1 Introduction

1.1 EVM Features

For detailed features and operation, refer to Table 1 for a list of devices and their data sheets.

Table 1. Device Data Sheets

Device	Document
bq24296/7	SLUSBP6

The bq24296 and bq24297 evaluation module (EVM) is a complete charger module for evaluating an I^2C-controlled single NVDC-1 charge using the bq24296 and bq24297 devices.

This EVM doesn't include the USB-to-GPIO interface board. To evaluate the EVM, a USB-to-GPIO interface board must be ordered separately.

1.2 I/O Descriptions

Table 2 lists the jumper connections available on this EVM.

Table 2. EVM Connections

Jack	Description
J1–PMID	PMID pin connection/Power bank output
J1–VBUS	Input: positive terminal
J1–GND	Input: negative terminal (ground terminal)
J2-SYS	Connected to system
J2-BAT+	Connected to battery pack
J2-GND	Ground
J3	USB-to-GPIO connector (USB Interface Adapter Connector - HPA172)
J4–INT	INT pin connection
J4– OTG	OTG pin connection
J4-$\overline{CE}$	$\overline{CE}$ pin connection
J4-GND	Ground
J5-TS2	External TS2 pin connection
J5-GND	Ground
J6-TS1	External TS1 pin connection
J6-GND	Ground
J7	Mini_USB Connector

Table 3 lists the controls and key parameter settings for this EVM.

Table 3. Jumper Connections

Jack	Description	Factory Setting
JP1	For bq24296/7 input current setting: PSEL LOW: Adaptor input PSEL HIGH: USB input	bq24297: Not installed bq24296: Short PSEL to LOW
JP2	D-/PG pin selection	bq24297: Short D-/PG to D- bq24296: Short D-/PG to PG
JP3	STAT, PG, /CE, INT, OTG pin internal pull-up source (VSYS) jumper	Installed
JP4	USB current limit selection pin during buck mode and PSEL is high (JP1-High)/Enable pin during boost mode. In buck mode: OTG = High, IIN limit = 500 mA; OTG = Low, IIN limit = 100 mA. The boost mode is activated when the REG01[5:4] = 10 and OTG pin is HIGH.	Not installed
JP5	$\overline{CE}$ pin setting: pull low to enable the charge	Not Installed (GUI also can pull /CE low)
JP6	For bq24297 input current limit setting:	bq24297: installed bq24296: Not installed
JP7	TS1 resistor divider pull-up source (REGN) connection	Installed
JP8	internal 10k to ground to TS1	Installed
JP9	internal 10k to ground to TS2	Installed
JP10	TS2 pin setting:	bq24296/7: Short TS2 and TS2-I

Table 4 lists the recommended operating conditions for this EVM.

Table 4. Recommended Operating Conditions

Symbol	Description	MIN	TYP	MAX	Unit
Supply voltage, V_{IN} bq24296/7	Input voltage from AC adapter	3.9	5	6	VDC
Battery voltage, V_{BAT}	Voltage applied at V_{BAT} terminal	0	3.7	4.25	V
Supply current, I_{AC}	Maximum input current from AC adapter input	0		3	A
Output current, I_{OUT}	Output current	0		4	A
Operating junction temperature range, T_J		0		125	°C

2 Test Summary

Section 2.1 – Section 2.3 explains the equipment, the equipment setup, and the test procedures.

2.1 Equipment

2.1.1 Power Supplies

Power supply #1 (PS#1): a power supply capable of supplying 5 V at 1 A is required. While this part can handle larger voltage and current, it is not necessary for this procedure.

2.1.2 Load #1 (4-Quadrant Supply, Constant Voltage < 4.5 V)

A 0–20 V/0–5 A, > 30-W system, DC electronic load and setting as constant voltage load mode.

Or:

Kepco load: BOP 20–5M, DC 0 to ±20 V, 0 to ±5 A (or higher)

Or:

Real single-cell battery

2.1.3 Load#2 – Use with Boost Mode

PMID to GND load, 10 Ω, 5 W or greater

2.1.4 Meters

Six Fluke 75 multimeters, (equivalent or better)

Or:

Four equivalent voltage meters and two equivalent current meters.

The current meters must be capable of measuring 5 A+ current.

2.1.5 Computer

A computer with at least one USB port and a USB cable. The bq2429xEVM evaluation software must be properly installed.

