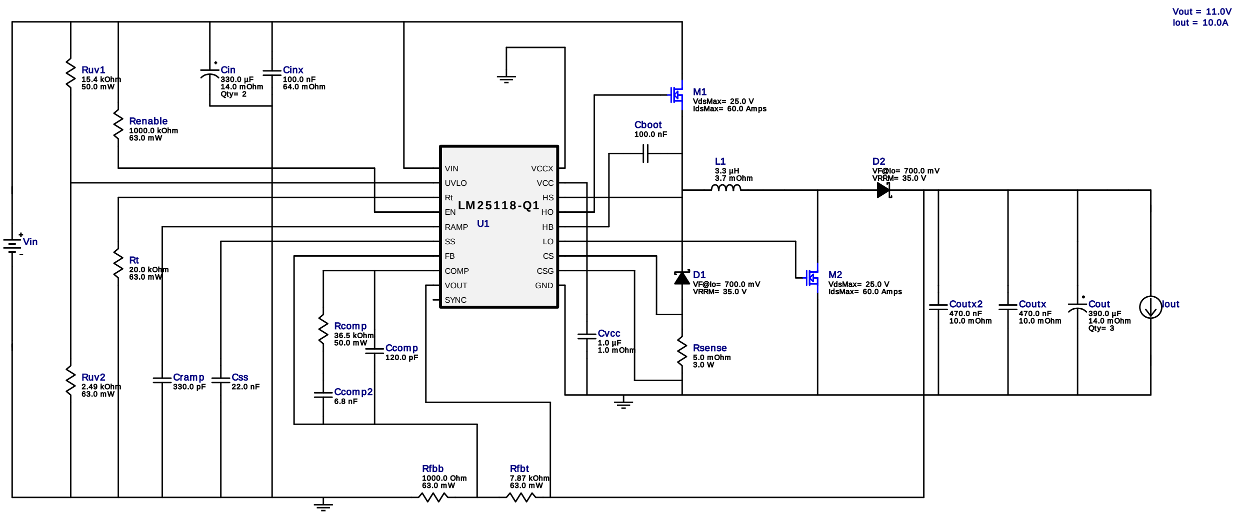
VinMin = 11.0V	Device = LM25118Q1MH/NOPB
VinMax = 14.0V	Topology = Buck_Boost
Vout = 11.0V	Created = 2022-08-02 22:30:44.371
Iout = 10.0A	BOM Cost = $10.72
	BOM Count = 28
	Total Pd = 11.79W

WEBENCH ® Design Report

Design : 2 LM25118Q1MH/NOPB
LM25118Q1MH/NOPB 11V-14V to 11.00V @ 10A

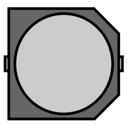
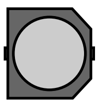


Design Alerts

LM25118-Q1 Design

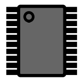
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

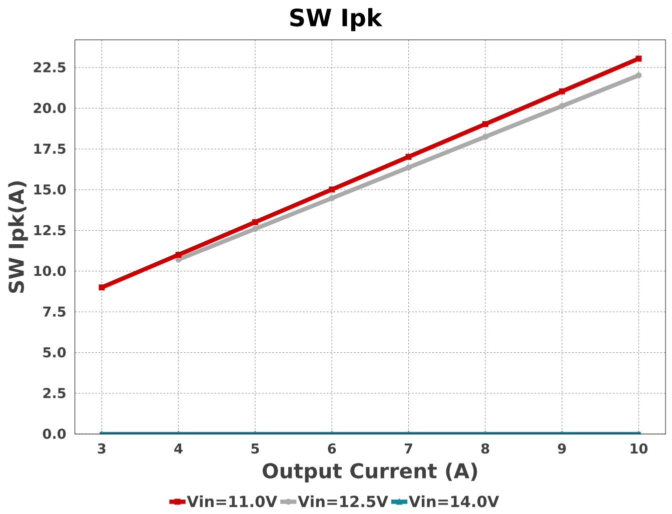
Electrical BOM

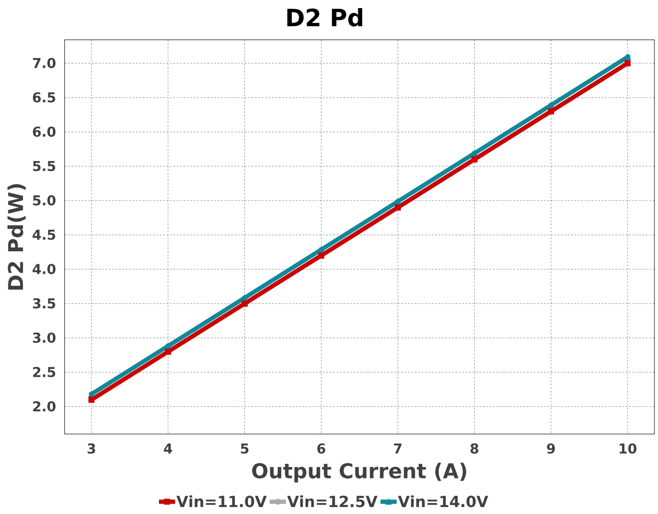
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Ccomp	Samsung Electro-Mechanics	CL21C121JBANNNC Series= C0G/NP0	Cap= 120.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Ccomp2	TDK	C2012C0G1H682J060AA Series= C0G/NP0	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm^2
Cin	Panasonic	25SVPF330M Series= SVPF	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	2	$0.73	 CAPSMT_62_F12 151 mm^2
Cinx	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Cout	Panasonic	20SVPF390M Series= SVPF	Cap= 390.0 uF ESR= 14.0 mOhm VDC= 20.0 V IRMS= 4.95 A	3	$0.65	 CAPSMT_62_E12 106 mm^2
Coutx	MuRata	GRM188R71C474KA88D Series= X7R	Cap= 470.0 nF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.03	0603 5 mm^2

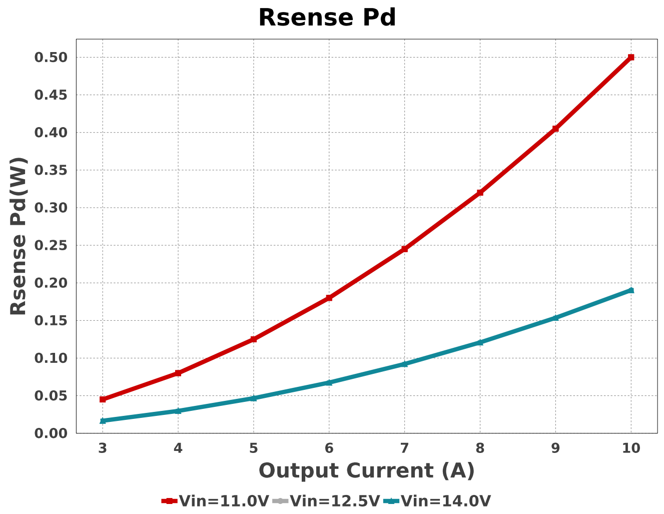
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx2	MuRata	GRM188R71C474KA88D Series= X7R	Cap= 470.0 nF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.03	0603 5 mm^2
Cramp	Samsung Electro-Mechanics	CL21C331JBANNNC Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
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	Taiyo Yuden	TMK212B7105KG-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
D1	Vishay-Semiconductor	M3035S-E3/4W	VF@Io= 700.0 mV VRRM= 35.0 V	1	$0.60	TO-220AB 79 mm^2
D2	Vishay-Semiconductor	M3035S-E3/4W	VF@Io= 700.0 mV VRRM= 35.0 V	1	$0.60	TO-220AB 79 mm^2
L1	Coilcraft	XAL1010-332MEB	L= 3.3 µH 3.7 mOhm	1	$1.71	XAL1010 160 mm^2
M1	Texas Instruments	CSD16340Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.35	DQG0008A 18 mm^2
M2	Texas Instruments	CSD16340Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.35	DQG0008A 18 mm^2
Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 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	CRCW04027K87FKED Series= CRCW..e3	Res= 7.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsense	Vishay-Dale	WSR35L000FEA Series= WSR	Res= 5.0 mOhm Power= 3.0 W Tolerance= 1.0%	1	$0.67	4527 122 mm^2
Rt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv1	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Ruv2	Vishay-Dale	CRCW04022K49FKED Series= CRCW..e3	Res= 2.49 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

