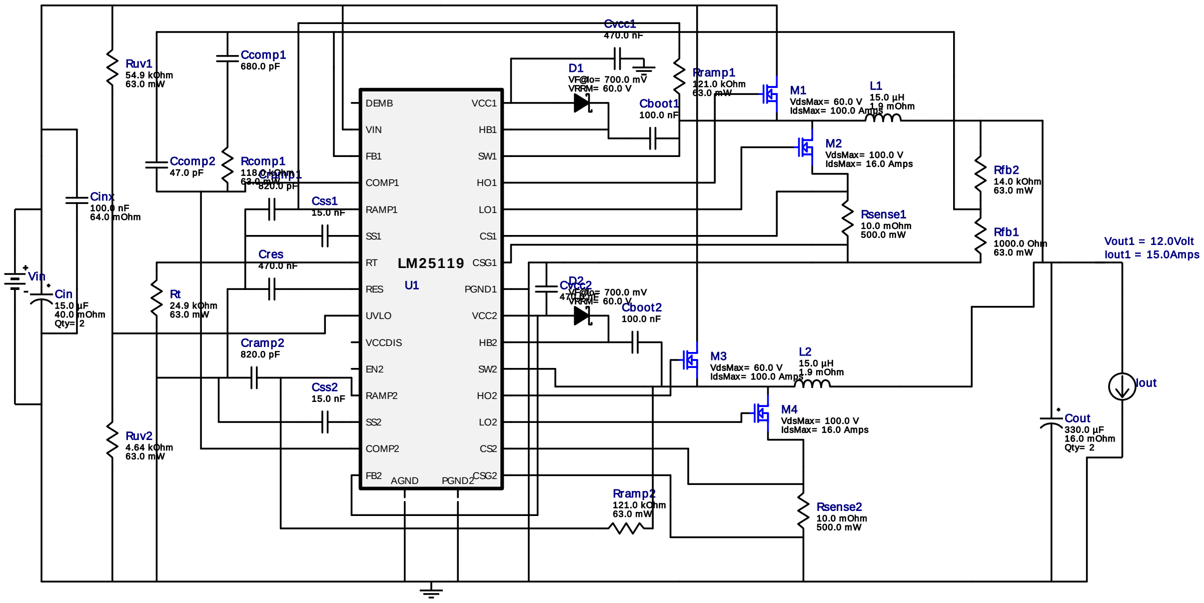
WEBENCH ® Design Report

VinMin = 20.0V
VinMax = 40.0V
Vout = 12.0V
Iout = 15.0A

Device = LM25119PSQ/NOPB
Topology = Buck
Created = 3/14/16 5:59:33 PM
BOM Cost = $13.76
BOM Count = 35
Total Pd = 5.78W

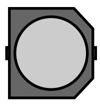
Design : 4161985/21 LM25119PSQ/NOPB
LM25119PSQ/NOPB 20.0V-40.0V to 12.00V @ 15.0A

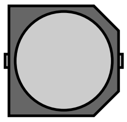
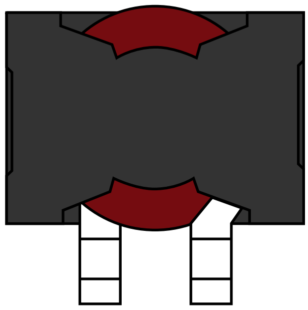
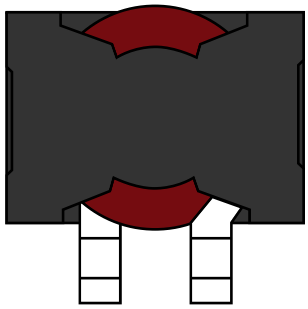
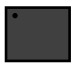


1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.View WEBENCH(R) Disclaimer.

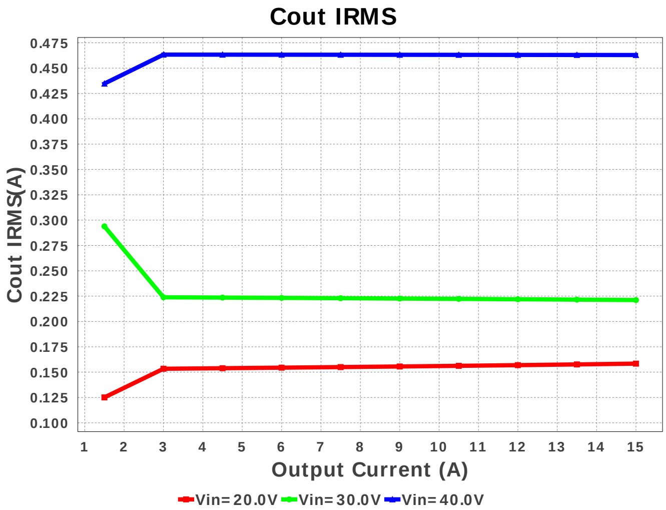
Electrical BOM

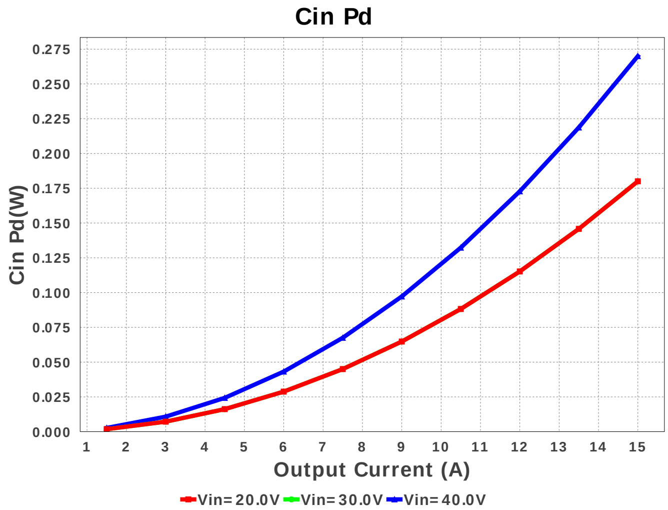
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Cboot2	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Ccomp1	Yageo America	CC0805KRX7R9BB681 Series= X7R	Cap= 680.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Ccomp2	Kemet	C0805C470K5GACTU Series= C0G/NP0	Cap= 47.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	Cin	Panasonic	100SXV15M Series= SXV	Cap= 15.0 uF ESR= 40.0 mOhm VDC= 100.0 V IRMS= 2.35 A	2	$1.25	CAPSMT_62_E12 106 mm^2
6.	Cinx	Kemet	C0805C104K5RACTU 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

