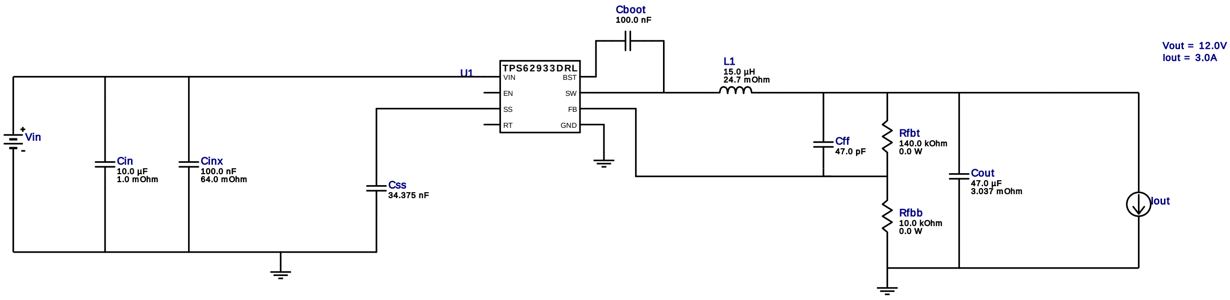
VinMin = 21.0V
VinMax = 29.0V
Vout = 12.0V
Iout = 3.0A

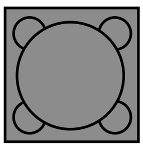
Device = TPS62933DRLR
Topology = Buck
Created = 2023-10-04 00:13:21.644
BOM Cost = NA
BOM Count = 10
Total Pd = 1.62W

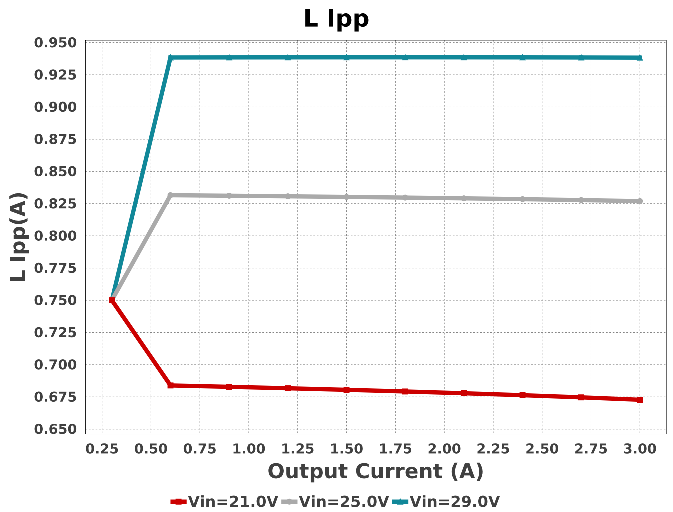
WEBENCH ® Design Report

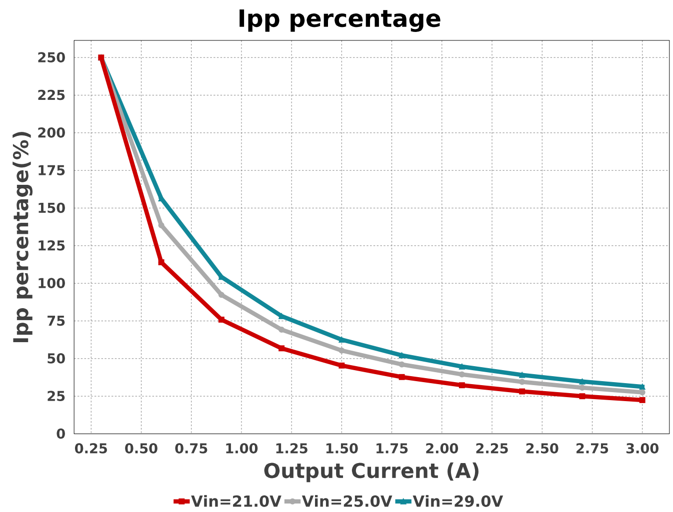
Design : 7 TPS62933DRLR
TPS62933DRLR 21V-29V to 12.00V @ 3A

