User's Guide
TPS65219EVM User's Guide

TEXAS INSTRUMENTS

ABSTRACT

This user's guide describes the characteristics, operation, and use of the TPS65219 evaluation module (EVM). The TPS65219EVM is a fully assembly platform for evaluating the performance and functionality of the TPS65219 power management IC (PMIC). The EVM includes an onboard USB-to-I^{2}C adapter, power terminals, and jumpers for all DC regulator inputs and outputs, as well as test points for common measurements.

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1 Caution

	Caution	**Read the user's guide before use**
	Caution	**Caution hot surface** **Contact can cause burns** **Do not touch!**

2 Introduction

The TPS65219 is a highly integrated power management solution for ARM® Cortex™ A53 Processors and FPGAs. This device combines 3 step down converters and 4 low-dropout (LDO) regulators. The Buck1 step down converter can support a load current of up to 3.5A, optimal for the core rail of a processor. All 3 step down converters support non-fixed switching frequency or fixed frequency mode. LDO1 and LDO2 are configurable in both load switch and bypass-mode to support SD-Card configuration. All LDO voltage inputs can be cascaded off the step down converter outputs or use the same system power to enable maximum design and sequencing functionality. Complete with 3 GPIOs and 3 Multi-Function-Pins (MFPs), TPS65219 offers the complete package for full control of the power and sequencing of a System on Chip (SoC).

3 Requirements

3.1 Hardware

This section list the minimum hardware requirements needed to operate the EVM.

EVM

TPS65219 evaluation board.

Host Computer

A computer with an available USB port is required to make use of the EVM software. The EVM software

runs on the computer and communicates with the EVM via a USB-A to micro-B cable.

Power Supply

A 5V DC power supply is required to power the EVM. If loading the EVM, a 10 A limit or higher is recommended.

3.2 Software

TPS65219xx EVM GUI

The EVM will power-up and operate without use of software. A GUI is currently under development and will provide a simple way to communicate to the device via I2C using the build-in USB2ANY utilizing an MSP430.

While the GUI is released, the USB2ANY along with the USB2ANY application can be used to read and write single registers. Section Section 6.1 provides the instructions for the setup.

4 TPS65219 Resources Overview

The TPS65219 PMIC has multiple analog and digital resources that can be configured to power different processors, FPGAs and SoCs. Table 4-1 and Table 4-2 summarize some of the key electrical spec specification for the analog rails, the possible supply configurations and programmable features for each regulator.

Table 4-1. TPS65219 Power Resources

	Buck1	Buck2/3	LDO1/2	LDO3/4
Input Voltage Range	2.5V to 5.5V	2.5V to 5.5V	1.5V to 5.5V	2.5V to 5.5V
Output Voltage Range	0.6V to 3.4V	0.6V to 3.4V	0.6V to 3.4V	1.2V to 3.3V
Operating Current	Maximum of 3.5A	Maximum of 2A	400mA	300mA
Current Limiting	5.7A to 6.9A	3.9A to 4.7A	600A to 900mA	400A to 900mA
Status Monitoring	UV, NEG_OC, OC, SCG, RV	UV, NEG_OC, OC, SCG, RV	UV, OC, SCG, RV	UV, OC, SCG, RV
Rail Configuration	Buck Converter	Buck Converter	LDO; load switch; bypass-mode	LDO; load switch
Short-Circuit Threshold (SCG)	220mV to 300mV	220mV to 300mV	220mV to 300mV	220mV to 300mV

TPS65219 Multi function Pins

TPS65219 has three multi-function-pins that can be configured depending on functional use. Table 4-2 shows the functions available for each of these pins as well as how these functions are configured and operated.

Note: Only one of the following pins, MODE/RESET or MODE/STBY, may be configured as MODE. If both are configured as MODE, MODE/RESET will take priority and MODE/STBY will be ignored.

Table 4-2. TPS65219 Multi function Pins

Pin Name	Pin Configuration	Operation
VSEL_SD/VSEL_DDR	**VSEL_SD** SD-card-IO-voltage selection	Trigger voltage change between 1.8V and register-based VLDO1 or VLDO2. Polarity is configurable.
	VSEL_DDR DDR-voltage selection	Hard-wired pull-up, pull-down, or floating. Sets VBUCK3 to 1.35V, 1.2V or register-based VBUCK3. Level-sensitive.
MODE/RESET	**MODE** Forces Buck converters into PWM or auto-entry in PFM-mode	Connected to SoC or hard-wired pull-up/down. Level-sensitive.
	RESET Forces a WARM or COLD reset.	Connected to SoC. WARM reset: reset output voltages to default COLD reset: sequence down all enabled rails and power up again Edge-sensitive.
MODE/STBY	**MODE** Forces Buck converters into PWM or auto-entry in PFM-mode	Pin-status determines the switching mode of the buck converters. Assert pin low for longer than $t_{DEGLITCH\_MFP}$ to force buck regulators into PWM-mode. I^{2}C selection also available by writing to MODE_I2C_CTRL in MFP_1_CONFIG register.
	STBY Low power mode	Disables selected rails. Assert pin low for longer than Both MODE and STBY can be combined. Level sensitive.

5 EVM Configuration

The following sections outline how to configure the TPS65219EVM for general experimentation.

EVM Configuration

The TPS65219EVM can be configured as follows:

1. Configure regulator input supply rails for the expected application using the jumpers indicated in the "Supply Voltage Setup "
2. Configure the multi-function pins externally using the mode configuration descriptions indicated in "Multi-Function pin setup". Please note that the default configuration for regulator choice in SD or DDR voltage selection may differ for each individual NVM configuration (polarity is configurable).
3. Connect VSYS to a power supply capable of supporting the application and enable the supply. Typical supply for TPS6521901 is 5V.
4. If using a version of TPS65219 configured for First Supply Detection (FSD), the power-up sequence will be executed as soon as the 5V supply is connected to VSYS.

5.1 Default EVM Configuration

This section describes the default configuration programmed on the TPS6521901 PMIC.

The TPS65219EVM comes with the TPS6521901 PMIC installed which is one of the orderable part numbers of the TPS65219 device family. Table 5-1 shows the default jumper configuration that can be used to evaluate the PMIC performance. For reference, Figure 5-1 demonstrates the output voltages and jumper location on the EVM. These information is based on the programmed default configuration on the TPS6521901 NVM. The EVM can be used to evaluate other TPS65219 variants. External passive components and jumper configuration might need to be changed if the PMIC is reconfigured or replaced with a different orderable.

For more information about the settings that can be re configured and the I2C registers associated, please refer to the device data sheet and technical reference manual (TRM).

The TPS65219EVM is designed to demonstrate some of the potential uses of the PMIC family. The EVM has more limitations than the TPS65219x device.

