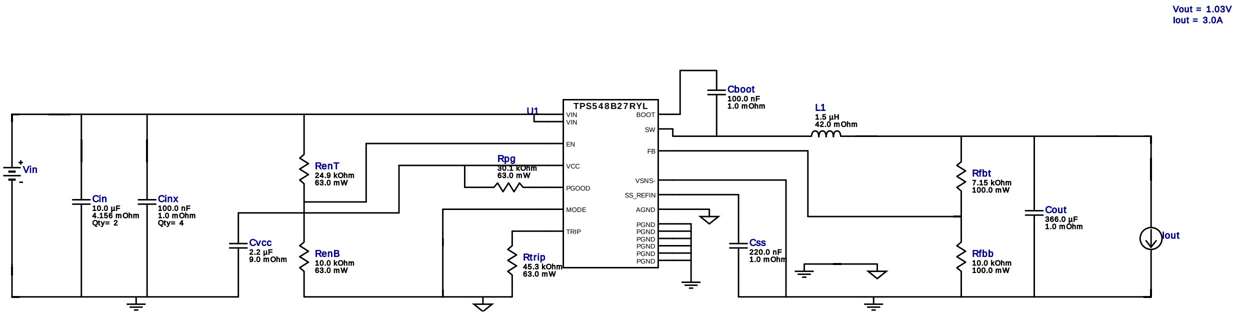
VinMin = 4.5V	Device = TPS548B27RYLR
VinMax = 5.5V	Topology = Buck
Vout = 1.03V	Created = 2023-02-07 10:21:50.693
Iout = 3.0A	BOM Cost = NA
	BOM Count = 18
	Total Pd = 0.72W

WEBENCH ® Design Report

Design : 12 TPS548B27RYLR

TPS548B27RYLR 4.5V-5.5V to 1.03V @ 3A



Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	Taiyo Yuden	EMK107B7104KA-T Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cin	MuRata	GRM31CR71C106KAC7L Series= X7R	Cap= 10.0 uF ESR= 4.156 mOhm VDC= 16.0 V IRMS= 2.59073 A	2	$0.08	1206_190 11 mm^2
Cinx	CUSTOM	CUSTOM Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 3.85 A	4	NA	0805 0 mm^2
Cout	CUSTOM	CUSTOM Series= X6S	Cap= 366.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	1	NA	1210_270 0 mm^2
Css	MuRata	GRM155R71C224KA12D Series= X7R	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm^2
Cvcc	MuRata	GRM188R71A225KE15D Series= X7R	Cap= 2.2 uF ESR= 9.0 mOhm VDC= 10.0 V IRMS= 3.3 A	1	$0.02	0603 5 mm^2
L1	CUSTOM	CUSTOM	L= 1.5 µH 42.0 mOhm	1	NA	IHLP-3232DZ 0 mm^2
RenB	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
RenT	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Susumu Co Ltd	RG1608P-103-B-T5 Series= RG1608	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.04	0603 5 mm^2
Rfbt	Susumu Co Ltd	RG1608P-7151-B-T5 Series= RG1608	Res= 7.15 kOhm Power= 100.0 mW Tolerance= 0.1%	1	$0.06	0603 5 mm^2