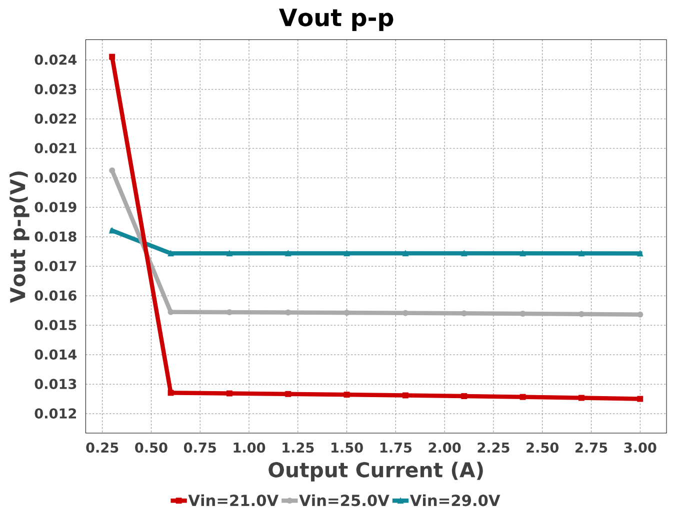


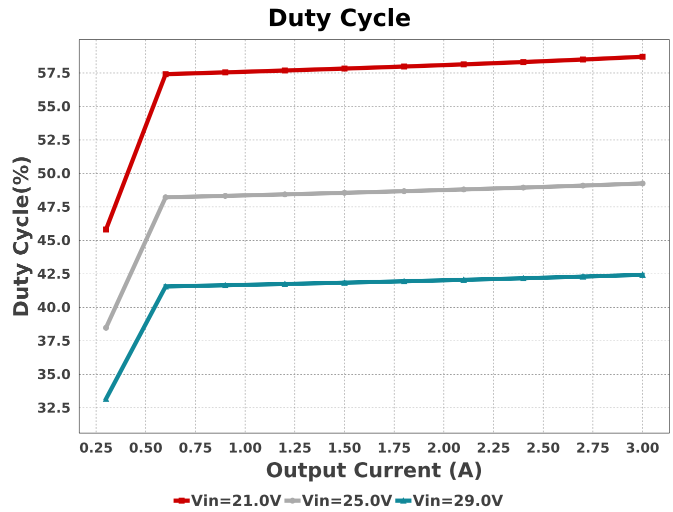
Electrical BOM

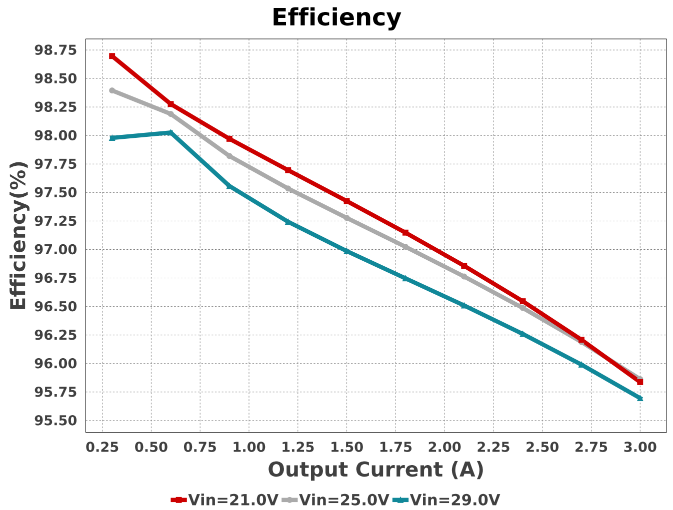
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	CUSTOM	CUSTOM Series= ?	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cff	CUSTOM	CUSTOM Series= ?	Cap= 47.0 pF VDC= 24.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cin	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.9 A	1	$0.24	1206_180 11 mm^2
Cinx	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Cout	MuRata	GRM32ER61C476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	1	$0.17	1210_280 15 mm^2
Css	CUSTOM	CUSTOM Series= ?	Cap= 34.375 nF VDC= 10.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
L1	Coiltronics	DR127-150-R	L= 15.0 µH 24.7 mOhm	1	$0.66	 DR127 210 mm^2
Rfbb	CUSTOM	CUSTOM Series= ?	Res= 10.0 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rfbt	CUSTOM	CUSTOM Series= ?	Res= 140.0 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	TPS62933DRLR	Switcher	1	$0.18	DRL0008A-MFG 9 mm^2

