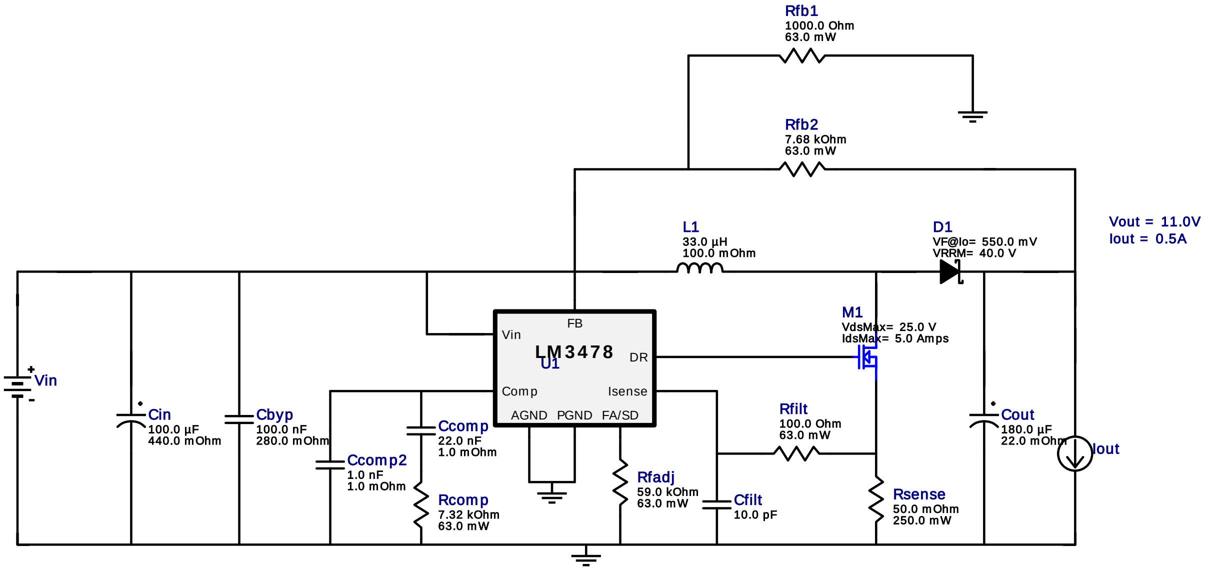
TEXAS INSTRUMENTS

VinMin = 5.0V
VinMax = 10.0V
Vout = 11.0V
Iout = 0.5A

Device = LM3478MM/NOPB
Topology = Boost
Created = 2025-12-31 21:42:14.187
BOM Cost = $2.52
BOM Count = 16
Total Pd = 0.53W

WEBENCH® Design Report

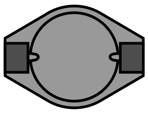
Design : 89 LM3478MM/NOPB
LM3478MM/NOPB 5V-10V to 11.00V @ 0.5A

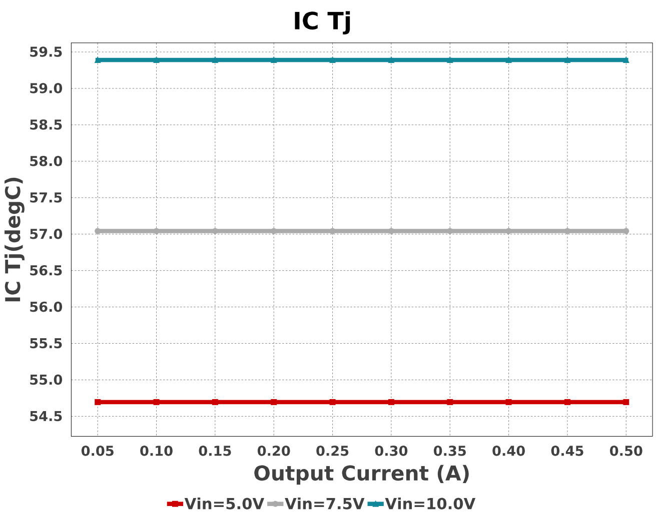


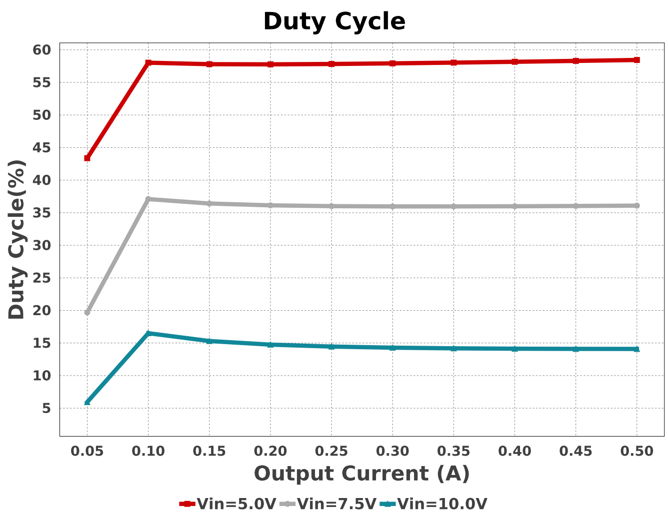
1. With the low turn of voltage of the LM34x8 your power supply may current limit before you reach your working input voltage. If this happens, or to preempt this from happening, you can include a low pass RC filter from input voltage to Vin on the IC. Make sure the rise time on the RC network is slower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

