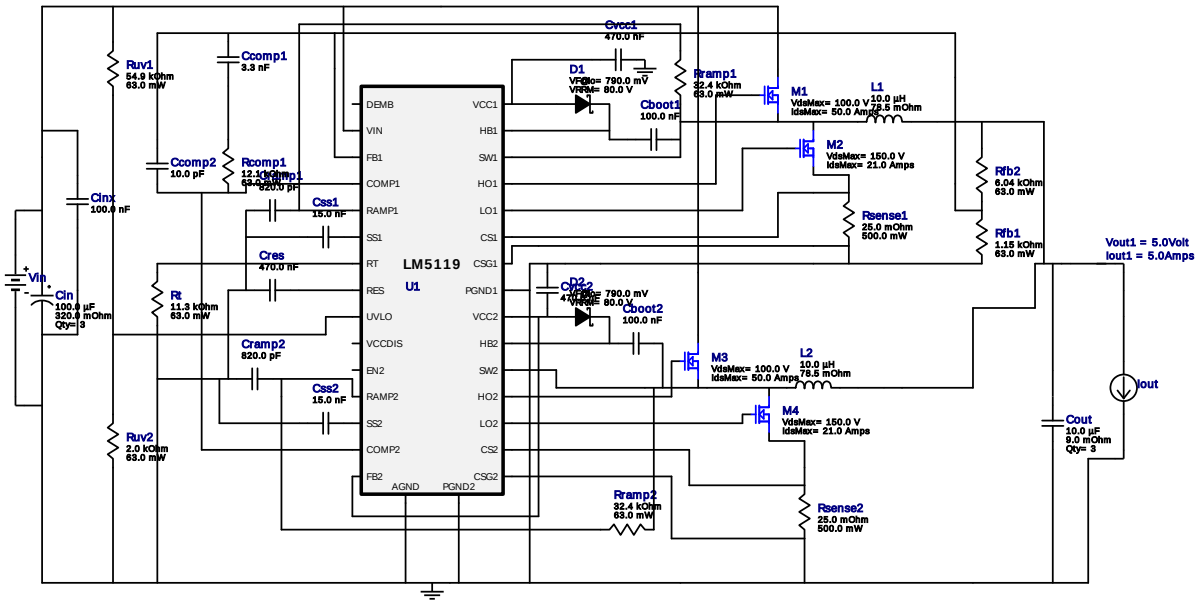
WEBENCH® Design Report

VinMin = 44.0V
VinMax = 56.0V
Vout = 5.0V
Iout = 5.0A

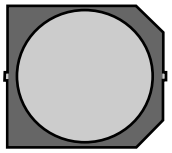
Device = LM5119PSQ/NOPB
Topology = Buck
Created = 8/12/16 5:43:54 PM
BOM Cost = $8.42
BOM Count = 37
Total Pd = 5.39W

Design : 4766763/1 LM5119PSQ/NOPB
LM5119PSQ/NOPB 44.0V-56.0V to 5.00V @ 5.0A



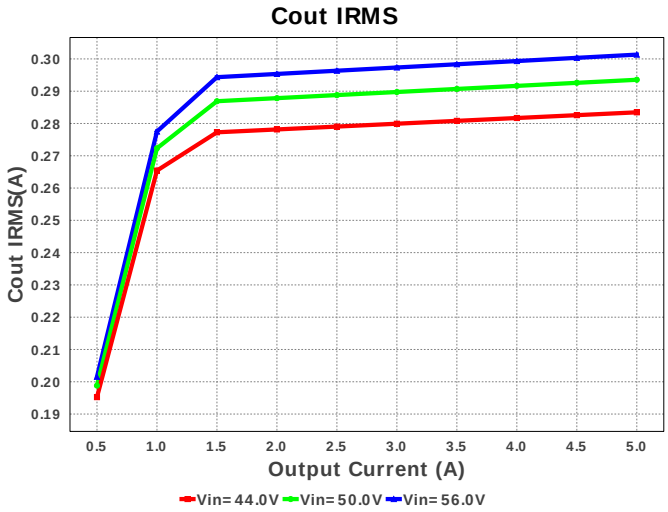
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

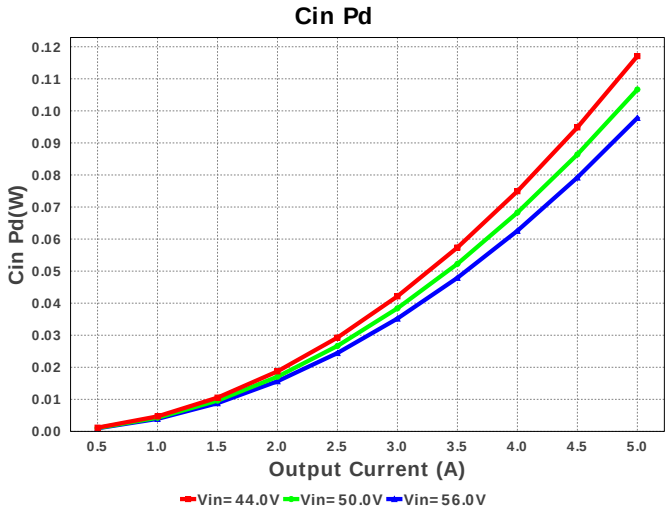
Electrical BOM

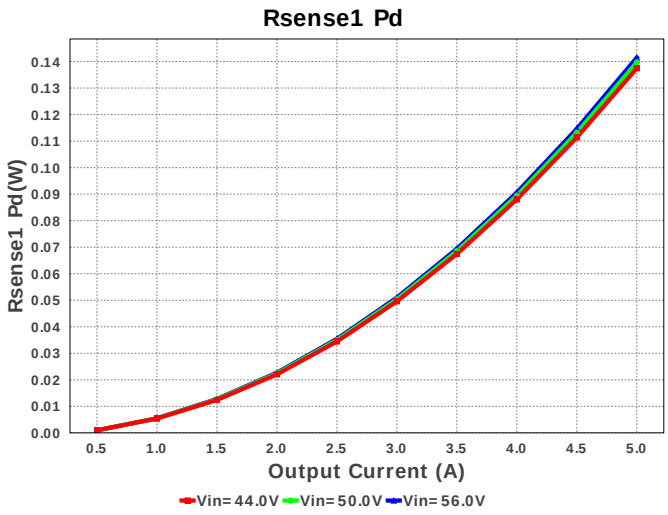
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Cboot2	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
3.	Ccomp1	MuRata	GRM216R71E332KA01D Series= X7R	Cap= 3.3 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Ccomp2	Kemet	C0805C100K5GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
5.	Cin	Panasonic	EEV-FK1K101Q Series= FK	Cap= 100.0 uF ESR= 320.0 mOhm VDC= 80.0 V IRMS= 500.0 mA	3	$0.45	 SM_RADIAL_H13 264 mm²
6.	Cinx	Taiyo Yuden	HMK212B7104KG-T Series= X7R	Cap= 100.0 nF VDC= 100.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
7.	Cout	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	3	$0.02	0603 5 mm²

