

## **BQ2515xEVM Evaluation Module**

This user's guide provides detailed testing instructions for the BQ2515x 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 abbreviations *EVM*, *BQ2515xEVM*, and the term *evaluation module* are synonymous with the BQ2515x evaluation module, unless otherwise noted.

### **Contents**

1	Introduction .....	2
	1.1 EVM Features .....	2
	1.2 I/O Descriptions .....	2
2	Test Summary .....	4
	2.1 Equipment .....	4
	2.2 Charge Mode .....	5
	2.3 Ship Mode .....	6
	2.4 Warning .....	6
	2.5 Comparison Table .....	6
3	Board Layouts, Schematics, and Bill of Materials .....	7
	3.1 Board Layouts .....	7
	3.2 Schematics .....	12
	3.3 Bill of Materials .....	15

### **List of Figures**

1	BQ2515xEVM Connections .....	3
2	Connections for Test Setup .....	5
3	BQStudio Software Tool .....	6
4	Top Overlay .....	7
5	Top Layer .....	7
6	Signal Layer 1 .....	8
7	Signal Layer 2 .....	8
8	Bottom Layer .....	9
9	Bottom Overlay .....	9
10	Top Solder Mask .....	10
11	Bottom Solder Mask .....	10
12	Drill Drawing .....	11
13	Board Dimensions .....	11
14	BQ2515xEVM Schematic .....	12
15	BQ2515xEVM Jumper Connectors .....	13
16	BQ2515xEVM Interface Connector .....	13
17	User Menu Switches .....	14
18	LDO for Display/Other Peripherals .....	14

### **List of Tables**

1	Device Data Sheet .....	2
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2	Jumper Connections .....	2
3	Recommended Operating Conditions.....	3
4	Comparison Table .....	6
5	Bill of Materials .....	15

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## 1 Introduction

The BQ2515xEVM is an evaluation kit for the BQ2515x integrated battery charge management IC. The BQ2515x is an integrated battery charge management IC that integrates the most common functions for wearable devices: Linear charger, regulated output/ load switch, manual reset with timer, ADC and ship mode function.

### 1.1 EVM Features

Key features of this EVM include:

- 500mA Linear battery charger
- I2C Configurable Battery Regulation Voltage with 0.5% Accuracy
- Configurable Termination Current down to 0.5mA
- Programmable thermal charging profile with configurable Hot, Warm, Cool and Cold thresholds
- Power Path Management for powering the system and charging the battery
- 10nA Ship Mode battery Iddq for longest shelf life
- One I2C Configurable Load Switch or 150mA LDO Output
- One Button Wake-up and Reset Input with Adjustable Timers
- ADC Monitoring of Input voltage, Battery voltage, Charge current, Battery Thermistor
- I2C Communication Control

See the device data sheet ([SLUSD04](#)) for detailed features and operation of the integrated circuit (IC).

**Table 1. Device Data Sheet**

Device	Data Sheet
BQ25150	<a href="#">SLUSD04</a>
BQ25155	<a href="#">SLUSDO1</a>

### 1.2 I/O Descriptions

[Table 2](#) lists the jumper connections available on this EVM.

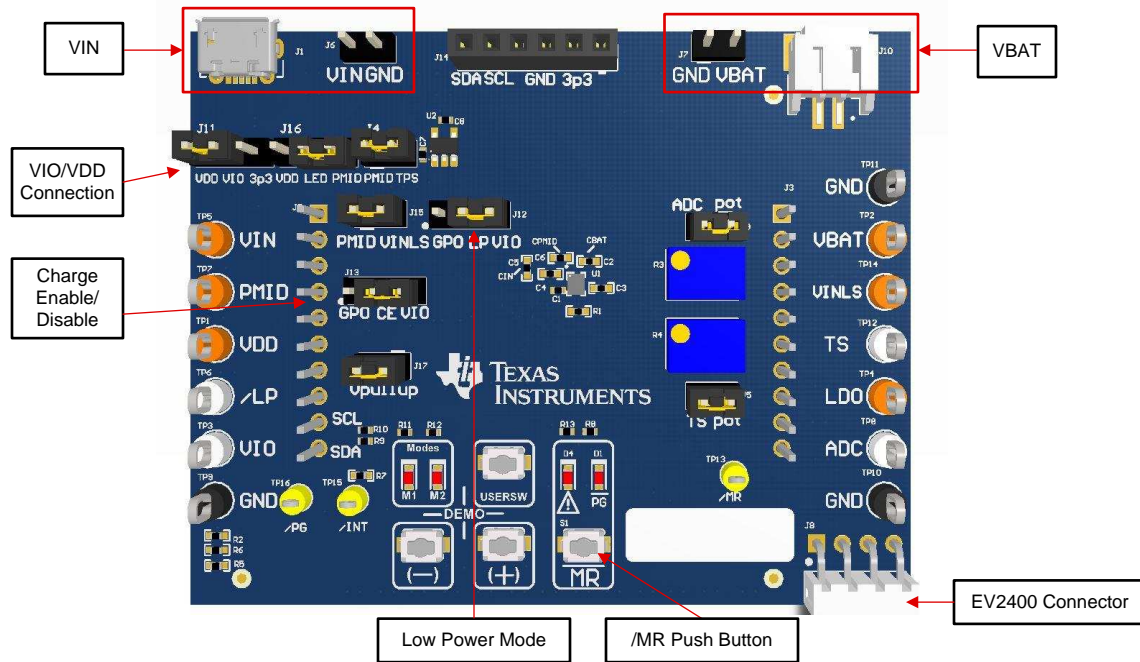
**Table 2. Jumper Connections**

Jumper Name	Description	Setting
J1	Micro USB connector (optional for VIN)	NA
J2, J3	Board connector to other modules	NA
J4	External LDO ON	Not Connected
J5	TS potentiometer connector	Connected
J6	VIN and GND connector	NA
J7	VBAT and GND connector	NA
J8	EV2400 Connector	NA
J9	ADC potentiometer connector	Connected
J10	Battery Pack Connector	NA

