*User's Guide*

# *BQ25180 EVM User's Guide*


**ABSTRACT**

This user's guide provides detailed testing instructions for the BQ25180 evaluation module (EVM). Also included are descriptions of the necessary equipment, equipment setup, procedures, the printed-circuit board layouts, schematics, and the bill of materials (BOM).

Throughout this user's guide, the abbreviation *EVM, BQ25180EVM,* and the term evaluation module are synonymous with the BQ25180 evaluation module, unless otherwise noted.


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## Trademarks

**WARNING**

**Hot surface! Contact may cause burns. Do not touch!**

Some components may reach high temperatures >55°C when the board is powered on. The user must not touch the board at any point during operation or immediately after operating, as high temperatures may be present.

# 1 Introduction

The BQ25180EVM is an evaluation kit for the BQ25180 integrated battery charge management IC. The BQ25180 is an integrated battery charge management IC that integrates the most common functions for wearable devices: linear charger, regulated output, manual reset with timer, and ship mode function.

## 1.1 Features

This EVM has the following features:

- 1-A Linear battery charger
- I2C Configurable Battery Regulation voltage with 0.5% Accuracy
- Configurable Termination Current down to 0.5 mA
- Programmable thermal charging profile with configurable Hot, Warm, Cool, and Cold thresholds
- Power Path Management for powering the system and charging the battery
- 15-nA shutdown mode for longest shelf life
- One Button Wake-up and Reset Input with Adjustable Timers
- I2C Communication control

See the device datasheet for detailed features and operation of the integrated IC

# 2 EVM Setup

Table 2-1 lists the jumper connections and the jumper description. Table 2-2 lists the recommended operating conditions.

**Table 2-1. Jumper Descriptions**

| Jumper Name | Description |
|---|---|
| J1 | Provides the I2C Pins a pull-up to 3p3V |
| J2 | VIN and GND connector. Input voltage from external power supply. Recommended voltage is 5V and OVP is 5.7V. Max input voltage is 25V while in OVP |
| J3 | VBAT and GND connector. Battery connection using jumper for easy access |
| J4 | Battery Pack Connecctor. Battery connection using JST header |
| J5 | TS potentiometer connector. Connects TS potentiometer to TS pin. Leaving this jumper open will leave the TS pin open. |
| J6 | USB2ANY connector. For connecting the device to the USB2ANY evaluation board to allow computer to interface with the EVM |
| J7 | VIO connector to 3p3V |
| J8, J9 | Board Connector to the other module |
| J10 | /INT connector to 3p3V |
| J11 | I2C Pull-up |
| J14 | Mirco-USB connector (optional for VIN) BQ25180EVM Connections |

