Evaluation Board User Guide

MAX14918

MAX14918 Evaluation Kit

General Description

The MAX14918 evaluation kit (EV kit) provides the hardware and software necessary to evaluate the MAX14918, SPI controlled quad low-side switches with reverse-current detection. The MAX14918 EV kit receives commands from a PC through the USB port and creates SPI transactions for communication between the software and the MAX14918 on the EV kit. The MAX14918 EV kit also has a Pmod™-compatible connector for SPI communication with an external host device such as an MCU or FPGA.

The MAX14918 EV kit includes a graphic user interface (GUI) that provides communication between the target device and the PC. The GUI allows individual control of each output channel and reading of each channel status through SPI.

The EV kit features galvanic isolation for both power and SPI and provides the option to power the MAX14918 from an isolated +5V generated from the USB supply. The EV kit also features reverse-current protection to prevent damage caused by miswiring faults at output and COM return terminals. The EV kit comes with two MAX14918ATG+ devices in the 4mm x 5mm 24-pin TQFN package, installed as U1 and U2.

The EV kit can operate in multiple modes, as shown in the *MAX14918 EV Kit Block Diagram*:

- **USB Daisy-Chain Mode (Default Mode)**: U1 and U2 are connected in the SPI daisy-chain mode, and both devices receive SPI commands through the onboard USB-to-SPI interface from the Analog Devices-supplied EV kit software.
- **USB Single-Device Mode (U1 Only)**: U1 is connected in the SPI independent mode. U2 is disconnected from the SPI and unpowered. U1 receives SPI commands through the onboard USB-to-SPI interface from the Analog Devices-supplied EV kit software.
- **Pmod Mode**: Both U1 and U2 SPI signals are disconnected from the onboard USB-to-SPI interface and are connected to the onboard Pmod connector. This industry standard connector interfaces with popular MCU or FPGA platforms. A user is required to generate firmware to provide the SPI commands.

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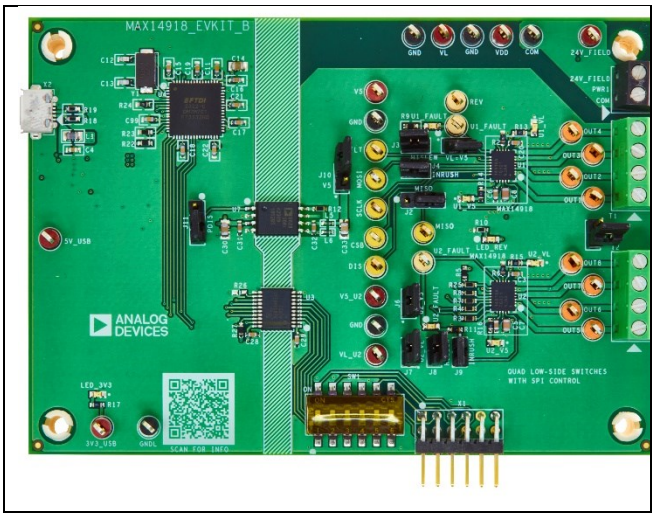
Features and Benefits

- Easy Evaluation of the MAX14918
- Robust Operation with a Wide Range of Output Voltages and Load Conditions
- Robust Design at Field Outputs
  - Internal Inductive Fast Demagnetization
  - Short-Circuit Protection
  - Up to ±1.2kV IEC 61000-4-5 Surge Protection
  - Up to ±8kV IEC 61000-4-2 Contact ESD Protection
  - Up to ±25kV IEC 61000-4-2 Air-Gap ESD Protection
- Onboard MOSFET for Output Reverse-Current Protection
- LED Indication of Fault and Reverse-Current Detection Conditions
- EV Kit Logic Side is USB-Powered
- Optional Onboard Isolated 5V to Power the MAX14918 from the USB Supply
- Galvanic Power and Data Isolation Using *MAX14483* and *ADuM6028*
- Supports SPI Daisy-Chain Mode and SPI Independent Mode
- Windows 10® Compatible Software
- Proven PCB Layout
- Fully Assembled and Tested
- RoHS Compliant

MAX14918 EV Kit Photo



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

MAX14918 EV Kit Files

FILE	DESCRIPTION
MAX14918EVKitSetupV1.0.0.exe	Install EV kit files onto computer.

Quick Start

Required Equipment

- MAX14918 EV kit
- +24V DC power supply
- Resistive load
- Oscilloscope
- Micro-USB cable
- Windows 10, Windows 8.1, and Windows 7 with a spare USB port

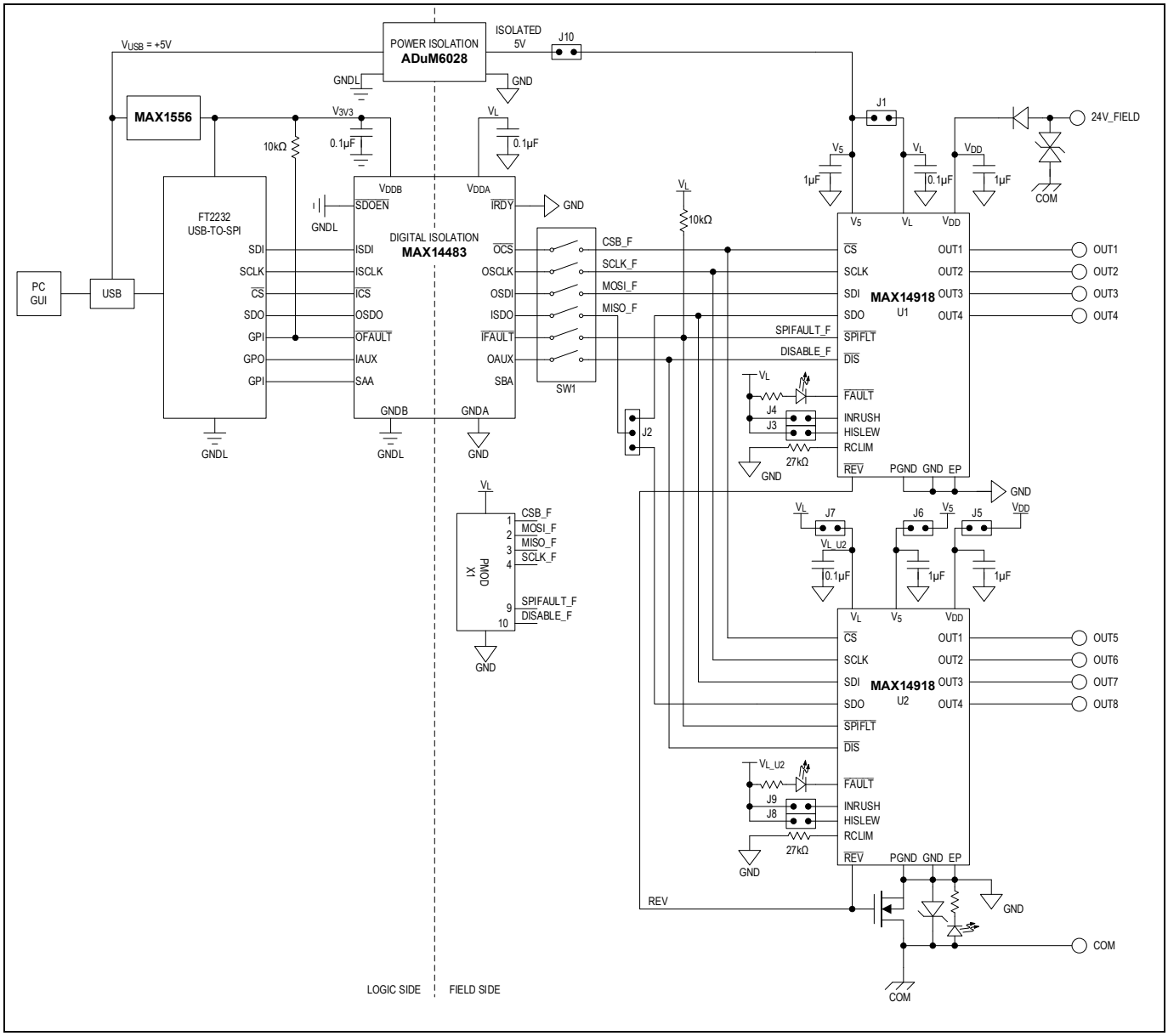
Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

The EV kit is fully assembled and tested. The default jumper settings configure the EV kit to operate in the USB daisy-chain mode. In this configuration, the EV kit **logic side** is powered by +5V from the X2 USB connector, the **field side** is powered by the external DC supply connected to the 24V_FIELD and COM test points (or PWR1 terminal block). Both MAX14918 devices (U1 and U2) are connected in the SPI daisy-chain mode receiving SPI commands from the EV kit software through the USB connector. Terminal blocks T1 and T2 provide access to eight low-side output switches. The test setup is shown in *Figure 1*. To verify the EV kit operation, do the following steps:

1. Verify that all jumper settings are in the default position from *Table 1*.
2. For initial testing, the MAX14918 EV kit is powered from USB connector (+5V) and +24V at the 24V_FIELD and COM test points.
3. Visit *ADI* website to download the latest version of the EV kit software, MAX14918EVKitSetupV1.0.0.exe.
4. Install the EV kit software and USB driver on your computer by running the MAX14918EVKitSetupV1.0.0.exe program. A message box might appear asking, **Do you want to allow the following program to make changes to this computer?**. If so, click **Yes**.
5. The program files are copied to the PC and icons are created in the Windows **Start | Programs** menu. At the end of the installation process, the FTDI Chip CDM driver installation is launched by the installer.
6. The installer includes the drivers for the hardware and software. Follow the instructions on the installer and once complete, click **Finish**. The default location of the software is in the program files directory Analog Devices folder.
7. The EV kit software launches automatically after install, or it can be launched by clicking on its icon in the Windows **Start** menu.
8. Connect the MAX14918 EV kit USB connector X2 to the PC with the micro-USB cable. Windows recognize the device automatically and display a message near the **System Icon** menu, which indicates that the hardware is ready to use. Observe that LED_3V3 (green) is turned on, which indicates that the EV kit logic side is powered up normally.
9. Connect the EV kit PWR1 terminal Pin 1 and Pin 2 to the +24V DC supply. Connect the positive terminal of the power supply to Pin 2, which is the 24V field supply of the EV kit, and the negative terminal to Pin 1, which is the COM return of the EV kit.
10. Turn on the +24V DC supply and verify that LED_U1_V5 (green), LED_U1_VL (green), LED_U2_V5 (green), and LED_U2_VL (green) are illuminated, which indicates that both U1 and U2 V_5 and V_L are present, and the EV kit field side is powered up normally.

MAX14918 EV Kit Block Diagram



11. Connect the positive terminal of the +24V DC supply to one end of the resistive load. Connect the other end of the resistive load to OUT1 test point or terminal block T1 Pin 1.
12. Connect a scope probe at OUT1 with respect to the COM test point of the EV kit for monitoring purpose.
13. Multiple resistive loads may be connected between the +24V supply and other output test points (OUT2 to OUT8) or terminal pins of T1 and T2.
14. Once the hardware is ready to use, launch the EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software appears as shown in *Figure 2.*
15. If the software is launched with the EV kit connected, the hardware is detected, and the lower-right status bar indicates **Connected**. If the hardware is connected after the software is launched, from the **Device** menu, click **Search for Hardware** as shown in *Figure 3*. Then select a device in the list or use the default device already selected.
16. Observe that radio button **POWER** in the EV kit software **USB-to-SPI** box is green, which indicates that the field-side power is normal, and the software can communicate with the MAX14918 SPI. By default, the software is configured in the SPI daisy-chain mode to communicate with both U1 and U2 (see *Figure 2*).

