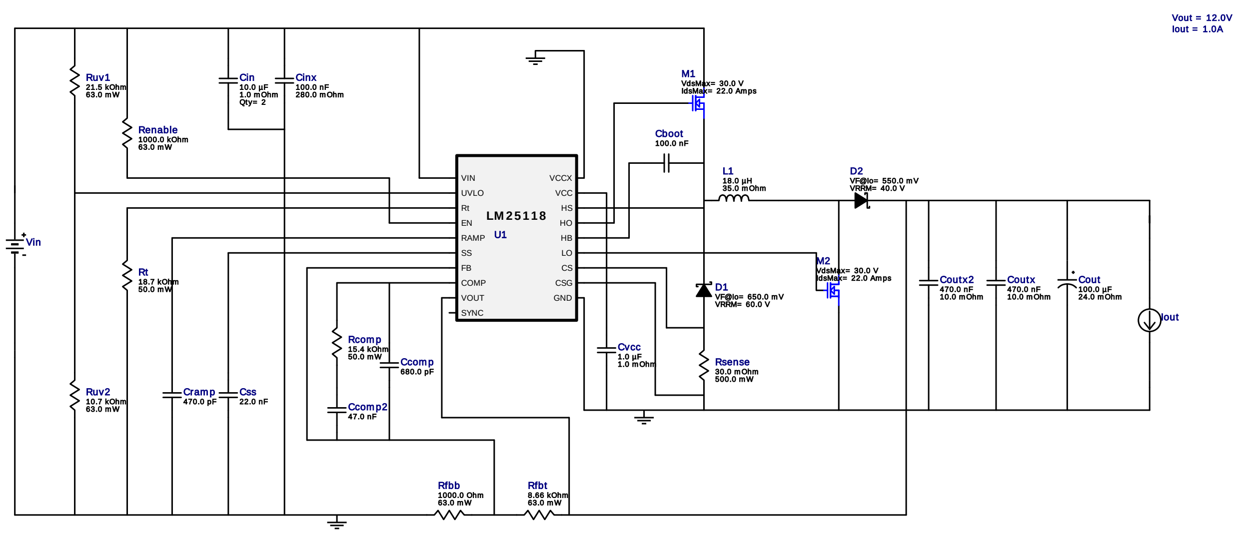
VinMin = 4.5V
VinMax = 20.0V
Vout = 12.0V
Iout = 1.0A

Device = LM25118MH/NOPB
Topology = Buck_Boost
Created = 2022-10-26 09:30:18.954
BOM Cost = $5.30
BOM Count = 26
Total Pd = 0.43W

WEBENCH ® Design Report

Design : 70 LM25118MH/NOPB
LM25118MH/NOPB 4.5V-20V to 12.00V @ 1A



Design Alerts

LM25118 Design

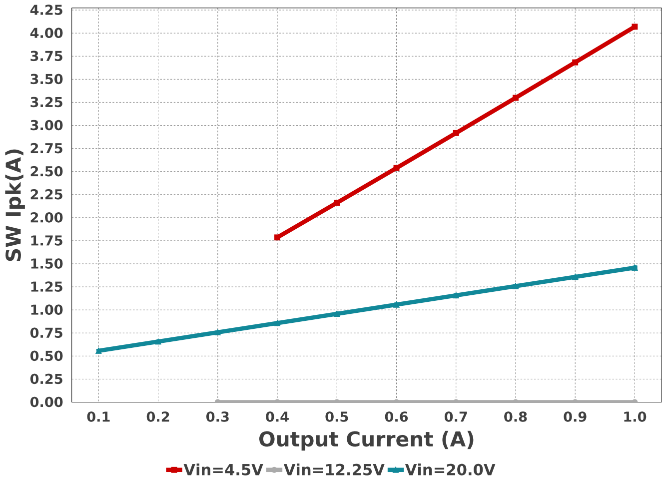
Tool Tip for Keep selected FETs during Redesign Configuration Option: By Default if you hit REDESIGN button, Webench re-designs all the external components including Fets. But if we have checked this configuration option, currently selected fets in schematic will get locked and re-design happens for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

Electrical BOM

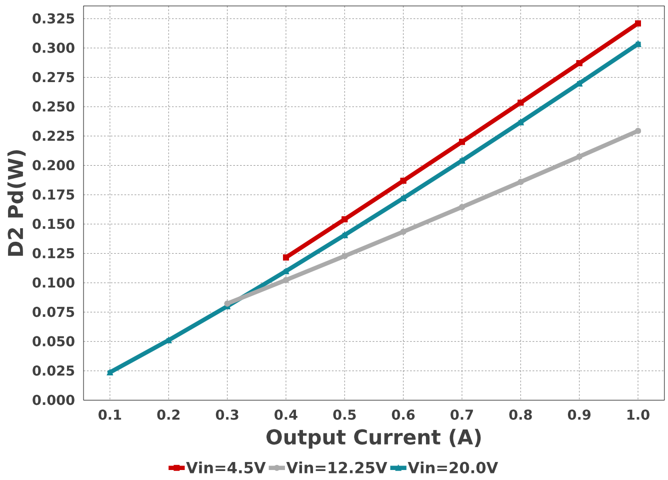
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm^2
Ccomp	Samsung Electro-Mechanics	CL05C681JB5NNNC Series= C0G/NP0	Cap= 680.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp2	Kemet	C0805C473J3GACTU Series= C0G/NP0	Cap= 47.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.21	0805 7 mm^2
Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	2	$0.27	1210 15 mm^2
Cinx	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Cout	Panasonic	25SVPF100M Series= SVPF	Cap= 100.0 uF ESR= 24.0 mOhm VDC= 25.0 V IRMS= 3.2 A	1	$0.66	CAPSMT_62_E7 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	CL21C471JBANNNC Series= C0G/NP0	Cap= 470.0 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	$0.07	0805 7 mm^2
Cvcc	Taiyo Yuden	TMK212BJ105KG-T Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm^2
D1	Fairchild Semiconductor	FSV360FP	VF@Io= 650.0 mV VRRM= 60.0 V	1	$0.13	SOD-123HE 13 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	Bourns	SRR1280-180M	L= 18.0 µH 35.0 mOhm	1	$0.60	SRR1280 210 mm^2
M1	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.11	DQK0006C 9 mm^2
M2	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.11	DQK0006C 9 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	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 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	CRCW040221K5FKED Series= CRCW..e3	Res= 21.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ruv2	Vishay-Dale	CRCW040210K7FKED Series= CRCW..e3	Res= 10.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	LM25118MH/NOPB	Switcher	1	$2.32	MXA20A 71 mm^2

