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MAX44006 Evaluation System
Evaluates: MAX44006

General Description

The MAX44006 evaluation system (EV system) includes one MAX44006 evaluation kit (EV kit) and one MAX44006 daughter board. The EV kit is a fully assembled and tested PCB that evaluates the MAX44006 digital RGB color sensor with temp sensor. The EV system also includes Windows XP®-, Windows Vista®-, and Windows® 7-compatible software that provides a simple graphical user interface (GUI) for exercising the features of the IC. The EV kit comes installed with a MAX44006EDT+ in 6-pin OTDFN package.

The daughter board is an external device-under-test module that also comes with a MAX44006EDT+ installed. The daughter board can be connected to and controlled by the EV kit. The user can also evaluate the IC by connecting a user-supplied controller to the daughter board.

Features

♦ **USB Powered**
♦ **Daughter Board Powered by the EV Kit**
♦ **On-Board RGB LED on the EV Kit**
♦ **Windows XP-, Windows Vista-, and Windows 7-Compatible Software**
♦ **Block Sampling**
♦ **Signal Plotting in the EV System Software**
♦ **Proven PCB Layout**
♦ **RoHS Compliant**
♦ **Fully Assembled and Tested**

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

Component Lists

MAX44006 EV Kit

DESIGNATION	QTY	DESCRIPTION
C1–C17	17	47nF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C473K
C18–C33	16	1nF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H102K
C34, C52, C101–C103, C113–C116	9	1µF ±10%, 16V X5R ceramic capacitors (0603) Murata GRM188R61C105K
C35, C44, C46, C50, C53–C56, C60–C62, C64–C66, C74, C76, C100, C107–C109, C117	21	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K
C36, C39	2	0.01µF ±10%, 50V, X7R ceramic capacitors (0603) Murata GRM188R71H103K

DESIGNATION	QTY	DESCRIPTION
C37	1	10pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H100J
C38	1	15pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H150J
C40, C41	2	39pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H390J
C47, C48	2	4.7µF ±10%, 25V X5R ceramic capacitors (1206) Murata GRM31CR71E475M
C49, C63, C67, C68, C73, C75, C118	7	10µF ±10%, 25V, X5R ceramic capacitors (1206) Murata GRM31CR61E106K
C57	1	0.033µF ±10%, 16V X5R ceramic capacitor (0603) Taiyo Yuden EMK107BJ333KA
C58, C59	2	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C104, C110–C112	4	2.2µF ±10%, 10V X7R ceramic capacitors (0603) Murata GRM188R71A225K

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Component Lists (continued)

DESIGNATION	QTY	DESCRIPTION
C105, C106	2	4.7µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J475K
DGND, GND (x2)	3	Black test points
DVDD, EXT_VDD	2	Red test points
EXT_SCL, EXT_SDA, EXT_INTB	3	White test points
J1	1	6-pin (2 x 3) right-angle female header
J2	0	Not installed, 24-pin (2 x 12) dual-row header
J3	1	USB type-B right-angle PC-mount receptacle
J4	1	6-pin (2 x 3) right-angle male header
JSPI	0	Not installed, 6-pin header
JTAG1	1	6-pin JTAG header
JTAG2	1	10-pin (2 x 5) dual-row JTAG header
JU1–JU4	0	Not installed, 2-pin headers
JU5	0	Not installed, 3-pin header
JU6–JU8, JU11	4	2-pin headers
JU10, JU12–JU16	6	3-pin headers
L1	1	Ferrite bead (0603) TDK MMZ1608R301A
LD1	1	Light dam Maxim EPCB44000LD+
LED1–LED3	3	Red LEDs (0603) Panasonic LNJ208R8ARA
Q100	1	p-channel FET (SOT223)
R1, R3, R4, R19, R21–R24	8	4.7kΩ ±5% resistors (0603)
R2, R16–R18	4	100Ω ±5% resistors (0603)
R5	1	390Ω ±5% resistor (0603)
R6–R8, R27, R36, R59–R61	8	10kΩ ±5% resistors (0603)

DESIGNATION	QTY	DESCRIPTION
R9–R11	3	200Ω ±5% resistors (0603)
R12, R14, R25, R29	4	10Ω ±5% resistors (0603)
R13	1	150Ω ±5% resistor (0603)
R15	1	56Ω ±5% resistor (0603)
R20, R28	2	680Ω ±5% resistors (0603)
R26, R100	2	1kΩ ±5% resistors (0603)
R30	1	18.7kΩ ±1% resistor (0603)
R31, R43, R44, R46	4	10kΩ ±1% resistors (0603)
R32, R33	2	27Ω ±5% resistors (0603)
R34, R57, R58	3	1.5kΩ ±5% resistors (0603)
R35	1	2.2kΩ ±5% resistor (0603)
R37–R41	0	Not installed, resistors—short (PCB trace) (0603)
R42, R45	2	100kΩ ±5% resistors (0603)
R47	1	20kΩ ±1% resistor (0603)
R48	1	470Ω ±5% resistor (0603)
R55	1	49.9kΩ ±1% resistor (0603)
R56	1	40.2kΩ ±1% resistor (0603)
R62	1	5.1kΩ ±5% resistor (0603)
RGBLED	1	RGB LED
S1	1	4-position SMT DIP switch
U1	1	RGB ambient IR red combo sensor (6 OTDFN) Maxim MAX44006EDT+
U2	1	LED driver (49 WLP) Maxim MAX8930EWJ+
U3	0	Not installed, Xilinx serial PROM (20 TSSOP)
U4	0	Not installed, Atmel SPI flash (8 SO)
U6, U7	2	LDOs (16 TSSOP-EP*) Maxim MAX1793EUE50+
U8	1	USB-to-UART converter (32 TQFP)
U9	1	93C46 type 3-wire EEPROM (8 SO)
U10, U15	2	LDOs (6 SOT23) Maxim MAX1983EUT+
U13	1	Spartan 3AN FPGA (144 TQFP) Xilinx XC3S50AN-4TQG144I
U14	1	Microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+

Component Lists (continued)

MAX44006 EV Kit (continued)

DESIGNATION	QTY	DESCRIPTION
U16, U17	2	Level translators (10 µMAX®) Maxim MAX1840EUB+
U18	1	SRAM (48 TSOP)
Y1	1	50MHz oscillator
Y2	1	6MHz crystal Hong Kong X'tals SSL60000N1HK188F0-0
Y3	0	Not installed, crystal (CMR200T)
Y4	1	20MHz crystal
—	1	Brown box, 9-3/16in x 7in x 7/8in

DESIGNATION	QTY	DESCRIPTION
—	4	0.250in x 0.625in 4-40 round nylon spacers
—	4	4-40 x 0.375in nylon machine screws
—	1	USB high-speed A-to-B cables 5ft (1.5m)
—	10	Shunts
—	1	PCB: MAX44006 EVALUATION KIT

EP = Exposed pad.

DESIGNATION	QTY	DESCRIPTION
C1	1	1µF ±10%, 10V X7R ceramic capacitor (0603) Murata GRM188R71A105K
J1	1	6-pin (2 x 3) female header
R1	1	0Ω ±5% resistor (0603)
R2	0	Not installed, resistor (0603)

MAX44006 Daughter Board

DESIGNATION	QTY	DESCRIPTION
U1	1	Ambient IR red combo sensor (6 OTDFN) Maxim MAX44006EDT+
PCB	1	PCB: MAX44006 DAUGHTER BOARD

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: Indicate that you are using the MAX44006 when contacting these component suppliers.

MAX44006 EV System Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV system files on your computer
MAX44006.EXE	Application program
CDM20600.EXE	Installs the USB device driver
UNINSTALL.EXE	Uninstalls the EV kit software
USB_Driver_Help_200.PDF	USB driver installation help file

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Quick Start

Required Equipment

- MAX44006 EV kit (USB cable included)
- Windows XP, Windows Vista, or Windows 7 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 underlined** refers to items from the Windows operating system.

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation:

1) Visit **www.maximintegrated.com/evkitsoftware** to download the latest version of the EV kit software, 44006Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.

2) Install the EV kit software and USB driver on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied to your PC and icons are created in the Windows **Start | Programs** menu. During software installation, some

versions of Windows may show a warning message indicating that this software is from an unknown publisher. This is not an error condition and it is safe to proceed with installation. Administrator privileges are required to install the USB device driver on Windows.

3) Verify that all jumpers (JU6, JU7, JU8 and JU10–JU16) are in their default positions, as shown in Table 1.

4) Connect the USB cable from the PC to the EV kit board. A Windows message appears when connecting the EV kit board to the PC for the first time. Each version of Windows has a slightly different message. If you see a Windows message stating **ready to use**, then proceed to the next step. Otherwise, open the USB_Driver_Help_200.PDF document in the Windows **Start | Programs** menu to verify that the USB driver was installed successfully.

5) Start the EV kit software by opening its icon in the **Start | Programs** menu. The EV system software main window appears, as shown in Figure 1.

6) Select **Clear+RGB+IR** in the **Operating Mode** drop-down list in the top left side of the software GUI.

