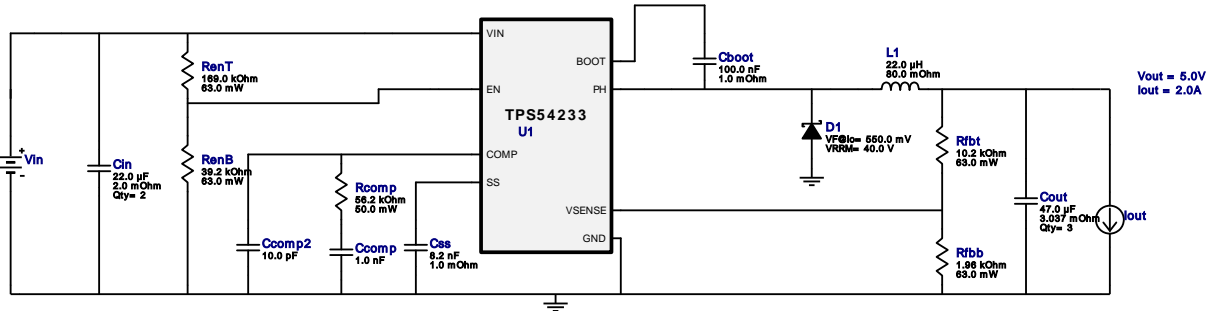


WEBENCH® Design Report

Design : 11 TPS54233DR
TPS54233DR 11V-15V to 5.00V @ 2A

VinMin = 11.0V
VinMax = 15.0V
Vout = 5.0V
Iout = 2.0A

Device = TPS54233DR
Topology = Buck
Created = 2024-02-26 17:21:27.375
BOM Cost = \$2.21
BOM Count = 17
Total Pd = 1.35W



