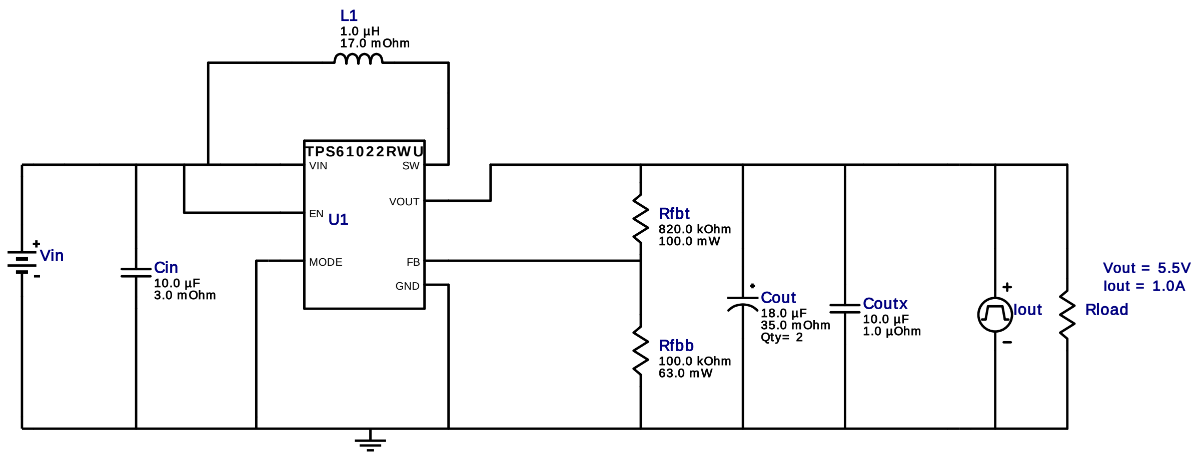
WEBENCH® Design Report

VinMin = 3.0V
VinMax = 5.0V
Vout = 5.5V
Iout = 1.0A

Device = TPS61022RWUR
Topology = Boost_PassThrough
Created = 2024-10-13 06:16:53.480
BOM Cost = NA
BOM Count = 8
Total Pd = 0.31W

Design : 1 TPS61022RWUR
TPS61022RWUR 3V-5V to 5.50V @ 1A



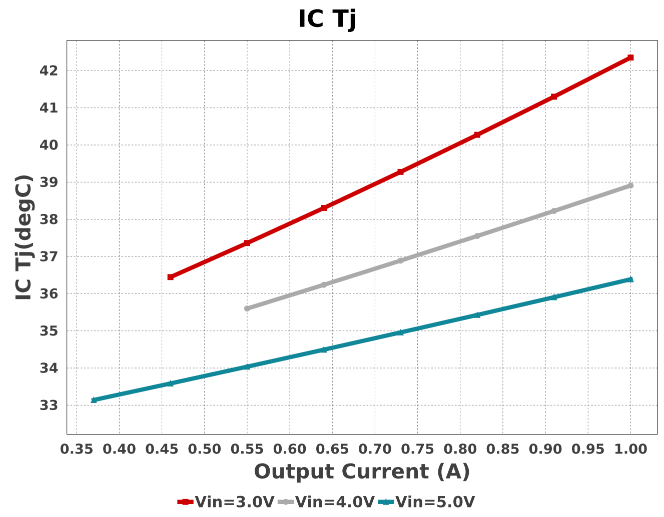
Design Alerts

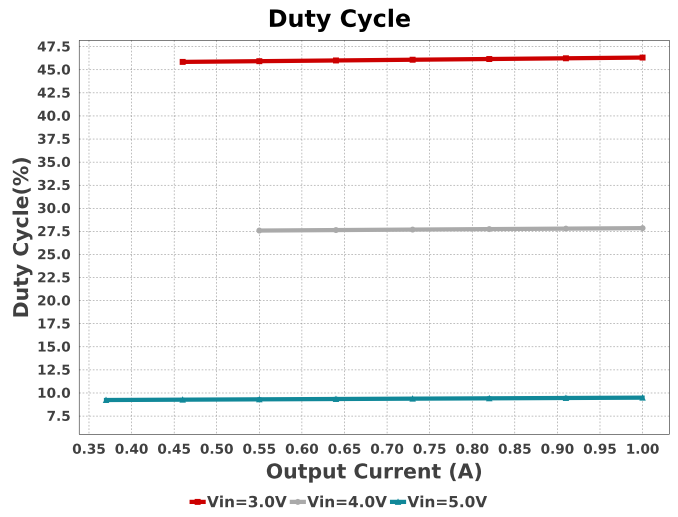
Component Selection Information

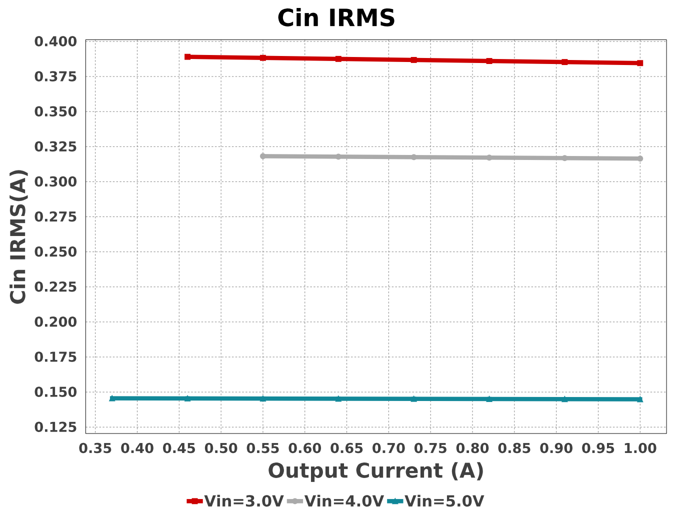
1. The TPS61022 Device will operate in Pass-Through mode when Vin is greater than Vout. In Pass-Through mode, Vout is not regulated to the set Vout, instead Vout is Vin with the drop across the FETï¿½s on-resistance and the DCR of the inductor. 2. This is a Boost Converter with 0.5V ultra-low input voltage. 3. The efficiency validation is done only for FPWM mode. Charts may be inaccurate for AutoMode at light loads and hence they are disabled for light loads.

