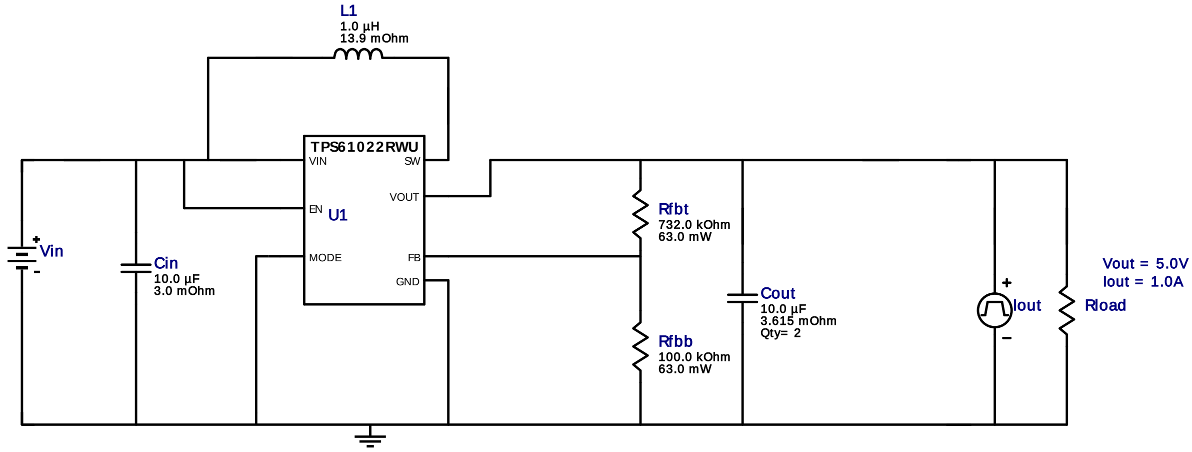
VinMin = 2.5V
VinMax = 4.2V
Vout = 5.0V
Iout = 1.0A

Device = TPS61022RWUR
Topology = Boost_PassThrough
Created = 2020-07-24 02:33:16.667
BOM Cost = $0.98
BOM Count = 7
Total Pd = 0.32W

