General Description

The MAX31856 evaluation system (EV system) provides the hardware and software necessary to evaluate the MAX31856 thermocouple-to-digital converter.

The EV system includes the MAX31856PMB1 peripheral module with a Pmod™-compatible connector for SPI communication. The system also includes the USB2PMB1 adapter board for communication with the software and a K-type thermocouple for temperature sensing. Other thermocouple types (J, N, R, S, T, E, and B) can be evaluated with a user-supplied thermocouple.

EV System Contents

- MAX31856PMB1 including the MAX31856
- USB2PMB1 Adapter Board
- Mini-USB Cable
- K-Type Thermocouple

Features

- Easy Evaluation of the MAX31856
- Includes K-Type Thermocouple
- USB Power and Interface with USB2PMB1 Board
- Windows XP**®**, Windows**®** 7, Windows 8.1-Compatible Software
- 12-Pin Pmod-Compatible Connector (SPI)
- Fully Assembled and Tested
- Proven PCB Layout
- RoHS Compliant

MAX31856 EV Kit Files

FILE	DESCRIPTION
MAX31856EVSystemSetup.EXE	Application Program

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

MAX31856 EV System Photo
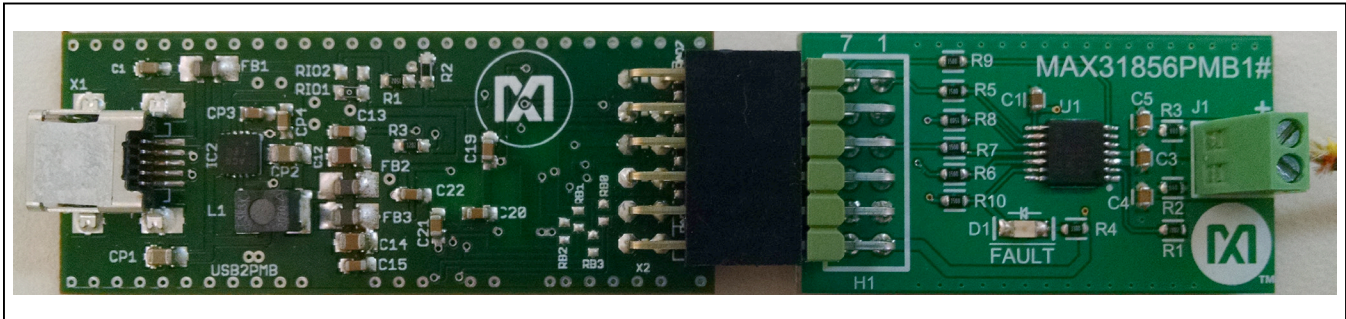
Pmod is a trademark of Digilent Inc.

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

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

Quick Start

Required Equipment

- MAX31856PMB1 peripheral module
- USB2PMB1 adapter board
- Mini-USB cable
- K-Type thermocouple
- Screw driver
- Windows XP, Windows 7, or Windows 8.1 PC 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 system software. Text in **bold and underline** refers to items from the Windows operating system.

Procedure

Follow the steps below to get started measuring temperature with a K-type thermocouple:

1) Visit www.maximintegrated.com/evkitsoftware to download the latest version of the EV system software, MAX31856EVSystemSetup.ZIP.
2) Save the EV system software to a temporary folder. Unzip the .ZIP file and double-click the .EXE file to run the installer. A message box asking **Do you want to allow the following program to make changes to this computer?** may appear. If so, click **Yes**.
3) 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.
4) Connect the K-type thermocouple to J1 of the MAX31856PMB1 with the yellow wire on the plus side.
5) Connect the MAX31856PMB1 Pmod connector H1 to the connector on USB2PMB1.
6) Connect the USB2PMB1 to the PC with the Mini-USB cable. Windows should automatically recognize the device and display a message near the **System Icon** menu indicating that the hardware is ready to use.
7) Once the hardware is ready to use, launch the software. The status bar in the GUI should display **USB2PMB1 Hardware Connected** in the bottom right-hand corner. Go to the **Configuration** tab to select the desired configuration and then check the **Auto Convert** checkbox.
8) Go back to the **Status** tab and click **Read Once** or **Auto Polling** to read the temperatures.