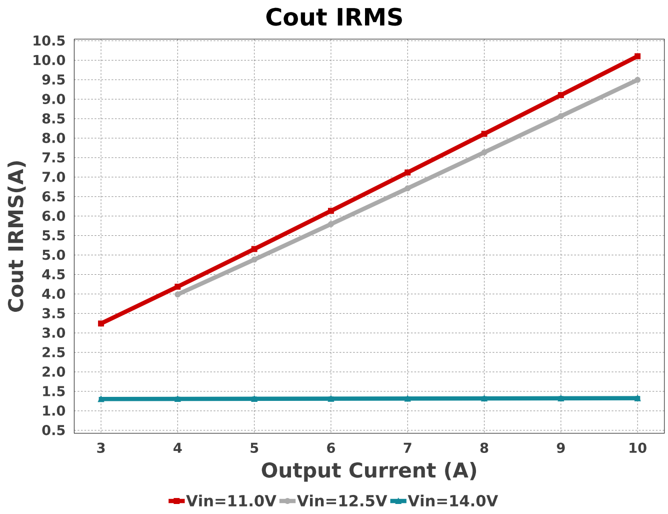
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	LM25118Q1MH/NOPB	Switcher	1	$2.67	MXA20A 71 mm^2

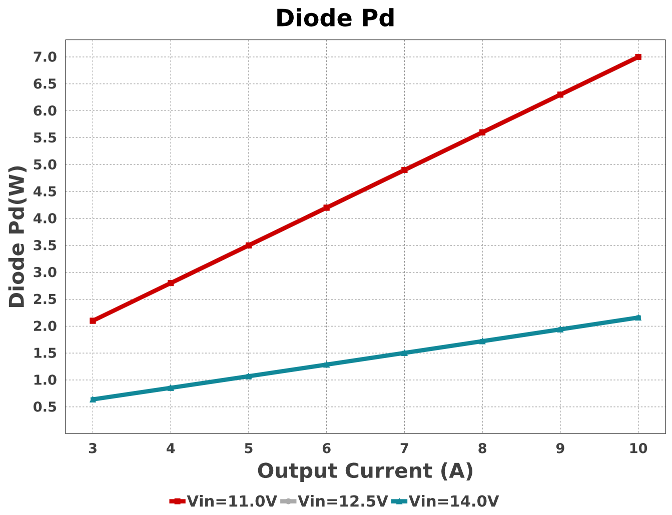


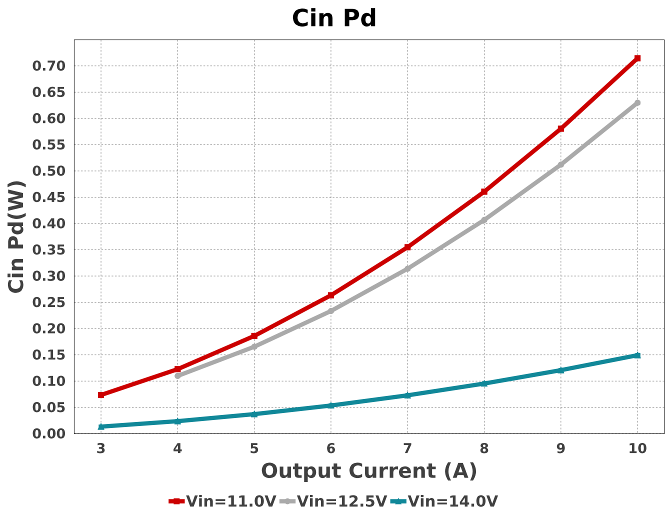


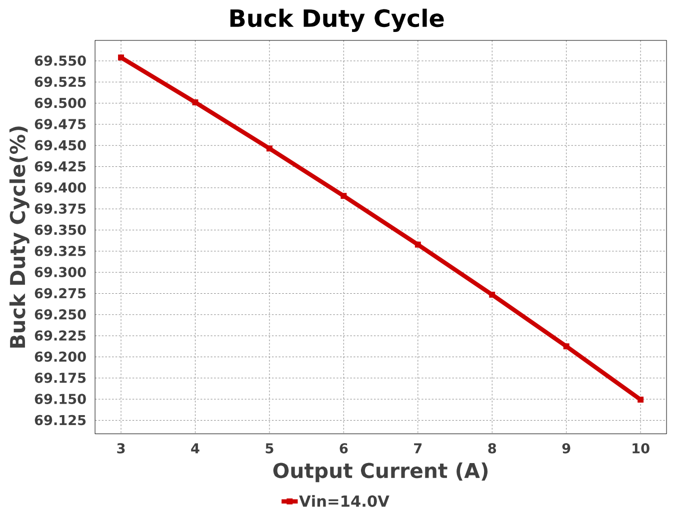


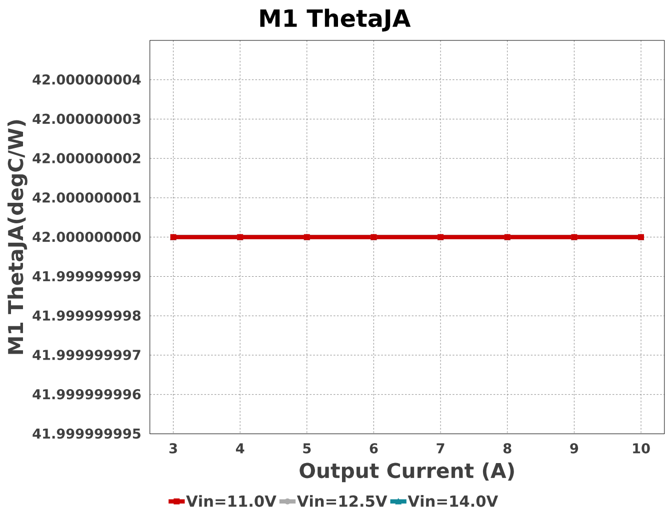


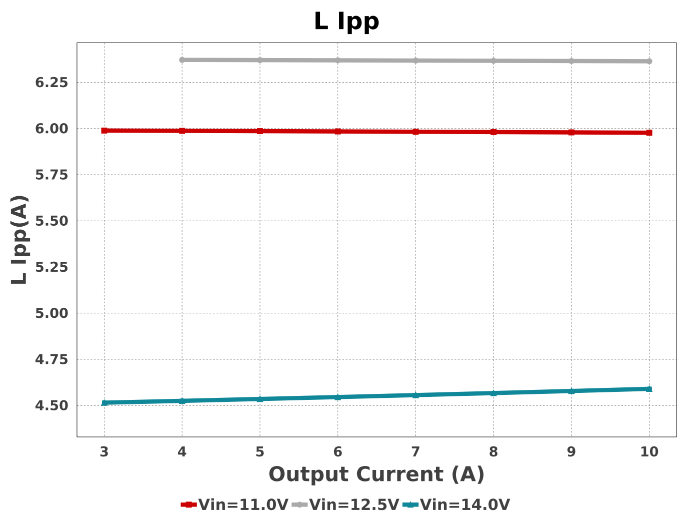


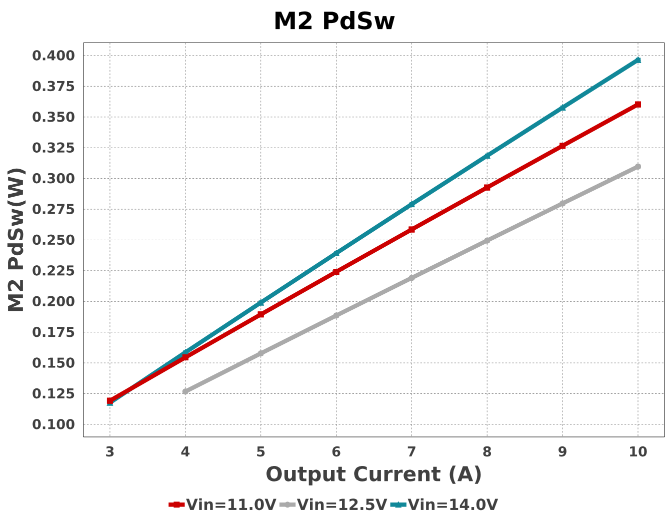


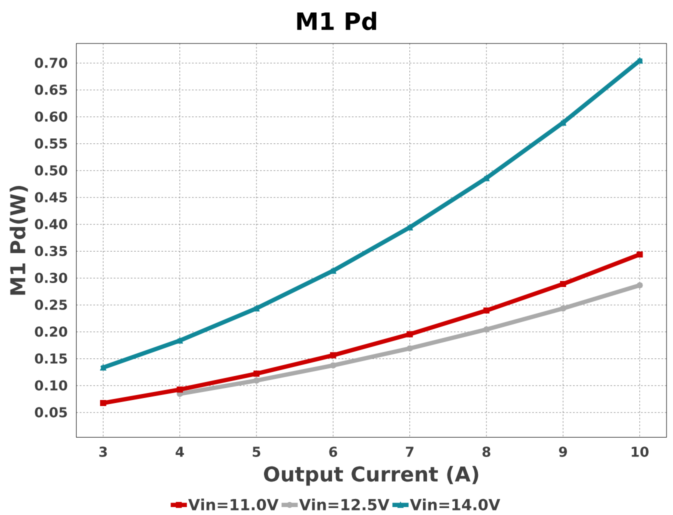


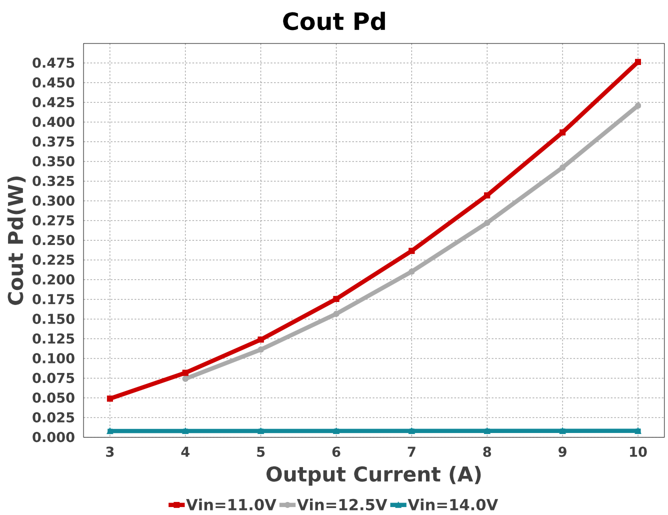

Buck Duty Cycle
Buck Duty Cycle(%)
69.550
69.525
69.500
69.475
69.450
69.425
69.400
69.375
