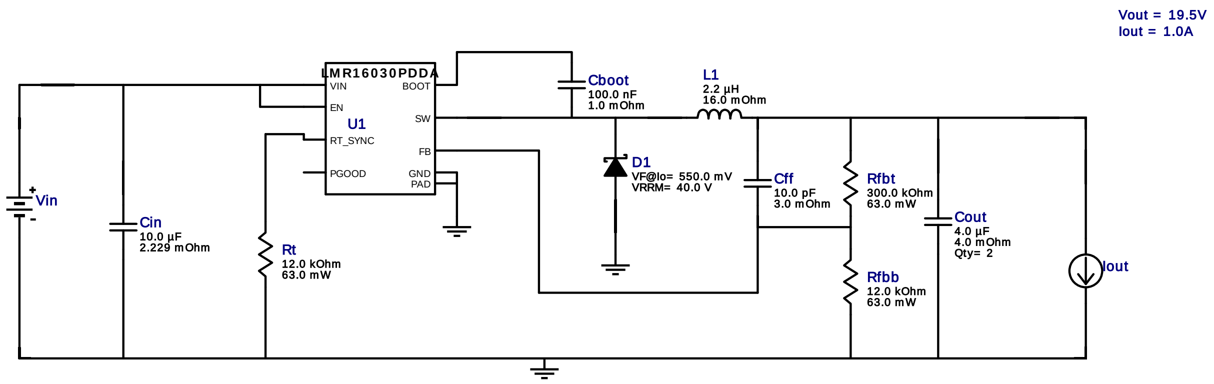
VinMin = 23.0V VinMax = 25.0V Vout = 19.5V Iout = 1.0A	Device = LMR16030PDDA Topology = Buck Created = 2022-12-28 19:54:03.734 BOM Cost = NA BOM Count = 11 Total Pd = 1.1W

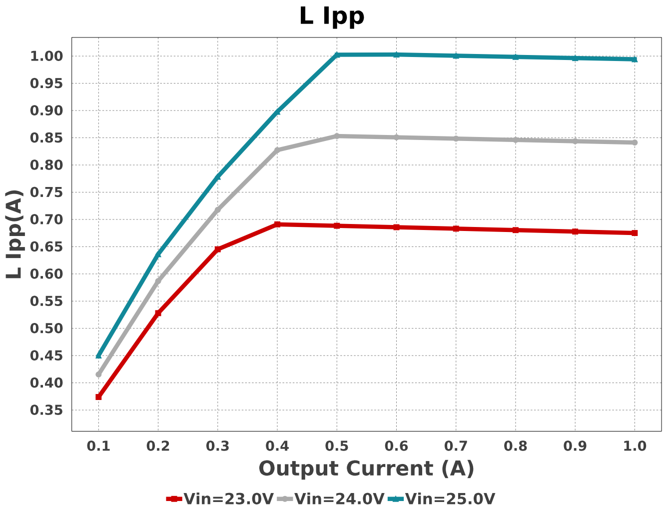
WEBENCH ® Design Report

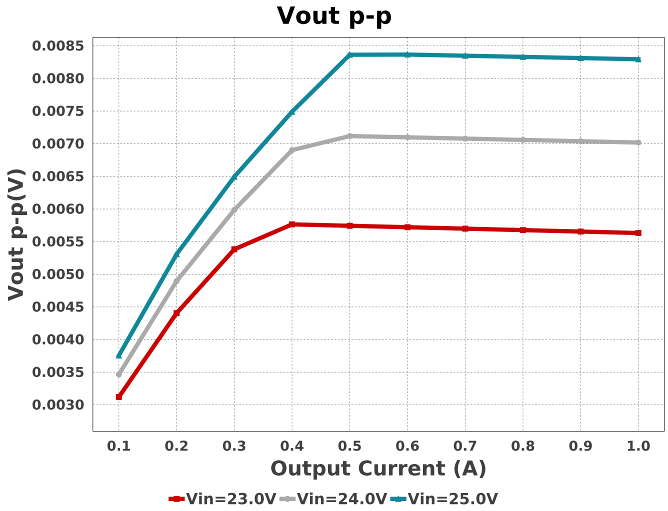
Design : 108 LMR16030PDDA
LMR16030PDDA 23V-25V to 19.50V @ 1A

