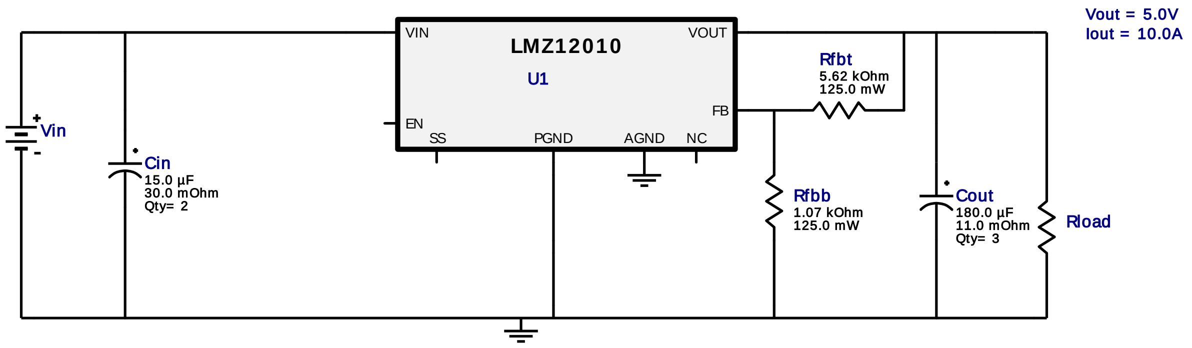
VinMin = 11.0V
VinMax = 17.0V
Vout = 5.0V
Iout = 10.0A

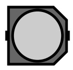
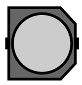
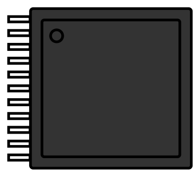
Device = LMZ12010TZ/NOPB
Topology = Buck
Created = 2020-03-11 19:34:01.102
BOM Cost = $12.82
BOM Count = 8
Total Pd = 5.44W

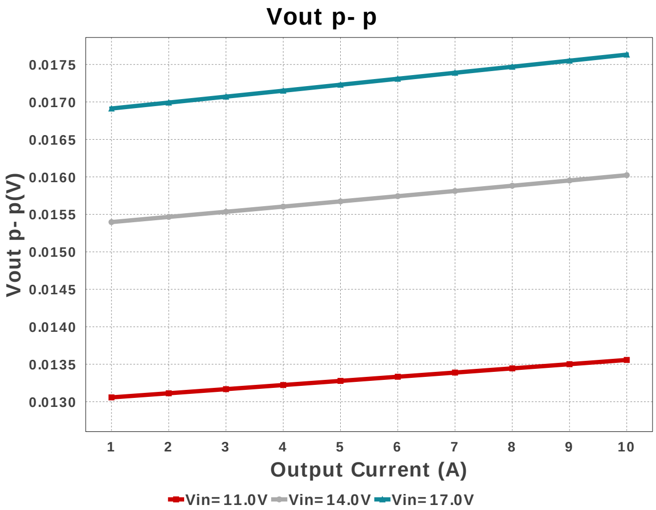
WEBENCH ® Design Report

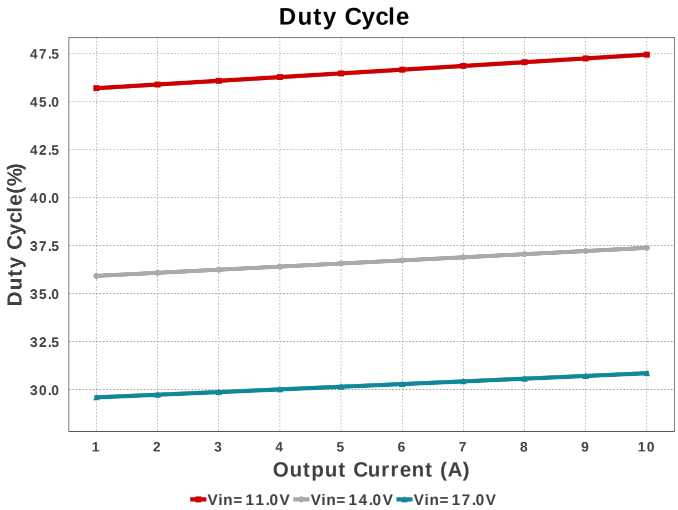
Design : 6 LMZ12010TZ/NOPB
LMZ12010TZ/NOPB 11V-17V to 5.00V @ 10A

