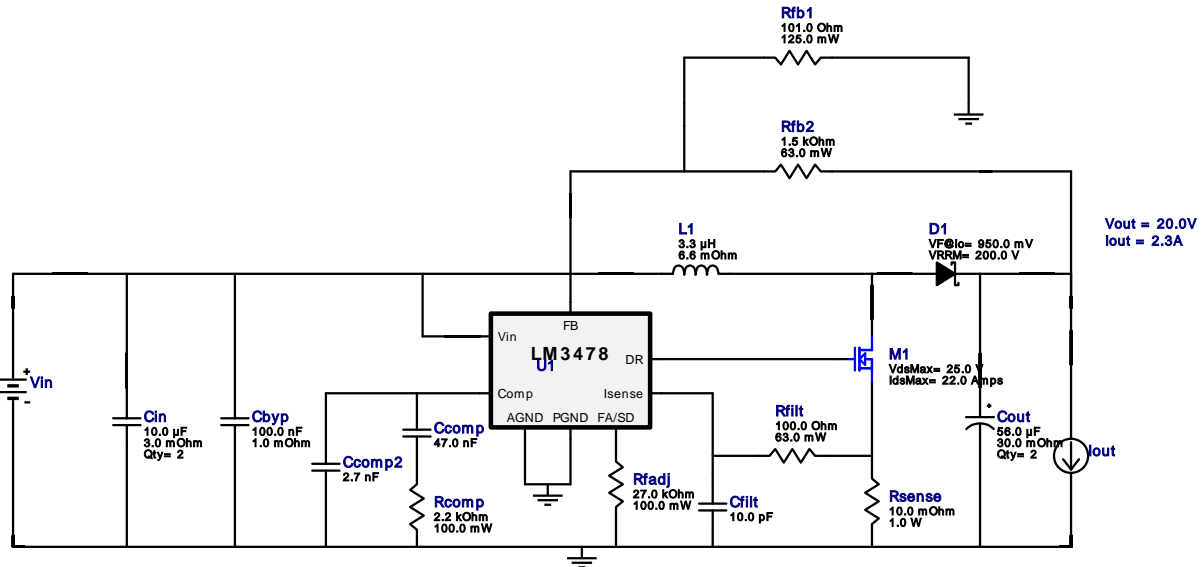


VinMin = 5.0V
 VinMax = 5.0V
 Vout = 20.0V
 Iout = 2.3A

Device = LM3478MM/NOPB
 Topology = Boost
 Created = 2021-10-18 06:07:45.775
 BOM Cost = NA
 BOM Count = 18
 Total Pd = 5.83W

WEBENCH® Design Report



Design : 2 LM3478MM/NOPB
 LM3478MM/NOPB 5V-5V to 20.00V @ 2.3A

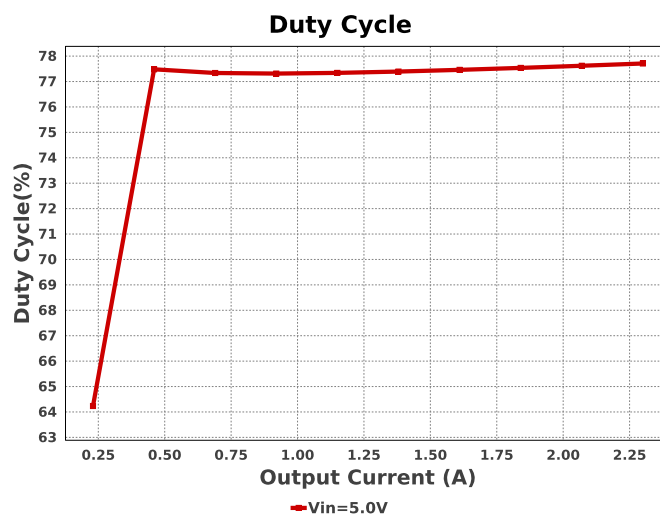
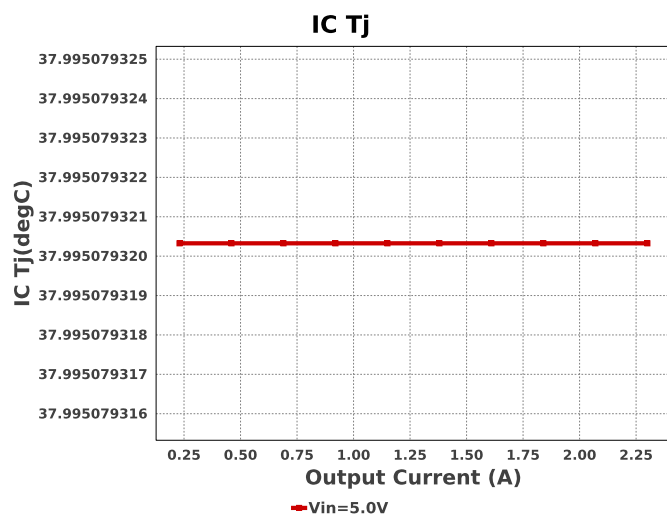


