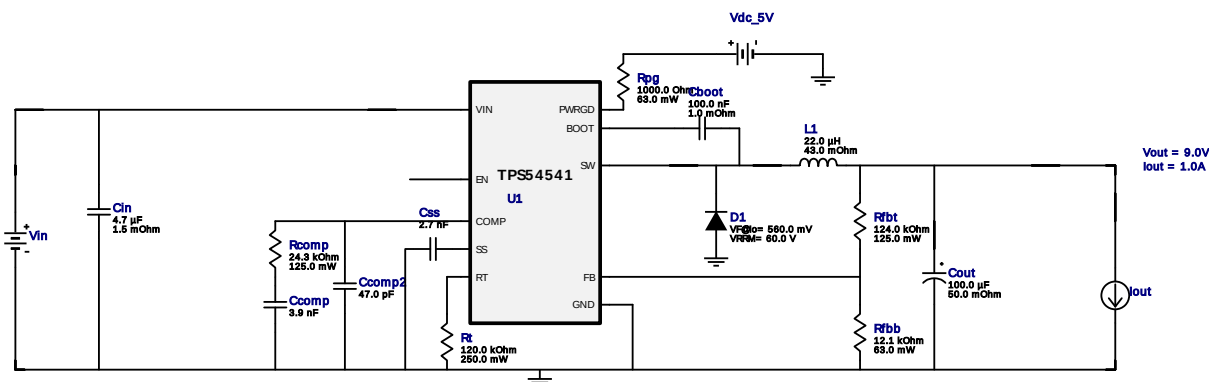


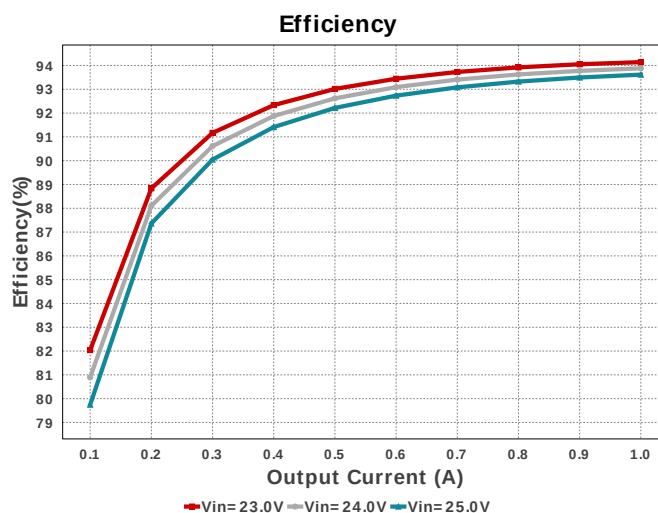
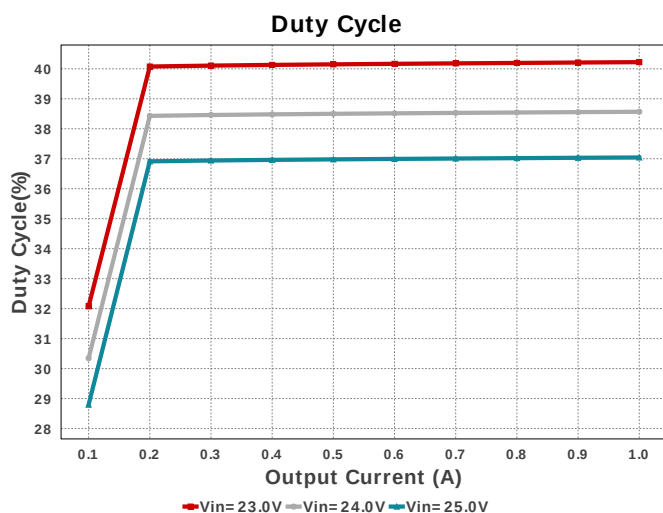
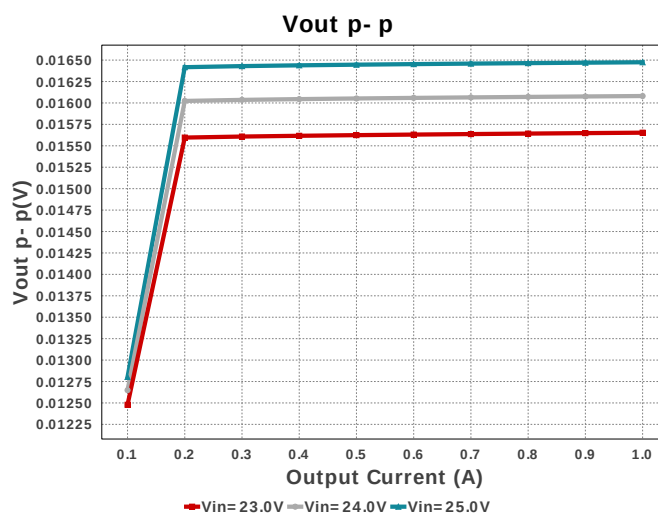
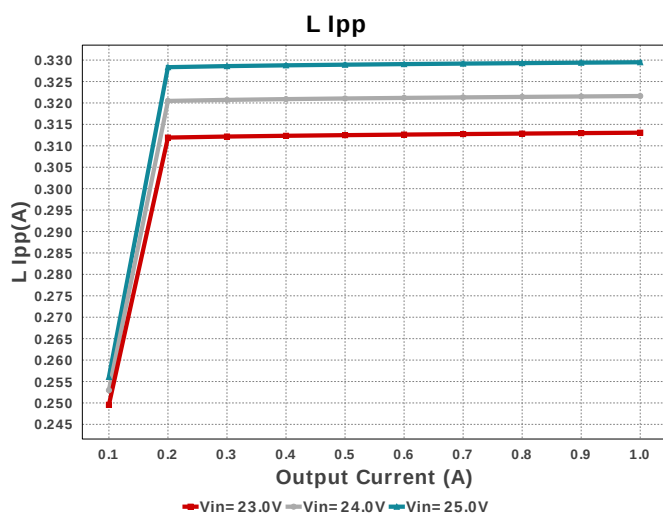


