General Description

The MAX17055G/MAX17055X evaluation kits (EV kits) are fully assembled and tested surface-mount PCBs that evaluate the stand-alone ModelGauge™ m5 host-side fuel gauge ICs for lithium-ion (Li+) batteries in handheld and portable equipment.

The MAX17055G/MAX17055X EV kits include the Maxim DS91230+ USB interface, IC evaluation board, and RJ-11 connection cable. Windows® based graphical user interface (GUI) software is available for use with the EV kit and can be downloaded from Maxim's website **www.maximintegrated.com/evkitsoftware**. Windows 7 or newer Windows operating system is required to use the EV kit GUI software.

Features

- ModelGauge m5 Algorithm
- Monitors 1-Cell Lithium-Ion Battery Packs
- Battery Pack Input Voltage Range of +2.3V to +4.9V
- On-chip Temperature Measurement and External Thermistor Measurement Network
- Optional On-Board PCB Trace Sense Resistor
- Windows 7 or Newer Compatible Software
- Proven PCB Layout
- Fully Assembled and Tested

MAX17055K EV Kit Files

FILE	DECRIPTION
MAX17055K_Vx_x_x_x_Install.exe	Installs all EV kit files on your computer

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

Quick Start

Required Equipment

- MAX17055G/MAX17055X EV kit
- 1-cell lithium-ion battery pack
- Battery charger or power supply
- Load circuit
- DS91230+ USB adapter
- RJ-11 6pos reverse modular cord
- PC with Windows 7 or newer Windows operating system and USB port

Procedure

The EV kits are fully assembled and tested. Follow the steps below to install the EV kit software, make required hardware connections, and start operation of the kits. The EV kit software can run without hardware attached. It automatically locates the hardware when connections are made. Note that after communication is established, the IC must still be configured correctly for the fuel gauge to be accurate. See the *Battery Selection* section for details.

1) Visit **www.maximintegrated.com/evkitsoftware** to download the latest version of the MAX17055K EV kit software. Save the EV kit software to a temporary folder and unpack the ZIP file.
2) Install the EV kit software on your computer by running the MAX17055K_Install.exe program inside the temporary folder. The program files are copied and icons are created in the Windows **Start** menu. The software requires the .NET Framework 4.5 or later. If you are connected to the Internet, Windows automatically updates .NET framework as needed.

19-8760; Rev 0; 1/17

maxim integrated™

3) The EV kit software launches automatically after install or alternatively it can be launched by clicking on its icon in the Windows **Start** menu.
4) Connect the DS91230+ adapter to a USB port on the PC. The DS91230+ is a HID device and is located automatically by Windows without the need to install additional drivers.
5) Make connections to the EV kit board based on cell pack configuration as shown in Figure 1. The load or charger circuit can be connected at this time as well. The cell connects between the PACK- and PACK+ pads and the charger/load connect between the SYSGND- and SYSPWR+ pads.
6) Connect the RJ-11 cable between the USB adapter and the EV kit board. The GUI software establishes communication automatically.
7) At initial power-up, a battery profile must be created. The battery selection window opens and allows the user to generate a profile for the battery they are using. They can either select EZ configuration or if a custom .INI characterization file is available for the battery it can be selected at this time. See the *Battery Selection* section for details.

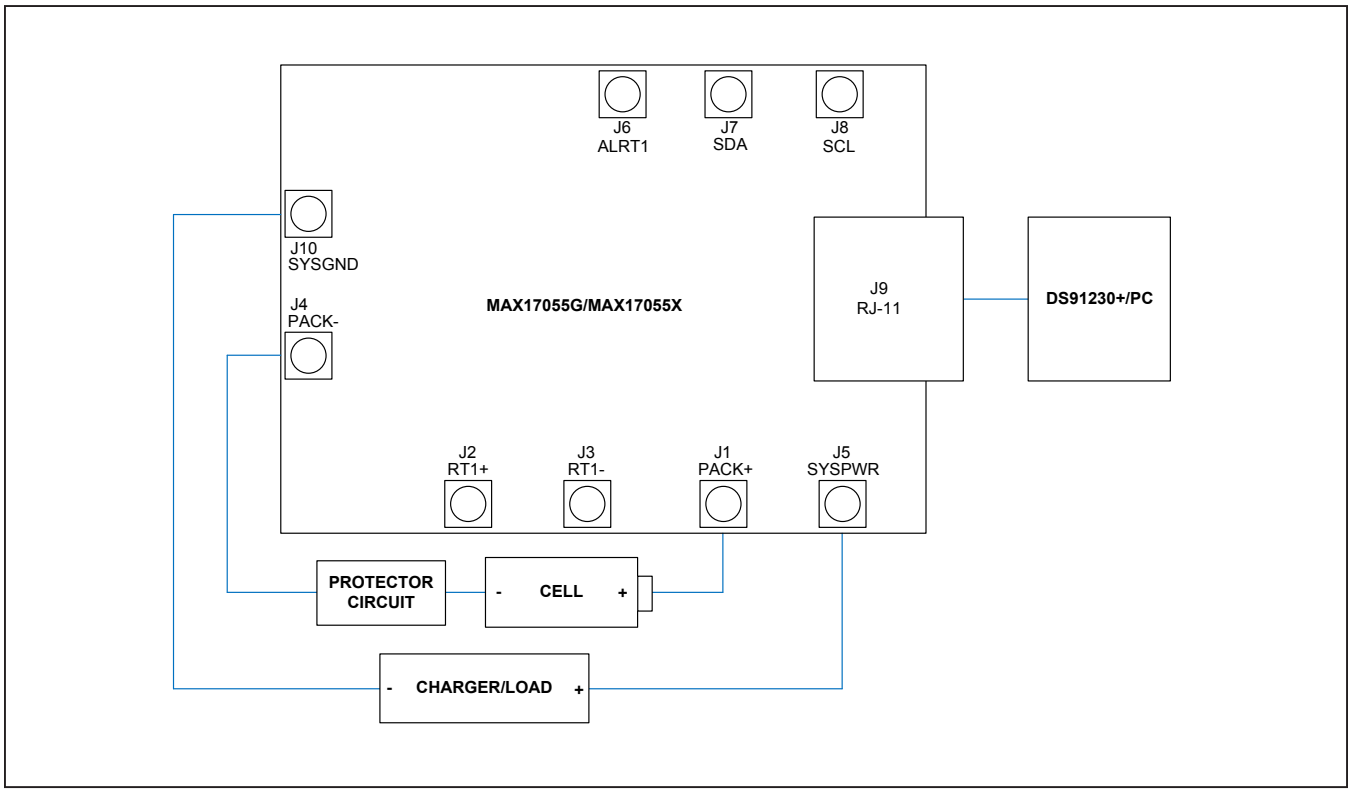


Figure 1. MAX17055 Board Connections

Detailed Description of Hardware

The MAX17055 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 RJ-11 connector provides all signal lines necessary for I2C communication between the IC and the software GUI interface. When developing code separately, connections to the communication lines can be made directly to the board. Table 1 summarizes the connections. The user must apply the appropriate external pullup resistors to the communication lines when not using the DS91230+ communication interface.

External Thermistor

The MAX17055 can be configured to use internal temperature measurements or an external thermistor. All EV kit boards come with a thermistor installed as surface mount component RT1. If the application requires direct thermal contact to the cells, RT1 can be removed and replaced with a leaded thermistor connected between the RT1+/RT1- solder pads (J2 and J3).

Sense Resistor Options

All EV kit boards are shipped with an 0805 size 0.010Ω chip sense resistor installed. Oversized land pattern pads allow for different size sense resistors to be used if desired. Also, each board contains an optional 0.003Ω copper trace sense resistor that can be enabled if desired. To do so, the chip sense resistor must be removed and 0Ω jumpers must be resoldered to change the circuit. Table 2 summarizes the changes. Note that the IC must be reconfigured to support the new resistor type.

Detailed Description of Software

The MAX17055G/MAX17055X evaluation kit software gives the user complete control of all functions of the MAX17055, as well as the ability to load a custom model into the ICs. 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.

