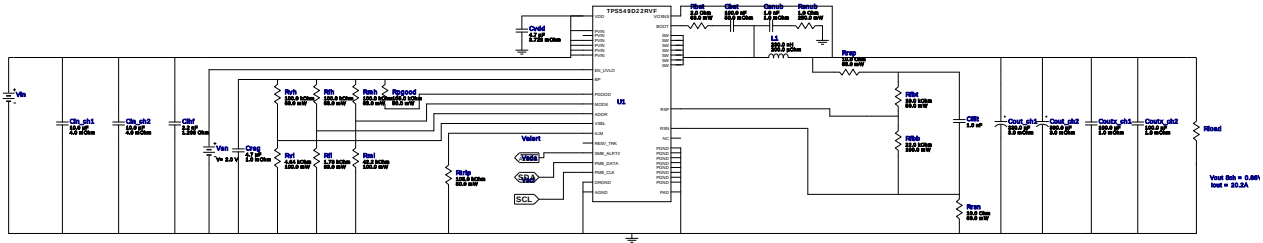


WEBENCH® Design Report

Design : 255 TPS549D22RVFR
TPS549D22RVFR 12V-12V to .88V @ 20.2A

VinMin = 12.0V
VinMax = 12.0V
Vout = 0.88V
Vout Sch = 0.88V
Iout = 20.2A

Device = TPS549D22RVFR
Topology = Buck
Created = 2023-07-31 00:54:55.675
BOM Cost = \$7.24
BOM Count = 28
Total Pd = 2.53W



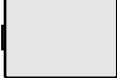
Design Alerts

TPS549D22 Design

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.

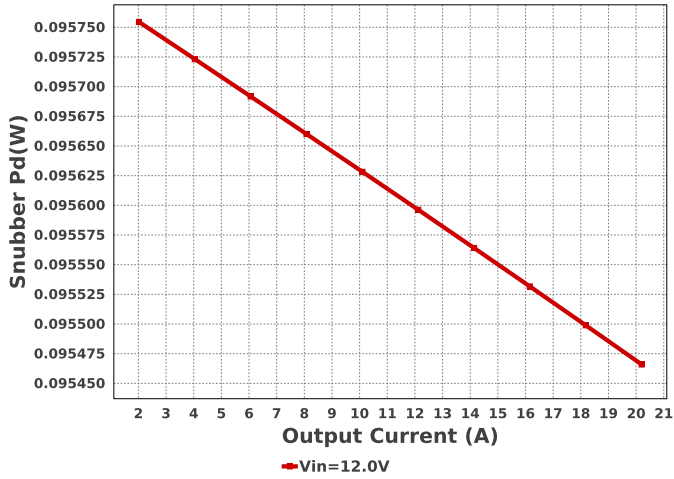
Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	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 mm ²
Cfilt	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
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 mm ²
Cin_ch1	MuRata	GRM31CR71E106KA12L Series= X7R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 6.0 A	1	\$0.06	1206_180 11 mm ²
Cin_ch2	MuRata	GRM31CR71E106KA12L Series= X7R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 6.0 A	1	\$0.06	1206_180 11 mm ²
Cout_ch1	Panasonic	EEFGX0D331R Series= GX	Cap= 330.0 uF ESR= 3.0 mOhm VDC= 2.0 V IRMS= 10.2 A	1	\$0.77	7343-20 59 mm ²
Cout_ch2	Panasonic	EEFGX0D331R Series= GX	Cap= 330.0 uF ESR= 3.0 mOhm VDC= 2.0 V IRMS= 10.2 A	1	\$0.77	7343-20 59 mm ²
Coutx_ch1	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 mm ²
Coutx_ch2	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 mm ²

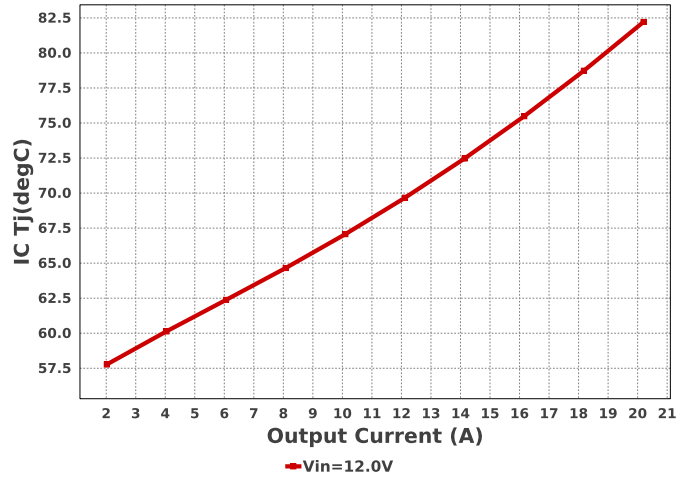
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Creg	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.06	 0805 7 mm ²
Csnu	MuRata	GRM1885C1H102JA01D Series= C0G/NP0	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
Cvdd	TDK	C1608X5R1V475K080AC Series= X5R	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 35.0 V IRMS= 2.69359 A	1	\$0.10	 0603 5 mm ²
L1	Coilcraft	SLC1175-231MEB	L= 230.0 nH 200.0 µOhm	1	\$0.48	 SLC1175 125 mm ²
Rbst	Vishay-Dale	CRCW04022R00FKED Series= CRCW..e3	Res= 2.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbb	Yageo	RC0603FR-0722KL Series= ?	Res= 22.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rfbt	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	 0201 2 mm ²
Rfh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfl	Vishay-Dale	CRCW04021K78FKED Series= CRCW..e3	Res= 1.78 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rmh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rml	Vishay-Dale	CRCW060342K2FKEA Series= CRCW..e3	Res= 42.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rpgood	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	 0201 2 mm ²
Rrsn	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rrsp	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rsnub	Vishay-Dale	CRCW12061R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
Rtrip	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	 0201 2 mm ²
Rvh	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rvl	Yageo	RC0603FR-074K64L Series= ?	Res= 4.64 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	TPS549D22RVFR	Switcher	1	\$4.42	 RVF0040A 63 mm ²

