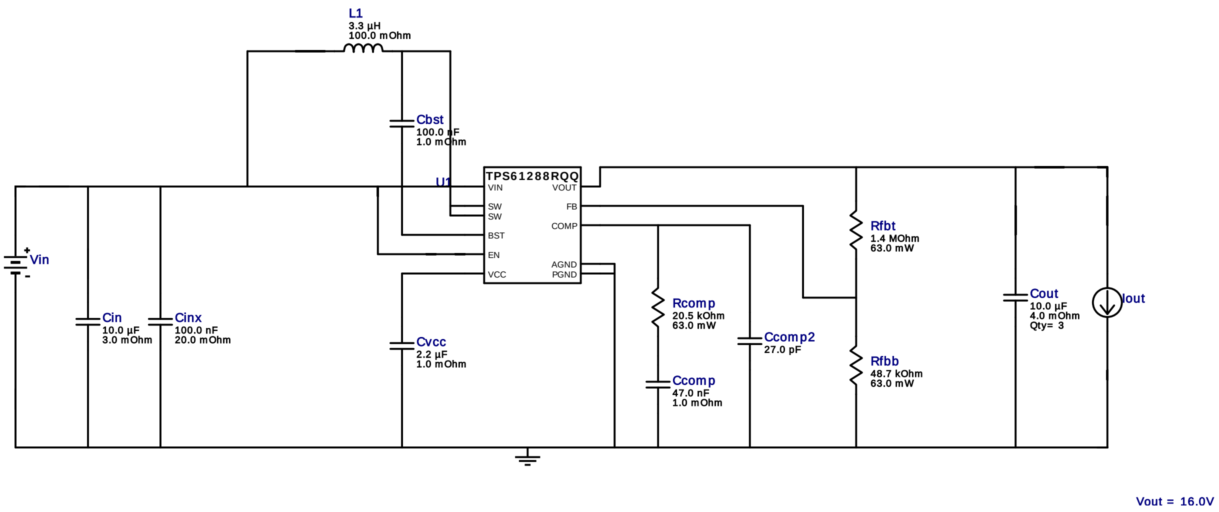
VinMin = 2.8V
VinMax = 4.6V
Vout = 16.0V
Iout = 0.0A

Device = TPS61288RQQR
Topology = Boost
Created = 2021-10-13 05:04:58.827
BOM Cost = NA
BOM Count = 14
Total Pd = 0.02W

WEBENCH ® Design Report

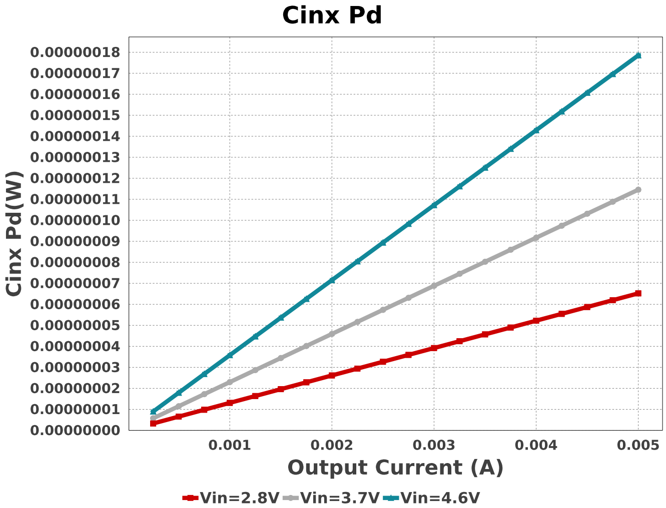
Design : 331 TPS61288RQQR
TPS61288RQQR 2.8V-4.6V to 16.00V @ 0.005A