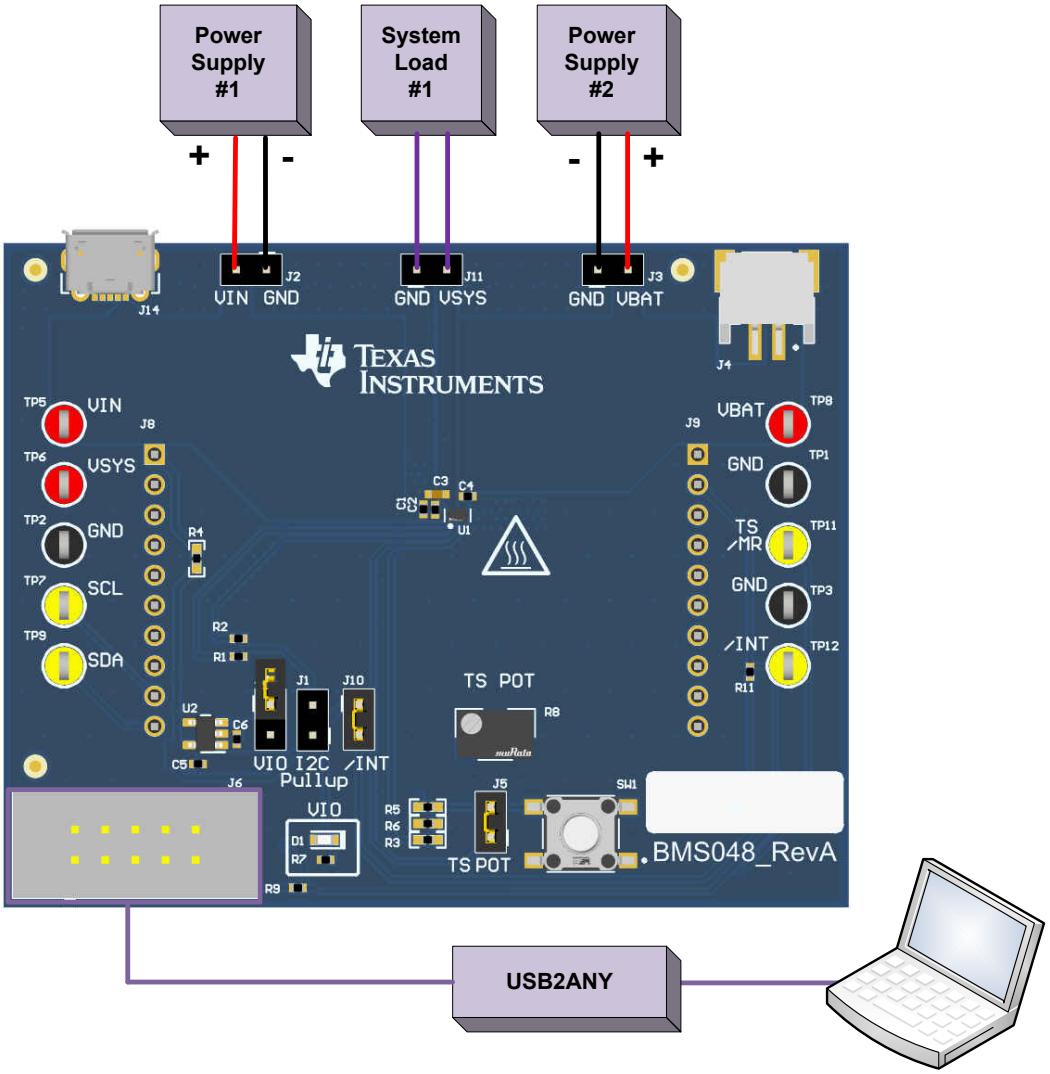



**Table 2-2. Recommended Operating Conditions**

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| VBAT | Battery Voltage Range | 2.2 | | 4.6 | V |
| VIN | Input Voltage Range | 2.7 | | 5.5 | V |
| IIN | Input Current Range (IN to SYS) | | | 1.1 | A |
| IBAT | Battery Discharge Current (BAT to SYS) | | | 1.5 | A |
| TA | Operating Ambient Temperature Range | -40 | | 85 | °C |
| TJ | Operating Junction Temperature Range | -40 | | 125 | °C |

# 3 EVM Connectors and Test Points

Table 3-1 shows the default configuration for connectors.

**Table 3-1. Factory Jumper Settings**

| Jumper Name | Description | Setting |
|---|---|---|
| J1 | I2C Pullup | NA |
| J2 | VIN and GND connector | NA |
| J3 | VBAT and GND connector | NA |
| J4 | Battery Pack Connector | NA |
| J5 | TS Potentiometer Connector | Connected |
| J6 | USB2ANY Connector | NA |
| J7 | VIO Connector to 3p3V. | NA |
| J8, J9 | Board connector to other modules | NA |
| J10 | /INT connector to 3p3V | Connect 3p3V to /INT |
| J11 | VSYS and GND connector | NA |
| J14 | Micro USB connector (optional for VIN) | NA |

**Note**

Connecting the J7 jumper will enable the VIO LED. This LED will draw 10mA.

# 4 Testing Procedures

## 4.1 Equipment

This section includes a list of supplies required to perform tests on this EVM

1. *Two Power Supplies*: Keithley 2400 Powersupply or equivalent
   a. Power Supply #1 (PS #1) will be used as input voltage
   b. Power Supply #2 (PS #2) will be used as battery voltage
2. *4 Channel Oscilloscope*: To monitor voltages at VIN, VBAT, and VSYS
   a. Channel 1 (SC #1) will be used to probe VIN
   b. Channel 2 (SC #2) will be used to probe VBAT
   c. Channel 3 (SC #3) will be used to probe VSYS
3. *Computer:* A computer with at least one USB port and a USB cable
4. *PC communication interface*: USB2ANY with the latest firmware
5. *Software:* Download the TI Charger GUI from Texas Instruments.

## 4.2 Charge Mode

Connect the equipment as the following:

- Power Supply PS#1: VIN of the BQ25180 at 5V
- Power supply PS#2: VBAT of the BQ25180 at 3.7V
- Scope Channel SC#1: VIN
- Scope Channel SC#2: VSYS
- Scope Channel SC#3: VBAT

Turn ON the supply PS#2, then turn ON the supply PS#1. The VSYS will rise to the level of 4.5V. The device will begin to charge as long as the TS is left at default configuration and there are no other faults.

