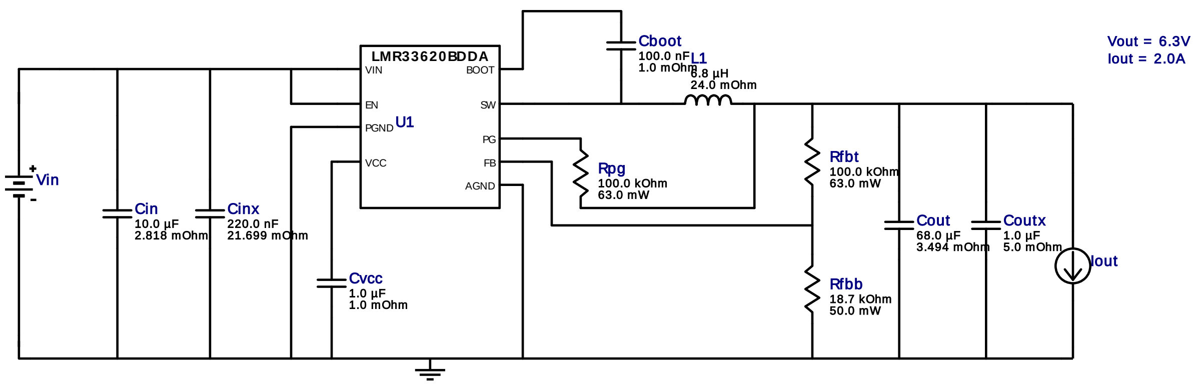
VinMin = 20.0V
VinMax = 26.0V
Vout = 6.3V
Iout = 2.0A

Device = LMR33620BDDAR
Topology = Buck
Created = 2021-05-17 09:27:30.191
BOM Cost = $1.67
BOM Count = 11
Total Pd = 2.03W

WEBENCH ® Design Report

Design : 1 LMR33620BDDAR
LMR33620BDDAR 20V-26V to 6.30V @ 2A

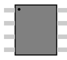


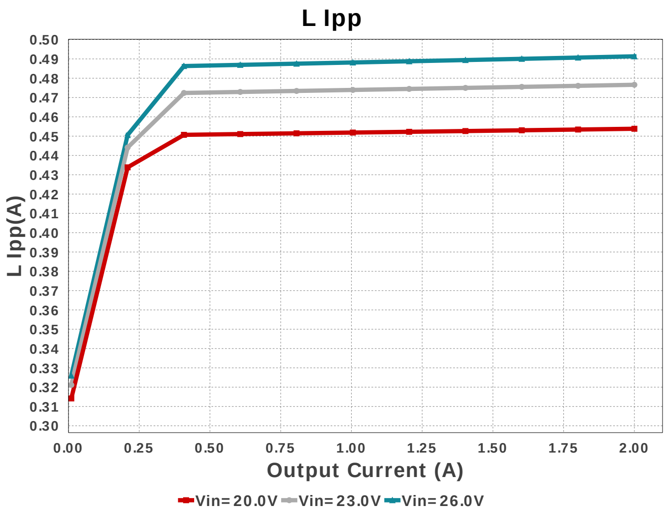
1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

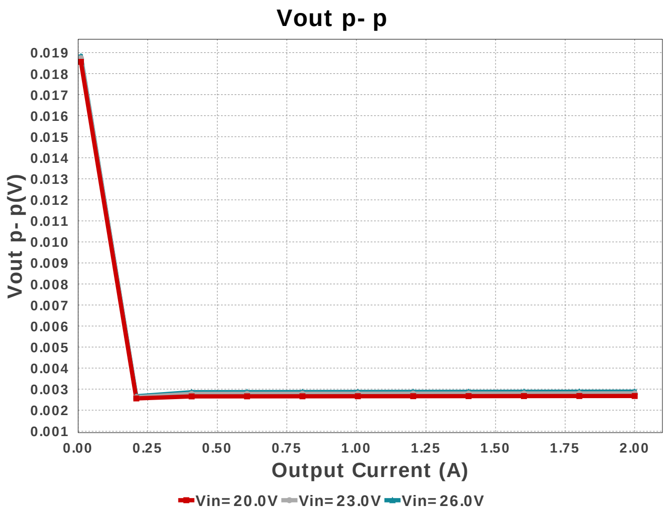
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating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

