User's Guide

USB Interface Adapter Evaluation Module User's Guide

ABSTRACT

This EVM serves as an interface adapter or a bridge between a host PC and one or multiple targeted devices through a standard type-A to mini-B USB cable. The communication between the USB interface adapter and the host PC is through USB, while the communication between the USB interface adapter and the target device or devices is through an inter-integrated circuit (I^2C), general-purpose inputs and outputs GPIOs, or both. The bridge converts communication transactions between the USB and I^2C/GPIO.

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Trademarks

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1 Read This First

1.1 Information About Cautions and Warnings

CAUTION

This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, refer to the *Electrostatic Discharge (ESD)* application note.

WARNING

By default, the I^2C data and clock lines are pulled up internally to 3.3 V. If internal pullup resistors are not used and external ones are used instead, please make sure to pull up to 3.3 V only. Operation from 5 V is not specified and may permanently damage this USB Interface Adapter EVM.

The information in the caution and warning is provided for the user's protection. Please read each caution and warning carefully.

1.2 FCC Warning

This equipment is intended for use in a laboratory test environment only. The equipment 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 can cause interference with radio communications, in which case, the user, at their own expense, will be required to take whatever measures can be required to correct this interference.

2 What is in the Box

2.1 List of Hardware Items for Operation

In order to operate this USB interface adapter, the following items are required:

- USB Interface Adapter (see Figure 2-1)
- Standard type-A to type-mini-B (5-pin) USB cable
- 10-pin ribbon cable with connectors on both ends

Figure 2-1. USB Interface Adapter

Note

For the USB interface adapter to communicate with multiple I^2C targets, build a special 10-pin ribbon cable with multiple connector or connectors, so that all the I^2C targeted devices can be daisy-chained together on the same ribbon cable.

2.2 List of Software Items for Operation

In addition to the previously listed hardware items, the following software also is needed:

- Download the Graphical User Interface (GUI) used to configure and monitor selected devices with the Fusion Digital Power designer.

The USB interface adapter is recognized by a PC as a generic human interface device (HID), which is supported by the built-in USB/HID drivers of the Windows operating system. Therefore, it is plug-and-play and no proprietary USB driver is required.

If flashing the firmware onto the USBGPIOv2 is necessary, go to UniFlash and download the needed firmware for the USBGPIOv2. Select the XDS110 Debug probe under detected devices (auto select option is also available). Then select MSP43E401Y under *New Configuration* and click start to proceed with the firmware download.

3 Summary of Hardware Design

The hardware is based on a USB peripheral chip from TI. The major features of the hardware design are detailed in the following sections.

3.1 Ribbon-Cable Connector J2 and Pinout

This connector is used for communications and controls between the USB interface adapter and one or more I^2C device(s). A description of each terminal point is shared in Table 3-1.

Table 3-1. Pin Functions

Pin		Type	Description
Name	NO.		
PMBCTRL5/GPIO7	1	I/O	Used as either the fifth PMBUS CONTROL line (output) or as GPIO pin 7 (input or output, with internal pullup enabled)
PMBCTRL4/GPIO6	2	I/O	Used as either the fourth PMBUS CONTROL line (output) or as GPIO pin 6 (input or output, with internal pullup enabled)
PMBCTRL3/GPIO5	3	I/O	Used as either the third PMBUS CONTROL line (output) or as GPIO pin 5 (input or output, with internal pullup enabled)
PMBCTRL2/GPIO4	4	I/O	Used as either the second PMBUS CONTROL line (output) or as GPIO pin 4 (input or output, with internal pullup enabled)
+3.3V	5	PWR	This pin can provide a 3.3-V output power supply at up to 100 mA. Any target device or devices can use this power supply as long as the total current consumption is less than 100 mA.
Ground	6	GND	Common ground for the entire evaluation board
PMBCTRL1/GPIO3	7	I/O	Used as either the first PMBUS CONTROL line (output) or as GPIO pin 3 (input or output, with internal pullup enabled)
PMBALERT/SMBALERT/GPIO2	8	I/O	Used as either the ALERT line (input) for PMBUS or SMBUS communications, or as GPIO pin 2 (input or output, with internal pullup disabled, and with an external programmable pullup)
PMBC/SMBC/SCL/GPIO1	9	I/O	Used as either the CLOCK line (output) for PMBUS or SMBUS or I^2C communications, or as GPIO pin 1 (input or output, with internal pullup disabled, and with an external programmable pullup)
PMBD/SMBD/SDA/GPIO0	10	I/O	Used as either the DATA line (input or output) for PMBUS or SMBUS or I^2C communications, or as GPIO pin 0 (input or output, with internal pullup disabled, and with an external programmable pullup)

3.2 Configuration of Pullup Resistors for Pins 8, 9, and 10

The pullups for pins 8, 9, and 10 are configurable through communications with the embedded firmware in the USB interface. The default setting is for all these three pins to have pullups of 2.2 kΩ. Table 3-2 lists the possible options for each pin.

