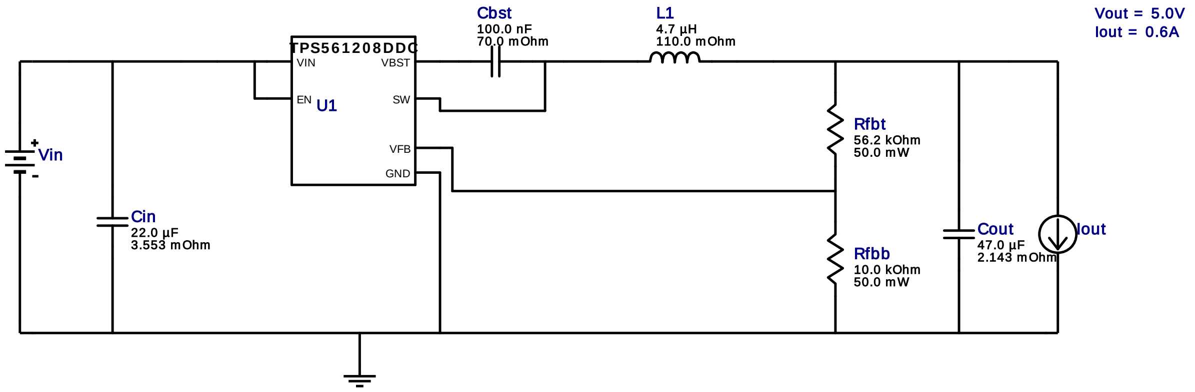
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 10.0V
VinMax = 14.0V
Vout = 5.0V
Iout = 0.6A

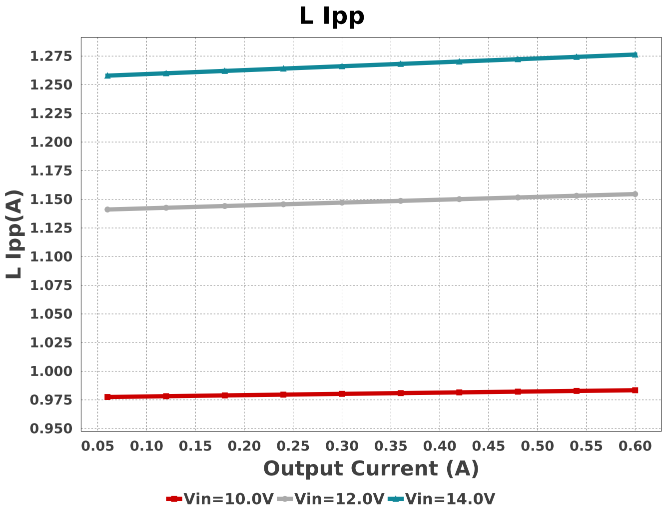
Device = TPS561208DDCR
Topology = Buck
Created = 2025-12-28 11:48:54.906
BOM Cost = $0.80
BOM Count = 7
Total Pd = 0.19W

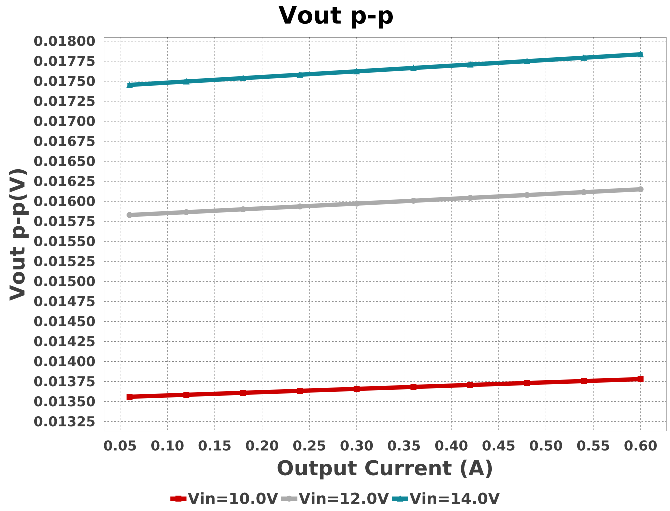
Design : 3 TPS561208DDCR
TPS561208DDCR 10V-14V to 5.00V @ 0.6A

