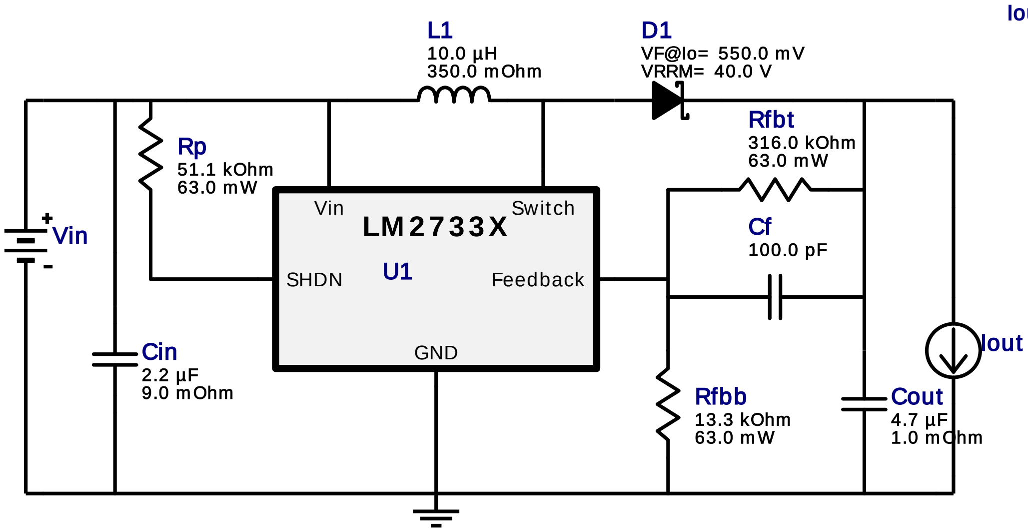
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 4.5V
VinMax = 5.5V
Vout = 30.0V
Iout = 0.02A

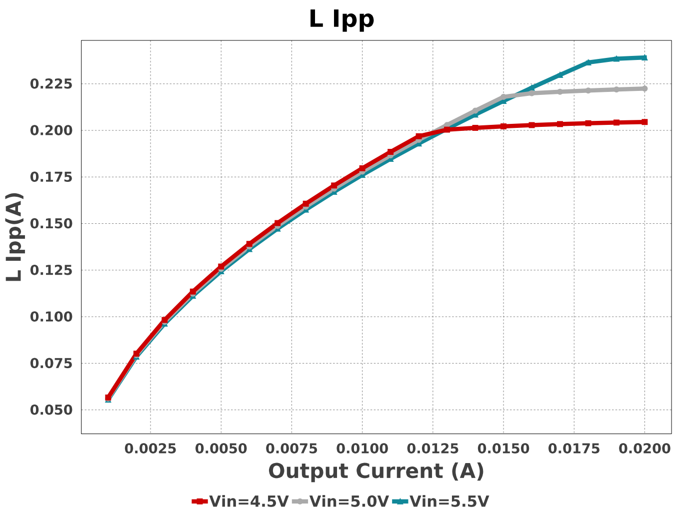
Device = LM2733XMF/NOPB
Topology = Boost
Created = 2024-10-27 18:43:03.213
BOM Cost = $1.20
BOM Count = 9
Total Pd = 0.11W

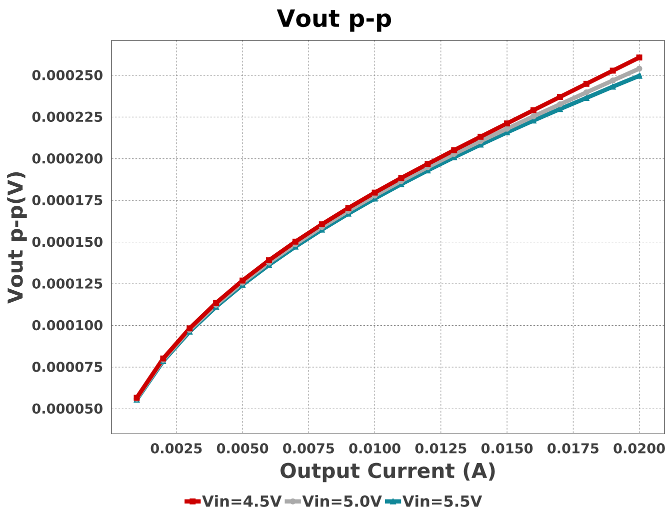
Design : 2 LM2733XMF/NOPB
LM2733XMF/NOPB 4.5V-5.5V to 30.00V @ 0.02A