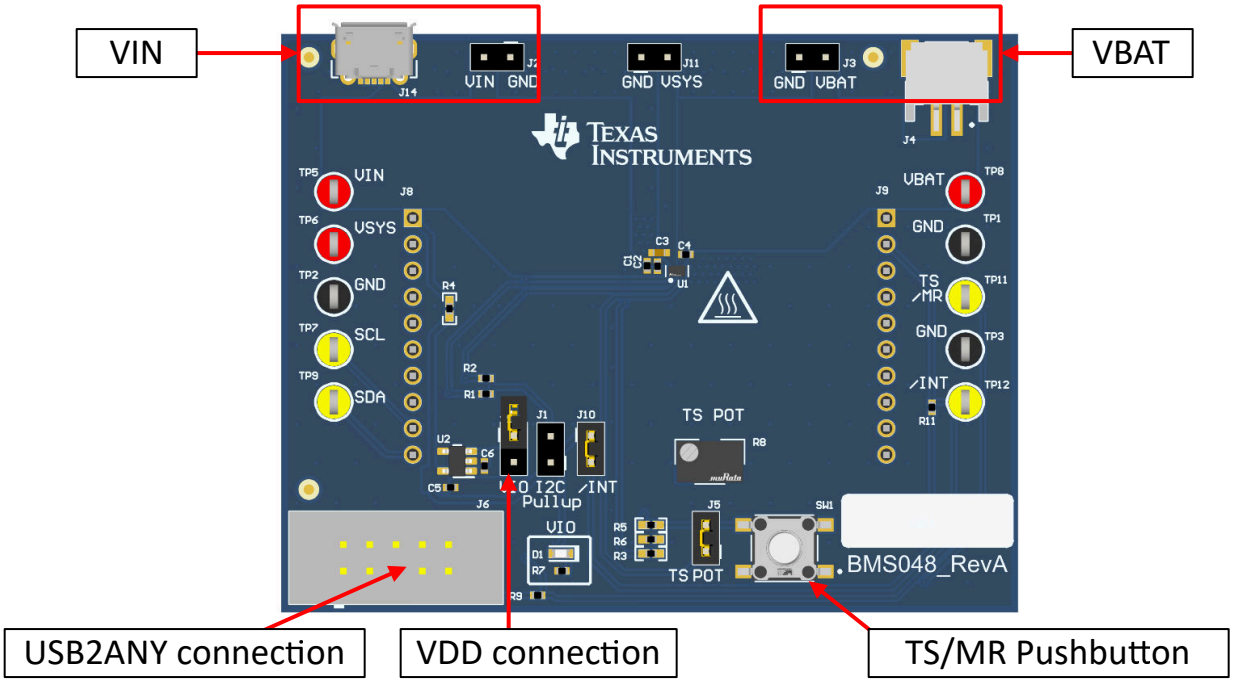



**Figure 4-1. BQ25180 EVM Connections**

To adjust the charge current or change other parameters, connect the USB2ANY to the EVM and then startup TI Charger GUI.

**Note**

If the supplies (VIN and VBAT) are turned off, you will need to restart the TI Charger GUI for correct $I^2C$ transactions to be reflected in the TI Charger GUI

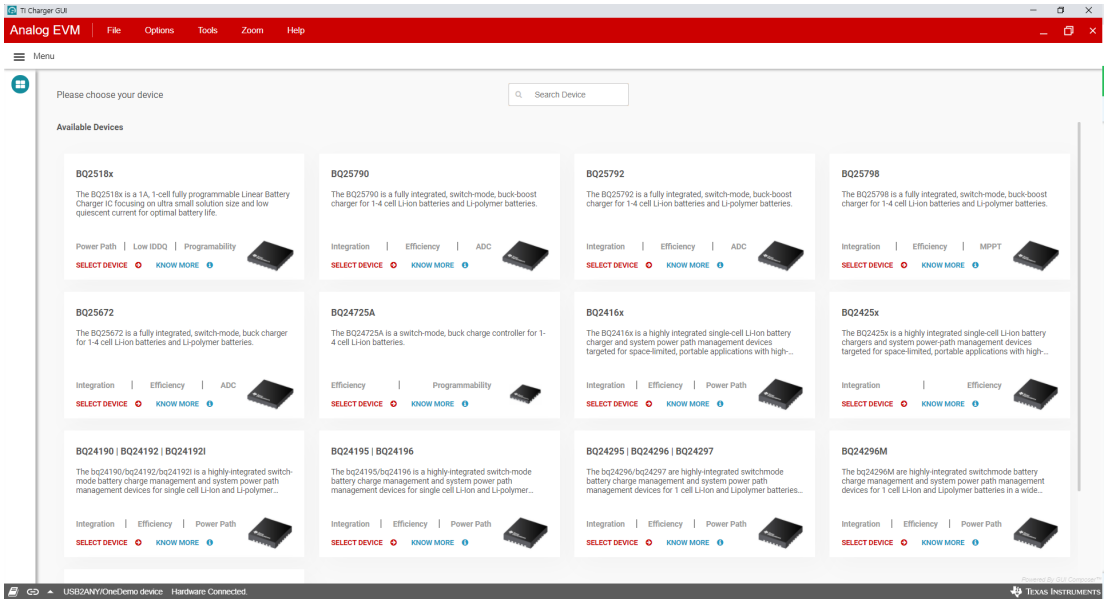



**Figure 4-2. TI Charger GUI Device Selection**

Select the BQ2518X from the charger selection. Click *Quick Start* or *Register Map*.