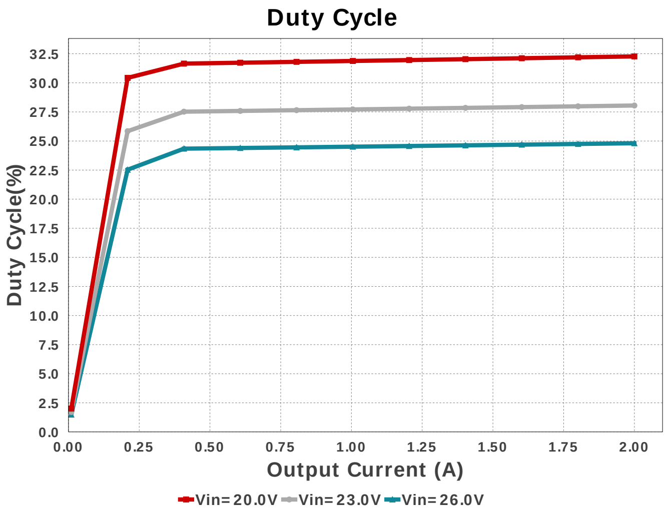
Electrical BOM

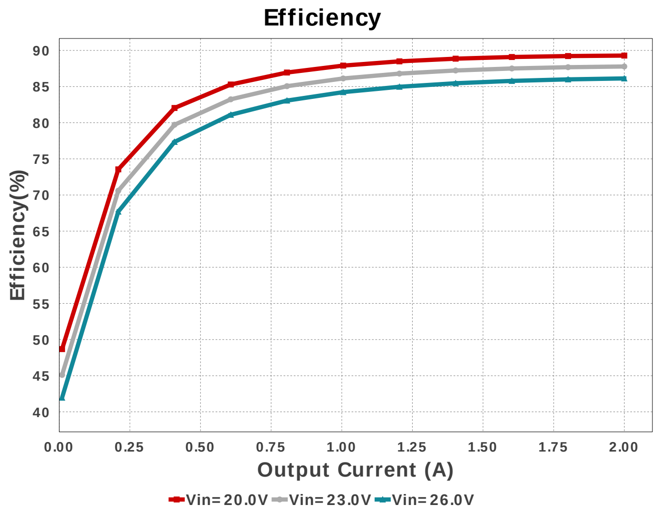
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Yageo	CC0805KRX7R9BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Cin	TDK	C2012X5R1V106K085AC Series= X5R	Cap= 10.0 uF ESR= 2.818 mOhm VDC= 35.0 V IRMS= 3.8868 A	1	$0.17	0805 7 mm^2
Cinx	TDK	C1608X5R1H224K080AB Series= X5R	Cap= 220.0 nF ESR= 21.699 mOhm VDC= 50.0 V IRMS= 1.125 A	1	$0.03	0603 5 mm^2
Cout	TDK	C3216X5R1A686M160AC Series= X5R	Cap= 68.0 uF ESR= 3.494 mOhm VDC= 10.0 V IRMS= 3.8813 A	1	$0.51	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	C0603C105K8PACTU Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
L1	TDK	VLP8040T-6R8M	L= 6.8 µH 24.0 mOhm	1	$0.22	VLP8040 113 mm^2

