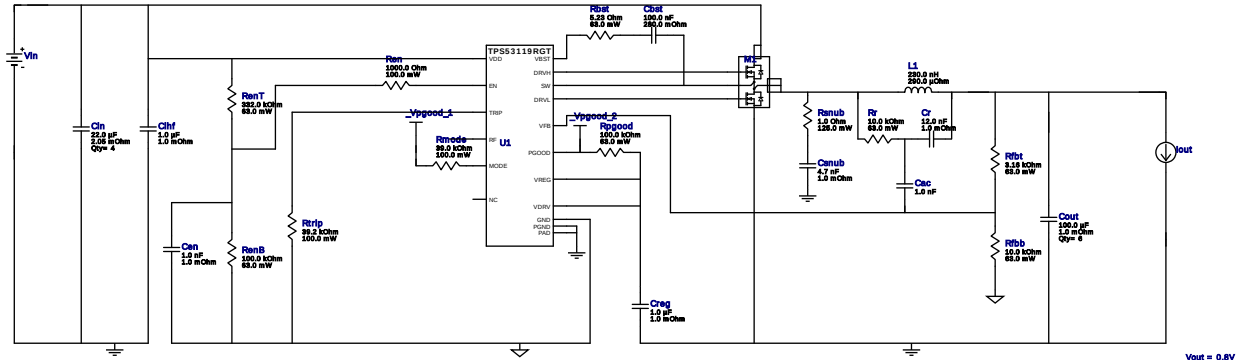
VinMin = 11.5V
VinMax = 12.5V
Vout = 0.8V
Iout = 22.0A

Device = TPS53119RGTR
Topology = Buck
Created = 2023-04-20 23:42:21.895
BOM Cost = $5.49
BOM Count = 31
Total Pd = 2.99W

WEBENCH® Design Report

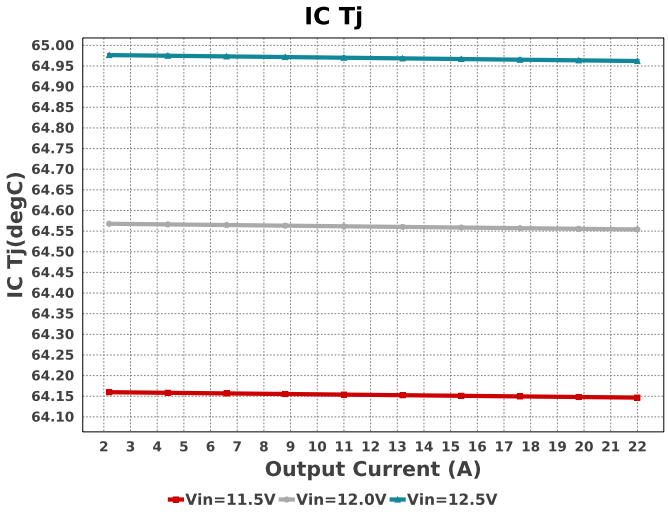
Design : 56 TPS53119RGTR
TPS53119RGTR 11.5V-12.5V to .80V @ 22A(Beta 2)

