SMBus Controlled NVDC-1 Charge Controller, N-CH MOSFET Selector and Current Monitor

The bq2471x evaluation module (EVM) is an SMBus controlled NVDC-1 charge controller with N-CH MOSFET selector and current monitoring. The input voltage range, for the buck converter, is between 6 and 24 V, with a programmable output of 2–3 cells (bq24715) and 3–4 cells (bq24717) and charge output current range of 128 mA to 8.128 A.

This EVM doesn't include the EV2400 interface device (HPA500); this must be ordered separately to evaluate the bq2471x EVM.

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1 Introduction

1.1 Features

Refer to the data sheet (SLUSBD1) for detailed features and operation.

1.2 I/O Descriptions

Table 1. I/O Descriptions

Jack	Description
J1–DCIN	AC to VDC adapter, positive output
J1–GND	AC to VDC adapter, negative output
J2–SCL	SCL pin output, SMBus clock line
J2–SDA	SDA pin output, SMBus data line
J2– GND	External power supply, negative output
J3-Cell	External input for disable learn pulse
J3-ACOK	ACOK pin
J3-IOUT	IOUT pin
J3-3.3V	External voltage supply 3.3 V
J4-SYS	Connected to system
J4-GND	Ground
J4-BAT	Connected to battery pack

1.3 Jumpers

JP1
bq24715: 2 Cells – Float, 3 Cells – Apply Jumper (High);
bq24717: 3 Cells – Float, 4 Cells – Apply Jumper (High);

Table 2. Recommended Operating Conditions

Description			Min	Typ	Max	Unit
V_{IN}	Supply voltage	Input voltage from ac adapter input	18	19–20	22	V
V_{BAT}	Battery voltage	Voltage applied at VBAT terminal	0	6–12.6	17.408	V
I_{AC}	Supply current	Maximum input current from ac adapter input	0		4.5	A
I_{out}	Output current	Output current	1		8	A
T_J	Operating junction temperature range		0		125	°C

2 Test Summary

2.1 Equipment

Power Supplies
Power supply #1 (PS#1): a power supply capable of supplying 20 V at 5 A is required.
Power supply #2 (PS#2): a power supply capable of supplying 3.3 V at 0.2 A is required.

Load #1
A 20-V (or above), 10-A (or above) electronic load that can operate at constant current mode

Load #2
A Kepco BOP36-12M, 0~±36 V/0~±12 A, bipolar operational power supply
Or: equivalent

Meters
Seven Fluke 75 multimeters, (equivalent or better)
or: Four equivalent voltage meters and three equivalent current meters.
The current meters must be capable of measuring 5 A+ current.

Computer
A computer with at least one USB port and a USB cable. The EV2400 USB driver and the bq24715 SMB evaluation software must be properly installed.

EV2400 SMBUS Communication Kit
An EV2400 SMBUS communication kit

EV2400 Controller
The EV2400 controller is an MSP430F5529 running at 4 MHz. The controller firmware is stored in flash memory and is executed by the core at power-up. The controller communicates with target device(s) through either: a 2-wire SMBus communication port, a 1-wire HDQ port, or a 2-wire EEPROM I^2C port. The 2-wire SMBus communication port supports both SMBus and I^2C protocols. CRC-8 checksum verification for the data packets prevents data corruption over the USB.

USB Interface (USB)
The interface board connects to a USB port (version 1.1 or later) on a host computer and is powered from the port. All communication over the USB is human interface device (HID) class. Drivers are built into Windows® and most of the operating systems.

2.2 Equipment Setup

(A) Set the PS#1 for 0 V ±100 mVDC, with the current limit set to > 5 A, then turn off supply.

(B) Connect the output of PS#1 in series with a current meter (multimeter) to J1 (DCIN, GND).

(C) Connect a voltage meter across J1 (DCIN, GND).

(D) Set the PS#2 for 3.3 V ±100 mVDC, 0.2 ±0.1 A current limit and then turn off supply.

(E) Connect the output of the PS#2 to J3 (3.3V) and J4 (GND).

(F) Connect a voltage meter across J4 (BAT, GND).

(G) Connect a voltage meter across J4 (SYS, GND).

(H) Connect J2 (SDA, SCL) and J2 (GND) to the EV2400 kit *SMB* port. Refer to Table 3 for a connection reference. Connect the USB port of the EV2400 kit to the USB port of the computer. The connections are shown in Figure 1.

Table 3. EV2400 and bq24715 EVM Connections

Bq24715 EVM-115	EV2400
GND (J2)	GND (1)
SCL (J2)	SMBC (2)
SDA (J2)	SMBD (3)