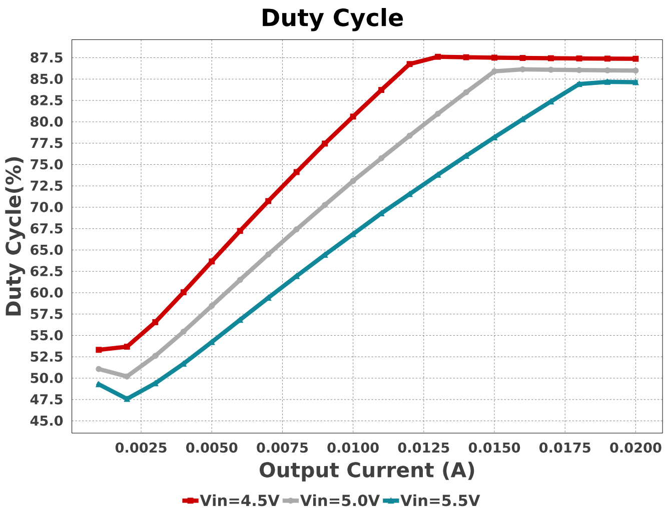


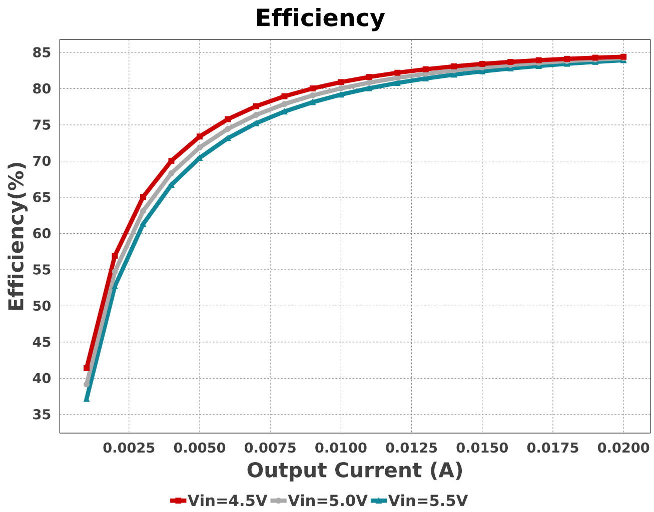
Electrical BOM

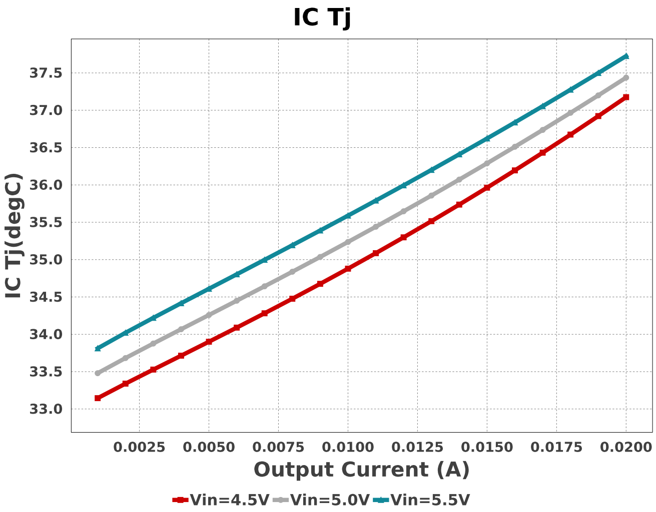
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cf	Samsung Electro-Mechanics	CL21C101JBANNNC Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Cin	MuRata	GRM188R71A225KE15D Series= X7R	Cap= 2.2 uF ESR= 9.0 mOhm VDC= 10.0 V IRMS= 3.3 A	1	$0.02	0603 5 mm^2
Cout	TDK	C2012X5R1H475K125AB Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.3 A	1	$0.12	0805 7 mm^2
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.03	SOD-123F 12 mm^2
L1	NIC Components	NPI32C100MTRF	L= 10.0 µH 350.0 mOhm	1	$0.07	IND_NPI32C 21 mm^2
Rfbb	Vishay-Dale	CRCW040213K3FKED Series= CRCW..e3	Res= 13.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402316KFKED Series= CRCW..e3	Res= 316.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rp	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LM2733XMF/NOPB	Switcher	1	$0.92	MF05A 15 mm^2

