TEXAS INSTRUMENTS

USB Keyboard/Hub EVM Featuring the TPS2149 3.3-V LDO and Dual Switch

User's Guide

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Mixed Signal Products

SLVU050

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Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Preface

Read This First

How to Use This Manual

This document contains the following chapters:

- ❏ Chapter 1 – Introduction
- ❏ Chapter 2 – Hardware Overview
- ❏ Chapter 3 – EVM Operation
- ❏ Chapter 4 – Bill of Materials
- ❏ Chapter 5 – EVM Layout

Related Documentation From Texas Instruments

TPS2149 3.3-V LDO and Dual Switch data sheet, literature number SLVS401.

TUSB2136 USB Keyboard Hub Controller data sheet, literature number SLLS442.

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This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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Chapter 1

Introduction

This user's guide describes the setup and operation of the USB keyboard/hub evaluation module (EVM). Information and instruction presented throughout this document assumes user familiarity with universal serial bus (USB) protocol and the use of common lab testing equipment.

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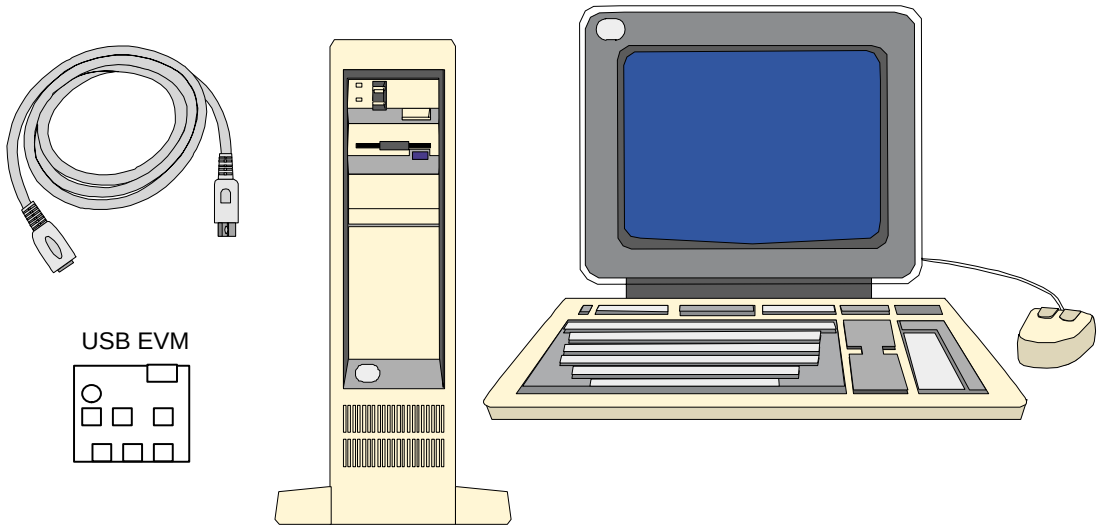
1.1 Required Hardware and Software 1-2

1.1 Required Hardware and Software

The USB keyboard/hub EVM is designed for use with a personal computer running a USB-enabled operating system. The PC, with BIOS, chipsets, and operating system, should be USB 1.1 specification-compliant. If the BIOS is not compliant, the system may not boot when USB devices are connected at power up, and the EVM may not function in DOS mode. Additionally, one or more USB devices are needed to plug into the downstream ports of the USB keyboard/hub EVM to exercise the hub ports. A standard USB cable is needed to connect the USB keyboard/hub EVM to a downstream port of the PC or a USB hub tier.

Figure 1–1. USB Keyboard/Hub EVM Hardware



Chapter 2

Hardware Overview

The USB keyboard/hub EVM is 4-inches L × 3.5-inches W and features the TPS2149 made by Texas Instruments. The TPS2149 is a power management device that integrates an LDO and two power switches into one small package. Jumpers (0-Ω resistors) and jumper blocks provided on the EVM are installed with the factory settings. The settings are described in Table 3–2. Review all setting changes prior to powering the EVM. Improper settings could result in damage to some of the EVM components. The factory settings allow the EVM to operate using a 12-MHz crystal along with an I^2C EEPROM. The EVM has also been configured to work only in bus-powered mode. The firmware installed at the factory and stored in the EEPROM will allow the EVM to function as a two port keyboard hub. Users are responsible for developing their own application firmware for the target hardware device.

