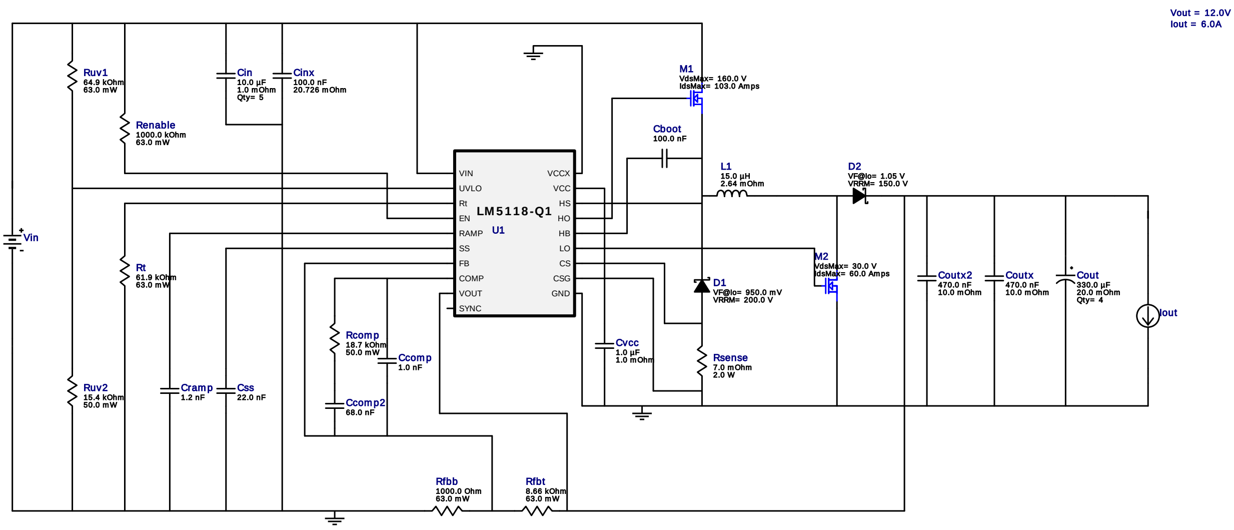
TEXAS INSTRUMENTS	VinMin = 8.0V VinMax = 60.0V Vout = 12.0V Iout = 6.0A	Device = LM5118Q1MH/NOPB Topology = Buck_Boost Created = 2024-08-07 08:47:08.811 BOM Cost = NA BOM Count = 32 Total Pd =

WEBENCH ® Design Report

Design : 3167 LM5118Q1MH/NOPB
LM5118Q1MH/NOPB 8V-60V to 12.00V @ 6A



Design Alerts

LM5118-Q1 Design

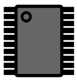
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for only other external components. This helps to update the desing by keeping Fets unchanged.

