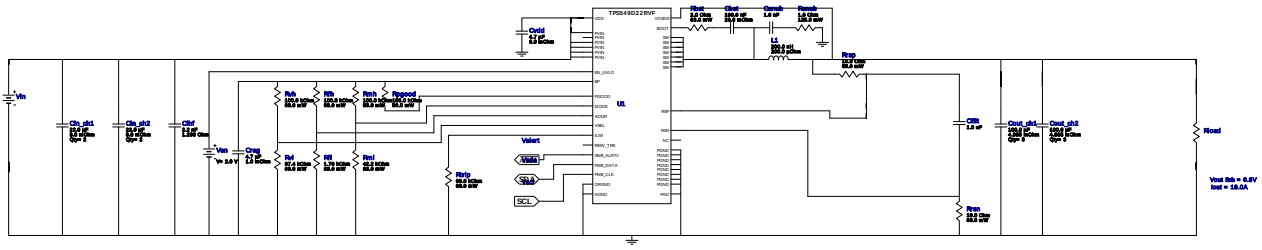
WEBENCH® Design Report

VinMin = 5.0V
VinMax = 5.0V
Vout = 0.9V
Vout Sch = 0.9V
Iout = 18.0A

Device = TPS549D22RVFR
Topology = Buck
Created = 2021-02-08 01:12:19.307
BOM Cost = $7.35
BOM Count = 30
Total Pd = 1.67W

Design : 35 TPS549D22RVFR
TPS549D22RVFR 5V-5V to .90V @ 18A



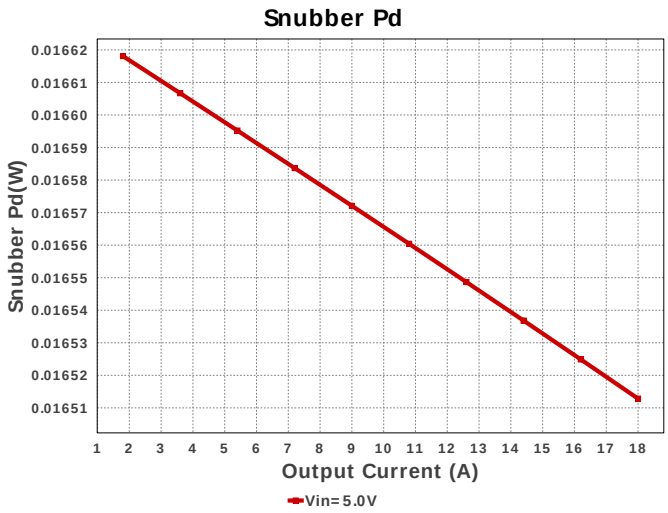
Design Alerts

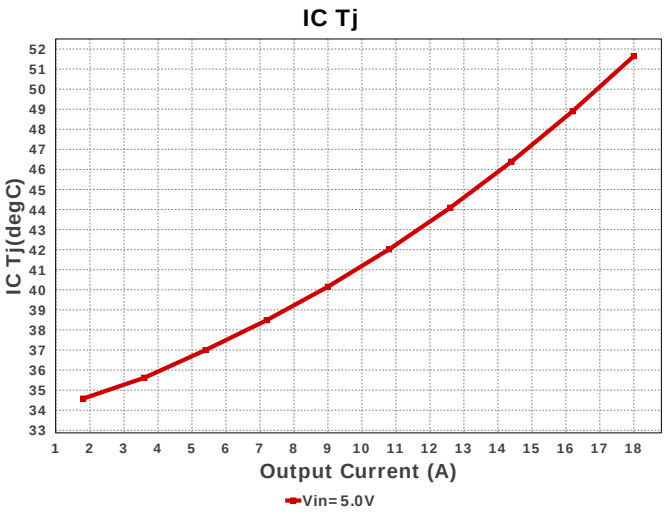
Component Selection Information
The design was created for a nominal Vout of 0.9V, but the OpVals and Charts use the programmed Vout of 0.9V as specified in the Advanced Options.In the Simulation page, the Steady State, Load Transient, and Input Transient simulations also reflect the programmed Vout operating point.The Vout Transition simulation shows the change in Vout when the PMBus(TM) VOUT_COMMAND is issued to change the output from the nominal 0.9V to the new value of 0.9V.To change the nominal Vout value of the design, use the "Change Design Inputs" button to specify the new design requirements._____TPS549D22 is a PMBus(TM) device with key features listed below. PMBus(TM) features marked with * are included in WEBENCH(R) Power Designer. - On-the-fly output programming (VOUT_COMMAND) * - Output voltage margining (VOUT_MARGIN) - Programmable switching frequency * - Programmable soft-start rate * - Selectable conduction mode * - Fault reporting (OV, OC, Temperature)Use the Advanced Options on the left side to set the PMBus(TM) commands.Please refer to the TPS549D22 datasheet and visit http://www.ti.com/pmbus for more information.

