User's Guide
TPS38700Q1EVM Voltage Sequencer

TEXAS INSTRUMENTS

ABSTRACT

This user guide describes the operational use of the TPS38700Q1EVM evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TPS38700-Q1 Multichannel I2C Programmable Voltage Sequencer. This guide contains the EVM schematic, bill of materials (BOM), assembly drawing, and top and bottom board layouts.

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1 Introduction

The TPS38700Q1EVM is an evaluation module (EVM) for the TPS38700-Q1 Multichannel I2C Programmable Voltage Sequencer. Test points are provided to give the user additional access, if needed, for oscilloscope or multi-meter measurements.

The TPS38700Q1EVM comes pre-populated with TPS38700C03NRGERQ1. This option offers NEM_PD pin which allow the system to issue an emergency power down while also being able to sequence up to ten different devices all with a precise predefined sequence. The device also offers the option of battery backup power, a precise 32.768 kHz clock, and the ability to communicate faults via I2C. ACT and $\overline{\text{SLEEP}}$ pins allow for the device to change state depending on the logic level present on each. The NIRQ pin serves as an interrupt flag to alert the system to possible faults, and the NRST pin asserts logic high under reset condition.

Figure 1-1. TPS38700Q1EVM Board Top
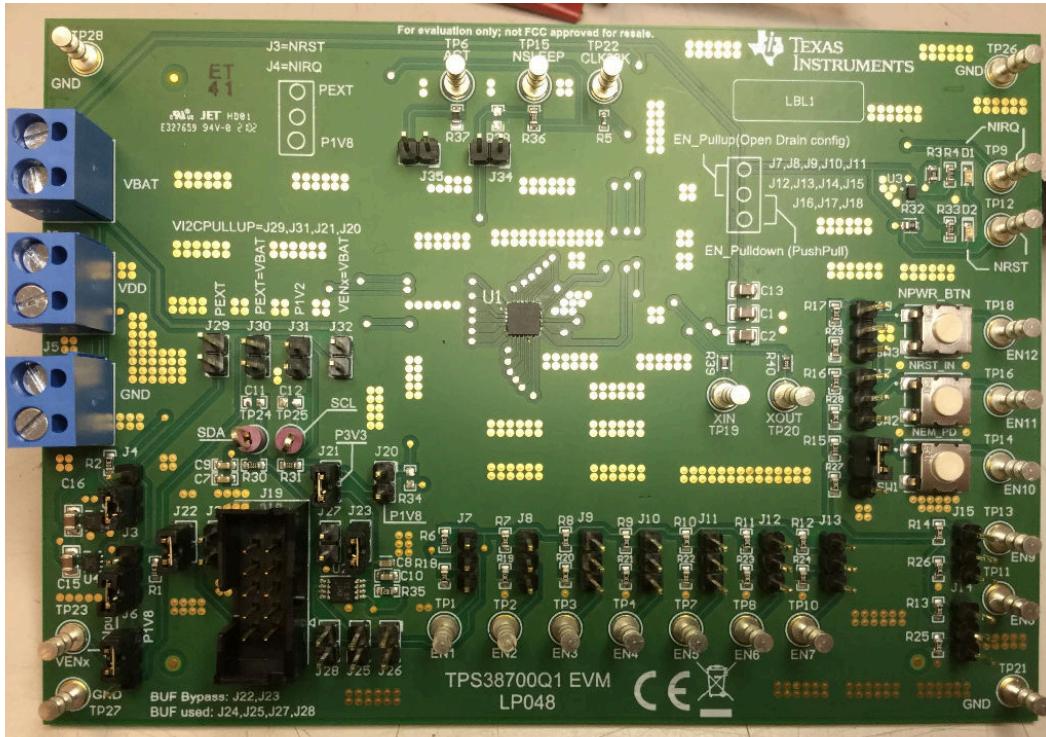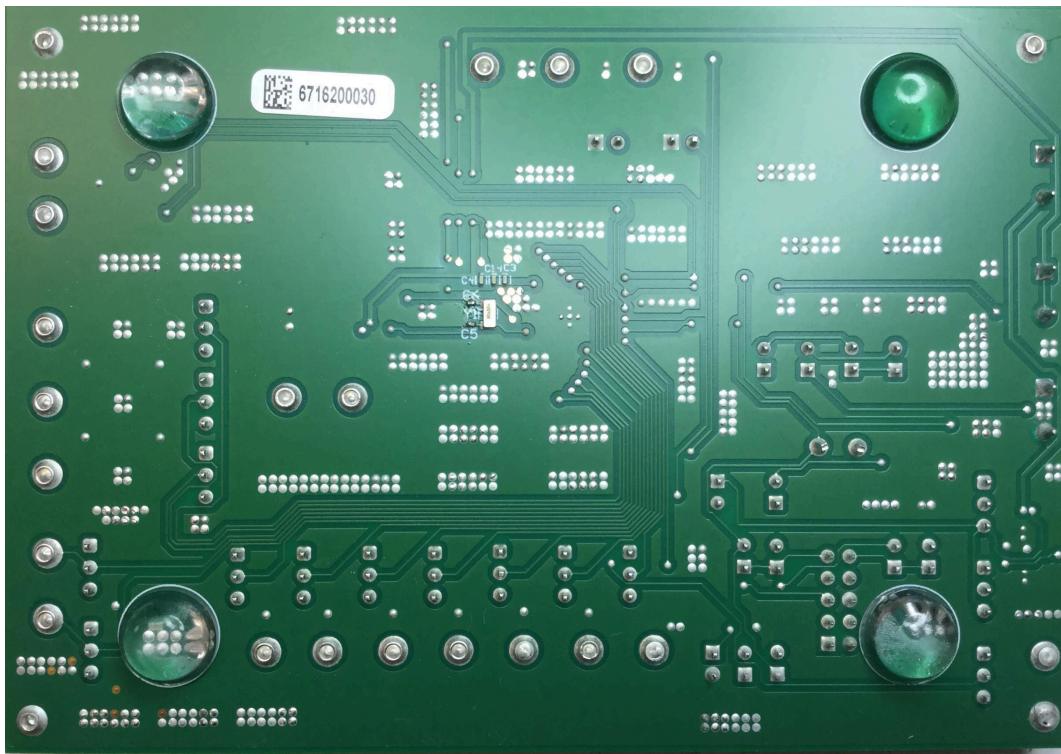
Figure 1-2. TPS38700Q1EVM Board Bottom

1.1 Related Documentation

Datasheet: *TPS38700-Q1 Multichannel I2C Programmable Voltage Sequencer*

1.2 TPS38700-Q1 Applications

- Advanced Driver Assistance System (ADAS)
- Medical robotics
- Industrial robotics

2 Schematic, Bill of Materials, and Layout

This section provides a detailed description of the TPS38700Q1EVM schematic, bill of materials (BOM), and layout.

2.1 TPS38700Q1EVM Schematic

Figure 2-1. TPS38700Q1EVM Schematic 1 of 2
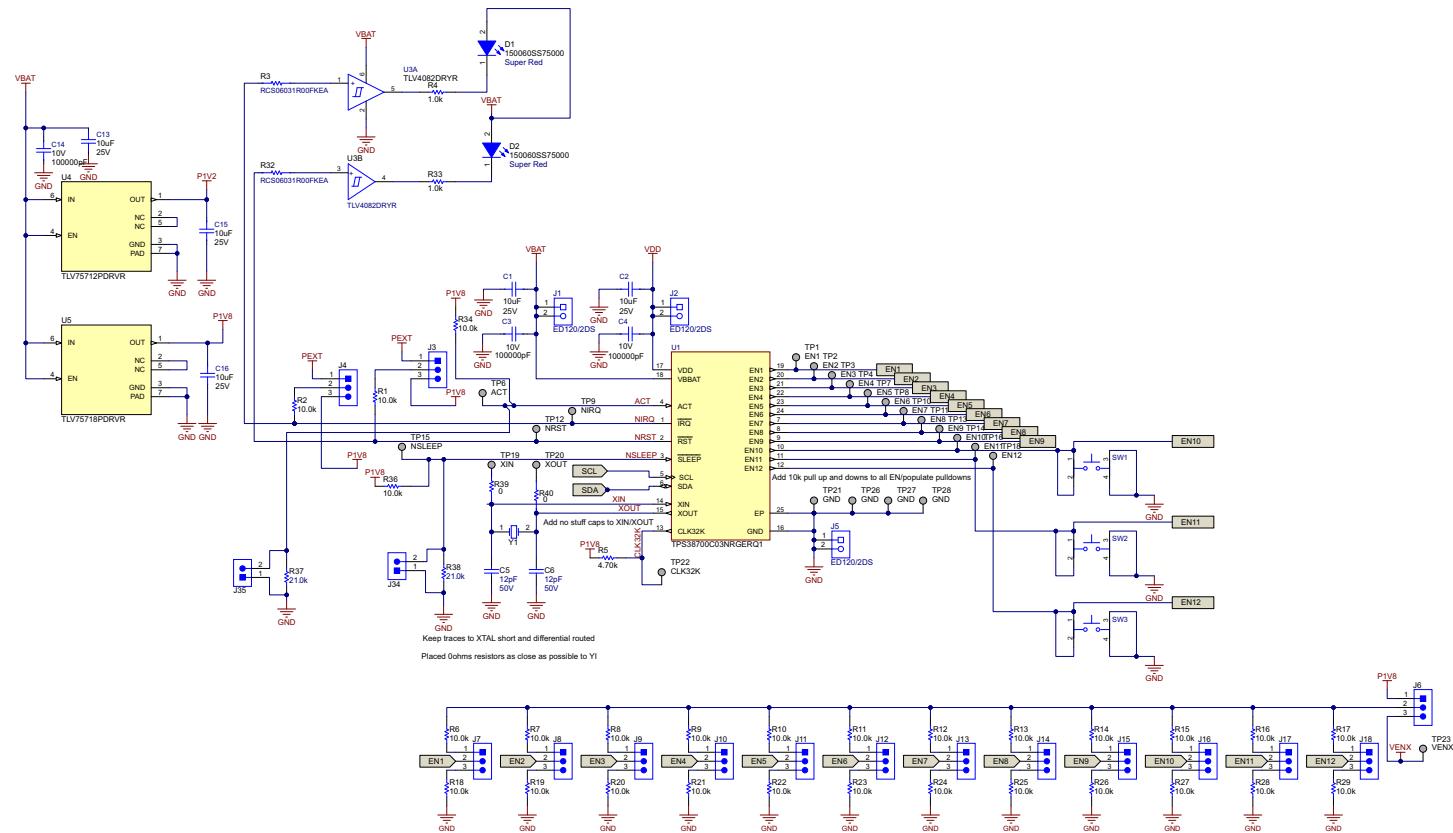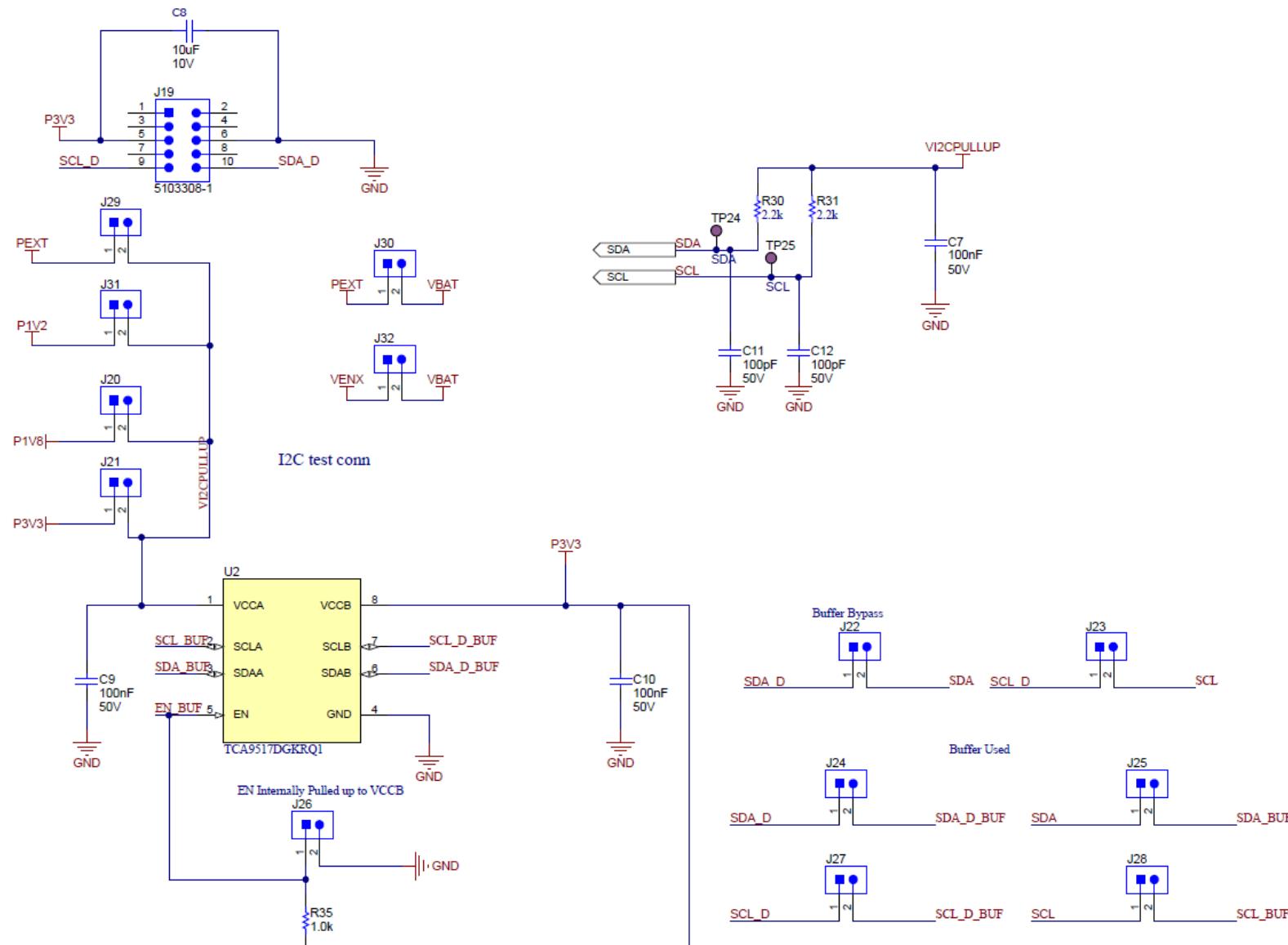
Figure 2-2. TPS38700Q1EVM Schematic 2 of 2