Software Installation

The software requires a Windows 7 or newer operating system. .NET version 4.5 is required for operation and is automatically installed if an older version of .NET framework is detected. To install the evaluation software, exit all programs currently running and unzip the provided MAX17055K Installation Package zipped file.

Double click the MAX17055K_V_x_x_x_x Install.exe icon and the installation process begins. Follow the prompts to complete the installation. The evaluation software can be uninstalled in the **Add/Remove** programs tool in the **Control Panel**. After the installation is complete, open the **Maxim Integrated/MAX17055K** folder and run **MAX17055K.exe** or select it from the program menu. Figure 2 shows a splash screen containing information about the evaluation kit that appears while program is loading.

Table 1. Communication Line Solder Points

COMMUNICATION LINE	CONNECTION POINT
SDA	J7
SCL	J8
GND	J10

Table 2. Sense Resistor Selection for MAX17055

COMPONENT	VALUE FOR SMD RESISTOR SENSE	VALUE FOR BOARD TRACE SENSE
R3	0Ω	Not populated
R4	Not populated	0Ω
R5	Desired sense value	Not populated
R6	Not populated	0Ω (R7 is trace resistor)

Communication Port

The EV kit software automatically finds the DS91230+ adapter 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 adapter cannot be found, a "No USB Adapter" message is displayed. If the adapter is found, but the EV kit board cannot be found, a "No Slave Device" message is displayed. Otherwise, if communication is valid, a green bar updates as the software continuously reads the IC registers.

If the DS91230+ is connected, the status bar should be active. The bottom status bar also displays information on hibernation status, IC serial number, selected current-sense resistor value, selected battery profile, and IC's firmware revision.

Battery Selector

The MAX17055 must always have a battery profile for the battery it is presently fuel gauging. The first time the MAX17055K software is run, the **Battery Selector Form** opens automatically to allow the user to set up the first profile. Afterwards, the user can launch the form either from the **Configure** tab or the **Device** pull-down menu. A new profile should be created for each individual battery monitored by the IC. Care should also be taken to always have the correct profile selected for the battery that is attached to the IC so that the fuel gauge is accurate and that save and restore information is properly maintained. Battery profile files are stored under **My Documents/Maxim Integrated/MAX17055/Batteries**. Custom .INI files are also automatically copied by the program to this location as well.

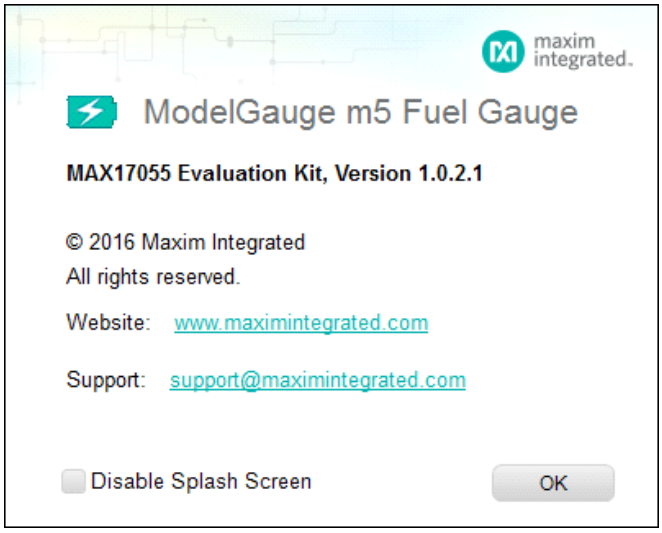


Figure 2. EV Kit Splash Screen

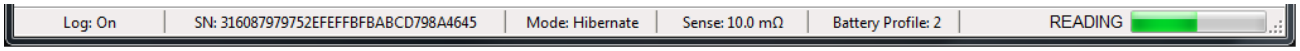


Figure 3. EV Kit Bottom Status Bar

Figure 4 shows the format of the Battery Selector Form. To change known batteries, the user should select the proper battery profile from the pull-down box and then click **Save Profile and Update IC**. To create a profile for a new battery, follow these steps:

1) Select a new profile number from the **Battery Profile** pull-down box.
2) Give the profile a detailed description so that it can easily be matched to its battery.
3) If no custom .INI file has been created, select the **Use Default IC Settings (EZ Config)** option and fill out the five settings for your application. Proceed to Step 5.
4) If a custom .INI file has been provided by Maxim, select **Load INI File** option and select the file.
5) Select to restore battery history data after model load or not to.
6) Click **Save Profile and Update IC** to load the model and exit the form.

If the user ever wishes to delete a battery profile, select the profile number from the drop-down box and then click **Delete Profile** to remove it permanently.

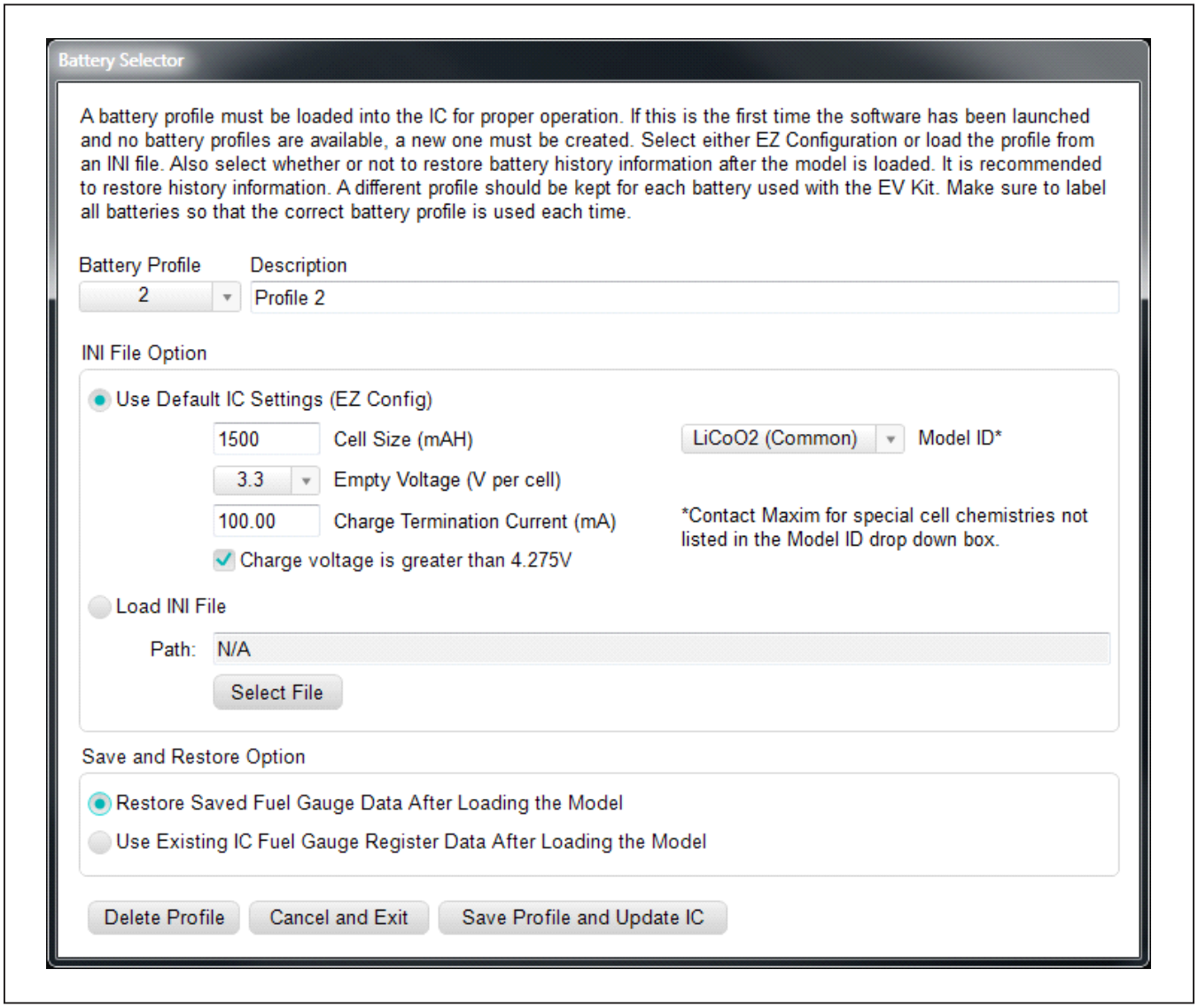


Figure 4. Battery Selector Form

Program Tabs

All functions of the program are divided under four 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 **Graphs** tab visually displays fuel gauge register changes over time. The **Registers** tab allows the user to modify common fuel gauge registers one at a time. The **Configure** tab allows for special operations such as initiating fuel gauge logging and performing fuel gauge reset. All tabs are described in more detail in the following sections.

