EVM User's Guide: LM74681

LM74681 Evaluation Module for Ideal Diode Bridge Controller

Description

The LM74681 Evaluation Module (LM74681EVM) helps designers evaluate the operation and performance of the LM74681 ideal diode bridge controller (12-pin DRR package). This evaluation module demonstrates how an N-channel power MOSFET driven by LM74681 can emulate a very-low forward voltage diode and helps powering up polarity agnostic systems with very low I_Q during detection and classification phase in POE applications.

Features

- Reverse current blocking feature required for polarity agnostic systems
- Input reverse battery protection
- Drives external N-Channel MOSFETs in bridge configuration
- Output LED for output high indication

Applications

- PoE powered devices (48V)
- Polarity agnostic systems

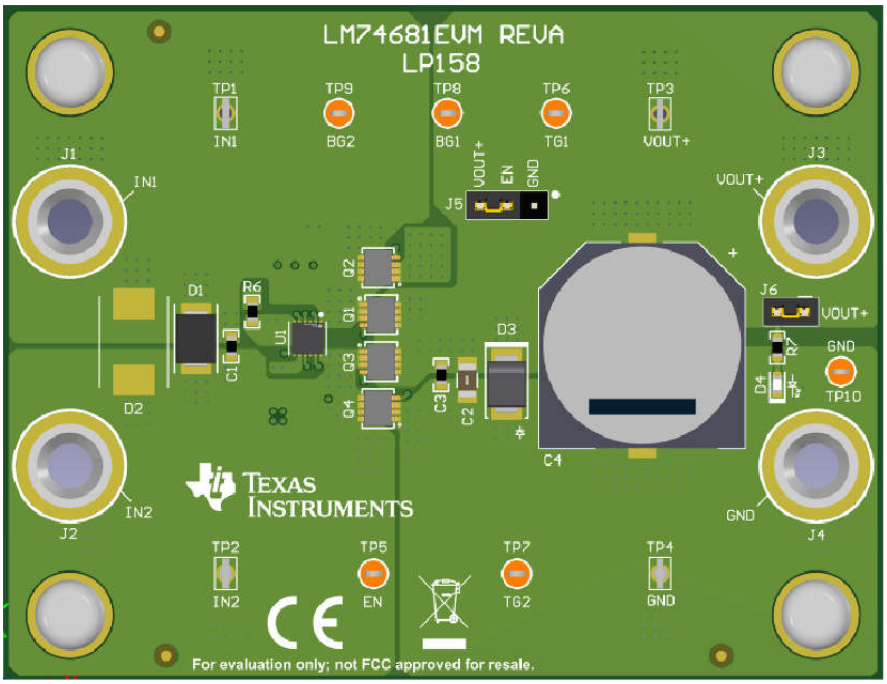

Figure 1-1. LM74681EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the LM74681EVM evaluation module for evaluating the performance of the LM74681 Ideal Diode Bridge Controller devices. This document provides EVM configuration information and test setup details for evaluating the LM74681 device. The EVM schematic, board layout, and bill of materials (BOM) are also included.

1.2 Kit Contents

Table 1-1. LM74681EVM Kit Contents

Item	Description	Quantity
LM74681EVM	PCB	1

1.3 Device Information

LM74681 is an ideal diode bridge controller that can drive four external N-channel MOSFETs in bridge configuration to eliminate traditional diode bridges for superior thermals and efficiency. The top-gates are driven to emulate a very-low forward voltage (11.5mV typ.) diode with low IQ. The wide input supply of 30V to 80V allows protection and control of 48V PoE systems with ultra low Iq in detection and classification phase.

2 Hardware

2.1 Test Points and Connectors

Table 2-1 lists the LM74681EVM evaluation board input and output connector functionality. Table 2-2 and Table 2-3 describe the test point availability and the jumper functionality.

Table 2-1. Input and Output Connector Functionality

Connector	Label	Description
J1	IN1	Power input connector to the positive rail of the input power supply.
J2	IN2	Power input connector to the negative rail of the input power supply.
J3	VOUT+	Power output connector to the positive side of the load.
J4	VOUT-	Ground connection for the load.