2.2 TPS38700Q1EVM Bill of Materials

Table 2-1. BOM

| DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
PCB	1		Printed Circuit Board		LP048	Any
C1, C2, C13, C15, C16	5	10 µF	10 µF ±10% 25 V Ceramic Capacitor X7S 0805 (2012 Metric)	0805	C2012X7S1E106K125AC	TDK
C3, C4, C14	3	0.1 µF	0.1 µF ±10% 10 V Ceramic Capacitor X7R 0402 (1005 Metric)	0402	885012205018	Wurth Electronics
C5, C6	2	12 pF	CAP, CERM, 12 pF, 50 V, +/- 5%, C0G/NP0, 0201	0201	GRM0335C1H120JA01D	MuRata
C7, C9, C10	3	0.1 µF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603	06035C104KAT2A	AVX
C8	1	10 µF	10 µF ±10% 10 V Ceramic Capacitor X5R 0603 (1608 Metric)	0603	C1608X5R1A106K080AC	TDK
C11, C12	2	100 pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A101JAT2A	AVX
D1, D2	2	Red	LED, Super Red, SMD	SMD	150060SS75000	Wurth Elektronik
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.		N/A	N/A
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear		SJ-5303 (CLEAR)	3M
J1, J2, J5	3		Terminal Block, 5.08 mm, 2x1, Brass, TH	2x1 TH	ED120/2DS	On-Shore Technology
J3, J4, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J17, J18	15		Header, 100mil, 3x1, Gold, TH	3x1 TH	TSW-103-07-G-S	Samtec
J19	1		Header (shrouded), 100mil, 5x2, Gold, TH	5x2 TH	5103308-1	TE Connectivity
J20, J21, J22, J23, J24, J25, J26, J27, J28, J29, J30, J31, J32, J34, J35	15		Header, 100mil, 2x1, Gold, TH	2x1 TH	TSW-102-07-G-S	Samtec
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll		THT-14-423-10	Brady
R1, R2, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R28, R29	26	10.0 kΩ	RES, 10.0 kΩ, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo
R3, R32	2	1 Ω	1 Ω ±1% 0.25 W, ¼ W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200, Pulse Withstanding Thick Film	0603	RCS06031R00FKEA	Vishay
R4, R33	2	1.0 kΩ	RES, 1.0 kΩ, 5%, 0.1 W, 0603	0603	RC0603JR-071KL	Yageo
R5	1	4.7 kΩ	RES, 4.70 kΩ, 1%, 0.063 W, 0402	0402	CRG0402F4K7	TE Connectivity
R30, R31	2	2.2 kΩ	RES, 2.2 kΩ, 5%, 0.1 W, 0603	0603	RC0603JR-072K2L	Yageo
R34, R36	2	10.0 kΩ	RES, 10.0 kΩ, 1%, 0.1 W, 0603	0603	RCG060310K0FKEA	Vishay Draloric

Table 2-1. BOM (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
R35	1	1.0 kΩ	RES, 1.0 kΩ, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R37, R38	2	21.0 kΩ	RES, 21.0 kΩ, 1%, 0.1 W, 0603	0603	RC0603FR-0721KL	Yageo
R39, R40	2	0 Ω	0 Ω Jumper 0.1 W, 1/10 W Chip Resistor 0603 (1608 Metric) Automotive AEC-Q200 Thick Film	0603	ERJ-3GEY0R00V	Panasonic
SW1, SW2, SW3	3		Switch Tactile N.O. SPST Round Button J-Bend 32VAC 32 VDC 1VA 100000Cycles 3N SMD Tube/T/R	SMD	KT11P3JM34LFS	C&K Components
TP1, TP2, TP3, TP4, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP18, TP19, TP20, TP21, TP22, TP23, TP26, TP27, TP28	24		Terminal, Turret, TH, Triple	TH	1598-2	Keystone
TP24, TP25	2		Test Point, Multipurpose, Purple, TH	TH	5129	Keystone
U2	1		Automotive, Level-Shifting I2C Bus Repeater, DGK0008A (VSSOP-8)	VSSOP-8	TCA9517DGKRQ1	Texas Instruments
U3	1		Dual-Channel, Low-Power Comparator with Integrated Reference (USON)	USON	TLV4082DRYR	Texas Instruments
U4	1		1 A Low-Quiescent-Current Low-Dropout (LDO) Regulator, DRV0006A (WSON-6)	WSON-6	TLV75712PDRVR	Texas Instruments
U5	1		1 A Low-Quiescent-Current Low-Dropout (LDO) Regulator, DRV0006A (WSON-6)	WSON-6	TLV75718PDRVR	Texas Instruments
U1	1		ASIL-B Multichannel I2C Programmable Voltage Sequencer (VQFN)	VQFN	TPS38700C03NRGERQ1	Texas Instruments
Y1	1		Crystal, 32.768 kHz, 12.5 pF, SMD	SMD	NX3215SA-32.768K-STD-MUA-8	NDK

2.3 Layout and Component Placement

Figure 2-3 and Figure 2-4 show the top and bottom assemblies of the printed circuit board (PCB) to show the component placement on the EVM.

Figure 2-5 and Figure 2-6 show the top and bottom layouts, Figure 2-7 and Figure 2-8 show the top and bottom layers, and Figure 2-9 shows the top solder mask of the EVM.

