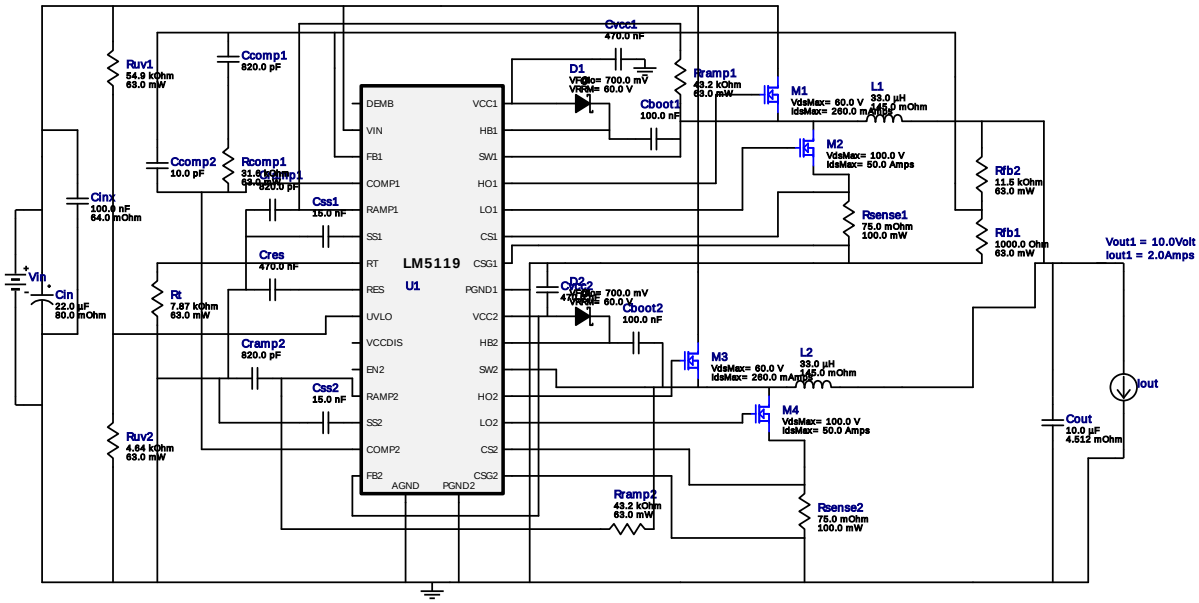
WEBENCH® Design Report

VinMin = 20.0V
VinMax = 40.0V
Vout = 10.0V
Iout = 2.0A

Device = LM5119PSQ/NOPB
Topology = Buck
Created = 8/9/16 2:03:45 AM
BOM Cost = $6.16
BOM Count = 33
Total Pd = 2.19W

Design : 4352199/71 LM5119PSQ/NOPB
LM5119PSQ/NOPB 20.0V-40.0V to 10.00V @ 2.0A



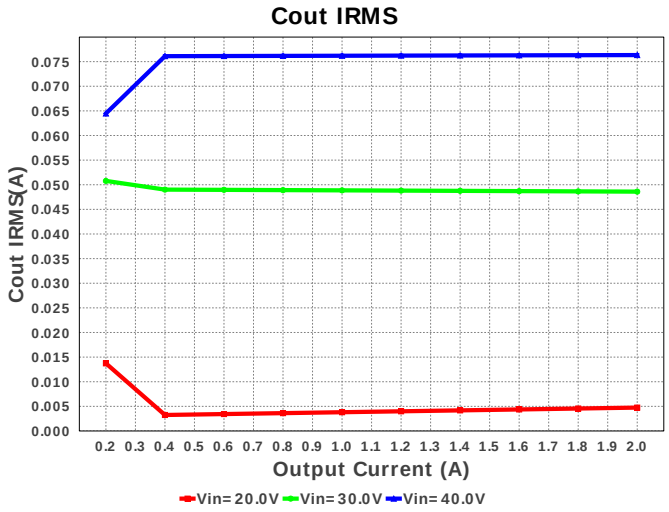
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