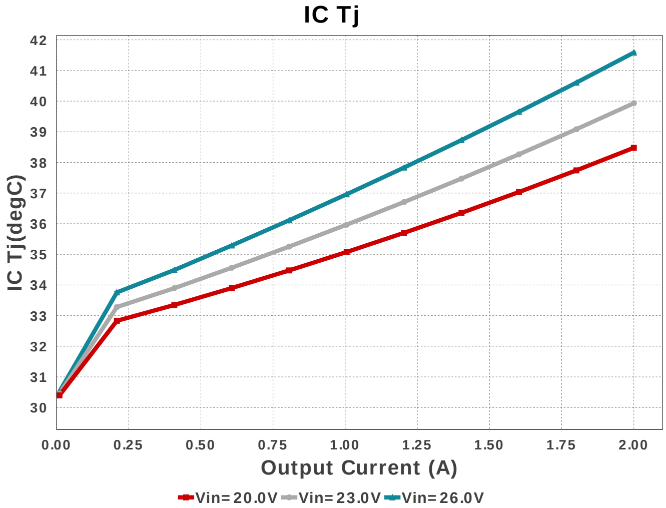
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfbt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LMR33620BDDAR	Switcher	1	$0.65	 DDA0008J 55 mm²

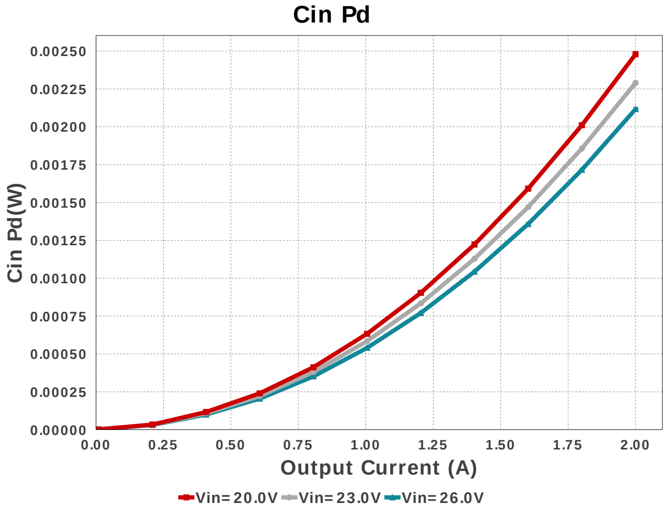


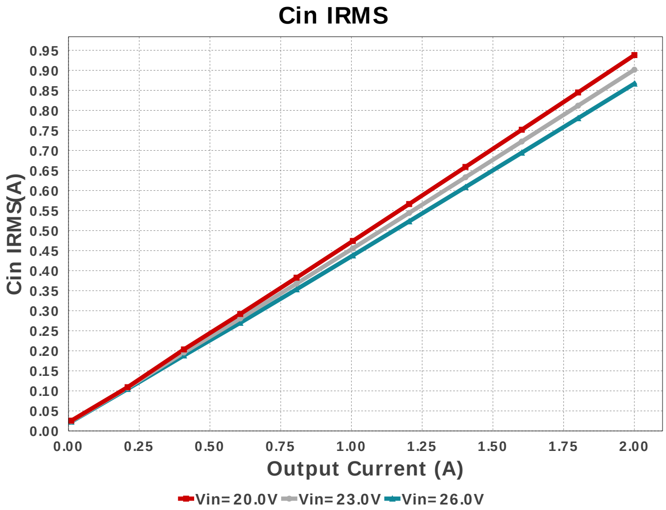


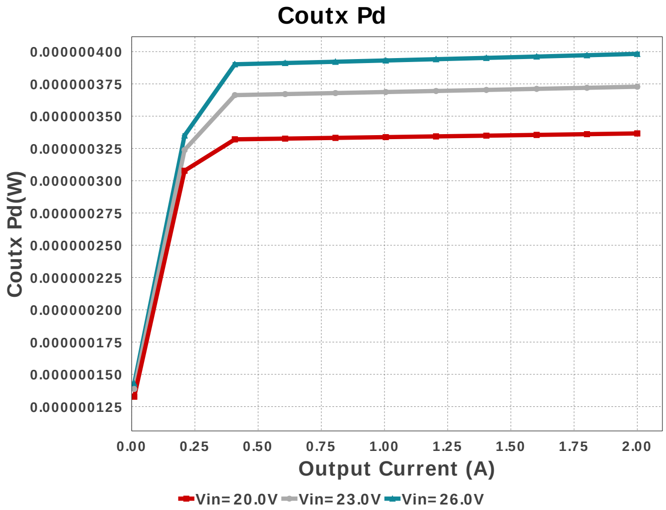


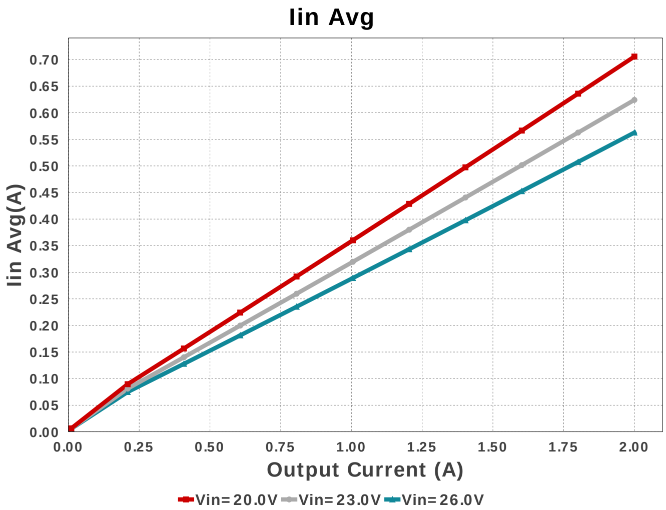


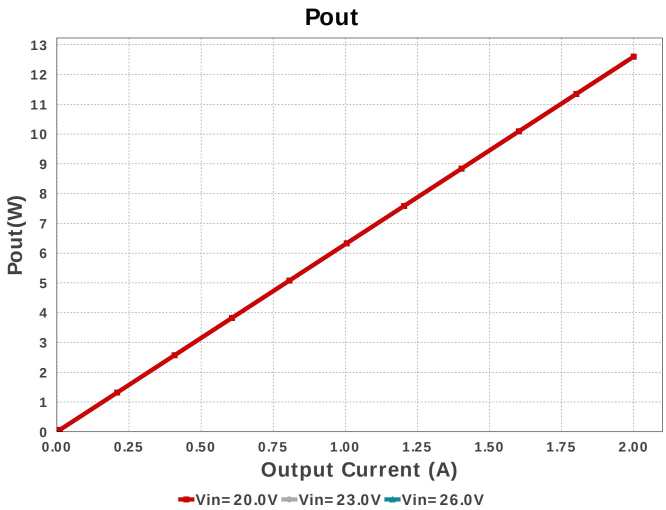

IC Tj
IC Tj(degC)
42
41
40
39
38
37
36
35
34
33
32
31
30
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

