



ABSTRACT

This user's guide describes the evaluation module (EVM) for TI's reverse polarity protection controller, LM74501-Q1. This document provides configuration information and test setup details for evaluating LM74501-Q1 devices. An EVM schematic, board layout images, and bill of materials (BOM) are included.

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1 Introduction

The LM74501-Q1 evaluation module (LM74501-Q1EVM) helps designers evaluate the operation and performance of the LM74501-Q1 reverse polarity protection controller. This evaluation module demonstrates how an N-channel power MOSFET can emulate a very-low forward voltage diode with low I_Q and low-leakage current flowing through the IC. In this design scheme, the LM74501-Q1 is combined with a MOSFET and used in series with a battery as a replacement for a Schottky diode and PFET, in reverse-polarity protection circuitry as shown in [Figure 2-1](#). For more information on the LM74501-Q1 functional and electrical characteristics, see [LM74501-Q1 "TVS Less" Reverse Battery Protection Controller](#) data sheet.

2 Setup

This section describes the jumpers and connectors on the EVM, and how to properly connect, setup, and use the LM74501-Q1EVM. Ensure the power supply is turned off while making connections on the board.

2.1 I/O Connector Description

VIN	J1: Power input connector to the positive rail of the input power supply
GND1	J3: Ground connection for the power supply
VOUT	J2: Power output connector to the positive side of the load
GND2	J4: Ground connection for the load
EN	J5: Jumper to enable LM74501Q1 gate driver 1-2 position connects EN to Source, 2-3 position connects EN to GND
Test Points	VINA, VOUTA, GATE, ENA, BATT_MON, GND1, and GND2 are test points

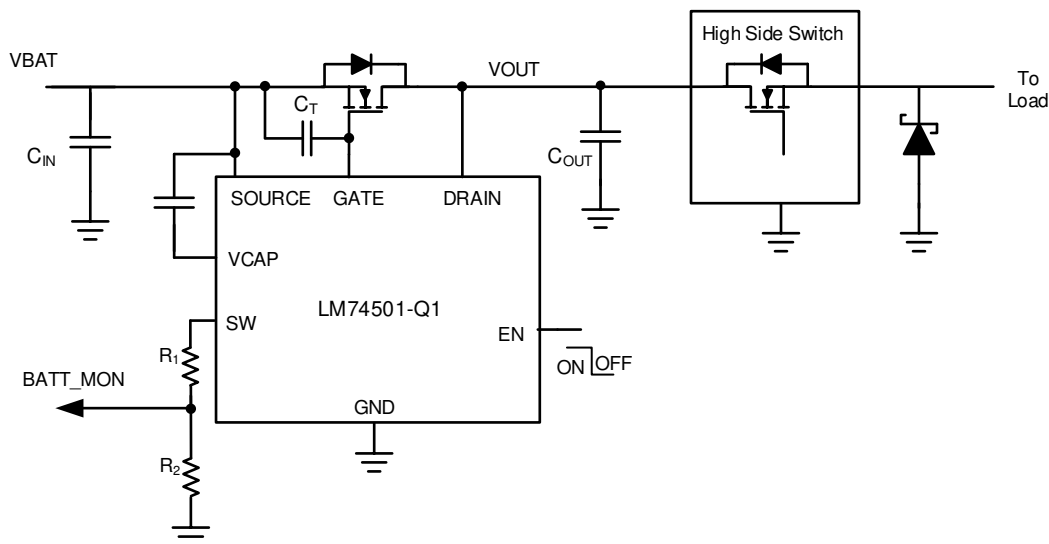


Figure 2-1. LM74501-Q1EVM Typical Application Circuit

2.2 Board Setup

- Before applying power to the LM74501-Q1EVM, verify all external connections.
- Turn off external power supplies and connect them with the proper polarity to the VIN and GND1 connectors.
- An electronic or resistive load must be connected at the output VOUT and GND2 connectors.
- The tests outlined in this document are conducted with 3-A constant current as the load and 12 V at the input.
- Make sure that the external power-supply source for the input voltage is capable of providing enough current to the output load so that the output voltage can be obtained.

When all connections to the LM74501-Q1EVM are verified, apply power to VIN. [Figure 2-2](#) captures EVM board setup.