7) In the **Color Map Display** tab sheet, check the **Auto Convert** checkbox in the **Single Conversion** group box to read the ADC values.

Table 1. Jumper Settings (JU6, JU7, JU8 and JU10–JU16)

JUMPER	SHUNT POSITION	DESCRIPTION
JU6	1-2*	The on-board LDO (U6) provides 3.6V output to the EV kit.
	Pin 1	Disconnects the output of the on-board LDO (U6).
JU7	1-2*	The on-board LDO (U7) provides 2.5V output to the EV kit.
	Pin 1	Disconnects the output of the on-board LDO (U7).
JU8	1-2*	The on-board LDO (U10) provides 1.2V output to the EV system.
	Pin 1	Disconnects the output of the on-board LDO (U10).
JU10	1-2*	On-board LDOs powered from the USB port.
	2-3	Connects an external 5V supply to the DVDD connector.
JU11	1-2*	The on-board LDO (U15) provides 1.8V output to the EV system.
	Pin 1	Disconnects the output of the on-board LDO (U15).
JU12	1-2*	Connects the A0 pin of the on-board MAX44006 to VDD (I²C slave address = 0x88).
	2-3	Connects the A0 pin of the on-board MAX44006 to GND (I²C slave address = 0x8A).
JU13	1-2*	The on-board 1.8V supply connects to the VDD pin of the MAX44006.
	2-3	Connects an external supply to the EXT_VDD connector.
JU14	1-2*	MAX44006 SDA signal connected to the on-board microcontroller.
	2-3	Connects a user-supplied SDA signal to the on-board EXT_SDA PCB pad.
JU15	1-2*	MAX44006 SCL signal connected to the on-board microcontroller.
	2-3	Connects a user-supplied SCL signal to the on-board EXT_SCL PCB pad.
JU16	1-2*	MAX44006 $\overline{INT}$ signal connected to the on-board microcontroller.
	2-3	Connects a user-supplied $\overline{INT}$ signal to the on-board EXT_INTB PCB pad.

*Default position.
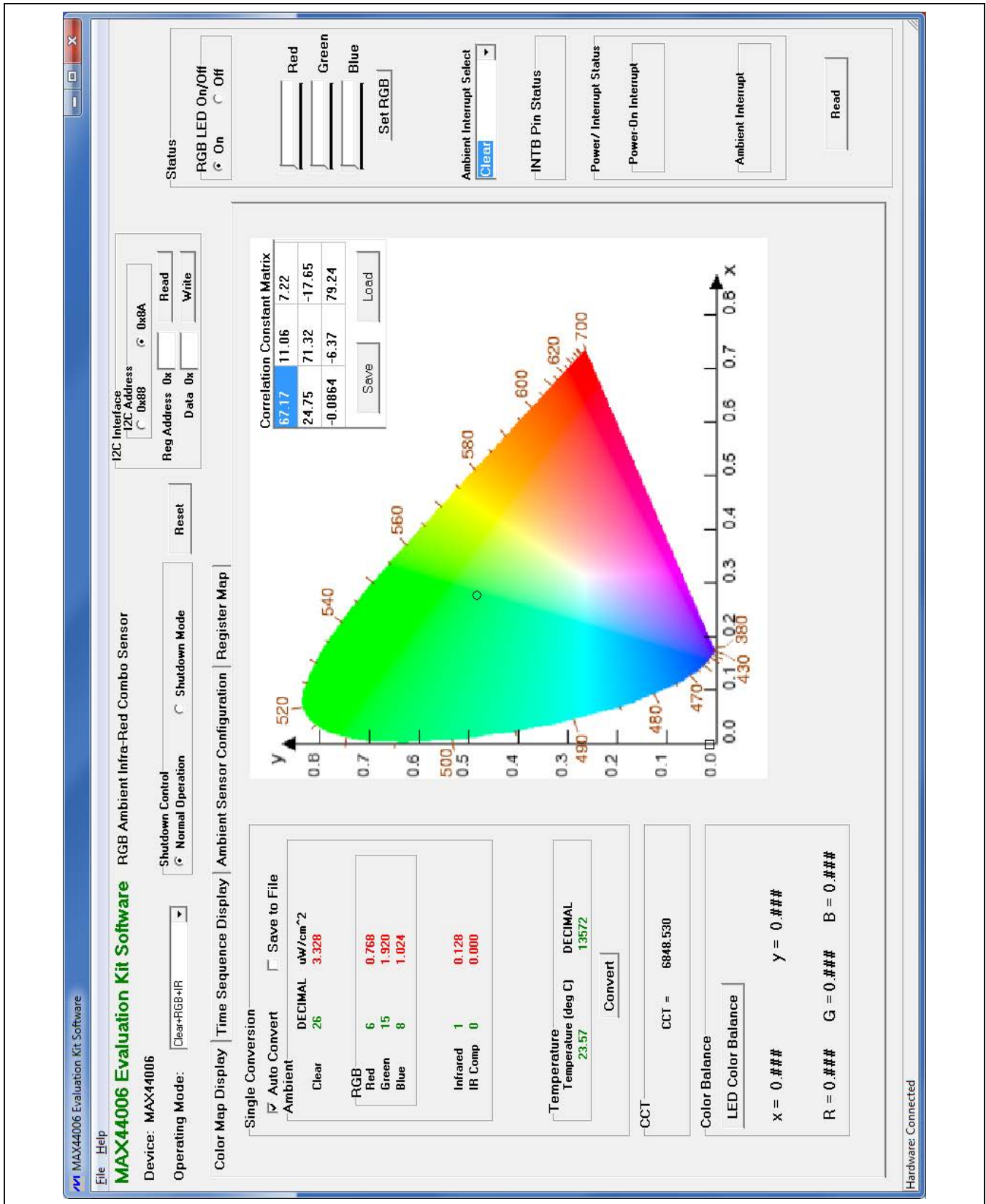
Figure 1. MAX44006 EV Kit Software Main Window (Color Map Display Tab)

Detailed Description of Software

The MAX44006 EV kit software (Figure 1) contains an **I2C Interface** group box, a **Status** group box, and four tab sheets (**Color Map Display**, **Time Sequence Display**, **Ambient Sensor Configuration**, and **Register Map**) to configure the MAX44006 IC and display the ADC data received from the IC.

I²C Interface

In the **I2C Interface** group box, choose the appropriate I²C slave address in the **I2C Address** group box. Enter the register address in the **Reg Address** edit box and press the **Read** button to read the register. The returned value is shown in the **Data** edit box. To write a data value into a register, enter the register address in the **Reg Address** edit box, enter the data value into the **Data** edit box, and press the **Write** button.

Operating Mode

Use the **Operating Mode** drop-down list to select one of the three operating modes. The operating modes are: **Clear**, **Clear+IR**, and **Clear+RGB+IR**.

Color Map Display Tab

The **Single Conversion** group box on the **Color Map Display** tab sheet displays the ADC values for a single sample. Press the **Convert** button to update the values in the **Ambient**, **Temperature**, and **CCT** group boxes. The received RGB ADC values are converted to the chromaticity coordinates (x, y) values using the 3-by-3 **Correlation Constant Matrix** located in the upper-right corner of the chromaticity diagram. The calculated x, y value is plotted on the chromaticity diagram in a circle shape. Overwrite the values in the matrix and press the **Save** button to save the matrix settings. Press the **Load** button to restore the previously saved matrix. See below for the RGB-to-chromaticity coordinate-conversion formulas and CCT calculation formulas:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 3\,BY\,3 \\ CM \\ MATRIX \end{bmatrix} \times \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$x = \frac{X}{X+Y+Z}$$

$$y = \frac{Y}{X+Y+Z}$$

$$CCT = 449n^3 + 3525n^2 + 6823.3n + 5520.33$$

$$\text{where} \quad n = \frac{x - 0.3320}{0.1858 - y}$$

Check the **Auto Convert** checkbox to automatically and repeatedly do the ADC conversion and update the values in the **Ambient**, **Temperature**, and **CCT** group boxes. Check the **Save to File** checkbox to save the received data to a file.

To use the **Color Balance** function, the user must first connect the daughter board to the EV kit. See the *MAX44006 Daughter Board* section for details on how to connect the daughter board. The **Color Balance** feature allows the user to select a color on the chromaticity diagram by clicking on the diagram. The selected color is boxed by a square shape. When the **LED Color Balance** button is pressed, the on-board RGB LED then servos to output the selected color. The IC RGB sensor is used to get feedback to determine whether the RGB LED is outputting the right color.

Time Sequence Display Tab

In the **Time Sequence Display** tab sheet (Figure 2), the user can select the desired number of conversions in the **Number of Samples** drop-down list in the **Continuous Conversion** group box. The rate that the controller reads the ADC data from the IC is selected from the **Read Rate** drop-down list. Press the **Convert Start** button to start sampling from the ADC channel selected from the **Channel Select** drop-down list. After the **Convert Start** button is pressed, the sampled data is plotted on the graph. If the **Save to File** checkbox is checked, the received ADC data is saved to a file after each conversion

Ambient Sensor Configuration Tab

The **Ambient Sensor Configuration** tab sheet (Figure 3) has all the functions to configure the ambient sensors of the IC.