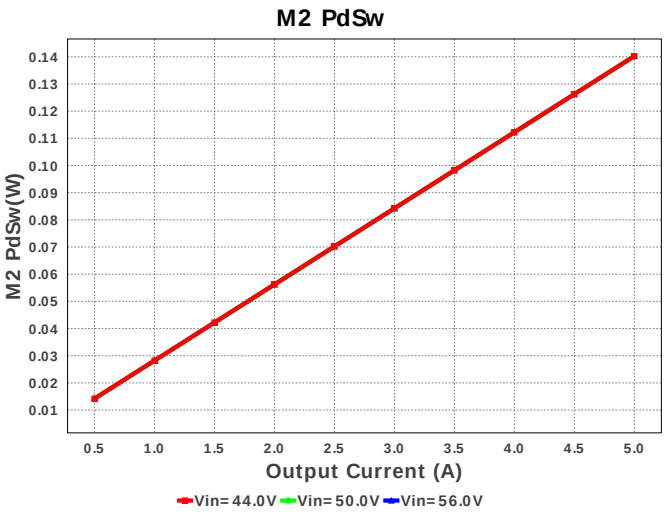
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cramp1	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
9.	Cramp2	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
10.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
11.	Css1	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
12.	Css2	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
13.	Cvcc1	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
14.	Cvcc2	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
15.	D1	Diodes Inc.	B280-13-F	VF@Io= 790.0 mV VRRM= 80.0 V	1	$0.13	 SMB 44 mm²
16.	D2	Diodes Inc.	B280-13-F	VF@Io= 790.0 mV VRRM= 80.0 V	1	$0.13	 SMB 44 mm²
17.	L1	Bourns	SRP6540-100M	L= 10.0 µH DCR= 78.5 mOhm	1	$0.49	 SRP6540 83 mm²
18.	L2	Bourns	SRP6540-100M	L= 10.0 µH DCR= 78.5 mOhm	1	$0.49	 SRP6540 83 mm²
19.	M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.50	 TRANS_NexFET_Q3 18 mm²
20.	M2	Infineon Technologies	BSZ520N15NS3 G	VdsMax= 150.0 V IdsMax= 21.0 Amps	1	$0.55	 PG-TSDSON-8 19 mm²
21.	M3	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.50	 TRANS_NexFET_Q3 18 mm²
22.	M4	Infineon Technologies	BSZ520N15NS3 G	VdsMax= 150.0 V IdsMax= 21.0 Amps	1	$0.55	 PG-TSDSON-8 19 mm²
23.	Rcomp1	Vishay-Dale	CRCW040212K1FKED Series= CRCW..e3	Res= 12.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
25.	Rfb2	Vishay-Dale	CRCW04026K04FKED Series= CRCW..e3	Res= 6.04 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
26.	Rramp1	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

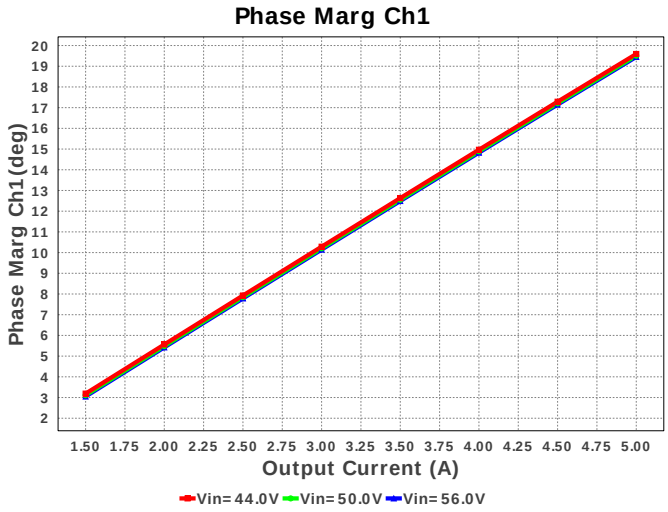
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rramp2	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
28.	Rsense1	Stackpole Electronics Inc	CSR1206FK25L0 Series= ?	Res= 25.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm²
29.	Rsense2	Stackpole Electronics Inc	CSR1206FK25L0 Series= ?	Res= 25.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm²
30.	Rt	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
31.	Ruv1	Vishay-Dale	CRCW040254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	Ruv2	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	U1	Texas Instruments	LM5119PSQ/NOPB	Switcher	1	$3.25	SQA32A 49 mm²

