MAX17823H Evaluation System

Evaluates: MAX17823H

General Description

The MAX17823H evaluation kit (EV kit) demonstrates the capabilities of the MAX17823H advanced smart battery-pack controller. Vertical headers (P2, P3, P5, and P6) allow for the connection of multiple EV kits to support the maximum 32-device daisy-chain capability.

Benefits and Features

- Battery-Cell String Emulation
- UART interface
- Windows XP®-, Windows Vista®-, or Windows® 7-Compatible Software
- Fully Assembled and Tested

Component Lists

Table 1. MAX17823H EV System

PART	QTY	DESCRIPTION
MAX17823HEVKIT#	2	MAX17823H EV kit

MAX17823H EV Kit

Table 2. Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX17823H when contacting these component suppliers.*

Table 3. MAX17823H EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX17823_MAX17880.EXE	Application program
CDM20600.EXE	Installs the USB device driver
UNINSTALL.EXE	Uninstalls the EV kit software
USB_Driver_Help.pdf	USB driver installation help file

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

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Quick Start

Recommended Equipment

- Two MAX17823H EV Kits
- One MAX17841 EV Kit
- MINQUSB+ command module
- MINIQUSB board
- MINIQUSB-XHV board (this board is not used)
- Two 9V to 60V DC power supplies (refer to the MAX17823H IC datasheet for recommended operating ranges)
- User-supplied Windows XP-, Windows Vista-, or Windows 7-compatible 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 kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

The MAX17823H EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not enable the power supplies until all connections are completed.**

1) Visit **www.maximintegrated.com/design/tools/applications/evkit-software/** to download the latest version of the EV kit software, 17823xxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
2) Install the EV kit software on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.
3) Connect the MINIQUSB+ to the J3 and J4 headers on the MAX17841 EV kit.
4) Connect the USB cable from the PC to the MINIQUSB board. A **Building Driver Database** window pops up in addition to a **New Hardware Found** message if this is the first time the EV kit board is connected to the PC. If a window is not seen that is similar to the one described above after 30 seconds, remove the USB cable from the MINIQUSB and reconnect it. Administrator privileges are required to install the USB device driver on Windows XP, Windows Vista, and Windows 7.
5) Follow the directions of the **Add New Hardware Wizard** to install the USB device driver. Choose the **Search for the best driver for your device** option. Specify the location of the device driver to be **C:\Program Files\MAX17823** (default installation directory) using the **Browse** button. Refer to the USB_Driver_Help.PDF document included with the software for additional information.
6) Appropriate FTDI drivers might need to be installed from the website **http://www.ftdichip.com/Drivers/D2XX.htm**.
7) Ensure that all jumper shunts and switches are configured as listed in Table 1, Table 2, and Table 3.
8) Configure the DC power supplies for 18V, and disable their outputs.
9) Connect the power supply grounds together. Then connect this common ground to AGND on the MAX17841 EV kit.
10) Connect the first 18V supply between the PACK+ and PACK- pads on the first MAX17823H EV kit.
11) Connect the second 18V supply between the PACK+ and PACK- pads on the second MAX17823H EV kit.
12) Using the six blue two-wire crossover cables, make the following connections:
    - Connect P1 on MAX17841 EV kit to P6 on the first MAX17823H EV kit
    - Connect P2 on MAX17841 EV kit to P5 on the first MAX17823H EV kit
    - Connect P2 on the first MAX17823H EV kit to P6 on the second MAX17823H EV kit
    - Connect P3 on the first MAX17823H EV kit to P5 on the second MAX17823H EV kit
    - Connect the red loop-back cable from P2 to P3 of the second MAX17823H EV kit
13) Enable the DC power supply.
14) Start the MAX17823EV kit software by opening the corresponding icon in the **Start | Programs** menu. The EV kit software automatically establishes a connection with the EV kit. Once the status bar at the bottom of the window displays **Interface found**, proceed to the next step.
15) If checked, uncheck the **MAX17841 $\overline{\text{SHDN}}$** checkbox in the upper left box.
16) Select **Initialization** tab.
17) Click the **Wake Up** button.
18) Click the **Hello ALL** button in **MAX17823** box.
19) Click the **Set First Address** button in **MAX17823** box.
20) Verify that the **Device Addresses** grid contains two device addresses and that the status bar at the bottom indicates **Initialization Successful**.
21) The EV kit is now ready for further evaluation.

Table 4. MAX17823H EV Kit Default Jumper Settings

JUMPER	SHUNT POSITION
JU0-JU3, JU15-JU18, CELL2-CELL12	On one pin only
JU14, JU19	Installed

Table 5. MAX17841 EV Kit Default Jumper Settings

JUMPER	SHUNT POSITION
JU1-JU4, JU6, JU7	On one pin only
JU5	1-2

Table 6. MAX17823H EV Kit Quick Start Switch Settings

SWITCH	SETTING
SW1	ON (actuators toward the top)

Note:

1) The default position of SW1 is OFF (actuators to-wards bottom) and this setup is for Battery input on P1.

2) The optional position of SW1 is ON (actuators towards top) and this setup is for an external power supply input between BAT0 and BAT12 with the 2kΩ resistor ladder.

Detailed Description of Software

The MAX17823H EV kit is evaluated in conjunction with the MAX17823H evaluation software. The graphical user interface (GUI) provides a user-friendly environment for reading and writing to all device registers, as well as executing the seven device commands. The GUI is divided into two sections: group boxes and command tabs.

The upper-left group box provides shutdown/enabling of the MAX17841 device.

The **Initialization** tab provides controls to execute the **Wake Up** command, the **MAX17823 - HELLOALL** command , and **MAX17823 - Set First Address** command for writing the first address to the ADDRESS register of each device in the daisy chain. This tab also includes a **Device Address** grid that displays the address of each device in the daisy chain, a **Communication Log** that displays a summary of bus activity, and a **Short Cuts** tab that provides faster methods of executing useful software functions.

The **Read/Write** tab located in MAX17823 tab provides controls for executing the WRITEDEVCIE, WRITEALL, READDEVICE, and READALL commands.

The **Voltage Measurements** tab provides initiating and monitoring the ADC scanning of the connected devices.

The **MAX17823** tab provides access to the registers of all MAX17823H devices on the daisy chain. Each tab includes a grid that is used to display the contents read from the registers. The grid is made of x columns and y rows, where x is the number of registers (shown above each grid) associated with that tab and y is the number of devices in the daisymchain. In addition, each tab includes various controls (checkboxes, edit boxes, buttons, labels, etc.) for configuring each device. Refer to the MAX17823H IC datasheet for additional register and interface details.

The **MAX17841** tab provides access to the MAX17841 device registers.

The software also provides functions to facilitate the evaluation process. These include a PEC calculator, the capability to save ADC measurements to file, and the ability to save/load register configurations to/from a file. When evaluating the EV kit, refer to the MAX17823H IC datasheet and the MAX17841 IC datasheet for additional details.

System Initialization

The daisy chain of MAX17823H EV kit is initialized using the controls provided in the **Initialization** tab on the MAX17823EV kit software GUI. The recommended initialization sequence is provided below:

1) Verify jumper configuration. See the *Device Startup* section.

2) Uncheck the **MAX17841 $\overline{\text{SHDN}}$** checkbox.

3) Click the **Wake Up** button. This will execute a sequence that wakes up the MAX17823H devices in the daisy chain.

4) Select the address of the first device in the daisy chain in the edit box adjacent to the **MAX17823 - HELLOALL** button.

   • The value entered here contains the address (A[4:0]) of the first device in the daisy chain. The A[4:0] value is written to the most significant bits of the ADDRESS register of the first device.

   • Refer to the HELLOALL Command section in the MAX17823H IC data sheet for additional details

Note: When re-initializing the device, the address unlock bit (ADDRUNLOCK) must be set before proceeding to the next step. This is done by clicking the **Unlock Device**

Address button on the software's **Configuration** tab in the **MAX17823** tab.

1) Click the MAX17823 - **HELLOALL** button.

   This command sends out the HELLOALL command along with the chosen first device address. It also determines how many devices are in the daisy chain, based on the address byte that is returned by the last device.

2) Click the **MAX17823 - Set First Address** button. This control writes the address of the first device to the upper 8 bits of each device's 16-bit ADDRESS register. This control uses the WRITEALL command.

The daisy chain is initialized once all devices have been programmed with the address of the first device. The software is now fully operational, and all active devices are configurable. Refer to the UART Daisy-Chain Initialization Sequence section in the MAX17823H IC datasheet for additional initial configuration recommendations.

Grid Initialization

When the Set First Address sequence is complete, the software updates the grids on the **MAX17823H Device Addresses** box in the **Initialization** tab and the **Thresholds, Voltage Measurement, DIAGCFG/FMEA, Alert/Status, Enables, Configuration, BALSW**, and **Model/Version/ADC Test** tabs in the **MAX17823** tab.

Table 7. ADDRESS Register

ADDRESS REGISTER ADDRESS							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit0
0	0	0	0	0	0	0	1
ADDRESS REGISTER (Upper 8bits)							
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
0	0	0	FA4	FA3	FA2	FA1	FA0
ADDRESS REGISTER (Lower 8bits)							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	DA4	DA3	DA2	DA1	DA0

Device Addresses Grid

The **Device Addresses** box is initialized after clicking the **MAX17823 - Set First Address** button. The grid contains the addresses of all detected devices. Selecting a cell that contains a device address updates the **Active Device** drop-down list. For a two-device daisy chain with a start address of 0x00, the grid would be displayed as shown in Figure 1.

Register Grids

The **Thresholds**, **Voltage Measurement**, **DIAGCFG/FMEA**, **Alert/Status**, **Enables**, **Configuration**, **BALSW**, and **Model/Version/ADC Test** tabs in the **MAX17823** tab include grids that display the contents of the selected device registers. These tabs are all updated to contain n number of rows, where n equals the total number of detected devices.

For a two-device daisy chain, the grids on each tab are configured with two rows, as shown in Figure 2. The number of columns in each grid is set by the number of registers associated with that grid. In addition, each row has an associated device number button that, when clicked, sets that device as the active device, updating the **Active Device** drop-down list.
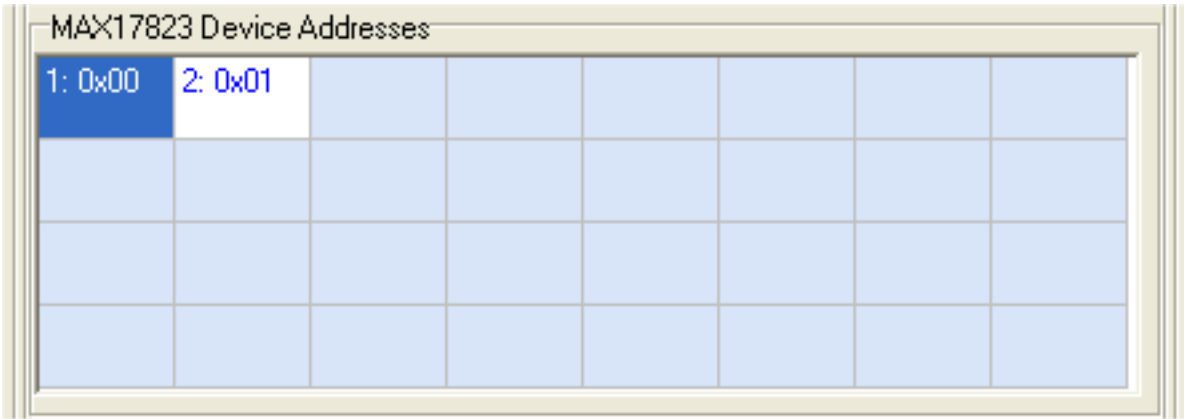

Figure 1. MAX17823H EV Kit Software—Device Address Grid

Figure 2. MAX17823H EV Kit Software—Device Rows

Write Registers

A specific device in the daisy chain can be written to by using the **Read/Write** tab and **Active Device** drop-down list. Follow the steps below to perform a write to a specific register of a single device:

1. Select the device to be written to from the **Active Device** drop-down list (Figure 3).

2. Select the register to be written to from the **Select MAX17823 Register** box in **Read/Write** tab.

3. Enter the hex value (####) into the **Data: 0x** edit box in the **Write Devices** box (Figure 4).

4. Click the **Write Active Device** button.

The **Write Devices** box can also be used to write an entered value into the active register of all the devices in the daisy chain. Follow the steps below to perform a write to a specific register of all devices:

1) Select the register to be written to from the **Select MAX17823 Register** box.

2) Enter the hex value (####) into the **Data: 0x** edit box in the **Write Devices** box.

3) Click the **Write All Devices** button.

Read Registers

A specific device in the daisy chain can be read by using the **Read/Write** tab and the **Active Device** drop-down list. Follow the steps below to perform a read of a specific register of a single device:

1) Select the device to read from the **Active Device** drop-down.

2) Select the register to be read from the **Select MAX17823 Register** box in **Read/Write** tab.

3) Click the **Read Active Device** button.

4) The read data is displayed in the left-side edit box.

The **Read** tab can also be used to read the active register of all the devices in the daisy chain. Follow the steps below to perform a read from a specific register of all devices:

1) Select the register to be read from the **Select MAX17823 Register** box.

2) Click the **Read All Devices** button.

3) The read data is displayed in the same order as the device address in the left-side edit box.

In addition, there is another read control located at the upper left on the display: **Refresh Active Tab F8**. The **Refresh Active Tab F8** control will read the registers that have been selected. To select a register, check the associated checkbox located above the grid on each register tab. Each tab also has an associated **ALL** checkbox that

when checked/unchecked selects/deselects all the register checkboxes on that tab. The Select All and Deselect All operations can also be executed by clicking the **Set All >>** button or **Clear All >>** button. At the completion of a read operation, the edit box in the **Read/Write** tab displays the data of the selected registers. Figure 5 shows the edit box in the **Read/Write** tab. Figure 6 shows the result of clicking the **Refresh Active Tab F8** button with the **Enables** tab displayed, and Table 8 lists the available read controls and their respective functions.
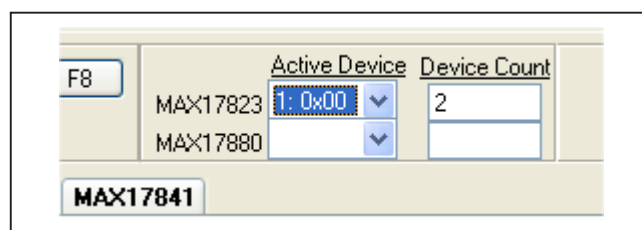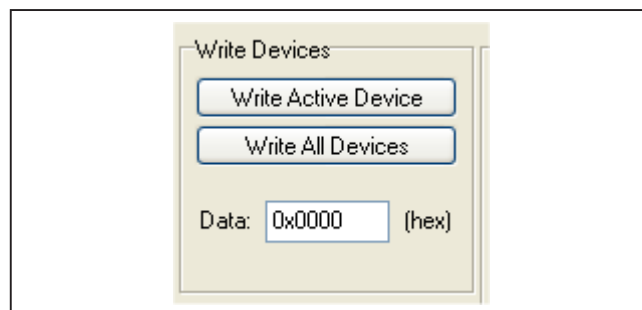

Figure 3. Active Device Drop-Down List
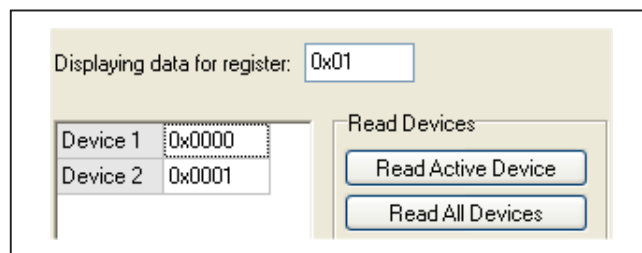

Figure 4. Write Devices Box
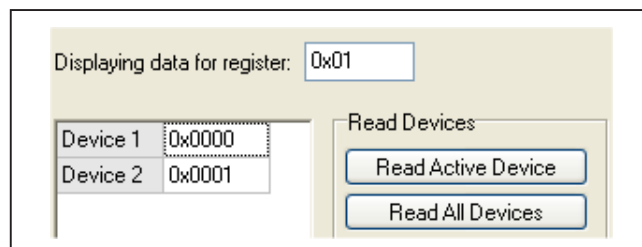

Figure 5. Read Devices Box

Figure 6. Enables Tab After Executing Set All

Table 8. Read Controls

CONTROL NAME	CONTROL TYPE	FUNCTION
Read Active Device	Button	Reads the active MAX17823H register of the active MAX17823H device
Read All Devices	Button	Reads the active MAX17823H register of all devices
Refresh Active Tab F8	Button*, Menu item	Performs a read of all selected registers on the active/visible register tab
Auto Refresh on Tab Change	Checkbox*	When checked, the register tabs are automatically refreshed when becoming active/visible

*See the ADC Scan section.