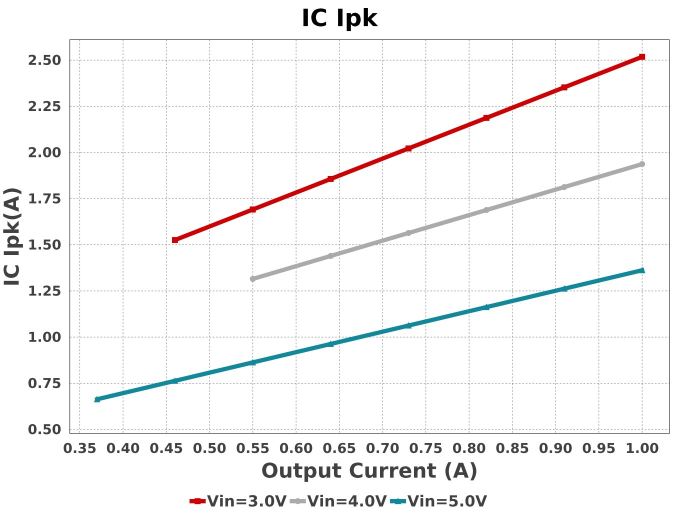
Electrical BOM

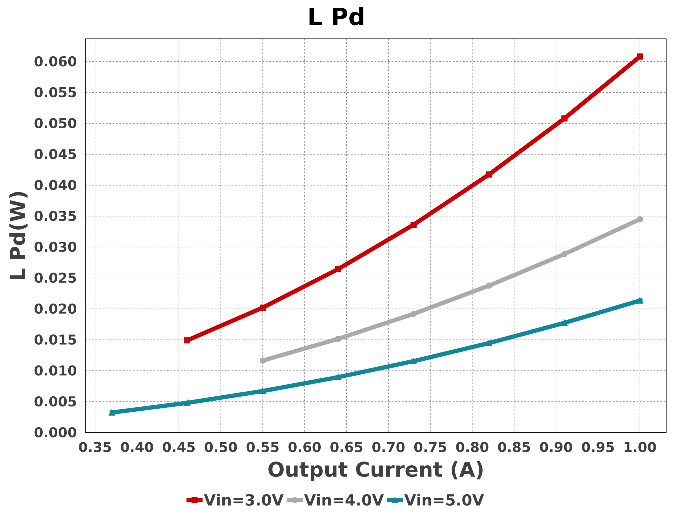
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	1	$0.03	0805 7 mm^2
Cout	Panasonic	50SVPF18M Series= SVPF	Cap= 18.0 uF ESR= 35.0 mOhm VDC= 50.0 V IRMS= 2.7 A	2	$0.70	CAPSMT_62_E7 106 mm^2
Coutx	CUSTOM	CUSTOM Series= ?	Cap= 10.0 uF ESR= 1.0 uOhm VDC= 11.0 V IRMS= 1.377 A	1	NA	CUSTOM 0 mm^2
L1	Wurth Elektronik	74404043010A	L= 1.0 µH 17.0 mOhm	1	$0.34	WE-LQS_4025 25 mm^2
Rfbb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC0603FR-07820KL Series= ?	Res= 820.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
U1	Texas Instruments	TPS61022RWUR	Switcher	1	$0.60	RWU0007A 9 mm^2