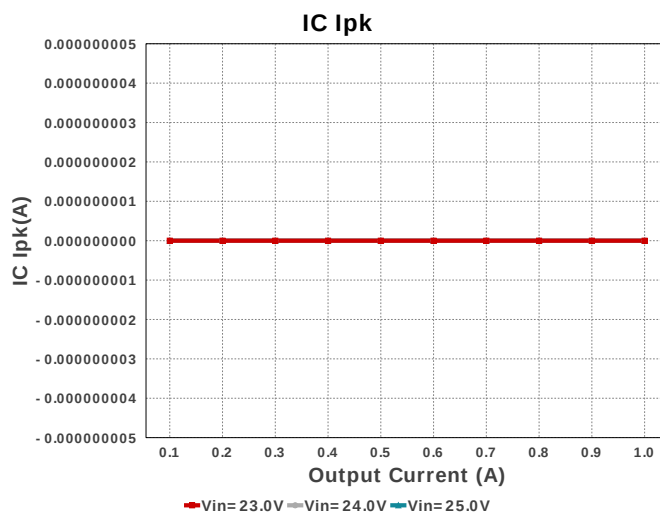
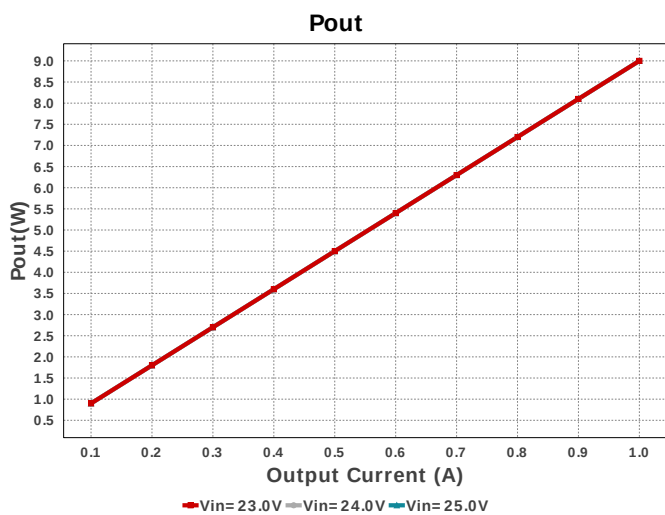
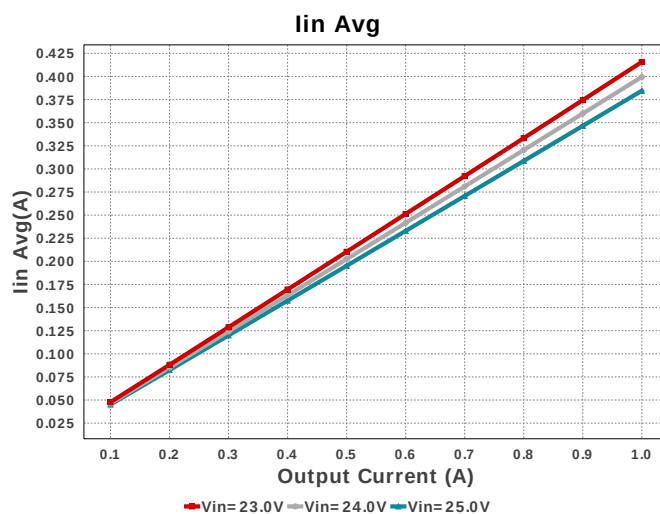
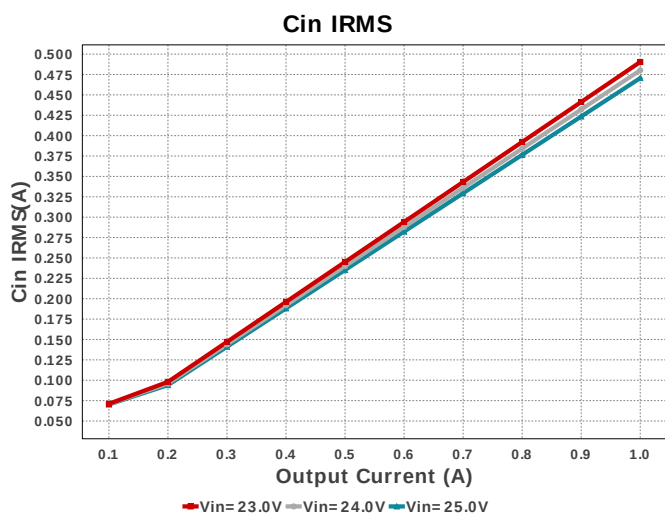
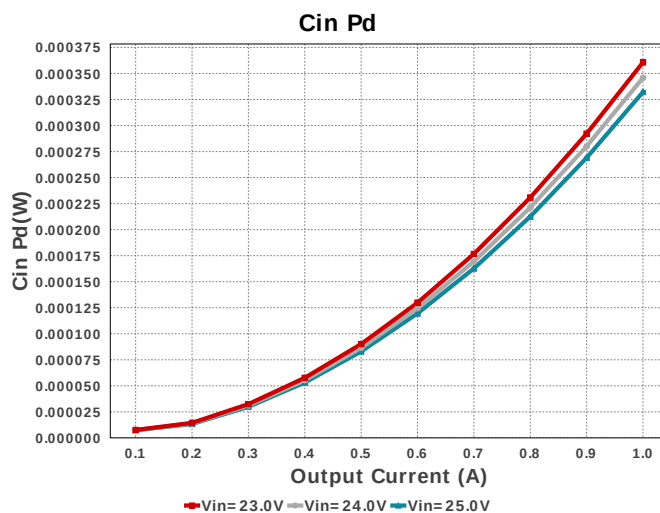
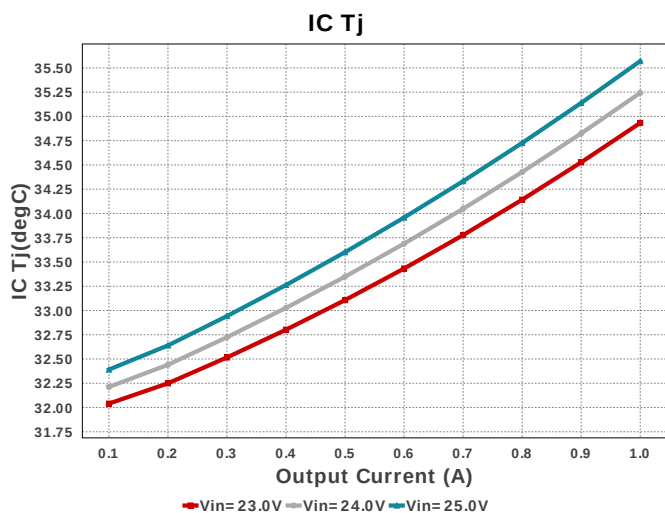
