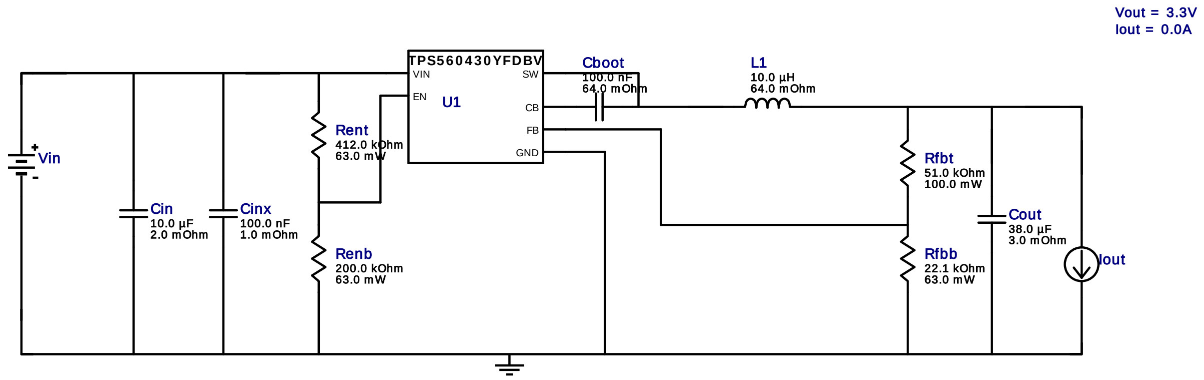
VinMin = 11.0V
VinMax = 13.0V
Vout = 3.3V
Iout = 0.0A

Device = TPS560430YFDBVR
Topology = Buck
Created = 2024-02-20 00:37:57.301
BOM Cost = NA
BOM Count = 10
Total Pd = 0.13W

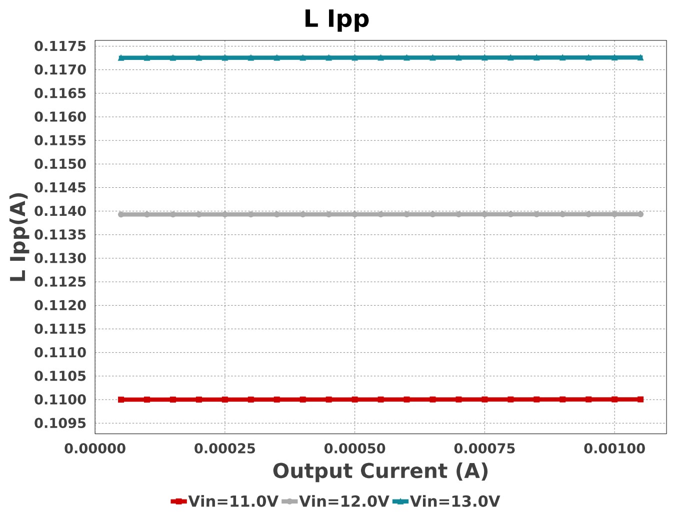
WEBENCH ® Design Report

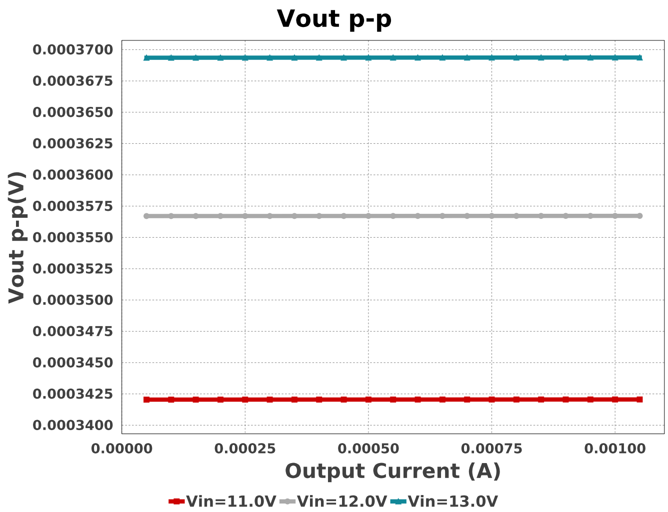
Design : 144 TPS560430YFDBVR
TPS560430YFDBVR 11V-13V to 3.30V @ 0.001A