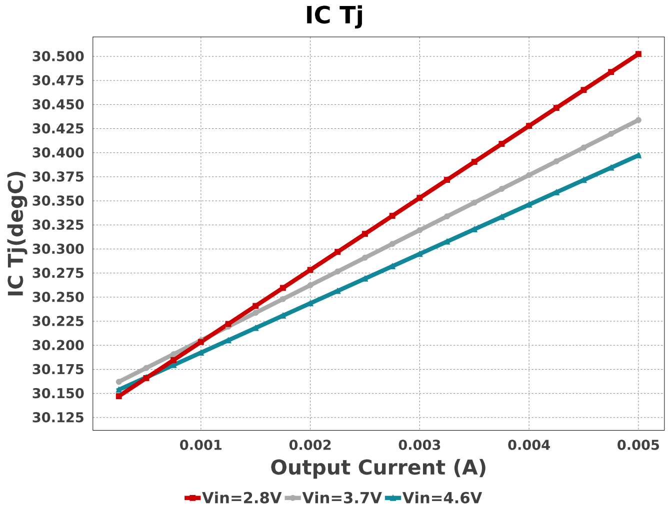


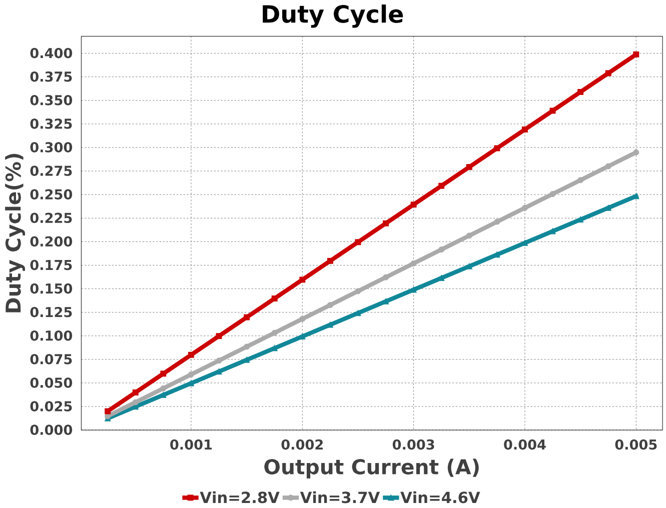
Electrical BOM

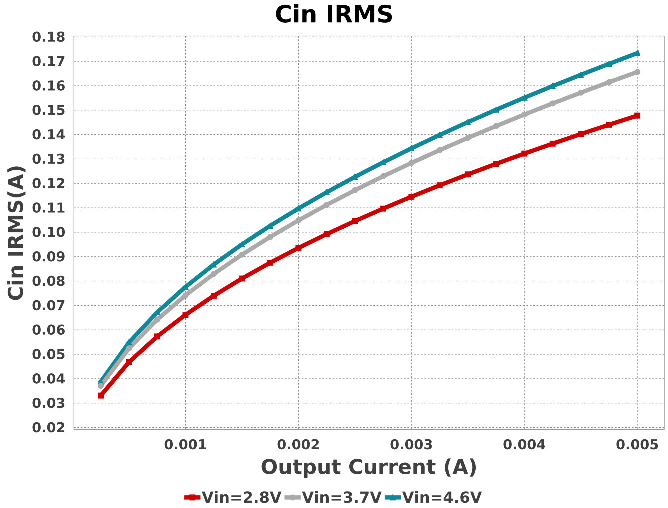
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	MuRata	GRM033R60J473KE19D Series= X5R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
Ccomp2	CUSTOM	CUSTOM Series= C0G/NP0	Cap= 27.0 pF VDC= 50.0 V IRMS= 0.0 A	1	NA	0805 0 mm²
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	1	$0.03	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	CUSTOM	CUSTOM Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	3	NA	0805 0 mm²
Cvcc	Kemet	C0603C225K8PACTU Series= X5R	Cap= 2.2 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.04	0603 5 mm²
L1	CUSTOM	CUSTOM	L= 3.3 µH 100.0 mOhm	1	NA	IHLP-3232DZ 0 mm²
Rcomp	CUSTOM	CUSTOM Series= CRCW..e3	Res= 20.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm²

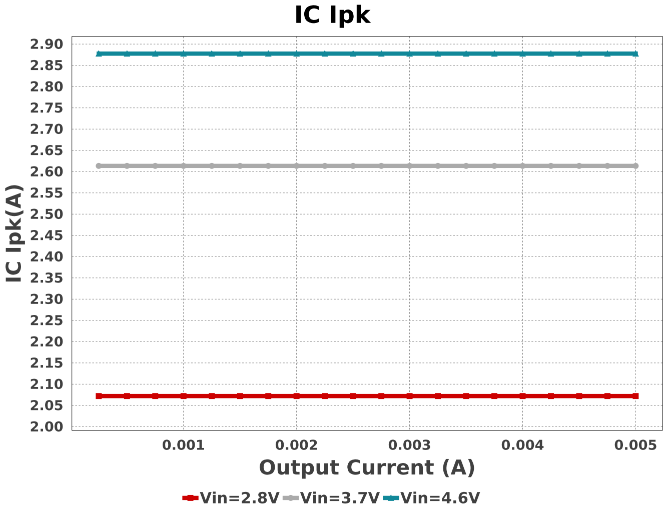
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	CUSTOM	CUSTOM Series= CRCW..e3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
Rfbt	CUSTOM	CUSTOM Series= CRCW..e3	Res= 1.4 MOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
U1	Texas Instruments	TPS61288RQQR	Switcher	1	$1.48	RQQ0011A-MFG 9 mm^2