Table 3-2. Configurable Options of Pullup Resistors for Pins 8, 9, and 10

Pullup Resistor Option (Byte Value)	Option 1 (0x00)	Option 2 (0x01) (Default)	Option 3 (0x02)	Option 4 (0x03)
Pin 8 of J2: ALERT line	No pullup (open)	2.2 kΩ	N/A	N/A
Pin 9 of J2: CLOCK line	No pullup (open)	2.2 kΩ	1 kΩ	499 Ω
Pin 10 of J2: DATA line	No pullup (open)	2.2 kΩ	1 kΩ	499 Ω

3.3 LED Indication of USB Attached

A green LED is mounted next to the USB connector on the USB2GPIOv2. The green LED (D1) illuminates once the device detects and numerates the USB device successfully to indicate a successful communication; otherwise, the LED remains off. After unplugging the USB cable, the LED turns off immediately.

3.4 Step-by-Step Instructions for Operation and Troubleshooting

After the user has acquired the necessary hardware and software, follow these steps to operate the USB interface adapter:

1. Plug in the USB cable to both the PC and the USB interface adapter and wait for the green LED to illuminate.
   Troubleshooting: If the green LED does not illuminate after 30 seconds, check to ensure the USB cable is securely connected. If the connection is secure, try a different USB port. If a different USB port does not solve the problem, try to reboot the computer. If rebooting the computer does not fix the problem, try a different USB cable. If trying different USB cable does not solve the problem, contact TI technical support for help.
2. Plug in the 10-pin ribbon cable to both the USB interface adapter and an I^2C device board. Make sure that the notch on the ribbon-cable connector matches the keyhole of the socket in the enclosure.
3. Power up the I^2C board. Note that the default I^2C speed is set at 100 kHz and the default pullups for I^2C data and clock lines are set at 2.2 kΩ.
4. Open the Fusion Digital Power designer tool and follow the instructions for the GUI.
   Troubleshooting: If the I^2C target board cannot talk with the USB interface adapter, first check to ensure the 10-pin ribbon cable has been securely connected. If the ribbon cable has been securely connected, check the I^2C communication speed and the pullups for I^2C data and clock lines suitable for the application. If not, modify the I^2C communication speed and the pullups accordingly. If this still does not solve the problem, contact the manufacturer of the I^2C targeted board for help.

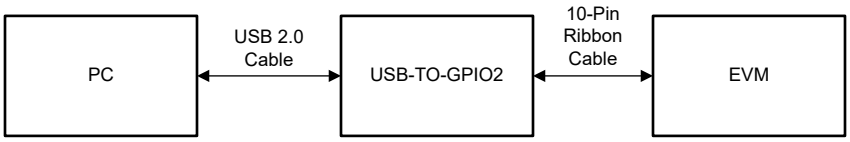

Figure 3-1. Simplified Connection Block-Diagram

4 PMBUS and SMBUS Communications

The default firmware for USB Interface Adapter provides support for USB to PMBUS and SMBUS communications. Similar to its I^2C application, the USB Interface Adapter acts as a PMBUS and SMBUS host, which can talk with one or multiple PMBUS and SMBUS devices daisy-chained to a 10-pin ribbon cable.

4.1 Basic SMBUS Transaction Types Supported

Because PMBUS communication is derived from SMBUS communication, they share basic SMBUS transaction types in common. These basic SMBUS transaction types include:

- Send byte
- Receive byte
- Write byte
- Read byte
- Write word
- Read word
- Block write
- Block read
- Process call
- Block read – block write process call

In addition, PMBUS communication also supports Group command.

All these commands are implemented in the USB Interface Adapter firmware.

4.2 Special Signals Used for PMBUS and SMBUS Communications

Refer to Table 3-2 for special signal lines used for PMBUS and SMBUS communications.

Specifically, a target device can assert an ALERT signal (by pulling it low) to report a fault or a warning condition to the USB Interface Adapter; the host PC can obtain the ALERT signal by polling the USB Interface Adapter. Note that the USB Interface Adapter does not support any Host Notify Protocol, which means that the USB Interface Adapter cannot become a PMBUS or SMBUS target and, therefore, cannot support a target to temporarily become a host and notify the host about the fault or the warning condition.

For PMBUS communications, the USB Interface Adapter provides five CONTROL signals, each of which can be used to enable or disable the powering up of one or multiple targeted device or devices.

Write Protect signal is not supported; neither is the RESET signal.

4.3 Packet Error Checking (PEC) Implementation

By default, the USB Interface Adapter firmware implements PEC for all the different commands. However, the implementation of PEC byte is optional. There is a special host PC to USB Interface Adapter command that can be used to turn PEC on or off.

If PEC is on or enabled, the firmware in the USB Interface Adapter either appends a PEC byte to a command sent to one or multiple targeted devices or checks the validity of a PEC byte received from a target device.

4.4 Communication Clock Speed and Clock Stretching

The default clock speed is 100 kHz, which is compatible with PMBUS 1.0 and SMBUS 2.0. For compatibility with future PMBUS specs, the clock speed can be increased to 400 kHz or 1 MHz.

As per the SMBus protocol, the minimum and maximum value for the Clock Stretching is 25 ms and 35 ms, respectively.

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

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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.*

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

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(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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