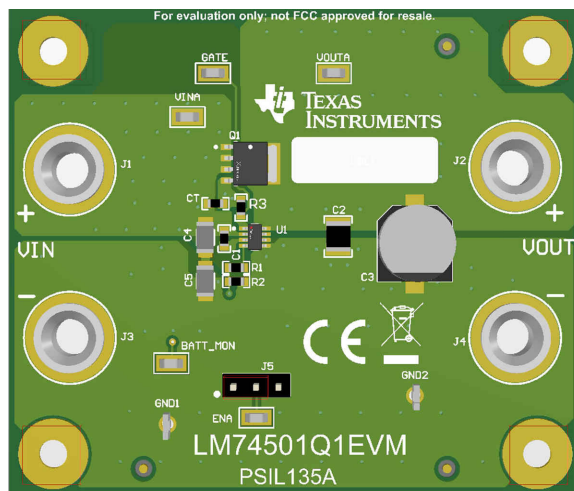


Figure 2-2. LM74501-Q1EVM

2.3 Schematic

Figure 2-3 illustrates the EVM schematic.

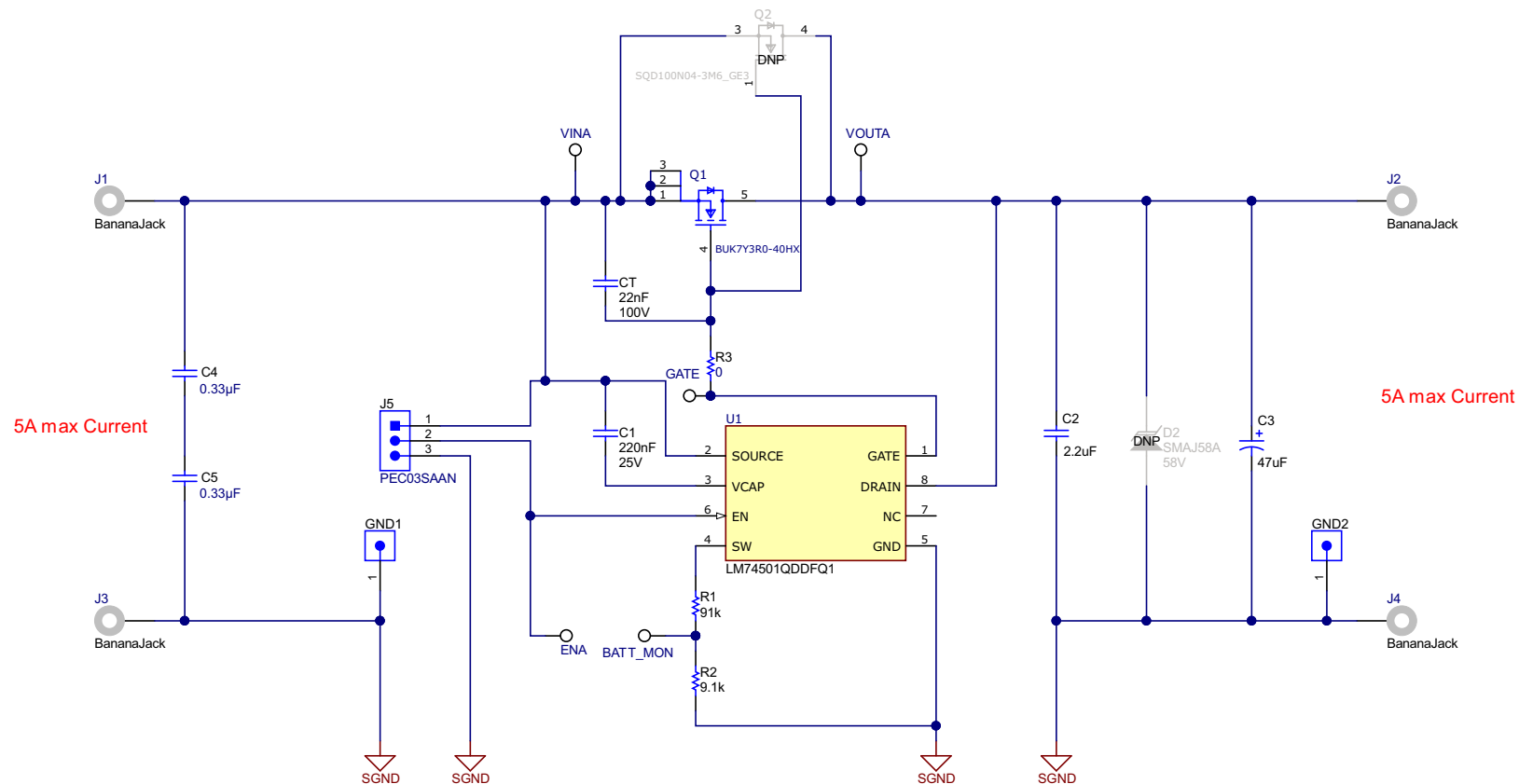


Figure 2-3. LM74501-Q1EVM Schematic

3 Operation

3.1 LM74501-Q1EVM Performance Capture

3.1.1 LM74501-Q1EVM Startup

- A startup pulse from 0 V to 12 V is applied at the input of the LM74501-Q1EVM.
- [Figure 3-1](#) shows the input voltage (CH2) rises from 0 V to 12 V and the gate voltage (CH3) comes up after input voltage crosses device PoR threshold.
- The gate of external N-FET is fully enhanced and FET is turned on. Output voltage (CH1) rises smoothly from 0 V to 12 V.