Scan

Table 9. Scan Controls

| CONTROL NAME	CONTROL TYPE	FUNCTION
Start ADC Scanning	Checkbox	When checked, a scan of the ADC is initiated every x milliseconds, where x is set by the Interval controls below
Interval (msec)	Edit box	Used to enter the time interval between ADC scans
Set Interval	Button	Sets the time interval shown in the **Interval** (msec) edit box
Scan DONE	Button	Clears the SCANDONE bit
DATA ready	Button	Clears the DATARDY bit
TIMEOUT	Button	Clears the SCANTIMEOUT bit
Data Move	Button	Sets the DATAMOVE bit. Moves the data from internal registers to user-accessible registers
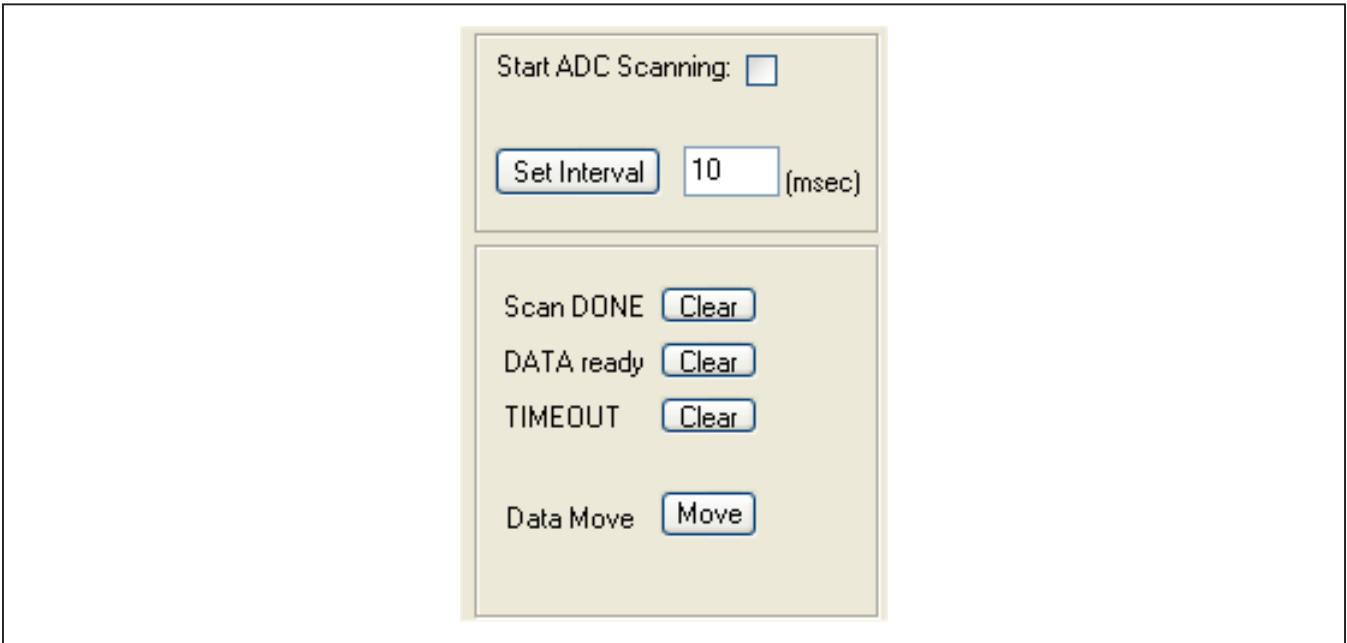
Figure 7. Scan Tab Snapshot

Register Tabs

The 58 device registers are organized onto the following tab sheets in the **MAX17823** tab: **Thresholds**, **Voltage Measurements**, **DIAGCFG/FMEA**, **Alert/Status**, **Enables**, **Configuration**, **BALSW**, **Model/Version/ADC Test**, and **Read/Write**. Each tab provides write access to each device in the daisy chain, as well as a grid that displays the contents of the devices' registers. The display grids are updated by performing read operations through the **Refresh Active Tab F8**. See the *Read Registers* section for more details. The write operations are performed using the individual **Configure Active Device** button or **Configure All Devices** button located on the register tabs.

Thresholds Tab

The **Thresholds** tab (Figure 8) is used to configure the seven threshold registers. The data for the threshold registers is entered and displayed on the GUI as either a voltage or hex value. The threshold registers and their associated GUI controls are listed in Table 10.

The **Write Device** buttons are used to write the entered data to the active device. The active device is selected through the **Active Device** drop-down list. The **Write All** buttons are used to write the entered data to all devices in the daisy chain.

For all the threshold registers, the data (D[11:0]) is contained in the upper 12 bits of the 16-bit register. When entering data into the **Undertemperature Threshold (AINOT)** and **Overtemperature Threshold (AINUT)** edit boxes, enter only the hex value of the upper 12 bits. The lower nibble of each threshold register is ignored during a write, and is read back as zeros.

Table 10. Threshold Registers

THRESHOLD REGISTER (ADDRESS)	GUI CONTROL	DISPLAY/DATA INPUT FORMAT
Overvoltage Clear (0x40)	OVTHRCLR	Voltage*
Overvoltage Set (0x42)	OVTHRSET	Voltage*
Undervoltage Set (0x44)	UVTHRSET	Voltage*
Undervoltage Clear (0x46)	UVTHRCLR	Voltage*
Cell Mismatch (0x48)	MSMTCH	Voltage*
Auxiliary Analog Input Overtemperature (0x49)	AINOT	Hex
Auxiliary Analog Input Undertemperature (0x4A)	AINUT	Hex

*The voltage range for unipolar measurements is 0V to 5V and the voltage range for bipolar measurements is -2.5V to +2.5V

Figure 8. MAX17823H Evaluation Kit Software (Thresholds Tab)

Voltage Measurements Tab

The **Voltage Measurements** tab (Figure 9) displays the results for the ADC conversions on cells 1–12, as well as the results from the TOTAL, MINCELL, MAXCELL, BLOCK, AIN1, AIN2, and DIAG registers. The checkboxes at the top of the tab and their associated **Configure Cells (F9)** button are used to enable ADC scanning of the associated measurement. These checkboxes have the same function as the **CELL_EN** checkboxes on the **Configuration** tab. See the *ADC Scan* section for details on setting up and initiating an ADC scan.
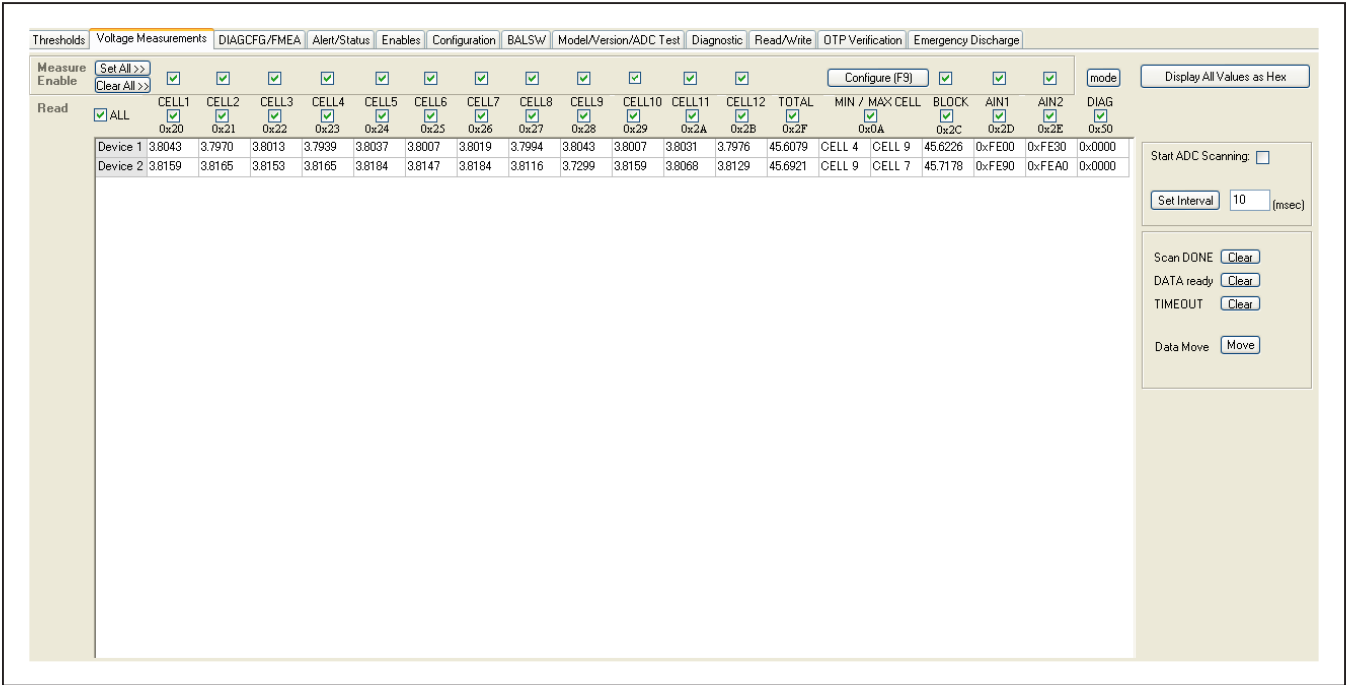

Figure 9. MAX17823H Evaluation Kit Software (Voltage Measurements Tab)

DIAGCFG/FMEA Tab

The diagnostic (DIAG) and failure-mode effects analysis (FMEA) registers are accessed from this tab (Figure 10). The tab is divided into two group boxes: **DIAGCFG** and **FMEA**. The **DIAGCFG** group box displays controls for configuring the register settings. The **FMEA** group box displays the FMEA alerts.
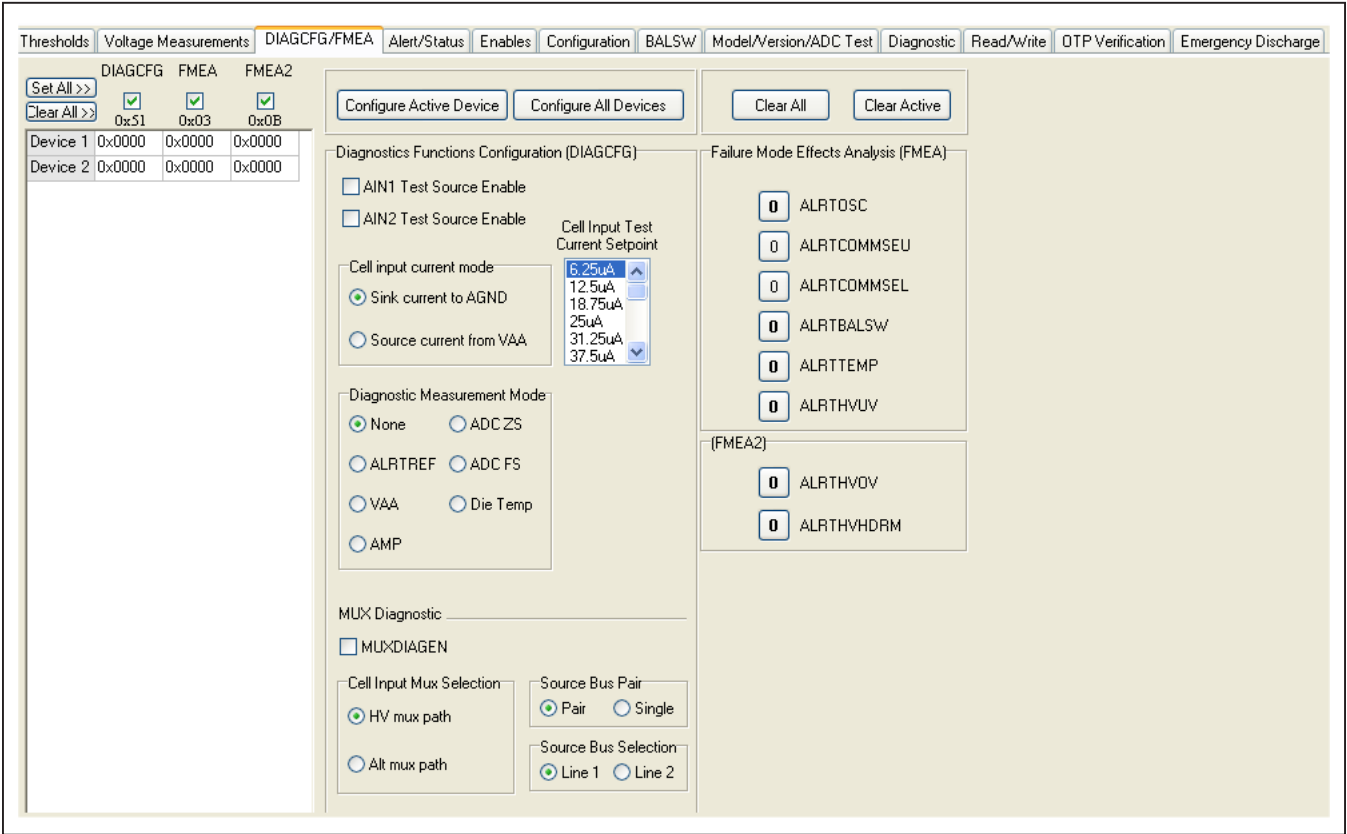

Figure 10. MAX17823H Evaluation Kit Software (DIAGCFG/FMEA Tab)

Alert/Status Tab

All device alerts are monitored from the **Alert/Status** tab (Figure 11). The right side of the tab is divided into three group boxes: **Status Flags (STATUS)**, **Cell Balancing Diagnostic Alert**, and **Alert Status (ALRTCELL, ALRTOVCELL, ALRTUVCELL)**. The **Status Flags (STATUS)** group box displays the alerts from the STATUS (0x02) register. The **Cell Balancing Diagnostic Alert** group box displays the alerts from the ALRTBALSWCELL (0x08) register. The **Alert Status (ALRTCELL, ALRTOVCELL, ALRTUVCELL)** group box displays the alerts from the ALRTCELL (0x04), ALRTOVCELL (0x05), and ALRTUVCELL (0x07) registers. Refer to the Cell Measurements and Balancing Switch Fault Detection sections in the MAX17823H IC datasheet for additional information.

