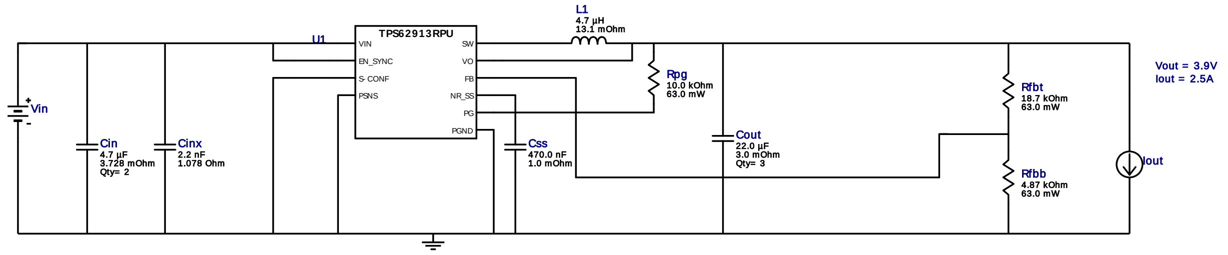
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 11.0V
VinMax = 16.0V
Vout = 3.9V
Iout = 2.5A

Device = TPS62913RPUR
Topology = Buck
Created = 2020-08-21 01:00:40.498
BOM Cost = $2.47
BOM Count = 12
Total Pd = 0.43W

