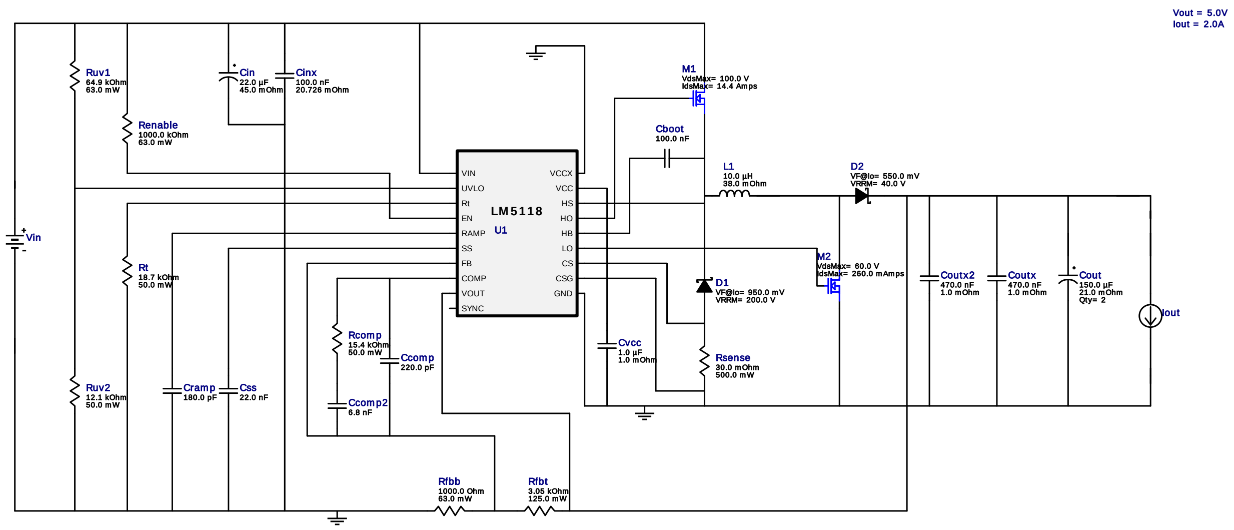
WEBENCH® Design Report

VinMin = 10.0V
VinMax = 60.0V
Vout = 5.0V
Iout = 2.0A

Device = LM5118MH/NOPB
Topology = Buck_Boost
Created = 2025-10-24 01:17:13.145
BOM Cost = $7.71
BOM Count = 26
Total Pd = 3.02W

Design : 3 LM5118MH/NOPB
LM5118MH/NOPB 10V-60V to 5.00V @ 2.0A

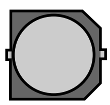
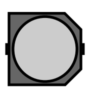


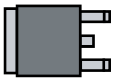
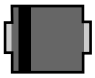
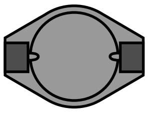
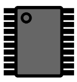
Design Alerts

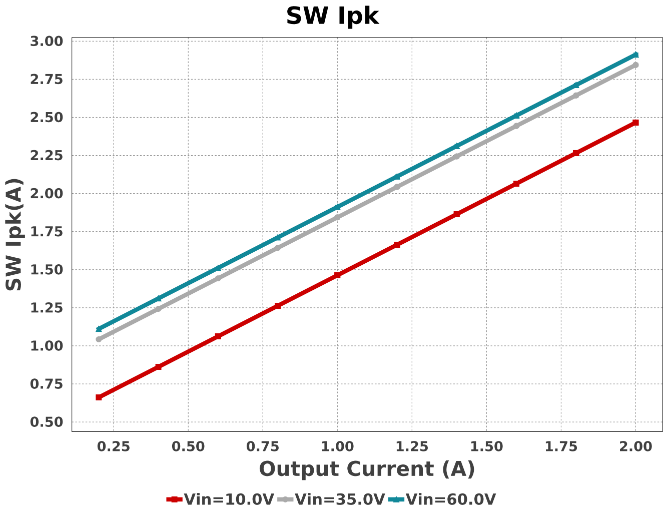
Component Selection Information

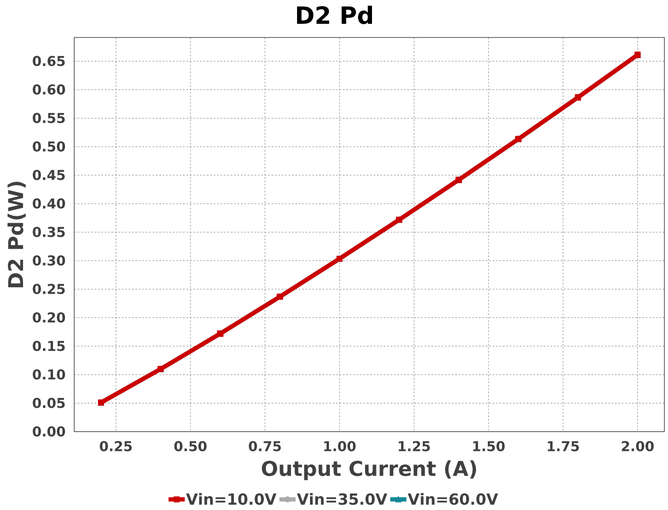
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