Table 5-1. TPS65219EVM default jumper configuration

|	Header		Jumper Default Position
Supply voltage setup	J1	VIN_BUCK3	setup to supply Buck3 with VSYS
	J3	VIN_LDO1	setup to supply LDO1 with BUCK2
	J9	VIN_LDO2	setup to supply LDO2 with BUCK2
	J10	VIN_LDO34	setup to supply LDO3/4 with BUCK2
	J11	EXTLDO_VIN	setup to supply the discrete 3.3V LDO with VSYS (U2 Ref designator on schematic)
	J4	I2C_SELECT	setup to use the 3.3V discrete LDO as the pull-up supply for the I2C pins.
Multi-Function pin setup	J5	VSEL	Low = sets 1.8V output voltage on LDO1 (default EVM config) High = sets 3.3V output voltage on LDO1 if the LDO is supplied by a 3.3V source.
	J8	MODE/STBY	High = ACTIVE state (default EVM config) Low = STBY state
	J12	MODE_RESET	High = normal operation (default EVM config) Low = performs a warm reset (reset target voltage and Bypass mode configs to their default NVM values)
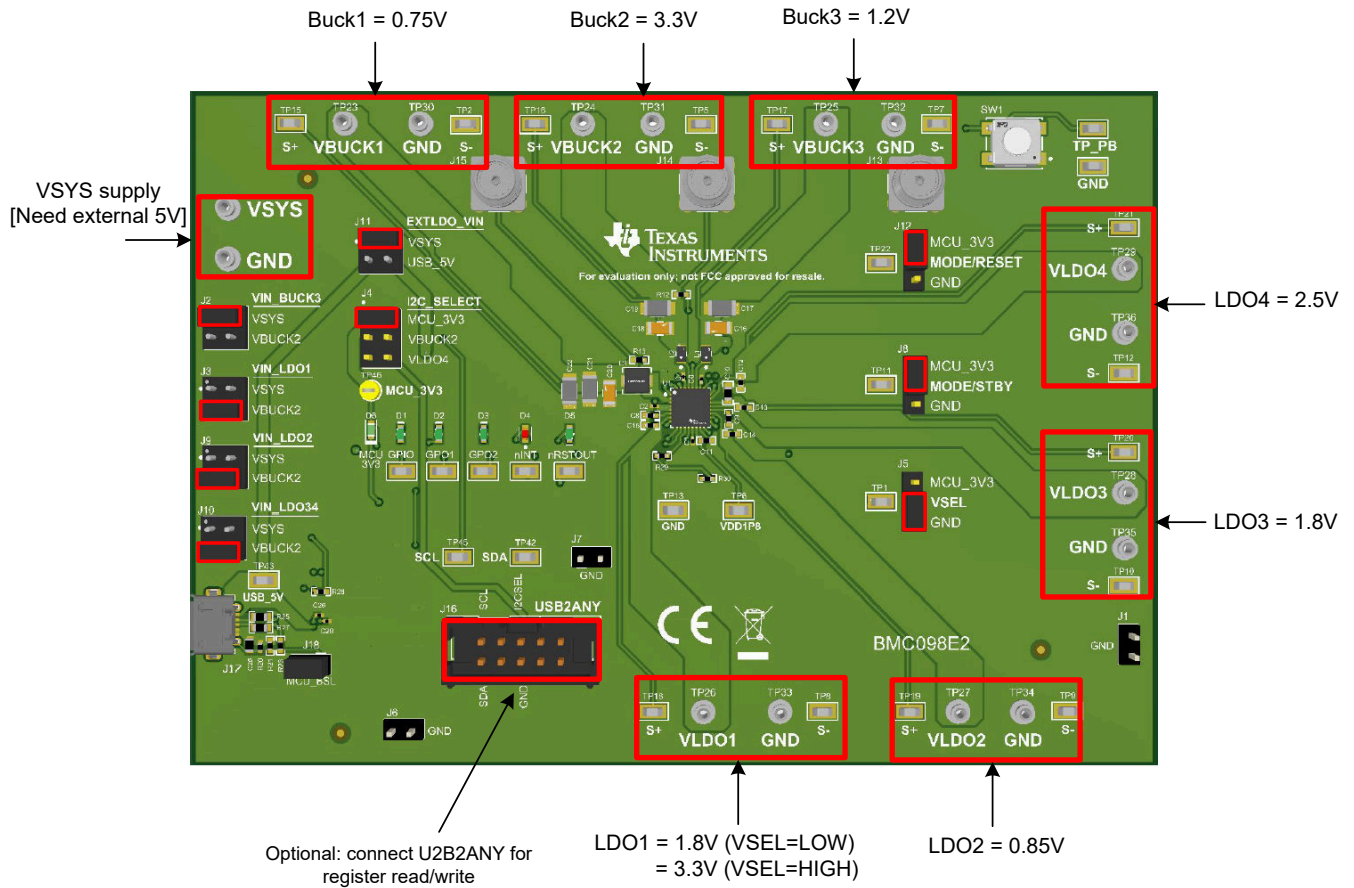
Figure 5-1. TPS65219EVM Default Configuration
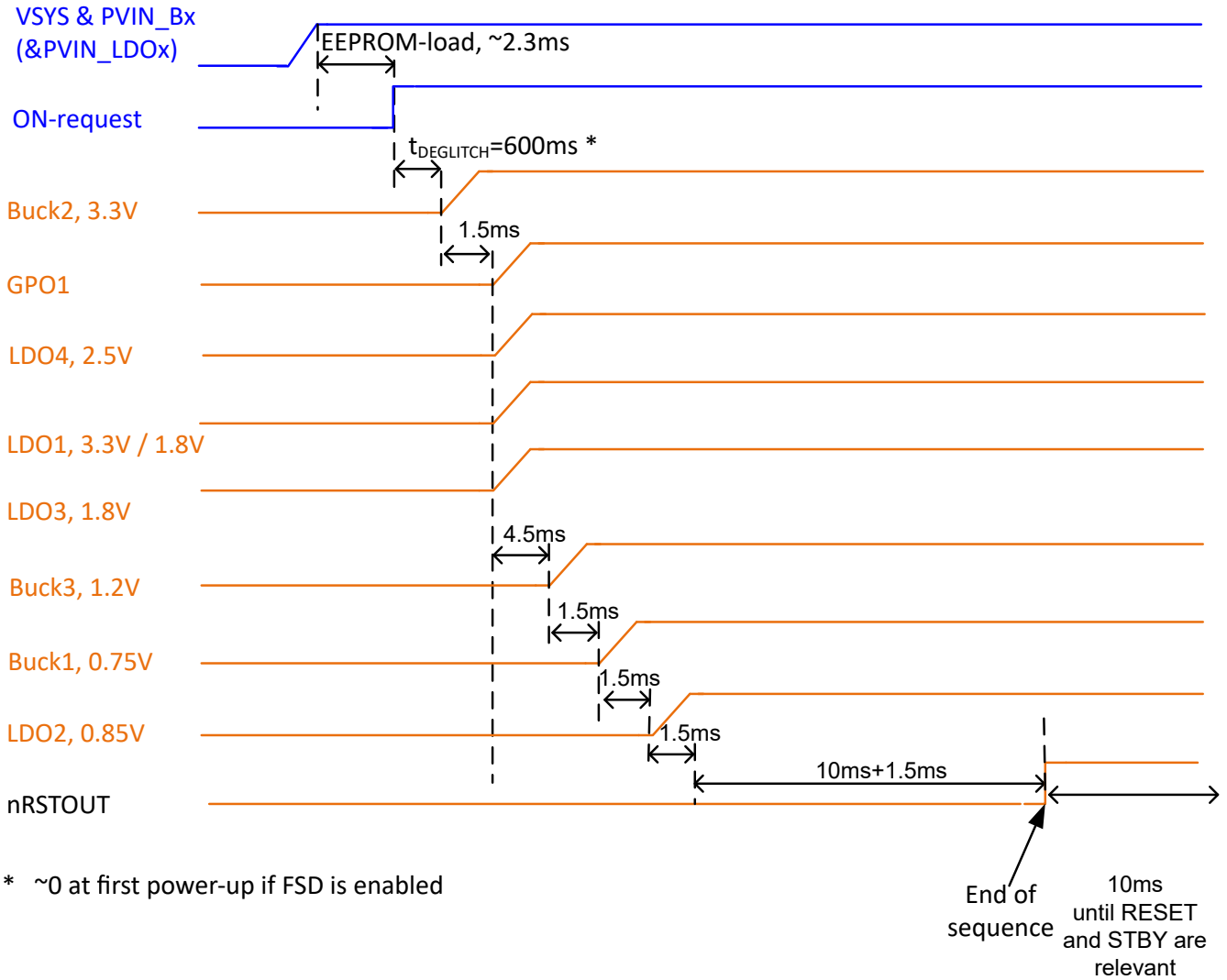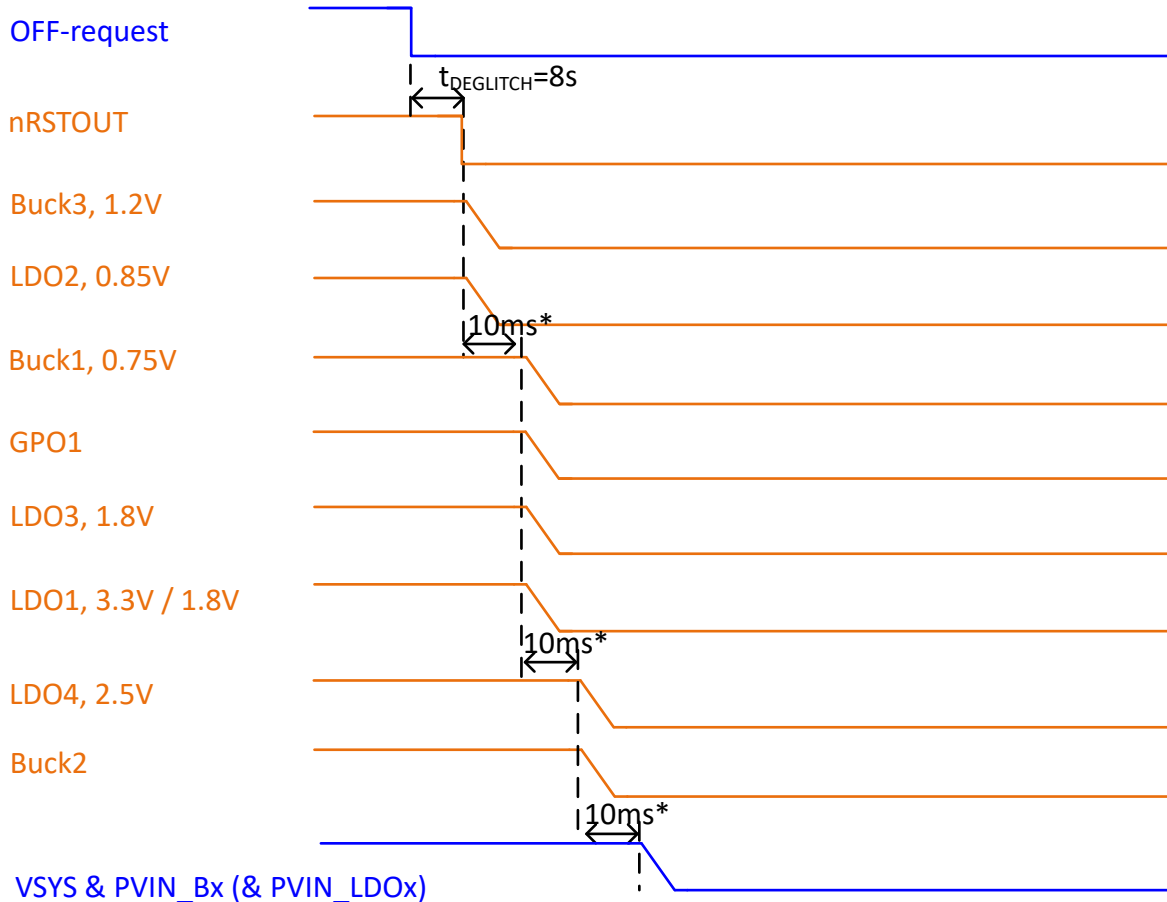
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Figure 5-2. TPS6521901 Power-Up Sequence

