User's Guide

SLVU348–October 2009

TPS54162EVM

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1 Introduction

The Texas Instruments TPS54162EVM evaluation module (EVM) helps designers evaluate the operation and performance of the TPS54162 Switch Mode Power Supply – Buck Regulator. The device offers configurability and can be setup to switch from 200 kHz up to 2.2 MHz.

The EVM contains one DC / DC converter (see Table 1).

Table 1. Device and Package Configurations

Converter	IC	Package
U1	TPS54162QPWPQ1	PWP-20

2 Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the TPS54162EVM.

2.1 Input/Output Connector Description

J1 – Input is the power input terminal for the converter. The terminal block provides a power (VBAT) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

J2 – Output is the regulated output voltage for the converter. The terminal block provides a power (Vout) and ground (GND) connection to allow the user to attach the EVM to a cable harness.

J3 – Sync is the input terminal for an optional external input clock to the converter. The external clock can be used to synchronize the switching frequency for multiple devices. The external clock frequency must meet the $f_{sw} < f_{ext} < 2 \times f_{sw}$ guideline, if used.

JP1 – LPM is the jumper used to enable Low Power Mode. The jumper allows LPM to be enabled or disabled. The "disabled with protection diode" selection should be used if the output voltage is programmed for voltages greater than 5 V. The external zener prevents over voltage damage to the LPM input.

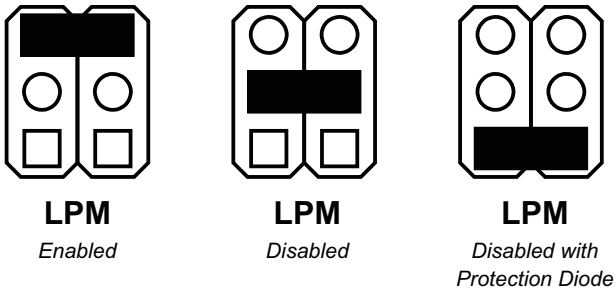


Figure 1. LPM Jumper Settings

JP2 – Enable is the jumper used to enable the converter. The converter is enabled when the enable is high and disabled when low. The jumper placement allows the converter to be enabled or disabled.

Undervoltage lockout can be implemented by setting the R6 and R7 resistors to transition the enable (EN) input low as the supply voltage drops. The equation to set the values for R6 and R7 is:

$$\text{DisableVoltage} = \text{ENTHRES} \times \left(1 + \frac{R6}{R7}\right) \text{ where the ENTHRES ~ 1V.} \quad (1)$$

Resistor R7 is not populated on this EVM to reduce the quiescent supply current if this feature is not required.

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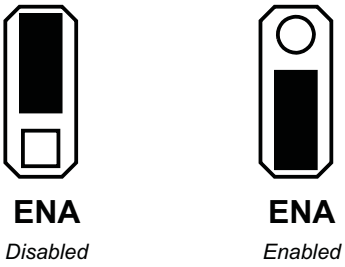


Figure 2. Enable Jumper Settings

JP3 – Slew Rate is the jumper used to set the slew rate for the switch pin. The device slew rate should be set between 15 ns and 200 ns. Slower slew rates can improve EMI performance, but they increase switching losses. Jumper resistors allow the slew rate to be set to four set points. The user can set a specific slew rate by changing one of the slew rate set resistors – R8, R9, or R10. Note that the slew rate should be set to 1 V/1.2 ns if the EVM is configured for a 2-MHz switching frequency.

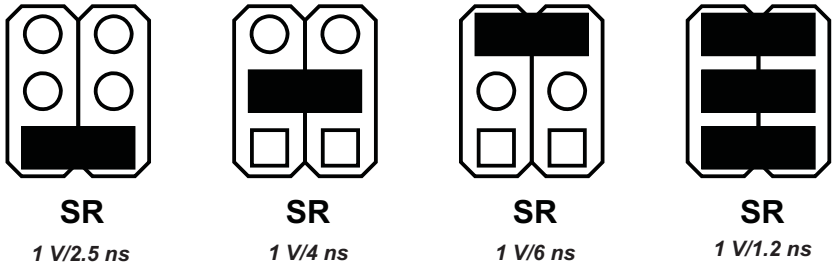


Figure 3. Slew Rate Settings

JP4 – Delay is the jumper used to set the delay time to assert the RESET pin low after the supply has exceeded the programmed Vreg_RST voltage. The delay may be programmed in the range of 2.2 ms to 200 ms. Jumper capacitors allow the reset delay to be set to four set points. The user can set a specific delay time by changing one of the delay capacitors – C13, C14, or C15.