Detailed Description of Software

Software Startup

When the software starts, it searches for a USB2PMB1 and connects to the first one found, then displays **USB2PMB1 Hardware Connected** in the bottom right-hand corner. If hardware is not found, the software displays **USB2PMB1 not Detected** and starts in offline mode.

Offline Mode

Offline mode is entered when the software is started without hardware connected. In this mode, the **Configuration** tab allows the user to read/write to registers in a virtual device. These register values can be saved in a configuration file that can be loaded at a later time. See the *Save/Load Configuration* section for more details. To exit offline mode, connect the hardware to the PC and then search and connect to the hardware using the **Device** menu. See the *Connect To Hardware* section for details.

Save/Load Configuration

In the **File** menu, there are options to save or load a configuration file. **Save Config As..** and **Save Config** read the registers from the connected MAX31856 and saves these values to an XML file. If the software is in offline mode, then the current register values displayed on the **Configuration** tab are saved to the XML file. **Load Config** gets register values from an XML file and writes them to the MAX31856 if connected. In offline mode, the register values in the XML are saved to the virtual device and displayed in the software.

Connect To Hardware

The **Device** menu has options to search and connect to the hardware. Use the **Search for USB2PMB1** option to search for the USB2PMB1 modules connected to the PC. If modules are found, the serial numbers of the modules are listed in the **USB2PMB1s** menu item. Select the serial number in the **USB2PMB1s** list to connect the software to communicate with that module. The software can only communicate to one module at a time. Selecting another serial number in the list disconnects the current module and then connects the newly selected module.

Status Tab

The **Status** tab ([Figure 1](#)) displays the current tempera-ture conversion and the fault status. The **Read Once** button reads the cold junction temperature, linearized thermocouple temperature, and the fault status. The data from the read is shown in the **Temperatures** and **Fault Status** group boxes. If the user does not want to read all three values, the data that is read can be selected with the **Cold Junction**, **Linearized Thermocouple**, and **Fault Status** checkboxes. For example, if only the linearized thermocouple temperature is of interest to read, then check the **Linearized Thermocouple** checkbox and deselect the other two checkboxes. The next time **Read Once** is clicked, only the linearized thermocouple tem-perature is read. To read continuously, select the **Auto Polling** checkbox. This reads at a rate selected from the **Polling Rate** list in the **Options** menu. **Auto Polling** dis-plays the temperature data in the graph. See the *Graph* section for more details. To stop auto polling, deselect the **Auto Polling** checkbox.

The status of all the faults are displayed in the **Fault Status** group box. If a fault occurs, the color indicator turns red and the status bar at the bottom of the window displays **FAULT**. To clear the fault in interrupt mode, click the **Clear Faults** button. When the fault is removed, the color indicator turns green and the status bar displays **GOOD**. If the fault still exists, the color indicator turns red again and displays **FAULT** in the status bar.

Graph

To collect data in the graph, select the **Auto Polling** checkbox. To show/hide the data in the graph, check/uncheck the **Display TC Temp** or **Display CJ Temp** checkboxes below the graph. To save the data in the graph, go to the **Options** menu and select **Save Graph** to save the data to a .CSV file. The **Options** menu also has the **Clear Graph** option to remove all the data in the graph. Data in the graph is automatically cleared when auto polling is restarted.

Configuration Tab

The **Configuration** tab ([Figure 2](#)) allows the user to select different options for the device. All registers are read when the tab is selected. To read the registers again, click the **Read All** button on the right-hand side. The con-trols on the left side provide an easy way to view and set the registers. When an option is changed on a control, the corresponding register is written and the **Status Log** displays the written raw hex value. Registers can also be read/written in raw hex values using the **Registers** table**,** on the right. To write a hex value double-click on the **Value** cell of the register to change and enter a hex value. The value is written by pressing Enter on the key-board or selecting another cell or control in the GUI. The **Bit Description** section shows the format of the register selected in the **Registers** table. Refer to the MAX31856 IC datasheet for more details of the configuration settings.