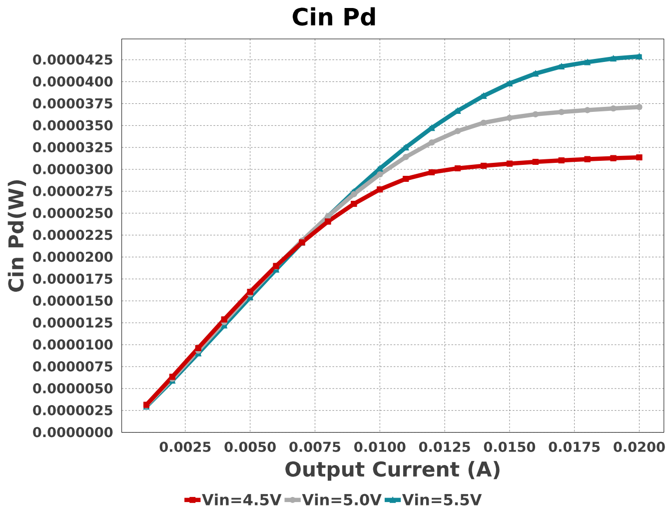

L Ipp
L Ipp(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

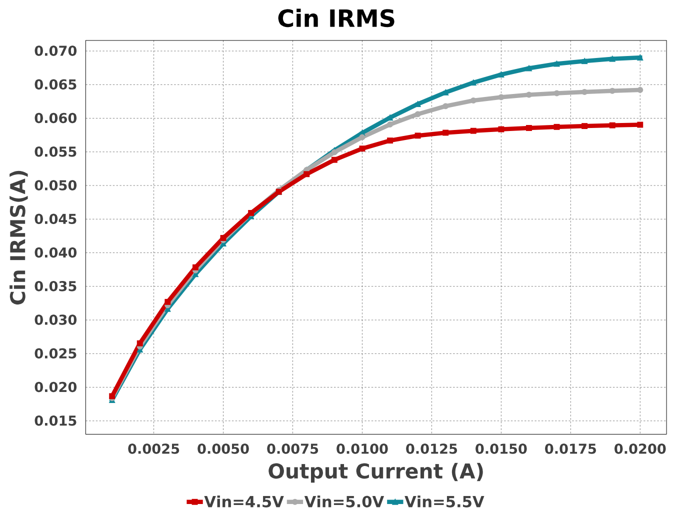

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

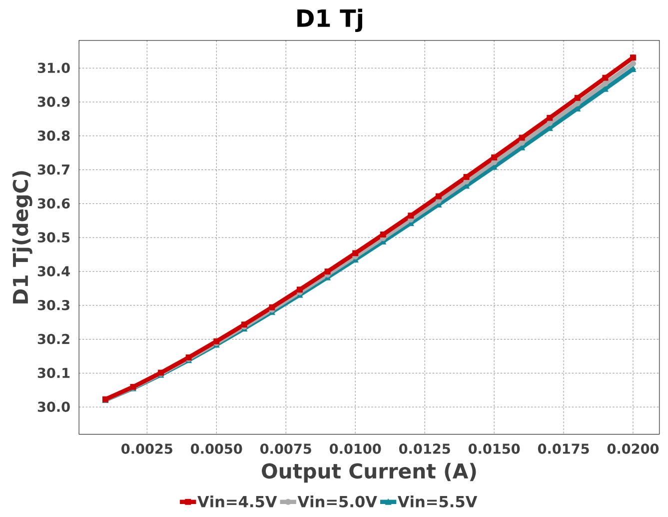

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