69.350
69.325
69.300
69.275
69.250
69.225
69.200
69.175
69.150
69.125
3 4 5 6 7 8 9 10
Output Current (A)
Vin=14.0V

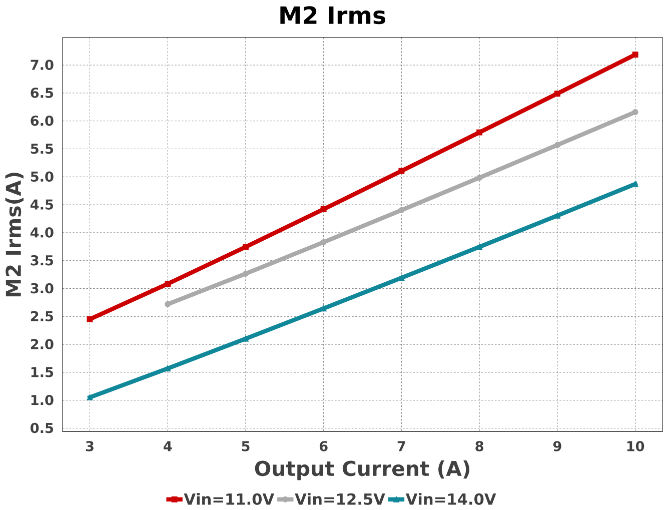

M1 ThetaJA
M1 ThetaJA(degC/W)
42.000000004
42.000000003
42.000000002
42.000000001
42.000000000
41.999999999
41.999999998
41.999999997
41.999999996
41.999999995
3 4 5 6 7 8 9 10
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

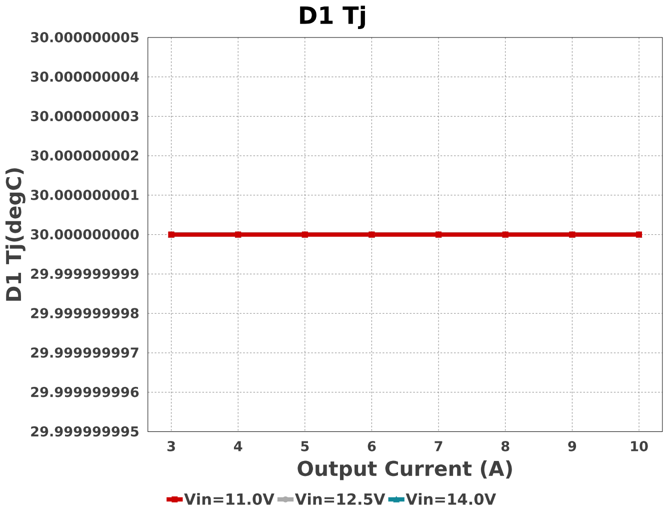

L Ipp
L Ipp(A)
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
3 4 5 6 7 8 9 10
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