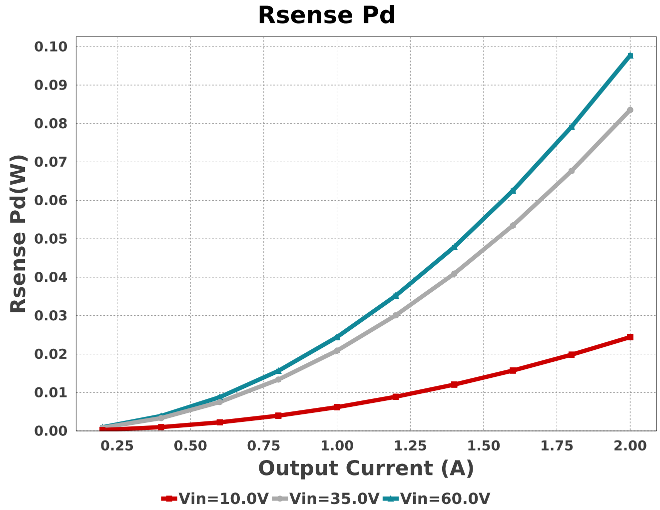
Electrical BOM

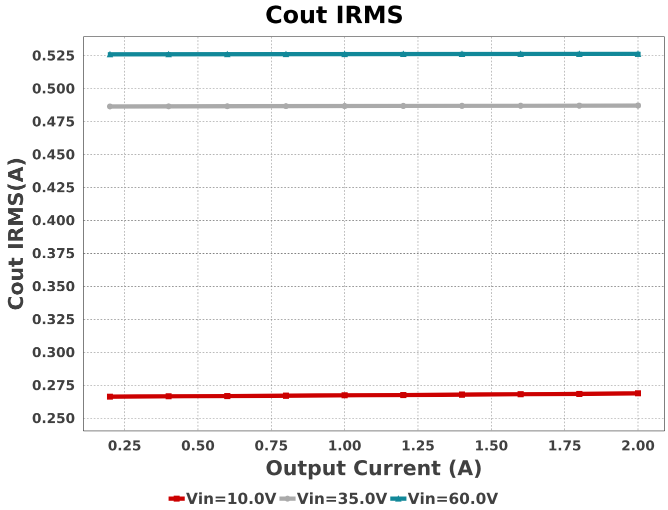
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
Ccomp	Samsung Electro-Mechanics	CL21C221JBANNNC Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
Ccomp2	TDK	C2012C0G1H682J060AA Series= C0G/NP0	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
Cin	Panasonic	EEHZA1K220P Series= ZA	Cap= 22.0 uF ESR= 45.0 mOhm VDC= 80.0 V IRMS= 1.55 A	1	$1.31	 SM_RADIAL_8MM 113 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	Chemi-Con	APXE100ARA151MF80G Series= PXE	Cap= 150.0 uF ESR= 21.0 mOhm VDC= 10.0 V IRMS= 2.88 A	2	$0.92	 CAPSMT_62_F80 74 mm²
Coutx	MuRata	GRM155R60J474KE19D Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²

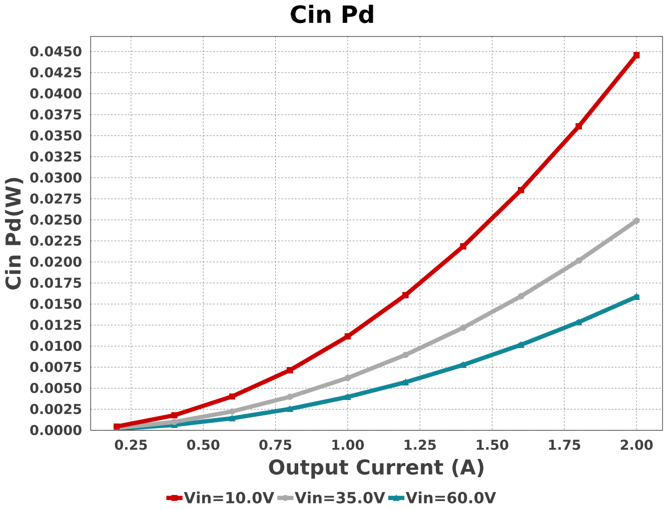
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM155R60J474KE19D Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cramp	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Css	TDK	C2012C0G1H223K125AA Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.08	0805 7 mm^2
Cvcc	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
D1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm^2
D2	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.19	 SMC 83 mm^2
L1	NIC Components	NPI31W100MTRF	L= 10.0 µH 38.0 mOhm	1	$0.36	 IND_NPI31W 172 mm^2
M1	Texas Instruments	CSD19538Q2	VdsMax= 100.0 V IdsMax= 14.4 Amps	1	$0.13	DQK0006C 9 mm^2
M2	ON Semiconductor	2N7002ET1G	VdsMax= 60.0 V IdsMax= 260.0 mAmps	1	$0.04	 SOT-23 14 mm^2
Rcomp	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 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	Yageo	RT0805BRD073K05L Series= ?	Res= 3.05 kOhm Power= 125.0 mW Tolerance= 0.1%	1	$0.05	0805 7 mm^2
Rsense	Stackpole Electronics Inc	CSR1206FK30L0 Series= ?	Res= 30.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	 1206 11 mm^2
Rt	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 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-0712K1L Series= ?	Res= 12.1 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	LM5118MH/NOPB	Switcher	1	$3.18	 MXA20A 71 mm^2

