Using the LM8330EVM Evaluation Module

User's Guide

Literature Number: SNVU166
FEBRUARY 2013

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Introduction

The Texas Instruments (TI) LM8330 evaluation module (EVM) helps designers evaluate the operation and performance of the LM8330 I^2C ™ Keyscan Controller. The LM8330 keyscan operates from a 1.8V supply and supports 7- and 10-bit I^2C addressing in both Standard (100 kHz) and Fast (400 kHz) modes. It offers exceptional ESD performance designed to tolerate IEC6100-4-2 level 4 ±8 kV direct contact. With 20 configurable GPIO pins, it can support 12x8 keypad array. This operation frees the processor from scanning the keypad for presses and releases, thus saving power and bandwidth of the system.

The LM8330EVM serves as an I^2C interface adapter between a host PC, the LM8330, and/or other I^2C-compatible devices externally connected to the EVM. The communication between the EVM and host PC is via USB (through a standard type-A to type-B USB cable), while the communication between the EVM, the LM8330, and/or other slave devices is via I^2C bus. The EVM converts communication transactions between the USB and I^2C. The LM8330EVM is a USB powered device with no external power supply required.

1.1 List of Hardware Items for Operation

To operate the LM8330EVM, the following items are required:

- The LM8330EVM
- Standard type-A to type-B mini-USB cable
- PC with Windows XP, Win7 or later operating system installed

The LM8330EVM contains a USB-to-I^2C convertor (MSP430F5529), USB ESD Protection, LDOs, Level Shifters, and the LM8330.

Table 1-1. Device and Package Configurations

Reference Designator	Device	Package
U1	MSP430F5529IPN	LQFP-80
U2	LM8330	YFQ-25
U3	LP5990TM-1.8/NOPB	YFQ-4
U4	SN74AVC1T45YZPR	YZP-6
U5	TPS73533DRB	DRB-8
U6	TPD4E004DRY	DRY-6
U7	SN74AVC1T45YZPR	YZP-6
U8	PCA9306DQER	DQE-8

1.2 List of Software Items for Operation

In addition to the hardware items listed in Table 1-1, this software is required:

- Demo GUI Software (LM8330.exe)

The software can be downloaded from the TI website at www.ti.com.

The EVM 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 XP or later operating system. Therefore, it is plug-and-play, and no proprietary USB driver is required.

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1.3 Step-by-step Instructions for Operation and Troubleshooting

After downloading and installing the GUI demo software, follow these steps to operate the EVM:

- Plug the USB cable into both the PC and the EVM and wait for the LED to illuminate.
  Troubleshooting: if the LED does not illuminate after 30 seconds, follow these steps:
  - Verify that the USB cable is securely connected.
  - If the connection is secure, try a different USB port.
  - If the problem persists, try rebooting the PC.
  - If the problem still persists, try a different USB cable.
  - If these steps did not solve the problem, contact TI technical support for help.
- Run the LM8330EVM GUI software and follow the instructions for the GUI (refer to Chapter 3).

1.4 Hardware Uninstall Instructions

Unplug the EVM from the USB port to uninstall the hardware from the host PC.

1.5 Software Uninstall Instructions

For Windows operating system, go to Control Panel > Add or Remove Programs to remove the LM8330 GUI software.

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EVM Configuration and Description

2.1 EVM Options

The hardware is based on the TI MSP430 16-bit, ultra-low power, mixed signal micro-controller with integrated USB. The PCB is a four-layer board with components mounted on both top and bottom layers (refer to SCHEMATIC).

2.2 LED (D1) Indication of USB Attached

A green LED is mounted adjacent to the USB (J3) connector on the EVM. Every time the USB interface adapter is attached to a PC via a USB cable, and if the host PC detects it and goes through enumeration successfully, the embedded firmware illuminates the LED (D1); otherwise, the LED remains off. After unplugging the USB cable, the LED turns off immediately.

2.3 Input/Output Connector Description

J2 - Input/Output is the keypad IO connector. This connector provides the connection between the keypad and the LM8330.

J3 - Input is the USB input connector. This connector provides USB data communication, 5V Power In and ground (GND) connections.

J4 - Input/Output is the I^2C input/output connector. This connector provides access to the I^2C SCL and SDA signals for monitoring from an external device.

2.4 Test Point Connectors

Test point connectors TP1 through TP4 allow the users to verify internal power rails on the LM8330EVM. describes the functions of all of the test points on the EVM.

Table 2-1. Test Point Descriptions

Test Point	Signal	Functionality
TP1	1.8V Test Point	Connect to DMM positive terminal to monitor the LM8330 1.8V power rail
TP2	GND Test Point	Connect to DMM negative terminal to monitor the LM8330 1.8V power rail
TP3	GND Test Point	Connect to DMM negative terminal to monitor the LM8330 3.3V power rail
TP4	3.3V Test Point	Connect to DMM positive terminal to monitor the LM8330 3.3V power rail