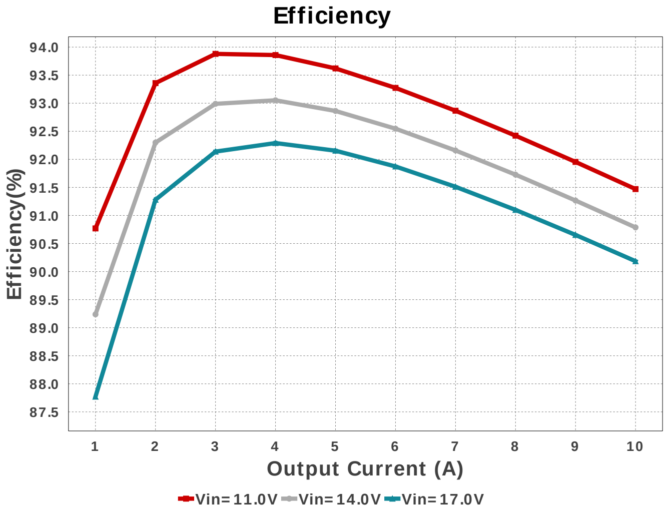


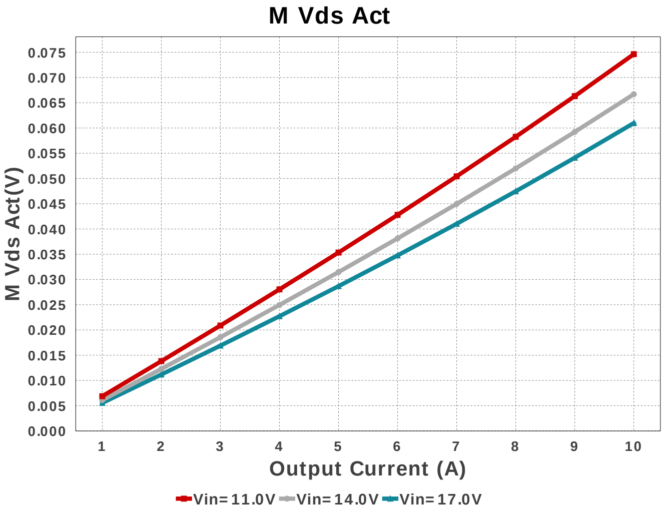
Electrical BOM

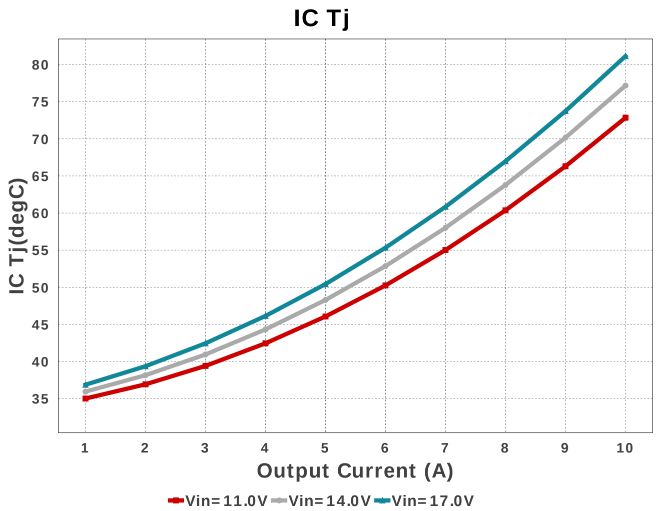
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	Panasonic	25SVPG15M Series= SVPG	Cap= 15.0 uF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 2.8 A	2	$0.40	 CAPSMT_62_B45 53 mm^2
Cout	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	3	$0.50	 CAPSMT_62_C10 74 mm^2
Rfbb	Panasonic	ERJ-6ENF1071V Series= ERJ-6E	Res= 1.07 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rfbt	Panasonic	ERJ-6ENF5621V Series= ERJ-6E	Res= 5.62 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
U1	Texas Instruments	LMZ12010TZ/NOPB	Switcher	1	$10.50	 TZA11A 342 mm^2

