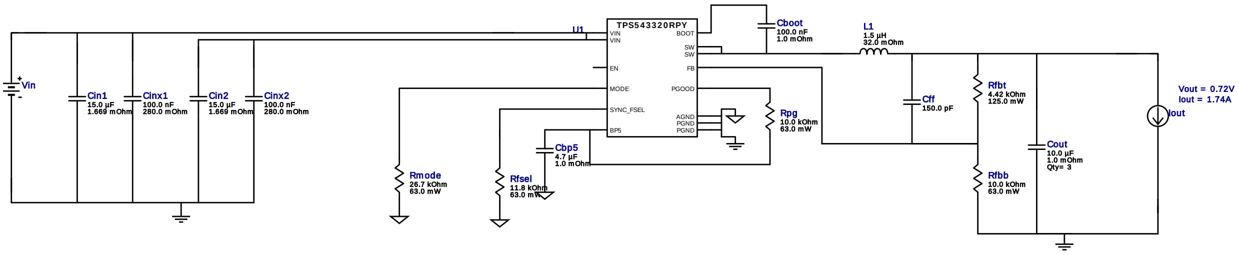
WEBENCH ® Design Report

VinMin = 6.0V
VinMax = 6.0V
Vout = 0.72V
Iout = 1.74A

Device = TPS543320RPYR
Topology = Buck
Created = 2024-07-10 04:46:57.377
BOM Cost = $1.88
BOM Count = 17
Total Pd = 0.31W

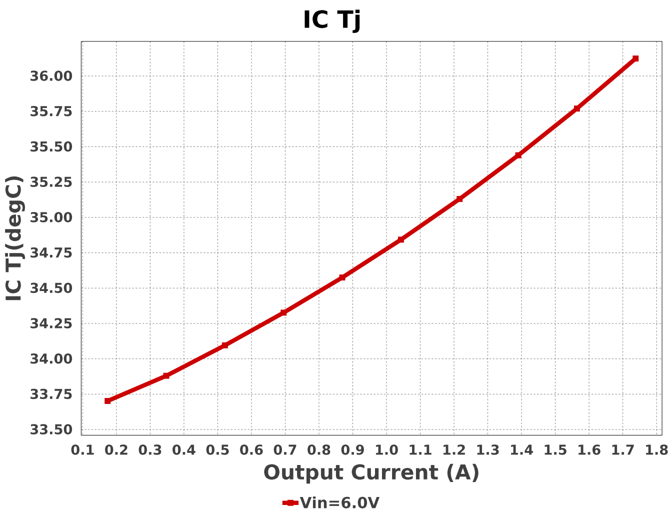
Design : 17 TPS543320RPYR
TPS543320RPYR 6V-6V to .72V @ 1A

