User's Guide

SBOU098–January 2011

SM-USB-DIG Platform

This user's guide describes the characteristics, operation, and use of the SM-USB-DIG Platform. It provides a detailed description of the hardware design. The SM-USB-DIG Platform is used as part of several of Texas Instruments evaluation module kits; this document supplements the documentation of those evaluation module kits.

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1 Overview

The SM-USB-DIG Platform is a data acquisition system that generates digital and power signals. Specifically, the system generates I²C™, SPI™, and general-purpose digital I/O signals. The system also generates a power-supply connection that has three options: +3.3V, +5V, and Hi-Z (0V).

In general, the SM-USB-DIG Platform is connected to an evaluation module test board; these two components, along with the related cables and power supplies, form a complete evaluation module (EVM). This EVM facilitates the evaluation of a specific device. For example, the TMP006EVM is a printed circuit board (PCB) that connects to the SM-USB-DIG Platform that allows customers to evaluate and understand all the features on the TMP006 integrated circuit device.

1.1 Hardware Included with a Typical SM-USB-DIG Platform

Figure 1 illustrates the typical hardware included the SM-USB-DIG Platform.

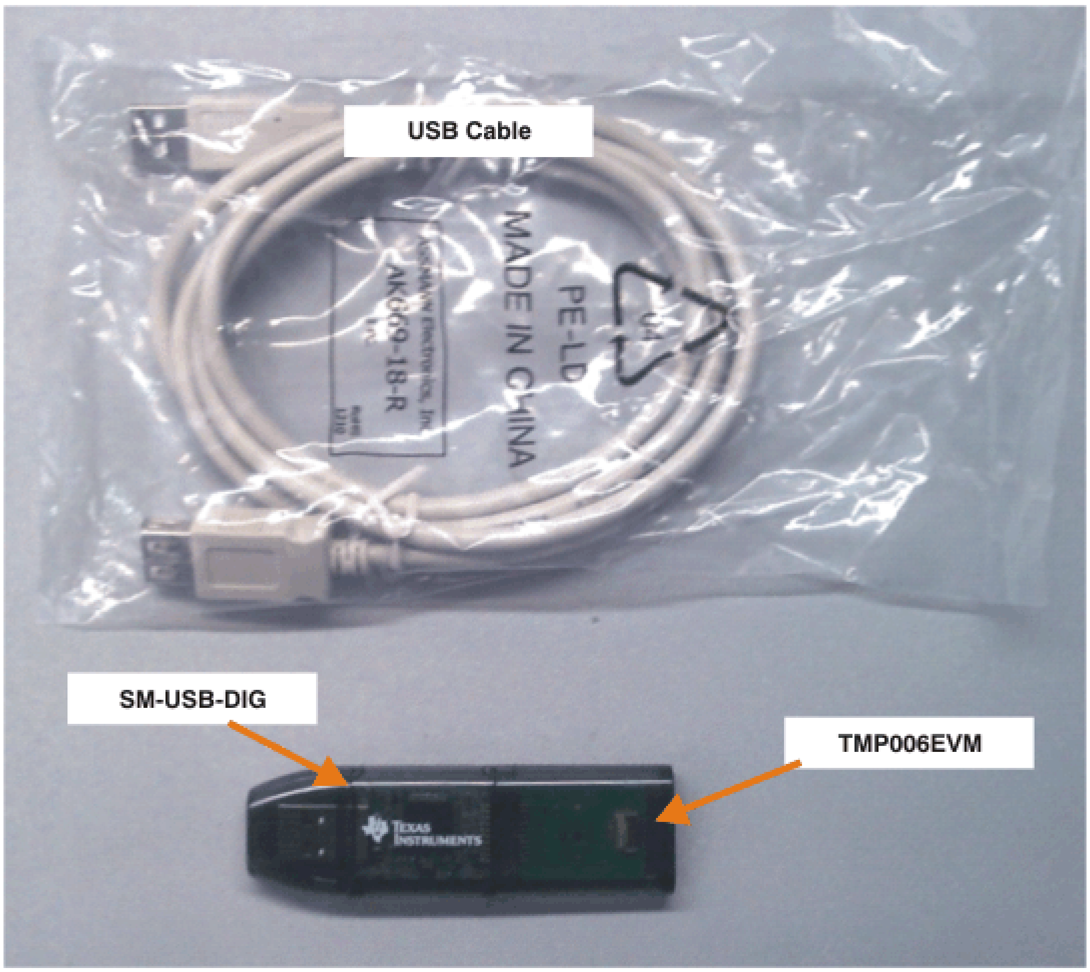

Figure 1. Typical Hardware Included with the SM-USB-DIG Platform

1.2 If You Need Assistance

If you have questions about the INA209 evaluation module, contact the Linear Amplifiers Applications Team at precisionamps@list.ti.com. Include *SM-USB-DIG Platform* as the subject heading.

1.3 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 is required to take whatever measures may be required to correct this interference.

2 System Setup

Figure 2 shows the typical system setup for the SM-USB-DIG Platform. The PC runs software that communicates with the SM-USB-DIG Platform, while the SM-USB-DIG Platform generates the digital signals used to communicate with the test board. Connectors on the test board are occasionally used to connect external signals to the device under test (DUT). Jumpers and other circuitry on the test board allow for different configurations of the DUT.

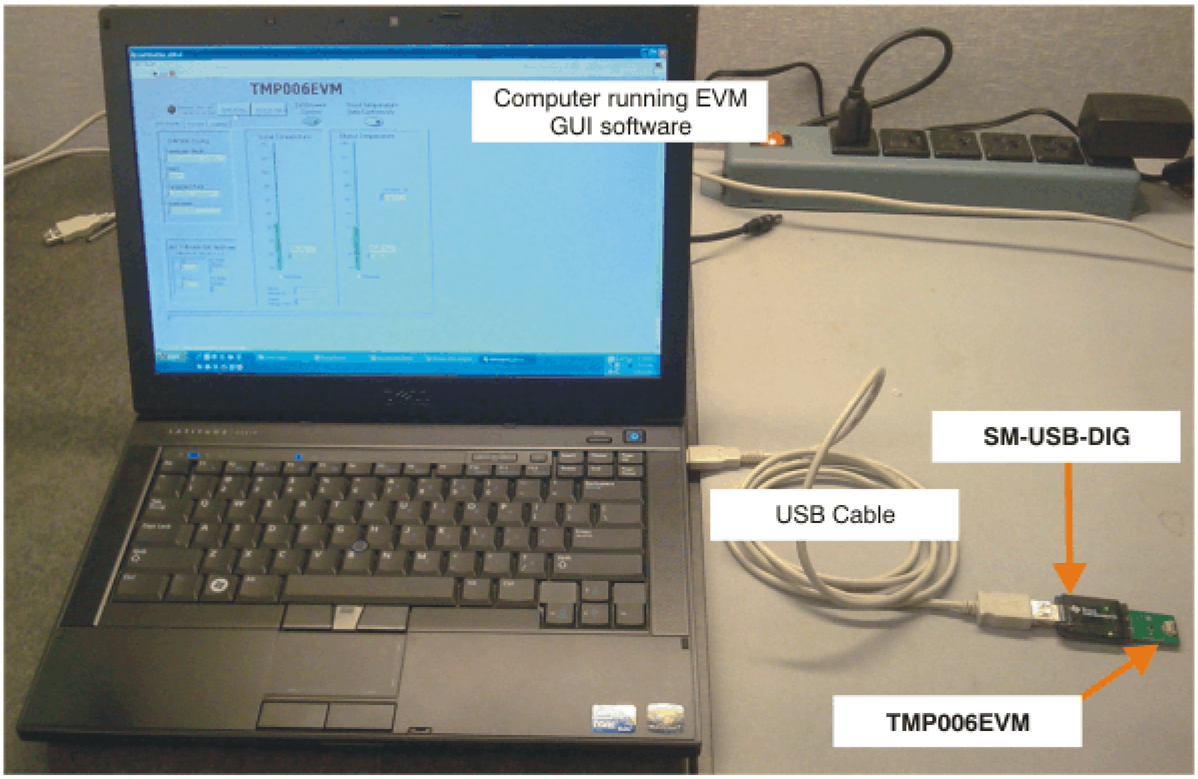

Figure 2. Hardware Setup for the SM-USB-DIG Platform

Minimum PC operating requirements:

- Microsoft® Windows® XP or higher
- Available USB port

NOTE: Works with either US or European regional settings.