17. Configure each output switch to be **ON** or **OFF** by toggling the slide bar control at each channel. Note that the channels are displayed in the order of **OUT4** to **OUT1** and **OUT8** to **OUT5** (see *Figure 4*), following the same order as on the EV kit hardware.
18. Once all channels are configured, click the **WRITE** button to send the SPI commands to both U1 and U2. Observe and verify that the corresponding outputs are turned on or off on the EV kit hardware by connecting scope probe between corresponding OUT_ test point and COM test point.
19. The thermal faults (FLT_ and LFLT_) are indicated by radio buttons in the **FAULT STATUS** box and are updated after every successful SPI transaction. The SDI data sent to U1 and U2 are displayed in **SDI DATA U1** and **U2** boxes to allow user to verify the parity bits on SDI. Observe that the thermal faults and U1 and U2 SDI data are updated after clicking the **WRITE** button (see *Figure 4*).

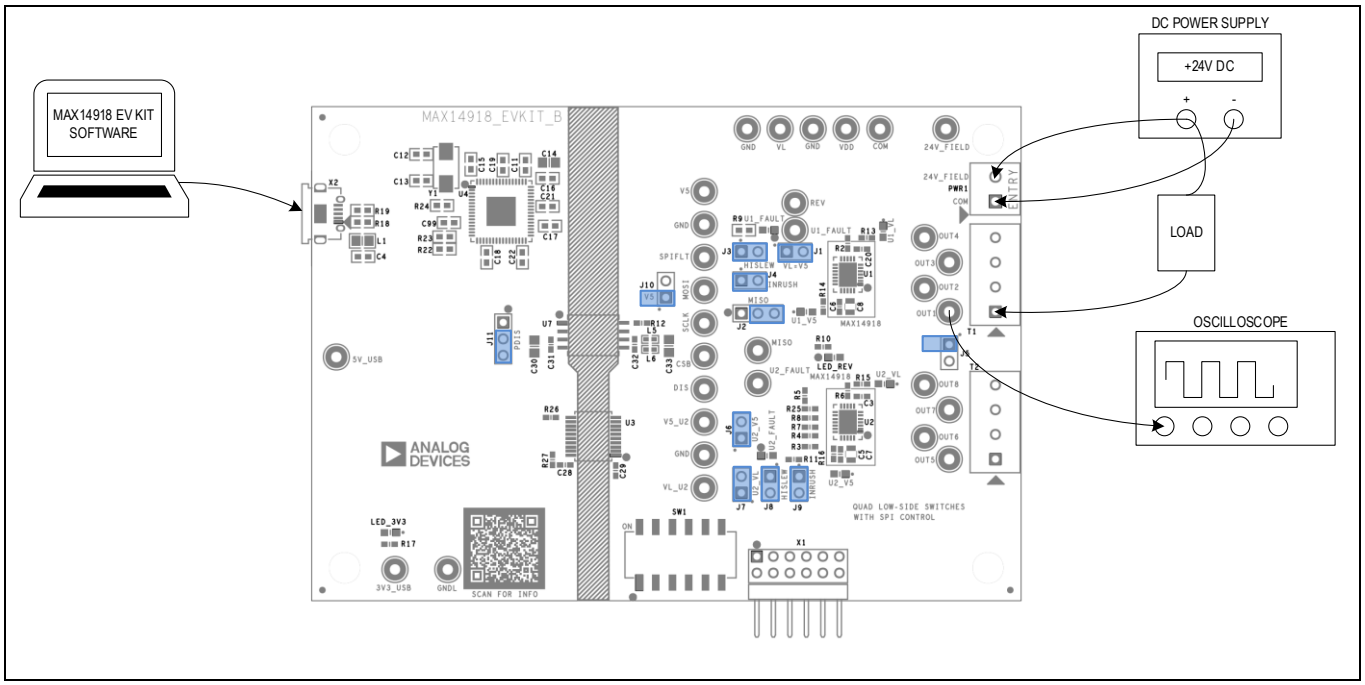


Figure 1. MAX14918 EV Kit Board Connections

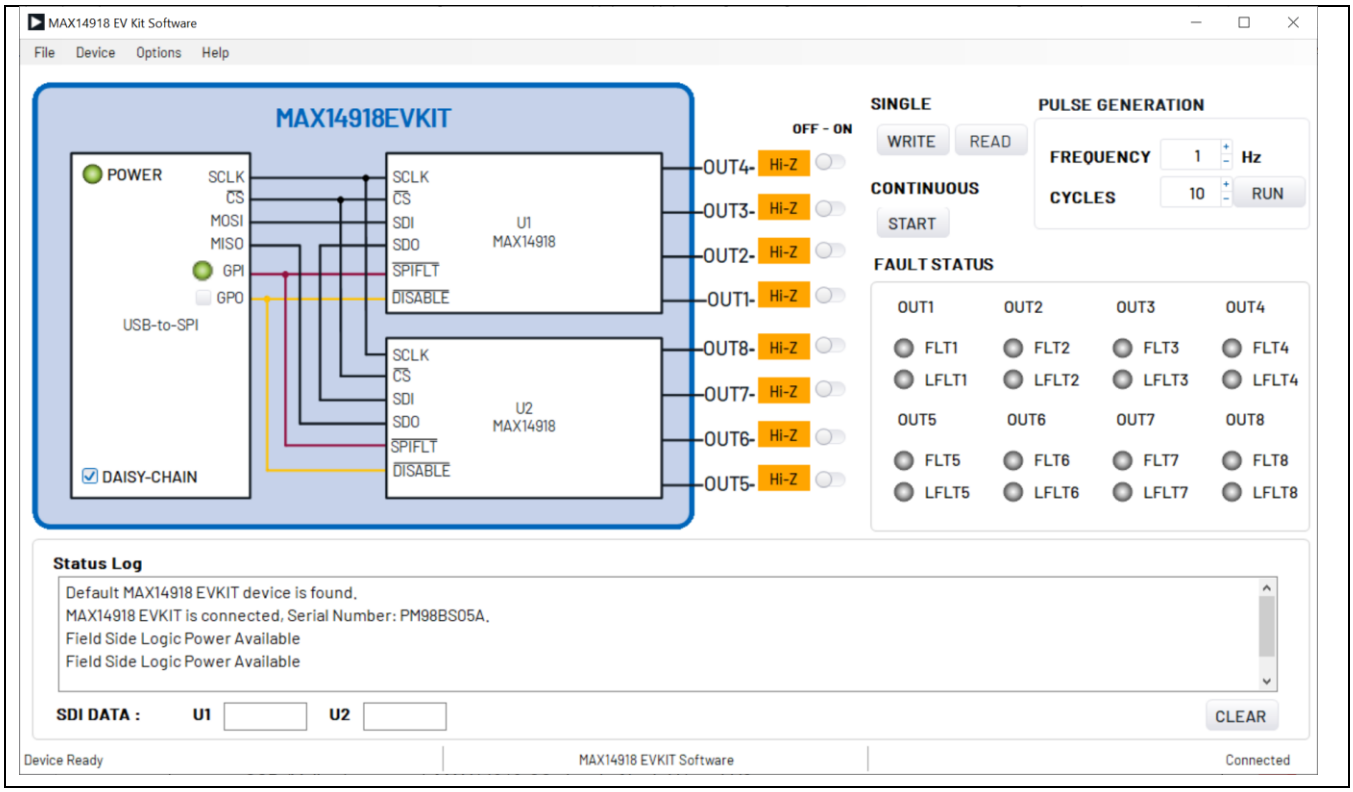


Figure 2. MAX14918 EV Kit Software Startup Window

Table 1. MAX14918 EV Kit Jumper Positions and Settings

JUMPER	CONNECTION	FEATURE
FIELD SIDE		
J1	**1-2***	Connect the U1 (MAX14918) V_5 supply to U1 V_L supply. When U1 V_{DD} is powered by an external power supply, V_5 is the 5V internal regulator output and V_L is powered by V_5. When U1 V_{DD} is connected to ground (GND) or left unconnected, connect an external 5V supply at VL or V5 test point.
	Open	The U1 (MAX14918) V_5 and V_L supply are disconnected. Connect an external +1.62V to +5.5V supply to VL test point. When U1 V_{DD} is powered by an external power supply, V_5 is the 5V internal regulator output. When U1 V_{DD} is connected to ground (GND) or left unconnected, connect an external 5V supply to V5 test point.
J2	1-2	Connect the SDO signal of U1 (MAX14918) to the ISDO input of the digital isolator, *MAX14483*. This option is used when the EV kit is operating in the USB single-device mode that the EV kit software or the external microcontroller only communicates with U1.
	2-3*	Connect the SDO signal of U2 (MAX14918) to the ISDO input of the digital isolator, MAX14483. This option is used when the EV kit is operating in the USB daisy-chain mode (default) that the EV kit software or the external microcontroller communicates with both U1 and U2.
J3	**1-2***	Connect the U1 (MAX14918) HISLEW pin to V_L to enable high slew rate on all outputs.
	Open	Leave the U1 (MAX14918) HISLEW pin unconnected for slow slew rate on all outputs.
J4	**1-2***	Connect the U1 (MAX14918) INRUSH pin to V_L to enable 2x current limit for 10ms (min) after any switch is turned on.

	Open	Leave the U1 (MAX14918) INRUSH pin unconnected to disable inrush current mode.
J5	1-2	Connect the field-side supply V_{DD} to the U2 (MAX14918) V_{DD} pin. V_{DD} is protected by the reverse polarity diode D3. This option is used when U2 is supplied by V_{DD}. J6 must be open in this configuration.
	Open*	Disconnect the field-side supply V_{DD} from the U2 (MAX14918) V_{DD} pin. This option is used when U2 is supplied by the onboard +5V supply (V_5) with J6 in 1-2 position, or when U2 is unpowered in the USB single-device mode.
J6	**1-2***	Connect the onboard +5V supply (V_5) to the U2 (MAX14918) V_5 pin. This option is used when U2 is supplied by V_5 and when the EV kit is operating in the USB daisy-chain mode. J5 must be open in this configuration.
	Open	Disconnect the onboard +5V supply (V_5) from the U2 (MAX14918) V_5 pin. This option is used when U2 is supplied by the field-side supply V_{DD} with J5 in 1-2 position, or when U2 is unpowered in the USB single-device mode with J5 open.
J7	**1-2***	Connect the onboard field-side logic supply (V_L) to the U2 (MAX14918) V_L pin. This option is used when operating in the USB daisy-chain mode.
	Open	Disconnect the onboard field-side logic supply (V_L) from the U2 (MAX14918) V_L pin. This option is used when U2 is unpowered in the USB single-device mode.
J8	**1-2***	Connect the U2 (MAX14918) HISLEW pin to U2 V_L to enable high slew rate on all outputs.
	Open	Leave the U2 (MAX14918) HISLEW pin unconnected for slow slew rate on all outputs.
J9	**1-2***	Connect the U2 (MAX14918) INRUSH pin to U2 V_L to enable 2x current limit for 10ms (min) after any switch is turned on.
	Open	Leave the U2 (MAX14918) INRUSH pin unconnected to disable inrush current mode.
J10	1-2	Connect the onboard isolated +5V supply, generated by the isolated DC-DC converter *ADuM6028*, to V_5. This configuration is used when V_5 is not powered by an external 5V supply through V5 test point, or by the MAX14918 internal regulator when the field-side supply V_{DD} is powered.
	Open*	Disconnect the onboard isolated +5V supply, generated by the isolated DC-DC converter ADuM6028, from V_5. This configuration is used when the field-side supply V_{DD} is powered by an external supply and V_5 is the internal regulator output, or when V_{DD} is connected to ground (GND) or left unconnected and V_5 is powered by an external +5V supply through V5 test point.
SW1	**ON***	All switches on SW1 are closed. The MAX14918 logic signals $\overline{CS}$, SCLK, SDI, SDO, $\overline{SPIFLT}$ and $\overline{DIS}$ are connected to the *MAX14483* isolator. This option is used when the EV kit is operating in the USB daisy-chain mode or USB single-device mode.
	OFF	All switches on SW1 are open. The MAX14918 logic signals $\overline{CS}$, SCLK, SDI, SDO, $\overline{SPIFLT}$ and $\overline{DIS}$ are disconnected from the MAX14483 isolator. This option is used when the EV kit is operating in the Pmod mode.
LOGIC SIDE		
J11	1-2	Connect the PDIS pin of the onboard isolated DC-DC converter ADuM6028 to logic-side +5V USB supply to disable the field-side +5V output.
	2-3*	Connect the PDIS pin of the onboard isolated DC-DC converter ADuM6028 to logic-side ground (GNDL) to enable the field-side +5V output.

