

Using the bq241xx (bqSWITCHER™)

User's Guide

Literature Number: SLUU200A
July 2004–Revised December 2007

Contents

1	Introduction	5
	1.1 Background	5
	1.2 Performance Specification Summary.....	5
2	Test Summary	6
	2.1 Equipment.....	6
	2.2 Setup.....	6
	2.3 Test Procedure	7
3	Schematic	9
4	Physical Layouts	10
	4.1 Board Layout	10
5	List of Materials	13
6	References	18
	Important Notices	19

List of Figures

1	bq241xxEVM Schematic.....	9
2	bq241xxEVM Top Assembly.....	10
3	bq241xxEVM Top Silk Screen.....	11
4	bq241xxEVM Top Layer.....	11
5	bq241xxEVM Bottom Layer.....	12

List of Tables

1	Performance Specification Summary	6
2	I/O and Jumper Connections (Factory Jumper Selections shown in Bold Text)	7
3	bq24100EVM-001 List of Materials	13
4	bq24105EVM-002 List of Materials	14
5	bq24113EVM-003 List of Materials	15
6	bq24115EVM-004 List of Materials	16
7	bq24103EVM-005 List of Materials	17
8	bq24103AEVM-006 List of Materials	18

Using the bq241xx (bqSWITCHER™)

1 Introduction

This user's guide describes the bq241xxEVM (bqSWITCHER™) Evaluation Module. The Evaluation Module provides a convenient method for evaluating the performance of a charge management solution for portable applications using the bq241xx product family. A complete designed and tested charger is presented. The charger is designed to deliver up to 2.0 A of continuous output current. The charger is programmed from the factor to deliver 1.33 A of charging current. Follow the instructions in this user's guide that pertain to the specific bq241xxEVM (one-, two- or three-cell) to be evaluated. See the bqSWITCHER data sheet ([SLUS606](#)) prior to evaluation for detailed information on the bqSWITCHER device.

1.1 Background

The bqSWITCHER series are highly integrated Li-Ion and Li-Pol switch-mode charge management devices targeted at a wide range of portable applications. The bqSWITCHER series offer integrated synchronous PWM Controller and PowerFETs, high-accuracy current and voltage regulation, charge conditioning, charge status, and charge termination, in a small thermally enhanced QFN package. The system-controlled version provides additional input for full charge management under system control.

The bqSWITCHER charges the battery in three phases: conditioning, constant current, and constant voltage. Charge is terminated based on user-selectable minimum current level. A programmable charge timer provides a backup safety for charge termination. The bqSWITCHER automatically restarts the charge if the battery voltage falls below an internal threshold. The bqSWITCHER automatically enters sleep mode when V_{CC} supply is removed.

1.2 Performance Specification Summary

This section summarizes the performance specifications of the EVM. [Table 1](#) gives the EVM performance specifications. The TS pin has been disabled, for easier charging evaluation, by fixing its voltage to a set value. See the EVM schematic ([Figure 1](#)) and data sheet ([SLUS606](#)) for information on how to change R10 and R11 values to use with an external thermistor

Table 1. Performance Specification Summary

SPECIFICATION		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input DC voltage, $V_{(DC)}$			$V_{REG} + 0.6$	5.0	16	V
Battery charge current, $I_{O(CHG)}$				1.33	2.0	A
Power dissipation	bq24100 (1 cell)	$5\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 4.2\text{ V}$, $I_{OUT} = 1.33\text{ A}$		0.6		W
	bq24103 bq24103A bq24113 (1 cell)	$5\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 4.2\text{ V}$, $I_{OUT} = 1.33\text{ A}$		0.6		W
	bq24103 bq24103A bq24113 (2 cell)	$9\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 8.4\text{ V}$, $I_{OUT} = 1.33\text{ A}$		0.85		W
	bq24105 bq24115 (1 cell)	$5\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 4.2\text{ V}$, $I_{OUT} = 1.33\text{ A}$		0.0		W
	bq24105 bq24115 (2 cell)	$9\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 8.4\text{ V}$, $I_{OUT} = 1.33\text{ A}$		0.65		W
	bq24105 bq24115 (3 cell)	$13.5\text{ V} \leq V_{IN} \leq 16\text{ V}$, $V_{(BAT)} = 12.6\text{ V}$, $I_{OUT} = 1.33\text{ A}$		1.17		W

2 Test Summary

This chapter covers the test setups and tests performed, in evaluating the EVM.