* discharge-duration depends on Vout, Cout and load. Slot-duration needs to adopt.
Slot-duration extends up to 8x its configured value.

Figure 5-3. TPS6521901 Power-Down Sequence

5.2 Configuration Headers

The TPS65219EVM has multiple headers that can be used to change the input supply for some of the power rails. It also includes headers that allows changing the specific functions of the PMIC using the multi-function pins. Table 5-2 list all the headers and the expected configuration for each selection.

Table 5-2. TPS65219 Configuration Headers

	Header Name	Description	Configuration
J1	GND	GND connection	N/A
J2	VIN_BUCK3	Buck3 input voltage selection	**J2-1** PVIN_B3 supplied by VSYS
			J2-3 PVIN_B3 supplied by Buck2 output (VBUCK2)
J3	VIN_LDO1	LDO1 input voltage selection	**J3-1** JPVIN_LDO1 supplied by VSYS
			J3-3 PVIN_LDO1 supplied by BUCK2 output (VBUCK2)
J4	I2C_Select	Pull-up supply for I2C pins	**J4-1** External 3.3 V LDO used for I2C pull-up supply
			J4-3 BUCK2 output used for I2C pull-up supply
			J4-5 LDO4 output used for I2C pull-up supply
J5	VSEL	High/Low selection for VSEL_SD/VSEL_DDR pin	**J5-3** VSEL_SD/VSEL_DDR pin pulled high (3.3 V)
			J5-1 VSEL_SD/VSEL_DDR pulled down
J6	GND	GND connection	N/A

Table 5-2. TPS65219 Configuration Headers (continued)

	Header Name	Description	Configuration
J7	GND	GND connection	N/A
J8	MODE/STBY	High/Low selection for MODE/STBY pin	**J8-3** MODE/STBY pin pulled high (3.3 V)
			J8-1 MODE/STBY pin pulled down
J9	VIN_LDO2	LDO2 input voltage selection	**J9-1** PVIN_LDO2 supplied by VSYS
			J9-3 PVIN_LDO2 supplied by BUCK2 output (VBUCK2)
J10	VIN_LDO34	LDO3/LDO4 input voltage selection	**J10-1** PVIN_LDO34 supplied by VSYS
			J10-3 PVIN_LDO34 supplied by BUCK2 output (VBUCK2)
J11	EXTLDO_VIN	Input voltage selection for external 3.3 V LDO	**J11-1** External LDO supplied by VSYS
			J11-3 External LDO supplied by 5 V from USB
J12	MODE/RESET	High/Low selection for MODE/RESET	**J12-3** MODE/RESET pin pulled high (3.3 V)
			J12-1 MODE/RESET pin pulled low

5.3 Test Points

The TPS65219 EVM contains 48 test points for various measurements. Trace assignments to the test points are shown in Table 5-3. For reference, Figure 5-4 demonstrates the test point locations on the EVM.

Table 5-3. TPS65219 EVM Test Points

Test Point Number	Associated Trace
TP1	VSEL_SD/VSEL_DDR
TP2	GND
TP3	VSYS
TP4-5	GND
TP6	VDD1P8
TP7-10	GND
TP11	MODE/STBY
TP12	GND
TP13	GND
TP14	PB / EN
TP15	Buck 1 Output SENSE
TP16	Buck 2 Output SENSE
TP17	Buck 3 Output SENSE
TP18	LDO 1 Output SENSE
TP19	LDO 2 Output SENSE
TP20	LDO 3 Output SENSE
TP21	LDO 4 Output SENSE
TP22	MODE/RST
TP23	Buck 1 Output
TP24	Buck 2 Output
TP25	Buck 3 Output
TP26	LDO 1 Output
TP27	LDO 2 Output

Table 5-3. TPS65219 EVM Test Points (continued)

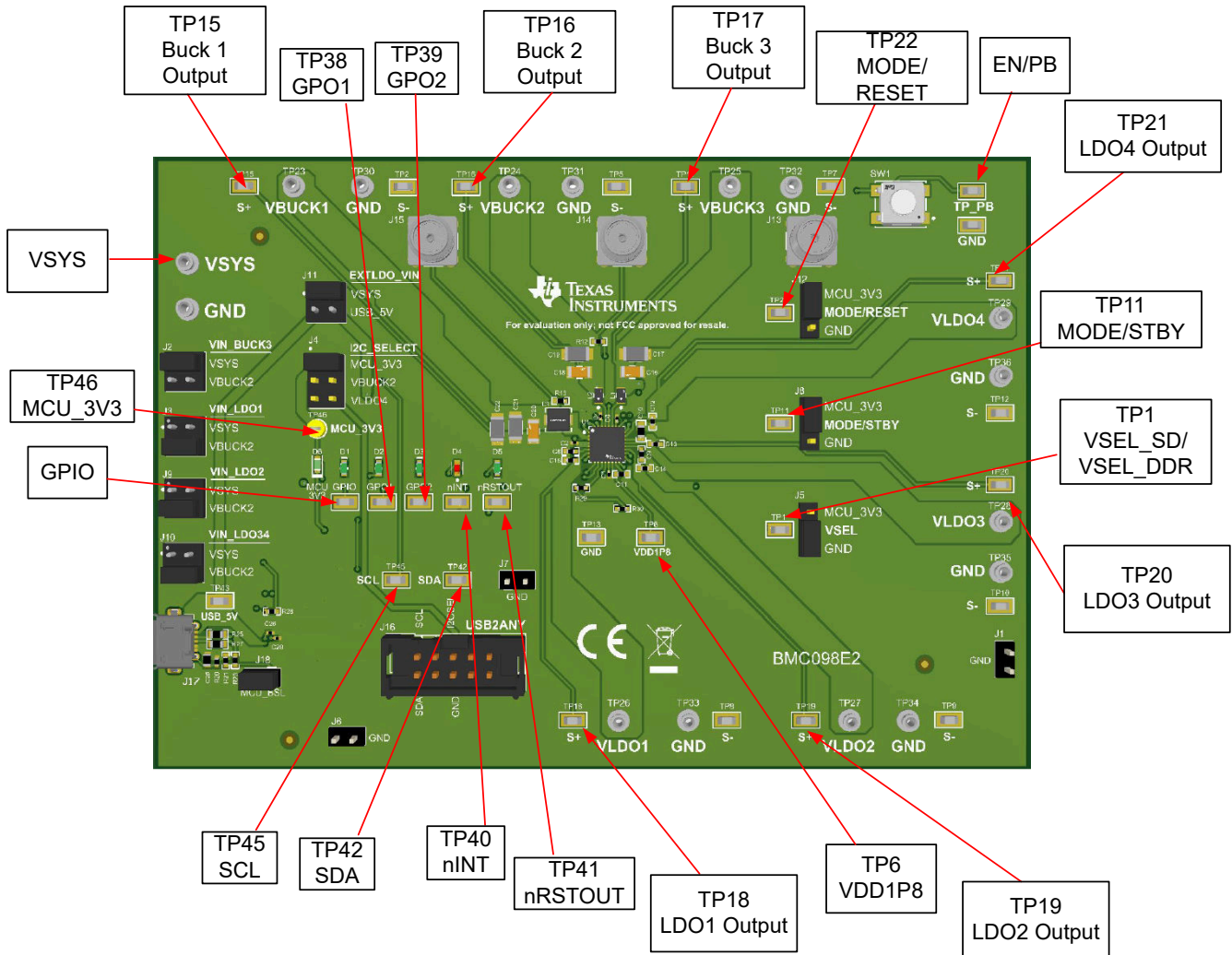| Test Point Number	Associated Trace
TP28	LDO 3 Output
TP29	LDO 4 Output
TP30-36	GND
TP37	GPIO
TP38	GPO1
TP39	GPO2
TP40	nINT
TP41	nRSTOUT
TP42	SDA
TP44	GND
TP45	SCL
TP46	MCU3V3

