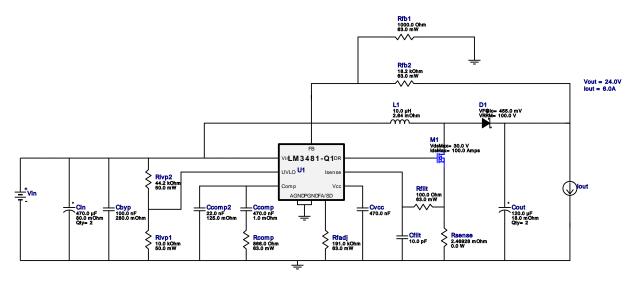


WEBENCH[®] Design Report

VinMin = 8.0V VinMax = 16.0V Vout = 24.0V Iout = 6.0A Device = LM3481QMM/NOPB Topology = Boost Created = 2024-08-21 20:30:52.066 BOM Cost = NA BOM Count = 21 Total Pd = 5.27W

Design : 86 LM3481QMM/NOPB LM3481QMM/NOPB 8V-16V to 24.00V @ 6A



Design Alerts

Component Selection Information

The LM3481-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

Electrical BOM

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Сbур	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 mm ²
Ccomp	Taiyo Yuden	TMK212BJ474KD-T Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 20.0 V IRMS= 0.0 A	1	\$0.02	0805 7 mm ²
Ccomp2	Kemet	C0805C223K5RACTU Series= X7R	Cap= 22.0 nF ESR= 125.0 mOhm VDC= 50.0 V IRMS= 645.0 mA	1	\$0.01	0805 7 mm²
Cfilt	Yageo	CC0805JRNPO9BN100 Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
Cin	Chemi-Con	EMZA250ADA471MJA0G Series= MZA	Cap= 470.0 uF ESR= 80.0 mOhm VDC= 25.0 V IRMS= 850.0 mA	2	\$0.45	CAPSMT_62_JA0 151 mm ²
Cout	Panasonic	35SVPF120M Series= SVPF	Cap= 120.0 uF ESR= 18.0 mOhm VDC= 35.0 V IRMS= 4.4 A	2	\$1.33	CAPSMT_62_F12 151 mm ²

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WEBENCH[®] Design

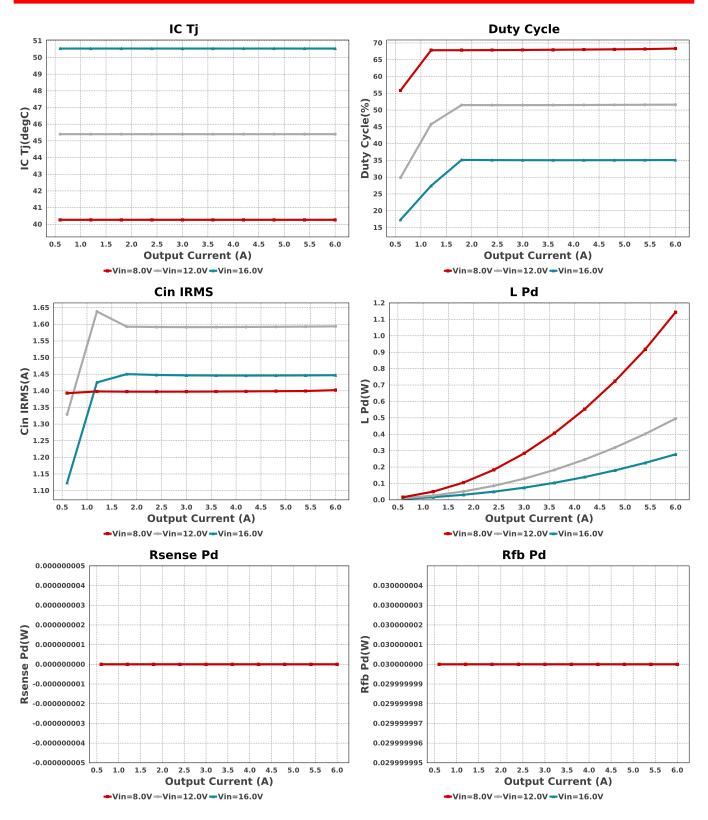
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvcc	Panasonic	ECPU1C474MA5 Series= ECPU(A)	Cap= 470.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.27	1206 11 mm ²
D1	STMicroelectronics	STPS20M100SG-TR	VF@lo= 455.0 mV VRRM= 100.0 V	1	\$1.94	DDPAK 210 mm ²
_1	Wurth Elektronik	7443641000	L= 10.0 μH 2.64 mOhm	1	\$7.28	
W1	Texas Instruments	CSD17303Q5	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	\$0.56	WE-HCF_2818 656 mm ² TRANS_NexFET_Q5 55 mm ²
Rcomp	Vishay-Dale	CRCW0402866RFKED Series= CRCWe3	Res= 866.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	■ 0402 3 mm ²
Rfadj	Vishay-Dale	CRCW0402191KFKED Series= CRCWe3	Res= 191.0 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	CRCW040218K2FKED Series= CRCWe3	Res= 18.2 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
Rivp1	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	• 0201 2 mm ²
Rivp2	Vishay-Dale	CRCW020144K2FNED Series= ?	Res= 44.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	\$0.01	• 0201 2 mm ²
Rsense	CUSTOM	CUSTOM Series= ?	Res= 2.46928 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
J1	Texas Instruments	LM3481QMM/NOPB	Switcher	1	\$0.83	

