

EVM User's Guide: TPS61383QEV-167

TPS61383-Q1 Evaluation Module



Description

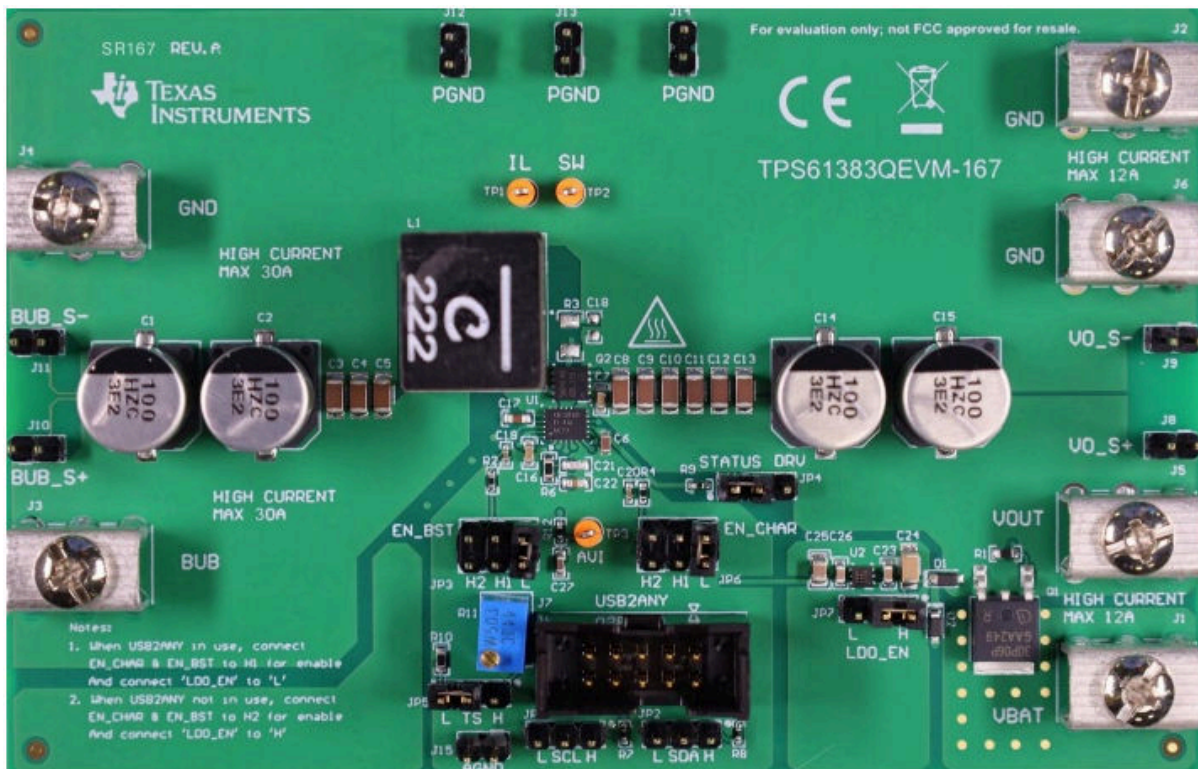
The TPS61383QEV-167 operates over a wide backup battery voltage range from 0V to 12V and main battery (VBAT port) voltage range from 0V to 40V to achieve a bi-directional operation. The EVM supports an output up to 7.5A load at 6V BUB and 12V output in boost mode, and supports from 50mA to 5A charging current in charger mode. The TPS61383QEV-167 supports 2.5% output voltage regulation accuracy in boost mode and 1% voltage accuracy in charger mode. The device functions are adjustable using the I2C interface.

Features

- Back-up battery (BUB) voltage in boost mode: 0.5V to 12V, 3V minimum voltage for start up
- Support absolute maximum (VOUT pin) up to 40V
- Boost output voltage: up to 12V
- Fault or operation status indication by STATUS pin and I2C
- Backup battery State-of-Health (SOH) detection
- Frequency: 400kHz for automotive applications

Applications

- [Emergency call \(eCall\)](#)
- [Door handle module](#)
- [Fault indicator \(FI\)](#)



TPS61383QEV-167

1 Evaluation Module Overview

1.1 Introduction

The TPS61383-Q1 is a 40V, 30A, bi-directional boost converter and buck charger that integrates battery state of health detection function. This user's guide describes the characteristics, operation, and the use of the TPS61383-Q1 evaluation module (EVM). The EVM contains the TPS61383-Q1, bi-directional boost converter with integrated charger, boost and state of health (SOH) detection function. The user's guide includes EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

1.2 Kit Contents

- One EVM to evaluate TPS61383-Q1
- EVM disclaimer Read Me

1.3 Specification

A summary of the TPS61383QEVM-167 performance specifications is provided in [Table 1-1](#). The ambient temperature is 25°C for all measurement, unless otherwise noted.

Table 1-1. Boost Mode Performance Specification Summary

PARAMETER	TEST CONDITION	VALUE	UNIT
Back up Battery (BUB) voltage	N/A	1 – 12	V
Output voltage	N/A	5 – 12	V
Maximum output current	BUB 3V, VOUT 12V	3.5	A
	BUB 6V, VOUT 12V	7.5	
	BUB 9V, VOUT 12V	9.5	
Default switching frequency	N/A	400	kHz

Table 1-2. Charger Mode Performance Specification Summary

PARAMETER	TEST CONDITION	VALUE	UNIT
Back up Battery (BUB) voltage	N/A	0 – 12	V
Output voltage	N/A	$V_{BUB} + 0.1V - 40$	V
Charging current	N/A	0.05 – 5	A

1.4 Device Information

The purpose of TPS61383QEVM-167 is to showcase the typical application of the TPS61383-Q1 device. This EVM requires an appropriate I2C interface, such as the TI USB2ANY. This evaluation module is designed to evaluate TPS61383-Q1, which is an I2C compatible, low Iq, AEC-Q100 qualified bi-directional boost converter and buck charger integrated with battery health detection function. This device provides an integrated power design in back-up power systems like e-latch. The TPS61383-Q1 supports a high absolute maximum voltage up to 40V on the VOUT pin to support load-dump condition and allow direct connection on 12V car battery systems. The TPS61383-Q1 monitors system voltage and automatically switches to boost mode when car battery malfunction occurs and voltage drop on the system side is detected.

2 Hardware

2.1 Connector, Test Point, and Jumper Descriptions

This section describes how to properly connect, set up, and use the TPS61383QEVm-167.

2.1.1 Connector and Test Point Descriptions

This EVM includes I/O connectors and test points as [Connectors and Test Points](#) shows. Connect the backup battery to BUB connectors, J3 and J4. Connect the load to output connectors, J5 and J6. Connect the car main battery to V_{BAT} connectors, J1 and J2.

