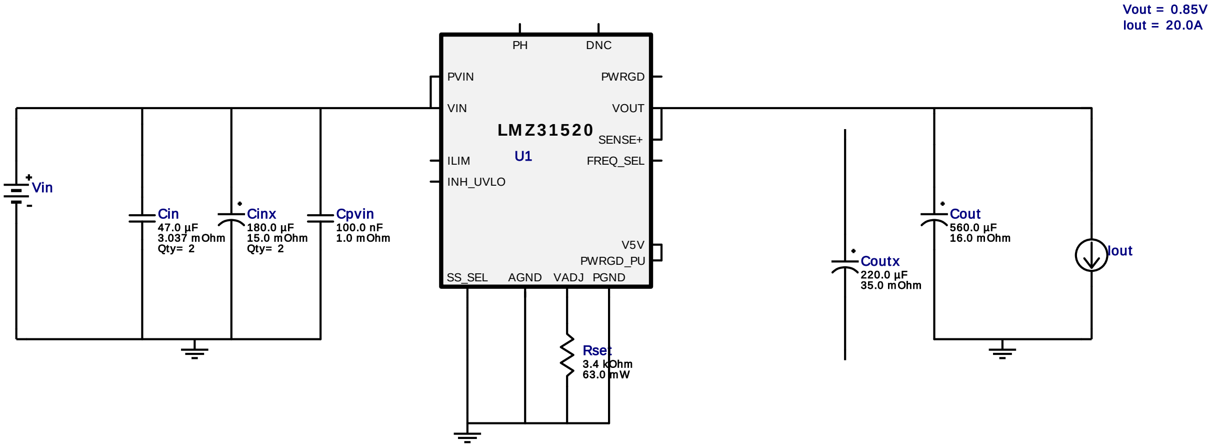
VinMin = 5.0V
VinMax = 5.0V
Vout = 0.85V
Iout = 20.0A

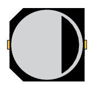
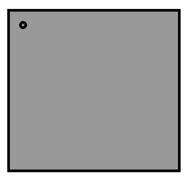
Device = LMZ31520RLGT
Topology = Buck
Created = 2023-09-06 17:47:31.137
BOM Cost = $14.83
BOM Count = 9
Total Pd = 2.6W

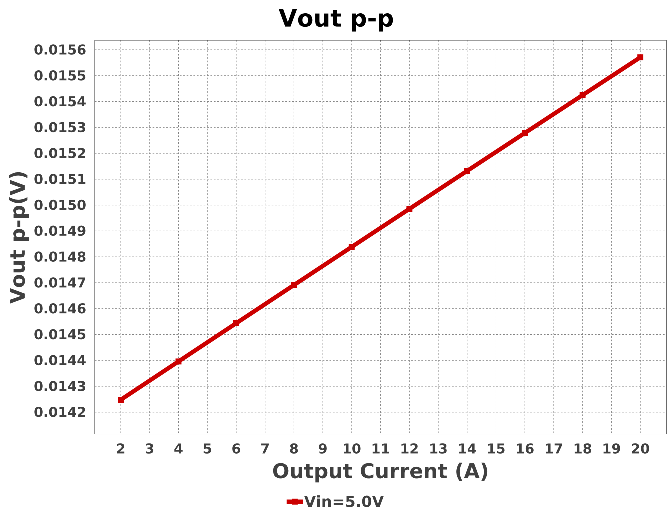
WEBENCH ® Design Report

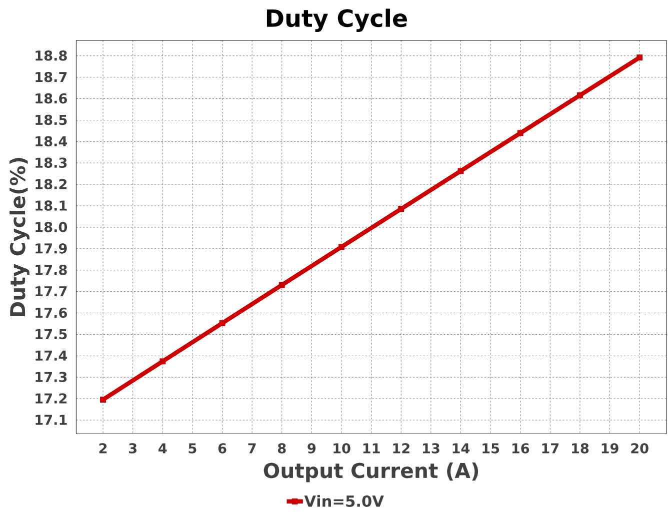
Design : 6 LMZ31520RLGT
LMZ31520RLGT 5V-5V to .85V @ 20A

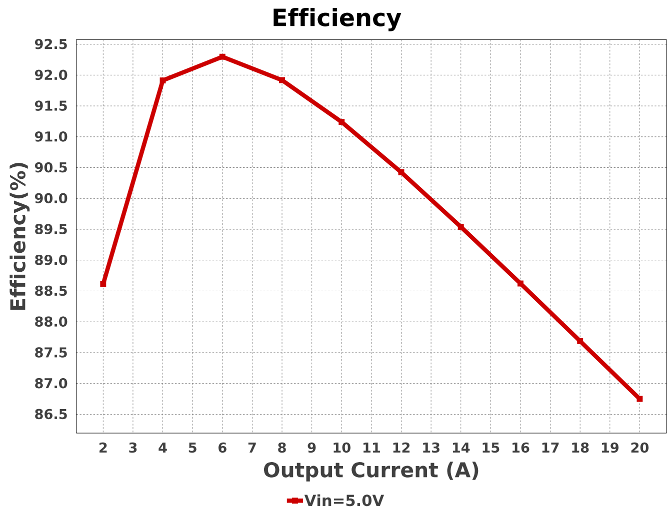


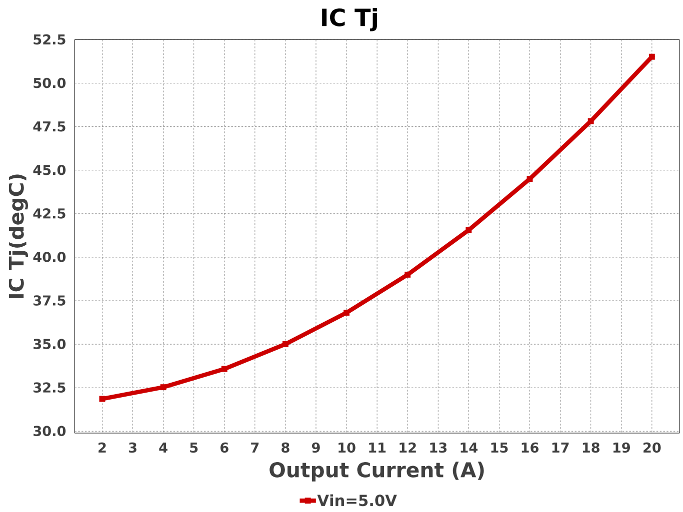
Electrical BOM

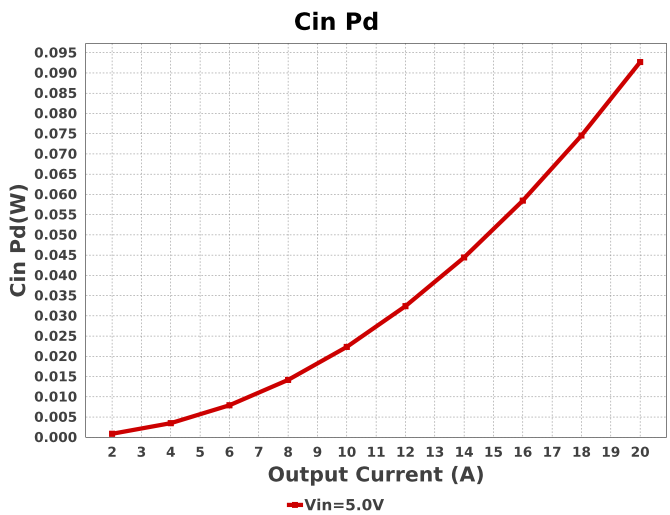
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	MuRata	GRM32ER61C476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	2	$0.17	 1210_280 15 mm²
Cinx	Panasonic	EEFCX0J181R Series= CX	Cap= 180.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 5.1 A	2	$0.78	 7343-20 59 mm²
Cout	Panasonic	2R5SVPC560M Series= SVPC	Cap= 560.0 uF ESR= 16.0 mOhm VDC= 2.5 V IRMS= 3.5 A	1	$0.47	 SM_RADIAL_6.3AMM 80 mm²
Coutx	Panasonic	2R5TPE220MAZB Series= TPE	Cap= 220.0 uF ESR= 35.0 mOhm VDC= 2.5 V IRMS= 1.4 A	1	$0.44	 3528-21 17 mm²
Cpvin	MuRata	GRM155R70J104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Rset	Vishay-Dale	CRCW04023K40FKED Series= CRCW..e3	Res= 3.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LMZ31520RLGT	Switcher	1	$12.00	 R-PB4QFN-N72 306 mm²

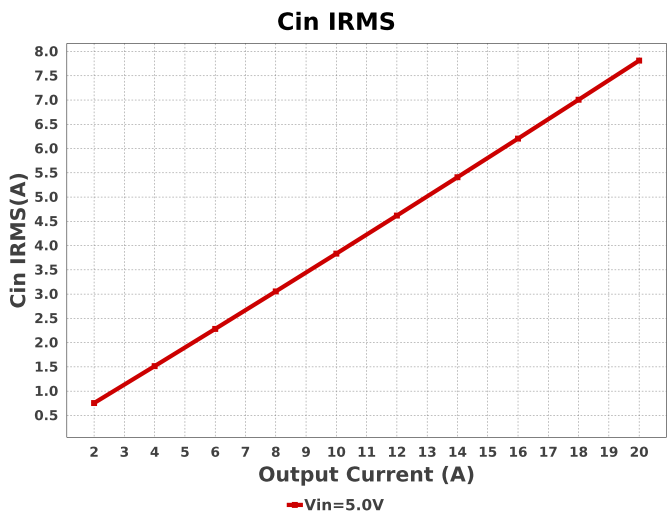

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=5.0V

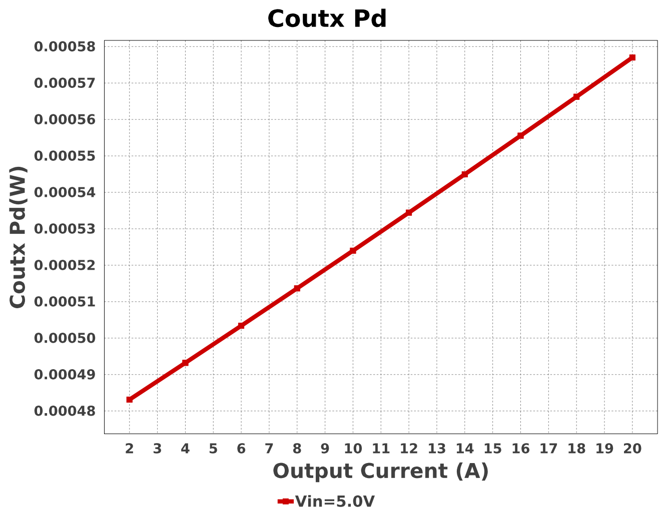

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=5.0V

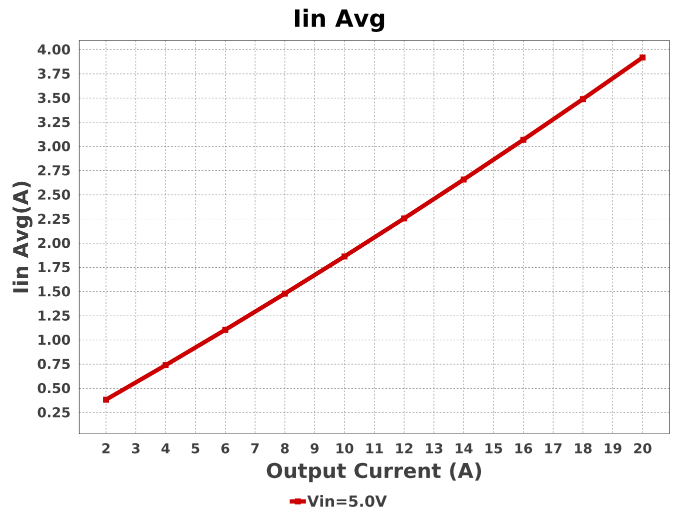

Efficiency
Efficiency(%)
Output Current (A)
Vin=5.0V

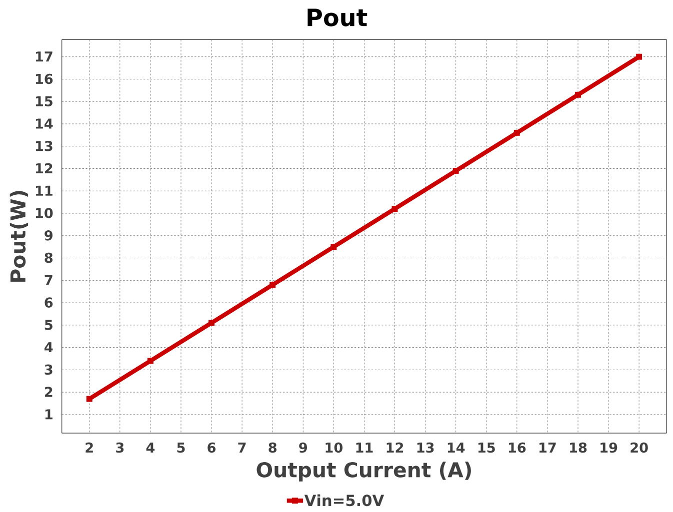

IC Tj
IC Tj(degC)
Output Current (A)
Vin=5.0V

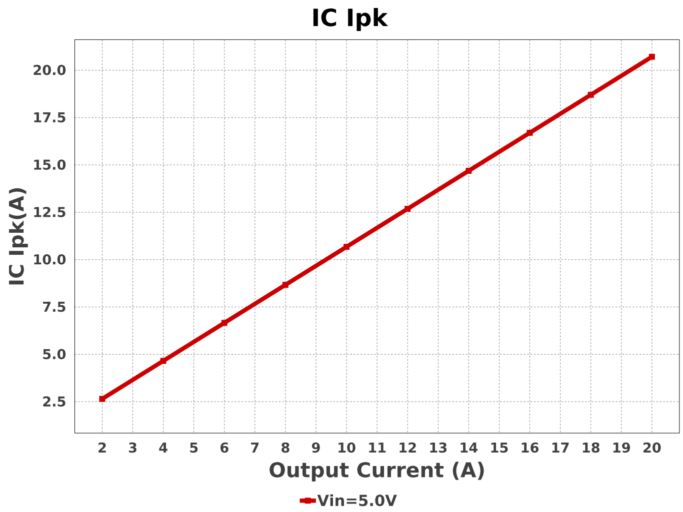

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=5.0V

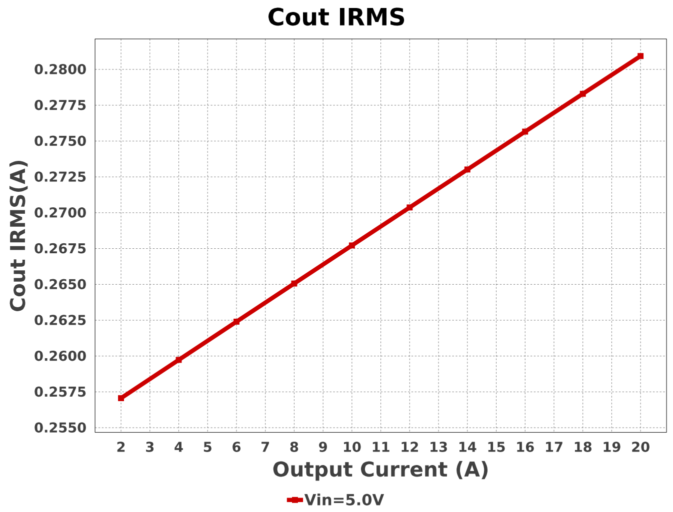

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=5.0V

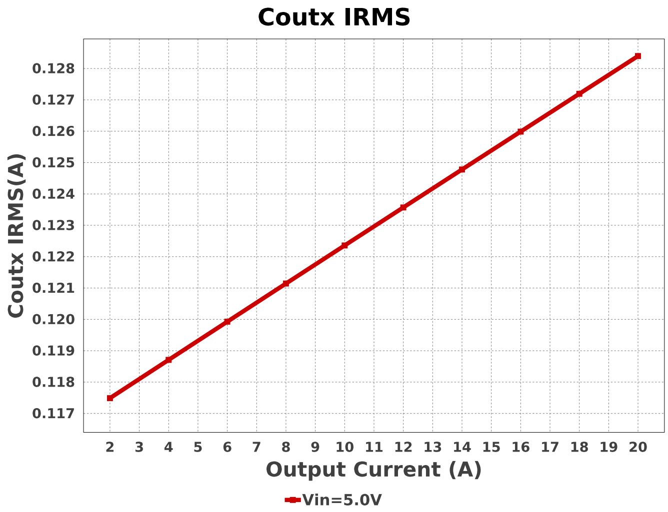

Coutx Pd
Coutx Pd(W)
0.00058
0.00057
0.00056
0.00055
0.00054
0.00053
0.00052
0.00051
0.00050
0.00049
0.00048
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V

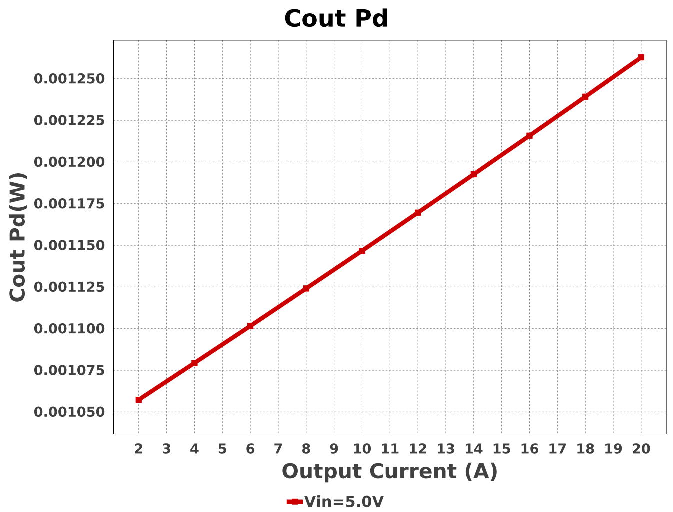

Iin Avg
Iin Avg(A)
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V

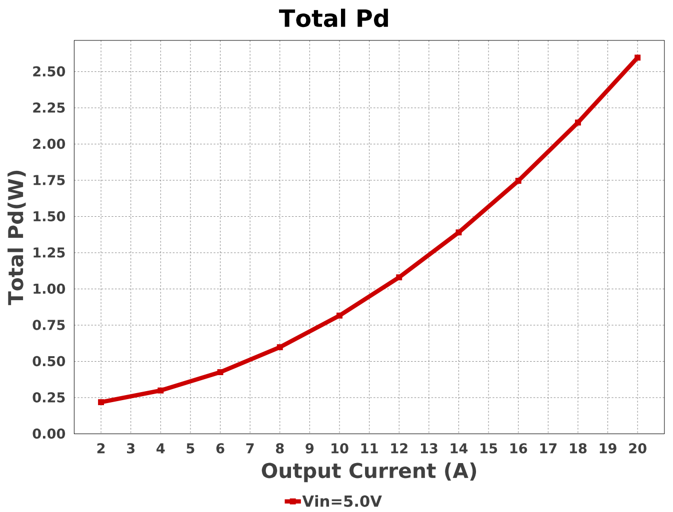

Pout
Pout(W)
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V

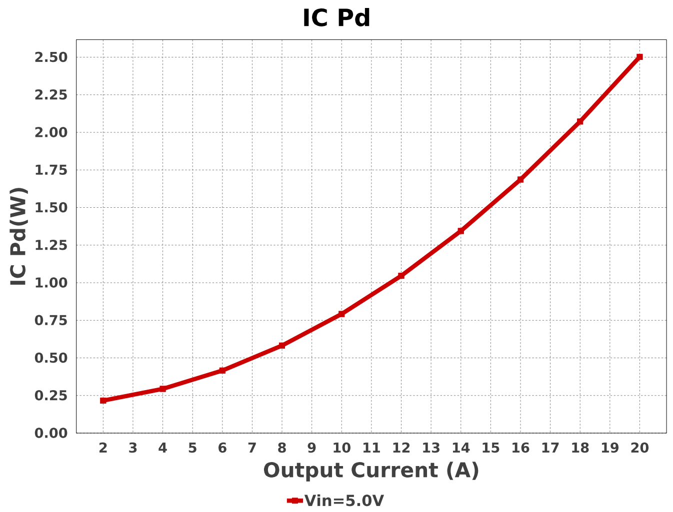

IC Ipk
IC Ipk(A)
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V


Cout IRMS
Cout IRMS(A)
0.2800
0.2775
0.2750
0.2725
0.2700
0.2675
0.2650
0.2625
0.2600
0.2575
0.2550
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V


Coutx IRMS
Coutx IRMS(A)
0.128
0.127
0.126
0.125
0.124
0.123
0.122
0.121
0.120
0.119
0.118
0.117
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Output Current (A)
Vin=5.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	7.813 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	92.694 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	280.931 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	1.263 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	128.397 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	577.0 µW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	20.709 A	IC	Peak switch current in IC
8.	IC Pd	2.502 W	IC	IC power dissipation
9.	IC Tj	51.518 degC	IC	IC junction temperature
10.	ICThetaJA	8.6 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	3.919 A	IC	Average input current
12.	Cin Pd	92.694 mW	Power	Input capacitor power dissipation
13.	Cout Pd	1.263 mW	Power	Output capacitor power dissipation
14.	Coutx Pd	577.0 µW	Power	Output capacitor_x power loss
15.	IC Pd	2.502 W	Power	IC power dissipation
16.	Total Pd	2.597 W	Power	Total Power Dissipation
17.	BOM Count	9	System Information	Total Design BOM count
18.	Duty Cycle	18.792 %	System Information	Duty cycle
19.	Efficiency	86.75 %	System Information	Steady state efficiency
20.	FootPrint	556.0 mm^2	System Information	Total Foot Print Area of BOM components
21.	Frequency	500.0 kHz	System Information	Switching frequency
22.	Iout	20.0 A	System Information	Iout operating point
23.	Mode	CCM	System Information	Conduction Mode
24.	Pout	17.0 W	System Information	Total output power

#	Name	Value	Category	Description
25.	Total BOM	$14.83	System Information	Total BOM Cost
26.	Vin	5.0 V	System Information	Vin operating point
27.	Vout	850.0 mV	System Information	Operational Output Voltage
28.	Vout Tolerance	1.271 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
29.	Vout p-p	15.571 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	20.0	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	850.0 m	Output Voltage
base_pn	LMZ31520	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

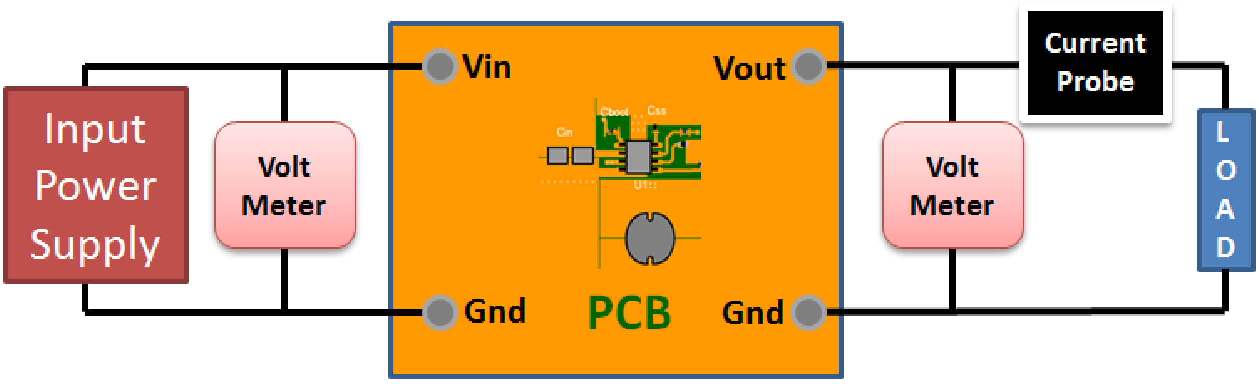
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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 : 99CBB26647818962F696164E0239B07C[v1]

2. **LMZ31520** Product Folder : http://www.ti.com/product/LMZ31520 : contains the data sheet and other resources.