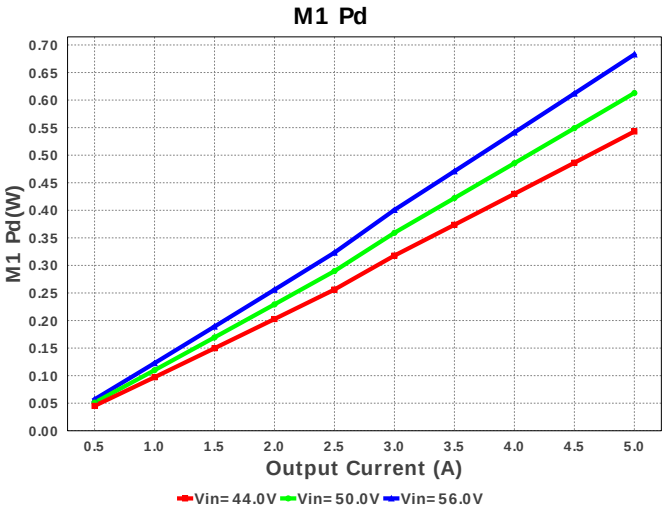


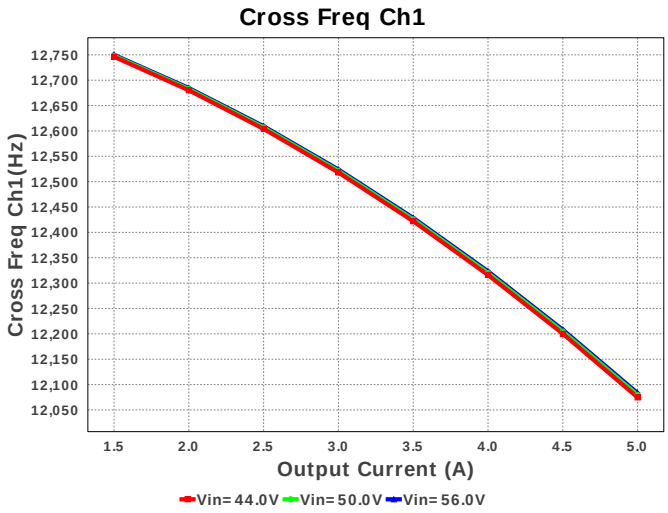


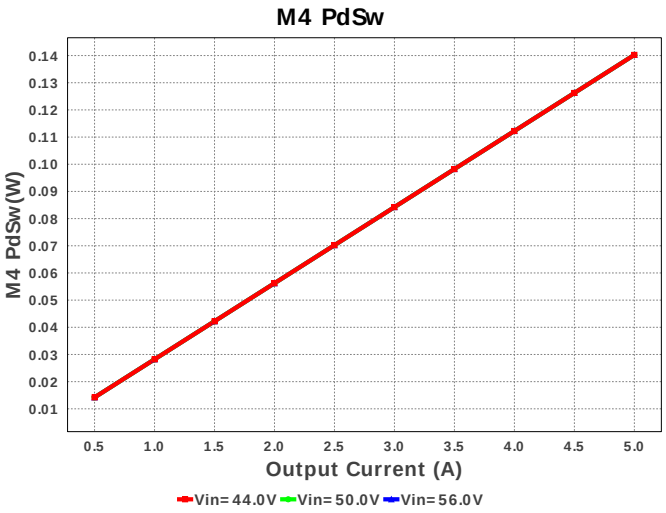


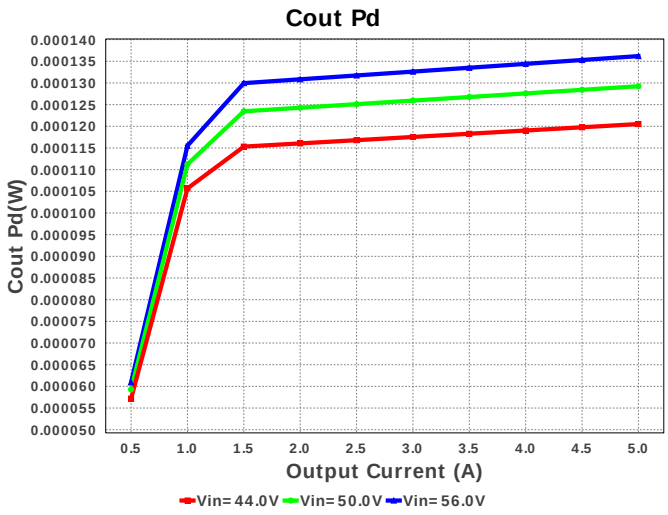


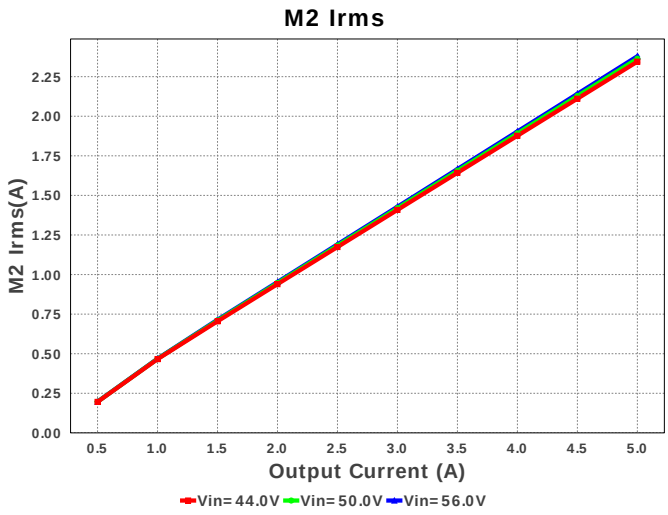


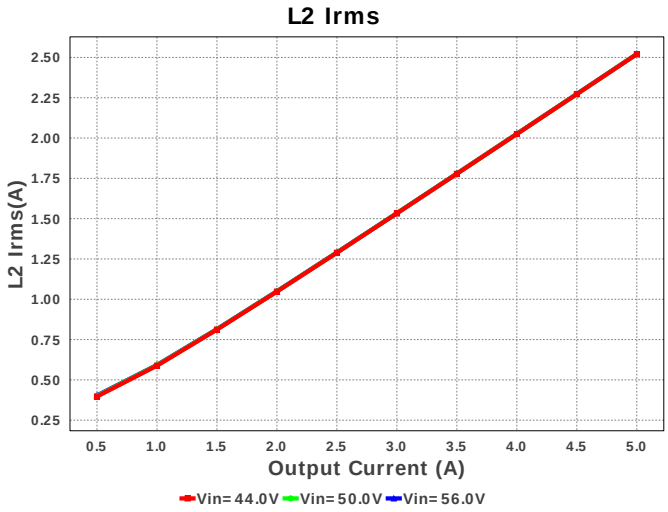


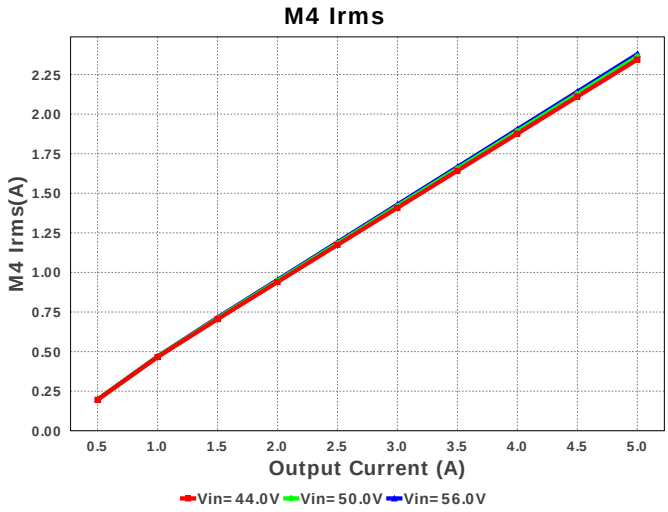


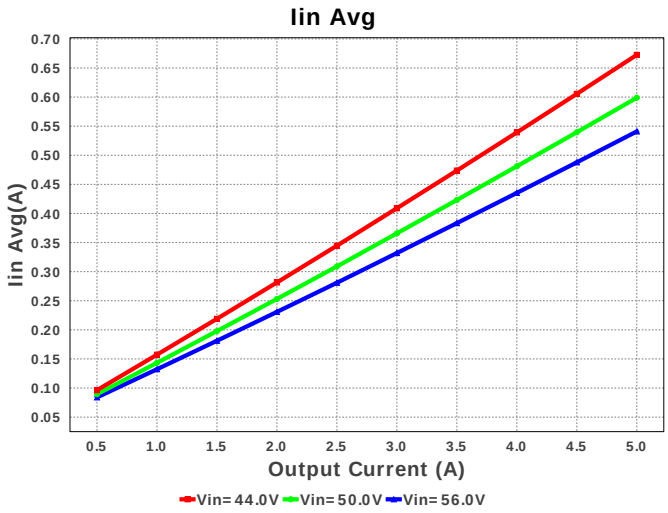


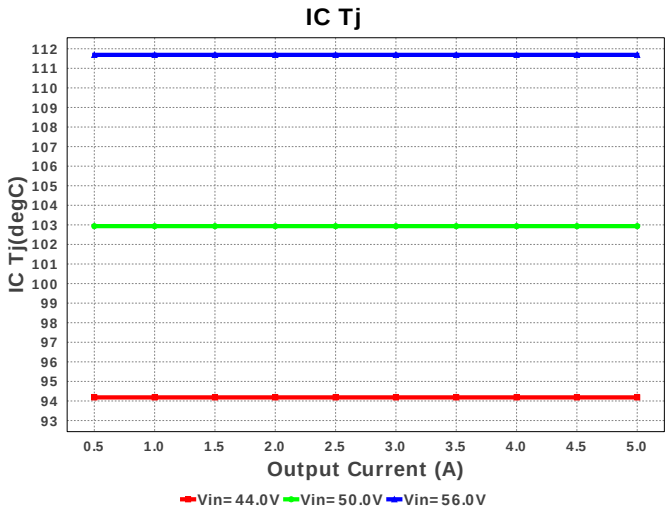


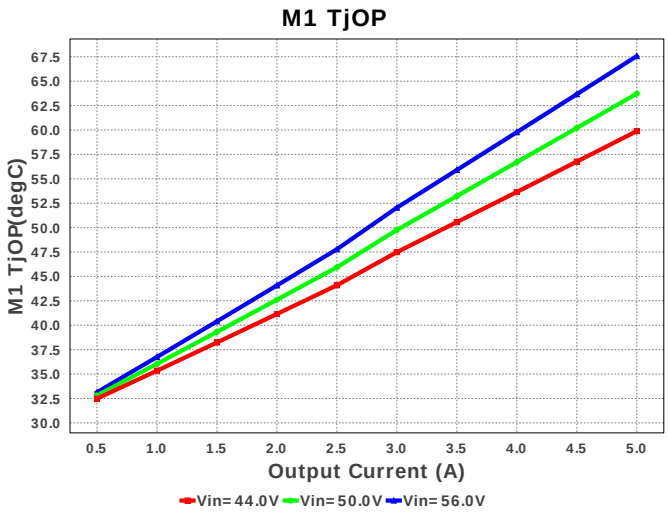


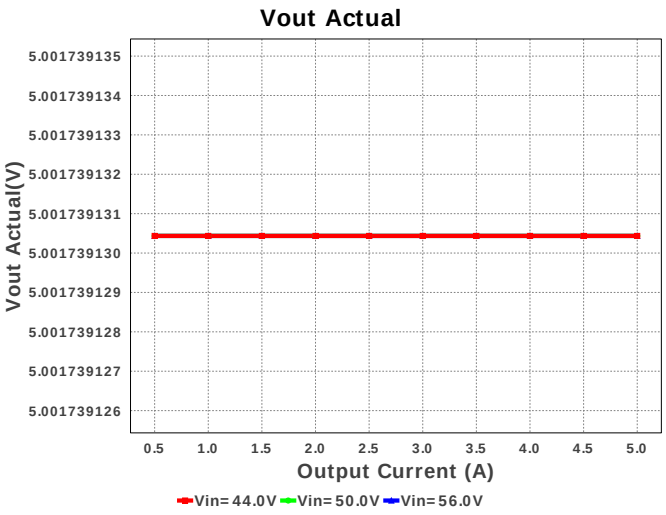


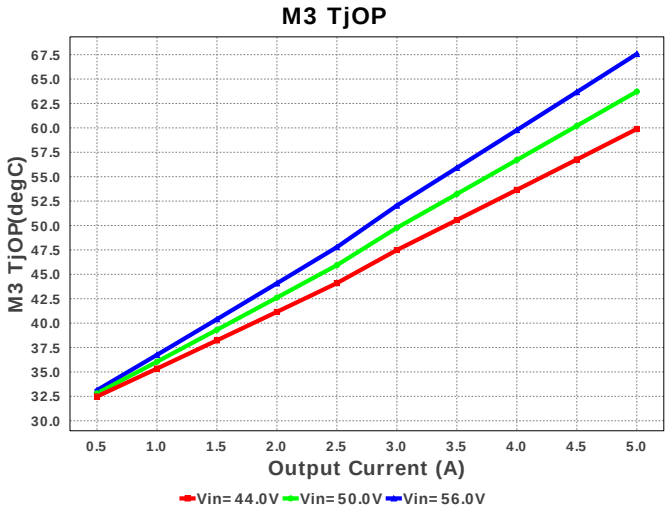


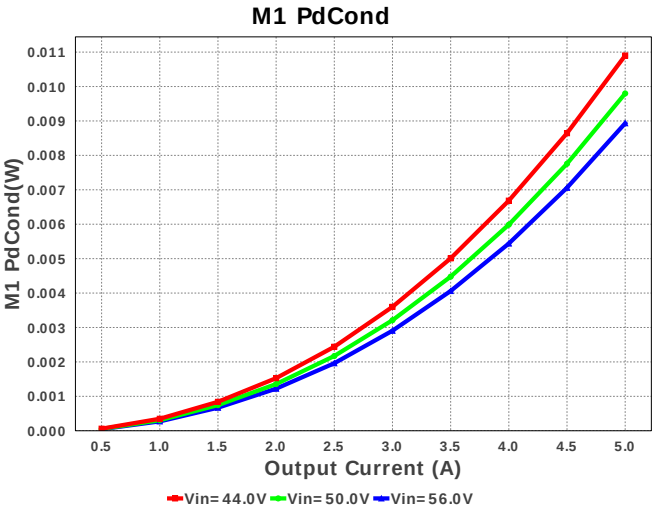


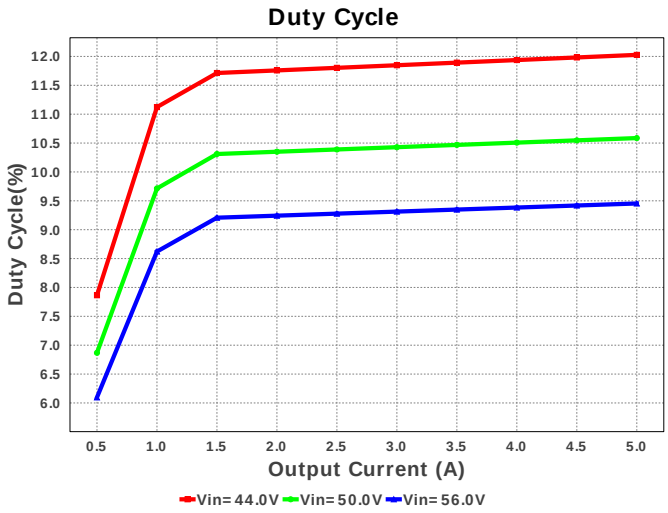


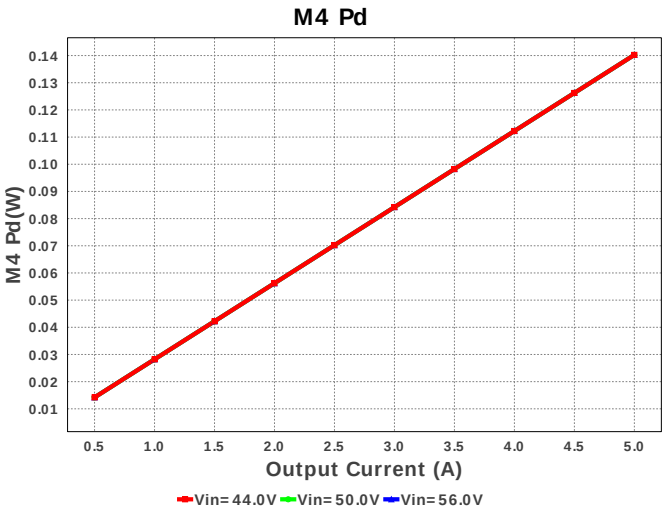


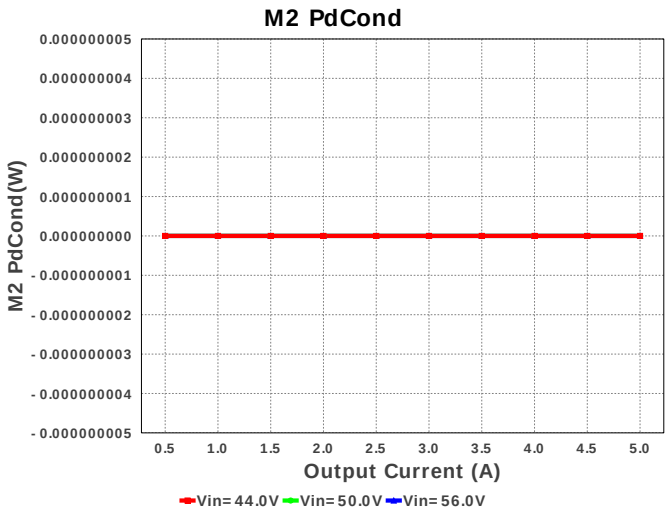


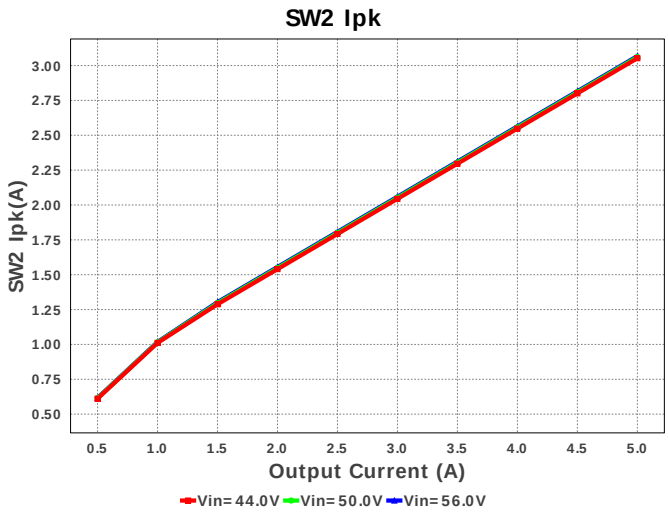


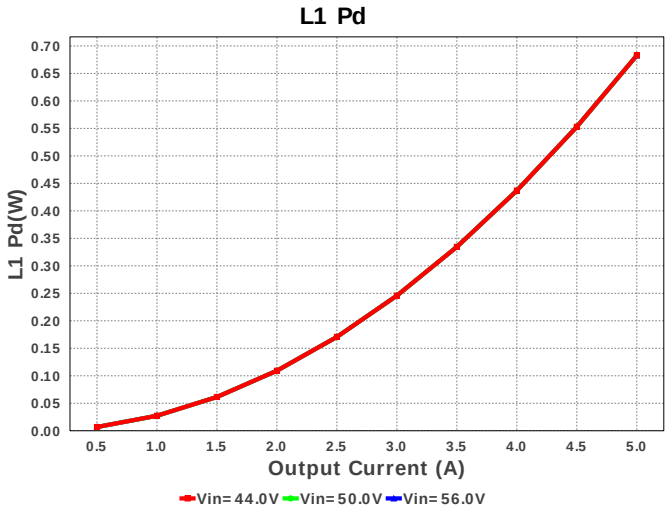


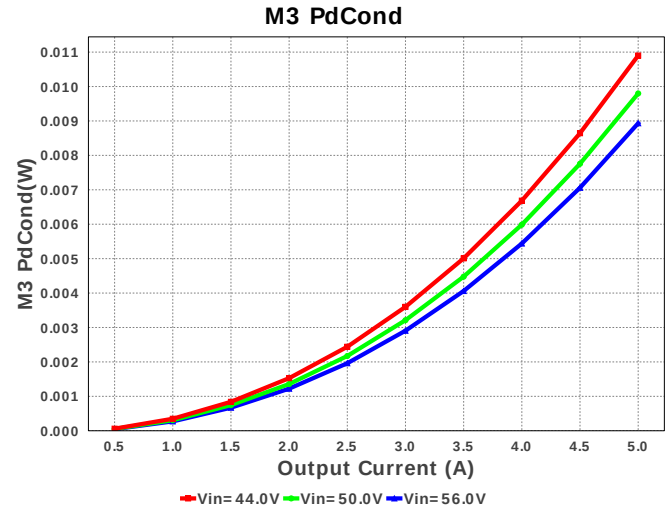


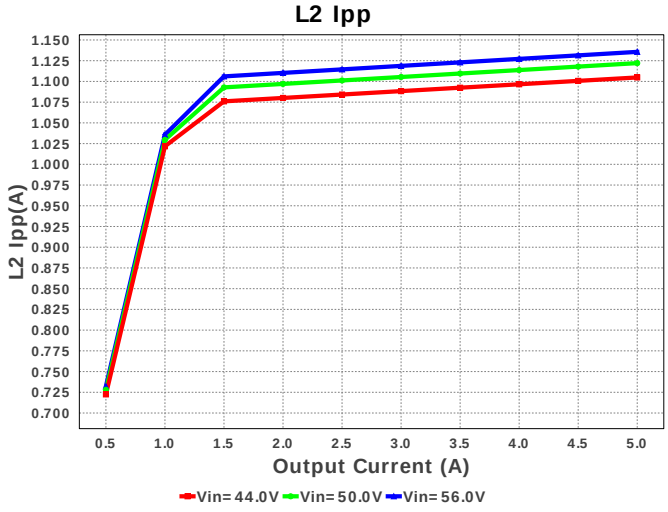


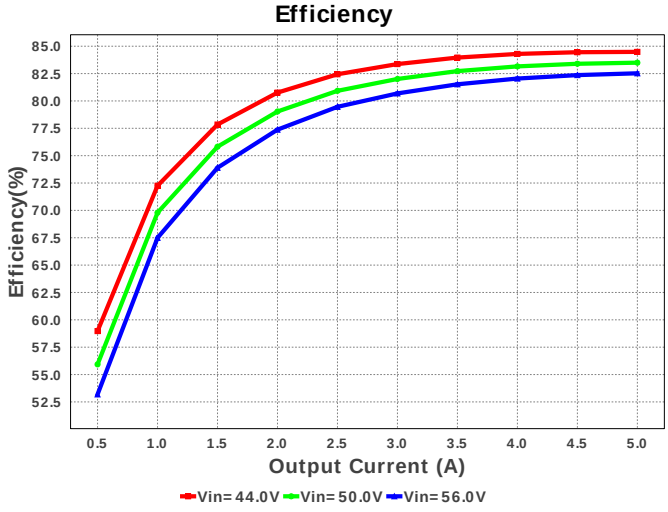