Electrical BOM

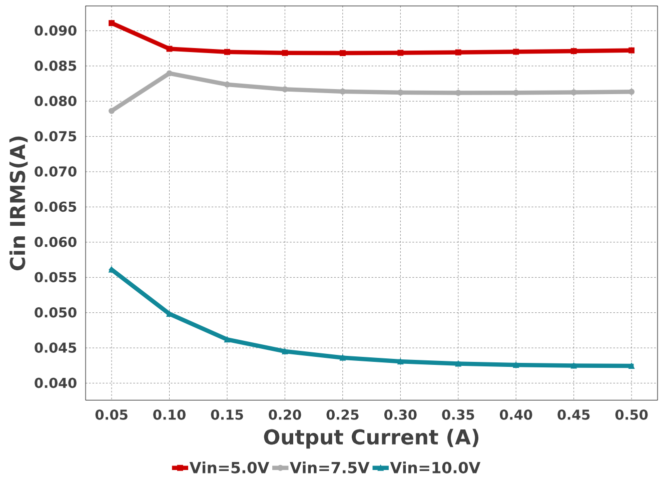
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbyp	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Ccomp	MuRata	GRM155R71C223KA01D Series= X7R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	Yageo	CC0805KRX7R9BB102 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	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	Nichicon	UUD1C101MCL1GS Series= uD	Cap= 100.0 uF ESR= 440.0 mOhm VDC= 16.0 V IRMS= 230.0 mA	1	$0.09	SM_RADIAL_6.3AMM 80 mm^2
Cout	Panasonic	16SVPF180M Series= SVPF	Cap= 180.0 uF ESR= 22.0 mOhm VDC= 16.0 V IRMS= 3.3 A	1	$0.57	CAPSMT_62_F61 74 mm^2
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.03	SOD-123F 12 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
L1	NIC Components	NPI31W330MTRF	L= 33.0 µH 100.0 mOhm	1	$0.26	 IND_NPI31W 172 mm^2
M1	Texas Instruments	CSD16301Q2	VdsMax= 25.0 V IdsMax= 5.0 Amps	1	$0.11	DQK0006C 9 mm^2
Rcomp	Vishay-Dale	CRCW04027K32FKED Series= CRCW..e3	Res= 7.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfadj	Vishay-Dale	CRCW040259K0FKED Series= CRCW..e3	Res= 59.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfb2	Vishay-Dale	CRCW04027K68FKED Series= CRCW..e3	Res= 7.68 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	Bourns	CRM0805-FW-R050ELF Series= ?	Res= 50.0 mOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.06	0805 7 mm^2
U1	Texas Instruments	LM3478MM/NOPB	Switcher	1	$1.31	 MUA08A 24 mm^2

