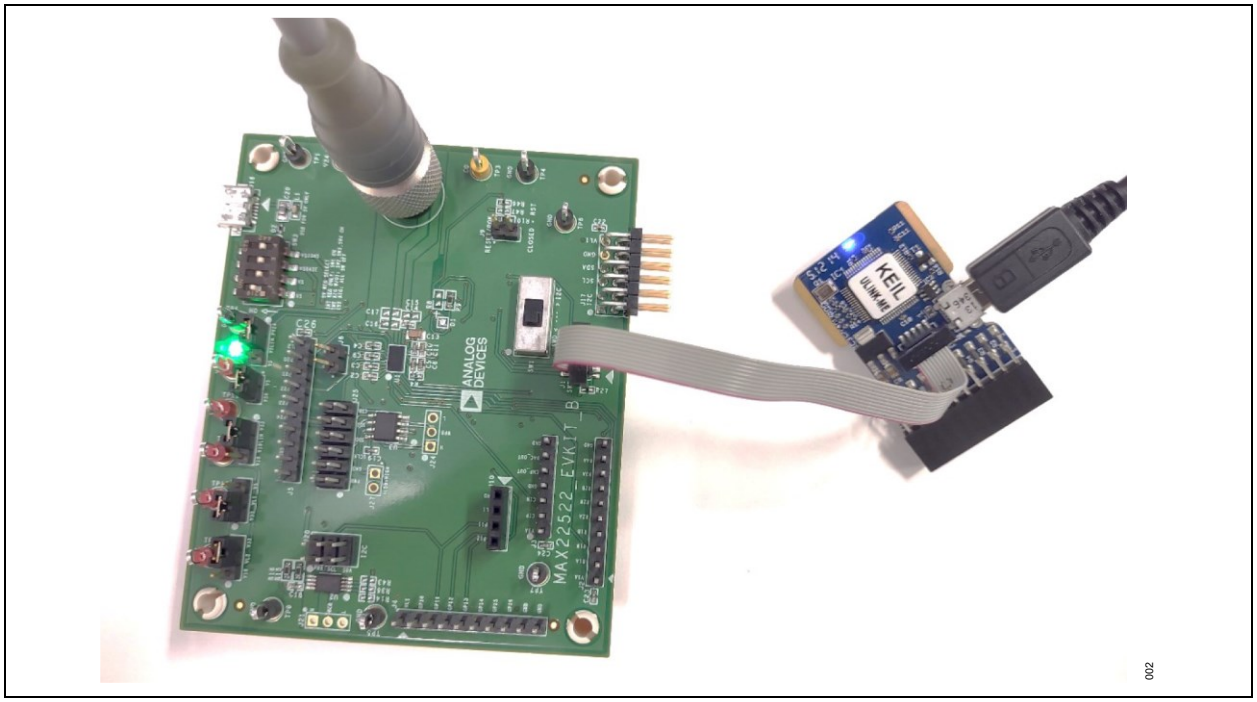


Figure 1. MAX22512 EV Kit Serial Debugger Connection

3. Open the Keil µVision programmer. Open the sample project and verify that the project options appear as shown in *Figure 2* through *Figure 7*.