**Table 2. Jumper Connections (continued)**

J11	VIO connector to VDD or 3p3V	Connect VDD to VIO
J12	/LP connector to GPIO or VIO	Connect /LP to VIO
J13	/CE connector to GPIO or VIO	Connect /CE to VIO
J14	Display connector for other modules	NA
J15	PMID to VINLS connector	Connected
J16	On board LED pullup to VDD or PMID	Connected to PMID
J17	I2C Pullup	Connected

Table 3 lists the recommended operating conditions for this EVM.



**Figure 1. BQ2515xEVM Connections**

**Table 3. Recommended Operating Conditions**

Symbol	Description	MIN	TYP	MAX	Unit
Supply voltage, $V_{VBUS}$	Input voltage from AC adapter		5	20	V
Battery voltage, $V_{BAT}$ in charge mode	Voltage applied at $V_{BAT}$ terminal		4.2		V
$I_{BAT}$	Fast charging current		0.5		A
	Discharging current through internal MOSFET		1		A
Supply current, $I_{IN}$	Maximum input current from AC adapter input		0.6		A

## 2 Test Summary

### 2.1 Equipment

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

1. *Powersupply (PS#1), Powersupply (PS#2)*: Keithley 2400 Powersupply or equivalent
2. *SC#1- SC#3*: 4 channel Oscilloscope
3. *Computer*: A computer with at least one USB port and a USB cable
4. *PC communication interface*:
5. *Software*: Download [bqStudio](#) from Texas Instruments  
Double click the *Battery management studio* installation file and then follow the installation steps. The software supports Microsoft® Windows® 7 and Windows 10 operating systems.

## 2.2 Charge Mode

Connect the equipment as following:

Power supply PS#1: VIN of the BQ2515x at 5V

Power supply PS#2: VBAT of the BQ2515x at 3.7V

Scope channel SC#1: VIN

Scope channel SC#2: VPMID

Scope channel SC#3: VBAT

Turn ON the supply PS#2, then turn ON the supply PS#1. The VPMID will rise to the level of VIN. The device will begin to charge as long as /CE pin jumper (J13 being pulled off will result in the pulldown internal to the device, charge enabled), the TS is left at default configuration and there are no other faults.

To adjust the charge current or change other parameters, connect the EV2400 to the EVM and then startup BQStudio.

Select the Charger\_1\_00-bq25150.bqz from the Charger selection for the BQ25150EVM or charger\_1\_00-bq25155.bqz from the charger selection for the BQ25155EVM. Click "Read Register" to read all the registers and navigate to the Field View to make changes.

