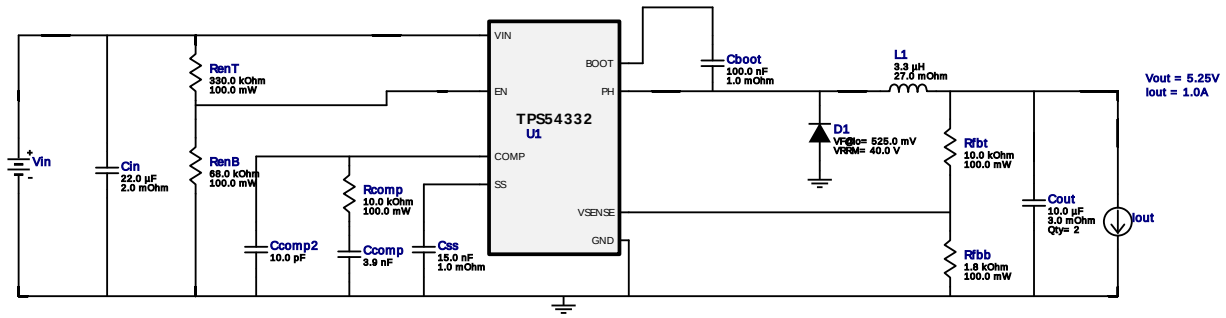
WEBENCH® Design Report

VinMin = 11.5V
VinMax = 12.5V
Vout = 5.25V
Iout = 1.0A

Device = TPS54332DDAR
Topology = Buck
Created = 2020-08-25 13:11:51.595
BOM Cost = $1.85
BOM Count = 15
Total Pd = 0.43W

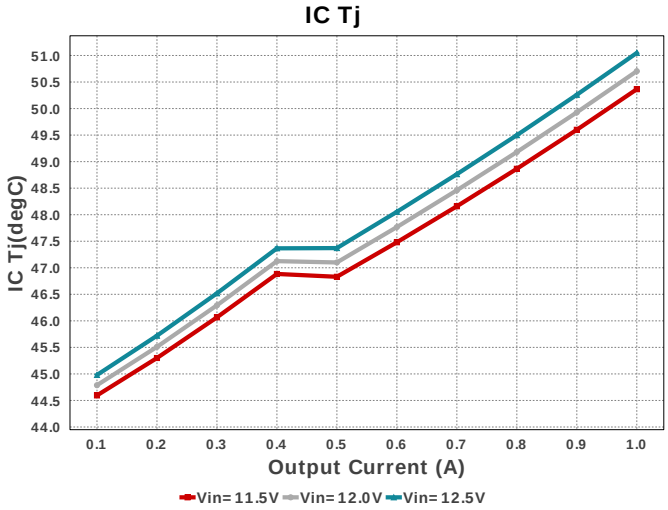
Design : 1 TPS54332DDAR
TPS54332DDAR 11.5V-12.5V to 5.25V @ 1.5A

