User Guide

MP2651 Evaluation Kit (EVKT-MP2651)

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Overview

Introduction

MPL Optimized Performance with MPS MPL-AI5030 Inductor Series

The EVKT-MP2651 is an evaluation kit designed for the MP2651. It demonstrates the capabilities of the MP2651, a buck-boost charger IC designed for battery packs with 1 cell to 4 cells in series. The device can accept a wide 4V to 22V input voltage (V_{IN}) range to charge the battery. It also supplies a wide 3V to 21V voltage range at the IN pin in source mode. This function is compliant to the USB PD specification.

Kit Contents

EVKT-MP2651 kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EV2651-VT-00A	MP2651-xxxx evaluation board	1
2	EVKT-USBI2C-02	Includes one USB-to-I²C communication interface, one USB cable, and one ribbon cable	1
3	Online resources	Include GUI and supplemental documents	-

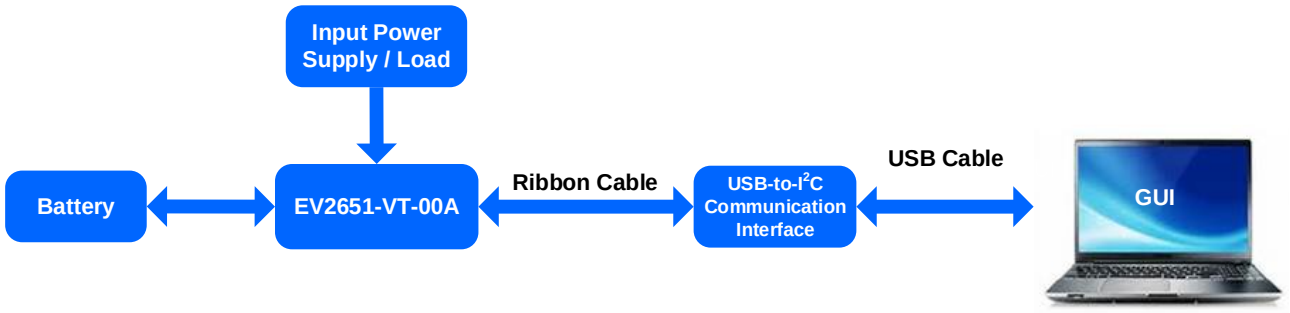


Figure 1: EVKT-MP2651 Evaluation Kit Set-Up

Features and Benefits

MPL Optimized Performance with MPS Inductor

- Fully Integrated Buck-Boost Charger with Low On Resistance ($R_{DS(ON)}$) Power MOSFETs for Battery Packs with 1 Cell to 4 Cells in Series
- Wide Operation Ranges:
  - 4V to 22V Operation Input Voltage (V_{IN})
  - 3V to 21V Reverse Output Voltage (V_{OUT}) with 20mV/Step
  - Up to 6A Input Current (I_{IN}) Limit with 50mA/Step
  - Up to 6A Charge Current with 50mA/Step
  - Up to 6A Output Current (I_{OUT}) with 50mA/Step
  - 3.4V/Cell to 4.67V/Cell Battery-Full Voltage with 0.5% Accuracy
  - 4V to 20.4V Input Minimum Voltage Limit with 80mV/Step
  - 500kHz to 1.2MHz Switching Frequency (f_{SW})
- I^2C or SMBus Host Control Interface to Support Flexible Parameter Setting and Status Reporting
- Integrated, 10-Bit Analog-to-Digital Converter (ADC) for Voltage, Current and Temperature Monitor
- Analog Output Pin to Monitor Charge Current
- Robust, Built-In Protections:
  - Input Over-Voltage Protection (OVP)
  - Battery OVP
  - Output Short-Circuit-Protection (SCP) in Source Mode
  - Battery Missing Detection
  - NTC Pin Floating Detection
  - Integrated N-Channel MOSFET Driver for Input Power Pass Through or OVP
  - Configurable JEITA for Battery Temperature Protection
  - Thermal Regulation and Thermal Shutdown
  - Safety Charge Timer
- Available in a TQFN-30 (4mmx5mm) Package

⚠ *All changes made in I^2C mode are not retained once the evaluation board shuts down.*

