TPS659037 EVM User's Guide

This user's guide describes the characteristics, operation, and use of the TPS659037EVM. An EVM description, GUI description, interface requirements, and complete schematic are included.

1 Introduction

The TPS650937 device is a power-management integrated circuit (PMIC) for industrial and consumer applications. The device provides seven configurable step-down converters, with up to 9 A of output current for memory, processor core, input/output (I/O), or preregulation of LDOs. The TPS659037 device contains 7 LDO regulators for external use. For more details, see the device datasheet, *TPS659037 Power Management Unit (PMU) for Processor*, SLIS165.

1.1 EVM Overview

The features of this EVM are as follows:

- Allows monitoring of all LDO and SMPS output voltages.
- Allows loading of all SMPS outputs.
- Allows access to the GPIOs and other logic signals to test functionality.
- Optimized layout for stable operation of all SMPS.
- Onboard MSP430 to enable communication with the PMIC.
- Graphical User Interface (GUI) on Windows® to allow access to the registers of the PMIC through USB-I2C.

1.2 EVM with Components Identified

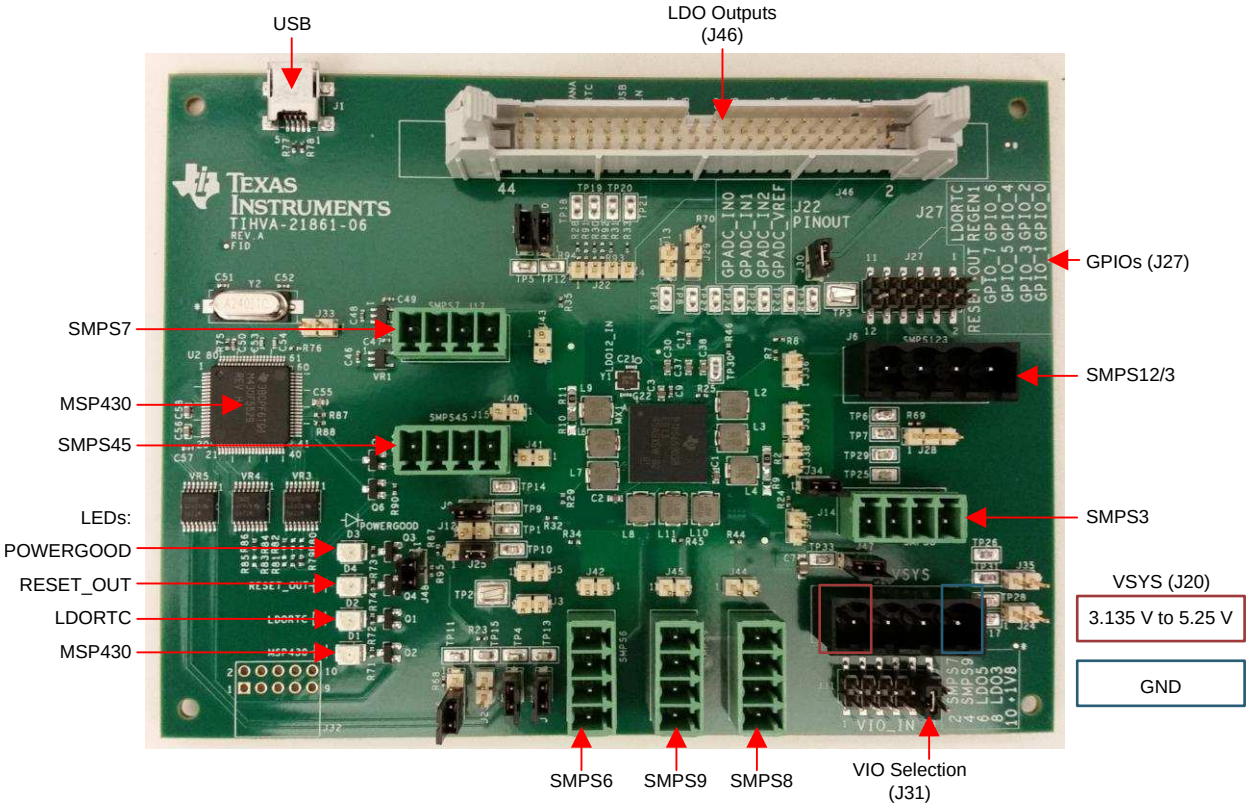

Figure 1. EVM

LEDs— Display status of POWERGOOD, RESET_OUT, LDORTC and power supply of MSP430

USB— Connection to PC to enable communication through the GUI

MSP430— Microcontroller used to convert USB data to I^2C format

SMPSxx— Monitor point for SMPS outputs

J46— Monitor point for LDO outputs

J31— Jumper used to select VIO voltage. J31 requires a jumper installed (only one), and by default is in position 10, 1V8.

J27— Jumper that provides access to the GPIOs

J20— VSYS power supply input. J20 is the same connector as SMPS123, and must not be confused to prevent applying VSYS to SMSP123-output.

1.3 Power-Supply Requirements and Connections

Only one power supply is needed to power the VSYS domain of the PMIC. Apply 3.135 VDC to 5.25 VDC to the J20 connector of the TPS659037EVM to supply power to the PMIC device. Four-wire sensing of the input power supply is recommended and can be achieved through the middle two terminals of J20.