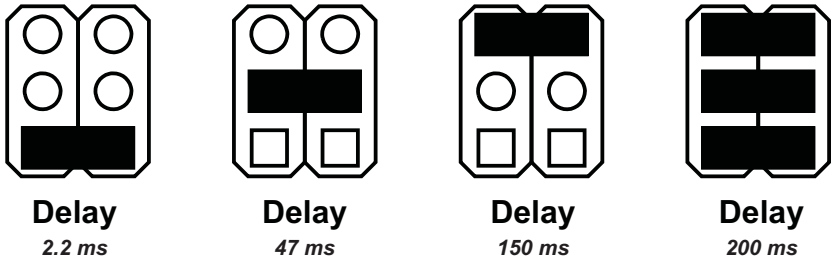


Figure 4. Reset Delay Time Settings

2.2 Setup

The input voltage range for the converter is 3.6 V to 48 V. A load should be applied to the output terminal for proper operation.

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2.3 Operation

For proper operation of the TPS54162, JP1, JP2, JP3, and JP4 should be properly configured. These are the recommended settings, using shorting blocks:

JP1 to Enabled
JP2 to Enabled
JP3 to 1 V/2.5 ns
JP4 to 200 ms

In this configuration, the device powers up when power is applied.

JP1 LPM selects how low-power mode is set, enabled or disabled. JP2 ENA turns the device on or off. JP3 SR selects the slew rate for the switch pin, 1 V/2.5 ns, 1 V/4 ns, 1 V/6 ns or 1 V/1.2 ns. JP4 Delay selects the reset delay time for the device, 2.2 ms, 47 ms, 150 ms, or 200 ms.

3 Board Layout

Figure 5, Figure 6 and Figure 7 show the board layout for the TPS54162EVM PWB. The EVM offers resistors, capacitors and jumpers to program the switch pin slew rate and regulator turn on delay. Jumpers are also provided to enable the device and to enable the low-power mode option.

The TPS54162 converter offers high efficiency but does dissipate power. The PowerPAD™ package offers an exposed thermal pad to enhance thermal performance. This must be soldered to the copper landing on the PCB for optimal performance. The PCB provides 1 oz copper planes on the top and bottom to dissipate heat.

