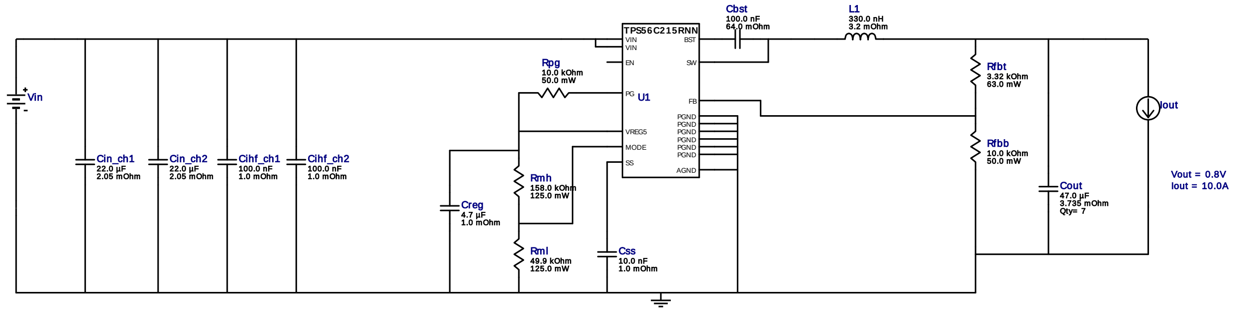
TEXAS INSTRUMENTS

VinMin = 4.5V
VinMax = 5.5V
Vout = 0.8V
Iout = 10.0A

Device = TPS56C215RNNR
Topology = Buck
Created = 2019-04-14 03:16:06.981
BOM Cost = $4.60
BOM Count = 21
Total Pd = 2.4W