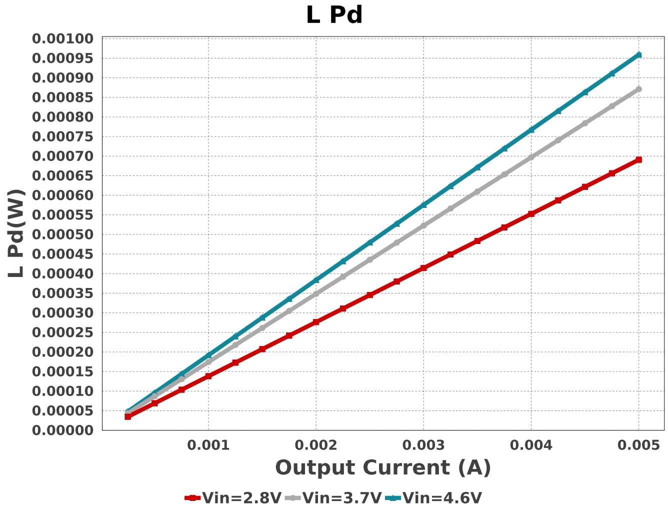


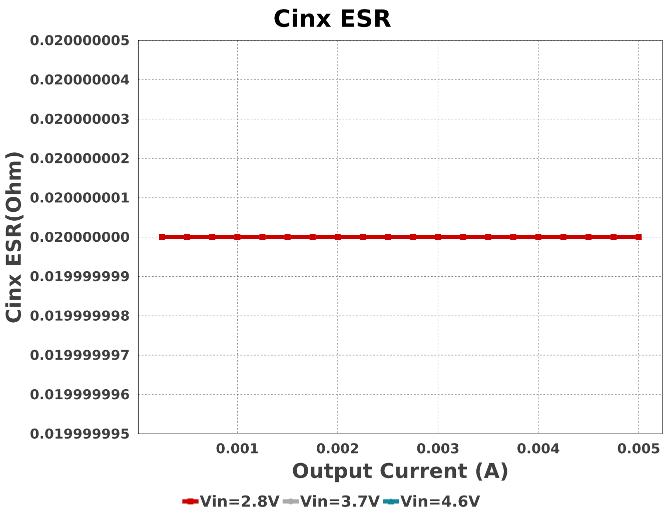


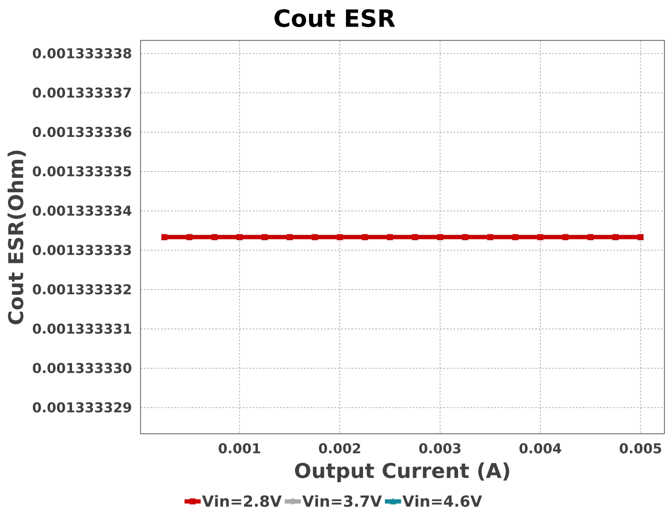


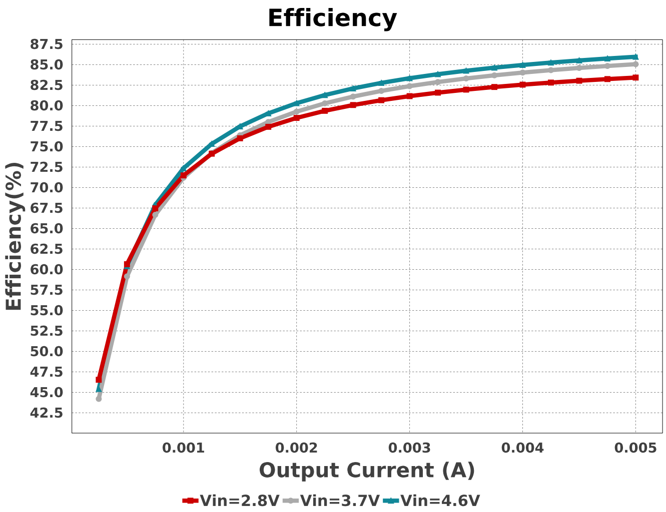


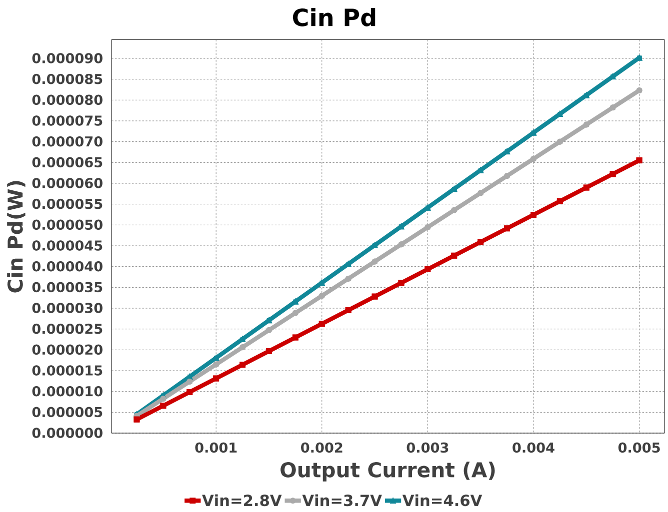


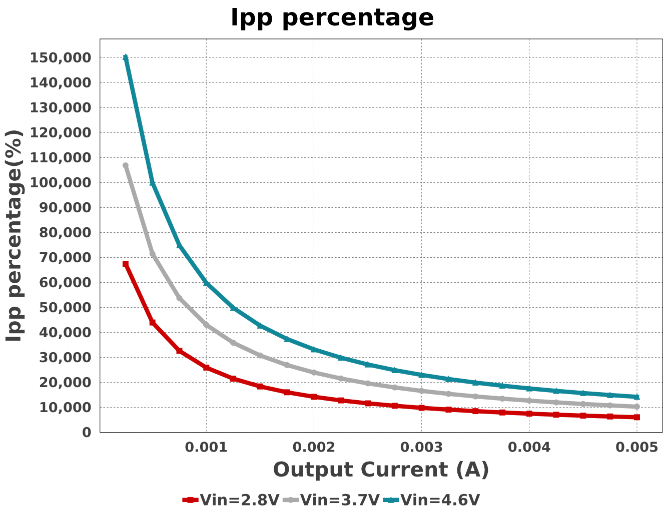


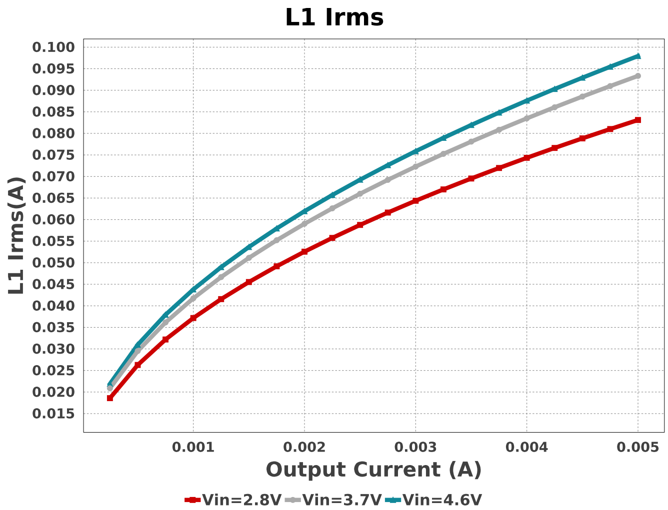

Cinx ESR
Cinx ESR(Ohm)
0.020000005
0.020000004
0.020000003
0.020000002
