![Texas Instruments]

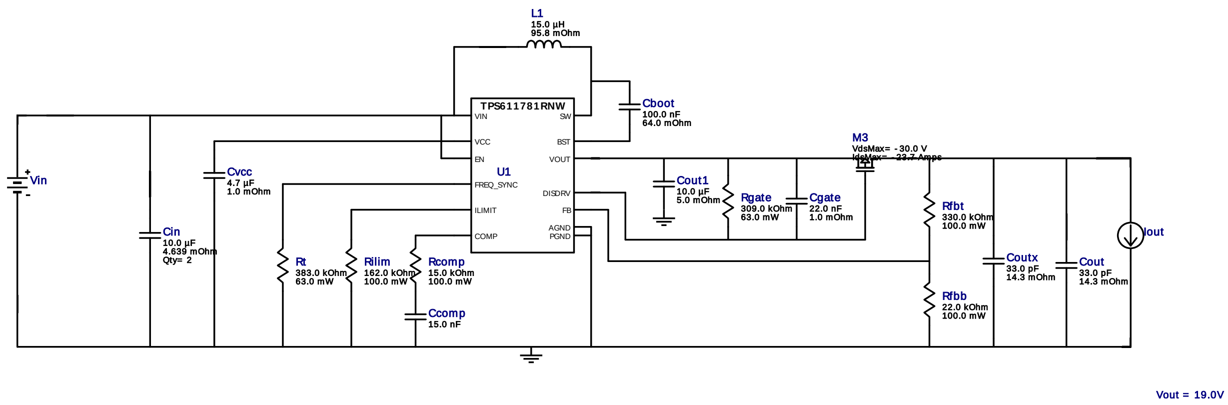
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 2.7V
VinMax = 4.8V
Vout = 19.0V
Iout = 0.15A

Device = TPS611781RNWR
Topology = Boost
Created = 2020-04-27 02:50:38.123
BOM Cost = $3.47
BOM Count = 18
Total Pd = 0.31W

