MAX17330 Evaluation Kit

General Description

The MAX17330 evaluation kit (EV kit) is a fully assembled and tested surface-mount PCB that evaluates the stand-alone charger, fuel gauge IC with protector and optional SHA-256 authentication for 1 cell lithium-ion/polymer batteries.

The MAX17330 EV kits include the IC evaluation board with integrated I²C interface and USB micro-B cable. Windows® based graphical user interface (GUI) software is available for use with the EV kit and can be downloaded from https://www.maximintegrated.com/MAX17330 product page under **Design Resources** tab. Windows 7 or newer Windows operating system is required to use with the EV kit GUI software.

Benefits and Features

- ModelGauge m5 Algorithm
- Charges, Monitors, and Protects a 1S Battery
- Full Protection Solution On-Board for Evaluation
- Battery Voltage (V_{BATT}) Range of +2.16V to +4.9V with Default Hardware
- Input Voltage up to 5.7V
- Default Current Range -5A (Discharge) to +2.56A (Charge) with 10mΩ Sense Resistor (Higher Currents can be Supported by Changing to a Smaller Sense Resistor)
- 2 Thermistor Measurements
- On-Board I²C Communication Interface with Built-In MAXUSB Interface
- Windows 7 or Newer Compatible Software
- Proven PCB Layout
- Fully Assembled and Tested

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

MAX17330 EV Kit Files

FILE	DESCRIPTION
MAX17330EVKitGUISetup.msi	Installs all EV kit files on a computer

Quick Start

Required Equipment

- MAX17330 Evaluation kit
- Lithium-ion/Polymer cell
- Voltage source/Power supply
- Load circuit
- USB Micro B cable
- PC with Windows 7 or newer windows operating system and USB port

Procedure

Follow the steps to install the EV kit software, make required hardware connections, and start operation of the kits. The EV kit software can be launched without the hardware attached. It automatically recognizes the hardware when connections are made. Note that after communication is established with the IC, it must be configured correctly for proper operation.

1) Visit https://www.maximintegrated.com/MAX17330 page under Design Resources tab to download the latest version of the MAX17330 EV kit software. Save the EV kit software to a temporary folder and unpack the ZIP file.
2) Install the EV kit software on a computer by running the MAX17330EVKitGUISetup.msi program inside the temporary folder. The program files are copied, and icons are created in the Windows **Start** menu. The software requires Windows 7 or a newer operating system. The software requires the .NET Framework 4.5 or later. If you are connected to the internet, Windows automatically updates the .NET framework as needed.
3) Follow the prompts to complete the installation. The evaluation software can be uninstalled in the **Add/Remove programs** tool in the **Control Panel**.
4) The EV kit software launches automatically after installation or alternatively, it can be launched by clicking on its icon in the Windows **Start** menu.

5) Make connections to the EV kit board based on Figure 1. The cell connects between the BATTN/BATTP pads. The load or charger circuit can be connected between the SYSN and SYSP pads at this time as well.
6) Connect the EV kit to a USB port on the PC using the USB cable. Press the PKWK button to wake up the MAX17330. The GUI software establishes communication automatically.
7) At startup, the IC defaults to EZ Configuration. If a custom .INI file for the application is available, it should be loaded at this time.
8) To begin charging, connect a source at SYSP/SYSN. MAX17330 will regulate the voltage and current based on the settings in the Charging Configuration. Connect a resistor or an E-Load to begin discharging the battery.

Detailed Description of Hardware

The MAX17330 EV kit board provides a variety of features that highlight the functionality of the IC. The following sections detail the most important aspects of the EV kit board.

Communication Connections

The USB interface on the PCB establishes I^2C communication between the IC and the software GUI interface. When developing application code separately, connections to the communication lines can be made directly to the board SDA and SCL pins. The user must apply the appropriate external pullup resistors to the communication lines when not using the built-in MAXUSB interface.

Wake buttons

When the MAX17330 is first connected to a cell, the IC will be in a shutdown state. To wake the device, either apply a voltage source across SYSN and SYSP, or if no source or load is connected but a cell is connected, press the PKWK button. When the Pushbutton function is used, the ALRTWK button can be used to pull down the ALRT pin to wake the IC.

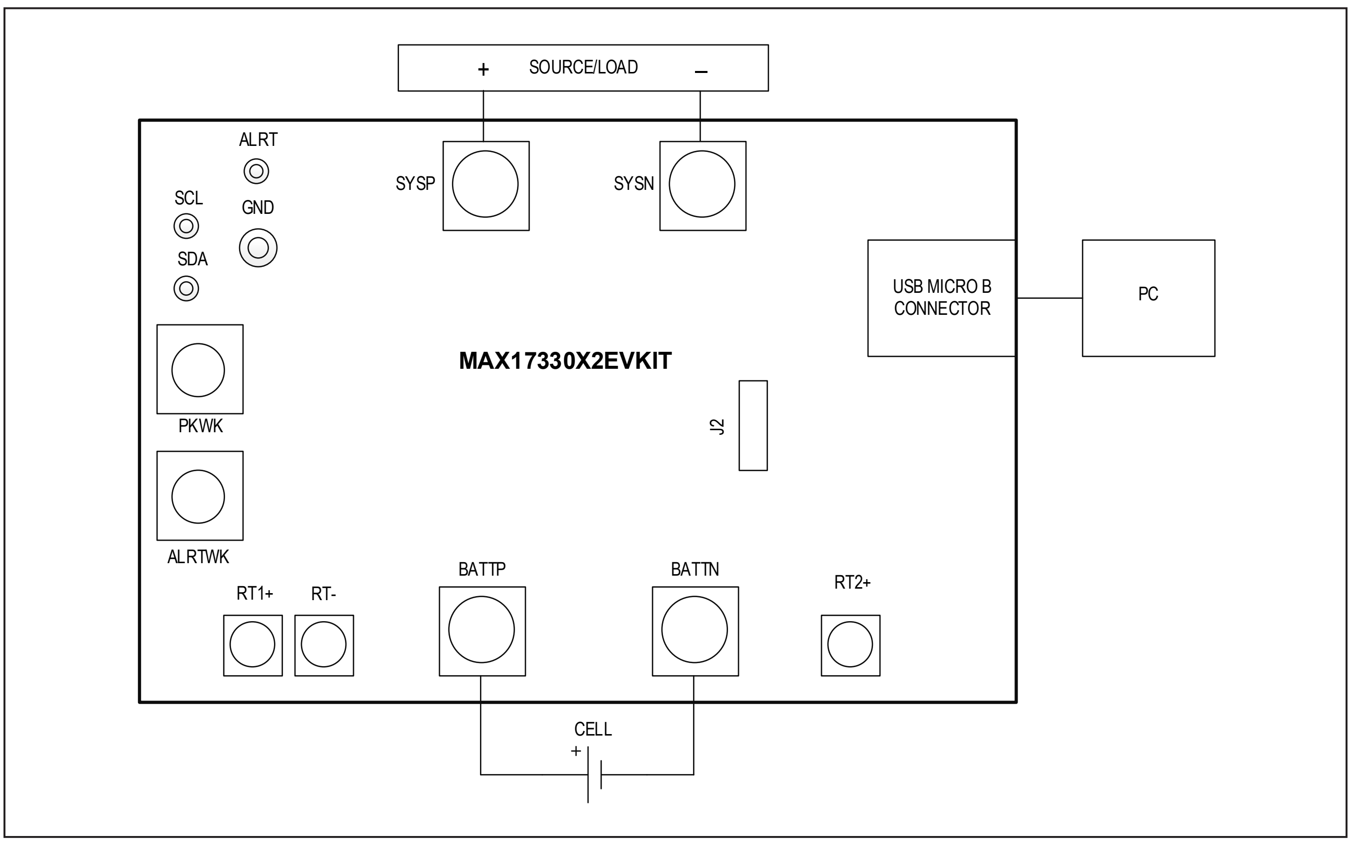


Figure 1. MAX17330 Board Connections

External Thermistor/Zero Volt Charge

The MAX17330 can be configured to use temperature measurements from 1 or 2 external thermistors. All EV kit boards come with 2 thermistors installed as surface mount components RT1 and RT2. If the application requires direct thermal contact to the cells, RT1 can be removed and replaced with a leaded thermistor connected between the RT+/RT- solder pads. RT2 is placed close to the FET Q3 to monitor the FET temperature. JU2 must be selected to TH2 setting to use the second thermistor to measure the FET temperature, or JU2 may be connected to ZVC to charge a cell below MAX17330 V_{UVLO}.

Sense Resistor Options

All EV kit boards are shipped with a 10mΩ 0805-size chip sense resistor installed. Oversized land pattern pads allow for different size sense resistors to be used if desired.

External I²C Interface

J3 is an unpopulated header that may be used to interface the MAX17330 USB interface to a custom board, or to interface a custom I²C master to the MAX17330 on the EV Kit. Cut the traces between the two rows of headers to separate the MAXUSB interface from MAX17330. To interface to a MAX17330 IC on another PCB using the MAXUSB and EV Kit GUI, use the pins on the pin 1 side. To connect to a different I²C master, use the pins on the GND/SCL/SDA silkscreen side. An external pullup must be supplied on SDA and SCL when interfacing with a different master.

Detailed Description of Software

The MAX17330 EV kit software gives the user complete control of all functions of the MAX17330, as well as the ability to load a custom model into the IC. Separate control tabs allow the user access to view real-time updates of all monitored parameters. The software also incorporates a data-logging feature to monitor a cell over time.

After the installation is complete, open the **Program Files (x86)\Maxim Integrated\MAX17330** folder and run **MAX17330.exe** or select it from the **program** menu. Figure 2 shows a splash screen containing information about the EV kit that appears as the program is being loaded.

Communication Port

The EV kit software automatically finds the EV kit when connected to any USB port. Communication status is shown on the right-hand side of the bottom status bar. See Figure 3. If the EV kit cannot be found, a **No USB Adapter** message is displayed. If the EV Kit is found, but the IC cannot be found, a **No Slave Device** message is displayed. If the IC is properly powered, pressing the PKWK button will wake up the IC. Otherwise, if communication is valid, a green bar updates as the software continuously reads the IC registers.

The bottom status bar also displays information on data logging status, the communication mode, power mode, selected current-sense resistor value, device serial number, and the EV kit GUI's version number.

Program Tabs

All functions of the program are distributed under various tabs in the main program window. Click on the appropriate tab to move to the desired function page.

- Located on the **ModelGauge m5** tab is the primary user information measured and calculated by the IC.
- The **Charger + Protectio**n tab displays all the charger and protection settings of the IC.
- The **Graphs** tab visually displays fuel gauge changes over time.

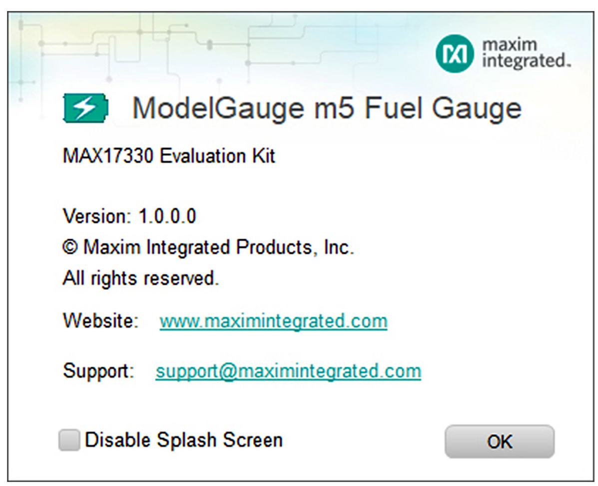


Figure 2. EV kit Splash Screen

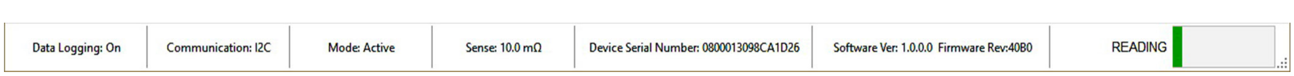


Figure 3. EV kit Bottom Status Bar

- The **Registers** tab allows the user to view and modify common fuel gauge registers one at a time.
- The **Commands** tab allows for special operations such as initializing the fuel gauge logging and performing fuel gauge reset.
- The **Configuration** tab allows the user to modify the NVMemory registers one at a time, but any changes here are not written to NVMemory.
- The **Authentication** tab allows the user to send and verify the SHA commands.
- The **History** tab allows all of the history information to be recalled and viewed from the IC.
- If SBS Mode is enabled on the IC, the **SBS** tab is displayed to show the SBS Memory Map.
- The **I2C Traffic Log** tab maintains a log of any special communication with the IC.

All tabs are described in more detail in the following sections.

ModelGauge m5 Tab

The **ModelGauge m5** tab in Figure 4 displays the important output information read from the IC. Information is grouped by function and each is detailed separately.

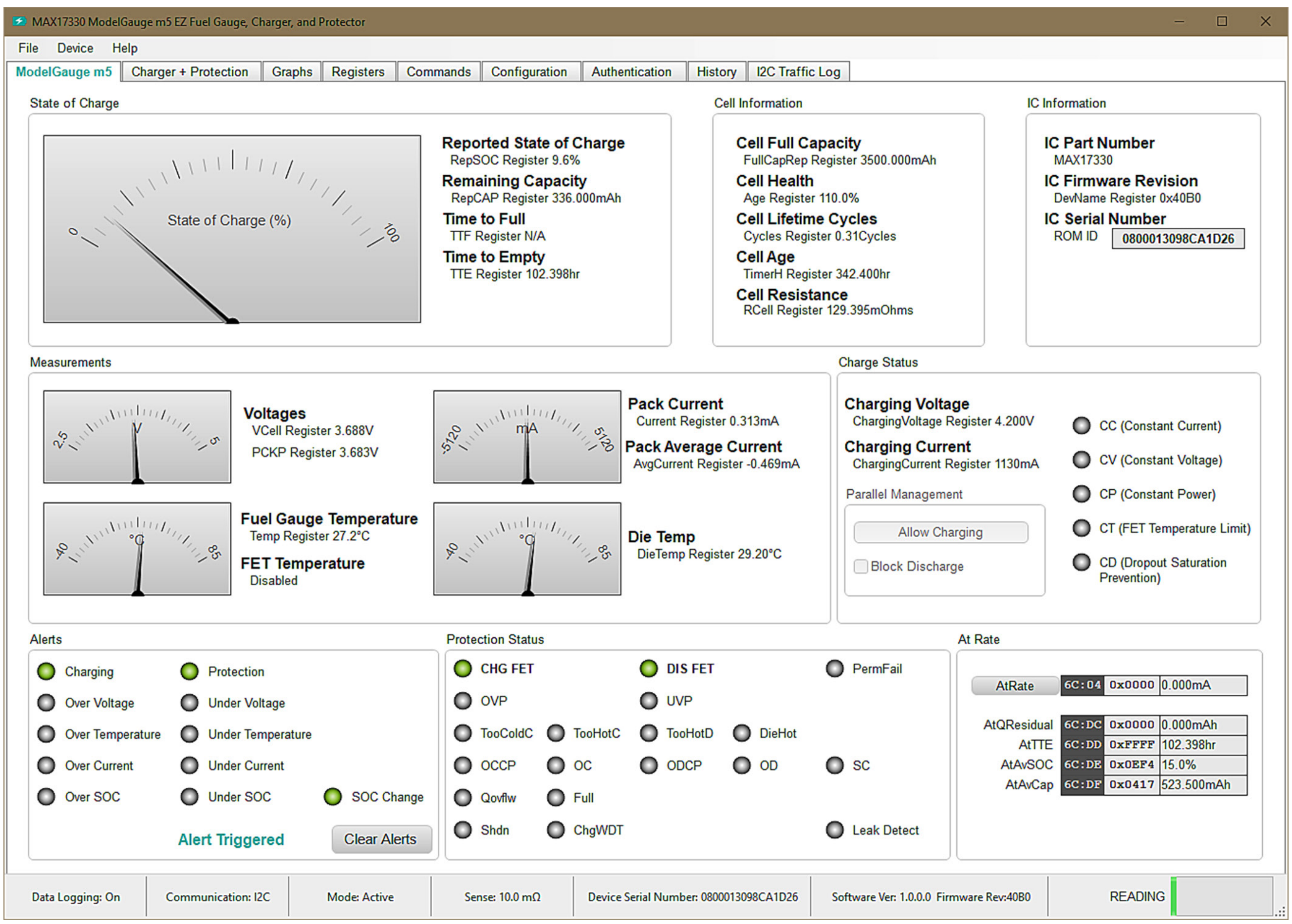


Figure 4. ModelGauge m5 Tab

State of Charge

The **State of Charge** group box displays the main output information from the fuel gauge: state of charge of the cell, remaining capacity, time to full, and time to empty.

Cell Information

The **Cell Information** group box displays information related to the health of the cell such as the cell's age, internal resistance, present capacity, number of equivalent full cycles, and change in capacity from when it was new.

Measurements

The **Measurements** group box displays ADC measurements that are used by the fuel gauge to determine the state of charge.

Charge Status

The **Charge Status** group box displays the desired charging current and voltage for the battery state and temperature. It also indicates the charging control mode. When the mode is CC, the Pack Current will match the Charging Current register. When the CV mode is indicated, VCell will match Charging Voltage. If the Pack Current is lower than Charging Current, the reason will be indicated in this group box.