**Default options are bold.*

Table 2. MAX14918 EV Kit Test Point and Connector Description

ITEM	DESCRIPTION
TEST POINTS	
24_FIELD (Red)	External +24V field supply input for the MAX14918 EV kit. Connect +24V DC power supply between 24V_FIELD and COM test points.
COM (Black)	Field supply and load return.
VDD (Red)	Field-side supply input for the MAX14918 V_{DD}. Protected by reverse polarity diode D3.
V5 (Red)	Field-side analog supply for the U1 (MAX14918) V_5. +5V when the MAX14918 V_{DD} is powered by an external power supply or when J10 is in 1-2 position. Apply an external +5V supply when the MAX14918 V_{DD} is connected to ground (GND) or left unconnected.
VL (Red)	Field-side logic supply for the U1 (MAX14918) V_L. V_L is connected to the U1 V_5 when jumper J1 is closed. Apply an external +1.62V to +5.5V supply when J1 is open.
V5_U2 (Red)	Field-side analog supply for the U2 (MAX14918) V_5. +5V when J6 is in 1-2 position, connected to U1 V_5. Apply an external +5V supply when J6 is open.
VL_U2 (Red)	Field-side logic supply for the U2 (MAX14918) V_L. U2 V_L is connected to U1 V_L when J7 is in 1-2 position. Apply an external +1.62V to +5.5V supply when J7 is open.
GND (Black)	Field-side ground (GND).
OUT1 to OUT8 (Orange)	Field-side outputs for U1 outputs OUT1 to OUT4, and U2 outputs OUT5 to OUT8.
REV (White)	MAX14918 $\overline{REV}$ signal of both U1 and U2.
U1_FAULT (White)	MAX14918 $\overline{FAULT}$ signal of U1.
U2_FAULT (White)	MAX14918 $\overline{FAULT}$ signal of U2.
SPIFLT (Yellow)	MAX14918 $\overline{SPIFLT}$ signal of both U1 and U2.
CSB (Yellow)	MAX14918 $\overline{CS}$ signal of both U1 and U2.
SCLK (Yellow)	MAX14918 SCLK signal of both U1 and U2.
MISO (Yellow)	MAX14918 SDO signal of either U1 (J2 in 1-2 position) or U2 (J2 in 2-3 position).
MOSI (Yellow)	MAX14918 SDI signal of U1.
DIS (Yellow)	MAX14918 $\overline{DIS}$ signal of both U1 and U2.
5V_USB (Red)	Logic-side +5V supply for the isolated DC-DC converter *ADuM6028*, which generates the isolated field-side +5V supply.
3V3_USB (Red)	Logic-side +3.3V supply, generated by the onboard DC-DC converter *MAX1556* from the logic-side +5V supply.
GNDL (Black)	Logic-side ground.
CONNECTORS	
PWR1	Terminal block for the +24V field supply input and COM return for the MAX14918 EV kit. Pin 1 is the COM return, same as COM test point, and Pin 2 is the +24V field supply input, same as 24V_FIELD test point.
T1	Terminal block for the U1 (MAX14918) OUT1 to OUT4 digital outputs. Pin 1 is OUT1, Pin 2 is OUT2, Pin 3 is OUT3, and Pin 4 is OUT4, same as OUT1 to OUT4 test points. Note that on the EV kit hardware, the channel order is OUT4 to OUT1 from top down.
T2	Terminal block for the U2 (MAX14918) OUT1 to OUT4 digital outputs. Pin 1 is OUT5, Pin 2 is OUT6, Pin 3 is OUT7, and Pin 4 is OUT8, same as OUT5 to OUT8 test points. Note that on the EV kit hardware, the channel order is OUT8 to OUT5 from top down, following T1 terminal block and OUT4 to OUT1 test points.
X1	12-pin Pmod-compatible male connector to allow external microcontroller or FPGA to configure the MAX14918.
X2	Micro-USB connector to connect the MAX14918 EV kit to a PC USB port.

Detailed Description of Hardware

The MAX14918 EV kit provides an easy-to-use and flexible solution to evaluate the MAX14918, SPI controlled quad low-side switches with reverse-current detection, for industrial applications. The EV kit comes with field-side terminal blocks to allow connections to industrial loads for easy evaluation of the device and the system. The EV kit can be powered by the +5V USB supply, which powers the onboard isolated DC-DC converter generating an isolated +5V analog supply as the main supply for the MAX14918. The EV kit includes two MAX14918 devices that can be configured in either SPI independent mode (U1 only) or SPI daisy-chain mode. The galvanic digital isolation on the SPI signals is implemented to protect the logic side from the high-voltage transients from the field side.

The EV kit comes with an n-channel MOSFET installed to protect against reverse current at outputs. All field-side outputs and field-side supply are protected against line-to-ground surges up to ±1.2kV/42Ω per IEC 61000-4-5.

This MAX14918 EV kit user guide must be used with the *MAX14918/MAX14918A* data sheet.

For the latest versions of the documents, refer to the *MAX14918* product page.

Power Supplies

The EV kit has two power domains, the **logic side**, which is powered from +5V USB supply (5V_USB and GNDL) and the +3.3V supply generated onboard from the +5V USB supply (3V3_USB and GNDL), and the **field side**, which is typically powered from an external +24V DC supply connected to PWR1 terminal block or 24V_FIELD and COM test points.

The logic side of the MAX14918 EV kit is powered by the USB connector X2. The +5V DC supply from the USB connector is the supply for the onboard isolated DC-DC converter *ADuM6028*, which generates an isolated +5V output at the field side to power the MAX14918 V_5 when J10 is closed (see *Table 1*). A logic-side +3.3V DC supply is generated by the onboard DC-DC converter *MAX1556* from the +5V USB supply, which powers the FT2232HQ, the USB-to-SPI interface device, and the logic-side of the digital isolator *MAX14483* (V_{DDB}).

When the field-side +24V supply is provided, the MAX14918 is powered by V_{DD}. In this case, the MAX14918 (U1) internal regulator is enabled to provide low voltage output at V_5 (5V, nominal), which is connected to V_L, the logic supply of the MAX14918 (U1), when J1 is closed (see *Table 1*). V_L also powers the field-side of the digital isolator MAX14483 (V_{DDA}). The U2 V_5 can be powered by the U1 V_5 when J6 is closed, and the U2 V_L can be powered by the U1 V_L when J7 is closed (see *Table 1*). U2 can also be powered by the field supply V_{DD} when J5 is closed. In this case, J6 must be open to avoid the U2 internal regulator output to be shorted to U1 V_5.

When the field-side +24V supply is not connected or the MAX14918 V_{DD} is connected to field-side ground (GND), the MAX14918 (U1) main analog supply V_5 can be powered by either an external +5V DC voltage through V5 and GND test points, or by the onboard isolated +5V supply generated by the ADuM6028 when J10 is closed (see *Table 1*).

The MAX14918 EV kit can be powered by the single +5V supply from the USB connector X2. The isolated field-side +5V generated by the ADuM6028 provides the main analog supply to the U1 V_5 with J10 in 1-2 position, to the U1 V_L with J1 in 1-2 position, to the U2 V_5 with J6 in 1-2 position, and to the U2 V_L with J7 in 1-2 position. For more details, see the *MAX14918 EV Kit Schematic* section.

MAX14918 Output Control

The MAX14918 EV kit comes with eight output channels from the two MAX14918 devices (U1 and U2). Each of the output switches can be individually controlled by the EV kit software.

All the MAX14918 output switches are turned off regardless of their respective input state when the global $\overline{DIS}$ input is set to low. When $\overline{DIS}$ is set to high, all outputs are switched according to the configuration sent by the SPI command. The $\overline{DIS}$ pin of both U1 and U2 are controlled by the **GPO** checkbox in the EV kit software (see *Figure 4*).

SPI Interface

The EV kit software communicates over USB to the MAX14918 SPI and supports the maximum SCLK frequency of 10MHz. The EV kit can be configured to operate in either SPI daisy-chain mode or SPI independent mode. By default, the EV kit is configured in the daisy-chain mode. The digital isolator OSDI output (MOSI) is connected to U1 SDI, U1 SDO is connected to U2 SDI and U2 SDO is connected back to the digital isolator ISDO (MISO) by setting jumper J2 to 2-3 position. The EV kit software must also be configured in the daisy-chain mode to allow configuration and diagnostic reading of both U1 and U2. When the EV kit is configured in the independent mode or single-device mode, U1 SDO is

connected back to the digital isolator ISDO (MISO) by setting jumper J2 to 1-2 position. Jumper J5, J6, and J7 are open to disconnect the onboard supplies from U2 V_{DD}, V_5 and V_L pins, so U2 is unpowered and does not interfere with U1 operation. The EV kit software must be configured in the single-device mode by unchecking the DAISY-CHAIN checkbox (see *Figure 5*).

The EV kit includes a standard Pmod-compatible 12-pin header to connect to an external adapter board (MCU or FPGA). If the user wants to interface to their own microcontroller or FPGA, simply connect to the Pmod connector X1, open all SW1 switches, and provide the user-supplied firmware. For more details, see the *MAX14918 EV Kit Schematic* section.

Slew Rate Control

The MAX14918 features output slew-rate control on turn-on edges. When the HISLEW input is low (jumper J3 for U1 and J8 for U2 in open position), output transitions are slower, and the MAX14918 operates up to 50kHz switching frequency. The HISLEW input has a weak internal pull-down. The slow slew-rate mode is useful in applications where the load is capacitive and is connected through a long cable.

When the HISLEW input is high (jumper J3 for U1 and J8 for U2 in 1-2 position), the output transitions are much faster, and the MAX14918 can operate up to 500kHz switching frequency. This mode is useful in applications where the device drives resistive loads.

Current Limit Setting and INRUSH Mode

The MAX14918 features resistor-settable active current limiting, common to all output switches (OUT1 to OUT4). When the current across the switch exceeds the current limit, the load current is limited by the low-side switch. The current limit is set by the R_{CLIM} resistor between RCLIM pin and device ground.