2.1.6 USB-to-GPIO Communication Kit (HPA172-USB Interface Adapter)

2.1.7 Software

Unzip the bq2429xEVM_GUI.zip and double-click on the *SETUP.EXE* file. Follow the installation steps. The software supports the Windows™ XP and Windows 7 operating systems.

2.2 Equipment Setup

1. Set PS#1 for 5-V DC, 1-A current limit and then turn off the supply.
2. Connect the output of PS#1 in series with a current meter (multimeter) to J1 (V_{BUS} and GND).
3. Connect a voltage meter across J1 (V_{BUS}) and J1 (GND).
4. Turn on the Load, set to constant voltage mode and output to 2.5 V. Turn off (disable) Load. Connect Load in series with a current meter (multimeter), ground side, to J2 (BAT+ and GND) as shown in Figure 2.
5. Connect a voltage meter across J2 (BAT+ and GND).
6. Connect the HPA172 USB interface adapter to the computer with a USB mini-cable and to J3 with the 10-pin ribbon cable. The connections are shown in Figure 1.

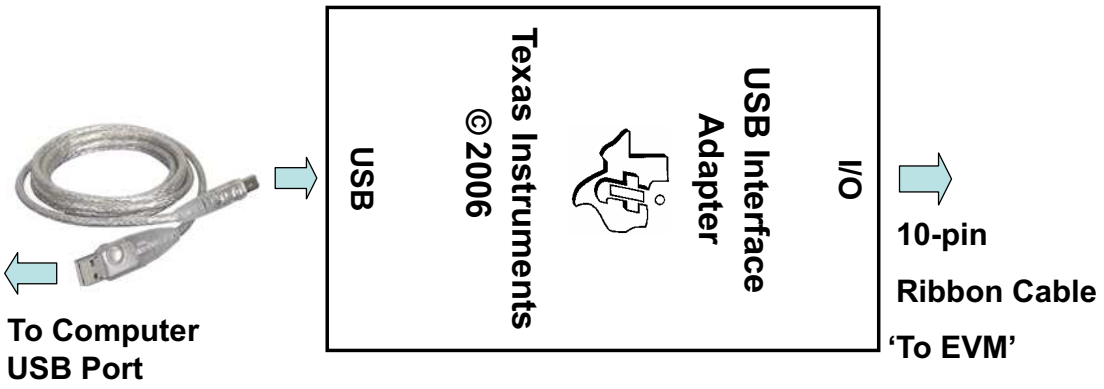


