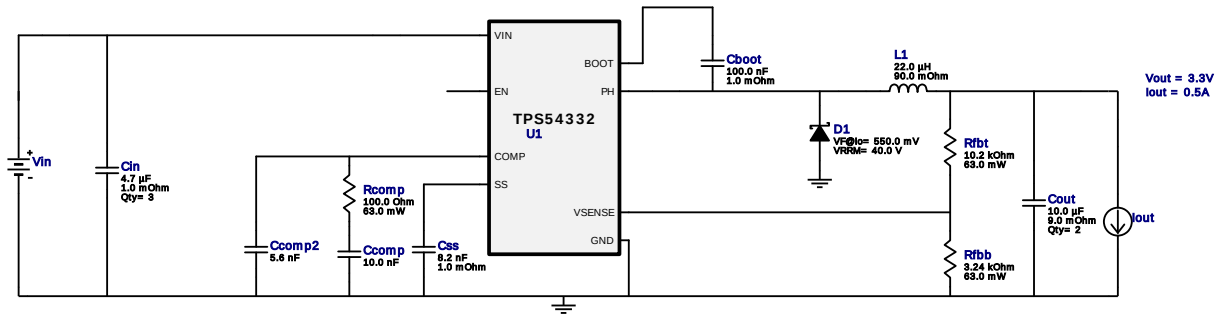
VinMin = 4.5V
VinMax = 20.0V
Vout = 3.3V
Iout = 0.5A

Device = TPS54332DDAR
Topology = Buck
Created = 2022-10-26 13:43:53.844
BOM Cost = $1.82
BOM Count = 15
Total Pd = 0.43W

WEBENCH® Design Report

Design : 72 TPS54332DDAR
TPS54332DDAR 4.5V-20V to 3.30V @ 0.5A

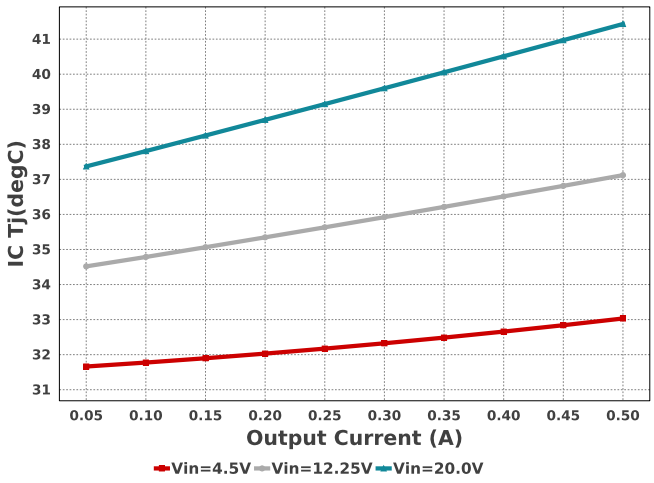


Electrical BOM

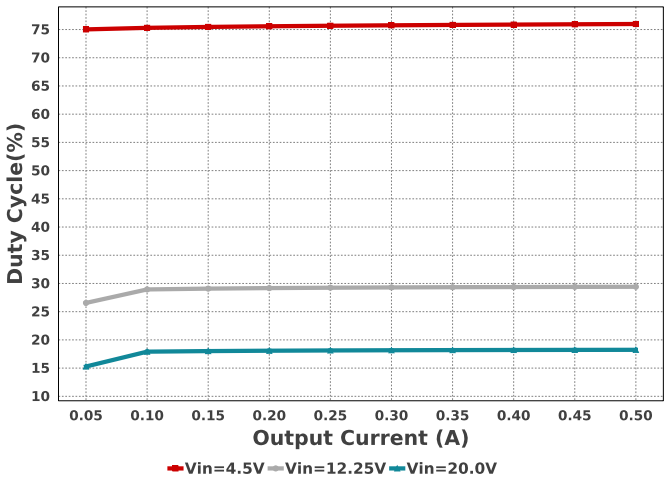
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	TDK	CGA4C2C0G1H103J060AA Series= C0G/NP0	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
Ccomp2	TDK	CGA4C2C0G1H562J060AA Series= C0G/NP0	Cap= 5.6 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 6.0 A	3	$0.16	1210 15 mm²
Cout	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	2	$0.03	0603 5 mm²
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 mm²
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.03	SOD-123F 12 mm²
L1	TDK	CLF6045T-220M	L= 22.0 µH 90.0 mOhm	1	$0.39	CLF6045 68 mm²
Rcomp	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW04023K24FKED Series= CRCW..e3	Res= 3.24 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	TPS54332DDAR	Switcher	1	$0.70	DDA0008H 55 mm²

