This user's guide details the hardware overview and setup, and the installation instructions for the TUSB1210 EVM. Also included are a top-layer layout image, schematics, and the bill of materials (BOM).

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1 Introduction

The TI TUSB1210EVM is a functional board design of a single device that implements a USB PHY with a ULPI interface. The EVM can support Host, Device, and On-the-Go (OTG) modes and also has output voltage support at the UTMI+ Low Pin Interface (ULPI) for +1.8 V. This EVM also acts as a hardware reference design for any implementation of the TUSB1210. Figure 1 shows the TUSB1210EVM top-layer layout.

Upon request, layout files for the EVM can be provided to illustrate techniques used to route the differential pairs, split power planes, and placement of filters.

Figure 1. TUSB1210EVM Top Layer Layout
2 Hardware Overview

The TUSB1210EVM (EVM) board hardware can be divided into three functional areas.

2.1 TUSB1210

The TUSB1210 on the EVM (U5 on the schematic) operates as a USB PHY with ULPI interface. It has several unique features, including DP/DM Line External Component Compensation, VBUS Overvoltage Protection Circuit, support for HS, FS and LS, OTG compliant, internal Power-on Reset and very low current consumption optimized for portable devices.

TUSB1210 supports ULPI clock mode both input and output: input clock mode, in which case a square-wave 60-MHz clock is provided to TUSB1210 at the ULPI interface CLOCK pin; and output clock mode in which case TUSB1210 can accept a square-wave reference clock at REFCLK of either 19.2 MHz or 26 MHz. Frequency is indicated to TUSB1210 via the configuration pin, CFG. This can be useful if a reference clock is already available in the system.

2.2 Power Supply

The EVM operates from the power provided by the 20-pin header (CN1). The VDD5 (+5 V) terminal (pins 2 and 6) is used to generate the +3.3-V power supply needed by the TUSB1210 device. Also, VDD5 can be used to provide VBUS when the TUSB1210 is in Host mode. The BOARD_1P8V terminals (pins 19 and 20) are connected to the VDDIO of the TUSB1210 and must be in the range of +1.8 V ±10%.

2.3 USB Bus Connector

The EVM is equipped with a USB2 Micro B/AB connector (U4), through this the TUSB1210 can operate as Host, Device or OTG.

3 Hardware Set Up

3.1 Configuration Jumpers

This EVM has a set of jumpers to make configuration changes. Configuration inputs are read while the EVM is powered on and are always in effect. Please refer to Section 5 for additional information about the EVM’s schematics. The switch definitions are in the following paragraphs.

3.1.1 REFCLK (J6 and J7)

The TUSB1210 has the REFCLK terminal to determine the clock mode either input or output. If the Mode Select jumper (J7) is left open and the OSC CTRL jumper (J6) is set on the 1-2 position, a +3.3-V 26-MHz clock signal is provided to the TUSB1210 in the REFCLK pin, setting it in output mode. If the Mode Select jumper is set on the 1-2 position, REFCLK pin is connected to ground, and setting the TUSB1210 in Input Mode.

3.1.2 CS (J9)

The TUSB1210 has a Chip Select (CS) terminal to set the device in power down. If the CS SEL jumper is set on the 2-3 position, the CS terminal is connected to VDD and the TUSB1210 is on normal operation. If the CS jumper is set on 1-2 position, the CS terminal is connected to VBUS; therefore, the device is on normal operation when VBUS is present, otherwise, it is on power down mode.

3.1.3 ID (J8)

The TUSB1210 has an ID terminal of the USB connector. If the ID jumper is set, the TUSB1210’s ID pin is connected to the USB connector’s ID pin as expected when the TUSB1210 is on HOST or OTG mode. If the ID jumper is left floating, a TUSB1210 acting as device is expected.
3.1.4 VBUS (J11)

If the SHTDN jumper is left floating and if the R9 resistor is not populated, current consumption of the TUSB1210’s VBUS pin can be taken.

3.1.5 USB POWER 1 (J3)

The TUSB1210 has a CPEN active-high digital output to control the external +5-V VBUS. If the USB POWER 1 jumper is set on bypass position, the USB Power pin is bypassed and the CPEN pin activity does not control VBUS. If the USB POWER 1 jumper is set on SWITCH position, the TUSB1210 CPEN pin is controlling the VBUS power.

3.1.6 Host Device (J5)

The TUSB1210 device can support Host, OTG, or Device functionality. If the J5 jumper is set on the 1-2 and 3-4 positions, VBUS according to the Host functionality is configuring. If the J5 jumper is set on 1-3 and 2-4 positions, VBUS according to the Device functionality is configuring. Finally if the J5 jumper is set on 1-2 position, VBUS according to the OTG functionality is configuring.

4 EVM Installation

Install the EVM with the following steps:
1. Configure the jumpers in the TUSB1210 EVM as follows:
   • J6 [1-2] Output mode
   • J7 [open] Output mode
   • J9 [2-3] CS connected to VDD1P8
   • J11 [open]
   • J8 [open]
   • J3 [1-2] External Power Switch Bypass
   • J5 [1-3 and 2-4] Device
2. Connect the USB link board with ULPI interface to the TUSB1210 EVM ULPI connector (CN1)
3. Configure the USB link as device
4. Connect a USB cable between the TUSB1210 EVM USB port and a computer’s USB port
5. Connect the oscilloscope's probe to pin 1 in the J7 connector
6. Turn on USB Link
5 TUSB1210EVM Schematics

Figure 2 and Figure 3 contain the schematics for this EVM.

Figure 2. Power Supply
Figure 3. TUSB1210 Device
Table 1 lists the TUSB1210EVM BOM.

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3 Regulatory Notices:

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3.1.1 Notice applicable to EVMs not FCC-Approved:

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

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.
FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 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

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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.

Concernant les EVMs avec appareils radio:

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.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

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 par 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 Industry 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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3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/sds/ti/ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のとこをご覧ください。

http://www.tij.co.jp/sds/ti/ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿6丁目24番1号
西新宿三井ビル

3.3.3 Notice for EVMs for Power Line Communication: Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page
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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

4 EVM Use Restrictions and Warnings:
4.1 EVMs ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
4.3 Safety-Related Warnings and Restrictions:
4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit access to leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. Accuracy of Information: To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
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