Each group box contains buttons that are associated with that register's alert bits. When performing a read of these alert registers, the state of each alert bit is displayed on the buttons' faces. To clear an alert, a zero must be written to the bit position assigned to that specific alert. An alert is cleared as follows:

1) Select the alerts to be cleared. Click the button displaying the alert. The button's label changes from 1 to 0.

2) Write to the alert register(s) using one of the following options:

a) Click the **Clear Device** button to clear the selected alerts of the active device (see the **Active Device** drop-down list),or

b) Click the **Clear All** button to clear the selected alerts of all devices in the chain

Note: Only the buttons displaying bold text can be cleared by clicking the button. Buttons with non-bold text are read-only bits and are automatically cleared.

The alarm enable bits for the ALRTOV and ALRTUV alerts are located in the OVALRTEN (0x06) and UVALRTEN (0x07) registers, respectively. The ALRTCELL alerts result from an ALRTOV or ALRTUV alert. Therefore, to disable an ALRTCELL alert, both the ALRTOV and ALRTUV alerts for that cell must be disabled (i.e., to disable the alert for cell 12 (AL12), the OV12 and UV12 enable bits must be set to 0).

Figure 11. MAX17823H Evaluation Kit Software (Alert/Status Tab)

Enables Tab

The MAX17823H alert and alarm functions are enabled/disabled by checking/unchecking the **Enables** tab (Figure 12) checkboxes and then clicking either the **Configure Active Device** or the **Configure All Devices** button. When enabled, the overvoltage and undervoltage alerts can be monitored and cleared using the buttons on the **Alert/Status** tab. See the *Alert/Status Tab* section. The overvoltage and undervoltage alert enable bits are contained in their respective register's lower 12 bits (_VALRTEN[11:0]). The **Scan Control (SCANCTRL)** group box provides controls for configuring the scan settings.
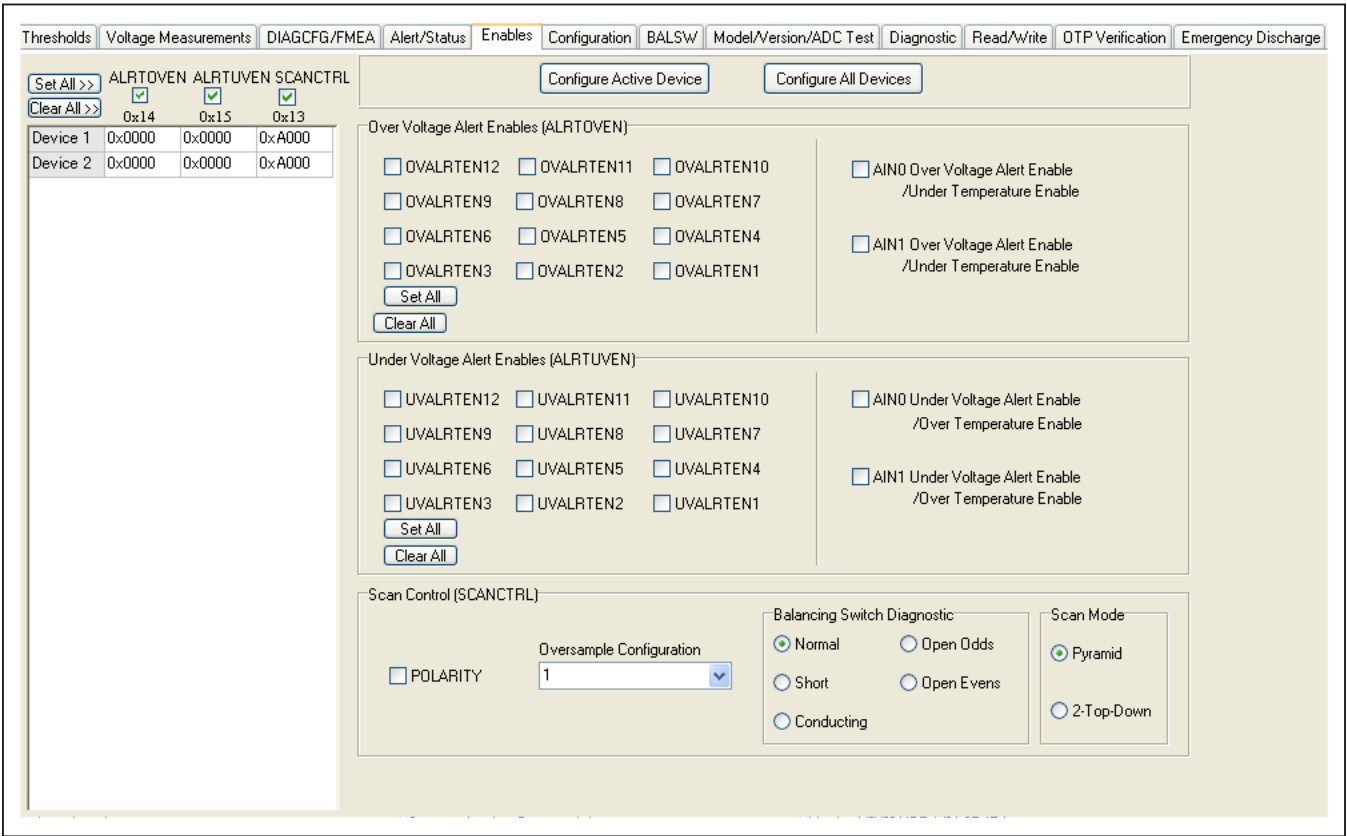

Figure 12. MAX17823H Evaluation Kit Software (Enables Tab)

Configuration Tab

The Configuration tab (Figure 13) is divided into nine group boxes: **Measurement Enable (MEASUREEN)**, **General Purpose I/O (GPIO)**, **ADC Acquisition Time (ACQCFG)**, **Watchdog Configuration (WATCHDOG)**, **Device Configuration (DEVCFG)**, **Device Configuration 2 (DEVCFG2)**, **Top Cell (TOPCELL)**, **Watch Dog Demo**, and **Balancing Switch Discharge (BALSWDISCHG)**. Table 11 lists the main **Configuration** tab's controls and their respective functions.

Table 11. Configuration Controls

General Purpose I/O (GPIO)		
Input	Radio button	Configures the GPIO pin as an input
Output	Radio button	Configures the GPIO pin as an output
GPIO Logic State	Label	Displays the current state of the GPIO pin
GPIO_OUT	Checkbox	Controls the GPIO pin when configured as an output
ADC Acquisition Time (ACQCFG)		
Acquisition Time	Edit box	6-bit acquisition time for AUXIN1/AUXIN2
Watchdog Configuration (WATCHDOG)		
Timer Value	Edit Box	Sets the cell-balancing timer
Timer Pre-Divider	Drop-Down List	Sets the step size of the cell-balancing timer
Device Configuration (DEVCFG)		
Scan Timeout	Radio Button	Enables/disables watchdog timeout
Packet Error Checking	Radio button	Enables/disables packet error checking
Double Buffering	Radio Button	Enables/disables double buffering of the measurement registers
ADC Datapath Test	Radio Button	Enables/disables ADC datapath diagnostic test
Alive Counter	Radio Button	Enables/disables alive counter
Measurement Enable (MEASUREEN)		
CELL1 - CELL12	Checkbox	Selects which cell to enable for measurement
Set All >>	Button	Enables all cells for measurement
Clear All >>	Button	Disables all cells for measurement
BLOCK	Checkbox	Enables Block voltage measurement
VBLK Divider	Radio Button	Connects/disconnects VBLK measurement path
AIN1, AIN2	Checkbox	Selects which AUX to enable for measurement
Configure Active Device	Button	Writes the configuration settings to the device listed in the **Active Device** drop-down list
Configure All Devices	Button	Writes the configuration settings to all devices in the daisy chain
Unlock Device Address	Button	Sets the address unlock bit (ADDRUNLOCK) high to allow a new HELLOALL command
Initiate Soft Reset	Button	Sets the SPOR bit high, initiating a digital power-on-reset event
Initiate Hardware Reset	Button	Sets the FORCEPOR bit high, initiating a hardware power-on-reset event

Figure 13. MAX17823H Evaluation Kit Software (Configuration Tab)

BALSW Tab

The BALSW tab (Figure 14) is divided into four group boxes: **CELLTEST**, **BALSWEN**, **Balancing Diagnostic (BALDIAGCFG1)**, and **Balancing Switch Thresholds**.

Table 12. Cell and Balancing Switch Controls

Cell Input Test Switches (CELLTEST)		
CTSTEN0 - CTSTEN12	Checkboxes	Enables unconnected cell input detection
Cell Balancing Switch Enable (BALSWEN)		
BAL1 - BAL12	Checkboxes	Enables external cell balancing
Balancing Diagnostic (BALDIAGCFG1)		
CELLxxEN_M	Checkboxes	Selects which cell to enable for measurement
Cell Input MUX Selection	Radio Button	Selects multiplexer (HV-MUX, ALT-MUX)
Scan Polarity	Radio Button	Selects ADC mode (Uni-polar, Bi-polar)
Balancing Switch Thresholds		
Short Circuit Threshold	Edit box	Set the threshold voltage by HEX format
Voltage Low Threshold	Edit box	Set the threshold voltage by HEX format
Voltage High Threshold	Edit box	Set the threshold voltage by HEX format
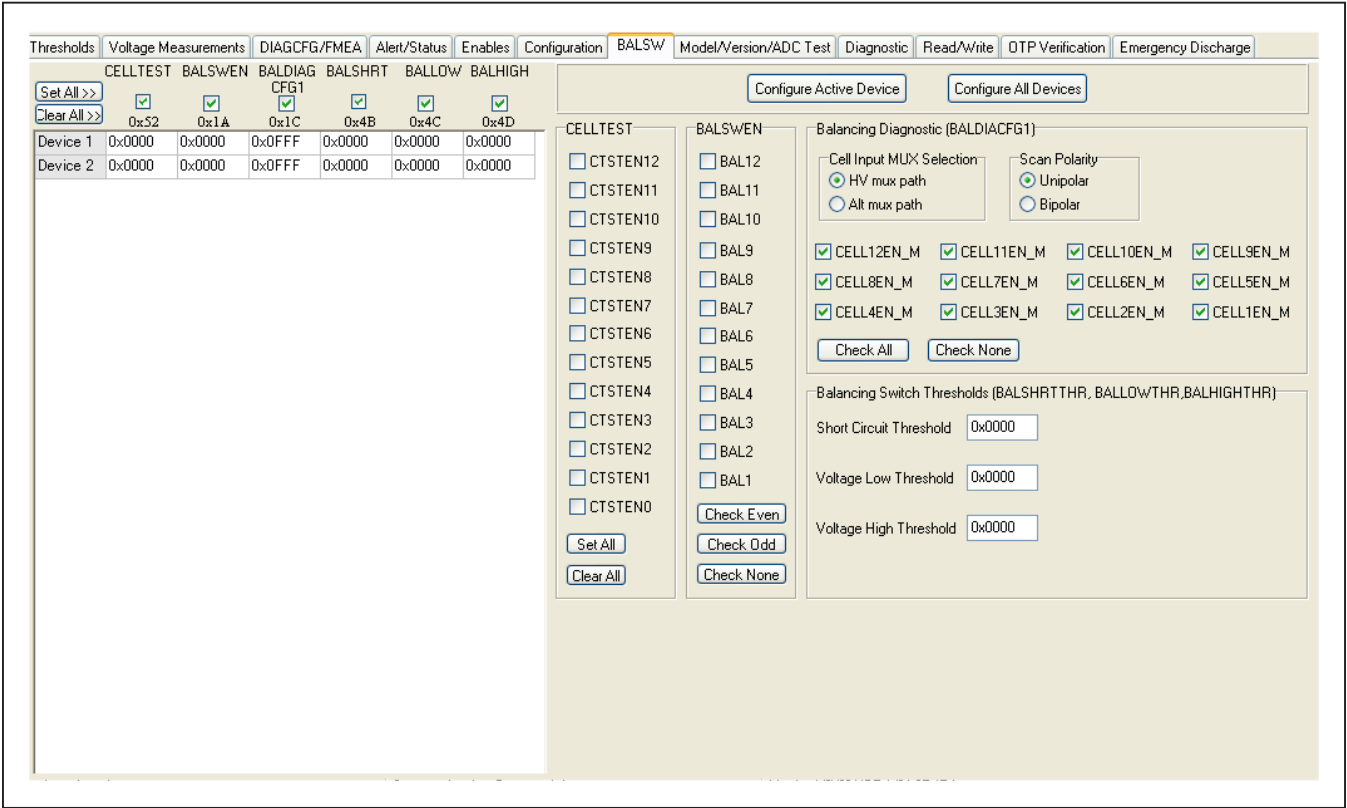
Figure 14. MAX17823H Evaluation Kit Software (Switches Tab)

Model/Version/ADC Test Tab

This register tab (Figure 15) displays the contents of each devices' ADDRESS and MODEL VERSION register. It also reads the ID1 and ID2 register and verifies that the device ID is valid.

Model and Version Number: The lower nibble of the Version register (VER[3:0]) contains the IC's version number. The upper 12 bits (VER[15:4]) contain the MAX17823H model number, which is set to 0x823 (1000 00100011). The Version register is a read-only register.

Table 13. Version Register

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
1	0	0	0	0	0	1	0
Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
0	0	1	1	VER[3:0]			

Figure 15. MAX17823H Evaluation Kit Software (Model/Version/ADC Test Tab)

ADC Scan

An ADC scan measures all enabled cell inputs, all enabled auxiliary inputs, and the self-diagnostics channel (if enabled). The conversion begins once the SCAN bit in the SCANSTART register is set. The following procedure outlines the steps to set up and initiate single or continuous ADC scanning.

Set Up

1) Enable the cells to measure the following:
   - Check the **CELL_EN** checkboxes in the **Measure Enable** box on the **Voltage Measurements** tab.
   - Click the **Configure (F9)** button.

Note: The cell channels can also be enabled with the checkboxes on the **Configuration** tab.

