User's Guide

TPS6213xEVM Buck Converter Evaluation Module User's Guide

TEXAS INSTRUMENTS

ABSTRACT

This user's guide describes the characteristics, operation, and use of TI's TPS62135 and TPS62136 evaluation modules (EVM). These EVMs are designed to help the user easily evaluate and test the operation and functionality of the TPS62135 and TPS62136 4-A buck converters. The EVMs convert a 3-V to 17-V input voltage to a regulated 3.3-V or 5-V output voltage that delivers up to 4 A. This user's guide includes setup instructions for the hardware, a printed-circuit board (PCB) layout, a schematic diagram, a bill of materials (BOM), and test results of the EVMs. Throughout this document, TPS6213xEVM-698 is used as an abbreviation representing the TPS62135EVM-698 (001) and TPS62136EVM-698 (002) EVMs.

Table of Contents

List of Figures

List of Tables

Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The TPS62135 and TPS62136 are 4-A, synchronous, step-down converters in 3 mm × 2 mm, 11-pin QFN packages. The TPS62135EVM-698 (PWR698-001) uses the TPS62135 integrated circuit (IC) which operates with a nominal switching frequency of 2.5 MHz. The TPS62136EVM-698 (PWR698-002) uses the TPS62136 IC which operates with a nominal switching frequency of 1 MHz.

1.1 Performance Specification

Table 1-1 provides a summary of the TPS6213xEVM-698 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1-1. Performance Specification Summary

Specification		Test Conditions	MIN	TYP	MAX	Unit
Input voltage			3		17	V
Output voltage setpoint	VSEL = High			5		V
	VSEL = Low			3.3		V
Output current			0		4	A

1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate the adjustable voltage version of this integrated circuit (IC). On the EVM, additional input and output capacitors can be added, the soft-start time can be changed, the tracking voltage and the input voltage at which the IC turns on can be adjusted. Finally, the loop response of the IC can be measured.

1.2.1 Input and Output Capacitors

C5 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

C7, C8, and C9 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. For output voltages higher than 5 V, more output capacitance is necessary. The total output capacitance must remain within the recommended range in the TPS62135 (SLVSBH3) and TPS62136 (SLVSDV2) data sheet for proper operation.

1.2.2 Soft-Start Time

C3 controls the soft-start time of the output voltage on the TPS6213xEVM-698. It can be changed for a shorter or slower ramp up of Vout. Note that as the value of C3 is decreased, the inrush current increases.

1.2.3 Configurable Tracking Voltage

R5 and R6 can be installed to set a user-selectable tracking voltage. See the equations in the data sheet for details of calculating the resistor values.

1.2.4 Configurable Enable Threshold Voltage

With JP1 removed, R7 and R8 can be installed to set a user-selectable input voltage at which the IC turns on. See the equations in the data sheet for details of calculating the resistor values.

1.2.5 Loop Response Measurement

The loop response of the TPS6213xEVM-698 can be measured with two simple changes to the circuitry. First, install a 10-Ω resistor across the pads in the middle of the back of the PCB. The pads are spaced to allow installation of 0603-sized resistors. Second, cut the trace between the via on the VOS pin on the top layer and output capacitor. These changes are shown in Figure 1-1. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor.
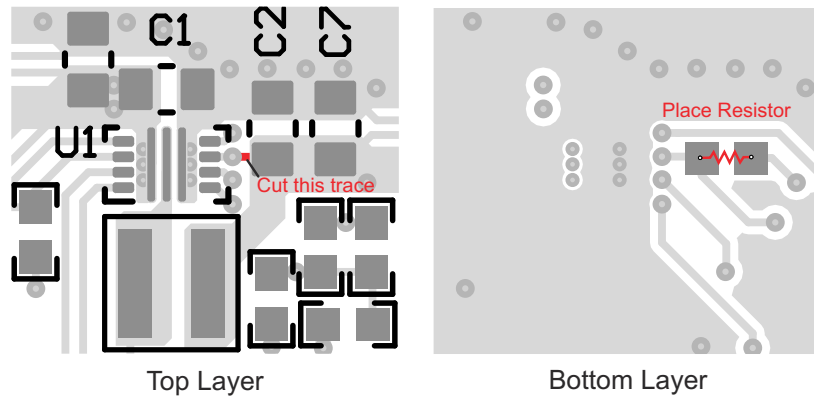
Figure 1-1. Loop Response Measurement Modification

2 Setup

This section describes how to properly use the TPS6213xEVM-698.