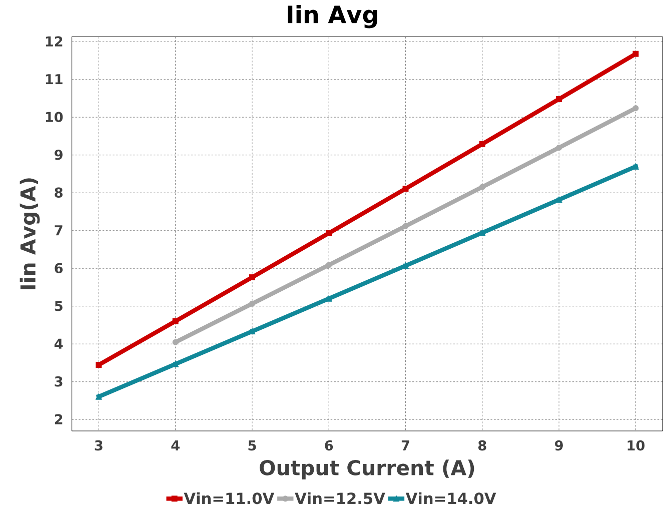

M2 PdSw
M2 PdSw(W)
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
3 4 5 6 7 8 9 10
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

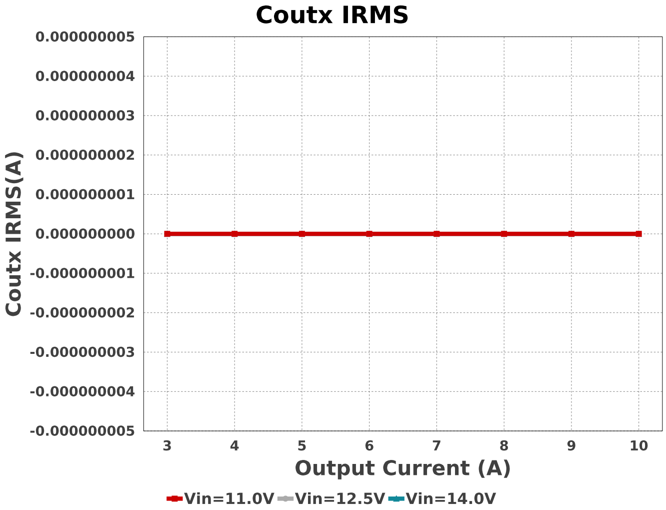

M1 Pd
M1 Pd(W)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
3 4 5 6 7 8 9 10
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

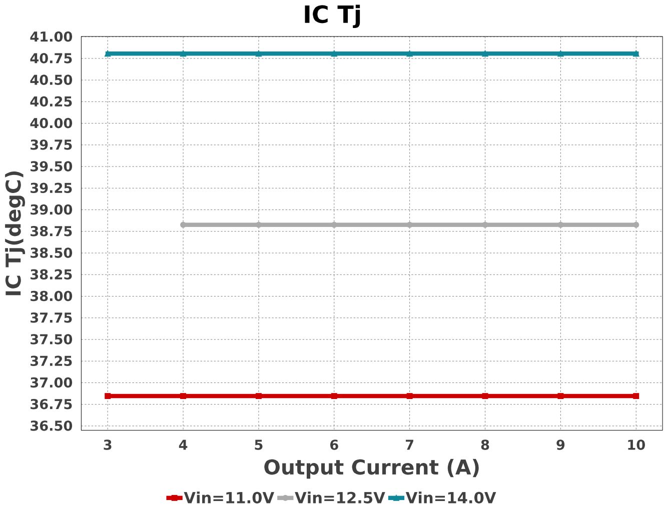

Cout Pd
Cout Pd(W)
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
3 4 5 6 7 8 9 10
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

