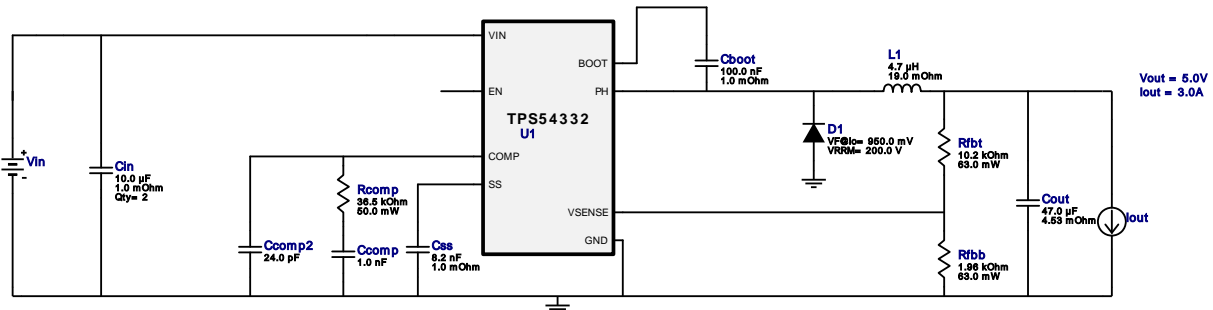


VinMin = 9.0V
VinMax = 20.0V
Vout = 5.0V
Iout = 3.0A

Device = TPS54332DDAR
Topology = Buck
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BOM Cost = \$2.24
BOM Count = 13
Total Pd = 3.08W