Design : 12745 TPS62913RPUR
TPS62913RPUR 11V-16V to 3.90V @ 2.5A



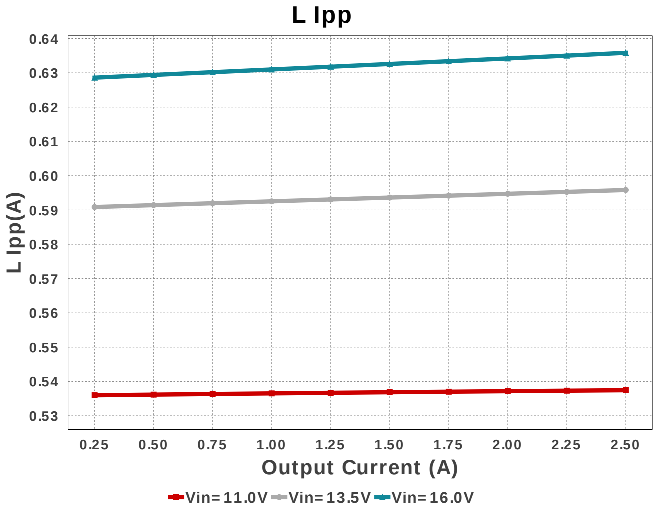
Design Alerts

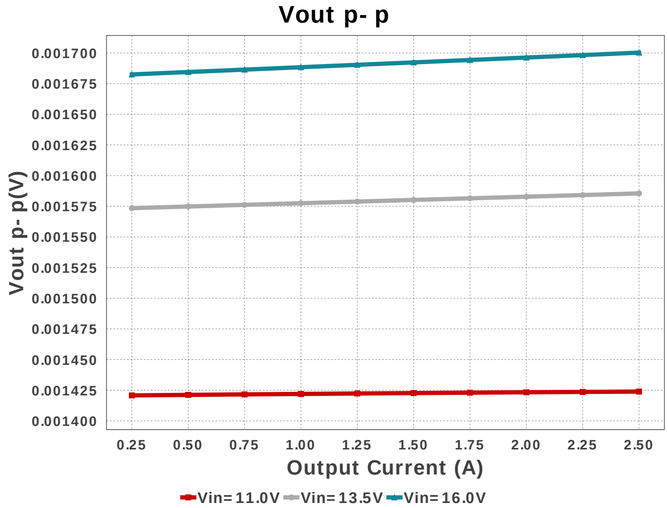
TPS62913 Design

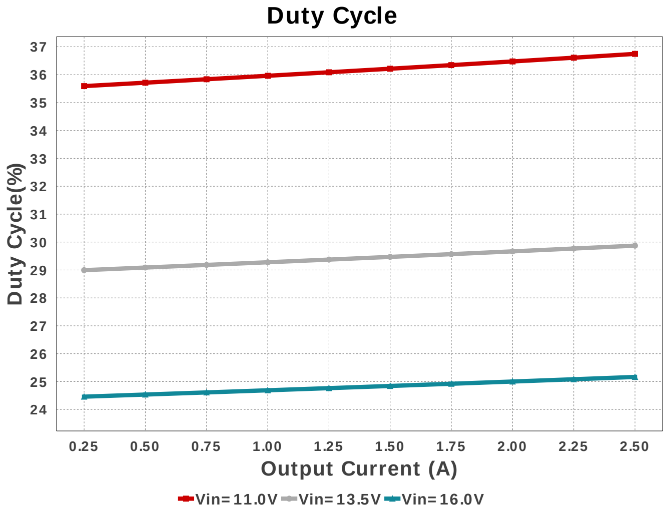
The TPS62913 supports a second LC ferrite bead output filter to achieve lowest output voltage ripple. To enable this filter in the design, use the Second Stage Output Filter dropdown option from Advanced options on the left side. Please refer to the TPS62913 datasheet for more information.

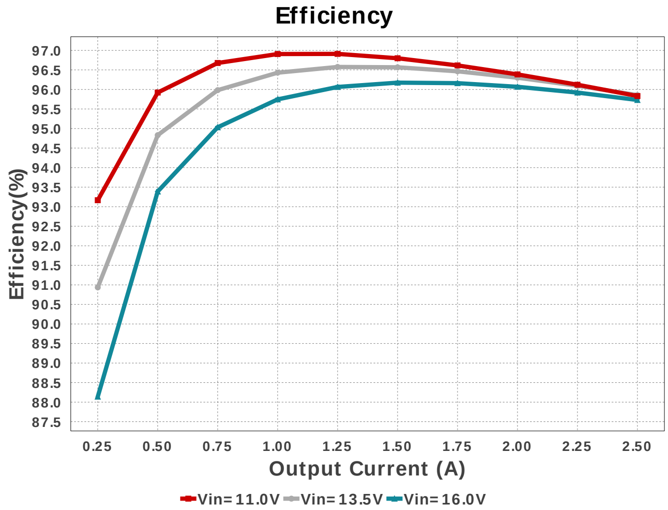
Electrical BOM

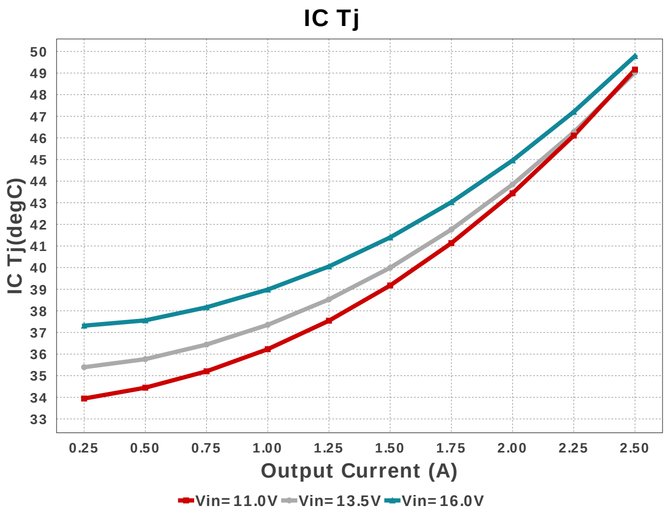
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	TDK	C1608X5R1V475K080AC Series= X5R	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 35.0 V IRMS= 2.69359 A	2	$0.10	0603 5 mm^2
Cinx	TDK	CGA2B2X7R1H222K050BA Series= X7R	Cap= 2.2 nF ESR= 1.0779 Ohm VDC= 50.0 V IRMS= 264.071 mA	1	$0.01	0402 3 mm^2
Cout	MuRata	GRM21BR61A226ME44L Series= X5R	Cap= 22.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 3.84 A	3	$0.13	0805 7 mm^2
Css	MuRata	GRM188R60J474KA01D Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.02	0603 5 mm^2
L1	Coilcraft	XAL6060-472MEB	L= 4.7 µH 13.1 mOhm	1	$0.82	XAL6060 72 mm^2
Rfbb	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW040218K7FKED Series= CRCW..e3	Res= 18.7 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	TPS62913RPUR	Switcher	1	$1.00	RPU0010A-MFG 9 mm^2

