Evaluate: MAX17320

General Description

The MAX17320X/MAX17320G evaluation kits (EV kits) are fully assembled and tested surface-mount PCBs that evaluate the stand-alone pack-side fuel gauge IC with protector and optional SHA-256 authentication for 2-4 cell lithium-ion/polymer batteries.

The MAX17320 EV kits include the IC evaluation board with integrated I²C/1-Wire[®] 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 <u>https://www.maximintegrated.com/</u>products/MAX17320.html/ product page under "Design Resources" tab. Windows 7 or newer Windows operating system is required to use with the EV kit GUI software.

Features

- ModelGauge m5 Algorithm
- Monitors Multicell Packs
- Full Protection Solution On-Board for Evaluation
- Battery Pack Input Voltage Range of +2.3V to +4.9V/ Cell with Default Hardware
- Default Current Range -10A to +10A with 5mΩ Sense Resistor, Higher Currents Can Be Supported by Changing to a Smaller Sense Resistor
- Thermistor Measurement
- On-Board I²C/1-Wire 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.

MAX17320 Evaluation EV Kit Files

FILE	DESCRIPTION
MAX17320EVKitGUISetup.msi	Installs all EV kit files on a computer

Windows is a registered trademark and registered service mark of Microsoft Corporation.

Maxim Integrated Products, Inc. registered trademark.

Quick Start

Required Equipment

- MAX17320 Evaluation kit
- Lithium-ion/polymer cells
- Battery charger
- Load circuit
- USB cable
- PC with Windows 7 or newer Windows operating system and USB port

Note: In the following sections, software-related items are identified by bolding. Text in **bold** only refers to items directly from the EV kit software. Text in **bold and under**<u>lined</u> refers to items from the Windows OS.

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 be launched without hardware attached. It automatically locates the hardware when connections are made. Note that after communication is established with the IC, the IC must be configured correctly for the fuel gauge to be accurate.

- Visit <u>https://www.maximintegrated.com/products/</u> <u>MAX17320.html/</u> page under Design Resources tab to download the latest version of the MAX17320 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 MAX17320EVKitGUISetup.msi program inside the temporary folder. The program files are copied, and icons are created in the Windows <u>Start</u> menu. The software requires 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 and if the computer is connected to the Internet.
- Follow the prompts to complete the installation. The evaluation software can be uninstalled in the <u>Add/</u> <u>Remove programs</u> tool in the <u>Control Panel</u>.
- The EV kit software launches automatically after installation or alternatively it can be launched by clicking on its icon in the Windows <u>Start</u> menu.



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- 5) Make connections to the EV kit board based on pack configuration. <u>Figure 1</u> shows the connections for a 4S configuration. The cells connect between the BATTN/BATT1/BATT2/BATT3/BATTP pads. <u>Table 1</u> describes the connections for 2S, 3S, and 4S configurations. The load or charger circuit can be connected between the SYSGND and SYSPWR pads at this time as well.
- 6) Connect the EV kit to a USB port on the PC using the USB cable. Press the S1 button to wake up the MAX17320. The GUI software establishes communication automatically.
- 7) At startup, the IC defaults to the EZ Configuration. If a custom .INI file for the application is available, it should be loaded at this time.



Figure 1. MAX17320 Board Connections

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Detailed Description of Hardware

The MAX17320 EV kit board provides a variety of features that highlight the functionality of the IC. The following sections explain the most important aspects of the EV kit board.

Communication Connections

The USB interface on the PCB establishes I²C or 1-Wire[®] 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 (DQ) and SCL (OD) pins. The user must apply the appropriate external pullup resistors to the communication lines when not using the built-in MAXUSB interface.

Number of Cells

The MAX17320 can be configured for use with 2 to 4 series cells. The cell connections and jumper settings for J2 and J5 should be set according to Table 1. CellxN indicates the negative terminal of the cell. CellxP indicates the positive terminal of the cell. The number of cells should be configured in the **Configuration Wizard**.

External Thermistors

The MAX17320 can be configured to use temperature measurements from 1 to 4 external thermistors. All EV kit boards come with 4 thermistors installed as surface mount components RT1-RT4. If the application requires direct thermal contact to the cells, RT1-RT4 can be removed and replaced with a leaded thermistor connected between the RTx+/RT- solder pads. The number of thermistors should be configured in the **Configuration Wizard**.

Sense Resistor Options

All EV kit boards are shipped with a $5m\Omega$ 0805-size chip sense resistor installed. Oversized land pattern pads allow for different size sense resistors to be used if desired.

Detailed Description of Software

The MAX17320G/X evaluation kit software gives the user complete control of all functions of the MAX17320, 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\MAX17320 folder and run MAX17320.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.



Figure 2. EV Kit Splash Screen

Table 1. Cell and Jumper Configuration

NUMBER OF CELLS	J2	J5	BATTN	BATT1	BATT2	BATT3	BATTP
2	1-2	1-2	Cell1N	Open	Cell1P/Cell2N	Open	Cell2P
3	1-2	Open	Cell1N	Open	Cell1P/Cell2N	Cell2P/Cell3N	Cell3P
4	Open	Open	Cell1N	Cell1P/Cell2N	Cell2P/Cell3N	Cell3P/Cell4N	Cell4P

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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 S1 button wakes 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 **Protector** tab displays all the protection settings of the IC.

- The **Graphs** tab visually displays fuel gauge changes over time.
- 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 **Register View** tab allows the user to view the individual bitfields of all registers.
- 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.

Data Logging: On	Communication: I2C	Mode: Active	Sense: 5.0 mΩ	Device Serial Number: 000000000000000000000000000000000000	Software Ver: 1.0.4.0 Firmware Rev:4089	READING	:

Figure 3. EV Kit Bottom Status Bar

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.

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 state of charge.

Pre-qual / Balancing Status

The **Pre-qual** / **Balancing Status** group box displays the status of any cell balancing or prequalification charge current modulation that is being controlled by the IC.

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.



Figure 4. ModelGauge m5 Tab

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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, 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 user to input a hypothetical load current (AtRate) and the fuel gauge calculates the corresponding hypothetical **AtQResidual**, **AtTTE**, **AtAvSOC**, and **AtAvCap** values.

Protector Tab

The **Protector** tab in Figure 5 displays the protection settings read from the IC. The settings cannot be changed from this tab. 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 all the protection settings related to charging as well as a graphical view 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

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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 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. Voltages in the graph are plotted as an average cell voltage measurement.



Figure 6. Graphs Tab

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Registers Tab

The **Registers** tab in <u>Figure 7</u> 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, hexadecimal representation of the data stored in the register, and if applicable a conversion to application units.

The MAX17320 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 automatically reenables 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.