2.4 Layout
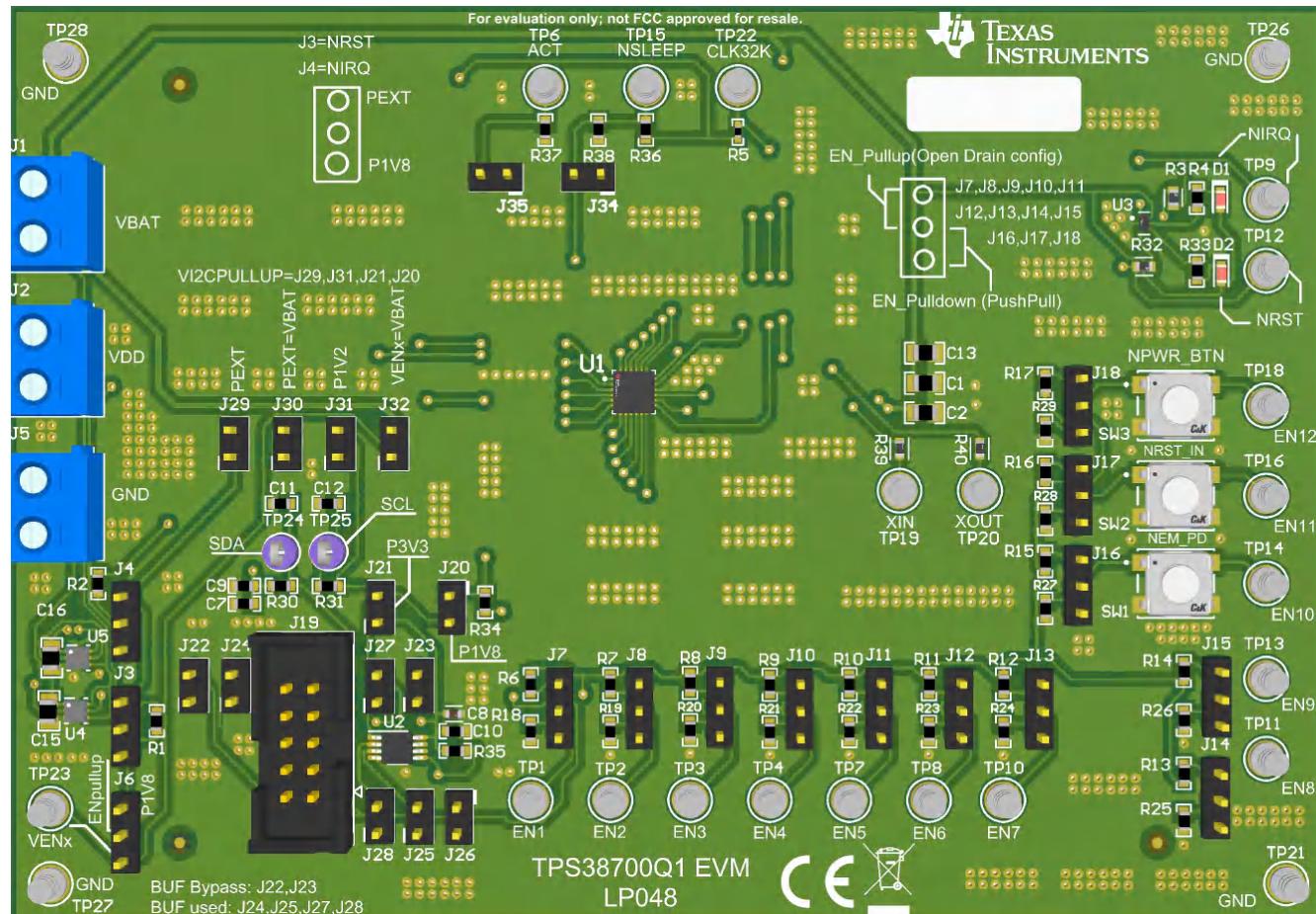
**Figure 2-3. Component Placement—Top Assembly**
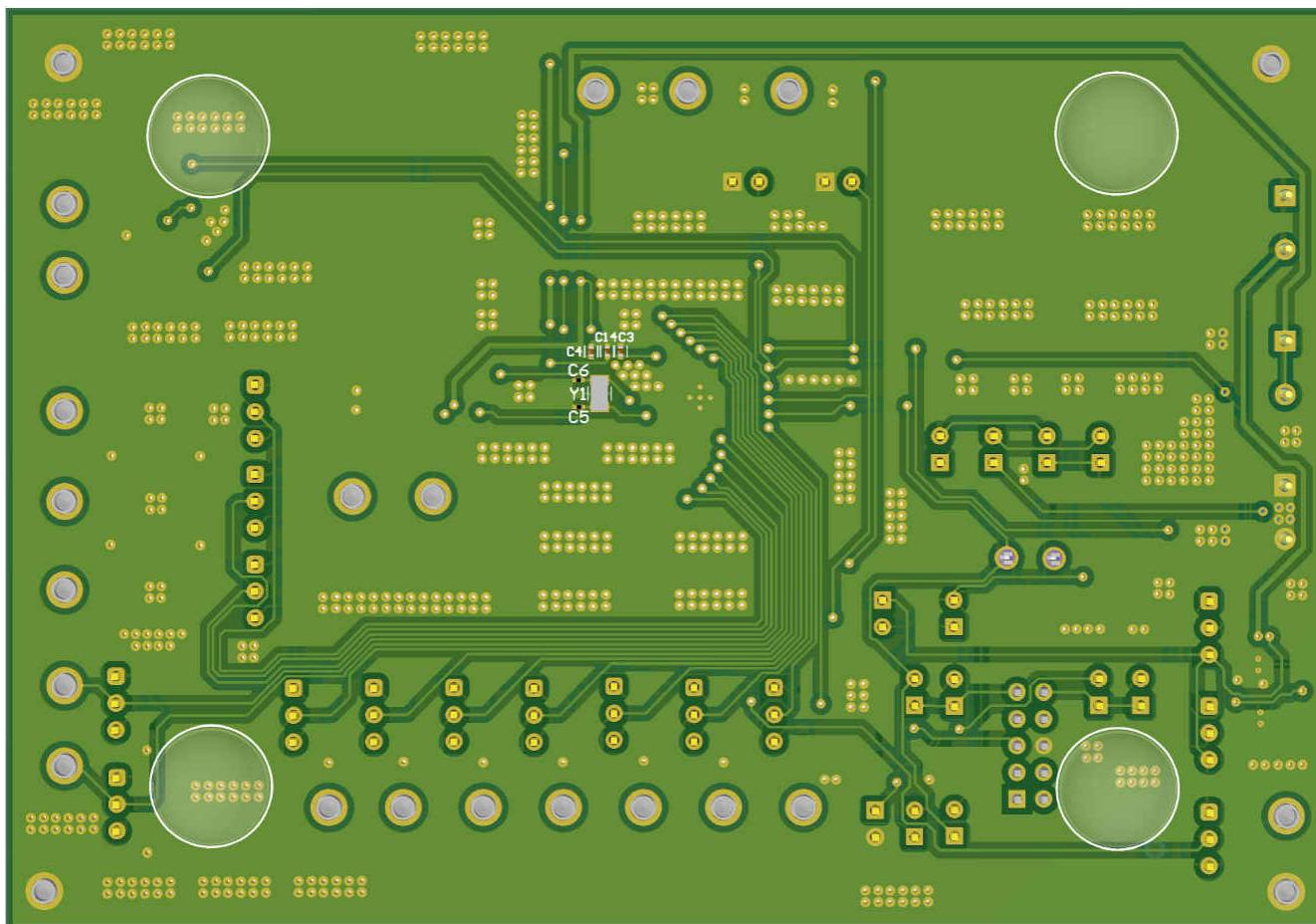
Figure 2-4. Component Placement—Bottom Assembly
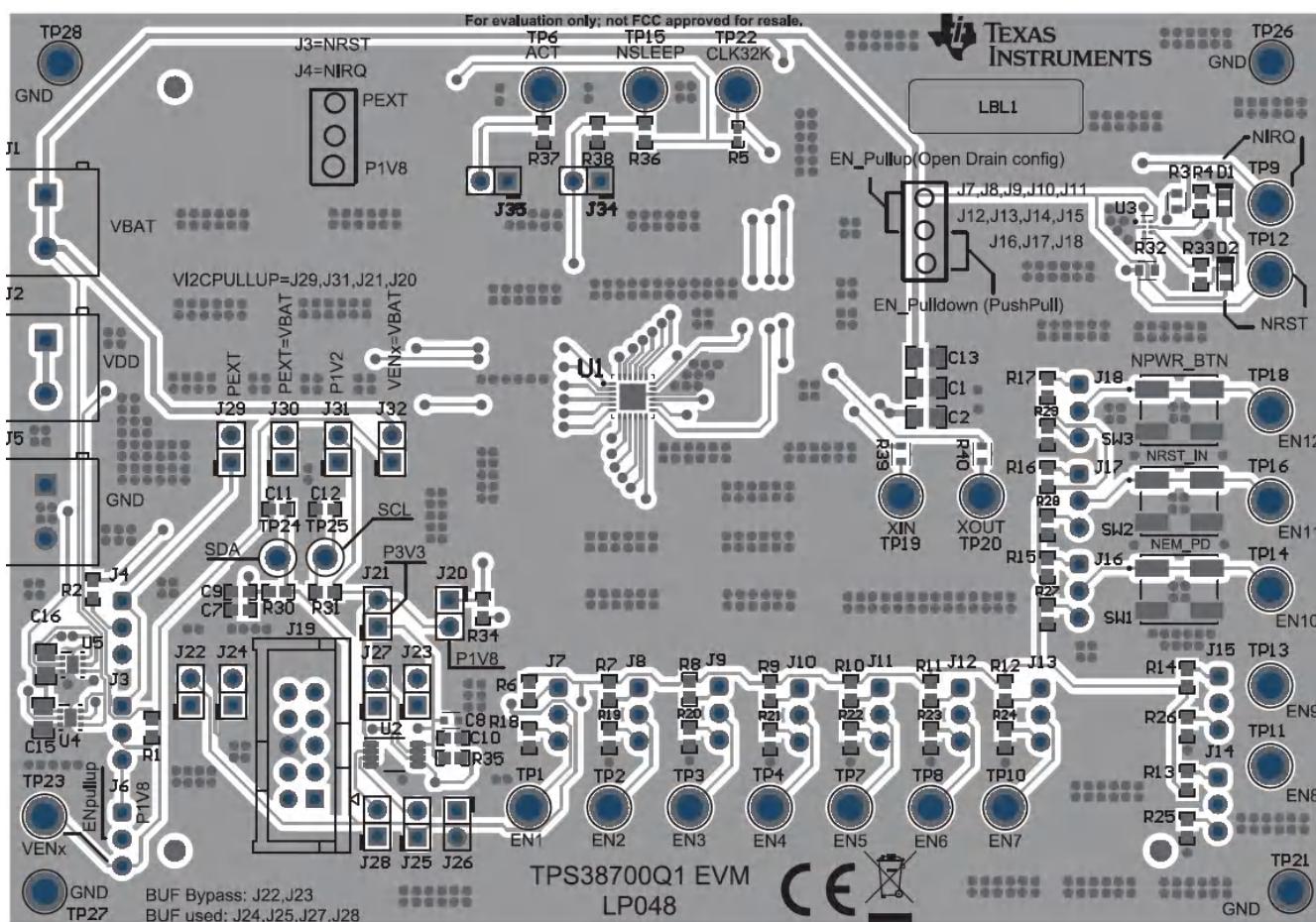
Figure 2-5. Layout—Top
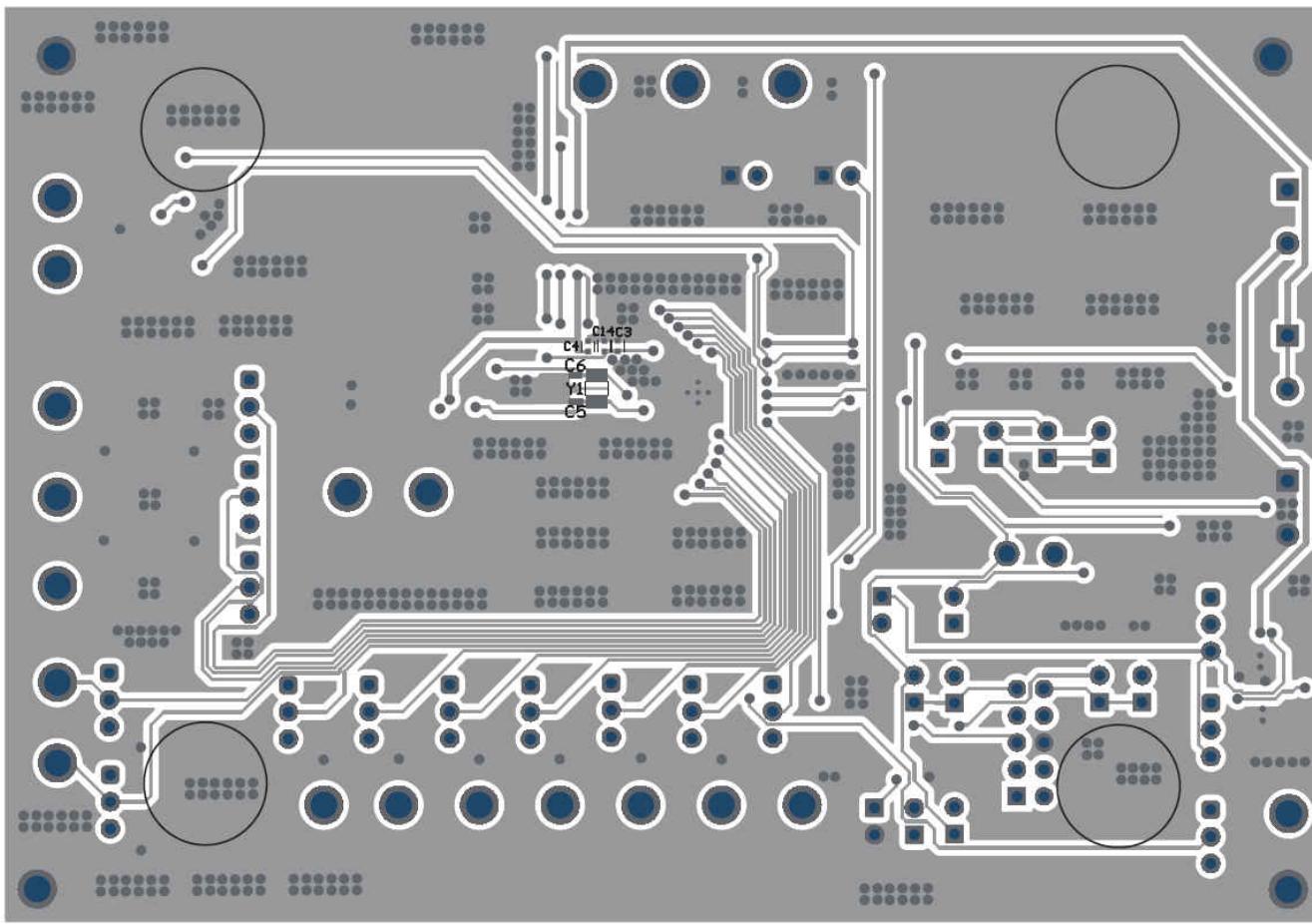
Figure 2-6. Layout—Bottom
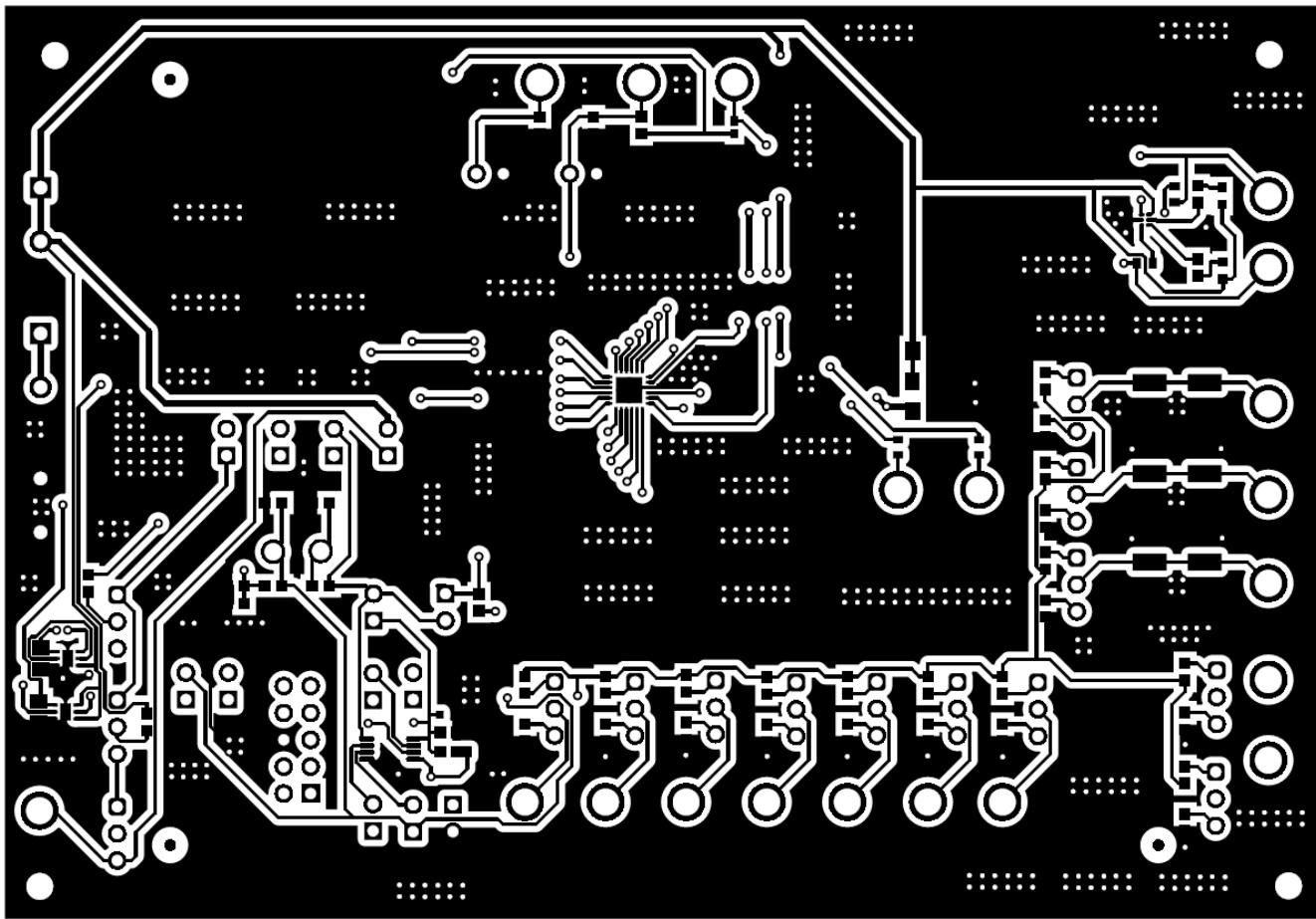
Figure 2-7. Top Layer
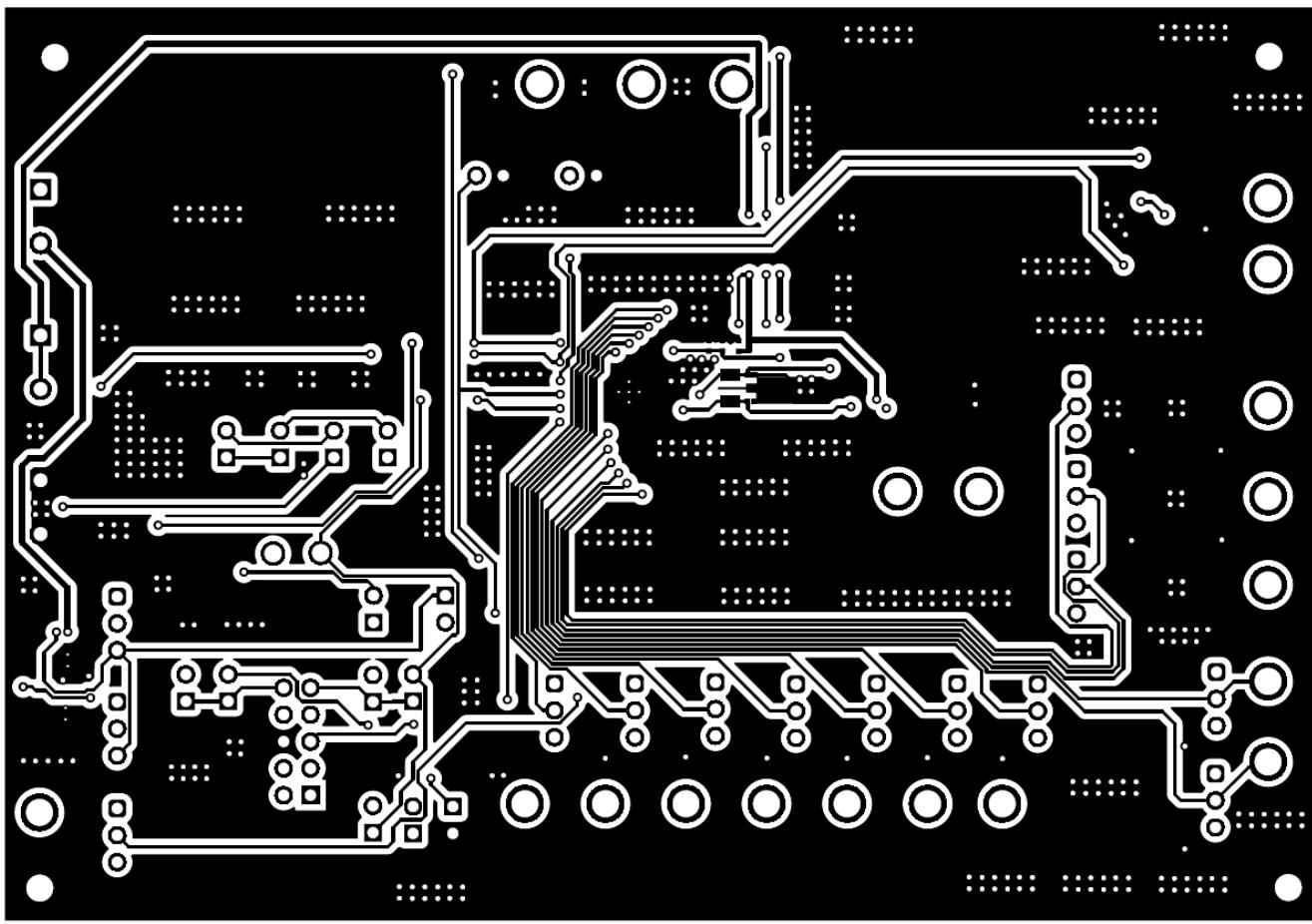
Figure 2-8. Bottom Layer
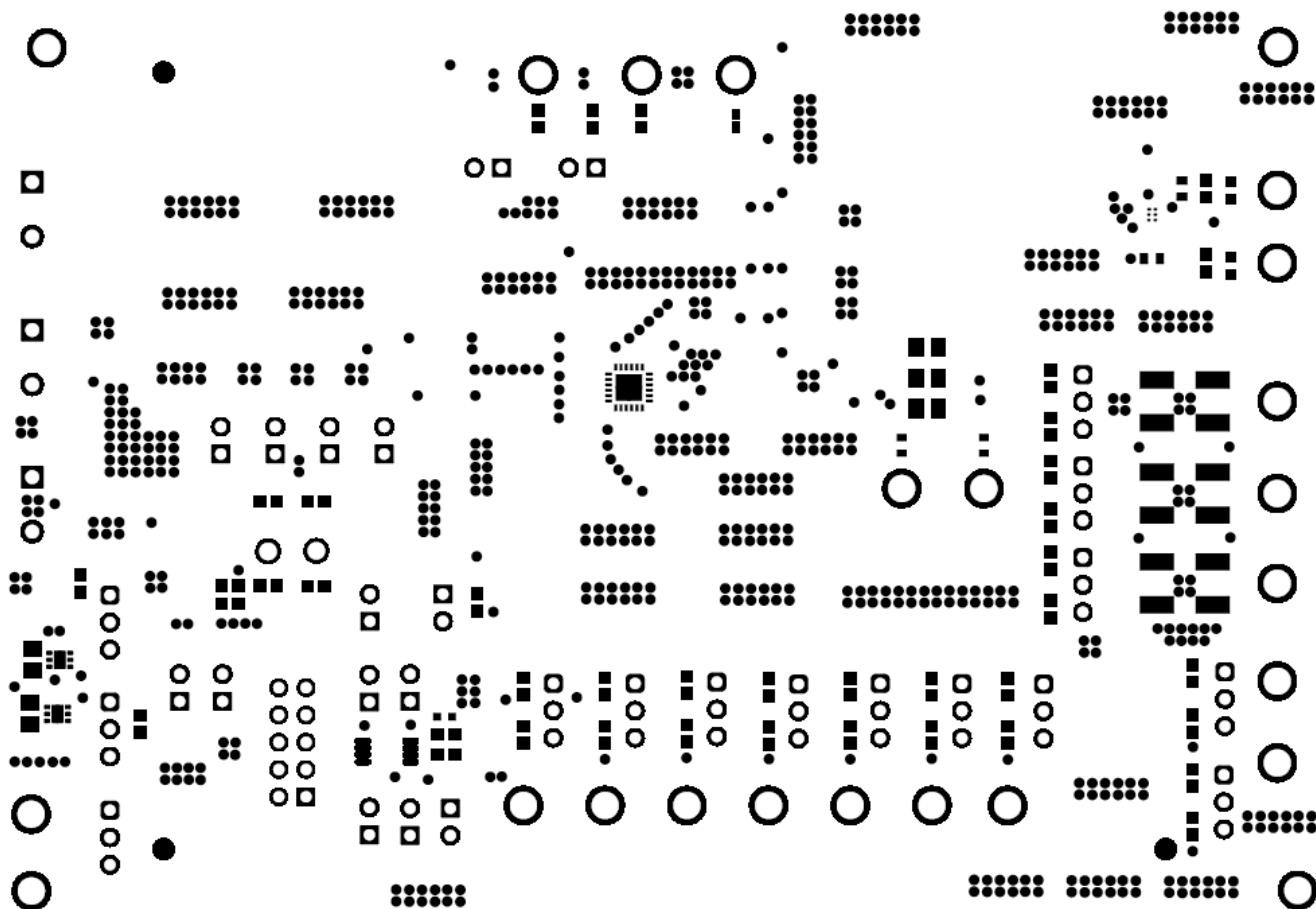
Figure 2-9. Top Solder Mask