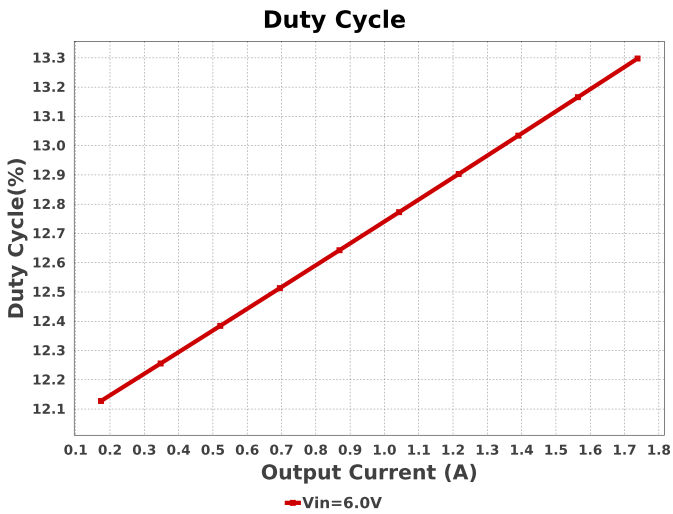


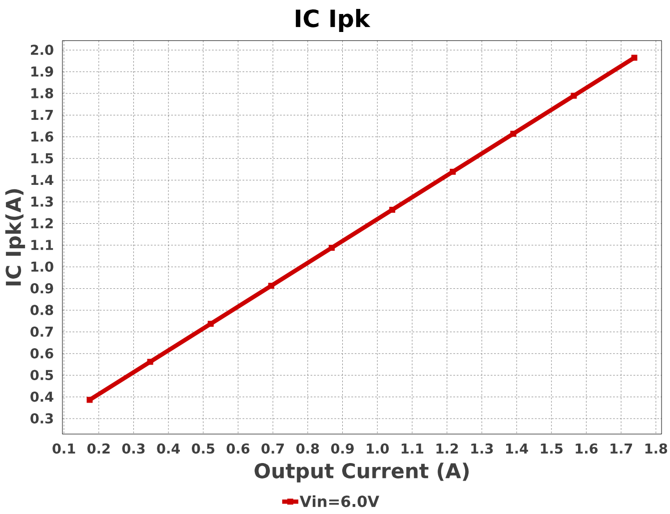
Electrical BOM

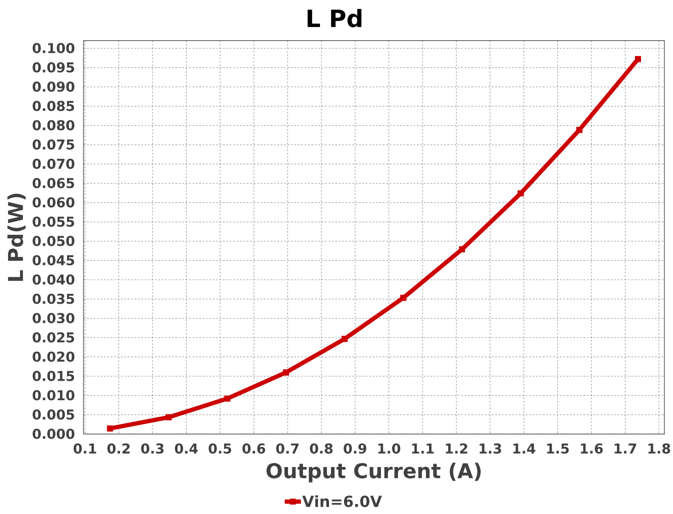
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cbp5	MuRata	GRM155R61A475MEAAD Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.02	0402_065 3 mm²
Cff	Johanson Technology	250R07N151JV4T Series= C0G/NP0	Cap= 150.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin1	TDK	C2012X5R1V156M125AC Series= X5R	Cap= 15.0 uF ESR= 1.669 mOhm VDC= 35.0 V IRMS= 5.0498 A	1	$0.20	0805 7 mm²
Cin2	TDK	C2012X5R1V156M125AC Series= X5R	Cap= 15.0 uF ESR= 1.669 mOhm VDC= 35.0 V IRMS= 5.0498 A	1	$0.20	0805 7 mm²
Cinx1	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
Cinx2	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
Cout	MuRata	GRM155R60J106ME15D Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 3.52 A	3	$0.03	0402 3 mm²
L1	Vishay-Dale	IHLP1212BZER1R5M11	L= 1.5 µH 32.0 mOhm	1	$0.63	IHLP-1212BZ 19 mm²
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW08054K42FKEA Series= CRCW..e3	Res= 4.42 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfsel	Vishay-Dale	CRCW040211K8FKED Series= CRCW..e3	Res= 11.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmode	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS543320RPYR	Switcher	1	$0.65	RPY0014A-MFG 14 mm^2

