TPS61093EVM-519 User's Guide

The TPS61093EVM is an evaluation board to assist in evaluting the TPS61093 IC as a boost or step-up power supply.

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1 Introduction

1.1 Description

The TPS61093 is a 1.2-MHz, fixed-frequency boost converter designed for high integration and high reliability. The IC integrates a 20-V power switch, input/output isolation switch, and power diode. When the output current exceeds the over load limit, the IC's isolation switch opens up to disconnect the output from the input. This protects the IC and the input supply. The isolation switch also disconnects the output from the input during shutdown to minimize leakage current. When the IC is shutdown, the output capacitor is discharged to a low voltage level by internal diodes. Other protection features include 1.1-A peak over-current protection (OCP) at each cycle, output over voltage protection (OVP), thermal shutdown, and under voltage lockout (UVLO).

With its 1.6-V minimum input voltage, the IC can be powered by two alkaline batteries, a single Li-ion battery, or 3.3-V and 5-V regulated supply. The output can be boosted up to 17-V. The TPS61093 is available in 2.5 mm × 2.5 mm SON package with thermal pad.

1.2 Applications

- Glucose Meter
- OLED Power Supply
- 3.3-V to 12-V, 5-V to 12-V Boost Converter

1.3 Features

- Input Range: 1.6-V to 6-V
- Integrated Power Diode and Isolation FET
- 20-V Internal Switch FET With 1.1-A Current
- Fixed 1.2-MHz Switching Frequency
- Over Load and Over Voltage Protection
- Programmable Soft Start-up
- Load Discharge Path After IC Shutdown

2 TPS61093EVM Electrical Performance Specifications

The specifications below are for TA = 25°C unless otherwise specified.

Table 1. TPS61093EVM Electrical and Performance Specifications

Parameter		Notes & Conditions	Min	Nom	Max	Units
INPUT CHARACTERISTICS						
V_{IN} at J1	Input Voltage		1.6		6	V
V_{IN_UVLO}	Input UVLO	V_{IN} falling		1.5	1.55	V
OUTPUT CHARACTERISTICS						
OUT at J7	Output Voltage	V_{IN} = 1.6 V, I_{OUT} < 25 mA	14.4	15.0	15.6	V
		V_{IN} = 6 V, I_{OUT} < 300 mA				
F_{SW}	Switching Frequency		1.0	1.2	1.4	MHz

3 Modifications

3.1 General

To aid user customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space. Changing components can improve or degrade EVM performance. For example, adding a larger output capacitor reduces output voltage undershoot but lengthens response time after a load transient event. Due to the internal compensation, the inductor and output capacitor must remain within the datasheet limits in order for the boost converter to remain control loop stability.

3.2 Output Voltage

The TPS61093's output voltage is adjutable and is set by resistors R1 and R2. To change the output voltage, the user should consult the datasheet on how to properly size R1 and R2 and potentially C6.

3.3 Using VO instead of OUT

The TPS61093 has two output pins, OUT and VO. The EVM is designed to regulate the voltage on the OUT pin, with external loads being applied between J7 and J8. If the application requires slightly higher efficiency at heavy loads but does not need input-to-output isolation during shutdown or over load protection, the user can modify the EVM so that it regulates the voltage at the VO pin by

- moving the 0 ohm resistor from R4 to R3,
- replacing C2=0.1uF with a 1 uF or larger output capacitor and
- removing C4=1uF.

Once the above modifications are made, the user must only apply external loads between J4 and J6 in order for the converter to properly regulate the output voltage.