0.020000001
0.020000000
0.019999999
0.019999998
0.019999997
0.019999996
0.019999995
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

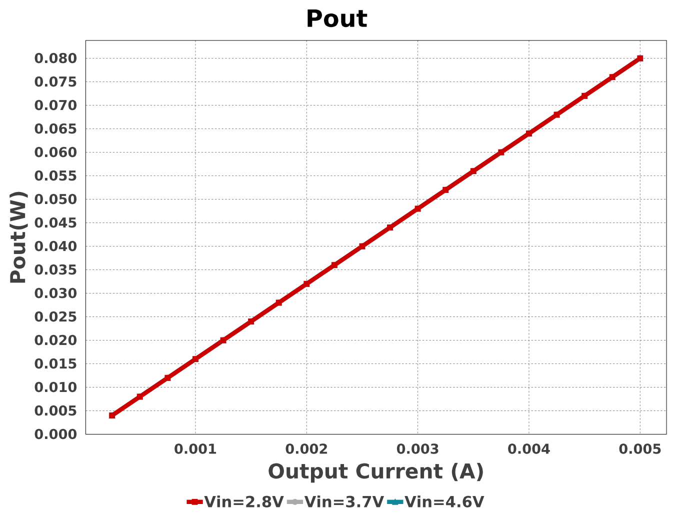

Cout ESR
Cout ESR(Ohm)
0.001333338
0.001333337
0.001333336
0.001333335
0.001333334
0.001333333
0.001333332
0.001333331
0.001333330
0.001333329
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