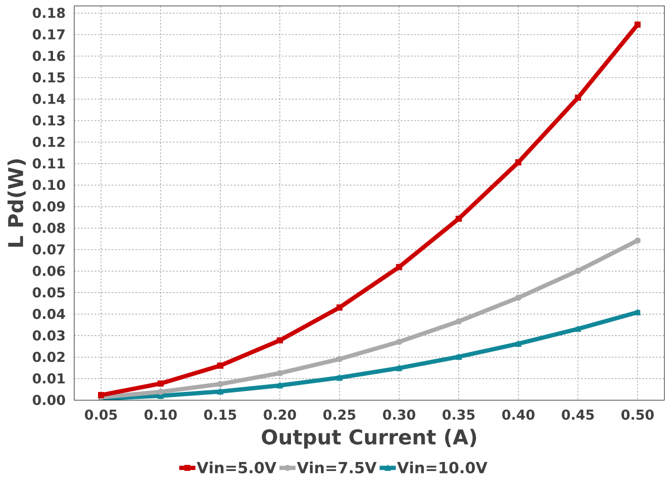




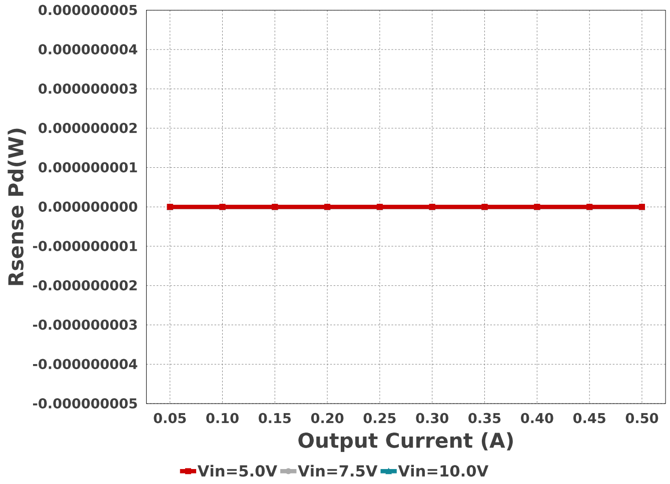
Cin IRMS



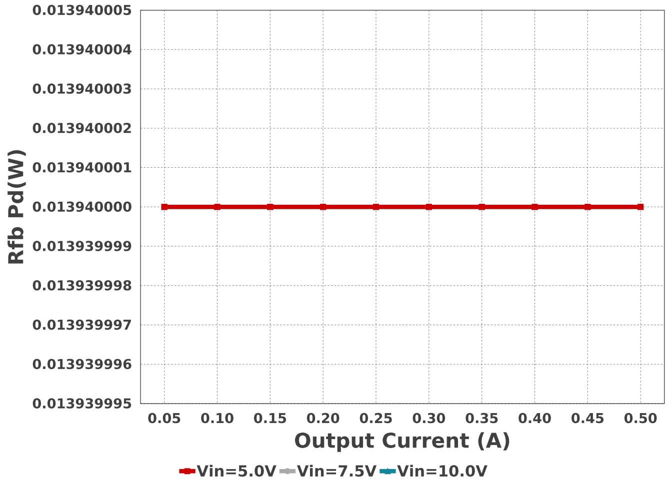
L Pd



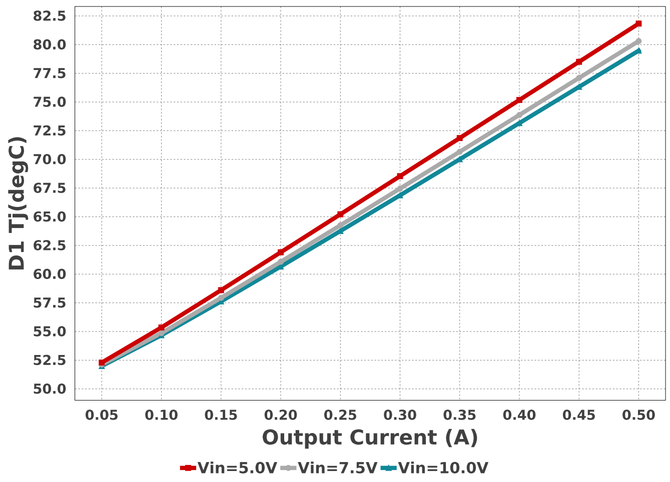
Rsense Pd



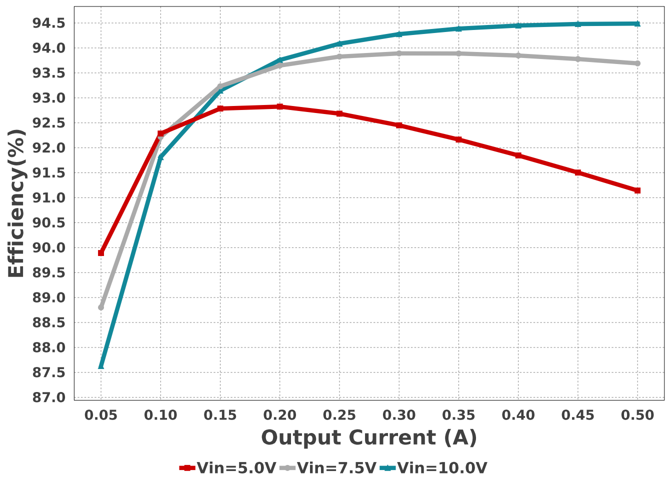
Rfb Pd



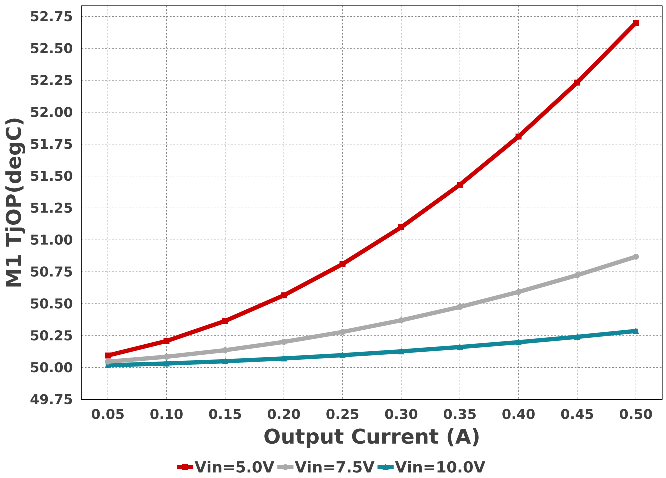
D1 Tj



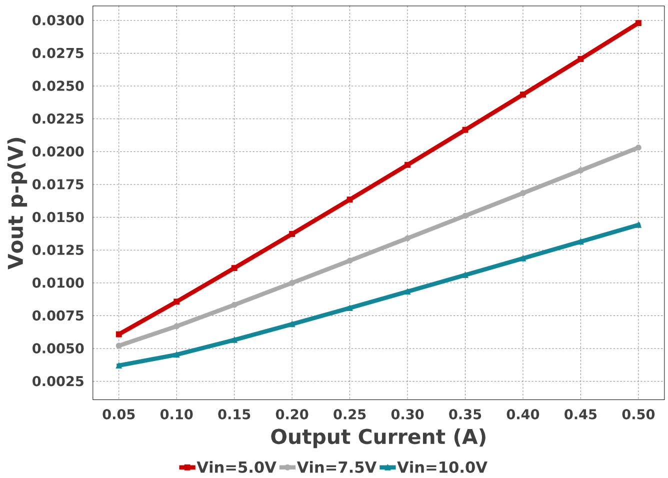
Efficiency



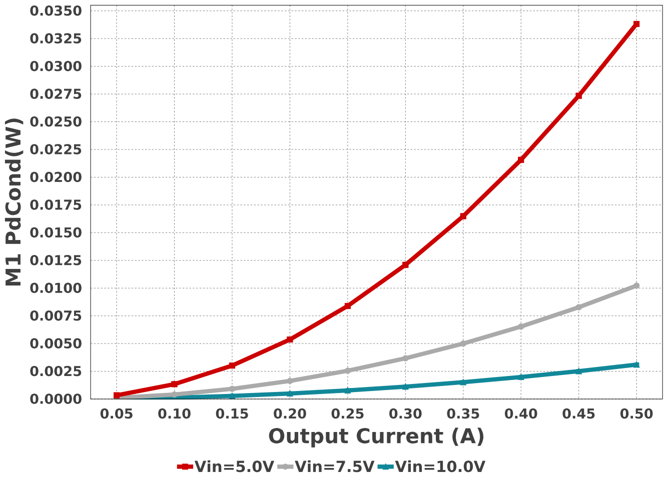
M1 TjOP



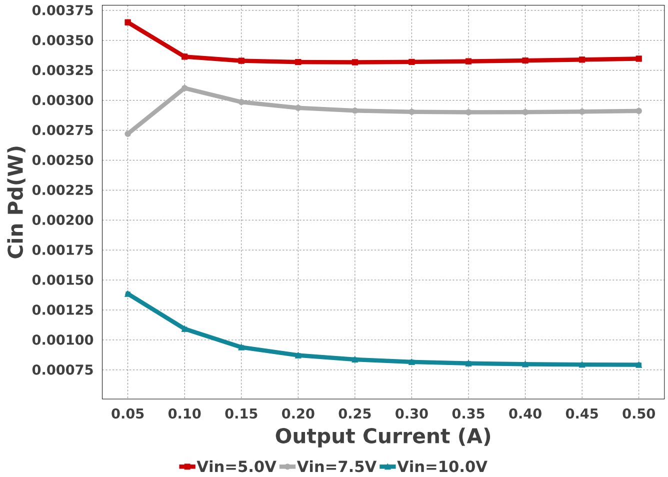
Vout p-p



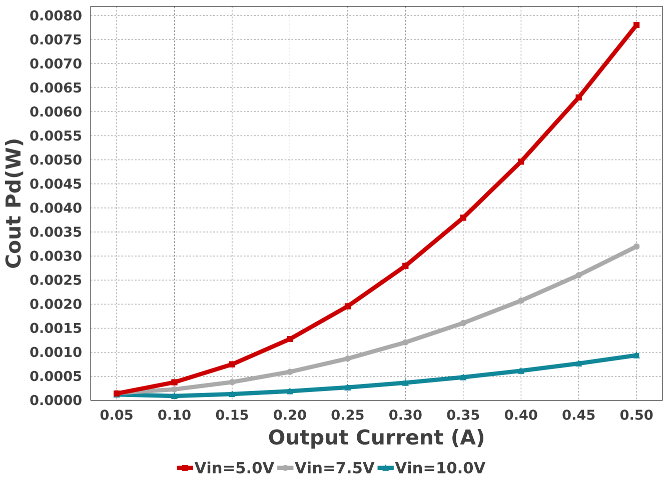
M1 PdCond



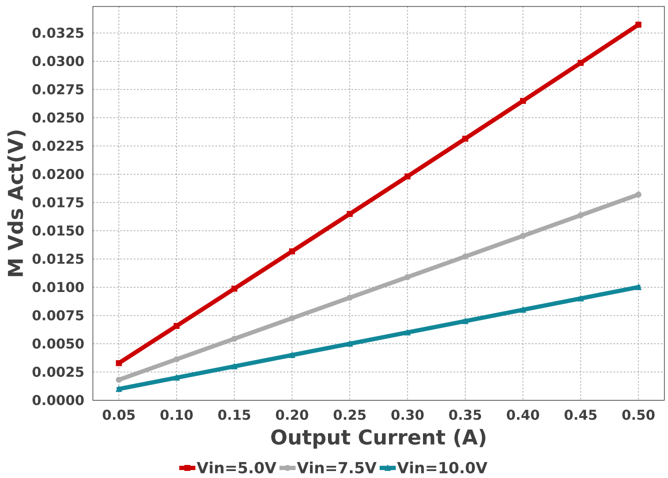
Cin Pd



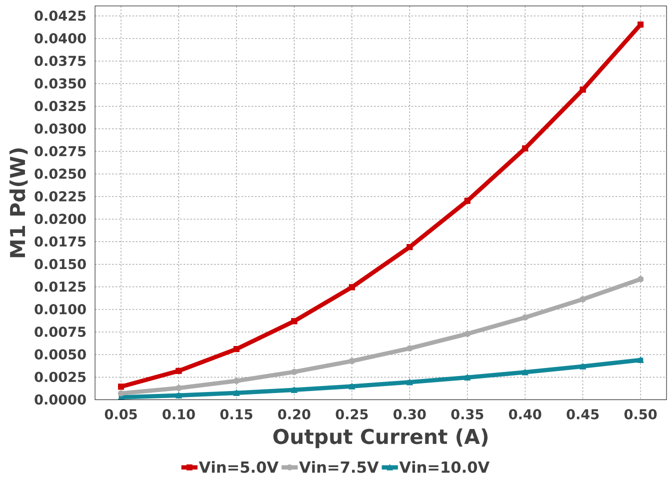
Cout Pd



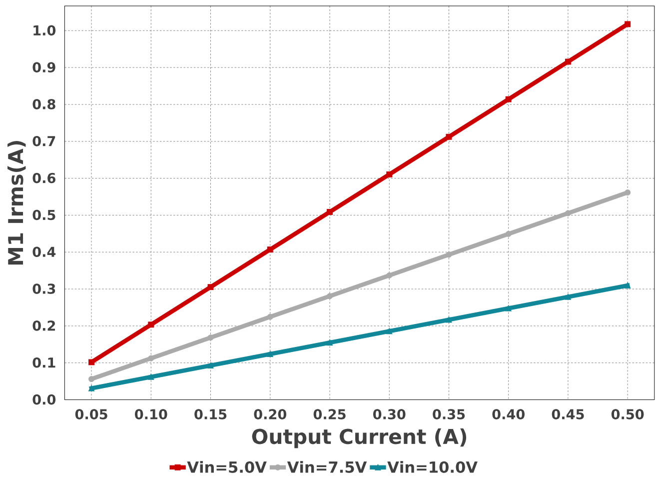
M Vds Act



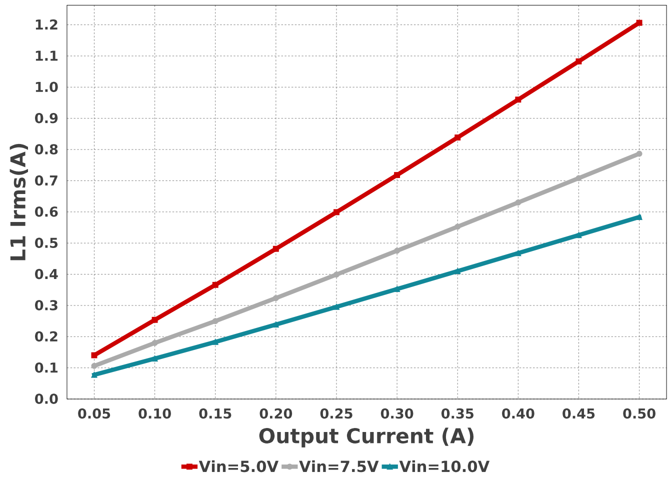
M1 Pd



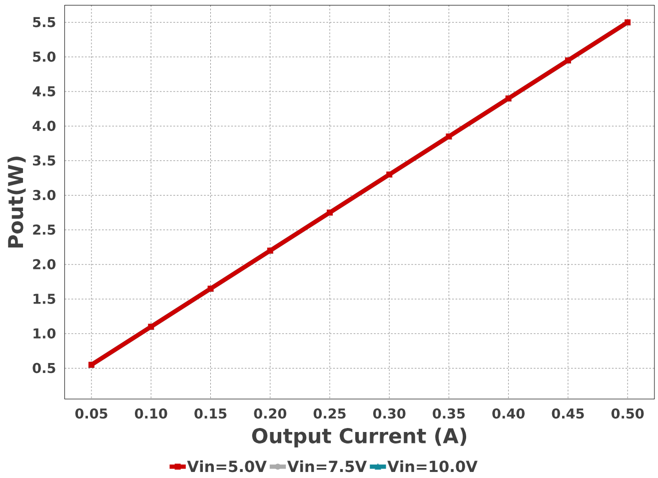
M1 Irms



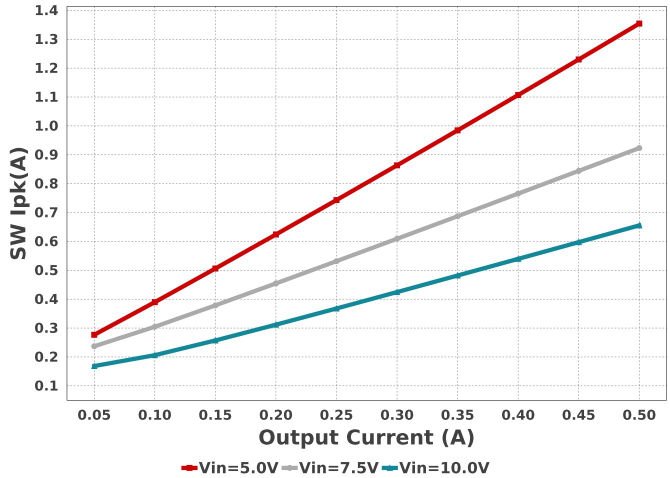
L1 Irms



