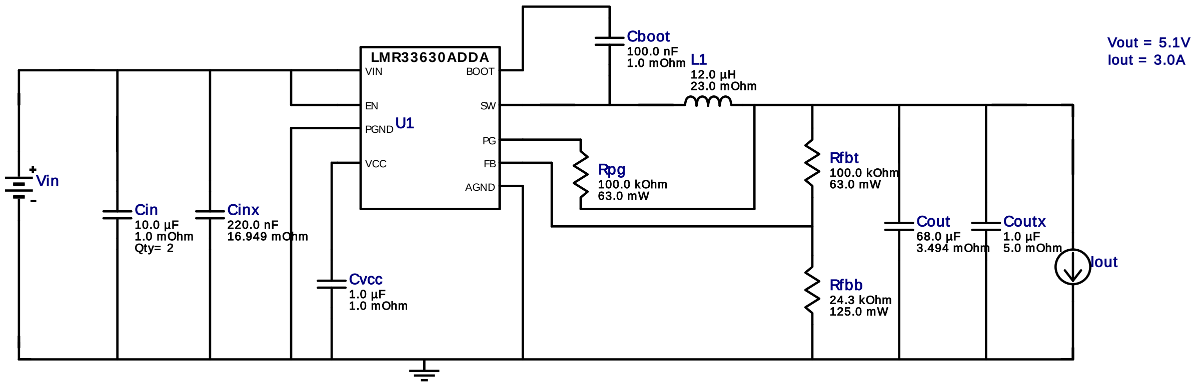
WEBENCH ® Design Report

VinMin = 6.5V
VinMax = 30.0V
Vout = 5.1V
Iout = 3.0A

Device = LMR33630ADDAR
Topology = Buck
Created = 2019-04-28 01:14:37.733
BOM Cost = $3.39
BOM Count = 12
Total Pd = 1.81W

Design : 1 LMR33630ADDAR
LMR33630ADDAR 12V-24V to 5.00V @ 3A

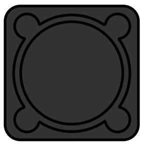
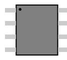


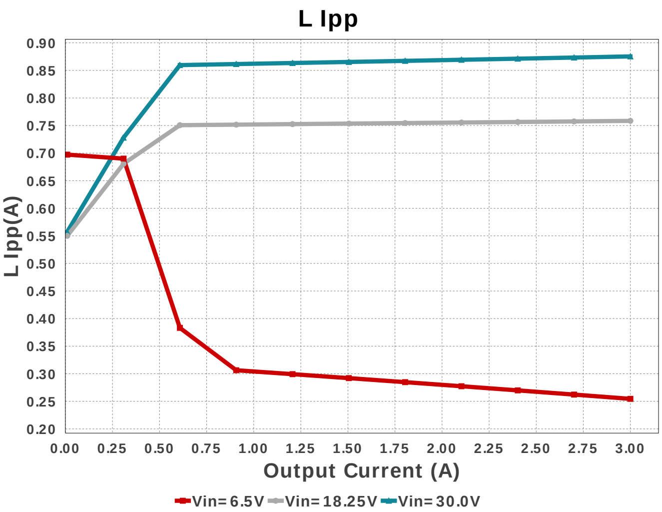
1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

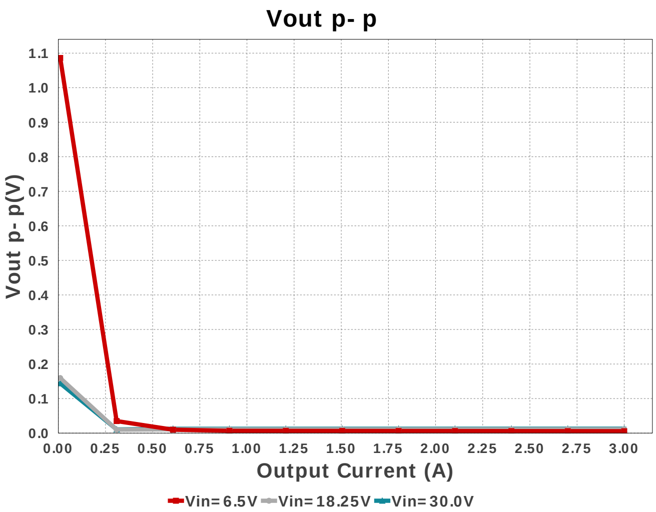
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating 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.

