SDM-USB-DIG Platform

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

Contents

List of Figures

List of Tables

1 Related Documentation From Texas Instruments

The following related documents are available through the Texas Instruments web site at www.ti.com.

Table 1. Related Documentation

Device	Literature Number
MSP430F5528	SLAS590
MSP430x5xx and MSP430x6xx Family User's Guide	SLAU208
MSP430 Hardware Tools User's Guide	SLAU278

Questions and any other comments regarding the platform can be sent to the Data Converters Forum on E2E. http://e2e.ti.com/

2 SDM-USB-DIG Platform Overview

The SDM-USB-DIG platform is a data acquisition system, which is used to create different communication protocols, and general-purpose I/O signals. Specifically, the system generates I^2C, SPI, and general-purpose I/O signals. The system also generates a power-supply connection that has three options: +3.3 V, +5 V, and Hi-Z (0 V).

The purpose of the SDM-USB-DIG platform is for communication and I/O control of evaluation modules. An evaluation module is a printed-circuit board (PCB) that contains basic circuitry to test and evaluate a TI-specific device. In general, the SDM-USB-DIG connects to an evaluation module, along with the related cables and power supplies. An example of an EVM is the AMC7832EVM, which is a PCB with different circuitry developed around the AMC7832 TI device. This board connects to the SDM-USB-DIG platform and allows customers to test and evaluate the features of the AMC7832 device.

2.1 Hardware Included with the SDM-USB-DIG Platform

Figure 1 shows the hardware included with the SDM-USB-DIG platform.

Figure 1. Included Hardware SDM-USB-DIG Platform

3 System Setup

An example system setup for the SDM-USB-DIG is shown in Figure 2. The PC runs software an executable GUI which communicates with the SDM-USB-DIG. The SDM-USB-DIG interprets the commands sent from the PC, and outputs different digital signals used to communicate with the EVM. EVMs typically contain hardware connections allowing users to access and connect external signals to the device under test (DUT). EVMs may also contain different jumper settings that enable different configurations for the DUT.

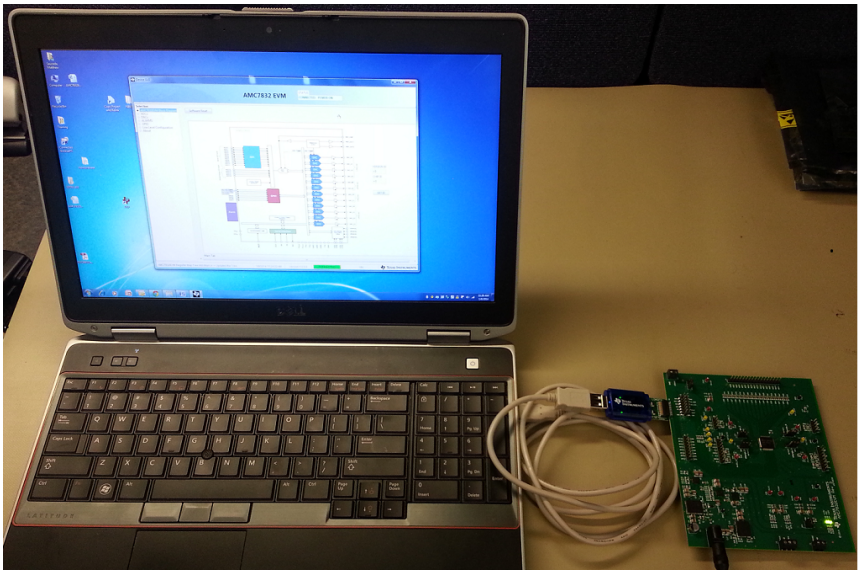

Figure 2. Typical Hardware Setup for the SDM-USB-DIG Platform

4 Theory of Operation for SDM-USB-DIG Platform

The SDM-USB-DIG platform is a general-purpose data acquisition system that is part of select TI EVMs. Figure 3 illustrates a block diagram of the platform.