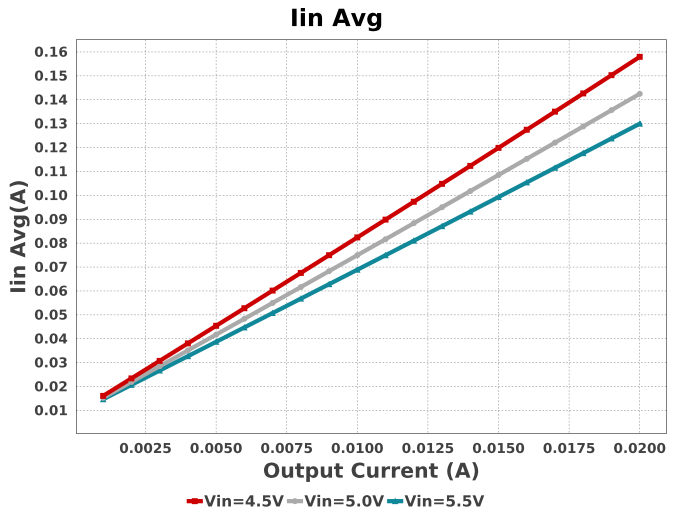

Efficiency
Efficiency(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

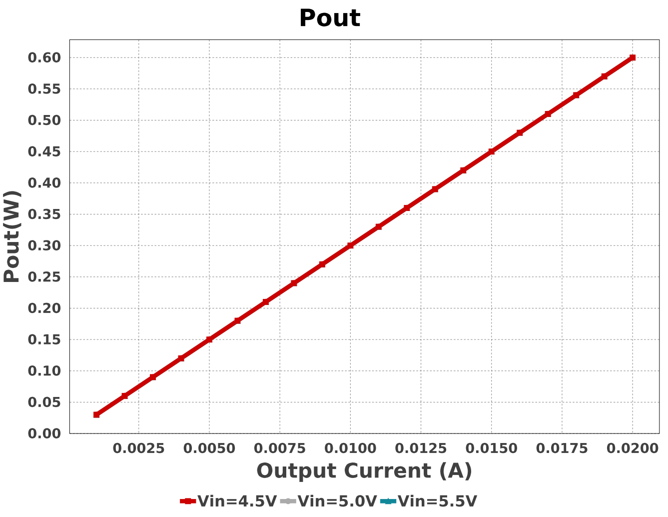

IC Tj
IC Tj(degC)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

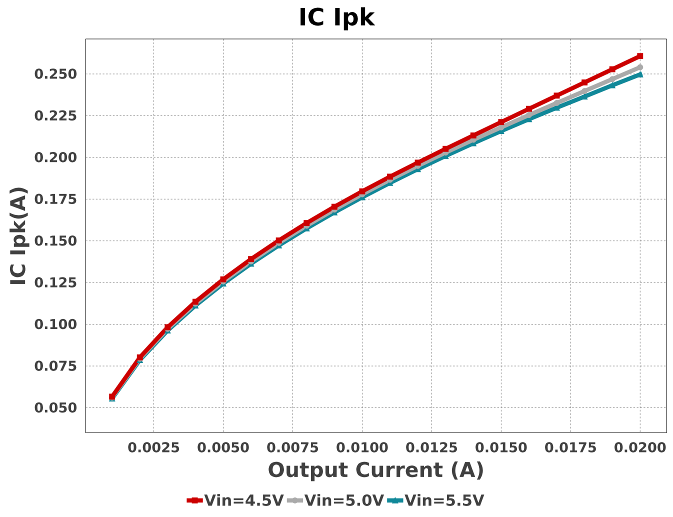

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

