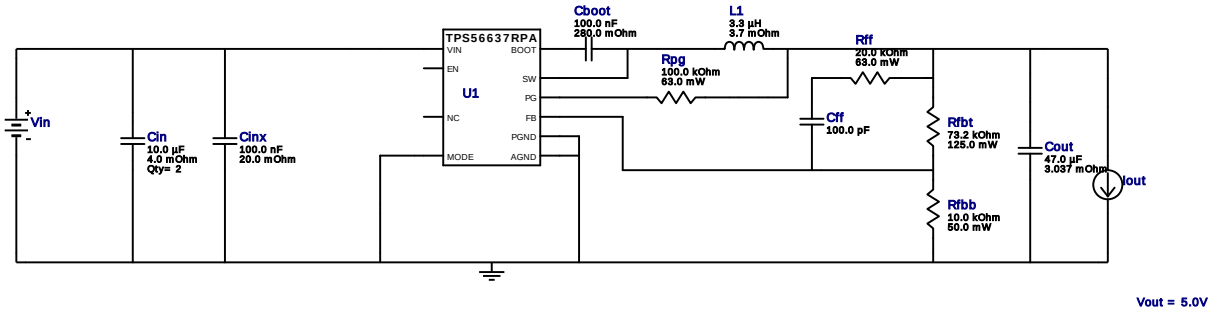
VinMin = 7.0V
VinMax = 14.0V
Vout = 5.0V
Iout = 5.0A

Device = TPS56637RPAR
Topology = Buck
Created = 2023-08-25 00:26:29.938
BOM Cost = $3.43
BOM Count = 12
Total Pd = 1.25W

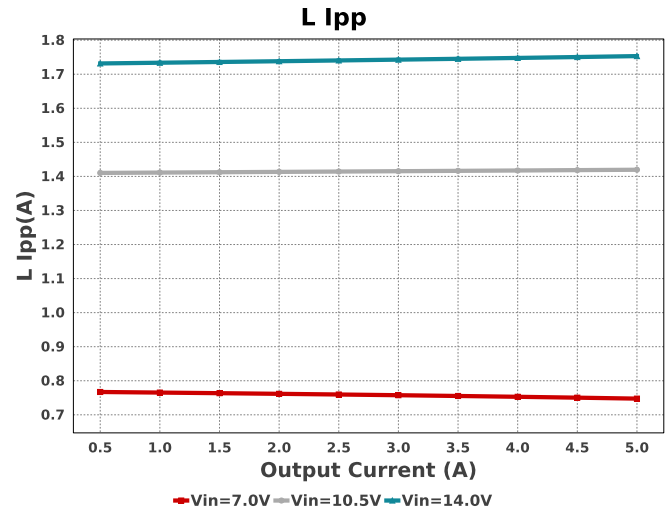
WEBENCH® Design Report

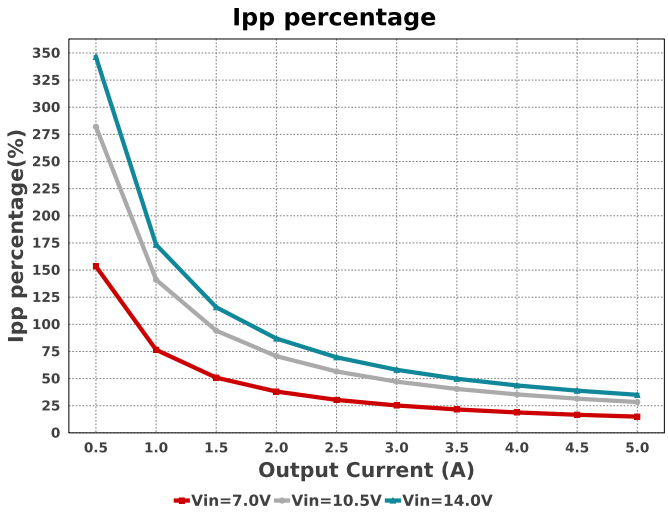
Design : 2 TPS56637RPAR
TPS56637RPAR 7V-14V to 5.00V @ 5A