Figure 5-4. TPS65219EVM Test Points

6 Graphical User Interface (GUI)

The Graphical User Interface (GUI) for the EVM can be found in the Gallery at TI DevTools. The GUI can be operated through Google Chrome™ or Mozilla Firefox™ web browsers. To run the GUI in the browser, click the thumbnail and follow the prompted instructions for first time installation. The GUI requires both a browser plugin and the TI Cloud Agent software for access to the local USB ports. The GUI can also be downloaded for offline operation by hovering over the download arrow in the GUI thumbnail and selected the desired platform - Windows®, macOS®, or Linux®.

6.1 Using USB2ANY With the TPS65219EVM

This section describes an alternate method to communicate with the TPS65219 PMIC through I2C.

While the TPS65219EVM GUI becomes available, the USB2ANY along with the USB2ANY Explorer application can be used to read and write to the PMIC registers. The U2B2ANY does not come with the EVM but can be ordered separately through ti.com. Here are the instructions:

1. Use female-female wires to connect the SDA, SCL, and GND pins of the USB2ANY to the corresponding pins of the EVM. DO NOT CONNECT the 3V3 of the USB2ANY to the EVM. There are already 3V3 pull-ups on the EVM itself.
2. Connect USB2ANY controller to laptop
3. Open the "USB2ANY Explorer" application
4. Select the second tab "I2C". There is a hidden tab bar at the top. The explorer will automatically open up to the first.
5. Slave address is the I2C address of the device (0x30 in our case). Internal address is the register address. Set bit rate and ensure the 3.3V internal pull-ups are OFF. The SDA and SCL lines are internally pulled up already on the EVM. Use the read and write buttons to read/write to your internal address register.
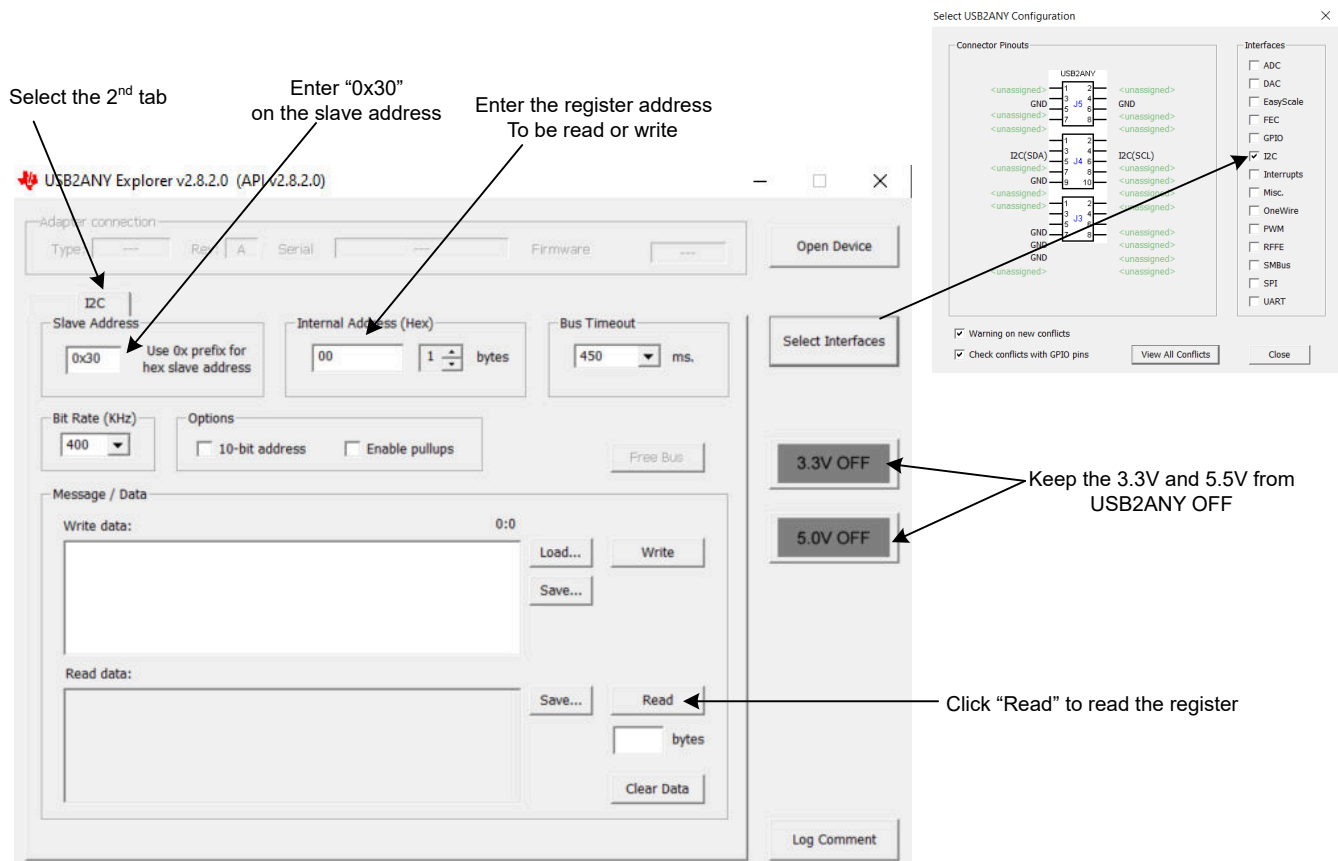