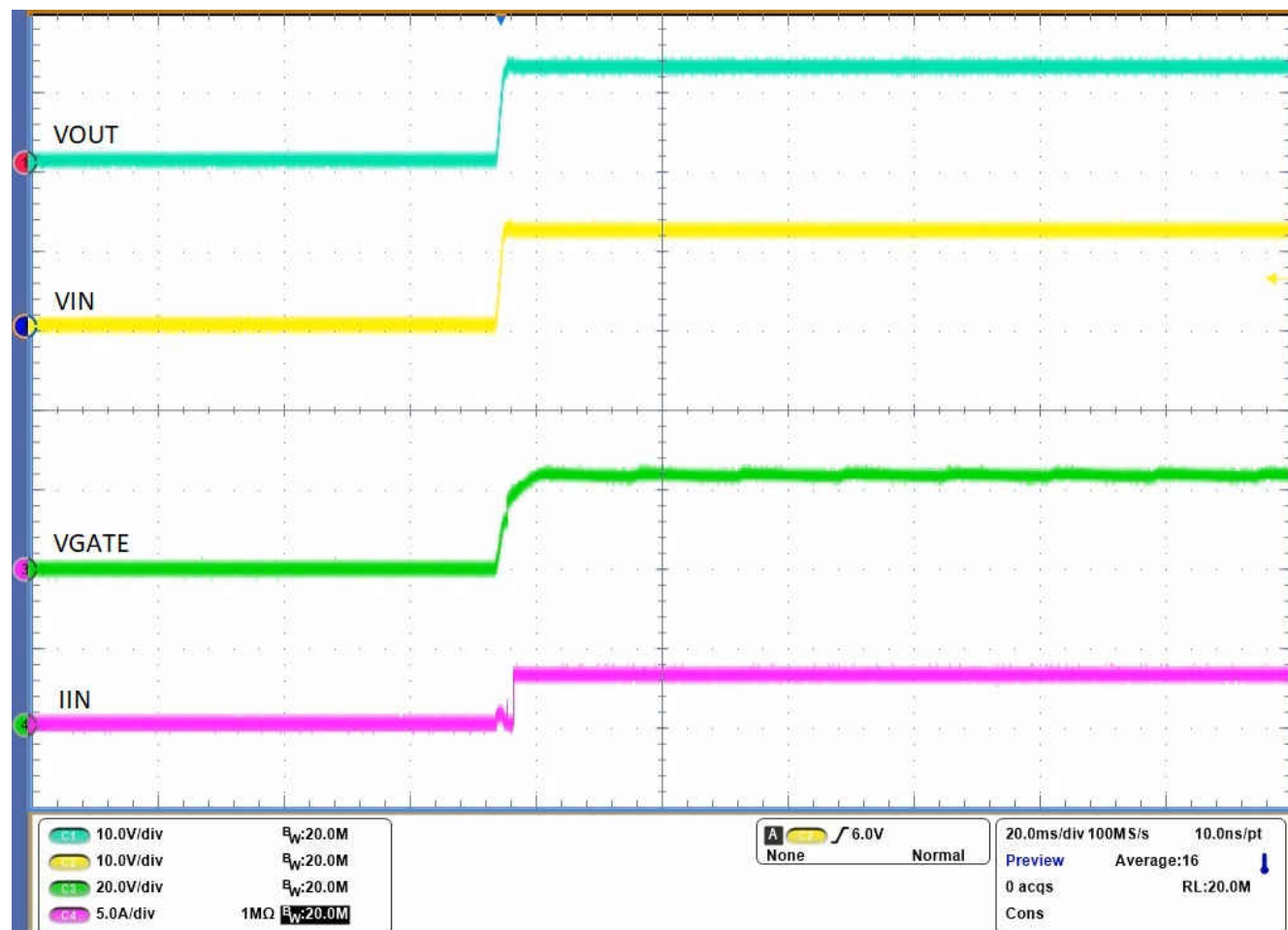


Figure 3-1. LM74501-Q1EVM Startup

3.1.2 Startup Reverse Polarity (–12 V)

- A –12-V source is connected to the VIN input of the LM74501-Q1EVM.
- [Figure 3-2](#) shows that the output voltage remains at a constant 0 V in this situation.
- This test simulates the event of connecting a 12-V battery in the reverse direction; therefore, protecting the load from negative input voltages.