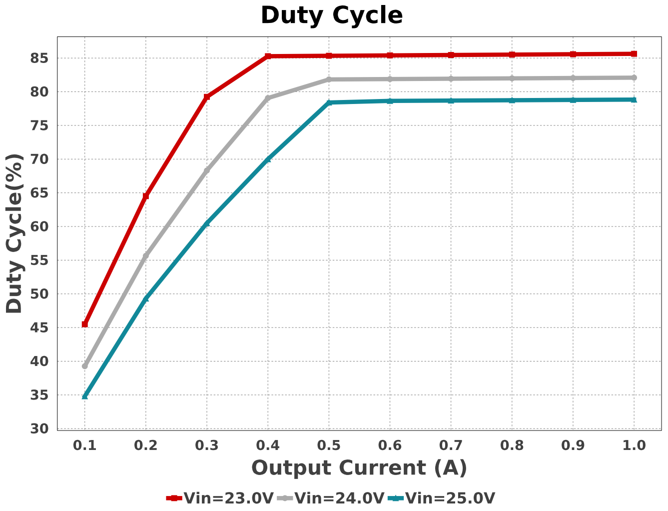


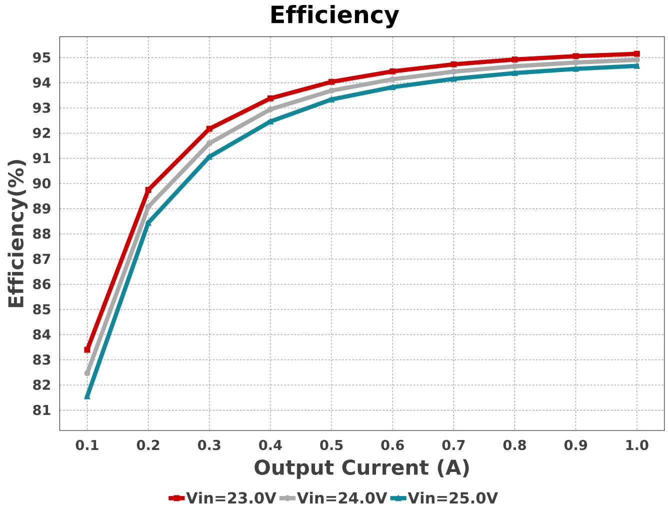
Electrical BOM

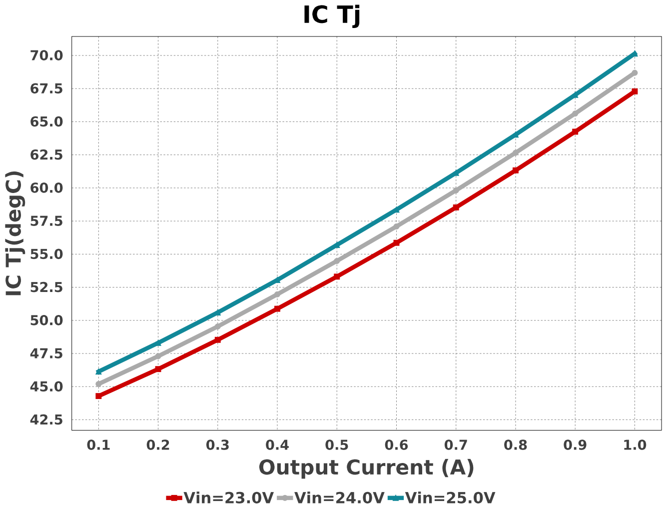
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cff	CUSTOM	CUSTOM Series= C0G/NP0	Cap= 10.0 pF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	NA	0603 0 mm^2
Cin	TDK	C3216X7R1V106K160AC Series= X7R	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	1	$0.18	1206_180 11 mm^2
Cout	CUSTOM	CUSTOM Series= ?	Cap= 4.0 uF ESR= 4.0 mOhm VDC= 27.8571 V IRMS= 315.861 mA	2	NA	CUSTOM 0 mm^2
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.03	SOD-123F 12 mm^2
L1	CUSTOM	CUSTOM	L= 2.2 µH 16.0 mOhm	1	NA	TFM201610 0 mm^2
Rfbb	CUSTOM	CUSTOM Series= CRCW..e3	Res= 12.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
Rfbt	CUSTOM	CUSTOM Series= CRCW..e3	Res= 300.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
Rt	CUSTOM	CUSTOM Series= CRCW..e3	Res= 12.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
U1	Texas Instruments	LMR16030PDDA	Switcher	1	$1.74	DDA0008E_N 55 mm^2