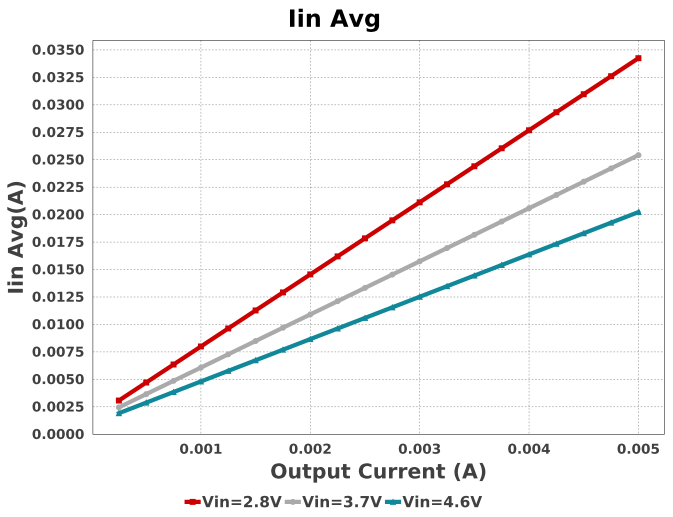

Efficiency
Efficiency(%)
87.5 85.0 82.5 80.0 77.5 75.0 72.5 70.0 67.5 65.0 62.5 60.0 57.5 55.0 52.5 50.0 47.5 45.0 42.5
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

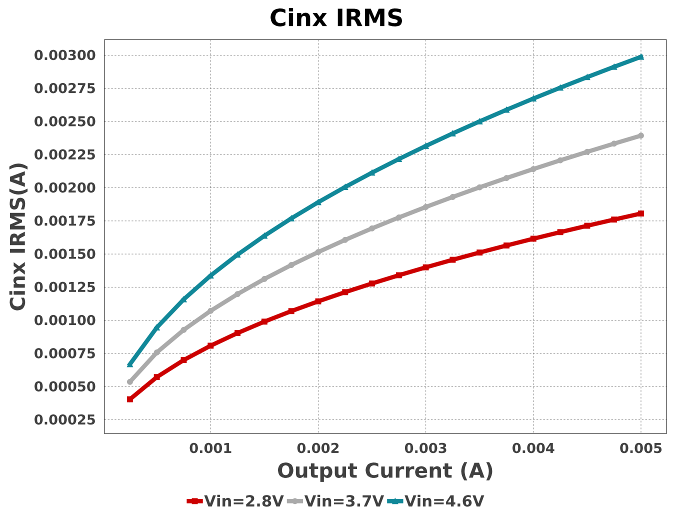

Cin Pd
Cin Pd(W)
0.000090 0.000085 0.000080 0.000075 0.000070 0.000065 0.000060 0.000055 0.000050 0.000045 0.000040 0.000035 0.000030 0.000025 0.000020 0.000015 0.000010 0.000005 0.000000
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

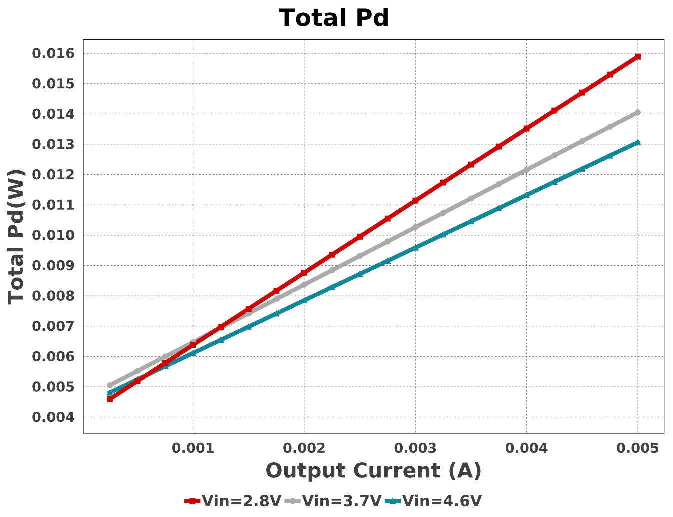

Ipp percentage
Ipp percentage(%)
150,000 140,000 130,000 120,000 110,000 100,000 90,000 80,000 70,000 60,000 50,000 40,000 30,000 20,000 10,000 0
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

