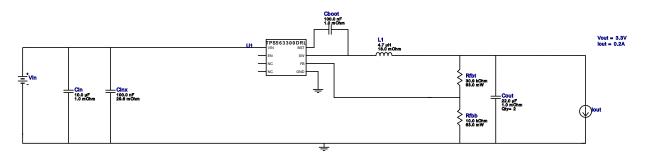
VinMin = 24.0V VinMax = 24.0V Vout = 3.3V Iout = 0.2A Device = TPS563300DRLR Topology = Buck Created = 2024-02-15 11:13:45.095 BOM Cost = \$0.77 BOM Count = 9 Total Pd = 0.09W

WEBENCH® Design Report

Design: 1 TPS563300DRLR TPS563300DRLR 24V-24V to 3.30V @ 0.2A



Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Cin	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 4.9 A	1	\$0.24	1206_180 11 mm ²
Cinx	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 mm ²
Cout	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	2	\$0.04	0603 5 mm ²
L1	NIC Components	NPI31W4R7MTRF	L= 4.7 μH 18.0 mOhm	1	\$0.23	
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCWe3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	IND_NPI31W 172 mm ² 0402 3 mm ²
Rfbt	Vishay-Dale	CRCW040230K9FKED Series= CRCWe3	Res= 30.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
U1	Texas Instruments	TPS563300DRLR	Switcher	1	\$0.18	DRL0008A 8 mm²

Operating Values

#	Name	Value	Category	Description
	Cin IRMS			•
1.		131.067 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	17.179 μW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	300.0 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	45.0 μW	Capacitor	Output capacitor power dissipation
5.	IC lpk	975.0 mA	IC	Peak switch current in IC
6.	IC Pd	84.437 mW	IC	IC power dissipation
7.	IC Tj	35.087 degC	IC	IC junction temperature
8.	IC Tolerance	16.0 mV	IC	IC Feedback Tolerance
9.	ICThetaJA Effective	60.25 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	lin Avg	31.129 mA	IC	Average input current
11.	Ipp percentage	487.5 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
12.	L lpp	975.0 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	2.34 mW	Inductor	Inductor power dissipation
14.	Cin Pd	17.179 μW	Power	Input capacitor power dissipation
15.	Cout Pd	45.0 μW	Power	Output capacitor power dissipation
16.	IC Pd	84.437 mW	Power	IC power dissipation
17.	L Pd	2.34 mW	Power	Inductor power dissipation
18.	Total Pd	87.104 mW	Power	Total Power Dissipation
19.	BOM Count	9	System	Total Design BOM count
	20 000		Information	10ta: 2001g.: 2011 00a.it
20.	Duty Cycle	5.662 %	System	Duty cycle
20.	Daty Cyclo	0.002 /0	Information	Daty dydio
21.	Efficiency	88.341 %	System	Steady state efficiency
۷١.	Linciency	00.541 /6	Information	Steady State entitlerity
22	ContDrint	245.0		Total Fact Print Area of DOM companyon
22.	FootPrint	215.0 mm ²	System	Total Foot Print Area of BOM components
	_	055 400 111	Information	0.344.
23.	Frequency	255.496 kHz	System	Switching frequency
			Information	
24.	Inductor ripple current	40.0 %	System	Custom Inductor ripple current (% of average inductor current)
	requirement used for		Information	requirement used for Inductor selection
	Inductor selection			
25.	lout	200.0 mA	System	lout operating point
			Information	
26.	lout transient step used	100.0 mA	System	Custom Transient current step requirement that was used for Cout
	for Cout calculations		Information	selection (A).
27.	Mode	PFM	System	Conduction Mode
			Information	
28.	Overshoot Value	451.101 μV	System	Theoretical Vout Overshoot Value
			Information	
29.	Pout	660.0 mW	System	Total output power
	1 001	000.0 11111	Information	Total output power
30.	Total BOM	\$0.77	System	Total BOM Cost
30.	Total BOW	ψ0.77	Information	Total BOW Cost
21	Undershoot Value	21.456 mV	_	Theoretical Vout Undershoot Value
31.	Officershoot value	21.450 1110	System	Theoretical vout officershoot value
20	\/i=	24.0.1/	Information	Vin anarating point
32.	Vin	24.0 V	System	Vin operating point
			Information	
33.	Vin p-p	38.407 mV	System	Peak-to-peak input voltage
			Information	
34.	Vout	3.3 V	System	Operational Output Voltage
			Information	
35.	Vout Actual	3.272 V	System	Vout Actual calculated based on selected voltage divider resistors
			Information	
36.	Vout Ripple	1.0 %	System	Custom maximum output ripple requirement that was used for Cout
	requirement used for		Information	selection(% of Vout).
	Cout calculations			
37.	Vout Tolerance	3.557 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider
			Information	resistors if applicable
38.	Vout p-p	31.818 mV	System	Peak-to-peak output ripple voltage
			Information	, , , , , , , , , , , , , , , , , , ,
39.	Vout transient	3.0 %	System	Custom Transient voltage change requirement that was used for Cout
50.	requirement used for	/0	Information	selection (% of Vout).
	Cout calculations			

Design Inputs

Name	Value	Description	
lout	200.0 m	Maximum Output Current	
VinMax	24.0	Maximum input voltage	
VinMin	24.0	Minimum input voltage	

Name	Value	Description	
Vout	3.3	Output Voltage	
base_pn	TPS563300	Base Product Number	
source	DC	Input Source Type	
Та	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 24.0V 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 lout 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.

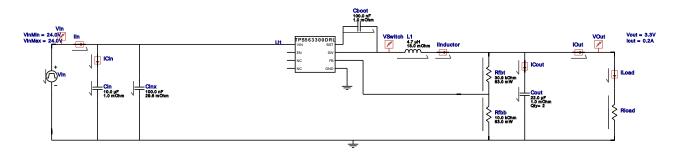


WEBENCH® Electrical Simulation Report

Design Id = 1

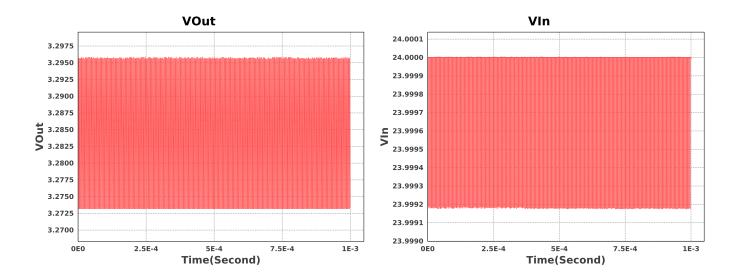
 $sim_id = 4$

Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1	. Cout	IC	initial condition	3.3 V
2	. L1	IC	Initial Current	0.2 A
3	. Rload	R	Load Resistance	16.49999999999999 ohm



Design Assistance

- 1. Master key: 37C3C50233B7D137384961381C9450C6[v1]
- 2. TPS563300 Product Folder: https://www.ti.com/product/TPS563300: contains the data sheet and other resources.

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