2.1 Equipment

- **Power Source:** Current limited 15 V lab supply with its current limit set to 25% above the programmed charging current (1.7 A for setup from factory). This is basically a safety limit. The actual DC input current should be less than the charging current.
- **Two Fluke 75:** (optional) To measure input and output voltage and drop across current sense resistor.

2.2 Setup

The bq241xx EVM board requires a regulated supply approximately 0.3 V minimum above the regulated voltage of the battery pack (1-cell pack: 4.2 V; 2-cell pack: 8.4 V; 3-cell pack: 12.6 V) to a maximum input voltage of 16 V_{DC} .

A one- to three-cell battery pack is needed for EVM evaluation. The EVM should be chosen and set up to charge the same numbers of cells as the evaluated (see [Table 2](#)).

Set up the EVM as shown in [Table 2](#). Preset the input supply to the desired voltage, turn off supply, and finally connect supply to J1. Set the supply's current limit 25% above the programmed charging current. The test setup connections and jumper setting selections are configured for a stand-alone evaluation and can be changed to interface with external hardware such as a microcontroller. See the EVM schematic ([Figure 1](#)) and data sheet ([SLUS606](#)) for functional information on other optional connections.

Table 2. I/O and Jumper Connections (Factory Jumper Selections shown in Bold Text)

ASSEMBLY		-001	-002	-003	-004	-005	-006
U1	Device	bq24100	bq24105 ⁽¹⁾	bq24113 ⁽²⁾	bq24115 ⁽¹⁾	bq24103 ⁽²⁾	bq24103A ⁽²⁾
J1	DC+/DC-:Input voltage range (V)	5 to 16	V_{REG}+0.8 to 16 ⁽¹⁾	5 to 16	V_{REG}+0.8 to 16 ⁽¹⁾	5 to 16 ⁽²⁾	5 to 16 ⁽²⁾
J2	BAT+/BAT-No. cell in series	1	1	1	1	1	1
	Output regulation voltage (V)	4.2	4.2 ⁽¹⁾	4.2 ⁽²⁾	4.2 ⁽¹⁾	4.2 ⁽²⁾	4.2 ⁽²⁾
J5	$\overline{\text{PG}}$	LED or EXT	LED or EXT	LED or EXT	LED or EXT	LED or EXT	LED or EXT
J6	STAT1	LED or EXT	LED or EXT	LED or EXT	LED or EXT	LED or EXT	LED or EXT
J7	STAT2	LED or EXT	LED or EXT	N/C no jumper	N/C no jumper	LED or EXT	LED or EXT
J8	TTC or CMOD	TTC no jumper	TTC no jumper	CMOD jumper HI	CMOD jumper HI	TTC no jumper	TTC no jumper
J9	$\overline{\text{CE}}$	$\overline{\text{CE}}$ jumper LO	$\overline{\text{CE}}$ jumper LO	$\overline{\text{CE}}$ jumper LO	$\overline{\text{CE}}$ jumper LO	$\overline{\text{CE}}$ jumper LO	$\overline{\text{CE}}$ jumper LO
J10	Cells or FB	No jumper	No jumper	Cells jumper LO	No jumper	Cells jumper LO	Cells jumper LO

⁽¹⁾ R5 and R7 can be changed to regulate output between approximately 3.2 V to 15.5 V. Adjust the input voltage as required. Output set to operate at 4.2 VDC from the factory.

⁽²⁾ To operate as a two cell version (8.4V), replace battery with a two-series cell pack, set J10 to High and adjust the Input voltage between 9.2 V to 16 V.

2.3 Test Procedure

Set up the evaluation board as described above, by making the necessary I/O connections and jumper selections.

WARNING

Prior to test and evaluation, it is important to verify that the EVM selected is set up correctly for the battery pack to be charged; several evaluation modules have a CELLS option that can be programmed for two different size – number of series cells. TI highly recommends that the battery pack to be charged, has internal protection as a safety backup.