2) Select the cell registers to read by checking the **CELL_** checkboxes on the **Voltage Measurements** tab.
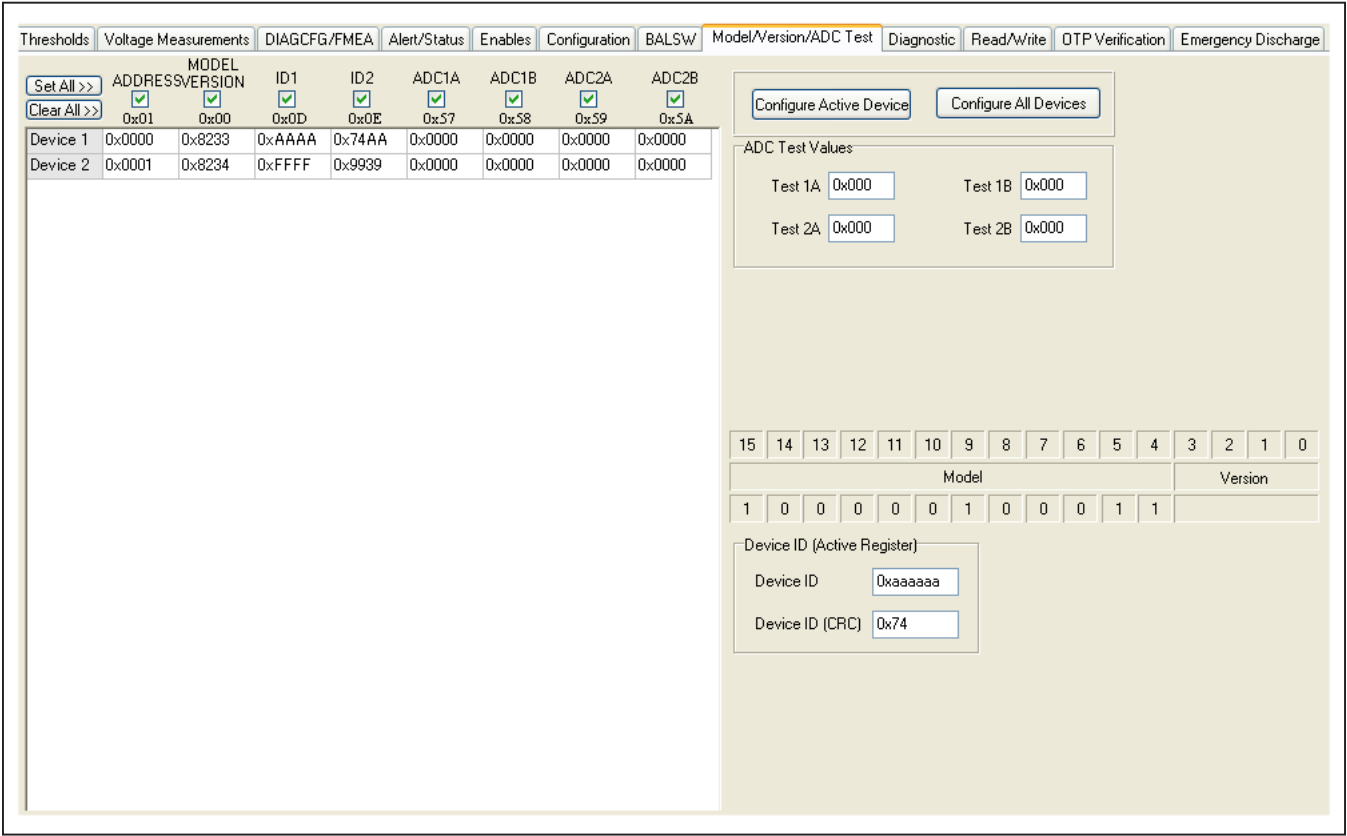3) Enable the self-diagnostics and auxiliary inputs to measure by checking the **AIN1**, **AIN2** and **DIAG** checkboxes in the **Measure Enable** box on the **Voltage Measurements** tab.
4) Select the self-diagnostics and auxiliary input registers for reading by checking the **AIN1**, **AIN2**, and **DIAG** checkboxes on the **Voltage Measurements** tab.

Initiate a Single ADC Scan

1) Select the **Voltage Measurements** tab.
2) Click the **Refresh Active Tab F8** button

Note: The SCAN bit is automatically set before a read is done on the **Voltage Measurements** tab.

Initiate Continuous ADC Scanning:

1) Select the **Voltage Measurements** tab.
2) Enter the time delay between ADC scans into the **Interval (msec)** edit box.
3) Click the **Set Interval** button.
4) Check the **Start ADC Scanning** checkbox.

Note: To save the data during a continuous ADC scan, perform the steps from the Log Scanned Data section.

Log Scanned Data

The MAX17823H EV kit software allows the data measured during continuous ADC scanning to be saved to a file. This feature is available by selecting the **File | Log Scan Data** menu item, and should be set up before scanning is started. The steps below explain how to set up data logging:
1) Perform steps 1–4 in the *ADC Scan* section.

2) Select the **File | Log Scan Data** menu item or press CTRL+L. The **Scan Count** window should appear.
3) Enter the number (n) of ADC scans to record, and then click **Enter**.
4) Select the **Voltage Measurements** tab.
5) Enter the time delay between ADC scans into the **Interval (msec)** edit box.
6) Check the **Start ADC Scanning** checkbox. A red **Logging Data** label appears, indicating that data is being recorded.
7) Once n number of scans has been completed, the **Log Complete** window appears. Click **OK**.
8) A **Log Data** dialog box appears. The default file name is *17823all* and the default file type is .xls (excel spreadsheet). If a different name or file type is preferred, enter it into the **File name** edit field. Click **Save**.

At the completion of this process, data logging is disabled, but the continuous ADC scanning continues until the **Start ADC Scanning** checkbox is unchecked. The file generated by the software logs the measured data of the enabled channels for all the devices in the daisy chain.
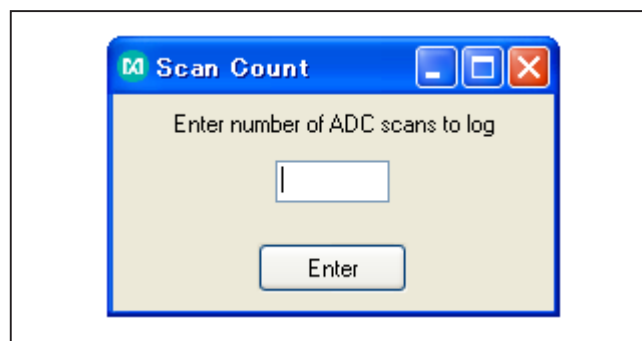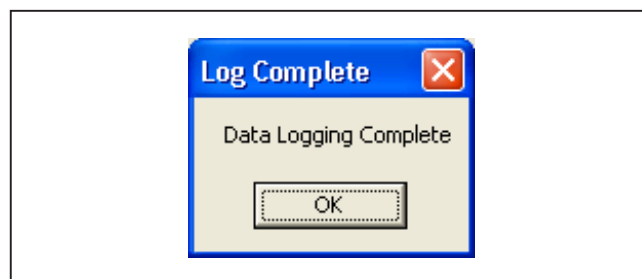

Figure 16. File | Log Scan Data

Figure 17. Log Complete Window

Save/Load Register Configuration

The software features functions to save register configuration and load register configuration. This allows all current register configurations and GUI control settings to be saved and loaded at a later time. When saving, the software first performs a read of all the registers of each device in the daisy chain to obtain their current configurations. Once complete, a **Save All Data** dialog box appears and asks for a file name and type (the default is *17823config.csv*). When loading, a **Load Configuration** file window appears and asks for a file to open (the default is *17823config.csv*). The load function configures the GUI, writes the data from the file to the registers of all the devices in the daisy chain, and finishes by performing a read of all the selected device registers.

Note: Read-only data is not saved to the configuration file. Only configurable options are saved to the configuration file.

PEC Byte

The MAX17823H EV kit software supports packet-error checking (PEC) by implementing a CRC-8 algorithm to maintain data integrity with the devices in the daisy chain. The software generates the PEC byte when performing a write to a MAX17823H device and verifies the PEC byte received from the devices after a read operation. The software makes this algorithm available as a PEC calculator, which is found under the **Tools** menu. Figure 18 shows the PEC calculator.

Detailed Description of Hardware

The MAX17823H evaluation kit (EV kit) demonstrates the capabilities of the MAX17823H advanced smart battery-pack controller. Vertical headers (P2-P6) allow for the connection of multiple EV kits, supporting the maximum 32-device daisy-chain capability.

The MAX17823H device can be configured to operate with 3–12 battery cells. The cells can be directly connected to the EV kit or can be routed through header P1. See the *Battery Cells* section. The EV kit also facilitates utilizing the auxiliary pins and accessing the general-purpose input/output (GPIO) pins.

Device Startup

To start the EV kit, apply at least 9V across the PACK+ and PACK- PCB pads and then follow the startup sequence below:

1) Connect a pack voltage across the PACK+ and PACK- pads.

2) Connect a battery voltage across the BAT0–BAT12 pads (battery cells or external power supply).

3) Connect the MINIQUSB command module to the MAX17841EV kit's J3 and J4 headers.

4) Using the provided USB cable, connect the MINIQUSB command module to a PC.

5) Start the MAX17823EV kit software.

6) Ensure that the **MAX17841 $\overline{\text{SHDN}}$** checkbox on the MAX17823 software is not checked.

7) Click the **Wake Up** button on the **Initialization** tab in the MAX17823 software.

Note: The $\overline{\text{SHDN}}$ pin of the MAX17841 device is pulled up to +3.3V by the MINIQUSB's K1 GPIO pin.

Once the wake-up routine is completed, the $\overline{\text{SHDN}}$ pin of each device on the daisy chain should rise to approximately 8.5V. The devices are now enabled and ready for communication.
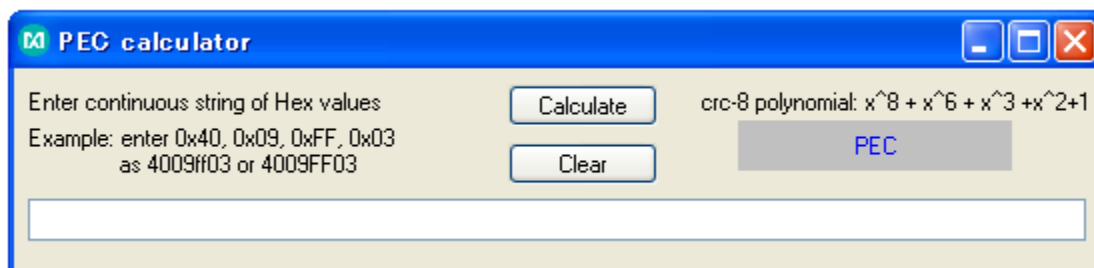

Figure 18. PEC Calculator

Battery Cells

When evaluating the MAX17823H EV kit, the cell stack voltage is provided by cascading 3–12 battery cells or by applying a DC voltage between the BAT0-BAT12 pads. The following sections explain how to configure the EV kit and connect the battery cells.

Cell Configuration

1) Configure switch SW1 according to Table 14.

2) When using a DC power supply, the cascaded 2kΩ resistors provide divided-down voltages to the cell input pins. This, in effect, emulates the connection of 12 battery cells.

3) Configure jumpers CELL1–CELL12 according to the number of battery cells (actual or emulated) that are connected to the system (see Table 15).

Cell Connections

When using actual or emulated battery cells, keep in mind the following cell-connection requirements (see Table 16 for an 8-cell example):

- A minimum of three cells must be connected to each MAX17823H device.

- A maximum of 12 cells can be connected to each MAX17823H device.

- The BAT0_ to BAT1_ cell inputs must always be populated with a battery cell.

- The remaining cells are populated between BAT 1_ and BAT 2_, BAT 2_ and BAT 3_, and so on, until all cells are connected.

- All unused cell inputs must be shorted together, using the appropriate CELL2–CELL12 jumpers.

When DC power supplies are used to emulate battery cells, set its output in the range from 9V to 60V. Connect the power supplies between the PACK+ and PACK- pads and ensure that a shunt is installed on jumpers JU14 and JU19.

When using actual battery cells, connect them across the appropriate BAT_ pads, or route them through the P1connector.

Table 14. Switch SW1 Description

SW1	CELL-STACK VOLTAGE	CONNECTION
All off*	2–12 battery cells	Cells cascaded between BAT0 and BAT12
All on	DC power supply to emulate battery	See step 10 in the *Quick Start*, *Procedure* section

Default position.

Table 15. Jumpers JU2–JU12and JU102–JU112 Description

NO. OF CELLS	SHUNT POSITION										
	CELL 2	CELL 3	CELL 4	CELL 5	CELL 6	CELL 7	CELL 8	CELL 9	CELL 10	CELL 11	CELL12
3	Off	Off	On	On	On	On	On	On	On	On	On
4	Off	Off	Off	On	On	On	On	On	On	On	On
5	Off	Off	Off	Off	On	On	On	On	On	On	On
6	Off	Off	Off	Off	Off	On	On	On	On	On	On
7	Off	Off	Off	Off	Off	Off	On	On	On	On	On
8	Off	Off	Off	Off	Off	Off	Off	On	On	On	On
9	Off	Off	Off	Off	Off	Off	Off	Off	On	On	On
10	Off	Off	Off	Off	Off	Off	Off	Off	Off	On	On
11	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	On
12*	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off

Default position.

Table 16. 8-Cell Connection

CELL	+ TERMINAL	- TERMINAL
1	BAT1_	BAT0_
2	BAT2_	BAT1_
3	BAT3_	BAT2_
4	BAT4_	BAT3_
5	BAT5_	BAT4_
6	BAT6_	BAT5_
7	BAT7_	BAT6_
8	BAT8_	BAT7_
—	BAT9_shorted to BAT8_	
—	BAT10_shorted to BAT9_	
—	BAT11_shorted to BAT10_	
—	BAT12_shorted to BAT11_	

Table 17. Header P1 Cell Connections

CELL	+ TERMINAL	- TERMINAL
1	P1-1	P1-3
2	P1-3	P1-5
3	P1-5	P1-7
4	P1-7	P1-9
5	P1-9	P1-11
6	P1-11	P1-13
7	P1-13	P1-15
8	P1-15	P1-17
9	P1-17	P1-19
10	P1-19	P1-21
11	P1-21	P1-23
12	P1-23	P1-25

Daisy-chain

The MAX17823H includes a UART bus system that allows cascading of up to 32 MAX17823H devices. The EV kit facilitates device cascading by routing the UART bus between the P2/P3 and P5/P6 connectors. These connectors are used to cascade multiple EV kit boards together. See Table 18 – Table 21.

Table 18 – Table 21 provide the complete pinouts for the interboard connectors provided on the EV kit.

Table 18. Header P2

PIN	NET
1	TXUN_A
2	TXUP_A

Table 19. Header P3

PIN	NET
1	RXUN_A
2	RXUP_A

Table 20. Header P5

PIN	NET
1	TXLP_A
2	TXLN_A

Table 21. Header P6

PIN	NET
1	RXLP_A
2	RXLN_A

Auxiliary Inputs

The auxiliary inputs of the MAX17823H devices are routed to jumpers JU0 and JU1. This allows the auxiliary analog inputs to be used to measure external resistance temperature detector (RTD) components. A negative temperature coefficient (NTC) RTD can be configured with the AUXIN1 or AUXIN2 analog inputs to accurately monitor module or battery-cell temperature. When the auxiliary inputs are not used, a shunt can be installed on its associated jumper, providing a known pin state (AGNDA).

MINIQUSB Command Module

The MINIQUSB command module is powered by the host PC's USB port. Refer to the MINIQUSB User Guide for additional information. See Table 23 for a pin-to-pin association between the MINIQUSB command module and the EV kit's J3 header

16-Pin Header Footprints

The following tables provide the complete pinouts for each of the 16-pin single-row headers (J1-J4) provided on the EV kit. Between the headers is a MAX17823H device that is fanned out to the four 16-pin headers.

J4 and J5 Headers

The J4 and J5 header footprints provide direct access to the MAX17823H IC.

Table 22. Auxiliary Jumpers

AUXILIARY INPUT (DEVICE)	JUMPER*
AUXIN1A (U1)	JU0
AUXIN2A (U1)	JU1

To use the auxiliary input, remove the shunt from the jumper.

