TPS65084x Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS65084x evaluation module (EVM). The TPS65084x EVM is a fully assembled platform for evaluating the performance of the TPS65084x power management device. This document should be used with the schematic diagrams, the printed-circuit board (PCB) layout, and the bill of materials (BOM) supplied in conjunction with this document.

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Trademarks

1 Introduction

The TPS65084x is a highly integrated power management solution for the Intel Braswell processors.

Features of the TPS65084x include:

- Three Variable-Output Voltage Step-Down Controllers
  - Wide V_{IN} range from 5.4 V to 21 V
  - Up to 7-A output current for BUCK1 (VCC) and BUCK6 (VDDQ), and 11-A for BUCK2 (VGG) using external FETs
  - I^2C DVS Control (0.5 V to 1.45 V in 10-mV steps) for BUCK1 and BUCK2
  - Pin-selectable output voltages (1.1 V, 1.2 V, or 1.35 V) for BUCK6 (VDDQ)
- Three variable-output voltage synchronous step-down converters
  - V_{IN} range from 4.5 V to 5.5 V
  - Up to 3.5 A of output current for BUCK3 (VNN) with I^2C DVS control (0.65 V to 1.45 V in 25-mV steps)
  - Up to 3 A of output current for BUCK4 (V1P05A) and up to 1.5 A of output current for BUCK5 (V1P8A)
- Three LDO regulators with I^2C-adjustable-output voltage
  - LDOA1: from 1.35 V to 3.3 V for up to 200 mA of output current
  - LDOA2: from 1.05 V, 1.1 V, 1.15 V, and 1.2 V for up to 500 mA of output current
  - LDOA3: from 1.1 V, 1.15 V, 1.2 V, and 1.24 V for up to 500 mA of output current
- VTT LDO for DDR3 and DDR4 memory termination
  - Fixed-output voltage of $0.5 \times V_{BUCK6}$
  - Can sink and source output current up to 500 mA
- Three load switches with slew-rate control
  - Up to 300 mA of output current with voltage drop less than 1.5% of nominal input voltage
  - R_{DSON} < 96 mΩ at input voltage of 1.8 V
- I^2C interface (Device Address 0x5E) supports standard mode (100 kHz), fast mode (400 kHz), and fast mode plus (1 MHz)
- 64-Pin, single-row, 0.4-mm pitch QFN package

2 Requirements

2.1 Software

The EVM will power-up and operate without use of software. A GUI is supplied to provide a simple way to communicate to the device via I^2C. The GUI can be downloaded from:
http://www.ti.com/tool/IPG-UI

Additional installers are needed to update the GUI to contain the register map for this device. They can be downloaded from:
https://ti.com/licreg/docs/swlicexportcontrol.tsp?form_id=184041&prod_no=TPS65084X_94X&ref_url=hval_ipg

The EVM has a built-in USB2ANY module utilizing an MSP430. The GUI uses this to communicate with the device.

2.2 Host Computer

A computer with an available USB port is required to make use of the EVM software. The EVM software runs on the computer and communicates with the EVM via a USB-A to micro-B cable.

2.3 Power Supply

A DC power supply capable of delivering at least 5.6 V and 1 A is required to power on the EVM. If loading the EVM, a power supply with a 10 A limit or higher is recommended.

2.4 EVM Kit

The EVM kit contains the following items:

- TPS65084x HVL116A evaluation board

3 Terminal Block Descriptions

The EVM features 14 terminal blocks around the perimeter of the EVM. These are used for providing VSYS (J1) and loading the outputs. Each terminal block is labeled with the input or output on one side and GND on the other. Each terminal block also has a pair of test points for sense line probing.

4 Test Point Descriptions

Numerous test points are provided for sensing voltages on the EVM. The CTL1–6 test points also provide a way to override the on-board switches, when desired. Note that to override the switches, they must be in the 'OFF' position (not shorted to GND).

Table 1. Test Points(1)

Test Point	Description
CTL1	PMICEN
CTL2	DDR_SEL
CTL3	SLP_S0IXB
CTL4	SLP_S3B
CTL5	SLP_S4B
CTL6	DDRVTTCTRL
GPO1	RSMRSTB
GPO2	DRAMPWROK
GPO3	COREPWROK
GPO4	VCCAPWROK
V5ANA	External 5-V supply input to internal load switch that connects this pin to LDO5P0 pin.
LDO5V	5-V internal LDO (LDO5P0) sense
LDO3P3	3.3-V internal LDO sense
VREF	Bandgap reference output
GND	Connected to GND planes
DIG_1P8V	1.8-V external LDO sense
USB_3P3V	3.3-V external LDO sense for USB2ANY onboard MSP430
BUCK3P3V	3.3-V external BUCK sense
BUCK5V	5-V external BUCK sense
EPGOOD	Power good indicator of external dual controller (requires pull-up to indicate properly)
Output Sense+ (Unlabeled)	Each rail has a sense+ line connected to the central output cap
Output Sense– (Unlabeled)	Each rail has a sense– line connected to the central output cap
Input Sense+ (TP1)	VSYS sense+ line connected to input cap of PMIC
Input Sense– (TP2)	VSYS sense– line connected to input cap of PMIC

(1) Test points are not designed to carry current. They are intended for measuring voltage.