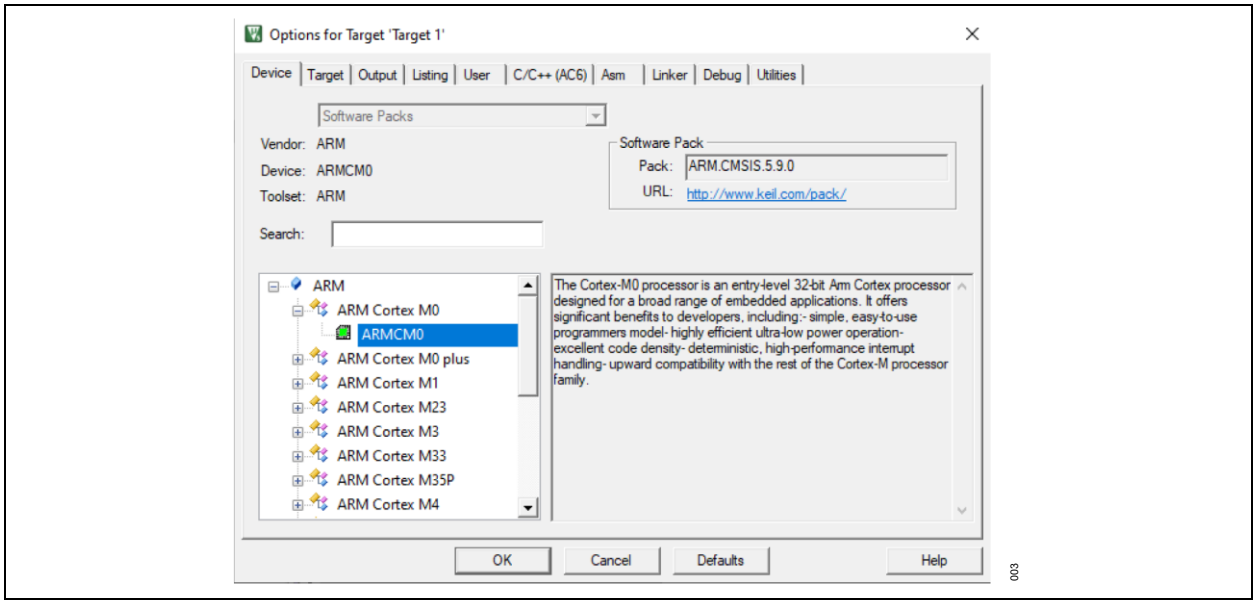


Figure 2. Keil µVision Settings—Device Tab

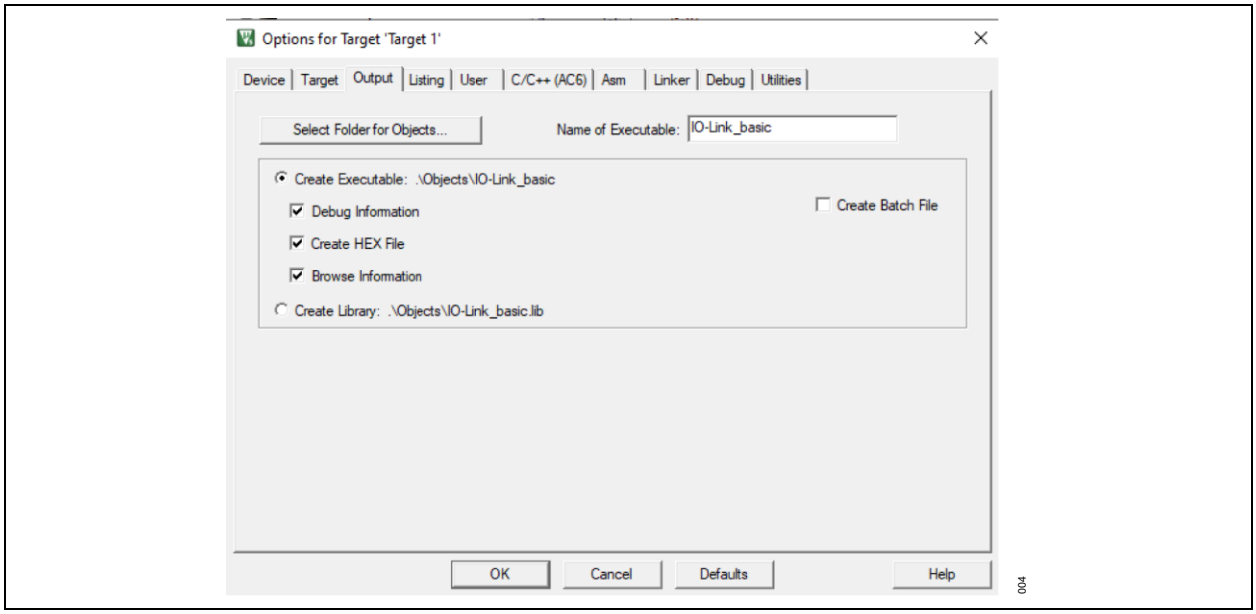


Figure 3. Keil µVision Settings—Output Tab

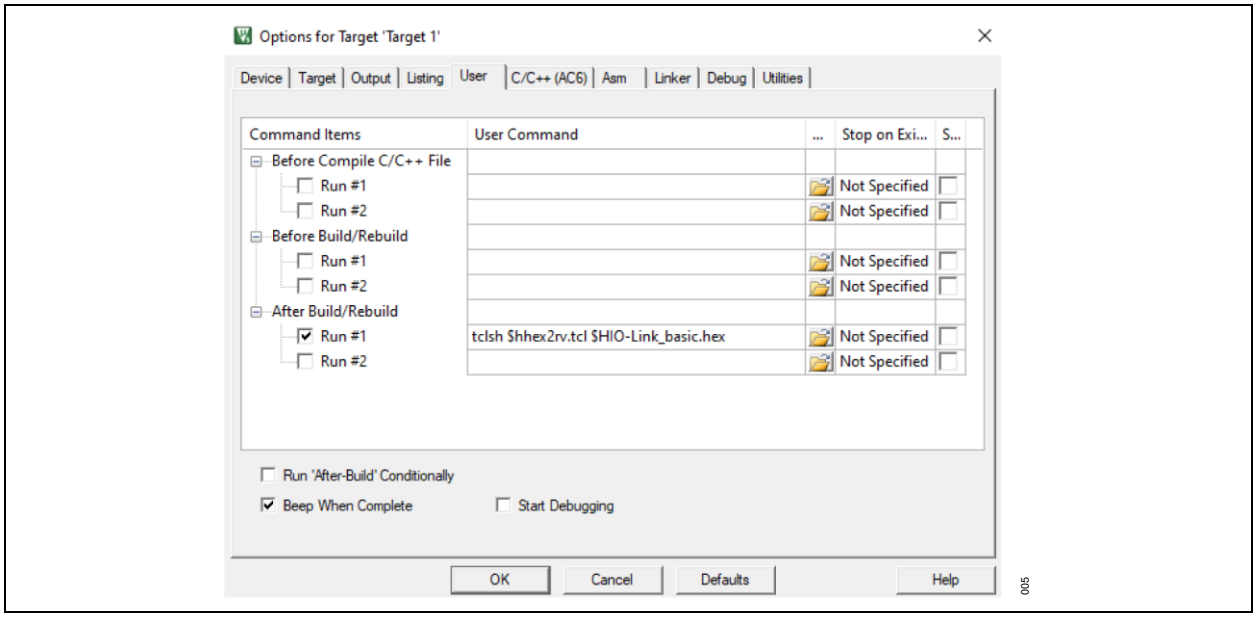


Figure 4. Keil µVision Settings—User Tab

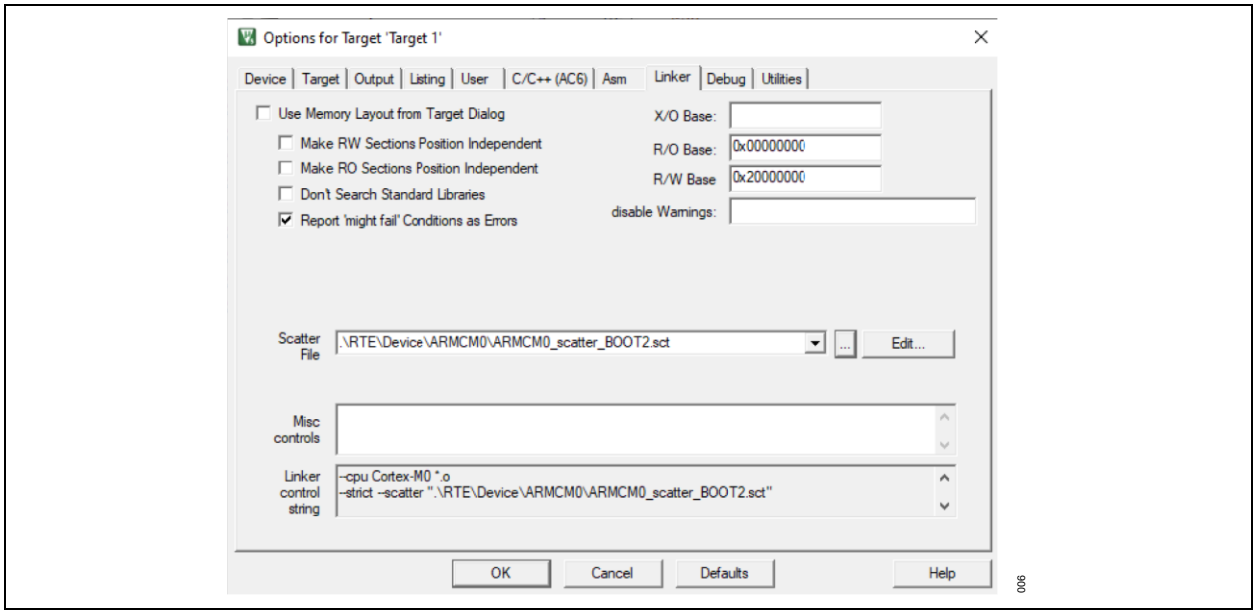


Figure 5. Keil µVision Settings—Linker Tab

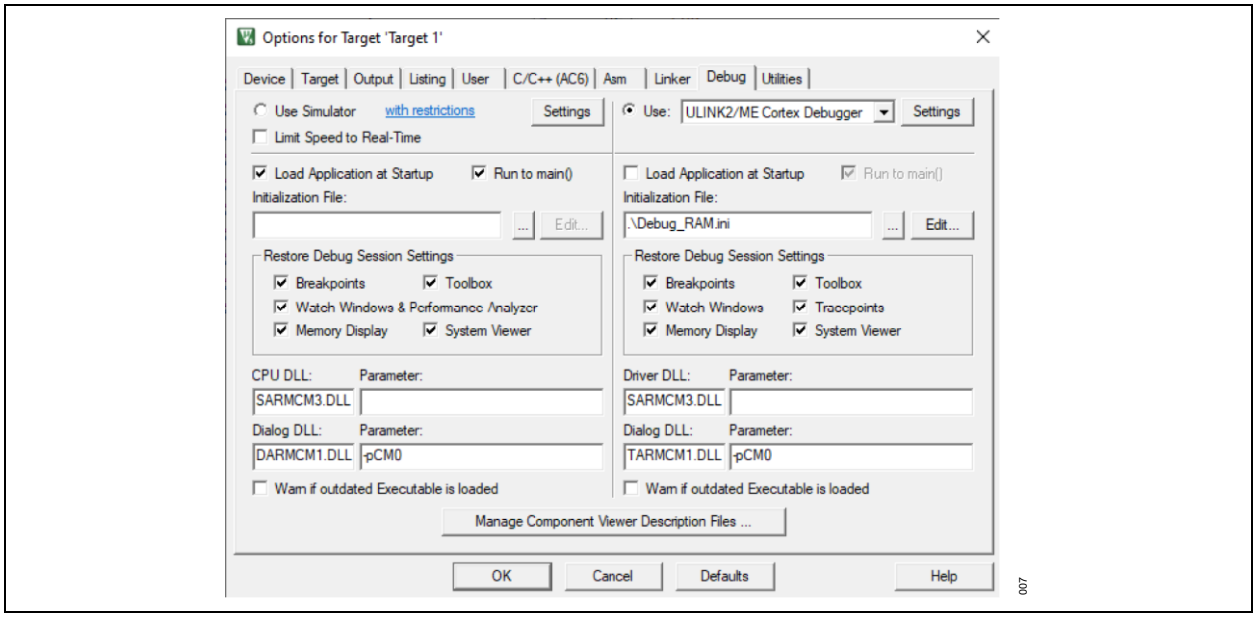
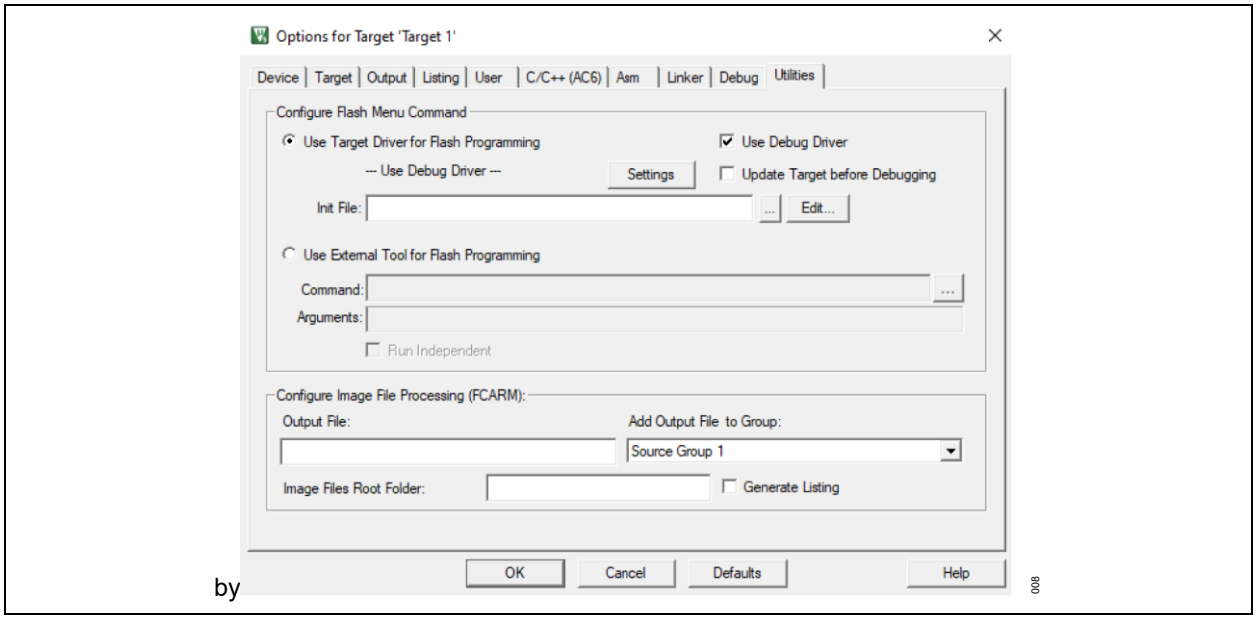


Figure 6. Keil µVision Settings—Debug Tab



by

Figure 7. Keil µVision Settings—Utilities Tab

4. Modify the code as required.
5. Build and compile the project.
6. Open the debugger and run the code.

Programming the MAX22512 EV Kit through EEPROM

When the MAX22512 EV kit is powered up, it boots by up using the firmware programmed into connected EEPROM over the SPI interface.