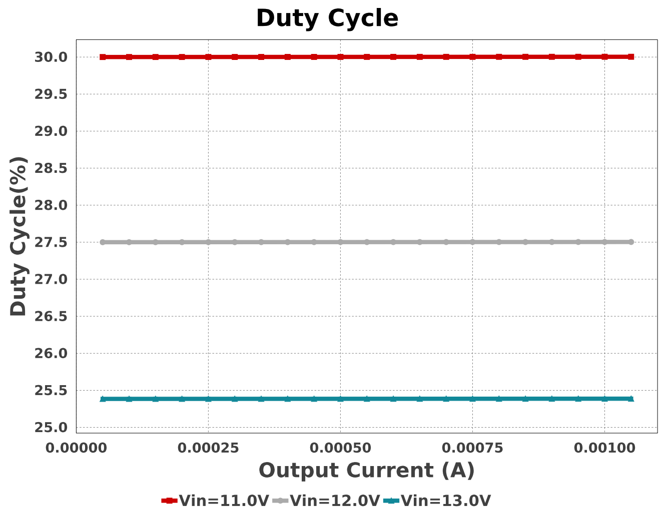


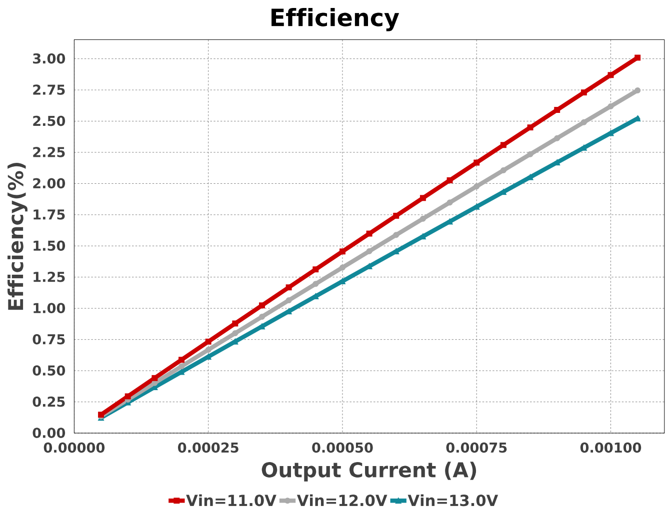
Electrical BOM

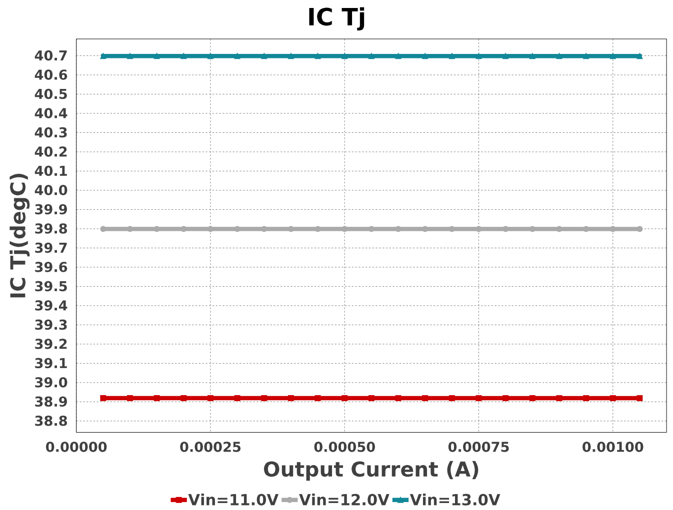
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Cin	CUSTOM	CUSTOM Series= X7R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	NA	1206 0 mm^2
Cinx	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cout	CUSTOM	CUSTOM Series= X7S	Cap= 38.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 5.0498 A	1	NA	0805 0 mm^2
L1	CUSTOM	CUSTOM	L= 10.0 µH 64.0 mOhm	1	NA	IND_NPIS43D 0 mm^2
Renb	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rent	Vishay-Dale	CRCW0402412KFKED Series= CRCW..e3	Res= 412.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC0603FR-0751KL Series= ?	Res= 51.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
U1	Texas Instruments	TPS560430YFDBVR	Switcher	1	$0.32	DBV0006A_N 15 mm^2

