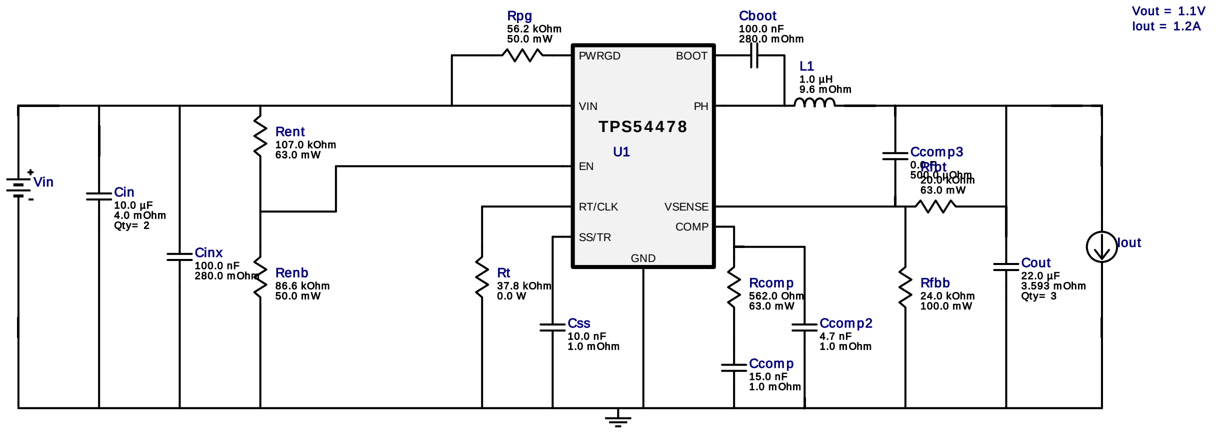
VinMin = 3.3V
VinMax = 3.3V
Vout = 1.1V
Iout = 1.2A

Device = TPS54478RTER
Topology = Buck
Created = 2022-09-15 03:08:34.260
BOM Cost = NA
BOM Count = 20
Total Pd = 0.15W

WEBENCH ® Design Report

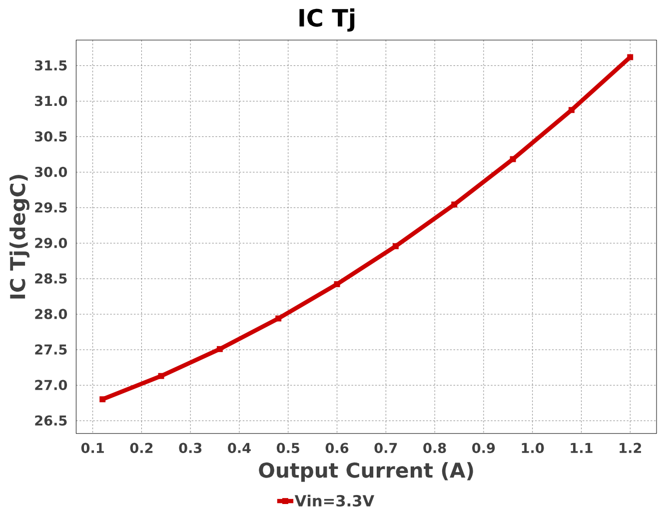
Design : 7 TPS54478RTER
TPS54478RTER 3.3V-3.3V to 1.10V @ 1.2A