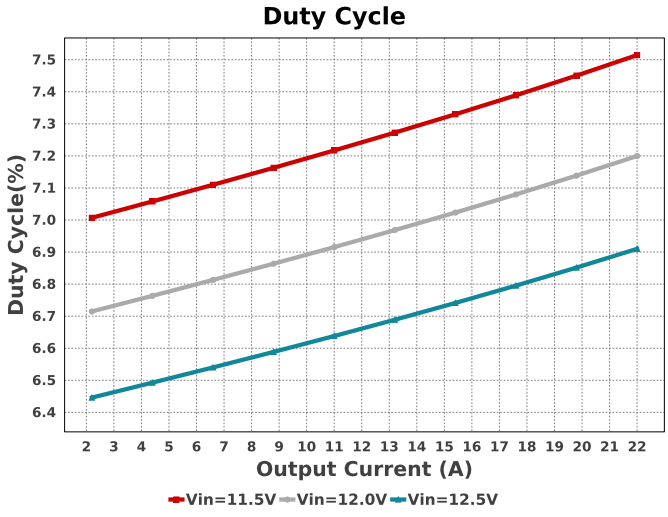


Electrical BOM

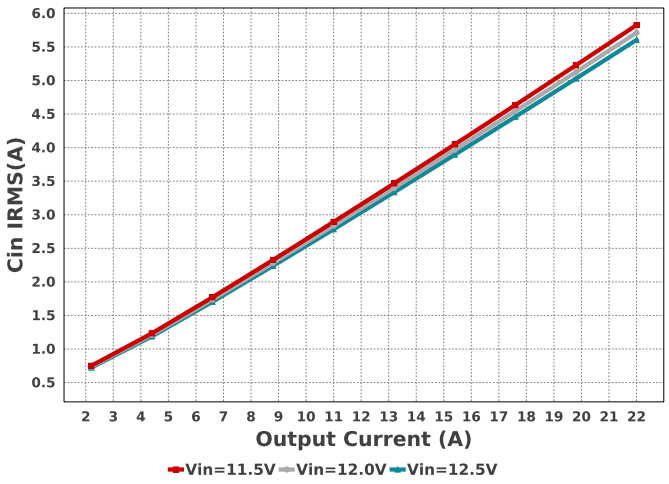
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cac	Yageo	CC0603JRNPO8BN102 Series= C0G/NP0	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cen	Yageo	CC0805KRX7R9BB102 Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Cihf	Taiyo Yuden	TMK212BJ105KG-T Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Cin	TDK	C2012X5R1V226M125AC Series= X5R	Cap= 22.0 uF ESR= 2.05 mOhm VDC= 35.0 V IRMS= 4.5559 A	4	$0.31	0805 7 mm²
Cout	MuRata	GRM32EC80J107ME20L Series= X6S	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 6.0 A	6	$0.17	1210_270 15 mm²
Cr	MuRata	GRM155R71E123KA61D Series= X7R	Cap= 12.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Creg	Taiyo Yuden	TMK212BJ105KG-T Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Csnub	MuRata	GRM155R71E472KA01D Series= X7R	Cap= 4.7 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Coiltronics	FP1107R1-R23-R	L= 230.0 nH 290.0 µOhm	1	$0.79	 FP1107 120 mm^2
M1	Texas Instruments	CSD86350Q5D	PowerBlock	1	$1.49	 DQY0008A 56 mm^2
Rbst	Vishay-Dale	CRCW04025R23FKED Series= CRCW..e3	Res= 5.23 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Ren	Yageo	RC0603FR-071KL Series= ?	Res= 1000.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
RenB	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
RenT	Vishay-Dale	CRCW0402332KFKED Series= CRCW..e3	Res= 332.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rfbt	Vishay-Dale	CRCW04023K16FKED Series= CRCW..e3	Res= 3.16 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rmode	Yageo	RC0603FR-0739KL Series= ?	Res= 39.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 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
Rr	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rsnub	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
Rtrip	Vishay-Dale	CRCW060339K2FKEA Series= CRCW..e3	Res= 39.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
U1	Texas Instruments	TPS53119RGTR	Switcher	1	$0.73	 RGT0016A 16 mm^2