Power for the MSP430 and the two fixed voltage LDOs (3.3-V and 1.8-V outputs) is supplied through the USB connection, as shown in Figure 2.

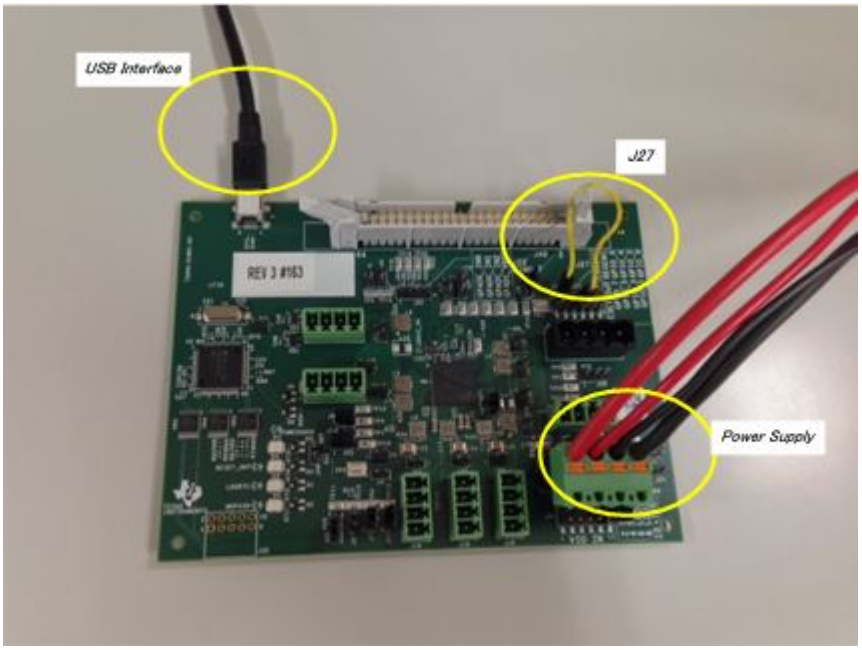

Figure 2. Power Supply

1.4 Default Jumper Settings

Table 1 lists the options for each header and the default jumper settings for the TPS659037EVM.

Table 1. Default Jumper Settings for the TPS659037EVM

Reference	Jumper Setting	Function	Default
J3	Closed	I2C1_SCL and I2C1_SDA are shorted	Open
	Open	I2C1_SCL and I2C1_SDA are separated	
J5	Closed	I2C2_SCL and I2C2_SDA are shorted	Open
	Open	I2C2_SCL and I2C2_SDA are separated	
J7	Closed	PWRDOWN pin is controlled by MSP430	Closed
	Open	PWRDOWN pin is floating	
J8	Closed	NRESWARM pin is controlled by MSP430	Closed
	Open	NRESWARM is floating	
J9	Closed	ENABLE1 pin is controlled by MSP430	Closed
	Open	ENABLE1 is floating	
J10	Closed	NSLEEP pin is controlled by MSP430	Closed
	Open	NSLEEP is floating	
J11	Closed	RESET_IN pin is controlled by MSP430	Closed
	Open	RESET_IN is floating	
J12	Closed	INT pin is connected to MSP430	Open
	Open	INT pin is floating	
J13	Closed	SYNCDCDC pin is connected to GND	Open
	Open	SYNCDCDC pin is floating	
J22	1	GPADC_IN0	Open
	2	GPADC_IN1	
	3	GPADC_IN2	
	4	GPADC_VREF	
J23	Open	POWERGOOD pin is floating	Open
	Closed	POWERGOOD pin is connected to GND	
J24	Open	CLK32KGO pin is floating	Open
	Closed	CLK32KGO pin is connected to GND	
J25	Jumper b/w 1 and 2	BOOT0 is tied to LDORTC	Jumper b/w 2 and 3
	Jumper b/w 2 and 3	BOOT0 is tied to GND	
J26	Jumper b/w 1 and 2	BOOT1 is tied to LDORTC	Jumper b/w 2 and 3
	Jumper b/w 2 and 3	BOOT1 is tied to GND	

Table 1. Default Jumper Settings for the TPS659037EVM (continued)

