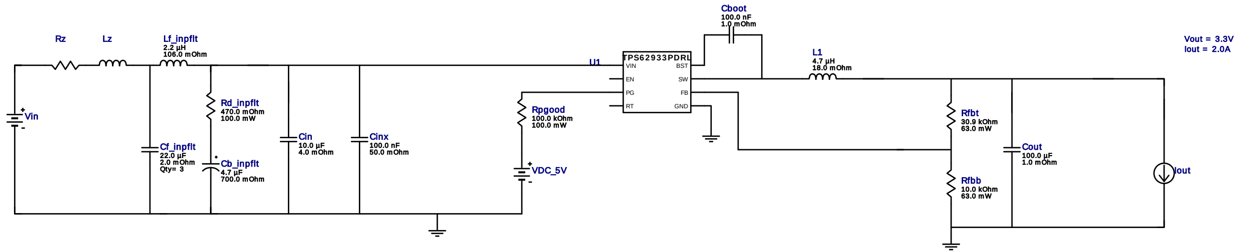
VinMin = 3.8V	Device = TPS62933PDRL
VinMax = 15.0V	Topology = Buck
Vout = 3.3V	Created = 2024-09-20 19:19:22.224
Iout = 2.0A	BOM Cost = $2.76
	BOM Count = 15
	Total Pd = 0.87W

WEBENCH ® Design Report

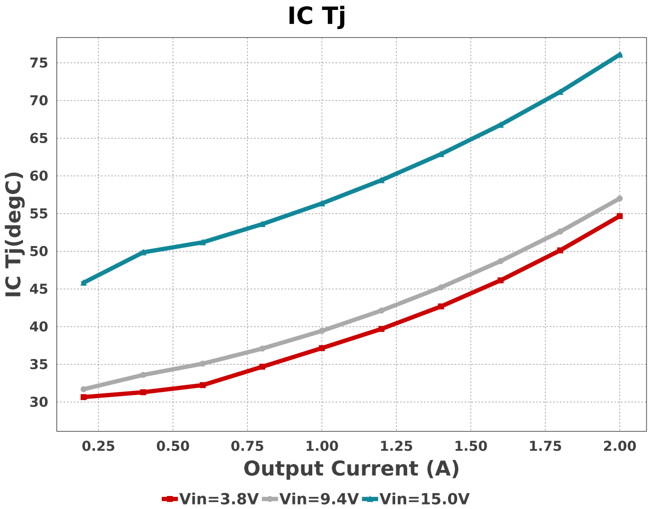
Design : 13 TPS62933PDRL
TPS62933PDRL 3.8V-15V to 3.30V @ 2A