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2.5 Schematics

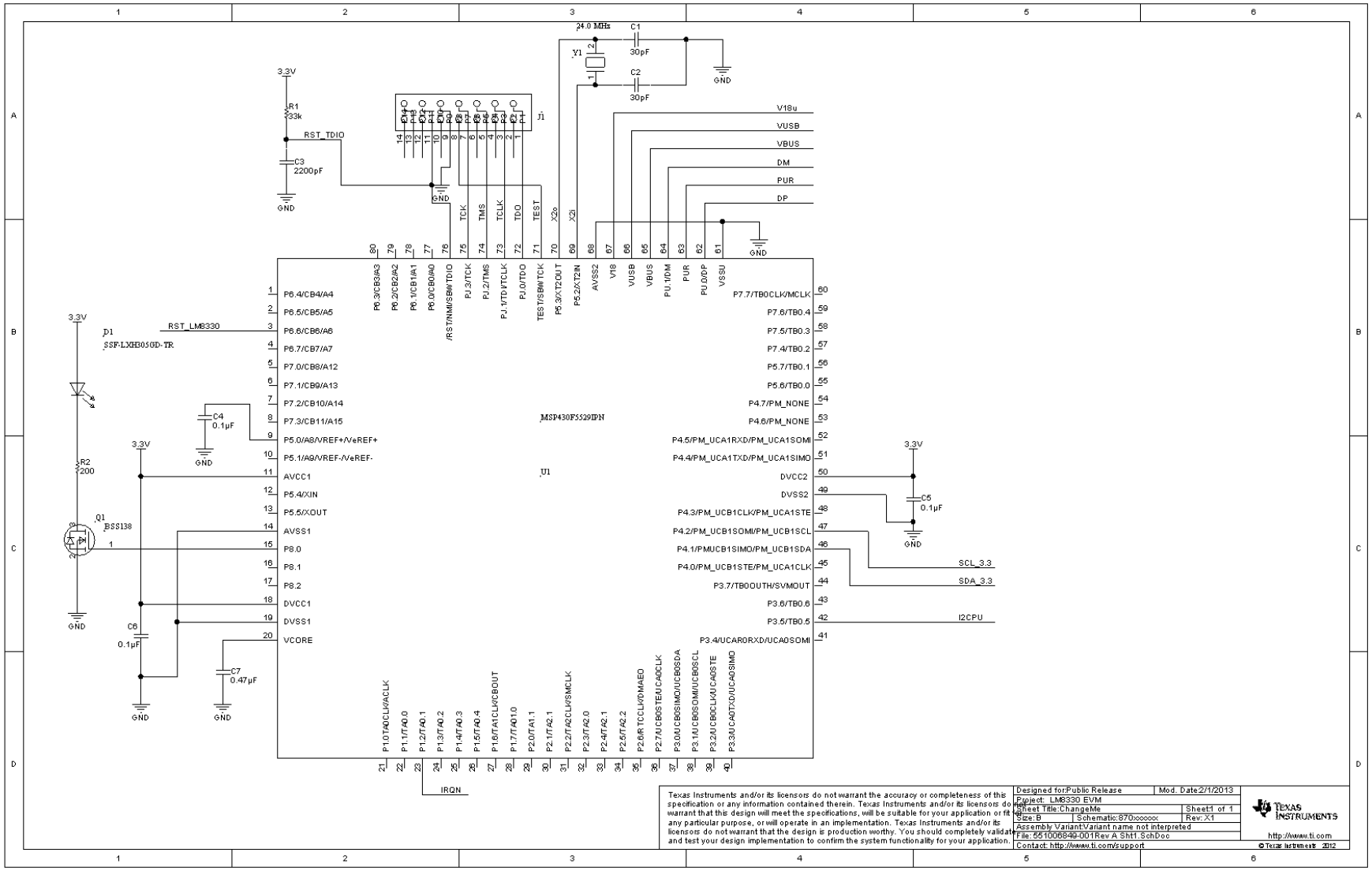

Figure 2-1. LM8330EVM Schematic Sheet1

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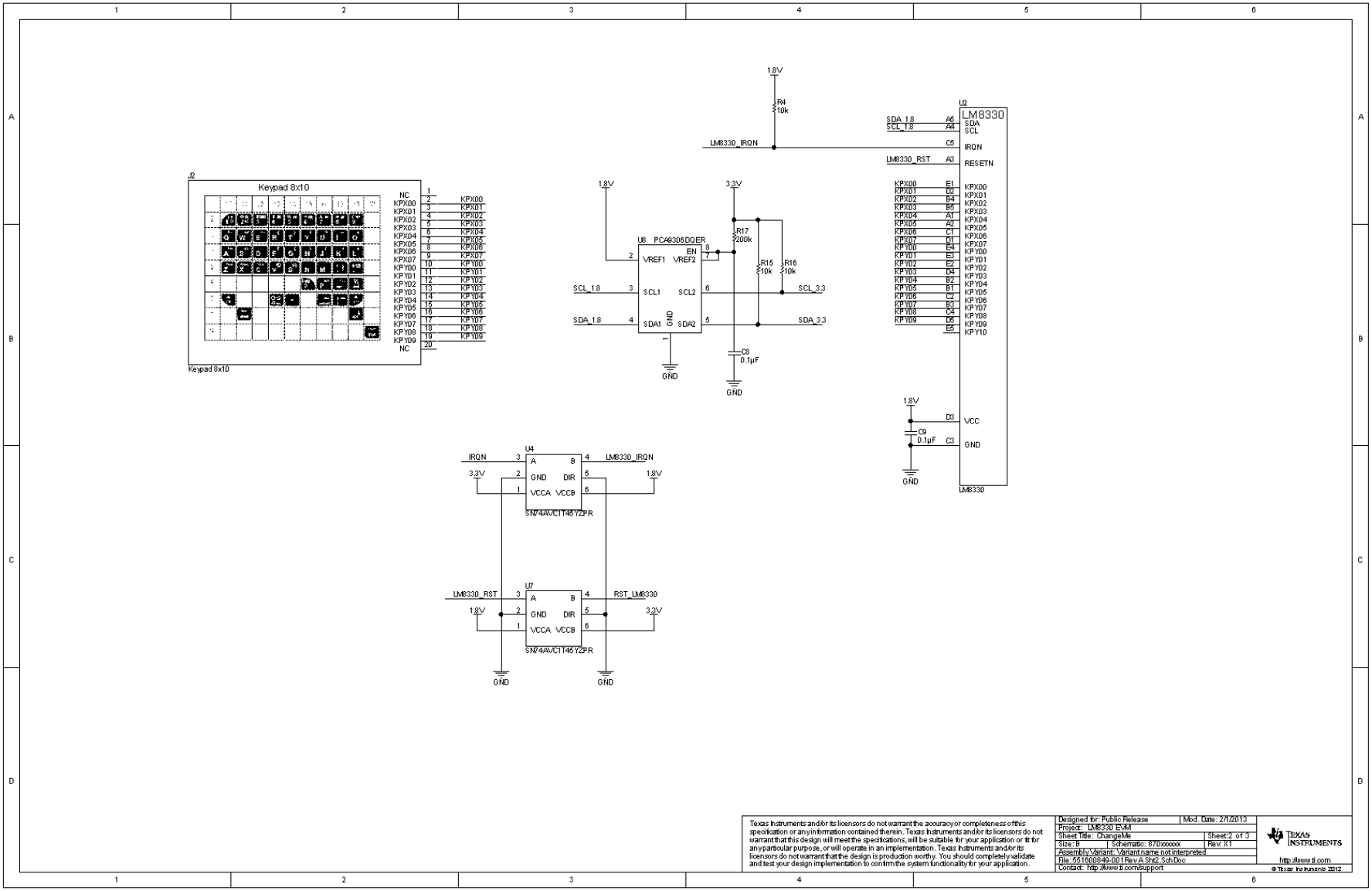

Figure 2-2. LM8330EVM Schematic Sheet2

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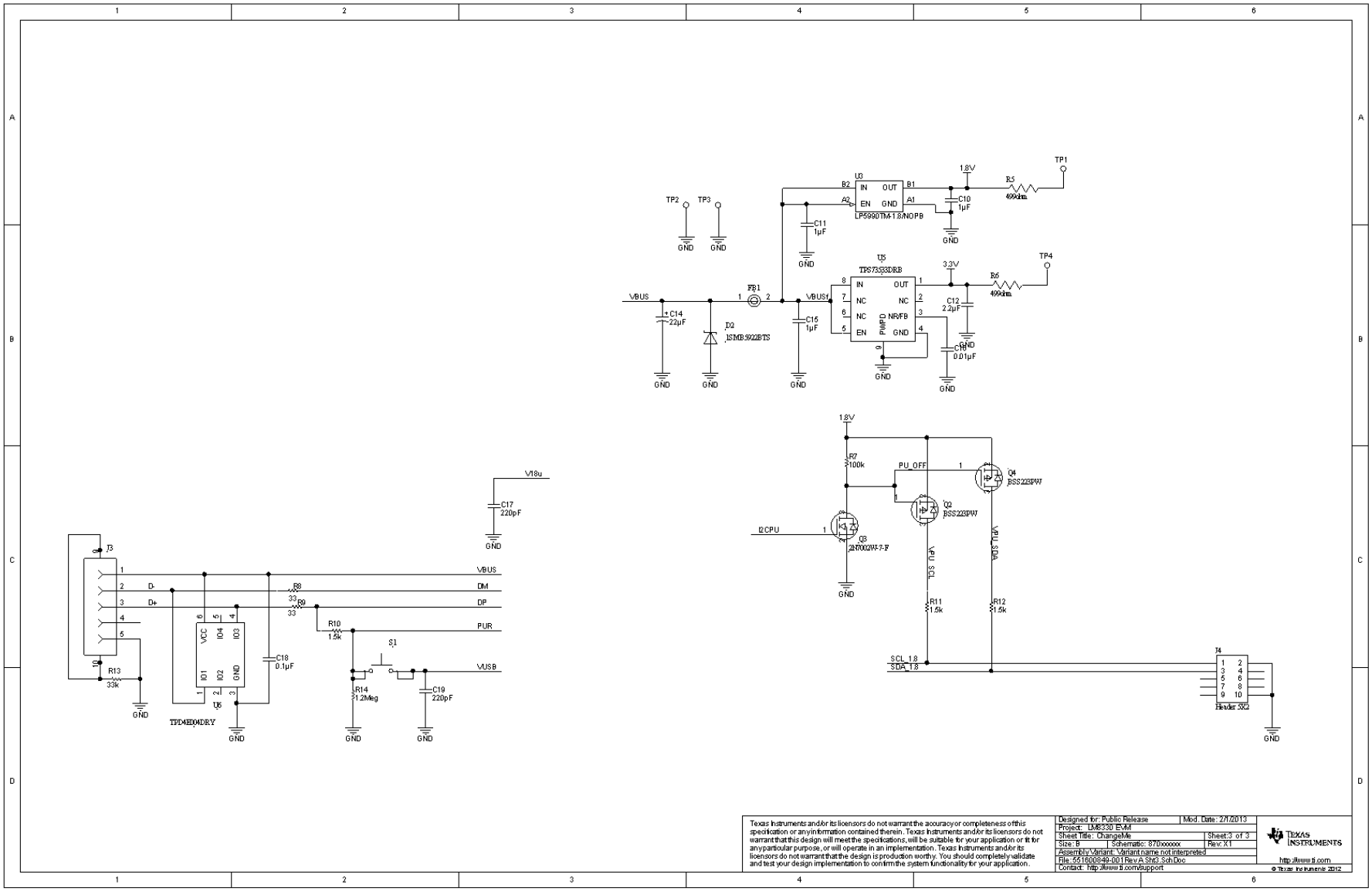

