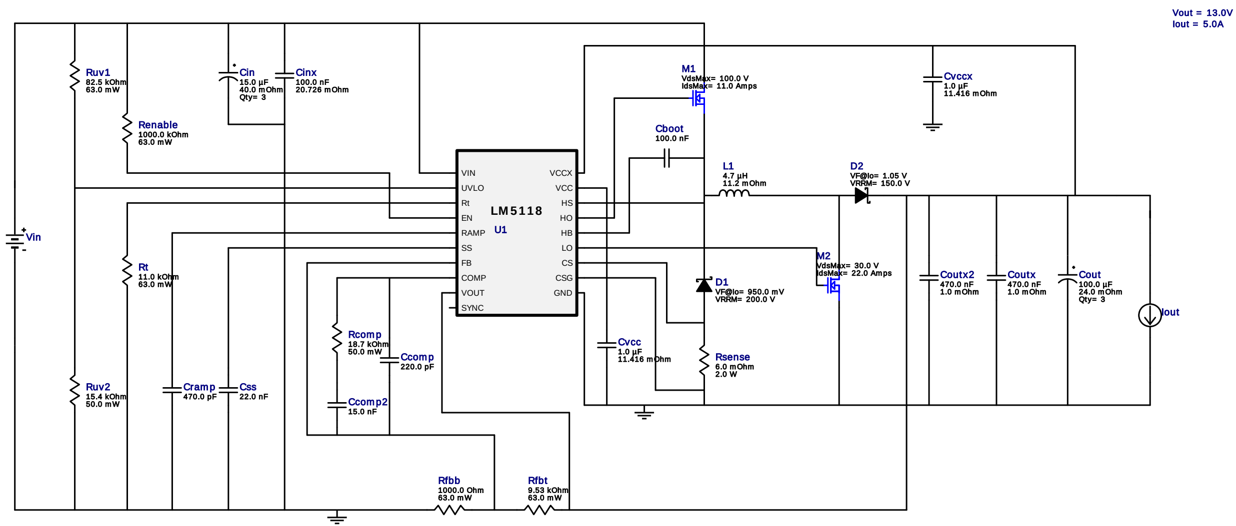
VinMin = 10.0V
VinMax = 75.0V
Vout = 13.0V
Iout = 5.0A

Device = LM5118MH/NOPB
Topology = Buck_Boost
Created = 2022-03-02 20:49:12.781
BOM Cost = $11.78
BOM Count = 30
Total Pd = 11.51W

WEBENCH ® Design Report

Design : 5 LM5118MH/NOPB
LM5118MH/NOPB 10V-75V to 13.00V @ 5A

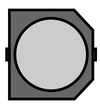
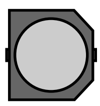


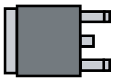
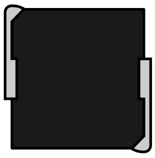
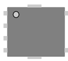
Design Alerts

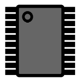
LM5118 Design

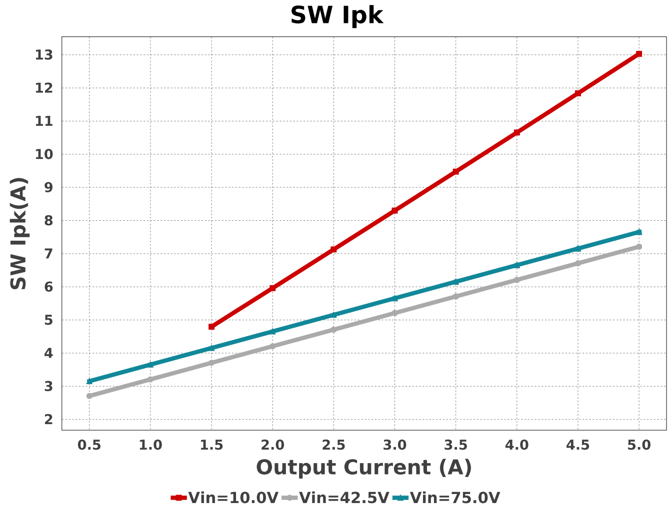
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

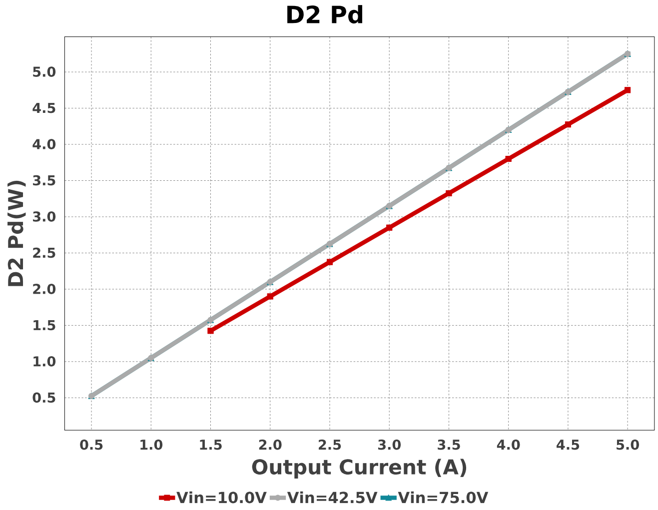
Electrical BOM

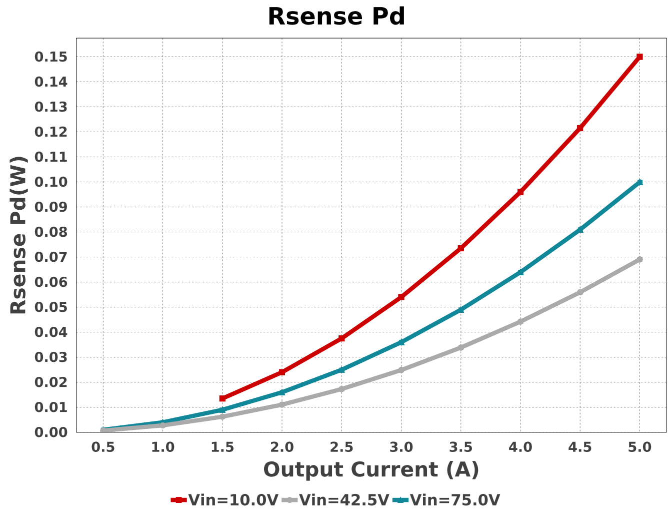
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Ccomp	Samsung Electro-Mechanics	CL21C221JBANNNC Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Ccomp2	TDK	CGA4F2C0G1H153J085AA Series= C0G/NP0	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm^2
Cin	Panasonic	100SXV15M Series= SXV	Cap= 15.0 uF ESR= 40.0 mOhm VDC= 100.0 V IRMS= 2.35 A	3	$1.18	 CAPSMT_62_E12 106 mm^2
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 mm^2
Cout	Panasonic	25SVPF100M Series= SVPF	Cap= 100.0 uF ESR= 24.0 mOhm VDC= 25.0 V IRMS= 3.2 A	3	$0.47	 CAPSMT_62_E7 106 mm^2
Coutx	MuRata	GRM188R61E474KA12D Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.04	0603 5 mm^2

