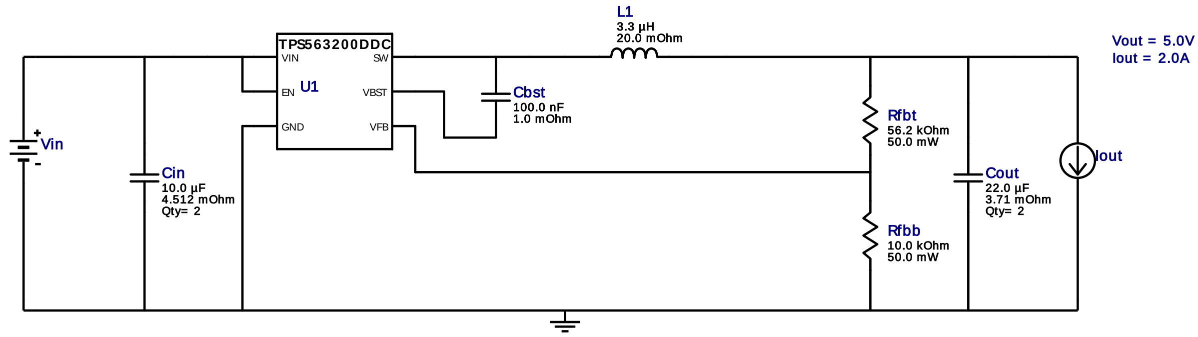
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 11.8V
VinMax = 12.2V
Vout = 5.0V
Iout = 2.0A

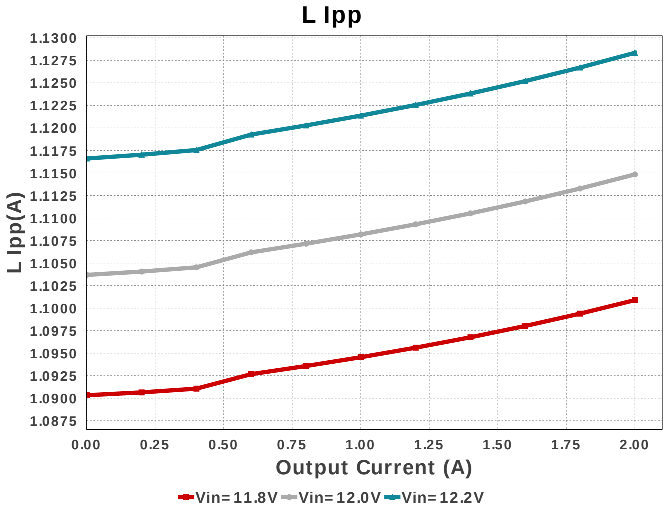
Device = TPS563200DDCR
Topology = Buck
Created = 2020-03-15 20:22:46.461
BOM Cost = $1.13
BOM Count = 9
Total Pd = 0.56W

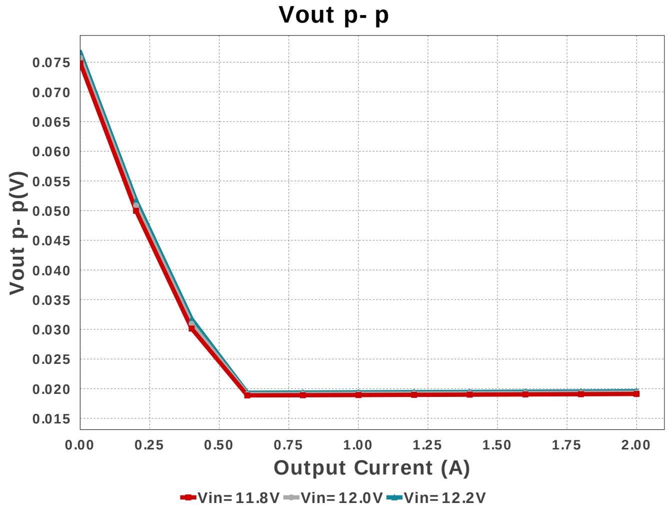
Design : 130 TPS563200DDCR
TPS563200DDCR 11.8V-12.2V to 5.00V @ 2A