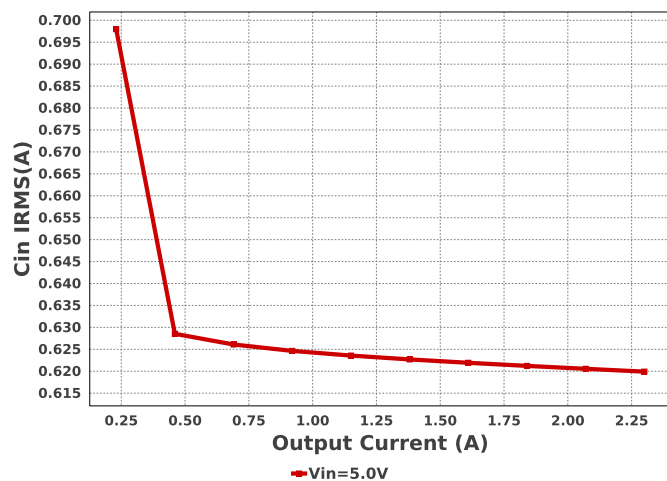
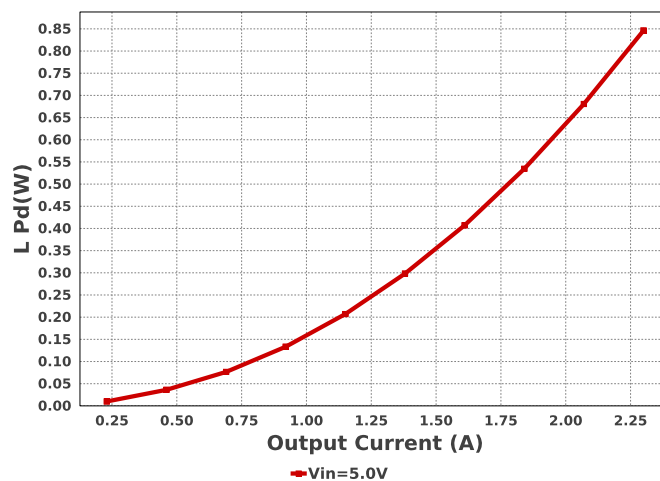
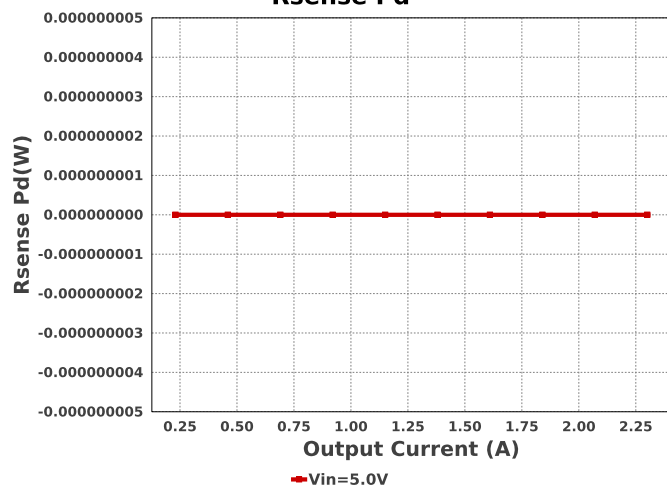
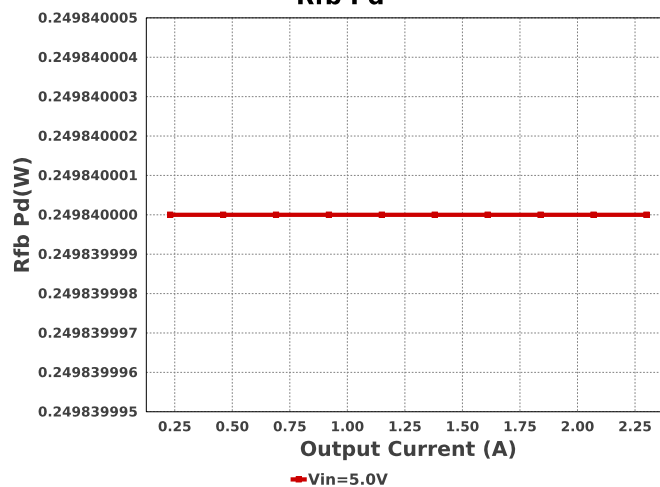
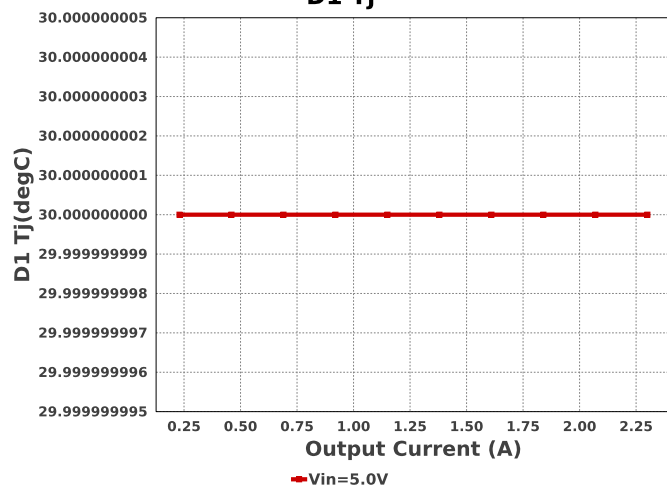
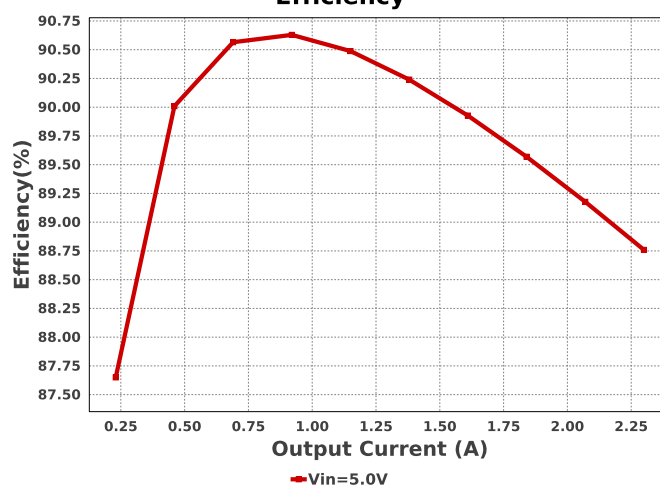
1. With the low turn of voltage of the LM34x8 your power supply may current limit before you reach your working input voltage. If this happens, or to preempt this from happening, you can include a low pass RC filter from input voltage to Vin on the IC. Make sure the rise time on the RC network is slower than your supply's rise time.