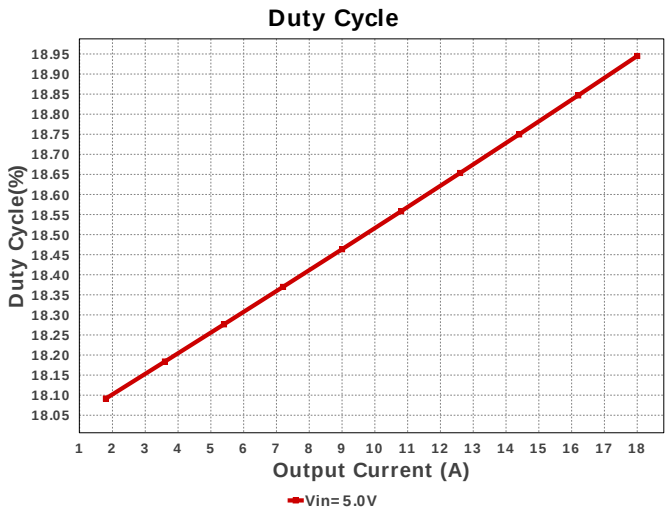
Electrical BOM

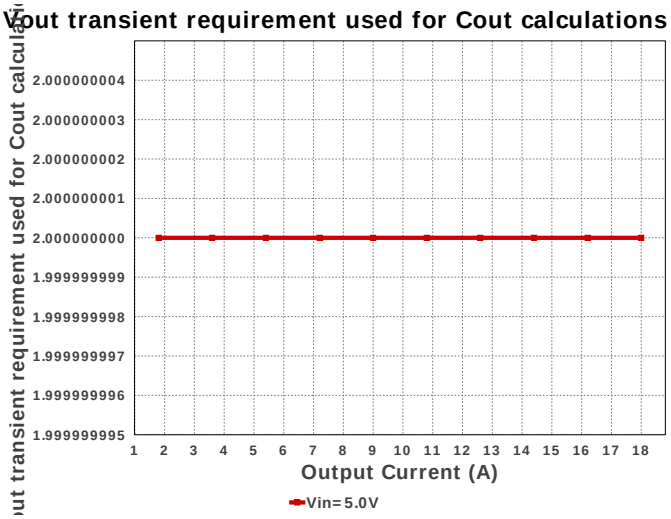
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	TDK	CGA3E2X7R1H104K080AA Series= X7R	Cap= 100.0 nF ESR= 29.6 mOhm VDC= 50.0 V IRMS= 971.99 mA	1	$0.01	0603 5 mm²
Cfilt	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cihf	TDK	CGA1A2X7R1E222K030BA Series= X7R	Cap= 2.2 nF ESR= 1.26834 Ohm VDC= 25.0 V IRMS= 201.468 mA	1	$0.01	0201_033 2 mm²
Cin_ch1	MuRata	GRM21BR61A226ME44L Series= X5R	Cap= 22.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 3.84 A	2	$0.13	0805 7 mm²
Cin_ch2	MuRata	GRM21BR61A226ME44L Series= X5R	Cap= 22.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 3.84 A	2	$0.13	0805 7 mm²
Cout_ch1	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	3	$0.34	1206_190 11 mm²
Cout_ch2	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	3	$0.34	1206_190 11 mm²
Creg	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²

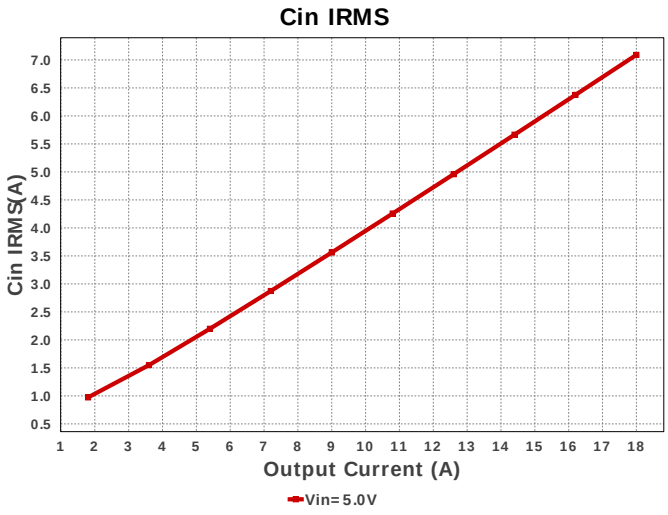
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Csnub	Yageo	CC0603JRNPO8BN102 Series= C0G/NP0	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
Cvdd	Kemet	C0603C475K8PACTU Series= X5R	Cap= 4.7 uF ESR= 6.0 mOhm VDC= 10.0 V IRMS= 7.24 A	1	$0.07	 0603 5 mm²
L1	Coilcraft	SLC1175-201MEB	L= 200.0 nH 200.0 µOhm	1	$0.48	 SLC1175 125 mm²
Rbst	Vishay-Dale	CRCW04022R00FKED Series= CRCW..e3	Res= 2.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rfh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rfl	Vishay-Dale	CRCW04021K78FKED Series= CRCW..e3	Res= 1.78 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rmh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rml	Vishay-Dale	CRCW040242K2FKED Series= CRCW..e3	Res= 42.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rpgood	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm²
Rrsn	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rrsp	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rsnub	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
Rtrip	Vishay-Dale	CRCW040269K8FKED Series= CRCW..e3	Res= 69.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rvh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rvl	Vishay-Dale	CRCW040237K4FKED Series= CRCW..e3	Res= 37.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
U1	Texas Instruments	TPS549D22RVFR	Switcher	1	$4.02	 RVF0040A 63 mm²