2.1 Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input voltage connection from the input supply for the EVM.
J1, Pin 3 and 4 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM.
J2, Pin 1 and 2 – VOUT	Positive output voltage connection.
J2, Pin 3 and 4 – S+/S–	Output voltage sense connections. Measure the output voltage at this point.
J2, Pin 5 and 6 – GND	Output return connection.
J3 – SS/TR/GND	The SS/TR pin voltage appears on pin 1 of this header with a convenient ground on pin 3.
J3 – TRACK-IN	The TRACK-IN pin can be used to scale down a tracking-voltage.
J4 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
JP1 – EN	EN pin jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
JP2 – MODE	Mode pin jumper. Place the supplied jumper across PWM and MODE to operate the converter in a forced PWM mode. Placed the jumper across MODE and PFM to operate the converter in power-saving mode.
JP3 – VSEL	VSEL pin jumper. Place the supplied jumper across LOW and VSEL for 3.3-V output. Place the jumper across HIGH and VSEL for 5-V output.
JP4 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP4 to connect the PG pin pullup resistor to the output voltage. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 1 to pull up the PG pin to a different level. This externally applied voltage must remain below 6 V.

2.2 Hardware Setup

To operate the EVM, set jumpers JP1 through JP4 to the desired positions per Section 2.1. Connect the input supply to J1, and connect the load to J2.

3 TPS6213xEVM-698 Test Results

The TPS6213xEVM-698 was used to take the data in the TPS62135 (SLVSBH3) and TPS62136 (SLVSDV2) data sheet. See the device data sheet for the performance of this EVM.

