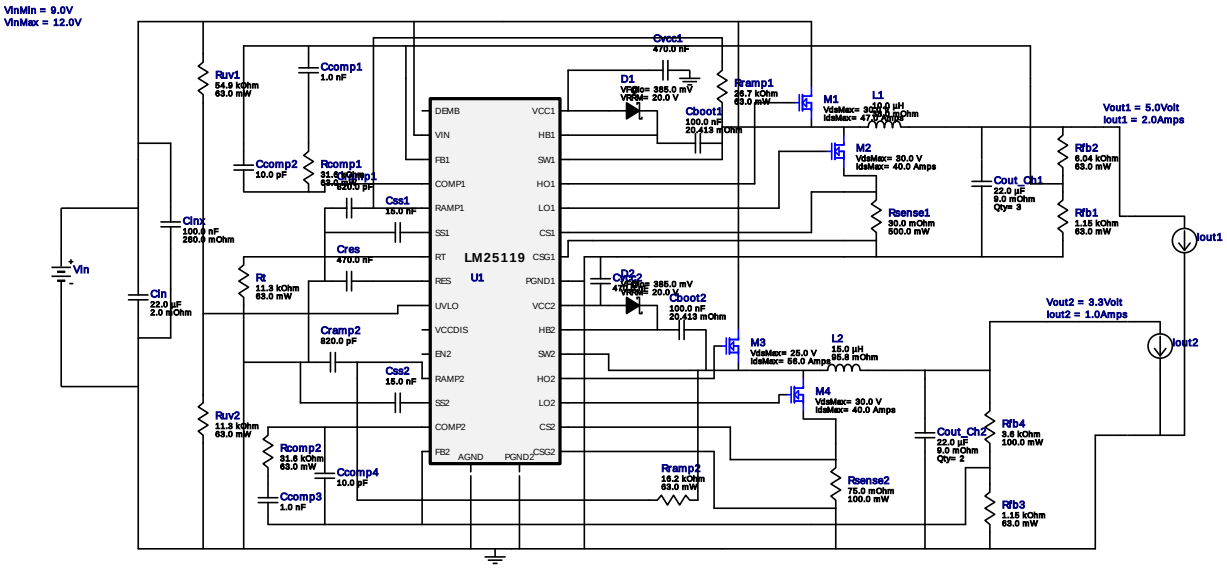
WEBENCH® Design Report

VinMin = 9.0V
VinMax = 12.0V
Vout = 5.0V
Iout = 2.0A

Device = LM25119PSQ/NOPB
Topology = Buck
Created = 6/14/15 8:59:03 PM
BOM Cost = $5.09
Footprint = 507.0 mm^2
BOM Count = 42
Total Pd = 1.03W

Design : 4352221/1 LM25119PSQ/NOPB
LM25119PSQ/NOPB 9.0V-12.0V to 3.30V @ 1.0A



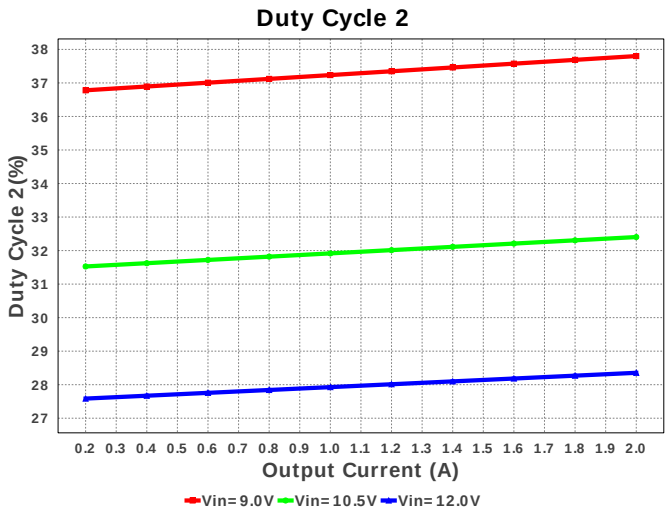
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

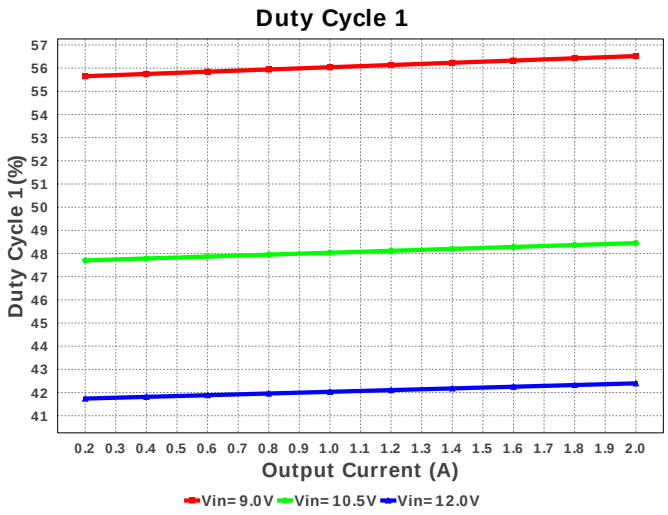
Electrical BOM

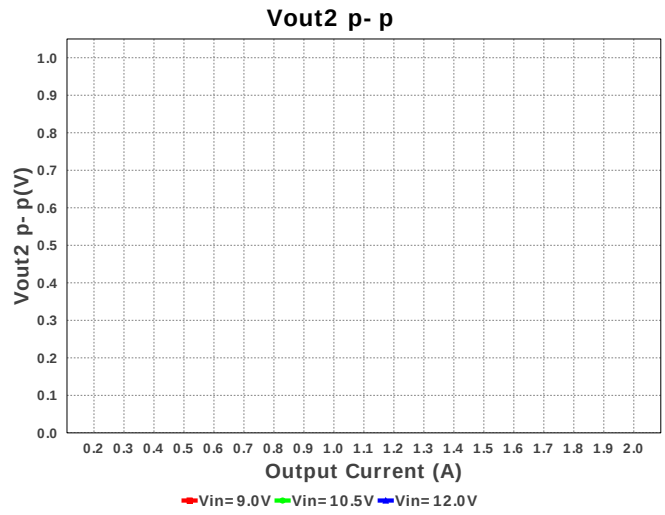
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	TDK	C1005X5R1A104K Series= X5R	Cap= 100.0 nF ESR= 20.413 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Cboot2	TDK	C1005X5R1A104K Series= X5R	Cap= 100.0 nF ESR= 20.413 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Ccomp1	Yageo America	CC0805JRNPO9BN102 Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Ccomp2	Kemet	C0805C100K5GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	Ccomp3	Yageo America	CC0805JRNPO9BN102 Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
6.	Ccomp4	Kemet	C0805C100K5GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
7.	Cin	MuRata	GRM32ER61C226KE20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	1	$0.16	1210 15 mm^2
8.	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

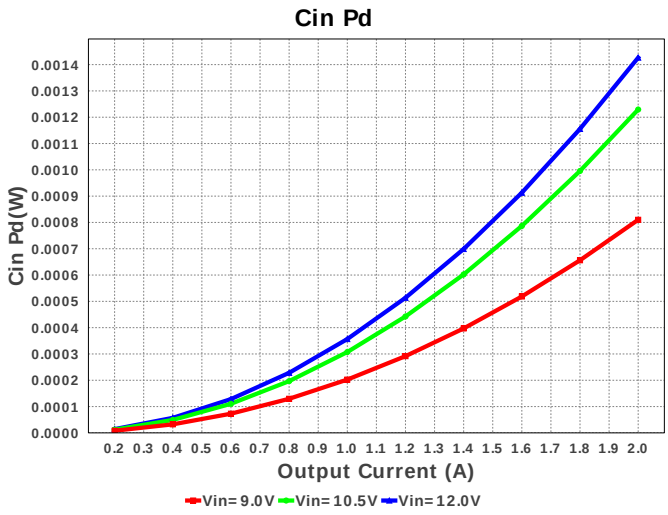
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout_Ch1	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	3	$0.05	0805 7 mm²
10.	Cout_Ch2	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	2	$0.05	0805 7 mm²
11.	Cramp1	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
12.	Cramp2	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
13.	Cres	MuRata	GRM155C80G474KE01D Series= 379	Cap= 470.0 nF VDC= 4.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
14.	Css1	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
15.	Css2	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
16.	Cvcc1	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
17.	Cvcc2	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
18.	D1	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	$0.06	SOD-123 13 mm²
19.	D2	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	$0.06	SOD-123 13 mm²
20.	L1	TDK	VLP8040T-100M	L= 10.0 µH DCR= 38.0 mOhm	1	$0.22	VLP8040 113 mm²
21.	L2	Bourns	SRN6045-150M	L= 15.0 µH DCR= 95.8 mOhm	1	$0.16	SRN6045 64 mm²
22.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 47.0 Amps	1	$0.34	TRANS_NexFET_Q3 19 mm²
23.	M2	Infineon Technologies	BSZ100N03MS G	VdsMax= 30.0 V IdsMax= 40.0 Amps	1	$0.23	PG-TSDSON-8 19 mm²
24.	M3	Texas Instruments	CSD16411Q3	VdsMax= 25.0 V IdsMax= 56.0 Amps	1	$0.34	TRANS_NexFET_Q3 19 mm²
25.	M4	Infineon Technologies	BSZ100N03MS G	VdsMax= 30.0 V IdsMax= 40.0 Amps	1	$0.23	PG-TSDSON-8 19 mm²
26.	Rcomp1	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	Rcomp2	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