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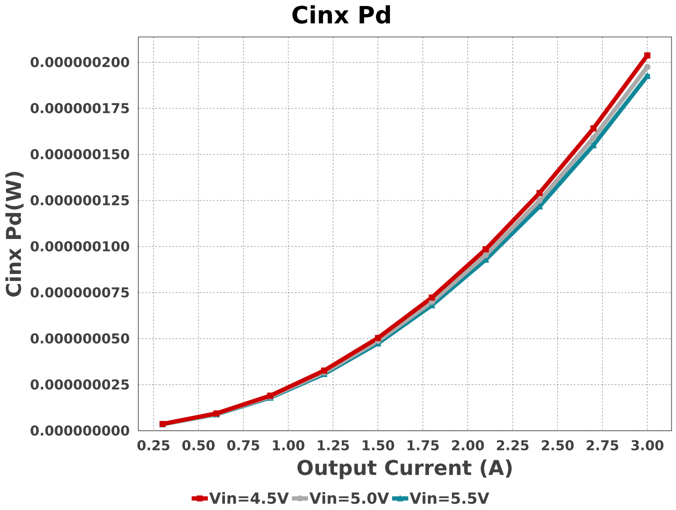
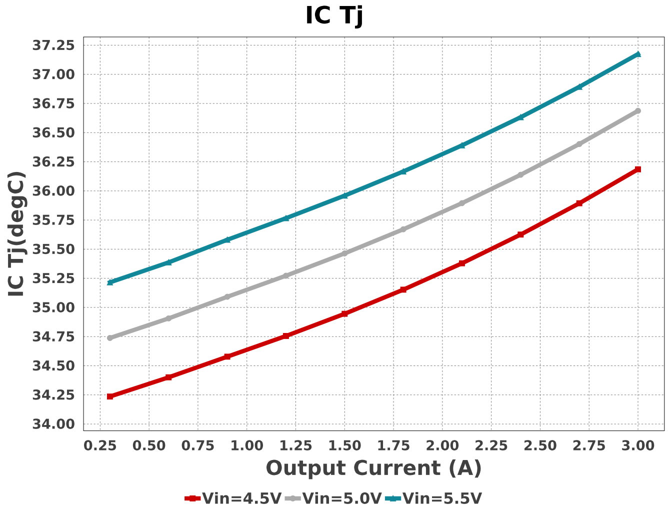
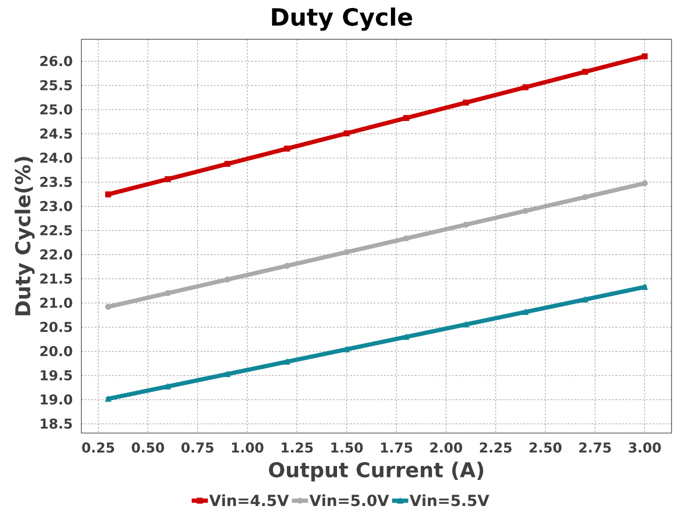
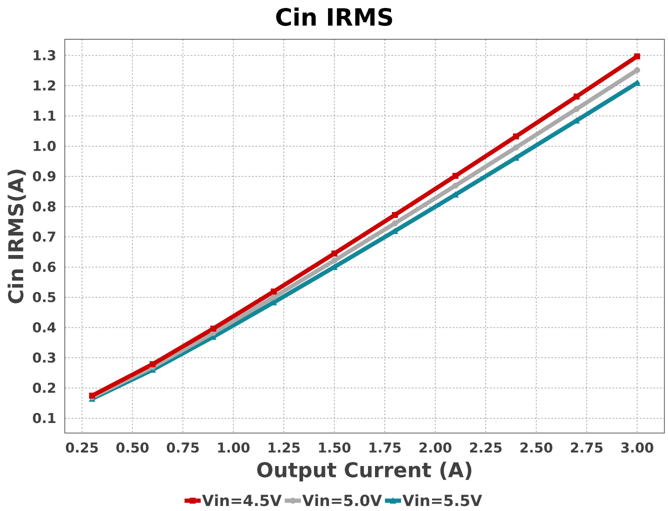
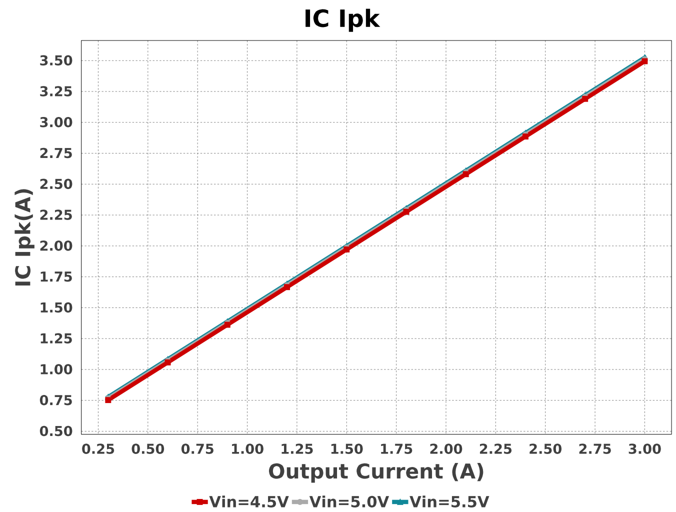
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rpg	Vishay-Dale	CRCW040230K1FKED Series= CRCW..e3	Res= 30.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rtrip	CUSTOM	CUSTOM Series= CRCW..e3	Res= 45.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 0 mm^2
U1	Texas Instruments	TPS548B27RYLR	Switcher	1	$2.60	RYL0019A-MFG 20 mm^2