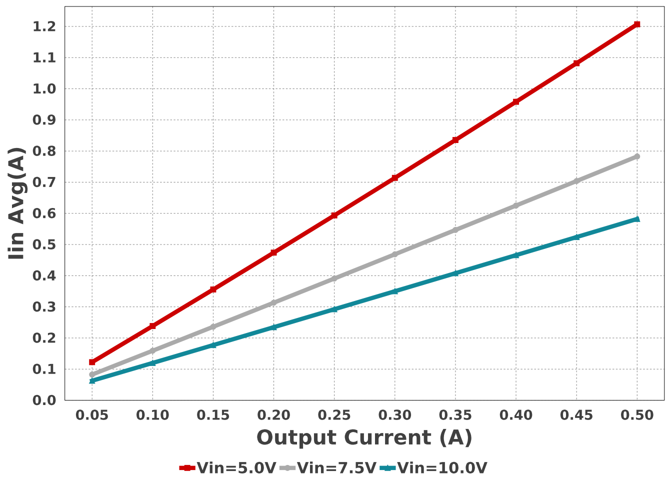
Pout



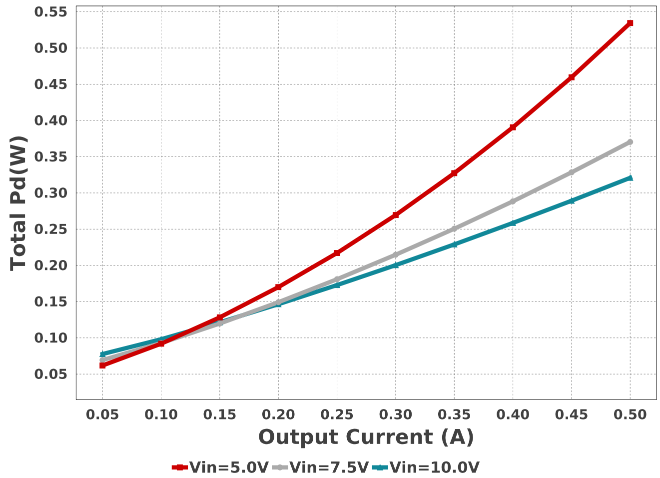
SW Ipk



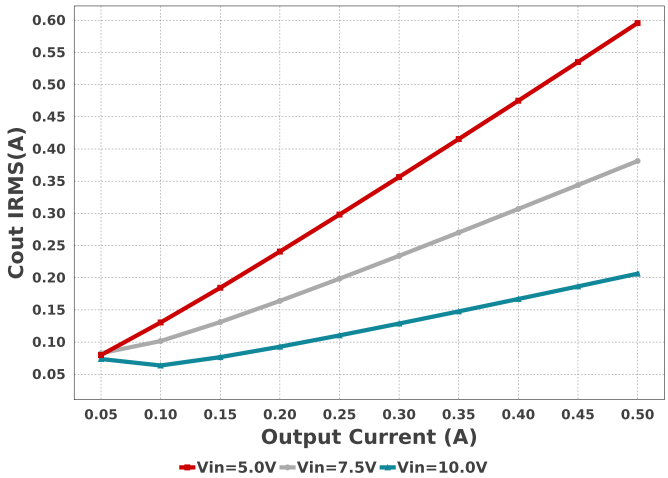
Iin Avg



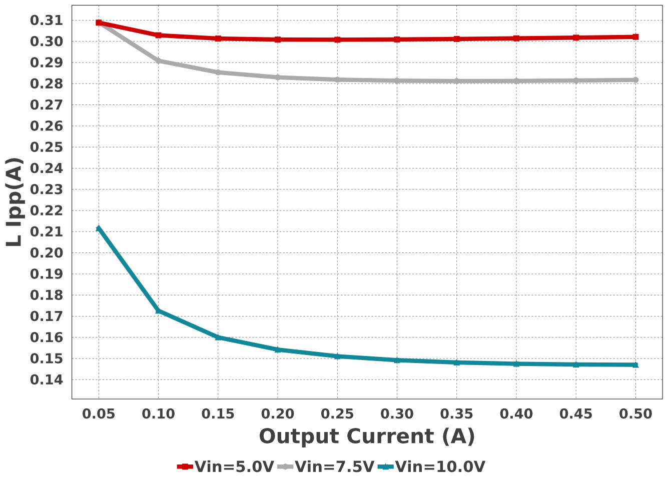
Total Pd



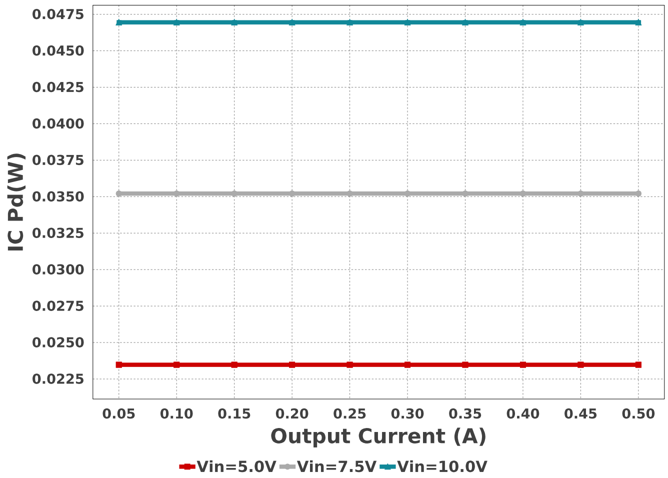
Cout IRMS



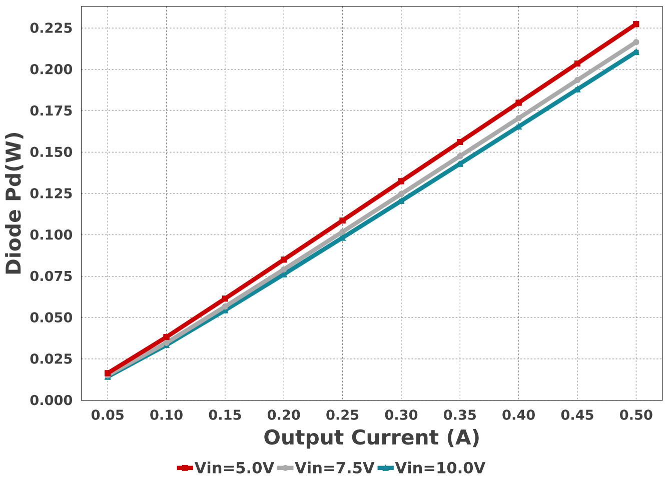
L Ipp



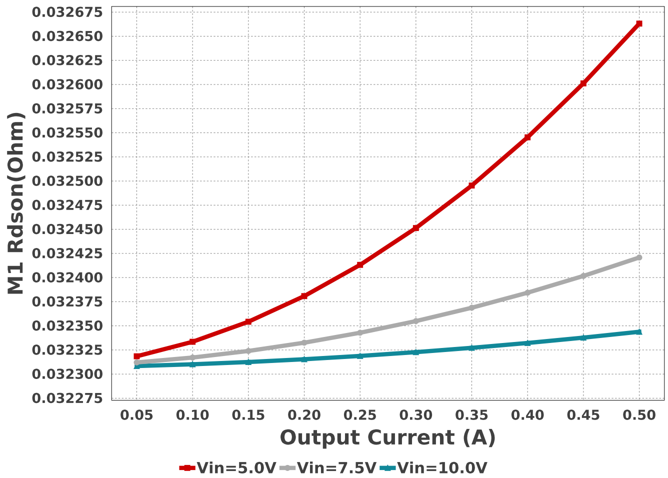
IC Pd

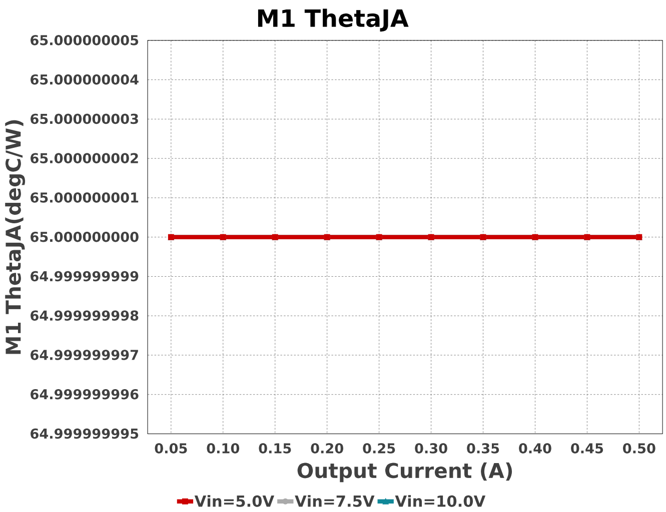


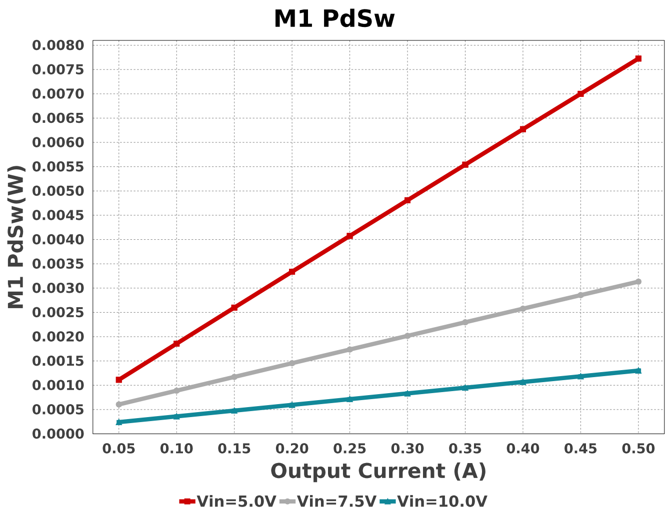
Diode Pd

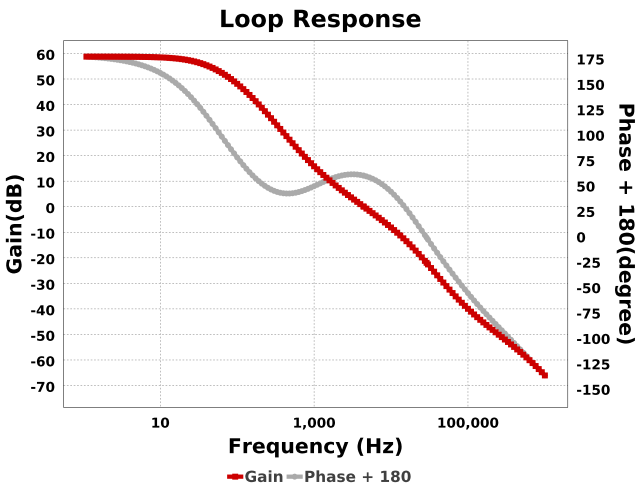


M1 Rdson









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	16		Total Design BOM count
2.	Total BOM	$2.52		Total BOM Cost
3.	Cin IRMS	87.214 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	3.347 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	595.61 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	7.804 mW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	81.833 degC	Diode	D1 junction temperature