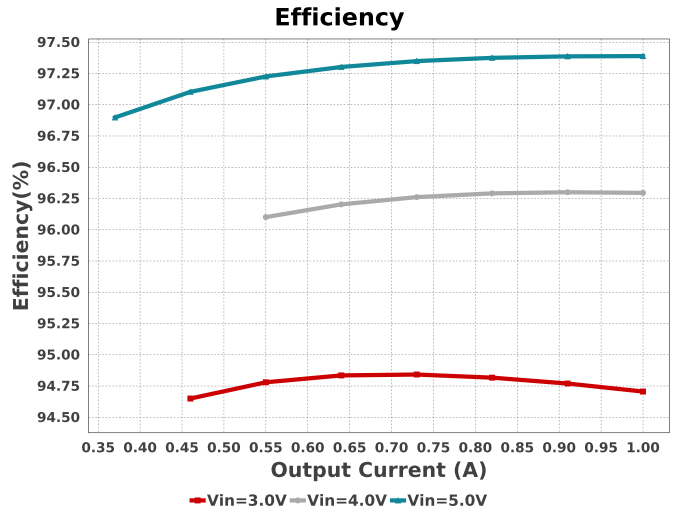

IC Tj
IC Tj(degC)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

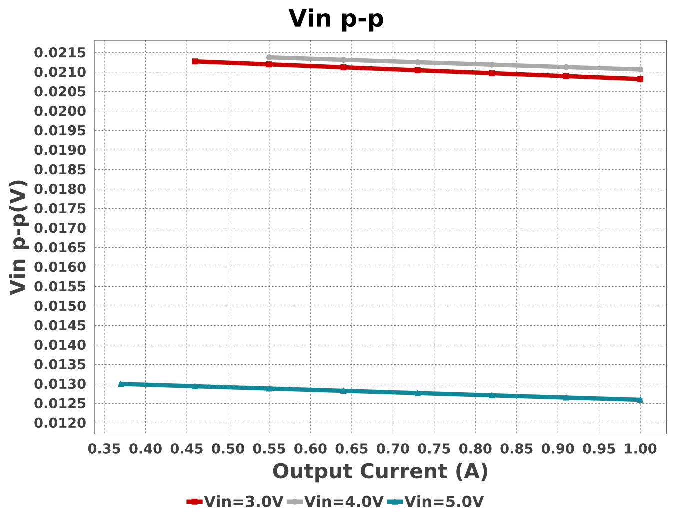

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

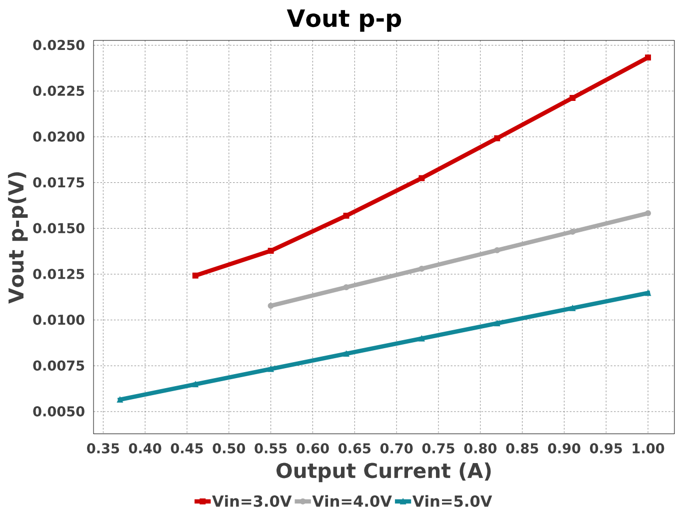

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

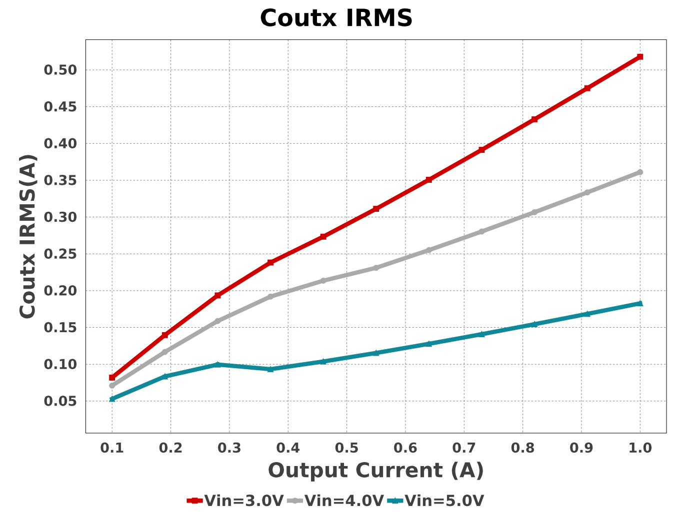

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

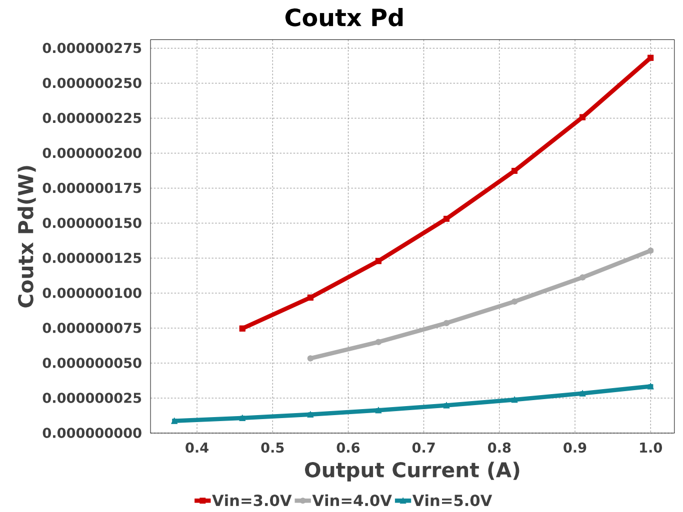

L Pd
L Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

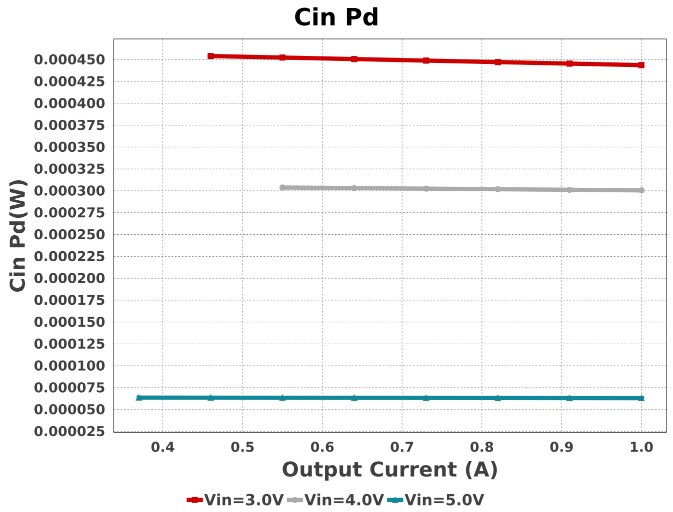

Efficiency
Efficiency(%)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

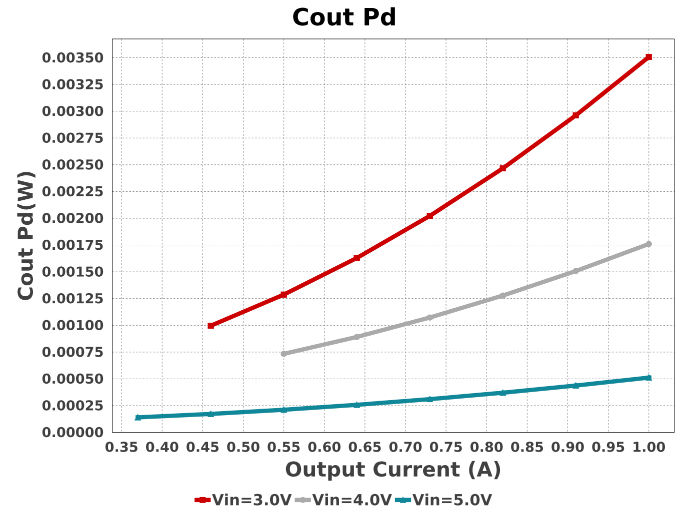

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

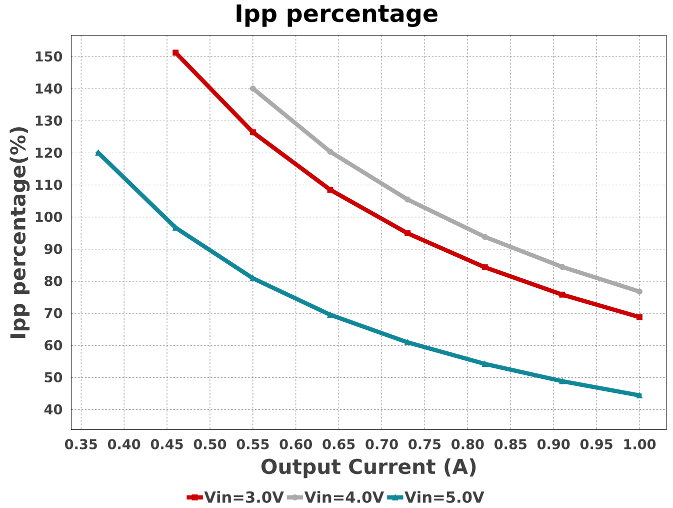

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

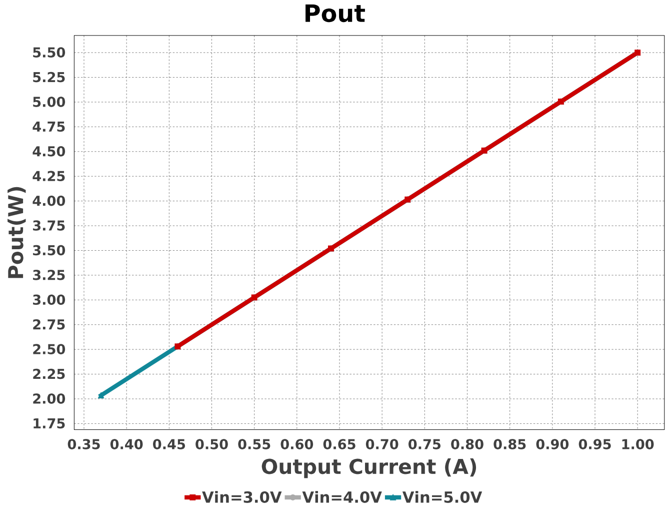

Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

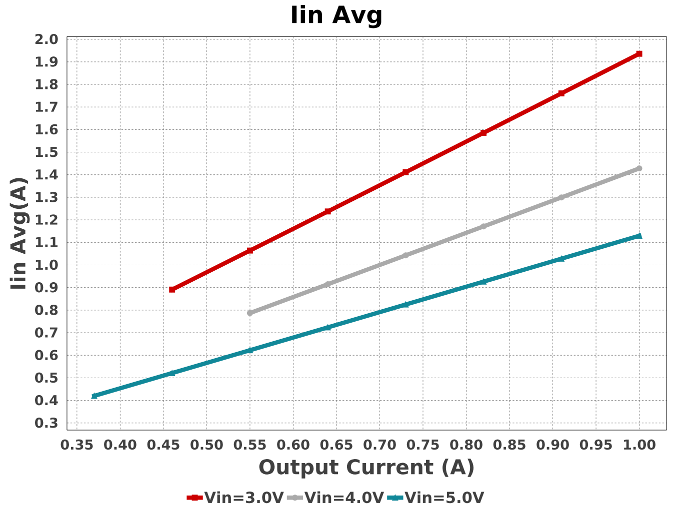

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

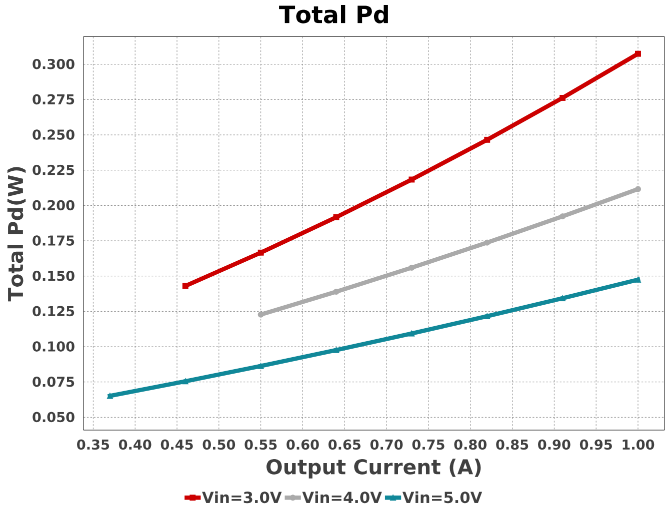

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

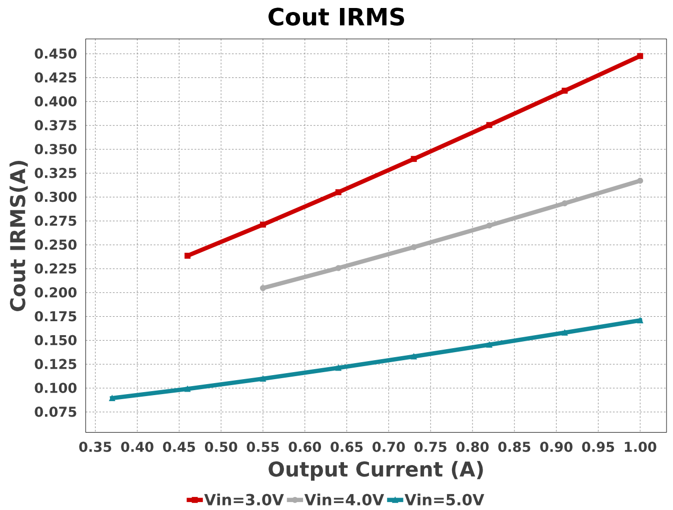

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

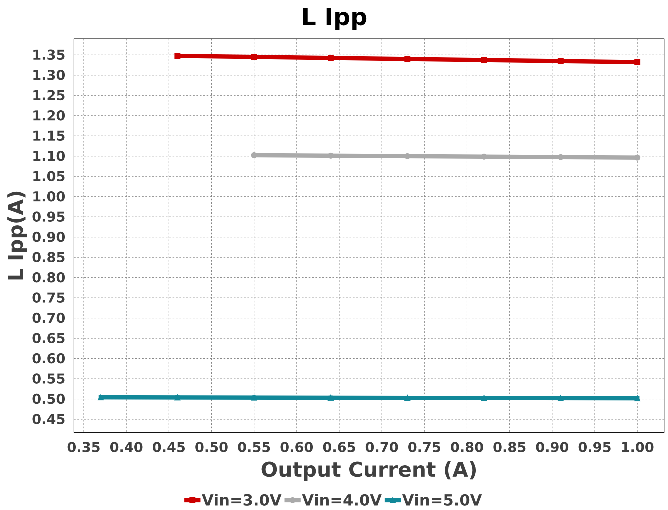

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

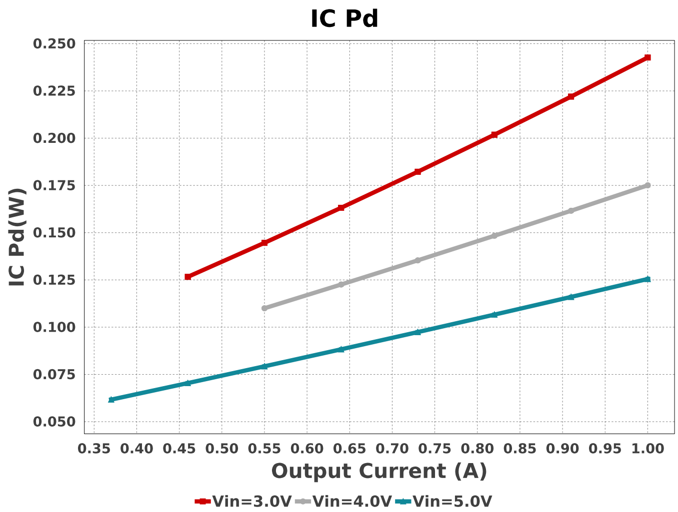

Pout
Pout(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V