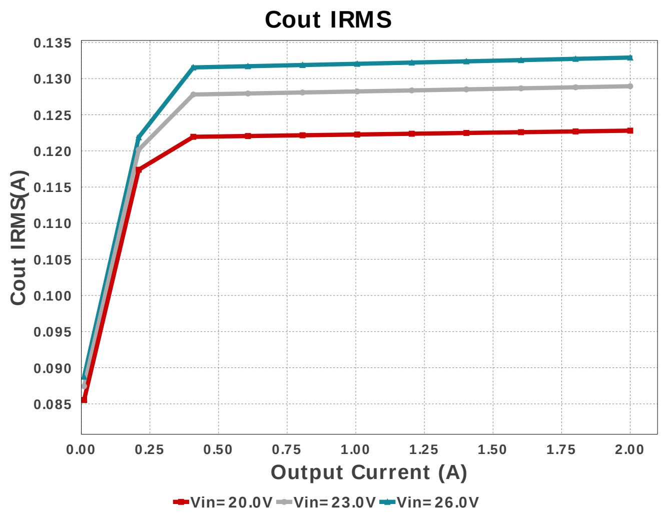

Cin Pd
Cin Pd(W)
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

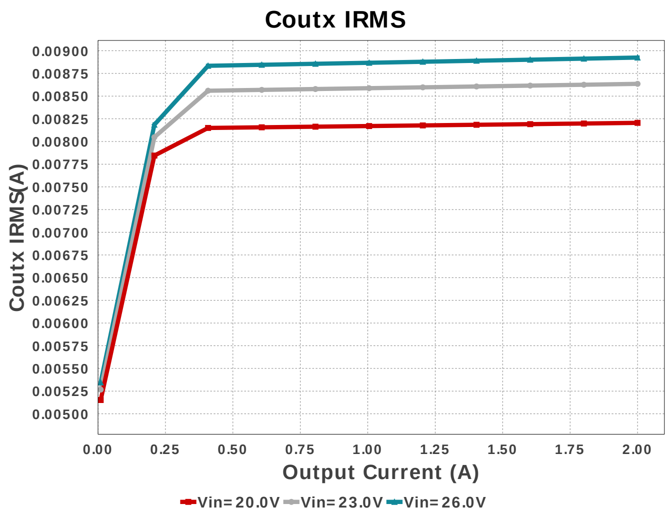

Cin IRMS
Cin IRMS(A)
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

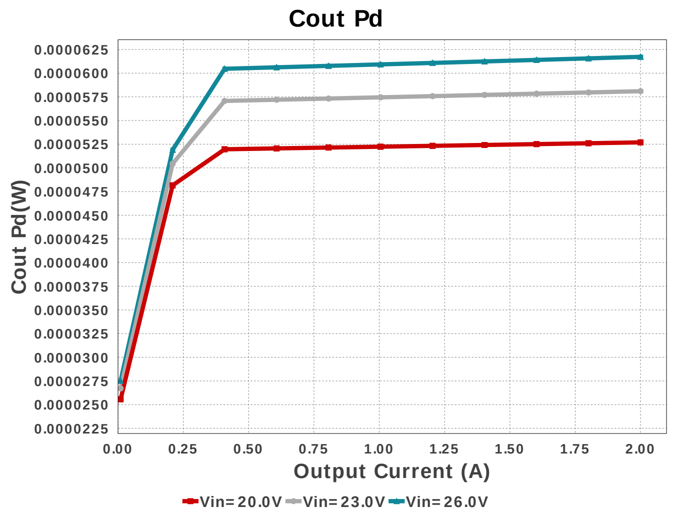

Coutx Pd
Coutx Pd(W)
0.000000400
0.000000375
0.000000350
0.000000325
0.000000300
0.000000275
0.000000250
0.000000225
0.000000200
0.000000175
0.000000150
0.000000125
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