4 Schematic

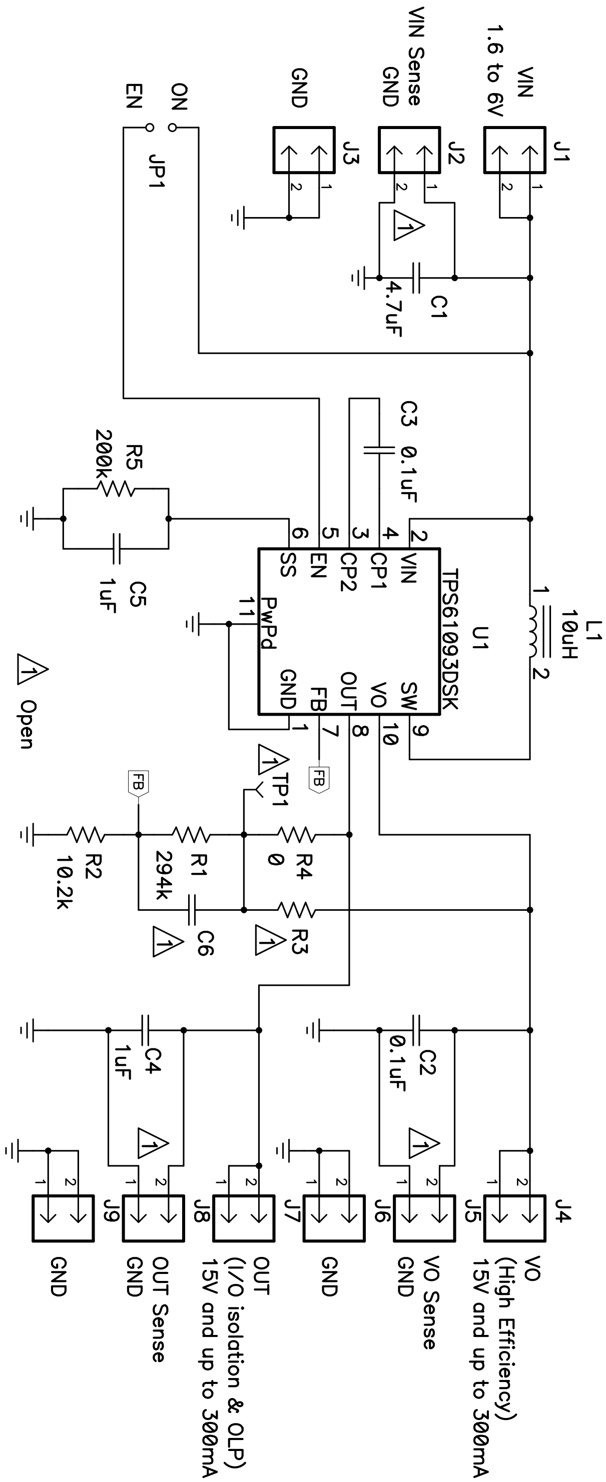

Figure 1. TPS61093 EVM Schematic

5 Connector and Test Point Descriptions

5.1 J1 –VIN

This header is the positive connection to the input power supply and is tied to the ICs VIN pin. The power supply must be connected between J1 and J3 (GND). The leads to the input supply should be twisted and kept as short as possible. The input voltage must be between 1.6-V and 6-V.

5.2 J2 – VIN and GND Kelvin Sense

Although not installed, this header provides Kelvin sense connections across the input capacitor C1.

5.3 J3 – GND

This header is the return connection to the input power supply and is tied to the ICs GND pin. The user must connect the power supply between J3 and J1 (VIN). The leads to the input supply should be twisted and kept as short as possible. The input voltage must be between 1.6-V and 6-V.

5.4 J4 – VO

This header connects to the pin that is the output of the non-synchronous boost converter before the input-to-output isolation switch. Unless the modifications in section 3.2 are made, this header should only be used for measuring the boost converter output voltage prior to the input-to-output isolation. If the modifications in section 3.2 are made, then the output voltage at this header is the regulated output voltage and the user can apply external loads between J4 and J6 (GND).

5.5 J5– VO and GND Kelvin Sense

Although not installed, this header provides Kelvin sense connections across the input capacitor C2.

5.6 J6 – GND

This header is connected to the IC's GND pin. If the modifications in section 3.2 are made to cause the voltage at J4 to be the regulated output voltage, then this header provides the return connection for an external load applied at J4.

5.7 J7– OUT

This header connects to the pin that is the output of the non-synchronous boost converter after the input-to-output isolation switch. Unless the modifications in section 3.2 are made, the output voltage at this header is the regulated output voltage and external loads can be applied between J7 and J9 (GND). If the modifications in section 3.2 are made, this header should not be used.