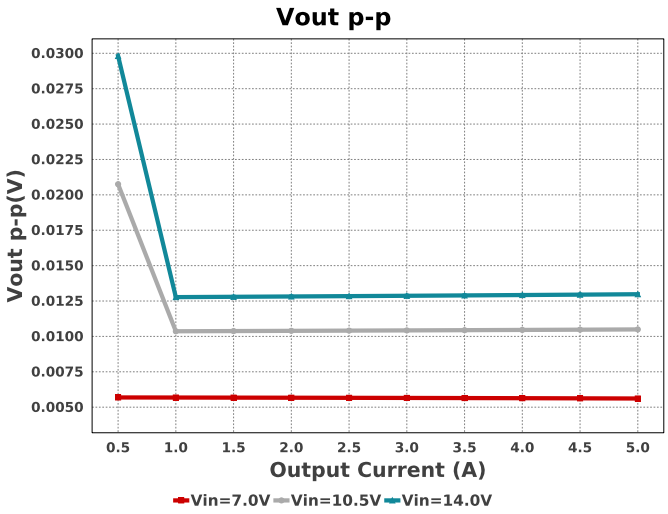


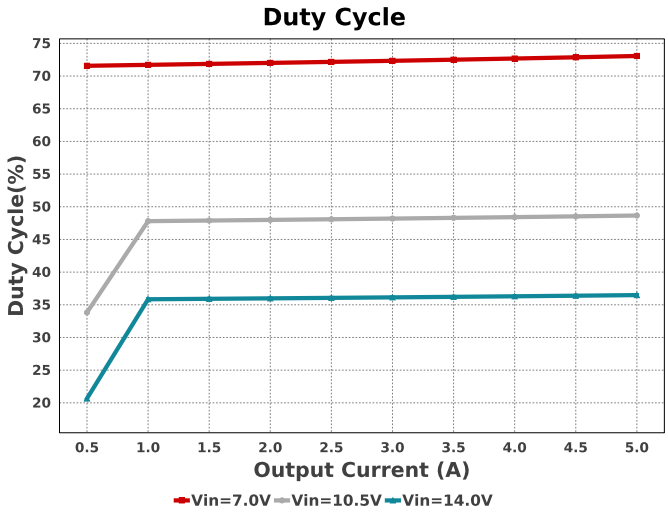
Electrical BOM

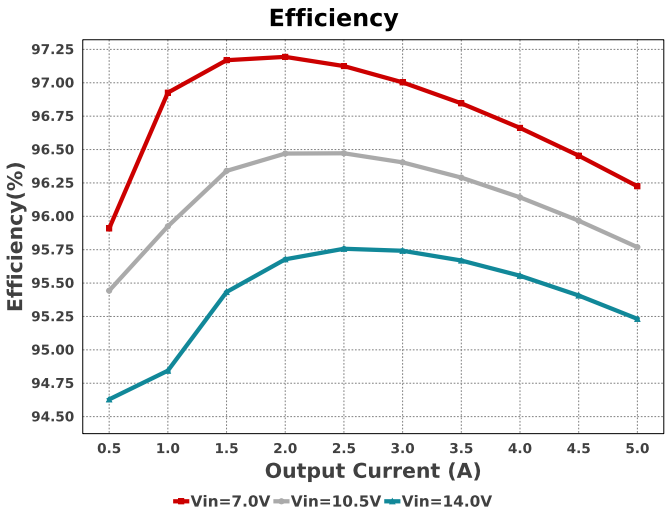
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cff	Kemet	C0201C101K3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Cin	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	2	$0.04	0805 7 mm²
Cinx	MuRata	GRM188R71H104KA93D Series= X7R	Cap= 100.0 nF ESR= 20.0 mOhm VDC= 50.0 V IRMS= 3.8 A	1	$0.02	0603 5 mm²
Cout	MuRata	GRM32ER61C476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	1	$0.17	1210_280 15 mm²
L1	Coilcraft	XAL1010-332MEB	L= 3.3 µH 3.7 mOhm	1	$1.71	XAL1010 160 mm²
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbt	Panasonic	ERJ-6ENF7322V Series= ERJ-6E	Res= 73.2 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rff	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS56637RPAR	Switcher	1	$1.39	RPA0010A 16 mm²