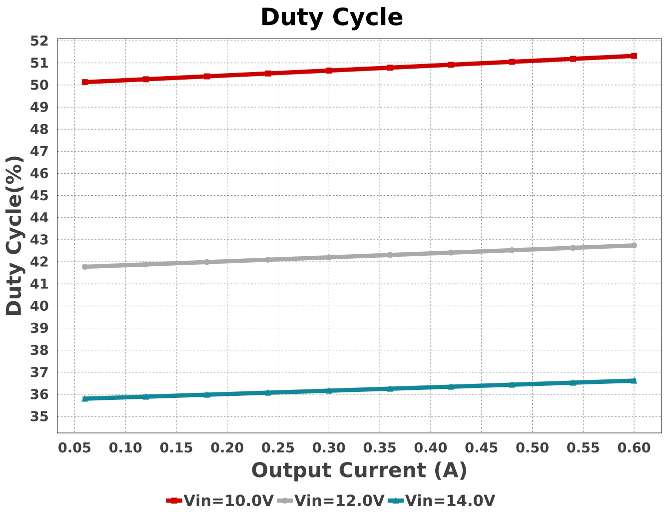


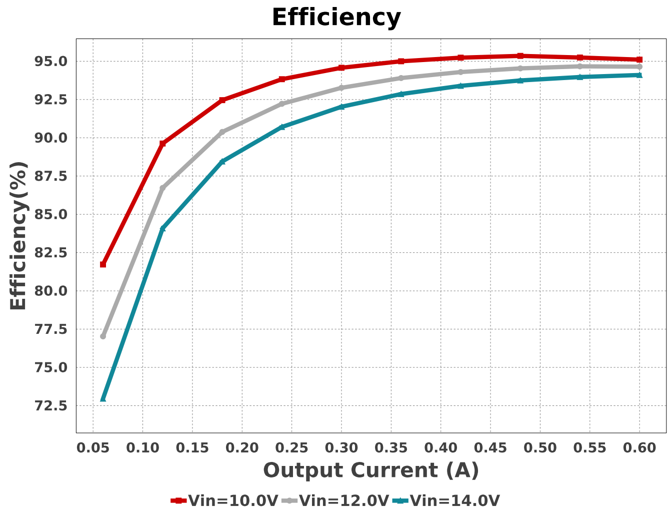
Electrical BOM

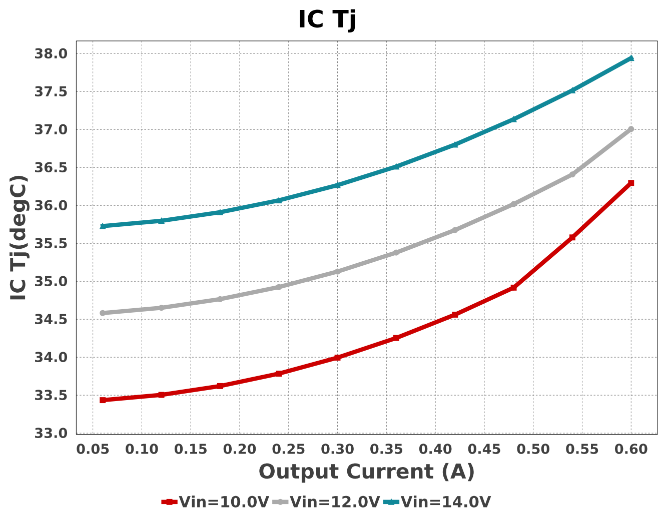
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	TDK	C0603X5R1E104K030BB Series= X5R	Cap= 100.0 nF ESR= 70.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0201 2 mm^2
Cin	Taiyo Yuden	MSAST21GBB5226MTNC12 Series= X5R	Cap= 22.0 uF ESR= 3.553 mOhm VDC= 25.0 V IRMS= 2.17467 A	1	$0.22	0805 7 mm^2
Cout	TDK	C3216X5R1C476M160AB Series= X5R	Cap= 47.0 uF ESR= 2.143 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.28	1206 11 mm^2
L1	MuRata	LQM2HPN4R7MG0L	L= 4.7 µH 110.0 mOhm	1	$0.09	1008 10 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
Rfbt	Yageo	RC0201FR-0756K2L Series= ?	Res= 56.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	TPS561208DDCR	Switcher	1	$0.18	DDC0006A 15 mm^2