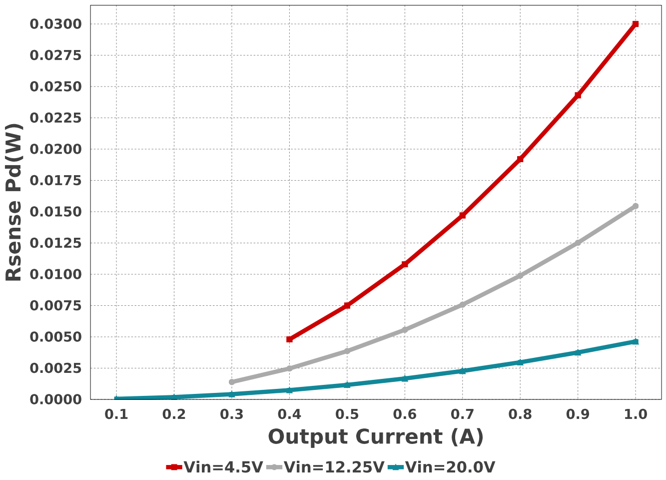
SW Ipk



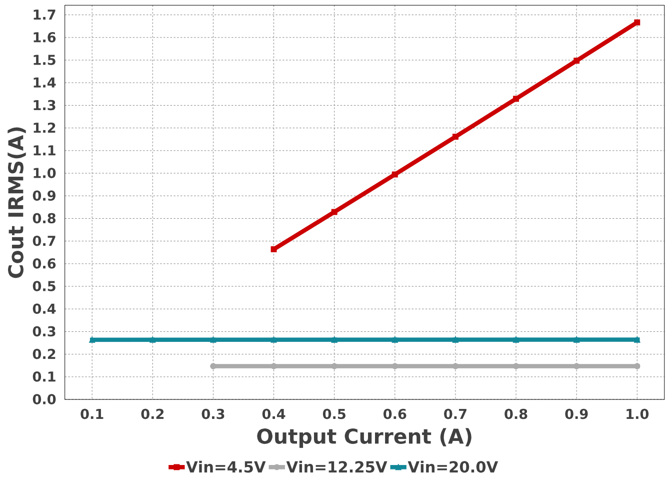
D2 Pd



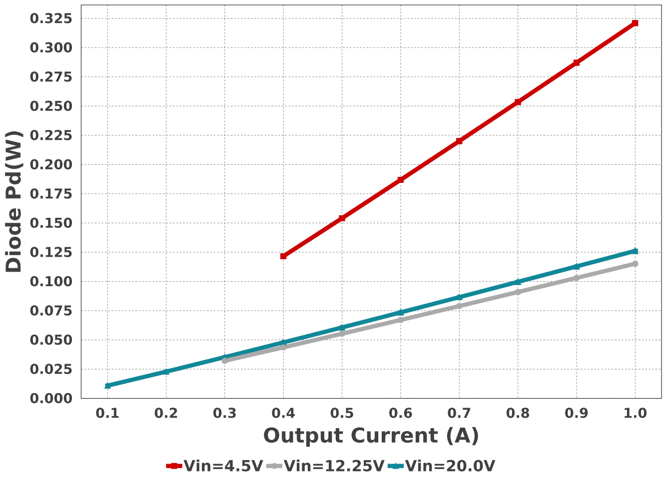
Rsense Pd



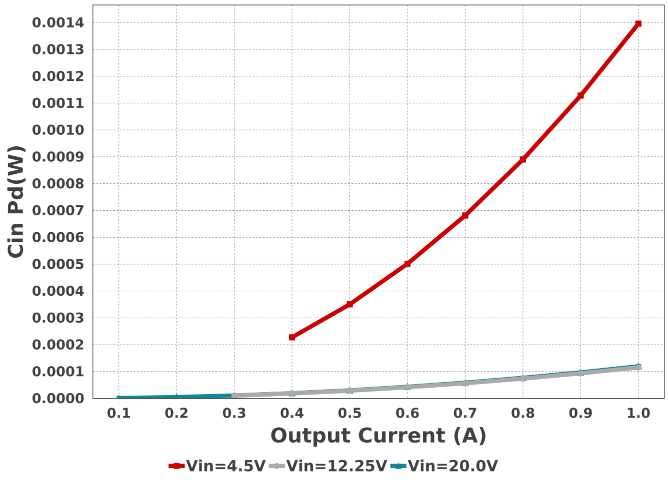
Cout IRMS

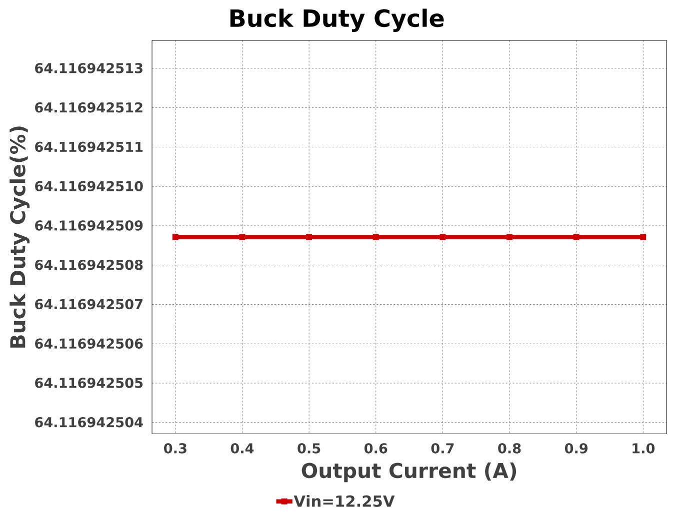


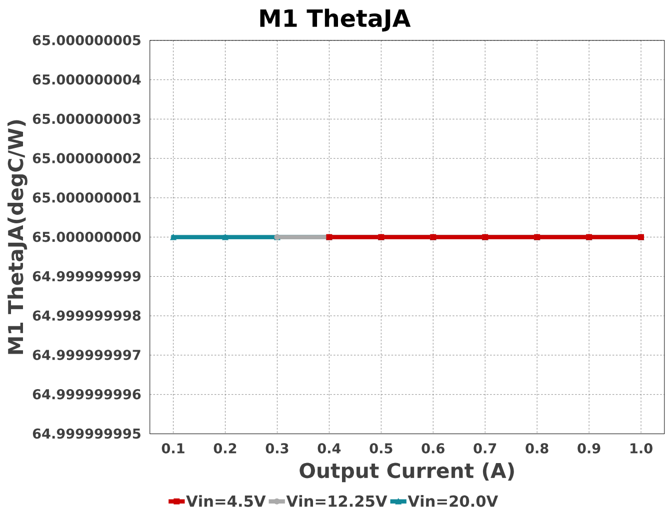
Diode Pd

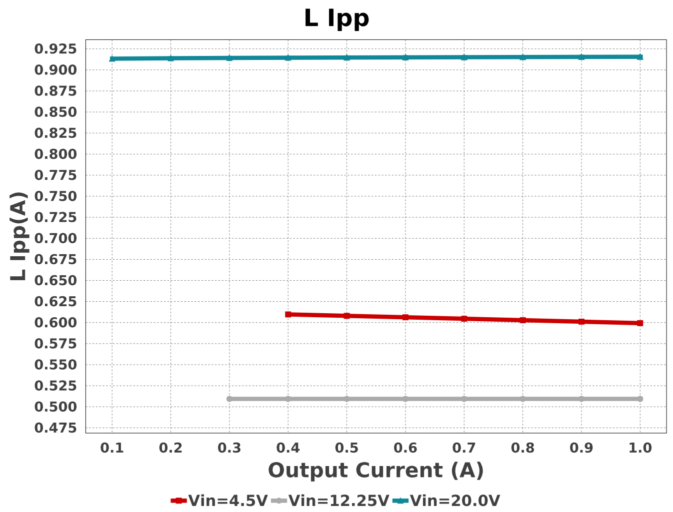


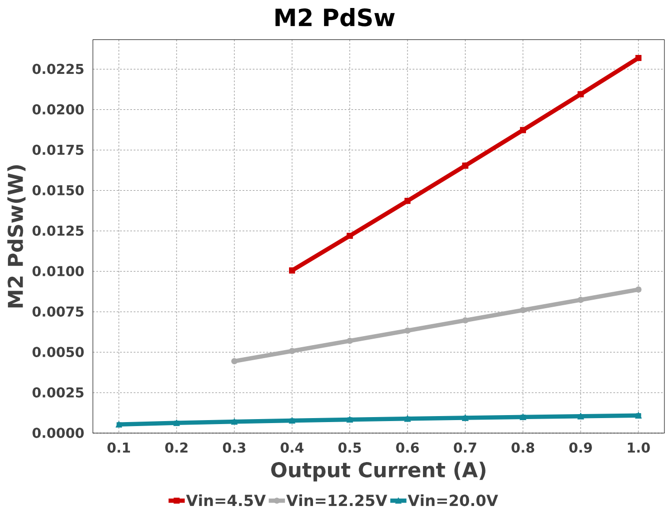
Cin Pd

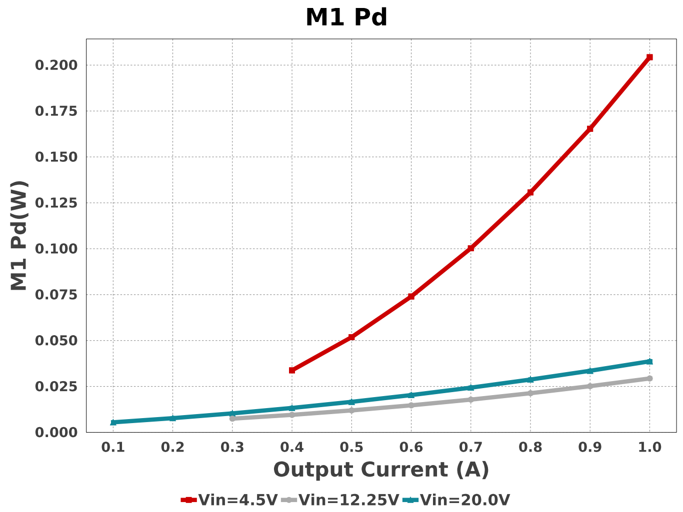


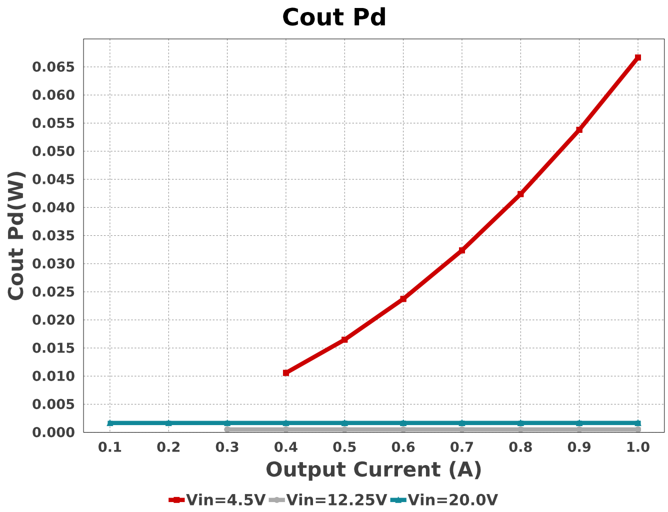

Buck Duty Cycle
Buck Duty Cycle(%)
64.116942513
64.116942512
64.116942511
64.116942510
64.116942509