Table 23. MAX17841 EV kit's J3 Header

PIN	NAME
1	GND
2	INT
3	GPIO7
4	COMP_OUT
5	GPIO8
6	ALRMUV/
7	DIN
8	ALRMOV/
9	CS/
10	MCLR/
11	SCLK
12	USHDN/
13	DOUT
14	NC
15	VDD
16	NC

Table 24. HeadersJ1–J4

PIN NO.	PIN NAME			
	J1	J2	J3	J4
1	NC	GPIO0	SW0	SW8
2	AGND	NC	C0	C8
3	SHDNL/	NC	SW1	SW9
4	AGND	TXLP	C1	C9
5	VAA	TXLN	SW2	SW10
6	TXUN	VDDL2	C2	C10
7	TXUP	GNDL2	SW3	SW11
8	GNDL1	RXLP	C3	C11
9	VDDL1	RXLN	SW4	SW12
10	GNDL3	NC	C4	C12
11	VDDL3	NC	SW5	VBLKP
12	RXUN	CTG	C5	NC
13	RXUP	AUXIN2	SW6	HV
14	GPIO3	AUXIN1	C6	DCIN
15	GPIO2	AGND	SW7	CPP
16	GPIO1	THRM	C7	CPN

Test Procedures:

Overvoltage and Undervoltage Threshold Testing

With the ASIC communicating normally to the host in a single ASIC configuration, configure the OV and UV set and clear thresholds in the **Thresholds** tab and check if the appropriate alerts are set. The detailed procedure is as follows:

A variable 80V, 10A power supply is used to power the MAX17823H. Set initial module voltage to 36V (3V/cell).

Test Procedure:

1) ASIC is ready to measure (cell measurement channels enabled, device addresses configured).

2) Start measurement.

3) Read cell voltages.

4) Confirm cell voltages are as expected by clicking **F8 (Refresh Active Tab)** button.

5) Confirm that STATUS/ ALRTCell/ ALRTOVCell/ ALRTUVCell registers read 0x0000 by selecting them and reading the register values (click **F8** button to read them).

6) In the **Thresholds** tab, OVTHRSET (Overvoltage Set) is configured to 4.2V, OVTHRCLR (Overvoltage Clear) is configured to 3.8V, UVTHRSET (Undervoltage Set) is configured to 2.4V, and UVTHRCLR (Undervoltage Clear) is configured to 2.7V.

7) After writing these values in the appropriate boxes, click the adjacent **Configure All Devices** button.

8) Select the registers and confirm the values are written appropriately in the registers by clicking the **F8** button.

9) In the **Enables** tab, click **Set All** buttons for **Overvoltage Alert Enables** and **Undervoltage Alert Enables** and then click the **Configure All Devices** button.

10) Select the ALRTOVEN and ALRTUVEN registers and confirm the registers are updated appropriately by clicking **F8** button.

11) Increase the supply voltage steadily up to 52V so that each cell reads 4.33V (> 4.2V).

12) Refresh the new readings on the **Voltage Measurements** tab.

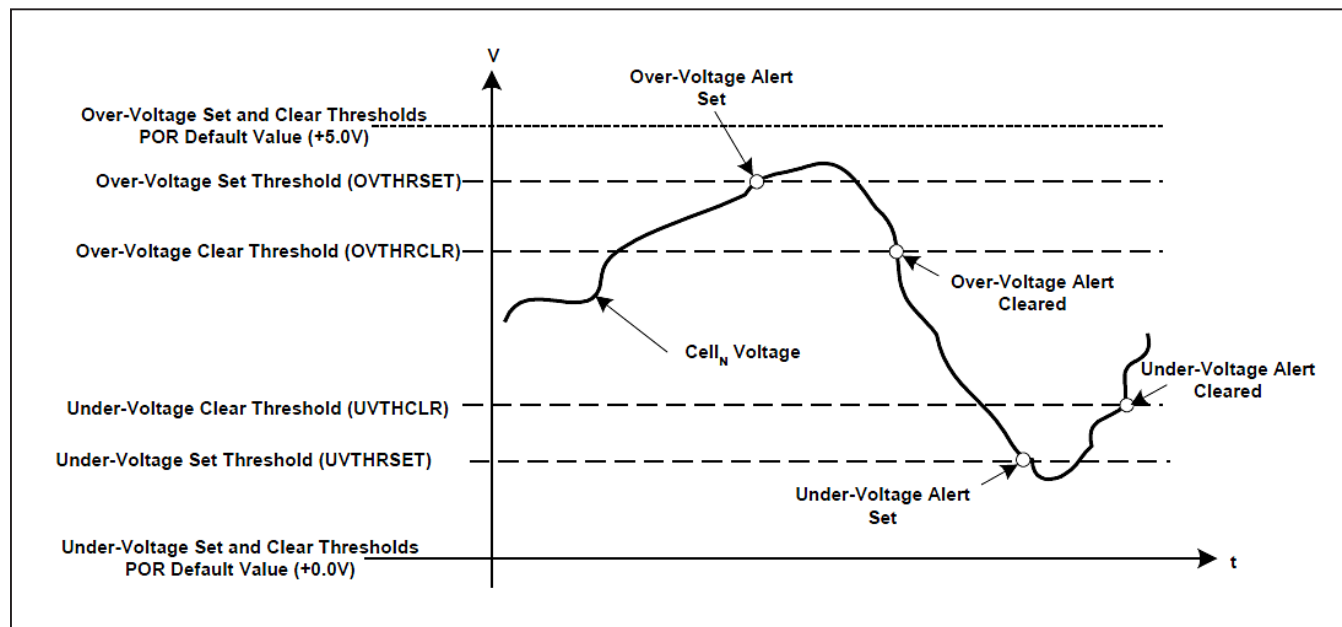13) Open the **Alert/Status** tab and click the **F8** button.

Figure 19. Programmable OV and UV Thresholds Diagram

14) The ALRTOV bit in the Status register should be set to 1. Also, all the OV bits (OV1 to OV12) in the ALR-TOVCELL register should be set to 1 and bits AL1 to AL12 in the ALRTCELL register should be set to 1.

15) In the **DC Byte** box, OV flag also sets to 1 in the Datacheck byte.

16) Steadily decrease the supply voltage to 42V (3.5 Volts/cell).

17) Repeat steps 12 and 13.

18) The ALRTOV bit in the Status register should be cleared to 0. Also, all the OV bits (OV1 to OV12) in the ALRTOVCELL register should be cleared and bits AL1 to AL12 in the ALRTCELL register should be cleared to 0.

19) In the **DC Byte** box, OV flag also gets cleared to 0 in the Datacheck byte.

20) Decrease the supply voltage steadily down to 24V so that each cell reads 2.0V (< 2.4V).

21) Refresh the new readings on the **Voltage Measurements** tab.

22) Open the **Alert/Status** tab and click the **F8** button.

23) The ALRTUV bit in the Status register should be set to 1. Also, all the UV bits (UV1 to UV12) in the ALRTUVCELL register should be set to 1 and bits AL1 to AL12 in the ALRTCELL register should be set to 1.

24) In the **DC Byte** box, UV flag also sets to 1 in the Datacheck byte.

25) Steadily increase the supply voltage to 36V (3.0 Volts/cell)

26) Repeat steps 12 and 13.

27) The ALRTUV bit in the Status register should be cleared to 0. Also, all the UV bits (UV1 to UV12) in the ALRTUVCELL register should be cleared and bits AL1 to AL12 in the ALRTCELL register should be cleared to 0.

28) In the **DC Byte** box, UV flag also gets cleared to 0 in the Datacheck byte.

This verifies the OV/UV Set and Clear thresholds for MAX17823. The Overvoltage or Undervoltage alert in the **Enables** tab can be selected for any specific cell.

Cell Balancing and Watchdog Timer Testing:

With the ASIC communicating normally to the host in a single-ASIC configuration, cell balancing and watchdog timer configuration are tested. The detailed procedure is as follows:

Connect 12 Li-Ion cells to the MAX17823H device. Set module voltage to 45.55V

Use software revision R342 for this testing.

Test Procedure:

1) ASIC is ready to measure (cell measurement channels enabled, device addresses configured).

2) Confirm cell voltages are as expected by clicking the **F8** button on the **Voltage Measurements** tab.

3) Open the **BALSW** tab and click **Check Odd** button under the BALSWEN title.

4) Click **Configure All Devices** button.

5) Confirm that the BALSWEN register reads 0x0555 by selecting it and reading the register value (click **F8** button to read) in the **BALSW** tab. All of the odd cell balancing switches will be turned on.

6) Open the **Voltage Measurement** tab and read the voltages by clicking the **F8** button.

7) All of the odd cell voltages will drop by a few mV. (This drop depends on battery impedance and the parasitic I x R drop in the path of that measurement. On Maxim EV kits, this drop is approximately 80 to 100 mV).

8) Open the **BALSW** tab and click **Check Even** button under the BALSWEN title.

9) Cick the **Configure All Devices** button.

10) Confirm that the BALSWEN register reads 0x0AAA by selecting it and reading the register value (click the **F8** button to read) in the **BALSW** tab. All of the even cell balancing switches will be turned on.

11) Open the **Voltage Measurement** tab and read the voltages by clicking **F8** button.

12) All even cell voltages will drop by a few mV. (This drop depends on battery impedance and the parasitic I x R drop in the path of that measurement. On Maxim EV kits, this drop is approximately 80 to 100 mV).

13) Open the **Configuration** tab and select a timer pre-divider value from the drop-down list in the **Watch Dog Configuration** box. For example, 1 sec[range = 1 to 15sec].

14) Write the timer value as 15(0xF) in the **Watch Dog Configuration** box.

15) Click the **Configure All Devices** button and confirm that the WATCHDOG register reads the appropriate value based on pre-divider and timer configuration (in this case, it should read 0x1F00) by selecting it and reading the register value (click the **F8** button to read) in the **Configuration** tab.

16) Click the **F8** button periodically to see the timer value steadily go from 0xF to 0x0. In this case, the timer is set to 15 seconds and the cell balancing is turned off after the amount of time set by the user.

17) After the timer reaches 0, open the **Voltage Measurement** tab and click the **F8** button to read cell voltages. They should have returned to their initial values, indicating that the cell balancing has been turned off by the timer.

Note: The cell balancing timeout feature consists of a 4-bit countdown timer and a pre-divider with three control bits for range selection. Both the timer and pre-divider are programmed through the MSB of the WATCHDOG register. The pre-divider sets the effective LSb time of the counter-timer. If the value of the CBTIMER does reach zero, the cell balancing switches are disabled until the timer is either disabled or is refreshed by writing a non-zero value.

Die Temperature Diagnostic Testing

With the ASIC communicating normally to the host in a single ASIC configuration, perform the die temperature diagnostic test. The detailed procedure is as follows:

Connect 12 Li-Ion cells to the MAX17823H device. Set module voltage to 45.55V

Test Procedure:

1) ASIC ready to measure (cell measurement channels enabled, device addresses configured).

2) Confirm cell voltages are as expected by clicking **F8** button on **Voltage Measurements** tab.

3) In the **Voltage Measurements** tab, click **mode** button above the DIAG check box.

4) A new pop-up window will appear with the diagnostic measurement mode.

5) Select **Die Temp** option and click **Configure All Devices** button.

6) Make sure the DIAG register is checked so that it can be read by clicking **F8** button.

7) The user will see the result in °C below the DIAG register.

8) In this case, since the part was tested at room temperature, the DIAG showed a value of 21.86°C.

Open Sense Leads

With the ASIC communicating normally to the host in a single ASIC configuration, randomly force an open on a particular cell input, or a set of cell inputs. Then how all cell voltage measurements are affected is noted down with and without using the BALSW diagnostics.

12 Li-Ion cells were connected to MAX17823H device. Set module voltage to 45.55V

1) Results with device configured for standard measurement path (no diagnostics enabled):

   Test Procedure:

   a) ASIC is ready to measure (cell measurement channels enabled, device addresses configured).

   b) Start measurement.

   c) Read cell voltages.

   d) Confirm cell voltages are as expected.

   e) Apply open sense wire condition as specified.

   f) Start measurement.

   g) Read cell voltages.

   Note: Input voltage is floating in this case, so measurement values will not be determinant. Diagnostic test is run to definitively detect this fault.

   ● Sub-test1: C0 and AGND: Cell 1 measurement goes to 0 volts

   ● Sub-test2: C12 and DCIN: Cell 12 measurement goes to 0 volts.

   ● Sub-test3: C1: Cell 1 measures 4.9988 V while cell 2 goes to 2.45 V.

   ● Sub-test4: C4: Cell 4 measures 2.02 V while cell 5 voltage is observed to be 4.9988V

   ● Sub-test5: C8: Cell 8 measures 1.62 V while cell 9 voltage is observed to be 4.9988V

2) Results using cell-sense wire open diagnostic:

 Test Procedure:

a) ASIC is ready to measure (cell measurement channels enabled, device addresses configured).Start measurement

b) Read cell voltages.

c) Confirm cell voltages are as expected.

d) Read FMEA register and check ALRTBALSW = 0.

e) Read STATUS register and check ALRTFMEA = 0.

f) Apply open sense wire condition as specified.

g) Enable the BALSWDIAG [2:0] first to a setting of 101 (open odd switches) and then to 110 (open even switches) in the SCANCTRL (0x013) register. Cell-sense wire odd check combined with cell-sense wire even check indicates to the user which cell-sense wire is in open condition.

h) Write BALLOWTHR to [0x84AC] and BAL-HIGHTHR to [0xA8F4].

The preceding values were chosen as typical Vds = 0.75V using the 150mA balancing current and 5Ω worst-case RON. The 0xA8F4 ➔ 800mV threshold, while the 0x84AC ➔ 150mV threshold.

i) Start measurement and read cell voltages (click the **F8** button when the **Voltage Measurement** tab is active in EV kit software)

i. Read the FMEA register and check ALRTBALSW = 1

ii. Read the STATUS register and check that ALRTFMEA = 1

j) Read the ALRTBALSWCELL register and check ALRTBALSWn = 1, where n is the sense line number that is open.

k) Read cell voltages.

Sub-test1: C0 and AGND

Note: For C0 and AGND open test, a Schottky diode was added in parallel with the C0/C1 ESD diode on the EV kit to allow return current path through C1.

Cell No	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12
Voltage (Volts)	2.48	0.00	2.77	0.00	2.77	0.00	2.77	0.00	2.80	0.00	2.77	0.00

• ALRTFMEA in STATUS register set to 1.

• ALRTBALSW in FMEA register set to 1.

• ALRTBALSW1 in ALRTBALSW register set to 1.

Sub-test2: C12 and DCIN

Cell No	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12
Voltage (Volts)	0.00	2.77	0.00	2.77	0.00	2.77	0.00	2.77	0.00	2.75	0.00	2.49

• ALRTFMEA in STATUS register set to 1.

• ALRTBALSW in FMEA register set to 1.

• ALRTBALSW12 in ALRTBALSW register set to 1.

Sub-test3: C1

Cell No	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12
Voltage (Volts)	2.56	0.00	2.78	0.00	2.77	0.00	2.80	0.00	2.77	0.00	2.78	0.00

• ALRTFMEA in STATUS register set to 1.

• ALRTBALSW in FMEA register set to 1.

• ALRTBALSW1 in ALRTBALSW register set to 1.

Sub-test4: C4:

Cell No	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12
Voltage (Volts)	0.00	2.78	0.00	2.54	0.00	2.77	0.00	2.77	0.00	2.75	0.00	2.77

- ALRTFMEA in STATUS register set to 1.
- ALRTBALSW in FMEA register set to 1.
- ALRTBALSW4 in ALRTBALSW register set to 1.

Sub-test5: C8:

Cell No	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12
Voltage (Volts)	0.00	2.77	0.00	2.77	0.00	2.77	0.00	2.54	0.00	2.75	0.00	2.49

- ALRTFMEA in STATUS register set to 1.
- ALRTBALSW in FMEA register set to 1.
- ALRTBALSW8 in ALRTBALSW register set to 1.

Ordering Information

PART	TYPE
MAX17823HEVKIT#	EV Kit

#Denotes RoHS compliant.