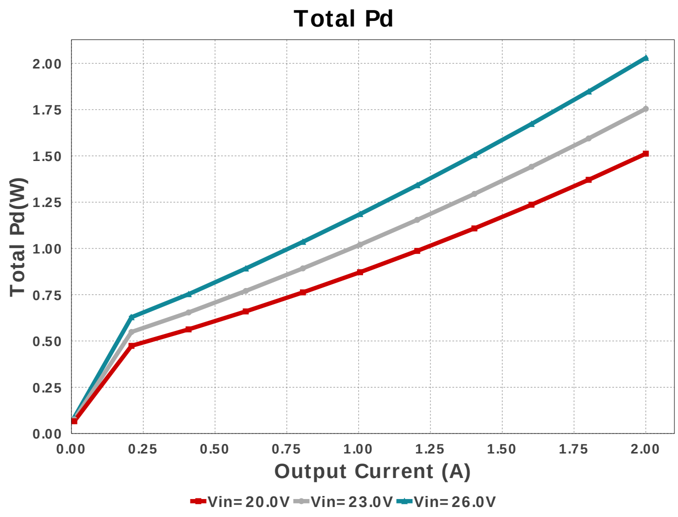

Iin Avg
Iin Avg(A)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

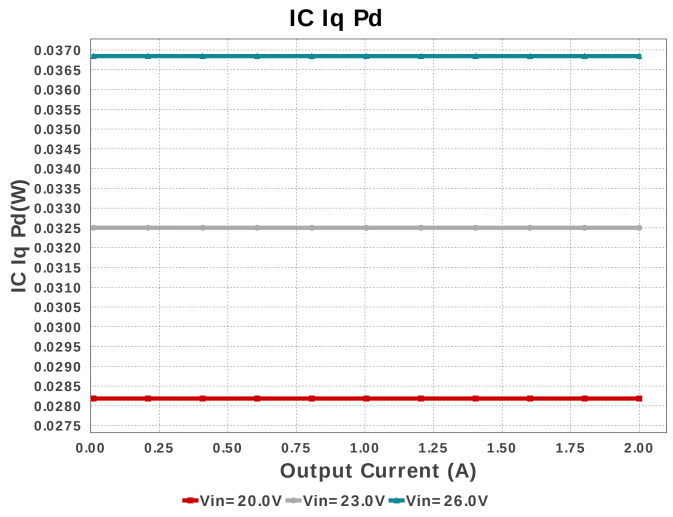

Pout
Pout(W)
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=20.0V Vin=23.0V Vin=26.0V