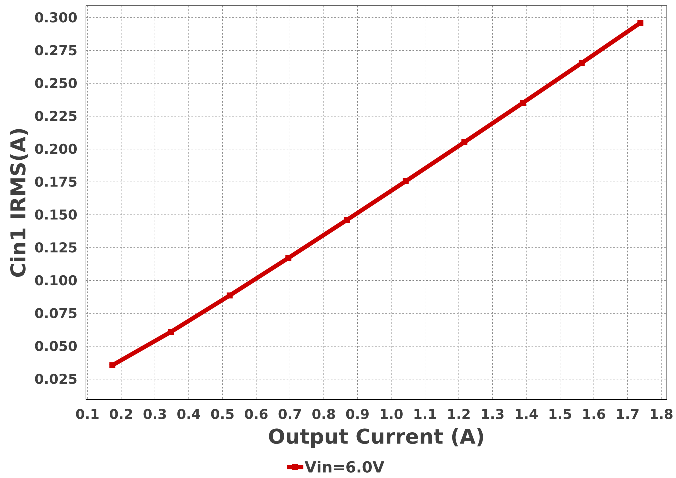




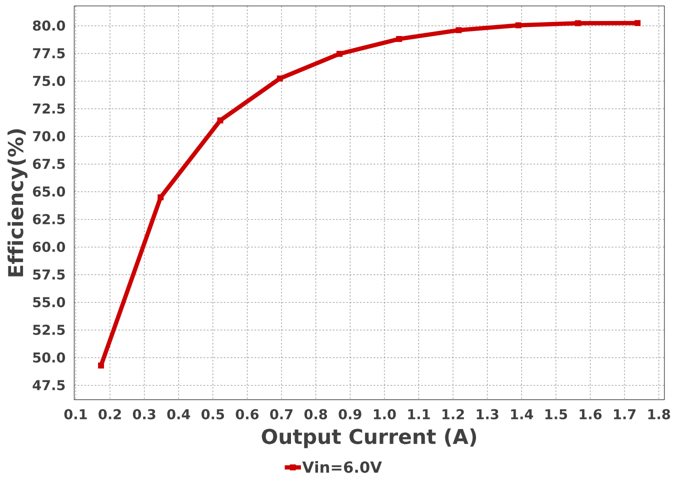




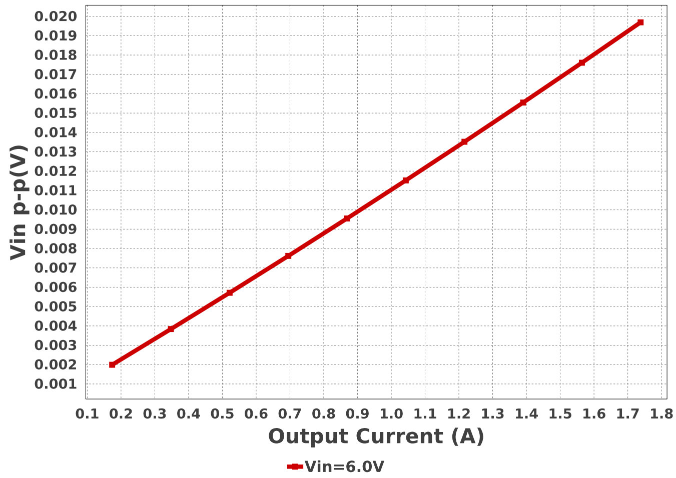
Cin1 IRMS



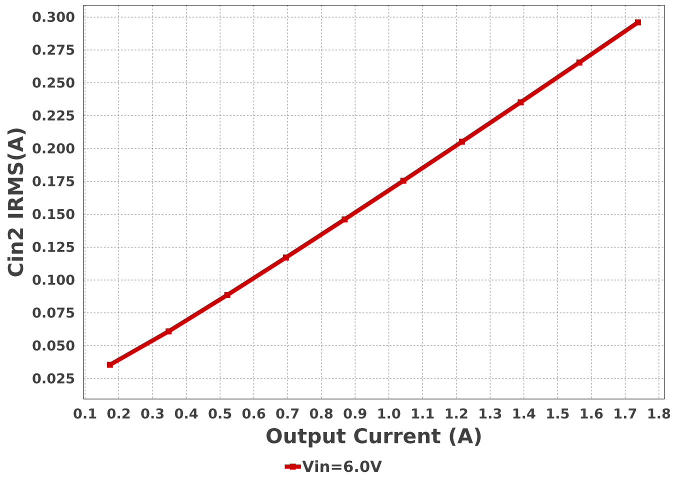
Efficiency



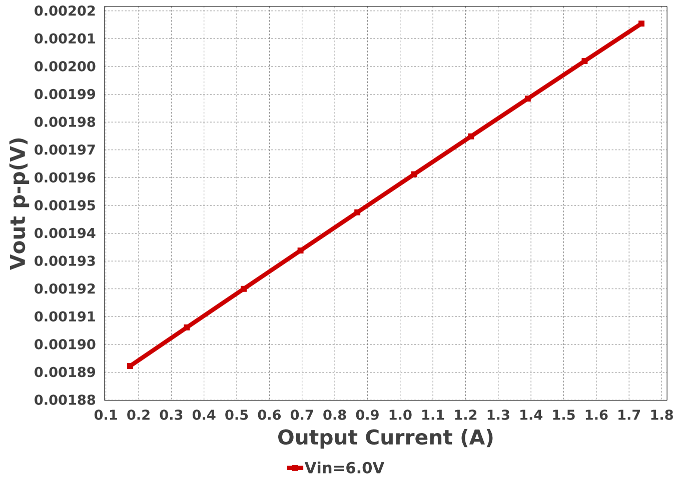
Vin p-p



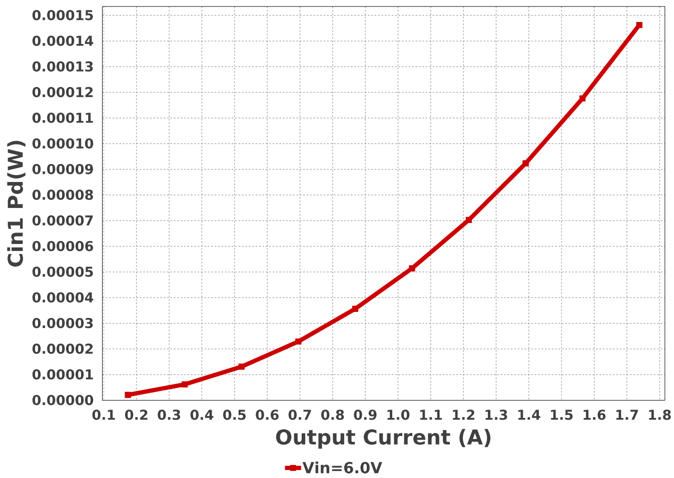
Cin2 IRMS



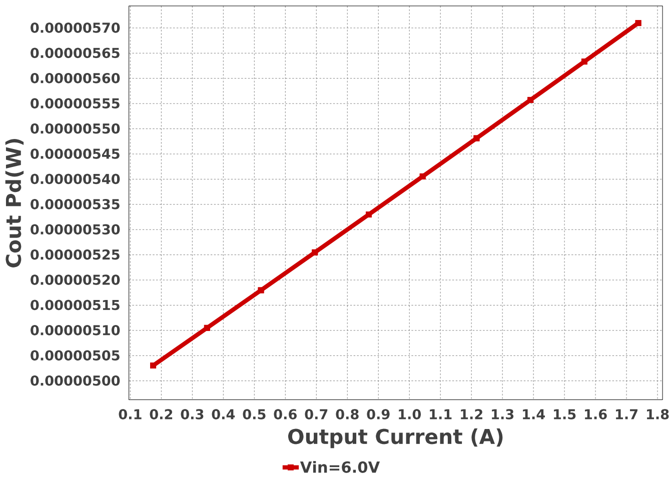
Vout p-p



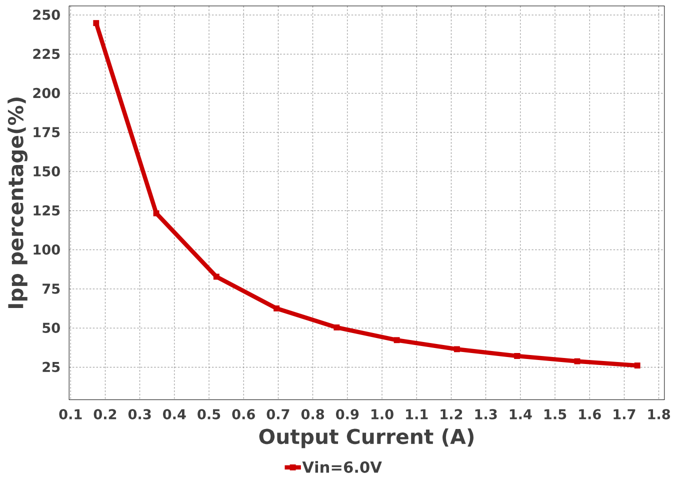
Cin1 Pd



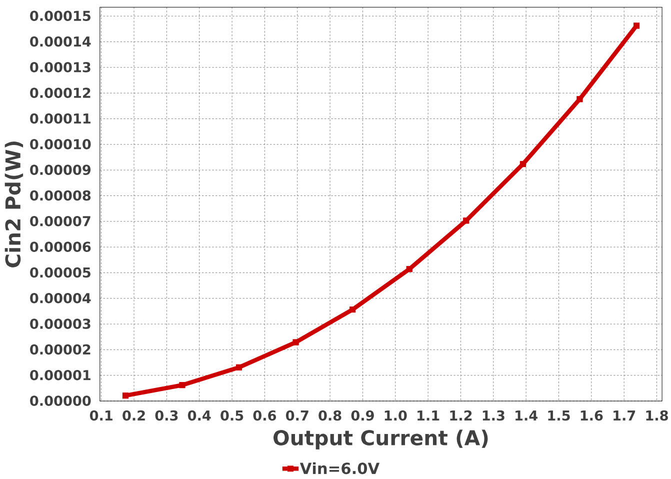
Cout Pd



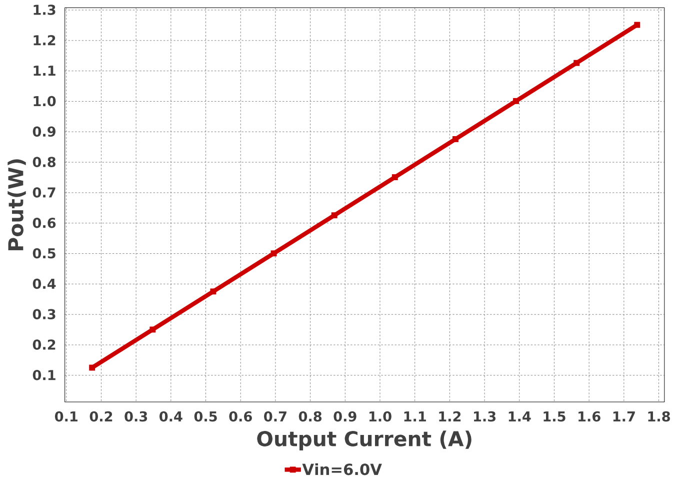
Ipp percentage



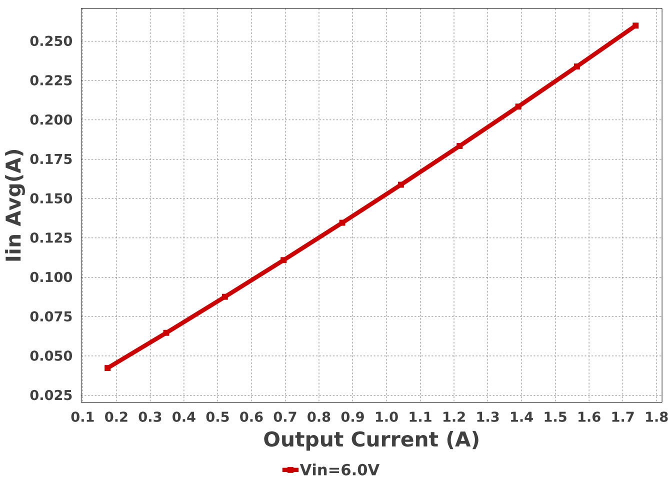
Cin2 Pd



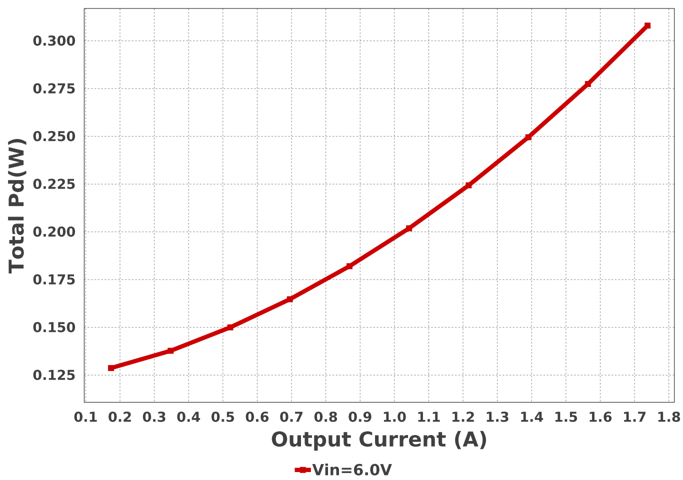
Pout

