TEXAS INSTRUMENTS

USB Keyboard/Hub EVM Featuring the TUSB2136 and the TPS2149

User's Guide

December 2001

Mixed Signal Products

SCAU003

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the specified input and output ranges described in the EVM User's Guide.

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

FCC Warning

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.

Additional information about this EVM can be found at:

www.ti.com/sc/usb–kbdkit

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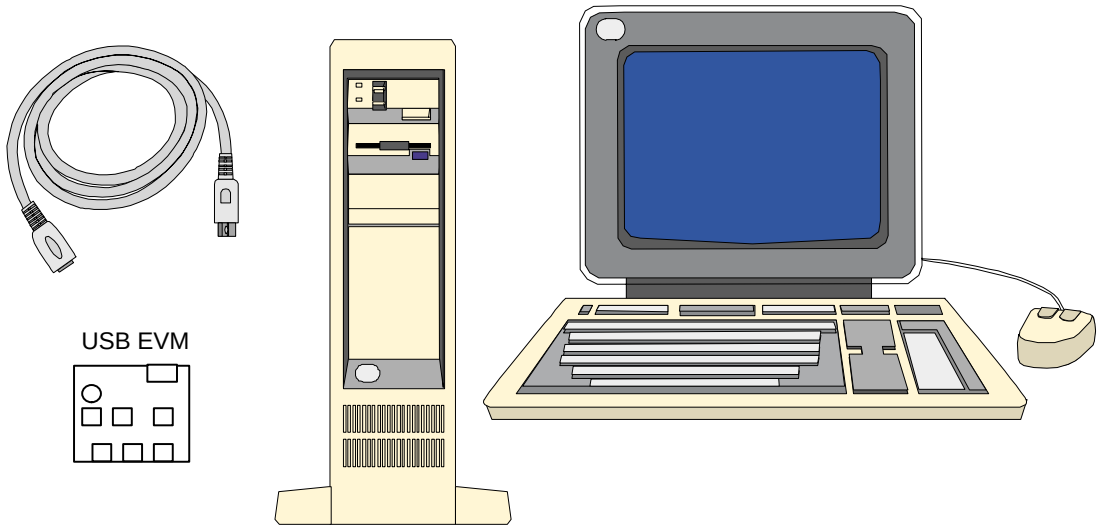
1.1 Required Hardware and Software

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 or 2.0 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. Additionally, one or more low- or full-speed 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 features the TUSB2136 and the TPS2149 made by Texas Instruments. The EVM is a two-board set made up of a stand alone two-port hub (edge #6436539) and a miniature QWERTY keyboard (edge #6436540). 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 allows 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 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, a power management device that integrates an LDO and two power switches into one small package. The LDO is used to provide power to the TUSB2136. The USB specification requires 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 are used to implement the keyboard function. The miniature QWERTY keyboard plugs directly into J3 and J4 to implement a fully functional keyboard.

Jumpers, test points, and LEDs have been added for testing, troubleshooting and debugging purposes. There are 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. An RS–232 port is available for monitoring 8052 MCU activity. The port uses a one-to-one cable and not a null-modem cable.

Chapter 3

EVM Operation

Operation of the USB keyboard/hub EVM is summarized in this chapter.

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3.1 Setup

The USB keyboard/hub EVM is designed to allow evaluation of the TUSB2136 and 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 TUSB2136 and the TPS2149 devices, consult the TUSB2136 and the TPS2149 data sheets (literature numbers SLLS442 and SLVS401, respectively).

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 from the upstream USB 5-V source through 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 *Light Emitting Diodes (LEDs)* in this chapter).

3.3 Power Supplies

The USB keyboard/hub EVM requires no external power supply for operation. The EVM receives power via the upstream USB cable. The USB 5-V source is limited by the USB specification to 500 mA max. 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) turns 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, literature number SLLS442) via SW1–3 and SW1–4.

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, see the *EVM Layout* section of this user's guide.

Table 3–2. Jumpers and Test Points

Jumpers	Description
J1	Connects P3.1 to D7
J2	Connects P3.0 to D6
J9	Connects the serial data line of the EEPROM to the TUSB2136. Installed at factory.
J10	Connects power to the RS232 interface chip
J11, J12	Connects the transmit and receive lines on the RS232 interface chip to the TUSB2136
SW1	A set of six switches used to configure the TUSB2136. For proper operation with the firmware and EVM, SW1–3, SW1–5, and SW1–6 should be set to on.
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 automatically reads 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 (literature number SLLU025), which can be found on the EVM web page at www.ti.com/sc/usb–kbdkit. The header may be generated automatically with the I^2C header generation utility software also found on the EVM website

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. The firmware installed at the factory supports the miniature QWERTY keyboard with the matrix shown in Table 3–3. The miniature QWERTY keyboard connects to J3 and J4.

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

This chapter contains the EVM bill of materials for edge number 6436539 and edge number 6436540.