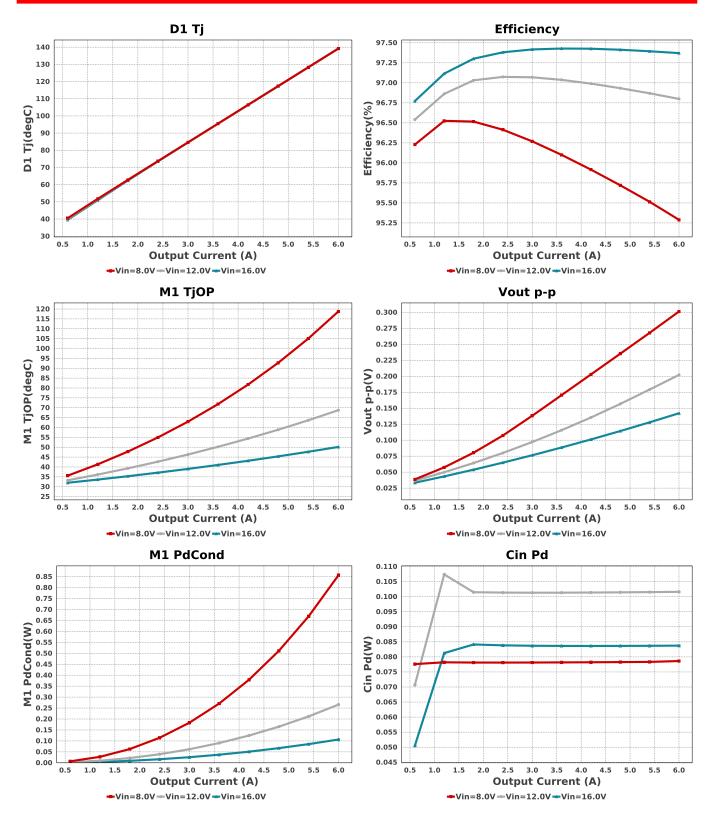
MUB10A 24 mm²

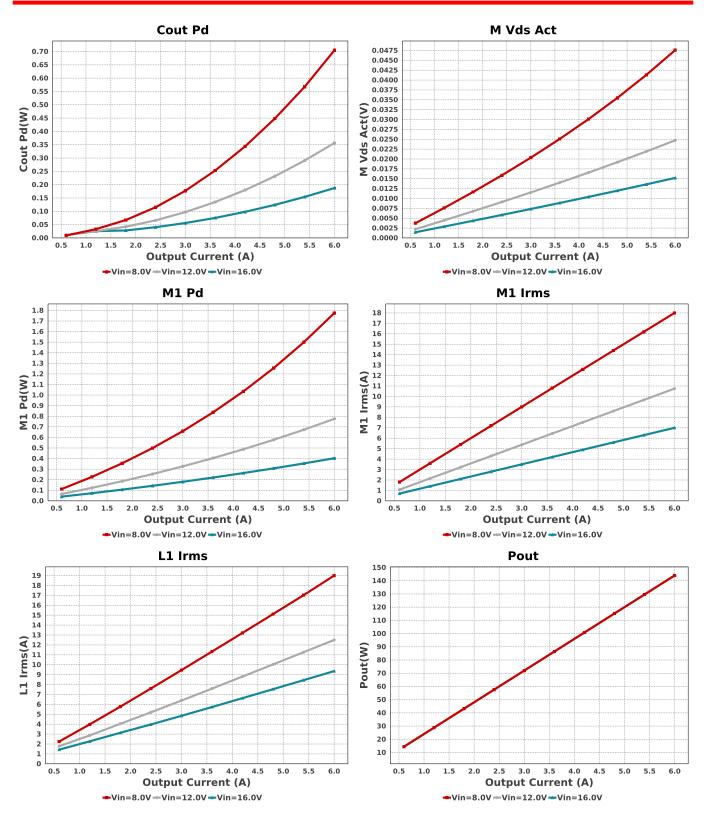
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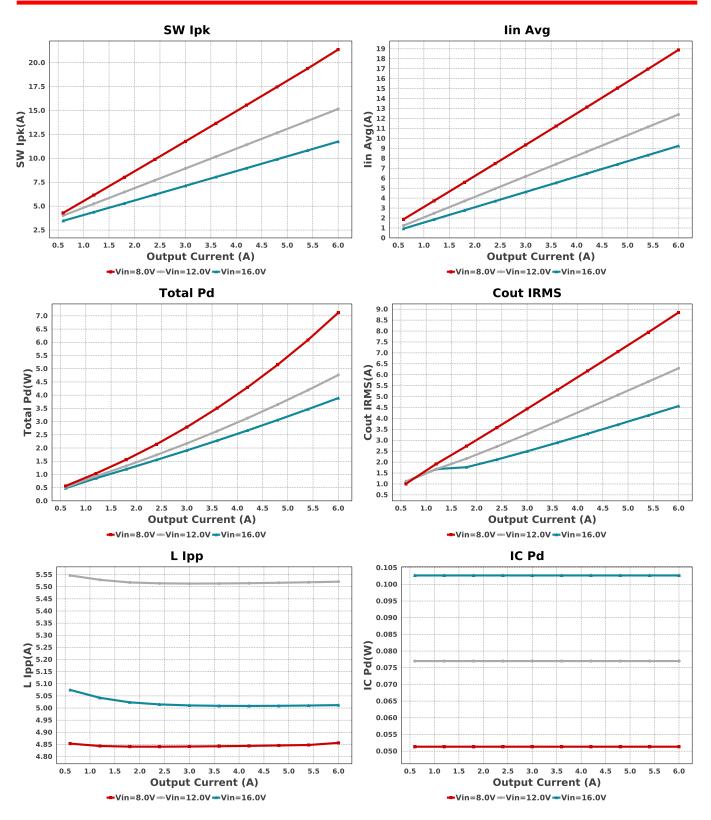
2

WEBENCH[®] Design Report LM3481QMM/NOPB : LM3481QMM/NOPB 8V-16V to 24.00V @ 6A August 21, 2024 20:34:09 GMT-05:00

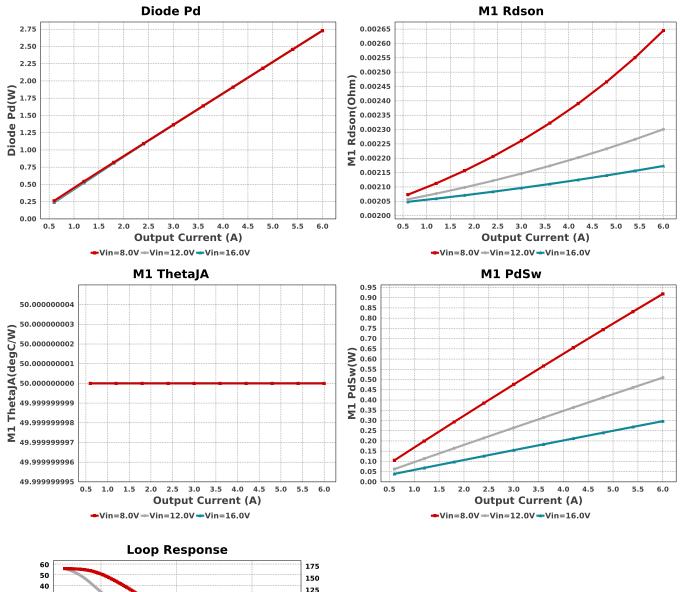


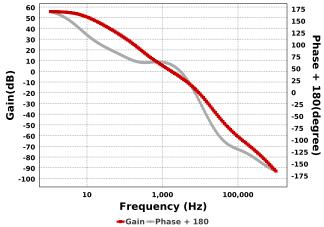






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Operating Values

	5			
#	Name	Value	Category	Description
1.	Cin IRMS	1.392 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	77.546 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	8.754 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	689.68 mW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	139.2 degC	Diode	D1 junction temperature
6.	Diode Pd	2.73 W	Diode	Diode power dissipation
7.	IC Pd	51.008 mW	IC	IC power dissipation
8.	IC Tj	40.202 degC	IC	IC junction temperature
9.	IC Tolerance	19.0 mV	IC	IC Feedback Tolerance
10.	ICThetaJA	200.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	lin Avg	18.659 A	IC	Average input current