Reference	Jumper Setting	Function	Default
J27	1	GPIO_0	Jumper b/w 8 and 11 to tie POWERHOLD pin to VRTC
	2	GPIO_1	
	3	GPIO_2	
	4	GPIO_3	
	5	GPIO_4	
	6	GPIO_5	
	7	GPIO_6	
	8	GPIO_7	
	9	REGEN1	
	10	RESET_OUT	
	11	LODRTC	
	12	GND	
J28	1	VSYS	Open
	2	PWRON	
	3	GND	
J29	1	VSYS	Open
	2	PWRON	
	3	GND	
J30	-	Reserved	Closed
J31	1	VIO_IN	Jumper b/w 9 and 10
	2	SMSP7	
	3	VIO_IN	
	4	SMSP9	
	5	VIO_IN	
	6	NC	
	7	VIO_IN	
	8	LDO3	
	9	VIO_IN	
	10	+1V8	
	11	VIO_IN	
	12	+3V3	
J34	Open	All LDO_INs are floating	Closed
	Closed	All LDO_INs are connected to VSYS	
J35	Open	VPROG/TESTV is floating	Open
	Closed	VPROG/TESTV is connected to GND	
J36	—	SMPS12/3	Open
J37	—	SMPS12/3	Open
J38	—	SMPS12/3	Open
J39	—	SMPS3	Open
J40	—	SMPS45	Open
J41	—	SMPS45	Open
J42	—	SMPS6	Open
J43	—	SMPS7	Open
J44	—	SMPS8	Open
J45	—	SMPS9	Open
J47	Open	VCC1 isn't shorted to VSYS	Closed
	Closed	VCC1 is shorted to VSYS	
J48	Open	POWERGOOD is floating	Closed
	Closed	POWERGOOD is pulled up to 3.3V	

Table 1. Default Jumper Settings for the TPS659037EVM (continued)

Reference	Jumper Setting	Function	Default
J46	1	LDO1	
	2	LDO1_SENSE	
	3	LDO1_GND_SENSE	
	4	LDO2	
	5	LDO2_SENSE	
	6	LDO2_GND_SENSE	
	7	LDO3	
	8	LDO3_SENSE	
	9	LDO3_GND_SENSE	
	10	LDO4	
	11	LDO4_SENSE	
	12	LDO4_GND_SENSE	
	13	NC	
	14	NC	
	15	NC	
	16	NC	
	17	NC	
	18	NC	
	19	NC	
	20	NC	
	21	NC	
	22	NC	
	23	NC	
	24	NC	
	25	LDO9	
	26	LDO9_SENSE	
	27	LDO9_GND_SENSE	
	28	LDOLN	
	29	LDOLN_SENSE	
	30	LDOLN_GND_SENSE	
	31	LDOUSB	
	32	LDOUSB_SENSE	
	33	LDOUSB_GND_SENSE	
	34	LDORTC	
	35	LDORTC	
	36	GND	
	37	LDOVANA	
	38	LDOVANA	
	39	GND	
	40	GND	
	41	GND	
	42	GND	
	43	GND	
	44	GND	