3 Theory of Operation

The SM-USB-DIG Platform is a general-purpose data acquisition system that is part of several different Texas Instruments EVMs. Figure 3 illustrates a block diagram of the platform.

The core of the SM-USB-DIG Platform is the TUSB3210, an 8052 microcontroller (μC) that has a built-in USB interface. The microcontroller receives information from the host computer that it translates into I²C, SPI, or other digital I/O patterns. During the digital I/O transaction, the microcontroller reads the response of any device connected to the I/O interface. The response from the device is then sent back to the PC where it is interpreted by the host computer.

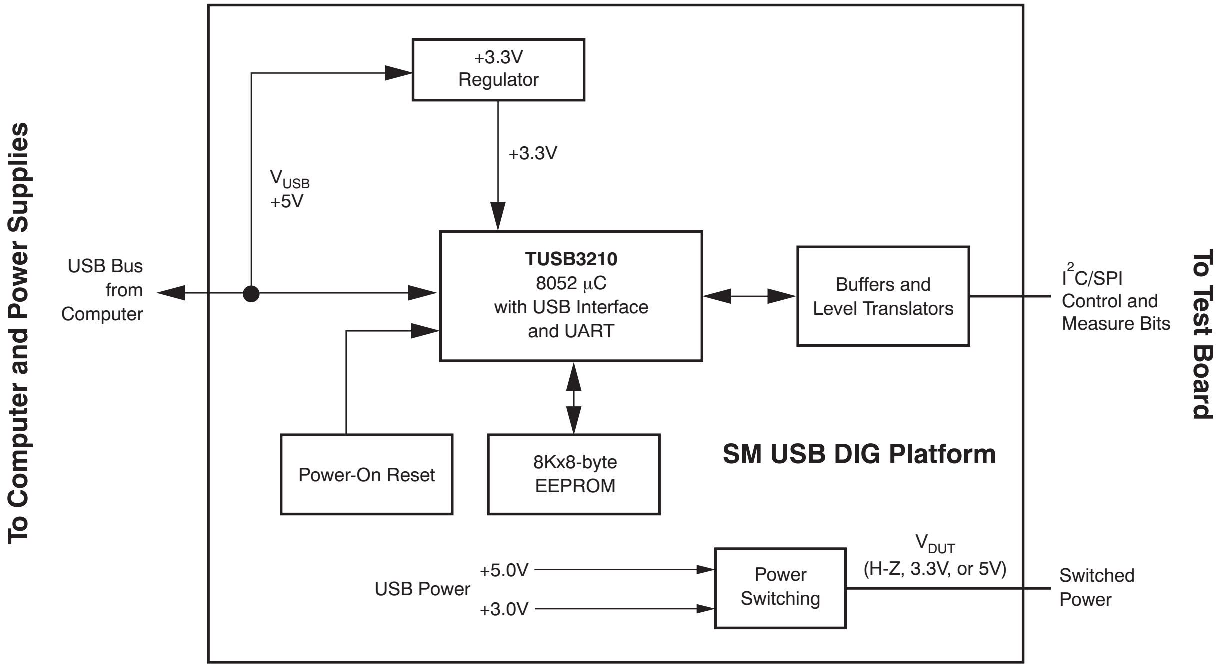

Figure 3. SM-USB-DIG Platform Block Diagram

3.1 Digital I/O Area

The following subsections discuss the digital I/O areas that surround the microcontroller. Refer to SBOR012 (available for download from www.ti.com) for a detailed copy of the entire schematic.

3.1.1 Microcontroller

Figure 4 shows the detailed area surrounding the microcontroller. U2 is a TUSB3210 microcontroller—an 8052 core with a built-in USB interface. U2 converts information from the USB bus on the PC to I^2C, SPI, and One-Wire digital transactions. U2 runs on 3.3V; the inputs are not 5V tolerant. As a result, all external input signals are level-translated.