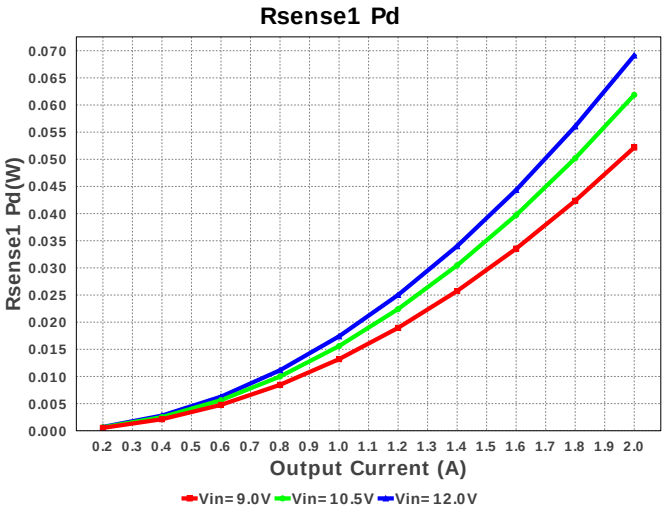
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
29.	Rfb2	Vishay-Dale	CRCW04026K04FKED Series= CRCW..e3	Res= 6.04 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
30.	Rfb3	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
31.	Rfb4	Susumu Co Ltd	RR1220P-362-D Series= 264	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	0805 7 mm²
32.	Rramp1	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	Rramp2	Vishay-Dale	CRCW040216K2FKED Series= CRCW..e3	Res= 16.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
34.	Rsense1	Stackpole Electronics Inc	CSR1206FK30L0 Series= ?	Res= 30.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm²
35.	Rsense2	Panasonic	ERJ-L03UF75MV Series= 231	Res= 75.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.09	0603 5 mm²
36.	Rt	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
37.	Ruv1	Vishay-Dale	CRCW0402254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
38.	Ruv2	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
39.	U1	Texas Instruments	LM25119PSQ/NOPB	Switcher	1	$2.60	SQA32A 49 mm²