Table 2-2. Test Points Description

Test Points	Label	Description
TP1	IN1	Input power supply to the EVM.
TP2	IN2	Input power supply to the EVM.
TP3	VOUT+	Output from the EVM.
TP4	PGND	Ground connection for the load.
TP5	EN	Enable control (active high) of the controller.
TP6	TG1	GATE of the external top side MOSFET1.
TP7	TG2	GATE of the external top side MOSFET2.
TP8	BG1	GATE of the external bottom side MOSFET1
TP9	BG2	GATE of the external bottom side MOSFET2.
TP10	VOUT-	Connect to PGND.

Table 2-3. Jumper and LED Descriptions

Jumper	Connection	Description
J5	1-2	EN connected to GND. EN pulled high.
	2-3	EN connected to VOUT+. EN pulled high.
J6	1-2	D4 LED indication when output high.

2.2 Test Equipment and Setup

2.2.1 Power Supplies

One adjustable power supply with 0V to 60V output and 0A to 3A output current limit.

2.2.2 Meters

One DMM minimum needed.

2.2.3 Oscilloscope

An MSO58B or equivalent, 8 × 10 voltage probes, and a DC current probe.

2.2.4 Loads

One resistive load or equivalent that can tolerate up to 3A DC load at 60V.

2.3 Test Setup and Procedures

Make sure the evaluation board has default jumper settings as shown in Table 2-4.

Table 2-4. Default Jumper Setting for LM74681EVM Evaluation Board

Jumper	Default Setting	Functionality
J5	2-3	EN connected to VOUT+. EN pulled high.
J6	1-2	Output high D4 LED indication.

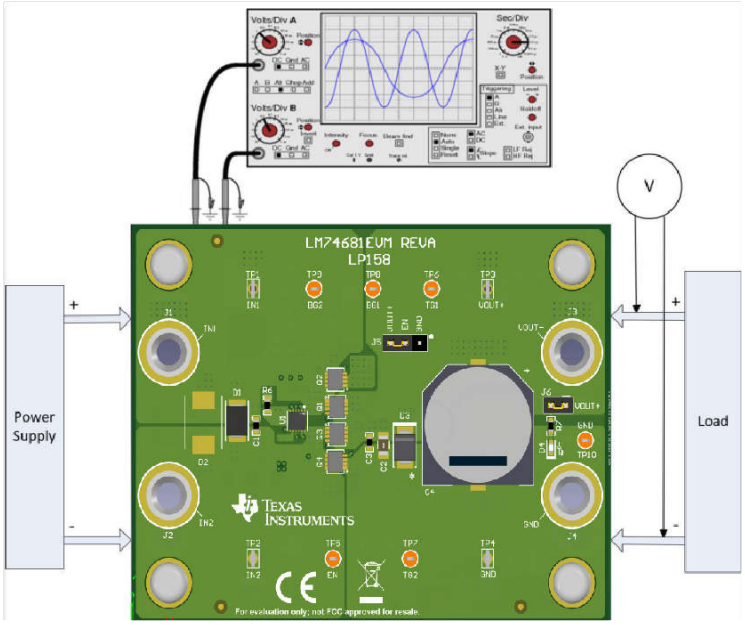

Figure 2-1. LM74681EVM Setup With Test Equipment

Use the following instructions before starting any test and repeat again before moving to next test.

1. Set the power supply output VIN to 0V.
2. Turn ON the power supply and set the power supply output VIN to 48V and current limit of 3A.
3. Turn OFF the power supply.
4. Set the jumper setting on EVM to default position as shown in Table 2-4.

2.3.1 UVLO Functionality

Use the following instructions to capture the UVLO behavior of the device.

1. Set the input supply voltage VIN to 25V and current limit of 3A.
2. Turn ON the input power supply.
3. Observe the behavior of TG1-IN1 and BG1.
4. Turn OFF the power supply and reverse the connection on J1 and J2.
5. Observe the behavior of TG2-IN2 and BG2.

Figure 2-2 and Figure 2-3 show examples of the UVLO profile captured on the LM74681EVM evaluation board.