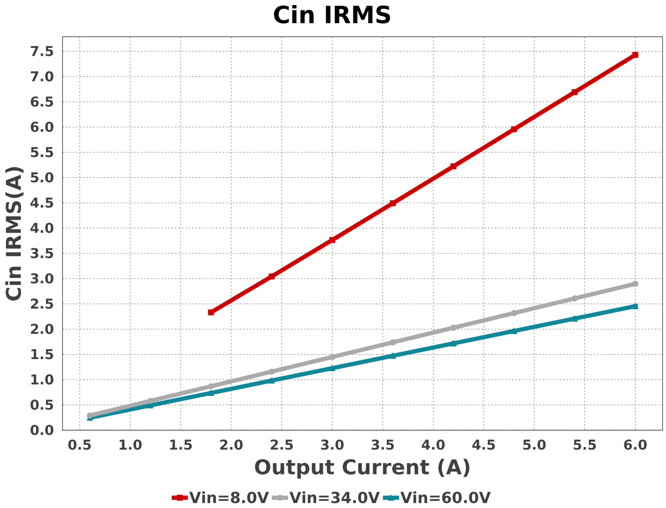
Electrical BOM

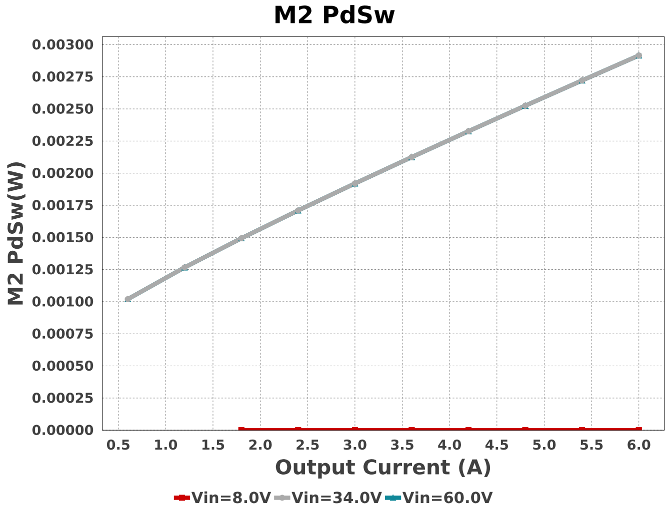
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
Ccomp	Samsung Electro-Mechanics	CL21C102JBCNNNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp2	TDK	C3216C0G1H683J160AA Series= C0G/NP0	Cap= 68.0 nF VDC= 5.0 V IRMS= 0.0 A	1	$0.16	1206 11 mm²
Cin	TDK	CKG57NX7R2A106M500JH Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 4.22 A	5	$1.80	CKG57N 56 mm²
Cinx	TDK	C2012X7R2A104K125AA Series= X7R	Cap= 100.0 nF ESR= 20.726 mOhm VDC= 100.0 V IRMS= 1.456 A	1	$0.03	0805 7 mm²
Cout	Panasonic	EEHZC1E331P Series= ZC	Cap= 330.0 uF ESR= 20.0 mOhm VDC= 25.0 V IRMS= 2.0 A	4	$1.01	SM_RADIAL_10BMM 160 mm²
Coutx	MuRata	GRM188R71C474KA88D Series= X7R	Cap= 470.0 nF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.03	0603 5 mm²

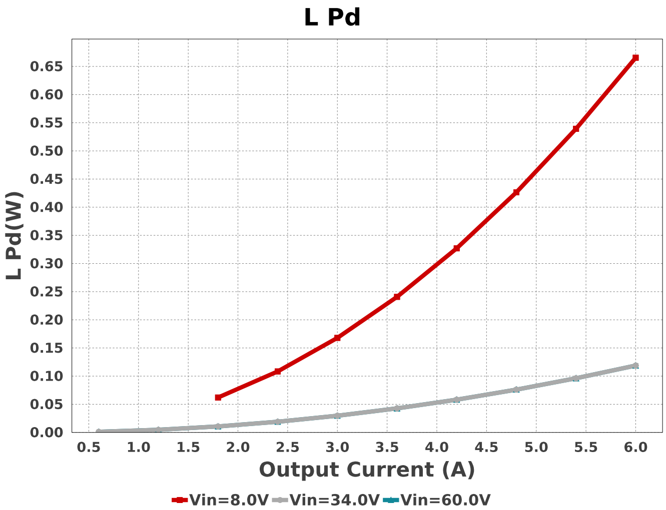
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM188R71C474KA88D Series= X7R	Cap= 470.0 nF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.03	0603 5 mm^2
Cramp	TDK	C2012C0G1H122J060AA Series= C0G/NP0	Cap= 1.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Css	TDK	CGA4J2C0G1H223J125AA Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm^2
Cvcc	Taiyo Yuden	TMK212BJ105KG-T Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm^2
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	DPAK 102 mm^2
D2	SMC Diode Solutions	SB20150TR	VF@Io= 1.05 V VRRM= 150.0 V	1	$0.32	DO-201AD 166 mm^2
L1	Wurth Elektronik	7443641500	L= 15.0 µH 2.64 mOhm	1	$7.28	WE-HCF_2818 656 mm^2
M1	NA	IdealFET	VdsMax= 160.0 V IdsMax= 103.0 Amps	1	NA	KCS0003B 80 mm^2
M2	Texas Instruments	CSD17575Q3	VdsMax= 30.0 V IdsMax= 60.0 Amps	1	$0.28	DQG0008A 18 mm^2
Rcomp	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Renable	Vishay-Dale	CRCW04021M00FKED Series= CRCW..e3	Res= 1000.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsense	Rohm	PMR100HZPFU7L00 Series= ?	Res= 7.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.19	2512 43 mm^2
Rt	Vishay-Dale	CRCW040261K9FKED Series= CRCW..e3	Res= 61.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv1	Vishay-Dale	CRCW040264K9FKED Series= CRCW..e3	Res= 64.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv2	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2