ModelGauge m5 Tab

The **ModelGauge m5** tab displays the important output information read from the IC. Figure 5 shows the format of the ModelGauge m5 Tab. Information is grouped by function and each is detailed separately.

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.

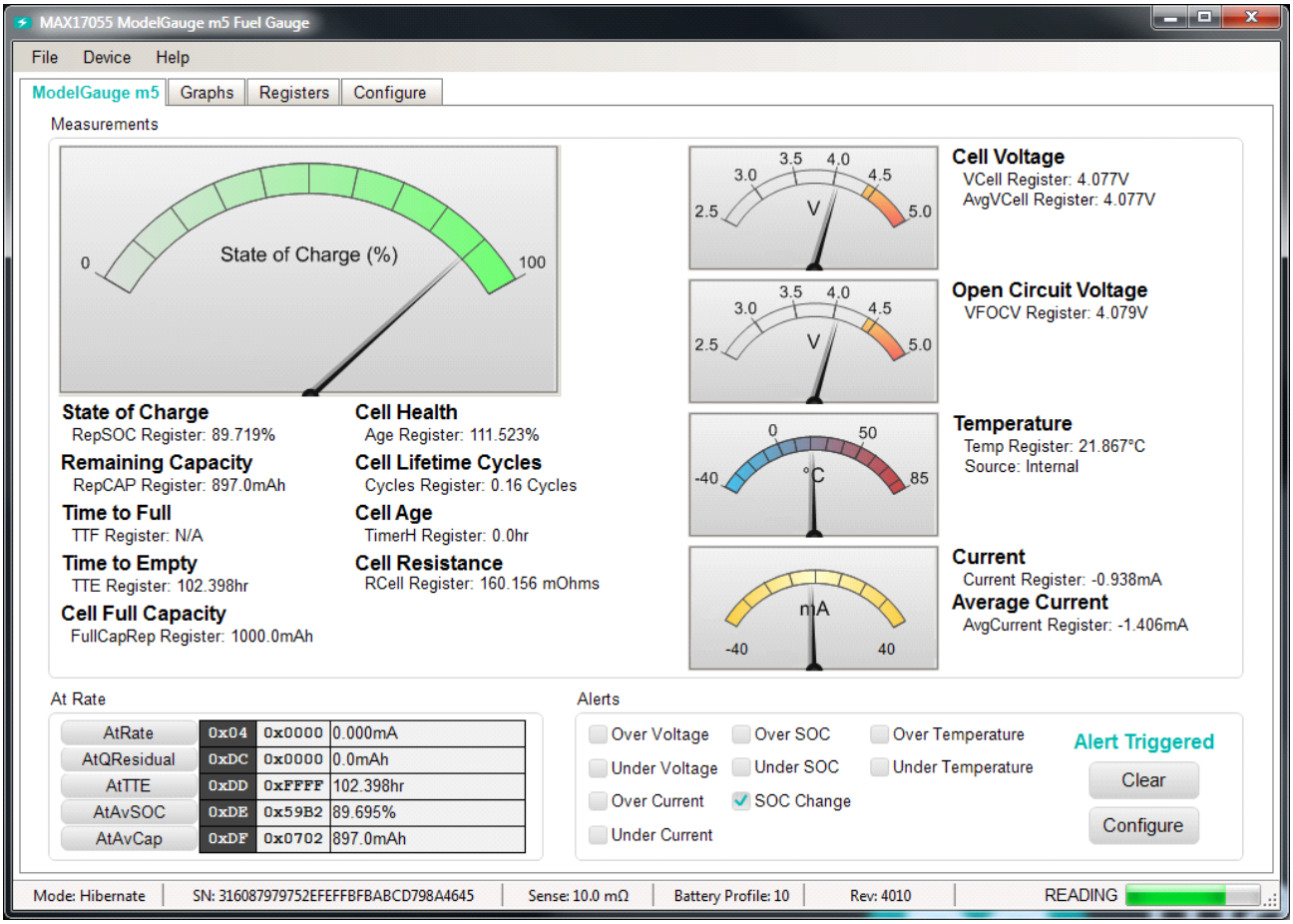


Figure 5. ModelGauge m5 Tab

Measurements

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

Alerts

The **Alerts** group box tracks all eleven possible alert trigger conditions. If any alert occurs, the corresponding checkbox is checked for the user to see. The clear alerts button resets all alert flags. The configure button allows the alert threshold settings to be changed by the user. Figure 6 shows the **Alerts Configuration** application form.

At Rate

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

Graphs Tab

The **Graphs** tab displays up to 13 fuel gauge outputs. Figure 7 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 check boxes 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 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.