Check the **Ambient Interrupt Enable** checkbox to enable the detection of ambient interrupt events. Check the **IR Compensation Enable** checkbox to enable the IR compensation. Check the **Temperature Sensor Enable** checkbox to enable the temperature sensor.

In the **Receive Configuration** group box, use the **AMBTIM[2:0]** drop-down list to set the integration time and resolution for the ambient ADC. The **AMBPGA[1:0]** drop-down list sets the gain of the ambient light-sensing measurement.

Use the **Ambient Thresholds** group box to set the upper and lower ambient interrupt threshold. The ambient measurement of the ADC channel that is sbeing compared to the thresholds is selected from the **Ambient Interrupt Select** drop-down list in the **Status** group box. After the **Ambient Interrupt Enable** checkbox is checked, if the ambient measurement is higher than the upper threshold or lower than the lower threshold, the interrupt event is recorded (provided the persist timer condition is met). The interrupt bit is reset only after reading the interrupt status register.
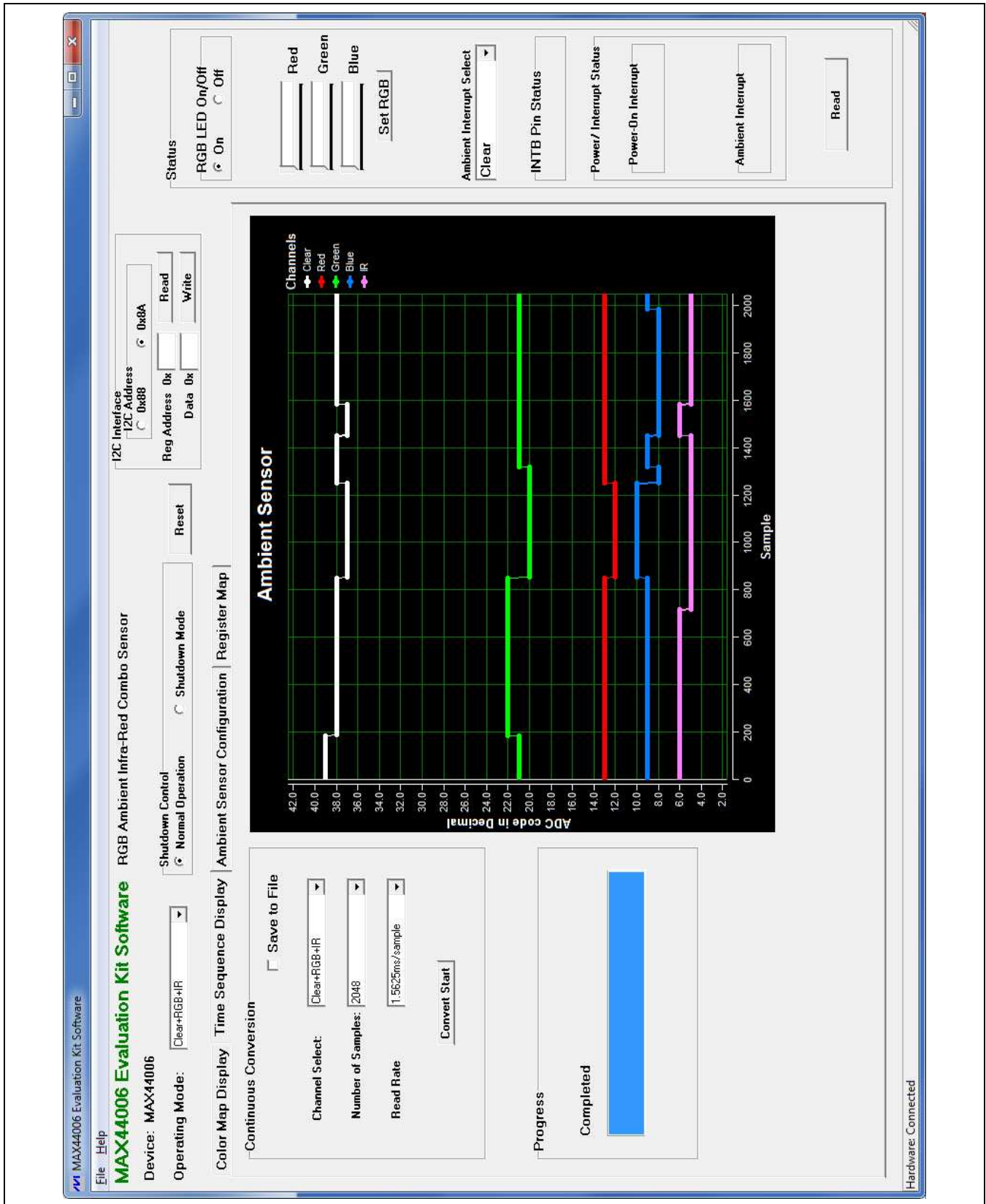
Figure 2. MAX44006 EV Kit Software (Time Sequence Display Tab)
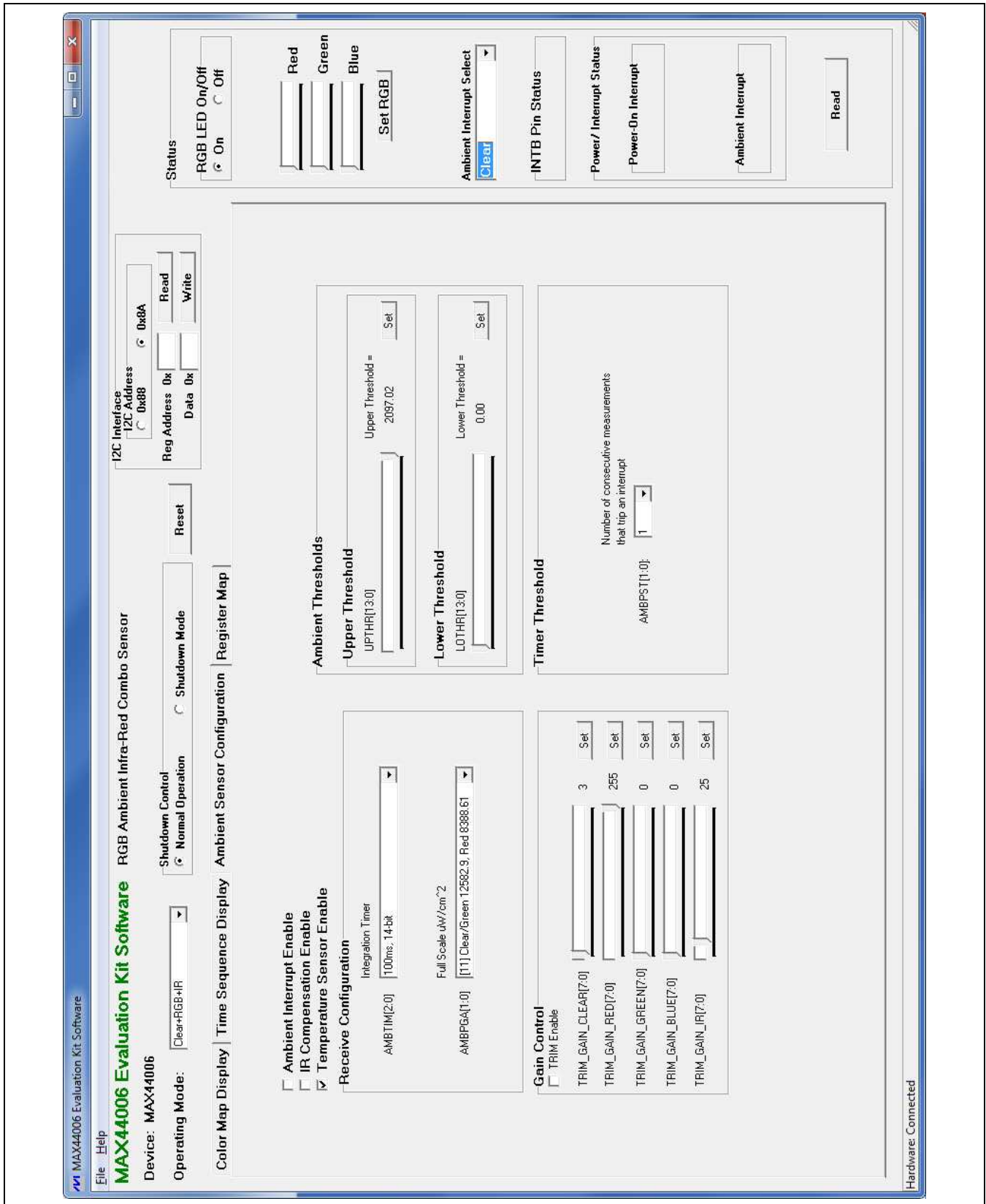
Figure 3. MAX44006 EV Kit Software (Ambient Sensor Configuration Tab)

In the **Upper Threshold** group box, use the **UPTHR[13:0]** track bar to select the desired upper ambient interrupt threshold. Press the adjacent **Set** button to set the UPTHR register. Similarly use the **LOTHR[13:0]** track bar in the **Lower Threshold** group box to select the desired lower ambient interrupt threshold and press the adjacent **Set** button to set the LOTHR register.