⚠ *Information written in OTP mode cannot be changed.*

Adjustable Features

I^2C	OTP
• Charge Currents (I_{TC}, I_{PRE}, I_{CC}, and I_{TERM}) • Battery Cell Number and Battery-Full Voltage • Minimum Input Voltage (V_{IN_MIN}) Regulation • Minimum Input Current (I_{IN_LIM}) Regulation • Switching Frequency (f_{SW}) • Output Voltage (V_{OUT}) in Source Mode • Output Current (I_{OUT}) Limit in Source Mode • Safety Charge Timer • Over-Voltage Protection (OVP) Thresholds • Under-Voltage (UV) Thresholds • NTC Thresholds • Thermal Regulation	• Charge Currents (I_{TC}, I_{PRE}, I_{CC}, and I_{TERM}) • Battery Cell Number and Battery-Full Voltage • V_{IN_MIN} Regulation Voltage • I_{IN_LIM} Regulation • Switching Frequency (f_{SW})

Kit Specifications

Features	Specifications
Supply for Board	4V to 22V
Operating Input Voltage	4V to 22V
Battery Regulation Voltage	3.6V/Cell to 4.68V/Cell
Fast Charge Current	Up to 6000mA
Minimum Input Voltage Regulation	4V to 20.4V
Input Current Limit	Up to 6000mA
Output Voltage in Source Mode	3V to 21V
Operating Systems Supported	Windows XP, 7, or later
System Requirements	Minimum 22.2MB free
GUI Software	Programming Tool MP2651
EVB Size (LxW)	8.9cmx8.9cm

Section 1. Hardware Specifications

1.1 Personal Computer Requirements

The following minimum requirements must be met to use the EVKT-MP2651:

- Operating system of Windows XP, 7, or later
- Net Framework 4.0
- PC with a minimum of one available USB port
- At least 22.2MB of free space

1.2 EV2651-VT-00A Specifications MPL Optimized Performance with MPS Inductor

The EV2651-VT-00A is an evaluation board designed for the MP2651-xxxx. The default code for this part is the MP2651-0000. For more information, refer to the EV2651-VT-00A datasheet.

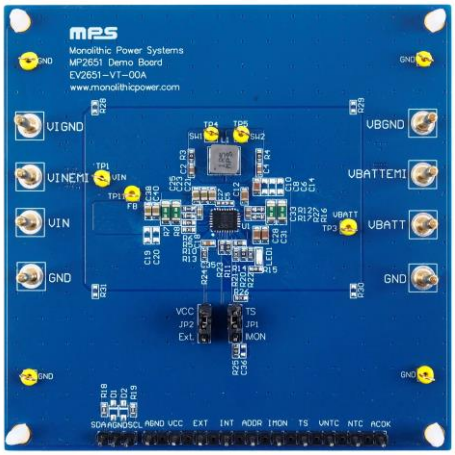


Figure 2: EV2651-VT-00A Evaluation Board

Feature	Specifications
Supply for Evaluation Board	4V to 22V
Operating Input Voltage	4V to 22V
EVB Size (LxW)	8.9cmx8.9cm

1.3 EVKT-USBI2C-02 Specifications

The EVKT-USBI2C-02 refers to the USB-to-I²C communication interface, which connects the EVB, the PC, and its supporting accessories (see Figure 3). It provides PMBus capabilities. Together with MPS Virtual Bench Pro and I²C GUI tools, it provides a quick and easy way to evaluate the performance of MPS digital products. For more details, refer to the EVKT-USBI2C-02 datasheet.

Figure 3: EVKT-USBI2C-02 Communication Interface

Section 2. Software Requirements

2.1 Software Installation Procedure

Programming occurs through the MPS I²C GUI. Follow the instructions below to install the software:

Note: This software can be downloaded from the MPS website.

1. Download and extract the relevant files from the MPS website.
2. Double click the ".exe" file to open the set-up guide (see Figure 4). If a protection window comes up, click "More info," then click "Run anyway."
3. Follow the prompts in the set-up guide.
4. Wait for the status screen to verify that installation is complete (see Figure 5).