The core component of the platform is the MSP430F5528, an ultra-low power 16-bit MCU. The microcontroller receives information from the host PC and translates it into I^2C, SPI, or other digital I/O patterns. The connected device, or DUT, connects to the I/O interface of the platform. During digital I/O transactions, the platform obtains information from the connected device and sends it to the host PC for interpretation.

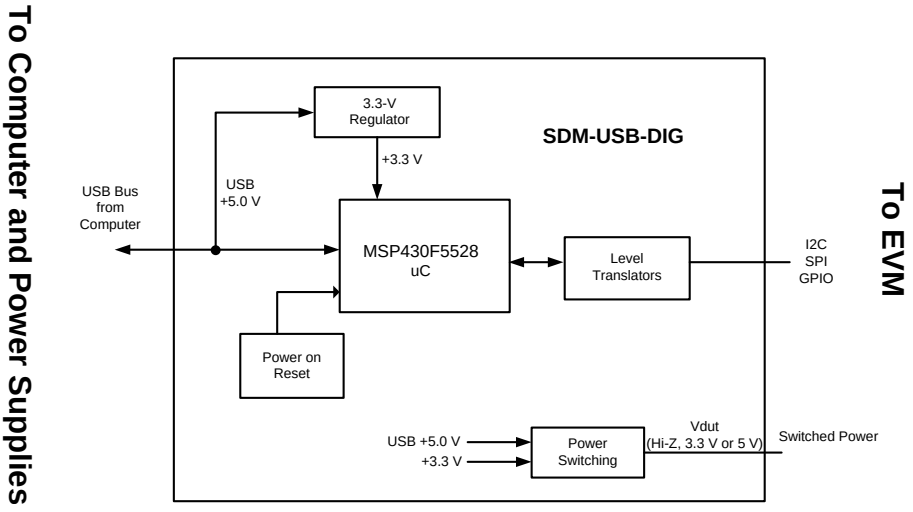

Figure 3. SDM-USB-DIG Platform Block Diagram

4.1 Digital I/O Area

The following subsections discuss the digital I/O areas that surround the microcontroller. For a detailed schematic of the SDM-USB-DIG platform please refer to the SDM-USB-DIG schematic (SBOR014).

4.1.1 Microcontroller

The area surrounding the microcontroller is displayed in Figure 4. The component U5 is an MSP430F5528, an ultra-low power 16-bit MCU. The microcontroller, U5, converts information, received from the PC via the USB bus, to I^2C, SPI, and digital I/O transactions. The microcontroller operates on 3.3 V, which is regulated from an on board linear regulator, LDO. The inputs of the microcontroller are protected with a level-translator IC that shifts the input signals to a safe and compatible voltage level, in this case 3.3 V.