odelGauge m5	Protec	tor Gra	phs Registers	Commands Co	onfigurat	ion R	egister View Aut	hentication Hist	ory 120	C Traffic L	.og				
egister Data						W	rite Protection 🤍	Locked					By D	ata Type	By Address
Protection	Addr	Hex	Value	Voltages	Addr	Hex	Value	Temps	Addr	Hex	Value	Percents	Addr	Hex	Value
Status	6C:00	0x0082		VCell	6C:1A	0xBE2C	3.803V	Temp	6C:1B	0x1CC6	28.8°C	RepSOC	6C:06	0x23DA	35.9%
ProtStatus	6C:D9	0x0000		AvgVCell	6C:19	0xBCD8	3.777V	AvgTA	6C:16	0x1C79	28.5°C	VFSOC	6C:FF	0x2456	36.3%
ProtAirts	6C:AF	0x0000		ChargingVoltage	6C:2A	0xD200	4.200V	DieTemp	6C:34	0x1BCC	27.80°C	Age	6C:07	0x6400	100.0%
HProtCfg	6C:F0	0xC423		VFOCV	6C:FB	0xBD56	3.787V	AvgDieTemp	6C:40	0x1BF8	27.97°C	FullSocThr	6C:13	0x5000	80.0%
nBattStatus	16:A8	0x0000										MixSOC	6C : 0D	0x240C	36.0%
				CELL1	6C:D8	0xBE19	3.802V	Temp1	16:3A	0x1CCE	28.8°C	AvSOC	6C:0E	0x221E	34.1%
nVPrtTh1	16:D0	0x508C		CELL2	6C:D7	0xBE5D	3.807V	Temp2	16:39	0x1C8E	28.6°C	dPAcc	6C:46	0x0190	25.0%
nTPrtTh1	16:D1	0x3700		CELL3	6C:D6	0x0000	0.000V	Temp3	16:38	0x1C54	28.3°C				
nTPrtTh3	16:D2	0x5528		CELL4	6C:D5	0x0000	0.000V	Temp4	16:37	0x1BA6	27.6°C				
nlPrtTh1	16:D3	0x4BB5		AvgCell1	6C:D4	0xBE25	3.803V	AvgTemp1	16:36	0x1CE7	28.9°C				
nBALTh	16:D4	0x0000		AvgCell2	6C:D3	0xBE64	3.808V	AvgTemp2	16:35	0x1CA0	28.6°C				
nTPrtTh2	16:D5	0x2D0A		AvgCell3	6C:D2	0x0000	0.000V	AvgTemp3	16:34	0x1C63	28.4°C				
				AvgCell4	6C:D1	0x0000	0.000V	AvgTemp4	16:33	OxFFFF	0.0°C				
				Batt	6C:DA	0x5F10	7.605V								
				PCKP	6C:DB	0x5EF9	7.598V								
				VRipple	6C:B2	0x09A4	0.024V								
Capacities	Addr	Hex	Value	Currents/Timer	Addr	Hex	Value	Model	Addr	Hex	Value				
RepCap	6C:05	0x04C3	1219.000mAh	Current	6C:1C	0xFFFA	-1.875mA	Config	6C:0B	0x2210					
FullCapRep	6C:10	0x0D48	3400.000mAh	AvgCurrent	6C:1D	OxFFFD	-0.938mA	MiscCfg	6C:OF	0x3070					
DesignCap	6C:18	0x0D48	3400.000mAh	ChargingCurrent	6C:28	0x3200	4000.000mA	FilterCfg	6C:29	0x0EA3					
FullCapNom	6C:23	0x0D48	3400.000mAh	AtRate	6C:04	0x0000	0.000mA	VEmpty	6C:3A	0xA561	3V				
								RelaxCfg	6C:A0	0x083B					
MixCap	6C:2B	0x04C9	1225.000mAh	TTE	6C:11	OxFFFF	102.398hr	LearnCfg	6C:A1	0x4696					
QResidual	6C:0C	0x0062	98.000mAh	TTF	6C:20	OxFFFF	102.398hr	Config2	6C:AB	0x2058		_			
AvCap	6C:1F	0x0467	1127.000mAh	Timer	6C:3E	0x0CA2	0.158hr	QRTable00	6C:12	0x1080		_			
dQAcc	6C:45	0x00D4	848.000mAh	TimerH	6C:BE	0x0000	0.000hr	QRTable10	6C:22	0x2043		_			
VFRemCap	6C:4A	0x04D3	1235.000mAh					QRTable20	6C:32	0x0344		_			
FullCap	6C:35	OxUCE6	13.000 Ah					QRTable30	6C:42	Ux12FF		-			
QH	6C:4D	OXFFF3	- 13.000mAn									-			
AtQResidual	SC:DC	0x0000	0.000mAn									-			
AtAVCap	OC:DF	0X04C9	1220.000mAn									-			
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												-			

Figure 7. Registers Tab

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Commands Tab

The **Commands** tab in <u>Figure 8</u> 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.

1-Wire Communication Speed

This option affects 1-Wire ICs only. The user can select either standard or overdrive communication speed. Communication speed is controlled by the EV kit software by driving the OD pin of the IC high or low. Regardless of the desired communication rate, the kit software communicates with any IC it discovers at either communication speed. The actual communication speed is displayed in the bottom status bar of the EV kit window.

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.

MAX17320 Modelsauge mo Fuel Gauge with Protector	-	U
ile Device Help		
odelGauge mb Protector Graphs Registers Commands Configuration Register View A	uthentication History I2C Iraffic Log	
1-Wire Communication Speed	Reset IC	
When communicating to a 1-Wire version of the IC, the EV kit controls 1-Wire communication speed through the SCL pin of the USB interface. Select the communication speed option below. Whenever communication speed is changed, the new state is automatically detected by the EV kit software. The status strip always reflects the detected (not expected) communication state. For external hardware control of communication speed, enable overdrive communication in the EV kit software and then drive the SCL/OD pin high or Iow as desired.	To reset the IC through software, first write 0x0000 to location 0x080, and then send the software Power-on-Reset (POR) command 0x000F to the Command Register. The result will be the same has been completely power cycled. Full Reset	as if the IC
1-Wire Communication Mode		
1-Wire Overdrive Communication Mode	Write Non-Volatile Memory Block	
Read/Write Register Reads or Writes a single register location. Valid register addresses are any location from 0 through 1FF. Use the full 9 bit address below and the software will automatically convert based on communication	Write all non-volatile memory on pages 18 through 1E. This operation will also copy non-volatile s their corresponding register locations so that the new settings will take effect without the need to gauge operation. Write NV Block	ettings into reset fuel
mode.		
Register 0x 0D Write	Write Protect and Lock Register Blocks	
Data 0x 240F Read	To enable/disable the write protect or permanently lock any of the five memory blocks, click on th corresponding button below. Write protection can be enabled and disabled. Locking a block is a operation that cannot be reversed.	ie permanent
.og Data to File	Write Protection Perman	ent Lock
IC registers will be stored in the selected logfile at the datalog interval using a .csv format. The datalog interval can be adjusted from 5 seconds to 5 minutes and can be changed while logging.	Locked Lock1 Non-Volatile Memory Pages 1A, 1B and 1E	nlocked
C:\Users\jason.cole\Documents\Maxim Integrated\MAX17320\Datalog 11-27-15-AM 10-28-2019 .cs	CLocked Lock2 ModelGauge Register Pages 00 to 04, 0B, and 0D	nlocked
Stop I og Change Filename 15 * Datalog Interval (seconds) V I og Events	Locked Lock3 Non-Volatile Memory Pages 18 and 19	nlocked
	Cocked Lock4 Non-Volatile Memory Page 1C	nlocked
Vanual FET Control	Locked Lock5 Non-Volatile Memory Page 1D	inlocked
The CHG and DIS FETs can be manually turned off by setting the ChgOff and DisOff bits of the CommStat register when the Comm Override Enable bit of the nProtCfg Register is enabled.		
CHG FET OFF C Automatic Control	CLocked Write Protect Global Lock	
DIS FET OFF CAutomatic Control	Note: The Global Lock must be unlocked before unlocking any of the individual locks.	
Data Logging: On Communication: I2C Mode: Active Sense: 5.0 mΩ Devic	e Serial Number: 000000000000000 Software Ver: 1.0.4.0 Firmware Rev:4089 READING	

Figure 8. Commands Tab

Log Data to File

Data logging is always active when the kit software is started. The default data log storage location is the My Documents/Maxim Integrated/MAX17320/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 aljust 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.

Manual FET Control

Before using the **Manual FET Control**, the function must be enabled in the IC by clicking the **Enable FETs Off-Override by I2C / 1Wire Command** in Step 7 of the **Configuration Wizard**. Clicking the appropriate slider can open the either FET or return control of the FET to the IC. **Note:** The user only has the ability to open the FETs or pass control back to the IC. The user cannot close the FET if the IC has opened the FET in order to protect the battery.

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 operation as if the IC had been power cycled. Note that resetting the IC when the cell is not relaxed causes fuel gauge error.

Write Non-Volatile 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 1DFh to be stored to nonvolatile memory. Nonvolatile memory has a limited number of copies and the user is prompted to confirm prior to 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. Prior to 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 prior to setting the lock.

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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 is 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 <u>Configuration</u> <u>Wizard</u> section for details. Note any register information that is displayed in 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.

