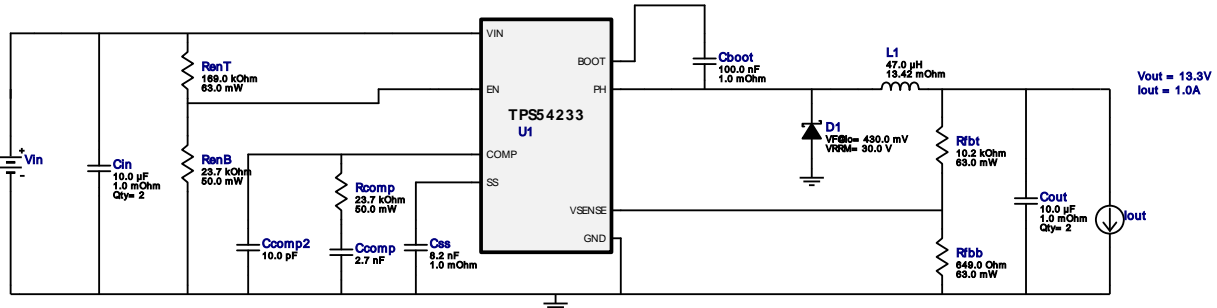


**WEBENCH® Design Report**

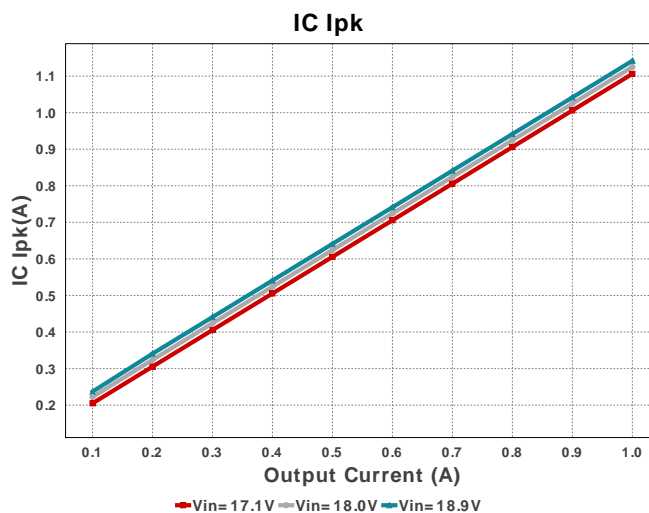
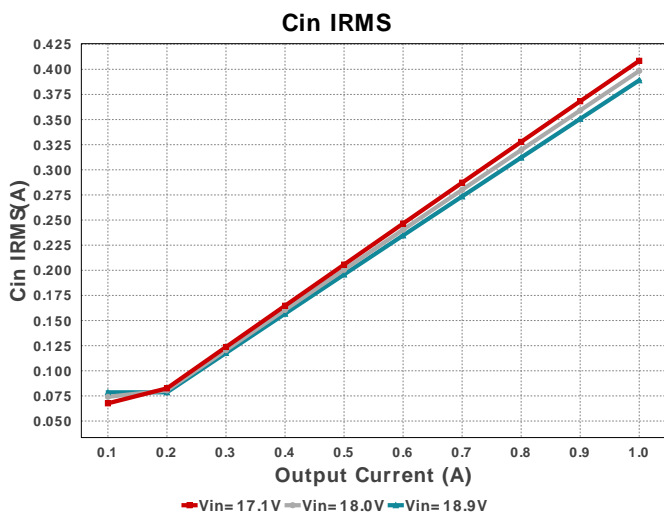
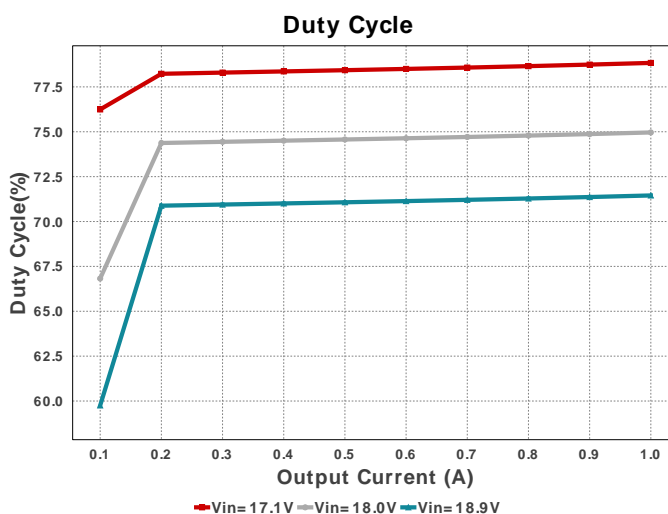
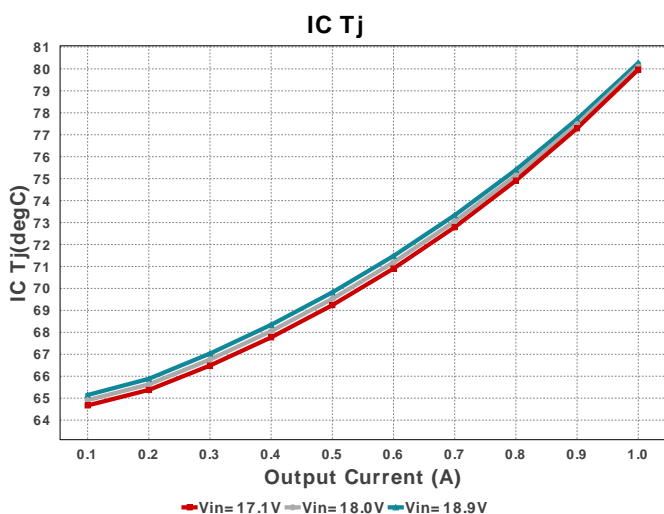
 Design : 3 TPS54233DR  
 TPS54233DR 17.1V-18.9V to 13.30V @ 1A