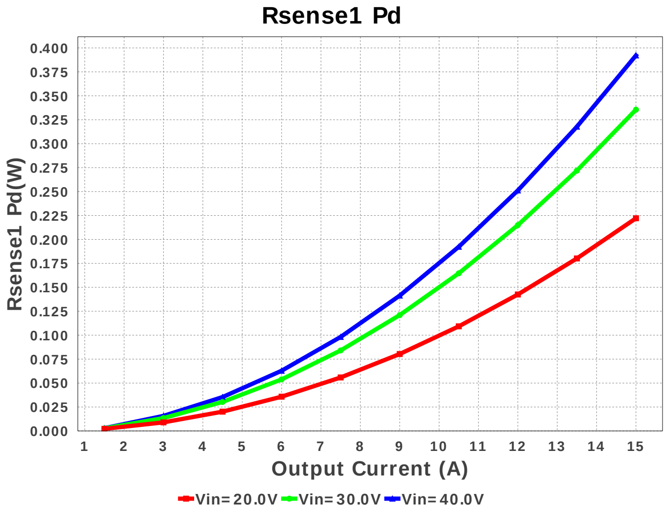


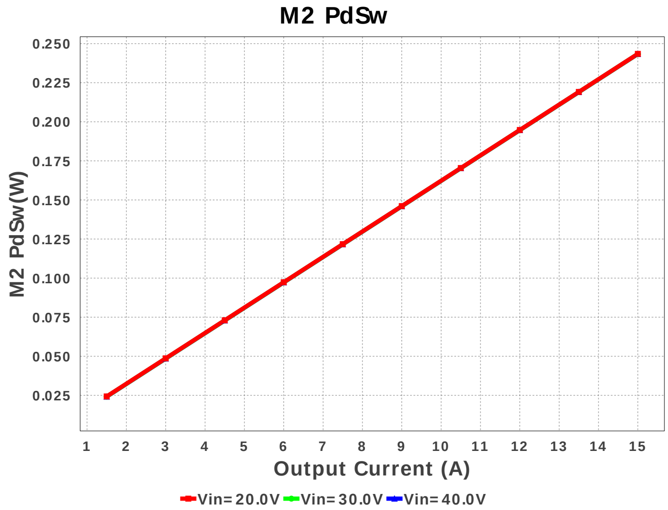
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cout	Panasonic	16SVP330M Series= SVP	Cap= 330.0 uF ESR= 16.0 mOhm VDC= 16.0 V IRMS= 4.72 A	2	\$0.39	 SM_RADIAL_10AMM 160 mm^2
8.	Cramp1	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm^2
9.	Cramp2	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm^2
10.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm^2
11.	Css1	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm^2
12.	Css2	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm^2
13.	Cvcc1	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm^2
14.	Cvcc2	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm^2
15.	D1	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	\$0.09	 SMA 37 mm^2
16.	D2	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	\$0.09	 SMA 37 mm^2
17.	L1	Coilcraft	SER2915H-153KL	L= 15.0 µH DCR= 1.9 mOhm	1	\$1.95	 SER2915H 652 mm^2
18.	L2	Coilcraft	SER2915H-153KL	L= 15.0 µH DCR= 1.9 mOhm	1	\$1.95	 SER2915H 652 mm^2
19.	M1	Texas Instruments	CSD18563Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	\$0.68	 TRANS_NexFET_Q5A 55 mm^2

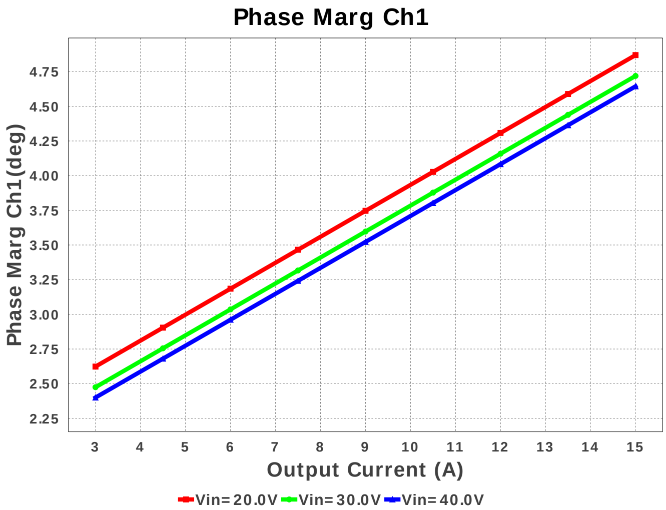
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
20.	M2	Texas Instruments	CSD19531Q5A	VdsMax= 100.0 V IdsMax= 16.0 Amps	1	$1.01	TRANS_NexFET_Q5A 55 mm^2
21.	M3	Texas Instruments	CSD18563Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.68	TRANS_NexFET_Q5A 55 mm^2
22.	M4	Texas Instruments	CSD19531Q5A	VdsMax= 100.0 V IdsMax= 16.0 Amps	1	$1.01	TRANS_NexFET_Q5A 55 mm^2
23.	Rcomp1	Vishay-Dale	CRCW0402118KFKED Series= CRCW..e3	Res= 118.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
24.	Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
25.	Rfb2	Vishay-Dale	CRCW040214K0FKED Series= CRCW..e3	Res= 14.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
26.	Rramp1	Vishay-Dale	CRCW0402121KFKED Series= CRCW..e3	Res= 121.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
27.	Rramp2	Vishay-Dale	CRCW0402121KFKED Series= CRCW..e3	Res= 121.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
28.	Rsense1	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.11	1206 11 mm^2
29.	Rsense2	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.11	1206 11 mm^2
30.	Rt	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
31.	Ruv1	Vishay-Dale	CRCW040254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
32.	Ruv2	Vishay-Dale	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
33.	U1	Texas Instruments	LM25119PSQ/NOPB	Switcher	1	$2.60	SQA32A 49 mm^2

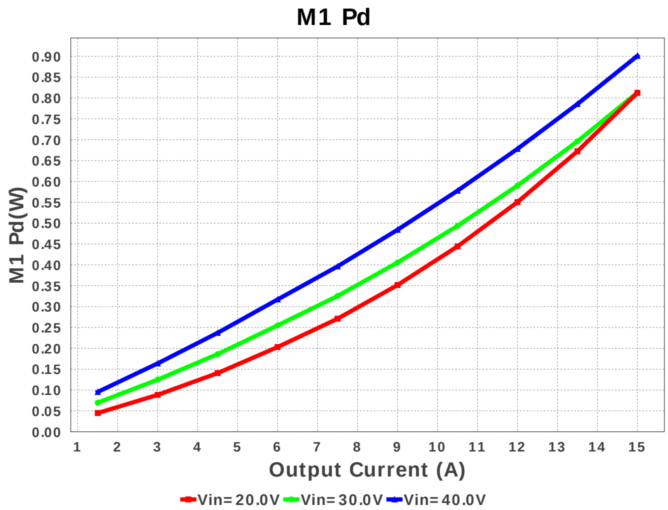

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


Cin Pd
Cin Pd(W)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

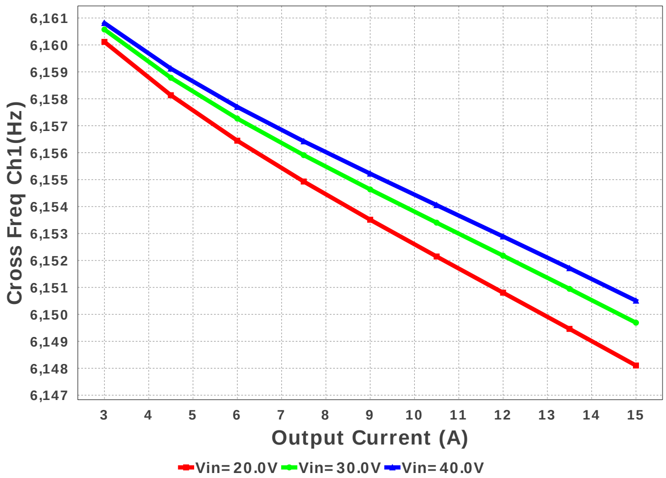

Rsense1 Pd
Rsense1 Pd(W)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

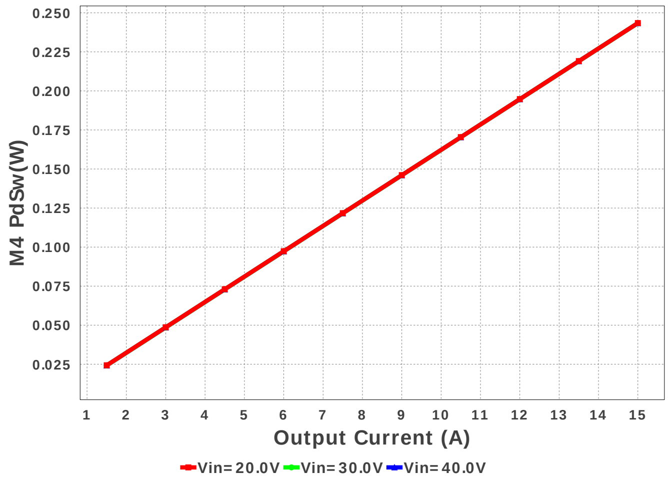

Phase Marg Ch1
Phase Marg Ch1(deg)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