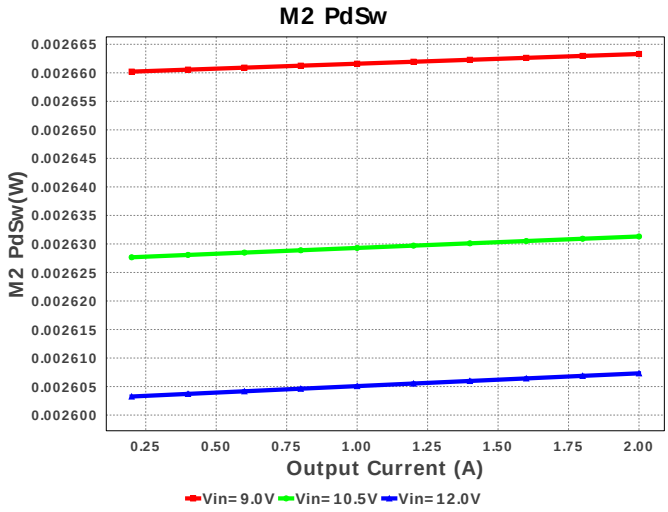


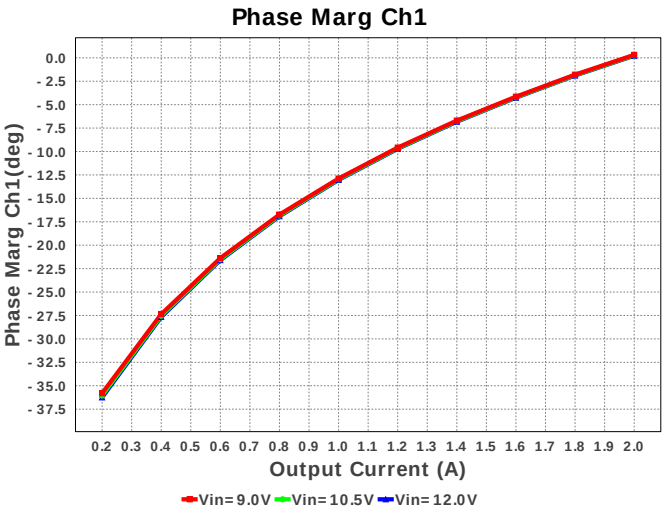


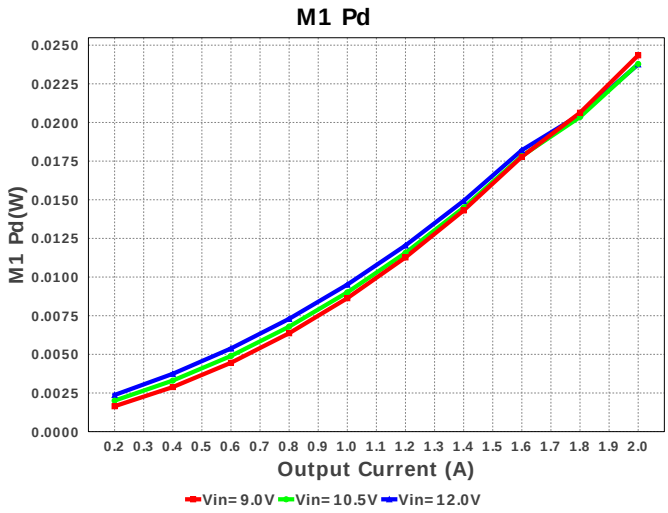


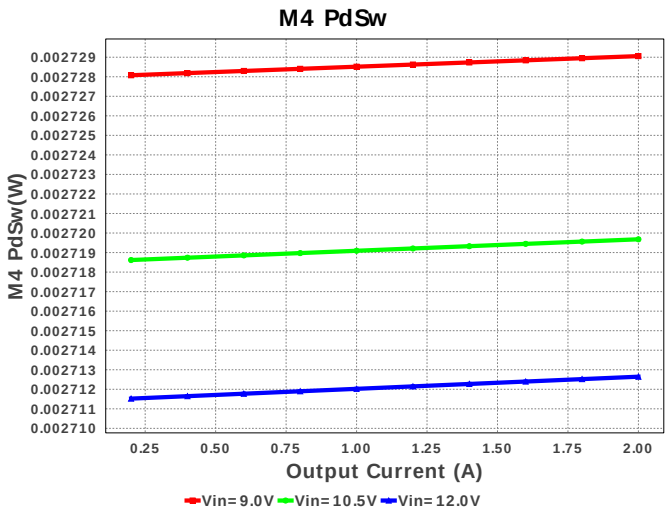


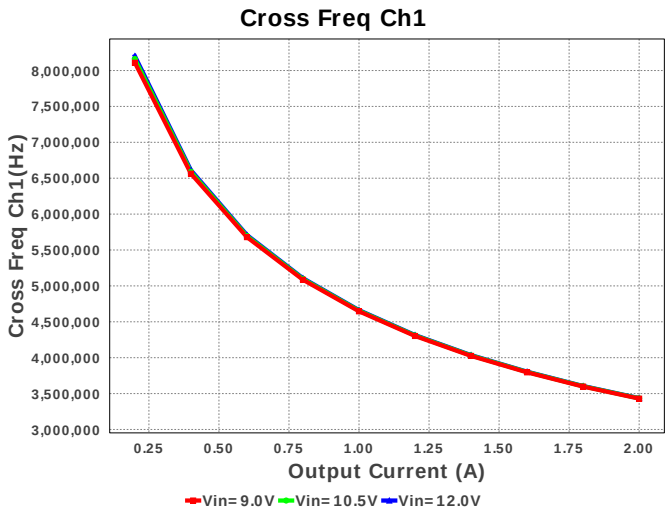


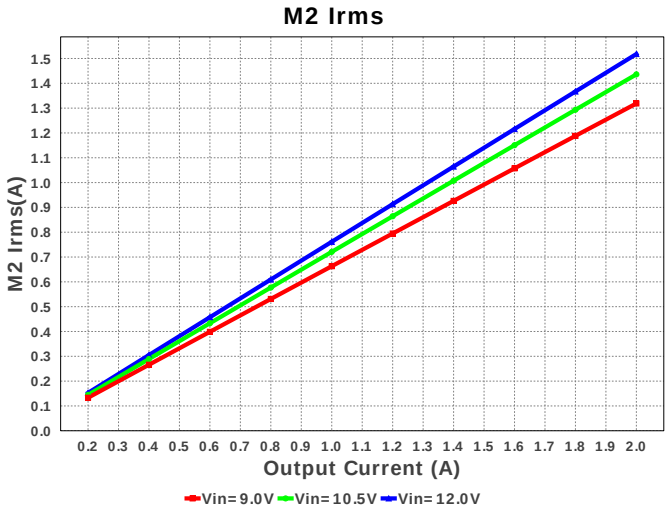


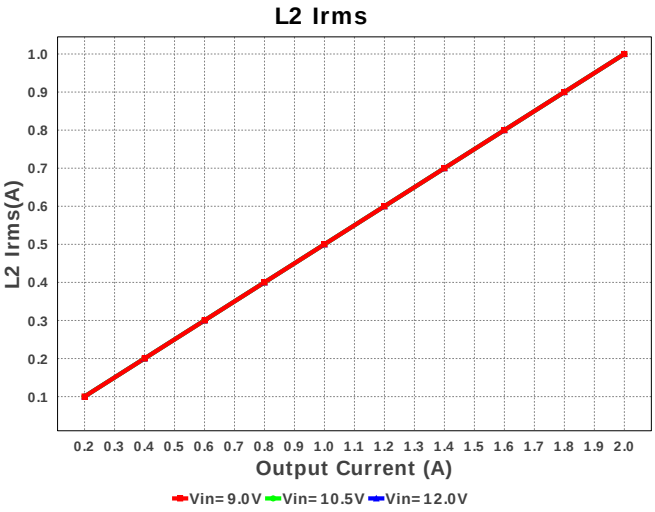


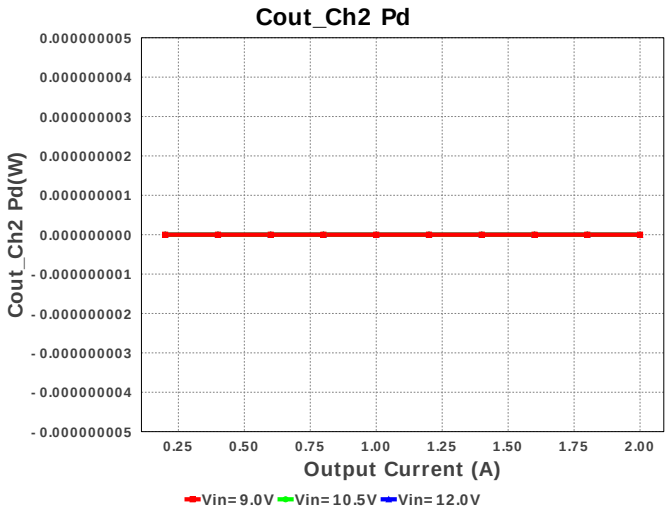


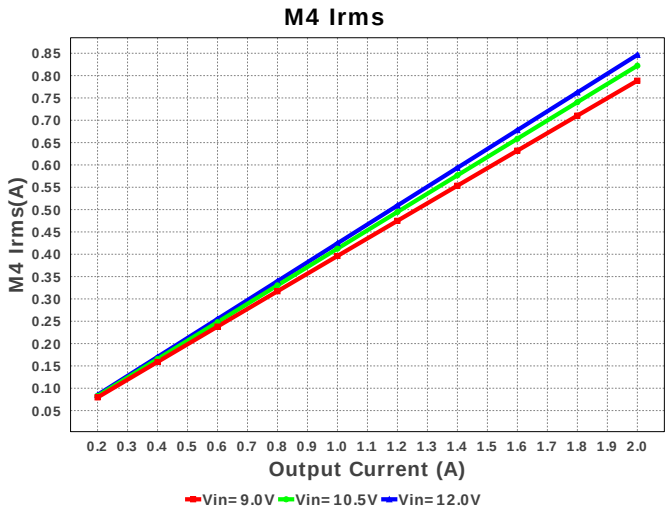


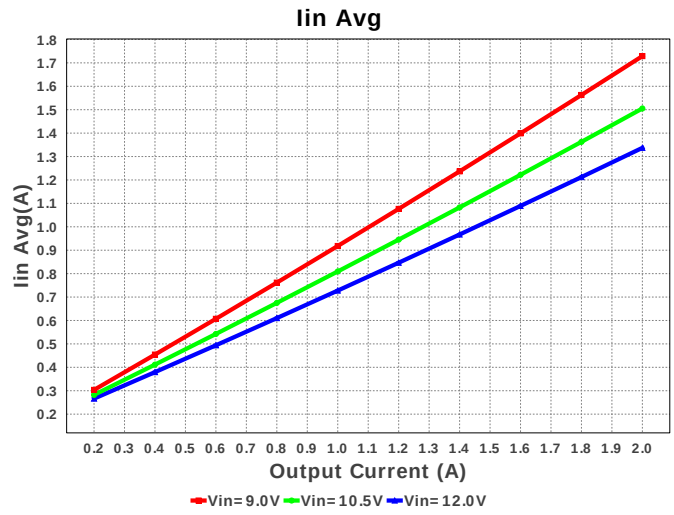


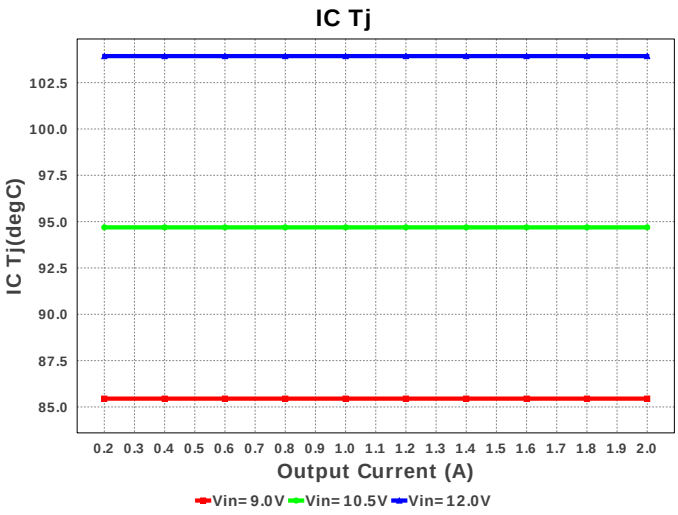


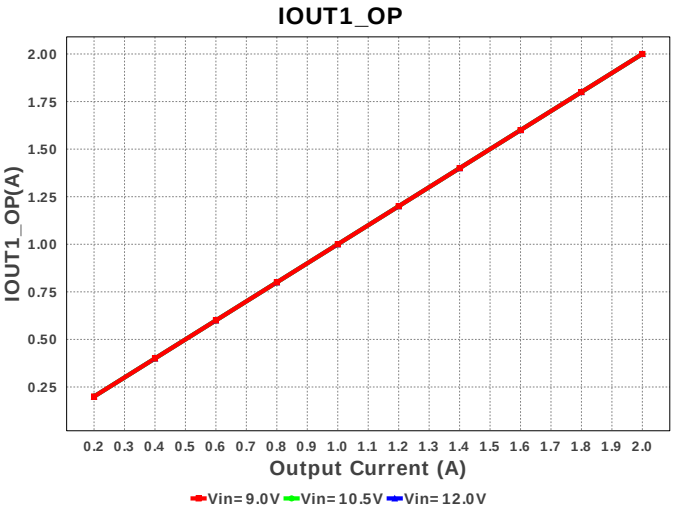


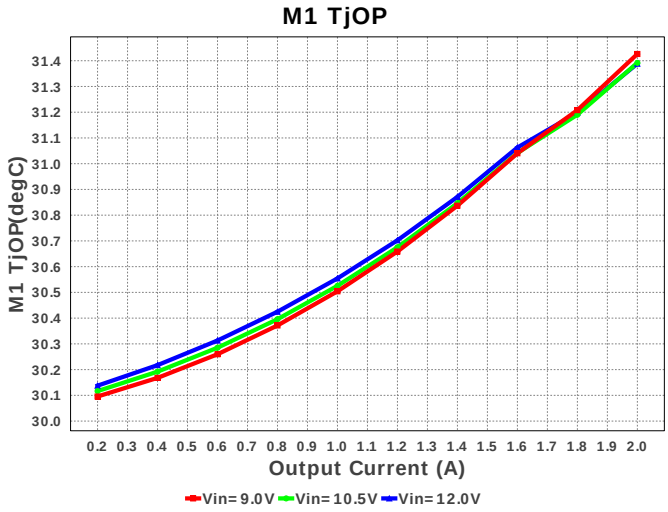


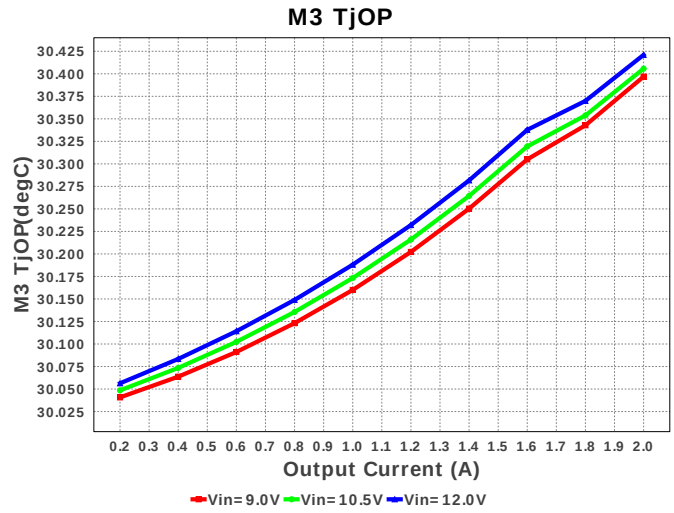


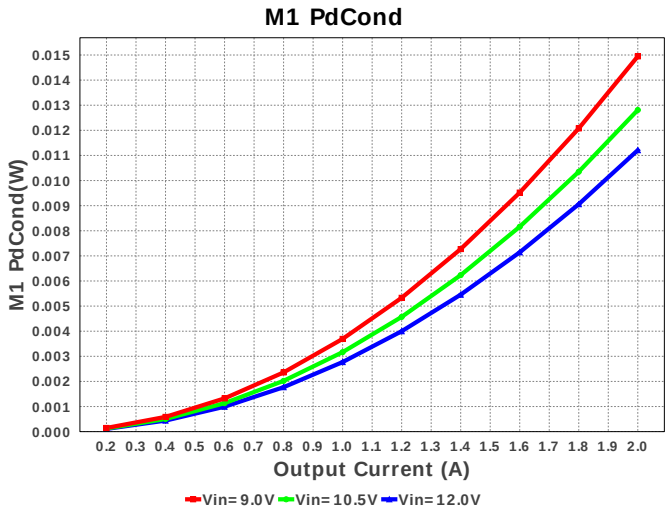


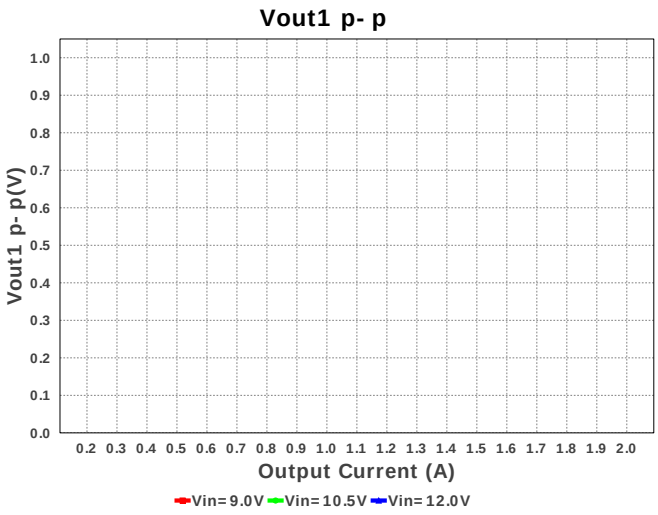


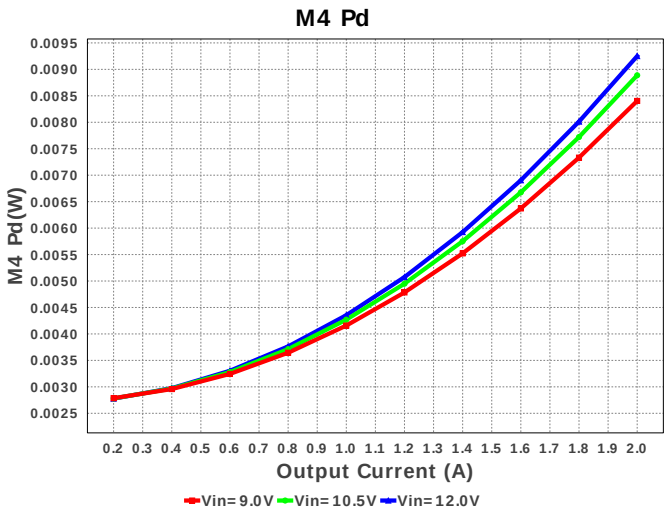


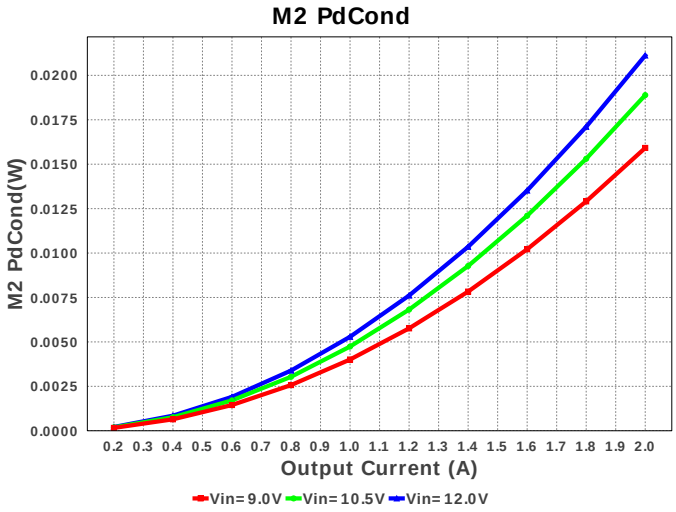


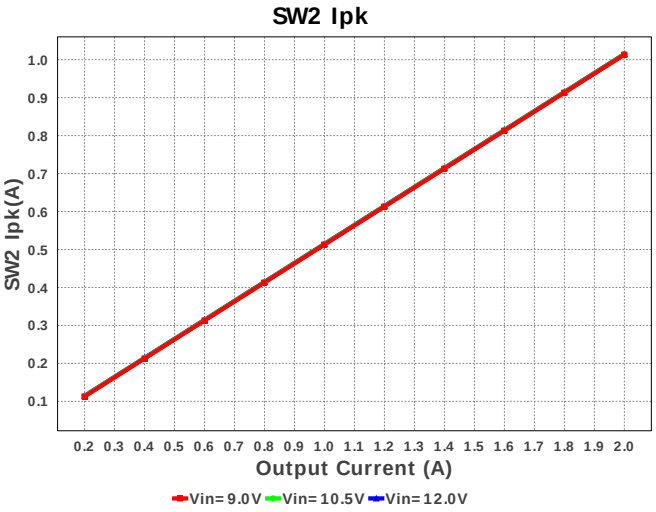


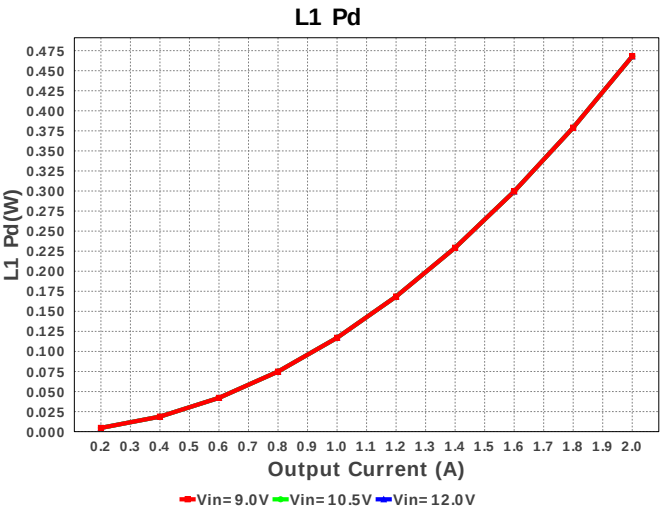


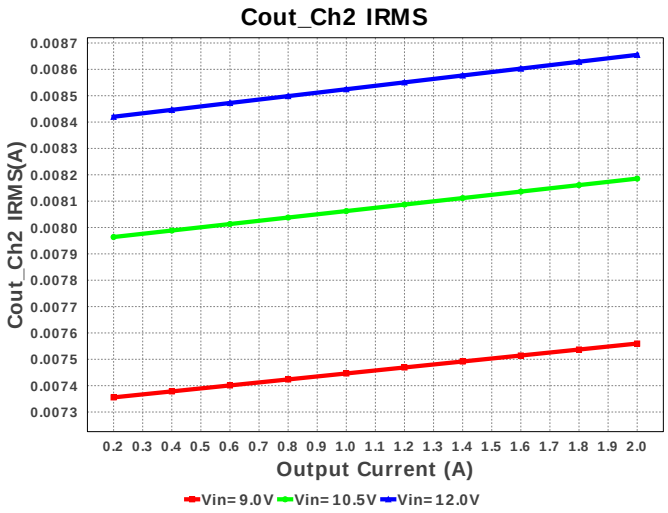


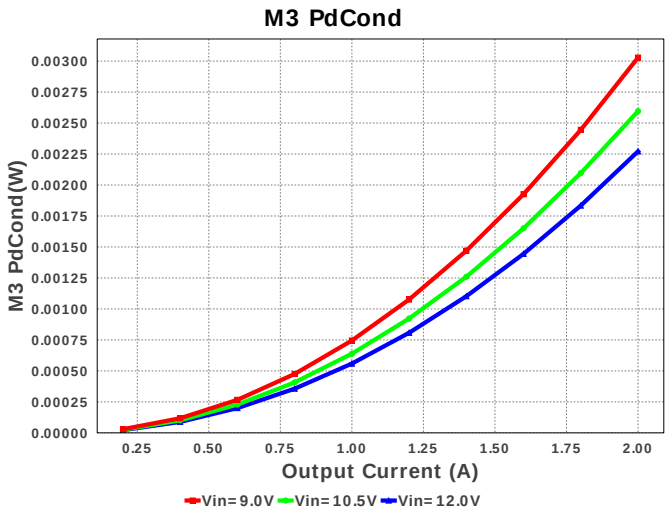


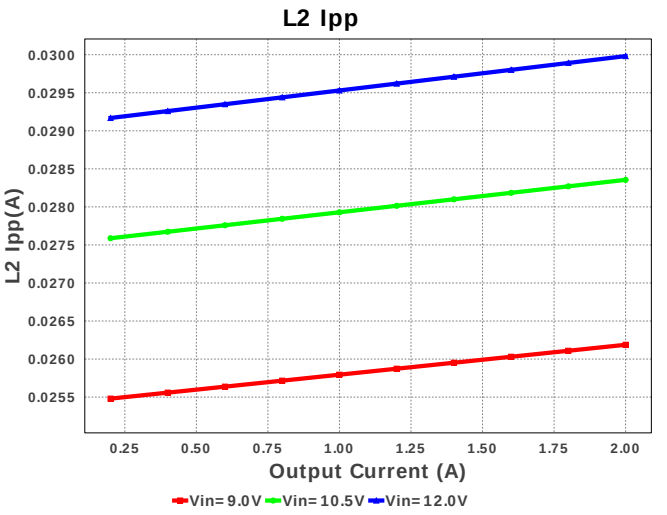


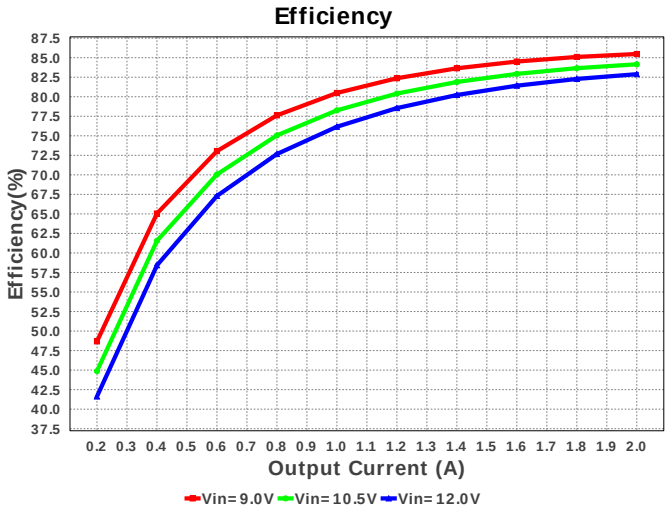


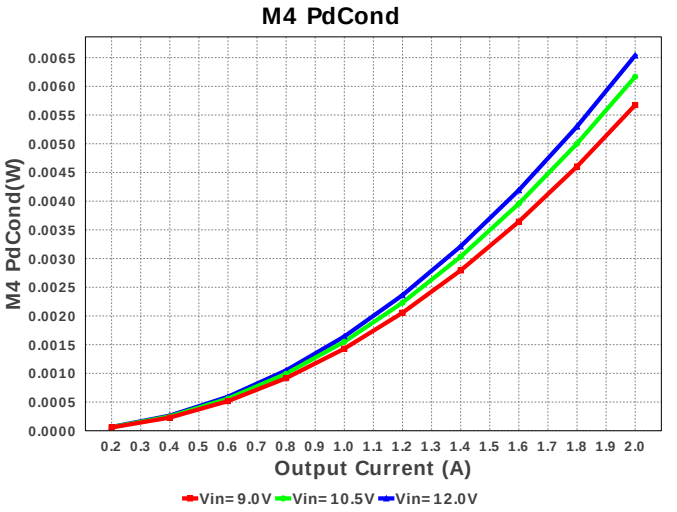


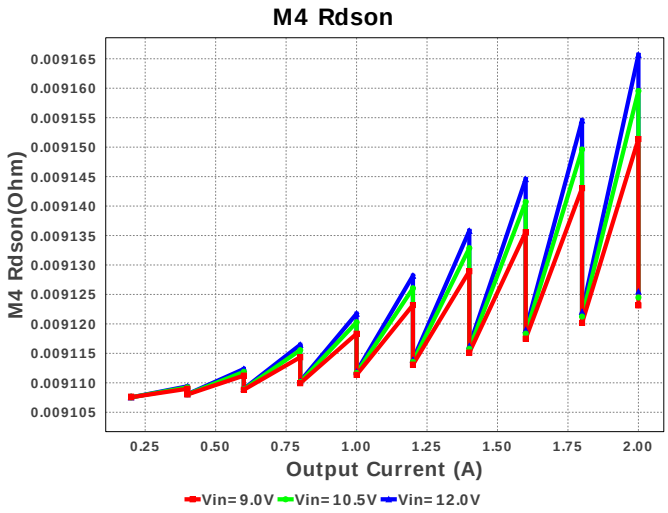