The EVM also uses a TUSB2136, USB keyboard/hub controller, made by Texas Instruments, to communicate with the host and the downstream devices. A USB cable is needed to connect the root hub of the PC to the EVM type B connector (J5). The downstream devices connect to the EVM via the J6 and J7 connectors. These downstream devices are powered through the TPS2149. The USB specifications require that downstream ports remain off until enumeration is complete. Together, the TUSB2136 and the TPS2149 ensure the hub meets this requirement. Two other connectors, J3 and J4, allow easy connection to the TUSB2136 general-purpose I/O lines. These lines can be used to implement the keyboard function.

Jumpers, test points, and LEDs have been added for testing, troubleshooting and debugging purposes. Most of the test points are located near the TPS2149. There are also test points on the differential pair lines of the upstream B-type connector and the two downstream A-type connectors. The I^2C port can be probed directly on the EEPROM. Six LEDs are provided for quick feedback during firmware debugging or as status information. One LED (D1) is fixed to provide power and suspend status of the TUSB2136 device.

Chapter 3

EVM Operation

Operation of the USB keyboard/hub EVM is summarized in paragraphs 3.1 through 3.6.

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3.1 TPS2149 Setup

The USB keyboard/hub EVM is designed to allow evaluation of the TPS2149 device. Test points and 0-Ω resistors are provided to simplify the evaluation process (see Section 3.5). The EVM comes in a default configuration that requires no additional components, other than the required hardware and software identified in Section 1.1 of this user's guide. For a complete description of the TPS2149 device, consult the TPS2149 data sheet (literature number SLVS401).

3.2 Interfaces and USB Ports

The EVM uses a standard Type-B connector for the upstream port and two single Type A connectors for the downstream ports. Power to the downstream ports is provided throught the TPS2149.

Two edge connectors, J3 and J4, connect to the TUSB2136 general-purpose I/O lines. Out of 32 general-purpose I/O lines, 26 are brought out to the J3 and J4 connectors. The remaining 6 I/O lines are used onboard to control the LEDs (see Section 3.4).

3.3 Power Supplies

The USB keyboard/hub EVM requires no external power supply for operation. The EVM receives power via the USB cable. The TPS2149 low-dropout regulator is used to generate the required 3.3-V supply from the USB 5-V supply. The power indicator LED (D1) will turn on whenever power is available to the EVM (see Table 3–1).

3.4 Light Emitting Diodes (LEDs)

Several onboard LEDs are provided on the EVM for quick and easy evaluation. A set of six green LEDs (D2 – D7), connected to P3.0 through P3.5 of the TUSB2136, may be used for general purposes in any code that is written for the TUSB2136 (see Table 3–1). By default, the factory code provides the EVM with the use of only three of the LEDs as keyboard status indicators for Scroll Lock (D2), Caps Lock (D3), and Num Lock (D4). The other three are not used.

Table 3–1. LED Description

LED	Description
D2–D7	Green LED ON indicates corresponding GPIO pin is low (when D1 is ON). Green LED OFF indicates corresponding GPIO pin is high (when D1 is ON).
D1	Red LED ON indicates that the EVM is powered on and not suspended. Red LED OFF indicates that the EVM is powered off or suspended.

3.5 Jumpers and Test Points

Table 3–2 describes the jumpers, J1 and J2, used to connect P3.0 and P3.1 to D6 and D7 respectively, which should only be done when P3.0/S0 and P3.1/S1 are not set to GND for VID/PID selection (see the TUSB2136 keyboard hub controller data sheet).

Table 3–2 also describes the various 0-Ω resistors used as jumpers. Test points are located throughout the EVM. For location of these test points, consult the layout in Section 5.

Table 3–2. Jumpers and Test Points

Jumpers	Description
J1	Installed: connects P3.1 to D7
J2	Installed: connects P3.0 to D6
R30 thru R35	0-Ω resistors used to configure the TUSB2136. For proper operation with the firmware and EVM, R30, R31, and R33 are installed at the factory.
R29, R36, R37, R38	0-Ω resistors on power lines which may be removed to insert a current meter.

3.6 EEPROM

The EEPROM is used for application-specific firmware. The TUSB2136 will automatically read the EEPROM at power up via the I^2C bus. A header must be added to the application firmware before loading into the EEPROM. This header format is specified in the bootcode document provided with the TUSB2136. The header may be generated automatically with the I^2C header generation utility software also provided with the TUSB2136.

For convenience, the EEPROM has been installed on a socket. If desired, the socket may be removed and the EEPROM can be soldered directly onto the board. Using J3 and J4, the firmware installed at the factory will support a QWERTY keyboard with the matrix shown in Table 3–3.