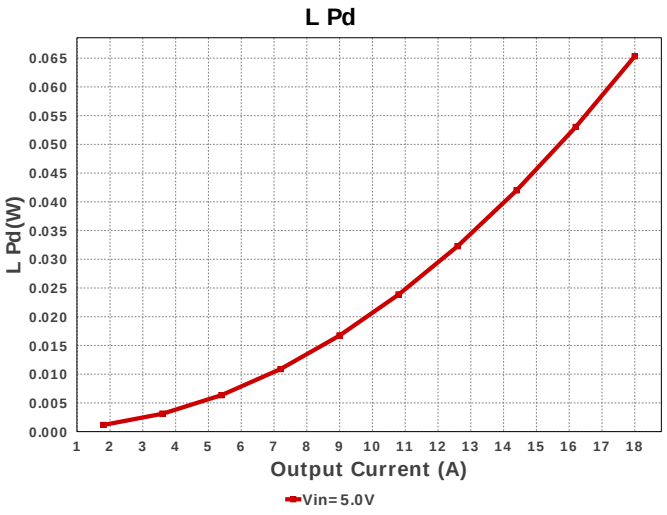


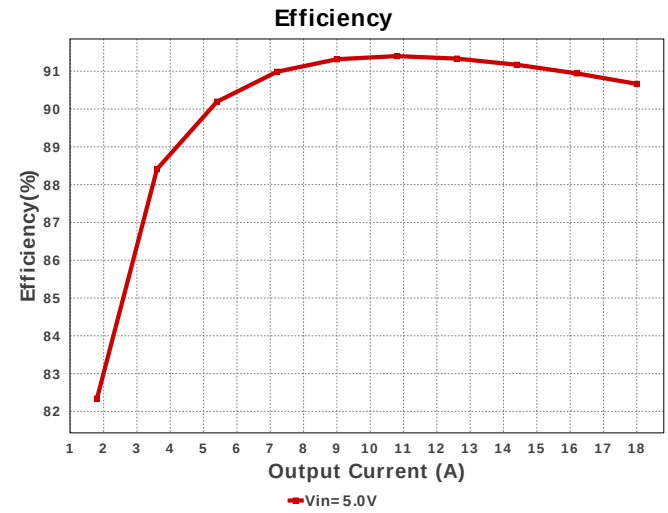


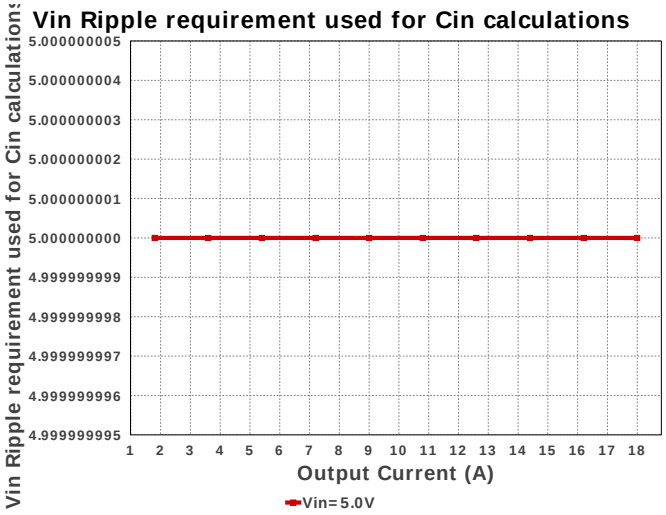


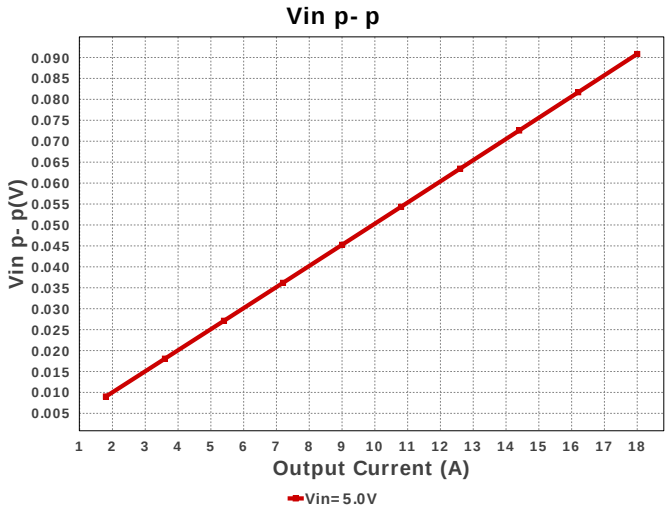


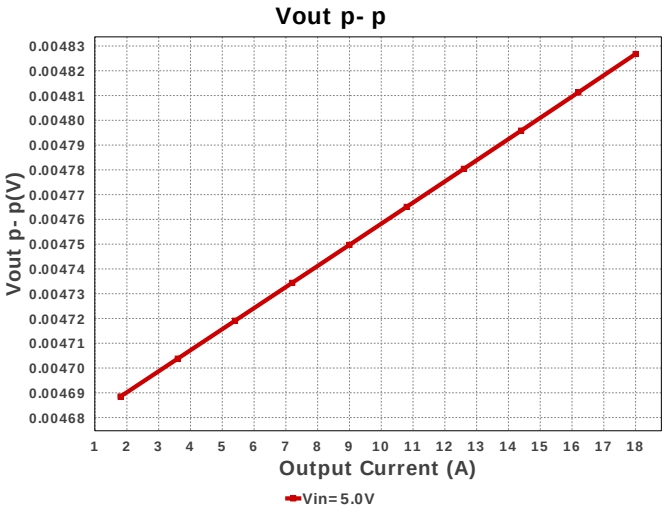


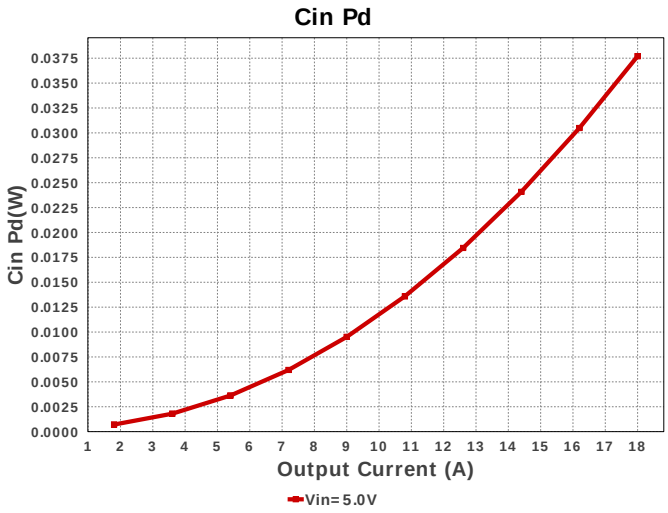


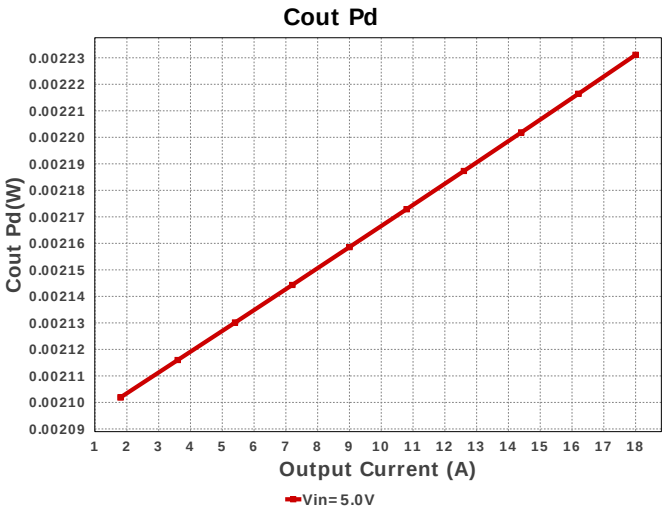


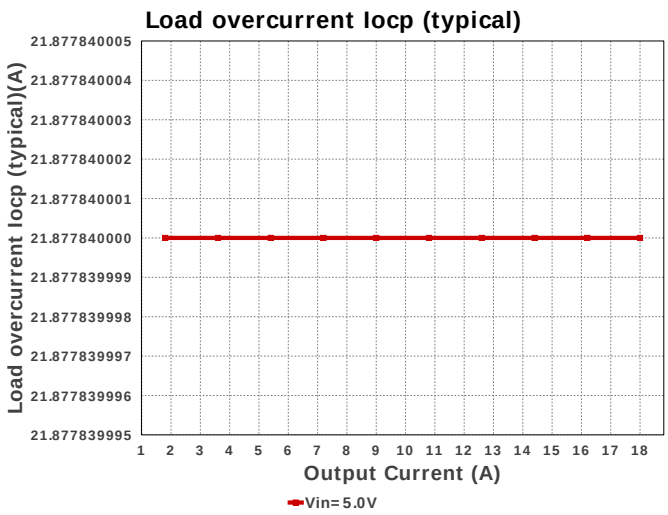


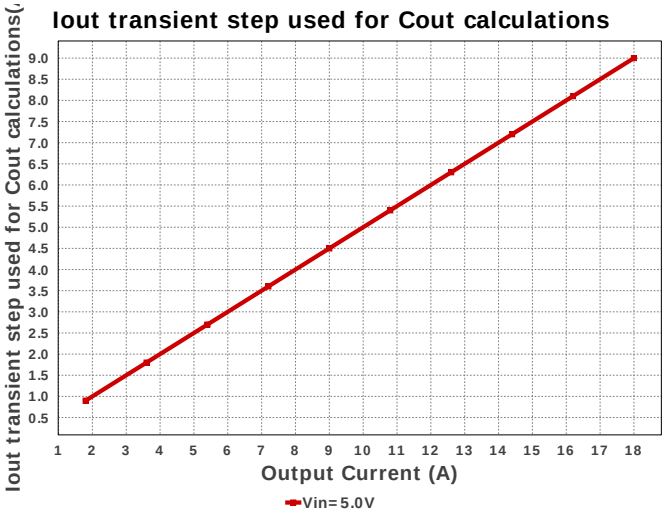


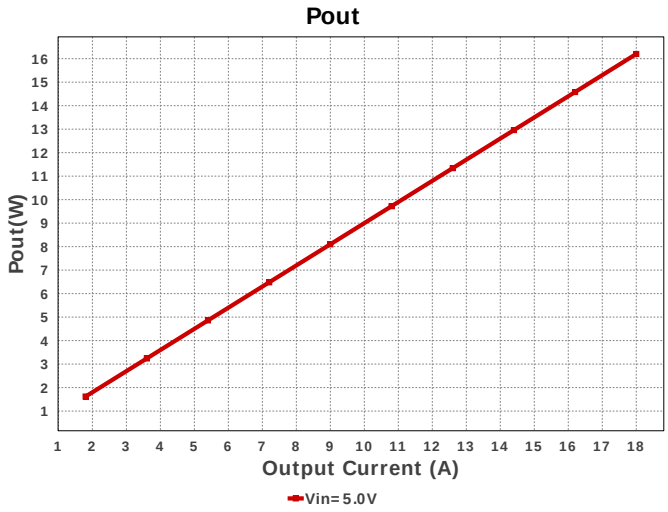


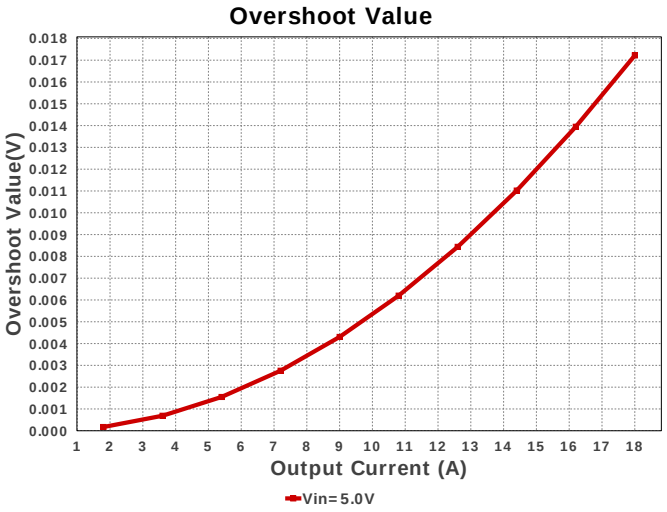


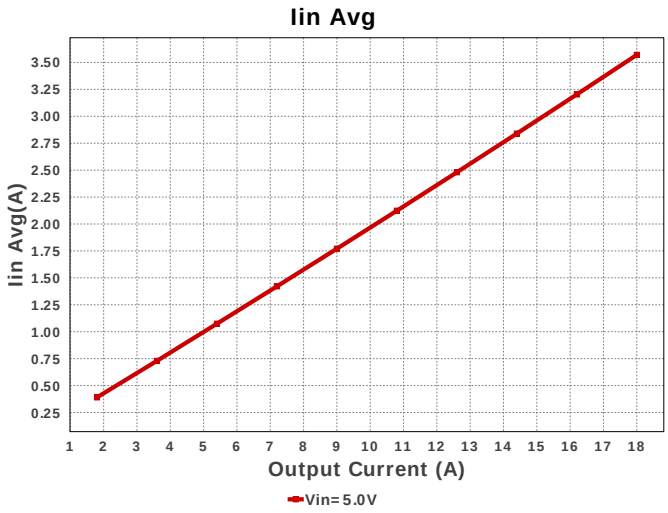


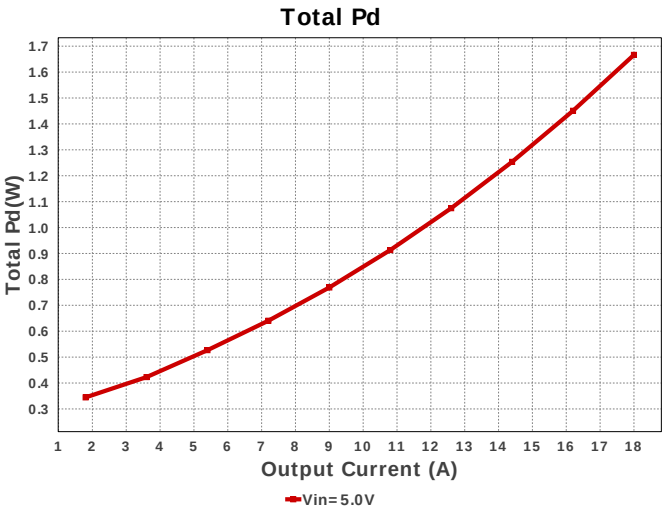


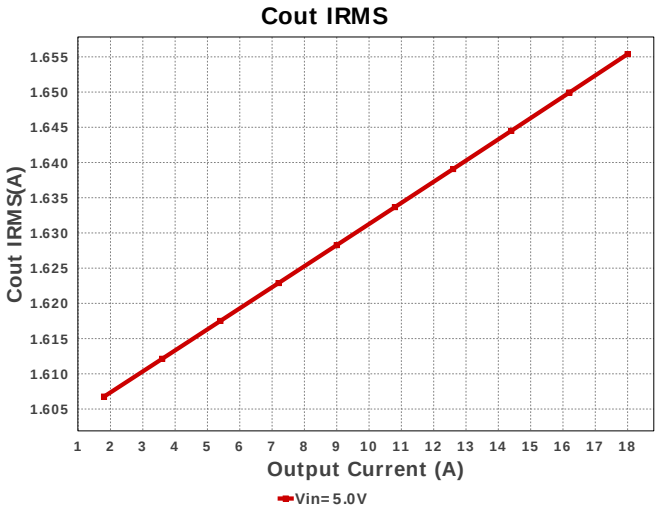


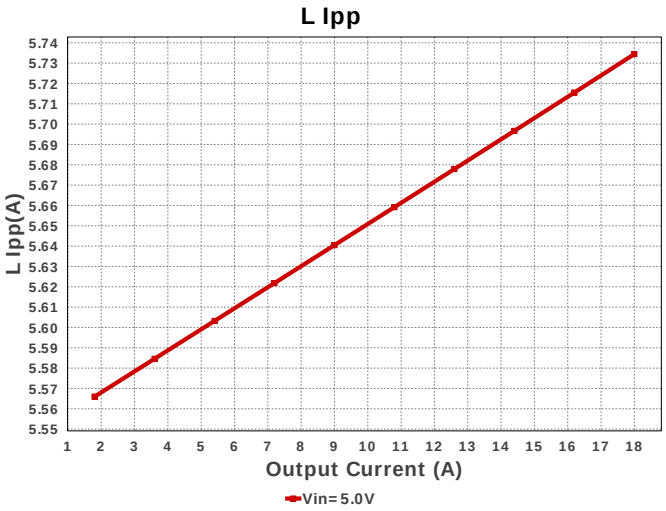


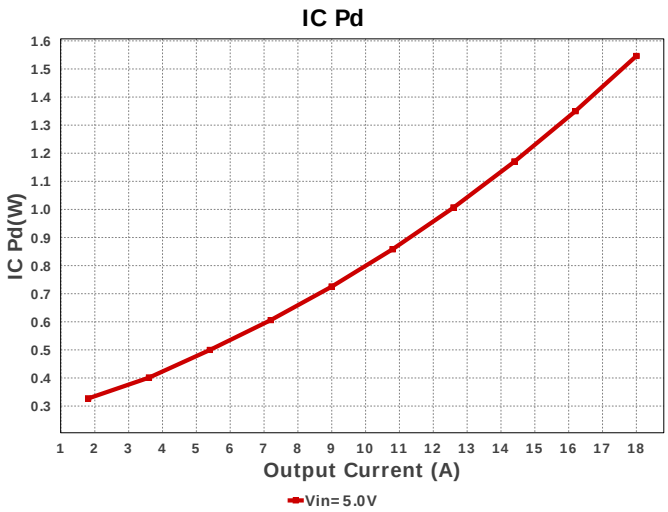


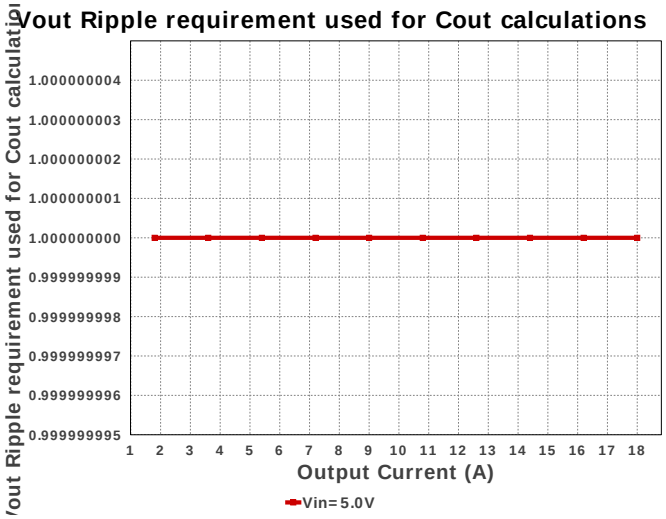


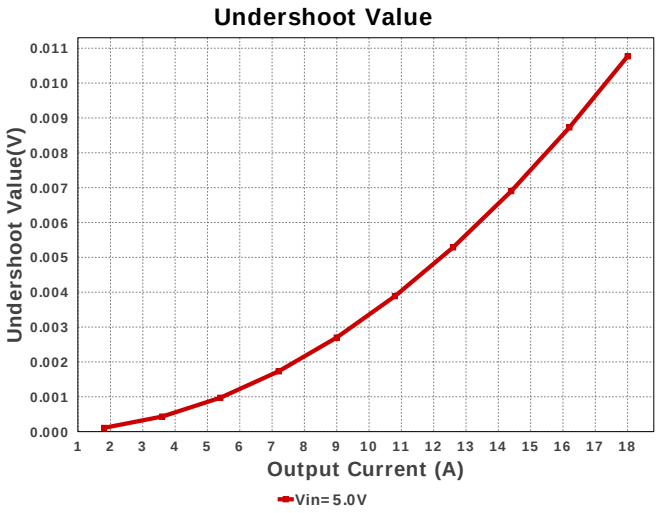