5.8 J8– OUT and GND Kelvin Sense

Although not installed, this header provides Kelvin sense connections across the input capacitor C4.

5.9 J9– GND

This header is connected to the IC's GND pin and provides the return connection for an external load applied at J7.

5.10 JP1– EN

Pin one of this jumper connects to the IC's EN pin. When its shunt is installed, this jumper ties the EN pin to VIN thereby turning on the boost converter. The isolation switch also turns on and connects pins VO (J4) and OUT (J7). Removing the shunt from this jumper allows its internal pull down resistor to pull it to ground thereby disabling the converter and disconnecting VO (J4) and OUT (J7).

5.11 TP1 – Test Point

This test point can be used to measure the small signal control loop gain and phase with a Venable or similar gain phase analyzer. The user must replace the 0-ohm resistor in R3 or R4 with a 49.9-100 ohm resistor before attaching a gain/phase analyzer between the output voltage and TP1.

6 Test Setup and Results

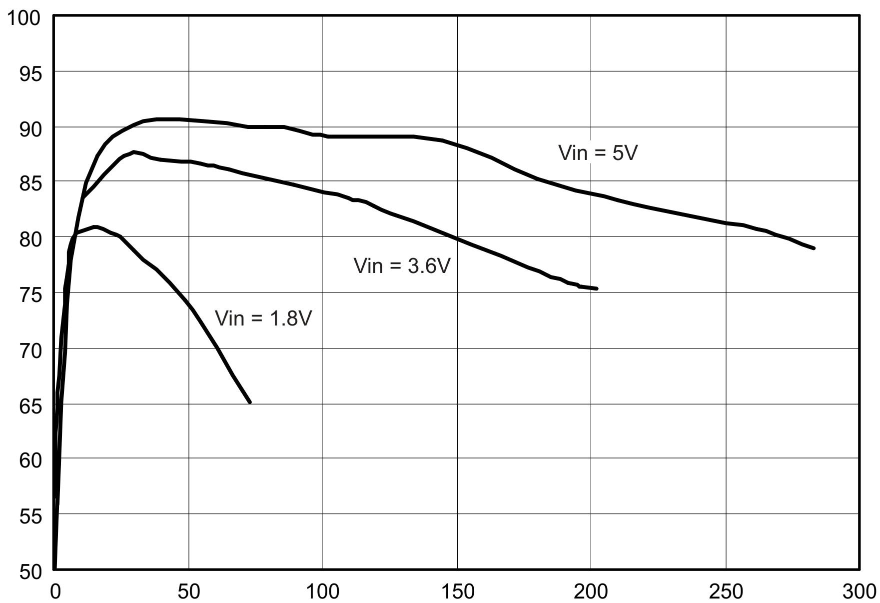

Figure 2. Efficiency at OUT

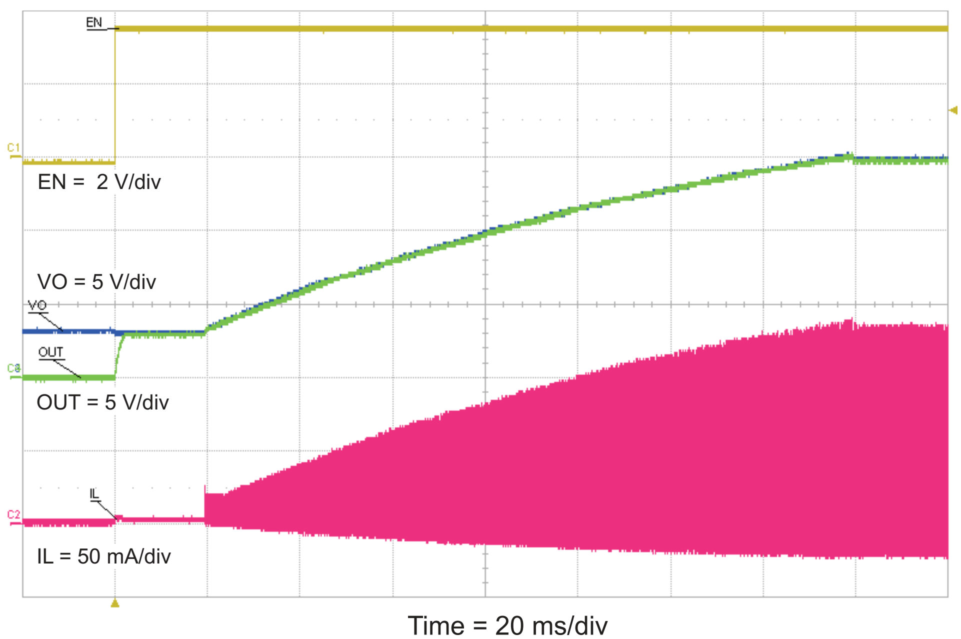