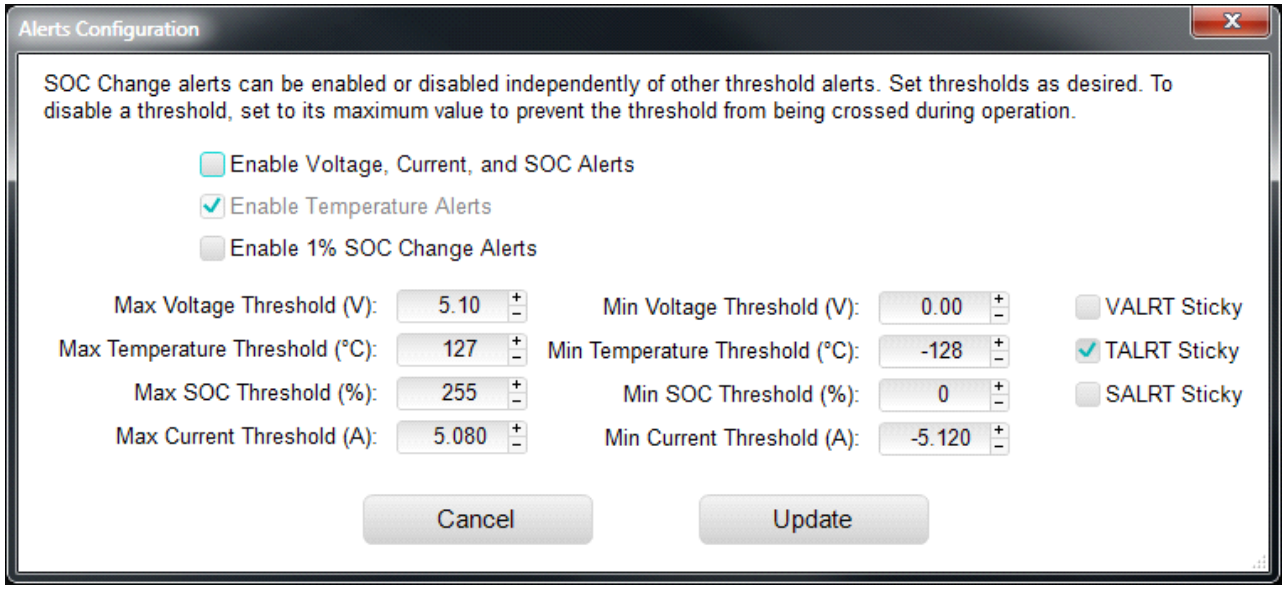


Figure 6. Alerts Configuration Form

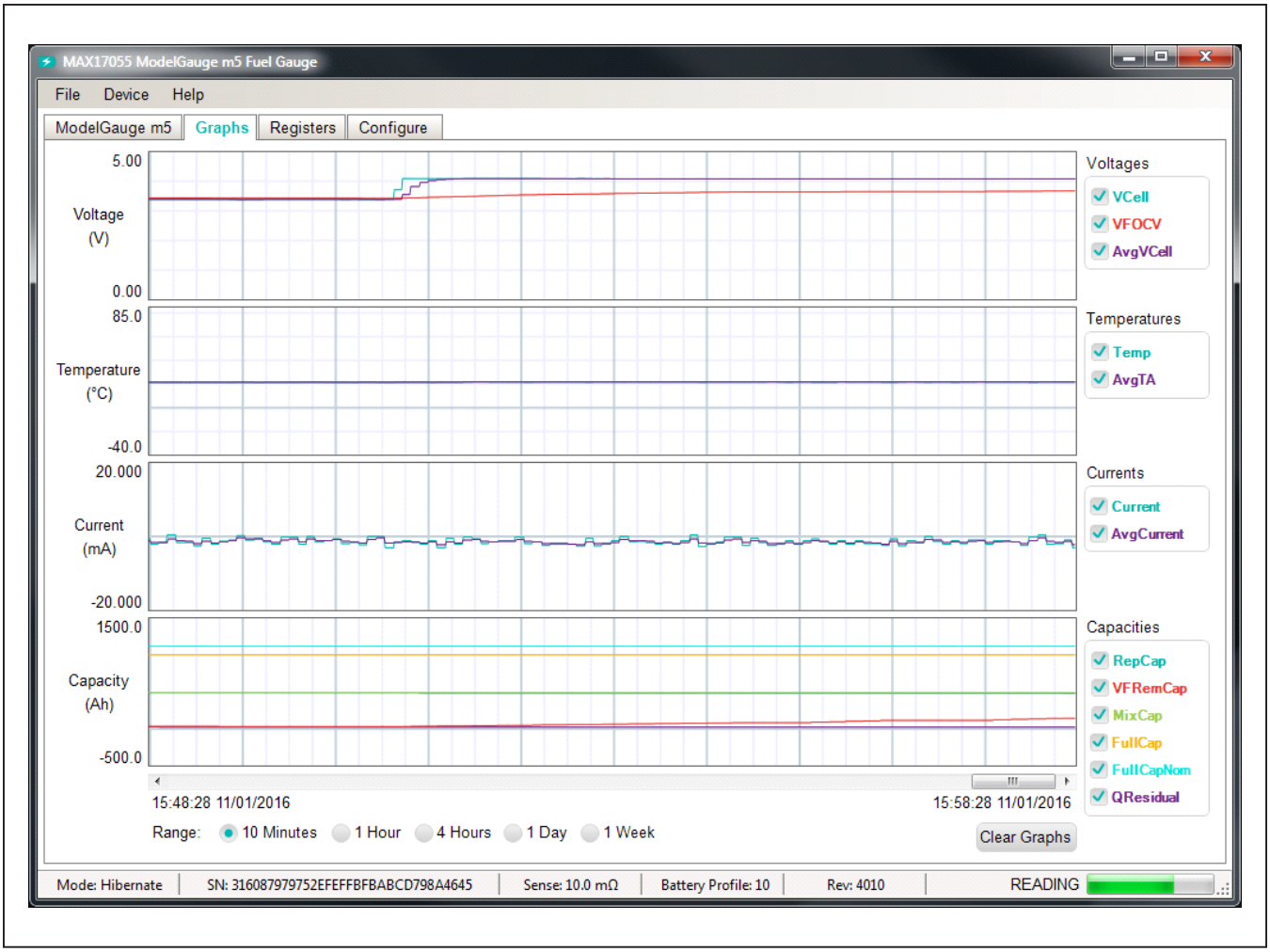


Figure 7. Graphs Tab

Registers Tab

The **Registers** tab allows the user access to all fuel gauge related registers of the IC. Figure 8 shows the format of the **Registers** tab. By using the drop-down menu on the left side of the tab, the user can sort the registers either by function or by their internal address. Each line of data contains the register name, register address, hexadecimal representation of the data stored in the register, and if applicable a conversion to application units. To write a register location 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.

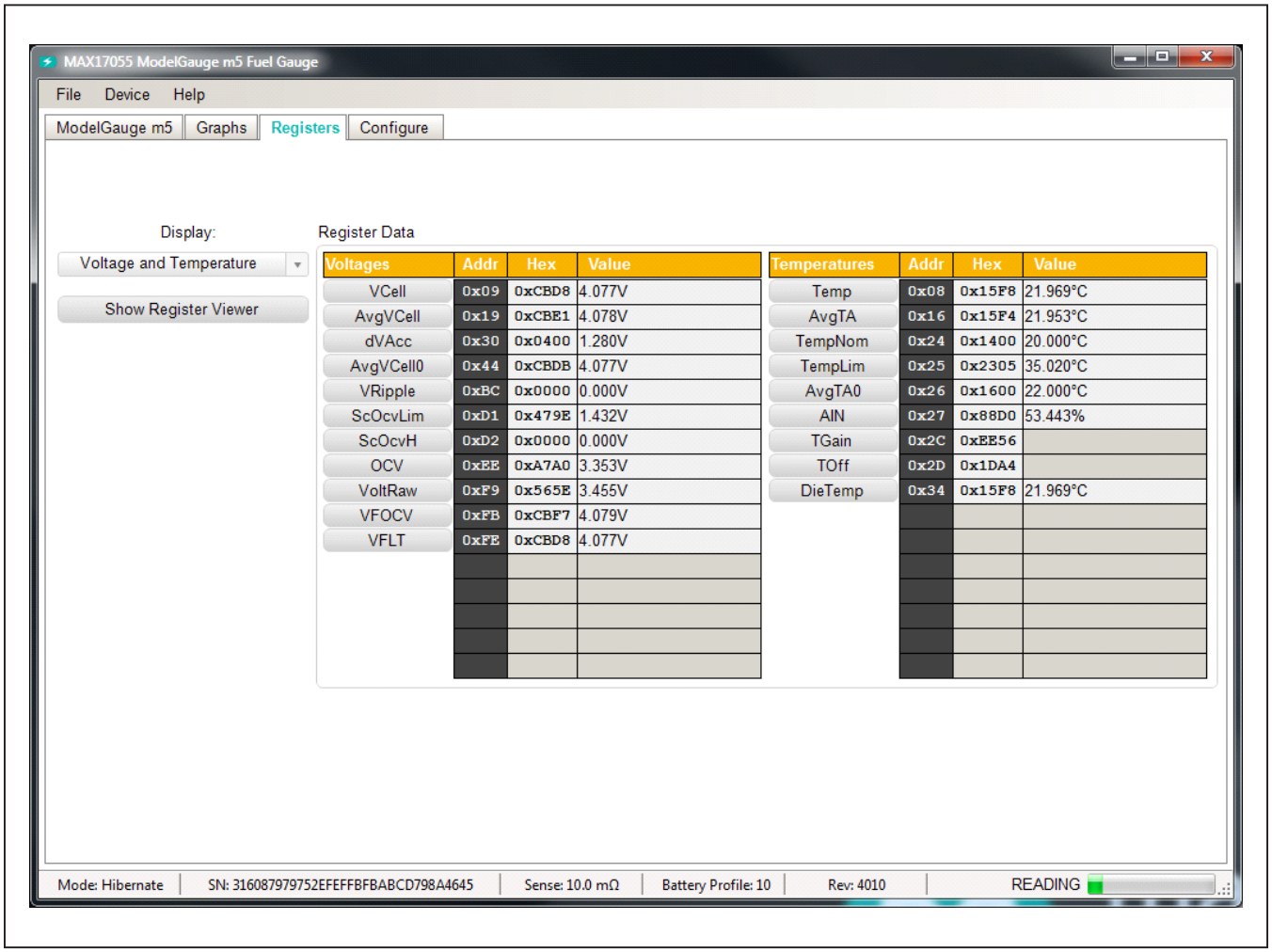
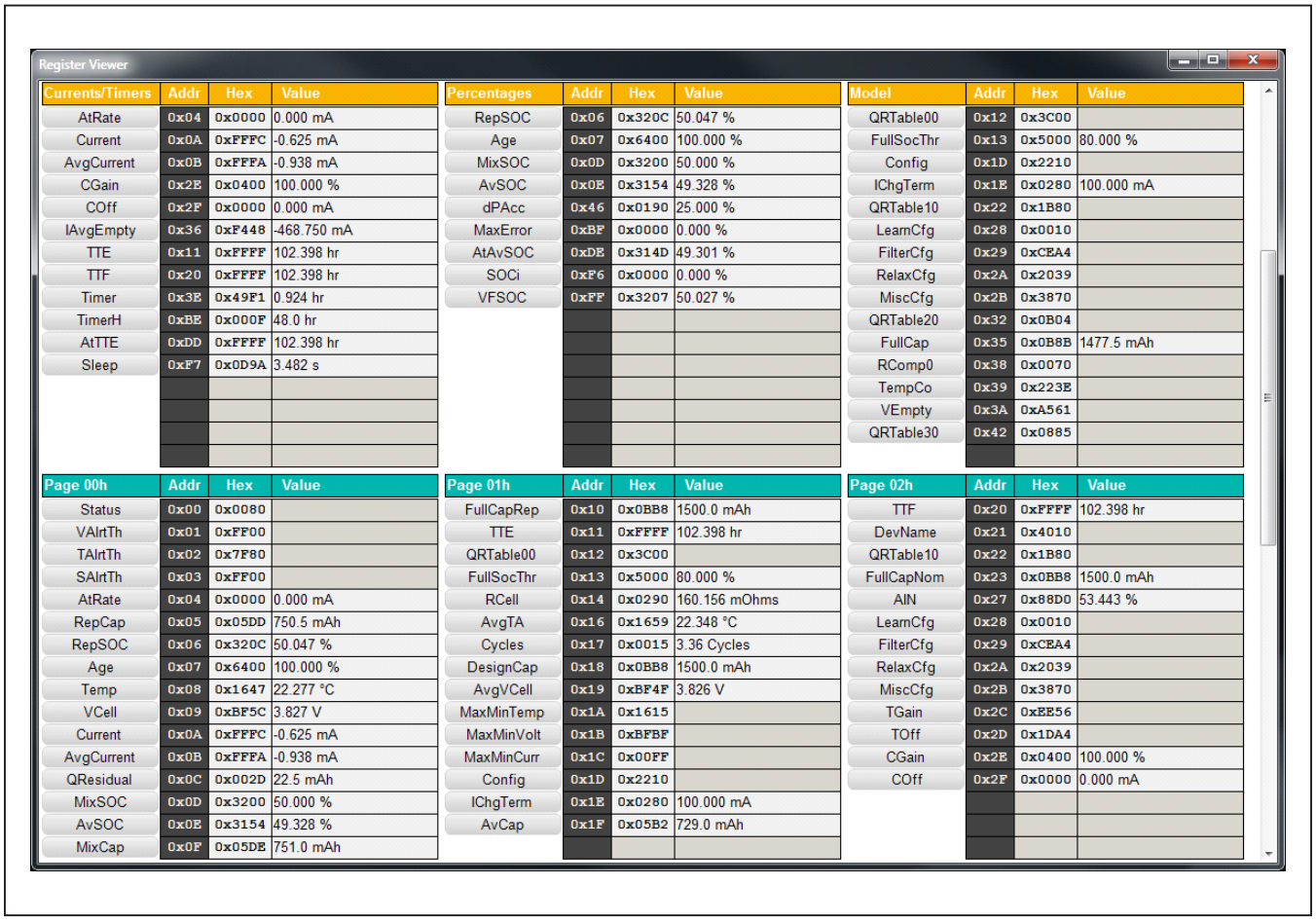