**Electrical BOM**

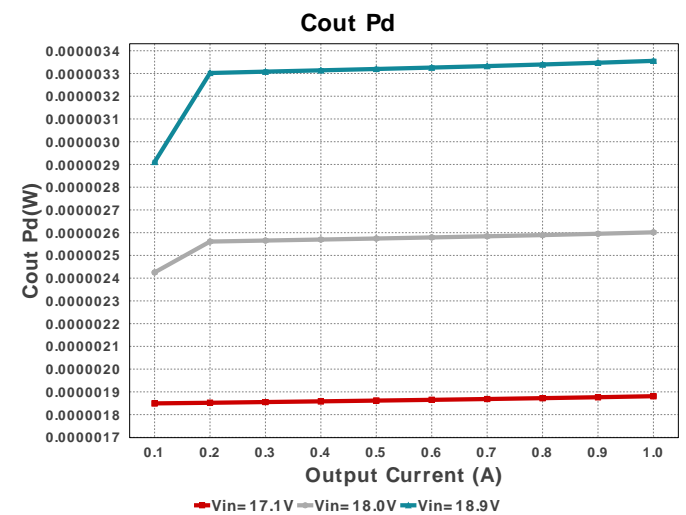
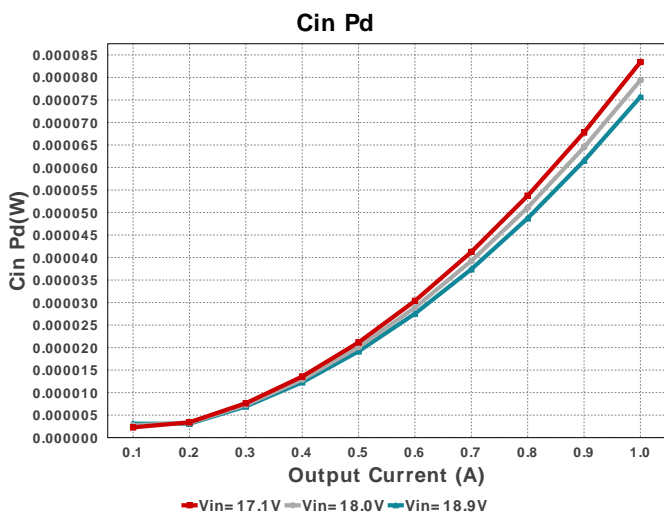
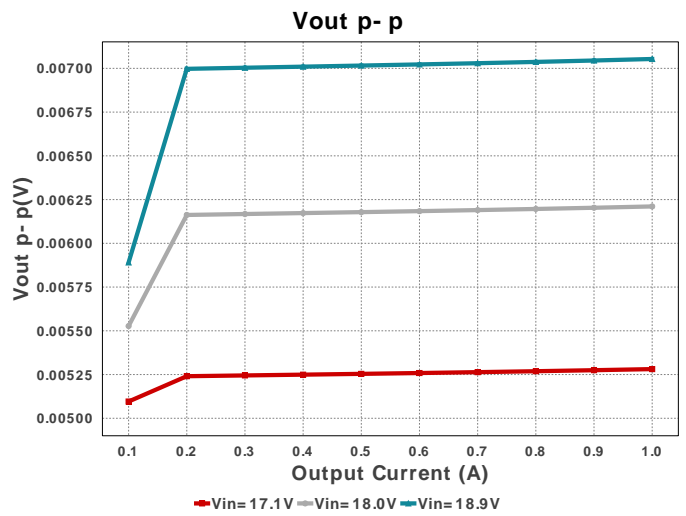
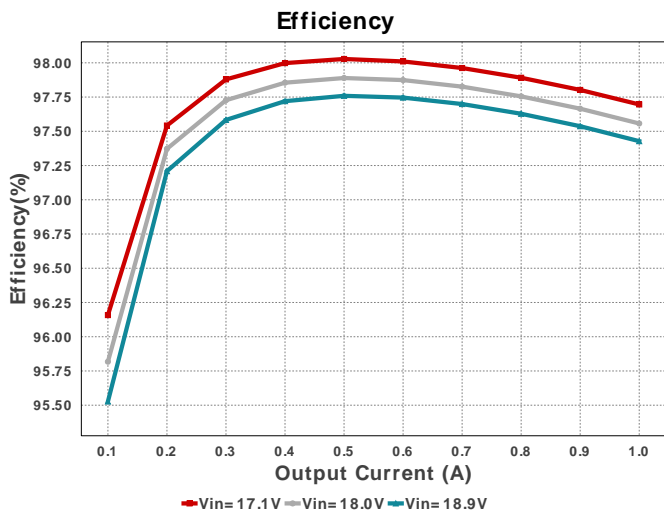
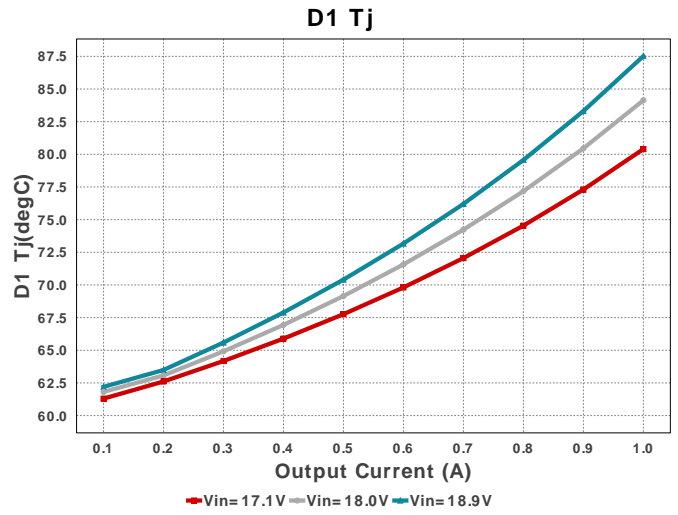
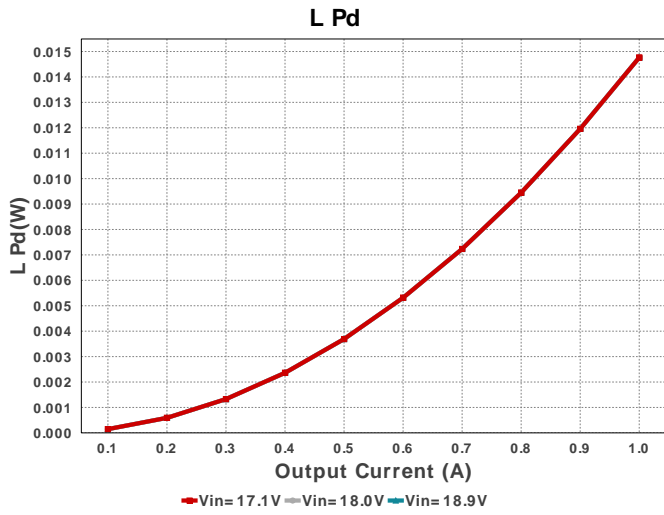
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
Ccomp	TDK	C2012C0G1H272J060AA Series= C0G/NP0	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.03	0805 7 mm <sup>2</sup>
Ccomp2	Samsung Electro-Mechanics	CL21C100JBANNNC Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
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 <sup>2</sup>
Cout	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 <sup>2</sup>
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 <sup>2</sup>
D1	ON Semiconductor	MBR0530T1G	VF@Io= 430.0 mV VRRM= 30.0 V	1	\$0.05	SOD-123 13 mm <sup>2</sup>
L1	Würth Elektronik	7443634700	L= 47.0 uH 13.42 mOhm	1	\$4.54	 WE-HCF_2013 559 mm <sup>2</sup>
Rcomp	Yageo	RC0201FR-0723K7L Series= ?	Res= 23.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 mm <sup>2</sup>
RenB	Yageo	RC0201FR-0723K7L Series= ?	Res= 23.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	0201 2 mm <sup>2</sup>