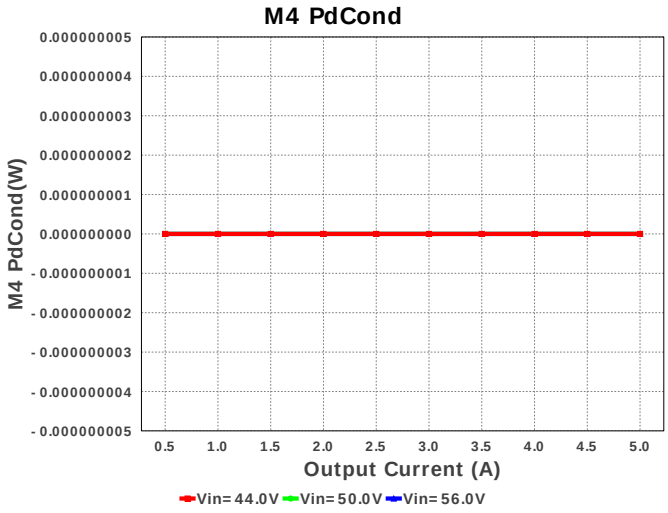


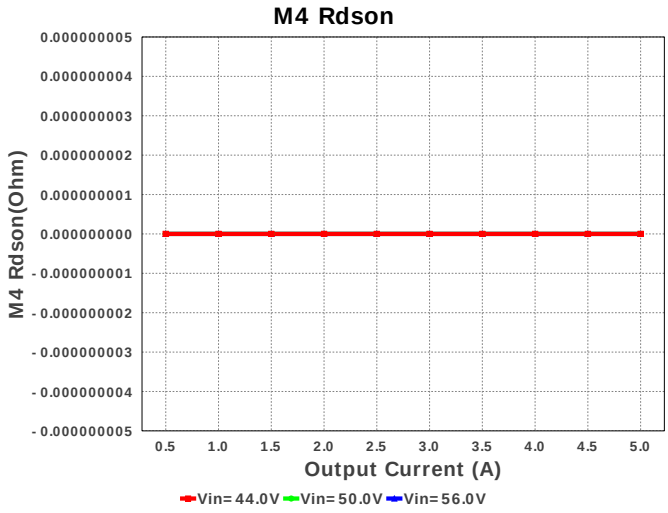


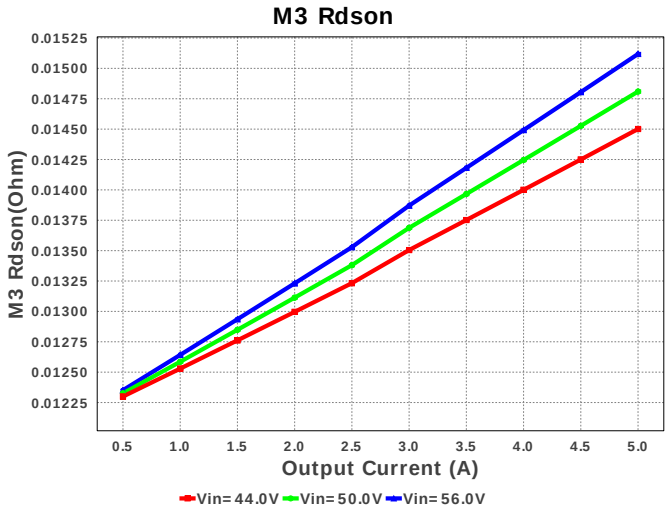


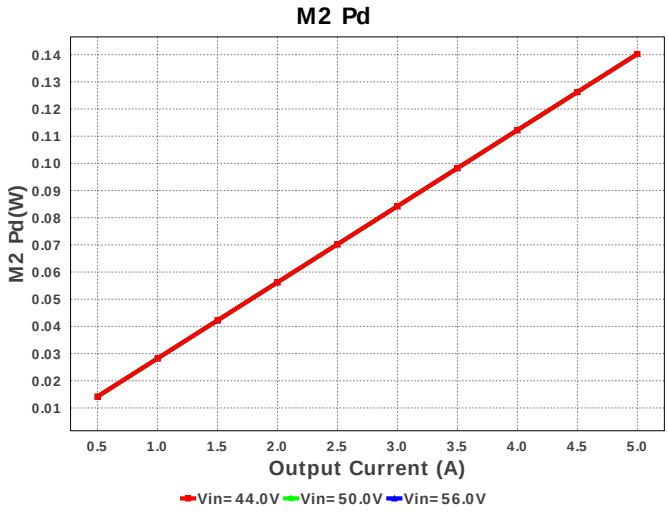


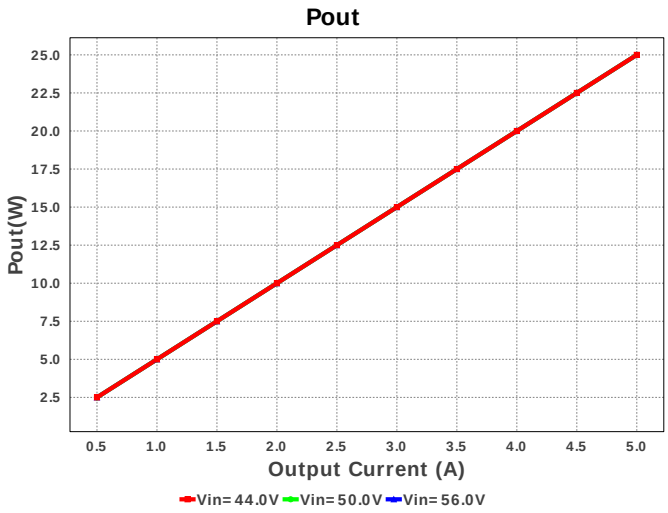


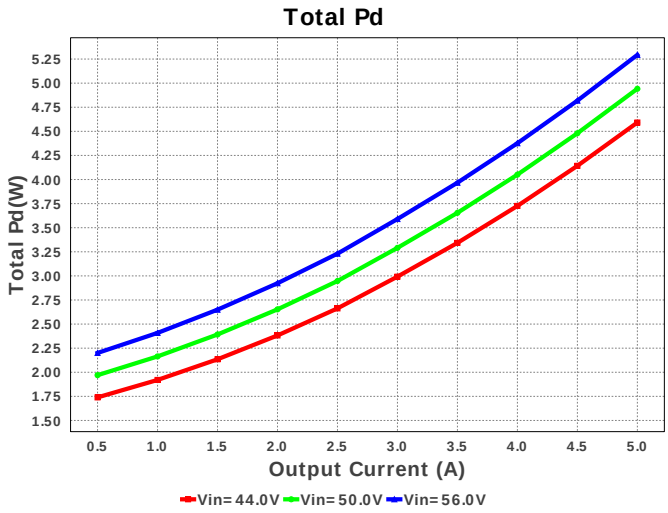


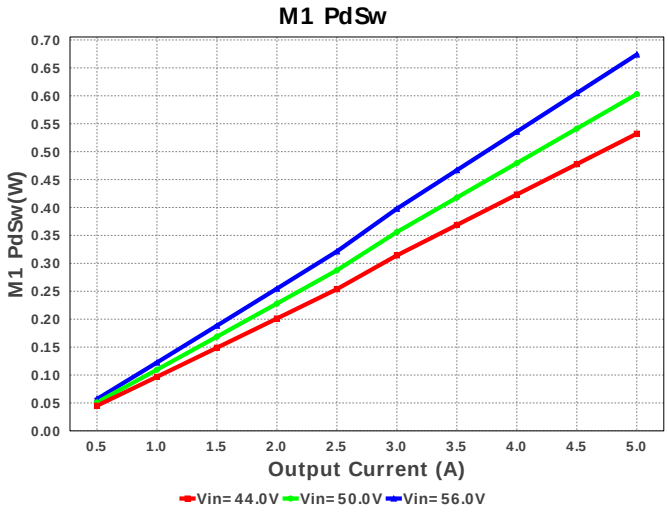


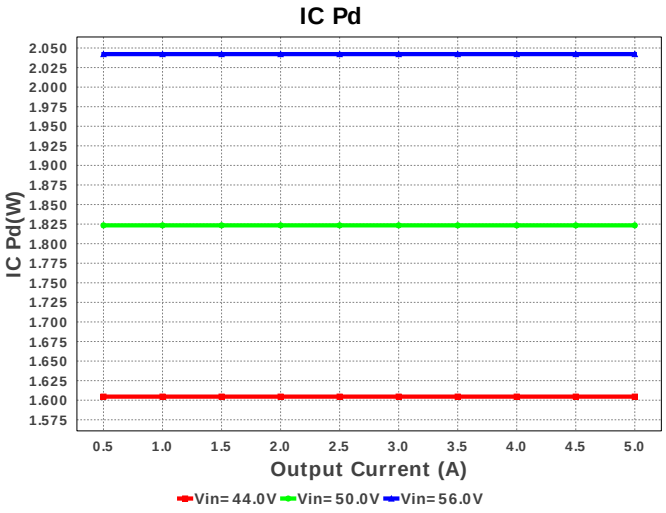


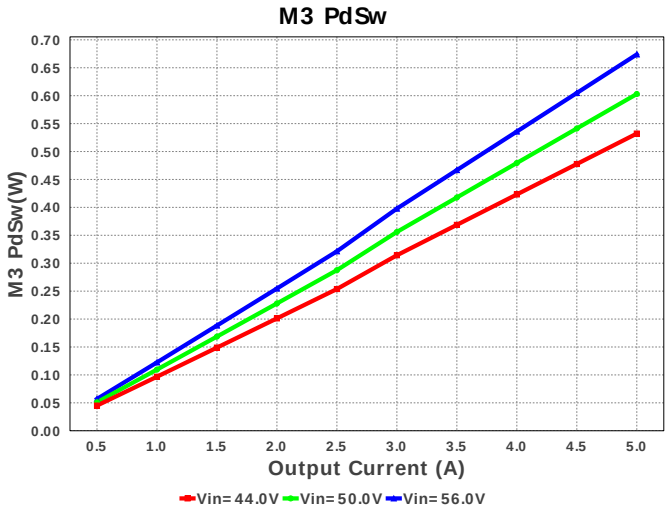


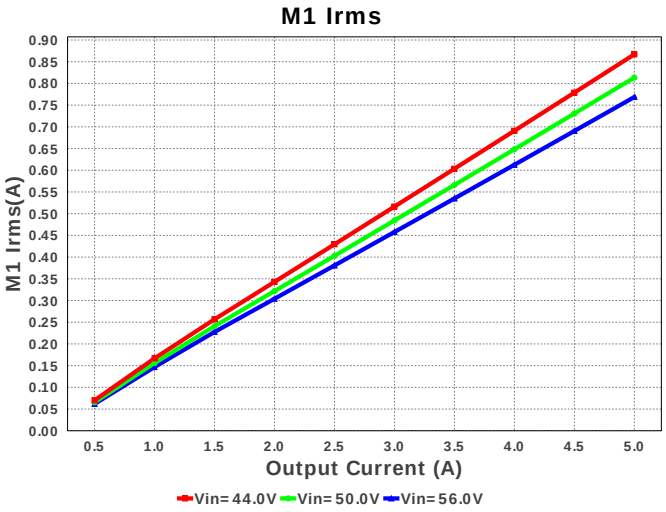


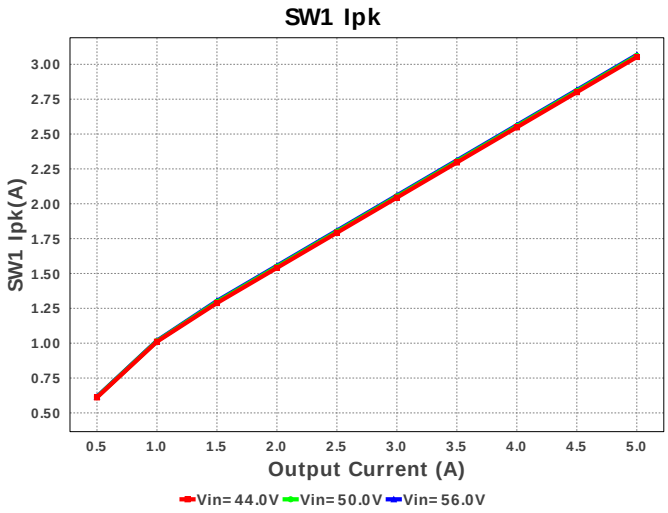


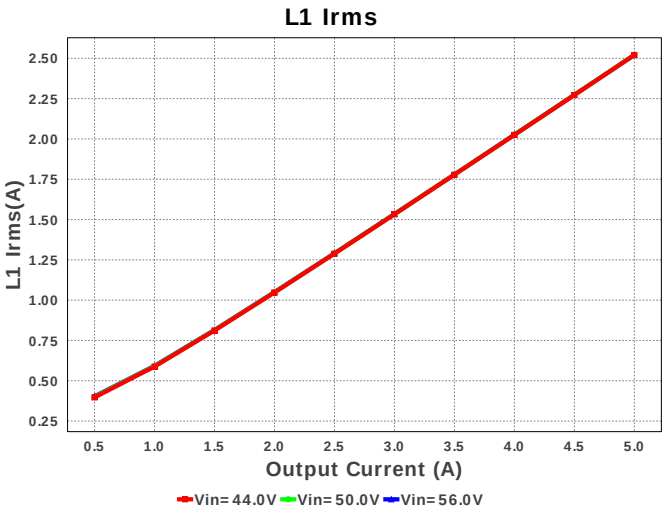


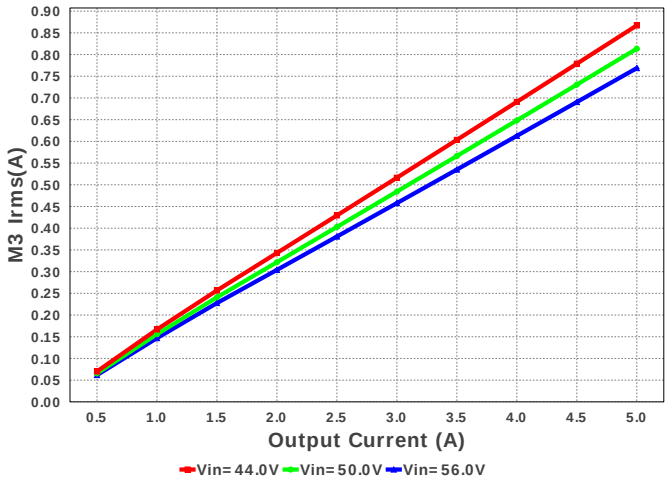


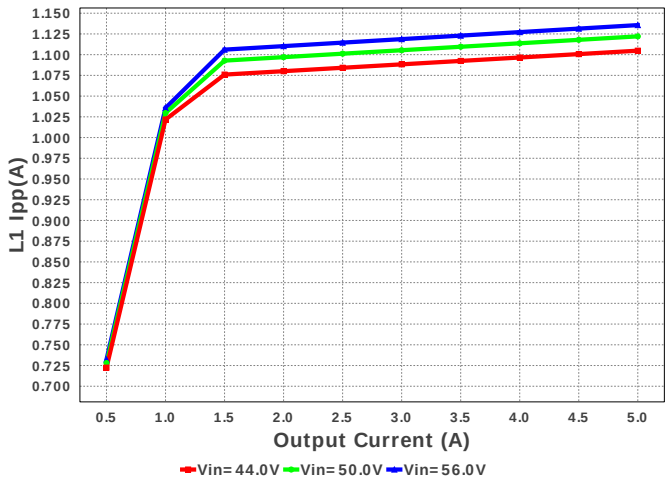


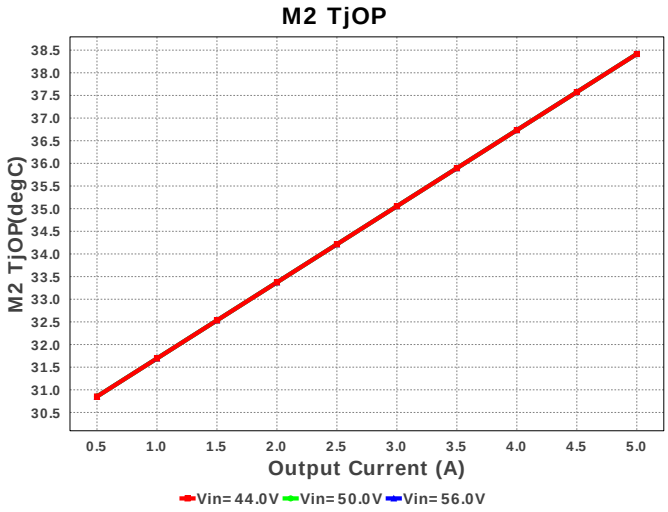


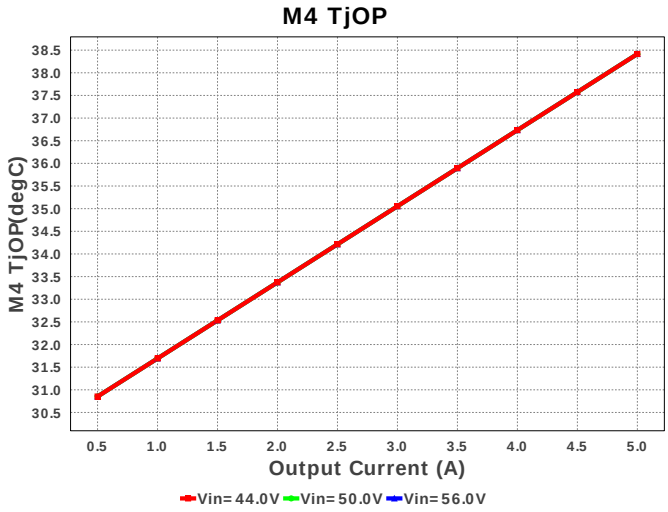


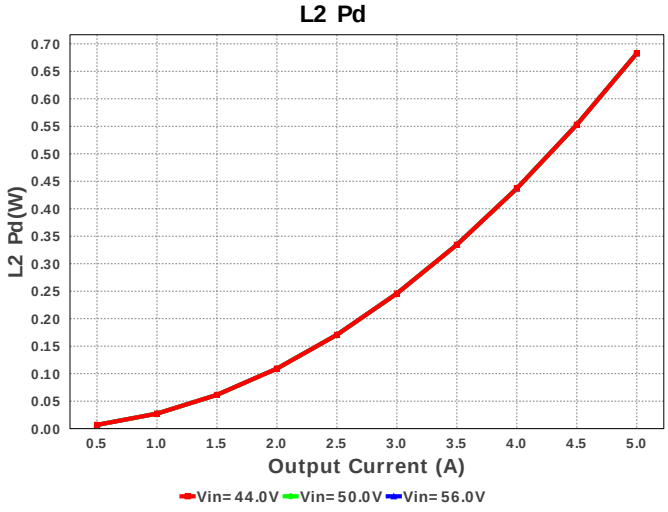


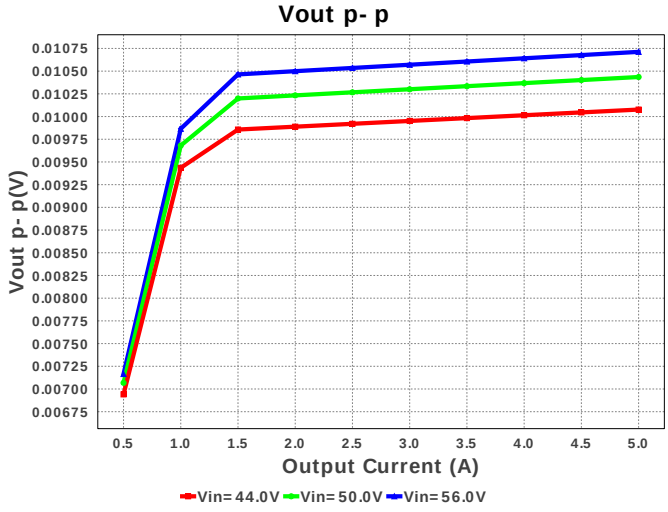


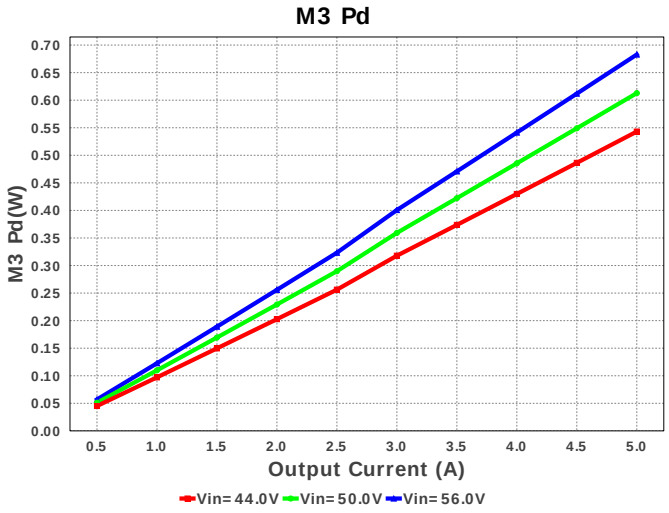


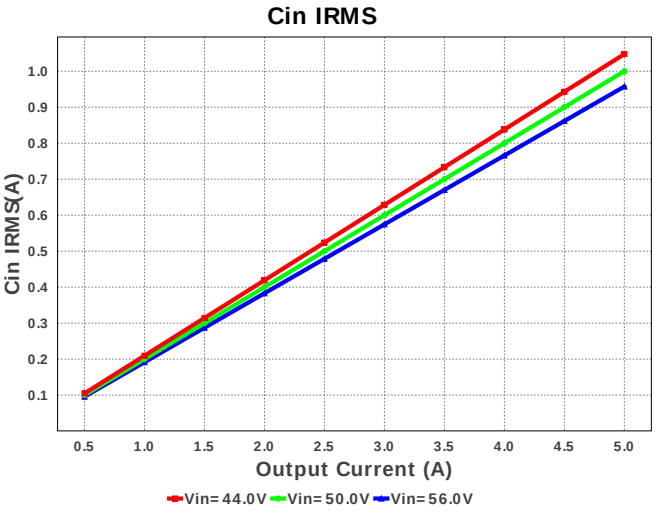