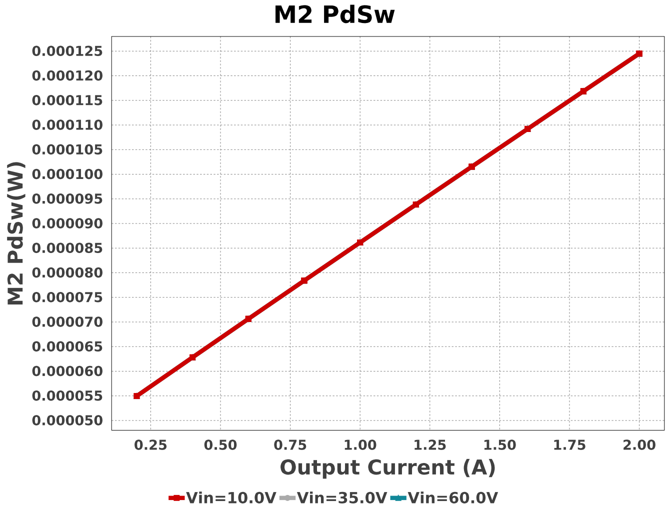

SW Ipk
SW Ipk(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

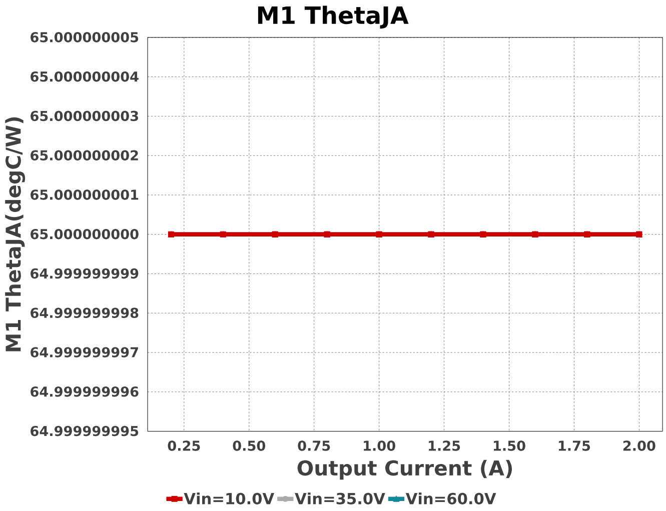

D2 Pd
D2 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

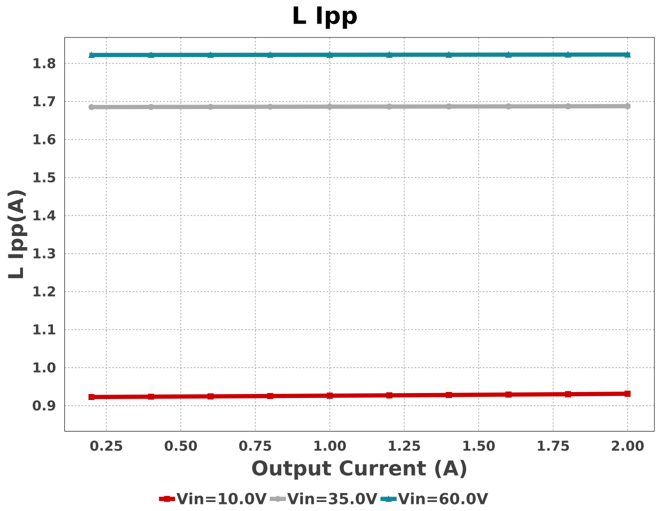

Rsense Pd
Rsense Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

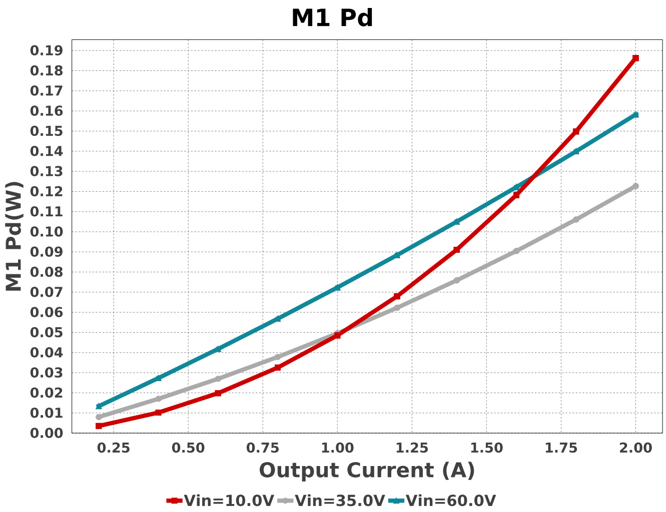

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

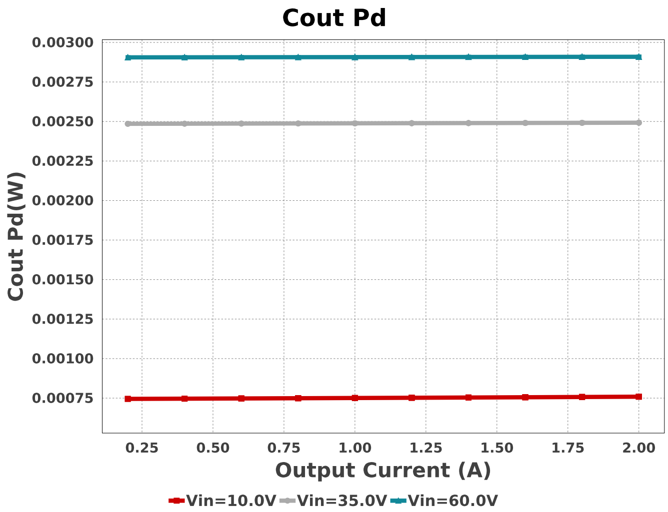

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

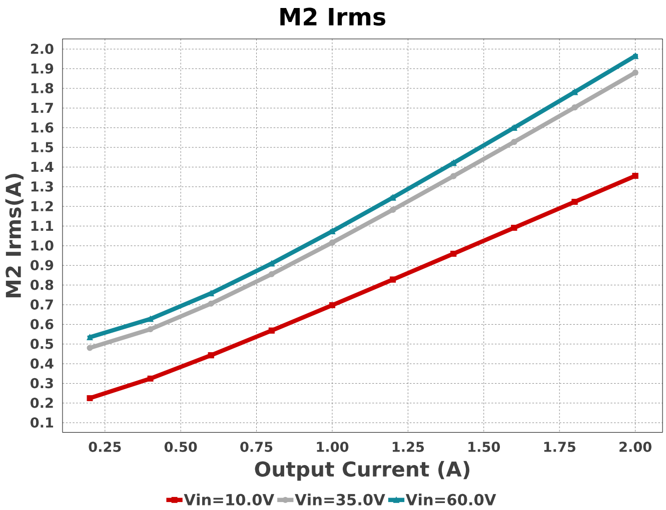

M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

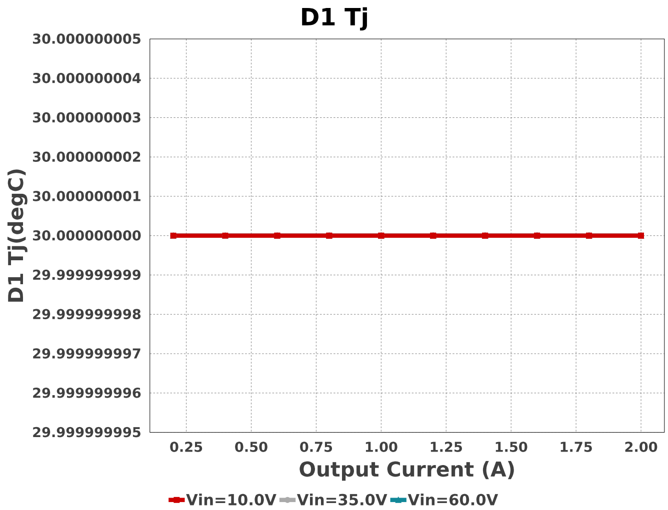

M1 ThetaJA
M1 ThetaJA(degC/W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