64.116942508
64.116942507
64.116942506
64.116942505
64.116942504
0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=12.25V


M1 ThetaJA
M1 ThetaJA(degC/W)
65.000000005
65.000000004
65.000000003
65.000000002
65.000000001
65.000000000
64.999999999
64.999999998
64.999999997
64.999999996
64.999999995
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

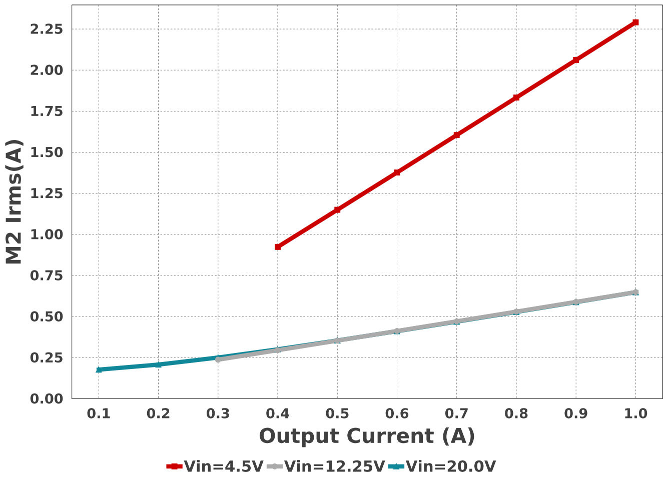

L Ipp
L Ipp(A)
0.925
0.900
0.875
0.850
0.825
0.800
0.775
0.750
0.725
0.700
0.675
0.650
0.625
0.600
0.575
0.550
0.525
0.500
0.475
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V