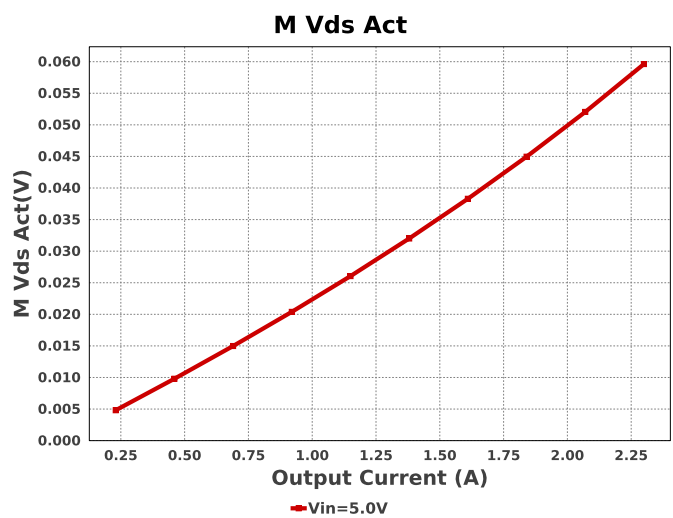
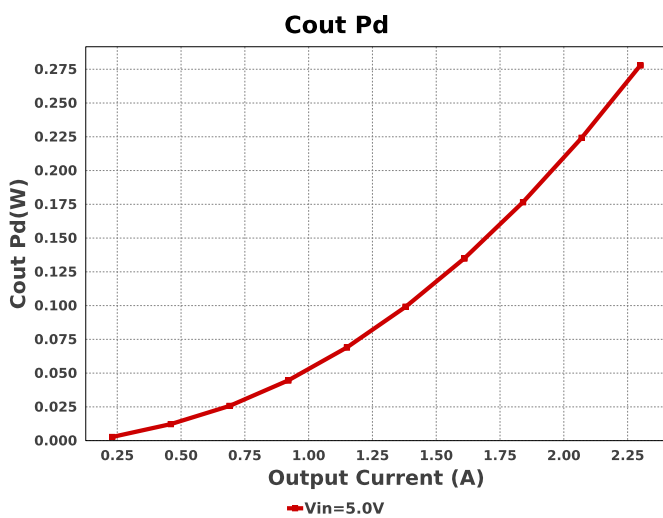
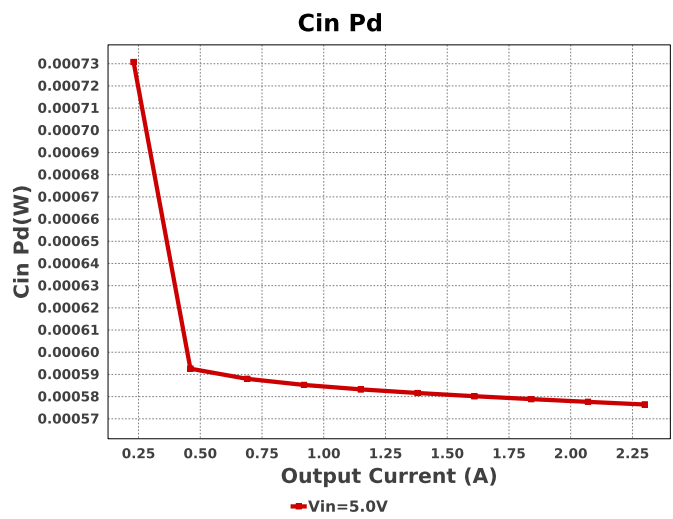
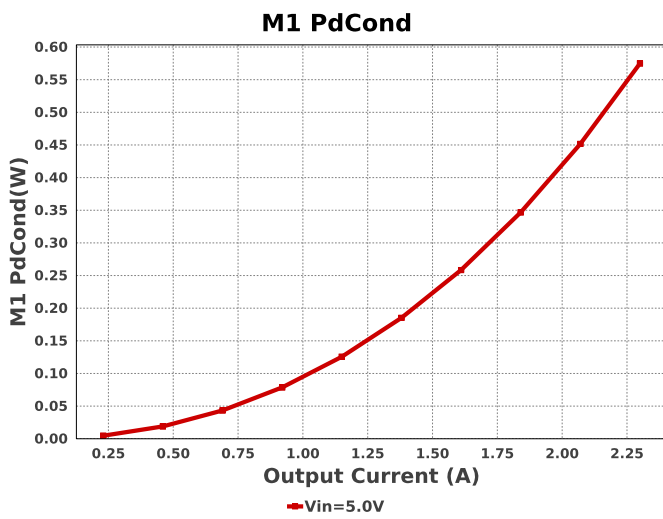
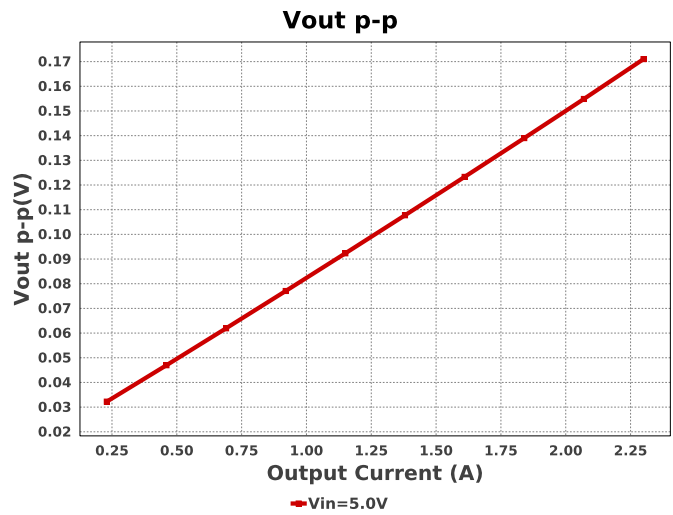
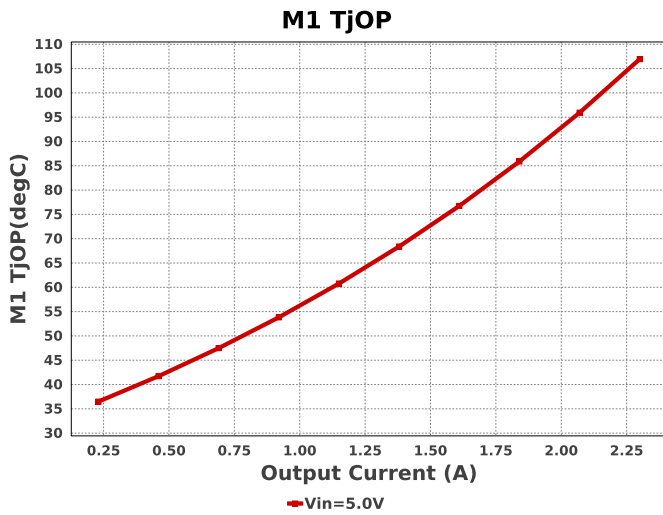
Electrical BOM

