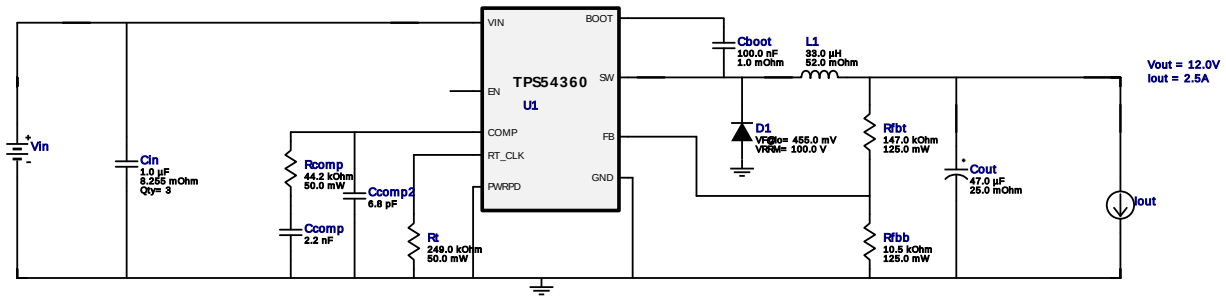
WEBENCH® Design Report

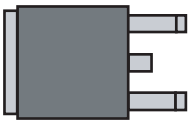
VinMin = 20.0V
VinMax = 55.0V
Vout = 12.0V
Iout = 2.5A

Device = TPS54360DDAR
Topology = Buck
Created = 2019-02-06 05:40:26.510
BOM Cost = $4.72
BOM Count = 14
Total Pd = 2.4W

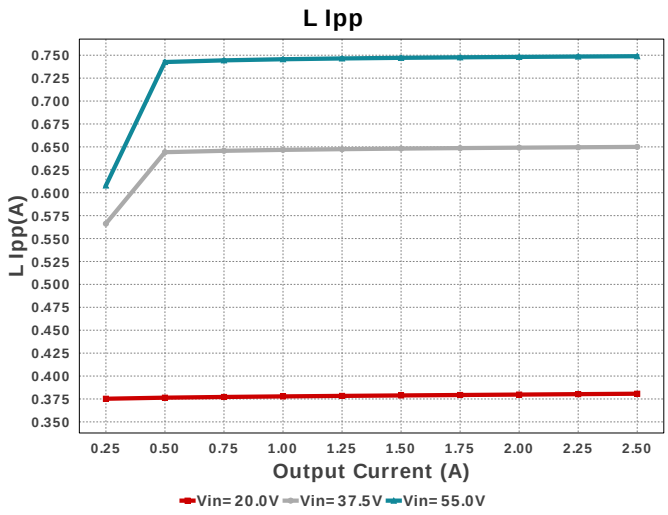
Design : 4 TPS54360DDAR
TPS54360DDAR 20V-55V to 12.00V @ 2.5A