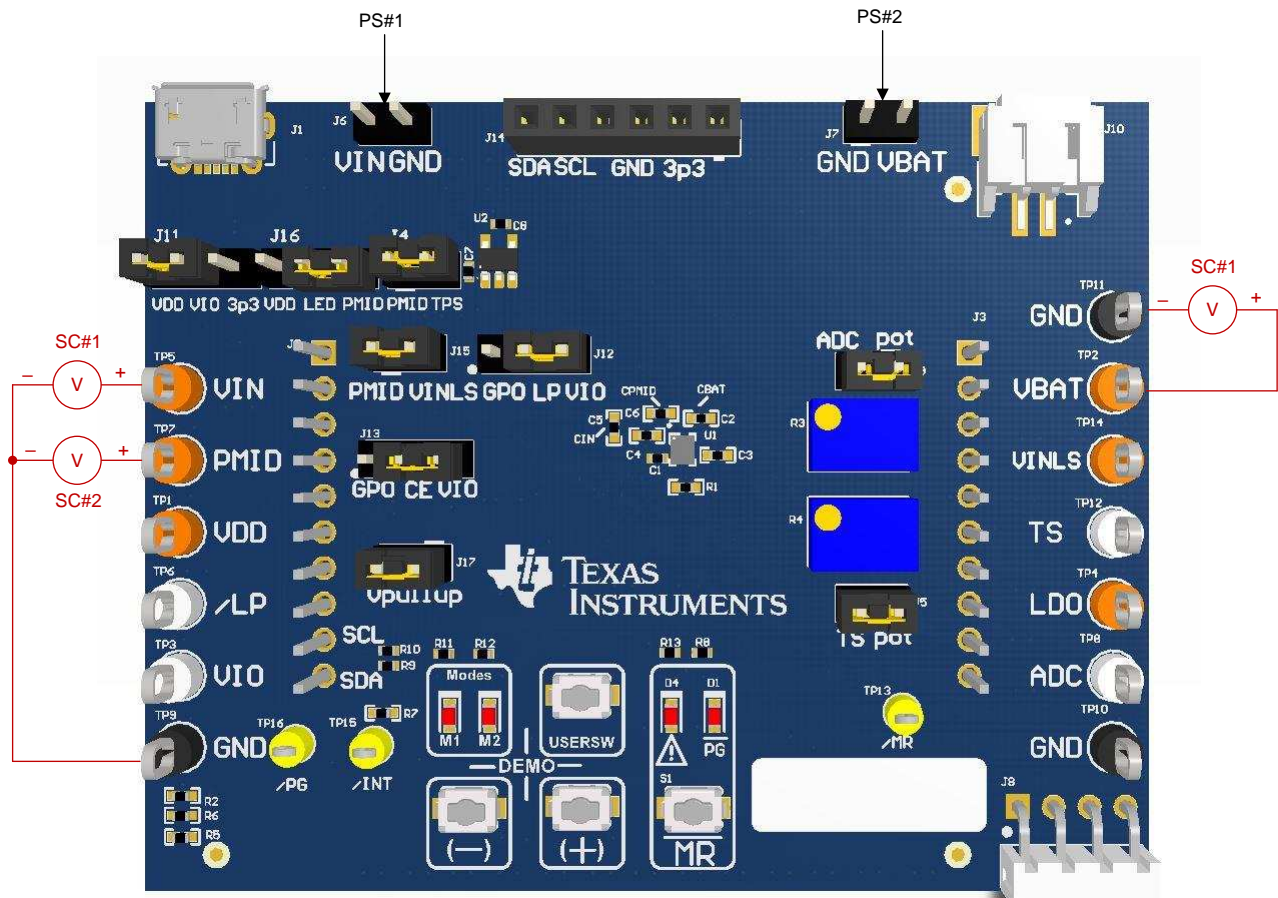


Figure 2. Connections for Test Setup

### 2.3 Ship Mode

To go to Ship Mode, turn OFF VIN (PS#1). Make sure /LP pin is connected to VIO(J12) and VIO is connected to VDD through J11. Read all the registers and click the Shipmode Enable checkbox (Bit B7 on register 0x35) to go to Ship Mode. You can know that you are in Ship Mode as the voltage on PMID (SC#2) will fall to 0V.

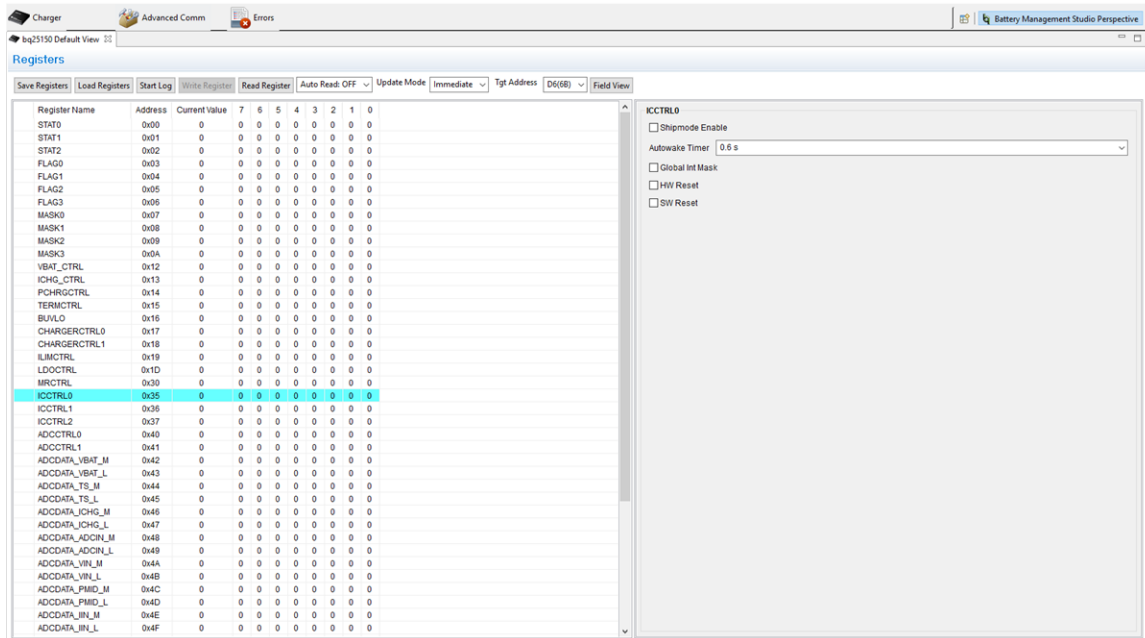


Figure 3. BQStudio Software Tool

### 2.4 Warning

The warning label indicates when there is a fault during communication with the MCU.

### 2.5 Comparison Table

Refer to the data sheet for detailed information on register defaults.

Table 4. Comparison Table

	BQ25150	BQ25155
Default PMID voltage when adapter is present	VIN level	4.5 V (can be adjusted through I2C)
Input current limit default	100 mA	500 mA
VINDPM	Enabled	Disabled
Warm battery discharge	Yes (up to 5 mA)	Yes (up to 20 mA)
IMAX limiting	Yes	No, saves area
Wake from Shipmode timer	2s	125 ms
VINUVLO (battery present)	3.4 V	3.15 V
Device ID	0x20	0x35

### 3 Board Layouts, Schematics, and Bill of Materials

#### 3.1 Board Layouts

Figure 4 through Figure 12 show the PCB board layouts.