WEBENCH ® Design Report

Design : 4 TPS61022RWUR
TPS61022RWUR 2.5V-4.2V to 5V @ 1A



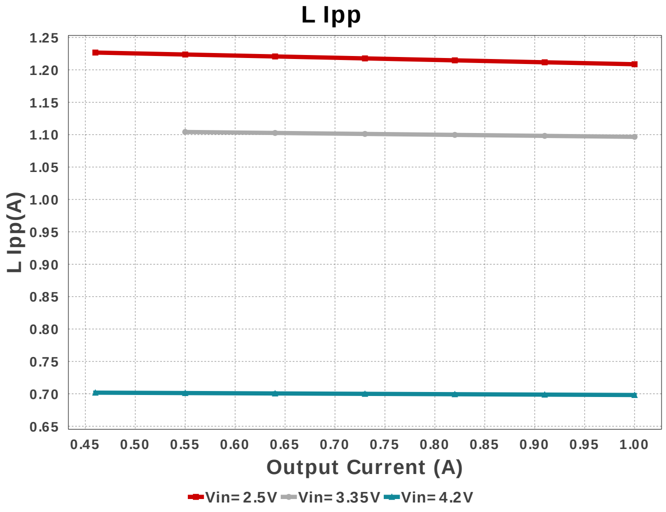
Design Alerts

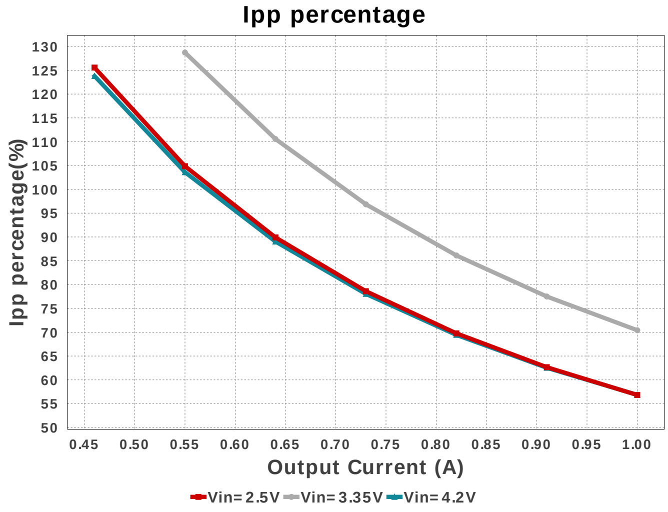
Component Selection Information

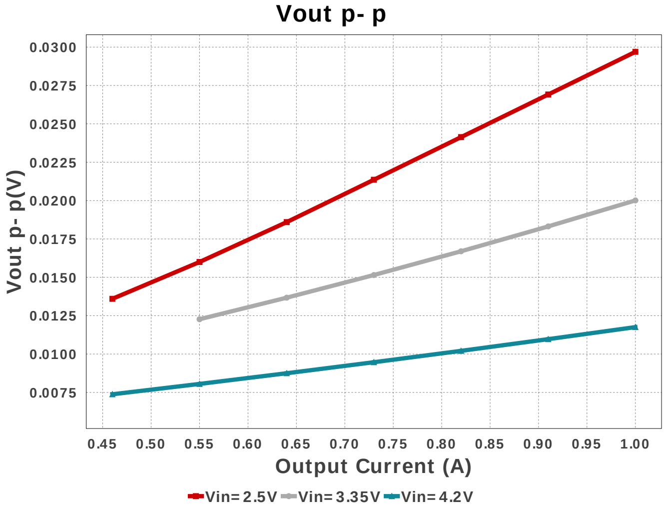
1. The TPS61022 Device will operate in Pass-Through mode when Vin is greater than Vout. In Pass-Through mode, Vout is not regulated to the set Vout, instead Vout is Vin with the drop across the FET?s on-resistance and the DCR of the inductor. 2. This is a Boost Converter with 0.5V ultra-low input voltage. 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.

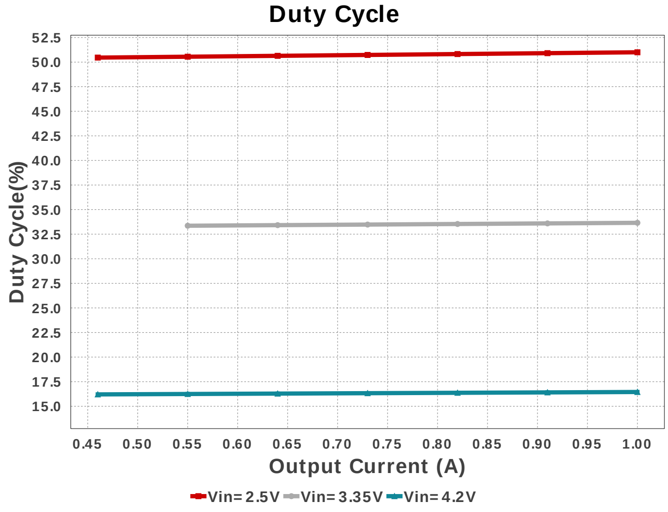
Electrical BOM

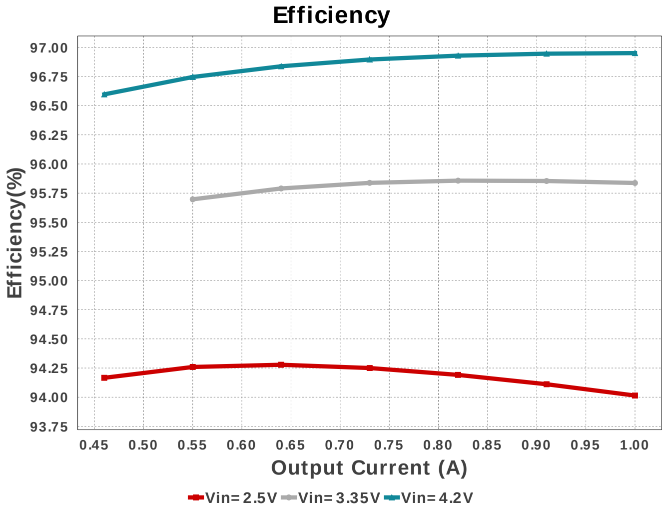
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	1	$0.03	0805 7 mm²
Cout	MuRata	GRM31CR61C106KA88L Series= X5R	Cap= 10.0 uF ESR= 3.615 mOhm VDC= 16.0 V IRMS= 3.8281 A	2	$0.08	1206_190 11 mm²
L1	Bourns	SRN6045-1R0Y	L= 1.0 µH 13.9 mOhm	1	$0.20	SRN6045 64 mm²
Rfbb	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW0402732KFKED Series= CRCW..e3	Res= 732.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	TPS61022RWUR	Switcher	1	$0.57	RWU0007A 9 mm²