Table 2-1. Connectors and Test Points

REFERENCE DESIGNATOR	DESCRIPTION
J1	Car main battery positive connection
J2	Car main battery return connection
J3	Back up battery positive connection
J4	Back up battery return connection
J5	Boost output positive connection
J6	Boost output return connection
J7	USB2ANY interface connector
J8	Boost output voltage positive sensing point
J9	Boost output voltage negative sensing point
J10	Back up battery voltage positive sensing point
J11	Back up battery voltage negative sensing point
J12, J13, J14	PGND sensing point
J15	AGND sensing point
TP1	IL pin test point
TP2	SW pin test point
TP3	AVI pin output test point

2.1.2 Jumper Configuration

2.1.2.1 JP1 and JP2 (I2C Interface Enable)

The JP1 jumper is used to configure SCL for the I2C interface. By default, this jumper is left open and the device uses the USB2ANY adapter internal pull up. Set this jumper to H position to enable pull-up circuit on the EVM. Put this jumper in the L position to disable the SCL.

The JP2 jumper is used to enable SDA for the I2C interface. By default, this jumper is left open and the device uses the USB2ANY adapter internal pull up. Set this jumper to H position to enable pull-up circuit on the EVM. Put this jumper in the L position to disable the SDA.

2.1.2.2 JP3 (Boost Enable)

The J5 jumper is used to enable boost function. By default, this jumper is set to the H2 position, which uses the LDO on the EVM to pull up the EN_BST pin and enable the boost function. Put this jumper in the H1 position to use the USB2ANY adapter to pull up the EN_BST pin and enable boost function. Put this jumper in the L position to disable boost function.

2.1.2.3 JP4 (Status or DRV Pin)

The JP4 jumper is used to configure Status or DRV pin. By default, this jumper is set to the STATUS position, which enables the pull-up circuit for the STATUS indicator function. Put this jumper in the DRV position to connect the PMOS driver.

2.1.2.4 JP5 (TS Pin)

The JP5 jumper is used to test the TS pin. By default, this jumper is set to the L position, which connects the TS pin with 10kΩ to GND to disable the TS pin monitoring function. Put this jumper in the H position to connect the TS pin to a potentiometer to set and test the TS pin resistance. Remove the jumper and connect the middle pin to the NTC network to use for temperature sensing.

2.1.2.5 JP6 (Charger Enable)

The JP6 jumper enables the charger function. By default, this jumper is set to the H2 position, which uses the LDO on the EVM to pull up the EN_CHGR pin and enables the charger function. Put this jumper in the H1 position to use the USB2ANY adapter to pull up the EN_BST pin and enable charger function. Put this jumper in the L position to disable charger function.

2.1.2.6 JP7 (LDO Enable)

The JP1 jumper enables the LDO, which can supply the EN pins of the device. By default, this jumper is set to the H position. Put this jumper in the L position to disable the LDO.

2.2 Test Procedure

The TPS61383-Q1 integrates charger, boost and SOH functions for back up power applications. Verify the device through these three functions.

2.2.1 Verifying Boost Function

1. Prepare 1 power supply, 1 battery simulator and an e-load.
2. Set the power supply current limit to 2A. Set the power supply to 14V. Turn off the power supply output, and connect the positive output of the power supply to J1 and connect the negative output to J2.
3. Set the battery simulator current limit to +15A, -5A. Set the battery voltage to 3V. Turn off the power supply output, and connect the positive output of the power supply to J3 and the negative output to J4.
4. Set the e-load to CC mode, set CC current to 1A, turn off the load, connect the positive output of the load to J5 and the negative output to J6.
5. Configure the jumpers as [Figure 2-1](#).
6. Turn on the power supply first, connect the USB2ANY adapter J7 and connect the TPS61383Q GUI to the PC. Then open the battery simulator and the e-load.
7. Close the power supply output and verify if VOUT voltage is approximately 12V when VBAT port voltage drops below 12V.

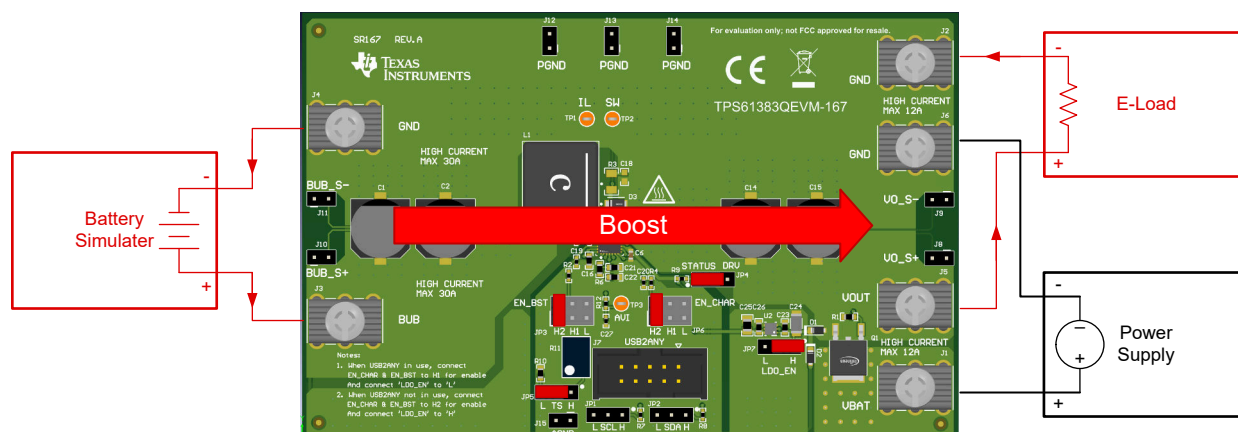


Figure 2-1. Verifying Boost Function

2.2.2 Verifying Charger Function

1. Keep the hardware connection as step 1-6 in [Section 2.2.1](#).
2. Go to GUI *Charger Settings* page, select 'Super Capacitor' in 'Choose the Battery type' bar, set Battery CV as 2.7V, set cell number as '3cell' and set charging current as '2A'.
3. Set *Charger, SOH* on the top bar as 'Enable Charger'.

4. Verify if the battery simulator is charged by approximately 2A
5. Turn off the power supply output. Verify if the battery simulator stops charging and starts outputting current when VOUT voltage drops below 12V. The VOUT voltage need to be held at approximately 12V when VOUT voltage drops below 12V if the device is working normally.