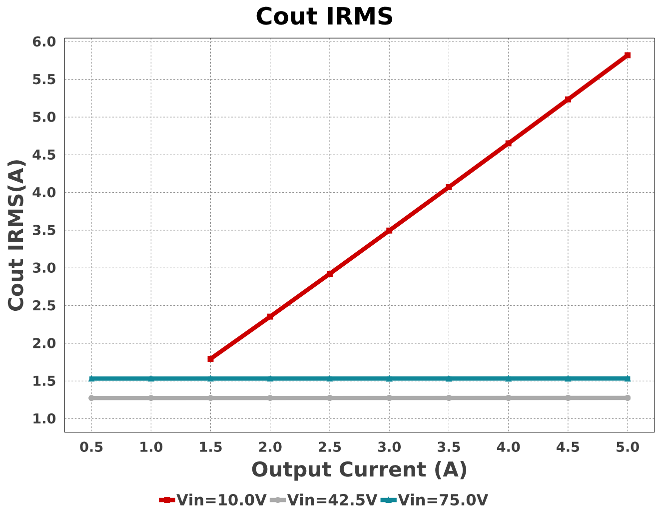
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM188R61E474KA12D Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.04	0603 5 mm^2
Cramp	AVX	04025A471JAT2A Series= C0G/NP0	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Css	TDK	CGA4J2C0G1H223J125AA Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.08	0805 7 mm^2
Cvcc	TDK	C1005X5R1V105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 35.0 V IRMS= 1.483 A	1	$0.03	0402 3 mm^2
Cvccx	TDK	C1005X5R1V105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 35.0 V IRMS= 1.483 A	1	$0.03	0402 3 mm^2
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.12	 DPAK 102 mm^2
D2	SMC Diode Solutions	SB20150TR	VF@Io= 1.05 V VRRM= 150.0 V	1	$0.20	 DO-201AD 166 mm^2
L1	Bourns	SRP1270-4R7M	L= 4.7 µH 11.2 mOhm	1	$0.72	 SRP1270 246 mm^2
M1	ON Semiconductor	NVMFS6B14NLT1G	VdsMax= 100.0 V IdsMax= 11.0 Amps	1	$2.31	 SO-8FL 58 mm^2
M2	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.11	DQK0006C 9 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	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsense	Rohm	PMR100HZPFU6L00 Series= ?	Res= 6.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.14	 2512 43 mm^2
Rt	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv1	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 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

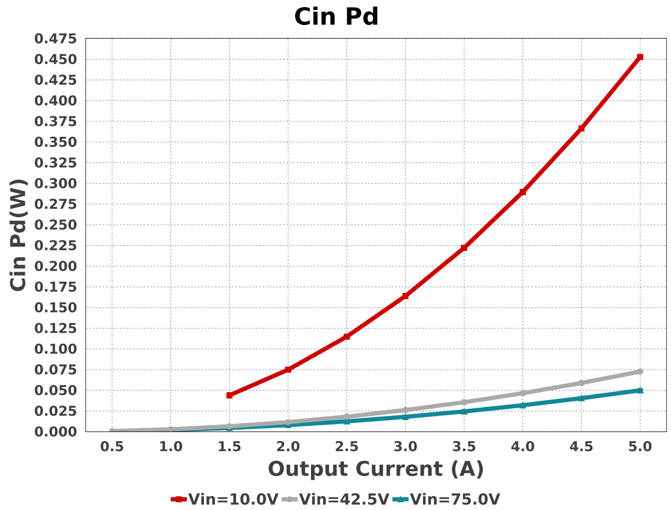
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LM5118MH/NOPB	Switcher	1	$2.76	 MXA20A 71 mm^2