Parallel Management

When the **parallel management** function is enabled, the **Allow Charging** button must be pressed to turn on the CHG FET while a charge source is connected. The button changes to show Stop Charging while charging is allowed. Press **Stop Charging** to block charging again.

The Block Discharging Checkbox turns on the Discharge Blocking function. If the Block Discharging box is pressed, the Allow Charging button will turn off the DIS FET when any negative current is detected. Discharging is allowed when the box is checked, or while the button is blocking charging (shows Allow Charging). See Table 1 for more details.

Alerts

The **Alerts** group box tracks all possible alert trigger conditions. If any alert occurs, the corresponding LED becomes green for the user to see. The **clear alerts** button resets all alert flags.

Protection Status

The **Protection Status** group box displays the status of the charge and discharge FETs as well as all bits of the ProtStatus register. If the FETs LED is green, the current can flow. If the LED is red, there is a fault condition and the FET is open, preventing current flow.

At Rate

The **At Rate** group box allows the user to input a hypothetical load current (AtRate) and the fuel gauge calculates the corresponding hypothetical Qresidual, TTE, AvSOC, and AvCap values.

Table 1. Parallel Management FET Control

BUTTON TEXT	BLOCK DISCHARGE BOX	CHG FET	DIS FET
Allow Charging	Unchecked	Blocked	ON
Stop Charging	Unchecked	ON	ON
Allow Charging	Checked	Blocked	ON
Stop Charging	Checked	ON	OFF

Charger + Protection Tab

The **Charger + Protection** tab in Figure 5 displays the charger and protection settings read from the IC. The settings cannot be changed from this tab. Please use the **Configuration Wizard** to update these settings. Information is grouped by function and each is detailed separately.

The **Measurements**, **Alerts**, and **Protection Status** group boxes display the same information that is shown on the **ModelGauge m5** tab.

Charging Configuration

The **Charging Configuration** group box displays the charging settings and all the protection settings related to charging as well as a graphical view of those selections across the programmable temperature ranges.

Discharging Configuration

The **Discharging Configuration** group box displays all the protection settings related to discharging.

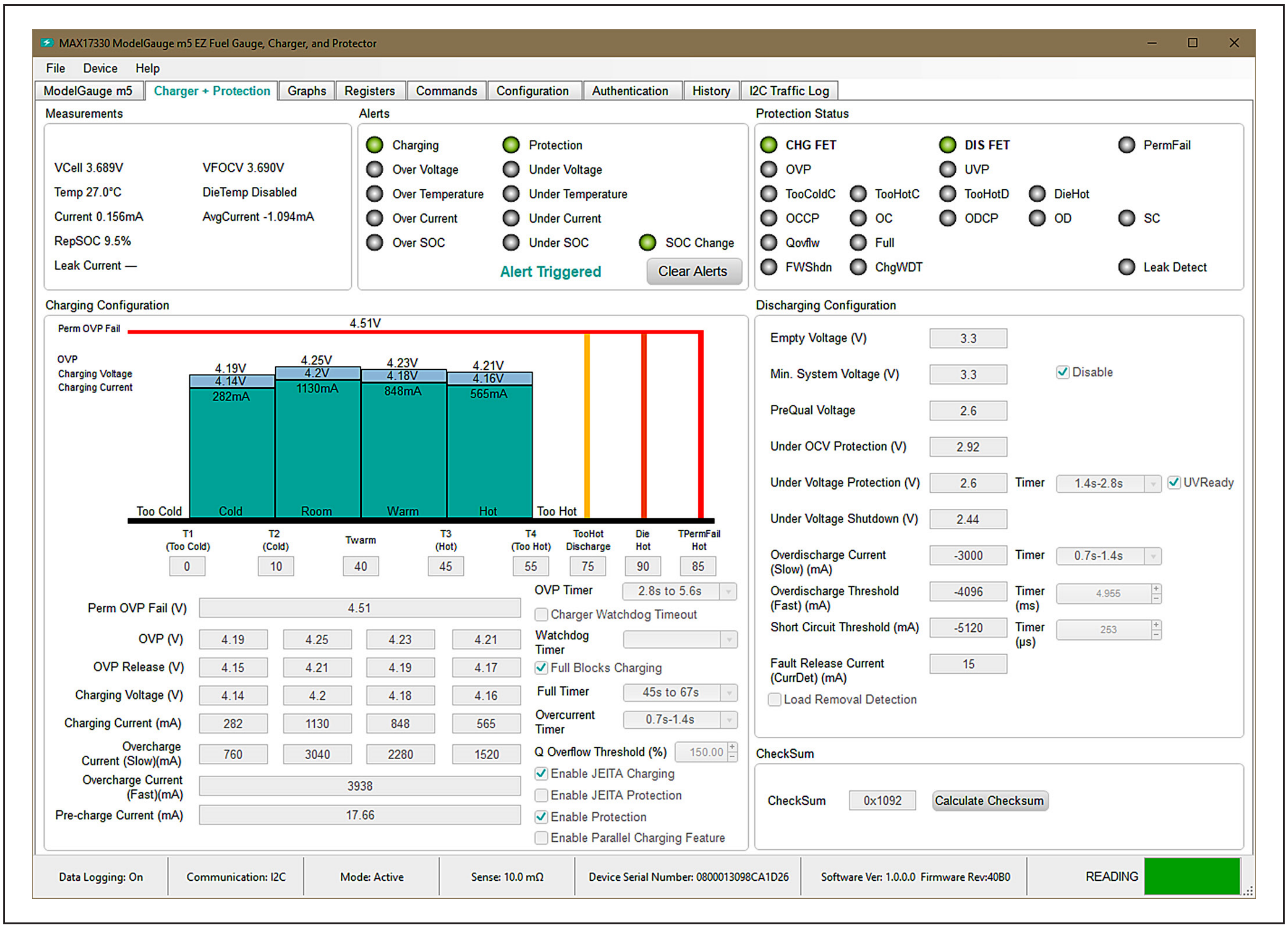


Figure 5. Protector Tab

Graphs Tab

Figure 6 shows the format of the **Graphs** Tab. Graph information is grouped into four categories: **Voltages**, **Temperatures**, **Capacities**, and **Currents**. The user can turn on or off any data series using the checkboxes on the right-hand side of the tab. The graph visible viewing area can be adjusted from 10 minutes up to 1 week. The graphs remember up to 1 week's worth of data. If the viewing area is smaller than the time range of the data already collected, the scroll bar below the graphs can be used to scroll through graph history. All graph history information is maintained by the program. Graph settings can be changed at any time without losing data. Voltages in the graph are plotted as an average cell voltage measurement.

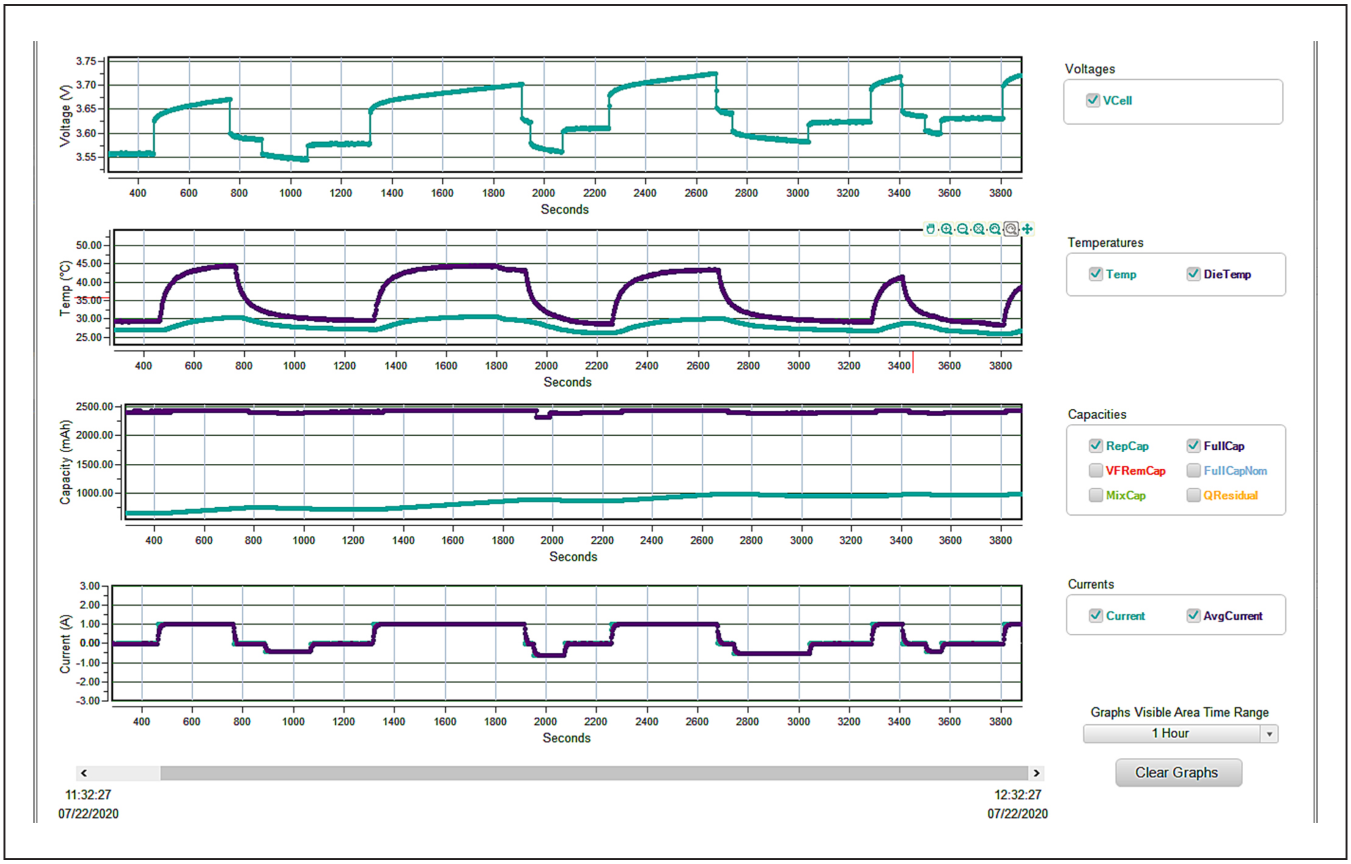


Figure 6. Graphs Tab

Registers Tab

The **Registers** tab in Figure 7 allows the user access to all fuel gauge-related registers of the IC. The user can sort the registers either by function or by their internal address by clicking the appropriate button at the top of the tab. Each line of data contains the register name, register address, a hexadecimal representation of the data stored in the register, and if applicable a conversion to application units.

The MAX17330 has a **Write Protection** function that prevents accidental writing of any register. Before writing any register, the Write Protection must be disabled. The GUI provides a convenient switch at the top of the **Registers** and **Configuration** tabs to lock and unlock the Write Protection. The **Write Protection** status will be automatically re-enabled if there is no movement of the mouse for 10 seconds to prevent accidentally leaving the **Write Protection** disabled.

To write a register location, first toggle the **Write Protection** slider to unlocked and then click on the button containing the register name. A pop-up window allows the user to enter a new value in either hexadecimal units or application units. The main read loop temporarily pauses while the register updates. The changes made on the **register** tab are reflected in the I2C Traffic log.

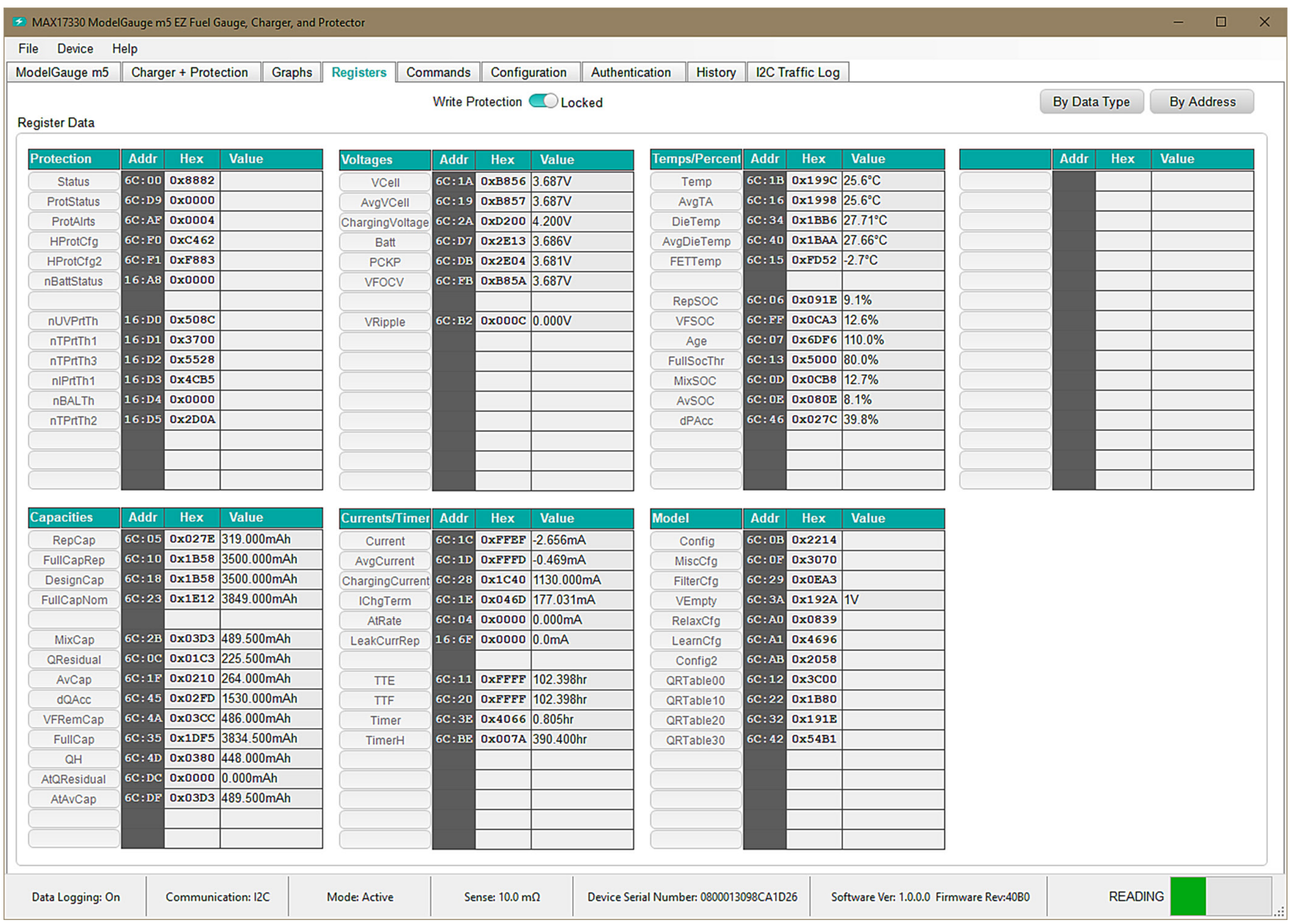


Figure 7. Registers Tab

Commands Tab

The **Commands** tab in Figure 8 allows the user to access any general IC functions not related to normal writing and reading of register locations. Each group box of the **Commands** tab is described in detail in the following sections.

Read/Write Register

The user can read a single register location by entering the address in hex and clicking the **Read** button. The user can write a single register location by entering the address and data in hex and clicking the **Write** button. The read loop is temporarily paused each time to complete this action.