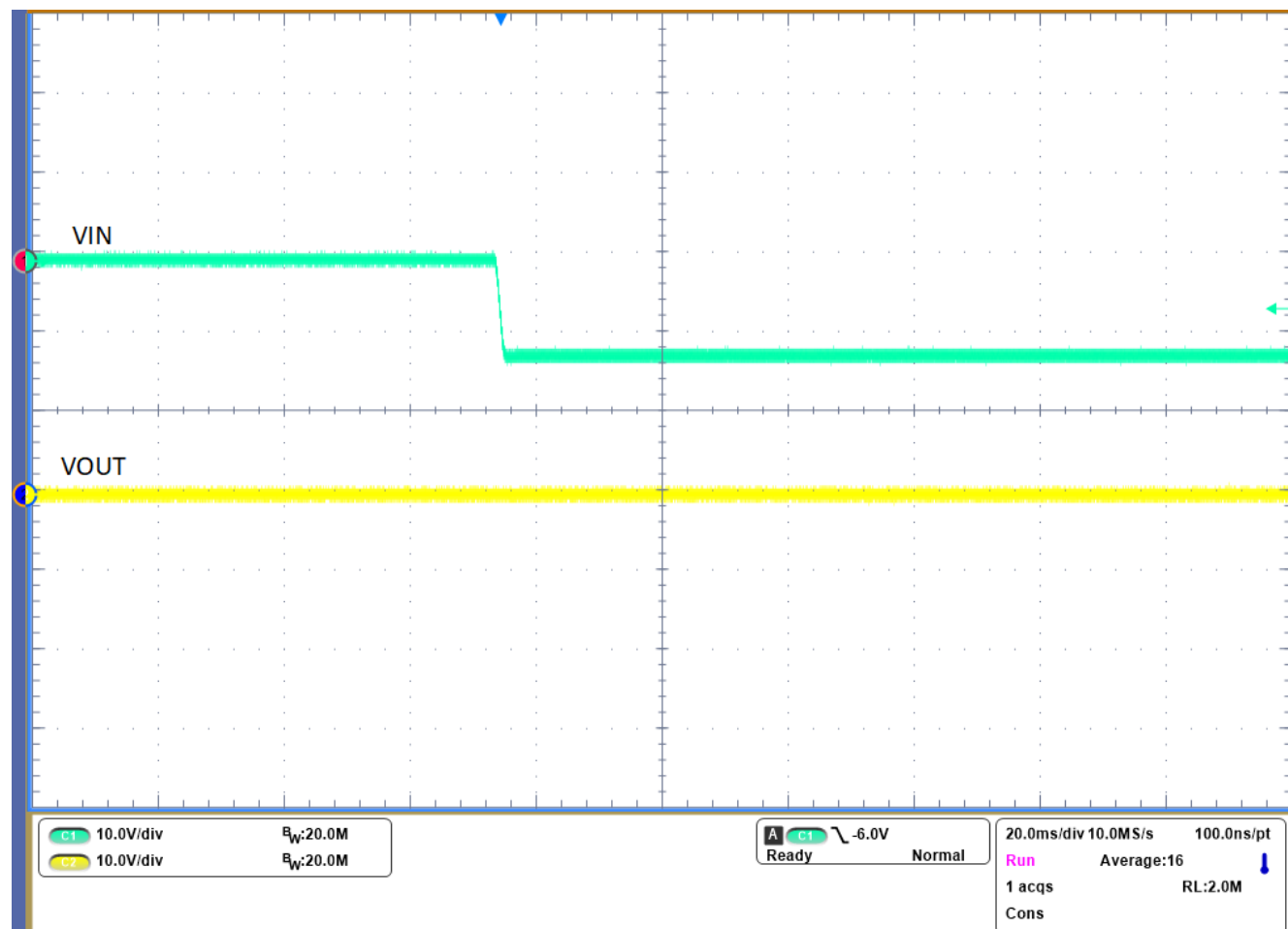


Figure 3-2. Startup Reverse Polarity (–12 V)

4 EVM Board Assembly Drawings and Layout Guidelines

4.1 PCB Drawings

Figure 4-1 through Figure 4-4 show component placement and layout of this EVM.