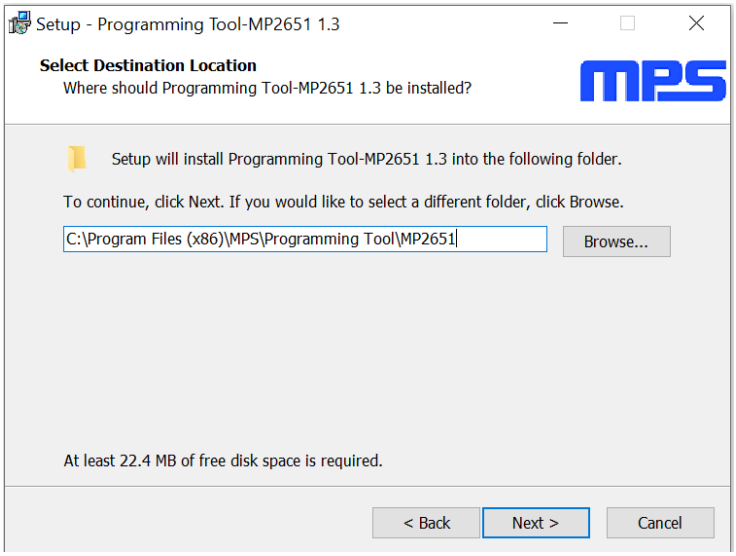


Figure 4: MPS I²C GUI Set-Up Guide

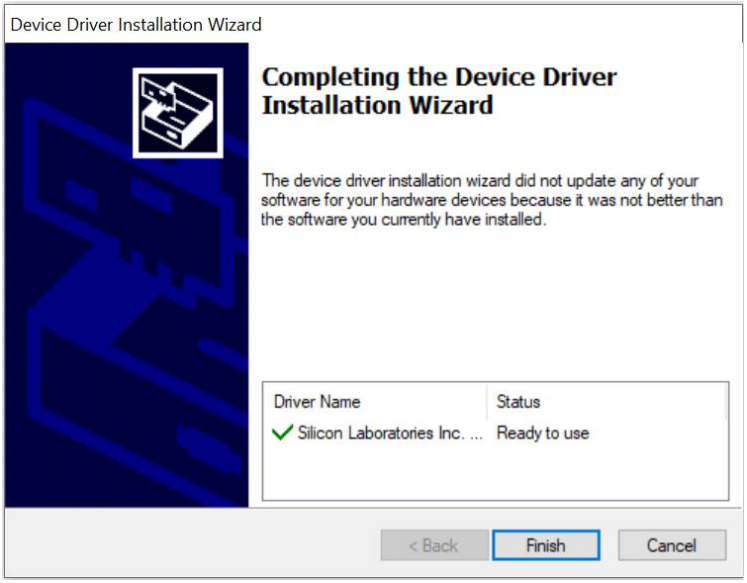


Figure 5: Driver Set-Up Success

Section 3. Evaluation Kit Test Set-Up

3.1 Hardware Set-Up (1)

The hardware must be properly configured prior to use. Follow the instructions below to set up the EVB:

1. Connect the EVB to the EVKT-USBI2C-02 communication interface with the 3-pin ribbon cable and ensure that they are connected.
2. Connect SCL, SDA, and GND (see Figure 6). Refer to the MP2651 datasheet for further clarification.
3. Connect the EVKT-USBI2C-02 to the computer.

Note:

1) It is important to adhere to the order of these steps. Failing to do so can damage the communication pins (SCL and SDA) during a hot-plug event.