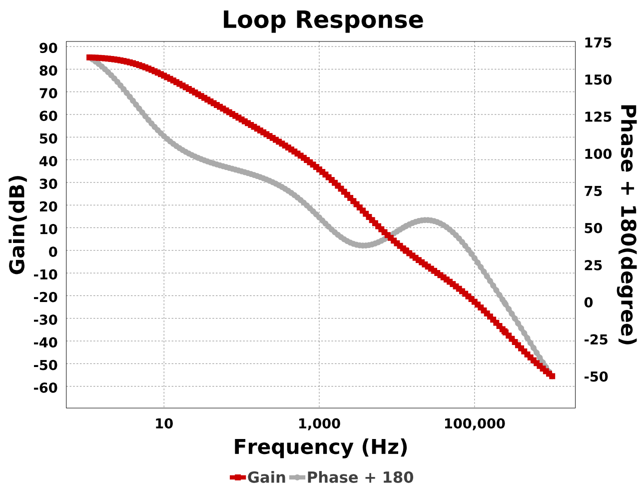

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V


L Ipp
L Ipp(A)
Output Current (A)
Vin=3.0V Vin=4.0V Vin=5.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	384.574 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	443.69 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	447.665 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	3.507 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	517.806 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	268.12 nW	Capacitor	Output capacitor_x power loss
7.	IC Ipk	2.518 A	IC	Peak switch current in IC
8.	IC Pd	242.67 mW	IC	IC power dissipation
9.	IC Tj	42.352 degC	IC	IC junction temperature
10.	IC Tolerance	15.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	50.9 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	1.936 A	IC	Average input current
13.	Ipp percentage	68.819 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	1.332 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	60.814 mW	Inductor	Inductor power dissipation
16.	Cin Pd	443.69 µW	Power	Input capacitor power dissipation
17.	Cout Pd	3.507 mW	Power	Output capacitor power dissipation
18.	Coutx Pd	268.12 nW	Power	Output capacitor_x power loss
19.	IC Pd	242.67 mW	Power	IC power dissipation
20.	L Pd	60.814 mW	Power	Inductor power dissipation
21.	Total Pd	307.444 mW	Power	Total Power Dissipation
22.	BOM Count	8	System Information	Total Design BOM count