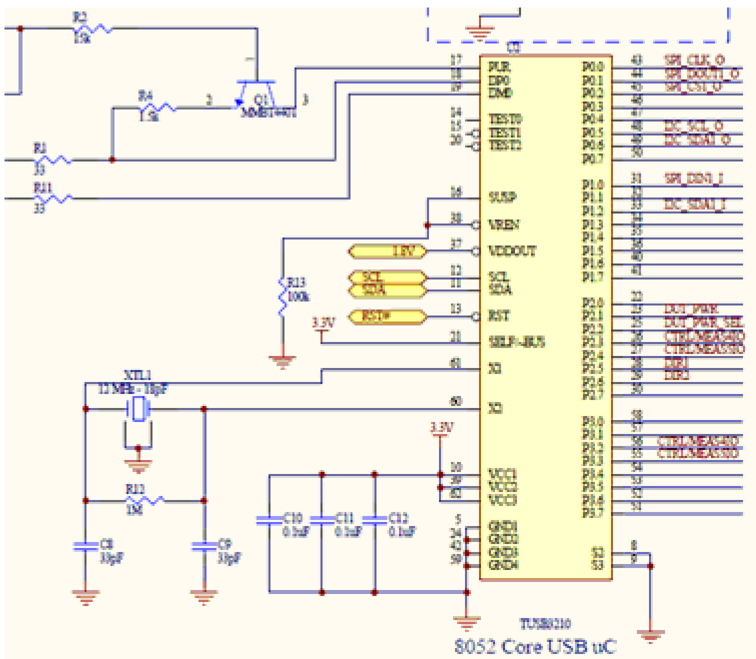

Figure 4. Digital I/O Area—Microcontroller

3.1.2 I²C and SPI

Figure 5 shows the digital I/O area that manages I²C and SPI communications. U3 and U4 are open collector drivers. These devices drive the I²C and SPI output signals. Note that the input is 3.3V and the output follows V_{DUT} (that is, 3V or 5V).

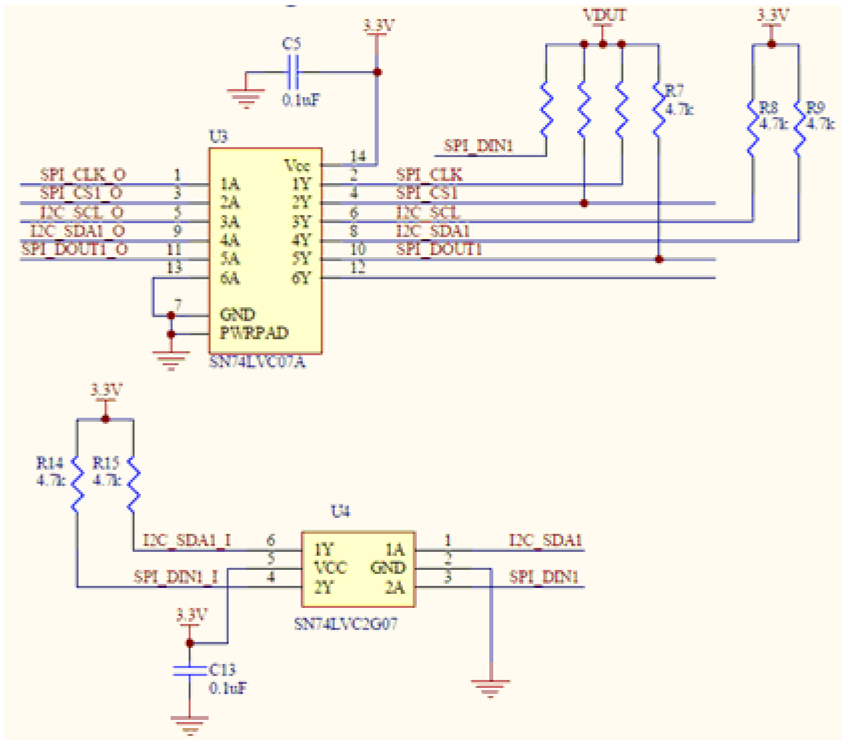

Figure 5. Digital I/O Area—I²C and SPI

3.1.3 CTRL and MEAS

Figure 6 shows the digital I/O area around the microcontroller. U5 and U9 are the bi-directional level-translators for the general-purpose output/input signals, CTRL/MEAS4 and CTRL/MEAS5. The CTRL signals are outputs, while the MEAS signals are inputs. The direction and function of the signals depends on the *DIR1* and *DIR2* signals from the microcontroller that control U5 and U9, respectively.