Design : 22 TPS611781RNWR
TPS611781RNWR 2.7V-6V to 19.00V @ 0.15A

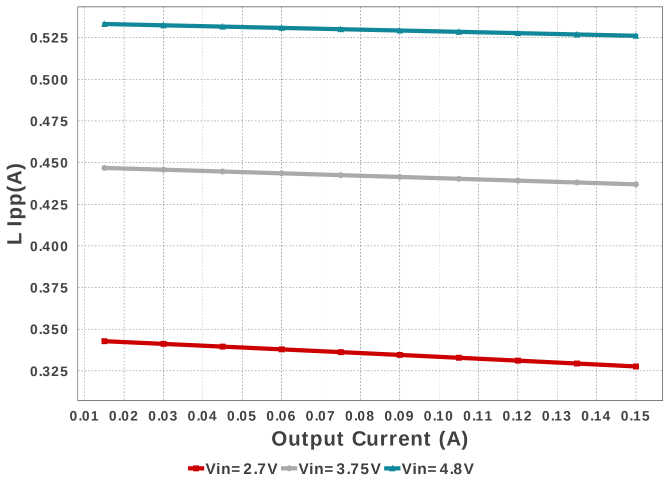


Electrical BOM

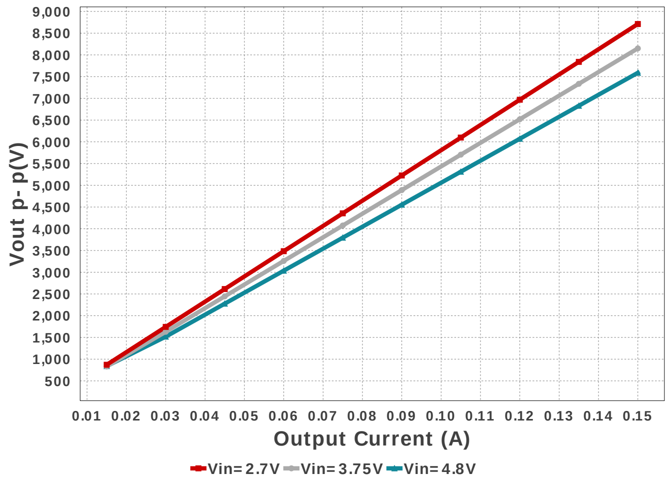
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Ccomp	Kemet	C0603C153G3GACTU Series= C0G/NP0	Cap= 15.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.28	0603 5 mm²
Cgate	MuRata	GRM155R71E223KA61D Series= X7R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	TDK	C1608X5R1E106M080AC Series= X5R	Cap= 10.0 uF ESR= 4.639 mOhm VDC= 25.0 V IRMS= 2.4141 A	2	$0.20	0603 5 mm²
Cout	Kemet	C0805C330J5GACTU Series= C0G/NP0	Cap= 33.0 pF ESR= 14.3 mOhm VDC= 50.0 V IRMS= 656.0 mA	1	$0.01	0805 7 mm²
Cout1	Samsung Electro-Mechanics	CL32B106KBJNNWE Series= X7R	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.17	1210_270 15 mm²
Coutx	Kemet	C0805C330J5GACTU Series= C0G/NP0	Cap= 33.0 pF ESR= 14.3 mOhm VDC= 50.0 V IRMS= 656.0 mA	1	$0.01	0805 7 mm²
Cvcc	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 mm²
L1	Bourns	SRN6045-150M	L= 15.0 µH 95.8 mOhm	1	$0.20	SRN6045 64 mm²
M3	Vishay-Siliconix	Si7149DP	VdsMax= -30.0 V IdsMax= -23.7 Amps	1	$0.68	PowerPAK_SO-8 55 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcomp	Yageo	RC0603FR-0715KL Series= ?	Res= 15.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbb	Yageo	RC0603FR-0722KL Series= ?	Res= 22.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbt	Yageo	RC0603FR-07330KL Series= ?	Res= 330.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rgate	Vishay-Dale	CRCW0402309KFKED Series= CRCW..e3	Res= 309.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rilim	Yageo	RC0603FR-07162KL Series= ?	Res= 162.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rt	Vishay-Dale	CRCW0402383KFKED Series= CRCW..e3	Res= 383.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS611781RNWR	Switcher	1	$1.58	RNW0013A 18 mm^2