M1 Pd
M1 Pd(W)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

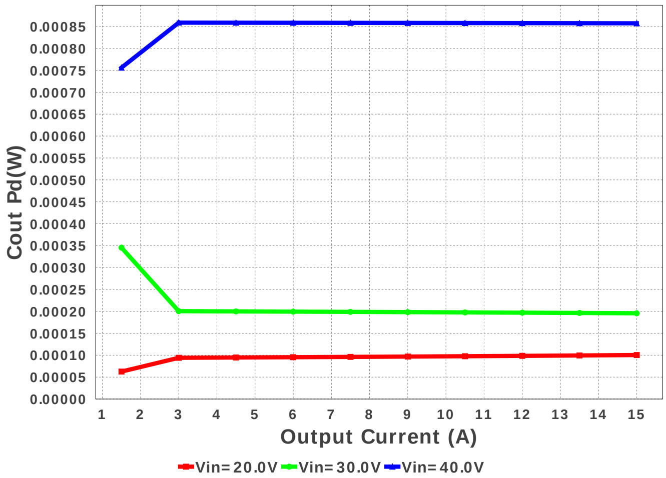
Cross Freq Ch1



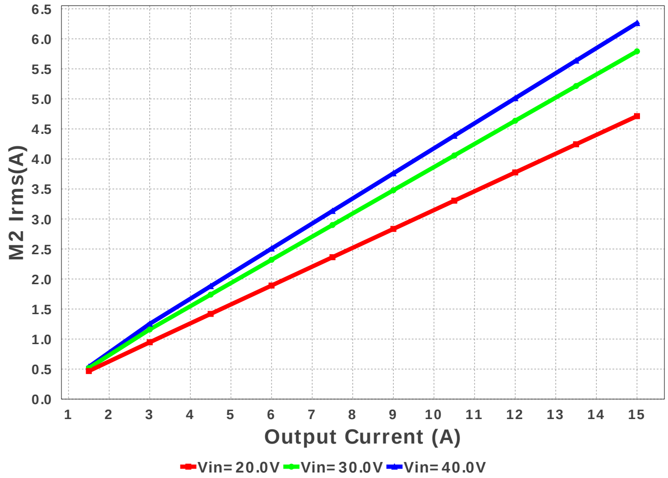
M4 PdSw



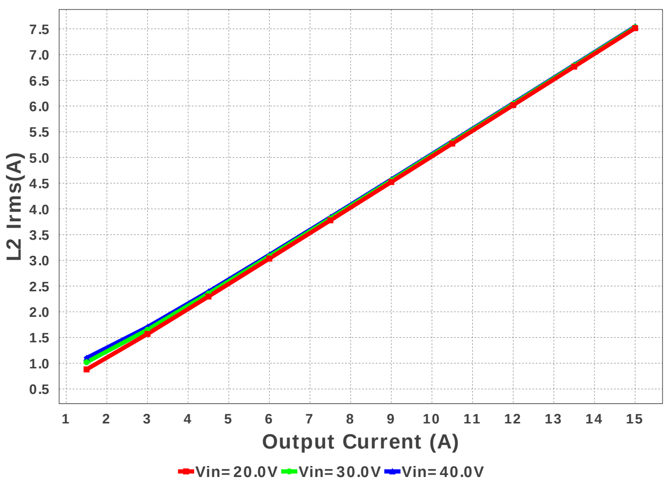
Cout Pd



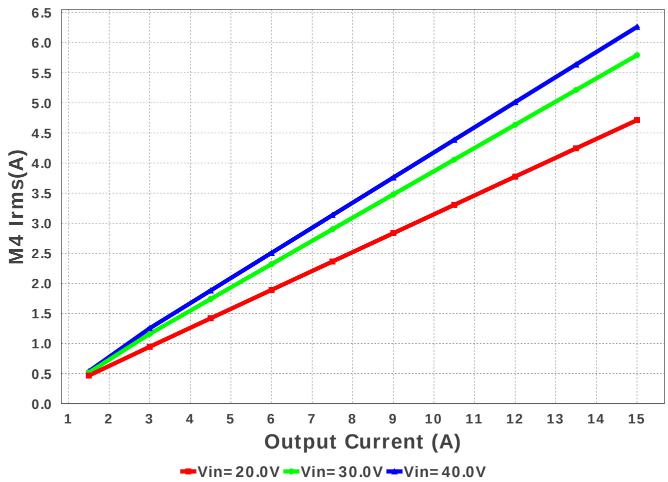
M2 Irms

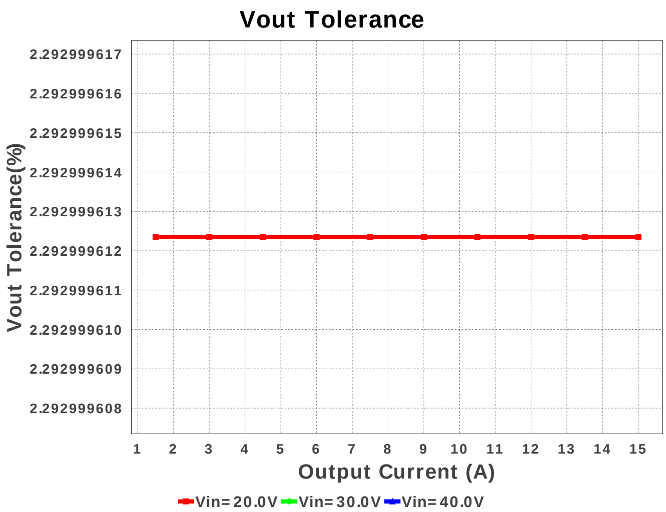


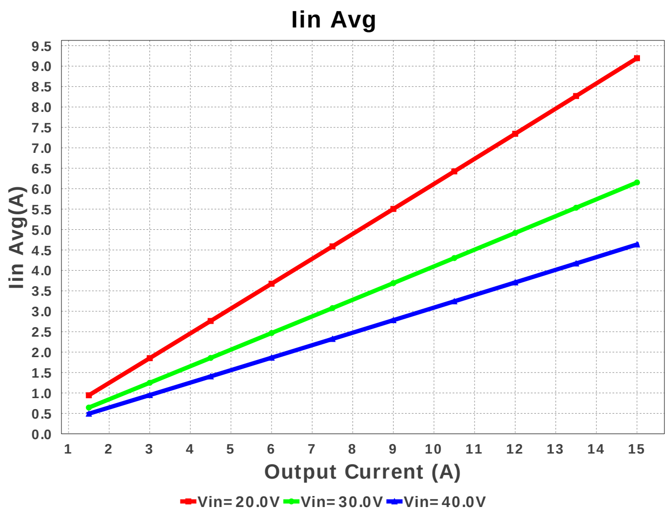
L2 Irms

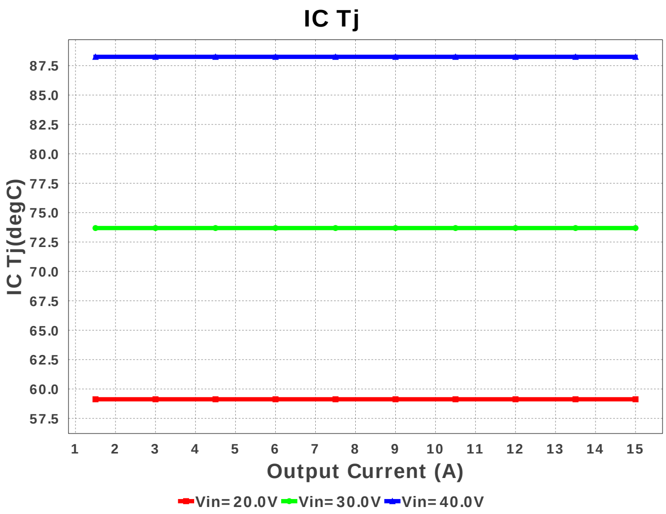


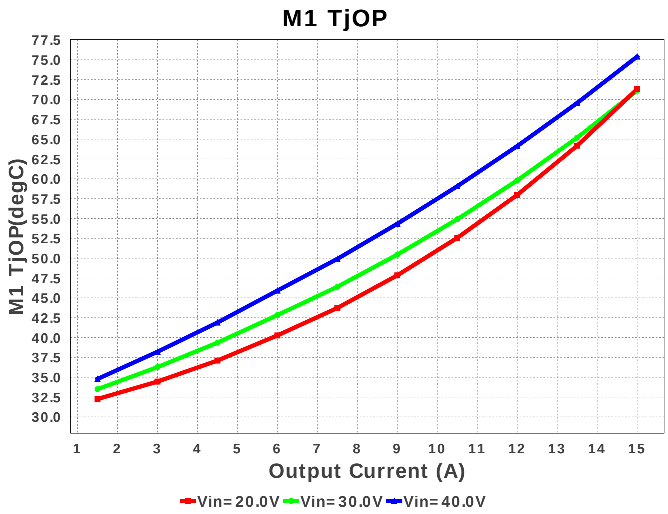
M4 Irms

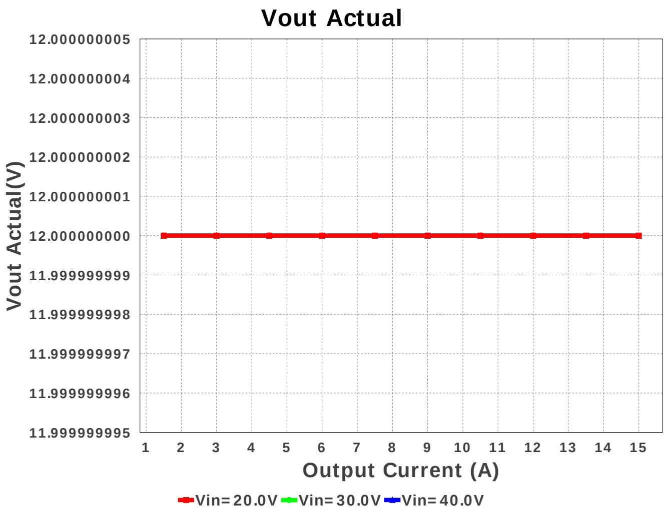


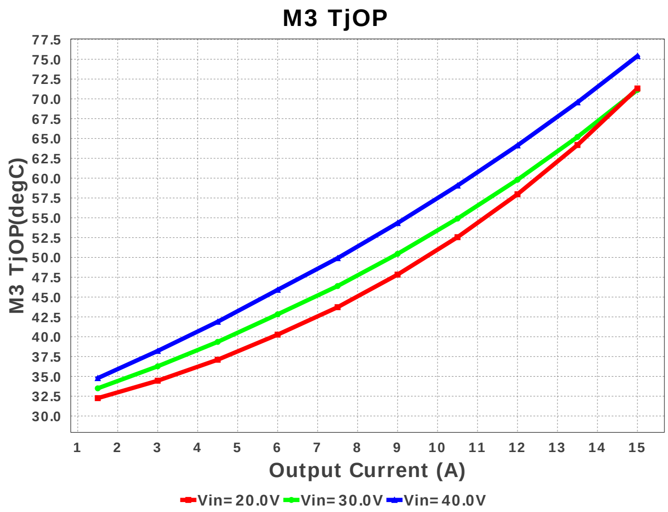

Vout Tolerance
Vout Tolerance(%)
2.292999617
2.292999616
2.292999615
2.292999614
2.292999613
2.292999612
2.292999611
2.292999610
2.292999609
2.292999608
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


Iin Avg
Iin Avg(A)
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