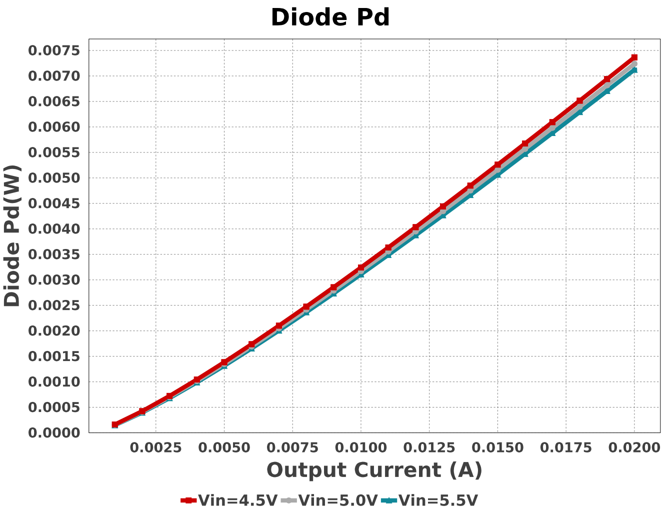

Cin IRMS
Cin IRMS(A)
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V

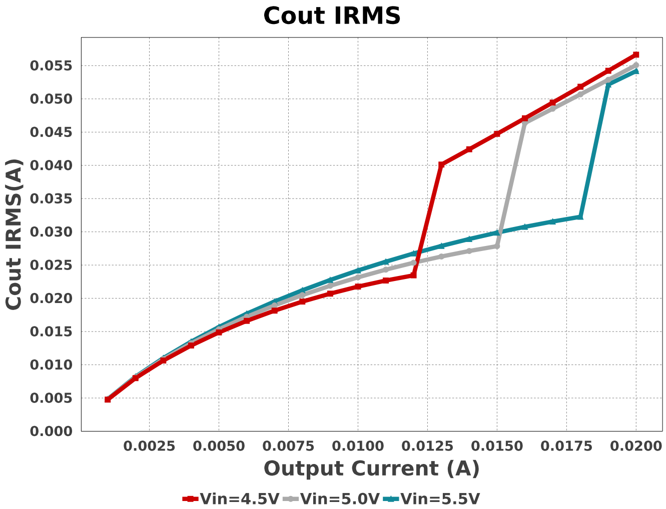

D1 Tj
D1 Tj(degC)
31.0
30.9
30.8
30.7
30.6
30.5
30.4
30.3
30.2
30.1
30.0
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V