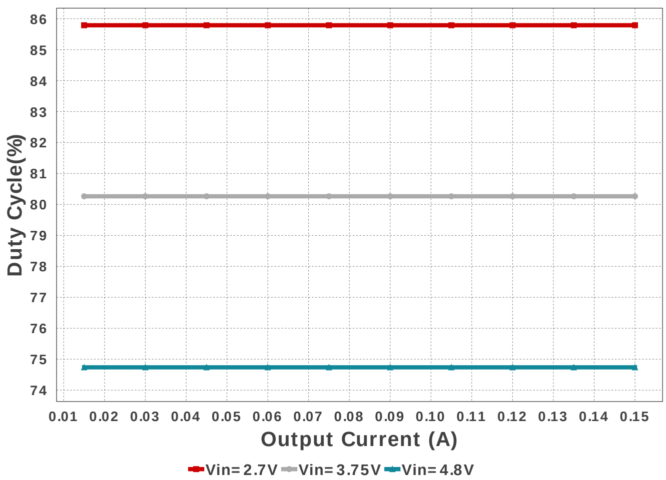
L Ipp



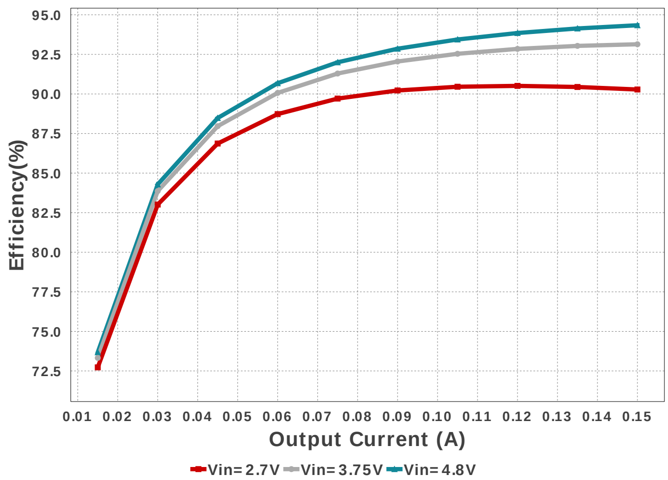
Vout p-p



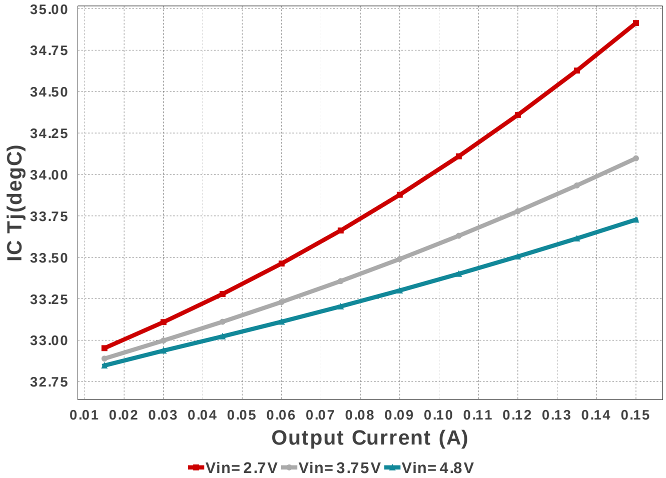
Duty Cycle



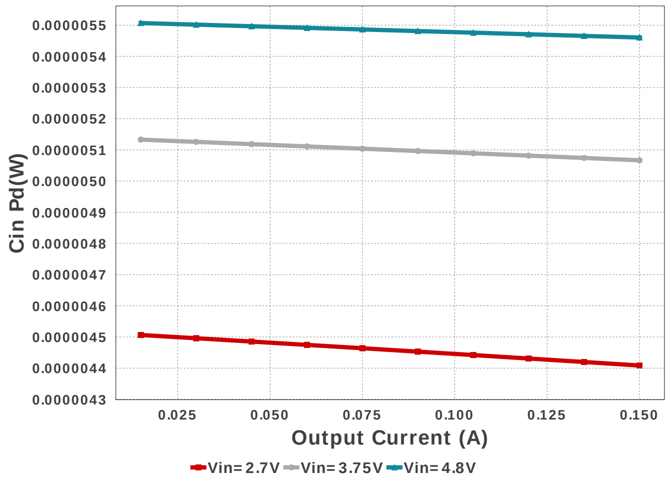
Efficiency



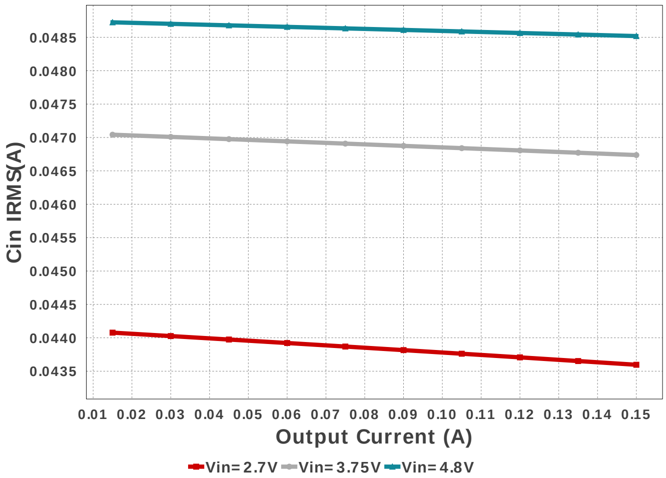
IC Tj



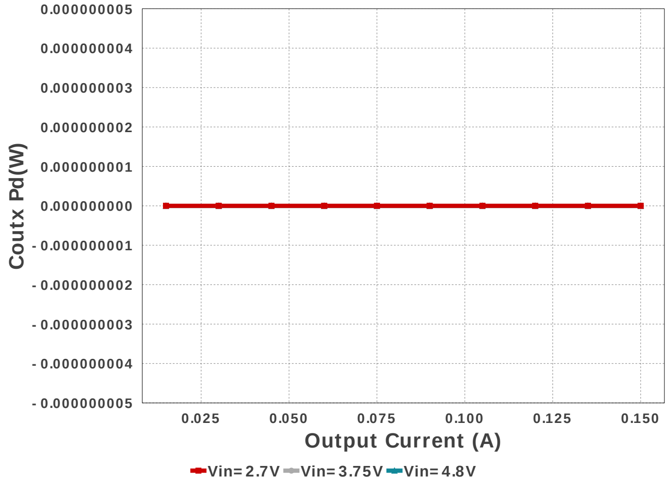
Cin Pd