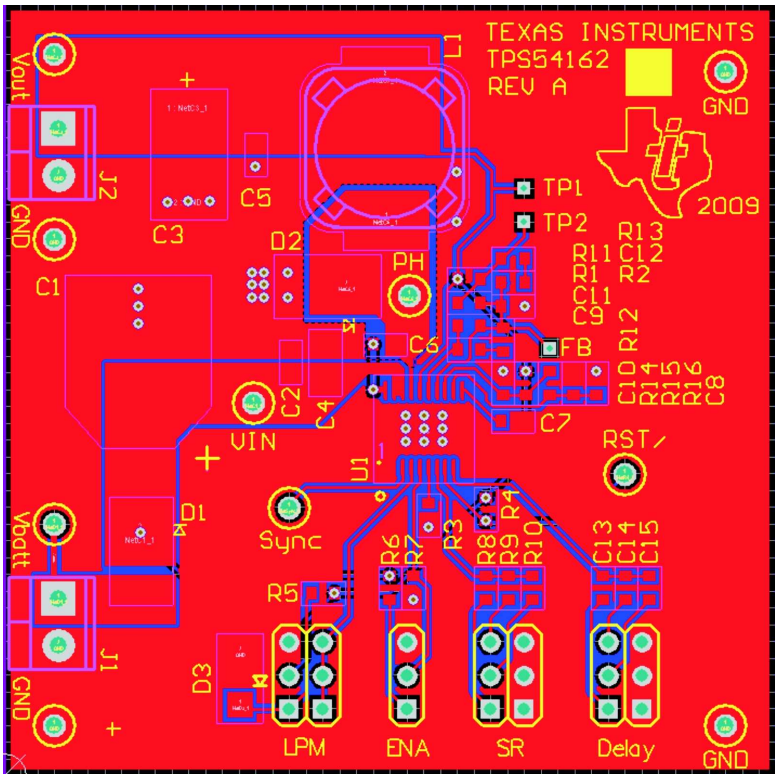


Figure 5. Top Assembly Layer

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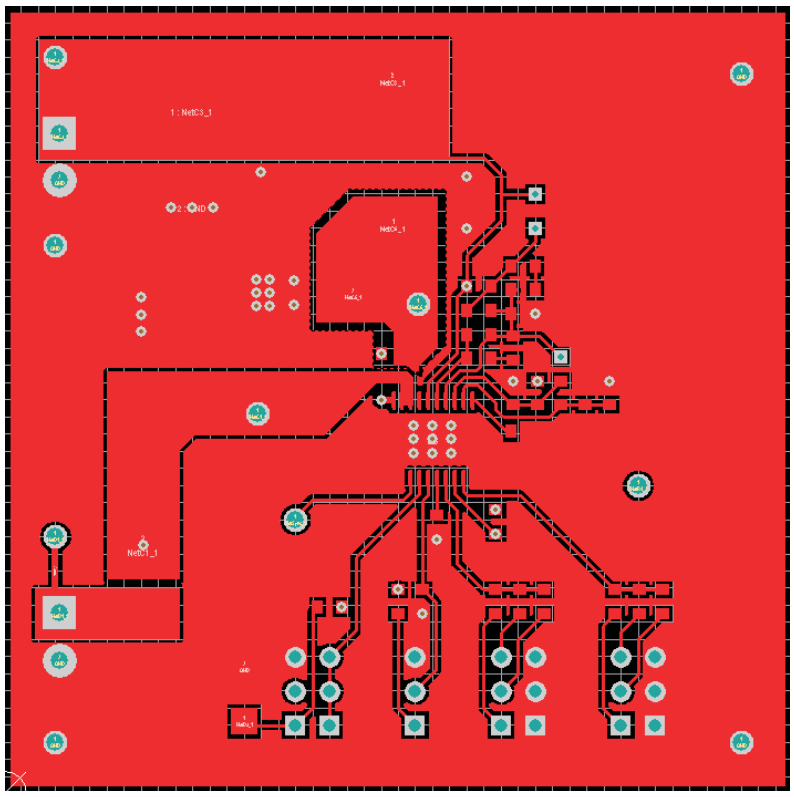


