

Introduction

The MAXREFDES1219 is an integrated smart solution for the 1-cell Li+ battery pack that provides a linear charger, Universal Serial Bus (USB) charger detect, and battery cell monitor including (State of Charge) SoC, (Open Circuit Voltage) OCV, temperature, current, etc.

This reference design is compliant with the USB BC Rev1.2*, which detects multiple USB battery-charging methods including Standard Downstream Port (SDP), Charging Downstream Port (CDP), and Dedicated Charging Port (DCP). The devices also detect common proprietary charge adapters, including those from Apple¹.

Maxim Integrated's single-chip solution, the MAX14746, is the optimal solution for both USB linear charger and charger detection.

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 MAXREFDES1219 is a fully tested solution for portable consumer devices, digital cameras, as well as portable industrial devices.

The design files, firmware, and software can be found on the **Design Resources** tab.

Features

- Proven PCB Layout
- Fully Assembled and Tested
- Monitors from 1S Battery Cell
- Windows 10 Compatible Software
- I²C Serial Interface

Applications

- Portable Consumer Devices
- Digital Imaging (DSC, DVC)
- Portable Industrial Devices
- USB 1-Cell Pack Equipment

Introduction

The MAXREFDES1219 solves the problem of USB linear charge of 1S battery products, and accurately estimates the battery power with a fuel gauge. It also gives users the best experience.

The MAXREFDES1219 includes the MAX14746 charger and MAX17260 fuel gauge IC. **Figure 1** shows the system hardware board.

The size of the entire solution is only 1.2cm² × 1.15cm², which meets the needs of small and compact design requests in the market.

The MAX14746 USB charger integrates a charger detector, linear regulator, and smart power selector to provide up to 2A safe charging of the 1S Li+ battery pack.

The MAX17260 is an ultra-low power fuel gauge IC that implements the Maxim ModelGauge™ m5 algorithm and monitors a 1-cell battery pack.

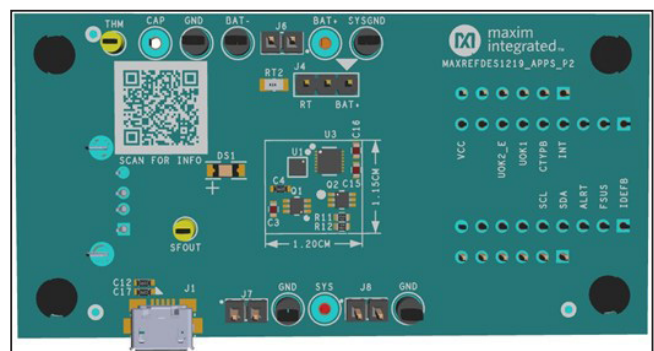


Figure 1. MAXREFDES1219 hardware.

¹ Apple is a registered trademark of Apple Inc.

² 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 1S battery charging solution with a USB Micro-B port and a fuel gauge.

The compatible firmware and GUI are used based on the MAX32660 directly for evaluation and system design, achieving faster product development. The reference design board can be directly connected to the MAX32660EVSYS.

The MAX32660EVSYS is a compact breakout board designed to make developing with the MAX32660 quick and easy. [Figure 3](#) shows the EVSYS hardware board.

The left half in [Figure 3](#) is the MAX32625PICO-based debug adapter attached to the main board. The two are connected to form a subsystem in a very small space, which helps to quickly implement various debugging and configurations of the charging system.

The reference design was built and tested. The details follow later in this document.