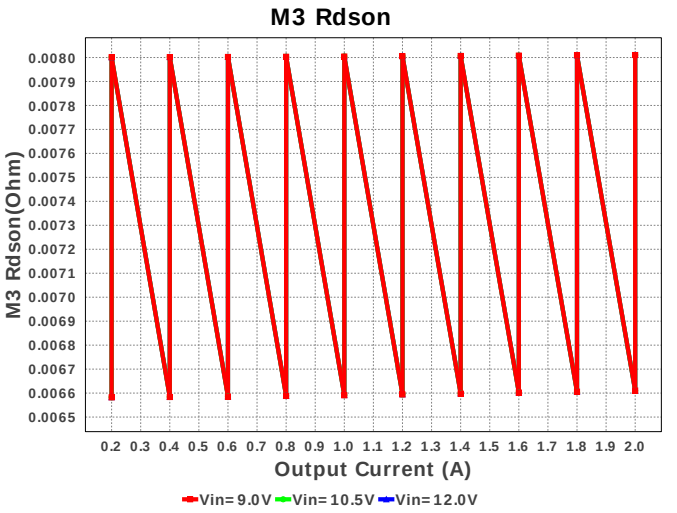


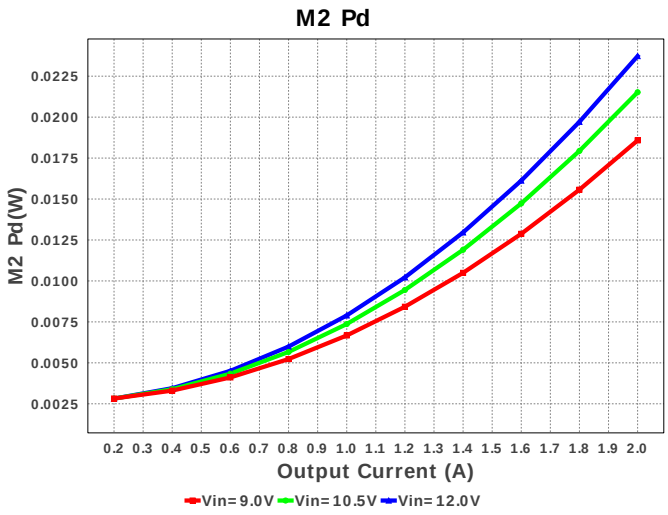


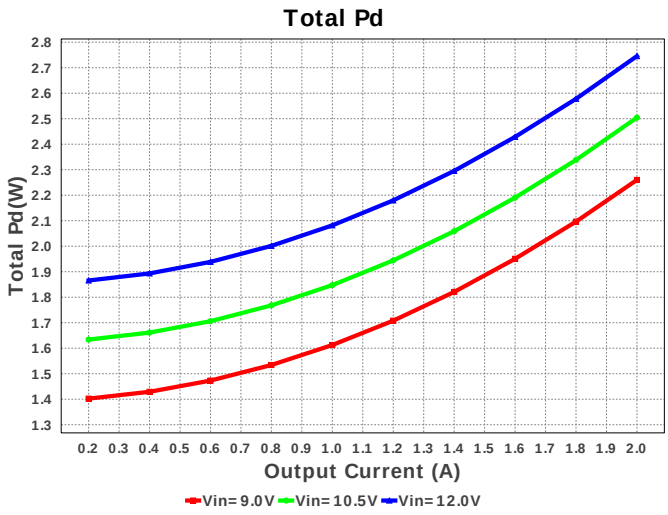


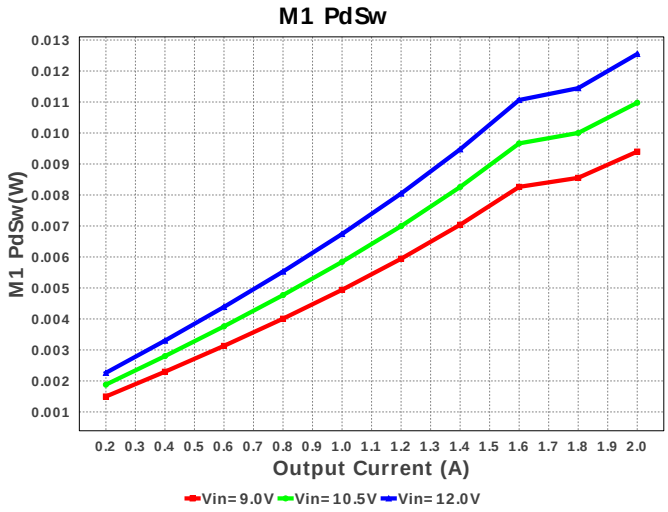


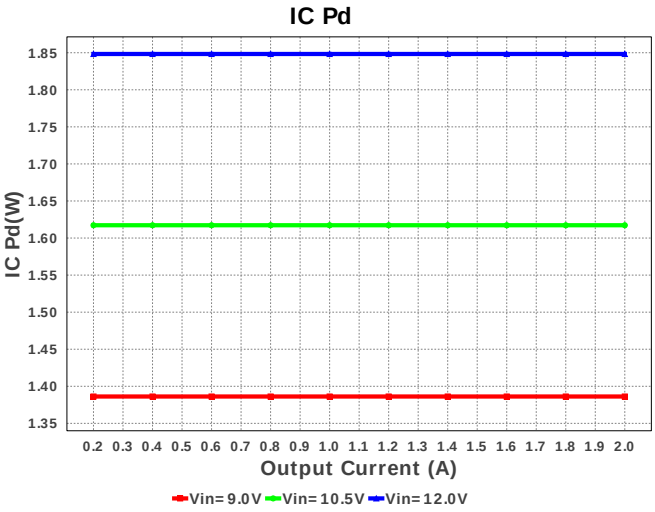


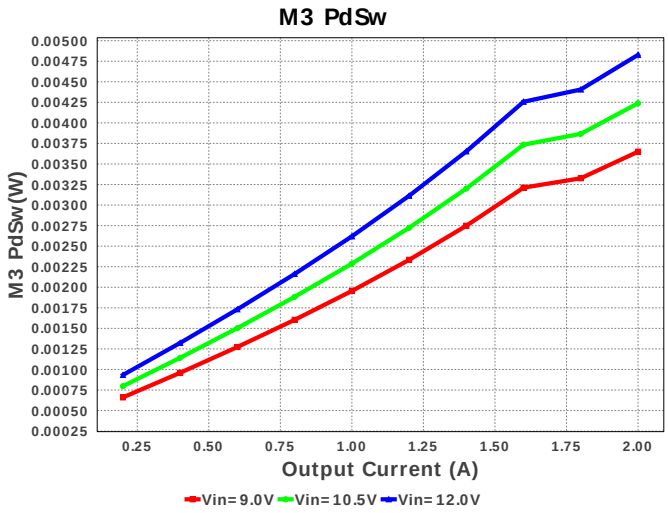


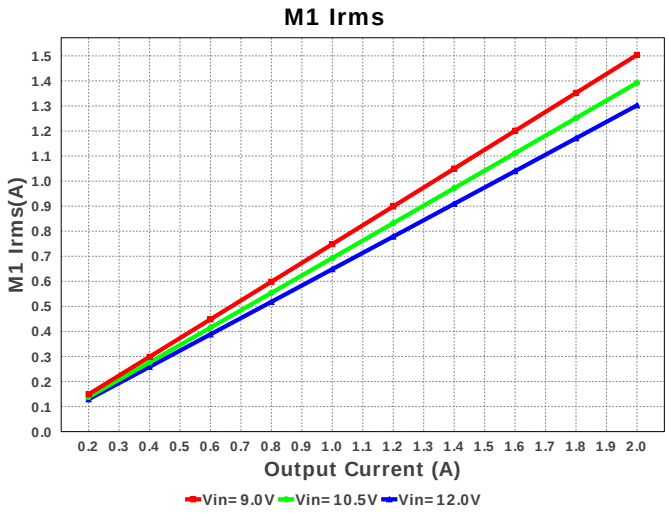


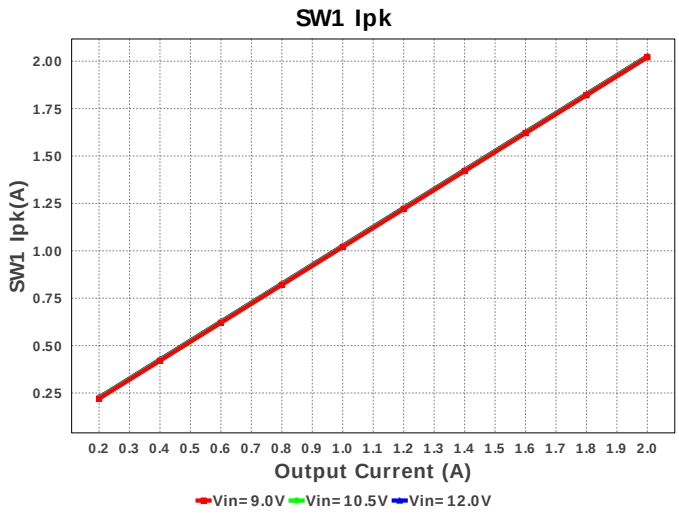


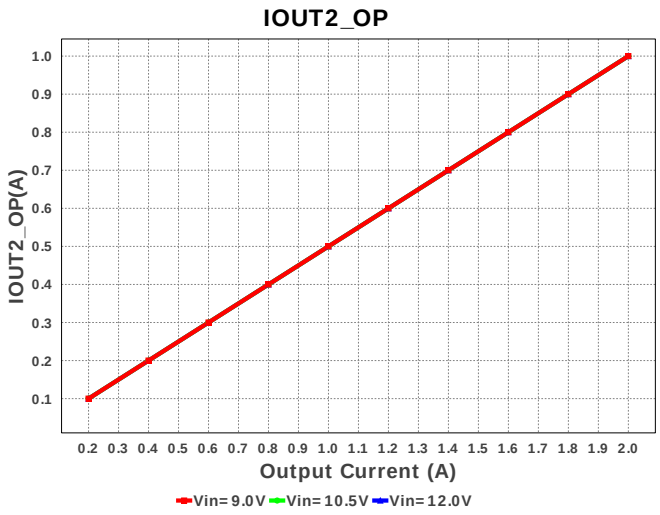


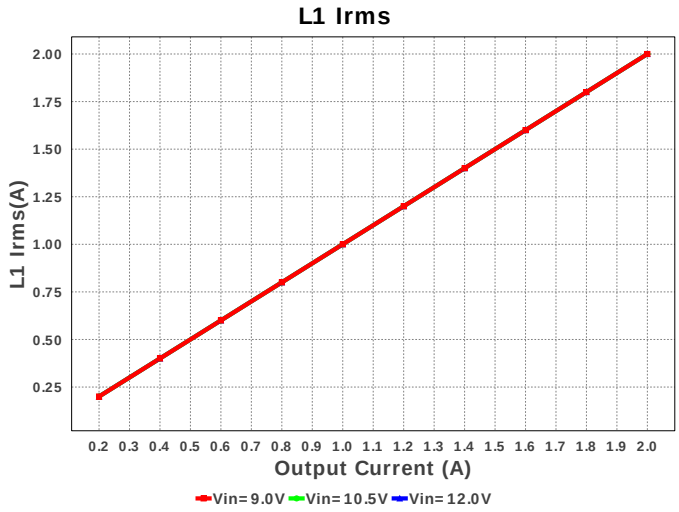


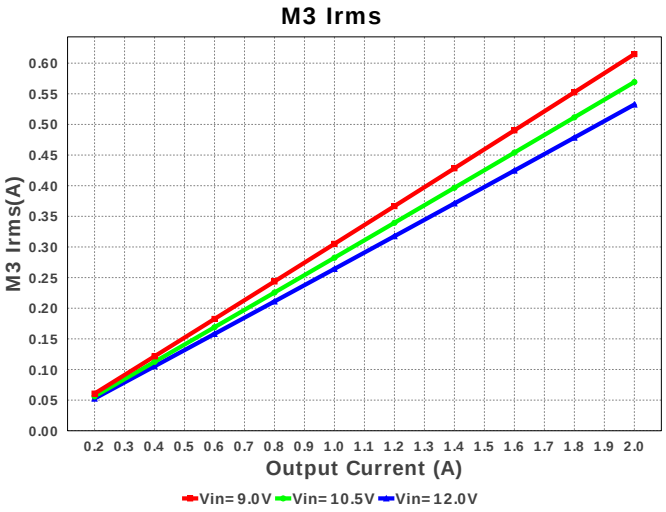


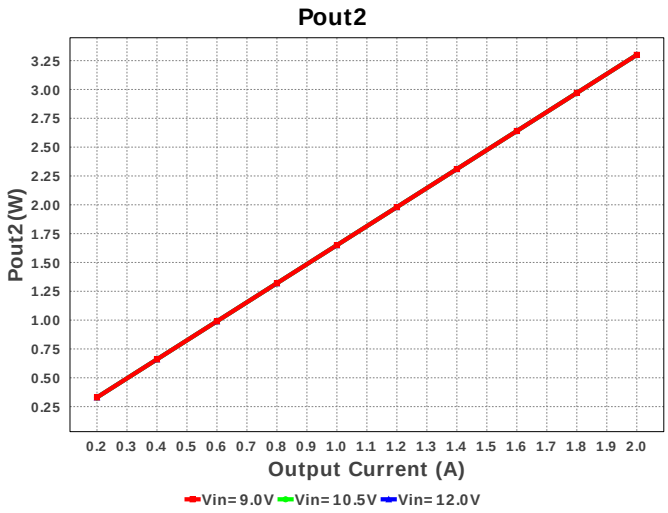


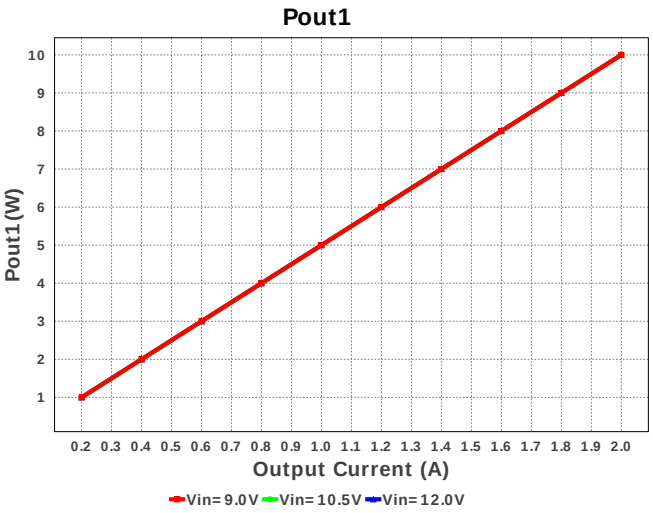


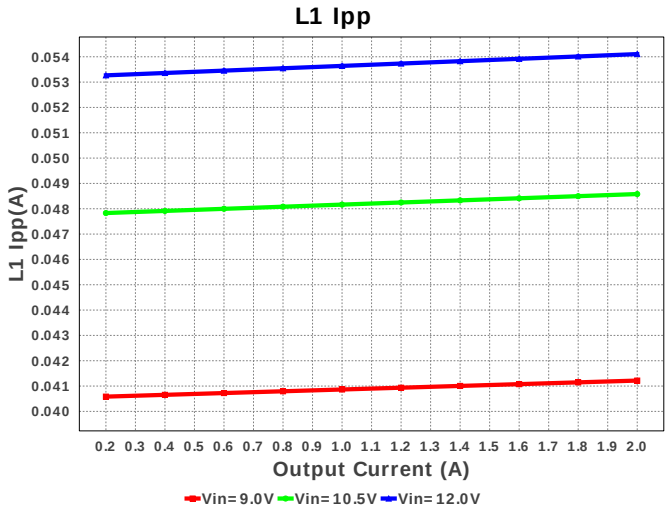


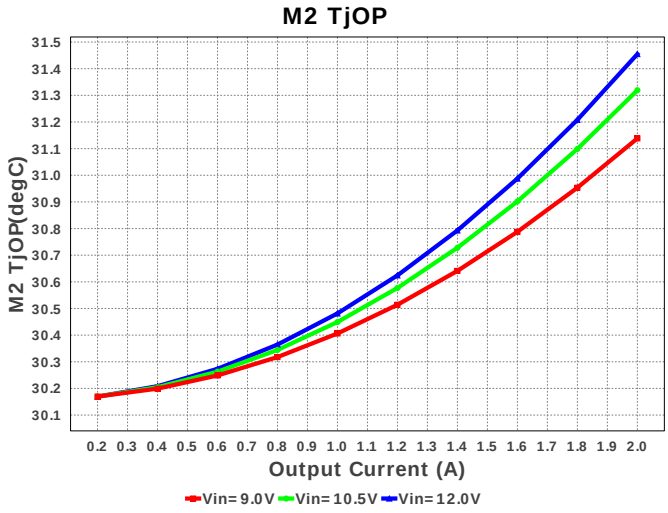


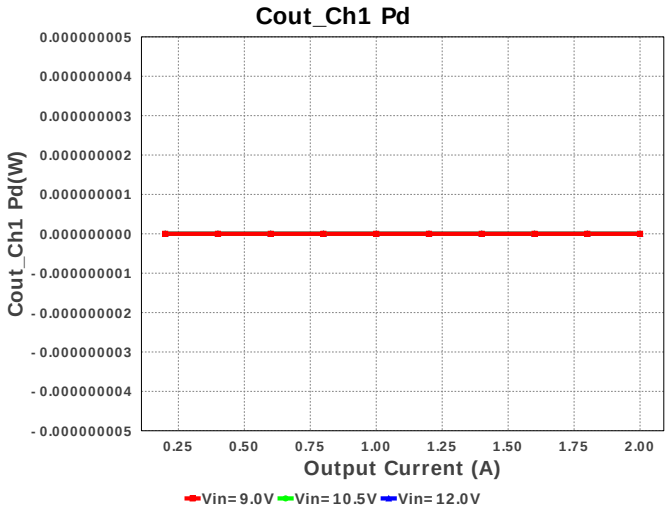


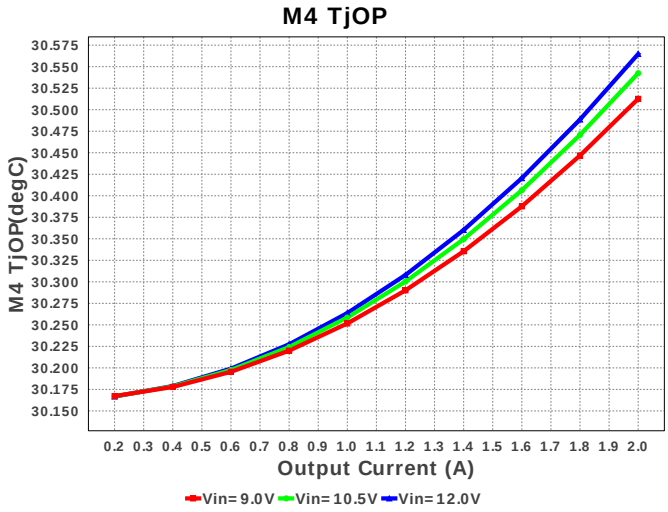


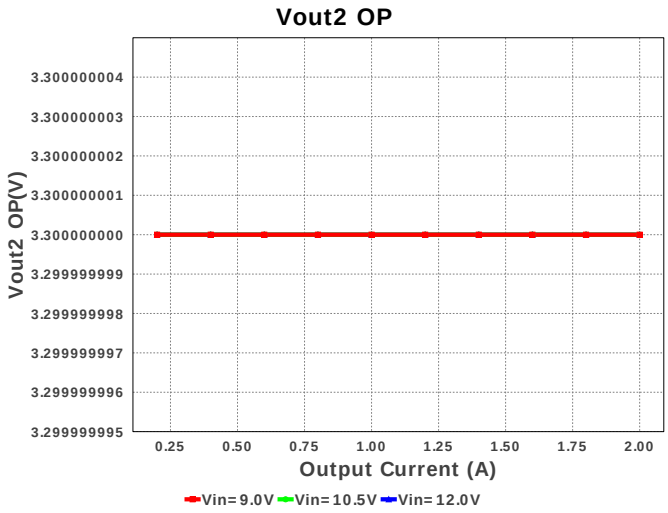


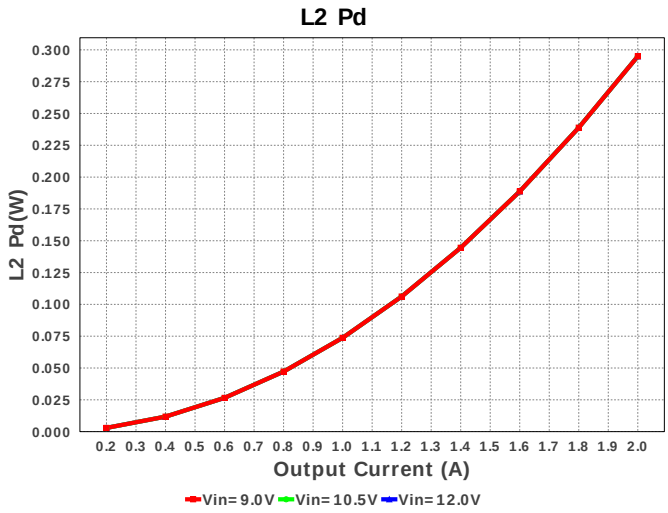


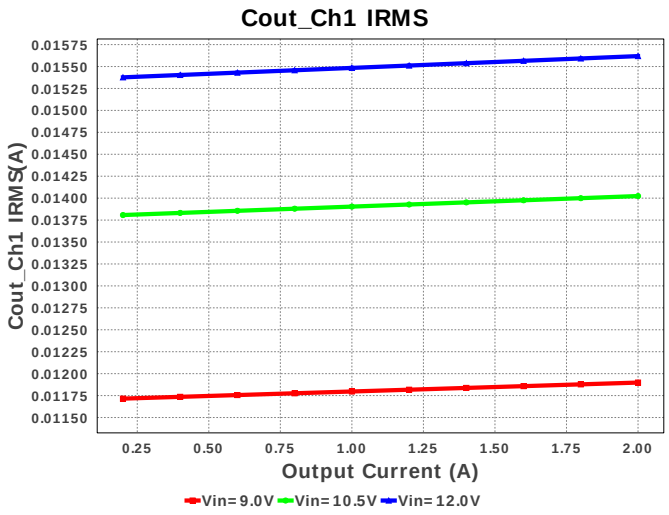


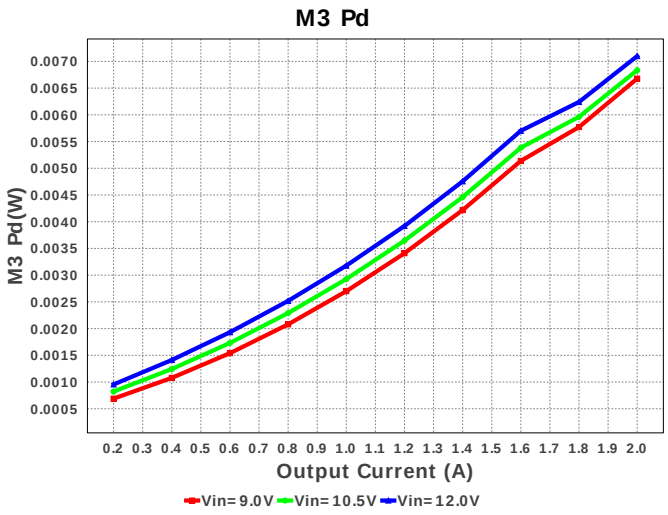


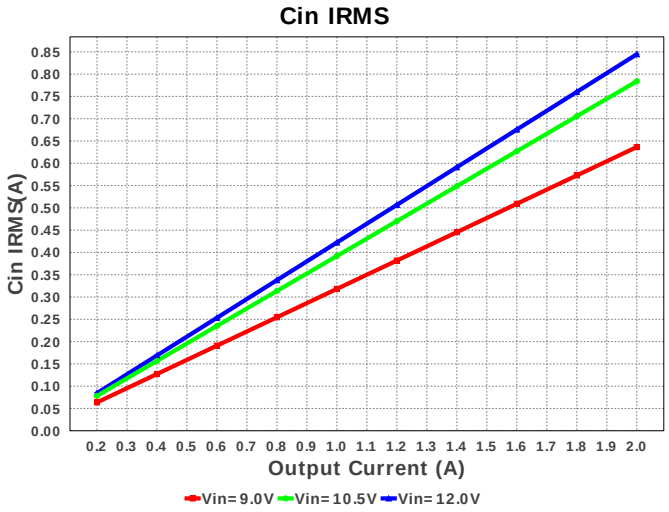












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	844.251 mA	Current	Input capacitor RMS ripple current
2.	Cout_Ch1 IRMS	204.334 mA	Current	Output Channel 1 Capacitor RMS ripple current
