Li+ Battery Charger and Monitor System with 3A USB-C Input

MAXREFDES1260

Overview

The requirements for higher quality and performance in digital SLR cameras, DSC, and other 2S Li+ battery electronic equipment is increasing. The most important among these is battery life. The USB Type-C meets the USB 3.0 high-speed data transmission requirements. It also supports up to 20V/5A charging power. It is the best way to solve the problem of fast charging multiple batteries. Maxim Integrated's highly integrated charger, MAX14748, is the optimal solution for both the high voltage and USB-C detector challenges. The estimation of battery power is also most relevant to the user experience. Maxim Integrated has specialized fuel gauge chips based on the ModelGauge™ m5 algorithm, with the lowest power consumption and estimation accuracy in the industry.

The MAXREFDES1260 is a proven integrated solution for the two problems. The design files, firmware, and software are found in the *Design Resources* tab. The board is also available for purchase.

Features

- Proven PCB Layout
- Full Assembled and Tested
- Monitors from 2S Cell Packs
- Windows 10 Compatible Software
- I2C serial interface

Applications

- Tablets, Two-in-One Laptops
- Digital Imaging (DSC, DVC)
- USB Type-C Two-Cell Pack Equipment

Introduction

The MAXREFDES1260 solves the problem of high-voltage fast charging of 2S battery products. It also accurately estimates the battery power with a fuel gauge. It gives users the best experience. The MAXREFDES1260 includes the MAX14748 charger and MAX17261 fuel gauge IC. Figure 1 shows the system hardware board. The size of the entire solution is only 2.00cm^2 x 1.75cm^2, which can meet the needs of small and compact design requests in the market. The MAX14748 USB-C charger integrates a charger detector, boost/buck converter, and Li+ battery charger with a smart power selector to provide up to 3A fast and safe charging of 2s Li+ battery packs. The MAX17261 is an ultra-low power fuel gauge IC, which implements the Maxim ModelGauge™ m5 algorithm, and monitors a two-cell battery pack with an external resistor divider.

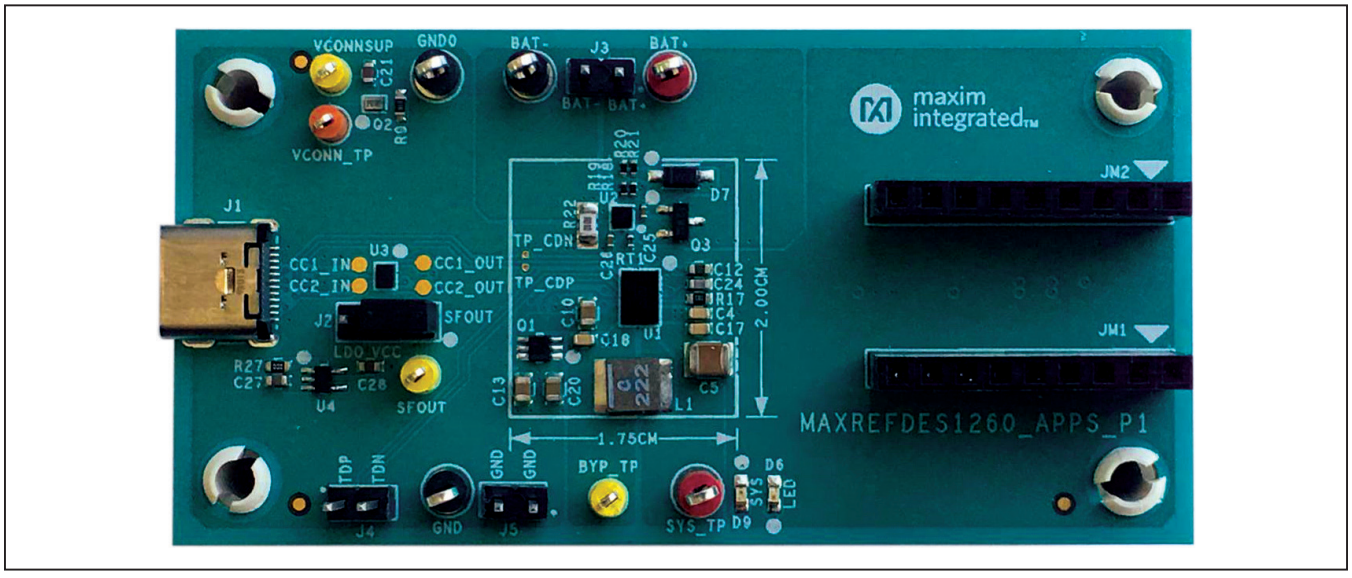

Figure 1. MAXREFDES1260 hardware.

