MAX22516 Evaluation Kit

Evaluates: MAX22516

General Description

The MAX22516 evaluation kit (EV kit) consists of the evaluation board and software. The EV kit is a fully assembled and tested circuit board that evaluates the MAX22516 IO-Link® data link controller with transceiver and integrated DC-DC buck regulator. The EV kit includes Windows®-compatible software that provides a graphical user interface (GUI) for exercising the features of the MAX22516. The EV kit is connected to a PC through a USB-A-to-micro-B cable.

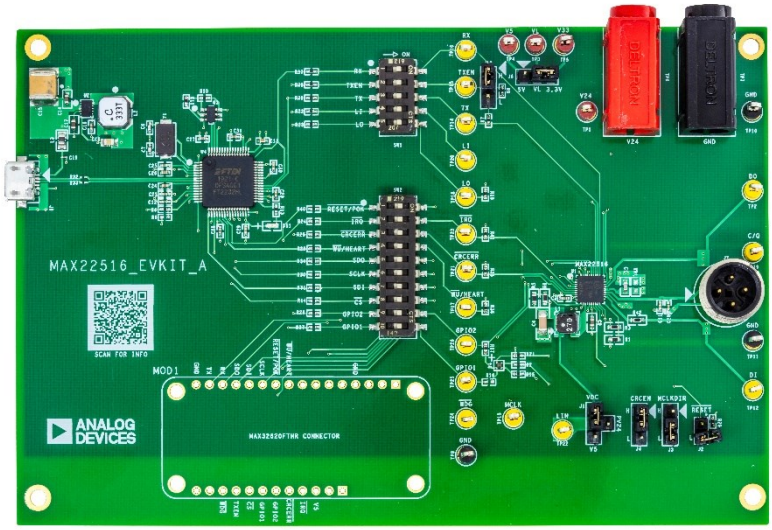
Windows based GUI software is available for use with the EV kit and can be downloaded from Analog Devices' website at www.analog.com/products/en/MAX22516. Windows 7 or newer Windows operating system is required to use the EV kit software.

Features and Benefits

- IO-Link Compliant Device Transceiver
- I/O and SPI Interface Terminals
- Windows 10 Compatible Software
- USB-PC Connection

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

EV Kit Photo



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Windows is a registered trademark and registered service mark of Microsoft Corporation.

319-101028; Rev 0; 10/23

MAX22516 EV Kit Files

FILE	DESCRIPTION
MAX22516EVKITSetupVx.xx.exe	Installs EV kit files onto computer.

Quick Start

Required Equipment

- MAX22516 EV Kit (USB-A-to-micro-B cable)
- User-supplied Windows 10 PC with a spare USB port
- 24V, 1A DC power supply
- 100kHz function generator
- Multimeter/voltmeter
- 2-channel oscilloscope

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

1. Install the EV kit software on the computer by running the **MAX22516EVKITSetupVx.x.x.exe** program inside the temporary folder. This copies the program files and creates an icon in the Windows **Start** menu. The software requires the .NET Framework 4.5 or later. If connected to the internet, Windows automatically updates the .NET Framework as needed.
2. The EV kit software launches automatically after install, and it can be launched by clicking its icon in the Windows **Start** menu.
3. Ensure that all jumpers are in their default position (*Table 1*).
4. Connect the 24V supply to the V_{24} test point (TP1) or using the V24 plug (TP6). Connect the ground terminal of the supply to the GND test point (TP10) or using the GND plug (TP7).
5. Connect the USB cable to the MAX22516 EV kit.
6. Turn on the 24V supply.
7. Connect the multimeter/voltmeter to the V_L test point (TP3) and verify that it reads 3.3V.
8. Launch the MAX22516 EV kit. When the board is recognized, the EV kit GUI shows that the board is connected in the lower right-hand corner of the GUI.
9. Connect the function generator to the TX test point (TP14).
10. Connect the oscilloscope channels to the TX test point (TP14) and the C/Q test point (TP19).
11. In the Register Settings tab, scroll down to the CQ_CTRL1 register and enable the C/Q driver by setting CQ_EN (B[0]) to 1.
12. Configure the C/Q driver in push-pull mode by setting the CQ_PP (B[2]) to 1.
13. Click **Write Modified** button to write these values to the MAX22516.
14. Turn on the function generator and verify that C/Q switches as expected.

Table 1. Jumper Connection Guide

JUMPER	DEFAULT CONNECTION	FEATURE
J1	1-2	LIN supply selection. 1-2: LIN is connected to the output of DC-DC. 1-3: LIN is connected to PV_{24}. 1-4: LIN is connected to V_5. Apply an external 5V supply to V_5 when using this configuration.
J2	Open	$\overline{RESET}$/POK setting. Open: $\overline{RESET}$/POK is pulled up to V_L. Closed: $\overline{RESET}$/POK is connected to ground.
J3	2-3	MCLKDIR setting. 1-2: MCLKDIR is high. MCLK is an output. 2-3: MCLKDIR is low. MCLK is an input.
J4	2-3	CRCEN setting. 1-2: CRCEN is high. CRC on the SPI interface is enabled. 2-3: CRCEN is low. CRC on the SPI interface is disabled.
J6	2-3	V_L supply selection. 1-2: $V_L = V_5$ 2-3: $V_L = V_{33}$
J10	1-2	TXEN setting. 1-2: TXEN is high. 2-3: TXEN is low.

Detailed Description of Hardware

Power

USB to PC Connection

The MAX22516 EV kit includes an FTDI 2232 USB converter to communicate with a PC. The 3.3V supply required to power the FTDI IC is supplied by the USB connection. LED DS1 turns on when the FTDI is powered and configured.