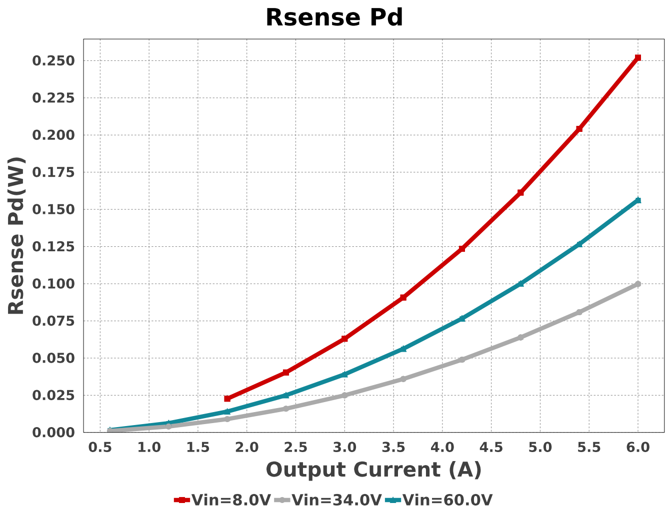
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LM5118Q1MH/NOPB	Switcher	1	$3.18	MXA20A 71 mm^2

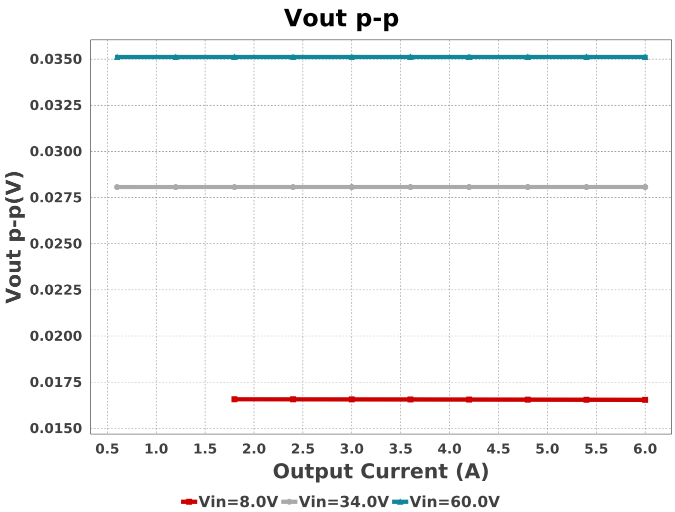


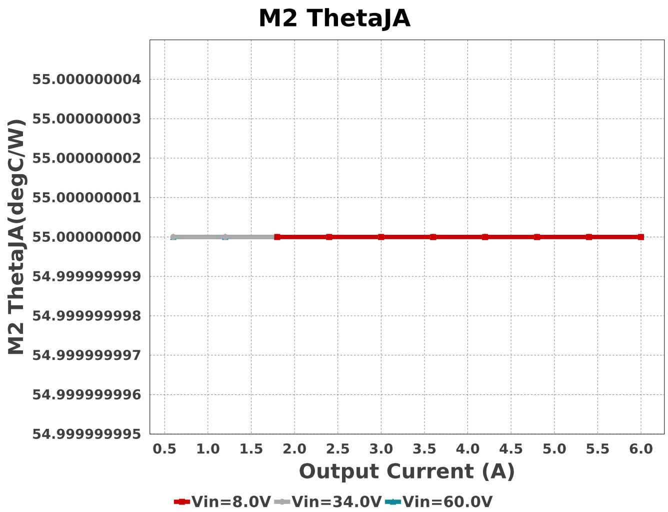


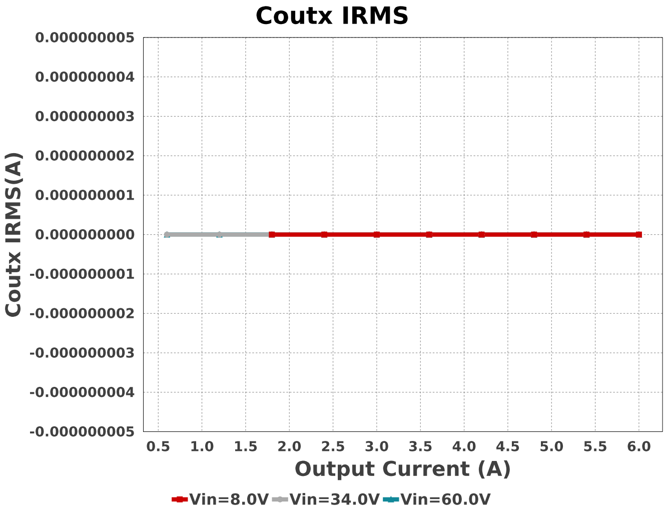


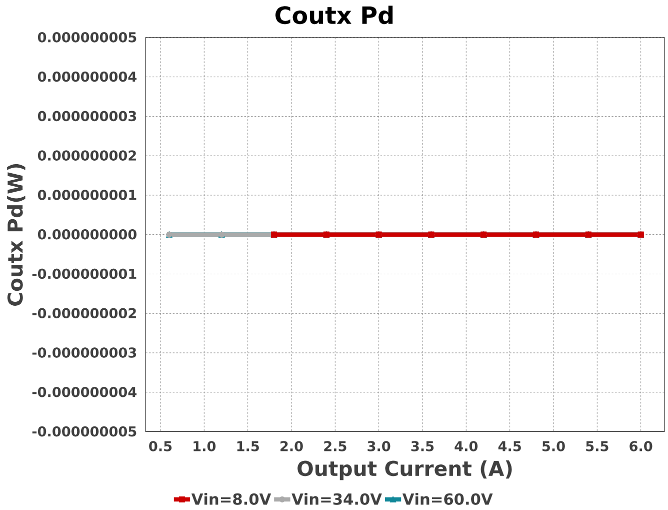


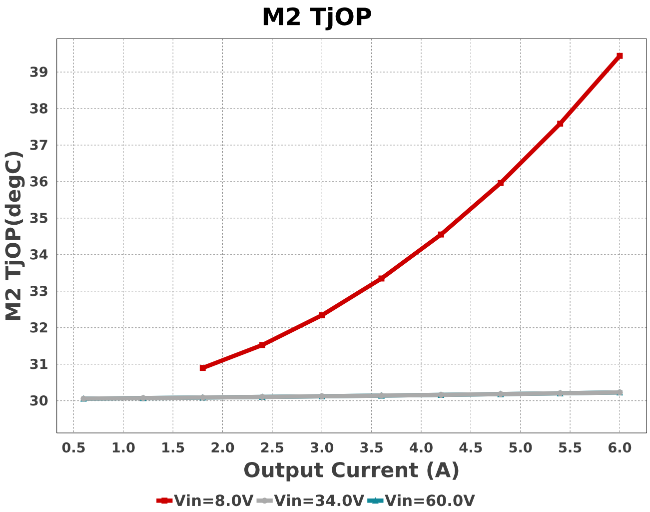