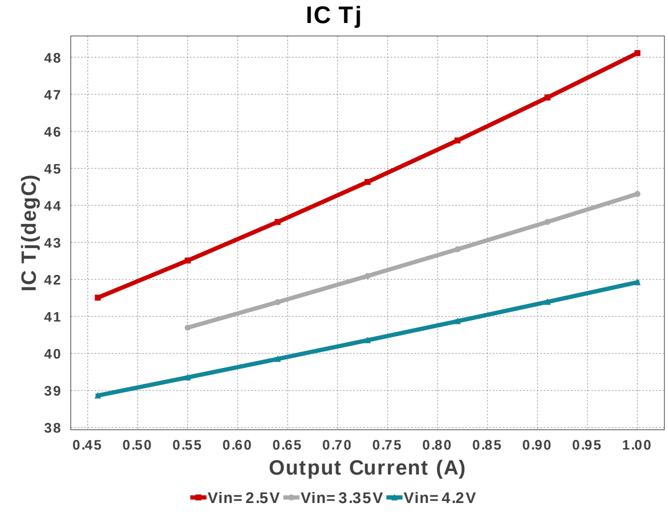

L Ipp
L Ipp(A)
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

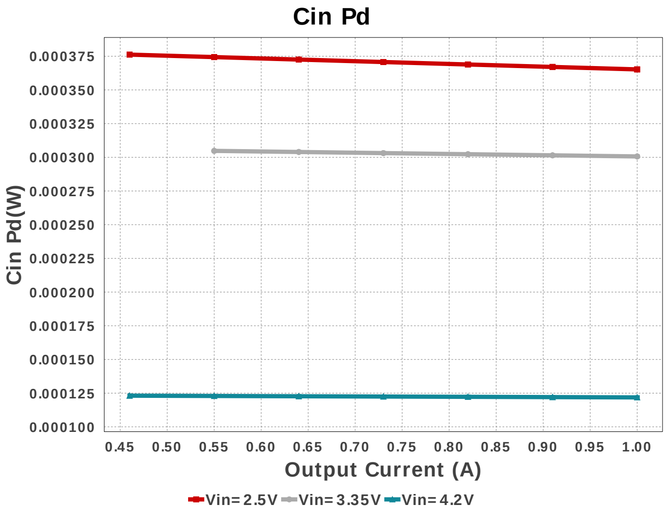

Ipp percentage
Ipp percentage(%)
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

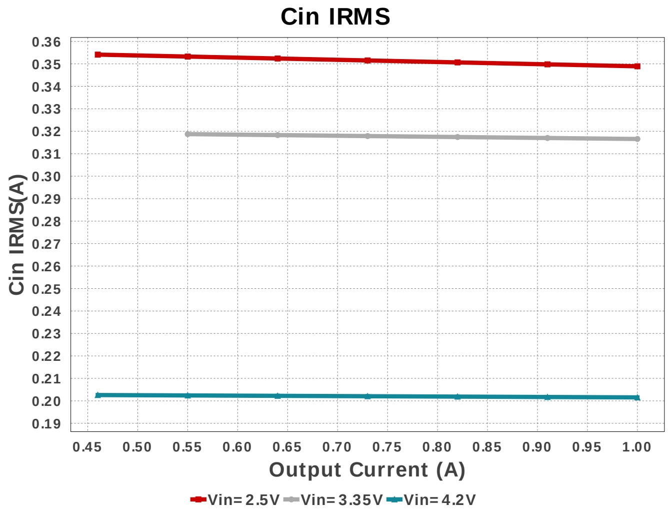

Vout p- p
Vout p- p(V)
0.0300
0.0275
0.0250
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