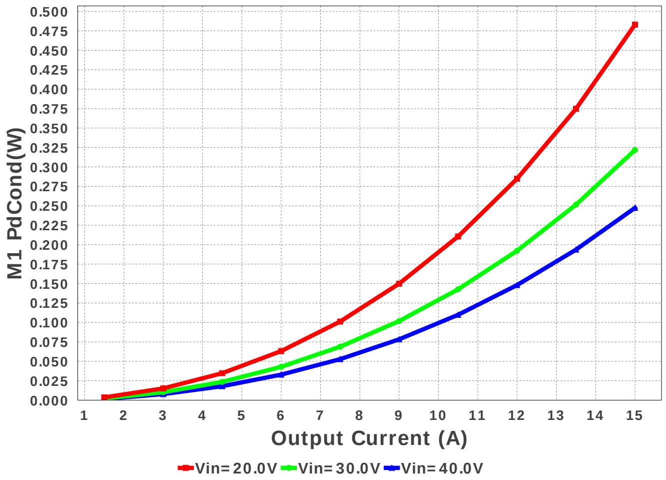

IC Tj
IC Tj(degC)
87.5 85.0 82.5 80.0 77.5 75.0 72.5 70.0 67.5 65.0 62.5 60.0 57.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


M1 TjOP
M1 TjOP(degC)
77.5 75.0 72.5 70.0 67.5 65.0 62.5 60.0 57.5 55.0 52.5 50.0 47.5 45.0 42.5 40.0 37.5 35.0 32.5 30.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

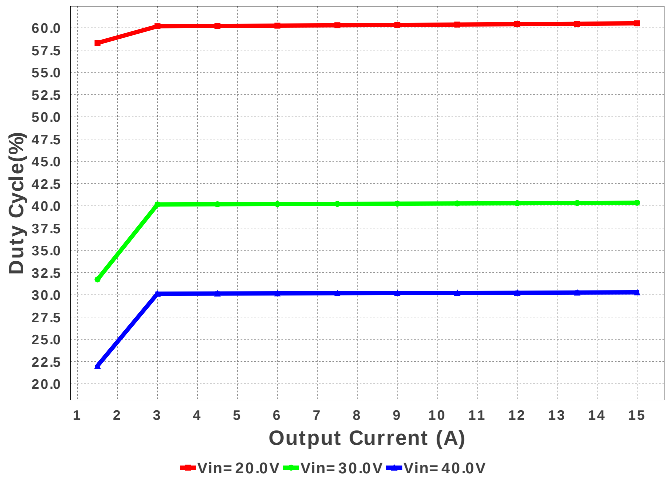

Vout Actual
Vout Actual(V)
12.000000005
12.000000004
12.000000003
12.000000002
12.000000001
12.000000000
11.999999999
11.999999998
11.999999997
11.999999996
11.999999995
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V


M3 TjOP
M3 TjOP(degC)
77.5 75.0 72.5 70.0 67.5 65.0 62.5 60.0 57.5 55.0 52.5 50.0 47.5 45.0 42.5 40.0 37.5 35.0 32.5 30.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