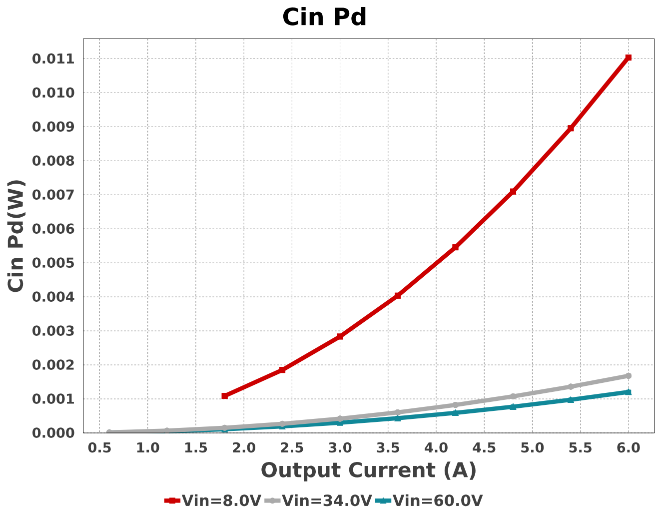


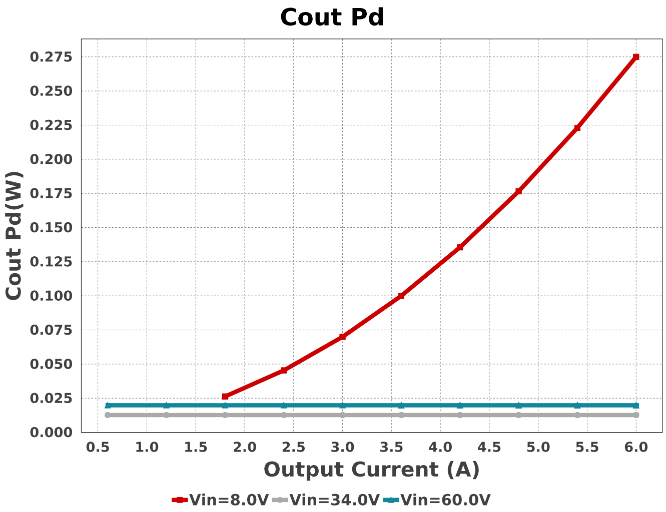


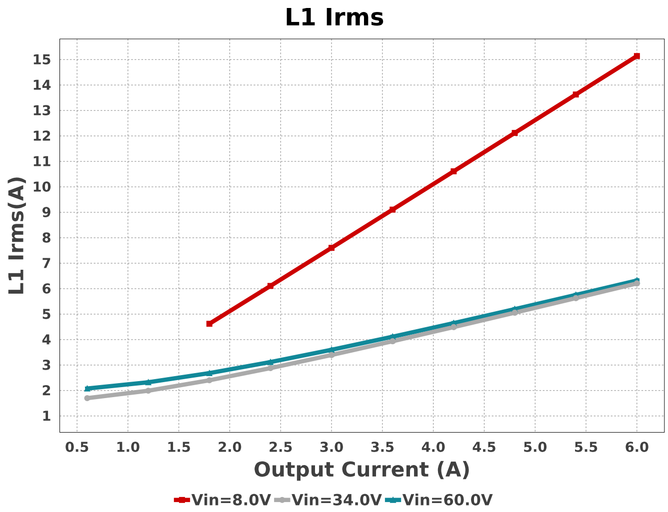

Coutx IRMS
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
Coutx IRMS(A)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

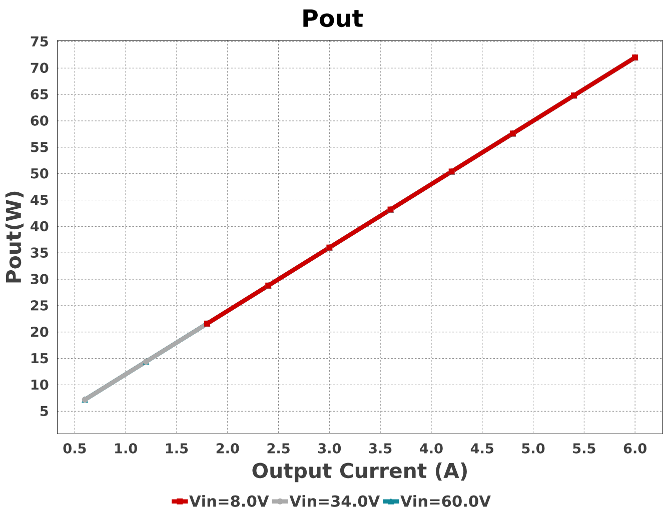

Coutx Pd
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
