Evaluates: MAX77963

MAX77963 Evaluation Kit

General Description

The MAX77963 evaluation kit (EV kit) is a fully assembled and tested surface-mount printed circuit board (PCB) that evaluates the MAX77963, a 3.2A USB Type-C® buck-boost charger.

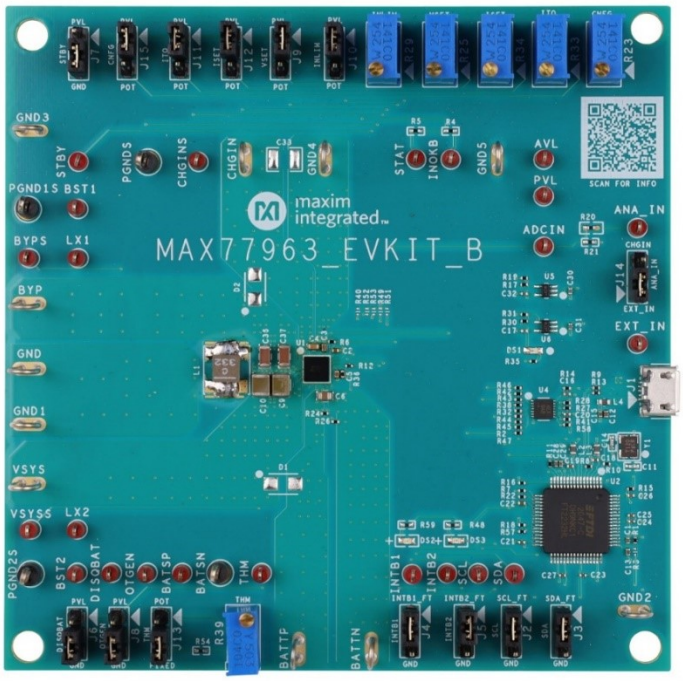
The MAX77963 EV kit includes the IC evaluation board with an integrated I²C-communication interface and USB micro-B cable. Windows® based graphical-user interface (GUI) software is available for use with the EV kit and can be downloaded from Analog Devices website at ***www.analog.com/max77963evkit***. Windows 7 or newer Windows operating system is required to use the EV kit software.

Features

- Evaluates the MAX77963 USB Type-C Buck-Boost Charger with Integrated FETs for 2S/3S Li-Ion Batteries
- Demonstrates 3.5V to 23V Input Operating Range
- Demonstrates Charging Up to 3.2A
- Demonstrates USB-OTG Functionality
- Demonstrates JEITA Compliance with On-Board Dummy Thermistors
- Demonstrates 8-Channel 12-Bit SAR ADC
- Demonstrates Spread Spectrum
- Fully Assembled and Tested
- I²C Serial Interface

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

EV Kit Photo



USB Type-C is a registered trademark of USB Implementers Forum.
Windows is a registered trademark and registered service mark of Microsoft Corporation.

319-100987; Rev 0; 3/23

MAX77963 EV Kit Files

FILE	DESCRIPTION
MAX77963GUISetupX.X.X.exe	Installs EV kit files onto computer

MAX77963 EV Kit Component List

PART	QTY	DESCRIPTION
MAX77963EVKIT	1	MAX77963 evaluation kit
USB high-speed A-to-B cable	1	USB Micro-B cable

Quick Start

Follow this procedure to familiarize yourself with the EV kit. **Note:** In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined refers to items from the Windows operating system.**

Required Equipment

- MAX77963 EV kit
- Adjustable DC power supply
- Battery or simulated battery
  - 2- or 3-cell Li-ion protected battery
  - Simulated battery or preloaded power supply
- Oscilloscope
- Two voltmeters
- Two ammeters
- Lab cables with appropriate current rating
- USB Micro-B cable
- PC with Windows 7 or newer operating system and USB port

Setup Overview

A typical bench setup for the MAX77963 EV kit is shown in *Figure 1*.

Procedure

The EV kit is fully assembled and tested. Follow the steps to install the EV kit software, make the required hardware connections, and start the operation of the kit. The EV kit software can be run without the hardware attached. Note that after communication is established, the IC must still be configured correctly for desired operation mode. Make sure the PC is connected to the internet throughout the process so that the USB driver can be automatically installed.

Note: Do not turn on the DC power supply until all connections are made.

1) Visit ***https://www.analog.com/max77963evkit*** to download the latest version of the MAX77963 EV kit software. Save the software to a temporary folder and unpack the zip file.
2) Install the EV kit software on the computer by running the **MAX77963GUISetupX.X.X.exe** program inside the temporary folder. This copies the program files and creates an icon in the Windows **Start** menu. The software requires the .NET Framework 4.5 or later. If connected to the internet, Windows automatically updates the .NET Framework as needed.
3) The EV kit software launches automatically after installation, and it can be launched by clicking on its icon in the Windows **Start** menu.
4) Make jumper connections based on the Default Connection column in *Table 1*. Change it later when evaluating more features.
5) Use the USB cable provided with the EV kit to connect the EV kit to the PC's USB port.
6) Connect a 2- or 3-cell Li-ion battery or simulated battery to the connectors labeled BATTP and BATTN.
7) Connect a DC power supply to the connectors labeled CHGIN and GND.
8) Launch the MAX77963 GUI software.
9) Select **Device** > **Connect** from the window options to connect to the EV kit.