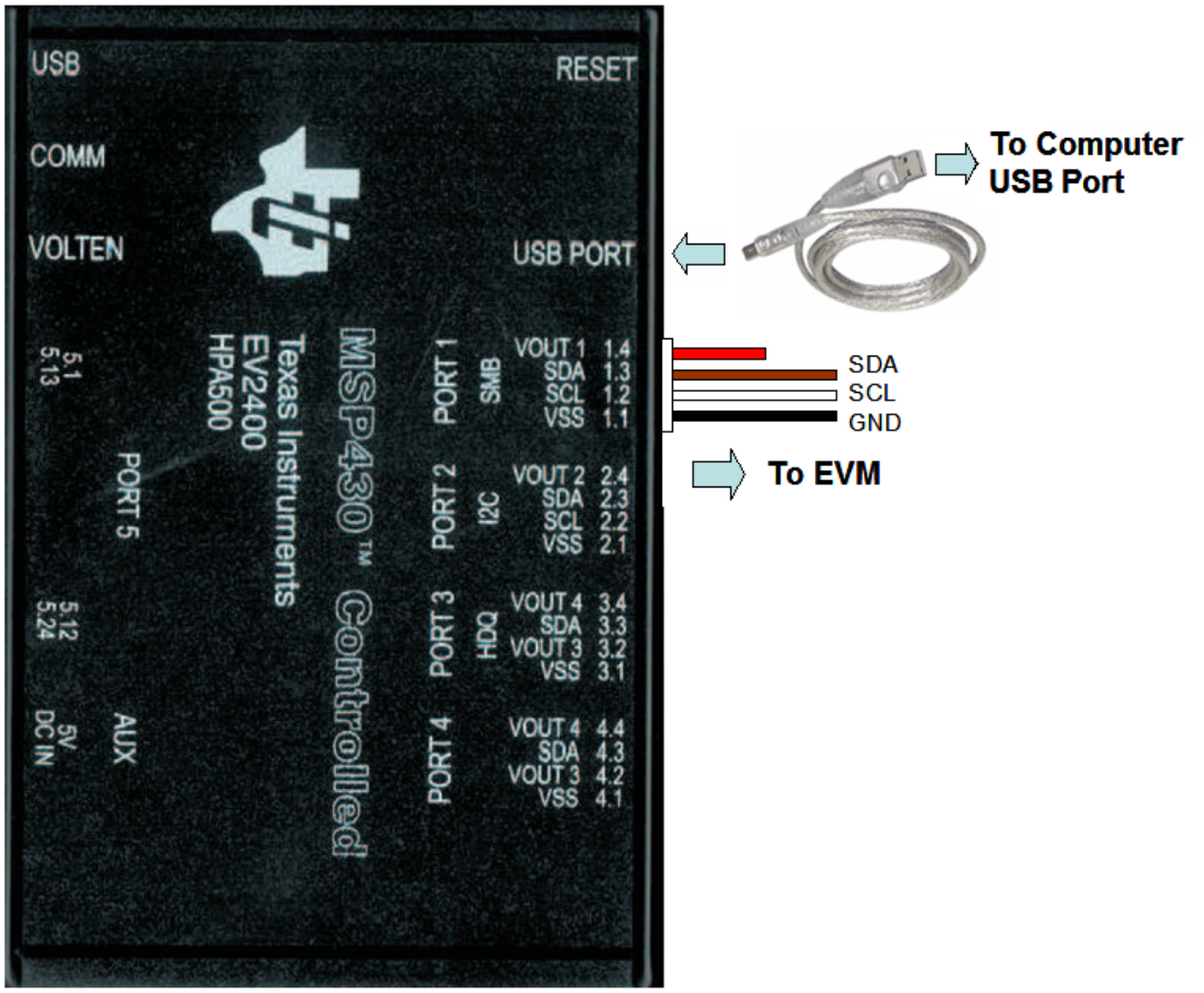


Figure 1. Connections of the EV2400 Kit

(I) If JP1 is not installed, install the jumper.

(J) After the steps above, the test setup for PWR115 is shown in Figure 2.

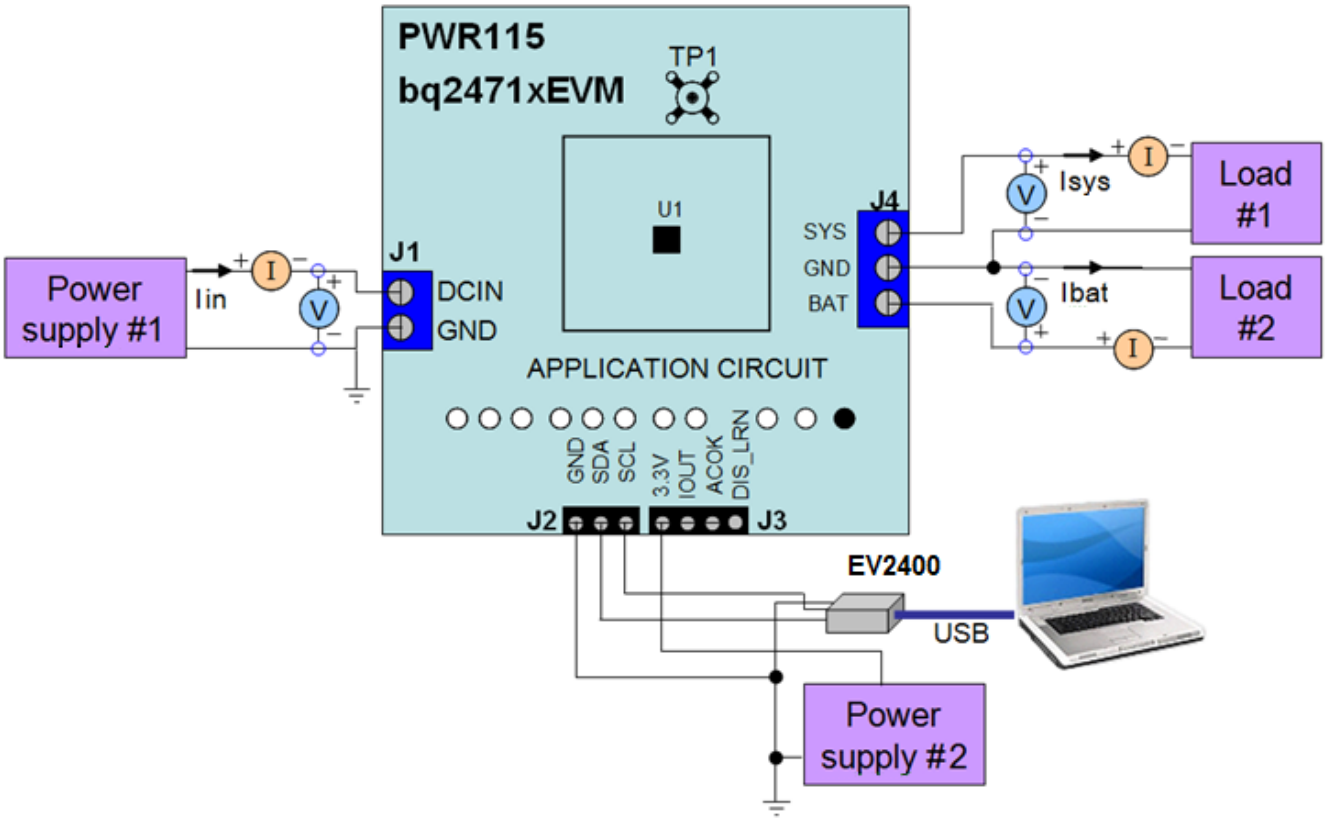
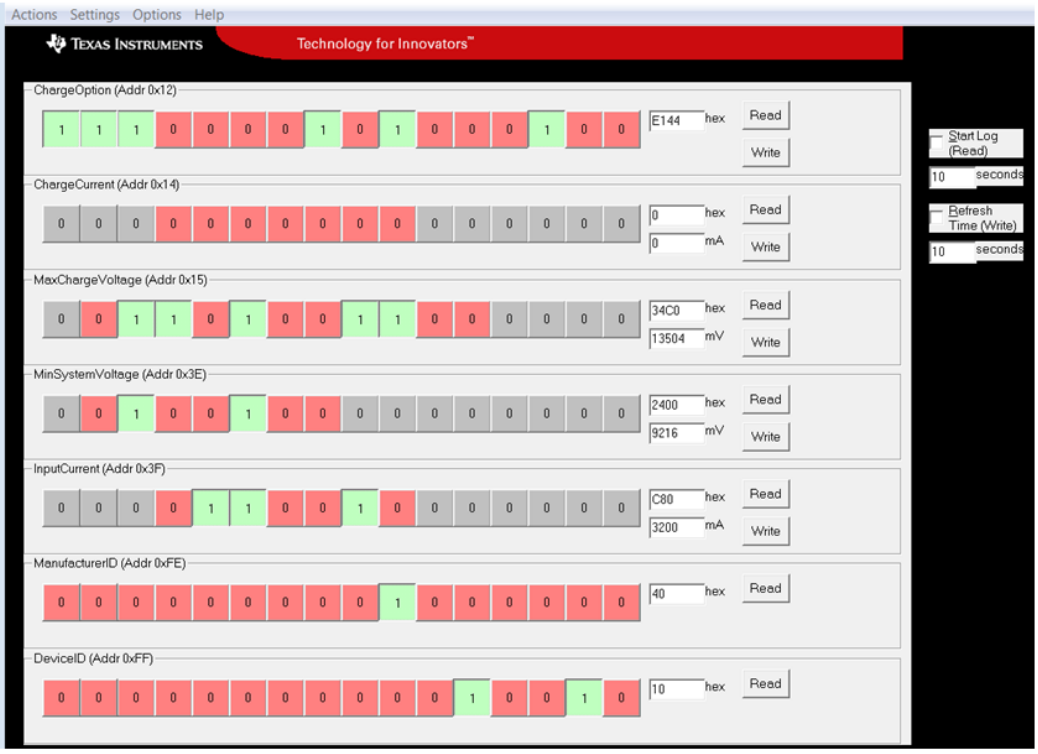
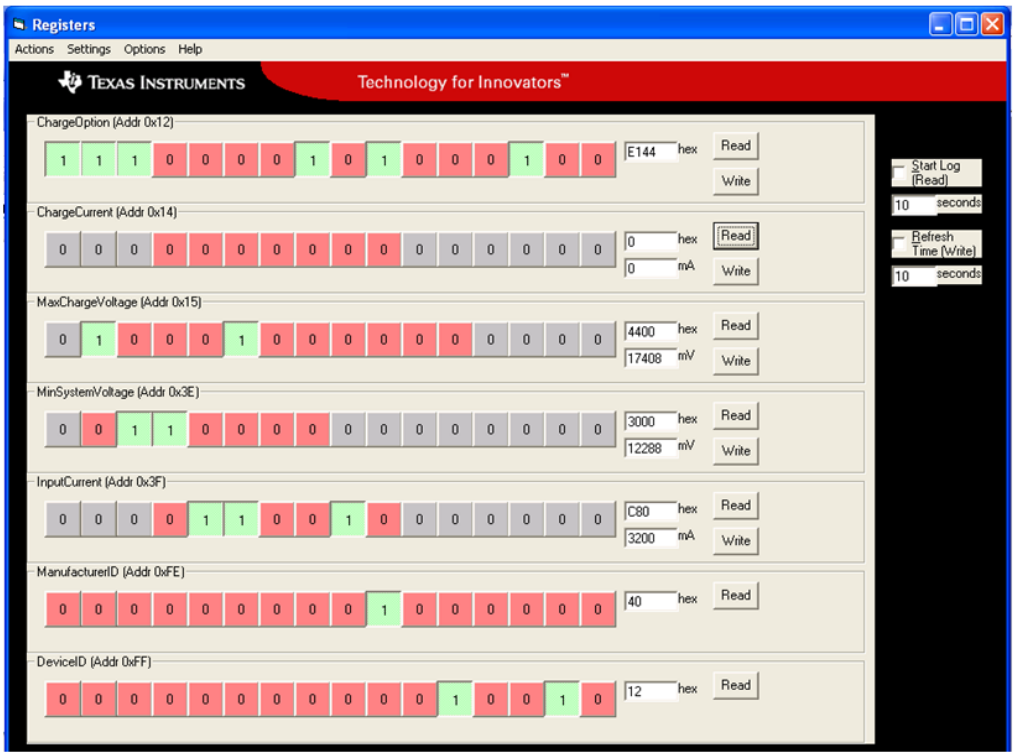