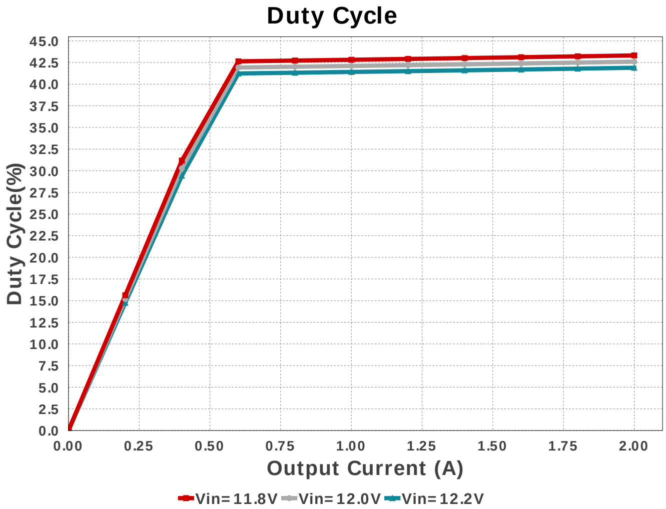


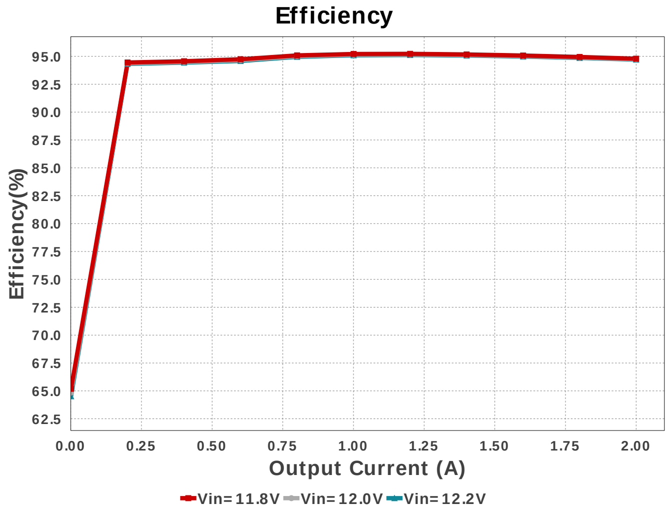
Electrical BOM

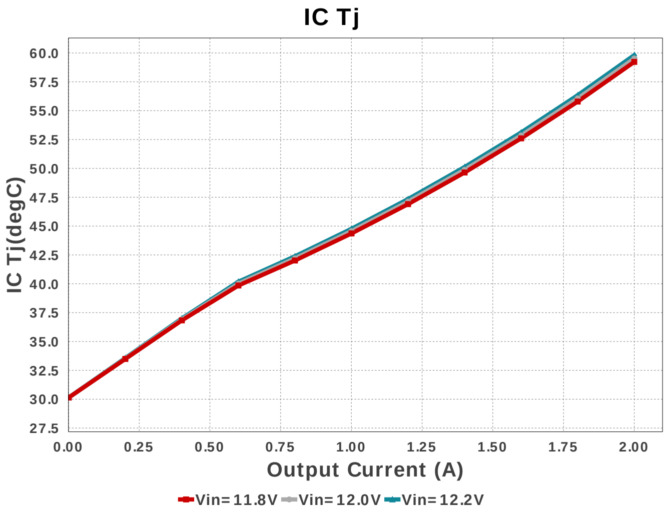
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cin	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 uF ESR= 4.512 mOhm VDC= 25.0 V IRMS= 2.447 A	2	$0.12	1206_190 11 mm^2
Cout	TDK	C1608X5R1A226M080AC Series= X5R	Cap= 22.0 uF ESR= 3.71 mOhm VDC= 10.0 V IRMS= 2.69936 A	2	$0.12	0603 5 mm^2
L1	TDK	VLP8040T-3R3N	L= 3.3 µH 20.0 mOhm	1	$0.22	VLP8040 113 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	TPS563200DDCR	Switcher	1	$0.40	DDC0006A 10 mm^2