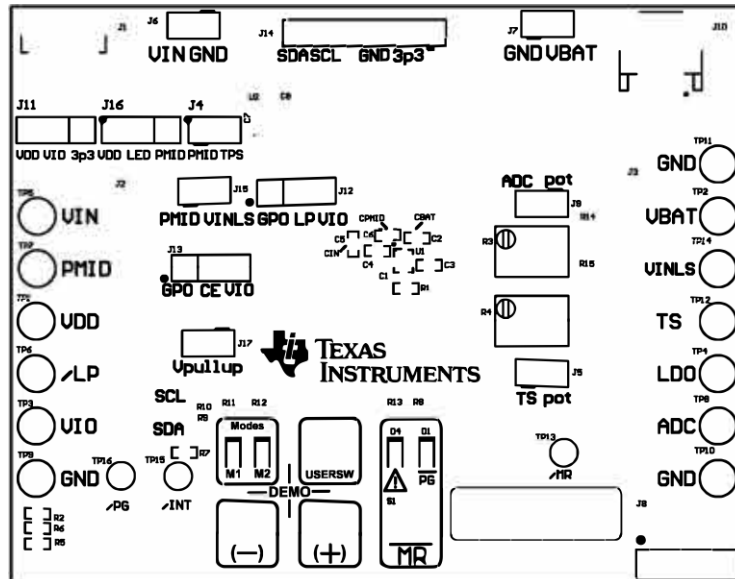


Figure 4. Top Overlay

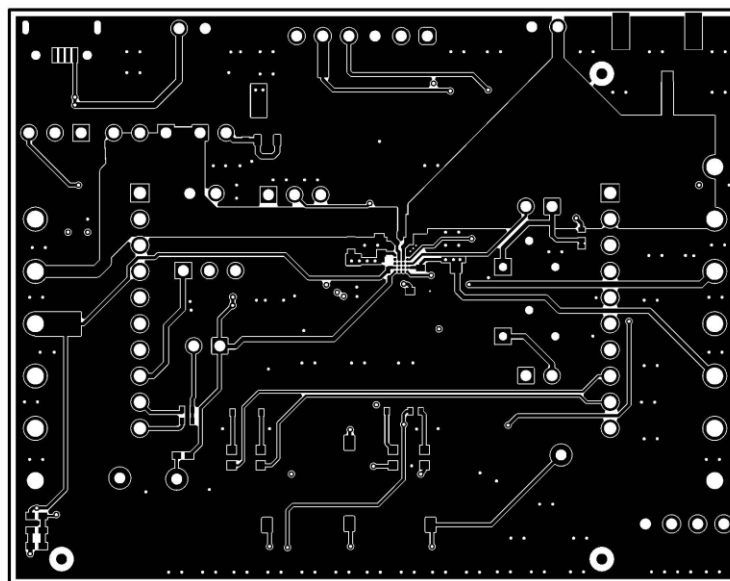


Figure 5. Top Layer

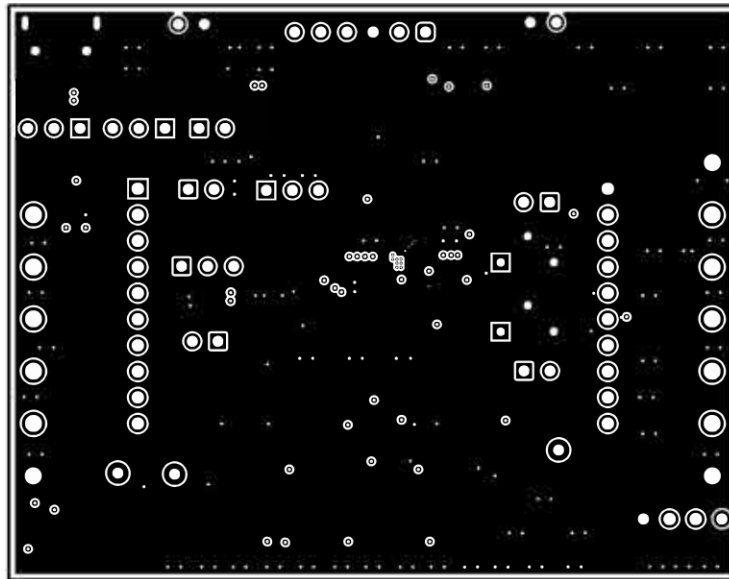


Figure 6. Signal Layer 1

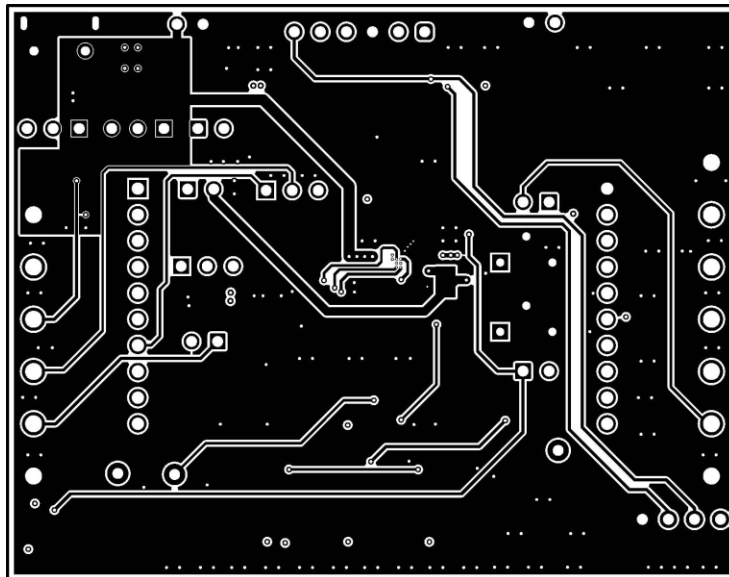


Figure 7. Signal Layer 2



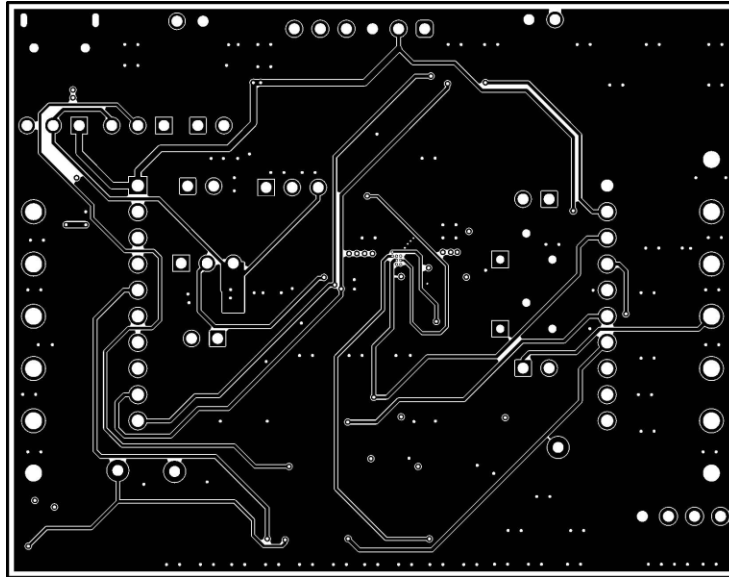


Figure 8. Bottom Layer

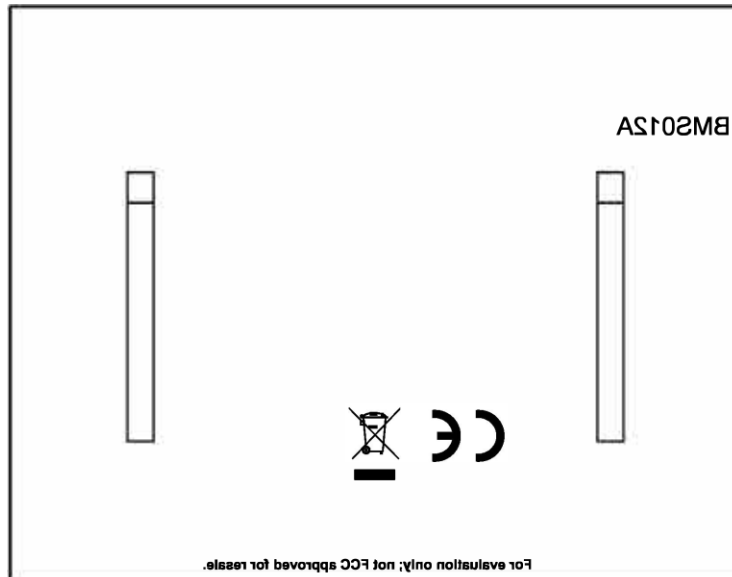


Figure 9. Bottom Overlay

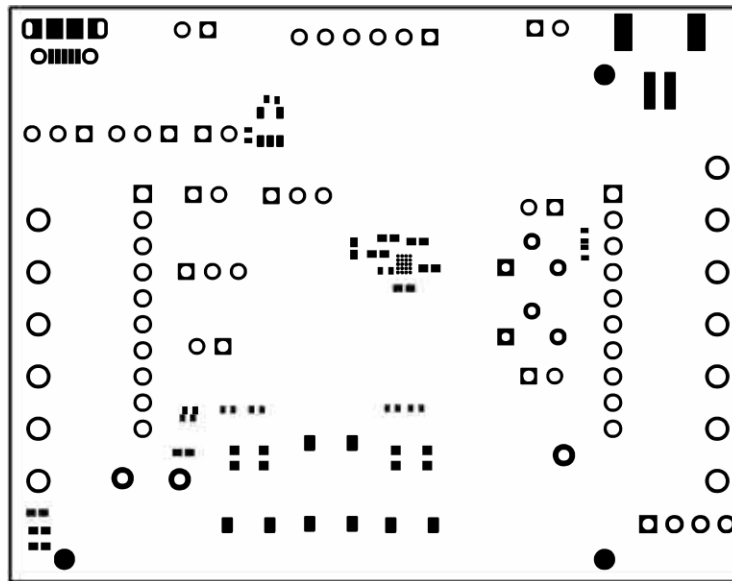


Figure 10. Top Solder Mask

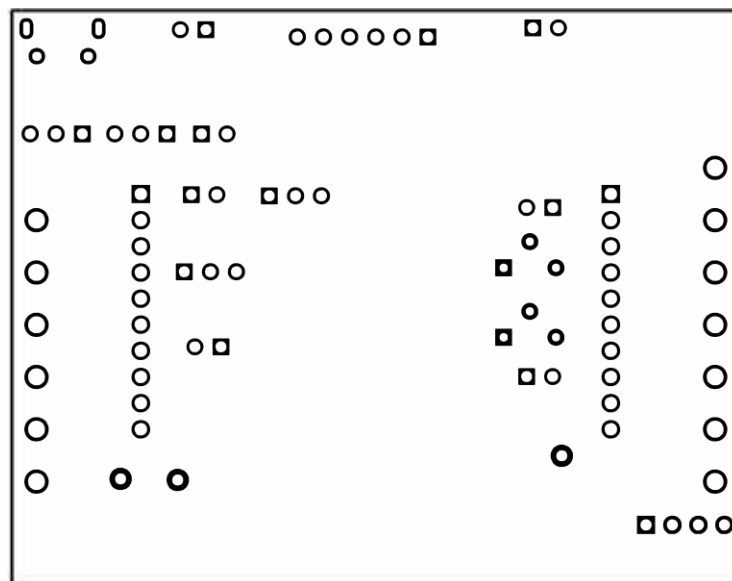


Figure 11. Bottom Solder Mask

Symbol	Count	Hole Size	Plated	Hole Type	Drill Layer Pair	Uia/Pad	Pad Shape	Template	Description	Hole Tolerance (+)	Hole Tolerance (-)	Hole Length	Routed Path Length
∅	2	23.42mil (0.600mm)	PTH	Slot	Top Layer - Bottom Layer Pad		Rounded	r190_120hd0_130-100				51.18mil (1.300mm)	27.56mil (0.700mm)
∅	2	23.47mil (0.595mm)	PTH	Round	Top Layer - Bottom Layer Pad		Rounded	c149hd				-	-
∅	4	40.16mil (1.020mm)	PTH	Round	Top Layer - Bottom Layer Pad		(filxvd)	(filxvd)				-	-