1. Apply power to the board with the power supply, preset to the suggested value in [Table 2](#), and use approximately 1.7 A for the current limit setting.
2. The $\overline{\text{PG}}$ LED and STAT1 should light, if the battery is charging.
3. The bq241xx enters pre-conditioning mode if the battery is below the $V_{(\text{LOWV})}$ threshold. In this mode, the bq241xx pre-charges the battery with a low current programmed by the ISET2 pin. If the R_{SET1} and R_{SET2} resistors are the same value then the precharge is one tenth the fast charge current ($I_{\text{PRE-CHG}} = 1.33 \text{ A}/10 = 133 \text{ mA}$) until the battery voltage reaches the $V_{(\text{LOWV})}$ threshold or until the precharge timer expires. If the timer expires then the charge current is terminated and the bq241xx enters fault mode. STAT1 and STAT2 (if available) LEDs go dark when in fault mode.

Note: There are several non-charging modes that share this status state. Toggling input power or battery replacement resets fault mode.

4. Once the battery voltage is above the $V_{(\text{LOWV})}$ threshold, the battery enters fast charge mode. This EVM is programmed for approximately 1.3 A of fast charging current. The $\overline{\text{PG}}$ and STAT1 LEDs should be on.
5. Once the battery reaches voltage regulation (4.2 V) the current tapers down as the battery reaches its full capacity. The $\overline{\text{PG}}$ and STAT1 LEDs should light.

Test Summary

6. When the current reaches the taper termination threshold, set by the R_{SET2} resistor, the charge is terminated. The \overline{PG} LED should be still lit and the STAT1 LED should turn off and STAT2 LED lights.
7. If the battery discharges down to the recharge threshold, the charger starts fast charging. The \overline{PG} LED should remain lit, the STAT2 LED should turn off and STAT1 LED lights.

An alternative method of testing the EVM is with a source meter, that can sink or source current. This can easily be adjusted to test each mode, in place of a battery.

3 Schematic

Figure 1 shows the schematic diagram for the EVM.