Figure 6-1. U2B2ANY Explorer

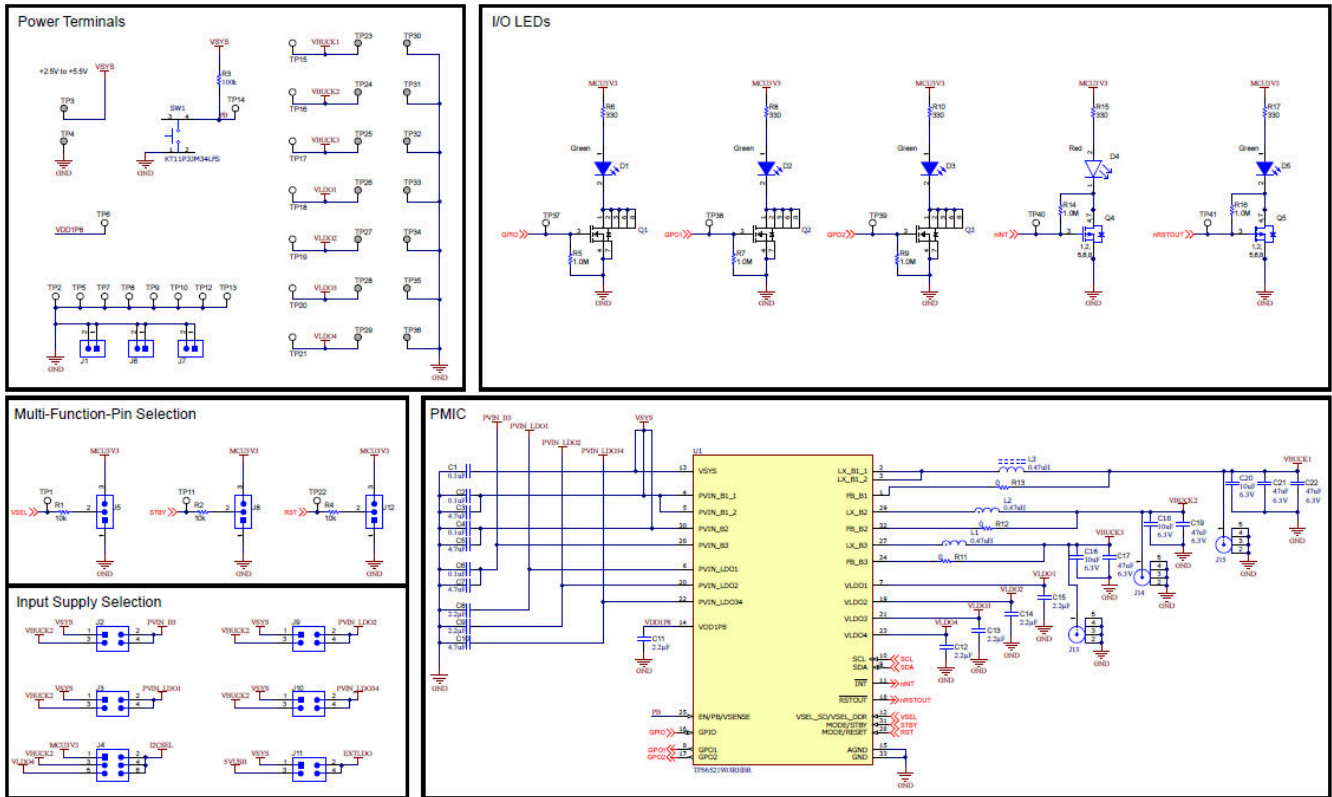# 7 Schematics, PCB Layouts, and Bill of Materials
7.1 TPS65219EVM Schematic

Figure 7-1. Schematic

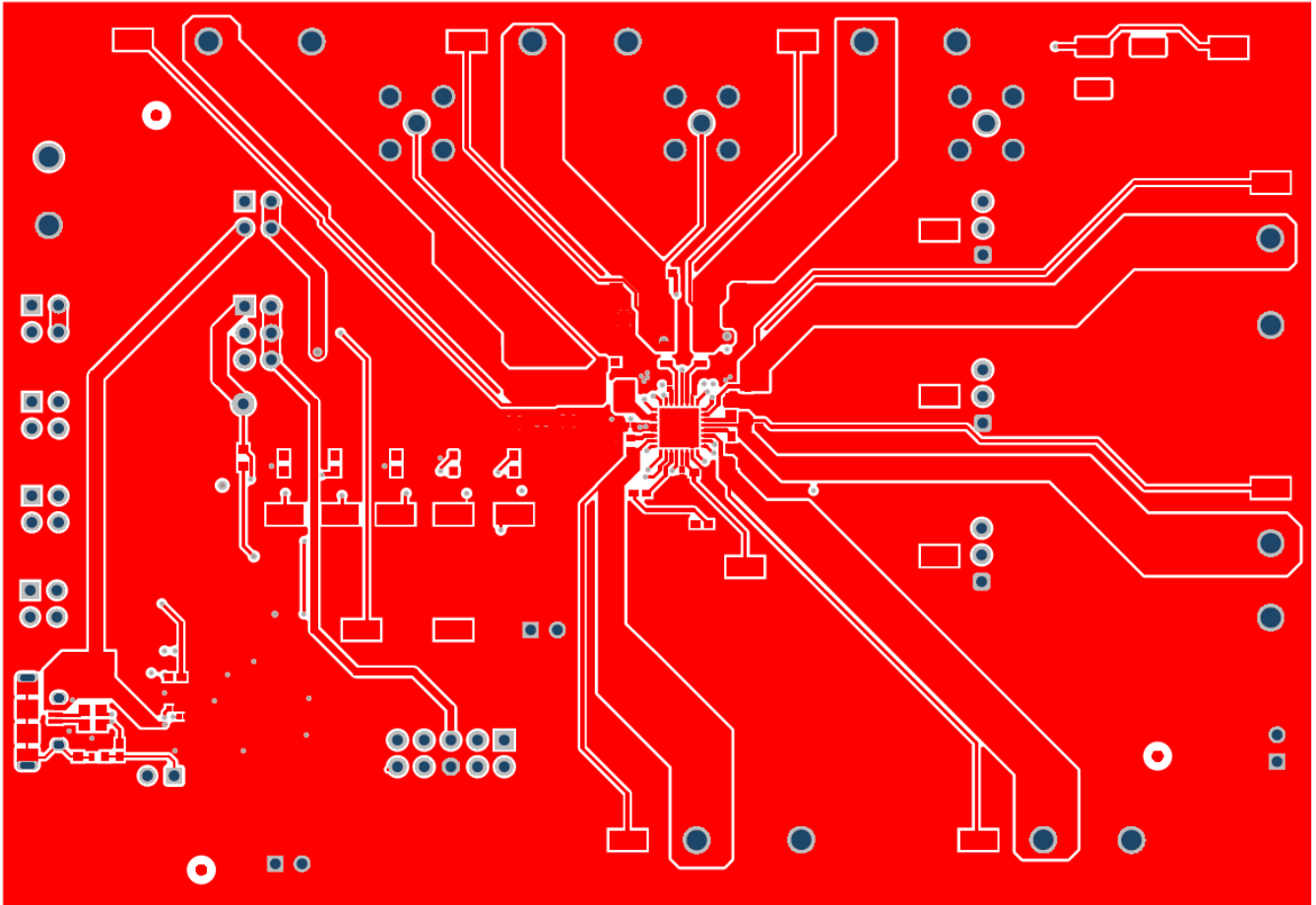## 7.2 TPS65219EVM PCB Layers
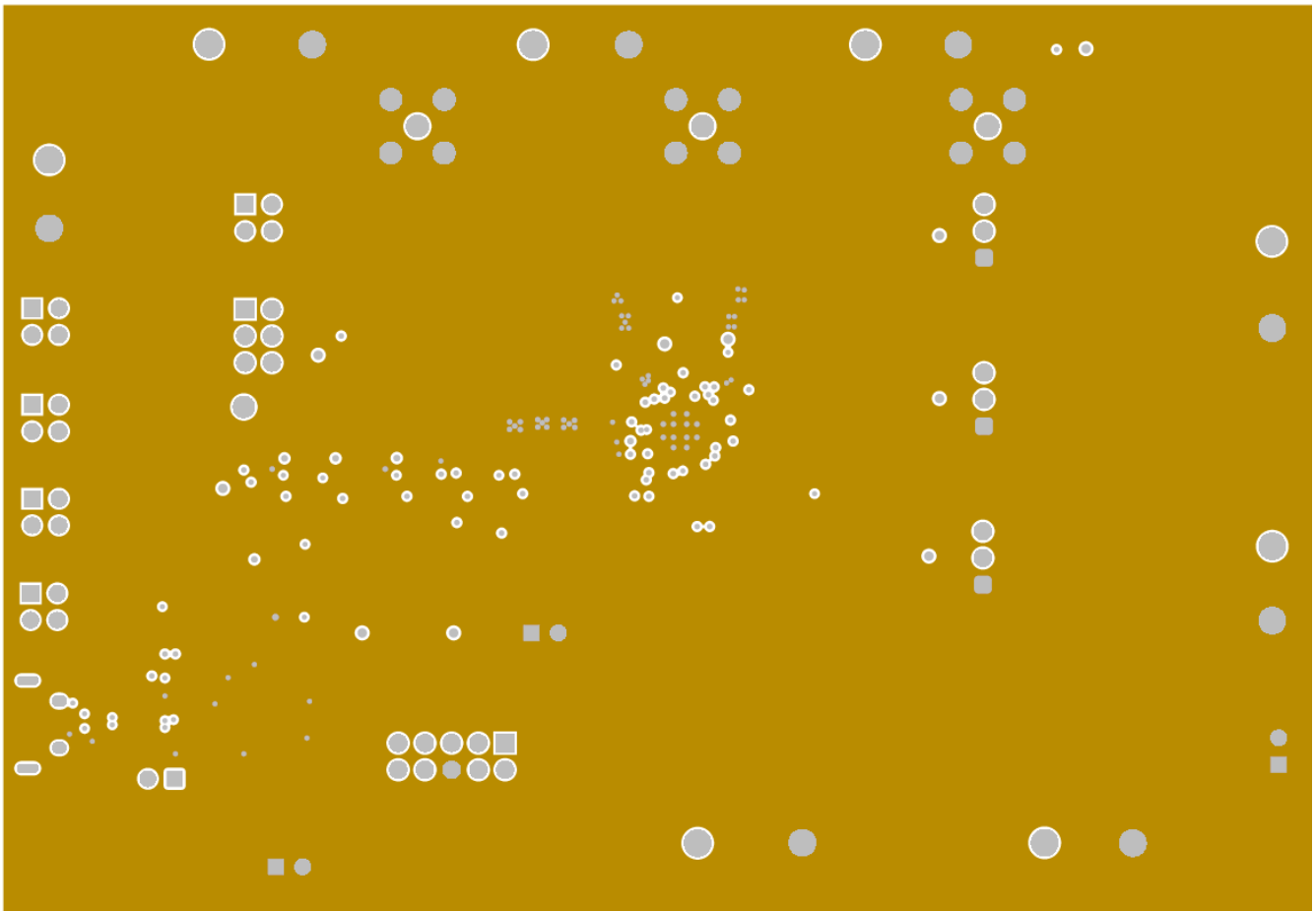