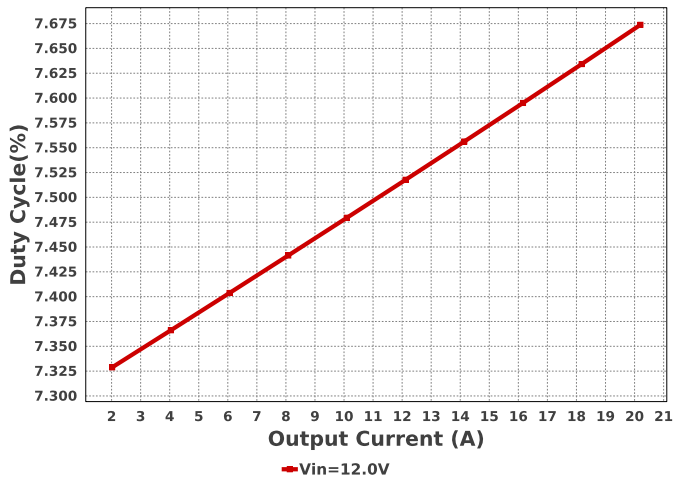
Snubber Pd



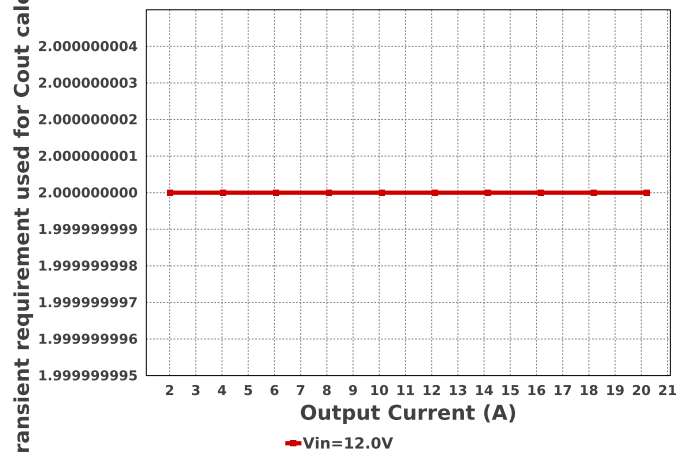
IC Tj



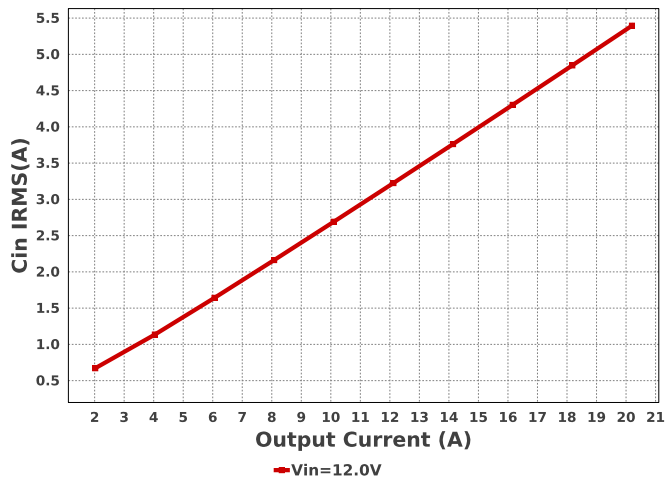
Duty Cycle



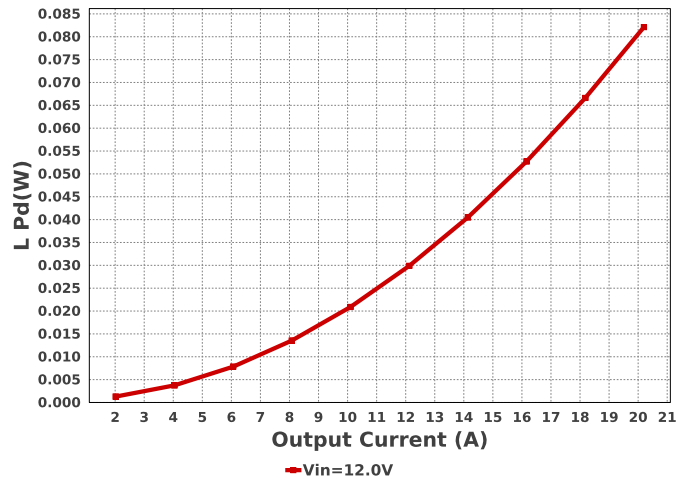
Vout transient requirement used for Cout calculations