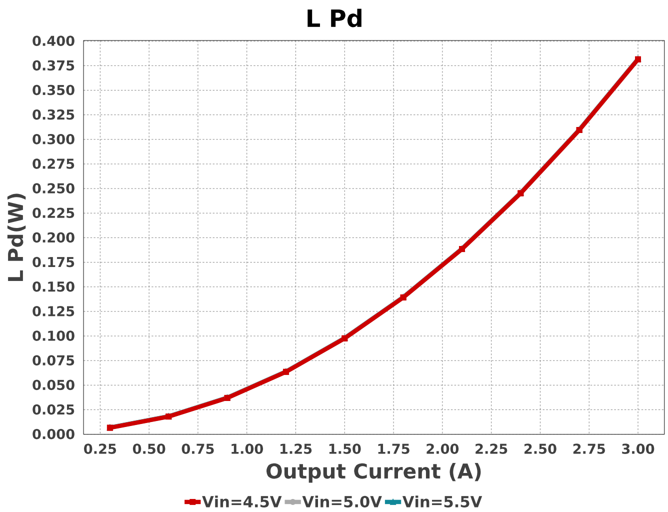












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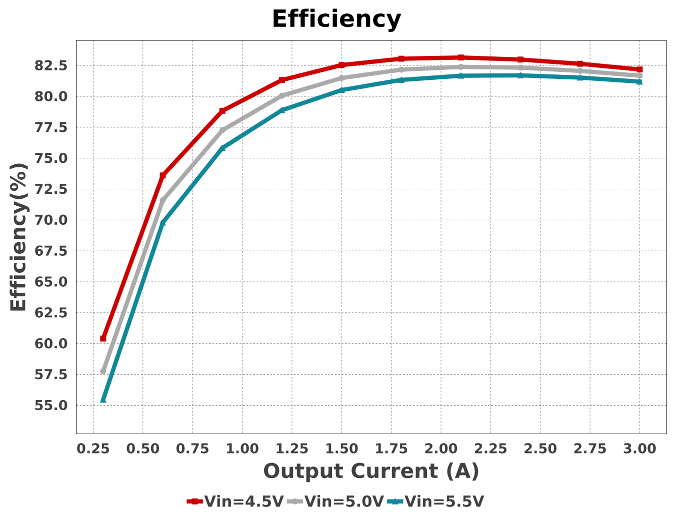
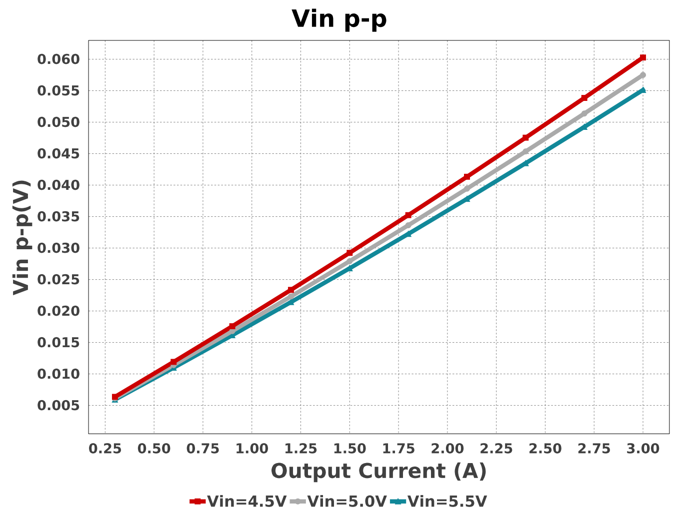