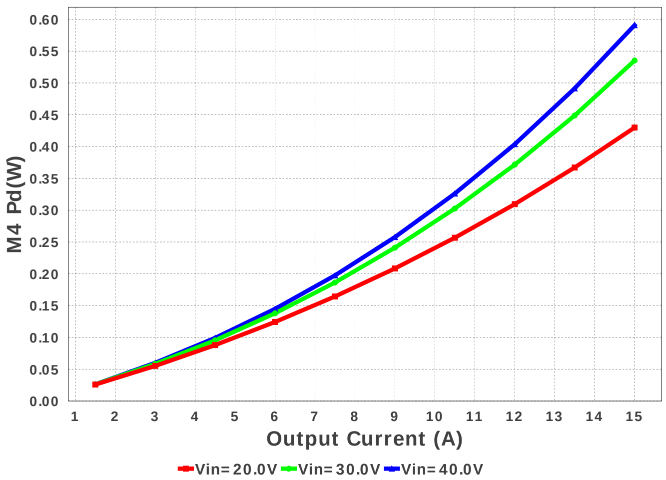
M1 PdCond



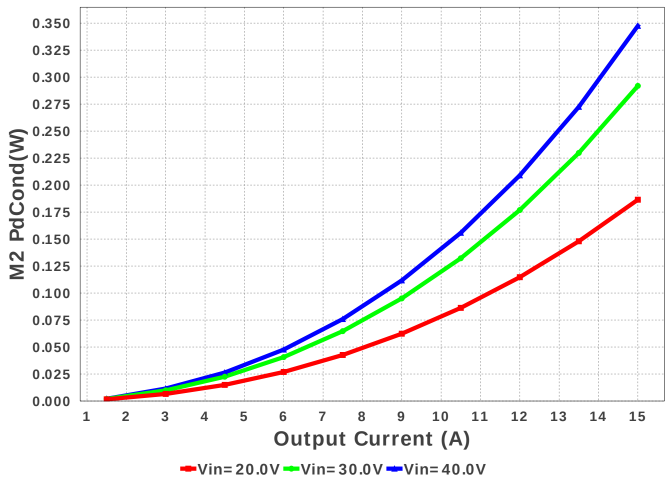
Duty Cycle



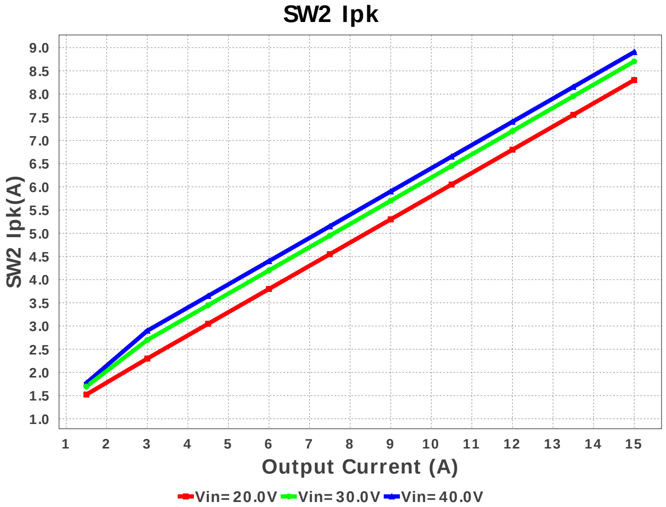
M4 Pd



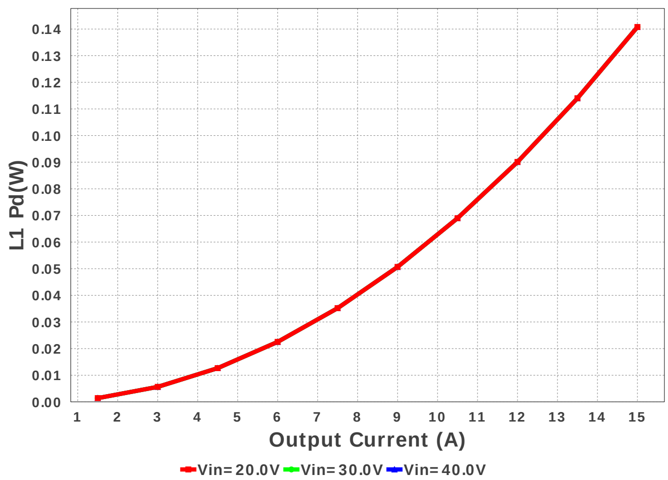
M2 PdCond



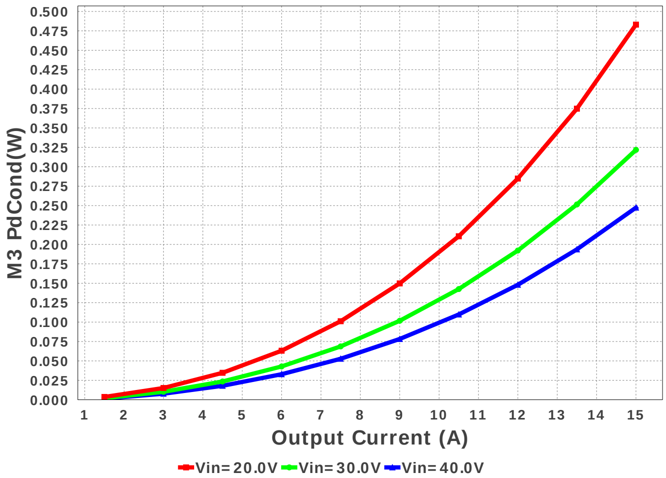
SW2 Ipk



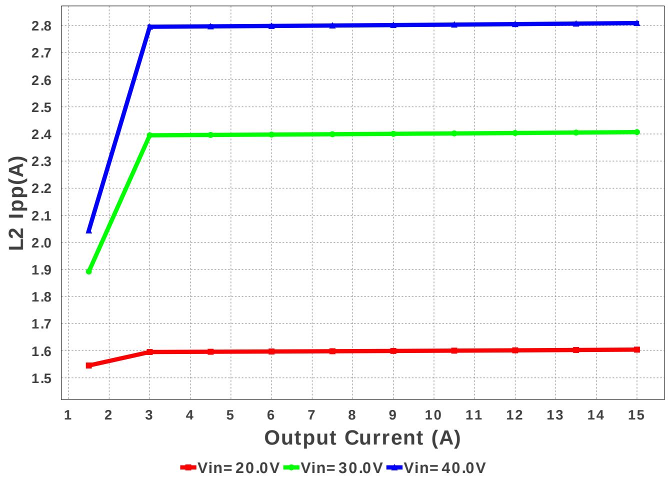
L1 Pd



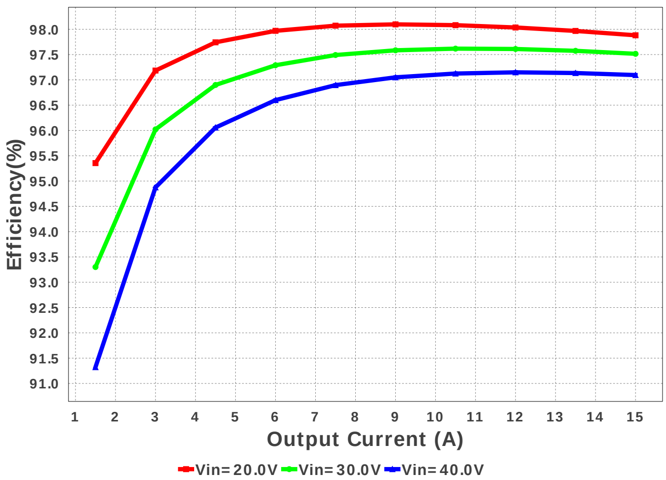
M3 PdCond



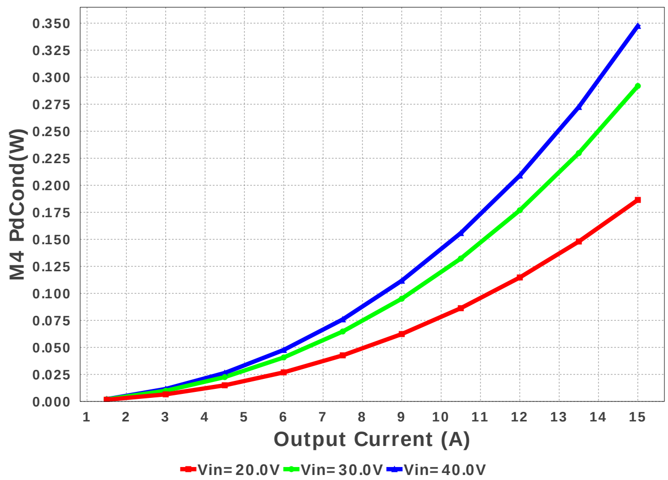
L2 Ipp



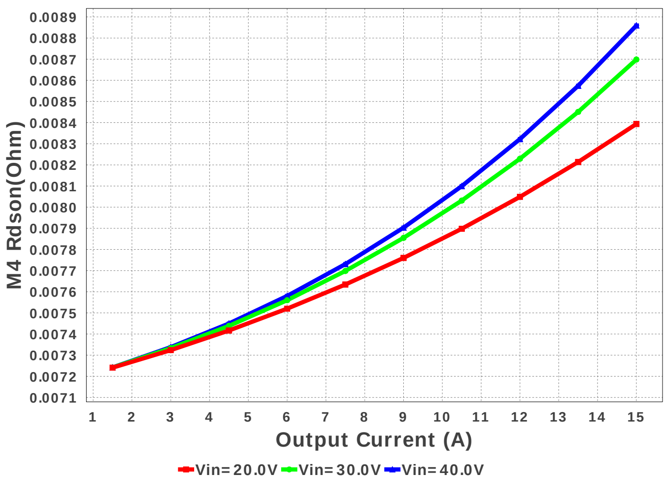
Efficiency



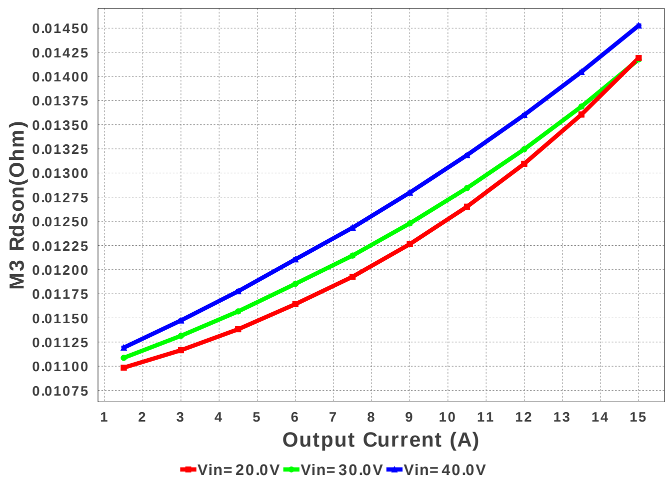
M4 PdCond



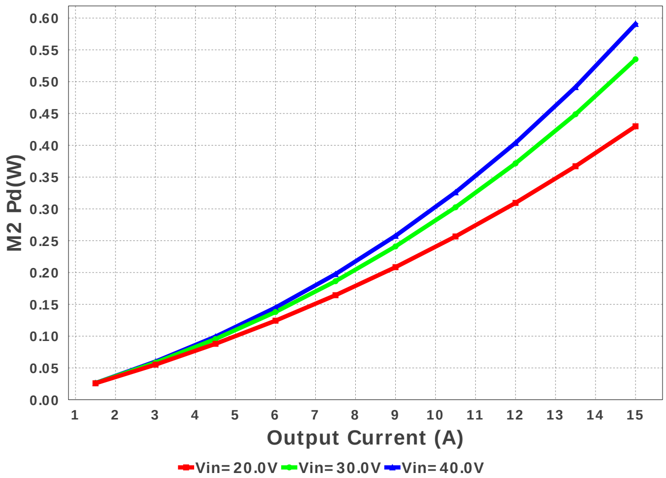
M4 Rdson



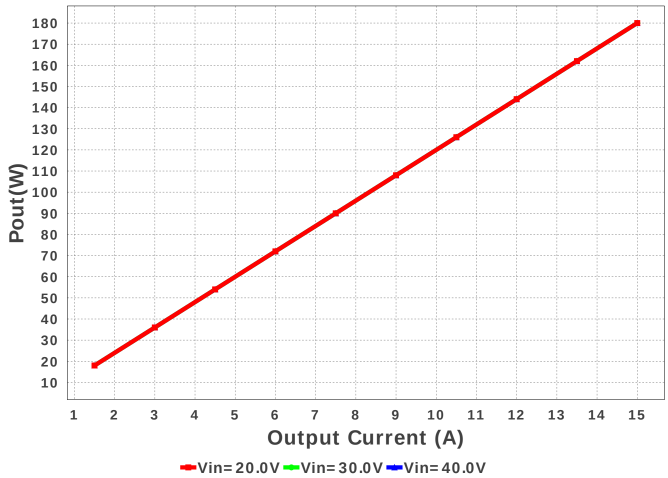
M3 Rdson



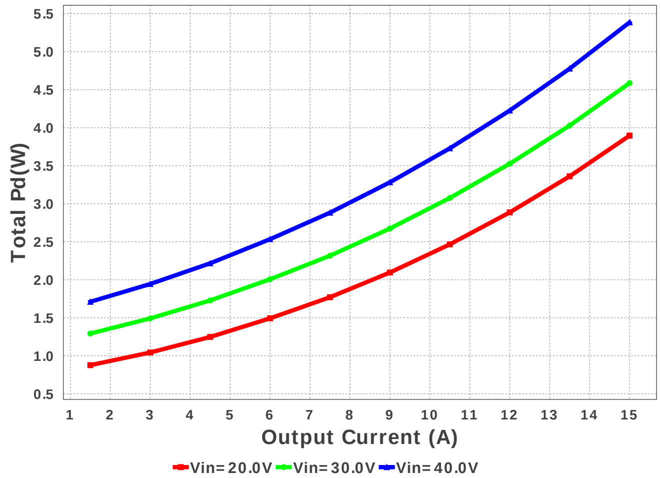
M2 Pd



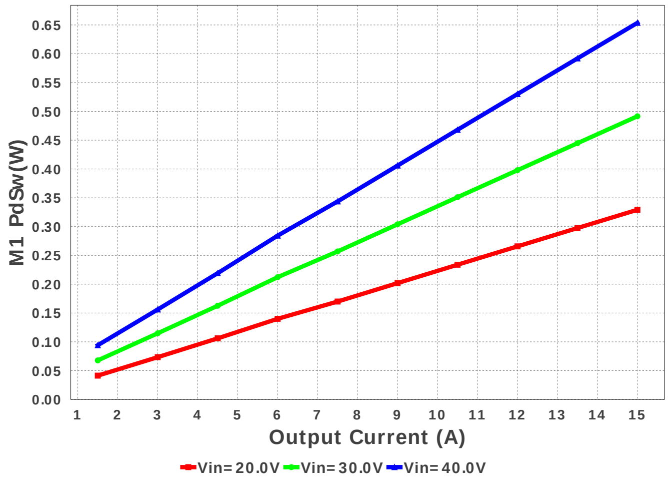
Pout



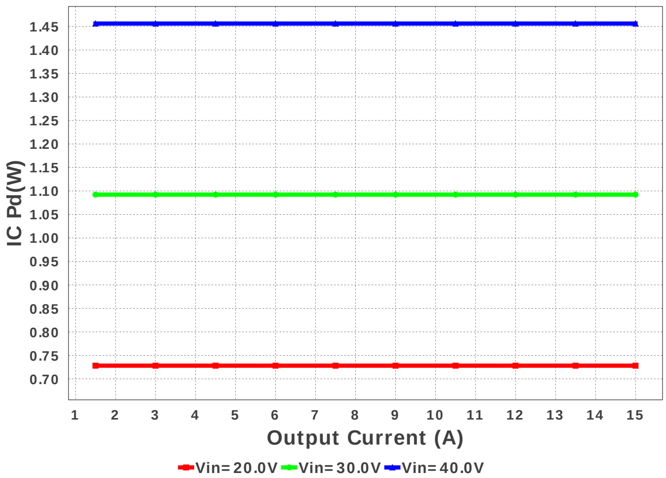
Total Pd



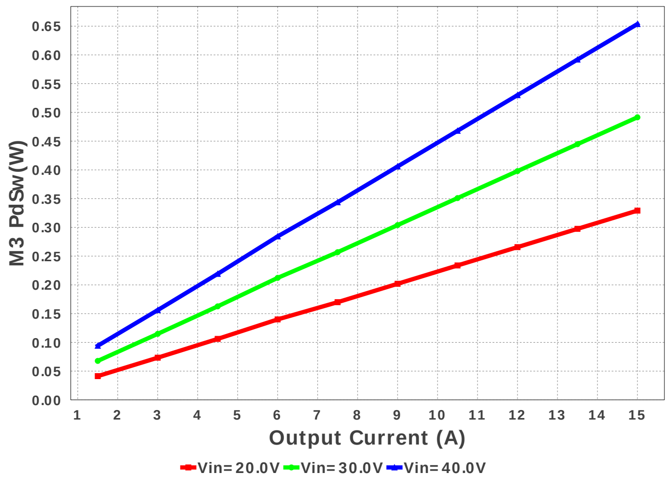
M1 PdSw

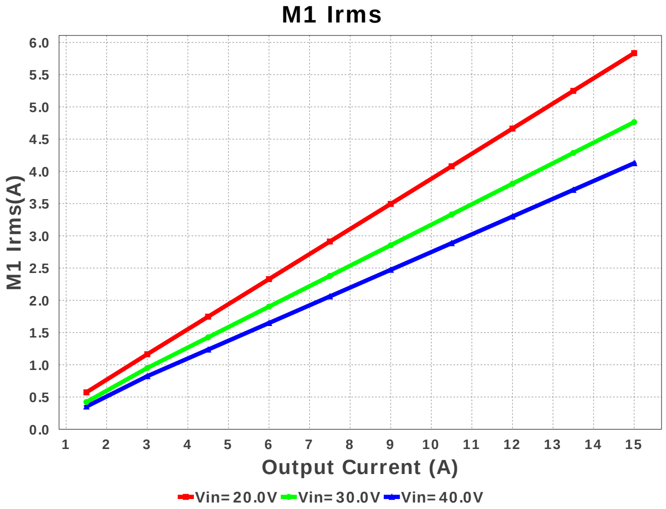


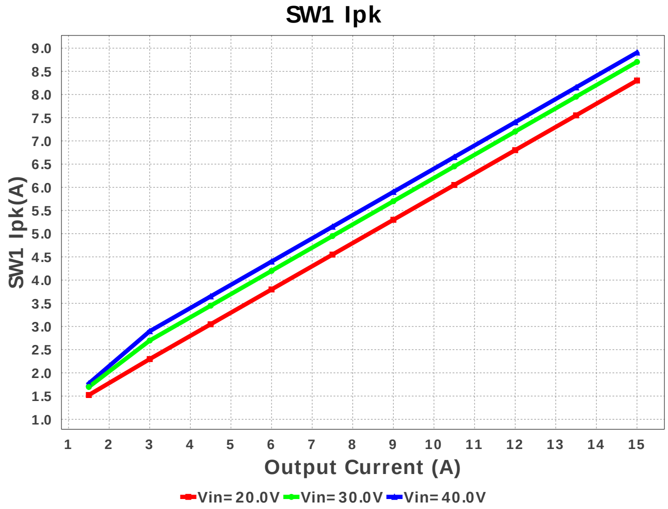
IC Pd

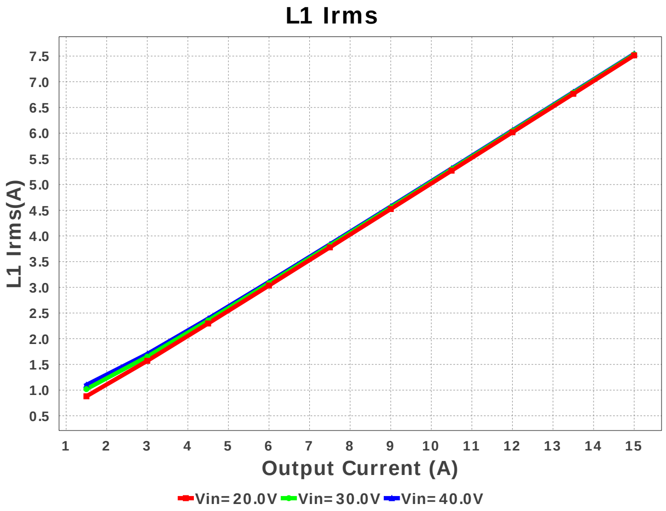


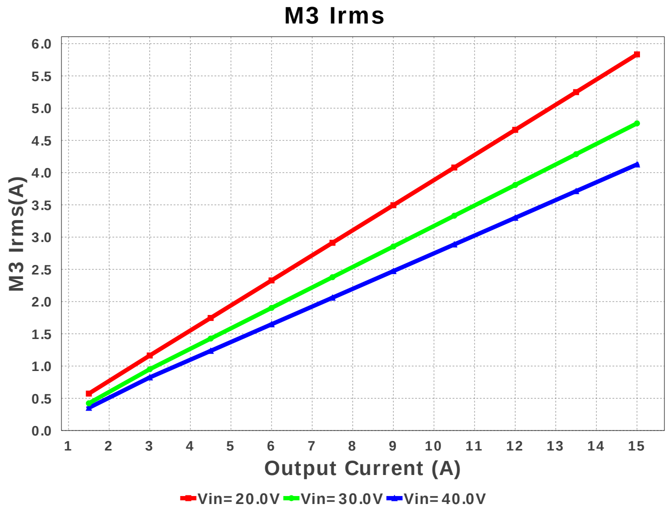
M3 PdSw

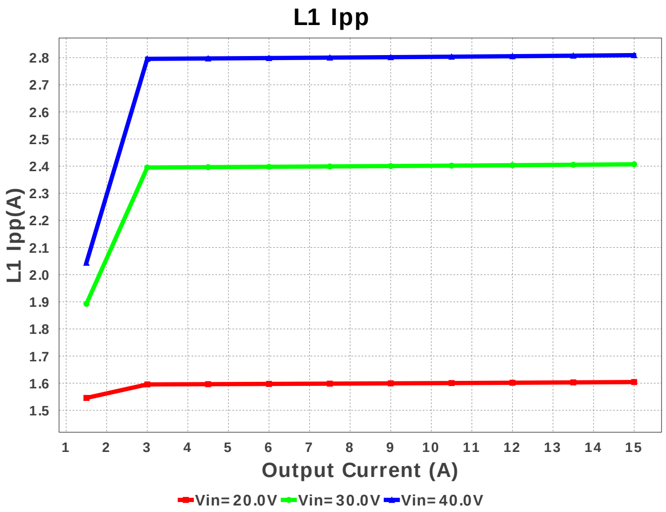


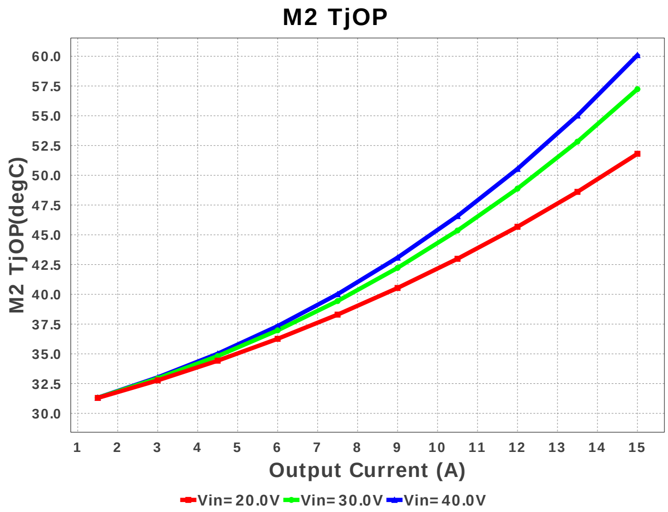

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

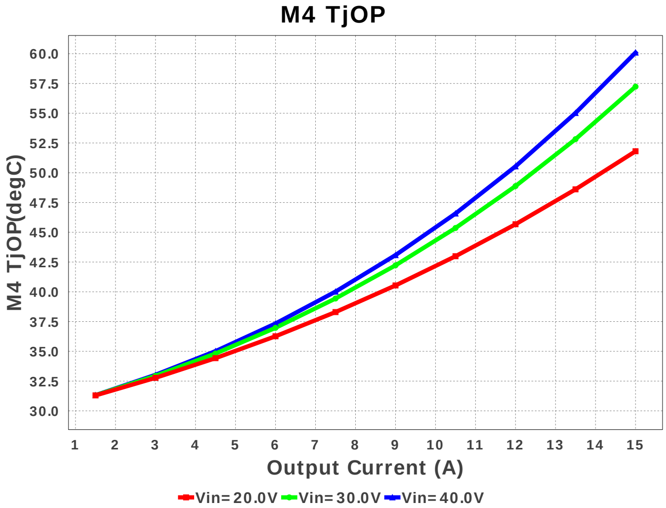

SW1 Ipk
SW1 Ipk(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

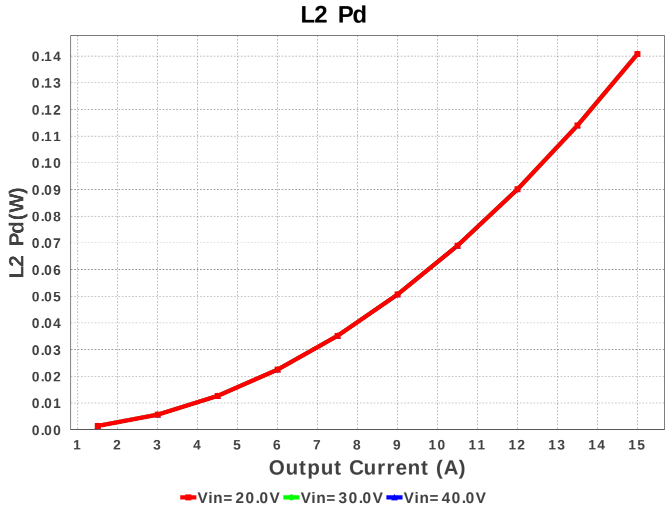

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

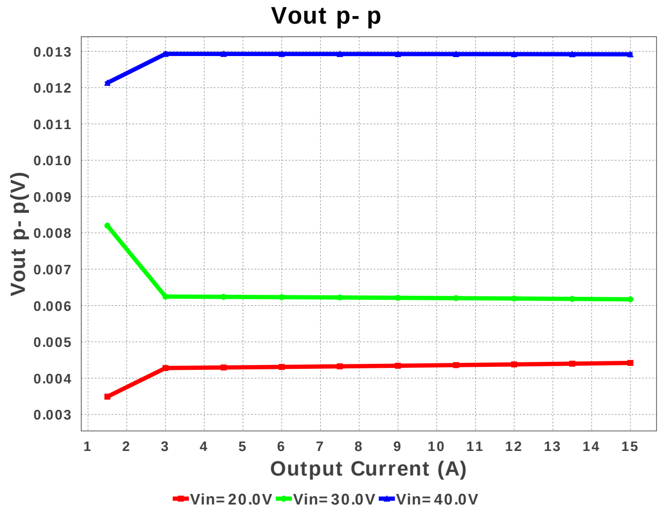

M3 Irms
M3 Irms(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

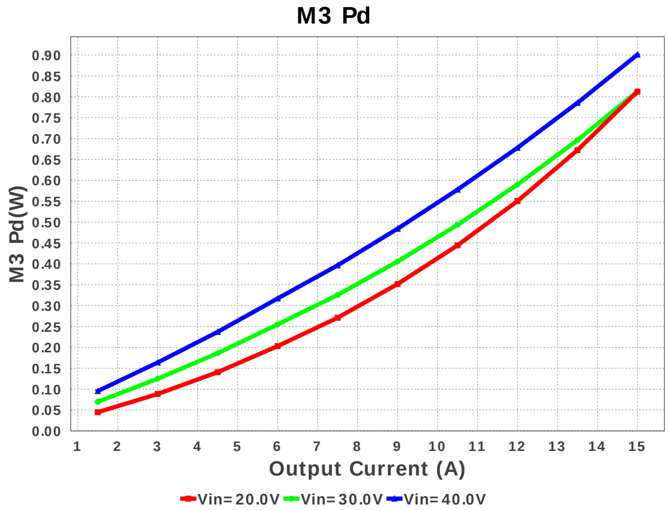

L1 Ipp
L1 Ipp(A)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V

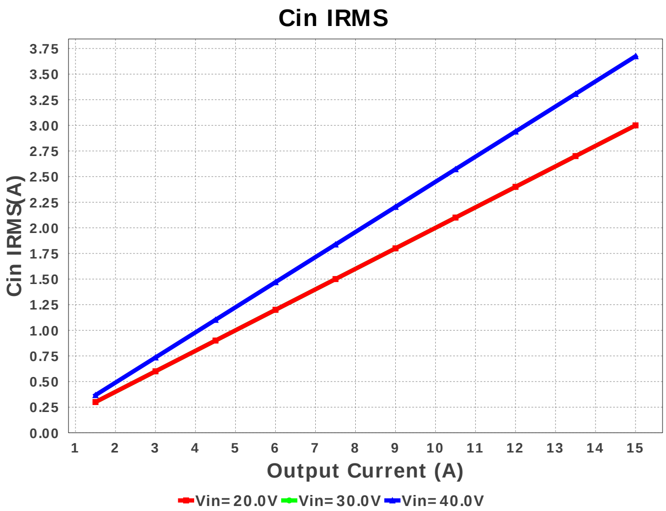