Figure 8. Registers Tab

The **Registers** tab has a button to launch the register viewer form. The viewer can also be launched under the Device pull-down menu. The register viewer is a separate application window that allows systems with higher screen resolutions to see more IC registers simultaneously.

A 1920 x 1080 screen resolution allows the user to view all user registers at once on the screen with the register viewer. The viewer size can be adjusted. Figure 9 shows the format of the register viewer form.



Currents/Timers	Addr	Hex	Value
AtRate	0x04	0x0000	0.000 mA
Current	0x0A	0xFFFC	-0.625 mA
AvgCurrent	0x0B	0xFFFA	-0.938 mA
CGain	0x2E	0x0400	100.000 %
COff	0x2F	0x0000	0.000 mA
IAvgEmpty	0x36	0xF448	-468.750 mA
TTE	0x11	0xFFFF	102.398 hr
TTF	0x20	0xFFFF	102.398 hr
Timer	0x3E	0x49F1	0.924 hr
TimerH	0xBE	0x000F	48.0 hr
AtTTE	0xDD	0xFFFF	102.398 hr
Sleep	0xF7	0x0D9A	3.482 s

Percentages	Addr	Hex	Value
RepSOC	0x06	0x320C	50.047 %
Age	0x07	0x6400	100.000 %
MixSOC	0x0D	0x3200	50.000 %
AvSOC	0x0E	0x3154	49.328 %
dPAcc	0x46	0x0190	25.000 %
MaxError	0xBF	0x0000	0.000 %
AtAvSOC	0xDE	0x314D	49.301 %
SOCi	0xF6	0x0000	0.000 %
VFSOC	0xFF	0x3207	50.027 %

Model	Addr	Hex	Value
QRTable00	0x12	0x3C00	
FullSocThr	0x13	0x5000	80.000 %
Config	0x1D	0x2210	
IChgTerm	0x1E	0x0280	100.000 mA
QRTable10	0x22	0x1B80	
LearnCfg	0x28	0x0010	
FilterCfg	0x29	0xCEA4	
RelaxCfg	0x2A	0x2039	
MiscCfg	0x2B	0x3870	
QRTable20	0x32	0x0B04	
FullCap	0x35	0x0B8B	1477.5 mAh
RComp0	0x38	0x0070	
TempCo	0x39	0x223E	
VEmpty	0x3A	0xA561	
QRTable30	0x42	0x0885	

Page 00h	Addr	Hex	Value
Status	0x00	0x0080	
VAlrtTh	0x01	0xFF00	
TAlrtTh	0x02	0x7F80	
SAlrtTh	0x03	0xFF00	
AtRate	0x04	0x0000	0.000 mA
RepCap	0x05	0x05DD	750.5 mAh
RepSOC	0x06	0x320C	50.047 %
Age	0x07	0x6400	100.000 %
Temp	0x08	0x1647	22.277 °C
VCell	0x09	0xBF5C	3.827 V
Current	0x0A	0xFFFC	-0.625 mA
AvgCurrent	0x0B	0xFFFA	-0.938 mA
QResidual	0x0C	0x002D	22.5 mAh
MixSOC	0x0D	0x3200	50.000 %
AvSOC	0x0E	0x3154	49.328 %
MixCap	0x0F	0x05DE	751.0 mAh

Page 01h	Addr	Hex	Value
FullCapRep	0x10	0x0BB8	1500.0 mAh
TTE	0x11	0xFFFF	102.398 hr
QRTable00	0x12	0x3C00	
FullSocThr	0x13	0x5000	80.000 %
RCell	0x14	0x0290	160.156 mOhms
AvgTA	0x16	0x1659	22.348 °C
Cycles	0x17	0x0015	3.36 Cycles
DesignCap	0x18	0x0BB8	1500.0 mAh
AvgVCell	0x19	0xBF4F	3.826 V
MaxMinTemp	0x1A	0x1615	
MaxMinVolt	0x1B	0xBFBF	
MaxMinCurr	0x1C	0x00FF	
Config	0x1D	0x2210	
IChgTerm	0x1E	0x0280	100.000 mA
AvCap	0x1F	0x05B2	729.0 mAh

Page 02h	Addr	Hex	Value
TTF	0x20	0xFFFF	102.398 hr
DevName	0x21	0x4010	
QRTable10	0x22	0x1B80	
FullCapNom	0x23	0x0BB8	1500.0 mAh
AIN	0x27	0x88D0	53.443 %
LearnCfg	0x28	0x0010	
FilterCfg	0x29	0xCEA4	
RelaxCfg	0x2A	0x2039	
MiscCfg	0x2B	0x3870	
TGain	0x2C	0xEE56	
TOff	0x2D	0x1DA4	
CGain	0x2E	0x0400	100.000 %
COff	0x2F	0x0000	0.000 mA

Figure 9. Register Viewer Form

Configure Tab

The **Configure** tab allows the user to access any general IC functions not related to normal writing and reading of register locations. Figure 10 shows the format of the **Configure** tab. Each group box of the **Configure** tab is described in detail in the following sections.

