

# ***bq2420x Single-Chip Li-Ion/ Li-Pol Charge Management IC for Current-Limited Applications Evaluation Module***

## *User's Guide*

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It is important to operate this EVM within the input voltage range of 3.0–13.5 V, output of up to 4.2 V and 0.5 A, and maximum power dissipation of 1.0 W.

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 50°C. The EVM is designed to operate properly with certain components above 50°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.

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# Introduction

This user's guide describes the bq2420x evaluation module (SLUP141), which conveniently evaluates a charge-management solution for portable applications using the bq2420x product family. This complete, designed-and-tested charger delivers up to 500 mA of continuous charge current for single-cell Li-Ion or Li-Pol applications using a current-limited power supply.

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## 1.1 Background

The bq2420x series are simple Li-Ion linear charge management devices for low-cost and space-limited charger applications. The bq2420x series offer integrated power FET, high-accuracy voltage regulation, temperature monitoring, charge status, and charge termination—all in a single IC.

The bq2420x works with a current-limited, wall-mount transformer and therefore does not provide any current regulation. However, these devices offer a fixed internal current limit to prevent damage to the internal powerFET. A time-limited preconditioning phase conditions deeply discharged cells. Once the battery reaches the charge voltage, the voltage-regulation loop takes over and completes the charge cycle. Charge is terminated on the basis of minimum current. An internal charge timer provides a backup safety for charge termination.

Other standard features include an automatic sleep mode activated when  $V_{CC}$  falls below the battery voltage and a recharge feature activated when the battery voltage falls below the  $V_{RCH}$  threshold.

In addition to the standard features, the core product provides two additional enhancements: temperature monitoring and status display. The temperature-sense circuit continuously measures battery temperature using an external thermistor and inhibits charge until the battery temperature is within the user-defined thresholds. The STAT pin indicates three conditions of charger operation: *charge-in-progress*, *charge complete*, and *fault*. This output can be used to drive an LED or to interface with a microcontroller.

## 1.2 Features

- ☐ Performance evaluation of a charge-management solution for portable applications using the bq2420x product family
- ☐ Complete designed-and-tested charger
- ☐ Integrated powerFET
- ☐ High-accuracy voltage regulation
- ☐ Temperature monitoring
- ☐ Charge status reporting
- ☐ Charge termination
- ☐ Up to 500 mA of continuous charge current for single-cell Li-Ion or Li-Pol applications using a current-limited power supply

### 1.3 Kit Contents

- ☐ bq242xx evaluation module (SLUP141)
- ☐ Set of support documentation

### 1.4 Performance Specification Summary

This section summarizes the performance specifications of the EVM. Table 1–1 gives the performance specifications of the EVM.

*Table 1–1. Performance Specification Summary*

| Specification                         | Test Conditions                      | Min             | Typ  | Max  | Unit |
|---------------------------------------|--------------------------------------|-----------------|------|------|------|
| Input dc voltage, $V_{DC}$            |                                      | $V_{REG} + 0.8$ |      | 13.5 | V    |
| Battery charge current, $I_{CHG}$     | See Note                             | 0.4             | 0.5  | 0.6  | Amps |
| Battery voltage regulation, $V_{REG}$ | Full battery                         |                 | 4.10 |      | V    |
| Battery voltage regulation, $V_{REG}$ | Full battery                         |                 | 4.20 |      | V    |
| Power dissipation, $P_D$              | $(V_{in} - V_{out}) \times I_{load}$ |                 |      | 1.0  | W    |

**Note:** Battery charge current must be limited by the external supply.

### 1.5 Ordering Information

*Table 1–2. Feature Sets of the bq2420x Family*

| Part Number | Package   | Functions |            | Regulation Voltage |
|-------------|-----------|-----------|------------|--------------------|
|             |           | STAT      | Temp Sense |                    |
| bq24200DGN  | DGN—8 Pin | X         | X          | 4.2 V              |
| bq24201DGN  | DGN—8 Pin | X         | X          | 4.1 V              |
| bq24202DGN  | DGN—8 Pin | X         |            | 4.2 V              |
| bq24203DGN  | DGN—8 Pin | X         |            | 4.1 V              |
| bq24204DGN  | DGN—8 Pin |           |            | 4.2 V              |
| bq24205DGN  | DGN—8 Pin |           |            | 4.1 V              |

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# Test Summary

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This chapter shows the test setups used, and the tests performed, in designing the bq2420xEVM.

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| 2.2 Test Procedure ..... | 2-2  |

## 2.1 Setup

The BQ2420X EVM board requires a current-limited dc power source to provide input power and a battery-pack charge current. The test setup connections and jumper setting selections are listed in Table 2–1.