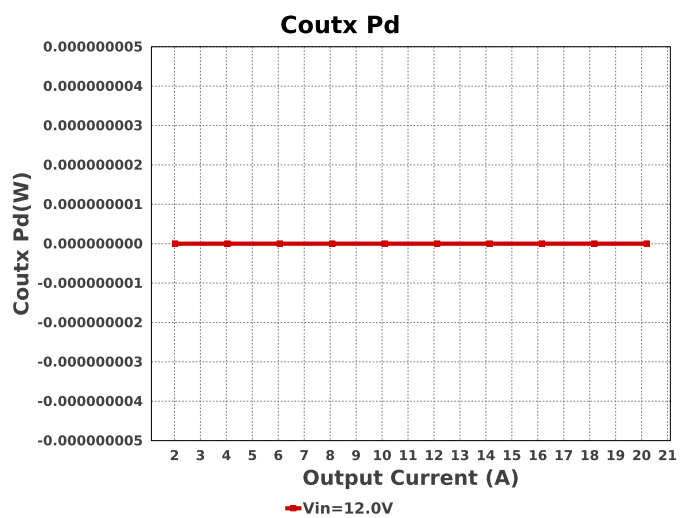
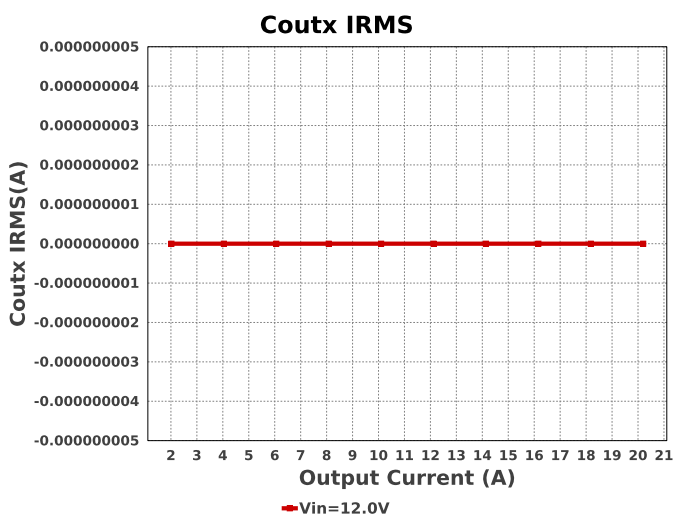
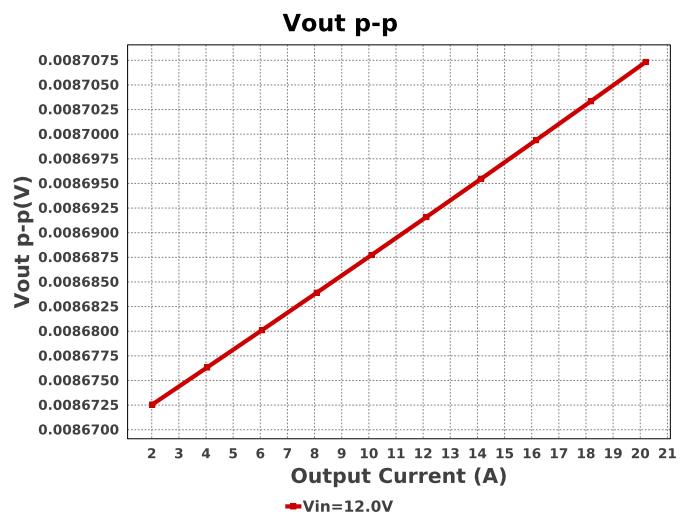
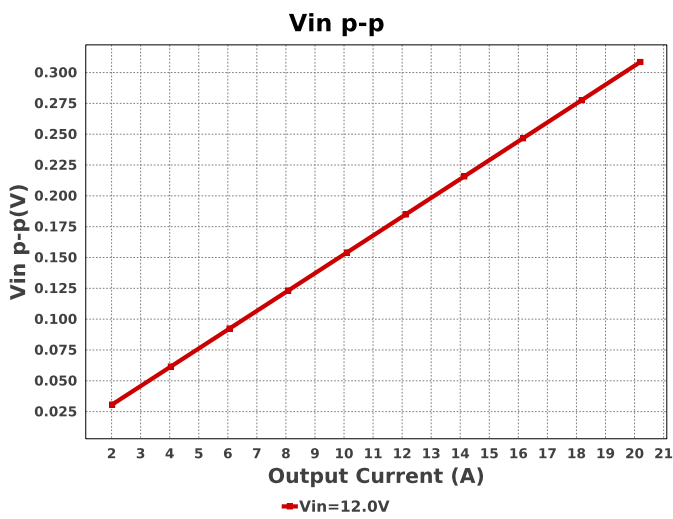
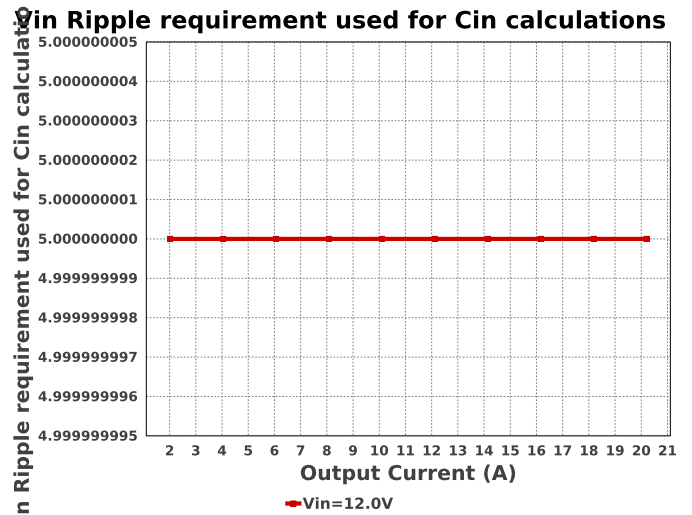
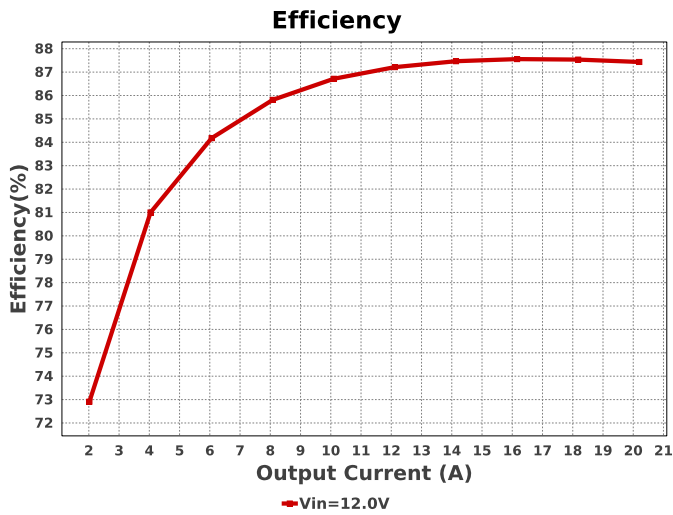


