4.5-V to 18-V Input, Dual 3.5-A Synchronous Step-Down Converter With I²C Controlled VID and Current Sharing Evaluation Module

This document is provided with the TPS65273V PMIC evaluation module (EVM) as a supplement to the TPS65273V datasheet. This user's guide includes the schematic, hardware setup, software installation and bill of materials (BOM).

Contents

1 Introduction 2
2 Background 2
3 TPS65273V Schematic 3
4 Board Layout 4
5 Bench Test Setup Conditions 7
5.1 Header Description and Jumper Placement 7
5.2 Hardware Requirement 8
5.3 Hardware Setup 8
5.4 Installing Software 9
5.5 Software Operation 10
6 Power-Up Procedure 11
7 TPS65273V EVM Bill of Materials 12

List of Figures

1 TPS65273V Schematic 3
2 Component Placement (Top Layer) 4
3 Board Layout (Top Layer) 5
4 Board Layout (Second Layer) 5
5 Board Layout (Third Layer) 6
6 Board Layout (Bottom Layer) 6
7 Header Description and Jumper Placement 7
8 USB Interface Adapter Quick Connection Diagram 9
9 Screen Capture of TPS65273V Software GUI Interface 10

List of Tables

1 Summary of Performance 2
2 Input/Output Connection 7
3 Jumpers and Switches 8
4 TPS65273V EVM Bill of Materials 12

Windows, Microsoft, Internet Explorer are registered trademarks of Microsoft Corporation.
VeriSign is a trademark of VeriSign, Inc.

Copyright © 2013, Texas Instruments Incorporated

1 Introduction

This document presents the information required to operate the TPS65273V PMIC as well as the support documentation including schematic, layout, hardware setup, software installation and bill of materials.

2 Background

The TPS65273V PMIC is designed to provide dual 3.5 A of continuous currents with an operational range of 4.5 to 18 V. The TPS65273V features I^2C controlled voltage identification (VID) and the output voltage can be set by I^2C from 0.68 V to 1.95 V. Without I^2C, voltage can also be programmed by an external resistor divider. The TPS65273V features externally programmed switching frequency ranging from 200 kHz to 1.6 MHz, external compensation, soft-start and enable.

As there are many possible options to set the converters, Table 1 presents the performance specification summary for the EVM.

Table 1. Summary of Performance

Test Conditions	Performance
Vin = 4.5 V to 18 V	Buck1 : 1.0 V, up to 3.5 A, VID control
fsw = 500 kHz (25°C ambient)	Buck2 : 1.1 V, up to 3.5 A, VID control

The EVM is designed to provide access to the features of the TPS65273V. Some modifications can be made to this module to test performance at different input and output voltages, current and switching frequency. Please contact TI Field Applications Group for advice on these matters.

Copyright © 2013, Texas Instruments Incorporated

3 TPS65273V Schematic

Figure 1 shows the TPS65273V PMIC EVM schematic.

