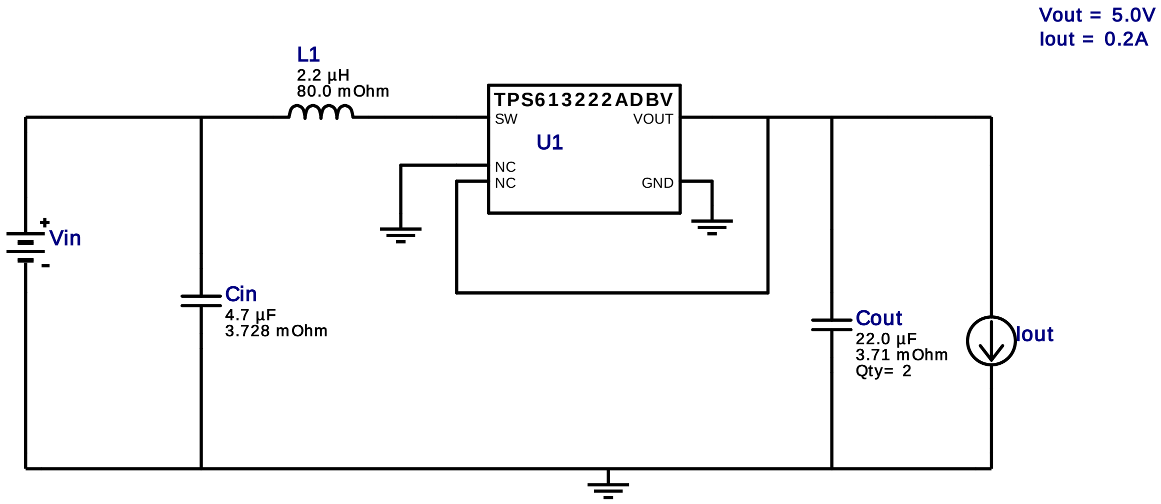
VinMin = 1.9V
VinMax = 3.1V
Vout = 5.0V
Iout = 0.2A

Device = TPS613222ADBVR
Topology = Boost
Created = 2023-03-03 11:38:37.007
BOM Cost = $0.43
BOM Count = 5
Total Pd = 0.22W

WEBENCH ® Design Report

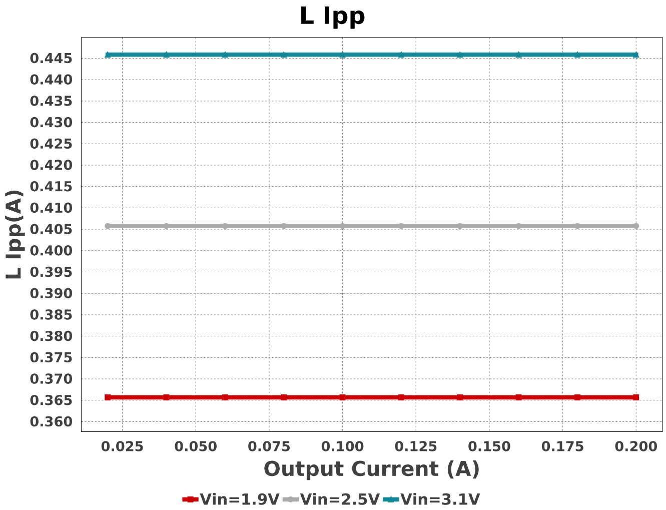
Design : 14 TPS613222ADBVR
TPS613222ADBVR 1.9V-3.1V to 5.00V @ 0.2A