M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin=20.0V Vin=30.0V Vin=40.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.674 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	462.937 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	4.644 A	Current	Average input current
4.	L1 Ipp	2.809 A	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	7.544 A	Current	Inductor ripple current
6.	L2 Ipp	2.809 A	Current	Inductor 2 peak to peak current
7.	L2 Irms	7.544 A	Current	Inductor ripple current
8.	M1 Irms	4.127 A	Current	MOSFET RMS ripple current
9.	M2 Irms	6.263 A	Current	MOSFET RMS ripple current
10.	M3 Irms	4.127 A	Current	MOSFET RMS ripple current
11.	M4 Irms	6.263 A	Current	MOSFET RMS ripple current

#	Name	Value	Category	Description
12.	SW1 Ipk	8.905 A	Current	Peak switch current
13.	SW2 Ipk	8.905 A	Current	Peak switch current
14.	BOM Count	35	General	Total Design BOM count
15.	FootPrint	2.288 k mm^2	General	Total Foot Print Area of BOM components
16.	Frequency	201.176 kHz	General	Switching frequency
17.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
18.	Pout	180.0 W	General	Total output power
19.	Total BOM	$13.76	General	Total BOM Cost
20.	M3 TjOP	75.401 degC	Op_Point	M3 MOSFET junction temperature
21.	M4 TjOP	60.092 degC	Op_Point	M4 MOSFET junction temperature
22.	Vout Actual	12.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
24.	Duty Cycle	30.276 %	Op_point	Duty cycle
25.	Efficiency	96.89 %	Op_point	Steady state efficiency
26.	IC Tj	88.251 degC	Op_point	IC junction temperature
27.	IOUT_OP	15.0 A	Op_point	Iout operating point
28.	M1 TjOP	75.401 degC	Op_point	M1 MOSFET junction temperature
29.	M2 TjOP	60.092 degC	Op_point	M2 MOSFET junction temperature
30.	VIN_OP	40.0 V	Op_point	Vin operating point
31.	Vout p-p	12.918 mV	Op_point	Peak-to-peak output ripple voltage