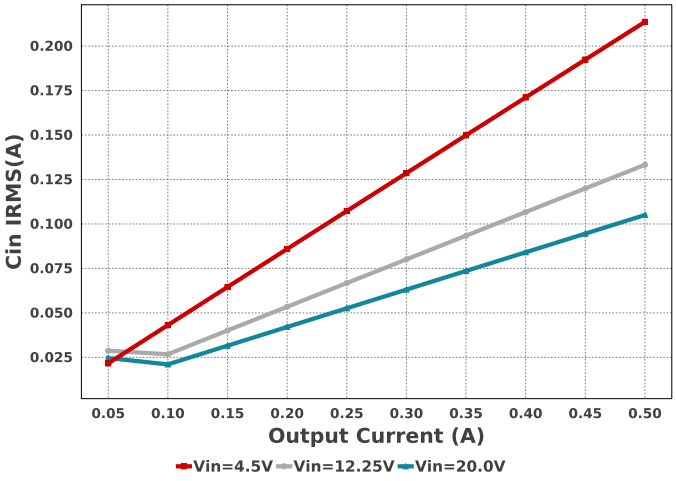
IC Tj



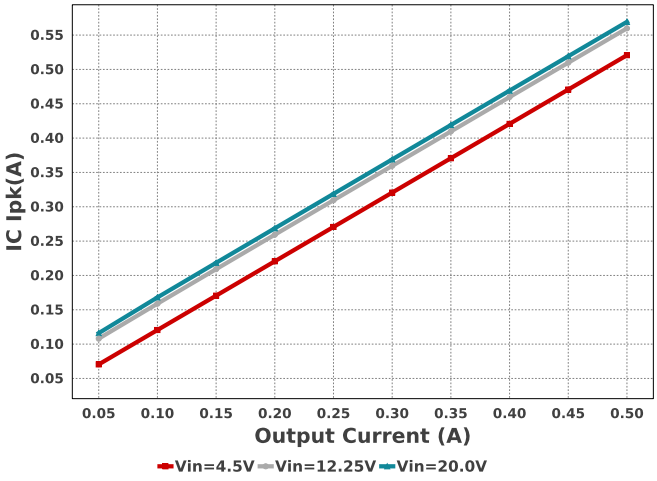
Duty Cycle



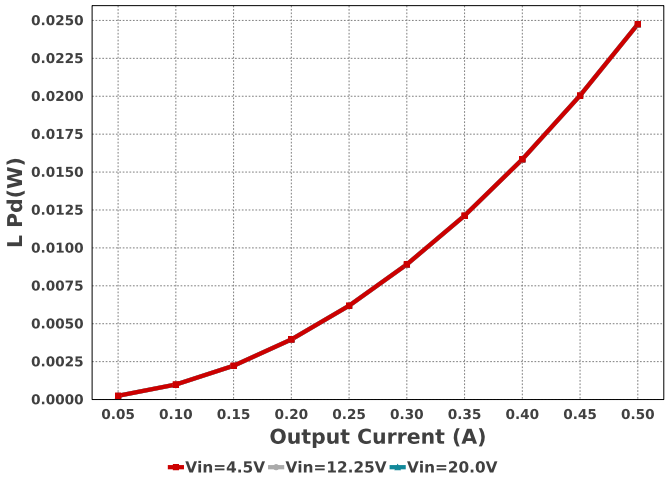
Cin IRMS



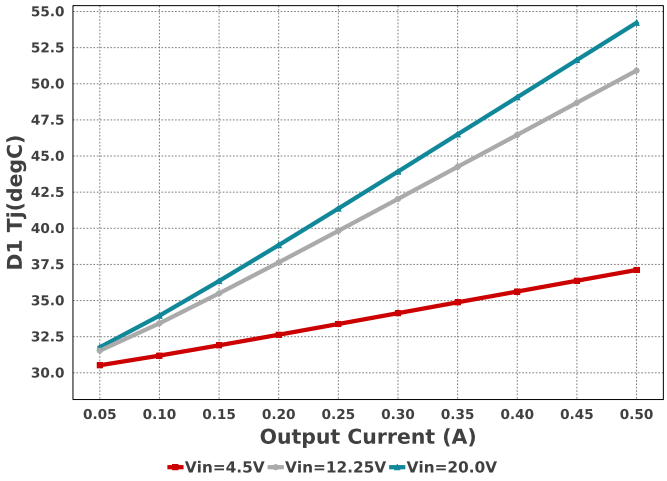
IC Ipk

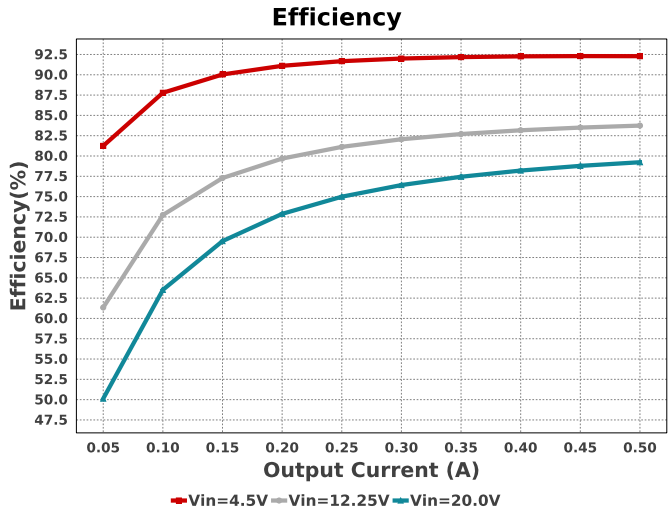


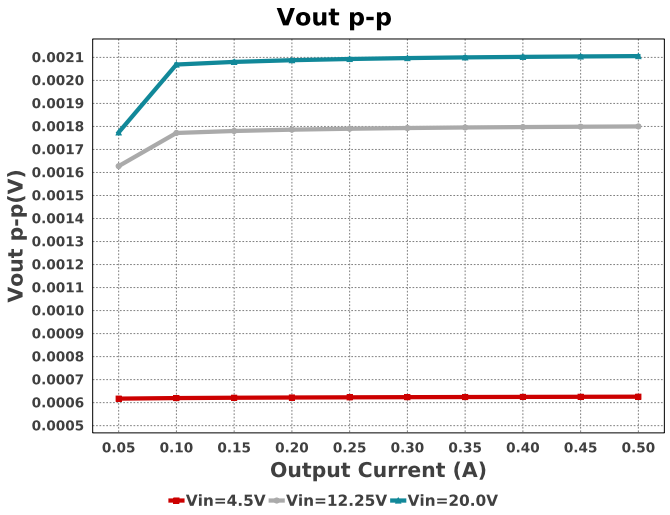
L Pd

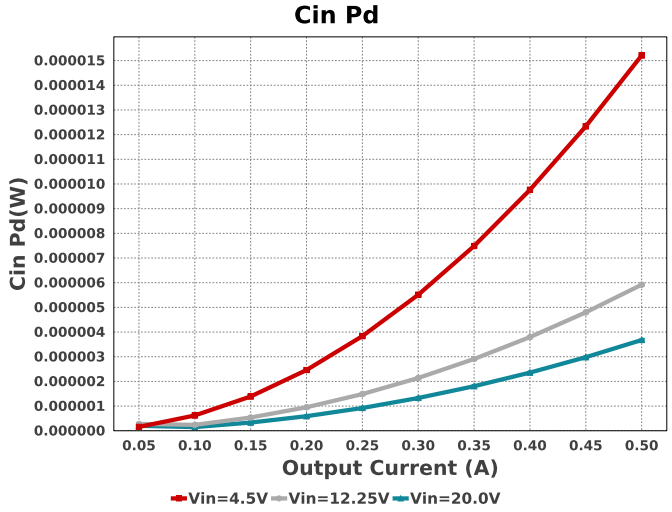


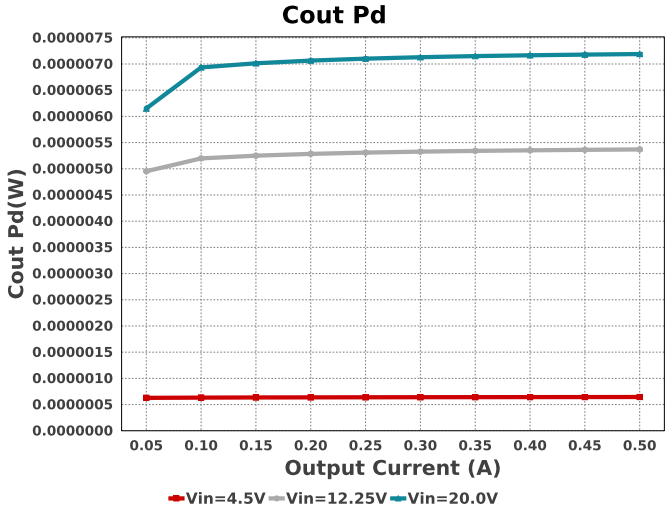
D1 Tj

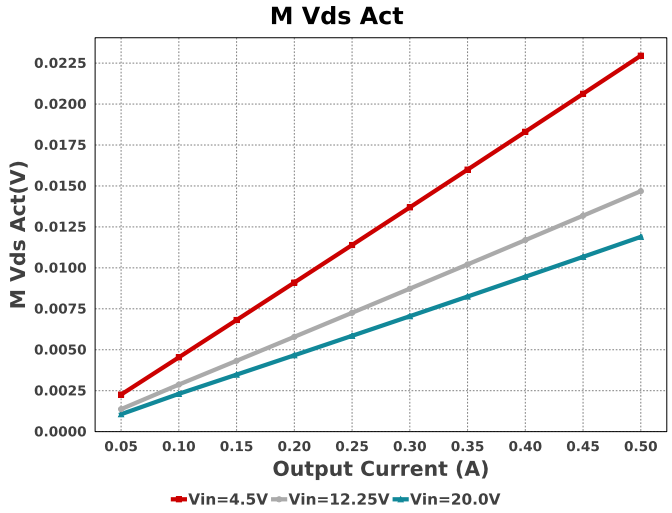


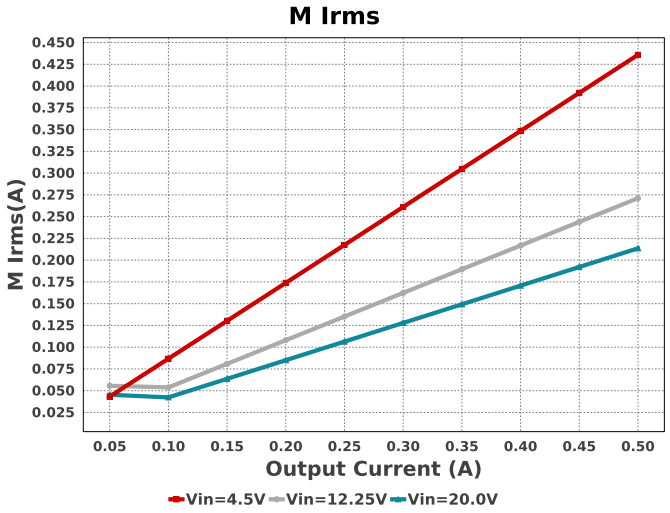


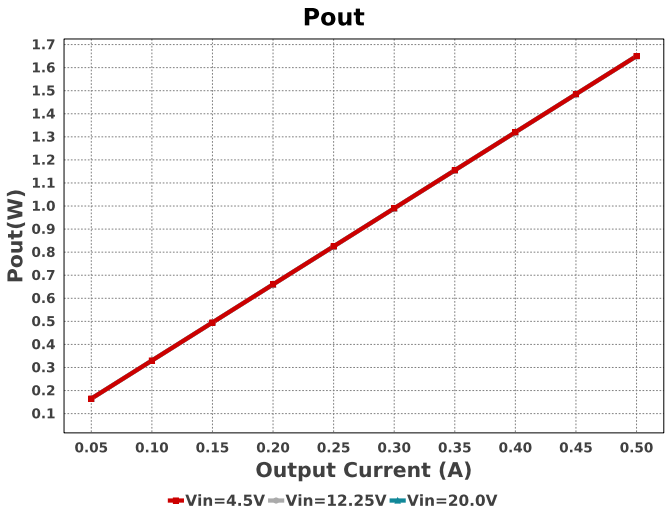


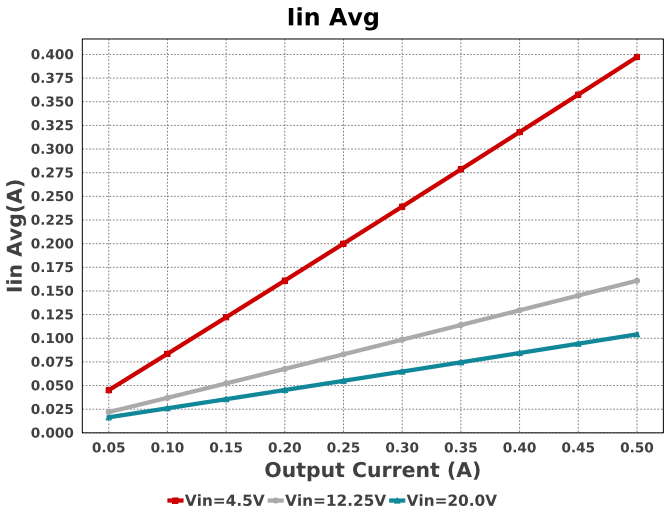


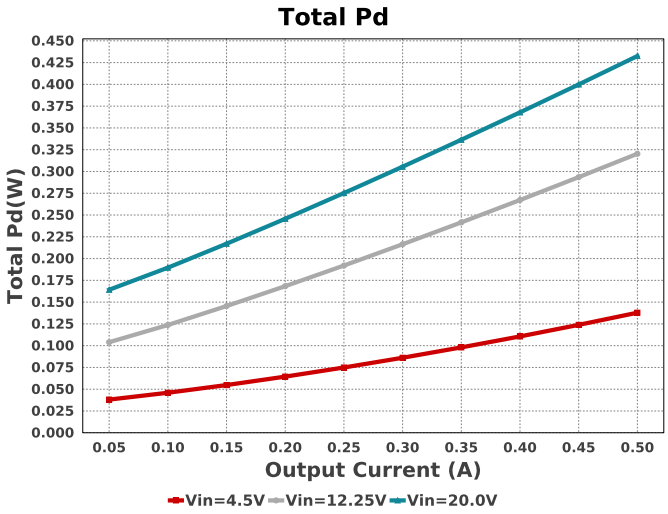


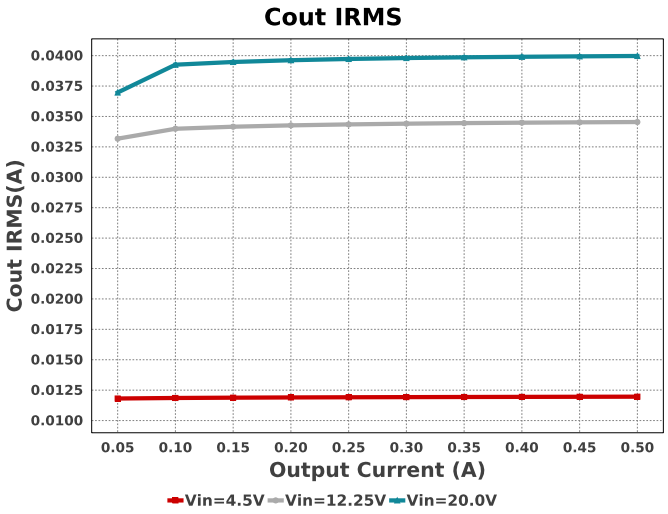