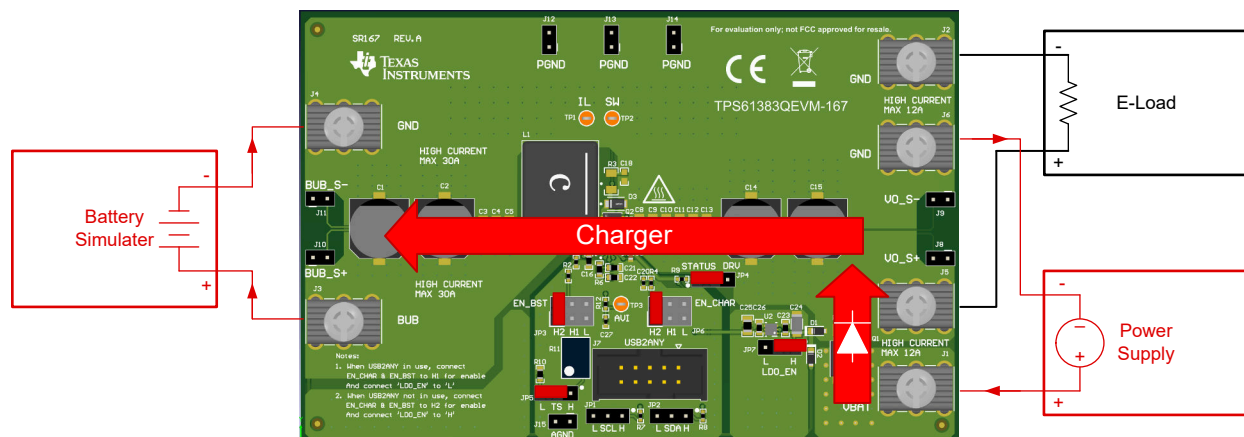


Figure 2-2. Verifying Charger Function

2.2.3 Verifying SOH Function

1. Keep the setup as similar to steps 1-6 in [Section 2.2.1](#).
2. Go to GUI SOH Settings page, set *Enable AVI Pin Output* to *Battery voltage* and set '*AVI Pin Ratio to The Backup Battery Voltage*' as '*1/2*'.
3. Select '*AVI Pin Ratio To The Discharge Current*' as '*4*'.
4. Set *Charger, SOH* as *Enable SOH*. Check if the AVI pin voltage is approximately 1.5V.
5. Set *SOH Discharge Current* to 200mA with GUI and check if the battery simulator is discharged by approximately 200mA.
6. Set '*Enable AVI Pin Output to Discharge Current*' and check if the AVI pin voltage is approximately 0.8V.

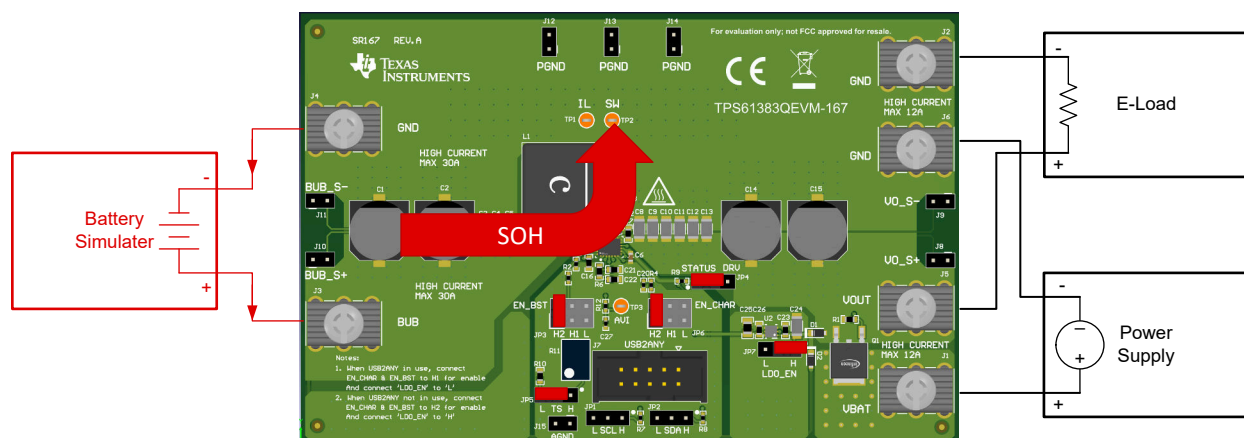


Figure 2-3. Verifying SOH Function

3 Software

3.1 Software User Interface

3.1.1 Install USB2ANY Explorer

Download and install the USB2ANY explorer from: <http://www.ti.com/tool/USB2ANY>. Upgrade the firmware version to 2.8.2.0.

3.1.2 GUI Installation

A graphical user interface (GUI) is available on:

[TPS61382A-Q1_TPS61383-Q1 GUI download](#)

The GUI allows simple and convenient programming of the device through the TI USB2ANY device.

- Download the zip file for the desired platform.
- Extract the zip folder and install the GUI.
- Run through the installation steps. The installation wizard prompts for GUI Composer Runtime. This is done automatically.
- Open the GUI → TPS61383Q1.

3.1.3 Interface Hardware Setup

Connect the USB2ANY adapter to the PC using the supplied USB cable. Connect the TPS61383EVM connector J6 to the USB2ANY adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

Figure 3-1 shows a quick connection overview.