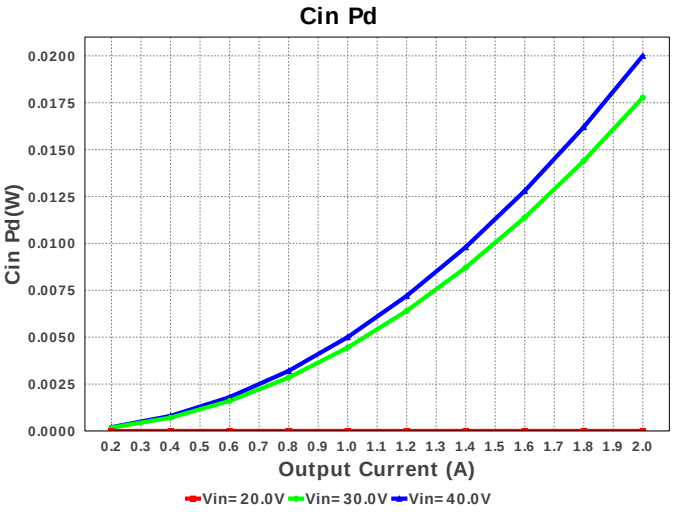
Electrical BOM

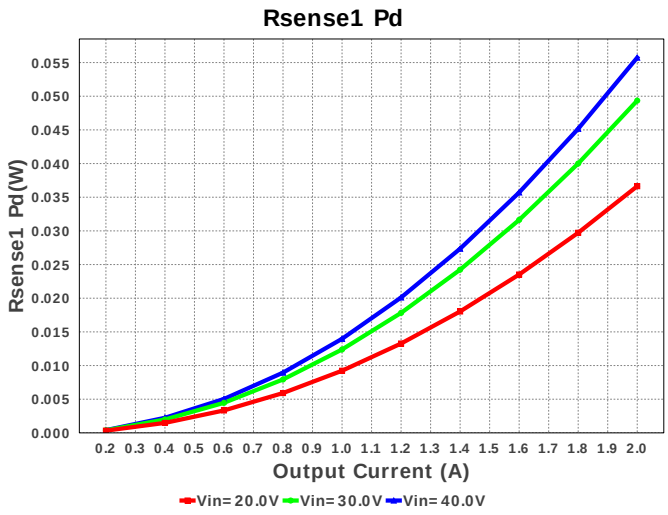
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Cboot2	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Ccomp1	MuRata	GRM033R71E821KA01D Series= X7R	Cap= 820.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
4.	Ccomp2	Samsung Electro-Mechanics	CL02C100JO2ANNC Series= C0G/NP0	Cap= 10.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	01005 2 mm^2
5.	Cin	Panasonic	EEHZA1J220XP Series= ?	Cap= 22.0 uF ESR= 80.0 mOhm VDC= 63.0 V IRMS= 1.5 A	1	$0.88	SM_RADIAL_6.3BMM 80 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
7.	Cout	MuRata	GRM31CR61E106KA12L Series= X5R	Cap= 10.0 uF ESR= 4.512 mOhm VDC= 25.0 V IRMS= 2.447 A	1	$0.05	1206_190 11 mm^2

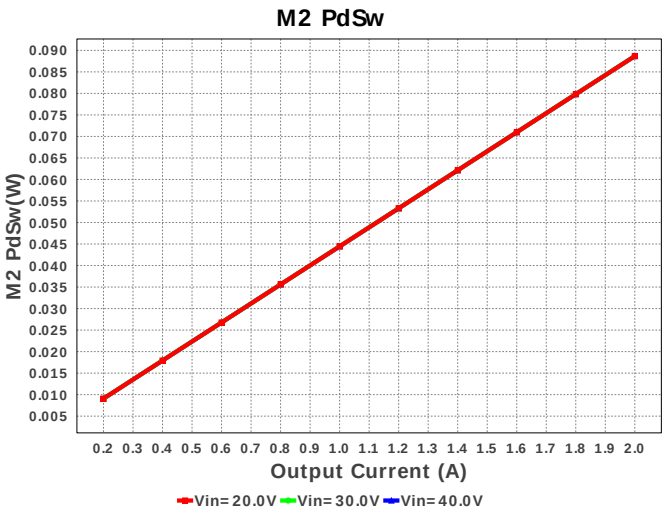
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cramp1	MuRata	GRM033R71E821KA01D Series= X7R	Cap= 820.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0201 2 mm²
9.	Cramp2	MuRata	GRM033R71E821KA01D Series= X7R	Cap= 820.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0201 2 mm²
10.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
11.	Css1	MuRata	GRM033R60J153KE01D Series= X5R	Cap= 15.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0201 2 mm²
12.	Css2	MuRata	GRM033R60J153KE01D Series= X5R	Cap= 15.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0201 2 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.	B160-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.06	 SMA 37 mm²
16.	D2	Diodes Inc.	B160-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.06	 SMA 37 mm²
17.	L1	Bourns	SRN8040-330M	L= 33.0 µH DCR= 145.0 mOhm	1	$0.22	 SRN8040 100 mm²
18.	L2	Bourns	SRN8040-330M	L= 33.0 µH DCR= 145.0 mOhm	1	$0.22	 SRN8040 100 mm²
19.	M1	ON Semiconductor	2N7002ET1G	VdsMax= 60.0 V IdsMax= 260.0 mAmps	1	$0.02	 SOT-23 14 mm²
20.	M2	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.50	 TRANS_NexFET_Q3 18 mm²
21.	M3	ON Semiconductor	2N7002ET1G	VdsMax= 60.0 V IdsMax= 260.0 mAmps	1	$0.02	 SOT-23 14 mm²
22.	M4	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.50	 TRANS_NexFET_Q3 18 mm²
23.	Rcomp1	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
25.	Rfb2	Vishay-Dale	CRCW040211K5FKED Series= CRCW..e3	Res= 11.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
26.	Rramp1	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