WEBENCH ® Design Report

Design : 1107 TPS56C215RNNR
TPS56C215RNNR 4.5V-5.5V to .80V @ 10A

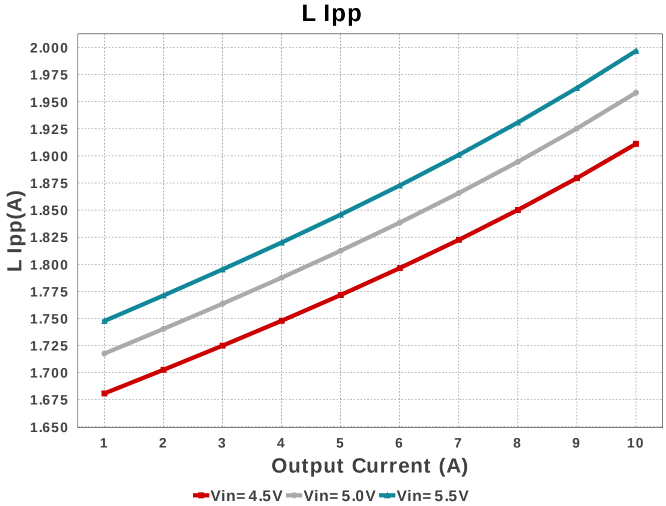


Electrical BOM

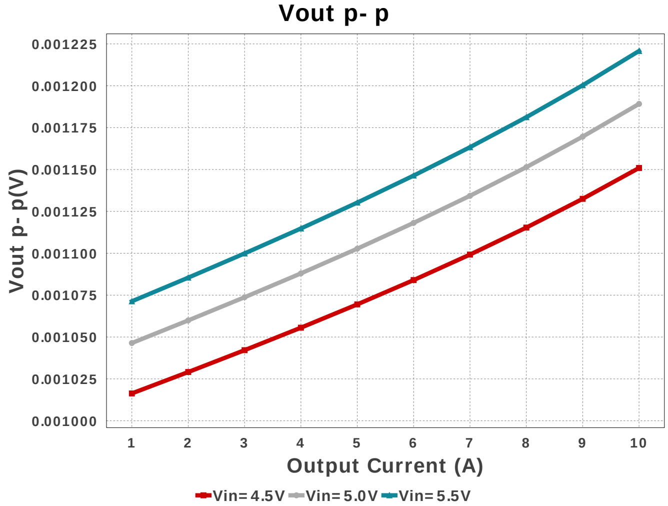
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Cihf_ch1	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cihf_ch2	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cin_ch1	TDK	C2012X6S1C226M125AC Series= X6S	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 16.0 V IRMS= 4.5559 A	1	$0.26	0805 7 mm^2
Cin_ch2	TDK	C2012X6S1C226M125AC Series= X6S	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 16.0 V IRMS= 4.5559 A	1	$0.26	0805 7 mm^2
Cout	MuRata	GRM31CC80J476KE18L Series= X6S	Cap= 47.0 uF ESR= 3.735 mOhm VDC= 6.3 V IRMS= 4.0522 A	7	$0.20	1206_190 11 mm^2
Creg	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Css	MuRata	GRM033R71A103KA01D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
L1	Coilcraft	XAL5030-331MEB	L= 330.0 nH 3.2 mOhm	1	$0.63	XAL5030 54 mm^2
Rfbb	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Vishay-Dale	CRCW04023K32FKED Series= CRCW..e3	Res= 3.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmh	Panasonic	ERJ-6ENF1583V Series= ERJ-6E	Res= 158.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rml	Vishay-Dale	CRCW080549K9FKEA Series= CRCW..e3	Res= 49.9 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rpg	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	TPS56C215RNNR	Switcher	1	$1.90	RNN0018A 20 mm^2