3 EVM Connectors

This section describes the connectors, jumpers, and test points on the EVM as well as how to connect, set up, and properly use the EVM. Each device has an independent supply connection, but all grounds are connected on the board.

3.1 EVM Test Points

Table 3-1 lists the EVM test points as well as their functional descriptions. All TPS38700-Q1 pins have a corresponding test point on the EVM. These test points are located close to the pins for more accurate measurements. In addition to the test points listed below, the EVM also has four additional GND test points.

Table 3-1. Test Points

TEST POINT NUMBER	TEST POINT SILKSCREEN LABEL	FUNCTION	DESCRIPTION
TP1	EN1	Connection to EN1 pin	Allows the user to monitor the SENSE1 pin
TP2	EN2	Connection to EN2 pin	Allows the user to monitor the EN2 pin
TP3	EN3	Connection to EN3 pin	Allows the user to monitor the EN3 pin
TP4	EN4	Connection to EN4 pin	Allows the user to monitor the EN4 pin
TP6	ACT	Connection to ACT pin	Allows the user to set ACT input
TP7	EN5	Connection to EN5 pin	Allows the user to monitor the EN5 output
TP8	EN6	Connection to EN6 pin	Allows the user to monitor the EN6 output
TP9	NIRQ	Connection to NIRQ pin	Allows the user to monitor the NIRQ output
TP10	EN7	Connection to EN7 pin	Allows the user to monitor the EN7 output
TP11	EN8	Connection to EN8 pin	Allows the user to monitor the EN8 output
TP12	NRST	Connection to NRST pin	Allows the user to monitor the NRST output
TP13	EN9	Connection to EN9 pin	Allows the user to monitor the EN9 output
TP14	EN10/NEM_PD	Connection to EN10 pin and Emergency Shutdown pin	Allows the user to monitor the EN10 output
TP15	$\overline{SLEEP}$	Connection to $\overline{SLEEP}$ pin	Allows the user to set $\overline{SLEEP}$ input
TP16	EN11/NRST_IN	Connection to EN11 pin and Reset In	Allows the user to monitor the EN11 output
TP18	EN12/NPWR_BTN	Connection to EN12 pin and Power Button	Allows the user to monitor the EN12 output
TP21	GND	GND for EVM	GND for EVM
TP22	CLK32K	Connection to CLK32K pin	Allows the user to monitor the CLK32K output
TP23	VENx	Connection to External Voltage	Allows the user to connect to an external voltage for pulling up enable pins
TP26	GND	GND for EVM	GND for EVM
TP27	GND	GND for EVM	GND for EVM
TP28	GND	GND for EVM	GND for EVM

3.2 EVM Jumpers

Table 3-2 lists the jumpers on the TPS38700Q1EVM. As ordered, the EVM will have sixteen (16) jumpers installed. Figure 3-1 is provided as visual aid.

Table 3-2. List of On-board Jumpers

| JUMPER	DEFAULT JUMPER CONFIGURATION	DESCRIPTION
J1	VBAT	For connecting VBAT power to the EVM
J2	VDD	For connecting VDD power to the EVM
J3 & J4	Shunt to bottom position	For connecting NRST and NIRQ to P1V8 or PEXT (Any external power)
J5	GND	For connecting GND to the EVM
J6	P1V8	For pulling- up ENABLE pins to P1V8 or VENX (Any external voltage)
J7 - J18	No connect	For pulling-up or down ENABLE pins (Only for open-drain configuration)/No connection for push-pull confiugration
J16	Shunt to top position	For pulling-up EN10 pin to P1V8.
J19	Connect	For connecting the EVM to TI's USB Interface Adapter
J20, J29, & J31	No connect	For connecting the on-board buffer to either P1V8, PEXT or P1V2. Only shunt one of these jumpers when using the buffer. Please revmove the shunt of J21 when using one of these jumpers.
J21	Shunt	For connecting the on-board bufffer IC to P3V3
J22 & J23	Shunt	For I2C lines to bypass buffer.
J24, J25, J27 & J28	No connect	For I2C lines to use the on-board buffer.
J30	No connect	For connecting VBAT to PEXT
J32	No connect	For connecting VENX to VBAT
J34 & J35	No connect	For manually pulling down NSLEEP and ACT pins
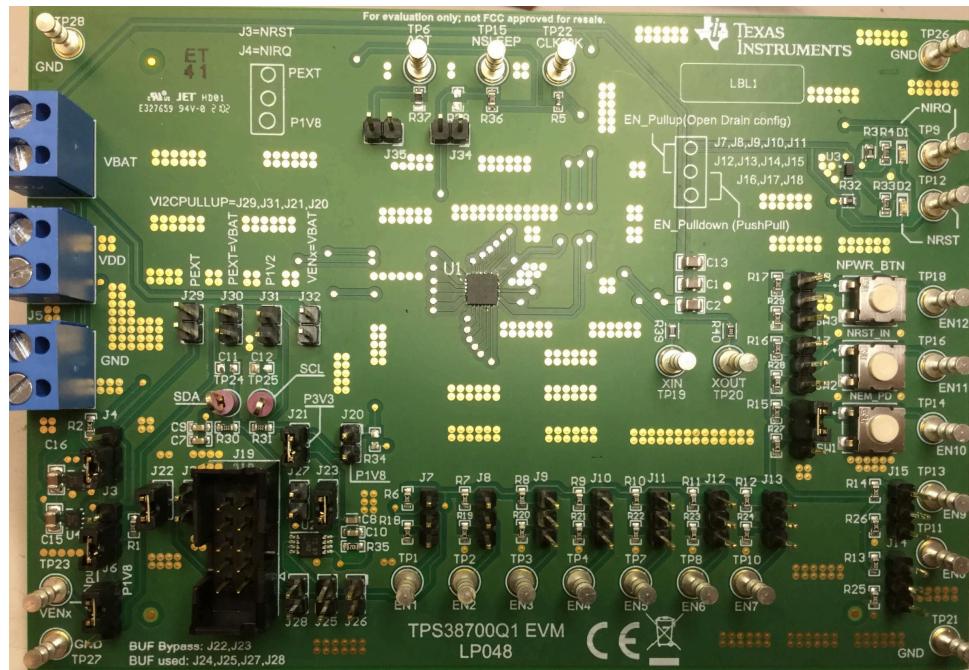
Figure 3-1. Jumper Settings

4 EVM Setup and Operation

This section describes the functionality and operation of the TPS38700Q1EVM. Refer to the TPS38700-Q1 Multichannel I2C Programmable Voltage Sequencer data sheet for details on the electrical characteristics of the device.

The TPS38700Q1EVM comes pre-populated with the TPS38700C03NRGERQ1. The EVM is capable of many different configurations in order to fully evaluate the functionality of all the TPS38700-Q1 device variants. The default configuration of the EVM Jumpers is mentioned in the Table 3-2. The TPS38700Q1EVM comes populated with I2C bus repeater, comparators, LDO, 32.768 kHz crystal and TPS38700C03NRGERQ1 programmable voltage sequencer.

The TPS38700Q1EVM also provides an option to apply a separate pull-up voltage to any of the ENABLE pins by changing the position of jumper J6 to VENx and connecting the pull-up voltage to test points TP23.