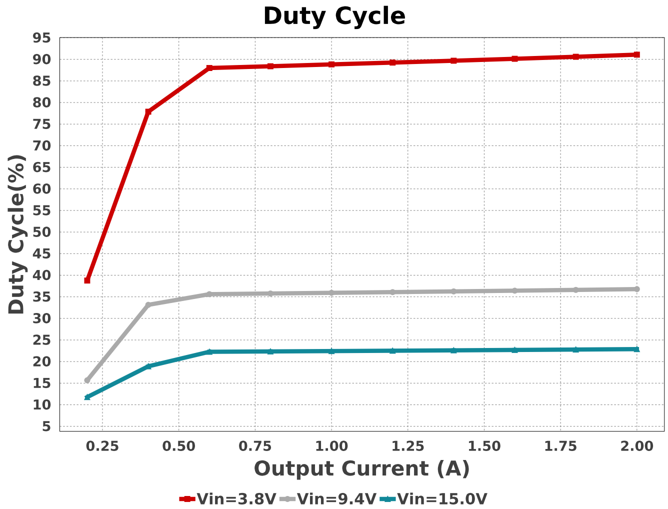


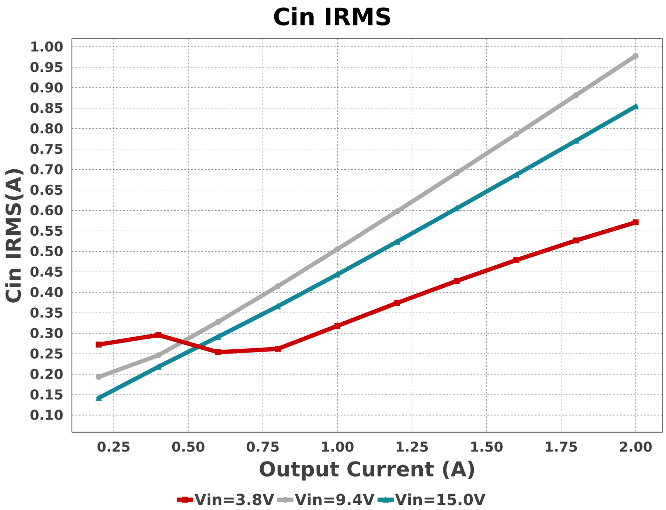
Electrical BOM

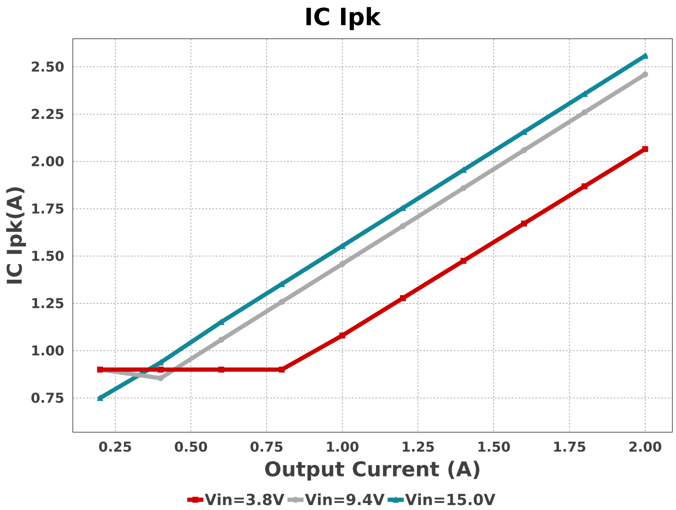
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cb_inpflt	AVX	TPSB475K035R0700 Series= TPS	Cap= 4.7 uF ESR= 700.0 mOhm VDC= 35.0 V IRMS= 314.0 mA	1	$0.24	3528-21 17 mm²
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cf_inpflt	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	3	$0.23	1210 15 mm²
Cin	MuRata	GRM21BR61E106MA73L Series= X5R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	$0.04	0805 7 mm²
Cinx	AVX	06033C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 50.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cout	MuRata	GRM32EC80J107ME20L Series= X6S	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	$0.17	1210_270 15 mm²
L1	NIC Components	NPI31W4R7MTRF	L= 4.7 µH 18.0 mOhm	1	$0.23	IND_NPI31W 172 mm²
Lf_inpflt	Wurth Elektronik	74479299222	L= 2.2 µH 106.0 mOhm	1	$0.72	WE-PMCI_1210_120 15 mm²
Rd_inpflt	Panasonic	ERJ-3RQFR47V Series= ERJ-3R	Res= 470.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.02	0603 5 mm²
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW040230K9FKED Series= CRCW..e3	Res= 30.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

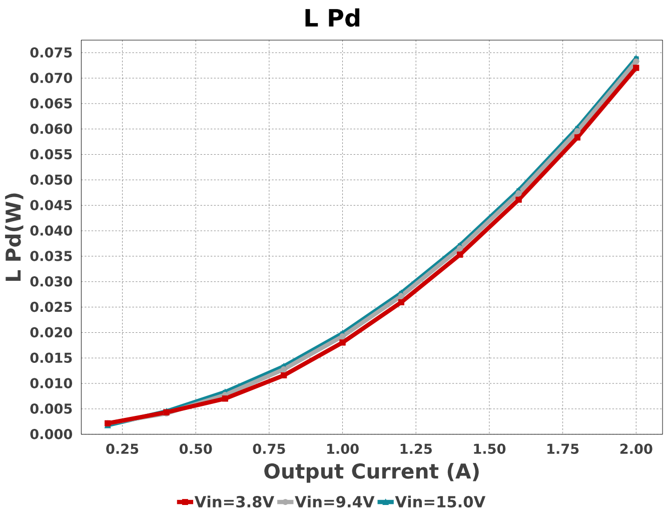
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rpgood	Vishay-Dale	CRCW0603100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
U1	Texas Instruments	TPS62933PDRL	Switcher	1	$0.60	DRL0008A-MFG 9 mm^2