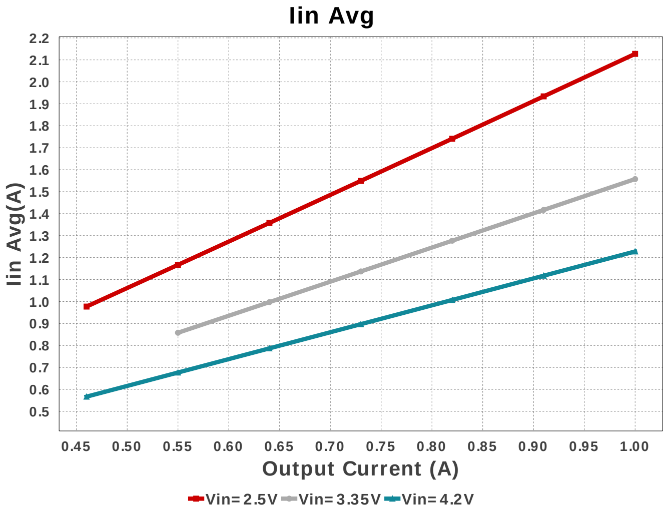

Duty Cycle
Duty Cycle(%)
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

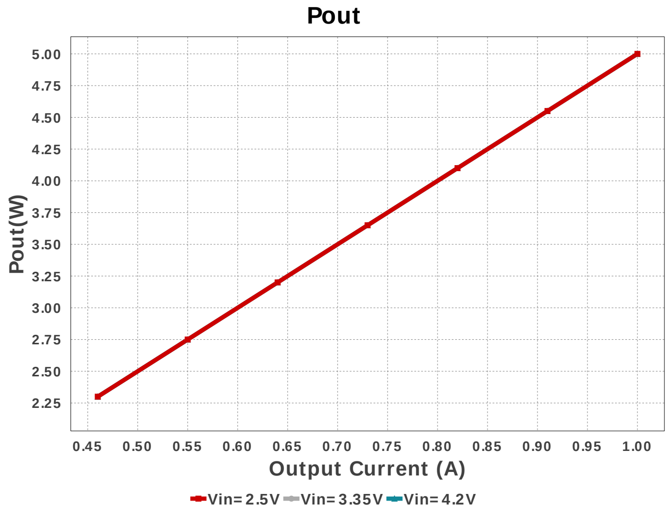

Efficiency
Efficiency(%)
97.00
96.75
96.50
96.25
96.00
95.75
95.50
95.25
95.00
94.75
94.50
94.25
94.00
93.75
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

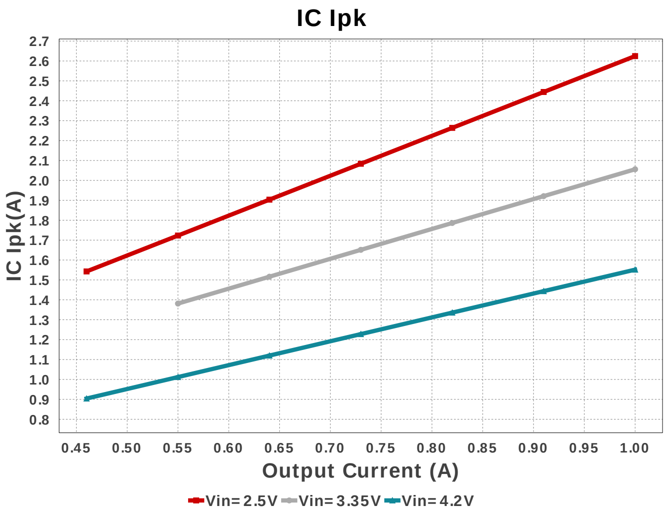

IC Tj
IC Tj(degC)
48
47
46
45
44
43
42
41
40
39
38
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin=2.5V Vin=3.35V Vin=4.2V