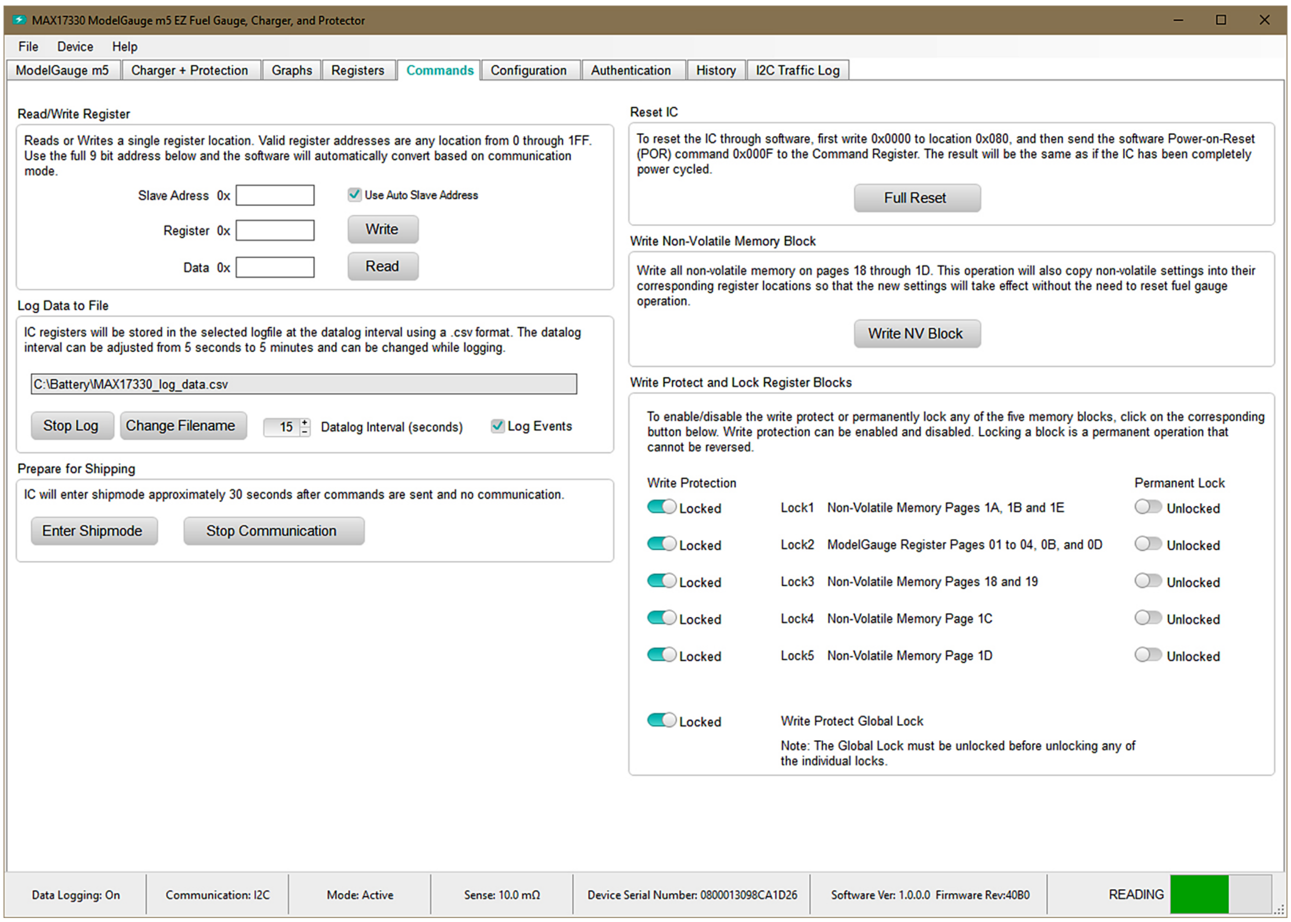


Figure 8. Commands Tab

Log Data to File

Data logging is always active when the EV kit software is started. The default data log storage location is the **My Documents/Maxim Integrated/MAX17330/Datalog.csv.** The user can stop data logging by clicking the **Stop Log** button or change the data log file name by clicking the **Change Filename** button. Whenever data logging is active, it is displayed on the bottom status bar of the EV kit window. All user-available IC registers are logging in a .csv formatted file. The user can adjust the logging interval at any time. The user can also enable or disable the event logging at any time. When event logging is enabled, the data log also stores any IC write or reads that are not part of the normal read data loop and indicates any time communication to the IC is lost.

Reset IC

Clicking the **Full Reset** button sends the software POR command to the command register and sets the POR_CMD bit of the Config2 register to fully reset fuel-gauge and charger operation as if the IC had been power cycled. Note that resetting the IC when the cell is not relaxed causes fuel gauge error.

Nonvolatile Memory Block

Clicking the **Write NV Block** button sends the Copy NV Block command to the command register that causes all register locations from 180h to 1EFh to be stored in nonvolatile memory. Nonvolatile memory has a limited number of copies and the user is prompted to confirm before executing the copy.

Write Protect and Lock Register Blocks

Clicking one of the six Write Protection sliders locks or unlocks a page or pages of memory as listed. Before unlocking any individual block, the Global Lock slider **must** first be unlocked.

Clicking one of the five Permanent Lock sliders locks a page or pages of memory as listed. This is a permanent operation, so the user is prompted to confirm the operation before setting the lock.

Configuration Tab

The **Configuration** tab has similar formatting to the standard **Registers** tab as shown in Figure 9, but there are some major differences. When the user changes a register value on the **Configuration** tab, only the RAM value of that location is changed. The nonvolatile value remains unchanged. Register text changes to **BLUE** to indicate the RAM and nonvolatile values do not match. The user must complete a nonvolatile burn on the **Commands** tab or run the **Configuration Wizard** to change the nonvolatile value. The nonvolatile memory has a limited number of updates that are shown in a box on the top right side of the tab. Maxim recommends using the **Configuration Wizard** to make any changes to nonvolatile memory instead of changing registers manually. The wizard can be launched through the **Device** drop-down menu at the top of the EV kit software window or by the button on the top-right of the **Configuration** tab. See the *Configuration Wizard* section for details. Note any register information that is displayed in the **RED** text indicates a nonvolatile write error where the data read back after a nonvolatile memory write does not match the expected value. Also note, the Write Protection must be unlocked before modifying any registers.

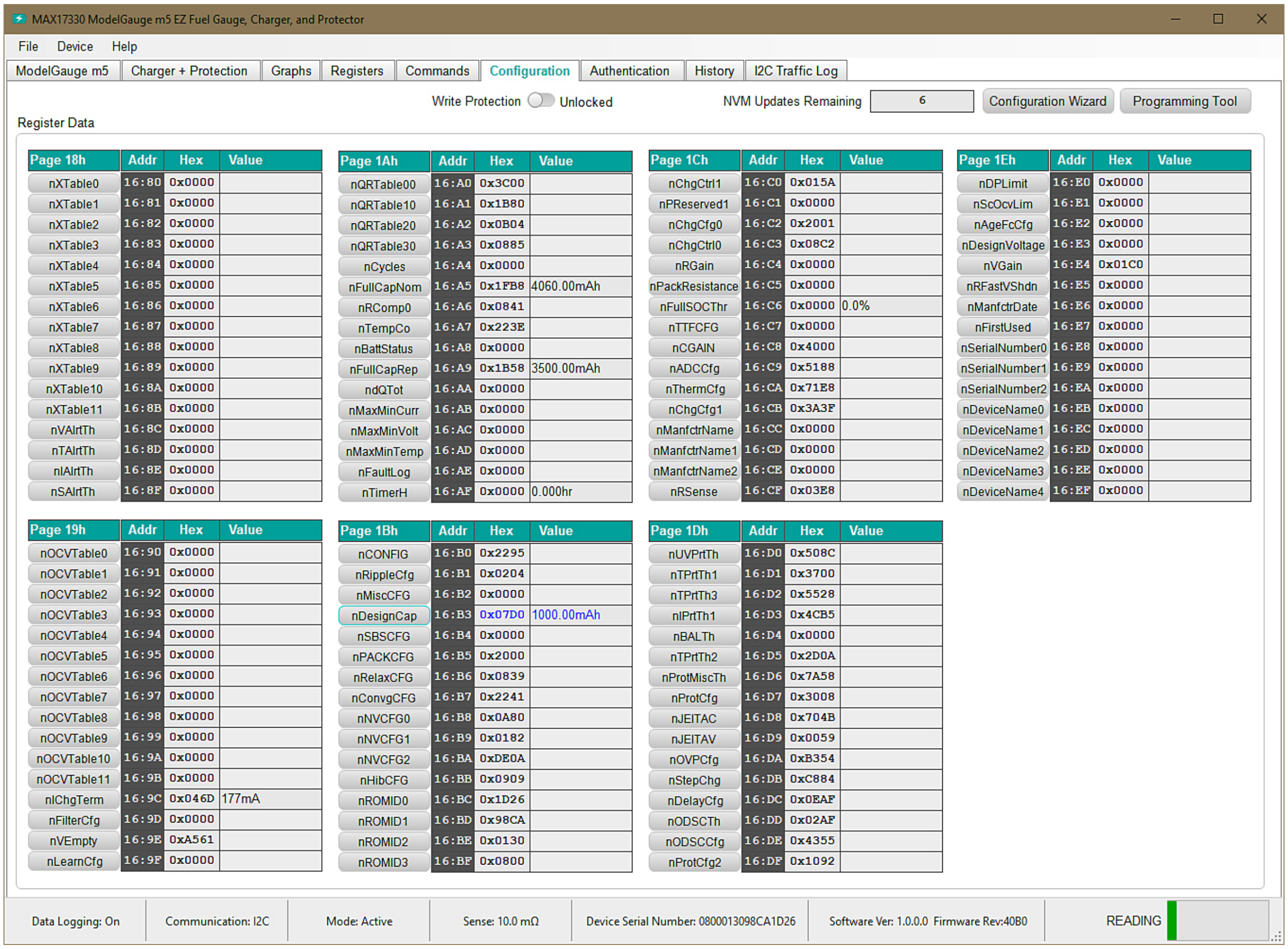


Figure 9. Configuration Tab

Authentication Tab

The **Authentication** tab in Figure 10 allows full evaluation of the SHA-256 security feature. Each group box of the **Authentication** tab is described in detail in the following sections.

SHA Challenge/ROM ID

The 160-bit SHA-256 Challenge message consists of ten 16-bit Challenges. To manually enter the challenge message, click the hex value field of each challenge number and edit the value in the text box. Click the **Randomize Challenge** button to create a random challenge message.

SHA Secret

The 160-bit SHA-256 Secret key consists of ten 16-bit Secret values. Unless the secret is specifically programmed by Maxim Integrated for the customer, the default key value is 0. To prepare for authentication with the IC, enter the known secret value for the IC connected to GUI. Click **Clear Secret** to reset the key values in the IC to 0. Please note that is not possible to clear secret if the secret is locked. Click Lock Secret to permanently lock the secret value for the IC. **Secret Changes Remaining** shows the remaining chances to update the SHA Secret value.

Authentication Result

This group box provides four methods to perform authentication evaluation. When the authentication process begins, the IC will calculate MAC based on the challenge and stored secret value. The GUI, which represents the host-side processor, will also calculate based on Challenge and known secret. If the **SHA Secret** is entered correctly matching the programmed secret state in the IC, the authentication should succeed given any challenge using any of the four methods. **Compute MAC with ROM**

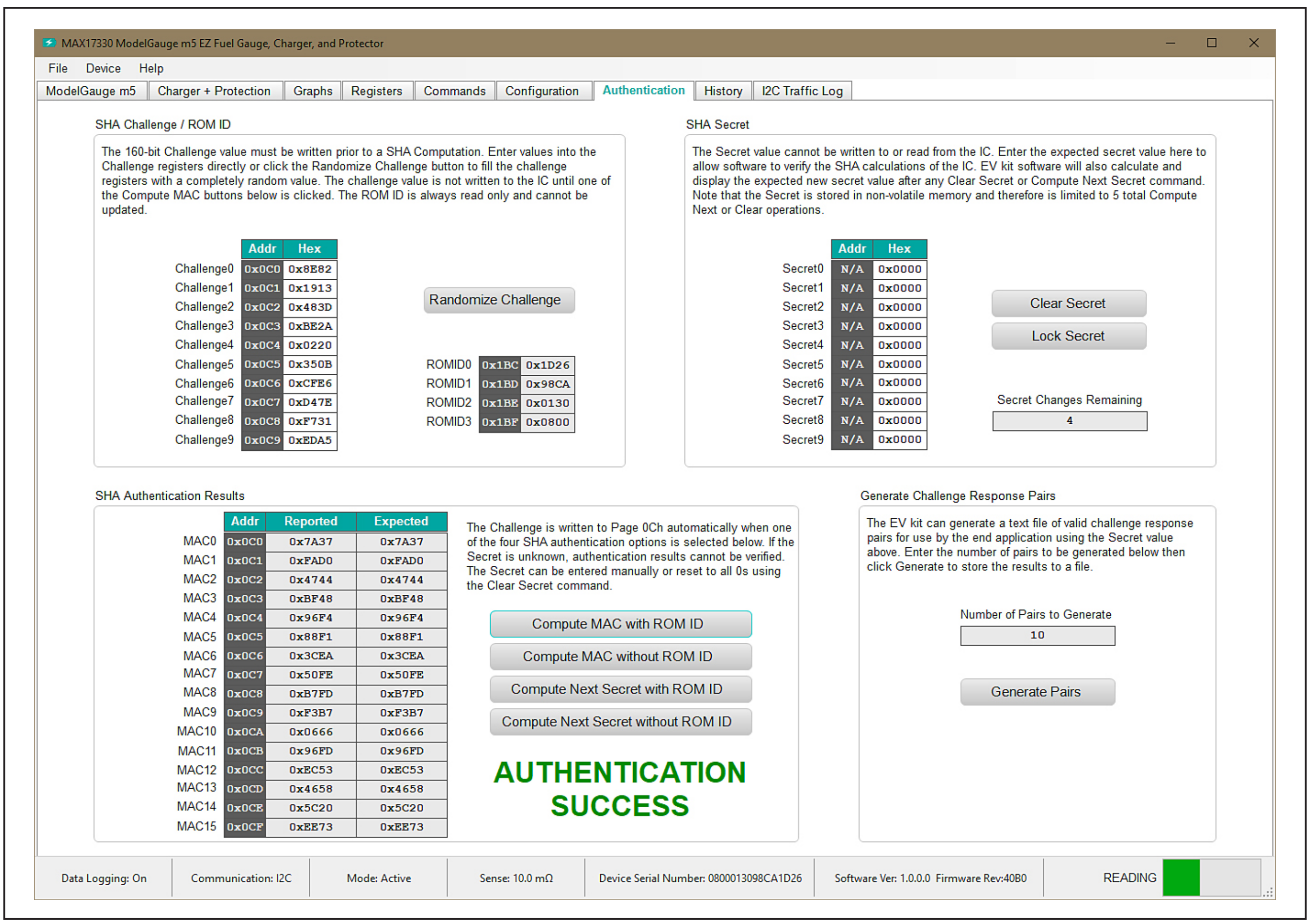


Figure 10. Authentication Tab

ID will compute MAC results based on chip ROM ID that is specific to the chip. **Compute MAC without ROM ID** would not involve ROM ID into computation, which means the MAC result for every chip given the same challenge and secret should be the same. **Compute Next Secret** commands will not only compute authentication result, but also update the secret value [Secret0–Secret9] to [MAC6–MAC15]. If there are no **Secret Changes Remaining** displayed in the **SHA Secret** group or the Secret is locked, the Secret will not update.

History Tab

The **History** tab visualizes all nonvolatile update history on the **0x1Ax** column of the nonvolatile memory map. Figure 11 shows the **History** Tab. This column of nonvolatile memory features the Fibonacci Saving mechanism to help the IC efficiently learn and adapt to battery characteristics change. This column of memory will be updated by the IC through usage cycles as the IC observes changes to the battery capacity, observed MaxMin voltages, currents, temperatures, and any battery faults. The updates are saved to nonvolatile memory and can be read over I^2C.

In the **Read History** group box, click the **Read Battery History** button to initiate the nonvolatile history recall process. Once the process is initiated, it takes a while to load the nonvolatile history from the IC. Click the **Read Battery History and Save to File** to save the nonvolatile history to a .csv file in addition to initiate the nonvolatile history recall process. After the recall process is finished, enter in the page number or select + or – sign to browse through the nonvolatile history at the **Display History Data** tool. The detailed information of the specific page selected will be displayed in the **Logging History** section.

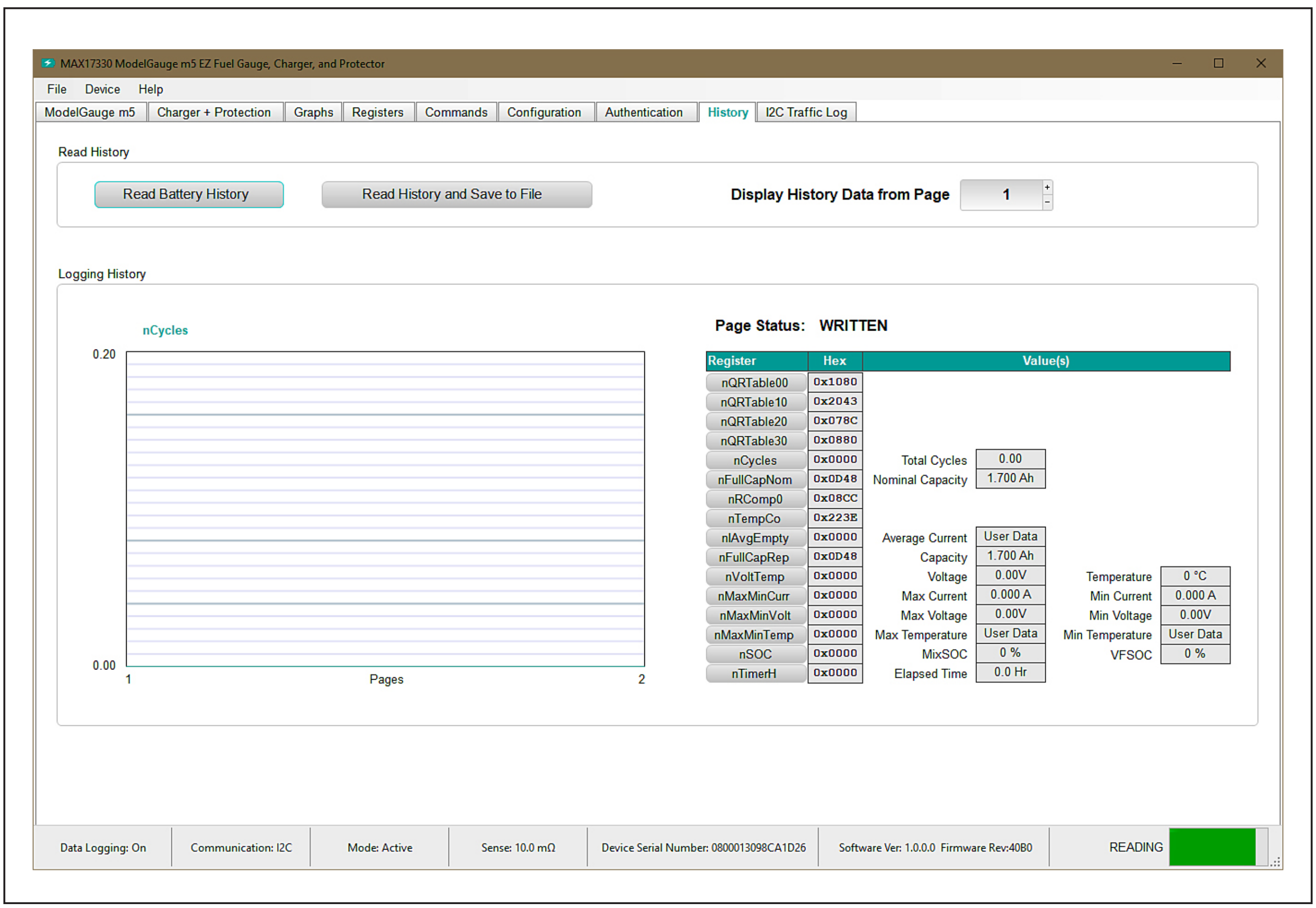


Figure 11. History Tab

Configuration Wizard

Before the IC accurately charge or calculate the state of the battery, it must be configured with characterization information. This can be accomplished in two ways. The first is through a custom characterization procedure that can be performed by Maxim under certain conditions. The result is a model.INI summary file that contains information that can be programmed into the IC by launching the Configuration Wizard and selecting the model.INI file in Step 2. Contact Maxim for details on this procedure.