odelGauge mo	Protec	tor Grap	ohs Registers	Commands C	onfigura	tion Re	gister View Auth	nentication Histo	ory 12	C Traffic Log	SBS					
edister Data	-				Write F	rotection	C Locked	Ν	IVM Up	dates Remainir	ng 7	Configur	ration Wi	zard F	Programming	J Tool
Dana 40h	Adda		Malua	Dama 44b	Adda	Have	Value	Dama 4Ch	Adda	11-11 Ma	lus De	455	Adda	lless	Mahua	
Page Ton	A001		value	Page IAn	16:A0	0x1080	value	Page ICh			Pa	aDDLimit			value	_
nXTable0	16.81	0x0000		nORTable00	16.41	0x2043		nPReserved0	16.01	0x0000		ScOcyl im	16.BI	0x0000		
nXTable2	16:82	0x0000		nORTable20	16:A2	0x078C		nChaCfa	16:C2	0x2000		AgeEcCfg	16:E2	0x0000		
nXTable3	16:83	0x0000		nORTable30	16:A3	0x0880		nChaCtrl	16:C3	0x0000	nD.	esignVoltage	16:E3	0xA5B9		
nXTable4	16:84	0x0000		nCycles	16:A4	0x0000		nRGain	16:C4	0x0000		nVGain	16:E4	0x0000		
nXTable5	16:85	0x0000		nFullCapNom	16:A5	0x0D48	3400.00mAh	nPackResistance		0x0000	nf	RFastVShdn	16:E5	0x0000		_
nXTable6	16:86	0x0000		nRComp0	16:A6	0x08CC		nFullSOCThr		0x0000 0.09	% nl	ManfctrDate	16:E6	0x0000		_
nXTable7	16:87	0x0000		nTempCo	16:A7	0x223E		nTTFCFG		0x0000		nFirstUsed	16:E7	0x0000		
nXTable8	16:88	0x0000		nBattStatus	16:A8	0x0000		nCGAIN		0x4000	nS	erialNumber0	16:E8	0x0000		
nXTable9	16:89	0x0000		nFullCapRep	16:A9	0x0D48	3400.00mAh	nTCurve		0x0025	nS	erialNumber1	16:E9	0x0000		
nXTable10	16:8A	0x0000		nVoltTemp	16:AA	0x0000		nThermCfg		0x0070	nS	erialNumber2	16:EA	0x0000		
nXTable11	16:8B	0x0000		nMaxMinCurr	16:AB	0x0000		undef1CB		0x0000	nD	eviceName0	16:EB	0x0000		
nVAIrtTh	16:8C	0x0000		nMaxMinVolt	16:AC	0x0000		nManfctrName		0x0000	nD	eviceName1	16:EC	0x0000		
nTAirtTh	16:8D	0x0000		nMaxMinTemp	16:AD	0x0000		nManfctrName1		0x0000	nD	eviceName2	16:ED	0x0000		
nlAirtTh	16:8E	0x0000		nFullCapFltr	16:AE	0x0000	0.000	nManfctrName2		0x0000	nD	eviceName3	16:EE	0x0000		
nSAirtTh	16:8F	0x0000		nTimerH	16:AF	0x0000	0.000hr	nRSense	16:CF	0x01F4 5.0n	nDhms	eviceName4	16:EF	0x0000		
Page 19h	Addr	Hex	Value	Page 1Bh	Addr	Hex	Value	Page 1Dh	Addr	Hex Va	lue					
nOCVTable0	16:90	0x0000		nCONFIG	16:BO	0x0000		nVPrtTh1	16:D0	0x508C						
nOCVTable1	16:91	0x0000		nRippleCfg	16:B1	0x0204		nTPrtTh1		0x3700						
nOCVTable2	16:92	0x0000		nMiscCFG	16:B2	0x0000		nTPrtTh3		0x5528						
nOCVTable3	16:93	0x0000		nDesignCap	16:B3	0x0000	0.00mAh	nlPrtTh1	16:D3	0x4BB5						
nOCVTable4	16:94	0x0000		nSBSCFG	16:B4	0x0000		nBALTh	16:D4	0x0000						
nOCVTable5	16:95	0x0000		nPACKCFG	16:B5	0x0010		nTPrtTh2	16:D5	0x2D0A						
nOCVTable6	16:96	0x0000		nRelaxCFG	16:B6	0x083B		nProtMiscTh	16:D6	0x7A28						
nOCVTable7	16:97	0x0000		nConvgCFG	16:B7	0x2241		nProtCfg	16:D7	0x0C00						
nOCVTable8	16:98	0x0000		nNVCFG0	16:B8	0x0221		NJEITAC	16:D8	0x324B						
nOCVTable9	16:99	0x0000		nNVCFG1	16:B9	0x0186		nJEITAV	16:D9	0x0059						
nOCVTable10	16:9A	0x0000		nNVCFG2	16:BA	OWDORG		nOVPCfg	16:DA	0xB054						
nOCVTable11	16:9B	0x0000		nHIDCFG	16:BB	0×0000		nStepChg	16:DB	OxC884						
nicingTerm	16:90	0x0000		nROMID0	16:BC	0x0000		nDelayCfg	16:DC	UXAB3D						
o Filtor Of a	16.90	0x4561		ROMID1	16.BP	0x0000		nouserh	16.00	0x4355						
nFilterCfg	10.05	SANSOI		IIROMIDZ	10.00			nouscorg	10.01	0						
nFilterCfg nVEmpty	16:9F	0x0000		nROMID2	16:BF	0×0000		nChockSum	1 5 1 1 5							

Figure 9. Configuration Tab

Evaluate: MAX17320

Register View Tab

The **Register View** tab provides a convenient interface to visualize and update the register settings in binary format. As shown in Figure 10, all configuration register names are listed on the left side of the **Register View** Tab. When one register is selected, detailed information about the register is displayed on the right-side panel. The corresponding name and binary value of each bitfield of the selected register are displayed on the top table. Clicking the **Read Register 0x00F** button refreshes the view and load the register reading into the top table. Single click on the binary bitfield to edit the register setting directly. When all the desired bitfield settings are updated, click

the Write Register 0x00F button to update the register value. If the change needs to be aborted, click the Read Register 0x00F button to reload the register value. The table on the bottom right lists all the bit descriptions and reset values based on the IC data sheet. Refer to the description of the bitfield for how to set the bitfield. The Find: Bit Fields feature is located at the bottom left of the Register View tab. To find a bitfield, type in the bitfield name in the Find: Bit Fields menu bar. The search result is available in the drop-down list. The History menu at the bottom left shows all the history searches from the Find: Bit Fields menu.

delGauge m5 Protector	Graphs	Registers	Command	ls Config	uration R	egister Vie	Authentication	History	I2C Traffic Log SBS				
01 VAIrtTh ^ 02 TAIrtTh	Value:	0	÷ 🖲 Hex	O Dec						Rea	d Register (0x00F	Write Register 0x00F
03 SAIrtTh 0B Config 0F MiscCfg 12 QRTable00 21 DavName	Mi	scCfg								Ir	ndex: 15d	1 0x000F	
22 QRTable10 24 TempNom	15	14	13	12	11	10	9	8 7	6 5	4	3	2	1 0
25 TempLim		r	05[3:0]		U	U		MH(4	eo]	1	U	U	SACFG[1:0]
29 FilterCfg 2C Temporary0			0000ь		Ob	0b		0000	00b	0b	0b	0b	00b
2D Temporary1 2E ReturnPtr 32 QRTable20													
37 ReturnPtr2 38 Temporary2		Index		Туре		Name	,	Reset		Ĺ	Description		
3F ShdnTimer 40 AvgDieTemp 42 QRTable30 49 ProtTmrStat		Bit 15:12		RW		FUS[3:0	0]	0x00	Full Update Slope. This field pre rate of adjustment of FullCapRep from 2% per 15 minutes (0000b)	vents jumps i near the end to a maximum	n the RepSOC of a charge cy 1 of 32% per 1!	and FullCapf cle. The upda 5 minutes (11	Rep registers by setting the te slope adjustment range is 11b).
50 undef050 A0 RelaxCfg A1 LearnCfg A3 undefine 8		Bit 11		RW		0		0x0	Bit must be written 0. Do not wri				
AB Config2 AC IAIrtTh B5 TTFCfg		Bit 10		RW		0		0x0	Bit must be written 0. Do not wri	te 1.			
B6 CVMixCap B7 CVHalfTime B8 CGTempCo B9 AgeForecast BA Temporary4 DA FProtStat		Bit 9:5		RW		MR[4:0	1	0x00	Mixing Rate. This value sets the reached (> 2.08 complete cycles standard 0.0100 sense resistor. continues with time-constant mix standard sense resistor.	strength of th). The units ar Setting this va ing indefinitely	e servo mixin re MR0 = 6.25 slue to 00000b y. The default	g rate after the µV. giving a ra disables sen setting is 18.7	e final mixing state has been ange up to 19.375mA with a vo mixing and the IC 5μV or 1.875mA with a
DB ModelCfg F0 HProtCfg F2 ODSCTh F3 ODSCCfg		Bit 4		RW		1		0x1	Bit must be written 1. Do not wri	te 0.			
F4 MTPHCfg F5 HConfig2 >		Bit 3		RW		0		0x0 Bit must be written 0. Do not write 1.					
Bit Fields ~		Bit 2		RW		0		0x0	Bit must be written 0. Do not wri	te 1.			

Figure 10. Register View Tab

Authentication Tab

The **Authentication** tab in <u>Figure 11</u> allows full evaluation of the SHA-256 battery security feature for the MAX17320 fuel-gauge. 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. Note that is not possible to clear the 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 SHA Secret value.

SHA Authentication Results

This group box provides four method to perform authentication evaluation. When the authentication process begins, the IC calculates MAC based on the challenge and stored secret value. The GUI, which represents the host side processor, also calculates based on the challenge and 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 ID computes the MAC result based on the chip ROM ID that is specific to the chip. Compute MAC without ROM ID does not involve ROM ID computation, which means the MAC result for every chip given the same challenge and secret should be the same. Compute Next Secret with ROM ID commands not only computes the authentication result, but also updates the secret value [Secret0...Secret9] to [MAC6...MAC15]. If there is no Secret Changes Remaining displayed in the SHA Secret group or the secret is locked, the secret does not update.