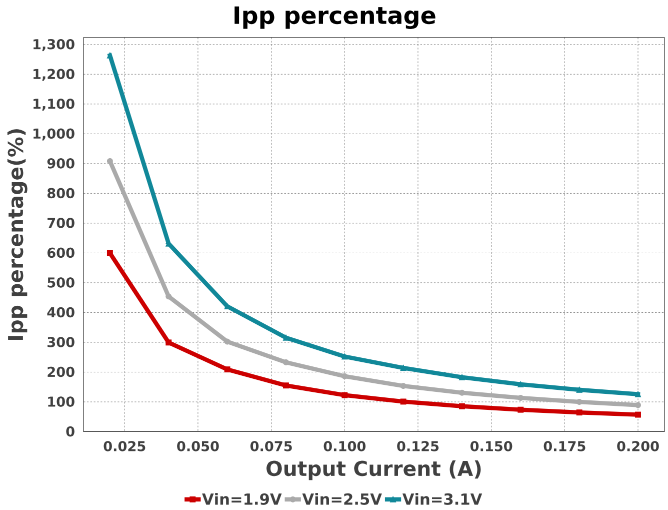


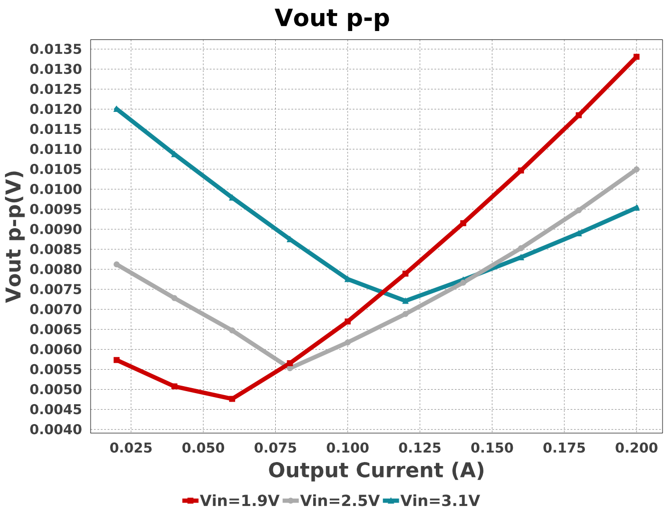
1. The inductor is designed for input current and not the current limit of the device.

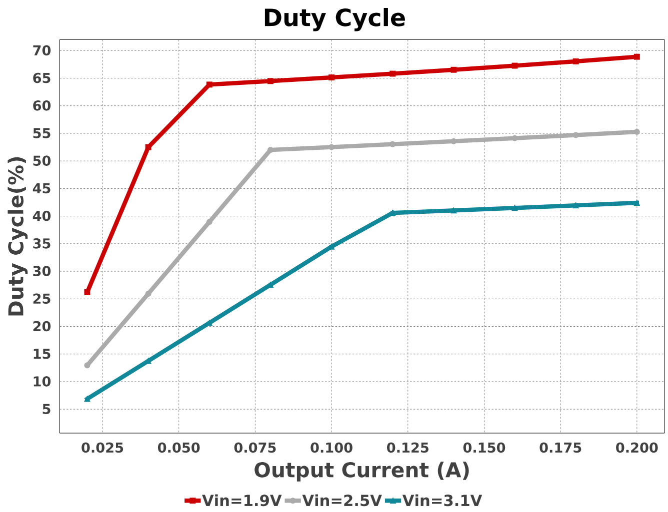
Electrical BOM

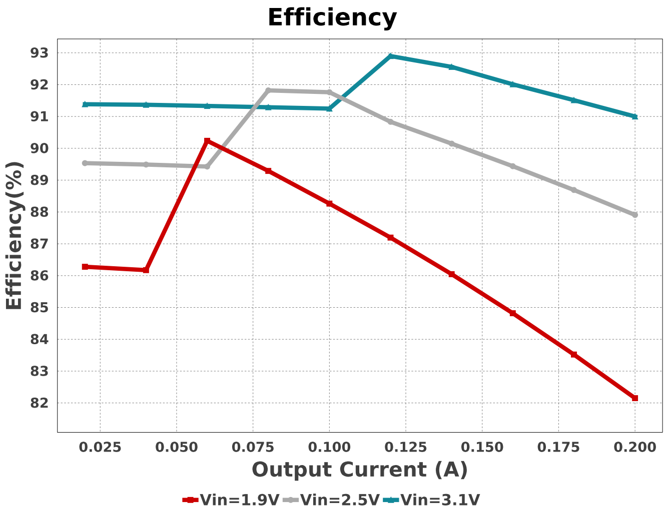
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	TDK	C1608X7S1A475K080AC Series= X7S	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 10.0 V IRMS= 2.69359 A	1	$0.05	0603 5 mm²
Cout	TDK	C1608X5R1A226M080AC Series= X5R	Cap= 22.0 uF ESR= 3.71 mOhm VDC= 10.0 V IRMS= 2.69936 A	2	$0.08	0603 5 mm²
L1	MuRata	LQM2HPN2R2MG0L	L= 2.2 µH 80.0 mOhm	1	$0.09	1008 10 mm²
U1	Texas Instruments	TPS613222ADBVR	Switcher	1	$0.13	DBV0005A_N 15 mm²