IO-Link Power (V_{24})

Power for the MAX22516 is supplied by connecting a power supply to the V_{24} test points (TP1 or TP6), or by connecting an IO-Link master to the MAX22516 EV kit board and supplying power through the L+ (V_{24}) line. When using an IO-Link master to power the board, ensure that no external supplies are connected to the V_{24} test points.

Regulators and Logic (V_5, V_{33}, V_L)

The LIN regulator input pin can be connected to PV_{24}, the output of the on-board DC-DC, or to the V_5 pin using the J1 jumper. The DC-DC is configured to output a voltage of 5.9V. Connect J1 to the 1-2 position to connect LIN to the output of the DC-DC.

To disable the integrated V_5 regulator, connect LIN to V_5 (J1 is 1-4), and connect an external 5V supply to the V_5 test point (TP4). 5V on V_5 is required for normal operation.

The V_L logic supply can be selected using the J6 jumper. Connect J6 to the 1-2 position to set $V_L = V_5$. Connect J6 to 2-3 to set $V_L = V_{33}$. If required, remove the shunt on J6 and connect an external supply from 2.5V to 5.5V to the V_L test point (TP3). V_L is required for normal operation.

IO-Link Connection

The MAX22516 EV kit includes a standard 4-pin M12 connector used in IO-Link communication. Connect a cable between an IO-Link master and the MAX22516 EV kit to use MAX22516 to communicate with the IO-Link master. The EV kit GUI includes an IO-Link Communication tab to simplify this. For more information, see the *IO-Link Tab* section. The MAX22516 is tested on the EV kit to survive surge pulses up to ±1.2kV/500Ω on the C/Q and DO pins. Note that the 1kΩ series impedance (R42) on the DI input, however, is not rated for high voltage/current events and does not survive surge testing. Replace the R42 with a 1kΩ pulse resistor for surge testing, if needed.

Detailed Description of Software

The MAX22516 is designed to allow quick and easy evaluation of the device. The MAX22516 EV kit GUI contains two tabs: **Register Settings** tab that allows individual register and bit access, and an **IO-Link** tab for fast IO-Link communication setup. For more information, see *Figure 1*.

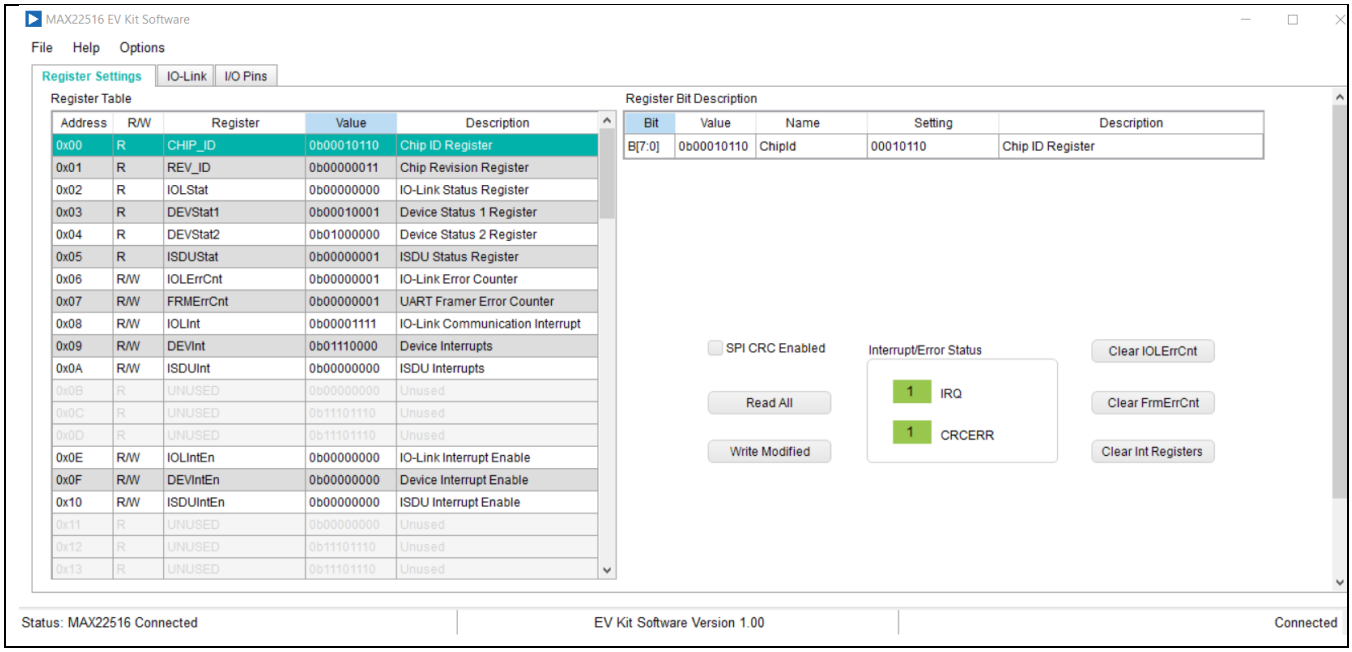


Figure 1. MAX22516 EV Kit GUI, Register Settings Tab

The bottom of the MAX22516 EV kit GUI contains the version and connection status of the EV kit GUI and EV kit, itself. Ensure that the EV kit is connected to the PC to begin evaluation.

Register Settings Tab

The Register Settings tab opens by default and includes two tables: **Register Table**, (on the left), and **Register Bit Description** table (on the right), SPI read and write buttons, interrupt indicators, and clear command buttons.