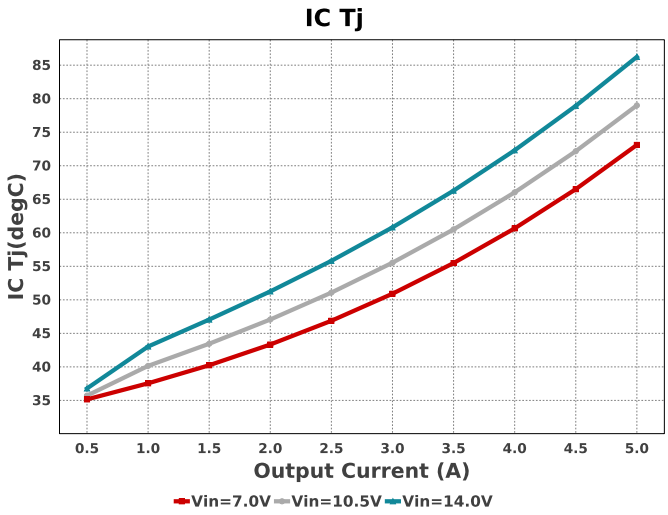


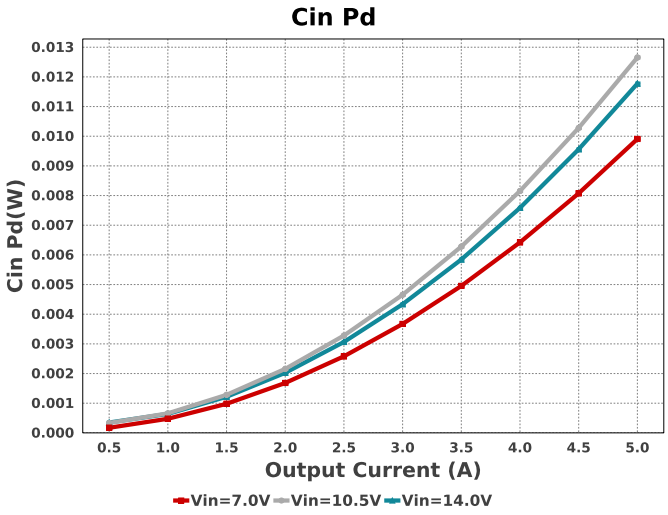


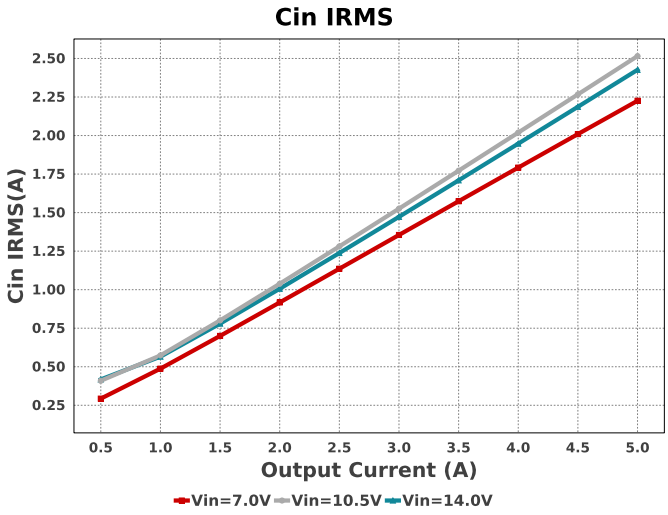


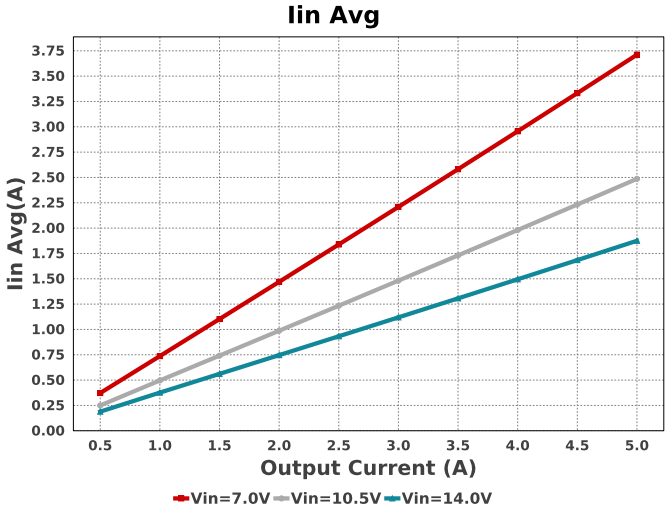


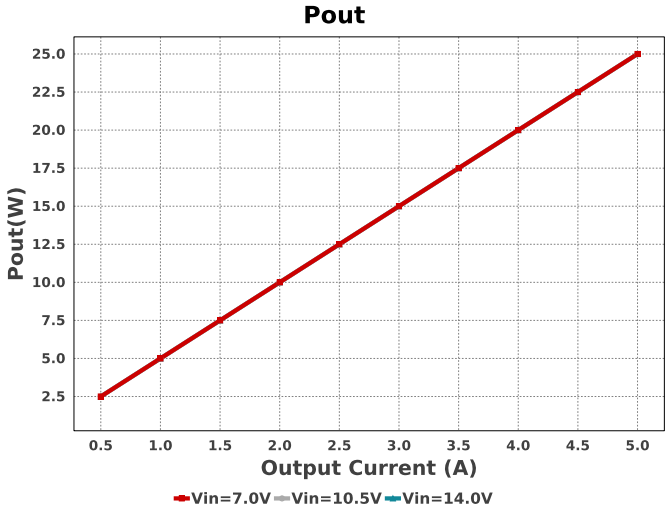


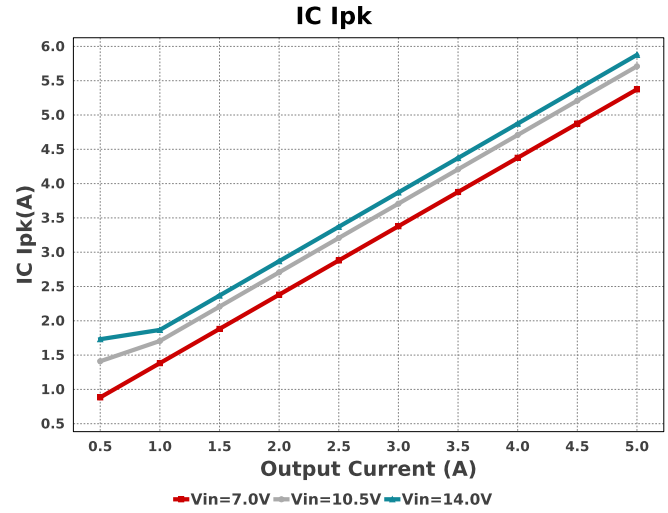


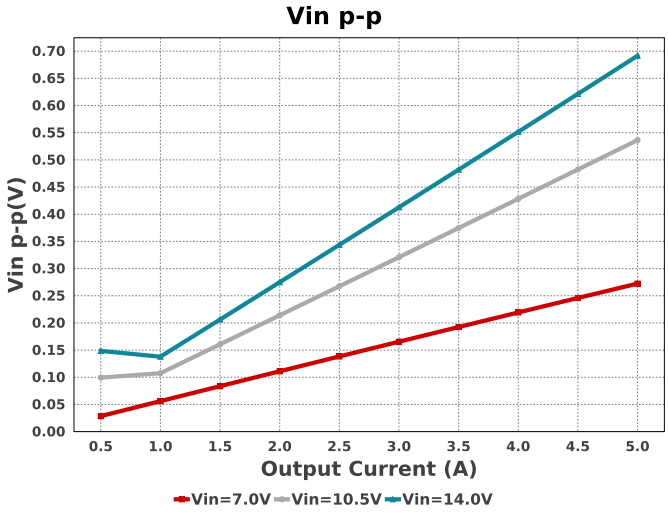


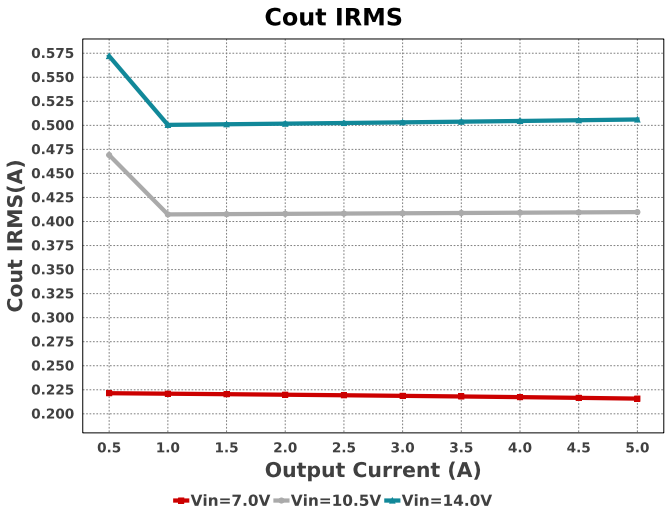


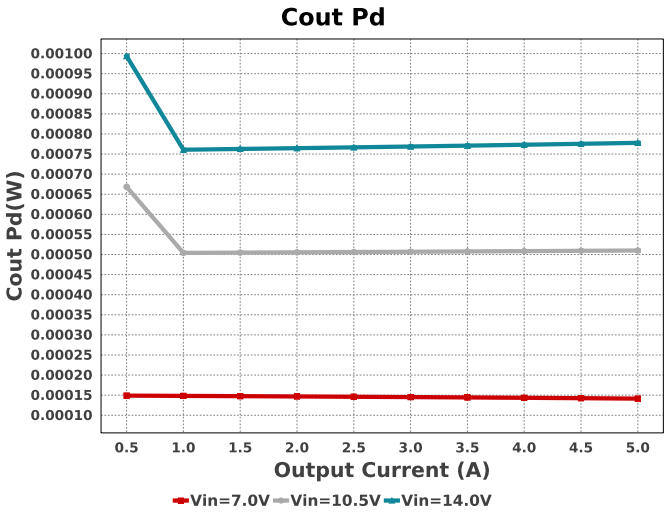


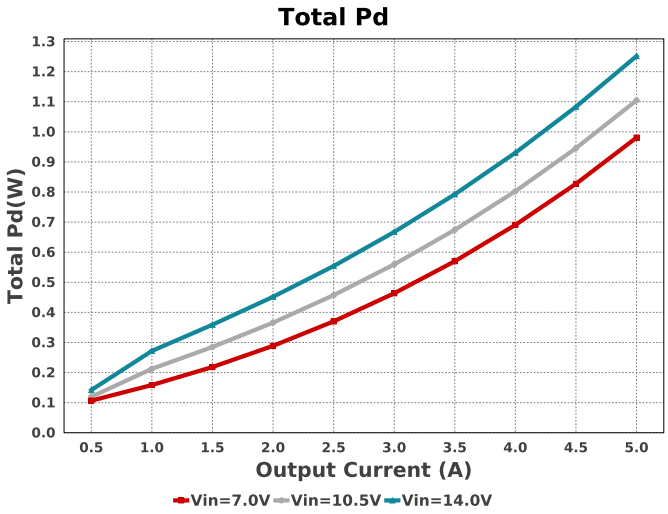


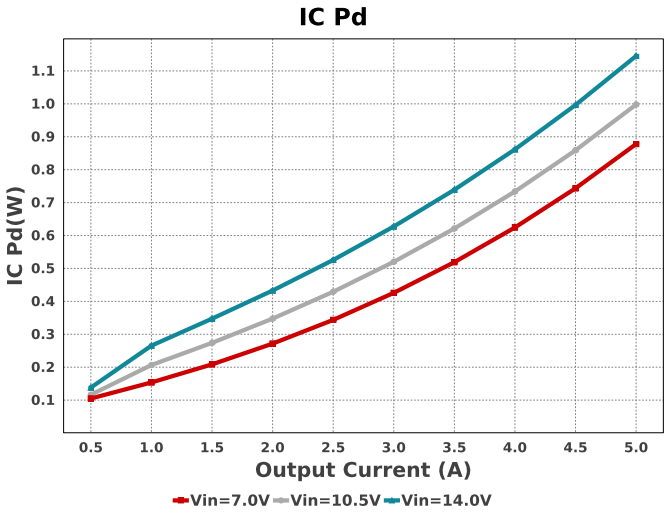


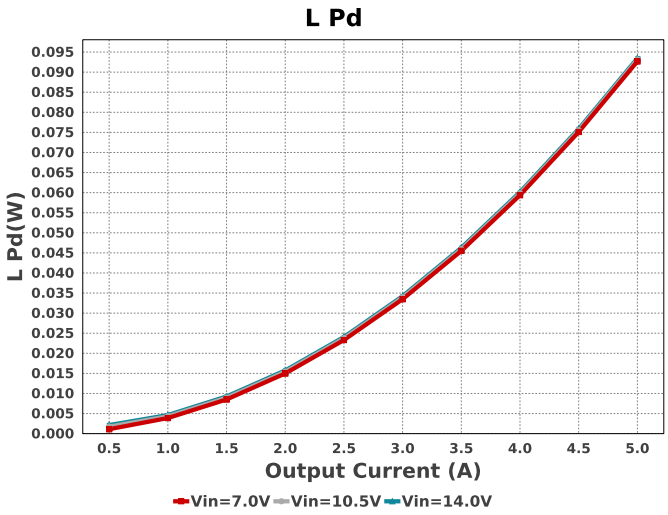


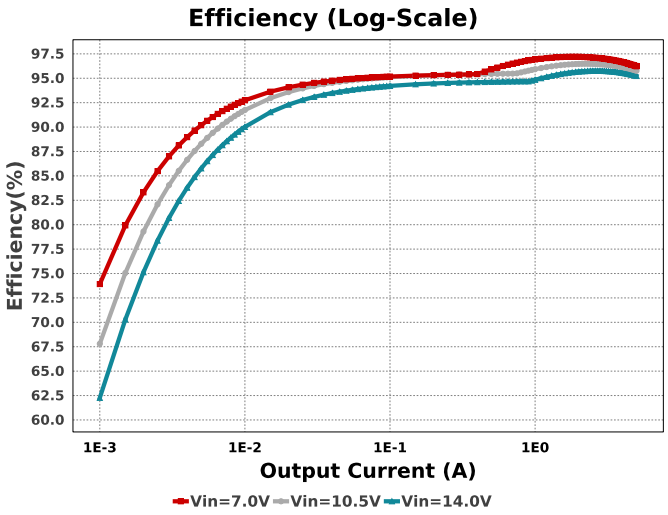












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.426 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	