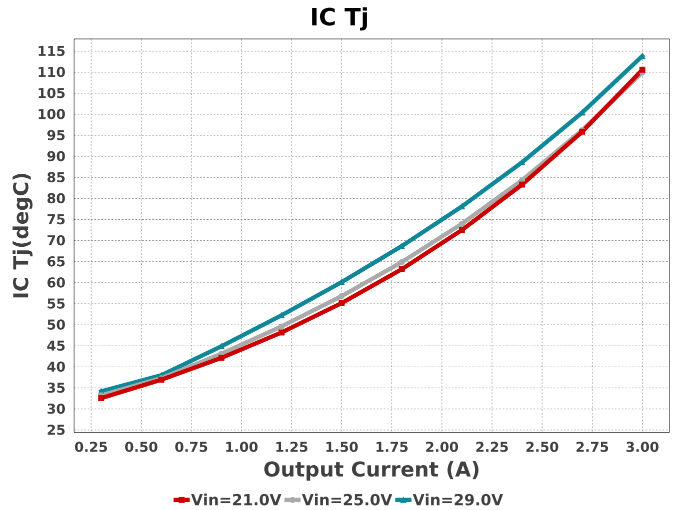

L Ipp
L Ipp(A)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

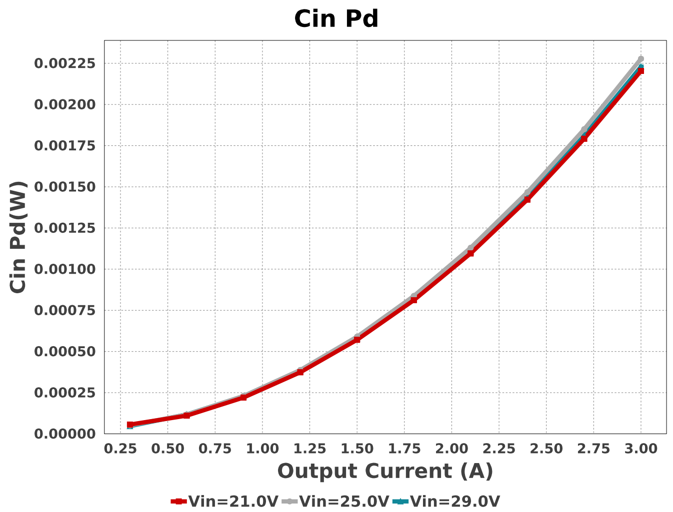

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

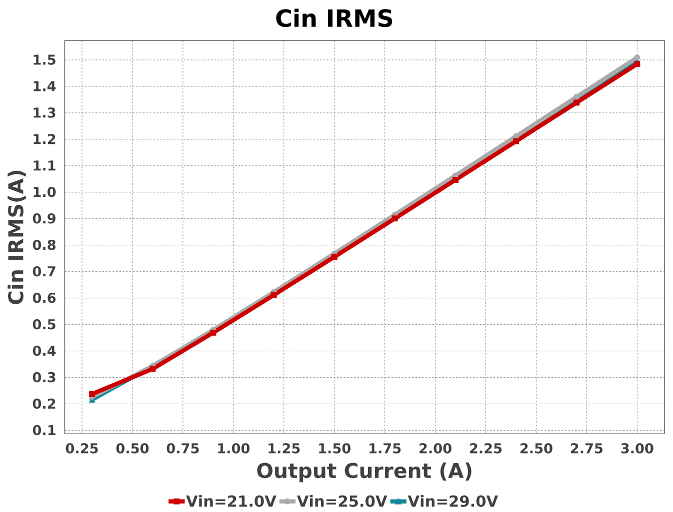

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

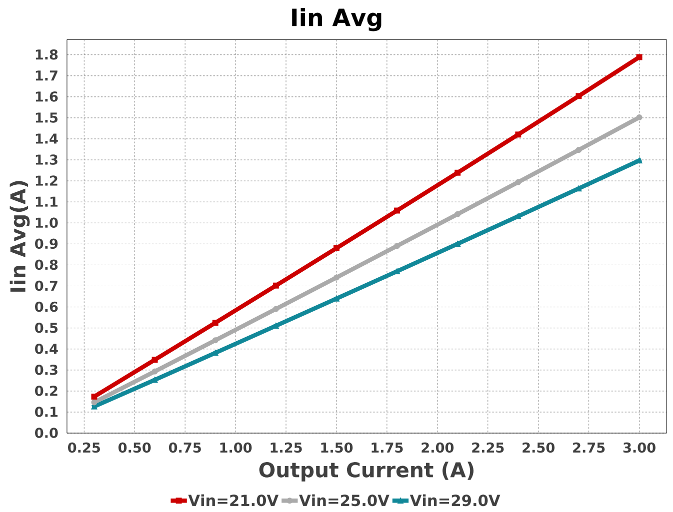

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

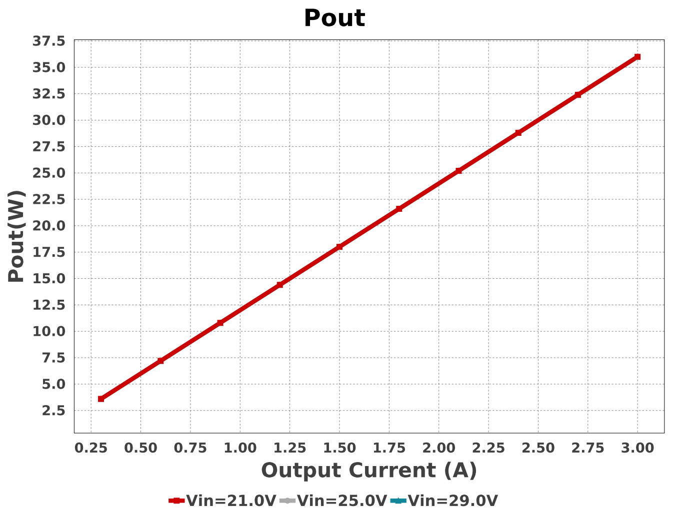

Efficiency