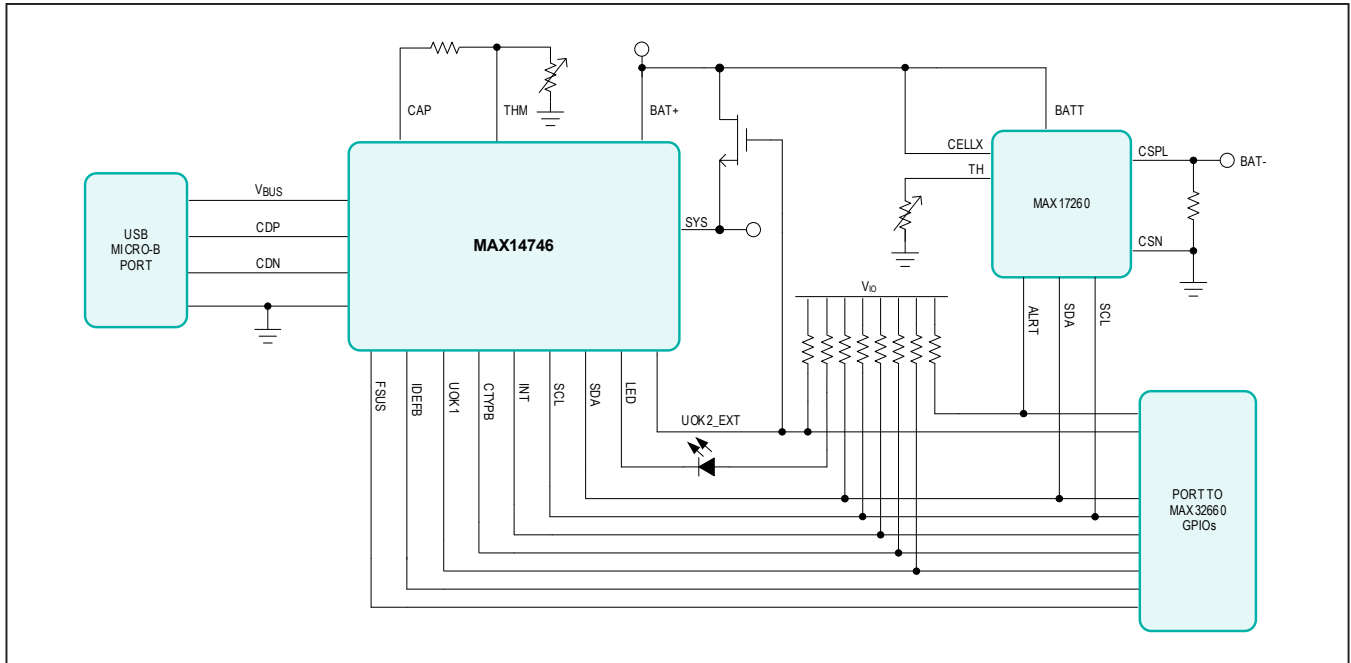


Figure 2. MAXREFDES1219 block diagram.

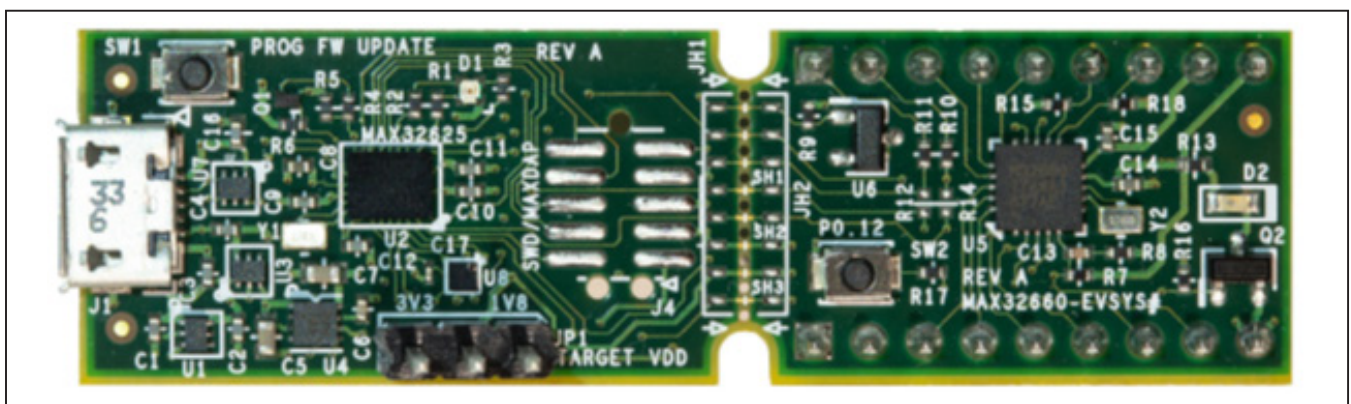


Figure 3. MAX32660EVSYS board.

Detailed Description

The MAXREFDES1219 includes the MAX14746 and MAX17260. Also, the MAXREFDES1219 can be directly connected to the MAX32660EVSYS through ports H1 and H2.

Figure 4 shows the MAXREFDES1219 demo and Figure 5 the H1/H2 pinout.

Digital I/O and I²C Interface

The V_{CC} pin of the H2 connector provides the bias VIO for the logic inputs and open-drain indicators.

The CTYPB, UOK1, UOK2, INT, and ALRT open-drain outputs use the V_{IO} supply for their respective pullup voltages.

The IDEFB and FSUS are digital inputs set by the Host/PC.

IDEFB is the current-limit setting input. If pulled high, the input current limit is set to 100mA.

FSUS is the force suspend input. If pulled high, it forces the input current limit to 0A.