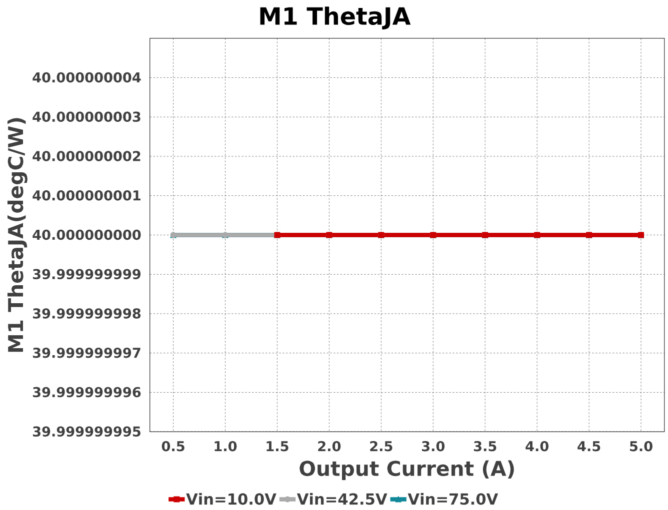


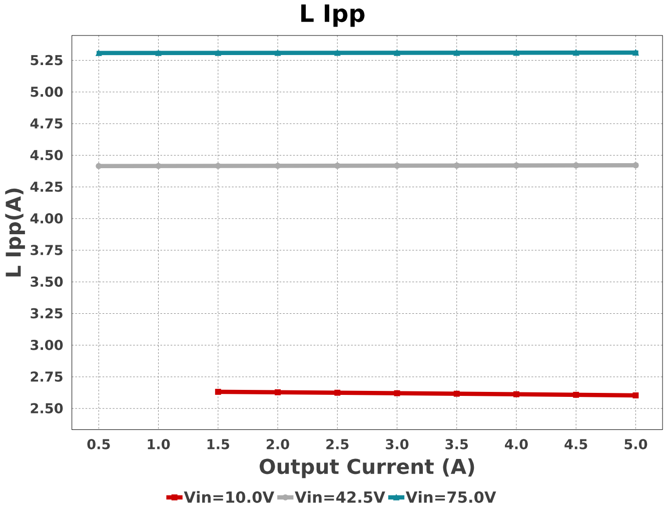


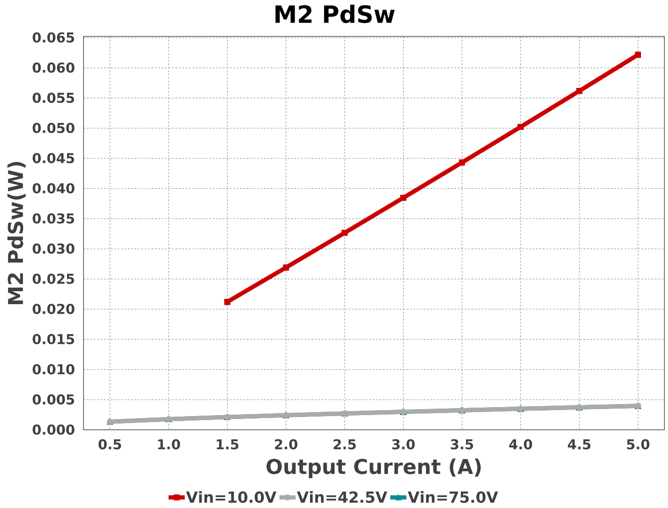


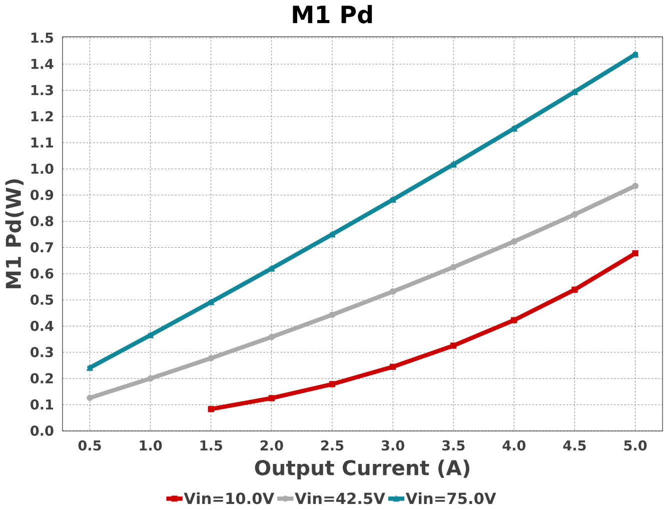


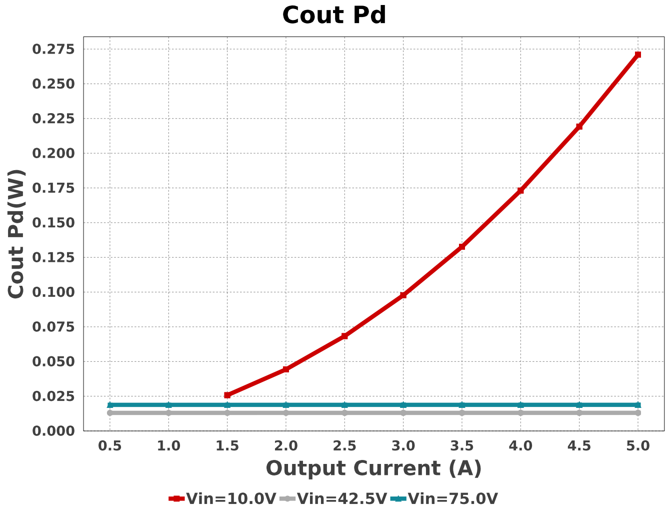


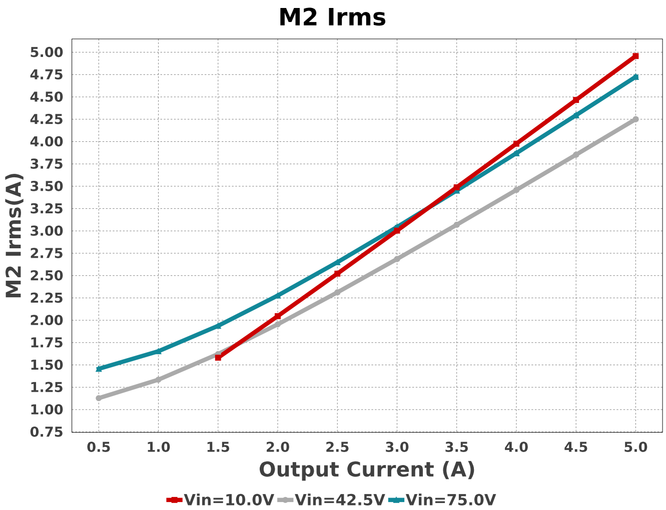


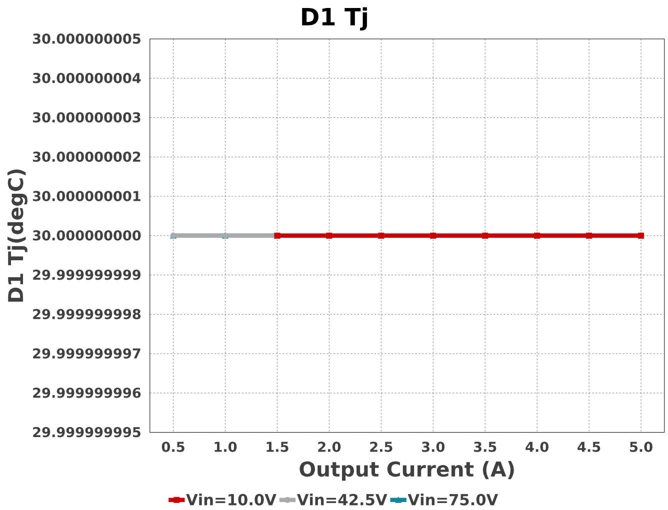

L Ipp
L Ipp(A)
5.25
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

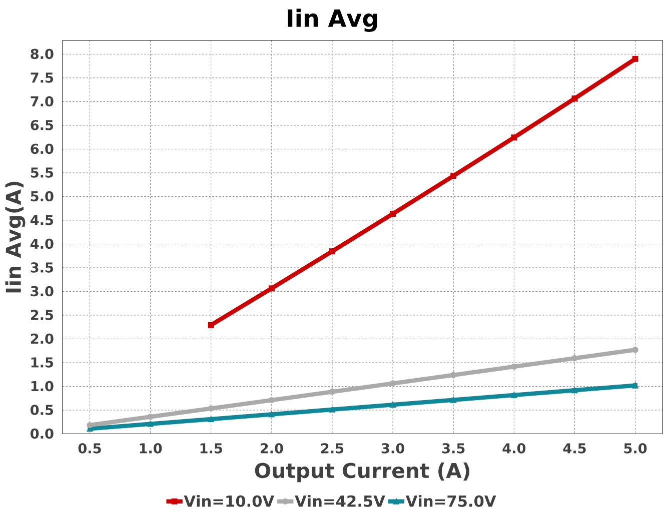

M2 PdSw
M2 PdSw(W)
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V


M1 Pd
M1 Pd(W)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

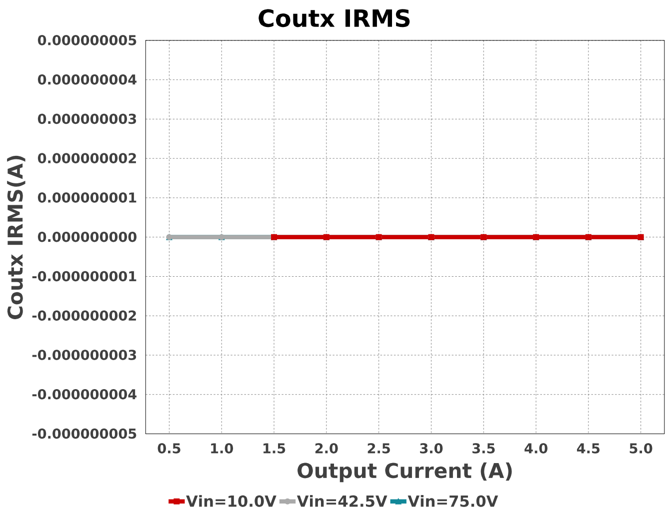

Cout Pd
Cout Pd(W)
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V


M2 Irms
M2 Irms(A)