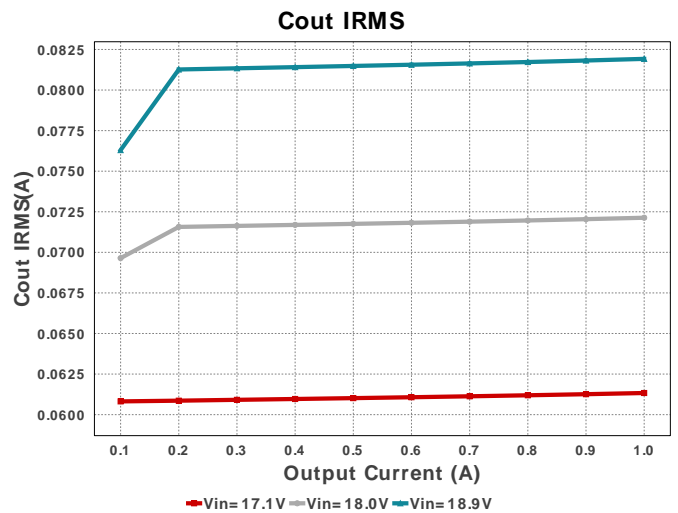
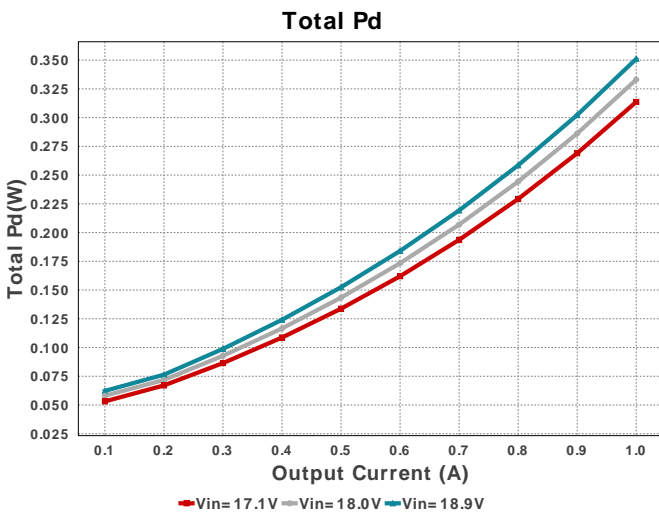
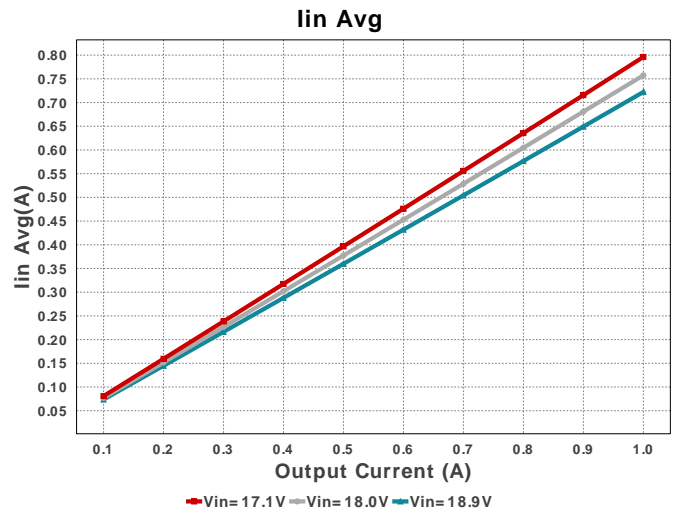
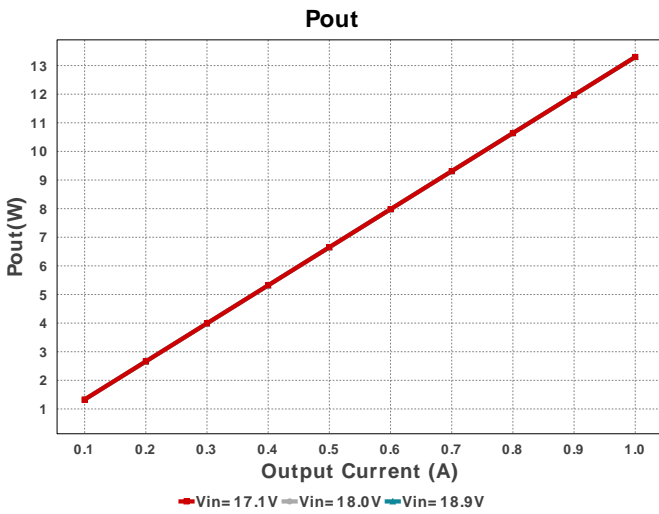
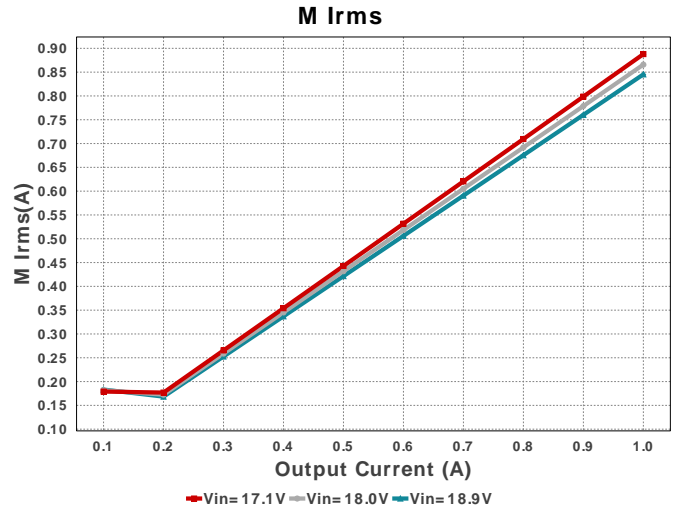
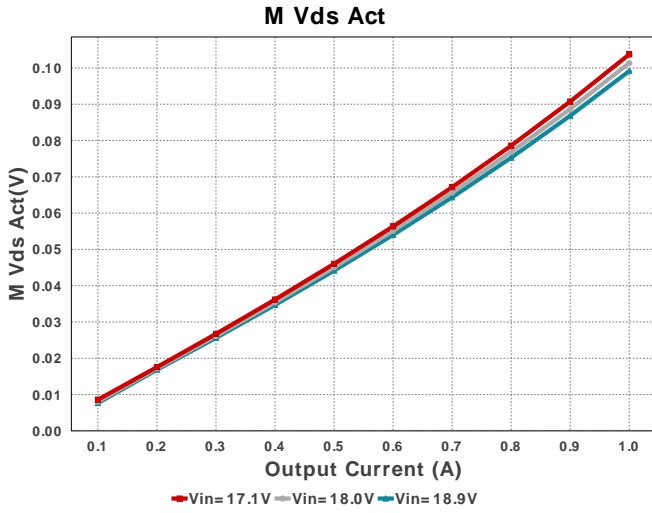
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
RenT	Vishay-Dale	CRCW0402169KFKED Series= CRCW..e3	Res= 169.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rfbb	Vishay-Dale	CRCW0402649RFKED Series= CRCW..e3	Res= 649.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
U1	Texas Instruments	TPS54233DR	Switcher	1	\$0.47	