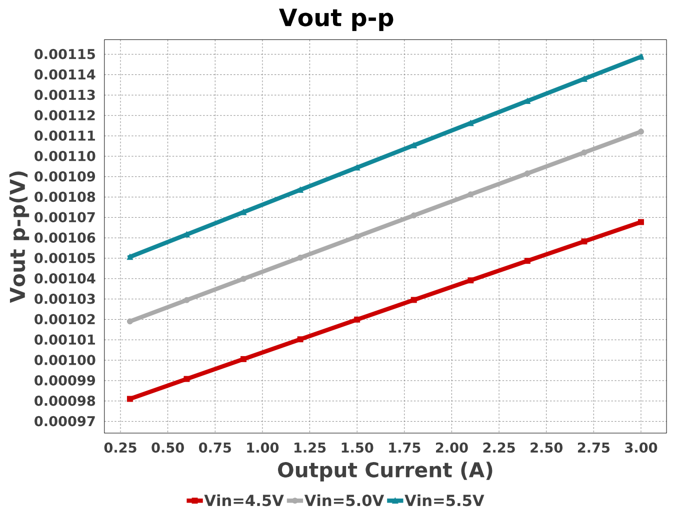
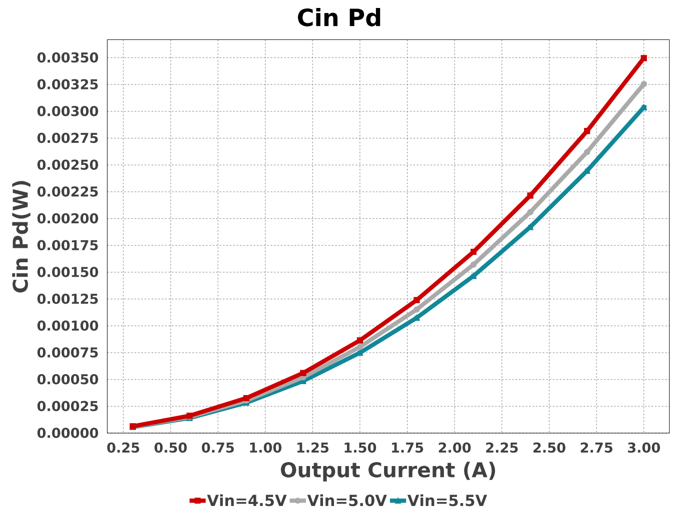
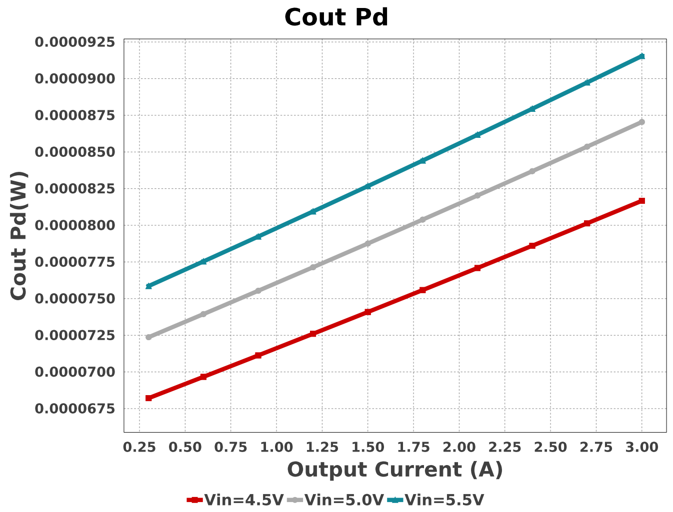
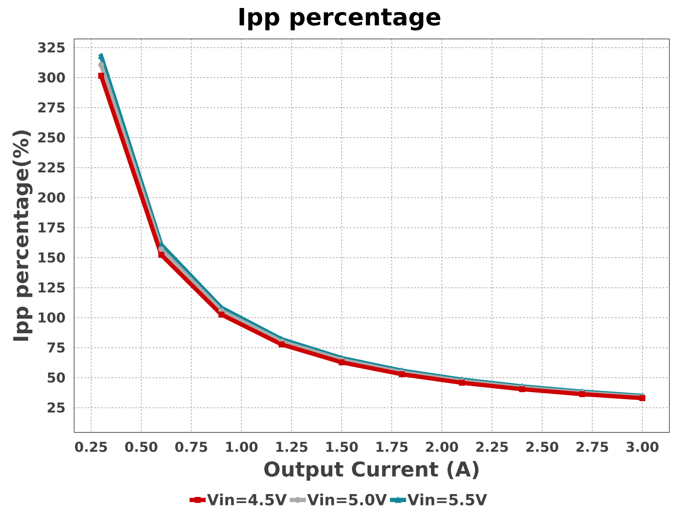