Use the **AMBPST[1:0]** drop-down list in the **Timer Threshold** group box to set the persist value that controls how readily the ambient interrupt logic reacts to a detected event.

In the **Gain Control** group box, check the **TRIM Enable** checkbox to force the part to use the trim value written in the trim gain registers. Use the track bars and the adjacent **Set** buttons to set the trim gain registers for the corresponding ambient ADC channels.

Status

In the **Status** group box, press the **Read** button to read the status of the interrupt pin, $\overline{INT}$. If the interrupt signal is asserted, the status register (0x00) is read and displayed in the **Power/Interrupt Status** group box.

The measurement of the ADC channel selected from the **Ambient Interrupt Select** drop-down list is being compared to the ambient interrupt thresholds. When the **Ambient Interrupt Enable** checkbox is checked, if the ambient measurement is higher than the upper threshold or lower than the lower threshold, the interrupt event is recorded (provided the persist timer condition is met).

The **Red**, **Green**, and **Blue** track bars, and the **Set RGB** button are used to manually adjust the brightness of the on-board RGB LED. Use the **RGB LED On/Off** group box to turn on/off the RGB LED.

Register Map

The **Register Map** tab (Figure 4) contains a register map of the IC. The tab is organized from left to right with register names, bit names, register address, edit boxes, **Read** buttons, and **Write** buttons. The bit names are used to display the current state of each bit (visible text = 1). In addition, a register's bits can be individually toggled by single-clicking on the bit's name. The edit boxes are used to display a register's state and are updated after a bit click or **Read** button press. The user can also change the value of the register by entering a value in the edit box and pressing the adjacent **Write** button.

Detailed Description of Hardware

The MAX44006 EV system includes one MAX44006 EV kit and one MAX44006 daughter board. The EV kit is a fully assembled and tested PCB that evaluates the MAX44006 digital RGB color sensor with temp sensor. The EV kit comes installed with a MAX44006EDT+ in a 6-pin OTDFN package.

The daughter board is an external device-under-test module that also comes with a MAX44006EDT+ installed. The daughter board can be connected to and controlled by the EV kit. The user can also evaluate the IC by connecting a user-supplied controller to the daughter board.

Power Supply

By default, the EV kit is USB powered. To use the external power supply, connect a 5V supply to the DVDD and DGND connectors, and place the shunt on jumper JU10 in the 2-3 position. The daughter board is powered by the EV kit board.

User-Supplied I²C Interface

To use the IC on the EV kit with the user-supplied I²C interface, install the shunts on jumpers JU12–JU16 in the 2-3 position. Connect the SCL, SDA, $\overline{INT}$, and VDD signals from the external SPI interface to the EXT_SCL, EXT_SDA, EXT_INTB, and EXT_VDD connectors on the EV kit, respectively.

MAX44006 Daughter Board

To use the daughter board with the EV kit and the EV kit software, remove the shunts on jumpers JU14, JU15, and JU16 to disconnect the IC on the EV kit from the on-board controller (see Table 2). Carefully connect the EV kit and the daughter board by aligning pin 1 (see the silkscreen) of connector J1 of the daughter board to pin 1 (see the silkscreen) of the right-angle header J4 ov the EV kit and press them together. If done correctly, U1 on the daughter board should be facing the RGBLED on the EV kit.

Table 2. Selection Between EV Kit On-Board DUT and Daughter Board DUT

JUMPER	ON-BOARD PART	DAUGHTER BOARD PART
JU14	1-2*	Pin 1
JU15	1-2*	Pin 1
JU16	1-2*	Pin 1

*Default position.

Figure 4. MAX44006 EV Kit Software (Register Map Tab)