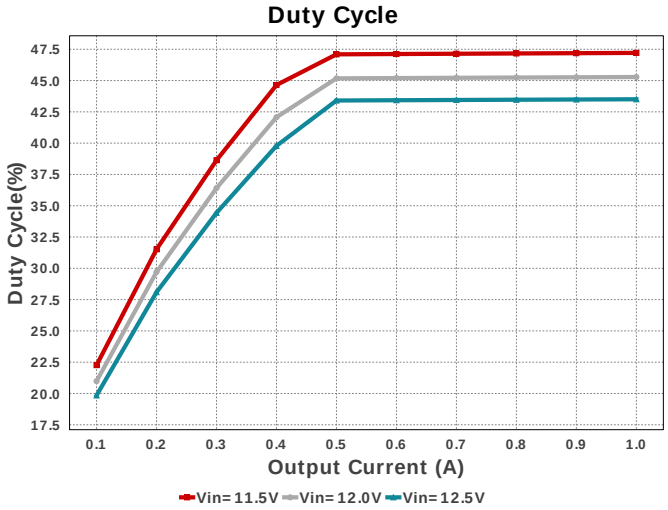


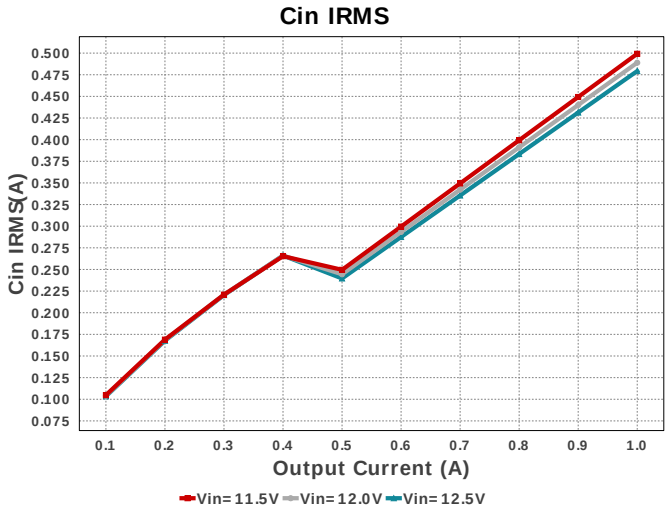
Electrical BOM

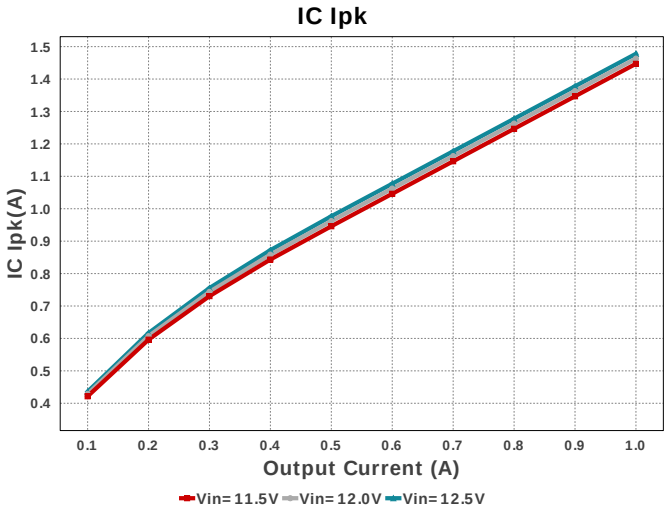
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp	TDK	CGA4C2C0G1H392J060AA Series= C0G/NP0	Cap= 3.9 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C100JBANNNC Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	$0.65	1210 15 mm²
Cout	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	2	$0.03	0805 7 mm²
Css	MuRata	GRM155R71C153KA01D Series= X7R	Cap= 15.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
D1	ON Semiconductor	MBRS340T3G	VF@Io= 525.0 mV VRRM= 40.0 V	1	$0.13	 SMC 83 mm²
L1	Bourns	SRR7032-3R3M	L= 3.3 µH 27.0 mOhm	1	$0.32	 SRR7032 81 mm²
Rcomp	Yageo	RC0603FR-0710KL Series= ?	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
RenB	Yageo	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
RenT	Yageo	RC0603FR-07330KL Series= ?	Res= 330.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²

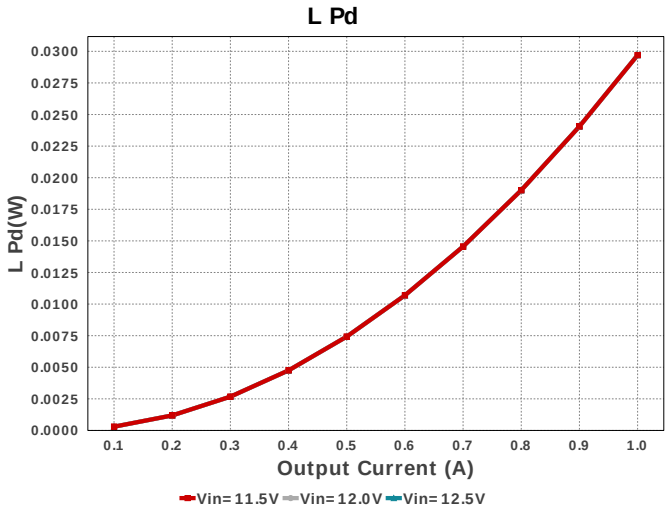
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbb	Yageo	RC0603FR-071K8L Series= ?	Res= 1.8 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rfbt	Yageo	RC0603FR-0710KL Series= ?	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
U1	Texas Instruments	TPS54332DDAR	Switcher	1	$0.57	DDA0008H 55 mm²