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	30		Total Design BOM count
2.	Ramp Height	Rx2		Ramp height
3.	Total BOM	$7.352		Total BOM Cost
4.	Cin IRMS	7.09 A	Capacitor	Input capacitor RMS ripple current
5.	Cin Pd	37.704 mW	Capacitor	Input capacitor power dissipation
6.	Cout IRMS	1.655 A	Capacitor	Output capacitor RMS ripple current
7.	Cout Pd	2.231 mW	Capacitor	Output capacitor power dissipation
8.	IC Pd	1.546 W	IC	IC power dissipation
9.	IC Tj	51.647 degC	IC	IC junction temperature
10.	ICThetaJA Effective	14.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	3.57 A	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	5.734 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	65.348 mW	Inductor	Inductor power dissipation
14.	PMBus Vout Command	461.0	PMBus	PMBus Vout Command
15.	Cin Pd	37.704 mW	Power	Input capacitor power dissipation
16.	Cout Pd	2.231 mW	Power	Output capacitor power dissipation
17.	IC Pd	1.546 W	Power	IC power dissipation
18.	L Pd	65.348 mW	Power	Inductor power dissipation
19.	Snubber Pd	16.513 mW	Power	Snubber Power Dissipation
20.	Total Pd	1.666 W	Power	Total Power Dissipation
21.	Duty Cycle	18.945 %	System Information	Duty cycle
22.	Efficiency	90.665 %	System Information	Steady state efficiency
23.	FootPrint	346.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	660.514 kHz	System Information	Switching frequency
25.	Iout	18.0 A	System Information	Iout operating point
26.	Iout transient step used for Cout calculations	9.0 A	System Information	Custom Transient current step requirement that was used for Cout selection (A).