Figure 7-2. TPS65219EVM Top Layer

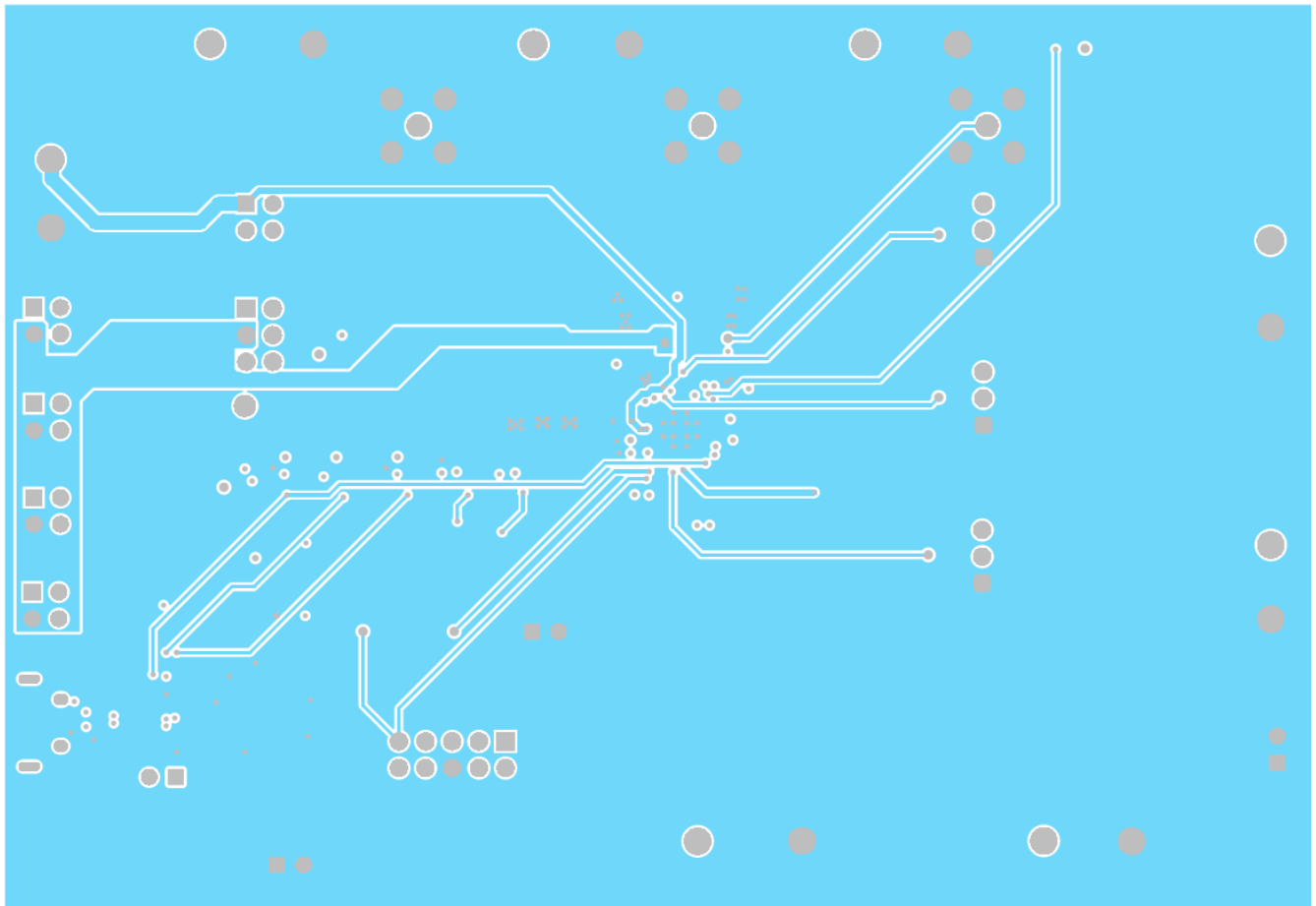**Figure 7-3. TPS65219EVM signal Layer 1**

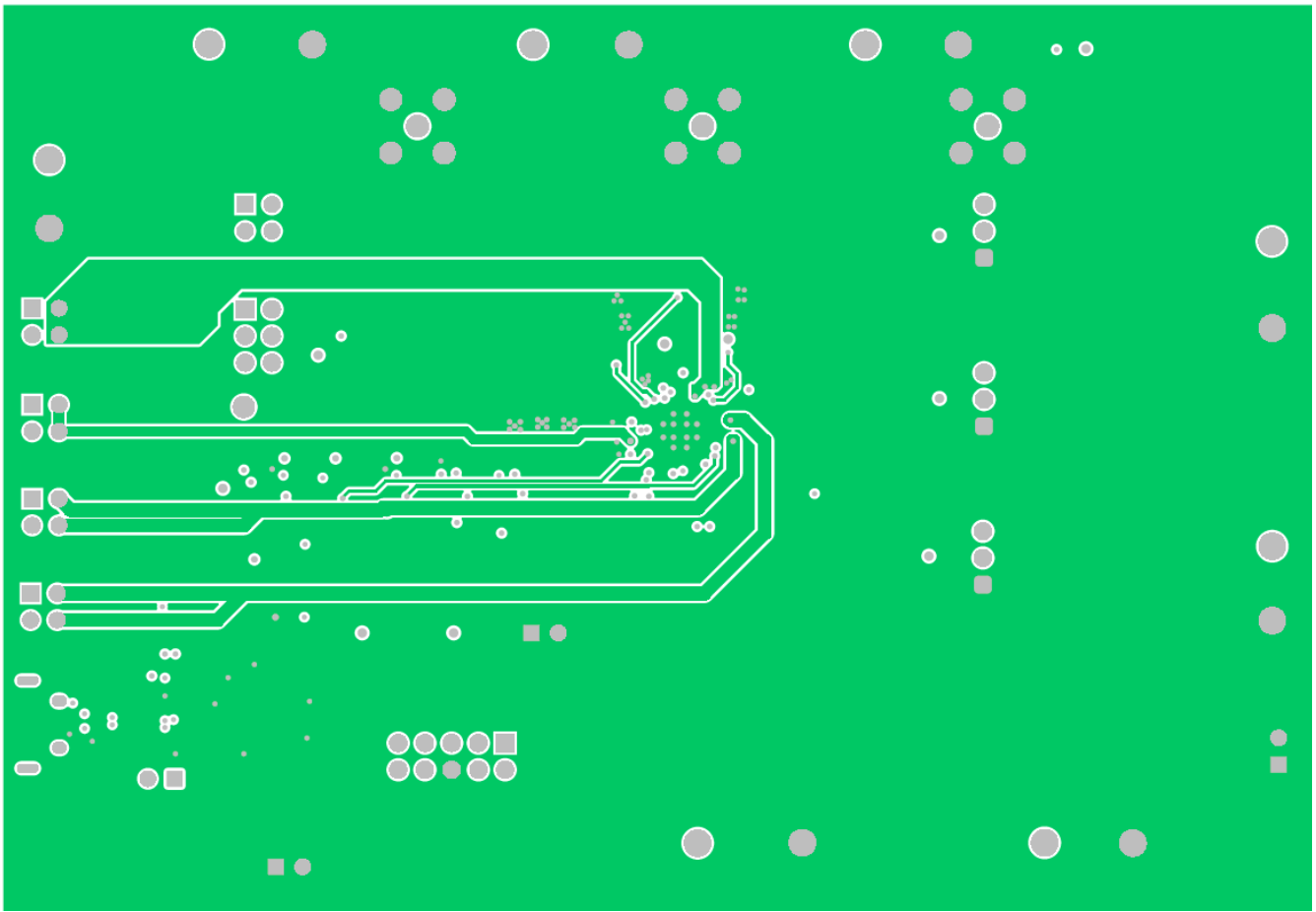**Figure 7-4. TPS65219EVM Signal Layer 2**

