General Description

The MAX31850/MAX31851 evaluation kit (EV kit) provides the hardware and software graphical user interface (GUI) necessary to evaluate the MAX31850/MAX31851 cold-junction compensated, 1-Wire® thermocouple-to-digital converter.

The EV kit comes with a MAX31850KATB+ soldered to the PCB. This is the K-type thermocouple version of the device. Other thermocouple types can be evaluated by procuring the desired thermocouple, thermocouple socket, and corresponding MAX31850 or MAX31851. Contact the factory for free samples of the devices to match your desired thermocouple type. See the *Evaluating Other Thermocouple Types* section for part numbers and additional information regarding other thermocouple types.

EV Kit Contents

- Assembled Circuit Board Including MAX31850K
- Micro-USB Cable
- K-Type Thermocouple

Features

- Includes Everything Needed to Evaluate a MAX31850K with a K-Type Thermocouple
- EV Kit Hardware is USB Powered (USB Cable Included)
- Windows XP®- and Windows® 7-Compatible Operating System Software
- USB HID Interface
- Second Channel Allows Easy Evaluation of Other Thermocouple Types
- Fully Assembled and Tested on Proven PCB Layout
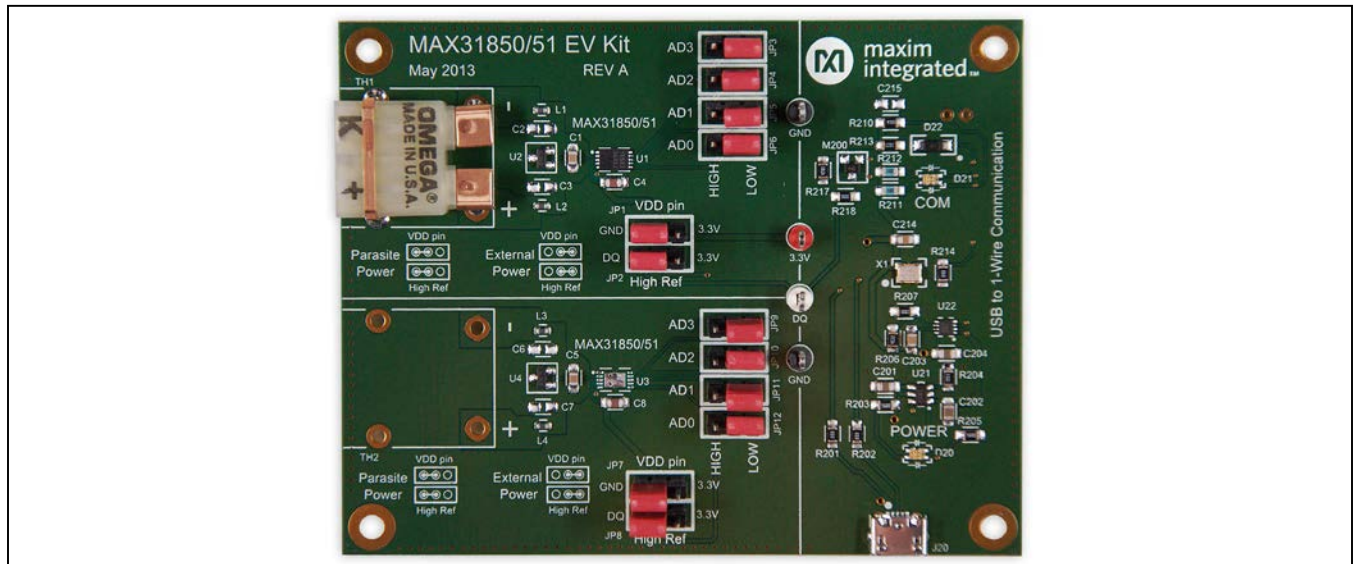- RoHS Compliant

MA31850/MAX31851 EV Kit Files

FILE	DESCRIPTION
MAX31850_51EVKitSetup.EXE	Application Program

Note: *The .EXE is downloaded as a .ZIP file.*

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

MAX31850/MAX31851 EV Kit Board

1-Wire is a registered trademark of Maxim Integrated Products, Inc.

Windows and Windows XP are registered trademarks and registered service marks of Microsoft Corporation.

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Component List

DESIGNATION	QTY	DESCRIPTION
C1, C5, C203, C214	4	0.01µF ceramic capacitors (0805)
C2, C3, C6, C7, C215	0	Do not populate, ceramic capacitors (0805)
C4, C8, C212	3	0.1µF ceramic capacitors (0805)
C201, C202, C204	3	10µF ceramic capacitors (0805)
C211	1	1.0µF ceramic capacitor (0805)
C213	1	0.22µF ceramic capacitor (0805)
D20, D21	2	Red/green dual LEDs
D22	1	Schottky diode
J20	1	5-pin female Micro-USB connector
J21	0	Do not populate, 2-pin header
JP1–JP12	12	3-pin (1 x 3) headers, 2.54mm pitch
L1–L4	4	470Ω ferrite beads (0603) BLM18PG471SN1D
M200	1	30V, 1.2A pMOS (3 SC70)
R201, R202, R214, R218	4	0Ω ±1% resistors (0805)
R203, R205	1	560Ω ±1% resistors (0805)
R204	1	100kΩ ±1% resistor (0805)
R206	1	45.3kΩ ±1% resistor (0805)
R207	1	10kΩ ±1% resistor (0805)
R210, R217	2	4.7kΩ ±1% resistors (0805)
R211, R212	2	330Ω ±1% resistors (0805)
R213	1	2.2kΩ ±1% resistor (0805)