Table 3–3. QWERTY Keyboard Matrix

Port No.	Matrix	P3.6 COL 1	P0.6 COL 2	P0.7 COL 3	P0.4 COL 4	P0.5 COL 5	P0.2 COL 6	P0.3 COL 7	P0.0 COL 8	P0.1 COL 9	P1.6 COL 10
P2.7	**ROW 1**	Q	9	A	6	Z	3	DEL			
P2.6	**ROW 2**	W	8	S	5	X	2	0			
P2.5	**ROW 3**	E	7	D	4	C	1	INS			
P2.4	**ROW 4**	R	ESC	F	HOME	V	END	R ARROW			
P2.3	**ROW 5**	T	I	G	K	B	/	SPACE			
P2.2	**ROW 6**	Y	P	H	“	N	U ARROW	D ARROW			
P2.1	**ROW 7**	U	O	J	L	M	\	L ARROW			
P2.0	**ROW 8**		–	,	+		ENTER	.	SHIFT	ALT	CTL

Chapter 4

Bill of Materials

Table 4–1. EVM Bill of Materials

Item	Qty	Ref. Des.	Footprint	MFR	Part Number	Description
1	1	U1	PKG_8P_DGK8	TI	TPS2149	3.3-V LDO and dual switch
2	1	U2	PKG_5P_SOT23	TI	TPS77018DBVR	LDO 1.8 V output
3	1	U4	TUSB2136PM	TI	TUSB2136PM	IC, 2 PORT USB HUB with FUN CONTR, 64 pin
4	4	FB1, FB2, FB3, FB4	1812	Mouser	623-2743019447	Ferrite bead
5	10	C3, C5, C11–C14, C17–C20	C0805	KEMET	C0805C104K5RAC7800	Capacitor, ceramic, 0.1-µF, 50 V, X7R, 10%
6	1	C6	C0805	Murata	GRM40X7R105K16PT	Capacitor, ceramic, 1.0-µF, 16 V, 20%
7	4	C7–C10	C0605	Murate	GRM39C0G220J050AD	Capacitor, ceramic, 22-pF, 50 V, 5%
8	2	C1, C2	C0605	Murata	GRM39C0G330J050AD	Capacitor, ceramic, 33 pF, 16 V, 20%
9	2	C15, C16	7343D	NEMCO	LSR100/16DK125	Capacitor, tantalum, 100 µF, 16 V, 20%
10	1	C4	CAP_TANTALUM_B	Sprague	293D475X0010B2T	Capacitor, tantalum, 4.7 µF, 10 V, 20%
11	2	J6, J7	CONN_USB_A	Digi-Key	AU-Y1005	Connector, USB down-stream (Type A)
12	1	J5	CONN_USB_B	Digi-Key	AU-Y1007	Connector, USB upstream (Type B)
13	1	X1	CRYSTAL_016695	Crytek	16695	Crystal, 12 MHz, 20 pF, ±50 PPM at 25°C
14	6	D2–D7	D-LTST-C170FKT	Liteon	LTST-C170FKT	Diode, LED, green, 2.1 V, 14.2-mcd, 20 Ma, 0805
15	1	D1	D-LTST-C170UKT	Liteon	LTST-C170UKT	Diode, LED, red, 2.1 V, 14.2-mcd, 20 Ma, 0805
16	2	J1, J2	HEADER_1X2	Digi-Key	S1012-36-ND	Header, 2 pin, 100 mil spac-ing, 36-pin strip
17	2	J3, J4	HEADER_2X7	Samtec	SSW-107-02-T-D-RA	Header, 2x7 RT ANG. pin, 100 mil
18	4	R9, R12–R14	R0805	Std	Std	Resistor, chip, 15 kΩ, 1/10 W, 5%

Table 4–1. EVM Bill of Materials (Continued)