Efficiency
Efficiency(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

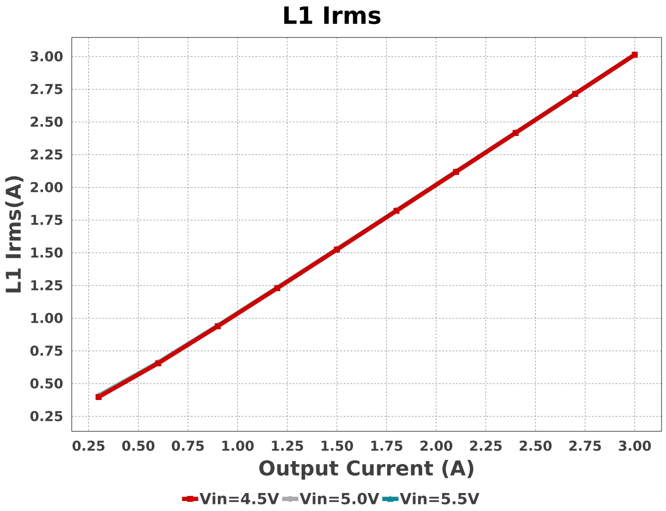

Vin p-p
Vin p-p(V)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

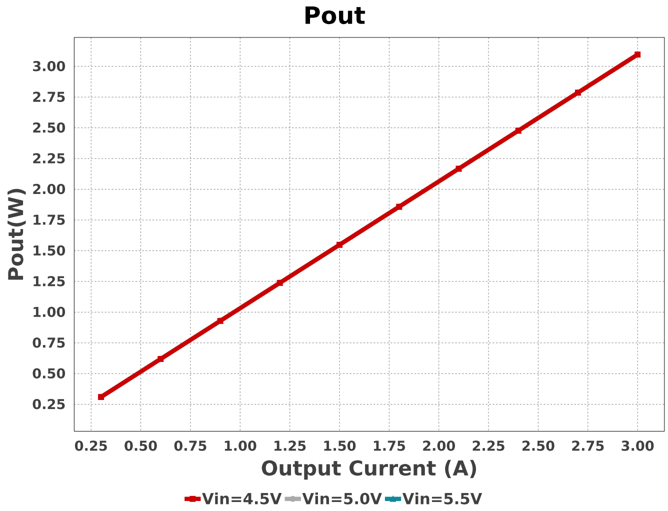

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

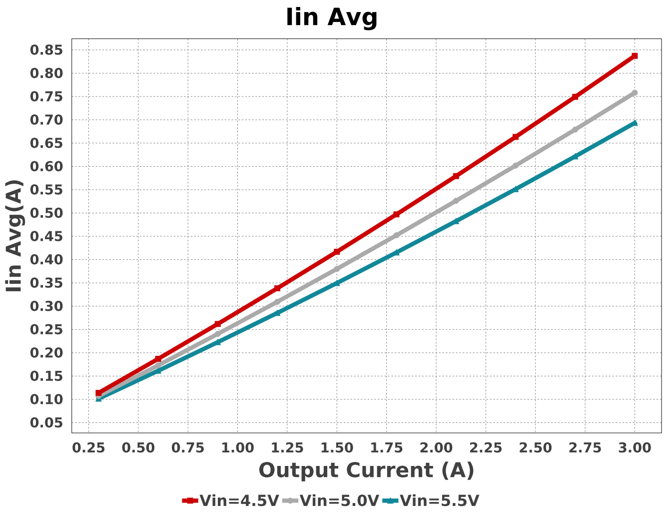

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

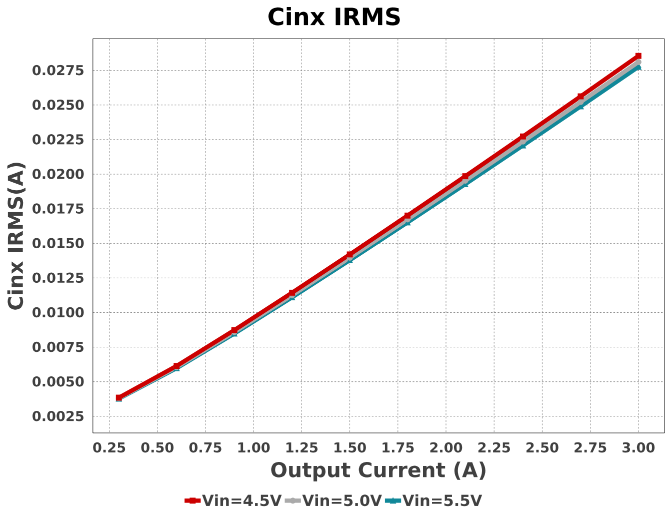

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

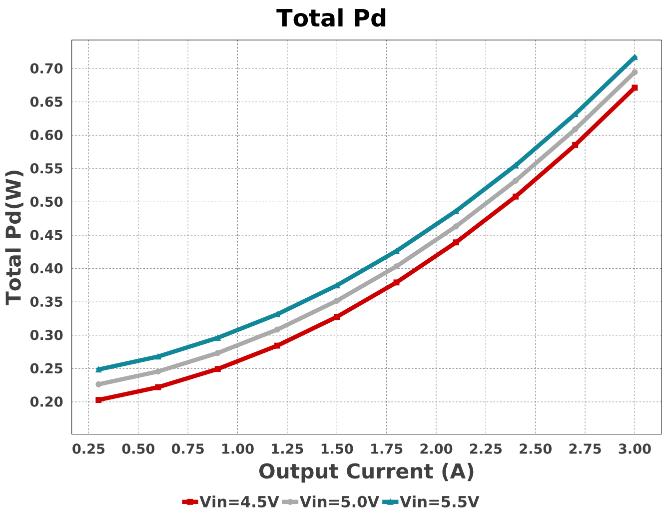

Ipp percentage
Ipp percentage(%)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