Figure 2-3. LM8330EVM Schematic Sheet3

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2.6 Layout

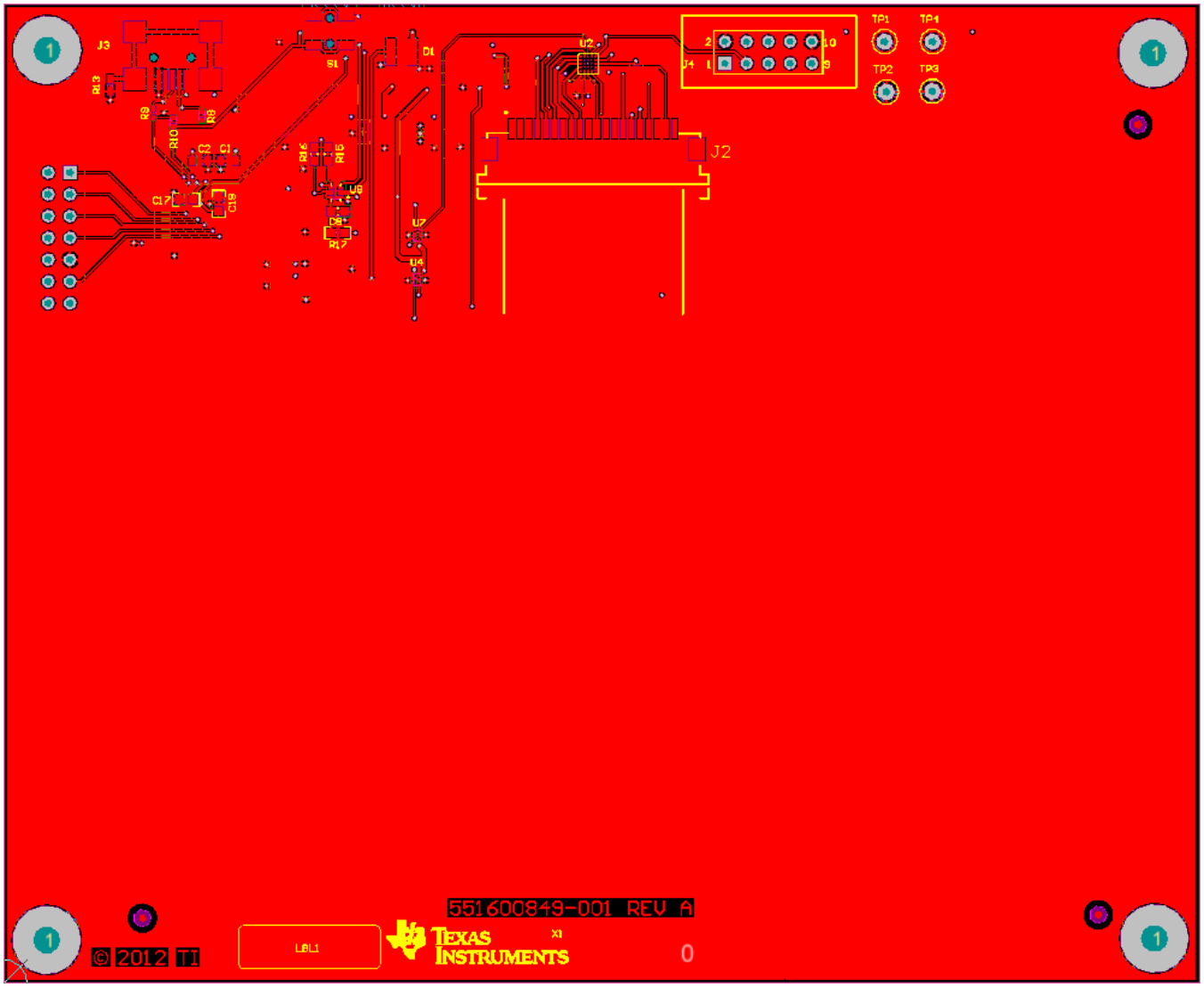

Figure 2-4. LM8330EVM Top Layer

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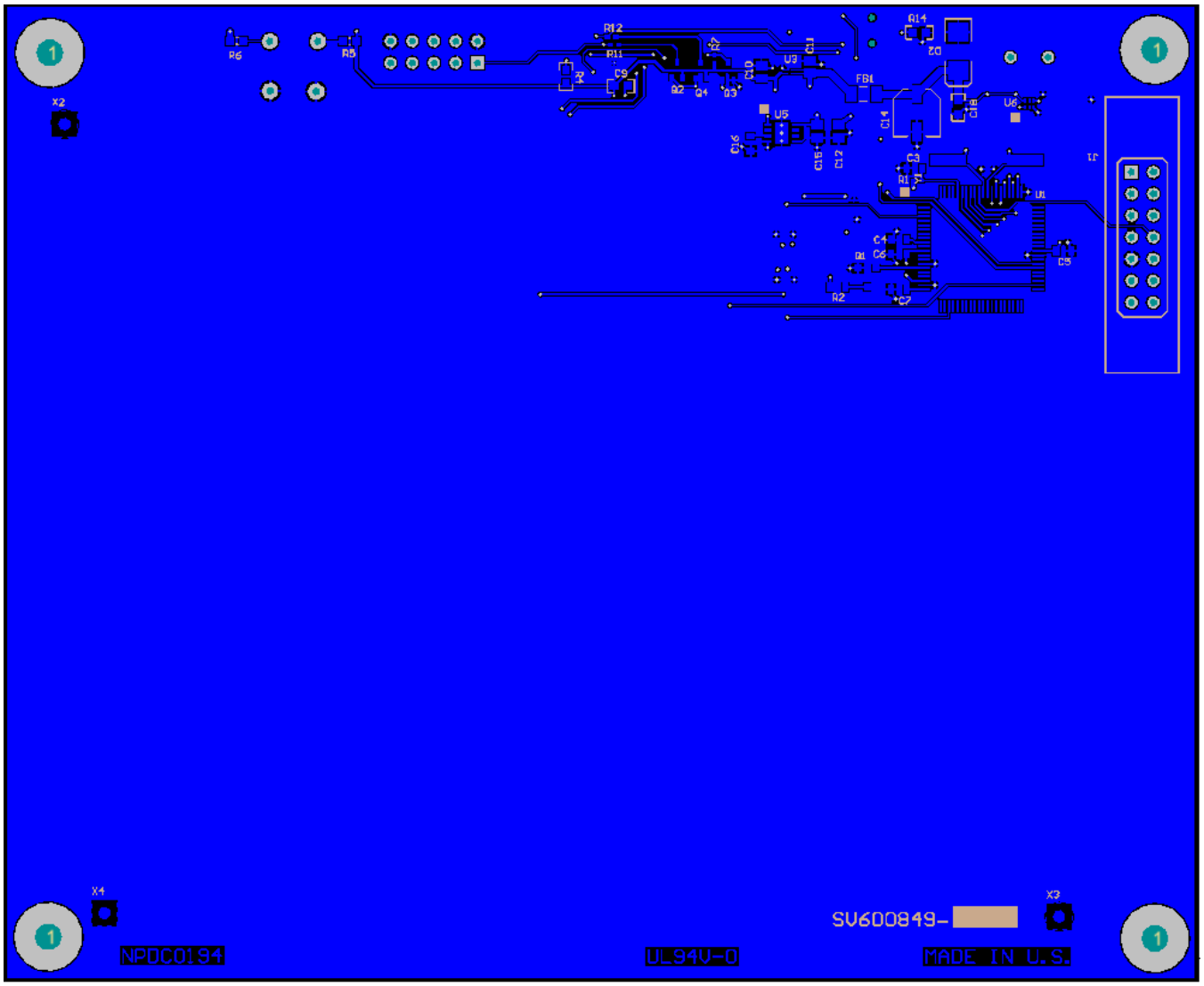