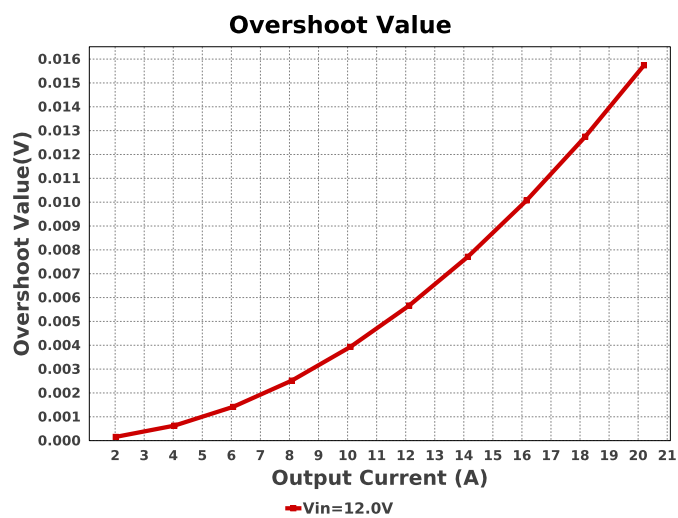
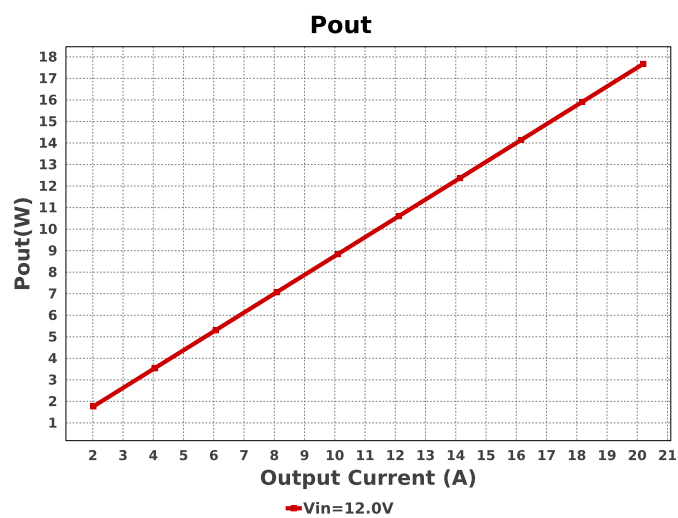
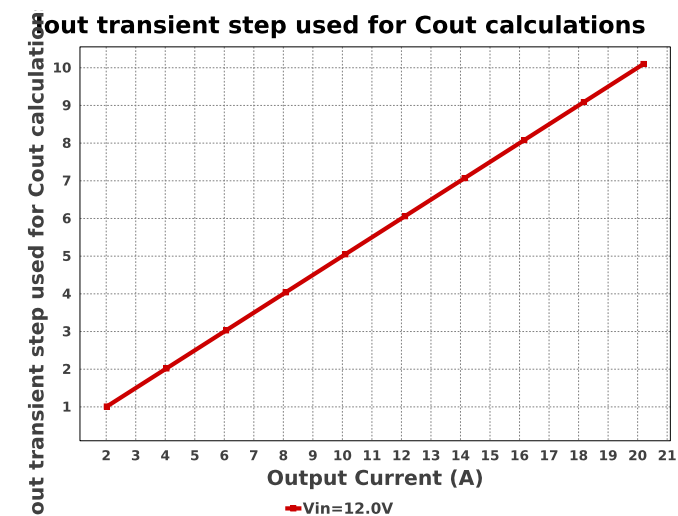