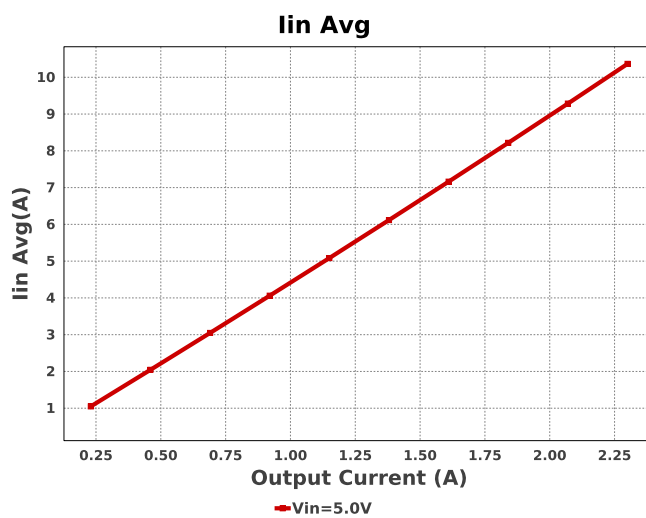
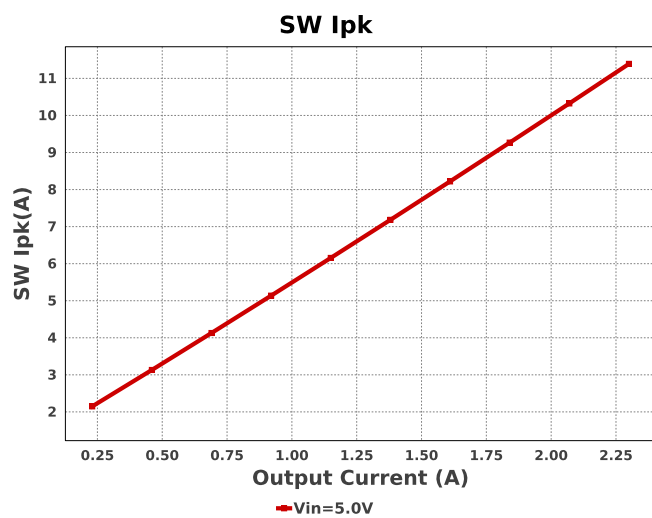
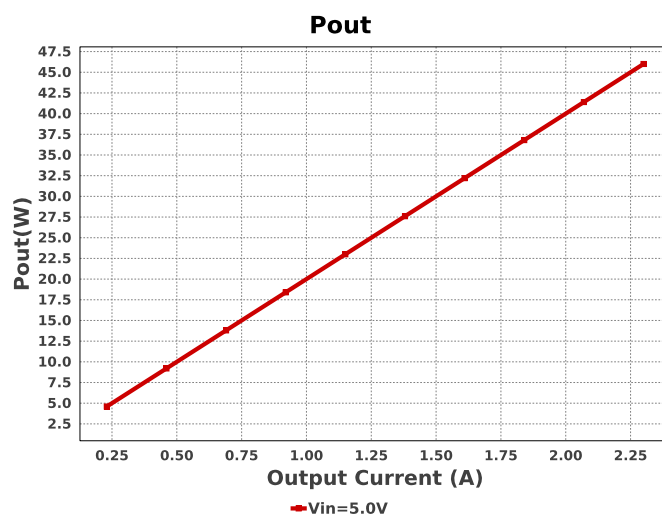
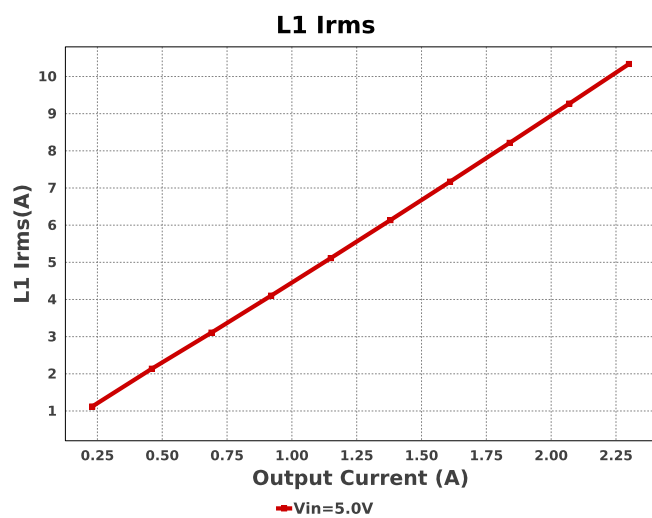
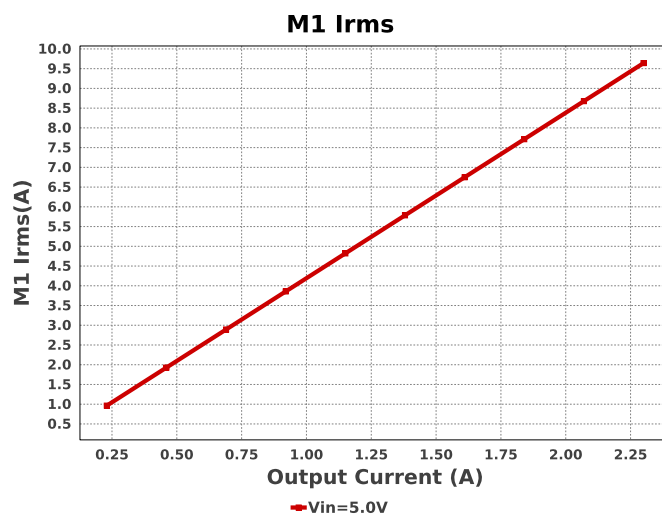
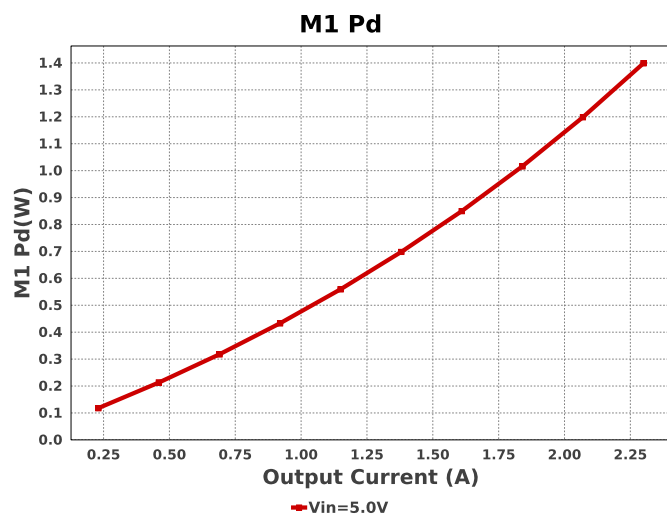
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cby	MuRata	GRM155R70J104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp	Kemet	C0805C473J3GACTU Series= C0G/NP0	Cap= 47.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.23	0805 7 mm ²
Ccomp2	TDK	C2012C0G1H272J060AA Series= C0G/NP0	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.03	0805 7 mm ²
Cfilt	Samsung Electro-Mechanics	CL21C100JBANNNC Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
Cin	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	2	\$0.03	0805 7 mm ²
Cout	Panasonic	25SVPF56M Series= SVPF	Cap= 56.0 uF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 2.8 A	2	\$0.44	CAPSMT_62_F61 74 mm ²
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	\$0.12	DPAK 102 mm ²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	Bourns	SRP1270-3R3M	L= 3.3 μ H 6.6 mOhm	1	\$0.72	 SRP1270 246 mm ²
M1	Texas Instruments	CSD16327Q3	VdsMax= 25.0 V IdsMax= 22.0 Amps	1	\$0.34	 DQG0008A 18 mm ²
Rcomp	Yageo	RC0603FR-072K2L Series= ?	Res= 2.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rfadj	Yageo	RC0603FR-0727KL Series= ?	Res= 27.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rfb1	Yageo	RT0805BRD07101RL Series= RT0805	Res= 101.0 Ohm Power= 125.0 mW Tolerance= 0.1%	1	NA	 0805 7 mm ²
Rfb2	Vishay-Dale	CRCW04021K50FKED Series= CRCW..e3	Res= 1.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfilt	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rsense	Susumu Co Ltd	PRL1632-R010-F-T1 Series= PRL1632	Res= 10.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.20	 0612 11 mm ²
U1	Texas Instruments	LM3478MM/NOPB	Switcher	1	\$0.88	 MUA08A 24 mm ²

