QFN-Packaged bq24278 Evaluation Module

The bq24278 evaluation module is a complete charger module for evaluating a compact, flexible, high-efficiency, switch-mode charge management solution for single-cell, Li-ion and Li-polymer batteries used in a wide range of portable applications.

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1 Introduction

1.1 bq2427x IC Features

The bq24278 integrates a synchronous PWM controller, power MOSFETs, input current sensing, high-accuracy current and voltage regulation, charge termination and power path management into a chipscale package. Key integrated circuit (IC) features include:

- High-efficiency, fully integrated, NMOS-NMOS, synchronous buck charger with 1.5-MHz frequency
- Integrated power FETs for up to 2.5-A charge rate
- Power path management between battery and system voltages

For details, see the bq24278 data sheet (SLUSB04).

1.2 bq24278 EVM Features

The bq24278 evaluation module (EVM) is a complete charger module for evaluating compact, flexible, high-efficiency, switch-mode battery charge and power path management solution for single-cell, Li-ion and Li-polymer battery-powered systems used in a wide range of portable applications. Key EVM features include:

- Programmable charge current, input current on, and V_{INDPM} threshold using jumpers
- Input power connector for ac adapter
- IN operating range of 4.2 V – 10 V
- LED indication for status signals
- Test points for key signals available for testing purposes. Easy probe hook-up