The MAX14918 EV kit by default has a 27kΩ resistor connected between RCLIM pin and GND for both U1 and U2, setting the current limit of both devices at 800mA (typ). A user can update the current limit of the MAX14918 devices by soldering a different R_{CLIM} resistor on the board, R2 for U1, and R6 for U2. For the equation to calculate the current limit I_{LIM} based on the R_{CLIM} resistor value, refer to the *MAX14918/MAX14918A* data sheet.

The MAX14918 offers the inrush mode, which supports loads that draw higher current during turn-on. In the inrush mode, each switch provides at least double the current set by the R_{CLIM} resistor for the inrush duration of 10ms (min). After the inrush period, the switch current limit reverts to the value set by R_{CLIM}. The inrush mode is enabled when the INRUSH pin is set to high (jumper J4 for U1 and J9 for U2 in 1-2 position) and disabled when the INRUSH pin is set to low (jumper J4 for U1 and J9 for U2 in open position). The INRUSH input has a weak internal pull-down.

Reverse-Current Protection

The MAX14918 features reverse-current detection with OUT_ switch either in on or off state, which is signaled by the $\overline{REV}$ logic output. A reverse current on any output (OUT_) can happen when the field supply is miswired with a reverse polarity, or when a direct reverse connection is between OUT_ and COM.

When any reverse current more than 150mA (typ) is flowing out of any output, the $\overline{REV}$ output transitions low and the MAX14918 automatically turns off all outputs. The $\overline{REV}$ output drives the gate of the onboard n-channel MOSFET (Q1) low, which opens the MAX14918 device ground (GND) to the field COM (COM) connection, therefore stopping the reverse current flow. Both MAX14918 devices on the EV kit share the same NMOS (Q1), and the $\overline{REV}$ signal from the two devices are connected together to drive the gate of Q1, so that the devices are protected against reverse current on any of the eight outputs. For more details on the reverse-current detection feature, refer to the *MAX14918/MAX14918A* data sheet.

The EV kit also protects against reverse polarity on the MAX14918 V_{DD} pin by implementing reverse protection diode D3. For more details, see the *MAX14918 EV Kit Schematic* section.

Diagnostic Features

The MAX14918 features a global fault indication pin, $\overline{FAULT}$. It is an open-drain logic output that transitions low when the MAX14918 detects a fault condition and is pulled high when the device exits fault status. For each of the MAX14918 devices (U1 and U2), a red LED is connected in series with the pull-up resistor on the $\overline{FAULT}$ pin to indicate when fault conditions are detected, LED_U1_FAULT for U1, and LED_U2_FAULT for U2. The fault conditions include chip thermal shutdown, any of the output switches that are turned on in thermal overload, reverse current detected at any of the outputs, V_5 UVLO or short-circuit detected on the RCLIM pin.

The MAX14918 comes with a SPI fault indication pin, $\overline{SPIFLT}$. It is an open-drain logic output that transitions low when the parity bits on SDI do not match or the number of SCLK pulses within an SPI transaction is not a multiple of 8. The

$\overline{\text{SPIFLT}}$ pin from U1 and U2 are connected together and read back by the EV kit software through the digital isolator $\overline{\text{FAULT}}$ channel.

Another red LED is implemented between the MAX14918 local ground (GND) and field return connection (COM). It is turned on when any reverse current is flowing from COM to GND, which indicates that a reverse current fault on the MAX14918 EV kit. For more details, see the *MAX14918 EV Kit Schematic* section.

Galvanic Isolation

The MAX14918 EV kit uses an isolated DC-DC converter and a digital isolator to provide galvanic isolation for both power and data between the logic side and the field side. The *ADuM6028* is a low-emission, 5kV isolated DC-DC converter that generates an isolated 5V (V_{ISO}) on the field side (GND) when powered by the +5V USB power on the logic side (GNDL). Both MAX14918 devices can be powered by V_{ISO} when it is connected to both devices V_5 and V_L with jumper J11 in 2-3 position, J10, J1, J6, and J7 in 1-2 position (see *Table 1*). This allows the MAX14918 EV kit to be powered by a single logic-side supply with no external field-side supply needed.

The digital isolation is achieved by the *MAX14483*, 6-channel 3.75kV_{RMS} SPI digital isolator, which provides data isolation on $\overline{\text{CS}}$, SCLK, SDI, SDO, $\overline{\text{SPIFLT}}$, and $\overline{\text{DIS}}$ signals. The isolator has two power supplies (V_{DDA} and V_{DDB}), which operate between +1.71V to +5.5V and provide voltage translation as well as galvanic isolation. The logic-side V_{DDB} of the isolator is powered by the +3.3V (3V3_USB), generated by the onboard DC-DC converter *MAX1556* from the +5V USB supply, which also powers the FT2232HQ, the USB-to-SPI interface device. The field-side V_{DDA} of the isolator is powered from V_L and GND, same as the MAX14918 logic supply. When testing isolation performance, a user must take care that there is no short connection between GND and GNDL through a multichannel oscilloscope ground connection.

The MAX14483 also provides a FIELD_POWER_OK signal to the EV kit software when both the logic side and field side of the MAX14483 are powered up normally. This feature is enabled by the SAA signal of the isolator, which is asserted high when both sides of the isolator are powered up normally and is low when the field side power (V_L) is not available. The FIELD_POWER_OK signal is indicated by the radio button **POWER** in the EV kit software (see *Figure 4*).

IEC 61000-4 Transient Immunity

Each output of the MAX14918 EV kit is protected against IEC 61000-4-5 1.2µs/50µs surges up to ±1.2kV/(42Ω + 0.5µF) line-to-ground, IEC 61000-4-2 ESD contact discharge up to ±8kV line-to-ground, and IEC 61000-4-2 ESD air-gap discharge up to ±25kV line-to-ground without the need for external protection diodes from OUT_ to GND. The MAX14918 EV kit comes with an external n-channel MOSFET (Q1) for reverse-current protection. A TVS diode (D1) is placed in parallel to Q1 to protect it from high voltage transients such as surge or ESD events. Another TVS diode (D4) provides protection against surges and ESD transients applied through 24V_FIELD and COM terminal block and diode D3 blocks the reverse current to the V_{DD} pin of the MAX14918 during negative transients.

Detailed Description of Software

When the MAX14918 EV kit software starts, it automatically detects if the EV kit is connected to a PC and indicates its status in the status bar at the bottom edge of the GUI. If the software does not recognize the EV kit hardware, make sure that the software and all drivers are properly installed, check the USB connection, go to the **Device** menu and select **Search for Hardware** option (see *Figure 3*).

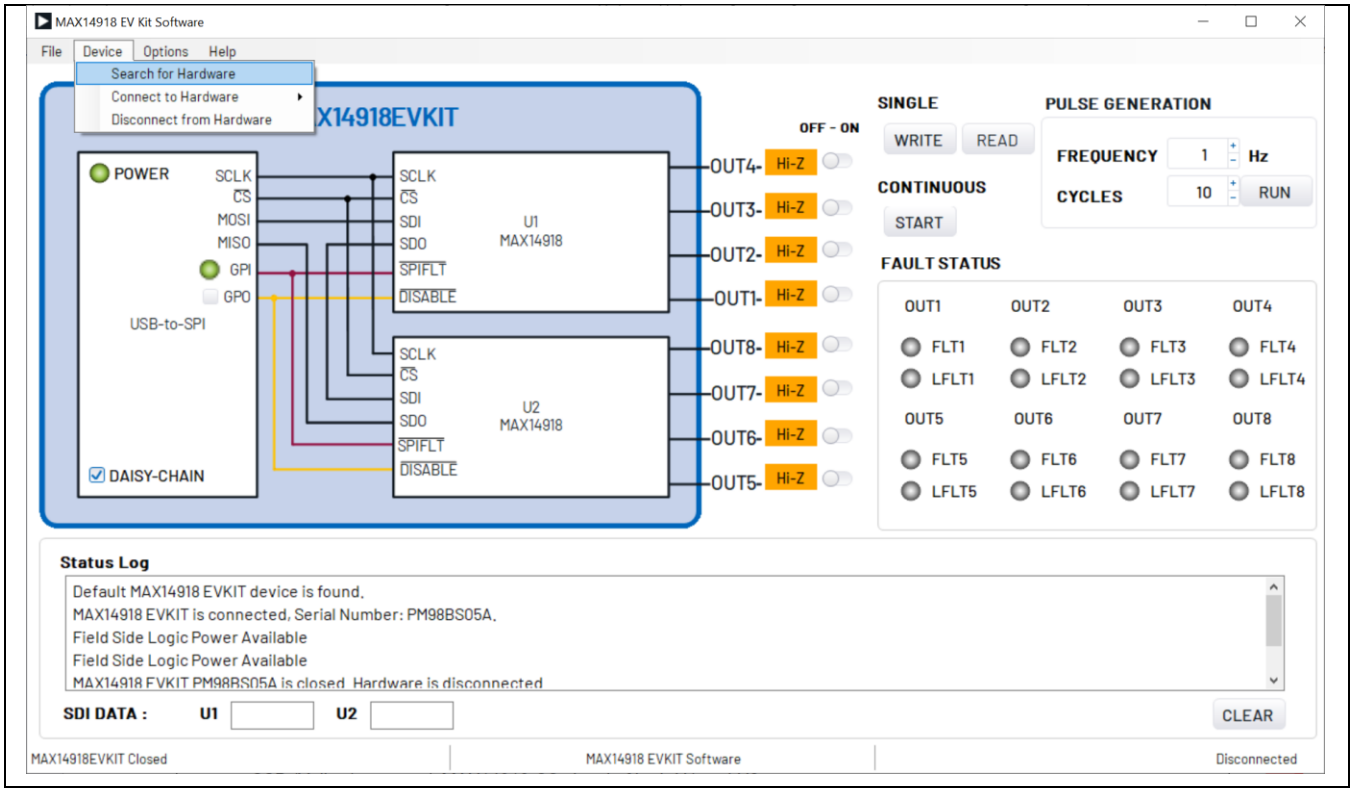


Figure 3. MAX14918 EV Kit Software – USB Communication

The EV kit software is configured in the USB daisy-chain mode by default, indicated by **DAISY-CHAIN** checkbox. In the daisy-chain mode, the output controls and diagnostic indicators for both U1 and U2 are shown in the main control window as shown in *Figure 4*. If the USB single-device mode is required, uncheck the **DAISY-CHAIN** checkbox to operate in the single-device mode and only communicate with U1. The main control window is updated to only display the output controls and diagnostic indicators for U1 as shown in *Figure 5*.

Make sure that the jumper settings are updated properly when switching between the daisy-chain mode and single-device mode. To help user find the jumper locations, when the **DAISY-CHAIN** checkbox is updated, the software displays the jumper positions based on the checkbox selection in the top silkscreen diagram as shown in *Figure 6* and *Figure 7*. For jumper setting details, see *Table 1*.

The EV kit software monitors the field-side power by reading the FIELD_POWER_OK signal from the *MAX14483* SAA pin. When the field-side power is present, radio button **POWER** is green and all controls in the software are enabled. When the field-side power is not detected, an error message is displayed, **POWER** turns red and channel status indicators are turned gray. Click the **WRITE** button to update the power status when the field-side power is restored.