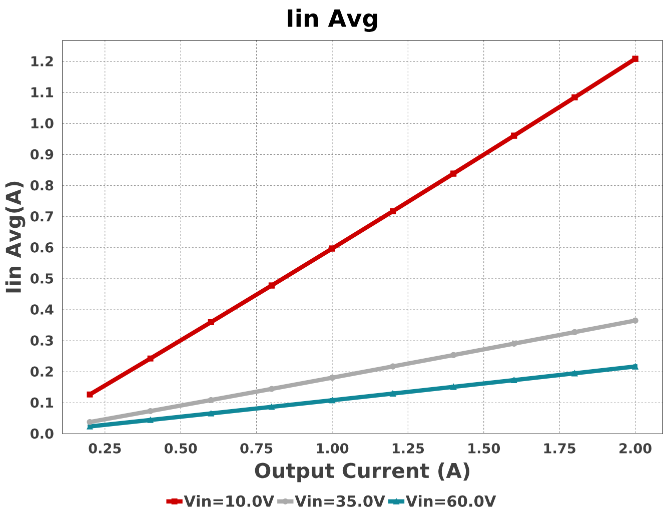

L Ipp
L Ipp(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

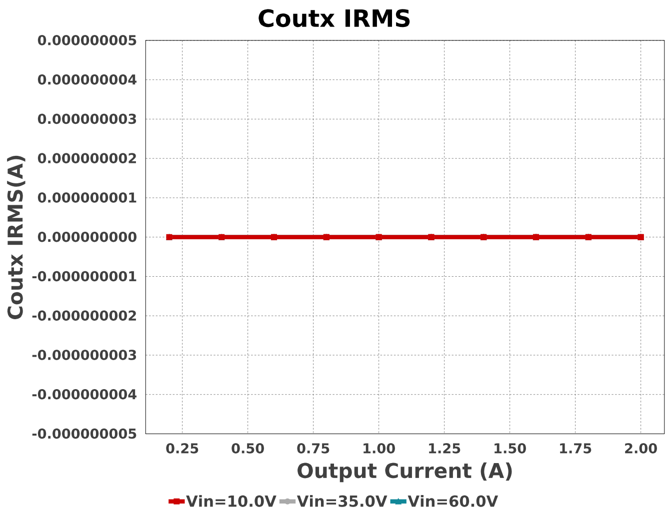

M1 Pd
M1 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

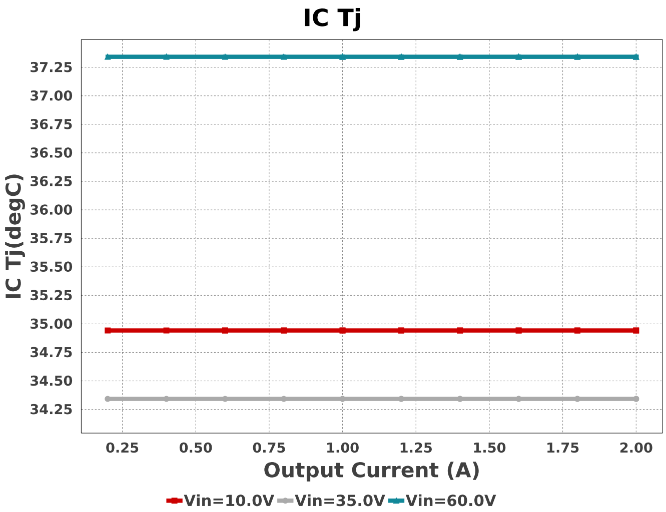

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

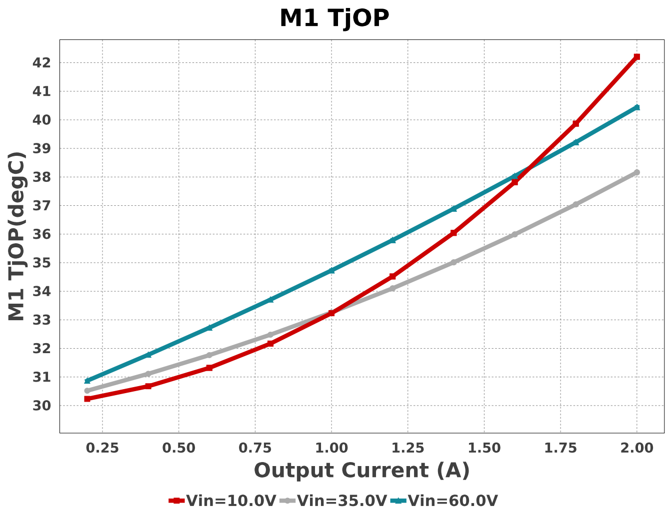

M2 Irms
M2 Irms(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

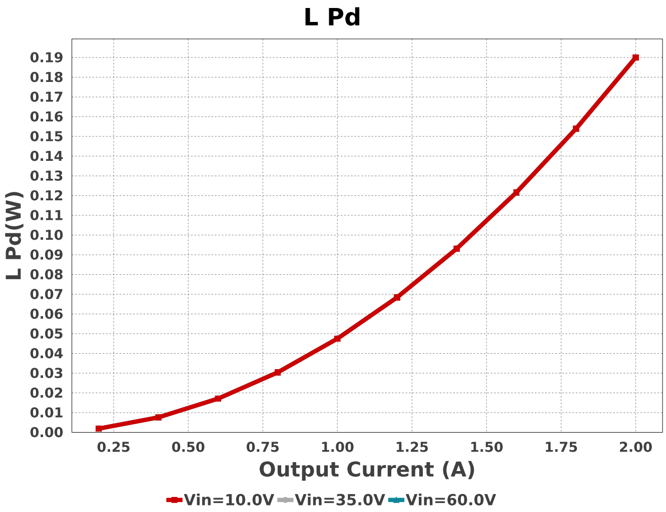

D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