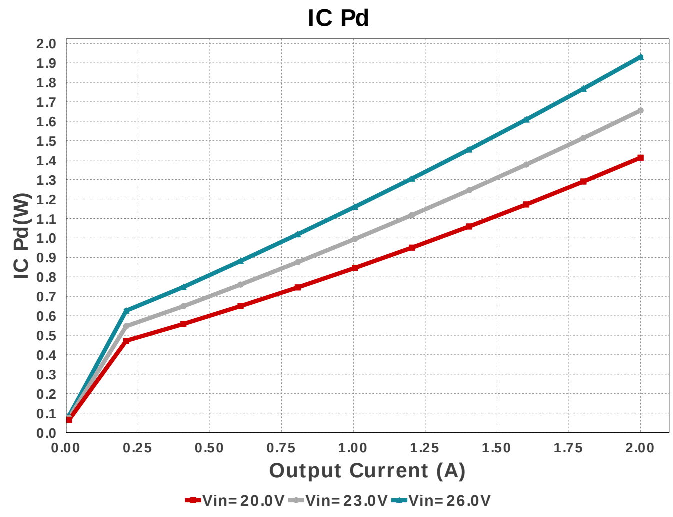

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V

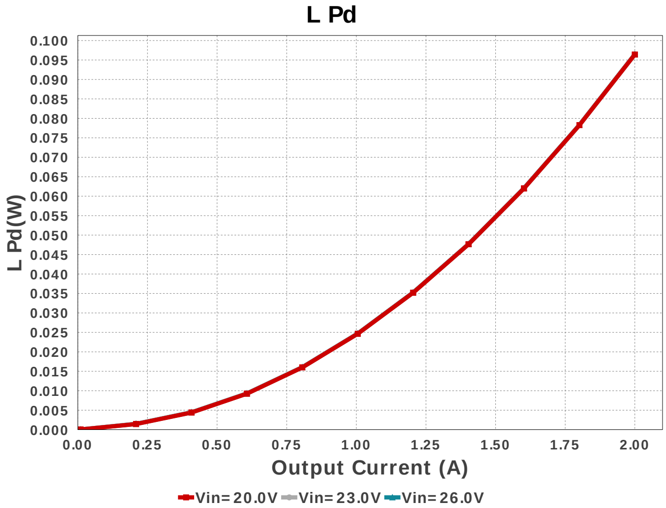

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V

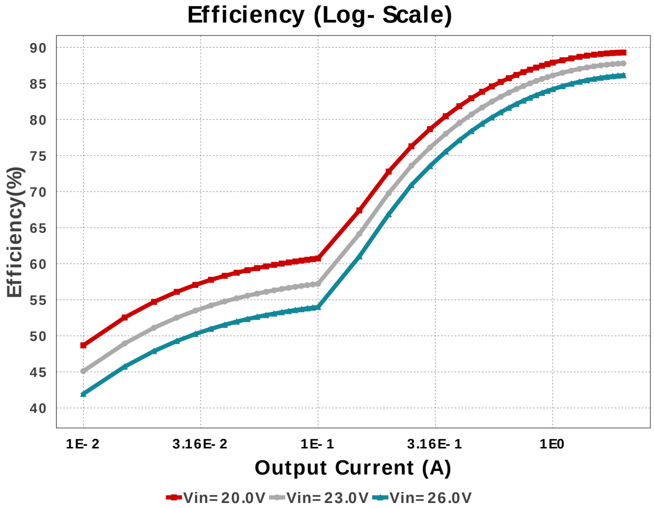

Cout Pd
Cout Pd(W)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V


IC Iq Pd
IC Iq Pd(W)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin= 20.0V Vin= 23.0V Vin= 26.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	866.675 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.117 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	132.913 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	61.724 µW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	8.925 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	398.25 nW	Capacitor	Output capacitor_x power loss
7.	IC Iq Pd	36.844 mW	IC	IC Iq Pd
8.	IC Pd	1.931 W	IC	IC power dissipation
9.	IC Tj	41.583 degC	IC	IC junction temperature
10.	ICThetaJA Effective	6.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	562.68 mA	IC	Average input current
12.	L Ipp	491.34 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	96.483 mW	Inductor	Inductor power dissipation
14.	Cin Pd	2.117 mW	Power	Input capacitor power dissipation
15.	Cout Pd	61.724 µW	Power	Output capacitor power dissipation
16.	Coutx Pd	398.25 nW	Power	Output capacitor_x power loss