WEBENCH® Design Report

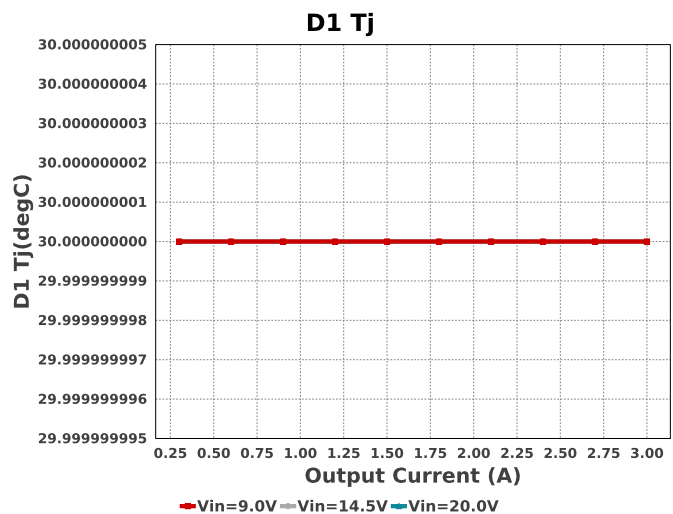
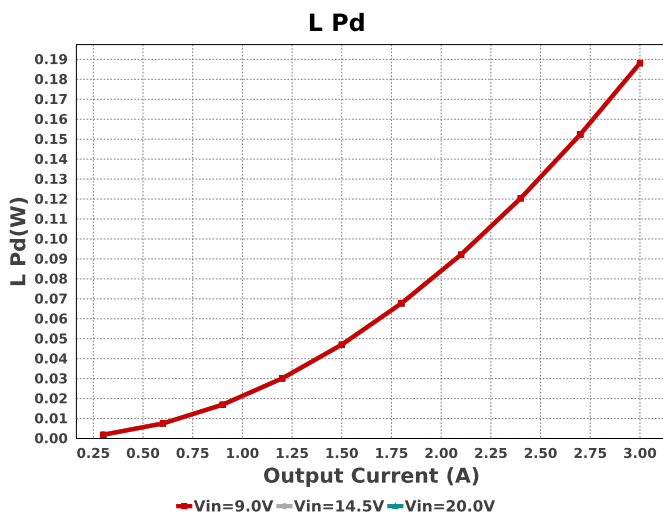
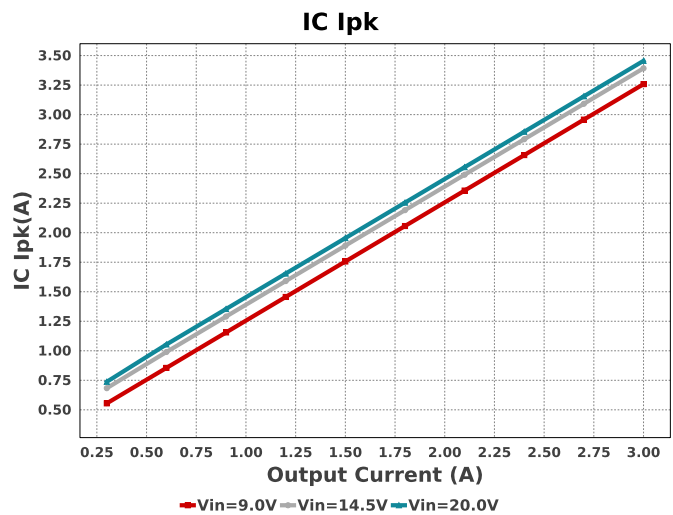
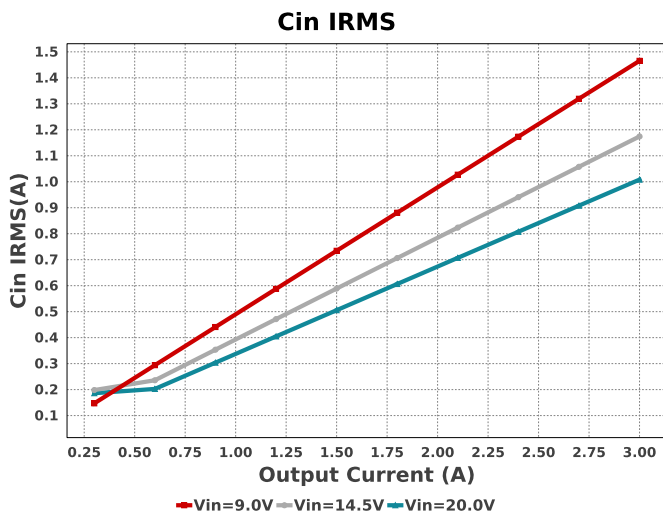