Table 4–1. EVM Bill of Materials for Edge Number 6436539

QTY	RefDes	Description	Size	MFR	Part Number
2	C1, C2	Capacitor, ceramic, 33 pF, 16 V, [temp], 5%	805	MuRata	GRM39C0G330J100V
3	C3, C4, C25	Capacitor, tantalum, 4.7 µF, 10 V, zz mΩ, 20%	3528	Panasonic	293D475X0010B2T
9	C5, C11 – C14, C17 – C20	Capacitor, ceramic, 0.1 µF, 50 V, X7R,10%	805	Kemet	C0805C104K5RAC7800
4	C7 – C10	Capacitor, ceramic, 22 pF, 50 V, 5%	805	Murata	GRM39C0G220J50V
2	C15, C16	Capacitor, POSCAP, 100 µF, 16 V	7343 (D)	NEMCO	LSR10016DK125
4	C21 – C24	Capacitor, ceramic, 1 µF, 50 V, X7R, 10%	805	Murata	GRM40X7R105K16PT
1	D1	Diode, LED, red, 2.1 V, 14.2 mcd, 20 mA	805	Liteon	LTST–C170UKT
6	D2 – D7	Diode, LED, green, 2.1 V, 14.2 mcd, 20 mA	805	Liteon	LTST–C170FKT
4	FB1 – FB4	SMB20 surface ferrite mount bead		Allied Components	SMB20
6	J1, J2, J9 – J12	Header, 2-pin, 100mil spacing			PTC36SAAN
2	J3, J4	Header, 2 x 7 RT ANG. pin, 100mil		Samtec	SSW–107–02–T–D–RA
1	J5	Connector, USB upstream (Type B)		Molex	AU–Y1007
2	J6, J7	Connector, USB downstream (Type A)			AU–Y–1005
1	J8	Connector, 9-pin D, right angle, male		AMP	747250–4
1	Q1	Bipolar, PNP, 40 V, 350 mA, zz W	SOT23	On Semi	MMBT3904LT1
8	R1 – R8	Resistor, chip, 510 Ω, 1/10 W, 5%	805	Std	Std
4	R9, R12 – R14	Resistor, chip,15 kΩ, 1/10 W, 5%	805	Std	Std

Table 4–1. EVM Bill of Materials for Edge Number 6436539 (Continued)

QTY	RefDes	Description	Size	MFR	Part Number
6	R10, R11, R18, R19, R22, R26	Resistor, chip, 30 Ω, 1/10 W, 5%	805	Std	Std
3	R15, R17, R30	Resistor, chip, 1 kΩ, 1/10 W, 5%	805	Std	Std
2	R20, R21	Resistor, chip, 20 kΩ, 1/10 W,5%	805	Std	Std
2	R16, R23	Resistor, chip, 200 kΩ, 1/10 W, 5%	805	Std	Std
1	R24	Resistor, chip, 10 Ω, 1/10 W, 5%	805	Std	Std
1	R25	Resistor, chip, 1.5 kΩ, 1/10 W, 5%	805	Std	Std
2	R27, R28	Resistor, chip, 30.1 kΩ, 1/10 W,1%	805	Std	Std
1	R31	Resistor, chip, 100 kΩ, 1/10 W, 5%	805	Std	Std
1	R32	Resistor, chip, 90 kΩ, 1/10 W, 5%	805	Std	Std
4	R29, R36, R37, R38	Resistor, chip, 0 Ω, 1/10 W, 5%	805	Std	Std
1	S1	Switch, 1P1T, 20 mA, 15 V		Panasonic	EVQ–PAD04M
1	SW1	Switch, 6 POS, SPST, low profile, SMT, 0.5 inch centers	CTS Corp.	CTS Corp.	
1	TP14	Test point, black, 1 mm		Farnell	240–333
20	TP1, TP2, TP7 – TP13, TP15 – TP25	Test point, red, 1 mm		Farnell	240–345
1	U1	3.3-V LDO and dual switch	DGN8	TI	TPS2149
1	U3	IC, dual EIA–232, driver/receiver	SO16	TI	MAX232ID
1	U4	IC, 2 port USB hub w/Funcontr, 64 pin S–PQFP–G64 Pkg		TI	TUSB2136PM
1	X1	Crystal, 12 MHz, 20 pF, ±50 PPM @ 25°C		Crytek	16695
1	XU1	Socket, 8-pin DIP			110–99–308–41–001

Table 4–2. EVM Bill of Materials For fdge Number 6436540

QTY	RefDes	Description	Size	MFR	Part Number
2	J1, J2	Header, 2 x 7 RT. ANG. pin 100mil			
18	R39 – R45, R48, R49, R50, R57, R58, R61 – R66	Resistor, chip, 511 Ω, 1/10 W 5%	R0805	Std	Std
57	0 – 56	Switch, 1P1T, 20 mA, 15 V		Panasonic	EVQ–PAD04M

Chapter 5

EVM Layout

This chapter contains the EVM layout and schematics for edge number 6436539 and 6436540.