Once a new program has been verified using the debug mode (SWD interface), use an SPI controller to program the on-board EEPROM with the required program. Cycle power to restart the MAX22512 EV kit with the application programmed in the EEPROM.

To program the device using the external EEPROM, use the following steps (the SPI controller used in this example is the *USB2PMB2*):

1. Connect the SPI controller to the J25 header (see *Figure 8)*. Signals on the J25 header are laid out using the standard Pmod connector pinout.

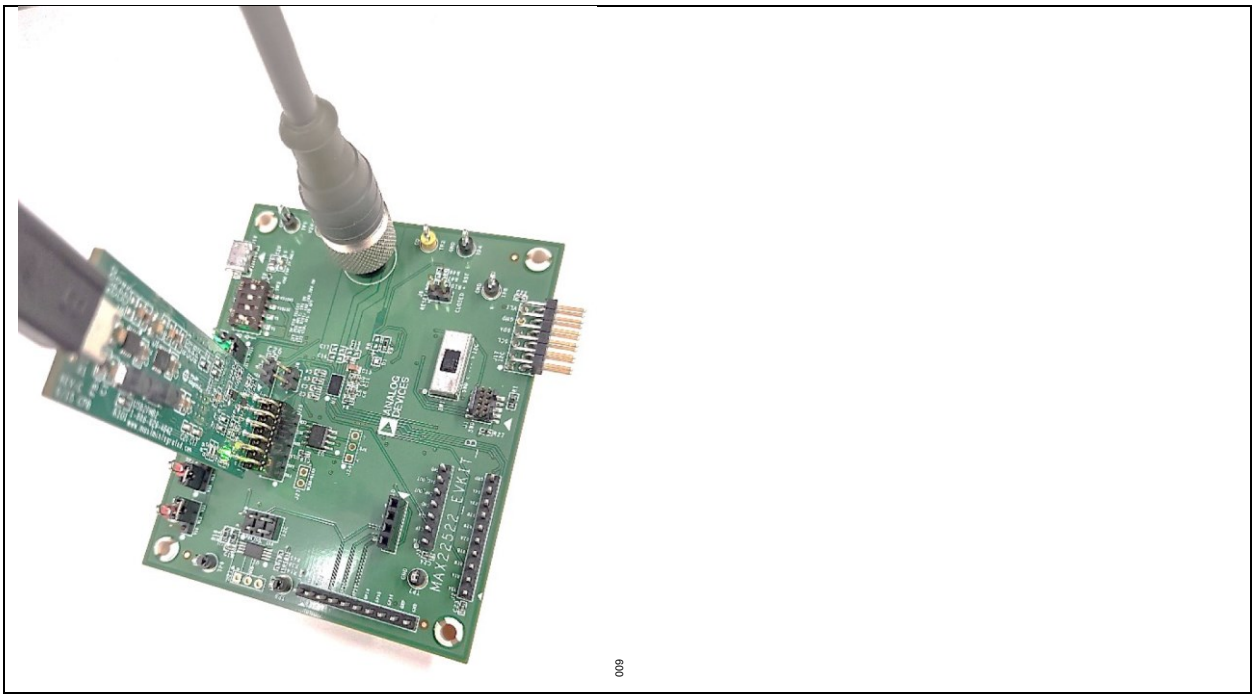


Figure 8. USB2PMB2 Connection to Program On-Board EEPROM

2. Open the **MAX22512/MAX22522 EEPROM Tool** and select the **EEPROM – USB2PMB2 (direct)** tab. Click the **EEPROM Connect** button to connect to the EEPROM. The device's connection status is shown in the bottom right of the GUI screen. See *Figure 9*.