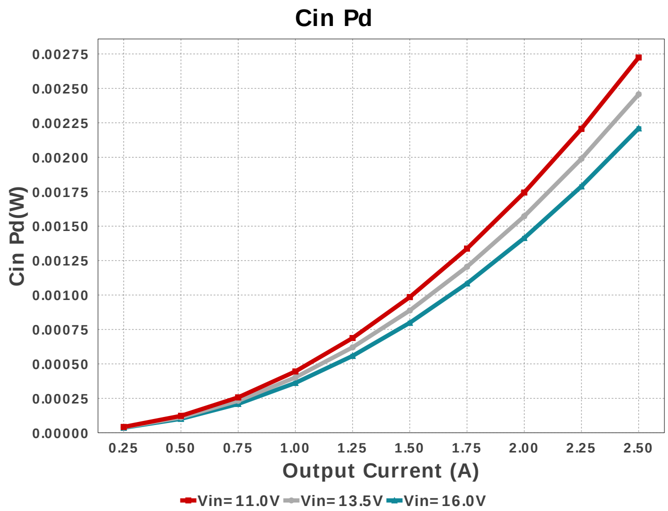

L Ipp
L Ipp(A)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Vout p- p
Vout p- p(V)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Efficiency
Efficiency(%)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


IC Tj
IC Tj(degC)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Cin Pd
Cin Pd(W)
Output Current (A)
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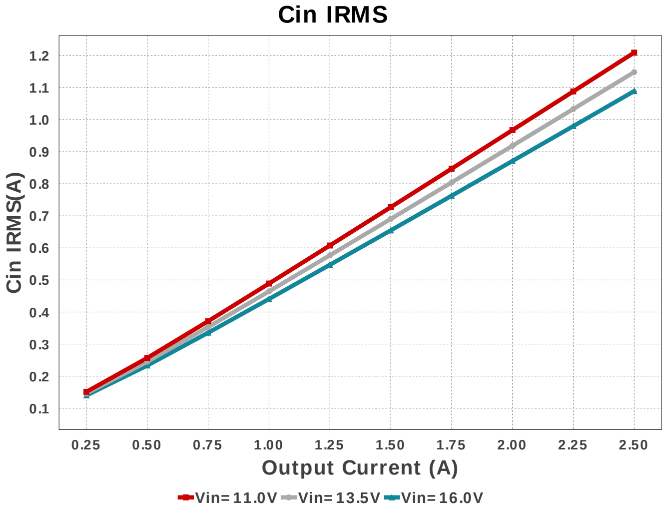
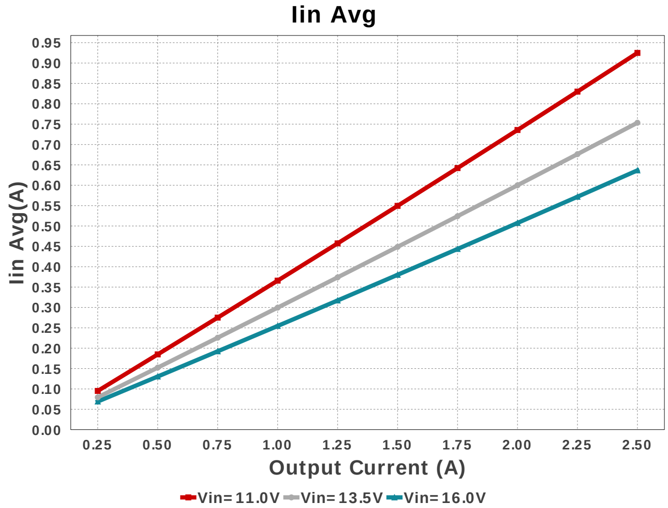
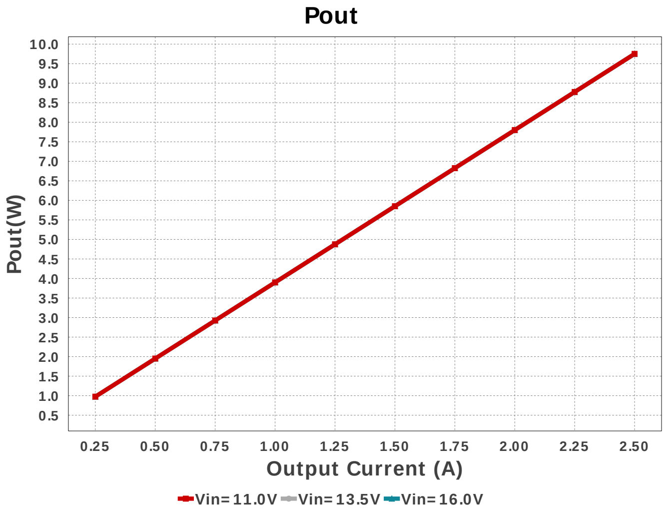
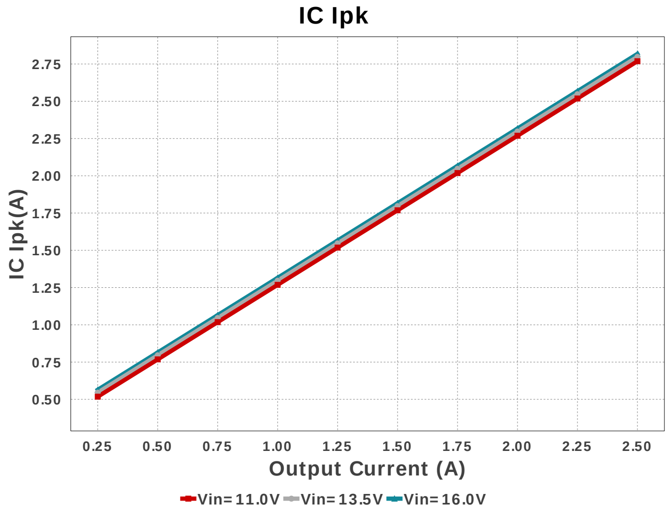