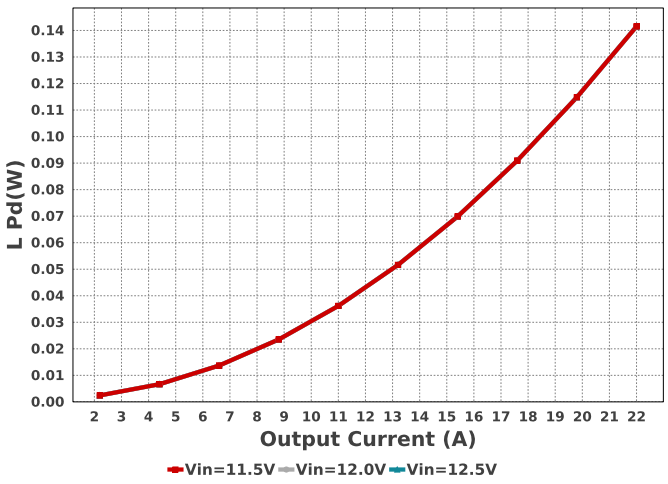




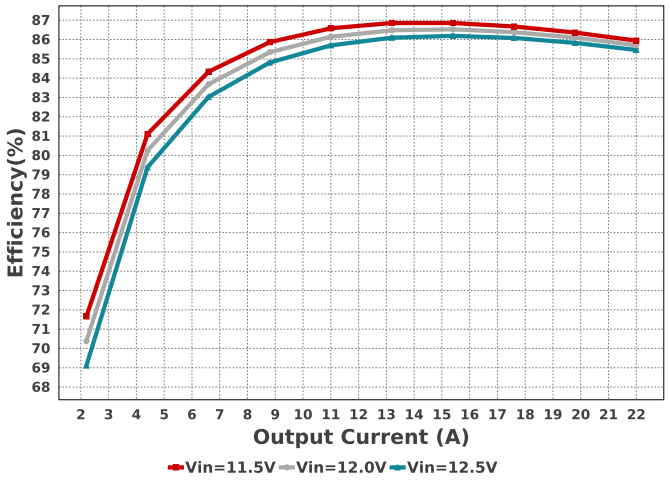
Cin IRMS



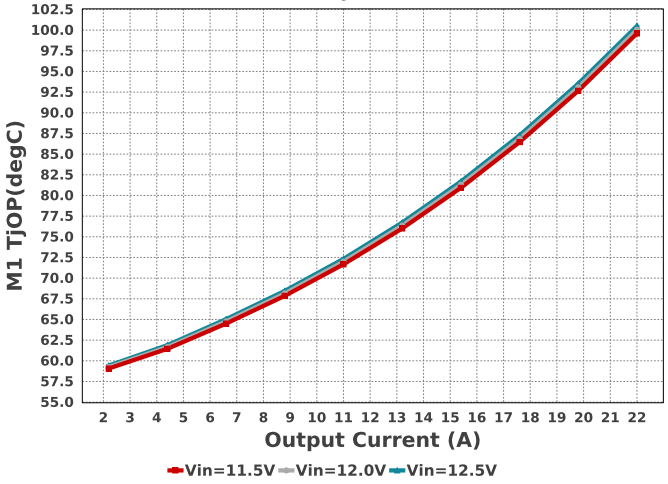
L Pd



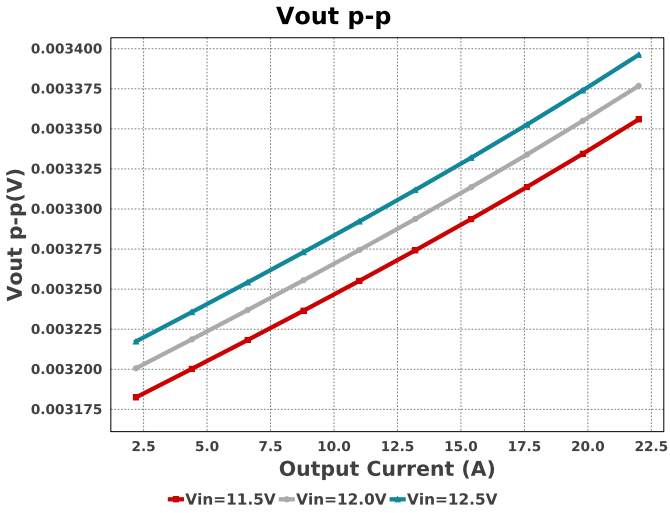
Efficiency



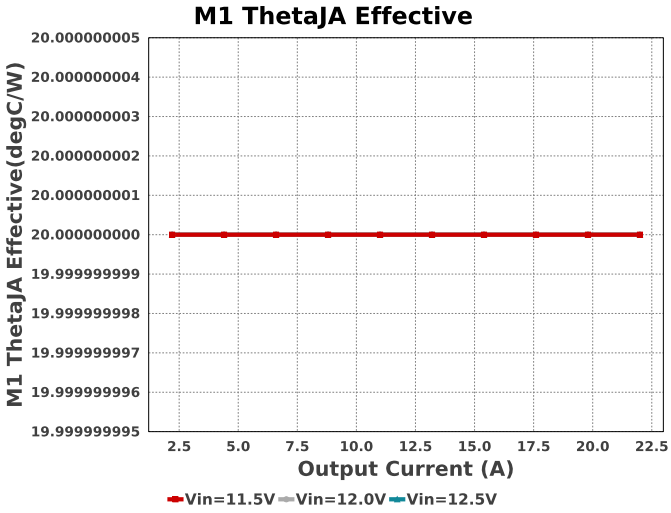
M1 TjOP

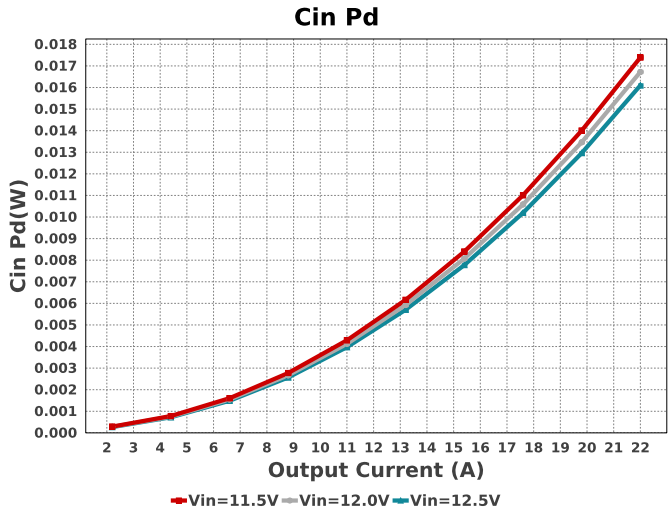


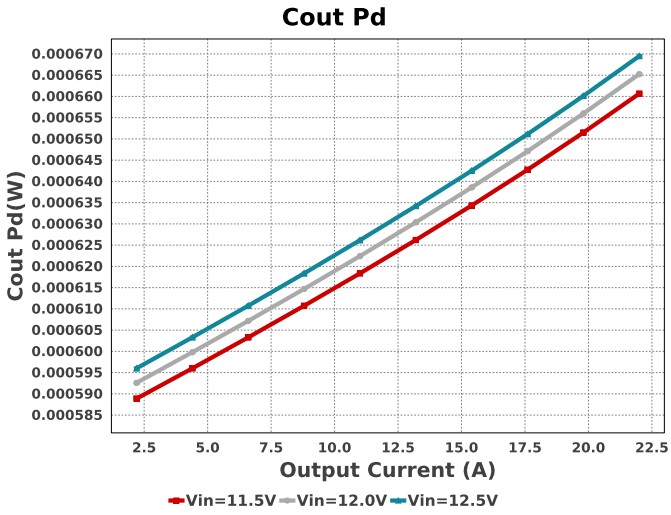
Vout p-p

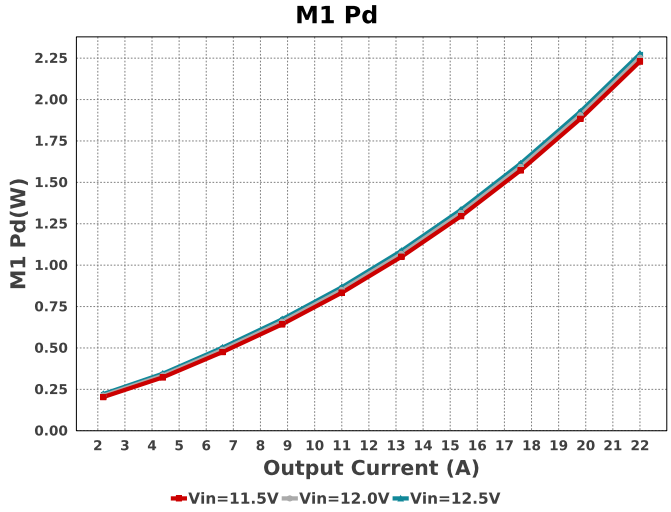


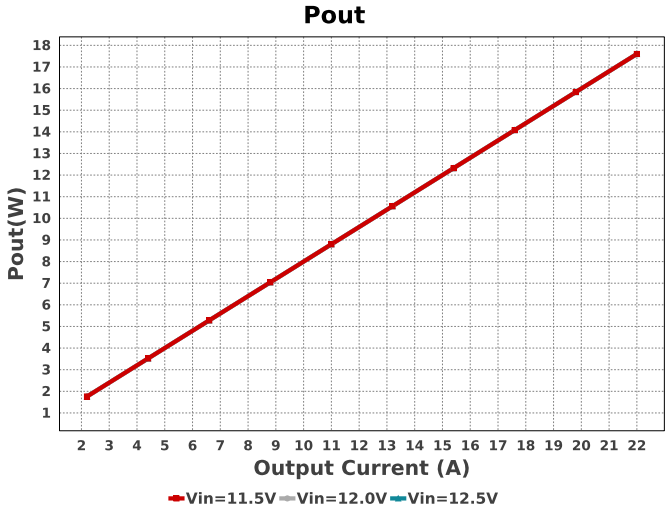
M1 ThetaJA Effective

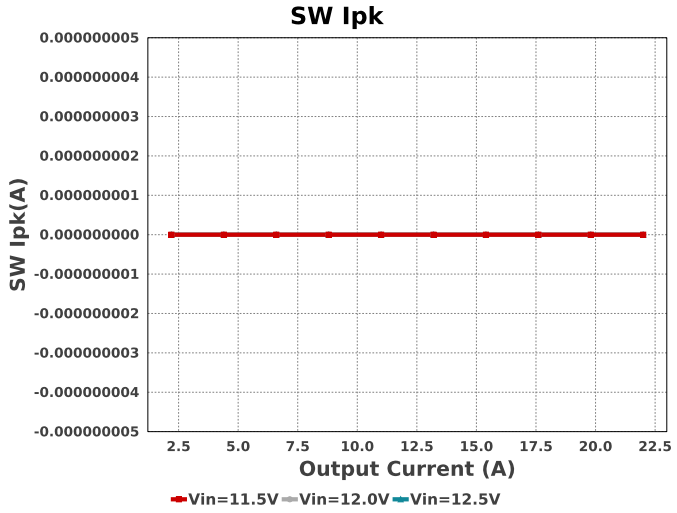


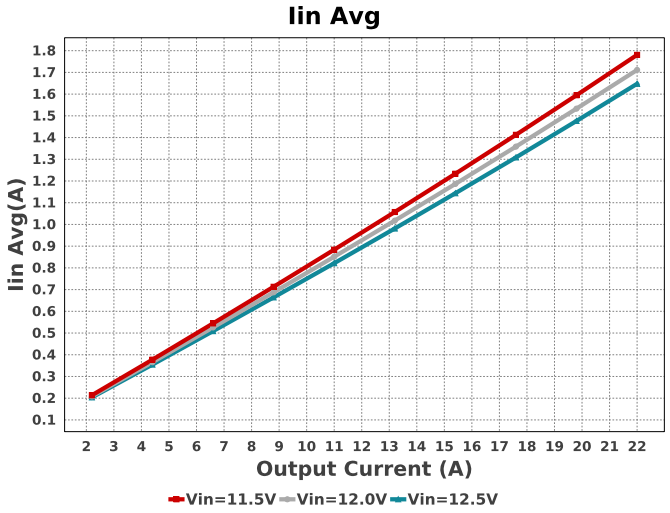


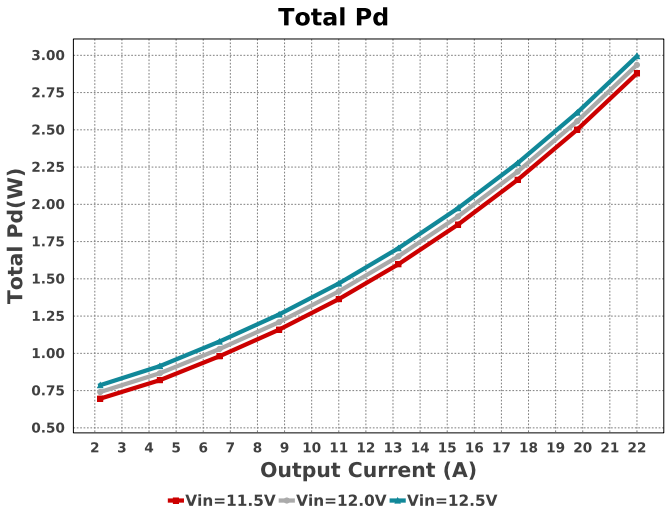


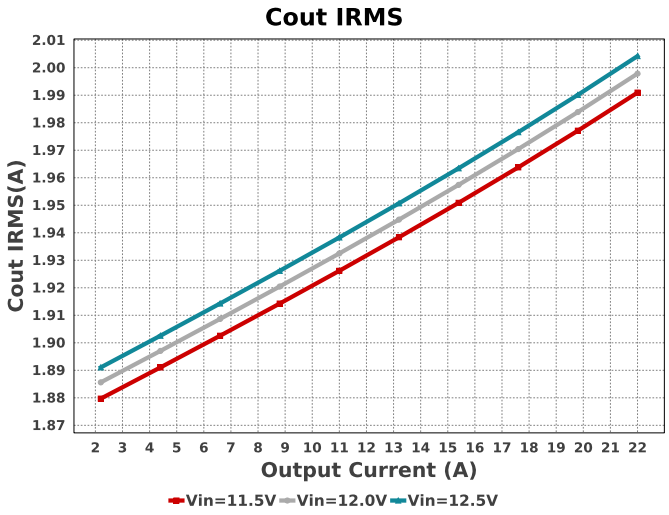


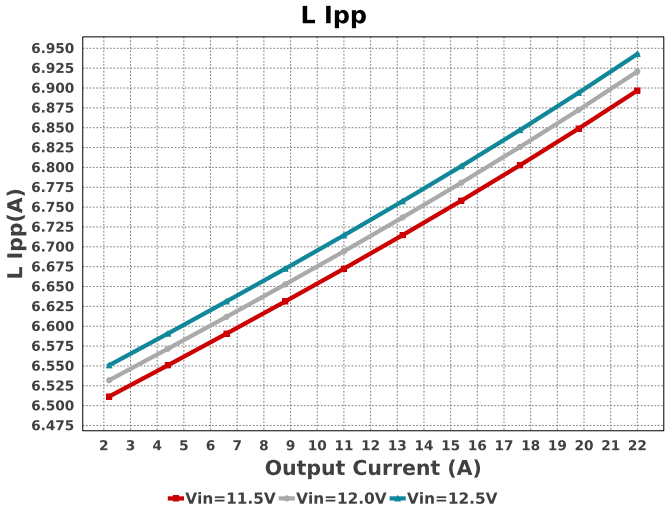


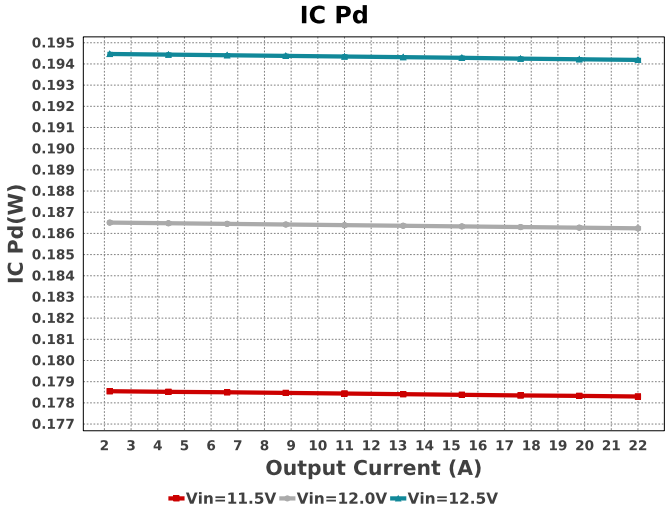












