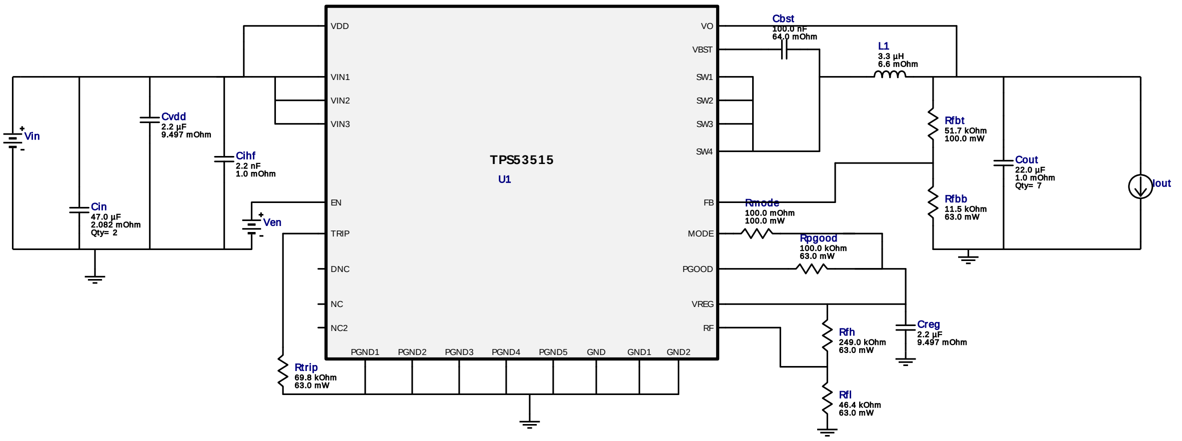
VinMin = 12.0V
VinMax = 12.0V
Vout = 3.3V
Iout = 10.0A

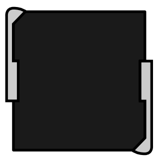
Device = TPS53515RVER
Topology = Buck
Created = 2019-06-28 07:15:10.075
BOM Cost = $4.95
BOM Count = 22
Total Pd = 2.07W

WEBENCH ® Design Report

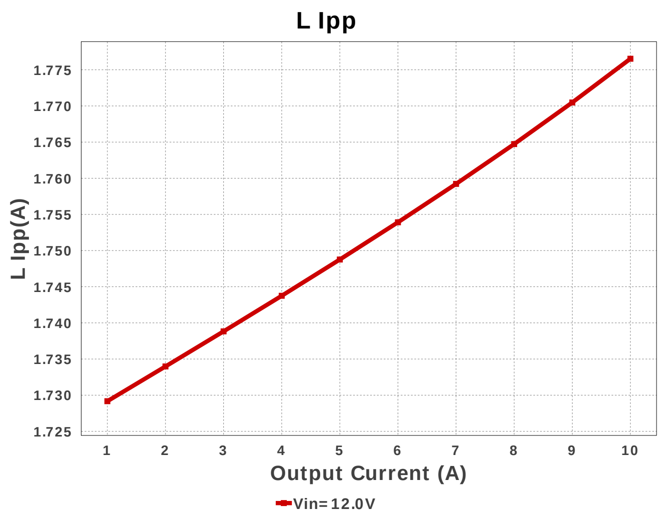
Design : 5 TPS53515RVER
TPS53515RVER 12V-12V to 3.30V @ 10A