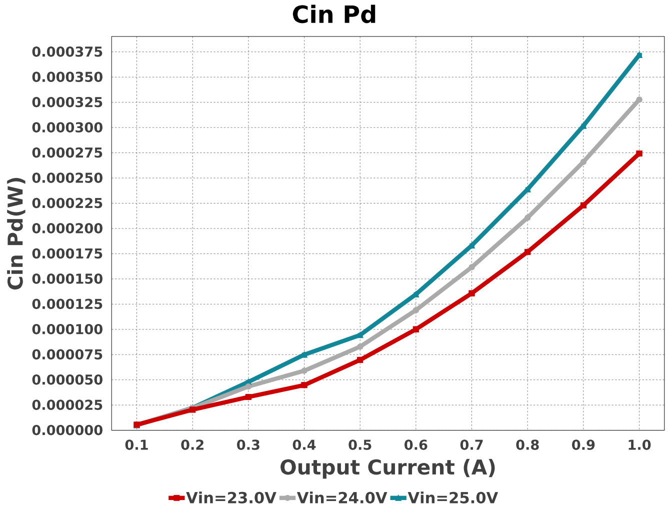












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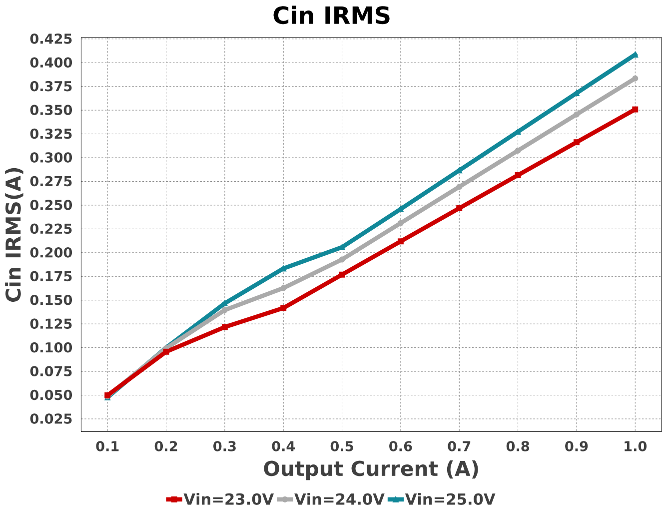
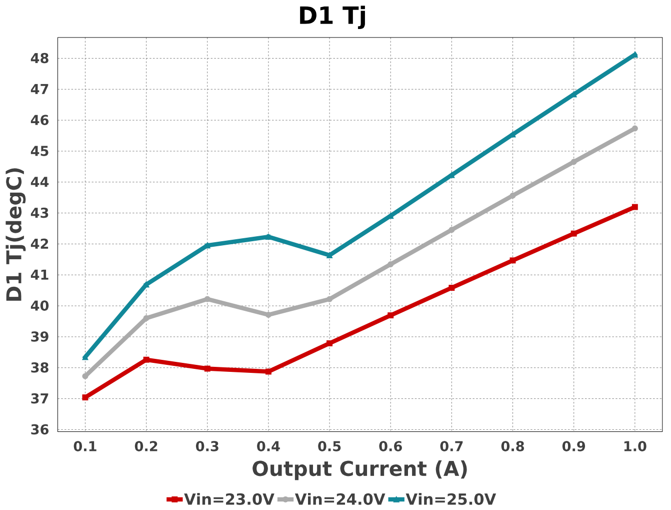
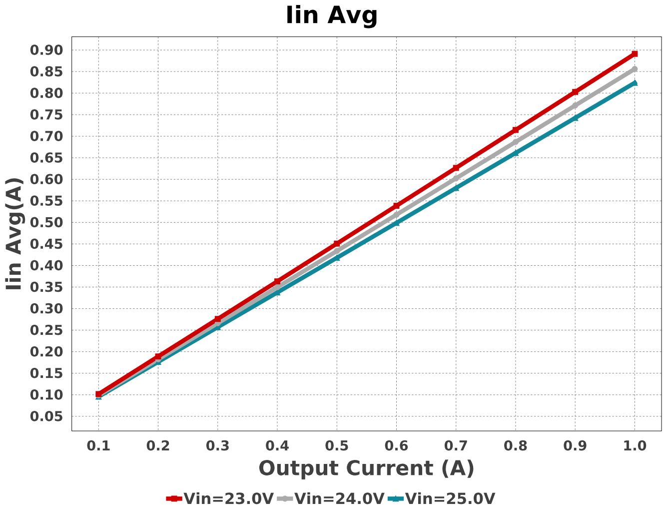
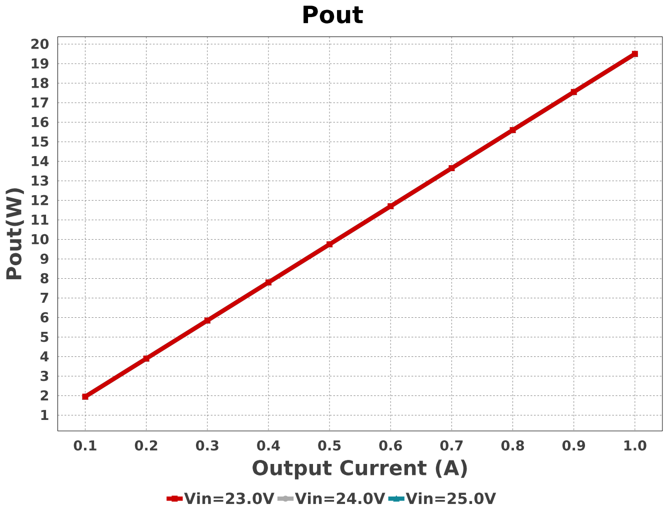
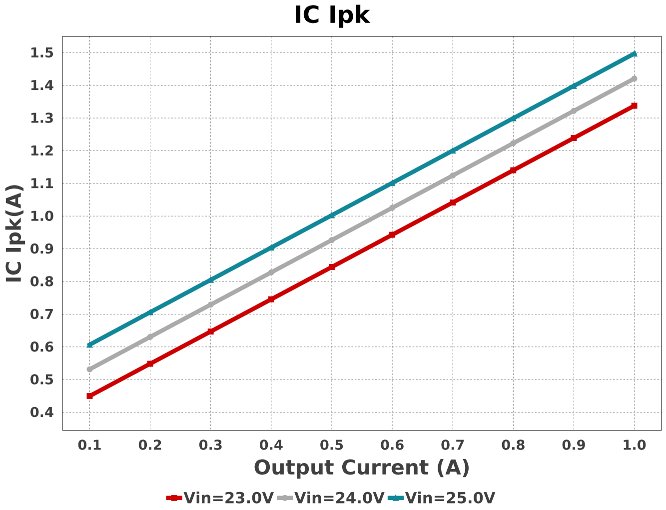
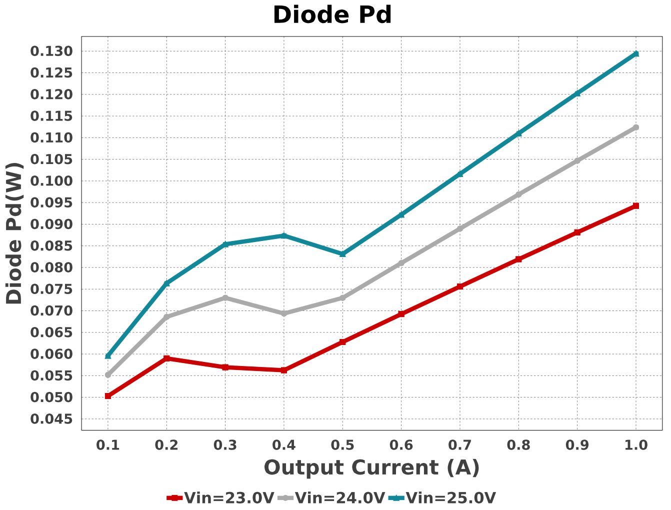