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	5.605 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	16.098 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	2.004 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	669.49 µW	Capacitor	Output capacitor power dissipation
5.	IC Pd	194.19 mW	IC	IC power dissipation
6.	IC Tj	64.962 degC	IC	IC junction temperature
7.	IC Tolerance	6.0 mV	IC	IC Feedback Tolerance
8.	ICThetaJA	51.3 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	1.648 A	IC	Average input current
10.	L Ipp	6.943 A	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	141.52 mW	Inductor	Inductor power dissipation
12.	M1 Pd	2.275 W	Mosfet	Power Block power dissipation
13.	M1 TjOP	100.5 degC	Mosfet	Power Block junction temperature
14.	Cin Pd	16.098 mW	Power	Input capacitor power dissipation
15.	Cout Pd	669.49 µW	Power	Output capacitor power dissipation
16.	IC Pd	194.19 mW	Power	IC power dissipation
17.	L Pd	141.52 mW	Power	Inductor power dissipation
18.	M1 Pd	2.275 W	Power	Power Block power dissipation
19.	Total Pd	2.995 W	Power	Total Power Dissipation
20.	BOM Count	31	System Information	Total Design BOM count
21.	Duty Cycle	6.91 %	System Information	Duty cycle
22.	Efficiency	85.459 %	System Information	Steady state efficiency
23.	FootPrint	386.0 mm^2	System Information	Total Foot Print Area of BOM components
24.	Frequency	500.0 kHz	System Information	Switching frequency
25.	Iout	22.0 A	System Information	Iout operating point

#	Name	Value	Category	Description
26.	M1 ThetaJA Effective	20.0 degC/W	System Information	Effective Power Block Junction-to-Ambient Thermal Resistance
27.	Mode	CCM	System Information	Conduction Mode
28.	Pout	17.6 W	System Information	Total output power
29.	SW Ipk	0.0 A	System Information	Peak switch current
30.	Total BOM	$5.49	System Information	Total BOM Cost