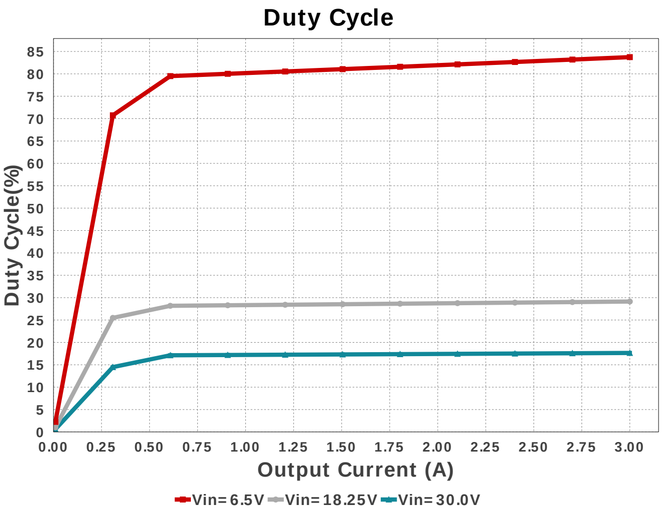
Electrical BOM

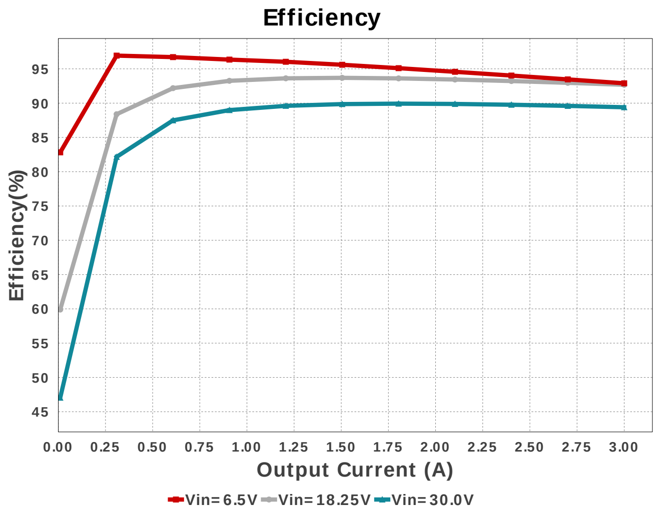
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Yageo	CC0805KRX7R9BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Cin	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.9 A	2	$0.30	1206_180 11 mm^2
Cinx	TDK	C2012X5R1H224K125AA 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
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	SRR1260-120M	L= 12.0 µH 23.0 mOhm	1	$0.50	 SRR1260 210 mm²
Rfbb	Panasonic	ERJ-6ENF2432V Series= ERJ-6E	Res= 24.3 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LMR33630ADDAR	Switcher	1	$1.62	 DDA0008J 55 mm²