The MAX32660 can achieve read and write control of the MAX14746/MAX17260 registers through the I²C interface.

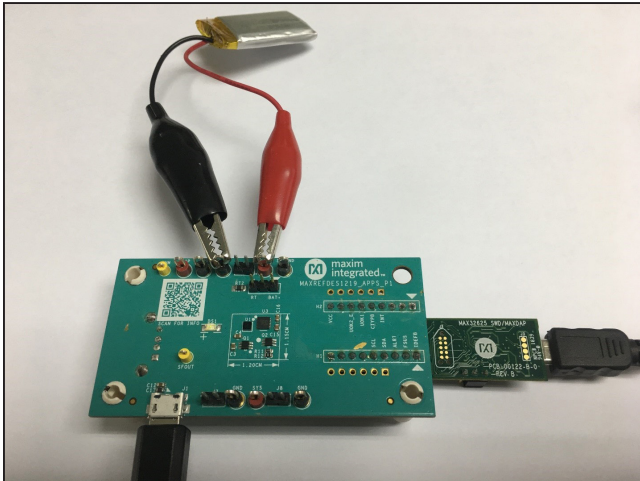


Figure 4. MAXREFDES1219 demo.

Required Equipment

- MAXREFDES1219 Board
- MAX32660 EVSYS Board
- USB-A to Micro-B Cable
- USB Adapter Power Supply
- 1S Li+ Battery Pack of Desired Configuration
- PC with Windows 10 Operating System and USB Port

Connecting the Hardware

- 1) Connect the H1/H2 of the MAXREFDES1219 board to the JH3/JH4 of the MAX32660EVSYS. Connect the MAX32660EVSYS to the PC through the Micro-USB interface.
- 2) Ensure the jumpers J4, J6, J7 are not installed.
- 3) Connect the positive and negative terminals of the 1S battery pack to the connectors BAT+ and BAT-. Then connect the adapter power supply to J1 through the Micro-B cable.

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

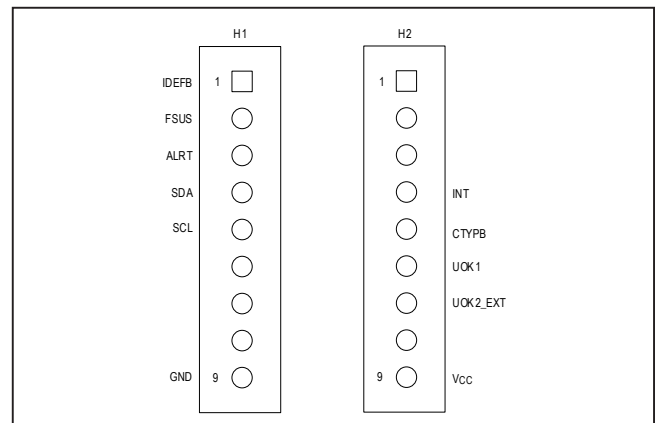


Figure 5. Classification.

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, connect the required hardware, and start operation. The software automatically locates the hardware on making the connections. After communication is established, the IC must still be configured correctly for the fuel gauge to be accurate.

- 1) Visit www.maximintegrated.com to search for and download the latest versions of the GUI software and firmware. Save the software to a temporary folder.

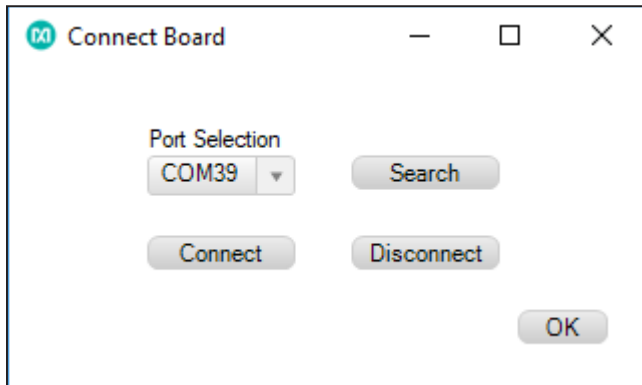


Figure 6. Connecting the board window.

- 2) Run the **UsbChargerGuiSetupV1.0.exe** program in the temporary folder to install the software.
- 3) Download the firmware **UsbCharger.hex** to the MAX32660EVSYS.
- 4) Run the GUI software after the installation. The **Connect Board** window pops up (Figure 6) after the splash screen is dismissed. This page includes the COM port control functions. Click **OK** after setting the COM port. This page is dismissed. The main form appears. The details of the buttons are as follows:

Search: Searches for the available COM port and displays the port names in the **Port Selection** dropdown.