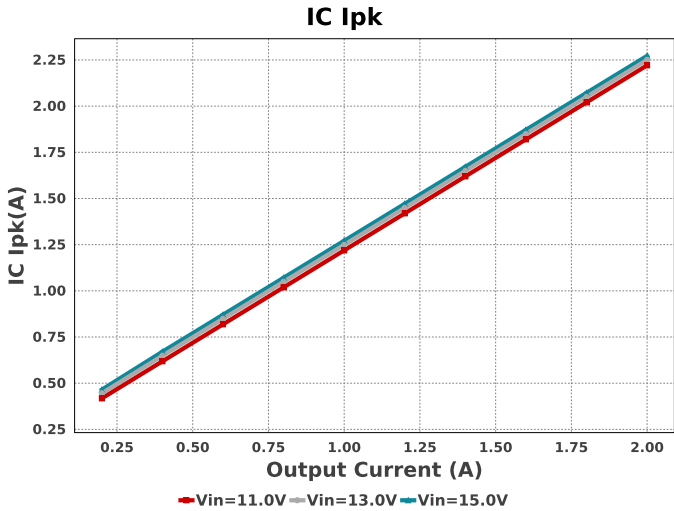
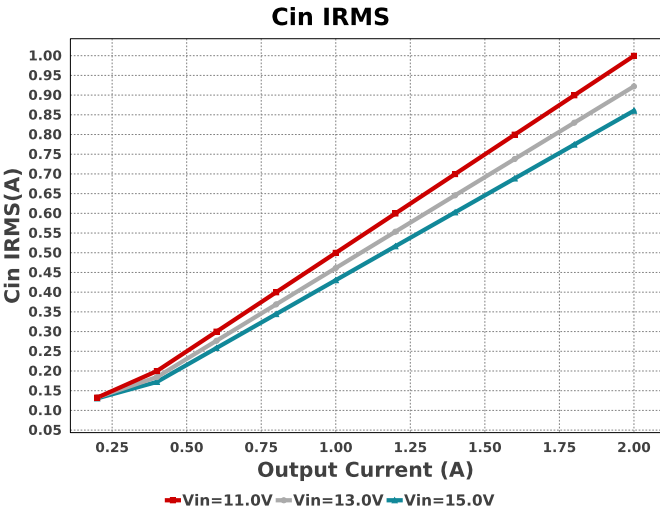
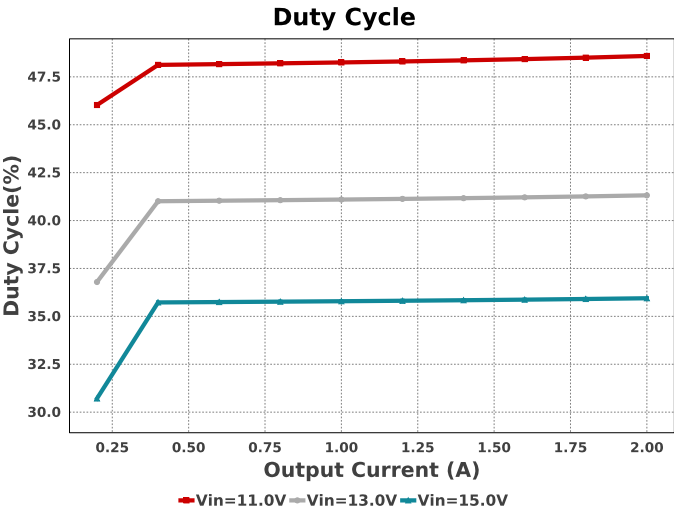
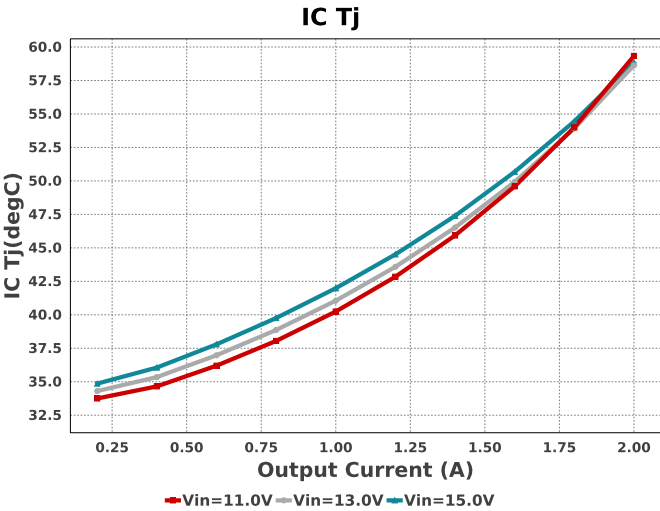
Electrical BOM