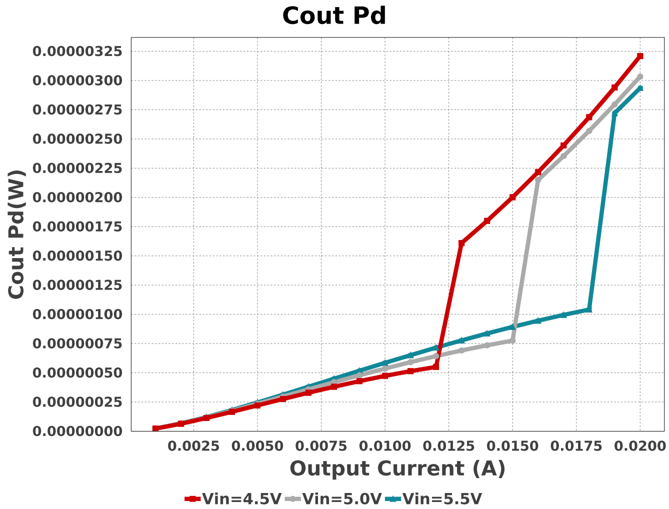

Iin Avg
Iin Avg(A)
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V

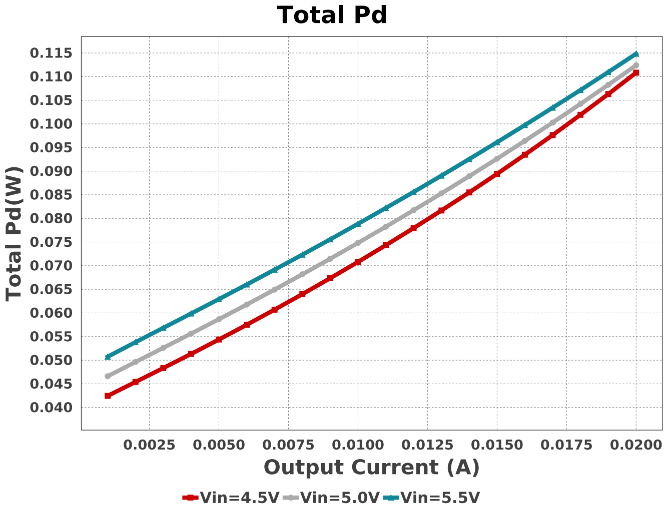

Pout
Pout(W)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V

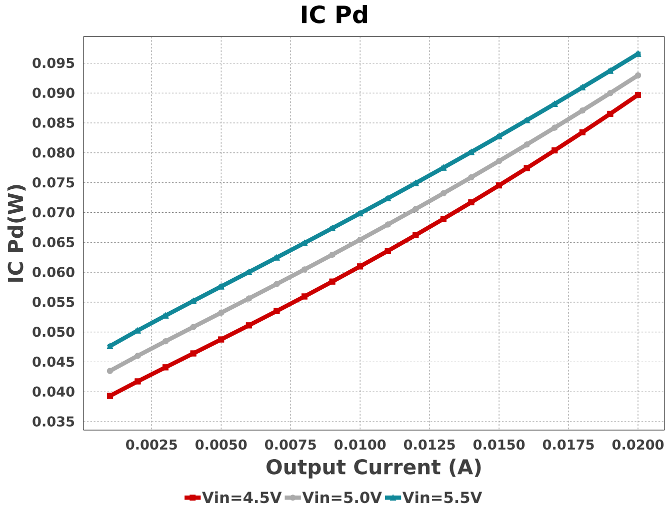

IC Ipk
IC Ipk(A)
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V

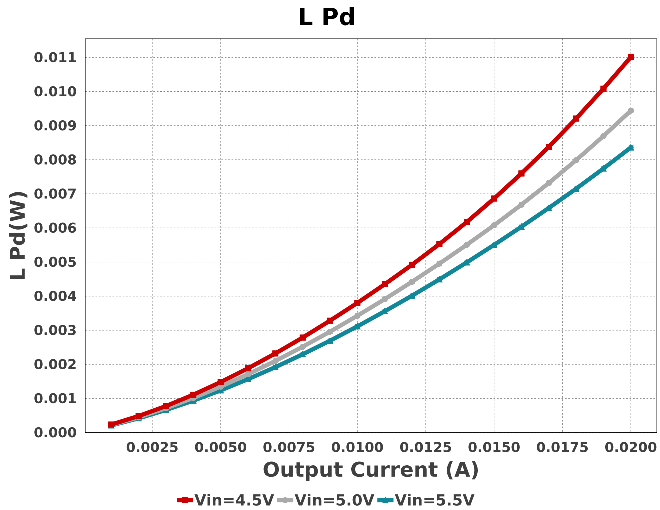

Diode Pd
Diode Pd(W)
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
0.0025
0.0050
0.0075
0.0100
0.0125
0.0150
0.0175
0.0200
Output Current (A)
Vin=4.5V
Vin=5.0V
Vin=5.5V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	59.035 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	31.366 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	56.648 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	3.209 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	31.031 degC	Diode	D1 junction temperature
6.	Diode Pd	7.365 mW	Diode	Diode power dissipation
7.	IC Ipk	260.707 mA	IC	Peak switch current in IC
8.	IC Pd	89.691 mW	IC	IC power dissipation
9.	IC Tj	37.175 degC	IC	IC junction temperature
10.	Iin Avg	157.96 mA	IC	Average input current
11.	L Ipp	204.503 mA	Inductor	Peak-to-peak inductor ripple current

#	Name	Value	Category	Description
12.	L Pd	11.008 mW	Inductor	Inductor power dissipation
13.	Cin Pd	31.366 µW	Power	Input capacitor power dissipation
14.	Cout Pd	3.209 µW	Power	Output capacitor power dissipation
15.	Diode Pd	7.365 mW	Power	Diode power dissipation
16.	IC Pd	89.691 mW	Power	IC power dissipation