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V

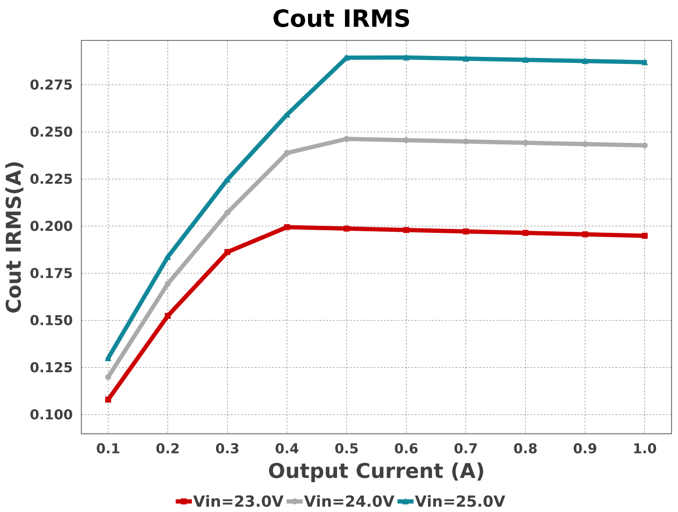

D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V

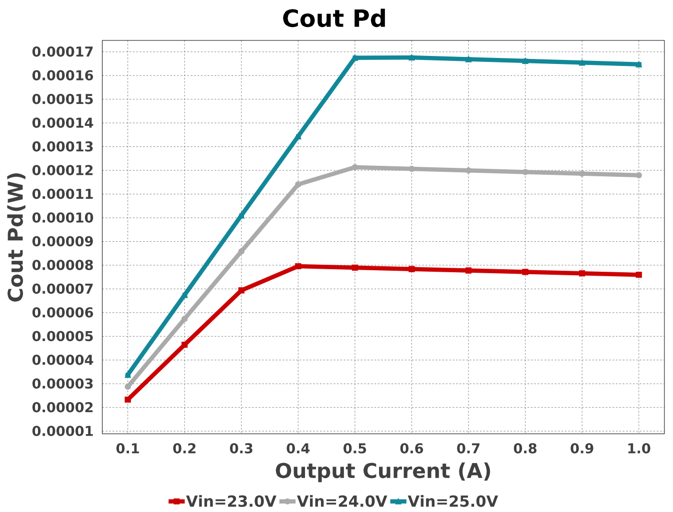

Pout
Pout(W)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V


IC Ipk
IC Ipk(A)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V

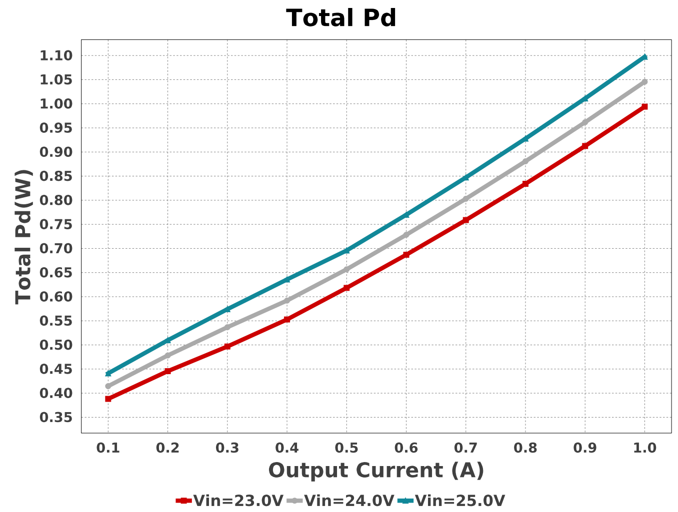

Diode Pd
Diode Pd(W)
Output Current (A)
Vin=23.0V Vin=24.0V Vin=25.0V



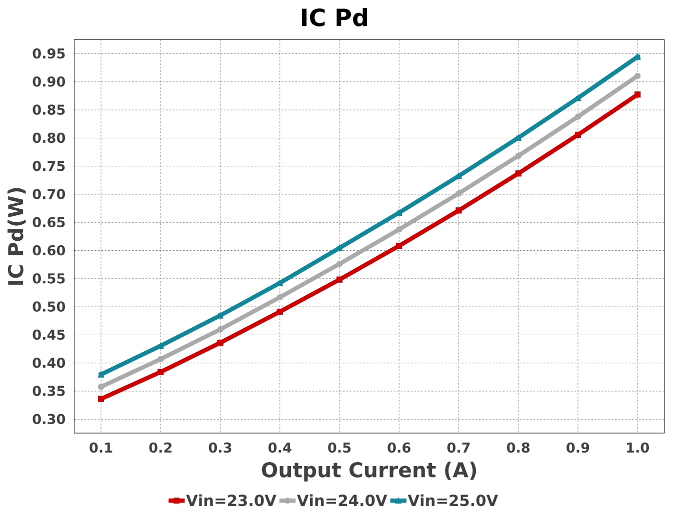
Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=23.0V
Vin=24.0V
Vin=25.0V



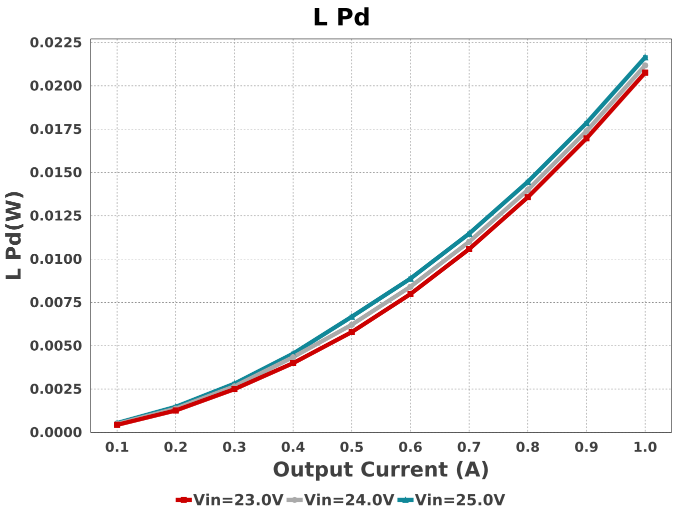
Cout Pd
Cout Pd(W)
Output Current (A)
Vin=23.0V
Vin=24.0V
Vin=25.0V