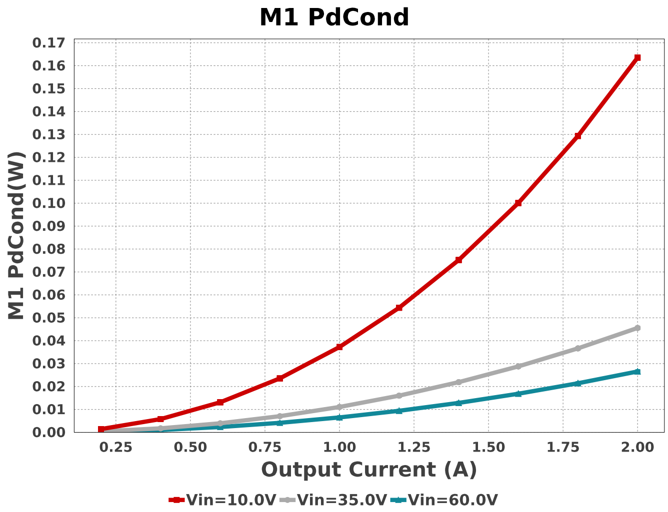

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


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

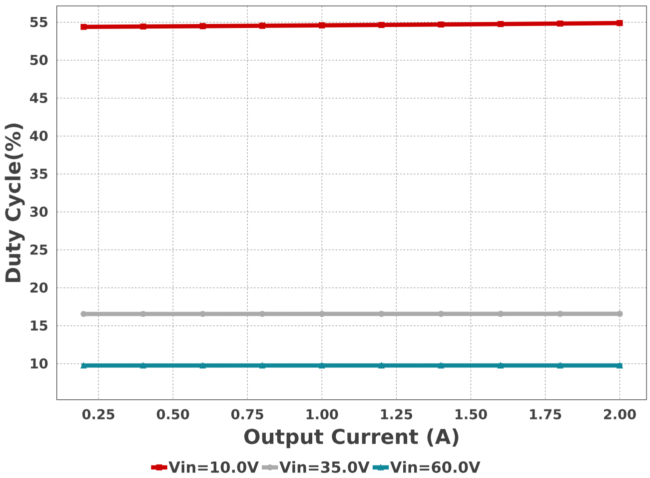

IC Tj
IC Tj(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


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

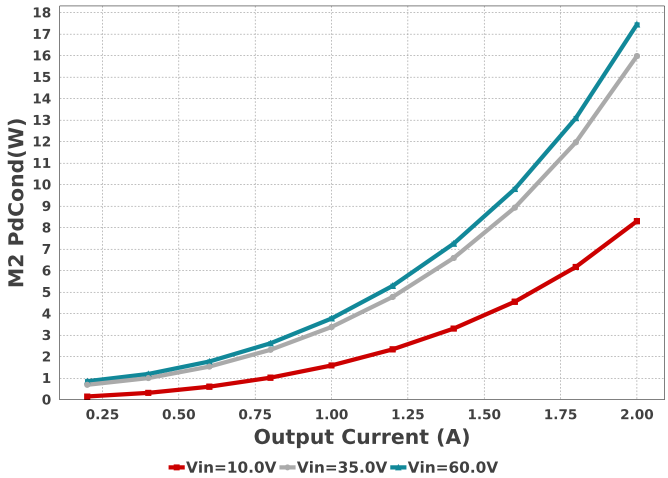

L Pd
L Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


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

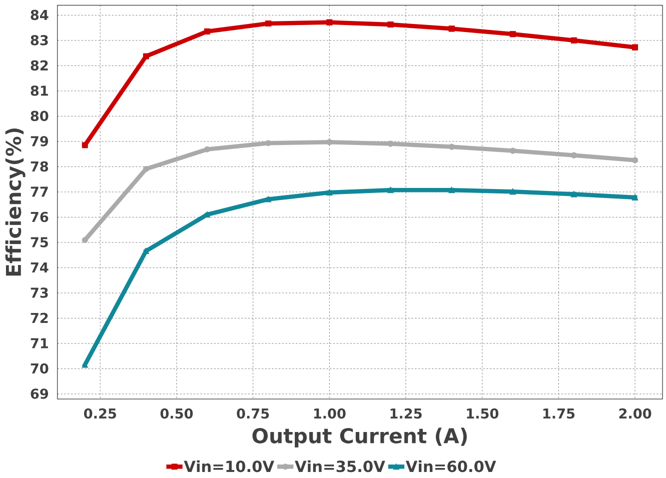