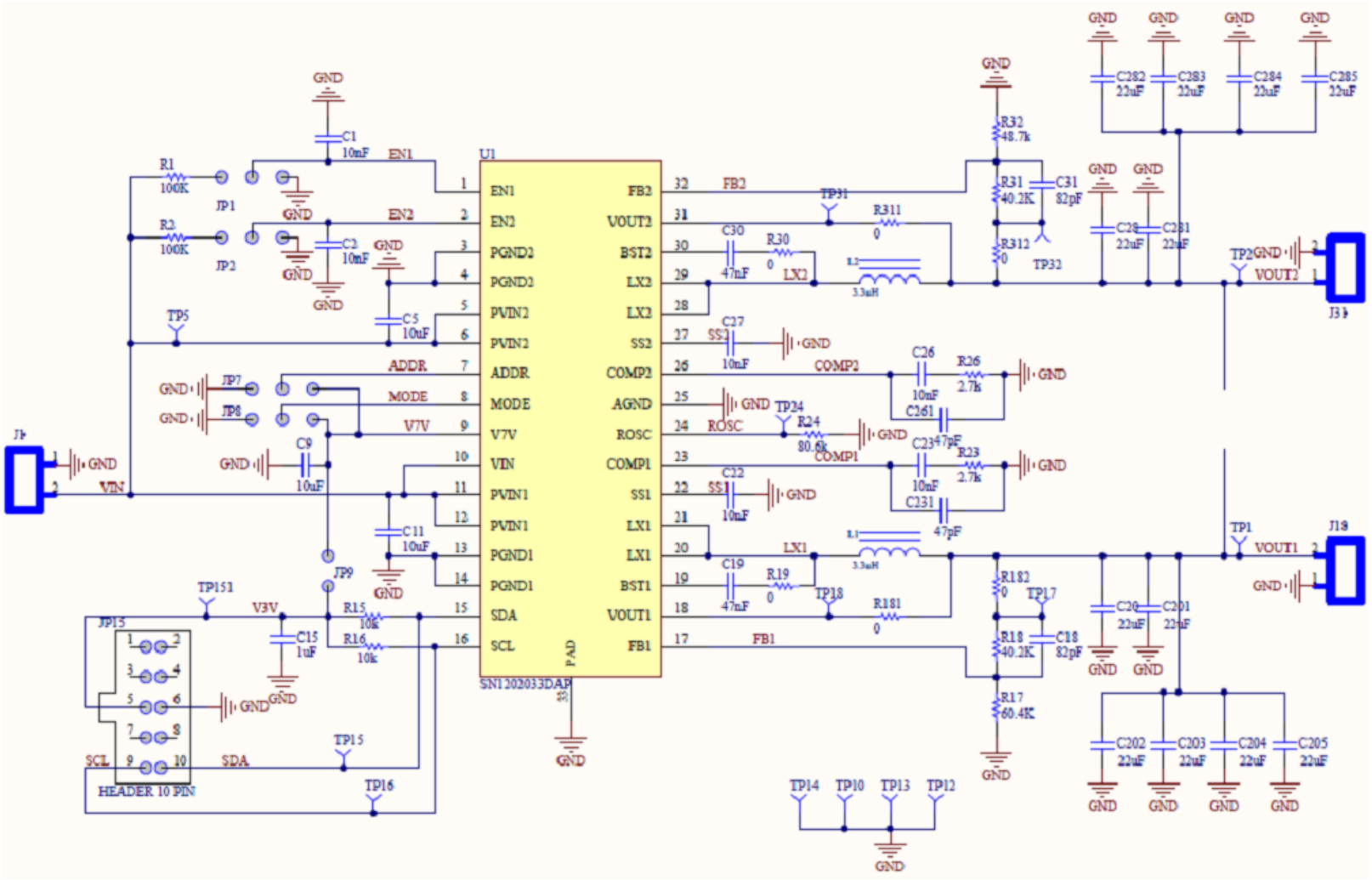


Figure 1. TPS65273V Schematic

Copyright © 2013, Texas Instruments Incorporated

4 Board Layout

Figure 2 through Figure 6 illustrate the printed-circuit boards for this EVM.