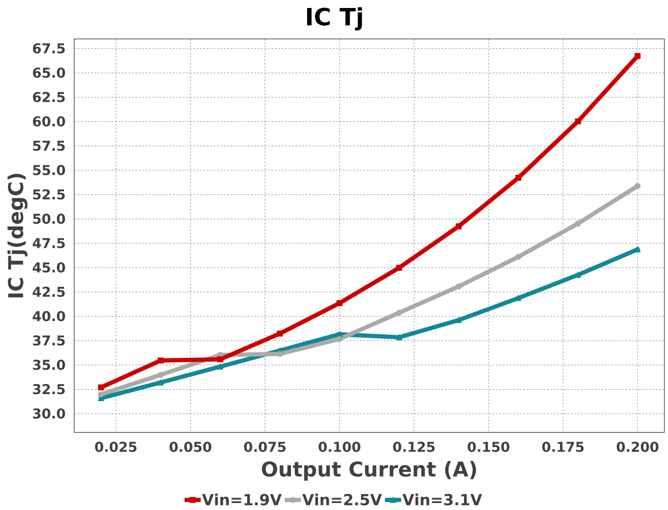

L Ipp
L Ipp(A)
0.445
0.440
0.435
0.430
0.425
0.420
0.415
0.410
0.405
0.400
0.395
0.390
0.385
0.380
0.375
0.370
0.365
0.360
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

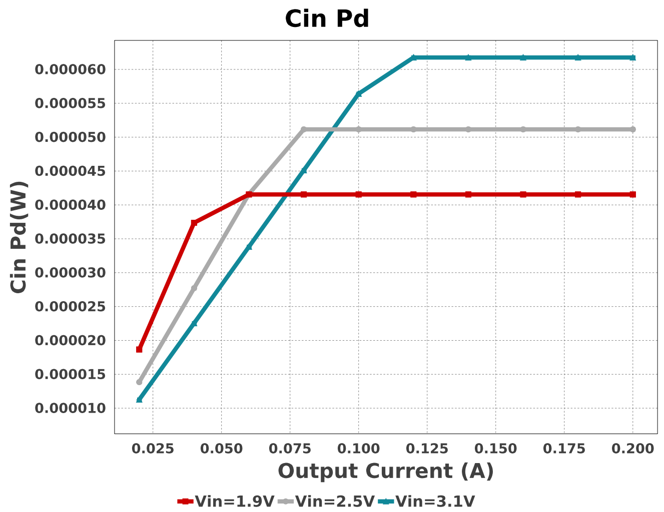

Ipp percentage
Ipp percentage(%)
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

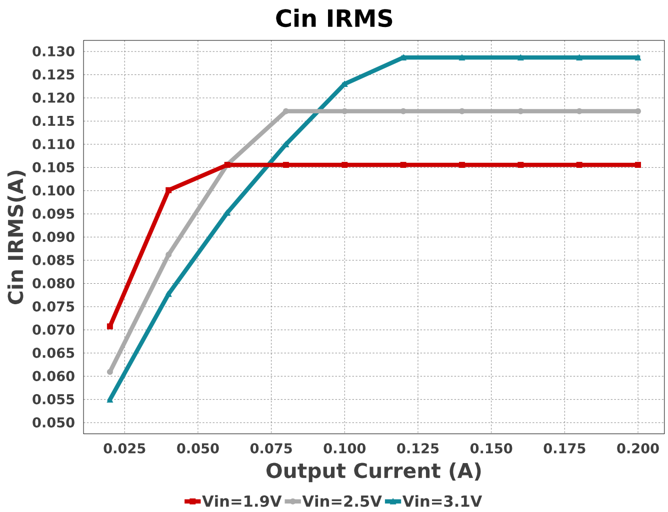

Vout p-p
Vout p-p(V)
0.0135
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
0.0095
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