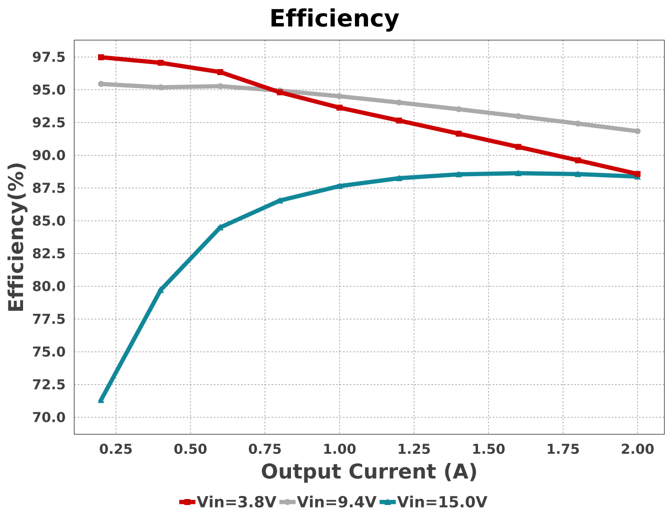




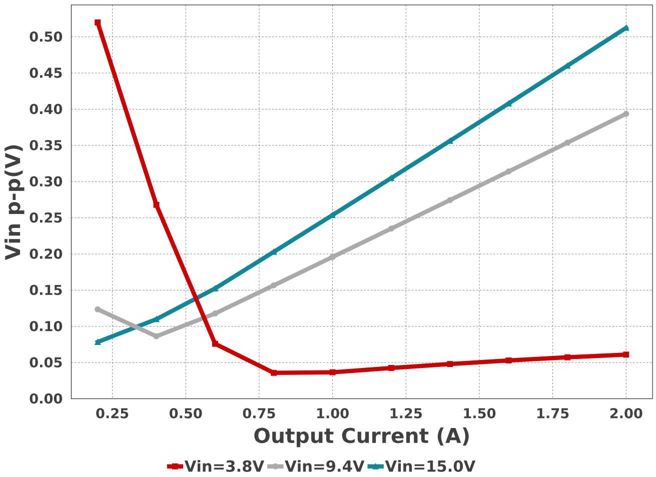




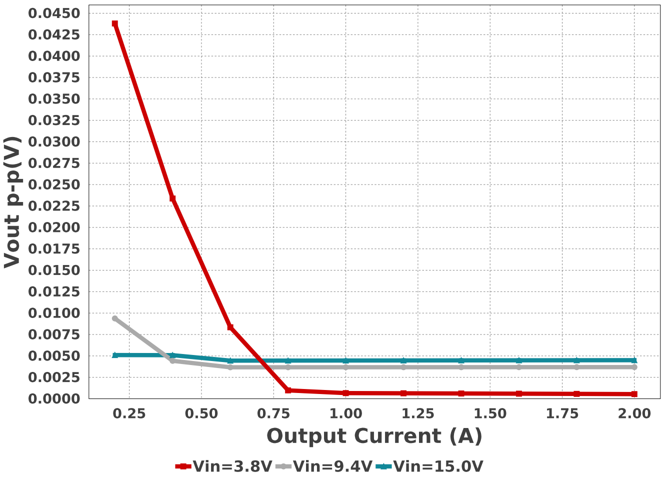




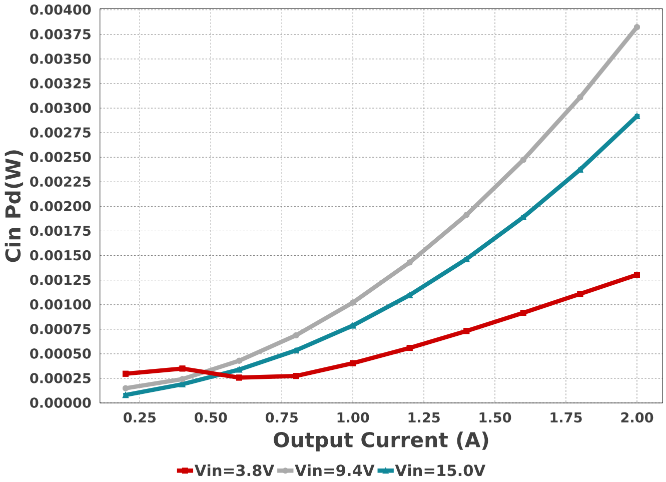
Vin p-p



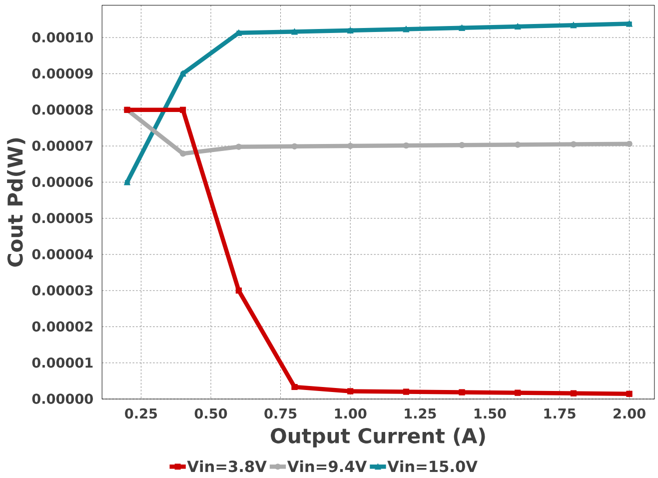
Vout p-p



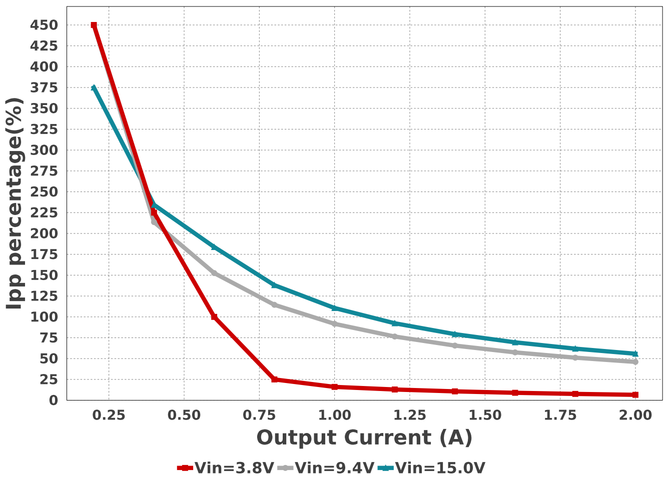
Cin Pd



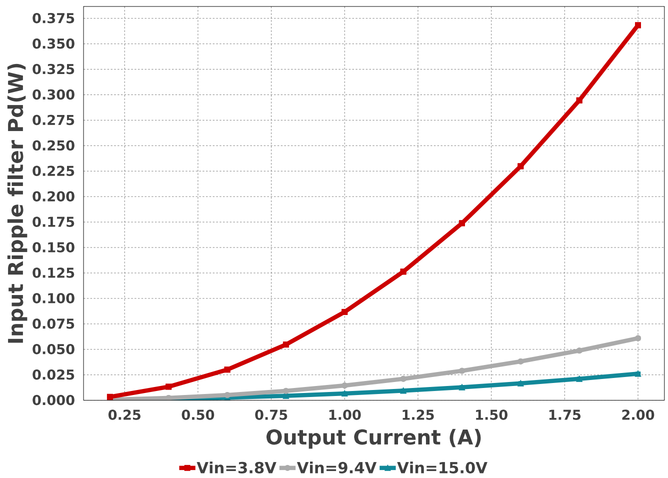
Cout Pd

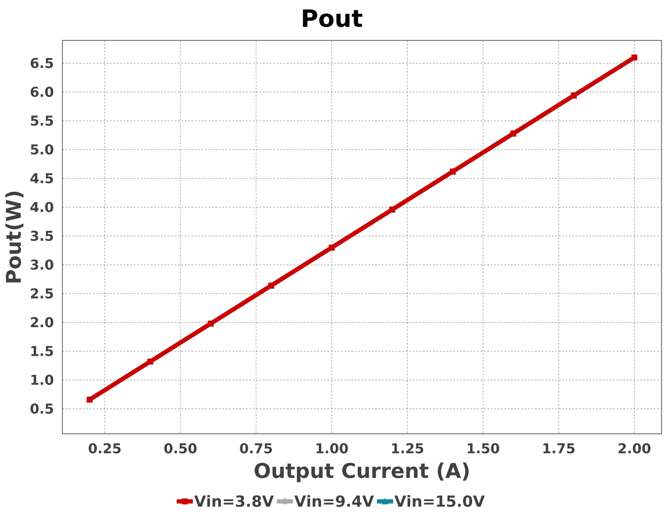