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	957.548 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	301.327 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	542.82 mA	Current	Average input current
4.	L1 Ipp	1.136 A	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	2.521 A	Current	Inductor ripple current
6.	L2Ipp	1.136 A	Current	Channel 2 Inductor Peak to peak Current
7.	L2 Irms	2.521 A	Current	Inductor ripple current
8.	M1 Irms	768.808 mA	Current	MOSFET RMS ripple current
9.	M2 Irms	2.379 A	Current	MOSFET RMS ripple current
10.	M3 Irms	768.682 mA	Current	MOSFET RMS ripple current
11.	M4 Irms	2.379 A	Current	MOSFET RMS ripple current
12.	SW1 Ipk	3.068 A	Current	Peak switch current
13.	SW2 Ipk	3.068 A	Current	Peak switch current
14.	BOM Count	37	General	Total Design BOM count
15.	FootPrint	1.291 k mm^2	General	Total Foot Print Area of BOM components
16.	Frequency	424.559 kHz	General	Switching frequency
17.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
18.	Mode	CCM	General	Conduction Mode
19.	Pout	25.009 W	General	Total output power
20.	Total BOM	$8.42	General	Total BOM Cost
21.	M3 TjOP	66.425 degC	Op_Point	M3 MOSFET junction temperature
22.	M4 TjOP	38.415 degC	Op_Point	M4 MOSFET junction temperature
23.	Vout Actual	5.002 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
24.	Vout OP	5.002 V	Op_Point	Operational Output Voltage
25.	Duty Cycle	9.457 %	Op_point	Duty cycle
26.	Efficiency	82.257 %	Op_point	Steady state efficiency
27.	IC Tj	111.688 degC	Op_point	IC junction temperature
28.	IOUT_OP	5.0 A	Op_point	Iout operating point
29.	M1 TjOP	66.425 degC	Op_point	M1 MOSFET junction temperature
30.	M2 TjOP	38.415 degC	Op_point	M2 MOSFET junction temperature
31.	VIN_OP	56.0 V	Op_point	Vin operating point
32.	Vout p-p	10.712 mV	Op_point	Peak-to-peak output ripple voltage
33.	Cin Pd	97.802 mW	Power	Input capacitor power dissipation
34.	Cout Pd	136.197 µW	Power	Output capacitor power dissipation