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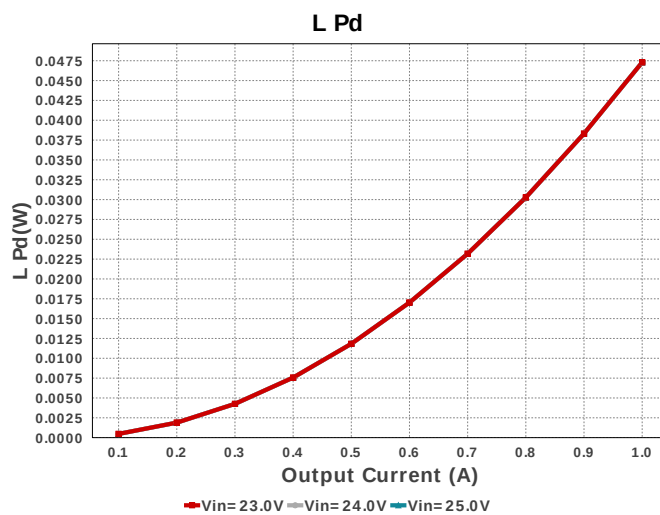
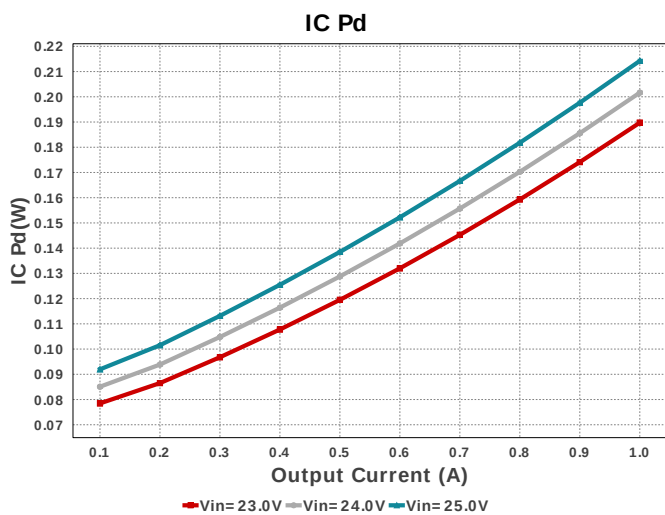
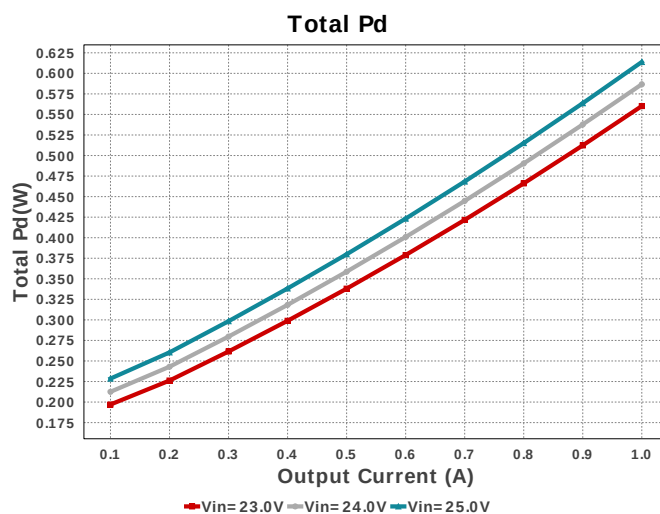
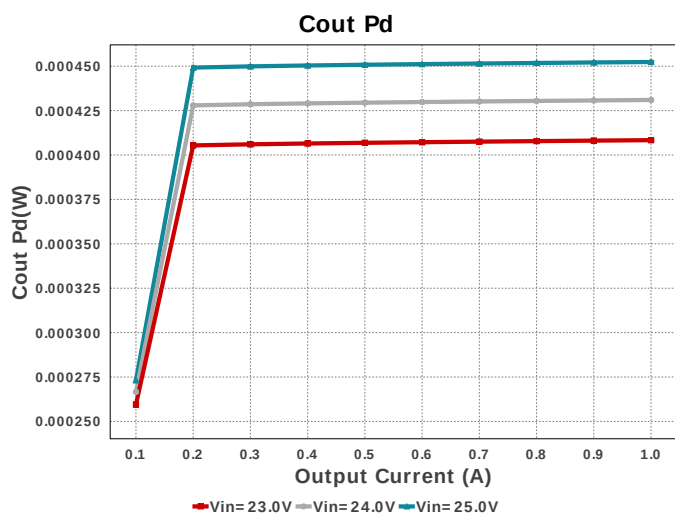
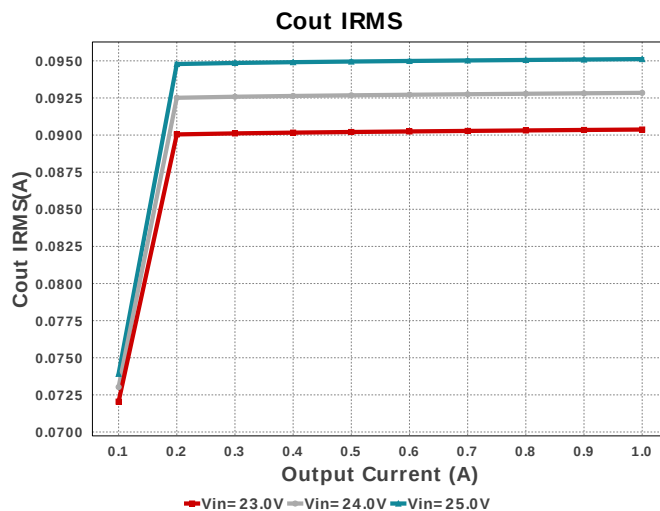
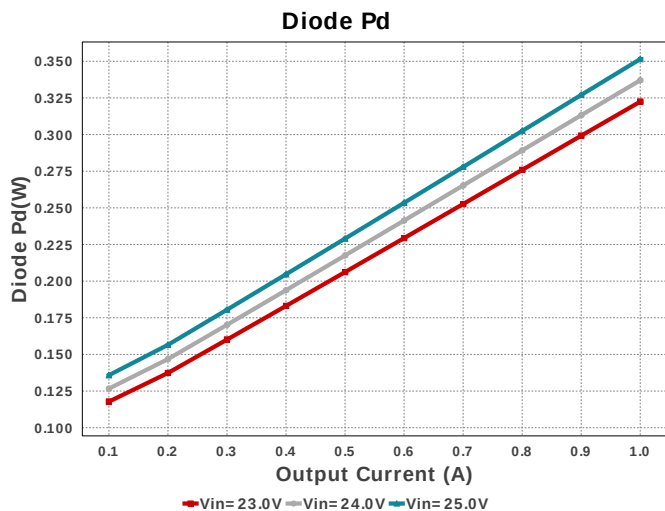


