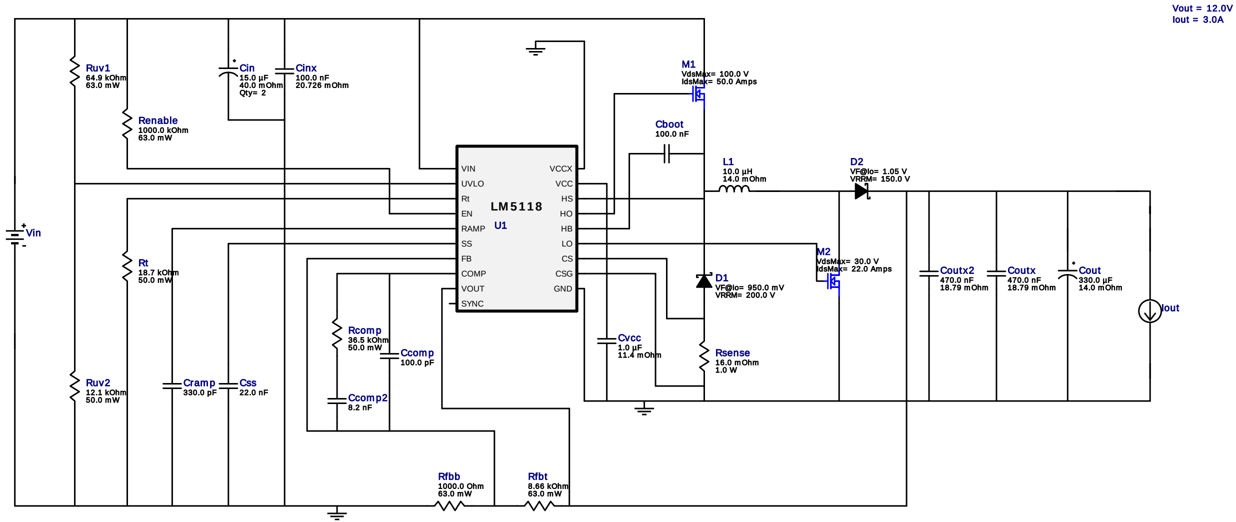
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 10.0V
VinMax = 60.0V
Vout = 12.0V
Iout = 3.0A

Device = LM5118MH/NOPB
Topology = Buck_Boost
Created = 2025-10-24 01:17:13.145
BOM Cost = $10.70
BOM Count = 26
Total Pd = 1.29W

Design : 3 LM5118MH/NOPB
LM5118MH/NOPB 10V-60V to 12.00V @ 3A

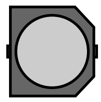
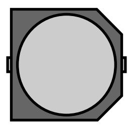


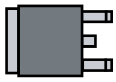
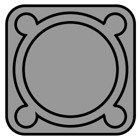
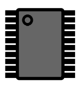
Design Alerts

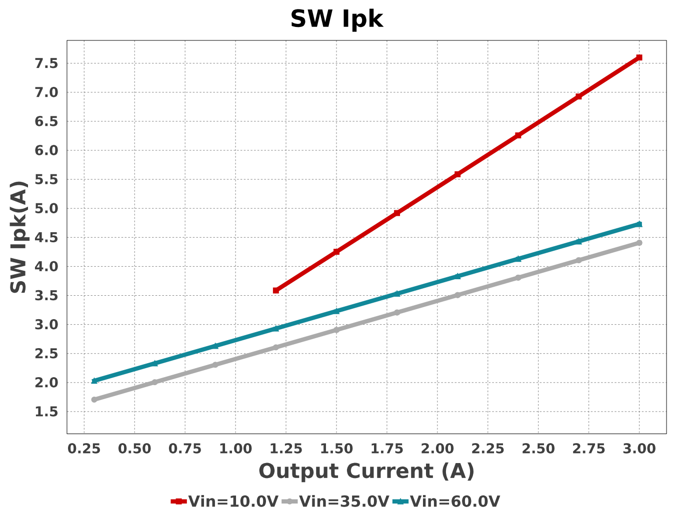
Component Selection Information

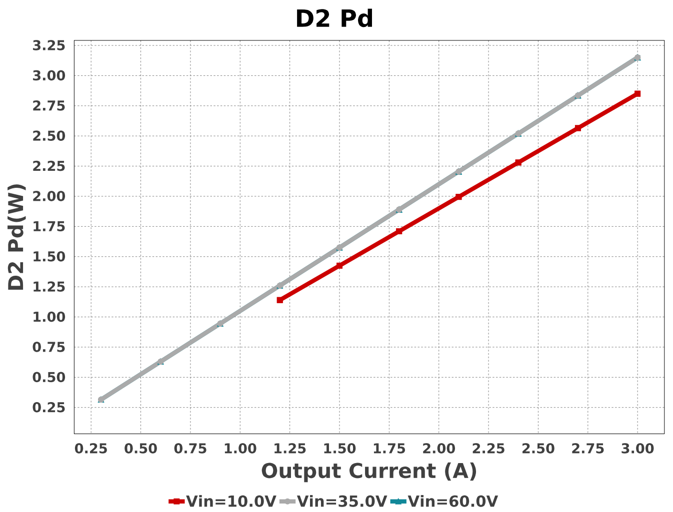
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