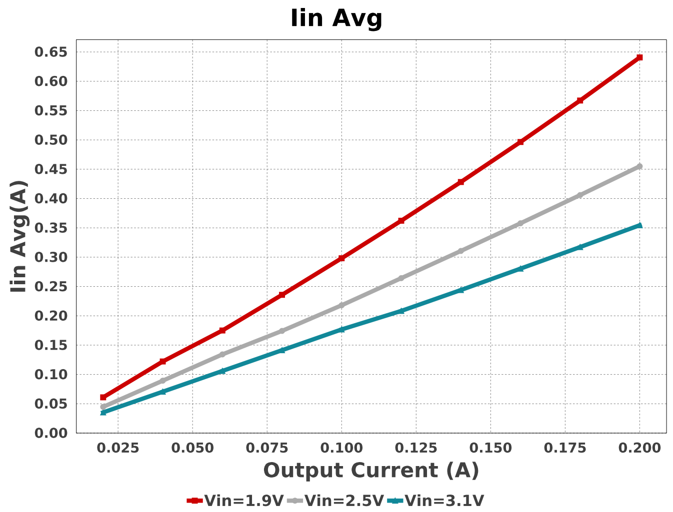

Duty Cycle
Duty Cycle(%)
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

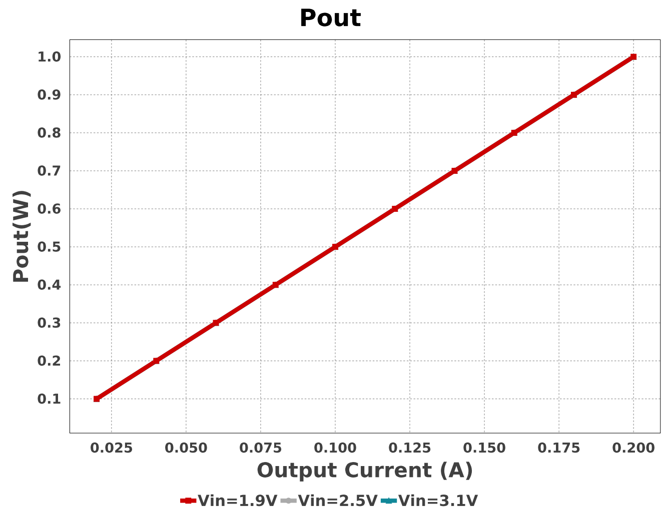

Efficiency
Efficiency(%)
93
92
91
90
89
88
87
86
85
84
83
82
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

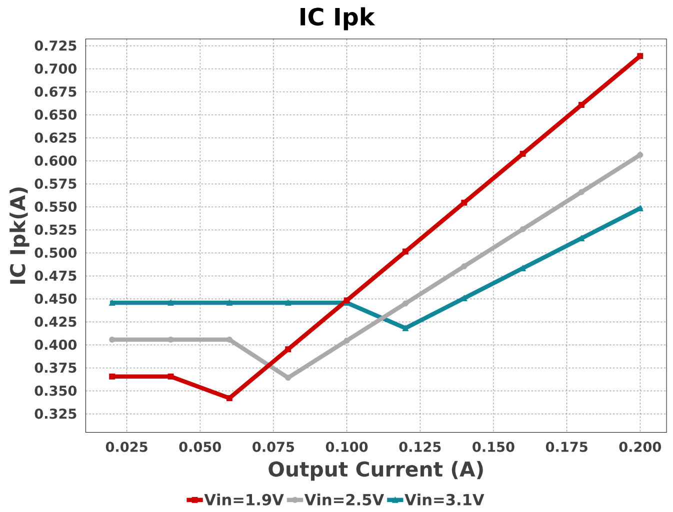

IC Tj
IC Tj(degC)
67.5
65.0
62.5
60.0
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
0.025
0.050
0.075
0.100
0.125
0.150
0.175
0.200
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