31.	Vin	12.5 V	System Information	Vin operating point
32.	Vout	800.0 mV	System Information	Operational Output Voltage
33.	Vout Actual	800.544 mV	System Information	Vout Actual calculated based on selected voltage divider resistors
34.	Vout Tolerance	986.33 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
35.	Vout p-p	3.396 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	22.0	Maximum Output Current
VinMax	12.5	Maximum input voltage
VinMin	11.5	Minimum input voltage
VinTyp	12.0	Typical input voltage
Vout	800.0 m	Output Voltage
base_pn	TPS53119	Base Product Number
source	DC	Input Source Type
Ta	55.0	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

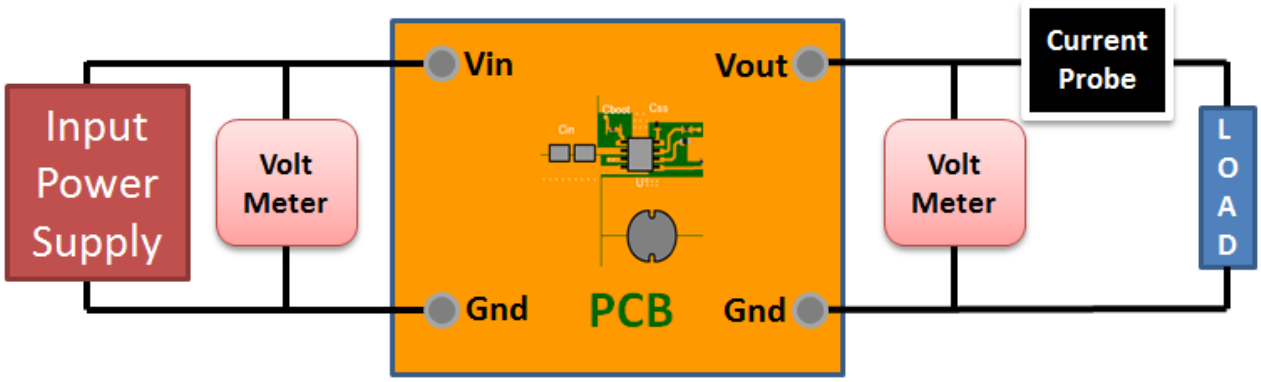
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.5V 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.