M2 PdSw
M2 PdSw(W)
0.0225
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

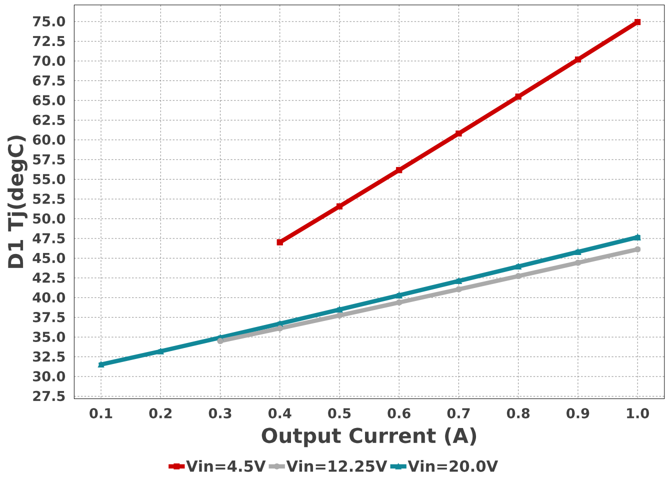

M1 Pd
M1 Pd(W)
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V


Cout Pd
Cout Pd(W)
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

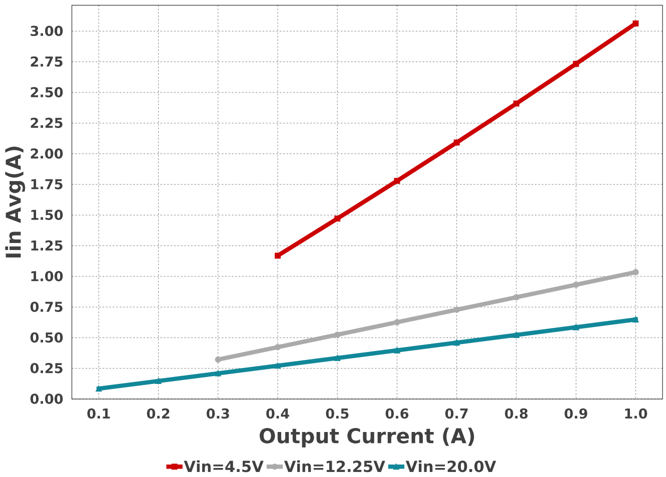
M2 Irms



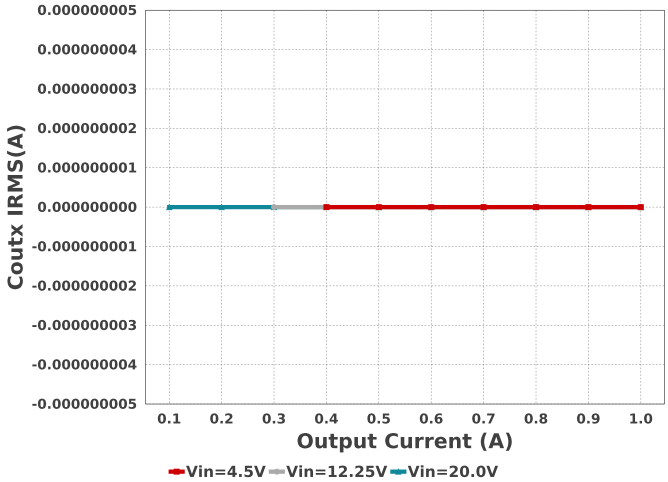
D1 Tj



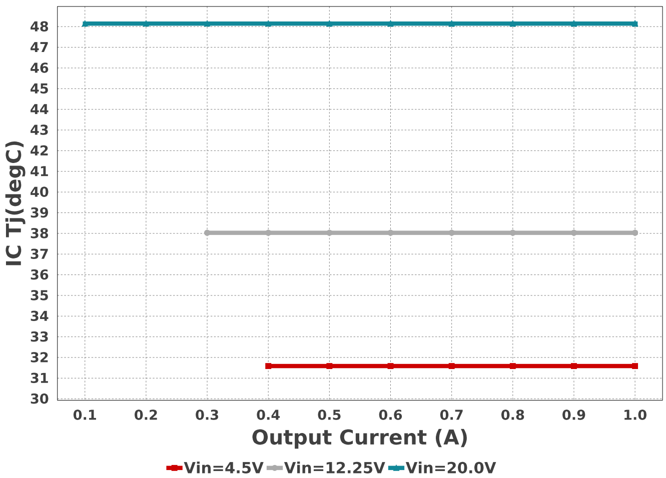
Iin Avg



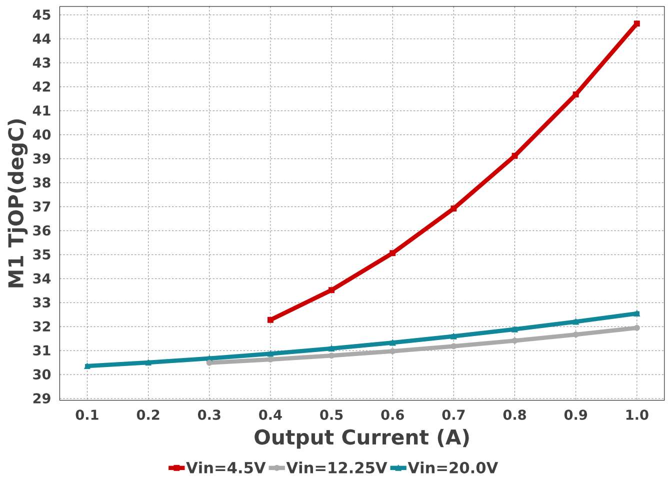
Coutx IRMS

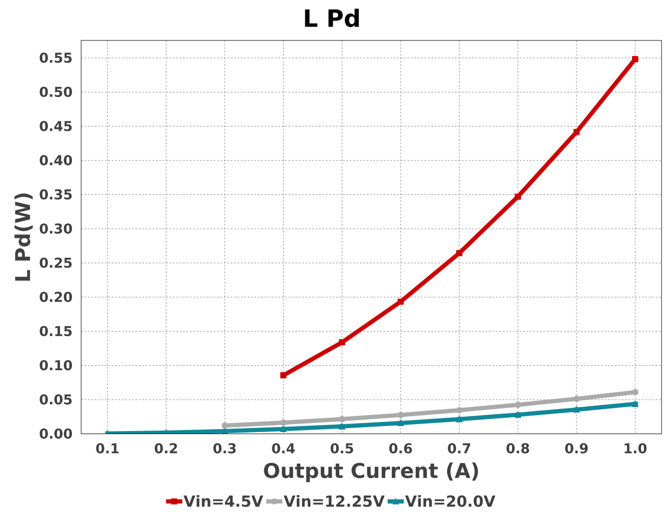


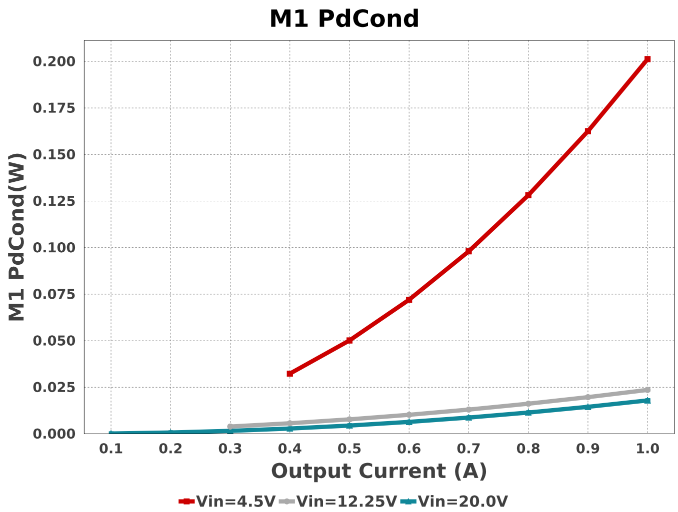
IC Tj

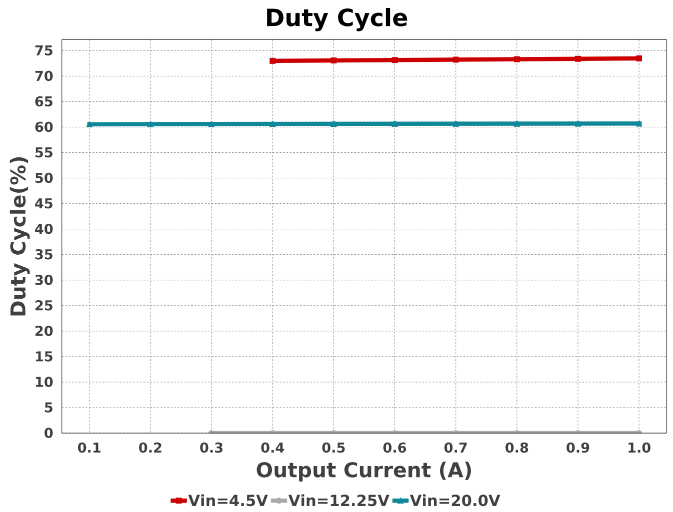


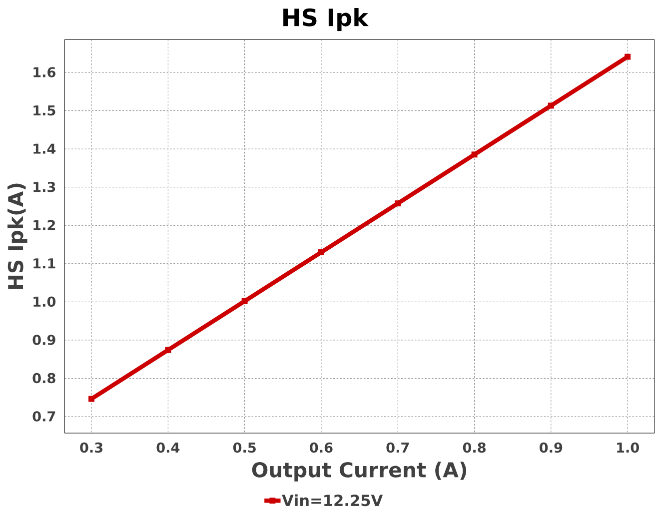
M1 TjOP

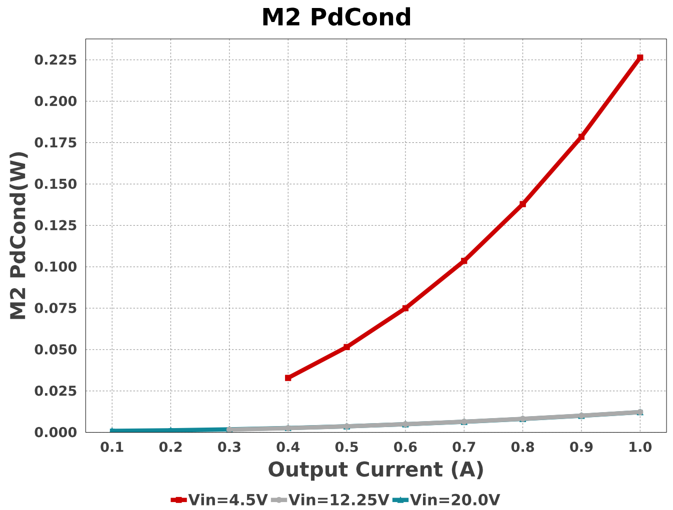


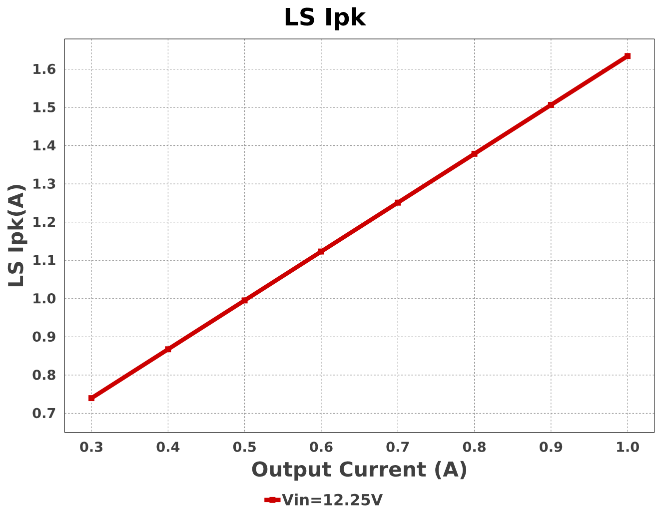