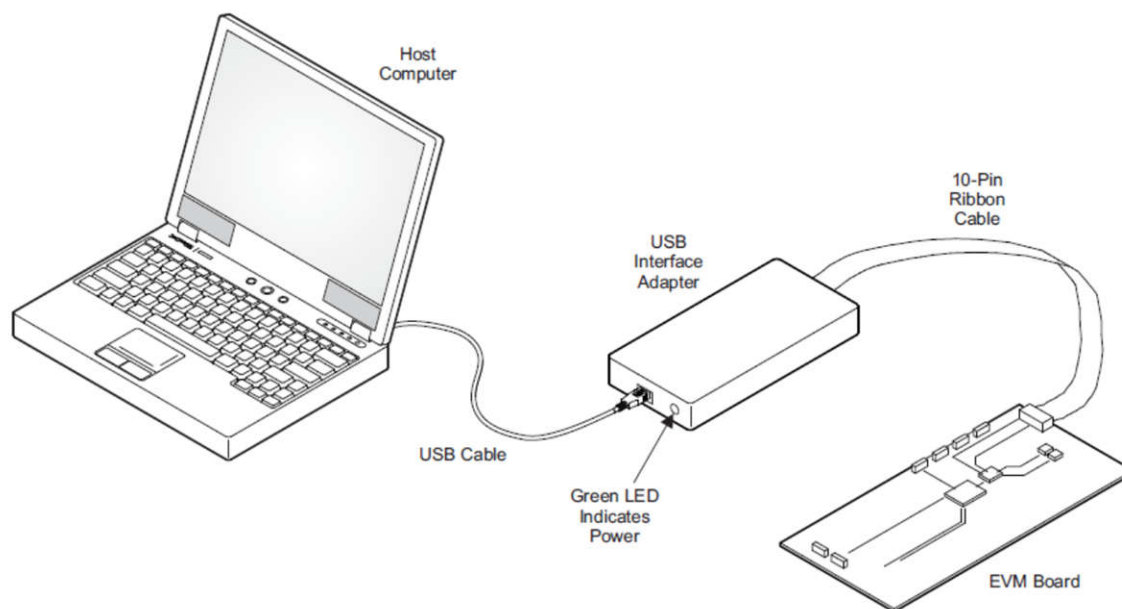


Figure 3-1. Quick Connection Overview

3.1.4 User Configuration Screen

Enable the TPS61383QEVM-167 board by following the steps below:

1. Set the EVM hardware as described in step 1-6 in [Section 2.2.1](#). Turn on the power supply.
2. Open the TPS61383-Q1EVM GUI.

- Select the connect button on the bottom bar, as [Figure 3-2](#) shows. After connecting the GUI and device, the GUI reads all registers and shows a notification.

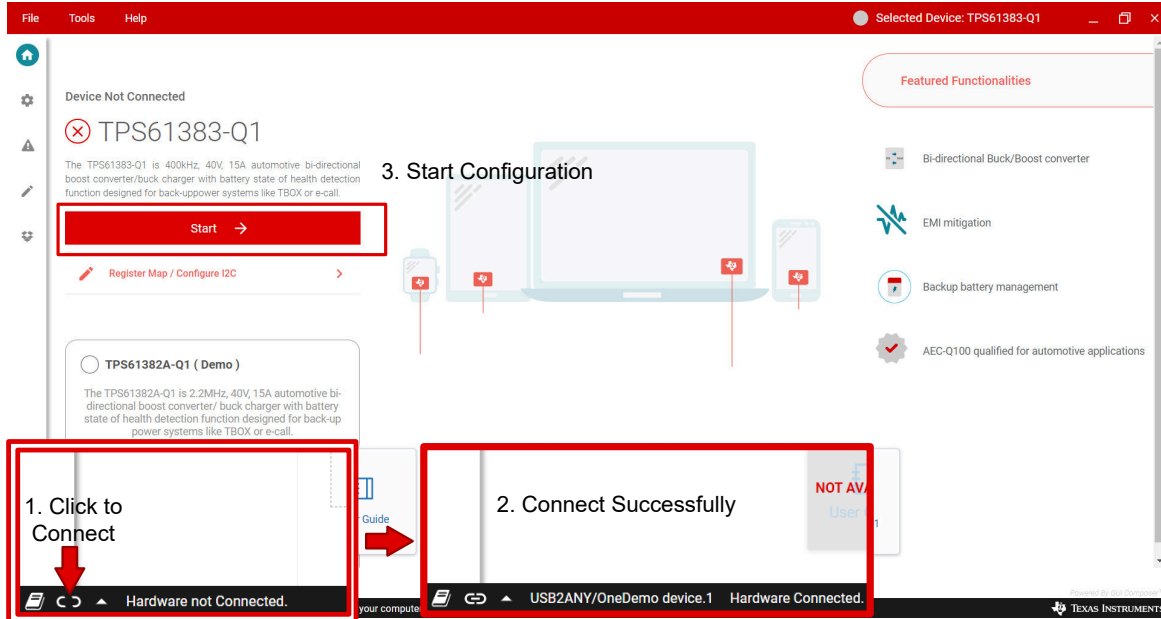


Figure 3-2. Connect and Start

- Select the *Start* button and the GUI automatically turns on to the Configuration Screen (see [Figure 3-3](#)). The settings of TPS61383 boost enable by default. The default output voltage is 12V. Set the boost mode output voltage, current limit point, and so forth according to the design target.

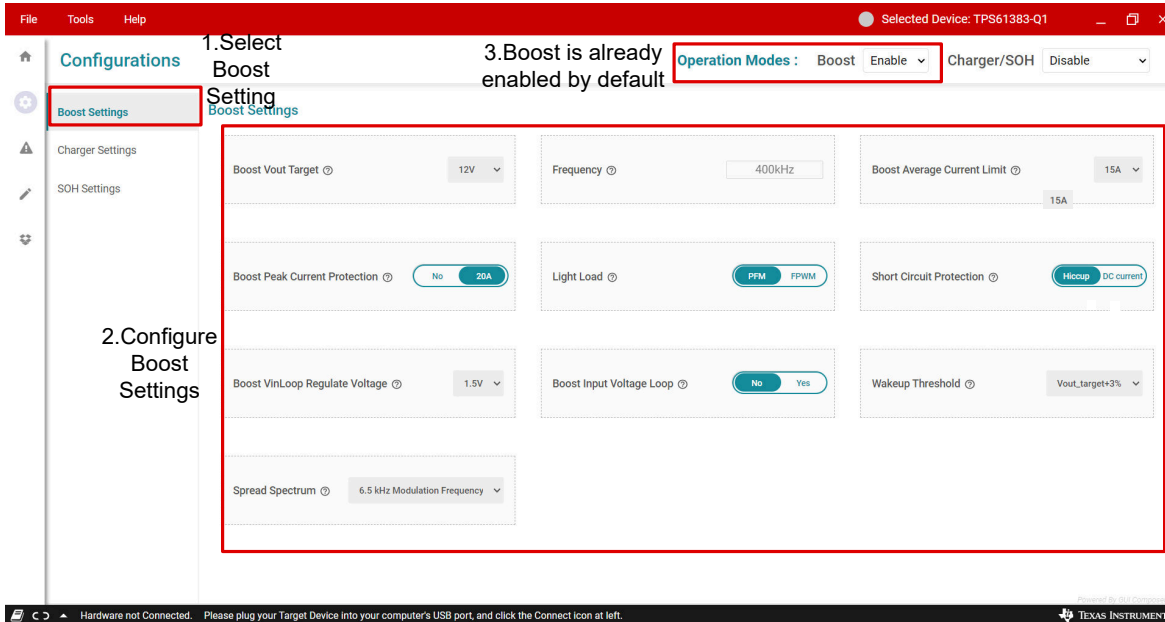


Figure 3-3. Boost Settings Sheet

5. Select the *Charger Settings* button and switch to Charger Settings Sheet (see Figure 3-4). The default settings of the charger is to Li-ion mode. Set the charger mode battery type, cell number, CC current, and so forth according to the design target.