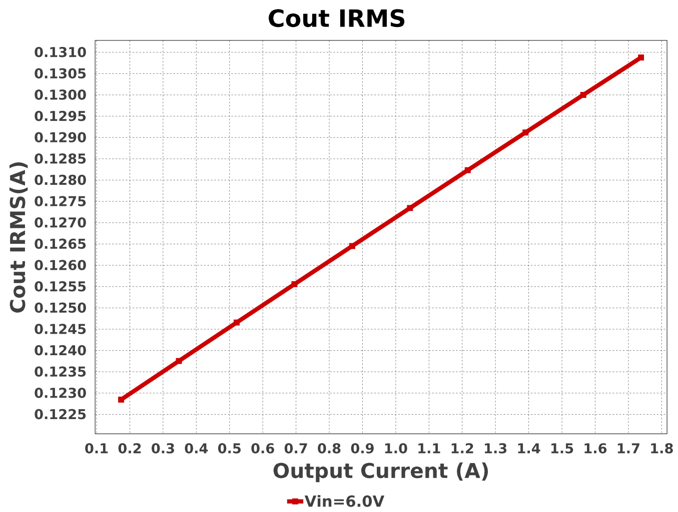


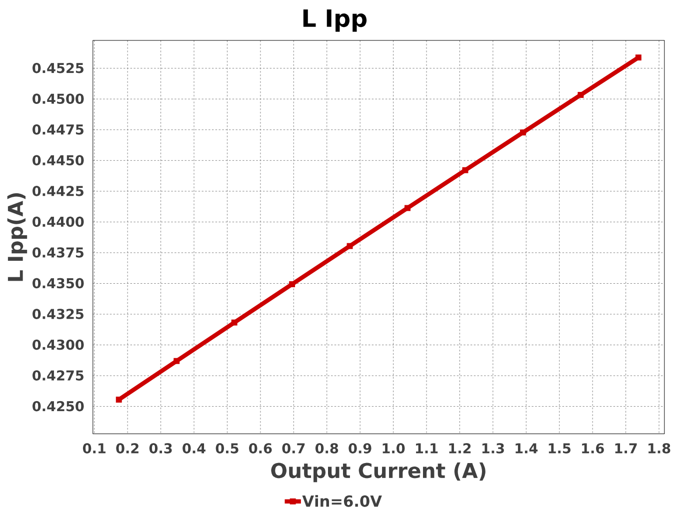
Iin Avg

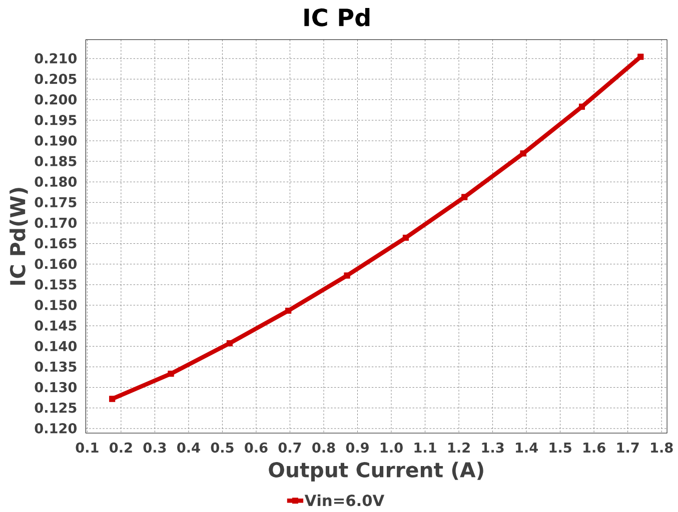


Total Pd









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	17		Total Design BOM count
2.	Total BOM	$1.88		Total BOM Cost
3.	Cin1 IRMS	296.032 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin1 Pd	146.26 µW	Capacitor	Input capacitor power dissipation
5.	Cin2 IRMS	296.032 mA	Capacitor	Input capacitor RMS ripple current
6.	Cin2 Pd	146.26 µW	Capacitor	Input capacitor power dissipation
7.	Cout IRMS	130.878 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	5.71 µW	Capacitor	Output capacitor power dissipation