Figure 2-5. LM8330EVM Bottom Layer

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2.7 Bill of Materials

Table 2-2. Bill of Materials

Qty.	Designator	Value	Description	Size	Part Number	Manufacturer
2	C1, C2	30pF	CAP, CERM, 30pF, 100V, ±5%, C0G/NP0, 0603	0603	GRM1885C2A300JA01D	MuRata
1	C3	2200pF	CAP, CERM, 2200pF, 50V, ±10%, X7R, 0603	0603	C0603X222K5RACTU	Kemet
3	C4, C5, C6	0.1µF	CAP, CERM, 0.1µF, 16V, ±5%, X7R, 0603	0603	0603YC104JAT2A	AVX
1	C7	0.47µF	CAP, CERM, 0.47µF, 10V, ±10%, X7R, 0603	0603	GRM188R71A474KA61D	MuRata
2	C8, C9	0.1µF	CAP, CERM, 0.1µF, 25V, ±10%, X5R, 0603	0603	06033D104KAT2A	AVX
3	C10, C11, C15	1µF	CAP CER 1µF 16V 10% X7R 0805	0805	C2012X7R1C105K/1.25	TDK
1	C12	2.2µF	CAP, CERM, 2.2µF, 16V, ±10%, X5R, 0805	0805	0805YD225KAT2A	AVX
1	C14	22µF	CAP ALUM 22µF 10V 20% SMD	5x5.2mm	EEE-1AA220WR	Panasonic - ECG
1	C16	0.01µF	CAP, CERM, 0.01µF, 50V, ±10%, X7R, 0603	0603	C1608X7R1H103K	TDK
2	C17, C19	220pF	CAP, CERM, 220pF, 50V, ±1%, C0G/NP0, 0603	0603	06035A221FAT2A	AVX
1	C18	0.1µF	CAP, CERM, 0.1µF, 16V, ±5%, X7R, 0603	0603	0603YC104JAT2A	AVX
1	D1	SSF-LXH305GD-TR	LED 3MM RA GREEN DIFFUSED SMD	0.250 x 0.250 inches	SSF-LXH305GD-TR	Lumex
1	D2	1SMB5922BTS	Diode, Zener, 7.5V, 50-mA, 3W	SMB	1SMB5922BT3G	On Semi
1	FB1	BK1608HS600-T	Bead, Ferrite, SMT, 60Ω, 800mA	1206	BK1608HS600-T	Taiyo Yuden
1	J1	PEC07DAAN	Header, Male 2x7 pin, 100mil spacing	0.100 inch x 2X7	PEC07DAAN	Sullins
1	J2	1464-1	Keypad, Membrane, 49 Key, 8x10 matrix	2.5 x 4.75 inches	1464-1	CSI Keyboards
1	J3	1734035-2	Connector, Recpt, USB-B, Mini, 5-pins, SMT	0.354 X 0.400 Inches	1734035-2	Tyco
1	J4	PEC05DAAN	Header, 5-Pin, Dual row	0.100 inch x 2x5	PEC05DAAN	Sullins
1	Q1	BSS138	MOSFET, Nch, 50V, 0.22A, 3.5Ω	SOT23	BSS138	Fairchild
2	Q2, Q4	BSS223PW	MOSFET, Pch, -20 V, -0.39 A, 1.2Ω	SOT323	SI1307DL-T1-E3	Siliconix
1	Q3	2N7002W-7-F	MOSFET, Nch, 60V, 115mA	SOT323 [SC70]	2N7002W-7-F	Diodes
1	R1	33k	RES, 33kΩ, 5%, 0.063W, 0402	0402	CRCW040233K0JNED	Vishay-Dale

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Table 2-2. Bill of Materials (continued)

Qty.	Designator	Value	Description	Size	Part Number	Manufacturer
1	R2	200	RES, 200Ω, 1%, 0.1W, 0603	0603	CRCW0603200RFKEA	Vishay-Dale
3	R4, R15, R16	10k	RES, 10kΩ, 5%, 0.1W, 0603	0603	CRCW060310K0JNEA	Vishay-Dale
2	R5, R6	499Ω	RES, 499Ω, 5%, 0.1W, 0603	0603	CRCW0603499RFKEA	Vishay-Dale
1	R7	100k	RES, 100kΩ, 5%, 0.063W, 0402	0402	CRCW0402100KJNED	Vishay-Dale
2	R8, R9	33	RES, 33Ω, 5%, 0.063W, 0402	0402	CRCW040233R0JNED	Vishay-Dale
3	R10, R11, R12	1.5k	RES, 1.5kΩ, 5%, 0.063W, 0402	0402	CRCW04021K50JNED	Vishay-Dale
1	R13	33k	RES, 33kΩ, 5%, 0.063W, 0402	0402	CRCW040233K0JNED	Vishay-Dale
1	R14	1.2MΩ	RES, 1.2MΩ, 5%, 0.1W, 0603	0603	CRCW06031M20JNEA	Vishay-Dale
1	R17	200k	RES, 200kΩ, 1%, 0.1W, 0603	0603	CRCW0603200KFKEA	Vishay-Dale
1	S1	EVQPSD02K	Switch, SMD Light-Touch, Side Operation	6.1mm x 4.0mm	EVQPSD02K	Panasonic
2	TP1, TP4	Red	Test Point, TH, Miniature, Red	80mil pad with 40mil via	5000	Keystone
2	TP2, TP3	Black	Test Point, TH, Miniature, Black	80mil pad with 40mil via	5001	Keystone
1	U1	MSP430F5529IPN	IC, Mixed Signal Microcontroller	TQFP-80	MSP430F5529IPN	TI
1	U2	LM8330	IC, 8x20 Keypad Controller, 25DSBGA	YFQ-25	LM8330TME	TI
1	U3	LP5990	Micropower 200mA Low Dropout Voltage Regulator, 4-pin DSBGA, Pb-Free	YFQ-4	LP5990TM-1.8/NOPB	TI
2	U4, U7	SN74AVC1T45	IC BUS TRANSCVR TRI-ST 6DSBGA	YZP-6	SN74AVC1T45YZPR	TI
1	U5	TPS73533DRB	IC, 500mA, Low Quiescent Current, Ultra-Low Noise, High PSRR LDO, 3.3-V	SON-8	TPS73533DRB	TI
1	U6	TPD4E004DRY	IC, 4-Chan ESD-Protection Array	SON-6	TPD4E004DRY	TI
1	U8	PCA9306	IC VOLT LEVEL TRANSLATOR 8-VSSOP	DQE-8	PCA9306DQER	TI
1	Y1	24.0 MHz	Crystal, SMT Quart Crystal	0.484 x 0.190 inch	ECS-240-20-5PX-TR	ECS