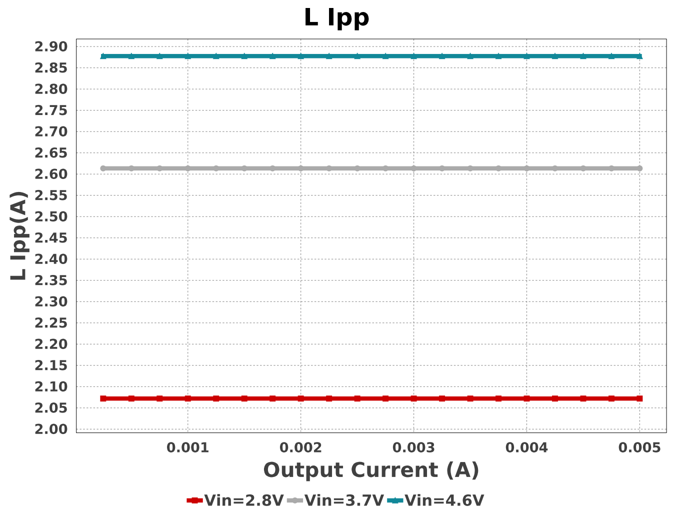

L1 Irms
L1 Irms(A)
0.100 0.095 0.090 0.085 0.080 0.075 0.070 0.065 0.060 0.055 0.050 0.045 0.040 0.035 0.030 0.025 0.020 0.015
0.001 0.002 0.003 0.004 0.005
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