Equipment Needed

- TPS38700Q1EVM
- TI's USB Interface Adapter (with ribbon cable)
- Power Supply (3.3 V)
- Function Generator (provide pulse input for evaluation)
- Multi-channel Oscilloscope (review evaluation waveforms)
- Jumper Cables (additional evaluation)

4.1 Setup and GUI Installations

Follow the steps below for EVM connections and GUI installation:

1. Connect VBAT (J1) and VDD (J2) to 3.3 V from the power supply.
2. Connect GND (J5) to ground from the power supply.
3. Make sure the jumpers are connected as per the guidelines in the Table 3-2.
4. Power on the power supply briefly to check if the voltage is at 3.3 V and the quiescent current is at 10 mA. Once reviewed, power down the power supply.
5. Connect the Oscilloscope's channel 1 to TP1, channel 2 to TP2, and channel 3 to TP6.
6. Connect the function generator to TP6.
7. Connect the TI's USB Interface Adapter to J19 using a ribbon cable.
8. Connect the TI's USB Interface Adapter to the computer using the USB.
9. Final connections should look similar to . Figure 4-1.
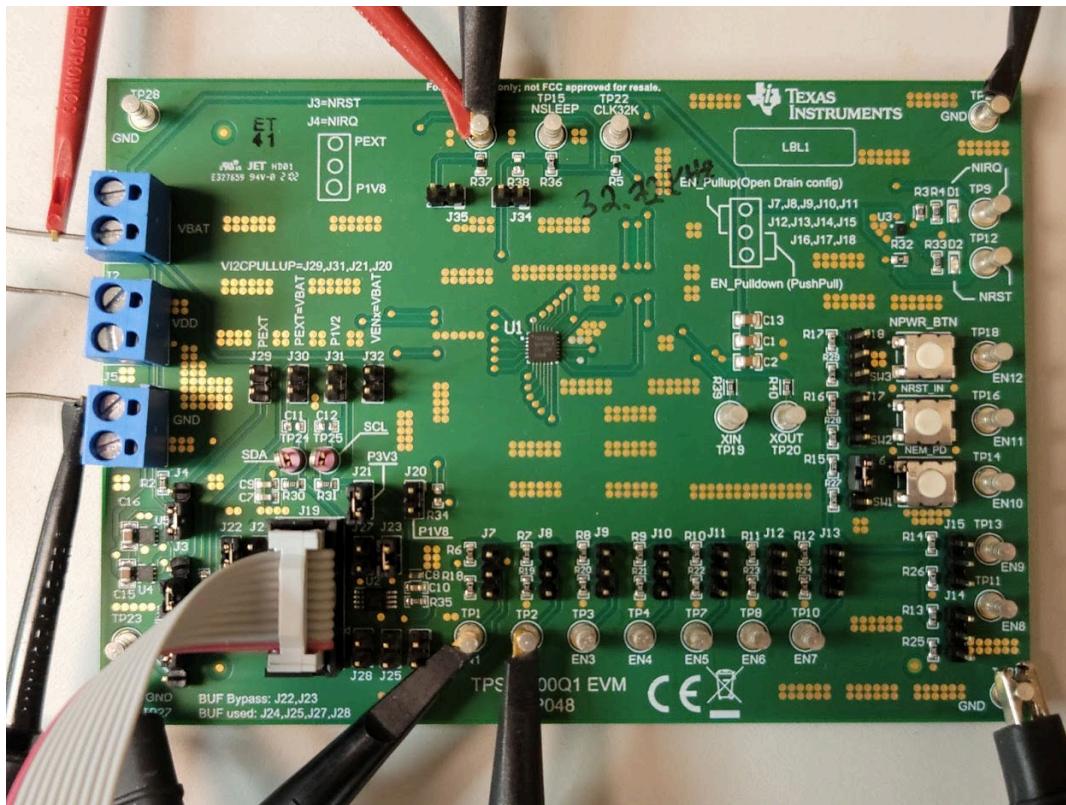
Figure 4-1. EVM Connections for Testing EN1 and EN2

10. Install the GUI.
    a. Download the Fusion Digital Power Designer Platform GUI for TPS38700Q1EVM
    b. Open the downloaded file.
    c. In the Welcome Wizard window, click Next.
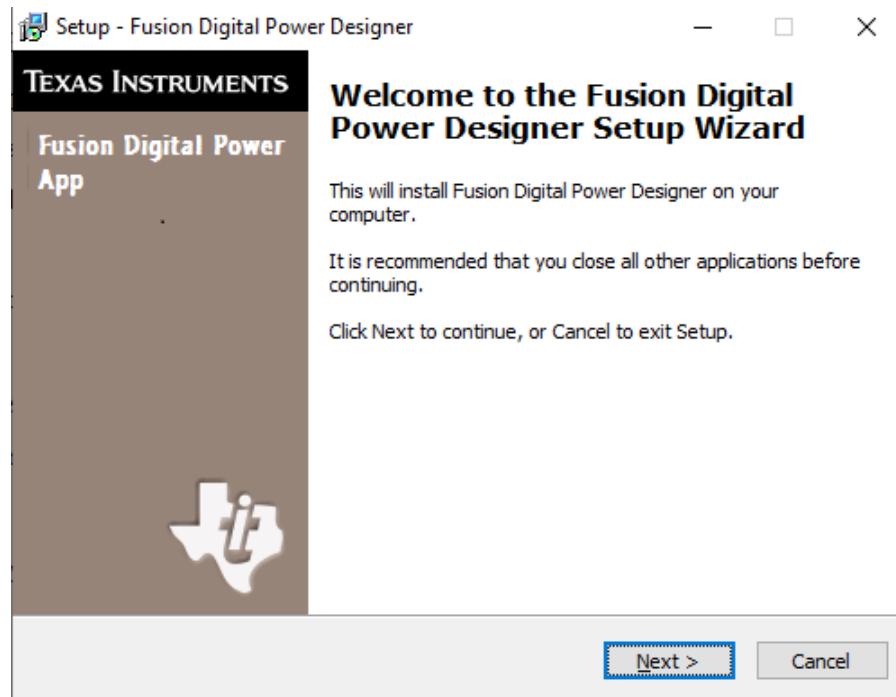
Figure 4-2. Welcome Setup Window

d. Accept the license agreement and then click Next.
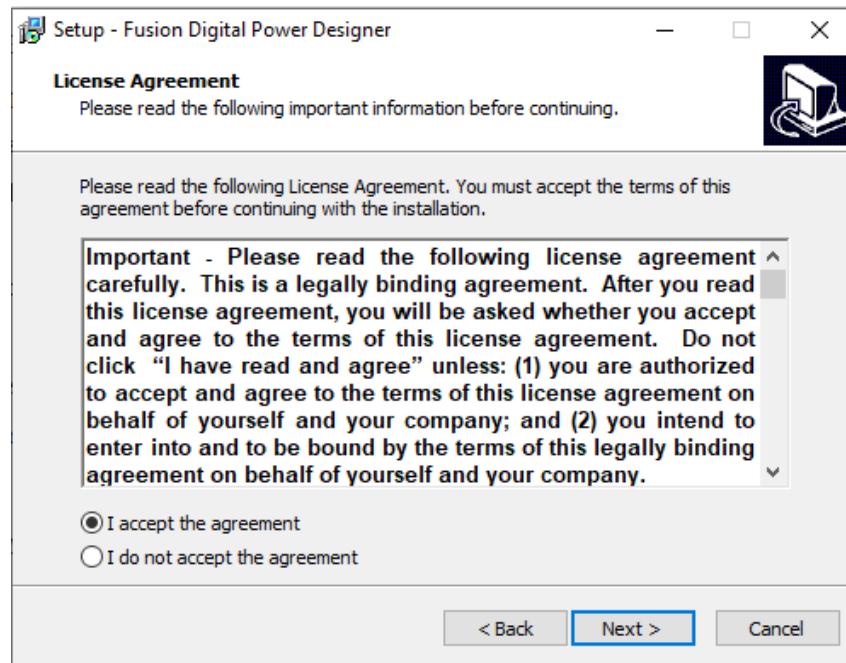
Figure 4-3. Setup License Agreement Window

e. The default destination folder works best. Click Next.
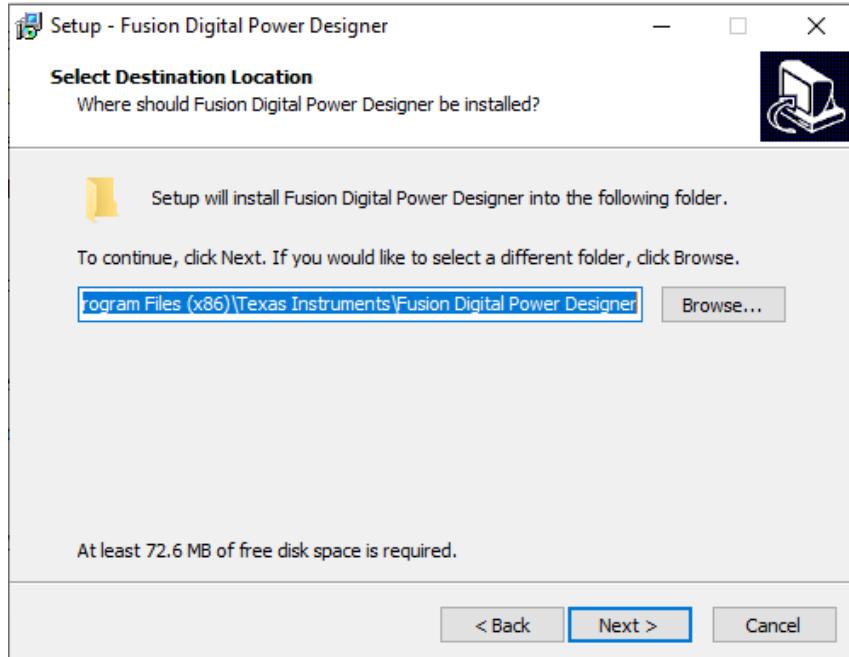
Figure 4-4. Setup Destination Window

f. Click Next for the Select Start Menu Folder option.
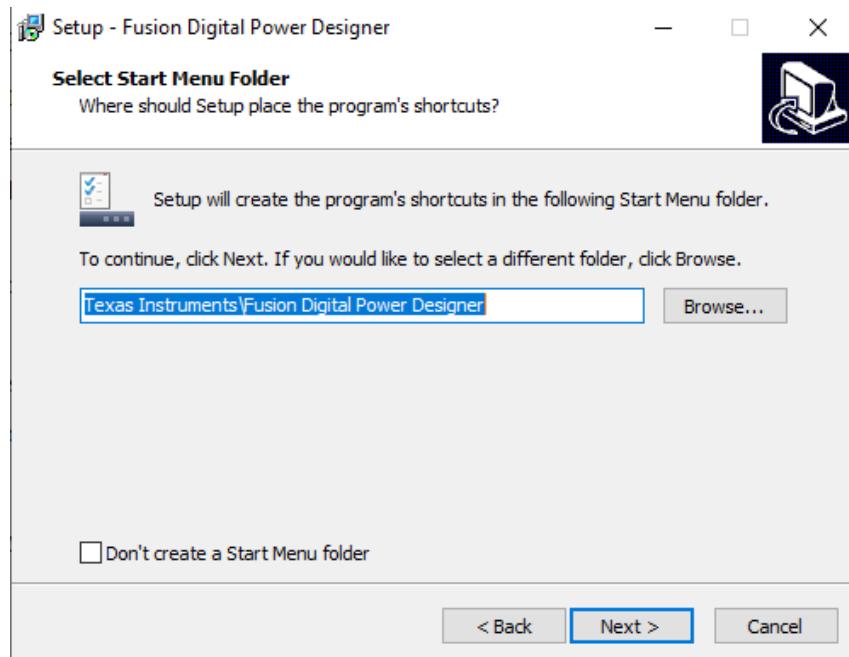
Figure 4-5. Setup Window - Start Menu Selection

g.   There is no need to install additional options for this EVM. Click Next.
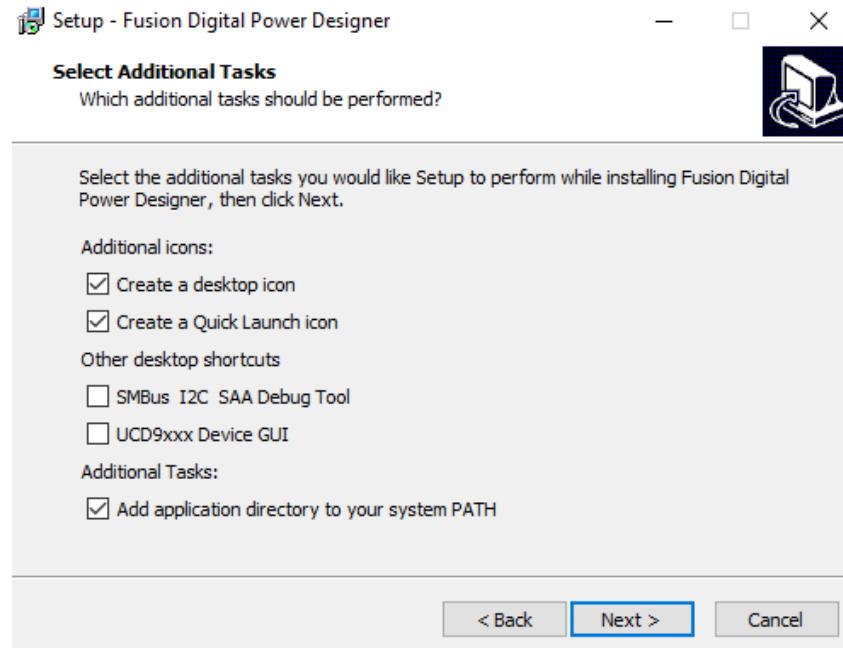
Figure 4-6. Setup Window - Additional Tasks