DESIGNATION	QTY	DESCRIPTION
TH1	1	K-type thermocouple socket Omega PCC-SMP-K-5-ROHS
TH2	0	Do not populate, thermocouple socket
TP1	1	White test point
TP2, TP3	2	Black test points
TP6	1	Red test point
U1	1	Thermocouple-to-digital converter (10 TDFN-EP*) Maxim MAX31850KATB+
U3	0	Do not populate, MAX31850/ MAX31851
U2, U4	2	TVS diode arrays (3 SOT) NUP2105LT1G
U20	1	Microcontroller (28 SO) Microchip PIC18LF2550-I/SO
U21	1	50mA to 600mA current-limit switch (6 SOT23) Maxim MAX4995AAUT+
U22	1	500mA LDO regulator Maxim MAX8902BATA+
X1	1	48MHz, 3.3V oscillator (SMD) AVX KC3225A48.0000C30E00
—	1	Micro-USB cable
—	1	K-type thermocouple Omega 5SRTC-GG-K-24-36-ROHS
—	12	Jumpers/shunts
—	1	PCB: MAX31850/51 EV Kit

*EP = Exposed pad.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX North America	864-967-2150	www.avx.com
Omega Engineering, Inc	888-826-6342	www.omega.com

Note: Indicate that you are using the MAX31850/MAX31851 when contacting these component suppliers.

Quick Start

Required Equipment

- MAX31850/MAX31851 EV kit hardware
- Windows XP or Windows 7 PC with a spare USB port
- USB Port
- Micro-USB cable (included)
- K-type thermocouple (included)

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

Follow the steps below to get started measuring temperature using the device interfaced to a K-type thermocouple.

1) Connect the included K-type thermocouple to TH1 (thermocouple socket) of the EV kit hardware. One terminal of the thermocouple is wider than the other, ensuring proper polarity.

2) Ensure that jumpers/shunts are installed on JP1–JP6. JP1 and JP2 should both be either positioned on the left for parasitic power mode or positioned on the right to be externally powered. JP3–JP6 jumpers can be in either position depending on the desired location address.

3) Set the EV kit hardware on a nonconductive surface to ensure that nothing on the PCB gets shorted together.

4) Prior to starting the GUI, connect the EV kit hardware to a PC using the supplied Micro-USB cable, or equivalent. The power LED (D20) should be green and the com LED (D21) should be red and slowly flash orange.

5) Windows should automatically begin installing the necessary device driver. The USB interface of the EV kit hardware is configured as an HID device and therefore does not require a unique/custom device driver. Once the driver installation is complete, a Windows message appears near the **System Icon** menu indicating that the hardware is ready to use. Do not attempt to run the GUI prior to this message. If you do, you must close the application and restart it once the driver installation is complete. On some versions of Windows, Administrator privileges may be required to install the USB device.

6) Once the device driver installation is complete, visit www.maximintegrated.com/evkitsoftware to download the latest version of the EV kit software, titled MAX31850_51EVKitSetup.ZIP. Save the EV kit software to a temporary folder.

7) Unzip the .ZIP file and double click the .EXE file to run the installer. A message box stating **The publisher could not be verified. Are you sure you want to run this software?** may appear. If so, click **Yes**.

8) Follow the instructions on the installer and once complete, click **Finish**. The default location of the GUI is in the program files directory.

9) When the GUI appears, the status bar should display **EV kit hardware Connected** in the bottom right hand corner. The com LED (D21) on the EV kit board should turn green.

Detailed Description of Software

Software Startup

If the MAX31850/MAX31851 EV kit is connected when the software is opened, the software first initializes the hardware to communicate. Then the software searches for all ROM codes on the bus and lists them in the **ROM Code** drop-down lists. If a ROM code is found with the correct family code (3Bh), the software reads all data from the device. If the software is started without the hardware connected, the initialization sequence above is executed once the EV kit is connected.