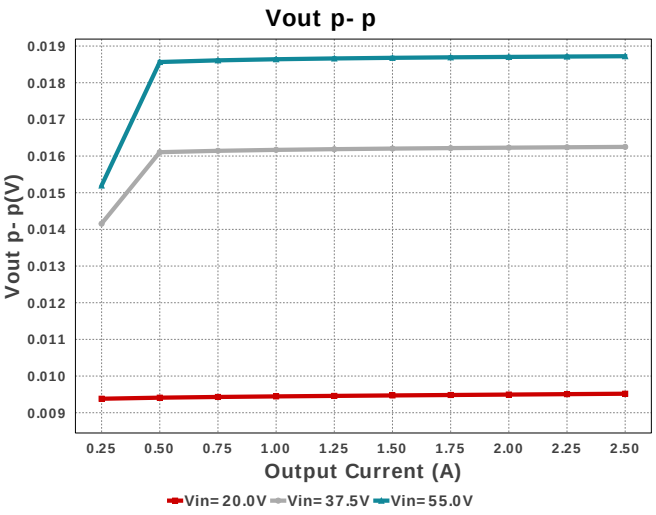


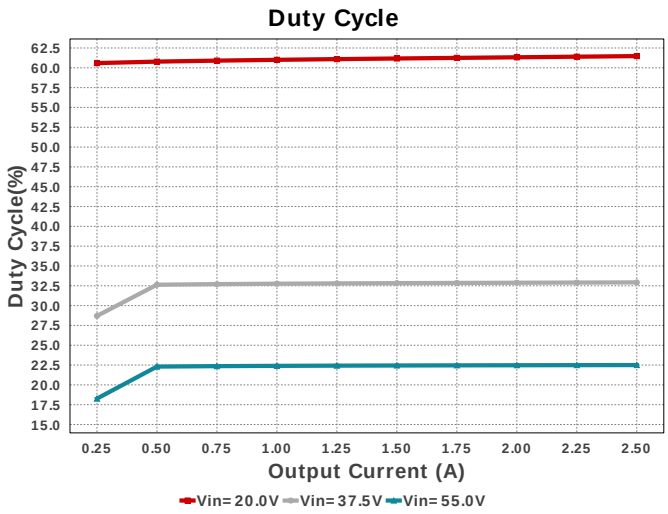
Electrical BOM

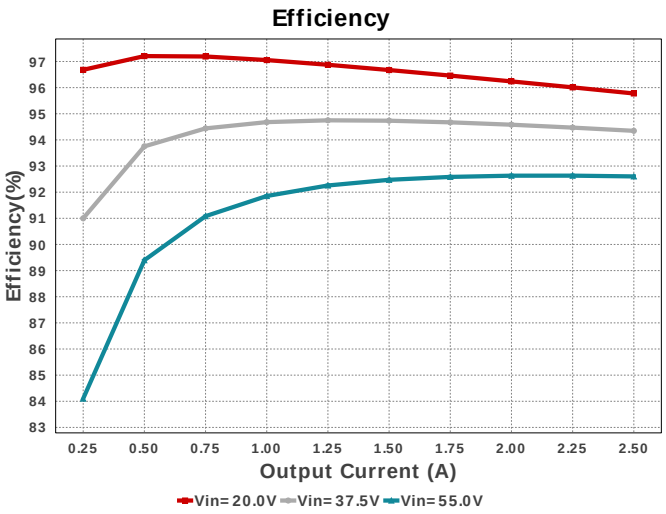
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	TDK	C2012C0G1H222K060AA Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Ccomp2	AVX	06031U6R8BAT2A Series= C0G/NP0	Cap= 6.8 pF VDC= 100.0 V IRMS= 0.0 A	1	$0.07	0603 5 mm²
Cin	TDK	C2012X7S2A105K125AB Series= X7S	Cap= 1.0 uF ESR= 8.255 mOhm VDC= 100.0 V IRMS= 2.27442 A	3	$0.14	0805 7 mm²
Cout	Panasonic	16SVPG47M Series= SVPG	Cap= 47.0 uF ESR= 25.0 mOhm VDC= 16.0 V IRMS= 3.2 A	1	$0.43	 CAPSMT_62_B45 53 mm²
D1	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.39	 DDPAK 210 mm²
L1	Bourns	SRR1210-330M	L= 33.0 µH DCR= 52.0 mOhm	1	$0.53	 SRR1210 196 mm²
Rcomp	Yageo	RC0201FR-0744K2L Series= ?	Res= 44.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbb	Panasonic	ERJ-6ENF1052V Series= ERJ-6E	Res= 10.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rfbt	Panasonic	ERJ-6ENF1473V Series= ERJ-6E	Res= 147.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