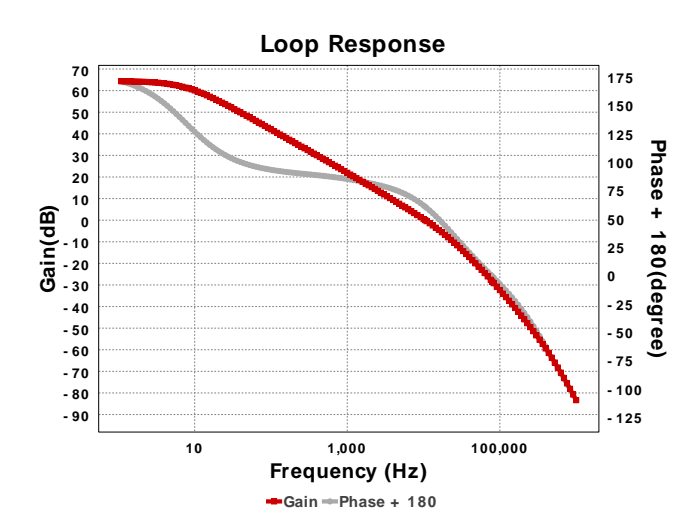
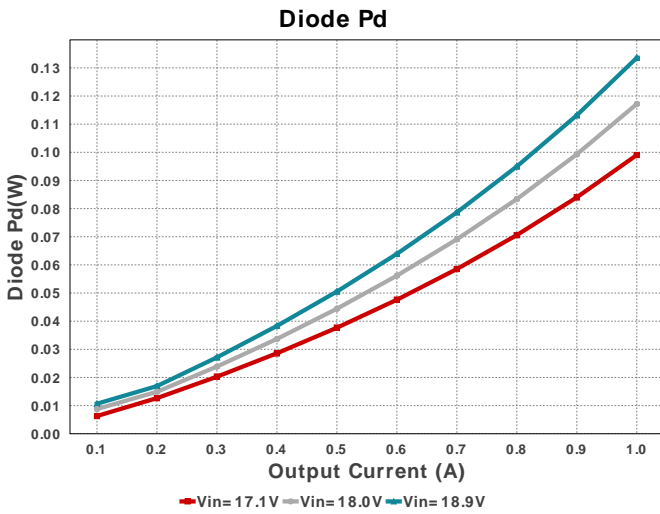
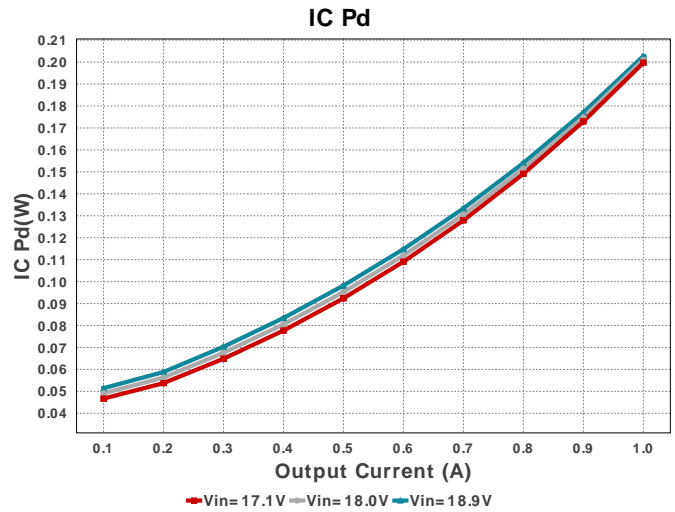
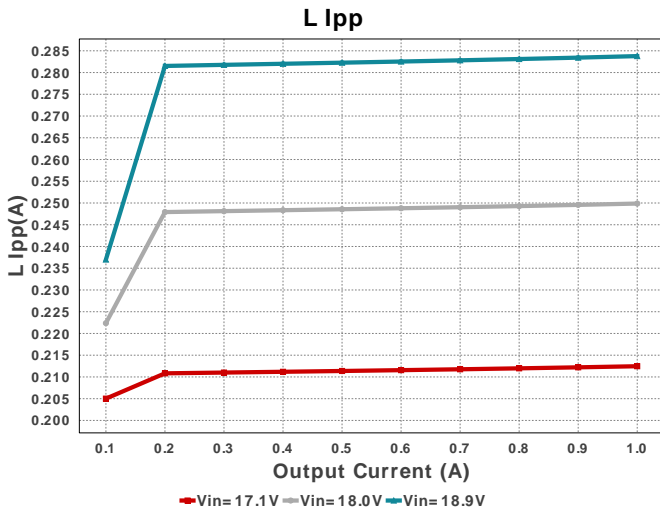