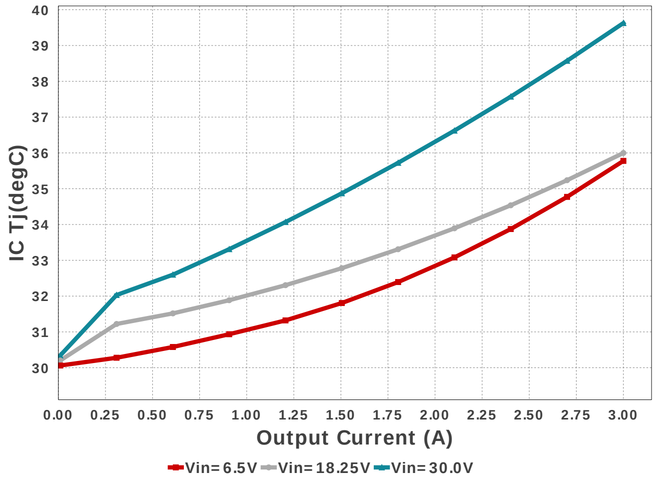




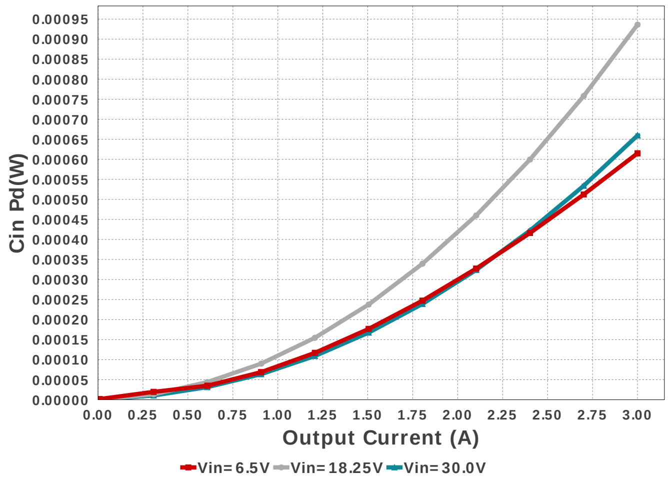




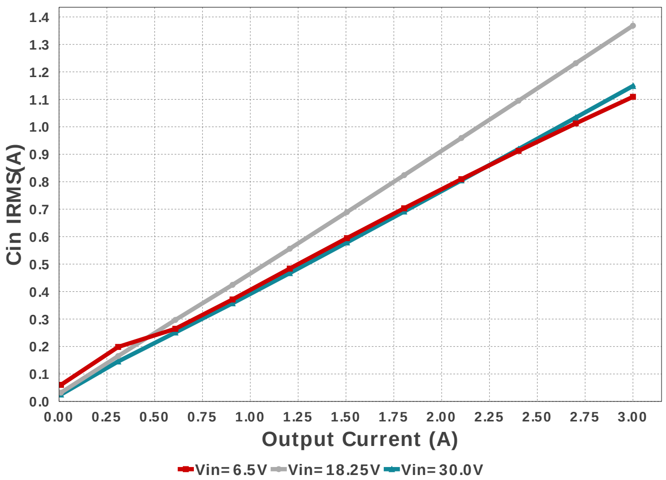
IC Tj



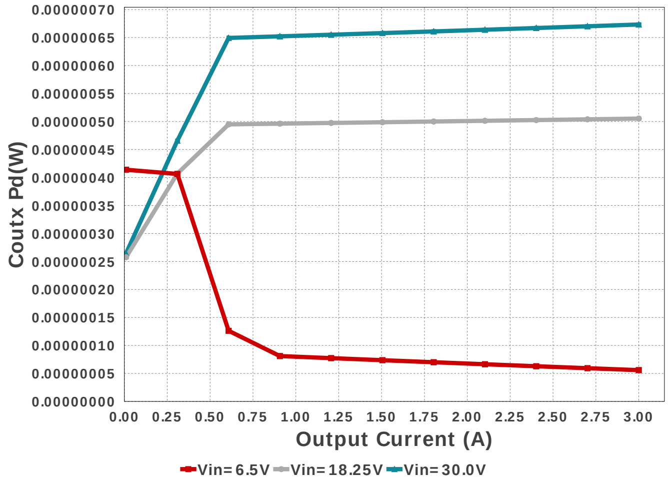
Cin Pd



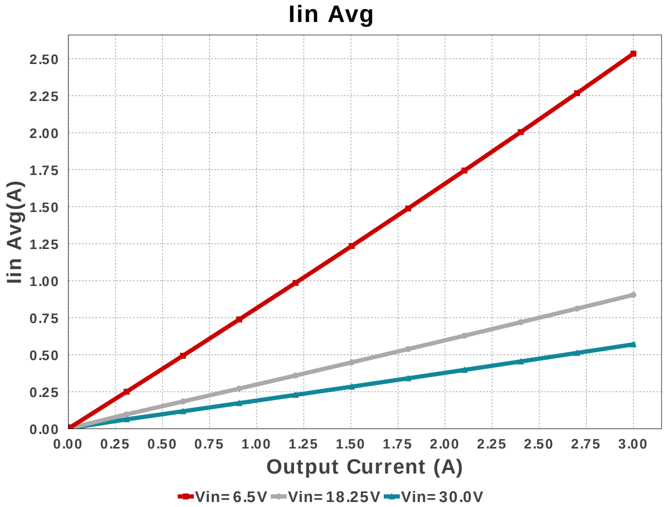
Cin IRMS



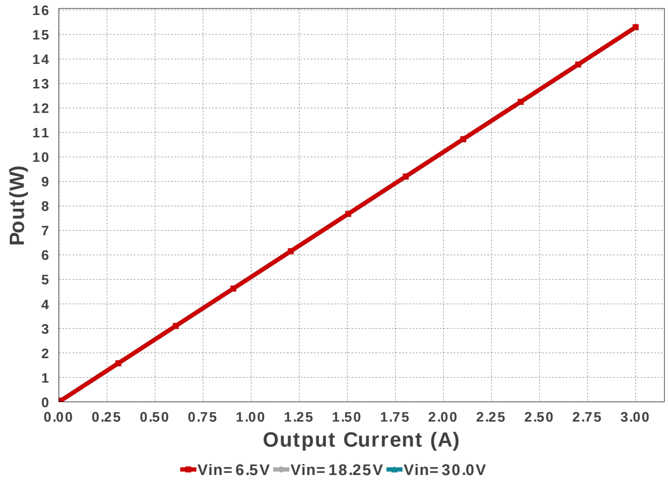
Coutx Pd



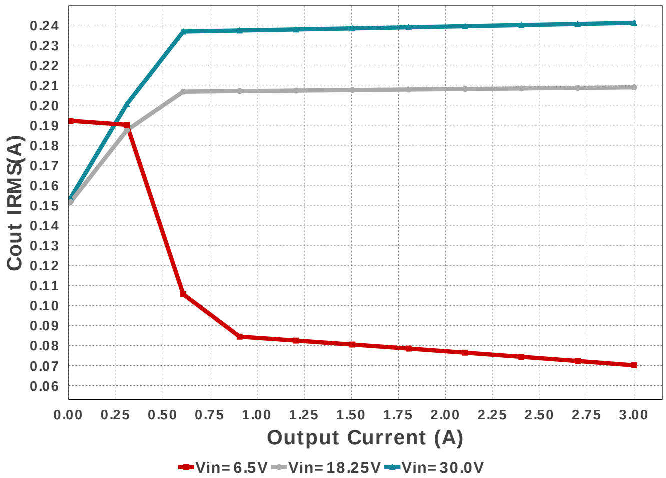
Iin Avg



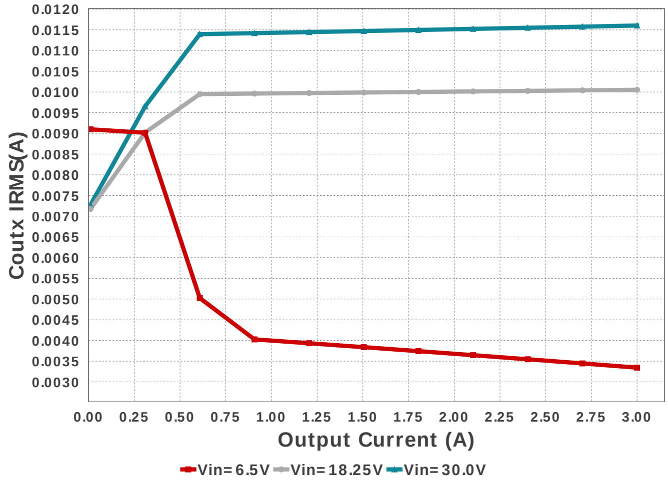
Pout



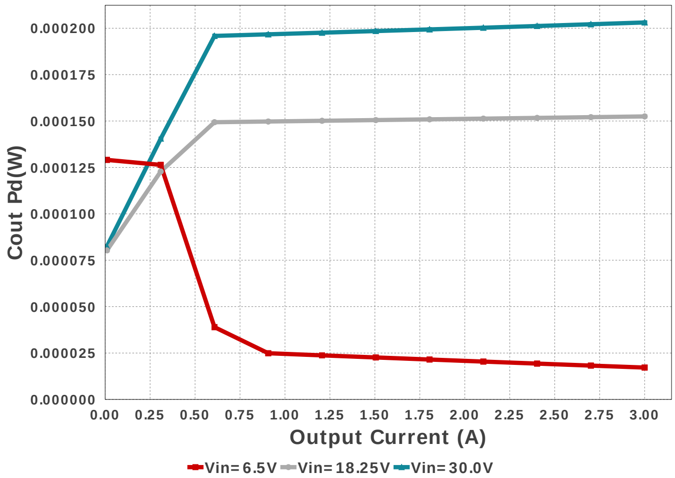
Cout IRMS



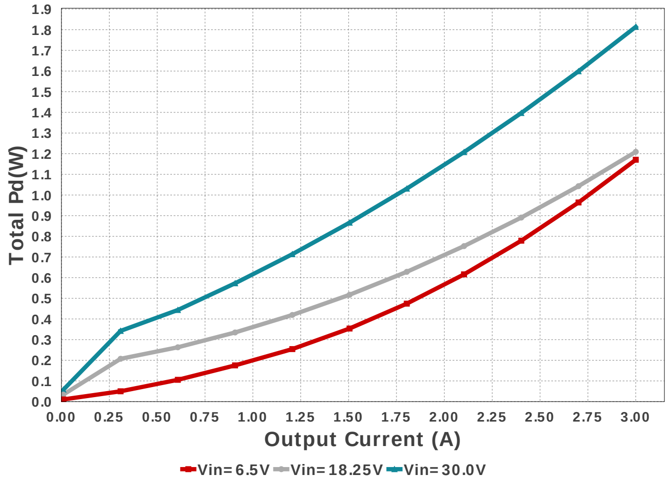
Coutx IRMS



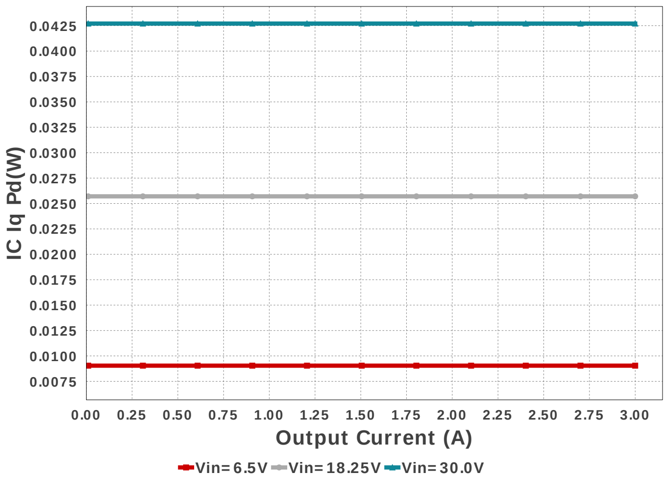
Cout Pd



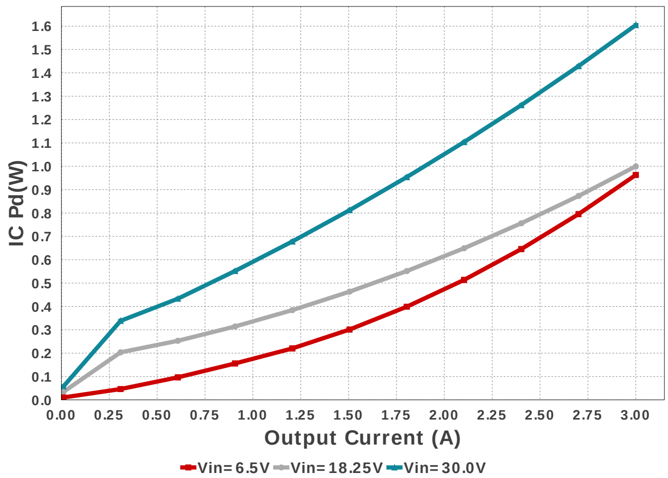