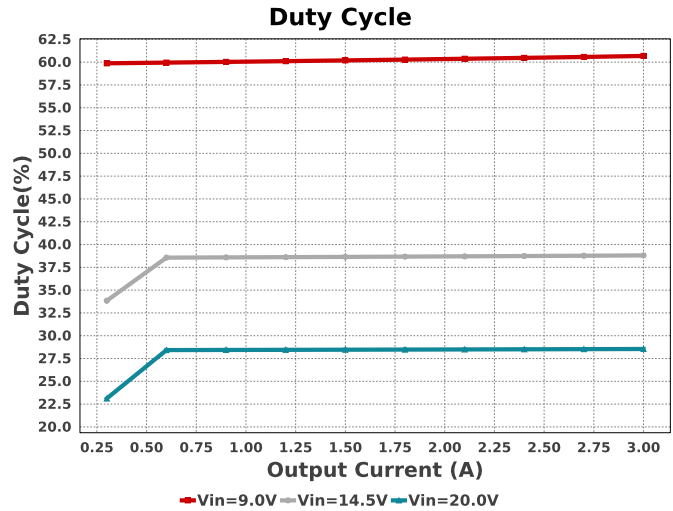
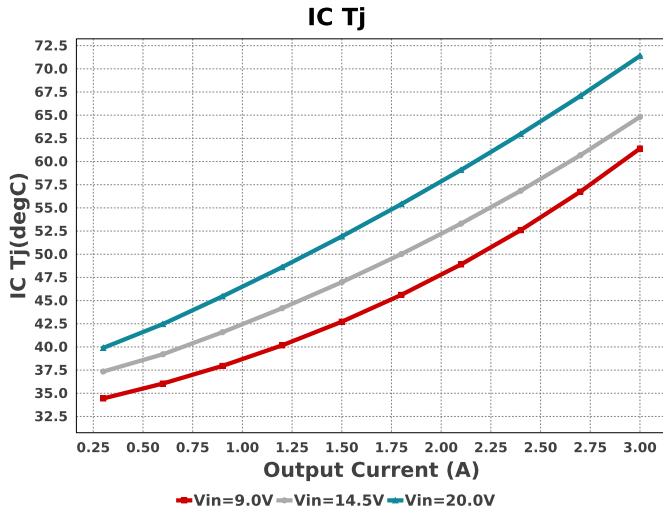
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TPS54332DDAR 9V-20V to 5.00V @ 3A