23.	Cross Freq	8.975 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	46.323 %	System Information	Duty cycle
25.	Efficiency	94.706 %	System Information	Steady state efficiency
26.	FootPrint	301.0 mm²	System Information	Total Foot Print Area of BOM components
27.	Frequency	1.021 MHz	System Information	Switching frequency
28.	Gain Marg	-31.127 dB	System Information	Bode Plot Gain Margin
29.	Iout	1.0 A	System Information	Iout operating point
30.	Low Freq Gain	80.662 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	44.953 deg	System Information	Bode Plot Phase Margin
33.	Pout	5.5 W	System Information	Total output power
34.	Total BOM	NA	System Information	Total BOM Cost
35.	Vin	3.0 V	System Information	Vin operating point
36.	Vin p-p	20.822 mV	System Information	Peak-to-peak input voltage

#	Name	Value	Category	Description
37.	Vout	5.5 V	System Information	Operational Output Voltage
38.	Vout Actual	5.52 V	System Information	Vout Actual calculated based on selected voltage divider resistors
39.	Vout Tolerance	4.346 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	24.33 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	3.0	Minimum input voltage
Vout	5.5	Output Voltage
base_pn	TPS61022	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

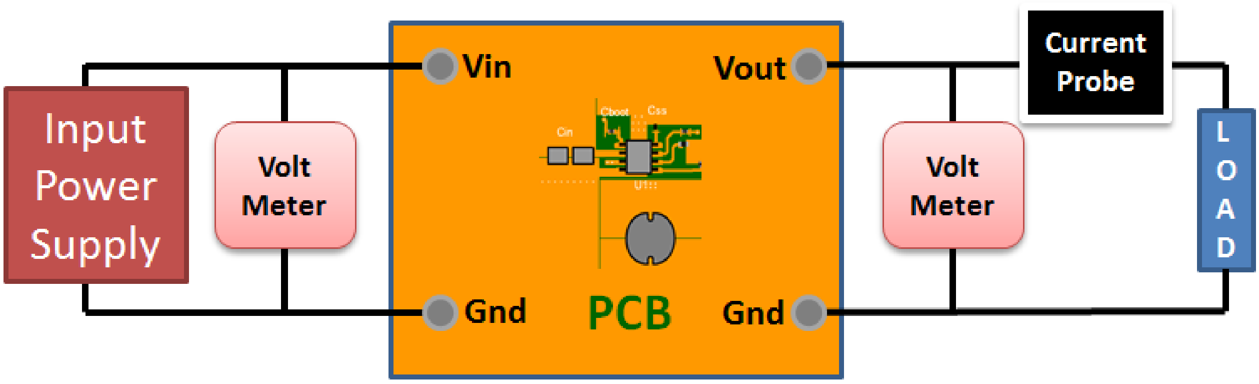
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.0V 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.