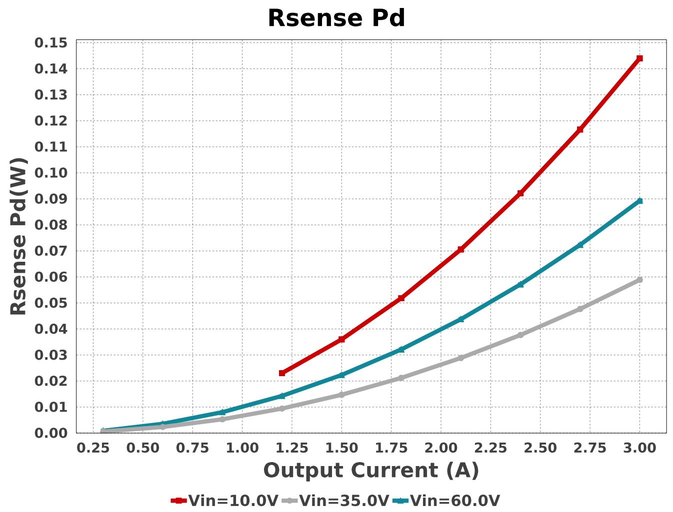
Electrical BOM

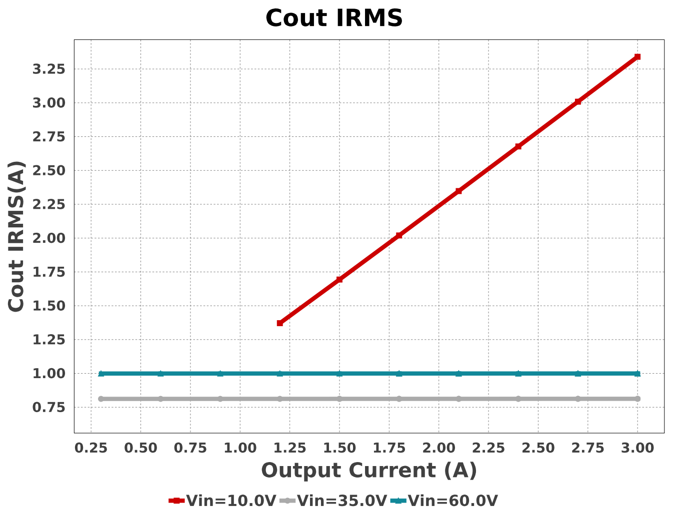
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
Ccomp	Samsung Electro-Mechanics	CL21C101JBANNNC Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp2	TDK	CGA4C2C0G1H822J060AA Series= C0G/NP0	Cap= 8.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
Cin	Panasonic	100SXV15M Series= SXV	Cap= 15.0 uF ESR= 40.0 mOhm VDC= 100.0 V IRMS= 2.35 A	2	$1.95	 CAPSMT_62_E12 106 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	25SVPF330M Series= SVPF	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	1	$1.33	 CAPSMT_62_F12 151 mm²
Coutx	TDK	C1005X6S1C474K050BC Series= X6S	Cap= 470.0 nF ESR= 18.79 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm²

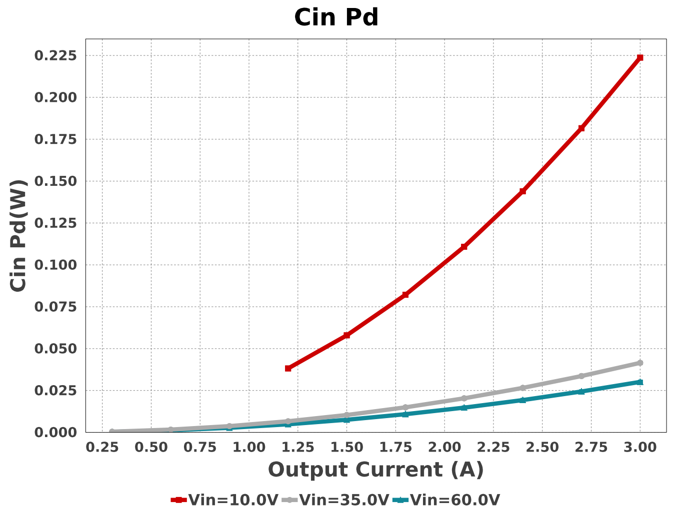
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	TDK	C1005X6S1C474K050BC Series= X6S	Cap= 470.0 nF ESR= 18.79 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm²
Cramp	Taiyo Yuden	UMK105CG331JV-F Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Css	TDK	C2012C0G1H223K125AA Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.08	0805 7 mm²
Cvcc	TDK	C1005X5R1E105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.4 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0402 3 mm²
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm²
D2	SMC Diode Solutions	SB10150TA	VF@Io= 1.05 V VRRM= 150.0 V	1	$0.26	 DO-201AD 166 mm²
L1	Coilcraft	MSS1210-103MEB	L= 10.0 µH 14.0 mOhm	1	$0.81	 MSS1210 204 mm²
M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.35	 DQG0008A 18 mm²
M2	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.10	DQK0006C 9 mm²
Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Renable	Vishay-Dale	CRCW04021M00FKED Series= CRCW..e3	Res= 1000.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
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 mm²
Rt	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Ruv1	Vishay-Dale	CRCW040264K9FKED Series= CRCW..e3	Res= 64.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Ruv2	Yageo	RC0201FR-0712K1L Series= ?	Res= 12.1 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
U1	Texas Instruments	LM5118MH/NOPB	Switcher	1	$3.18	 MXA20A 71 mm²

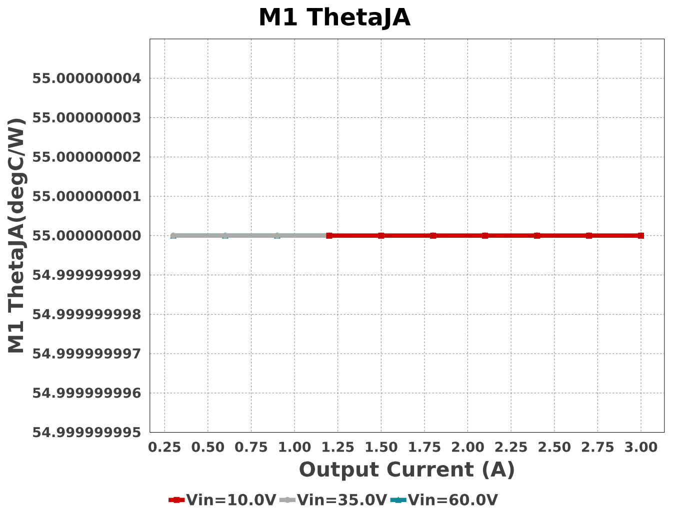

SW Ipk
SW Ipk(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


D2 Pd
D2 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

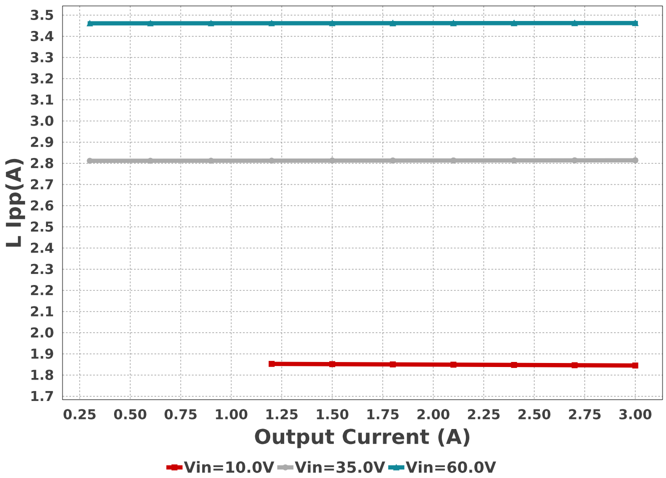

Rsense Pd
Rsense Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

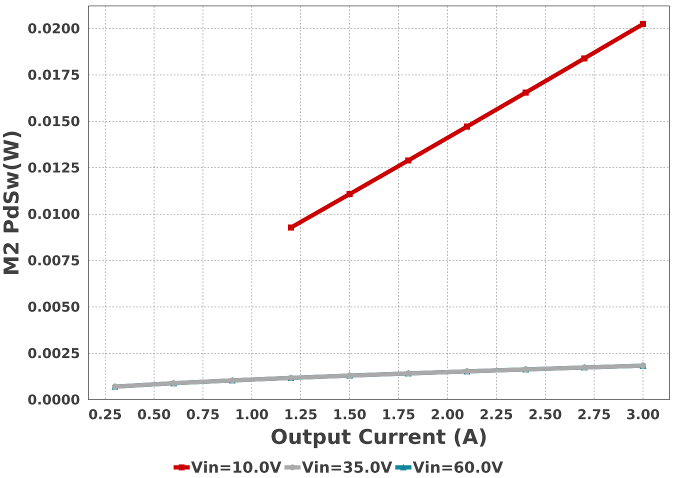

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


M1 ThetaJA
M1 ThetaJA(degC/W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