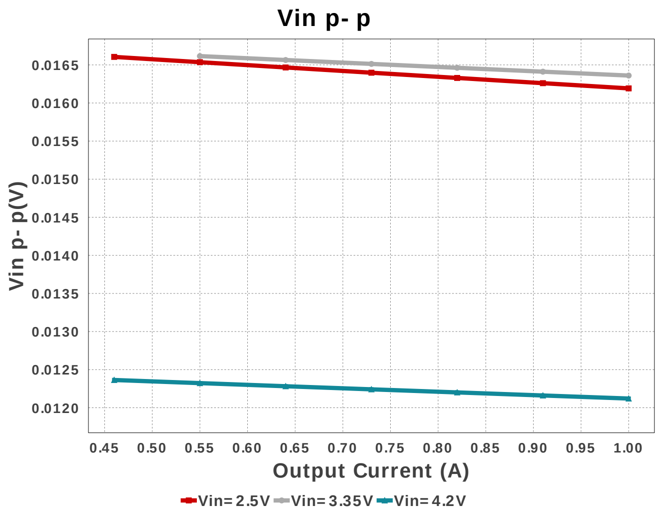

Cin Pd
Cin Pd(W)
0.000375
0.000350
0.000325
0.000300
0.000275
0.000250
0.000225
0.000200
0.000175
0.000150
0.000125
0.000100
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

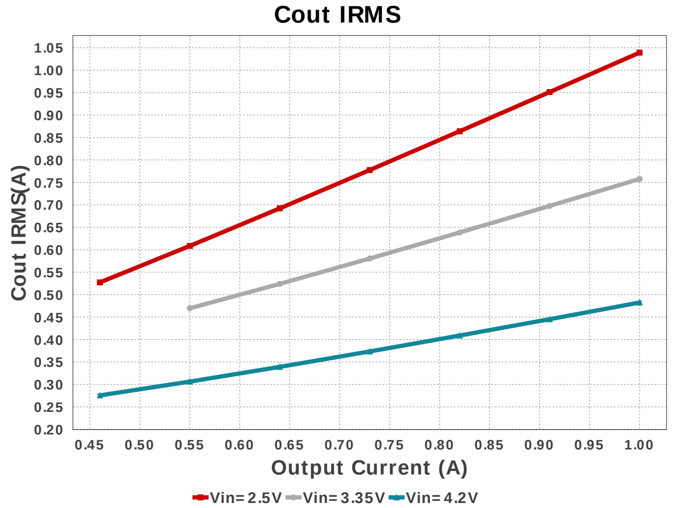

Cin IRMS
Cin IRMS(A)
0.36 0.35 0.34 0.33 0.32 0.31 0.30 0.29 0.28 0.27 0.26 0.25 0.24 0.23 0.22 0.21 0.20 0.19
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

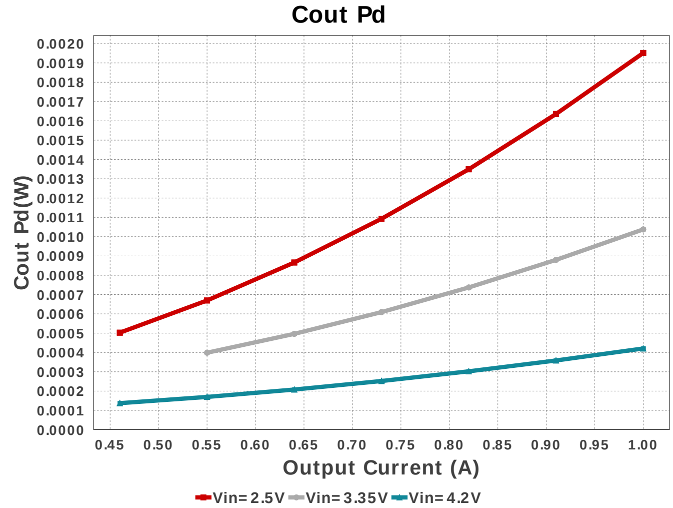

Iin Avg
Iin Avg(A)
2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

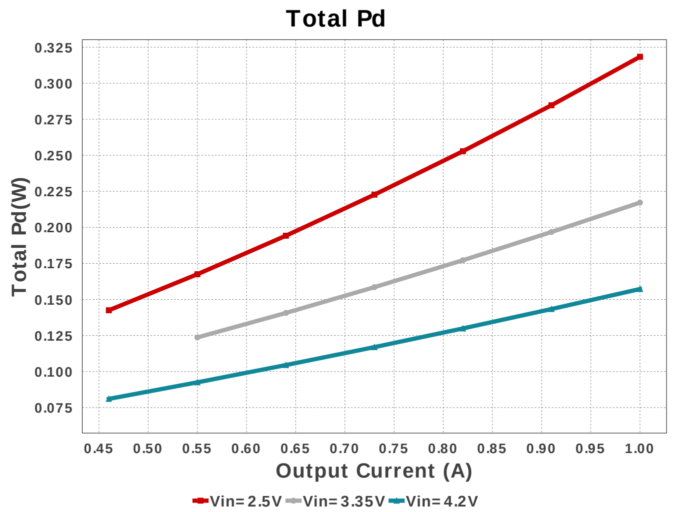

Pout
Pout(W)
5.00 4.75 4.50 4.25 4.00 3.75 3.50 3.25 3.00 2.75 2.50 2.25
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