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12. Lipp 4.823 A Inductor Peak-to-peak inductor pipe current 13. LiPd 1.11 W Inductor Inductor pipe current 14. Li Ims 18.72 A Inductor Inductor pipe current 15. M Vás Act 47.48 mV Mosfet M I MOSFET Ims 16. M I Tab 1.757 W Mosfet M I MOSFET Ims 17. M Pai 1.757 W Mosfet M I MOSFET Ims 18. M TobCond 854.49 mV Mosfet M I MOSFET Ims 18. M TobCond 854.49 mV Mosfet M I MOSFET Ims 19. M Table 0.00 deg/CW Mosfet M I MOSFET Inducton temperature 21. M TiPoP 17.48 deg/C Mosfet M I MOSFET Inducton temperature 22. Con Pd 77.546 mW Power Input capacitor power dissipation 23. Con Pd 51.006 mW Power Input capacitor power dissipation 24. Cou Pd 17.57 W Power Inductor power dissipation 25. Dicke Pd 1.77 W Power Inductor power dissipation 26. IPd 1.75 W Power Inductor power dissipation 27. LPd 1.71 W <	#	Name	Value	Category	Description
14. L1 Imms 18.72 A Inductor Inductor inple current 15. M V4s Act 47.485 mV Mosfet M V4s 16. M I Imms 17.77 W Mosfet MI MOSFET Imms Mi MOSFET Imms 18. M PGCond 854.46 mW Mosfet MI MOSFET Imms Mi MOSFET India power dissipation 18. M Rdson 2.639 mOhm Mosfet MI MOSFET India power dissipation 20. M TheLAJA 5.0 degCW Mosfet MI MOSFET India power dissipation 21. M TheLAJA 6.0 degCW Mosfet MI MOSFET India power dissipation 22. MI TOP 17.76 de mW Power Duck power dissipation 23. Cin Pd 27.74 mW Power Duck power dissipation 24. Coarl Pd 27.3 W Power Duck power dissipation 25. Duck Pd 27.3 W Power Duck power dissipation 26. Draf 7.746 mW Power Duck power dissipation 27. Draf 7.757 W Power Mi MOSFET conductor losses 28. M Pd 1.177 W Power Mi MOSFET conductor losses 29. M Pd 3.0 mW Power Total power Dissipation				Inductor	
15. M Vids Act 47.465 mV Mosfet M Vids 16. M I Imm 17.394 A Mosfet M I MOSFET Imms 17. M PdCond 85.46 mW Mosfet MI MOSFET Imms 19. M PdSw 902.8 mW Mosfet MI MOSFET imms 19. M PdSw 902.8 mW Mosfet MI MOSFET immit losses 21. M Thotay 50.0 degCW Mosfet MI MOSFET imcion-to-mabient thermal resistance 22. M TiOP 17.86 degC Mosfet MI MOSFET imcion-to-mabient thermal resistance 23. Cin Pd 77.546 mW Power Inucto approximation 24. Coul Pd 689.68 mW Power Inucto approximation 25. Dicke Pd 2.73 W Power Inductor power dissipation 26. C Pd 51.008 mW Power Inductor power dissipation 27. L Pd 1.11 W Power Inductor power dissipation 28. MI PdCond 864.46 mW Power MI MOSFET total power dissipation 29. MI PdCond 864.46 mW Power MI MOSFET total power dissipation 20. MI PdCond 864.46 mW Power MI MOSFET total power dissipation 21.					
16. Mi Imms 17.994 A Mosfet MI MOSFET Imms 17. MI P4 Cond 854.46 mW Mosfet MI MOSFET Conduction losses 18. MI P4Cond 854.46 mW Mosfet MI MOSFET Function losses 20. MI Rdson 2.639 mOhm Mosfet Diministry Structure losses 21. MI TheIAIA 50.0 degCW Mosfet Diministry Structure losses 22. MI TOP 117.66 degC Mosfet MI MOSFET iuncton-to-ambient termaral resistance 22. MI TOP 117.86 degC Mosfet MI MOSFET iuncton-to-ambient termaral resistance 23. Cin P4 7.346 mW Power Outer power dissipation 24. Court P4 51.008 mW Power Outer power dissipation 25. Dide P4 2.73 W Power Inducts power dissipation 26. IC P4 11.07 W Power Inducts power dissipation 27. LPd 11.07 W Power Inducts power dissipation 28. MI P4Cond 854.46 mW Power Inducts power dissipation 29. MI P4W 30.0 mW Power Total Power Dissipation 31. Rth Pd 30.0 mW Power Total Power Dissipation					
