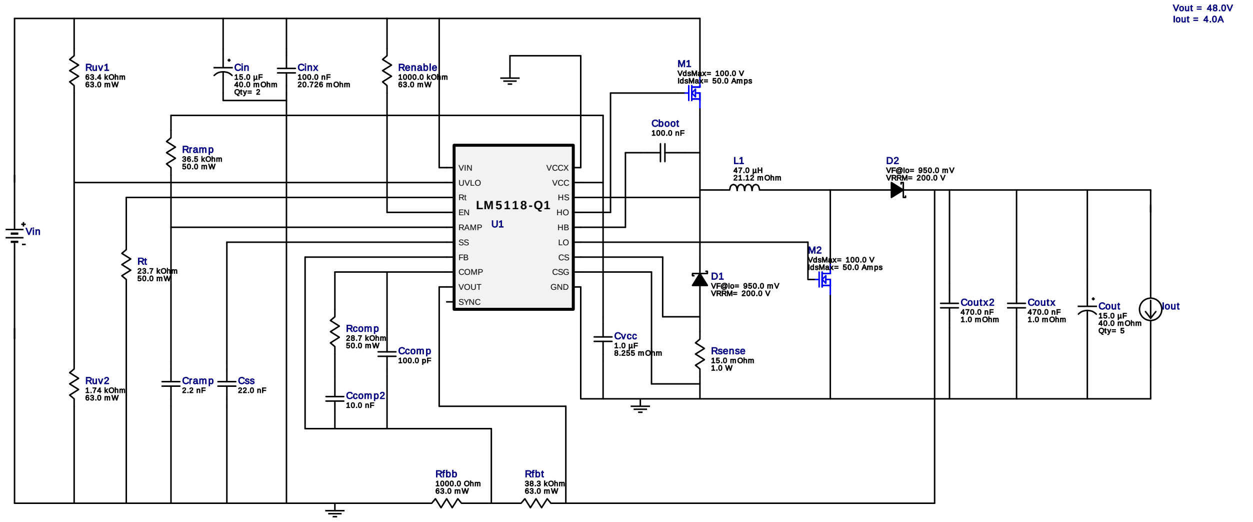
VinMin = 57.5V
VinMax = 58.5V
Vout = 48.0V
Iout = 4.0A

Device = LM5118Q1MH/NOPB
Topology = Buck_Boost
Created = 2023-08-10 02:56:38.695
BOM Cost = $24.39
BOM Count = 31
Total Pd = 8.16W

WEBENCH ® Design Report

Design : 61 LM5118Q1MH/NOPB
LM5118Q1MH/NOPB 57.5V-58.5V to 48.00V @ 4A



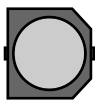
Design Alerts

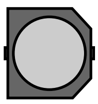
LM5118-Q1 Design

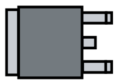
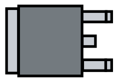
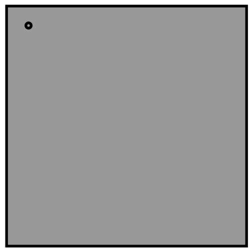
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

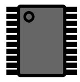
Electrical BOM

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 mm^2
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 mm^2
Ccomp2	TDK	CGA4C2C0G1H103J060AA Series= C0G/NP0	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.06	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	2	$1.95	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	100SXV15M Series= SXV	Cap= 15.0 uF ESR= 40.0 mOhm VDC= 100.0 V IRMS= 2.35 A	5	$1.95	CAPSMT_62_E12 106 mm^2
Coutx	MuRata	GRM21BR72A474KA73L Series= X7R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.13	0805 7 mm^2

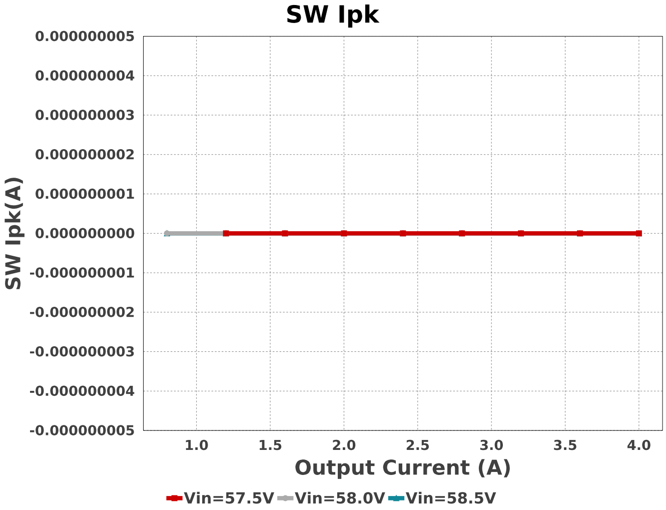




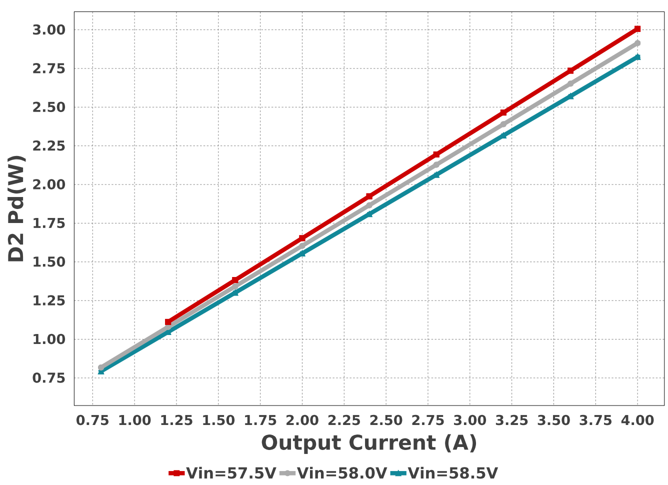
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM21BR72A474KA73L Series= X7R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.13	0805 7 mm^2
Cramp	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Css	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	TDK	C2012X7S2A105K125AB Series= X7S	Cap= 1.0 uF ESR= 8.255 mOhm VDC= 100.0 V IRMS= 2.27442 A	1	$0.11	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	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm^2
L1	Wurth Elektronik	74435584700	L= 47.0 µH 21.12 mOhm	1	$4.99	 WE-HCI_2212 588 mm^2
M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.39	 DQG0008A 18 mm^2
M2	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.39	 DQG0008A 18 mm^2
Rcomp	Yageo	RC0201FR-0728K7L Series= ?	Res= 28.7 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	CRCW040238K3FKED Series= CRCW..e3	Res= 38.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rramp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rsense	Susumu Co Ltd	PRL1632-R015-F-T1 Series= PRL1632	Res= 15.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 mm^2
Rt	Yageo	RC0201FR-0723K7L Series= ?	Res= 23.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Ruv1	Vishay-Dale	CRCW040263K4FKED Series= CRCW..e3	Res= 63.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ruv2	Vishay-Dale	CRCW04021K74FKED Series= CRCW..e3	Res= 1.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM5118Q1MH/NOPB	Switcher	1	$3.18	 MXA20A 71 mm²