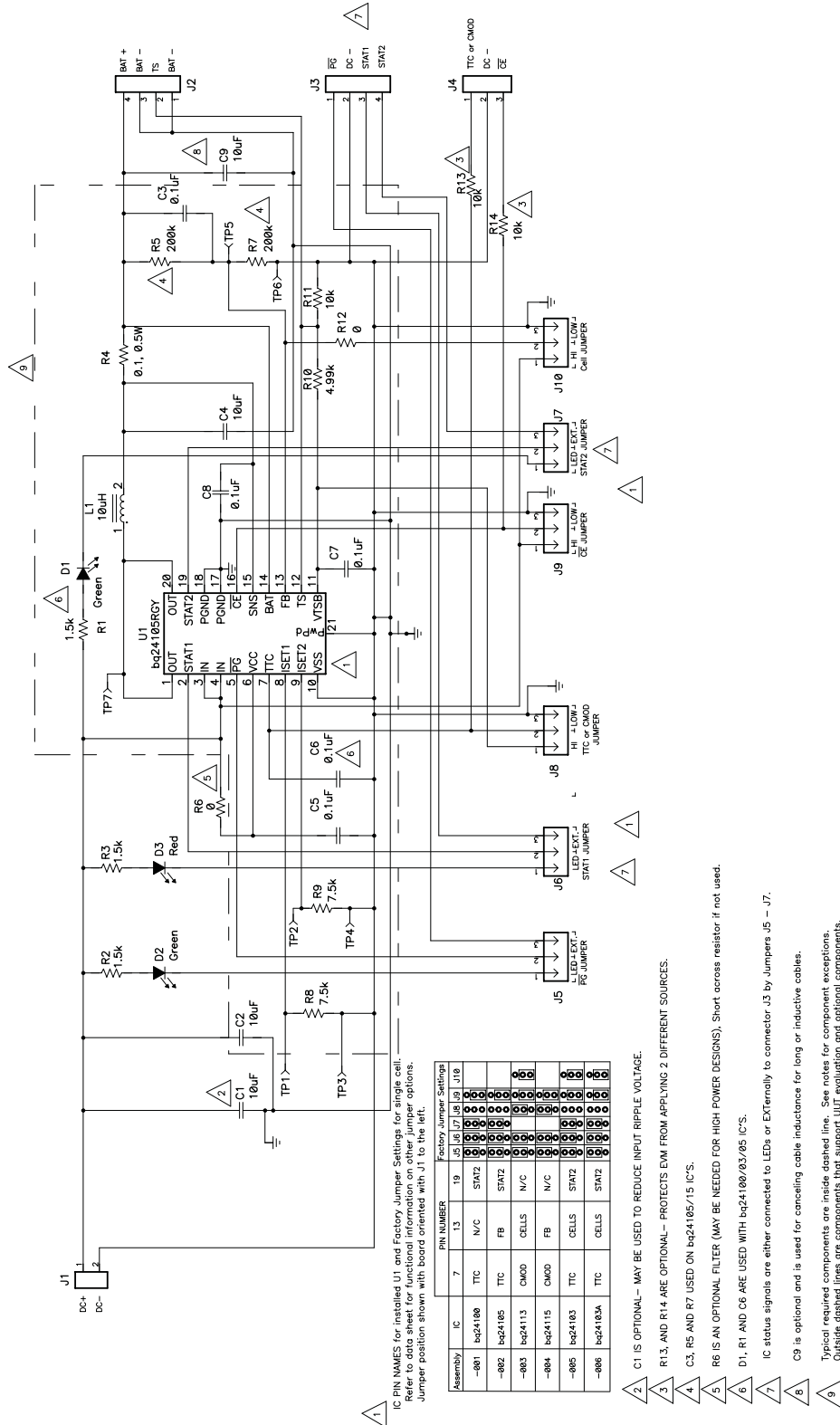


Figure 1. bq241xxEVM Schematic

4 Physical Layouts

This chapter contains the board layout and assembly drawings for the EVM.

4.1 Board Layout

Figure 2 shows the top assembly of the EVM. Figure 3 shows the top silk screen. Figure 4 shows the top layer. Figure 5 shows the bottom layer view.