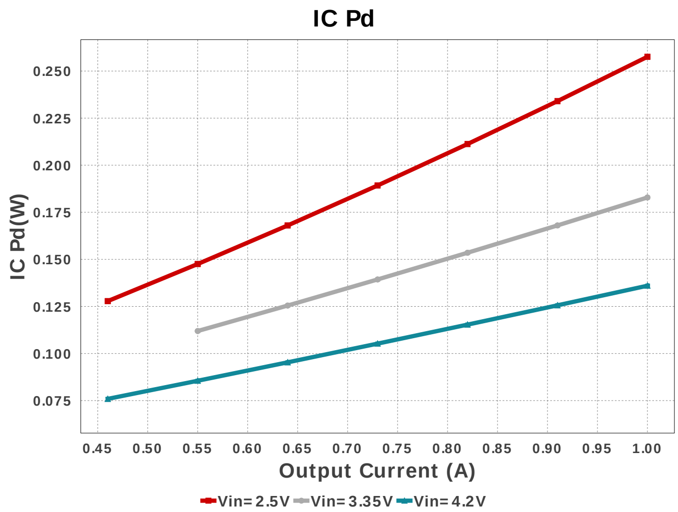

IC Ipk
IC Ipk(A)
2.7 2.6 2.5 2.4 2.3 2.2 2.1 2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

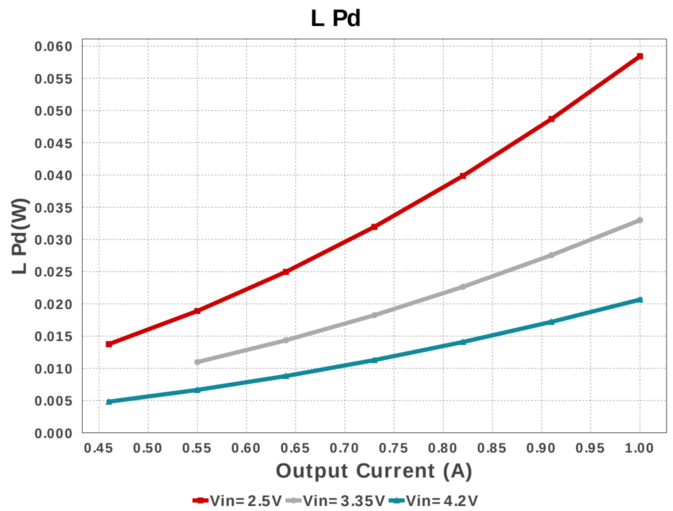

Vin p- p
Vin p- p(V)
0.0165 0.0160 0.0155 0.0150 0.0145 0.0140 0.0135 0.0130 0.0125 0.0120
0.45 0.50 0.55 0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
Output Current (A)
Vin= 2.5V Vin= 3.35V Vin= 4.2V

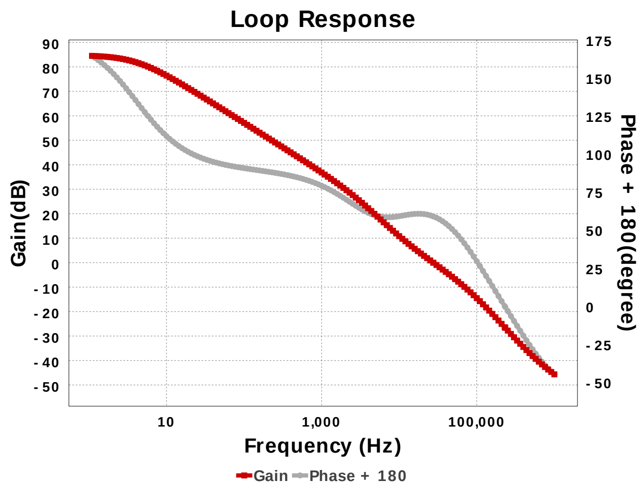












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	348.92 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	365.23 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.039 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	1.951 mW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	2.625 A	IC	Peak switch current in IC
6.	IC Pd	257.58 mW	IC	IC power dissipation
7.	IC Tj	48.111 degC	IC	IC junction temperature
8.	IC Tolerance	15.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA	50.9 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	2.127 A	IC	Average input current