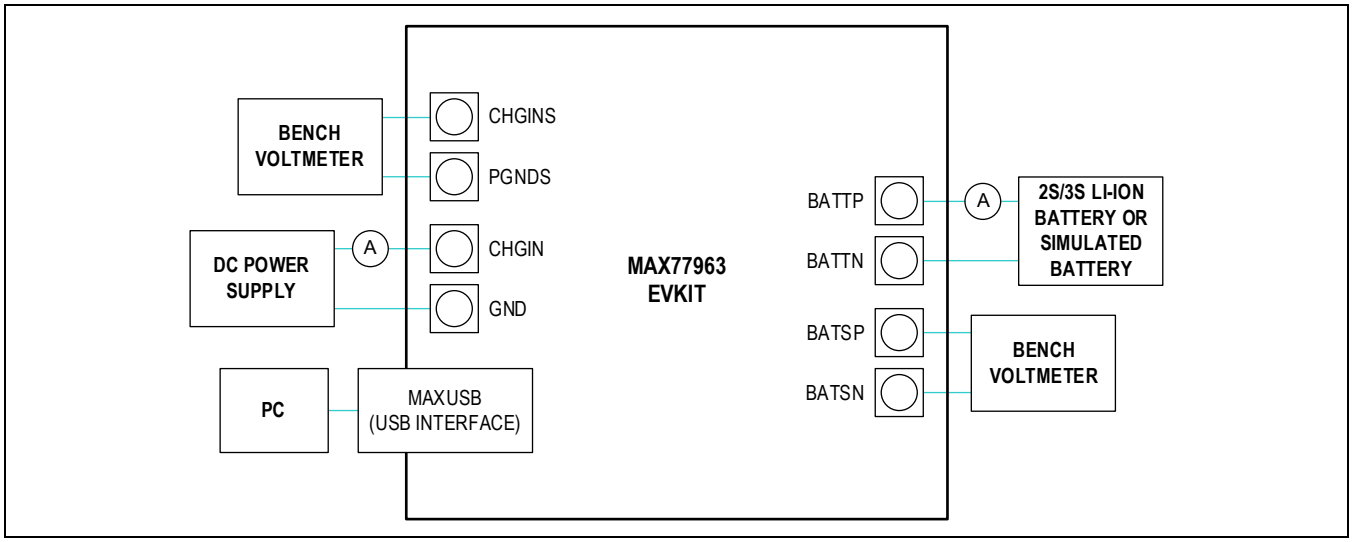


Figure 1. MAX77963 EV Kit Board Connections

Table 1. Jumper Connection Guide

JUMPER	PCB SILKSCREEN	DEFAULT CONNECTION	FEATURE
J2	SCL	1-2	**1-2:** Connects SCL with the onboard MAXUSB (USB-to-I²C interface) to allow communication with the GUI software. 2-3: Disconnects SCL from the onboard MAXUSB.
J3	SDA	1-2	**1-2:** Connects SDA with the onboard MAXUSB to allow communication with the GUI software. 2-3: Disconnects SDA from the onboard MAXUSB.
J4	INTB1	1-2	**1-2:** Connects INTB1 with the onboard MAXUSB to allow communication with the GUI software. 2-3: Disconnects INTB1 from the onboard MAXUSB.
J5	INTB2	1-2	**1-2:** Connects INTB2 with the onboard MAXUSB to allow communication with the GUI software. 2-3: Disconnects INTB2 from the onboard MAXUSB.
J6	DISQBAT	2-3	1-2: Connects DISQBAT to PVL. QBAT FET is disabled. **2-3:** Connects DISQBAT to GND. QBAT FET is controlled by the DISIBS bit and power-path state machine/internal logic control.
J7	STBY	2-3	1-2: Connects STBY to PVL. DC-DC is disabled. **2-3:** Connects STBY to GND. DC-DC is controlled by STBY_EN bit and power-path state machine/internal logic control.
J8	OTGEN	2-3	1-2: Connects OTGEN to PVL. OTG function is enabled. **2-3:** Connects OTGEN to GND. OTG function enable is controlled by MODE[3:0] bitfield.
J9	VSET	1-2	**1-2:** Connects VSET to PVL. Default charge termination voltage is same as decode of reset value of CHG_CV_PRM[7:0]. 2-3: Connects VSET to R25. Default charge termination voltage is programmed by R25.

J10	INLIM	1-2	**1-2:** Connects INLIM to PVL. Default input current limit is same as decode of reset value of CHGIN_ILIM[6:0]. 2-3: Connects INLIM to R29. Default input current limit is programmed by R29.
J11	ITO	1-2	**1-2:** Connects ITO to PVL. Default top-off charge current is same as decode of reset value of TO_ITH[2:0]. 2-3: Connects ITO to R33. Default top-off charge current is programmed by R33.
J12	ISET	1-2	**1-2:** Connects ISET to PVL. Default fast-charge current is same as decode of reset value of CHGCC_MSB and CHGCC[7:0]. 2-3: Connects ISET to R34. Default fast-charge current is programmed by R34.
J13	THM	2-3	1-2: Connects THM to potentiometer R39. Adjust the resistance of R39 to emulate the resistance change of a 10kΩ thermistor at different temperatures. **2-3:** Connects THM to a fixed 10kΩ resistor. This emulates the resistance of a 10kΩ thermistor at 25°C.
J14	ANA_IN	1-2	**1-2:** Connects ADCIN to an external input EXT_IN through a resistor divider. Voltage dividing ratio is (R20 + R21) / R21 = 20.1. Voltage of EXT_IN should be no higher than 25V to avoid saturating voltage sensing at ADCIN. 2-3: Connects ADCIN to CHGIN through a resistor divider. Voltage dividing ratio is (R20 + R21) / R21 = 20.1. Voltage of CHGIN should be no higher than 25V to avoid saturating voltage sensing at ADCIN.
J15	CNFG	1-2	**1-2:** Connects CNFG to PVL. Number of serially connected battery cells is configured as 2S. Switching frequency is configured as 600kHz. Inductance is selected as 2.2µH or 3.3µH. 2-3: Connects CNFG to R23. Number of serially connected battery cells, switching frequency, and inductance selection are programmed by R23.

*Default options are in **bold**.*

Detailed Description of Software

The MAX77963 GUI software provides an easy-to-use interface to control the functional blocks of the IC.

Software Installation

Double-click the **MAX77963GUISetupX.X.X.exe** icon to begin the installation process. 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/MAX77963** folder and run **MAX77963.exe** or select it from the program menu. *Figure 2* shows a splash screen containing information about the evaluation kit that appears while the program is loading.

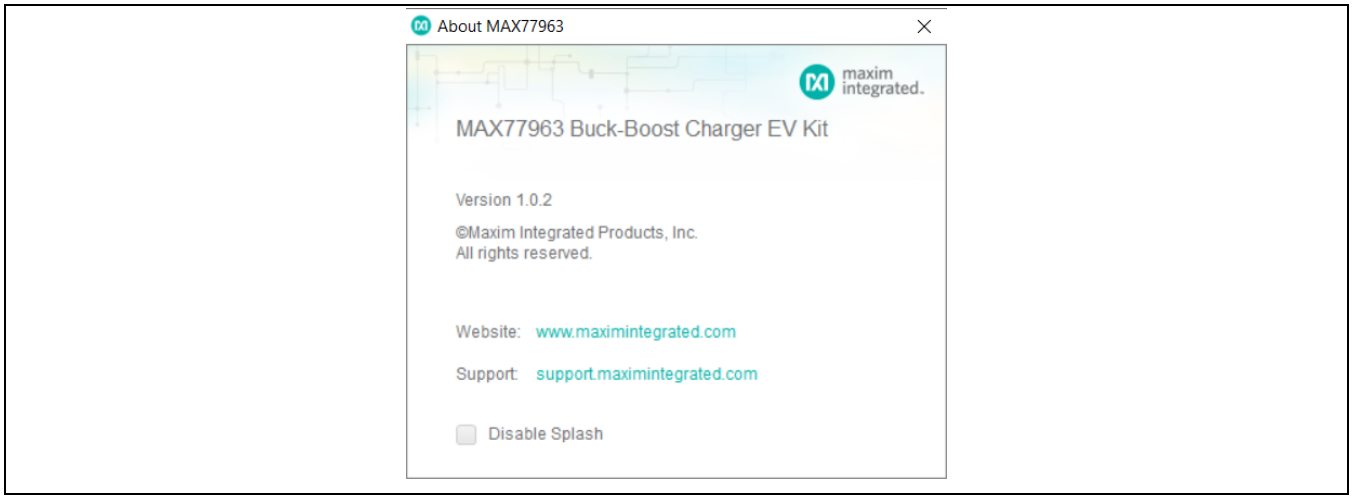


Figure 2. Splash Screen

Establish Communication

Power up the MAX77963 by connecting a 2- or 3-cell Li-ion battery or simulated battery at BATTP/BATTN. Open the GUI software and select **Device > Connect**. A window should pop up showing that a slave address 0x69 (7-bit address) has been found. If not, check the USB connection and power. Choose **Read and Close** and the status bar displays “Connected” to signify active communication. An example of a successful connection is shown in *Figure 3*.