17.	IC Pd	1.931 W	Power	IC power dissipation
18.	L Pd	96.483 mW	Power	Inductor power dissipation
19.	Total Pd	2.03 W	Power	Total Power Dissipation
20.	BOM Count	11	System Information	Total Design BOM count
21.	Duty Cycle	24.807 %	System Information	Duty cycle
22.	Efficiency	86.127 %	System Information	Steady state efficiency
23.	FootPrint	217.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	1.446 MHz	System Information	Switching frequency
25.	Iout	2.0 A	System Information	Iout operating point
26.	Mode	CCM	System Information	Conduction Mode
27.	Pout	12.6 W	System Information	Total output power
28.	Total BOM	$1.67	System Information	Total BOM Cost
29.	Vin	26.0 V	System Information	Vin operating point
30.	Vout	6.3 V	System Information	Operational Output Voltage
31.	Vout Actual	6.348 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	3.533 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	2.881 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current

Name	Value	Description
VinMax	26.0	Maximum input voltage
VinMin	20.0	Minimum input voltage
Vout	6.3	Output Voltage
base_pn	LMR33620B-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

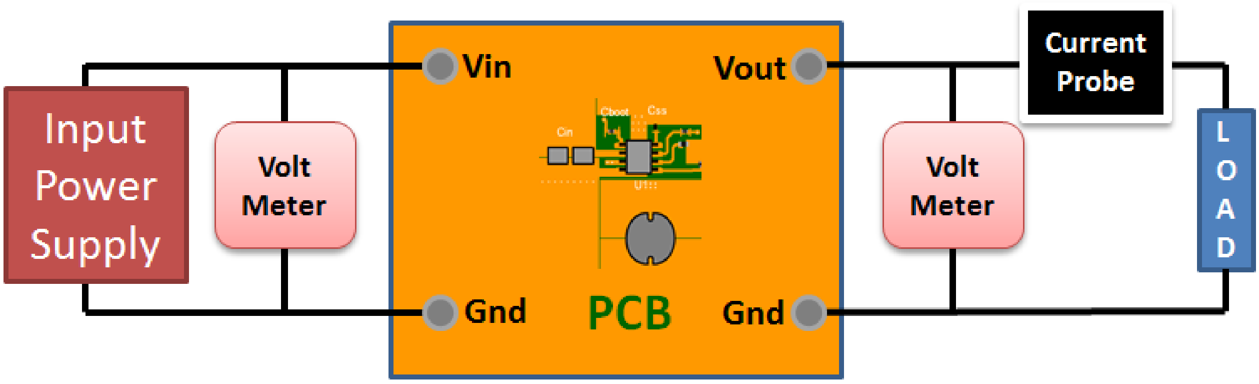
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 20.0V 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.