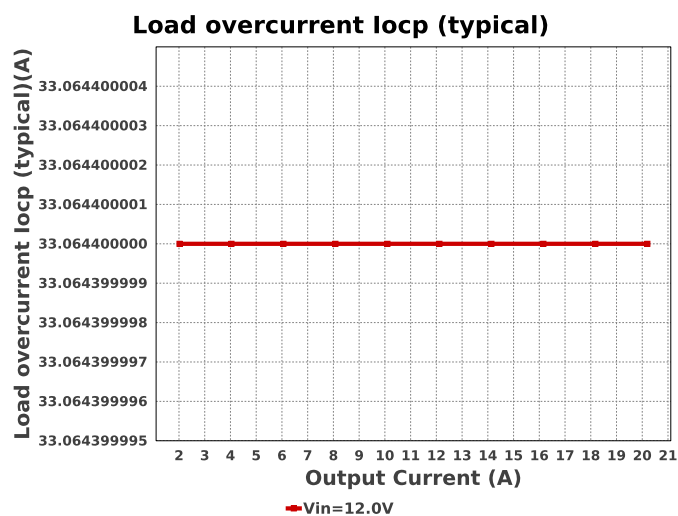
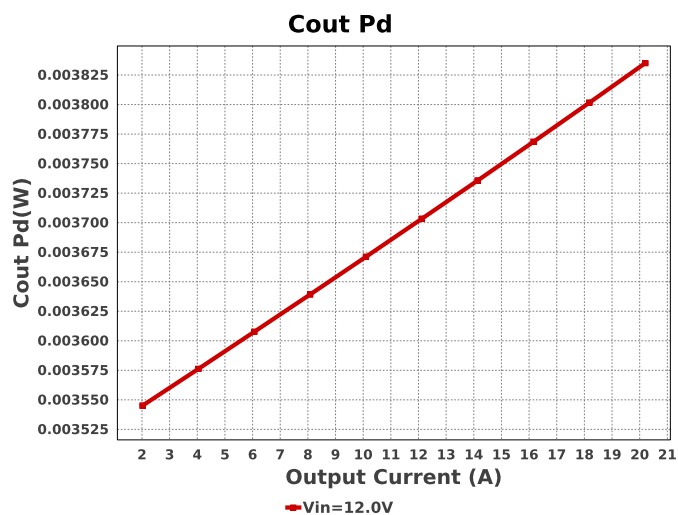
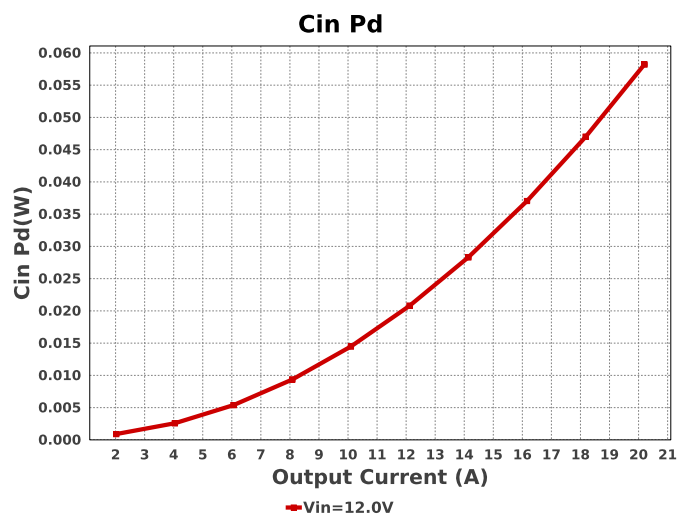
Cin IRMS