1.3 Schematic

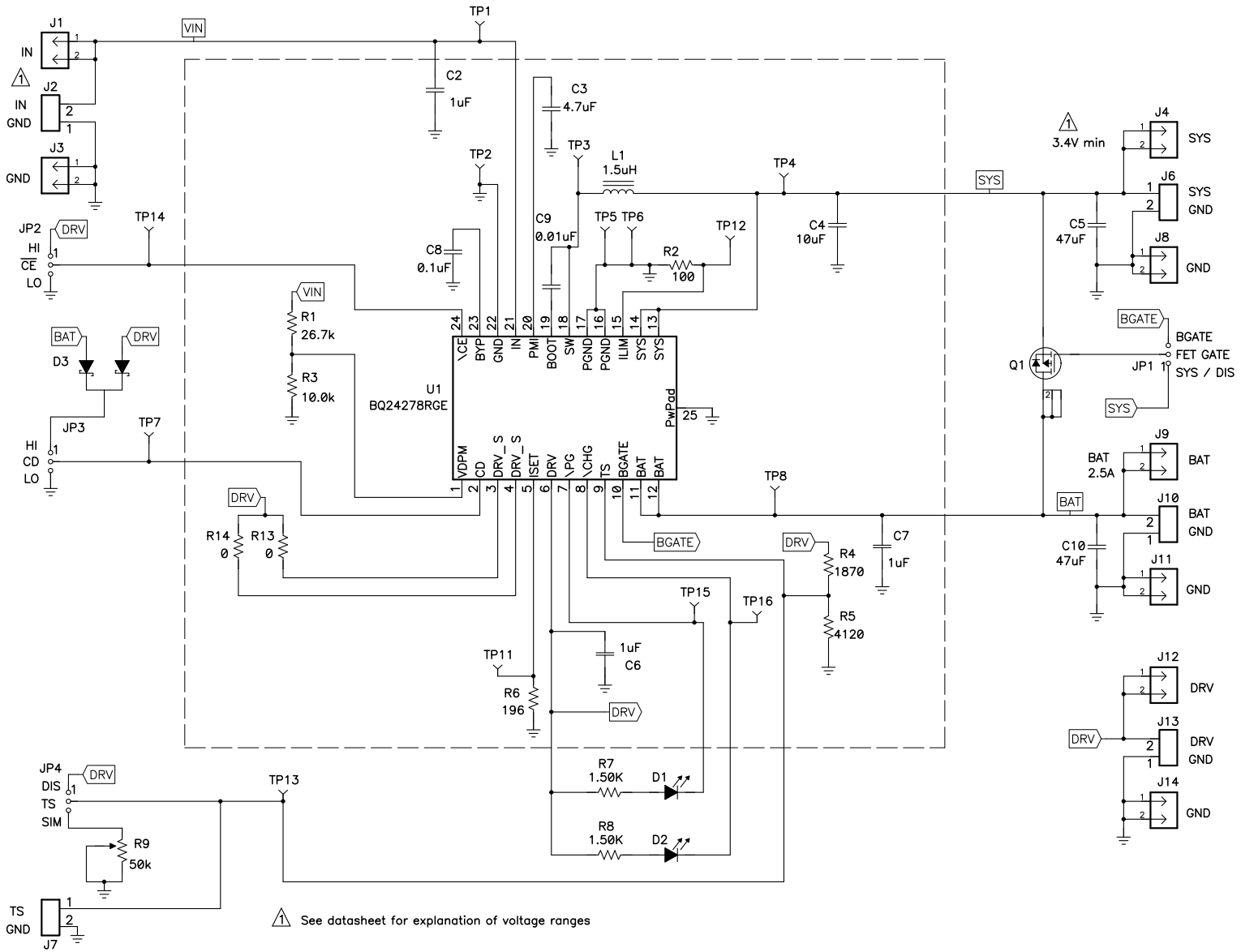

Figure 1. bq24278EVM (HPA759) Schematic

1.4 I/O Description

Header/Terminal Block	Description
J1-IN	Adapter positive header
J2-IN	Adapter positive terminal
J2-GND	Adapter negative terminal
J3-GND	Adapter negative header
J4-SYS	System output positive header
J6-SYS	System output positive terminal
J6-GND	System output negative terminal
J7-TS	External thermistor positive terminal
J7-GND	Ground connection for external thermistor
J8-GND	System output negative header
J9-BAT+	Battery positive header
J10-BAT+	Battery positive terminal
J10-GND	Battery negative terminal
J11-GND	Battery negative header
J12-DRV	DRV reference voltage positive header
J13-DRV	DRV reference voltage positive terminal
J13-GND	DRV reference voltage negative terminal
J14-GND	DRV reference voltage negative header

1.5 Test Points

Test Point	Description
TP1	Kelvin to IN
TP2	GND
TP3	SW
TP4	Kelvin to SYS
TP5	GND
TP6	GND
TP7	CD
TP8	Kelvin to BAT
TP9	DRV_S
TP10	DRV_S
TP11	ISET
TP12	ILIM
TP13	TS
TP14	$\overline{CE}$
TP15	$\overline{PG}$
TP16	$\overline{CHG}$

1.6 Control and Key Parameters Setting

Jumper	Description	
JP1	1-2: FET GATE = SYS: External PFET's gate tied to SYS and therefore disabled. 2-3: FET GATE = BGATE: External PFET's gate tied to BGATE pin and therefore controlled by IC. It is recommended that this jumper be changed only when the device is not enabled or in Hi-Z mode so that the PFET's gate is never left open.	1-2 (FET GATE = BGATE)
JP2	1-2: $\overline{CE}$ = HI: Active-low charge enable high to disable charge and enter Hi-Z mode 2-3: $\overline{CE}$ = LO: Active-low charge enable low for normal operation	2-3 ($\overline{CE}$ = LO)
JP3	1-2: CD = HI: Active high chip disable high to disable charge and disable system 2-3: CD = LO: Active high chip disable low for normal operation	2-3 (CD = LO)
JP4	1-2 (TS = DIS): Connects TS high to DRV and disables the temperature sense function on the IC 2 (JP4 Open): Connects the TS pin to an external thermistor. The resistor divider formed by R1 and R3 has been sized to accommodate a 10-kΩ thermistor. If a different thermistor is used, R1 and R3 need to be resized. 2-3 (TS = SIM): Connects a potentiometer to the TS pin so the potentiometer can emulate a thermistor. The potentiometer has been preset to approximately 3.4 kΩ so that the TS voltage is 0.5 × V(DRV).	2-3 (TS = SIM)

1.7 Recommended Operating Conditions

		Min	Typ	Max	Unit
Supply voltage, V_{IN}	Operating input voltage from ac adapter	4.2		10	V
Battery voltage, V_{BAT}	Voltage applied at VBAT terminal	4.02	4.2	4.24	V
System voltage, V_{SYS}	Voltage output at SYS terminal (depends on VBAT voltage and status of V_{INDPM})	3.4		4.37	V
Supply current, $I_{IN(MAX)}$	Maximum input current limit for ac adapter input (set by user-selectable resistor)	1.5		2.5	A
Max fast charge current, $I_{CHRG(MAX)}$	Battery charge current	0.550		2.5	A
Operating junction temperature range, T_J		-40		125	°C

2 Test Summary

This procedure describes one test configuration of the HPA759 evaluation board for bench evaluation.

2.1 Definitions

The following naming conventions are followed.

VXXX :	External voltage supply name (VIN)
LOAD#:	External load name
V(TPyyy):	Voltage at internal test point TPyyy. For example, V(TP12) means the voltage at TP12.
V(Jxx):	Voltage at header Jxx
V(TP(XXX)):	Voltage at test point XXX. For example, V(ACDET) means the voltage at the test point which is marked as ACDET.
V(XXX, YYY):	Voltage across point XXX and YYY.
I(JXX(YYY)):	Current going out from the YYY terminal of header XX.
Jxx(BBB):	Terminal or pin BBB of header xx
JPx ON :	Internal jumper Jxx terminals are shorted.
JPx OFF:	Internal jumper Jxx terminals are open.
JPx (-YY-)	ON: Internal jumper Jxx adjacent terminals marked as YY are shorted.
Measure: → A, B	Check specified parameters A, B. If measured values are not within specified limits the unit under test has failed.
Observe → A, B	Observe if A, B occur. If they do not occur, the unit under test has failed.