h.   Finally click Install to install the Fusion software.
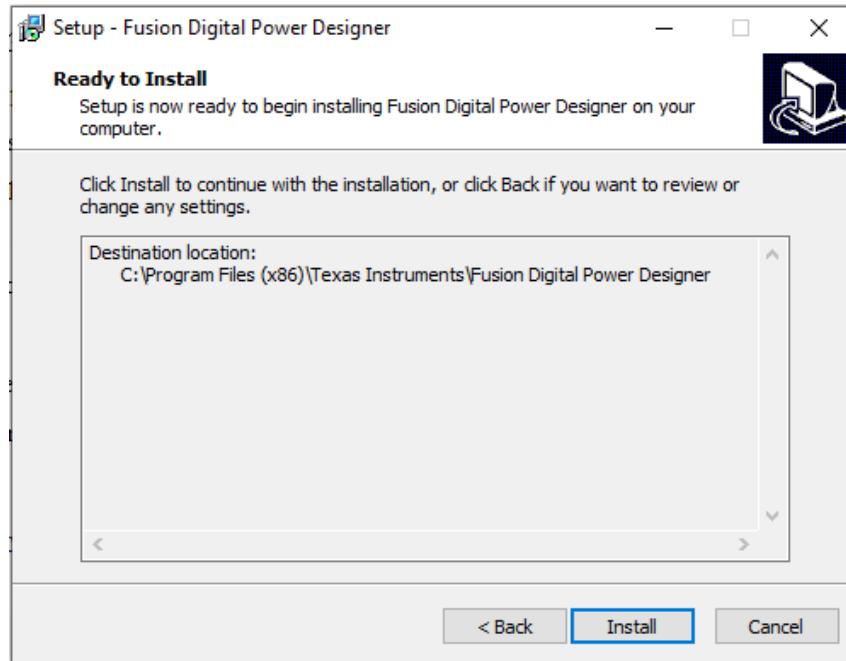
Figure 4-7. Setup Installation Window

i. Click on Finish to complete the installation setup and launch the software.
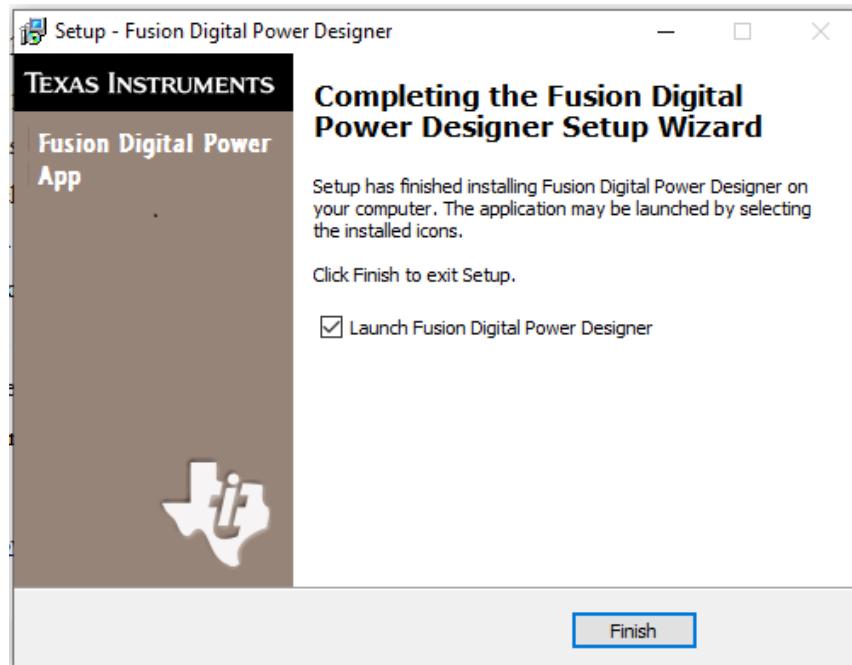
Figure 4-8. Installation Complete Window

4.2 GUI

This section shows the graphical user interface (GUI) the user will use to interact with the EVM. Refer to the TPS38700-Q1 Multichannel I2C Programmable Voltage Sequencer datasheet for details on the register description of the device.
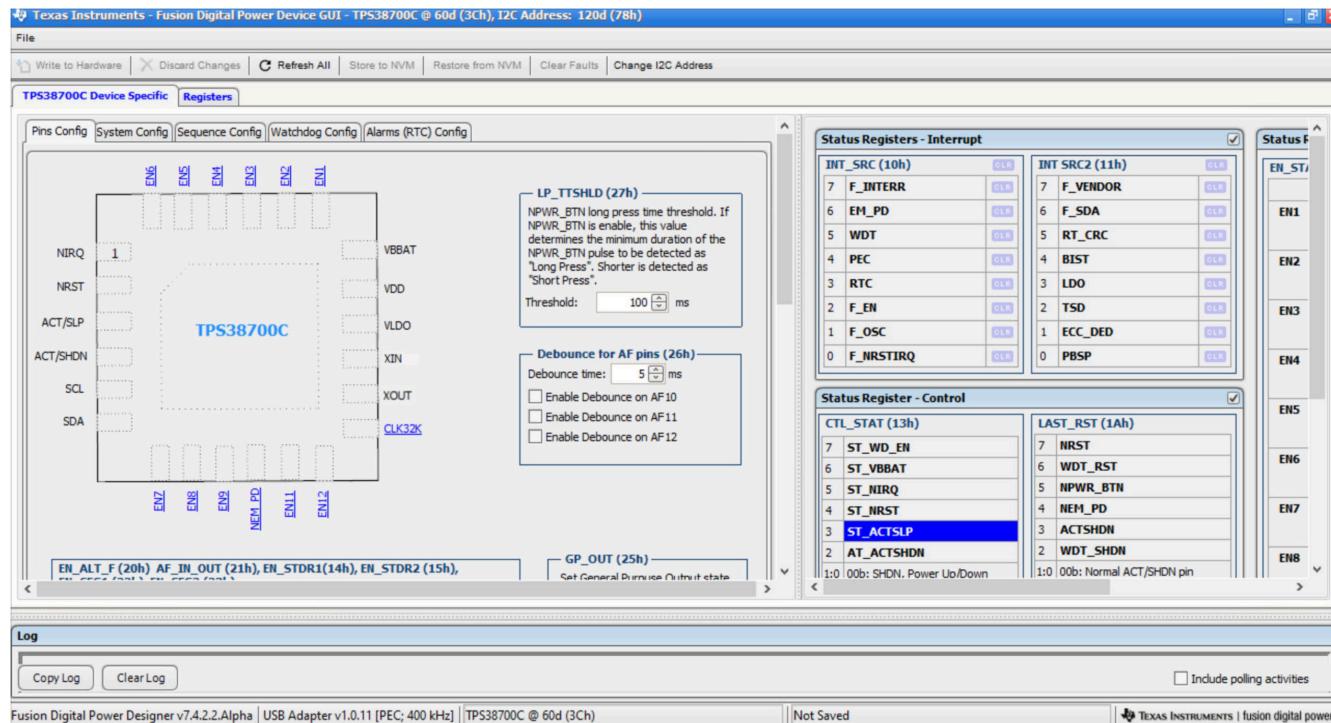
Figure 4-9. Main GUI Screen
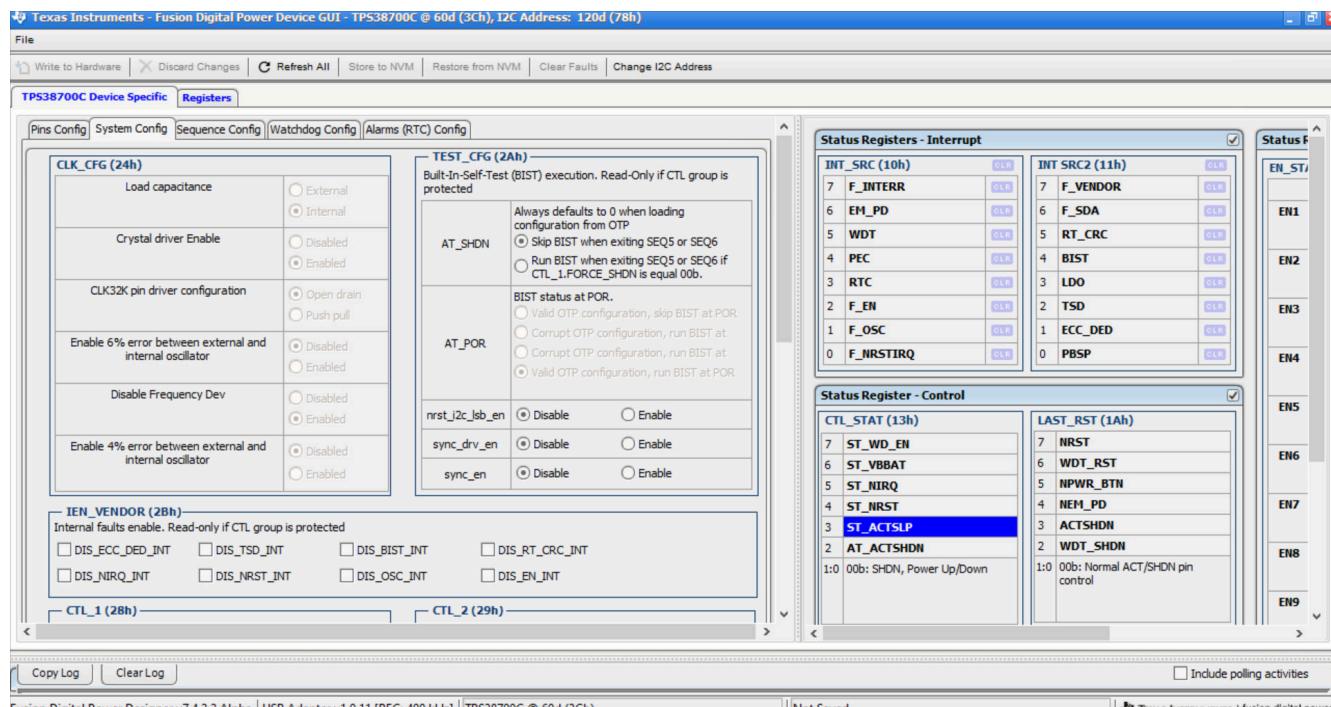
Figure 4-10. System Config
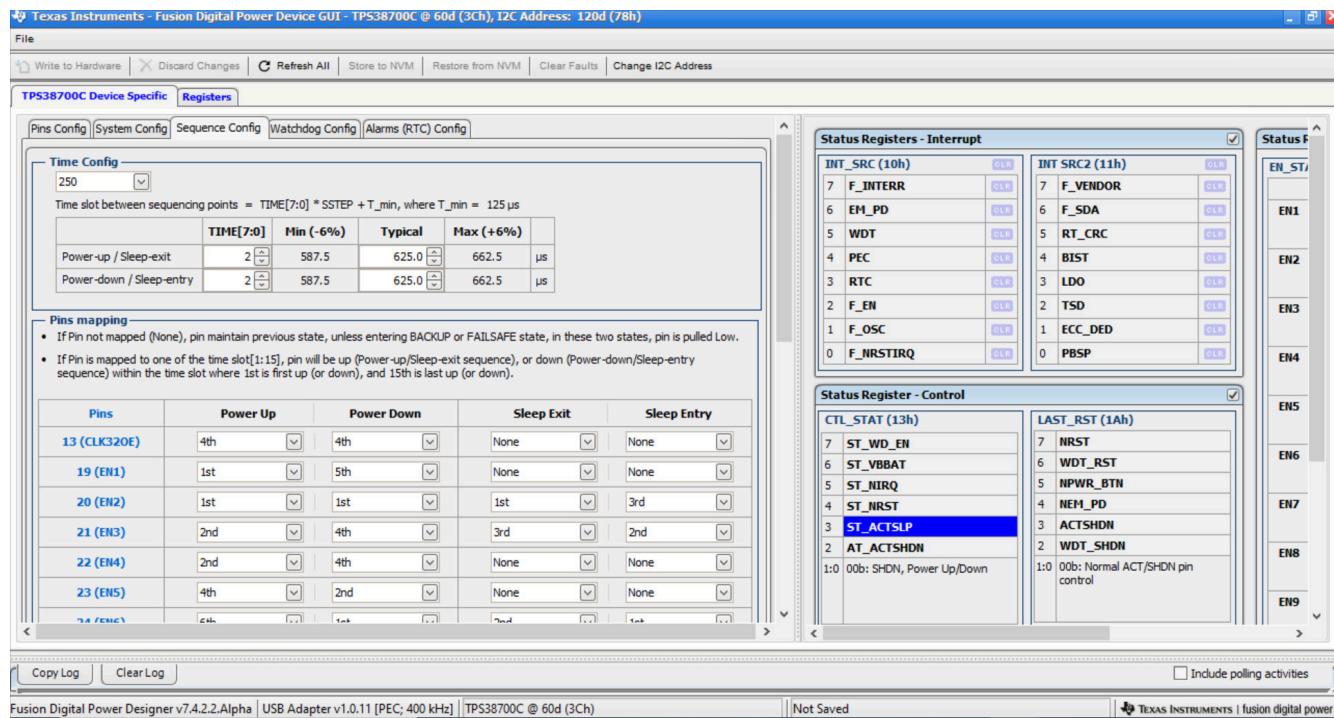
Figure 4-11. Sequence Config
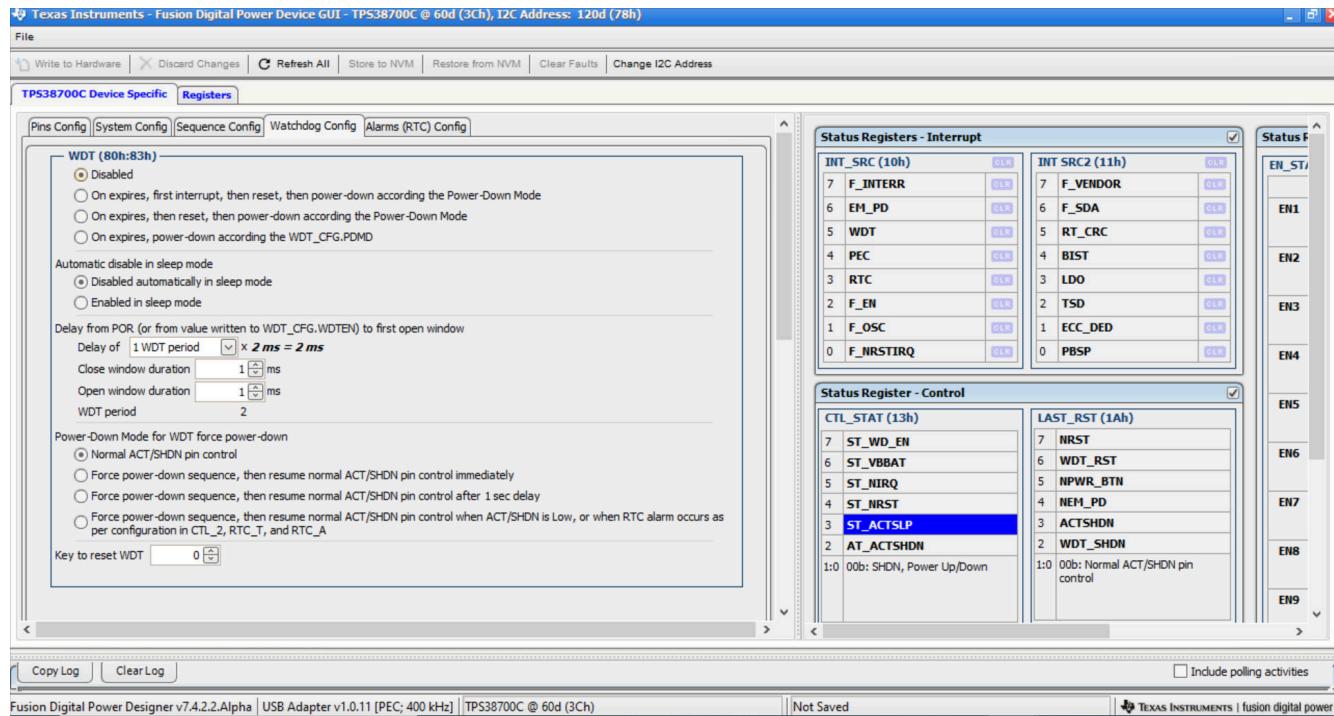
Figure 4-12. Watchdog Config
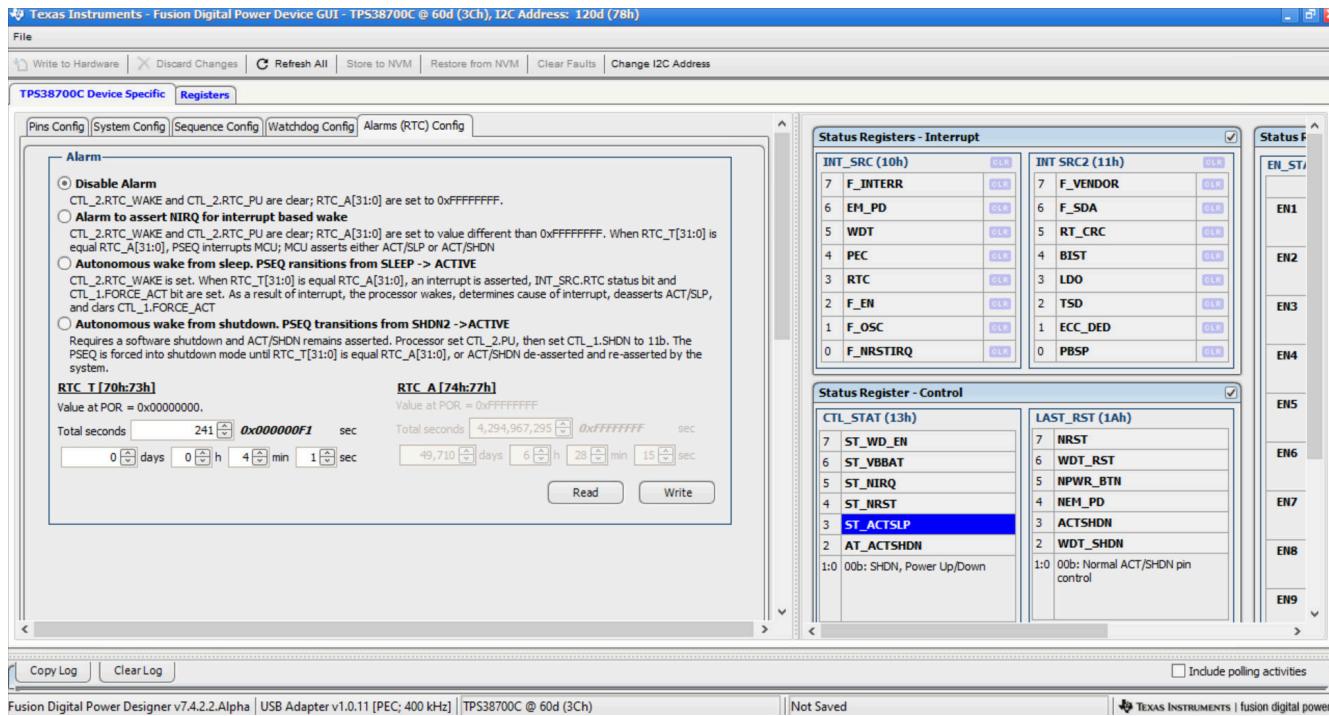
Figure 4-13. Alarms Config
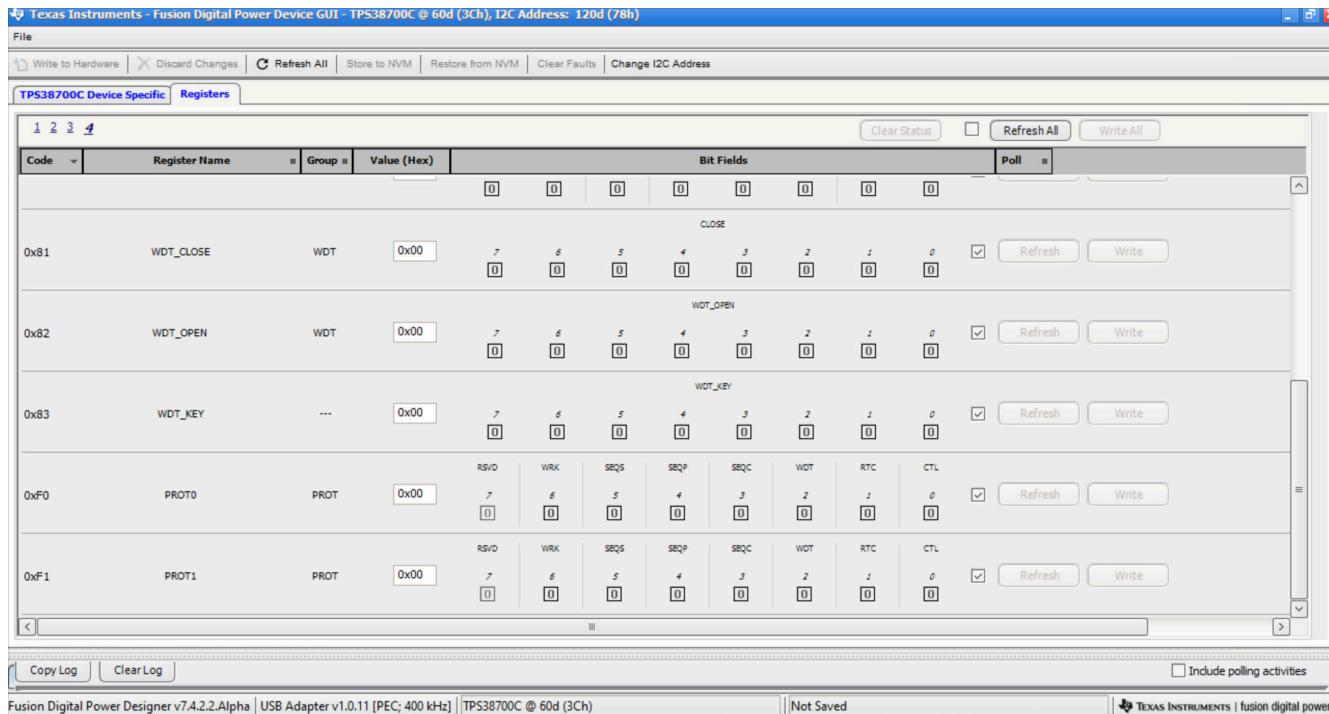
Figure 4-14. Registers