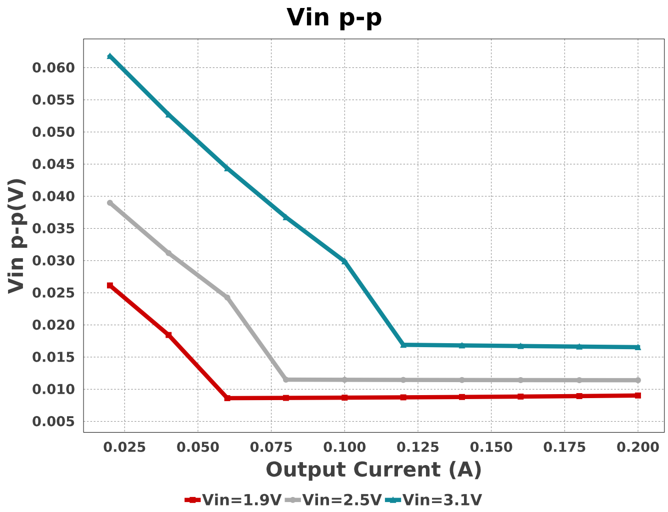

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

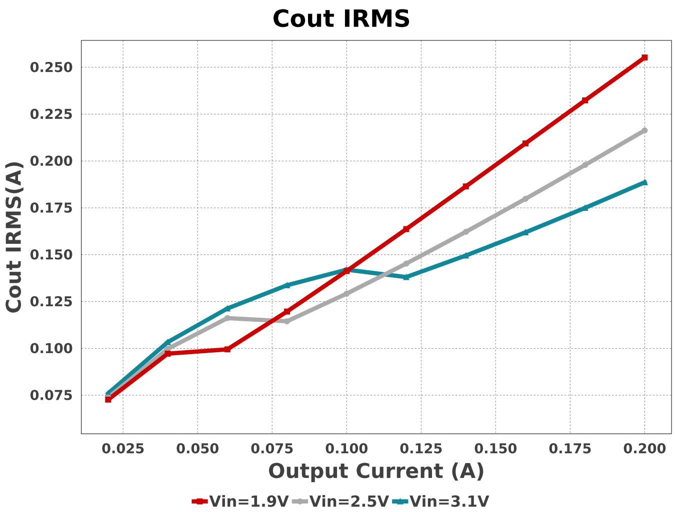

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

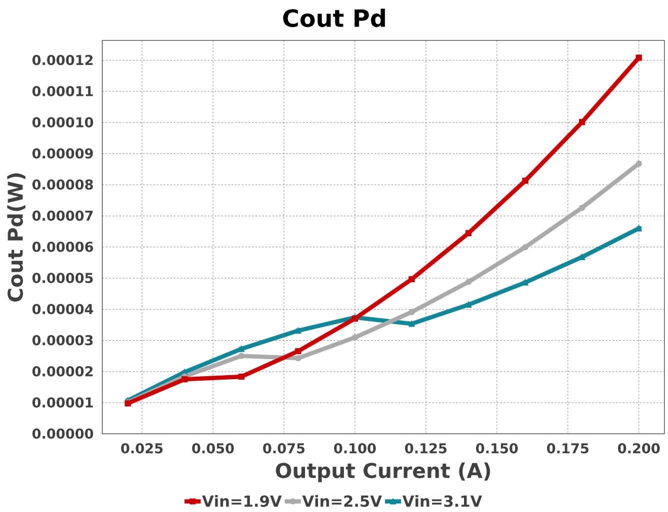

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

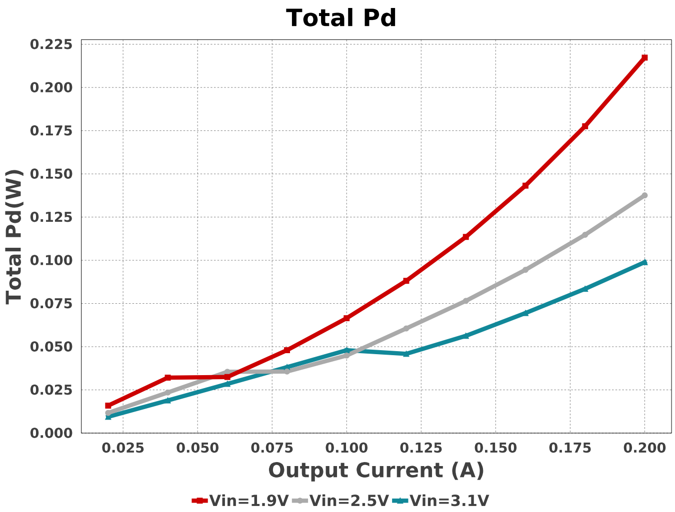

Pout
Pout(W)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

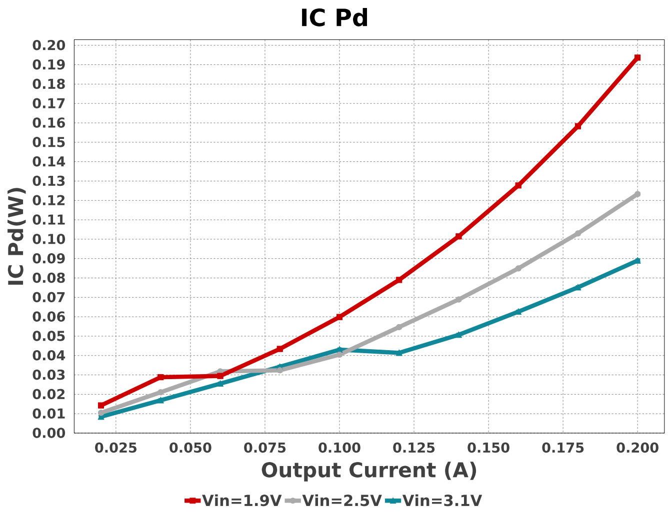

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

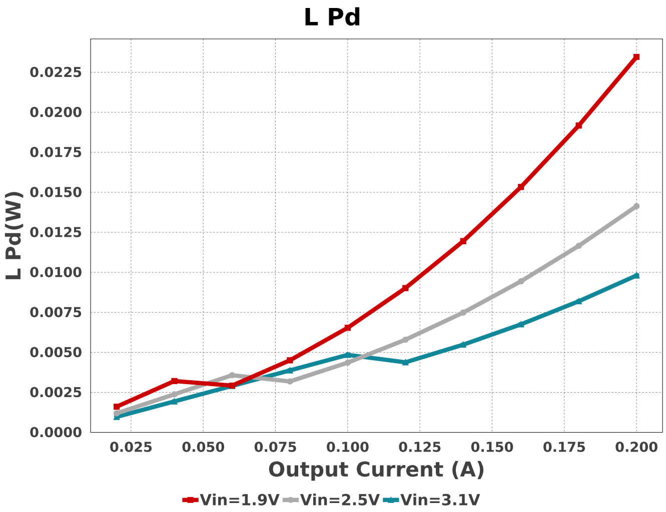

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=1.9V
Vin=2.5V
Vin=3.1V

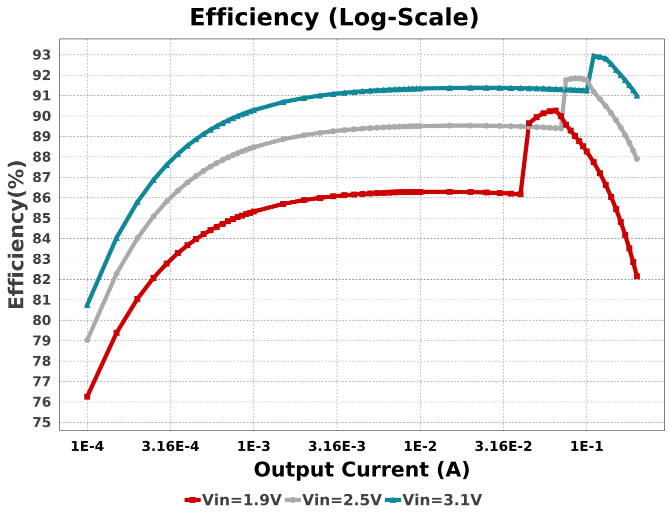












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	105.561 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	41.542 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	255.216 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	120.83 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	713.933 mA	IC	Peak switch current in IC
6.	IC Pd	193.65 mW	IC	IC power dissipation
7.	IC Tj	66.735 degC	IC	IC junction temperature
8.	ICThetaJA	189.7 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	640.67 mA	IC	Average input current
10.	Ipp percentage	57.077 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)