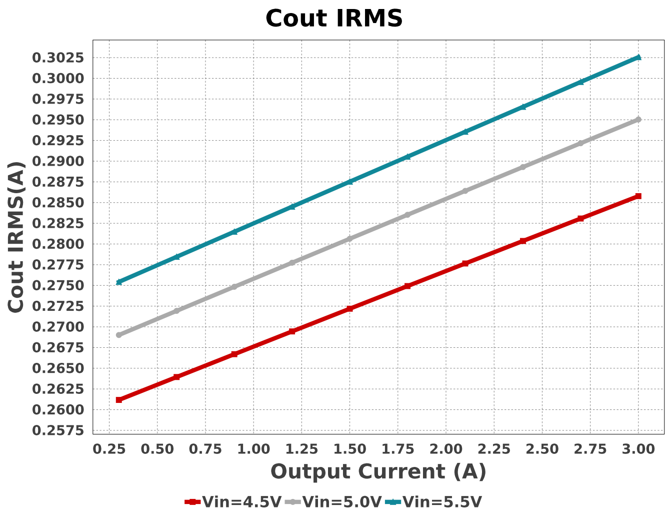

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

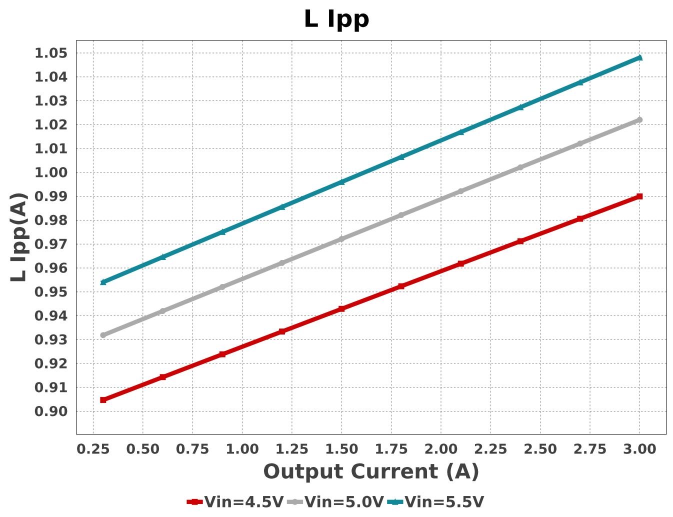

Pout
Pout(W)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

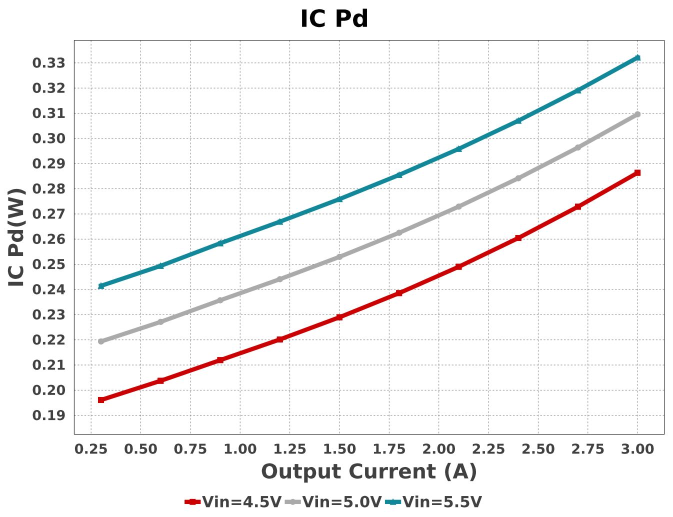

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V

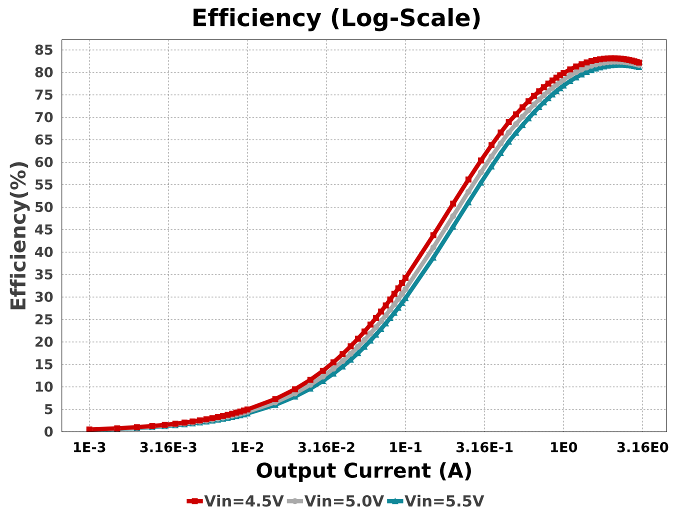

Cinx IRMS
Cinx IRMS(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V


Total Pd
Total Pd(W)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=4.5V Vin=5.0V Vin=5.5V