L Pd
L Pd(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

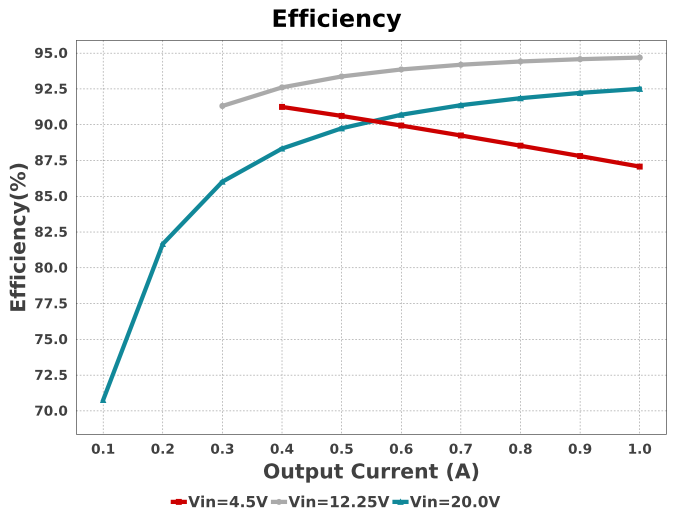

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

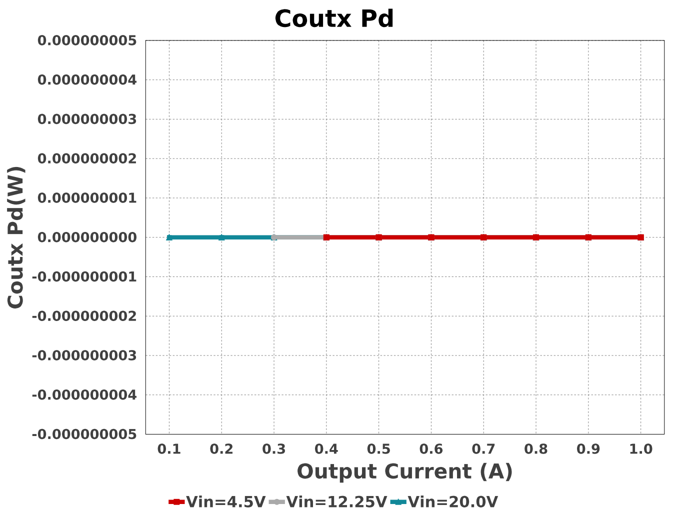

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

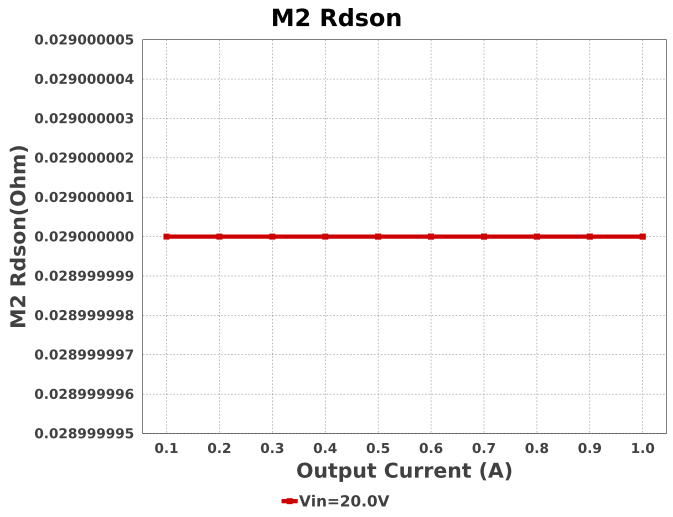

HS Ipk
HS Ipk(A)
Output Current (A)
Vin=12.25V

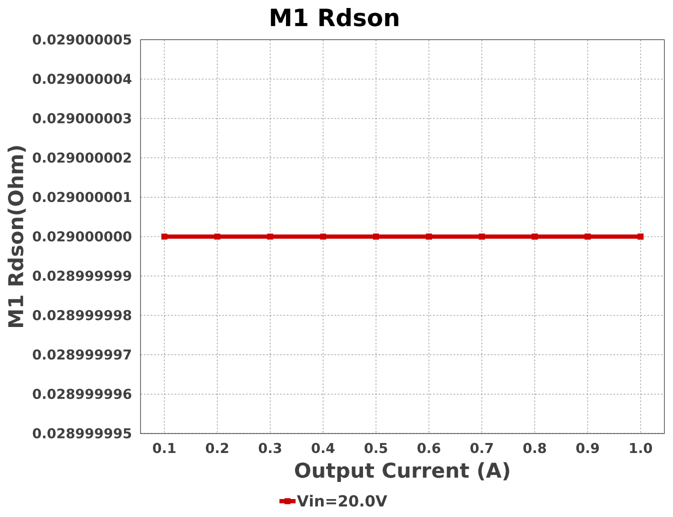

M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

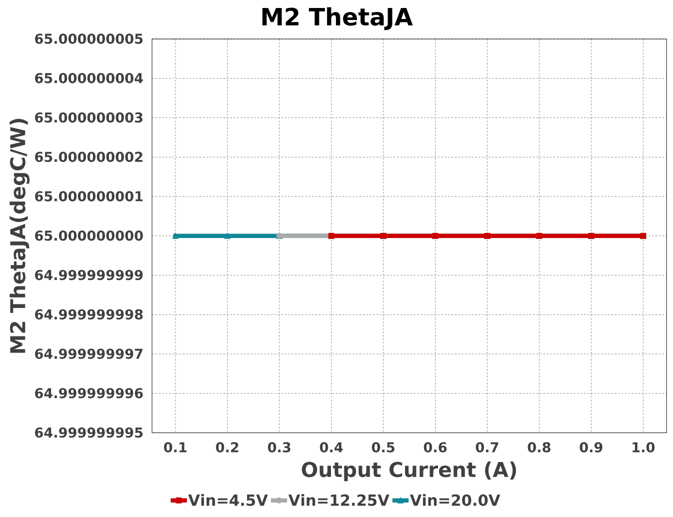

LS Ipk
LS Ipk(A)
Output Current (A)
Vin=12.25V

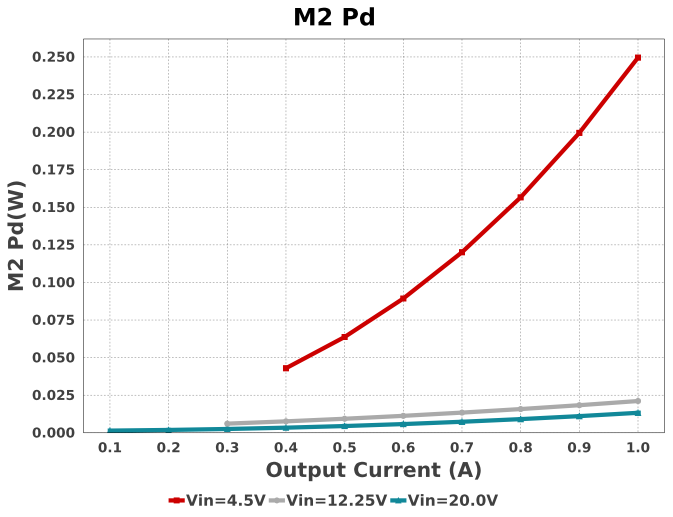

Efficiency
Efficiency(%)
95.0
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
70.0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