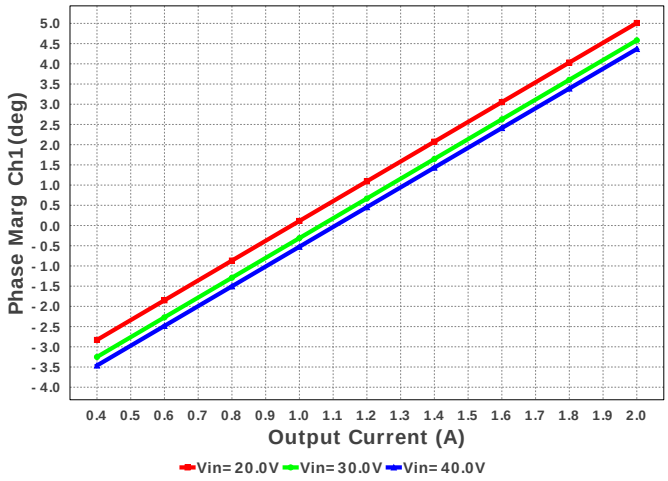
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rramp2	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
28.	Rsense1	Panasonic	ERJ-L03UF75MV Series= ERJ-L03	Res= 75.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.09	0603 5 mm²
29.	Rsense2	Panasonic	ERJ-L03UF75MV Series= ERJ-L03	Res= 75.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.09	0603 5 mm²
30.	Rt	Vishay-Dale	CRCW04027K87FKED Series= CRCW..e3	Res= 7.87 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	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 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