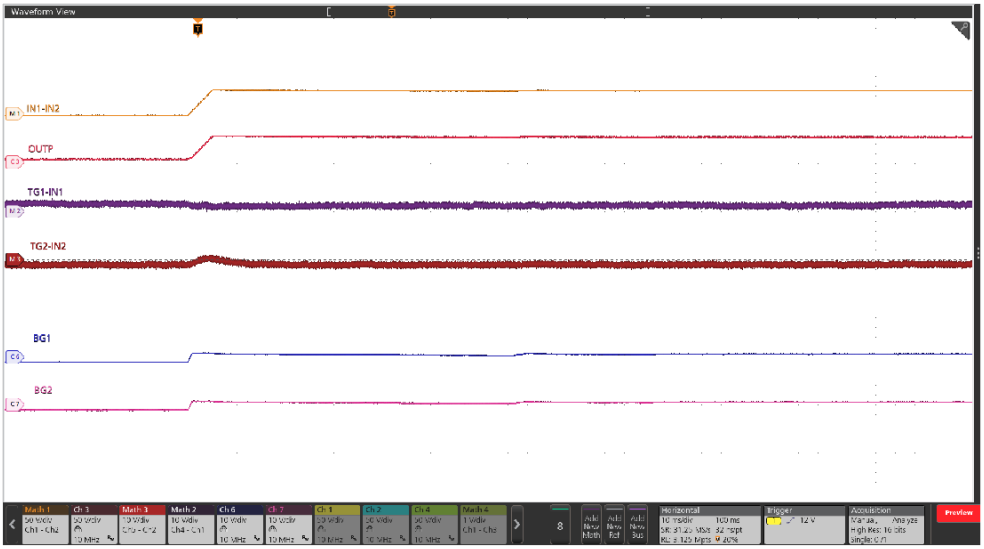

Figure 2-2. LM74681 Forward Connection UVLO Behavior

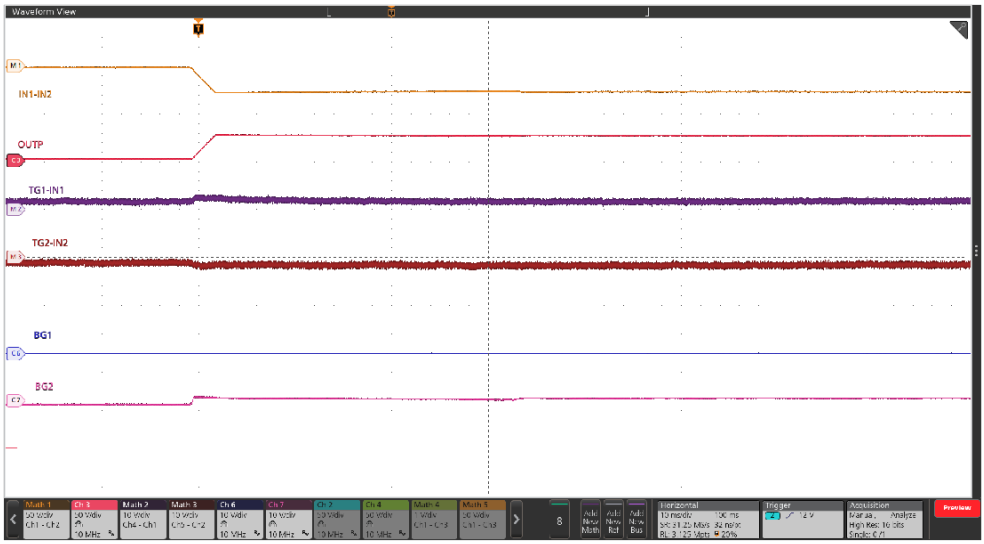

Figure 2-3. LM74681 Reverse Connection UVLO Behavior

2.3.2 Polarity Agnostic Startup

Use the following instructions to verify the startup behavior of LM74681.

1. Set the input supply voltage to 48V and current limit of 3A
2. Make sure the J2 jumper setting is set to 2-3.
3. Plug the positive end of power supply to J1 and negative end to J2.
4. Turn ON the power supply and observe the behavior of TG1-IN1, BG1, and OUTP.
5. Turn OFF the power supply and reverse the connection on J1 and J2.
6. Turn ON the power supply and observe the behavior of TG2-IN2 and BG2 with OUTP same as step 4.