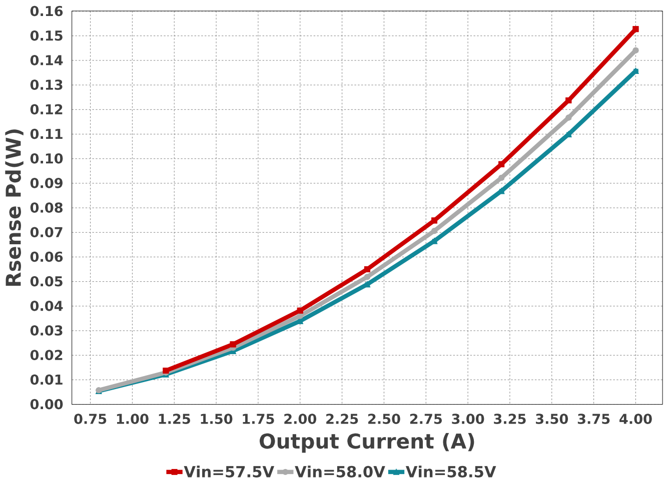
SW Ipk



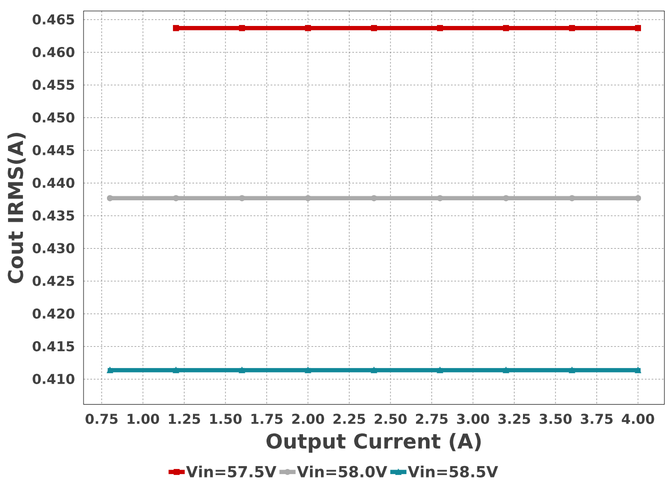
D2 Pd



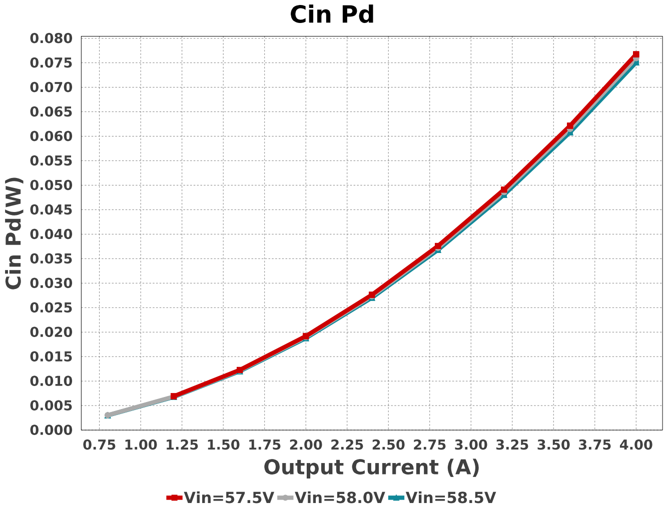
Rsense Pd



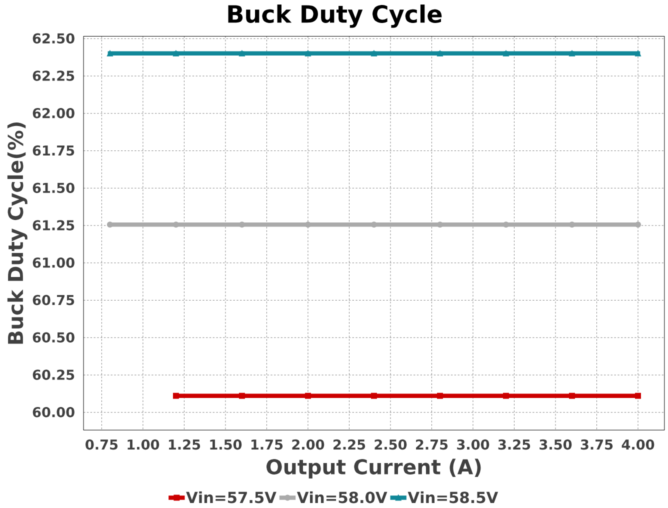
Cout IRMS

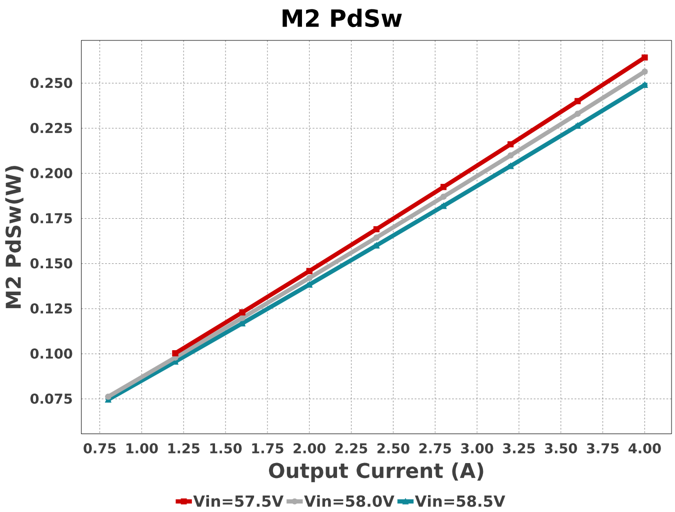


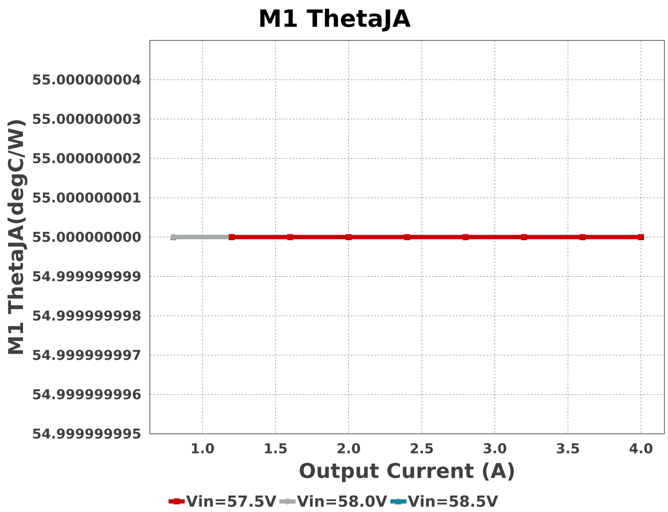
Cin Pd