#	Name	Value	Category	Description
11.	L Ipp	365.67 mA	Inductor	Peak-to-peak inductor ripple current
12.	L Pd	23.456 mW	Inductor	Inductor power dissipation
13.	Cin Pd	41.542 µW	Power	Input capacitor power dissipation
14.	Cout Pd	120.83 µW	Power	Output capacitor power dissipation
15.	IC Pd	193.65 mW	Power	IC power dissipation
16.	L Pd	23.456 mW	Power	Inductor power dissipation
17.	Total Pd	217.271 mW	Power	Total Power Dissipation
18.	BOM Count	5	System Information	Total Design BOM count
19.	Duty Cycle	68.879 %	System Information	Duty cycle
20.	Efficiency	82.151 %	System Information	Steady state efficiency
21.	FootPrint	39.0 mm^2	System Information	Total Foot Print Area of BOM components
22.	Frequency	1.384 MHz	System Information	Switching frequency
23.	Iout	200.0 mA	System Information	Iout operating point
24.	Mode	CCM	System Information	Conduction Mode
25.	Pout	1.0 W	System Information	Total output power
26.	Rload_crit	500.0 Ohm	System Information	Minimum Rload required during Start up
27.	Total BOM	$0.43	System Information	Total BOM Cost
28.	Vin	1.9 V	System Information	Vin operating point
29.	Vin p-p	9.028 mV	System Information	Peak-to-peak input voltage
30.	Vout	5.0 V	System Information	Operational Output Voltage
31.	Vout p-p	13.308 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	200.0 m	Maximum Output Current
VinMax	3.1	Maximum input voltage
VinMin	1.9	Minimum input voltage
VinTyp	2.5	Typical input voltage
Vout	5.0	Output Voltage
base_pn	TPS613222A	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

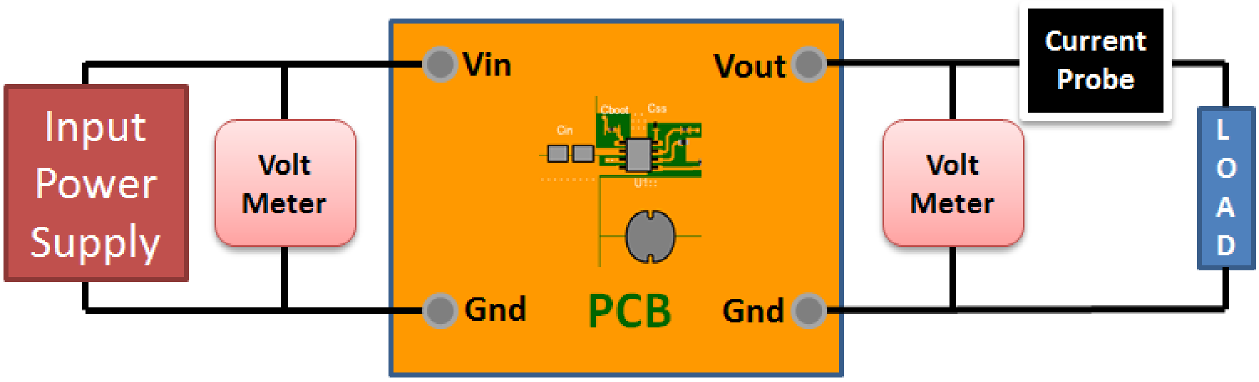
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 1.9V 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.