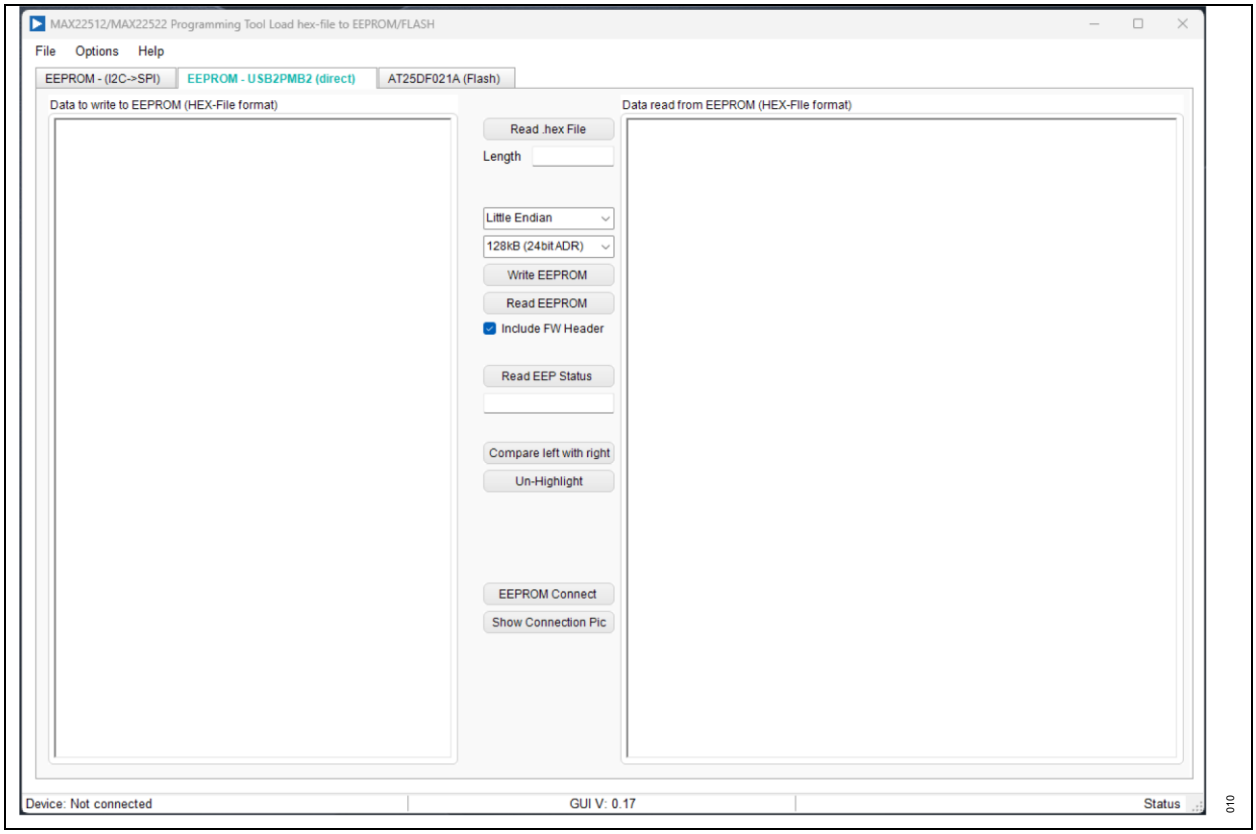


Figure 9. MAX22512/MAX22522 OTP/EEPROM GUI EEPROM - USB2PMB2 (direct) Tab

3. Using the drop-down menus, select **Little Endian** and **128kB (24-bit ADR)** settings.
4. Click the **Read .hex File** button and select the hex file for the information to program into the EEPROM. Once the hex file is select, the window on the left side of the GUI, **Data to write to EEPROM (HEX-File format)** fills with the data to write. The length of the hex file appears in the **Length** box. See *Figure 10*.

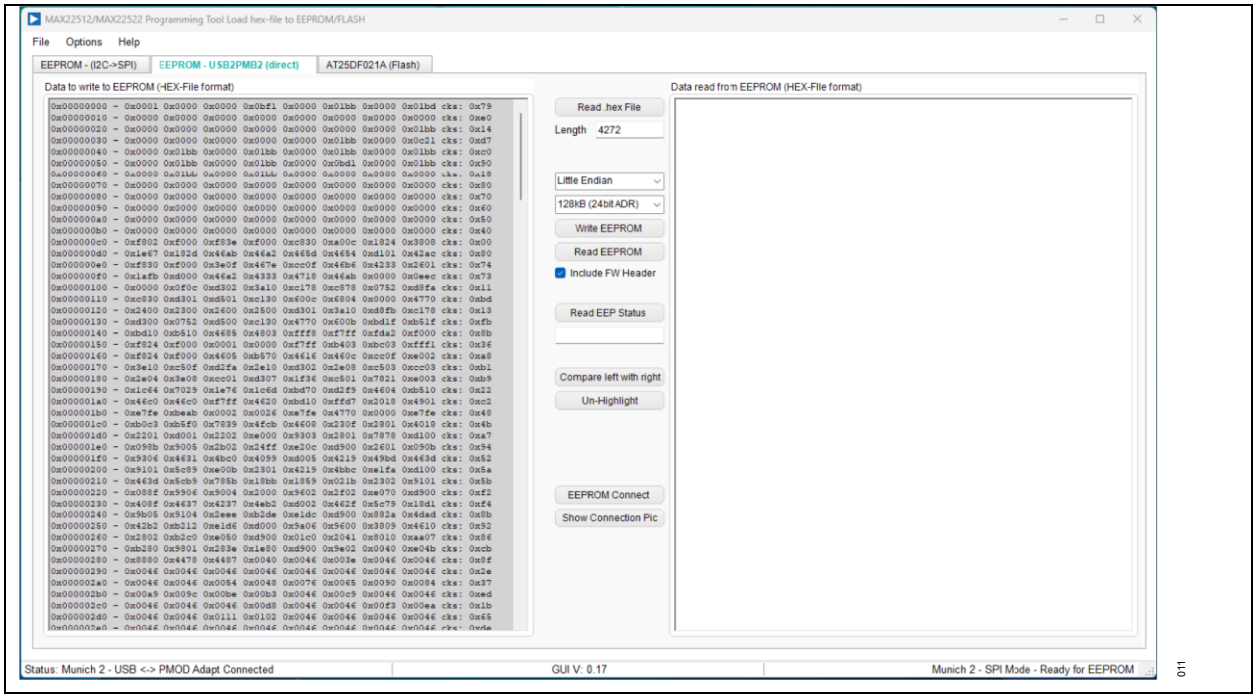


Figure 10. Data to Write to EEPROM Window in GUI before Write is Started

5. Click the **Write EEPROM** button to write the information to the EEPROM. The background of the left window turns bright green when data has been programmed. See *Figure 11*.