#	Name	Value	Category	Description
11.	Ipp percentage	56.817 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L Ipp	1.209 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	58.422 mW	Inductor	Inductor power dissipation
14.	Cin Pd	365.23 µW	Power	Input capacitor power dissipation
15.	Cout Pd	1.951 mW	Power	Output capacitor power dissipation
16.	IC Pd	257.58 mW	Power	IC power dissipation
17.	L Pd	58.422 mW	Power	Inductor power dissipation
18.	Total Pd	318.35 mW	Power	Total Power Dissipation
19.	BOM Count	7	System Information	Total Design BOM count
20.	Cross Freq	17.536 kHz	System Information	Bode plot crossover frequency
21.	Duty Cycle	51.0 %	System Information	Duty cycle
22.	Efficiency	94.014 %	System Information	Steady state efficiency
23.	FootPrint	108.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	1.027 MHz	System Information	Switching frequency
25.	Gain Marg	-21.276 dB	System Information	Bode Plot Gain Margin
26.	Iout	1.0 A	System Information	Iout operating point
27.	Low Freq Gain	79.87 dB	System Information	Gain at 1Hz
28.	Mode	CCM	System Information	Conduction Mode
29.	Phase Marg	57.852 deg	System Information	Bode Plot Phase Margin
30.	Pout	5.0 W	System Information	Total output power
31.	Total BOM	$0.98	System Information	Total BOM Cost
32.	Vin	2.5 V	System Information	Vin operating point
33.	Vin p-p	16.192 mV	System Information	Peak-to-peak input voltage
34.	Vout	5.0 V	System Information	Operational Output Voltage
35.	Vout Actual	4.992 V	System Information	Vout Actual calculated based on selected voltage divider resistors
36.	Vout Tolerance	4.322 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	29.693 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	4.2	Maximum input voltage
VinMin	2.5	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	TPS61022	Base Product Number
source	DC	Input Source Type
Ta	35.0	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

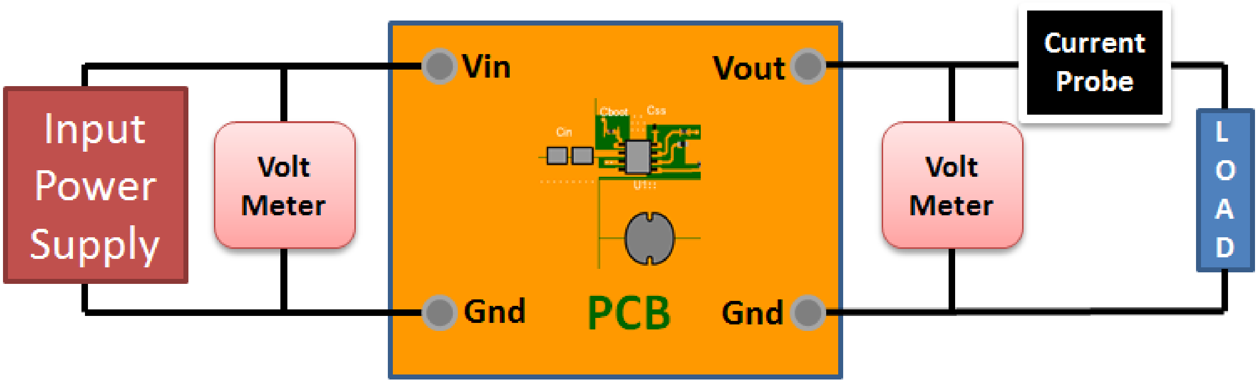
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 2.5V 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.