Assembly drawings have location for jumpers, test points, and individual components.

2.2 Recommended Test Equipment

2.2.1 Power Supplies

1. Power Supply #1 (PS #1) capable of supplying 6 V at 3 A is required.
2. If not using a battery as the load, then Power Supply #2 (PS #2) capable of supplying up to 5 V at 4 A is required to power the circuit shown in Figure 2.

2.2.2 Load #1 between BAT and GND

Testing with an actual battery is the best way to verify operation in the system. If a battery is unavailable, then a circuit similar to the one shown in Figure 2 can simulate a battery when connected to a second power supply.

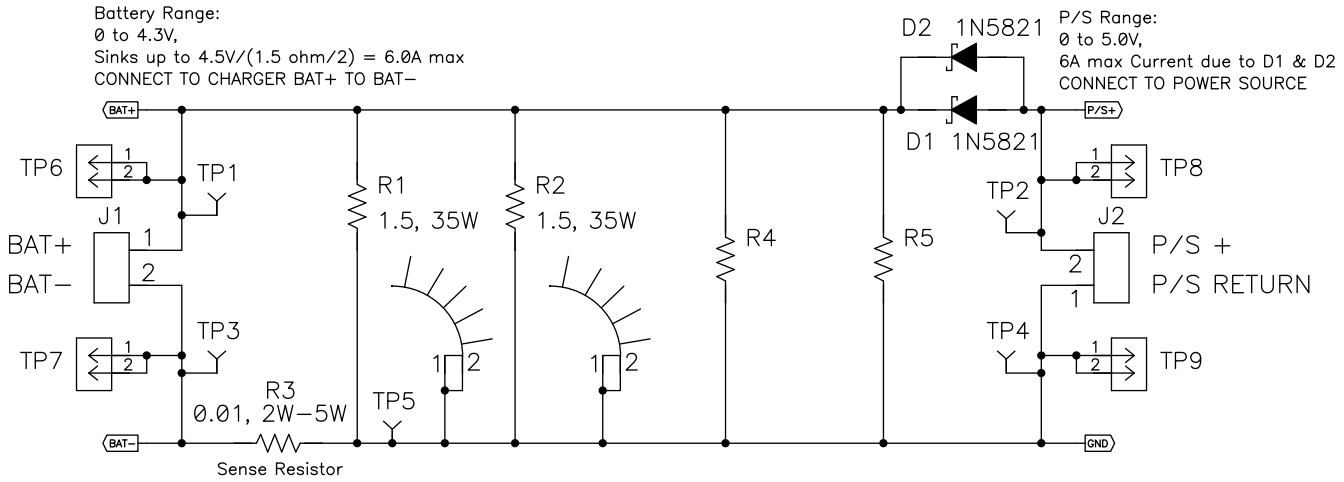

Figure 2. BAT Load (PR1010) Schematic

2.2.3 Load #2 Between SYS and GND

Although not required, a resistive load in the form of a decade box or electronic load capable of sinking up to 3 A can be used.

2.2.4 Meters

Four equivalent voltage meters (VM #) and two equivalent current meters (CM #) are required. The current meters must measure at least a 4-A current.

2.3 Recommended Test Equipment Setup

1. For all power connections, use short, twisted-pair wires of appropriate gauge for the amount of the current.
2. Set PS #1 for 6 V ± 100 mV, 3-A current limit, and then turn off supply.
3. If BAT_Load (PR1010) as shown in Figure 2 is used, connect PS #2, set to approximately 3.1 V, to the input side (PS #2 ±) of BAT_Load (PR1010), then turn off PS #2.
4. Connect the output side of the battery or BAT_Load (PR1010) in series with current meter (multimeter) #2 (CM #2) to J9 and J11 or J10 (BAT, GND). Ensure that a voltage meter is connected across J9 or TP8 and J11 or TP6 (BAT, GND).
5. Connect the electronic load or resistor decade box in series with a current meter (multi-meter) to J6(SYS, GND). Ensure the electronic load is in current mode and set to 0 A or the resistor decade box is set to the maximum resistance.
6. Connect VM #3 across J4 or TP4 and J8 (SYS, GND).
7. Connect VM #4 across J12 and J14 (DRV, GND).
8. Ensure jumpers are at the default factory settings per Section 1.6.
9. After the preceding steps are accomplished, the test setup for HPA759 is as shown in Figure 3