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GUI Configuration and Description

3.1 GUI Installation

1. Extract the zip file to a temporary folder.

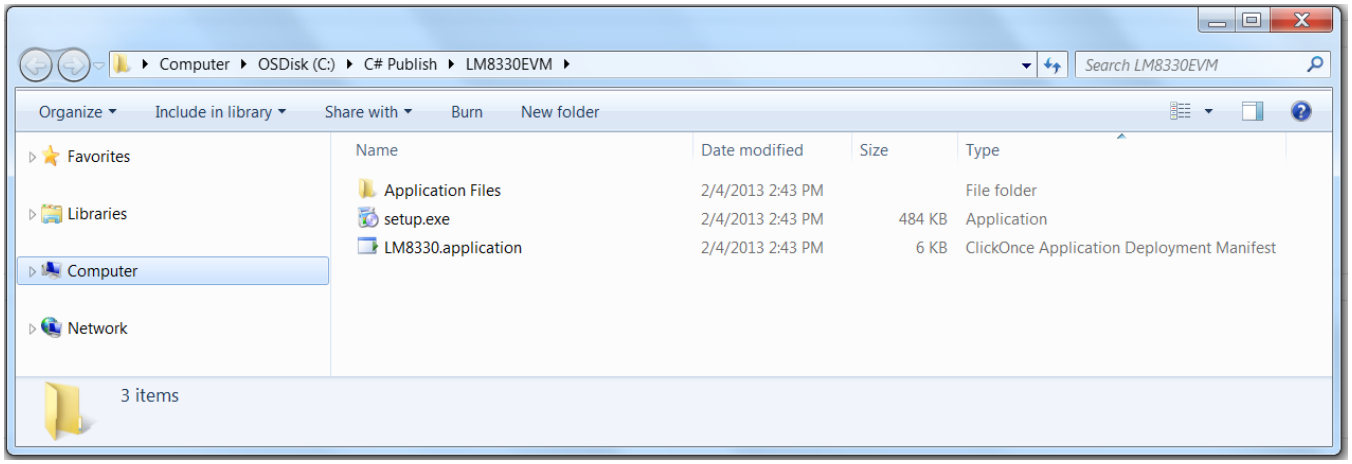

Figure 3-1. LM8330EVM GUI Installation Files

2. Open the setup.exe file and click Install to finish the GUI installation.

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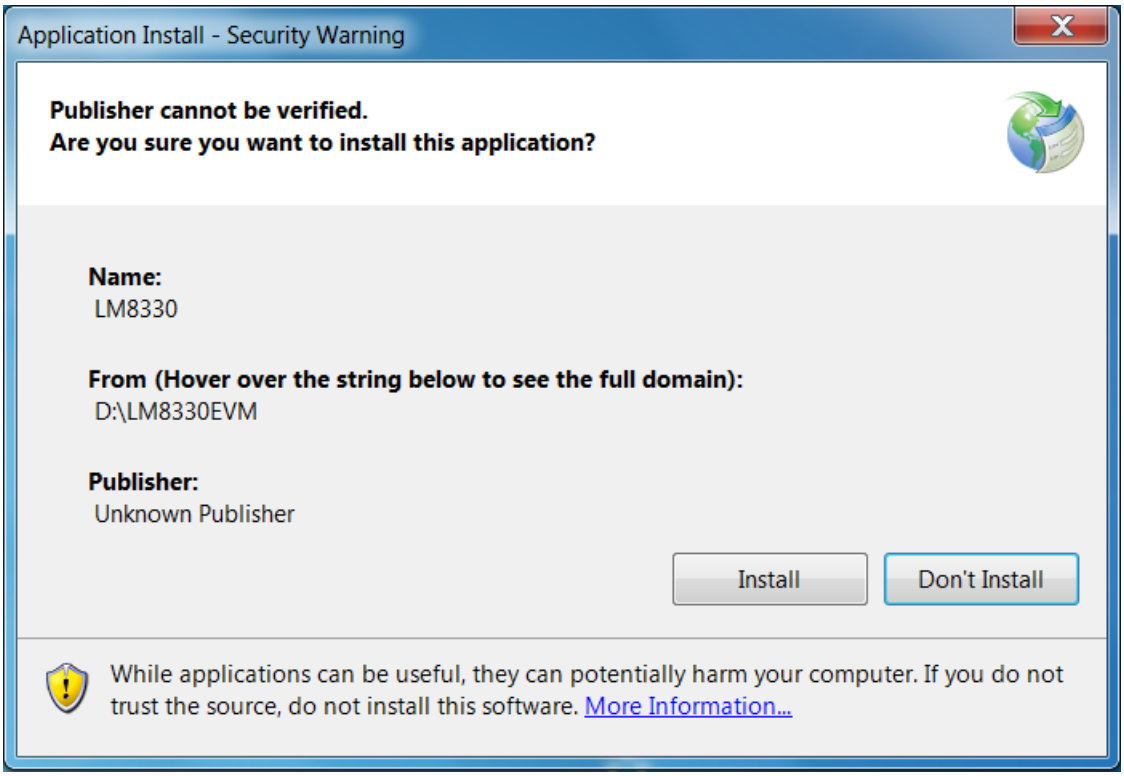

Figure 3-2. LM8330EVM GUI Install

3. Launch the GUI from Start > All Programs > Texas Instruments, Inc > LM8330.

3.2 GUI Functionality

The LM8330 GUI is organized into six sections:

- Control Access: establishes the USB connection between PC and EVM
- Initialization and LED Control: provides access to the LED and initialization of the LM8330
- I2C Access: provides single byte read and write access to any I^2C Slave Address
- LM8330 Registers: provides multi-byte read and write access to the LM8330
- Keypad Status : indicates the status of the keypad (key pressed or released)
- Keypad Test: provides test capability to verify each key press & release

3.2.1 Control Access

The control access section is used to establish the USB connection between PC and EVM after the USB cable is connected. Click the Open button to establish the USB connection. The Serial and Firmware Version fields will be updated if the USB connection is properly established. Clicking the Close button will disable USB access, reinitialize the LM8330 to default values, and reset all GUI settings to the default values. Anytime the USB cable is disconnected the Close button will need to be clicked or the program terminated by clicking on the Windows Close ICON in the upper right hand corner of the GUI Window.