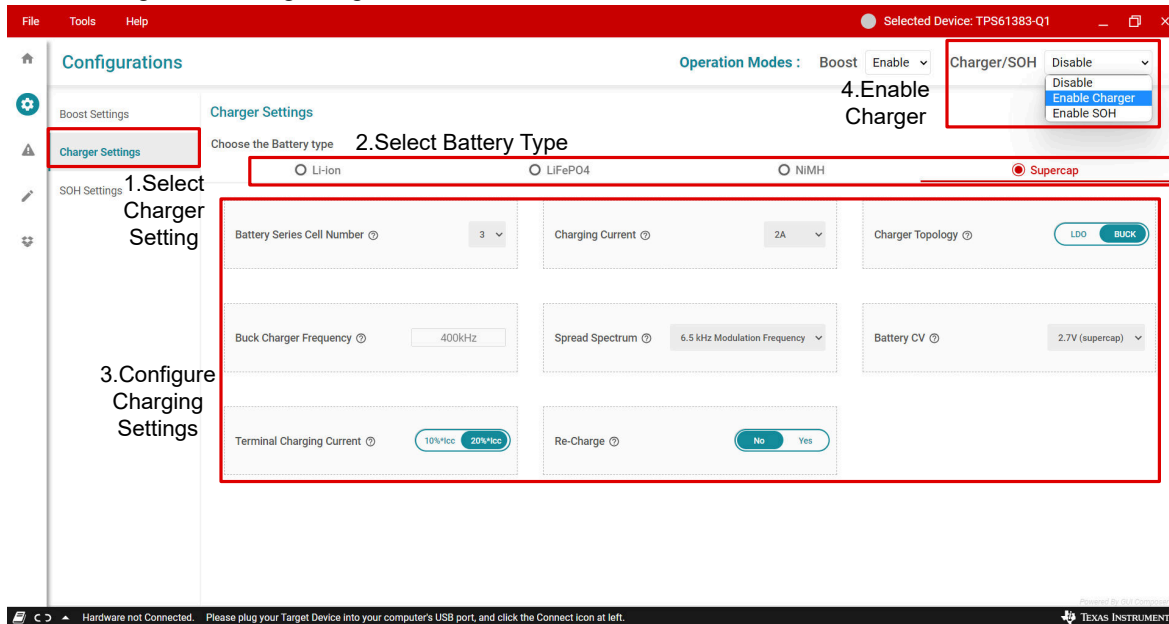


Figure 3-4. Charger Settings Sheet

6. Select the *SOH Settings* button and switch to the SOH Settings Sheet (see Figure 3-5). Set the SOH discharge current, AVI pin output ratio, AVI output, and so forth according to the design target.

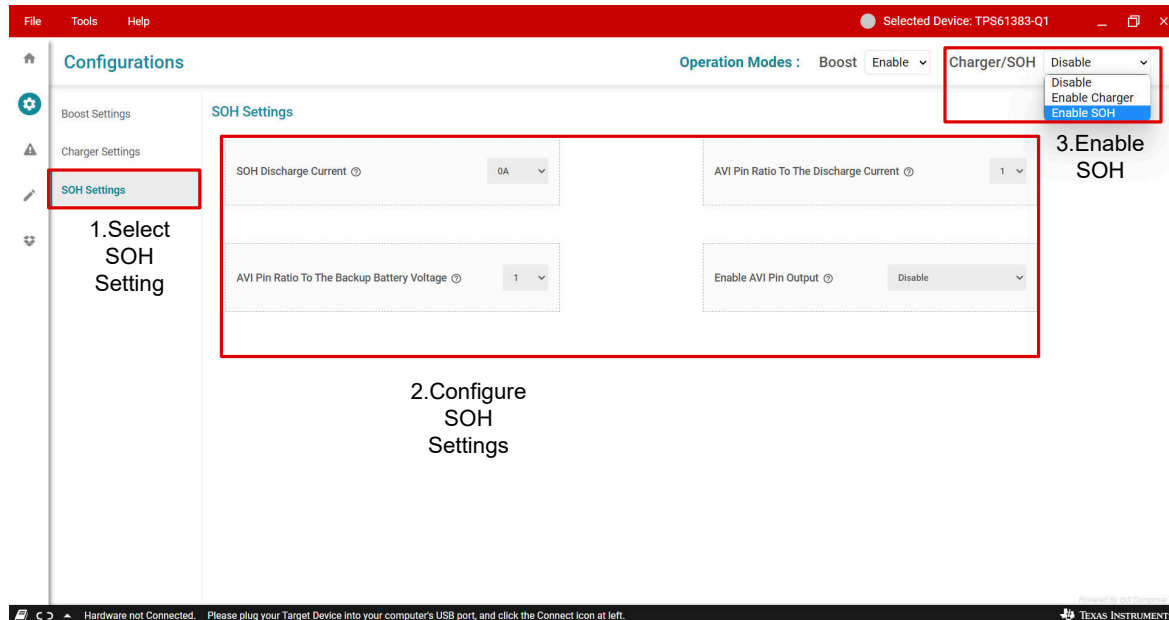


Figure 3-5. SOH Settings Sheet

3.1.5 Status and Fault Indications Screen

TPS61383-Q1 GUI offers multiple device status and fault indications function. Enter the Status and Fault Indications Screen to check the devices status and fault condition.