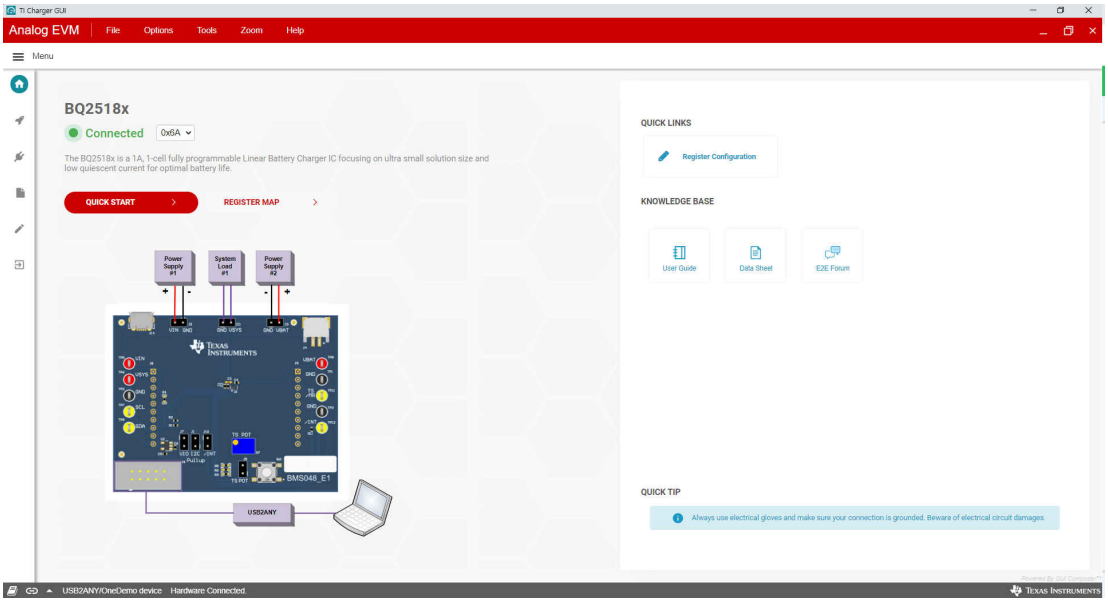



**Figure 4-3. BQ25180EVM Connected**

The Quick Start is shown in Figure 4-4

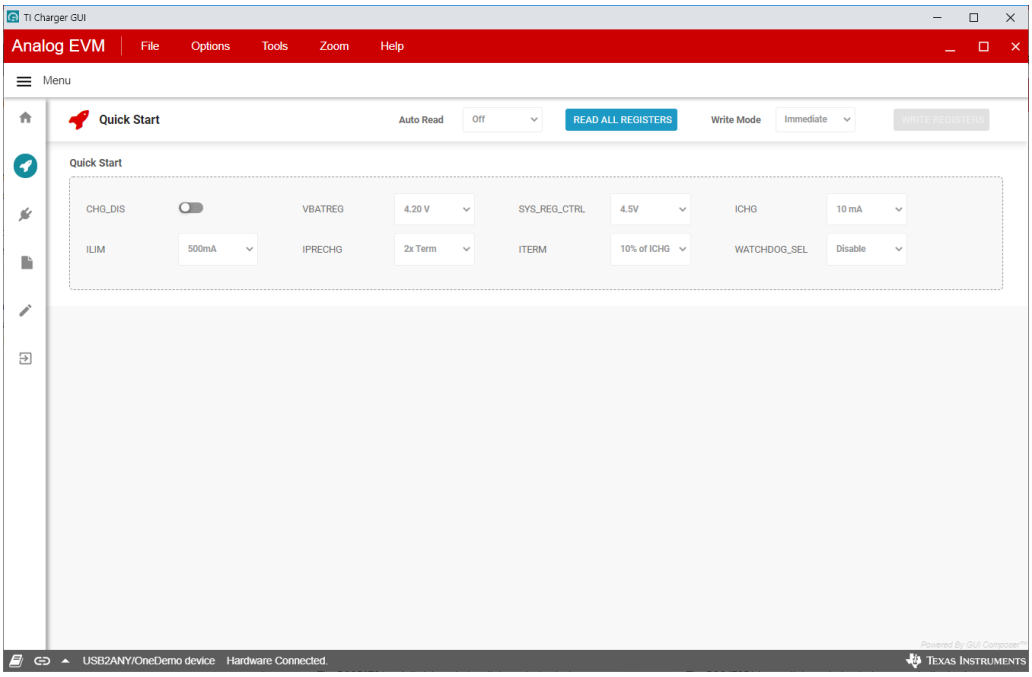



**Figure 4-4. Quick Start**

The register map is shown in Figure 4-5.

Register Map

Auto Read: Off | READ REGISTER | READ ALL REGISTERS

Search Registers by name or address (0x...) | Search Bitfields | Show Bits

| Register Name | Address | Value | Bits 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| **BQ2518x** | | | | | | | | | | |
| STAT0 | 0x00 | 0x01 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| STAT1 | 0x01 | 0x40 | 0 | 1 | - | 0 | 0 | 0 | 0 | 0 |
| FLAG0 | 0x02 | 0x00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| VBAT_CTRL | 0x03 | 0x46 | - | 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| ICHG_CTRL | 0x04 | 0x05 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| CHARGECTRL0 | 0x05 | 0x2C | - | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| CHARGECTRL1 | 0x06 | 0x56 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| IC_CTRL | 0x07 | 0x87 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| TMR_ILIM | 0x08 | 0x4D | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| SHIP_RST | 0x09 | 0x11 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| SYS_REG | 0x0A | 0x40 | 0 | 1 | 0 | - | 0 | 0 | 0 | 0 |
| TS_CONTROL | 0x0B | 0x00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MASK_ID | 0x0C | 0xC0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 4-5. Register Map**

## 4.3 Ship Mode

To go to Ship Mode, enable ship mode through an $I^2C$ transaction to set EN_SHIP_RST bits or the PB_LPRESS_ACTION bits as shown in Figure 4-6:

- EN_RST_SHIP = 2b01 (Enable shipmode with wake on button press or adapter insert)
- PB_PRESS_ACTION = 2b10 (Enable shipmode)

Enter ship mode by removing VIN if setting EN_RST_SHIP to 2b01. If setting PB_LPRESS_ACTION to 2b10 to enable shipmode, hold the TS/MR button for the configured $t_{LPRESS}$ then remove VIN.