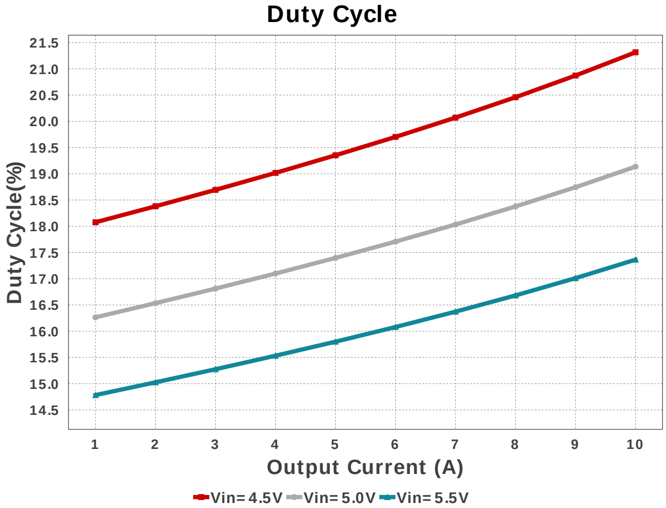
L Ipp



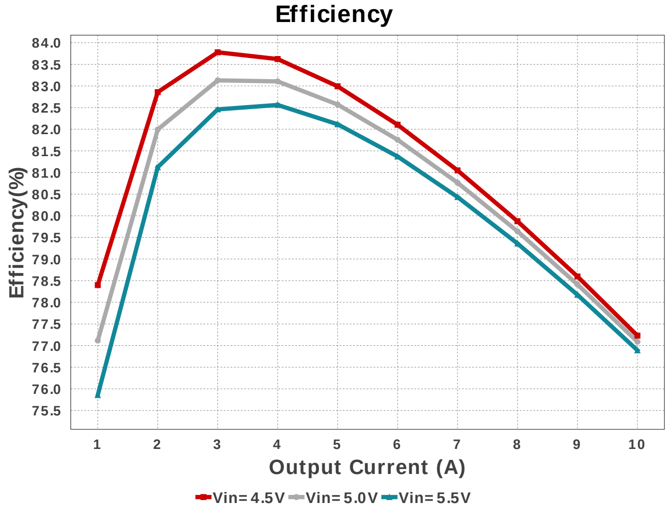
Vout p- p

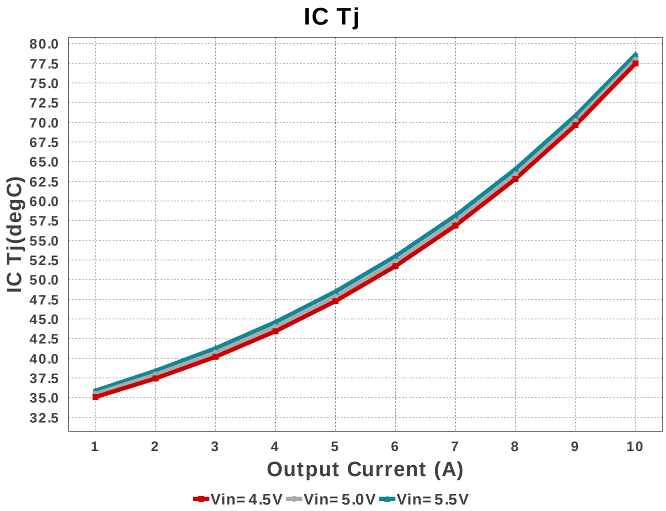


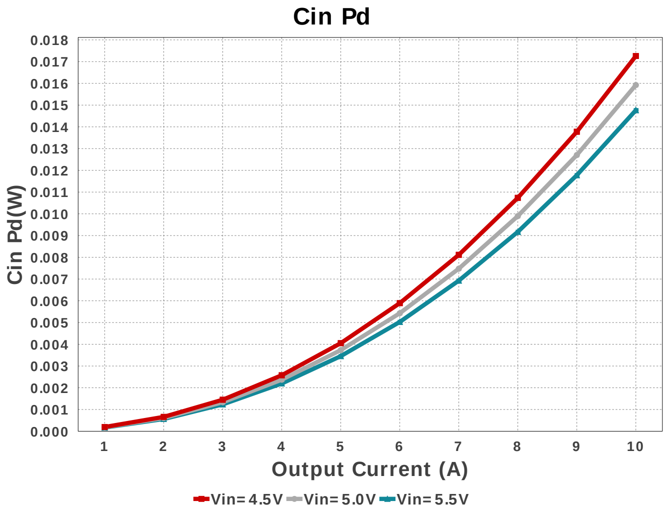
Duty Cycle

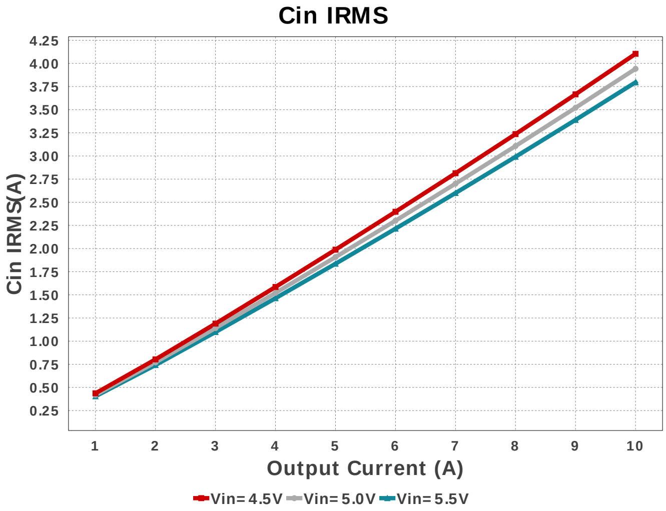