Figure 2. Original test setup for PWR115 (bq24715 EVM)

(K) Turn on the computer. Open the bq24715_717_GUI evaluation software. The GUI windows of the bq24715/7 3/4 cell-setting software are shown in Figure 3. The register values are read later in the procedure, after PS#2 is powered. For 3-cell bq24715 setting, the 0x15 and 0x3E register values are different.



(a) PWR115-001, bq24715 with JP1 installed (3 cell)



(b) PWR115-002, bq24717 with JP1 installed (4 cell)

Figure 3. a) bq24715 GUI Interface Window; b) bq24717 GUI Interface Window

3 Procedure

3.1 Power-up and Initial Checks

3.1.1 Make sure EQUIPMENT SETUP steps are followed. Turn on PS#2.

****NOTE**** Load #1 and Load #2 are not connected during this step.

3.1.2 Turn on PS#1

Increase the output voltage of PS#1 to 19.5 V and measure values with regard to GND.

3.1.3 Verify the Following Parameters

Measure → V(TP3 (ACDET)) = 2.6 V ±0.1 V
Measure → V(TP14 (ACOK)) = 3.3 V ±0.1 V
Measure for -001 → V(J4(SYS)) = 13.5 V ±0.5 V
Measure for -002 → V(J4(SYS)) = 17.5 V ±0.5 V
Measure → V(TP15 (REGN)) = 6 V ±0.5 V
Measure → V(J4(BAT, GND)) = 1 V ±1.1 V
Measure → V((TP2(ACDRV) with regard to TP1 (CMSRC)) = 6 V ±0.5 V

3.1.4 Default Parameters Settings

Click on *Actions* and *Read all Registers* in the GUI software. Make sure there is no error information generated. Verify reading for -001/2 in Figure 3 a/b respectively. Skip to Section 3.2, if no errors.

If there is an error information window pop up: *USB Error. Insure USB cable is connected and Driver is working*. Do the following steps:

(a) Click OK, then close main window that shows as Figure 3 and disconnect USB cable.

(b) Check 3.3 V PS#2 and PS#1 voltage on the EVM board.

(c) Disconnect other unsure SMBus connections. Plug in USB cable back to the original EV2400 installation USB port.

(d) Open the bq24715_717_GUI evaluation software. The main window of the software is shown in Figure 3.

3.2 Charge Regulation and System Load Checks

1. Type in *0xE145* in the Charge Option 0x12 and click the **Write** button, this disables charging.
2. Connect the Load #2 in series with a current meter (multimeter) to J4 (BAT, GND). Make sure a voltage meter is connected across J4 (BAT, GND). Turn on power to Load #2. Use the constant voltage mode. Set the output voltage to 10.5 V for 3 cell bq24715 (-001) setting or 15 V for 4 cell bq24717 (-002) setting. Enable Load #2 output.
3. Connect the output of the Load #1 in series with a current meter (multimeter) to J4 (SYS, GND). Make sure a voltage meter is connected across J4 (SYS, GND). Turn on power of Load #1. Set the load current to 0.5 A ±50 mA but disable the output. The setup is now like Figure 4 for PWR115. Make sure Ibat = 0 A ±10 mA and Isys = 0 A ±10 mA.