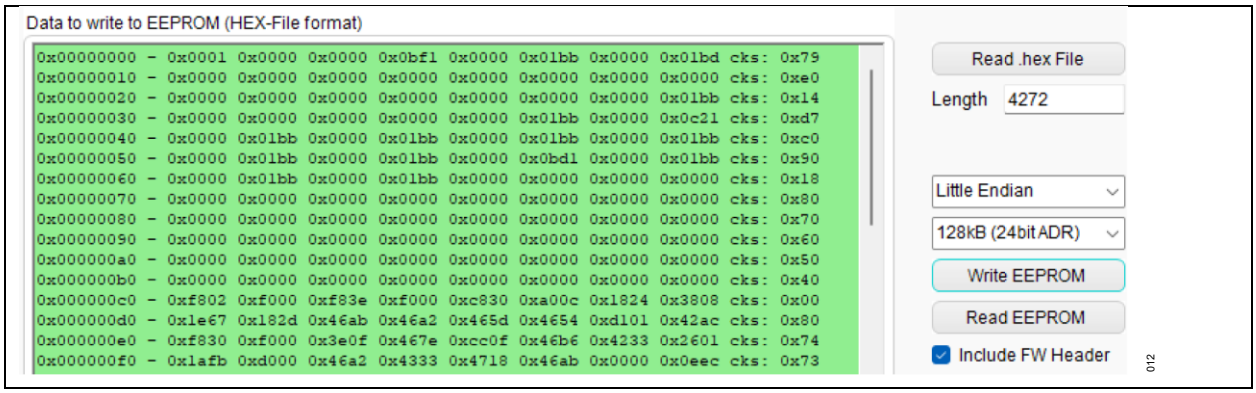


Figure 11. Data to Write to EEPROM Window in GUI after Write is Complete

6. To verify data is programmed to the EEPROM, click the **Read EEPROM** button. Data from the EEPROM is read and printed in the right-side window, **Data read from EEPROM (HEX-File format)**. Click the **Read EEP Status** button or **Compare left with right** button to verify the data read from EEPROM is the same as the data written to the EEPROM. See *Figure 12*.

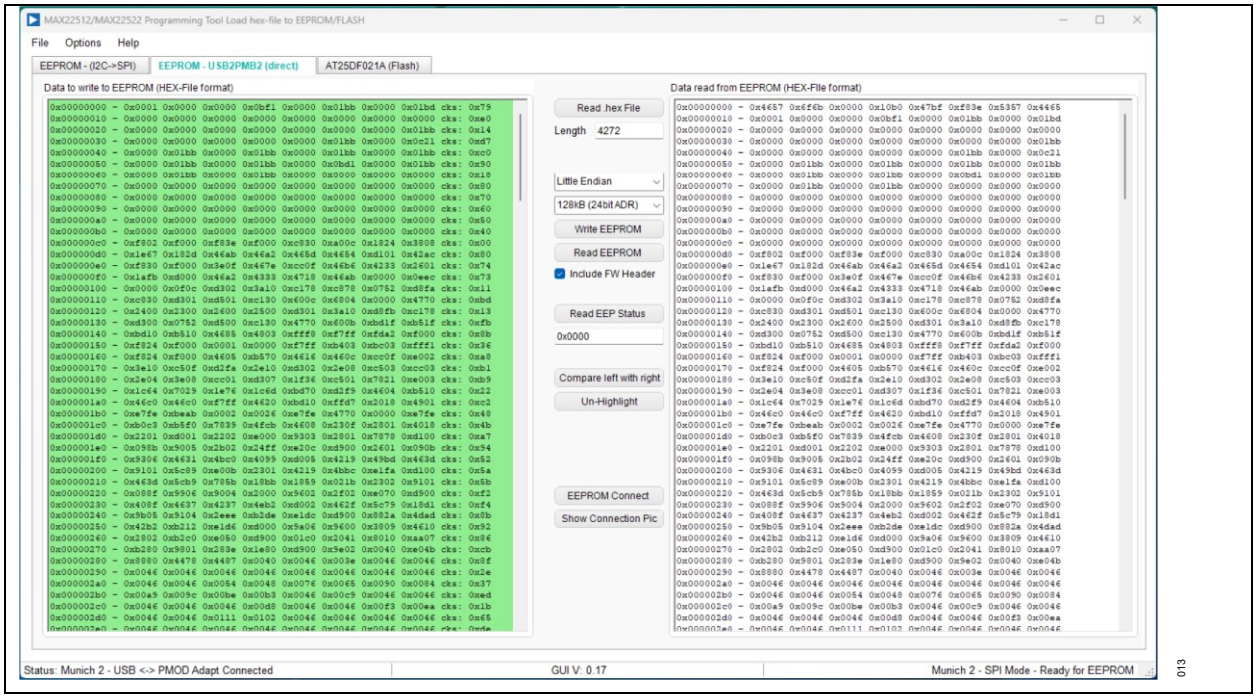


Figure 12. Data Read from EEPROM Window after EEPROM Write

7. Remove the SPI controller and replace shunts across the J25 header.
8. Cycle power to the MAX22512 EV kit. The device boots up using the application programmed into the EEPROM.

EV Kit Package

Analog Devices provides useful documentation and sample code that serve as a guide for evaluation and development. The package includes examples of code for basic peripheral functionality. For more details, refer to the MAX22512/MAX22522 User Guide.