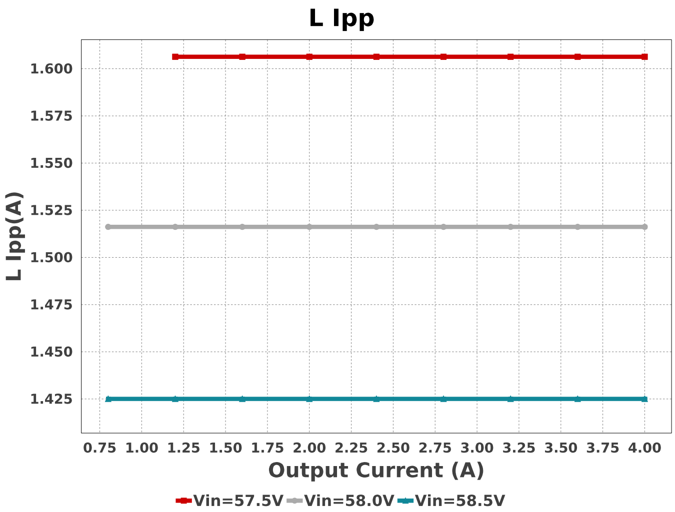


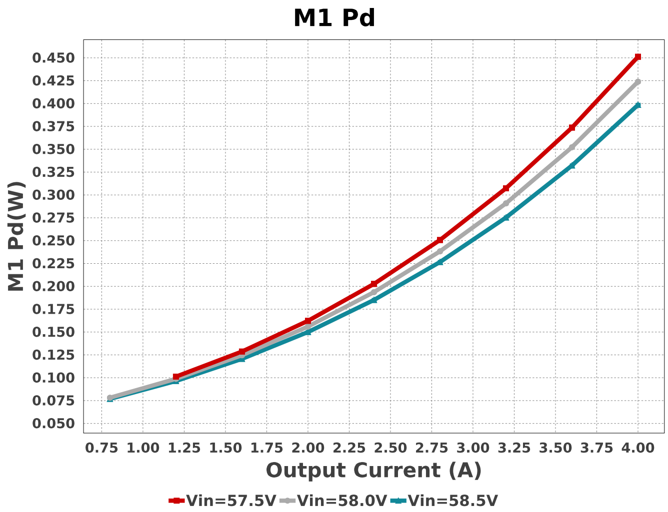
Buck Duty Cycle

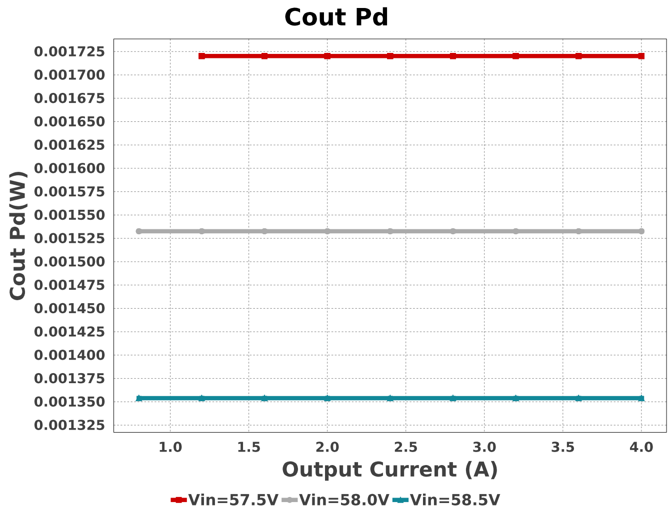


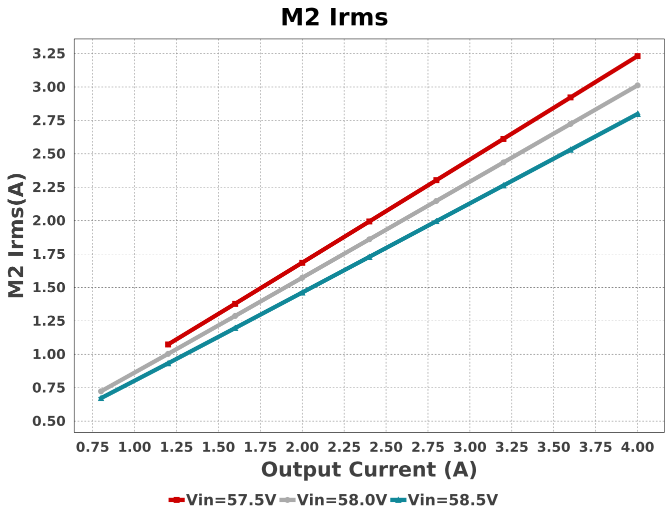

M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V


M1 ThetaJA
M1 ThetaJA(degC/W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