Efficiency(%)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

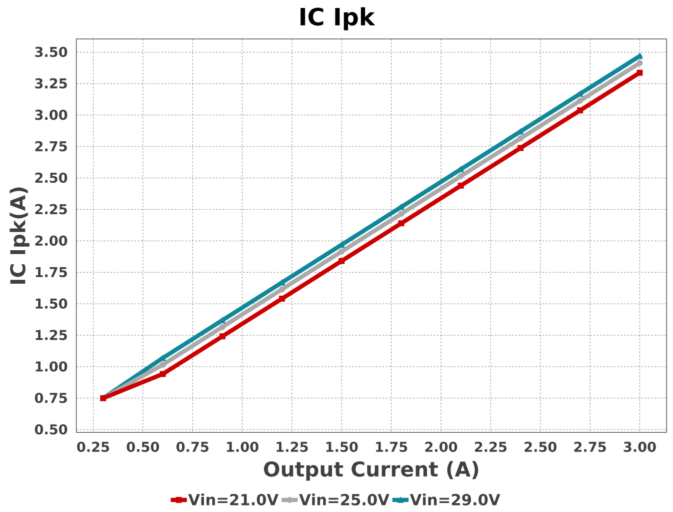

IC Tj
IC Tj(degC)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

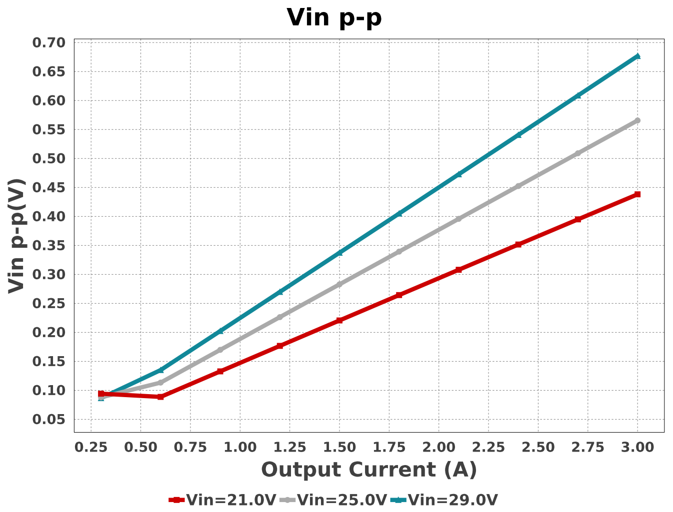

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

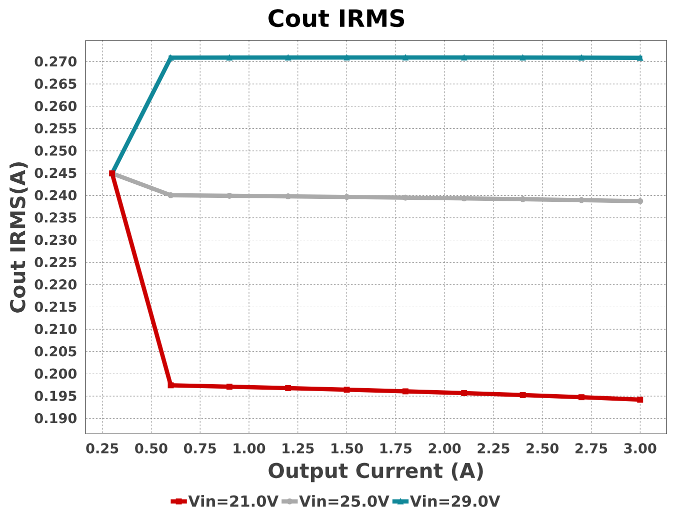

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

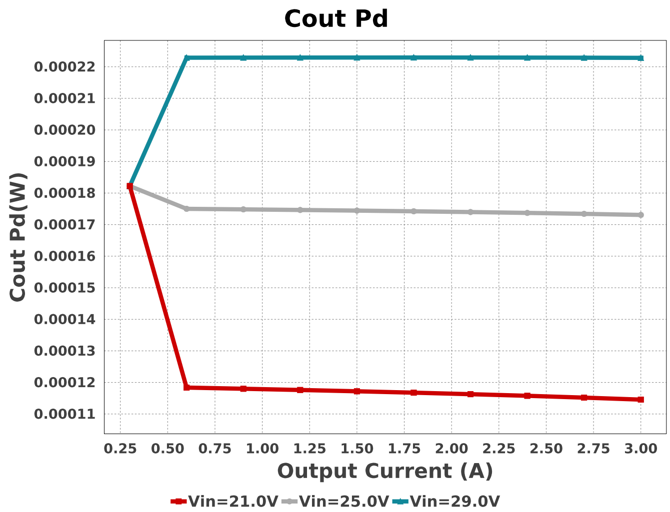

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

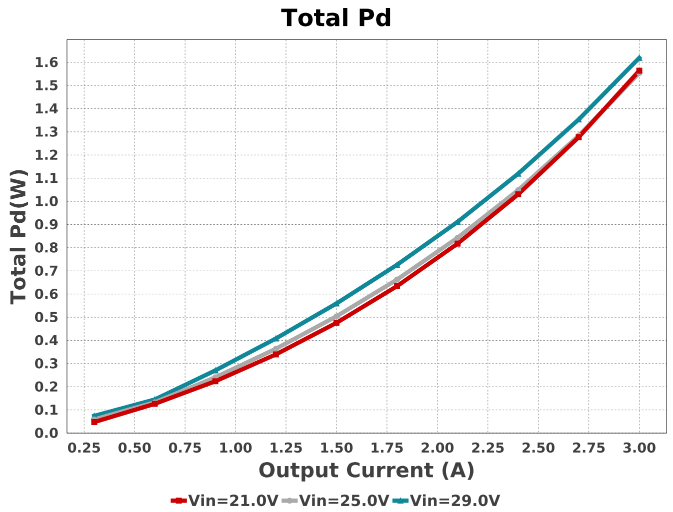