Conversions

To start continuous conversions, check the **Auto Convert** checkbox. The results of the conversions can be read by clicking the **Read Once** button or checking **Auto Polling** on the **Status** tab. For a single conversion, uncheck **Auto Convert** and click the **One Shot** button.

Cold-Junction Temperature

The internal cold-junction temperature sensor can be disabled by selecting the **Disable Cold Junction Sense** checkbox. When the internal cold-junction sensor is dis-abled, a cold-junction temperature value can be written to the register by entering the new value into the **Cold Junction Temp** numeric box. All new linearization and cold-junction compensation calculations will be done using this value.

Status Log

The status log group box below the tabs displays all the actions the GUI performs. When an action is requested, the log confirms the action or shows an error message. The log can be cleared by pressing the **Clear Log** button.
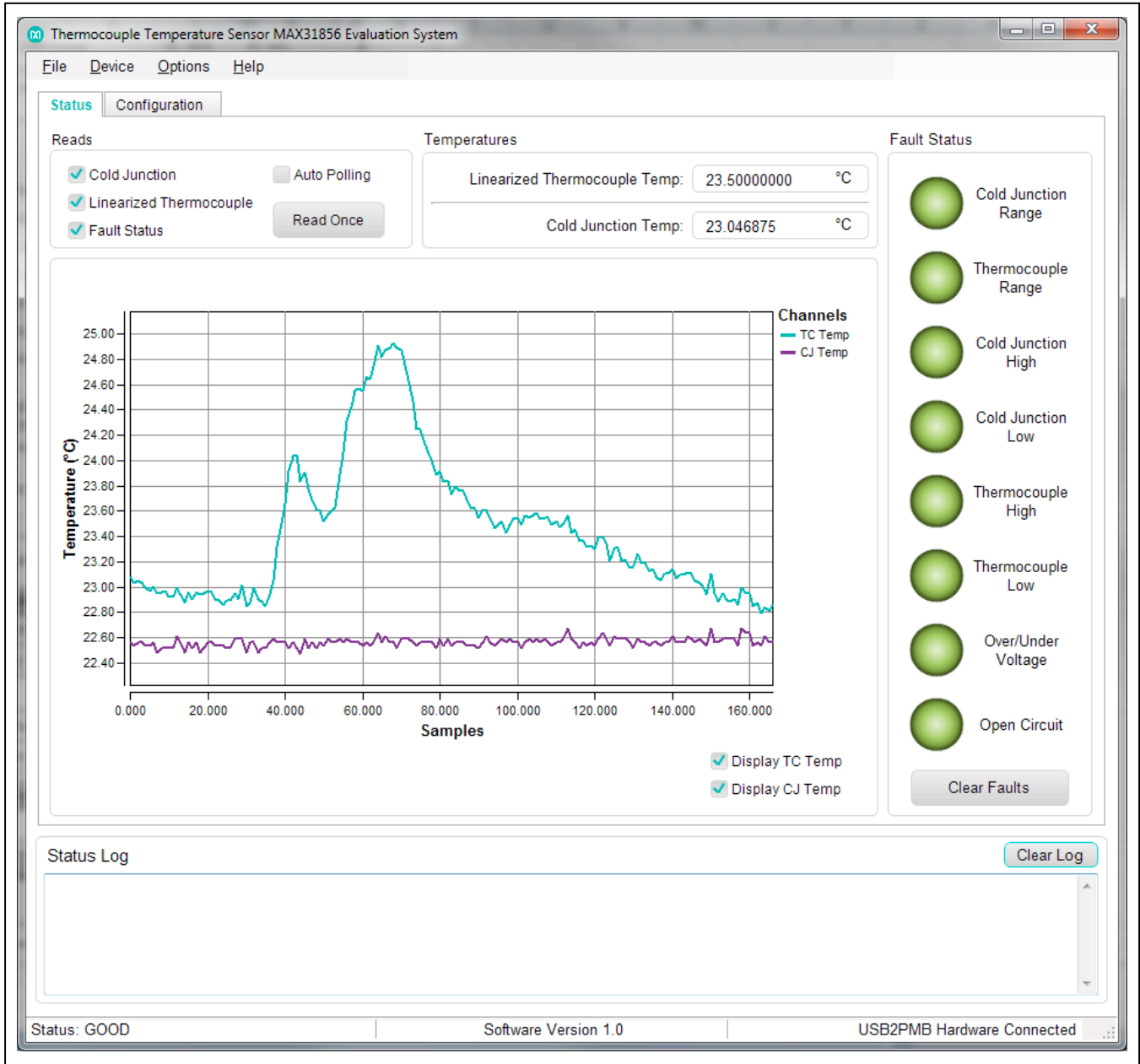
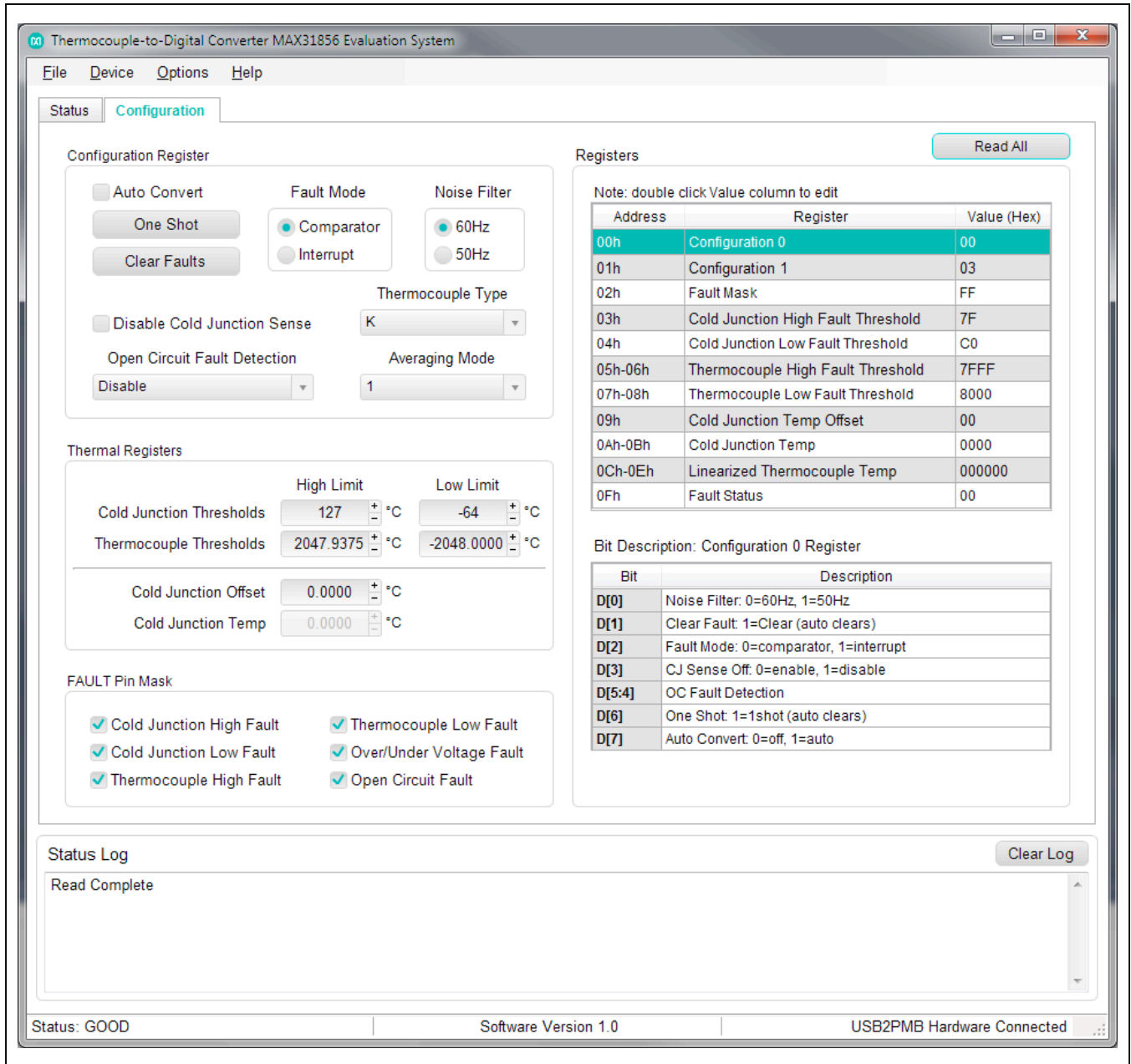*Figure 1. MAX31856PMB1 Software (Status Tab)*