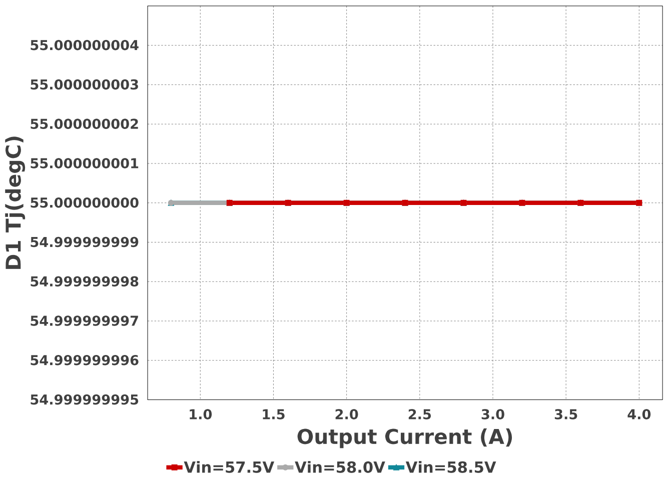

L Ipp
L Ipp(A)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V


M1 Pd
M1 Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

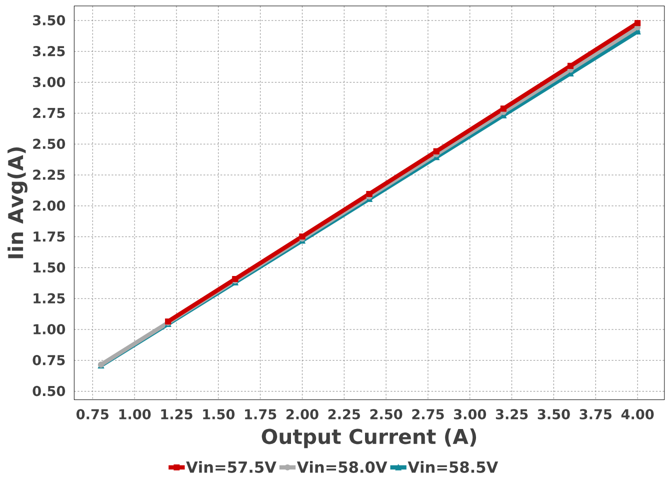

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V


M2 Irms
M2 Irms(A)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

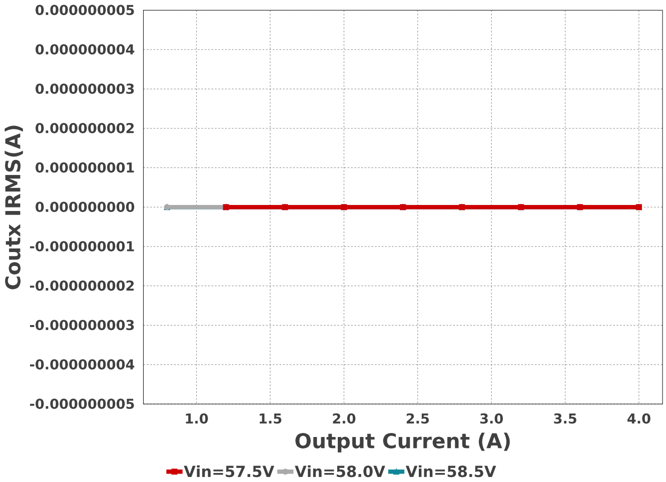
D1 Tj



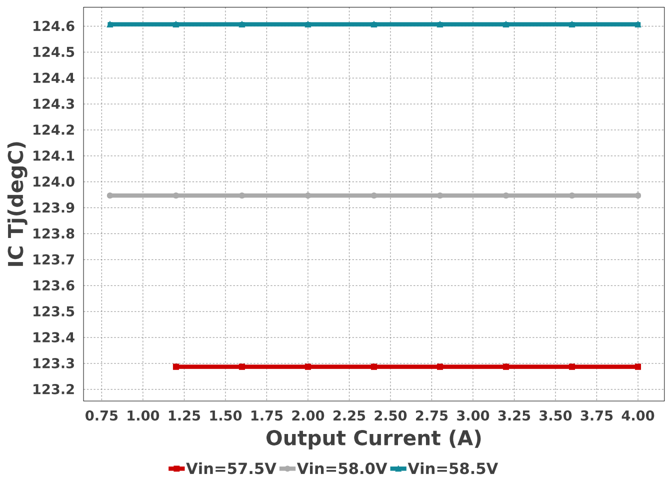
Iin Avg



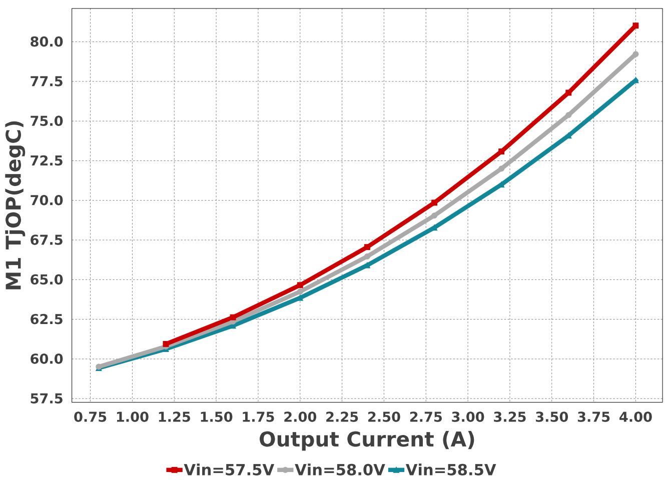
Coutx IRMS



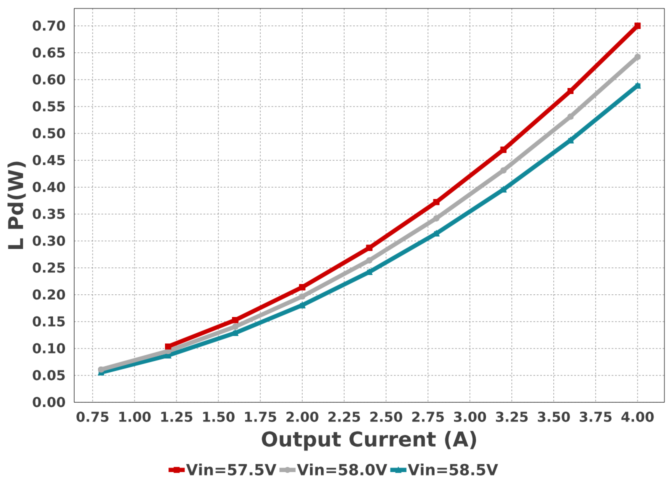