3.	Cout_Ch2 IRMS	114.415 mA	Current	Output Channel 2 Capacitor RMS ripple current
4.	Iin Avg	1.194 A	Current	Average input current
5.	L1 Ipp	707.834 mA	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	2.01 A	Current	Inductor ripple current
7.	L2 Ipp	396.345 mA	Current	Inductor 2 peak to peak current
8.	L2 Irms	1.007 A	Current	Inductor ripple current
9.	M1 Irms	1.311 A	Current	MOSFET RMS ripple current
10.	M2 Irms	1.511 A	Current	MOSFET RMS ripple current
11.	M3 Irms	538.766 mA	Current	MOSFET RMS ripple current
12.	M4 Irms	842.456 mA	Current	MOSFET RMS ripple current
13.	SW1 Ipk	2.354 A	Current	Peak switch current
14.	SW2 Ipk	1.198 A	Current	Peak switch current
15.	BOM Count	42	General	Total Design BOM count
16.	FootPrint	507.0 mm^2	General	Total Foot Print Area of BOM components
17.	Frequency	424.559 kHz	General	Switching frequency
18.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
19.	Total BOM	$5.09	General	Total BOM Cost
20.	IOUT1_OP	2.0 A	Op_Point	Iout1 operating point
21.	IOUT2_OP	1.0 A	Op_Point	Iout2 operating point