MAX17823H EV Kit Bill of Materials

REF_DES	QTY	DESCRIPTION	MFG PART #	MFG
C2, C84, C102	4	0.47µF ±10%, 16V X7R ceramic capacitor (0603)	C1608X7R1C474K	TDK
C3	1	1µF ±10%, 16V X7R ceramic capacitor (0603)	GRM188R71C105K	MURATA
C5	1	2.2µF ±10%, 100V X7R ceramic capacitor (1210)	GRM32ER72A225K	MURATA
C23	1	4.7µF ±10%, 50V X7R ceramic capacitor (1210)	GRM32ER71H475KA88L	MURATA
C6-C17, C25	37	0.1µF ±10%, 100V X7R ceramic capacitor, automotive grade (0805)	GCM21BR72A104KA37L	MURATA
C41-C52, C67-C78	37	0.1µF ±10%, 100V X7R ceramic capacitor, automotive grade (0805)	GCM21BR72A104KA37L	MURATA
C24	1	0.1µF ±10%, 100V X7R ceramic capacitor automotive grade (0603)	GCM188R72A104KA64D	MURATA
C18, C19, C20	3	100pF ±5%, 50V C0G ceramic capacitor (0402)	GRM1555C1H101J	MURATA
C21	1	1000pF ±10%, 25V X7R ceramic capacitor, automotive grade (0603)	GCM188R71E102K	MURATA
C40	1	1µF ±10%, 100V X7R ceramic capacitor (1206)	GRM31CR72A105K	MURATA
C53, C54, C79, C81	4	15pF ±5%, 100V C0G ceramic capacitor, automotive grade (0603)	GCM1885C2A150J	MURATA
C1, C57, C58, C83	4	2200pF ±5%, 630V C0G ceramic capacitor, auto grade (1206)	CGA5H4C0G2J222J	TDK
C27	1	0.47µF ±10%, 100V X7S ceramic capacitor, automotive grade (0805)	CGA4J3X7S2A474K/SOFT	TDK
C1001, C1002, C1003	3	0.1µF ±10%, 50V X7R ceramic capacitor (0603)	GRM188R71H104K	MURATA
D14, D27	2	Unidirectional ESD protection diode (SOD323)	PESD5V0U1UA	NXP
D1, D2, D7, D11	4	ESD protection diode (SOT-23)	PESD1CAN	NXP
D9, D10, D12, D13	4	1A, 150V diode POWERDI®123	DFLS1150-7	DIODES INC
D28,D29	2	Dual switching common cathode diode	BAV70LT3	ON
J5	1	26-pin dual row (2x13) header (0.1in centers)	PEC36DAAN	SULLINS
JU0-JU3, JU14-JU19, CELL2-CELL12	21	2-pin header (0.1in centers)	PEC36SAAN	SULLINS
L1, L2	2	2-Line common-mode filter (SMD)	ACT45B-101-2P	TDK
P1	1	15-circuit CLIK-Mate vertical PCB receptacle, 1.50mm pitch	5025841570	MOLEX
P2, P3, P5, P6, P8,P9	6	2-circuit CLIK-Mate vertical PCB receptacle, 1.50mm pitch	5025840270	MOLEX
R1	1	100Ω ±5% resistor (1206)		
R2	1	1kΩ ±5% resistor (0603)		
R3-R15	13	1kΩ ±1%, resistor (0603)		
R16-R27,R30,R80,R87-R92,R96,R100,R102-R104,R107,R113-R125	39	12Ω, 0.5W resistor (1210)	CRCW251212R0F	VISHAY/DALE
R28, R29, R56, R57, R60, R61, R64, R65, R75, R76	10	10kΩ ±1%, resistor (0603)		
R32, R33, R34, R35	4	150kΩ ±5% resistor (0402)		
R36-R39, R79, R95, R105, R106, R111, R1016	10	0Ω resistor (0603)		
R40, R62, R63, R66	4	100kΩ ±5%, resistor (0603)		
R42-R53	12	2.0kΩ ±0.1% resistor (0805)	ECG ERA-6YEB202V	PANASONIC
R31, R41, R58, R59	4	100Ω ±1% resistor (1206)		
R54, R55, R77, R78, R67, R68, R70, R72	8	26.1Ω ±1% resistor (1206)		
R69, R71, R83-R86, R93, R94	8	0Ω resistor (1206)		
R73, R74, R81, R82	4	1.5kΩ ±1% resistor (1206)		
R110	1	10.0Ω ±1% resistor (0805)	ERJ-6ENF10R0V	PANASONIC
SW1	1	12-position SPST DIP switch	CTS 206-12ST	

MAX17823H EV Kit Bill of Materials (continued)

REF_DES	QTY	DESCRIPTION	MFG PART #	MFG
DCIN, THRM, VDDL1, VDDL2, VDDL3, VDDL4, VAA, VAA, GPIO3_A, GPIO2_A, GPIO1_A, GPIO0_A, HV, TXUP, TXUN, RXUP, RXUN, TXUP_A, TXUN_A, RXUP_A, RXUN_A, TXLP, TXLN, RXLP, RXLN, TXLP_A, TXLN_A, RXLP_A, RXLN_A, /SHDNL\	30	Multipurpose test point, red	5010	KEYSTONE
AGND (x6)	6	Multipurpose test point, black	5011	KEYSTONE
PACK+, PACK-, BAT0-BAT12, AGND	16	20G tinned copper bus wire formed into "U" shaped loop (0.25" off the PC board)		
U1	1	Daisy-chainable analog front end (64L LQFP)	MAX17823HGCB/V+	MAXIM
U2, U3	2	FMB3906A dual PNP SSOT-6	FMB3906	FAIRCHILD
	21	Shunt	STC02SYAN	SULLINS
C4	0	Not Installed, ceramic capacitor (2220)		
C22	0	Not Installed, ceramic capacitor (1210)		
C28-C39, C65, C66, C85, C86, C87, C90, C91, C100, C101, C103	0	Not Installed, ceramic capacitor (0603)		
C61, C62, C92, C93	0	Not Installed, ceramic capacitor (0805)		
C80, C82, C94, C95	0	Not Installed, 3-terminal capacitor (0805)		
D3, D4, D5, D6	0	Not Installed, Zener diode (SOD123)		
D15-D26	0	Not Installed, unidirectional ESD protection diodes (SOD323)	PESD5V0U1UA	NXP
D30, D31, D32, D33	0	Not Installed, 100V, 1A Schottky diode (SOD123-FL)	MBR1H100SF	ON
D34	0	1A, 150V diode POWERDI®123	DFLS1150-7	DIODES INC
J1, J2, J3, J4	0	Not Installed, 16 -in receptacle (0.1in centers)	SSW-116-01-T-S	SAMTEC
J6	0	Not Installed, 14-pin dual row shrouded (7x2) header (0.1 in centers)	SBH11-PBPC-D07-ST-BK	SULLINS
L3, L4	0	Not Installed, automotive common mode filter		
R98, R99, R108, R109, R1014, R1015, R112	0	Not Installed, resistor (0603)		
R97, R101	0	Not Installed, 0Ω resistor (1206)		
D8	0	Not Installed 500mW, 4.3V Zener diode	MMSZ5229BT1G	ON
D38	0	Not Installed 1A, 100V diode (SMA)	Semiconductor S1B	FAIRCHILD
C26	0	Not Installed 2.2uF ±10%, 100V X7R ceramic capacitor (1210)	GRM32ER72A225K	MURATA
Pack-out	2	CLIK-MATE crossover cable (2-wire) Rev 3	MAXCLICK-MATE	

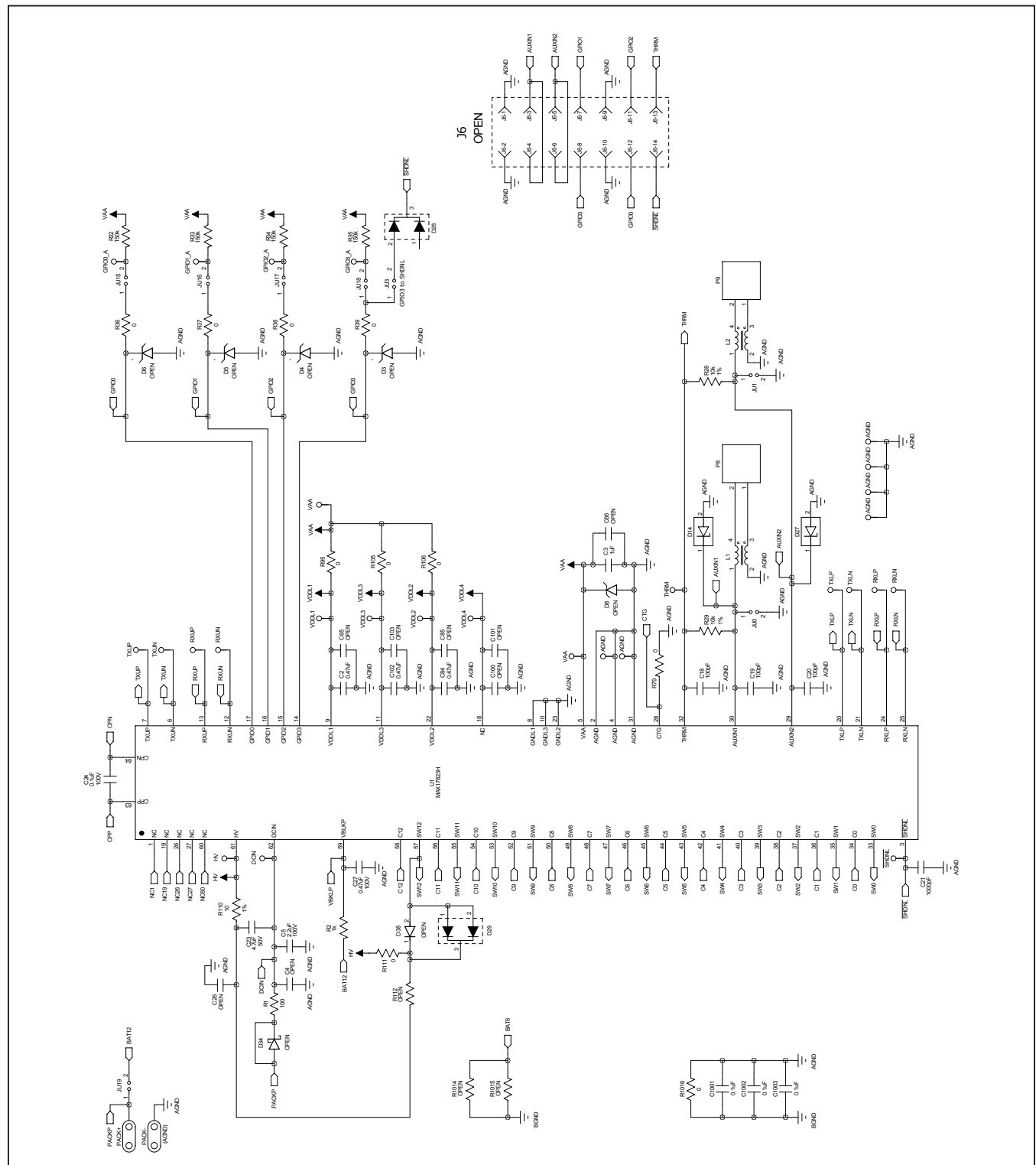## MAX17823H EV Kit Schematics

Figure 20. MAX17823H EV Kit Schematic Page 1

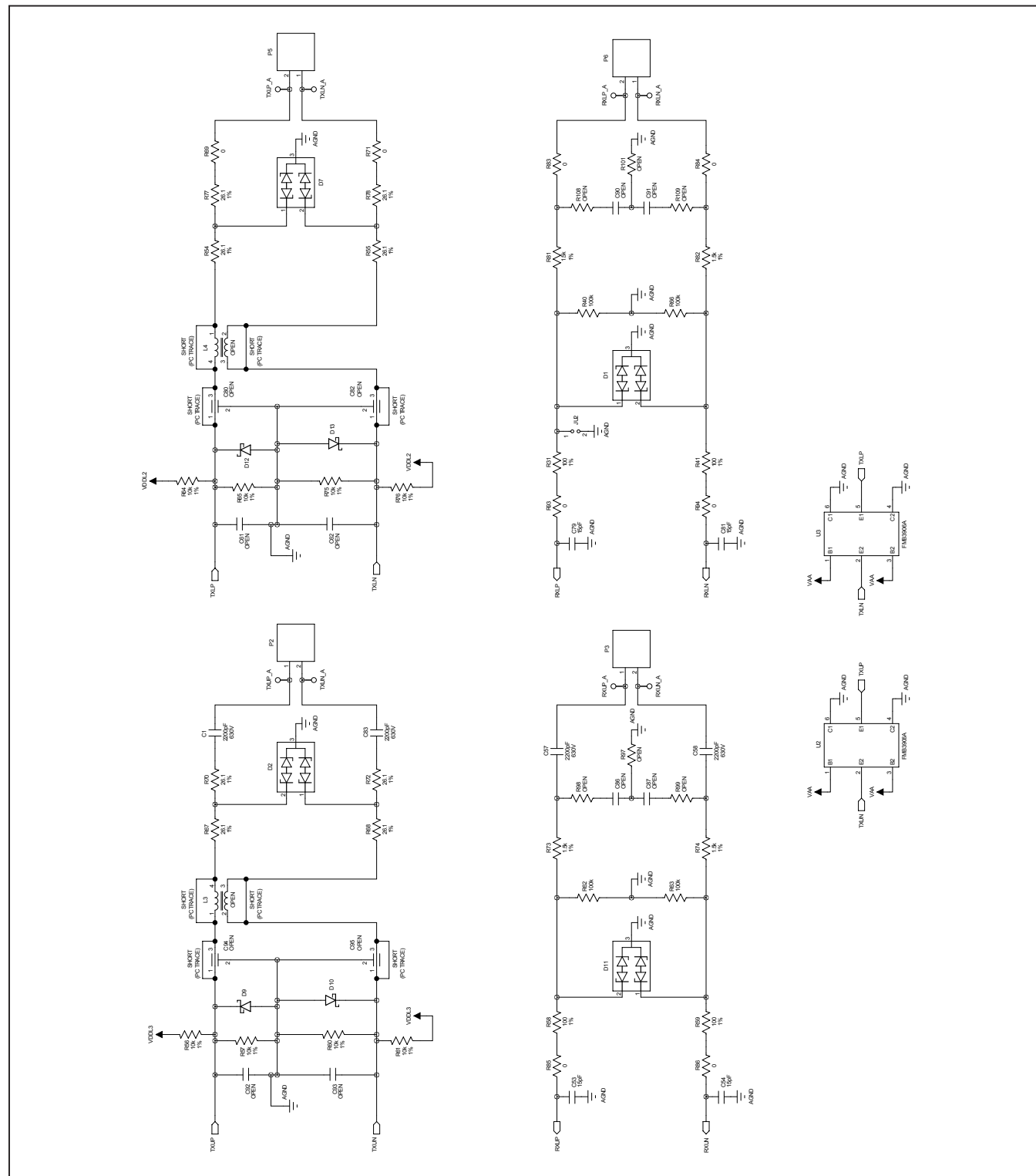## MAX17823H EV Kit Schematics (continued)