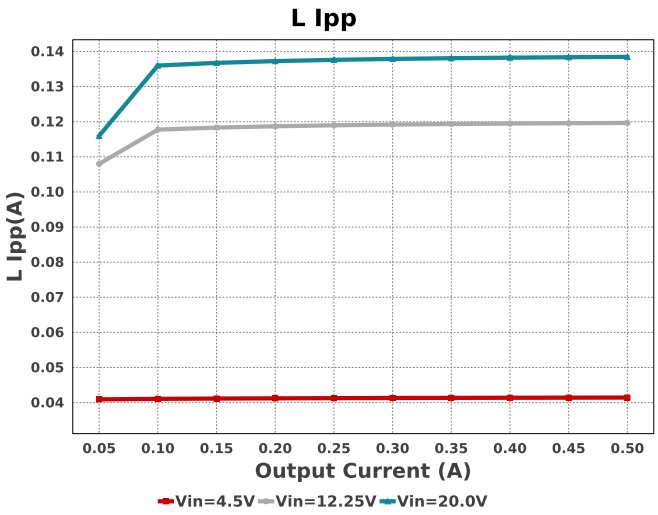


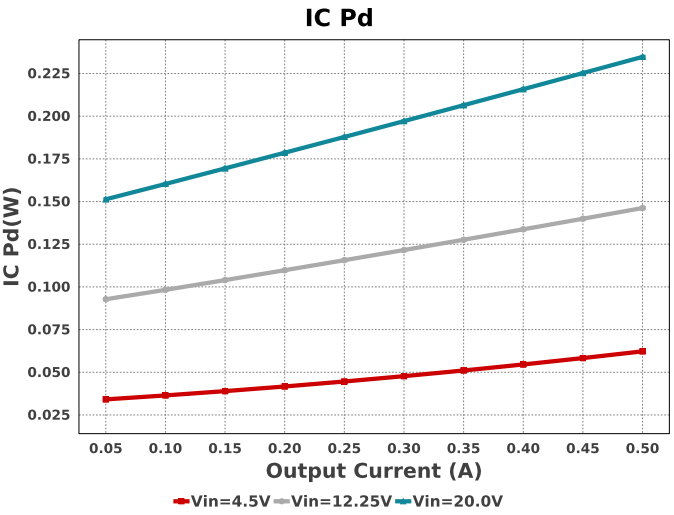


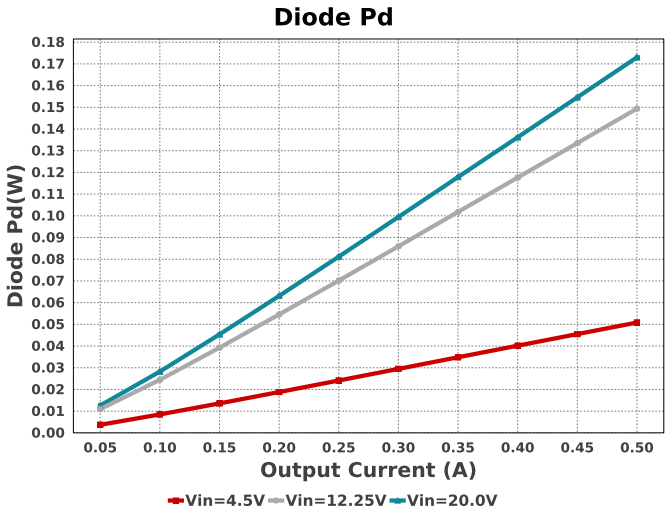


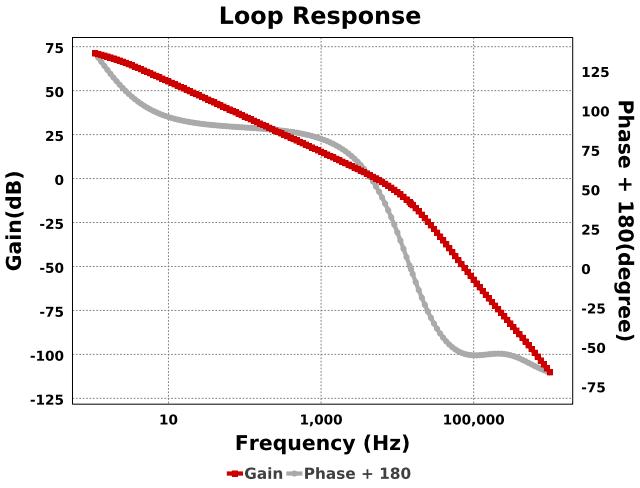












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	105.032 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	3.677 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	39.972 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	7.19 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	54.222 degC	Diode	D1 junction temperature
6.	Diode Pd	173.01 mW	Diode	Diode power dissipation
7.	IC Ipk	569.233 mA	IC	Peak switch current in IC
8.	IC Pd	234.74 mW	IC	IC power dissipation