22.	M3 TjOP	31.29 degC	Op_Point	M3 MOSFET junction temperature
23.	M4 TjOP	33.829 degC	Op_Point	M4 MOSFET junction temperature
24.	Vout1 OP	5.002 V	Op_Point	Operational Voltage 1
25.	Vout2 OP	3.304 V	Op_Point	Operational Voltage 2
26.	Efficiency	92.843 %	Op_point	Steady state efficiency
27.	IC Tj	41.146 degC	Op_point	IC junction temperature
28.	M1 TjOP	33.261 degC	Op_point	M1 MOSFET junction temperature
29.	M2 TjOP	38.306 degC	Op_point	M2 MOSFET junction temperature
30.	VIN_OP	12.0 V	Op_point	Vin operating point
31.	Vout1 p-p	3.805 mV	Op_point	Peak-to-peak output1 ripple voltage

#	Name	Value	Category	Description
32.	Vout2 p-p	3.196 mV	Op_point	Peak-to-peak output2 ripple voltage
33.	Cin Pd	1.426 mW	Power	Input capacitor power dissipation
34.	Cout_Ch1 Pd	62.629 µW	Power	Ouput channel 1 capacitor power dissipation
35.	Cout_Ch2 Pd	58.908 µW	Power	Ouput channel 2 capacitor power dissipation
36.	IC Pd	278.659 mW	Power	IC power dissipation
37.	L1 Pd	211.511 mW	Power	Inductor power dissipation
38.	L2 Pd	133.308 mW	Power	Inductor power dissipation
39.	M1 Pd	55.952 mW	Power	M1 MOSFET total power dissipation