You will know you are in Ship Mode as the voltage on the SYS (SC#2) will fall to 0 V.

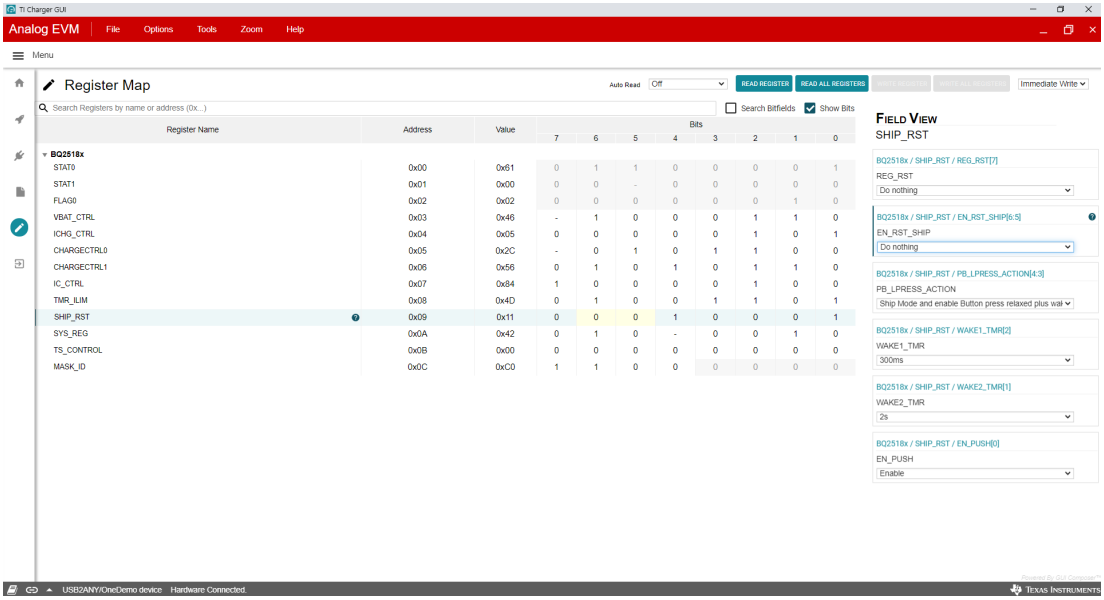



**Figure 4-6. SHIP_RST Register**

# 5 PCB Layouts

Figure 5-1 through Figure 5-6 show the EVM PCB layout images.