IC Tj

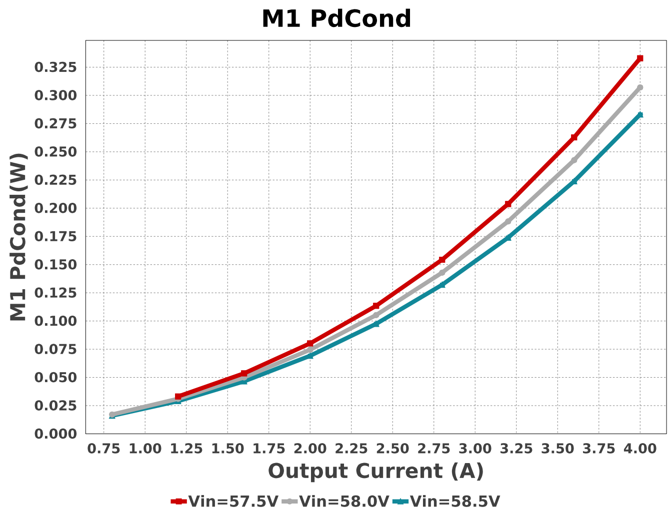


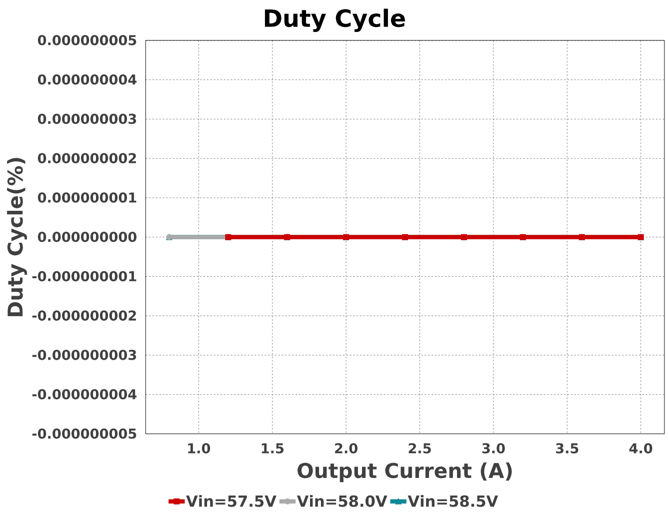
M1 TjOP

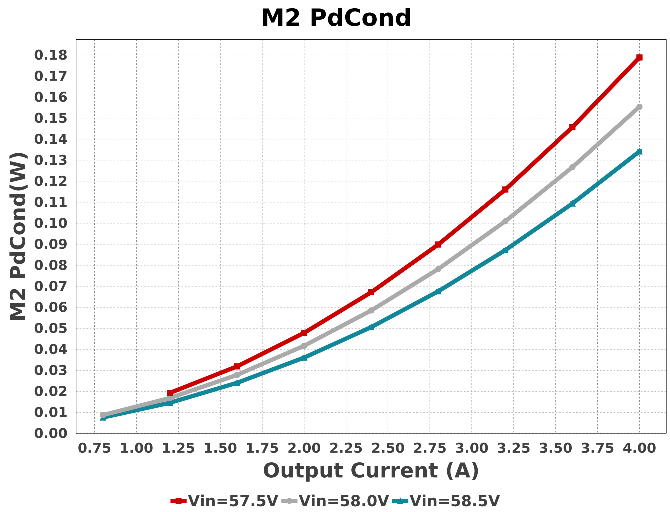


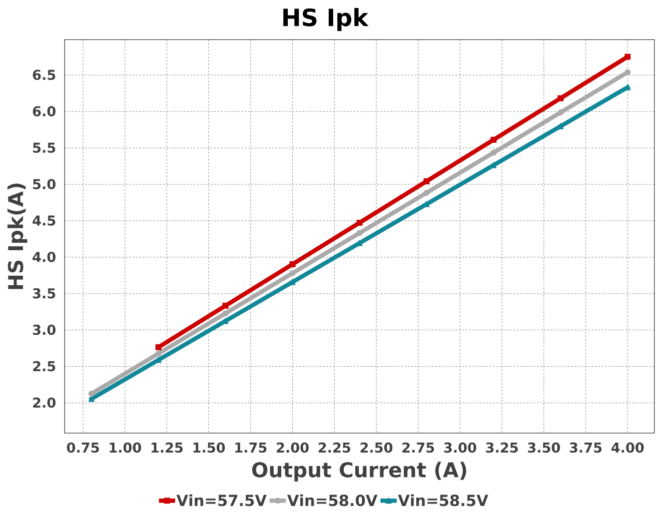
L Pd

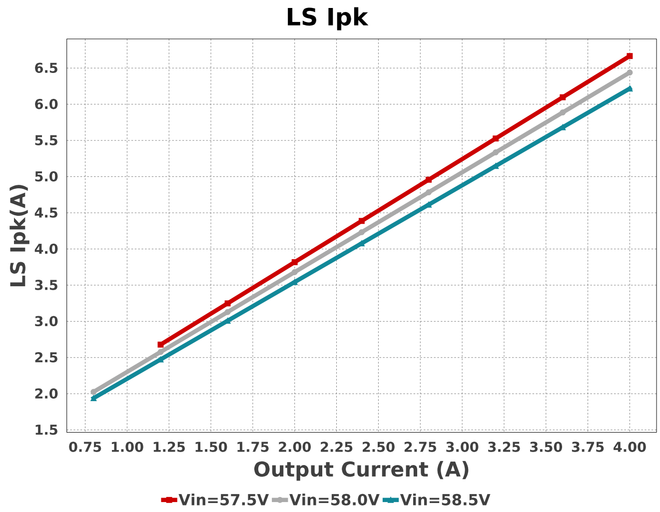


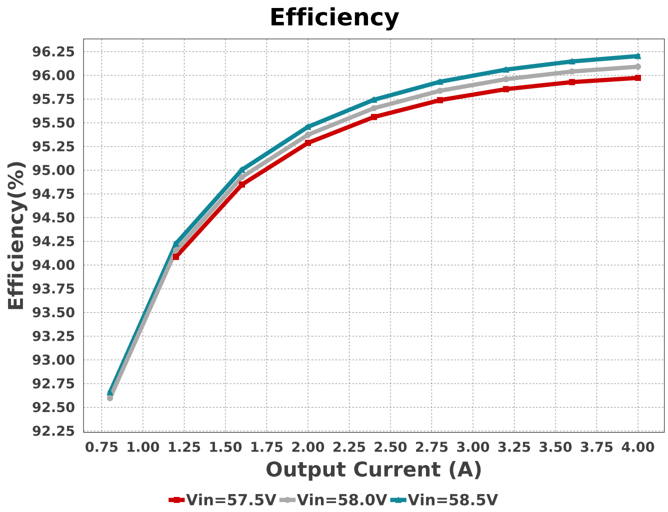

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

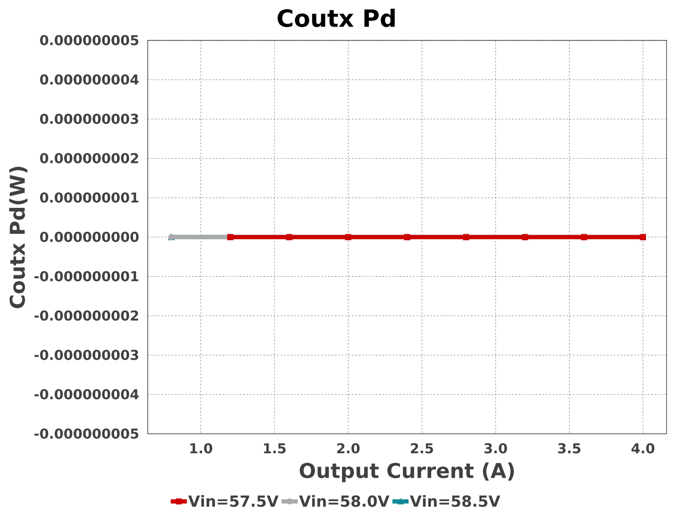

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

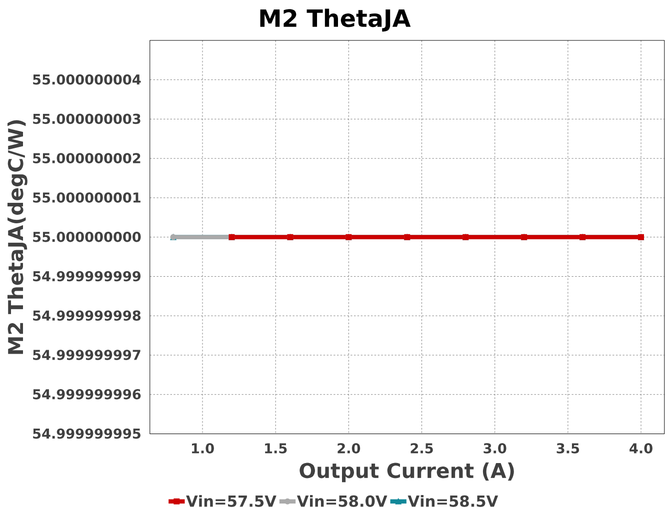

M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

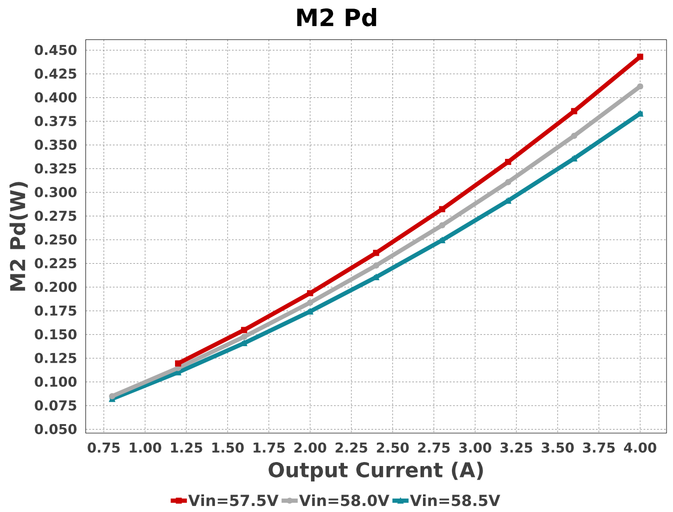