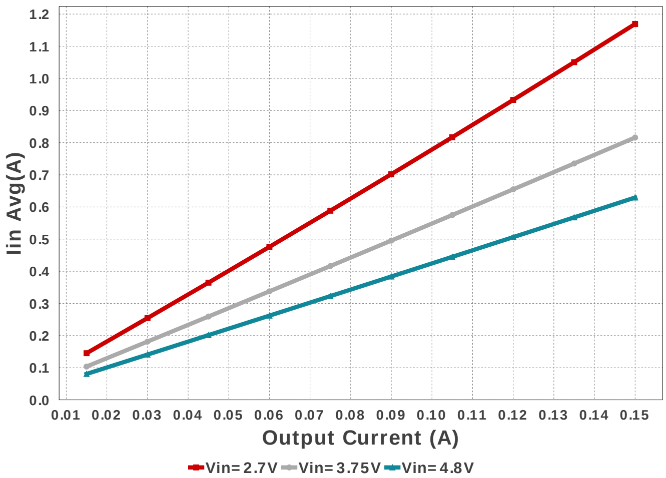
Cin IRMS



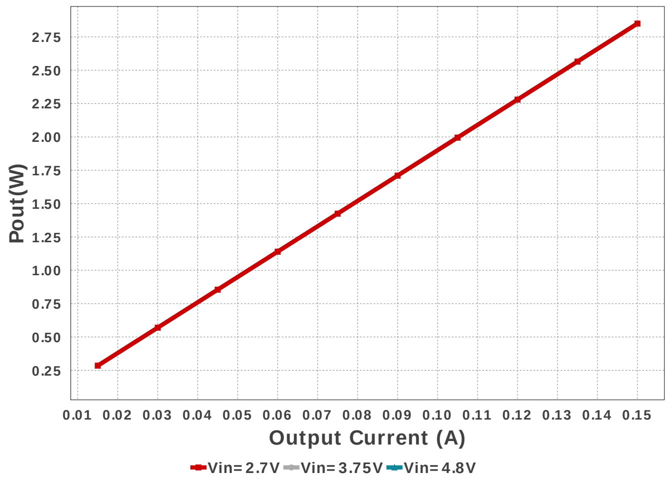
Coutx Pd

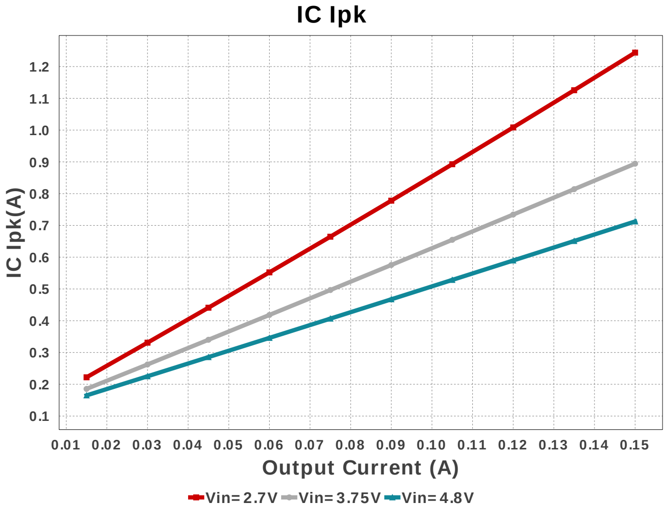


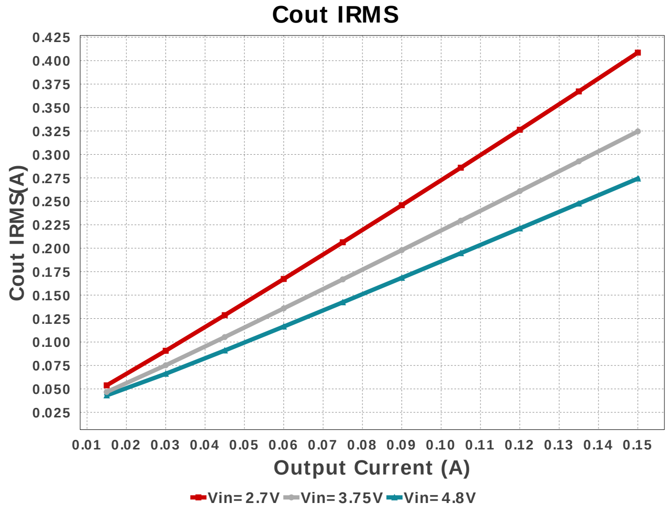
Iin Avg

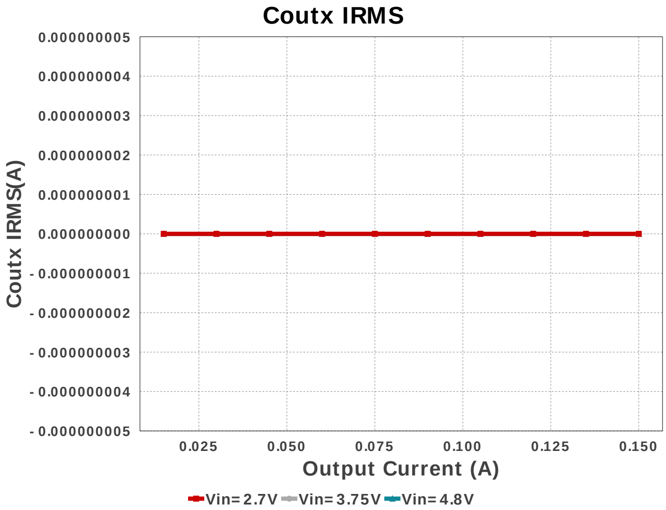


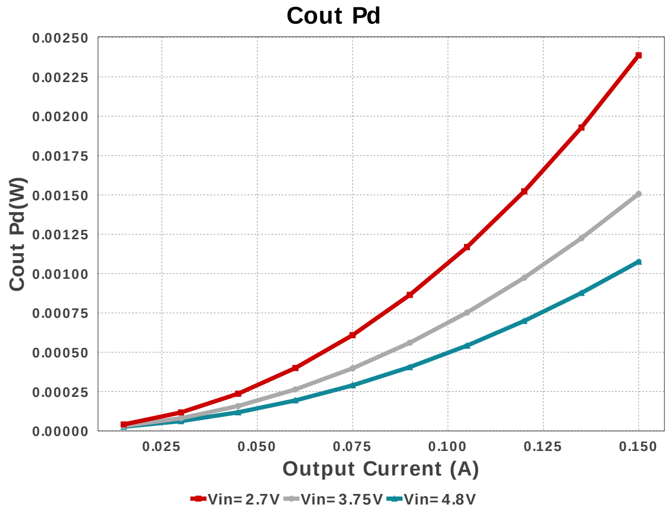
Pout

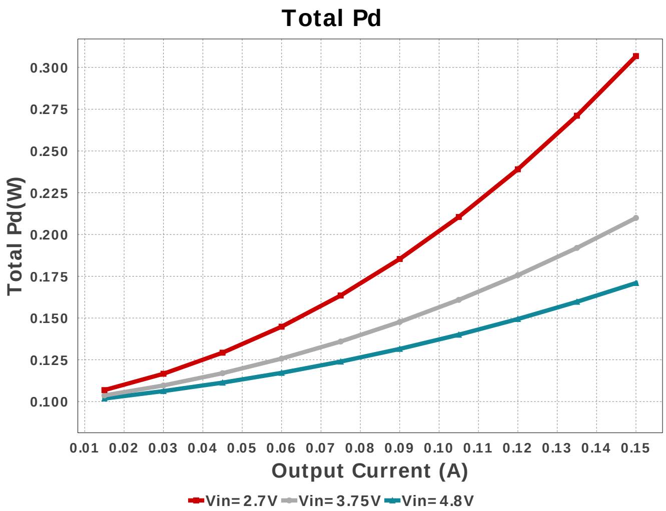


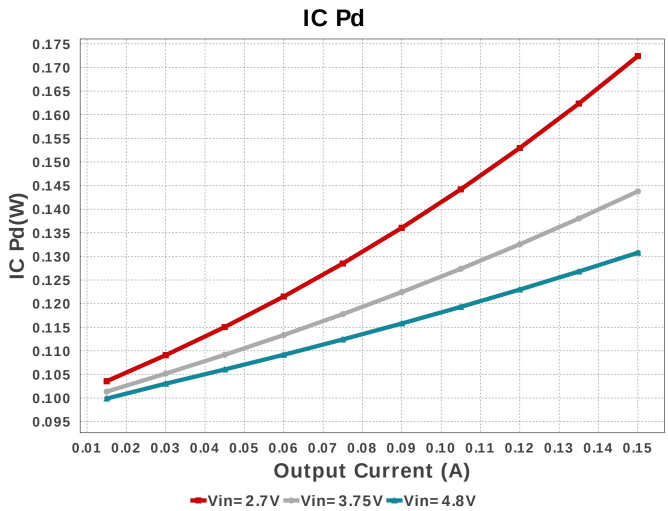