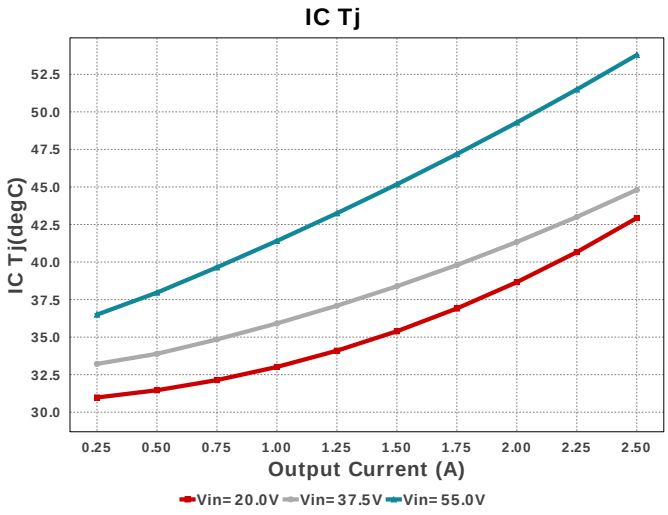
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rt	Yageo	RC0201FR-07249KL Series= ?	Res= 249.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	TPS54360DDAR	Switcher	1	$1.80	R-PDSO-G8 55 mm^2