Pout
Pout(W)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

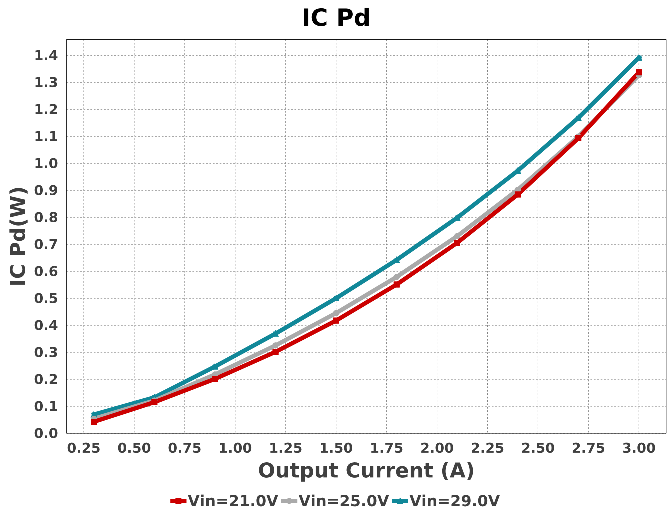

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

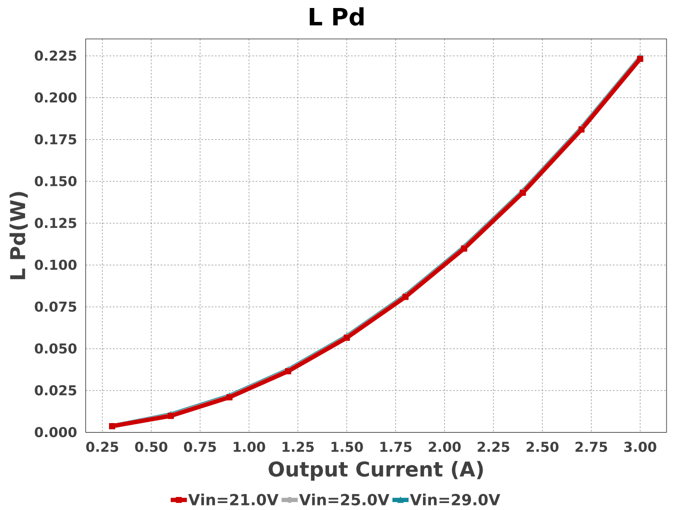

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

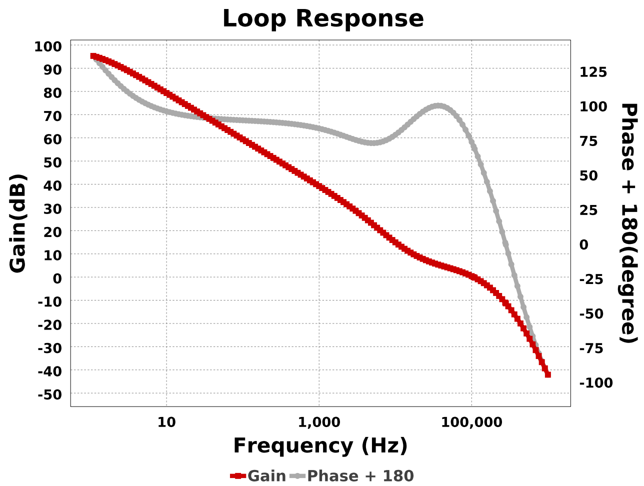

Cout IRMS
Cout IRMS(A)
0.270
0.265
0.260
0.255
0.250
0.245
0.240
0.235
0.230
0.225
0.220
0.215
0.210
0.205
0.200
0.195
0.190
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V