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

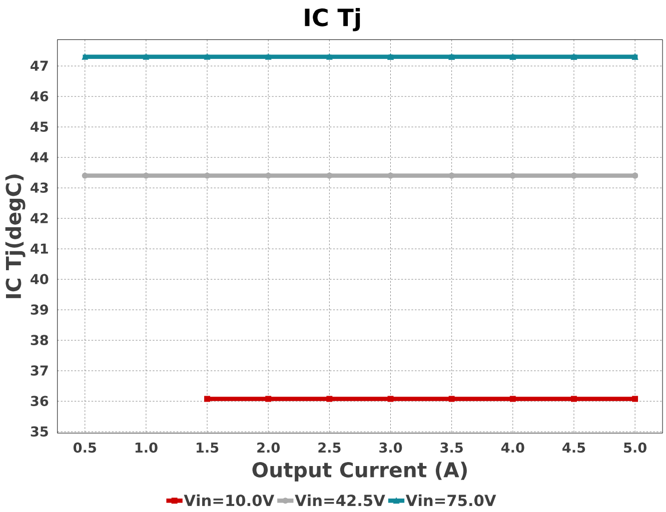

D1 Tj
D1 Tj(degC)
30.000000005
30.000000004
30.000000003
30.000000002
30.000000001
30.000000000
29.999999999
29.999999998
29.999999997
29.999999996
29.999999995
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V



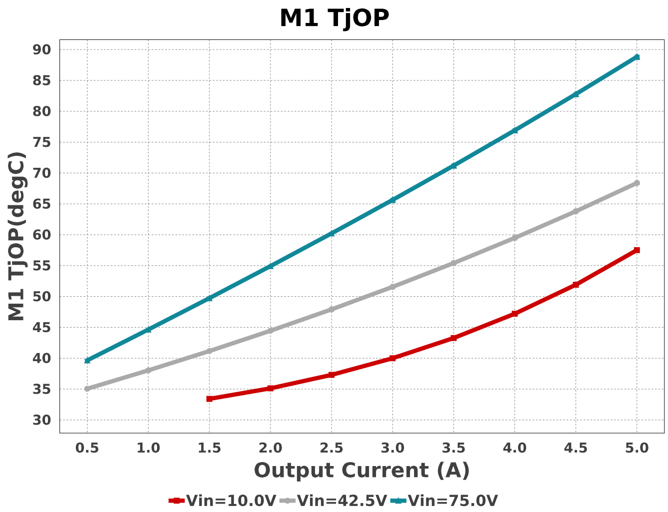
Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V



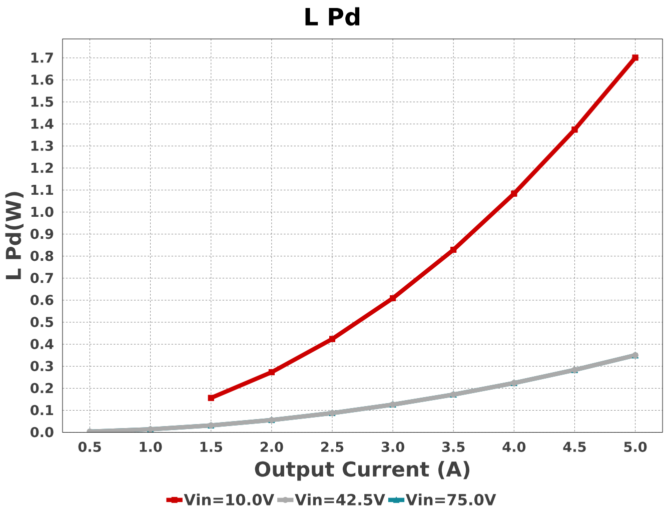
Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V



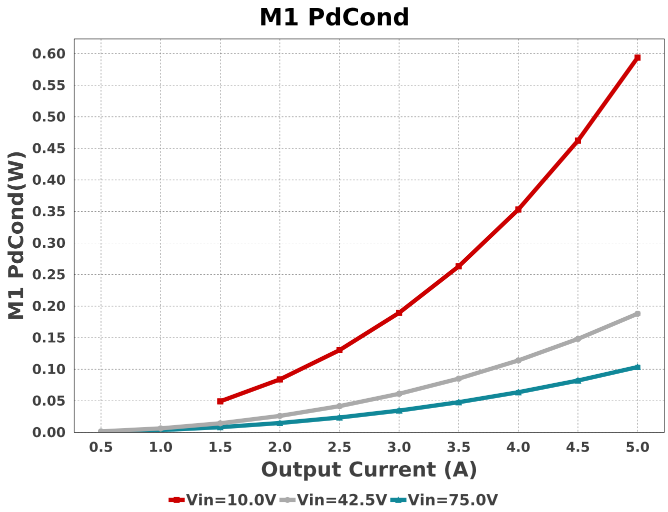
IC Tj
IC Tj(degC)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V



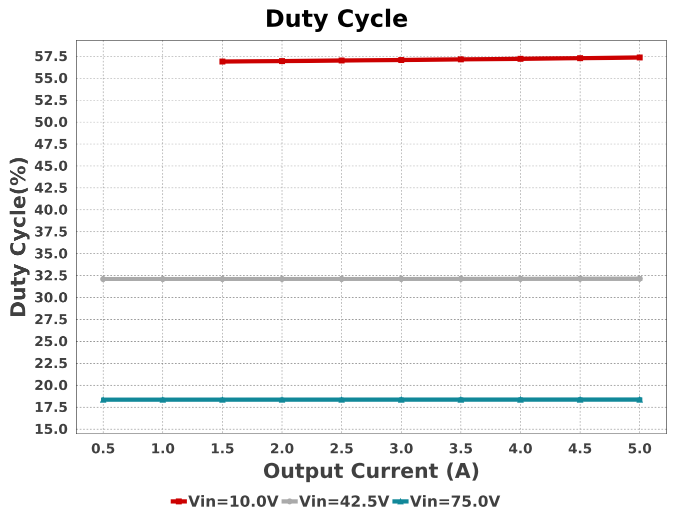
M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