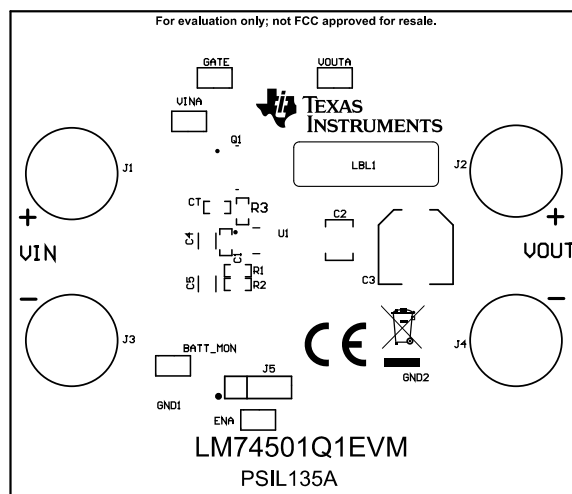


Figure 4-1. LM74501-Q1EVM Top Side Placement

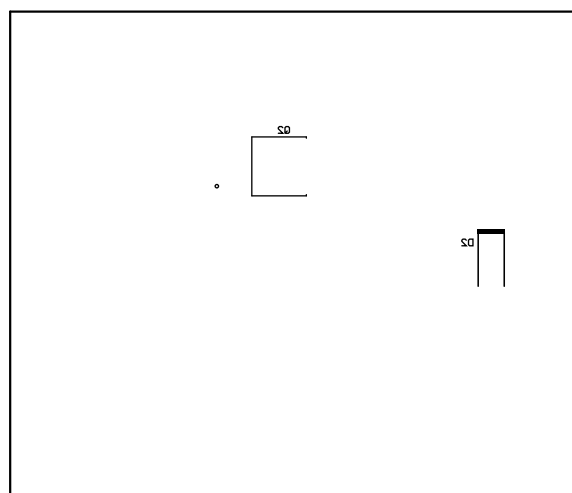


Figure 4-2. LM74501-Q1EVM Bottom Side Placement

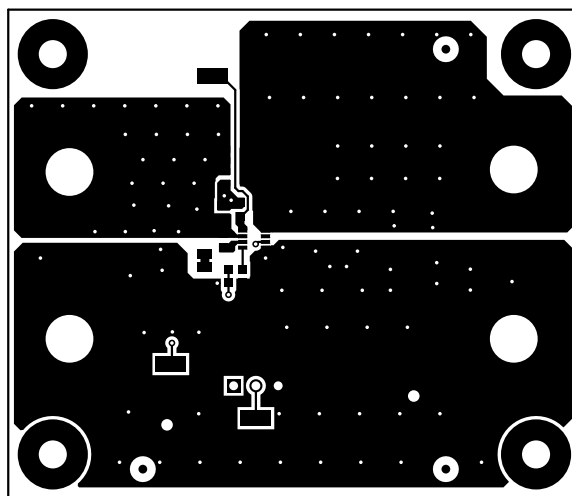


Figure 4-3. LM74501-Q1EVM Top Layer Routing

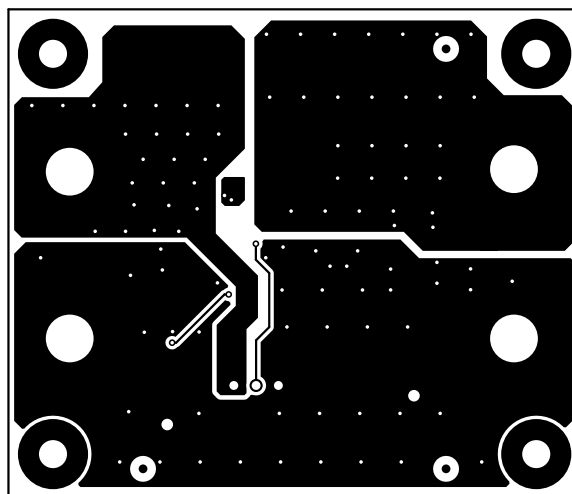


Figure 4-4. LM74501-Q1EVM Bottom Layer Routing

4.2 Bill of Materials

Table 4-1 lists the LM74501-Q1EVM BOM.

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		PSIL135	Any
BATT_MON, ENA, GATE, VINA, VOUTA	5		Test Point, Miniature, SMT	Testpoint_Keystone_Minature	5015	Keystone
C1	1	0.1uF	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E2X7R1E104K080A	TDK
C2	1	2.2uF	CAP, CERM, 2.2 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1,		CGA6N3X7R2A225K230A	TDK
C3	1	47uF	CAP, AL, 47 uF, 63 V, +/- 20%, AEC-Q200 Grade 2, SMD	D8xL10.2mm	EEE-HA1J470UP	Panasonic
C4, C5	2	0.33uF	CAP, CERM, 0.33 uF, 50 V, +/- 10%, X8R, AEC-Q200 Grade 0, 1206	1206	CGA5L2X8R1H334K160A	TDK
CT	1	0.022uF	CAP, CERM, 0.022 uF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E2X7R2A223K080A	TDK
GND1, GND2	2		TEST POINT SLOTTED .118", TH	Test point, TH Slot Test point	1040	Keystone
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J3, J4	4		Standard Banana Jack, Uninsulated, 8.9mm	Keystone575-8	575-8	Keystone