Figure 2. MAX31856PMB1 Software (Configuration Tab)

Detailed Description of Hardware

The MAX31856 EV System hardware provides everything needed to evaluate a K-type thermocouple. Other thermocouple types can also be evaluated with a user-supplied thermocouple. The MAX31856PMB includes the MAX31856 with a screw terminal for the thermocouple. The USB2PMB1 module provides the USB-to-SPI interface for communication with the software and it also provides USB power to the Pmod.

Pmod Connector

The MAX31856PMB1 Pmod can plug directly into a SPI-configured, Pmod-compatible port through H1. This connector supports the MAX31856 4-wire SPI interface and also provides power to the device through the 3.3V pin. For more information on the SPI protocol, refer to the MAX31856 IC data sheet. The $\overline{DRDY}$ and $\overline{FAULT}$ pins can also be monitored through H1. See Figure 3 for the H1 pinout.

Thermocouple

A thermocouple is connected to the MAX31856 through the screw terminal J1 on the MAX31856PMB1 Pmod. The MAX31856 supports the following thermocouples: K, J, N, R, S, T, E, and B. To connect a thermocouple, insert the thermocouple wires into the screw terminal, ensuring the correct polarity, and then tighten the screws. For the K-type thermocouple provided, the yellow wire is the positive side and connects to pin 2 of J1.

In the software, the thermocouple type must be selected using the **Thermocouple Type** drop-down list on the **Configuration** tab. If the thermocouple connected cannot be found in the list, select **Volts (Gain = 8)** or **Volts (Gain = 32)** to obtain the voltage conversions. Refer to the MAX31856 IC data sheet for more details on unsupported thermocouples.

Fault LED

The $\overline{FAULT}$ LED reflects the status of the MAX31856 $\overline{FAULT}$ pin. When the LED is on, the $\overline{FAULT}$ pin is active indicating there is a fault occurring. Read the Fault Status register on the **Status** tab to see which fault is occurring. On power-up, the $\overline{FAULT}$ pin is masked and does not indicate faults. To unmask the $\overline{FAULT}$ pin and see the LED turn on during a fault, uncheck the fault in the **FAULT Pin Mask** group box on the **Configuration** tab.

Troubleshooting

All efforts were made to ensure that each kit works on the first try, right out the box. If a problem is suspected, see Table 1 to help troubleshoot the issue.