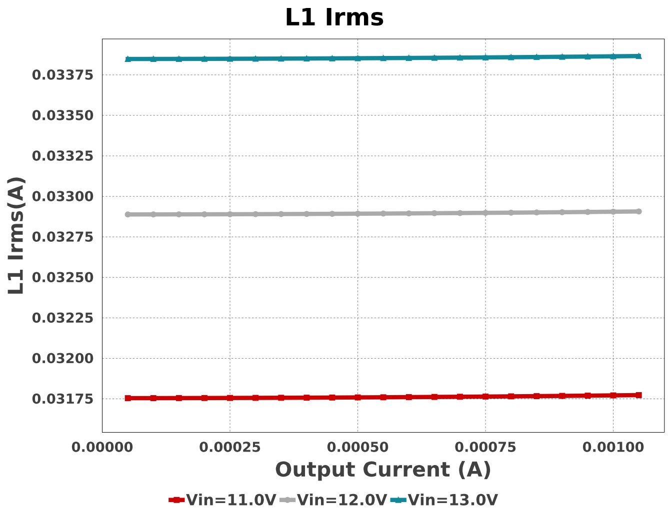

L Ipp
L Ipp(A)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

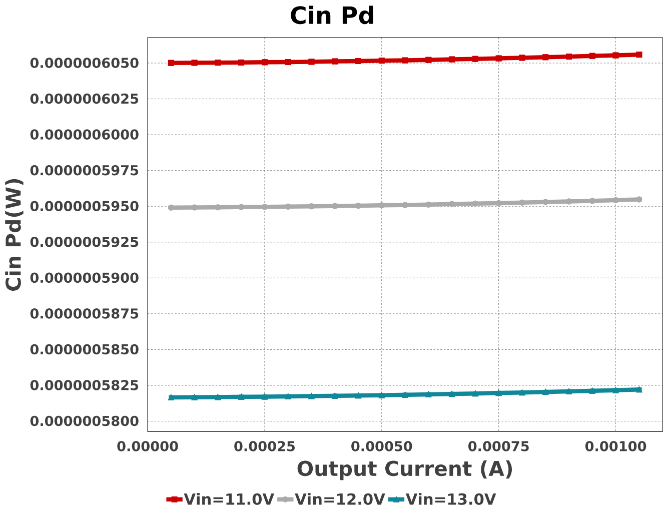

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

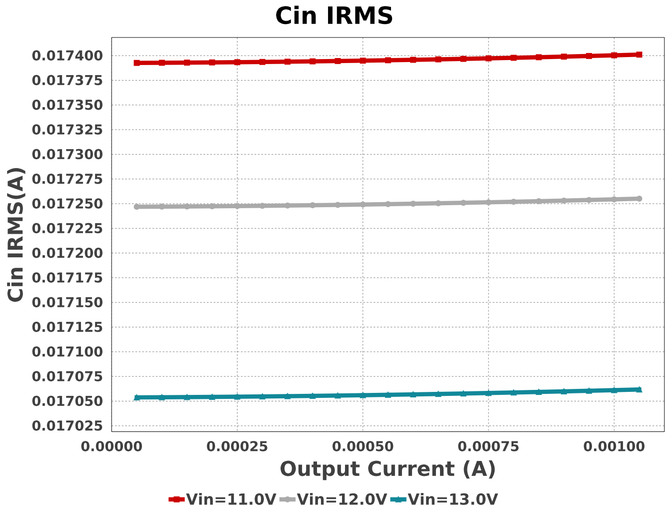

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

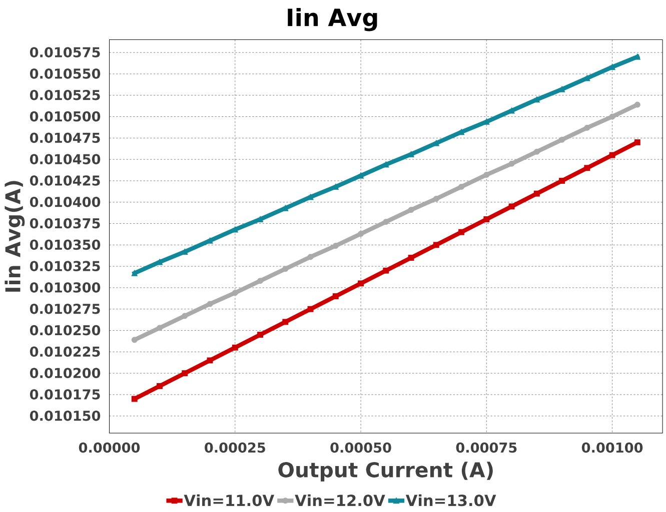

Efficiency
Efficiency(%)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

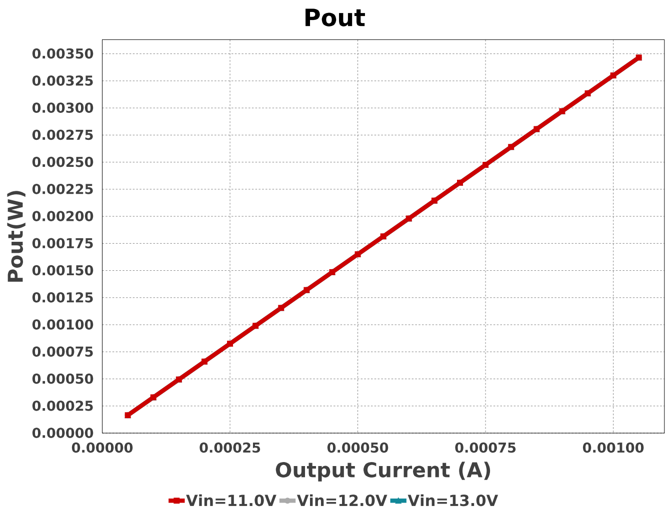

IC Tj
IC Tj(degC)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

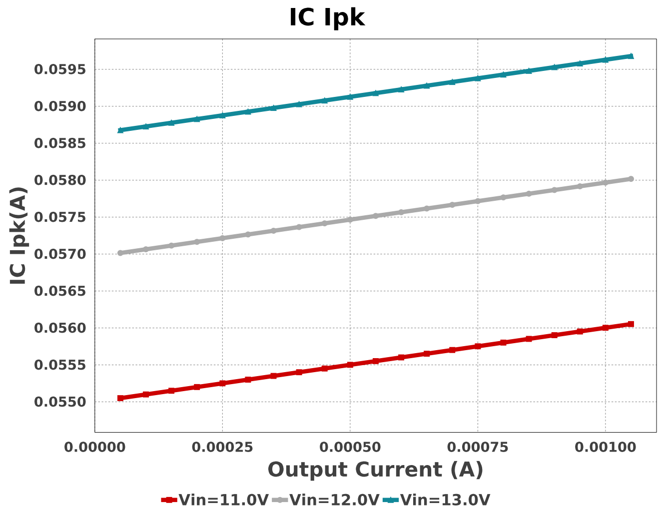

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=11.0V Vin=12.0V Vin=13.0V

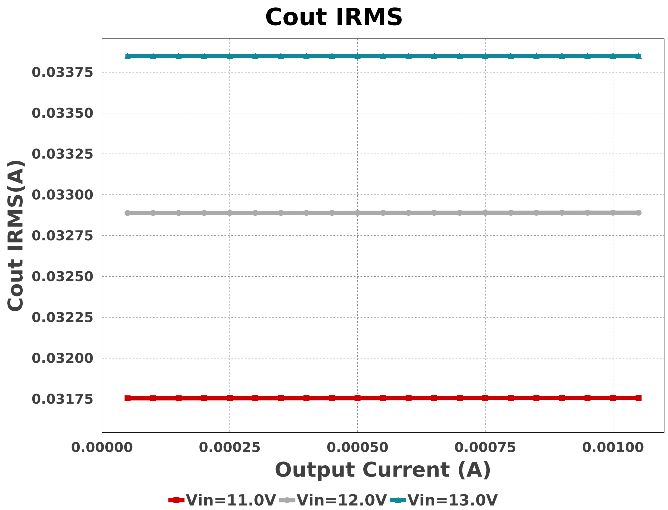

Cin Pd
Cin Pd(W)
0.0000006050
0.0000006025
0.0000006000
0.0000005975
0.0000005950
0.0000005925
0.0000005900
0.0000005875
0.0000005850
0.0000005825
0.0000005800
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