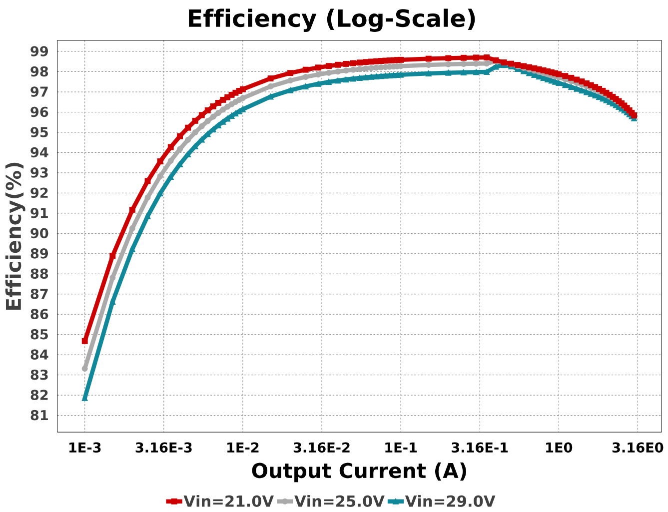

Cout Pd
Cout Pd(W)
0.00022
0.00021
0.00020
0.00019
0.00018
0.00017
0.00016
0.00015
0.00014
0.00013
0.00012
0.00011
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V


Total Pd
Total Pd(W)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V


IC Pd
IC Pd(W)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V


L Pd
L Pd(W)
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=21.0V Vin=25.0V Vin=29.0V