Coutx Pd(W)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

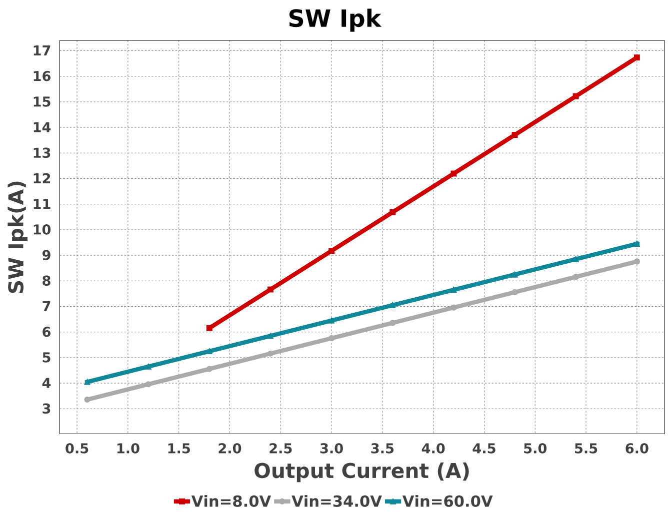

M2 TjOP
39
38
37
36
35
34
33
32
31
30
M2 TjOP(degC)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

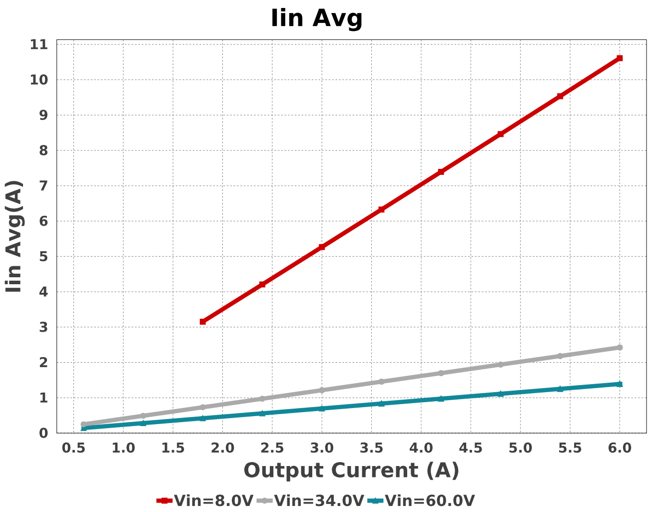

Cin Pd
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Cin Pd(W)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