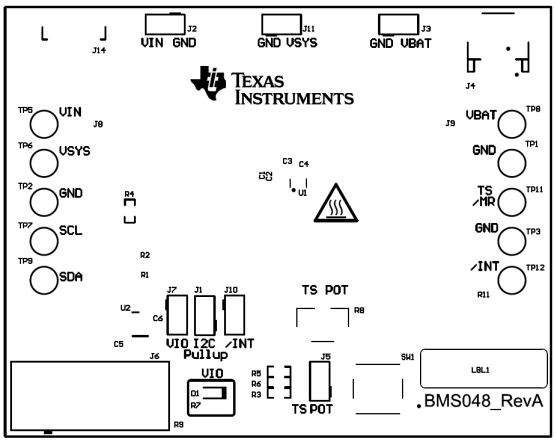



**Figure 5-1. Top Overlay**

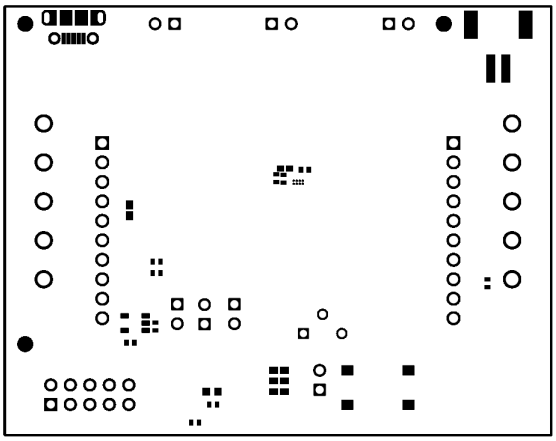


**Figure 5-2. Top Solder**

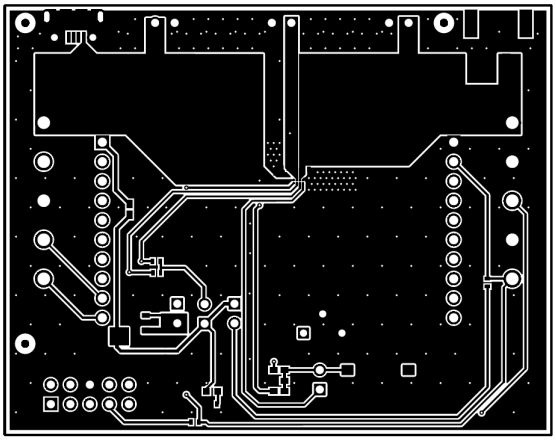


**Figure 5-3. Top Layer**

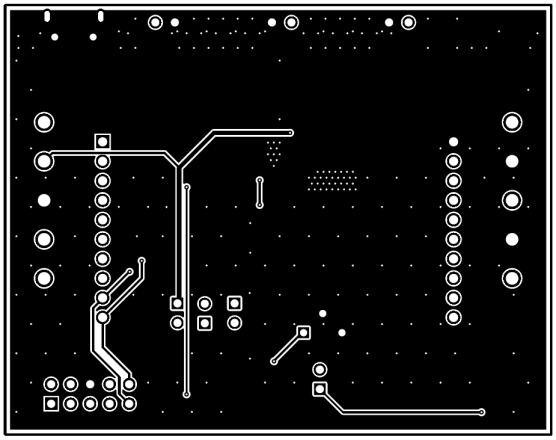


**Figure 5-4. Bottom Layer**

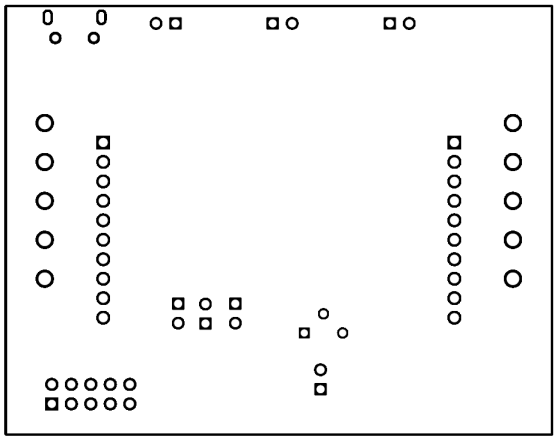


**Figure 5-5. Bottom Solder**

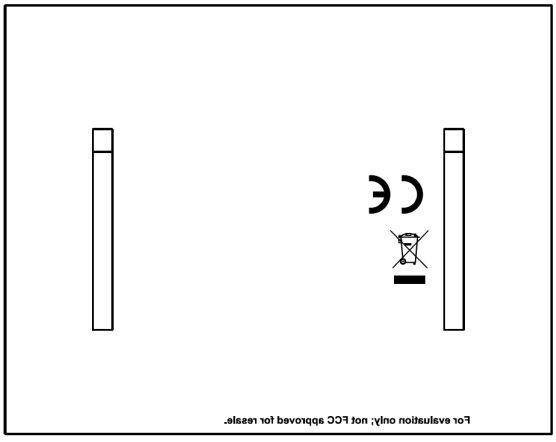



**Figure 5-6. Bottom Overlay**

# 6 Schematic

Figure 6-1 illustrates the EVM schematic.