Figure 11. Authentication Tab

Evaluate: MAX17320

History Tab

The **History** tab visualizes all nonvolatile update history on 0x1Ax column of the nonvolatile memory map. Figure 12 shows the **History** tab. This column of nonvolatile memory features Fibonacci Saving mechanism to help the IC efficiently learn and adapt to battery characteristics change. The column of memory changes by nonvolatile programming and updates automatically as the battery pack experience through usage cycles. 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 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 page number or select + or – sign to browse through the nonvolatile history at the **Display History Data from Page** tool. The detailed information is displayed in the **Logging History** section.

ogging History nCycles Page Status: WRITTEN 0.20 Register Hex Va nQRTable00 0x1080 nQRTable10 0x2043 nQRTable10 0x2043 nQRTable20 0x078C nQRTable20 0x078C nQRTable20 0x078C nCycles 0x0000 nCycles 0x0000 nFullCapNom 0x0488 Nominal Capacity 3.400 Ah	
nCycles Page Status: WRITTEN 0.20 Register Hex Va nQRTable10 0x2043 nQRTable10 0x2043 nQRTable20 0x078c nQRTable20 0x078c nQRTable30 0x0080 Total Cycles 0.00 nFullCapNom 0x0486 Nominal Capacity 3.400 Ah	
0.20 Register Hex Va nQRTable00 0x1080 0x2043 nQRTable10 0x2043 0x0780 nQRTable20 0x0780 0x0780 nQrtable30 0x0040 0x0040 nFullCapNom 0x0040 Nominal Capacity	
nQRTable00 0x1080 nQRTable10 0x2043 nQRTable20 0x078C nQRTable30 0x0880 nCycles 0x0000 nFullCapNom 0x0498 Nominal Capacity 3.400 Ah	ie(s)
nQRTable10 0x2043 nQRTable20 0x07ec nQRTable30 0x08e0 nQCtable30 0x08e0 nCycles 0x0000 nFullCapNom 0x004 Nominal Capacity 3.400 Ah	
nQRTable20 0x078C nQRTable30 0x0880 nCycles 0x0000 nFullCapNom 0x0040 Nominal Capacity 3.400 Ah	
nQRTable30 0x0880 nCycles 0x0000 Total Cycles 0.00 nFullCapNom 0x0048 Nominal Capacity 3.400 Ah	
nCycles 0x0000 Total Cycles 0.00 nFullCapNom 0x0048 Nominal Capacity 3.400 Ah	
nFullCapNom 0x0048 Nominal Capacity 3.400 Ah	
nRComp0 Ux08Ce	
nlAvgEmpty vxvvvv Average Current Oser Data	
n ruit-aprep oxobro Capacity 3-000 ru	Temperature 0 °C
nMaxMinCurr Dx0000 MaxCurrent 0.000A	Min Current 0.000 A
nMaxMinVolt 0x0000 Max Voltage 0.00V	Min Voltage 0.00V
nMaxMinTemp 0x0000 Max Temperature 0 °C	Min Temperature 0 °C
nSOC 0x0000 MixSOC 0 %	VFSOC 0 %
1 Pages 1 nTimerH 0x0000 Elapsed Time 0.0 Hr	

Figure 12. History Tab

Configuration Wizard

Before the IC accurately fuel gauges the battery pack, it must be configured with characterization information. This can be accomplished two ways. The first is through a custom characterization procedure that can be performed by Maxim under certain conditions. The result is an 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 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 **Configuration Wizard** button. The **Configuration Wizard** window pops up, as shown in <u>Figure 13</u>. 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 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 model selection options. Enter the Sense resistor value into the **Sense (mOhms)** text box. 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 Other Configuration Registers from Model.INI or Complete .INI File** and load model INI file provided by Maxim directly.

In Step 3, the basic Schematic Configuration is selected including the number of cells, number of thermistors, Always On LDO Output setting and Gate Driver Voltage setting.

In Step 4, the cell Balancing Configuration (mV) is selected.

Configuration Wizard			×
Step 1 / 19: Starting Template			
The configurator can begin with either the existing IC memory settings or revert back to factory default setting	JS.		
Start with Existing Nonvolatile Memory Data			
Start with Factory Default Values			
Step 2 / 19: Cell Model Selection			
Select the cell model to be used prior to setting other configuration options. Either use the existing model inf non-volatile memory, load new model data from an .INI file, or use the ModelGauge m5 EZ Model.	formation already stored in the I	C's	
Sense (mOhms) 5.00			
Do Not Change Model			
Use ModelGauge m5 EZ Model			
1000.0 Cell Size (mAh) LiCoO2(Common) * Ba	attery Chemistry*		
3.3 ▼ Empty Voltage (V per cell) *Contact Maxim for special cell chen Charge voltage is greater than 4.275V per cell. LITIO3 or LiFePO4 that are not listed	nistries like LiMnO2, d.		
150.0 Charge Termination Current (mA)			
Use Custom Model and Other Configuration Registers from Model.INI or Complete.INI File			
Path			
Title			
Select File			
	(Next	

Figure 13. Configuration Wizard—Step 1 and 2

Evaluate: MAX17320

							1.77.10		^
Step 3 / 19: Schematic Config	guration								
Cell Count	2 -								
Thermistor Count	4 =								
Always On LDO Output	Disabled								
	1.8V								
	3.4V								
Gate Driver Voltage	6V								
	8V								
	10V								
Cell balancing occurs whe maximum and minimum of	en cell balancing cell voltages grea	is enabled (by selec ter than the balancir	ting a non-zero ig threshold and	Balancing Con I if either of the	figuration) and th following condition	ere is a voltage n ons are met	nismatch bet	ween th	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S	en cell balancing sell voltages grea value must be ab State of Charge (\	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu	ting a non-zero ig threshold and in Det, which ind ie must be large	Balancing Con I if either of the icates the battle In than the Fulls	figuration) and th following conditi ery is charging. SOCThr register v	ere is a voltage n ons are met alue indicating th	nismatch bet e pack is ne	ween th arly full.	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration	en cell balancing sell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled	fing a non-zero og threshold and rrDet, which ind re must be large	Balancing Con I if either of the icates the battle in than the Fullt	figuration) and th following conditi ery is charging. SOCThr register t	ere is a voltage n ons are met: ralue indicating th	nismatch bet e pack is ne	ween th arly full.	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms)	en cell balancing rell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero og threshold and rrDet, which ind re must be large v	Balancing Con i if either of the icates the bath ir than the Full	figuration) and th following conditi ery is charging. SOCThr register (ere is a voltage n ons are met: ralue indicating th	nismatch bet	ween th arly full.	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms)	en cell balancing rell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero og threshold and rrDet, which ind ie must be large v	Balancing Con if either of the icates the bath or than the Fullt	figuration) and th following conditi ery is charging. SOCThr register t	ere is a voltage n ons are met: ralue indicating th	nismatch bet	ween th arly full.	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms) Enable Zener Balanci	en cell balancing rell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero ig threshold and in must be large v v	Balancing Con if either of the icates the batt ir than the Fullt	figuration) and th following conditi ery is charging. SOCThr register v	ere is a voltage n ons are met: ralue indicating th	ismatch bet	ween th	e
Cell balancing occurs whe maximum and minimum of The AvgCurrent register The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms) Enable Zener Balanci	en cell balancing rell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero og threshold and rrDet, which ind ie must be large v	Balancing Con if either of the icates the battle or than the Fullt	figuration) and th following conditi ery is charging. SOCThr registery	ere is a voltage n ons are met: ralue indicating th	e pack is ne	ween th	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms) Enable Zener Balanci	en cell balancing ell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero ig threshold and in must be large v v	Balancing Con if either of the icates the batt ir than the Full	figuration) and th following conditi ery is charging. SOCThr register v	ere is a voltage n ons are met: ralue indicating th	ismatch bet	ween th	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge 5 Balancing Configuration Rmismatch (mOhms) Enable Zener Balanci	en cell balancing ell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero ig threshold and in must be large	Balancing Con if either of the icates the batt ir than the Full	figuration) and th following conditi ery is charging. SOCThr register v	ere is a voltage n ons are met: ralue indicating th	ismatch bet	ween th	e
Cell balancing occurs whe maximum and minimum of • The AvgCurrent register • The Voltage Fuelgauge S Balancing Configuration Rmismatch (mOhms) Enable Zener Balanci	en cell balancing rell voltages grea value must be ab State of Charge (\ (mV)	is enabled (by selec ter than the balancir ove nProtMiscTh.Cu /FSOC) register valu Disabled 0	ting a non-zero ig threshold and in must be large v v	Balancing Con if either of the icates the batt ir than the Fullt	figuration) and th following conditi ery is charging. SOCThr register v	ere is a voltage n ons are met: ralue indicating th	e pack is ne	ween th	e

Figure 14. Configuration Wizard—Step 3 and 4

Evaluate: MAX17320

In **Step 5**, charge protection-related settings need to be configured. <u>Figure 15</u> shows this step. The checkboxes at the bottom right enable or disable the protection features. The **Enable Protection** feature need 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 condition. If JEITA Charging feature is desired, check the Enable JEITA 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, user can edit detailed settings like the temperature zone setting, OVP setting, charging voltage settings, and charging current setting. When all the JEITA settings are completed, check the upper section graph to make sure settings are correct.