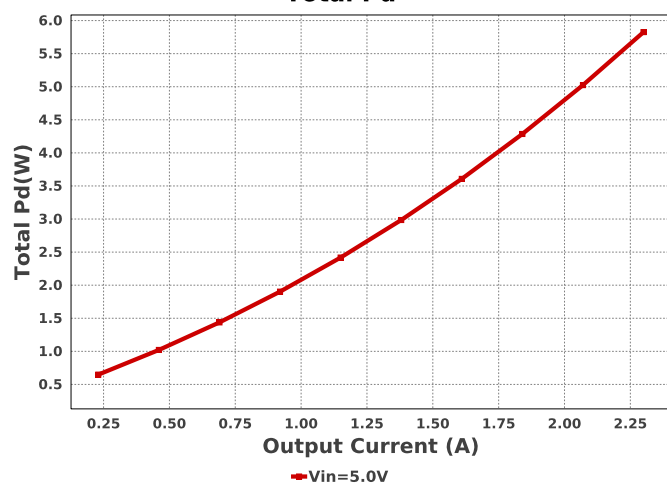


Cin IRMS**L Pd****Rsense Pd****Rfb Pd****D1 Tj****Efficiency**

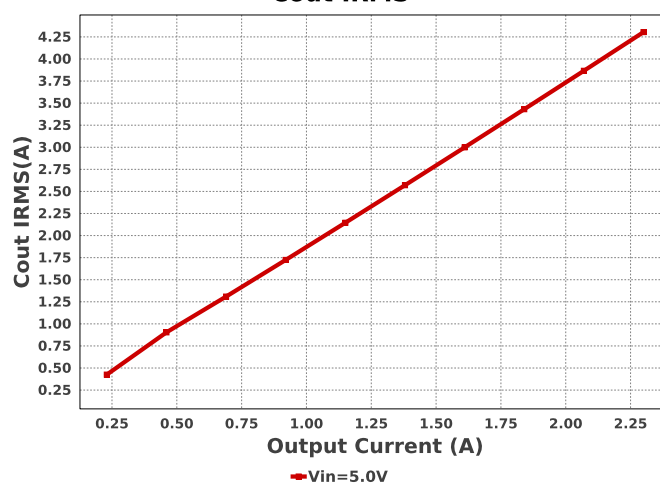




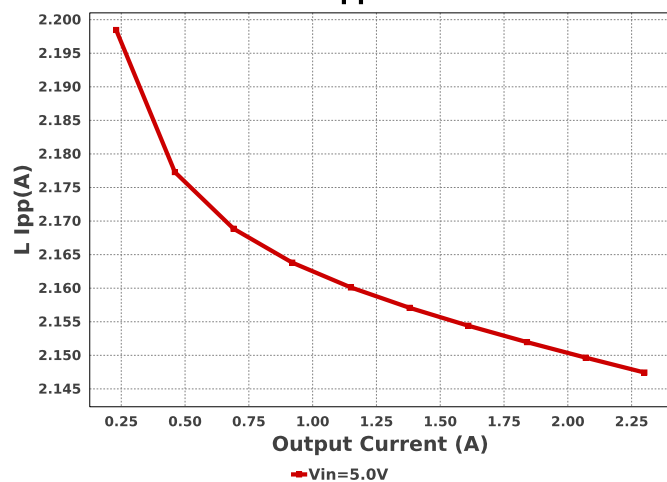
Total Pd



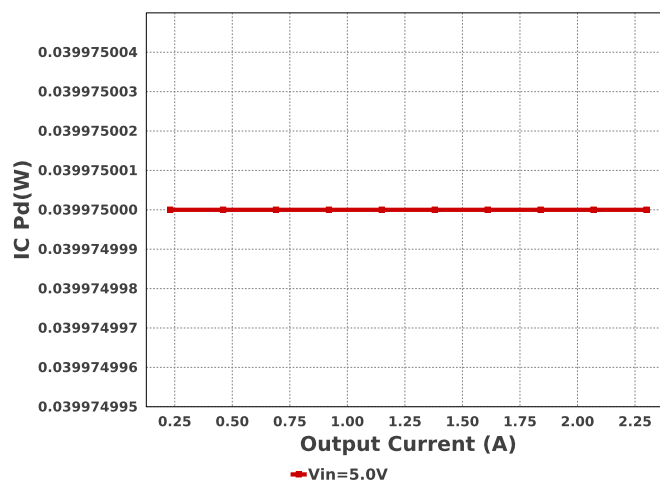
Cout IRMS



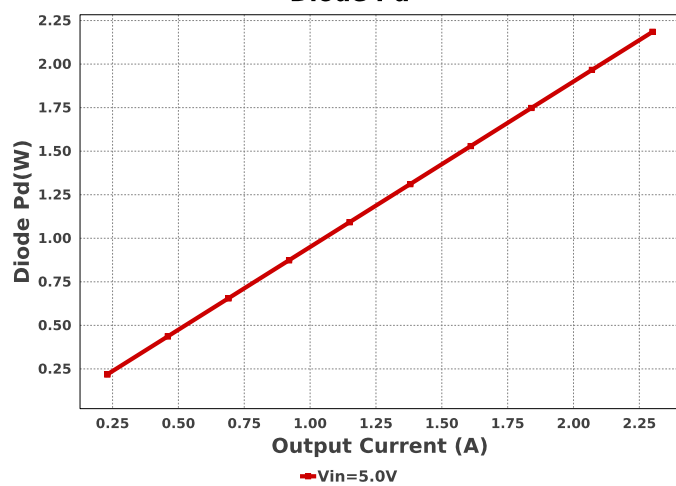
L Ipp



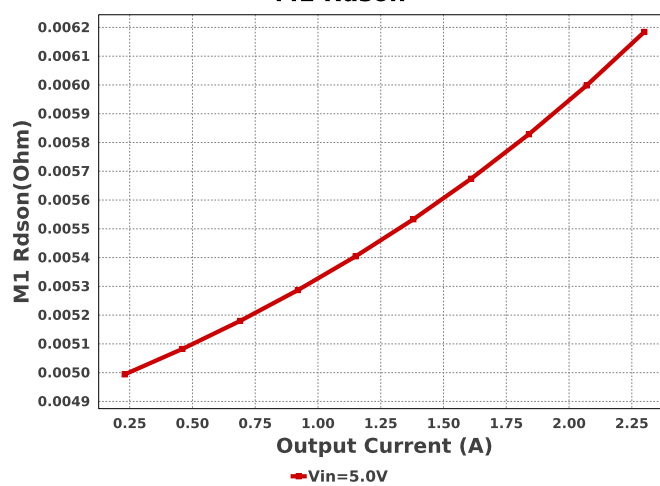
IC Pd



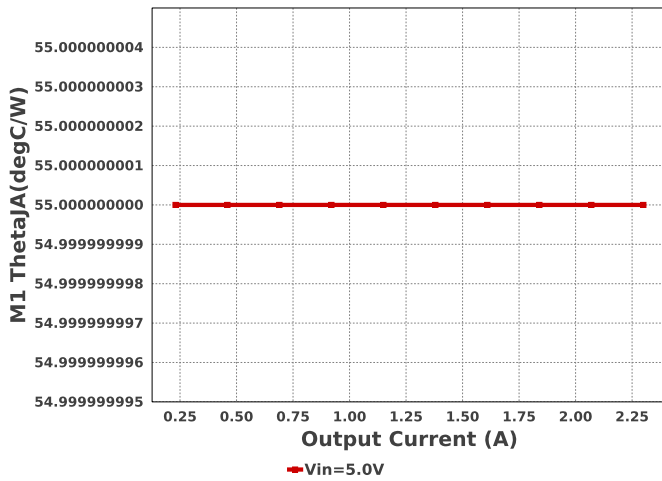
Diode Pd



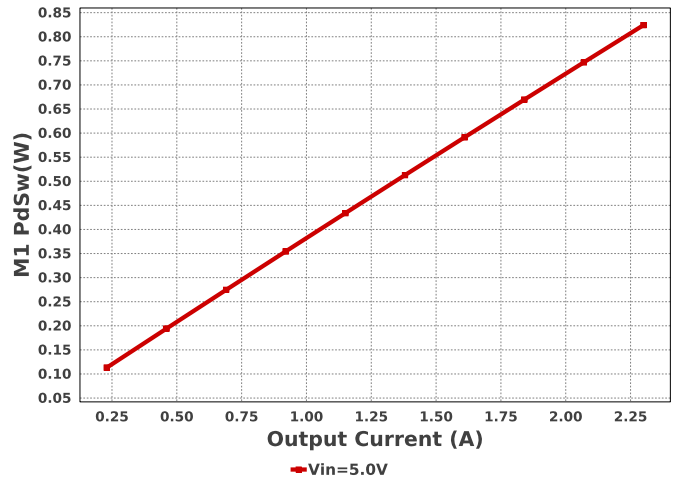
M1 Rdson



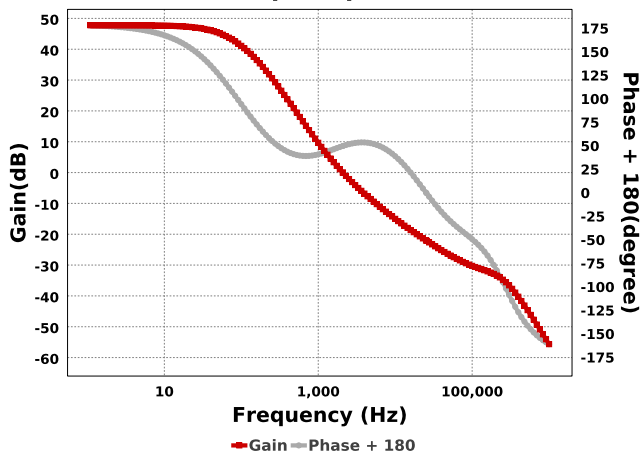
M1 ThetaJA



M1 PdSw



Loop Response



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	18		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	619.913 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	576.44 μ W	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	4.304 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	277.91 mW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	30.0 degC	Diode	D1 junction temperature
8.	Diode Pd	2.185 W	Diode	Diode power dissipation
9.	IC Pd	39.975 mW	IC	IC power dissipation
10.	IC Tj	37.995 degC	IC	IC junction temperature
11.	IC Tolerance	24.3 mV	IC	IC Feedback Tolerance