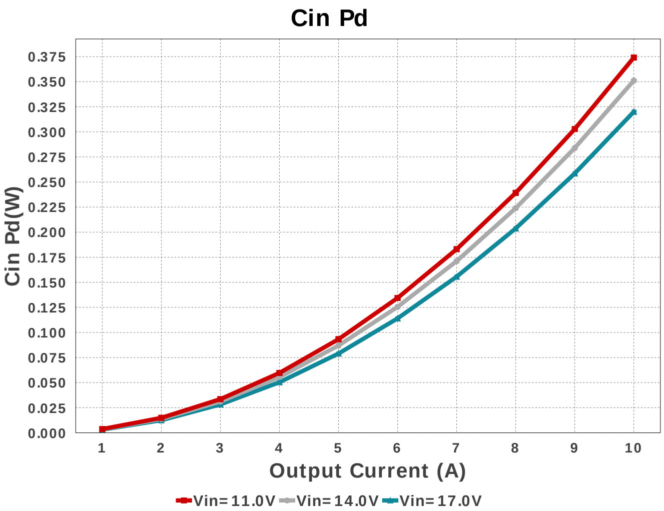

Vout p- p
Vout p- p(V)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

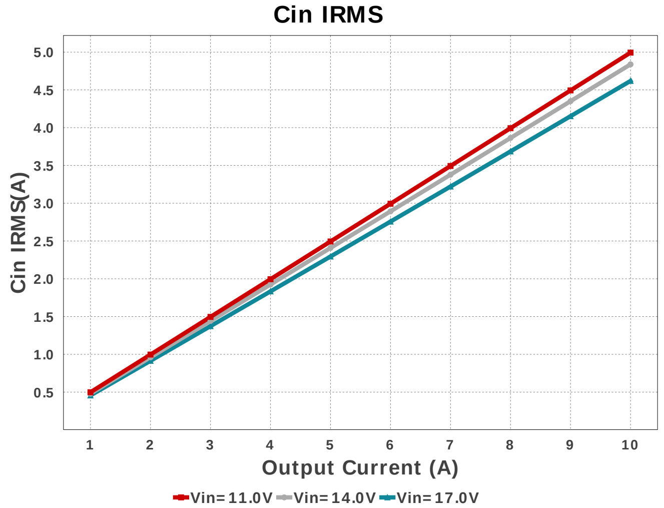

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

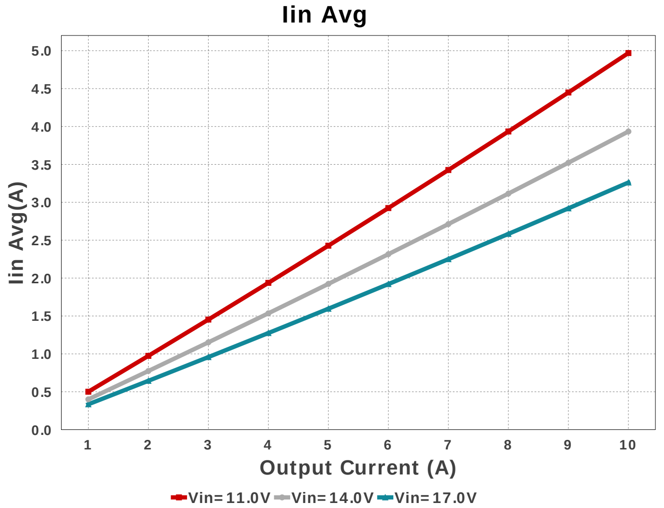

Efficiency
Efficiency(%)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

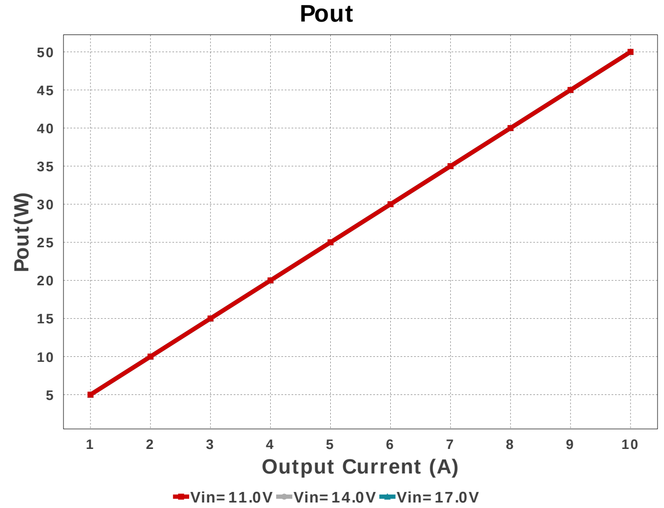

M Vds Act
M Vds Act(V)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

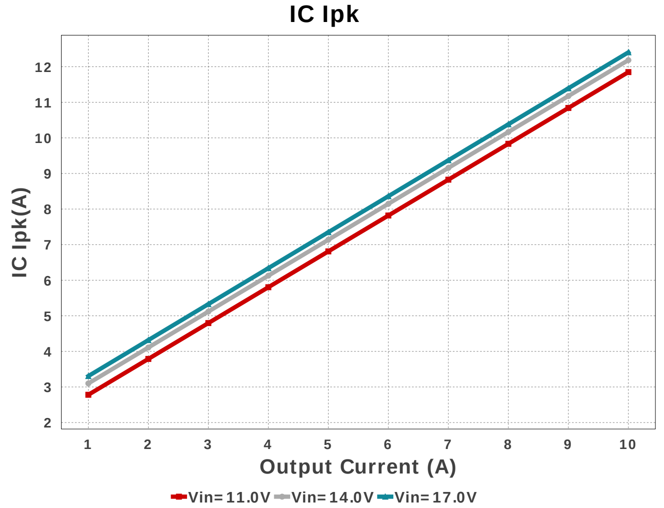

IC Tj
IC Tj(degC)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

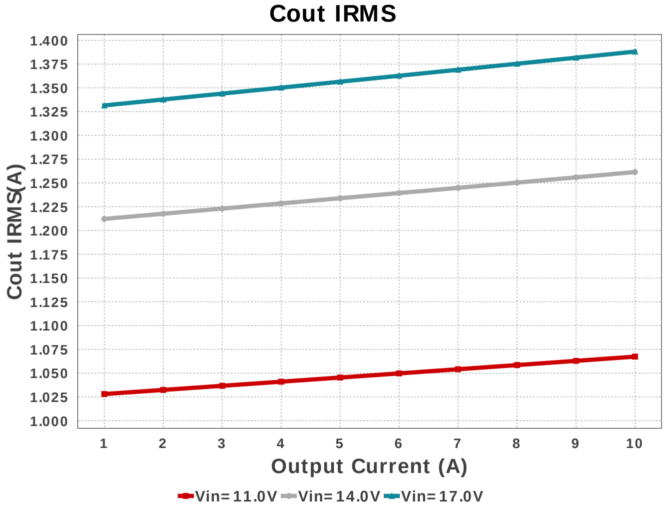

Cin Pd
Cin Pd(W)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

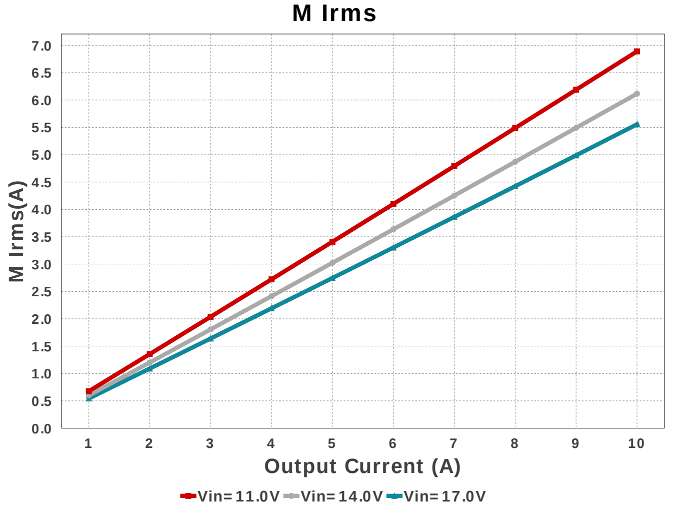

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

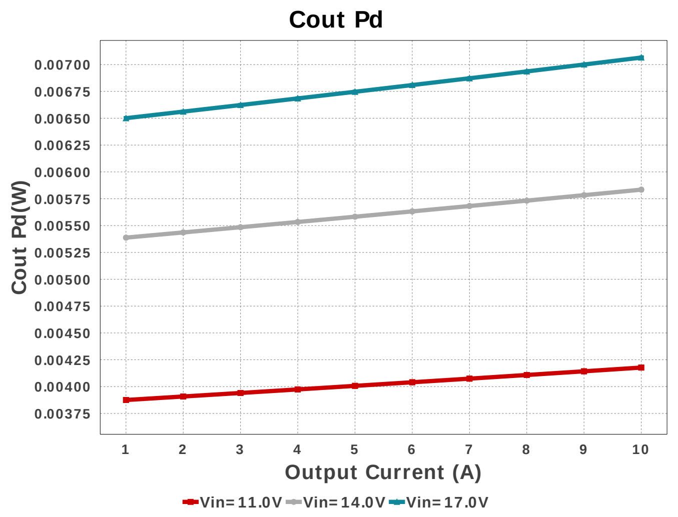

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

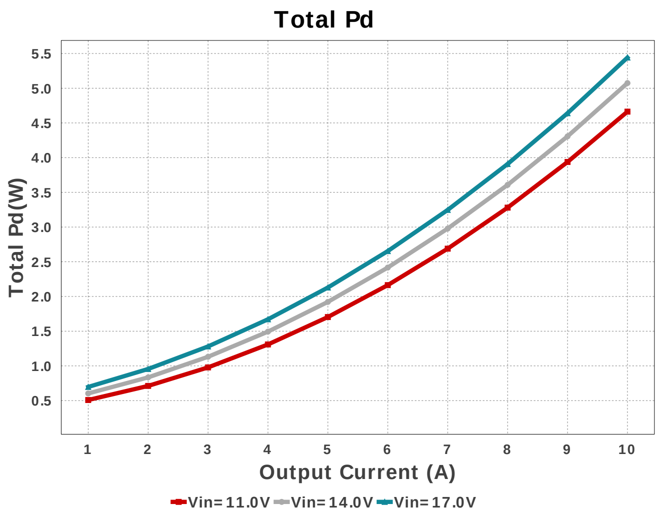

Pout
Pout(W)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

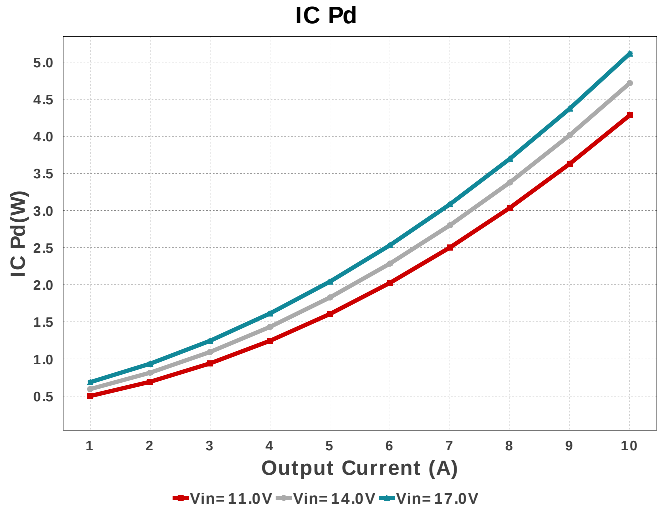