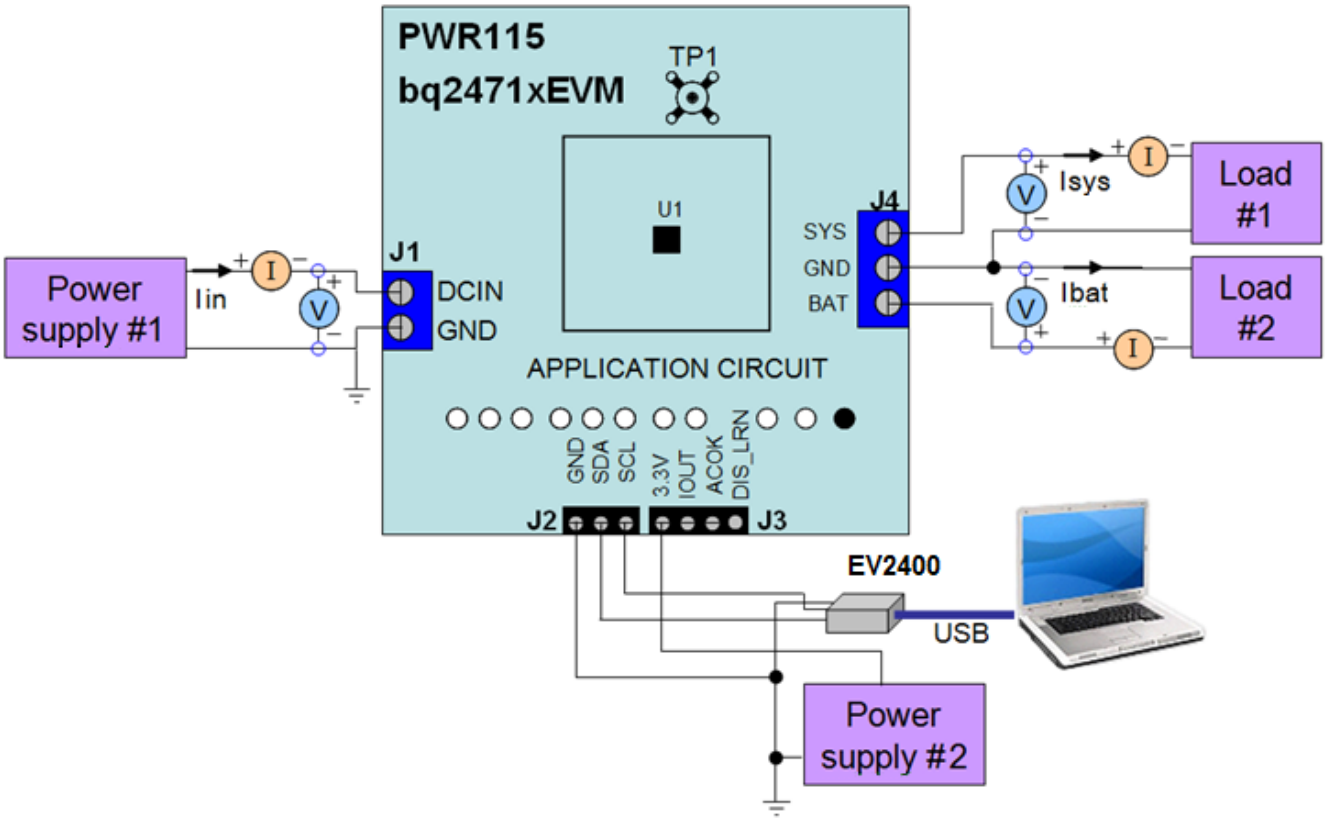


Figure 4. Test setup for PWR115

4. Type *3008* (mA) in the *Charge Current DAC* and click the **Write** button. This sets the battery charge current regulation threshold to 3.008 A.
5. Type *8144* in the *Charge Option 0x12* and click the **Write** button, this enables charging.

   Measure → Ibat = 3000 mA ±300mA
6. Type *1984* (mA) for (-001) and *2880* (mA) for (-002) in the *Input Current 0x3F* window and click the **Write** button
7. Type *8146* in the *Charge Option 0x12* and enable the output of the Load #1.

   Measure→ Isys = 500 mA ±50 mA,
   Measure → (-001): Iin = 1980 mA ±150 mA, (-002): Iin = 2800 mA ±150 mA
8. Turn off the Load #1.

   Measure → Isys = 0 ±100 mA, Ibat = 3000 mA ±300 mA.
9. Set the Load #2 voltage to 8 V ±0.1 V

   Measure → Ibat = 384 mA ±100 mA
10. Turn off Load #2

3.3 Equipment Shutdown

Turn off all the power supplies and remove connections to EVM.

4 PCB Layout Guideline

The switching node rise and fall times should be minimized for minimum switching loss. Proper layout of the components to minimize high frequency current path loop is important to prevent electrical and magnetic field radiation and high-frequency resonant problems. Here is a PCB layout priority list for proper layout. It is essential that the PCB is laid out according to this specific order.

1. Place the input capacitor as close as possible to switching MOSFET's supply and ground connections and use the shortest possible copper trace connection. These parts should be placed on the same layer of the PCB instead of on different layers and using vias to make this connection.
2. The IC should be placed close to the switching MOSFET's gate terminals and keep the gate drive signal traces short for a clean MOSFET drive. The IC can be placed on the other side of the PCB of switching MOSFETs.
3. Place inductor input terminal as close as possible to the switching MOSFET's output terminal. Minimize the copper area of this trace to lower electrical and magnetic field radiation but make the trace wide enough to carry the charging current. Do not use multiple layers in parallel for this connection. Minimize parasitic capacitance from this area to any other trace or plane.
4. The charging current sensing resistor should be placed right next to the inductor output. Route the sense leads connected across the sensing resistor back to the IC in the same layer, close to each other (minimize loop area) and do not route the sense leads through a high-current path. Place the decoupling capacitor on these traces next to the IC.
5. Place an output capacitor next to the sensing resistor output and ground.
6. Output capacitor ground connections need to be tied to the same copper that connects to the input capacitor ground before connecting to system ground.
7. Use a single ground connection to tie charger power ground to charger analog ground. Just beneath the IC, use analog ground copper pour but avoid power pins to reduce inductive and capacitive noise coupling.
8. Route the analog ground separately from the power ground. Connect the analog ground and the power ground separately. Connect the analog ground and power ground together using the power pad as the single ground connection point, or using a 0-Ω resistor to tie the analog ground to the power ground (the power pad should tie to the analog ground in this case, if possible).
9. Decoupling capacitors should be placed next to the IC pins and make the trace connection as short as possible.
10. It is critical that the exposed power pad on the backside of the IC package be soldered to the PCB ground. Ensure that there are sufficient thermal vias directly under the IC, connecting to the ground plane on the other layers.