12.	ICThetaJA	200.0 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	10.365 A	IC	Average input current
14.	L Ipp	2.147 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	846.26 mW	Inductor	Inductor power dissipation
16.	L1 Irms	10.337 A	Inductor	Inductor ripple current
17.	M Vds Act	59.625 mV	Mosfet	M Vds
18.	M1 Irms	9.641 A	Mosfet	M1 MOSFET Irms
19.	M1 Pd	1.399 W	Mosfet	M1 MOSFET total power dissipation
20.	M1 PdCond	574.83 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 PdSw	824.18 mW	Mosfet	M1 MOSFET switching losses
22.	M1 Rdson	6.185 mOhm	Mosfet	Drain-Source On-resistance
23.	M1 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
24.	M1 TjOP	106.946 degC	Mosfet	M1 MOSFET junction temperature
25.	Cin Pd	576.44 μ W	Power	Input capacitor power dissipation
26.	Cout Pd	277.91 mW	Power	Output capacitor power dissipation
27.	Diode Pd	2.185 W	Power	Diode power dissipation
28.	IC Pd	39.975 mW	Power	IC power dissipation
29.	L Pd	846.26 mW	Power	Inductor power dissipation
30.	M1 Pd	1.399 W	Power	M1 MOSFET total power dissipation
31.	M1 PdCond	574.83 mW	Power	M1 MOSFET conduction losses
32.	M1 PdSw	824.18 mW	Power	M1 MOSFET switching losses