*Table 2–1. I/O and Jumper Connections*

| Jack             | Connect To:                                                              |
|------------------|--------------------------------------------------------------------------|
| J1–DC+           | Power supply positive                                                    |
| J1–DC–           | Power supply ground                                                      |
| J2 (Jumper)      | Normally connected. Option for adding current limiting resistor on board |
| J3 (STAT Jumper) | Option for connecting STAT pin externally                                |
| J4–BAT+          | Positive battery pack terminal                                           |
| J4–BAT–          | Negative battery pack terminal                                           |
| J4–TS            | Thermistor connection                                                    |
| J4–BAT–          | Negative battery pack terminal                                           |
| J5– STAT         | Charge status output                                                     |
| J5–DC–           | Power supply ground                                                      |

## 2.2 Test Procedure

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

**Note:**

This EVM is designed specifically to work with a current-limited dc power supply. Before test and evaluation, it is important to verify that the maximum power dissipation on the IC is not exceeded:  $P_{(MAX)} = 1.0$  watts.

- 1) Select a power supply with the following specifications:
  - DC output voltage at the rated current: 3–5 V
  - DC no-load output voltage: 7–10 V
  - Rated current: 300–500 mA
- 2) The bq2420x enters preconditioning mode if the battery is below the LowV threshold. In this mode, the bq2420x precharges the battery with a low current (typically 13 mA) for approximately 30 minutes. If the battery does not reach the LowV threshold after this period, then the charge current is terminated, and the bq2420x enters fault mode. Both LEDs illuminate in fault mode. Toggling input power or battery replacement resets fault mode.
- 3) Once charged to the LowV-stop threshold, the battery enters fast-charge mode. The external power supply limits the charge current during the initial stage of charge. Note that bq2420x does not provide any current regulation.

- 4) Once the battery reaches the voltage limit (4.1 V or 4.2 V), the bq2420x begins the voltage regulation phase of the charge.
- 5) The battery remains at the fast charge mode until either the charge timer expires or taper current is detected.
- 6) If the battery discharges down to the recharge threshold, the charger starts fast charging.

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# Schematic, Physical Layouts, and Bill of Materials

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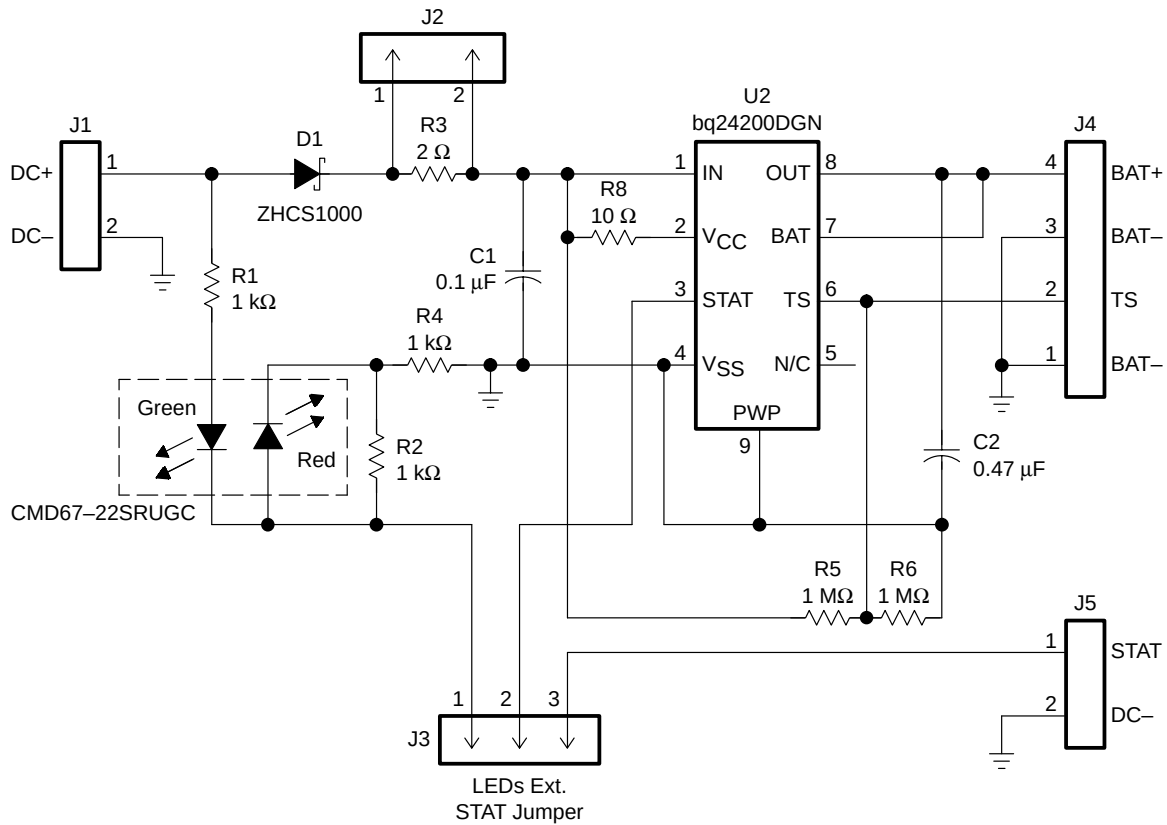
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This chapter contains the bq2420xEVM schematic diagram, board layout, assembly drawings and bill of materials.