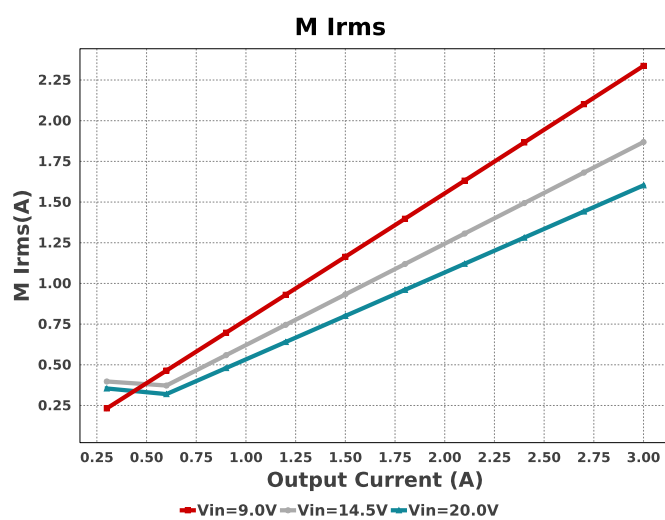
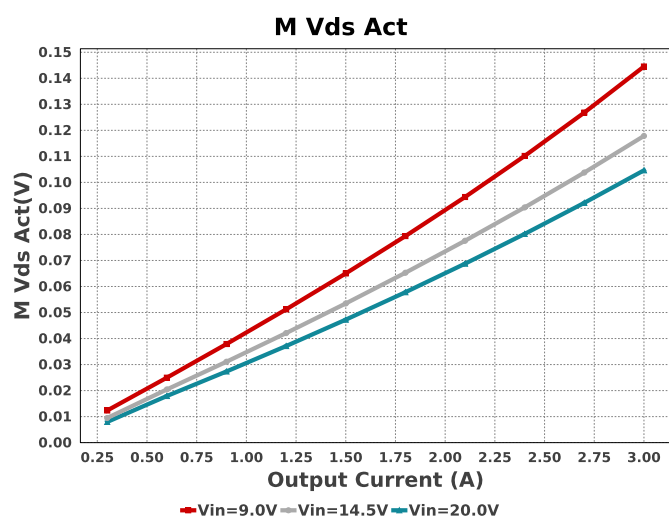
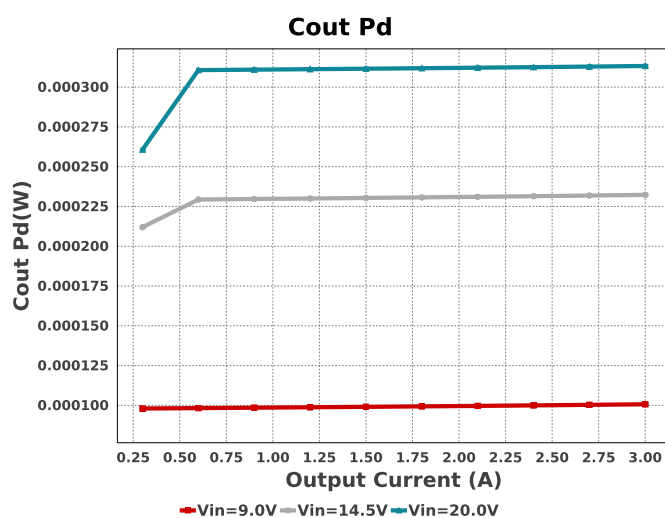
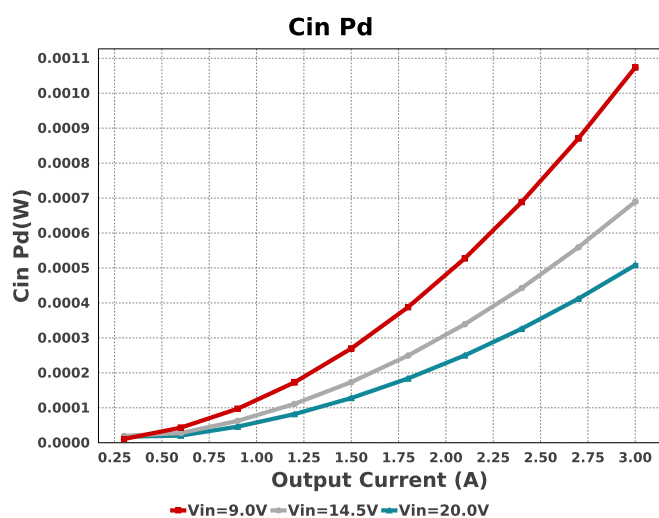
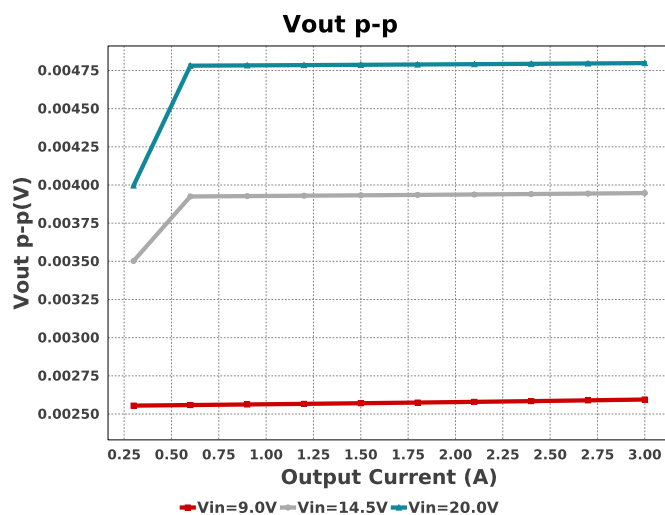
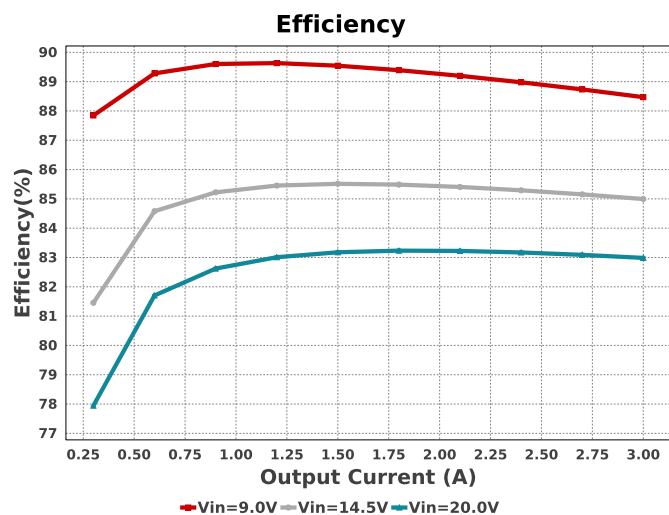