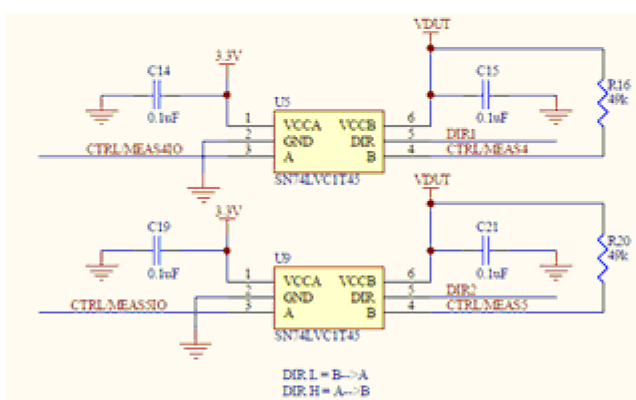

Figure 6. Digital I/O Area—CTRL and MEAS

3.1.4 Power Regulator

Figure 7 shows the power regulator that supplies +3.3V to the microcontroller, digital circuitry, and V_{DUT} supply. U1 converts a +5V input to the +3.3V output. The +5V input is provided via the USB port.

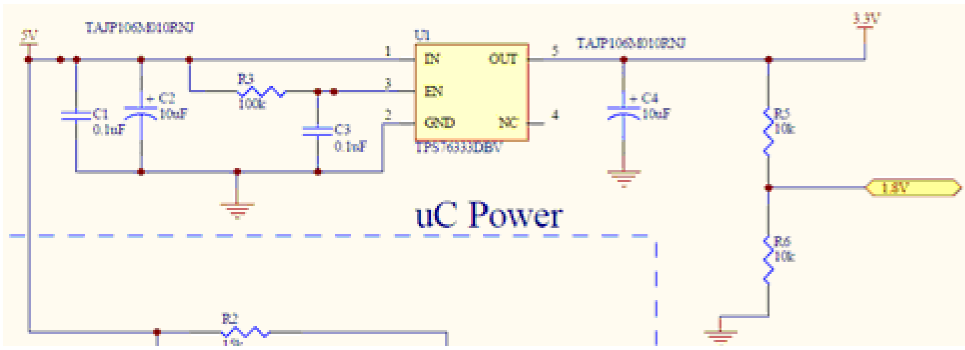

Figure 7. Digital I/O Area—Power Regulator

3.2 USB I/O

Figure 8 shows the USB I/O area. H1 connects the USB bus to the TUSB3210 microcontroller. The transistor and resistors are standard support circuitry for this device. See the TUSB3210 data sheet (SLLS466F), available from www.ti.com, for more information.

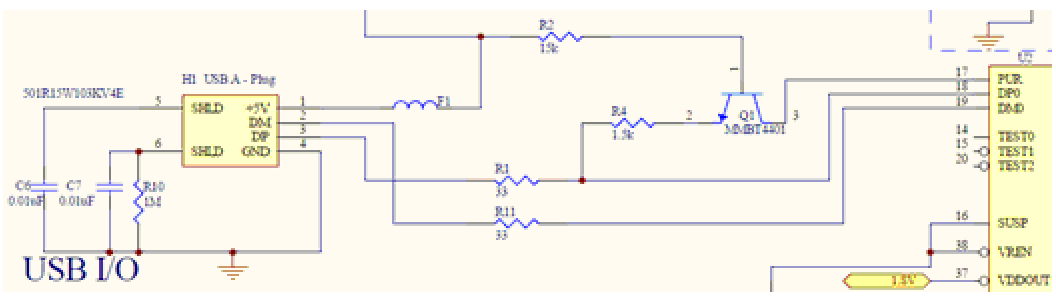

Figure 8. USB I/O

3.3 Firmware EEPROM

Figure 9 shows the firmware EEPROM area. U6 is the 64K-byte EEPROM that contains the firmware program used to run the microcontroller.