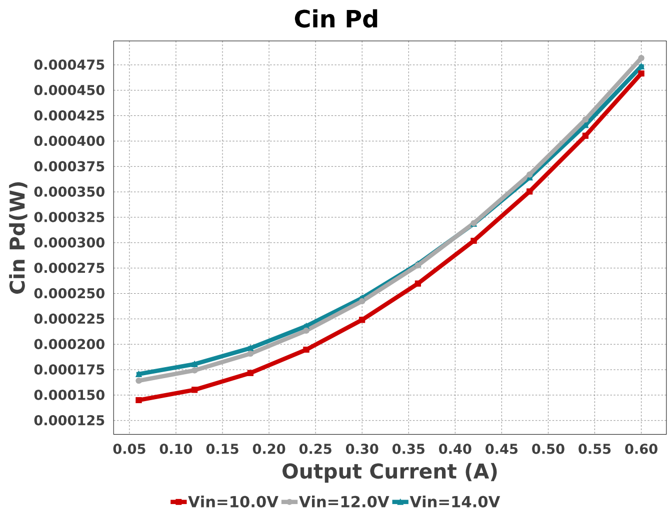

L Ipp
L Ipp(A)
1.275
1.250
1.225
1.200
1.175
1.150
1.125
1.100
1.075
1.050
1.025
1.000
0.975
0.950
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Vout p-p
Vout p-p(V)
0.01800
0.01775
0.01750
0.01725
0.01700
0.01675
0.01650
0.01625
0.01600
0.01575
0.01550
0.01525
0.01500
0.01475
0.01450
0.01425
0.01400
0.01375
0.01350
0.01325
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

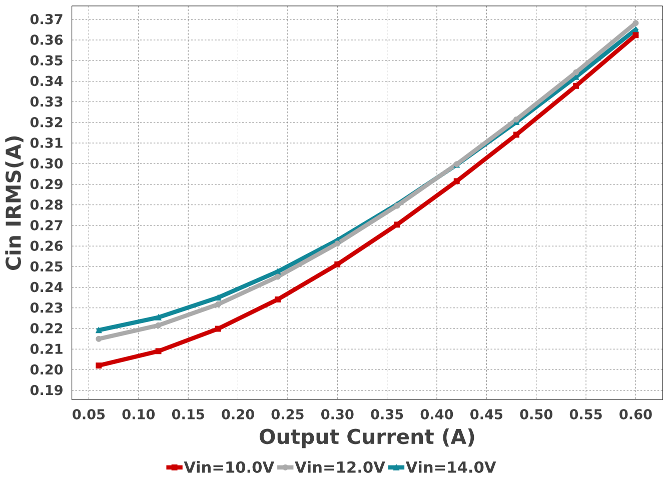

Duty Cycle
Duty Cycle(%)
52
51
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Efficiency
Efficiency(%)
95.0
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

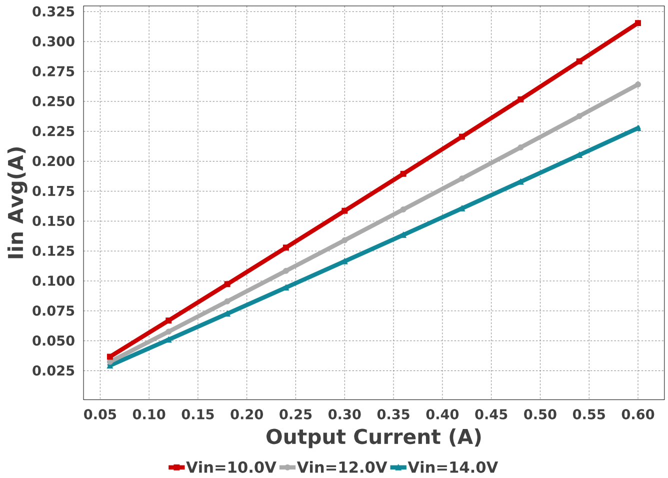

IC Tj
IC Tj(degC)
38.0
37.5
37.0
36.5
36.0
35.5
35.0
34.5
34.0
33.5
33.0
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V


Cin Pd
Cin Pd(W)
0.000475
0.000450
0.000425
0.000400
0.000375
0.000350
0.000325
0.000300
0.000275
0.000250
0.000225
0.000200
0.000175
0.000150
0.000125
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Output Current (A)
Vin=10.0V Vin=12.0V Vin=14.0V