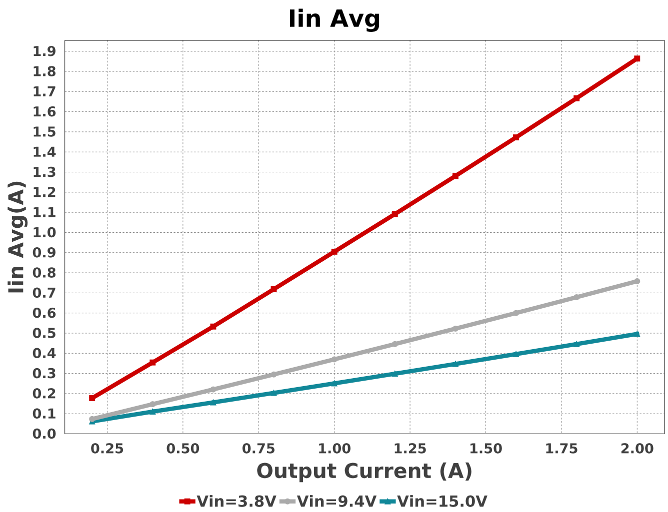
Ipp percentage

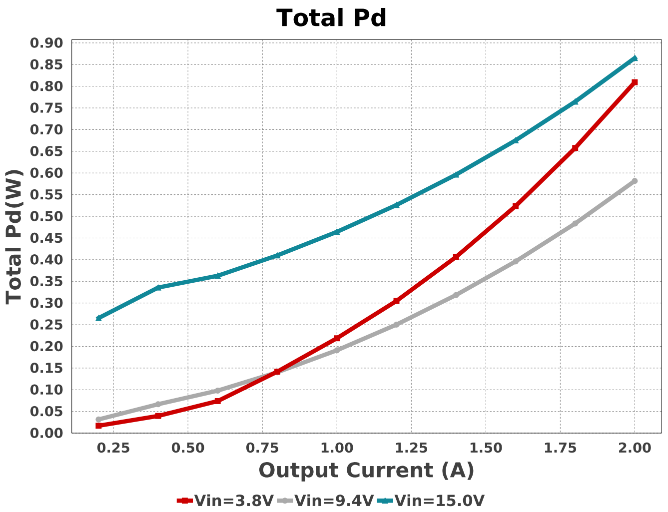


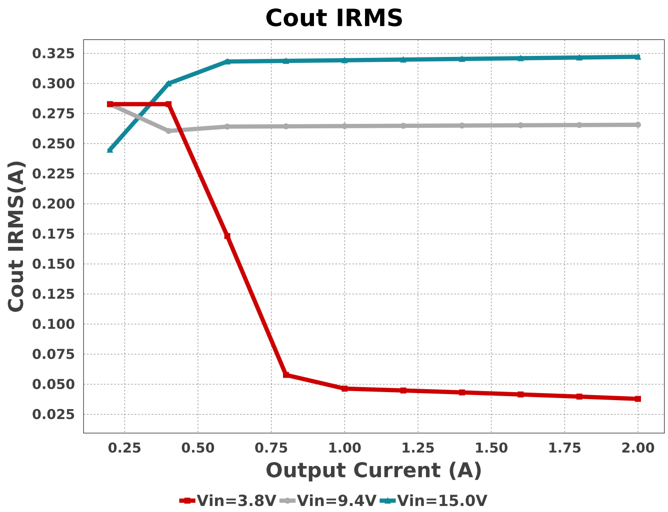
Input Ripple filter Pd

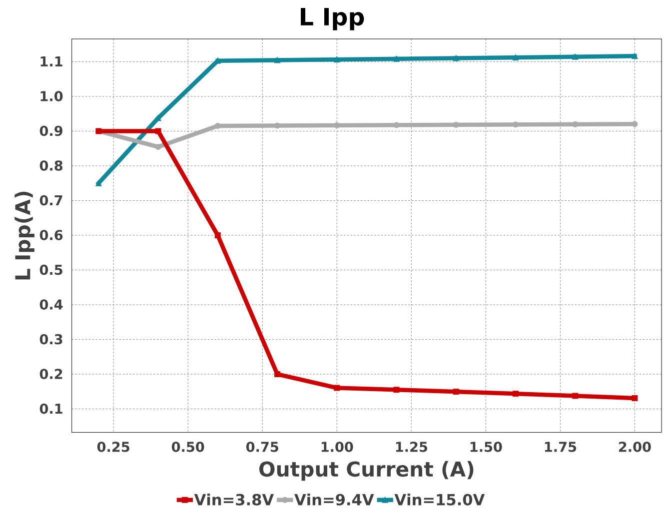


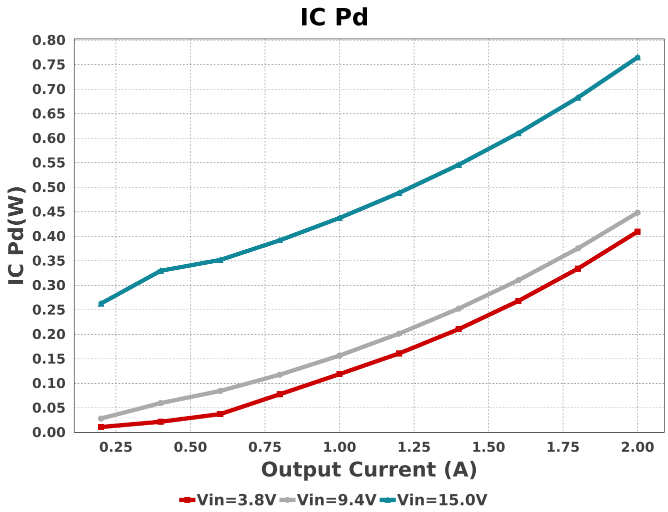

Pout
Pout(W)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V


Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V

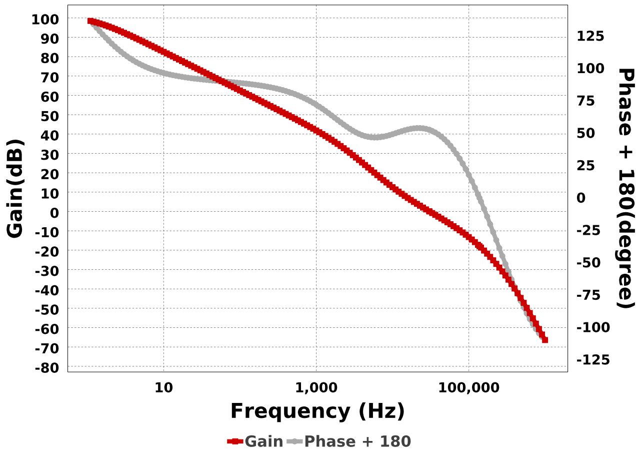