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


Pout
Pout(W)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V


IC Ipk
IC Ipk(A)
Output Current (A)
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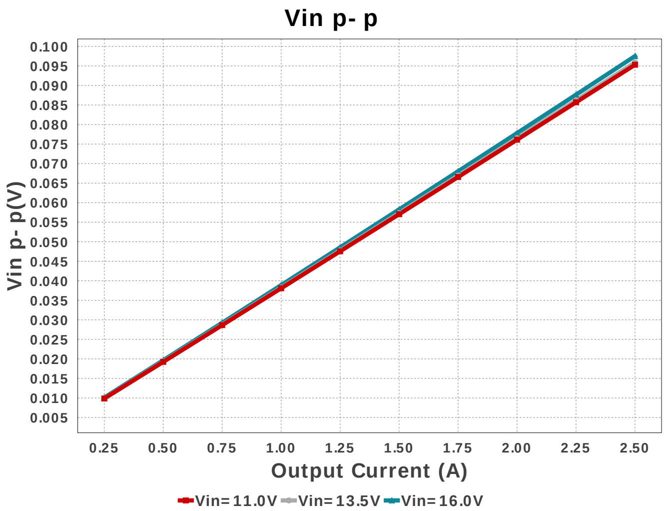
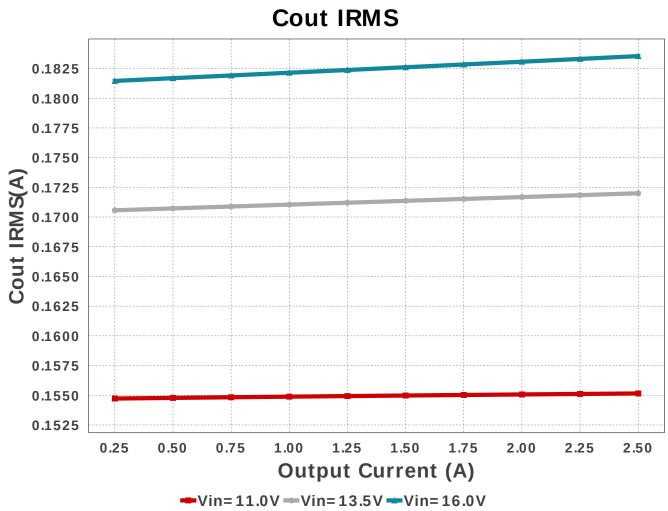
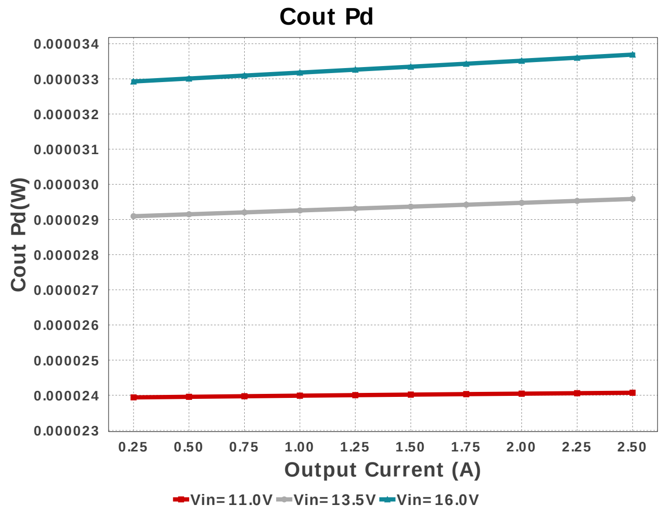
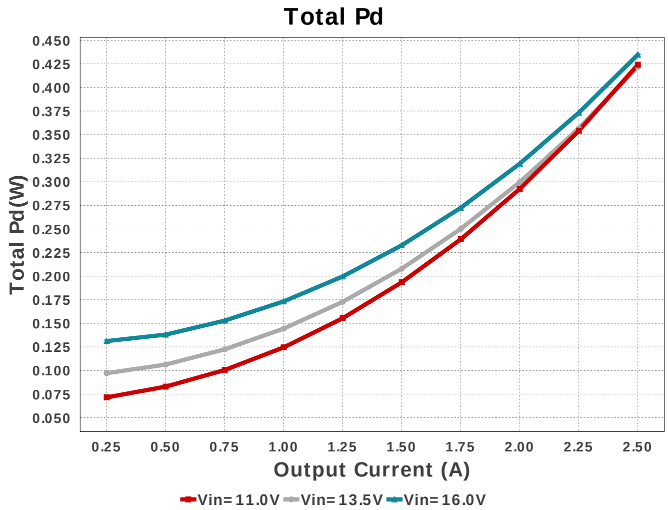
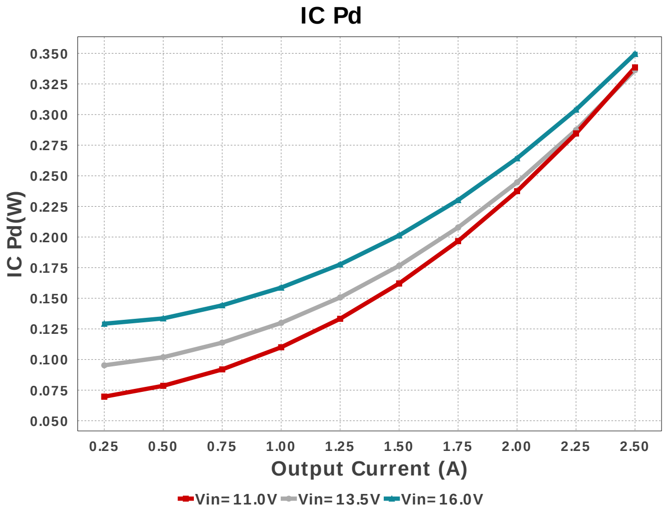
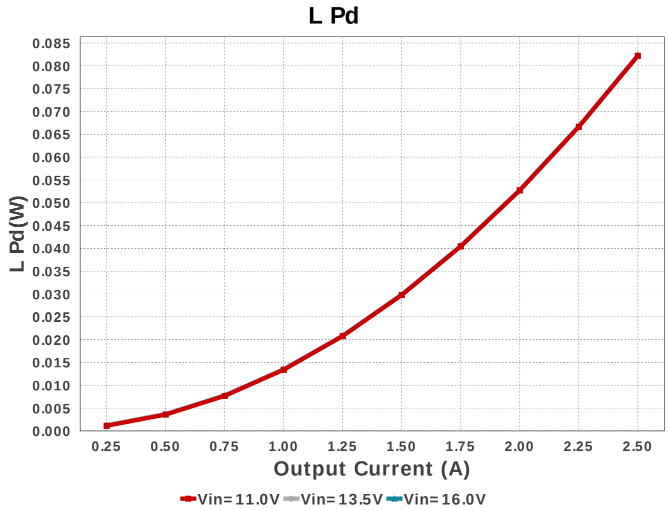