11.773 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	506.108 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	777.91 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	5.877 A	IC	Peak switch current in IC
6.	IC Pd	1.145 W	IC	IC power dissipation
7.	IC Tj	86.239 degC	IC	IC junction temperature
8.	IC Tolerance	10.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA	49.1 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	1.875 A	IC	Average input current

#	Name	Value	Category	Description
11.	Ipp percentage	35.064 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	1.753 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	93.448 mW	Inductor	Inductor power dissipation
14.	Cin Pd	11.773 mW	Power	Input capacitor power dissipation
15.	Cout Pd	777.91 µW	Power	Output capacitor power dissipation
16.	IC Pd	1.145 W	Power	IC power dissipation
17.	L Pd	93.448 mW	Power	Inductor power dissipation
18.	Total Pd	1.252 W	Power	Total Power Dissipation
19.	BOM Count	12	System Information	Total Design BOM count
20.	Duty Cycle	36.484 %	System Information	Duty cycle
21.	Efficiency	95.232 %	System Information	Steady state efficiency
22.	FootPrint	232.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	559.346 kHz	System Information	Switching frequency
24.	Iout	5.0 A	System Information	Iout operating point
25.	Mode	CCM	System Information	Conduction Mode
26.	Pout	25.0 W	System Information	Total output power
27.	Total BOM	$3.426	System Information	Total BOM Cost
28.	Vin	14.0 V	System Information	Vin operating point
29.	Vin p-p	691.578 mV	System Information	Peak-to-peak input voltage
30.	Vout	5.0 V	System Information	Operational Output Voltage
31.	Vout Actual	4.992 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	3.474 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	12.98 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	14.0	Maximum input voltage
VinMin	7.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS56637	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

