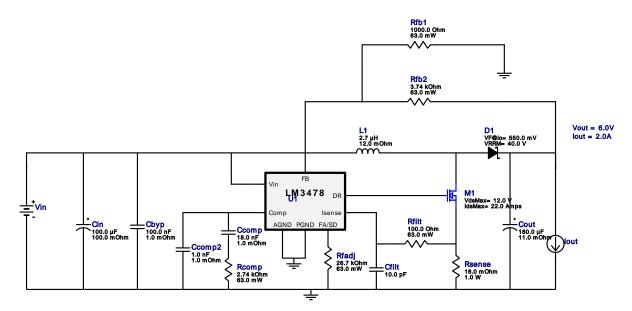
$\begin{aligned} & \text{VinMin} = 3.5 \text{V} \\ & \text{VinMax} = 4.2 \text{V} \\ & \text{Vout} = 6.0 \text{V} \\ & \text{Iout} = 2.0 \text{A} \end{aligned}$

Device = LM3478MM/NOPB Topology = Boost Created = 2022-08-25 10:07:59.511 BOM Cost = \$2.75 BOM Count = 16 Total Pd = 1.51W

WEBENCH® Design Report

Design: 4 LM3478MM/NOPB LM3478MM/NOPB 3.5V-4.2V to 6.00V @ 2A

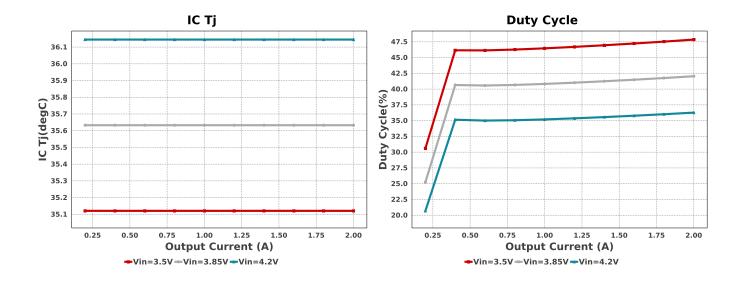


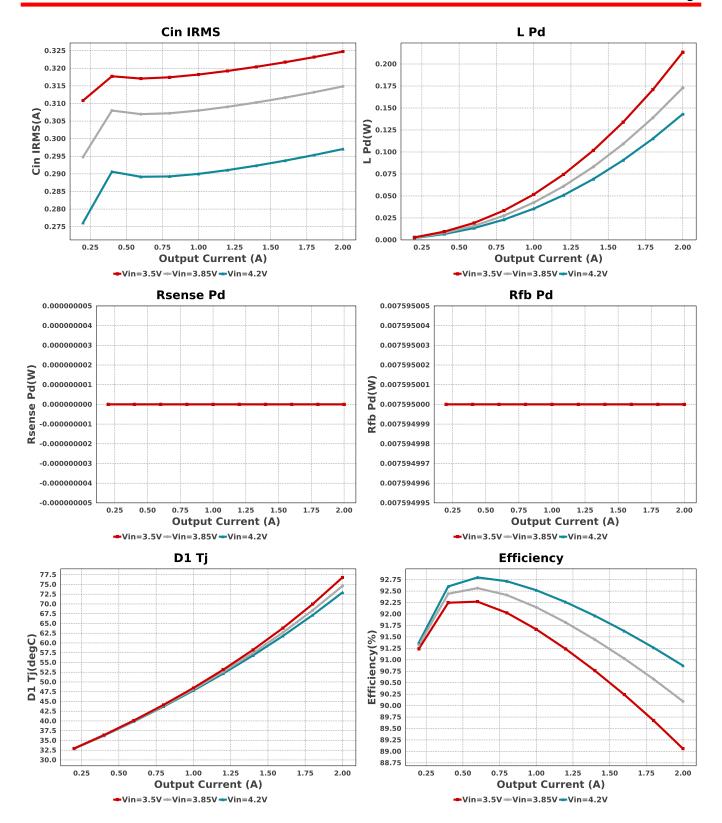
1. With the low turn of voltage of the LM34x8 your power supply may current limit before you reach your working input voltage. If this happens, or to preempt this from happening, you can include a low pass RC filter from input voltage to Vin on the IC. Make sure the rise time on the RC network is slower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