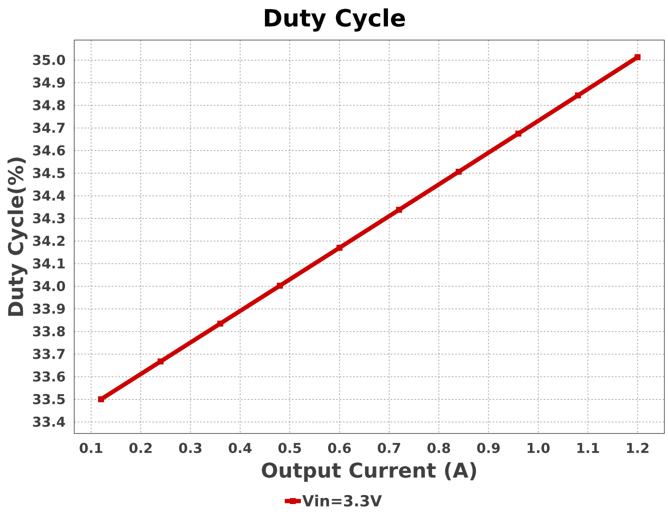


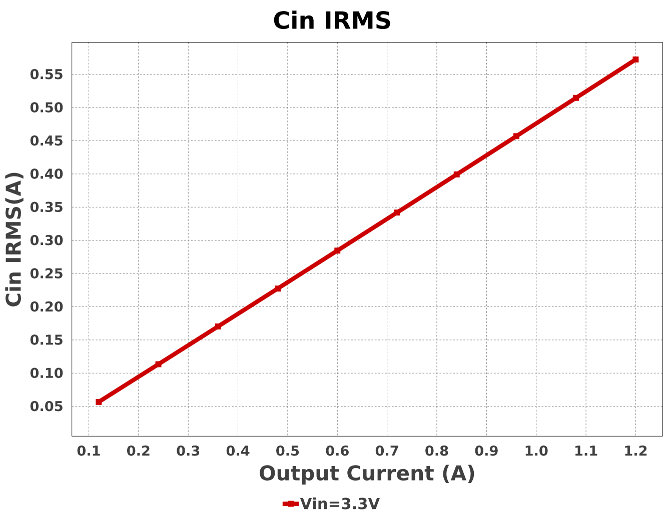
Electrical BOM

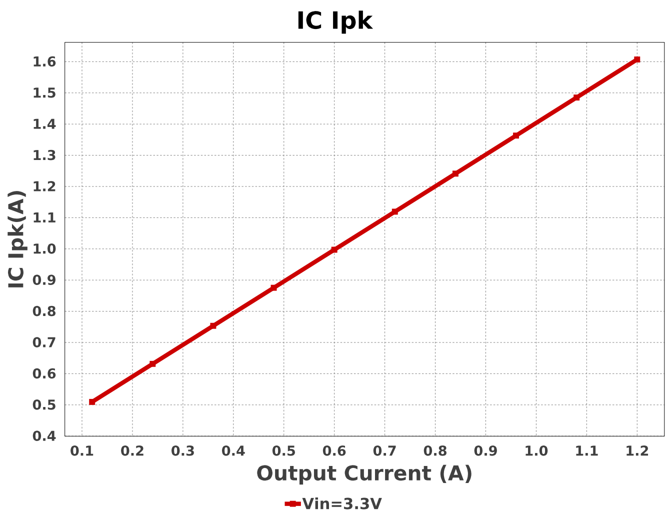
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp	MuRata	GRM155R71H153KA12D Series= X7R	Cap= 15.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp2	MuRata	GRM155R71H472KA01D Series= X7R	Cap= 4.7 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp3	CUSTOM	CUSTOM Series= ?	Cap= 0.0 F ESR= 500.0 uOhm VDC= 12.0 V IRMS= 1.0 A	1	NA	CUSTOM 0 mm²
Cin	MuRata	GRM21BR70J106KE76L Series= X7R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 6.3 V IRMS= 4.65 A	2	$0.15	0805 7 mm²
Cinx	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
Cout	MuRata	GRM31CR70J226KE19L Series= X7R	Cap= 22.0 uF ESR= 3.593 mOhm VDC= 6.3 V IRMS= 3.44359 A	3	$0.34	1206_190 11 mm²
Css	MuRata	GRM155R61A103KA01D Series= X5R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
L1	Panasonic	ETQP3M1R0KVP	L= 1.0 µH 9.6 mOhm	1	NA	IND_NPI54C 0 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcomp	Vishay-Dale	CRCW0402562RFKED Series= CRCW..e3	Res= 562.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Renb	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rent	Vishay-Dale	CRCW0402107KFKED Series= CRCW..e3	Res= 107.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Yageo	RC0603FR-0724KL Series= ?	Res= 24.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rfbt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpg	Yageo	RC0201FR-0756K2L Series= ?	Res= 56.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rt	CUSTOM	CUSTOM Series= ?	Res= 37.8 kOhm Power= 0.0 W Tolerance= 1%	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	TPS54478RTER	Switcher	1	$1.07	S-PWQFN-N16 17 mm^2