40.	M1 PdCond	16.319 mW	Power	M1 MOSFET conduction losses
41.	M1 PdSw	39.634 mW	Power	M1 MOSFET switching losses
42.	M2 Pd	137.795 mW	Power	M2 MOSFET total power dissipation
43.	M2 PdCond	27.091 mW	Power	M2 MOSFET conduction losses
44.	M2 PdSw	110.704 mW	Power	M2 MOSFET switching losses
45.	M3 Pd	21.806 mW	Power	M3 MOSFET total power dissipation
46.	M3 PdCond	3.498 mW	Power	M3 MOSFET conduction losses
47.	M3 PdSw	18.308 mW	Power	M3 MOSFET switching losses
48.	M3 Rdson	9.501 mOhm	Power	Drain-Source On-resistance
49.	M3 Rdson	12.051 mOhm	Power	Drain-Source On-resistance
50.	M4 Pd	63.624 mW	Power	M4 MOSFET total power dissipation
51.	M4 PdCond	8.245 mW	Power	M4 MOSFET conduction losses
52.	M4 PdSw	55.379 mW	Power	M4 MOSFET switching losses
53.	M4 Rdson	11.87 mOhm	Power	Drain-Source On-resistance
54.	M4 Rdson	11.617 mOhm	Power	Drain-Source On-resistance
55.	Rsense1 Pd	68.47 mW	Power	Current Limit Sense Resistor Power Dissipation
56.	Rsense2 Pd	53.23 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Total Pd	1.026 W	Power	Total Power Dissipation
58.	Cross Freq Ch1	37.767 kHz	Unknown	Bode plot crossover frequency