Register Tables

The **Register Table** includes a complete list of available registers as outlined in the MAX22516 data sheet. Select a register by clicking at any point in the register row. When a register is selected in the in the **Register Table**, the **Register Bit Description** table populates with information for each bit in that register.

SPI Communication (Read All, Write Modified, and CRC)

To set a bit, in the **Register Bit Description** table, click the drop-down box in the **Setting** column and select the required bit value. Note that bits that are unused or not available do not have drop-down boxes. Alternatively, click the **Value** column of a given register to type on the register value directly, in binary format, starting with 0b.

Any register that is edited and/or changed is highlighted with red text in the main table until the updated values are written to the MAX22516. Click the **Write Modified** button to write the new register values to the MAX22516. Note that only registers highlighted in red text are written when the **Write Modified** button is clicked and all register text returns to black when the write is complete.

Click the **Read All** button to read all of the registers in the MAX22516.

The MAX22516 is capable of SPI communication with CRC protection. CRC functionality is enabled by setting the CRCEn bit in the IOLCfg register to 1 or by driving the CRCEN pin high (J4 is 1-2). Select the **SPI CRC Enabled** check box.

Interrupt/Error Status ($\overline{IRQ}$ and $\overline{CRCERR}$)

The **Interrupt/Error Status** box reports the logic level of the $\overline{IRQ}$ and $\overline{CRCERR}$ pins on the MAX22516.

$\overline{IRQ}$ asserts when an enabled interrupt occurs and the associated indicator box in the **Interrupt/Error Status** box turns yellow. Enable interrupts by setting the bits in the IOLIntEn, DEVIntEn, and/or ISDUIntEn registers. Click the **Clear Int Register** button to clear the IOLInt, DEVInt, and ISDUInt registers and deassert $\overline{IRQ}$, if asserted. Alternatively, write 0xFF to each register to clear it.

$\overline{CRCERR}$ asserts when the MAX22516 detects a CRC error in the SPI communication. The associated indicator box in the **Interrupt/Error Status** box turns yellow to indicate that an error has occurred. $\overline{CRCERR}$ does not deassert until a valid write sequence is completed. Ensure that the **SPI CRC Enabled** check box is selected and CRCEn = 1 or CRCEN is high, if using CRC for the SPI interface.

Clearing the IO-Link Error Counter, UART Framer Error, and Interrupt Registers

The IOLErrCnt and FRMErrCnt registers increase with each IO-Link and/or UART framer error received by the MAX22516. Click the **Clear IOLErrCnt** button to reset the IOLErrCnt register to 0, when needed. Similarly, click the **Clear FRMErrCnt** button to clear the FRMErrCnt register.

Bits in the IOLInt, DEVInt, and ISDUInt registers are not automatically cleared after an interrupt-triggering event occurs. Click the **Clear Int Registers** button to clear the IOLInt, DEVInt, and ISDUInt registers after an interrupt bit in any of these registers has been set.

IO-Link Tab

The MAX22516 is capable of establishing a connection and basic communication with an IO-Link master with minimal programming. While programming individual registers is available in the **Register Settings** tab, the **IO-Link** tab provides an easy-to-use interface including all of the settings and data needed to evaluate basic IO-Link communication with the MAX22516.

Configure the MAX22516 for IO-Link configuration in the following sequence (as shown in the group boxes in the GUI, *Figure 2*):

1. Set the required IO-Link communication rate.
2. Configure the C/Q driver.
3. Set the Direct Page 1 parameters.
4. Input the PDIn process data to be written to the IO-Link master.
5. Click the **Start IO-Link Communication** button to write all the settings to the associated registers and set the ConfDone bit.

Once the **Start IO-Link Communication** button is clicked, the MAX22516 is ready to respond to an incoming wake-up pulse from a connected IO-Link master and begins IO-Link communication once a valid wake-up signal is received.