Figure 5a. MAX44006 EV Kit Schematic (Sheet 1 of 5)
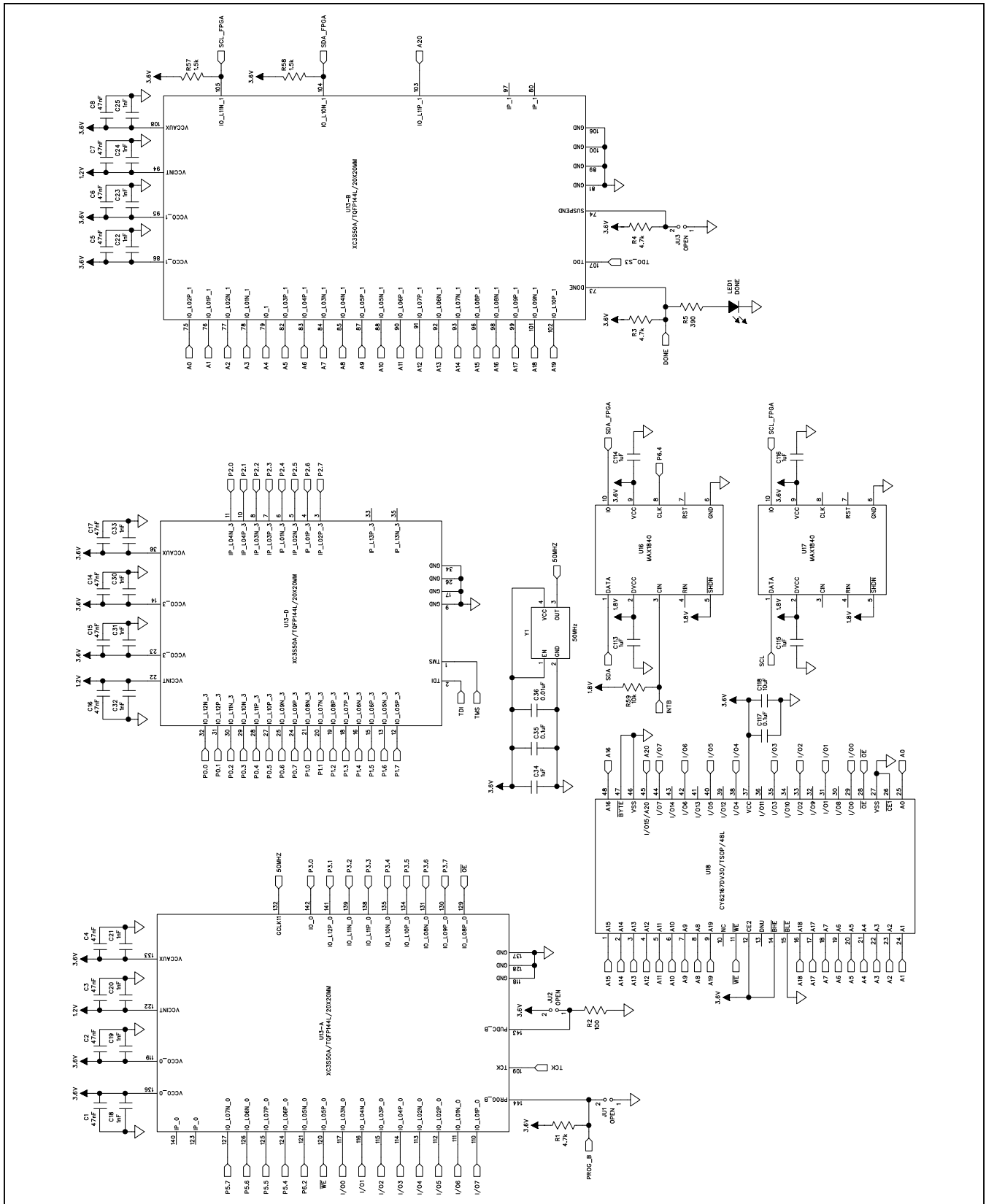
Figure 5b. MAX44006 EV Kit Schematic (Sheet 2 of 5)
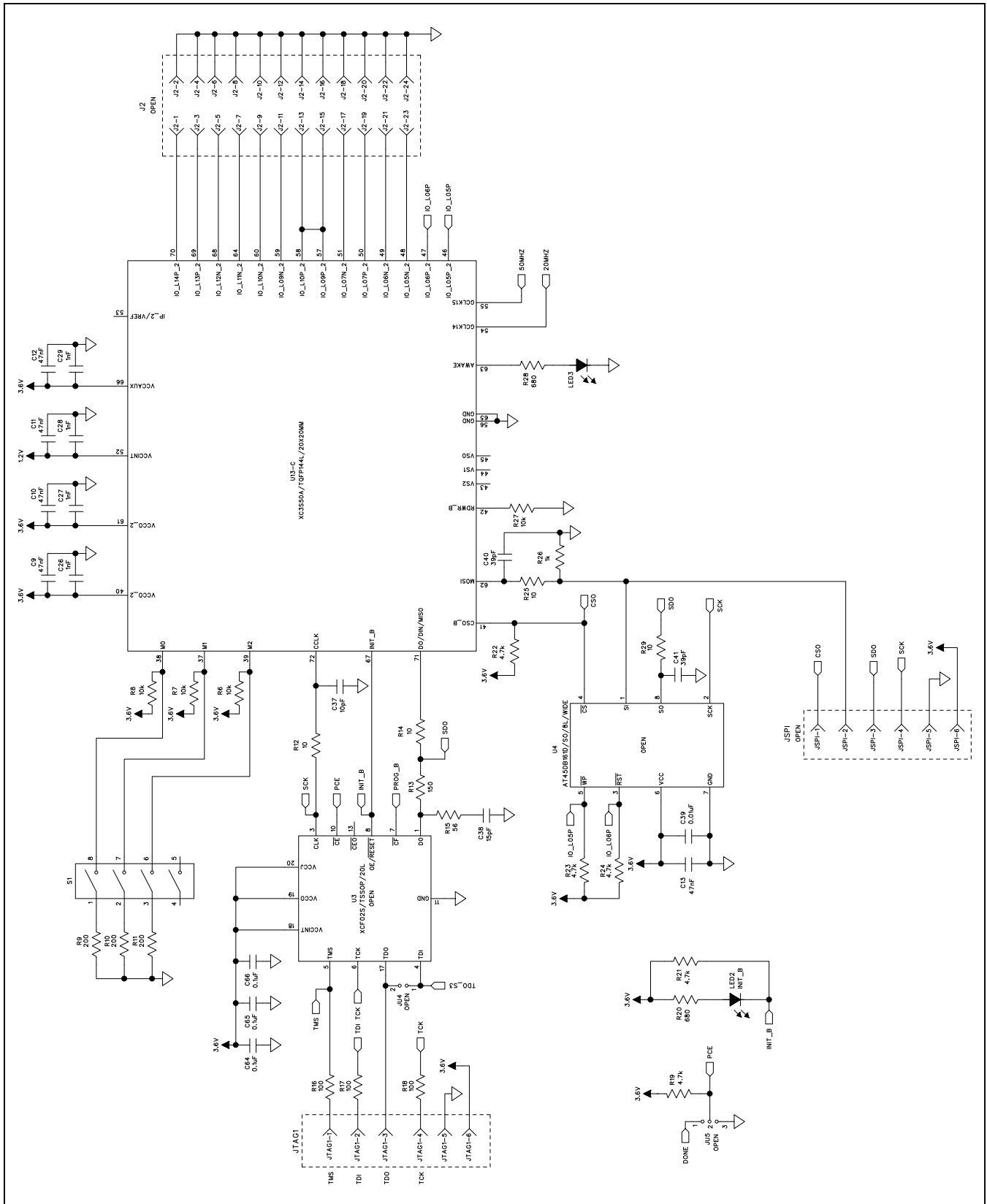
Figure 5c. MAX44006 EV Kit Schematic (Sheet 3 of 5)
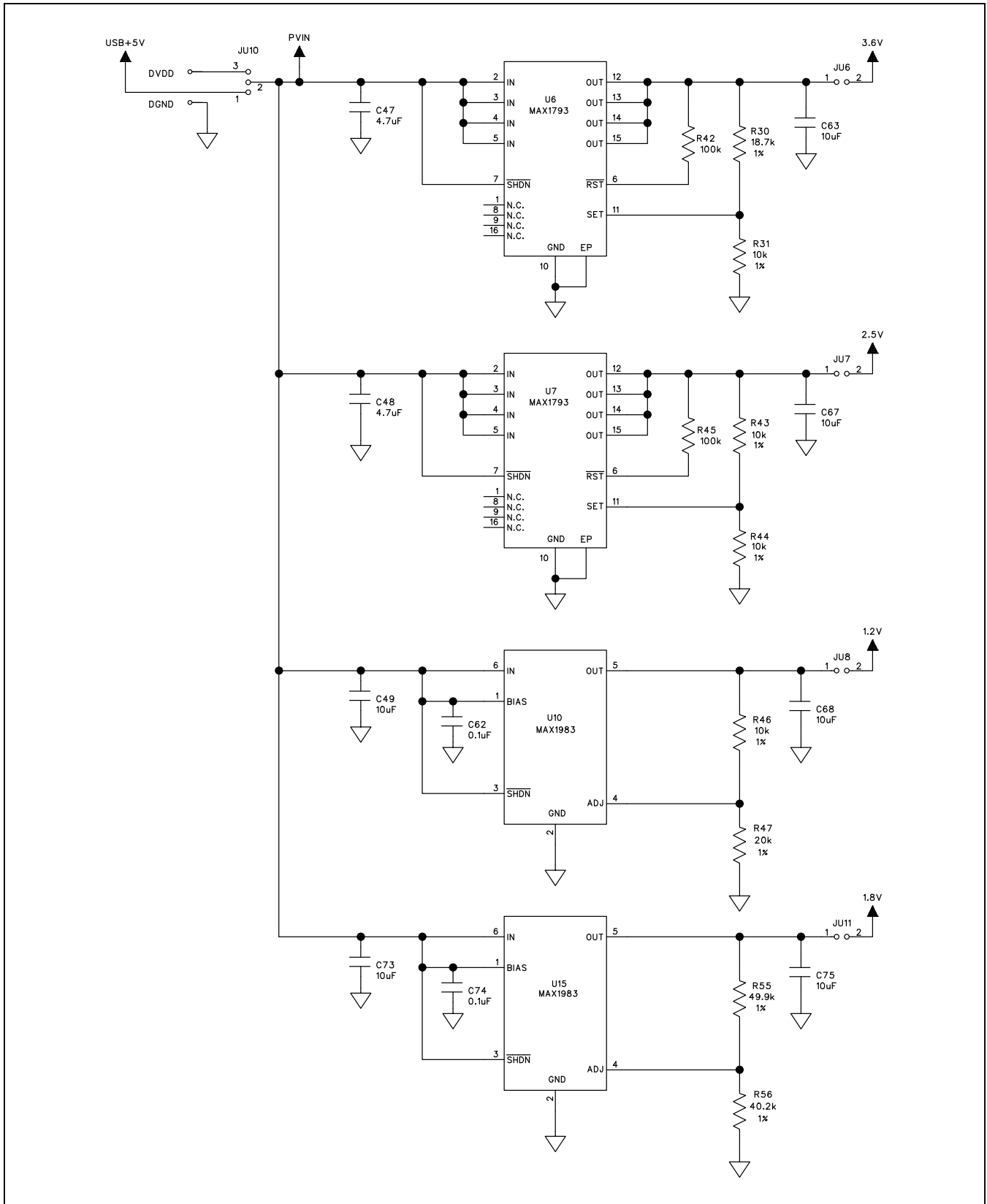
Figure 5d. MAX44006 EV Kit Schematic (Sheet 4 of 5)
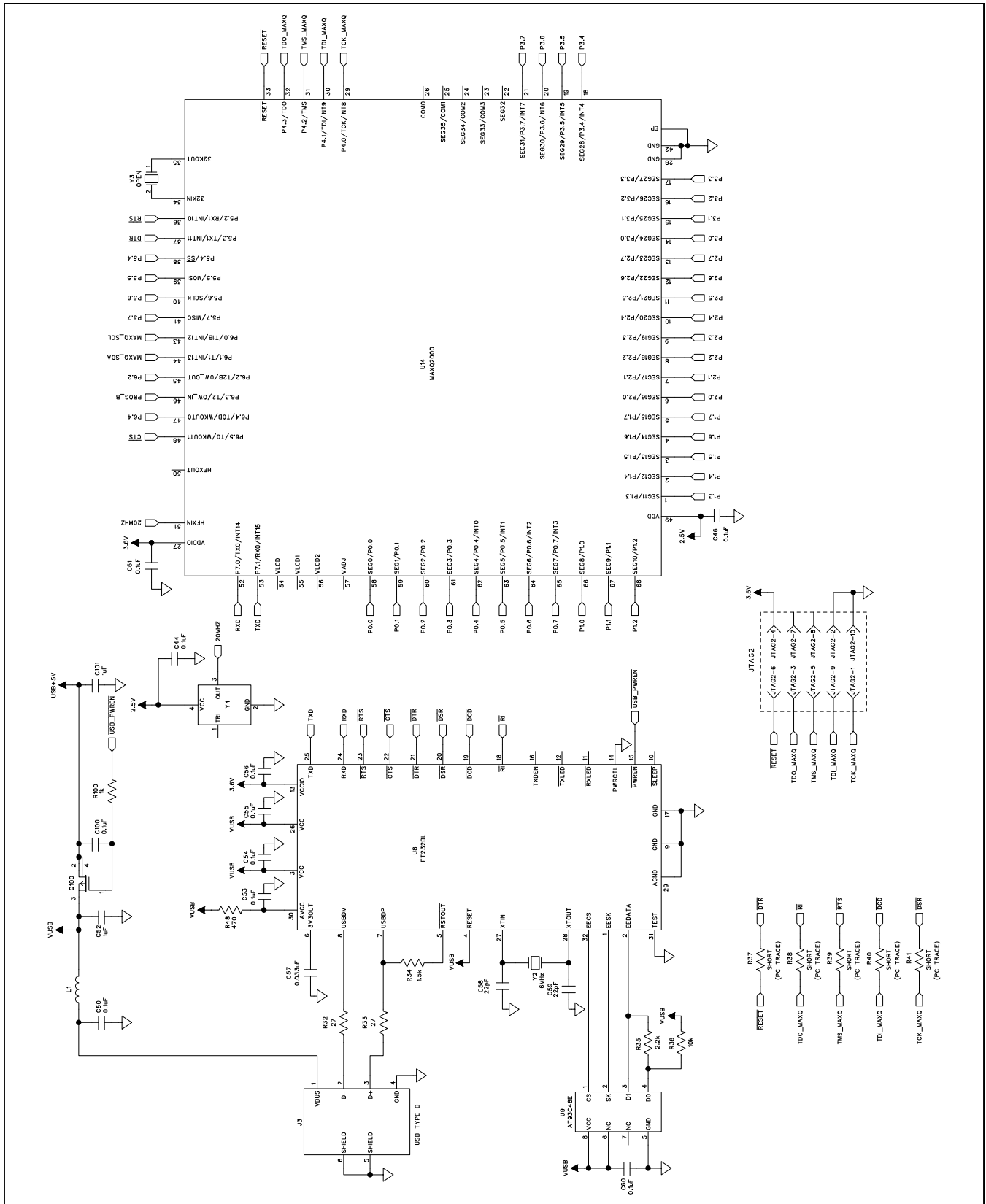
Figure 5e. MAX44006 EV Kit Schematic (Sheet 5 of 5)
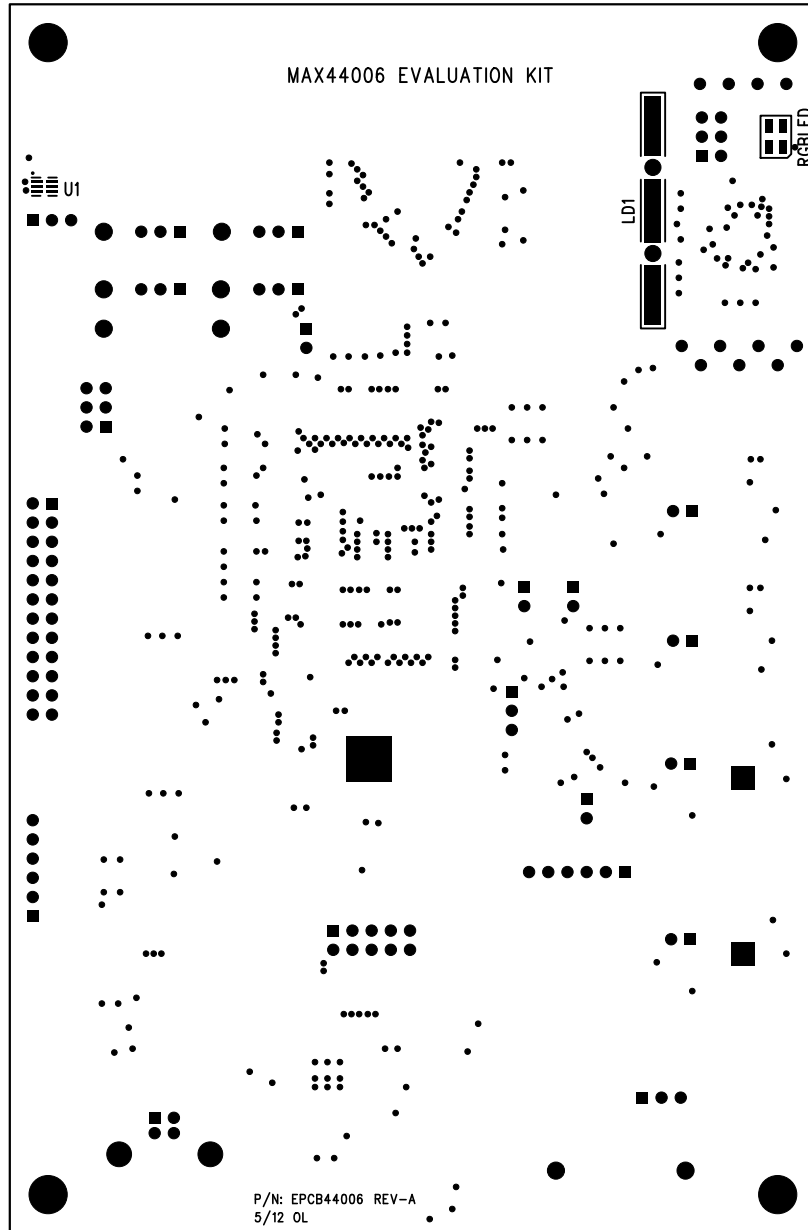
Figure 6. MAX44006 EV Kit Component Placement Guide—Component Side