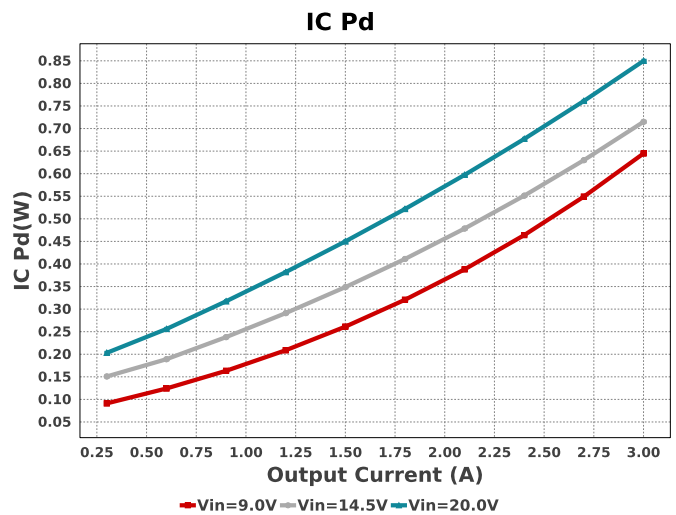
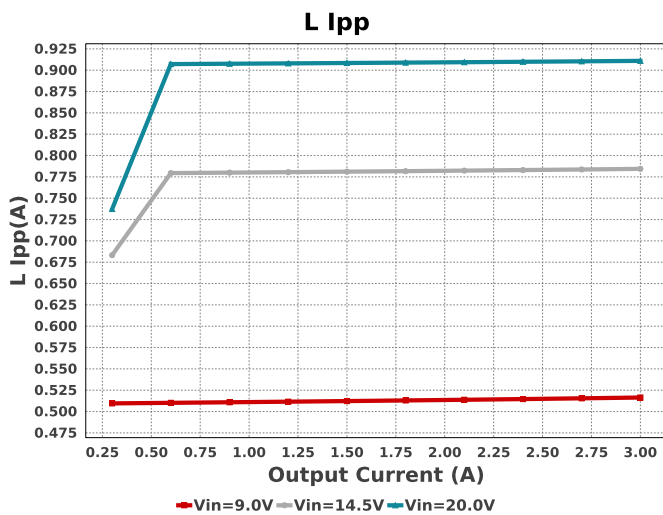
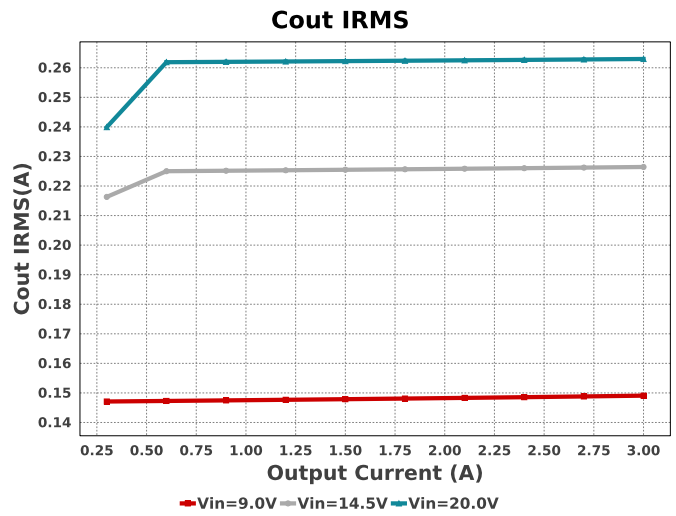