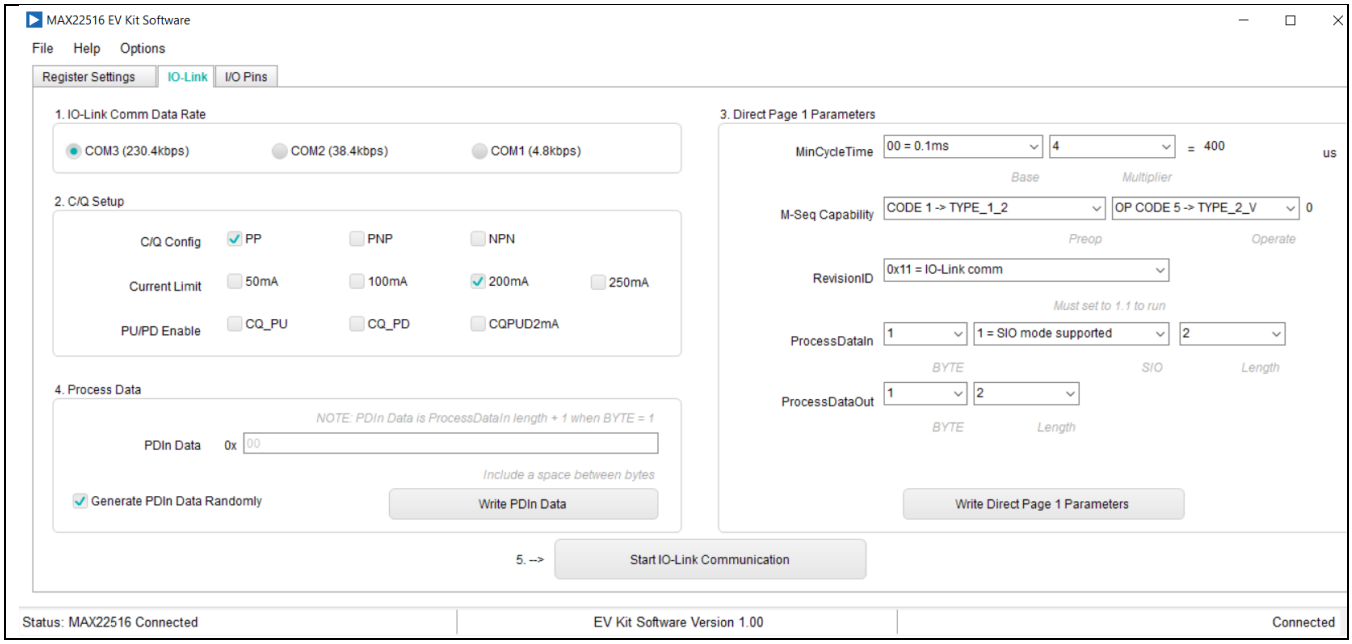


Figure 2. IO-Link Tab in the MAX22516 EV Kit GUI

IO-Link Comm Data Rate

Select the required IO-Link data rate (COM1, COM2, or COM3) here. COM3 is selected by default.

C/Q Setup

Configure the C/Q for IO-Link configuration. Push-pull (PP) mode with a 200mA is selected as default.

Direct Page 1 Parameters

Direct Page 1 parameters are required to establish communication with an IO-Link master. Details for each of these parameters can be found in the IO-Link standard. Click the **Write Direct Page 1 Parameters** button to write the data rate, C/Q configuration, and Direct Page 1 parameters to the MAX22516.

Process Data

Process data configuration settings are programmed in the Direct Page 1 Parameters section. Write or generate the required process data to send by entering data in the **PDIn Data** text box or by selecting the **Generate PDIn Data Randomly** check box. Click the **Write PDIn Data** button to write the data to the PDIn buffer.

Note that the PDIn buffer is not updated continuously with new data, and the MAX22516 sends the data in the PDIn buffer. Write new data in the **PDIn Data** text box and click the **Write PDIn Data** button to write new data to the buffer after communication has been established, if required. Similarly, select the **Generate PDIn Data Randomly** check box and click the **Write PDIn Data** button to write new data to the PDIn buffer after communication has been established, if required.

Start IO-Link Communication

The MAX22516 stops all communication through the C/Q line when the ConfDone bit in the IOLCfg register is 0. Click the **Start IO-Link Communication** button, after setting all other registers using the **Write Direct Page 1 Parameters** and **Write PDIn Data** buttons, or by individually setting the register values in the **Register Settings** tab, to enable the MAX22516 for IO-Link communication. Initiate communication from the IO-Link master after the ConfDone bit is set.

I/O Pins Tab

Two switches, SW1 and SW2, on the MAX22516 EV kit allow direct access to the UART control pins (TXEN, TX, RX, LO), and to the GPIO1 and GPIO2 pins. Ensure that the individual switches on SW1 and SW2 are ON and toggle the **Enable Pin Control** button in the upper left corner of the **I/O Pins** tab to enable control of these pins using the GUI (*Figure 3*).

Figure 3. I/O Pin Tab in the MAX22516 EV Kit GUI

UART and GPIO Pin Control (TXEN, TX, RX, LO, GPIO1, GPIO2)

Click the toggle button for each UART control pin or GPIO to set the associated pin high or low. The associated box in the **Read** column for each pin indicates whether the pin is a set high (1) or low (0). If GUI pin control is enabled and the voltage on a pin does not match the setting on the **I/O Pins** tab, a warning box indicates that the pin voltage does not match the requested setting. Ensure that external signals are not connected to the UART controller pins and/or GPIO pins when pin control is enabled in the GUI.

Interrupts and Indicators

Other switches in SW2 also allow the GUI to indicate the status of the $\overline{IRQ}$, $\overline{WU}$/HEART, $\overline{CRCERR}$, and $\overline{RESET}$/POK pins when the **Read All** button is clicked. Text boxes also appear indicating when $\overline{IRQ}$ is low (Interrupt Received) or a valid-wake up has been detected (Wake-Up Received).

Ordering Information

PART	TYPE
MAX22516EVKIT#	EV Kit

#Denotes RoHS-compliant.