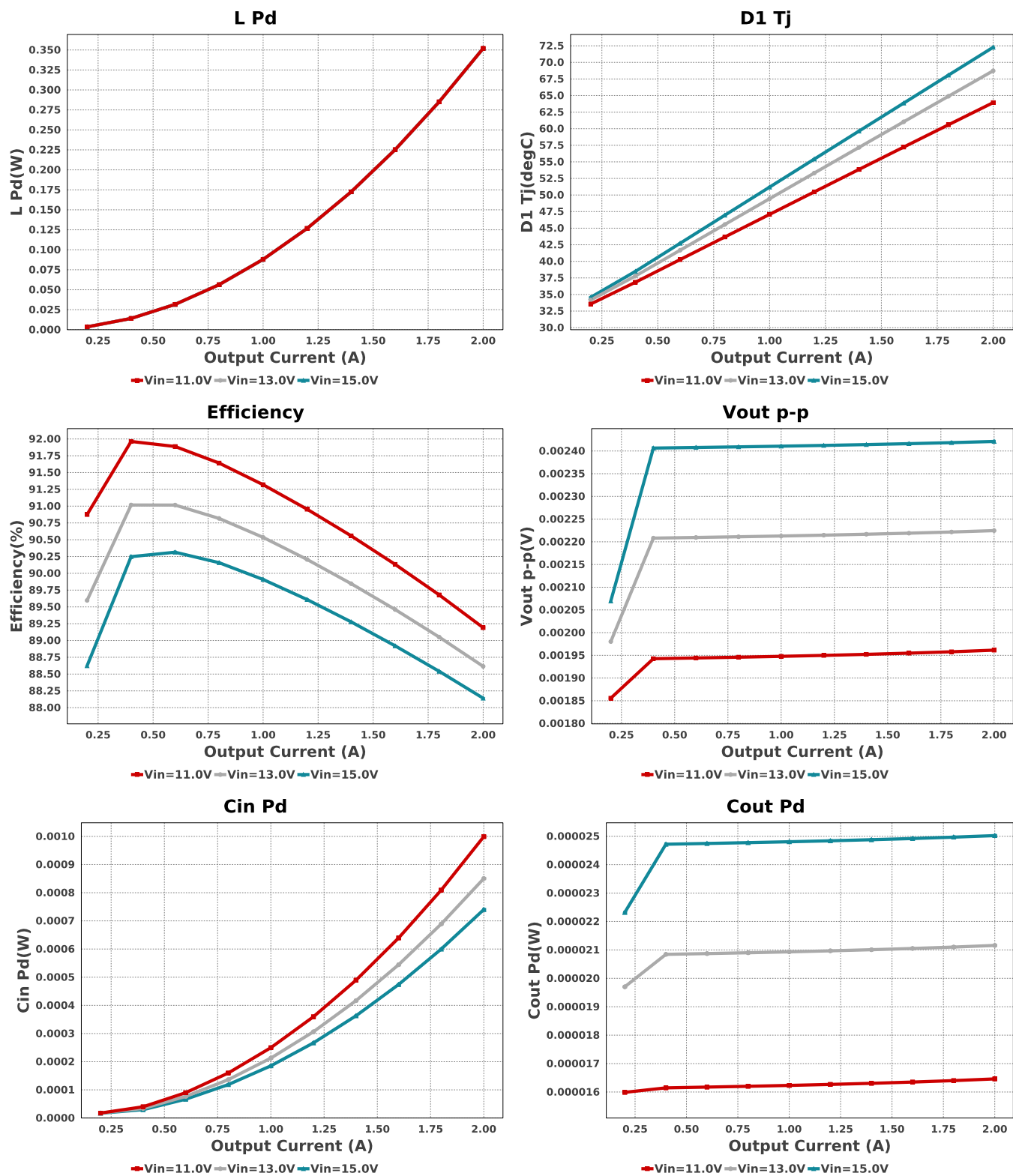
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp2	Yageo	CC0805JRNPO9BN100 Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	2	\$0.23	1210 15 mm ²
Cout	MuRata	GRM32ER61C476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	3	\$0.17	1210_280 15 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	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	\$0.09	SOD-123F 12 mm ²
L1	Bourns	SDR1105-220ML	L= 22.0 uH 80.0 mOhm	1	\$0.49	SDR1105 157 mm ²
Rcomp	Yageo	RC0201FR-0756K2L Series= ?	Res= 56.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 mm ²
RenB	Vishay-Dale	CRCW040239K2FKED Series= CRCW..e3	Res= 39.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
RenT	Vishay-Dale	CRCW0402169KFKED Series= CRCW..e3	Res= 169.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²