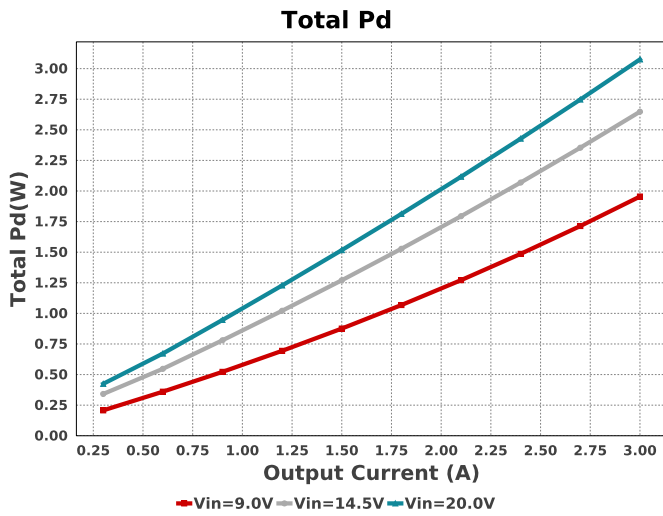
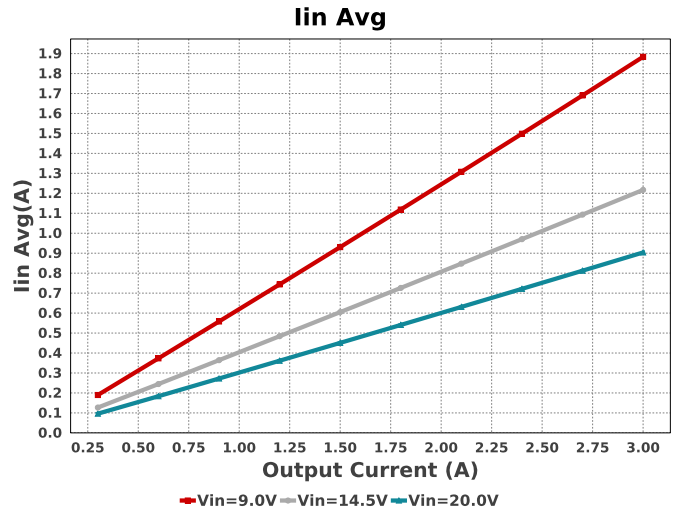
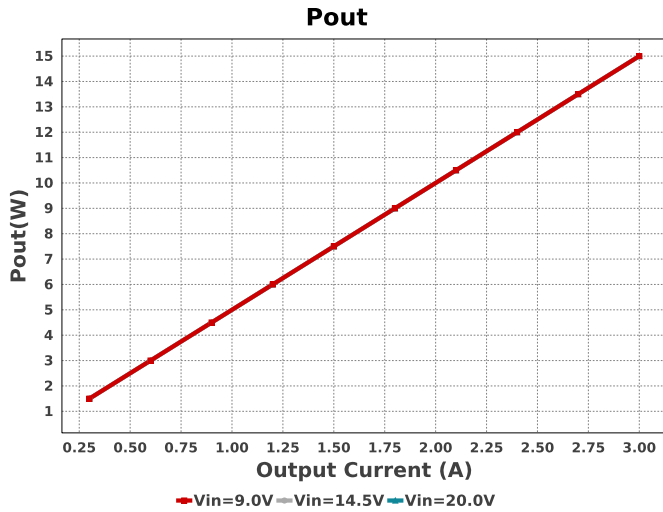
Electrical BOM