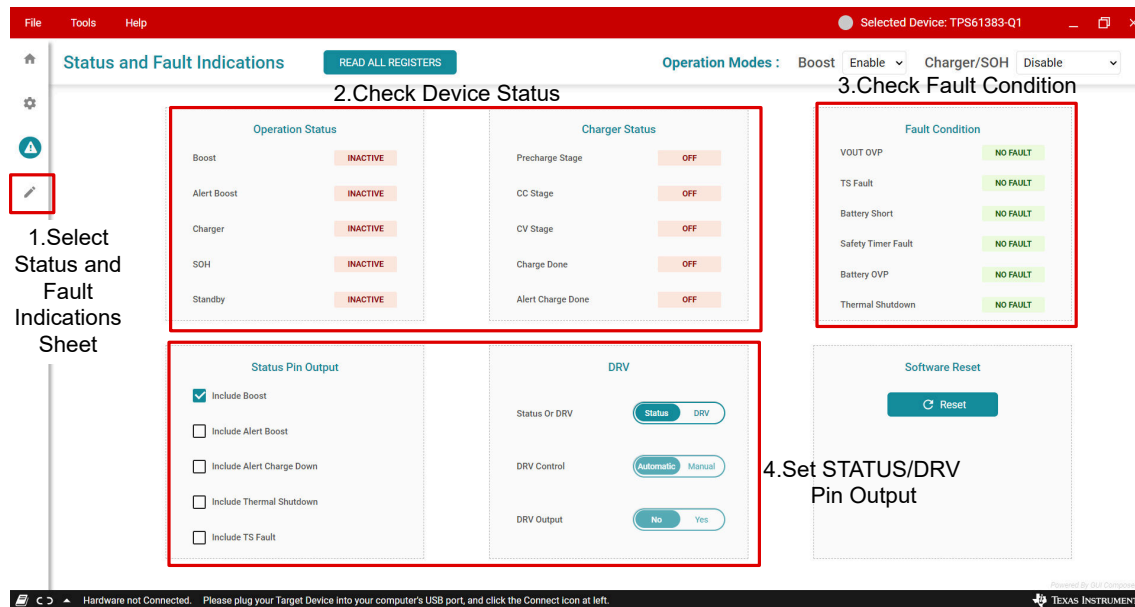


Figure 3-6. Status and Fault Indications Screen

3.1.6 Register Map Screen

The Register Map Screen (see Section 3.1.6) shows a register-wise view of all parameters. A detailed description of each register bit can be found in this screen. Enter this screen to read and update the register bits.

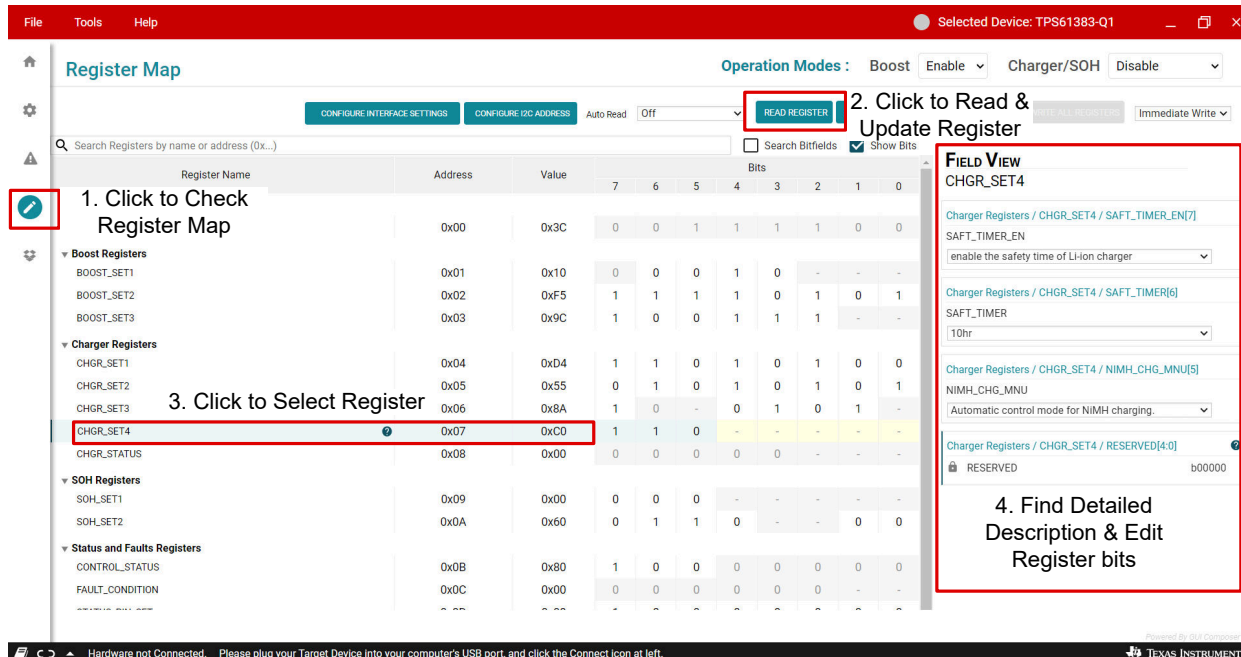
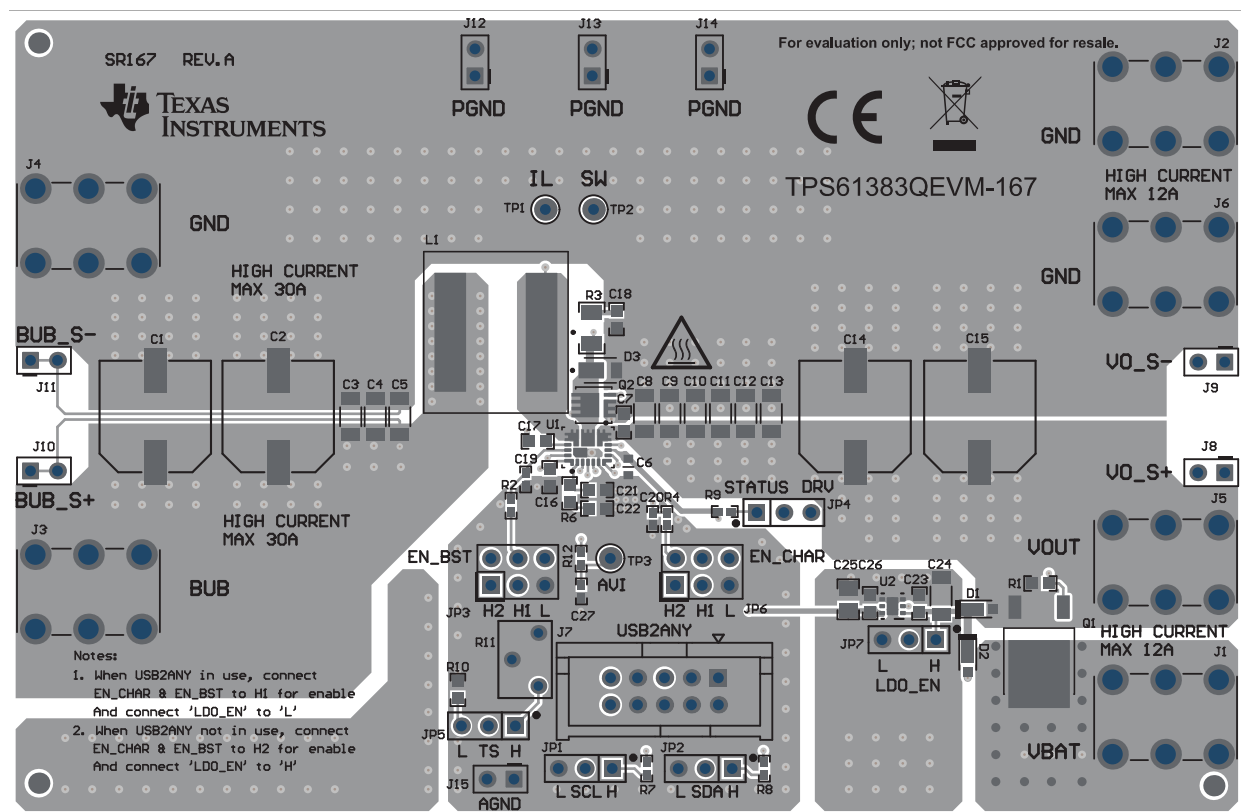


Figure 3-7. Register Map Screen

3.2 Modification

This EVM requires an appropriate I²C interface, such as the TI USB2ANY, to configure the TPS61383-Q1.