The main control window of the MAX14918 EV kit software allows channel configuration, diagnostic reporting, and pulse generation. The channel configuration section provides controls to set each output switch to be **ON** or **OFF** by toggling the slide bar at each output (see *Figure 4*). Note that the channel order shown in the software matches the channel order on the EV kit hardware, OUT4 to OUT1 from U1 and OUT8 to OUT5 from U2, from top down. When all channels are configured, click the **WRITE** button to send the configuration to the MAX14918 devices. All channels can be disabled regardless their respective output configuration when checkbox **GPO** is selected, which asserts the $\overline{DIS}$ signal of both MAX14918 devices low.

The **FAULT STATUS** box provides the **FLT_** and **LFLT_** thermal faults for all channels. When the **WRITE** or **READ** button is clicked, the software updates the **FLT_** and **LFLT_** indicators based on the SDO data from the MAX14918. The **GPI** indicator showing the $\overline{\text{SPIFLT}}$ status from both U1 and U2 is also updated. When an $\overline{\text{SPIFLT}}$ fault is detected, all channel status indicators are turned gray. Click the **WRITE** button to retrieve the updated $\overline{\text{SPIFLT}}$ status.

The software provides the latest SDI data sent to U1 and U2 in the **SDI DATA** section to help user verify the parity bits.

Continuous write option is provided in the EV kit software by clicking the **CONTINUOUS** button. In the continuous write mode, updating any output channel slide bar control triggers an SPI command to be sent to the MAX14918 and the corresponding output switch is turned on or off immediately. Fault status of all channels are also updated at the same time. Click the **CONTINUOUS** button again to exit the continuous write mode.

The EV kit software provides a pulse generation mode to support continuous switching on the output channels that are turned on. Set the required switching frequency and number of cycles in the **PULSE GENERATION** box and click the **RUN** button. The outputs then switch at the desired frequency till the number of cycles is reached. Due to the USB-to-SPI interface limitation, the software only supports switching frequency up to 100kHz while the MAX14918 supports up to 500kHz.

