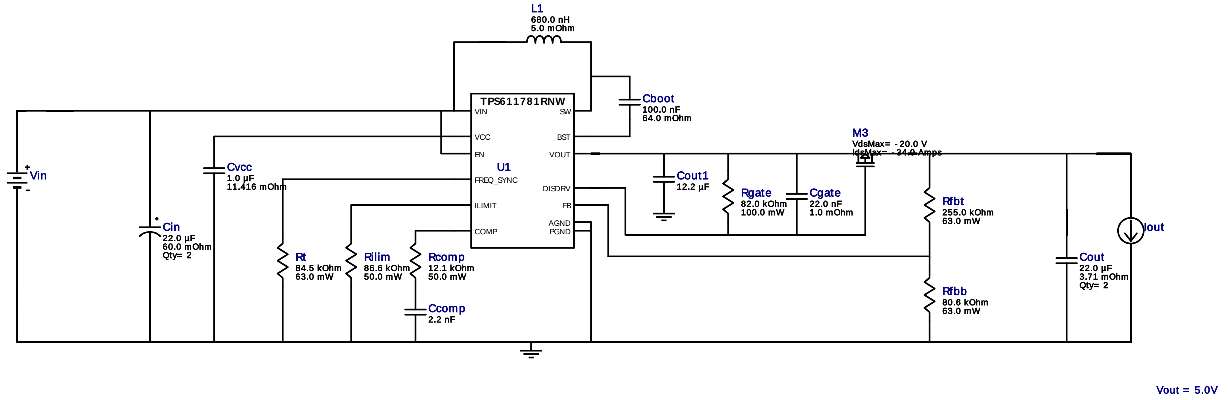
![Texas Instruments]

WEBENCH® Design Report

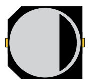
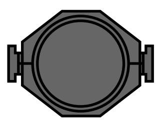
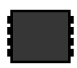
VinMin = 3.0V
VinMax = 4.4V
Vout = 5.0V
Iout = 2.5A

Device = TPS611781RNWR
Topology = Boost
Created = 2021-01-04 00:30:58.148
BOM Cost = NA
BOM Count = 18
Total Pd = 0.96W

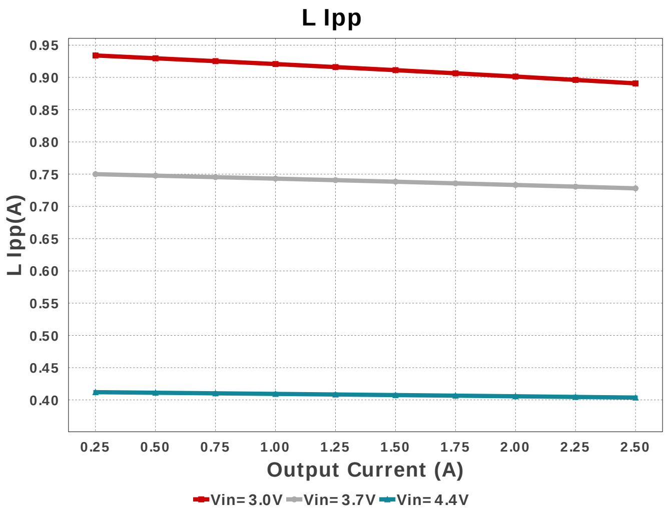
Design : 106 TPS611781RNWR
TPS611781RNWR 3V-4.4V to 5.00V @ 2.5A