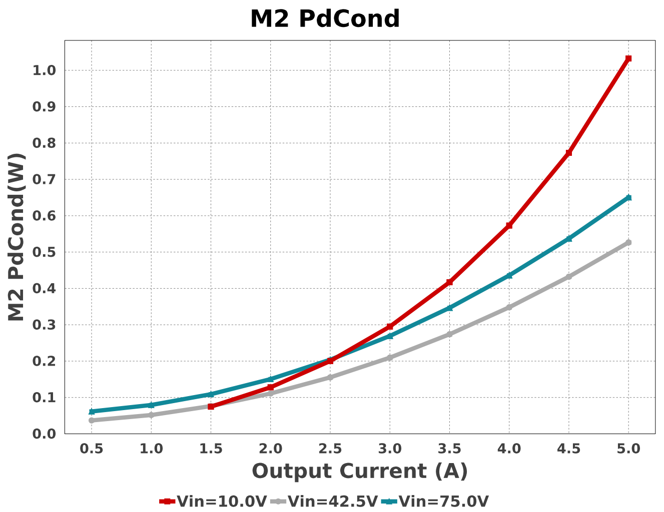


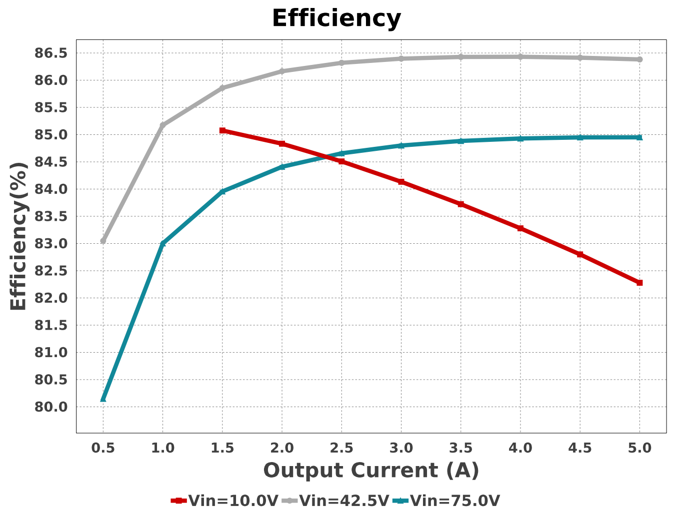
L Pd
L Pd(W)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

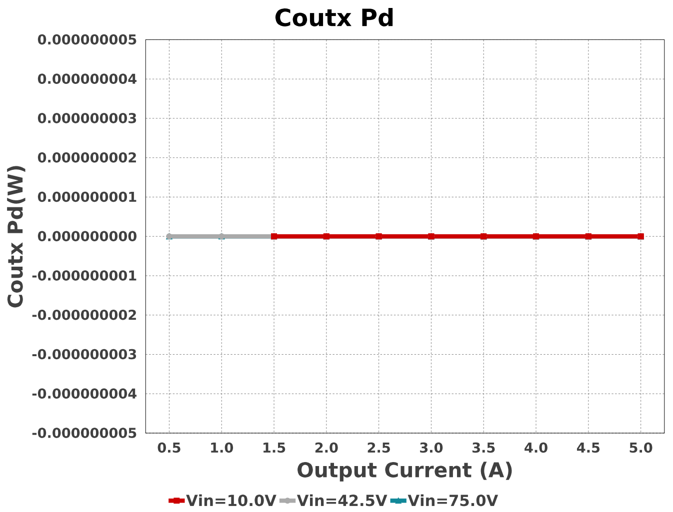


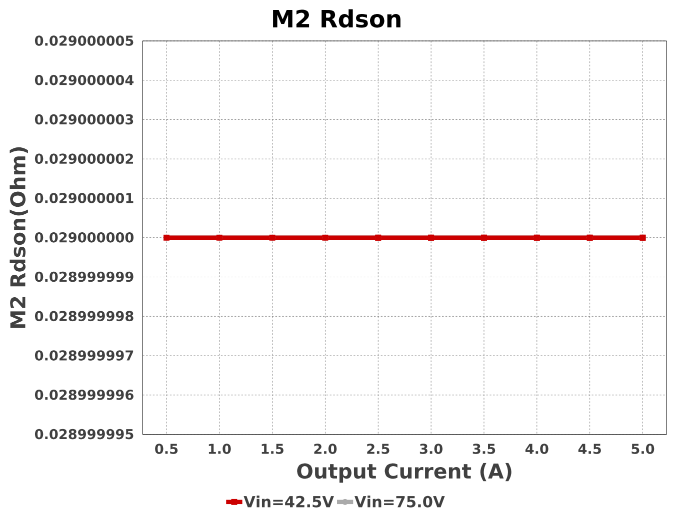
M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