Total Pd
Total Pd(W)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V

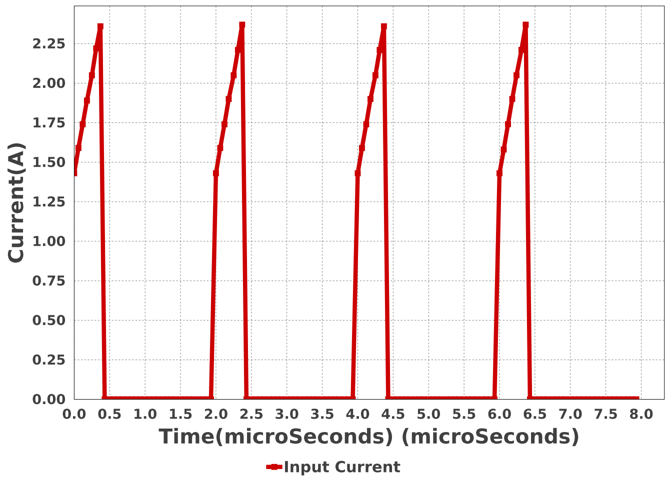

L Ipp
L Ipp(A)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=3.8V Vin=9.4V Vin=15.0V

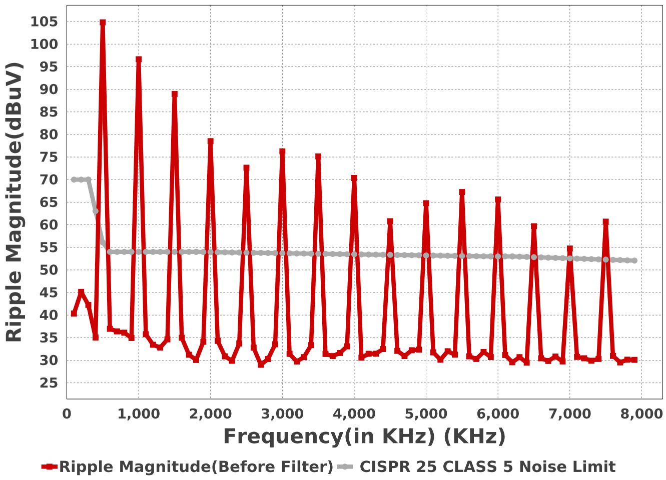
Loop Response



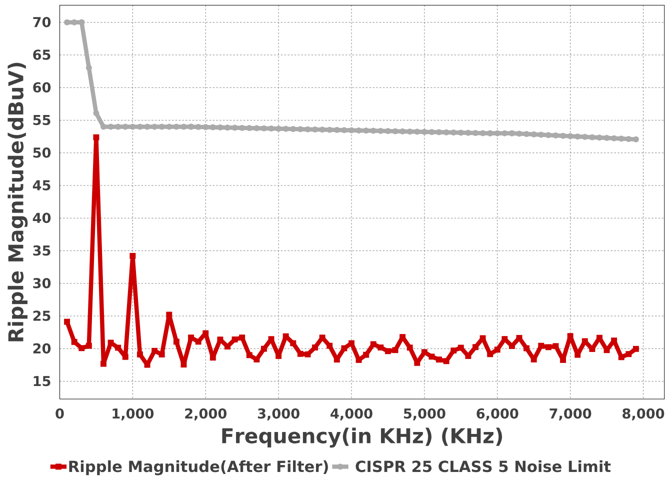
Input Current



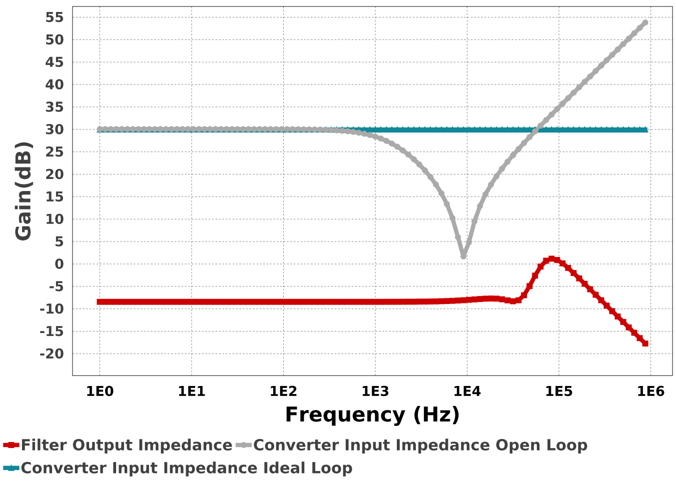
Ripple Freq Spectrum(Before Filter)