The second method is the ModelGauge m5 EZ configuration. This is the default characterization information shipped inside every IC. This default model produces accurate results for most applications under most operating conditions. It is the recommended method for new designs as it bypasses the custom cell characterization procedure. Some additional information is required from the user for EZ configuration initialization.

In the **Configuration** Tab, click the **Configuration Wizard** button. The **Configuration Wizard** window will pop up, as shown in Figure 12. Follow the description and complete all the steps in **Configuration Wizard**. Click **Next** when each step is finished.

Step 1 shows the options for how to start with nonvolatile programming. For previously unprogrammed chip, select **Start with Factory Default Values** to begin the evaluation. If there are already nonvolatile memory changes in the IC to be kept, select **Start with Existing Nonvolatile Memory Data**.

Step 2 shows the critical charging and model selection options. Enter the cell nominal voltage and select the Charge Source Voltage (Managed or Fixed input voltage). Enter the Desired Fast Charge current, Sense resistor value into the text boxes, and select the Heat Limit of the FET from the drop down menu. For EZ configuration without using INI file, select the **Use ModelGauge m5 EZ Model** option. Enter the rated battery capacity, empty voltage (minimum safe system supply voltage), charge termination current, and check the checkbox if charge voltage is greater than 4.275V. If .INI file is available, select **Use Custom Model** and load the model.INI file provided by Maxim directly.

To connect to an external communication device, select the slave address. The GUI software automatically tries all slave addresses and will communicate with a device at any address. If multiple slave devices are connected to the same GUI, it will select the first device that responds during the address search routine.

In **Step 3,** charging configuration and protection-related settings need to be configured. Figure 13 shows this step. Use the Charging Voltage and Charging Current fields to set the voltage and current for each temperature zone. If the same voltage and current are desired for all temperatures, either set all fields to the same value, or just set the 2nd column (Room temperature), and deselect Enable JEITA Prescription. The checkboxes at the bottom right enable or disable these features. The **Enable Protection** feature needs to be checked to enable protection. JEITA Charging allows the IC to calculate and report the required charging voltage and charging current base on temperature. If the JEITA Charging feature is desired, check the **Enable JEITA Charging** checkbox. JEITA Protection allows the IC to protect charging at different charging rate base on temperature condition. Check the **Enable JEITA Protection** to enable this feature. The upper section of the panel visualizes the JEITA temperature zones and protection thresholds. In the lower section, the user can edit detailed settings like the temperature zone setting, OVP setting, charging voltage setting, and charging current setting. When all the JEITA settings are completed, check the upper section graph to make sure the settings are correct.

The Voltage settings are relative to the Room temperature Charging Voltage. The settings should be done in the order below:

1) Room Charging Voltage
2) Cold/Warm/Hot Charging Voltage
3) OVP
4) OVP Release
5) Perm OVP Fail

The Room charging current must be set first before Cold/Warm/Hot currents are set. Other settings may be adjusted independently.

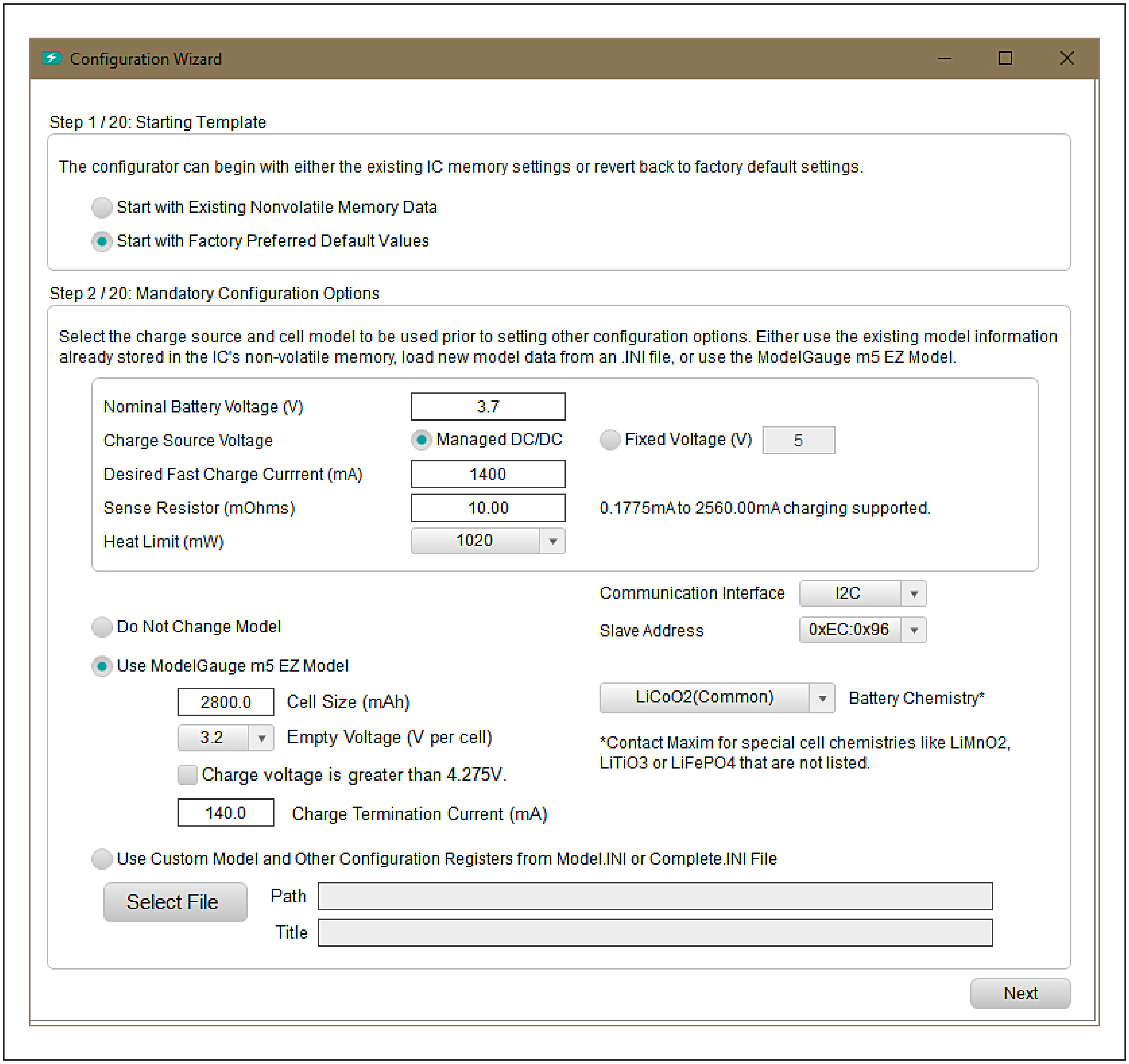


Figure 12. Configuration Wizard – Front Page

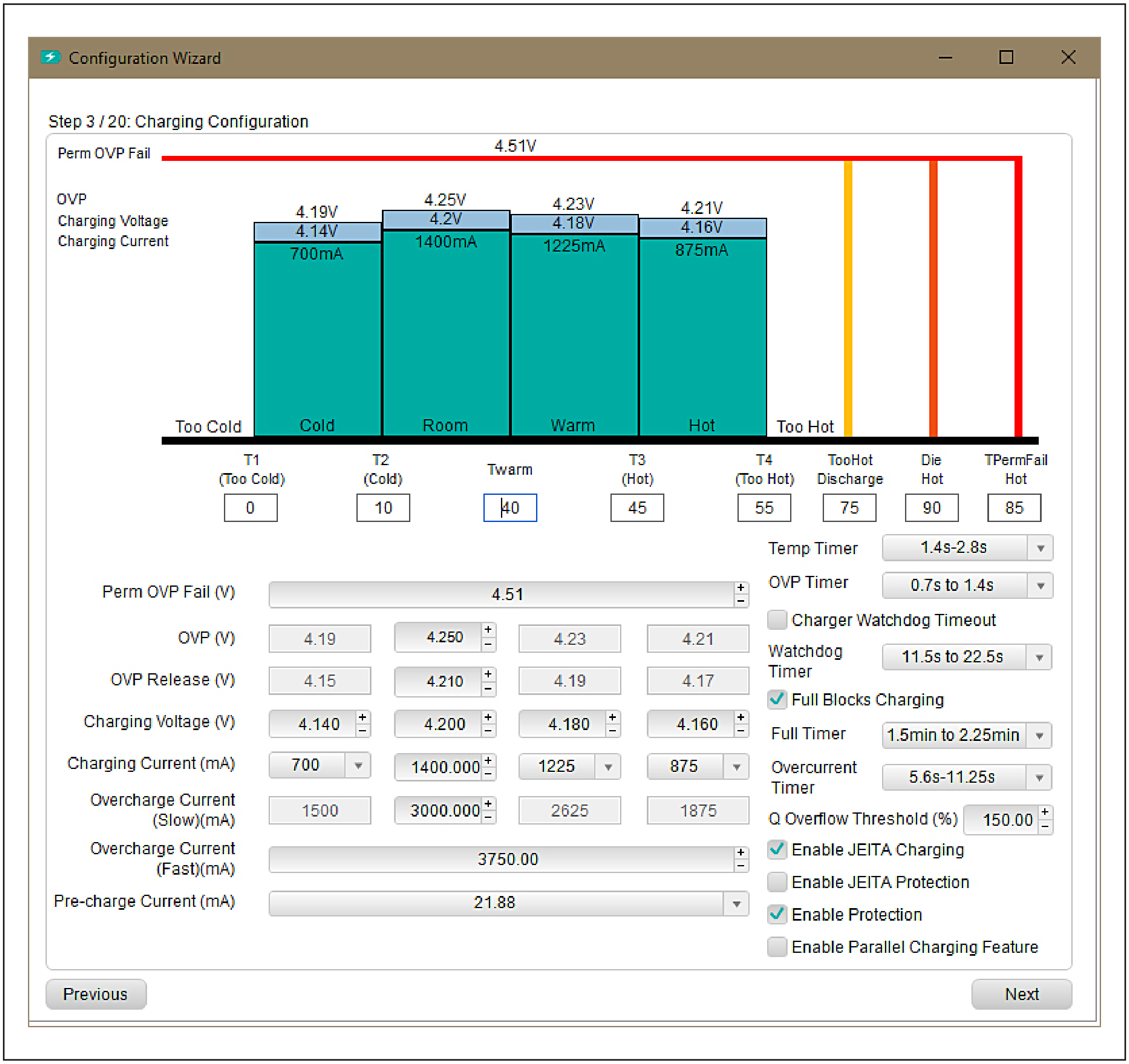


Figure 13. Configuration Wizard - Step 3

Charger configuration continues on **Step 4** and **Step 5**, as shown in Figure 14. In Step 4, Step-Charging may be enabled, and the voltage and current for each battery state may be set. These parameters are based on room temperature, and if JEITA Charging is enabled, the currents will scale relative to the maximum charging current for that temperature.

Step 5 configures the HeatLim (Package Power rating) of the FET in mW, the FET Temperature limit in °C, and the FETTheta, which is used to approximate the FET temperature when the second thermistor (TH2) is used. The FET temperature is calculated with the equation *FETTemp = DieTemp + (TH2 - DieTemp) x FETTheta*.

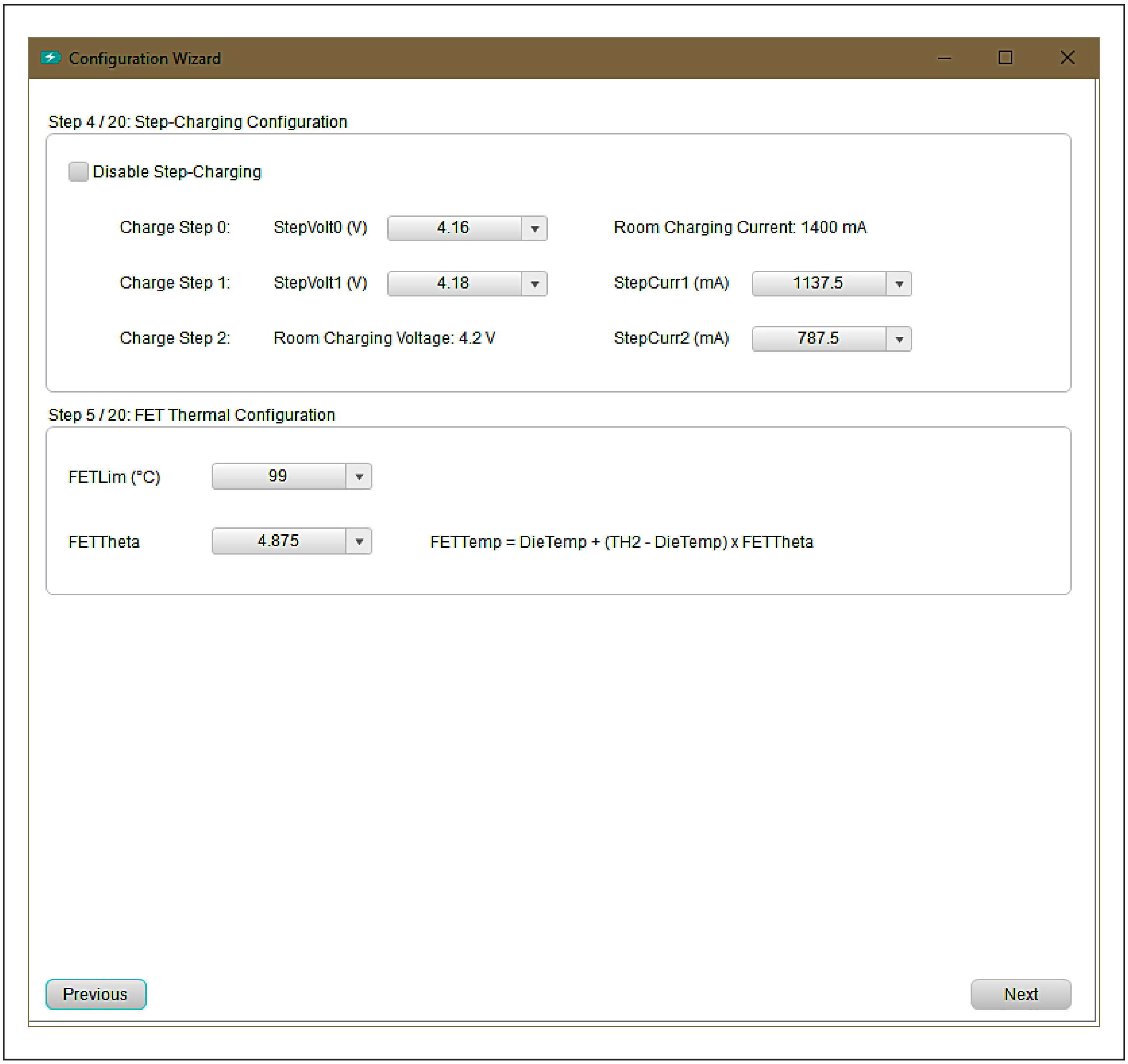


Figure 14. Configuration Wizard – Step 4 and Step 5

From **Step 6** to **Step 7**, the user can edit the Internal Self-Discharge Detection and Discharge protection parameters. See Figure 15 and Figure 16. The parameters include detailed protection configurations, thresholds, and timings. **Step 8** configures permanent fail and some additional FET control options. In **Step 9**, choose the power mode for the IC. Enabling hibernate mode allows reduction of current consumption by lowering the rate of ADC sampling. Enabling Deepship mode will open the FETs and shut-down any protection functionality during shipping and storage conditions. In **Step 8**, check the **Battery Out** option to allow the communication stop shutdown feature. Check **Pushbutton Wakeup** to allow wakeup MAX17330 using the ALRT pin.