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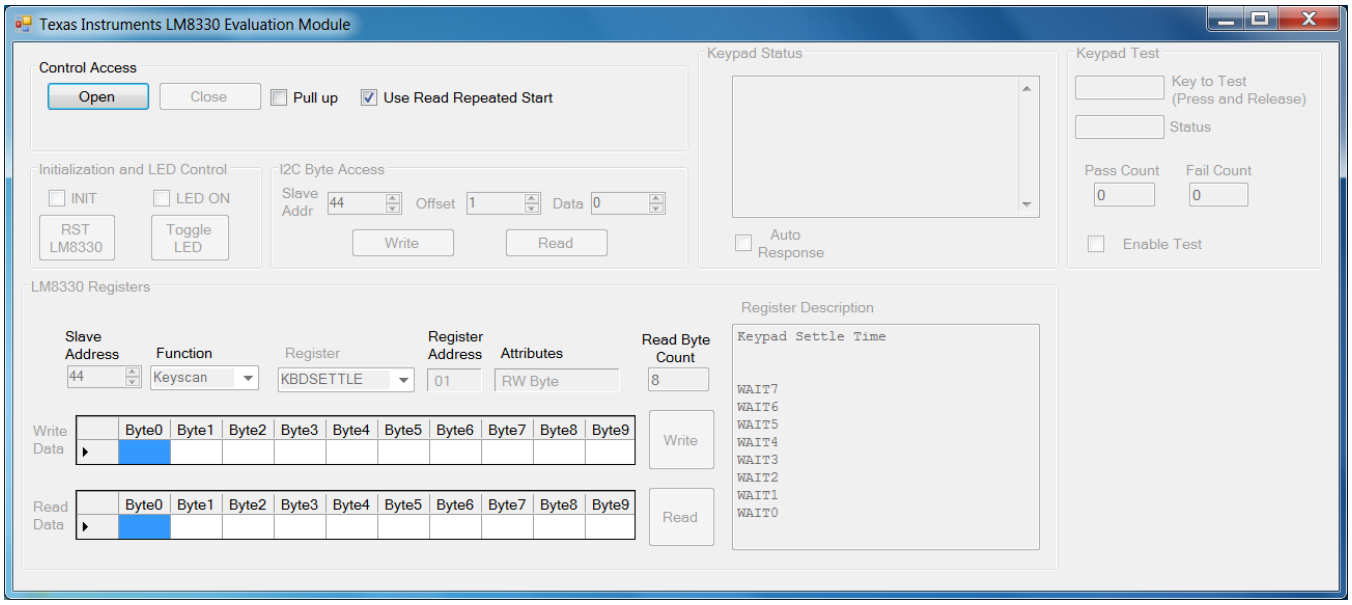

Figure 3-3. LM8330 GUI Initial Screen

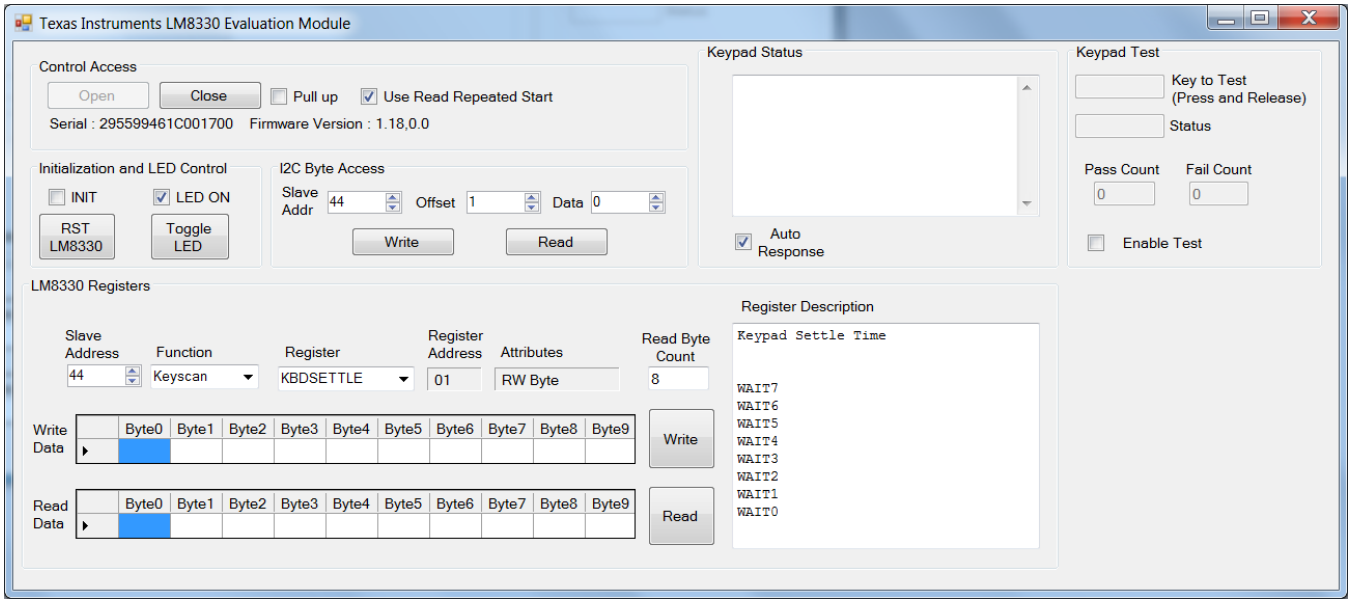

Figure 3-4. LM8330 GUI Open Success Screen

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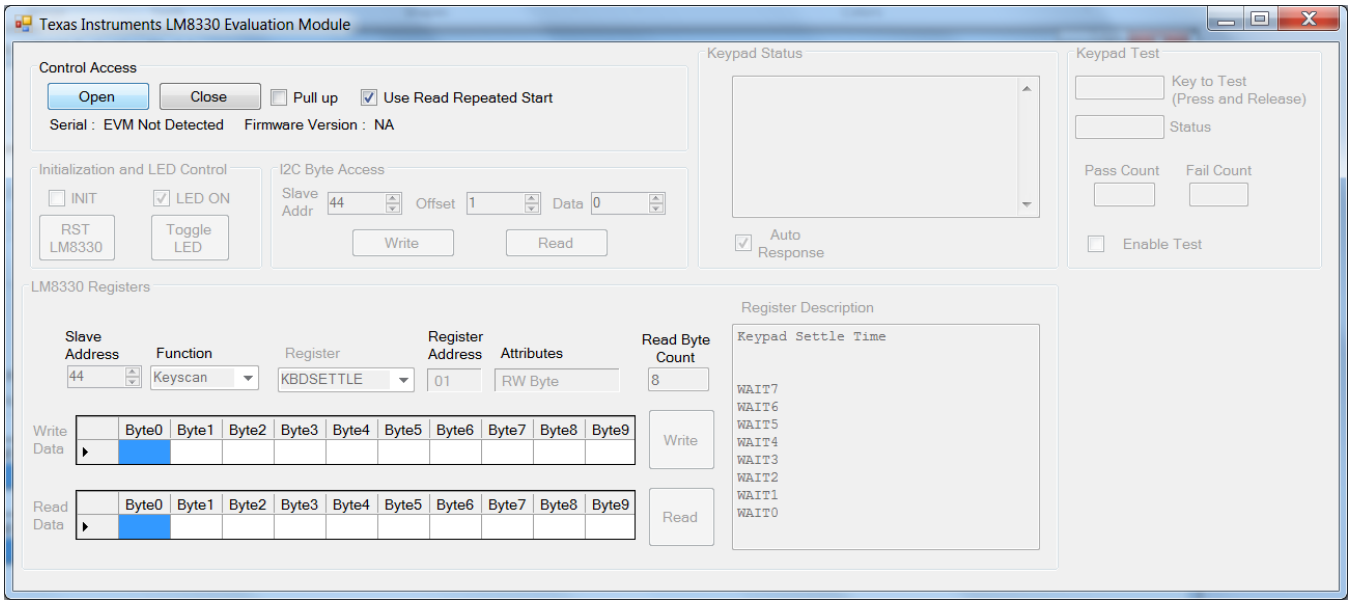