Ordering Information

PART	TYPE
MAX22512EVKIT#	EV Kit

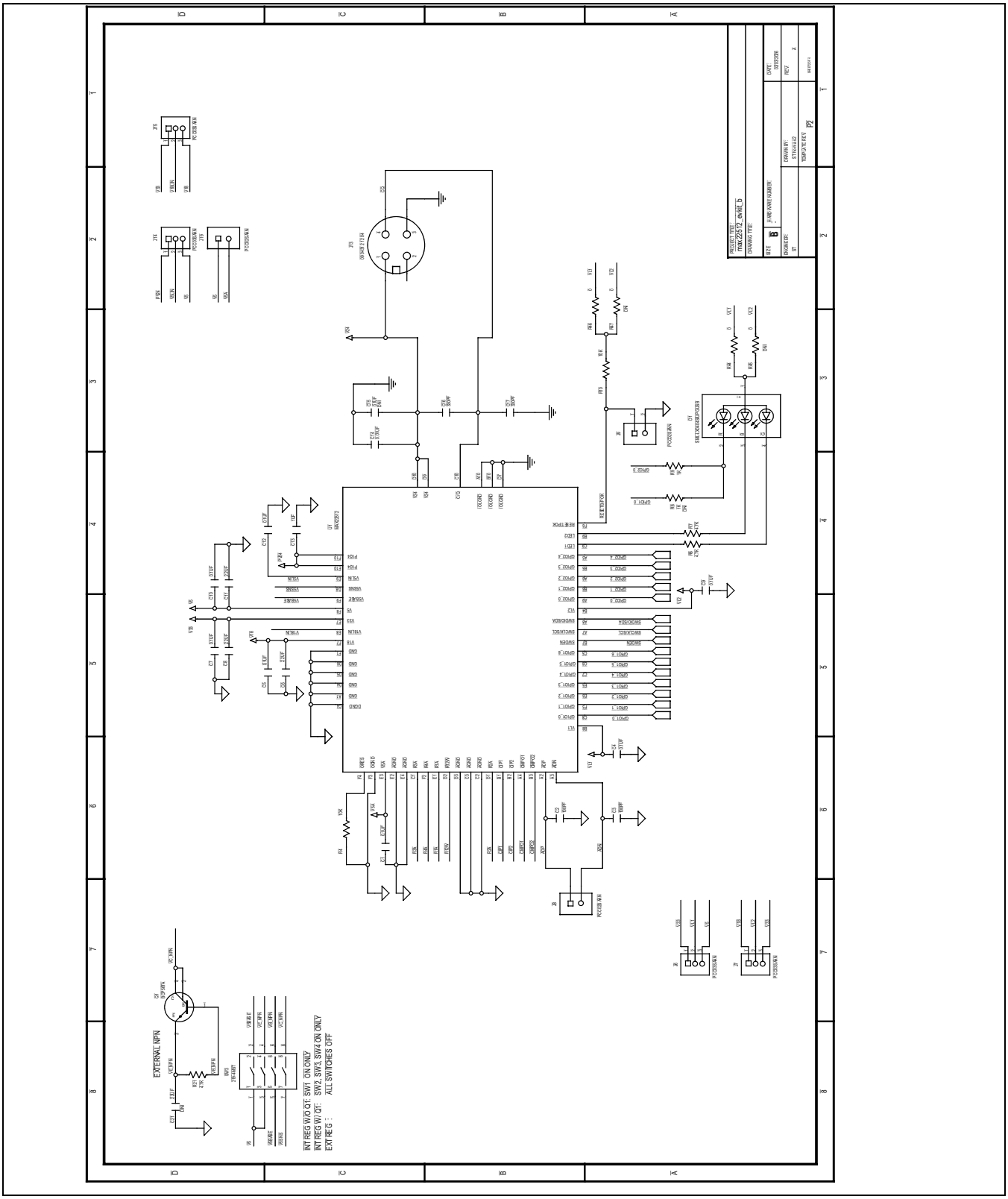
#Denotes RoHS-compliant.

MAX22512 EV Kit Bill of Materials

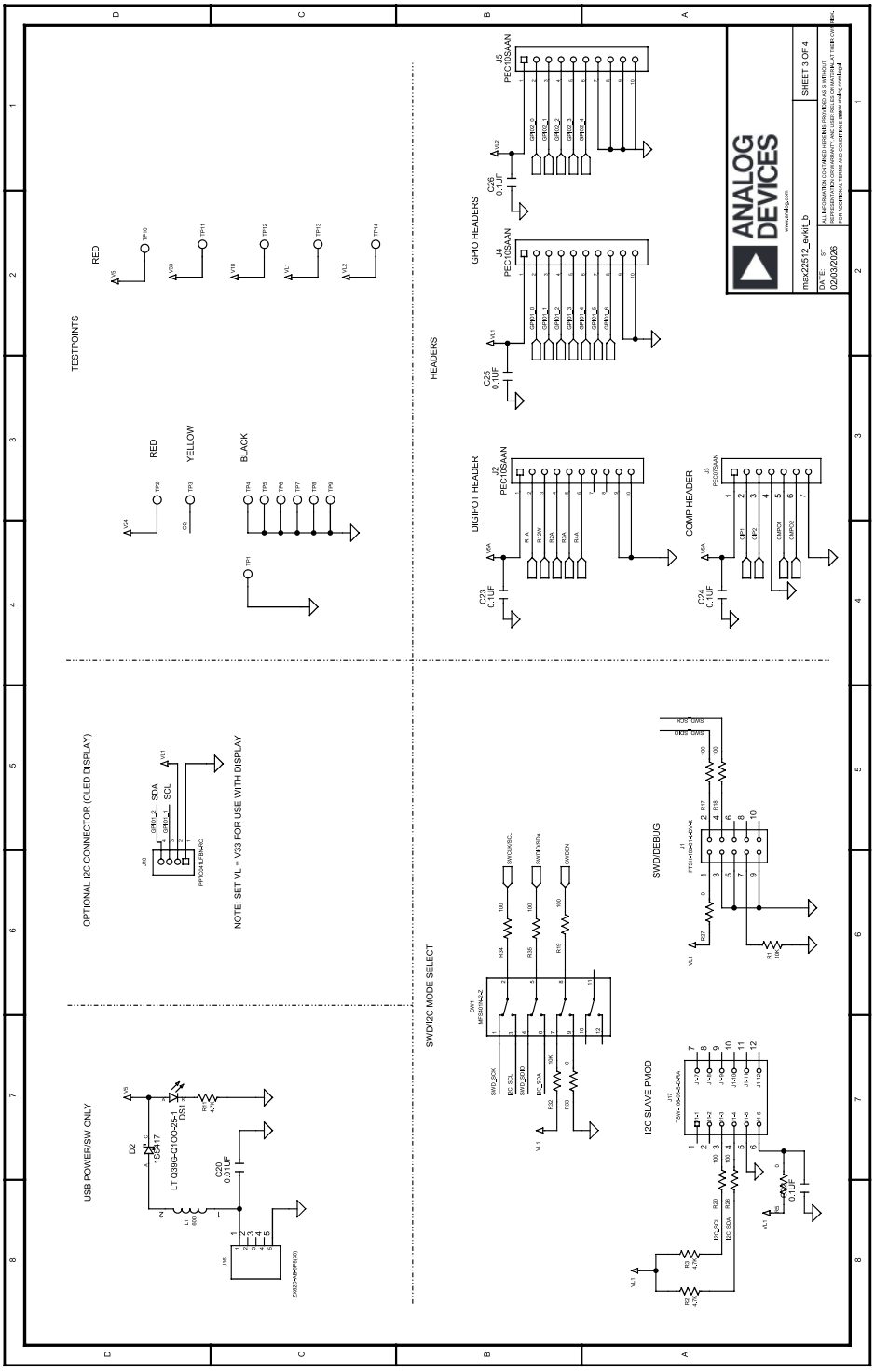
PART	QTY	DESCRIPTION
C1, C4, C5, C7, C9, C10, C18, C19, C22–C26	13	CAP; SMT (0402); 0.1µF; 5%; 16V; X7R; CERAMIC
C2, C3	2	CAP; SMT (0402); 100PF; 5%; 50V; C0G; CERAMIC
C6, C8, C11	3	CAP; SMT (0402); 2.2µF; 10%; 10V; X7R; CERAMIC
C12	1	CAP; SMT (0603); 0.1µF; 10%; 100V; X7R; CERAMIC
C13	1	CAP; SMT (0805); 1µF; 10%; 100V; X7R; CERAMIC
C14	1	CAP; SMT (0402); 0.01µF; 10%; 100V; X7S; CERAMIC
C16, C17	2	CAP; SMT (0603); 330PF; 10%; 50V; X7R; CERAMIC
C20	1	CAP; SMT (0603); 0.01µF; 10%; 16V; X7R; CERAMIC
D1	1	DIODE; LED; SML; FULL COLOR; WATER CLEAR LENS; RED-GREEN-BLUE; SMT; VF=2.95V; IF=0.1A
D2	1	DIODE; SCH; SMT (SOD-923); PIV=45V; IF=0.1A
DS1	1	DIODE; LED; TRUE GREEN; SMT (0603); VF=2.85V; IF=0.005A;
J1	1	CONNECTOR; MALE; SMT; 0.05 (1.27MM) SMT MICRO HEADER; STRAIGHT; 10PINS