Figure 6. Top Layer Routing

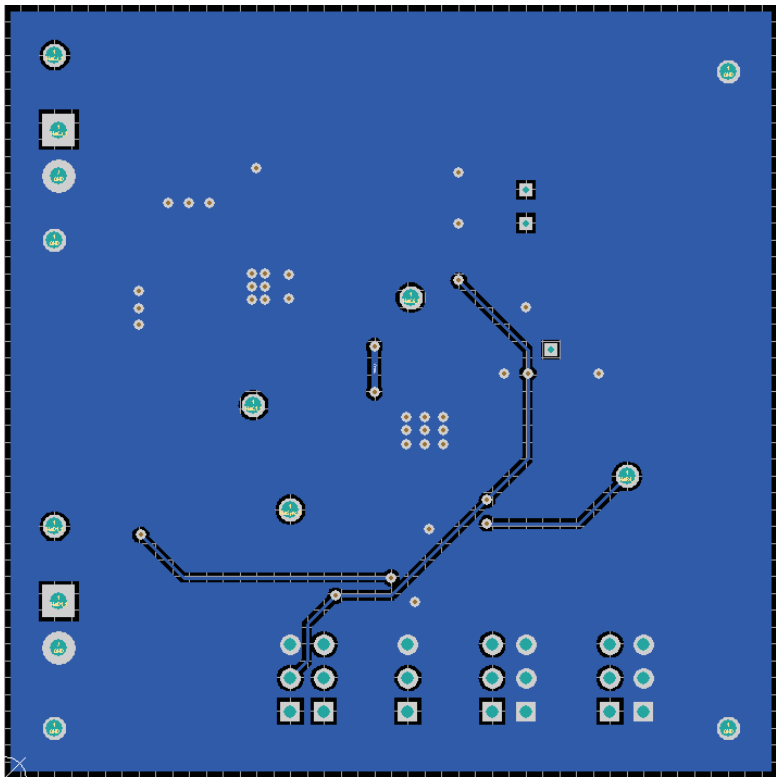


Figure 7. Bottom Layer Routing

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4 Schematic and Bill of Materials