35.	IC Pd	2.042 W	Power	IC power dissipation
36.	L1 Pd	682.714 mW	Power	Inductor power dissipation
37.	L2 Pd	682.714 mW	Power	Inductor power dissipation
38.	M1 Pd	662.043 mW	Power	M1 MOSFET total power dissipation
39.	M1 PdCond	8.882 mW	Power	M1 MOSFET conduction losses
40.	M1 PdSw	653.161 mW	Power	M1 MOSFET switching losses
41.	M2 Pd	140.254 mW	Power	M2 MOSFET total power dissipation
42.	M2 PdCond	0.0 W	Power	M2 MOSFET conduction losses
43.	M2 PdSw	140.254 mW	Power	M2 MOSFET switching losses
44.	M3 Pd	662.044 mW	Power	M3 MOSFET total power dissipation
45.	M3 PdCond	8.879 mW	Power	M3 MOSFET conduction losses
46.	M3 PdSw	653.165 mW	Power	M3 MOSFET switching losses
47.	M1 Rdson	15.027 mOhm	Power	Drain-Source On-resistance
48.	M3 Rdson	15.027 mOhm	Power	Drain-Source On-resistance
49.	M4 Pd	140.254 mW	Power	M4 MOSFET total power dissipation
50.	M4 PdCond	0.0 W	Power	M4 MOSFET conduction losses
51.	M4 PdSw	140.254 mW	Power	M4 MOSFET switching losses
52.	M2 Rdson	0.0 Ohm	Power	Drain-Source On-resistance

#	Name	Value	Category	Description
53.	M4 Rdson	0.0 Ohm	Power	Drain-Source On-resistance
54.	Rsense1 Pd	141.473 mW	Power	Current Limit Sense Resistor Power Dissipation
55.	Rsense2 Pd	141.478 mW	Power	Current Limit Sense Resistor Power Dissipation
56.	Total Pd	5.393 W	Power	Total Power Dissipation
57.	Cross Freq Ch1	37.917 kHz		Bode plot crossover frequency
58.	Phase Marg Ch1	64.844 deg		Bode Plot Phase Margin
59.	Vout Tolerance	3.222 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	5.0	Maximum Output Current
2.	VinMax	56.0	Maximum input voltage
3.	VinMin	44.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM5119	Base Product 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. **LM5119** Product Folder : http://www.ti.com/product/LM5119 : contains the data sheet and other resources.