17.	L Pd	11.008 mW	Power	Inductor power dissipation
18.	Total Pd	110.831 mW	Power	Total Power Dissipation
19.	BOM Count	9	System Information	Total Design BOM count
20.	Duty Cycle	87.378 %	System Information	Duty cycle
21.	Efficiency	84.408 %	System Information	Steady state efficiency
22.	FootPrint	75.0 mm^2	System Information	Total Foot Print Area of BOM components
23.	Frequency	1.6 MHz	System Information	Switching frequency
24.	Iout	20.0 mA	System Information	Iout operating point
25.	Mode	CCM	System Information	Conduction Mode
26.	Pout	600.0 mW	System Information	Total output power
27.	Total BOM	$1.204	System Information	Total BOM Cost
28.	Vin	4.5 V	System Information	Vin operating point
29.	Vout Actual	30.454 V	System Information	Vout Actual calculated based on selected voltage divider resistors
30.	Vout Tolerance	4.011 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
31.	Vout p-p	260.707 µV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	20.0 m	Maximum Output Current
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	30.0	Output Voltage
base_pn	LM2733X	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

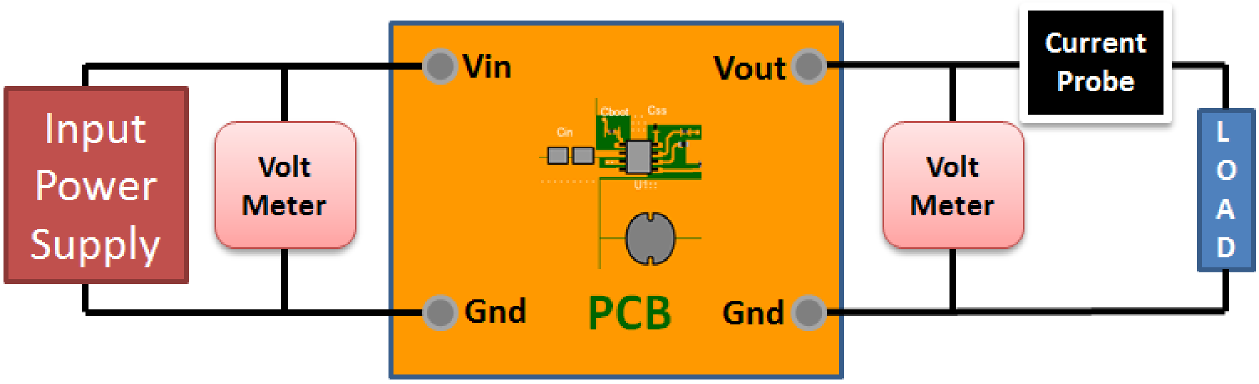
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 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 : BC5209B3293B6F833461C515FCD314A8[v1]

2. **LM2733X** Product Folder : http://www.ti.com/product/LM2733 : contains the data sheet and other resources.

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