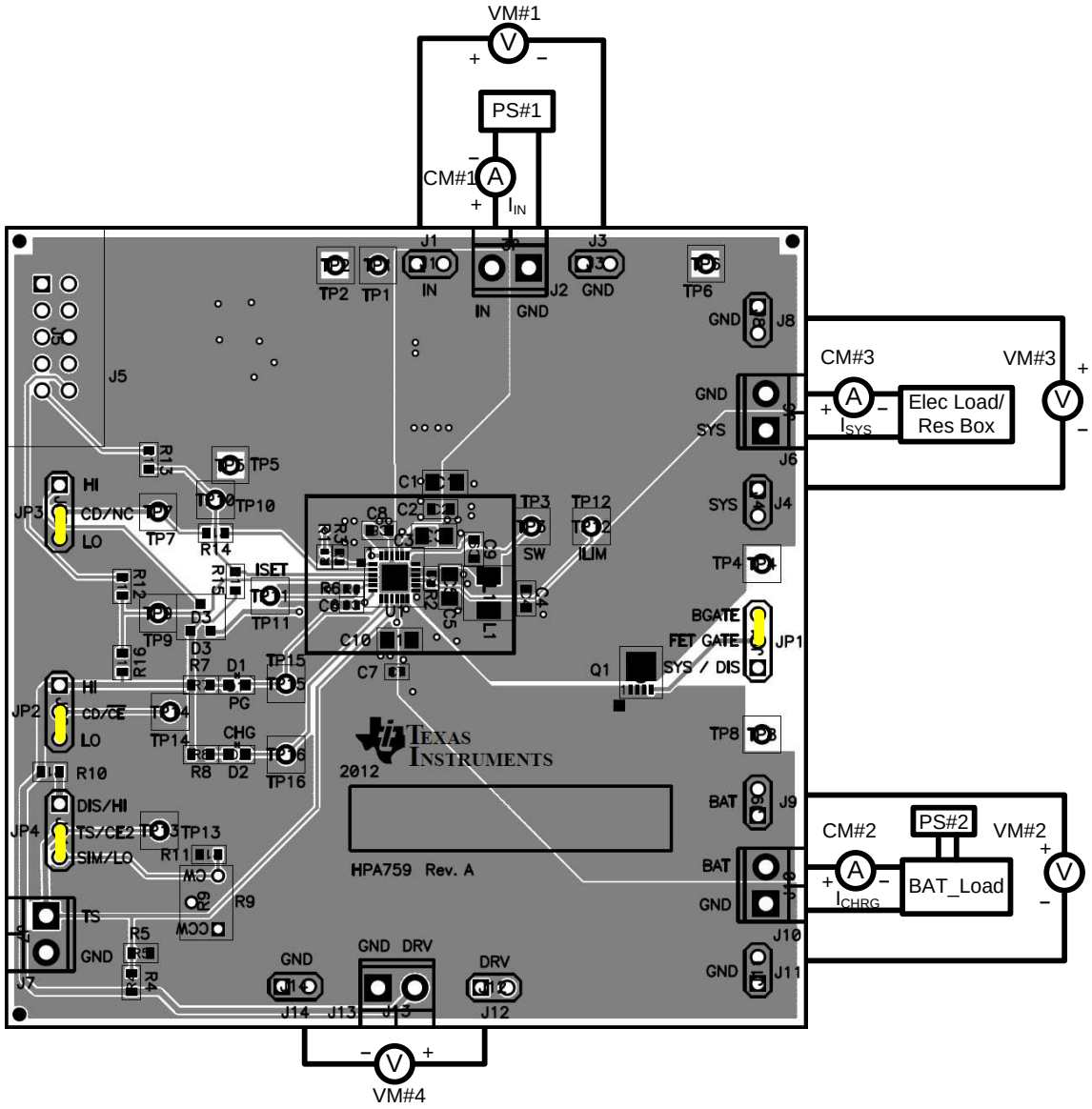

Figure 3. Original Test Setup for bq24278 EVM (HPA759)

2.4 Recommended Test Procedure

The following test procedure may be useful for evaluating the charger IC outside of a real system, if no battery is available to connect to the output and a simulated battery is needed.

2.4.1 System Voltage and Output Current

1. Ensure that the Section 2.3 steps are followed.
2. Connect the output of PS #1 in series with CM #1 to J2 (IN, GND).
3. Connect VM #1 across J1 or TP1 and J3 or TP6 (IN, GND).
4. With PS #2 disabled, turn on PS #1.
5. Ensure electronic load is on current mode and set the current to 1 A or turn down the resistor decade box until CM #3 measures 1000, ±100 mA.
6. Measure:

   Measure on VM #3 → V(J4(SYS), J8(GND)) = 3.7 ± 150 mV.

Observe → D1 and D2 are on.