Figure 21. MAX17823H EV Kit Schematic Page 2

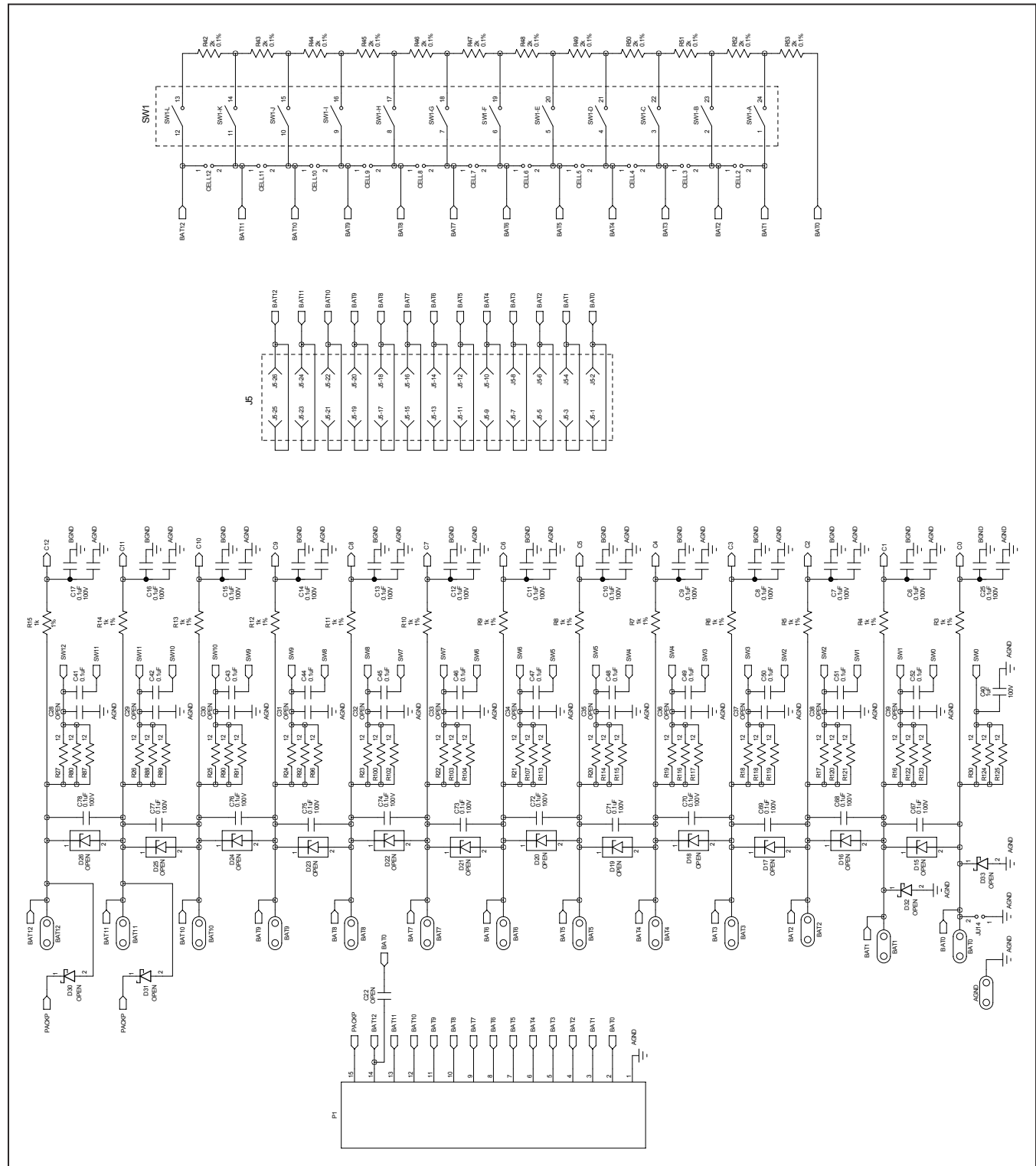## MAX17823H EV Kit Schematics (continued)

Figure 22. MAX17823H EV Kit Schematic Page 3
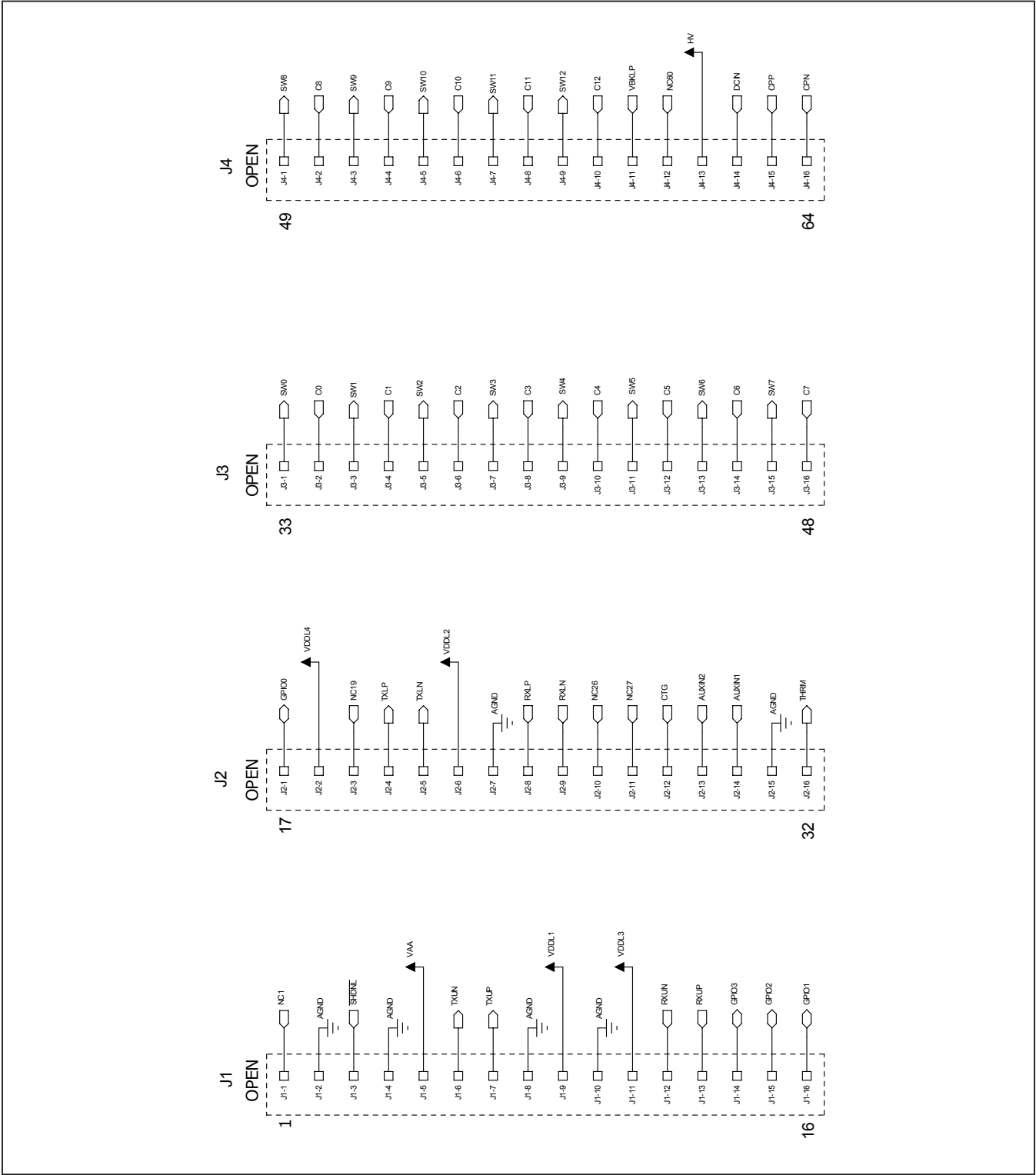
MAX17823H EV Kit Schematics (continued)

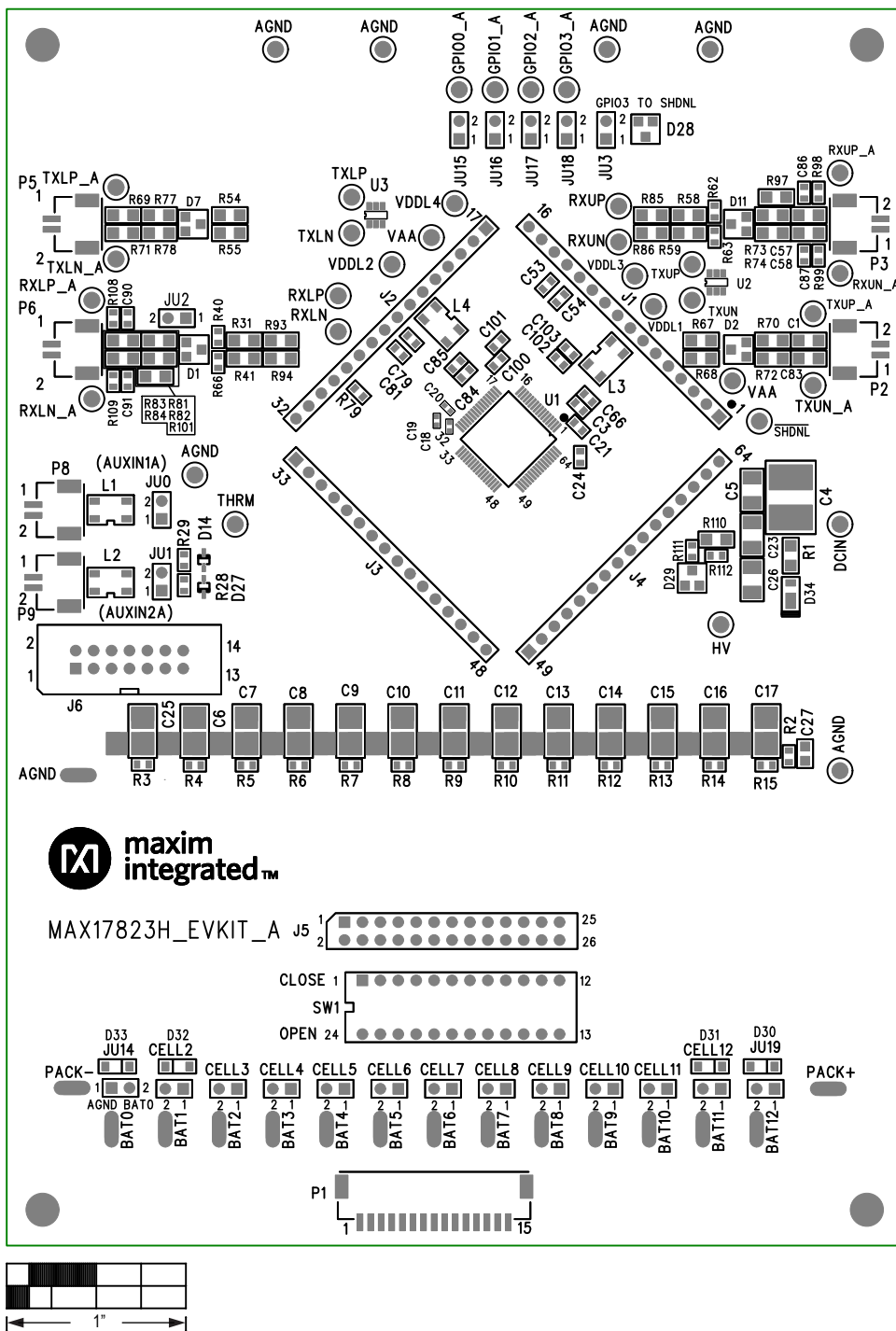*Figure 23. MAX17823H EV Kit Schematic Page 4*

MAX17823H EV Kit PCB Layouts

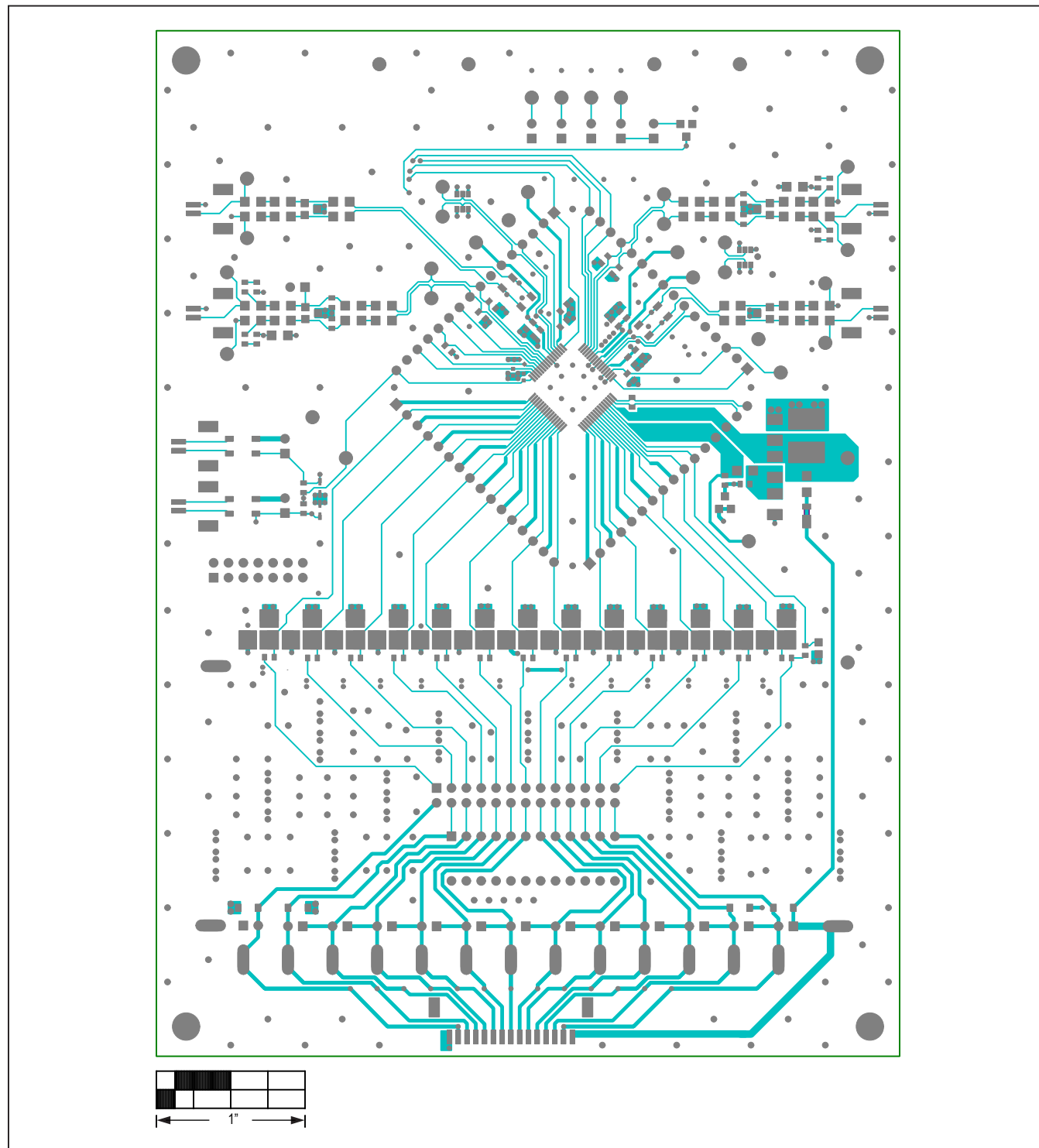*Figure 24. MAX17823H EV Kit PCB Top Layer Silkscreen*

MAX17823H EV Kit PCB Layouts (continued)