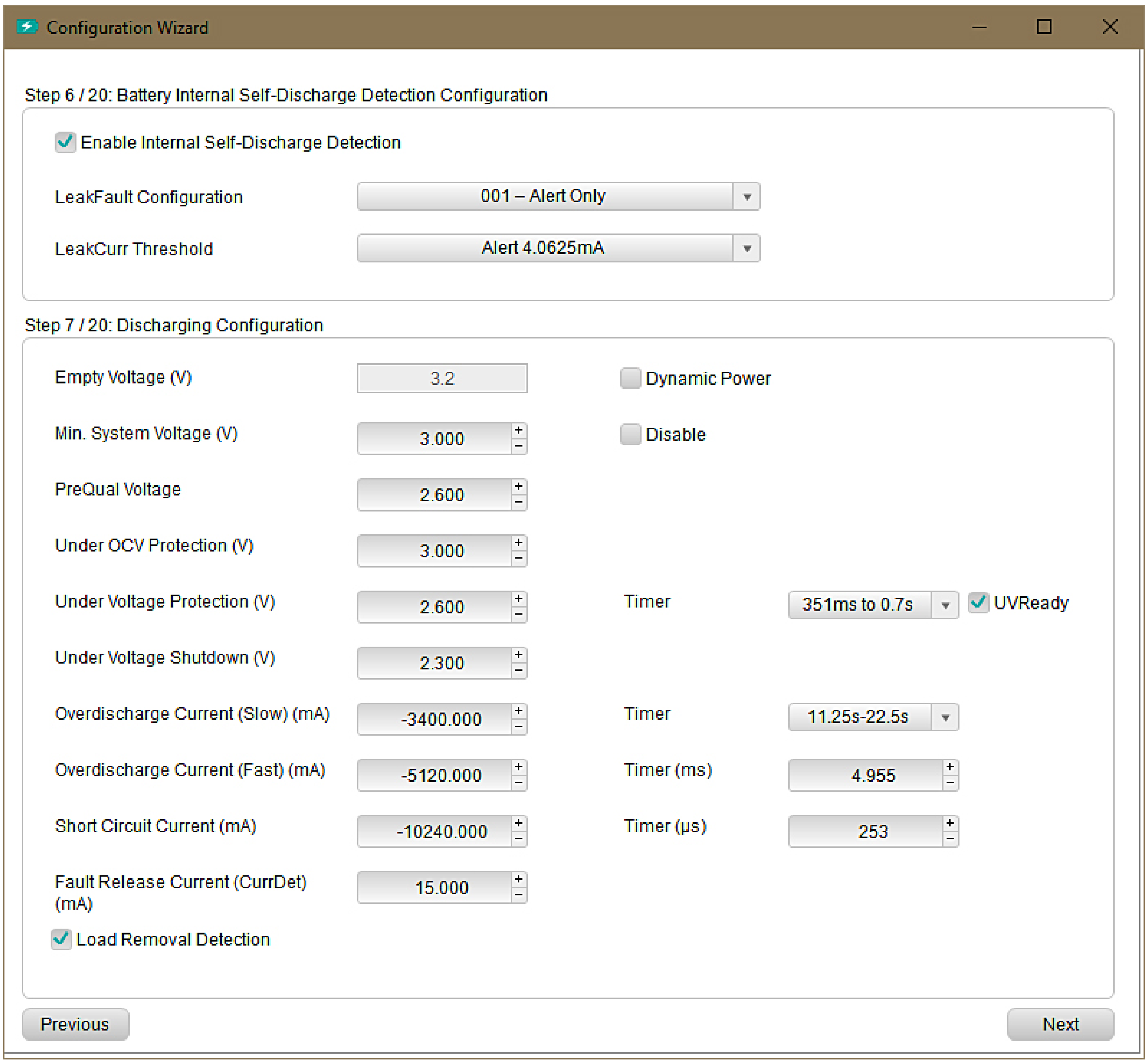


Figure 15. Internal Self-Discharge and Discharge protection configurations

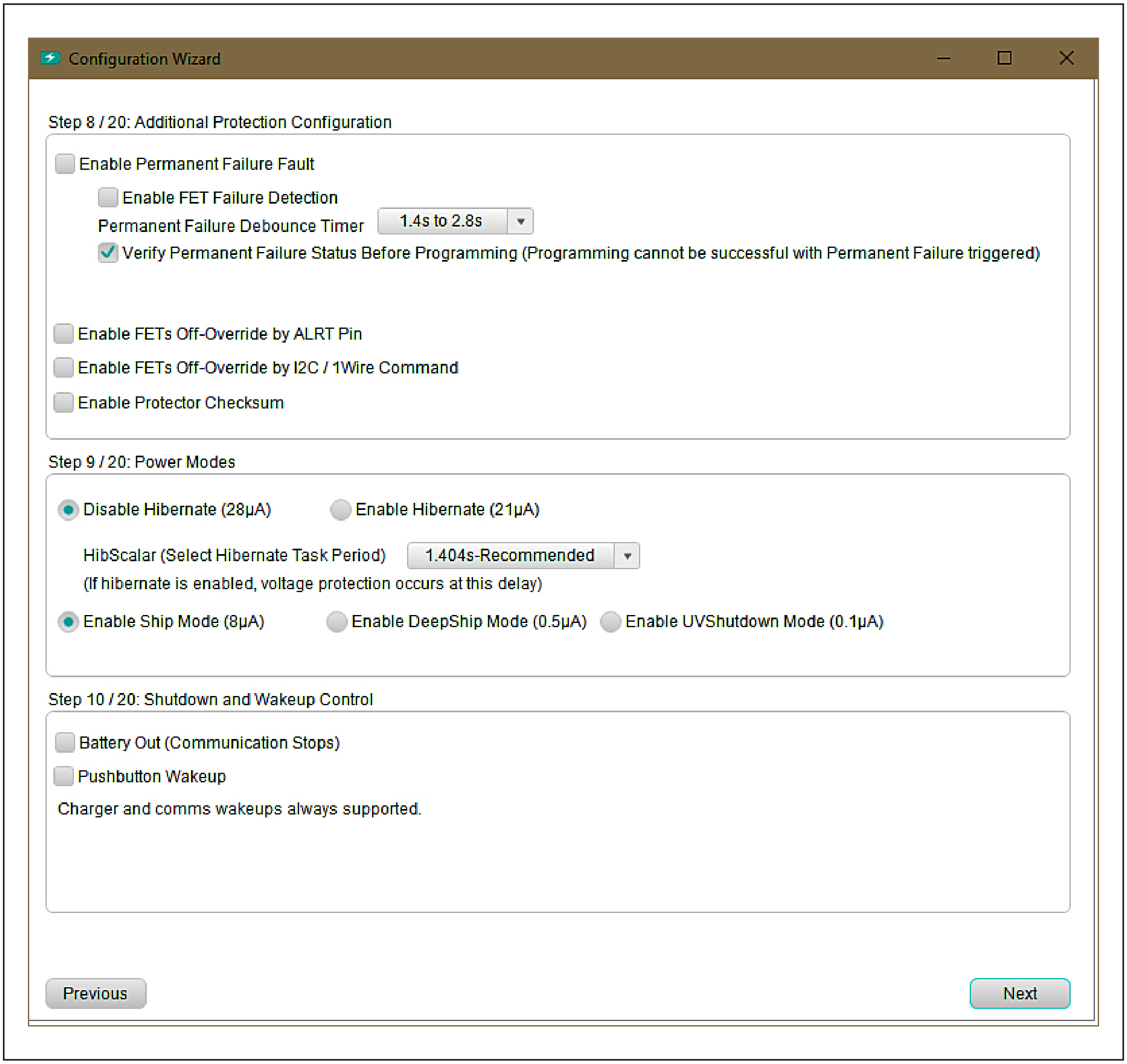


Figure 16. Additional protection configuration and power mode control

Step 11 sets up the temperature measurement functions of the IC. Select the thermistors and their usage in the drop-down list, and the thermistor coefficients in this step. If there is a special thermistor requirement, look for the NTC model with the closest Beta value in the drop-down list, or enter the value in the Beta field.

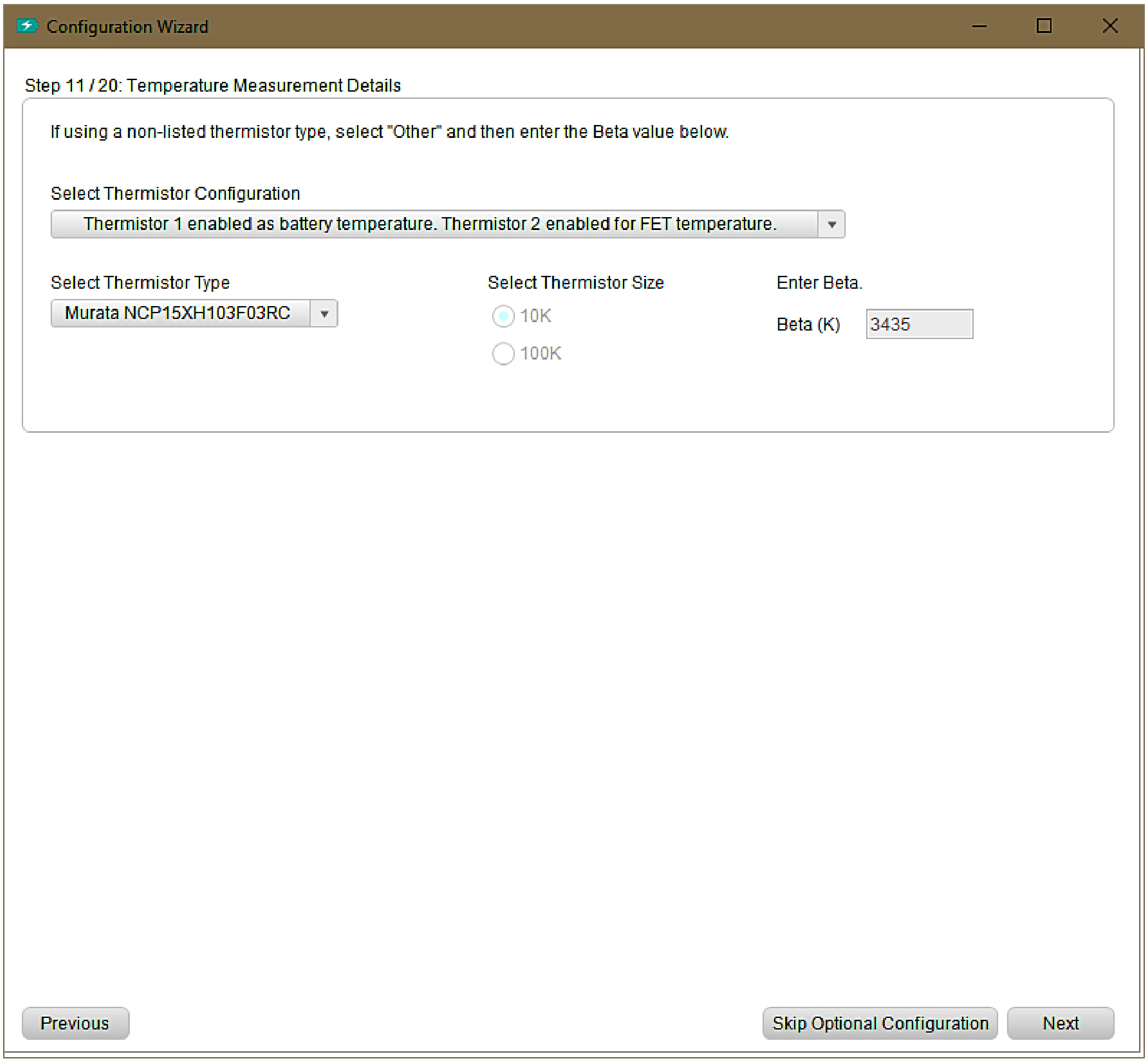


Figure 17. Temperature Measurement Details

From **Step 12** to **Step 20**, follow the step description to fill out all the application-specific information. Unless needed, leave options from step 12 to step 18 as default.

In **Step 20**, the GUI updates the IC based on previous configuration steps. See Figure 18. The non volatile configuration memory can only be updated 7 times. Users can choose to only update RAM by selecting the second option. This is a good method to evaluate previous settings without updating the nonvolatile memory. In this mode, if the IC is power cycled, the configuration will be lost. If the final configuration is decided, choose the third option **Write New Configuration to Non-volatile Memory**. It is recommended to check **Save New Configuration Settings to .INI file**. This allows the resulting configuration in previous steps to be recorded in a Complete.INI file. When the configuration wizard is closed, the previous configurations will not be remembered. Click the **Update IC** button to execute the changes and save the file. Click the **Close** button to exit the configuration wizard without doing anything.

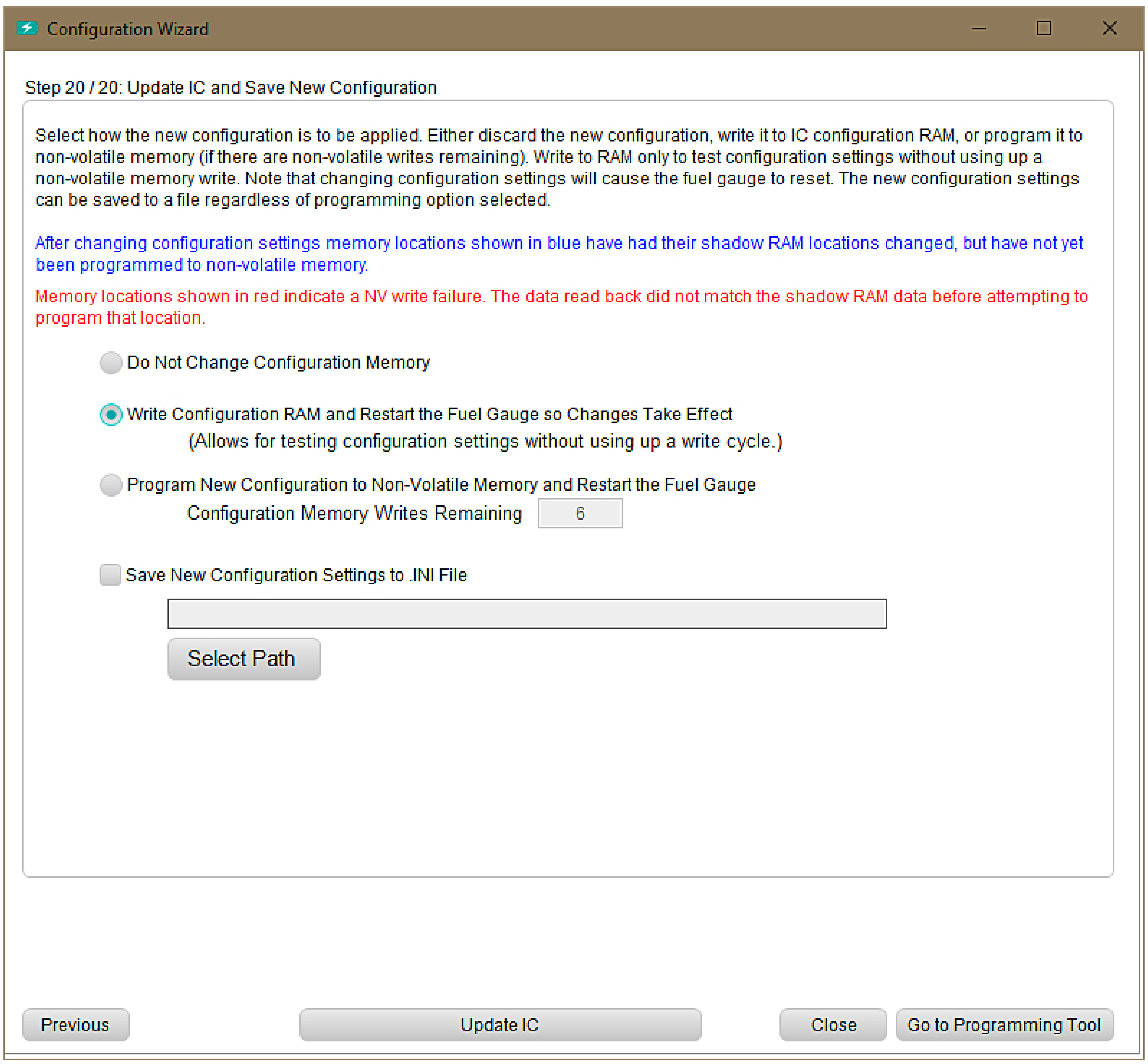


Figure 18. Configuration Step

Programming Tool

INI file provided by Maxim includes battery characteristic model only and is referred to as a model.INI file. It does not include custom settings for protector and device operation. The model.INI file must be used with the **Configuration Wizard** to create a complete.INI file. After completion of **Configuration Wizard**, a Complete.INI is generated with all nonvolatile register configurations. With a Complete.INI, the user doesn't need to go through the **Configuration Wizard** again. See Figure 19. In the **Programming Tool panel**, click **Select File** to select the saved Complete.INI configuration file. The configuration file is typically saved from the configuration step in the **Configuration Wizard** as shown in Figure 19. Click **Program IC** to program nonvolatile memory directly. When there is minor change required on one or two nonvolatile registers, edit the registers inside the complete configuration INI file using text editor, then program the IC using the programming tool. Manually editing the INI file is generally discouraged and should be done with extreme caution. Users can choose to only update RAM by checking the **Load INI to RAM** checkbox.