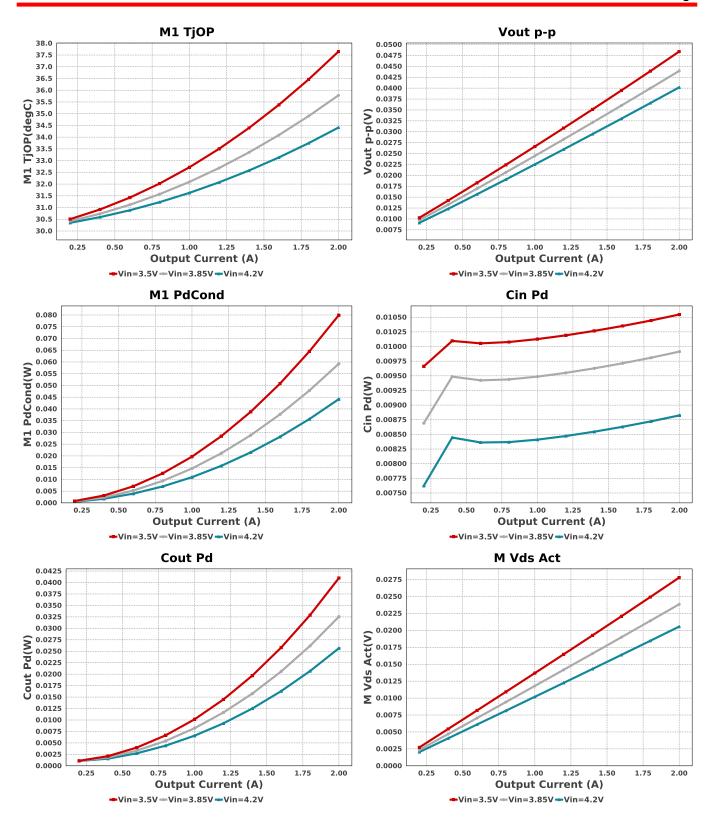
Electrical BOM

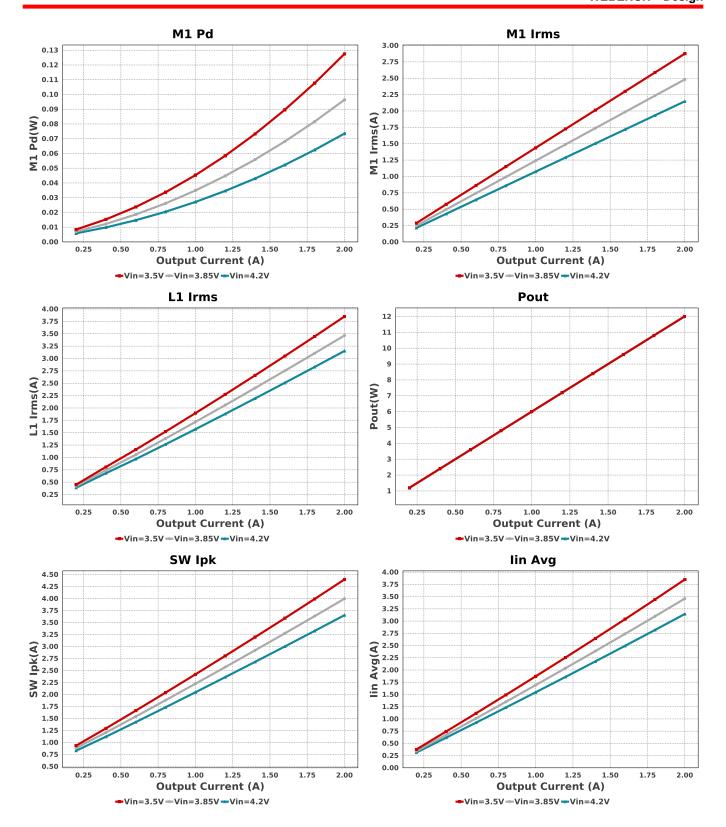
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbyp	MuRata	GRM155R70J104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp	MuRata	GRM155R71C183KA01D Series= X7R	Cap= 18.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp2	Yageo	CC0805KRX7R9BB102 Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 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	Panasonic	6TPH100MAEA Series= TPH	Cap= 100.0 uF ESR= 100.0 mOhm VDC= 6.3 V IRMS= 670.0 mA	1	\$0.32	CAPSMT_6_A09 11 mm²
Cout	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	1	\$0.50	CAPSMT_62_C10 74 mm ²
D1	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	\$0.17	SMC 83 mm ²