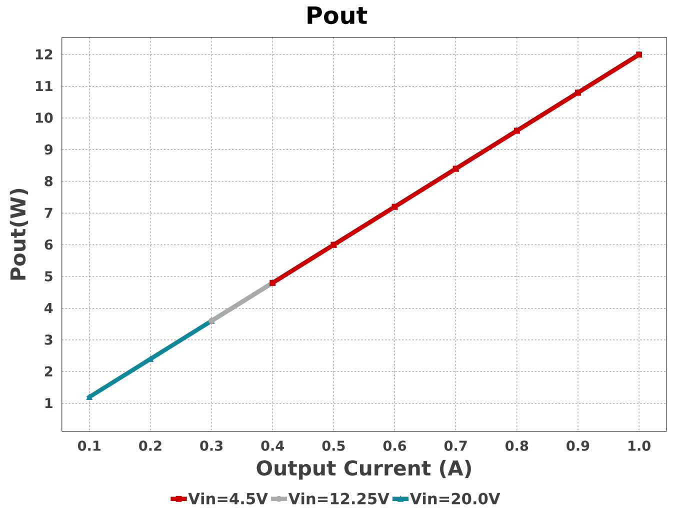

Coutx Pd
Coutx Pd(W)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

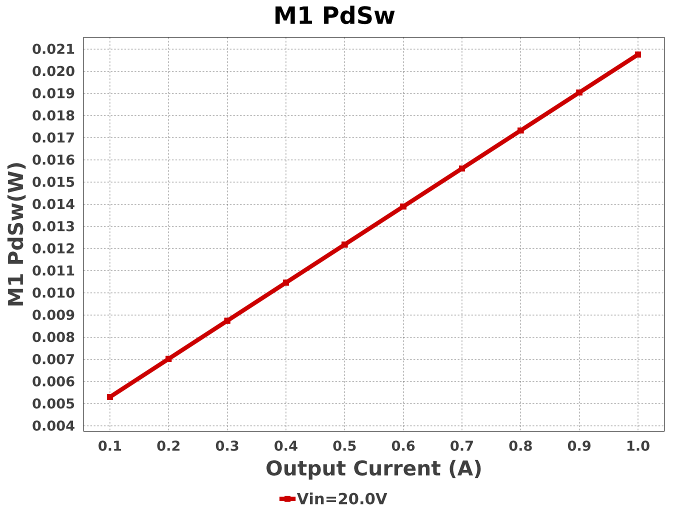

M2 Rdson
M2 Rdson(Ohm)
0.029000005
0.029000004
0.029000003
0.029000002
0.029000001
0.029000000
0.028999999
0.028999998
0.028999997
0.028999996
0.028999995
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=20.0V

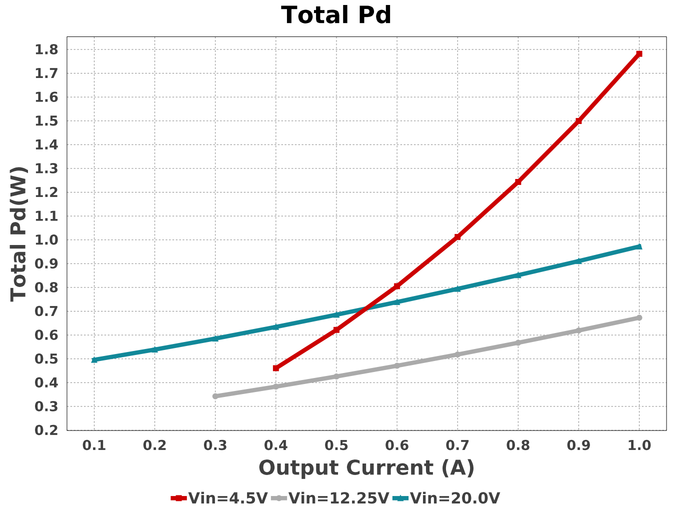

M1 Rdson
M1 Rdson(Ohm)
0.029000005
0.029000004
0.029000003
0.029000002
0.029000001
0.029000000
0.028999999
0.028999998
0.028999997
0.028999996
0.028999995
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=20.0V

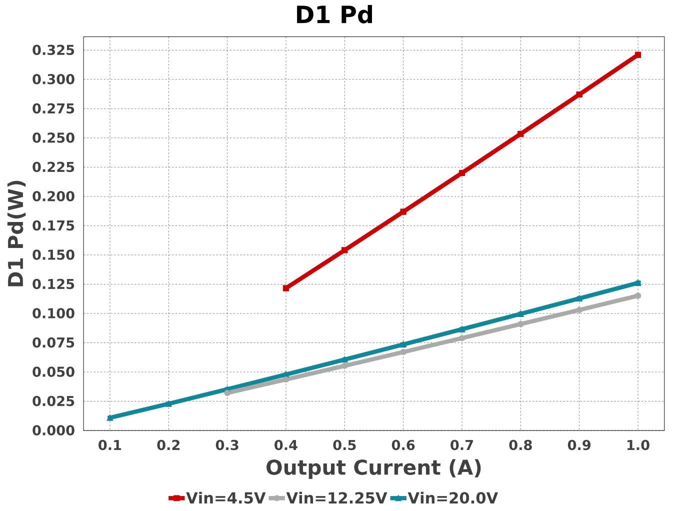

M2 ThetaJA
M2 ThetaJA(degC/W)
65.000000005
65.000000004
65.000000003
65.000000002
65.000000001
65.000000000
64.999999999
64.999999998
64.999999997
64.999999996
64.999999995
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