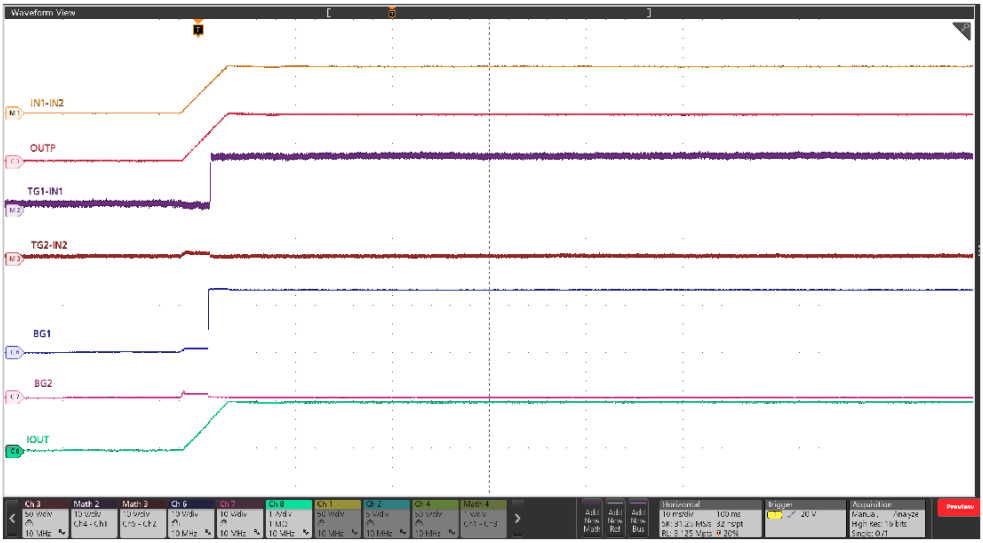

Figure 2-4. LM74681 Forward Connection Startup

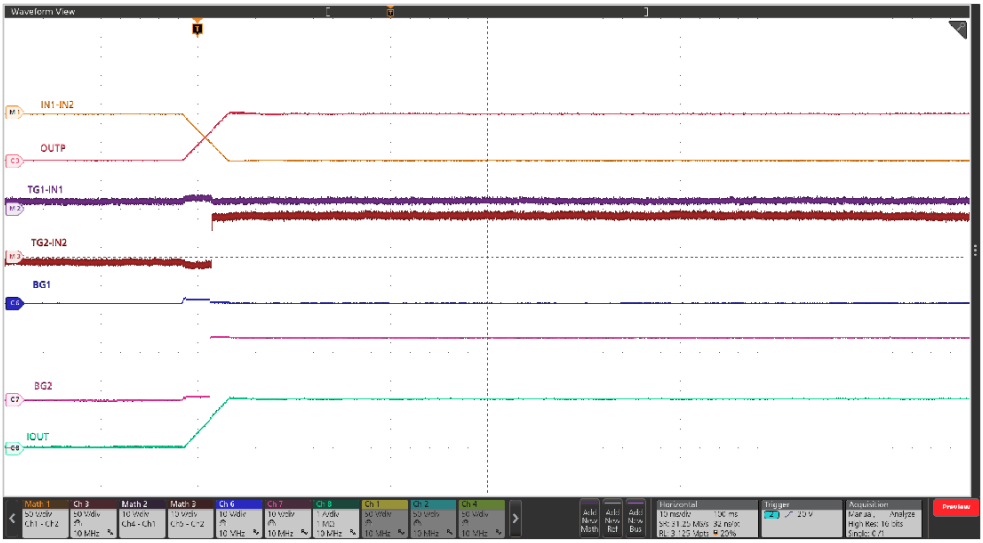

Figure 2-5. LM74681 Reverse Connection Startup

3 Hardware Design Files

3.1 Schematic

Figure 3-1 illustrates the EVM schematic.