9.	IC Tj	41.432 degC	IC	IC junction temperature
10.	ICThetaJA	48.7 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	104.13 mA	IC	Average input current
12.	L Ipp	138.465 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	24.75 mW	Inductor	Inductor power dissipation
14.	M Irms	213.547 mA	Mosfet	MOSFET RMS ripple current
15.	M Vds Act	11.893 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	3.677 µW	Power	Input capacitor power dissipation
17.	Cout Pd	7.19 µW	Power	Output capacitor power dissipation
18.	Diode Pd	173.01 mW	Power	Diode power dissipation
19.	IC Pd	234.74 mW	Power	IC power dissipation
20.	L Pd	24.75 mW	Power	Inductor power dissipation
21.	Total Pd	432.535 mW	Power	Total Power Dissipation
22.	BOM Count	15	System Information	Total Design BOM count
23.	Cross Freq	5.252 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	18.241 %	System Information	Duty cycle
25.	Efficiency	79.231 %	System Information	Steady state efficiency
26.	FootPrint	216.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	1000.0 kHz	System Information	Switching frequency
28.	Gain Marg	-14.233 dB	System Information	Bode Plot Gain Margin
29.	Iout	500.0 mA	System Information	Iout operating point
30.	Low Freq Gain	71.165 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	52.586 deg	System Information	Bode Plot Phase Margin