ModelGauge is a trademark of Maxim Integrated Products, Inc.
Windows is a registered service mark and registered trademark of Microsoft Corporation.

System Diagram

This reference design describes the block diagram in Figure 2. It provides a detailed, systematic technical guide to design a 2S battery, fast-charging solution with a USB-C charger and a multicell fuel gauge. The compatible firmware and GUI based on the MAX32660 can be used directly for evaluation and system design, achieving faster product development. The reference design was built and tested, details of which follow later in this document.

Detailed Description

The MAXREFDES1260 consists of a MAX14748 and MAX17261, with a MAX20323 as the USB-C CC pins overvoltage protector. Also, the MAXREFDES1260 can be directly connected to the MAX32660EVSYS through ports JM1 and JM2. Figure 3 shows the MAXREFDES1260 demo and Figure 5 shows the JM1/JM2 pinout.

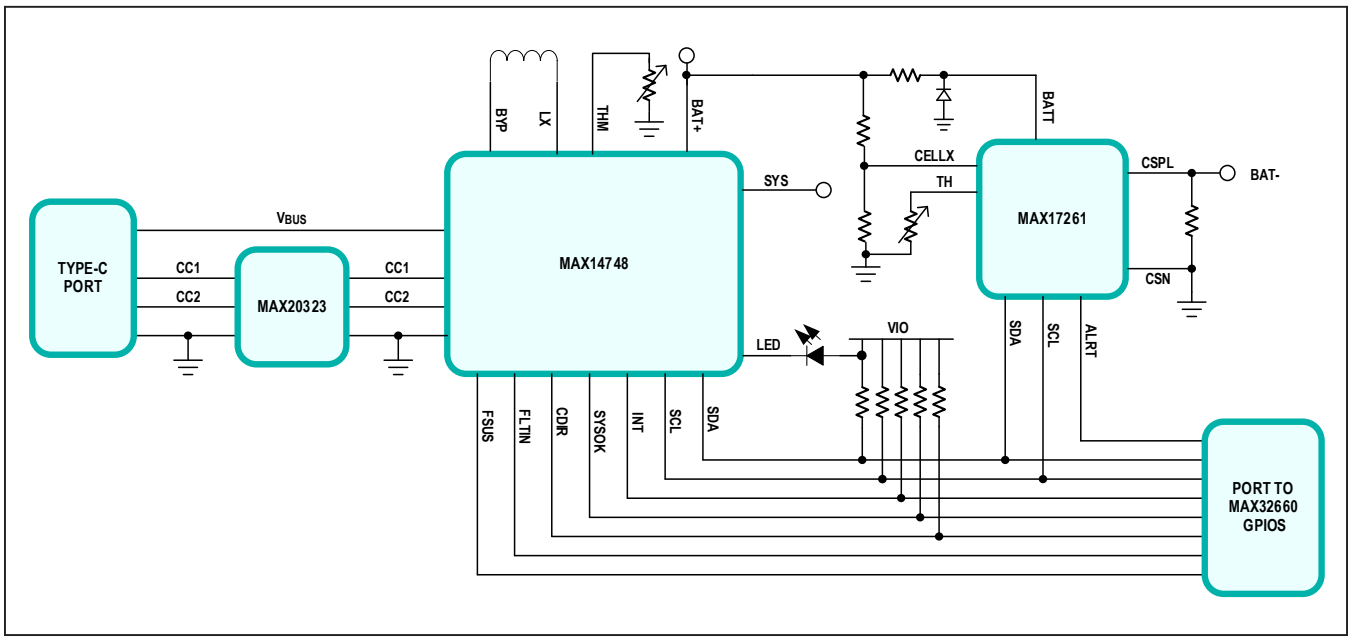

Figure 2. MAXREFDES1260 block diagram.