Total Pd

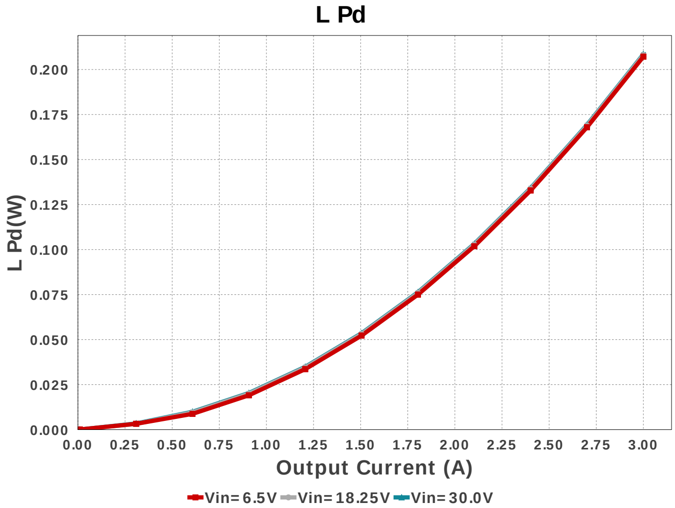


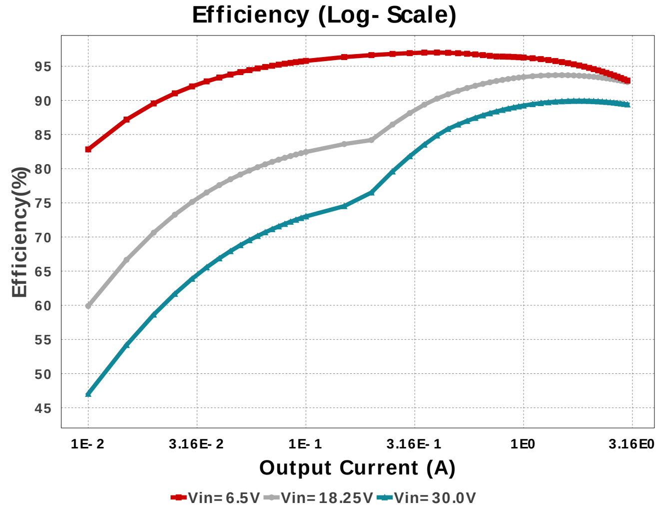
IC Iq Pd



IC Pd







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	12		Total Design BOM count
2.	Total BOM	$3.39		Total BOM Cost
3.	Cin IRMS	1.149 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	659.65 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	241.096 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	203.1 µW	Capacitor	Output capacitor power dissipation
7.	Coutx IRMS	11.604 mA	Capacitor	Output capacitor_x RMS ripple current