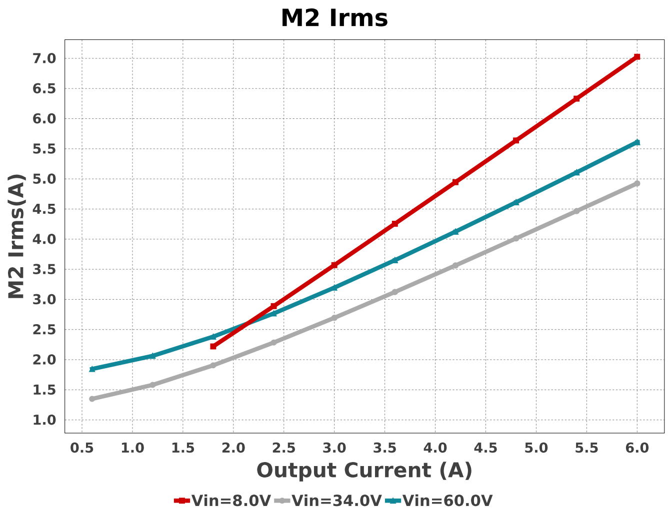

Cout Pd
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
Cout Pd(W)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

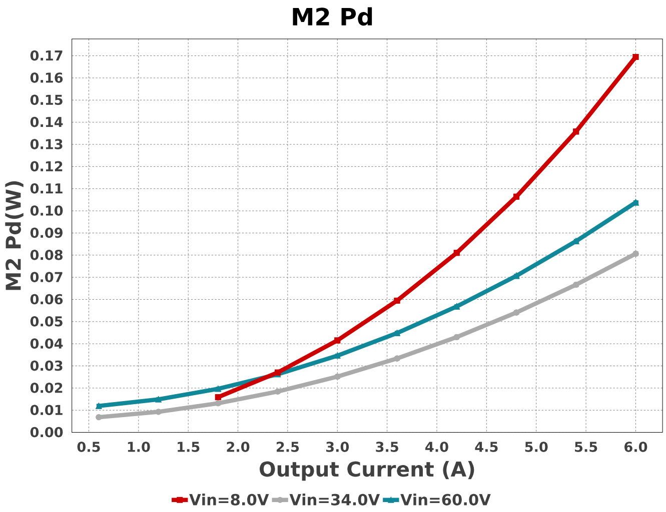

L1 Irms
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
L1 Irms(A)
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

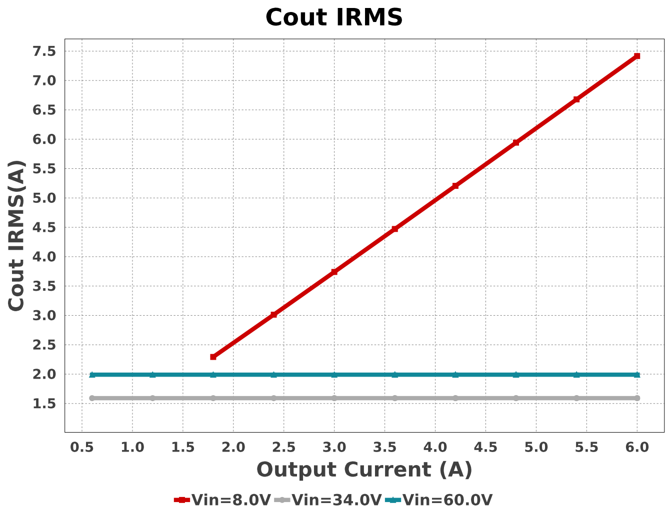

Pout
Pout(W)
75 70 65 60 55 50 45 40 35 30 25 20 15 10 5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