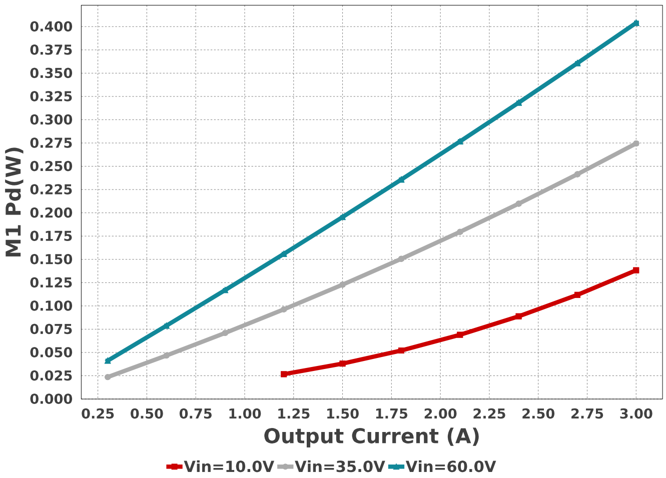
L Ipp



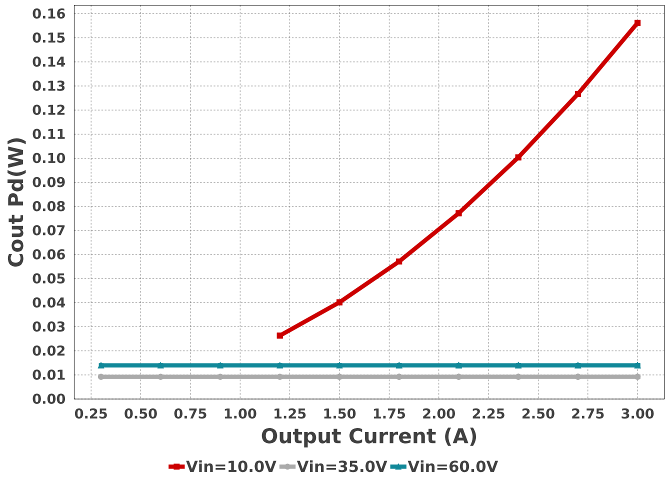
M2 PdSw



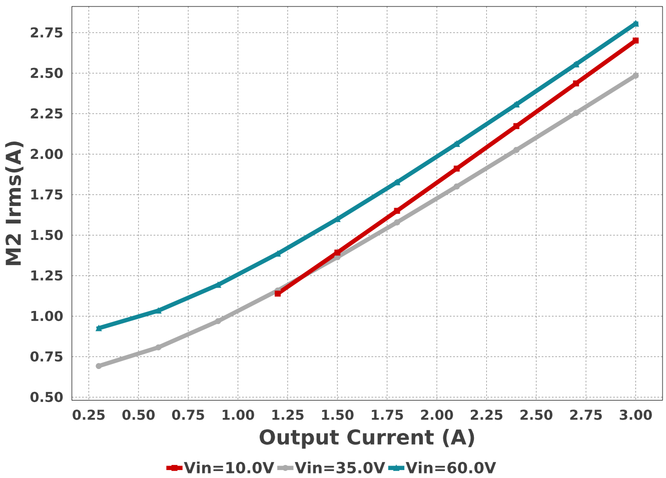
M1 Pd



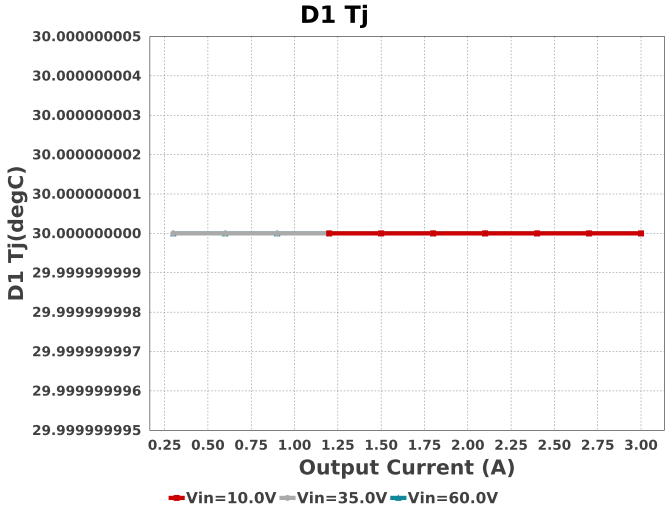
Cout Pd

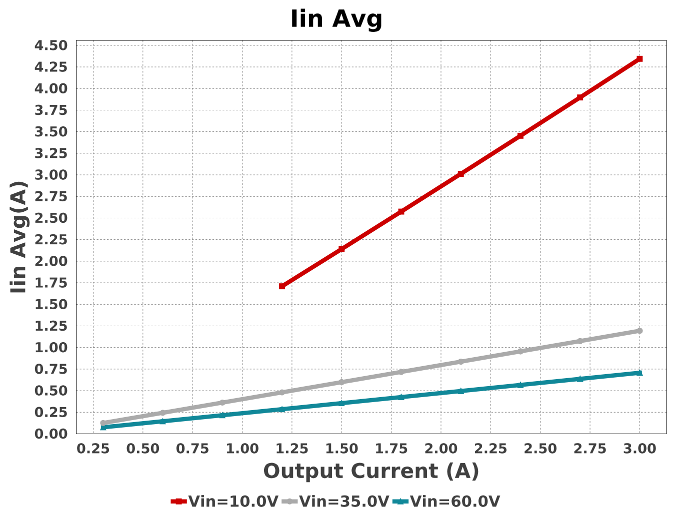


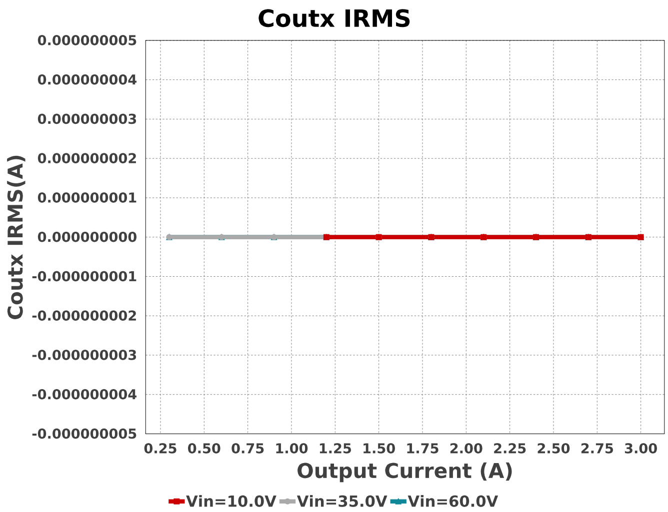
M2 Irms

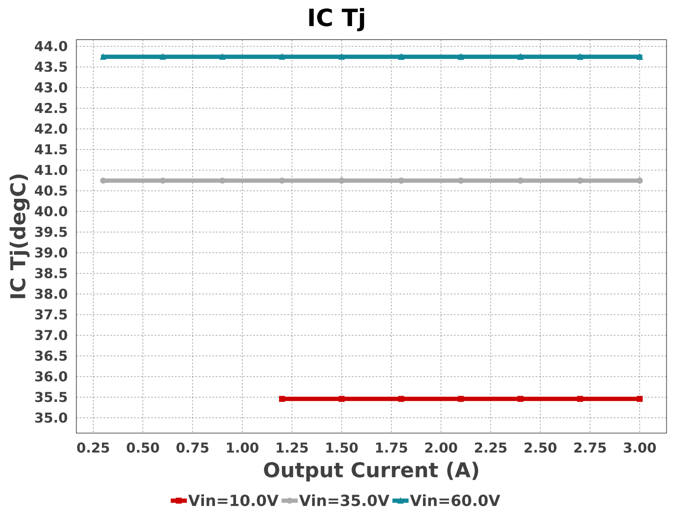