Figure 15. Configuration Wizard—Step 5

Evaluate: MAX17320

From **Step 6** to **Step 8**, user can edit the discharge protection parameters. See <u>Figure 16</u> and <u>Figure 17</u>. The parameters include detailed protection configurations, thresholds and timings. In Step 7, user can enable and configure the Battery Internal Self-Discharge Detection. In **Step 9**, choose the power mode for fuel-gauge device. Enabling hibernate mode allows reduction of current consumption by lowering the rate of ADC sampling. Enabling Deepship mode opens the FETs and shuts down any protection functionality during shipping and storage condition. In **Step 10**, check the **Battery Out** option to allow communication stop shutdown feature. Check **Pushbutton Wakeup** to allow wakeup fuel-gauge using the ALRT pin.

From **Step 11** to **Step 19**, follow along the step description to fill out all the application specific information related to fuel-gauging. Typically leave options from **Step 11 to Step 19** as default. If there is special thermistor requirement, look for the NTC model with closest beta value in the dropdown list. If the thermistor beta value is not covered by the models in the drop-down list, contact Maxim for support.

							_		
p 6 / 20: Discharging Configuration									
Empty Voltage (V)	3		Dynamic Power						
Under OCV Protection (V)	2.920	+							
Under Voltage Protection (V)	2.600	+	Timer	1.4s-2.8s	٣	UVReady			
Prequal Voltage (V)	2.600	+	PreQual Enable						
Under Voltage Shutdown (V)	2.440	+							
Min. Operating Voltage (V)	2.3								
Overdischarge Current (Slow) (mA)	-6000.000	+	Timer	2.8s-5.6s	v				
Overdischarge Current (Fast) (mA)	-8000.000	+	Timer (ms)	4.955	+ -				
Short Circuit Current (mA)	-10000.000	+	Timer (µs)	253	+ -				
Fault Release Current (CurrDet)	15.000	+							
Load Removal Detection									
n 7/20: Patton Internal Solf Discharge	Detection Configur	ation							
Enable Internal Self-Discharge Dete	ction	auon							
LeakFault Configuration	000) – Disable	d v						
LeakCurr Threshold		Disabled	¥						
revious							1	Nex	t

Figure 16. Configuration Wizard—Step 6 and 7

Evaluate: MAX17320

Configuration Wizard	<u> </u>		×
Step 8 / 20: Additional Protection Configuration			
 Enable Permanent Failure Fault Enable FET Failure Detection Permanent Failure Debounce Timer 1.4s to 2.8s Verify Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Programming (Programming cannot be successful with Permanent Failure Status Before Program fa	lure triggered)		
Enable FETs Off-Override by ALRT Pin Enable FETs Off-Override by I2C / 1Wire Command Enable Protector Checksum			
Step 9 / 20: Power Modes			
 Disable Hibernate (34µA) Enable Hibernate (16µA) HibScalar (Select Hibernate Task Period) 1.404s-Recommended (If hibernate is enabled, voltage protection occurs at this delay) Enable Ship Mode (6µA) Enable DeepShip Mode (2µA) 			
Step 10 / 20: Shutdown and Wakeup Control			
Battery Out (Communication Stops) Pushbutton Wakeup Charger and comms wakeups always supported.			
Previous Skin Onti	onal Configuration	Next	

Figure 17. Configuration Wizard—Step 8, 9, and 10

In **Step 20**, user can choose to update the IC based on previous configuration steps. See <u>Figure 18</u>. The nonvolatile configuration memory can only be updated 7 times. User 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 is lost. If final configuration is decided, choose the third option **Program New Configuration to Non-Volatile Memory.** It is recommended to check **Save New Configuration Settings to .INI file**. This allows resulting configuration in previous steps to be recorded in a Complete INI file. When **Configuration Wizard** is closed, the previous configurations are not be remembered. Click **Update IC** button to execute the changes and saves. Click **Close** button to exit configuration wizard without doing anything.

tep 20 / 20: Update IC and Save New Configuration		
Select how the new configuration is to be applied. Either discard the new configuration, write it to IC configuration RAM, or program it non-volatile memory (if there are non-volatile writes remaining). Write to RAM only to test configuration settings without using up a non-volatile memory write. Note that changing configuration settings will cause the fuel gauge to reset. The new configuration setting can be saved to a file regardless of programming option selected.	to	
After changing configuration settings memory locations shown in blue have had their shadow RAM locations changed, but have not y been programmed to non-volatile memory.	et	
Memory locations shown in red indicate a NV write failure. The data read back did not match the shadow RAM data before attempting program that location.	to	
Do Not Change Configuration Memory		
Write Configuration RAM and Restart the Fuel Gauge so Changes Take Effect (Allows for testing configuration settings without using up a write cycle.)		
Program New Configuration to Non-Volatile Memory and Restart the Fuel Gauge		
Save New Configuration Settings to .INI File		
Select Path		

Figure 18. Configuration Wizard—Step 20

Evaluate: MAX17320

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, user doesn't need to go through configuration wizard again. See <u>Figure 19</u>. In the **Programming Tool** panel, click **Select File** to select the saved Complete.INI

configuration file. The configuration file is typically saved from configuration step in the **Configuration Wizard** as shown in <u>Figure 18</u>. Click **Program IC** to program nonvolatile memory directly. When there is a 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. User can choose to only update the RAM by checking the **Load INI to RAM** checkbox.

				-		
Path						
Title						
	Select File Conf	iguration INI File is no	t yet selected.			
Step 2 / 2: Pr	ogram IC					
	Program IC					
	rogrammo					
	Load INI to RAM and rest	art fuel gauge so chan	ges take effect.			
	(Anows for testing conligt	iration settings without	using up a write cy	cie.)		

Figure 19. Programming Tool

Evaluate: MAX17320

Hardware Connection Guideline

When evaluating MAX17320 EV kit with high current or evaluating protection functionality, use real batteries instead of power supplies. When connecting batteries, use soldered connection instead of jumper cables. During protector switching event, the impedance caused by inductance of the lab jumper cables and power supply can cause overshoot on battery voltage. This voltage spike could potentially cause voltage across any of the BATTx pins to rise above the absolute maximum rating of 6V, damaging the chip permanently. <u>Figure 20</u> show good example of a battery connection using soldered connections, battery connectors, and its corresponding BATT voltage waveform during a switching event. <u>Figure</u> <u>21</u> show bad example of a battery connection using lab jumper wires and its corresponding BATT voltage waveform.



Figure 20. Good Hardware Connection Example (Use Real Batteries and Soldered Connections). BATT Voltage and Battery Current Waveform at Overcurrent Protection Event with Good Connection



Figure 21. Bad Hardware Connection Example (Use Lab Jumper Cable). 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 MAX17320 is being used when contacting these component suppliers.

Ordering Information

PART NUMBER	INTERFACE	U1 IC	PIN-PACKAGE
MAX17320X1EVKIT#	1-Wire	MAX17320X12+	30 WLP
MAX17320X2EVKIT#	l ² C	MAX17320X22+	30 WLP
MAX17320G1EVKIT#	1-Wire	MAX17320G12+	24 TQFN
MAX17320G2EVKIT#	l ² C	MAX17320G22+	24 TQFN

#Denotes RoHS compliance.