IC Ipk
IC Ipk(A)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V

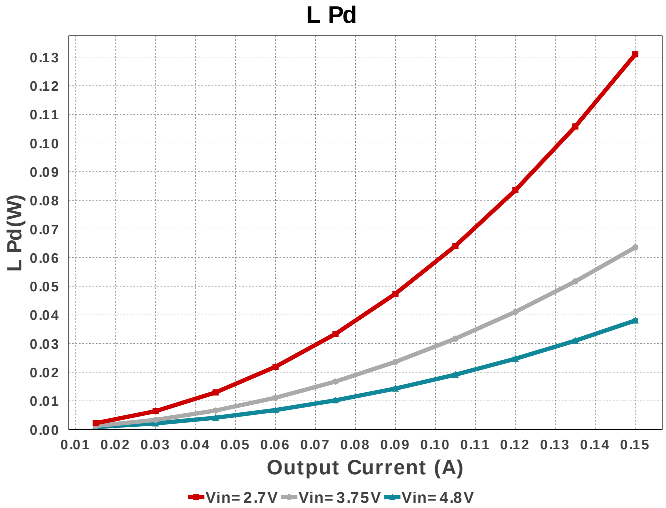

Cout IRMS
Cout IRMS(A)
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V


Coutx IRMS
Coutx IRMS(A)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V


Cout Pd
Cout Pd(W)
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V


Total Pd
Total Pd(W)
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V


IC Pd
IC Pd(W)
0.175
0.170
0.165
0.160
0.155
0.150
0.145
0.140
0.135
0.130
0.125
0.120
0.115
0.110
0.105
0.100
0.095
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15
Output Current (A)
Vin=2.7V Vin=3.75V Vin=4.8V