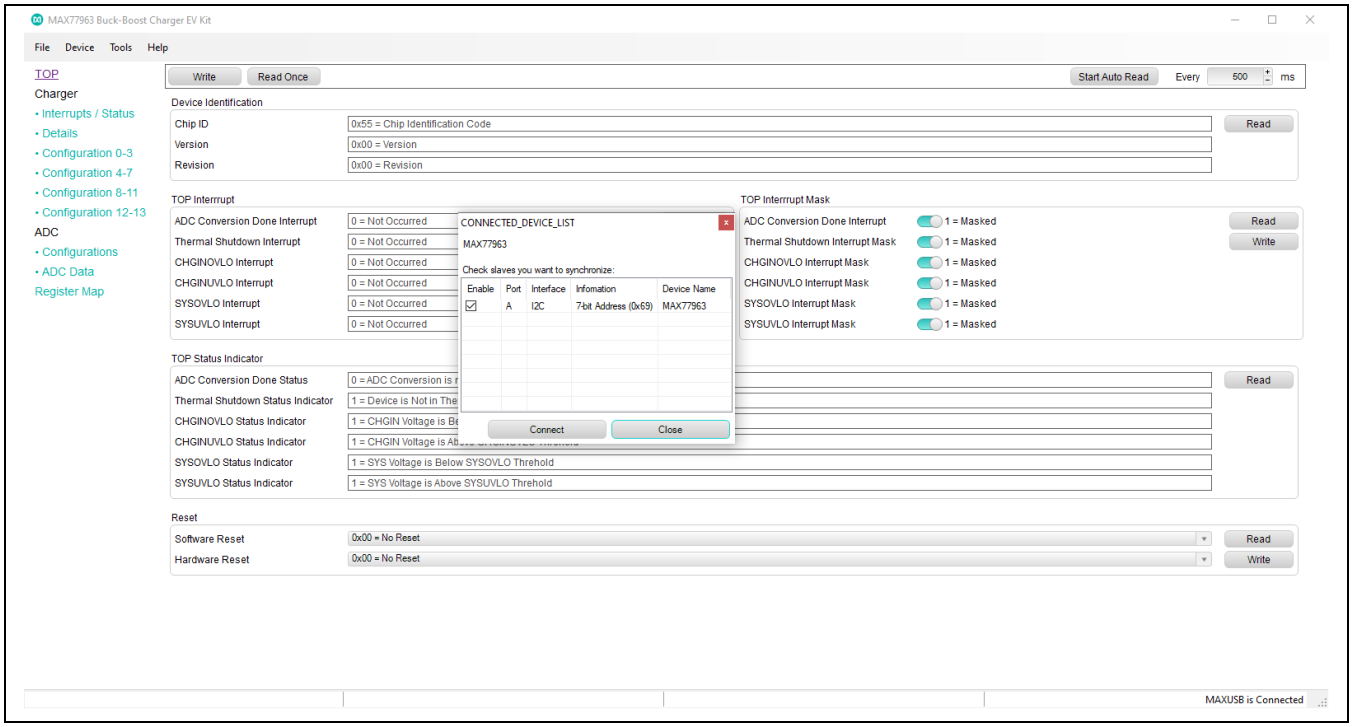


Figure 3. Communication Window

Main Display

Status bits and programmable functions of the charger can be accessed through the interface tabs in the left column of the window (*Figure 4*).

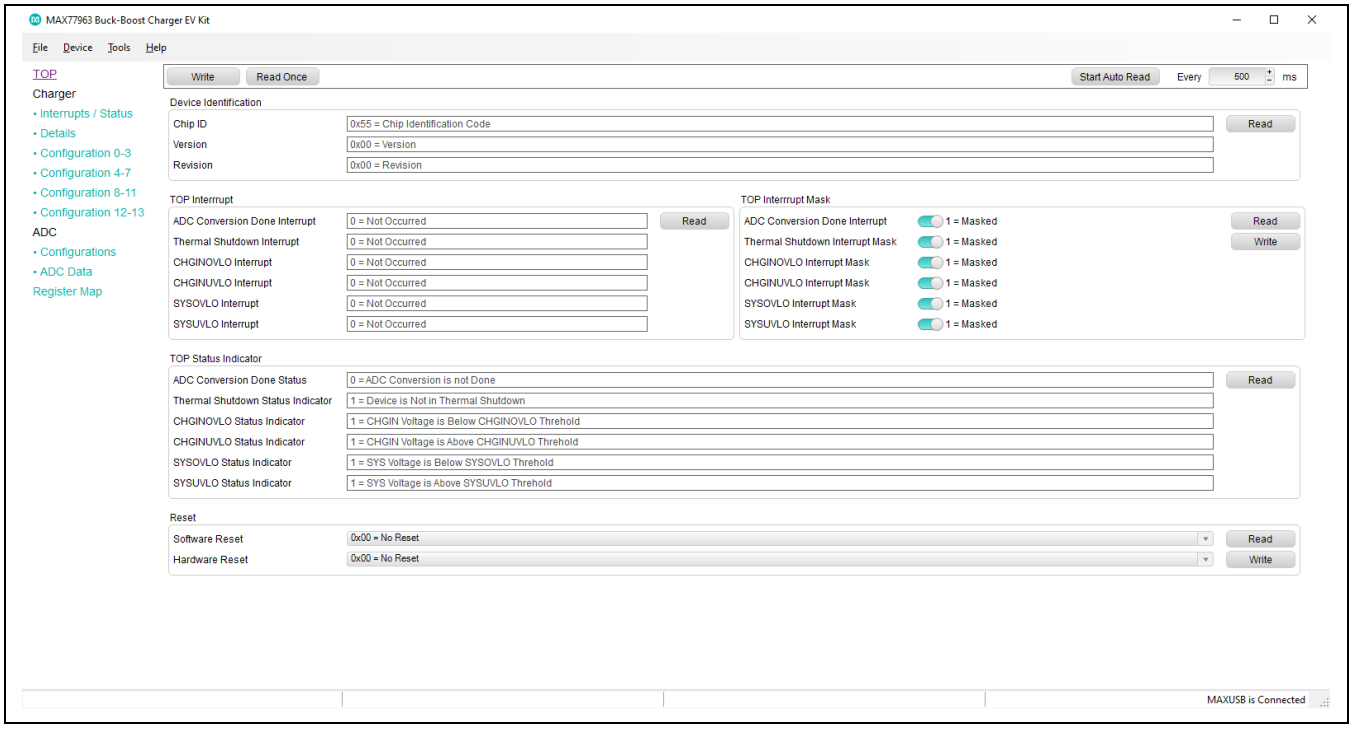


Figure 4. Top-Level Registers

Register Write Access

Modification of the charger registers is locked by default to prevent arbitrary changes. Therefore, changes made to the charger registers in the locked state are not applied to the EV kit. To unlock register writing, select the **0x3 = Unlocked** option in the **Charger Settings Protection** dropdown menu from the **Charger Configurations 6** register in the **Configuration 4-7** tab, and then click **Write** (*Figure 5*). Read the register and the **Charger Settings Protection** setting should remain in the **0x3 = Unlocked** state to signify open register access.

From this point onwards, modifications written to any of the registers apply to the EV kit. For example, the **CHGIN Input Current Limit** can be changed in the **Charger Configurations 8** register by selecting the required value and clicking **Write** (*Figure 6*), but only after the registers have been unlocked.