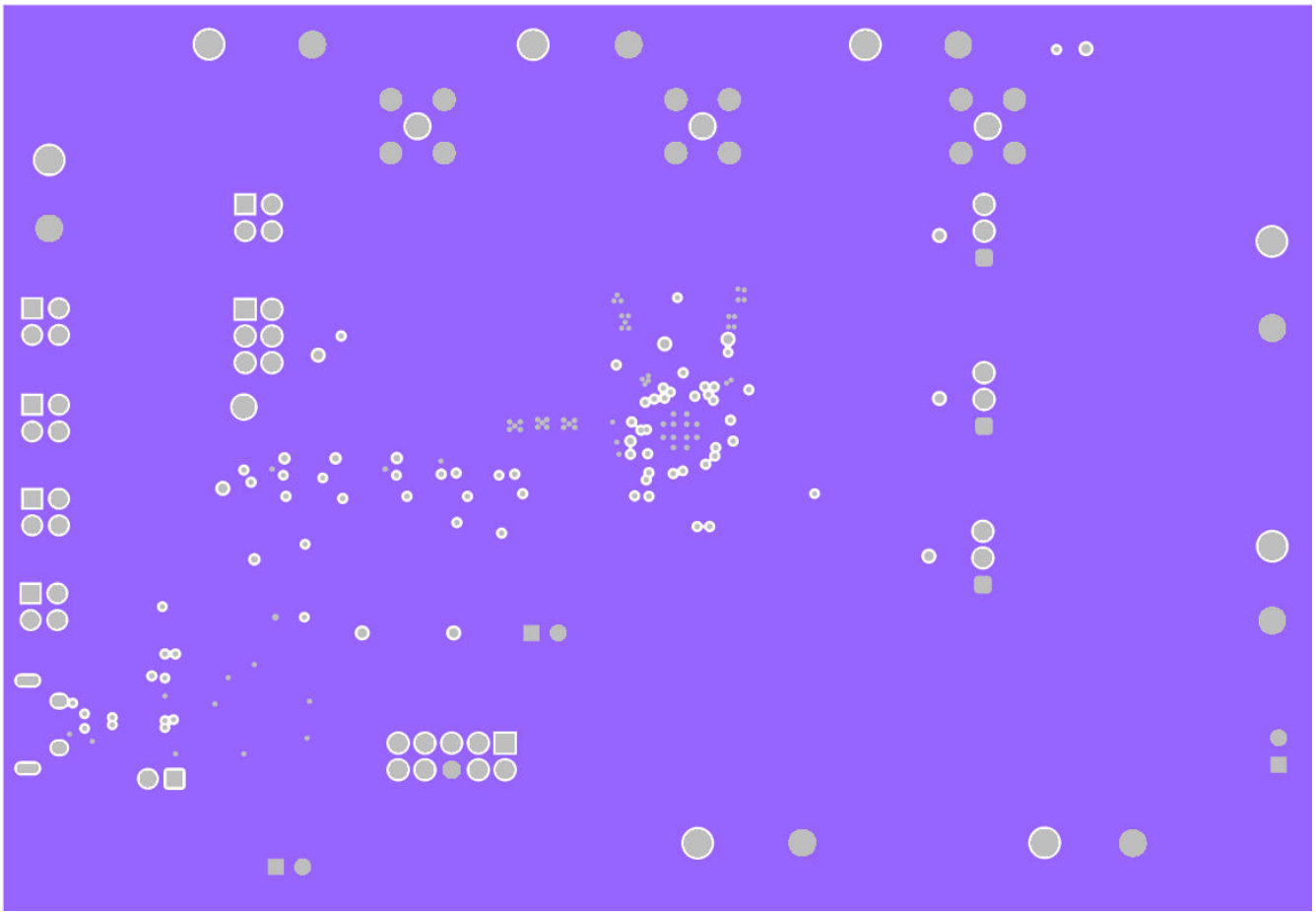**Figure 7-5. TPS65219EVM Signal Layer 3**

Figure 7-6. TPS65219EVM Signal Layer 4
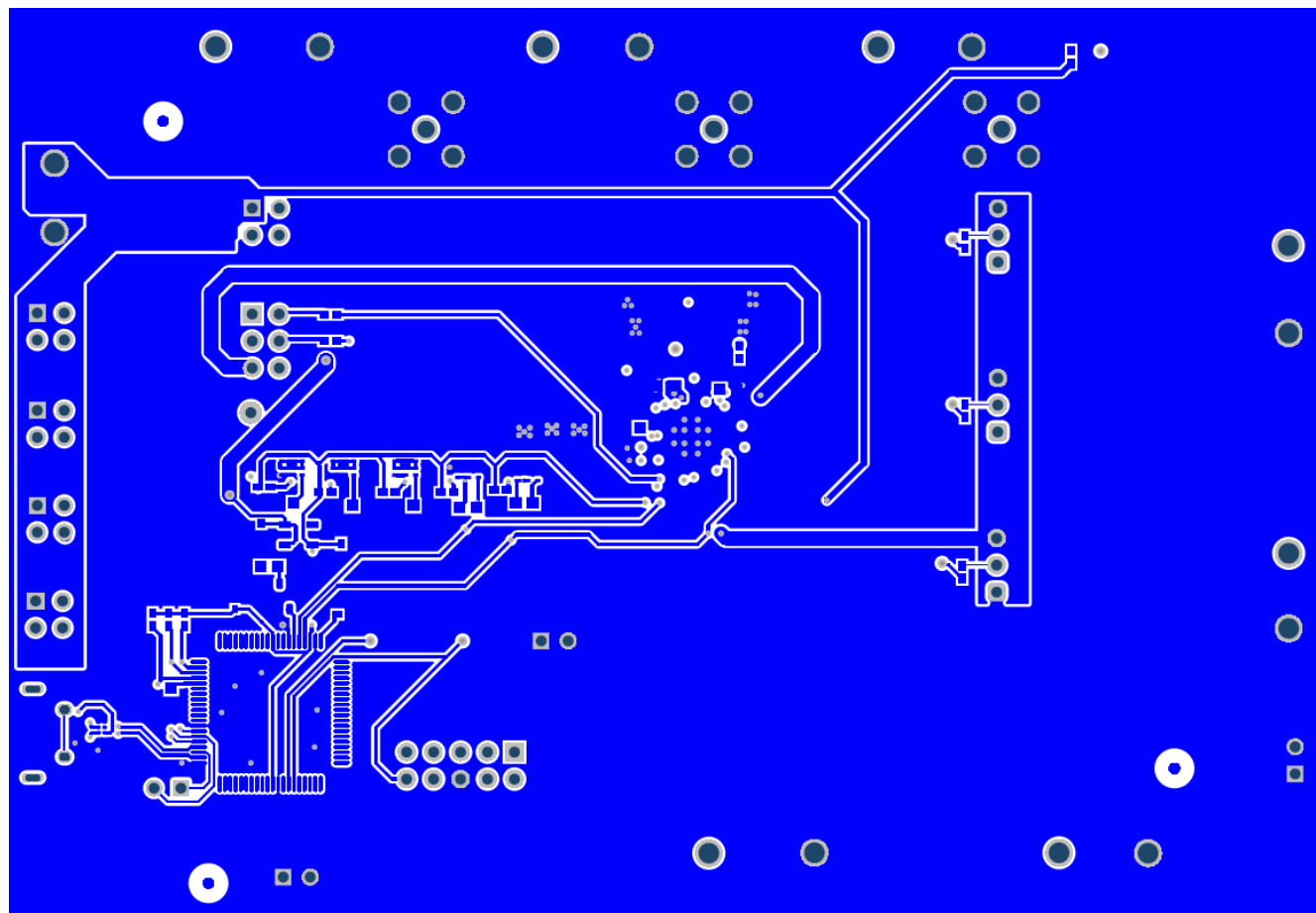
Figure 7-7. TPS65219EVM Bottom Layer