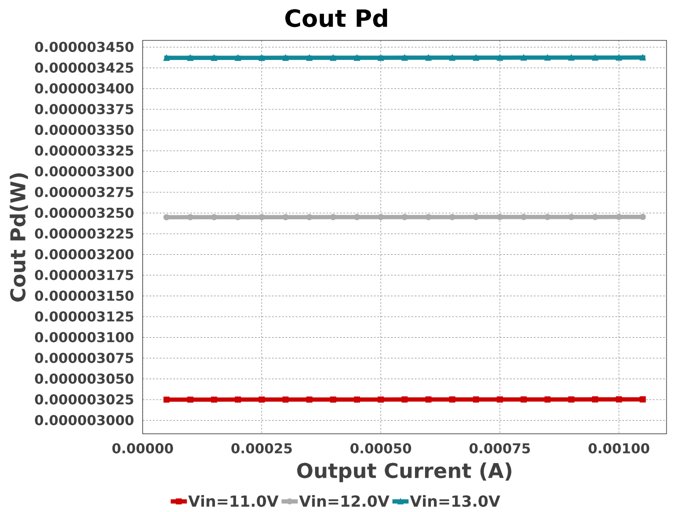

Cin IRMS
Cin IRMS(A)
0.017400
0.017375
0.017350
0.017325
0.017300
0.017275
0.017250
0.017225
0.017200
0.017175
0.017150
0.017125
0.017100
0.017075
0.017050
0.017025
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

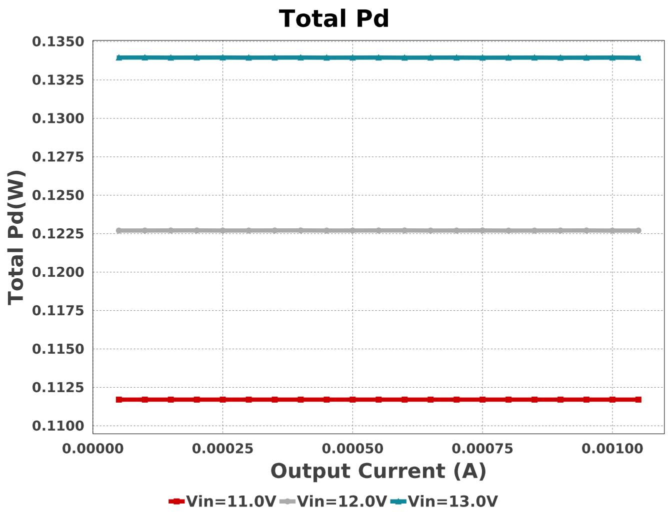

Iin Avg
Iin Avg(A)
0.010575
0.010550
0.010525
0.010500
0.010475
0.010450
0.010425
0.010400
0.010375
0.010350
0.010325
0.010300
0.010275
0.010250
0.010225
0.010200
0.010175
0.010150
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

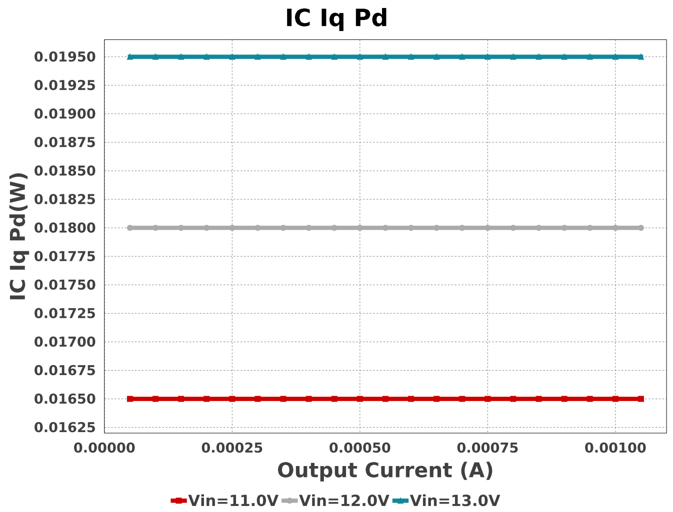

Pout
Pout(W)
0.00350
0.00325
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

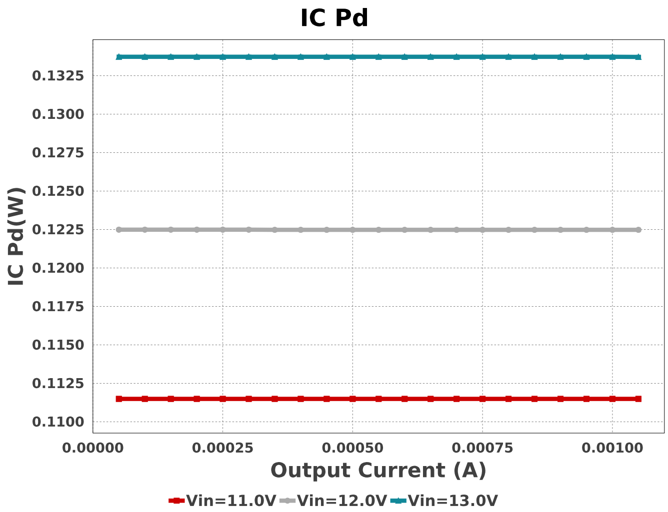

IC Ipk
IC Ipk(A)
0.0595
0.0590
0.0585
0.0580
0.0575
0.0570
0.0565
0.0560
0.0555
0.0550
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