4.3 Quick Start

Follow the steps below precisely to quickly evaluate the TPS38700-Q1. In this quick start, we will be looking at Enable 1 and Enable 2 signals after the ACT pin is triggered.

1. Make the connections described in Section 4.1. Skip the GUI installation if the TPS38700Q1EVM GUI is already installed.
2. Power the EVM by turning on the power supply. Note that the voltage and current at the supply are 3.3 V and 10 mA.
3. Once the TI's USB Interface Adapter is connected to EVM and the laptop, launch the evaluation software Fusion Digital Power Designer.
4. Click on I2C GUI in the bottom right.
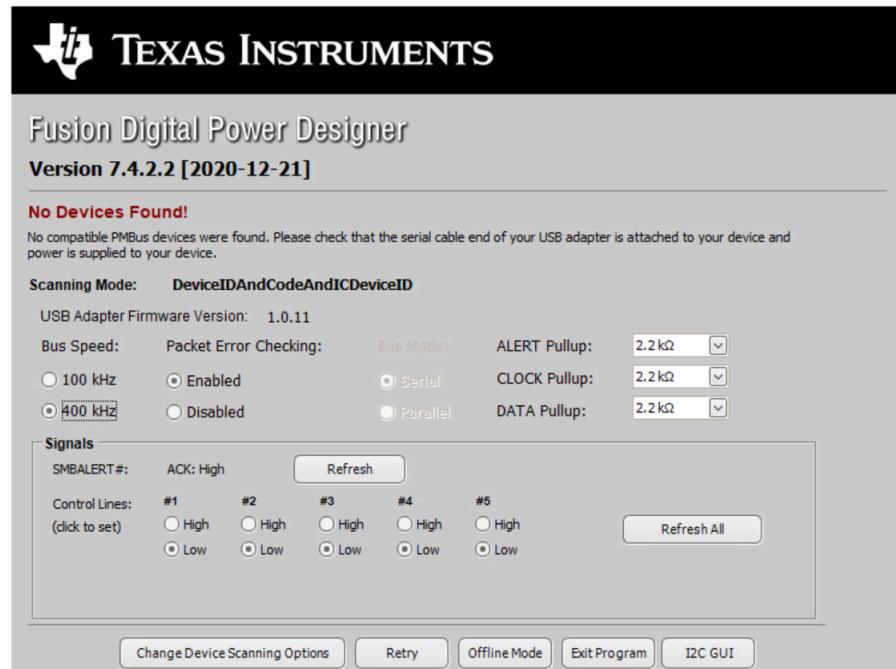
Figure 4-15. Fusion Welcome Window