5 Bill of Materials (BOM) PCB Layout and Schematic

5.1 Bill of Materials (BOM)

Table 4. PWR115A BOM

Count		RefDes	Value	Description	Size	Part Number	MFR
-001	-002						
1	1	C1	2.2uF	Capacitor, Ceramic, 25V, X7R, 10%	1210	Std	Std
0	0	C10 C12 C13 C9	Open	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
1	1	C24	470pF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
0	0	C18 C27	Open	Capacitor, Ceramic, 25V, [temp], [tol]	1206	Std	Std
0	0	C19	Open	Capacitor, Ceramic, 25V, X7R, 10%	1206	Std	Std
1	1	C20	2200pF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
6	6	C21, C5-7 C14-15	0.1uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
1	1	C23	100pF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
4	4	C2-3 C16-17	10uF	Capacitor, Ceramic, 25V, X7R, 10%	1206	Std	Std
1	1	C25	0.047uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
1	1	C26	Open	Capacitor, ALUM 220UF 25V 20% SMD	10.3mm (F8)	UCL1E221MCL6GS	Nichicon
1	1	C28	220uF	Capacitor, ALUM 220UF 25V 20% SMD	10.3mm (F8)	UCL1E221MCL6GS	Nichicon
4	4	C4, C8, C11, C22	1.0uF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
2	2	D1, D2	BAT54-V-G	Diode, Schottky, 200-mA, 30-V	SOT23	BAT54-V-G	Vishay-Liteon
1	1	J1	ED120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.40 x 0.35 inch	ED120/2DS	OST
1	1	J2	ED555/3DS	Terminal Block, 3-pin, 6-A, 3.5mm	0.41 x 0.25 inch	ED555/3DS	OST
1	1	J3	ED555/4DS	Terminal Block, 4-pin, 6-A, 3.5mm	0.55 x 0.25 inch	ED555/4DS	OST
1	1	J4	ED120/3DS	Terminal Block, 3-pin, 15-A, 5.1mm	0.60 x 0.35 inch	ED120/3DS	OST
1	1	JP1	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN	Sullins
1	1	L1	3.3uH	Inductor, SMT, 9.2A, 16.5milliohm	8.2X8.6 mm	IHLP3232DZER3R3M01	Vishay
1	1	Q1	CSD87312Q3E	MOSFET, Dual NexFET Power, 30 Vds	QFN-8 POWER	CSD87312Q3E	TI
2	2	Q2-3	CSD17308Q3	MOSFET, Fast Switching, NChan, 30V, 12A, 30millohm	PWRPAK 1212	CSD17308Q3	TI
1	1	Q4	CSD25401Q3	MOSFET, PChan, -20V, 60A, 8.7 milliOhm	QFN3.3X3.3mm	CSD25401Q3	TI
1	1	Q5	BSS138W-7-F	MOSFET, Nch, 50V, 200mA,	SOT323	BSS138W-7-F	Diodes
0	0	Q6	Open	MOSFET, P Chan, 20V, 60 A, 1.9 mOhm	SO-power	SI7141DP	Vishay
2	2	R1 R3	3.9	Resistor, Chip, 0.5W, 5%	1210	Std	Std
0	0	R10	Open	Resistor, Metal Film, 1/4 watt, 1%	1206	Std	Std
0	0	R12, R13	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R14	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R15	3.01M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	2	R16 R18	4.02k	Resistor, Chip, 1/10W, 1%	0603	Std	Std

Table 4. PWR115A BOM (continued)

Count		RefDes	Value	Description	Size	Part Number	MFR
-001	-002						
1	1	R17	4.7	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	3	R19 R21 R23	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	2	R2 R11	0.01	Resistor, Chip, 1/2W, 1%	1206	CSRF1206FT10L0	Stackpole
1	1	R20	10	Resistor, Metal Film, 1/4 watt, 1%	1206	Std	Std
2	2	R22 R25	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R24	15	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R26	348k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
4	4	R4, R7, R8, R9	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R5	430K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R6	66.5K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	0	TP11	DNI	Adaptor, 3.5-mm probe clip (or 131-5031-00)	0.200 inch	131-4244-00	Tektronix
11	11	TP1-5 TP10, TP13-16, TP18	5002	Test Point, White, Thru Hole Color Keyed	0.100 x 0.100 inch	5002	Keystone
1	1	TP17	5001	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	5001	Keystone
0	0	TP6-9 TP12	Open	Test Point, 0.020 Hole			STD
1	0	U1	BQ24715RGR	IC, SMBus Controlled 2-3S NVDC-1 Charge Controller with N-Ch MOSFET Selector and Current Monitoring	VQFN	BQ24715RGR	TI
0	1	U1	BQ24717RGR	IC, SMBus Controlled 3-4S NVDC-1 Charge Controller with N-Ch MOSFET Selector and Current Monitoring	VQFN	BQ24717RGR	TI
1	1	U2	TPS3803-01	Single Voltage Detector	SC-70-5	TPS3803-01DCK	TI
4	4		SJ61A4	Bump on Hemisphere, Black; Note 5	0.375x0.311	SJ61A4	3M
1	1	—	929950-00	Shunt, 100-mil, Black	0.100	929950-00	3M
1	1	—		Label	1.25 x 0.25 inch	THT-13-457-10	Brady
1	1	—	PWR115	2.5x2.5inch 4 layer 2oz. PCB	2.5x2.5inch	PCB	Any

Notes: 1. These assemblies are ESD sensitive, ESD precautions shall be observed.
2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk ('**') cannot be substituted. All other components can be substituted with equivalent MFG's components.
5. Install after final wash on bottom corners of PCB.

Table 1	
Assembly No.	**Text**
PWR115-001	bq24715EVM-115
PWR115-002	bq24717EVM-115