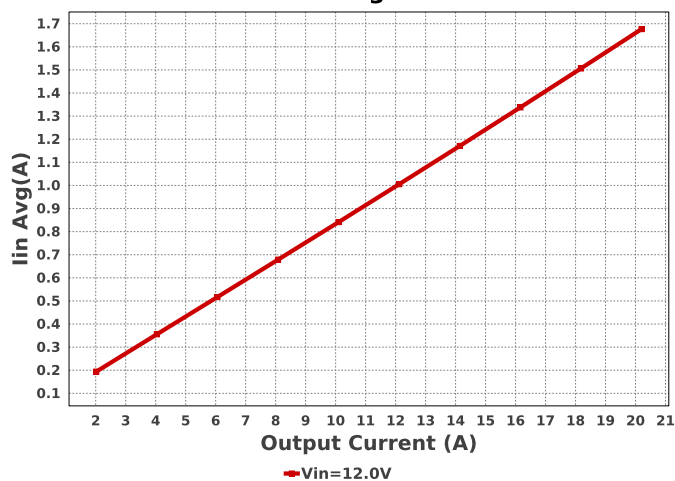
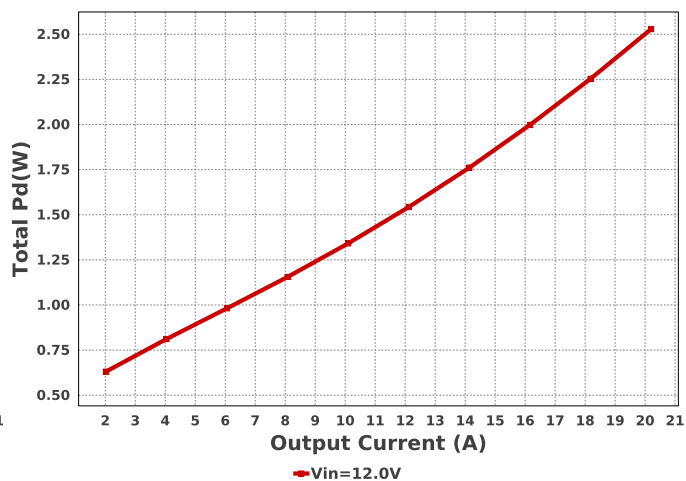
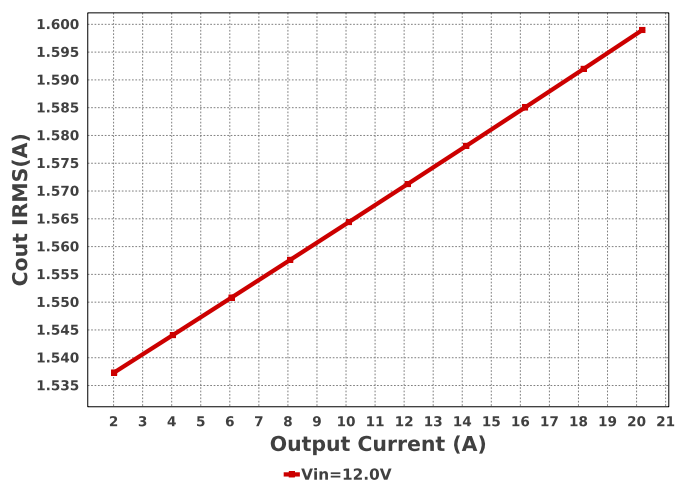
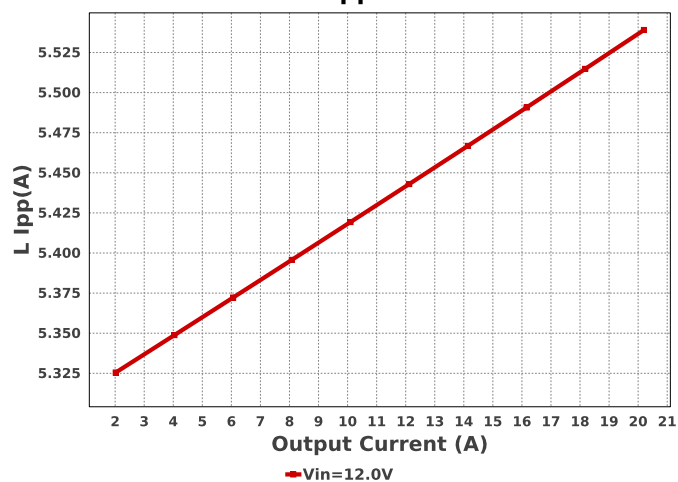
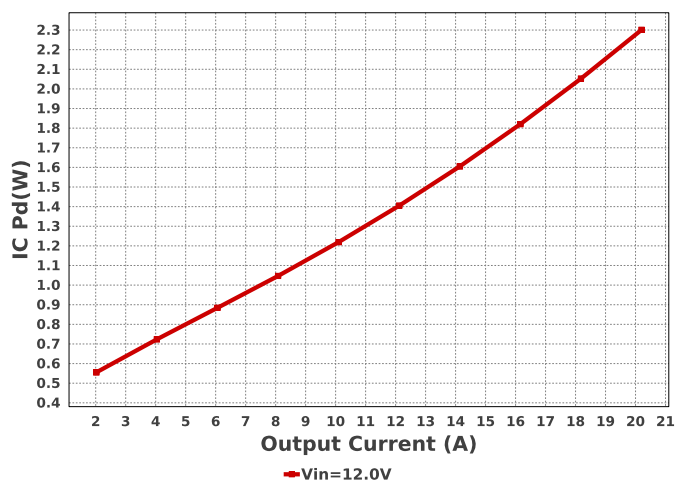
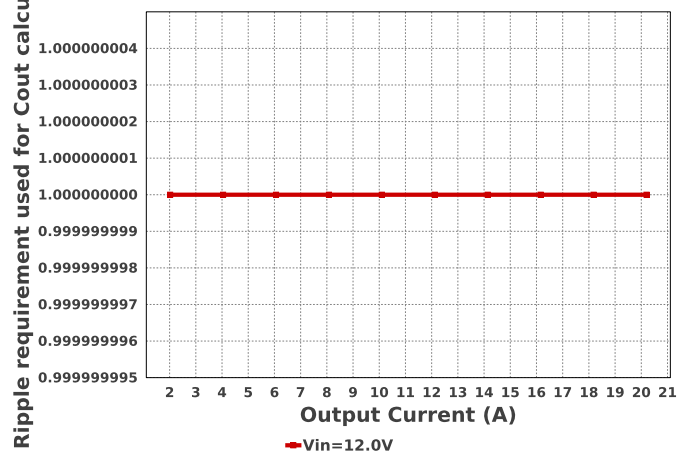