Read Data Tab

When the **Read Data** tab sheet (Figure 1) is selected, a temperature conversion is performed and the scratchpad and power-supply mode are read from the device. The **Read Power Mode** button executes the Match ROM (55h) and Read Power Supply (B4h) command and displays the data in the **Power Supply Mode** edit field. The **Read Temperature** button executes the Match ROM (55h), Convert T (44h), and Read Scratchpad (BEh) commands. This reads the **Thermocouple Temp**, **Cold Junction Temp**, **Fault Status**, and **Location Address**, and then the **Linearized Temp** is calculated. If the **Power Supply Mode** is parasite, then a strong pullup is enabled while the device converts temperature. If a fault is detected, then the color indicator turns red and the status bar displays **FAULT!**. Both buttons match the ROM code selected in the **ROM Code** drop-down list. The **Thermocouple Type** drop-down list is used to calculate the linearized temperature and should be changed to match the hardware thermocouple type. Table 1 lists all
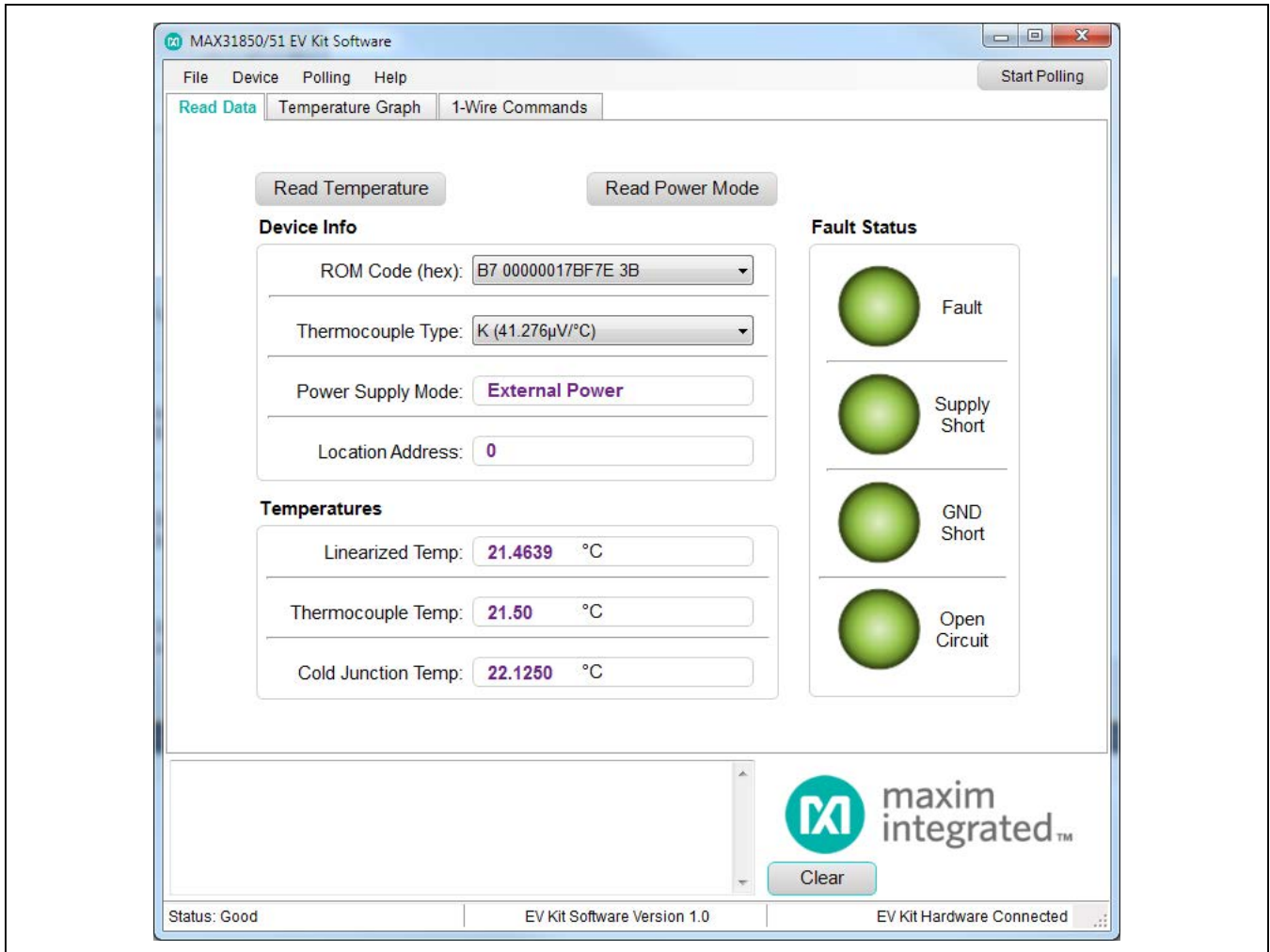
Figure 1. MAX31850/MAX31851 EV Kit GUI (Read Data Tab)

possible settings. The temperature can also be polled by pressing the **Start Polling** button in the upper right-hand corner. This executes the same commands as the **Read Temperature** button. The polling rate can be selected using the **Polling** menu bar option. To stop polling, press the **Stop Polling** button.

Table 1. Sensitivity of Thermocouples

TYPE	SENSITIVITY (µV/ºC)
K*	41.276
J	57.953
N	36.256
R	10.506
S	9.587
T	52.18
E	76.373

*Default setting.