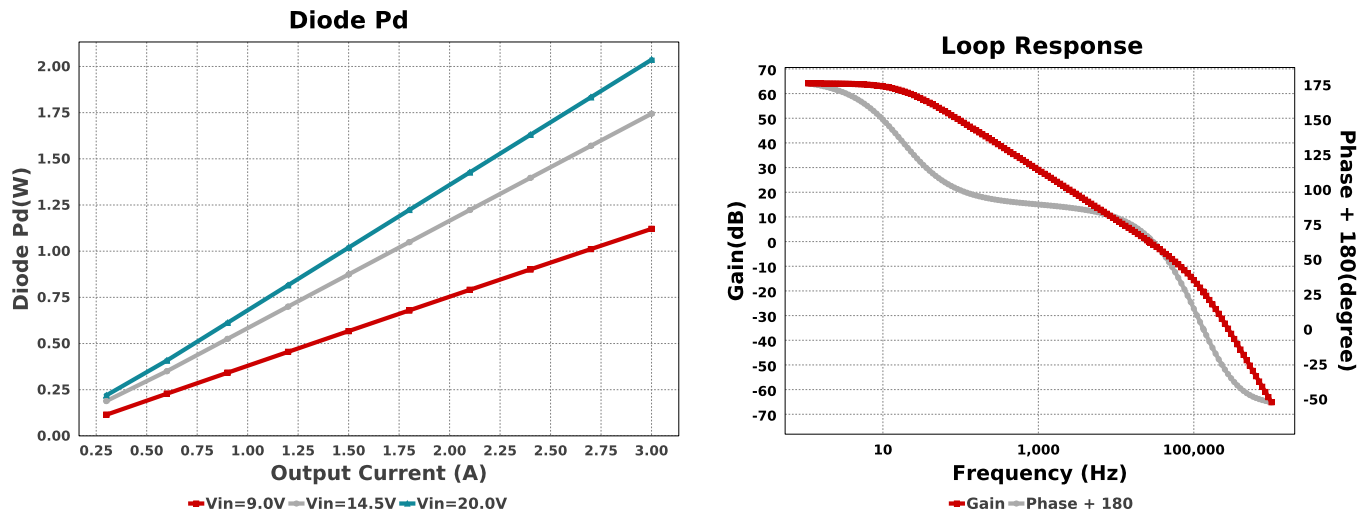
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp2	Samsung Electro-Mechanics	CL21C240JBANNNC Series= C0G/NP0	Cap= 24.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	2	\$0.28	1210 15 mm ²
Cout	TDK	C4532X5R1A476M280KA Series= X5R	Cap= 47.0 uF ESR= 4.53 mOhm VDC= 10.0 V IRMS= 3.6038 A	1	\$0.47	1812_320 23 mm ²
Css	MuRata	GRM033R71A822KA01D Series= X7R	Cap= 8.2 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	\$0.12	DPAK 102 mm ²
L1	Bourns	SDR1005-4R7ML	L= 4.7 uH 19.0 mOhm	1	\$0.32	SDR1005 176 mm ²
Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 mm ²
Rfbb	Vishay-Dale	CRCW04021K96FKED Series= CRCW..e3	Res= 1.96 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	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	TPS54332DDAR	Switcher	1	\$0.70	DDA0008H 55 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.008 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	508.2 μ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	262.972 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	313.27 μ W	Capacitor	Output capacitor power dissipation
5.	D1 Tj	30.0 degC	Diode	D1 junction temperature
6.	Diode Pd	2.036 W	Diode	Diode power dissipation
7.	IC Ipk	3.455 A	IC	Peak switch current in IC
8.	IC Pd	849.9 mW	IC	IC power dissipation
9.	IC Tj	71.39 degC	IC	IC junction temperature
10.	ICThetaJA	48.7 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	903.77 mA	IC	Average input current
12.	L Ipp	910.96 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	188.1 mW	Inductor	Inductor power dissipation
14.	M Irms	1.603 A	Mosfet	MOSFET RMS ripple current
15.	M Vds Act	104.632 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	508.2 μ W	Power	Input capacitor power dissipation
17.	Cout Pd	313.27 μ W	Power	Output capacitor power dissipation
18.	Diode Pd	2.036 W	Power	Diode power dissipation
19.	IC Pd	849.9 mW	Power	IC power dissipation
20.	L Pd	188.1 mW	Power	Inductor power dissipation
21.	Total Pd	3.075 W	Power	Total Power Dissipation
22.	BOM Count	13	System	Total Design BOM count
23.	Cross Freq	26.517 kHz	System	Bode plot crossover frequency
24.	Duty Cycle	28.544 %	System	Duty cycle
25.	Efficiency	82.986 %	System	Steady state efficiency
26.	FootPrint	409.0 mm ²	System	Total Foot Print Area of BOM components
27.	Frequency	1000.0 kHz	System	Switching frequency
28.	Gain Marg	-20.604 dB	System	Bode Plot Gain Margin
29.	Iout	3.0 A	System	Iout operating point
30.	Low Freq Gain	64.107 dB	System	Gain at 1Hz
31.	Mode	CCM	System	Conduction Mode
32.	Phase Marg	66.022 deg	System	Bode Plot Phase Margin
33.	Pout	15.0 W	System	Total output power
34.	Total BOM	\$2.24	System	Total BOM Cost
35.	Vin	20.0 V	System	Vin operating point
36.	Vout	5.0 V	System	Operational Output Voltage