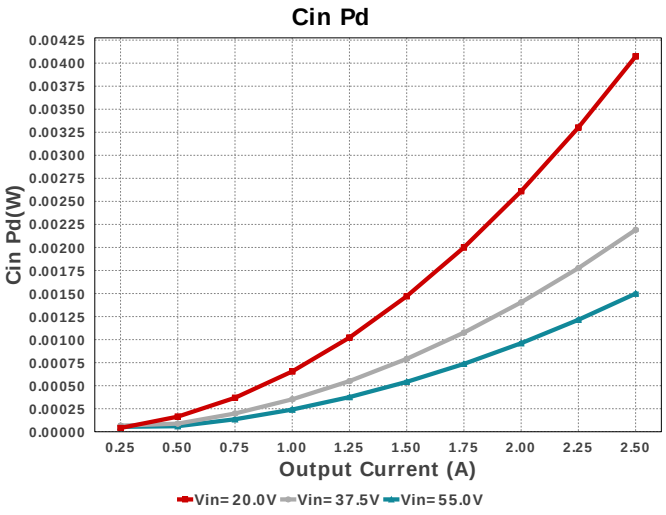


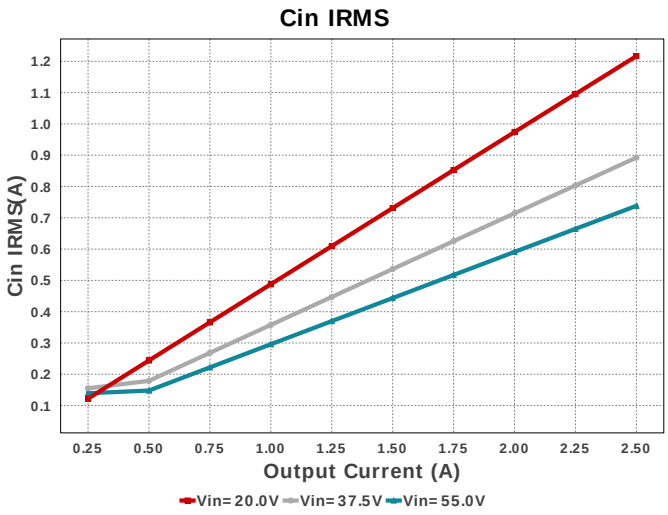


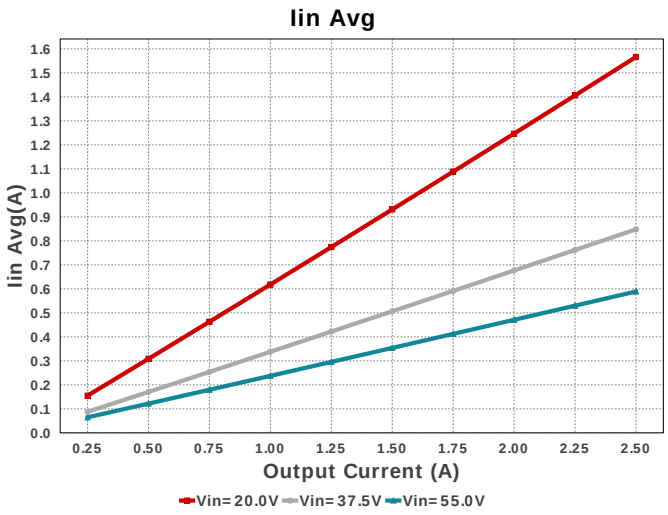


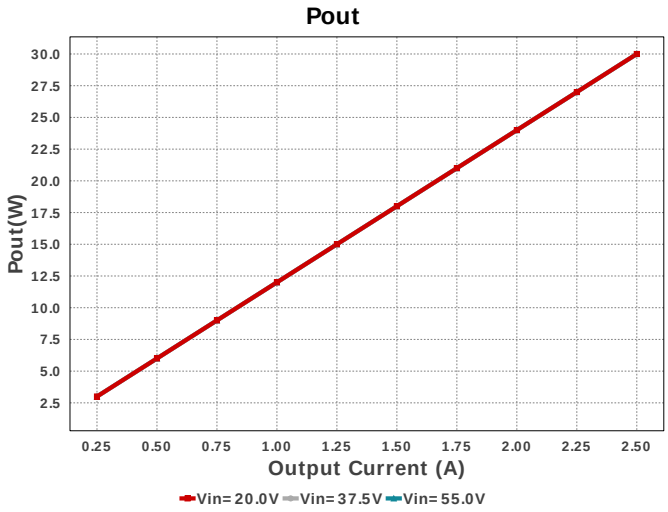


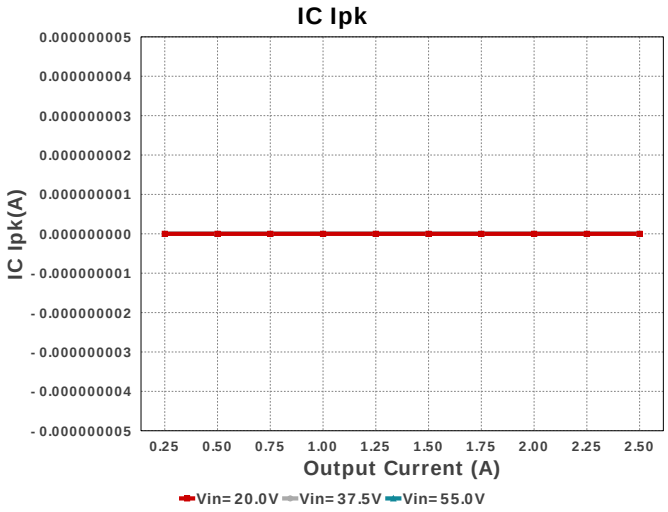


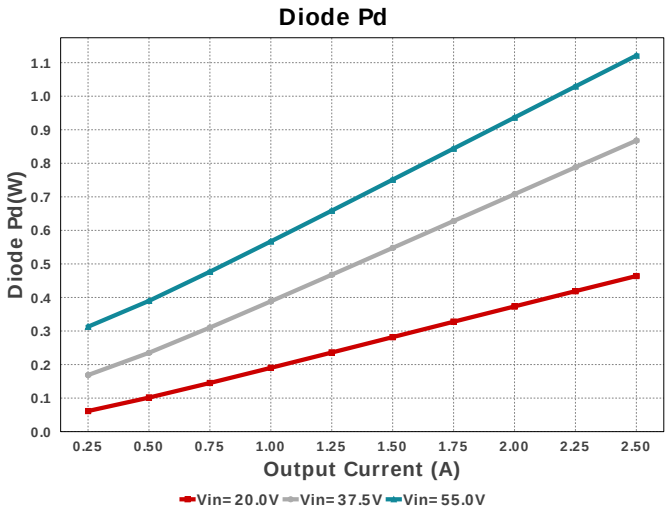


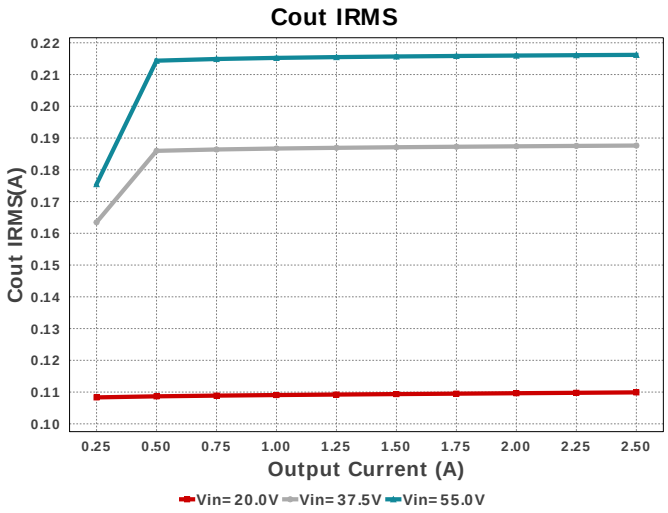


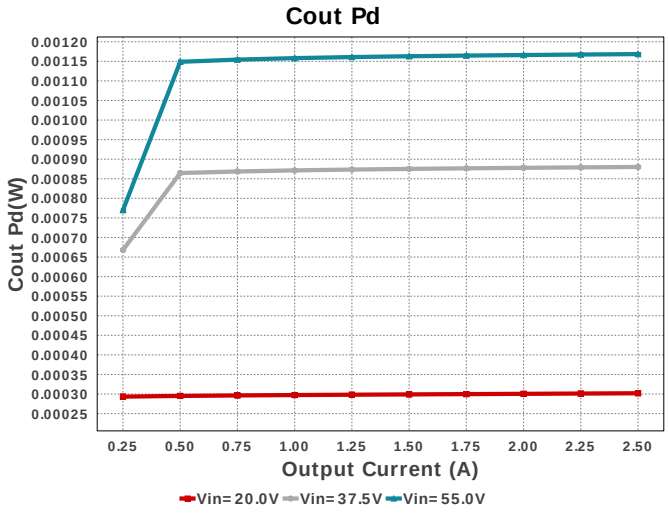


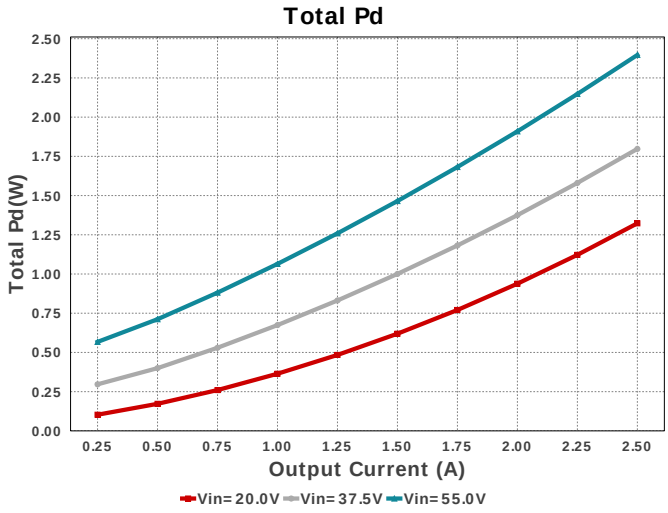


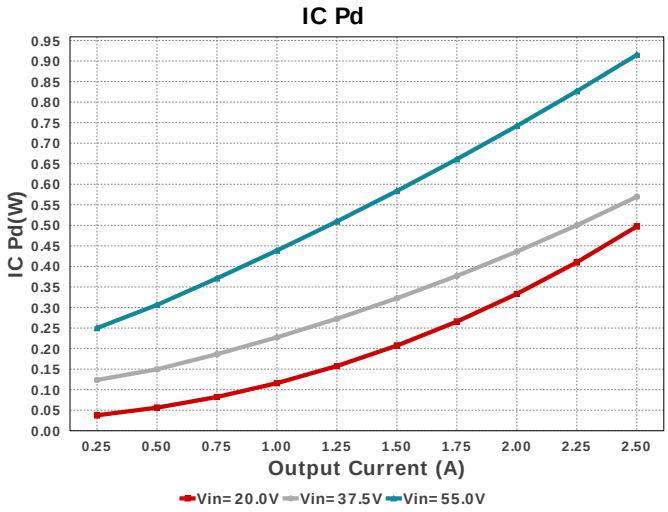


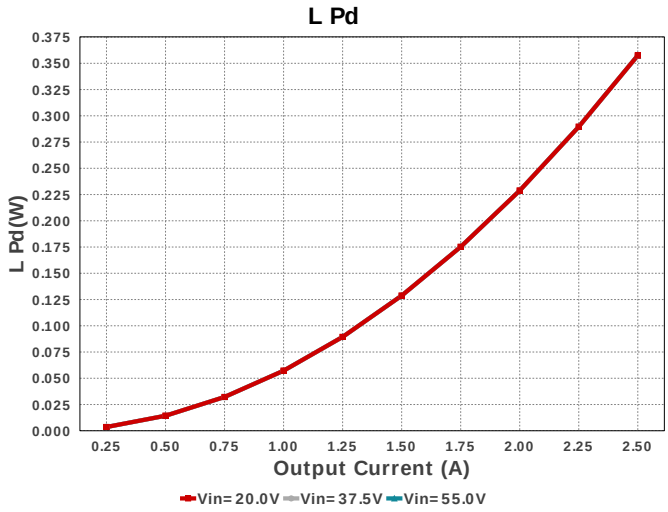


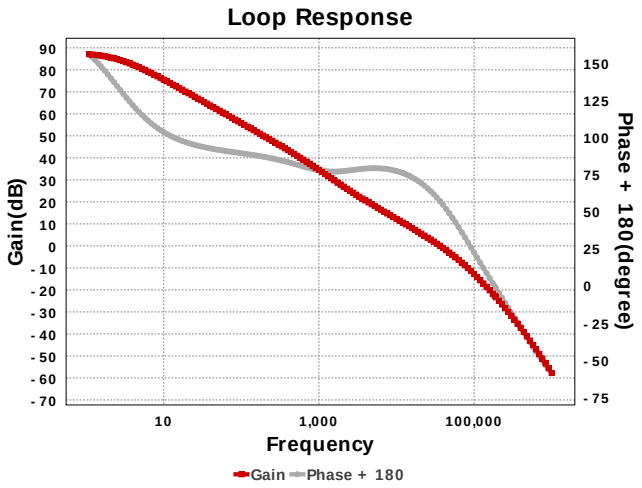












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	738.076 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	1.499 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	216.193 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	1.168 mW	Capacitor	Output capacitor power dissipation
5.	Diode Pd	1.121 W	Diode	Diode power dissipation
6.	IC Ipk	0.0 A	IC	Peak switch current in IC