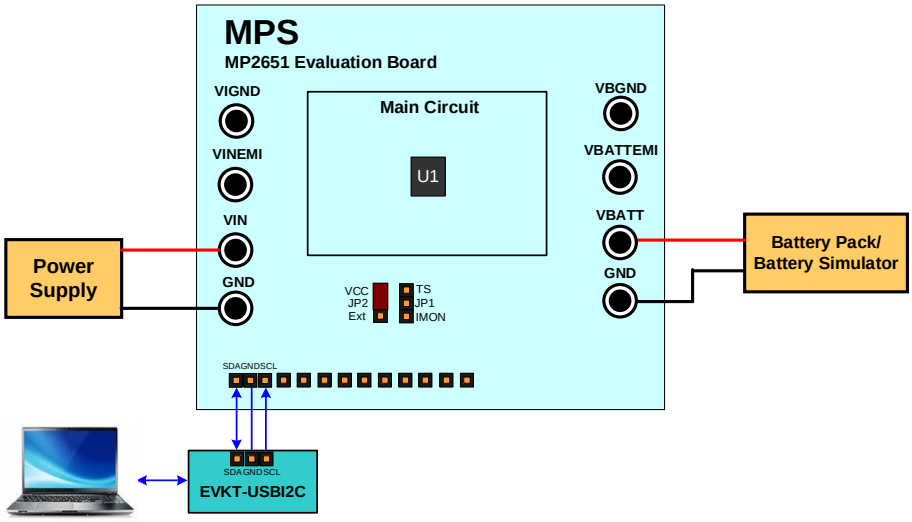


Figure 6: EVB to MPS I²C Communication Interface Wire Connection

3.2 Powering Up the EVB

1. Connect the battery terminals to:
   a. Positive (+): VBATT
   b. Negative (-): GND

   If using a battery simulator, preset the battery voltage to be between 0V and 8.4V, then turn the battery off. Connect the battery simulator outputs to the VBATT and GND pins, respectively.

   Ensure that the battery voltage is present (if using a battery simulator, turn the simulator on after making the connection).
2. For charge mode testing, connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND

   Preset the power supply output to be between 4V and 22V, then turn on the power supply.
3. For source mode testing, connect the load terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
4. For EMI testing, connect the input or load terminals to:

a. Positive (+): VINEMI

b. Negative (-): VIGND

5. For EMI testing, connect the battery terminals to:

a. Positive (+): VBATTEMI

b. Negative (-): VBGND

Remove all other connectors (VIN, GND, VBATT, and GND) and pin headers.

3.3 Software Set-Up

After connecting the hardware according to the steps above, follow the steps below to use the GUI software:

1. Start the software. It should automatically check the EVB connection.

- If the connection is successful, “Device connected” will be shown at the bottom left of the screen (see Figure 7).

Figure 7: Connected Status Shows Successful Connection

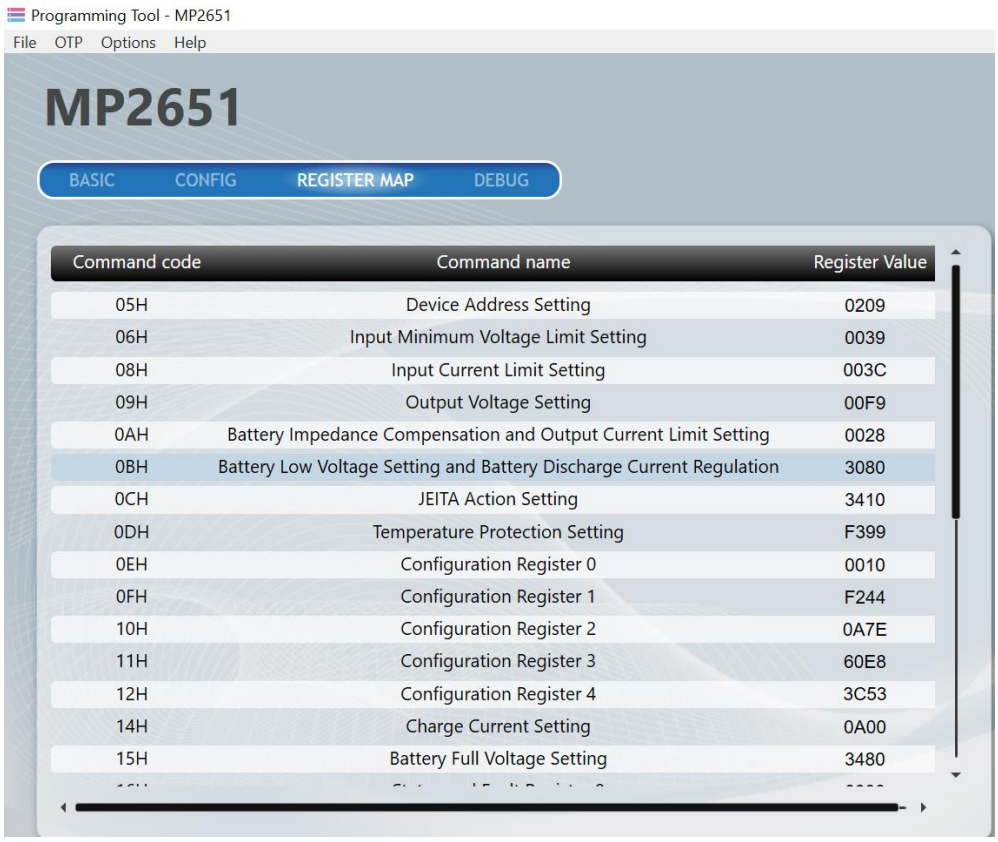
- If the connection is unsuccessful, a warning should appear at the bottom. There are two potential warnings.
  - If the application shows “Device disconnected,” this means that the evaluation board is not connected correctly (see Figure 8 on page 11).
  - If the application shows “USB disconnected,” this means that the USB-to-I²C communication interface is not connected correctly (see Figure 9 on page 11).