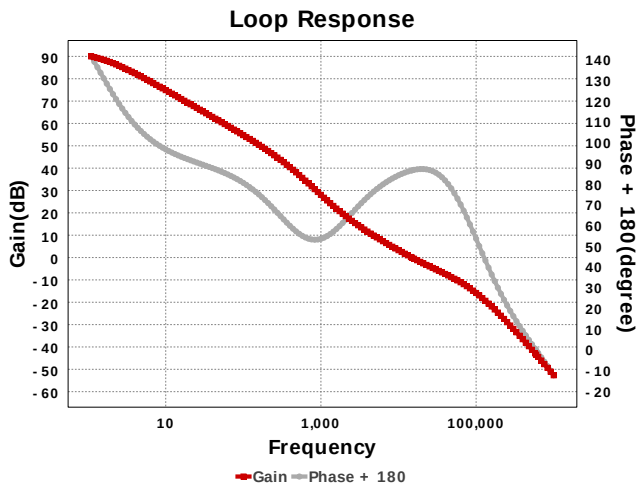
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
Ccomp	TDK	C2012C0G1H392K060AA Series= C0G/NP0	Cap= 3.9 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.04	 0805 7 mm ²
Ccomp2	TDK	C0603C0G1H470K030BA Series= C0G/NP0	Cap= 47.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
Cin	TDK	C5750X7R2A475M230KA Series= X7R	Cap= 4.7 uF ESR= 1.5 mOhm VDC= 100.0 V IRMS= 5.5 A	1	\$1.20	 2220_280 54 mm ²
Cout	Panasonic	16TQC100MYF Series= TQC	Cap= 100.0 uF ESR= 50.0 mOhm VDC= 16.0 V IRMS= 1.8 A	1	\$1.44	 7343-20 59 mm ²
Css	TDK	CGA4C2C0G1H272J060AA Series= C0G/NP0	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.04	 0805 7 mm ²
D1	Diodes Inc.	PDS760-13	VF@Io= 560.0 mV VRRM= 60.0 V	1	\$0.66	 PowerDI5 50 mm ²
L1	TDK	CLF12555T-220M	L= 22.0 µH DCR= 43.0 mOhm	1	\$0.62	 CLF12555 213 mm ²
Rcomp	Panasonic	ERJ-6ENF2432V Series= ERJ-6E	Res= 24.3 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
Rfbb	Yageo	AC0402FR-0712K1L Series= ?	Res= 12.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Vishay-Dale	CRCW0805124KFKEA Series= CRCW..e3	Res= 124.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
Rpg	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rt	Yageo	RC1206FR-07120KL Series= ?	Res= 120.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
U1	Texas Instruments	TPS54541DPRR	Switcher	1	\$1.90	 DPR0010A 25 mm ²