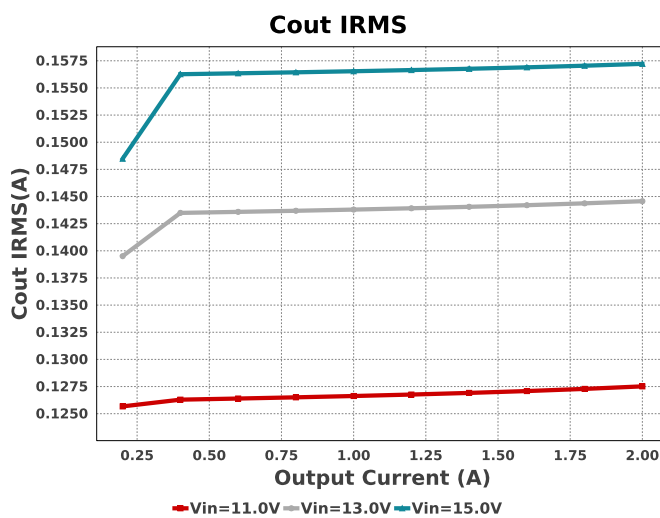
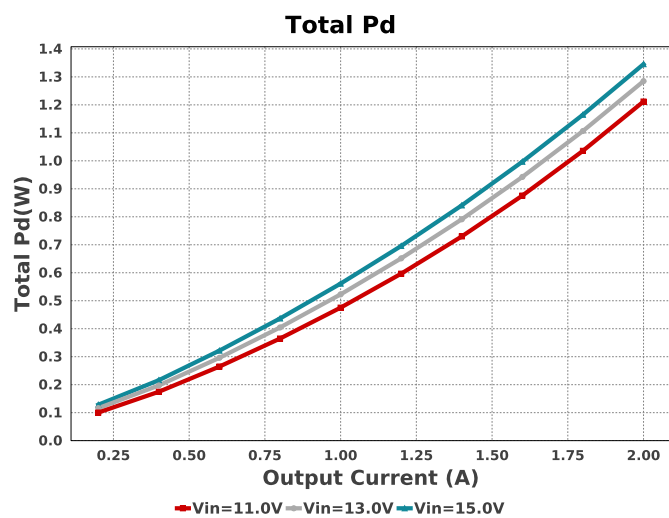
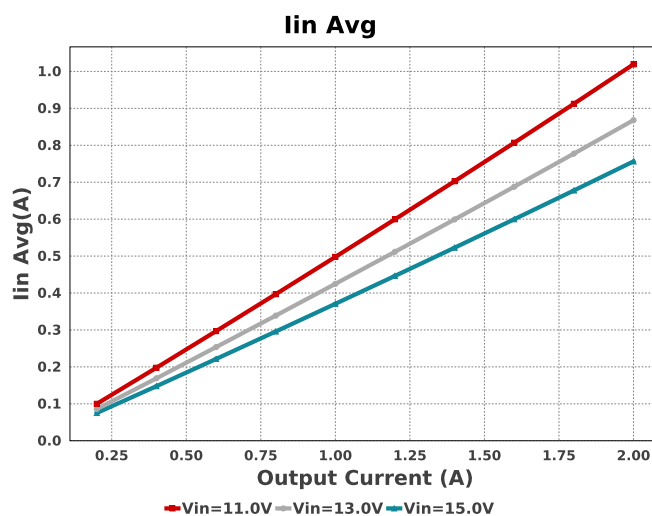
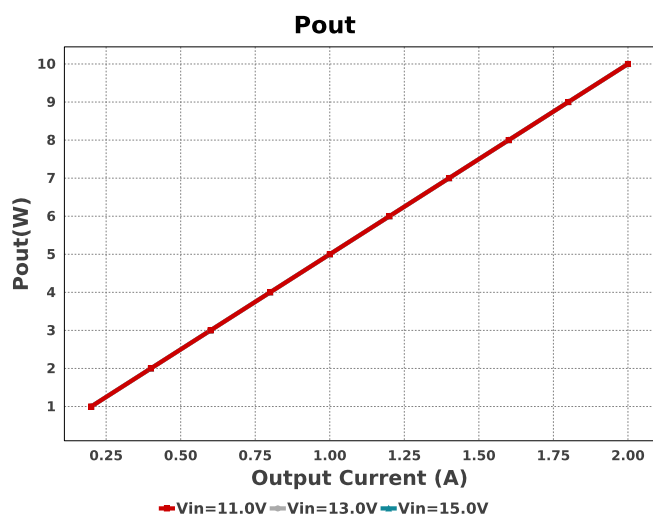
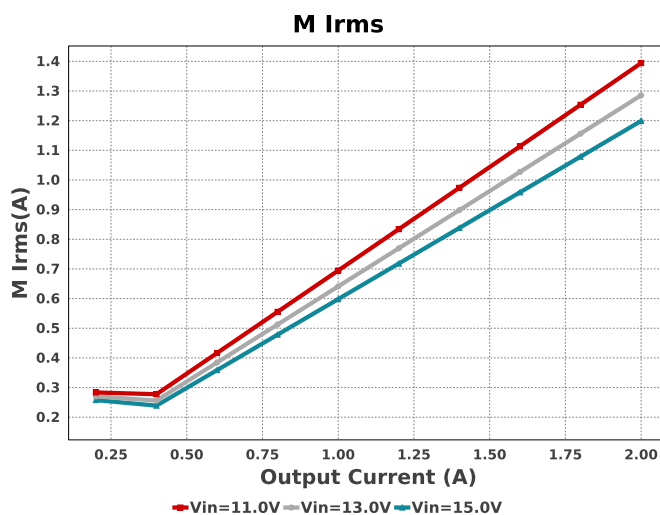