5.2 Schematic

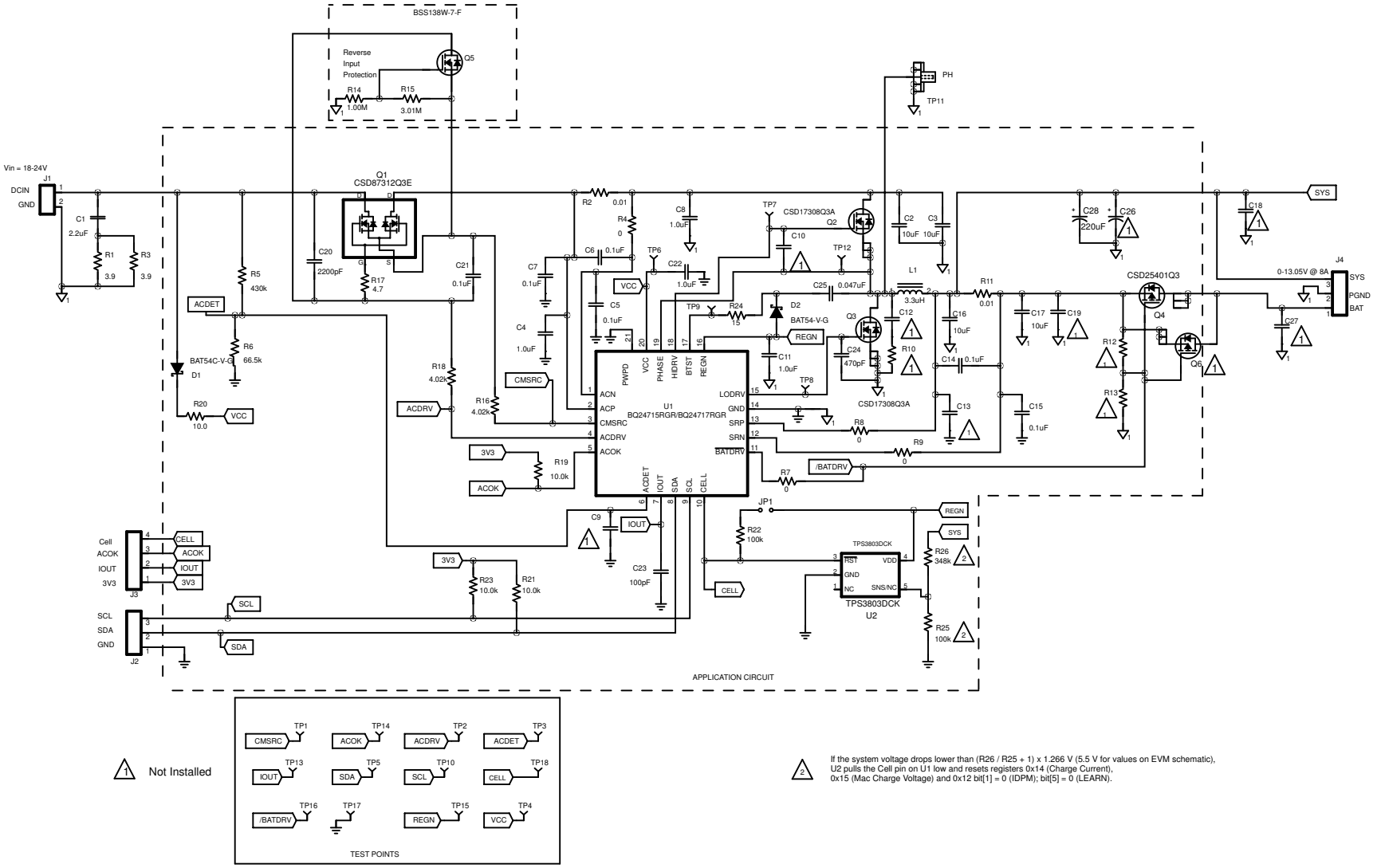


Figure 5. bq2471x Schematic

5.3 Layouts

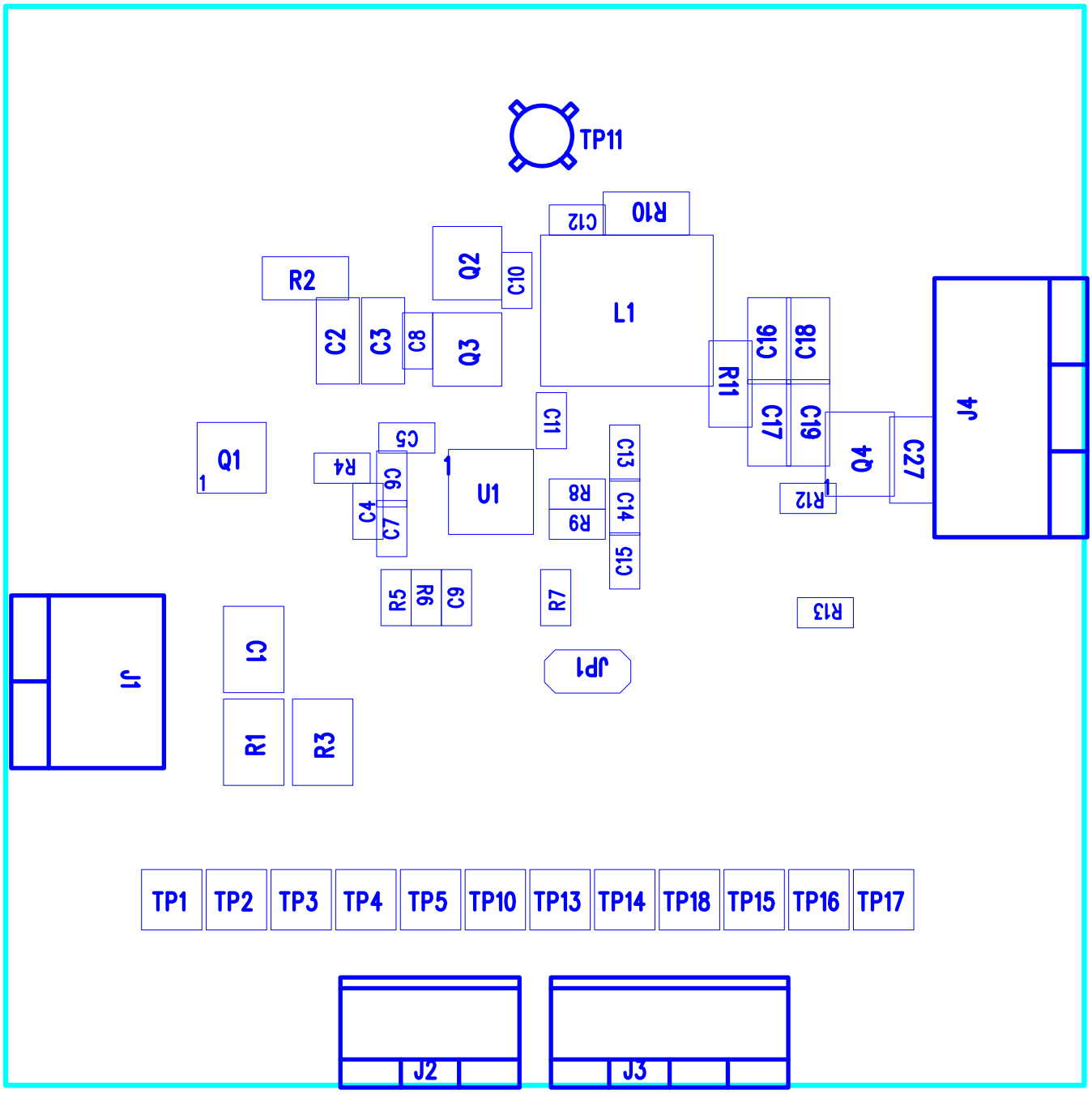


Figure 6. Assembly Layer

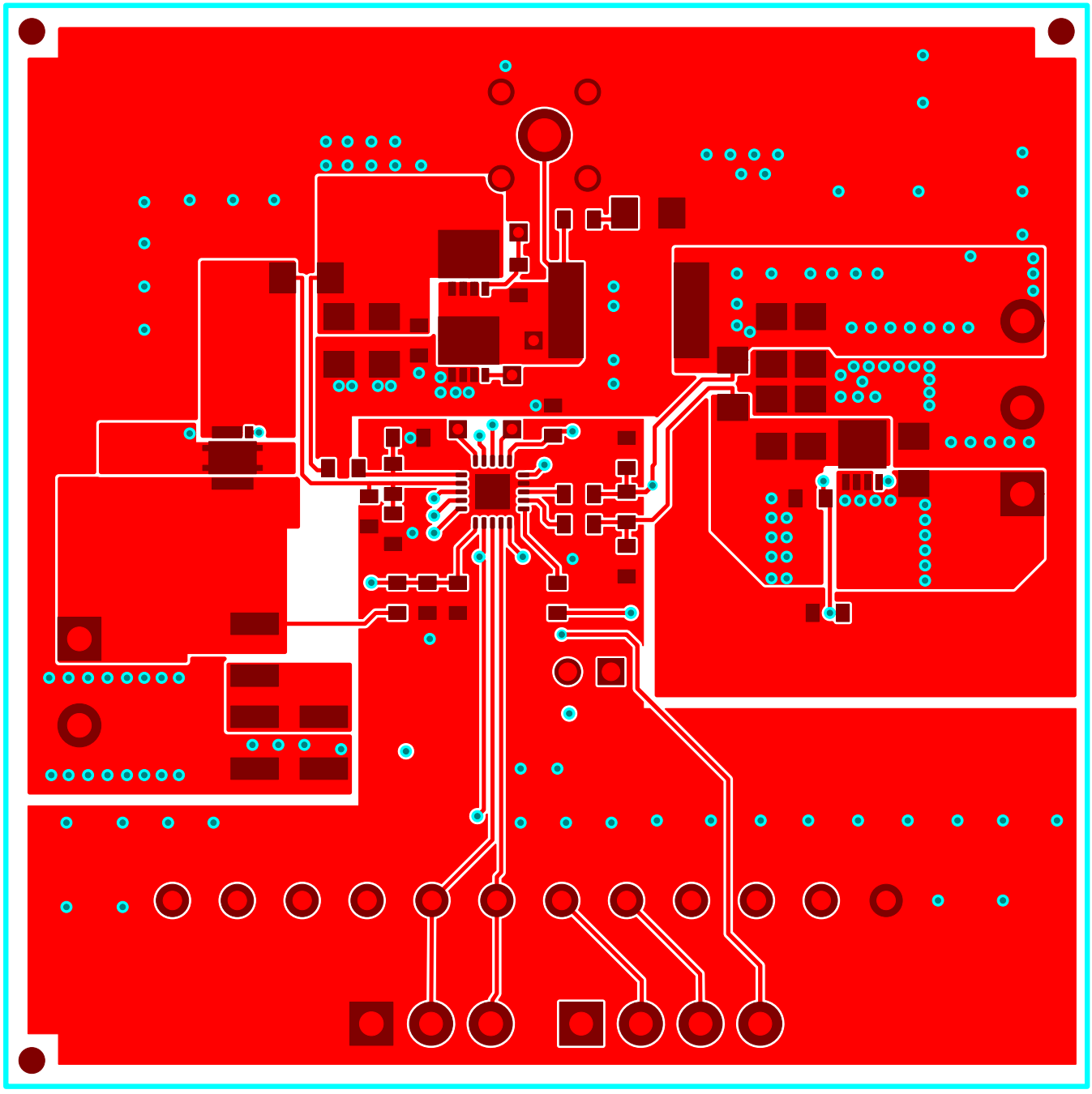


Figure 7. Top Layer

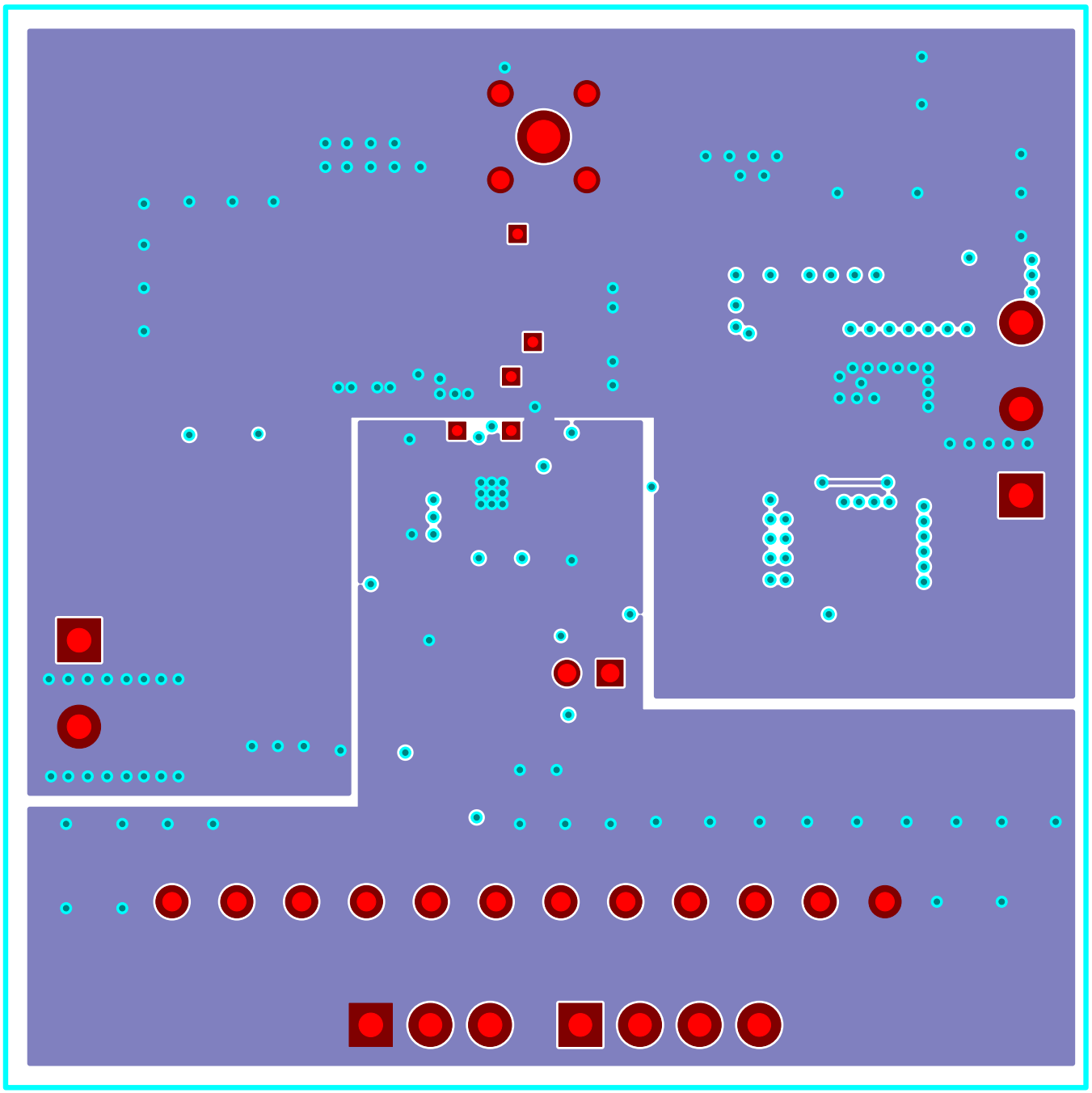


Figure 8. Layer 2

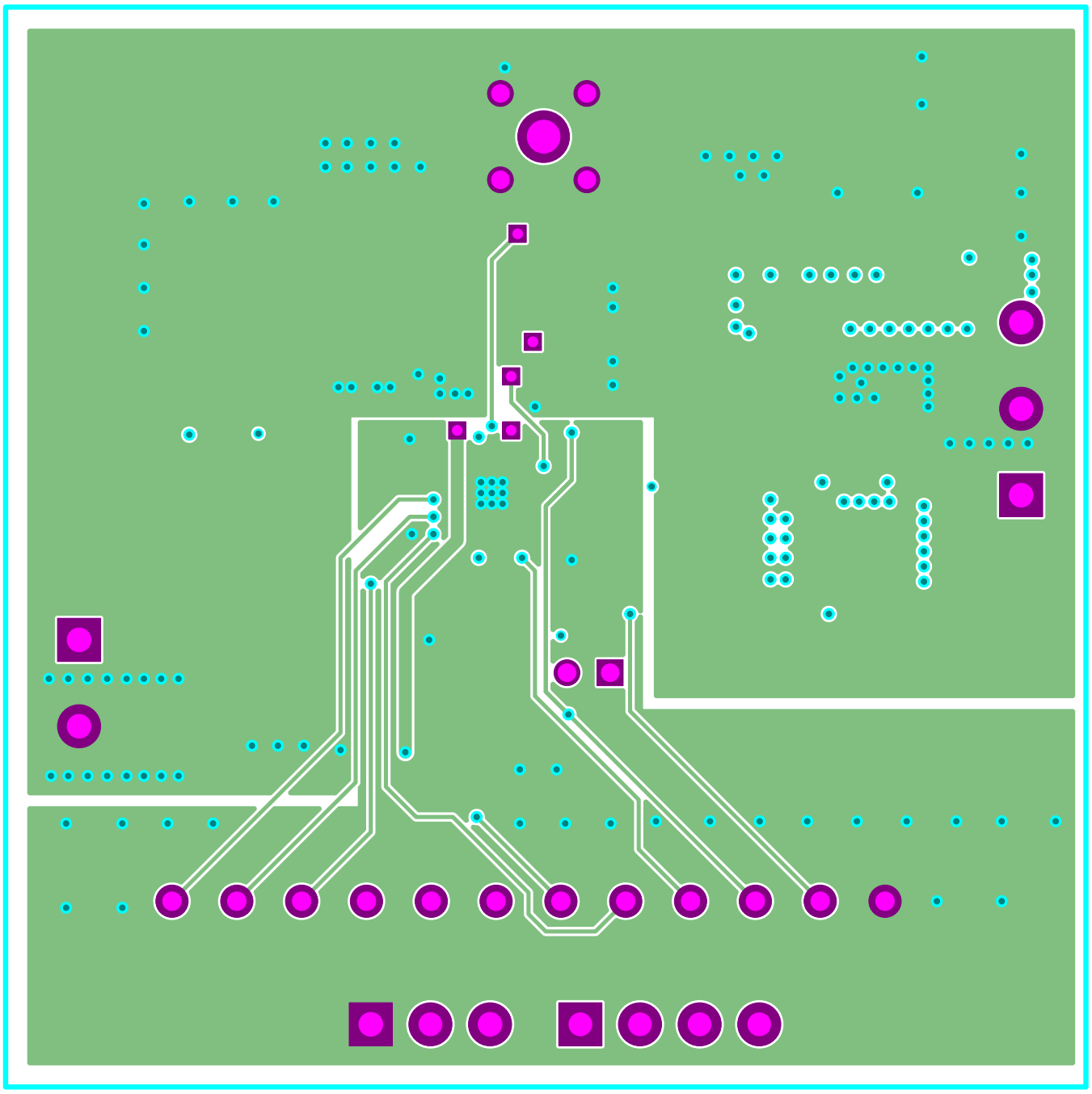


Figure 9. Layer 3

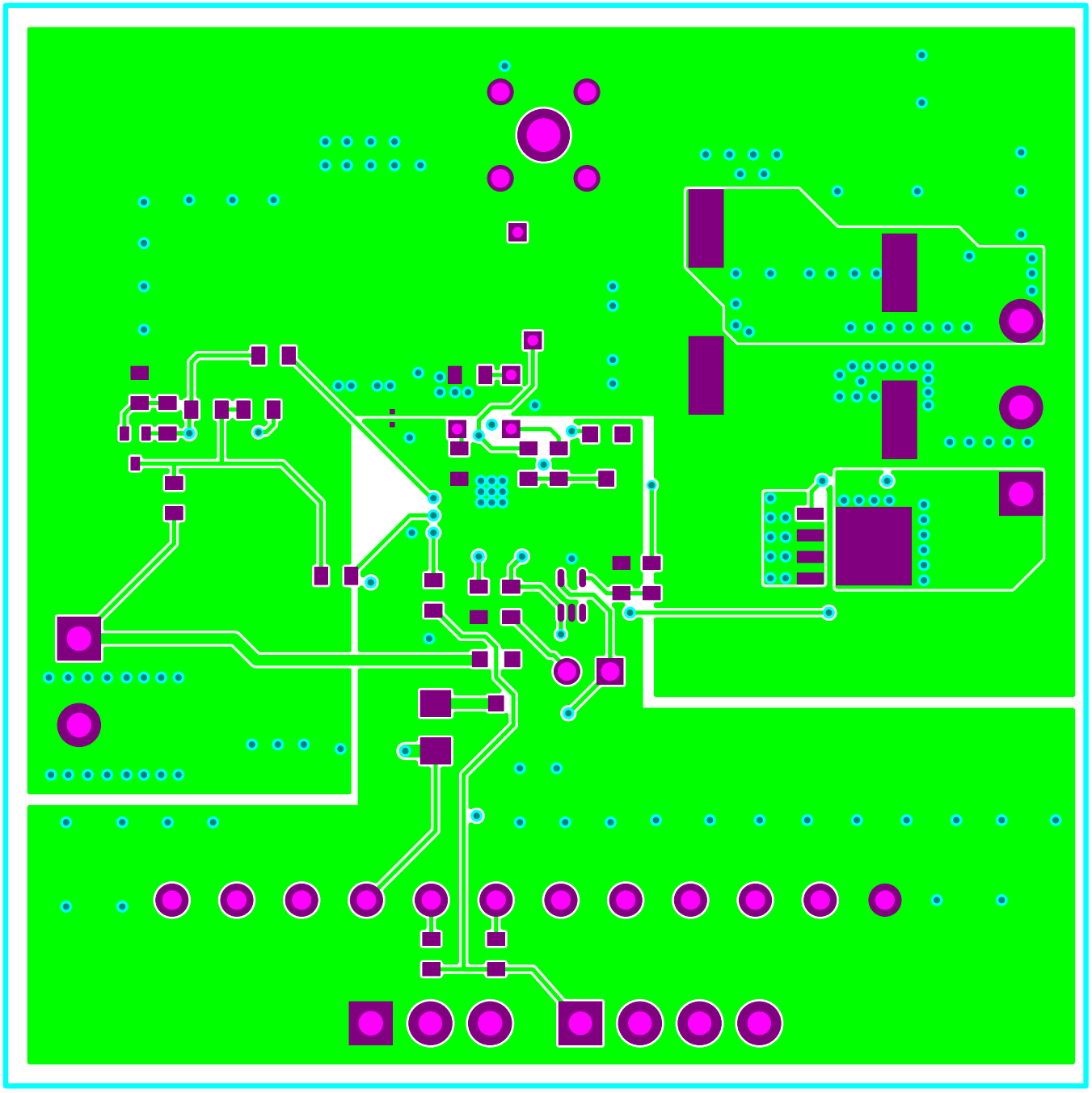


Figure 10. Bottom Layer

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

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REGULATORY COMPLIANCE INFORMATION

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

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

General Statement for EVMs including a radio

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

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

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

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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

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

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of this Product in Japan】

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

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

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

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

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

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

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

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

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