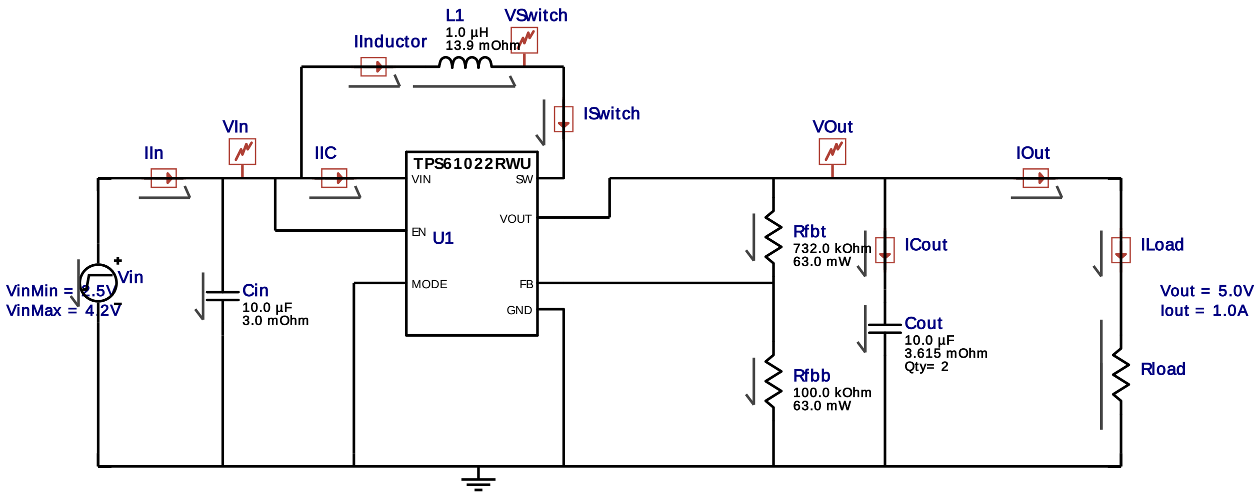


WEBENCH® Electrical Simulation Report

Design Id = 4

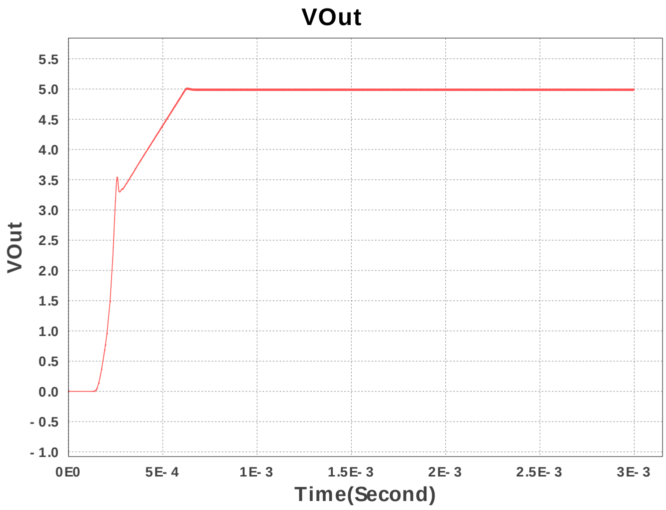
sim_id = 1

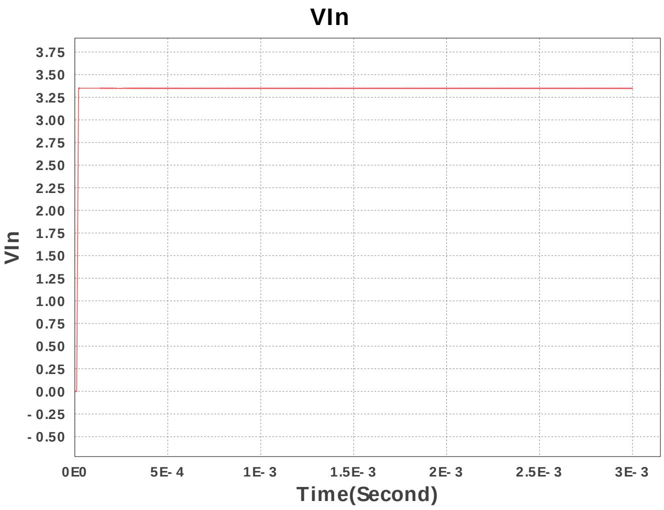
Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	5.0 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 FET?s on-resistance and the DCR of the inductor. 2. Device will operate in PassThrough Mode When Vin is greater than Vout

2. Master key : 09E862586525B1D3[v1]

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