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	14		Total Design BOM count
2.	Total BOM	\$5.97		Total BOM Cost
3.	Cin IRMS	470.578 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	332.17 μ W	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	95.117 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	452.37 μ W	Capacitor	Output capacitor power dissipation
7.	Diode Pd	351.48 mW	Diode	Diode power dissipation
8.	IC Ipk	0.0 A	IC	Peak switch current in IC
9.	IC Pd	214.24 mW	IC	IC power dissipation
10.	IC Tj	35.57 degC	IC	IC junction temperature
11.	ICThetaJA Effective	26.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
12.	Iin Avg	384.55 mA	IC	Average input current
13.	L Ipp	329.496 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	47.3 mW	Inductor	Inductor power dissipation
15.	Cin Pd	332.17 μ W	Power	Input capacitor power dissipation
16.	Cout Pd	452.37 μ W	Power	Output capacitor power dissipation
17.	Diode Pd	351.48 mW	Power	Diode power dissipation
18.	IC Pd	214.24 mW	Power	IC power dissipation
19.	L Pd	47.3 mW	Power	Inductor power dissipation
20.	Total Pd	613.838 mW	Power	Total Power Dissipation
21.	Cross Freq	14.917 kHz	System	Bode plot crossover frequency
22.	Duty Cycle	37.042 %	System	Duty cycle
23.	Efficiency	93.615 %	System	Steady state efficiency
24.	FootPrint	449.0 mm ²	System	Total Foot Print Area of BOM components
25.	Frequency	817.61 kHz	System	Switching frequency
26.	Gain Marg	-43.447 dB	System	Bode Plot Gain Margin
27.	Iout	1.0 A	System	Iout operating point
28.	Low Freq Gain	89.979 dB	System	Gain at 1Hz
29.	Mode	CCM	System	Conduction Mode
30.	Phase Marg	86.858 deg	System	Bode Plot Phase Margin
31.	Pout	9.0 W	System	Total output power
32.	Vin	25.0 V	System	Vin operating point
33.	Vout	9.0 V	System	Operational Output Voltage
34.	Vout Actual	8.998 V	System	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.859 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	16.475 mV	System	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	25.0	Maximum input voltage
VinMin	23.0	Minimum input voltage
Vout	9.0	Output Voltage
base_pn	TPS54541	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of C_{in} and C_{out} , and the inductance and DC resistance of $L1$ before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