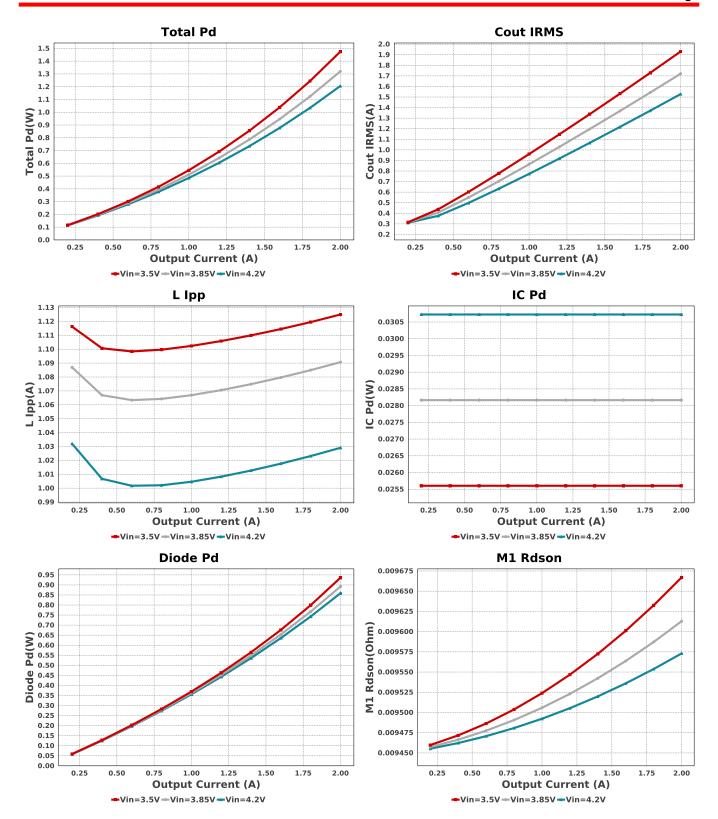
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	NIC Components	NPI31P2R7MTRF	L= 2.7 μH 12.0 mOhm	1	\$0.29	
						IND_NPI31P 185 mm²
M1	Texas Instruments	CSD13202Q2	VdsMax= 12.0 V IdsMax= 22.0 Amps	1	\$0.13	DQK0006C 9 mm ²
Rcomp	Vishay-Dale	CRCW04022K74FKED Series= CRCWe3	Res= 2.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfadj	Vishay-Dale	CRCW040226K7FKED Series= CRCWe3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCWe3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfb2	Vishay-Dale	CRCW04023K74FKED Series= CRCWe3	Res= 3.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rfilt	Vishay-Dale	CRCW0402100RFKED Series= CRCWe3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
Rsense	Susumu Co Ltd	PRL1632-R016-F-T1 Series= PRL1632	Res= 16.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.20	0612 11 mm ²
U1	Texas Instruments	LM3478MM/NOPB	Switcher	1	\$1.05	MUA08A 24 mm ²