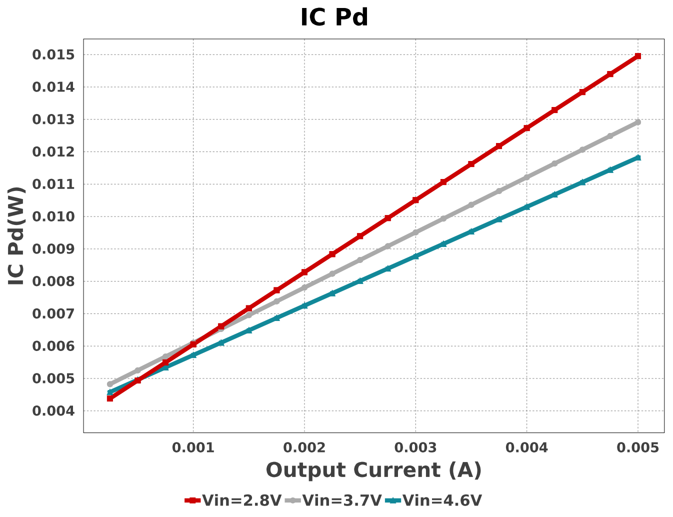

Pout
Pout(W)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

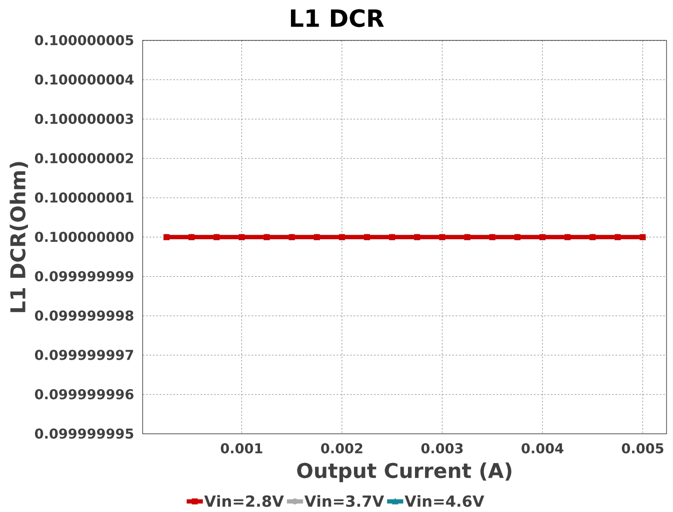

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

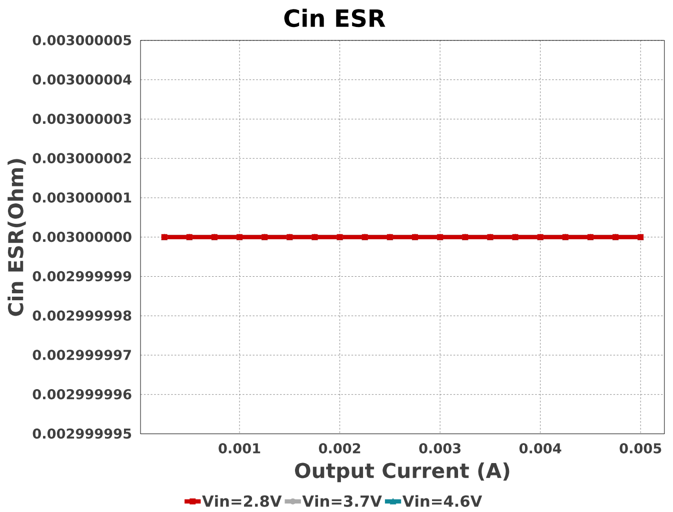

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V

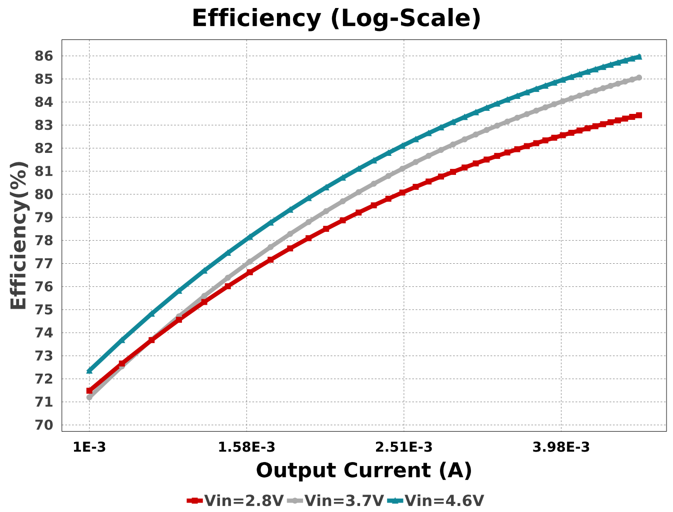

Total Pd
Total Pd(W)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V


L Ipp
L Ipp(A)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V


IC Pd
IC Pd(W)
Output Current (A)
Vin=2.8V Vin=3.7V Vin=4.6V







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	14		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin ESR	3.0 mOhm	Capacitor	Cin Capacitor ESR
4.	Cin IRMS	147.765 mA	Capacitor	Input capacitor RMS ripple current
5.	Cin Pd	65.504 µW	Capacitor	Input capacitor power dissipation
6.	Cinx ESR	20.0 mOhm	Capacitor	Cin Capacitor ESR
7.	Cinx IRMS	1.806 mA	Capacitor	Bulk capacitor RMS ripple current
8.	Cinx Pd	65.217 nW	Capacitor	Bulk capacitor power dissipation
9.	Cout ESR	1.333 mOhm	Capacitor	Cout Capacitor ESR
10.	IC Ipk	2.072 A	IC	Peak switch current in IC
11.	IC Pd	14.954 mW	IC	IC power dissipation
12.	IC Tj	30.502 degC	IC	IC junction temperature
13.	IC Tolerance	12.0 mV	IC	IC Feedback Tolerance
14.	ICThetaJA Effective	33.6 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
15.	Iin Avg	34.247 mA	IC	Average input current
16.	Ipp percentage	6.05 k%	Inductor	Inductor ripple current percentage (with respect to average inductor current)
17.	L Ipp	2.072 A	Inductor	Peak-to-peak inductor ripple current
18.	L Pd	690.67 µW	Inductor	Inductor power dissipation
19.	L1 DCR	100.0 mOhm	Inductor	L1 DCR
20.	L1 Irms	83.106 mA	Inductor	Inductor ripple current
21.	Cin Pd	65.504 µW	Power	Input capacitor power dissipation
22.	Cinx Pd	65.217 nW	Power	Bulk capacitor power dissipation
23.	IC Pd	14.954 mW	Power	IC power dissipation
24.	L Pd	690.67 µW	Power	Inductor power dissipation
25.	Total Pd	15.892 mW	Power	Total Power Dissipation
26.	Duty Cycle	398.8 m%	System Information	Duty cycle
27.	Efficiency	83.427 %	System Information	Steady state efficiency
28.	FootPrint	178.0 mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
29.	Iout	5.0 mA	System Information	Iout operating point
30.	Iout transient step used for Cout calculations	2.5 mA	System Information	Custom Transient current step requirement that was used for Cout selection (A).
31.	Mode	PFM	System Information	Conduction Mode
32.	Overshoot Value	4.061 nV	System Information	Theoretical Vout Overshoot Value
33.	Pout	80.0 mW	System Information	Total output power
34.	Undershoot Value	6.395 mV	System Information	Theoretical Vout Undershoot Value
35.	Vin	2.8 V	System Information	Vin operating point
36.	Vout	17.848 V	System Information	Operational Output Voltage
37.	Vout Actual	17.848 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
39.	Vout Tolerance	3.991 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	5.0 m	Maximum Output Current
VinMax	4.6	Maximum input voltage
VinMin	2.8	Minimum input voltage
Vout	16.0	Output Voltage
base_pn	TPS61288	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