2 EVM Schematics

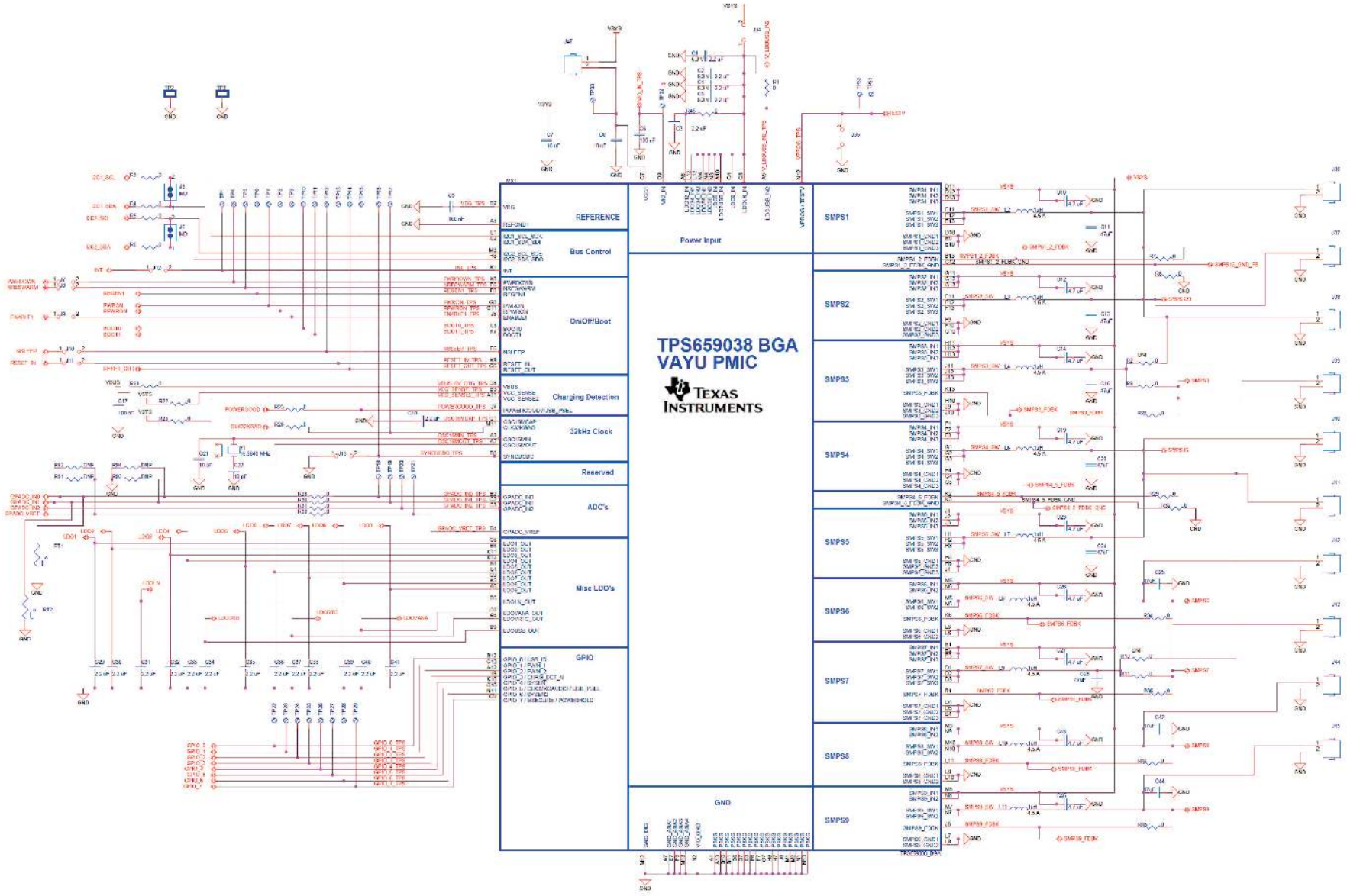

Figure 3. EVM Schematic

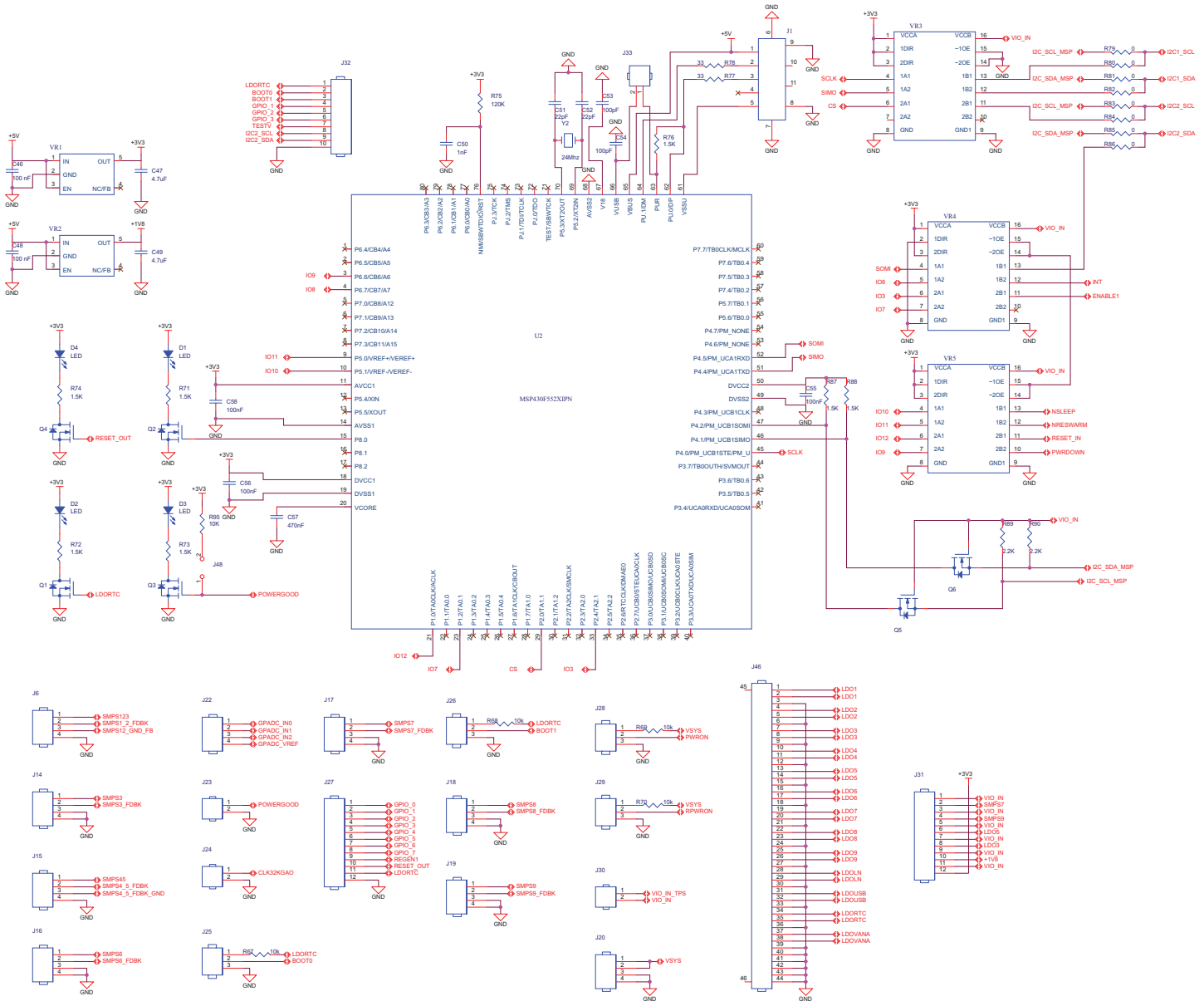

Figure 4. EVM Schematic

3 EVM BOM

Table 2 lists the bill of materials (BOM) for the TPS659037EVM. The latest BOM is included in the TPS659037 data sheet.