Temperature Graph Tab

The **Temperature Graph** tab sheet (Figure 2) displays a line graph of the polled temperatures. Data points are plotted when the **Start Polling** button is pressed. To show/hide a series in the graph, check/uncheck the checkboxes on the bottom. The graph can save up to 500,000 data points per series. To save the data to a CSV file, press the **Save Data** button. The graph can be cleared by pressing the **Clear Graph** button.
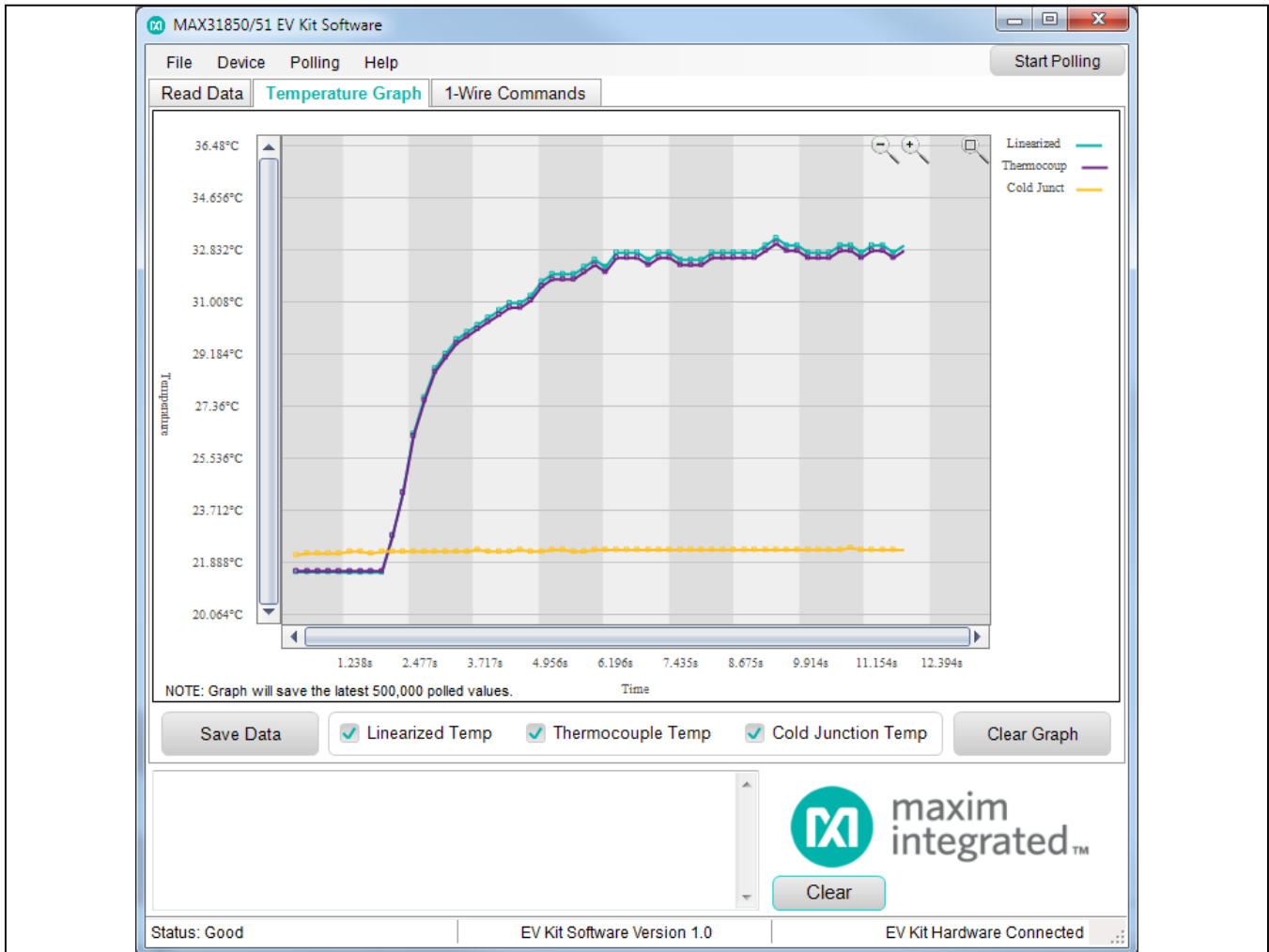

Figure 2. MAX31850/MAX31851 EV Kit GUI (Temperature Graph Tab)

1-Wire Commands Tab

The **1-Wire Commands** tab sheet (Figure 3) contains buttons for all the 1-Wire commands and displays the data in HEX format. All the ROM command buttons first issue a reset and detect a presence before sending their command. The device can also be reset using the **Reset Device** option in the **Device** menu. The **Search ROM (F0h)** button searches for all the ROM codes on the bus and places them in the **ROM Codes Found** drop-down list. This same search can be performed using the **Search for ROMs** option in the **Device** menu. When a ROM code is selected from the drop-down list, the **ROM Code** table is automatically populated with this selection. The **Match ROM (55h)** button matches the ROM selected in the drop-down list. The **Read ROM (33h)** button reads