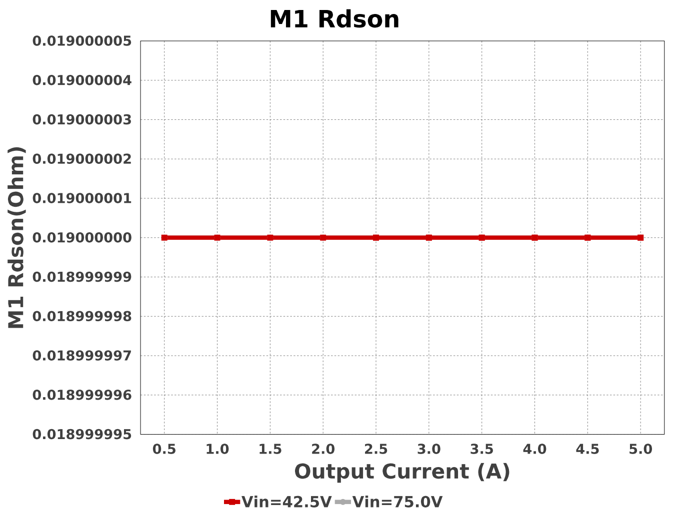

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V


M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

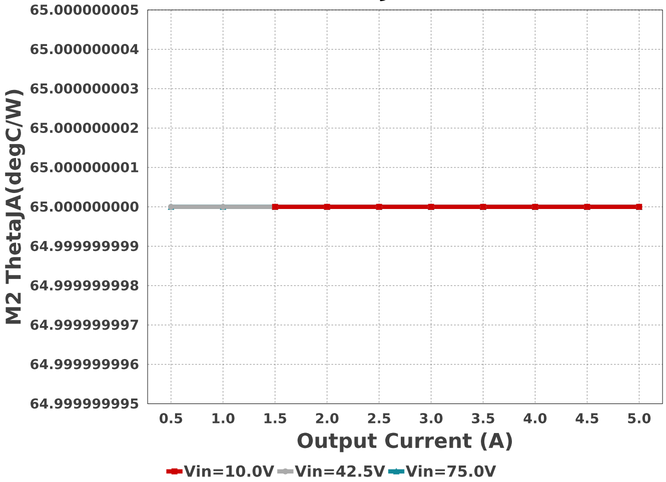

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V


Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=10.0V
Vin=42.5V
Vin=75.0V

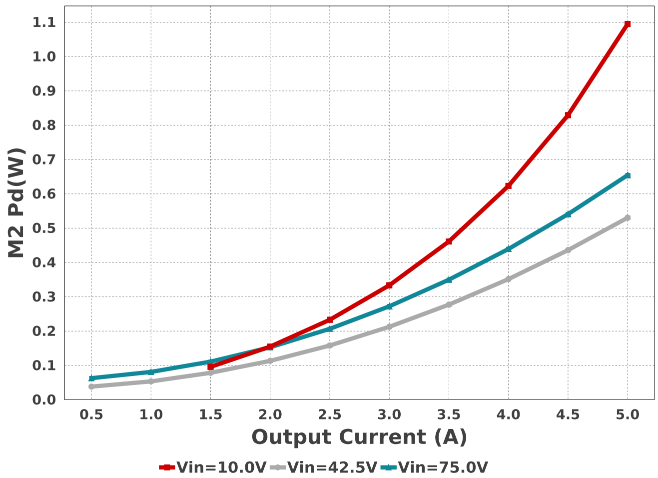

M2 Rdson
M2 Rdson(Ohm)
Output Current (A)
Vin=42.5V
Vin=75.0V


M1 Rdson
M1 Rdson(Ohm)
Output Current (A)
Vin=42.5V
Vin=75.0V

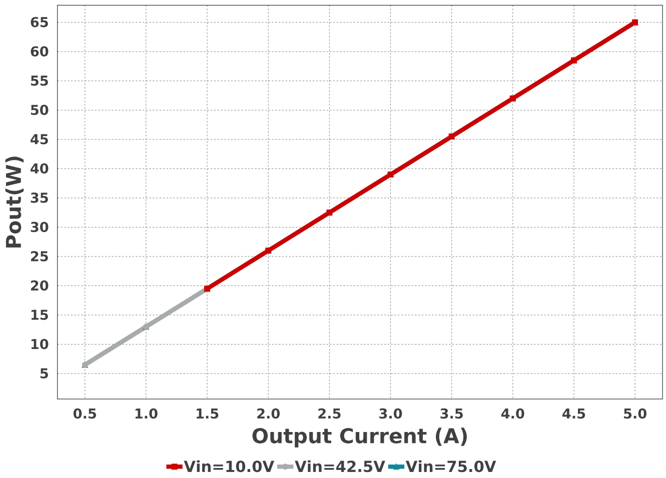
M2 ThetaJA



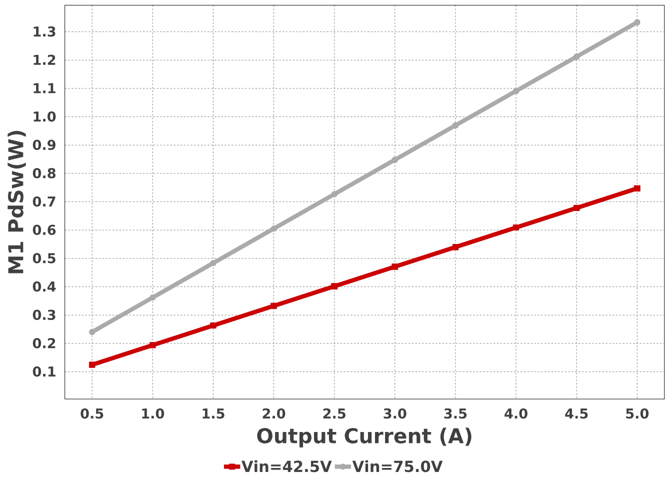
M2 Pd



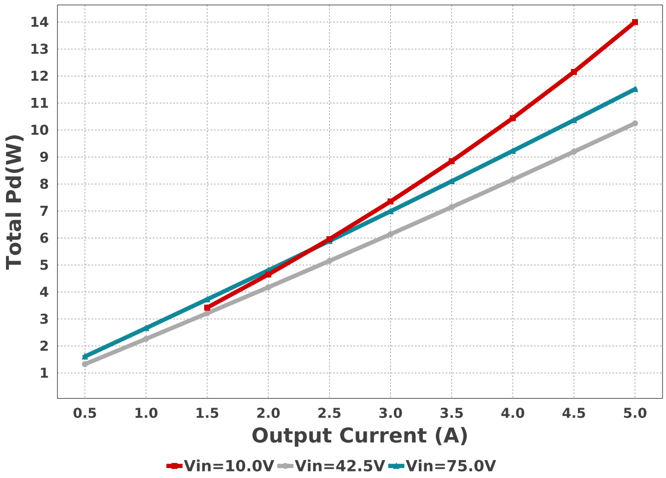
Pout



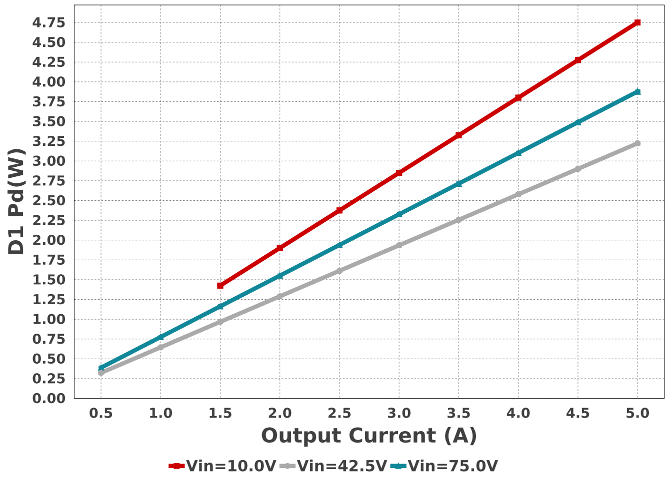
M1 PdSw



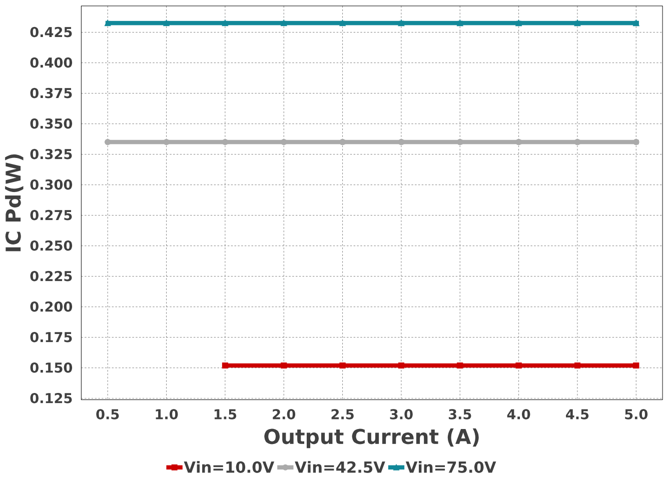
Total Pd



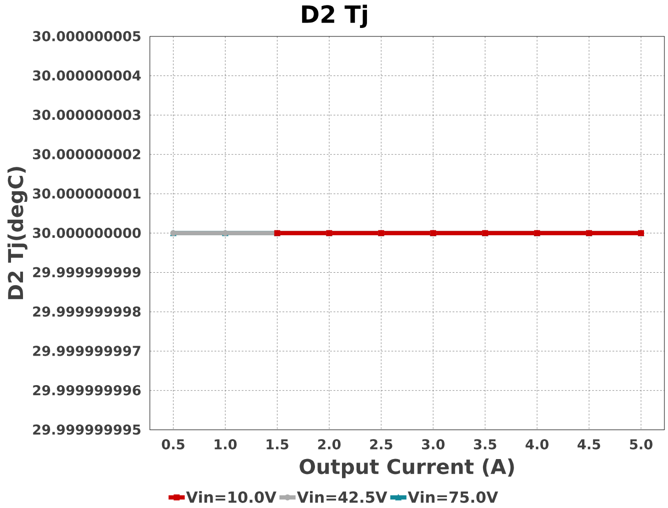
D1 Pd



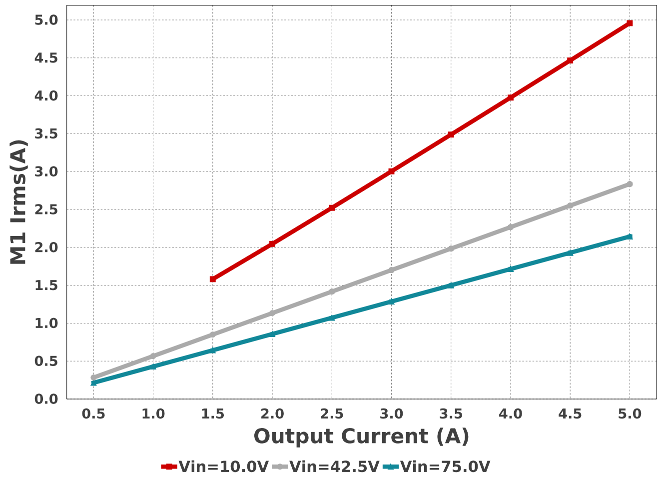
IC Pd



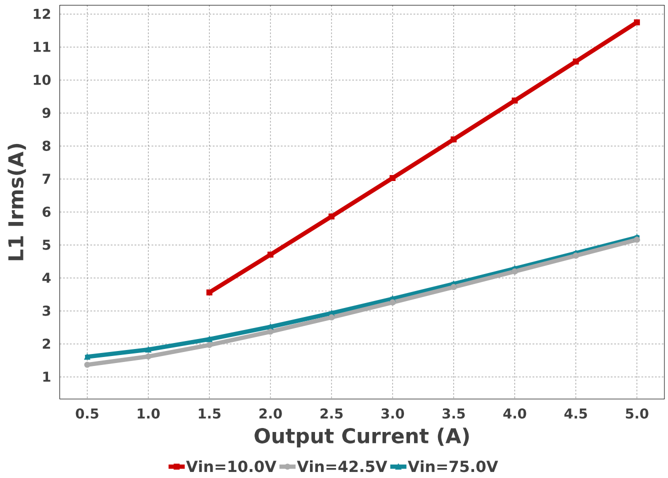
D2 Tj



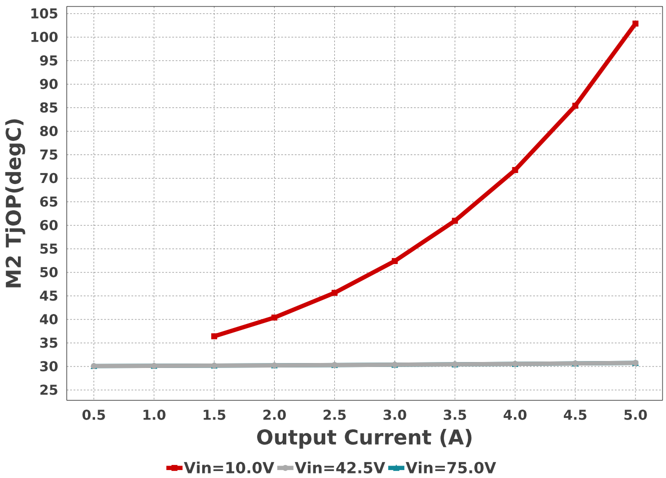
M1 Irms



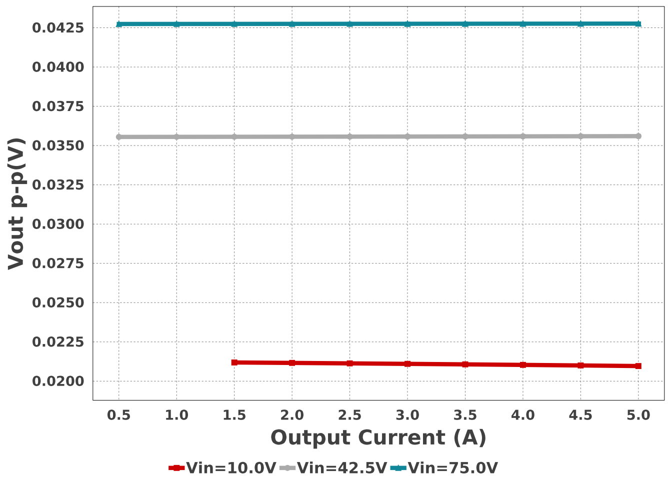
L1 Irms

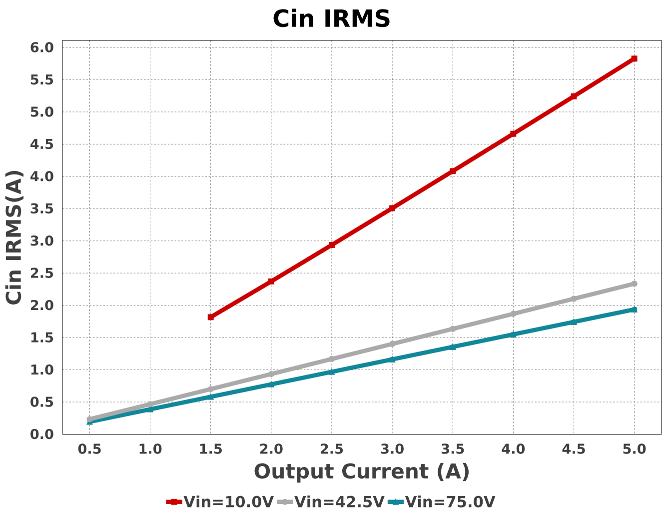


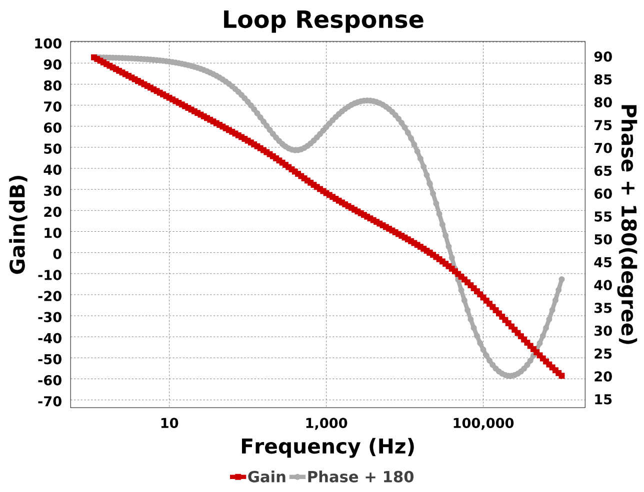
M2 TjOP



Vout p-p







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.937 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	50.016 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.533 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	18.817 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.	D1 Pd	3.877 W	Diode	Diode power dissipation
8.	D1 Tj	30.0 degC	Diode	D1 junction temperature
9.	D2 Pd	5.25 W	Diode	Diode2 power dissipation
10.	IC Pd	432.56 mW	IC	IC power dissipation
11.	IC Tj	47.302 degC	IC	IC junction temperature
12.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
13.	ICThetaJA	40.0 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	1.02 A	IC	Average input current
15.	L Ipp	5.311 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	350.0 mW	Inductor	Inductor power dissipation