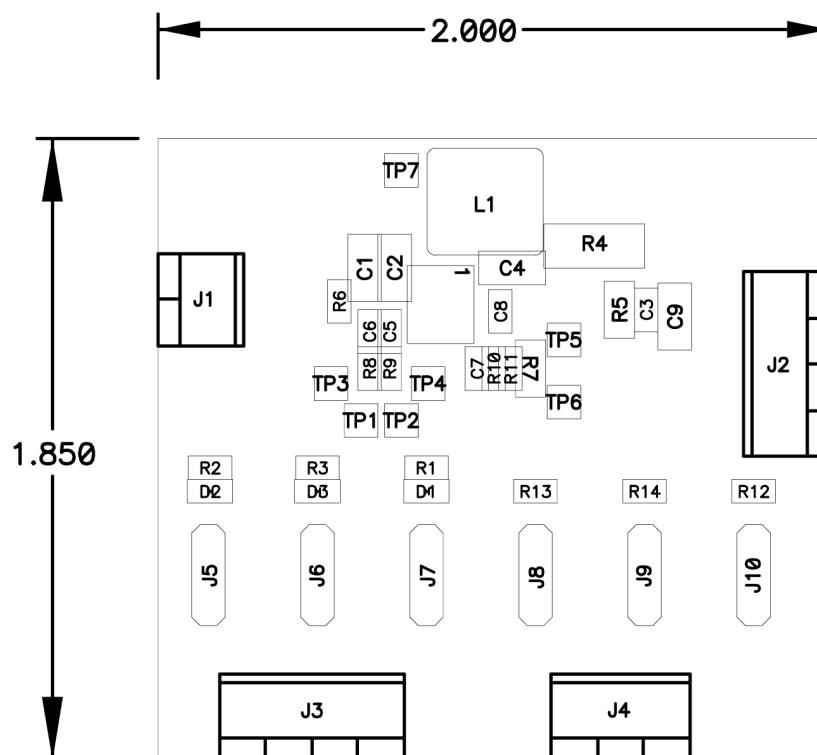


Figure 2. bq241xxEVM Top Assembly

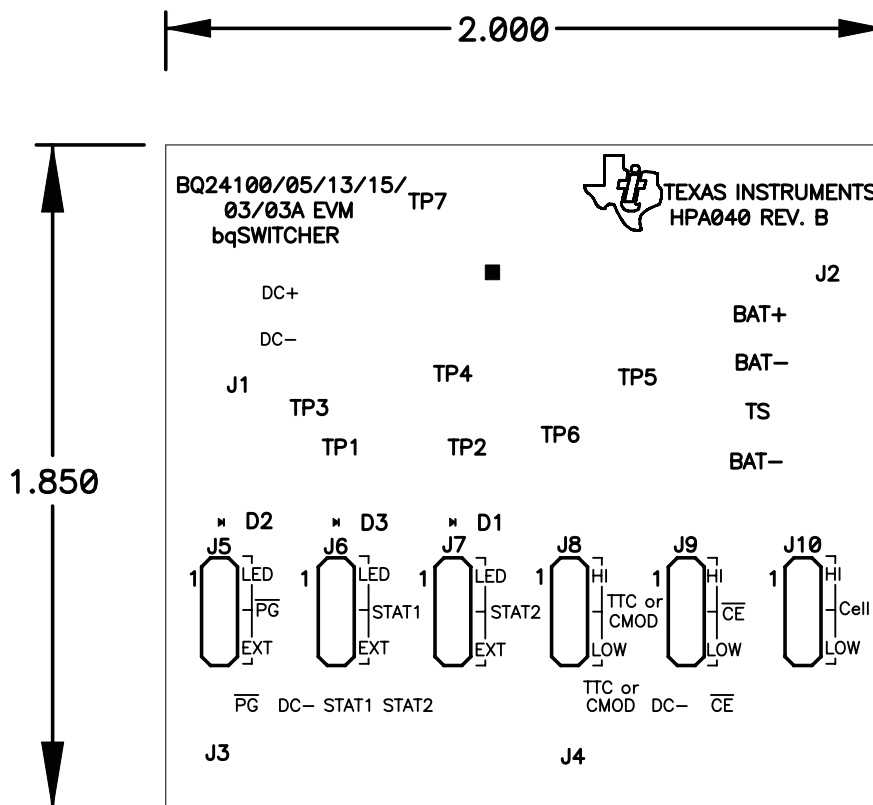


Figure 3. bq241xxEVM Top Silk Screen

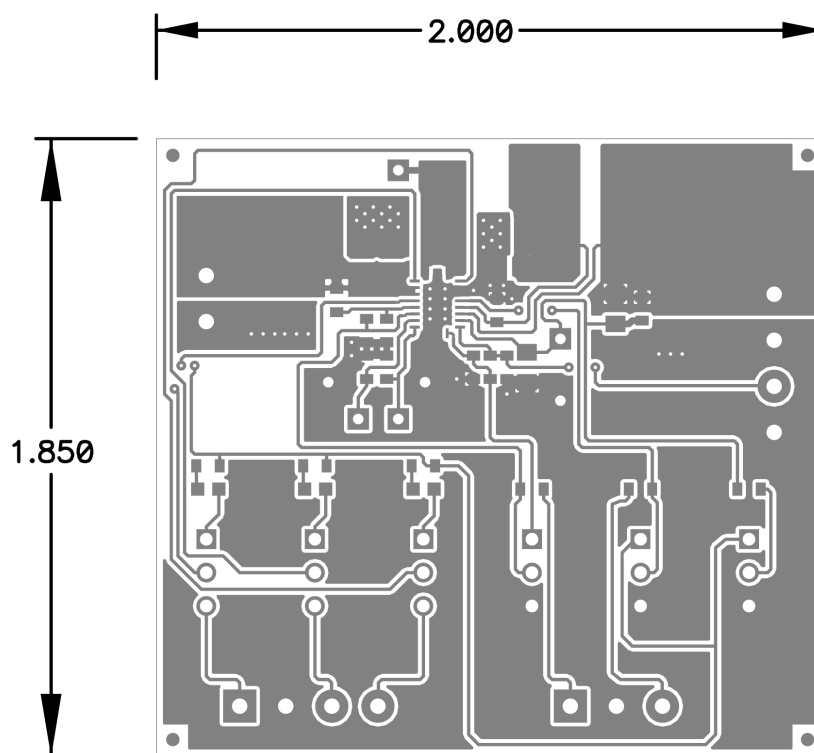


Figure 4. bq241xxEVM Top Layer

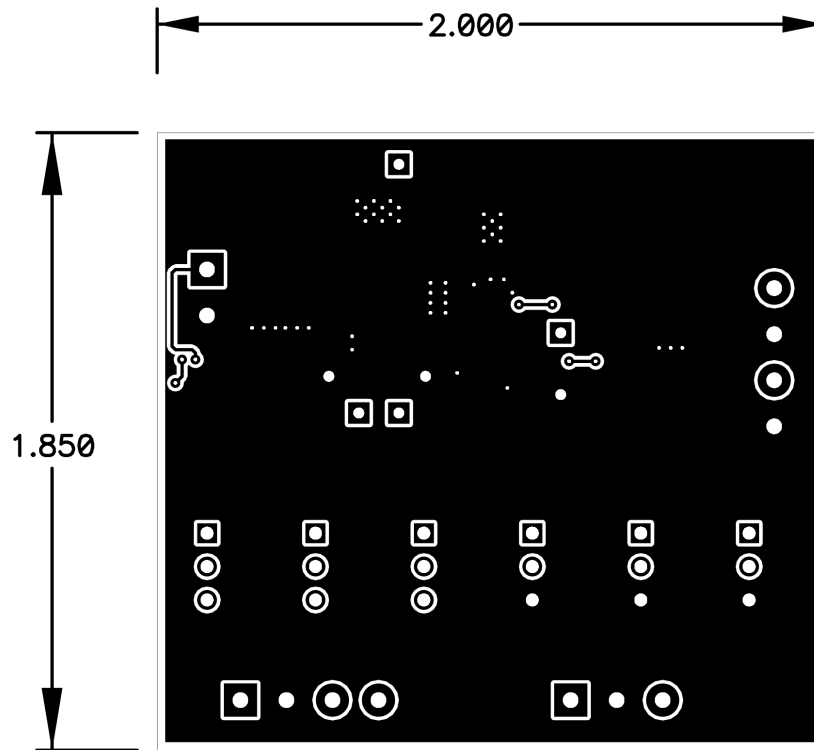


Figure 5. bq241xxEVM Bottom Layer

5 List of Materials

Table 3 through Table 7 list the components used in this design. With minor component adjustments this design could be modified to meet a wide range of applications.

Table 3. bq24100EVM-001 List of Materials^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	0	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	5	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	1	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	0	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	0	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24100RHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

- (1) These assemblies are ESD sensitive, ESD precautions shall be observed.
- (2) These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.
- (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
- (4) C9 can be installed by the customer if using long cables (inductive load)
- (5) Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J5, J6, J7-1/2 (LED); J9-2/3 (LOW); J8-2 (optional)

Table 4. bq24105EVM-002 List of Materials ^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	0	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	5	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	1	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	0	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	2	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24105RHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

(1) These assemblies are ESD sensitive, ESD precautions shall be observed.

(2) These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.

(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.

(4) C9 can be installed by the customer if using long cables (inductive load)

(5) Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J5, J6, J7-1/2 (LED); J9-2/3 (LOW); J8-2 (optional)

Table 5. bq24113EVM-003 List of Materials^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	0	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	0	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	5	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	0	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	0	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24113RHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

(1) These assemblies are ESD sensitive, ESD precautions shall be observed.

(2) These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.

(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.

(4) C9 can be installed by the customer if using long cables (inductive load)

(5) Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J8-1/2 (Hi), J5 & J6-1/2 (LED), J9-2/3 (LOW). Place shunts on J10-2/3 (LOW).

Table 6. bq24115EVM-004 List of Materials^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	0	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	0	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	0	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	4	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	0	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	0	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	2	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24115RHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

⁽¹⁾ These assemblies are ESD sensitive, ESD precautions shall be observed.

⁽²⁾ These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.

⁽³⁾ These assemblies must comply with workmanship standards IPC-A-610 Class 2.

⁽⁴⁾ C9 can be installed by the customer if using long cables (inductive load)

⁽⁵⁾ Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J8-1/2 (Hi), J5 & J6-1/2 (LED), J9-2/3 (LOW).

Table 7. bq24103EVM-005 List of Materials^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	6	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	1	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	0	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24103RHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

⁽¹⁾ These assemblies are ESD sensitive, ESD precautions shall be observed.