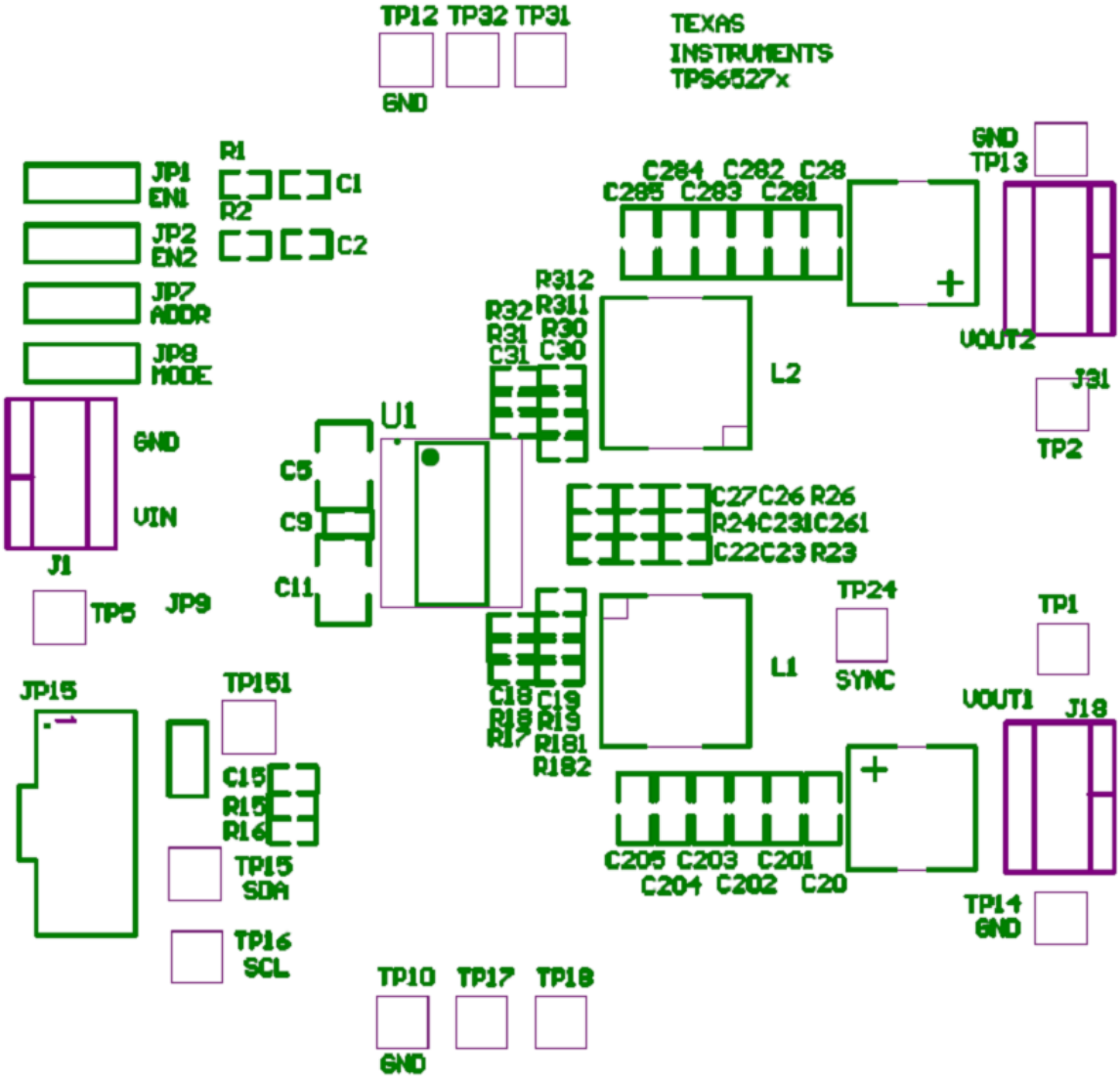


Figure 2. Component Placement (Top Layer)

Copyright © 2013, Texas Instruments Incorporated

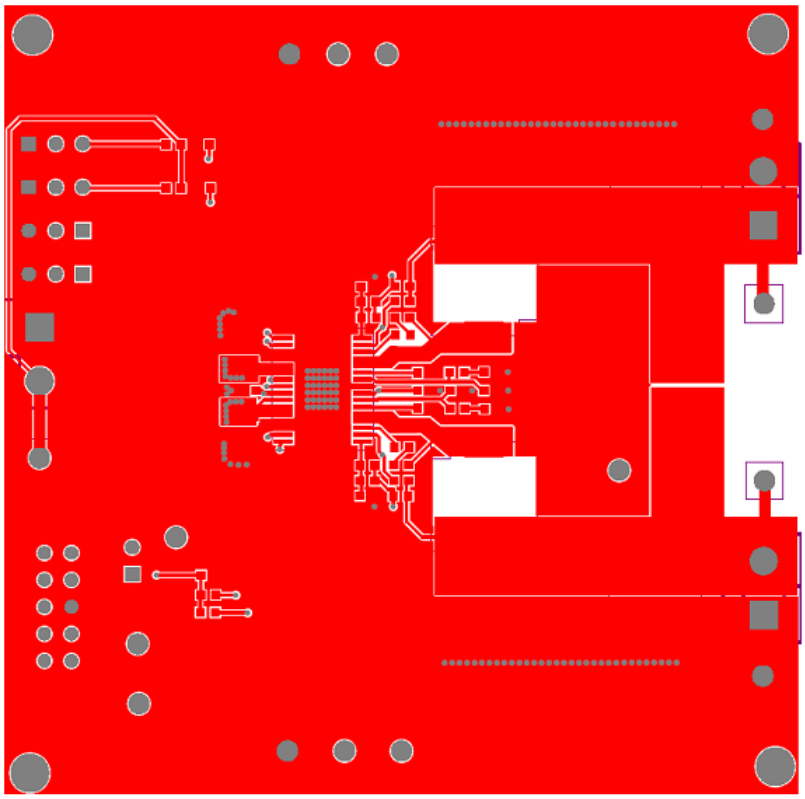


Figure 3. Board Layout (Top Layer)

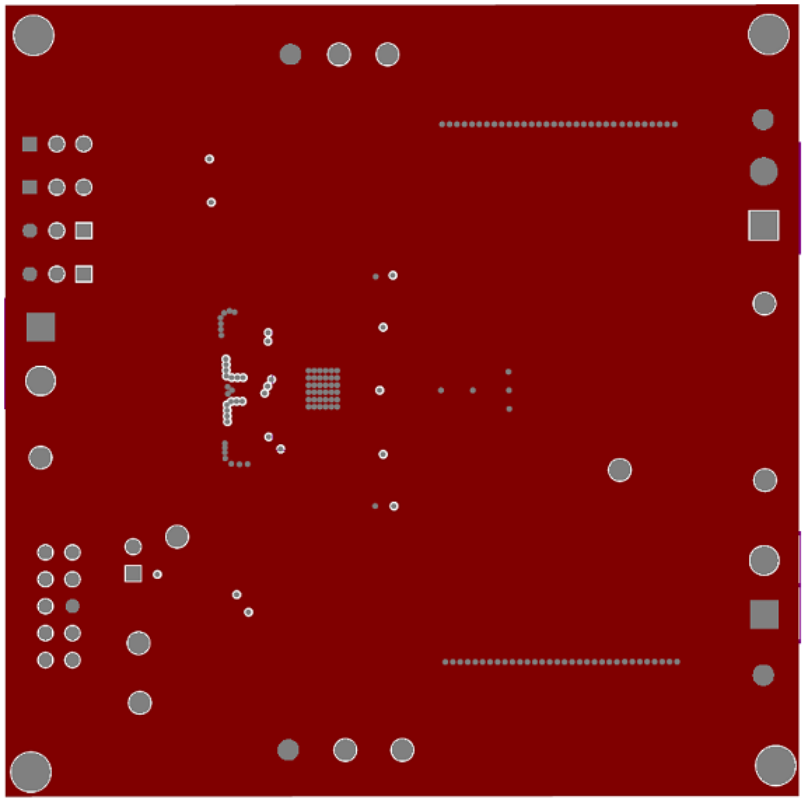


Figure 4. Board Layout (Second Layer)