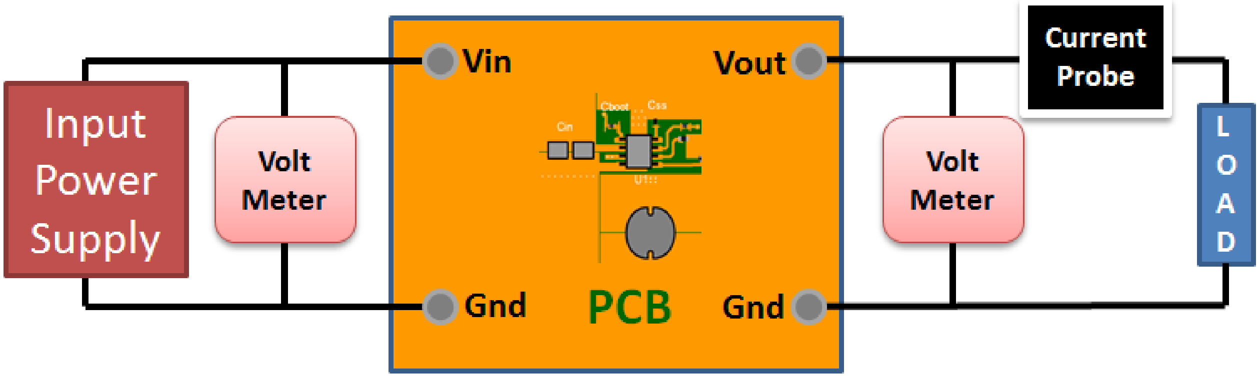
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 2.8V 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.

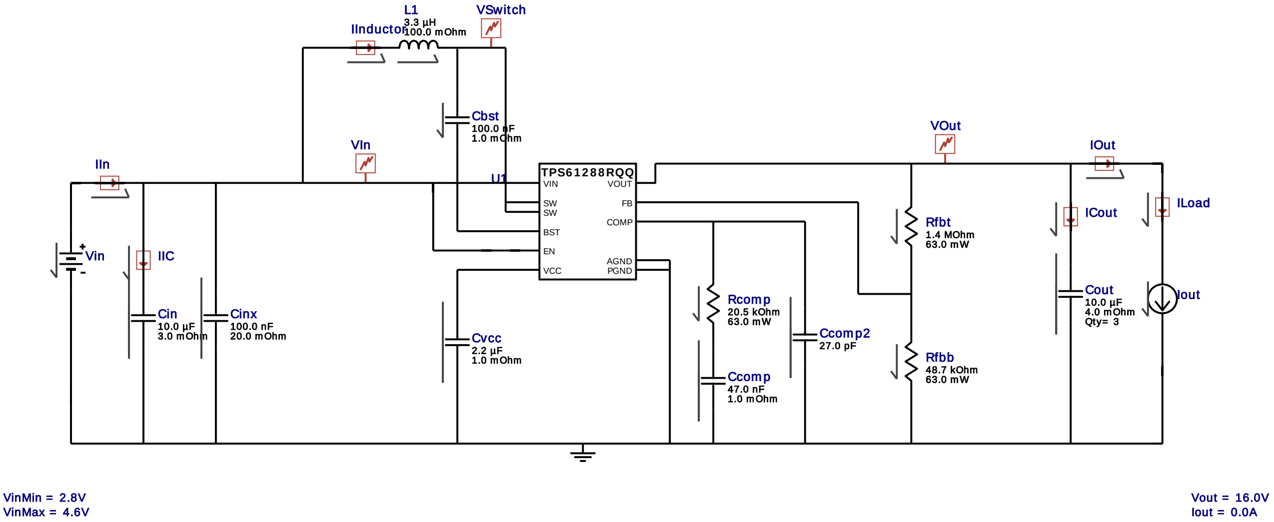


WEBENCH® Electrical Simulation Report

Design Id = 331

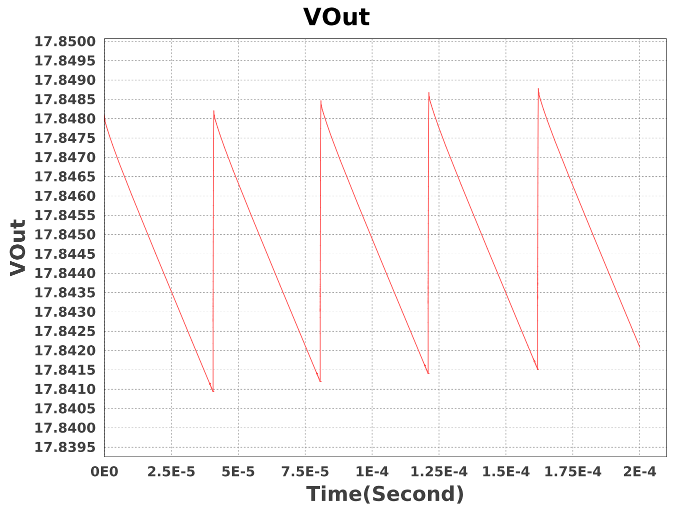
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Iout	I	Load Current	0.005 A



Design Assistance

1. Master key : D9CED8BEE5623EB1[v1]
2. **TPS61288** Product Folder : https://www.ti.com/product/TPS61288 : contains the data sheet and other resources.

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