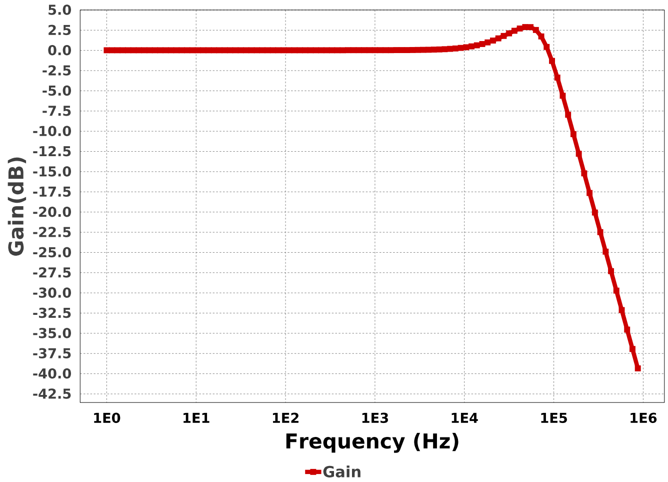
Ripple Freq Spectrum(After Filter)

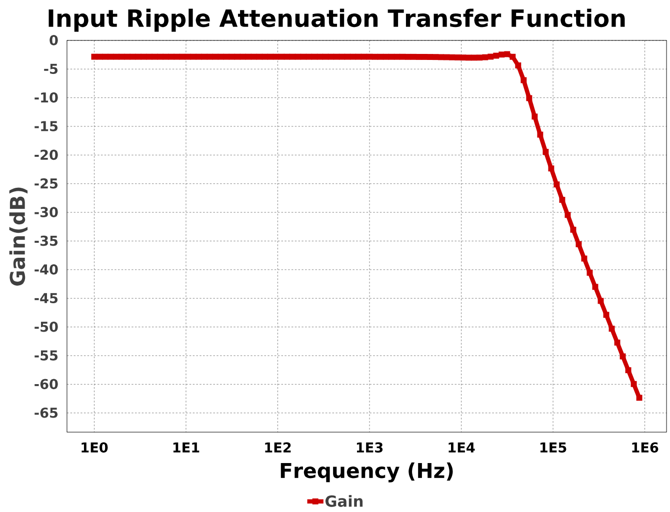


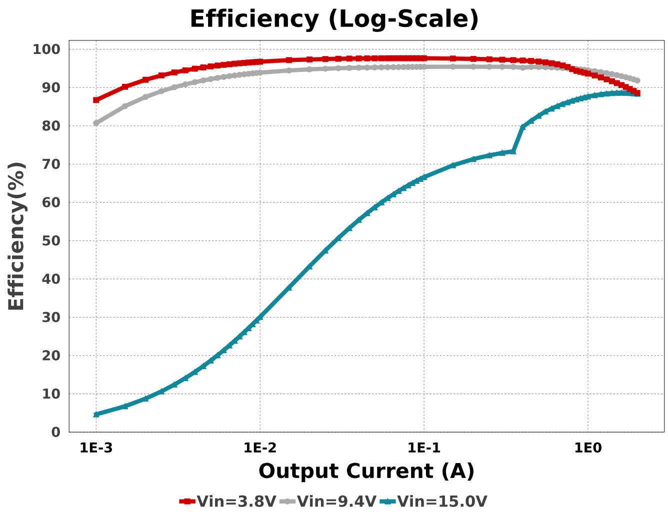
Filter vs Converter Impedance Comparison



Filter Forward Transfer Function







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	15		Total Design BOM count
2.	Total BOM	$2.761		Total BOM Cost
3.	Cin IRMS	854.216 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	2.919 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	322.219 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	103.83 µW	Capacitor	Output capacitor power dissipation
7.	Input Ripple Noise After input filter	52.33 dBuV	EMI Noise	Input Ripple Noise after filter at switching frequency
8.	Input Ripple Noise before input filter	104.83 dBuV	EMI Noise	Input Ripple Noise before filter at switching frequency
9.	Input Ripple filter Pd	26.092 mW	EMI Noise	Input Ripple Filter Power Dissipation
10.	Noise limits defined by CISPR Standards	56.08 dBuV	EMI Noise	Noise limits for CLASS 5 of CISPR 25 standard
11.	IC Ipk	2.558 A	IC	Peak switch current in IC
12.	IC Pd	764.86 mW	IC	IC power dissipation
13.	IC Tj	76.083 degC	IC	IC junction temperature
14.	IC Tolerance	16.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA Effective	60.25 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
16.	Iin Avg	496.13 mA	IC	Average input current
17.	Ipp percentage	55.81 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
18.	L Ipp	1.116 A	Inductor	Peak-to-peak inductor ripple current
19.	L Pd	73.869 mW	Inductor	Inductor power dissipation
20.	Cin Pd	2.919 mW	Power	Input capacitor power dissipation
21.	Cout Pd	103.83 µW	Power	Output capacitor power dissipation
22.	IC Pd	764.86 mW	Power	IC power dissipation
23.	Input Ripple filter Pd	26.092 mW	Power	Input Ripple Filter Power Dissipation
24.	L Pd	73.869 mW	Power	Inductor power dissipation
25.	Total Pd	865.052 mW	Power	Total Power Dissipation
26.	Cross Freq	30.605 kHz	System Information	Bode plot crossover frequency
27.	Duty Cycle	22.886 %	System Information	Duty cycle
28.	Efficiency	88.376 %	System Information	Steady state efficiency
29.	FootPrint	302.0 mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	500.0 kHz	System Information	Switching frequency
31.	Gain Marg	-17.923 dB	System Information	Bode Plot Gain Margin
32.	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
33.	Iout	2.0 A	System Information	Iout operating point
34.	Iout transient step used for Cout calculations	1.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
35.	Low Freq Gain	98.46 dB	System Information	Gain at 1Hz
36.	Mode	CCM	System Information	Conduction Mode