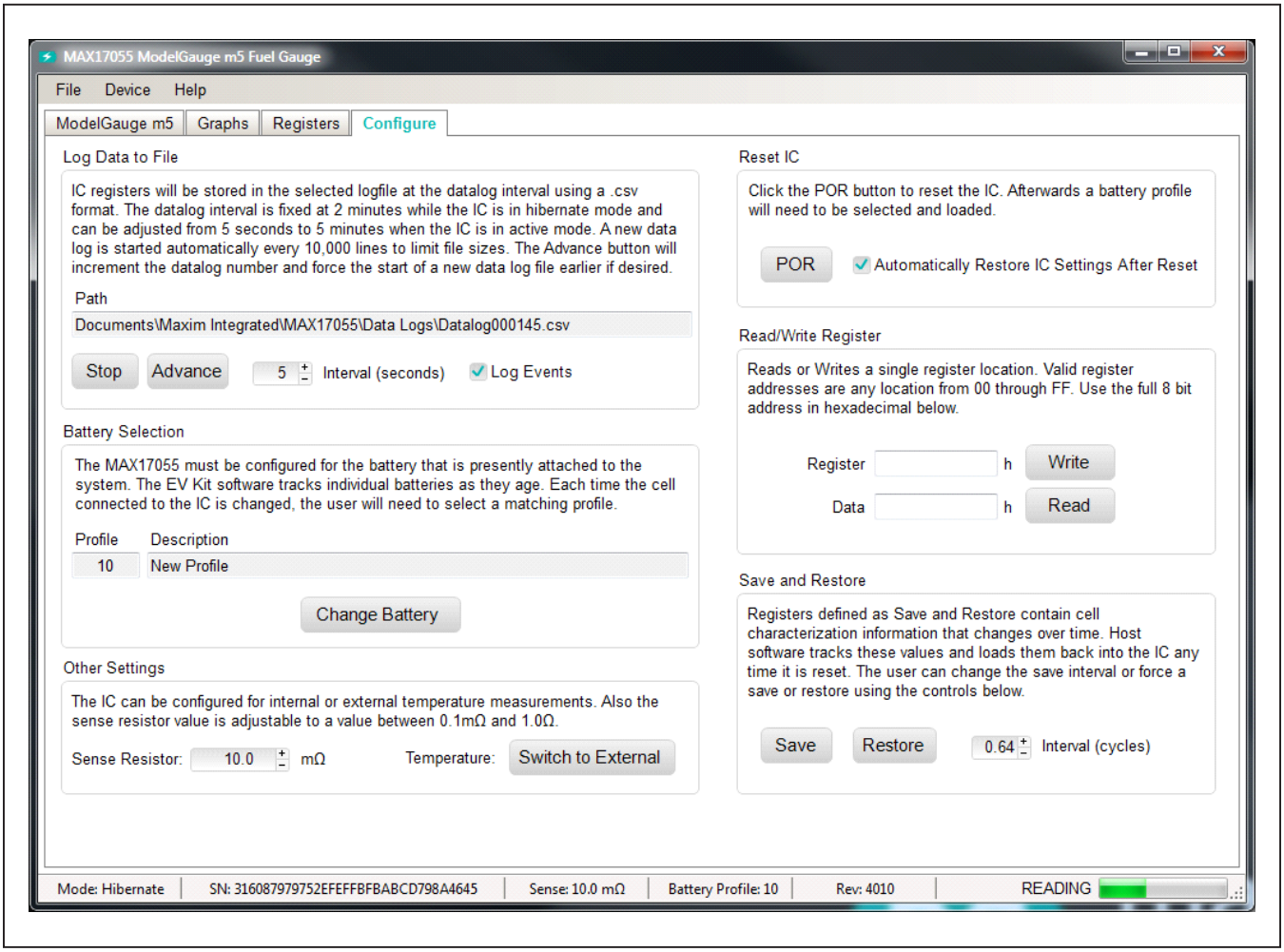


Figure 10. Configure Tab

Log Data to File

Data logging is always active when the kit software starts. The default data log storage location is the My Documents/Maxim Integrated/MAX17055/Data Logs/DatalogXXXXXX.csv where XXXXXX is the data log number. Each time the program is started, the previous data log reaches 10,000 lines, or the user clicks the **Advance** button, a new data log is started and the data log number is advanced. The user can stop or start data logging by clicking the **Stop/Start** button. 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.

Battery Selection

The battery selection box shows which battery profile is presently selected and the user description of that profile. Clicking the **Change Battery** button opens the **Battery Selector Form** to allow the user to change the active profile, create a new profile, or delete old profiles. See the Battery Selector section for details.

Other Settings

The other settings box allows the user to change the sense resistor setting and select either internal or external temperature measurement. All capacity and current type registers use the sense resistor value to convert voltage to current and updates occur immediately when the sense resistor value is changed.

Reset IC

Clicking the **POR** button starts the IC firmware reset sequence. Operation of the IC is restarted. If the associated check box is checked, IC settings such as the battery model, thermistor selection, and alert thresholds are reloaded into the IC. It is recommended this box always remained checked. Note that resetting the IC when the cell is not relaxed causes a temporary fuel gauge error.

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.

Save and Restore

The EV kit software periodically saves the values from registers related to cell characteristics that change over time. These values are then restored into an IC after reset so that the fuel gauge remains accurate as the cell ages. The software automatically performs a save operation every 64% of one cycle or when the software exits. The user can change the save interval or force a save operation at any time by clicking the **Save** button. To restore this information after the IC has been power cycled or reset through software, click the **Restore** button.

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 you are using the MAX17055 when contacting these component suppliers.*

Ordering Information

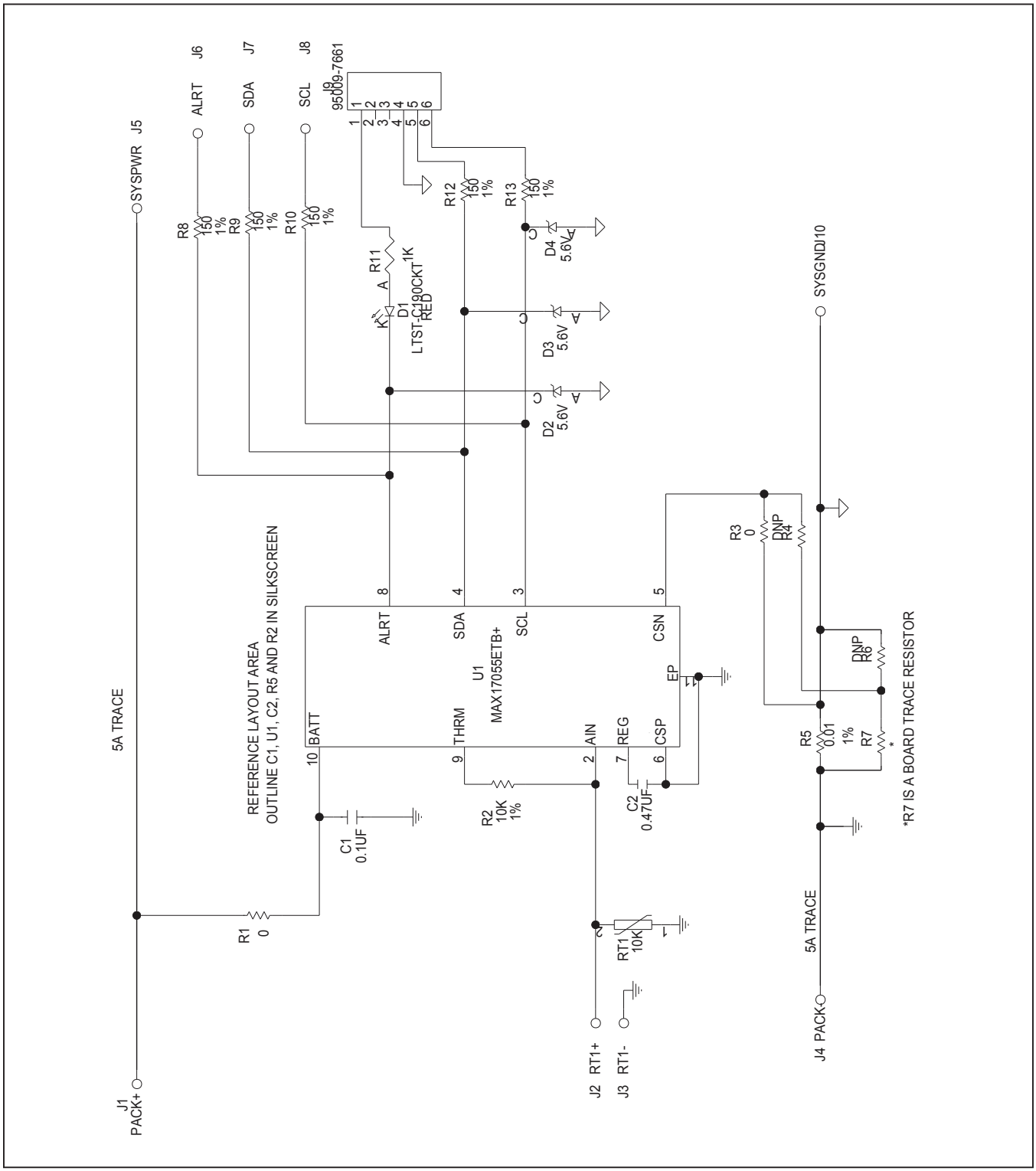
PART	TYPE
MAX17055GEVKIT#	EV Kit (for TDFN)
MAX17055XEVKIT#	EV Kit (for WLP)