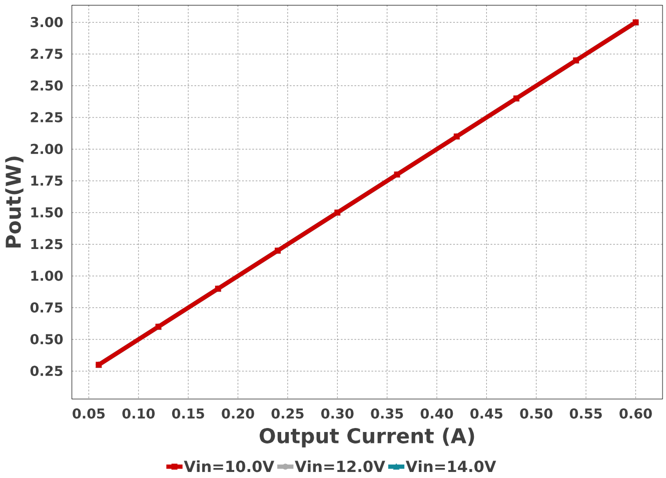
Cin IRMS



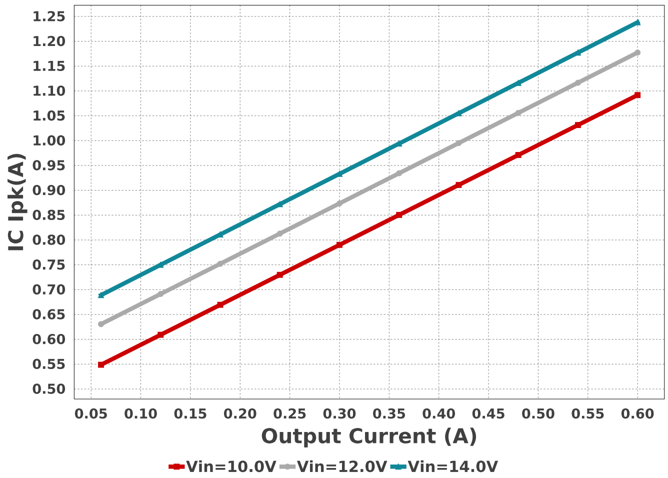
Iin Avg



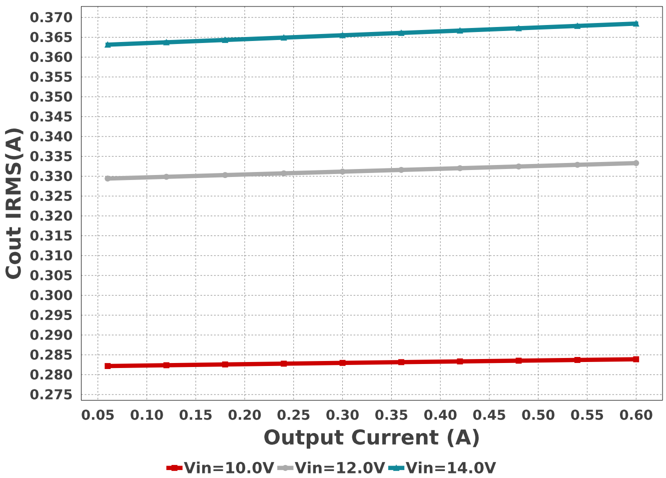
Pout



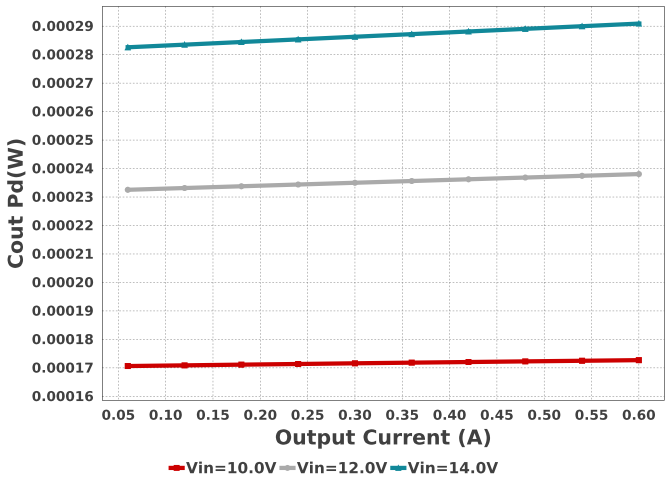
IC Ipk

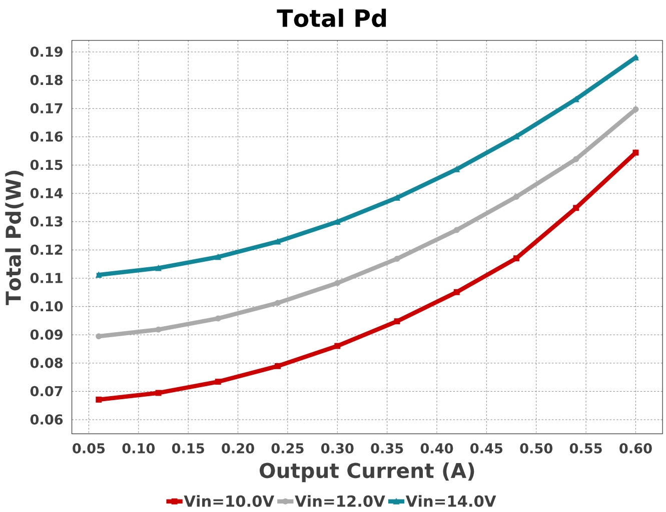


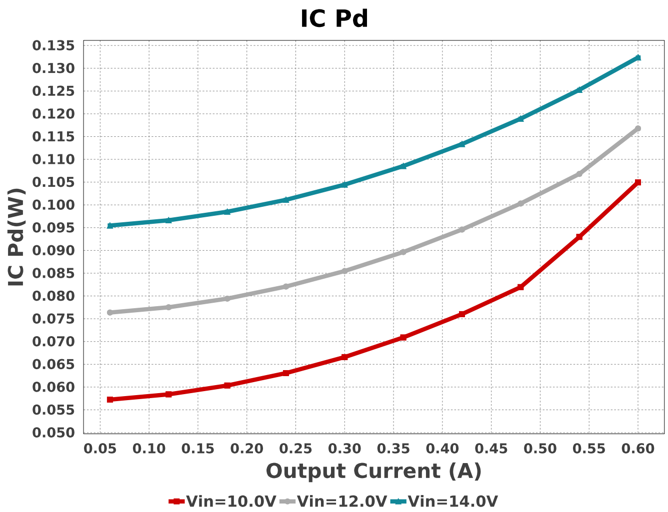
Cout IRMS

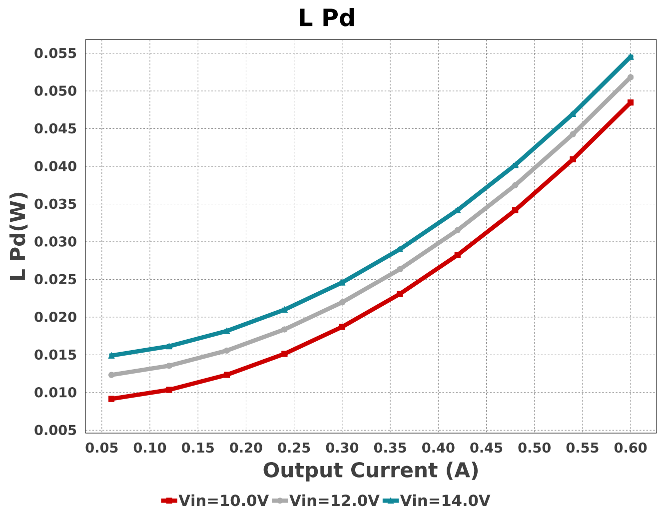


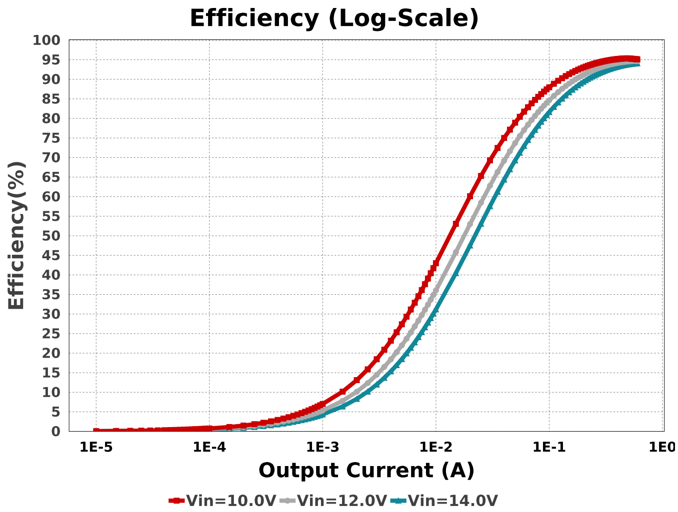
Cout Pd

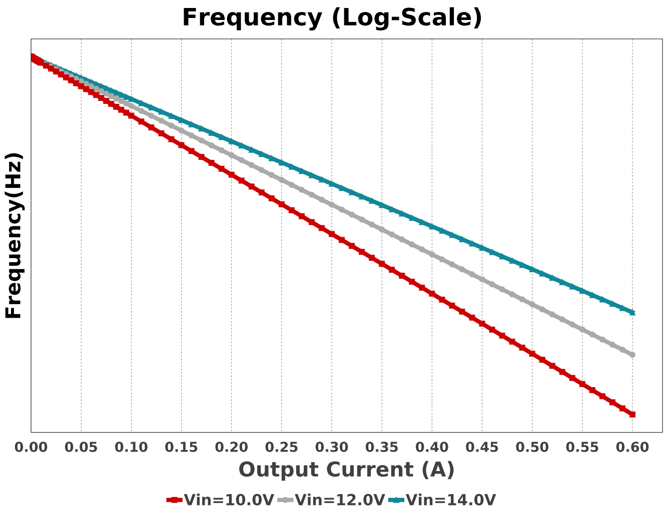












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	365.056 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	473.49 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	368.443 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	290.91 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	1.238 A	IC	Peak switch current in IC
6.	IC Pd	132.36 mW	IC	IC power dissipation
7.	IC Tj	37.941 degC	IC	IC junction temperature