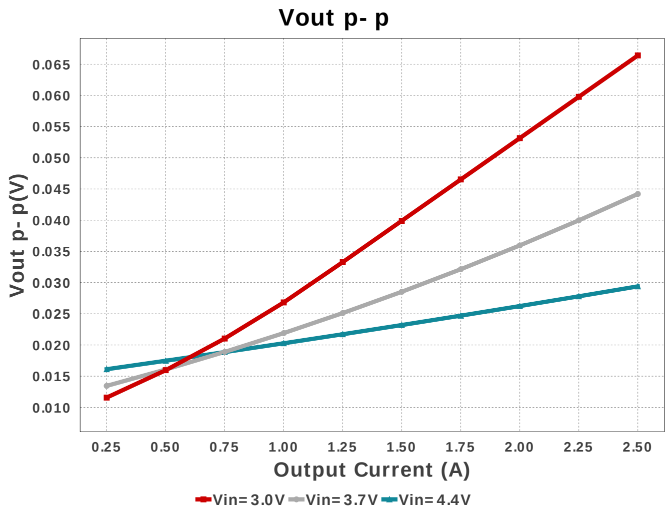


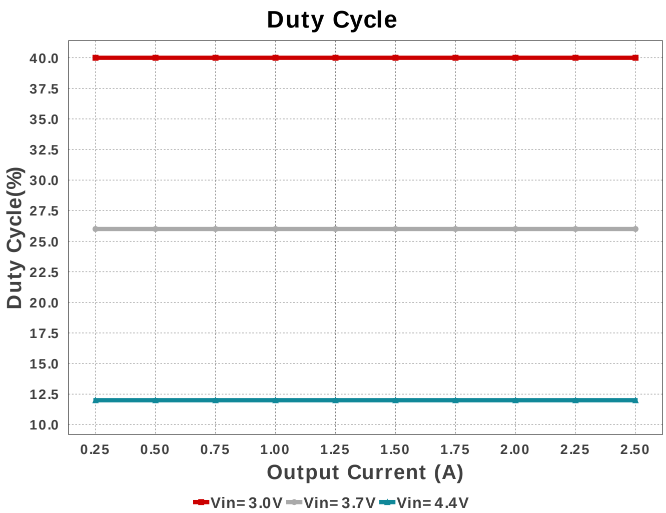
Electrical BOM

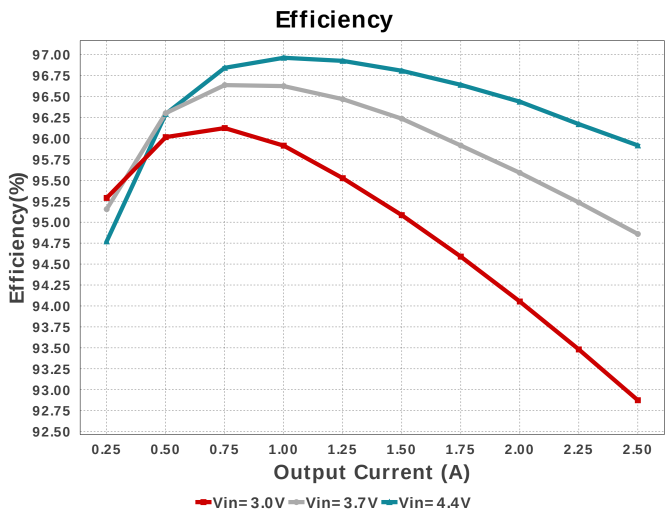
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Ccomp	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Cgate	MuRata	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	Panasonic	20SVP22M Series= SVP	Cap= 22.0 uF ESR= 60.0 mOhm VDC= 20.0 V IRMS= 1.45 A	2	$0.43	 SM_RADIAL_6.3AMM 80 mm²
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 mm²
Cout1	CUSTOM	CUSTOM Series= X5R	Cap= 12.2 uF VDC= 10.0 V IRMS= 0.0 A	1	NA	0805 0 mm²
Cvcc	TDK	C1005X5R1V105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 35.0 V IRMS= 1.483 A	1	$0.03	0402 3 mm²
L1	NIC Components	NPI31PR68MTRF	L= 680.0 nH 5.0 mOhm	1	$0.29	 IND_NPI31P 185 mm²
M3	Vishay-Siliconix	Si7633DP	VdsMax= -20.0 V IdsMax= -34.0 Amps	1	$0.77	 PowerPAK_SO-8 55 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcomp	Yageo	RC0201FR-0712K1L Series= ?	Res= 12.1 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rfbb	Vishay-Dale	CRCW040280K6FKED Series= CRCW..e3	Res= 80.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402255KFKED Series= CRCW..e3	Res= 255.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rgate	Yageo	RC0603FR-0782KL Series= ?	Res= 82.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rilim	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rt	Vishay-Dale	CRCW040284K5FKED Series= CRCW..e3	Res= 84.5 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