#*Denotes RoHS compliant.*

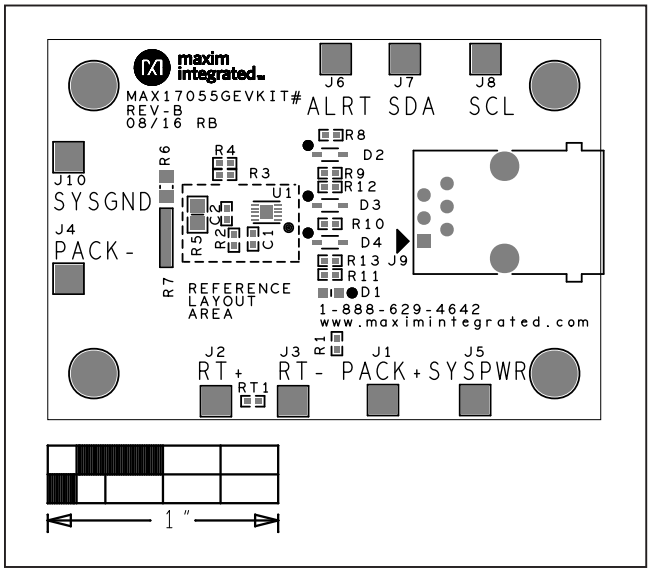
MAX17055G EV System Bill of Materials

PART	QTY	DESCRIPTION
C1	1	0.1uF ±10%, 16V X7R ceramic capacitor (0402)
C2	1	0.47uF ±10%, 16V X5R ceramic capacitor (0402)
R1, R3	2	0Ω resistor (0402)
R2	1	10kΩ ±1%, resistor (0402)
R4	1	0Ω resistor (0402), not populated
R5	1	0.010Ω ±1%, resistor (0805)
R6	1	0Ω resistor (0805), not populated
R8-R10, R12, R13	5	150Ω ±1%, resistor (0402)
R11	1	1KΩ ±1%, resistor (0402)
RT1	1	Thermistor 10K NTC (0402) Murata NCP15XH103F03RC
D1	1	Diode, LED Red (0603)
D2-D4	3	5.6V Zener Diode (SOD323)
J1-J8, J10	9	Plated through hole solder pad (16g wire)
J9	1	RJ-11,R/A,6-POSITION/6-CONTACTS
U1	1	MAX17055ETB+ Li+ fuel gauge IC 2x2.5 TDFN 10 pin
	1	PCB: MAX17055EVKIT
	1	USB-to-RJ11 board DS91230+
	1	RJ11 6pos-6pos reverse modular cord 6ft.