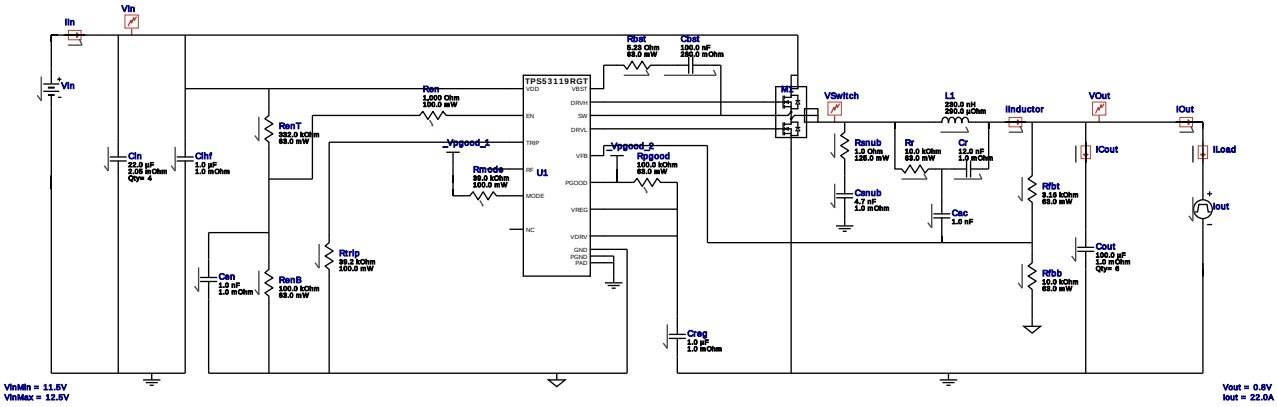


WEBENCH® Electrical Simulation Report

Design Id = 56

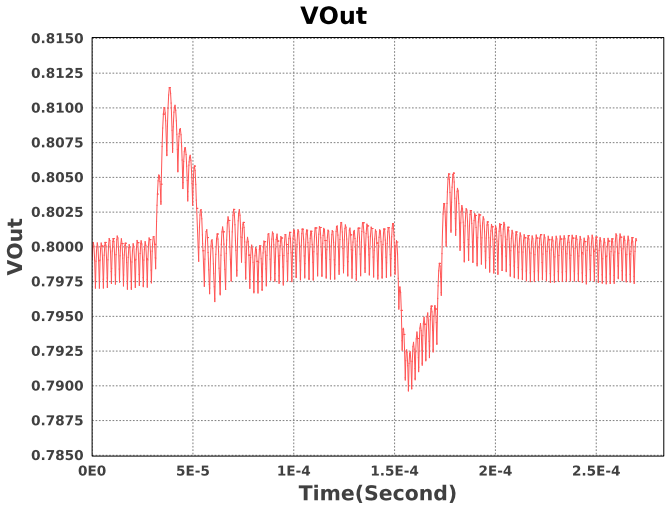
sim_id = 1

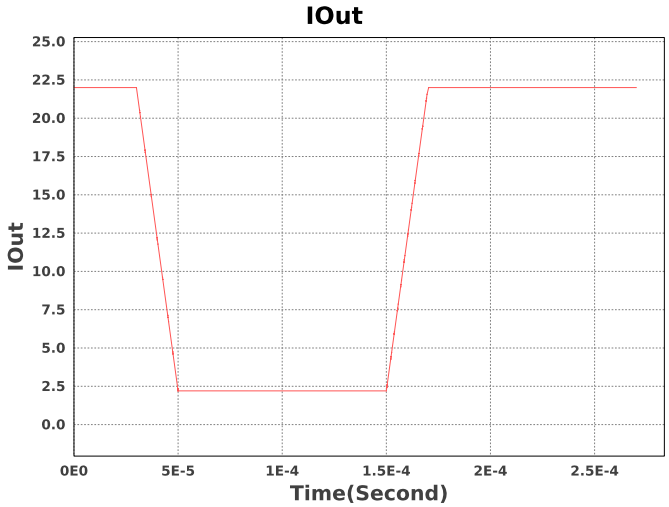
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Cr	IC	Initial condition	0 V
2.	L1	IC	Initial Current	-22.0 A
3.	Creg	IC	Initial Voltage	6.2 V
4.	Cen	IC	Initial condition	1.6 V
5.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	22.0 A
		I2	Minimum Load Current	2.2 A
		Td	Initial Time Delay	3.0E-5 s
		Tf	Fall Time	20u s
		Tr	Rise Time	20u s
		Pw	Pulse Width	1.0E-4 s