HS Ipk
HS Ipk(A)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

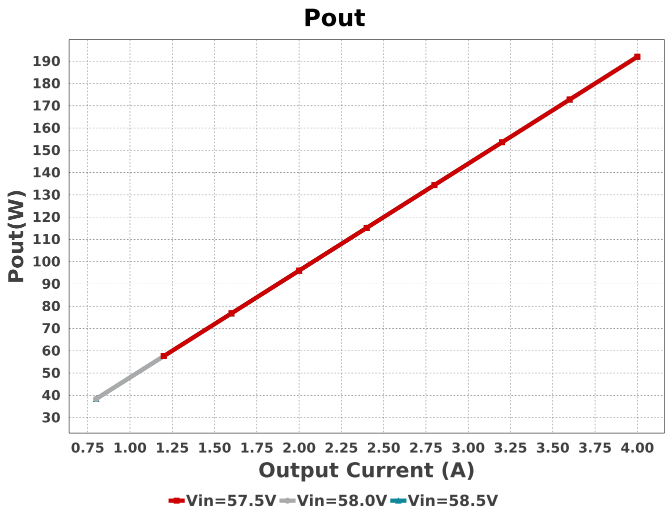

LS Ipk
LS Ipk(A)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

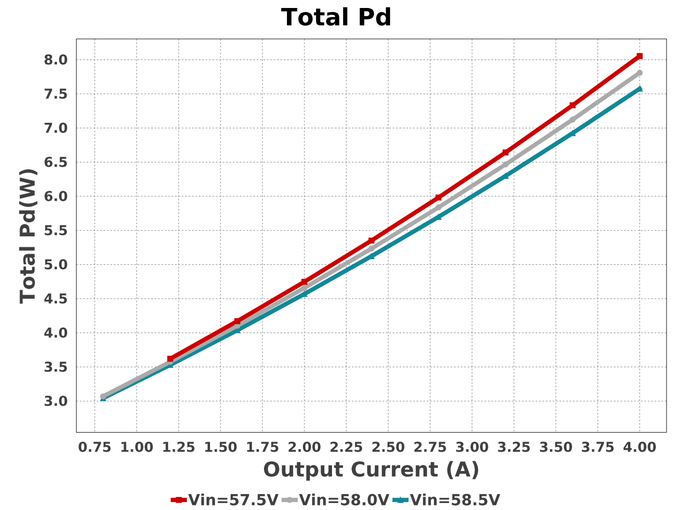

Efficiency
Efficiency(%)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

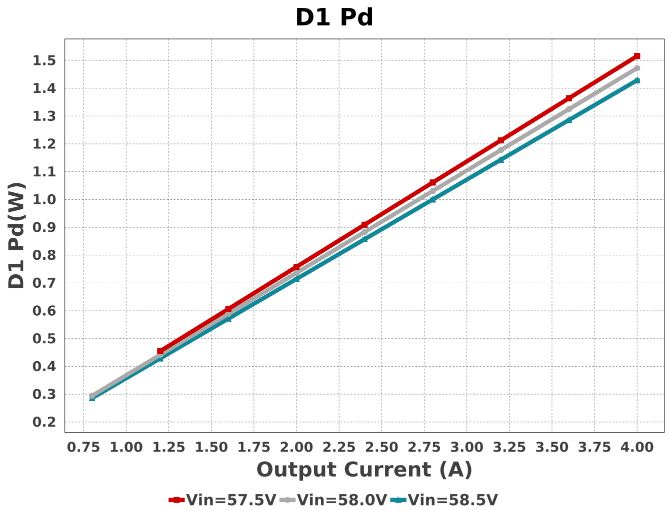

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

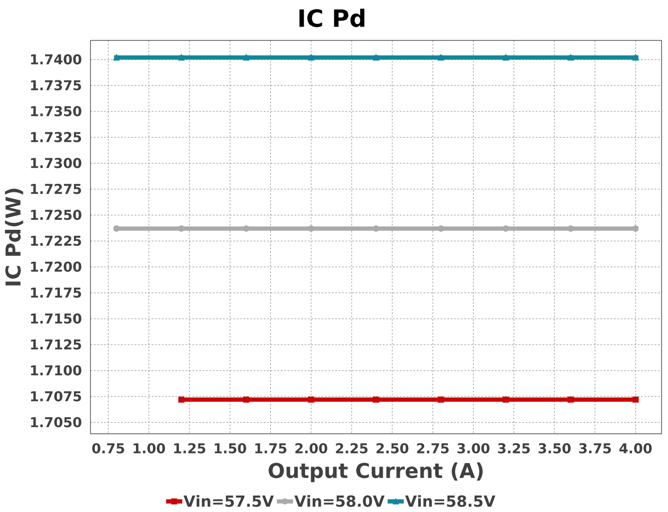

M2 ThetaJA
M2 ThetaJA(degC/W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