the ROM on the 1-Wire bus and displays it in the **ROM Code** table. The **Skip ROM (CCh)** sends the skip ROM command. The **Read ROM (33h)** and **Skip ROM (CCh)** buttons should be used if only one device is on the bus. The **MAX31850/51 Commands** should only be pressed after a ROM command is complete. To perform a temperature conversion, press the **Convert T (44h)** button. If the device is configured in parasite power mode (00h), then the **Enable Strong Pull Up** checkbox should be checked before the **Convert T (44h)** button is pressed. The **Read Scratchpad (BEh)** button reads the scratchpad and displays the 9 bytes in the **Scratchpad** table. The **Read Power Supply (B4h)** button reads the power-supply mode and displays the byte in the **Power Supply Mode** edit field.
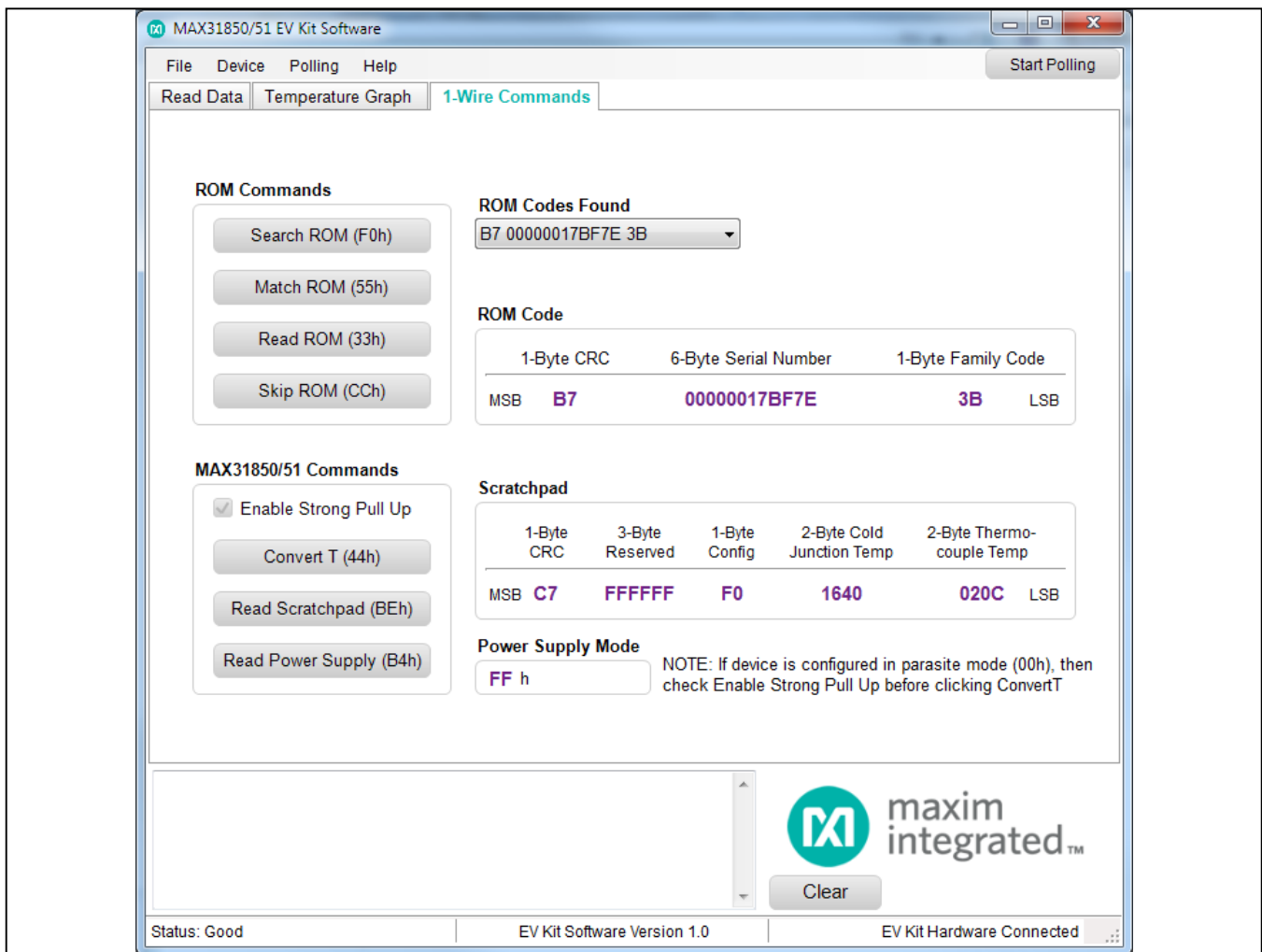

Figure 3. MAX31850/MAX31851 EV Kit GUI (1-Wire Commands Tab)

Detailed Description of Hardware

The MAX31850/MAX31851 EV kit hardware provides everything needed to evaluate a K-type thermocouple. In addition to a thermocouple and MAX31850, the hardware includes a USB interface that is used to communicate with the PC-based software. An added feature is that the hardware is USB powered, meaning that no power supplies are needed.

Thermocouple Channels

The EV kit hardware features two thermocouple channels. The top channel comes preconfigured with a MAX31850KATB+, K-type thermocouple, and thermocouple socket. A second channel is provided to make it easy to evaluate other thermocouple types. The bottom channel is almost fully populated, missing only the desired MAX31850 or MAX31851 version, corresponding thermocouple, and thermocouple socket. The following section describes how to modify the hardware in order to evaluate other thermocouple types.

Evaluating Other Thermocouple Types

To use the bottom channel, see Table 2 for the part numbers of the three items required for the desired thermocouple type.

Once the three items have been procured, power down the EV kit by disconnecting the Micro-USB cable. Carefully solder the Maxim device to the footprint labeled U3 and the thermocouple socket to the footprint labeled TH2. Finally, connect the thermocouple to the socket.

Reconnect the USB cable to the EV kit and then run the software. In the **Device** menu on the GUI, select the **Search for ROMs** option. Two devices should be found and shown in the **ROM Codes** drop-down list. Select the correct **Thermocouple Type** in the table and the device is ready to be evaluated.

User-Supplied 1-Wire interface

To communicate with the devices with a user-supplied 1-Wire interface, first disconnect the USB and remove resistor R218 to disconnect the on-board interface. Connect the off-board 1-Wire interface to the GND, DQ, and 3.3V test points for the externally powered mode. If parasite-power mode is configured on JP1 and JP2, only the GND and DQ test points need to be connected to the user-supplied interface.

Power Configuration

To power the device externally with 3.3V, move both jumpers on JP1 and JP2 to the 3.3V position on the right. For parasite power, move JP1 and JP2 to the GND and DQ position on the left. See Table 3 for the jumper descriptions.

Table 2. Items for Other Thermocouple Types

TYPE	PART	THERMOCOUPLE*	SOCKET*
K	**MAX31850**KATB+	5SRTC-GG-K-24-36	PCC-SMP-K-5
J	MAX31850JATB+	5SRTC-GG-J-24-36	PCC-SMP-J-5
N	MAX31850NATB+	NMQIN-010E-6 (unverified)	PCC-SMP-N-5
T	MAX31850TATB+	5SRTC-GG-T-24-36	PCC-SMP-T-5
E	MAX31850EATB+	5SRTC-GG-E-24-36	PCC-SMP-E-5
S	**MAX31851**SATB+	—	—
R	MAX31851RATB+	—	—

Thermocouple and socket part numbers are Omega part numbers. Contact Omega for RoHS part numbers.