Figure 25. MAX17823H EV Kit PCB Top Layer Metal
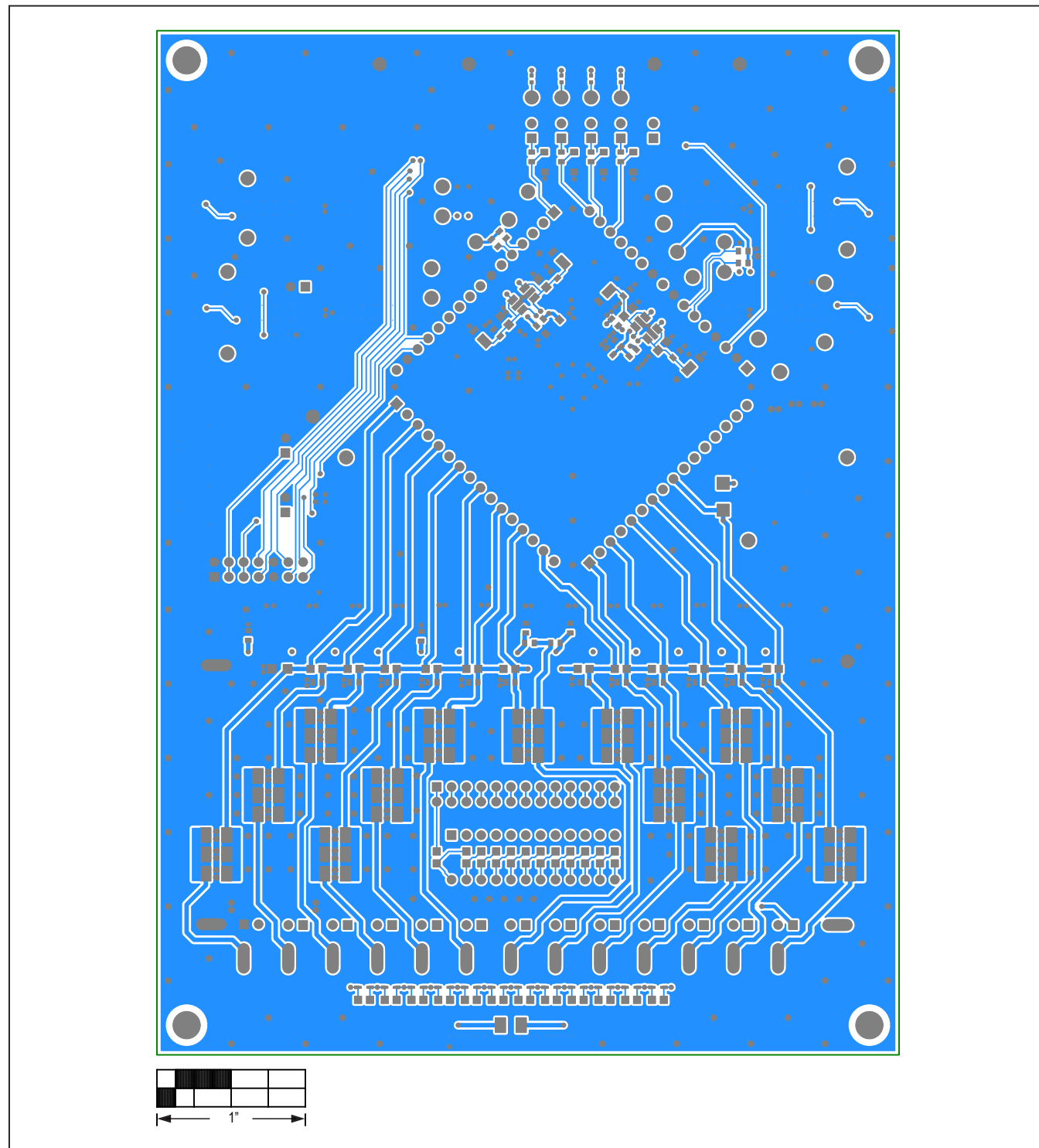
MAX17823H EV Kit PCB Layouts (continued)
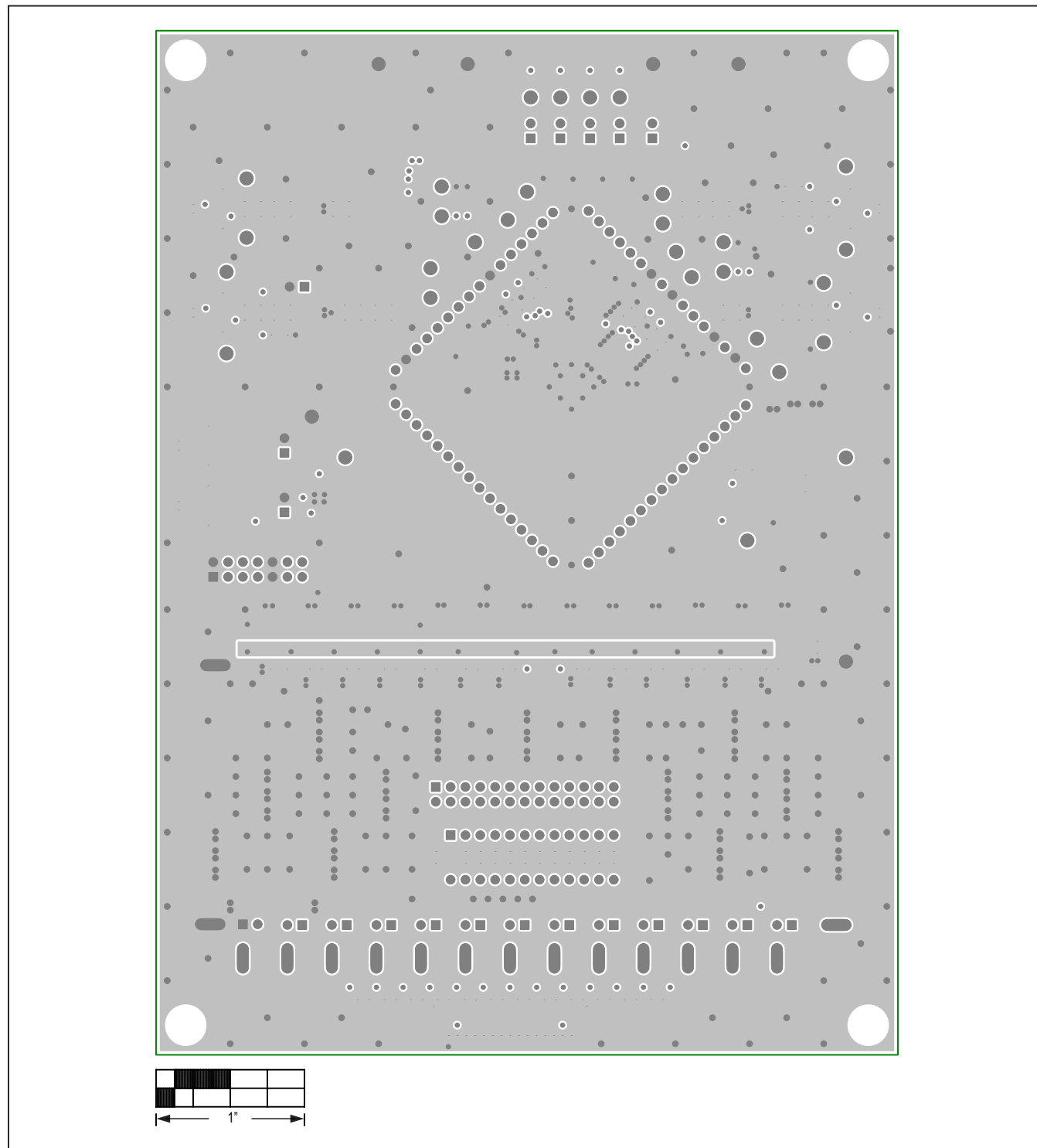
Figure 26. MAX17823H EV Kit PCB Layer Two Metal

MAX17823H EV Kit PCB Layouts (continued)
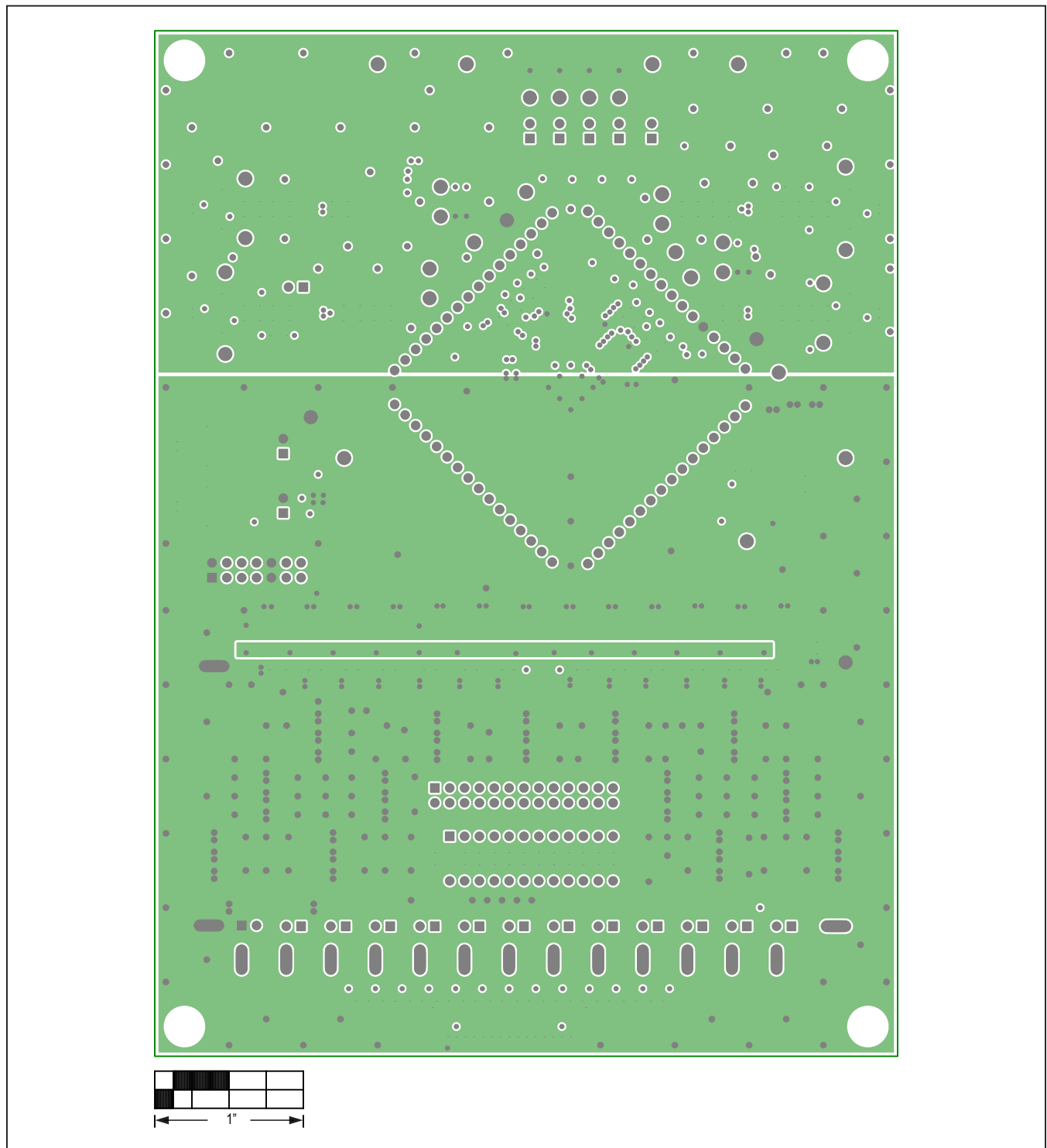
Figure 27. MAX17823H EV Kit PCB Layer Three Metal

MAX17823H EV Kit PCB Layouts (continued)

Figure 28. MAX17823H EV Kit PCB Bottom Layer Metal
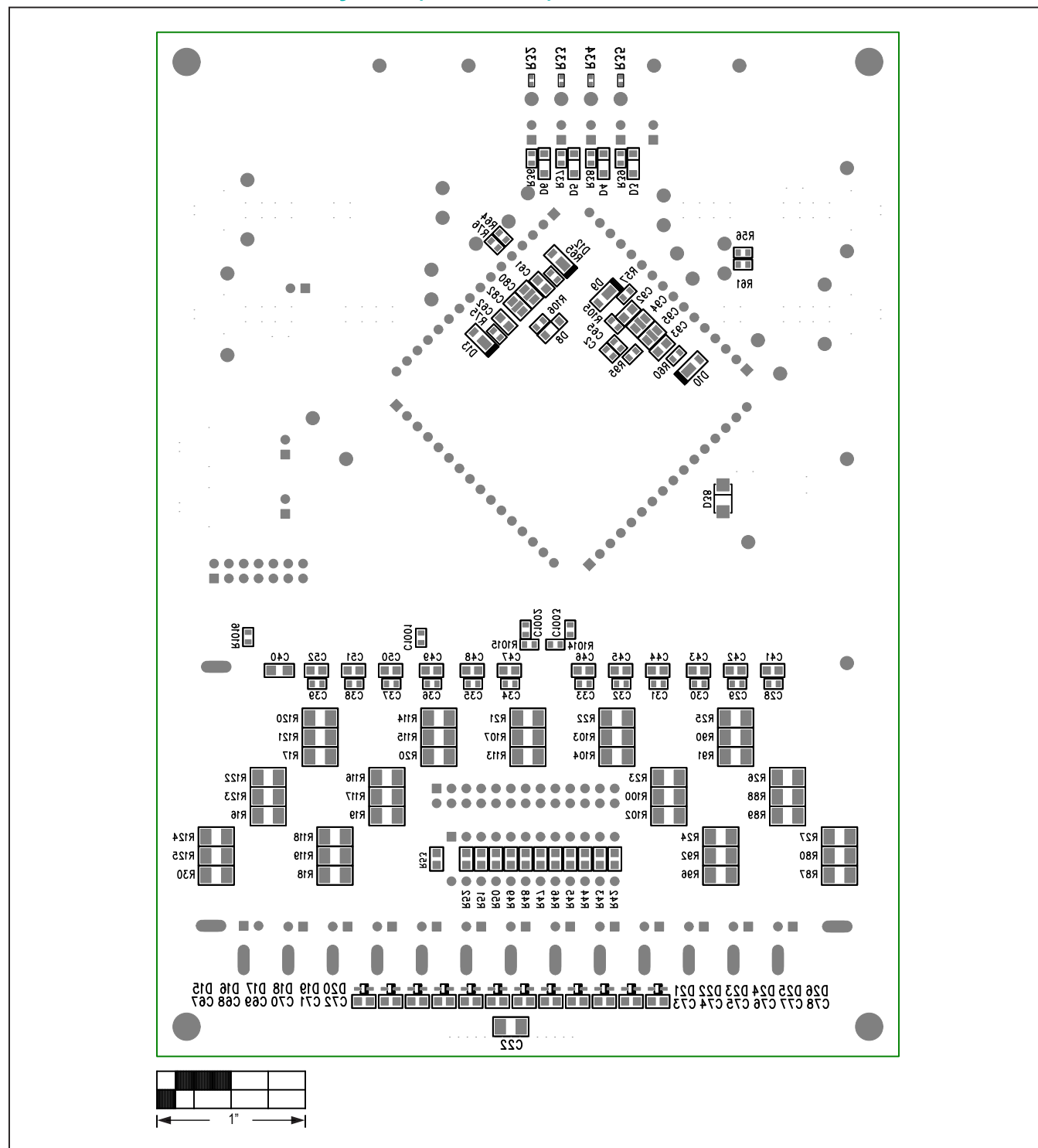
MAX17823H EV Kit PCB Layouts (continued)

Figure 29. MAX17823H EV Kit PCB Bottom Layer Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/19	Initial Release	-
1	5/19	Updated *Ordering Information* section	27

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