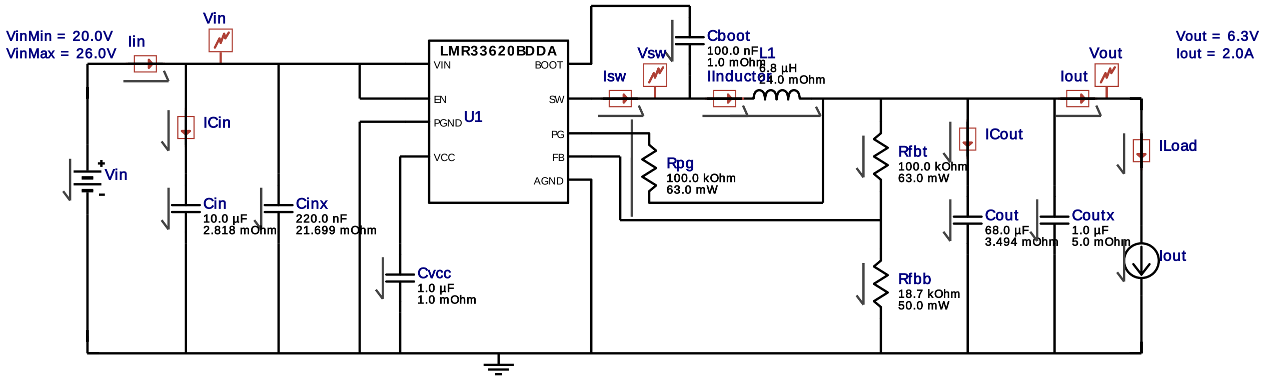


WEBENCH® Electrical Simulation Report

Design Id = 1

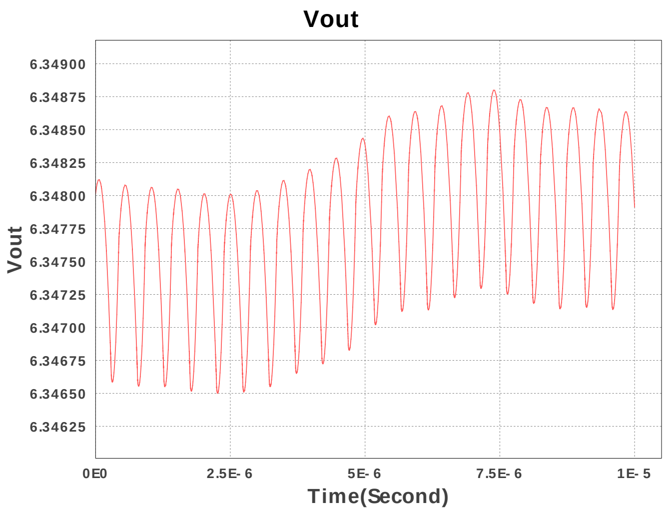
sim_id = 1

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Condition	2.0 A
2.	Cout	IC	Initial Voltage	6.3 V
3.	Iout	I	Load Current	2.0 A



Design Assistance

1. Master key : 62F4F9B0B36A21A0[v1]

2. **LMR33620B-SOIC** Product Folder : http://www.ti.com/product/LMR33620 : contains the data sheet and other resources.