7.3 Bill of Materials

Table 7-1. Bill of Materials

Designator	Quantity	Description	Package Reference	Part Number	Manufacturer
C1, C2, C4, C6	4	CAP, CERM, 0.1 uF, 10 V,+/- 10%, X7S, 0201	201	GRM033C71A104KE 14D	MuRata
C3, C5, C7, C10	4	CAP, CERM, 4.7 uF, 10 V, +/- 10%, X7S, 0603	603	C1608X7S1A475K08 0AC	TDK
C8, C9, C11, C12, C13, C14, C15, C23, C24	9	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X7S, 0402	402	C1005X7S1A225K05 0BC	TDK
C16, C18, C20	3	Cap Ceramic 10uF 6.3V X7R ±10% SMD 1206 +125°C Embossed T/R	1206	CL31B106KQHNFNE	Samsung
C21	1	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X7S, 1206	1206	C3216X7S0J476M16 0AC	TDK
C25	1	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0603	603	C0603C332K5RACT U	Kemet

Table 7-1. Bill of Materials (continued)

Designator	Quantity	Description	Package Reference	Part Number	Manufacturer
C26	1	CAP, CERM, 100 pF, 16 V, +/- 10%, X7R, 0201	201	GRM033R71C101KA01D	MuRata
C27	1	CAP, CERM, 0.47 µF, 16 V,+/- 10%, X7S, 0402	402	CGA2B1X7S1C474K050BE	TDK
C28	1	CAP, CERM, 220 pF, 16 V, +/- 10%, X7R, 0201	201	GRM033R71C221KA01D	MuRata
C29	1	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	402	GCM155R71C104KA55D	MuRata
C30	1	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	603	C0603C102K5RACTU	Kemet
D1, D2, D3, D5	4	LED, Green, SMD	1.7x0.65x0.8mm	LG L29K-G2J1-24-Z	OSRAM
D4	1	Red 631nm LED Indication - Discrete 2.2V 0603 (1608 Metric)	603	HSMZ-C190	Broadcom
D6	1	LED, Green, SMD	LED_0603	150060VS75000	Wurth Elektronik
H1, H2, H3, H4	4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J6, J7, J18	4	Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
J2, J3, J9, J10, J11	5	Header, 100mil, 2x2, Tin, TH	Header, 2x2, 2.54mm, TH	PEC02DAAN	Sullins Connector Solutions
J4	1	Header, 100mil, 3x2, Gold, TH	3x2 Header	TSW-103-07-G-D	Samtec
J5, J8, J12	3	Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J16	1	Receptacle, 0.5mm, USB TYPE C, R/A, SMT	Receptacle, 0.5mm, USB TYPE C, R/A, SMT	12401610E4#2A	Amphenol Canada
J17	1	Header (shrouded), 100mil, 5x2, High-Temperature, Gold, TH	5x2 Shrouded header	N2510-6002-RB	3M
L1, L2	2	Thin Film Power Inductor 0.47uH 20% 4.5A 29mOhm 0805	805	TFM201208BLE-R47MTCF	TDK
L3	1	470 nH Shielded Wirewound Inductor 7 A 23mOhm Max 2-SMD	SMD2	SRP3020TA-R47M	Bourns

Table 7-1. Bill of Materials (continued)

Designator	Quantity	Description	Package Reference	Part Number	Manufacturer
Q1, Q2, Q3	3	30-V N-Channel NexFET™ Power MOSFET	WSON6	CSD17318Q2	Texas Instruments
Q4, Q5	2	MOSFET, P-CH, -20 V, -20 A, DQK0006C (WSON-6)	DQK0006C	CSD25310Q2	Texas Instruments
Q6	1	MOSFET, N-CH, 50 V, 0.22 A, SOT-23	SOT-23	BSS138	Fairchild Semiconductor
R1, R2, R4	3	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW040210K0JNED	Vishay-Dale
R3	1	RES, 100 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	402	ERJ-2GEJ104X	Panasonic
R5, R7, R9, R14, R16	5	RES, 1.0 M, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	603	CRCW06031M00JNEA	Vishay-Dale
R6, R8, R10, R15, R17	5	RES, 330, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW0402330RJNED	Vishay-Dale
R11, R12, R13	3	RES, 0, 0%, 0.2 W, AEC-Q200 Grade 0, 0402	402	CRCW04020000Z0EDHP	Vishay-Dale
R18, R21	2	RES, 4.87 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04024K87FKED	Vishay-Dale
R19, R20	2	RES, 1.0 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04021K00JNED	Vishay-Dale
R22	1	RES, 1.0 M, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04021M00JNED	Vishay-Dale
R23	1	RES, 1.07 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04021M07FKED	Vishay-Dale
R24, R26, R28, R31, R32	5	RES, 1.0 k, 5%, 0.063 W, 0402	402	CRCW04021K00JNED	Vishay-Dale
R25	1	RES, 1.5 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW04021K50JNED	Vishay-Dale
R27, R29	2	RES, 33.0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	603	CRCW060333R0FKEA	Vishay-Dale
R30	1	RES, 120 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	402	CRCW0402120KJNED	Vishay-Dale

Table 7-1. Bill of Materials (continued)

Designator	Quantity	Description	Package Reference	Part Number	Manufacturer
R33	1	RES, 1.50 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	603	CRCW06031K50FKEA	Vishay-Dale
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10	10	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
SW1	1	Switch Tactile N.O. SPST Round Button J-Bend 32VAC 32VDC 1VA 100000Cycles 3N SMD Tube/T/R	SMT_SW_7MM1_6MM3	KT11P3JM34LFS	C&K Components
TP1, TP2, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP37, TP38, TP39, TP40, TP41, TP42, TP43, TP44, TP45, TP46, TP48	31	Test Point, Miniature, SMT	Testpoint_Keystone_Miniature	5015	Keystone
TP3, TP4, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP35, TP36	16	PCB Pin, Swage Mount, TH	PCB Pin(2505-2)	2505-2-00-44-00-00-07-0	Mill-Max
TP47	1	Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone
U1	1	Integrated Power Management IC for ARM Cortex—A53 Processors and FPGAs	VQFN32	PTPS6521901RHBR	Texas Instruments
U2	1	300-mA, Ultra-Low-Noise, Low-IQ, High PSRR LDO	SOT23-5	TPS7A2033PDBVR	Texas Instruments
U3	1	25 MHz Mixed Signal Microcontroller with 128 KB Flash, 8192 B SRAM and 63 GPIOs, -40 to 85 degC, 80-pin QFP (PN), Green (RoHS & no Sb/Br)	PN0080A	MSP430F5529IPN	Texas Instruments
U4	1	4-Channel USB ESD Solution with Power Clamp, DRY0006A (USON-6)	DRY0006A	TPD4S012DRYR	Texas Instruments

Table 7-1. Bill of Materials (continued)

Designator	Quantity	Description	Package Reference	Part Number	Manufacturer
C17, C19, C22	0	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X7S, 1206	1206	C3216X7S0J476M160AC	TDK
J13, J14, J15	0	SMA Jack, Straight, 50 Ohm, Gold, TH	TH, 5-Leads, Body 7x7mm	SMA-J-P-H-ST-TH1	Samtec

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.

<u>WARNING</u>

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。 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 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。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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