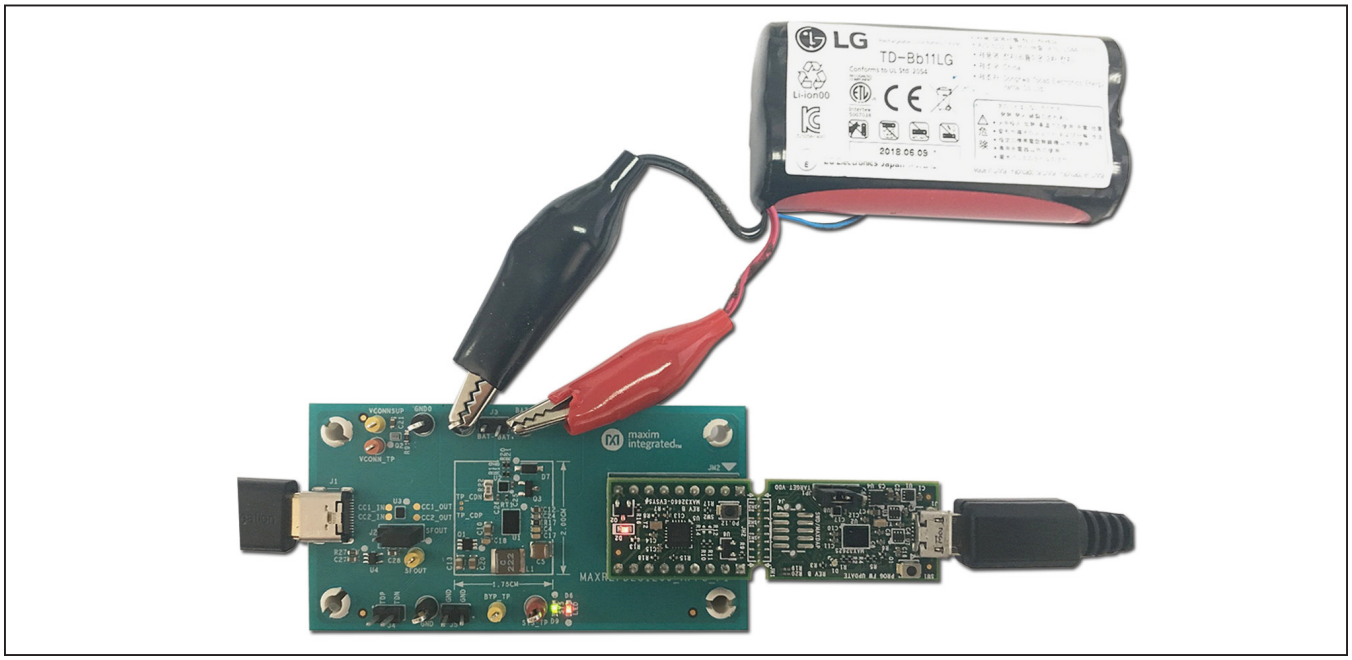

Figure 3. MAXREFDES1260 demo.

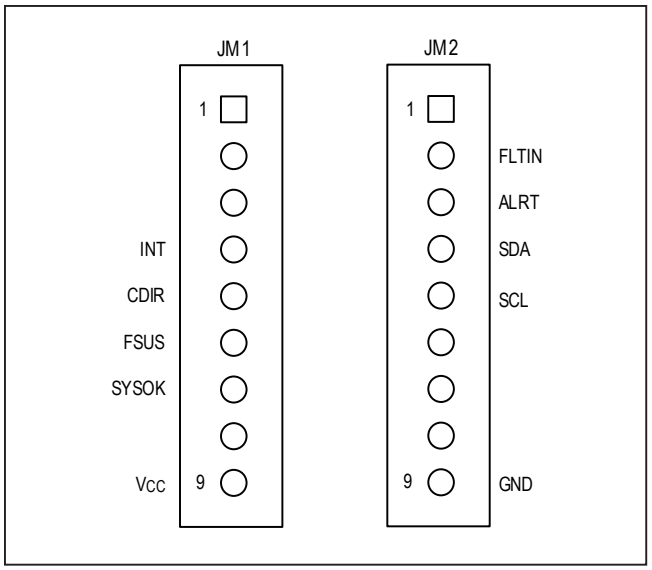

Figure 4. MAXREFDES1260 JM1/JM2 pinout.