8.	Coutx Pd	673.31 nW	Capacitor	Output capacitor_x power loss
9.	IC Iq Pd	42.707 mW	IC	IC Iq Pd
10.	IC Pd	1.604 W	IC	IC power dissipation
11.	IC Tj	39.627 degC	IC	IC junction temperature
12.	ICThetaJA Effective	6.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
13.	Iin Avg	570.47 mA	IC	Average input current
14.	L Ipp	875.379 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	208.47 mW	Inductor	Inductor power dissipation
16.	Cin Pd	659.65 µW	Power	Input capacitor power dissipation
17.	Cout Pd	203.1 µW	Power	Output capacitor power dissipation
18.	Coutx Pd	673.31 nW	Power	Output capacitor_x power loss
19.	IC Pd	1.604 W	Power	IC power dissipation
20.	L Pd	208.47 mW	Power	Inductor power dissipation
21.	Total Pd	1.814 W	Power	Total Power Dissipation
22.	Duty Cycle	17.648 %	System Information	Duty cycle
23.	Efficiency	89.4 %	System Information	Steady state efficiency
24.	FootPrint	336.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	411.941 kHz	System Information	Switching frequency
26.	Iout	3.0 A	System Information	Iout operating point
27.	Mode	CCM	System Information	Conduction Mode
28.	Pout	15.3 W	System Information	Total output power
29.	Vin	30.0 V	System Information	Vin operating point