Loop Response
Gain(dB)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
Phase + 180(degree)
125
100
75
50
25
0
-25
-50
-75
-100
10
1,000
100,000
Frequency (Hz)
Gain Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.493 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	2.23 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	270.869 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	222.83 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	3.469 A	IC	Peak switch current in IC
6.	IC Pd	1.392 W	IC	IC power dissipation
7.	IC Tj	113.839 degC	IC	IC junction temperature
8.	IC Tolerance	16.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	60.25 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	1.297 A	IC	Average input current
11.	Ipp percentage	31.277 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	938.32 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	224.11 mW	Inductor	Inductor power dissipation
14.	Cin Pd	2.23 mW	Power	Input capacitor power dissipation
15.	Cout Pd	222.83 µW	Power	Output capacitor power dissipation
16.	IC Pd	1.392 W	Power	IC power dissipation
17.	L Pd	224.11 mW	Power	Inductor power dissipation
18.	Total Pd	1.619 W	Power	Total Power Dissipation
19.	BOM Count	10	System Information	Total Design BOM count
20.	Cross Freq	105.922 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	42.434 %	System Information	Duty cycle
22.	Efficiency	95.696 %	System Information	Steady state efficiency
23.	FootPrint	276.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	500.0 kHz	System Information	Switching frequency
25.	Gain Marg	-11.321 dB	System Information	Bode Plot Gain Margin
26.	Inductor ripple current requirement used for Inductor selection	40.0 %	System Information	Custom Inductor ripple current (% of average inductor current) requirement used for Inductor selection
27.	Iout	3.0 A	System Information	Iout operating point
28.	Iout transient step used for Cout calculations	1.5 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
29.	Low Freq Gain	95.298 dB	System Information	Gain at 1Hz
30.	Mode	CCM	System Information	Conduction Mode
31.	Overshoot Value	103.802 mV	System Information	Theoretical Vout Overshoot Value
32.	Phase Marg	71.293 deg	System Information	Bode Plot Phase Margin
33.	Pout	36.0 W	System Information	Total output power
34.	Total BOM	NA	System Information	Total BOM Cost

#	Name	Value	Category	Description
35.	Undershoot Value	203.084 mV	System Information	Theoretical Vout Undershoot Value
36.	Vin	29.0 V	System Information	Vin operating point
37.	Vin p-p	676.753 mV	System Information	Peak-to-peak input voltage
38.	Vout	12.0 V	System Information	Operational Output Voltage
39.	Vout Actual	12.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
41.	Vout Tolerance	2.0 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
42.	Vout p-p	17.435 mV	System Information	Peak-to-peak output ripple voltage
43.	Vout transient requirement used for Cout calculations	3.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	29.0	Maximum input voltage
VinMin	21.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	TPS62933	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

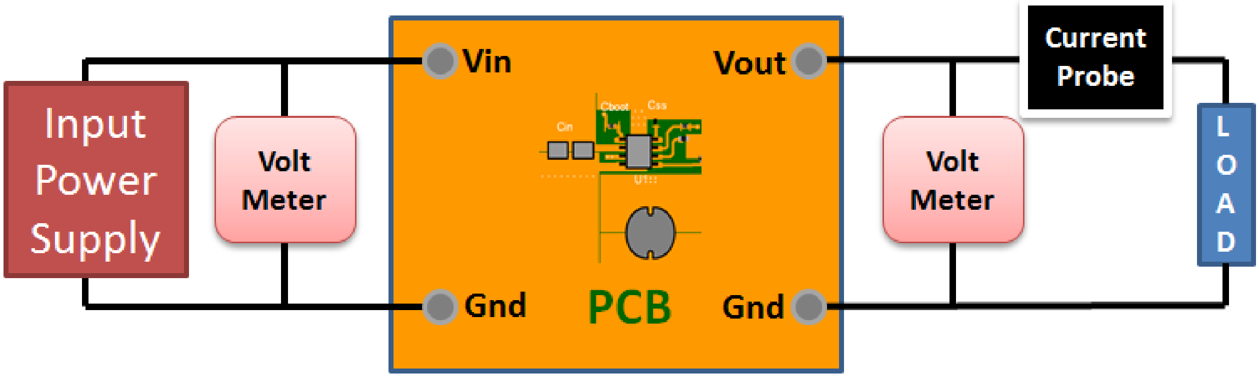
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 21.0V 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.



Design Assistance

1. Master key : EF098BE091BA81F5B1078AEA78AA8DAE[v1]

2. **TPS62933** Product Folder : http://www.ti.com/product/TPS62933 : contains the data sheet and other resources.

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