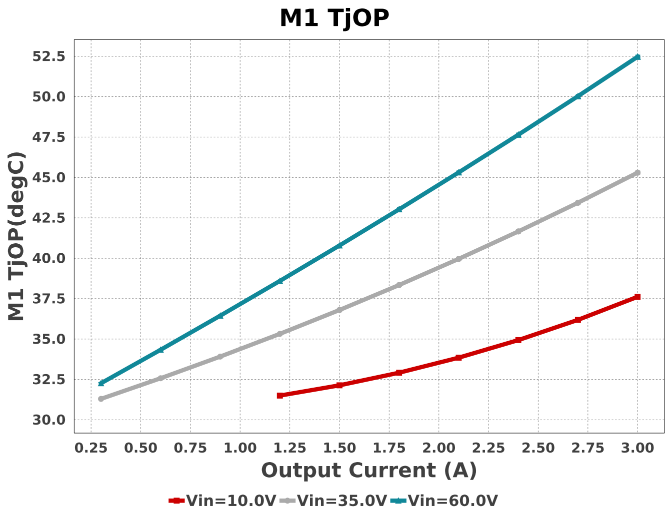
D1 Tj

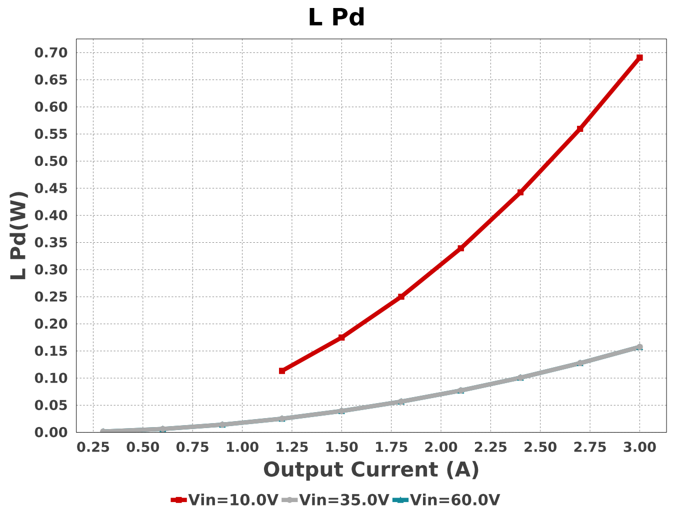


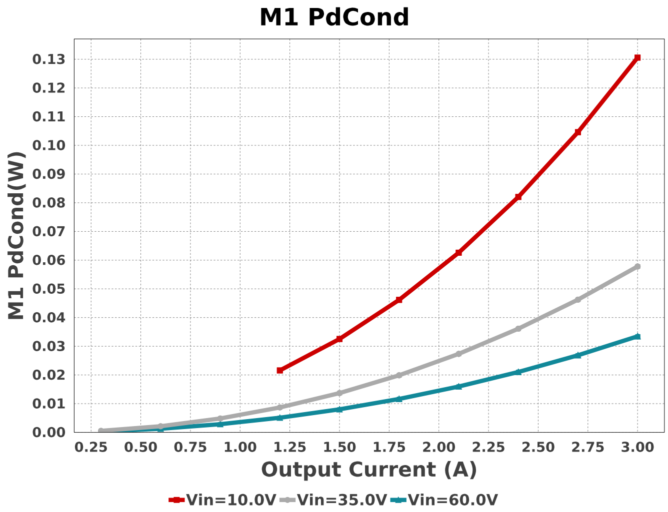

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

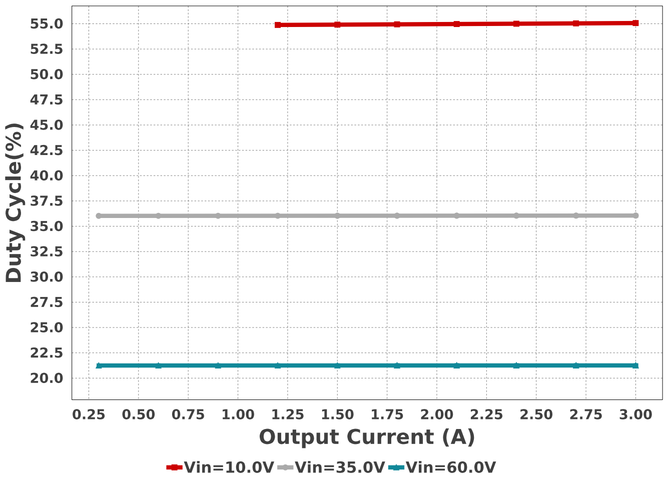

IC Tj
IC Tj(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