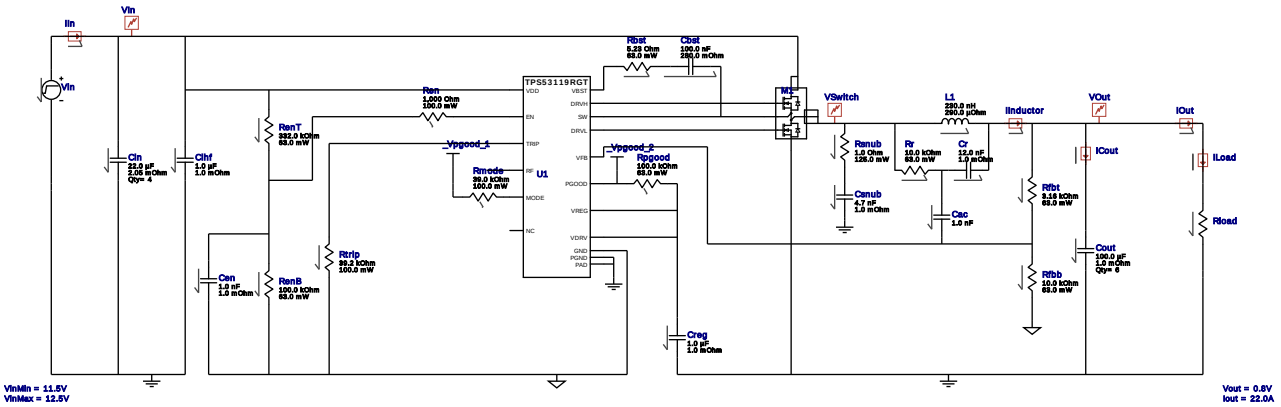




Design Id = 56

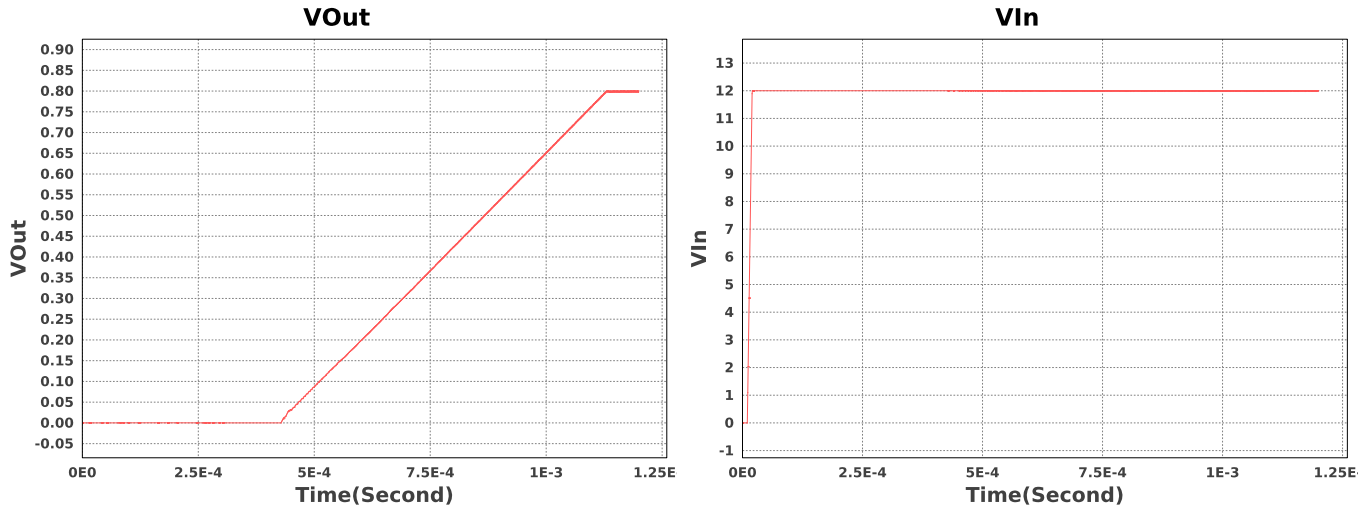
sim_id = 2

Simulation Type = Startup



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Rload	R	Load Resistance	0.03636363636363637 Ohm



Design Assistance

1. Master key : 0F0F4E54B4813362[v1]
2. **TPS53119** Product Folder : http://www.ti.com/product/TPS53119 : contains the data sheet and other resources.