Duty Cycle



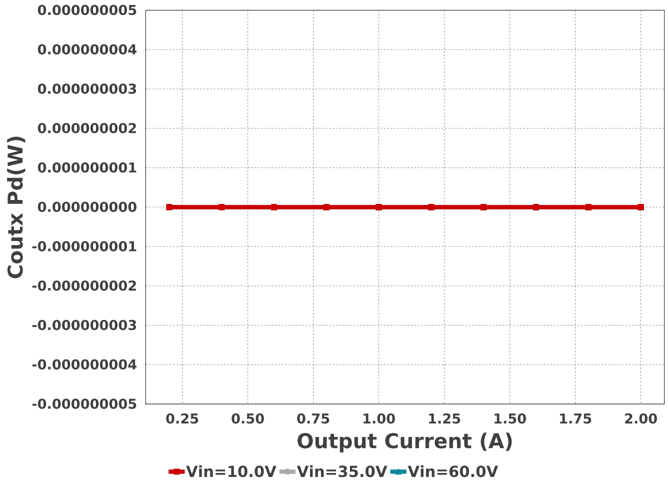
M2 PdCond



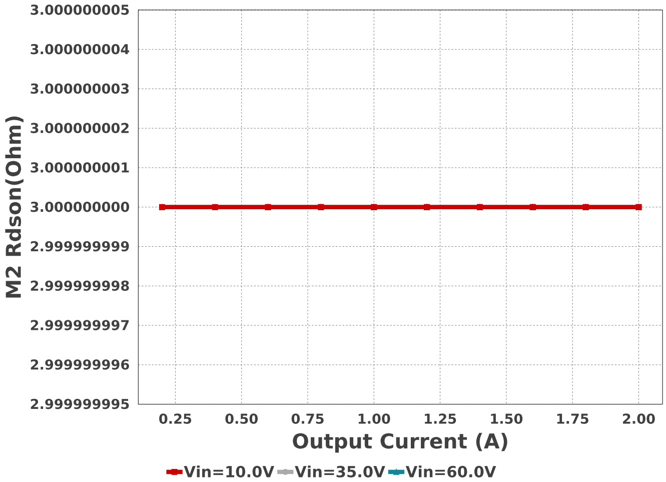
Efficiency



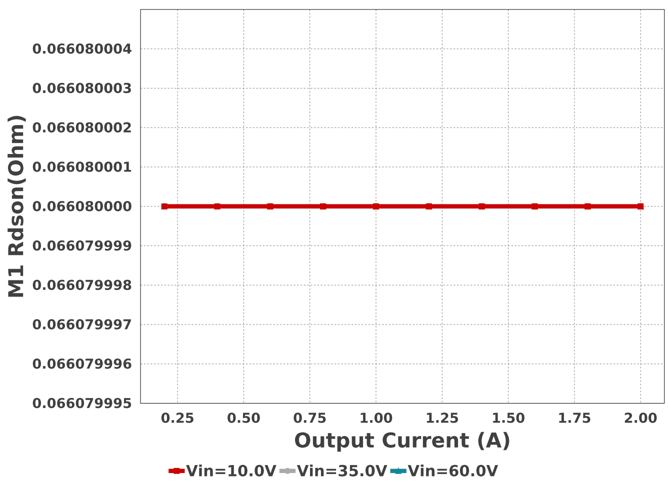
Coutx Pd

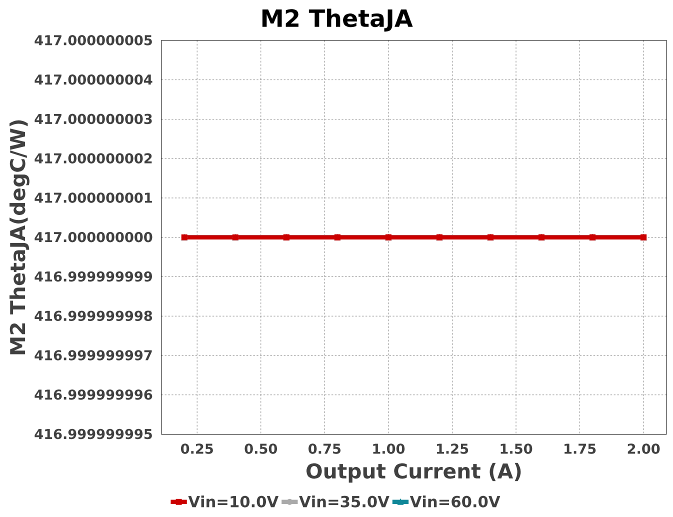


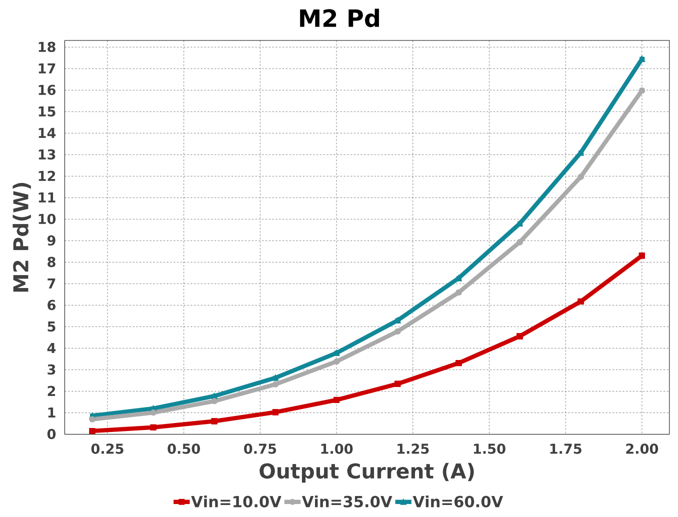
M2 Rdson

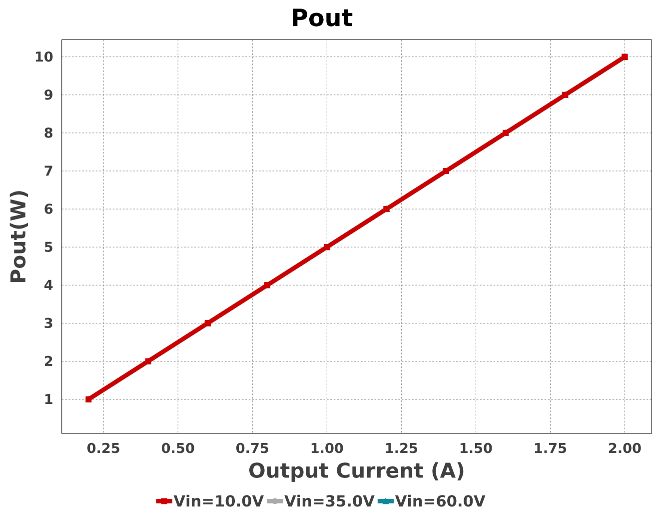


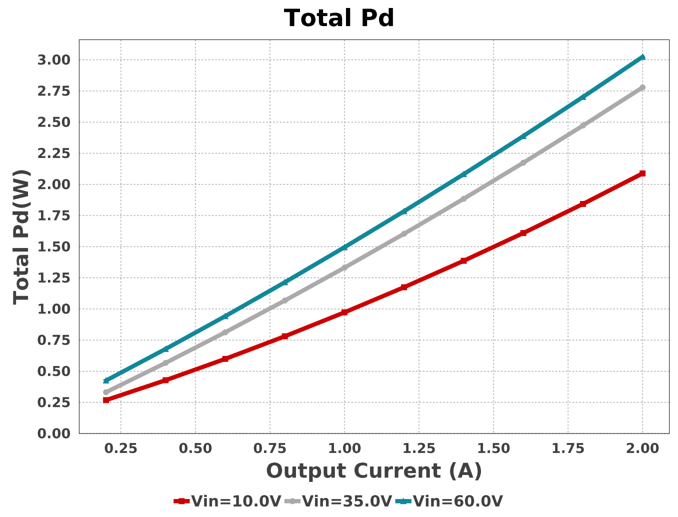
M1 Rdson

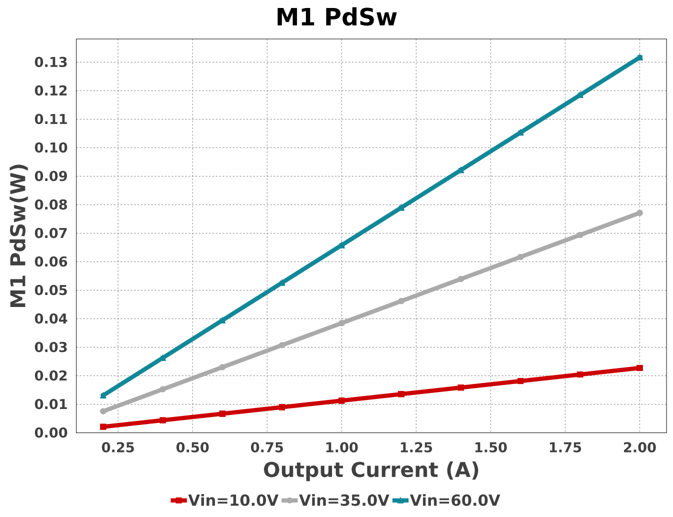


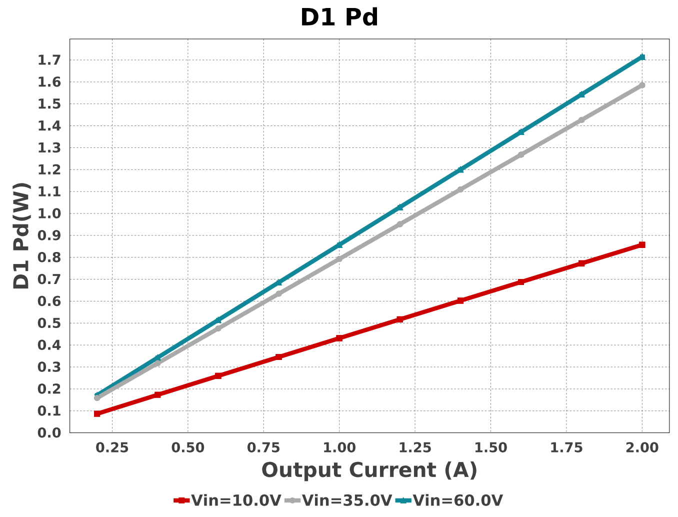

M2 ThetaJA
M2 ThetaJA(degC/W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