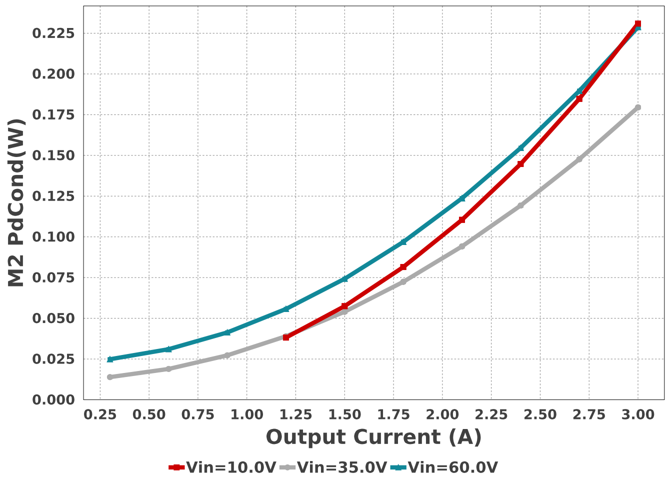

L Pd
L Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

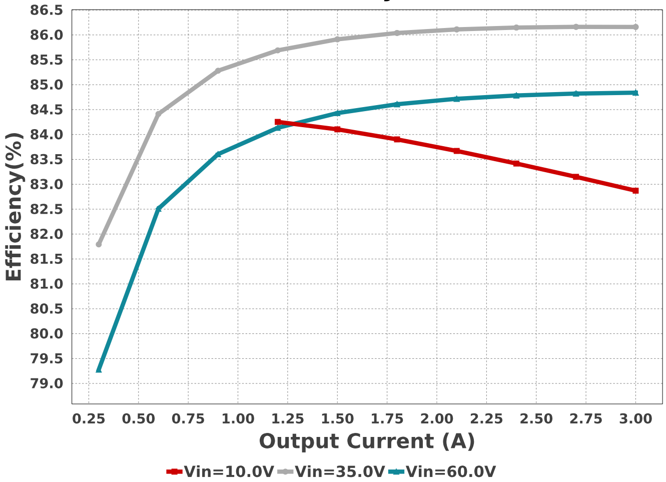
Duty Cycle



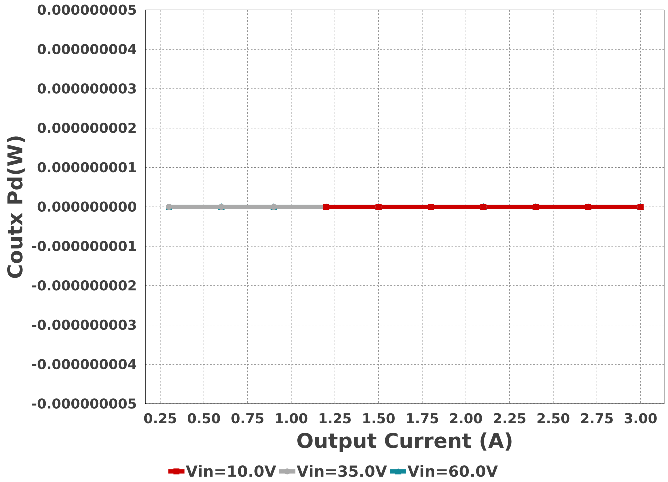
M2 PdCond



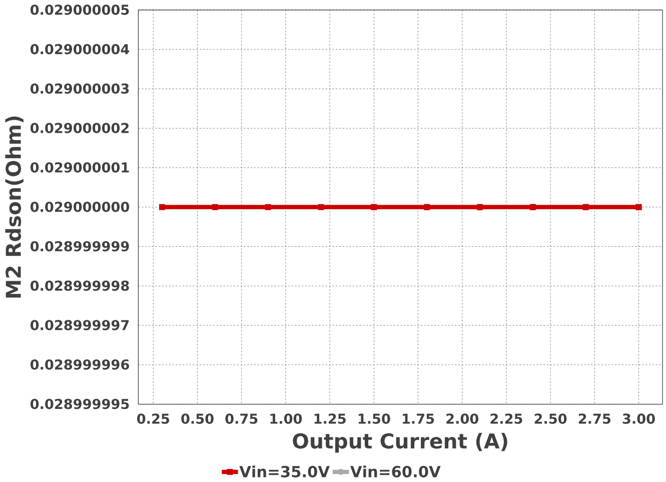
Efficiency



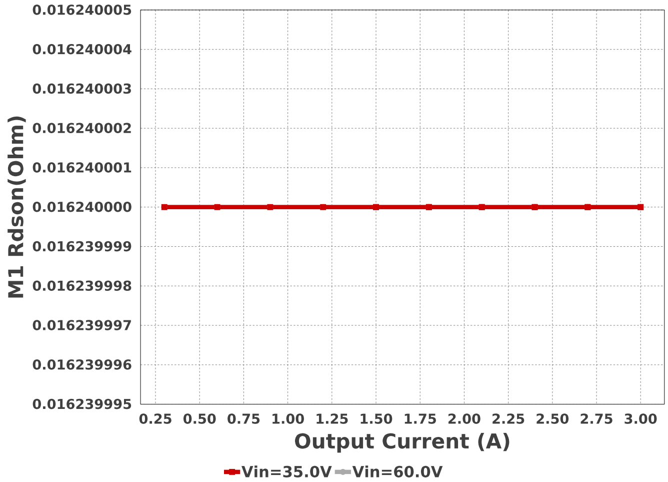
Coutx Pd

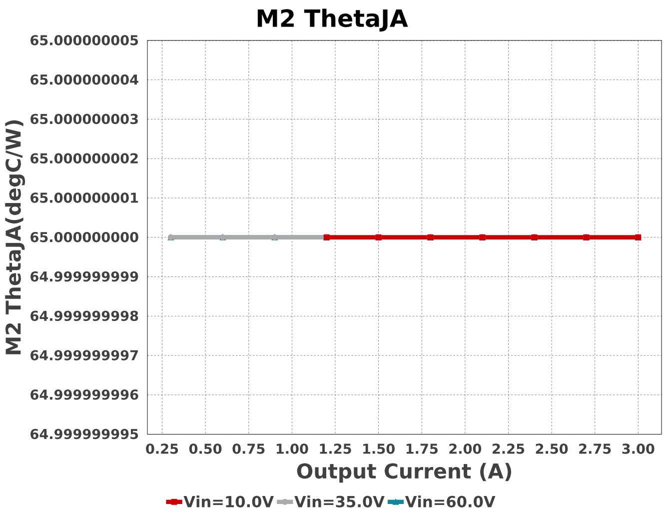