4.1 Schematic

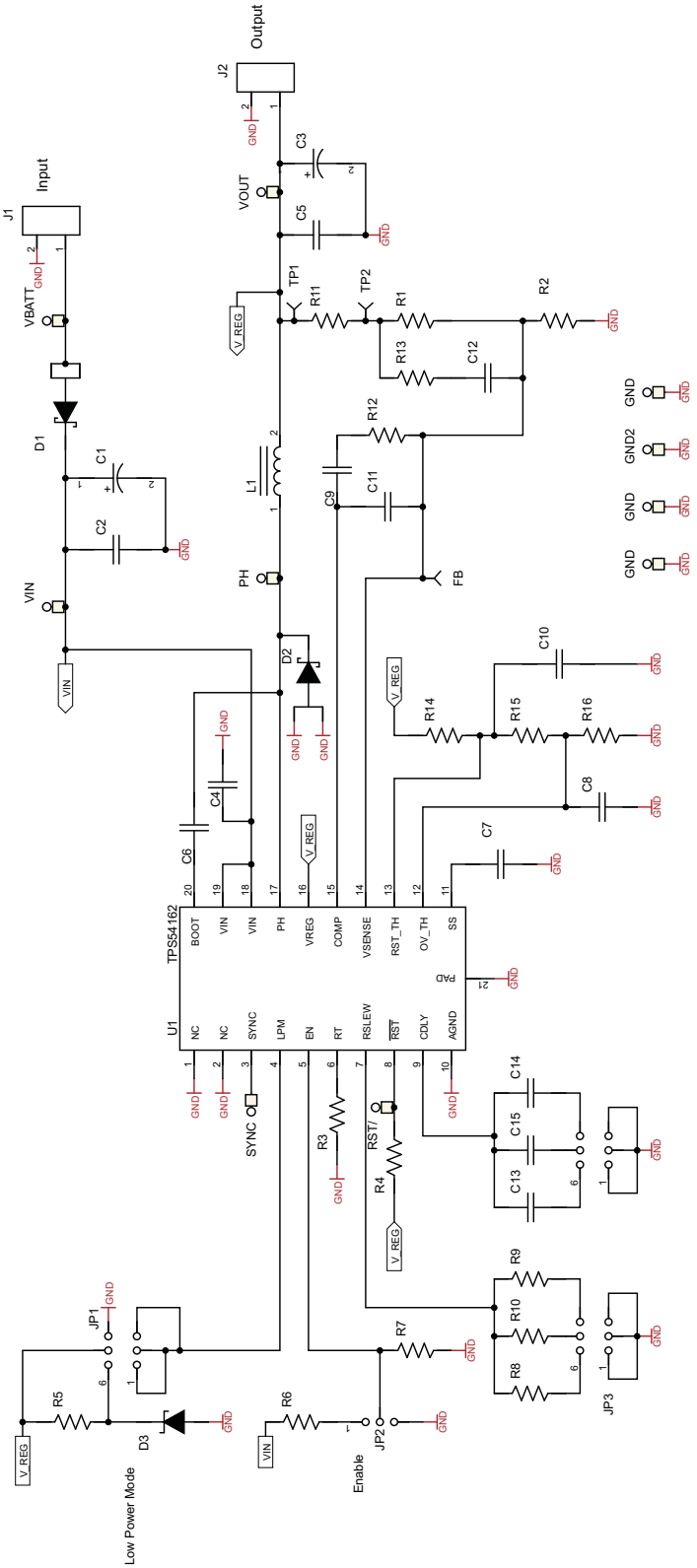


Figure 8. TPS54162EVM Schematic

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4.2 Bill of Materials

Table 2. TPS54162EVM Bill of Materials for 500-kHz Configuration

COUNT	REF DES	DESCRIPTION	SIZE	MFR	PART NUMBER
1	C1	Capacitor, electrolytic, 220 µF, 50 V	10.3mm x 10.3mm	Panasonic	EEVFK1H221P
4	C2, C5, C6, C7	Capacitor, ceramic, 0.1 µF, 50 V, 10%	0603	muRata	GCM188R71H104KA57
1	C3	Capacitor, tantalum, 100 µF, 16 V, 10%	7343-31	AVX	TPSD107M016R0060
1	C4	Capacitor, ceramic, 1 µF, 50 V, 10%	1206	muRata	GCM31MR71H105KA55
2	C8, C11	Capacitor, ceramic, 22 pF, 50 V, 5%	0603	muRata	GCM1885C1H220JA16
1	C9	Capacitor, ceramic, 330 pF, 50 V, 5%	0603	muRata	GCM1885C1H331JA16
1	C10	Capacitor, ceramic, 10 pF, 50 V, 5%	0603	muRata	GRM1885C1H100JA01
1	C12	Capacitor, ceramic, 220 pF, 50 V, 5%	0603	muRata	GCM1885C1H221JA16
1	C13	Capacitor, ceramic, 2.2 nF, 50 V, 5%	0603	muRata	GCM1885C1H222JA16
1	C14	Capacitor, ceramic, 150 nF, 25 V, 10%	0603	muRata	GRM188R71E154KA01
1	C15	Capacitor, ceramic, 47 nF, 50 V, 10%	0603	muRata	GRM188R71H473KA61
2	D1, D2	Diode, Schottky, 3 A, 60 V	PowerDI	Diodes	PDS360-13
1	D3	Diode, Zener, 1 A, 5 V	SMA	Diodes	SMAZ5V1-13
2	J1, J2	Terminal block, 2-pin, 6 A, 3.5 mm	0.25 x 0.27	OST	ED1514
10	Sync, GND (x4), PH, RST/, VBATT, VIN, VOUT	Test point, 52 mil	0.052	Kobiconn	151-103-RC
3	Delay, LPM, SR	Header, 6-pin, 100-mil spacing, (36-pin strip)	0.100 x 3	Sullins	PEC06DAAN
1	ENA	Header, 3-pin, 100-mil spacing, (36-pin strip)	0.100 x 3	Sullins	PEC03SAAN
6	DELAY(x3), ENA, LPM, SR	Connector jumper, shorting, 100-mil spacing	0.100	Sullins	SPC02SYAN
1	L1	Inductor, SMT, 22 µH	12.3mm x 12.3mm	Coilcraft	MSS1278T-223
1	R1	Resistor, chip, 187-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF1873V
1	R2	Resistor, chip, 35.7-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF3572V
1	R3	Resistor, chip, 221-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2213V
2	R4	Resistor, chip, 2-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2001V
3	R5, R6, R8	Resistor, chip, 30.1-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF3012V
1	R7	Do not populate	0603	Panasonic	
1	R9	Resistor, chip, 68.1-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF6812V
1	R10	Resistor, chip, 47.5-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF4752V
1	R11	Resistor, chip, 49.9-Ω, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF49R9V
1	R12	Resistor, chip, 274-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2743V
1	R13	Resistor, chip, 2.55-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2551V
1	R14	Resistor, chip, 82.5-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF8252V
1	R15	Resistor, chip, 2.32-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2321V
1	R16	Resistor, chip, 15-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF1502V
1	U1	IC, TPS54162QPWPRQ1		TI	TPS54162QPWPRQ1
	-	PCB, 2.3 x 2.3 x 0.062 inch		Any	TPS54162, REV A