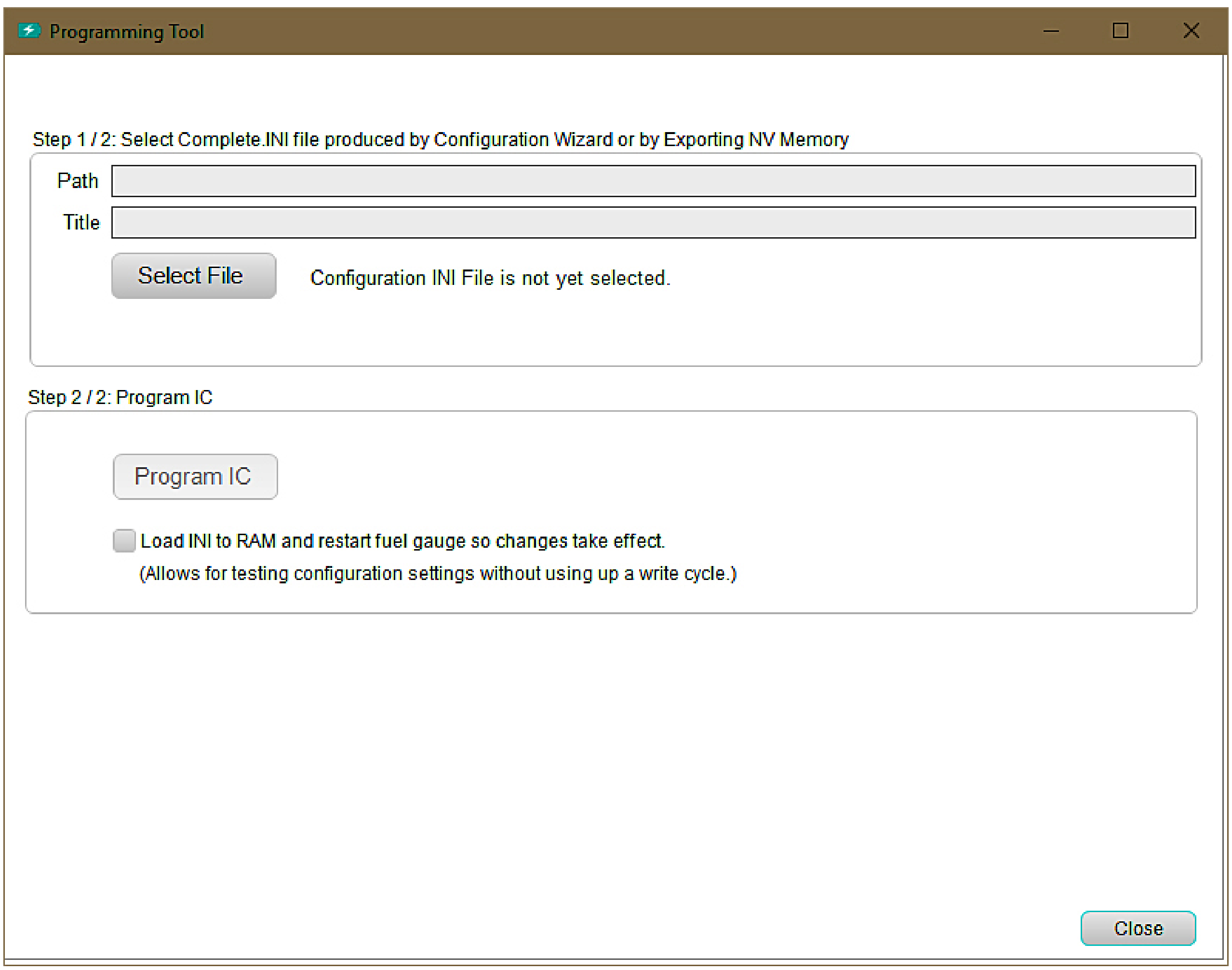


Figure 19. Programming Tool

Hardware Connection Guideline

When evaluating the MAX17330 EV kit with high current or evaluating protection functionality, use real batteries instead of power supplies. When connecting batteries, use a soldered connection instead of jumper cables. During protector switching event, the impedance (inductance) of the lab jumper cables and power supply can cause an overshoot on battery voltage. This voltage spike could potentially cause the voltage across the BATTP pin to rise above the absolute maximum rating of 6V, damaging the IC permanently. Figures 20 and 21 shows good examples of battery connection using soldered connections, battery connectors, and its corresponding BATT voltage waveform during switching event. Figures 22 and 23 show bad examples of battery connection using lab jumper wires and their corresponding BATT voltage waveform.

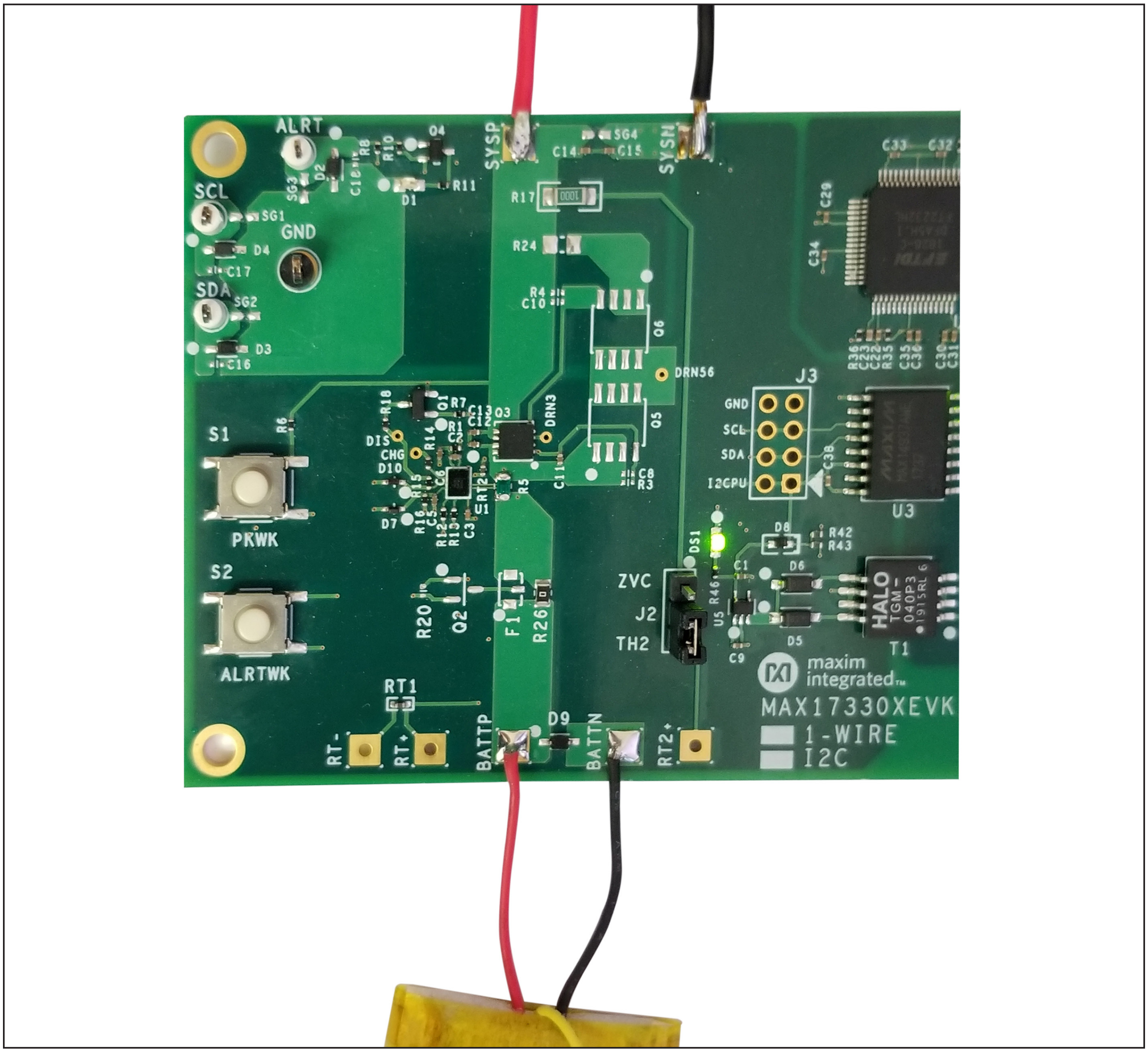


Figure 20. Good hardware connection example (Use real batteries and soldered connections)

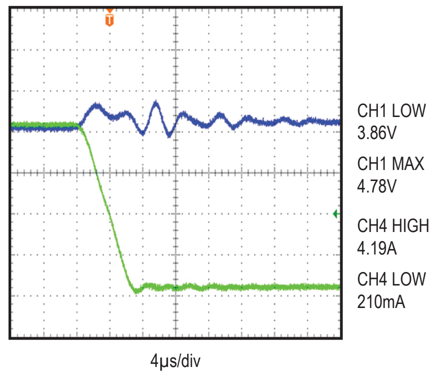


Figure 21. BATT voltage and battery current waveform at overcurrent protection event with good connection

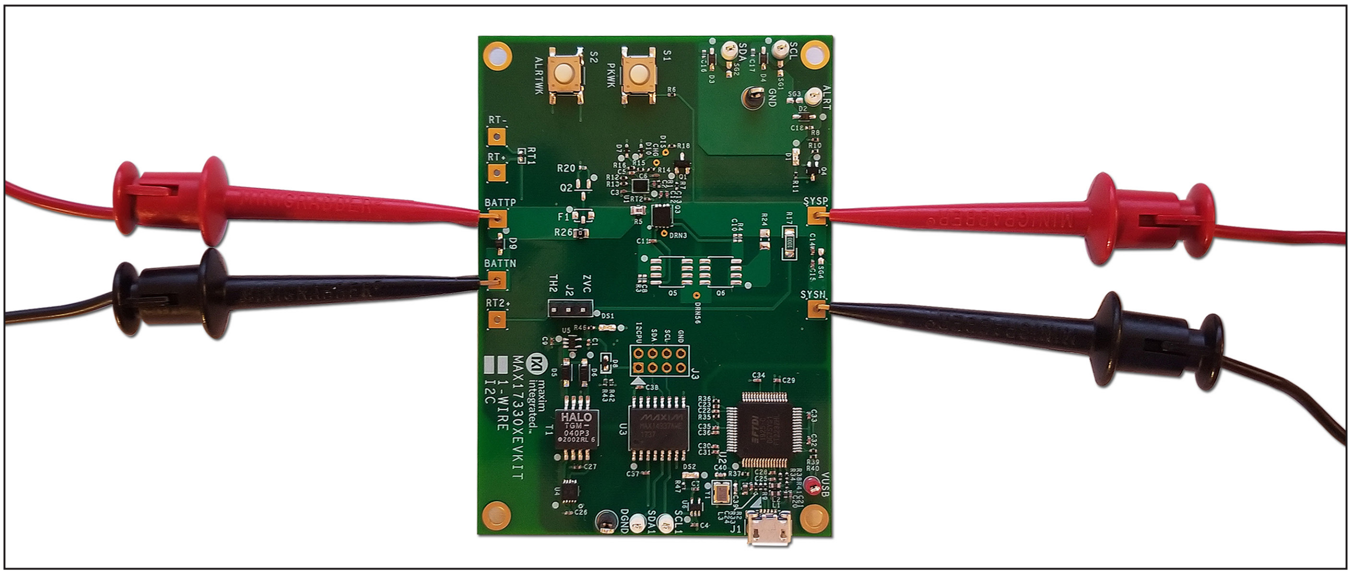


Figure 22. Bad hardware connection example (using lab jumper cable)

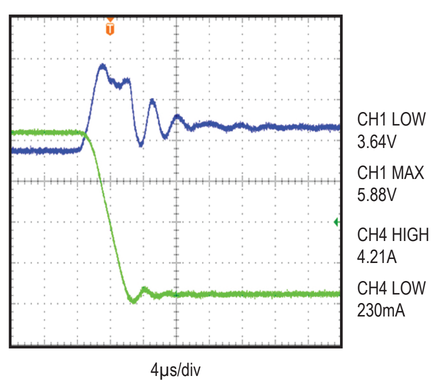


Figure 23. BATT voltage and battery current waveform at overcurrent protection event with bad connection

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America, Inc.	770-436-1300	www.murata.com/en-us
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that the MAX17330 is being used when contacting these component suppliers.*

Ordering Information

PART	COMMUNICATION INTERFACE	PIN-PACKAGE
MAX17330X2EVKIT#	I2C	15 WLP

#Denotes RoHS compliant

MAX17330 EV Kit Bill of Materials

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	ALRT, SCL, SCL1, SDA, SDA1	—	5	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER;
2	C1, C4, C7, C26	—	4	C0402C105K8PAC; CC0402KRX5R6BB105	KEMET;YAGEO	1UF	CAP; SMT (0402); 1UF; 10%; 10V; X5R; CERAMIC
3	C2, C12-C15, C21, C22, C24, C25, C28-C38	—	20	GRM155R71E104KE14; C1005X7R1E104K050BB; TMK105B7104KVH; CGJ2B3X7R1E104K050BB	MURATA;TDK; TAIYO YUDEN;TDK	0.1UF	CAP; SMT (0402); 0.1UF; 10%; 25V; X7R; CERAMIC
4	C3	—	1	C1005X5R1E474K050; GRT155R61E474KE01	TDK;MURATA	0.47UF	CAP; SMT (0402); 0.47UF; 10%; 25V; X5R; CERAMIC
5	C5	—	1	C0402H102J5GAC	KEMET	1000PF	CAP; SMT (0402); 1000PF; 5%; 50V; C0G; CERAMIC
6	C6, C9	—	2	GRM155R71A104JA01	MURATA	0.1UF	CAP; SMT (0402); 0.1UF; 5%; 10V; X7R; CERAMIC
7	C11	—	1	GRM155R71H223KA12	MURATA	0.022UF	CAP; SMT (0402); 0.022UF; 10%; 50V; X7R; CERAMIC
8	C20, C23, C27	—	3	ZRB15XR61A475ME01; CL05A475MP5NRN; GRM155R61A475MEAA; C1005X5R1A475M050BC	MURATA;SAMSUNG; MURATA;TDK	4.7UF	CAP; SMT (0402); 4.7UF; 20%; 10V; X5R; CERAMIC
9	C39, C40	—	2	C0402C0G500270JNP; GRM1555C1H270JA01	VENKEL LTD.; MURATA	27PF	CAP; SMT (0402); 27PF; 5%; 50V; C0G; CERAMIC
10	D1	—	1	LTST-C190CKT	LITE-ON ELECTRONICS INC.	LTST-C190CKT	DIODE; LED; STANDARD; RED; SMT (0603); PIV=5.0V; IF=0.04A; -55 DEGC TO +85 DEGC
11	D2-D4, D9	—	4	BZX384-C5V6	NXP	5.6V	DIODE; ZNR; SMT (SOD-323); Vz=5.6V; Izm=0.000001A; -65 DEGC TO +150 DEGC
12	D5, D6	—	2	MBR0520	MICRO COMMERCIAL COMPONENTS	MBR0520	DIODE; SCH; SCHOTTKY RECTIFIER; SMT (SOD-123); PIV=20V; IF=0.5A; -55 DEGC TO +150 DEGC
13	D7, D10	—	2	RB520G-30	GENERIC PART	RB520G-30	DIODE; SCH; SCHOTTKY BARRIER DIODE; SMT (SOD-723); PIV=30V; IF=0.1A
14	D8	—	1	RB751S40	FAIRCHILD SEMICONDUCTOR	RB751S40	DIODE; SCH; SMT (SOD-523F); PIV=40V; IF=0.03A
15	DGND, GND	—	2	5011	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
16	DS1, DS2	—	2	LTST-C190GKT	LITE-ON ELECTRONICS INC.	LTST-C190GKT	DIODE; LED; WATER CLEAR GREEN; SMT (0603); VF=2.1V; IF=0.03A; -55 DEGC TO +85 DEGC
17	J1	—	1	10118193-0001LF	FCI CONNECT	10118193-0001LF	CONNECTOR; FEMALE; SMT; MICRO USB B TYPE RECEPTACLE; RIGHT ANGLE; 5PINS