Connect: Connects the COM port.

Disconnect: Disconnects the COM port.

OK: Closes the page.

- 5) The **Demo View** window (Figure 7) appears.

The MAXREFDES1219 has two main devices, the charger MAX14746 and fuel gauge MAX17260.

The **Demo View** window includes the main control functions and displays the device status.

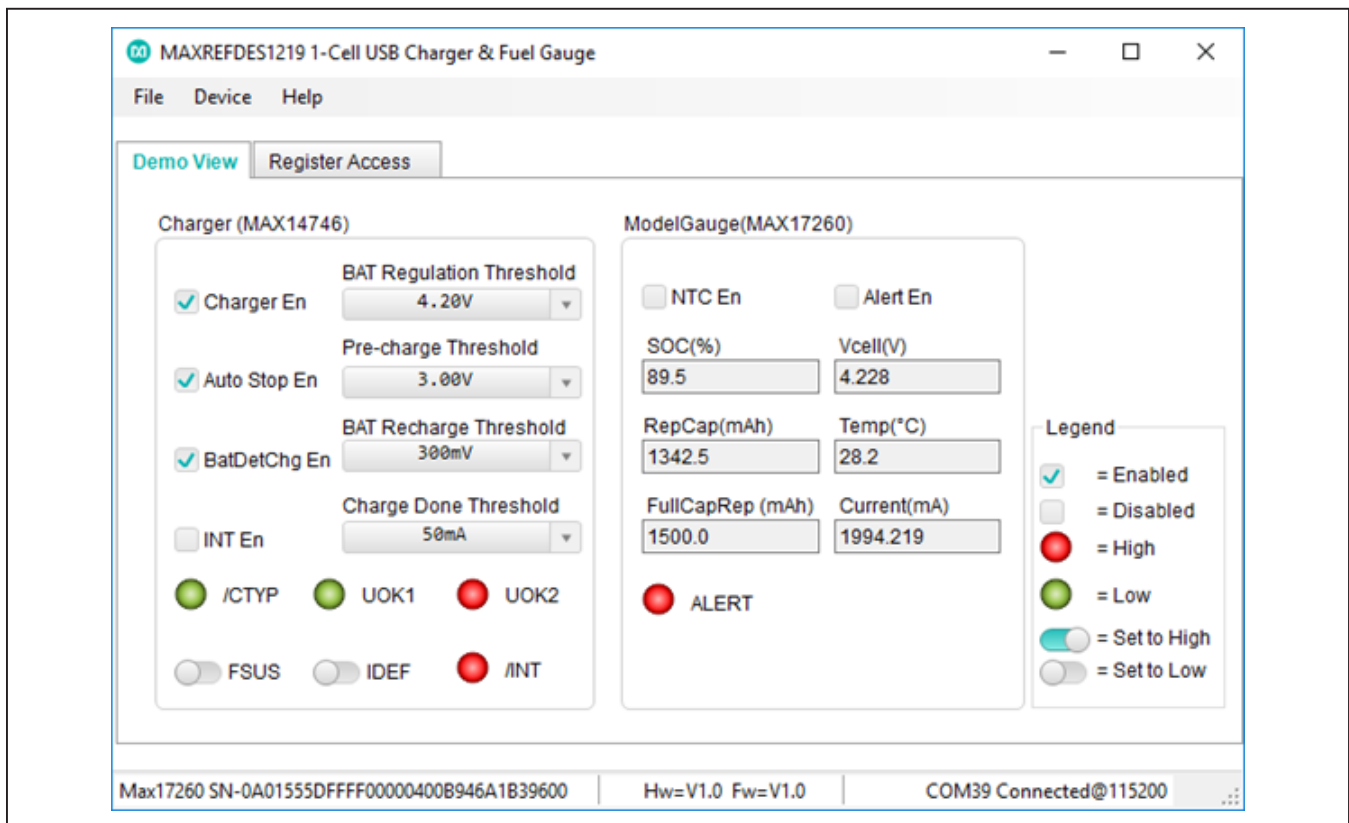


Figure 7. Demo View window.

Charger MAX14746

Charger En: Enables the linear charger for the 1S battery.

Auto Stop En: Enables the transition from the maintain charge mode to maintain charge done.

BatDetChg En: Enables running the charger during battery detection.

INT En: Unmask interrupt.

BAT Regulation Threshold: Selects the battery regulation threshold from 4.05V to 4.6V.

Pre-charge Threshold: Selects the precharge voltage threshold from 2.15V to 3V.

BAT Recharge Threshold: Selects the BAT recharge threshold from 200mV to 500mV.