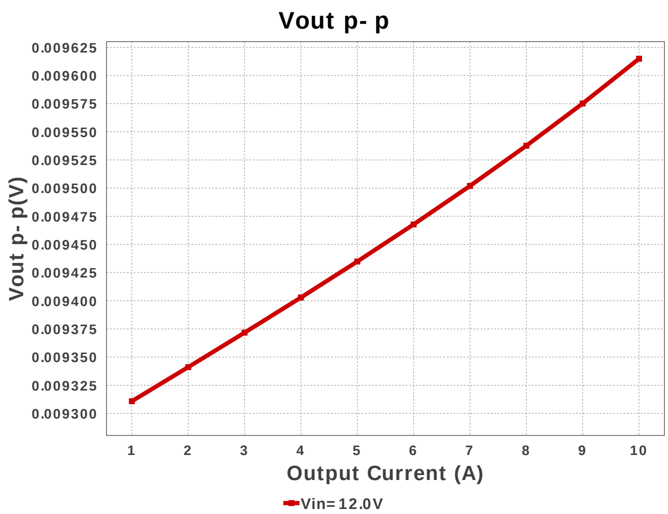


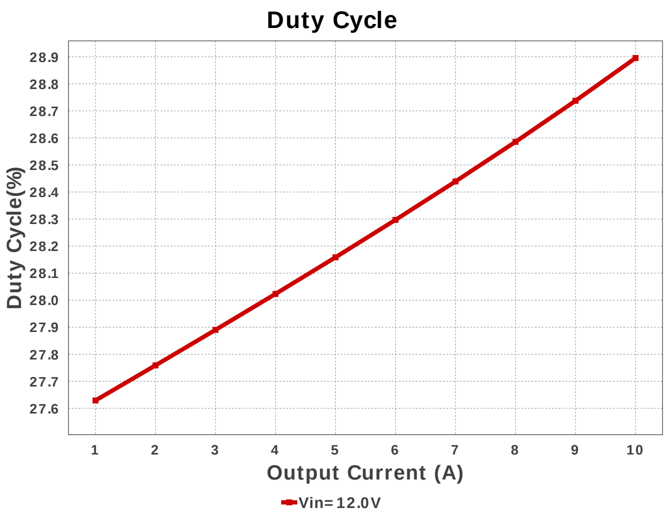
Electrical BOM

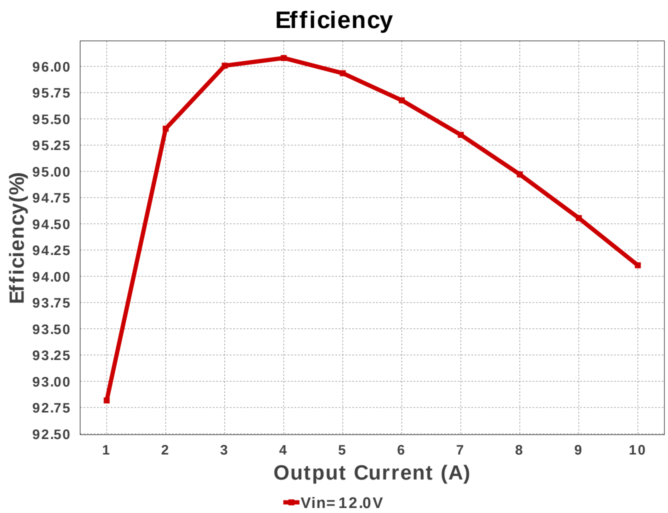
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Cihf	MuRata	GRM155R71E222KA01D Series= X7R	Cap= 2.2 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	2	$0.42	1206 11 mm²
Cout	MuRata	GRM188R60J226MEA0D Series= X5R	Cap= 22.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	7	$0.05	0603 5 mm²
Creg	MuRata	GRM219R61E225KA12D Series= X5R	Cap= 2.2 uF ESR= 9.497 mOhm VDC= 25.0 V IRMS= 1.40815 A	1	$0.11	0805 7 mm²
Cvdd	MuRata	GRM219R61E225KA12D Series= X5R	Cap= 2.2 uF ESR= 9.497 mOhm VDC= 25.0 V IRMS= 1.40815 A	1	$0.11	0805 7 mm²
L1	Bourns	SRP1270-3R3M	L= 3.3 µH 6.6 mOhm	1	$0.72	 SRP1270 246 mm²
Rfbb	Vishay-Dale	CRCW040211K5FKED Series= CRCW..e3	Res= 11.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

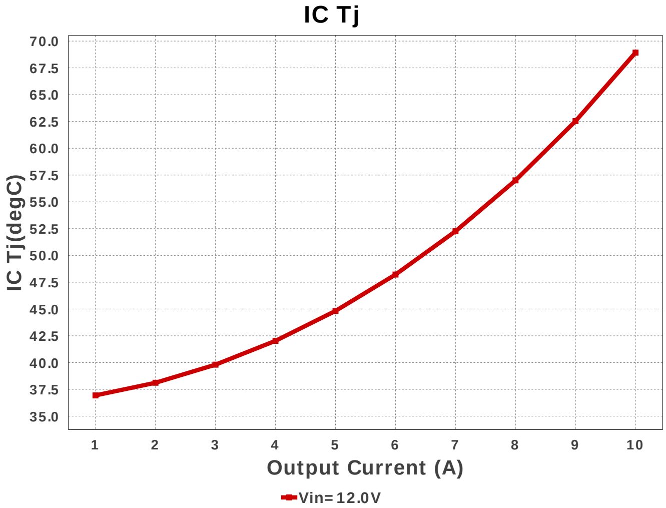
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rfbt	Yageo	RT0603DRE0751K7L Series= RT0603	Res= 51.7 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.02	0603 5 mm^2
Rfh	Yageo	RC0402FR-07249KL Series= ?	Res= 249.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfl	Vishay-Dale	CRCW040246K4FKED Series= CRCW..e3	Res= 46.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rmode	Panasonic	ERJ-3RSFR10V Series= ERJ-3R	Res= 100.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.03	0603 5 mm^2
Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rtrip	Vishay-Dale	CRCW040269K8FKED Series= CRCW..e3	Res= 69.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS53515RVER	Switcher	1	$2.70	R-PVQFN-N28 26 mm^2