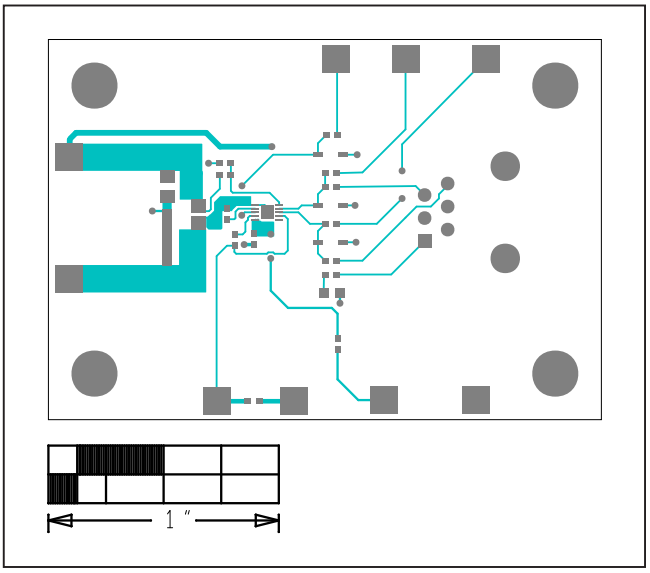
MAX17055G EV System Schematic



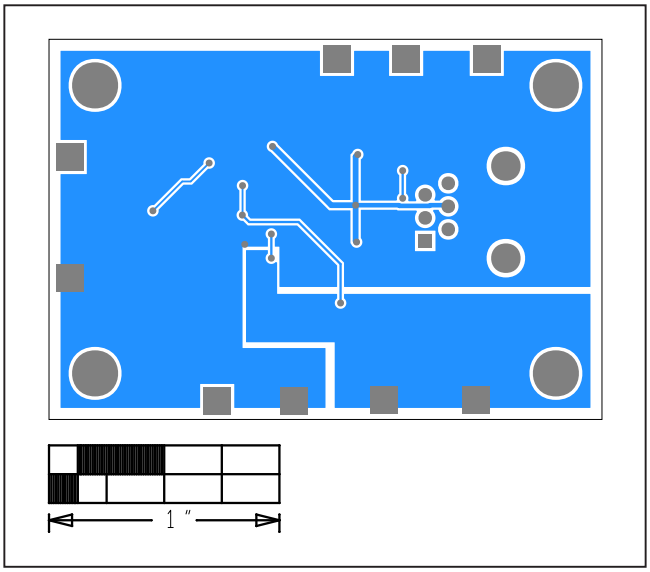
MAX17055G EV System PCB Layout



Component Placement



Top Layout

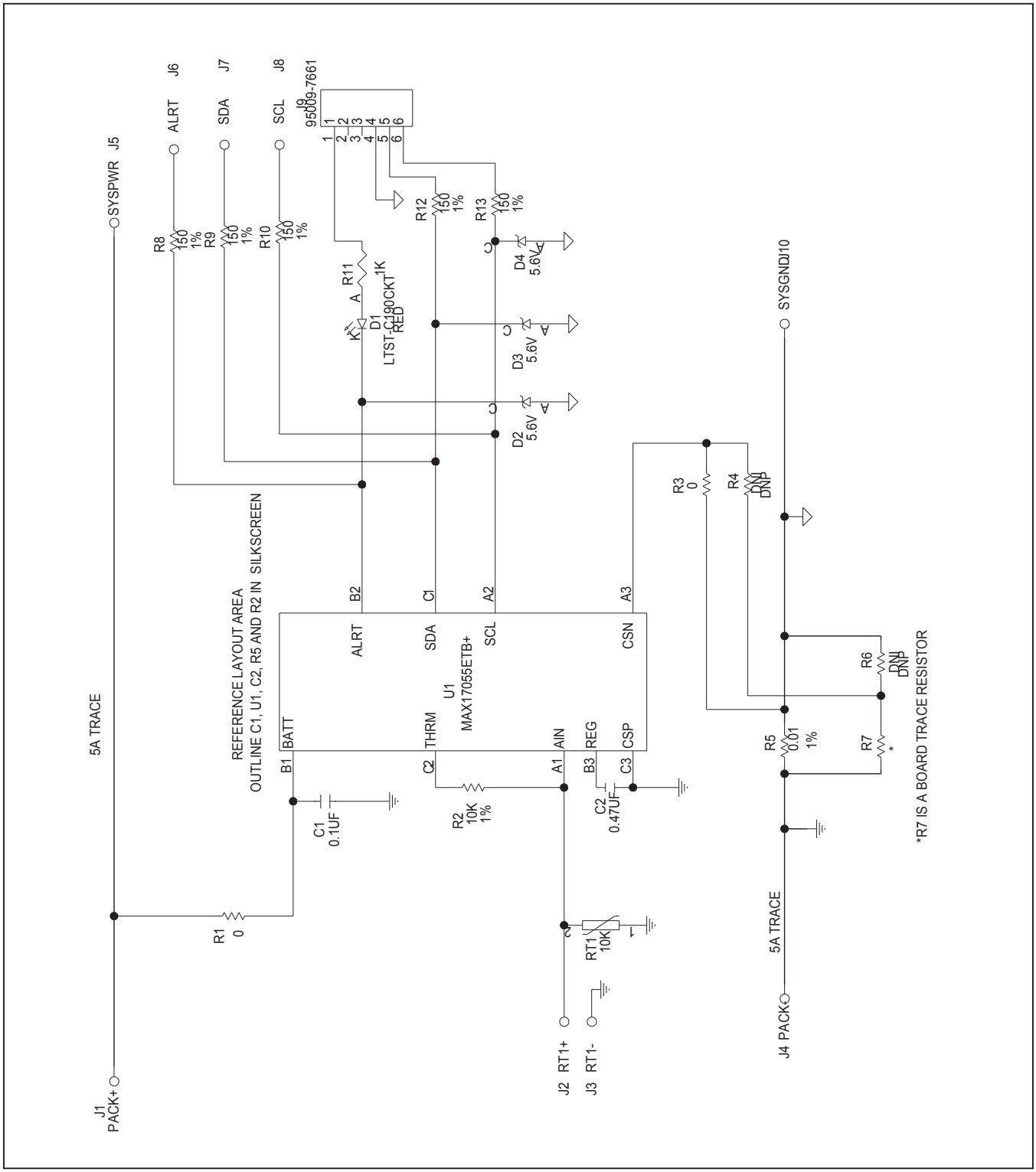


Bottom Layout

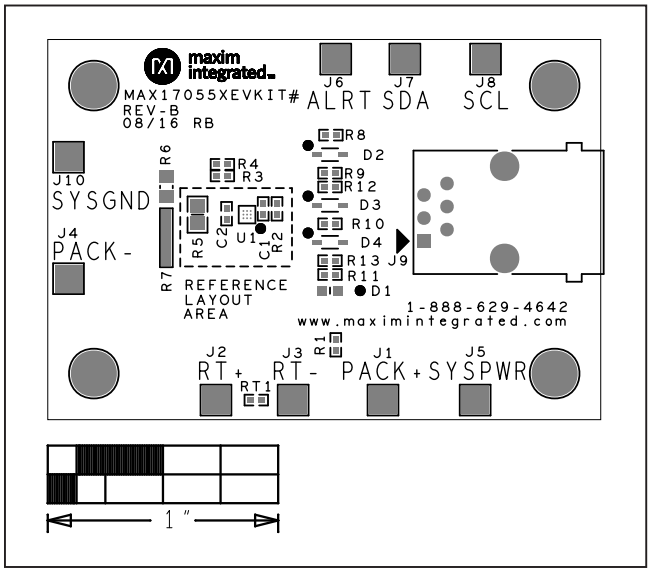
MAX17055X EV System Bill of Materials

PART	QTY	DESCRIPTION
C1	1	0.1uF ±10%, 16V X7R ceramic capacitor (0402)
C2	1	0.47uF ±10%, 16V X5R ceramic capacitor (0402)
R1, R3	2	0Ω resistor (0402)
R2	1	10kΩ ±1%, resistor (0402)
R4	1	0Ω resistor (0402), not populated
R5	1	0.010Ω ±1%, resistor (0805)
R6	1	0Ω resistor (0805), not populated
R8-R10, R12, R13	5	150Ω ±1%, resistor (0402)
R11	1	1KΩ ±1%, resistor (0402)
RT1	1	Thermistor 10K NTC (0402) Murata NCP15XH103F03RC
D1	1	Diode, LED Red (0603)
D2-D4	3	5.6V Zener Diode (SOD323)
J1-J8, J10	9	Plated through hole solder pad (16g wire)
J9	1	RJ-11,R/A,6-POSITION/6-CONTACTS
U1	1	MAX17055EWL+ Li+ fuel gauge IC WLP 9 pin
	1	PCB: MAX17055XEVKIT
	1	USB-to-RJ11 board DS91230+
	1	RJ11 6pos-6pos reverse modular cord 6ft.

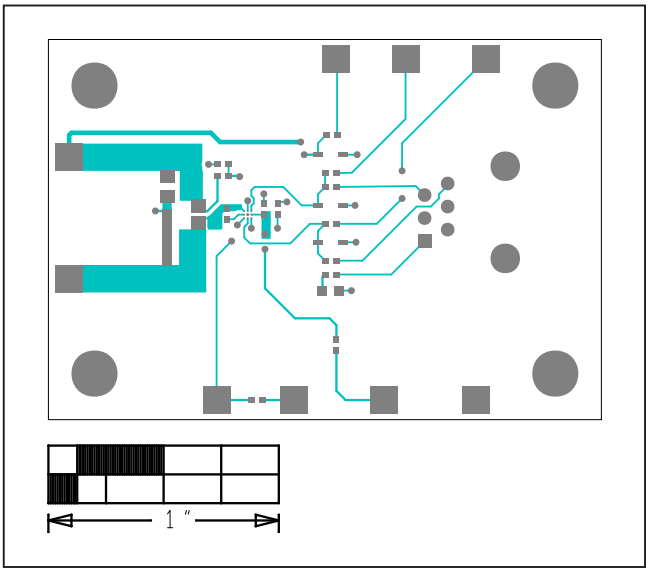
MAX17055X EV System Schematic



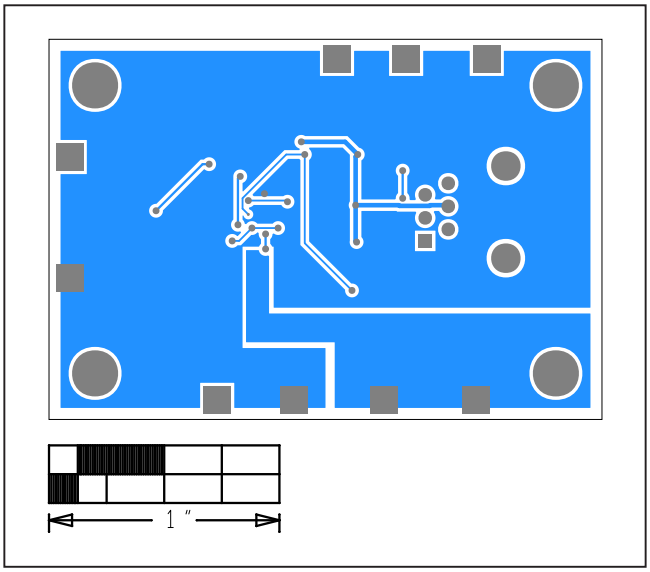
MAX17055X EV System PCB Layout



Component Placement



Top Layout



Bottom Layout

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/17	Initial release	—

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at www.maximintegrated.com.