1.0"

Figure 7. MAX44006 EV Kit PCB Layout—Component Side
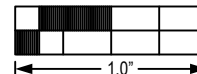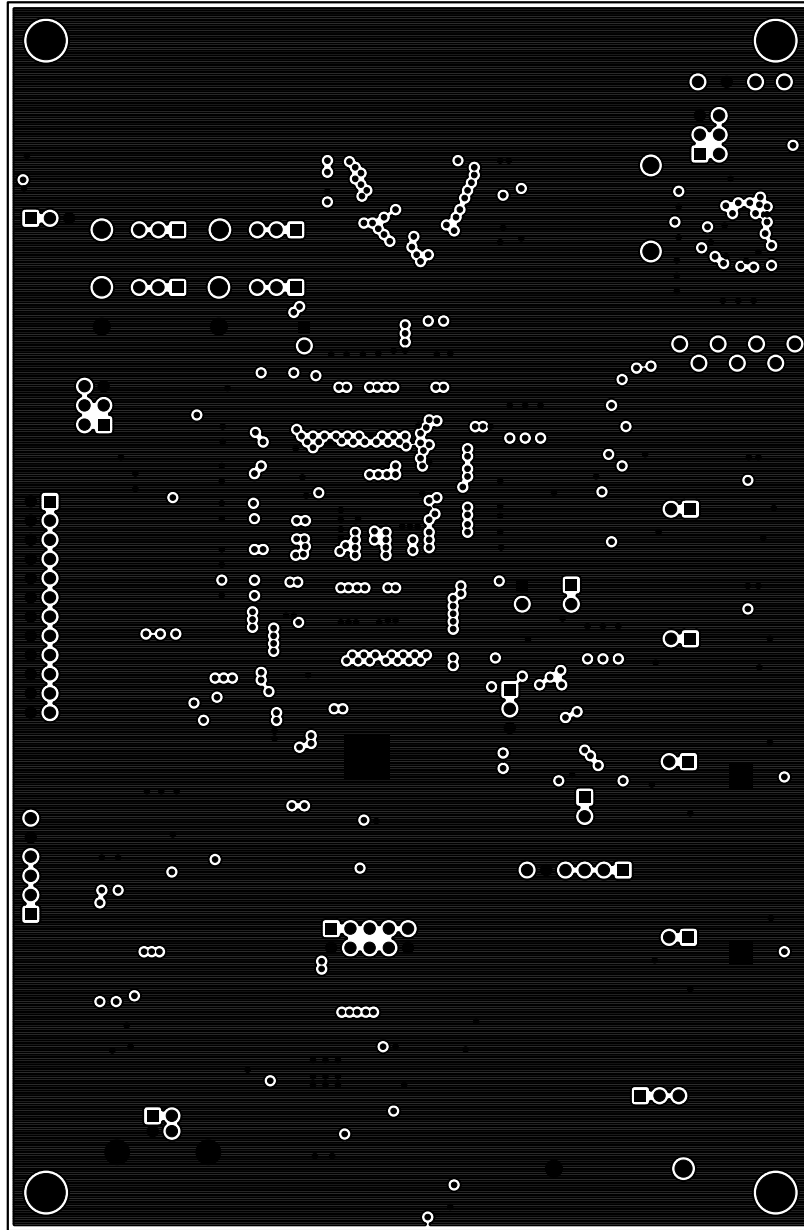
Figure 8. MAX44006 EV Kit PCB Layout—Layer 2
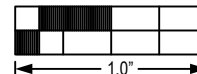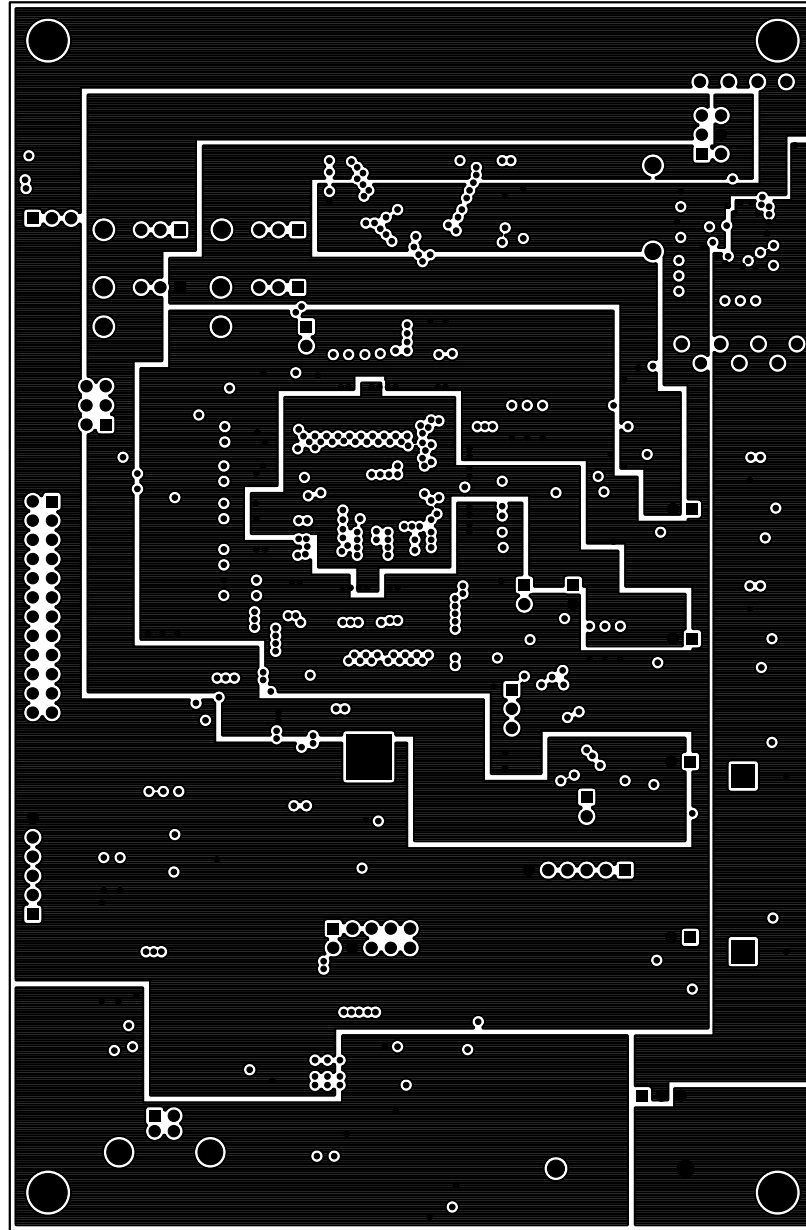
Figure 9. MAX44006 EV Kit PCB Layout—Layer 3
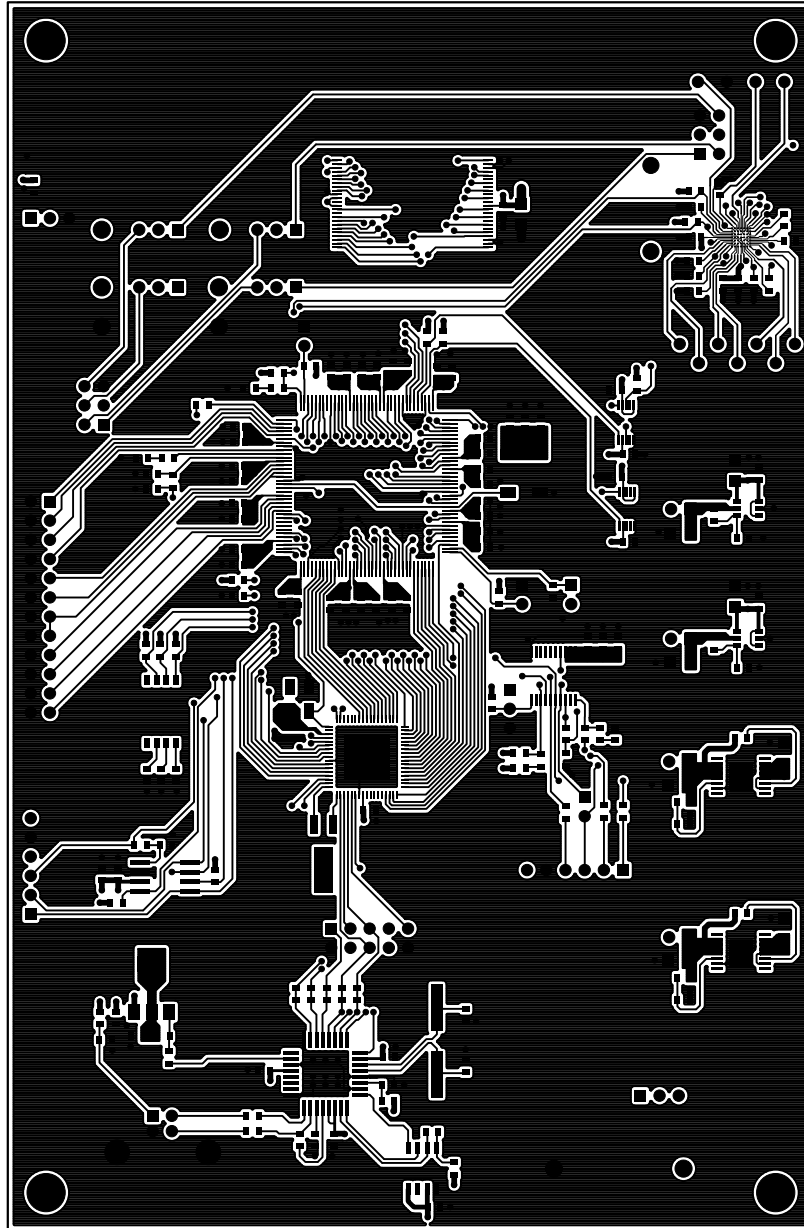
Figure 10. MAX44006 EV Kit PCB Layout—Bottom Side