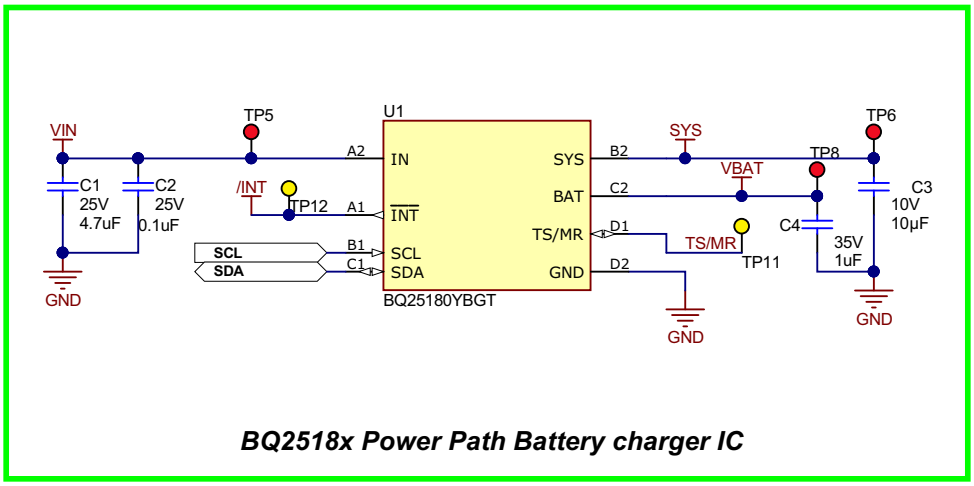
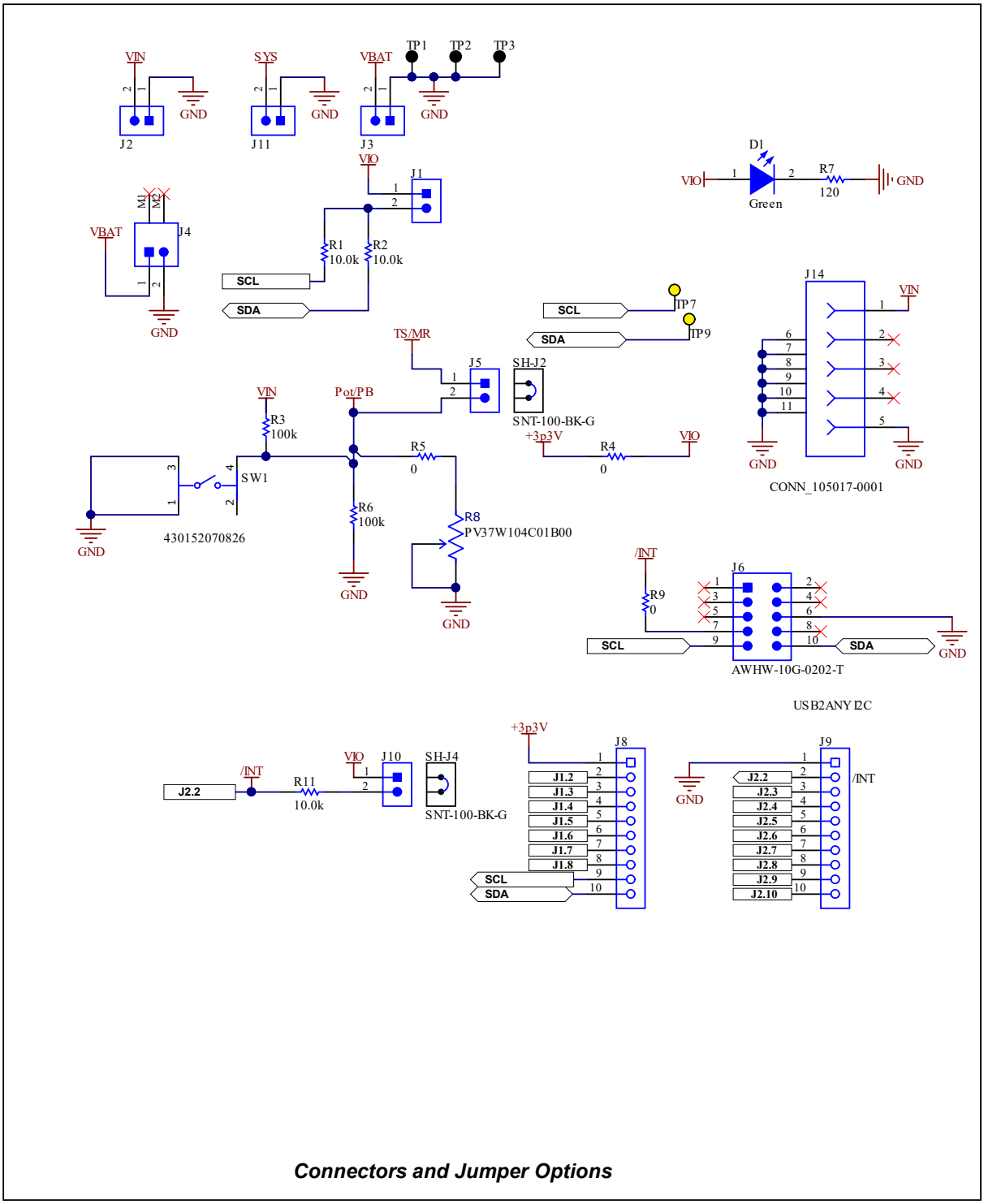



**Figure 6-1. BQ25180EVM Schematic**




***Connectors and Jumper Options***

**Figure 6-2. BQ25180EVM Jumper Connectors**

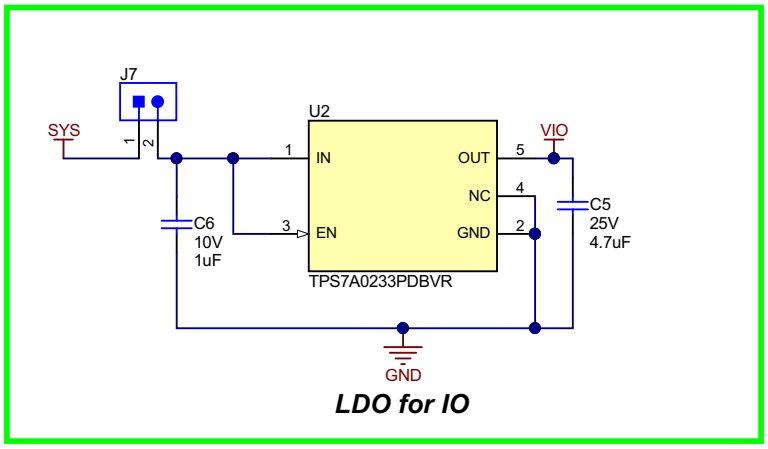



**Figure 6-3. LDO for Other Peripherals**

# 7 Bill of Materials

Table 7-1 lists the EVM bill of materials (BOM).