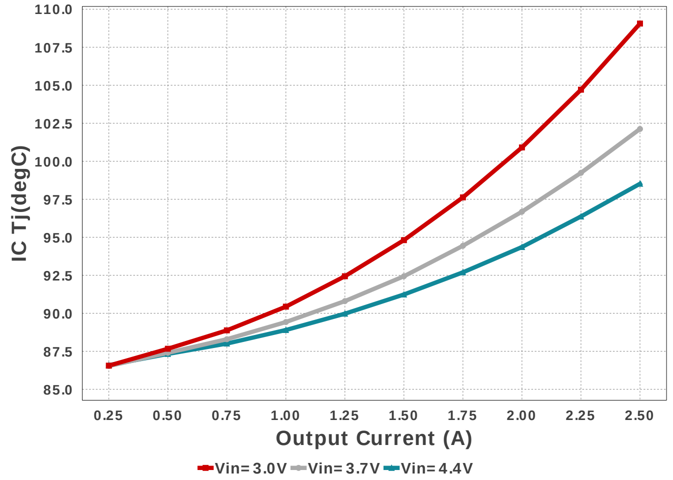




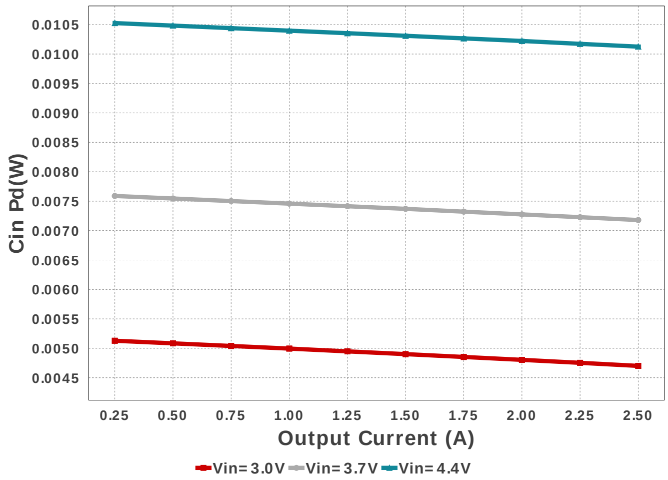




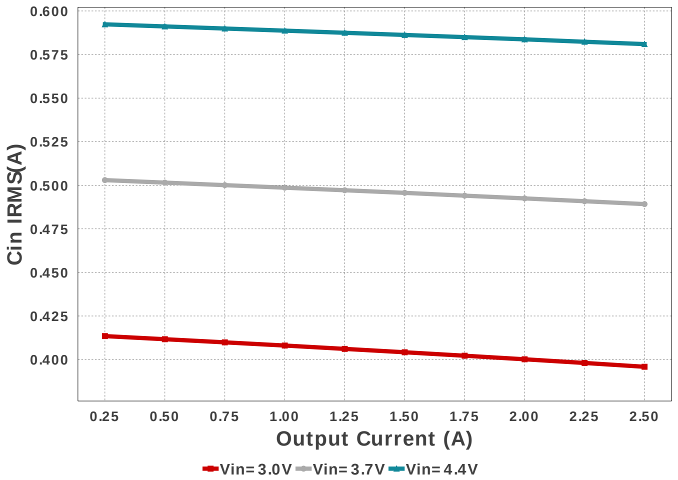
IC Tj



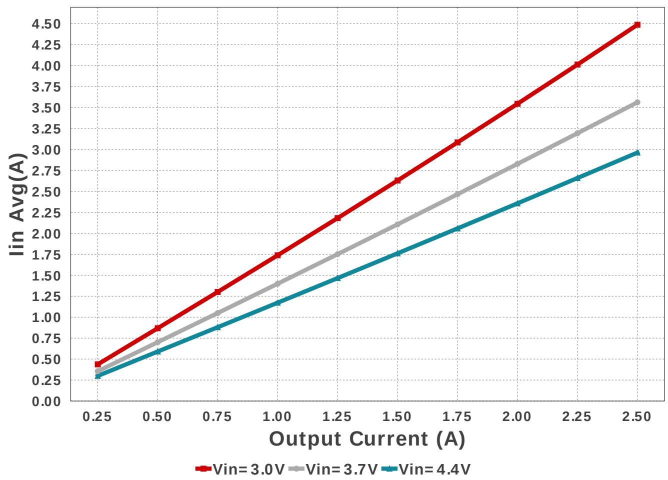
Cin Pd



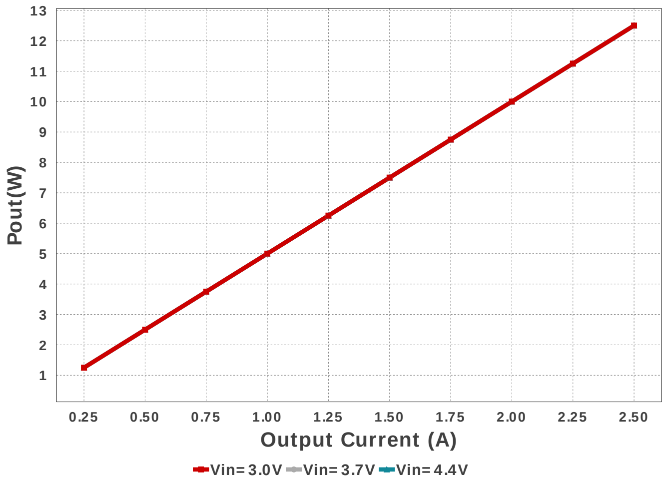
Cin IRMS



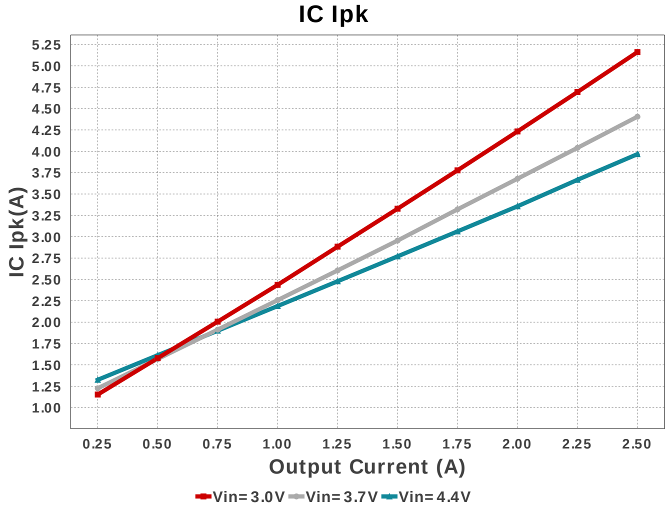
Iin Avg

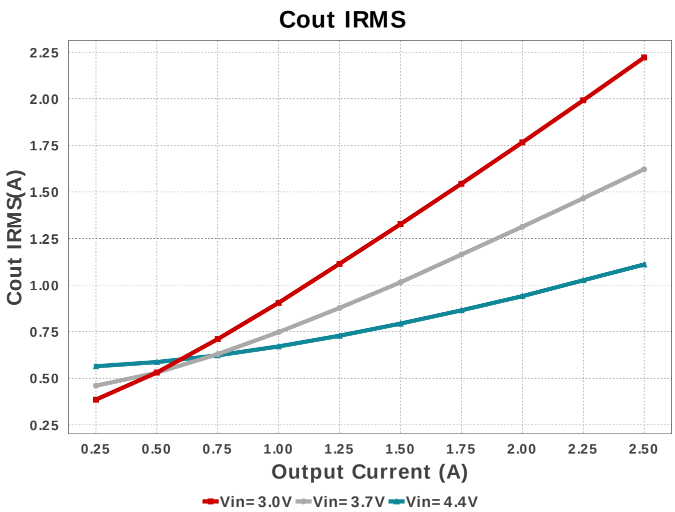


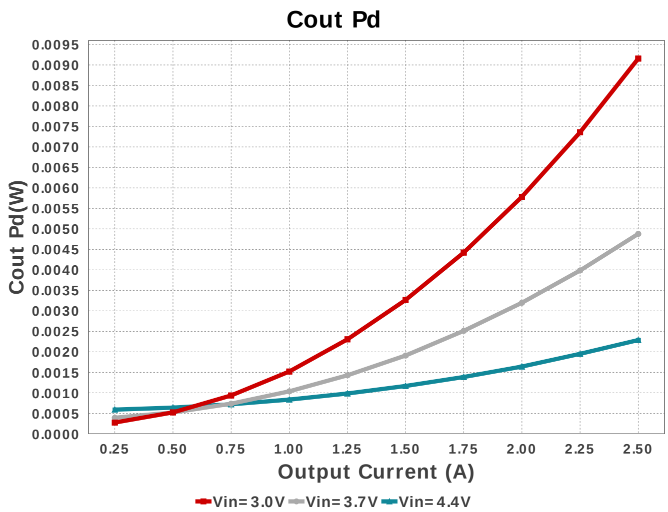
Pout

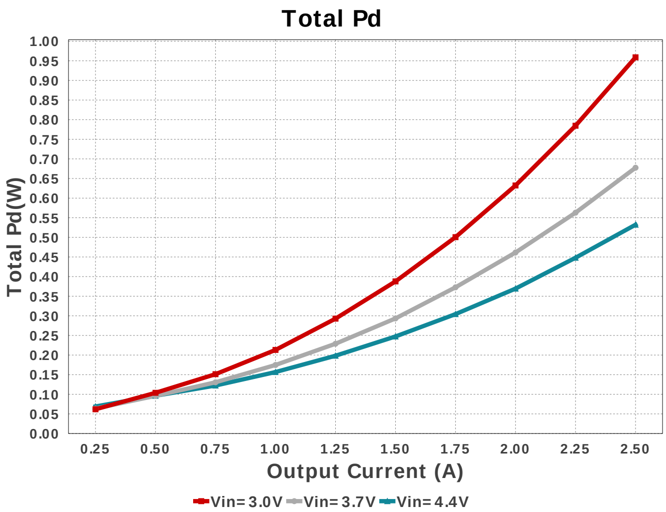


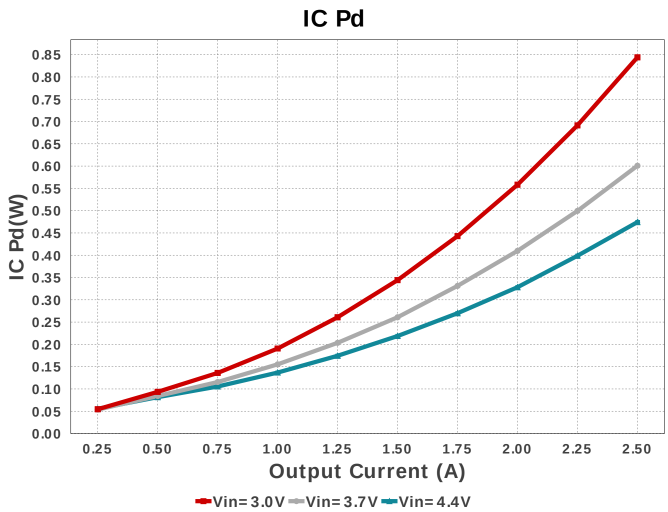
IC Ipk

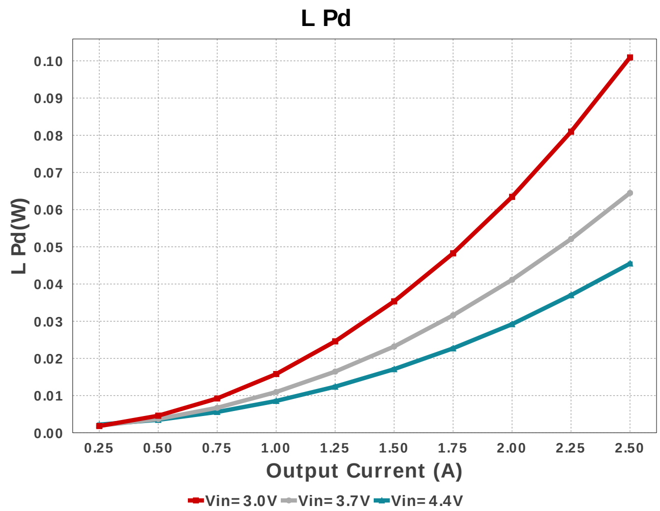


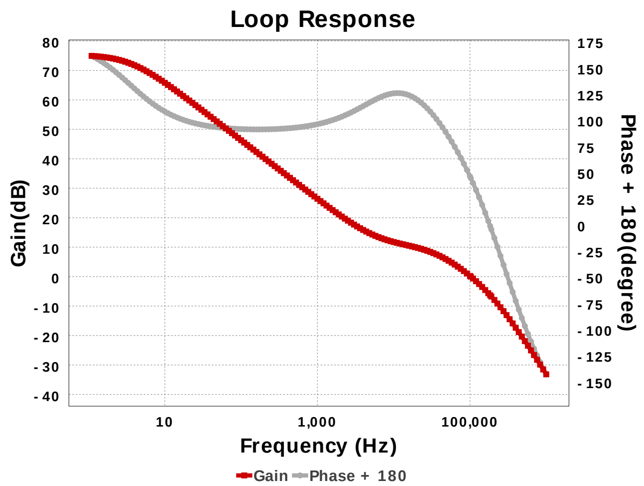












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	18		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	395.862 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	4.701 