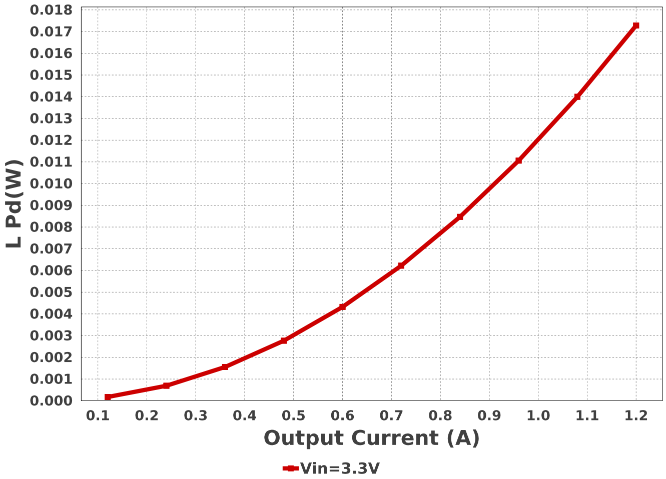




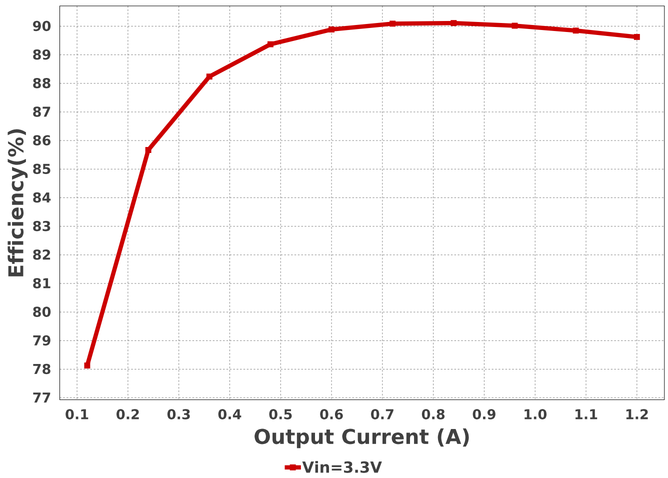




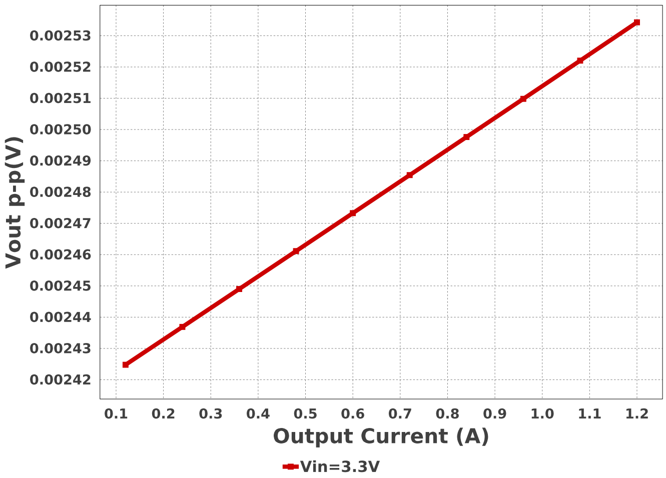
L Pd



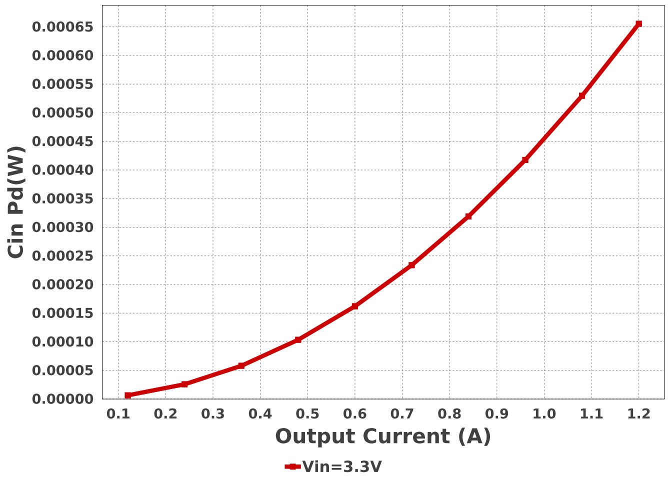
Efficiency



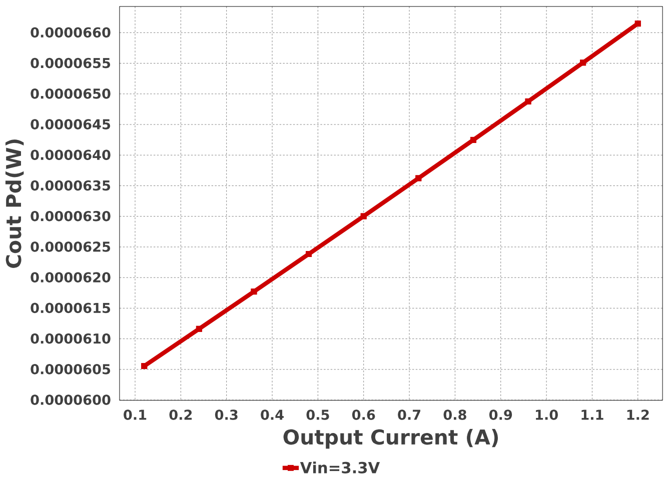