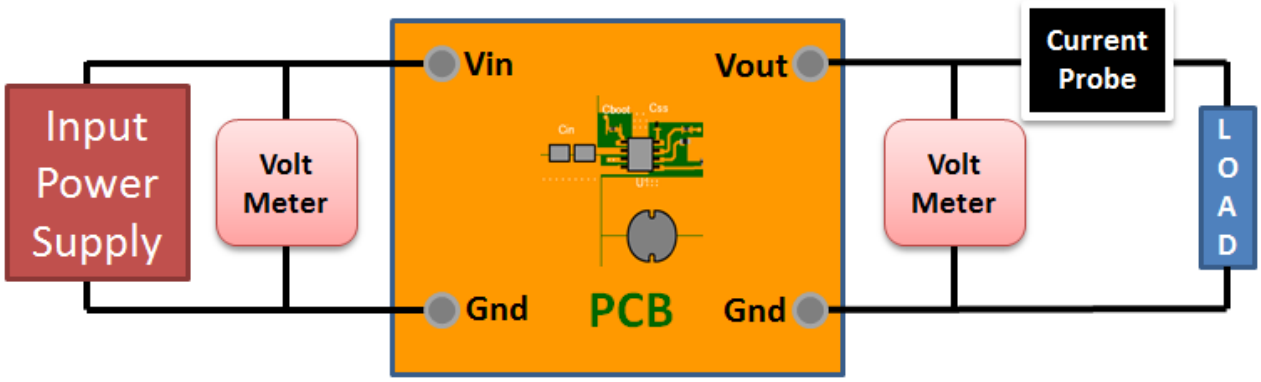
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 7.0V 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.

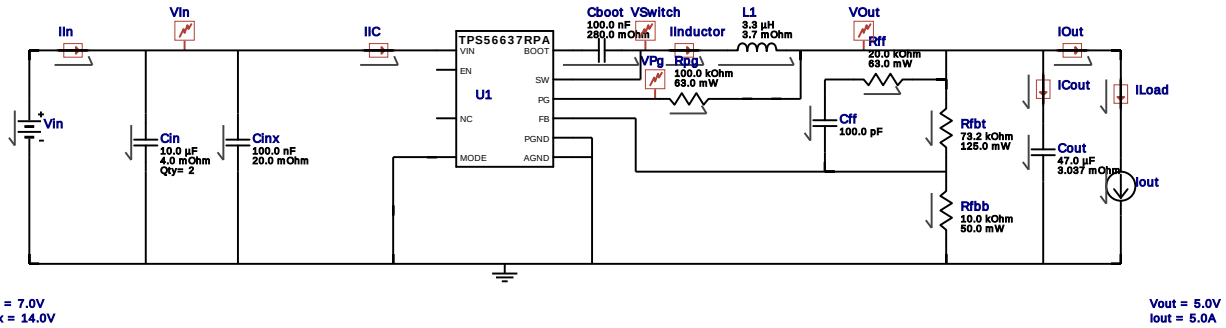


WEBENCH® Electrical Simulation Report

Design Id = 2

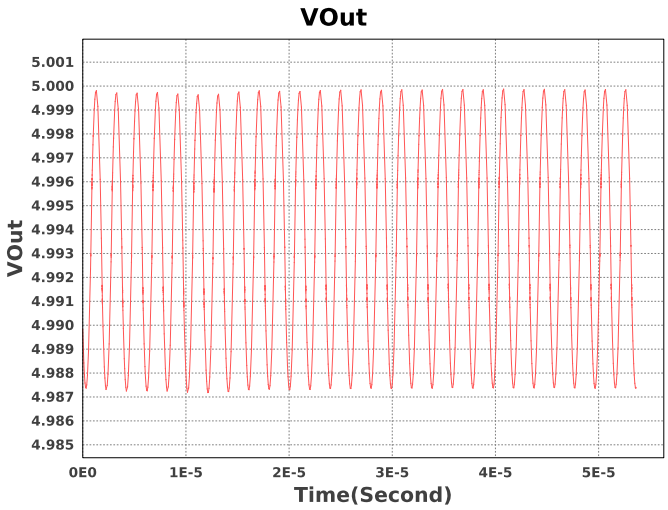
sim_id = 1

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	5.0 V
2.	L1	IC	Initial Current	-5.0 A
3.	Vzero	Vz2	no description	0 V
4.	Vzero	Vz1	no description	0 V
5.	Cboot	IC	Initial Voltage	5 V
6.	Iout	I	Load Current	5.0 A



Design Assistance

1. Master key : 3DAC64F553ECF0D083F521926C80ECDC[v1]
2. **TPS56637** Product Folder : http://www.ti.com/product/TPS56637 : contains the data sheet and other resources.