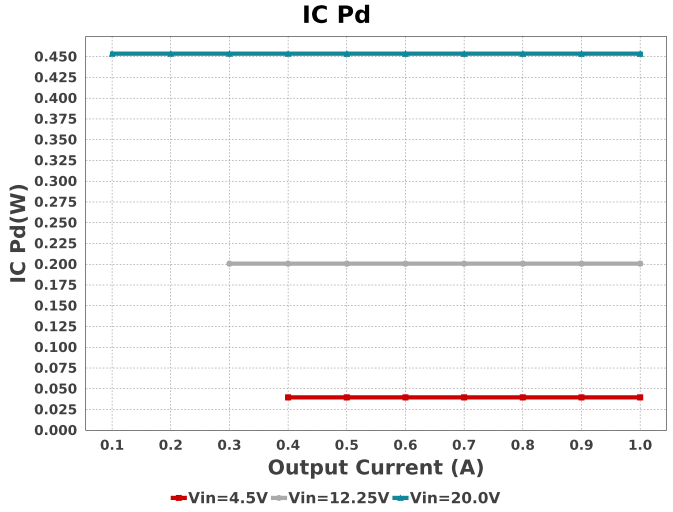

M2 Pd
M2 Pd(W)
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

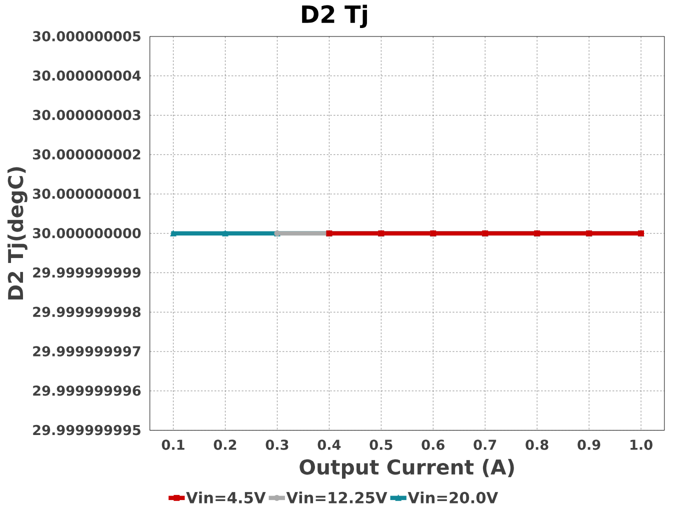

Pout
Pout(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

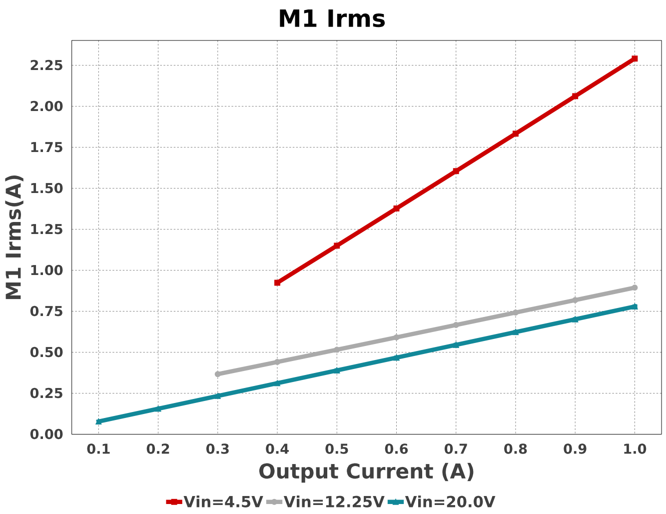

M1 PdSw
M1 PdSw(W)
Output Current (A)
Vin=20.0V

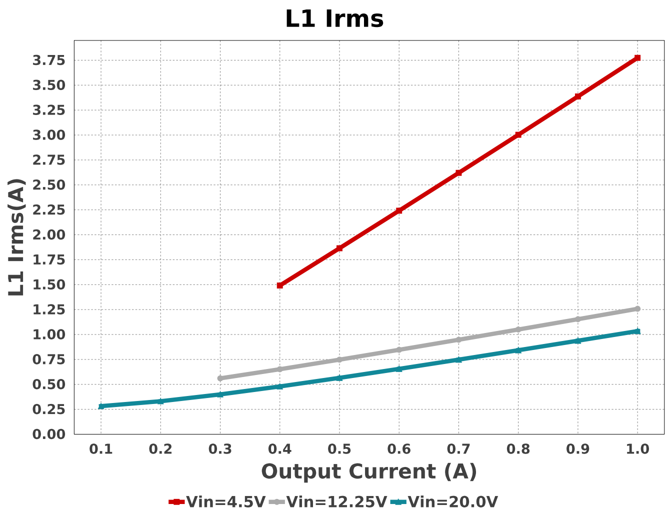

Total Pd
Total Pd(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

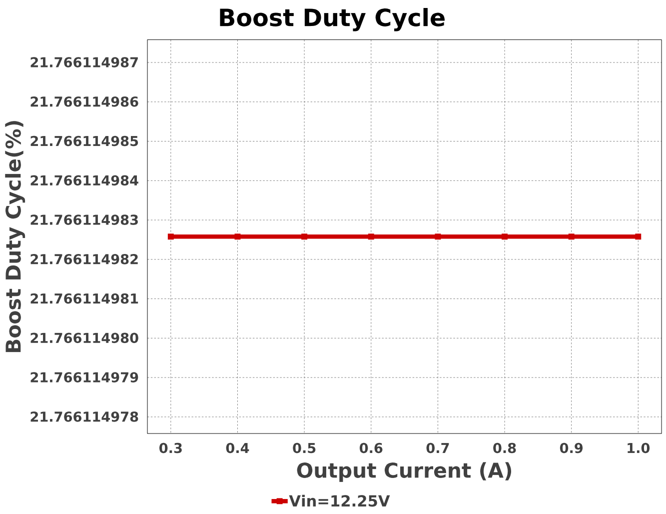

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

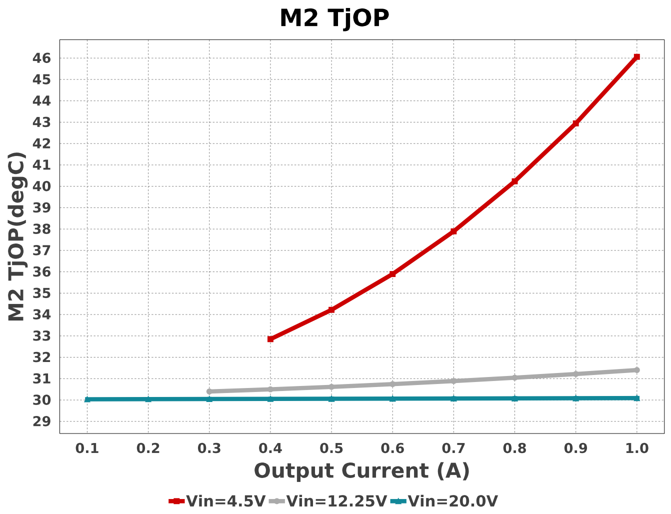

IC Pd
IC Pd(W)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

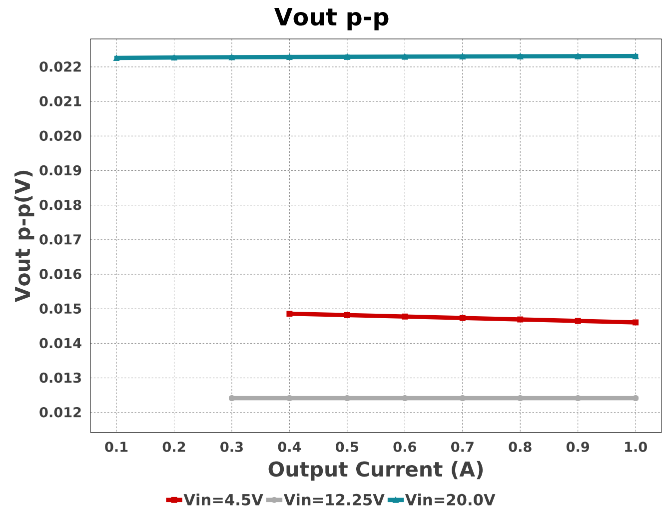

D2 Tj
D2 Tj(degC)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

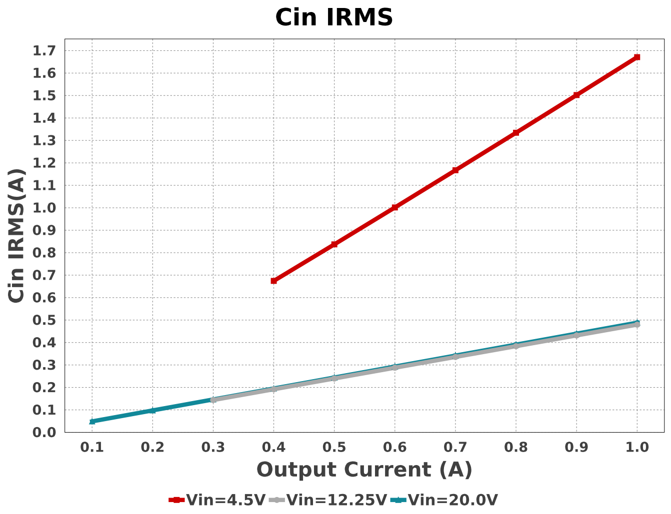

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V

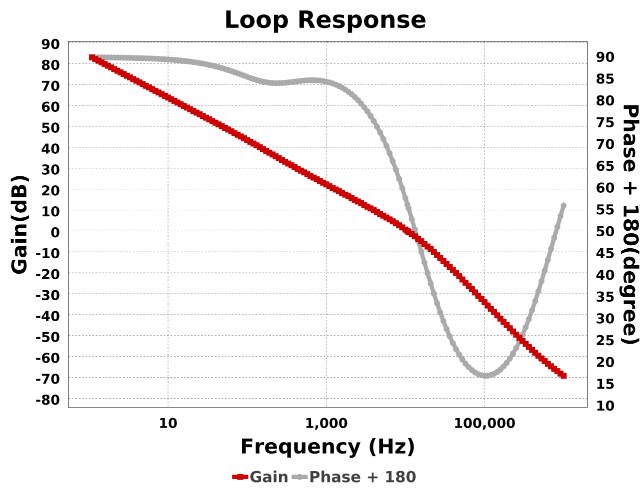

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V


Boost Duty Cycle
Boost Duty Cycle(%)
Output Current (A)
Vin=12.25V


M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V


Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=4.5V Vin=12.25V Vin=20.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.667 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	1.389 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.662 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	66.326 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	336.78 mW	Diode	Diode power dissipation
8.	D1 Tj	77.149 degC	Diode	D1 junction temperature
9.	D1 Tj	77.149 degC	Diode	D1 junction temperature
10.	D2 Pd	336.78 mW	Diode	Diode2 power dissipation
11.	Diode Pd	336.78 mW	Diode	Diode power dissipation
12.	IC Pd	216.47 mW	IC	IC power dissipation
13.	IC Tj	38.659 degC	IC	IC junction temperature
14.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
15.	ICThetaJA	40.0 degC/W	IC	IC junction-to-ambient thermal resistance
16.	Iin Avg	695.87 mA	IC	Average input current
17.	L Ipp	602.13 mA	Inductor	Peak-to-peak inductor ripple current
18.	L Pd	544.17 mW	Inductor	Inductor power dissipation
19.	L1 Irms	3.76 A	Inductor	Inductor ripple current
20.	M1 Irms	2.288 A	Mosfet	MOSFET RMS ripple current
21.	M1 Pd	188.3 mW	Mosfet	MOSFET power dissipation
22.	M1 PdCond	186.12 mW	Mosfet	M1 MOSFET conduction losses
23.	M1 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
24.	M1 TjOP	40.997 degC	Mosfet	MOSFET junction temperature
25.	M2 Irms	2.288 A	Mosfet	MOSFET RMS ripple current
26.	M2 Pd	197.22 mW	Mosfet	MOSFET power dissipation
27.	M2 PdCond	181.66 mW	Mosfet	M2 MOSFET conduction losses
28.	M2 PdSw	15.555 mW	Mosfet	M2 MOSFET switching losses
29.	M2 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
30.	M2 TjOP	41.923 degC	Mosfet	MOSFET junction temperature
31.	Cin Pd	1.389 mW	Power	Input capacitor power dissipation