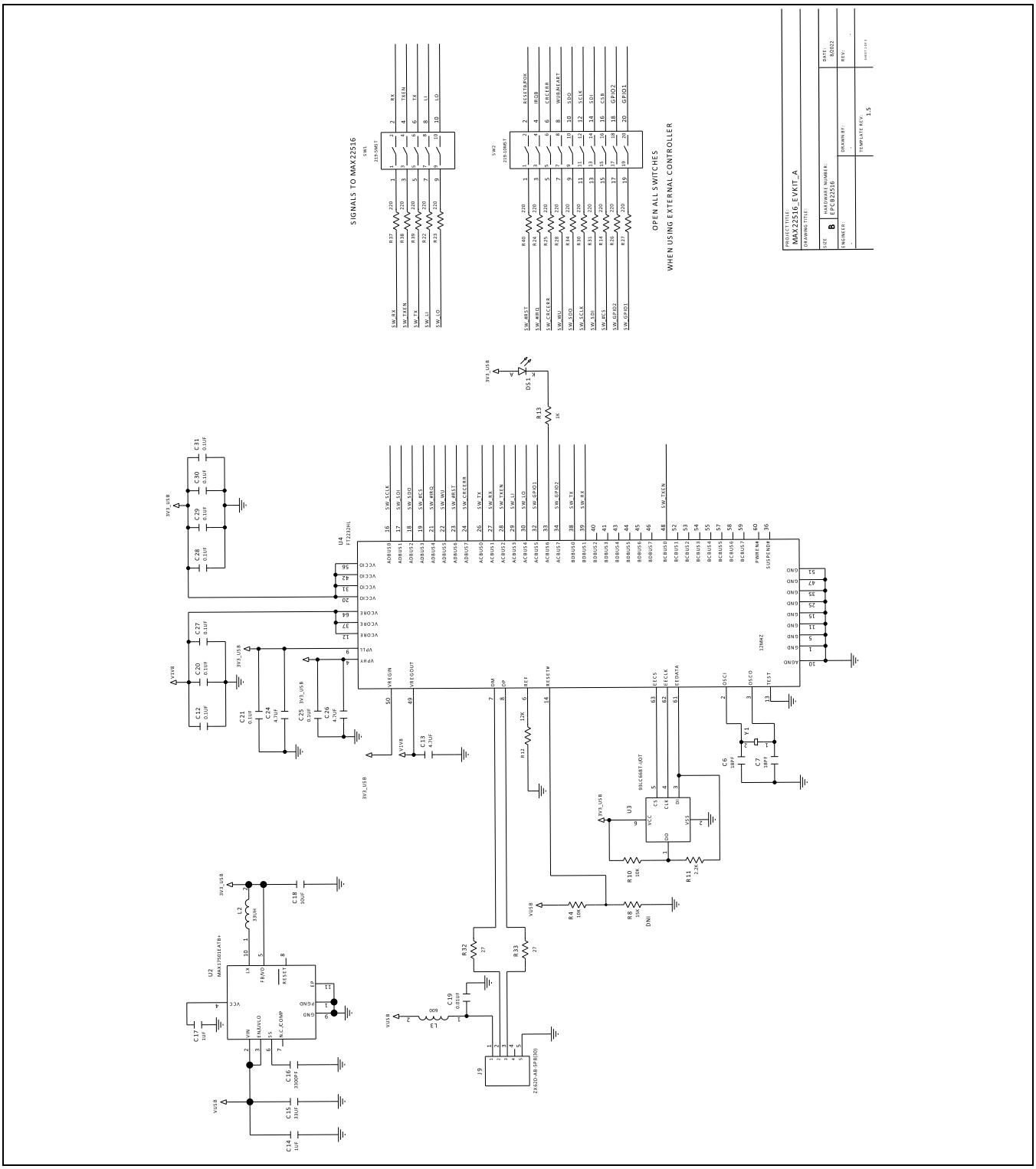
MAX22516 EV Kit Bill of Materials

REF DES	DNI/DNP	QTY	VALUE	DESCRIPTION
C1	-	1	0.01UF	CAP; SMT (0603); 0.01UF; 5%; 100V; C0G; CERAMIC
C2, C9	-	2	1UF	CAP; SMT (0603); 1UF; 10%; 50V; X7R; CERAMIC
C3, C5, C8	-	3	1UF	CAP; SMT (0402); 1UF; 10%; 6.3V; X7R; CERAMIC
C4	-	1	6.8UF	CAP; SMT (1206); 6.8UF; 10%; 50V; X5R; CERAMIC
C6, C7	-	2	18PF	CAP; SMT (0402); 18PF; 5%; 50V; C0G; CERAMIC
C10, C11	-	2	330PF	CAP; SMT (0402); 330PF; 10%; 50V; X7R; CERAMIC
C12, C20, C21, C25, C27-C31	-	9	0.1UF	CAP; SMT (0402); 0.1UF; 5%; 10V; X7R; CERAMIC
C13, C24, C26	-	3	4.7UF	CAP; SMT (0402); 4.7UF; 20%; 10V; X5R; CERAMIC
C14	-	1	1UF	CAP; SMT (0603); 1UF; 10%; 16V; X7R; CERAMIC
C15	-	1	33UF	CAP; SMT (2220); 33UF; 20%; 25V; X7R; CERAMIC
C16	-	1	3300PF	CAP; SMT (0402); 3300PF; 10%; 50V; X7R; CERAMIC
C17	-	1	1UF	CAP; SMT (0603); 1UF; 20%; 16V; X7R; CERAMIC
C18	-	1	10UF	CAP; SMT (0805); 10UF; 10%; 10V; X5R; CERAMIC
C19	-	1	0.01UF	CAP; SMT (0201); 0.01UF; 10%; 10V; X7R; CERAMIC
D4	-	1	SML-LX0404SIUPGUSB	DIODE; LED; SML; FULL COLOR; WATER CLEAR LENS; RED-GREEN-BLUE; SMT; VF=2.95V; IF=0.1A
DS1	-	1	LGL29K-G2J1-24-Z	DIODE; LED; SMARTLED; GREEN; SMT; PIV=1.7V; IF=0.02A
J1	-	1	TSW-104-07-L-S	EVKIT PART-CONNECTOR; MALE; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 4PINS
J2	-	1	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
J3, J4, J6, J10	-	4	TSW-103-07-T-S	CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 3PINS
J9	-	1	ZX62D-AB-5P8(30)	CONNECTOR; FEMALE; SMT; USB MICRO CONNECTOR; RIGHT ANGLE; 5PINS
L1	-	1	27UH	INDUCTOR; SMT; SHIELDED; 27UH; 20%; 0.8A
L2	-	1	33UH	INDUCTOR; SMT; MAGNETICALLY SHIELDED; 33UH; TOL=+/-20%; 1.3A
L3	-	1	600	INDUCTOR; SMT (0805); FERRITE-BEAD; 600; TOL=+/-25%; 0.2A
MISC1	-	1	68784-0001	CONNECTOR; MALE; USB; USB A PLUG TO MICRO B PLUG CABLE ASSY; STRAIGHT; 4PINS-5PINS
R1	-	1	453K	RES; SMT (0603); 453K; 1%; +/-100PPM/DEGC; 0.1000W
R2	-	1	3.09K	RES; SMT (0402); 3.09K; 1%; +/-100PPM/DEGC; 0.0630W
R3	-	1	49.9K	RES; SMT (0603); 49.9K; 1%; +/-100PPM/DEGC; 0.1000W
R4, R7, R9, R10, R18, R21, R29, R35, R36, R41	-	10	10K	RES; SMT (0402); 10K; 1%; +/-100PPM/DEGC; 0.0630W
R5	-	1	412K	RES; SMT (0603); 412K; 1%; +/-100PPM/DEGC; 0.1000W
R6	-	1	73.2K	RES; SMT (0603); 73.2K; 1%; +/-100PPM/DEGC; 0.1000W
R11	-	1	2.2K	RES; SMT (0402); 2.2K; 1%; +/-100PPM/DEGC; 0.0630W
R12	-	1	12K	RES; SMT (0402); 12K; 1%; +/-100PPM/DEGC; 0.0630W
R13, R15	-	2	1K	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W
R14, R22-R28, R30, R31, R34, R37-R40	-	15	220	RES; SMT (0402); 220; 1%; +/-100PPM/DEGC; 0.1000W
R19, R20	-	2	0	RES; SMT (0603); 0; JUMPER; JUMPER; 0.1000W