Figure 3-5. LM8330 GUI Open Error Screen

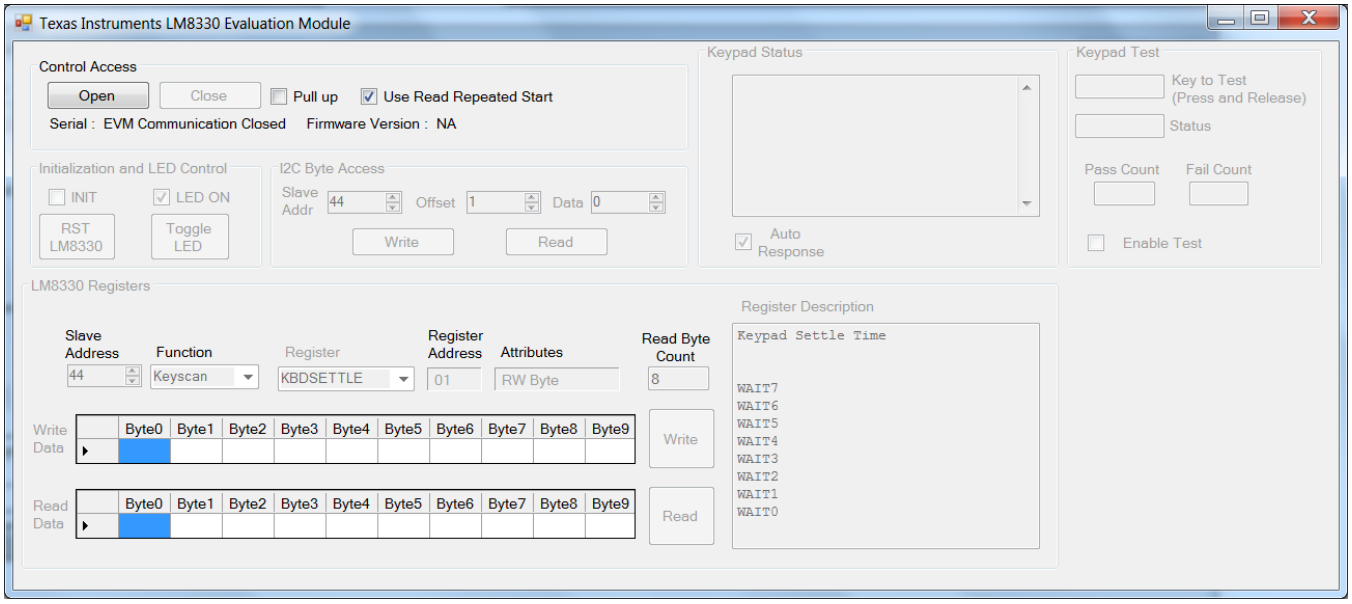

Figure 3-6. LM8330 GUI Close Screen

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3.2.2 Initialization and LED Control

The initialization and LED control provides LM8330 initialization, LM8330 reset and control of the LED mounted on the EVM. The initialization checkbox needs to be checked to configure the LM8330 for 8x10 keypad scanning. The LED control is provided to verify USB communication to the EVM.

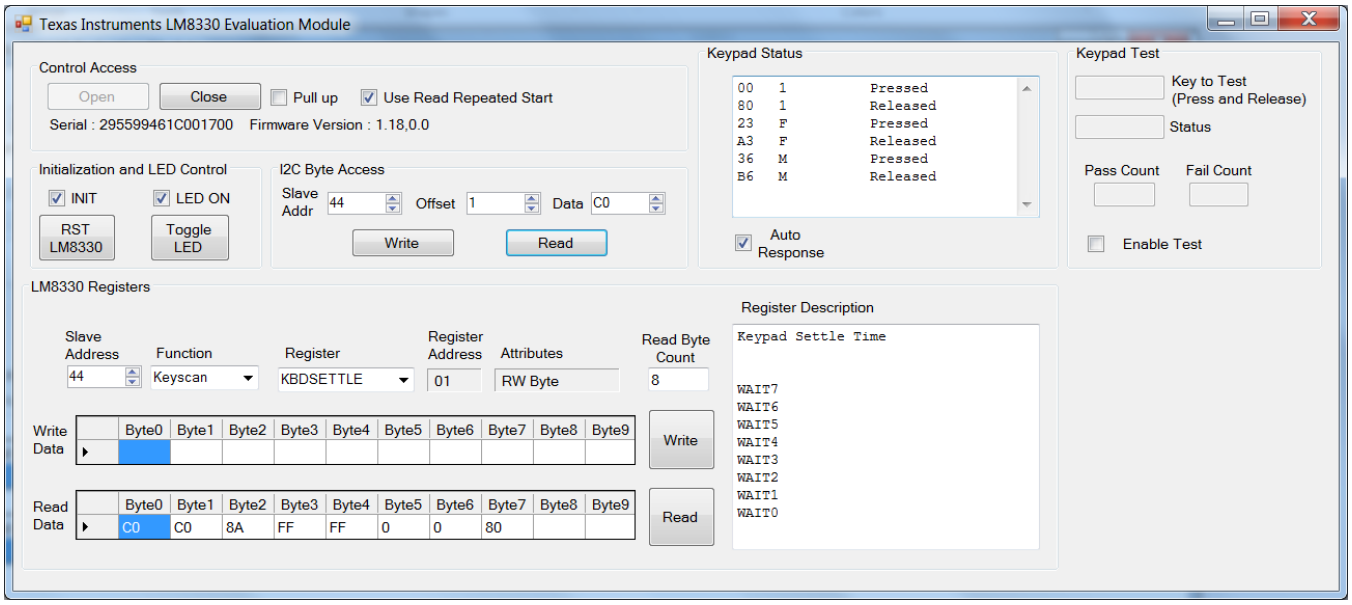

Figure 3-7. LM8330 Initialization Example

3.2.3 I2C Byte Access

The I^2C Byte Access section provides single byte read and write access to any slave address. The data field is used for both read and write operation. Note: the Slave Addr, Offset and Data fields are independent from the corresponding fields in the LM8330 registers section.

3.2.4 LM8330 Registers

The LM8330 registers section provides multi-byte read and write access to the LM8330 registers. The LM8330 registers are organized by function as follows:

1. Keyscan: provides access to the Keyscan specific registers
2. PWM: provides access to the PWM specific registers
3. System: provides access to the System registers
4. GPIO: provides access to the GPIO specific registers

When the specific register is selected via the register dialog box the Register Address, Attributes, and Register Description fields are updated with the specific register information. The multi-byte write access will begin at the address indicated in the Register Address field with the number of data bytes entered in the Write Data grid beginning with Byte 0 (Note: the maximum number of bytes written is limited to 10) when the Write button is clicked. The multi-byte read access will begin at the address indicated in the Register Address field for the number of bytes entered in the Read Byte Count box (Note: the maximum number of bytes read is limited to 10) when the Read button is clicked.

3.2.5 Keypad Status

The Keypad Status section provides direct reporting of the Key Code, Key Value, and Key State. This information is automatically updated by responding to the LM8330 interrupt (IRQN). If desired the interrupt response can be disabled by unchecking the Auto Response checkbox. When operating in this mode the user will need to manually read the EVTCODE register to ensure that no Key Codes are lost by overflow of the EVTCODE buffer.

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3.2.6 Keypad Test

The Keypad Test Section provides test capability of the LM8330EVM Keypad. The keypad test is executed as follows:

- Initialize the LM8330 by clicking on the INIT box in the Initialization and LED Control section
- Enable the Keypad test by clicking on the Enable Test box in the Keypad Test section
- Pressing/releasing the Key indicated in the Key to Test box in the Keypad Test section

The keypad test begins with the "1" key and advances through all ten columns and all five rows of the keypad (refer to Figure 3-8). The Status, Pass Count, and Fail Count fields are updated as the test progresses (Note: all 49 keys must be pressed/released to complete the keypad test refer to Figure 3-9 and Figure 3-10).