27.	Load overcurrent Iocp (typical)	21.878 A	System Information	Over current protection threshold
28.	Mode	CCM	System Information	Conduction Mode
29.	Overshoot Value	17.218 mV	System Information	Theoretical Vout Overshoot Value
30.	Pout	16.2 W	System Information	Total output power
31.	Undershoot Value	10.768 mV	System Information	Theoretical Vout Undershoot Value
32.	Vin	5.0 V	System Information	Vin operating point
33.	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).
34.	Vin p-p	90.838 mV	System Information	Peak-to-peak input voltage
35.	Vout	900.0 mV	System Information	Operational Output Voltage
36.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
37.	Vout Tolerance	499.783 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
38.	Vout p-p	4.827 mV	System Information	Peak-to-peak output ripple voltage
39.	Vout transient requirement used for Cout calculations	2.0 %	System Information	Custom Transient voltage change requirement that was used for Cout selection (% of Vout).

Design Inputs

	Name	Value	Description
	Iout	18.0	Maximum Output Current
	VinMax	5.0	Maximum input voltage
	VinMin	5.0	Minimum input voltage
	Vout	900.0 m	Output Voltage
	base_pn	TPS549D22	Base Product Number
	source	DC	Input Source Type
	Ta	30.0	Ambient temperature
1.	Vout Sch	900.0 m	Output voltage selected

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

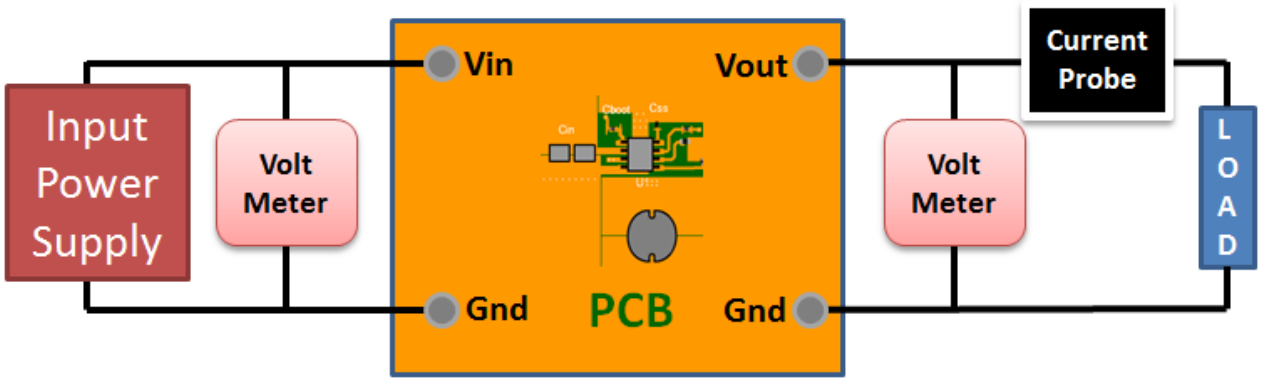
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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.