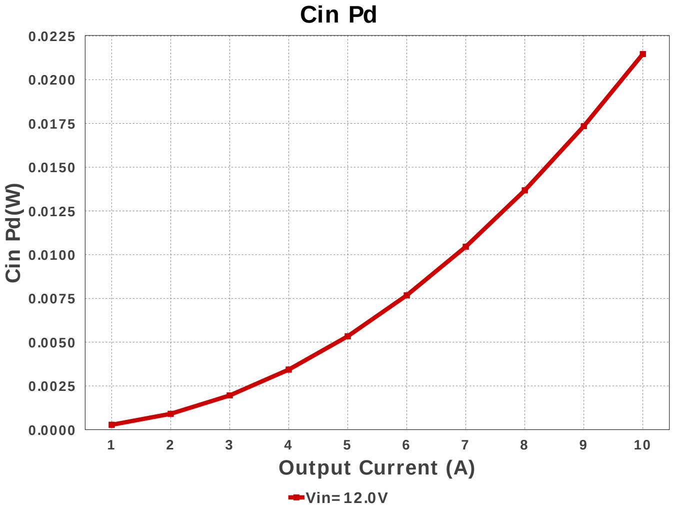


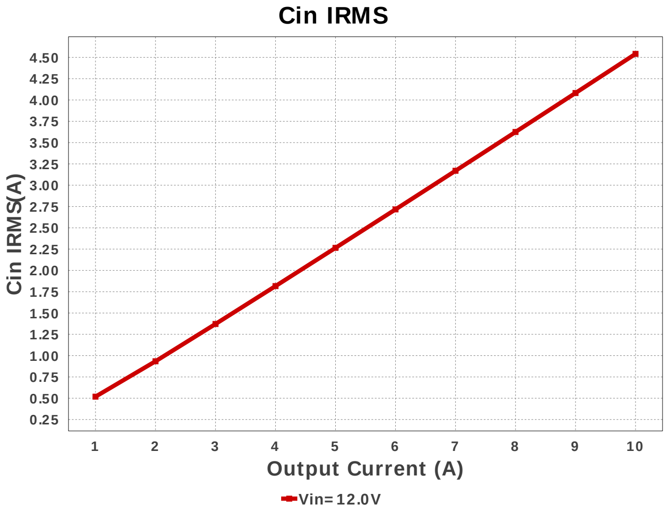


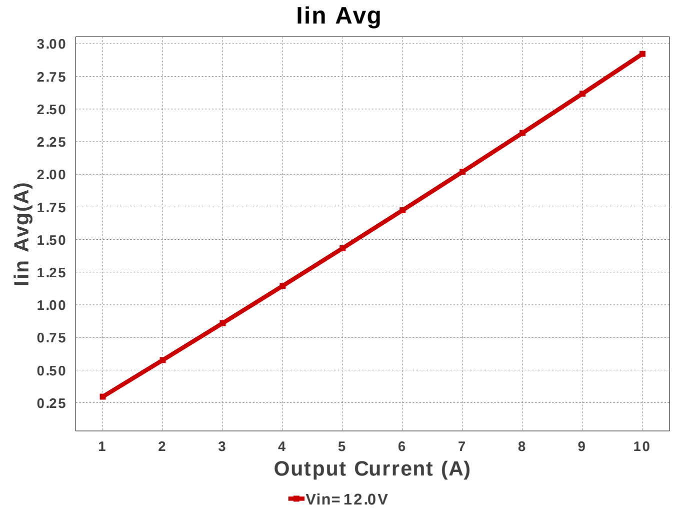


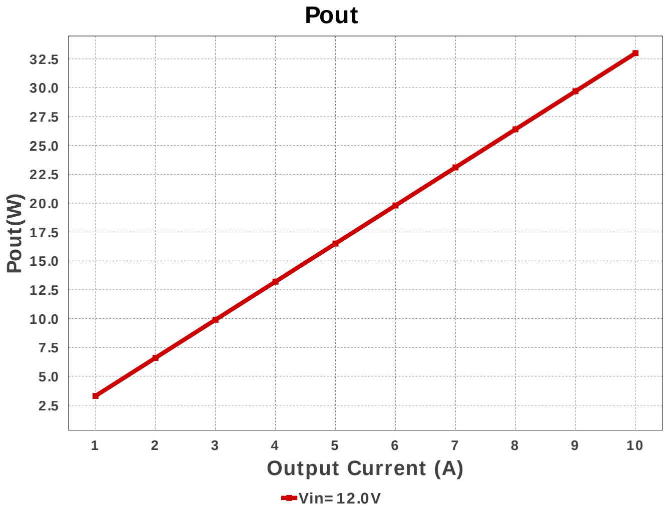


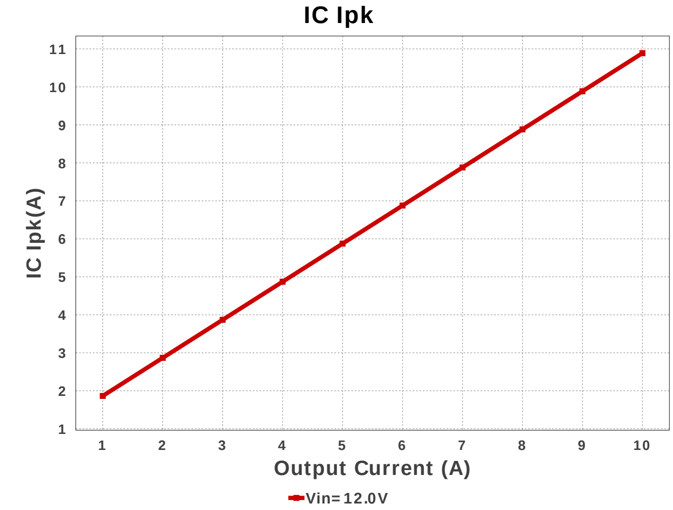

IC Tj
IC Tj(degC)
70.0
67.5
65.0
62.5
60.0
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V


Cin Pd
Cin Pd(W)
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V