59.	Cross Freq Ch2	38.194 kHz	Unknown	Bode plot crossover frequency
60.	Duty Cycle 1	42.942 %	Unknown	Duty cycle for Channel 1
61.	Duty Cycle 2	29.027 %	Unknown	Duty cycle for Channel 2
62.	Phase Marg Ch1	55.645 deg	Unknown	Bode Plot Phase Margin
63.	Phase Marg Ch2	59.61 deg	Unknown	Bode Plot Phase Margin
64.	Pout1	10.003 W	Unknown	Channel 1 output Power
65.	Pout2	3.304 W	Unknown	Channel 2 output Power

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	Iout2	1.0	Output Current #2
4.	VinMax	12.0	Maximum input voltage
5.	VinMin	9.0	Minimum input voltage
6.	Vout	5.0	Output Voltage
7.	Vout1	5.0	Output Voltage #1
8.	Vout2	3.3	Output Voltage #2
9.	base_pn	LM25119	Texas Instruments Base Part Number
10.	source	DC	Input Source Type
11.	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. Sequencing the 2 outputs The LM(2)5119 contains an enable function allowing shutdown control of channel2, independent of channel1. If the EN2 pin is pulled below 2.0V, channel2 enters shutdown mode. If the EN2 input is greater than 2.5V, channel2 returns to normal operation. 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.