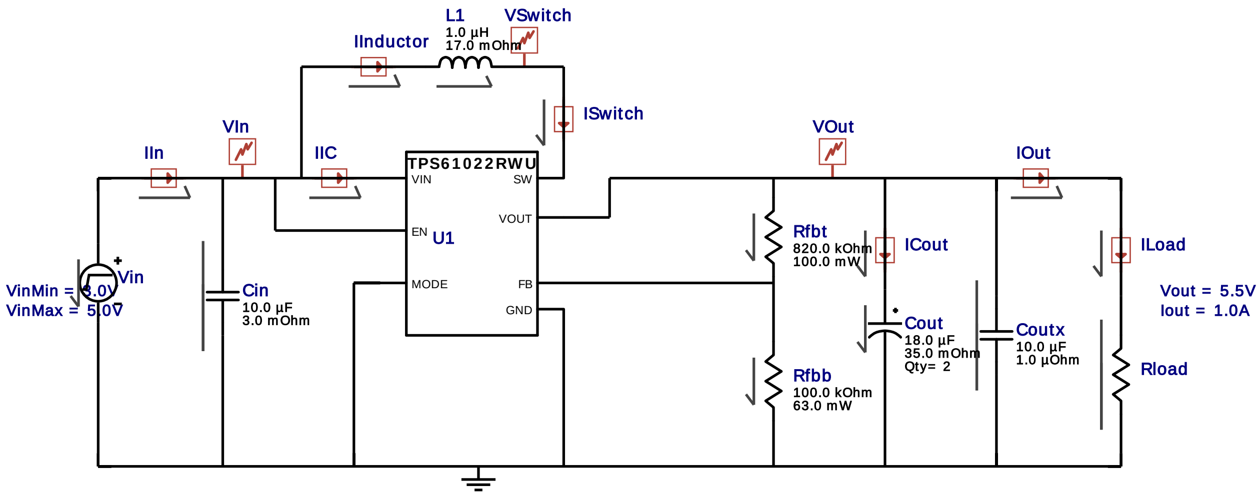


WEBENCH® Electrical Simulation Report

Design Id = 1

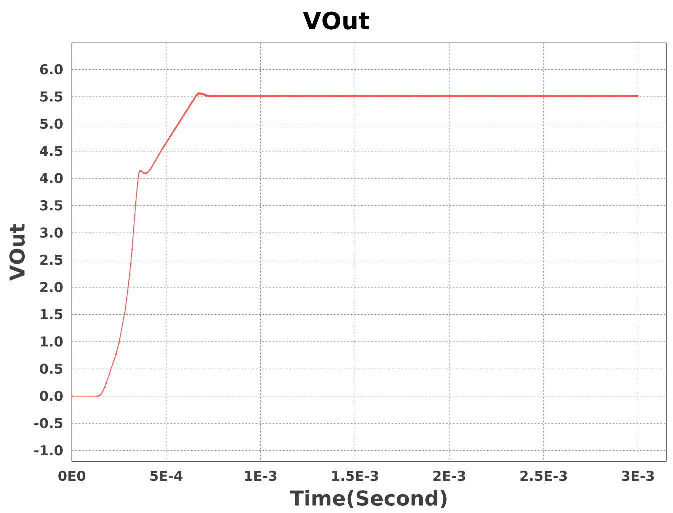
sim_id = 1

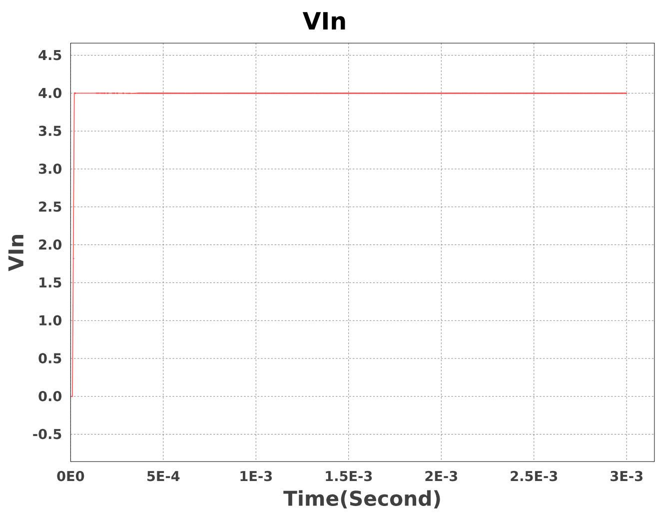
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	5.5 ohm