Vin p- p
Vin p- p(V)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V

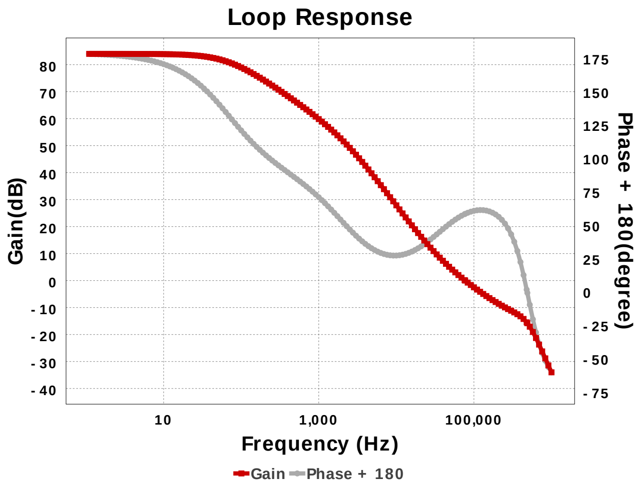

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=11.0V Vin=13.5V Vin=16.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.089 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.21 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	183.548 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	33.69 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	2.818 A	IC	Peak switch current in IC
6.	IC Pd	349.54 mW	IC	IC power dissipation
7.	IC Tj	49.784 degC	IC	IC junction temperature
8.	ICThetaJA	56.6 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	636.55 mA	IC	Average input current
10.	Ipp percentage	25.433 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)

#	Name	Value	Category	Description
11.	L Ipp	635.83 mA	Inductor	Peak-to-peak inductor ripple current
12.	L Pd	82.316 mW	Inductor	Inductor power dissipation
13.	Cin Pd	2.21 mW	Power	Input capacitor power dissipation
14.	Cout Pd	33.69 µW	Power	Output capacitor power dissipation
15.	IC Pd	349.54 mW	Power	IC power dissipation
16.	L Pd	82.316 mW	Power	Inductor power dissipation
17.	Total Pd	434.789 mW	Power	Total Power Dissipation
18.	BOM Count	12	System Information	Total Design BOM count
19.	Cross Freq	77.0 kHz	System Information	Bode plot crossover frequency
20.	Duty Cycle	25.167 %	System Information	Duty cycle
21.	Efficiency	95.731 %	System Information	Steady state efficiency
22.	FootPrint	127.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	1000.0 kHz	System Information	Switching frequency
24.	Gain Marg	-16.187 dB	System Information	Bode Plot Gain Margin
25.	Iout	2.5 A	System Information	Iout operating point
26.	Loop Phase Marg	58.791 deg	System Information	Bode Plot Phase Margin
27.	Low Freq Gain	83.98 dB	System Information	Gain at 1Hz
28.	Mode	FCCM	System Information	Conduction Mode
29.	Pout	9.75 W	System Information	Total output power
30.	Total BOM	$2.47	System Information	Total BOM Cost
31.	Vin	16.0 V	System Information	Vin operating point
32.	Vin p-p	97.52 mV	System Information	Peak-to-peak input voltage
33.	Vout	3.9 V	System Information	Operational Output Voltage
34.	Vout Actual	3.872 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	2.111 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors at 25 degC
36.	Vout p-p	1.7 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	16.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
VinTyp	15.0	Typical input voltage
Vout	3.9	Output Voltage
base_pn	TPS62913	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

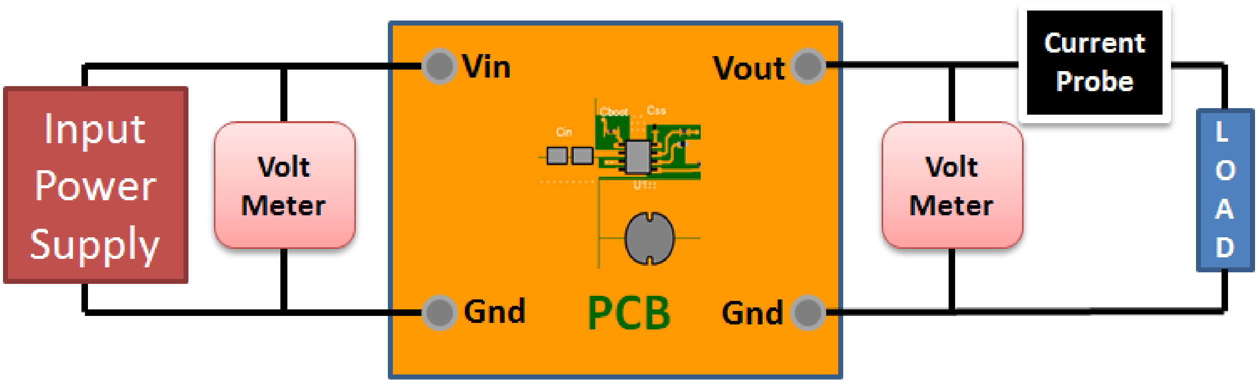
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.0V 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 : 1B0CCE6EBD53FA1F[v1]

2. **TPS62913** Product Folder : http://www.ti.com/product/TPS62913 : contains the data sheet and other resources.