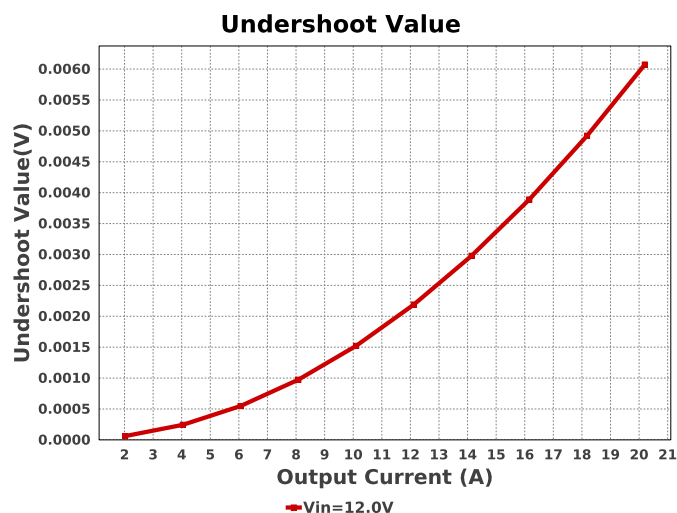
L Pd







Iin Avg**Total Pd****Cout IRMS****L Ipp****IC Pd****Vout Ripple requirement used for Cout calculations**



Operating Values

#	Name	Value	Category	Description
1.	Ramp Height	R/2		Ramp height
2.	Cin IRMS	5.395 A	Capacitor	Input capacitor RMS ripple current
3.	Cin Pd	58.211 mW	Capacitor	Input capacitor power dissipation
4.	Cout IRMS	1.599 A	Capacitor	Output capacitor RMS ripple current
5.	Cout Pd	3.835 mW	Capacitor	Output capacitor power dissipation
6.	Coutx IRMS	12.0 A	Capacitor	Output capacitor_x RMS ripple current
7.	Coutx Pd	0.0 W	Capacitor	Output capacitor_x power loss
8.	IC Pd	2.301 W	IC	IC power dissipation
9.	IC Tj	82.213 degC	IC	IC junction temperature
10.	ICThetaJA Effective	14.0 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
11.	Iin Avg	1.677 A	IC	Average input current
12.	L Ipp	5.539 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	82.119 mW	Inductor	Inductor power dissipation
14.	PMBus Vout Command	451.0	PMBus	PMBus Vout Command
15.	Cin Pd	58.211 mW	Power	Input capacitor power dissipation
16.	Cout Pd	3.835 mW	Power	Output capacitor power dissipation
17.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
18.	IC Pd	2.301 W	Power	IC power dissipation
19.	L Pd	82.119 mW	Power	Inductor power dissipation
20.	Snubber Pd	95.466 mW	Power	Snubber Power Dissipation
21.	Total Pd	2.529 W	Power	Total Power Dissipation
22.	BOM Count	28	System	Total Design BOM count
23.	Duty Cycle	7.674 %	System	Duty cycle
24.	Efficiency	87.433 %	System	Steady state efficiency
25.	FootPrint	435.0 mm ²	System	Total Foot Print Area of BOM components
26.	Frequency	662.958 kHz	System	Switching frequency
27.	Iout	20.2 A	System	Iout operating point
28.	Iout transient step used for Cout calculations	10.1 A	System	Custom Transient current step requirement that was used for Cout selection (A).
29.	Load overcurrent Iocp (typical)	33.064 A	System	Over current protection threshold
30.	Mode	CCM	System	Conduction Mode
31.	Overshoot Value	15.739 mV	System	Theoretical Vout Overshoot Value
32.	Pout	17.675 W	System	Total output power
33.	Total BOM	\$7.24	System	Total BOM Cost
34.	Undershoot Value	6.073 mV	System	Theoretical Vout Undershoot Value
35.	Vin	12.0 V	System	Vin operating point
36.	Vin Ripple requirement used for Cin calculations	5.0 %	System	Custom maximum input ripple requirement that was used for Cin selection(% of Minimum Vin).

#	Name	Value	Category	Description
37.	Vin p-p	312.379 mV	System Information	Peak-to-peak input voltage
38.	Vout	875.0 mV	System Information	Operational Output Voltage
39.	Vout Actual	872.145 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
40.	Vout Ripple requirement used for Cout calculations	1.0 %	System Information	Custom maximum output ripple requirement that was used for Cout selection(% of Vout).
41.	Vout Tolerance	1.387 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
42.	Vout p-p	8.707 mV	System Information	Peak-to-peak output ripple voltage
43.	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	20.2	Maximum Output Current
	VinMax	12.0	Maximum input voltage
	VinMin	12.0	Minimum input voltage
	Vout	875.0 m	Output Voltage
	base_pn	TPS549D22	Base Product Number
	source	DC	Input Source Type
	Ta	50.0	Ambient temperature
1.	Vout Sch	880.0 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 C_{in} and C_{out} , 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

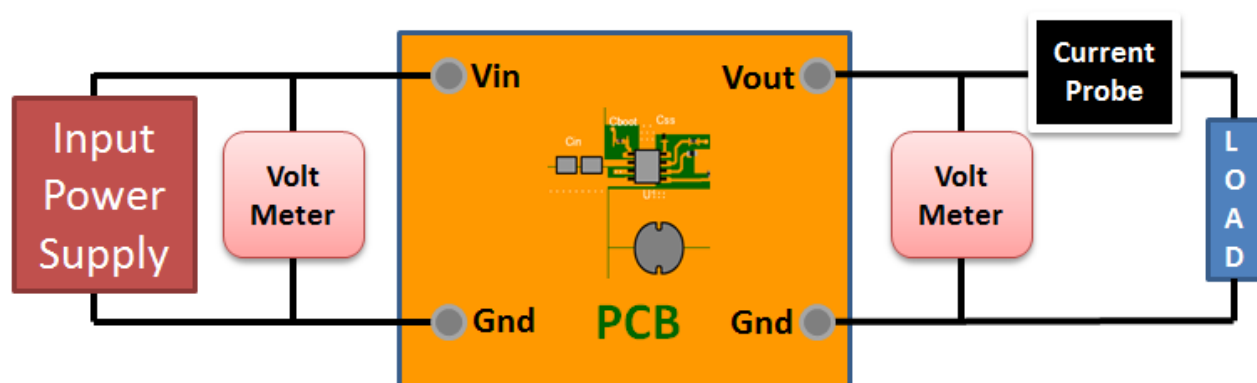
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down 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 12.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} 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 V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} 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.