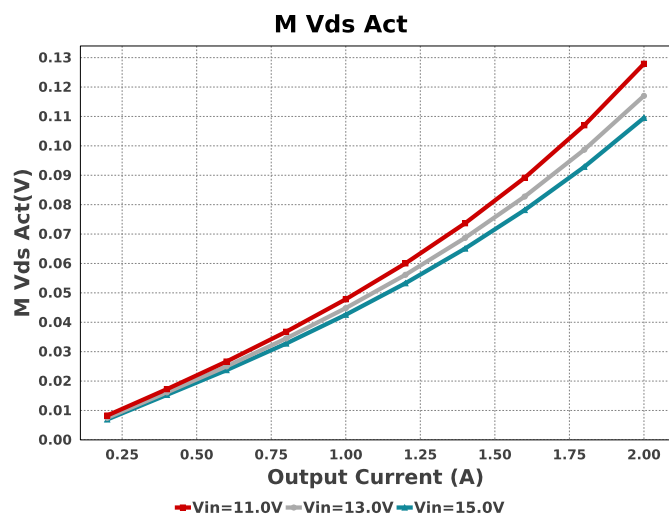
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	Vishay-Dale	CRCW04021K96FKED Series= CRCW..e3	Res= 1.96 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	TPS54233DR	Switcher	1	\$0.57	