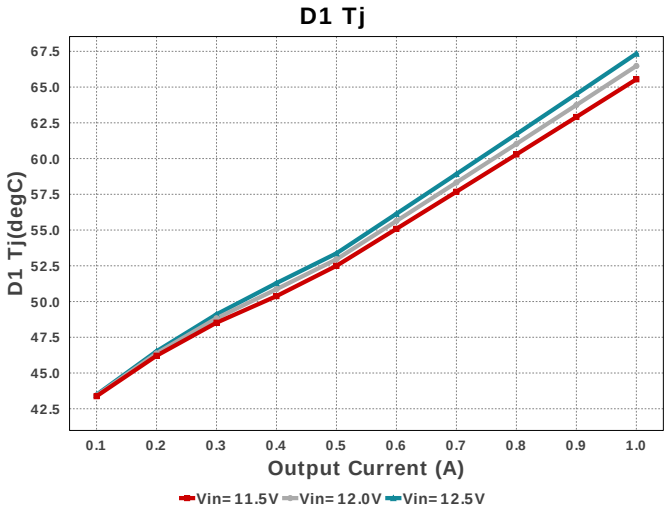




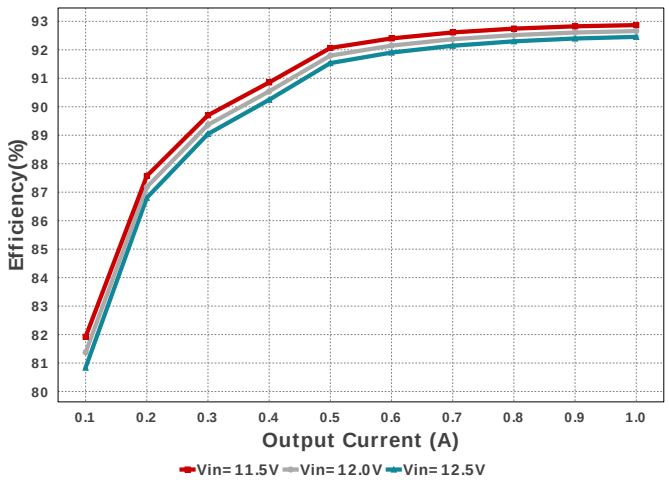




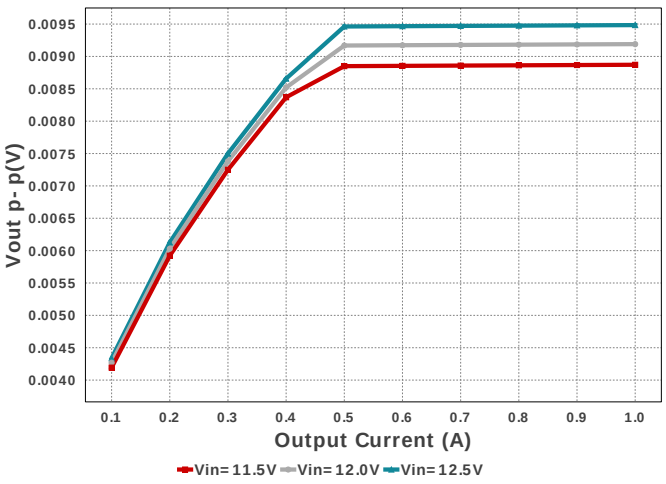




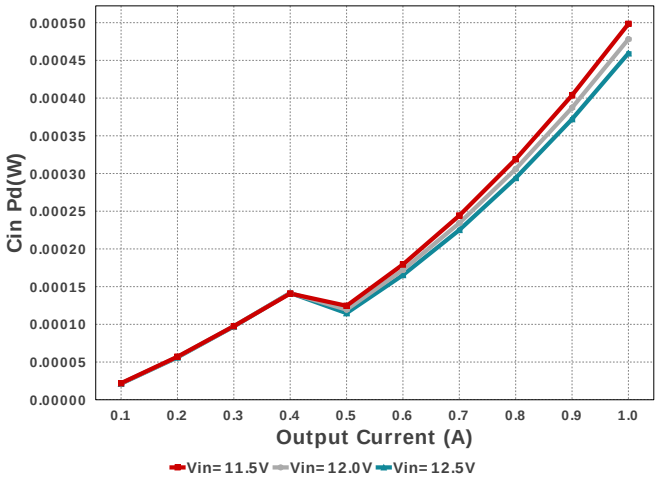
Efficiency



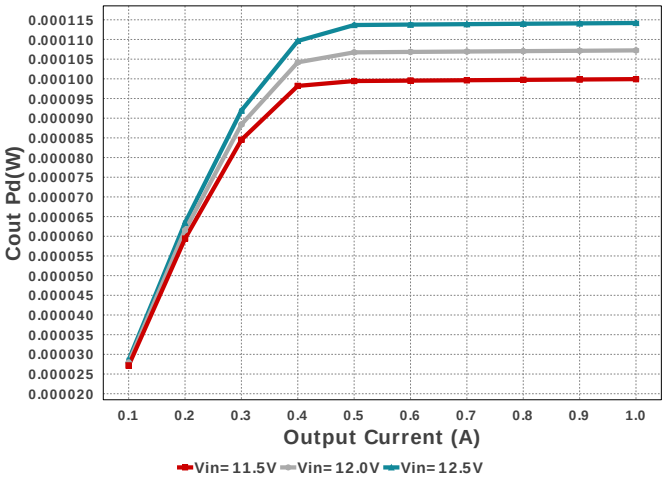
Vout p- p



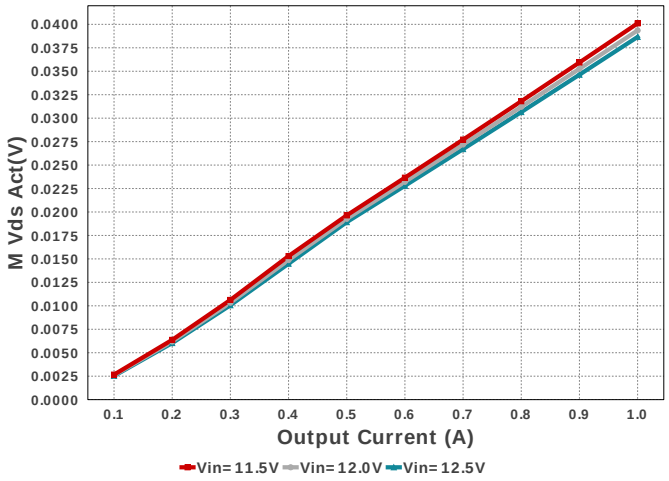
Cin Pd



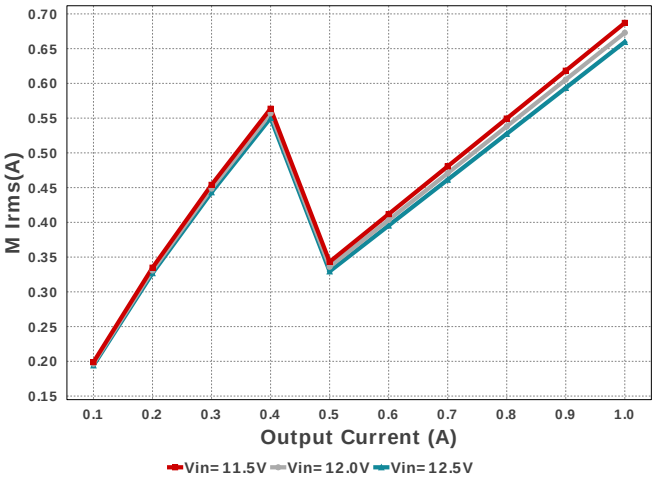
Cout Pd

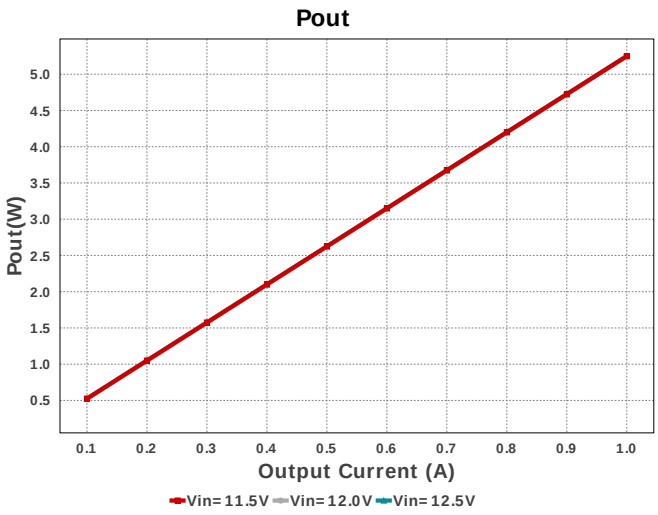


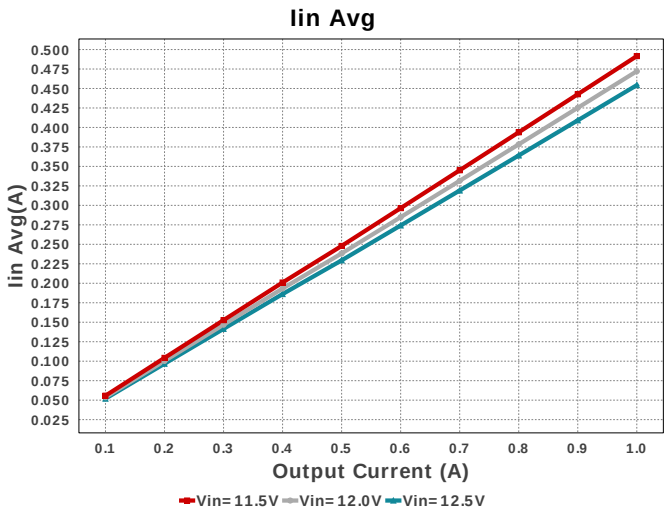
M Vds Act

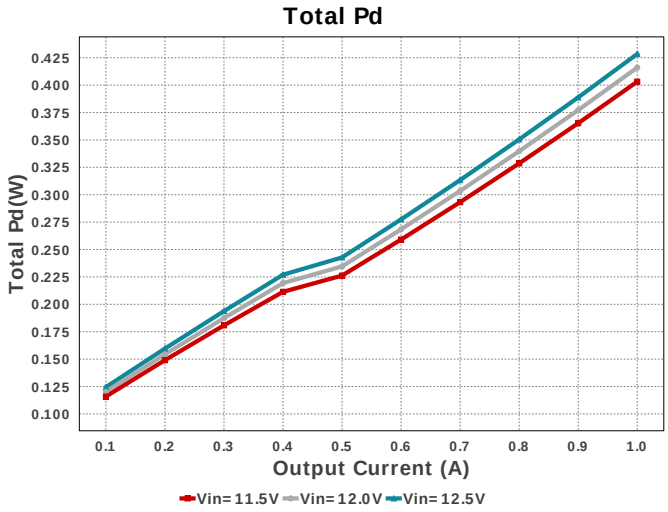


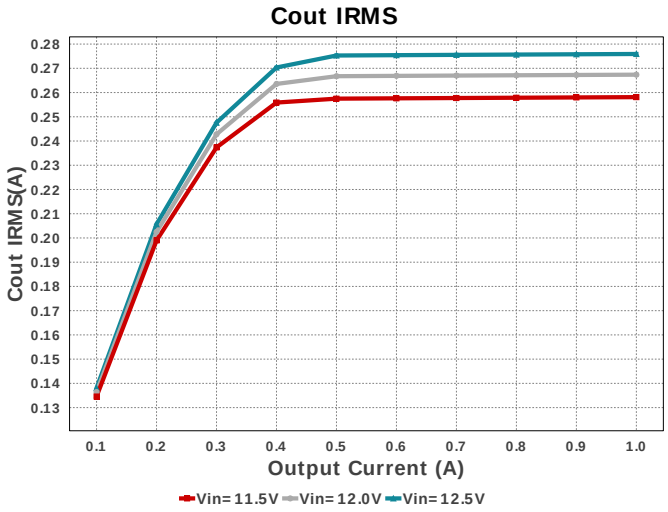
M Irms

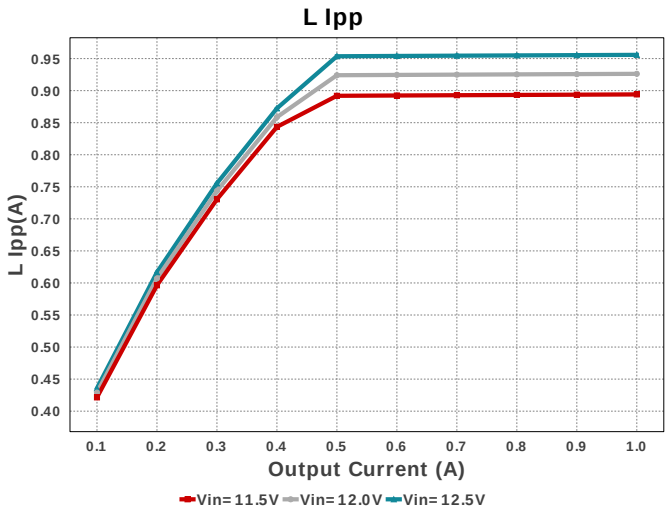


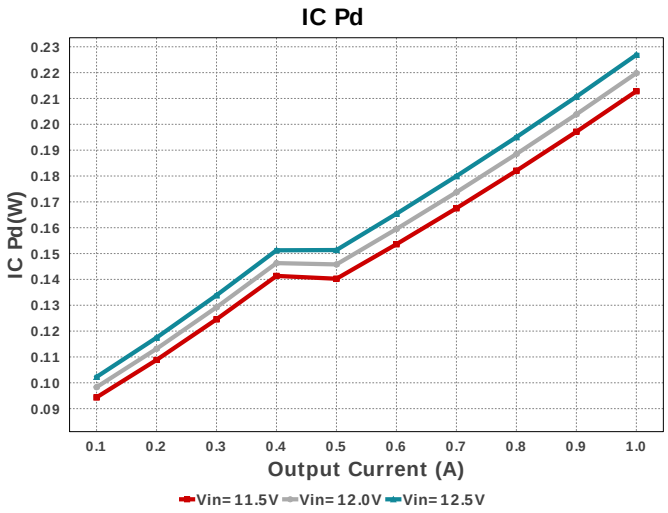


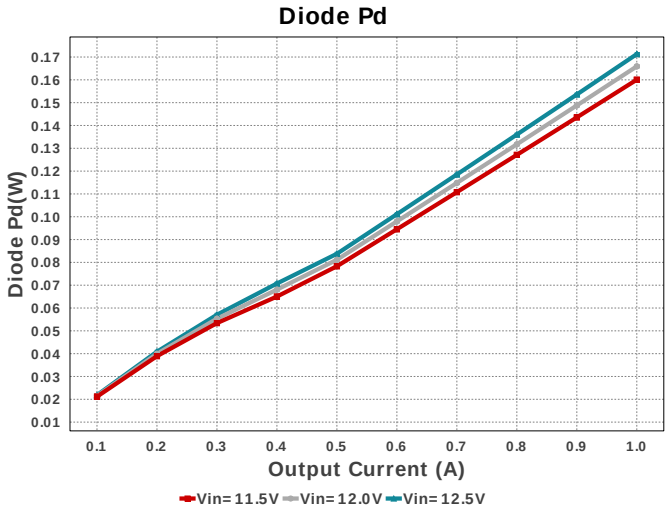


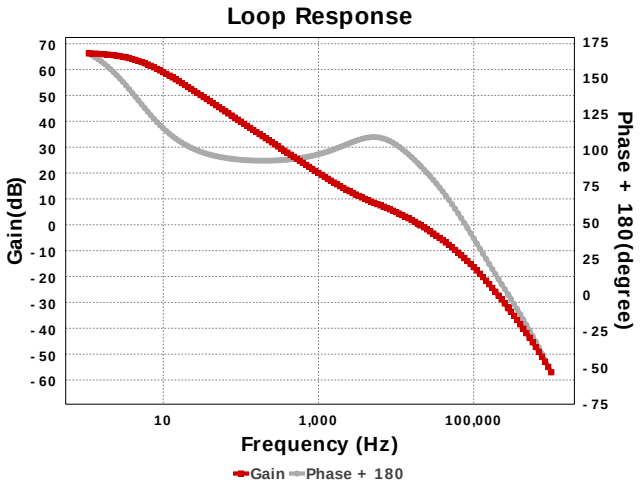












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	15		Total Design BOM count
2.	Total BOM	$1.852		Total BOM Cost
3.	Cin IRMS	479.263 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	459.39 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	275.912 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	114.19 µW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	67.337 degC	Diode	D1 junction temperature
8.	Diode Pd	171.28 mW	Diode	Diode power dissipation