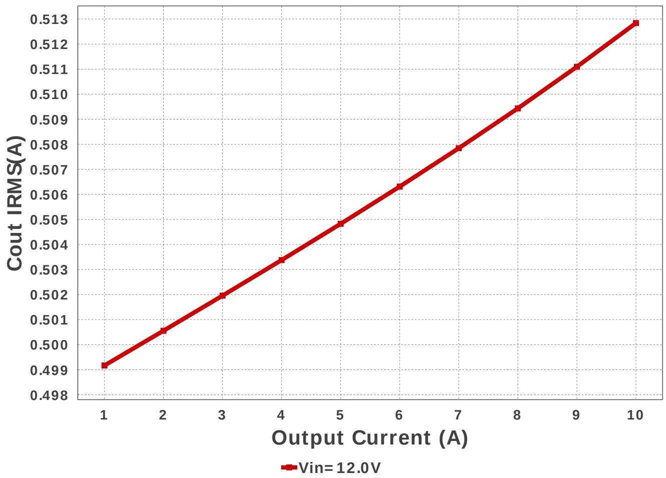

Cin IRMS
Cin IRMS(A)
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V


Iin Avg
Iin Avg(A)
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V

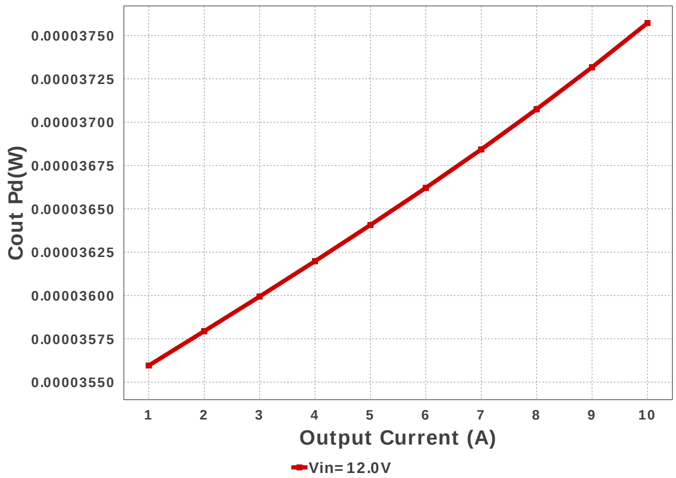

Pout
Pout(W)
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V


IC Ipk
IC Ipk(A)
11
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10
Output Current (A)
Vin=12.0V