7.	IC Pd	914.92 mW	IC	IC power dissipation
8.	IC Tj	53.788 degC	IC	IC junction temperature
9.	ICThetaJA Effective	26.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	589.02 mA	IC	Average input current
11.	L Ipp	748.92 mA	Inductor	Peak-to-peak inductor ripple current

#	Name	Value	Category	Description
12.	L Pd	357.5 mW	Inductor	Inductor power dissipation
13.	Cin Pd	1.499 mW	Power	Input capacitor power dissipation
14.	Cout Pd	1.168 mW	Power	Output capacitor power dissipation
15.	Diode Pd	1.121 W	Power	Diode power dissipation
16.	IC Pd	914.92 mW	Power	IC power dissipation
17.	L Pd	357.5 mW	Power	Inductor power dissipation
18.	Total Pd	2.396 W	Power	Total Power Dissipation
19.	BOM Count	14	System Information	Total Design BOM count
20.	Cross Freq	36.437 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	22.498 %	System Information	Duty cycle
22.	Efficiency	92.603 %	System Information	Steady state efficiency
23.	FootPrint	567.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	391.449 kHz	System Information	Switching frequency
25.	Gain Marg	-22.795 dB	System Information	Bode Plot Gain Margin
26.	Iout	2.5 A	System Information	Iout operating point
27.	Low Freq Gain	87.102 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	57.253 deg	System Information	Bode Plot Phase Margin
30.	Pout	30.0 W	System Information	Total output power
31.	Total BOM	$4.72	System Information	Total BOM Cost
32.	Vin	55.0 V	System Information	Vin operating point
33.	Vout	12.0 V	System Information	Operational Output Voltage
34.	Vout Actual	12.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.904 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout p-p	18.723 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	55.0	Maximum input voltage
VinMin	20.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS54360	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