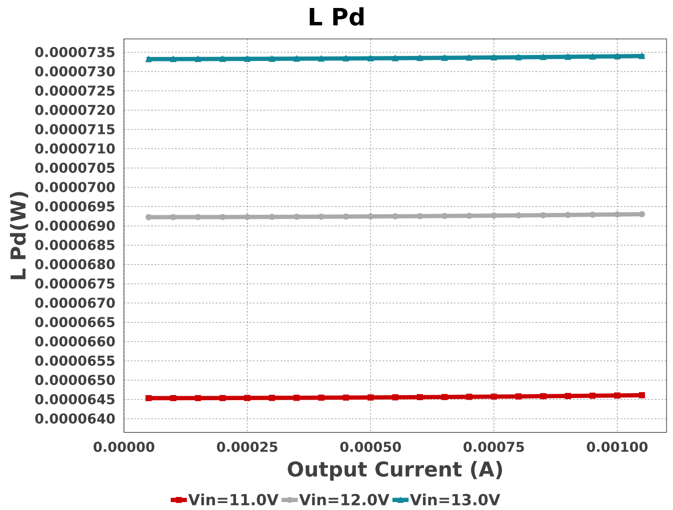

Cout IRMS
Cout IRMS(A)
0.03375
0.03350
0.03325
0.03300
0.03275
0.03250
0.03225
0.03200
0.03175
0.00000
0.00025
0.00050
0.00075
0.00100
Output Current (A)
Vin=11.0V
Vin=12.0V
Vin=13.0V

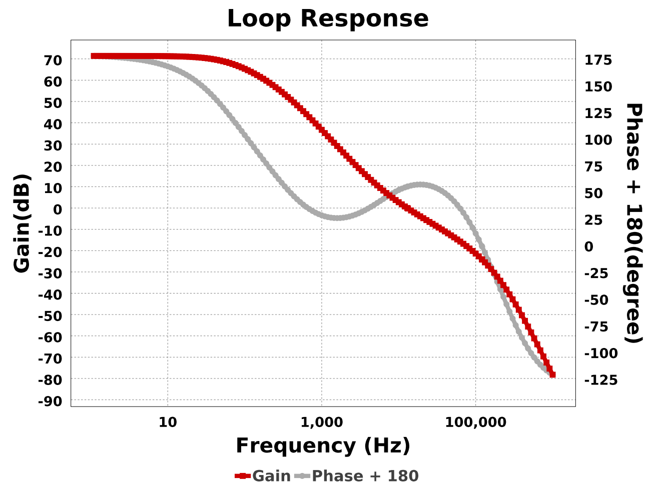












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	10		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	17.061 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	582.16 nW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	33.85 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	3.437 µW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	59.63 mA	IC	Peak switch current in IC
8.	IC Iq Pd	19.5 mW	IC	IC Iq Pd
9.	IC Pd	133.73 mW	IC	IC power dissipation
10.	IC Tj	40.698 degC	IC	IC junction temperature
11.	ICThetaJA Effective	80.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance

#	Name	Value	Category	Description
12.	Iin Avg	10.558 mA	IC	Average input current
13.	L Ipp	117.259 mA	Inductor	Peak-to-peak inductor ripple current
14.	L Pd	73.396 µW	Inductor	Inductor power dissipation
15.	L1 Irms	33.865 mA	Inductor	Inductor ripple current
16.	Cin Pd	582.16 nW	Power	Input capacitor power dissipation
17.	Cout Pd	3.437 µW	Power	Output capacitor power dissipation
18.	IC Pd	133.73 mW	Power	IC power dissipation
19.	L Pd	73.396 µW	Power	Inductor power dissipation
20.	Total Pd	133.954 mW	Power	Total Power Dissipation
21.	Cross Freq	12.923 kHz	System Information	Bode plot crossover frequency
22.	Duty Cycle	25.387 %	System Information	Duty cycle
23.	Efficiency	2.404 %	System Information	Steady state efficiency
24.	FootPrint	105.0 mm^2	System Information	Total Foot Print Area of BOM components
25.	Frequency	2.1 MHz	System Information	Switching frequency
26.	Gain Marg	-24.204 dB	System Information	Bode Plot Gain Margin
27.	Iout	1.0 mA	System Information	Iout operating point
28.	Low Freq Gain	71.385 dB	System Information	Gain at 1Hz
29.	Mode	FCCM	System Information	PWM/FPWM mode of operation
30.	Phase Marg	56.301 deg	System Information	Bode Plot Phase Margin
31.	Pout	3.3 mW	System Information	Total output power
32.	Vin	13.0 V	System Information	Vin operating point
33.	Vout Actual	3.308 V	System Information	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	1.409 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	369.37 µV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0 m	Maximum Output Current
VinMax	13.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
VinTyp	12.0	Typical input voltage
Vout	3.3	Output Voltage
base_pn	TPS560430YF	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