Digital I/O and I²C Interface

The bias V_{IO} for the logic inputs and open-drain indicators is provided from the V_{CC} pin of the JM1 connector. The CDIR, SYSOK, INT, and ALRT open-drain outputs use the V_{IO} supply for their respective pullup voltages. The BVCEN push-pull output controls the external load switch Q2 based on the Type-C state machine output. Switch Q2 connects V_{CONN} to the external supply source applied at TP19 when BVCEN is high. FLTIN and FSUS are the digital inputs set by the Host/PC. FLTIN is the charger fault input. It forces the charger into a fault state if pulled low. FSUS is the force suspend input. It forces the input current limit to 0A if pulled high. The MAX32660 can achieve read and write control of the MAX14748/MAX17261 through the I²C interface.

Quick Start Guide

Required Equipment

- MAXREFDES1260 Board
- MAX32660 EVSYS Board
- USB-A to Micro-B Cable
- USB adapter power supply
- USB-A to USB-C Cable
- 2S Li+ Battery Pack of Desired Configuration
- PC with Windows 10 Operating System and USB Port

Hardware Connection

1) Connect JM1/JM2 of the MAXREFDES1260 board to JH3/JH4 of the MAX32660EVSYS. Connect the MAX32660EVSYS to the PC through the Micro-USB interface.
2) Ensure the jumper between the 1 to 2 pins of J2 is installed, and the J3, J4, and J5 jumpers are not installed.
3) Connect the positive and negative terminals of the 2S battery pack to connectors BAT+ and BAT-. Connect the adapter power supply to J1 through the USB-C cable.

***Note:** Remove R19 and R20 on MAX32660EVSYS after getting the reference design boards.

Procedure

The PCB boards are fully assembled and tested. An easy-to-use evaluation software GUI is also provided. Follow the steps to install the GUI software, make the required hardware connections, and start the operation. The software automatically locates the hardware when connections are made. After the communication is established, the IC must still be configured correctly for the fuel gauge to be accurate.

1) Visit **www.maximintegrated.com** to search and download the latest versions of the GUI software and f rmware. Save the software to a temporary folder.
2) Install the software on the computer by running the **UsbChargerGuiSetupV1.0.exe** program in the temporary folder.
3) Download the f rmware **UsbCharger.hex** to MAX32660EVSYS.
4) Run the GUI software after installation. The **Connect Board** window pops up (Figure 5) after the splash screen is dismissed. It includes the COM port control functions. It is dismissed after setting the COM port and clicking OK. The main form appears. The details of the buttons:
   - **Search:** Searches for the available COM port and displays port names in the Port Selection dropdown list.
   - **Connect:** Connects the COM port.
   - **Disconnect:** Disconnects the COM port.
   - **OK:** Closes the page.

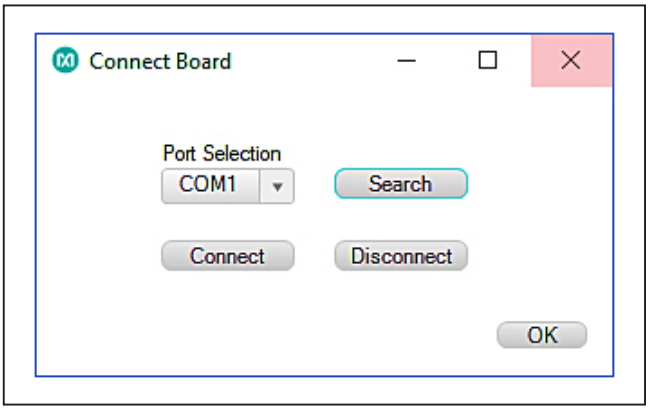

Figure 5. Connecting the board window.

5) The **Demo View** window pops up (Figure 6). MAXREFDES1260 has two main devices; the charger MAX14748 and fuel gauge MAX17261. The **Demo View** window includes the main control functions and displays the device status:

Charger MAX14748

- **Charger En**: Enables the boost charger for the 2S battery.
- **DCP/3A En**: Enables the 3A DCP detection.
- **AICL En**: Enables the AICL function.
- **INT En**: Unmasks the interrupt.
- **BAT Regulation Threshold**: Selects the Battery Regulation Threshold from 8.3V to 8.6V.
- **Pre-charge Threshold**: Selects the Pre-charge Voltage Threshold from 5.7V to 6.4V.
- **BAT Recharge Threshold**: Selects the BAT Recharge Threshold from 200mV to 500mV.
- **Charge Done Threshold**: Selects Charge Done Threshold from 0.05*IFChg to 0.2*IFChg.
- **CDIR**: Indicates the different insertion orientation of CC1/CC2.
- **SYSOK**: Indicates if VSYS is greater than SYS UVLO.
- **$\overline{\text{INT}}$**: Interrupts the output.
- **$\overline{\text{FLTIN}}$**: Sets low to force the charger into a fault state and resets all registers.
- **FSUS**: Force suspend. Enables the host to force the input current limit to zero.