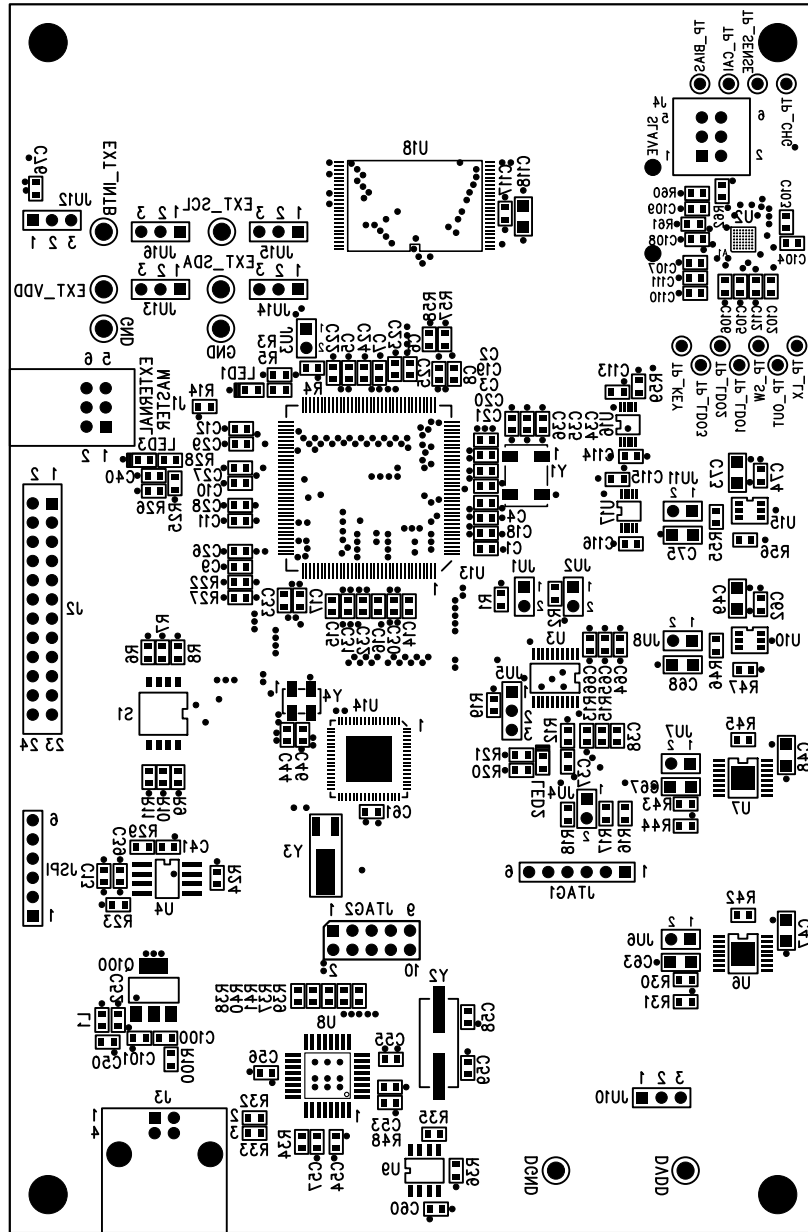
Figure 11. MAX44006 EV Kit Component Placement Guide—Bottom
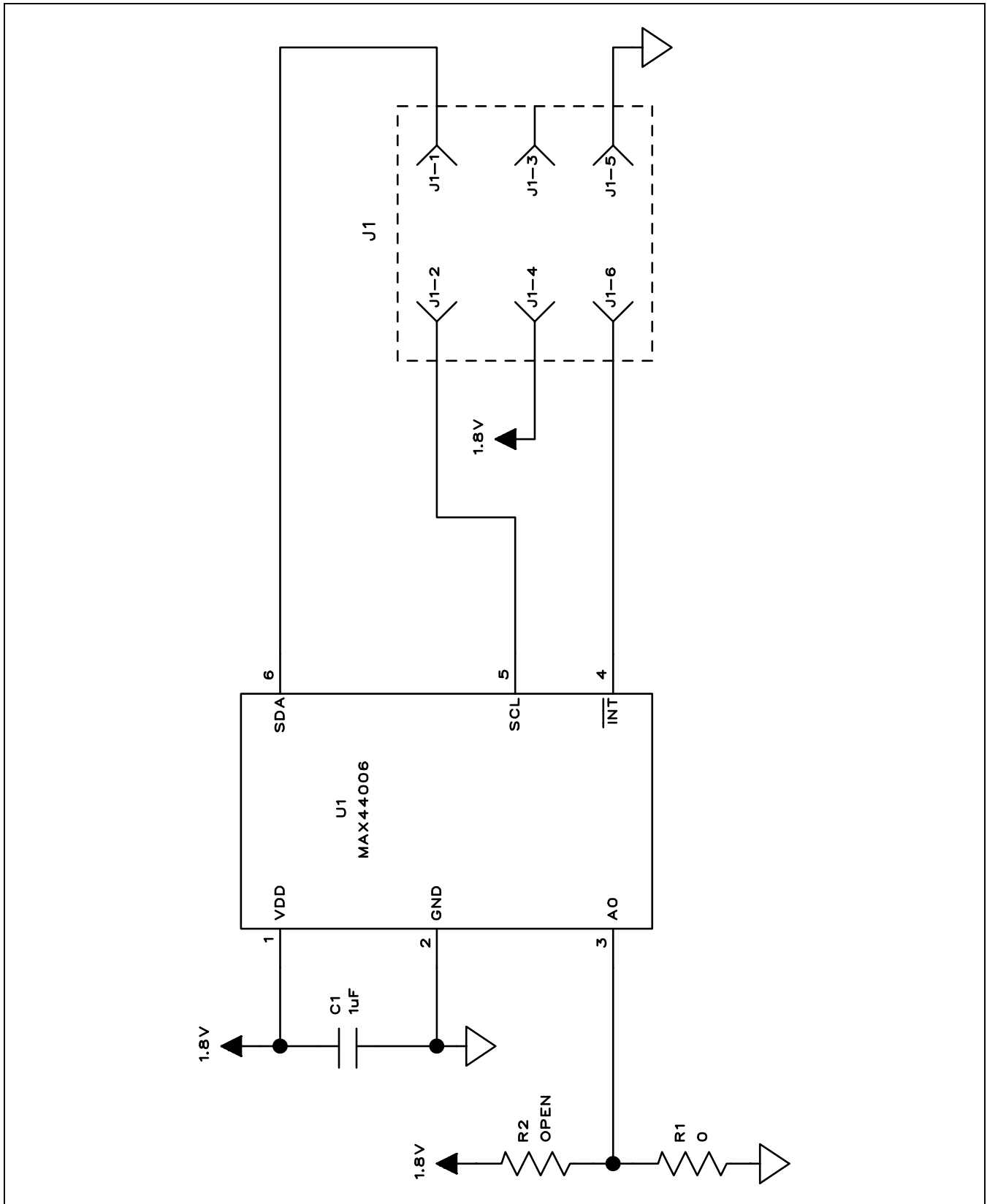
Figure 12. MAX44006 Daughter Board Schematic
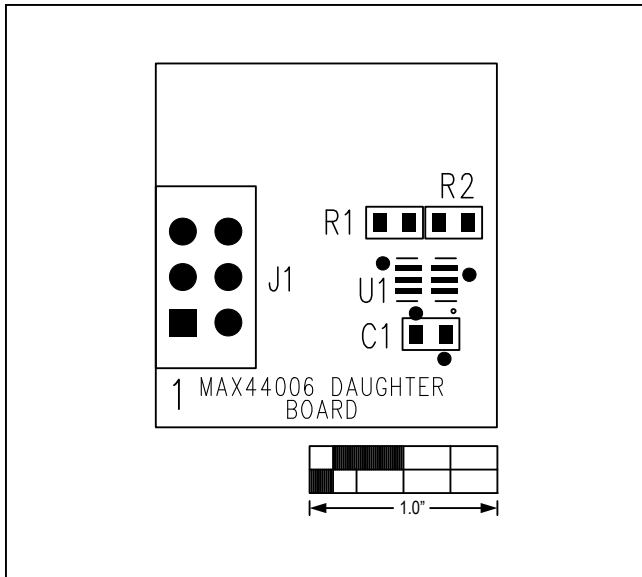
Figure 13. MAX44006 Daughter Board Component Placement Guide—Component Side
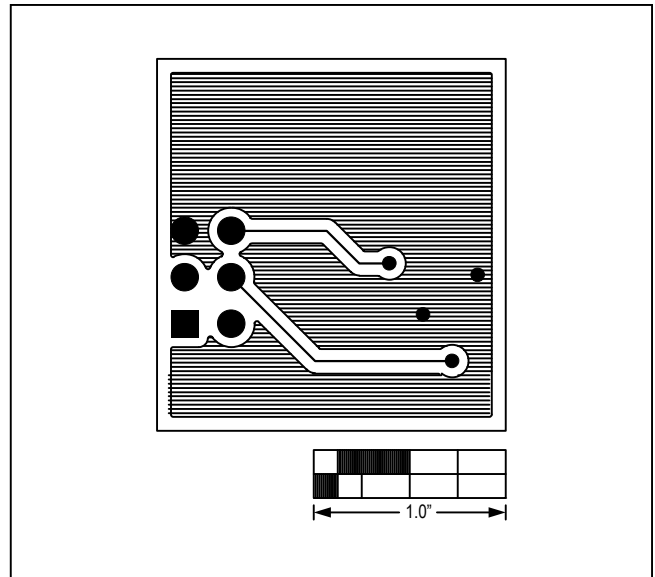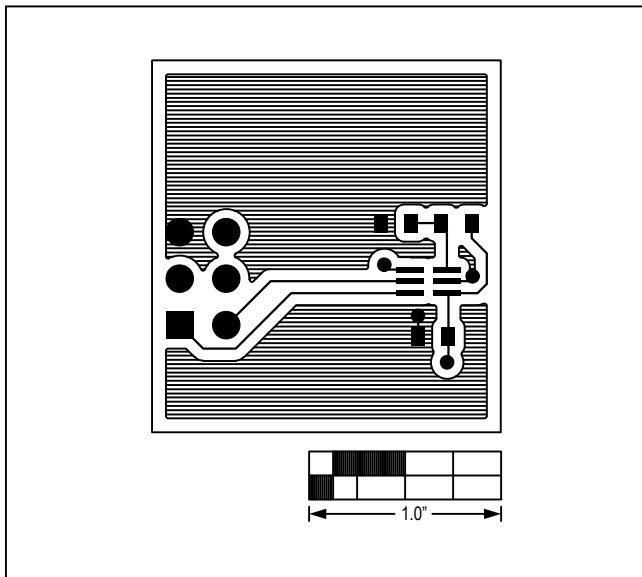