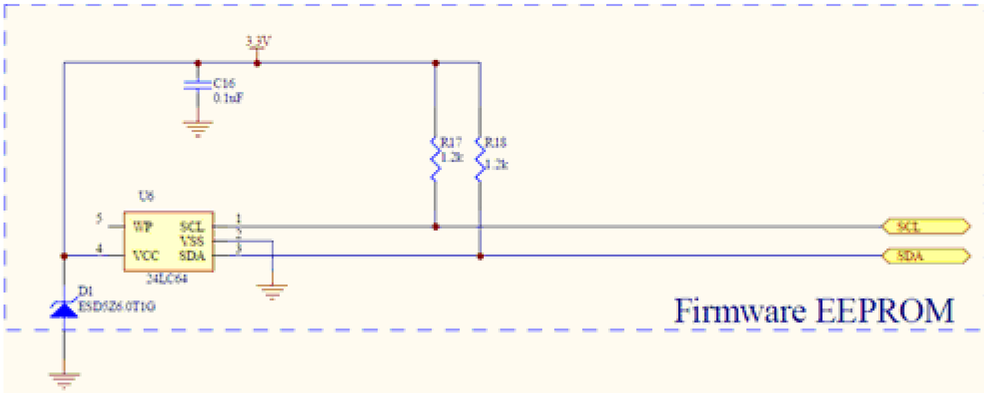

Figure 9. Firmware EEPROM

3.4 Power Indicators

Figure 10 shows the LED power indicators. The LEDs are used to indicate the power status of the unit. The LED (D3) labeled *3.3V* should be on when the system is powered up. V_{DUT} is switched power, and can be turned ON and OFF with software.

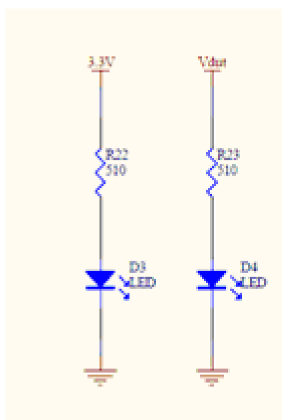

Figure 10. Power Indicators

3.5 Reset

Figure 11 shows the microcontroller reset circuitry. The reset circuit is connected to the $\overline{RST}$ pin on the microcontroller and resets the microcontroller upon power-up. U10 is a Schmitt buffer that is used to create a clean logic high or low (that is, the $\overline{RST}$ pin is connected to 3.3V or 0V, and not to intermediate voltage levels).

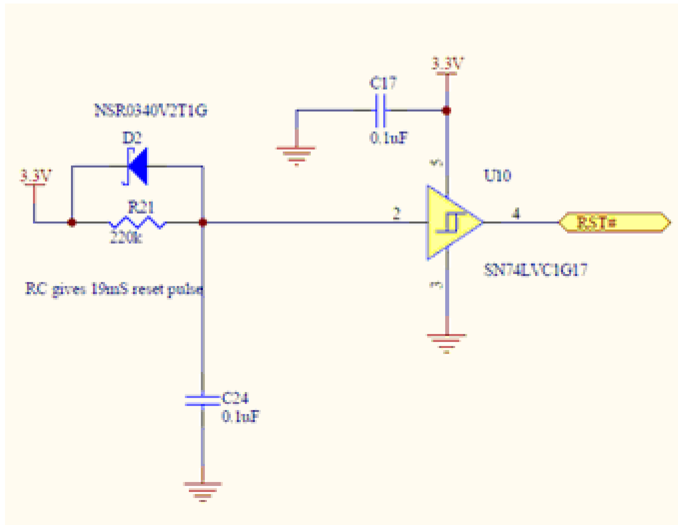

Figure 11. Reset

3.6 DUT Power Switching

Figure 12 shows the DUT power switching. U8 is an auto-switching power mux from Texas Instruments. It uses digital inputs as control lines to a Mux that can switch between two different voltages. On the SM-USB-DIG, the Power MUX switches between the +5V USB supply and the +3.3V power regulator output. Software can be used to set the V_{DUT} output to +3.3V, +5V, or a Hi-Z state(disconnected).