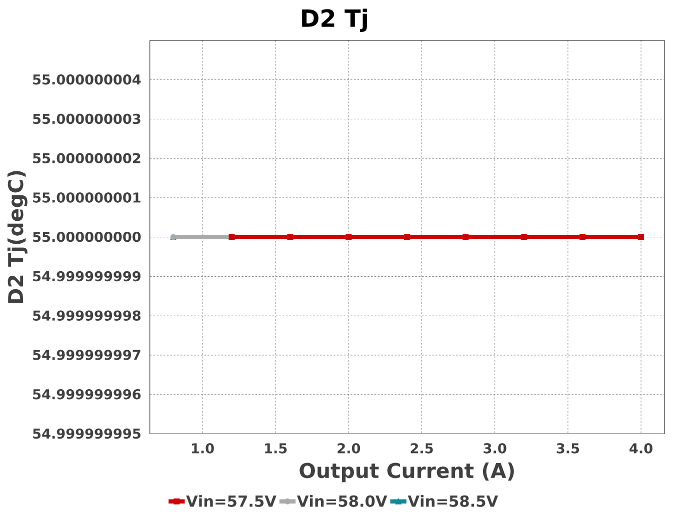

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

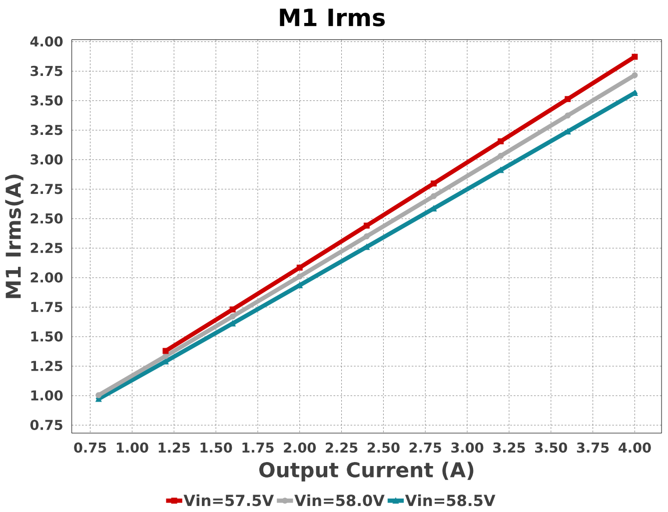

Pout
Pout(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

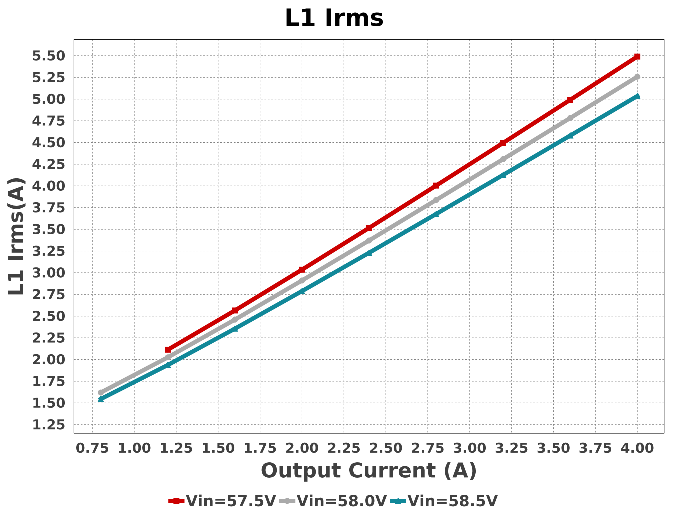

Total Pd
Total Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

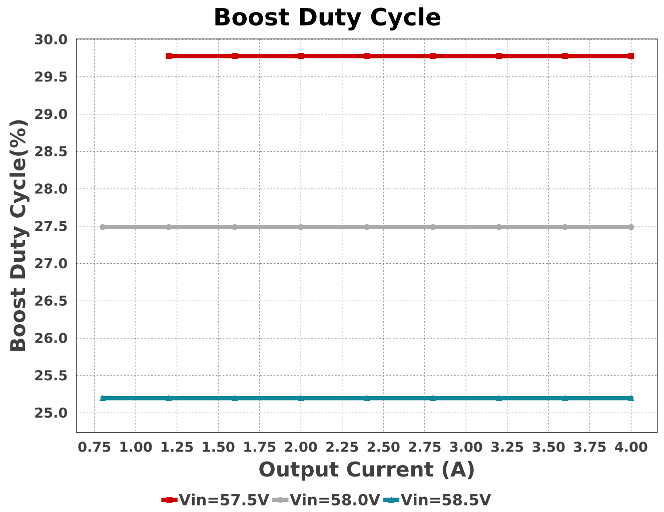

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=57.5V Vin=58.0V Vin=58.5V

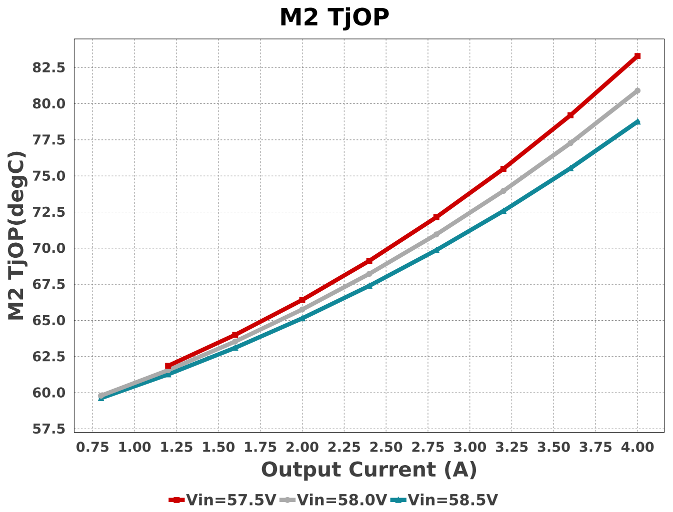

IC Pd
IC Pd(W)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V

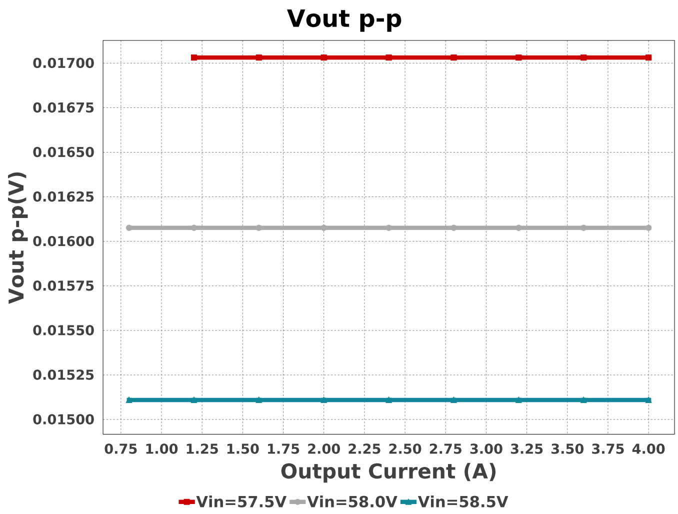

D2 Tj
D2 Tj(degC)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V

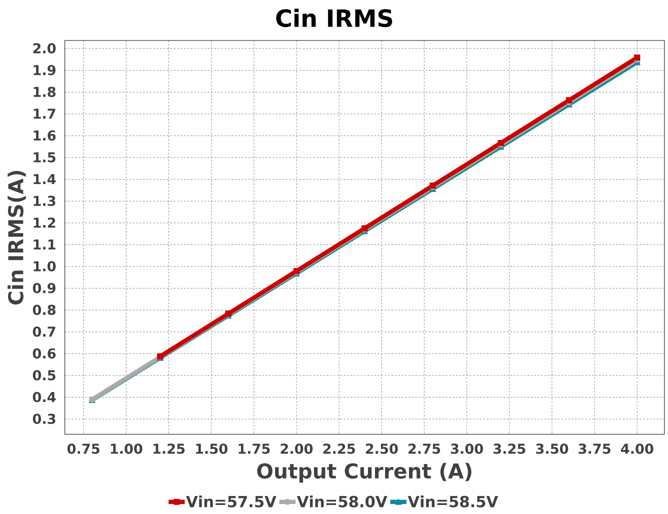

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V

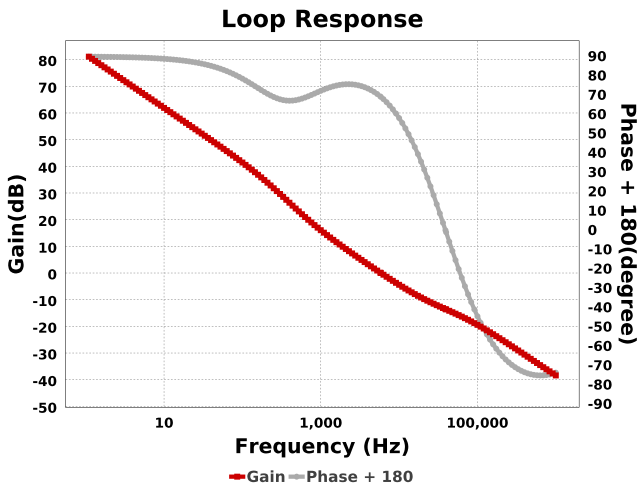

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V


Boost Duty Cycle
Boost Duty Cycle(%)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V