9.	Total Cin ESR	1.669 mOhm	Capacitor	Cin Capacitor ESR
10.	Total Cout ESR	333.333 µOhm	Capacitor	Cout Capacitor ESR
11.	Cramp	1.0 pF	IC	Selected Cramp for setting Ramp amplitude
12.	IC Ipk	1.965 A	IC	Peak switch current in IC
13.	IC Pd	210.44 mW	IC	IC power dissipation
14.	IC Tj	36.124 degC	IC	IC junction temperature
15.	IC Tolerance	2.5 mV	IC	IC Feedback Tolerance
16.	ICThetaJA Effective	29.1 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
17.	Iin Avg	259.89 mA	IC	Average input current
18.	Ipp percentage	26.086 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
19.	L Ipp	453.375 mA	Inductor	Peak-to-peak inductor ripple current
20.	L Pd	97.209 mW	Inductor	Inductor power dissipation
21.	L1 DCR	32.0 mOhm	Inductor	L1 DCR
22.	Cin1 Pd	146.26 µW	Power	Input capacitor power dissipation
23.	Cin2 Pd	146.26 µW	Power	Input capacitor power dissipation
24.	Cout Pd	5.71 µW	Power	Output capacitor power dissipation
25.	IC Pd	210.44 mW	Power	IC power dissipation
26.	L Pd	97.209 mW	Power	Inductor power dissipation
27.	Total Pd	307.985 mW	Power	Total Power Dissipation
28.	Duty Cycle	13.298 %	System Information	Duty cycle
29.	Efficiency	80.249 %	System Information	Steady state efficiency