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V


M Irms
M Irms(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	4.619 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	320.02 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.388 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	7.065 mW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	12.404 A	IC	Peak switch current in IC
6.	IC Pd	5.114 W	IC	IC power dissipation
7.	IC Tj	81.143 degC	IC	IC junction temperature
8.	IC Tolerance	20.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA	10.0 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	3.261 A	IC	Average input current
11.	M1 Irms	5.555 A	Mosfet	Q Iavg
12.	M Vds Act	60.974 mV	Mosfet	Voltage drop across the MosFET
13.	Cin Pd	320.02 mW	Power	Input capacitor power dissipation
14.	Cout Pd	7.065 mW	Power	Output capacitor power dissipation
15.	IC Pd	5.114 W	Power	IC power dissipation
16.	Total Pd	5.442 W	Power	Total Power Dissipation
17.	BOM Count	8	System Information	Total Design BOM count
18.	Cross Freq	7.708 kHz	System Information	Bode plot crossover frequency
19.	Duty Cycle	30.855 %	System Information	Duty cycle
20.	Efficiency	90.185 %	System Information	Steady state efficiency
21.	FootPrint	684.0 mm^2	System Information	Total Foot Print Area of BOM components
22.	Frequency	350.0 kHz	System Information	Switching frequency
23.	Iout	10.0 A	System Information	Iout operating point
24.	Mode	CCM	System Information	Conduction Mode

#	Name	Value	Category	Description
25.	Phase Marg	49.488 deg	System Information	Bode Plot Phase Margin
26.	Pout	50.0 W	System Information	Total output power
27.	Total BOM	$12.82	System Information	Total BOM Cost
28.	Vin	17.0 V	System Information	Vin operating point
29.	Vout	5.0 V	System Information	Operational Output Voltage
30.	Vout Actual	5.002 V	System Information	Vout Actual calculated based on selected voltage divider resistors
31.	Vout Tolerance	4.24 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
32.	Vout p-p	17.631 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	10.0	Maximum Output Current