Figure 15. MAX44006 Daughter Board PCB Layout—Bottom

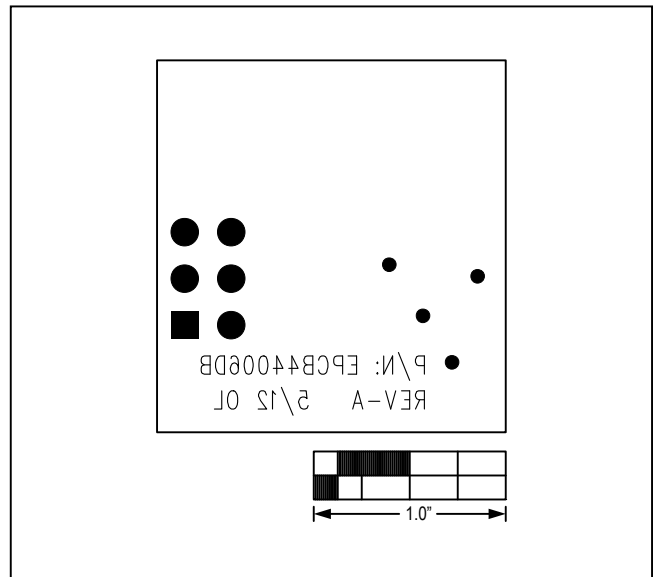Figure 14. MAX44006 Daughter Board PCB Layout—Top

Figure 16. MAX44006 Daughter Board Component Placement Guide—Bottom Side

Ordering Information

PART	TYPE
MAX44006EVSYS#	EV System

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/13	Initial release	—