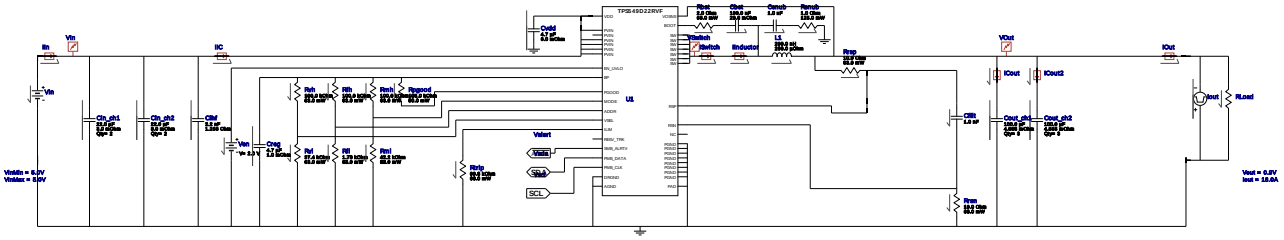


WEBENCH® Electrical Simulation Report

Design Id = 35

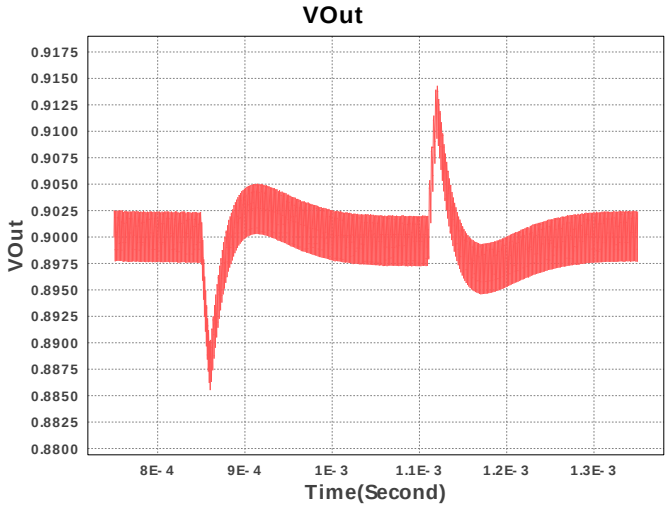
sim_id = 1

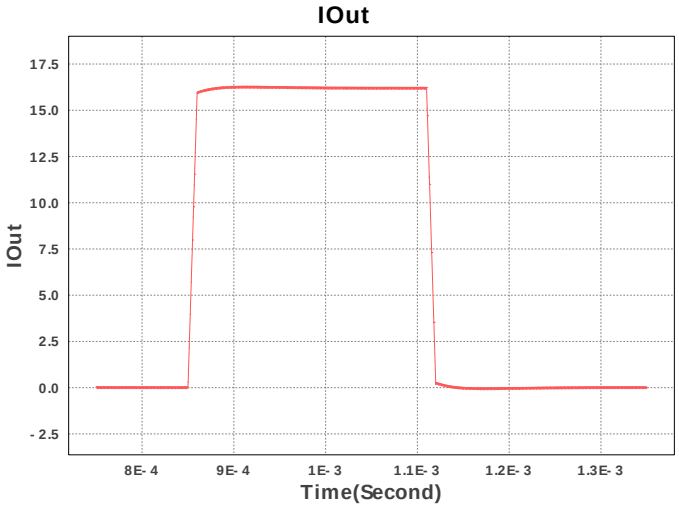
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	18.0 A
2.	Ven	V	Input Voltage	2 V
3.	Cout_ch2	IC	Initial Voltage	0.927 V
4.	Cbst	IC	no description	5
5.	Vscl	V	Input Voltage	0 V
6.	Vsda	V	Input Voltage	0 V
7.	Valert	V	no description	0
8.	Cout_ch1	IC	Initial Voltage	0.927 V
9.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	18.0 A
		I2	Minimum Load Current	1.8 A
		Td	Initial Time Delay	8.5E-4 s
		Tf	Fall Time	1.0E-5 s
		Tr	Rise Time	1.0E-5 s
		Pw	Pulse width	2.5E-4
10.	RLoad	R	Load Resistance	0.05 Ohm





Design Assistance

1. Master key : 26E0BD8B985A8456[v1]
2. **TPS549D22** Product Folder : http://www.ti.com/product/TPS549D22 : contains the data sheet and other resources.