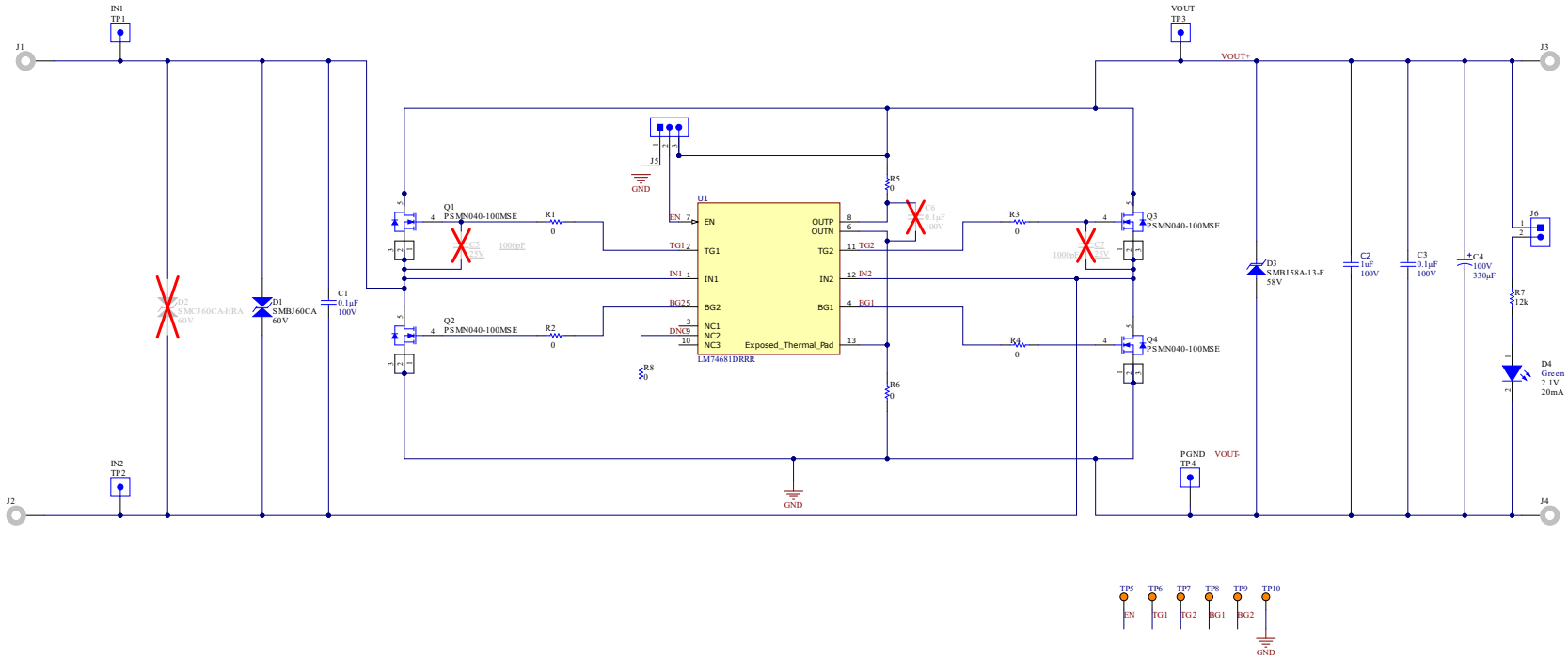

Figure 3-1. LM74681EVM: Evaluation Module Schematic

3.2 PCB Layouts

Figure 3-2 and Figure 3-3 show component placement of the EVAL board. Figure 3-4 and Figure 3-5 show PCB layout images.