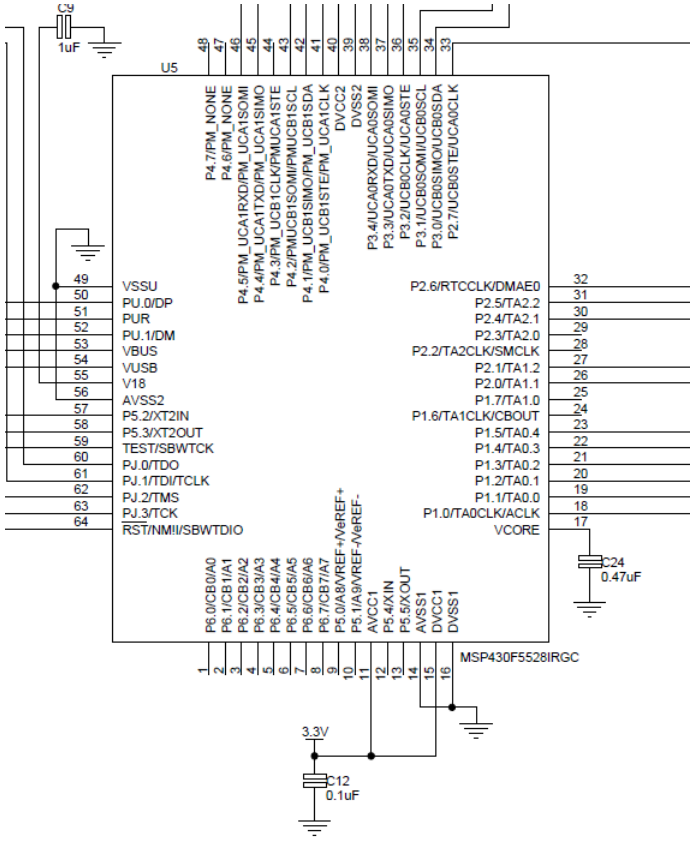

Figure 4. Digital I/O Area—Microcontroller

4.1.2 I²C, SPI, and GPIO

Figure 5 displays the digital I/O area that manages I²C and SPI communications. U6 is an open collector bidirectional translator for SDA and SCL Lines. Note that the input level, 3.3 V, is translated to the programmed VDUT voltage: 3.3 V or 5 V. U4 and U3 are also bidirectional translators that level-shift the SPI signals and general purpose I/O lines to the programmed VDUT voltage.

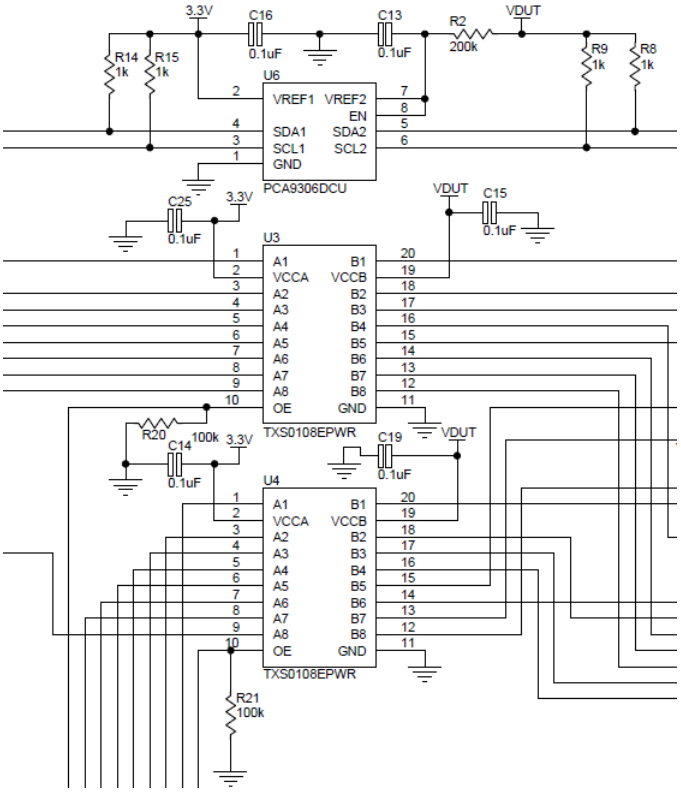

Figure 5. Digital I/O Area — I²C and SPI

4.1.3 Power Regulator

The USB bus provides a +5-V input to an LDO voltage regulator, U1. U1 converts the +5-V input to a +3.3-V output. The +3.3-V output voltage is distributed to all blocks within the platform that require +3.3 V, Figure 6.