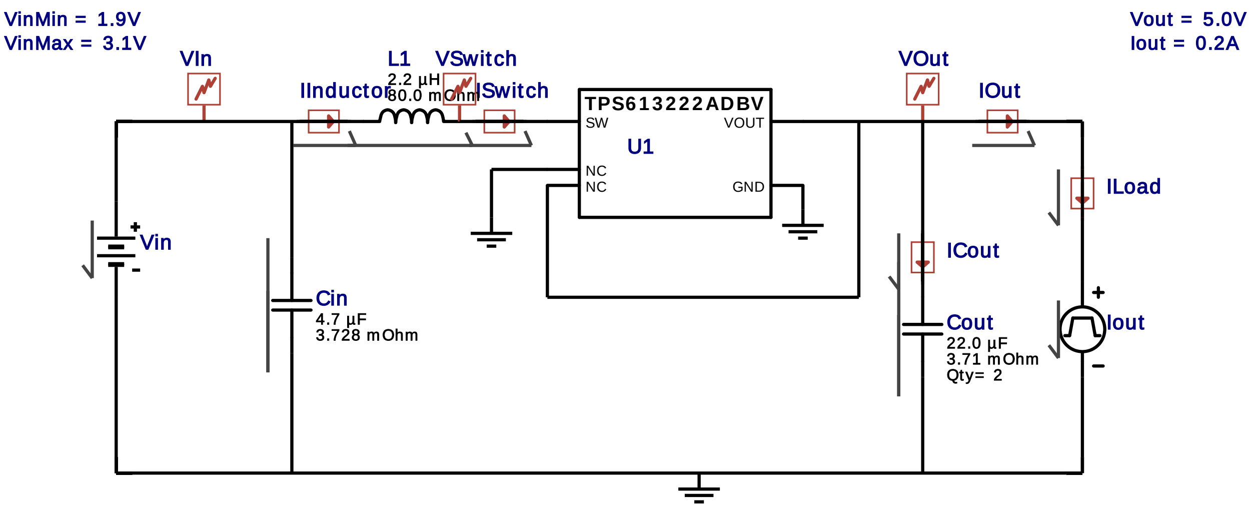


WEBENCH® Electrical Simulation Report

Design Id = 14

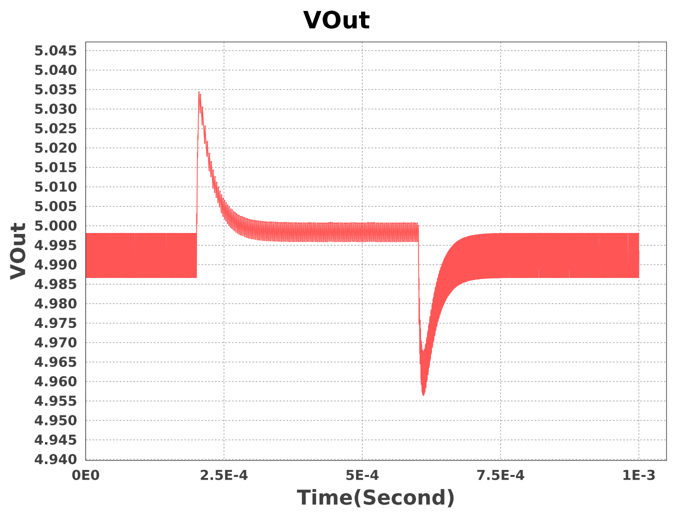
sim_id = 1

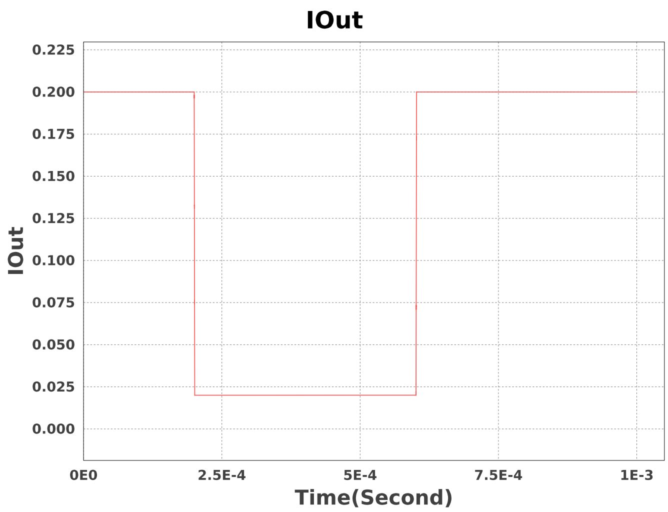
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	0.2 A
		I2	Minimum Load Current	0.02 A
		Td	Initial Time Delay	200u s
		Tf	Fall Time	1u s
		Tr	Rise Time	1u s
		Pw	Pulse Width	0.4m s





Design Assistance

1. Master key : CD3BDDFC417C3C49[v1]

2. **TPS613222A** Product Folder : http://www.ti.com/product/TPS61322 : contains the data sheet and other resources.