Figure 1. Connections of the HPA172 Kit

7. Install shunts as shown in Table 3.

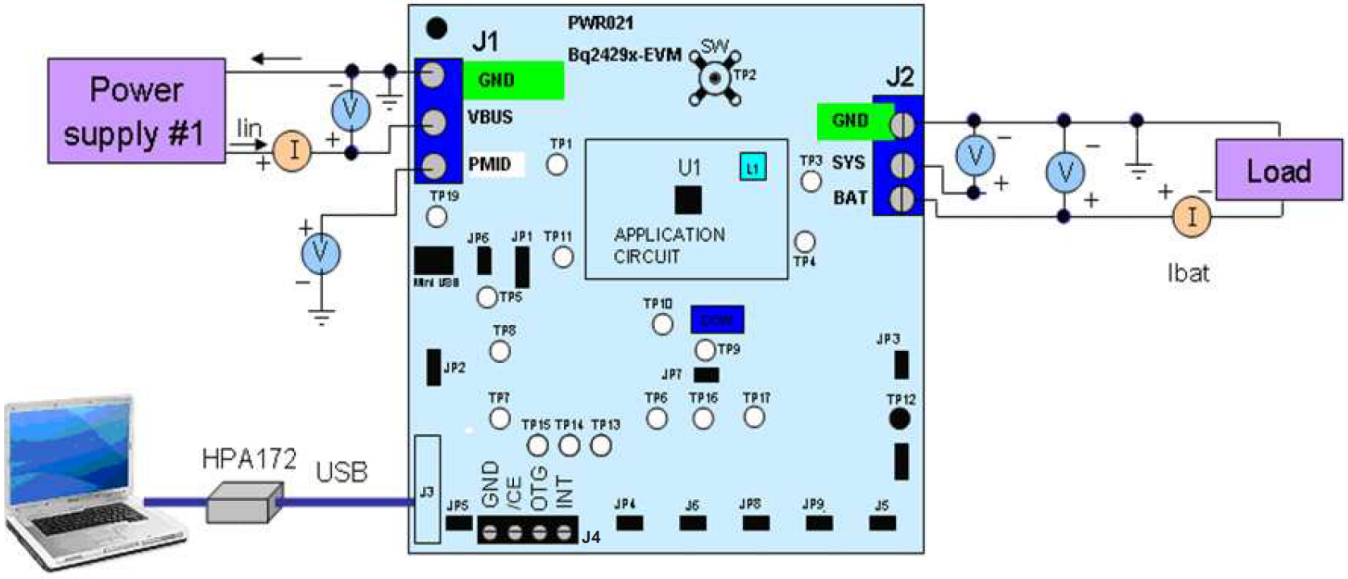


Figure 2. Original Test Setup for PWR021 (bq2429xEVM)

8. Turn on the computer. Launch the bq2429x evaluation software. The main window of the bq2429x software is shown in Figure 3.

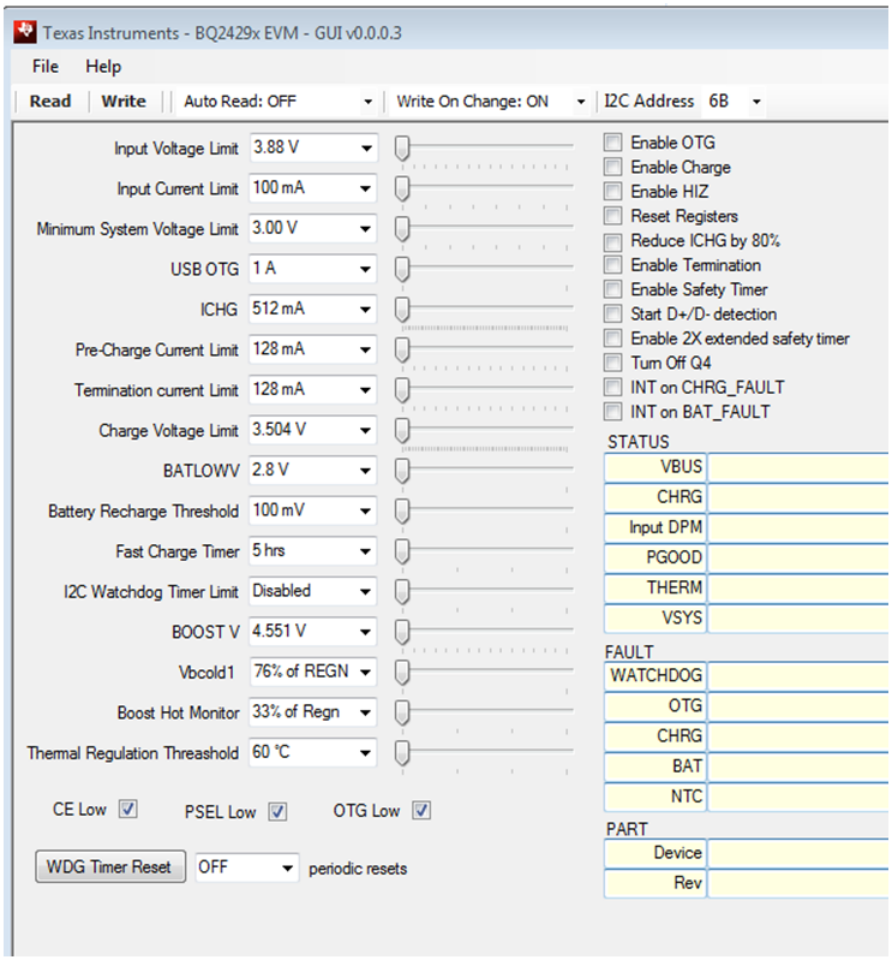


Figure 3. Main Window of the bq2429x Evaluation Software

2.3 Procedure

2.3.1 Current Settings

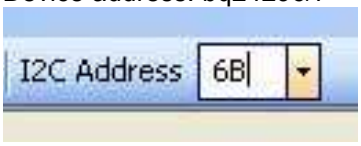
1. Make Sure EQUIPMENT SETUP steps are followed.
   ILIM Setting: Set the potentiometer to its lowest value for max input current by connecting an ohm-meter between point TP9 and ground. Turn the screw on the potentiometer counterclockwise until the resistance drops to its lowest point (this should be in the range of 125 Ω to 175 Ω, the value of R7)
2. Launch the Bq2429x EVM GUI software, if not already done
3. Turn on PS#1
   Measure → V (J2(SYS), J2(GND)) = 4.10 ±300 mV