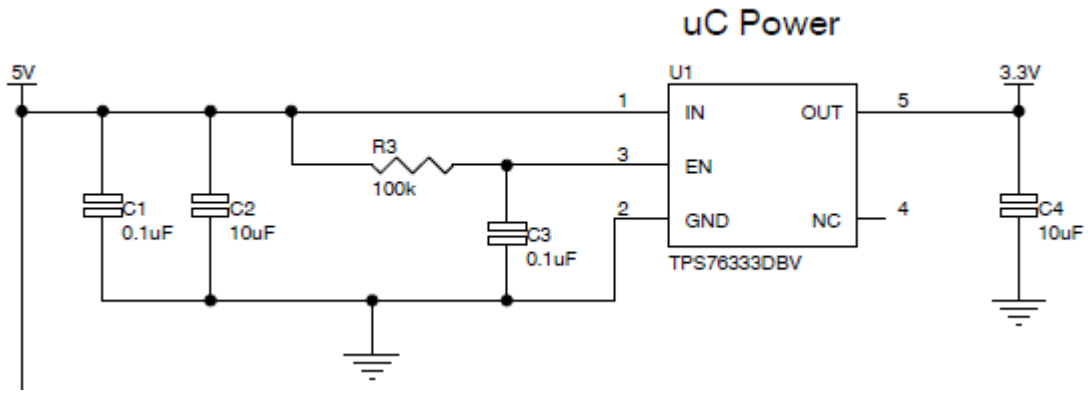

Figure 6. Power Regulator

4.2 USB I/O

The USB bus is accessed through the USB A – plug connection, J1. The plug connection connects the USB bus to the MSP430F5528 microcontroller, Figure 7. The passive components are standard support circuitry for this device.

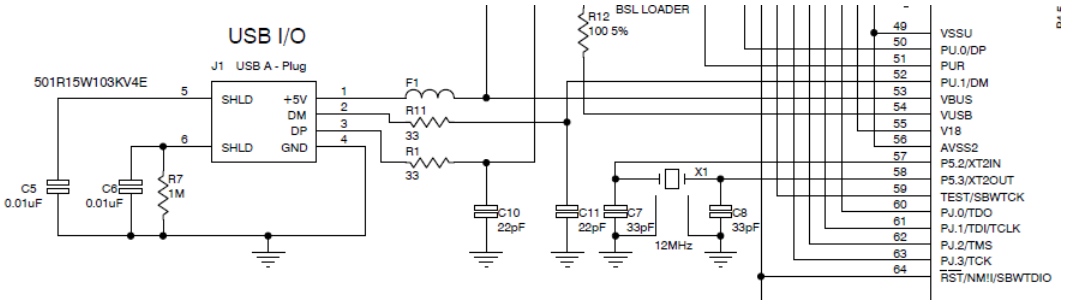

Figure 7. USB I/O

4.3 Power Indicators

The Power status of the platform can be visually verified through on board LEDs, D1 and D2. The LED D1, connected to the 3.3-V supply, powers on when the platform is connected to an active USB bus. The other LED, D2, activates when VDUT is programmed to 3.3 V or 5 V. Figure 8 shows the LED power indicators.

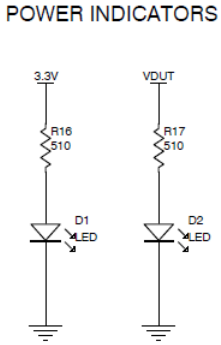

Figure 8. Power Indicators

4.4 Reset

The reset circuit consists of a power-on reset generator, U2, which resets the microcontroller upon power up. The device also supports manual reset through push button S1. Figure 9 displays the Reset output that connects to the microcontroller.

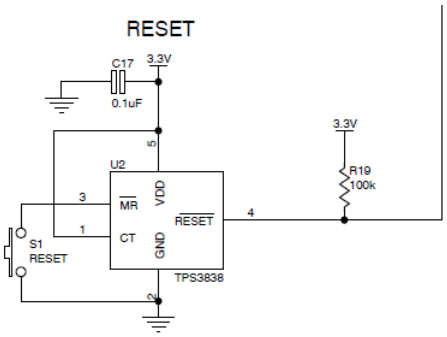

Figure 9. Reset

4.5 DUT Power Switching

The SDM-USB-DIG platform incorporates a two-input, one-output power multiplexer, U8, which switches between 3.3 V and 5 V. The inputs to the multiplexer are used to select the VDUT voltage. More specifically, the power multiplexer is used to switch between the +5-V USB supply and the +3.3-V power regulator output. Software is used to programmatically set the VDUT output to +3.3 V, +5 V, or Hi-Z (disconnected). The DUT Power Switching module is illustrated in Figure 10.