Figure 8: Warning Indicates Unsuccessful Connection (Evaluation Board Not Connected)

Figure 9: Warning Indicates Unsuccessful Connection (USB-to-I²C Communication Interface is Not Connected)

2. If the connection is successful, proceed to Step 3. Otherwise, check the connections between the EVB, communication interface, and PC. Re-plug the USB into the computer and restart the GUI.
3. Click the “Read All Register” button to read the I²C register values. The default values should be displayed (see Figure 10 on page 11).
4. Find the item(s) to be changed, then select the target value(s) from the drop-down menu.
5. Click the “Write All” button to update the values. The changed information should be downloaded to the IC.

⚠ *All changes made via the I²C are restored to their default values once the EVB shuts down.*



Command code	Command name	Register Value
05H	Device Address Setting	0209
06H	Input Minimum Voltage Limit Setting	0039
08H	Input Current Limit Setting	003C
09H	Output Voltage Setting	00F9
0AH	Battery Impedance Compensation and Output Current Limit Setting	0028
0BH	Battery Low Voltage Setting and Battery Discharge Current Regulation	3080
0CH	JEITA Action Setting	3410
0DH	Temperature Protection Setting	F399
0EH	Configuration Register 0	0010
0FH	Configuration Register 1	F244
10H	Configuration Register 2	0A7E
11H	Configuration Register 3	60E8
12H	Configuration Register 4	3C53
14H	Charge Current Setting	0A00
15H	Battery Full Voltage Setting	3480

Figure 10: Register Values from the I²C

3.4 Device Configuring Instructions

The MP2651-xxxx is a one-time programmable (OTP) part, where “xxxx” is the register setting option. The factory default is “0000”, and this content can be viewed in the I²C register map. Follow the instructions below to create and export customized configurations:

1. Use a computer to open the MPS GUI software. Ensure that the EVB has been powered on.
2. Ensure that there is a successful connection between the EVB and computer.
3. Select “OTP View” in the toolbar (see Figure 11).

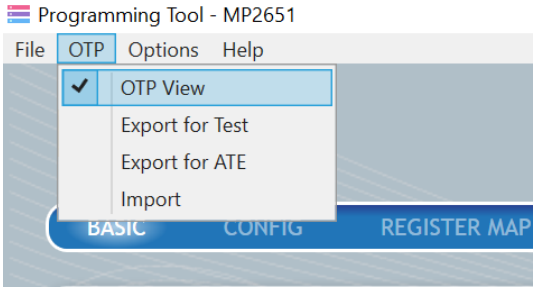


Figure 11: Select OTP View

4. Enter a new table (see Figure 12). All selectable parameters can be changed.

Figure 12: Adjustable Parameters in OTP Mode

5. Select the target value(s) from the drop-down menu(s).
6. Ensure that all of the parameters have been input before selecting “Export for test” in the toolbar.
7. Click “Export” to export the selected configurations (see Figure 13).

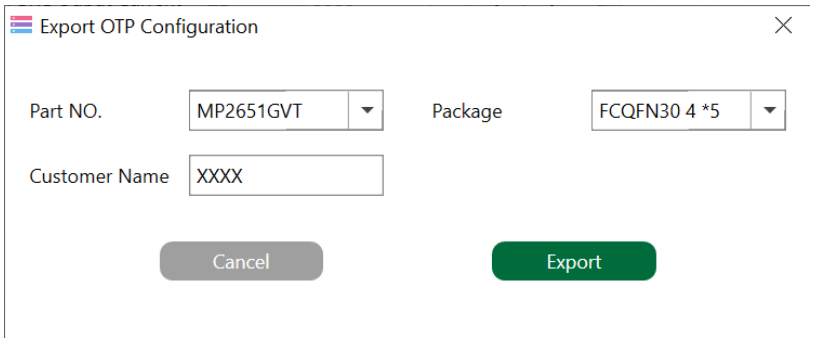


Figure 13: Click “Export” to Export the Input Parameter

8. Find a location for the exported file and click “Save”. The configurations should be saved in a text file (see Figure 14).