Table 1. Troubleshooting

| SYMPTOM	CHECK	SOLUTION
GUI says USB2PMB1 not Detected!	USB on USB2PMB1	Exit the GUI and check the USB connection on the USB2PMB1 board. Connect to another USB port on the PC and launch the GUI. If the GUI still does not find the hardware, try another USB cable.
Temperature changes in the wrong direction	J1 on MAX31856PMB1	The thermocouple may be connected backwards to J1. Disconnect the thermocouple from J1 and reconnect with the wires switched.
Data is read back as all FFs	H1 on MAX31856PMB1	Check that the pins on H1 are properly connected to the female header on USB2PMB1.
$\overline{FAULT}$ LED does not light up when there is a fault	FAULT Pin Mask settings	On the **Configuration** tab in the **FAULT Pin Mask** group box, uncheck the fault occurring to see the FAULT LED turn on.
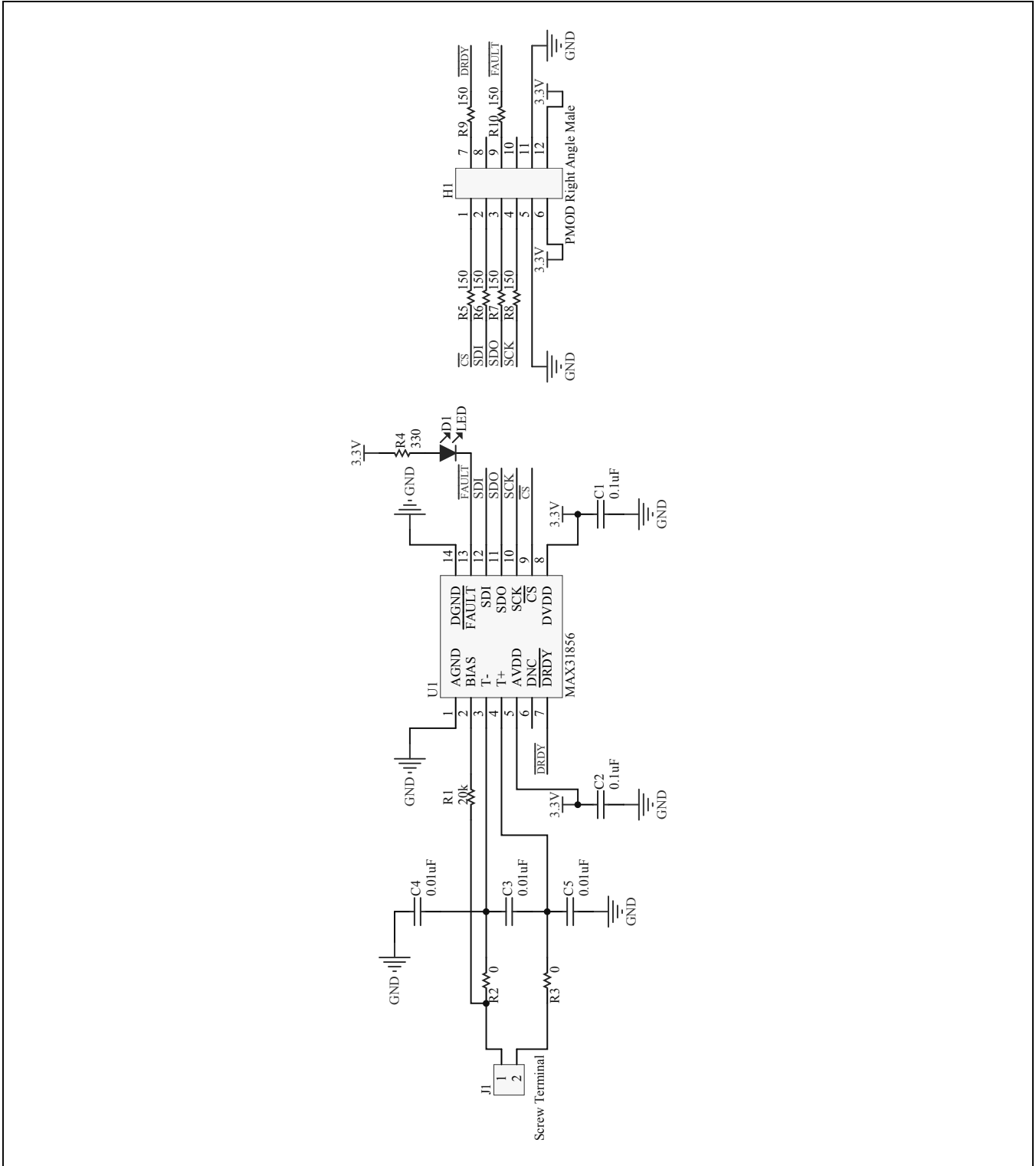
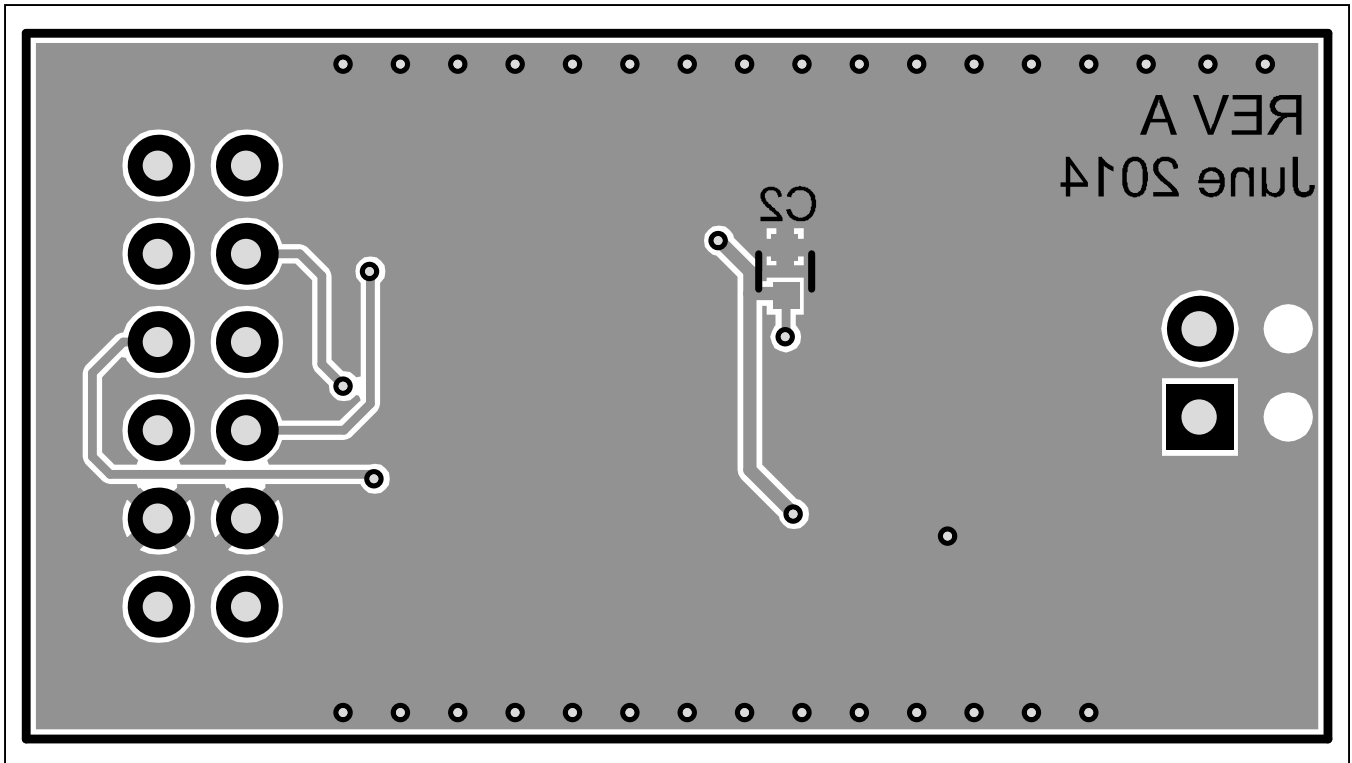*Figure 3. MAX31856PMB1 Schematic*
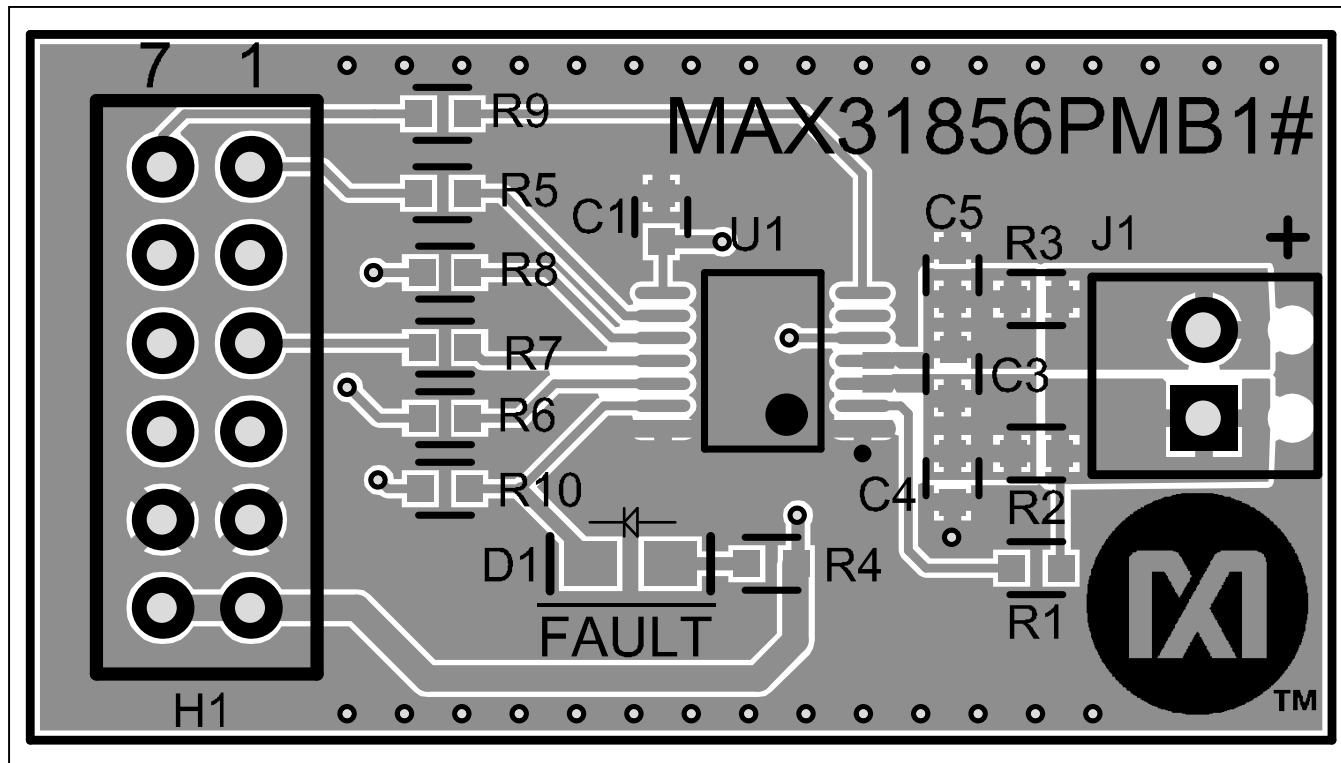
Figure 4. MAX31856PMB1 PCB Layout—Top

Figure 5. MAX31856PMB1 PCB Layout—Bottom

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	0.1µF ceramic capacitors (0603)
C3, C4, C5	3	0.01µF ceramic capacitors (0603)
D1	1	Red LED (0805)
H1	1	12-pin (2x6) right-angle header, 2.54mm pitch
J1	1	2-pin screw terminal, 2.54mm pitch Phoenix Contact 1725656
R1	1	20kΩ ±1% resistor (0603)

DESIGNATION	QTY	DESCRIPTION
R2, R3	2	0Ω ±1% resistors (0603)
R4	1	330Ω ±1% resistor (0603)
R5–R10	6	150Ω ±1% resistors (0603)
U1	1	Thermocouple-to-digital converter (14 TSSOP) Maxim MAX31856MUD+
—	1	PCB: MAX31856PMB1#
—	1	PCB: USB2PMB1#
—	1	K-type thermocouple Omega 5TC-GG-K-24-36
—	1	Mini-USB cable

Ordering Information

PART	TYPE
MAX31856EVSYS#	EV System

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/15	Initial release	—

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