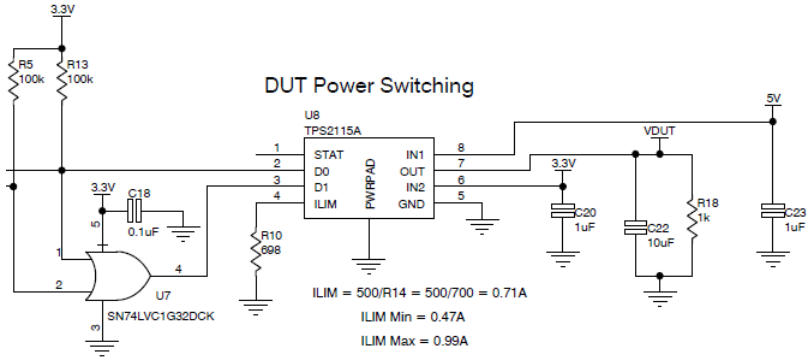

Figure 10. DUT Power Switching

4.6 Main Connector Definition on SDM-USB-DIG

The SDM-USB-DIG contains one external connector, J3, which connects the platform to select TI EVMs. Figure 11 shows the "J3" connector.

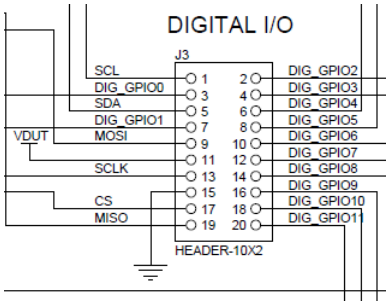

Figure 11. Main Connector (J3)

4.6.1 Signal Definition of "J3" Main EVM Connector on SDM-USB-DIG Platform

Table 2 shows the different signals connected to J3 on the SDM-USB-DIG platform and gives a description of each signal.

Table 2. Signal Definition of J3 (20-pin 50-mil Connector) on SDM-USB-DIG Platform

PIN On J3	Signal	Description
1	SCL	I^2C Clock Signal (SCL)
2	DIG_GPIO2	GPIO – Control Output or Measure Input
3	DIG_GPIO0	GPIO – Control Output or Measure Input
4	DIG_GPIO3	GPIO – Control Output or Measure Input
5	SDA	I^2C Data Signal (SDA)
6	DIG_GPIO4	GPIO – Control Output or Measure Input
7	DIG_GPIO1	GPIO – Control Output or Measure Input
8	DIG_GPIO5	GPIO – Control Output or Measure Input
9	MOSI	SPI Data Output (MOSI)
10	DIG_GPIO6	GPIO – Control Output or Measure Input
11	VDUT	Switchable DUT Power Supply: +3.3 V, +5 V, Hi-Z (Disconnected). Note: When VDUT is Hi-Z all Digital I/O are Hi-Z as well.
12	DIG_GPIO7	GPIO – Control Output or Measure Input
13	SCLK	SPI Clock Signal (SCLK)
14	DIG_GPIO8	GPIO – Control Output or Measure Input
15	GND	Power Return (GND)
16	DIG_GPIO9	GPIO – Control Output or Measure Input
17	CS	SPI Chip Select Signal (/CS)
18	DIG_GPIO10	GPIO – Control Output or Measure Input
19	MISO	SPI Data Input (MISO)
20	DIG_GPIO11	GPIO – Control Output or Measure Input

5 Schematic and Bill of Materials

This section contains the SDM-USB-DIG schematic and BOM.