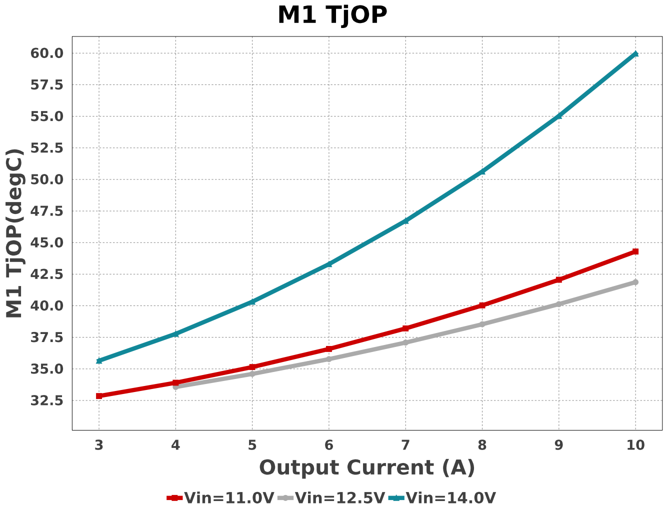

M2 Irms
M2 Irms(A)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V


D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

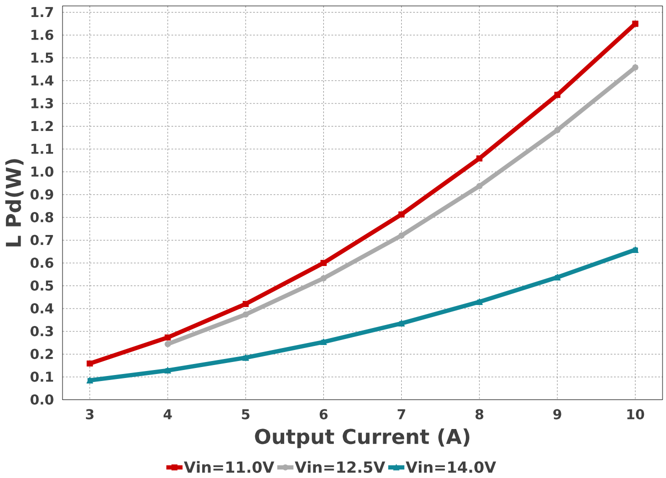

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V


Coutx IRMS
Coutx IRMS(A)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

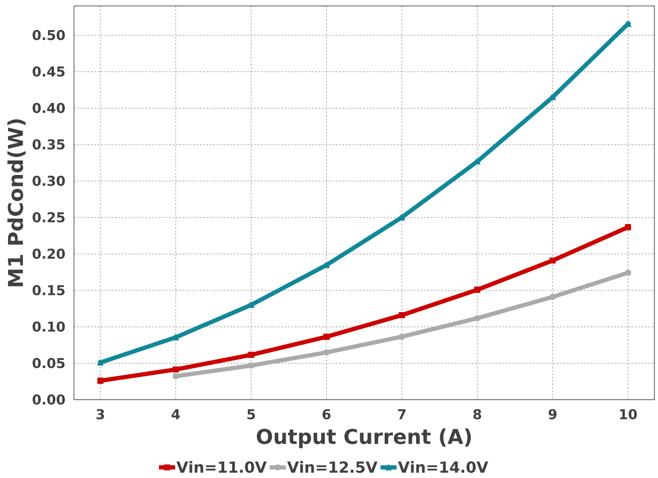

IC Tj
IC Tj(degC)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V


M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

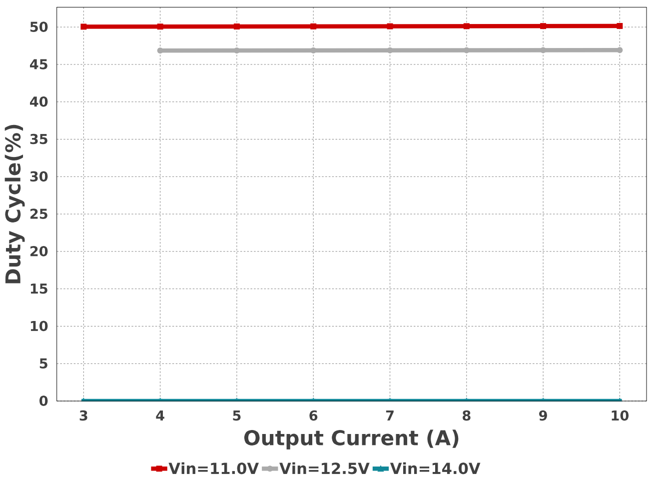
L Pd



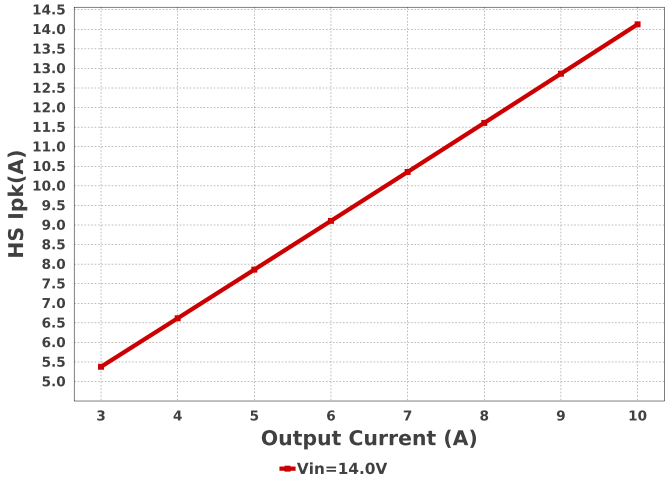
M1 PdCond



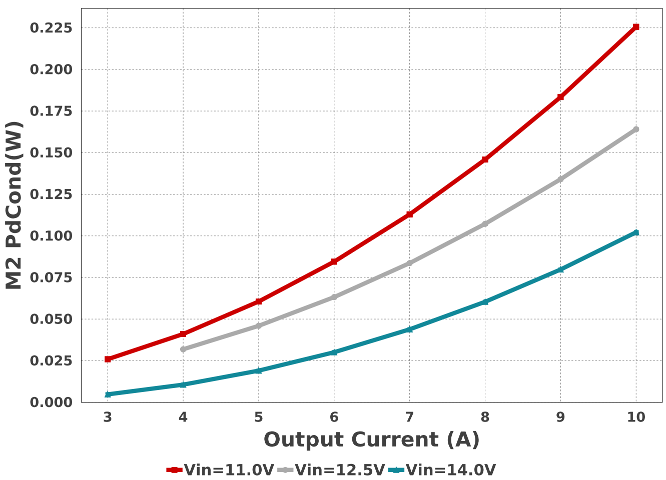