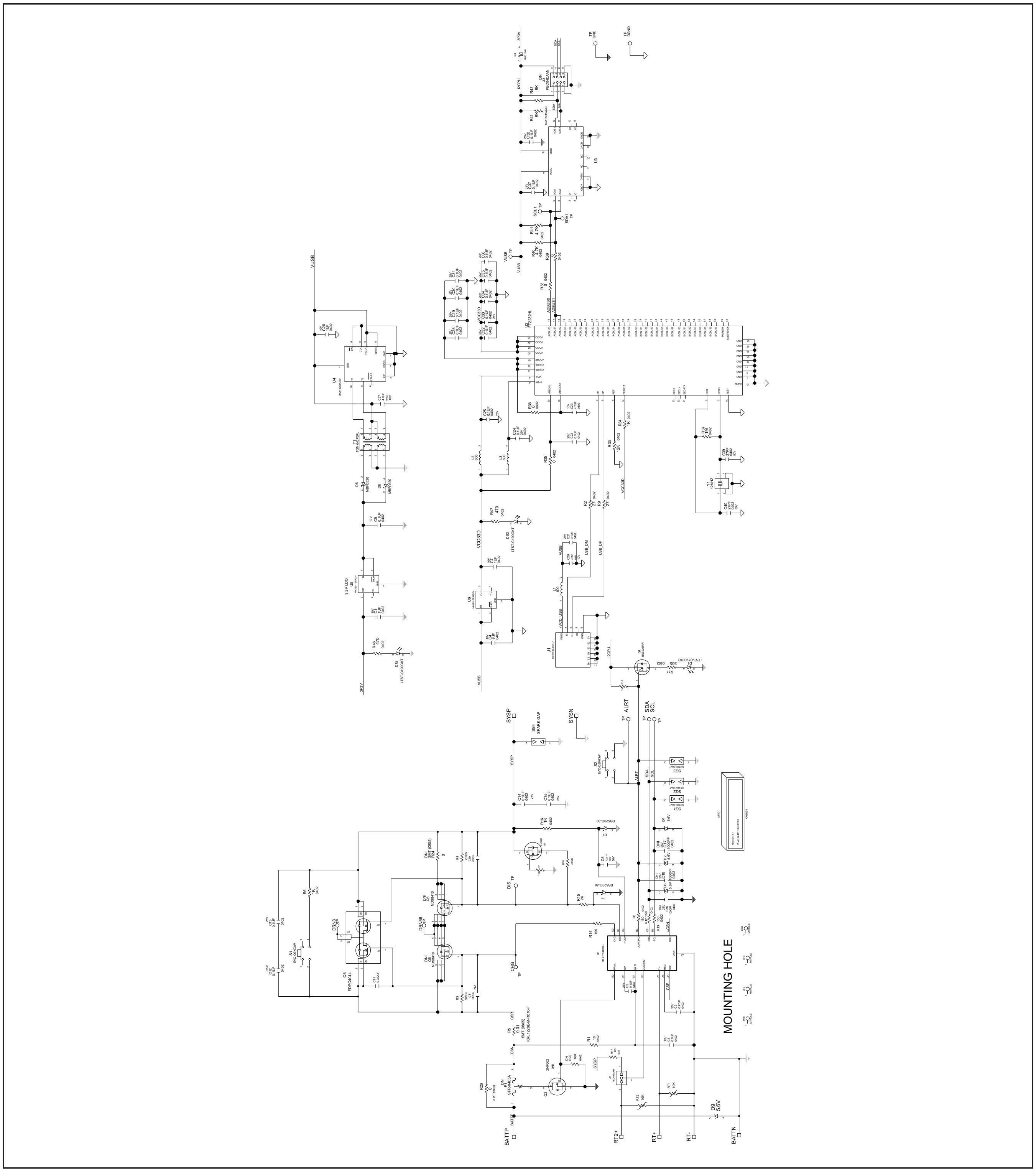
MAX17330 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
18	J2	—	1	PEC03SAAN	SULLINS	PEC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS
19	L1-L3	—	3	BLM18AG601SN1	MURATA	600	INDUCTOR; SMT (0603); FERRITE-BEAD; 600; TOL=+/-; 0.5A
20	MISC1	—	1	AK67421-1-R	ASSMANN	AK67421-1-R	CONNECTOR; MALE; USB; USB2.0 MICRO CONNECTION CABLE; USB B MICRO MALE TO USB A MALE; STRAIGHT; 5PINS-4PINS
21	Q1	—	1	2N7002;2N7002; 2N7002;2N7002	DIODES INCORPORATED; ST MICROELECTRONICS; ON SEMICONDUCTOR; MICRO COMMERCIAL COMPONENTS	2N7002	TRAN; ; NCH; SOT-23; PD-(0.33W); IC-(0.5A); VCEO-(60V); -55 DEGC TO +150 DEGC
22	Q3	—	1	FDPC4044	ON SEMICONDUCTOR	FDPC4044	TRAN; COMMON DRAIN N-CHANNEL POWERTRENCH MOSFET; NCH; POWERCLIP-33; PD-(2.7W); I-(27A); V-(30V)
23	Q4	—	1	BSS223PW	INFINEON	BSS223PW	TRAN; OPTIMOS SMALL-SIGNAL-TRANSISTOR; PCH; SOT323-3; PD-(0.25W); I-(-0.39A); V-(-20V)
24	R1	—	1	CRCW040210R0JN	VISHAY DALE	10	RES; SMT (0402); 10; 5%; +/-200PPM/DEGK; 0.0630W
25	R2, R9	—	2	ERJ-2RKF27R0X; RC0402FR-0727RL; CRCW040227R0FK	PANASONIC; YAGEO PHICOMP; VISHAY DALE	27	RES; SMT (0402); 27; 1%; +/-100PPM/DEGC; 0.0630W
26	R5	—	1	KRL1220E-M-R010-F	SUSUMU CO LTD.	0.01	RES; SMT (0805); 0.01; 1%; +/-50PPM/DEGC; 0.5W
27	R6, R16, R34	—	3	RC0402FR-071KL; MCR01MZPF1001	YAGEO; ROHM SEMICONDUCTOR	1K	RES; SMT (0402); 1K; 1%; +/-100PPM/DEGC; 0.0630W
28	R7	—	1	CRCW040210K0FK; RC0402FR-0710KL	VISHAY DALE; YAGEO PHICOMP	10K	RES; SMT (0402); 10K; 1%; +/-100PPM/DEGC; 0.0630W
29	R8, R12, R13	—	3	CRCW0402150RFK; 9C04021A1500FL	VISHAY DALE; YAGEO	150	RES; SMT (0402); 150; 1%; +/-100PPM/DEGC; 0.0630W
30	R10, R37	—	2	CRCW04021M00FK	VISHAY DALE	1M	RES; SMT (0402); 1M; 1%; +/-100PPM/DEGC; 0.0630W
31	R11	—	1	CR0402-16W-3650FT	VENKEL LTD.	365	RES; SMT (0402); 365; 1%; +/-100PPM/DEGK; 0.0630W
32	R14	—	1	9C04021A1000FL; RC0402FR-07100RL	PANASONIC; YAGEO PHYCOMP	100	RES; SMT (0402); 100; 1%; +/-100PPM/DEGC; 0.0630W
33	R15	—	1	ERA-2AEB202	PANASONIC	2K	RES; SMT (0402); 2K; 0.10%; +/-25PPM/DEGC; 0.0630W
34	R17	—	1	TNPW1206100RBE; RN73C2B100RB	TYCO ELECTRONICS; HOLSWORTHY	100	RES; SMT (1206); 100; 0.10%; +/-25PPM/DEGK; 0.2500W
35	R18	—	1	CRCW04024K02FK; ERJ-2RKF4021; RC0402FR-074K02L	VISHAY; PANASONIC;YAGEO	4.02K	RES; SMT (0402); 4.02K; 1%; +/-100PPM/DEGC; 0.0630W
36	R26	—	1	RC0805JR-070RL	YAGEO PHYCOMP	0	RES; SMT (0805); 0; 5%; JUMPER; 0.1250W
37	R33	—	1	CRCW040212K0FK; MCR01MZPF1202	VISHAY DALE; ROHM SEMICONDUCTOR	12K	RES; SMT (0402); 12K; 1%; +/-100PPM/DEGC; 0.0630W
38	R35, R36, R38, R39	—	4	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
39	R40, R41	—	2	CRCW04024K70FK; MCR01MZPF4701	VISHAY DALE; ROHM SEMICONDUCTOR	4.7K	RES; SMT (0402); 4.7K; 1%; +/-100PPM/DEGC; 0.0630W
40	R42, R43	—	2	PNM0402E5001BS	VISHAY DALE	5K	RES; SMT (0402); 5K; 0.10%; +/-25PPM/DEGC; 0.0500W
41	R46, R47	—	2	CRCW0402470RFK	VISHAY DALE	470	RES; SMT (0402); 470; 1%; +/-100PPM/DEGC; 0.0630W
42	RT1, RT2	—	2	NCP15XH103F03	MURATA	10K	THERMISTOR; SMT (0402); THICK FILM (NICKEL PLATED); 10K; TOL=+/-1%

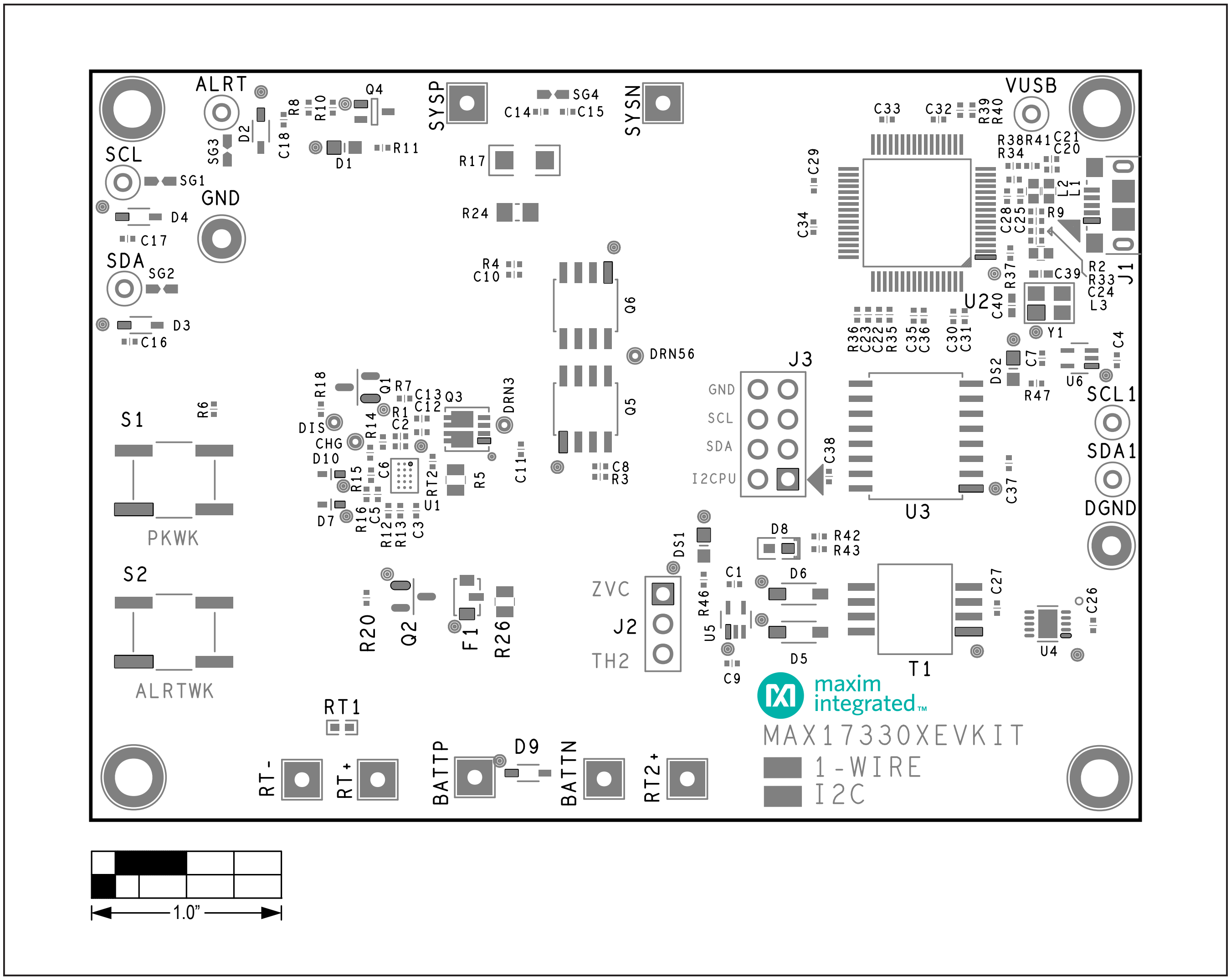
MAX17330 EV Kit Bill of Materials (continued)

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
43	S1, S2	—	2	EVQ-Q2K03W	PANASONIC	EVQ-Q2K03W	SWITCH; SPST; SMT; 15V; 0.02A; LIGHT TOUCH SWITCH; RCOIL= OHM; RINSULATION= OHM; PANASONIC
44	T1	—	1	TGM-040P3RL	HALO ELECTRONICS INC	TGM-040P3RL	TRANSFORMER; SMT; 1:1:1.3:1.3; PCMCIA DC/DC CONVERTER ;
45	U1	—	1	MAX17330X22+	MAXIM	MAX17330X22+	EVKIT PART - IC; MAX17330; 1-CELL MODELGAUGE M5 EZ FUEL GAUGE WITHCHARGER; PROTECTOR; INTERNAL SELF-DISCHARGEDETECTION AND SHA-256 AUTHENTICATIONPACKAGE OUTLINE DRAWING: 21-100433; PACKAGE CODE: W151J2+1
46	U2	—	1	FT2232HL	FUTURE TECHNOLOGY DEVICES INTL LTD.	FT2232HL	IC; MMRY; DUAL HIGH SPEED USB TO MULTIPURPOSE UART/FIFO; LQFP64
47	U3	—	1	MAX14937AWE+	MAXIM	MAX14937AWE+	IC; ISO; TWO CHANNEL; 5KVRMS I2C ISOLATOR; WSOIC16
48	U4	—	1	MAX13253ATB+	MAXIM	MAX13253ATB+	IC; DRV; 1A SPREAD-SPECTRUM; PUSH-PULL; TRANSFORMER DRIVER FOR ISOLATED POWER SUPPLIES; TDFN10-EP
49	U5, U6	—	2	MAX8511EXK33+	MAXIM	MAX8511EXK33+	IC; VREG; ULTRA-LOW-NOISE, HIGH PSRR, LOW-DROPOUT, LINEAR REGULATOR; SC70-5
50	VUSB	—	1	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
51	Y1	—	1	7M-12.000MAAJ	TXC CORPORATION	12MHZ	CRYSTAL; SMT; 12MHZ; 18PF; TOL = +/-30PPM; STABILITY = +/-30PPM
52	PCB	—	1	MAX17330	MAXIM	PCB	PCB:MAX17330
53	C16-C18	DNP	0	GRM1555C1E102JA01; C1005C0G1E102J050BA	MURATA;TDK	1000PF	CAP; SMT (0402); 1000PF; 5%; 25V; C0G; CERAMIC
54	F1	DNP	0	SFR-0405A	DEXERIALS	SFR-0405A	IC; PROT; SELF CONTROL PROTECTOR; SMT ;
55	J3	DNP	0	PBC04DAAN	SULLINS ELECTRONICS CORP.	PBC04DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 8PINS; -65 DEGC TO +125 DEGC
56	Q2	DNP	0	2N7002	NXP	2N7002	TRAN; N-CHANNEL TRENCH MOSFET; NCH; SOT-23; PD-(0.83W); I-(0.3A); V-(60V)
57	Q5, Q6	DNP	0	NDS8410A	FAIRCHILD SEMICONDUCTOR	NDS8410	MOSFET, N-CHANNEL, SO-8, PD=2.5W, ID=+/-10A, VDSS=30V, VGS=-20V, VSD=0.8V, RDS(ON)=0.013Ohm, -55degC TO +150degC
58	R20	DNP	0	CRCW040210K0JN	VISHAY DALE	10K	RES; SMT (0402); 10K; 5%; +/-200PPM/DEGC; 0.0630W
59	R24	DNP	0	RC0805JR-070RL	YAGEO PHYCOMP	0	RES; SMT (0805); 0; 5%; JUMPER; 0.1250W
60	C8, C10	DNP	0	N/A	N/A	OPEN	CAPACITOR; SMT (0402); OPEN; FORMFACTOR
61	R3, R4	DNP	0	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR
TOTAL			106				