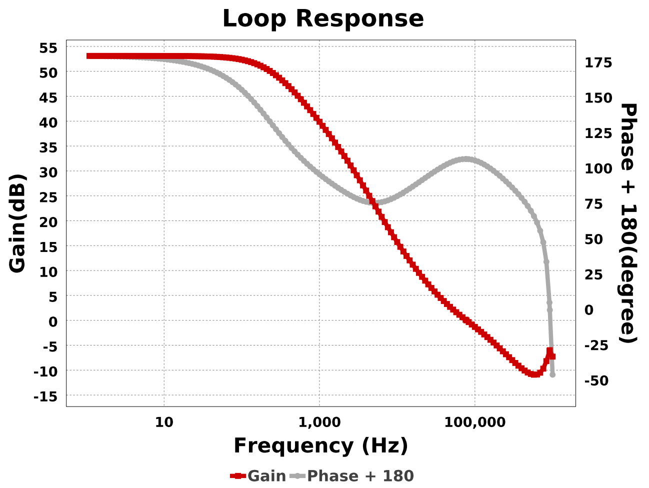
Total Pd
Total Pd(W)
Output Current (A)
Vin=23.0V
Vin=24.0V
Vin=25.0V



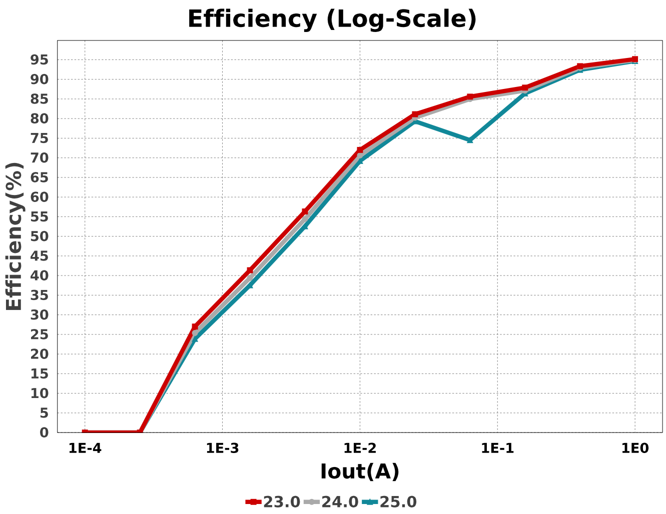
IC Pd
IC Pd(W)
Output Current (A)
Vin=23.0V
Vin=24.0V
Vin=25.0V



L Pd
L Pd(W)
Output Current (A)
Vin=23.0V
Vin=24.0V
Vin=25.0V



Loop Response
Gain(dB)
Phase + 180(degree)
Frequency (Hz)
Gain
Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	11		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	408.481 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	371.92 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	286.989 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	164.73 µW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	48.12 degC	Diode	D1 junction temperature
8.	Diode Pd	129.43 mW	Diode	Diode power dissipation
9.	IC Ipk	1.497 A	IC	Peak switch current in IC
10.	IC Pd	944.52 mW	IC	IC power dissipation
11.	IC Tj	70.142 degC	IC	IC junction temperature
12.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA	42.5 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	823.89 mA	IC	Average input current
15.	L Ipp	994.16 mA	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	21.647 mW	Inductor	Inductor power dissipation
17.	Cin Pd	371.92 µW	Power	Input capacitor power dissipation
18.	Cout Pd	164.73 µW	Power	Output capacitor power dissipation
19.	Diode Pd	129.43 mW	Power	Diode power dissipation
20.	IC Pd	944.52 mW	Power	IC power dissipation
21.	L Pd	21.647 mW	Power	Inductor power dissipation
22.	Total Pd	1.097 W	Power	Total Power Dissipation
23.	Cross Freq	77.895 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	78.835 %	System Information	Duty cycle
25.	Efficiency	94.672 %	System Information	Steady state efficiency
26.	FootPrint	202.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	1.929 MHz	System Information	Switching frequency
28.	Gain Marg	-5.997 dB	System Information	Bode Plot Gain Margin
29.	Iout	1.0 A	System Information	Iout operating point
30.	Low Freq Gain	53.096 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	106.805 deg	System Information	Bode Plot Phase Margin
33.	Pout	19.5 W	System Information	Total output power
34.	Vin	25.0 V	System Information	Vin operating point
35.	Vout	19.5 V	System Information	Operational Output Voltage
36.	Vout Actual	19.5 V	System Information	Vout Actual calculated based on selected voltage divider resistors
37.	Vout Tolerance	4.389 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

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#	Name	Value	Category	Description
38.	Vout p-p	8.294 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	25.0	Maximum input voltage
VinMin	23.0	Minimum input voltage
VinTyp	24.0	Typical input voltage
Vout	19.5	Output Voltage
base_pn	LMR16030P	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	2.0 M	Customer Selected Frequency

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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