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	18		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	1.209 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	3.038 mW	Capacitor	Input capacitor power dissipation
5.	Cinx IRMS	27.754 mA	Capacitor	Bulk capacitor RMS ripple current
6.	Cinx Pd	192.58 nW	Capacitor	Bulk capacitor power dissipation
7.	Cout IRMS	302.557 mA	Capacitor	Output capacitor RMS ripple current
8.	Cout Pd	91.541 µW	Capacitor	Output capacitor power dissipation
9.	IC Ipk	3.524 A	IC	Peak switch current in IC
10.	IC Pd	332.12 mW	IC	IC power dissipation
11.	IC Tj	37.174 degC	IC	IC junction temperature
12.	ICThetaJA Effective	21.6 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
13.	Iin Avg	693.3 mA	IC	Average input current
14.	Ipp percentage	34.936 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
15.	L Ipp	1.048 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	381.84 mW	Inductor	Inductor power dissipation
17.	L1 Irms	3.015 A	Inductor	Inductor ripple current
18.	Cin Pd	3.038 mW	Power	Input capacitor power dissipation
19.	Cinx Pd	192.58 nW	Power	Bulk capacitor power dissipation
20.	Cout Pd	91.541 µW	Power	Output capacitor power dissipation
21.	IC Pd	332.12 mW	Power	IC power dissipation
22.	L Pd	381.84 mW	Power	Inductor power dissipation
23.	Total Pd	717.139 mW	Power	Total Power Dissipation
24.	Duty Cycle	21.332 %	System Information	Duty cycle
25.	Efficiency	81.193 %	System Information	Steady state efficiency
26.	FootPrint	229.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	583.71 kHz	System Information	Switching frequency

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#	Name	Value	Category	Description
28.	Iout	3.0 A	System Information	Iout operating point
29.	Iout transient step used for Cout calculations	1.5 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
30.	Load overcurrent Iocp (typical)	2.649 A	System Information	Over current protection threshold
31.	Minimum Cout required for stability	8.731 µF	System Information	Minimum Cout required for stability
32.	Mode	CCM	System Information	Conduction Mode
33.	Overshoot Value	4.468 mV	System Information	Theoretical Vout Overshoot Value
34.	Pout	3.096 W	System Information	Total output power
35.	Undershoot Value	2.489 mV	System Information	Theoretical Vout Undershoot Value
36.	Vin	5.5 V	System Information	Vin operating point
37.	Vin Ripple requirement used for Cin calculations	5.0 %	System Information	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).
38.	Vin p-p	55.113 mV	System Information	Peak-to-peak input voltage
39.	Vout	1.032 V	System Information	Operational Output Voltage
40.	Vout Actual	1.029 V	System Information	Vout Actual calculated based on selected voltage divider resistors
41.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
42.	Vout Tolerance	683.966 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
43.	Vout p-p	1.149 mV	System Information	Peak-to-peak output ripple voltage
44.	Vout transient requirement used for Cout calculations	5.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
SoftStart	2.0 ms	Soft Start Time (ms)
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	1.032	Output Voltage
base_pn	TPS548B27	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

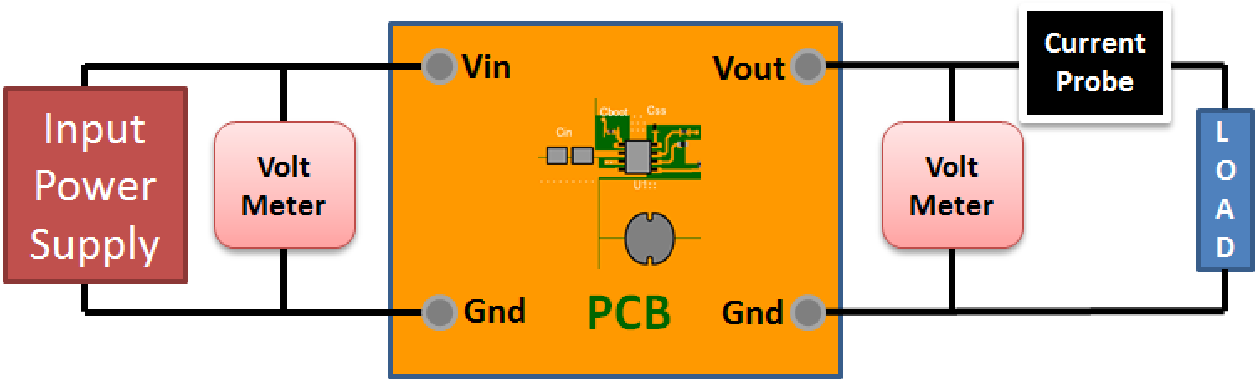
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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.