7. Move JP3 (CD) = HI.
8. *Measure on VM #3* → V(J4(SYS), J8(GND)) = 0 V.
9. Disable PS #1 and disconnect electronic load or resistor box and CM #3 from the HPA759 board.

2.4.2 Charge Voltage and Current Regulation of IN

1. Ensure that the Section 2.3 steps are followed.
2. Move JP2 ($\overline{CE}$) = HI and JP3 (CD) = LO.
3. Connect the output of PS #1 in series with CM #1 to J1 and J3 or J2 (IN, GND).
4. Connect VM #1 across J1 or TP1 and J3 or TP5 (IN, GND).
5. With PS #2 disabled, turn on PS #1.
6. Measure:

   Measure on VM #3 → V(J4/TP4(SYS),J8(GND)) = 4.3 ± 100 mV

   Measure on VM #4 → V(J12(DRV),J14(GND)) = 5.2 ± 200 mV

   Measure on CM #2→ I_{CHRG} = 0-20 mA
7. Move JP2 ($\overline{CE}$) = LO while keeping the default settings for JP1 (FET GATE), JP3 (CD) and JP4 (TS).
8. Enable PS #2 and adjust PS #2 so that the voltage measured by VM #2, across BAT and GND, measures 2.5 - 2.7 V.
9. Measure:

   Measure on CM #2→ I_{CHRG} = 40 ± 10mA
10. Slowly increase the voltage on PS #2 until:

    Measure on CM #2→ I_{CHRG} = 2500 mA ± 250 mA
11. Adjust PS #1 so that VM #1 still reads 6 V ± 100 mV, if necessary.

    Measure on CM #2→ I_{CHRG} = 2500 mA ± 250 mA

    Measure on CM #1 → I_{IN} < 2100 mA

    Observe → D1 and D2 are on.
12. Turn off PS #1 and PS #2.

2.4.3 Helpful hints

1. Observe the taper current as the battery voltage approaches the set regulation voltage by allowing the battery to charge or if using BAT_Load (PR1010), slowly increase the PS #2 voltage powering BAT_Load (PR1010). Use VM #2 across BAT and GND to measure the battery voltage seen by the IC.
2. Observe the V_{INDPM} function by lowering the current limit on PS #1.
3. Observe battery supplement mode by applying a resistive load across SYS and GND that is higher than the maximum charge current.

3 Printed-Circuit Board Layout Guideline

1. The power input capacitors, connected from the PMI input to PGND, must be placed as close as possible to the bq2427x to obtain optimal performance.
2. Place a 4.7-µF input capacitor as close as possible to the PMI pin and PGND pin making the high-frequency current loop area as small as possible. Place the 1-µF input capacitor GNDs as close as possible to the respective PMI capacitor GND and PGND pins to minimize the ground difference between the input and PMI.
3. The local bypass capacitor from SYS to GND must be connected between the SYS pin and PGND of the IC. The intent is to minimize the current path loop area from the SW pin through the LC filter and back to the PGND pin.
4. Place all decoupling capacitors close to their respective IC pins and as close as to PGND as possible (do not place components such that routing interrupts power stage currents). All small control signals must be routed away from the high-current paths.
5. The PCB must have a ground plane (return) connected directly to the return of all components through vias (two vias per capacitor for power-stage capacitors, one via per capacitor for small-signal components). It is also recommended to put vias inside the PGND pads for the IC, if possible. A star ground design approach is typically used to keep circuit block currents isolated (high-power/low-power small-signal) reducing noise-coupling and ground-bounce issues. A single ground plane for this design gives good results. With this small layout and a single ground plane, no ground-bounce issue occurs, and having the components segregated minimizes coupling between signals.
6. The high-current charge paths into IN, BAT, SYS, and from the SW pins must be sized appropriately for the maximum charge current to avoid voltage drops in these traces. The PGND pins must be connected to the ground plane to return current through the internal low-side FET.
7. For high-current applications, the balls for the power paths must be connected to as much copper in the board as possible. This allows better thermal performance because the board conducts heat away from the IC.