8.	Diode Pd	227.38 mW	Diode	Diode power dissipation
9.	IC Pd	23.475 mW	IC	IC power dissipation
10.	IC Tj	54.695 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	1.207 A	IC	Average input current
14.	L Ipp	302.119 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	174.63 mW	Inductor	Inductor power dissipation
16.	L1 Irms	1.206 A	Inductor	Inductor ripple current
17.	M Vds Act	33.236 mV	Mosfet	M Vds
18.	M1 Irms	1.018 A	Mosfet	M1 MOSFET Irms
19.	M1 Pd	41.544 mW	Mosfet	M1 MOSFET total power dissipation
20.	M1 PdCond	33.819 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 PdSw	7.725 mW	Mosfet	M1 MOSFET switching losses
22.	M1 Rdson	32.663 mOhm	Mosfet	Drain-Source On-resistance
23.	M1 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
24.	M1 TjOP	52.7 degC	Mosfet	M1 MOSFET junction temperature
25.	Cin Pd	3.347 mW	Power	Input capacitor power dissipation
26.	Cout Pd	7.804 mW	Power	Output capacitor power dissipation
27.	Diode Pd	227.38 mW	Power	Diode power dissipation
28.	IC Pd	23.475 mW	Power	IC power dissipation
29.	L Pd	174.63 mW	Power	Inductor power dissipation
30.	M1 Pd	41.544 mW	Power	M1 MOSFET total power dissipation
31.	M1 PdCond	33.819 mW	Power	M1 MOSFET conduction losses
32.	M1 PdSw	7.725 mW	Power	M1 MOSFET switching losses

#	Name	Value	Category	Description
33.	Rfb Pd	13.94 mW	Power	Rfb Power Dissipation
34.	Rsense Pd	0.0 W	Power	LED Current Rsns Power Dissipation
35.	Total Pd	534.415 mW	Power	Total Power Dissipation
36.	Rfb Pd	13.94 mW	Resistor	Rfb Power Dissipation
37.	Rsense Pd	0.0 W	Resistor	LED Current Rsns Power Dissipation