**Table 7-1. Bill of Materials**

| Designator | Quantity | Value | Description | Package Reference | PartNumber | Manufacturer |
|---|---|---|---|---|---|---|
| !PCB1 | 1 | | Printed Circuit Board | | BMS048 | Any |
| C1, C5 | 2 | 2.2uF | CAP, CERM, 2.2 uF, 25 V, +/- 10%, X5R, 0402 | 0402 | GRM155R61E225KE11D | MuRata |
| C2 | 1 | 0.1uF | CAP, CERM, 0.1 uF, 25 V, +/- 10%, X5R, 0402 | 0402 | GRM155R61E104KA87D | MuRata |
| C3 | 1 | 10uF | CAP, CERM, 10 µF, 10 V,+/- 20%, X5R, 0402 | 0402 | CL05A106MP8NUB8 | Samsung Electro-Mechanics |
| C4 | 1 | 1uF | CAP, CERM, 1 uF, 35 V, +/- 10%, JB, 0402 | 0402 | C1005JB1V105K050BC | TDK |
| C6 | 1 | 1uF | CAP, CERM, 1 uF, 10 V, +/- 10%, X5R, 0402 | 0402 | GRM155R61A105KE15D | MuRata |
| D1 | 1 | Green | LED, Green, SMD | 1.6x0.8x0.8mm | LTST-C190GKT | Lite-On |
| J1, J2, J3, J5, J7, J10, J11 | 7 | | Header, 100mil, 2x1, Tin, TH | Header, 2 PIN, 100mil, Tin | PEC02SAAN | Sullins Connector Solutions |
| J4 | 1 | | Header (shrouded), 2mm, 2x1, R/A, SMT | Header, 2x1, 2mm, R/A | S2B-PH-SM4-TB(LF)(SN) | JST Manufacturing |
| J6 | 1 | | Header(Shrouded), 2.54mm, 5x2, Gold, TH | Header, 2.54mm, 5x2, TH | AWHW-10G-0202-T | Assman WSW |
| J8, J9 | 2 | | Connector, Receptacle, 100mil, 10x1, Gold plated, TH | 10x1 Receptacle | SSW-110-23-F-S | Samtec |
| J14 | 1 | | Connector, Receptacle, Micro-USB Type B, R/A, Bottom Mount SMT | Micro USB receptacle | 105017-0001 | Molex |
| LBL1 | 1 | | Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll | PCB Label 0.650 x 0.200 inch | THT-14-423-10 | Brady |
| R1, R2, R11 | 3 | 10.0k | RES, 10.0 k, 1%, 0.063 W, 0402 | 0402 | RC0402FR-0710KL | Yageo America |

**Table 7-1. Bill of Materials (continued)**

| Designator | Quantity | Value | Description | Package Reference | PartNumber | Manufacturer |
|---|---|---|---|---|---|---|
| R5 | 1 | 0 | RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402 | 0402 | ERJ-2GE0R00X | Panasonic |
| R6 | 1 | 100k | RES, 100 k, 1%, 0.0625 W, AEC-Q200 Grade 0, 0402 | 0402 | AC0402FR-07100KL | Yageo America |
| R7 | 1 | 120 | RES, 120, 5%, 0.063 W, 0402 | 0402 | CRCW0402120RJNED | Vishay-Dale |
| R8 | 1 | 100kΩ | 12-Turn Through Hole Trimmer Resistor with Pin Terminations, 10% 1/4W 150ppm/C | PTH_POT_6MM4_4MM0 | PV37W104C01B00 | Murata |
| R9 | 1 | 0 | RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402 | 0402 | CRCW04020000Z0ED | Vishay-Dale |
| SH-J2, SH-J3, SH-J4 | 3 | 1x2 | Shunt, 100mil, Gold plated, Black | Shunt | SNT-100-BK-G | Samtec |
| SW1 | 1 | | Tactile Switch SPST-NO Top Actuated Surface Mount | SMT_TACT | 430152070826 | Wurth Electronics |
| TP1, TP2, TP3 | 3 | | Test Point, Multipurpose, Black, TH | Black Multipurpose Testpoint | 5011 | Keystone |
| TP5, TP6, TP8 | 3 | | Test Point, Multipurpose, Red, TH | Red Multipurpose Testpoint | 5010 | Keystone |
| TP7, TP9, TP11, TP12 | 4 | | Test Point, Multipurpose, Yellow, TH | Yellow Multipurpose Testpoint | 5014 | Keystone |
| U1 | 1 | | 1-Cell I2C/Standalone Linear Charger with Power Path, Regulated System Output and Push-Button Controller | DSBGA8 | BQ25180YBGT | Texas Instruments |
| U2 | 1 | | 1-uA IQ, 200-mA, Ultralow IQ Low-Dropout Regulator, DBV0005A (SOT-23-5) | DBV0005A | TPS7A0233PDBVR | Texas Instruments |
| FID1, FID2, FID3 | 0 | | Fiducial mark. There is nothing to buy or mount. | N/A | N/A | N/A |

**Table 7-1. Bill of Materials (continued)**

| Designator | Quantity | Value | Description | Package Reference | PartNumber | Manufacturer |
|---|---|---|---|---|---|---|
| R3 | 0 | 100k | RES, 100 k, 1%, 0.0625 W, AEC-Q200 Grade 0, 0402 | 0402 | AC0402FR-07100KL | Yageo America |
| R4 | 0 | 0 | RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402 | 0402 | ERJ-2GE0R00X | Panasonic |

# 8 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision A (January 2022) to Revision B (February 2022) | Page |
|---|---|
| • Added Hot Surface Warning | 3 |

| Changes from Revision * (August 2021) to Revision A (January 2022) | Page |
|---|---|
| • Production release of EVM user's guide | 1 |

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