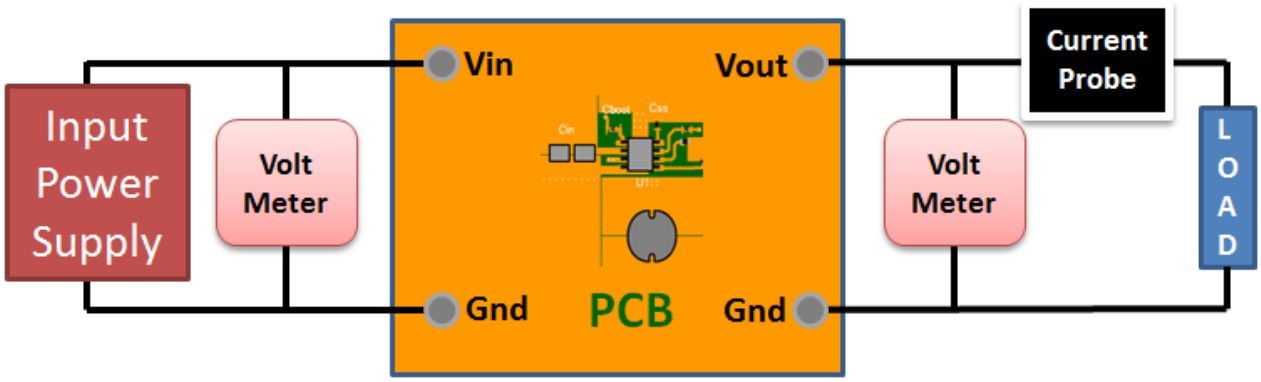
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 20.0V 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.