J2, J4, J5	3	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 10PINS
J3	1	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 7PINS
J6, J7, J14, J15	4	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS
J8, J9, J19	3	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS
J10	1	CONNECTOR; FEMALE; THROUGH HOLE; FEMALE HEADER; STRAIGHT; 4PINS
J12	1	MODULE; ANAVI MACRO PAD 8; 5.32 X 1.86 IN
J13	1	CONNECTOR; MALE; TH; MALE RECEPTACLE; THREADED; PCB SOLDER; STRAIGHT; 4PINS
J16	1	CONNECTOR; FEMALE; SMT; USB MICRO CONNECTOR; RIGHT ANGLE; 5PINS
J17	1	CONNECTOR; THROUGH HOLE; DOUBLE ROW; RIGHT ANGLE; 12PINS
J20	1	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 6PINS
L1	1	INDUCTOR; SMT (0805); FERRITE-BEAD; 600; TOL=+/-25%; 0.2A
MH1–MH4	4	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN;
Q1	1	TRAN; NPN SILICON PLANAR MEDUIM POWER TRANSISTOR; NPN; SOT-223 ; PD-(2.0W); I-(1A); V-(80V)
R1, R10	2	RES; SMT (0603); 10K; 1%; +/-100PPM/DEGC; 0.1000W
R2, R3, R6, R7, R11	5	RES; SMT (0402); 4.7K; 1%; +/-100PPM/DEGC; 0.0630W
R4	1	RES; SMT (0402); 10K; 0.10%; +/-25PPM/DEGK; 0.0630W
R5, R27, R33, R44, R46	5	RES; SMT (0402); 0; JUMPER; JUMPER; 0.2000W
R9, R12, R13, R15, R16, R22	6	RES; SMT (0603); 1K; 1%; +/-100PPM/DEGC; 0.1000W
R17–R20, R26, R34, R35	7	RES; SMT (0402); 100; 1%; +/-100PPM/DEGC; 0.0630W
R21	1	RES; SMT (0603); 4.7K; 1%; +/-100PPM/DEGC; 0.1000W
R32	1	RES; SMT (0402); 10K; 1%; +/-50PPM/DEGK; 0.0630W
SW1	1	SWITCH; 4PDT; THROUGH HOLE; STRAIGHT; +5V TO +30V; 0.01A-0.3A; MFS SERIES; RCONTACT=0.02 OHM; RINSULATION=100M OHM
SW3	1	SWITCH; SPST; SMT; STRAIGHT; 20V; 0.1A; SURFACE MOUNT DIP SWITCH-AUTO PLACEABLE; RINSULATION=1000M OHM
TP1, TP4–TP9	7	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK
TP2, TP10–TP14	6	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED
TP3	1	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; YELLOW
U1	1	EVKIT PART - IC; PACKAGE OUTLINE DRAWING: 21-100691; PACKAGE CODE: W602B4+1
U2	1	IC; EEPROM; 128-KBIT SERIAL I2C BUS EEPROM; TSSOP8
U3	1	IC; EEPROM; EEPROM SERIAL 1-MB SPI AUTOMOTIVE GRADE 1; NSOIC8;