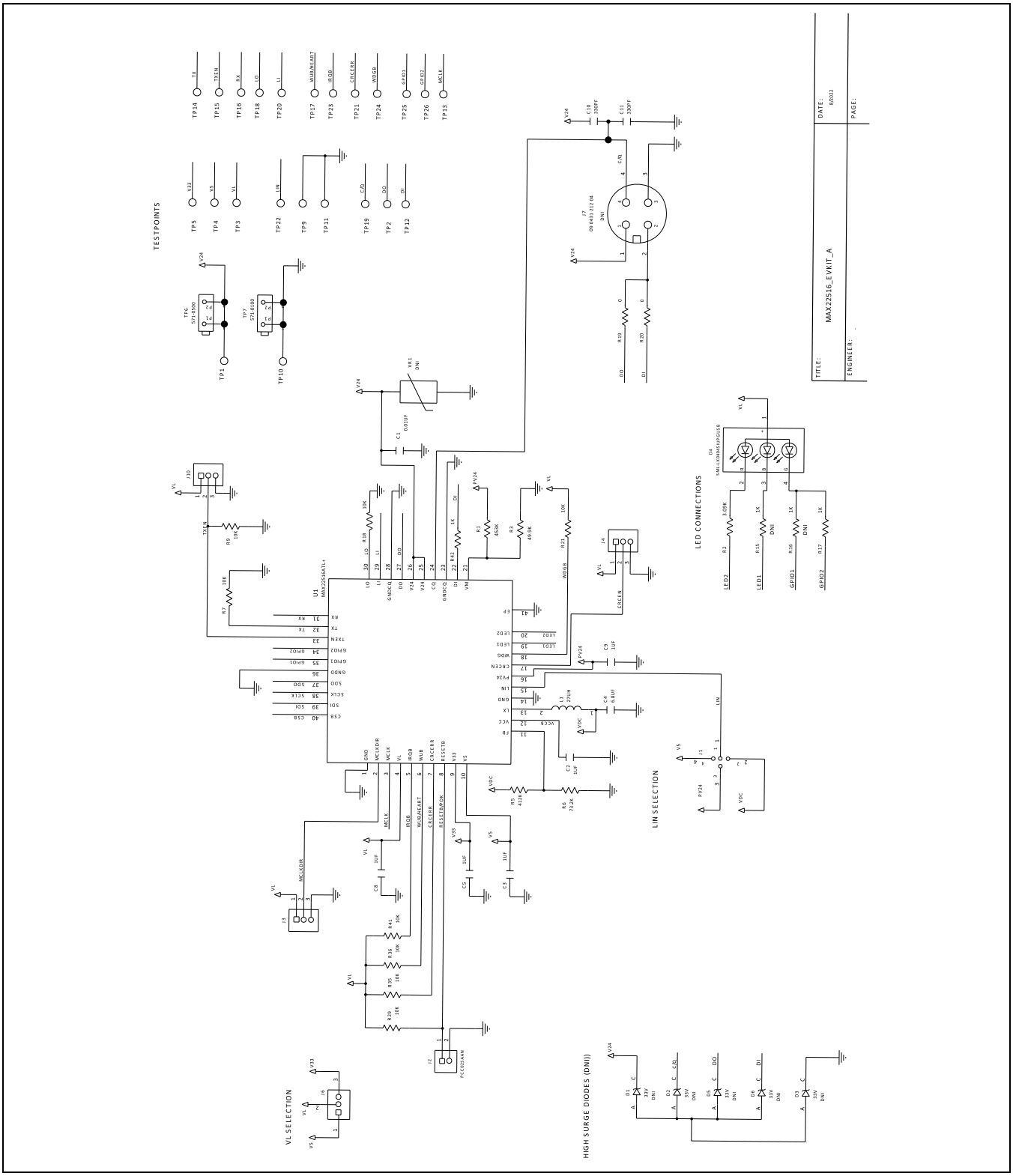
MAX22516 EV Kit Bill of Materials (continued)