Copyright © 2013, Texas Instruments Incorporated

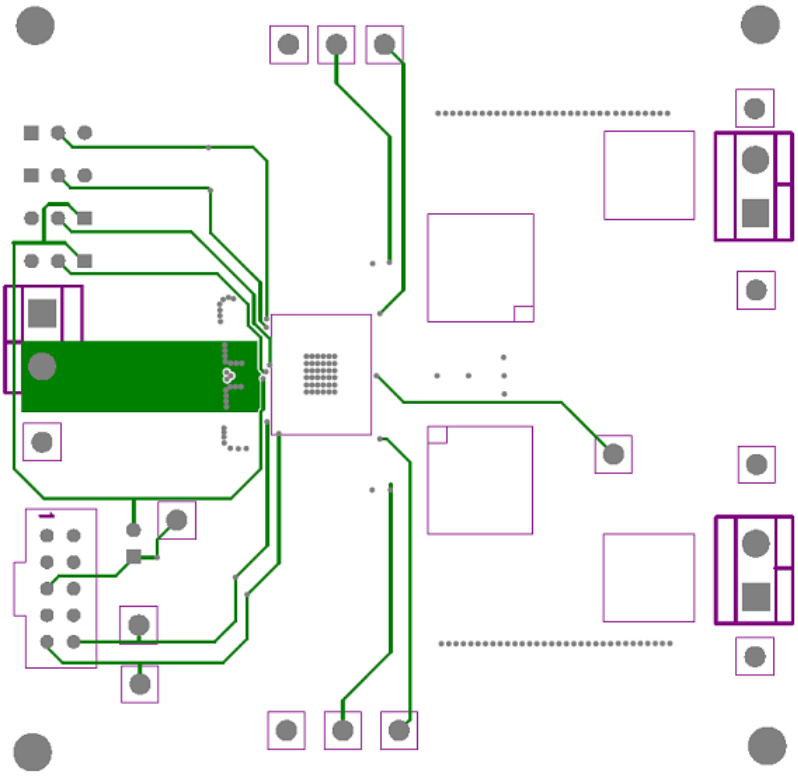


Figure 5. Board Layout (Third Layer)