Table 3. Description of Jumpers (JP1–JP6)

JUMPER	JUMPER POSITION	DESCRIPTION
JP1	3.3V	Connects the VDD pin of the device to 3.3V for external power mode
	GND	Connects the VDD pin of the device to GND for parasite power mode
JP2	3.3V	Connects the AD pin's high reference to 3.3V for external power mode
	DQ	Connects the AD pin's high reference to DQ for parasite power mode
JP3	High	Connects AD3 to a high reference
	Low	Connects AD3 to GND
JP4	High	Connects AD2 to a high reference
	Low	Connects AD2 to GND
JP5	High	Connects AD1 to a high reference
	Low	Connects AD1 to GND
JP6	High	Connects AD0 to a high reference
	Low	Connects AD0 to GND

Troubleshooting

The EV kit should work on the first try directly out of the box. In the rare occasion that a problem is suspected, see Table 4 to help troubleshoot the issue.

Table 4. Troubleshooting

| SYMPTOM	CHECK	SOLUTION
GUI says hardware not found	Is the power LED (D20) red?	If yes, then the electronic fuse is in a fault state. Inspect for electrical shorts on the PCB and make sure that the PCB is not sitting on a conductive surface.
	Does the com LED (D21) turn green when the GUI is running?	If not, then exit the GUI and try running it again. If the com LED still does not turn green, then exit the GUI and try connecting the USB cable to a different USB port on the PC. Wait for a Windows message that states the hardware is ready to use. Run the GUI again.
	Are any of the LEDs illuminated?	If not, then the PCB may not be getting power from the USB. Try a different USB cable or a different USB port.
The data temperature and power-supply data is incorrect	JP1 (VDD pin)	The VDD pin cannot be left unconnected. Populate a jumper to the right (3.3V) position for external power or to the left (GND) position for parasite power.