4 Bill of Materials and Board Layout

4.1 Bill of Materials

Table 1. Bill of Materials - HPA759A

Quantity	RefDes	Value	Description	Size	Part Number	Manufacturer
0	C1	Open	Capacitor, ceramic, 25 V, X5R, 10%	0805	Std	Std
1	C2	1 µF	Capacitor, ceramic, 25 V, X5R, 10%	0603	Std	Std
1	C3	4.7 µF	Capacitor, ceramic, 25 V, X5R, 10%	0805	Std	Std
1	C4	10 µF	Capacitor, ceramic, 6.3 V, X5R, 20%	0603	Std	Std
1	C5	47 µF	Capacitor, ceramic, 6.3 V, X5R, 20%	0805	Std	Std
1	C10	47 µF	Capacitor, ceramic, 6.3 V, X5R, 20%	0805	Std	Std
2	C6, C7	1 µF	Capacitor, ceramic, 6.3 V, X5R, 10%	0402	Std	Std
1	C8	0.1 µF	Capacitor, ceramic, 25 V, X7R, 10%	0603	Std	Std
1	C9	0.01 µF	Capacitor, ceramic, 10 V, X5R, 10%	0603	Std	Std
2	D1, D2	Green	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	0603	LTST-C190GKT	Liteon
1	D3	BAT54C	Diode, dual Schottky, 200 mA, 3 V	SOT23	BAT54C-V	Vishay-Liteon
6	J1, J3, J9, J11, J12, J14	PEC02SAAN	Header, 2 pin, 100 mil spacing	0.100 × 2	PEC02SAAN	Sullins
4	J2, J7, J10, J13	ED555/2DS	Terminal block, 2 pin, 6 A, 3.5 mm	0.27 × 0.25	ED555/2DS	OST
2	J4, J8	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 × 2	PEC02SAAN	Sullins
1	J6	ED555/2DS	Terminal block, 2 pin, 6 A, 3.5 mm	0.27 × 0.25	ED555/2DS	OST
1	JP1	PEC03SAAN	Header, male 3-pin, 100 mil spacing,	0.100 in × 3	PEC03SAAN	Sullins
2	JP2, JP4	PEC03SAAN	Header, male 3-pin, 100 mil spacing,	0.100 in × 3	PEC03SAAN	Sullins
1	JP3	PEC03SAAN	Header, male 3-pin, 100 mil spacing,	0.100 in × 3	PEC03SAAN	Sullins
1	L1	1.5 µH	Inductor, SMT, 3.5 A, 70 mΩ	4.1 × 4.4 mm	SPM4012T-1R5M Alternate: FDSD0415-H-1R5M	TDK Alternate: Toko
1	Q1	CSD25401Q3	MOSFET, PChan, -20 V, 60 A, 8.7 mΩ	QFN3.3 × 3.3 mm	CSD25401Q3	TI
1	R1	26.7 kΩ	Resistor, chip, 1/16W, 1%	0402	Std	Std
1	R2	100 Ω	Resistor, chip, 1/16W, 1%	0402	Std	Std
1	R3	10.0 kΩ	Resistor, chip, 1/16W, 1%	0402	Std	Std
1	R4	1870 Ω	Resistor, chip, 1/16W, 1%	0603	Std	Std
1	R5	4120 Ω	Resistor, chip, 1/16W, 1%	0603	Std	Std
1	R6	196 Ω	Resistor, chip, 1/16W, 1%	0402	Std	Std
2	R7, R8	1.50 kΩ	Resistor, chip, 1/16W, 1%	0603	Std	Std
1	R9	50 kΩ	Potentiometer, 3/8 Cermet, Single-Turn	0.25 × 0.17 in	3266W-1-503LF	Bourns
0	R10	Open	Resistor, chip, 1/16W, 1%	0603	Std	Std
2	R14, R13	0	Resistor, chip, 1/16W, 1%	0603	Std	Std
1	TP4	5000	Test point, red, thru hole color keyed	0.100 × 0.100 in	5000	Keystone
6	TP1, TP2, TP3, TP7, TP8, TP15, TP16	5000	Test point, red, thru hole color keyed	0.100 × 0.100 in	5000	Keystone

Table 1. Bill of Materials - HPA759A (continued)

2	TP5, TP6	5001	Test point, black, thru hole color keyed	0.100 × 0.100 in	5001	Keystone
4	TP11, TP12, TP13, TP14	5002	Test point, white, thru hole color keyed	0.100 × 0.100 in	5002	Keystone
1	U1	BQ24278RGE	IC, 2.5 A, single input, single cell Switchmode Li-Ion battery charger with power-path management	QFN-24	BQ24278RGE	TI
4	–		Shunt, 100 mil, black	0.100	929950-00	3M
1	–		PCB 3.00 in × 3.00 in × 0.062 in		HPA759	Any