Duty Cycle



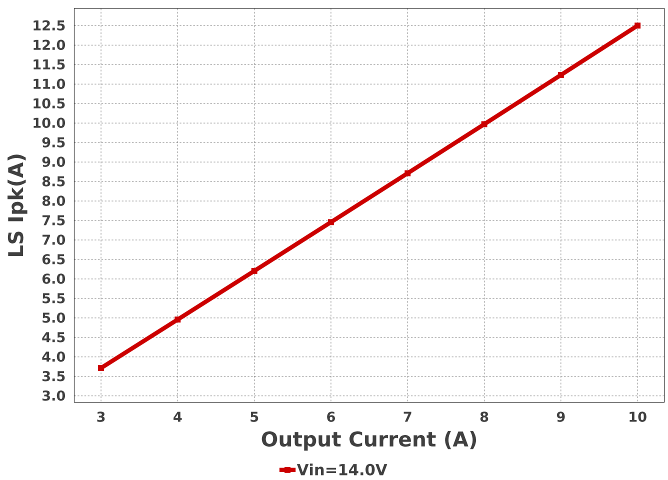
HS Ipk

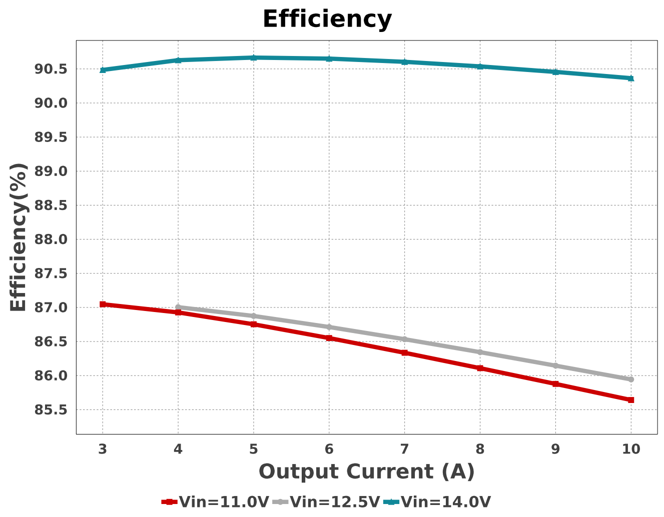


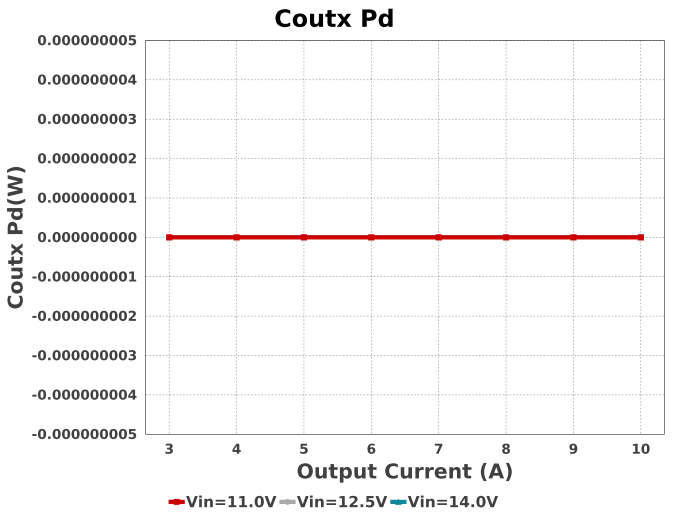
M2 PdCond

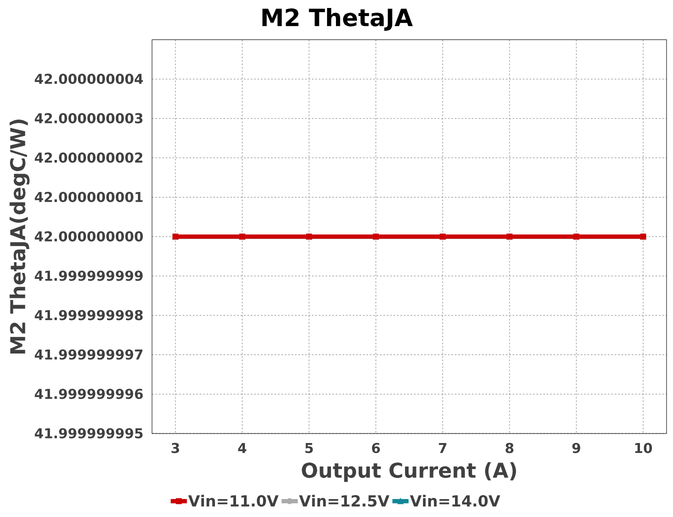


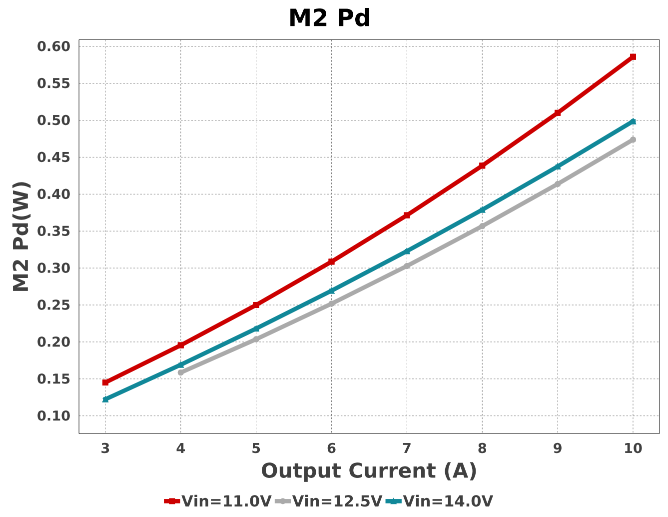
LS Ipk

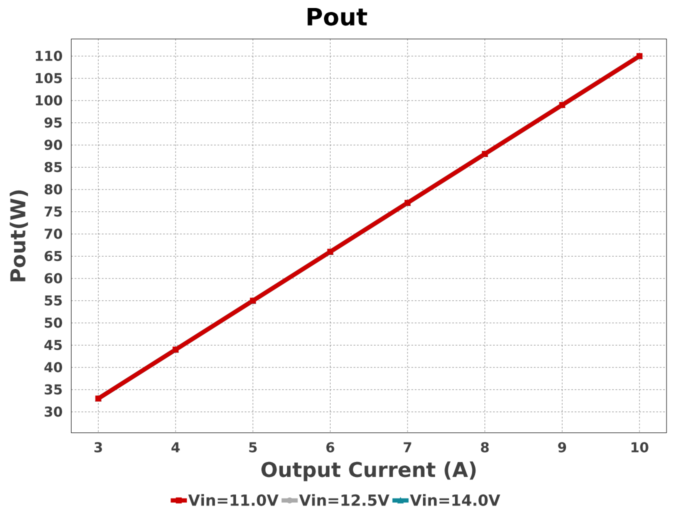


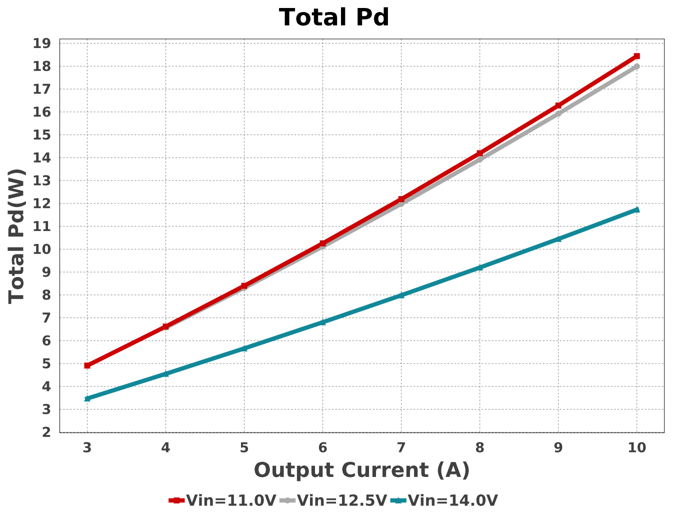

Efficiency
Efficiency(%)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

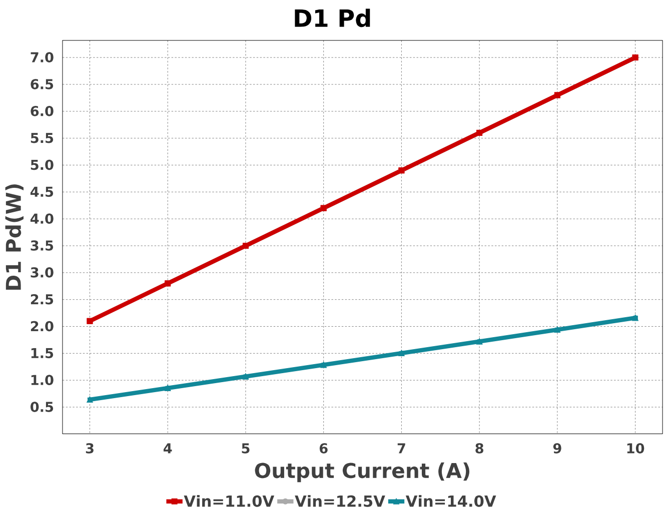

Coutx Pd
Coutx Pd(W)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

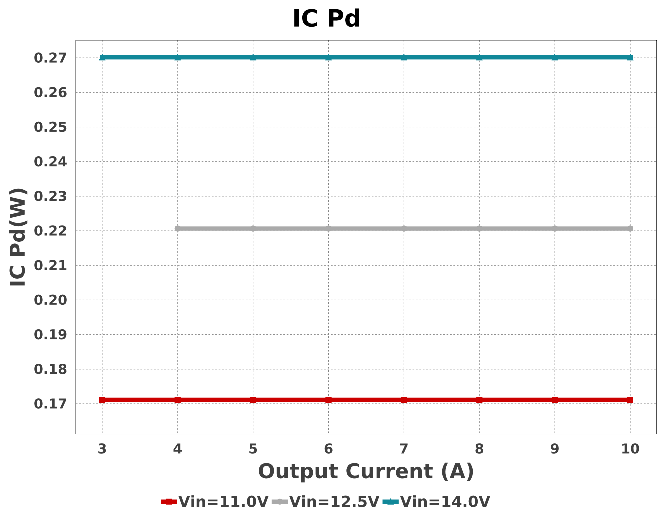

M2 ThetaJA
M2 ThetaJA(degC/W)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