REF DES	DNI/DNP	QTY	VALUE	DESCRIPTION
R32, R33	-	2	27	RES; SMT (0201); 27; 1%; +/-200PPM/DEGC; 0.0500W
R42	-	1	1K	RES; SMT (0603); 1K; 1%; +/-100PPM/DEGC; 0.1000W
SU1-SU6	-	6	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
SW1	-	1	219-5MST	SWITCH; SPST; SMT; STRAIGHT; 20V; 0.1A; SURFACE MOUNT DIP SWITCH-AUTO PLACEABLE; RINSULATION=1000M OHM
SW2	-	1	219-10MST	SWITCH; SPST; SMT; STRAIGHT; 20V; 0.1A; SURFACE MOUNT DIP SWITCH-AUTO PLACEABLE; RINSULATION=1000M OHM
TP1, TP3-TP5	-	4	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
TP2, TP12-TP26	-	16	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; YELLOW; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
TP6	-	1	571-0500	CONNECTOR; FEMALE; THROUGH HOLE; BANANA 4MM RED SOCKET; RIGHT ANGLE; 2PINS
TP7	-	1	571-0100	CONNECTOR; FEMALE; THROUGH HOLE; BANANA 4MM BLACK SOCKET; RIGHT ANGLE; 2PINS
TP9-TP11	-	3	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
U1	-	1	MAX22516ATL+	EVKIT PART - IC; IO-LINK DATA LINK CONTROLLER WITH TRANSCEIVER AND DC-DC; PACKAGE OUTLINE DRAWING: 21-140; PACKAGE LAND PATTERN: 90-0016; PACKAGE CODE: T4055+1C
U2	-	1	MAX17501EATB+	IC; CONV; ULTRA-SMALL; HIGH-EFFICIENCY; SYNCHRONOUS STEP-DOWN DC-DC CONVERTER; TDFN10-EP
U3	-	1	93LC66BT-I/OT	IC; EPROM; 4K MICROWIRE SERIAL EEPROM; SOT23-6
U4	-	1	FT2232HL	IC; MMRY; DUAL HIGH-SPEED USB TO MULTIPURPOSE UART/FIFO; LQFP64
Y1	-	1	12MHZ	CRYSTAL; SMT; 12MHZ; 18PF; TOL = +/-20PPM; STABILITY = +/-30PPM
PCB	-	1	PCB	PCB:MAX22516
D1-D3, D5, D6	DNP	0	33V	DIODE; TVS; SMT (DO-216AA); VRM=33V; IPP=7A
J7	DNP	0	09 0431 212 04	CONNECTOR; MALE; TH; MALE RECEPTACLE; THREADED; PCB SOLDER; STRAIGHT; 4PINS;
MOD1	DNP	0	MAX32620FTHR#	EVKIT PART - MODULE; BOARD ASSEMBLY; THROUGH HOLE; RAPID DEVELOPMENT PLATFORM;
R8	DNP	0	15K	RES; SMT (0402); 15K; 1%; +/-100PPM/DEGC; 0.1000W
R16, R17	DNP	0	1K	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W
VR1	DNP	0	VC060326A580DP	VARISTOR; TVS; SMT (0603); VB=34.5V; IP=30A

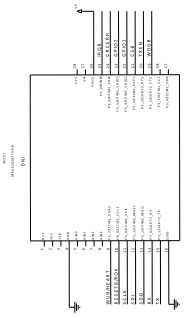
MAX22516 EV Kit Schematic



MAX22516 EV Kit Schematic (continued)

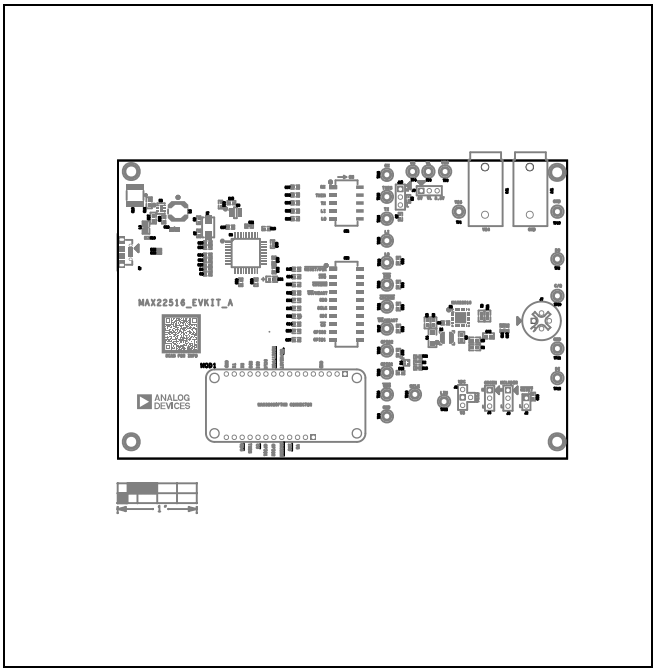


MAX22516 EV Kit Schematic (continued)