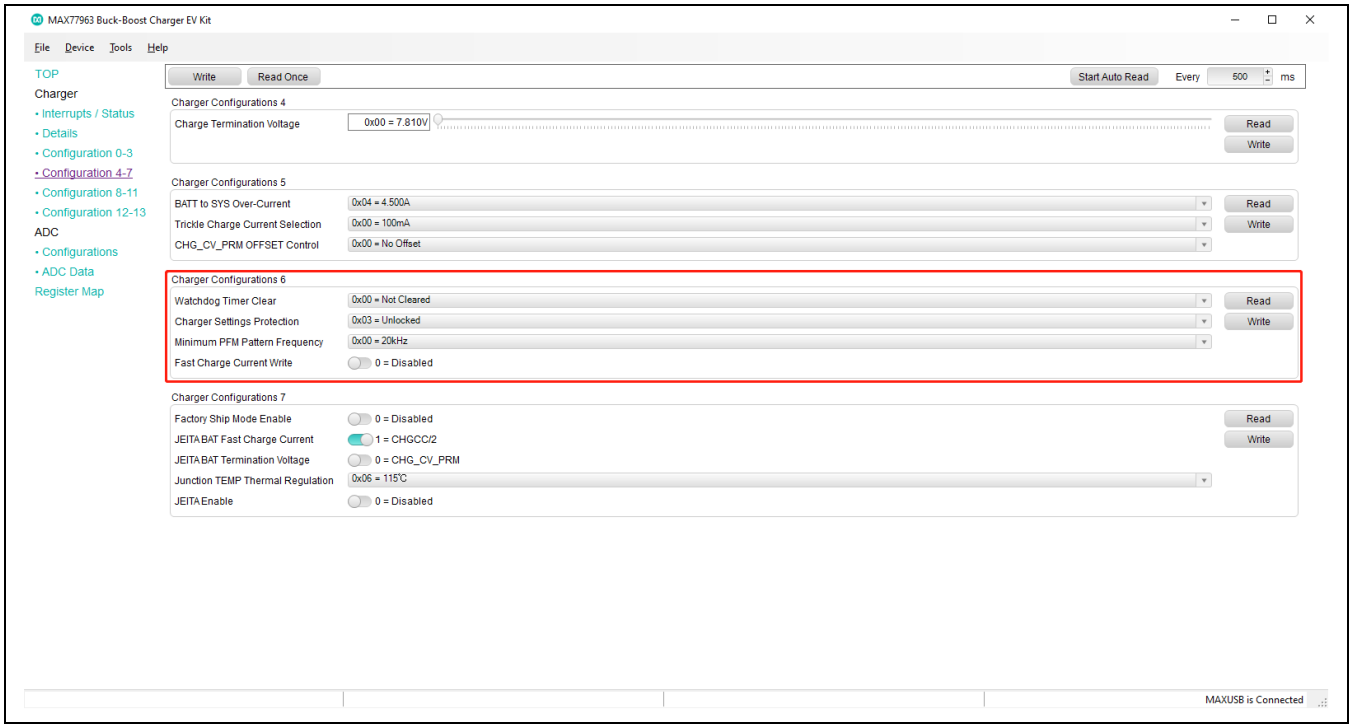


Figure 5. Charger Register Write Access

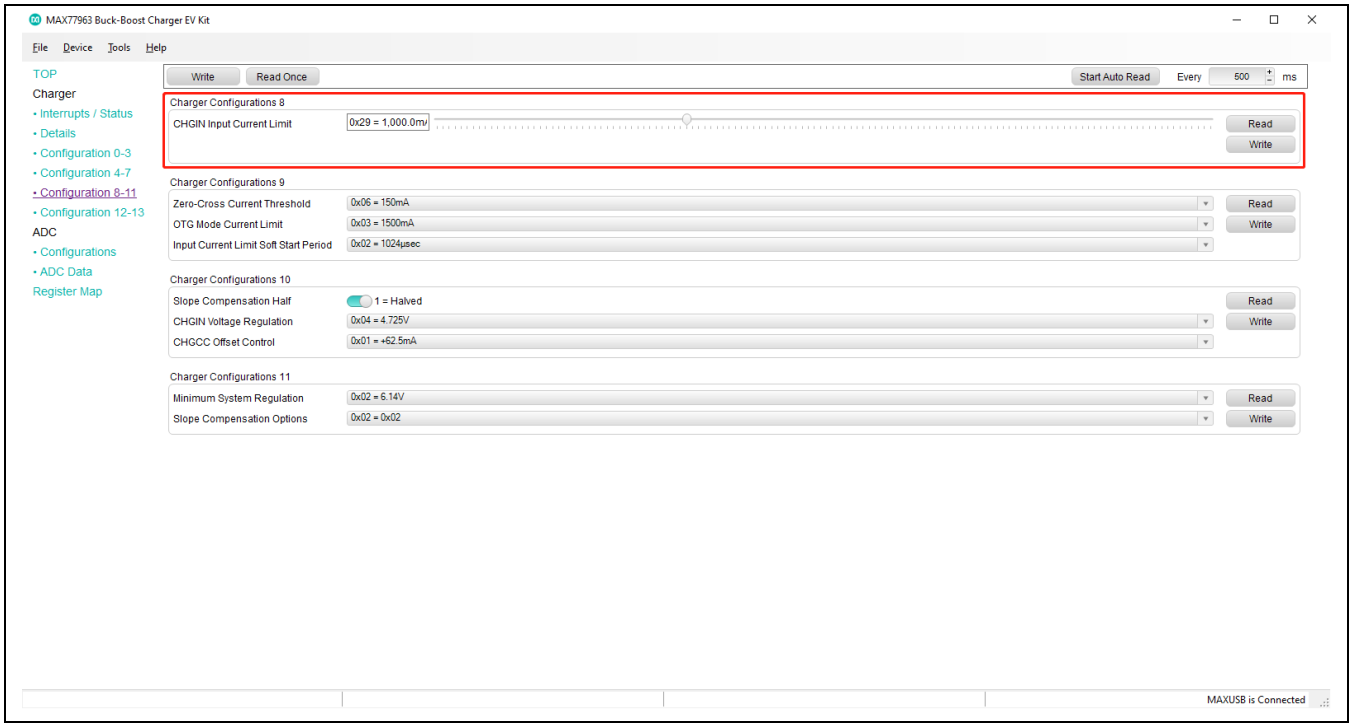


Figure 6. Change CHGIN Input Current Limit after Unlocking Charger Settings Protection

Detailed Description of Hardware

Battery Charger Test Setup

1) Connect a 2- or 3-cell Li-Ion battery or simulated battery between BATTP and BATTN.
2) Adjust the voltage and current limits of the DC power supply to 5.0V and 3.0A. The output of the power supply is off.
3) Connect the power supply between CHGIN and GND on the EV kit board.
4) Open the EV kit GUI and connect to the EV kit.
5) In the **Configuration 4-7** tab, set **Charger Settings Protection** in the **Charger Configurations 6** register to **0x3 = Unlocked**. Click **Write** to send the command to the charger.
6) Program the appropriate charger settings for your system. In the **Configuration 8-11** tab, set **CHGIN Input Current Limit** in the **Charger Configurations 8** register. Click **Write** to send the command to the charger.
7) The 9-bit **Fast Charge Current** bitfield resides in two registers (**CHGCC_MSB** of the **CHG_CNFG_08** register and **CHGCC[7:0]** of the **CHG_CNFG_02** register). To guarantee an atomic operation, a write-enable bit **CHGCC_WR_EN** is provided in the **CHG_CNFG_06** register. Writing 1 to this bit makes the value of the **Fast Charge Current** take effect. For changing the fast-charge current, perform the following steps (*Figure 7*):
   a. The EV kit GUI has been optimized by concatenating **CHGCC_MSB** and **CHGCC[7:0]** in the same setting. In the **Configuration 0-3** tab, set **Fast Charge Current** in the **Charger Configurations 2** register. Click **Write** to send the command to the charger.
   b. To apply the fast-charge current, enable **Fast Charge Current Write Command** in the **Charger Configurations 6** register under the **Configuration 4-7** tab. Toggle the button to **Enabled** and click **Write**.
8) In the **Charger Configuration 0** register of the **Configuration 0-3** tab, set **Smart Power Selector** to **0x5 = Charger = On**, **OTG = Off, and DCDC = On**, and click **Write** to enable charger mode.
9) Turn on the DC power supply's output to enable charging.
10) Use data log equipment to log the charge current and battery voltage profile while charging a 2- or 3-cell Li-ion battery.