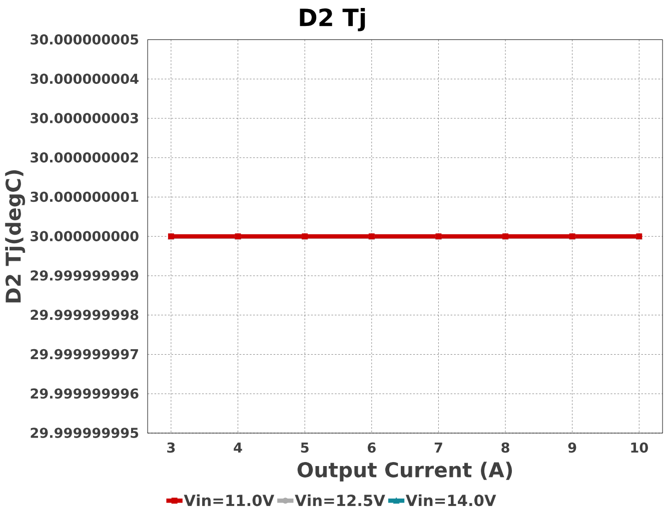

M2 Pd
M2 Pd(W)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

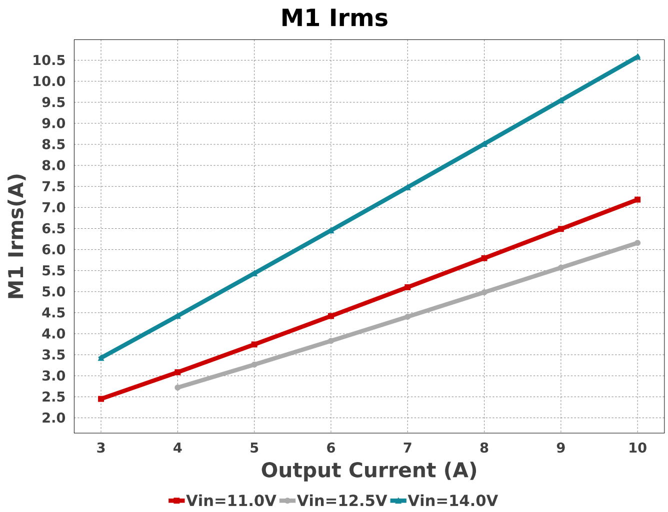

Pout
Pout(W)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

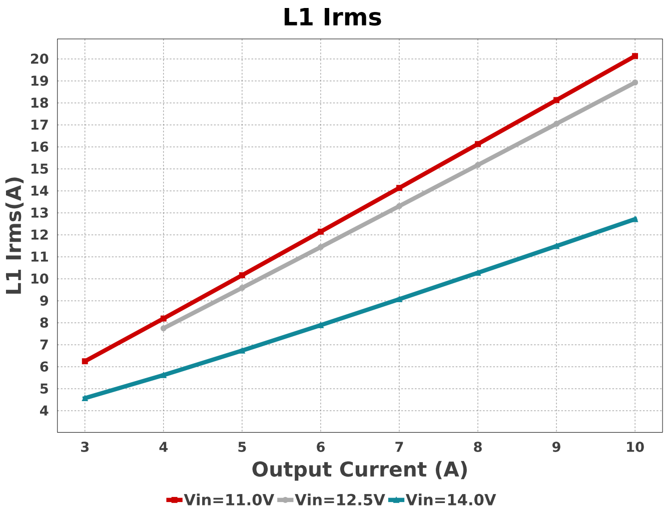

Total Pd
Total Pd(W)
Output Current (A)
Vin=11.0V
Vin=12.5V
Vin=14.0V

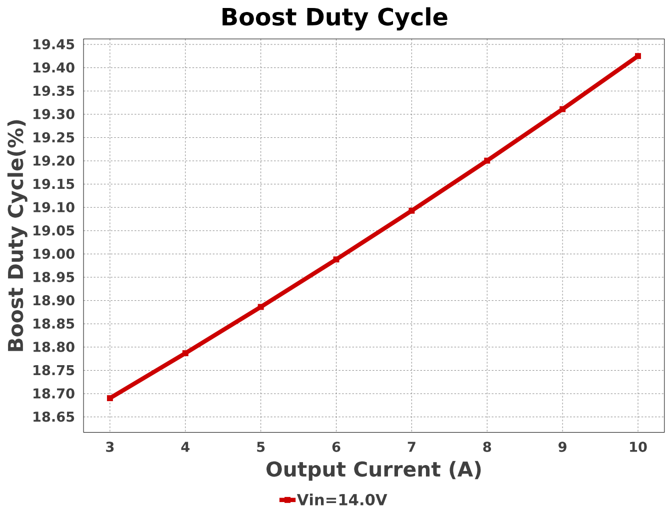

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

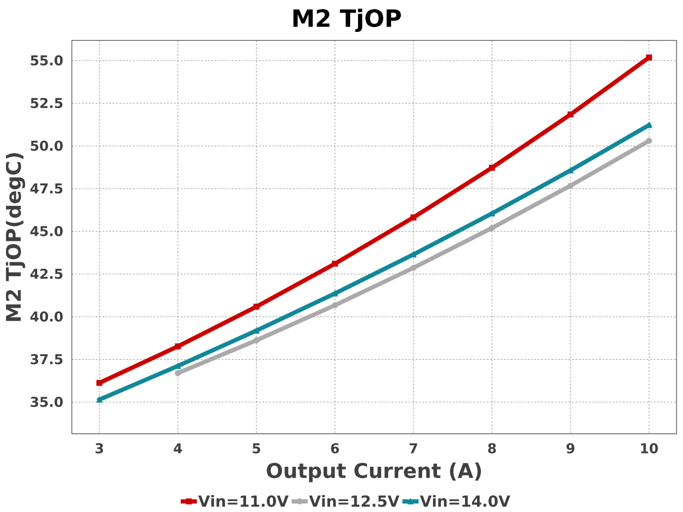

IC Pd
IC Pd(W)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

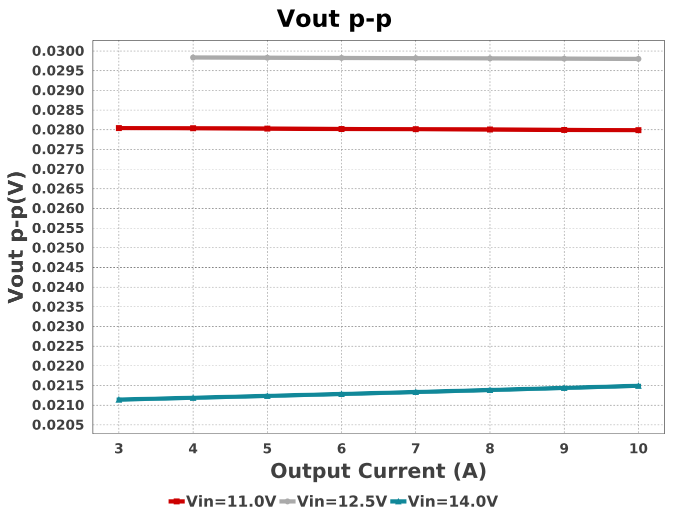

D2 Tj
D2 Tj(degC)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

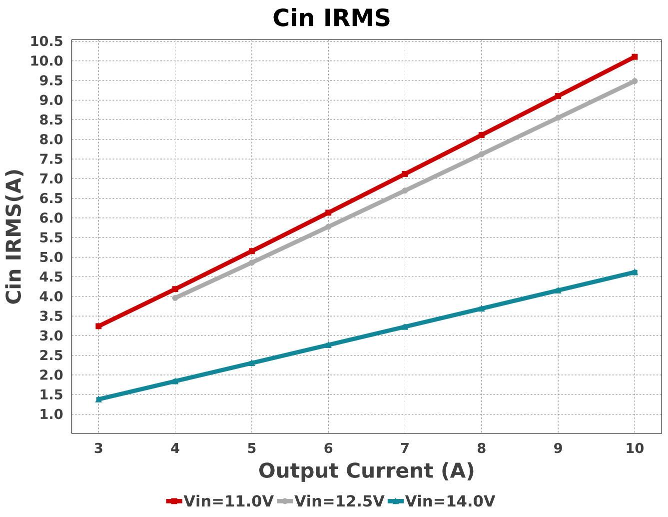

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V

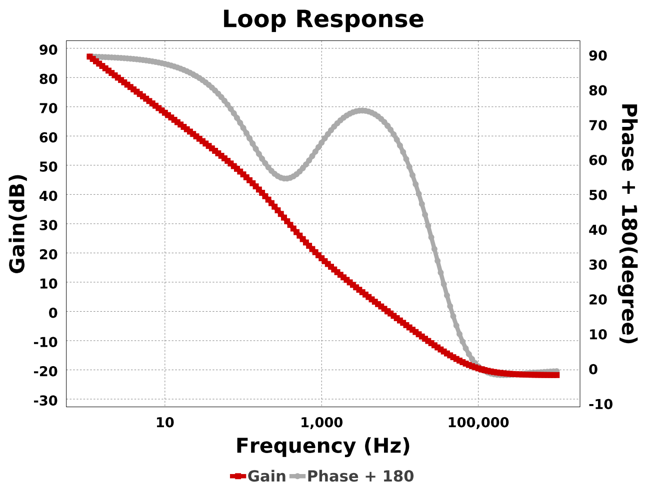

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=11.0V Vin=12.5V Vin=14.0V


Boost Duty Cycle
Boost Duty Cycle(%)
Output Current (A)
Vin=14.0V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	4.621 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	149.45 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.327 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	8.222 mW	Capacitor	Output capacitor power dissipation
5.	D1 Pd	2.162 W	Diode	Diode power dissipation
6.	D1 Tj	30.0 degC	Diode	D1 junction temperature
7.	D2 Pd	7.092 W	Diode	Diode2 power dissipation
8.	HS Ipk	14.142 A	IC	Peak switch current in IC
9.	IC Pd	270.15 mW	IC	IC power dissipation
10.	IC Tj	40.806 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	8.699 A	IC	Average input current
14.	LS Ipk	12.52 A	IC	Peak switch current in IC
15.	L Ipp	4.598 A	Inductor	Peak-to-peak inductor ripple current
16.	L Pd	659.35 mW	Inductor	Inductor power dissipation
17.	L1 Irms	12.728 A	Inductor	Inductor ripple current
18.	M1 Irms	10.59 A	Mosfet	MOSFET RMS ripple current
19.	M1 Pd	743.39 mW	Mosfet	MOSFET power dissipation
20.	M1 PdCond	554.56 mW	Mosfet	M1 MOSFET conduction losses
21.	M1 ThetaJA	42.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
22.	M1 TjOP	59.998 degC	Mosfet	MOSFET junction temperature
23.	M2 Irms	4.887 A	Mosfet	MOSFET RMS ripple current
24.	M2 Pd	508.82 mW	Mosfet	MOSFET power dissipation
25.	M2 PdCond	112.37 mW	Mosfet	M2 MOSFET conduction losses
26.	M2 PdSw	396.46 mW	Mosfet	M2 MOSFET switching losses
27.	M2 ThetaJA	42.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
28.	M2 TjOP	51.254 degC	Mosfet	MOSFET junction temperature
29.	Cin Pd	149.45 mW	Power	Input capacitor power dissipation
30.	Cout Pd	8.222 mW	Power	Output capacitor power dissipation
31.	D1 Pd	2.162 W	Power	Diode power dissipation