33.	Pout	1.65 W	System Information	Total output power
34.	Total BOM	$1.819	System Information	Total BOM Cost
35.	Vin	20.0 V	System Information	Vin operating point
36.	Vout	3.3 V	System Information	Operational Output Voltage

#	Name	Value	Category	Description
37.	Vout Actual	3.319 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	5.087 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	2.106 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	500.0 m	Maximum Output Current
VinMax	20.0	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	3.3	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 Cin and Cout, 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

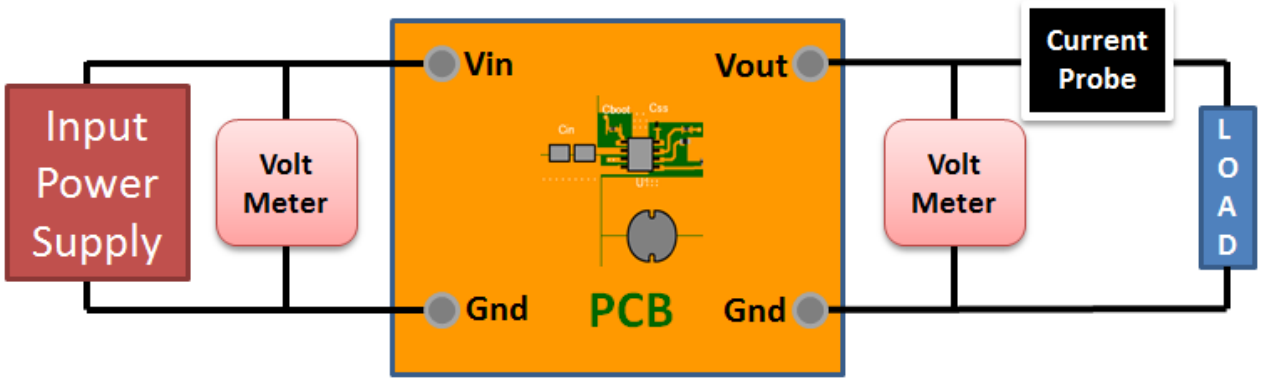
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town 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 4.5V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout 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 Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout 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.



Design Assistance

1. Master key : 7E00AF9B0638DEC2[v1]
2. **TPS54332** Product Folder : http://www.ti.com/product/TPS54332 : contains the data sheet and other resources.