Figure 7. Write Fast-Charge Current

ADC Test Setup

1) Follow the steps above to connect equipment and the GUI to the EV kit. Configure the IC by using the **Charger** configuration tabs.
2) In the **Configurations** tab, select channel(s) of ADC for sampling and conversion in the **ADC Configuration 0** register. Click **Write** to send the command to the charger.
3) Set single measurement or continuous measurement and other ADC configurations in the **ADC Configuration 1** register. Click **Write** to send the command to the charger (*Figure 8*).
4) In the **ADC Data** tab, click **Read Once** or **Start Auto Read**. Readback data of ADC channel(s) enabled is presented (*Figure 9*).

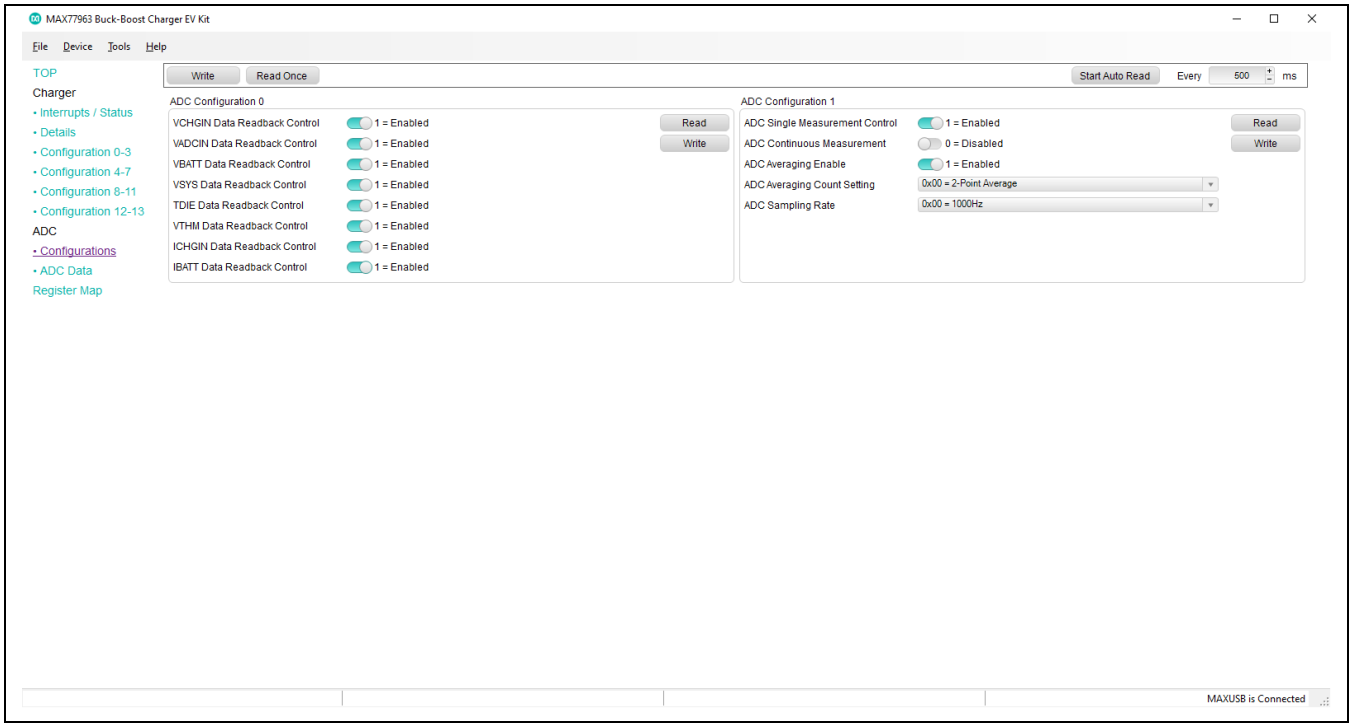


Figure 8. ADC Configurations

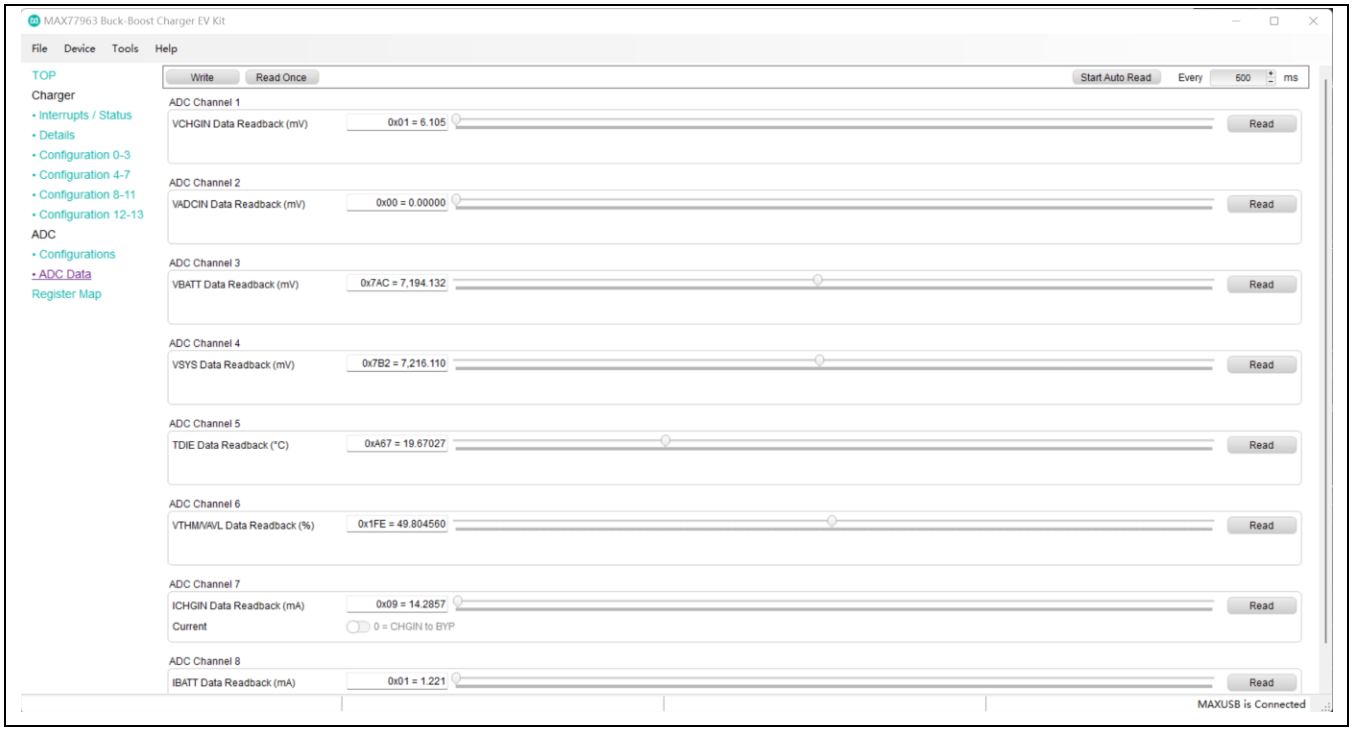


Figure 9. ADC Readback Data

Ordering Information

PART	TYPE
MAX77963EVKIT#	EV Kit

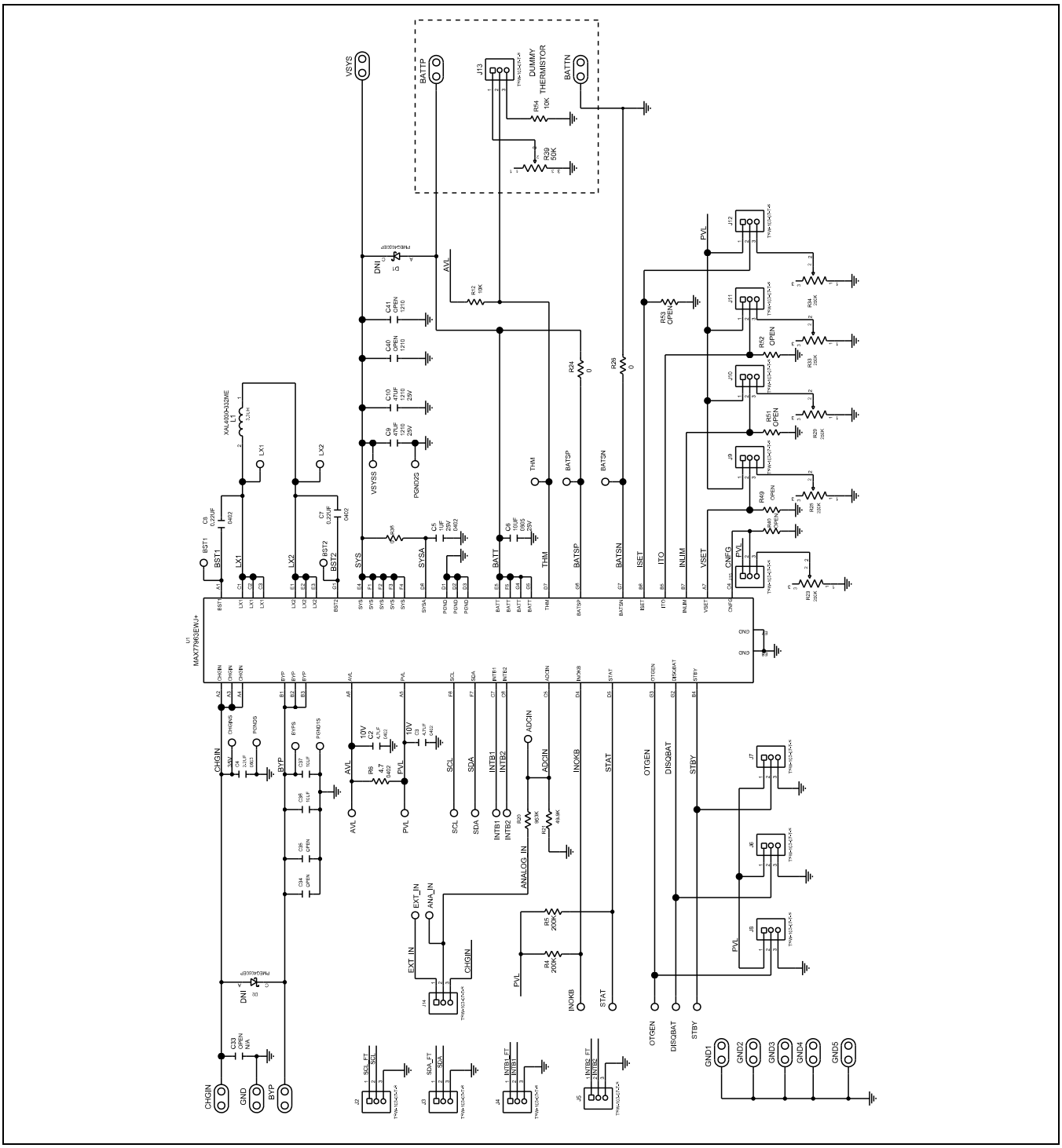
#Denotes RoHS-compliant.

MAX77963 EV Kit Bill of Materials

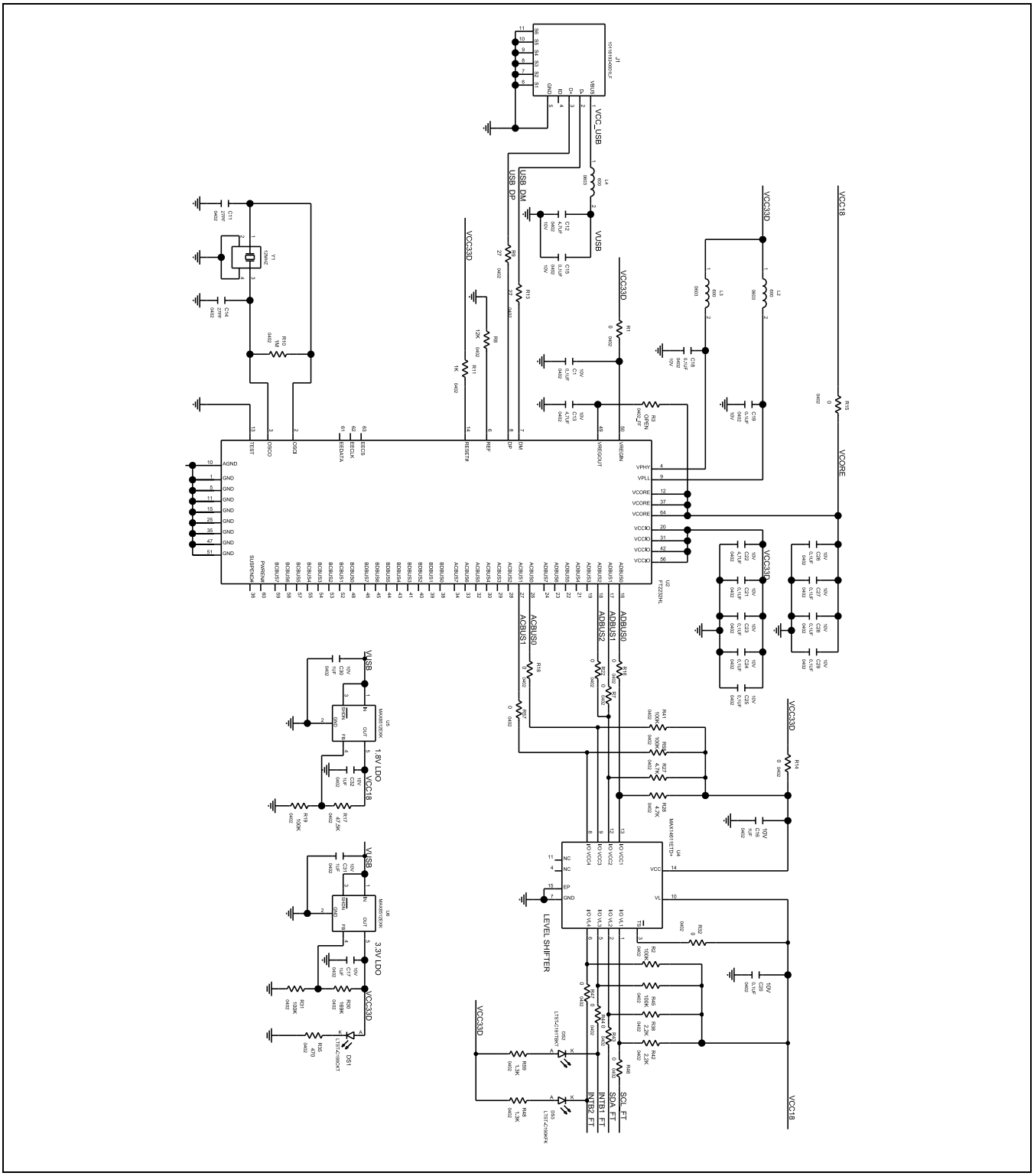
REF_DES	QTY	MFG PART #	DESCRIPTION
ADCIN, ANA_IN, AVL, BATSP, BST1, BST2, BYPS, CHGINS, DISQBAT, EXT_IN, INOKB, INTB1, INTB2, LX1, LX2, OTGEN, PVL, SCL, SDA, STAT, STBY, THM, VSYSS	23	5000	RED TEST POINT
BATSN, PGND1S, PGND2S, PGNDS	4	5011	BLACK TEST POINT
BATTN, BATTP, BYP, CHGIN, GND, GND1-GND5, VSYS	11	9020 BUSS	WIRE, BUSS 20G PLATED SOLID COPPER