D0008A 57 mm<sup>2</sup>









### Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	389.069 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	75.687 $\mu$ W	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	81.92 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	3.355 $\mu$ W	Capacitor	Output capacitor power dissipation
5.	D1 Tj	87.519 degC	Diode	D1 junction temperature
6.	Diode Pd	133.59 mW	Diode	Diode power dissipation
7.	IC Ipk	1.142 A	IC	Peak switch current in IC
8.	IC Pd	202.73 mW	IC	IC power dissipation
9.	IC Tj	80.273 degC	IC	IC junction temperature
10.	ICThetaJA	100.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	722.28 mA	IC	Average input current
12.	L Ipp	283.78 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	14.762 mW	Inductor	Inductor power dissipation
14.	M Irms	845.293 mA	Mosfet	MOSFET RMS ripple current
15.	M Vds Act	99.136 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	75.687 $\mu$ W	Power	Input capacitor power dissipation
17.	Cout Pd	3.355 $\mu$ W	Power	Output capacitor power dissipation
18.	Diode Pd	133.59 mW	Power	Diode power dissipation
19.	IC Pd	202.73 mW	Power	IC power dissipation
20.	L Pd	14.762 mW	Power	Inductor power dissipation
21.	Total Pd	351.106 mW	Power	Total Power Dissipation
22.	BOM Count	16	System	Total Design BOM count
			Information	
23.	Cross Freq	10.507 kHz	System	Bode plot crossover frequency
			Information	
24.	Duty Cycle	71.452 %	System	Duty cycle
			Information	
25.	Efficiency	97.428 %	System	Steady state efficiency
			Information	
26.	FootPrint	720.0 mm <sup>2</sup>	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	-28.437 dB	System Information	Bode Plot Gain Margin
29.	Iout	1.0 A	System Information	Iout operating point
30.	Low Freq Gain	64.304 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	61.272 deg	System Information	Bode Plot Phase Margin
33.	Pout	13.3 W	System Information	Total output power
34.	Total BOM	\$6.29	System Information	Total BOM Cost
35.	Vin	18.9 V	System Information	Vin operating point
36.	Vout	13.3 V	System Information	Operational Output Voltage
37.	Vout Actual	13.373 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	5.466 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	7.054 mV	System Information	Peak-to-peak output ripple voltage

## Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	18.9	Maximum input voltage
VinMin	17.1	Minimum input voltage
Vout	13.3	Output Voltage
base_pn	TPS54233	Base Product Number
source	DC	Input Source Type
Ta	60.0	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 17.1V 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.

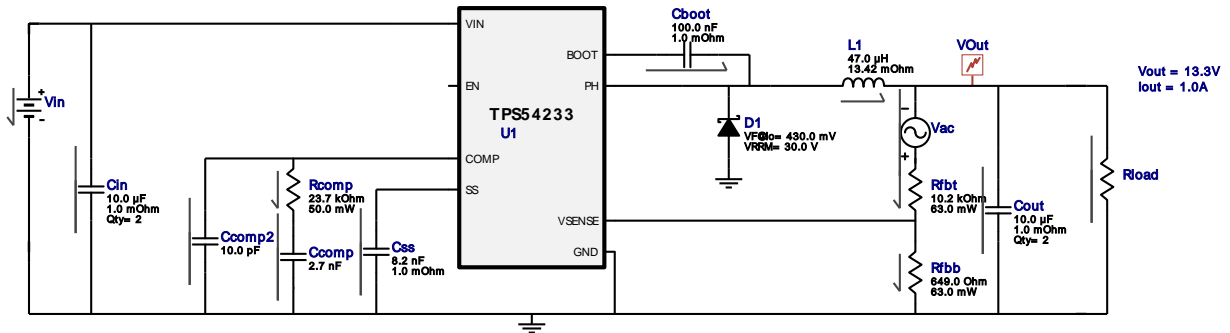


# WEBENCH® Electrical Simulation Report

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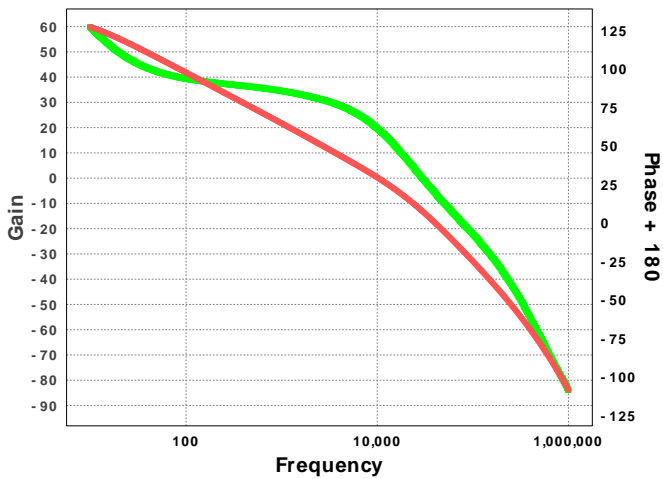
Simulation Type = Bode Plot