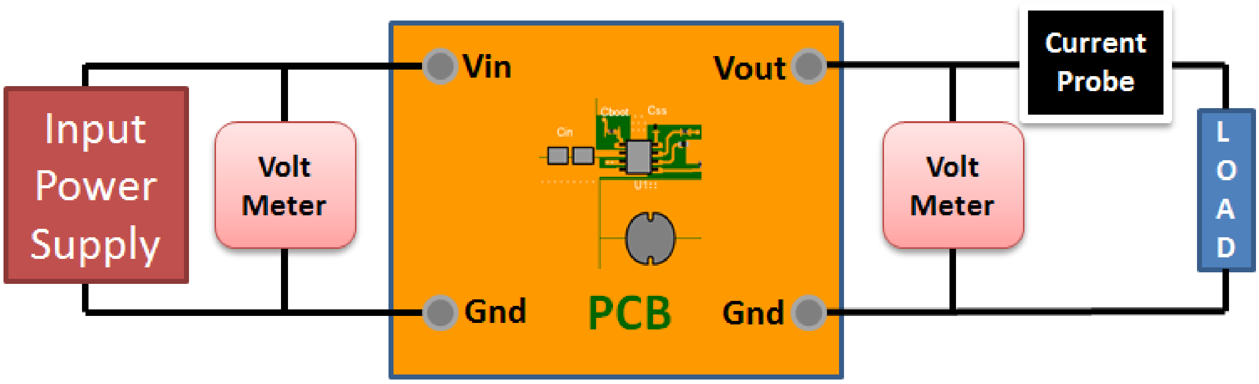
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 23.0V 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.

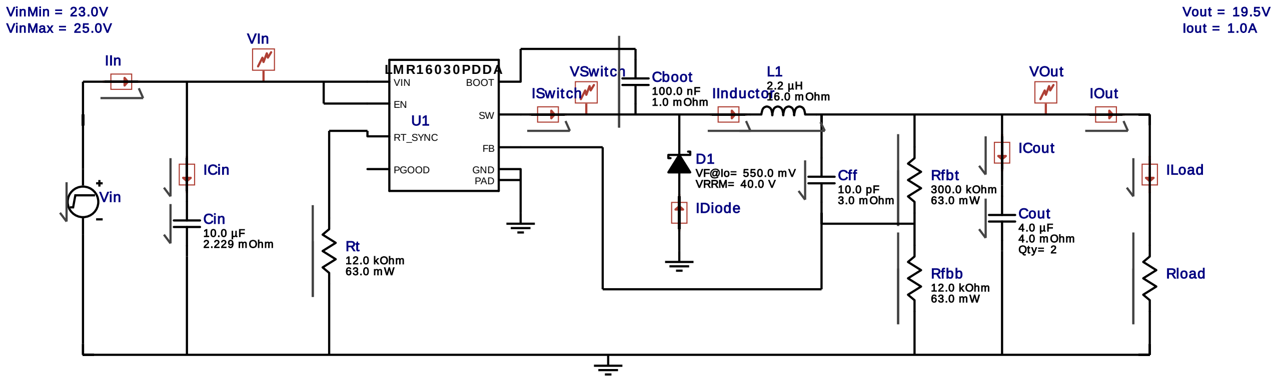


WEBENCH® Electrical Simulation Report

Design Id = 108

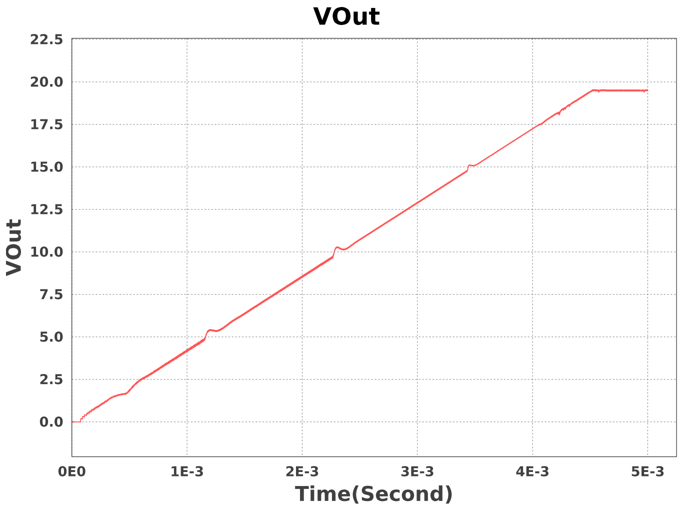
sim_id = 1

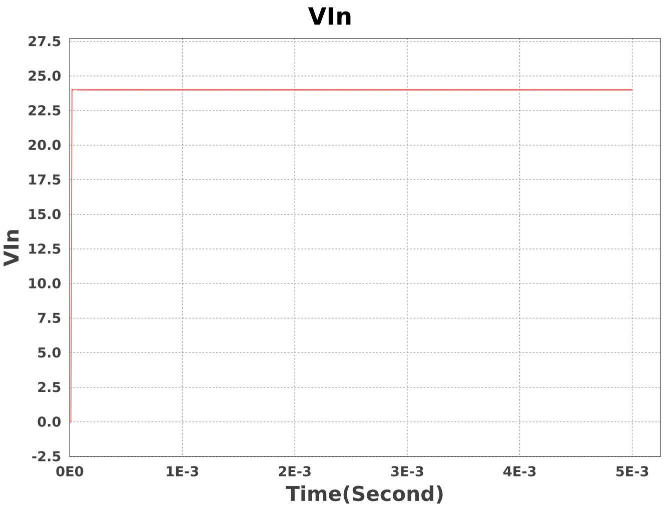
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load resisitance	19.5 ohm