C1, C15, C18-C21, C23-C29	13	GRM155R71A104JA01	CAP+, 0.1µF,10%, 6.3V, X5R, 0402
C2, C3, C12, C13, C22	5	GRM155R61A475MEAA	CAP+, 4.7µF, 20%, 10V, X5R, 0402
C4	1	GRM188R6YA225KA12	CAP+, 2.2µF, 10%, 35V, X5R, 0603
C5	1	GRM155C81E105KE11	CAP+, 1µF, 10%, 25V, X6S, 0402
C6	1	GRM21BR61E106K	CAP+, 10µF, 10%, 25V, X5R, 0805
C7, C8	2	GRM155R71C224KA12	CAP+, 0.22µF, 10%, 16V, X7R, 0402
C9, C10	2	TMK325ABJ476MM	CAP+, 47µF, 20%, 25V, X5R, 1210
C11, C14	2	GRM1555C1H270JA01	CAP+, 27pF, 5%, 50V, C0G, 0402
C16, C17, C30-C32	5	C0402C105K8PAC	CAP+, 1µF, 10%, 10V, X5R, 0402
C36, C37	2	CGA5L1X7R1V106K160AC	CAP+, 10µF, 10%, 35V, X7R, 1206
DS1	1	LTST-C190CKT	LED+, SURFACE MOUNT, RED
DS2	1	LTST-C191TBKT	LED+, SURFACE MOUNT, BLUE
DS3	1	LTST-C190KFK	LED+, SURFACE MOUNT, ORANGE
J1	1	10118193-0001LF	RCPT+, MICRO B USB 2.0, 5 POS
J2-J15	14	TSW-103-07-T-S	HEADER+, 3POS, .100”, SNGL
L1	1	XAL4030-332ME	INDUCTOR+, 3.3µH, 20%, 5.0A
L2-L4	3	BLM18AG601SN1	FERRITE BEAD, 600nH, 0.5A, 0603, 20%, 5.8A, 4.1x4.1MM
R1, R7, R14-R16, R18, R22, R24, R26, R32, R43, R44, R46, R47, R57	15	ERJ-2GE0R00	RES+, 0Ω, 0%, 0402
R2, R19, R31, R41, R45, R58	6	CRCW0402100KFK	RES+, 100KΩ, 1%, 0402
R4, R5	2	CRCW0402200KFK	RES+, 200KΩ, 1%, 0402
R6	1	CRCW04024R70FK	RES+, 4.7Ω, 1%, 0402
R8	1	CRCW040212K0FK	RES+, 12KΩ, 1%, 0402
R9, R13	2	CRCW040227R0FK	RES+, 27Ω, 1%, 0402
R10	1	CRCW04021M00FK	RES+, 1MΩ, 1%, 0402
R11	1	CRCW04021K00FK	RES+, 1KΩ, 1%, 0402