Fuel Gauge MAX17261

- **NTC En**: Enables the external NTC thermistor.
- **Alert En**: Enables the Alert function.
- **SOC**: Reports the state-of-charge percentage.
- **Vcell**: Reports the voltage measured at the CELLX pin.
- **RepCap**: Reports the remaining capacity in mAh.
- **Temp**: Reports the temperature measured by the thermistor or die temperature.
- **FullCapRep**: Reports the full capacity that goes with RepCap. A new full-capacity value is calculated at the end of every charge cycle in the application.
- **Current**: Reports the current flow through the battery.

Status Bar

- **Message**: Serial number of MAX17261.
- **Details1**: Version information, hardware and software version numbers.
- **Status**: Connection status, display COM port, and baud rate.

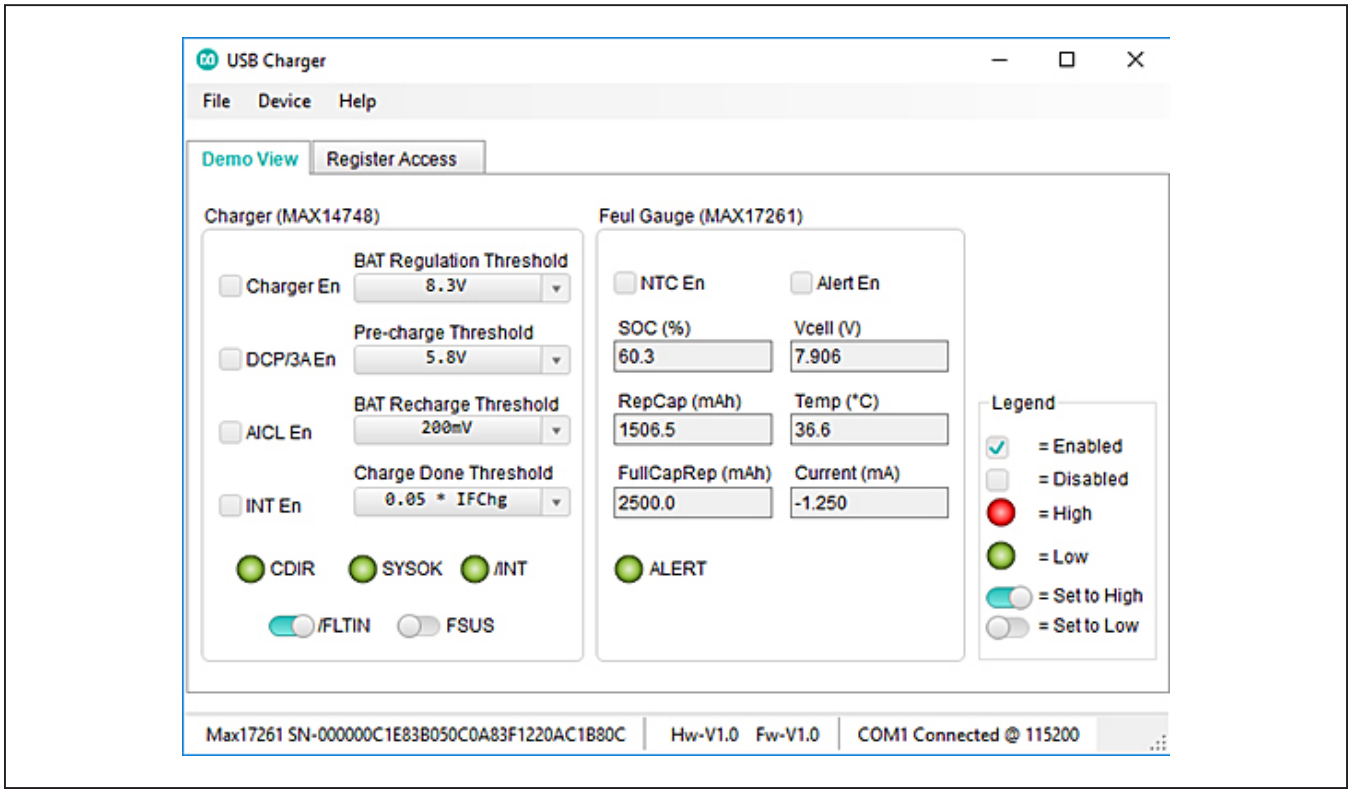

Figure 6. Demo View window.