∅	6	29.53mil (0.750mm)	PTH	Round	Top Layer - Bottom Layer Pad		(filxvd)	(filxvd)				-	-
∅	6	40.16mil (1.020mm)	PTH	Round	Top Layer - Bottom Layer Pad		(filxvd)	(filxvd)		1.97mil (0.050mm)	1.97mil (0.050mm)	-	-
∅	13	6.00mil (0.152mm)	PTH	Round	Top Layer - Bottom Layer Uia		Rounded	(filxvd)				-	-
∅	13	63.00mil (1.600mm)	PTH	Round	Top Layer - Bottom Layer Pad		Rounded	c221hd0				-	-
∅	20	45.28mil (1.150mm)	PTH	Round	Top Layer - Bottom Layer Pad		(filxvd)	(filxvd)				-	-
∅	29	40.00mil (1.016mm)	PTH	Round	Top Layer - Bottom Layer Pad		(filxvd)	(filxvd)				-	-
∅	189	10.00mil (0.254mm)	PTH	Round	Top Layer - Bottom Layer Uia		Rounded	(filxvd)				-	-
	284	Total											

Slot definition: Routed Path Length = Calculated from tool start centre position to tool end centre position.  
Hole Length = Routed Path Length + Tool Size + Slot length as defined in the PCB layout.

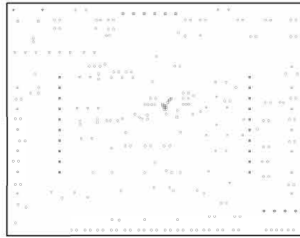


Figure 12. Drill Drawing



Figure 13. Board Dimensions

### 3.2 Schematics

Figure 14 and Figure 16 show the schematics for the BQ2515x EVM.