R12, R54	2	CRCW040210K0FK	RES+, 10KΩ, 1%, 0402
R17	1	CRCW04024752FK	RES+, 47.5KΩ, 1%, 0402
R20	1	CRCW0603953KFK	RES+, 953KΩ, 1%, 0603
R21	1	ERJ-2RKF4992	RES+, 49.9KΩ, 1%, 0402
R23, R25, R29, R33, R34	5	3296W-1-254LF	RES+, POT, 250KΩ
R27, R28	2	CRCW04024K70FK	RES+, 4.7KΩ, 1%, 0402
R30	1	CRCW0402169KFK	RES+, 169KΩ, 1%, 0402
R35	1	CRCW0402470RFK	RES+, 470Ω, 1%, 0402
R36	1	RC0402JR-070RL	RES+, 0Ω, 5%, 0402
R38, R42	2	RC0402FR-072K2L	RES+, 2.2KΩ, 1%, 0402
R39	1	3296Y-1-503LF	RES+, POT, 50KΩ
R48, R59	2	ERJ-2GEJ132	RES+, 1.3KΩ, 5%, 0402
U1	1	MAX77963EWJ+	MAX77963EWJ+
U2	1	FT2232HL	FT2232HL
U4	1	MAX14611ETD+	MAX14611ETD+
U5, U6	2	MAX8512EXK+	MAX8512EXK+
Y1	1	7M-12.000MAAJ	7M-12.000MAAJ
D1, D2	2	OPEN	N/A
C33-C35, C40, C41	5	OPEN	N/A
R3, R40, R49, R51-R53	6	OPEN	N/A

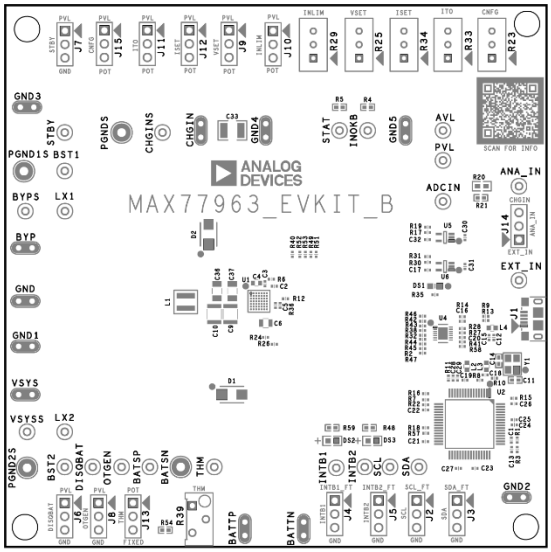
MAX77963 EV Kit Schematic



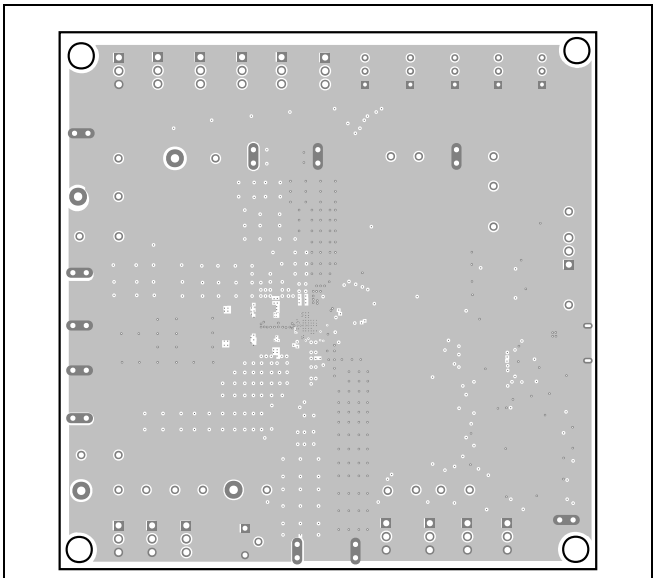
MAX77963 EV Kit Schematic (continued)