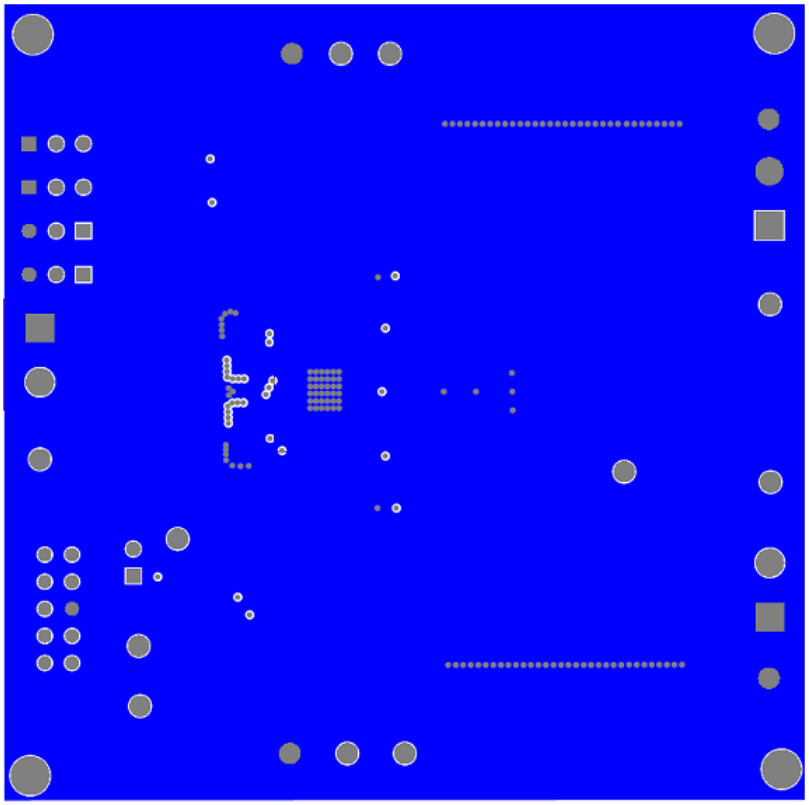


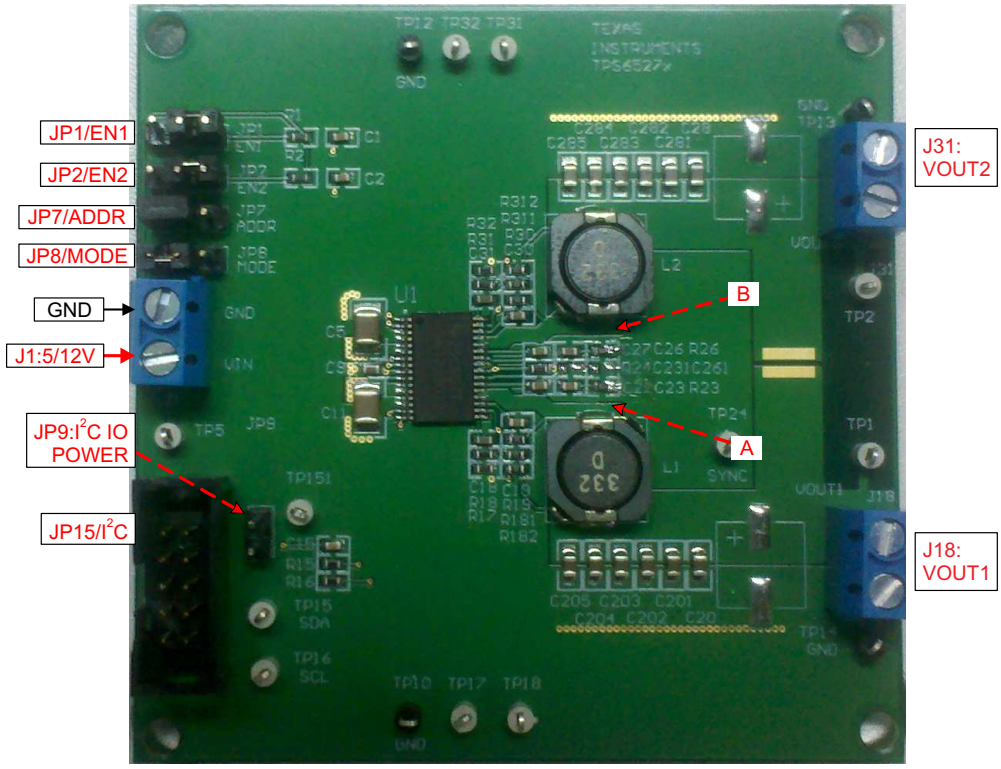
Figure 6. Board Layout (Bottom Layer)

Copyright © 2013, Texas Instruments Incorporated

5 Bench Test Setup Conditions

5.1 Header Description and Jumper Placement

Figure 7 illustrates the header description and jumper placement for the EVM.



Test points:

A: LX of Vout1

B: LX of Vout2

Vout1, Vout2

Figure 7. Header Description and Jumper Placement

Table 2 shows the I/O connections for the EVM.

Table 2. Input/Output Connection

Jumper Number	Function	Description
J1	Vin Connector	Apply power supply to this connector
J18	Buck1 Connector	Output of Buck1
J31	Buck2 Connector	Output of Buck2

Copyright © 2013, Texas Instruments Incorporated

Table 3 shows the jumpers and switches for the EVM.

Table 3. Jumpers and Switches

Jumper Number	Function	Placement	Comment
JP1	Buck1 enable (EN1)	Connect EN1 to GND to disable Vout1, connect EN1 to Vin through a 100-kΩ resistor to enable Vout1; Leave open to enable Vout1	
JP2	Buck2 enable (EN2)	Connect EN2 to GND to disable Vout2, connect EN2 to Vin through a 100-kΩ resistor to enable Vout2; Leave open to enable Vout2	
JP7	I^2C address	I^2C address configuration pin. Connect this pin to GND to set address 0x60H; connect it to Vcc to set address 0x61H; leave it open to set address 0x62H	On board Vcc is 6.25 V
JP8	Mode	Operation mode control pin. Connect this pin to GND to set forced PWM mode; leave the pin open to set auto PSM-PWM; connect this pin to Vcc, set the IC to run in current share mode.	
JP9	I^2C Power	Power connected to the I^2C IO pull-up resistor; Leave the two pins un-connected set the power to be 3.3V from the I^2C interface adaptor; short the two pins set the power to be Vcc.	On board Vcc is 6.25 V
JP15	I^2C interface connector	Pin 5 is 3.3 V from adaptor; pin 6 is Ground; pin 9 is SCL, pin 10 is SDA.	

5.2 Hardware Requirement

This EVM requires an external power supply capable of providing 4.5 V to 18 V at 7 A.

A function generator capable of driving the SYNC pin with 0.4- to 3.3-V amplitude and a 200-kHz to 1.6-MHz square wave signal is required for synchronization. The EVM kit includes a USB-TO-GPIO interface box which, when installed on a PC and connected to the EVM, allows communication with the EVM via a GUI interface. The minimum PC requirements are:

- Windows® 2000 or Windows XP operating system
- USB port
- Minimum of 30 MB of free hard disk space (100 MB recommended)
- Minimum of 256 MB of RAM

5.3 Hardware Setup

After connecting the power supply to J1, turn on the power supply, and connect JP1 to Vin through a 100-kΩ resistor, connect JP2 to Vin through a 100-kΩ resistor, connect JP7 to GND, connect JP8 to GND, the EVM will regulate the output voltages to the values shown in Table 1. Additional input capacitance may be required in order to mitigate the inductive voltage droop that may occur during a load transient event.