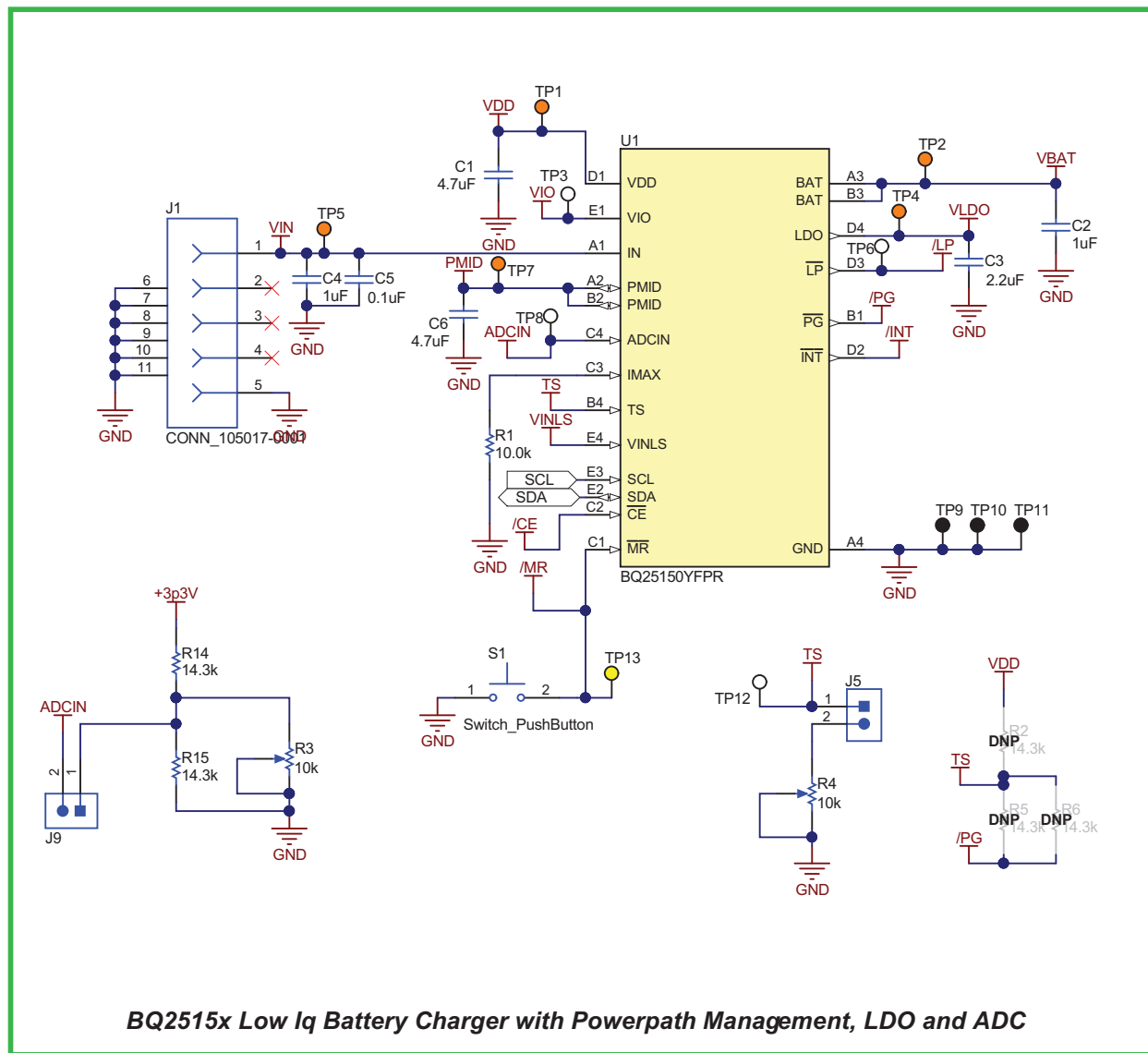


Figure 14. BQ2515xEVM Schematic

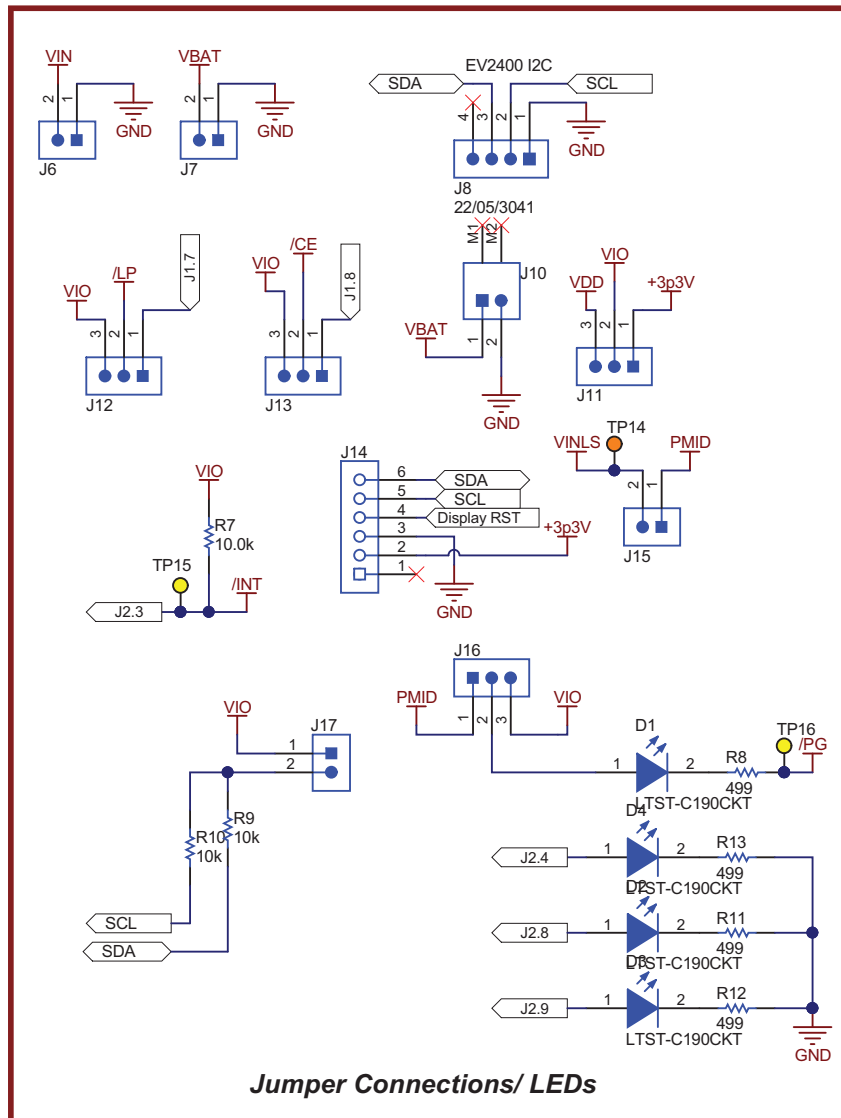


Figure 15. BQ2515xEVM Jumper Connectors