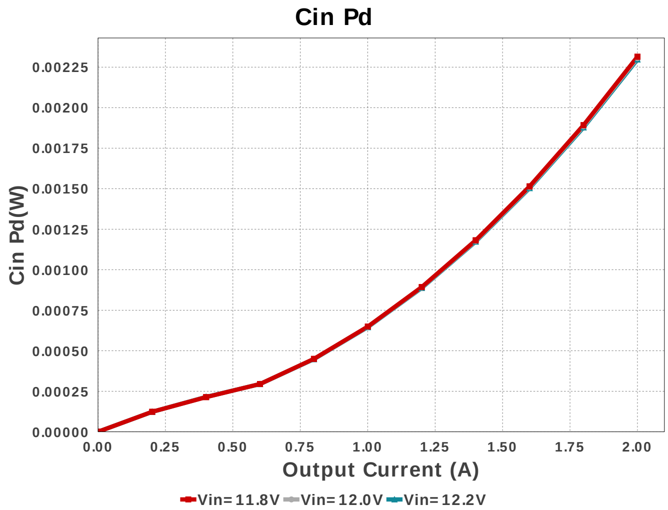

L Ipp
L Ipp(A)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

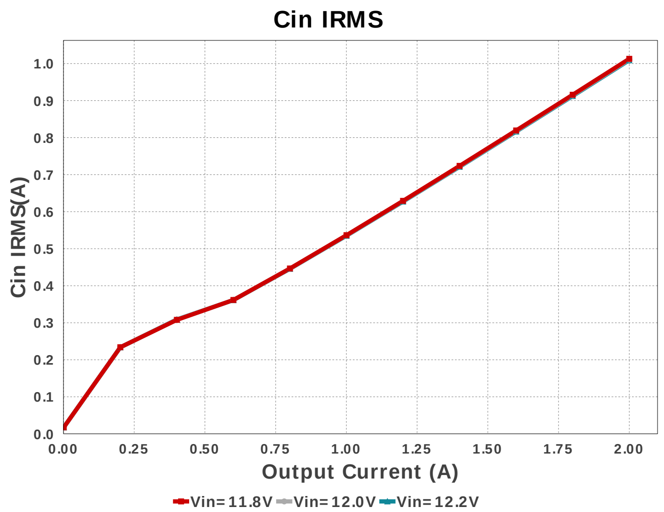

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

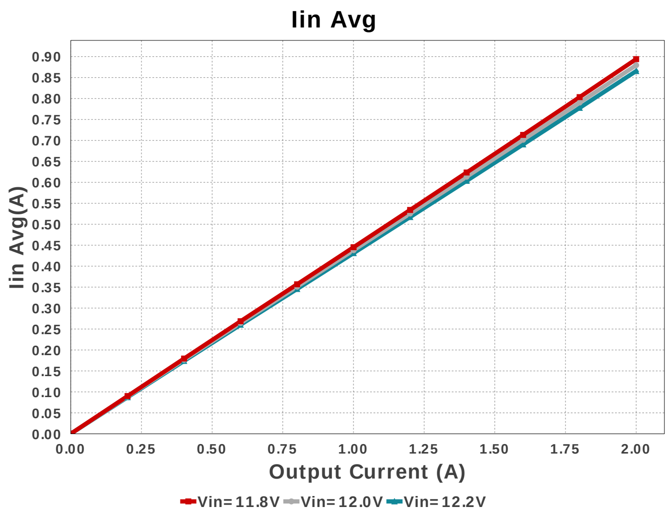

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

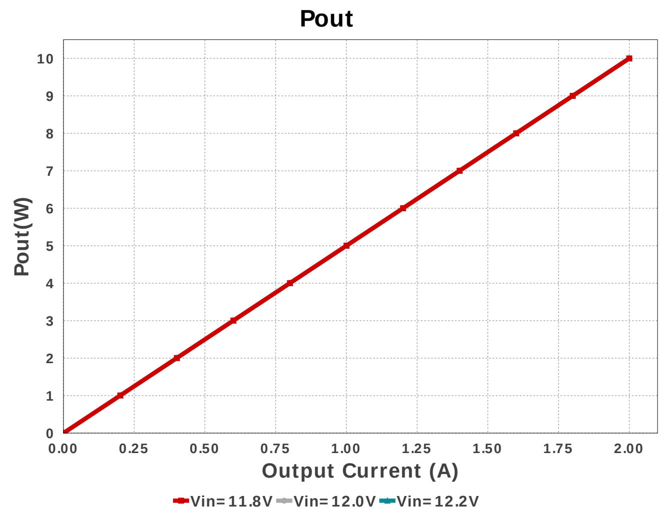

Efficiency
Efficiency(%)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

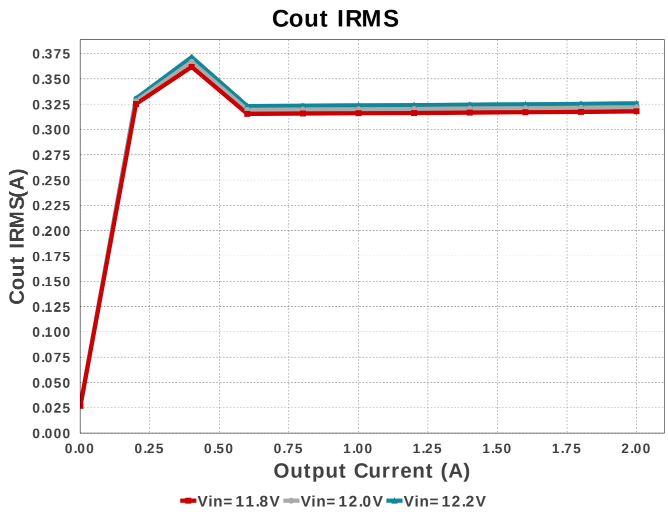

IC Tj
IC Tj(degC)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

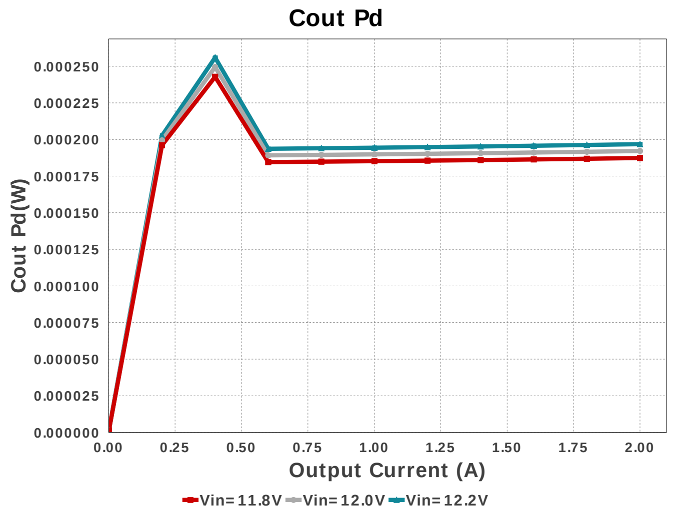

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

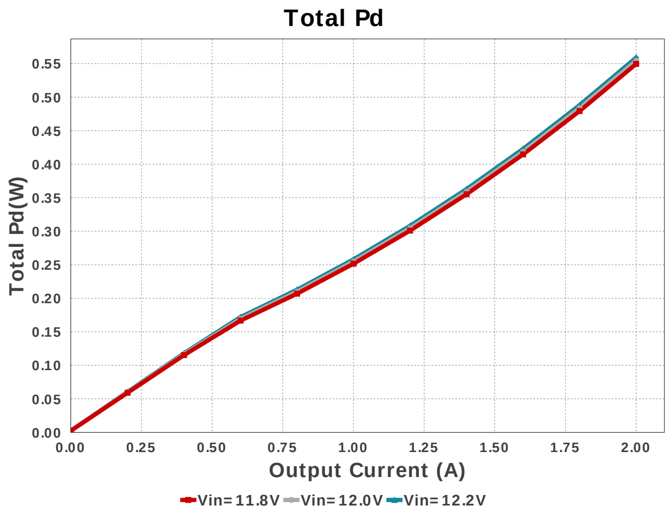

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

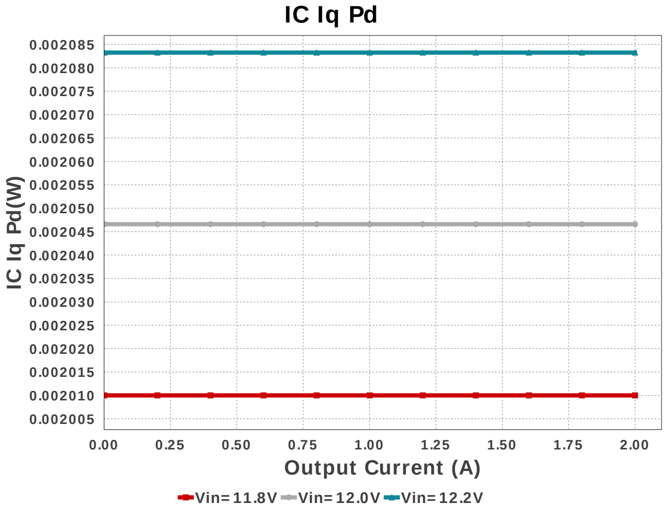

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

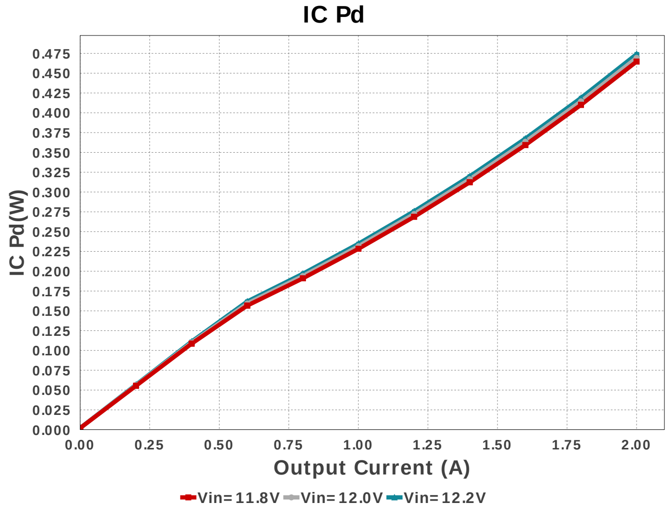

Pout