Evaluate: MAX17320

MAX17320X EV Kit Bill of Materials

REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
ALRT, AOLDO, RT-, RT1+-RT4+,		12	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE
SCL, SCL1, SDA, SDA1, VUSB	-	12	5002	REISTONE	NVA	WIRE SILVER;
C1, C3	-	2	LMK105B7474KV	PANASONIC	0.47UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.47UF; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
C2, C43	-	2	C1005X5R1E474K050;GRT155R61E474KE01	TDK;MURATA	0.47UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.47UF; 25V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R
C4 C7 C19 C26		4	C0402C105K8PAC:CC0402KRX5R6BB105	KEMET:YAGEO	1UF	CAPACITOR: SMT (0402): CERAMIC CHIP: 1UE: 10V: TOL=10%: TG=-55 DEGC TO +85 DEGC: TC=X5R
04, 01, 010, 020		-	C0402C103K5RAC:GRM155R71H103K488:C1005X7	Remer, more	101	
C5	-	1	R1H103K050BE;CL05B103KB5NNN;UMK105B7103K	KEMET;MURATA;TDK;SAMSUNG ELECTRONIC;TAIYO YUDEN	0.01UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.01UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
C6, C8, C10, C11	-	4	CL05B103KP5NNN	SAMSUNG ELECTRONICS	0.01UF	CAPACITOR; SMT (0402); CERAMIC; 0.01UF; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
C9. C12-C15. C21. C22. C24. C25.			GRM155R71E104KE14:C1005X7R1E104K050BB:TM			CAPACITOR: SMT (0402): CERAMIC CHIP: 0.1UF: 25V: TOL=10%: MODEL=GRM SERIES: TG=-55 DEGC TO
C28-C38	-	20	K105B7104KVH;CGJ2B3X7R1E104K050BB	MURATA; IDK; TAIYO YUDEN; IDK	0.10F	+125 DEGC; TC=X7R
C20, C23, C27	-	3	ZRB15XR61A475ME01; CL05A475MP5NRN;GRM155R61A475MEAA;C1005X5	MURATA;SAMSUNG;MURATA;TDK	4.7UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 4.7UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
C20 C40		2	C0402C0CE00270 IND: CDM1EEEC1U270 IA01		2705	CARACITORI CNT: 0402; CERANIC: 27eE; 501/ 59, COC; 55deeC to 1 125deeC; 0 1/ 2000MideeC
038,040		-	C0402C0B30027034F, GNWF353C1F12703A01	VENICE ETD., WORKTA	2/11	GRANTOR, OW, CERAWIC, 219, 307, 35, 603, 530890 to 1200890, 01-001 Weego
C41, C42	-	2	GRM155R71A104JA01	MURATA	0.1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.10F; 10V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=X/R
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
D2-D4, D10	-	4	BZX384-C5V6	NXP	5.6V	DIODE; ZNR; SMT (SOD-323); Vz=5.6V; lzm=0.000001A; -65 DEGC TO +150 DEGC
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
D7		1	SD1020WS		SD102AWS TR	
ы			351034W3	MICINO COMMERCIAE COMPONENTS	3D103AW3-11	DIODE, 3011, 3WALE 301011111 DIODE, 300-323, 110-400, 11-0.304
D8	-	1	RB751S40	FAIRCHILD SEMICONDUCTOR	RB751S40	DIODE; SCH; SMT (SOD-523F); PIV=40V; IF=0.03A
D9	-	1	SD101BWS-E3	VISHAY	SD101BWS-E3	DIODE; SCH; SMT (SOD-323); PIV=50V; IF=0.03A
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;
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
F1	-	1	SFJ-1215U	DEXERIALS	SFJ-1215U	EVKIT PART - FUSE; SELF CONTROL PROTECTOR; SFJ SERIES; 3-CELL; 15A
J1	-	1	10118193-0001LF	FCI CONNECT	10118193-0001LF	CONNECTOR: FEMALE: SMT: MICRO USB B TYPE RECEPTACLE: RIGHT ANGLE: 5PINS
						EVKIT PART-CONNECTOR: MALE: THROUGH HOLE: BREAKAWAY: STRAIGHT: 2PINS: -65 DEGC TO +125
J2, J5	-	2	PBC02SAAN	SULLINS ELECTRONICS CORP.	PBC02SAAN	DEGC;
J4	-	1	PBC03DAAN	SULLINS ELECTRONICS CORP.	PBC03DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 6PINS; -65 DEGC TO +125 DEGC
J8	-	1	PPPC062LJBN-RC	SULLINS ELECTRONICS CORP.	PPPC062LJBN-RC	CONNECTOR; FEMALE; THROUGH HOLE; 0.1IN CC; HEADER; 2 ROW; RIGHT ANGLE; 12PINS
11.13	-	3	BLM18AG601SN1	MIRATA	600	INDUCTOR: SMT (0603); EERRITE-BEAD: 600; TOI =+/-: 0.5a
2120		Ŭ	Beinfoldorfolt		000	CONNECTOR: MALE: USB: USB2 0 MICRO CONNECTION CABLE: USB B MICRO MALE TO USB & MALE:
MISC1	-	1	AK67421-1-R	ASSMANN	AK67421-1-R	STRAIGHT: SPINS-4PINS
01.02	-	2	IRE7458PBE	INFINEON	IRE7458PBE	TRAN: SMPS MOSEET: NCH: NSOIC8: PD-(2.5W): L(14A): V-(30V)
04.05		2	2N7002	NYB	2017002	TRANK N CHANNEL TRENCH MOSEET: NCH: SOT 22: 0D (0.9200) 1/0.240-V (6000)
44, 45 08		4	2147002 DCC2222DW		DECOODE	TRAN, NEORDANNEE THENOT MOST ET, NOT, SOTE23, FD-(0.53W), F(0.5A), V-(00V)
48	-		B33223FW		B33223FW	TRAIN, OF TIMOS SMALL-SIGNAL-TRAINSISTOR, FCH, SOT 323-3, FD-(0.23W), F(-0.39A), V-(-20V)
R1, R3-R5	-	4	RNCP0805FTD49R9	STACKPOLE ELECTRONICS INC	49.9	RESISTOR; 0805; 49.9 OHM; 1%; 100PPM; 0.25W; THIN FILM