Vout p-p



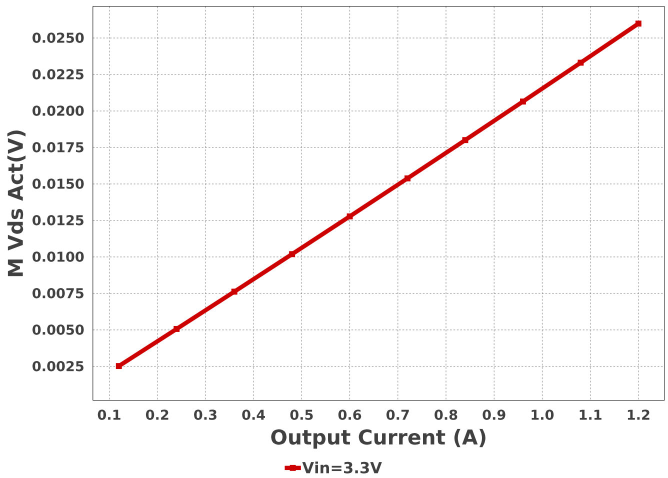
Cin Pd

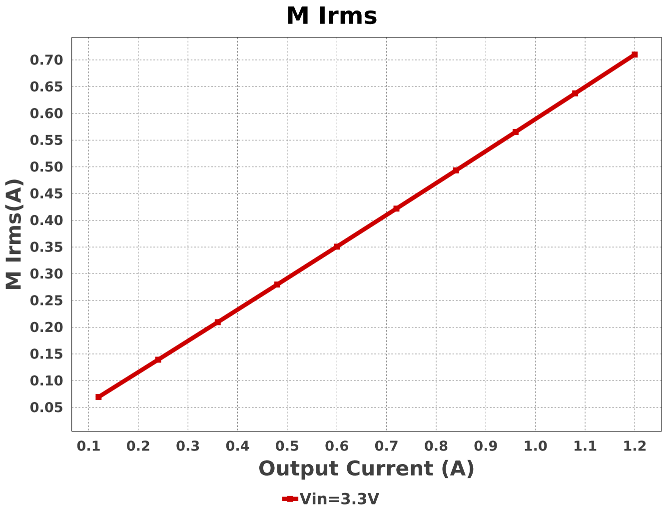


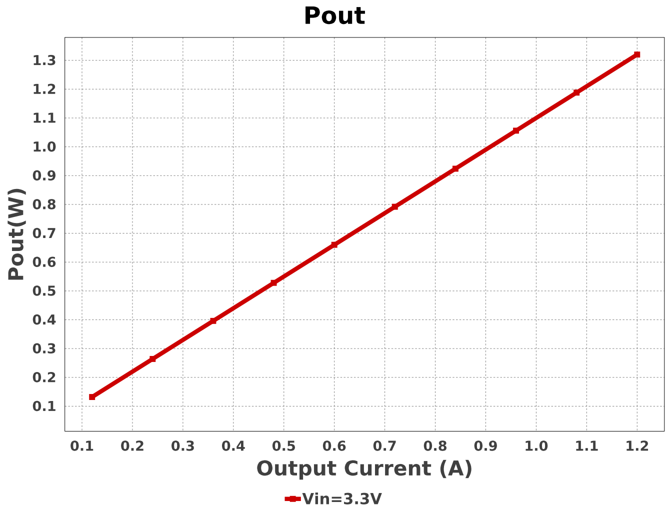
Cout Pd

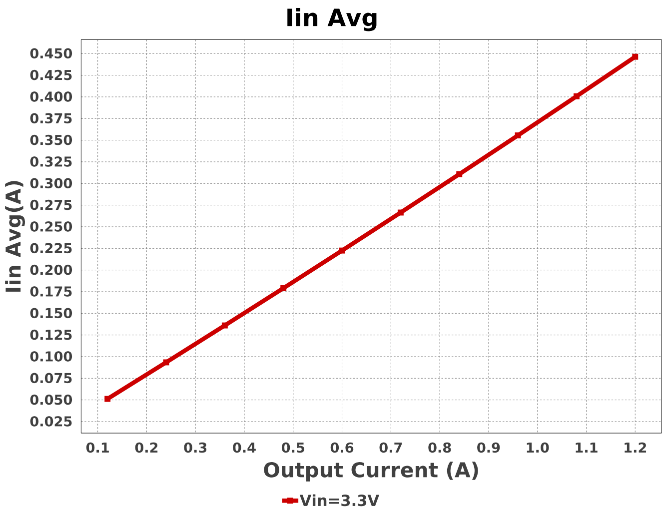


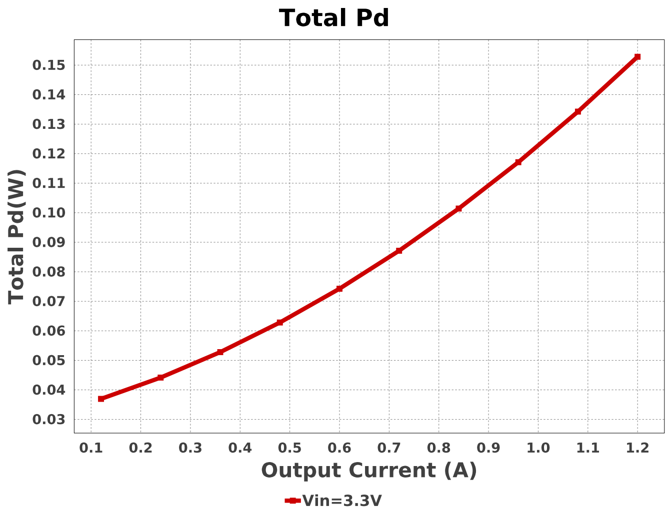