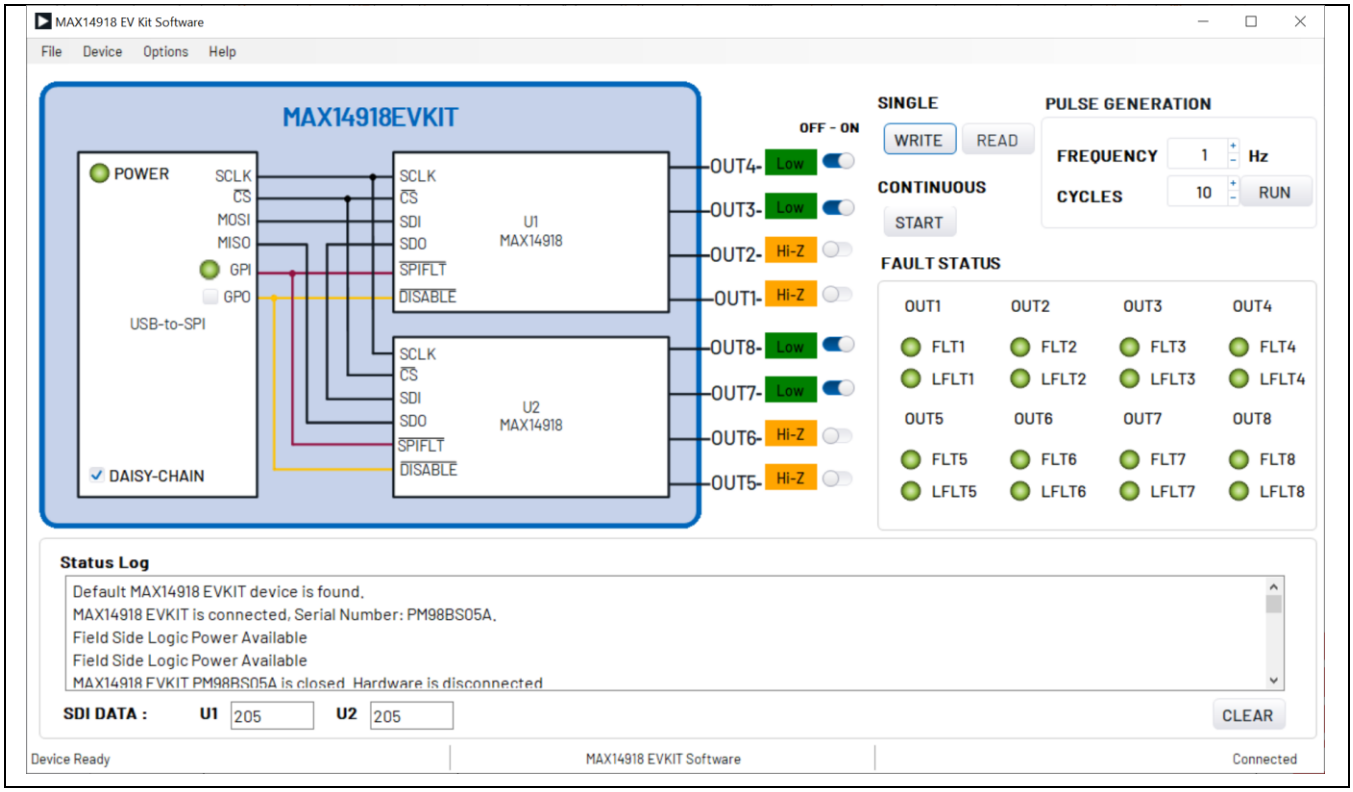


Figure 4. MAX14918 EV kit Software – Configure Output Switches

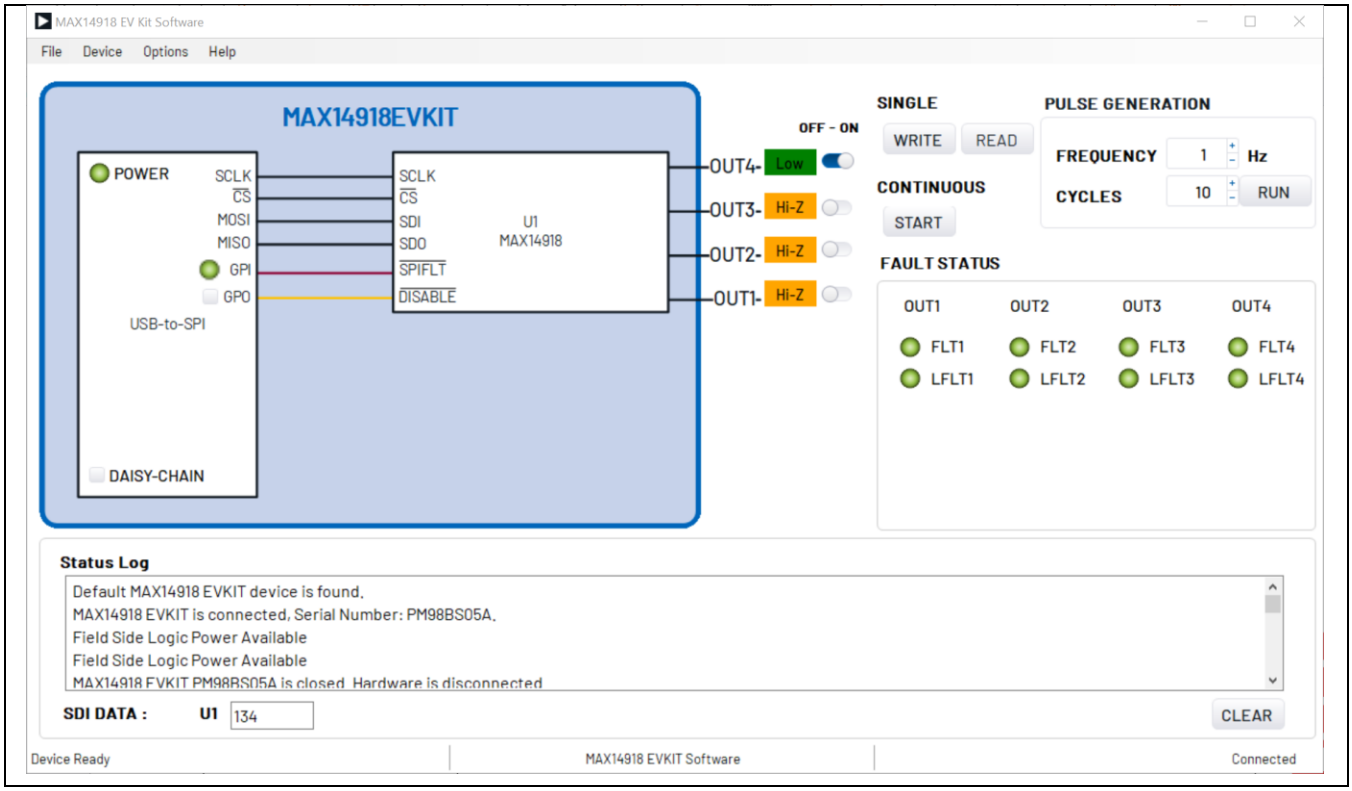


Figure 5. MAX14918 EV kit Software – Single-Device Mode

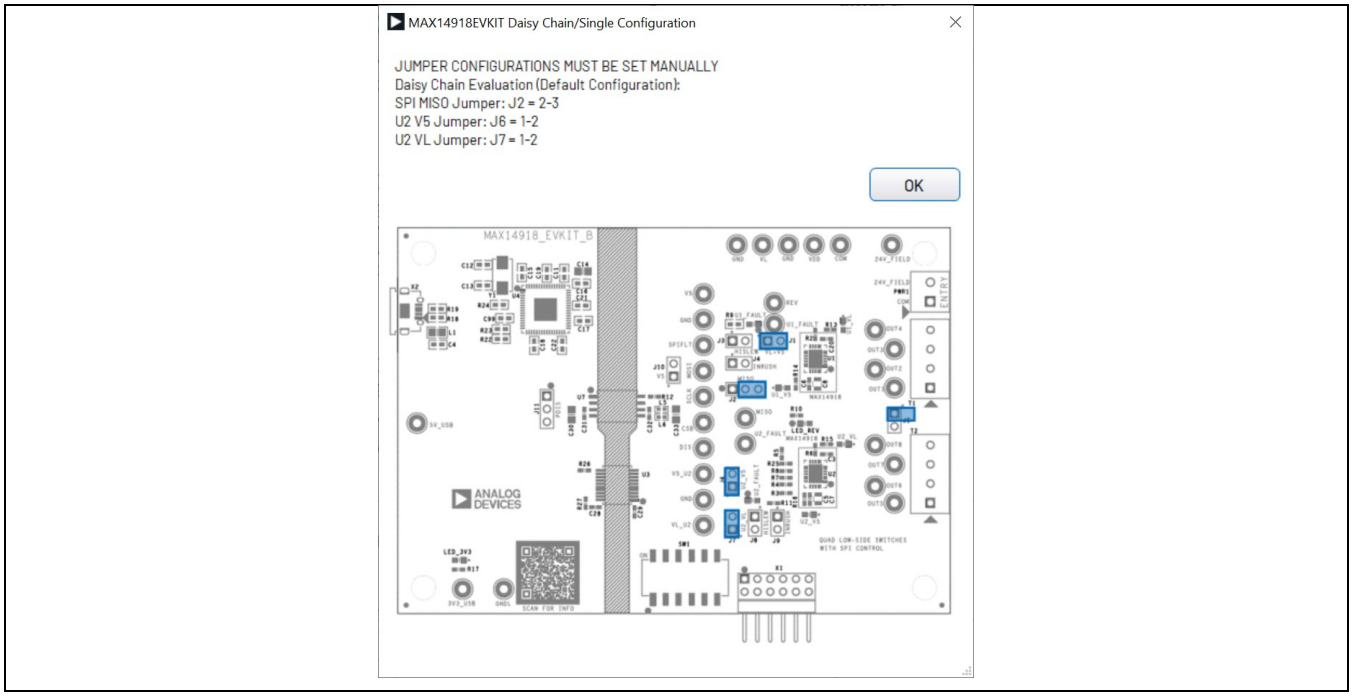


Figure 6. Jumper Setting Diagram – Daisy-Chain Mode

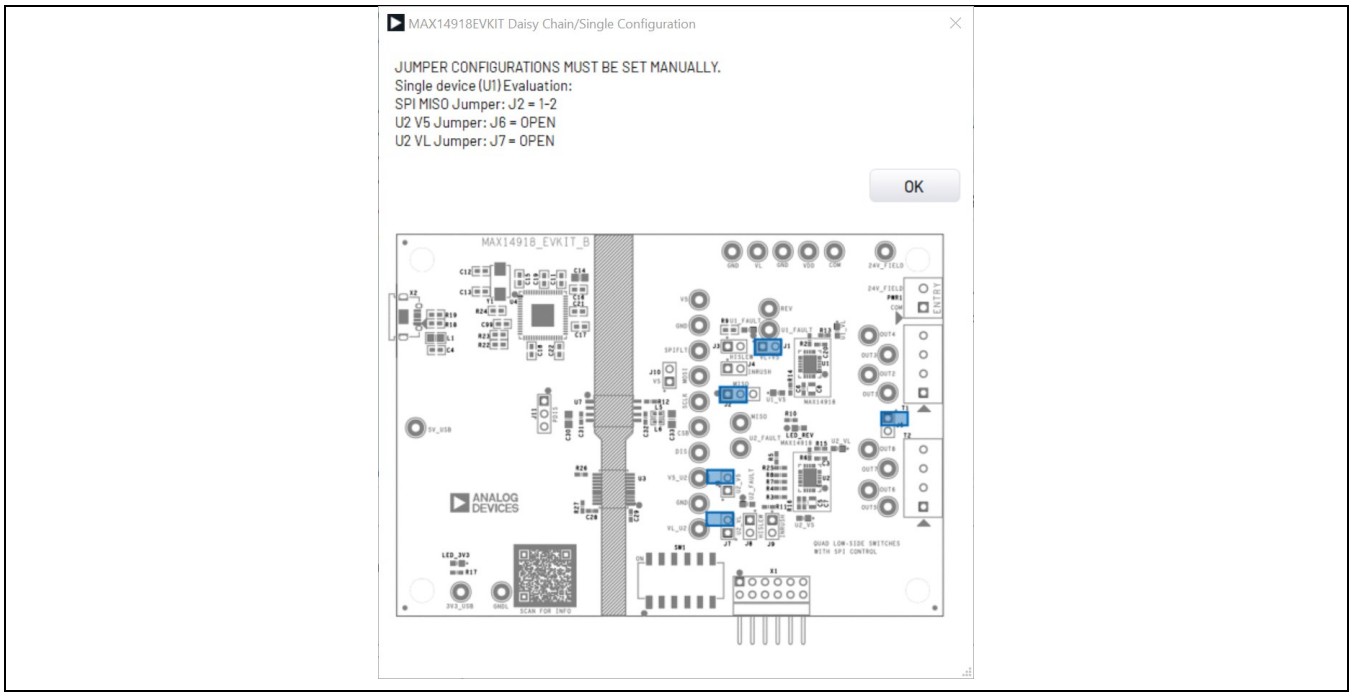


Figure 7. Jumper Setting Diagram – Single-Device Mode

Ordering Information

PART	TYPE
MAX14918EVKIT#	EV Kit

#Denotes RoHS-compliant.

MAX14918 EV Kit Bill of Materials

ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C1, C30, C33	3	CL21B106KOQNNN;GRM21BZ71C106KE15;GMC21X7R106K16NT	SAMSUNG;MURATA;CAL-CHIP	10UF	CAP; SMT (0805); 10UF; 10%; 16V; X7R; CERAMIC
2	C2	1	C1608X7R1H474K080AC	TDK	0.47UF	CAP; SMT (0603); 0.47UF; 10%; 50V; X7R; CERAMIC
3	C3, C10, C11, C15-C22, C25, C26, C28, C29, C31, C32, C99	18	CC0603KRX7R0BB104;GRM188R72A104KA35;HMK107B7104KA;06031C104KAT2A;GRM188R72A104K	YAGEO;MURATA;TAIYO YUDEN;AVX;MURATA	0.1UF	CAP; SMT (0603); 0.1UF; 10%; 100V; X7R; CERAMIC
4	C4	1	C0603C103K2RAC	KEMET	0.01UF	CAP; SMT (0603); 0.01UF; 10%; 200V; X7R; CERAMIC
5	C5, C6	2	UMK107AB7105KA;CC0603KRX7R9BB105	TAIYO YUDEN;YAGEO	1UF	CAP; SMT (0603); 1UF; 10%; 50V; X7R; CERAMIC
6	C7, C8	2	08051C105K4Z2A	AVX	1UF	CAP; SMT (0805); 1UF; 10%; 100V; X7R; CERAMIC
7	C9, C14, C27	3	TMK212AB7475K;C2012X7R1E475K125AB;GRM21BZ71E475KE15	TAIYO YUDEN;TDK;MURATA	4.7UF	CAP; SMT (0805); 4.7UF; 10%; 25V; X7R; CERAMIC
8	C12, C13	2	C0603C0G500-180JNE;C1608C0G1H180J080AA;GRM1885C1H180J	VENKEL LTD.;TDK;MURATA	18PF	CAP; SMT (0603); 18PF; 5%; 50V; C0G; CERAMIC
9	C23	1	C1608C0G2A102J080AA;C0603C102J1GAC	TDK;KEMET	1000PF	CAP; SMT (0603); 1000PF; 5%; 100V; C0G; CERAMIC
10	C24	1	C2012X5R1C226K125AC	TDK	22UF	CAP; SMT (0805); 22UF; 10%; 16V; X5R; CERAMIC
11	D1	1	SMCJ36A	LITTEL FUSE	36V	DIODE; TVS; SMC (DO-214AB); VRM=36V; IPP=25.9A
12	D3	1	MMBD6050LT1G	ON SEMICONDUCTOR	MMBD6050LT1G	DIODE; SWT; SMT (SOT-23); PIV=70V; IF=0.2A
13	D4	1	SMAJ33CA	VISHAY GENERAL SEMICONDUCTOR	33V	DIODE; TVS; SMA (DO-214AC); VRM=33V; IPP=7.5A

MAX14918 EV Kit Bill of Materials (continued)

ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
14	J1, J3-J10	9	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
15	J2, J11	2	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
16	L1, L3, L4	3	BLM21PG331SN1	MURATA	330	INDUCTOR; SMT (0805); FERRITE-BEAD; 330; TOL=+/-25%; 1.5A
17	L2	1	B82432T1332K000	TDK	3.3UH	INDUCTOR; SMT (1812); FERRITE CORE; 3.3UH; TOL=+/-10%; 0.9A
18	L5, L6	2	BLM15HD182SN1	MURATA	1800	INDUCTOR; SMT (0402); FERRITE-BEAD; 1800; TOL=+/-; 0.20A
19	LED_3V3, LED_U1_V5, LED_U1_VL, LED_U2_V5, LED_U2_VL	5	APT1608CGCK	KINGBRIGHT	APT1608CGCK	DIODE; LED; STANDARD; GREEN; SMT (0603); PIV=2.1V; IF=0.02A; -40 DEGC TO +85 DEGC
20	LED_REV, LED_U1_FAULT, LED_U2_FAULT	3	APT1608LSECK/J3-PRV	KINGBRIGHT	APT1608LSECK/J3-PRV	DIODE; LED; HYPER RED WATER CLEAR; RED; SMT (0603); VF=1.8V; IF=0.002A
21	MTH1-MTH4	4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
22	PWR1	1	1985823	PHOENIX CONTACT	1985823	CONNECTOR; FEMALE; THROUGH HOLE; PCB TERMINAL BLOCK; STRAIGHT; 2PINS
23	Q1	1	NVTFS010N10MCLTAG	ON SEMICONDUCTOR	NVTFS010N10MCLTAG	TRAN; NCH; POWER MOSFET; SINGLE N-CHANNEL; WDFN8; PD-(77.8W); I-(57.8A); V-(100V)
24	R1	1	RC0603FR-07100RL;CR0603-FX-1000ELF	YAGEO;BOURNS	100	RES; SMT (0603); 100; 1%; +/-100PPM/DEGC; 0.1000W
25	R2, R6	2	CRCW060327K0FK	VISHAY DALE	27K	RES; SMT (0603); 27K; 1%; +/-100PPM/DEGC; 0.1000W
26	R3, R4, R7, R8, R12, R25	6	CRCW06030000Z0	VISHAY DALE	0	RES; SMT (0603); 0; JUMPER; JUMPER; 0.1000W
27	R5, R20, R22, R27	4	CRCW060310K0FK;ERJ-3EKF1002;AC0603FR-0710KL;RMCF0603FT10K0	VISHAY;PANASONIC;YAGEO;STACKPOLE	10K	RES; SMT (0603); 10K; 1%; +/-100PPM/DEGC; 0.1000W
28	R9, R11	2	CRCW06034K70FK	VISHAY DALE	4.7K	RES; SMT (0603); 4.7K; 1%; +/-100PPM/DEGC; 0.1000W

MAX14918 EV Kit Bill of Materials (continued)