R2, R9	-	2	ERJ-2RKF27R0X;RC0402FR- 0727RL:CRCW040227R0EK	PANASONIC;YAGEO PHICOMP;VISHAY	27	RESISTOR, 0402, 27 OHM, 1%, 100PPM, 0.0625W, THICK FILM
			CRCW04021K00FK: RC0402FR-	VISHAY DALE: YAGEO PHICOMP: ROHM		
R6, R16, R34		3	071KL;MCR01MZPF1001	SEMI	1K	RESISTOR; 0402; 1K; 1%; 100PPM; 0.0625W; THICK FIEM
R8, R12, R13	-	3	CRCW0402150RFK; 9C04021A1500FL	VISHAY DALE;YAGEO	150	RESISTOR; 0402; 150 OHM; 1%; 100PPM; 0.0625W; THICK FILM
R10	-	1	RT0402BRD0710RL	YAGEO	10	RES; SMT (0402); 10; 0.1%; +/-25PPM/DEGC; 0.063W
R11	-	1	CR0402-16W-3650FT	VENKEL LTD.	365	RESISTOR: 0402: 365 OHM: 1%: 100PPM: 0.063W: THICK FILM
		-	CRCW0402100RFK: 9C04021A1000FL: RC0402FR-	VISHAY DALE: PANASONIC: YAGEO		
R14, R15		2	07100RL	PHYCOMP	100	RESISTOR; 0402; 100 OHM; 1%; 100PPM; 0.063W; THICK FILM
R17	-	1	WSLP12065L000F	VISHAY DALE	0.005	RESISTOR; 1206; 0.005 OHM; 1%; 400PPM; 1.0W; METAL FILM
R18	-	1	CRCW0402100KFK;RC0402FR-07100KL	VISHAY;YAGEO	100K	RESISTOR; 0402; 100K; 1%; 100PPM; 0.0625W; THICK FILM
R19	-	1	ERJ-1TNF4020U:CRCW2512402RFK	PANASONIC:VISHAY DALE	402	RESISTOR: 2512: 402 OHM: 1%: 100PPM: 1.0W: THICK FILM
B20 B25	-	2	CBCW040210K0.IN	VISHAY DALE	10K	RESISTOR: 0402: 10K OHM: 5%: 200PPM: 0.063W: THICK FILM
P21		-	EB 14X 102	PANASONIC	11/	RESISTOR: 1210: 1K OHM: 5%: 2000RM: 0.5W: THICK FILM
R21	-		ERJ-1413102	FANASONIC	16	RESISTOR, 1210, TK OHM, 5%, 200FFM, 0.5W, THICK FILM
R22	-	1	CRCW12062K00FK; MCR18EZPF2001	VISHAY DALE;ROHM	2K	RESISTOR; 1206; 2K; 1%; 100PPM; 1/4W; THICK FILM
R26	-	1	RC0805JR-070RL	YAGEO PHYCOMP	0	RESISTOR; 0805; 0 OHM; 5%; JUMPER; 0.125W; THICK FILM
R33		1	CRCW040212K0FK;MCR01MZPF1202	VISHAY DALE;ROHM	12K	RESISTOR, 0402, 12K OHM, 1%, 100PPM, 0.0625W, THICK FILM
			5910050000	SEMICONDUCTOR		
K35, K36, K38, K39		4	EKJ-2GEURUU	PANASUNIC	U	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
R37		1	CRCW04021M00FK	VISHAY DALE	1M	RESISTOR; 0402; 1M; 1%; 100PPM; 0.0625W; THICK FILM
R40, R41		2	CRCW04024K70FK;MCR01MZPF4701	VISHAY DALE;ROHM	4.7K	RESISTOR, 0402, 4.7K OHM, 1%, 100PPM, 0.0625W, THICK FILM
R42 R43		2	DNM0402E6001DS		5K	DESISTOD: 0402- 5K OLM- 0.1%- 2500M- 0.05M- TUN F" M
D10 D17		4	000000000000000000000000000000000000000		470	REGISTOR, 0402, SKOTIW, U.1%, 25FFM, U.03W, THIN FILM
R40, R4/	-	2	URUWU4U24/URFK	VIORAT DALE	470	REDIDIOR, 0402, 470 OHM, 1%, 100PPM, 0.0025W, 1HICK FILM
RT1-RT4	-	4	NCP15XH103F03	MURATA	10K	THERMISTOR; SMT (0402); THICK FILM (NICKEL PLATED); 10K; TOL=+/-1%
S1, S2	-	2	EVQ-Q2K03W	PANASONIC	EVQ-Q2K03W	SWITCH; SPST; SMT; 15V; 0.02A; LIGHT TOUCH SWITCH; RCOIL= OHM; RINSULATION= OHM; PANASONIC
T1			TGM 040B3BI	HALO ELECTRONICS INC.	TGM 040P2P1	TRANSFORMED: SMT: 1:1:1 2:1 2: DOMOIN DOMO CONSIGRITOR
11	-		1GM-040F3RL	HALO ELECTRONICS INC	I GIVE-040P3RL	TRAINSFORMER, SMIT, 1.1.1.3.1.3, FOMEIA DO/DE CONVERTER,
U1		1	See Ordering Information	MAXIM		100381
112		1	ET 2222HI	FUTURE TECHNOLOGY DEVICES INTL	ET2222U	
			r resserte	LTD.		IN THE REPORT OF LED OUD TO MOLETE ONE OUL OWNER THE REPORT
U3	-	1	MAX14937AWE+	MAXIM	MAX14937AWE+	IC; ISO; TWO CHANNEL; 5KVRMS I2C ISOLATOR; WSOIC16
U4		1	MAX13253ATB+	MAXIM	MAX13253ATB+	IC; DRV; 1A SPREAD-SPECTRUM; PUSH-PULL; TRANSFORMER DRIVER FOR ISOLATED POWER SUPPLIES;
116 116		2	MA Y9511EYK32+	MAXIM	MAX9511EVK22+	
			mphoo 1124/337		INPAGE LEAKSST	IO, VILO, ULITA-LOW-INDIGE, RIGH FORR, LOW-DROFOUT, LINEAR REGULATOR; 50/0-5
Y1		1	7M-12.000MAAJ	I XC CURPORATION	12MHZ	CRYSTAL; SMT; 18PF; 12MHZ; +/-30PPM; +/-30PPM
PCB	-	1	MAX17320XSOLDERDOWN	MAXIM	PCB	PCB:MAX17320XSOLDERDOWN
C16-C18	DNP	0	GRM1555C1E102JA01;C1005C0G1E102J050BA	MURATA;TDK	1000PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1000PF; 25V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G
J3	DNP	0	PBC04DAAN	SULLINS ELECTRONICS CORP.	PBC04DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 8PINS; -65 DEGC TO +125 DEGC
22	DNID		55504044		50004044	TRAN; COMMON DRAIN N-CHANNEL POWERTRENCH MOSFET; NCH; POWERCLIP-33; PD-(2.7W); I-(27A); V-
up .	UNP	U	FUFC4044	UN SEMICUNDUCTOR	rur'64044	(30V)
C44	DNP	0	N/A	N/A	OPEN	CAPACITOR; SMT (0402); OPEN; FORMFACTOR
R7	DNP	0	N/A	N/A	OPEN	RESISTOR; 0805; OPEN; FORMFACTOR
R23. R24. R50	DNP	0	N/A	N/A	OPEN	RESISTOR: 0402: OPEN: FORMFACTOR
						 A set of the set of