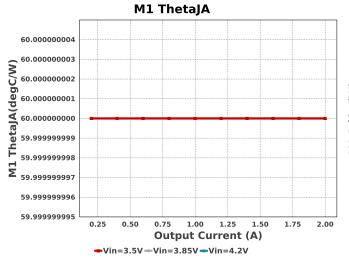


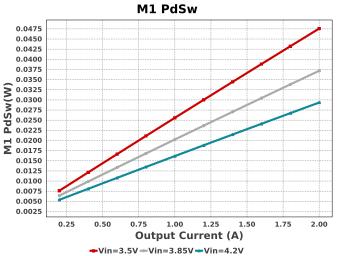


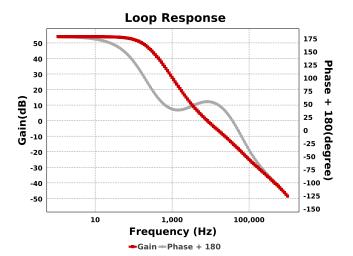












Operating Values

	3			
#	Name	Value	Category	Description
1.	Cin IRMS	325.704 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	10.608 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.936 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	41.214 mW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	85.0 degC	Diode	D1 junction temperature
6.	Diode Pd	1.1 W	Diode	Diode power dissipation
7.	IC Pd	25.781 mW	IC	IC power dissipation
8.	IC Tj	35.156 degC	IC	IC junction temperature
9.	IC Tolerance	24.3 mV	IC	IC Feedback Tolerance
10.	ICThetaJA	200.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	lin Avg	3.861 A	IC	Average input current
12.	L lpp	1.128 A	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	214.51 mW	Inductor	Inductor power dissipation
14.	L1 Irms	3.86 A	Inductor	Inductor ripple current
15.	M Vds Act	27.794 mV	Mosfet	M Vds
16.	M1 Irms	2.875 A	Mosfet	M1 MOSFET Irms
17.	M1 Pd	128.21 mW	Mosfet	M1 MOSFET total power dissipation
18.	M1 PdCond	79.902 mW	Mosfet	M1 MOSFET conduction losses
19.	M1 PdSw	48.308 mW	Mosfet	M1 MOSFET switching losses
20.	M1 Rdson	9.668 mOhm	Mosfet	Drain-Source On-resistance
21.	M1 ThetaJA	60.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
22.	M1 TjOP	37.693 degC	Mosfet	M1 MOSFET junction temperature
23.	Cin Pd	10.608 mW	Power	Input capacitor power dissipation
24.	Cout Pd	41.214 mW	Power	Output capacitor power dissipation
25.	Diode Pd	1.1 W	Power	Diode power dissipation
26.	IC Pd	25.781 mW	Power	IC power dissipation
27.	L Pd	214.51 mW	Power	Inductor power dissipation
28.	M1 Pd	128.21 mW	Power	M1 MOSFET total power dissipation
29.	M1 PdCond	79.902 mW	Power	M1 MOSFET conduction losses
30.	M1 PdSw	48.308 mW	Power	M1 MOSFET switching losses
31.	Rfb Pd	7.595 mW	Power	Rfb Power Dissipation
32.	Rsense Pd	188.08 mW	Power	LED Current Rsns Power Dissipation

# Name Value Category Description 33. Total Pd 1.513 W Power Total Power Dissipation 34. Rfb Pd 7.595 mW Resistor Rfb Power Dissipation 35. Resnes Pd 188.08 mW Resistor Rfb Power Dissipation 36. BOM Count 16 System Information 37. Cross Freq 6.927 kHz System Information 38. Duty Cycle 47.995 % System Information 39. Efficiency 88.802 % System Information 40. FootPrint 431.0 mm² System Information 41. Frequency 541.734 kHz System Information 42. Gain Marg -16.683 dB System Information 43. lout 2.0 A System Information 44. Low Freq Gain 52.246 dB System Information 45. Mode CCM System Information 46. Phase Marg 52.899 deg System Information 47. Pout 12.0 W System Information 48. SW lpk 4.41 A System Information 49. Total BOM \$2.75 System Information 50. Vin 3.5 V System Information 51. Vout 6.0 V System Information 52. Vout Actual 5.972 V System Information 53. Vout Tolerance 3.553 % System Information 54. Vout p-p 48.525 mV System Information 55. Vout Tolerance 3.553 % System Information 57. Vout Tolerance 3.553 % System Information Information 58. Vout Tolerance 3.553 W System Information 59. Vout P-p 48.525 mV System Information System Information 50. Vout Tolerance 3.553 % System Information Information 50. Vout Tolerance 3.553 % System Information Information 50. Vout Tolerance 3.553 % System Information 50. Vout Tolerance 3.553 % System Information Information 50. Vout Tolerance 3.553 % System Information Information 50. Vout Tolerance 3.553 % System Information Information Information 50. Vout Tolerance 3.553 % System Information Infor					
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38.Duty Cycle47.995 %System Information SystemDuty cycle39.Efficiency88.802 %System Information System InformationSteady state efficiency40.FootPrint431.0 mm²System Information InformationSystem Information System InformationSwitching frequency41.Frequency541.734 kHzSystem Information System InformationSwitching frequency42.Gain Marg-16.683 dBSystem Information System InformationBode Plot Gain Margin43.Iout2.0 ASystem Information Information44.Low Freq Gain52.246 dBSystem Information45.ModeCCMSystem Information Information46.Phase Marg52.899 degSystem Information47.Pout12.0 WSystem Information Information48.SW lpk4.41 ASystem Information49.Total BOM\$2.75System Information System Information50.Vin3.5 VSystem Information System Information51.Vout Actual5.972 VSystem Information System Information52.Vout Actual5.972 VSystem Information System Information Information System Information System Information InformationVout Actual calculated based on IC Tolerance (no load) and voltage divider resistors if applicable resistors in the prope	37.	Cross Freq	6.927 kHz	System	Bode plot crossover frequency
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40.FootPrint431.0 mm²System Information InformationTotal Foot Print Area of BOM components41.Frequency541.734 kHzSystem InformationSwitching frequency42.Gain Marg-16.683 dBSystem InformationBode Plot Gain Margin43.lout2.0 ASystem InformationIout operating point44.Low Freq Gain52.246 dBSystem InformationGain at 1Hz45.ModeCCMSystem System InformationConduction Mode Information46.Phase Marg52.899 degSystem InformationBode Plot Phase Margin47.Pout12.0 WSystem InformationTotal output power48.SW lpk4.41 ASystem InformationPeak switch current Information49.Total BOM\$2.75System Information InformationVin operating point50.Vin3.5 VSystem Information InformationVin operating point51.Vout Actual5.972 VSystem Information InformationVout Actual calculated based on selected voltage divider resistors Information Information53.Vout Tolerance3.553 %System Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable Peak-to-peak output ripple voltage	39.	Efficiency	88.802 %	System	Steady state efficiency
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49.Total BOM\$2.75System InformationTotal BOM Cost50.Vin3.5 VSystem InformationVin operating point51.Vout6.0 VSystem InformationOperational Output Voltage52.Vout Actual5.972 VSystem InformationVout Actual calculated based on selected voltage divider resistors53.Vout Tolerance3.553 %System InformationVout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable54.Vout p-p48.525 mVSystemPeak-to-peak output ripple voltage	48.	SW lpk	4.41 A	System	Peak switch current
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50.Vin3.5 VSystem InformationVin operating point51.Vout6.0 VSystem InformationOperational Output Voltage52.Vout Actual5.972 VSystem Vout Actual calculated based on selected voltage divider resistors53.Vout Tolerance3.553 %System Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable54.Vout p-p48.525 mVSystem Peak-to-peak output ripple voltage	49.	Total BOM	\$2.75	System	Total BOM Cost
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53. Vout Tolerance 3.553 % System Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable 54. Vout p-p 48.525 mV System Peak-to-peak output ripple voltage	52.	Vout Actual	5.972 V	System	Vout Actual calculated based on selected voltage divider resistors
Information resistors if applicable 54. Vout p-p 48.525 mV System Peak-to-peak output ripple voltage				Information	
54. Vout p-p 48.525 mV System Peak-to-peak output ripple voltage	53.	Vout Tolerance	3.553 %	,	
-7				Information	
Information	54.	Vout p-p	48.525 mV	System	Peak-to-peak output ripple voltage
				Information	