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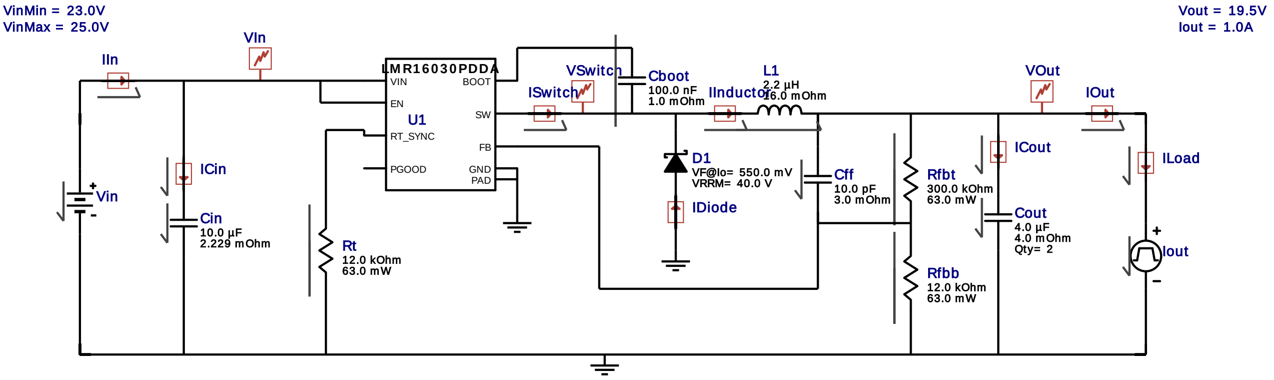
Design Id = 108

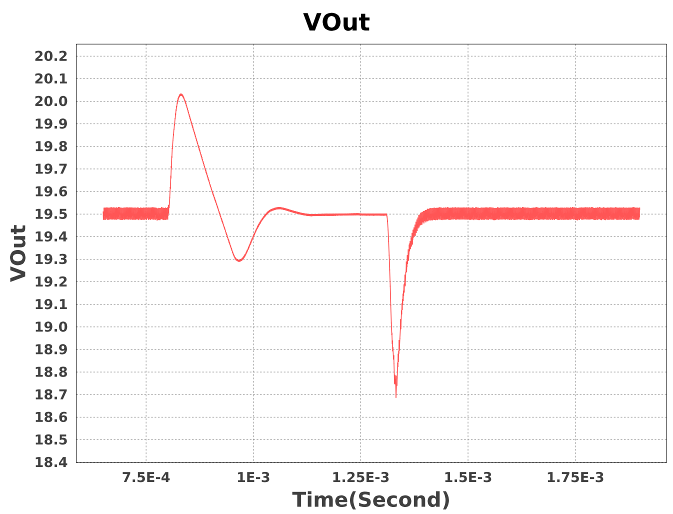
sim_id = 2

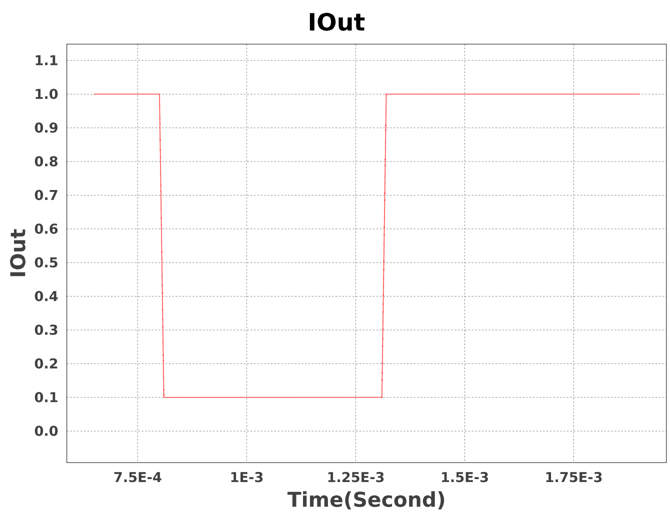
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	19.5
4.	ILoad	I	Load current	ILoad1 A
5.	Iout	Signal_type I1 I2 Td Tr Tf Pw	Signal Type Initial input current Peak Input current Initial time delay Rise time Fall time Pulse width	PULSE 1.0 A 0.1 A 800u s 10u 10u s 5.0E-4 s