#	Name	Value	Category	Description
33.	Rfb Pd	249.84 mW	Power	Rfb Power Dissipation
34.	Rsense Pd	0.0 W	Power	LED Current Rsns Power Dissipation
35.	Total Pd	5.826 W	Power	Total Power Dissipation
36.	Rfb Pd	249.84 mW	Resistor	Rfb Power Dissipation
37.	Rsense Pd	0.0 W	Resistor	LED Current Rsns Power Dissipation
38.	Cross Freq	2.087 kHz	System	Bode plot crossover frequency
			Information	
39.	Duty Cycle	77.709 %	System	Duty cycle
			Information	
40.	Efficiency	88.759 %	System	Steady state efficiency
			Information	
41.	FootPrint	608.0 mm ²	System	Total Foot Print Area of BOM components
			Information	
42.	Frequency	536.973 kHz	System	Switching frequency
			Information	
43.	Gain Marg	-22.138 dB	System	Bode Plot Gain Margin
			Information	
44.	Iout	2.3 A	System	Iout operating point
			Information	
45.	Low Freq Gain	47.754 dB	System	Gain at 1Hz
			Information	
46.	Mode	CCM	System	Conduction Mode
			Information	
47.	Phase Marg	50.309 deg	System	Bode Plot Phase Margin
			Information	
48.	Pout	46.0 W	System	Total output power
			Information	
49.	SW Ipk	11.392 A	System	Peak switch current
			Information	
50.	Vin	5.0 V	System	Vin operating point
			Information	
51.	Vout	20.0 V	System	Operational Output Voltage
			Information	
52.	Vout Actual	19.973 V	System	Vout Actual calculated based on selected voltage divider resistors
			Information	
53.	Vout Tolerance	2.98 %	System	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
			Information	
54.	Vout p-p	171.018 mV	System	Peak-to-peak output ripple voltage
			Information	

Design Inputs

Name	Value	Description
Iout	2.3	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	20.0	Output Voltage
base_pn	LM3478	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	542.0 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 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

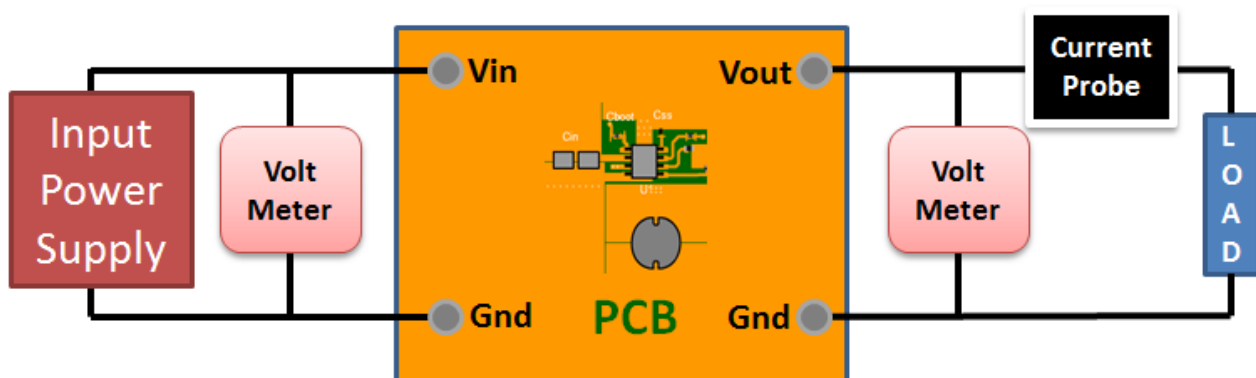
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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.

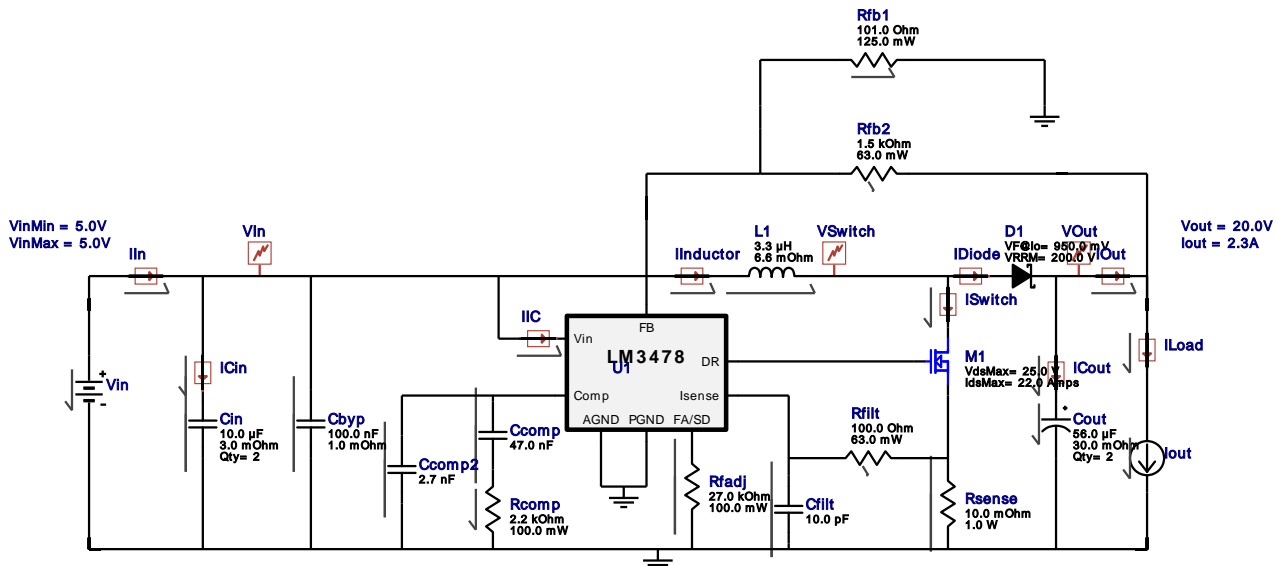


WEBENCH® Electrical Simulation Report

Design Id = 2

sim_id = 9

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Iout	I	Load Current	2.3 A

Design Assistance

1. Master key : F1D7F473A21C75E1[v1]

2. **LM3478** Product Folder : <http://www.ti.com/product/LM3478> : contains the data sheet and other resources.

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