32.	Cin Pd	270.0 mW	Power	Input capacitor power dissipation
33.	Cout Pd	857.244 µW	Power	Output capacitor power dissipation
34.	IC Pd	1.456 W	Power	IC power dissipation
35.	L1 Pd	140.761 mW	Power	Inductor power dissipation
36.	L2 Pd	140.761 mW	Power	Inductor power dissipation
37.	M1 Pd	901.027 mW	Power	M1 MOSFET total power dissipation
38.	M1 PdCond	247.389 mW	Power	M1 MOSFET conduction losses
39.	M1 PdSw	653.638 mW	Power	M1 MOSFET switching losses
40.	M2 Pd	590.813 mW	Power	M2 MOSFET total power dissipation
41.	M2 PdCond	347.451 mW	Power	M2 MOSFET conduction losses
42.	M2 PdSw	243.362 mW	Power	M2 MOSFET switching losses
43.	M3 Pd	901.027 mW	Power	M3 MOSFET total power dissipation
44.	M3 PdCond	247.389 mW	Power	M3 MOSFET conduction losses
45.	M3 PdSw	653.638 mW	Power	M3 MOSFET switching losses
46.	M3 Rdson	14.526 mOhm	Power	Drain-Source On-resistance
47.	M3 Rdson	14.526 mOhm	Power	Drain-Source On-resistance
48.	M4 Pd	590.813 mW	Power	M4 MOSFET total power dissipation
49.	M4 PdCond	347.451 mW	Power	M4 MOSFET conduction losses
50.	M4 PdSw	243.362 mW	Power	M4 MOSFET switching losses
51.	M4 Rdson	8.859 mOhm	Power	Drain-Source On-resistance
52.	M4 Rdson	8.859 mOhm	Power	Drain-Source On-resistance
53.	Rsense1 Pd	392.198 mW	Power	Current Limit Sense Resistor Power Dissipation
54.	Rsense2 Pd	392.198 mW	Power	Current Limit Sense Resistor Power Dissipation
55.	Total Pd	5.778 W	Power	Total Power Dissipation
56.	Cross Freq Ch1	17.341 kHz		Bode plot crossover frequency
57.	Phase Marg Ch1	56.698 deg		Bode Plot Phase Margin
58.	Vout Tolerance	2.293 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	15.0	Maximum Output Current
2.	VinMax	40.0	Maximum input voltage