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Table 3. TPS54162EVM Bill of Materials for 2-MHz Configuration

COUNT	REF DES	DESCRIPTION	SIZE	MFR	PART NUMBER
1	C1	Capacitor, electrolytic, 220 µF, 50 V	10.3mm x 10.3mm	Panasonic	EEVFK1H221P
4	C2, C5, C6, C7	Capacitor, ceramic, 0.1 µF, 50 V, 10%	0603	muRata	GCM188R71H104KA57
1	C3	Capacitor, tantalum, 100 µF, 16 V, 10%	7343-31	AVX	TPSD107M016R0060
1	C4	Capacitor, ceramic, 1 µF, 50 V, 10%	1206	muRata	GCM31MR71H105KA55
1	C8	Capacitor, ceramic, 22 pF, 50 V, 5%	0603	muRata	GCM1885C1H220JA16
1	C12	Capacitor, ceramic, 120 pF, 50 V, 5%	0603	muRata	GRM1885C1H121JA01
2	C10, C11	Capacitor, ceramic, 10 pF, 50 V, 5%	0603	muRata	GRM1885C1H100JA01
1	C9	Capacitor, ceramic, 82 pF, 50 V, 5%	0603	muRata	GRM1885C1H820JA01
1	C13	Capacitor, ceramic, 2.2 nF, 50 V, 5%	0603	muRata	GCM1885C1H222JA16
1	C14	Capacitor, ceramic, 150 nF, 25 V, 10%	0603	muRata	GRM188R71E154KA01
1	C15	Capacitor, ceramic, 47 nF, 50 V, 10%	0603	muRata	GRM188R71H473KA61
2	D1, D2	Diode, Schottky, 3 A, 60 V	PowerDI	Diodes	PDS360-13
1	D3	Diode, Zener, 1 A, 5 V	SMA	Diodes	SMAZ5V1-13
2	J1, J2	Terminal block, 2-pin, 6 A, 3.5 mm	0.25 x 0.27	OST	ED1514
10	Sync, GND (x4), PH, RST/, VBATT, VIN, VOUT	Test point, 52 mil	0.052	Kobiconn	151-103-RC
3	Delay, LPM, SR	Header, 6-pin, 100-mil spacing, (36-pin strip)	0.100 x 3	Sullins	PEC06DAAN
1	ENA	Header, 3-pin, 100-mil spacing, (36-pin strip)	0.100 x 3	Sullins	PEC03SAAN
6	DELAY(x3), ENA, LPM, SR	Connector jumper, shorting, 100-mil spacing	0.100	Sullins	SPC02SYAN
1	L1	Inductor, SMT, 4.7 µH	12.3mm x 12.3mm	Coilcraft	MSS1278T-4R7
1	R1	Resistor, chip, 187-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF1873V
1	R2	Resistor, chip, 35.7-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF3572V
1	R3	Resistor, chip, 51.1-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF5112V
2	R4	Resistor, chip, 2-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2001V
3	R5, R6	Resistor, chip, 30.1-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF3012V
1	R7	Do not populate	0603	Panasonic	
1	R8, R16	Resistor, chip, 15-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF1502V
1	R9	Resistor, chip, 68.1-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF6812V
1	R10	Resistor, chip, 47.5-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF4752V
1	R11	Resistor, chip, 49.9-Ω, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF49R9V
1	R12	Resistor, chip, 511-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF5113V
1	R13	Resistor, chip, 1.37-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF1371V
1	R14	Resistor, chip, 82.5-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF8252V
1	R15	Resistor, chip, 2.32-kΩ, 1/10 W, 1%	0603	Panasonic	ERJ-3EKF2321V
1	U1	IC, TPS54162QPWPRQ1		TI	TPS54162QPWPRQ1
	-	PCB, 2.3-inch x 2.3-inch x 0.062		Any	TPS54162, REV A

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -0.3 V to 48 V and the output voltage range of 0.9 V to 18 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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