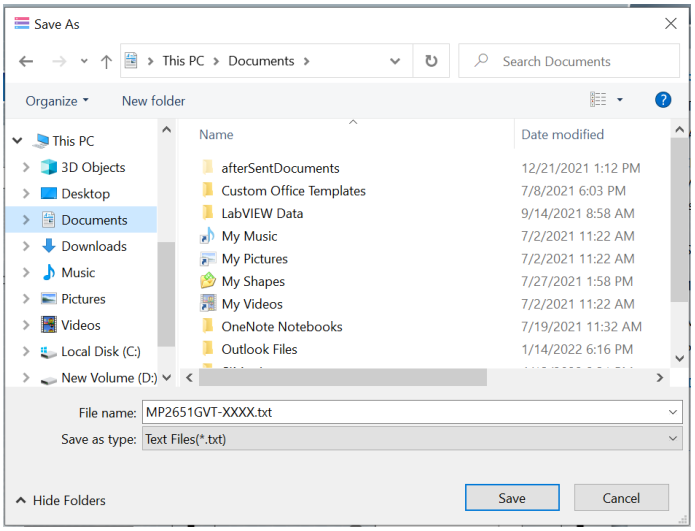


Figure 14: Export to the Desired Location

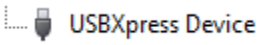
9. Send this file to an MPS FAE to apply for a customized “xxxx” code.

3.5 Troubleshooting Tips

EVKT-USBI2C-02 Driver Installation Problem

If the EVKT-USBI2C-02 driver is not properly installed, manual installation is required. Follow the steps below to manually install the EVKT-USBI2C-02 driver:

Note: Find “USBXpress Device” in the Device Manager.



If the PC is running Windows 10, check the driver version of USBXpress Device. Windows 10 will automatically install the older USB driver, which is not compatible. The correct driver version is 4.0.0.0 (see Figure 15).

1. Install the correct "USBXpress “.exe” file. Choose either the 32-bit or 64-bit operating system.

   32-bit: USBXpressInstaller_x86.exe

   64-bit: USBXpressInstaller_x64.exe

2. Connect the EVKT-USBI2C-02 communication interface to the PC with the USB cable.

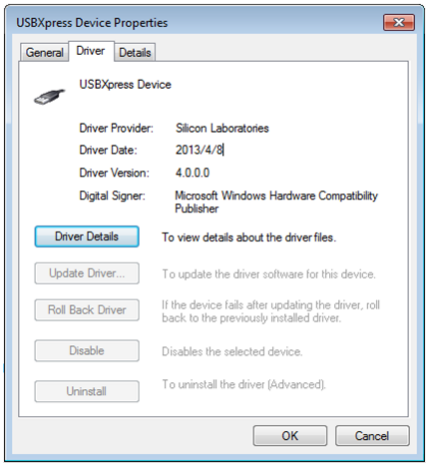


Figure 15: Correct Driver Version

No Supply

The IC's input pin has an under-voltage lockout (UVLO) detection circuit. If V_{IN} is below its UVLO rising threshold, the IC's functions are disabled.

Shutdown Event

If the IC detects that V_{IN} drops below its UVLO falling threshold (enter a no supply state) or over-temperature protection (OTP) is triggered (enter a shutdown state), the IC switches to a no supply state or shutdown state, regardless of the current state.

Thermal Recovery

If the MP2651 is in a shutdown state due to the die temperature exceeding the thermal protection threshold, the IC starts up again after the die's temperature decreases.

Section 4. Ordering Information

The components of the evaluation kit can be purchased separately, depending on user needs.

Part Number	Description
EVKT-MP2651	Complete evaluation kit
Contents of EVKT-MP2651	
EV2651-VT-00A	MP2651-xxxx evaluation board
EVKT-USBI2C-02	Includes one USB to I^2C communication interface, one USB cable, and one ribbon cable
Online resources	Include GUI and supplemental documents

Order directly from MonolithicPower.com or our distributors.

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	2/8/2023	Initial Release	-