Table 2. EVM BOM

Designator	Quatity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C2, C3, C4, C5	5	2.2uF	2.2uF/0603/10V X5R	cns_0603	GRM188R61A225KE34D	Murata
C6	1	100nF	100nF/0402/10V X5R	cns_0402	GRM155R61A104KA01D	Murata
C7	1	10uF	10uF/0805/10V X5R	cns_0805	GRM21BR61A106KE19L	Murata
C8	1	10uF	10uF/0603/6.3V X5R	cns_0603	C0603C106M9PAC	KEMET
C9, C17, C46, C48	4	100nF	100nF/0402/6.3V X5R	cns_0402	GRM155R60J104KA01D	Murata
C10, C12, C14, C19, C23, C26, C27, C43, C45	9	4.7uF	4.7uF/0805/10V X7R	cns_0805	GRM21BR71A475KA73K	Murata
C11, C13, C16, C20, C24, C25, C28, C42, C44	9	47uF	47uF/1210/10V X7R	cns_1210_02	GRM32ER71A476ME15	Murata
C18, C29, C30, C31, C32, C33, C34, C37, C40, C41	10	2.2uF	2.2uF/0603/6.3V X5R	cns_0603	C1608X5R0J225M	TDK
C35, C36, C38, C39	0	2.2uF	2.2uF/0402/6.3V X5R	cns_0402	C1005X5R0J225M	TDK
C21, C22	2	10pF	10pF/0402/50V C0G	cns_0402	GRM1555C1H100GA01D	Murata
C47, C49	2	4.7uF	4.7uF/0402/6.3V X5R	cns_0402	GRM155R60J475ME47	Murata
C50	1	1nF	1nF/0402/50V X7R	0402	GRM155R71H102KA01D	Murata
C51, C52	2	22pF	22pF/0402/50V C0G	0402	C1005C0G1H220J	TDK
C53, C54	2	100pF	100pF/0402/50V C0G	0402	GRM1555C1H101JA01J	Murata
C55, C56, C58	3	100nF	100nF/0603/16V X7R	0603	GRM188R71C104KA01	Murata
C57	1	470nF	470nF/0402/50V X7R	0402	04026D474KAT2A	AVX
D1	1	LO T67K-L1M2-24	LED, Orange	PLCC-2	LO T67K-L1M2 24-Z	Osram
D2, D3, D4	3	LY T67K-K2M1 26	LED, Yellow	PLCC-2	LY T67K-K2M1 26-Z	Osram
J1	1		UX60-MB-5ST	0.354 X 0.303 Inches	UX60-MB-5ST	Hirose
J6, J20	2		CONN HEADER 4POS	5.08MM	1740288	Phoenix Contact
J14, J15, J16, J17, J18, J19	6		CONN HEADER VERT 4POS	3.81MM	1803442	Phoenix Contact
J22	1		CONN HEADER .100 SINGL STR 4POS	2.54MM	PEC04SAAN	Sullins
J3, J5, J7, J8, J9, J10, J11, J12, J13, J23, J24, J30, J33, J34, J35, J36, J37, J38, J39, J40, J41, J42, J43, J44, J45, J47, J48	27		CONN HEADER .100 SINGL STR 2POS	2.54MM	PEC02SAAN	Sullins
J25, J26, J28, J29	4		CONN HEADER .100 SINGL STR 3POS	2.54MM	PEC03SAAN	Sullins
J27, J31	2		CONN HDR BRKWAY 12POS DUAL SMD	2.54MM	5-146130-5	TE Connectivity
J32	0		Header, Right Angle 10 pins, 5x 2 rows	.500 x .378 inch	TSSH-105-01-T-D-RA	Samtec
J46	1		CONN HEADER 44POS DUAL VERT PCB	2.54MM	71918-144LF	FCI
L2, L3, L4, L6, L7, L8, L9, L10, L11	9	1uH	1uH/4.5A		IHLP1616ABER1R0M11	Vishay
MX1	1		TPS659037	ZWS	TPS6590376ZWSR	TI
Q1, Q2, Q3, Q4, Q5, Q6	6	BSS138	Transistor/MOSFET	SOT23	BSS138	Fairchild

Table 2. EVM BOM (continued)