32.	Cout Pd	66.326 mW	Power	Output capacitor power dissipation
33.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
34.	D1 Pd	336.78 mW	Power	Diode power dissipation
35.	D2 Pd	336.78 mW	Power	Diode2 power dissipation
36.	Diode Pd	336.78 mW	Power	Diode power dissipation
37.	IC Pd	216.47 mW	Power	IC power dissipation
38.	L Pd	544.17 mW	Power	Inductor power dissipation
39.	M1 Pd	188.3 mW	Power	MOSFET power dissipation
40.	M1 PdCond	186.12 mW	Power	M1 MOSFET conduction losses
41.	M2 Pd	197.22 mW	Power	MOSFET power dissipation
42.	M2 PdCond	181.66 mW	Power	M2 MOSFET conduction losses
43.	M2 PdSw	15.555 mW	Power	M2 MOSFET switching losses
44.	Rsense Pd	30.0 mW	Power	LED Current Rsns Power Dissipation
45.	Total Pd	431.415 mW	Power	Total Power Dissipation
46.	Rsense Pd	30.0 mW	Resistor	LED Current Rsns Power Dissipation
47.	BOM Count	26	System Information	Total Design BOM count
48.	Cross Freq	5.459 kHz	System Information	Bode plot crossover frequency
49.	D2 Tj	46.839 degC	System Information	D2 junction temperature

#	Name	Value	Category	Description
50.	Duty Cycle	73.373 %	System Information	Duty cycle
51.	Efficiency	86.223 %	System Information	Steady state efficiency
52.	FootPrint	615.0 mm^2	System Information	Total Foot Print Area of BOM components
53.	Frequency	294.659 kHz	System Information	Switching frequency
54.	Gain Marg	-27.135 dB	System Information	Bode Plot Gain Margin
55.	Iout	1.0 A	System Information	Iout operating point
56.	Low Freq Gain	76.114 dB	System Information	Gain at 1Hz
57.	Mode	CCM	System Information	Conduction Mode
58.	Operating Topology	Buck-Boost	System Information	The current operating topology of the device
59.	Phase Marg	67.721 deg	System Information	Bode Plot Phase Margin
60.	Pout	12.0 W	System Information	Total output power
61.	SW Ipk	4.057 A	System Information	Peak switch current
62.	Total BOM	$5.3	System Information	Total BOM Cost
63.	Vin	4.5 V	System Information	Vin operating point
64.	Vout	12.0 V	System Information	Operational Output Voltage
65.	Vout Actual	11.882 V	System Information	Vout Actual calculated based on selected voltage divider resistors
66.	Vout Tolerance	3.301 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
67.	Vout p-p	14.675 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	20.0	Maximum input voltage
VinMin	4.5	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM25118	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

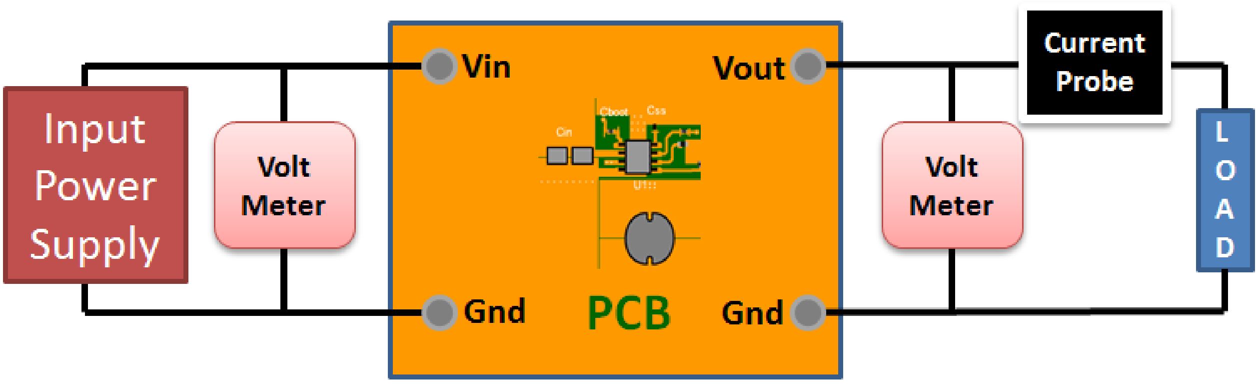
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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 LM25118 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 : 7E00AF9B0638DEC2[v1]

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

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