Pout(W)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

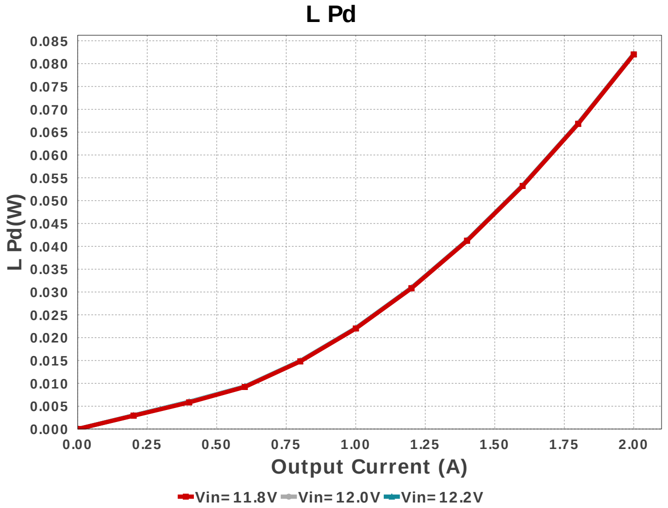

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V

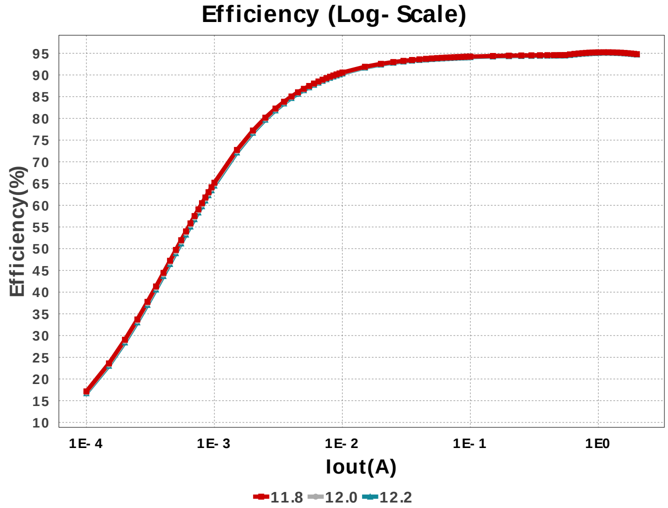

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V


Total Pd
Total Pd(W)
Output Current (A)
Vin=11.8V Vin=12.0V Vin=12.2V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.009 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.297 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	325.724 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	196.81 µW	Capacitor	Output capacitor power dissipation
5.	IC Iq Pd	2.083 mW	IC	IC Iq Pd
6.	IC Pd	474.03 mW	IC	IC power dissipation
7.	IC Tj	59.817 degC	IC	IC junction temperature
8.	ICThetaJA	62.9 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	865.49 mA	IC	Average input current
10.	L Ipp	1.128 A	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	82.122 mW	Inductor	Inductor power dissipation