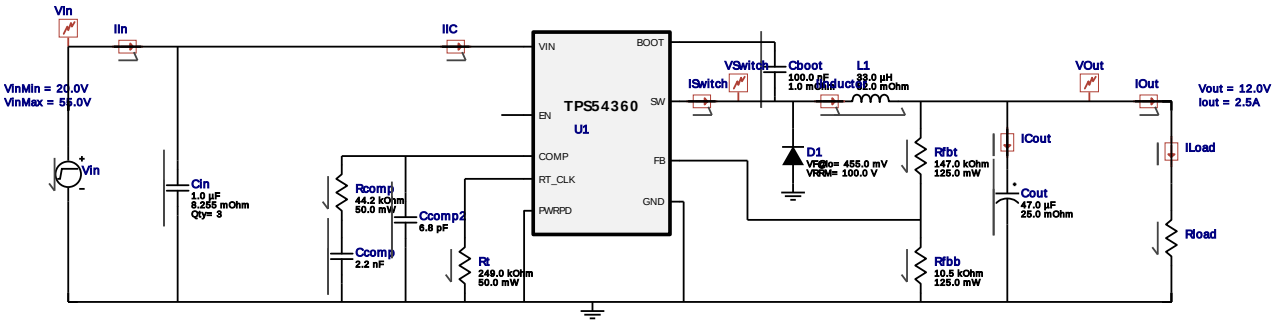


WEBENCH® Electrical Simulation Report

Design Id = 4

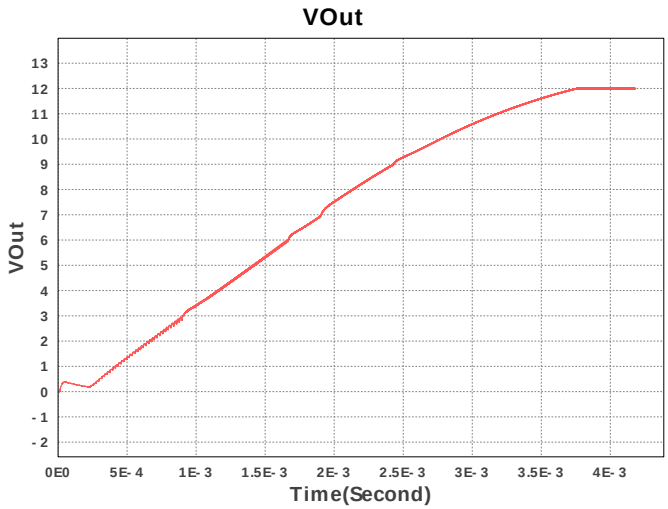
sim_id = 6

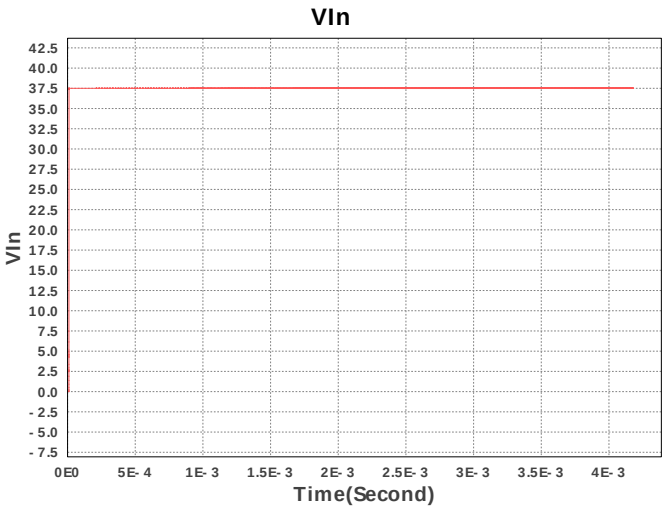
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	4.8 Ohm

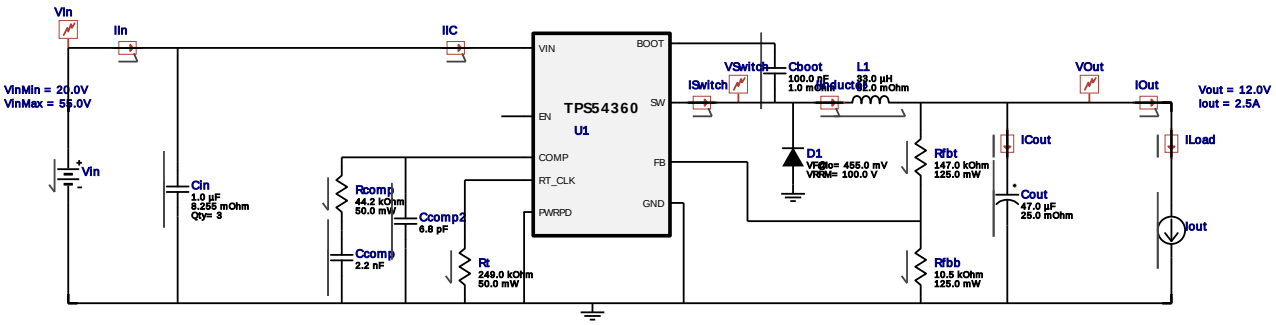




Design Id = 4

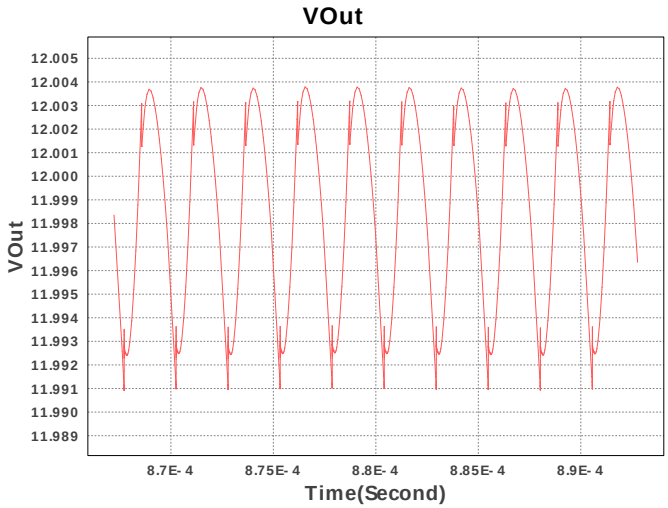
sim_id = 7

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	initial current	2.5 A
2.	Cboot	IC		8 V
3.	Iout	I	Load Current	2.5 A



Design Assistance

1. Master key : 3DD560FD4F706011[v1]
2. **TPS54360** Product Folder : http://www.ti.com/product/TPS54360 : contains the data sheet and other resources.