VinMax	17.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LMZ12010	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

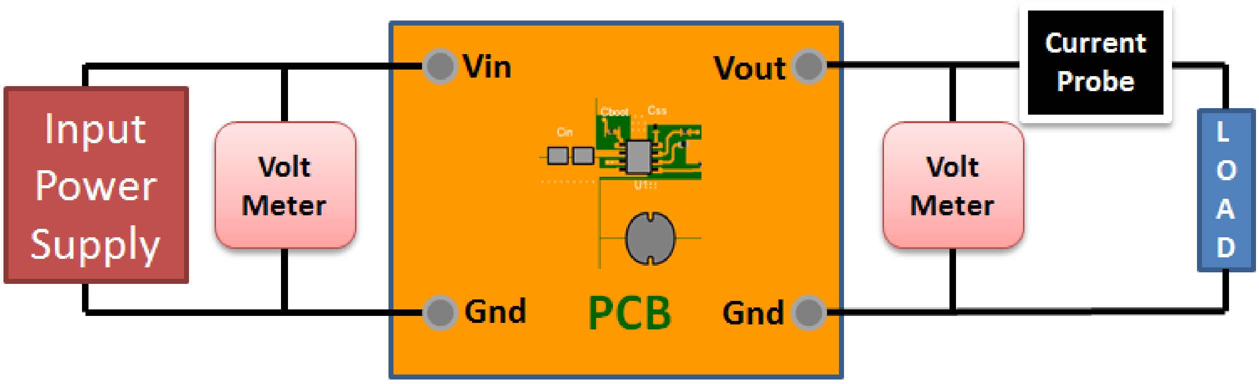
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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. The 2nd Gen Modules are very easy to use and just need a basic design using a resistor divider at the feedback and input and output caps to work. To design for UVLO you could click on the drop down menu in the 'Change Inputs' menu and select the 'UVLO Enabled Design'. The internal softstart time is set at 1.6mSec. If a longer softstart time is desired, you could change the preset to the desired amount and click on 'Submit'. Webench will then add an external softstartcap to the schematic.

2. Master key : 3ADD0724B632D79A[v1]

3. **LMZ12010** Product Folder : http://www.ti.com/product/LMZ12010 : contains the data sheet and other resources.

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