4 Board Layout

This section provides the TPS6213xEVM-698 board layout and illustrations. The Gerbers are available on the EVM product pages: TPS62135EVM-698 and TPS62136EVM-698.
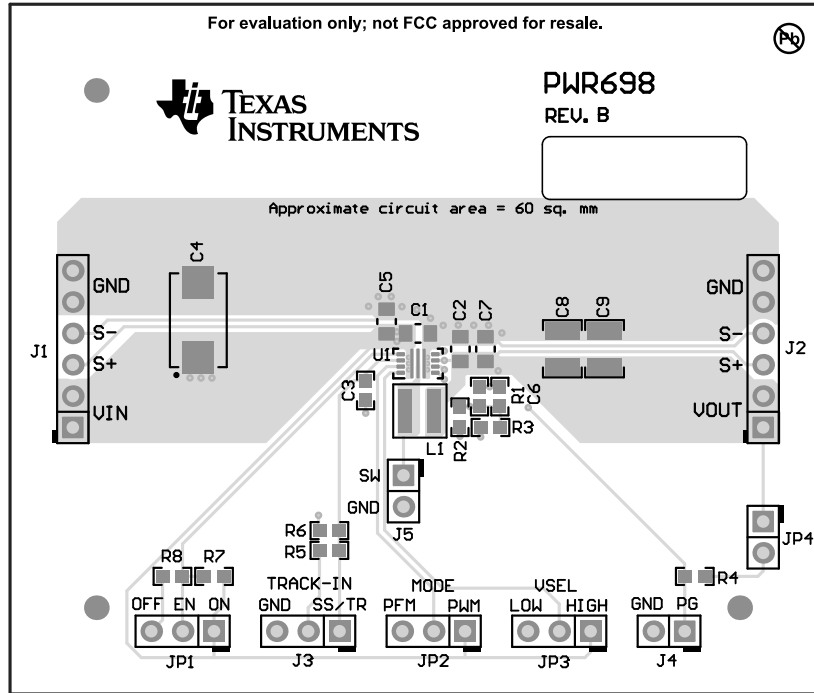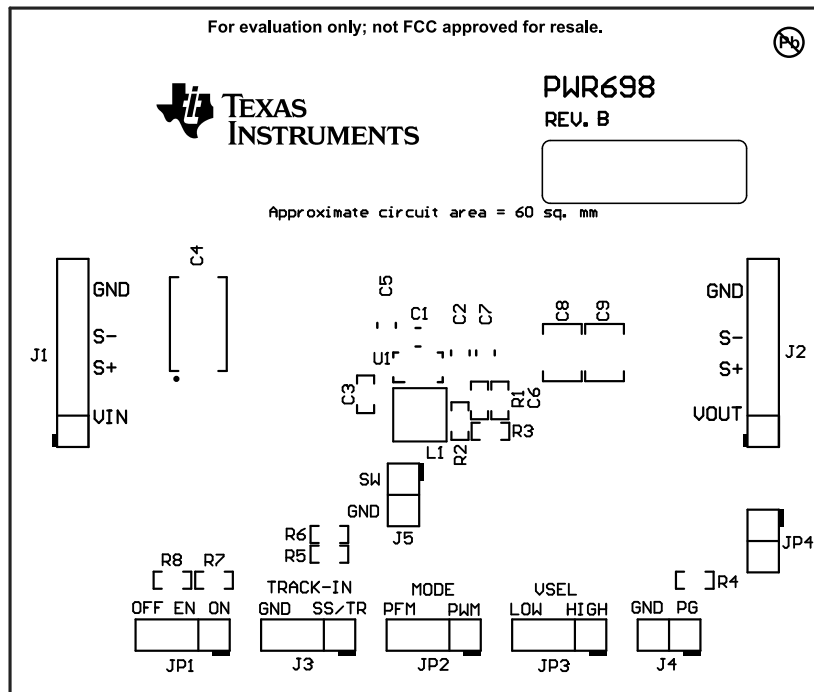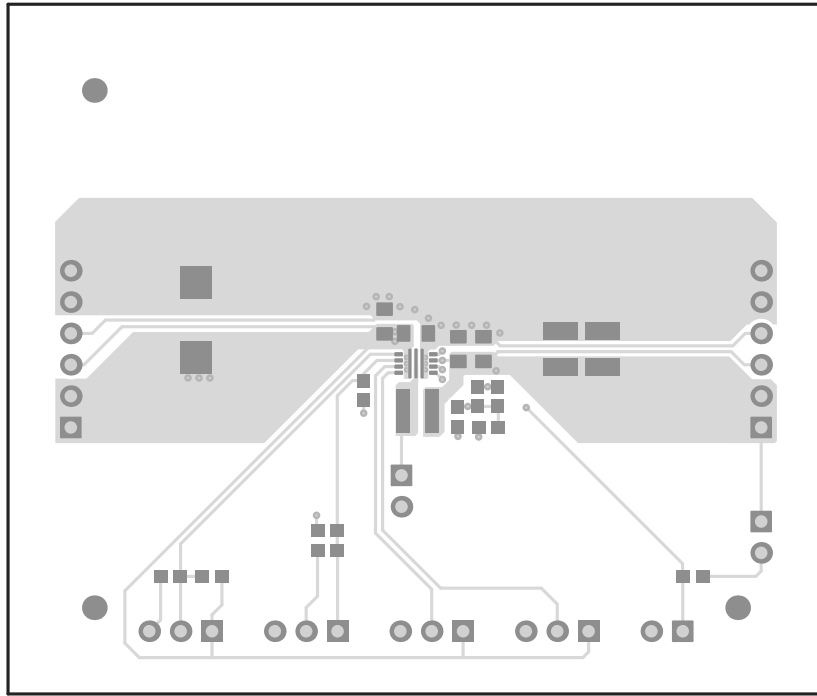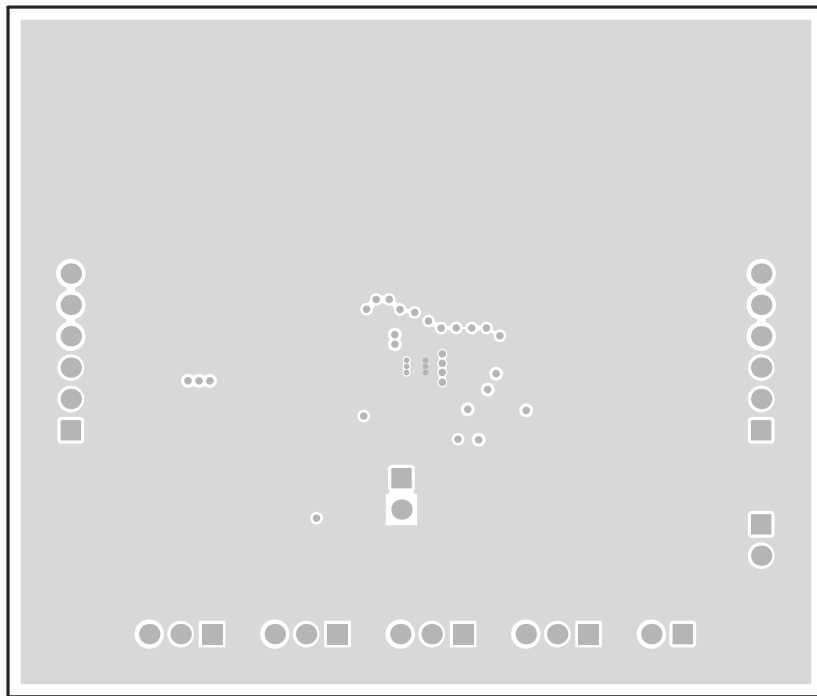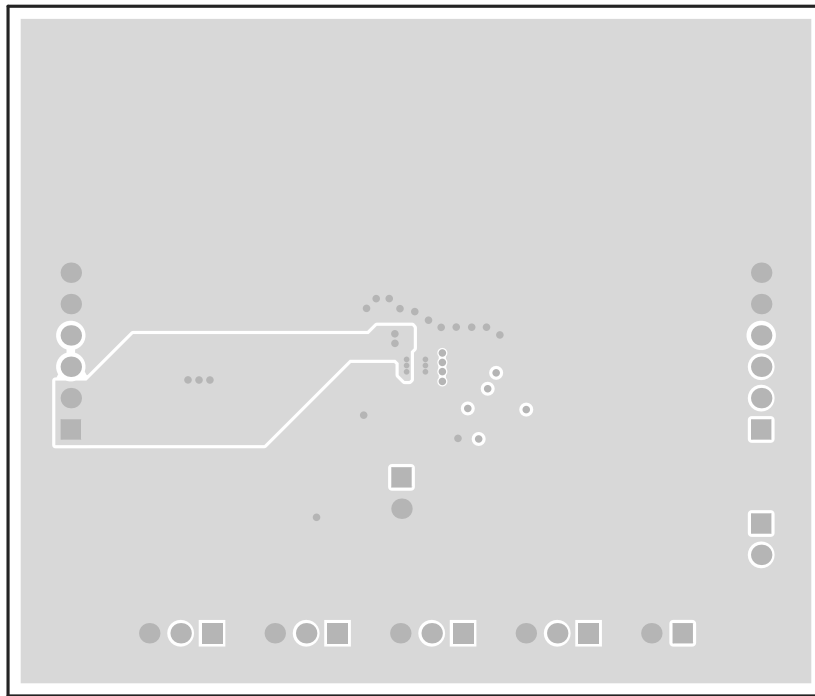