17.	L1 Irms	5.23 A	Inductor	Inductor ripple current
18.	M1 Irms	2.144 A	Mosfet	MOSFET RMS ripple current
19.	M1 Pd	1.488 W	Mosfet	MOSFET power dissipation
20.	M1 PdCond	155.04 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 PdSw	1.333 W	Mosfet	M1 MOSFET switching losses
22.	M1 Rdson	19.0 mOhm	Mosfet	Drain-Source On-resistance
23.	M1 ThetaJA	40.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
24.	M1 TjOP	88.831 degC	Mosfet	MOSFET junction temperature
25.	M2 Irms	4.725 A	Mosfet	MOSFET RMS ripple current
26.	M2 Pd	664.76 mW	Mosfet	MOSFET power dissipation
27.	M2 PdCond	651.01 mW	Mosfet	M2 MOSFET conduction losses
28.	M2 PdSw	13.75 mW	Mosfet	M2 MOSFET switching losses
29.	M2 Rdson	29.0 mOhm	Mosfet	Drain-Source On-resistance
30.	M2 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
31.	M2 TjOP	30.76 degC	Mosfet	MOSFET junction temperature
32.	Cin Pd	50.004 mW	Power	Input capacitor power dissipation
33.	Cout Pd	18.805 mW	Power	Output capacitor power dissipation
34.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
35.	D1 Pd	3.877 W	Power	Diode power dissipation
36.	D2 Pd	5.25 W	Power	Diode2 power dissipation
37.	IC Pd	432.56 mW	Power	IC power dissipation
38.	L Pd	350.0 mW	Power	Inductor power dissipation
39.	M1 Pd	1.437 W	Power	MOSFET power dissipation
40.	M1 PdCond	103.49 mW	Power	M1 MOSFET conduction losses
41.	M1 PdSw	1.333 W	Power	M1 MOSFET switching losses
42.	M2 Pd	654.41 mW	Power	MOSFET power dissipation
43.	M2 PdCond	650.45 mW	Power	M2 MOSFET conduction losses
44.	M2 PdSw	3.965 mW	Power	M2 MOSFET switching losses
45.	Rsense Pd	99.93 mW	Power	LED Current Rsns Power Dissipation
46.	Total Pd	11.515 W	Power	Total Power Dissipation
47.	Rsense Pd	99.915 mW	Resistor	LED Current Rsns Power Dissipation
48.	BOM Count	30	System Information	Total Design BOM count
49.	Cross Freq	20.726 kHz	System Information	Bode plot crossover frequency

