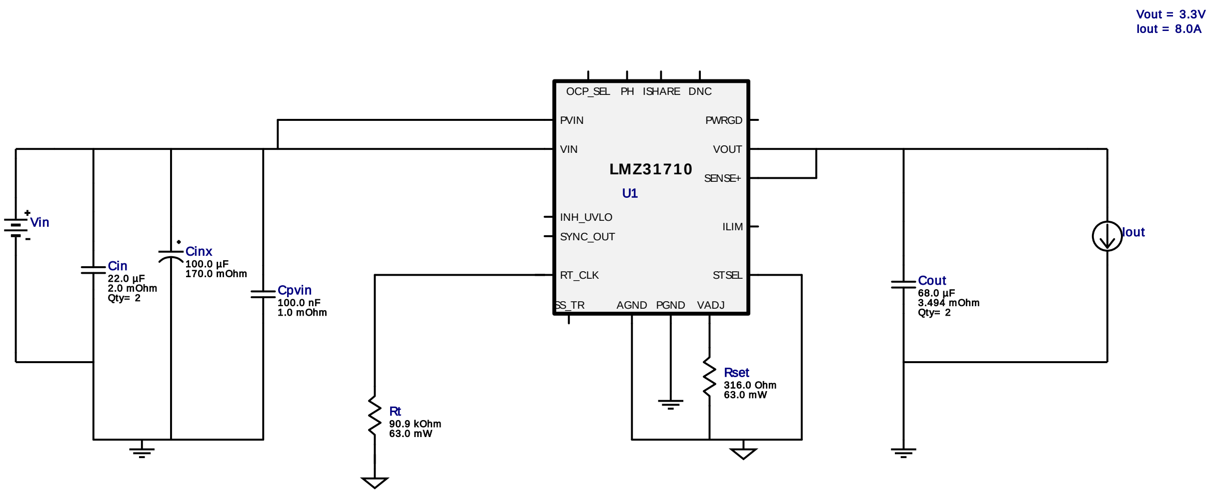
VinMin = 4.5V
VinMax = 5.5V
Vout = 3.3V
Iout = 8.0A

Device = LMZ31710RVQR
Topology = Buck
Created = 2021-06-16 00:32:11.253
BOM Cost = $8.47
BOM Count = 9
Total Pd = 2.09W

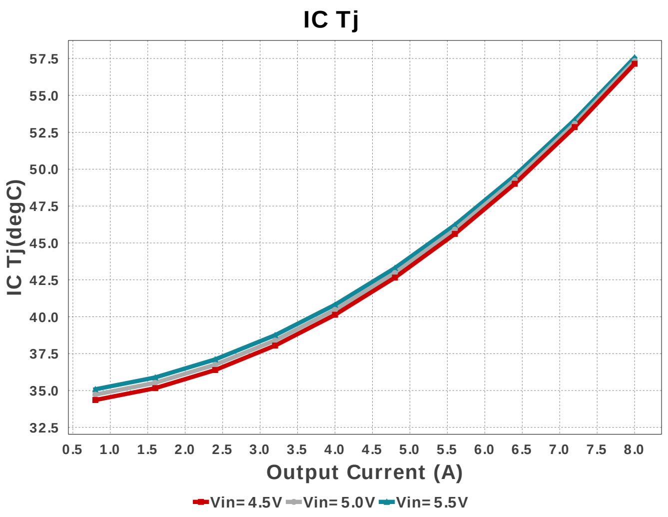
WEBENCH ® Design Report

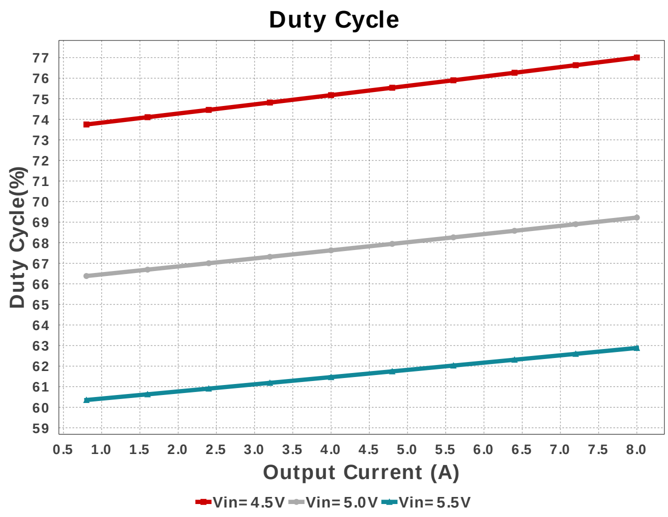
Design : 13 LMZ31710RVQR
LMZ31710RVQR 4.5V-5.5V to 3.30V @ 8A

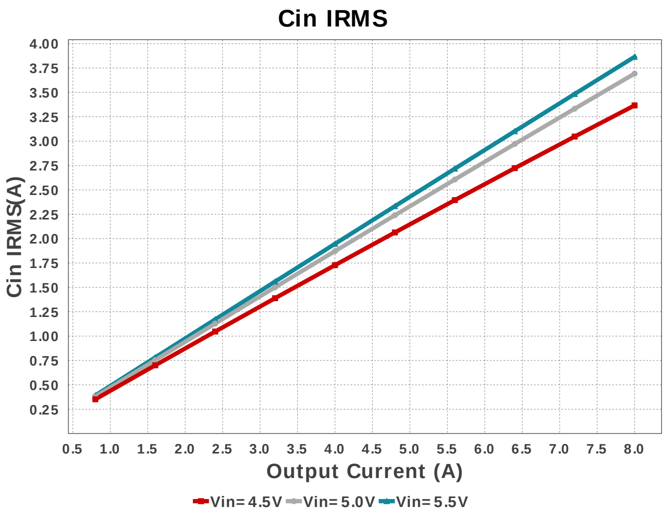


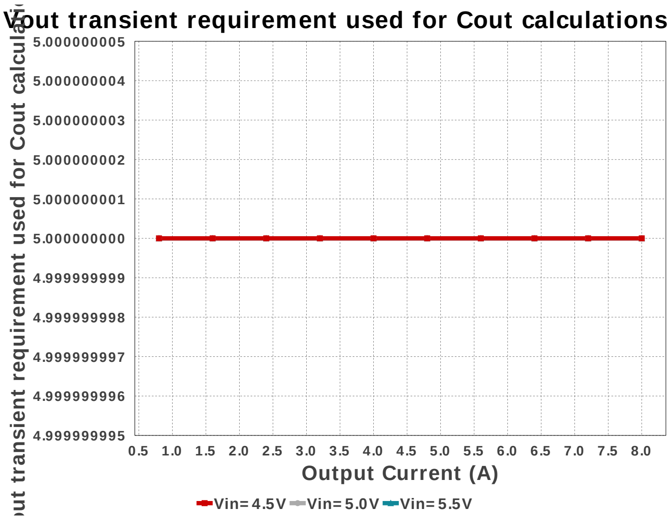
Electrical BOM

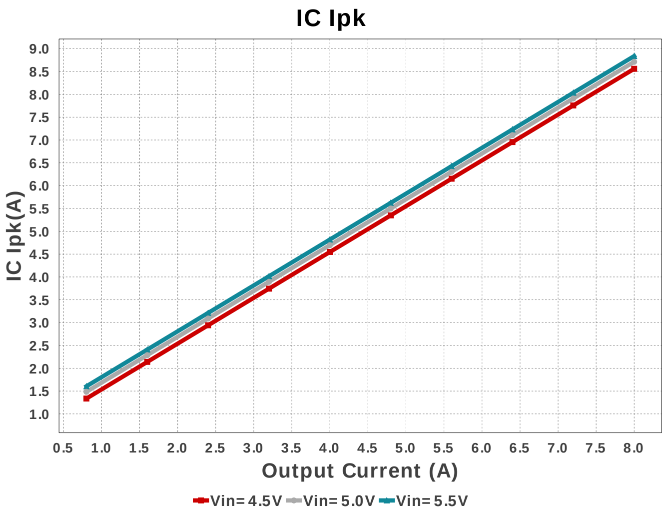
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	2	$0.55	1210 15 mm²
Cinx	Nichicon	UUD1V101MNL1GS Series= uD	Cap= 100.0 uF ESR= 170.0 mOhm VDC= 35.0 V IRMS= 450.0 mA	1	$0.21	SM_RADIAL_8MM 113 mm²
Cout	TDK	C3216X5R1A686M160AC Series= X5R	Cap= 68.0 uF ESR= 3.494 mOhm VDC= 10.0 V IRMS= 3.8813 A	2	$0.51	1206_190 11 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	CRCW0402316RFKED Series= CRCW..e3	Res= 316.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rt	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LMZ31710RVQR	Switcher	1	$6.10	S-PB2QFN-N42 144 mm²

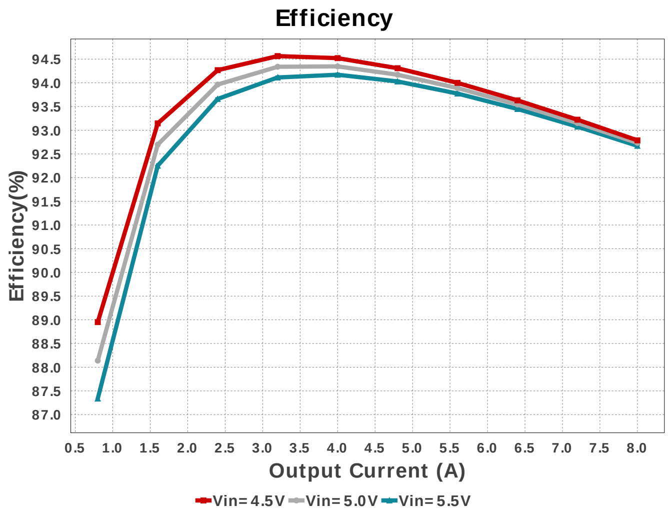

IC Tj
IC Tj(degC)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

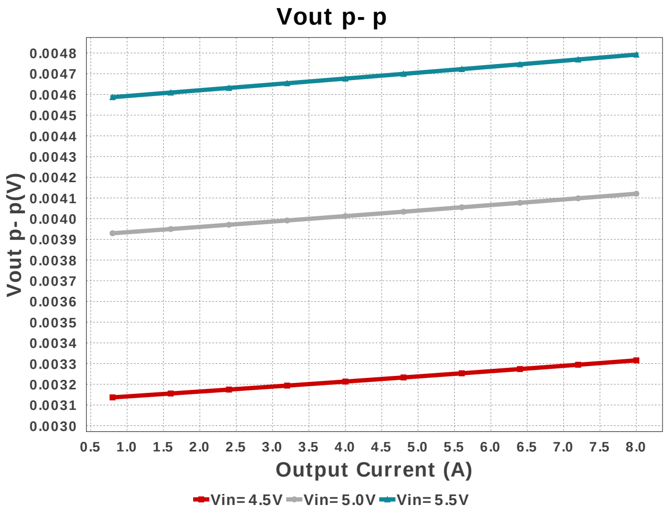

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

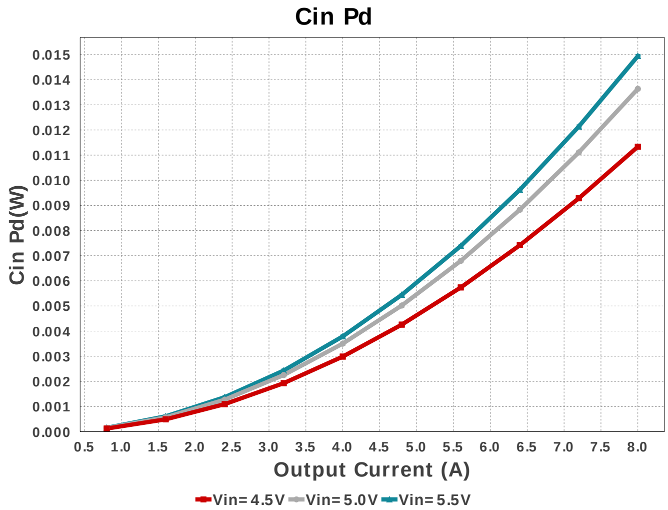

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

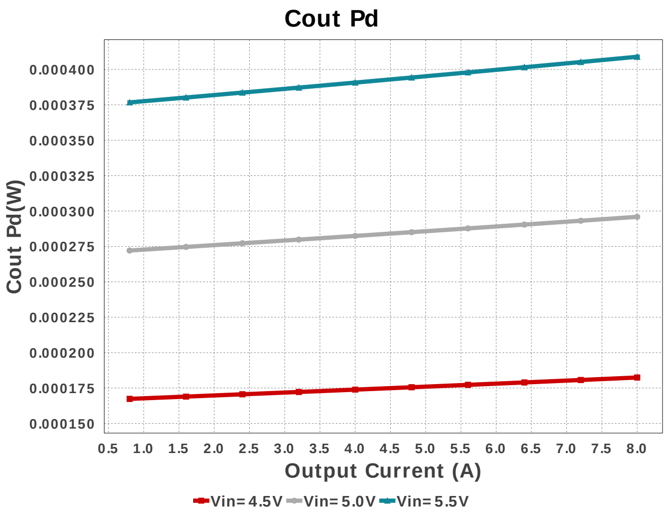

Vout transient requirement used for Cout calculations
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

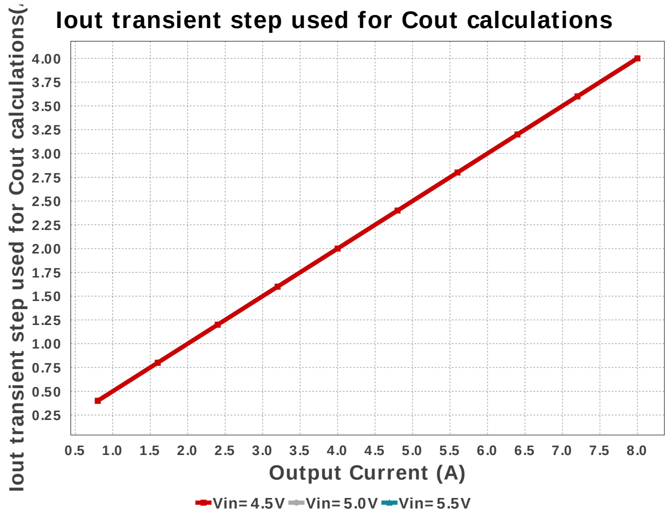

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

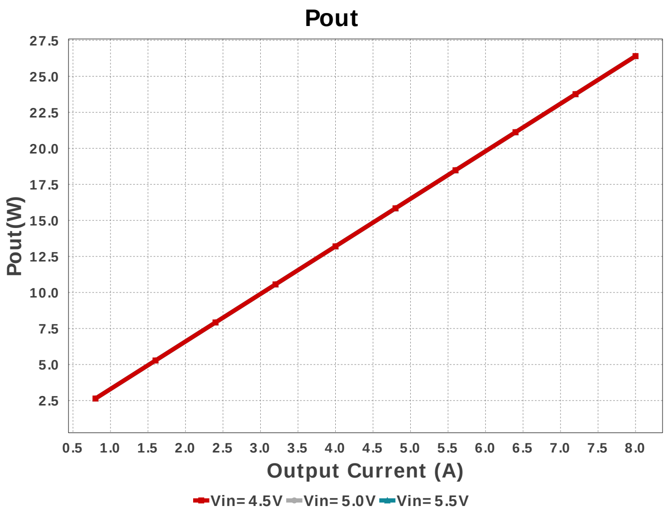

Efficiency
Efficiency(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

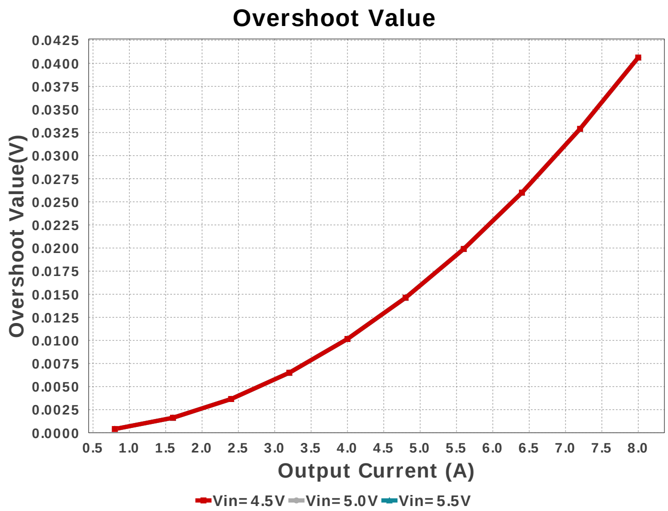

Vout p- p
Vout p- p(V)
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V


Cin Pd
Cin Pd(W)
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V

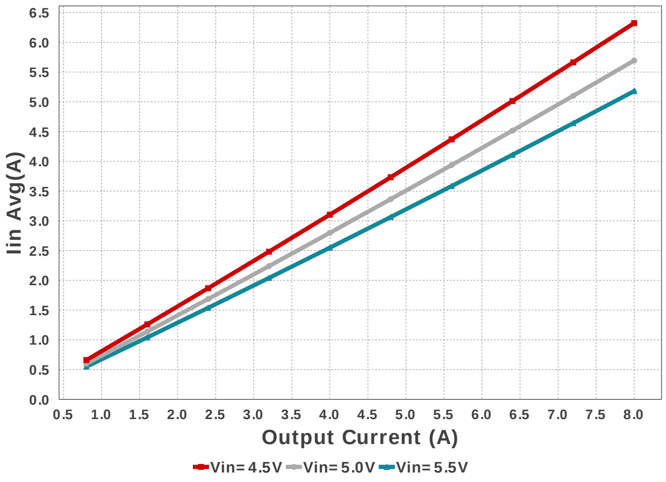

Cout Pd
Cout Pd(W)
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V


Iout transient step used for Cout calculations
Iout transient step used for Cout calculations(
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V

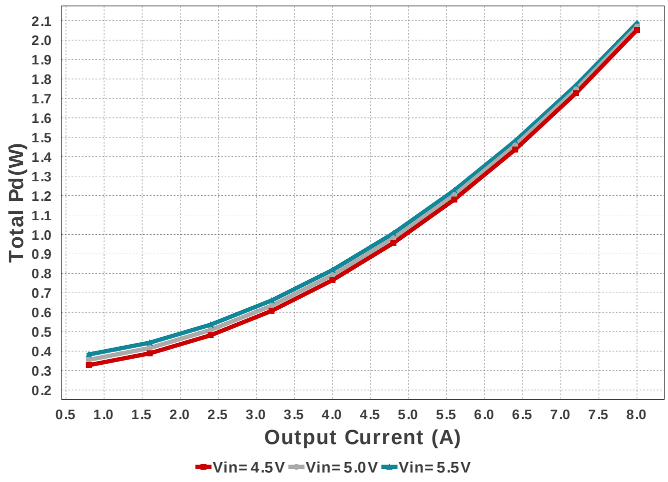

Pout
Pout(W)
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V


Overshoot Value
Overshoot Value(V)
Output Current (A)
Vin= 4.5V
Vin= 5.0V
Vin= 5.5V

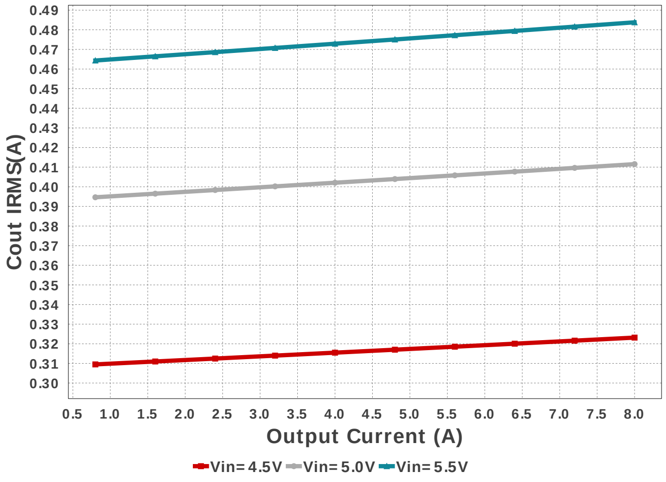
Iin Avg



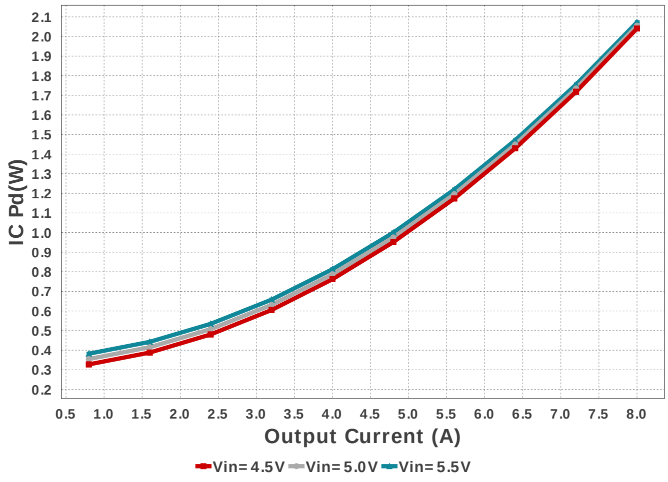
Total Pd



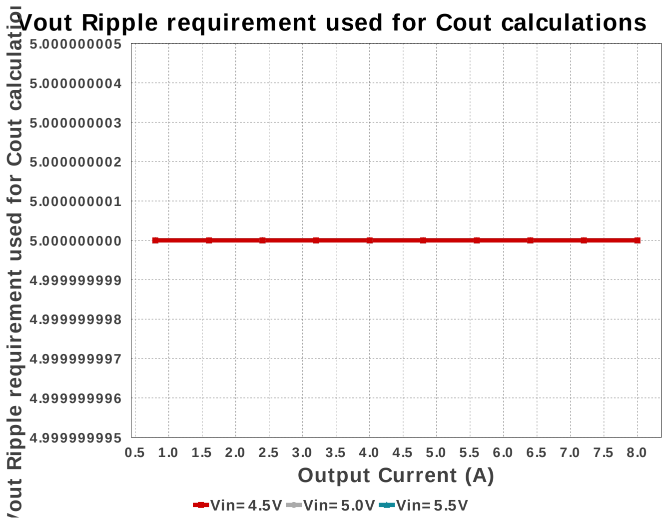
Cout IRMS



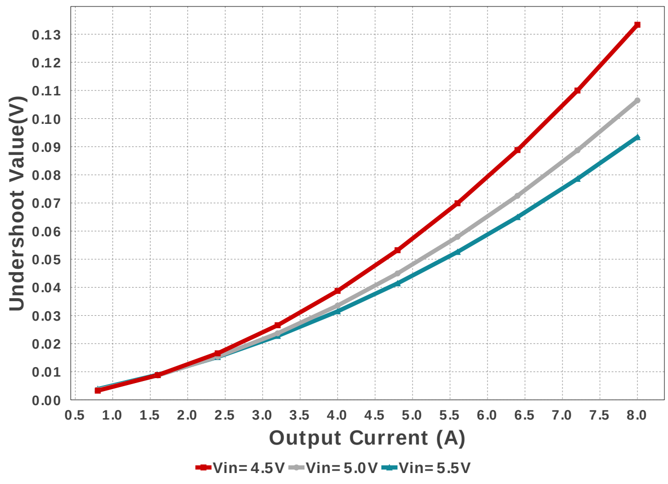
IC Pd

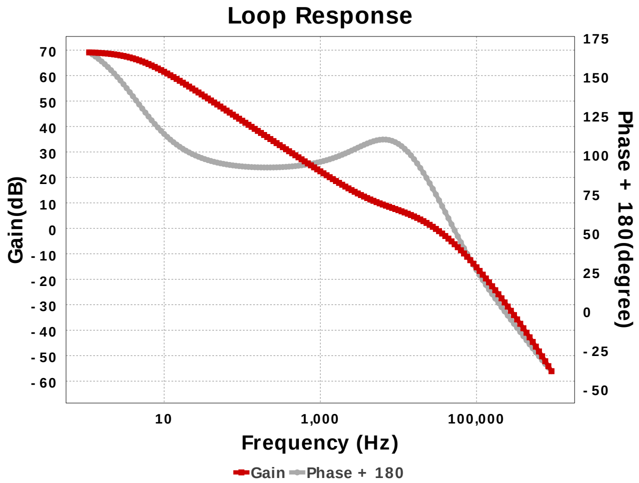


Vout Ripple requirement used for Cout calculations



Undershoot Value





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.865 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	14.938 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	483.814 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	408.93 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	8.838 A	IC	Peak switch current in IC
6.	IC Pd	2.072 W	IC	IC power dissipation
7.	IC Tj	57.563 degC	IC	IC junction temperature
8.	ICThetaJA	13.3 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	5.18 A	IC	Average input current
10.	Cin Pd	14.938 mW	Power	Input capacitor power dissipation
11.	Cout Pd	408.93 µW	Power	Output capacitor power dissipation
12.	IC Pd	2.072 W	Power	IC power dissipation
13.	Total Pd	2.088 W	Power	Total Power Dissipation
14.	BOM Count	9	System Information	Total Design BOM count
15.	Cross Freq	29.486 kHz	System Information	Bode plot crossover frequency
16.	Duty Cycle	62.883 %	System Information	Duty cycle
17.	Efficiency	92.671 %	System Information	Steady state efficiency
18.	FootPrint	318.0 mm^2	System Information	Total Foot Print Area of BOM components
19.	Frequency	750.396 kHz	System Information	Switching frequency
20.	Iout	8.0 A	System Information	Iout operating point
21.	Iout transient step used for Cout calculations	4.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
22.	Mode	CCM	System Information	Conduction Mode
23.	Overshoot Value	40.619 mV	System Information	Theoretical Vout Overshoot Value
24.	Phase Marg	76.148 deg	System Information	Bode Plot Phase Margin
25.	Pout	26.4 W	System Information	Total output power
26.	Total BOM	$8.47	System Information	Total BOM Cost
27.	Undershoot Value	93.406 mV	System Information	Theoretical Vout Undershoot Value
28.	Vin	5.5 V	System Information	Vin operating point
29.	Vout	3.3 V	System Information	Operational Output Voltage
30.	Vout Ripple requirement used for Cout calculations	5.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
31.	Vout Tolerance	1.755 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
32.	Vout p-p	4.792 mV	System Information	Peak-to-peak output ripple voltage

#	Name	Value	Category	Description
33.	Vout transient requirement used for Cout calculations	5.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	8.0	Maximum Output Current
SoftStart	1.2 ms	Soft Start Time (ms)
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	LMZ31710	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	750.0 k	Customer Selected Frequency

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

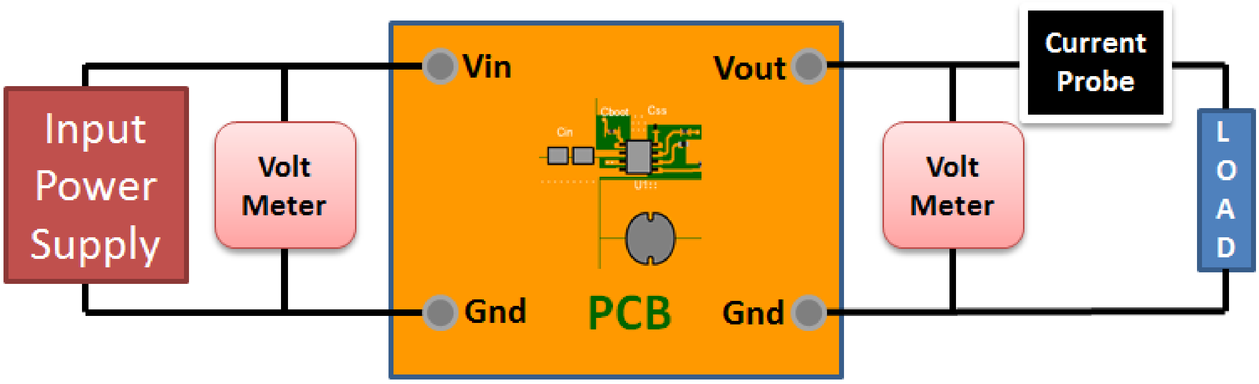
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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 : 0FD7E5138683924F[v1]

2. **LMZ31710** Product Folder : http://www.ti.com/product/LMZ31710 : contains the data sheet and other resources.

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