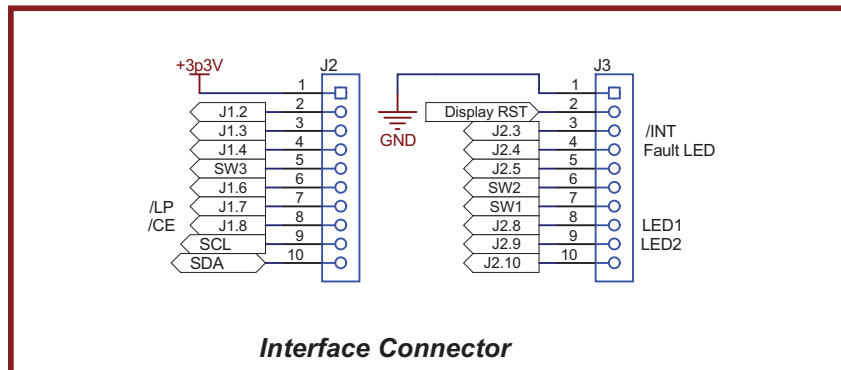
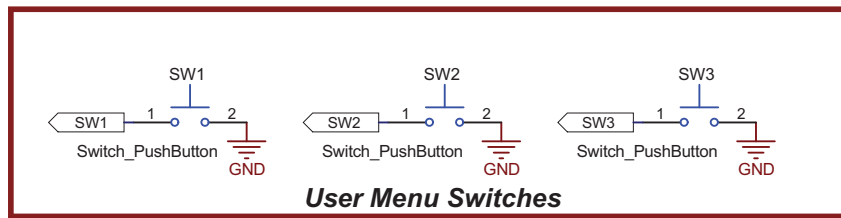
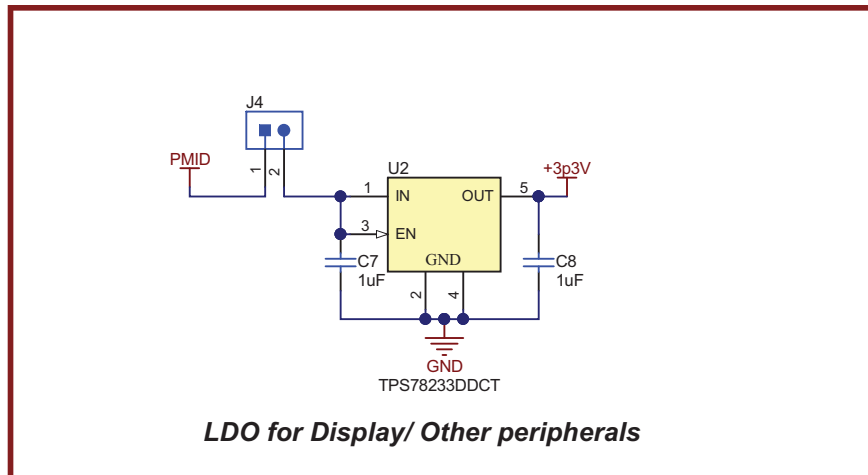