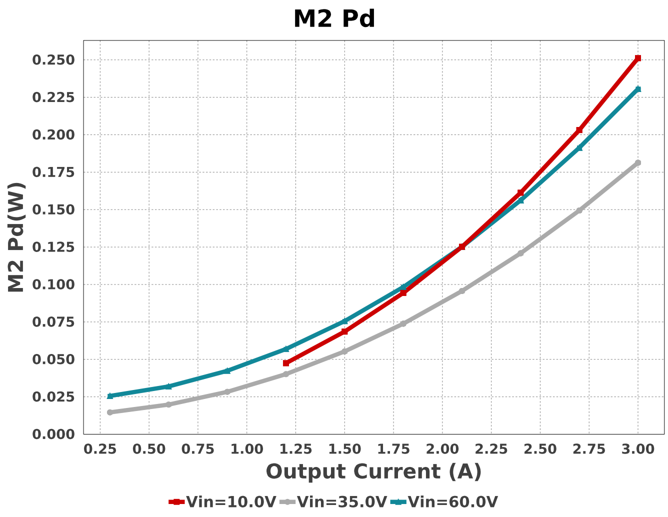
M2 Rdson

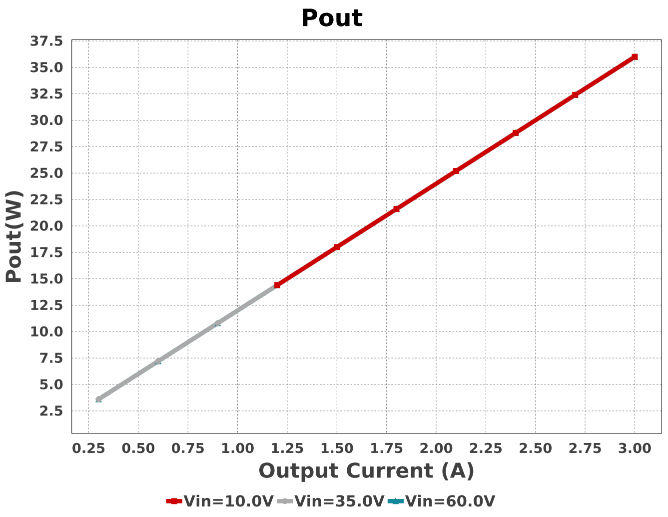


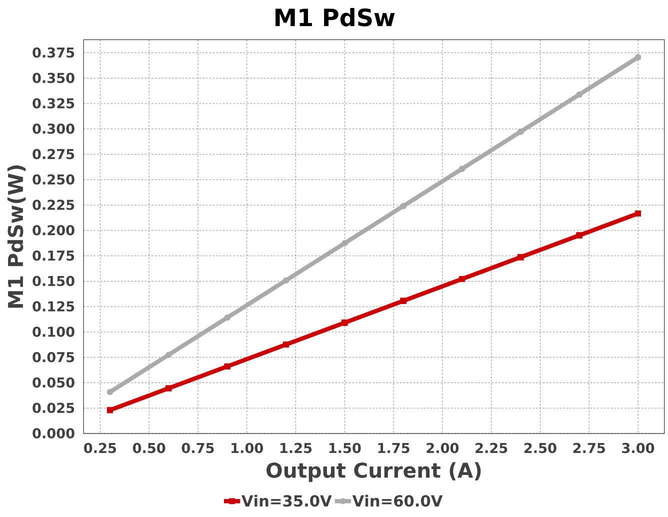
M1 Rdson

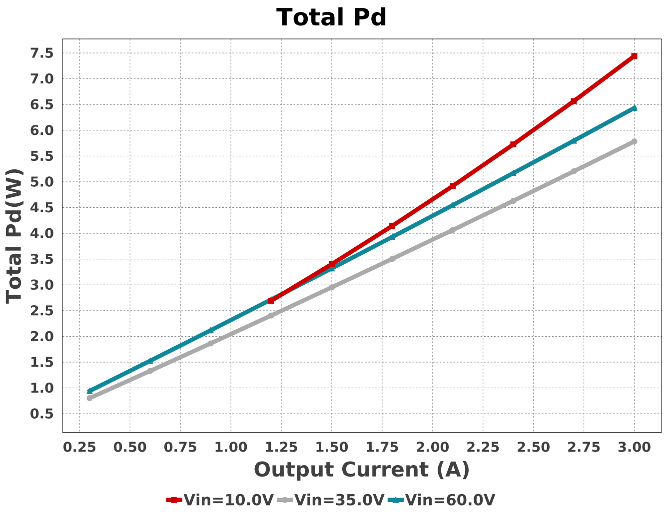


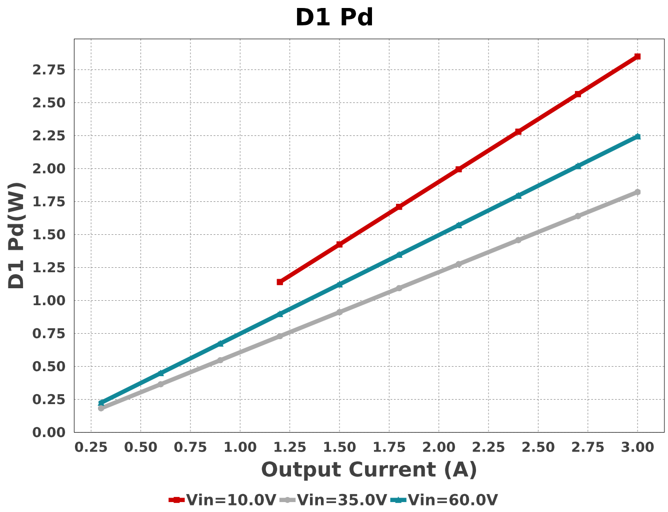

M2 ThetaJA
M2 ThetaJA(degC/W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