The output voltage is changed by sending the digital control signal via a PC running the TPS65273V controller software and USB-TO-GPIO interface box. Change the output voltage with the following steps:

- Connect one end of the USB-TO-GPIO box to the PC using the USB cable and the other end to JP15 of the TPS65273V using the supplied 10-pin ribbon cable as shown in Figure 8. The connectors on the ribbon cable are keyed to prevent incorrect installation.
- Connect the power supply on J1, and turn on the power supply.
- Run the software as explained in the next section.

Copyright © 2013, Texas Instruments Incorporated

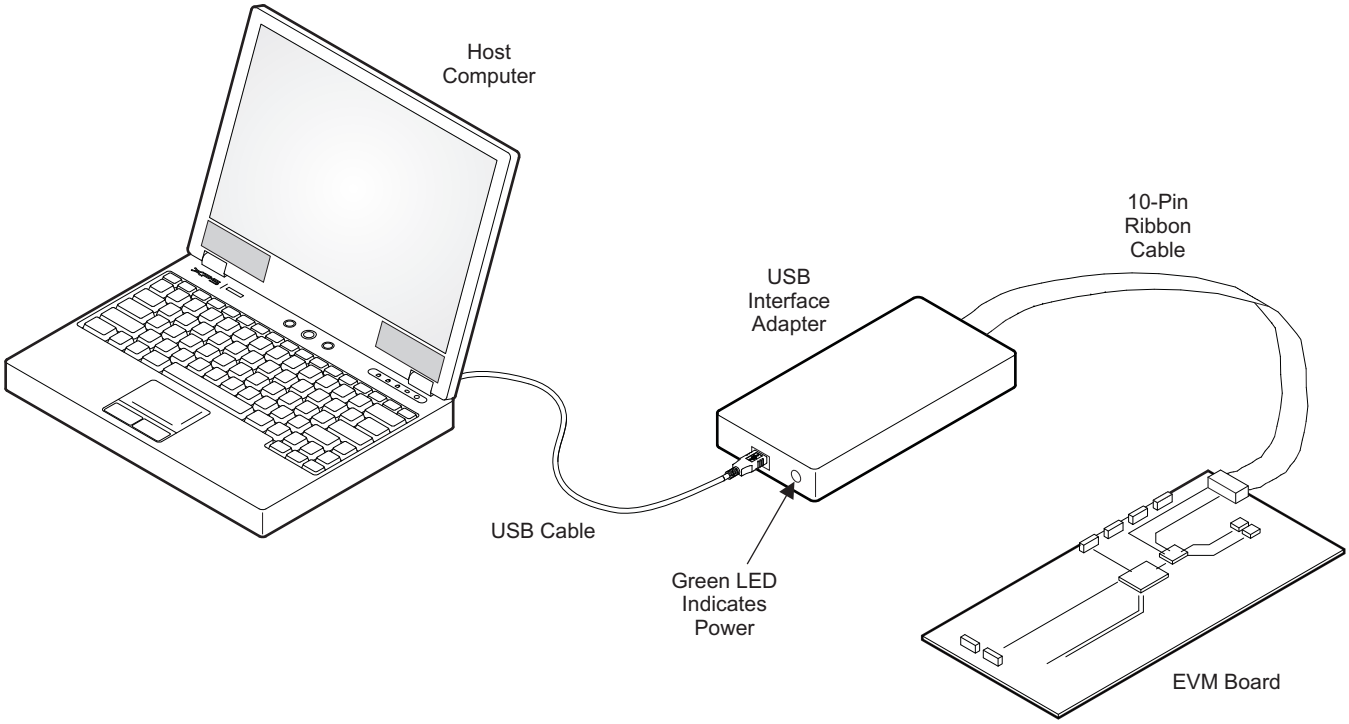


Figure 8. USB Interface Adapter Quick Connection Diagram

5.4 Installing Software

If installing from the TI Web site, go to www.ti.com.

Note: This installation page is best viewed with the Microsoft® Internet Explorer® browser (It may not work correctly with other browsers)

Click on the install button; your PC should give you a security warning and ask if you want to install this application. Select Install to proceed. If a pre-release or Beta version is currently installed on your PC, you must uninstall this version of the software before installing the final version.

To run the software after installation, go to Start → All programs → Texas Instruments → TPS65273V EVM Software.