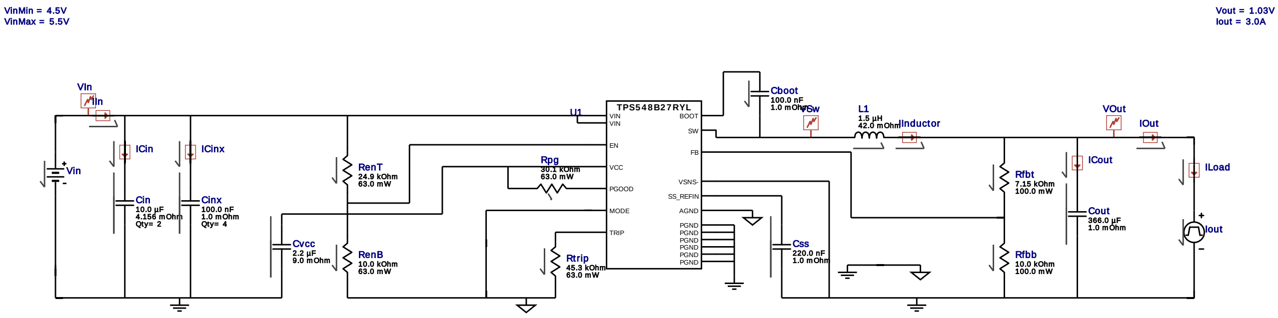


WEBENCH® Electrical Simulation Report

Design Id = 12

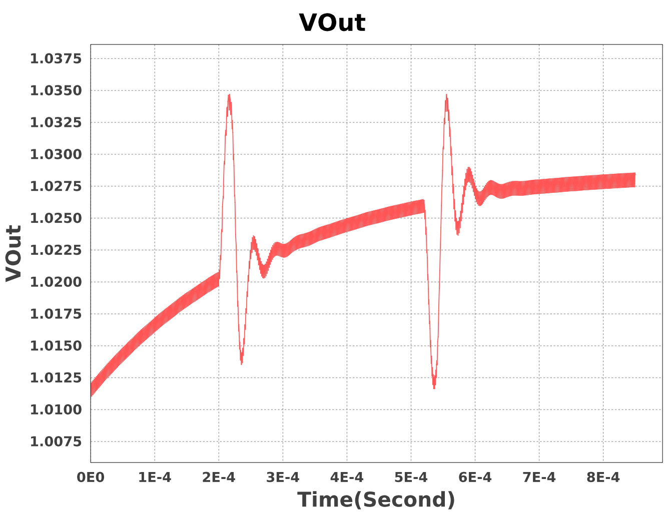
sim_id = 2

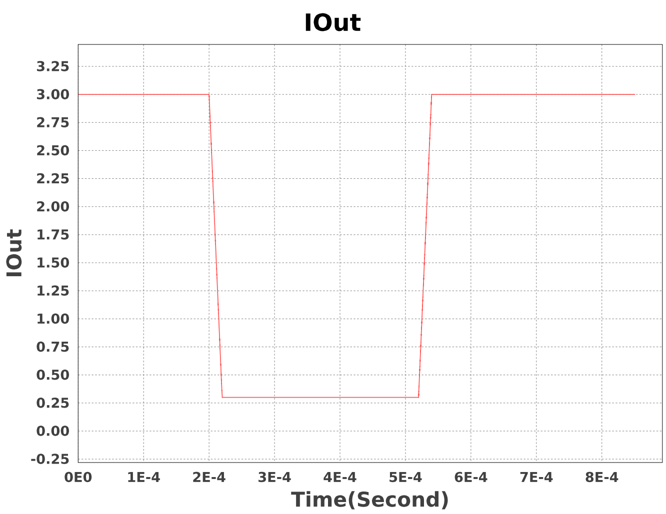
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	3.0 A
2.	Css	IC	Initial Condition	0.55 V
3.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	3.0 A
		I2	Minimum Load Current	0.3 A
		Td	Initial Time Delay	200u s
		Tf	Fall Time	20u s
		Tr	Rise Time	20u s
		Pw	Pulse Width	300u s





Design Assistance

1. Master key : D37063892807E531A50919D3F57EB068[v1]

2. **TPS548B27** Product Folder : http://www.ti.com/product/TPS548B27 : contains the data sheet and other resources.

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