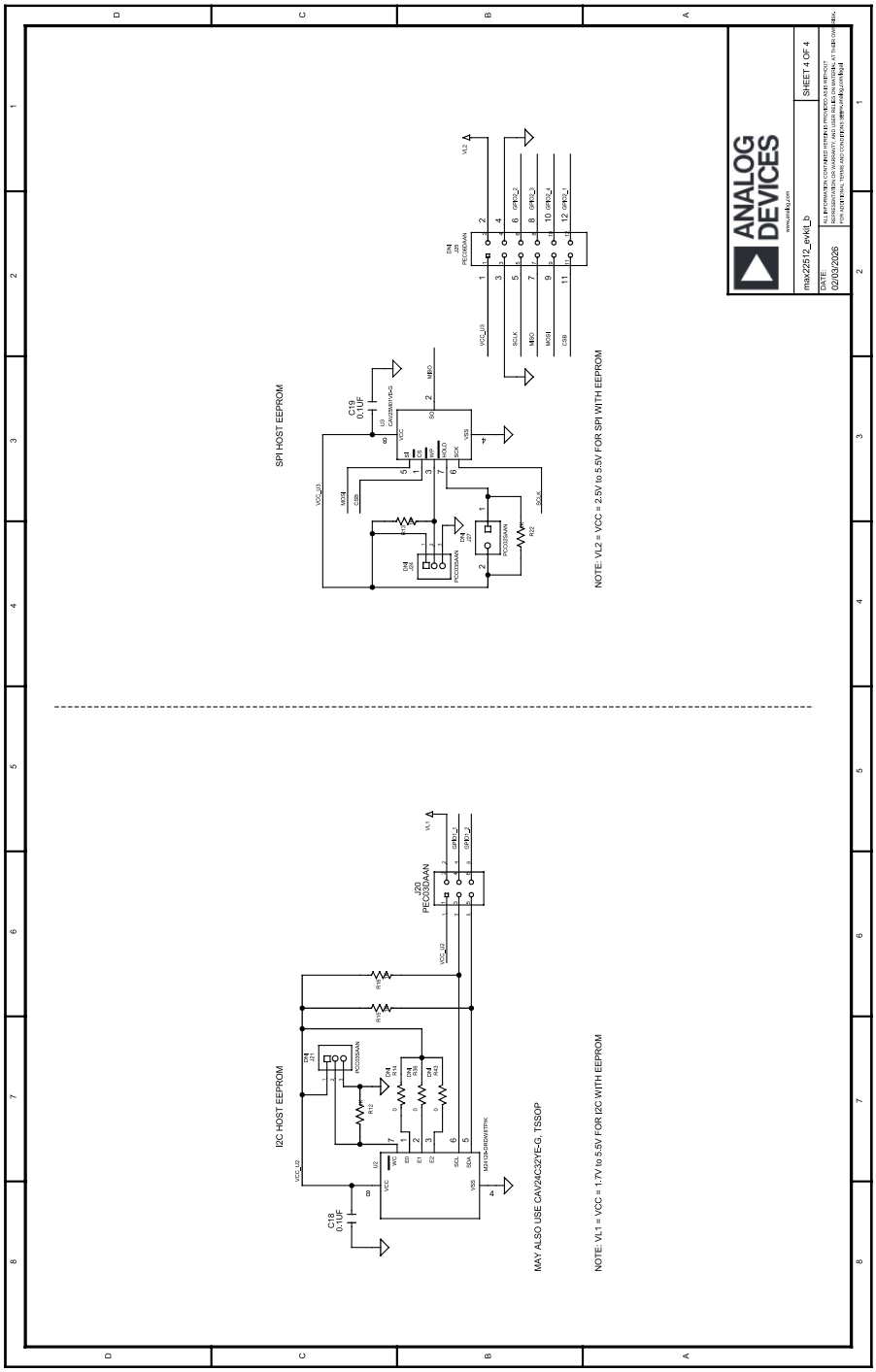
MAX22512 EV Kit Schematic



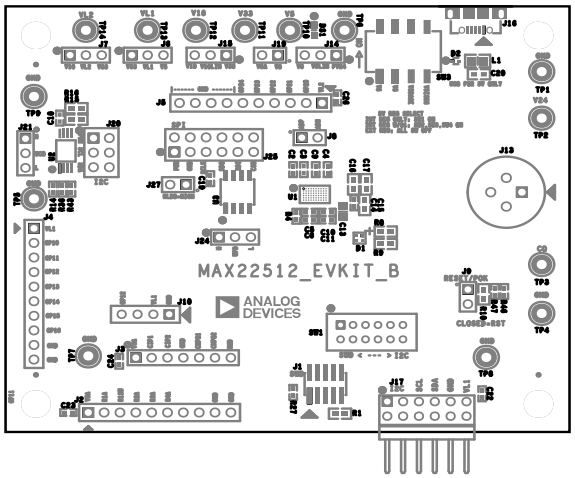
MAX22512 EV Kit Schematic (continued)



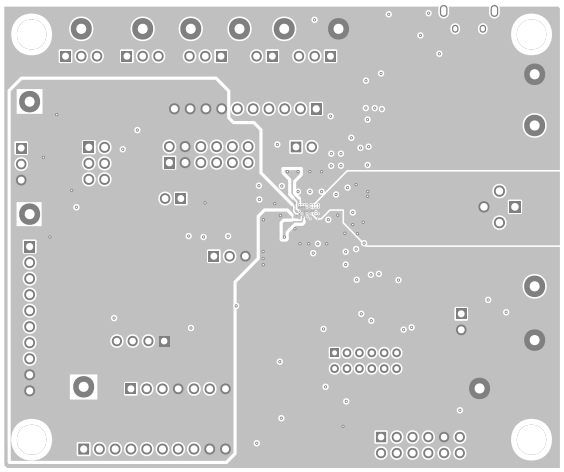
MAX22512 EV Kit Schematic (continued)



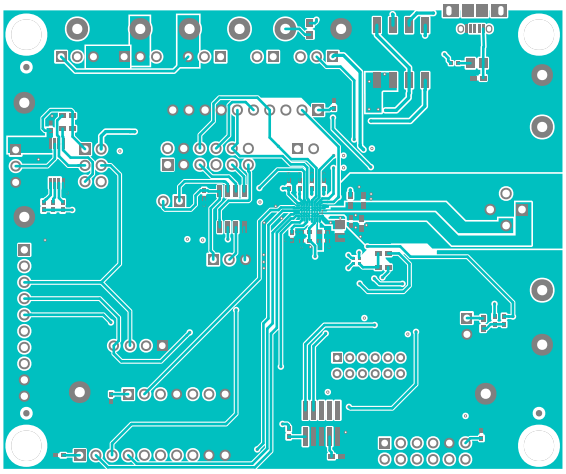
MAX22512 EV Kit PCB Layout



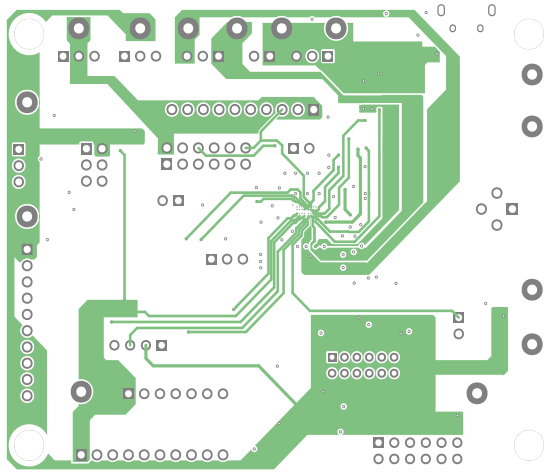
MAX22512 EV Kit Component Placement Guide—Top Silkscreen



MAX22512 EV Kit PCB Layout—Layer 2

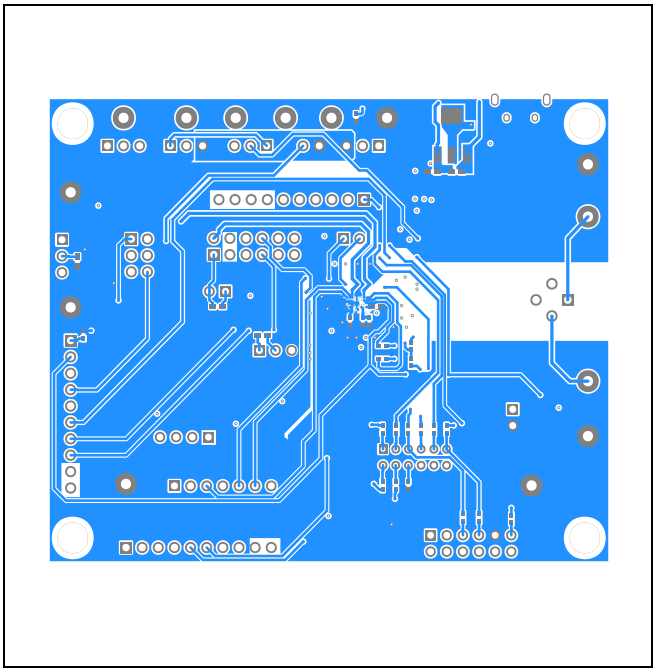


MAX22512 EV Kit PCB Layout—Top

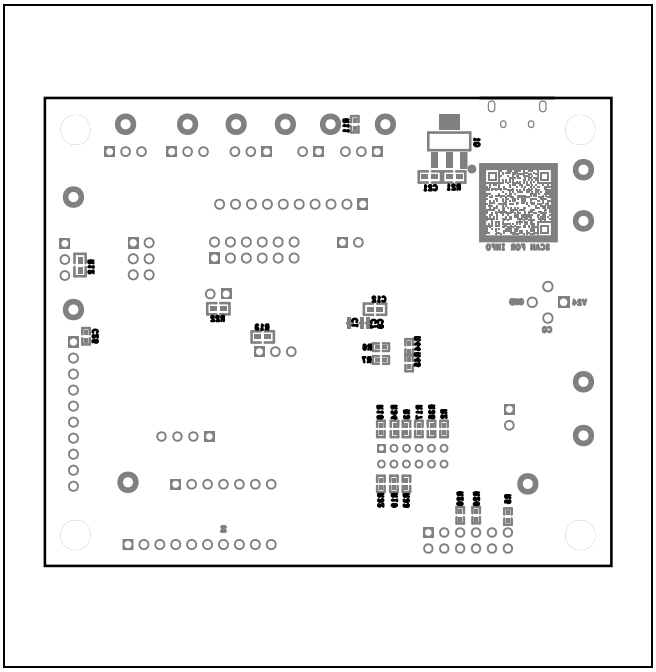


MAX22512 EV Kit PCB Layout—Layer 3

MAX22512 EV Kit PCB Layout (continued)



MAX22512 EV Kit PCB Layout—Bottom



MAX22512 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	06/26	Initial release	—

Notes