M Vds Act

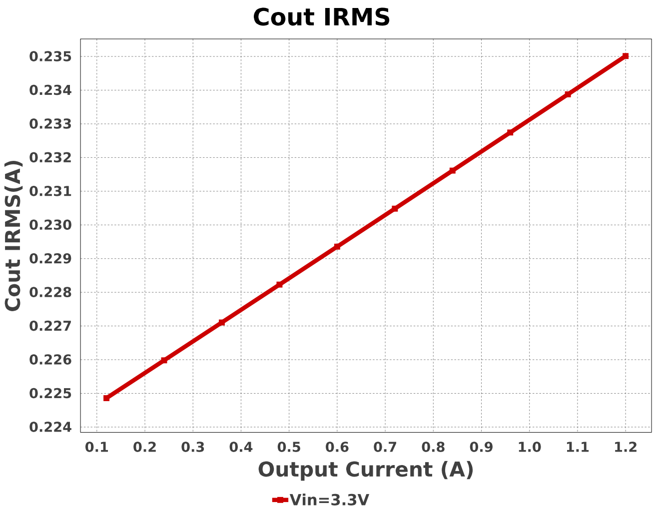


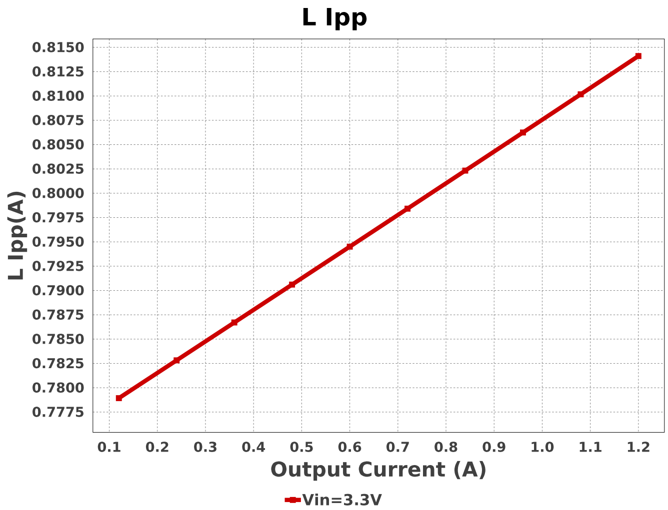

M Irms
M Irms(A)
Output Current (A)
Vin=3.3V

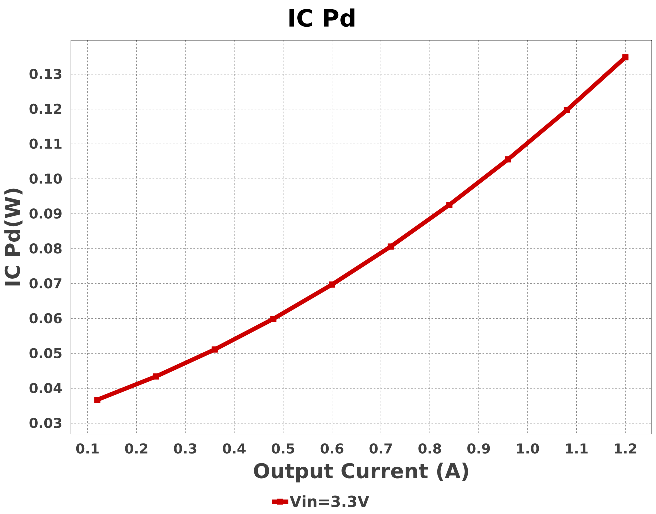

Pout
Pout(W)
Output Current (A)
Vin=3.3V