Designator	Quatity	Value	Description	Package Reference	Part Number	Manufacturer
R1, R3, R4, R5, R6, R7, R8, R21, R22, R23, R24, R25, R26, R28, R29, R30, R31, R32, R33, R34, R35, R44, R45, R46, R79, R81, R84, R86	28	0	SMD 0402 Zero ohms 5% Tol	r-s_0402	ERJ-2GE0R00X	Panasonic
R2	0	0	SMD 0805 Zero Ohms 5% Tol	r-s_0805	ERJ-6GEY0R00V	Panasonic
R11	1	0	SMD 0805 Zero Ohms 5% Tol	r-s_0805	ERJ-6GEY0R00V	Panasonic
R9	1	0	SMD 0805 Zero Ohms 5% Tol - DNP	r-s_0805	ERJ-6GEY0R00V	Panasonic
R10	0	0	SMD 0805 Zero Ohms 5% Tol - DNP	r-s_0805	ERJ-6GEY0R00V	Panasonic
R80, R82, R83, R85, R91, R92, R93, R94	0	0	SMD 0402 Zero ohms 5% Tol - DNP	r-s_0402	ERJ-2GE0R00X	Panasonic
R67, R68, R69, R70, R95	5	10k	SMD 0402 10Kohms 1% Tol	r-s_0402	ERJ-2RKF1002X	Panasonic
R71, R72, R73, R74, R76, R87, R88	7	1.5k	SMD 0402 1/16W 1.5Kohms	r-s_0402	ERA-2AEB152X	Panasonic
R75	1	120k	SMD 0402 120Kohms 1% Tol	r-s_0402	ERJ-2RKF1203X	Panasonic
R77, R78	2	33	SMD 33 OHM 1%	r-s_0402	RC0402FR-0733RL	Yageo
R89, R90	2	2.2k	SMD 2.2K OHM 1%	r-s_0402	RC0402FR-072K2L	Yageo
RT1, RT2	0		0402 RTC - DNP	0402		
TP1, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33	31		0603 Probe Pad Ring	1.60mm x 0.8mm x 1.15mm	1625854-3	TE Connectivity
TP2, TP3	2		Test Point SMD		5016	Keystone
U2	1		MSP430F5529IPN		MSP430F5529IPN	TI
VR1	1		TPS76333DBVT	DBV	TPS76333DBVT	TI
VR2	1		TPS76318DBVT	DBV	TPS76318DBVT	TI
VR3, VR4, VR5	3		SN74AVC4T245PW	PW	SN74AVC4T245PW	TI
Y1	1	16.384MHz	16.384MHz		7V-16.384MAAE-T	TXC Corporation
Y2	1	24MHz	24MHz	3.7x12.7 mm	ABLS-24.000MHZ-K4F-T	Abracon
	12		Shunt, 100-mil, black	0.100 inch	929950-00	3M
	1		Term Block Plug 4POS	3.81MM	1827143	Phoenix Contact
	2		Term Block Plug 4POS	5.08MM	1754814	Phoenix Contact
	1		Female Jumper Wire		M80-9190099	Harwin Inc.

4 Powering up the Device

To turn on the device, perform the following steps:

1. Turn off the supply voltage, unplug the USB, and close the GUI.
2. While the power supply is disabled, connect it to the EVM through the J20 connector.
3. Plug the USB cable to the EVM and the computer. The MSP430 LED should blink a few times and then stay on.
4. Set the power supply to a voltage between 3.135 V and 5.25 V. Turn on the supply voltage. The LDORTC LED should light up.
5. Launch the GUI on the computer. All sequenced rails will power up to the predefined voltage.
6. Under the *DUT_Control* tab, send a logic high signal to the RESET_IN pin by checking the box next to RESET_IN and clicking *Write Static*. The RESET_OUT LED should light up, and the PMIC is now enabled.

5 TPS659037EVM Graphical User Interface (GUI)

The GUI for TPS659037EVM gives the user the ability to interact with the internal registers of the device while also allowing control of some input pins. The GUI can be downloaded here. The TPS659037EVM GUI installation requires the LabVIEW run-time engine, which can be downloaded from the National Instruments website.

5.1 GUI Tabs

The TPS659037EVM GUI has two tabs. The first tab is labeled Registers, and the second tab is labeled *DUT_Control*.

5.1.1 DUT_Control

The digital input signals to the PMIC are controlled through the DUT_Control tab of the GUI. There are six pins controlled by the GUI. To send a logic low to any of the pins, uncheck the corresponding box and click *Write Static*. To send a logic high to any of the pins, check the corresponding box and click *Write Static*.