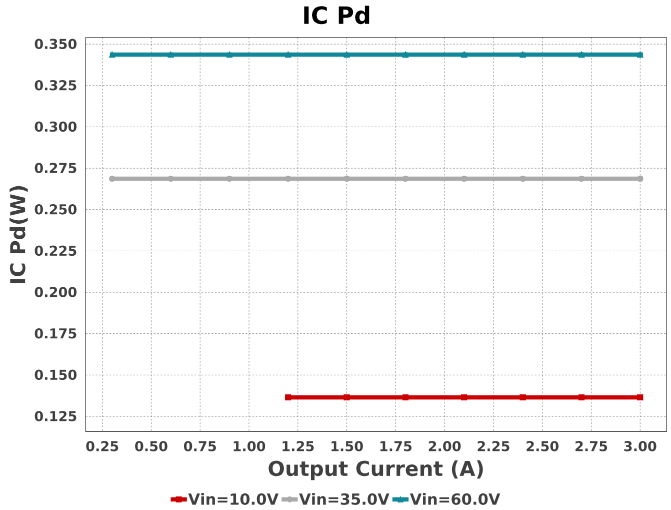

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

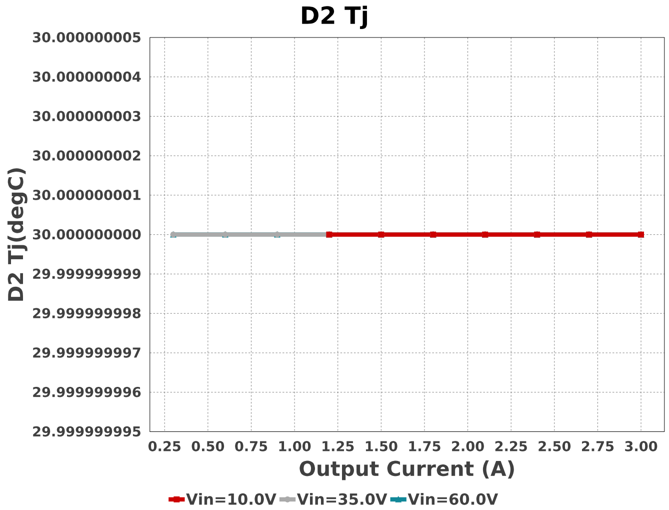

Pout
Pout(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

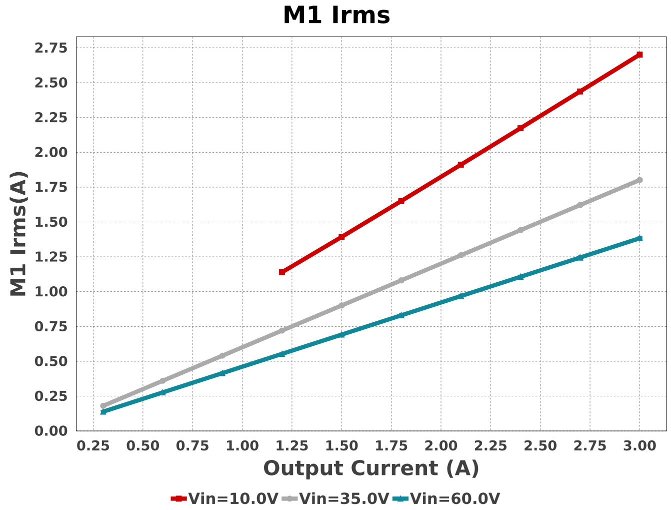

M1 PdSw
M1 PdSw(W)
Output Current (A)
Vin=35.0V Vin=60.0V

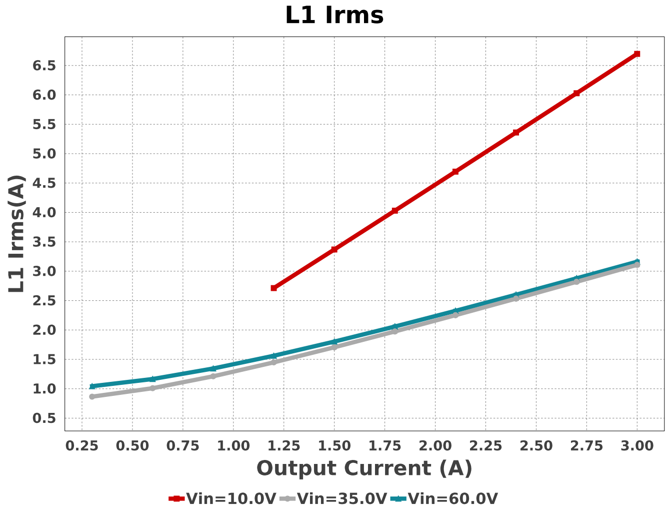

Total Pd
Total Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

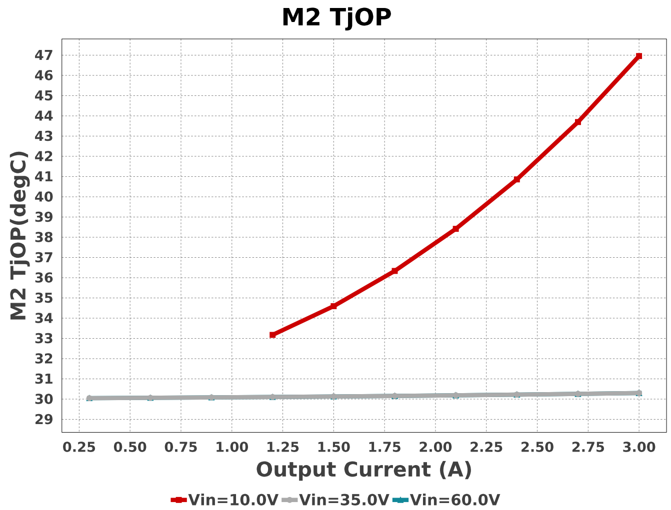

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

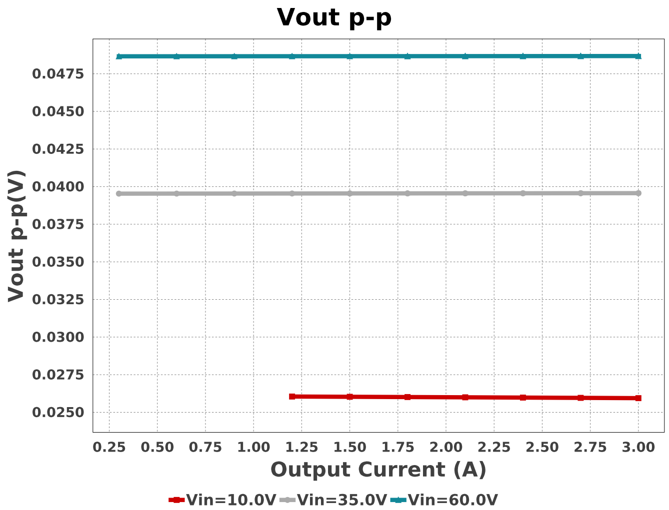

IC Pd
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
IC Pd(W)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

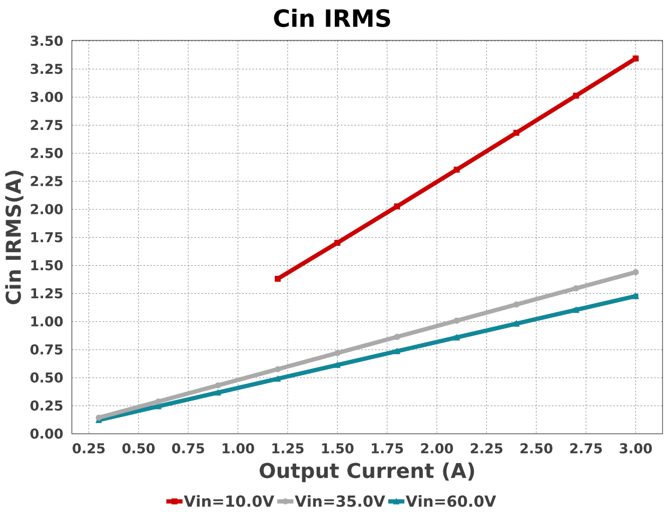

D2 Tj
30.000000005
30.000000004
30.000000003
30.000000002
30.000000001
30.000000000
29.999999999
29.999999998
29.999999997
29.999999996
29.999999995
D2 Tj(degC)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