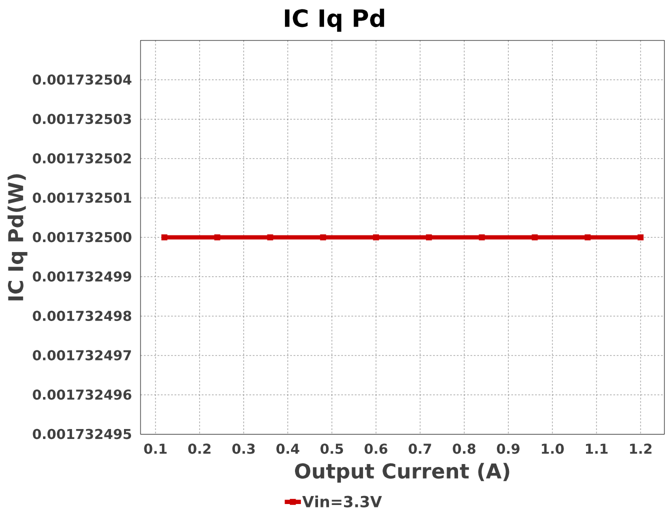

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.3V

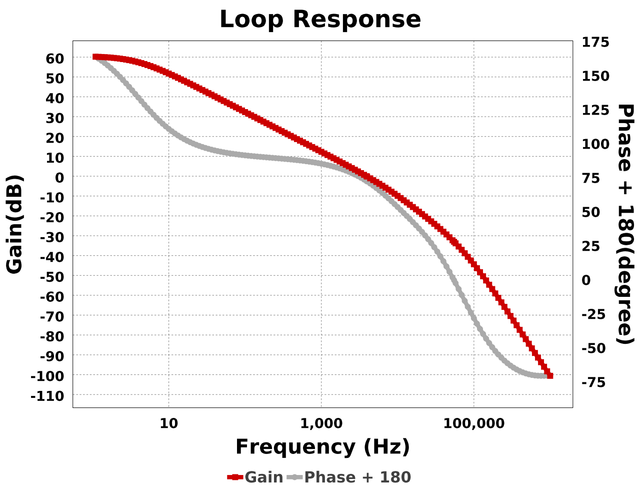

Total Pd
Total Pd(W)
Output Current (A)
Vin=3.3V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.3V