MAX17320X EV Kit Schematic



MAX17320X EV Kit Schematic (continued)



MAX17320X EV Kit PCB Layouts

Evaluate: MAX17320

C33 C32 222 SG4 S = R22 2 R38 R34 C19 🖏 GNE 340 C41 /KIT 28 SCI WIRF -0-000 `اللل ОC 0 0 18 o∎**€** 004 Ď **F**A 0 RT2+ RT1+ ALRTWK . 2 RT4+ RT3+ BATTP SATT3 RT-BATT C BAT

MAX17320X EV Kit Component Placement Guide—Top Silkscreen



MAX17320X EV Kit PCB Layout—Layer 2



MAX17320X EV Kit PCB Layout—Bottom Layer



MAX17320X EV Kit PCB Layout—Top Layer



MAX17320X EV Kit PCB Layout—Layer 3



MAX17320X EV Kit Component Placement Guide—Bottom Silkscreen

Evaluate: MAX17320

MAX17320G EV Kit Bill of Materials

REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
ALRT, AOLDO, RT-, RT1+-RT4+, SCL, SCL1, SDA, SDA1, VUSB	-	12	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER:
C1 C3		2	I MK105B7474KV	PANASONIC	0.47UE	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.47UF; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC;
01,00		-				TC=X7R CAPACITOR; SMT (0402); CERAMIC CHIP; 0.47UF; 25V; TOL=10%; TG=-55 DEGC TO +85 DEGC;
62, 643	-	2	C1005X5R1E474R050;GR1155R61E474RE01	IDK;MURATA	0.470F	TC=X5R CAPACITOR: SMT (0402): CERAMIC CHIP: 1UE: 10V: TOI = 10%: TG=-55 DEGC TO +85 DEGC
C4, C7, C19, C26	-	4	C0402C105K8PAC;CC0402KRX5R6BB105	KEMET;YAGEO	1UF	TC=X5R
C5	-	1	C0402C103K5RAC;GRM155R71H103KA88;C1005X7R 1H103K050BE;CL05B103KB5NNN;UMK105B7103KV	KEMET;MURATA;TDK;SAMSUNG ELECTRONIC;TAIYO YUDEN	0.01UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.01UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
C6, C8, C10, C11	-	4	CL05B103KP5NNN	SAMSUNG ELECTRONICS	0.01UF	CAPACITOR; SMT (0402); CERAMIC; 0.01UF; 10V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
C9, C12-C15, C21, C22, C24, C25, C28-C38	-	20	GRM155R71E104KE14;C1005X7R1E104K050BB;TMK 105B7104KVH;CGJ2B3X7R1E104K050BB	MURATA;TDK;TAIYO YUDEN;TDK	0.1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.1UF; 25V; TOL=10%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R
C20, C23, C27	-	3	ZRB15XR61A475ME01; CL05A475MP5NRN;GRM155R61A475MEAA;C1005X5 R1A475M050BC	MURATA;SAMSUNG;MURATA;TDK	4.7UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 4.7UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=XSR
C39, C40	-	2	C0402C0G500270JNP; GRM1555C1H270JA01	VENKEL LTD.;MURATA	27PF	CAPACITOR; SMT; 0402; CERAMIC; 27pF; 50V; 5%; C0G; -55degC to + 125degC; 0 +/-30PPM/degC
C41, C42	-	2	GRM155R71A104JA01	MURATA	0.1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 0.1UF; 10V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=X7R
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
D2-D4, D10	-	4	BZX384-C5V6	NXP	5.6V	DIODE; ZNR; SMT (SOD-323); Vz=5.6V; Izm=0.000001A; -65 DEGC TO +150 DEGC DIODE: SCH: SCHOTTKY RECTIFIER: SMT (SOD-123): PIV=20V: IE=0.5A: -55 DEGC TO +150
D5, D6	-	2	MBR0520	MICRO COMMERCIAL COMPONENTS	MBR0520	DEGC
D7	-	1	SD103AWS	MICRO COMMERCIAL COMPONENTS	SD103AWS-TP	DIODE; SCH; SMALL SIGNAL SCHOTTKY DIODE; SOD-323; PIV=40V; IF=0.35A
D9	-	1	SD101BWS-E3	VISHAY	SD101BWS-E3	DIODE; SCH; SMT (SOD-323); PIV=50V; IF=0.03A
DGND, GND	-	2	5011	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK;
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
F1	-	1	SFJ-1215U	DEXERIALS	SFJ-1215U	EVKIT PART - FUSE; SELF CONTROL PROTECTOR; SFJ SERIES; 3-CELL; 15A
J1	-	1	10118193-0001LF	FCI CONNECT	10118193-0001LF	CONNECTOR; FEMALE; SMT; MICRO USB B TYPE RECEPTACLE; RIGHT ANGLE; 5PINS
J2, J5	-	2	PBC02SAAN	SULLINS ELECTRONICS CORP.	PBC02SAAN	TO +125 DEGC;
J4	-	1	PBC03DAAN	SULLINS ELECTRONICS CORP.	PBC03DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 6PINS; -65 DEGC TO +125 DEGC
J8	-	1	PPPC062LJBN-RC	SULLINS ELECTRONICS CORP.	PPPC062LJBN-RC	CONNECTOR; FEMALE; THROUGH HOLE; 0.1IN CC; HEADER; 2 ROW; RIGHT ANGLE; 12PINS
L1-L3	-	3	BLM18AG601SN1	MURATA	600	INDUCTOR; SMT (0603); FERRITE-BEAD; 600; TOL=+/-; 0.5A
MISC1	-	1	AK67421-1-R	ASSMANN	AK67421-1-R	MALE; STRAIGHT; SPINS-4PINS
Q1, Q2	-	2	IRF7458PBF	INFINEON	IRF7458PBF	TRAN; SMPS MOSFET; NCH; NSOIC8; PD-(2.5W); I-(14A); V-(30V)
Q4, Q5	-	2	2N7002	NXP	2N7002	TRAN; N-CHANNEL TRENCH MOSFET; NCH; SOT-23; PD-(0.83W); I-(0.3A); V-(60V)
Q8	-	1	BSS223PW	INFINEON	BSS223PW	TRAN; OPTIMOS SMALL-SIGNAL-TRANSISTOR; PCH; SOT323-3; PD-(0.25W); I-(-0.39A); V-(-20V)
R1, R3-R5	-	4	RNCP0805F1D49R9 ERJ-2RKF27R0X;RC0402FR-	STACKPOLE ELECTRONICS INC	49.9	RESISTOR; 0805; 49.9 OHM; 1%; 100PPM; 0.25W; THIN FILM
R2, R9	-	2	0727RL;CRCW040227R0FK	PANASONIC; YAGEO PHICOMP; VISHAY DALE	27	RESISTOR, 0402, 27 OHM, 1%, 100PPM, 0.0625W, THICK FILM
R6, R16, R34	-	3	071KL;MCR01MZPF1001	VISHAY DALE;YAGEO PHICOMP;ROHM SEMI	1K	RESISTOR; 0402; 1K; 1%; 100PPM; 0.0625W; THICK FILM
R8, R12, R13		3	CRCW0402150RFK; 9C04021A1500FL	VISHAY DALE;YAGEO	150	RESISTOR; 0402; 150 OHM; 1%; 100PPM; 0.0625W; THICK FILM
R10		1	CR0402BRD0710RL CR0402-16W-3650ET	VENKELLTD	365	RES; SMT (0402); 10; 0.1%; +/-25PPM/DEGC; 0.063W RESISTOR: 0402: 365 OHM: 1%: 100PPM: 0.063W: THICK FILM
R14 R15		2	CRCW0402100RFK; 9C04021A1000FL; RC0402FR-	VISHAY DALE: PANASONIC: YAGEO PHYCOMP	100	RESISTOR: 0402: 100 OHM: 1%: 100PPM: 0.063W: THICK FILM
R17		1	07100RL WSI P12065I 000F	VISHAY DALE	0.005	RESISTOR: 1206: 0.005 OHM: 1%: 400PPM: 1.0W: METAL FILM
R18	-	1	CRCW0402100KFK;RC0402FR-07100KL	VISHAY;YAGEO	100K	RESISTOR; 0402; 100K; 1%; 100PPM; 0.0625W; THICK FILM
R19		1	ERJ-1TNF4020U;CRCW2512402RFK	PANASONIC;VISHAY DALE	402	RESISTOR; 2512; 402 OHM; 1%; 100PPM; 1.0W; THICK FILM
R20, R25		2	CRCW040210K0JN	VISHAY DALE	10K	RESISTOR; 0402; 10K OHM; 5%; 200PPM; 0.063W; THICK FILM
R21		1	CRCW12062K00EK: MCR18EZPE2001	VISHAY DALE: ROHM	2K	RESISTOR; 1210; 1K OHM; 5%; 200PPM; 0.5W; THICK FILM RESISTOR: 1206: 2K: 1%: 100PPM: 1/4W: THICK FILM
R26	-	1	RC0805JR-070RL	YAGEO PHYCOMP	0	RESISTOR; 0805; 0 OHM; 5%; JUMPER; 0.125W; THICK FILM
R33	-	1	CRCW040212K0FK;MCR01MZPF1202	VISHAY DALE; ROHM SEMICONDUCTOR	12K	RESISTOR, 0402, 12K OHM, 1%, 100PPM, 0.0625W, THICK FILM
R35, R36, R38, R39	-	4	ERJ-2GE0R00	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
R40, R41	-	2	CRCW04021M00FK CRCW04024K70FK:MCR01M7PF4701	VISHAY DALE:ROHM SEMICONDUCTOR	4.7K	RESISTOR, 0402; 1M; 1%; 100PPM; 0.0625W; 1HICK FILM RESISTOR, 0402; 4.7K OHM, 1%, 100PPM, 0.0625W THICK FILM
R42, R43	-	2	PNM0402E5001BS	VISHAY DALE	5K	RESISTOR; 0402; 5K OHM; 0.1%; 25PPM; 0.05W; THIN FILM
R46, R47	-	2	CRCW0402470RFK	VISHAY DALE	470	RESISTOR, 0402, 470 OHM, 1%, 100PPM, 0.0625W, THICK FILM
RT1-RT4	-	4	NCP15XH103F03	MURATA	10K	THERMISTOR; SMT (0402); THICK FILM (NICKEL PLATED); 10K; TOL=+/-1%
S1, S2	-	2	EVQ-Q2K03W	PANASONIC	EVQ-Q2K03W	PANASONIC
T1		1	TGM-040P3RL	HALO ELECTRONICS INC	TGM-040P3RL	TRANSFORMER; SMT; 1:11.3:1.3; PCMCIA DC/DC CONVERTER;
U1		1	See Ordering Information	MAXIM		21-0139
U2		1	FT2232HL	FUTURE TECHNOLOGY DEVICES INTL LTD.	FT2232HL	IC; MMRY; DUAL HIGH SPEED USB TO MULTIPURPOSE UART/FIFO; LQFP64
14	-	-	MAY12252ATD -		MAX1937AWE+	IC; DRV; 1A SPREAD-SPECTRUM; PUSH-PULL; TRANSFORMER DRIVER FOR ISOLATED
U4	-	1	MAX13203A1B+		MAX13253A1B+	POWER SUPPLIES; TDFN10-EP
из, иб Y1	-	2	7M-12.000MAAJ	TXC CORPORATION	12MHZ	IC, VREG, ULI RA-LUW-NUISE, HIGH PSRR, LUW-DRUPOUT, LINEAR REGULATOR; SC70-5 CRYSTAL: SMT: 18PF: 12MHZ: +/-30PPM: +/-30PPM
РСВ	-	1	MAX17320XSOLDERDOWN	MAXIM	PCB	PCB:MAX17320XSOLDERDOWN
C16-C18	DNP	0	GRM1555C1E102JA01;C1005C0G1E102J050BA	MURATA;TDK	1000PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1000PF; 25V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=COG
J3	DNP	0	PBC04DAAN	SULLINS ELECTRONICS CORP	PBC04DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 8PINS; -65 DEGC TO +125
02	DND	5	EDBC4044		EDDC4044	DEGC TRAN; COMMON DRAIN N-CHANNEL POWERTRENCH MOSFET; NCH; POWERCLIP-33: PD-
uo 044	DNP	U			ODEN	(2.7W); I-(27A); V-(30V)
R7	DNP	0	N/A	N/A	OPEN	RESISTOR: 0805: OPEN: FORMFACTOR
R23, R24, R50	DNP	0	N/A	N/A	OPEN	RESISTOR; 0402; OPEN; FORMFACTOR

Evaluate: MAX17320

MAX17320G EV Kit PCB Schematics



MAX17320G EV Kit PCB Schematics (continued)



Evaluate: MAX17320

MAX17320G EV Kit PCB Layouts



MAX17320G EV Kit Component Placement Guide—Top Silkscreen



MAX17320G EV Kit PCB Layout—Layer 2



MAX17320G EV Kit PCB Layout—Bottom Layer



MAX17320G EV Kit PCB Layout—Top Layer



MAX17320G EV Kit PCB Layout—Layer 3



MAX17320G EV Kit Component Placement Guide—Bottom Silkscreen

Evaluate: MAX17320

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/20	Initial release	
1	4/20	Updated Ordering Information table	24
2	7/20	Updated <i>General Description</i> section, <i>Configuration Wizard</i> section, and <i>ordering information</i> table, replaced MAX17320X EV kit schematic and MAX17320G EV kit schematic	1, 19–21, 24, 26, 27, 30, 31

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