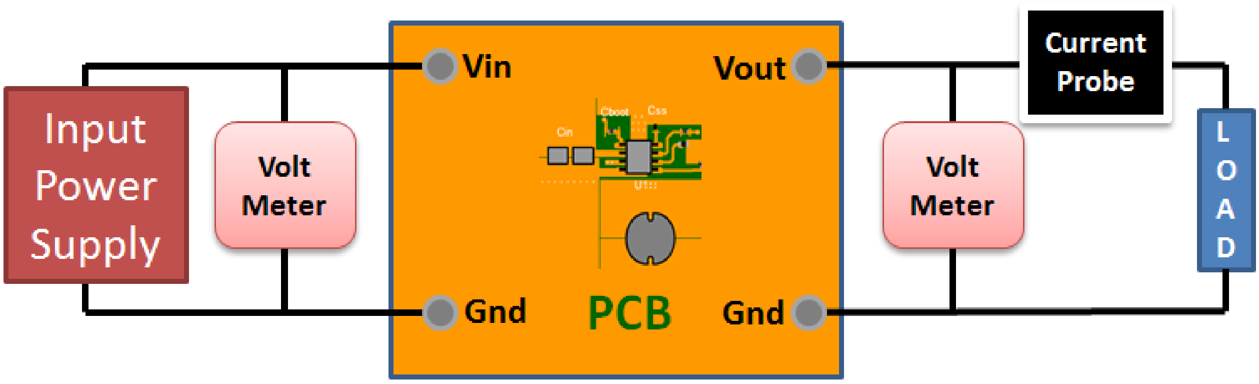
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.0V 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.

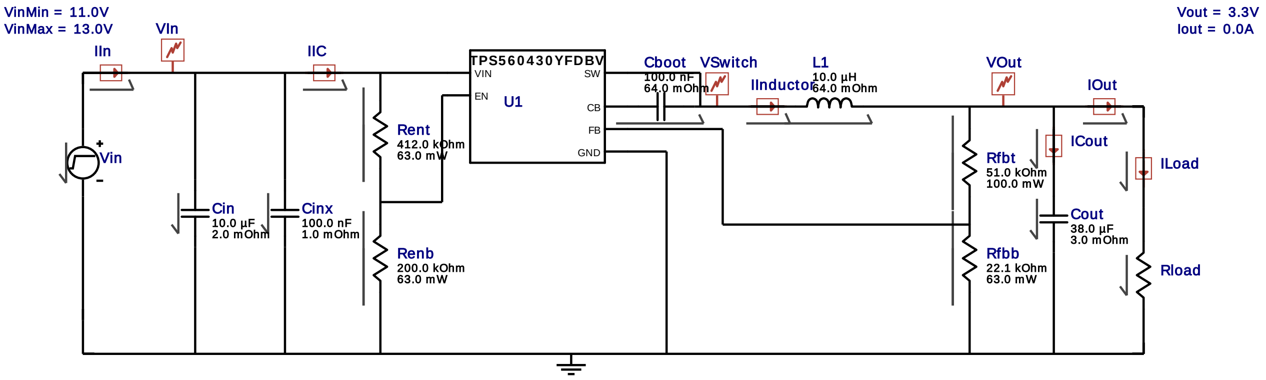


WEBENCH® Electrical Simulation Report

Design Id = 144

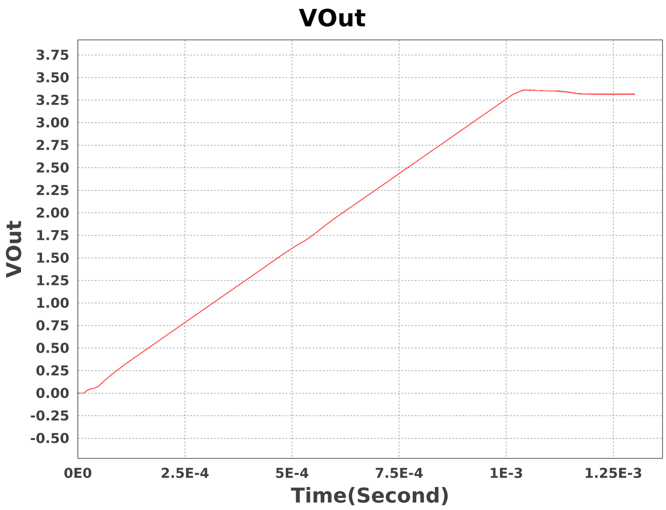
sim_id = 1

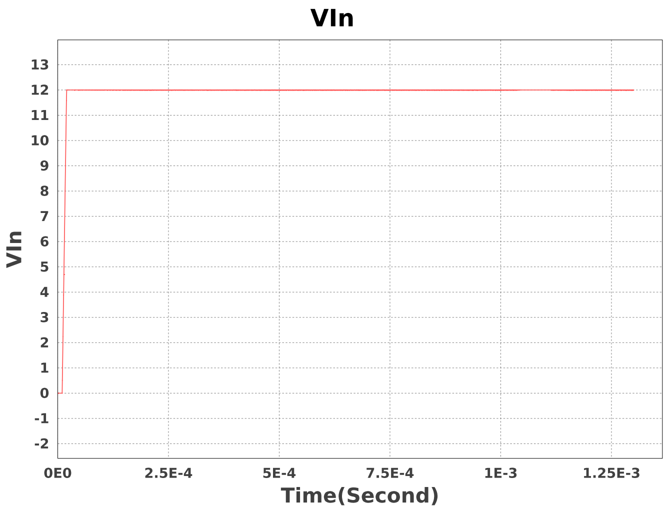
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	3299.9999999999995 Ohm