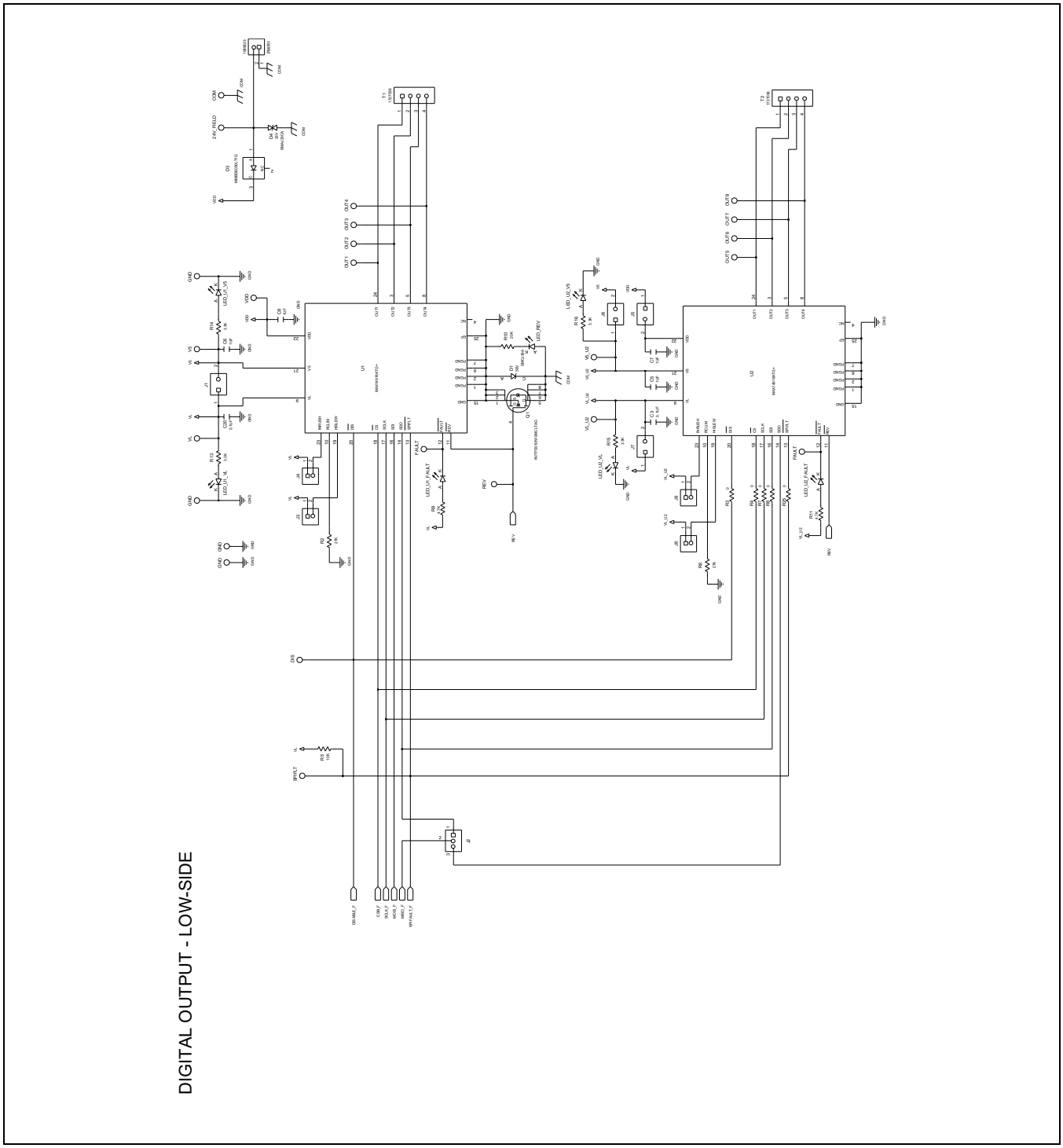
ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
29	R10	1	MCR03EZPFX2002;ERJ-3EKF2002;CR0603-FX-2002ELF;CRCW060320K0FK;RMCF0603FT20K0	ROHM;PANASONIC;BOURNS;VISHAY;STACKPOLE ELECTRONICS INC	20K	RES; SMT (0603); 20K; 1%; +/-100PPM/DEGC; 0.1000W
30	R13-R17	5	RCW06033K30FK;RC0603FR-073K3L;RK73H1J3301F	VISHAY;YAGEO;VISHAY	3.3K	RES; SMT (0603); 3.3K; 1%; +/-100PPM/DEGC; 0.1000W
31	R18, R19	2	CRCW060310R0FK; MCR03EZPFX10R0;ERJ-3EKF10R0	VISHAY;ROHM SEMICONDUCTOR;PANASONIC	10	RES; SMT (0603); 10; 1%; +/-100PPM/DEGC; 0.1000W
32	R21	1	CRCW06032K20FK	VISHAY DALE	2.2K	RES; SMT (0603); 2.2K; 1%; +/-100PPM/DEGC; 0.1000W
33	R23	1	CRCW060315K0FK	VISHAY DALE	15K	RES; SMT (0603); 15K; 1%; +/-100PPM/DEGC; 0.1000W
34	R24	1	CRCW060312K0FK;ERJ-3EKF1202	VISHAY;PANASONIC	12K	RES; SMT (0603); 12K; 1%; +/-100PPM/DEGC; 0.1000W
35	SU1-SU11	11	NPC02SXON-RC	SULLINS ELECTRONICS CORP.	NPC02SXON-RC	CONNECTOR; FEMALE; MINI SHUNT; 0.100IN CC; OPEN TOP; JUMPER; STRAIGHT; 2PINS
36	SW1	1	219-6MST	CTS	219-6MST	SWITCH; SPST; SMT; STRAIGHT; 20V; 0.1A; SURFACE MOUNT DIP SWITCH-AUTO PLACEABLE; RINSULATION=1000M OHM
37	T1, T2	2	1727036	PHOENIX CONTACT	1727036	CONNECTOR; FEMALE; THROUGH HOLE; GREEN PCB TERMINAL BLOCK; STRAIGHT; 4PINS
38	TP1, TP3, TP7-TP9, TP18, TP22, TP35	8	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL;
39	TP2, TP4-TP6, TP10, TP15	6	5014	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; YELLOW; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
40	TP11-TP14, TP24, TP34	6	5011	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
41	TP16, TP17, TP19	3	5012	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
42	TP23, TP25-TP31	8	5013	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; ORANGE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;

MAX14918 EV Kit Bill of Materials (continued)

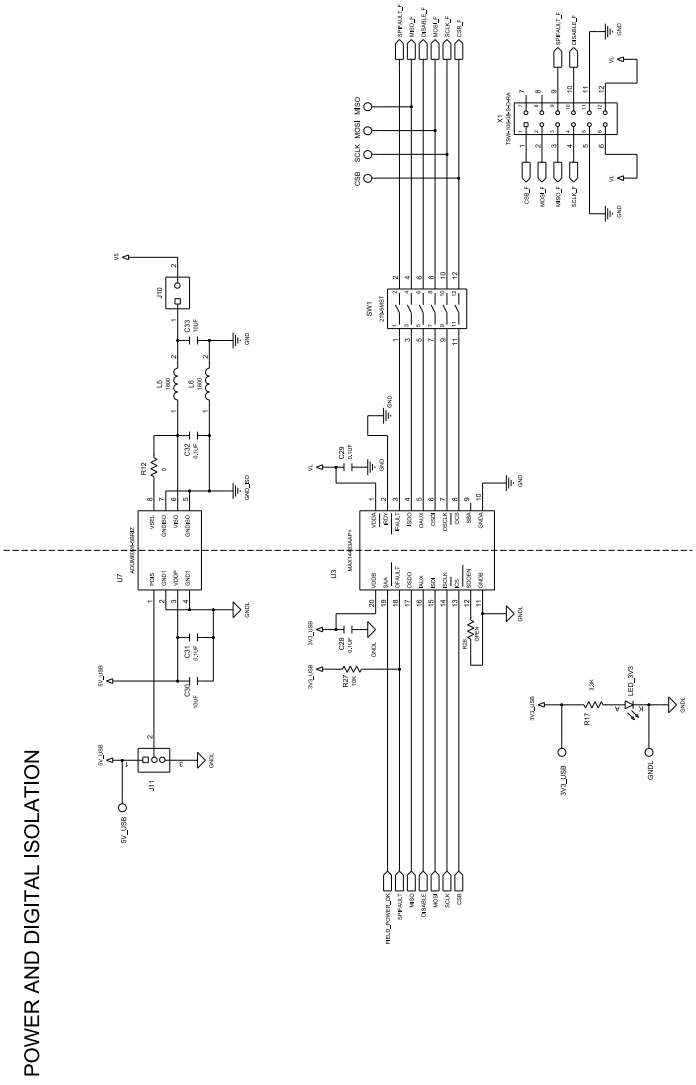
ITEM	REF_DES	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
43	U1, U2	2	MAX14918ATG+	ANALOG DEVICES	MAX14918ATG+	EVKIT PART - IC; MAX14918ATG+ PACKAGE OUTLINE DRAWING: 21-0201; LAND PATTERN: 90-0083; PACKAGE CODE: T2445+2C; TQFN24-EP
44	U3	1	MAX14483AAP+	ANALOG DEVICES	MAX14483AAP+	IC; DISO; 6-CHANNEL; LOW-POWER; 3.75KVRMS SPI DIGITAL ISOLATOR; SSOP20
45	U4	1	FT2232HQ	FUTURE TECHNOLOGY DEVICES INTL LTD.	FT2232HQ	IC; MMRY; DUAL HIGH SPEED USB TO MULTIPURPOSE UART/FIFO; QFN64-EP
46	U5	1	MAX1556ETB+	ANALOG DEVICES	MAX1556ETB+	IC; CONV; PWM STEP-DOWN DC-DC CONVERTER; TDFN10-EP 3X3
47	U6	1	93LC66BT-I/OT	MICROCHIP	93LC66BT-I/OT	IC; EPROM; 4K MICROWIRE SERIAL EEPROM; SOT23-6
48	U7	1	ADUM6028-5BRIZ	ANALOG DEVICES	ADUM6028-5BRIZ	IC; VCON; LOW EMISSION; 5 KV ISOLATED DC-TO-DC CONVERTERS; WSOIC8; WSOIC8 300MIL
49	X1	1	TSW-106-08-S-D-RA	SAMTEC	TSW-106-08-S-D-RA	CONNECTOR; THROUGH HOLE; DOUBLE ROW; RIGHT ANGLE; 12PINS;
50	X2	1	ZX62RD-AB-5P8(30)	HIROSE ELECTRIC CO LTD.	ZX62RD-AB-5P8(30)	CONNECTOR; MALE; THROUGH HOLE; MICRO-USB CONNECTOR MEETING REQUIREMENTS OF USB 2.0 STANDARD; RIGHT ANGLE; 5PINS
51	Y1	1	ABM7-12.000MHZ-D2Y-T	ABRACON	12MHZ	CRYSTAL; SMT; 12MHZ; 18PF; TOL = +/-20PPM; STABILITY = +/-30PPM
52	R26	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0603 RESISTOR

Note: N/A means not applicable.