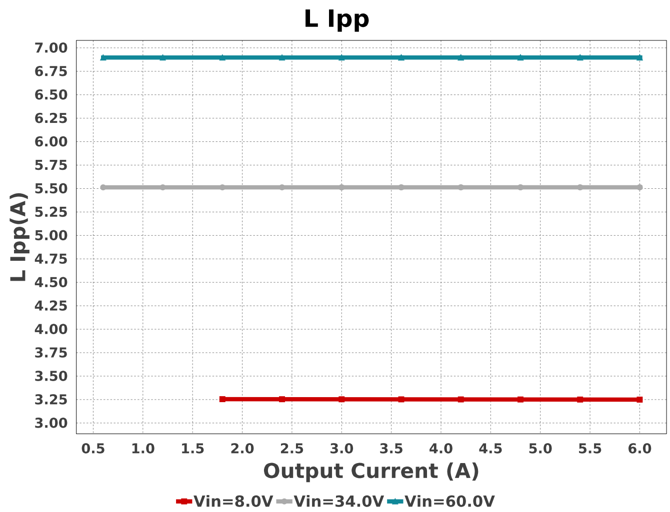

SW Ipk
SW Ipk(A)
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

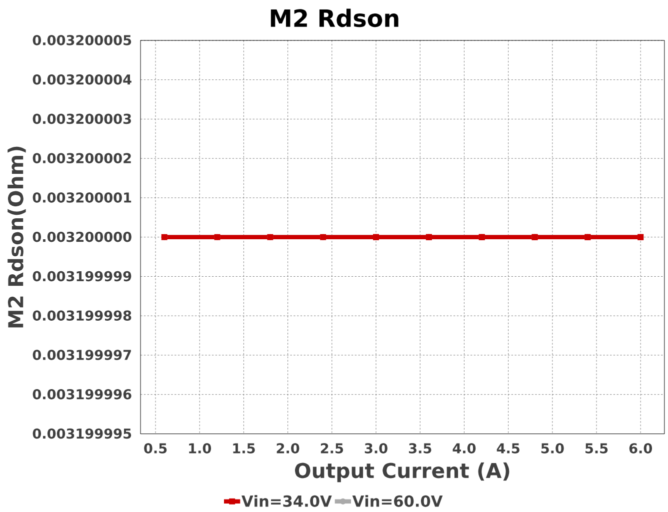

Iin Avg
Iin Avg(A)
11 10 9 8 7 6 5 4 3 2 1 0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

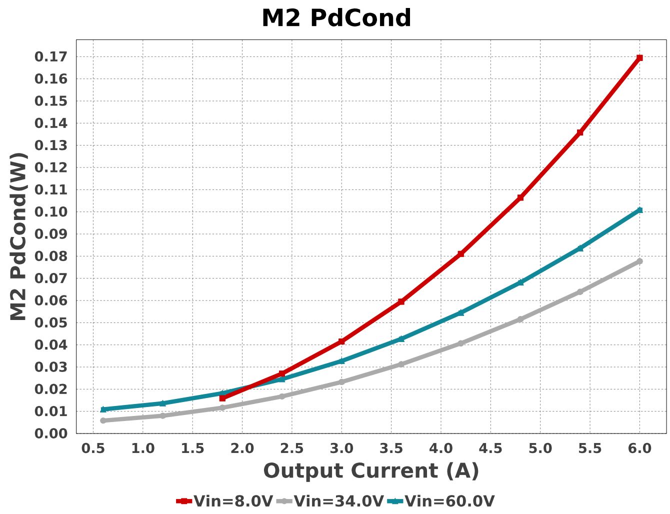

M2 Irms
M2 Irms(A)
7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V

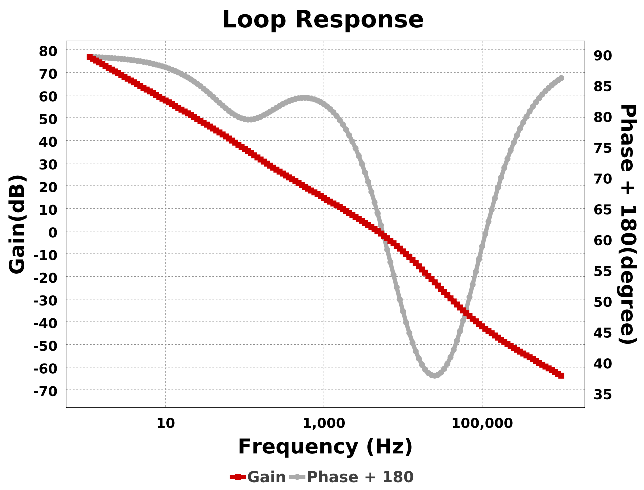

M2 Pd
M2 Pd(W)
0.17 0.16 0.15 0.14 0.13 0.12 0.11 0.10 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V