Figure 16. BQ2515xEVM Interface Connector



**Figure 17. User Menu Switches**



**Figure 18. LDO for Display/Other Peripherals**

### 3.3 Bill of Materials

The bill of materials is shown in the following table.

**Table 5. Bill of Materials**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number <sup>(1)</sup>	Alternate Manufacturer <sup>(1)</sup>
C1,	1	4.7uF	CAP, CERM, 4.7 $\mu$ F, 10 V, +/-20%, X5R, 0402	0402	GRM155R61A475MEAAD	MuRata		
C2, C4, C7, C8	4	1uF	CAP, CERM, 1 $\mu$ F, 25 V, +/-10%, X5R, 0402	0402	C1005X5R1E105K050BC	TDK		
C3	1	2.2uF	CAP, CERM, 2.2 $\mu$ F, 10 V, +/-10%, X7S, 0402	0402	C1005X7S1A225K050BC	TDK		
C5	1	0.1uF	CAP, CERM, 0.1 $\mu$ F, 25 V, +/-10%, X7R, 0402	0402	GRM155R71E104KE14D	MuRata		
C6 (BQ25150EVM)	1	4.7uF	CAP, CERM, 4.7 $\mu$ F, 10 V, +/-20%, X5R, 0402	0402	GRM155R61A475MEAAD	MuRata		
C6 (BQ25155EVM)	1	10uF	CAP, CERM, 10 $\mu$ F, 10 V, +/-20%, X5R, 0402	0402	0402ZD106MAT2A	AVX		
D1, D2, D3, D4	4	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	LTST-C190CKT	Lite-On		
J1	1		Receptacle, Micro-USB-B, Right Angle, SMD	Micro USB receptacle	105017-0001	Molex		
J2, J3	2		Connector, Receptacle, 100mil, 10x1, Gold plated, TH	10x1 Receptacle	SSW-110-23-F-S	Samtec		
J4, J5, J6, J7, J9, J15, J17	7		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
J8	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex		
J10	1		Header (shrouded), 2mm, 2x1, R/A, SMT	Header, 2x1, 2mm, R/A	S2B-PH-SM4-TB(LF)(SN)	JST Manufacturing		
J11, J12, J13, J16	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J14	1		Receptacle, 2.54mm, 6x1, Gold, TH	Receptacle, 2.54mm, 6x1, Gold, TH	PPPC061LFBN-RC	Sullins Connector Solutions		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650" x 0.200" W	THT-14-423-10	Brady	-	-

<sup>(1)</sup> Unless otherwise noted in the Alternate PartNumber and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.

**Table 5. Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number <sup>(1)</sup>	Alternate Manufacturer <sup>(1)</sup>
R1, R7	2	10.0k $\Omega$	RES, 10.0 k, 1%, 0.2 W, AEC-Q200 Grade 0, 0402	0402	ERJPA2F1002X	Panasonic		
R3, R4	2	10k $\Omega$	Trimmer, 10k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-103LF	Bourns		
R8, R11, R12, R13	4	499 $\Omega$	RES, 499, 1%, 0.063 W, 0402	0402	CRCW0402499RFKED	Vishay-Dale		
R9, R10	2	10k $\Omega$	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale		
S1, SW1, SW2, SW3	4		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9	9	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M
TP1, TP2, TP4, TP5, TP7, TP14	6		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone		
TP3, TP6, TP8, TP12	4		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone		
TP9, TP10, TP11	3		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		
TP13, TP15, TP16	3		Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone		
U1 (BQ25150EVM)	1		BQ25150YFP, YFP0020ACAC (DSBGA-20)	YFP0020ACAC	BQ25150YFPR	Texas Instruments	BQ25150YFPT	Texas Instruments
U1 (BQ25155EVM)	1		BQ25155, YFP0020ACAC (DSBGA-20)	YFP0020ACAC	BQ25155YFPR	Texas Instruments	BQ25155YFPT	Texas Instruments
U2	1		Single Output LDO, 150 mA, Fixed 3.3 V Output, 2.2 to 5.5 V Input, with 0.5 uA Quiescent Current, 5-pin SOT (DDC), -40 to 125 degC, Green (RoHS and no Sb/Br)	DDC0005A	TPS78233DDCT	Texas Instruments		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
R2, R5, R6	0	14.3k	RES, 14.3 k, 1%, 0.063 W, 0402	0402	CRCW040214K3FKED	Vishay-Dale		





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