Figure 3. Startup with V_{IN} = 3.6V and R_{LOAD} = 1500 Ω

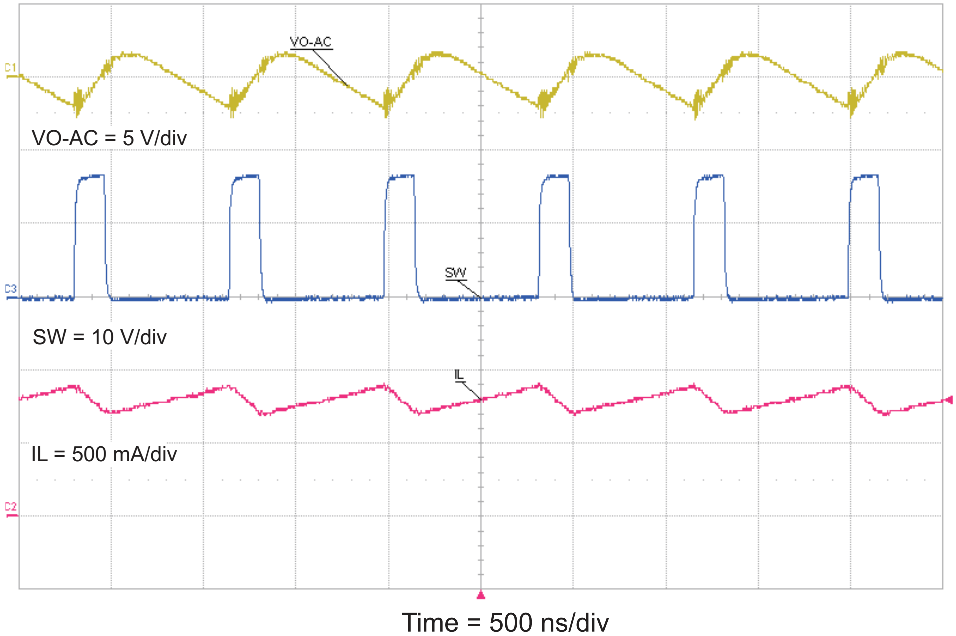

Figure 4. Operation with V_{IN} = 3.6V and I_{OUT} = 200mA

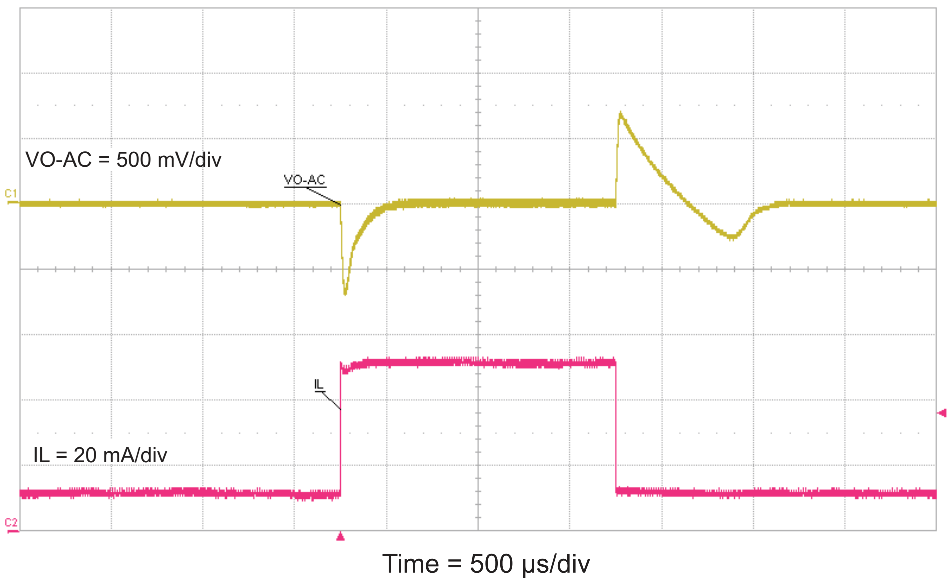

Figure 5. Load Transient with V_{IN} = 2.5V and I_{OUT} from 10mA to 50mA

7 EVM Assembly Drawings and Layout

Figure 6 through Figure 8 show the design of HPA519, the TPS61093EVM's printed circuit board. The EVM has been designed using a 2-Layer, 1oz copper-clad, 2 inch x 2 inch circuit board.

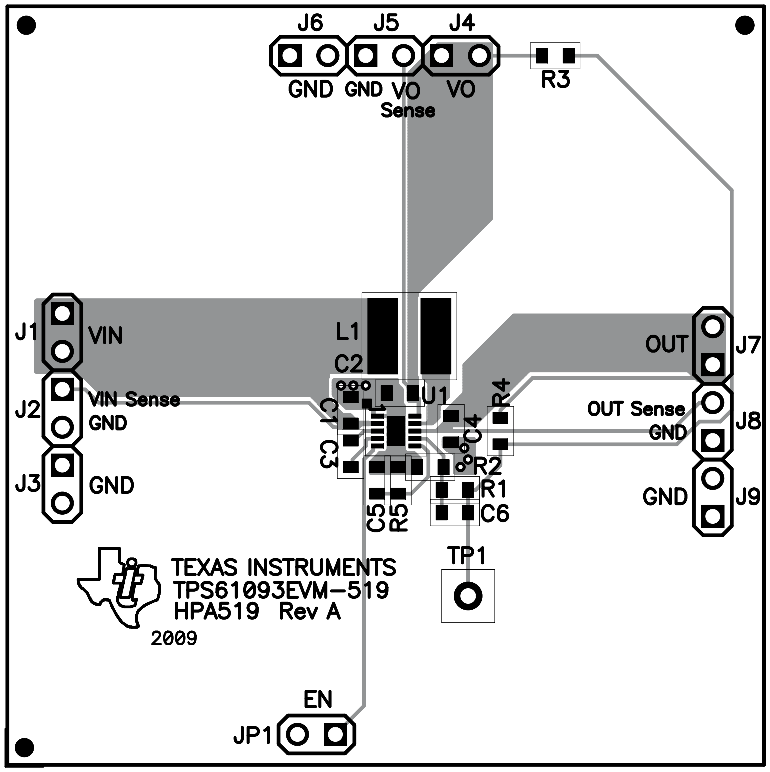

Figure 6. TPS61093EVM Top and Silkscreen (Viewed from Top)