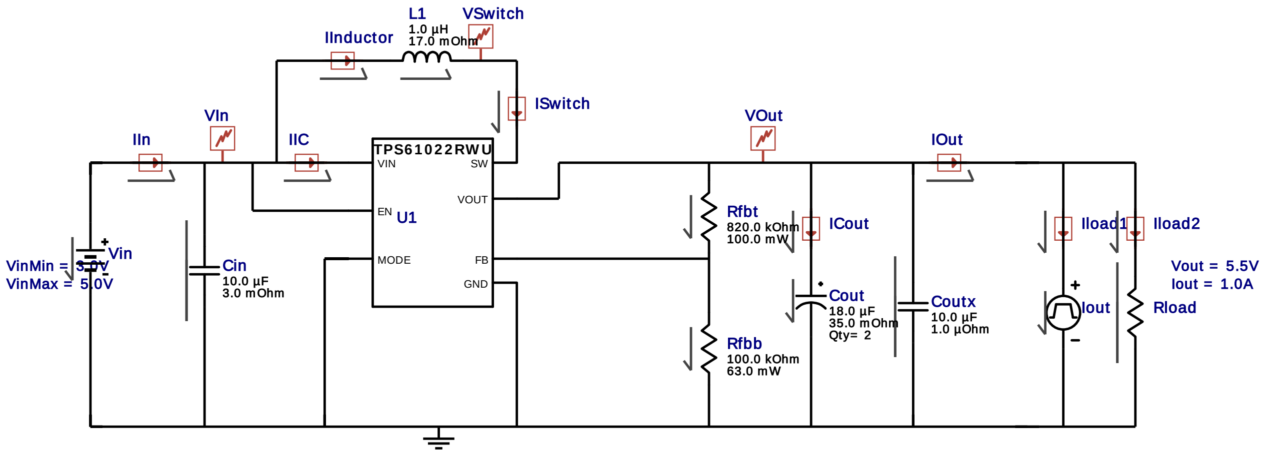




Design Id = 1

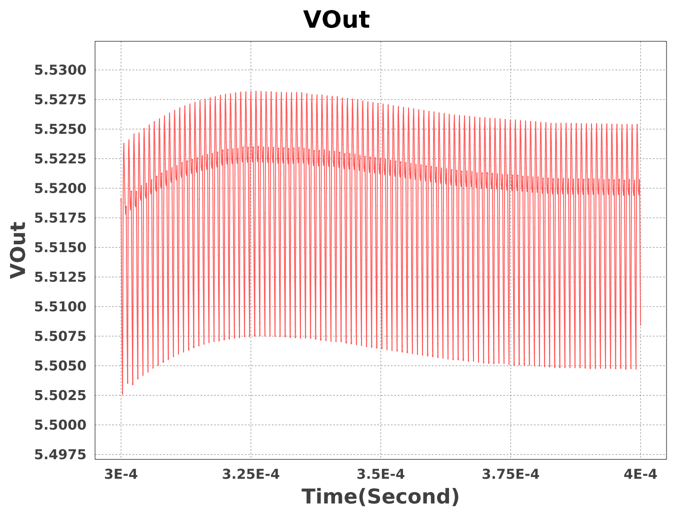
sim_id = 2

Simulation Type = Steady State



Simulation Parameters

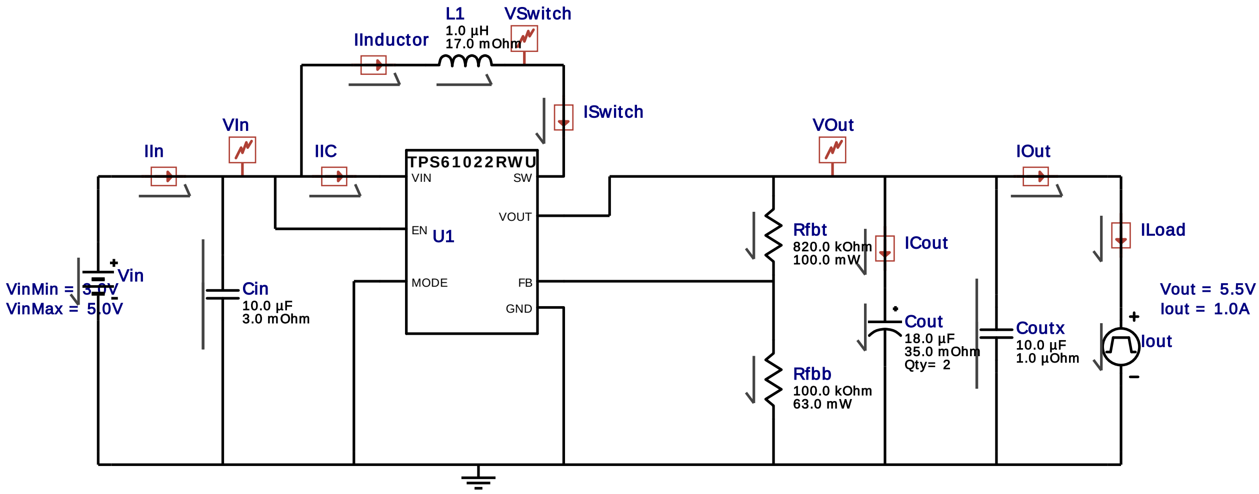
#	Name	Parameter Name	Description	Values
1.	Iout	signal_type	Signal Type	PULSE
		I1	no description	0 A
		I2	Minimum Load Current	0.0 A
		Td	no description	200u
		Tr	no description	1u
2.	Rload	R	Load Resistance	5.5 Ohm