32.	D2 Pd	7.092 W	Power	Diode2 power dissipation

#	Name	Value	Category	Description
33.	IC Pd	270.15 mW	Power	IC power dissipation
34.	L Pd	659.35 mW	Power	Inductor power dissipation
35.	M1 Pd	743.39 mW	Power	MOSFET power dissipation
36.	M1 PdCond	554.56 mW	Power	M1 MOSFET conduction losses
37.	M2 Pd	508.82 mW	Power	MOSFET power dissipation
38.	M2 PdCond	112.37 mW	Power	M2 MOSFET conduction losses
39.	M2 PdSw	396.46 mW	Power	M2 MOSFET switching losses
40.	Rsense Pd	190.88 mW	Power	LED Current Rsns Power Dissipation
41.	Total Pd	11.785 W	Power	Total Power Dissipation
42.	Rsense Pd	190.88 mW	Resistor	LED Current Rsns Power Dissipation
43.	BOM Count	28	System Information	Total Design BOM count
44.	Boost Duty Cycle	19.503 %	System Information	Boost Duty cycle
45.	Buck Duty Cycle	69.107 %	System Information	Buck Duty cycle
46.	Cross Freq	6.988 kHz	System Information	Bode plot crossover frequency
47.	D2 Tj	30.0 degC	System Information	D2 junction temperature
48.	Efficiency	90.323 %	System Information	Steady state efficiency
49.	FootPrint	1.245 k mm^2	System Information	Total Foot Print Area of BOM components
50.	Frequency	278.019 kHz	System Information	Switching frequency
51.	Gain Marg	-19.861 dB	System Information	Bode Plot Gain Margin
52.	Iout	10.0 A	System Information	Iout operating point
53.	Low Freq Gain	87.16 dB	System Information	Gain at 1Hz
54.	Operating Topology	Transition	System Information	The current operating topology of the device
55.	Phase Marg	69.826 deg	System Information	Bode Plot Phase Margin
56.	Pout	110.0 W	System Information	Total output power
57.	Total BOM	$10.72	System Information	Total BOM Cost
58.	Vin	14.0 V	System Information	Vin operating point
59.	Vout Actual	10.91 V	System Information	Vout Actual calculated based on selected voltage divider resistors
60.	Vout Tolerance	3.282 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
61.	Vout p-p	21.53 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	10.0	Maximum Output Current
VinMax	14.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	11.0	Output Voltage
base_pn	LM25118-Q1	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

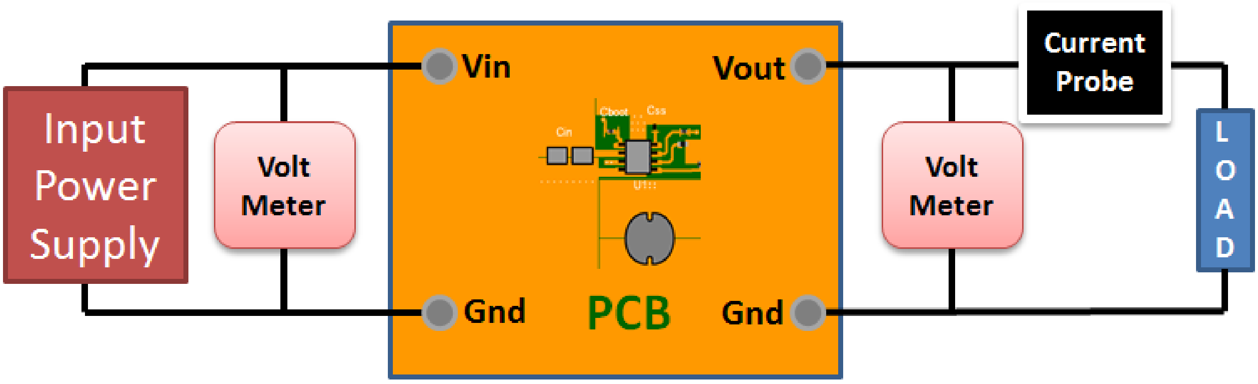
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 11.0V 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 LM25118-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 : BC176DCE794CD1B882A4E91714AABEBF[v1]

3. **LM25118-Q1** Product Folder : http://www.ti.com/product/LM25118%2DQ1 : contains the data sheet and other resources.

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