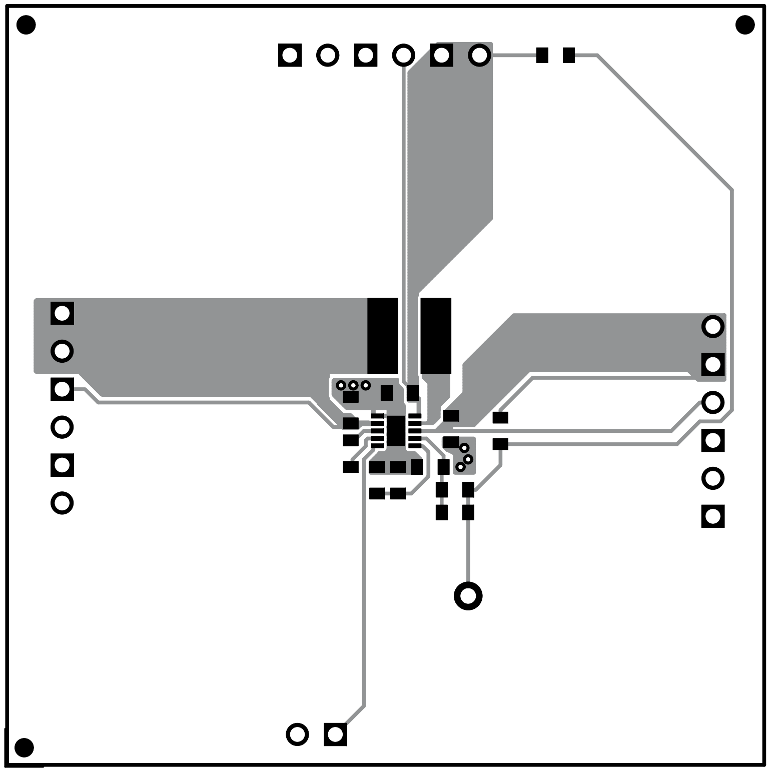

Figure 7. TPS61093EVM Top Copper

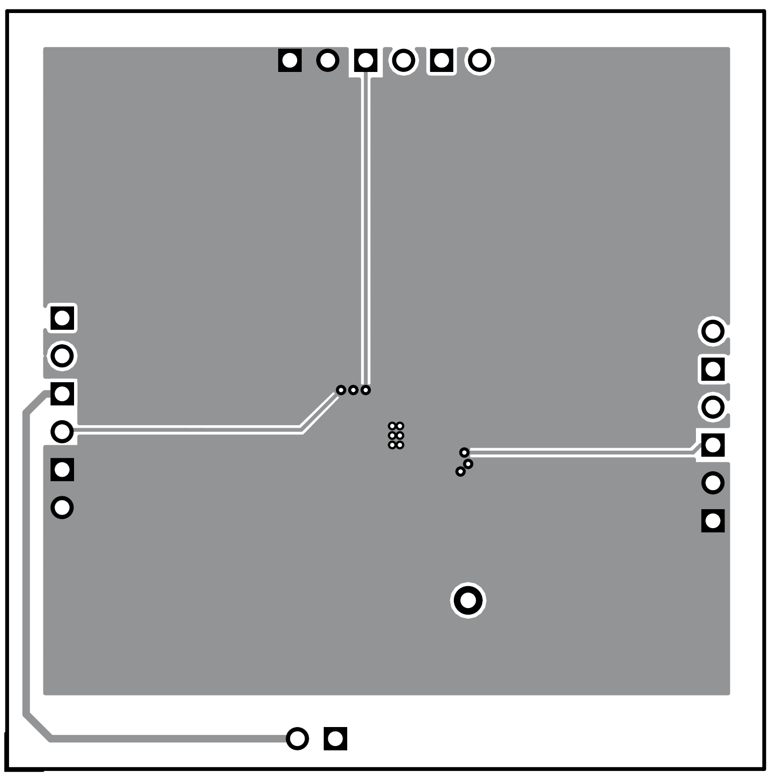

Figure 8. TPS61093 EVM Bottom Layer

8 Bill of Materials

Table 2 lists the EVM components as configured according to the schematic shown in Figure 1.

Table 2. TPS61093EVM Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	4.7µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	Std	Std
1	C2	0.1µF	Capacitor, Ceramic, 25V, X5R, 20%	0603	Std	Std
1	C3	0.1µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	Std	Std
1	C4	1µF	Capacitor, Ceramic, 25V, X5R, 20%	0603	Std	Std
1	C5	1µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	Std	Std
0	C6	Open	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	Std	Std
0	J2, J5, J8	Open	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
6	J1, J3, J4, J6, J7, J9	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN	Sullins
1	JP1	PEC02SAAN	Header, 2-pin, 100mil spacing Inductor,	0.100 inch x 2	PEC02SAAN	Sullins
1	L1	10uH	SMT, 1.4A, 127 milliohm	0.189 x 0.189 inch	LPS5030-103ML	Coilcraft
1	R1	294k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	10.2k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R3	Open	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	200k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	TP1	Open	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	U1	TPS61093DSK	IC, Low Input Boost Converter with Integrated Power Diode and Isolation	QFN	TPS61093DSK	TI
1	—		Shunt, 100-mil, Black	0.100	929950-00	3M
1			PCB	2.0"x 2.0"x 0.062"	HPA519	Any