MAX17330 EV Kit Schematic Diagram

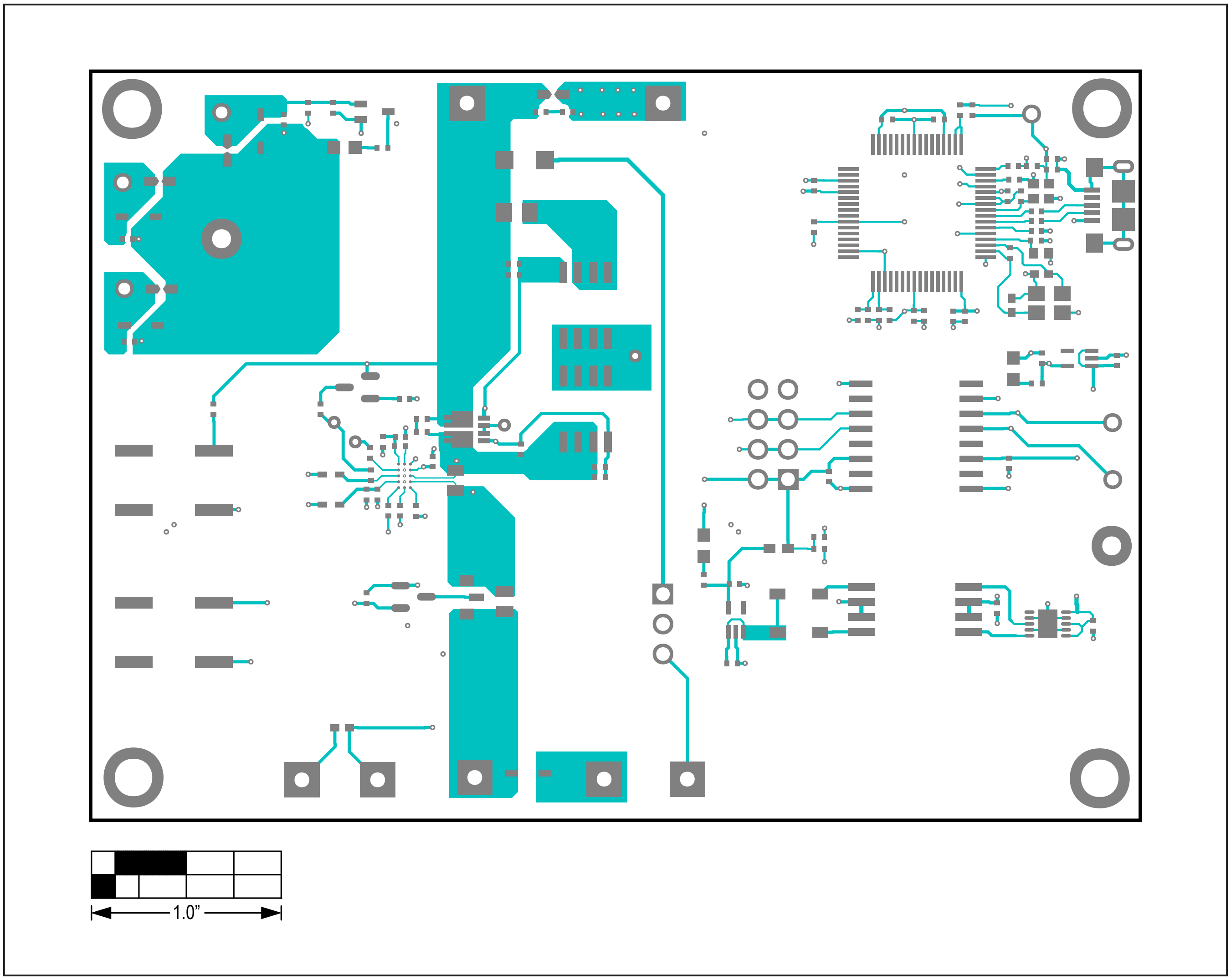


MAX17330 EV Kit PCB Layout Diagrams



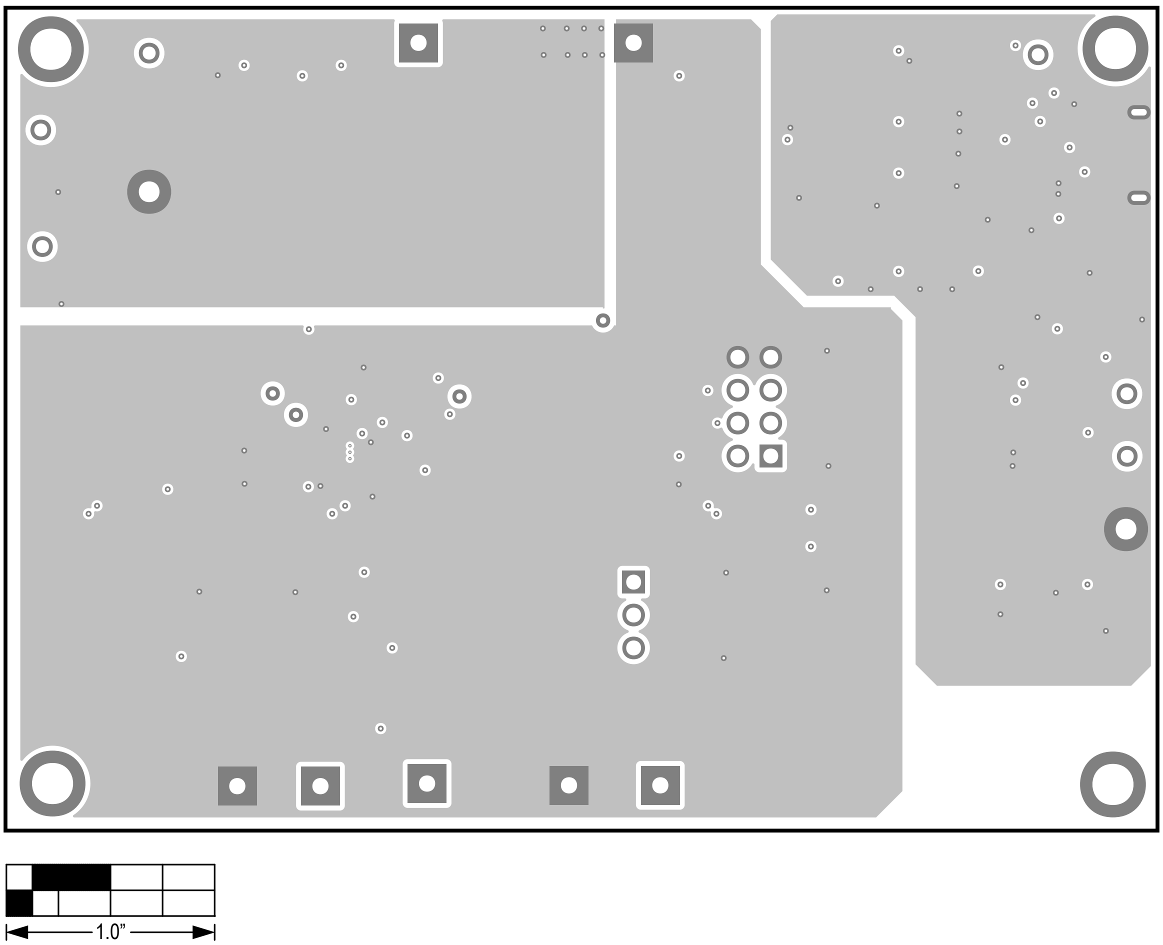
MAX17330 EV Kit Component Placement Guide—Top Silkscreen

MAX17330 EV Kit PCB Layout Diagrams (continued)



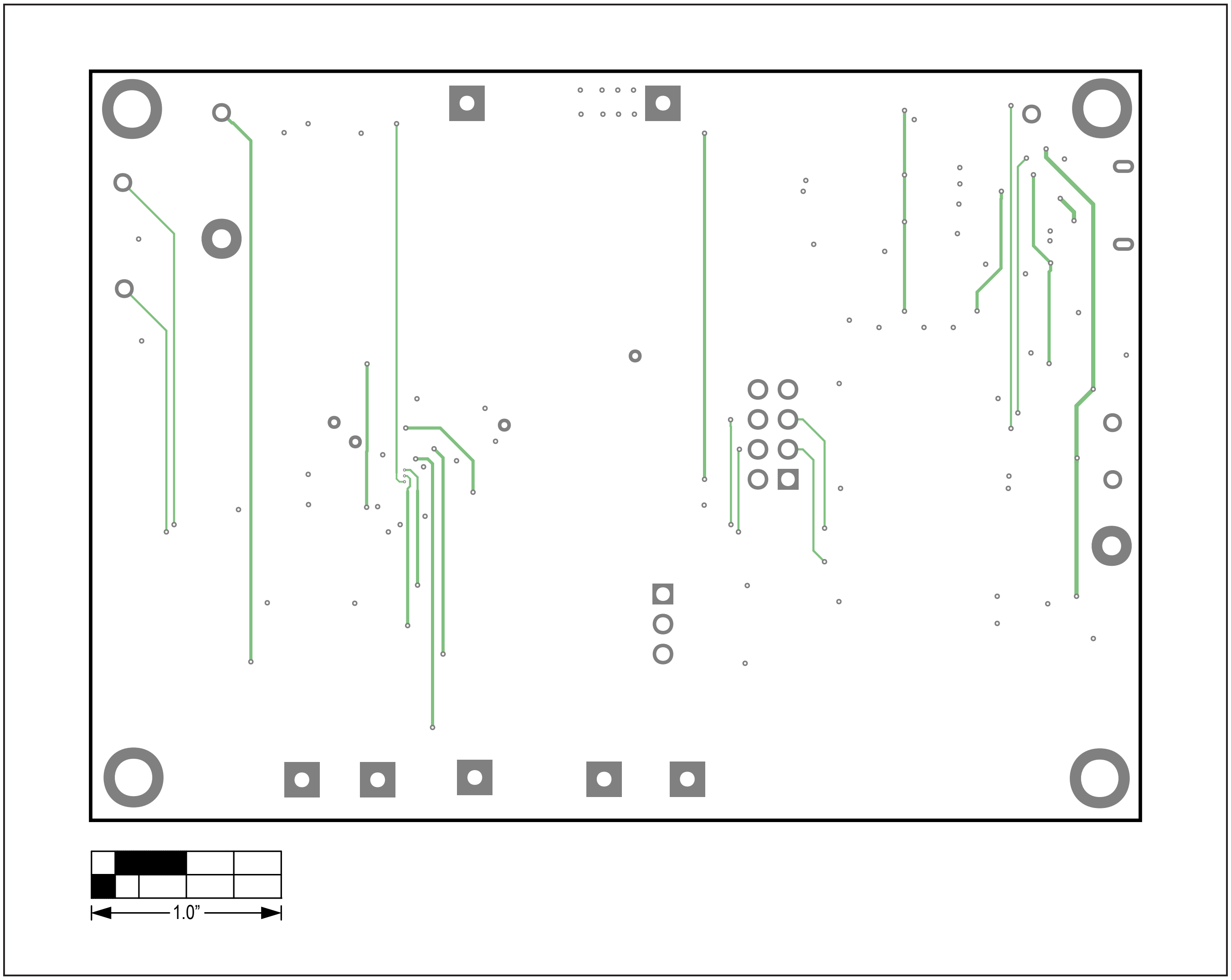
MAX17330 EV Kit PCB Layout Diagram—Top Layer

MAX17330 EV Kit PCB Layout Diagrams (continued)



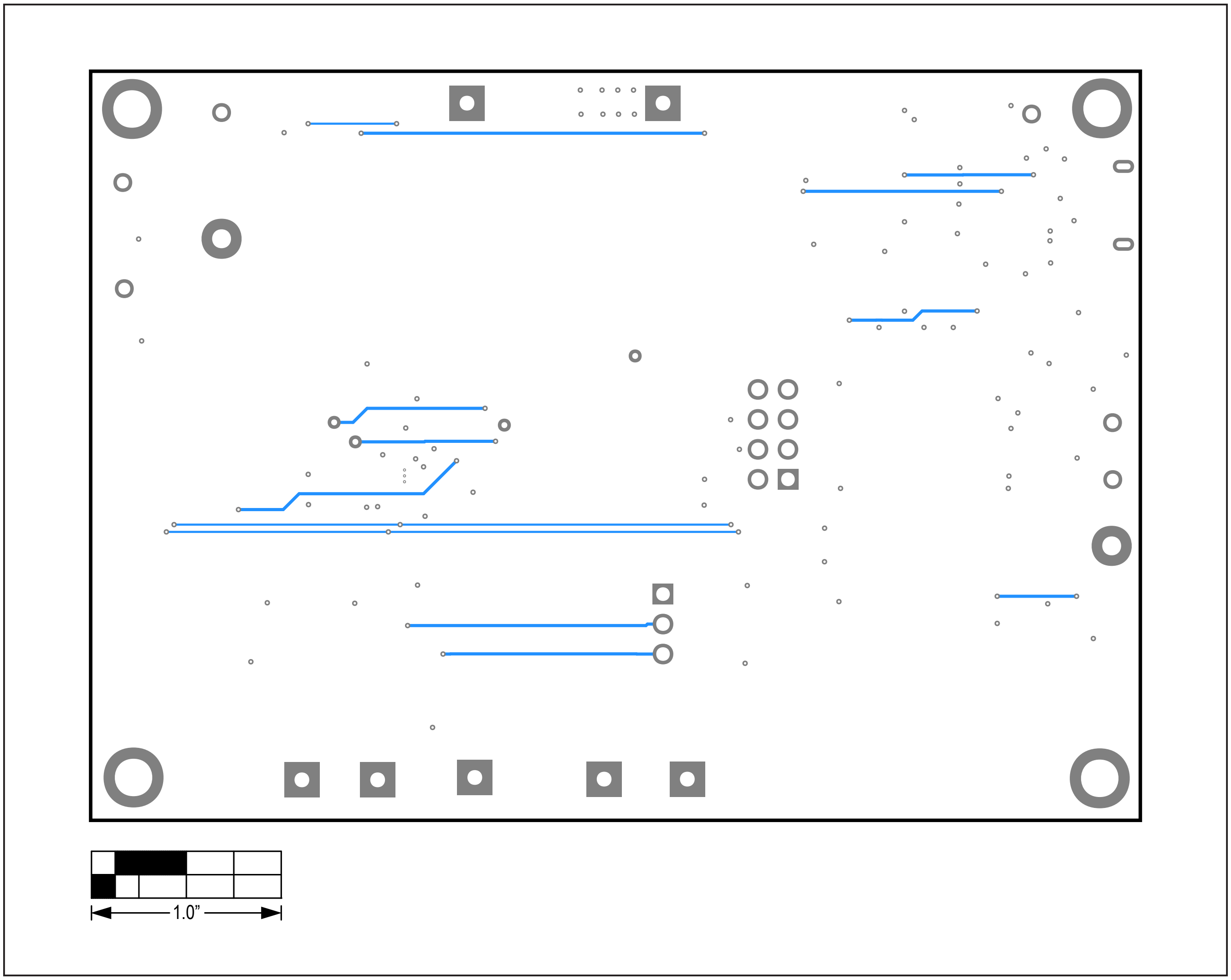
MAX17330 EV Kit PCB Layout Diagram—Layer 2

MAX17330 EV Kit PCB Layout Diagrams (continued)



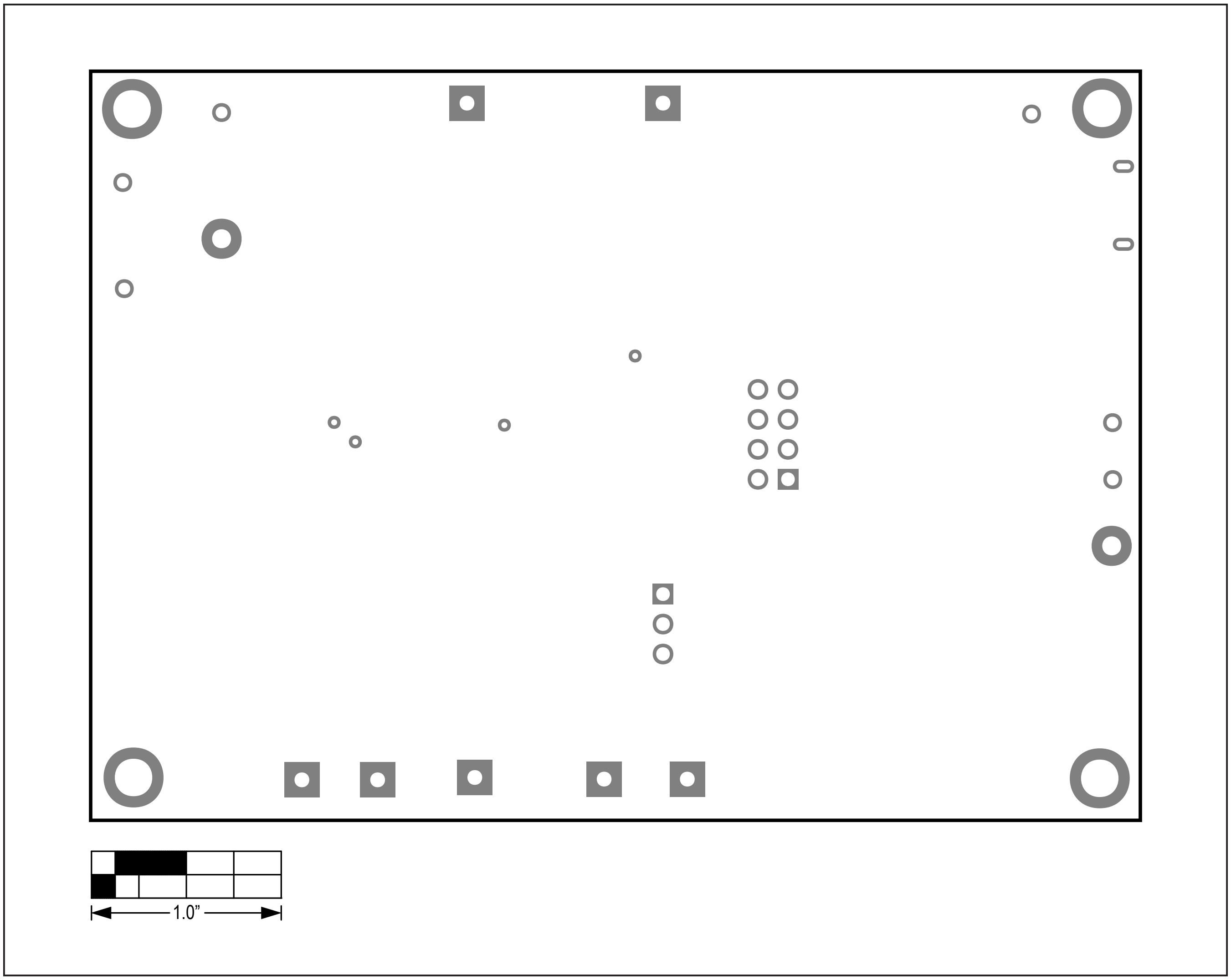
MAX17330 EV Kit PCB Layout Diagram—Layer 3

MAX17330 EV Kit PCB Layout Diagrams (continued)



MAX17330 EV Kit PCB Layout Diagram—Bottom Layer

MAX17330 EV Kit PCB Layout Diagrams (continued)



MAX17330 EV Kit PCB Layout Diagram—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/21	Initial release	—

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at https://www.maximintegrated.com/en/storefront/storefront.html.