5.1 SDM-USB-DIG Schematic

The SDM-USB-DIG schematic is illustrated in Figure 12.

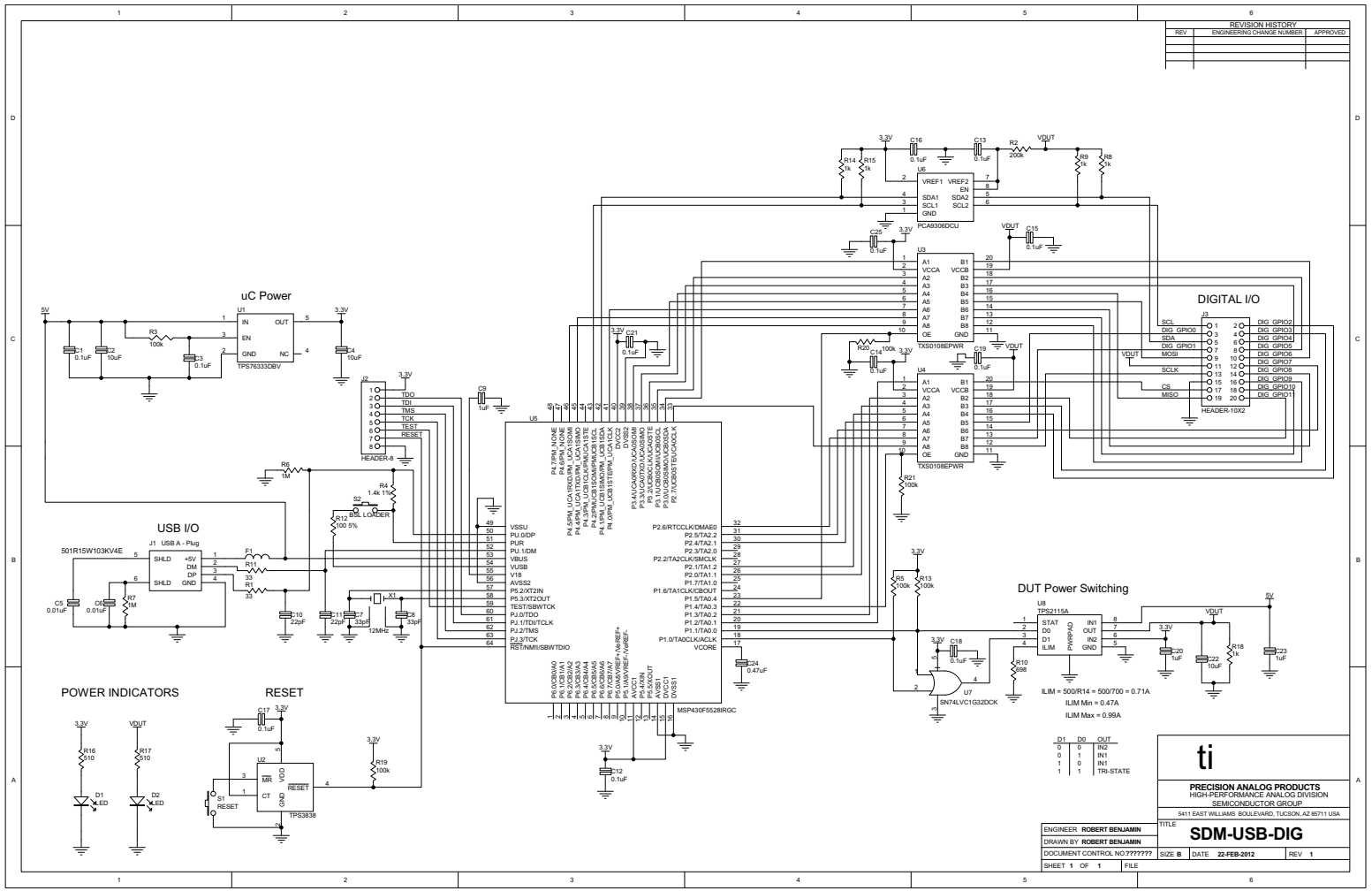

Figure 12. SDM-USB-DIG Schematic

5.2 SDM-USB-DIG Bill of materials

Table 3 shows the parts list.