At start-up, the software first checks the firmware version of the USB-TO-GPIO adapter box. If an incorrect firmware version is installed, the software automatically searches on the internet (if connected) for updates. If a new update is available, the software gives notification of the update, and downloads and installs the software. Note that after the firmware is updated the USB cable between the adapter and PC must be disconnected and then reconnected, as instructed during the install process. The host PC software also automatically searches on the internet (if connected) for updates. If a new update is available, the software gives notification of the update and downloads and installs it. During future use of the software, a prompt may be given to install a new version, if one becomes available.

NOTE: VeriSign™ Code Signing is used to prevent any malicious code from changing this application. If at any time in the future the binaries are modified, the code will no longer attempt to run.

Copyright © 2013, Texas Instruments Incorporated

5.5 Software Operation

This section provides descriptions of the EVM software.

The supplied software is used to communicate with the TPS65273V EVM. Click on the icon on the host computer to start the software. The software displays the main control panel for the user interface (Figure 9).

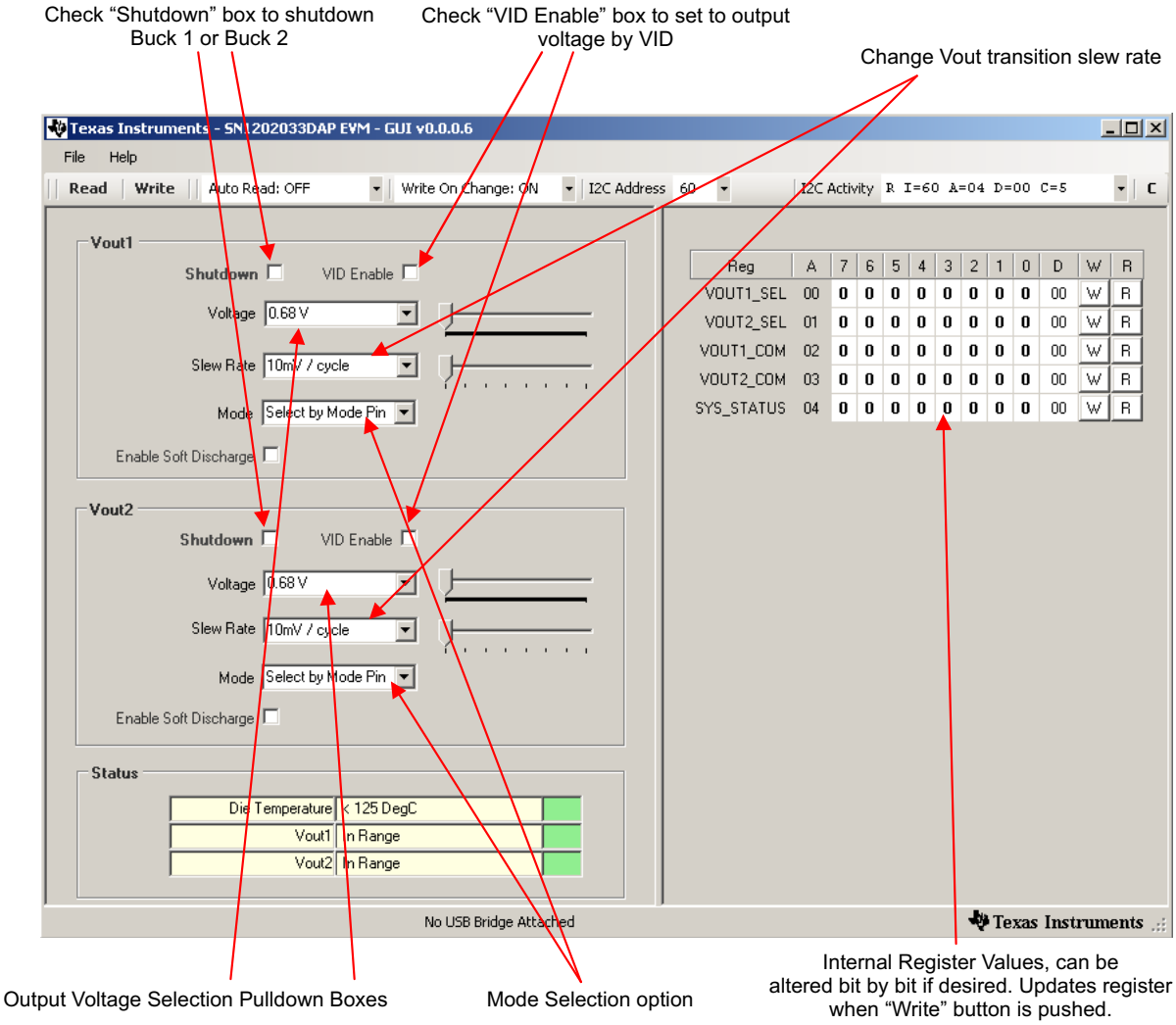


Figure 9. Screen Capture of TPS65273V Software GUI Interface

Figure 9 shows the GUI control interface. There are five 8-bit registers embedded in TPS65273V, two to select the output voltage, two to configure the buck converter’s operation, and one for status feedback. Changes are made by selecting and checking the components in the GUI on the left hand side and can also be made by directly clicking the bits of each register. I^2C address is set to default 0x60H, this address is corresponding to the EVM jumper JP7 to connect to GND. Changing the I^2C address requires that the EVM be configured accordingly.