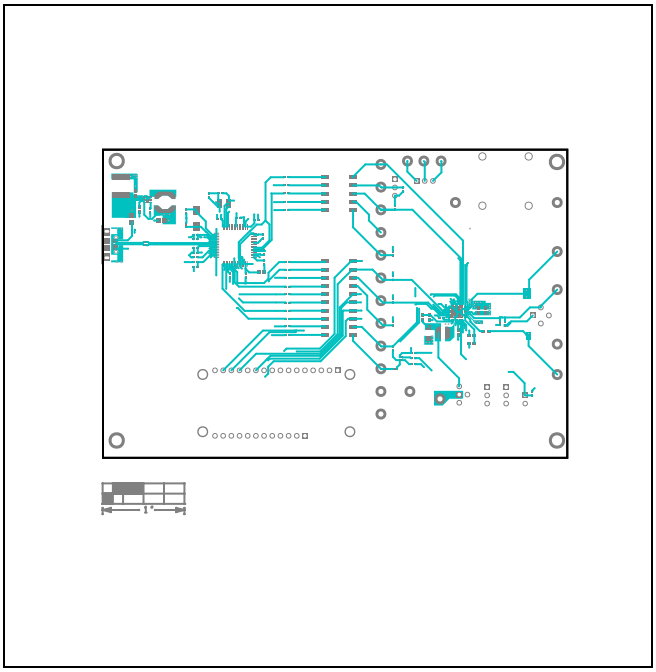


MAX32620FTHR BOARD CONNECTOR

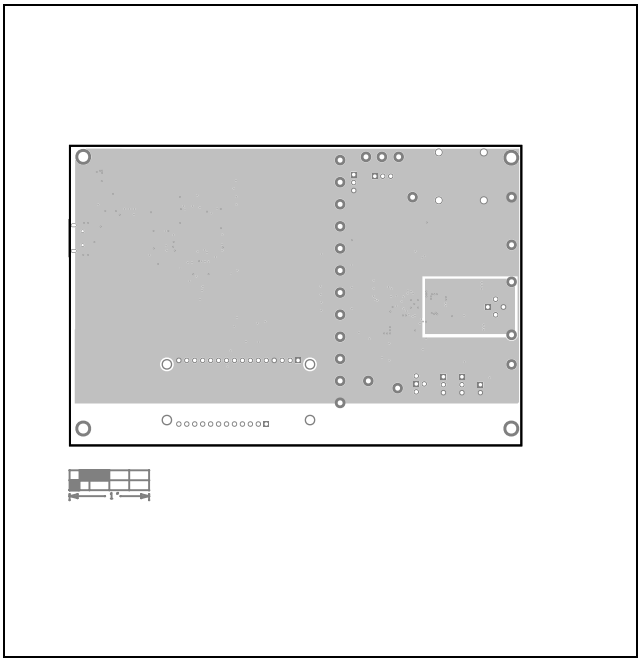
MAX22516 EV Kit PCB Layout



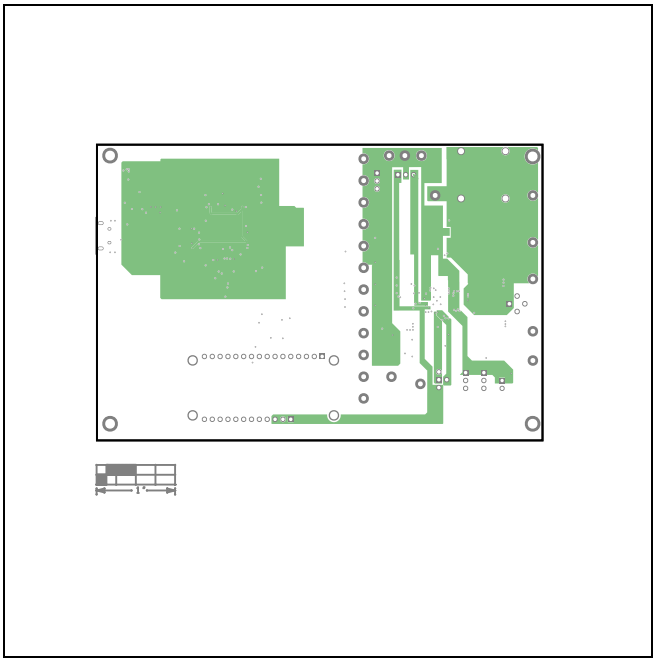
MAX22516 EV Kit Component Placement Guide—Top Silkscreen



MAX22516 EV Kit PCB Layout—Layer 2

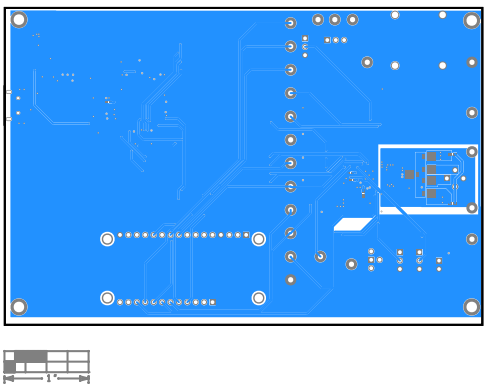


MAX22516 EV Kit PCB Layout—Top

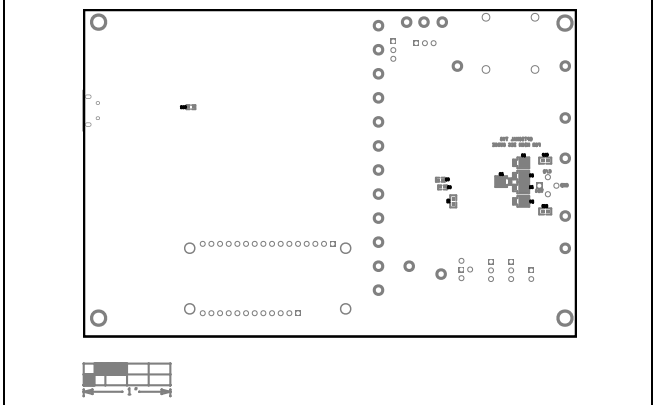


MAX22516 EV Kit PCB Layout—Layer 3

MAX22516 EV Kit PCB Layout (continued)



MAX22516 EV Kit PCB Layout—Bottom



MAX22516 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/23	Initial release	—