#	Name	Value	Category	Description
37.	Overshoot Value	11.235 mV	System Information	Theoretical Vout Overshoot Value
38.	Phase Marg	52.493 deg	System Information	Bode Plot Phase Margin
39.	Pout	6.6 W	System Information	Total output power
40.	Undershoot Value	27.78 mV	System Information	Theoretical Vout Undershoot Value
41.	Vin	15.0 V	System Information	Vin operating point
42.	Vin p-p	512.414 mV	System Information	Peak-to-peak input voltage
43.	Vout	3.3 V	System Information	Operational Output Voltage
44.	Vout Actual	3.272 V	System Information	Vout Actual calculated based on selected voltage divider resistors
45.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
46.	Vout Tolerance	3.557 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
47.	Vout p-p	4.503 mV	System Information	Peak-to-peak output ripple voltage
48.	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	2.0	Maximum Output Current
VinMax	15.0	Maximum input voltage
VinMin	3.8	Minimum input voltage
Vout	3.3	Output Voltage
base_pn	TPS62933P	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	500.0 k	Customer Selected Frequency

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

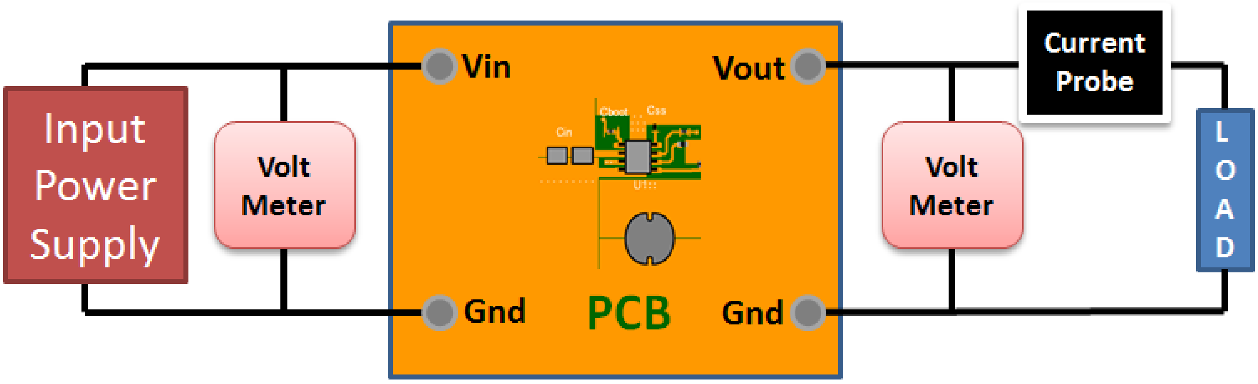
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.8V 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.