9.	IC Ipk	1.478 A	IC	Peak switch current in IC
10.	IC Pd	226.87 mW	IC	IC power dissipation
11.	IC Tj	51.049 degC	IC	IC junction temperature
12.	ICThetaJA	48.7 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	454.27 mA	IC	Average input current
14.	L Ipp	955.788 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	29.7 mW	Inductor	Inductor power dissipation
16.	M Irms	659.582 mA	Mosfet	MOSFET RMS ripple current
17.	M Vds Act	38.657 mV	Mosfet	Voltage drop across the MosFET
18.	Cin Pd	459.39 µW	Power	Input capacitor power dissipation
19.	Cout Pd	114.19 µW	Power	Output capacitor power dissipation
20.	Diode Pd	171.28 mW	Power	Diode power dissipation
21.	IC Pd	226.87 mW	Power	IC power dissipation
22.	L Pd	29.7 mW	Power	Inductor power dissipation
23.	Total Pd	428.433 mW	Power	Total Power Dissipation
24.	Cross Freq	20.219 kHz	System Information	Bode plot crossover frequency
25.	Duty Cycle	43.505 %	System Information	Duty cycle
26.	Efficiency	92.455 %	System Information	Steady state efficiency
27.	FootPrint	291.0 mm^2	System Information	Total Foot Print Area of BOM components
28.	Frequency	1000.0 kHz	System Information	Switching frequency