12.	Cin Pd	2.297 mW	Power	Input capacitor power dissipation
13.	Cout Pd	196.81 µW	Power	Output capacitor power dissipation
14.	IC Pd	474.03 mW	Power	IC power dissipation
15.	L Pd	82.122 mW	Power	Inductor power dissipation
16.	Total Pd	558.992 mW	Power	Total Power Dissipation
17.	BOM Count	9	System Information	Total Design BOM count
18.	Duty Cycle	41.897 %	System Information	Duty cycle
19.	Efficiency	94.706 %	System Information	Steady state efficiency
20.	FootPrint	164.0 mm²	System Information	Total Foot Print Area of BOM components
21.	Frequency	795.181 kHz	System Information	Switching frequency
22.	Iout	2.0 A	System Information	Iout operating point
23.	Mode	CCM	System Information	Conduction Mode
24.	Pout	10.0 W	System Information	Total output power

#	Name	Value	Category	Description
25.	Total BOM	$1.13	System Information	Total BOM Cost
26.	Vin	12.2 V	System Information	Vin operating point
27.	Vout	5.0 V	System Information	Operational Output Voltage
28.	Vout Actual	5.031 V	System Information	Vout Actual calculated based on selected voltage divider resistors
29.	Vout Tolerance	3.053 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
30.	Vout p-p	19.587 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	12.2	Maximum input voltage
VinMin	11.8	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS563200	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

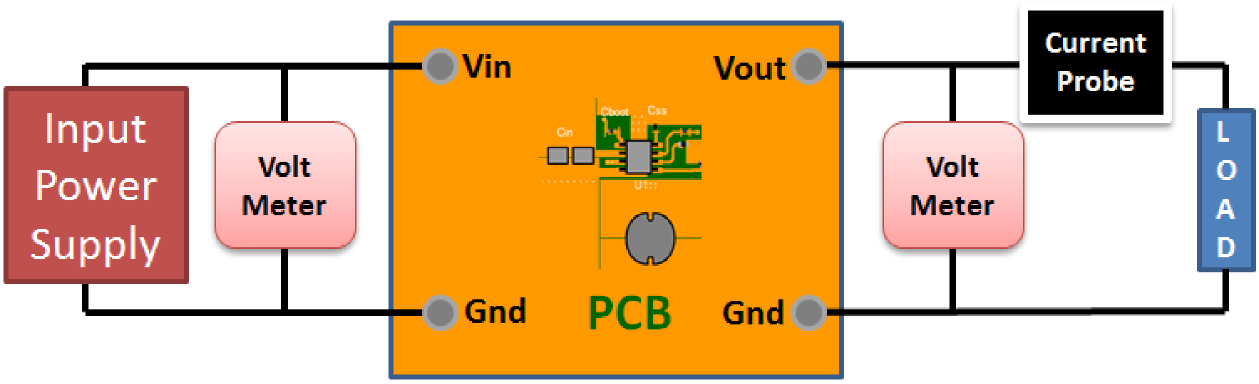
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.8V 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.



Design Assistance

1. Master key : E86007F5CFD5661C[v1]

2. **TPS563200** Product Folder : http://www.ti.com/product/TPS563200 : contains the data sheet and other resources.

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