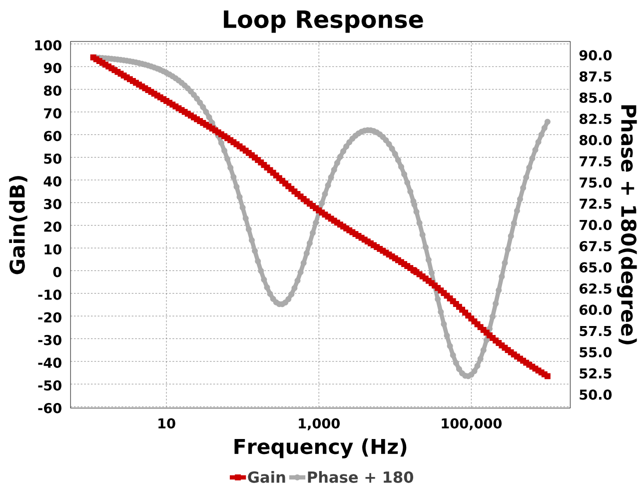

M1 Irms
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
M1 Irms(A)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


L1 Irms
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
L1 Irms(A)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


M2 TjOP
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31
30
29
M2 TjOP(degC)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


Vout p-p
0.0475
0.0450
0.0425
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
Vout p-p(V)
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.348 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	224.24 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	3.344 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	156.56 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	2.85 W	Diode	Diode power dissipation
8.	D1 Tj	30.0 degC	Diode	D1 junction temperature
9.	D2 Pd	2.85 W	Diode	Diode2 power dissipation
10.	IC Pd	346.48 mW	IC	IC power dissipation
11.	IC Tj	43.859 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	729.38 mA	IC	Average input current
15.	L Ipp	1.843 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	692.64 mW	Inductor	Inductor power dissipation
17.	L1 Irms	6.706 A	Inductor	Inductor ripple current
18.	M1 Irms	2.725 A	Mosfet	MOSFET RMS ripple current
19.	M1 Pd	202.49 mW	Mosfet	MOSFET power dissipation
20.	M1 PdCond	194.77 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
22.	M1 TjOP	37.745 degC	Mosfet	MOSFET junction temperature
23.	M2 Irms	2.725 A	Mosfet	MOSFET RMS ripple current
24.	M2 Pd	296.59 mW	Mosfet	MOSFET power dissipation
25.	M2 PdCond	276.35 mW	Mosfet	M2 MOSFET conduction losses
26.	M2 PdSw	20.243 mW	Mosfet	M2 MOSFET switching losses
27.	M2 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
28.	M2 TjOP	47.253 degC	Mosfet	MOSFET junction temperature
29.	Cin Pd	224.24 mW	Power	Input capacitor power dissipation
30.	Cout Pd	156.56 mW	Power	Output capacitor power dissipation
31.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
32.	D1 Pd	2.85 W	Power	Diode power dissipation
33.	D2 Pd	2.85 W	Power	Diode2 power dissipation
34.	IC Pd	346.48 mW	Power	IC power dissipation
35.	L Pd	692.64 mW	Power	Inductor power dissipation
36.	M1 Pd	202.49 mW	Power	MOSFET power dissipation
37.	M1 PdCond	194.77 mW	Power	M1 MOSFET conduction losses
38.	M2 Pd	296.59 mW	Power	MOSFET power dissipation
39.	M2 PdCond	276.35 mW	Power	M2 MOSFET conduction losses
40.	M2 PdSw	20.243 mW	Power	M2 MOSFET switching losses
41.	Rsense Pd	144.0 mW	Power	LED Current Rsns Power Dissipation
42.	Total Pd	1.294 W	Power	Total Power Dissipation
43.	Rsense Pd	144.0 mW	Resistor	LED Current Rsns Power Dissipation
44.	BOM Count	26	System Information	Total Design BOM count
45.	Cross Freq	10.214 kHz	System Information	Bode plot crossover frequency
46.	D2 Tj	58.5 degC	System Information	D2 junction temperature
47.	Duty Cycle	55.126 %	System Information	Duty cycle

#	Name	Value	Category	Description
48.	Efficiency	82.261 %	System Information	Steady state efficiency
49.	FootPrint	1.01 k mm^2	System Information	Total Foot Print Area of BOM components
50.	Frequency	294.659 kHz	System Information	Switching frequency
51.	Gain Marg	-40.218 dB	System Information	Bode Plot Gain Margin
52.	Iout	3.0 A	System Information	Iout operating point
53.	Low Freq Gain	91.12 dB	System Information	Gain at 1Hz
54.	Mode	CCM	System Information	Conduction Mode
55.	Operating Topology	Buck-Boost	System Information	The current operating topology of the device
56.	Phase Marg	75.762 deg	System Information	Bode Plot Phase Margin
57.	Pout	36.0 W	System Information	Total output power
58.	SW Ipk	7.607 A	System Information	Peak switch current
59.	Total BOM	$10.7	System Information	Total BOM Cost
60.	Vin	10.0 V	System Information	Vin operating point
61.	Vout	12.0 V	System Information	Operational Output Voltage
62.	Vout Actual	11.882 V	System Information	Vout Actual calculated based on selected voltage divider resistors
63.	Vout Tolerance	3.301 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
64.	Vout p-p	25.907 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
SoftStart	2.5 ms	Soft Start Time (ms)
VinMax	60.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM5118	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	300.0 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

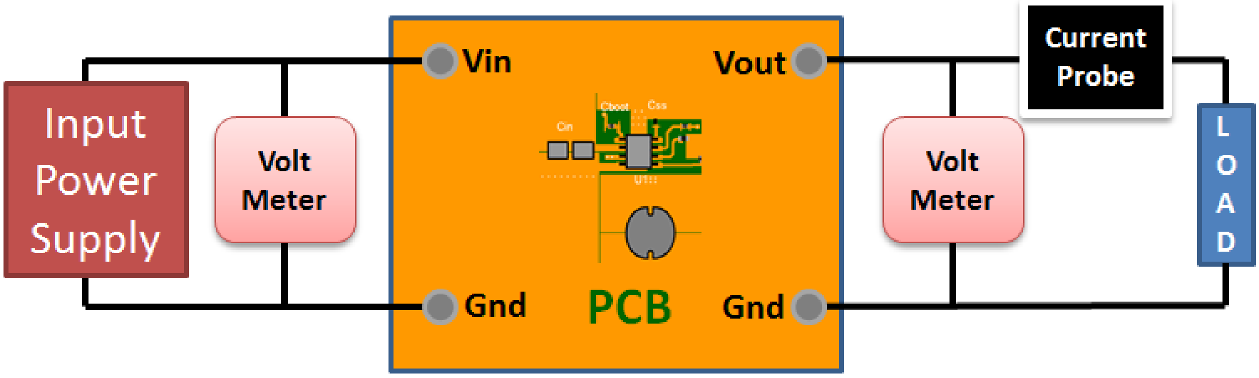
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 : 0729870FC81751C433BB4D4F5F9FB289[v1]

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