30.	Vout	5.1 V	System Information	Operational Output Voltage
31.	Vout Actual	5.115 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	3.15 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	12.739 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	6.5	Minimum input voltage

Name	Value	Description
Vout	5.1	Output Voltage
base_pn	LMR33630A-SOIC	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

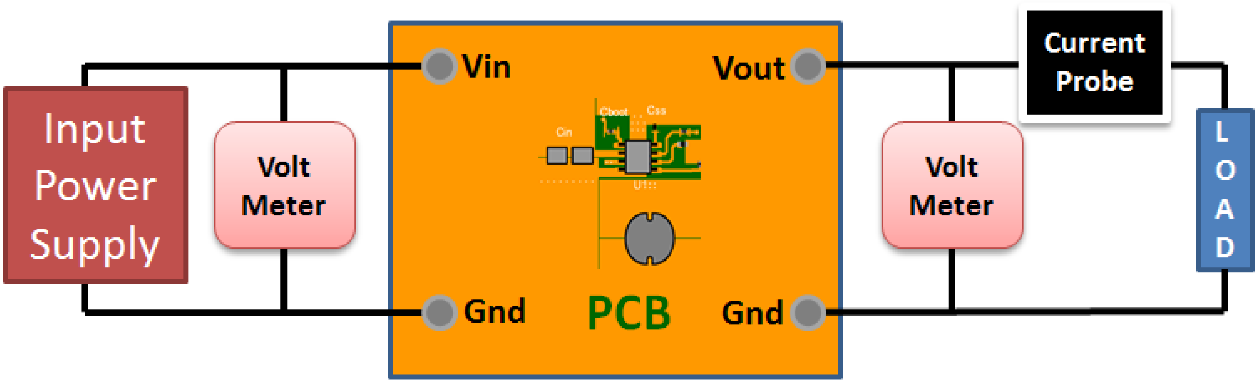
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 6.5V 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.