4.2 Board Layout

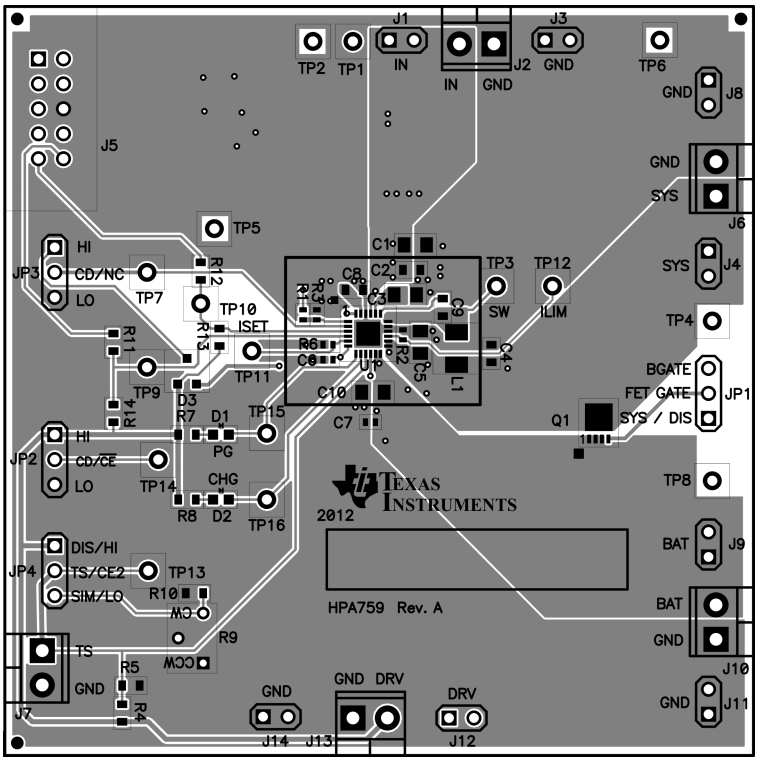

Figure 4. Top Assembly Layer

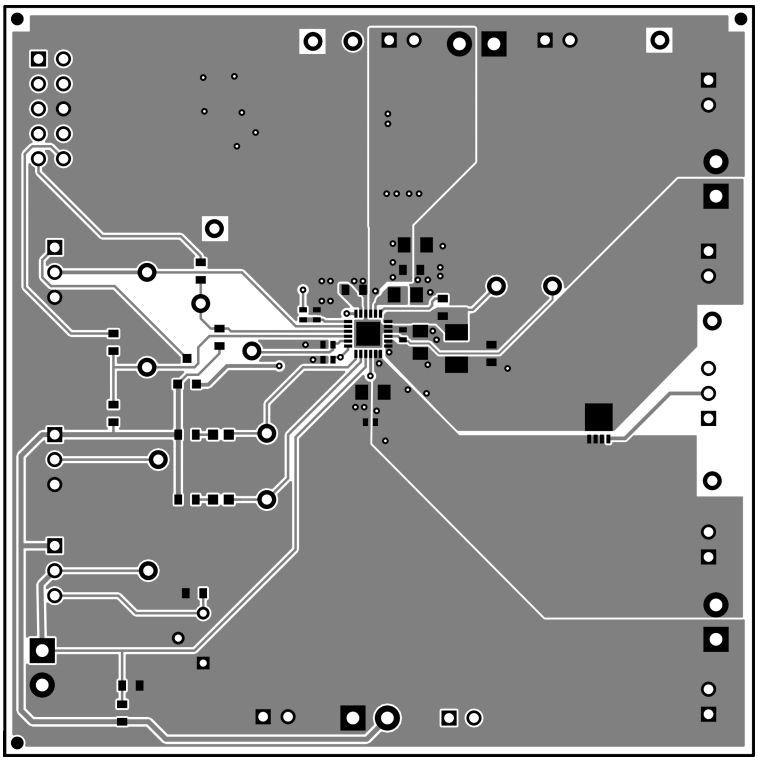

Figure 5. Top Layer

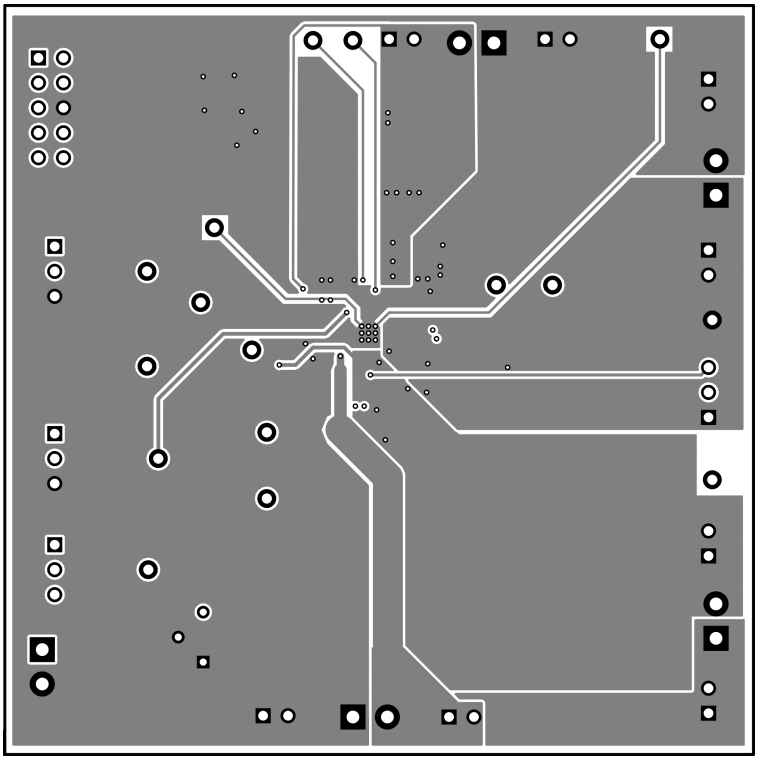

Figure 6. Bottom Layer

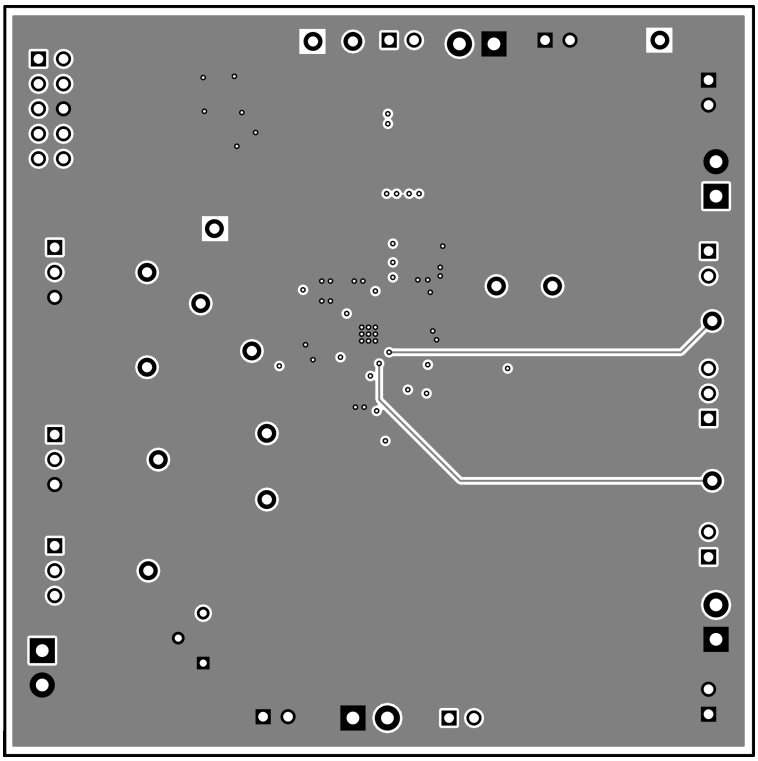

Figure 7. First Internal Layer

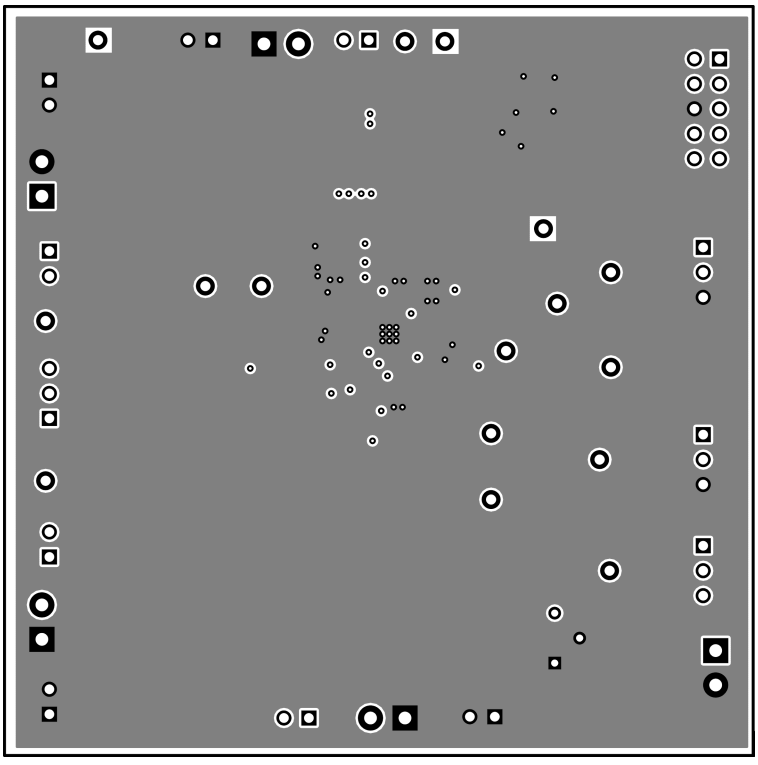

Figure 8. Second Internal Layer

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.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

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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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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。
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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。

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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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

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.

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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.
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IMPORTANT NOTICE

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TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

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Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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