An option is to “write on change”, if this option is set to ON, any change is sent to the EVM immediately; if this option is set to OFF, “Write” button or “W” button for each register must be clicked to send the control signal.

Register values can be read back from the EVM by clicking “Read” or “R” for each register.

Copyright © 2013, Texas Instruments Incorporated

6 Power-Up Procedure

Use the following steps to power-up the EVM:

1. Connect I^2C adaptor to JP15
2. Apply 4.5 V to J1
3. Toggle JP1 or JP2 to enable Vout1 and Vout2, respectively
4. Apply loads to the output connectors.

Copyright © 2013, Texas Instruments Incorporated

7 TPS65273V EVM Bill of Materials

Table 4 is the BOM for the EVM.

Table 4. TPS65273V EVM Bill of Materials

#	Value	Qty	Designator	Footprint	MFG	MFG Part Number	Description
1	10nF	2	C1, C2	0603	Generic		CAP 10nF 50V CERAMIC X7R 0603
2	10nF	4	C22, C23, C26, C27	0603	Generic		CAP 10nF 50V CERAMIC X7R 0603
3	10uF	2	C5, C11	1210	Panasonic -ECG	ECJ-4YB1E106M	CAP 10UF 25V CERAMIC X5R 1210
4	10uF	1	C9	0603	Panasonic -ECG	ECJ-1VB1A106M	CAP 10UF 10V CERAMIC X5R 0603
5	1uF	1	C15	0603	Generic		CAP 1UF 10V CERAMIC X5R 0603
6	82pF	2	C18, C31	0603	Generic		CAP 82pF 50V CERAMIC X7R 0603
7	47nF	2	C19, C30	0603	Generic		CAP 47nF 50V CERAMIC X7R 0603
8	22uF	12	C20, C28, C201, C202, C203, C204, C205, C281, C282, C283, C284, C285	0805	TDK	C2012X6S0J226M	CAP CER 22UF 6.3V 20% X6S 0805
9(1)	470uF	DNI	C204, C284	E_CAP_D8_L6.7	Nichicon	RHA0J471MCN1GS	CAP ALUM 470UF 6.3V 20% SMD
10	47pF	DNI	C231, C261	0603	Generic		CAP 47pF 50V CERAMIC X7R 0603
11(1)	ED500/2DS	3	J1, J18, J31	TB_2X5.0MM	OnShore Technology Inc	ED500/2DS	Terminal Block, 2-pin, 15-A, 5.0mm
12	HEADER 3 PIN	4	JP1, JP2, JP7, JP8	JMP0.3	Mil-Max	800-10-064-10-001000	Three Pin Header
13	HEADER 2 PIN(2)	1	JP9	JMP0.2	Mil-Max	800-10-064-10-001000	Two Pin Header
14	HEADER 10 PIN(3)	1	JP15,	HEADER10	3M	N2510-6002-RB	Ten Pin Header
15	3.3uH	2	L1, L2	IND3	Coilcraft	MSS1048-332NLB	SMT power inductor
16	100K	2	R1, R2	0603	Generic		RES 100k OHM 1/10W 1% 0603 SMD
17	100K	1	R24	0603	Generic		RES 100k OHM 1/10W 1% 0603 SMD
18	10k	2	R15, R16	0603	Generic		RES 10k OHM 1/10W 1% 0603 SMD
19	60.4K	1	R17	0603	Generic		RES 60.4k OHM 1/10W 1% 0603 SMD
20	40.2K	2	R18, R31	0603	Generic		RES 40.2k OHM 1/10W 1% 0603 SMD
21	0	6	R19, R30, R181, R182, R311, R312	0603	Generic		RES 0 OHM 1/10W 1% 0603 SMD
22	3.74k	2	R23, R26	0603	Generic		RES 3.7k OHM 1/10W 1% =0603 SMD
23	48.7k	1	R32	0603	Generic		RES 48.7k OHM 1/10W 1% 0603 SMD
24	Test Point White	11	TP1, TP2, TP5, TP15, TP16, TP17, TP18, TP24, TP31, TP32, TP151	TP	Keystone	5002	TEST POINT PC MINI .040"D WHITE
25	Test Point Black	4	TP10, TP12, TP13, TP14	TP	Keystone	5001	TEST POINT PC MINI .040"D BLACK
26(4)		4					Jumper, 2.54mm, applied on item 13
27(5)		4			3M	SJ-5303 (CLEAR)	BUMPON HEMISPHERE .44X.20 CLEAR
28		1	U1		Texas Instruments	TPS65273V	

(1) Item 9, 11: optional
(2) Item 13: split into 3 pins
(3) Item 14: split into 2 pins
(4) Install item 26 on item 13 no order - be consistent
(5) Install item 27 on bottom at corners

Copyright © 2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated