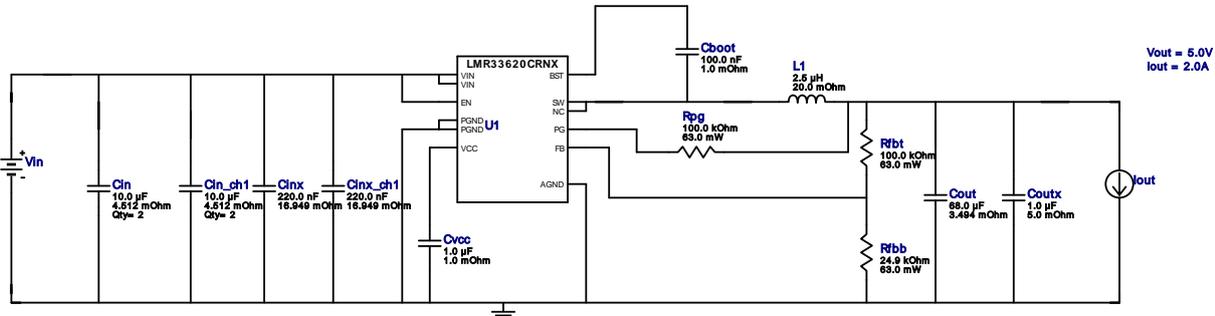


WEBENCH® Design Report

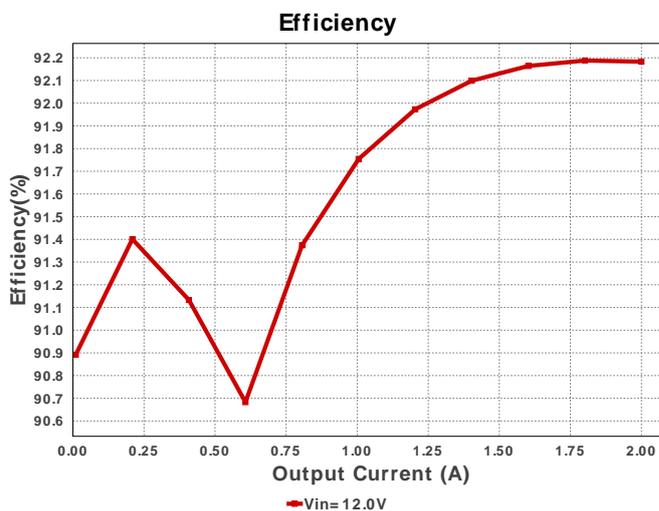
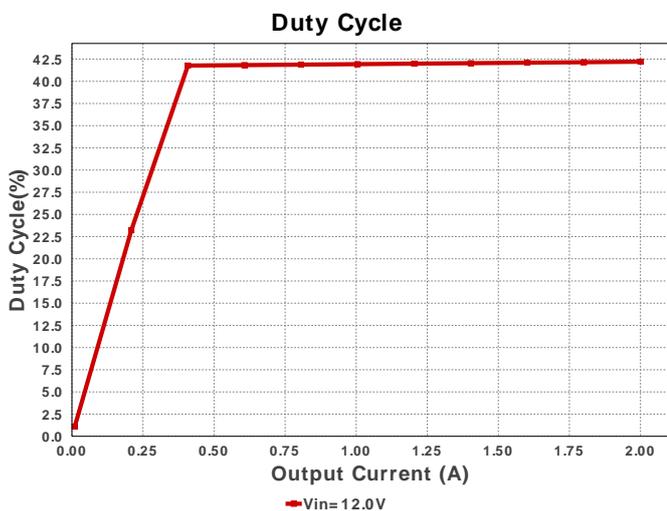
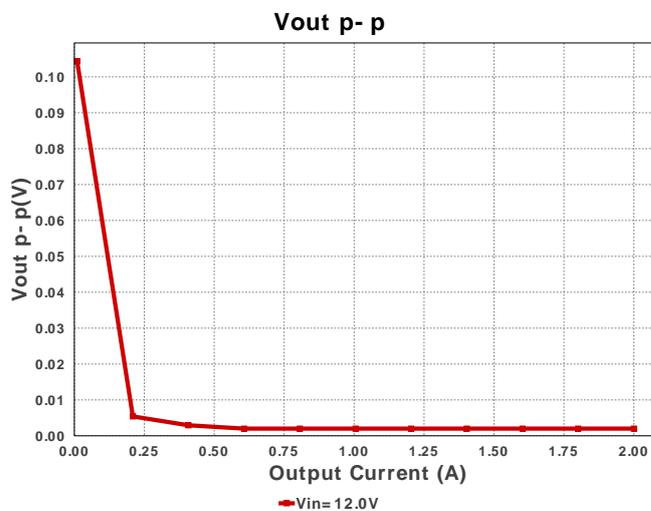
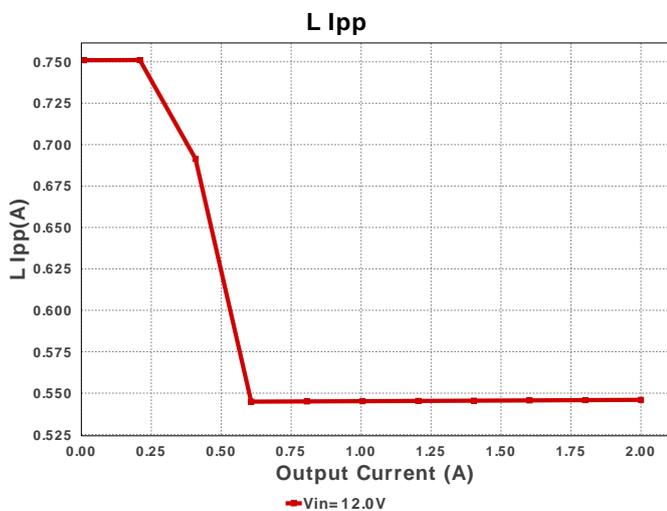
 Design : 436 LMR33620CRNXR
 LMR33620CRNXR 12V-12V to 5.00V @ 2A


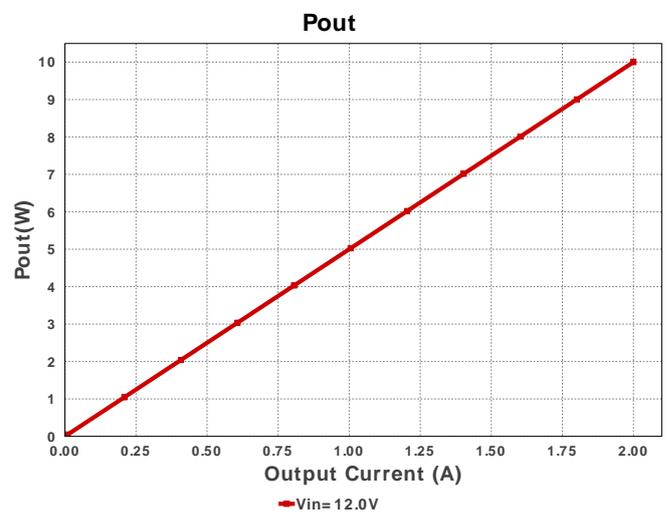
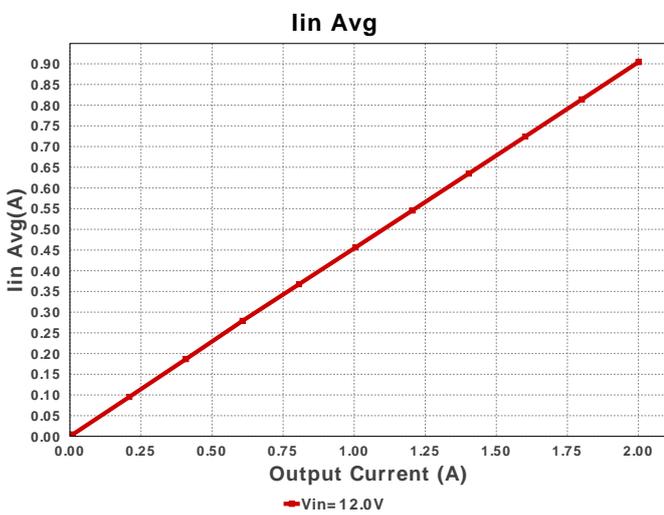
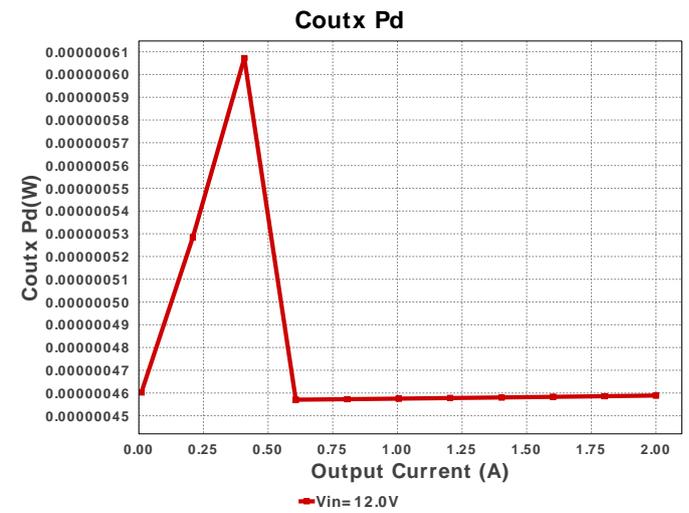
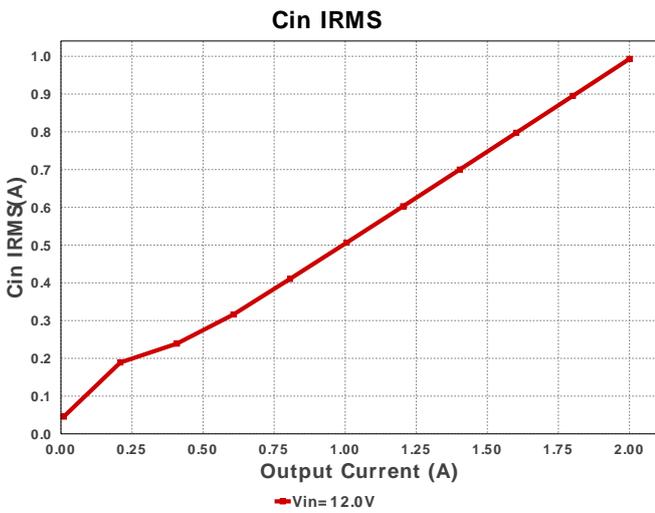
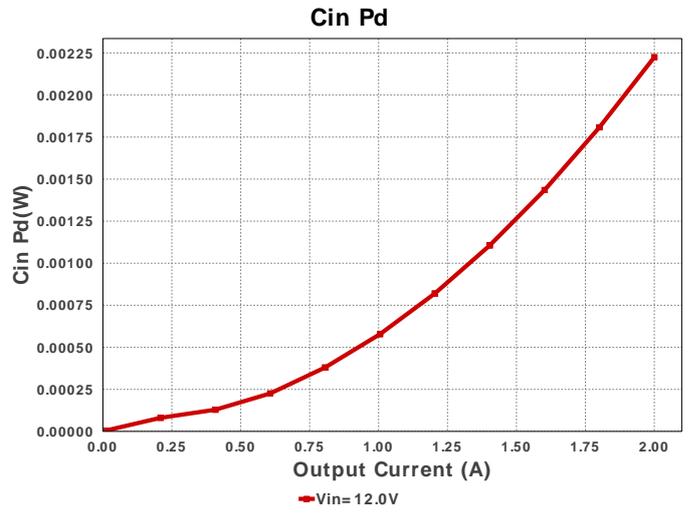
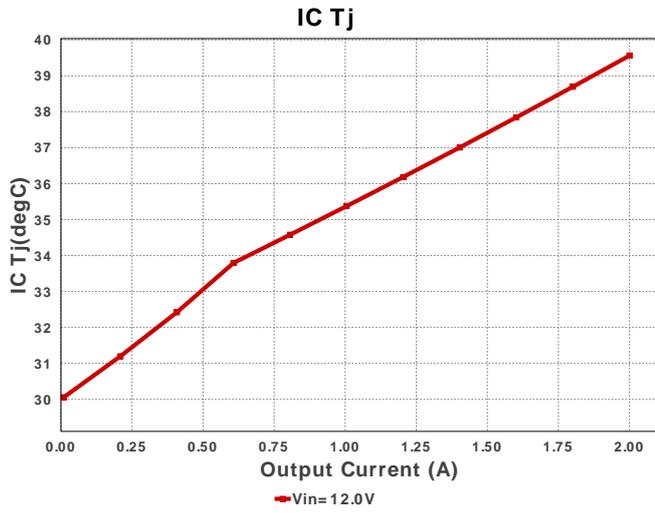
1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating at a much lower voltage than the maximum input voltage. Sizing the inductor based on the maximum input voltage may yield an inductance much larger than typically needed, causing a larger footprint for the overall design. At the same time, components such as the input capacitor must be rated based on the maximum input voltage. WEBENCH now supports the use of this additional input voltage specification.

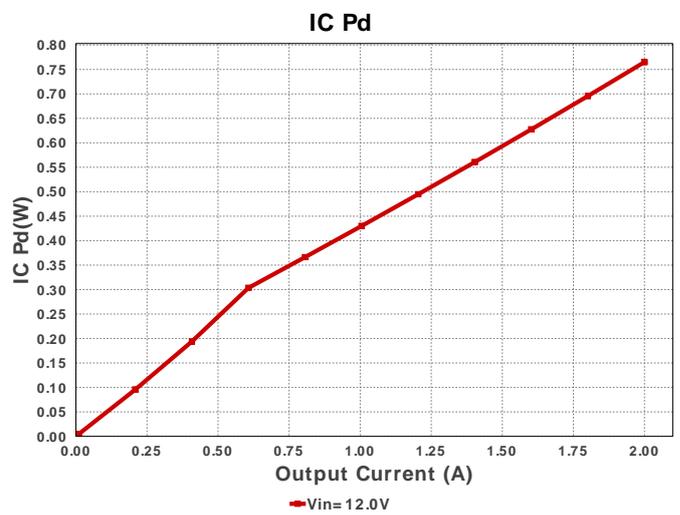
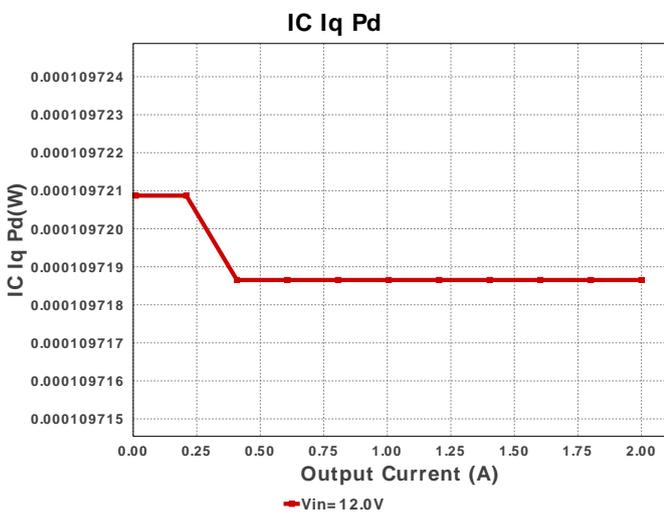
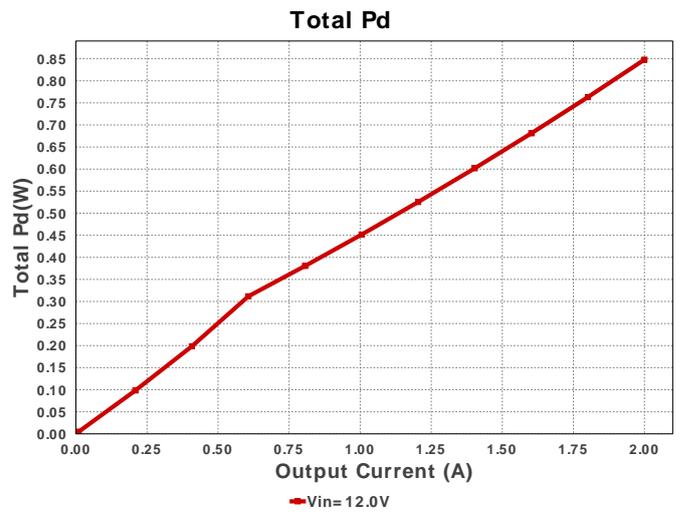
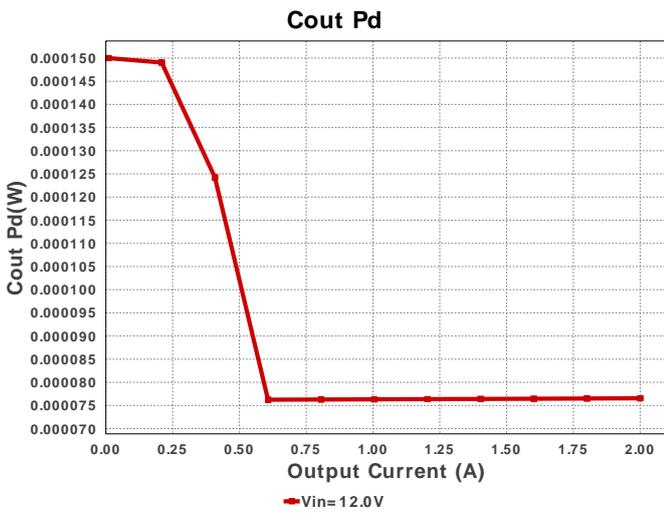
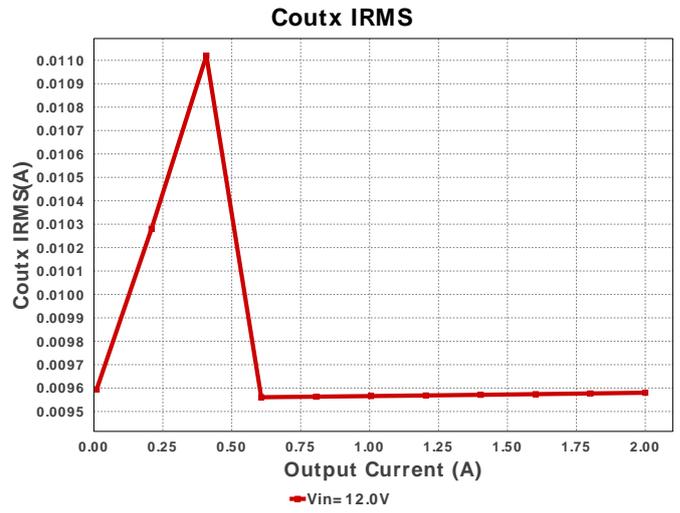
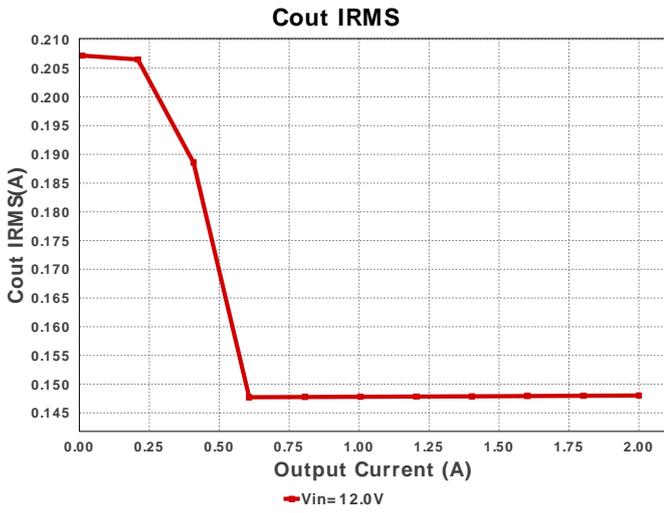
Electrical BOM

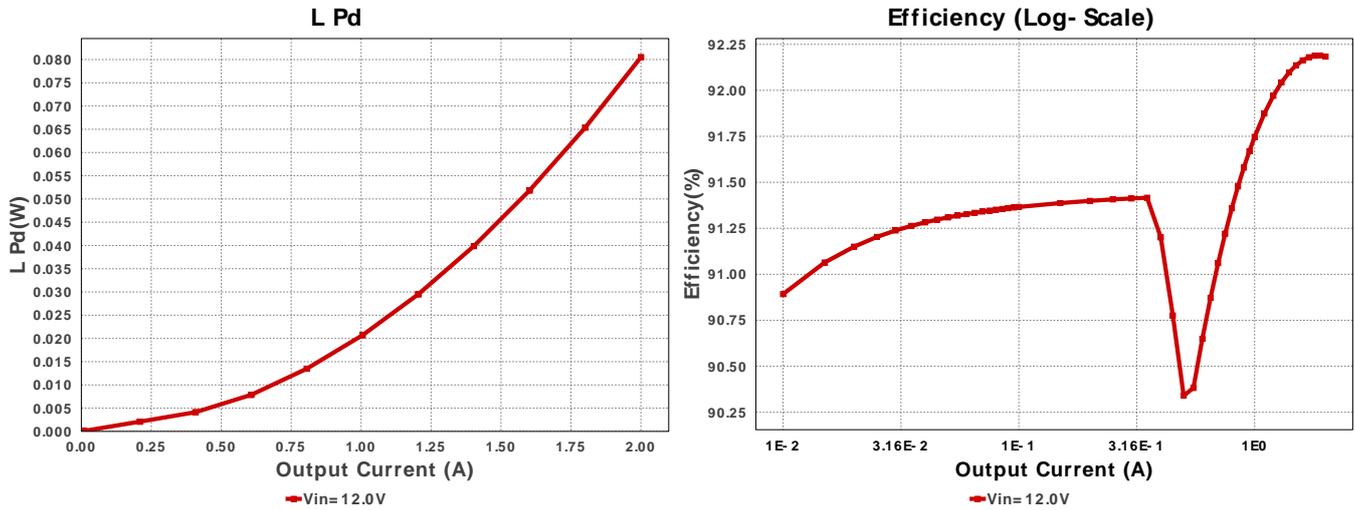
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Cin	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 uF ESR= 4.512 mOhm VDC= 25.0 V IRMS= 2.447 A	2	\$0.12	1206_190 11 mm ²
Cin_ch1	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 uF ESR= 4.512 mOhm VDC= 25.0 V IRMS= 2.447 A	2	\$0.12	1206_190 11 mm ²
Cinx	TDK	C2012X5R1H224K125AA Series= X5R	Cap= 220.0 nF ESR= 16.949 mOhm VDC= 50.0 V IRMS= 1.5961 A	1	\$0.03	0805 7 mm ²
Cinx_ch1	TDK	C2012X5R1H224K125AA Series= X5R	Cap= 220.0 nF ESR= 16.949 mOhm VDC= 50.0 V IRMS= 1.5961 A	1	\$0.03	0805 7 mm ²
Cout	TDK	C3216X5R1A686M160AC Series= X5R	Cap= 68.0 uF ESR= 3.494 mOhm VDC= 10.0 V IRMS= 3.8813 A	1	\$0.55	1206_190 11 mm ²
Coutx	MuRata	GRM21BR71A105KA01L Series= X7R	Cap= 1.0 uF ESR= 5.0 mOhm VDC= 10.0 V IRMS= 3.92 A	1	\$0.03	0805 7 mm ²
Cvcc	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Bourns	SDR0805-2R5ML	L= 2.5 μ H 20.0 mOhm	1	\$0.27	 SDR0805 96 mm ²
Rfbb	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
U1	Texas Instruments	LMR33620CRNXR	Switcher	1	\$1.79	RNX0012B 12 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	993.083 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	4.45 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	148.022 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	76.556 μ W	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	9.58 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	458.89 nW	Capacitor	Output capacitor_x power loss
7.	IC Iq Pd	109.719 μ W	IC	IC Iq Pd
8.	IC Pd	764.98 mW	IC	IC power dissipation
9.	IC Tj	39.562 degC	IC	IC junction temperature
10.	ICThetaJA Effective	12.5 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	904.0 mA	IC	Average input current
12.	L Ipp	545.95 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	80.497 mW	Inductor	Inductor power dissipation
14.	Cin Pd	2.225 mW	Power	Input capacitor power dissipation
15.	Cout Pd	76.556 μ W	Power	Output capacitor power dissipation
16.	Coutx Pd	458.89 nW	Power	Output capacitor_x power loss
17.	IC Pd	764.98 mW	Power	IC power dissipation
18.	L Pd	80.497 mW	Power	Inductor power dissipation
19.	Total Pd	847.988 mW	Power	Total Power Dissipation
20.	BOM Count	15	System	Total Design BOM count
21.	Duty Cycle	42.211 %	System	Duty cycle
22.	Efficiency	92.183 %	System	Steady state efficiency
23.	FootPrint	201.0 mm ²	System	Total Foot Print Area of BOM components
24.	Frequency	2.143 MHz	System	Switching frequency
25.	Iout	2.0 A	System	Iout operating point
26.	Mode	CCM	System	Conduction Mode
27.	Pout	10.0 W	System	Total output power
28.	Total BOM	\$3.23	System	Total BOM Cost
29.	Vin	12.0 V	System	Vin operating point
30.	Vout	5.0 V	System	Operational Output Voltage
31.	Vout Actual	5.016 V	System	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	3.447 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	2.009 mV	System	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current

Name	Value	Description
VinMax	12.0	Maximum input voltage
VinMin	12.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LMR33620C-WSON	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 C_{in} and C_{out} , 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

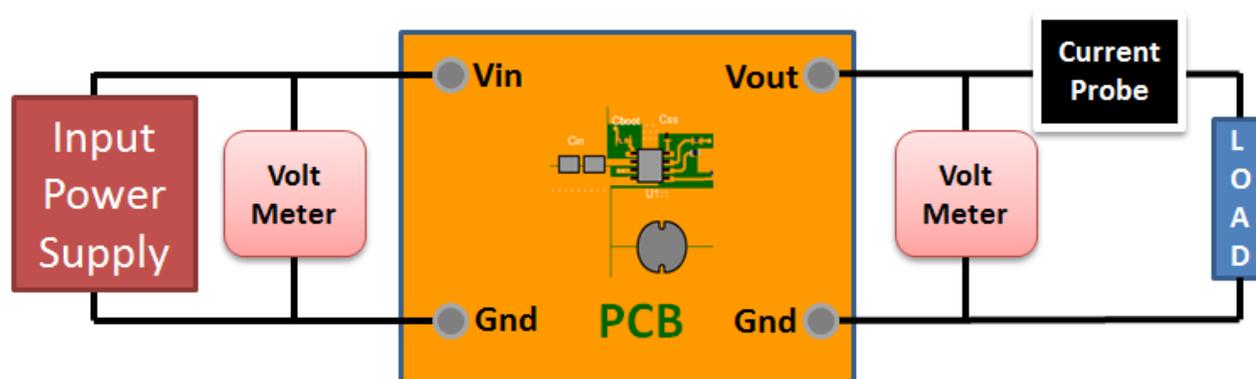
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down 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 12.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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 : 3FEB6243E93DE51D[v1]
2. **LMR33620C-WSON** Product Folder : <http://www.ti.com/product/LMR33620> : contains the data sheet and other resources.

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