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### 3.1 Schematic

Figure 3–1. bq2420xEVM Schematic Diagram



### 3.2 Physical Layouts

#### 3.2.1 Board Layouts

Figure 3–2. Top Layer

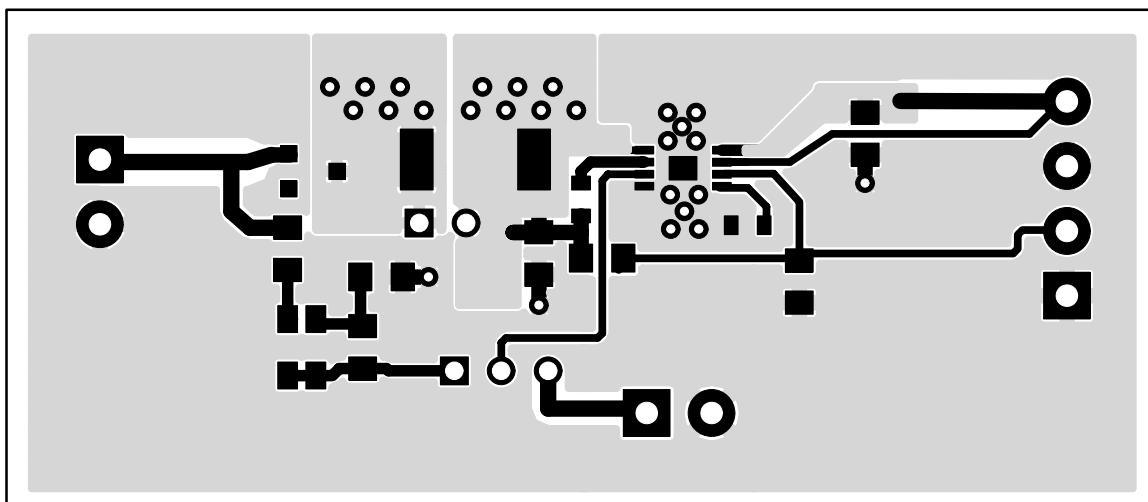


Figure 3–3. Bottom Layer

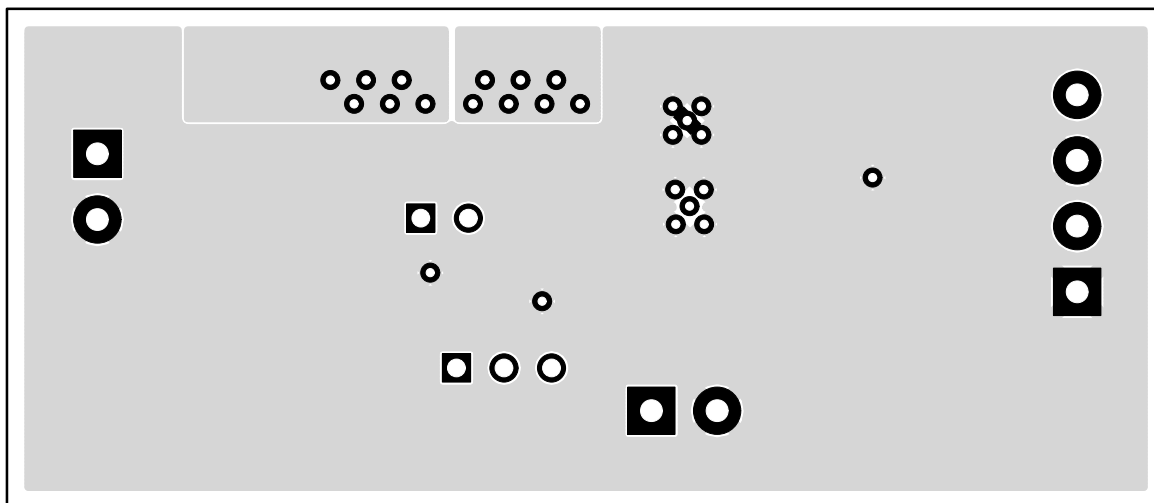
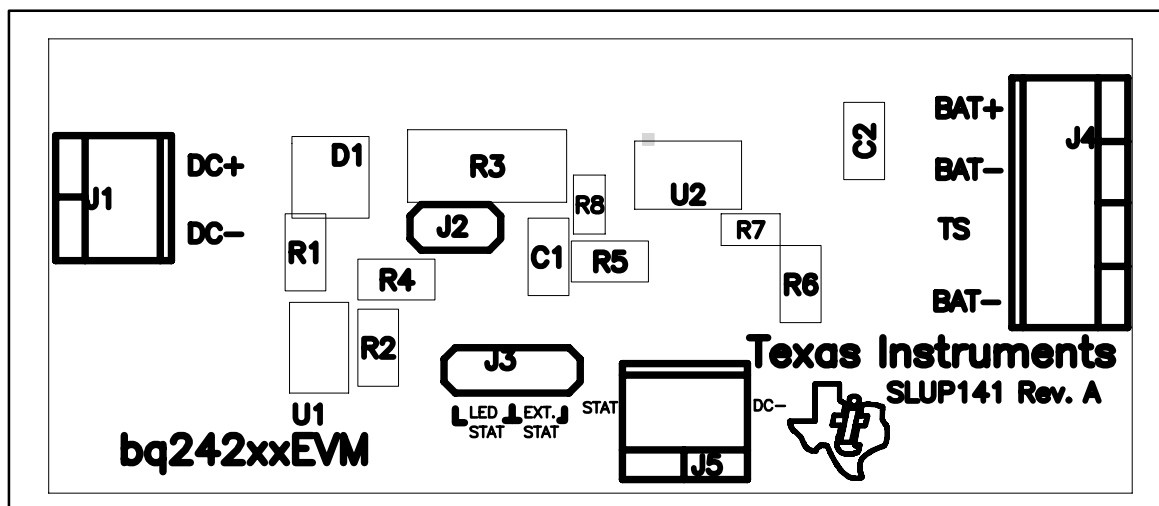