M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin=57.5V
Vin=58.0V
Vin=58.5V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.959 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	76.729 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	463.706 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	1.72 mW	Capacitor	Output capacitor power dissipation
5.	D1 Pd	1.516 W	Diode	Diode power dissipation
6.	D1 Tj	55.0 degC	Diode	D1 junction temperature
7.	D2 Pd	3.006 W	Diode	Diode2 power dissipation
8.	HS Ipk	6.751 A	IC	Peak switch current in IC
9.	IC Pd	1.74 W	IC	IC power dissipation
10.	IC Tj	124.607 degC	IC	IC junction temperature
11.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
12.	ICThetaJA	40.0 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	3.422 A	IC	Average input current
14.	LS Ipk	6.666 A	IC	Peak switch current in IC
15.	L Ipp	1.606 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	700.13 mW	Inductor	Inductor power dissipation
17.	L1 Irms	5.49 A	Inductor	Inductor ripple current
18.	M1 Irms	3.872 A	Mosfet	MOSFET RMS ripple current
19.	M1 Pd	487.8 mW	Mosfet	MOSFET power dissipation
20.	M1 PdCond	366.48 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
22.	M1 TjOP	81.207 degC	Mosfet	MOSFET junction temperature
23.	M2 Irms	3.232 A	Mosfet	MOSFET RMS ripple current
24.	M2 Pd	482.68 mW	Mosfet	MOSFET power dissipation
25.	M2 PdCond	218.47 mW	Mosfet	M2 MOSFET conduction losses
26.	M2 PdSw	264.21 mW	Mosfet	M2 MOSFET switching losses
27.	M2 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
28.	M2 TjOP	83.296 degC	Mosfet	MOSFET junction temperature
29.	Cin Pd	76.729 mW	Power	Input capacitor power dissipation
30.	Cout Pd	1.72 mW	Power	Output capacitor power dissipation
31.	D1 Pd	1.516 W	Power	Diode power dissipation
32.	D2 Pd	3.006 W	Power	Diode2 power dissipation

#	Name	Value	Category	Description
33.	IC Pd	1.74 W	Power	IC power dissipation
34.	L Pd	700.13 mW	Power	Inductor power dissipation
35.	M1 Pd	487.8 mW	Power	MOSFET power dissipation
36.	M1 PdCond	366.48 mW	Power	M1 MOSFET conduction losses
37.	M2 Pd	482.68 mW	Power	MOSFET power dissipation
38.	M2 PdCond	218.47 mW	Power	M2 MOSFET conduction losses
39.	M2 PdSw	264.21 mW	Power	M2 MOSFET switching losses
40.	Rsense Pd	152.75 mW	Power	LED Current Rsns Power Dissipation
41.	Total Pd	8.165 W	Power	Total Power Dissipation
42.	Rsense Pd	152.75 mW	Resistor	LED Current Rsns Power Dissipation
43.	BOM Count	31	System Information	Total Design BOM count
44.	Boost Duty Cycle	29.779 %	System Information	Boost Duty cycle
45.	Buck Duty Cycle	60.111 %	System Information	Buck Duty cycle
46.	Cross Freq	5.851 kHz	System Information	Bode plot crossover frequency
47.	D2 Tj	55.0 degC	System Information	D2 junction temperature
48.	Efficiency	95.921 %	System Information	Steady state efficiency
49.	FootPrint	1.735 k mm^2	System Information	Total Foot Print Area of BOM components
50.	Frequency	239.521 kHz	System Information	Switching frequency
51.	Gain Marg	-13.538 dB	System Information	Bode Plot Gain Margin
52.	Iout	4.0 A	System Information	Iout operating point
53.	Low Freq Gain	81.112 dB	System Information	Gain at 1Hz
54.	Operating Topology	Transition	System Information	The current operating topology of the device
55.	Phase Marg	69.045 deg	System Information	Bode Plot Phase Margin
56.	Pout	192.0 W	System Information	Total output power
57.	Total BOM	$24.39	System Information	Total BOM Cost
58.	Vin	58.5 V	System Information	Vin operating point
59.	Vout Actual	48.339 V	System Information	Vout Actual calculated based on selected voltage divider resistors
60.	Vout Tolerance	3.461 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
61.	Vout p-p	17.031 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
SoftStart	2.5 ms	Soft Start Time (ms)
VinMax	58.5	Maximum input voltage
VinMin	57.5	Minimum input voltage
Vout	48.0	Output Voltage
base_pn	LM5118-Q1	Base Product Number
source	DC	Input Source Type
Ta	55.0	Ambient temperature
UserFsw	239.521 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

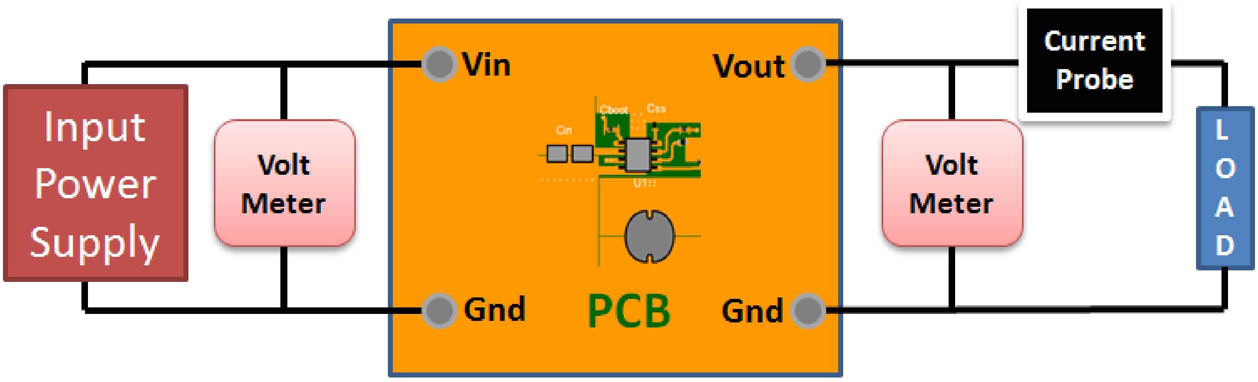
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 57.5V 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 : F1AEBBBE3F2F05F3[v1]

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

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