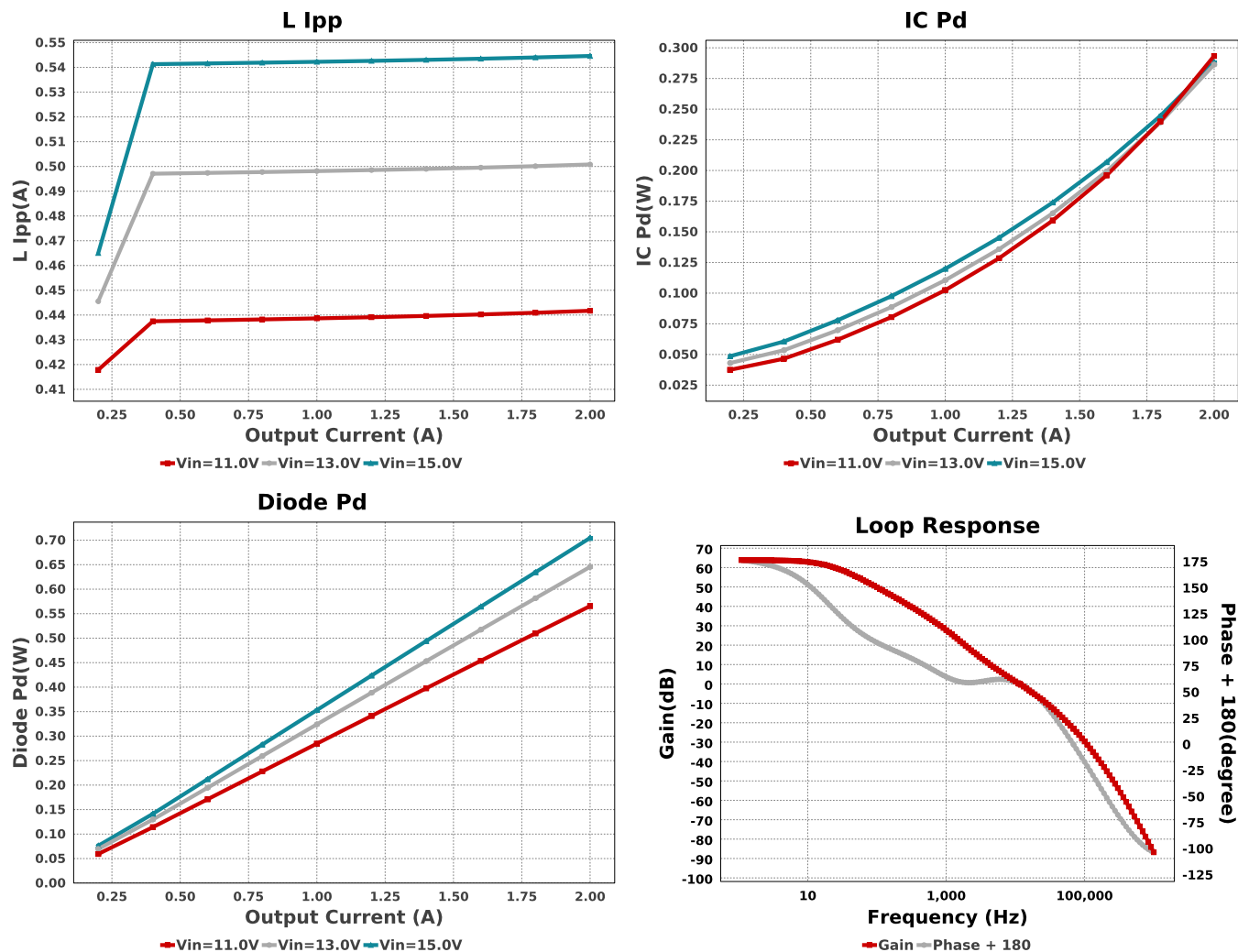


D0008A 57 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	860.398 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	740.28 μ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	157.216 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	25.022 μ W	Capacitor	Output capacitor power dissipation
5.	D1 Tj	72.277 degC	Diode	D1 junction temperature
6.	Diode Pd	704.61 mW	Diode	Diode power dissipation
7.	IC Ipk	2.272 A	IC	Peak switch current in IC
8.	IC Pd	288.14 mW	IC	IC power dissipation
9.	IC Tj	58.814 degC	IC	IC junction temperature
10.	ICThetaJA	100.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	756.37 mA	IC	Average input current
12.	L Ipp	544.61 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	352.0 mW	Inductor	Inductor power dissipation
14.	M Irms	1.199 A	Mosfet	MOSFET RMS ripple current
15.	M Vds Act	109.515 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	740.28 μ W	Power	Input capacitor power dissipation
17.	Cout Pd	25.022 μ W	Power	Output capacitor power dissipation
18.	Diode Pd	704.61 mW	Power	Diode power dissipation
19.	IC Pd	288.14 mW	Power	IC power dissipation
20.	L Pd	352.0 mW	Power	Inductor power dissipation
21.	Total Pd	1.345 W	Power	Total Power Dissipation
22.	BOM Count	17	System	Total Design BOM count
				Information
23.	Cross Freq	11.456 kHz	System	Bode plot crossover frequency
				Information
24.	Duty Cycle	35.944 %	System	Duty cycle
				Information
25.	Efficiency	88.141 %	System	Steady state efficiency
				Information
26.	FootPrint	328.0 mm ²	System	Total Foot Print Area of BOM components
				Information