## 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	13.3 ohm

Bode Plot

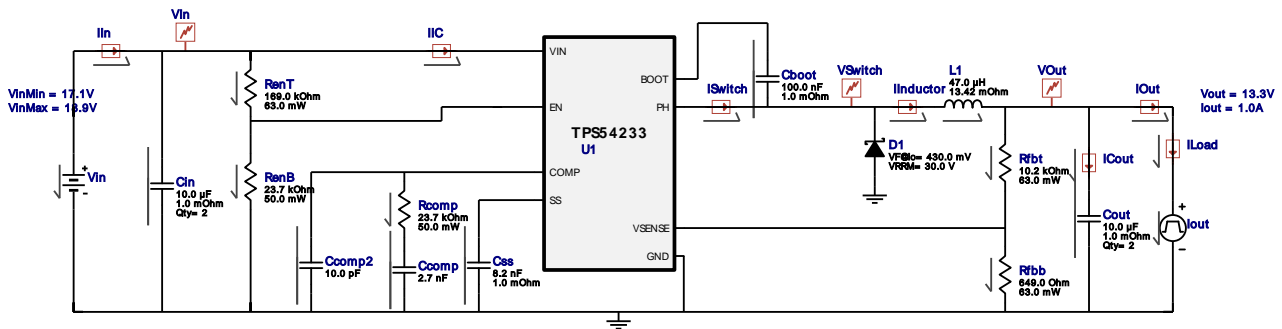




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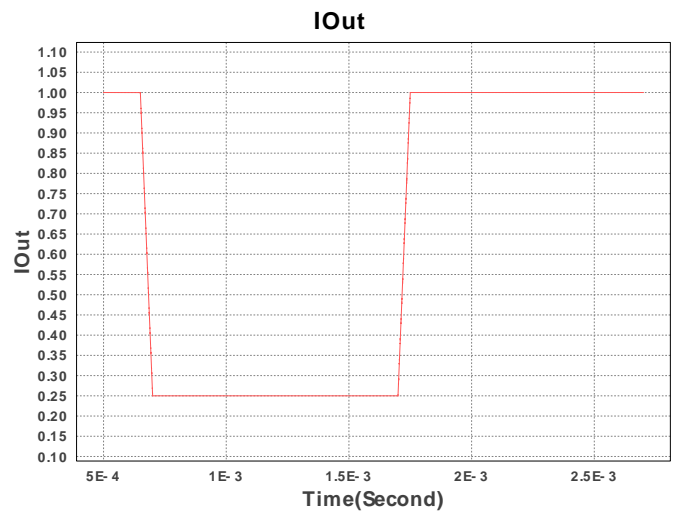
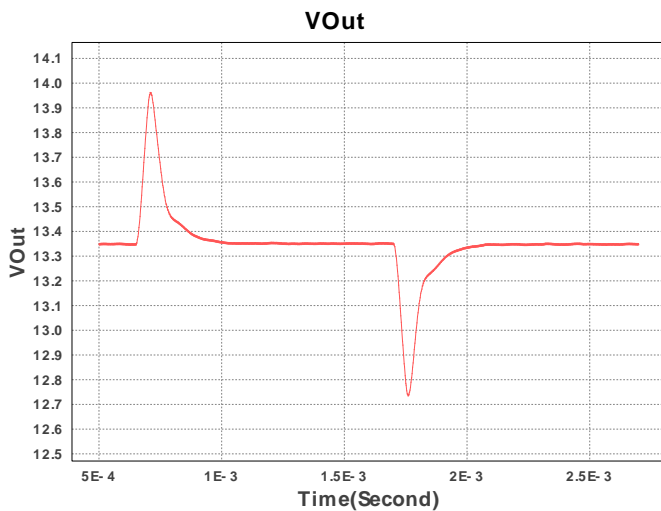
sim\_id = 2

Simulation Type = Load Transient



### Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Css	IC	initial condition	0.8
2.	Cboot	IC	initial condition	18.0
3.	L1	IC	initial condition	1.0
4.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	1.0 A
		I2	Minimum Load Current	0.25 A
		Td	Initial Time Delay	650u s
		Tf	Fall Time	50u s
		Tr	Rise Time	50u s
		Pw	Pulse Width	1m s



### Design Assistance

1. Master key : 358A1D874329ACA9[v1]

2. **TPS54233** Product Folder : <http://www.ti.com/product/TPS54233> : contains the data sheet and other resources.

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