29.	Gain Marg	-32.313 dB	System Information	Bode Plot Gain Margin
30.	Iout	1.0 A	System Information	Iout operating point
31.	Low Freq Gain	66.233 dB	System Information	Gain at 1Hz
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	89.654 deg	System Information	Bode Plot Phase Margin
34.	Pout	5.25 W	System Information	Total output power
35.	Vin	12.5 V	System Information	Vin operating point
36.	Vout	5.25 V	System Information	Operational Output Voltage
37.	Vout Actual	5.244 V	System Information	Vout Actual calculated based on selected voltage divider resistors

#	Name	Value	Category	Description
38.	Vout Tolerance	5.272 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	9.484 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
SoftStart	6.0 ms	Soft Start Time (ms)
VinMax	12.5	Maximum input voltage
VinMin	11.5	Minimum input voltage
Vout	5.25	Output Voltage
base_pn	TPS54332	Base Product Number
source	DC	Input Source Type
Ta	40.0	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

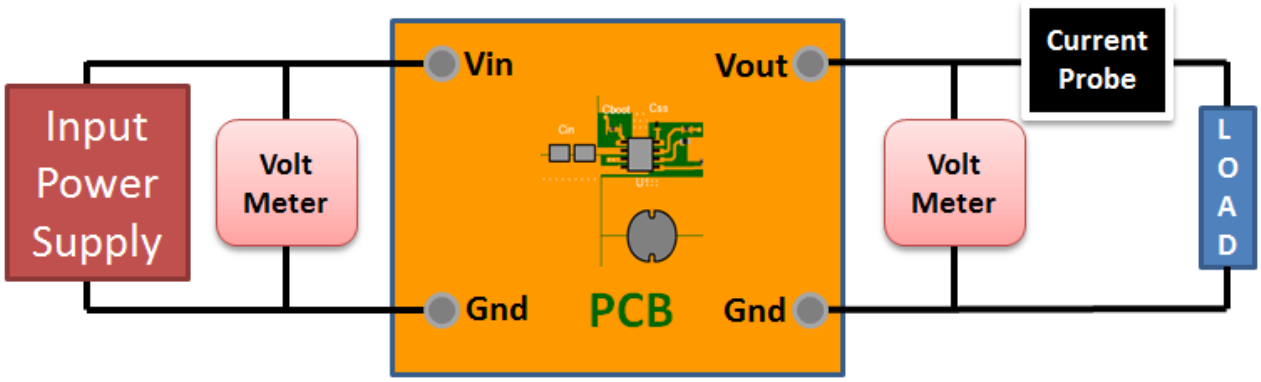
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.5V 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.