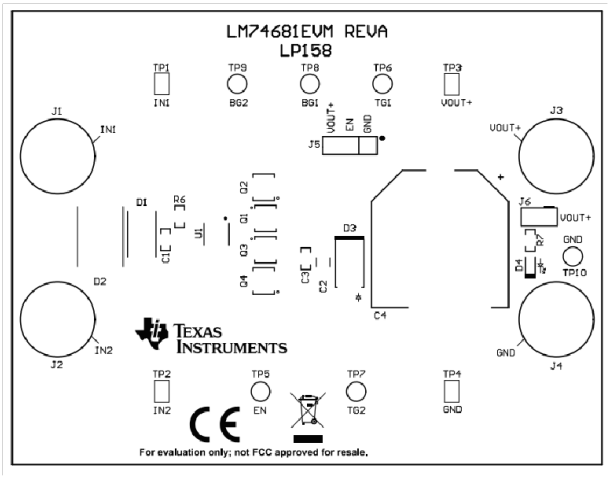

Figure 3-2. LM74681EVM Board Top Overlay

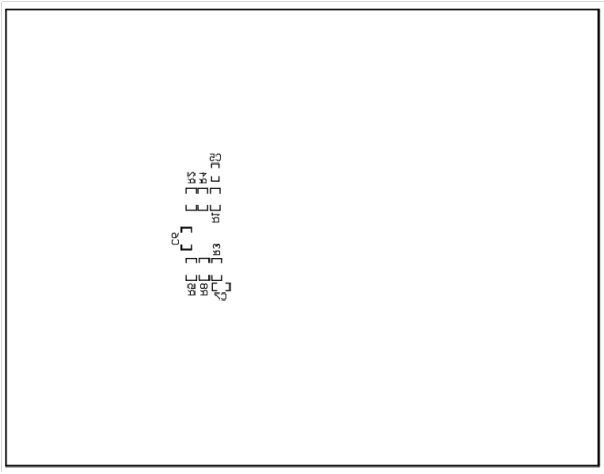

Figure 3-3. LM74681EVM Board Bottom Overlay

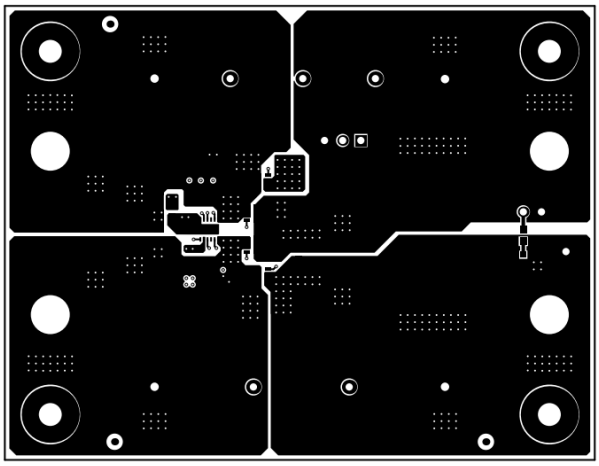

Figure 3-4. LM74681EVM Board Top Layer

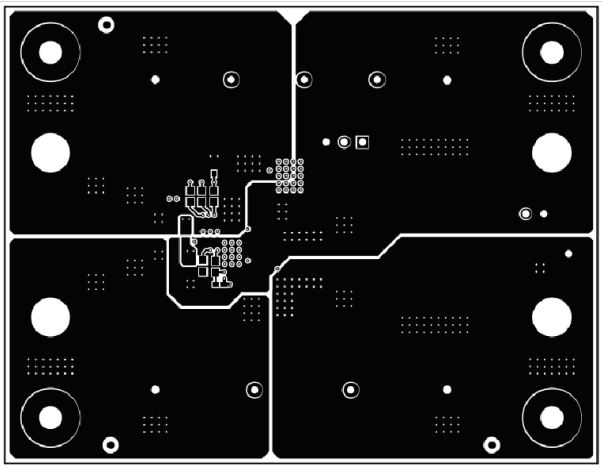

Figure 3-5. LM74681EVM Board Bottom Layer

3.3 Bill of Materials (BOM)

Section 3.3 lists the EVM BOM.

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		LM74681EVM	Any
C1, C3	2	0.1uF	CAP, CERM, 0.1 µF, 100 V,+/- 10%, X8L, AEC-Q200 Grade 0, 0603	0603	GCJ188L8EL104KA07D	MuRata
C2	1	1µF	1µF ±10% 100V Ceramic Capacitor X8L 1206 (3216 Metric)	1206	GCJ31CL8EL105KA07L	Murata
C4	1	330uF	CAP, AL, 330 µF, 100 V, +/- 20%, AEC-Q200 Grade 1, SMD	Cap, 1800x1650mm	EEVTG2A331M	Panasonic
D1	1	60V	Diode, TVS, Bi, 60 V, SMB	SMB	SMBJ60CA-13-F	Diodes Inc.
D3	1	58V	Diode, TVS, Uni, 58 V, 93.6 Vc, SMB	SMB	SMBJ58A-13-F	Diodes Inc.
D4	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
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
J5	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J6	1		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
Q1, Q2, Q3, Q4	4	100V	MOSFET, N-CH, 100 V, 30 A	LFPAK	PSMN040-100MSEX	Nexperia
R1, R2, R3, R4, R5, R6, R8	7	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R7	1	12k	RES, 12 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060312K0JNEA	Vishay-Dale
SH1, SH2	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4	4		TEST POINT SLOTTED .118", TH	Test point, TH Slot Test point	1040	Keystone
TP5, TP6, TP7, TP8, TP9, TP10	6		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
U1	1		Ideal Diode Bridge Controller	WSON12	LM74681DRRR	Texas Instruments
C5, C7	0	1000pF	CAP, CERM, 1000 pF, 25 V, +/- 5%, X7R, 0402	0402	C0402C102J3RACTU	Kemet
C6	0	0.1uF	CAP, CERM, 0.1 µF, 100 V,+/- 10%, X8L, AEC-Q200 Grade 0, 0603	0603	GCJ188L8EL104KA07D	MuRata
D2	0	60V	Diode, TVS, Bi, 60 V, 96.8 Vc, SMC (no polarity)	DO-214AB (no polarity)	SMCJ60CA-HRA	Littelfuse

4 Additional Information

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