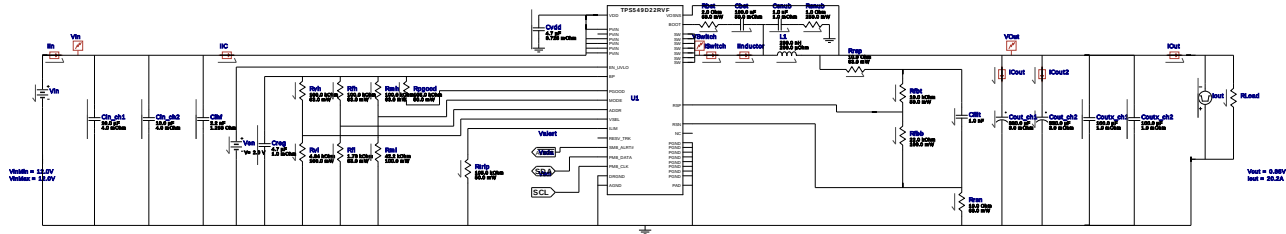


WEBENCH® Electrical Simulation Report

Design Id = 255

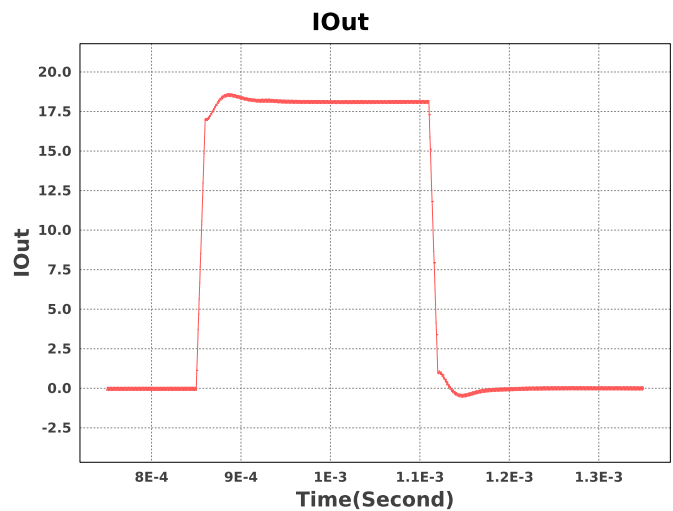
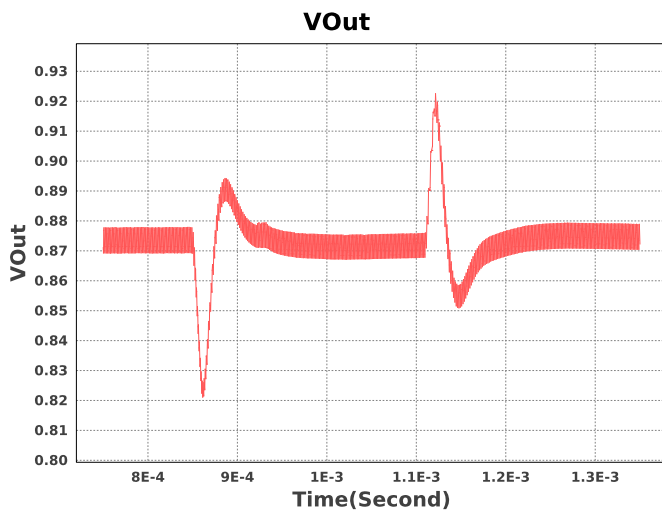
sim_id = 1

Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	20.2 A
2.	Coutx_ch1	IC	Initial Voltage	0.90125 V
3.	Coutx_ch2	IC	Initial Voltage	0.90125 V
4.	Ven	V	Input Voltage	2 V
5.	Cout_ch2	C	Initial Voltage	0.90125 V
6.	Cbst	IC	no description	5
7.	Vscl	V	Input Voltage	0 V
8.	Vsda	V	Input Voltage	0 V
9.	Valert	V	no description	0
10.	Cout_ch1	C	Initial Voltage	0.90125 V
11.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	20.2 A
		I2	Minimum Load Current	2.02 A
		Td	Initial Time Delay	8.500000000000001E-4 s
		Tf	Fall Time	10u s
		Tr	Rise Time	10u s
		Pw	Pulse width	2.5E-4
12.	Rload	R	Load Resistance	0.04331683168316832 Ohm



Design Assistance

1. Master key : A0589A032B95D6C5[v1]

2. **TPS549D22** Product Folder : <http://www.ti.com/product/TPS549D22> : contains the data sheet and other resources.

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