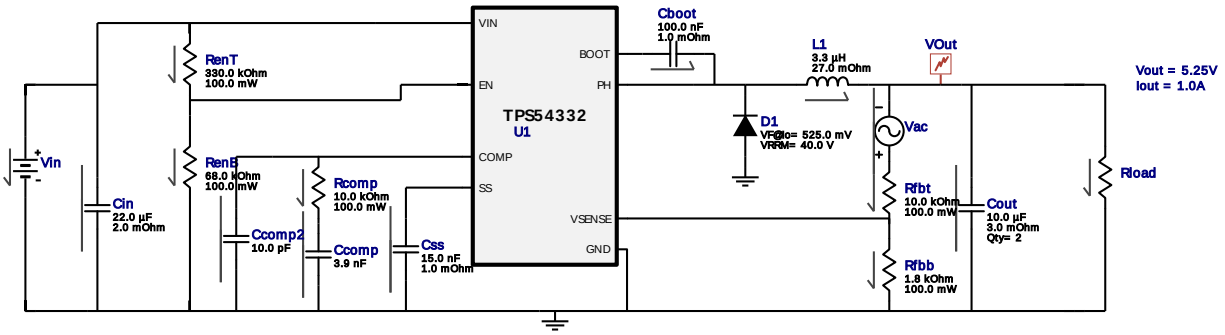


WEBENCH® Electrical Simulation Report

Design Id = 1

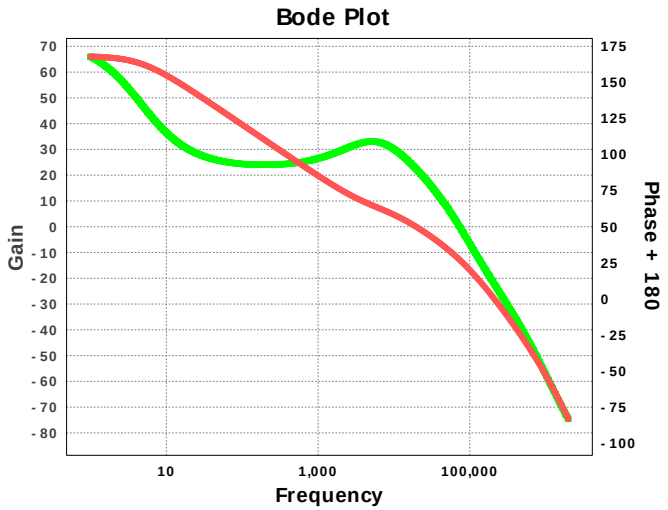
sim_id = 1

Simulation Type = Bode Plot



Simulation Parameters

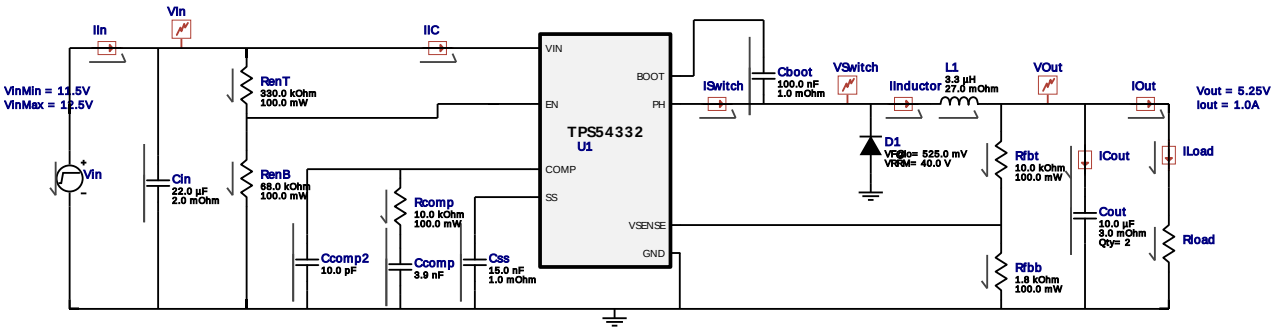
#	Name	Parameter Name	Description	Values
1.	Cout	IC	no description	no values
2.	Cinj	C	Injection Capacitance	10000000 F
3.	Linj	L	Injection Inductance	10000000 H
4.	Vinj	AC	AC Signal	1
5.	Rload	R	Load Resistance	5.25 ohm