Charge Done Threshold: Selects the charge done current threshold from 10mA to 0mA.

CTYP: Indicates the different charger type.

UOK1: Indicates the SYS voltage valid and battery detect.

UOK2: Indicates the delayed SYS voltage valid and battery detect.

FSUS: Force Suspend. Enables the host to force the input current limit to zero.

IDEF: Current-limit setting input.

INT: Interrupt output.

Fuel Gauge MAX17260

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 the 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 the MAX17260.

Details1: Version information, hardware version number, and software version number.

Status: Connection status, display COM port, connection status, and baud rate.

6) Read/write all the registers of the two chips and configure various functions independently according to different needs in the **Register Access** window (Figure 8).

Design Resources

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

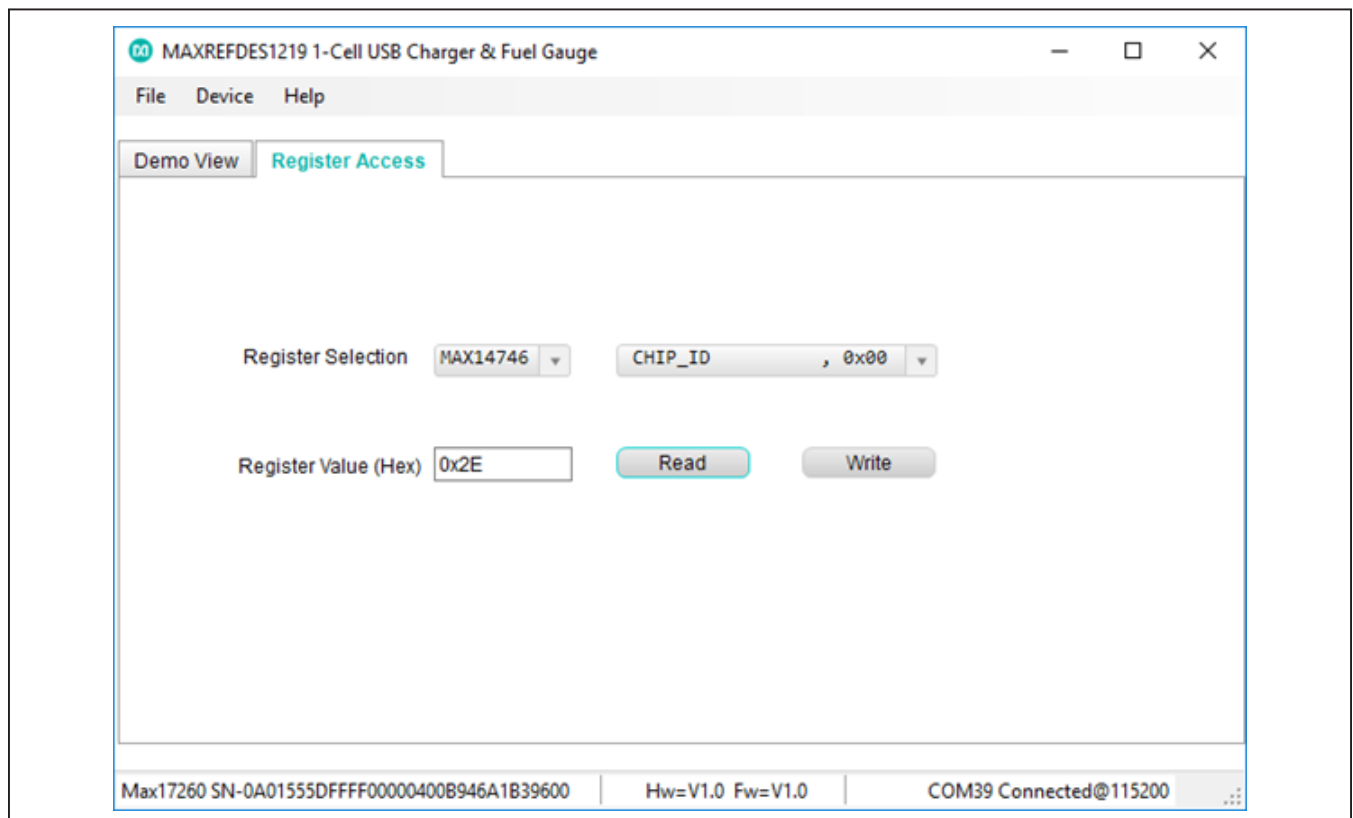


Figure 8. Register Access window.

Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|-----------------|---------------|-----------------|---------------|
| 0 | 2/21 | Initial release | — |

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