17. Mi Pid 1.757 W Mosfet Mi MOSFET total power dissipation 19. Mi PidSw 902.8 mW Mosfet Mi MOSFET switching losses 19. Mi PidSw 20.3 mOkm Mosfet Mi MOSFET switching losses 21. Mi ThotsJA 50.0 degCW Mosfet MOSFET switching losses 22. Mi TDOP 17.86 degC Mosfet Mi MOSFET junction-to-mabient thermal resistance 23. Cin Pd 77.546 mW Power Inuction-to-ambient thermal resistance 24. Cout Pd 68.8 mW Power Inuction-to-ambient thermal resistance 25. Diode Pd 2.73 W Power Inductor power dissipation 26. C Pd 51.008 mW Power Inductor power dissipation 27. L Pd 1.11 W Power Inductor power dissipation 28. MI PdCund 854.46 mW Power IndUSFET conductor losses 29. MI PdCund 854.46 mW Power IndUSFET switching losses 21. Pd 1.17 W Power IndUSFET switching losses 23. Total Pd 30.0 mW Power Resispation 33. Total Pd 5.27 W Power Total Power Dissipation <					
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19. MI PdSw 902.8 mW Mosfet M1 MOSFET switching losses 21. M1 ThetsJA 50.0 degC/W Mosfet MOSFET switching losses 22. M1 ThetsJA 50.0 degC/W Mosfet MOSFET junction thema resistance 23. Cin Pd 77.546 mW Power Input capacitor power dissipation 23. Cin Pd 68.06 mW Power Output capacitor power dissipation 24. Cut Pd 68.06 mW Power Inductor power dissipation 25. Diode Pd 2.73 W Power Inductor power dissipation 26. IC Pd 1.10 W Power Inductor power dissipation 27. L Pd 1.11 W Power M1 MOSFET conduction losses 28. M1 PdCond 854.46 mW Power M1 MOSFET witching losses 31. R1b Pd 30.0 mW Power Total Power Dissipation 33. Total Pd 5.272 W Power Total Power Dissipation 34. R1b Pd 30.0 mW Resistor LED Current Rans Power Dissipation 35. Resnes Pd 800.05 mW Resistor LED Current Rans Power Dissipation 36. BOM Cout 1.611 k mm² Notal Power Total Power Posipation <td></td> <td></td> <td></td> <td></td> <td></td>					
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28. M1 PdCond 854.46 mW Power M1 MOSFET conduction losses 30. M1 PdSw 902.8 mW Power M1 MOSFET conduction losses 31. Rth Pd 30.0 mW Power M1 MOSFET switching losses 32. Resnse Pd 30.0 mW Power Rth Pd 33. Total Pd 5.272 W Power LED Current Rsns Power Dissipation 33. Total Pd 5.272 W Power Total Power Dissipation 34. Rth Pd 30.0 mW Resistor Rth Power Dissipation 35. Resnse Pd 800.05 mW Resistor Rth Dever Dissipation 36. BOM Count 21 System Total Power Dissipation 37. Cross Freq 928.838 Hz System Duty cycle 1nformation Information Information Steady state efficiency 40. Frequency 111.905 KHz System Indormation 41. Indormation Information Information Information 42. Gain Marg -15.206 dB System Gaie at 1Hz 11.005 KHz System Information Information 44. Low Freq Gain 49.641 dB System Conduction Mode				_	
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				Information	

Design Inputs

Name	Value	Description	
lout	6.0	Maximum Output Current	
VinMax	16.0	Maximum input voltage	
VinMin	8.0	Minimum input voltage	
Vout	24.0	Output Voltage	
base_pn	LM3481-Q1	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

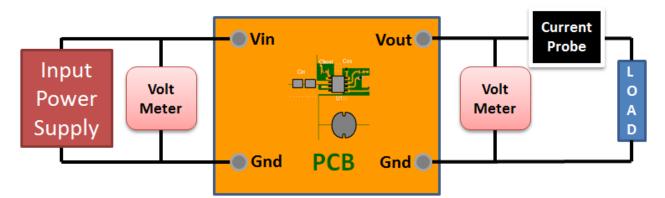
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 8.0V 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 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.



Design Assistance

1. Feature Highlights: Automotive Qualified, Wide supply voltage range Operation of 2.97V to 48V, 1A High Frequency Low side N-FET versatile High Performance Controller

2. Master key : 6DBEC7B690BB700F[v1]

3. LM3481-Q1 Product Folder : http://www.ti.com/product/LM3481%2DQ1 : contains the data sheet and other resources.

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