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	18		Total Design BOM count
2.	Total BOM	$3.47		Total BOM Cost
3.	Cin IRMS	43.596 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	4.408 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	408.573 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	2.387 mW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	0.0 A	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	0.0 W	Capacitor	Output capacitor_x power loss
9.	IC Ipk	1.244 A	IC	Peak switch current in IC
10.	IC Pd	172.41 mW	IC	IC power dissipation
11.	IC Tj	34.914 degC	IC	IC junction temperature
12.	ICThetaJA	28.5 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	1.169 A	IC	Average input current
14.	L Ipp	327.623 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	130.96 mW	Inductor	Inductor power dissipation
16.	Cin Pd	4.408 µW	Power	Input capacitor power dissipation
17.	Cout Pd	2.387 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
19.	IC Pd	172.41 mW	Power	IC power dissipation
20.	L Pd	130.96 mW	Power	Inductor power dissipation
21.	Total Pd	306.782 mW	Power	Total Power Dissipation
22.	Duty Cycle	85.789 %	System Information	Duty cycle
23.	Efficiency	90.282 %	System Information	Steady state efficiency
24.	FootPrint	221.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	447.673 kHz	System Information	Switching frequency
26.	Iout	150.0 mA	System Information	Iout operating point
27.	Mode	BOOST PWM CCM	System Information	PWM/PFM Mode
28.	Pout	2.85 W	System Information	Total output power
29.	Vin	2.7 V	System Information	Vin operating point
30.	Vout Actual	19.168 V	System Information	Vout Actual calculated based on selected voltage divider resistors
31.	Vout Tolerance	2.915 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
32.	Vout p-p	8.711 kV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	150.0 m	Maximum Output Current
VinMax	4.8	Maximum input voltage
VinMin	2.7	Minimum input voltage
Vout	19.0	Output Voltage
base_pn	TPS611781	Base Product Number

Name	Value	Description
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

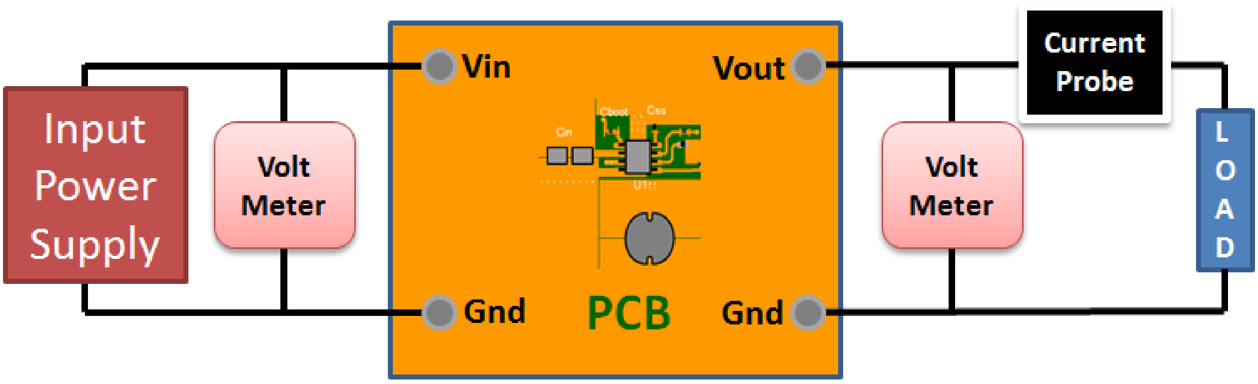
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 2.7V 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 : 1110494E15465408[v1]

2. **TPS611781** Product Folder : http://www.ti.com/product/TPS61178 : contains the data sheet and other resources.