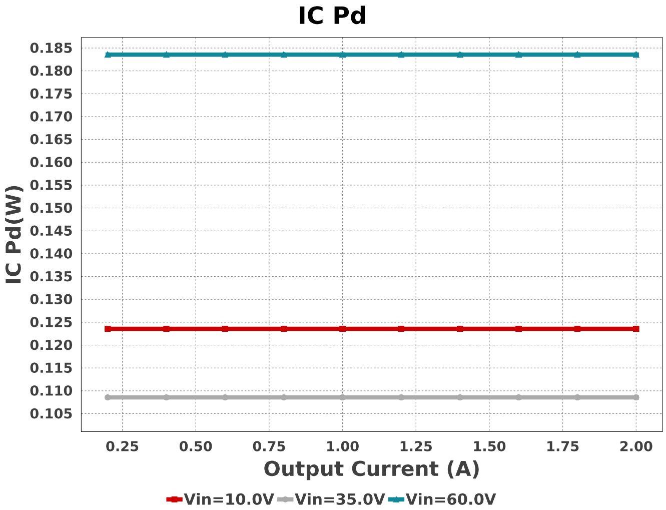

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

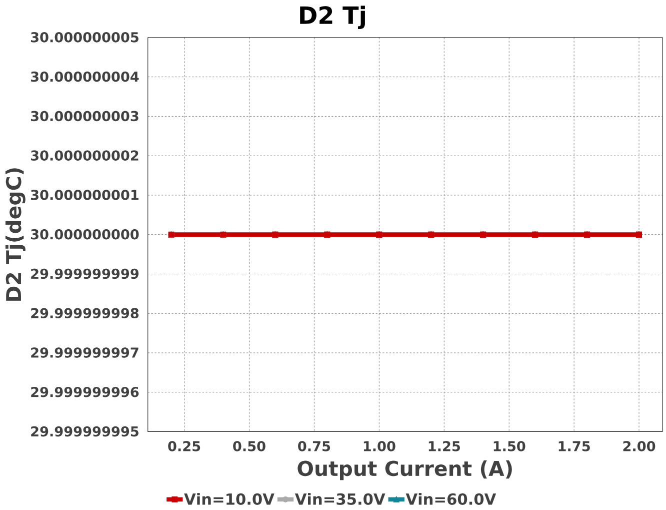

Pout
Pout(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

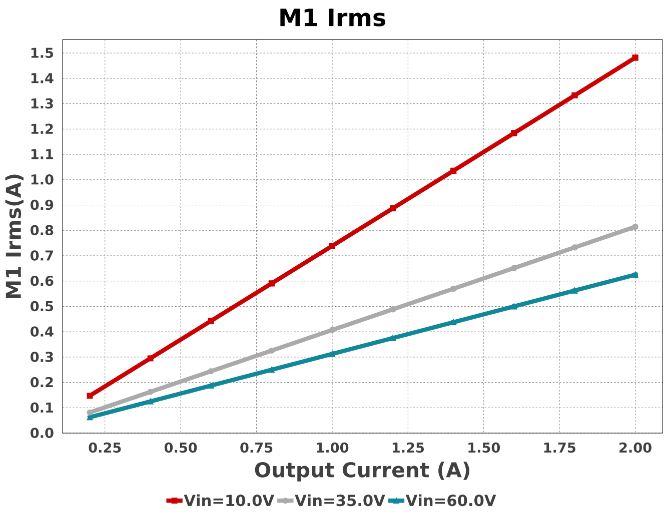

Total Pd
Total Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

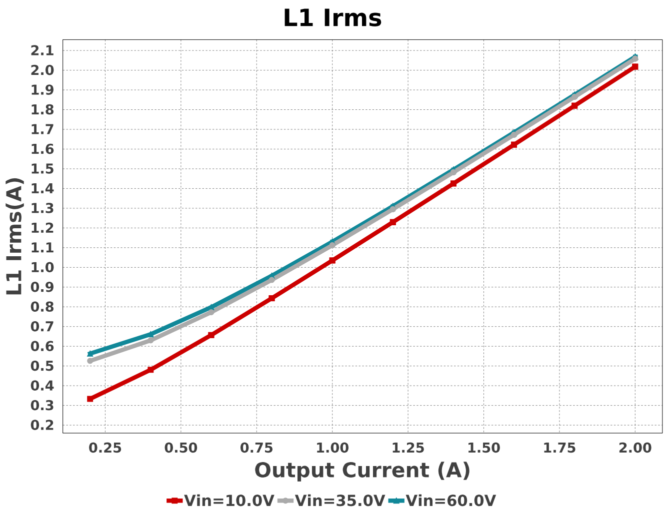

M1 PdSw
M1 PdSw(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

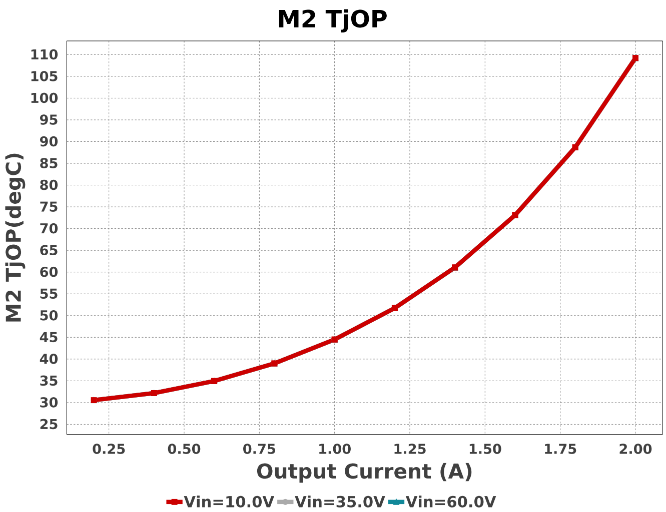

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

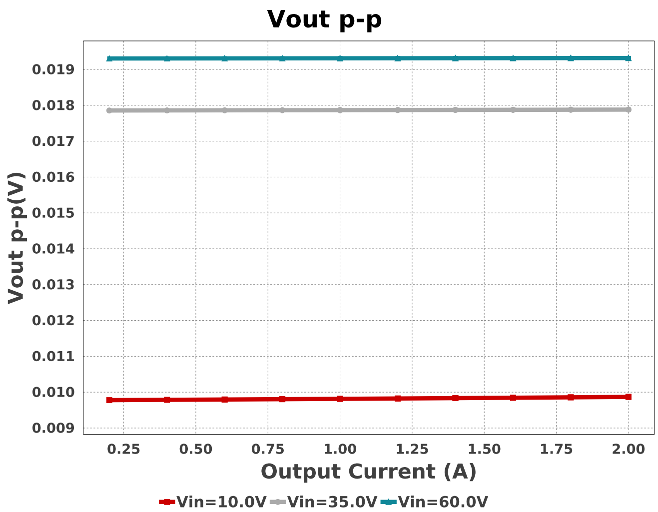

IC Pd
IC Pd(W)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

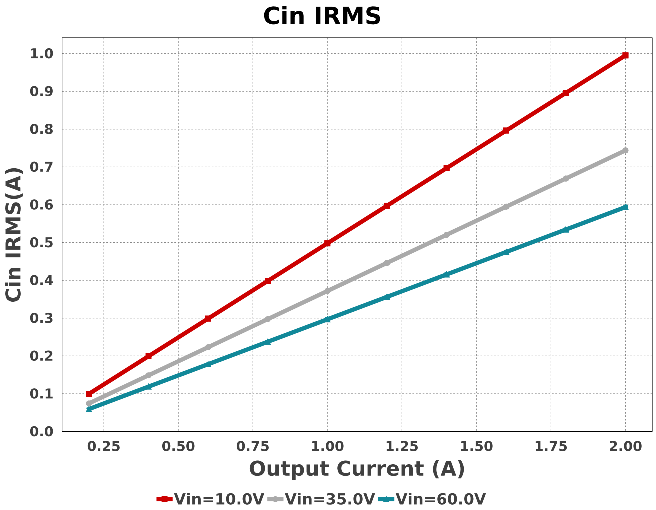

D2 Tj
D2 Tj(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V

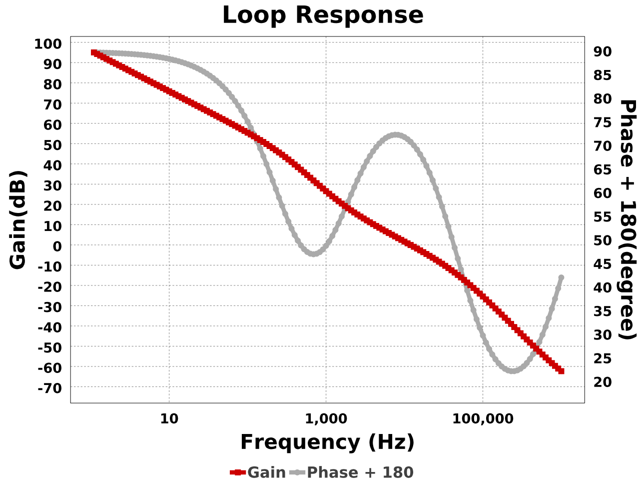

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


L1 Irms
L1 Irms(A)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V Vin=35.0V Vin=60.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	593.788 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	15.868 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	526.378 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	2.91 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	1.714 W	Diode	Diode power dissipation
8.	D1 Tj	30.0 degC	Diode	D1 junction temperature
9.	D2 Pd	746.45 mW	Diode	Diode2 power dissipation
10.	IC Pd	183.56 mW	IC	IC power dissipation
11.	IC Tj	37.342 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	217.06 mA	IC	Average input current
15.	L Ipp	1.823 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	190.0 mW	Inductor	Inductor power dissipation
17.	L1 Irms	2.068 A	Inductor	Inductor ripple current
18.	M1 Irms	625.105 mA	Mosfet	MOSFET RMS ripple current
19.	M1 Pd	163.96 mW	Mosfet	MOSFET power dissipation
20.	M1 PdCond	32.297 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 PdSw	131.67 mW	Mosfet	M1 MOSFET switching losses
22.	M1 Rdson	66.08 mOhm	Mosfet	Drain-Source On-resistance
23.	M1 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
24.	M1 TjOP	40.444 degC	Mosfet	MOSFET junction temperature
25.	M2 Irms	1.964 A	Mosfet	MOSFET RMS ripple current
26.	M2 Pd	11.665 W	Mosfet	MOSFET power dissipation
27.	M2 PdCond	11.665 W	Mosfet	M2 MOSFET conduction losses
28.	M2 PdSw	199.17 µW	Mosfet	M2 MOSFET switching losses
29.	M2 Rdson	3.0 Ohm	Mosfet	Drain-Source On-resistance
30.	M2 ThetaJA	417.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