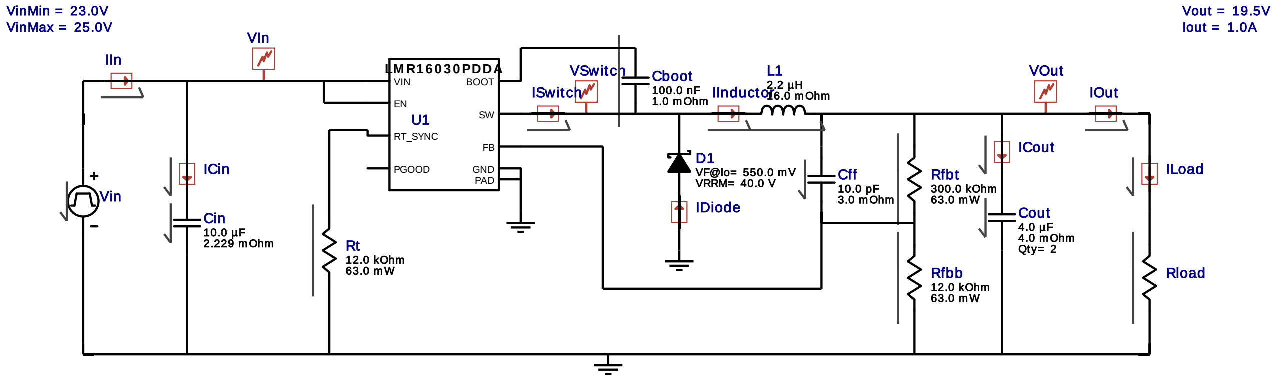




Design Id = 108

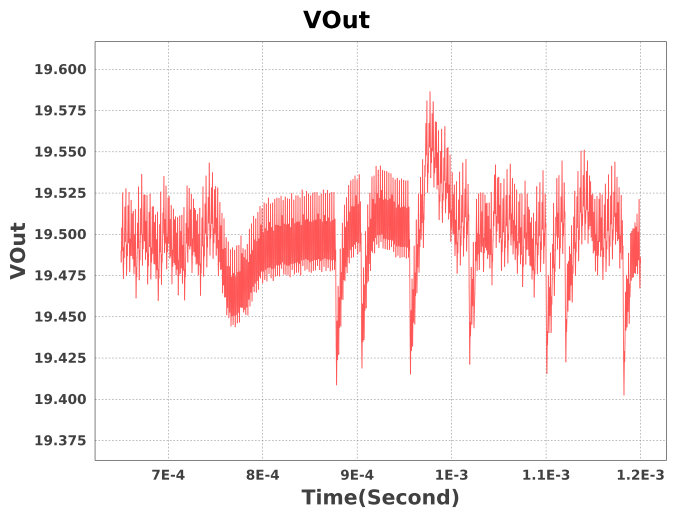
sim_id = 3

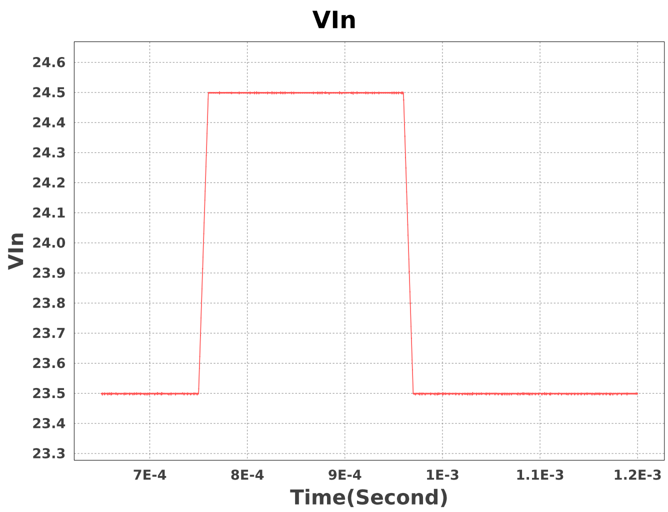
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	19.5
4.	Rload	R	Load Resistance	19.5 ohm

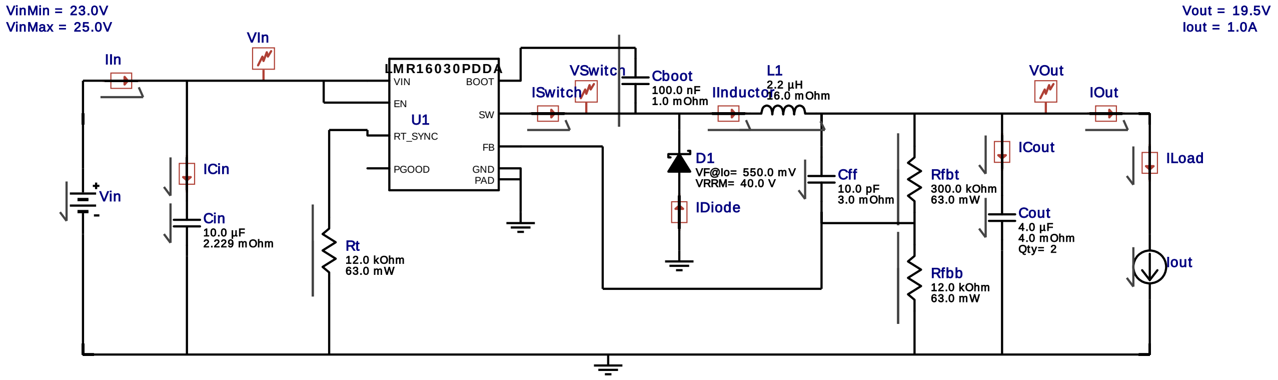




Design Id = 108

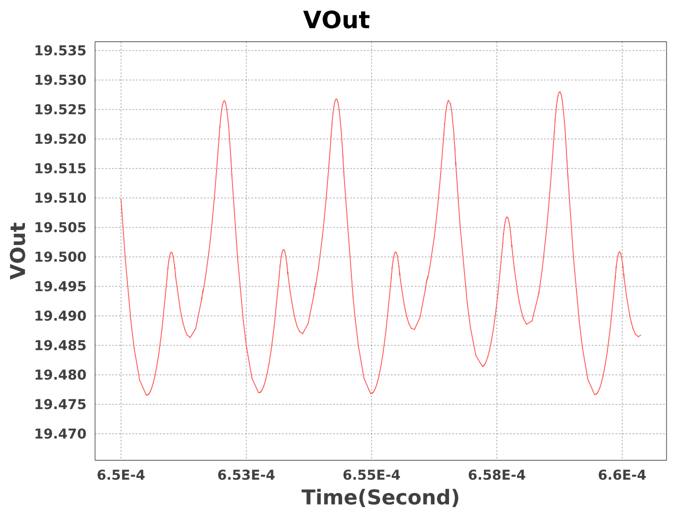
sim_id = 4

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	no description	5
2.	L1	IC	no description	-1.0
3.	Cout	IC	no description	19.5
4.	Iout	I	Load current	1.0 A



Design Assistance

1. Master key : BED2B438EB35597A[v1]

2. **LMR16030P** Product Folder : http://www.ti.com/product/LMR16030 : contains the data sheet and other resources.

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