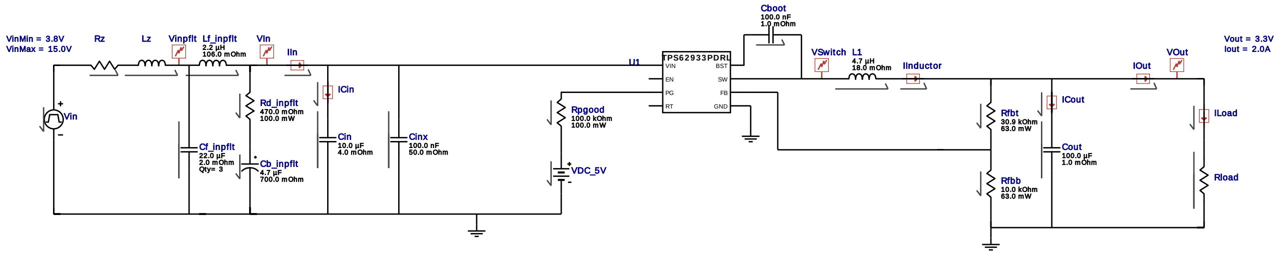


WEBENCH® Electrical Simulation Report

Design Id = 13

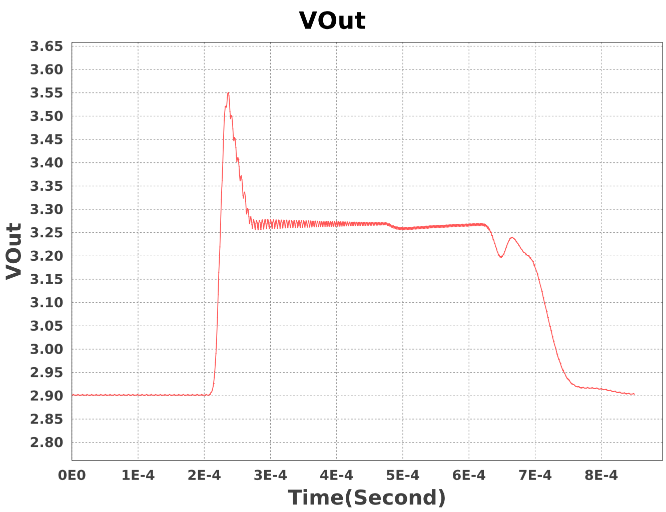
sim_id = 7

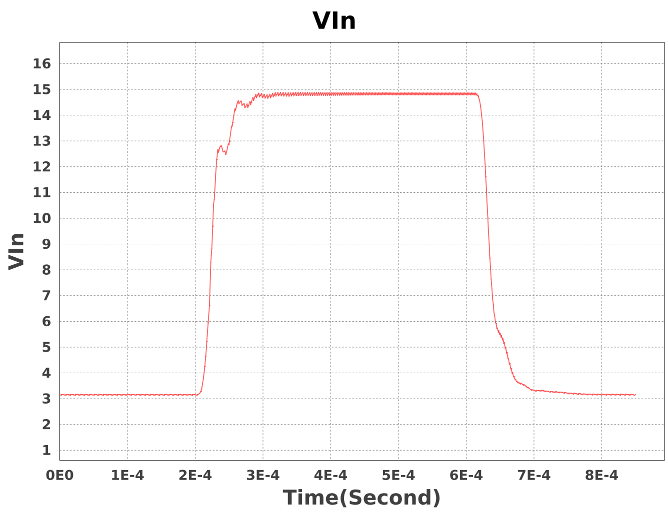
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	initial condition	3.3 V
2.	L1	IC	Initial Current	2.0 A
3.	Rload	R	Load Resistance	1.65 ohm
4.	Rz	R	no description	0.2721 Ohm
5.	Lz	L	no description	1.0E-6 H

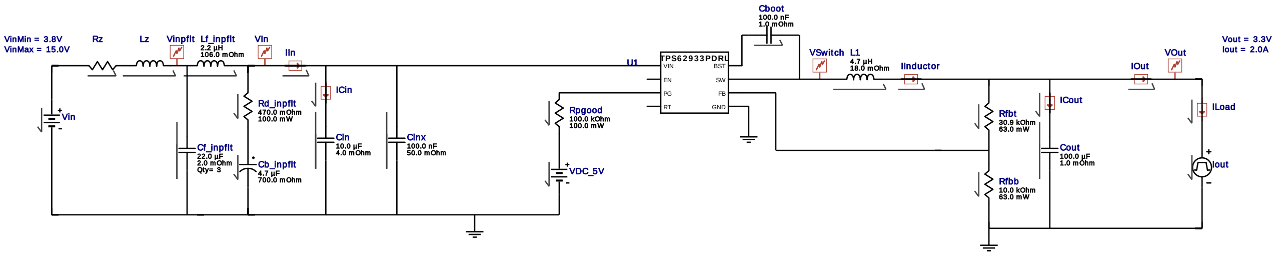




Design Id = 13

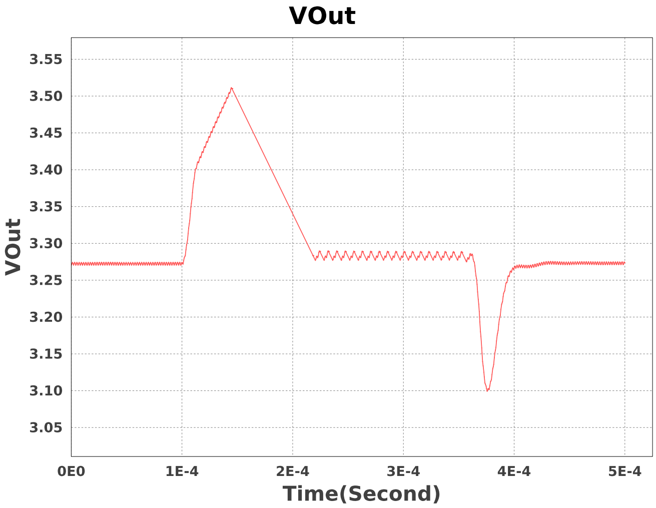
sim_id = 8

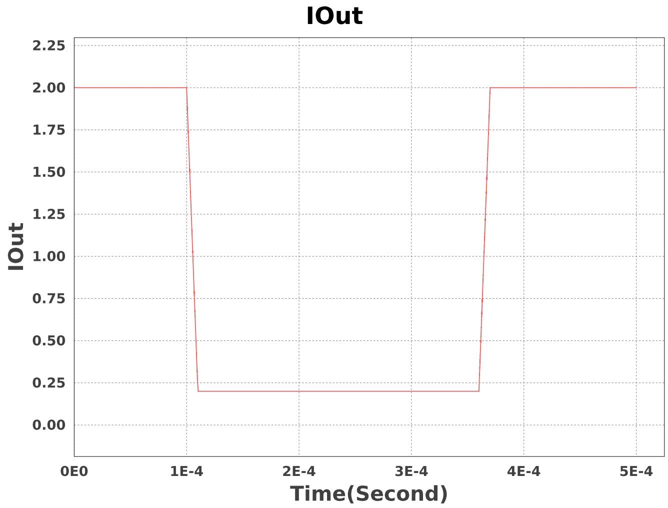
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cout	IC	Initial Condition	3.3 V
2.	L1	IC	initial current	2.0
3.	ILoad	I	Load Current	ILoad1 A
4.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	2.0 A
		I2	Minimum Load Current	0.2 A
		Td	Initial Time Delay	0.1m s
		Tf	Fall Time	10u s
		Tr	Rise Time	10u s
		Pw	Pulse Width	0.25m s
5.	Rz	R	no description	0.2721 Ohm
6.	Lz	L	no description	1.0E-6 H





Design Assistance

1. Master key : A1B40F3D1A652764031E2B93F10D1CC6[v1]

2. **TPS62933P** Product Folder : http://www.ti.com/product/TPS62933P : contains the data sheet and other resources.

Important Notice and Disclaimer