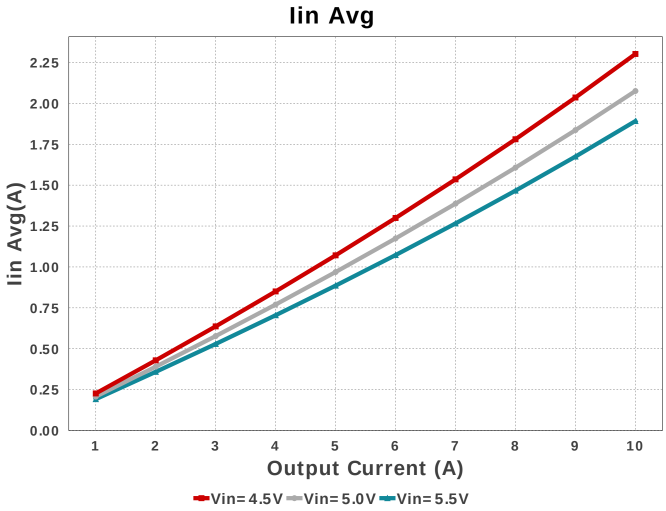
Efficiency

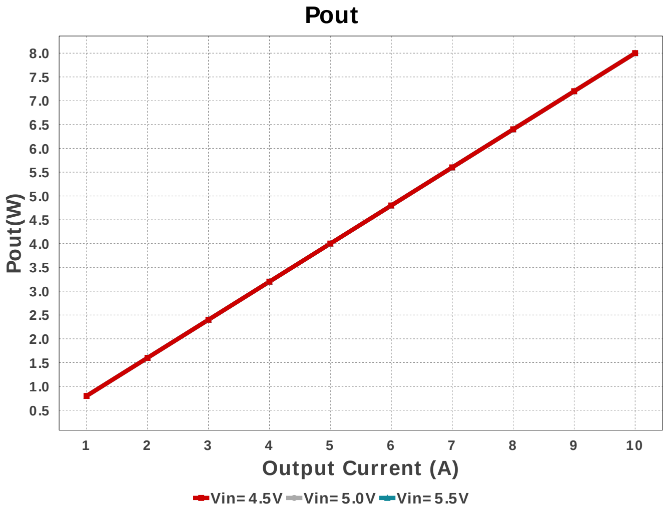


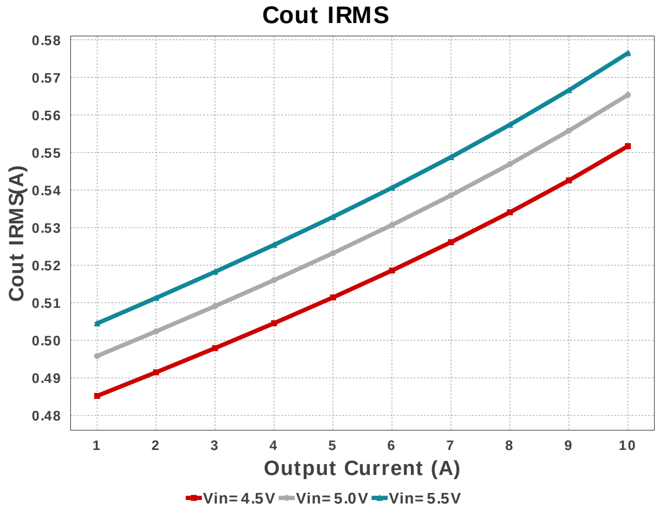

IC Tj
IC Tj(degC)
80.0
77.5
75.0
72.5
70.0
67.5
65.0
62.5
60.0
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