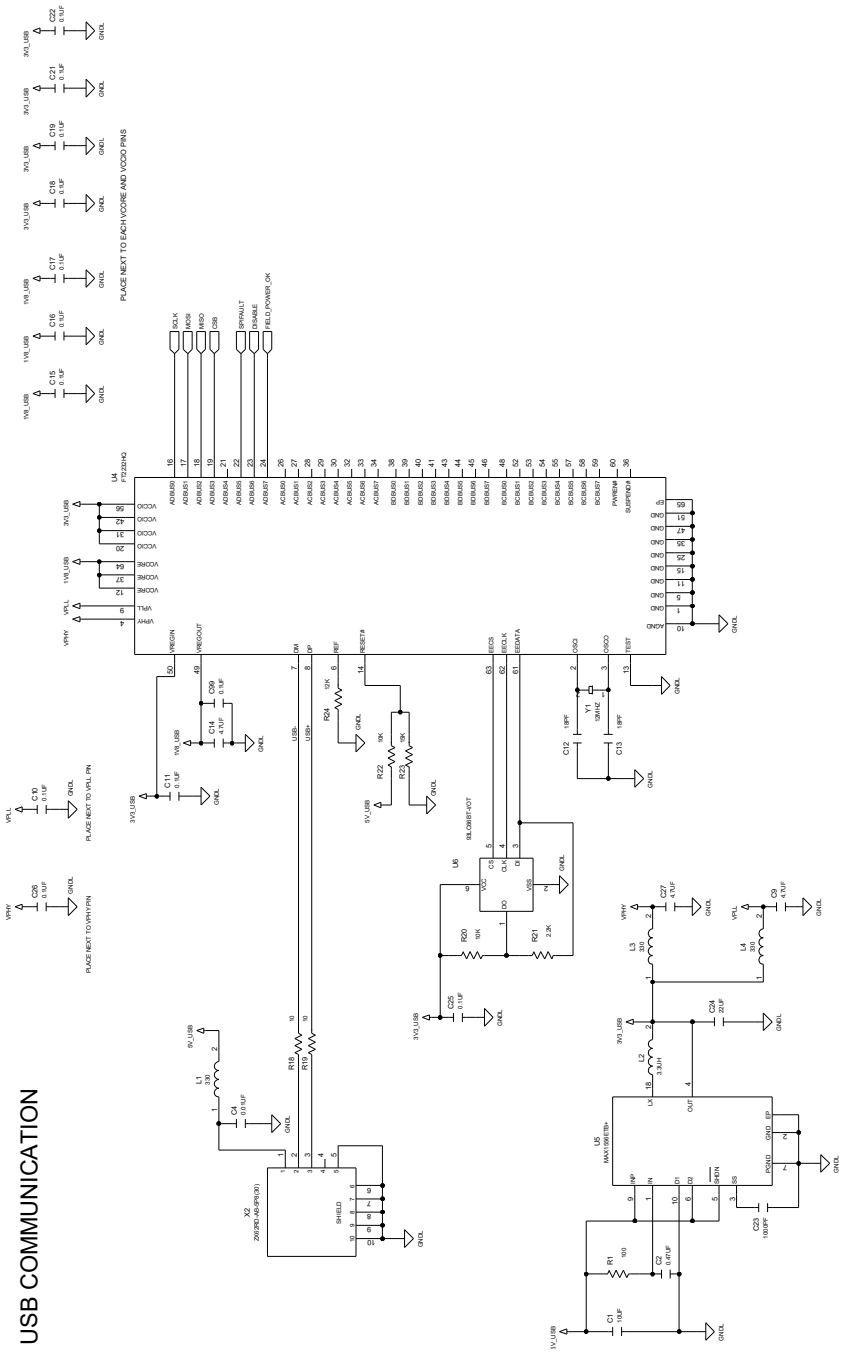
MAX14918 EV Kit Schematic



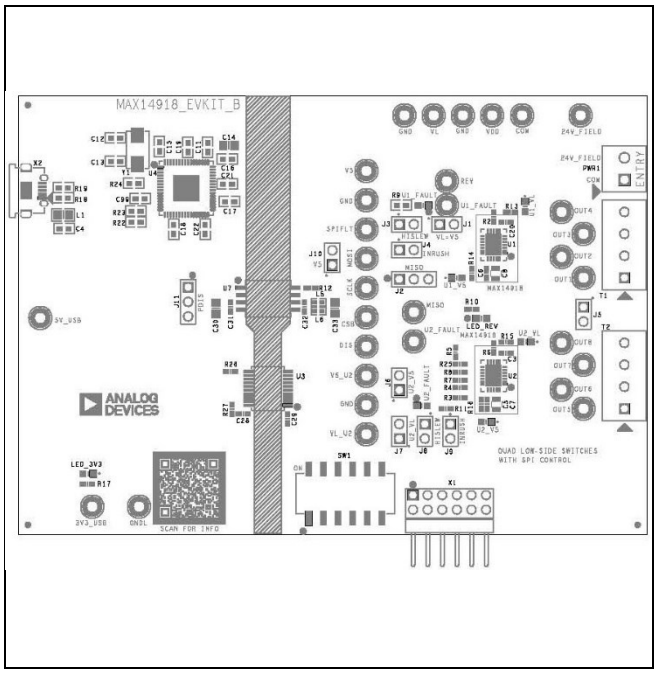
MAX14918 EV Kit Schematic (continued)



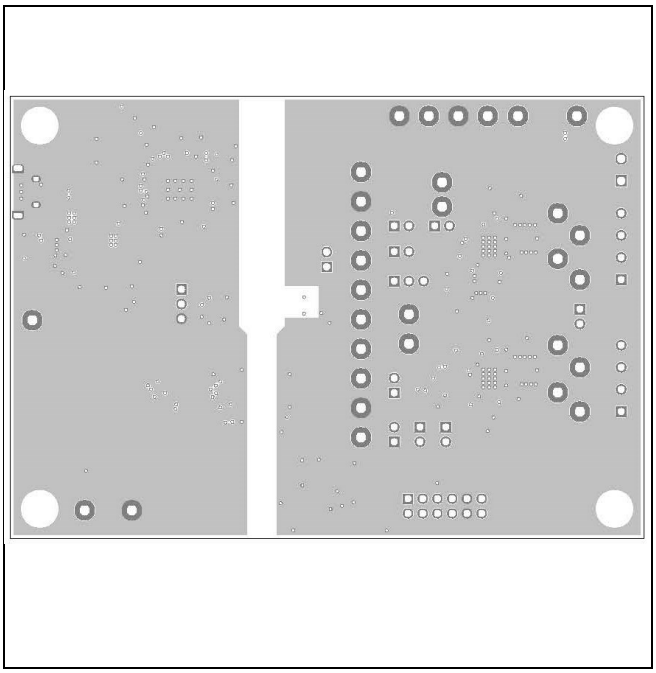
MAX14918 EV Kit Schematic (continued)



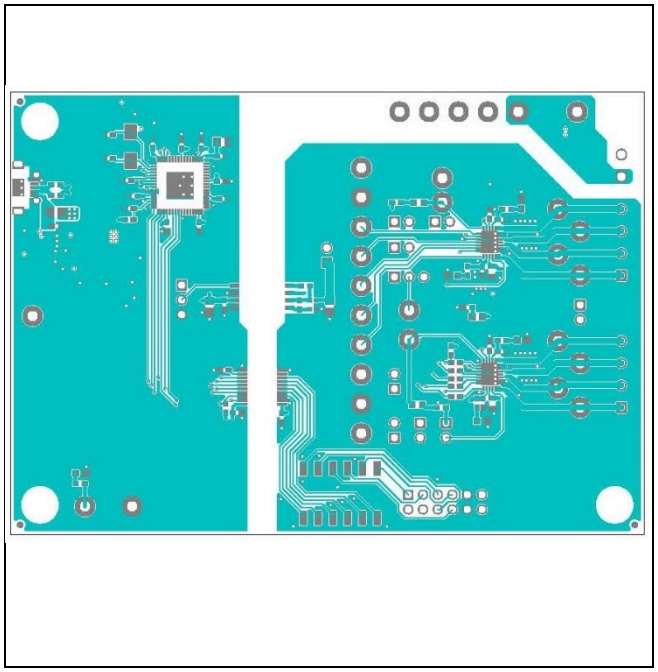
MAX14918 EV Kit PCB Layout Diagrams



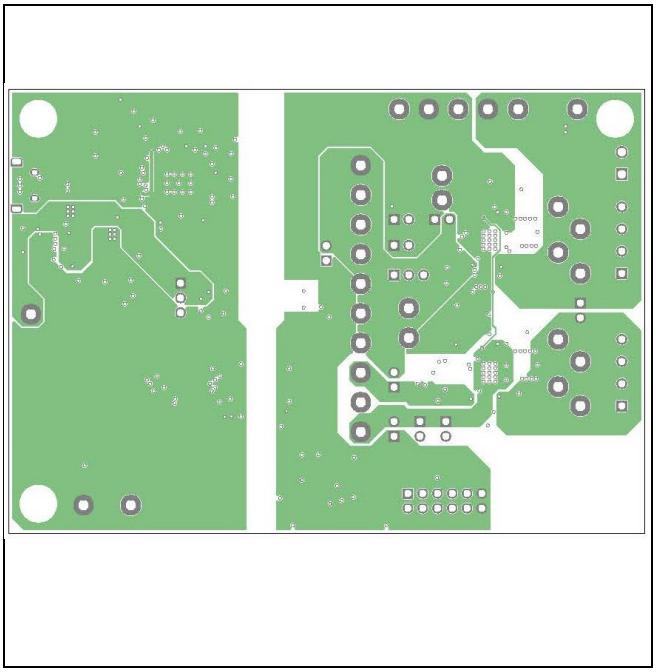
MAX14918 EV Kit Component Placement Guide—Top Silkscreen



MAX14918 EV Kit PCB Layout—Layer 2

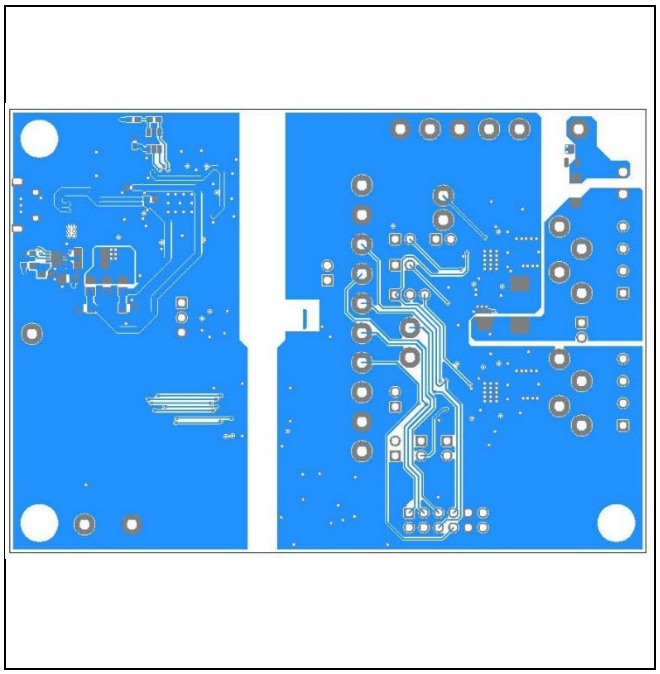


MAX14918 EV Kit PCB Layout—Top

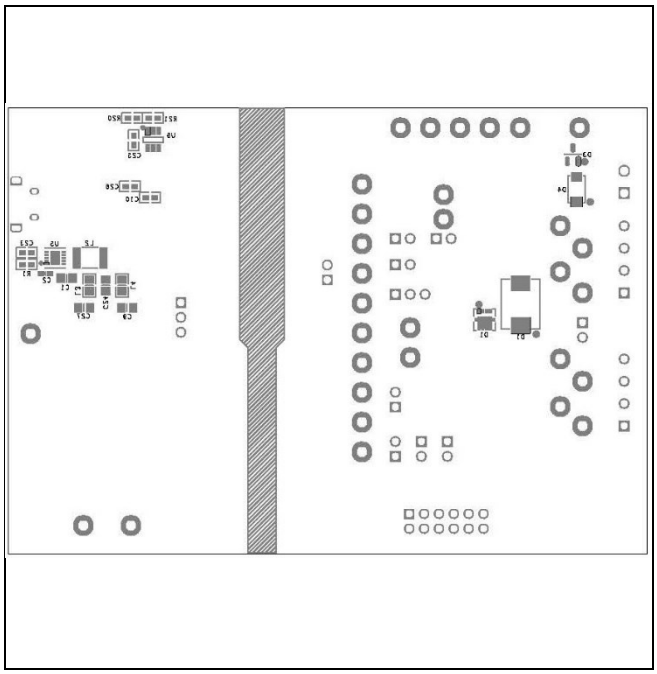


MAX14918 EV Kit PCB Layout—Layer 3

MAX14918 EV Kit PCB Layout Diagrams (continued)



MAX14918 EV Kit PCB Layout—Bottom



MAX14918 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/24	Initial release	—

Notes