Item	Qty	Ref. Des.	Footprint	MFR	Part Number	Description
19	10	R29–R38	R0805	Std	Std	Resistor, chip, 0 Ω, 1/10 W, 5%
20	2	R15, R17	R0805	Std	Std	Resistor, chip, 1 kΩ, 1/10 W, 5%
21	2	R16, R25	R0805	Std	Std	Resistor, chip, 1.5 kΩ, 1/10 W, 5%
22	1	R24	R0805	Std	Std	Resistor, chip, 10 Ω, 1/10 W, 5%
23	2	R20, R21	R0805	Std	Std	Resistor, chip, 20 kΩ, 1/10 W, 5%
24	6	R10, R11, R18, R19, R22, R26	R0805	Std	Std	Resistor, chip, 30 Ω, 1/10 W, 5%
25	2	R27, R28	R0805	Std	Std	Resistor, chip, 30.1 kΩ, 1/10 W, 5%
26	1	R23	R0805	Std	Std	Resistor, chip, 200 kΩ, 1/10 W, 5%
27	8	R1–R8	R0805	Std	Std	Resistor, chip, 511 Ω, 1/10 W, 5%
28	1	XU1	8 DIP	Digi-Key	24LC64P	IC serial EEPROM 8K x 8 2.5 V
29	1	XU1	8 pin socket	Digi-Key	110-99-308-41-001	IC socket 8 pin MS Tin/ Tin.300
30	1	S1	NC	Digi-Key	P80075-ND	Switch, 1P1T, 20 mA, 15 V
31	18	TP7–TP13, TP15–25	TP_RED_1MM	Farnell	240-345	Test pint, red, 1 mm
32	1	TP14	TP_BLACK_1MM	Farnell	240-333	Test pint, black, 1 mm
33	1	Q1	SOT-23	On Semi	TR-MMBT3906LT1	Bipolar, PNP, 40 V, 350 mA, zz W

Chapter 5

EVM Layout

Figure 5–1. TPS2149 Silk Screen

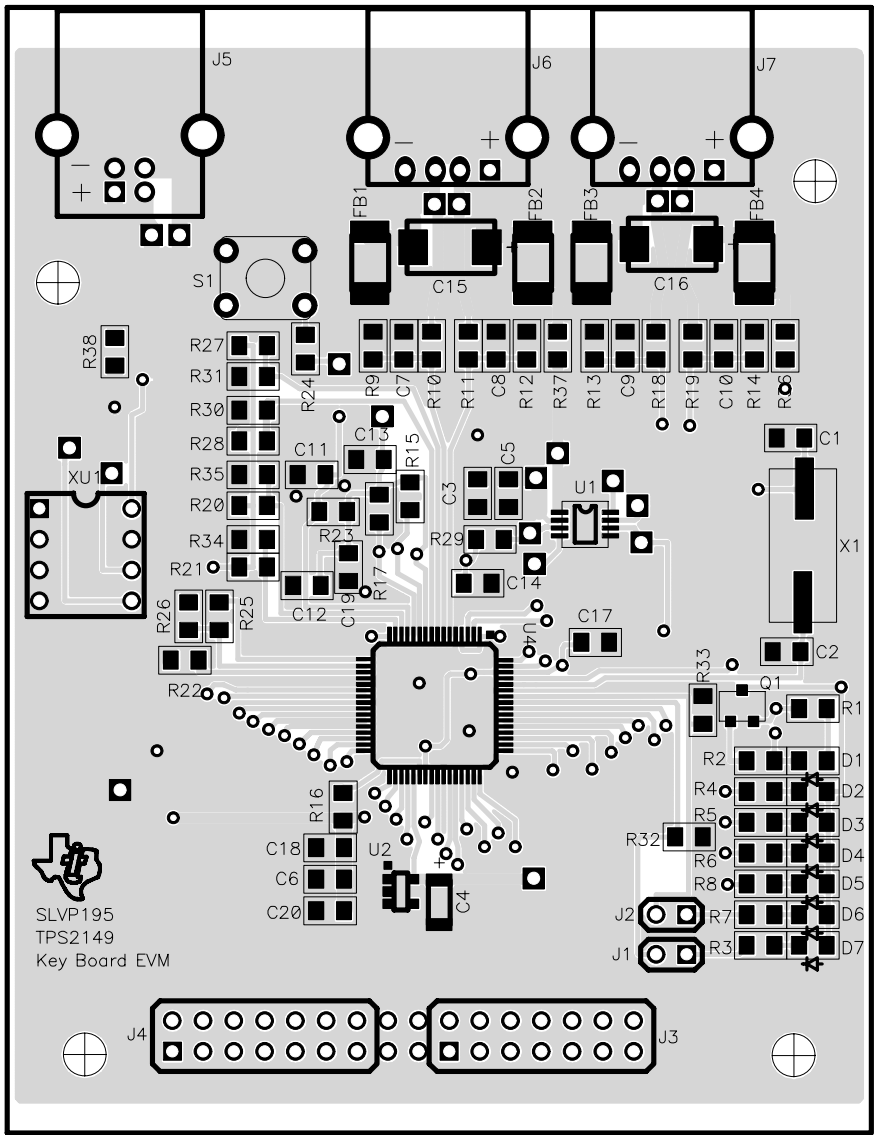

Figure 5–2. Schematic