4.2 PCB Layout



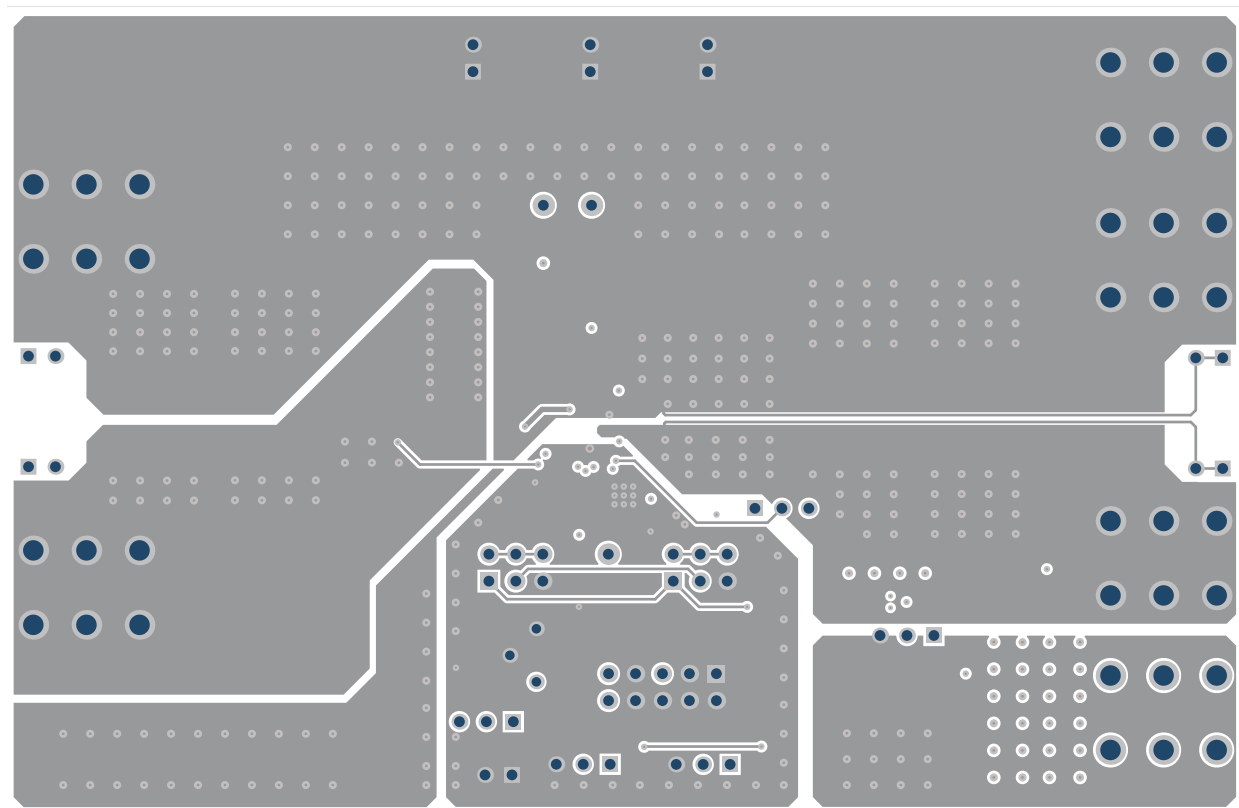


Figure 4-4. TPS61383QEVm-167 Inner Layer2

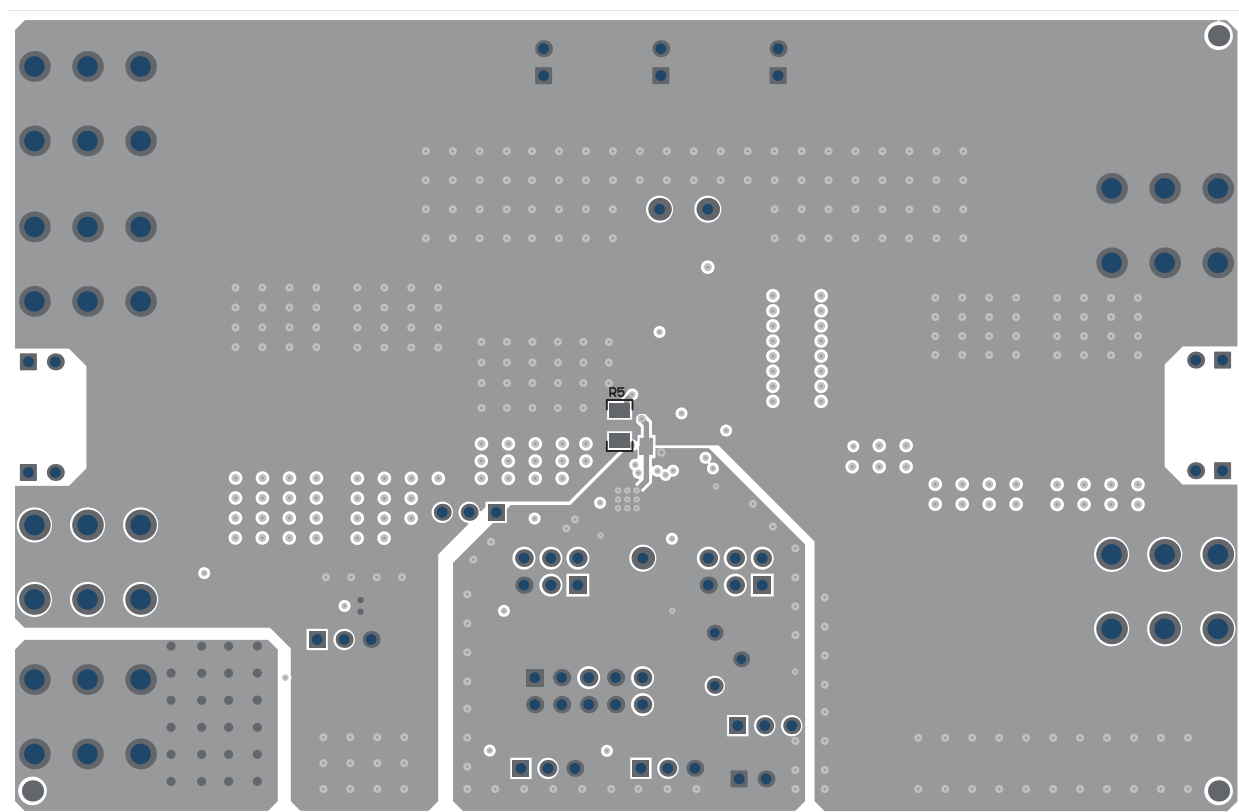


Figure 4-5. TPS61383QEVm-167 Bottom-Side Layout

4.3 Bill of Materials

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	Footprint	PartNumber	Manufacturer
C1, C2, C14, C15	4	100uF	CAP, Polymer Hybrid, 100uF, 50V,+/- 20%, 0.028ohm, AEC-Q200 Grade 1, D10xL10.2mm SMD	Panasonic_G	EEH-ZC1H101P	Panasonic
C3, C4, C5, C8, C9, C10, C11, C12, C13	9	10uF	CAP, CERM, 10 µF, 50V,+/- 10%, X7R, AEC-Q200 Grade 1, 1206	1206_190	CGA5L1X7R1H106 K160AC	TDK
C6	1	4.7µF	AEC-Q200 Compliant Chip Multilayer Ceramic Capacitor for Infotainment 4.7uF ±10% 16V X7S SMD 0603	FP-GRT188C71C475KE13D_0603-MFG	GRT188C71C475K E13D	Murata
C7, C16	2	1uF	CAP, CERM, 1 µF, 50V,+/- 20%, X5R, AEC-Q200 Grade 3, 0603	0603	GRT188R61H105M E13D	MuRata
C17	1	0.47uF	CAP, CERM, 0.47uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E3X7R1H474 K080AB	TDK
C19, C20, C27	3	0.1uF	CAP, CERM, 0.1 µF, 16V,+/- 5%, X7R, AEC-Q200 Grade 1, 0402	0402	GCM155R71C104J A55D	MuRata
C21	1	30pF	CAP, CERM, 30pF, 100V,+/- 1%, C0G/NP0, AEC-Q200 Grade 1, 0603	0603	GCM1885C2A300F A16D	MuRata
C22	1	0.012uF	CAP, CERM, 0.012 µF, 50V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C123K5RAC TU	Kemet
C23, C26	2	0.1uF	CAP, CERM, 0.1 µF, 50V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	06035C104KAZ2A	AVX
C24	1	10uF	CAP, CERM, 10uF, 50V, +/- 10%, X5R, AEC-Q200 Grade 1, 1206	1206_180	GRT31CR61H106K E01L	MuRata
C25	1	10uF	CAP, CERM, 10 µF, 10V,+/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805_HV	GCJ21BR71A106K E01L	MuRata
D1, D2	2	60V	Diode, Schottky, 60V, 1A, AEC-Q101, PowerDI323	PowerDI323	PD3S160Q-7	Diodes Inc.
D3	1		Diode Schottky 30V 2A Surface Mount PowerDI123	FP-DFLS230LQ-7_PowerDI123-MFG	DFLS230LQ-7	Diodes Inc.
FID1, FID2, FID3, FID4, FID5, FID6	6		Fiducial mark. There is nothing to buy or mount.	Fiducial10-20	N/A	N/A

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Footprint	PartNumber	Manufacturer
J1, J2, J3, J4, J5, J6	6		TERMINAL SCREW PC 30AMP, TH	SCREW_TERMINAL_8199	8199	Keystone