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	2.222 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	9.155 mW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	5.161 A	IC	Peak switch current in IC
8.	IC Pd	844.04 mW	IC	IC power dissipation
9.	IC Tj	109.055 degC	IC	IC junction temperature
10.	ICThetaJA	28.5 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	4.486 A	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	890.721 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	100.93 mW	Inductor	Inductor power dissipation
14.	Cin Pd	4.701 mW	Power	Input capacitor power dissipation
15.	Cout Pd	9.155 mW	Power	Output capacitor power dissipation
16.	IC Pd	844.04 mW	Power	IC power dissipation
17.	L Pd	100.93 mW	Power	Inductor power dissipation
18.	Total Pd	958.947 mW	Power	Total Power Dissipation
19.	Cross Freq	78.879 kHz	System Information	Bode plot crossover frequency
20.	Duty Cycle	40.0 %	System Information	Duty cycle
21.	Efficiency	92.875 %	System Information	Steady state efficiency
22.	FootPrint	471.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	1.88 MHz	System Information	Switching frequency
24.	Gain Marg	-4.785 dB	System Information	Bode Plot Gain Margin
25.	Iout	2.5 A	System Information	Iout operating point
26.	Low Freq Gain	73.473 dB	System Information	Gain at 1Hz
27.	Mode	BOOST PWM CCM	System Information	PWM/PFM Mode
28.	Phase Marg	45.663 deg	System Information	Bode Plot Phase Margin
29.	Pout	12.5 W	System Information	Total output power