#	Name	Value	Category	Description
27.	Frequency	300.0 kHz	System Information	Switching frequency
28.	Gain Marg	-23.133 dB	System Information	Bode Plot Gain Margin
29.	Iout	2.0 A	System Information	Iout operating point
30.	Low Freq Gain	63.829 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	58.585 deg	System Information	Bode Plot Phase Margin
33.	Pout	10.0 W	System Information	Total output power
34.	Total BOM	\$2.21	System Information	Total BOM Cost
35.	Vin	15.0 V	System Information	Vin operating point
36.	Vout	5.0 V	System Information	Operational Output Voltage
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	2.421 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	15.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS54233	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 11.0V 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.

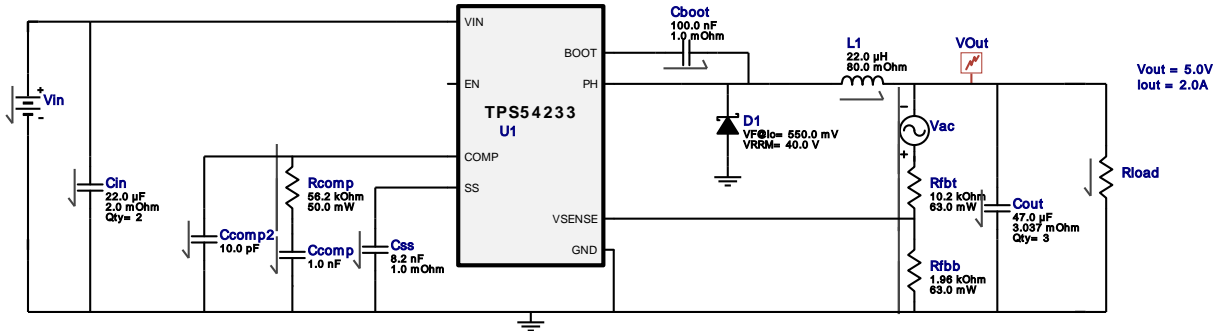
Load Testing

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.



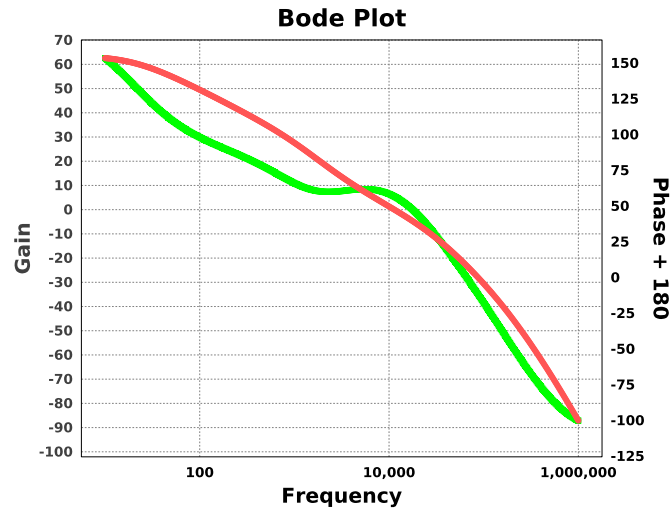
WEBENCH® Electrical Simulation Report

Design Id = 11
sim_id = 1
Simulation Type = Bode Plot



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cinj	C	Injection capacitor	10000000 F
2.	Linj	L	no description	10000000 H
3.	Vinj	AC	no description	1 V
4.	Cout	IC	no description	no values
5.	Rload	R	Load Resistance	2.5 ohm



Design Assistance

- Master key : B6D93EF7AC1258DF[v1]
- TPS54233 Product Folder : <http://www.ti.com/product/TPS54233> : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.