31.	M2 TjOP	109.215 degC	Mosfet	MOSFET junction temperature
32.	Cin Pd	15.866 mW	Power	Input capacitor power dissipation
33.	Cout Pd	2.909 mW	Power	Output capacitor power dissipation
34.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
35.	D1 Pd	1.714 W	Power	Diode power dissipation
36.	D2 Pd	661.16 mW	Power	Diode2 power dissipation
37.	IC Pd	183.56 mW	Power	IC power dissipation
38.	L Pd	190.0 mW	Power	Inductor power dissipation
39.	M1 Pd	158.23 mW	Power	MOSFET power dissipation
40.	M1 PdCond	26.568 mW	Power	M1 MOSFET conduction losses
41.	M1 PdSw	131.67 mW	Power	M1 MOSFET switching losses
42.	M2 Pd	17.447 W	Power	MOSFET power dissipation
43.	M2 PdCond	17.447 W	Power	M2 MOSFET conduction losses
44.	M2 PdSw	124.5 µW	Power	M2 MOSFET switching losses
45.	Rsense Pd	97.7 mW	Power	LED Current Rsns Power Dissipation
46.	Total Pd	3.024 W	Power	Total Power Dissipation
47.	Rsense Pd	97.697 mW	Resistor	LED Current Rsns Power Dissipation
48.	BOM Count	26	System Information	Total Design BOM count
49.	Cross Freq	11.941 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	9.769 %	System Information	Duty cycle
52.	Efficiency	76.782 %	System Information	Steady state efficiency
53.	FootPrint	797.0 mm^2	System Information	Total Foot Print Area of BOM components
54.	Frequency	294.659 kHz	System Information	Switching frequency
55.	Gain Marg	-55.054 dB	System Information	Bode Plot Gain Margin
56.	Iout	2.0 A	System Information	Iout operating point
57.	Low Freq Gain	95.04 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	70.913 deg	System Information	Bode Plot Phase Margin
61.	Pout	10.0 W	System Information	Total output power
62.	SW Ipk	2.912 A	System Information	Peak switch current
63.	Total BOM	$7.71	System Information	Total BOM Cost
64.	Vin	60.0 V	System Information	Vin operating point
65.	Vout	5.0 V	System Information	Operational Output Voltage
66.	Vout Actual	4.982 V	System Information	Vout Actual calculated based on selected voltage divider resistors
67.	Vout Tolerance	2.312 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
68.	Vout p-p	19.319 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	60.0	Maximum input voltage
VinMin	10.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LM5118	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

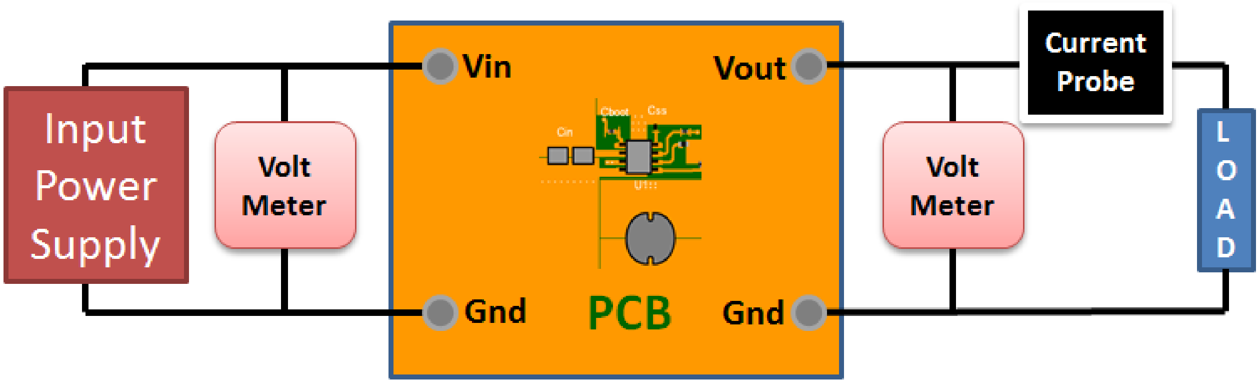
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins.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

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.