⁽²⁾ These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.

⁽³⁾ These assemblies must comply with workmanship standards IPC-A-610 Class 2.

⁽⁴⁾ C9 can be installed by the customer if using long cables (inductive load)

⁽⁵⁾ Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J5, J6, J7-1/2 (LED); J9-2/3 (LOW); J8-2 (optional). Place shunts on J10-2/3 (LOW).

Table 8. bq24103AEVM-006 List of Materials^{(1) (2) (3) (4) (5)}

REFERENCE DESIGNATOR	QTY	DESCRIPTION	SIZE	MFR	PART NUMBER
C1, C2, C4	3	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C9	0	Capacitor, ceramic, 10 μ F, 25 V, X5R, 20%	1206	Panasonic	ECJ-3YB1E106M
C3	0	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C5, C7, C8	3	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	ECJ-1VB1C104K
C6	1	Capacitor, ceramic, 0.1 μ F, 16 V, X7R, 10%	603	Panasonic	160-1183-1-ND
D1	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D2	1	Diode, LED, green, 2.1 V, 20 mA, 6 mcd	603	Liteon	160-1183-1-ND
D3	1	Diode, LED, red, 1.8 V, 20 mA, 20 mcd	603	Liteon	160-1181-1-ND
J1	1	Terminal block, 2-pin, 6 A, 3.5 mm	75525	OST	ED1514
J2, J3	2	Terminal block, 4-pin, 6 A, 3.5 mm	0.55 \times 0.25	OST	ED1516
J4	1	Terminal block, 3-pin, 6 A, 3.5 mm	0.41 \times 0.25	Sullins	ED1515
J5, J6, J8, J9	4	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J7	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	Sullins	PTC36SAAN
J10	1	Header, 3-pin, 100 mil spacing, (36-pin strip)	34100	3M	PTC36SAAN
	6	Shunt, 100 mil, black	0.100	Sumida	929950-00
L1	1	Inductor, SMT, 10 μ H, 1.84 A, 49 mW	0.315 \times 0.287	Vishay	CDRH74-100
R1	1	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R10	1	Resistor, chip, 4.99 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-4991-F
R11, R13, R14	3	Resistor, chip, 10 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1002-F
R12	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-0000-F
R2, R3	2	Resistor, chip, 1.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-1501-F
R4	1	Resistor, chip, 0.1 Ω , W, 1%	2010	Vishay	CRCW1210-0R10F
R5, R7	0	Resistor, chip, 200 k Ω , 1/8-W, 1%	805	Vishay	CRCW0805-2003-F
R6	1	Resistor, chip, 0 Ω , 1/16-W, 1%	603	Vishay	CRCW0603-00R0-F
R8, R9	2	Resistor, chip, 7.5 k Ω , 1/16-W, 1%	603	Vishay	CRCW0603-7501-F
U1	1	IC, advanced Li-Ion and Li-Pol charge management	RHL-20	TI	bq24103ARHL
—	1	PCB, 2.0 In \times 1.9 In \times 0.031 In		Any	HPA040

- (1) These assemblies are ESD sensitive, ESD precautions shall be observed.
- (2) These assemblies must be clean and free from flux and all contaminants. Refrain from using "no clean" flux on these assemblies.
- (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
- (4) C9 can be installed by the customer if using long cables (inductive load)
- (5) Place shunts as follows (Jumper pin orientation: pin 1: top (toward RD), pin 2: center, pin 3-bottom). Place shunts on J5, J6, J7-1/2 (LED); J9-2/3 (LOW); J8-2 (optional). Place shunts on J10-2/3 (LOW).

6 References

1. bq241xx Synchronous Switchmode Li-Ion and Li-Pol Charge Management IC With Integrated PowerFETs (bqSWITCHER™) data sheet ([SLUS606](#)).

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit 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. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

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 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.**

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. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

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.

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.

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 contact the TI application engineer or visit www.ti.com/esh.

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.

FCC Warning

This evaluation board/kit 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 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0.6 V to 16 V and the output voltage range of 0.6 V to 16 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 125° C. The EVM is designed to operate properly with certain components above 125° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#), [TI's General Quality Guidelines](#), or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2026, Texas Instruments Incorporated

Last updated 10/2025