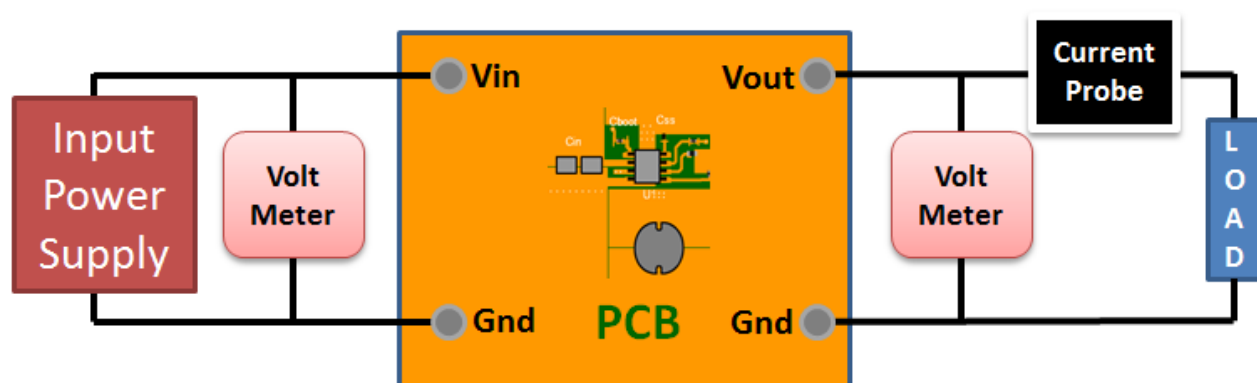
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 23.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.