#	Name	Value	Category	Description
50.	D2 Tj	30.0 degC	System Information	D2 junction temperature
51.	Duty Cycle	18.379 %	System Information	Duty cycle
52.	Efficiency	84.951 %	System Information	Steady state efficiency
53.	FootPrint	1.404 k mm^2	System Information	Total Foot Print Area of BOM components
54.	Frequency	456.491 kHz	System Information	Switching frequency
55.	Gain Marg	-49.679 dB	System Information	Bode Plot Gain Margin
56.	Iout	5.0 A	System Information	Iout operating point
57.	Low Freq Gain	92.743 dB	System Information	Gain at 1Hz
58.	Mode	CCM	System Information	Conduction Mode
59.	Operating Topology	Buck	System Information	The current operating topology of the device
60.	Phase Marg	62.335 deg	System Information	Bode Plot Phase Margin
61.	Pout	65.0 W	System Information	Total output power
62.	SW Ipk	7.656 A	System Information	Peak switch current
63.	Total BOM	$11.784	System Information	Total BOM Cost
64.	Vin	75.0 V	System Information	Vin operating point
65.	Vout	13.0 V	System Information	Operational Output Voltage
66.	Vout Actual	12.952 V	System Information	Vout Actual calculated based on selected voltage divider resistors
67.	Vout Tolerance	3.319 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
68.	Vout p-p	42.764 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
SoftStart	2.5 ms	Soft Start Time (ms)
VinMax	75.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	13.0	Output Voltage
base_pn	LM5118	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	460.0 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 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

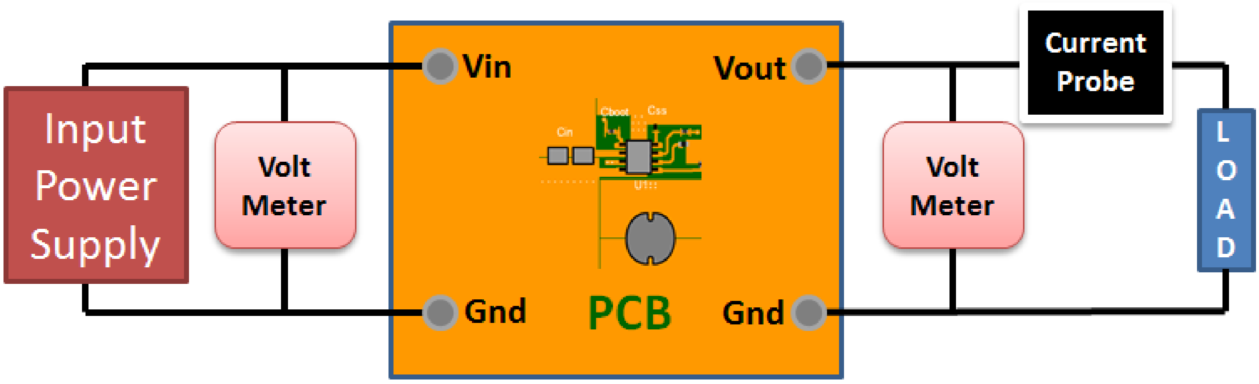
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 10.0V 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 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 : A58DB75E3AE313A2[v1]

3. **LM5118** Product Folder : http://www.ti.com/product/lm5118 : contains the data sheet and other resources.