J7	1		Header (shrouded), 100mil, 5x2, Gold, TH	CONN_5103308-1	5103308-1	TE Connectivity
J8, J9, J10, J11, J12, J13, J14, J15	8		Header, 100mil, 2x1, Tin, TH	CONN_PEC02SAAN	PEC02SAAN	Sullins Connector Solutions
JP1, JP2, JP4, JP5, JP7	5		Header, 100mil, 3x1, Tin, TH	CONN_PEC03SAAN	PEC03SAAN	Sullins Connector Solutions
JP3, JP6	2		Header, 100mil, 3x2, Tin, TH	SULLINS_PEC03DAAN	PEC03DAAN	Sullins Connector Solutions
L1	1	2.2uH	Shielded Power Inductor 2.2uH 20% 28.5A 1.6mOhm DCRmax, AECQ200, 13.4x15.0x13.0mm SMT	FP-XGL1313-222MED_SMT_I ND_13MM4_15MM0-MFG	XGL1313-222MED	Coilcraft
Q1	1		P-Channel 60V 30A (Tc) 125W (Tc) Surface Mount PG-TO252-3	FP-SPD30P06PGBTMA1_TO2 52-3-MFG	SPD30P06PGBTMA1	Infineon
Q2	1		N-Channel 40V 154A (Tj) 83W (Tc) Surface Mount PG-TSDSON-8-44	FP-IAUZN04S7L019ATMA1_T SDSON8-MFG	IAUZN04S7L019ATMA1	Infineon
R1	1	100k	RES, 100k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	0603	CRCW0603100KFK EA	Vishay-Dale
R2, R4, R12	3	0	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0 ED	Vishay-Dale
R5	1	1.0	RES, 1.0, 5%, 0.5W, 1206	1206	CRM1206- JW-1R0ELF	Bourns
R6, R10	2	10.0k	RES, 10.0k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	0603	CRCW060310K0FK EA	Vishay-Dale
R7, R8, R9	3	10.0k	RES, 10.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0FK ED	Vishay-Dale
R11	1	50k Ohm	Trimmer Potentiometer, Lead Sealed Type Multiturn PV37 Series, TH	Bourns_PV37W	PV37W503C01B00	Bourns

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Footprint	PartNumber	Manufacturer
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5	5		Shunt, 2.54mm, Gold, Black	Wurth_60900213421	60900213421	Wurth Elektronik
TP1, TP2, TP3	3		Test Point, Miniature, Orange, TH	Keystone5003	5003	Keystone Electronics
U1	1		TPS61383QRAVQ1	RAV0024A-MFG	TPS61383QRAVQ1	Texas Instruments
U2	1		Automotive 150mA high-voltage ultra-low-IQ low-dropout (LDO) linear regulator, DRV0006A (WSON-6)	DRV0006A	TPS7B8133QDRVRQ1	Texas Instruments

5 Additional Information

5.1 Trademarks

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