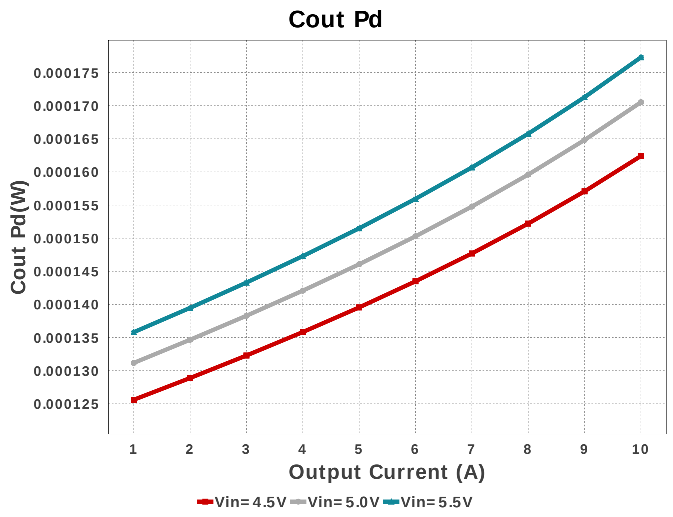

Cin Pd
Cin Pd(W)
0.018
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

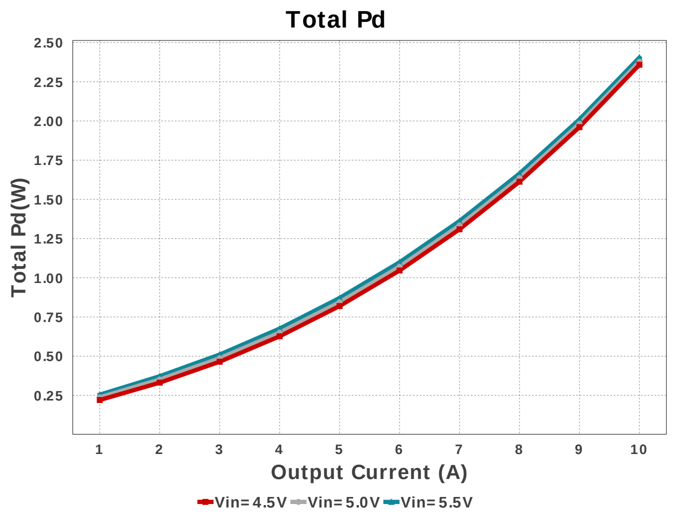

Cin IRMS
Cin IRMS(A)
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

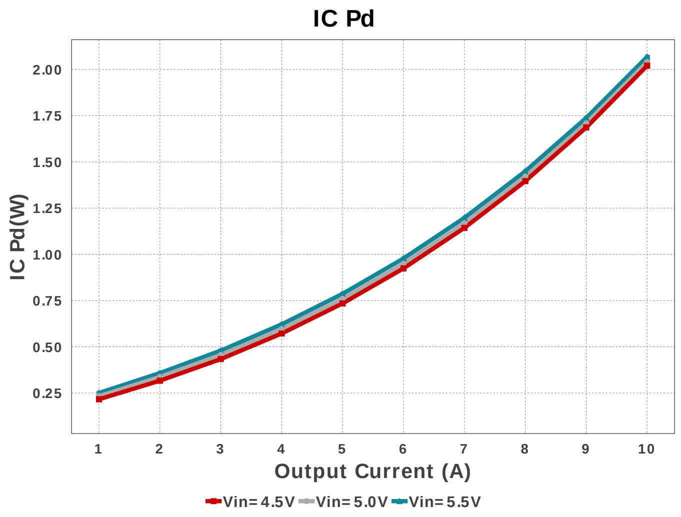

Iin Avg
Iin Avg(A)
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

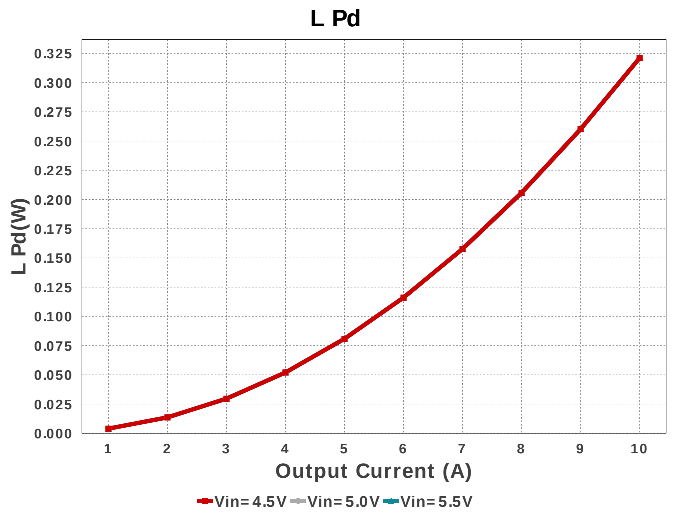

Pout
Pout(W)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V


Cout IRMS
Cout IRMS(A)
0.58
0.57
0.56
0.55
0.54
0.53
0.52
0.51
0.50
0.49
0.48
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.796 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	14.766 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	576.441 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	177.3 µW	Capacitor	Output capacitor power dissipation
5.	IC Pd	2.068 W	IC	IC power dissipation
6.	IC Tj	78.606 degC	IC	IC junction temperature
7.	ICThetaJA Effective	23.5 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
8.	Iin Avg	1.892 A	IC	Average input current
9.	L Ipp	1.997 A	Inductor	Peak-to-peak inductor ripple current
10.	L Pd	321.06 mW	Inductor	Inductor power dissipation
11.	Cin Pd	14.766 mW	Power	Input capacitor power dissipation
12.	Cout Pd	177.3 µW	Power	Output capacitor power dissipation
13.	IC Pd	2.068 W	Power	IC power dissipation
14.	L Pd	321.06 mW	Power	Inductor power dissipation
15.	Total Pd	2.404 W	Power	Total Power Dissipation