GUI says "No ROM Codes found"	R218	Make sure R218 is populated. This connects the DQ pin to the USB to 1-Wire interface.
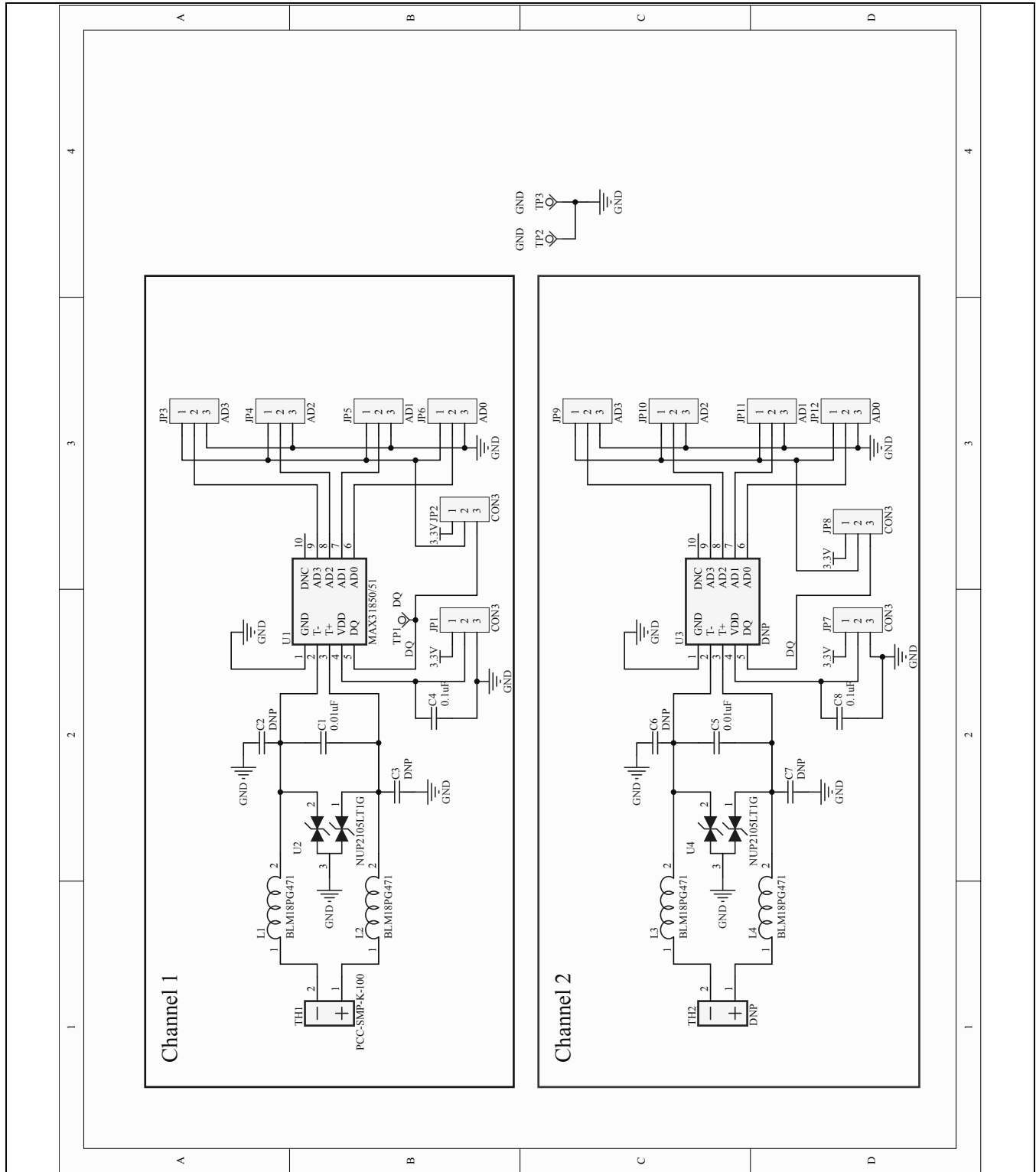
Figure 4a. MAX31850/MAX31851 EV Kit Schematic (Sheet 1 of 2)
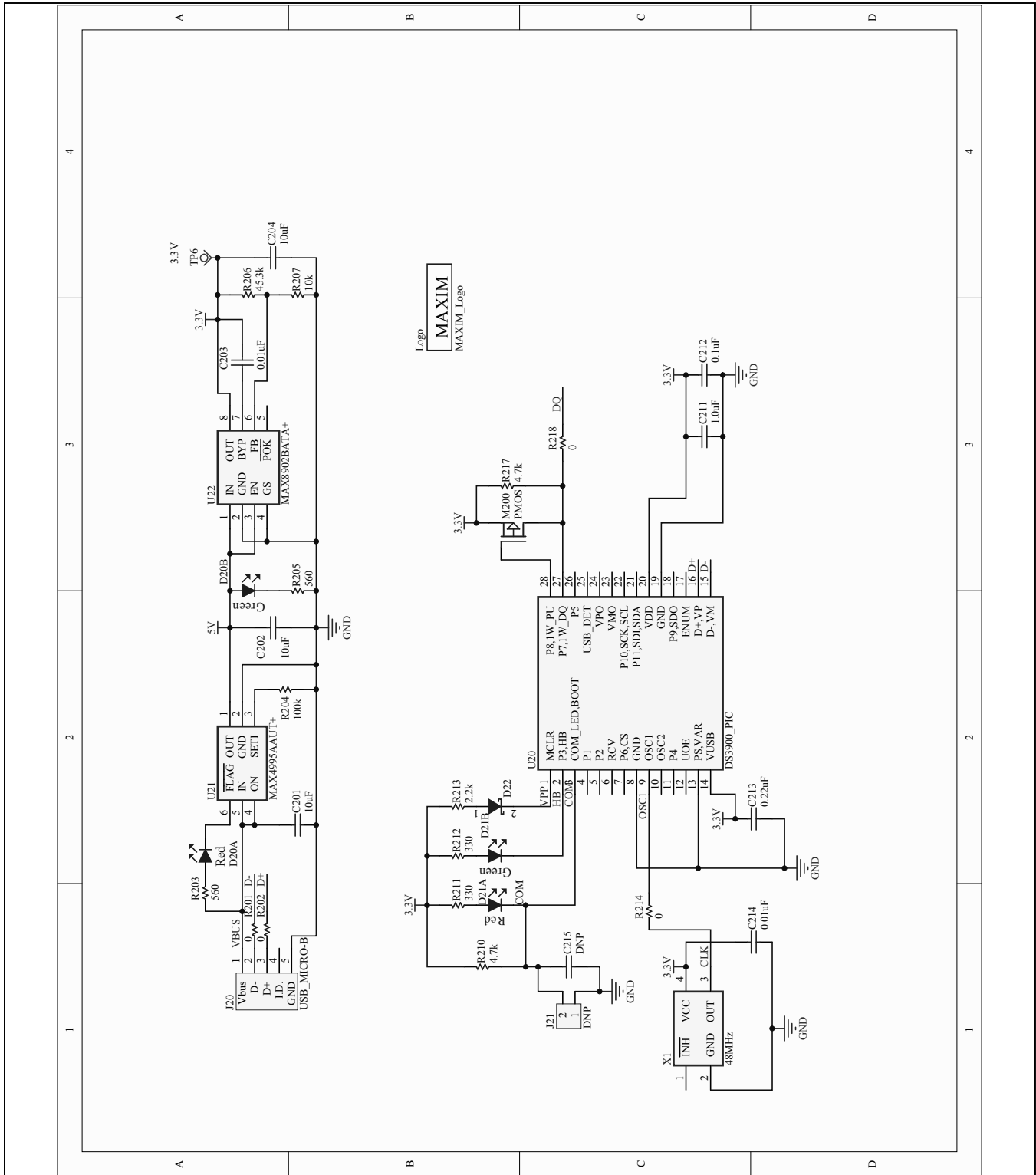
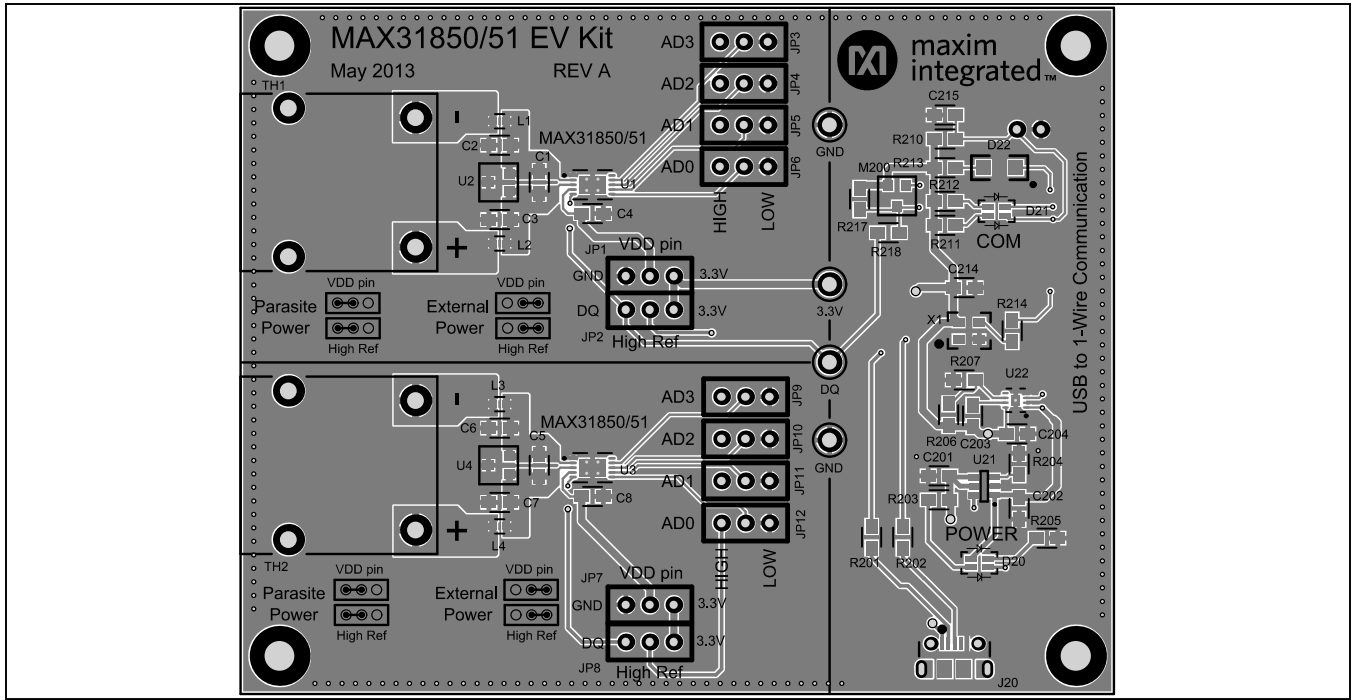*Figure 4b. MAX31850/MAX31851 EV Kit Schematic (Sheet 2 of 2)*
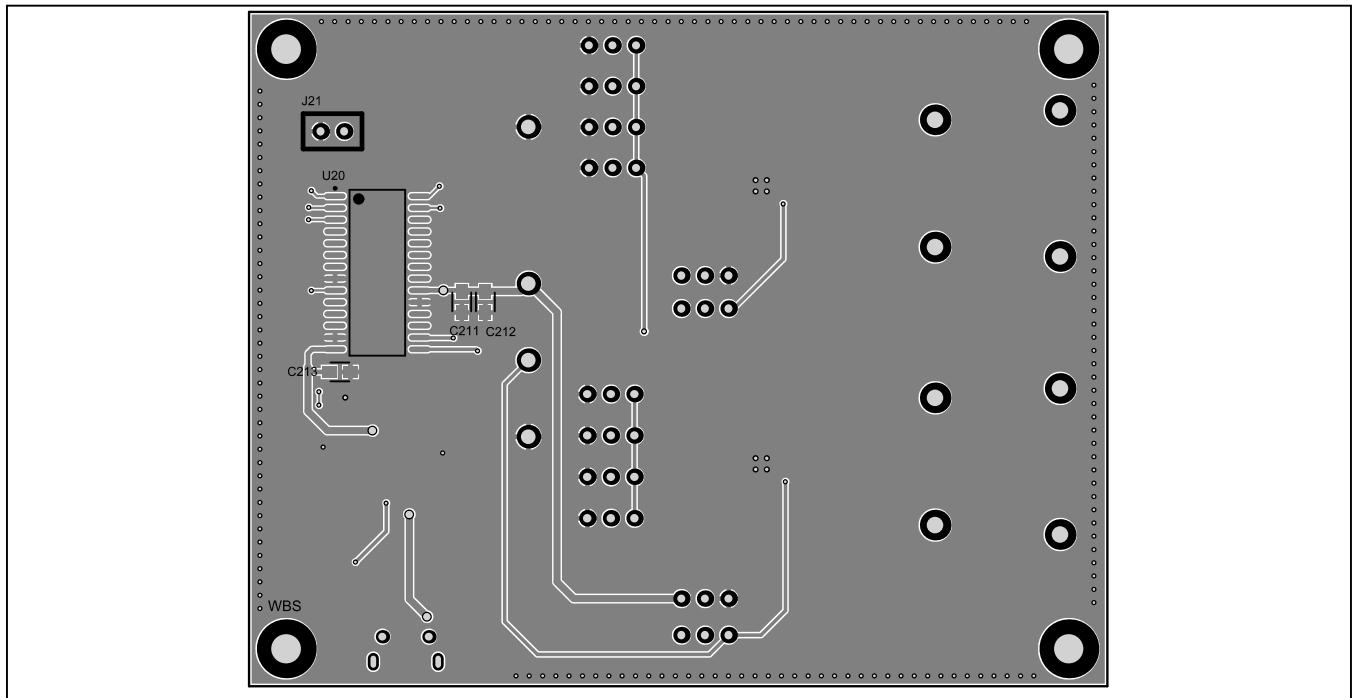
Figure 5. MAX31850/MAX31851 EV Kit PCB Layout—Top Layer

Figure 6. MAX31850/MAX31851 EV Kit PCB Layout—Bottom Layer

Ordering Information

PART	TYPE
MAX31850EVKIT#	EV Kit

#Denotes an RoHS-compliant device that may include lead(Pb), which is exempt under the RoHS requirements.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/13	Initial release	—

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