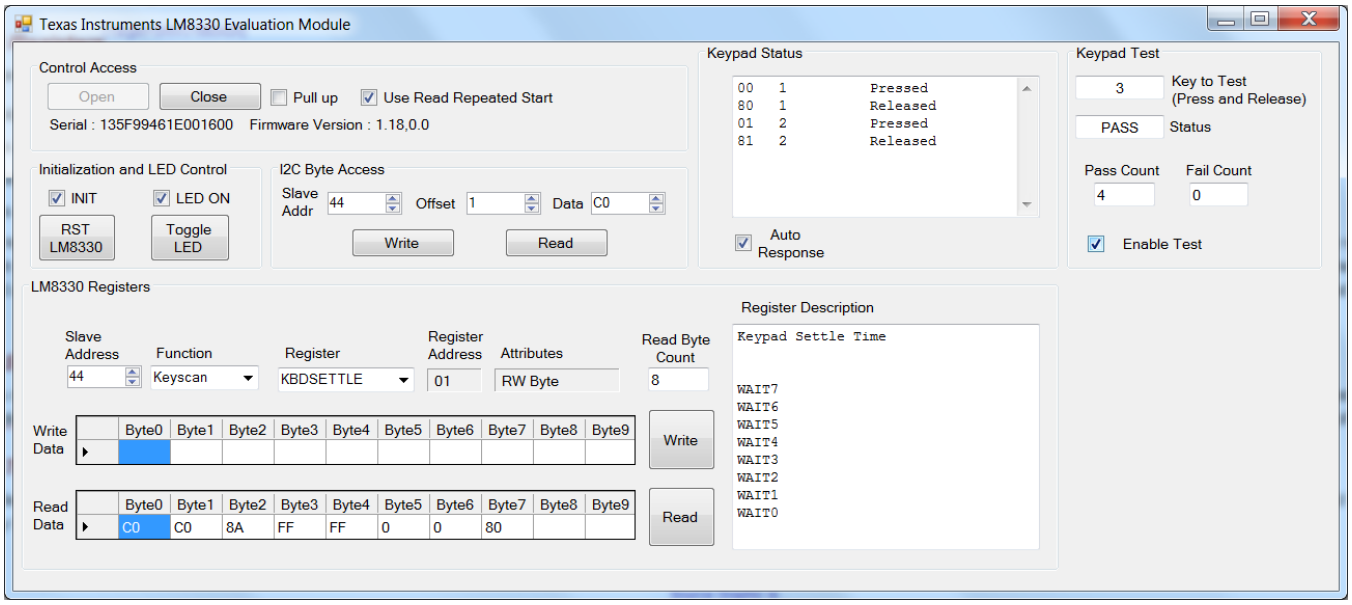

Figure 3-8. LM8330 GUI Keypad Test

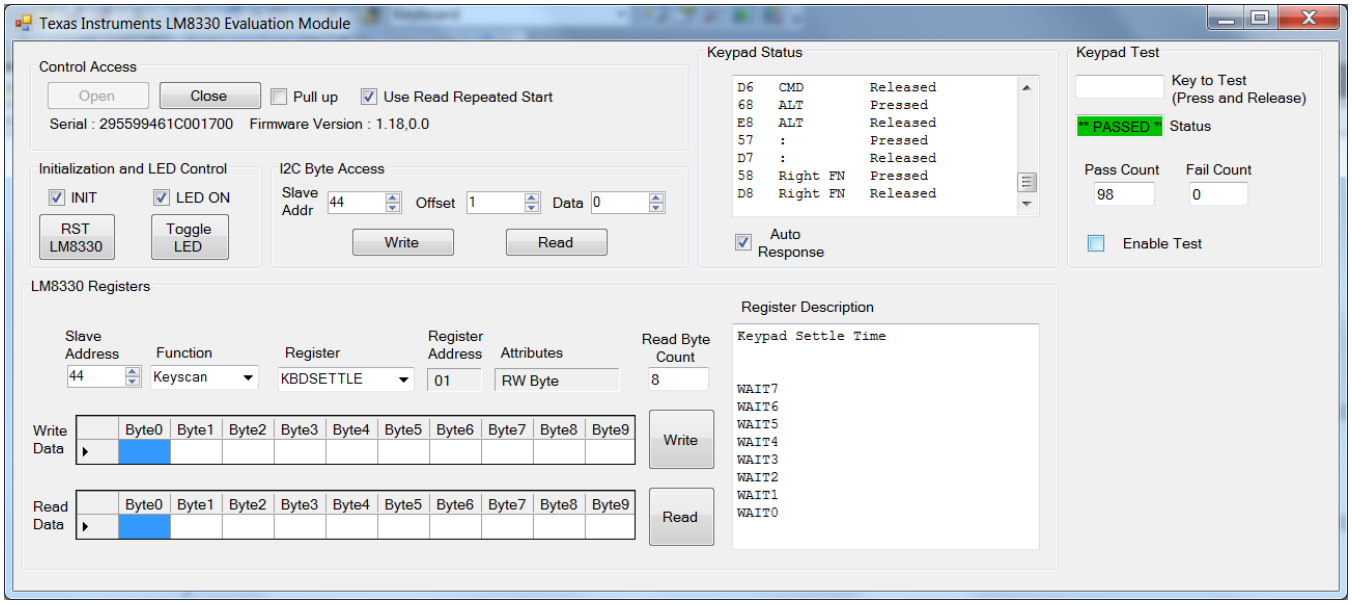

Figure 3-9. LM8330 GUI Keypad Test Passed Example

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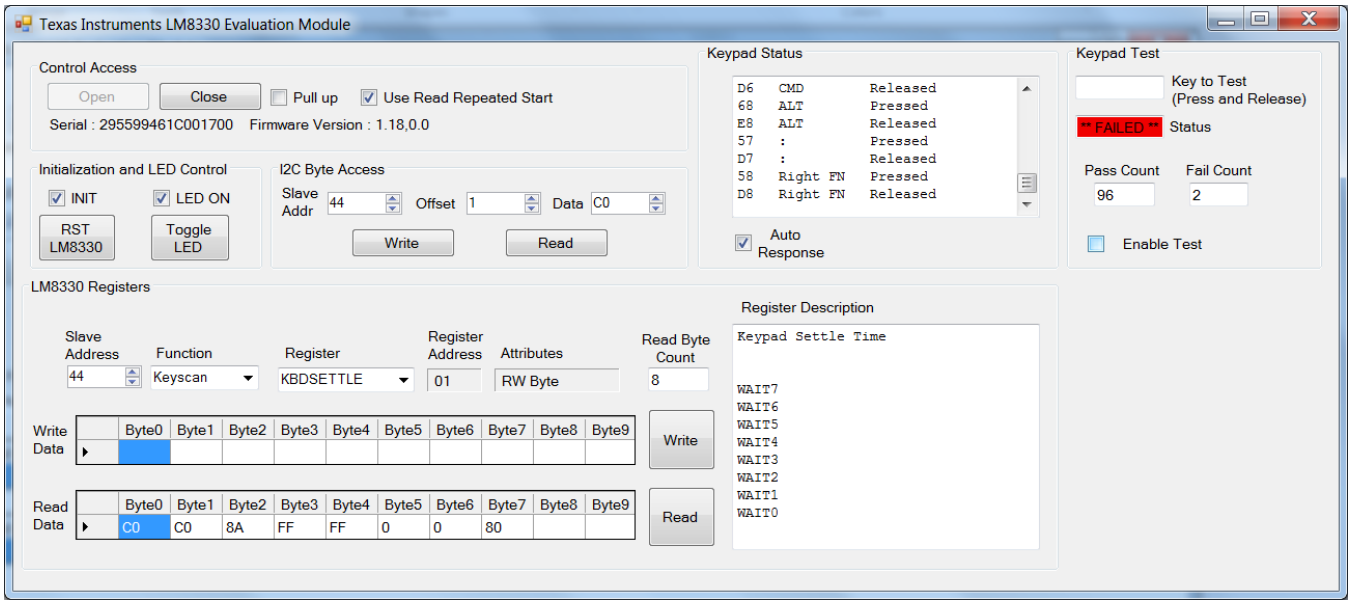

Figure 3-10. LM8330 GUI Keypad Test Failed Example

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Related Documentation from Texas Instruments

LM8330 I^2C-Compatible Keypad Controller with GPIO, PWM and IEC61000 ESD Protection data sheet ()

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

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.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 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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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
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. 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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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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