30.	Vin	3.0 V	System Information	Vin operating point
31.	Vout Actual	4.988 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	2.552 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	66.397 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.5	Maximum Output Current
VinMax	4.4	Maximum input voltage
VinMin	3.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS611781	Base Product Number
source	DC	Input Source Type
Ta	85.0	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

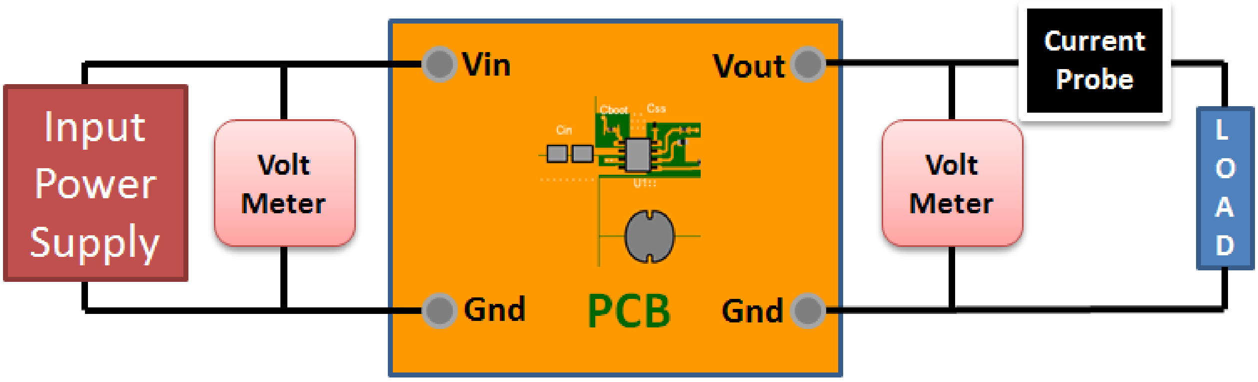
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.0V 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 : F6982803FF93BB7B[v1]

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

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