8.	IC Tolerance	19.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	60.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	227.72 mA	IC	Average input current
11.	L Ipp	1.276 A	Inductor	Peak-to-peak inductor ripple current

#	Name	Value	Category	Description
12.	L Pd	54.533 mW	Inductor	Inductor power dissipation
13.	Cin Pd	473.49 µW	Power	Input capacitor power dissipation
14.	Cout Pd	290.91 µW	Power	Output capacitor power dissipation
15.	IC Pd	132.36 mW	Power	IC power dissipation
16.	L Pd	54.533 mW	Power	Inductor power dissipation
17.	Total Pd	188.033 mW	Power	Total Power Dissipation
18.	BOM Count	7	System Information	Total Design BOM count
19.	Duty Cycle	36.619 %	System Information	Duty cycle
20.	Efficiency	94.102 %	System Information	Steady state efficiency
21.	FootPrint	49.0 mm^2	System Information	Total Foot Print Area of BOM components
22.	Frequency	540.168 kHz	System Information	Switching frequency
23.	Iout	600.0 mA	System Information	Iout operating point
24.	Mode	FCCM	System Information	Conduction Mode
25.	Pout	3.0 W	System Information	Total output power
26.	Total BOM	$0.8	System Information	Total BOM Cost
27.	Vin	14.0 V	System Information	Vin operating point
28.	Vout	5.0 V	System Information	Operational Output Voltage
29.	Vout Actual	5.084 V	System Information	Vout Actual calculated based on selected voltage divider resistors
30.	Vout Tolerance	4.231 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
31.	Vout p-p	17.836 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	14.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS561208	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

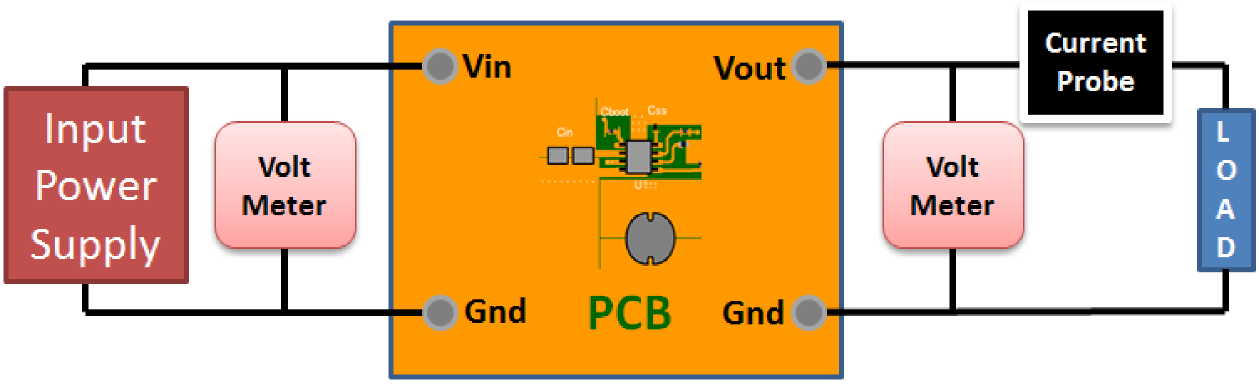
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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 : 13C9C93492FD24AF757A79815040020E[v1]

2. **TPS561208** Product Folder : http://www.ti.com/product/TPS561208 : contains the data sheet and other resources.