3.	VinMin	20.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	LM25119	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. Outline The LM5119 is a dual synchronous buck controller intended for step-down regulator applications from a high voltage or widely varying input supply. The control method is based upon current mode control utilizing an emulated current ramp. Current mode control provides inherent line feed-forward, cycle-by-cycle current limiting and ease of loop compensation. The use of an emulated control ramp reduces noise sensitivity of the pulse-width modulation circuit, allowing reliable control of very small duty cycles necessary in high input voltage applications. Interleaved Operation Interleaved operation can offer many advantages in single output, high current applications. The output power path is split between two identical channels reducing the current in each channel by one-half. Ripple current reduction in the output capacitors is reduced significantly since each channel operates 180 degrees out of phase from the other. Diode Emulation A fully synchronous buck regulator implemented with a freewheel MOSFET rather than a diode has the capability to sink current from the output in certain conditions such as light load, over-voltage or pre-bias startup. The LM(2)5119 provides a diode emulation feature that can be enabled to prevent reverse (drain to source) current flow in the low side free-wheel MOSFET.

2. LM25119 Product Folder : http://www.ti.com/product/LM25119 : contains the data sheet and other resources.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

Use of Texas Instruments' WEBENCH simulation tools is subject to Texas Instruments' Site Terms and Conditions of Use. Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the Evaluation License Agreement.