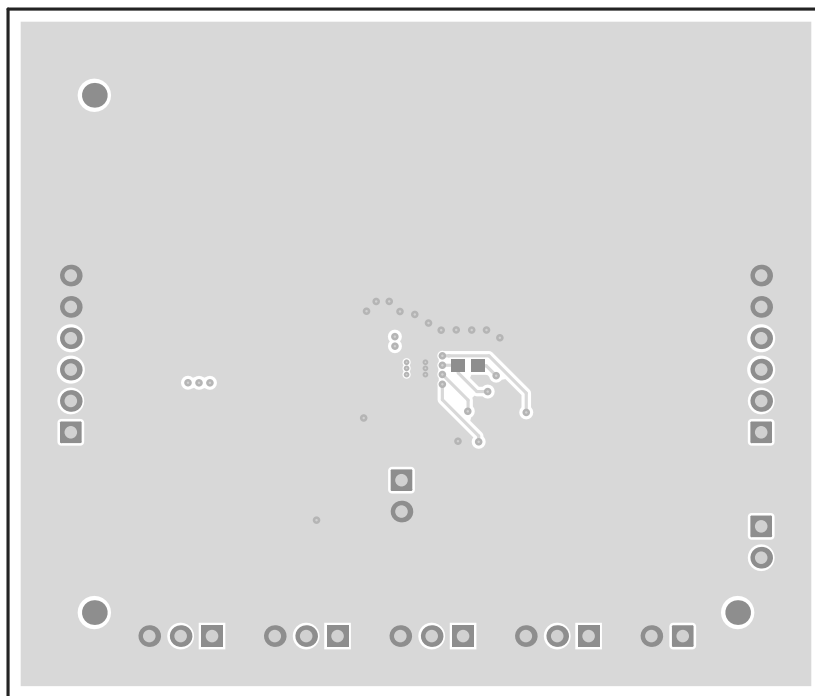**Figure 4-1. Top Assembly**

Figure 4-2. Top Overlay

Figure 4-3. Top Layer

Figure 4-4. Internal Layer 1

Figure 4-5. Internal Layer 2

Figure 4-6. Bottom Layer

5 Schematic and Bill of Materials

This section provides the TPS6213xEVM-698 schematic and bill of materials.

5.1 Schematic

Figure 5-1 and Figure 5-2 illustrate the TPS6213xEVM-698 schematics.
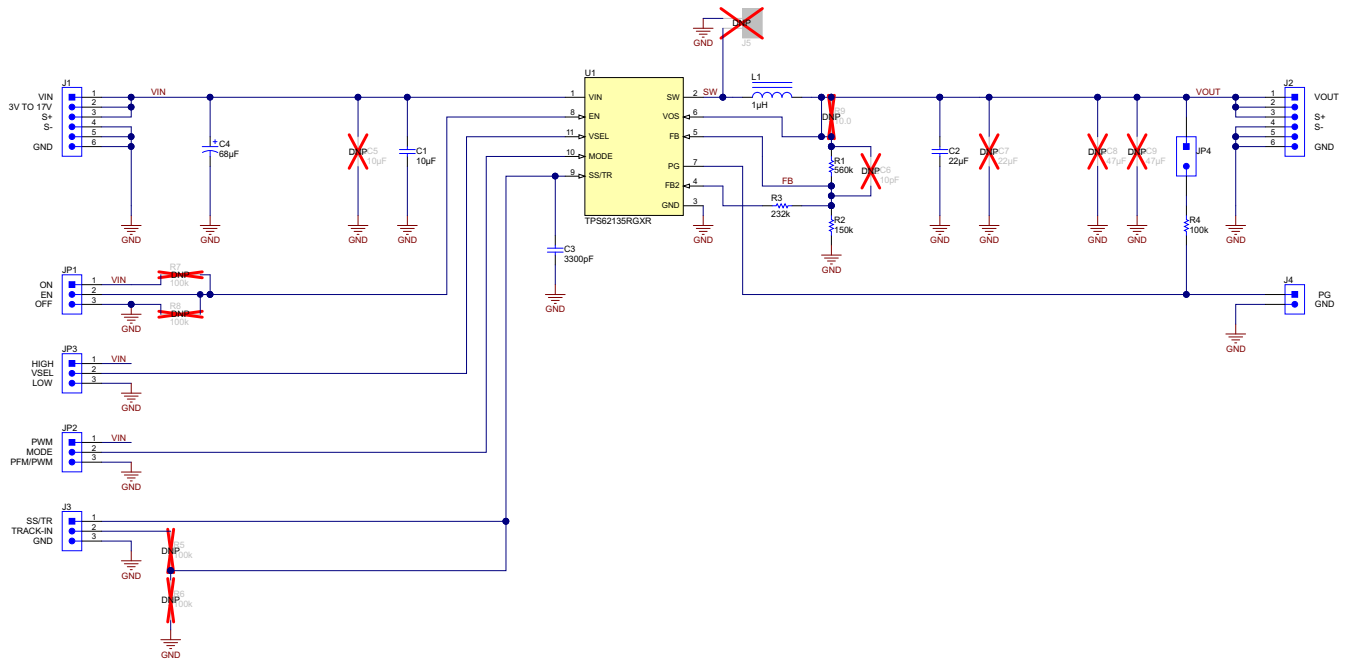
Figure 5-1. TPS62135EVM-698 Schematic
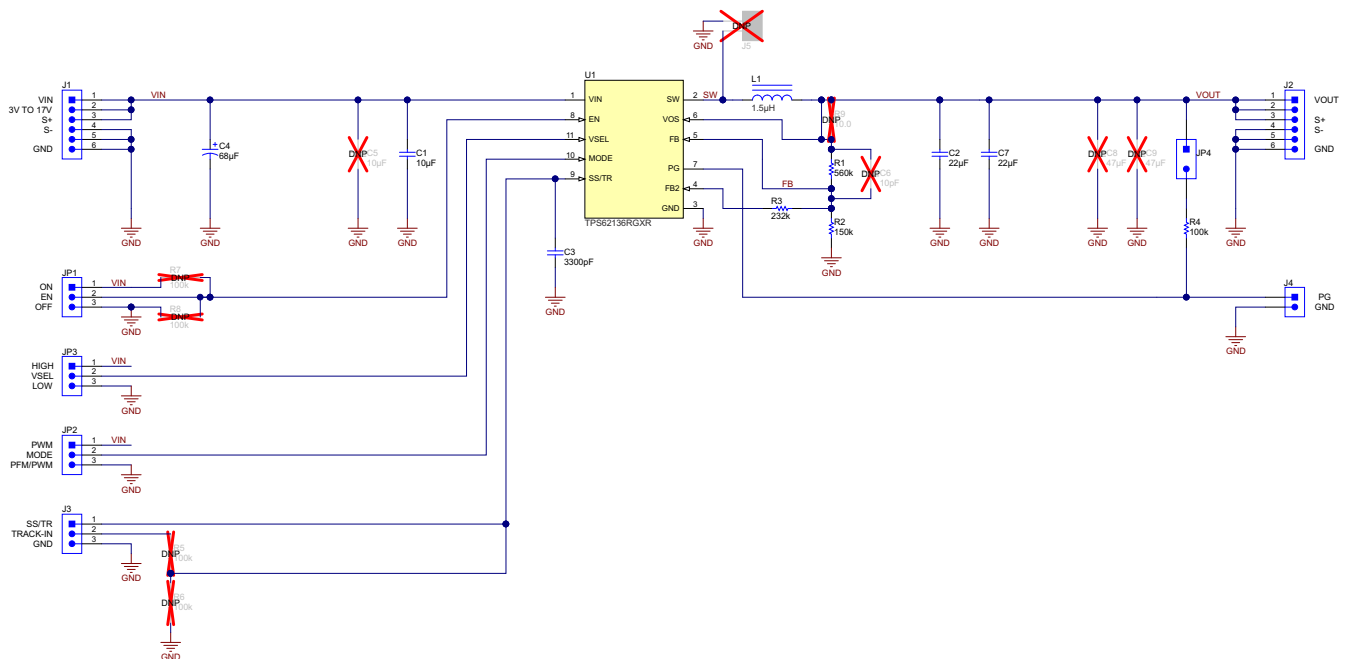
Figure 5-2. TPS62136EVM-698 Schematic