Design Id = 1

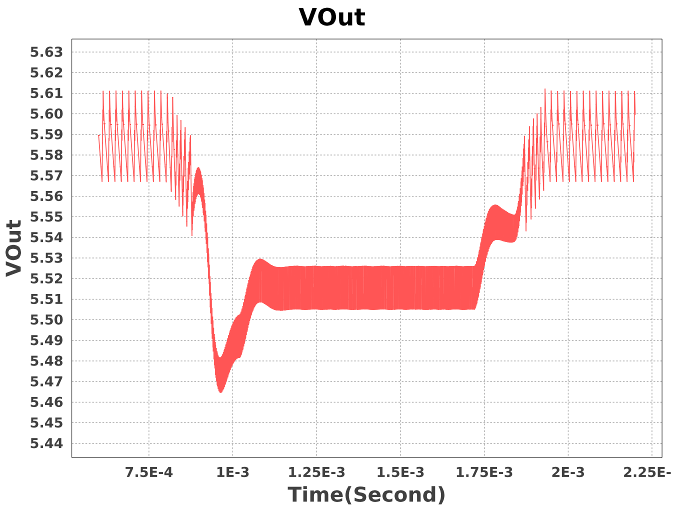
sim_id = 3

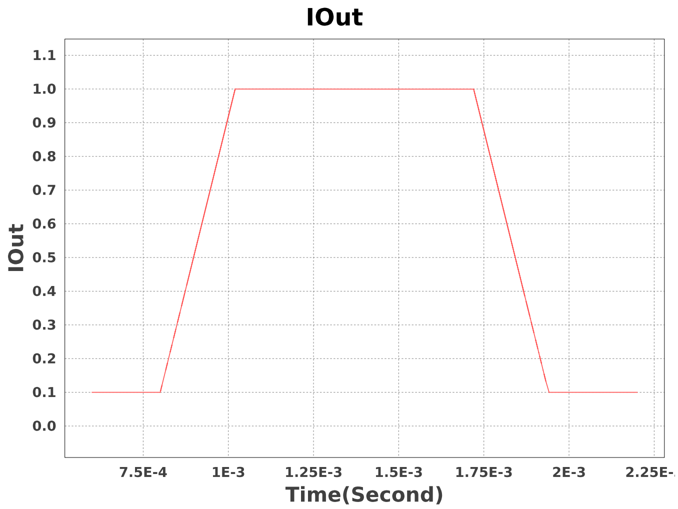
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Iout	signal_type	Signal Type	PULSE
		I1	Min Load Current	0.1 A
		I2	Min Load Current	1.0 A
		Td	Delay Time	8.0E-4 sec
		Tr	Rise Time	2.2E-4 sec
		Tf	Fall time	2.2E-4 sec
		Pw	Pulse Width	7.0E-4 sec

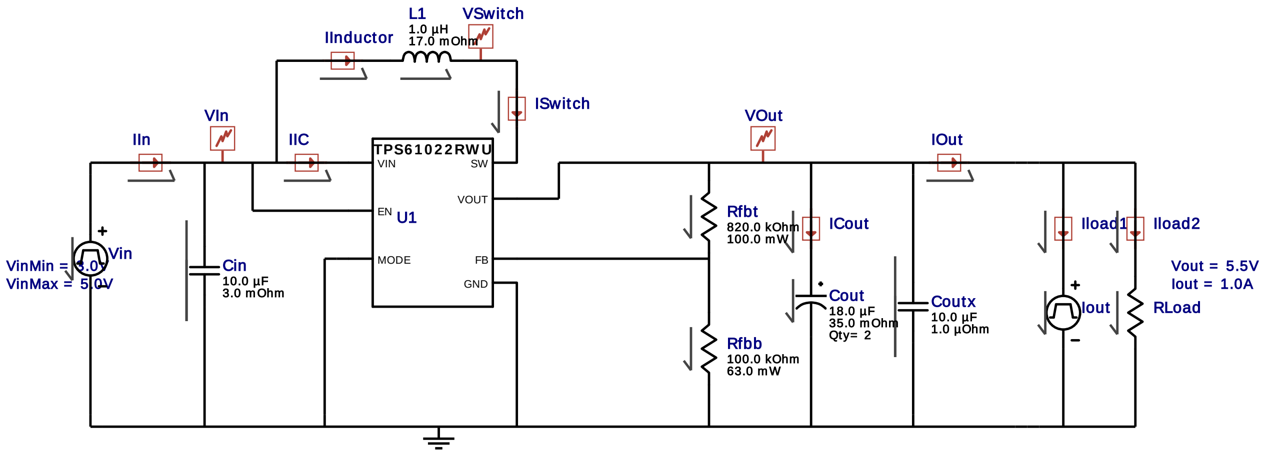




Design Id = 1

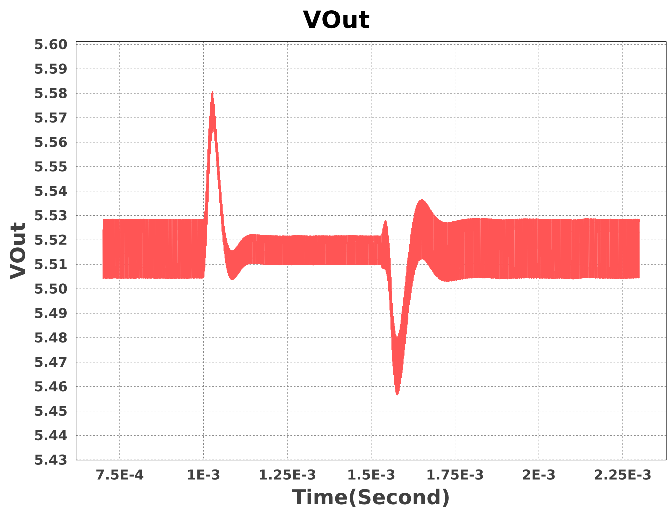
sim_id = 4

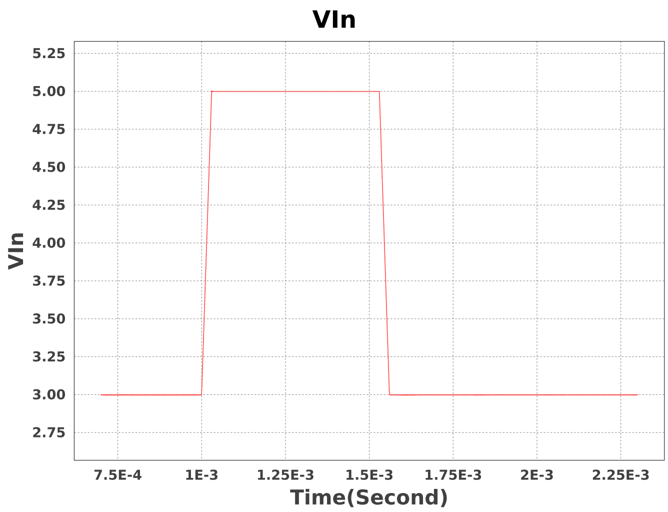
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	0 A
		I2	Minimum Load Current	0.0 A
		Td	Initial Time Delay	200u sec
		Tr	Rise Time	1u sec
2.	RLoad	R	Load Resistance	5.5 ohm





Design Assistance

1. Feature Highlights: 1. Device will operate in Pass-Through mode when Vin is greater than Vout. In Pass-Through mode, Vout is not regulated to the set Vout, instead Vout is Vin with the drop across the FETï¿½s on-resistance and the DCR of the inductor. 2. Device will operate in PassThrough Mode When Vin is greater than Vout

2. Master key : 5051F6BD097B3BB0A14395905FC0C345[v1]

3. **TPS61022** Product Folder : http://www.ti.com/product/TPS61022 : contains the data sheet and other resources.

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