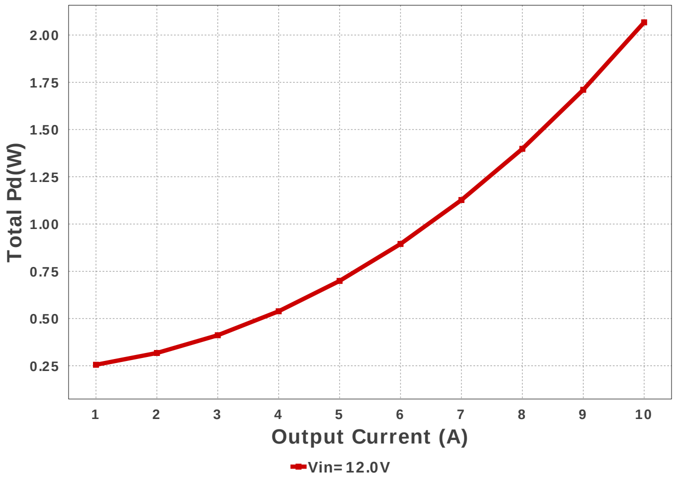
Cout IRMS



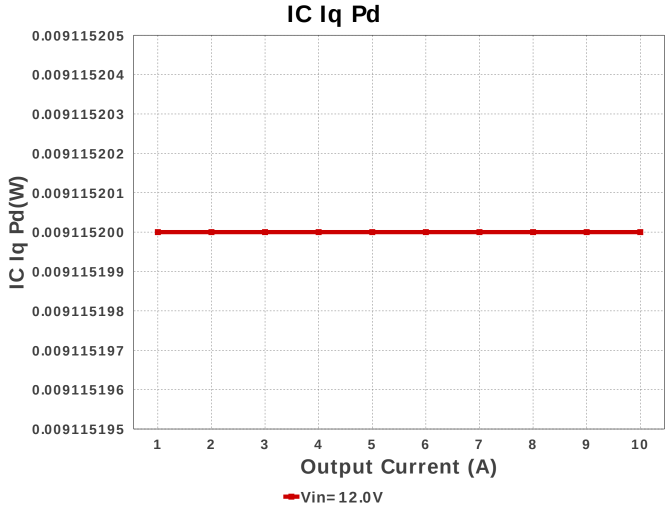
Cout Pd



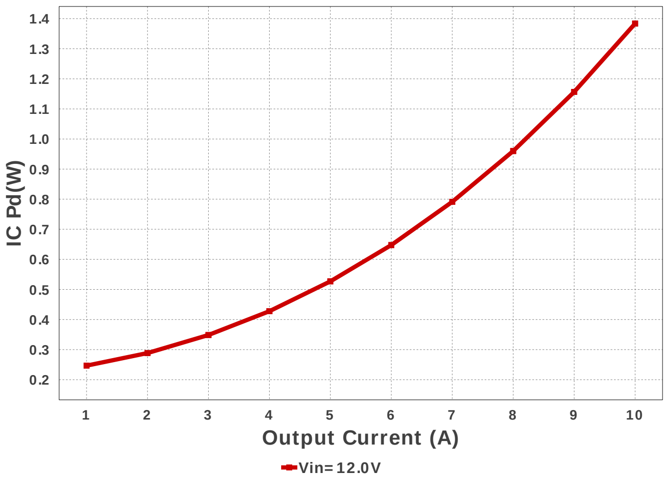
Total Pd



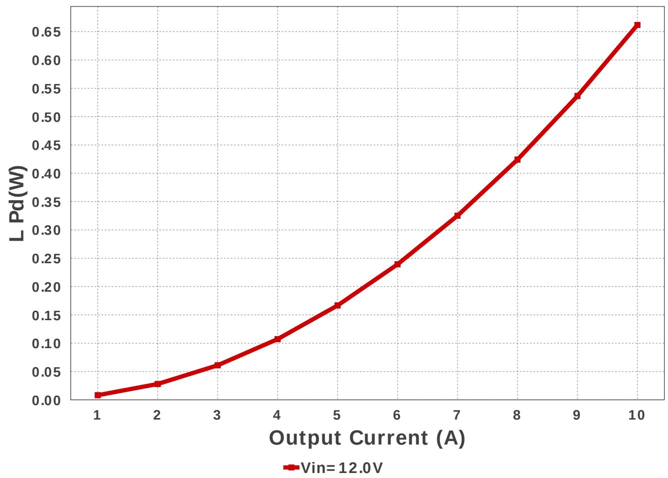
IC Iq Pd



IC Pd



L Pd



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	4.541 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	21.468 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	512.839 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	37.572 µW	Capacitor	Output capacitor power dissipation
5.	IC Ipk	10.888 A	IC	Peak switch current in IC
6.	IC Iq Pd	9.115 mW	IC	IC Iq Pd
7.	IC Pd	1.384 W	IC	IC power dissipation
8.	IC Tj	68.925 degC	IC	IC junction temperature
9.	ICThetaJA Effective	28.13 degC/W	IC	Effective IC Junction-to-Ambient Thermal Resistance
10.	Iin Avg	2.922 A	IC	Average input current
11.	L Ipp	1.776 A	Inductor	Peak-to-peak inductor ripple current

#	Name	Value	Category	Description
12.	L Pd	661.74 mW	Inductor	Inductor power dissipation
13.	Cin Pd	21.468 mW	Power	Input capacitor power dissipation
14.	Cout Pd	37.572 µW	Power	Output capacitor power dissipation
15.	IC Pd	1.384 W	Power	IC power dissipation
16.	L Pd	661.74 mW	Power	Inductor power dissipation
17.	Total Pd	2.067 W	Power	Total Power Dissipation
18.	BOM Count	22	System Information	Total Design BOM count
19.	Duty Cycle	28.896 %	System Information	Duty cycle