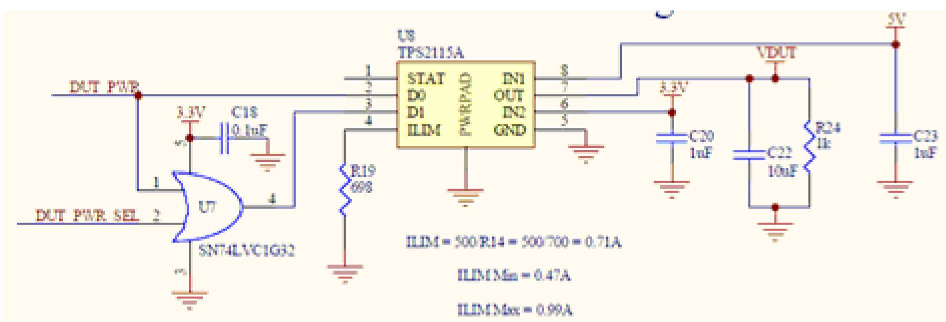

Figure 12. DUT Power Switching

3.7 Main EVM/Cable Connector Definition on SM-USB-DIG Platform

There is one primary connector, H2, on the SM-USB-DIG that is used to connect the unit directly to an EVM or to connect to a cable that connects to an EVM. Figure 13 shows the H2 connector.

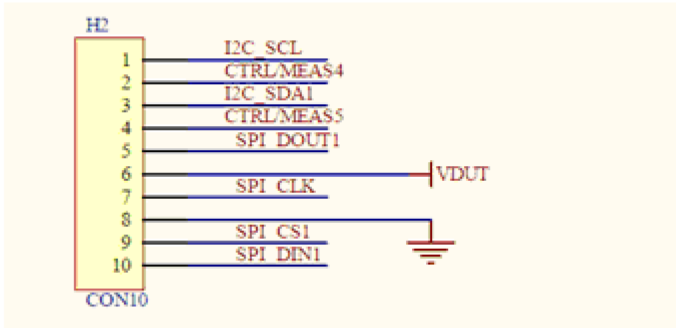

Figure 13. Main EVM/Cable Connector (H2)

3.7.1 H2 Signal Definition

Table 1 lists the different signals connected to H2 on the SM-USB-DIG Platform and gives a description of each signal.

Table 1. H2 Signal Definition (10-Pin, 50-mil Connector)

Pin on J1	Signal	Description
1	I2C_SCL	I^2C clock signal (SCL)
2	CTRL/MEAS4	GPIO: Control Output or Measure Input
3	I2C_SDA1	I^2C data signal (SDA)
4	CTRL/MEAS5	GPIO: Control Output or Measure Input
5	SPI_DOUT1	SPI data output (MOSI)
6	VDUT	Switchable DUT Power Supply: +3.3V, +5V, or Hi-Z (disconnected).(1)
7	SPI_CLK	SPI clock signal (SCLK)
8	GND	Power return (GND)
9	SPI_CS1	SPI chip select signal ($\overline{CS}$)
10	SPI_DIN1	SPI data input (MISO)

(1) When V_{DUT} is Hi-Z, all digital I/O are Hi-Z as well.

4 Bill of Materials

Table 2 shows the parts list.