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
J5	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	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 inch	THT-14-423-10	Brady
Q1	1		N-Channel 40V 120A (Ta) 172W (Ta) Surface Mount LFPAK56, Power-SO8	SOT669	BUK7Y3R0-40HX	Nexperia
R1	1	91k	RES, 91 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060391K0JNEA	Vishay-Dale
R2	1	9.1k	RES, 9.1 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06039K10JNEA	Vishay-Dale
R3	1	0	RES, 0, 5%, 0.1 W, 0603	0603	ERJ-3GEY0R00V	Panasonic
SH-J1	1	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
U1	1		Low IQ Reverse Battery Protection Controller with Integrated VDS Clamp	SOT23-8	LM74501QDDDFQ1	Texas Instruments
D2	0	58V	Diode, TVS, Uni, 58 V, SMA	SMA	SMAJ58A	Diodes Inc.
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
Q2	0		N-Channel 40V 100A (Tc) 136W (Tc) Surface Mount TO-252AA	TO-252	SQD100N04-3M6_GE3	Vishay

5 Revision History

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

Changes from Revision * (May 2021) to Revision A (September 2021)	Page
• Updated Figure 2-2	3
• Updated Figure 2-3	4
• Updated Figure 4-1 through Figure 4-4	7
• Updated Table 4-1	9

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