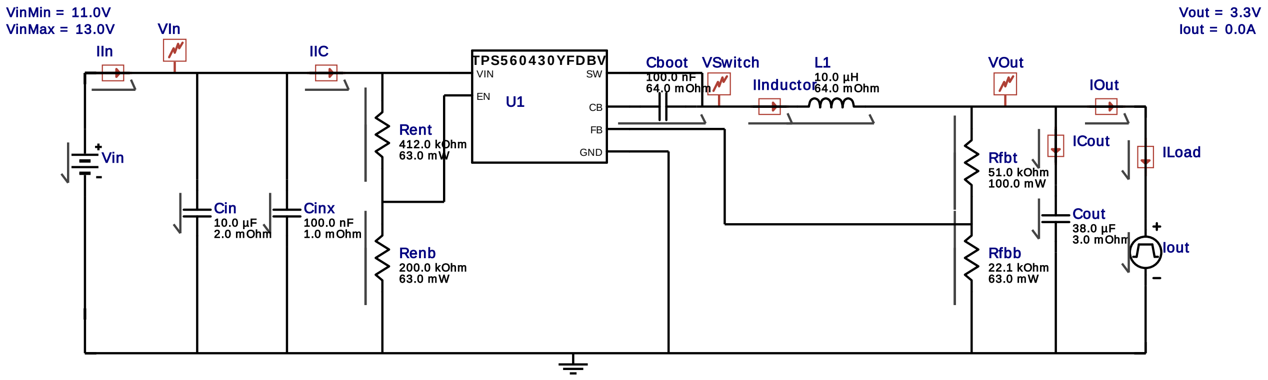




Design Id = 144

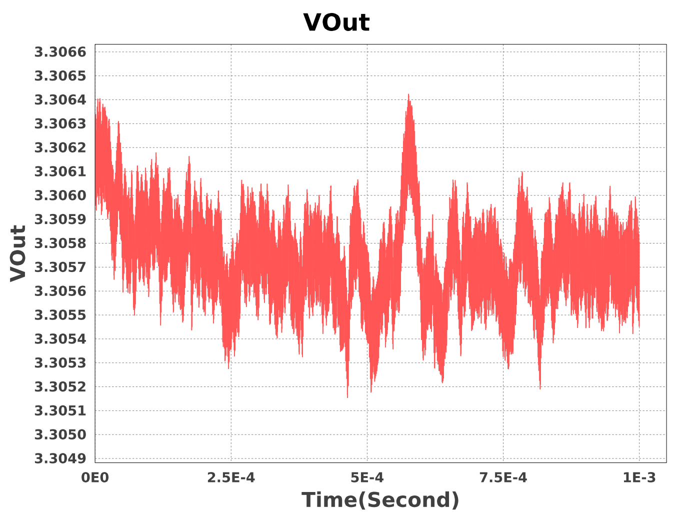
sim_id = 2

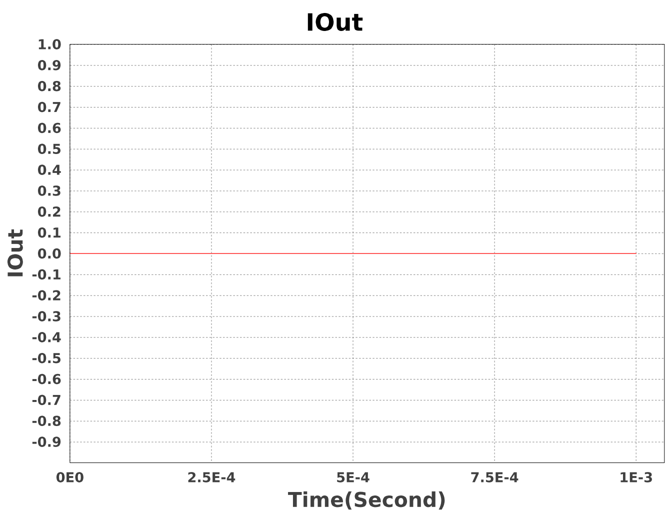
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	3.3 V
2.	L1	IC	Initial Current	0.001 A
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Input Voltage	0.001 A
		I2	Peak Input Voltage	0.001 A
		Td	Initial Time Delay	100u s
		Tr	Rise Time	30u s
		Tf	Fall Time	30u s
		Pw	Pulse Width	500u s