2.3.2 Charge Voltage and Current Regulation of V_{IN} and Device ID Verification

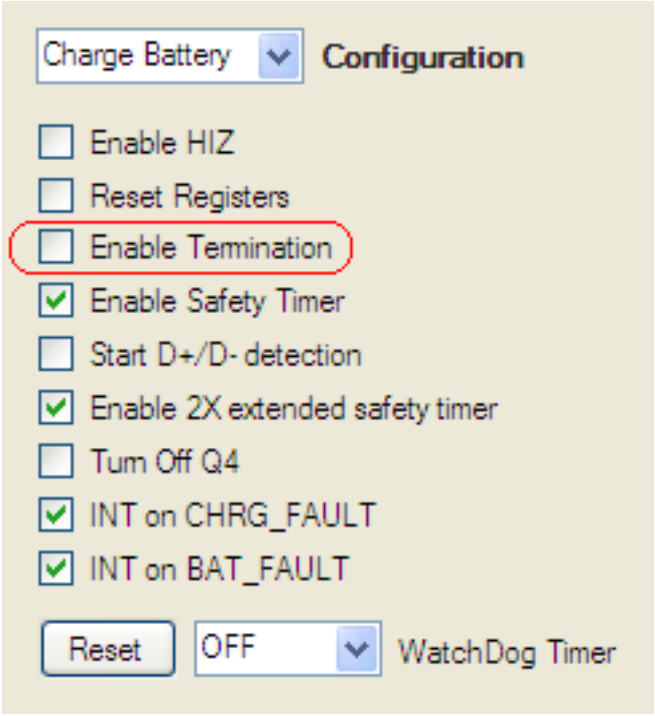
Follow the steps and verify the outputs and IC for the EVM.

2.3.2.1 Software setup (all of Section 2.3.2.1 is done in the GUI):

1. Device address: bq24296/7



2. Click the **Read** button
3. Select *Disabled for I²C Watchdog Timer Limit*
4. Set *Input Voltage Limit* to 4.2 V
5. Set *Input Current Limit* to 500 mA
6. Set *Charge Voltage Limit* to 4.208 V
7. Set *Fast Charge Current, ICHG* to 512 mA
8. Set *Pre-Charge Current* to 256 mA
9. Deselect *Enable Termination* (see the following image)



10. Click the **Read** button twice
    Observe → Everything normal at *FAULT* box
    Observe → D1 (STAT) is on
    Observe → D2 (/PG) is on for the bq24296EVM

2.3.2.2 Enable Load#1 from Section 2.2 step 4. Measure the voltage across J2 at two different points:

Measure → V(J2(SYS), J2(GND)) = 3.65 V ±300 mV

Measure → V(J2(BAT), J2(GND)) = 2.5 V ±200 mV

2.3.2.3 Increase the Constant Voltage Load to 3.7 V_{DC}

Measure → V(J2(SYS), J2(GND)) = 3.75 V ±200 mV

Measure → IBAT = 500 mA ±200 mA

Measure → V(J2(BAT), J2(GND)) = 3.7 V ±200 mV

2.3.2.4 In the software, set Fast Charge Current, ICHG to 1.012 A

Measure → Iin = 500 mA ±200 mA

2.3.2.5 Verify Scope Measurements (See Figure 4 – 500 ns/div)

C1 (AC coupled 20 mV/div): Vac_PMID (TP20 to GND) – Ripple excluding high frequency spikes < 10 mV

C2 (5 V/div): Vdc_SW (TP2) - Frequency between 1.25 MHz and 1.5 MHz, duty cycle between 73% and 81%

C3 (AC coupled 20 mV/div): Vac_VSYS (TP3 to GND) - excluding high frequency spikes < 15 mV