16.	BOM Count	21	System Information	Total Design BOM count
17.	Duty Cycle	17.363 %	System Information	Duty cycle
18.	Efficiency	76.891 %	System Information	Steady state efficiency
19.	FootPrint	210.0 mm^2	System Information	Total Foot Print Area of BOM components
20.	Frequency	1.171 MHz	System Information	Switching frequency
21.	Iout	10.0 A	System Information	Iout operating point
22.	Mode	CCM	System Information	Conduction Mode
23.	Pout	8.0 W	System Information	Total output power

#	Name	Value	Category	Description
24.	Total BOM	$4.6	System Information	Total BOM Cost
25.	Vin	5.5 V	System Information	Vin operating point
26.	Vout	800.0 mV	System Information	Operational Output Voltage
27.	Vout Actual	799.2 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
28.	Vout Tolerance	2.011 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
29.	Vout p-p	1.221 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	10.0	Maximum Output Current
SoftStart	1.0 ms	Soft Start Time (ms)
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	800.0 m	Output Voltage
base_pn	TPS56C215	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

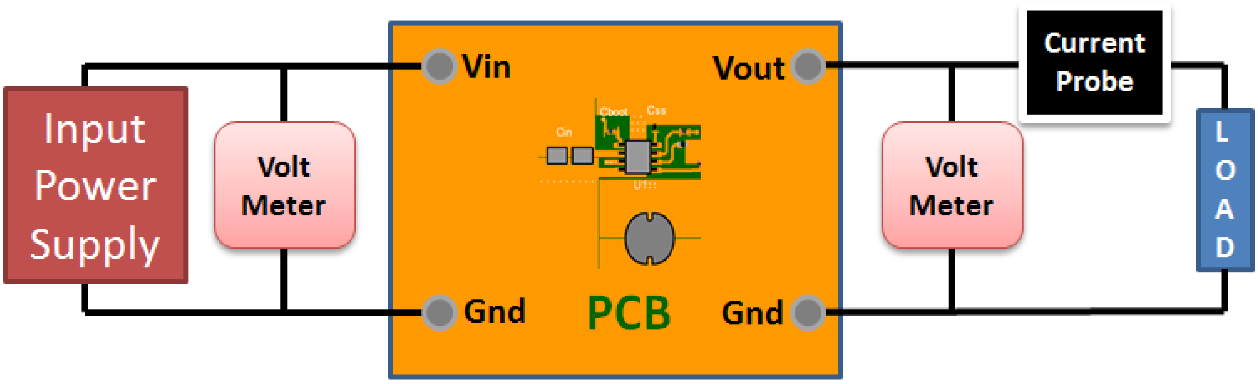
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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 : BD3596FF80C877A8[v1]

2. **TPS56C215** Product Folder : http://www.ti.com/product/TPS56C215 : contains the data sheet and other resources.