5. Click on Change Scan Mode to select TPS38700x and then click OK.
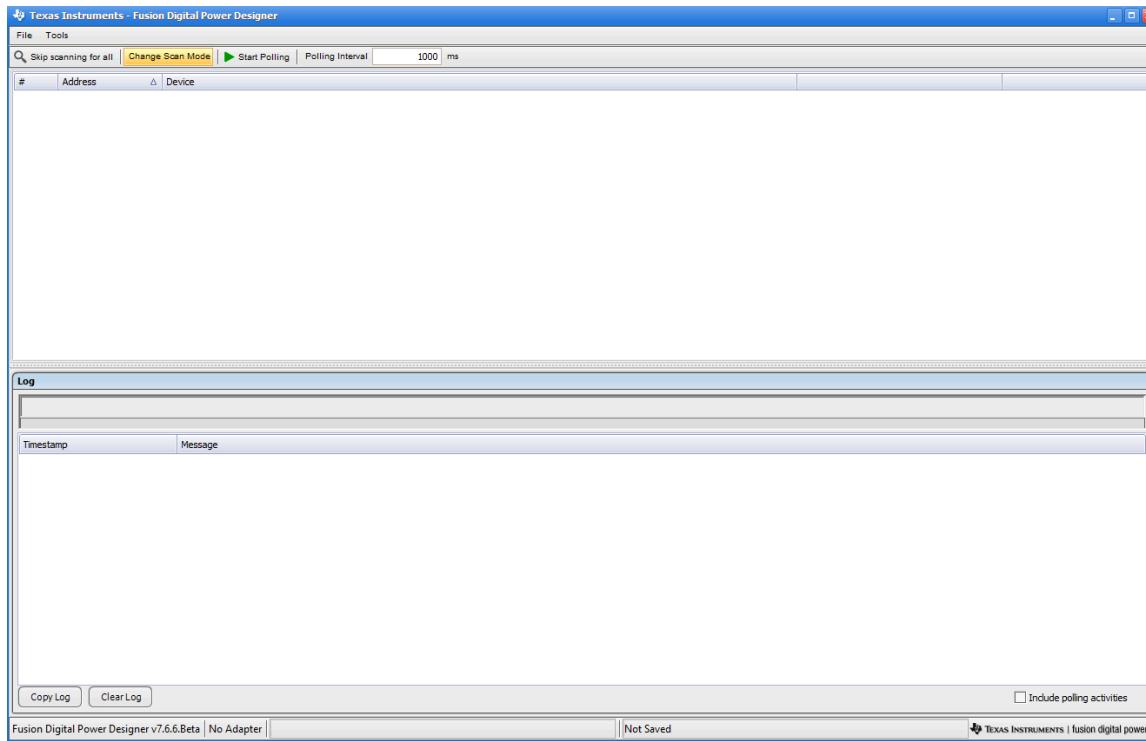
Figure 4-16. Fusion Scan Window
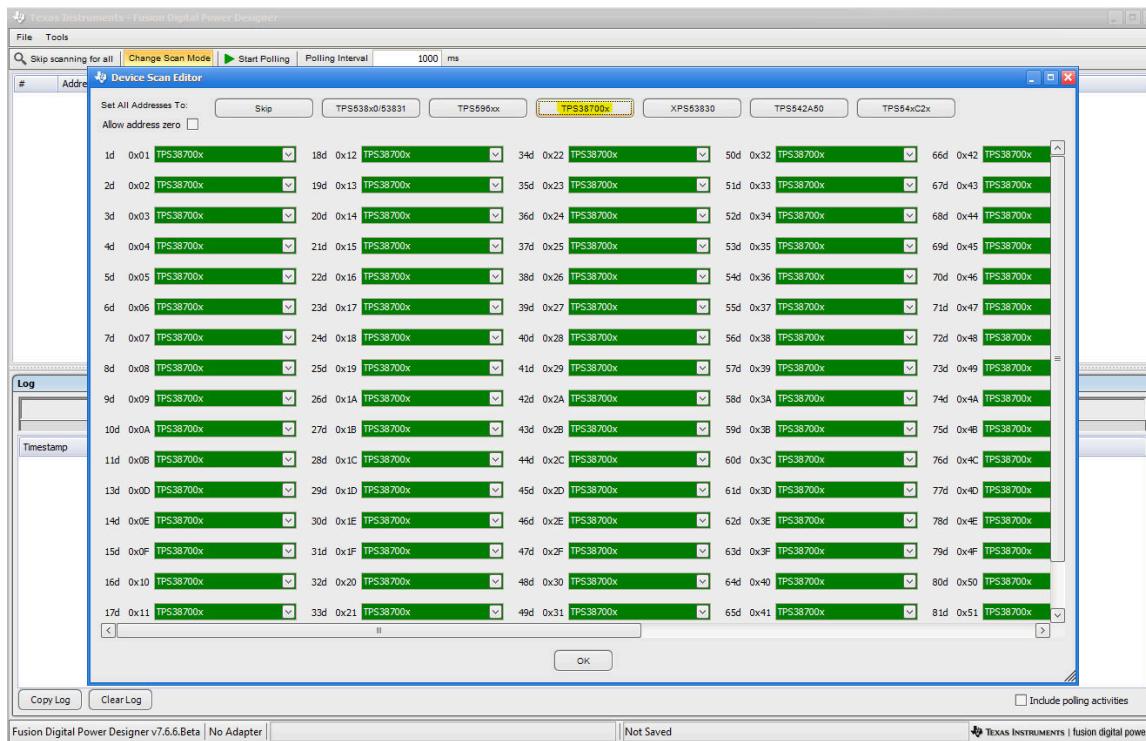
Figure 4-17. Fusion Scan Selection Window

6. Scan for the TPS38700Q1EVM by clicking on "*Scan for TPS38700x*" on top left of the window.
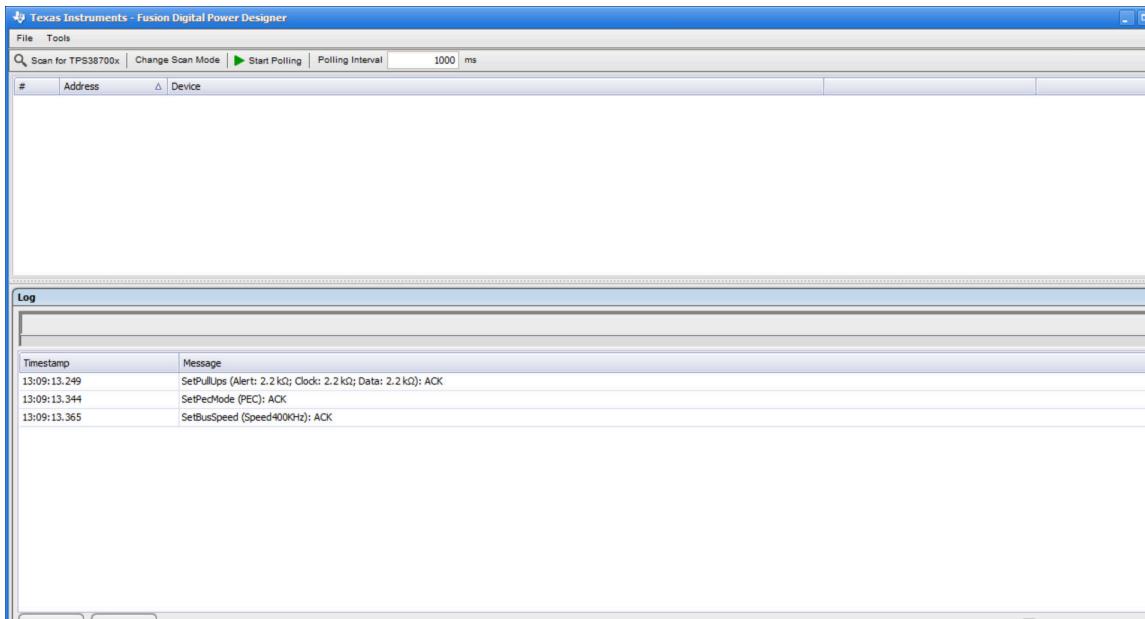
Figure 4-18. Fusion Scan Window - Scanning for TPS38700Q1EVM

7. Once the EVM is discovered, select Click to Configure (text in blue).
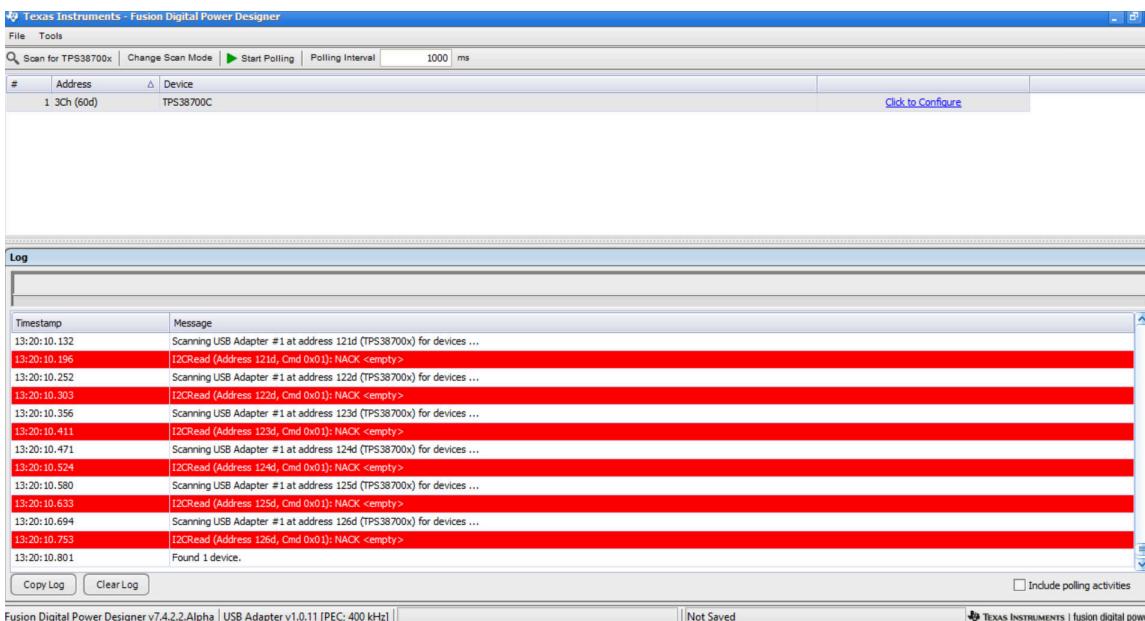
Figure 4-19. Fusion Scan Window - Scan for TPS38700Q1EVM Completed

8. Go to the Sequence Config tab. In the Pins mapping section, change the pin 19's (EN1) Power Up sequence from 1st to 4th sequence. Now, the Enable 1 signal is part of the 4th power-up sequence. Hence, delaying the signal by about 2 ms from Enable 2 signal (which is still part of the first power-up sequence).
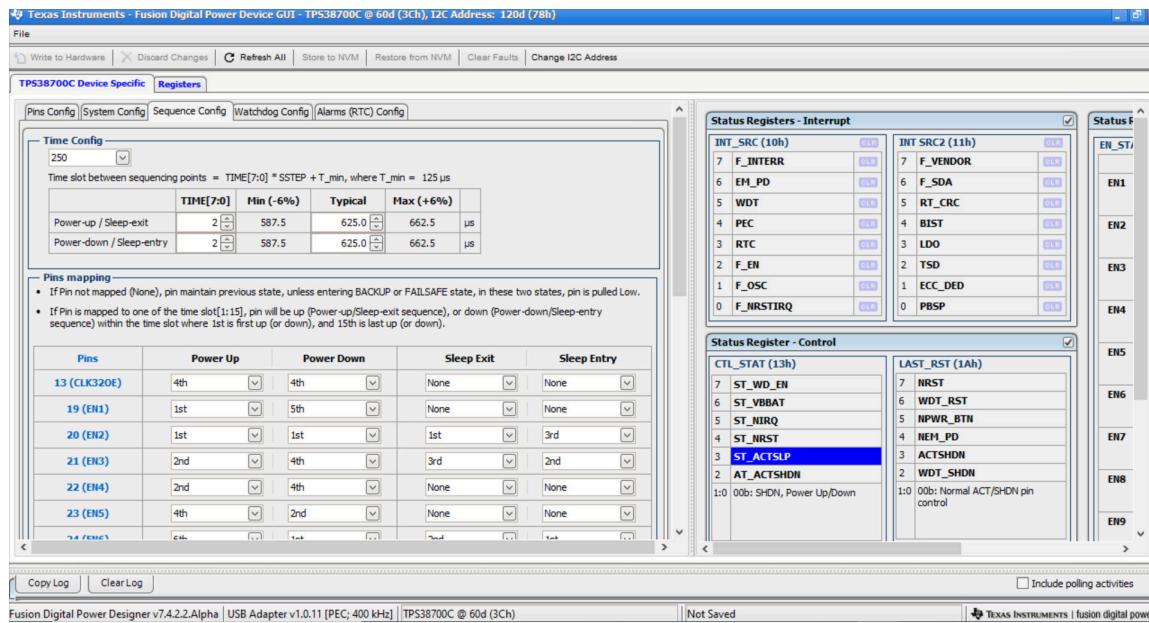
Figure 4-20. TPS38700 GUI Window - Sequence Config Tab

9. Change the trigger in the oscilloscope from channel 1 to channel 3 to get the trigger from ACT pin.
10. Set the Function Generator to create a 3.3 V pulse waveform. Turn-on the output from the Function Generator connected to the ACT pin to trigger the power-up sequence.
11. The output at the oscilloscope should look like the Figure 4-21 where green waveform is the pulse to the ACT pin (TP6), red waveform is Enable 2 signal and blue waveform is the Enable 1 Signal.
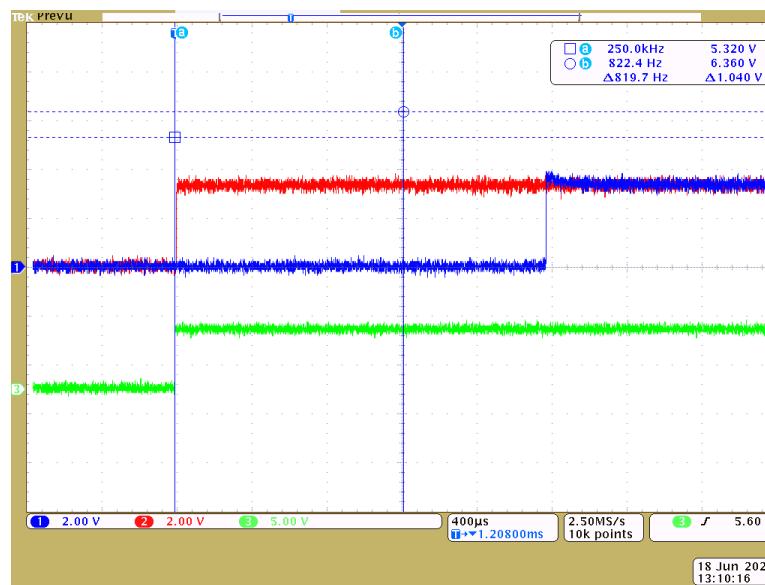
Figure 4-21. Expected Output Signal

5 Revision History

Changes from Revision A (April 2022) to Revision B (July 2023) **Page**

Changes from Revision * (July 2021) to Revision A (April 2022) **Page**

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

    1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

    1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

    2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

    2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

    2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:
EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: 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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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 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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/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、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けて

いないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの

措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。

2. 実験局の免許を取得後ご使用いただく。

3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。 上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 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

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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 accessible 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.

6.   *Disclaimers:*

6.1   EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2   EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7.   *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL 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 HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

IMPORTANT NOTICE AND DISCLAIMER