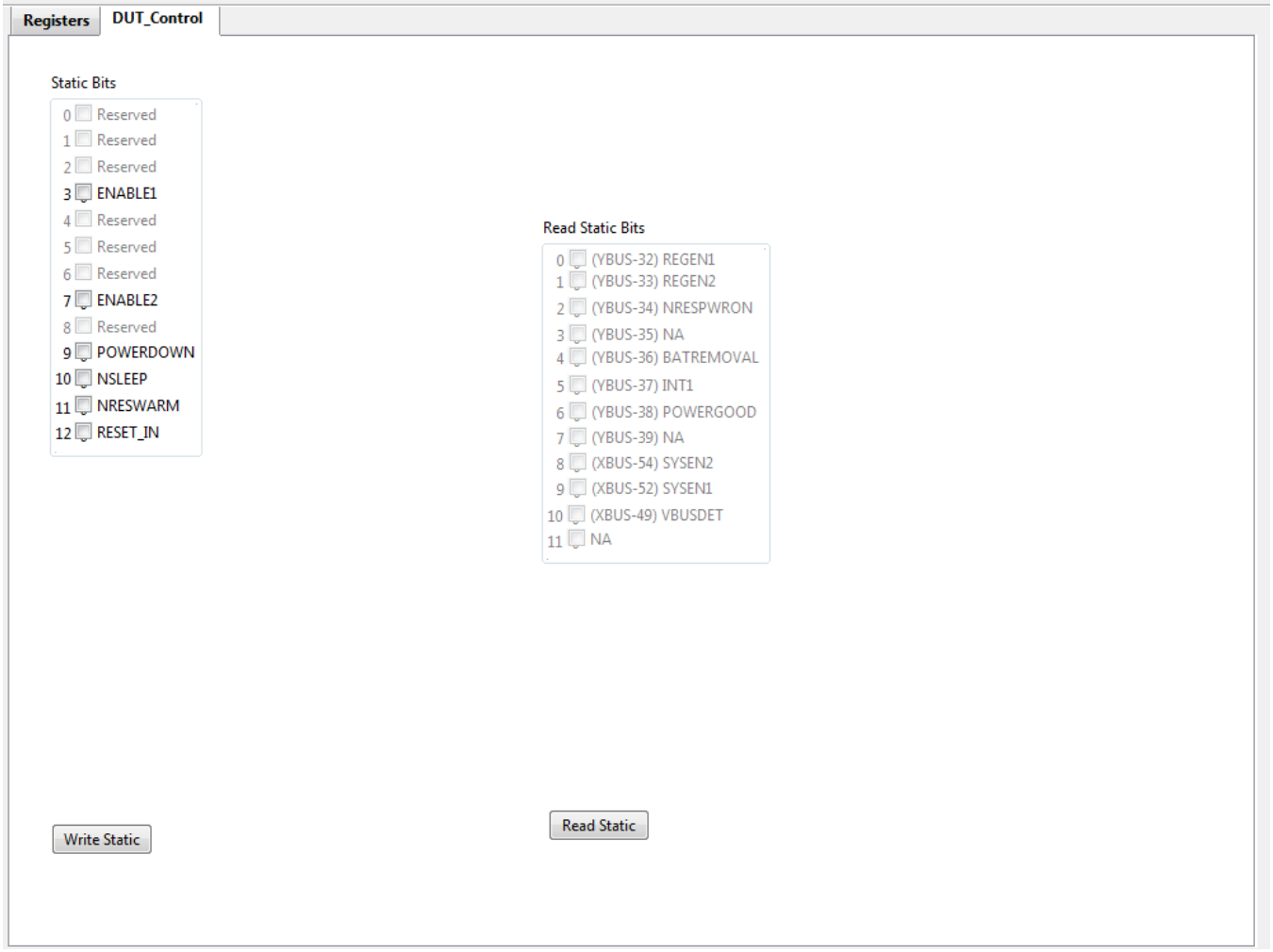

Figure 5. DUT_Control

5.1.2 Registers

I²C communication with the device uses the Registers tab of the GUI. There are five groups of registers. Clicking the + symbol next to the group lists all the registers in that group. A second column next to the register name shows the address offset of that register.

To read data from the register, select the appropriate register and click *Read*. The register data appears in the left column, and the hexadecimal value of the register appears in the *Read Data* field. To write data to the register, check the appropriate boxes in the right column and click *Write*, or enter the hex value in the *Write Data* field and click *Write*. The bits of the register are labeled on the left, with bit 0 in the top box and bit 7 in the bottom.