6) Read/write all the registers of the two chips on **Register Access** (Figure 7) and configure various functions independently according to different needs.

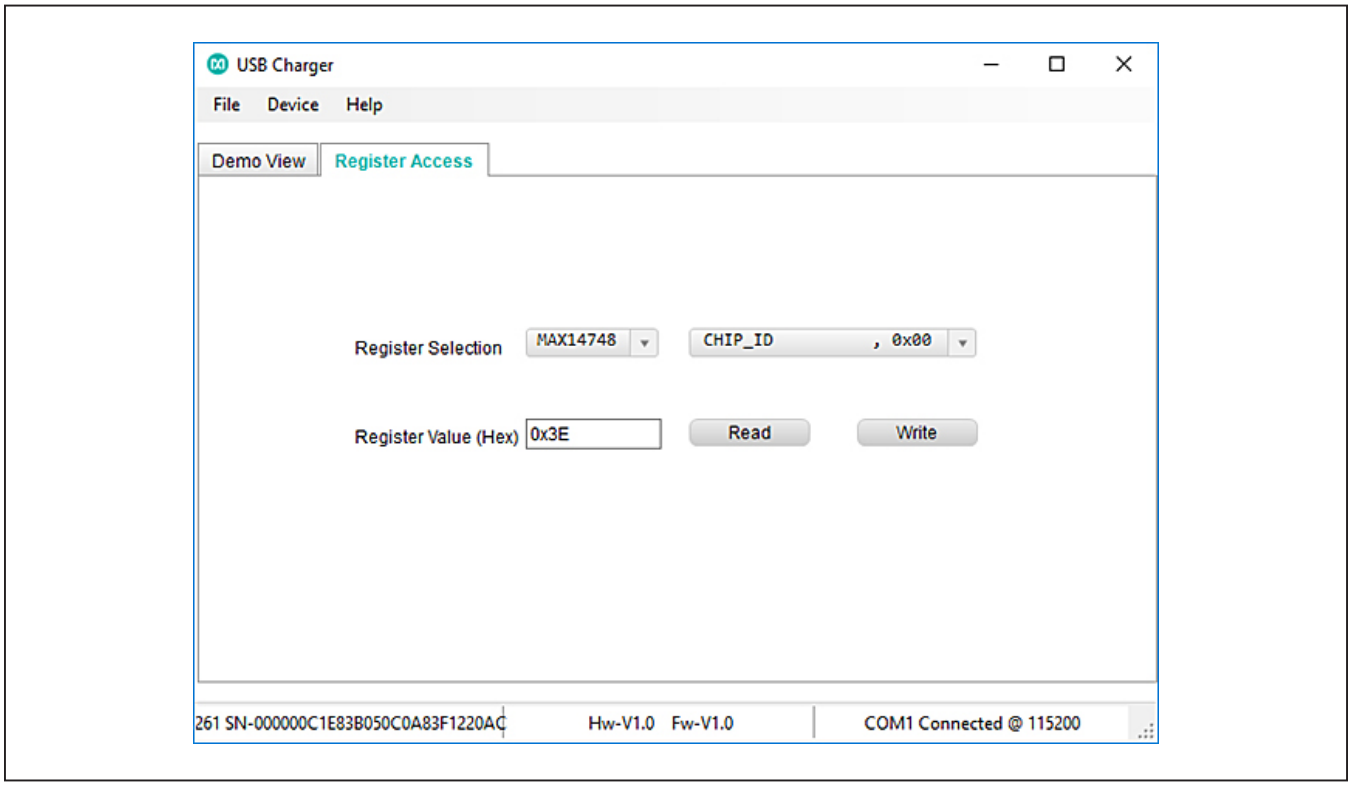

Figure 7. Register Access window.

Design Resources

Download the complete set of **Design Resources** including schematics, bill of materials, PCB layout, and test files.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/20	Initial release	—