Cout IRMS
Cout IRMS(A)
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=8.0V Vin=34.0V Vin=60.0V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	7.421 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	11.016 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	7.409 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	274.49 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	0.0 A	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	0.0 W	Capacitor	Output capacitor_x power loss
7.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
8.	ICThetaJA	40.0 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	1.418 A	IC	Average input current
10.	L Ipp	3.253 A	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	663.92 mW	Inductor	Inductor power dissipation
12.	L1 Irms	15.12 A	Inductor	Inductor ripple current
13.	M2 Irms	7.081 A	Mosfet	MOSFET RMS ripple current
14.	M2 Pd	118.0 mW	Mosfet	MOSFET power dissipation
15.	M2 PdCond	118.0 mW	Mosfet	M2 MOSFET conduction losses
16.	M2 PdSw	0.0 W	Mosfet	M2 MOSFET switching losses
17.	M2 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
18.	M2 TjOP	35.876 degC	Mosfet	MOSFET junction temperature
19.	Cin Pd	11.016 mW	Power	Input capacitor power dissipation
20.	Cout Pd	274.49 mW	Power	Output capacitor power dissipation
21.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
22.	L Pd	663.92 mW	Power	Inductor power dissipation
23.	M2 Pd	118.0 mW	Power	MOSFET power dissipation
24.	M2 PdCond	118.0 mW	Power	M2 MOSFET conduction losses
25.	M2 PdSw	0.0 W	Power	M2 MOSFET switching losses
26.	Rsense Pd	252.0 mW	Power	LED Current Rsns Power Dissipation
27.	Rsense Pd	252.0 mW	Resistor	LED Current Rsns Power Dissipation
28.	BOM Count	32	System Information	Total Design BOM count
29.	Cross Freq	2.899 kHz	System Information	Bode plot crossover frequency

#	Name	Value	Category	Description
30.	FootPrint	2.136 k mm^2	System Information	Total Foot Print Area of BOM components
31.	Frequency	98.583 kHz	System Information	Switching frequency
32.	Gain Marg	-47.606 dB	System Information	Bode Plot Gain Margin
33.	Iout	6.0 A	System Information	Iout operating point
34.	Low Freq Gain	73.884 dB	System Information	Gain at 1Hz
35.	Mode	CCM	System Information	Conduction Mode
36.	Operating Topology	Buck-Boost	System Information	The current operating topology of the device
37.	Phase Marg	70.762 deg	System Information	Bode Plot Phase Margin
38.	Pout	72.0 W	System Information	Total output power
39.	SW Ipk	16.718 A	System Information	Peak switch current
40.	Total BOM	NA	System Information	Total BOM Cost
41.	Vin	8.0 V	System Information	Vin operating point
42.	Vout	12.0 V	System Information	Operational Output Voltage
43.	Vout Actual	11.882 V	System Information	Vout Actual calculated based on selected voltage divider resistors
44.	Vout Tolerance	3.301 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
45.	Vout p-p	16.564 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	6.0	Maximum Output Current
VinMax	60.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM5118-Q1	Base Product Number
source	DC	Input Source Type
Ta	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

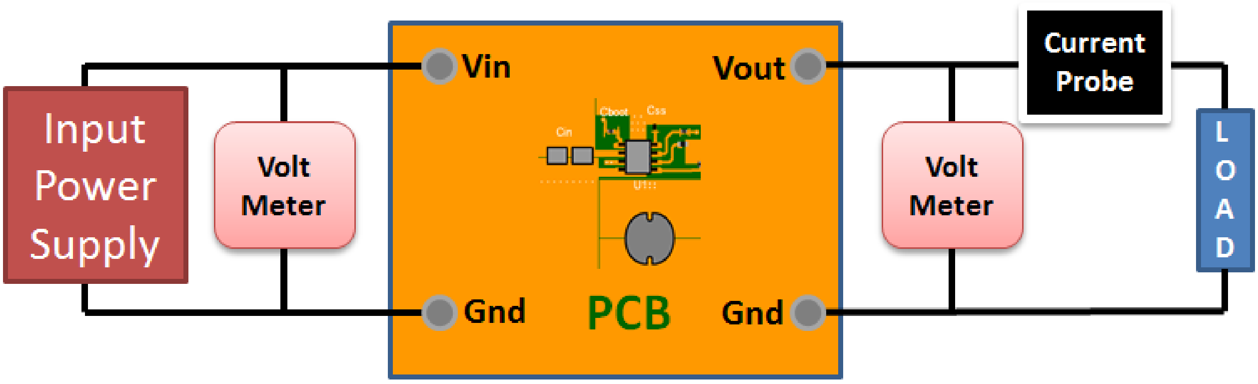
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 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. The LM5118-Q1 is a wide range buck-boost controller which is operable in an ultra wide input range of 3 to 75V. A buck-boost regulator can maintain regulation for input voltages either higher or lower than the output voltage. The challenge is that buck-boost power converters are not as efficient as buck regulators. The LM5118 has been designed as a dual mode controller whereby the power converter acts as a buck regulator while the input voltage is above the output. As the input voltage approaches the output voltage, a gradual transition to the buck-boost mode occurs. This gradual transition between modes eliminates disturbances at the output during transitions.

2. Master key : 4DBC92FC97185CFB[v1]

3. **LM5118-Q1** Product Folder : http://www.ti.com/product/LM5118%2DQ1 : contains the data sheet and other resources.

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