20.	Efficiency	94.105 %	System Information	Steady state efficiency
21.	FootPrint	374.0 mm^2	System Information	Total Foot Print Area of BOM components
22.	Frequency	418.103 kHz	System Information	Switching frequency
23.	Iout	10.0 A	System Information	Iout operating point
24.	Mode	CCM	System Information	Conduction Mode
25.	Pout	33.0 W	System Information	Total output power
26.	Total BOM	$4.95	System Information	Total BOM Cost
27.	Vin	12.0 V	System Information	Vin operating point
28.	Vout	3.3 V	System Information	Operational Output Voltage
29.	Vout Actual	3.297 V	System Information	Vout Actual calculated based on selected voltage divider resistors
30.	Vout Tolerance	1.948 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
31.	Vout p-p	9.615 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	10.0	Maximum Output Current
VinMax	12.0	Maximum input voltage
VinMin	12.0	Minimum input voltage
VinTyp	12.0	Typical input voltage
Vout	3.3	Output Voltage
base_pn	TPS53515	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

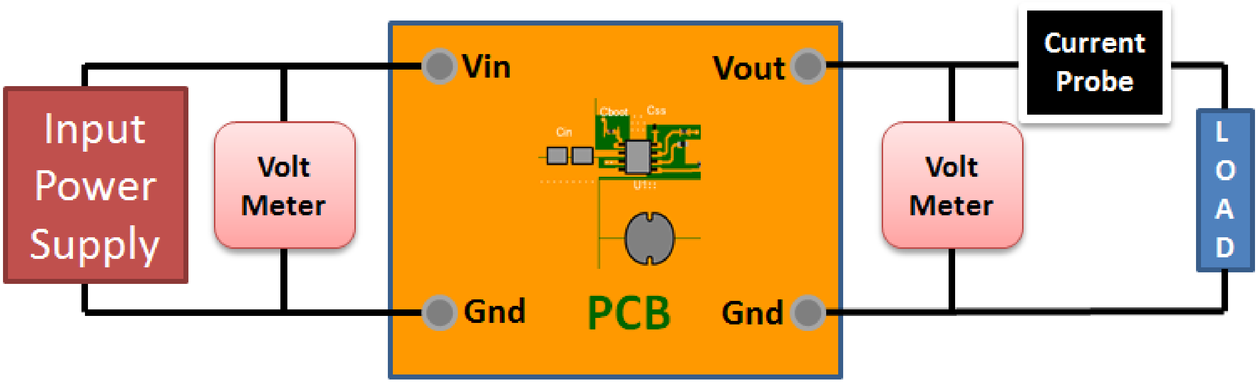
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 12.0V 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.



Design Assistance

1. Master key : 39702A89778F138D[v1]

2. **TPS53515** Product Folder : http://www.ti.com/product/TPS53515 : contains the data sheet and other resources.

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