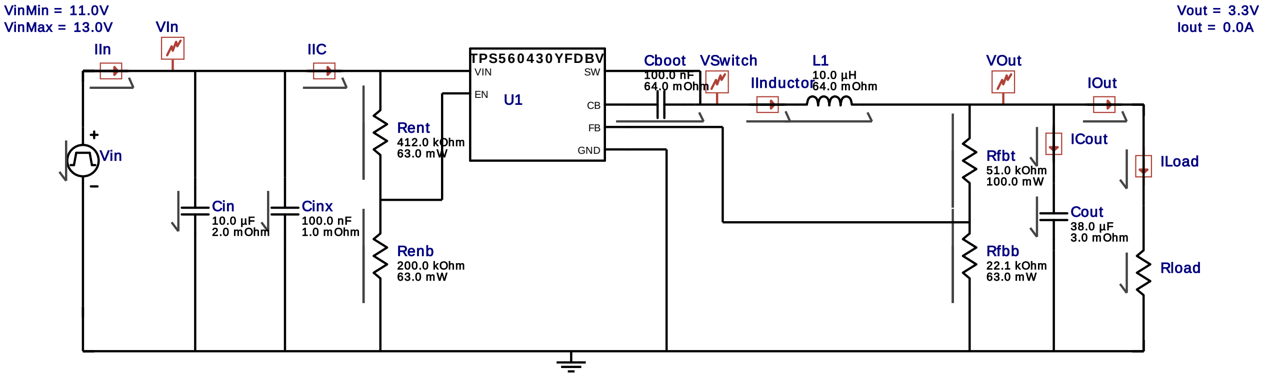




Design Id = 144

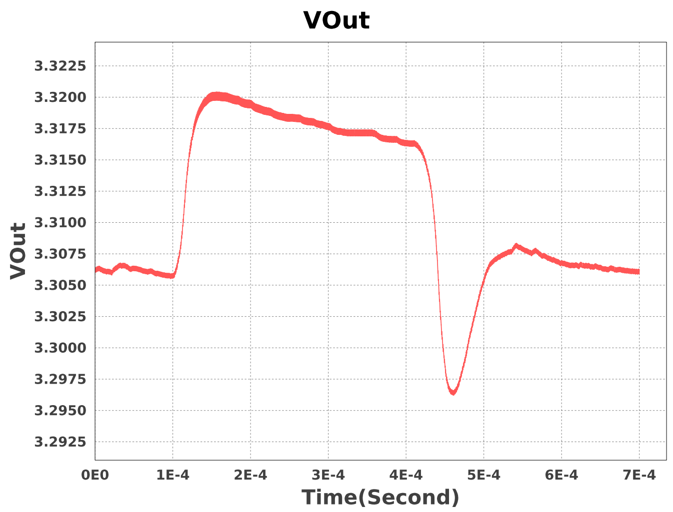
sim_id = 3

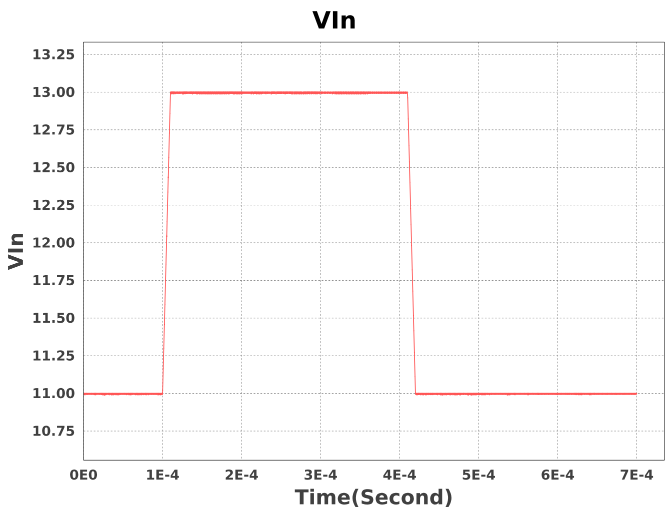
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	3.3 V
2.	L1	IC	Initial Current	0.001 A
3.	Rload	R	Load Resistance	3299.9999999999995 Ohm

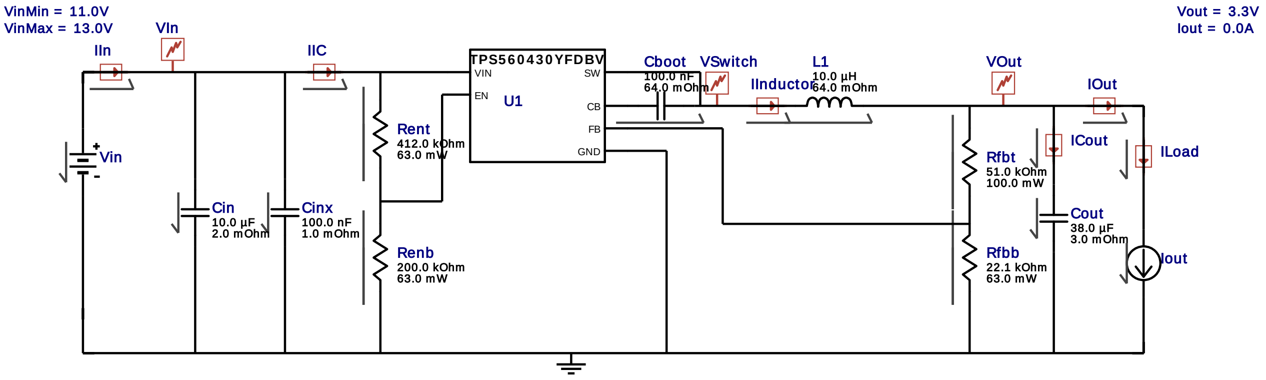




Design Id = 144

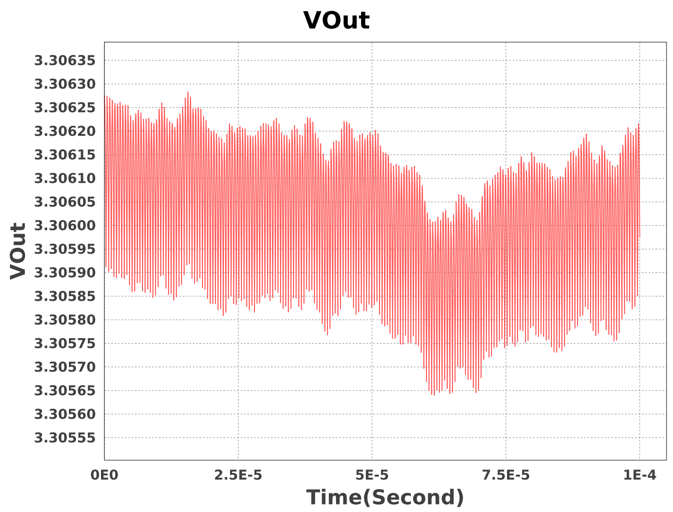
sim_id = 4

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Voltage	3.3 V
2.	L1	IC	Initial Current	0.001 A
3.	Iout	I	Load Current	0.001 A



Design Assistance

1. Master key : BED2B438EB35597A[v1]

2. **TPS560430YF** Product Folder : http://www.ti.com/product/TPS560430 : contains the data sheet and other resources.

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