5 Header Descriptions

There are 7 sets of headers which are used to provide greater access to several signals.

Table 2. Headers

Jumper	Description	Jumper Default Position
J21	Option to bypass the on-board 5-V external buck for the input to BUCK3, BUCK4, BUCK5, and V5ANA. 4 GND pins provided here as well.	VIN_BUCK345_ANA connected to BUCK5V with two jumpers to accommodate high current
J22	Option to bypass LDO5V for the input to DRV5V_2_A1 and DRV5V_1_6	VIN_DRV connected to LDO5V
J23	Option to bypass the on-board 3.3-V external buck for the input to SWA1. 2 GND pins provided here as well.	VIN_SWA1 connected to BUCK3P3V
J24	Option to bypass BUCKX_1P8V (1.8 V) for the input to LDOA2_A3	VIN_LDOA2_A3 connected to BUCKX_1P8V
J25	Option to bypass BUCKX_1P8V (1.8 V) for the input to SWB	VIN_SWB connected to BUCKX_1P8V
J33	SDA, SCL, and GND	Not intended for a jumper

6 Control, GPO, and External VRs

The EVM features a set of DIP switches for controlling CTL1–6 and 6 LEDs for GPO indicators. It also has built-in USB2ANY circuitry which utilizes an on-board MSP430 to enable the GUI to communicate with the device through a USB cable. Finally, it features an on-board TPS51285 device which provides 3.3- and 5-V rails from VSYS for use by BUCK3, BUCK4, BUCK5, V5ANA, and SWA1. Pads exist for the addition of Samtec HSEC8-110-01-S-DV-A vertical edge rate card sockets.

- For the CTL switches, S1, the “OFF” position is an open circuit and the CTL signal is pulled up to the corresponding rail. The “ON” position forces the CTL signal to GND.
- The LED order is D6, D1, D4, D5, D2, D3 with the resulting signal order from left to right being: USB, RSMRSTB, VCCAPWROK, IRQB, DRAMPWROK, COREPWROK.
- Due to the active low polarity of the IRQB signal, the IRQB LED input has been inverted so that a low IRQB turns the LED on. As a result, when VSYS is present but PMIC_EN is low, the IRQB LED turns on even though there is no interrupt since the device is off.

Table 3. Other Connectors

Designator	Description
S1	In order from left to write, the switches are for: PMICEN, DDR_SEL, SLP_S0IXB, SLP_S3B, SLP_S4B, DDRVTTCTRL. Note: the “ON” (up) position shorts the CTL signals to GND. As a result, to enable an active high signal, the switch should be set to the “OFF” (down) position.
D6	Indicator light for successful USB connection.
D1	GPO1 - RSMRSTB status indicator
D2	GPO2 – DRAMPWROK status indicator
D3	GPO3 – COREPWROK status indicator
D4	GPO4 – VCCAPWROK status indicator
D5	Inverted IRQB status indicator (since IRQB is active low)

7 Setup

The typical sequence for the switches is CTL1 (PMICEN), CTL5 (SLP_S4B), CTL4 (SLP_S3B) with CTL3 (SLP_S0IXB) already enabled to move through the sequence. From there, the CTL3 (SLP_S0IXB) pin can be toggled to test Connected Standby.

Figure 1 is an example setup for using the TPS65084x EVM:

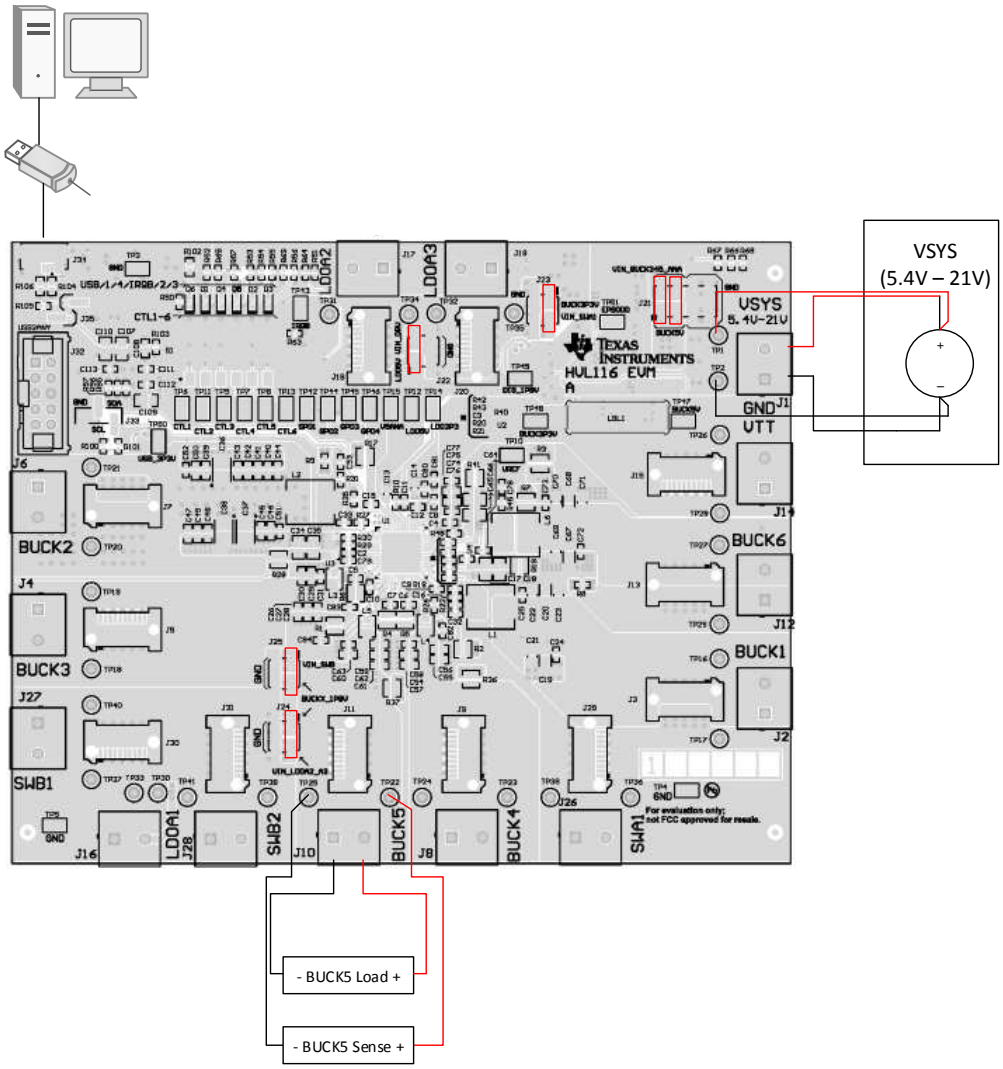

Figure 1. TPS65084x EVM Setup

8 Software

8.1 Software Installation Instruction

A GUI is supplied to provide a simple way to communicate to the device via I^2C. The GUI can be downloaded from:
http://www.ti.com/tool/IPG-UI

Additional installers are needed to update the GUI to contain the register map for this device. They can be downloaded from:
https://ti.com/licreg/docs/swlicexportcontrol.tsp?form_id=184041&prod_no=TPS65084X_94X&ref_url=hval_ipg

Information on the installation of the IPG-UI can be found in the *IPG-UI User's Guide* (SLVUAH9)

8.2 Using the TPS65084x GUI

Detailed information on the usage of the IPG-UI can also be found in the *IPG-UI User's Guide* (SLVUAH9). A brief overview is provided here for reference.

The proper device must first be selected from the "Select Devices" drop-down menu.

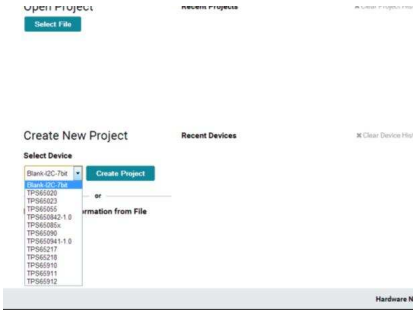

Figure 2. GUI Front Page

From there, the next screen is the device introduction page, which includes a brief overview as well as the functional block diagram for the device.

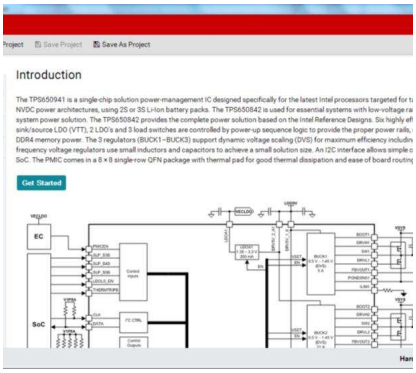

Figure 3. GUI Device Introduction

Finally, clicking on "Get Started" or on "Register Map" takes you to the I^2C controls for the device sorted by register address.

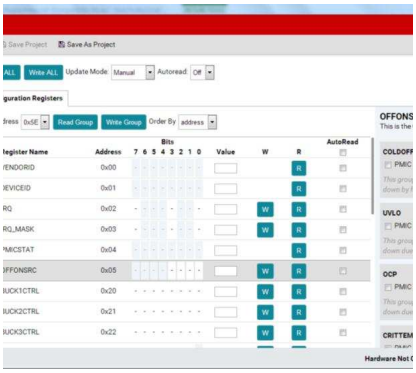

Figure 4. GUI Register Map

With this information, it is possible to begin evaluating the TPS65084x device.

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (November 2015) to A Revision	Page
• Fixed typo in URL for the installers in the *Software* section	2

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

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      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

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This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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