Figure 3–4. Assembly Layer



### 3.3 Bill of Materials

This section contains the bill of materials for the SLUP141.

Table 3–1 lists materials required for the DM2014H.

*Table 3–1. Bill of Materials for SLUP141–bq2420xEVM*

| RefDes     | Count | Description                                                         | Size   | MFR               | Part Number           | Area          |
|------------|-------|---------------------------------------------------------------------|--------|-------------------|-----------------------|---------------|
| C1         | 1     | Capacitor, ceramic, 0.1 $\mu$ F, 16 V, X7R                          | 805    | Panasonic         | ECJ–2VB1C104K         | 10560         |
| C2         | 1     | Capacitor, ceramic, 0.47 $\mu$ F, 16 V, X7R                         | 805    | Panasonic         | ECJ–2YB1C474K         | 10560         |
| D1         | 1     | Diode, Schottky, 1000 mA, 40 V                                      | SOT23  | Vishay–Liteon     | ZHCS1000              | 14105         |
| J1, J5     | 2     | Terminal block, 2 pin, 6 A, 3,5 mm                                  | 75525  | OST               | ED1514                | 6/21/00 21:46 |
| J2         | 1     | Header, 2 pin, 100-mil spacing, (36-pin strip)                      | 23100  | Sullins           | PTC36SAAN             | 6/21/00 21:46 |
| J3         | 1     | Header, 3 pin, 100-mil spacing, (36-pin strip)                      | 34100  | Sullins           | PTC36SAAN             | 6/21/00 21:46 |
| J4         | 1     | Terminal block, 4 pin, 6 A, 3,5mm                                   | 148400 | OST               | ED1516                | 6/21/00 21:46 |
| R1, R2, R4 | 3     | Resistor, chip, 1 k $\Omega$ , 1/10–W, 1%                           | 805    | Std               | Std                   | 10560         |
| R3         | 0     | Resistor, chip, 2.0 $\Omega$ , 1 W, 1%                              | 2512   |                   | WSL-2512-xx<br>1% R86 | 35100         |
| R5, R6     | 2     | Resistor, chip, 1 M $\Omega$ , 1/10 W, 1%                           | 805    | Std               | Std                   | 10560         |
| R7         | 0     | Resistor, NOT USED OR NEEDED                                        | 603    | Std               | Std                   | 5650          |
| R8         | 1     | Resistor, chip, 10 $\Omega$ , 1/16–W, 1%                            | 603    | Std               | Std                   | 5650          |
| U1         | 1     | Diode, LED, Bicolor, Green/Red, 20 mA, 25/40 mcd                    | 24360  | Chicago Miniature | CMD67–22SRUGC         |               |
| U2         | 1     | IC, charge management, linear Li-Ion, .5 A, 13 V VCC max., 4.2 Vreg | DGN8   | TI                | bq24200DGN            | 35250         |
| PWB        | 1     | PWB, SLUP141 (bq2420x)                                              |        |                   |                       | 6/21/00 21:46 |

- Notes:**
- 1) These assemblies are ESD-sensitive; observe ESD precautions.
  - 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.

### 3.4 Reference

- 1) bq2420x data sheet, literature number SLUS501A