L Ipp
L Ipp(A)
Output Current (A)
Vin=3.3V







Operating Values

#	Name	Value	Category	Description
1.	BOM Count	20		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	572.414 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	655.31 µW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	235.012 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	66.148 µW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	1.607 A	IC	Peak switch current in IC
8.	IC Iq Pd	1.732 mW	IC	IC Iq Pd
9.	IC Pd	134.82 mW	IC	IC power dissipation
10.	IC Tj	31.62 degC	IC	IC junction temperature
11.	IC Tolerance	6.0 mV	IC	IC Feedback Tolerance
12.	ICThetaJA	49.1 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	446.31 mA	IC	Average input current
14.	L Ipp	814.107 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	17.28 mW	Inductor	Inductor power dissipation
16.	M1 Irms	710.064 mA	Mosfet	Q Iavg
17.	M Vds Act	25.987 mV	Mosfet	Voltage drop across the MosFET
18.	Cin Pd	655.31 µW	Power	Input capacitor power dissipation
19.	Cout Pd	66.148 µW	Power	Output capacitor power dissipation
20.	IC Pd	134.82 mW	Power	IC power dissipation
21.	L Pd	17.28 mW	Power	Inductor power dissipation
22.	Total Pd	152.82 mW	Power	Total Power Dissipation
23.	Cross Freq	3.909 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	35.013 %	System Information	Duty cycle
25.	Efficiency	89.624 %	System Information	Steady state efficiency
26.	FootPrint	175.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	946.18 kHz	System Information	Switching frequency

#	Name	Value	Category	Description
28.	Gain Marg	-33.05 dB	System Information	Bode Plot Gain Margin
29.	Iout	1.2 A	System Information	Iout operating point
30.	Mode	CCM	System Information	Conduction Mode
31.	Phase Marg	72.842 deg	System Information	Bode Plot Phase Margin
32.	Pout	1.32 W	System Information	Total output power
33.	Vin	3.3 V	System Information	Vin operating point
34.	Vout	1.1 V	System Information	Operational Output Voltage
35.	Vout Actual	1.1 V	System Information	Vout Actual calculated based on selected voltage divider resistors
36.	Vout Tolerance	1.927 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	2.534 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.2	Maximum Output Current
SoftStart	1.0 ms	Soft Start Time (ms)
VinMax	3.3	Maximum input voltage
VinMin	3.3	Minimum input voltage
Vout	1.1	Output Voltage
base_pn	TPS54478	Base Product Number
source	DC	Input Source Type
Ta	25.0	Ambient temperature
UserFsw	944.057 k	Customer Selected Frequency

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

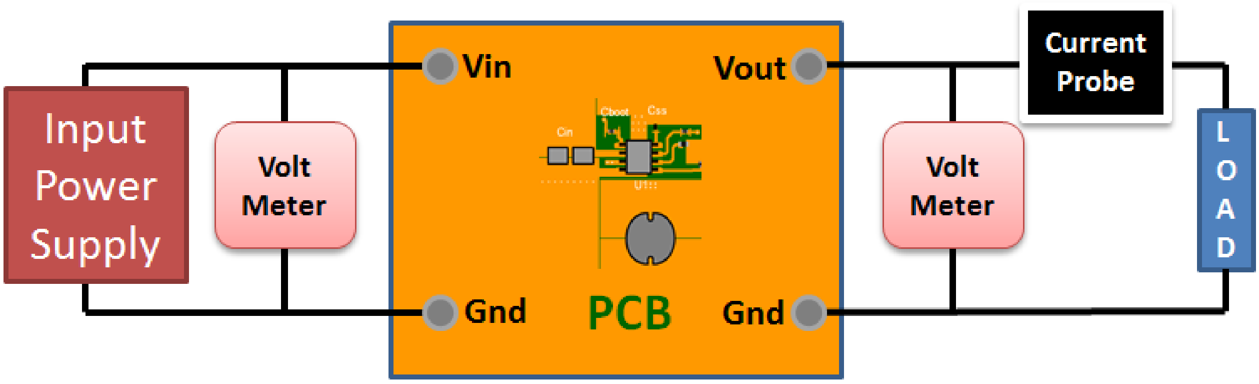
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 3.3V 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.