Table 3. Bill of Materials

Item	Qty	Ref Des	Description	MFR	Part Number
1	12	C1, C3, C12, C13, C14, C15, C16, C17, C18, C19, C21, C25	CAP CER 0.1UF 16V 10% X7R 0402	Murata	GRM155R71C104KA88D
2	1	C2	CAP CER 22UF 6.3V 20% X5R 0603	TDK	C1608X5R0J226M
3	2	C4, C22	CAP CER 10UF 6.3V 20% X5R 0603	Murata	GRM188R60J106ME47D
4	2	C5, C6	CAP CER 10000PF 50V 10% X7R 0402	Murata	GRM155R71H103KA88D
5	2	C7, C8	CAP CER 33PF 50V 5% NP0 0402	Murata	GCM1555C1H330JZ13D
6	3	C9, C20, C23	CAP CER 1UF 10V 10% X5R 0402	Murata	GRM155R61A105KE15D
7	2	C10, C11	CAP CER 22PF 50V 5% NP0 0402	Murata	GCM1555C1H220JZ13D
8	1	C24	CAP CER 0.47UF 10V 10% X5R 0402	Murata	GRM155R61A474KE15D
9	2	D1, D2	LED 565NM GRN DIFF 0603 SMD	Lumex	SML-LX0603GW-TR
10	1	F1	FERRITE 300mA 600 OHM 0603 SMD	Laird-Signal	HZ0603C601R-10
11	1	J1	CONN PLUG USB 4POS RT ANG SMD	Molex	480371000
12	0	J2	Not Installed		
13	1	J3	CONN HEADER RT ANG 2X50 .050	Mill-Max	852-10-100-20-001000
14	2	R1, R11	RES 33.0 OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF33R0X
15	1	R2	RES 200K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF2003X
16	6	R3, R5, R13, R19, R20, R21	RES 100K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1003X
17	1	R4	RES 1.40K OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1401X
18	2	R6, R7	RES 1.00M OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1004X
19	5	R8, R9, R14, R15, R18	RES 1.0K OHM 1/10W 5% 0402 SMD	Panasonic	ERJ-2GEJ102X
20	1	R10	RES 698 OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF6980X
21	1	R12	RES 100 OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF1000X
22	2	R16, R17	RES 510 OHM 1/10W 1% 0402 SMD	Panasonic	ERJ-2RKF5100X
23	2	S1, S2	SWITCH TACTILE SPST-NO 0.05A 12V	Omron	B3U-1000P
24	1	U1	IC REG LDO 3.3V .15A SOT-23-5	TI	TPS76333DBVR
25	1	U2	IC 2.64V NANOPWR MON SOT-23-5	TI	TPS3838L30DBVT
26	2	U3, U4	IC 8BIT NON-INV TRANSLTR 20TSSOP	TI	TXS0108EPWR
27	1	U5	IC MCU 16BIT 128KB FLASH 64VQFN	TI	MSP430F5528IRGCT
28	1	U6	IC VOLT LEVEL TRANSLATOR 8-VSSOP	TI	PCA9306DCUR
29	1	U7	IC POSITIVE-OR GATE 2-IN SC-70	TI	SN74LVC1G32DCKR
30	1	U8	IC AUTOSWITCH POWER MUX 8-TSSOP	TI	TPS2115ADRBR
31	1	X1	CRYSTAL 12.000 MHZ 18 PF SMD	Abracon	ABM8G-12.000MHZ-18-D2Y-T
32	1		Printed Circuit Board		6573758
33	1		Enclosure (blue)		TIENC-II

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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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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.

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 pour 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 Industrie 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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2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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