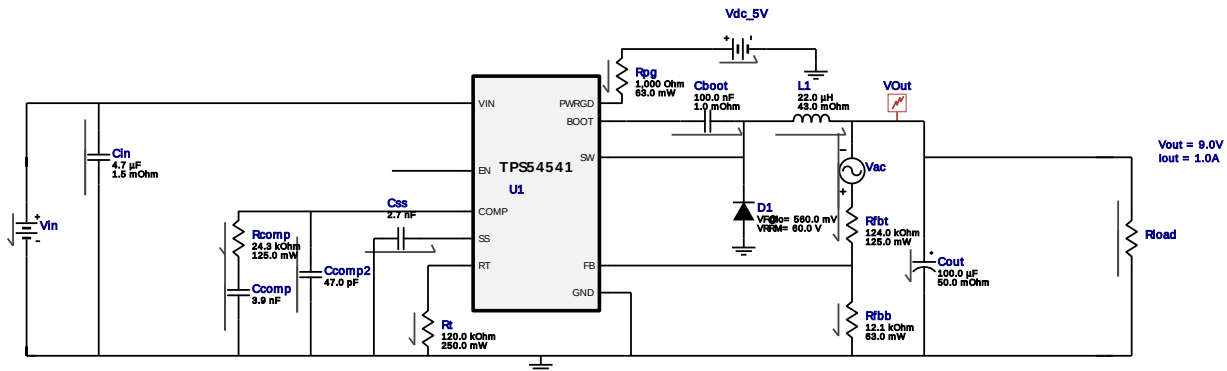


WEBENCH® Electrical Simulation Report

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sim_id = 3

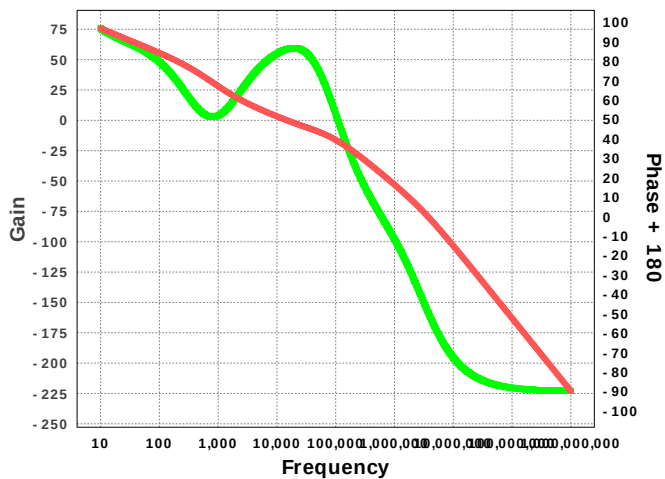
Simulation Type = Bode Plot



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cinj	C	no description	10000000 F
2.	Linj	L	no description	10000000 H
3.	Vinj	AC	AC signal	1 V
4.	Cout	IC	no description	no values
5.	Rload	R	Load Resistance	9.0 ohm

Bode Plot



Design Assistance

1. Master key : DD213F47A6534C16[v1]

2. **TPS54541** Product Folder : <http://www.ti.com/product/TPS54541> : contains the data sheet and other resources.

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