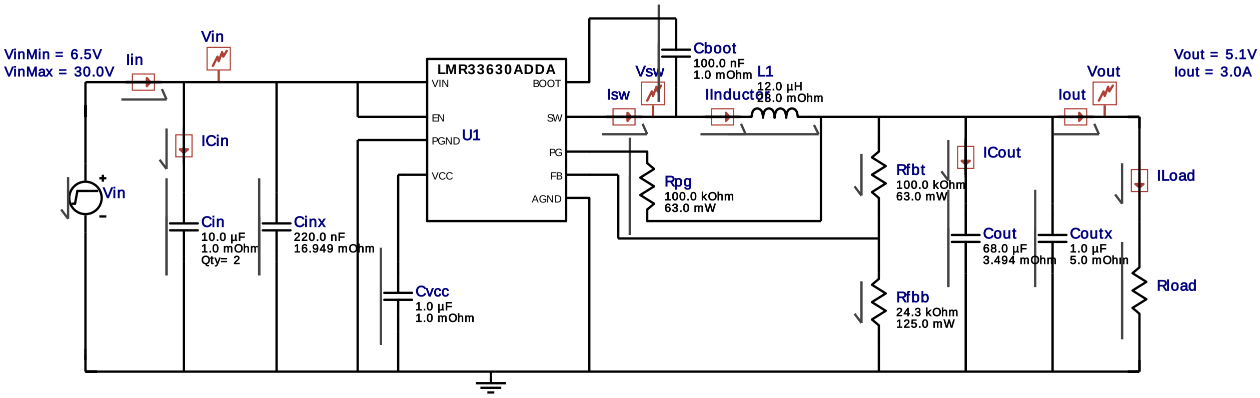


WEBENCH® Electrical Simulation Report

Design Id = 1

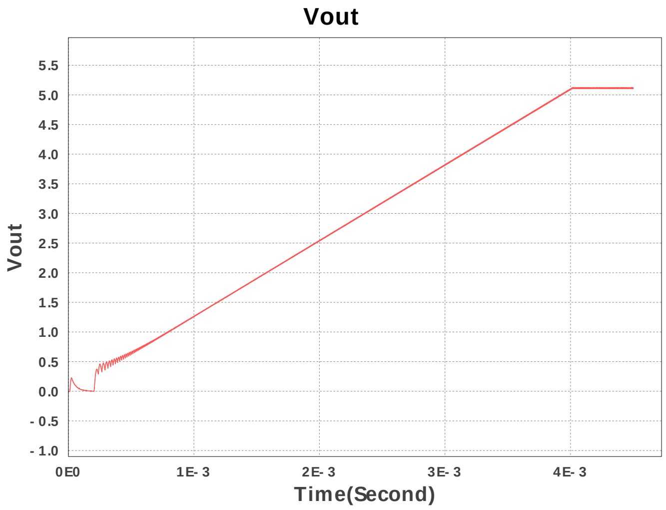
sim_id = 2

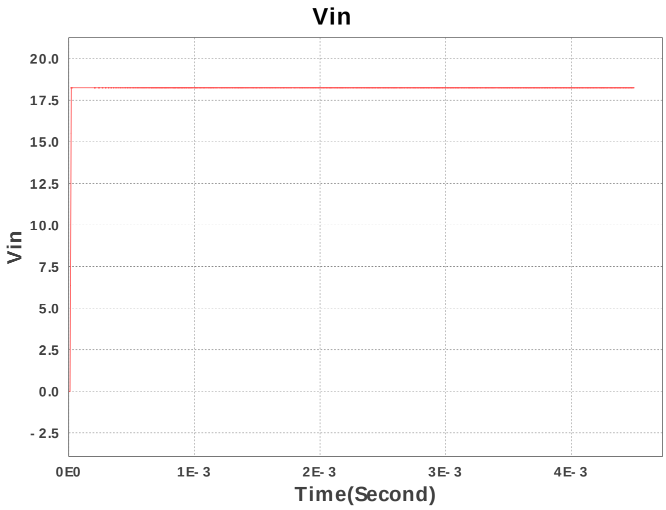
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	1.7 Ohm





Design Assistance

1. Master key : 305710B8CC4DC84B[v1]

2. **LMR33630A-SOIC** Product Folder : http://www.ti.com/product/LMR33630 : contains the data sheet and other resources.

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