38.	Cross Freq	2.337 kHz	System Information	Bode plot crossover frequency
39.	Duty Cycle	58.443 %	System Information	Duty cycle
40.	Efficiency	91.144 %	System Information	Steady state efficiency
41.	FootPrint	416.0 mm^2	System Information	Total Foot Print Area of BOM components
42.	Frequency	289.572 kHz	System Information	Switching frequency
43.	Gain Marg	-17.807 dB	System Information	Bode Plot Gain Margin
44.	Iout	500.0 mA	System Information	Iout operating point
45.	Low Freq Gain	52.438 dB	System Information	Gain at 1Hz
46.	Mode	CCM	System Information	Conduction Mode
47.	Phase Marg	57.083 deg	System Information	Bode Plot Phase Margin
48.	Pout	5.5 W	System Information	Total output power
49.	SW Ipk	1.354 A	System Information	Peak switch current
50.	Vin	5.0 V	System Information	Vin operating point
51.	Vout	11.0 V	System Information	Operational Output Voltage
52.	Vout Actual	10.937 V	System Information	Vout Actual calculated based on selected voltage divider resistors
53.	Vout Tolerance	3.751 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
54.	Vout p-p	29.799 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	500.0 m	Maximum Output Current
VinMax	10.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	11.0	Output Voltage
base_pn	LM3478	Base Product Number
source	DC	Input Source Type
Ta	50.0	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

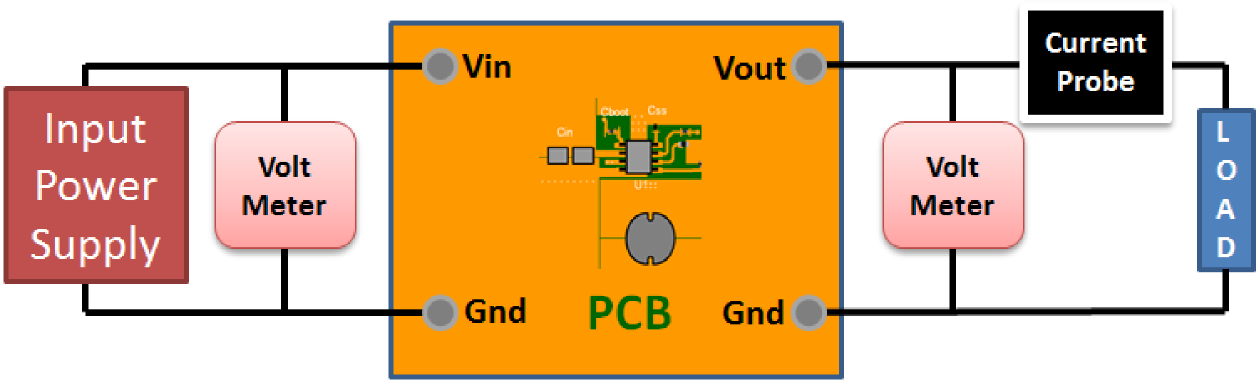
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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



Design Assistance

1. Master key : F9884934EAC7C183[v1]

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

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