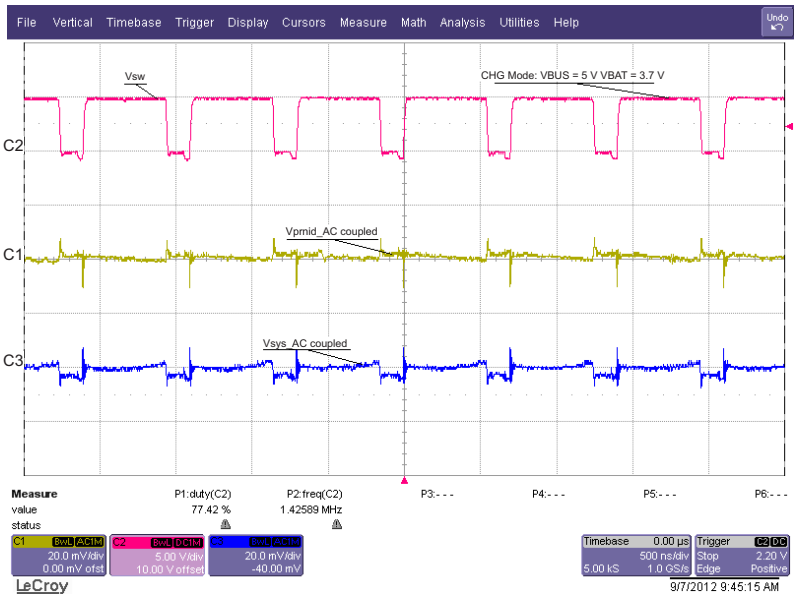


Figure 4. CHG Mode Ripple and Duty Cycle: V_{BUS} = 5 V, V_{BAT} = 3.7 V

2.3.2.6 Switch to Boost Mode

1. Turn off and disconnect PS#1
2. If the constant voltage load connected from BAT+ to GND is not a four-quadrant supply (sources current) remove the load and use the power source disconnected in step one, set to 3.7 V and 2 A current limit and connect between BAT+ and GND
3. Apply 10 Ω (5 W or greater) across J5 (PMID(+) to GND(–)
4. Uncheck the *OTG Low* box in the GUI
5. Select OTG in the *Configuration* drop-down window
6. Verify V_{PMID} to GND on J5 is between 4.9 V and 5.3 V
7. Verify scope measurement (See Figure 6)
   C1 (AC coupled 20 mV/div): Vac_PMID (TP20 to GND) – Ripple excluding high frequency spikes
   C2 (5 V/div): Vdc_SW (TP2) - Frequency between 1.2 MHz and 1.7 MHz, Duty cycle between 67% and 74%

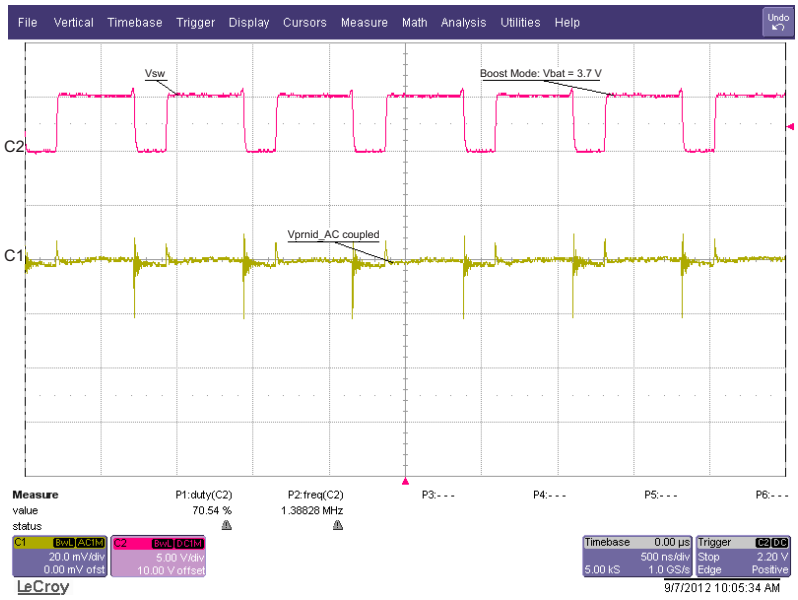


Figure 5. Boost Mode Ripple and Duty Cycle; V_{BAT} = 3.7 V

2.3.2.7 Verify Device ID JEITA shown in software matches Table 5

Table 5. Device ID JEITA Settings

Assembly Number	EVM Part Number	Device ID	JEITA
PWR021-009	bq24296EVM-021	bq24296	Disabled
PWR021-010	bq24297EVM-021	bq24297	Disabled

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