#	Name	Value	Category	Description
37.	Vout Actual	4.963 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	5.254 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	4.798 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	20.0	Maximum input voltage
VinMin	9.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS54332	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 9.0V 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.

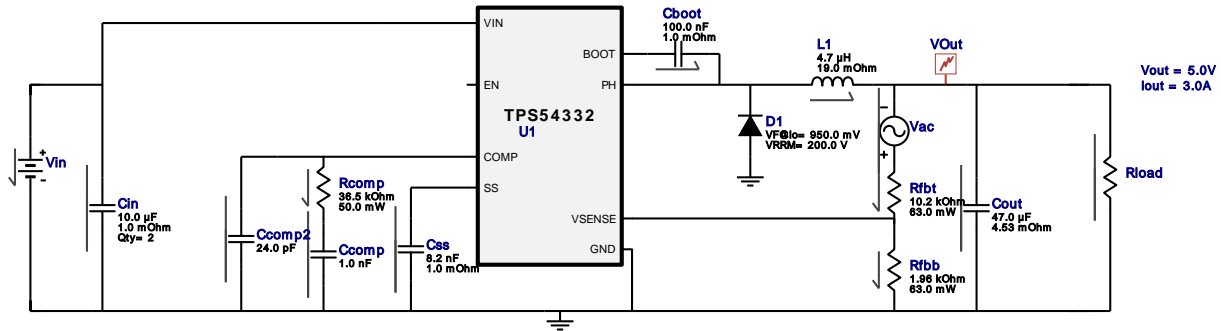


WEBENCH® Electrical Simulation Report

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sim_id = 1

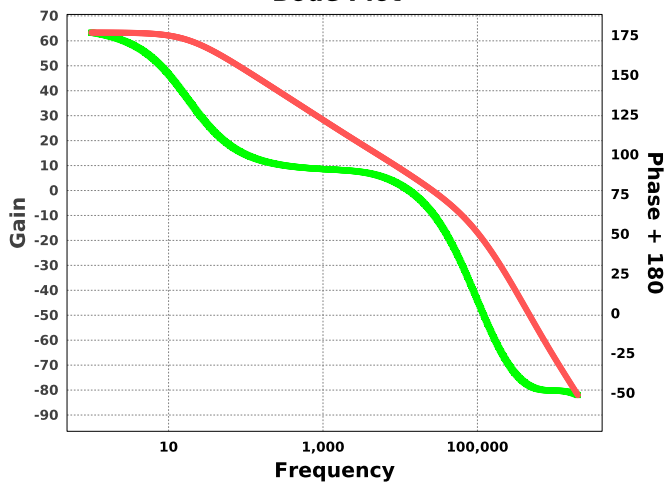
Simulation Type = Bode Plot



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	no description	no values
2.	Cinj	C	Injection Capacitance	10000000 F
3.	Linj	L	Injection Inductance	10000000 H
4.	Vinj	AC	AC Signal	1
5.	Rload	R	Load Resistance	1.6666666666666667 ohm

Bode Plot



Design Assistance

1. Master key : 83550B91A7E12685[v1]

2. **TPS54332** Product Folder : <http://www.ti.com/product/TPS54332> : contains the data sheet and other resources.

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