5.2 Bill of Materials

lists the BOM for the TPS6213xEVM-698.

Table 5-1. TPS6213xEVM-698 Bill of Materials

Qty		Ref Des	Value	Description	Size	Part Number	Manufacturer
TPS62135EVM-698	TPS62136EVM-698						
1	1	C1	10 µF	Capacitor, Ceramic, 25V, X5R, ±10%	0805	TMK212BBJ106KG-T	Taiyo Yuden
1	1	C2	22 µF	Capacitor, Ceramic, 16V, X5R, ±20%	0805	EMK212BBJ226MG-T	Taiyo Yuden
1	1	C3	3300 pF	Capacitor, Ceramic, 50V, C0G/NP0, ±5%	0603	Std	Std
1	1	C4	68 µF	Capacitor, Tantalum, 35V, 68uF, ±20%	7343-43	TPSE686M025R0125	AVX
1	0	L1	1.0 µH	Inductor, Shielded, 5.4A, 0.011 Ω, ±20%	4x4x2mm	XFL4020-102MEB	Coilcraft
0	1	L1	1.5 µH	Inductor, Shielded, 7.4A, 0.021 Ω, ±20%	4x4x2mm	XEL4020-152MEB	Coilcraft
1	1	R1	560k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R2	150k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R3	232k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R4	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	U1	TPS62135	IC, 17V 4-A, Step-Down Converter	2x3 mm	TPS62135RGX	TI
0	1	U1	TPS62136	IC, 17V 4-A, Step-Down Converter	2x3 mm	TPS62136RGX	TI

6 Revision History

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

Changes from Revision A (March 2017) to Revision B (June 2021)   **Page**

Changes from Revision * (August 2016) to Revision A (March 2017)   **Page**

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