Design Inputs

Name	Value	Description	
lout	2.0	Maximum Output Current	
VinMax	4.2	Maximum input voltage	
VinMin	3.5	Minimum input voltage	
Vout	6.0	Output Voltage	
base_pn	LM3478	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 3.5V 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 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.

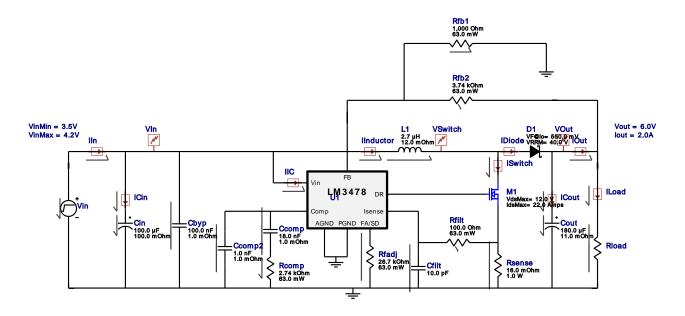


WEBENCH[®] Electrical Simulation Report

Design Id = 4

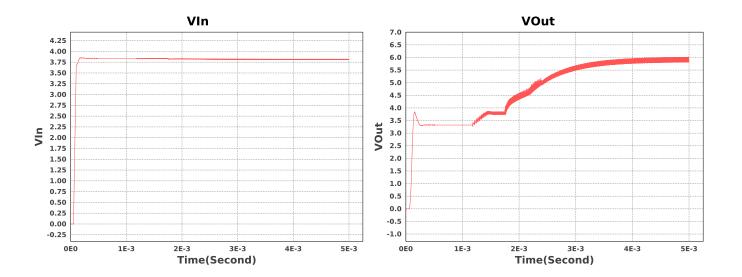
sim_id = 1

Simulation Type = Startup



Simulation Parameters

# Name	Parameter Name	Description	Values
1. Rload		Load Resistance	3.0 Ohm



Design Assistance

- 1. Master key: 9852E6C16827247CB7E100346849B713[v1]
- 2. LM3478 Product Folder: http://www.ti.com/product/LM3478: contains the data sheet and other resources.

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