Design Id = 1

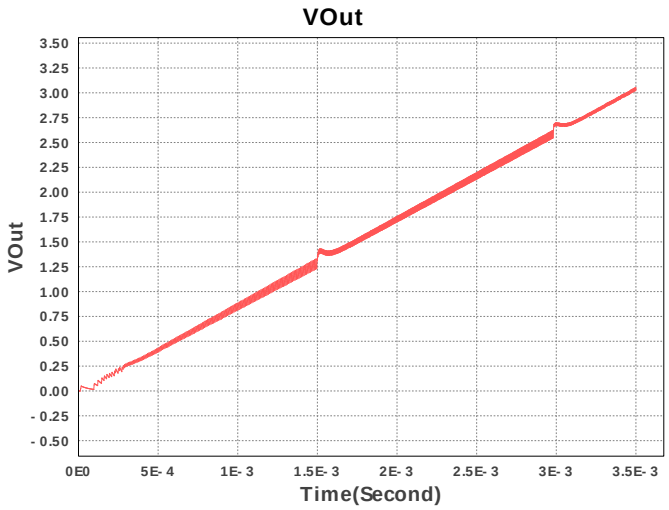
sim_id = 2

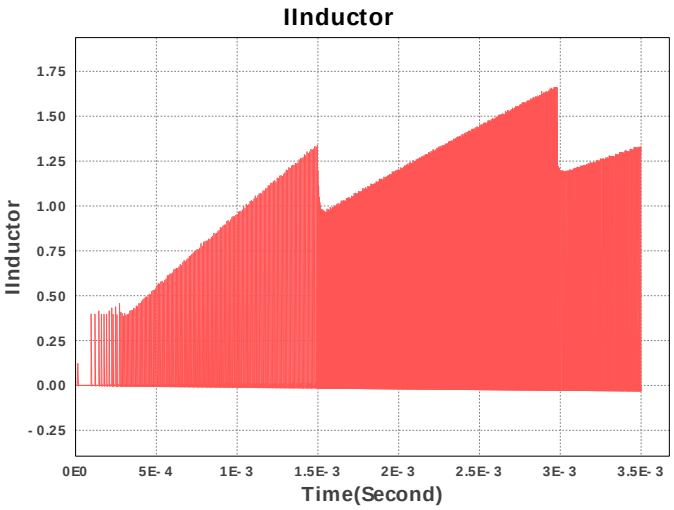
Simulation Type = Startup

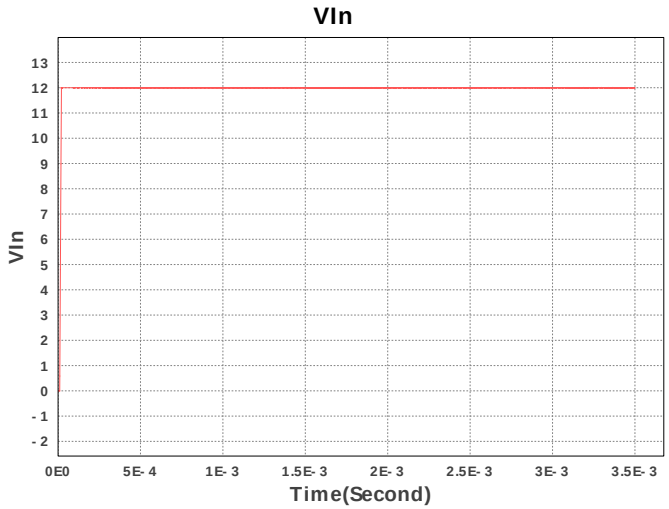


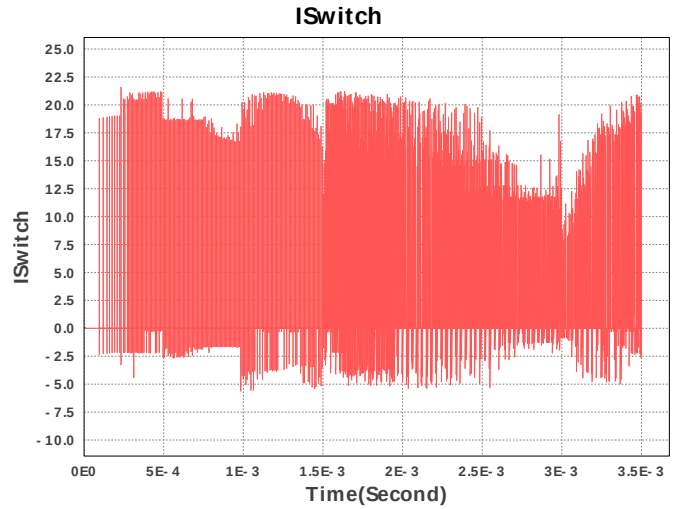
Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	5.25 Ohm