#	Name	Value	Category	Description
30.	FootPrint	97.0 mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	1000.0 kHz	System Information	Switching frequency
32.	Inductor ripple current requirement used for Inductor selection	30.0 %	System Information	Custom Inductor ripple current (% of average inductor current) requirement used for Inductor selection
33.	Iout	1.738 A	System Information	Iout operating point
34.	Iout transient step used for Cout calculations	434.5 mA	System Information	Custom Transient current step requirement that was used for Cout selection (A).
35.	Mode	CCM	System Information	Conduction Mode
36.	Overshoot Value	6.972 mV	System Information	Theoretical Vout Overshoot Value
37.	Peak Over current Limit HS FET(Maximum)	3.2 A	System Information	Over current protection threshold
38.	Peak Over current Limit HS FET(Minimum)	2.6 A	System Information	Over current protection threshold
39.	Peak Over current Limit HS FET(typical)	2.9 A	System Information	Over current protection threshold
40.	Pout	1.251 W	System Information	Total output power
41.	Undershoot Value	14.507 mV	System Information	Theoretical Vout Undershoot Value
42.	Vin	6.0 V	System Information	Vin operating point
43.	Vin Ripple requirement used for Cin calculations	5.0 %	System Information	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).
44.	Vin p-p	19.69 mV	System Information	Peak-to-peak input voltage
45.	Vout Actual	721.0 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
46.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
47.	Vout Tolerance	1.122 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
48.	Vout p-p	2.015 mV	System Information	Peak-to-peak output ripple voltage
49.	Vout transient requirement used for Cout calculations	4.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	1.738	Maximum Output Current
VinMax	6.0	Maximum input voltage
VinMin	6.0	Minimum input voltage
Vout	720.0 m	Output Voltage
base_pn	TPS543320	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

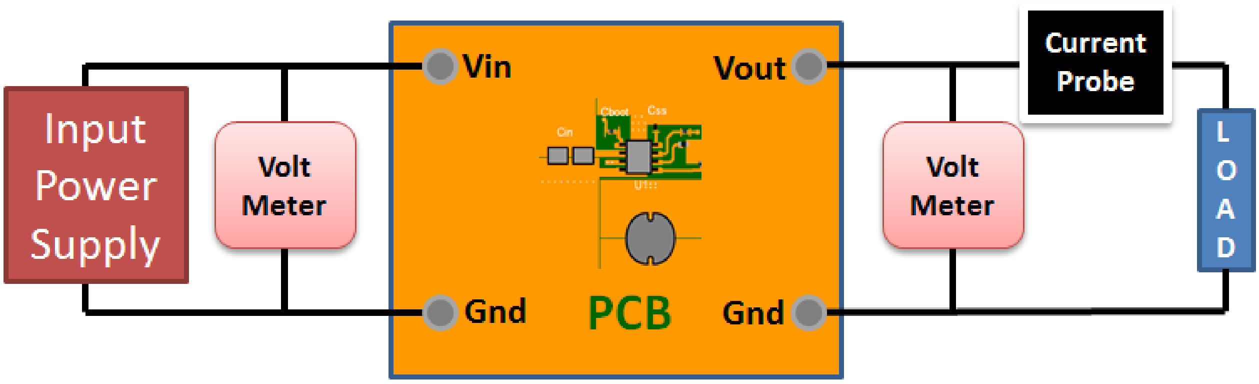
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 6.0V 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.



Design Assistance

1. Master key : D2F2031A06FD5B01[v1]

2. **TPS543320** Product Folder : http://www.ti.com/product/TPS543320 : contains the data sheet and other resources.