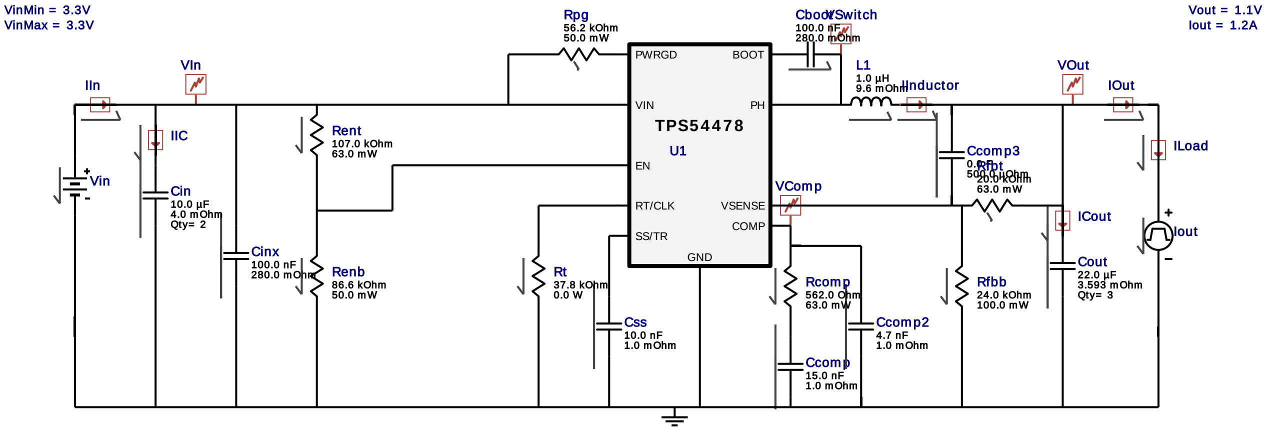


WEBENCH® Electrical Simulation Report

Design Id = 7

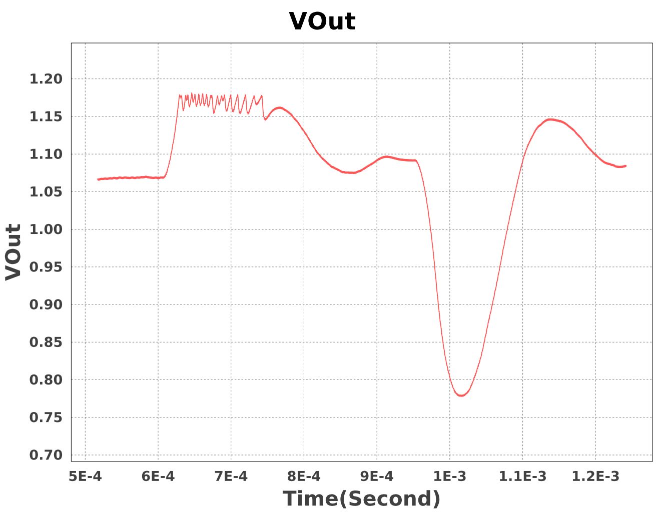
sim_id = 4

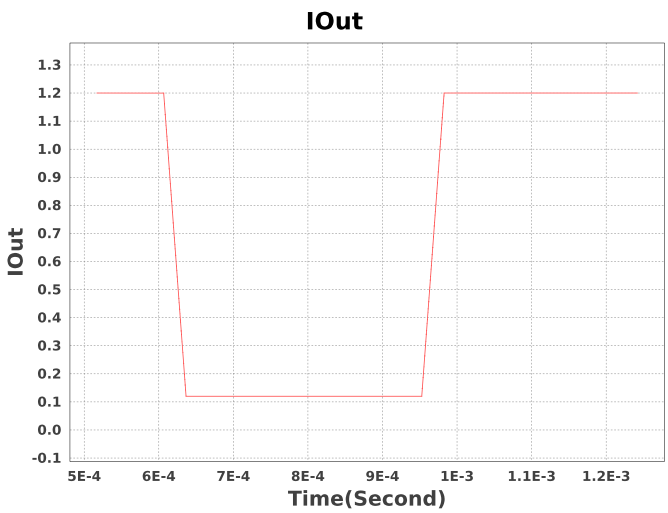
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	no description	1.2 A
2.	Css	IC	no description	0.61
3.	Cout	IC	no description	1.1 V
4.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Current	1.2 A
		I2	Minimum Current	0.12 A
		Td	Initial Time Delay	6.065708379736827E-4 s
		Tr	Rise Time	30u s
		Tf	Fall Time	30u s
		PW	Pulse Width	3.1609960923162725E-4 s





Design Assistance

1. Master key : 11D684A148251226[v1]

2. **TPS54478** Product Folder : http://www.ti.com/product/TPS54478 : contains the data sheet and other resources.