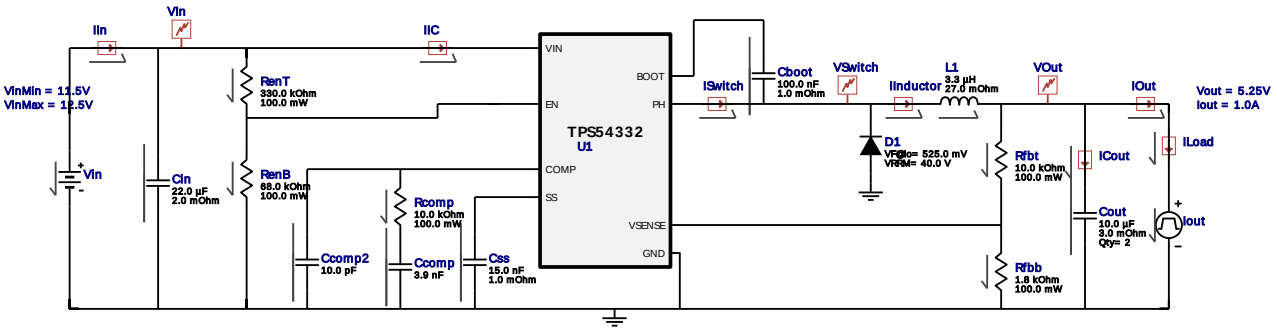




Design Id = 1

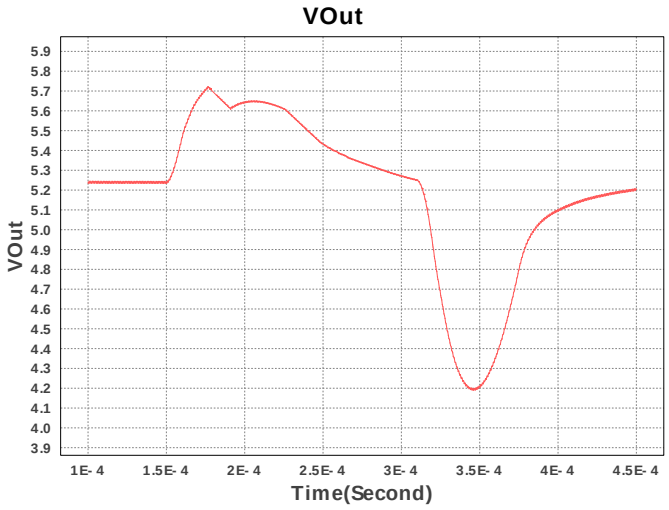
sim_id = 3

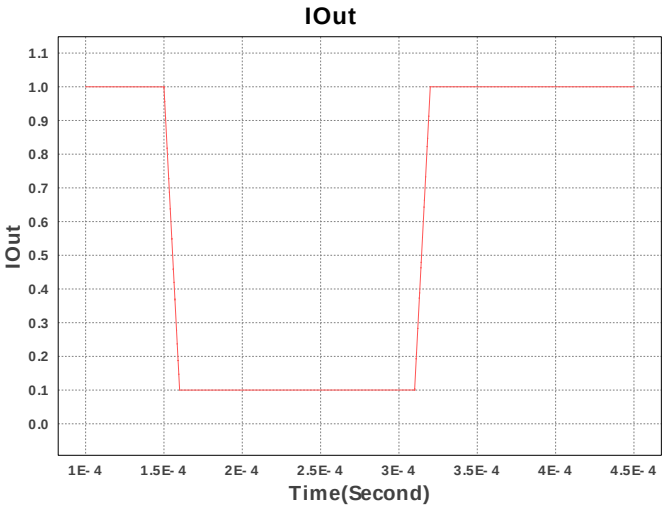
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	Initial Voltage	12.0 V
2.	L1	IC	Initial Current	1.0 A
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	1.0 A
		I2	Minimum Load Current	0.1 A
		Td	Initial Time Delay	150u s
		Tf	Fall Time	10u s
		Tr	Rise Time	10u s
		Pw	Pulse Width	150u s

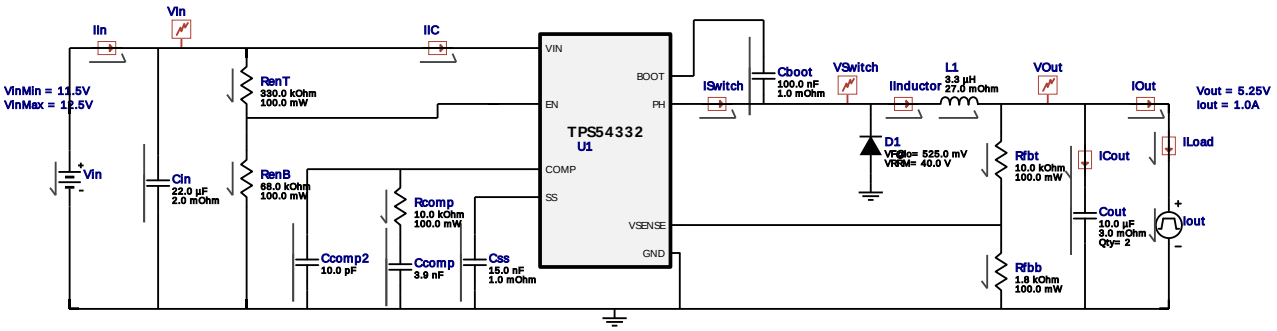




Design Id = 1

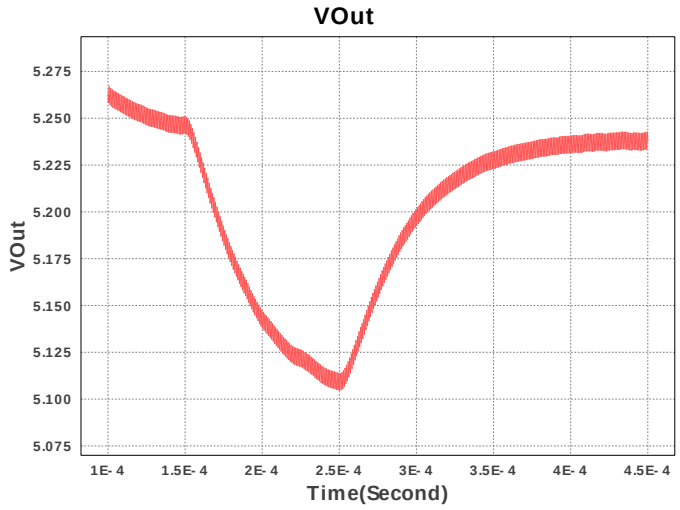
sim_id = 4

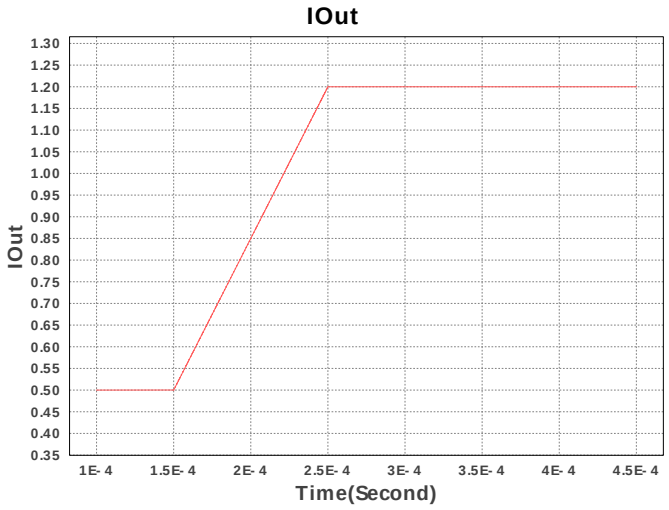
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cboot	IC	Initial Voltage	12.0 V
2.	L1	IC	Initial Current	1.0 A
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	0.5 A
		I2	Minimum Load Current	1.2 A
		Td	Initial Time Delay	1.5E-4 s
		Tf	Fall Time	1.0E-4 s
		Tr	Rise Time	1.0E-5 s
		Pw	Pulse Width	7.5E-4 s





Design Assistance

1. Master key : D402FA6FE69D6C85[v1]
2. **TPS54332** Product Folder : http://www.ti.com/product/TPS54332 : contains the data sheet and other resources.