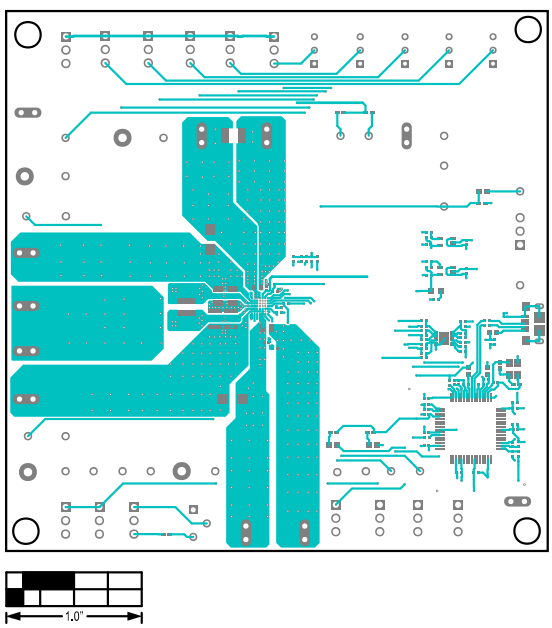
MAX77963 EV Kit PCB Layout



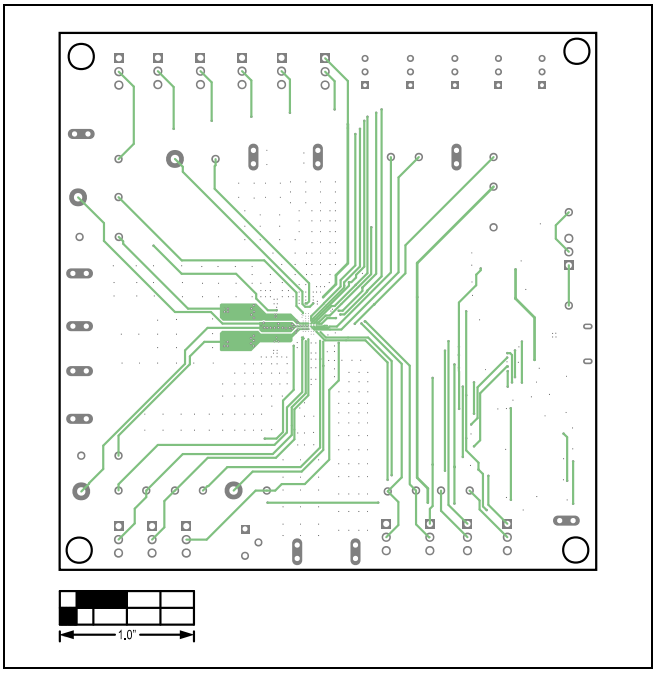
MAX77963 EV Kit Component Placement Guide—Top Silkscreen



MAX77963 EV Kit PCB Layout—Layer 2

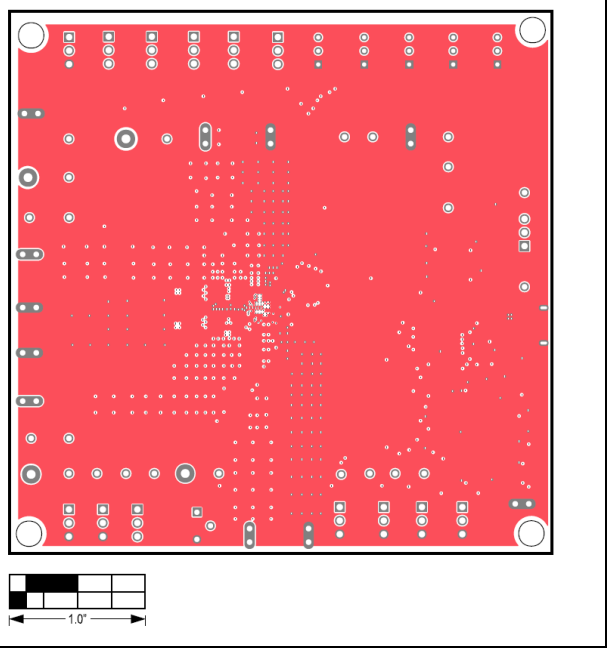


MAX77963 EV Kit PCB Layout—Top Layer

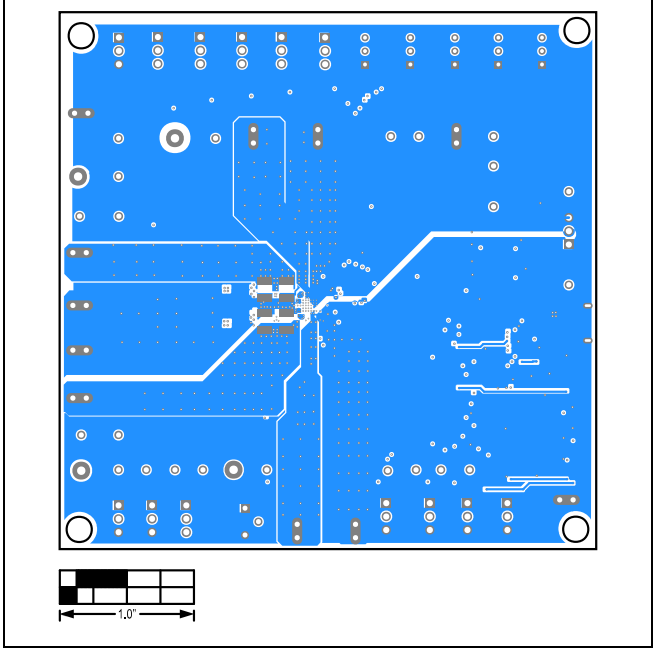


MAX77963 EV Kit PCB Layout—Layer 3

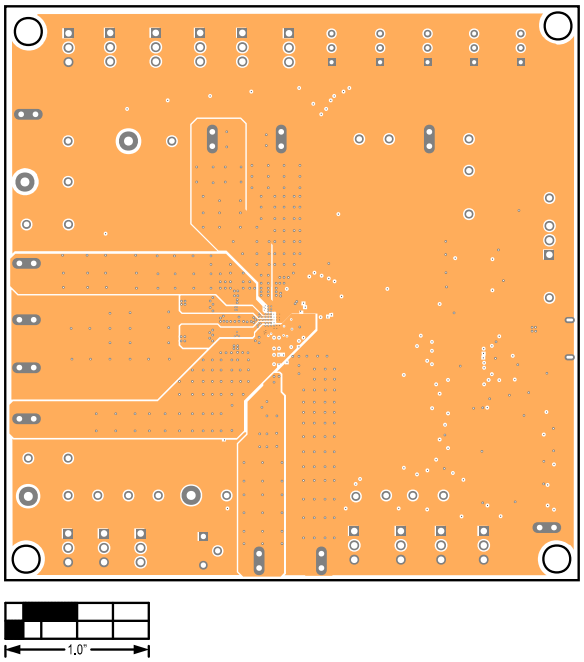
MAX77963 EV Kit PCB Layout (continued)



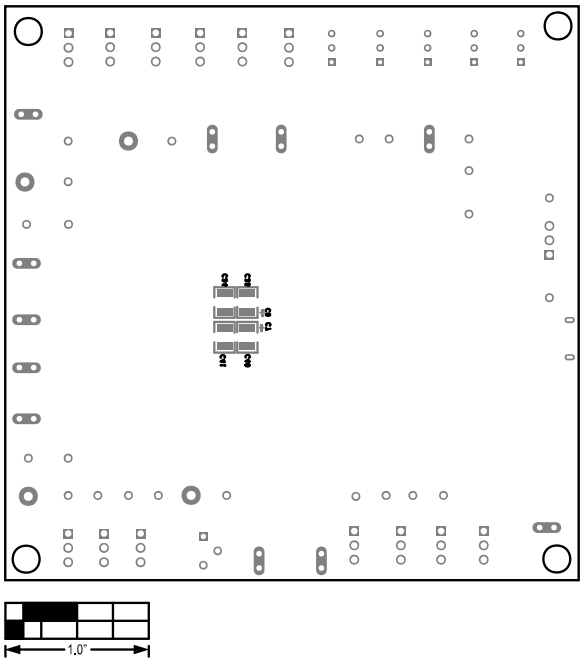
MAX77963 EV Kit PCB Layout—Layer 4



MAX77963 EV Kit PCB Layout—Bottom Layer



MAX77963 EV Kit PCB Layout—Layer 5



MAX77963 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/23	Initial release	—