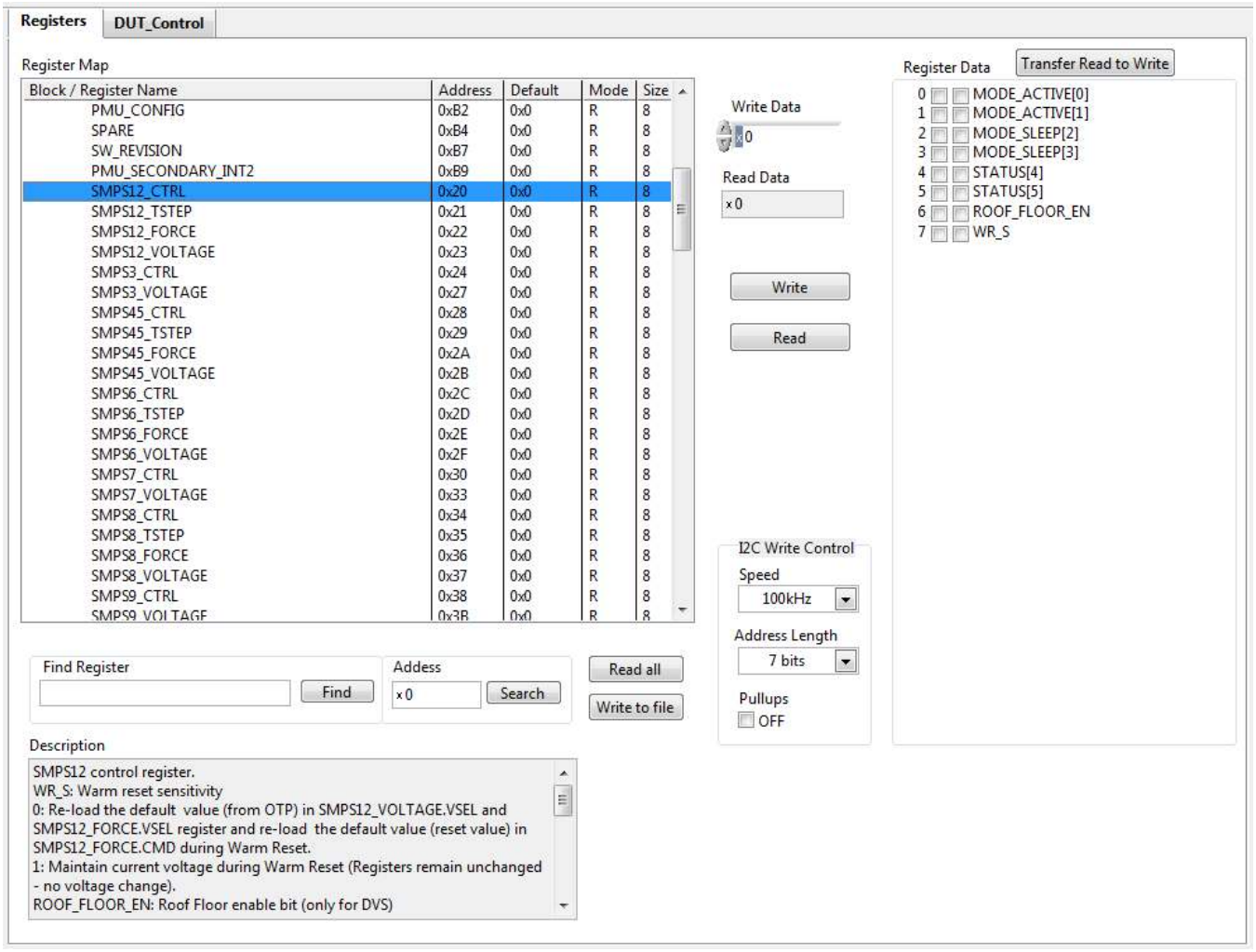

Figure 6. Registers

5.2 Running a Script with the GUI

The script editor is used to automate a series of register writes, static bit writes, and delays. To launch the script window from the main GUI menu, go to *Tools → Show Script Window*. The Script Editor opens with a blank window. To record a script, click *Start/Rec*, and run the commands from the main GUI. After each register write or static bit, the script editor records the command that was run. When finished, click *Stop*.

To run the script again, click *Run*. To save the script that was created, click *Save*, and select the destination for the script file. Click Load to load a previously saved script.

The two commands are:

- tlv_write_reg_i2c1(REGISTER_NAME, VALUE), where the value is the decimal value to write.
- wait(TIME_IN_MS)

The script in Figure 7 turns on SMPS12 to 1.1 V, waits 2 ms, and then turns on SMPS3 to 1.35 V. These commands can be used to run a power up and power down sequence quickly, eliminating the need to manually turn on each rail.

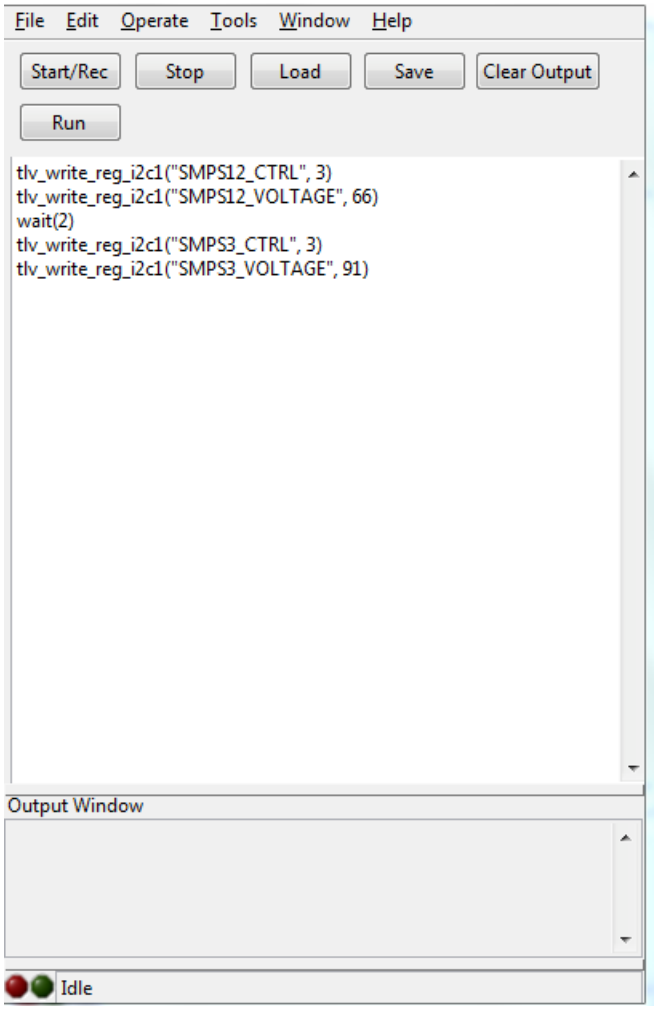

Figure 7. Sample Script

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

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   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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.

   2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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.

3 *Regulatory Notices:*

   3.1 *United States*

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

      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*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

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。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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.

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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

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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:*

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