Table 2. Bill of Materials

Item	Qty	Ref Des	Value	Description	Manufacturer	Part No
1	1	N/A		Printed circuit board	Texas Instruments	6522630
2	15	C1, C3, C5, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C21, C24	0.1μF	Capacitor, ceramic 0.1μF 16V X7R 0402	Murata	GRM155R71C104KA88D
3	2	C20, C23	1μF	Capacitor, ceramic 1.0μF 16V X5R 0402	TDK	C1005X5R1C105K
4	2	C2, C4	10μF	Capacitor, tantalum 10μF 10V 20% SMD	AVX	TAJP106M010RNJ
5	2	C6, C7	10000pF	Capacitor, ceramic 10000pF 500V X7R 0805	Johanson Dielectrics	501R15W103KV4E
6	2	C8, C9	33pF	Capacitor, ceramic 33PF 50V C0G 0402	Murata	GRM1555C1H330JZ01D
7	1	C22	10μF	Capacitor, tantalum 10μF 10V 20% SMD	Rohm	TCM1A106M8R
8	1	D1		TVS ESD ASD 181W 6.0V SOD-523	ON Semiconductor	ESD5Z6.0T1G
9	1	D2		Diode Schottky 40V 250MA SOD523	ON Semiconductor	NSR0340V2T1G
10	2	D3, D4		LED Green SS TYPE LOW CUR SMD	Panasonic -SSG	LNJ308G8LRA
11	1	F1		Ferrite 300mA 600Ω 0603 SMD	Laird Signal Integrity	HZ0603C601R-10
12	1	Q1		Trans GP SS NPN 40V SOT323	ON Semiconductor	MMBT2222AWT1G
13	2	R1, R11	33R	Resistor, 33Ω 1/16W 5% 0402 SMD	Rohm	MCR01MZPJ330
14	1	R2	15kΩ	Resistor, 15.0kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF1502
15	2	R3, R13	100kΩ	Resistor, 100kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF1003
16	1	R4	1.5kΩ	Resistor, 1.50kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF1501
17	2	R5, R6	10kΩ	Resistor, 10.0kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF1002
18	1	R7	47kΩ	Resistor, Array 47KΩ 8TERM 4RES SMD	Rohm	MNR14E0APJ473
19	4	R8, R9, R14, R15	47kΩ	Resistor, 47kΩ 1/16W 5% 0402 SMD	Rohm	MCR01MZPJ473
20	2	R10, R12	1MΩ	Resistor, 1.0MΩ 1/16W 5% 0402 SMD	Rohm	MCR01MZPJ105
21	2	R16, R20	49.9kΩ	Resistor, 49.9kΩ 1/10W 1% 0603 SMD	Rohm	MCR03EZPFX4992
22	2	R17, R18	1.2kΩ	Resistor, 1.20kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF1201
23	1	R19	698Ω	Resistor, 698Ω 1/10W 1% 0402 SMD	Panasonic - ECG	ERJ-2RKF6980X
24	1	R21	220kΩ	Resistor, 220kΩ 1/16W 1% 0402 SMD	Rohm	MCR01MZPF2203
25	2	R22, R23	510Ω	Resistor, 510Ω 1/16W 1% 0402 SMD	Rohm	MCR01MZPF5100

Table 2. Bill of Materials (continued)

Item	Qty	Ref Des	Value	Description	Manufacturer	Part No
26	1	R24	1kΩ	Resistor, 1kΩ 1/8W 1% 0603 SMD	Stackpole	RNCP0603FTD1K00
27	1	U1		IC 3.3V 150mA LDO REG SOT-23-5	Texas Instruments	TPS76333DBVR
28	1	U2		IC USB Controller storage 64-LQFP	Texas Instruments	TUSB3210PM
29	1	U3		IC Buff/Dvr Hex NON-INV 14VQFN	Texas Instruments	SN74LVC07ARGYR
30	1	U4		IC Buff/Dvr DL NON-INV SC706	Texas Instruments	SN74LVC2G07DCKR
31	2	U5, U9		IC Bus Transcvr TRI-ST SOT6	Texas Instruments	SN74LVC1T45DRLR
32	1	U6		IC EEPROM 64KBit 400kHz SOT23-5	MicroChip	24LC64T-I/OT
33	1	U7		IC Positive-OR Gate 2-IN SC-70	Texas Instruments	SN74LVC1G32DCKR
34	1	U8		IC Autoswitching Pwr Mux 8-SON	Texas Instruments	TPS2115ADRBR
35	1	U10		IC Buffer Schmitt Trig SOT5	Texas Instruments	SN74LVC1G17DRLR
36	1	XTL1		Crystal 12.000 MHz 18PF SMD	TXC CORPORATION	7M-12.000MAAJ-T
37	1	H1		Conn Plug USB 4POS RT ANG SMD	Molex	480371000
38	1	H2		Conn Header Rt Ang 10POS .050[(1)]	Mill-Max	850-10-010-20-001000

(1) Alternatively, cut down 850-10-050-20-001000 to 10-position size.

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 5.7V (min) to 9V (max) and the output voltage range of 0V (min) to 5V (max).

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 +25°C. The EVM is designed to operate properly with certain components above +25°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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