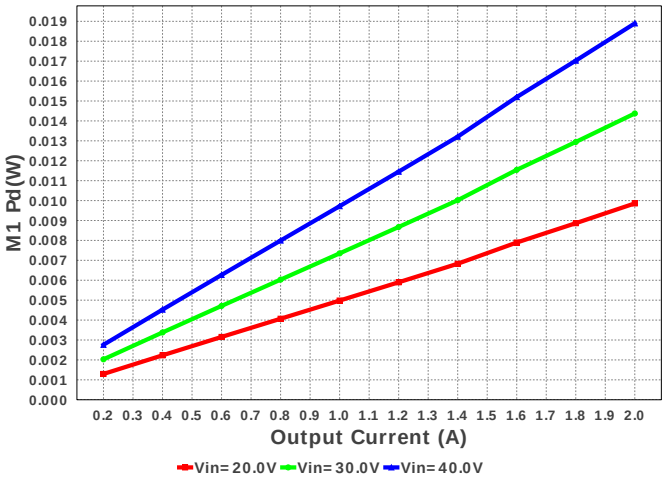


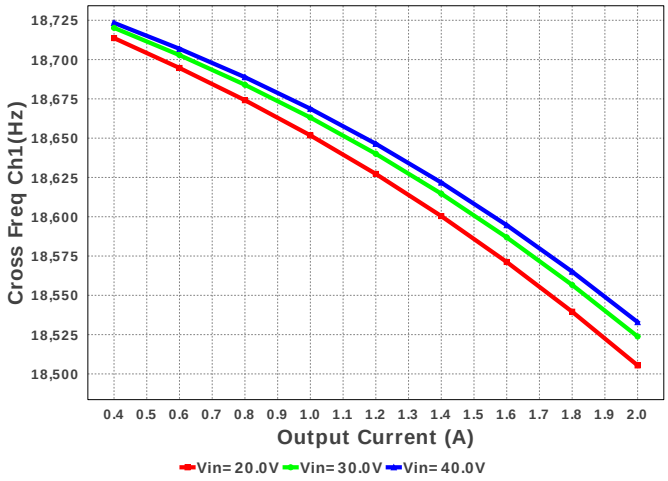


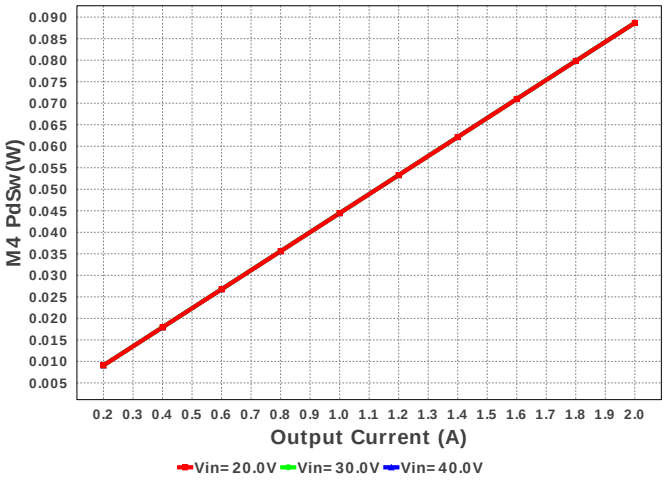


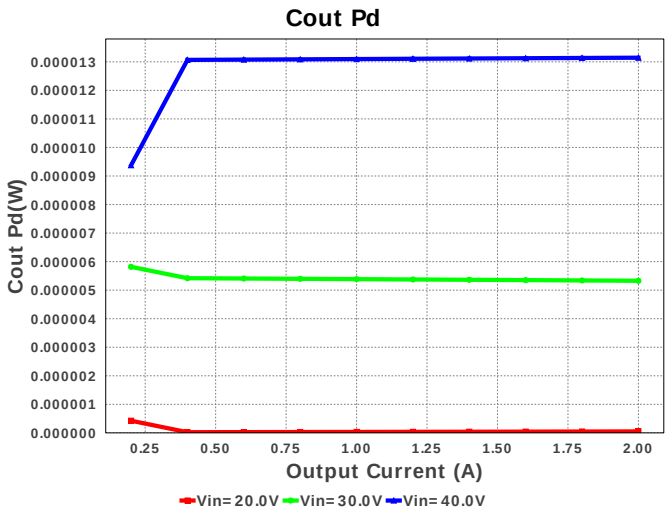


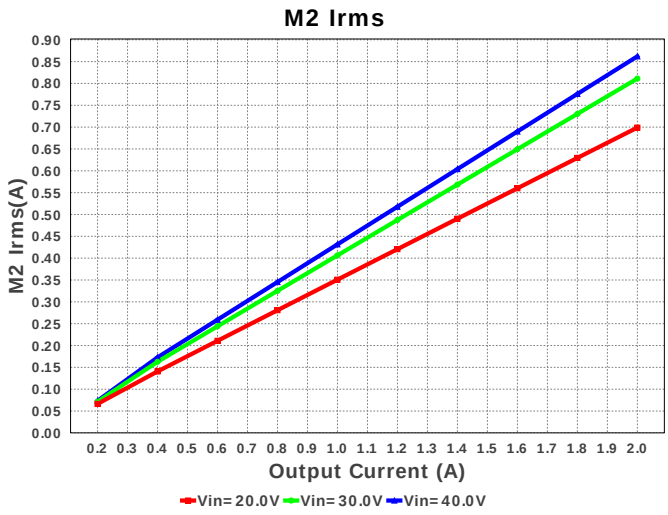


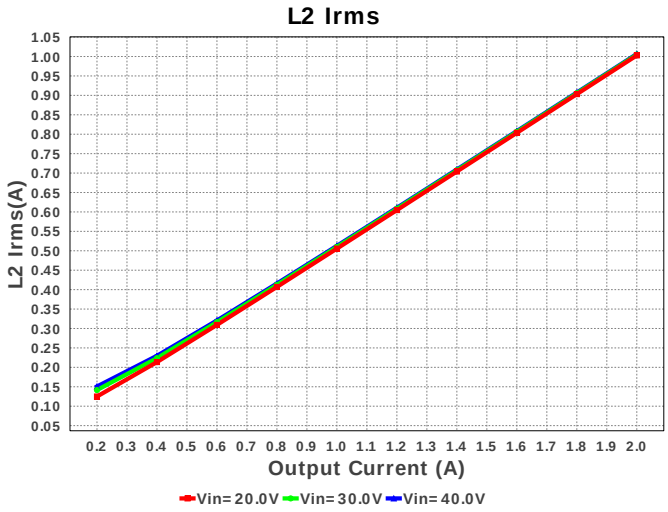


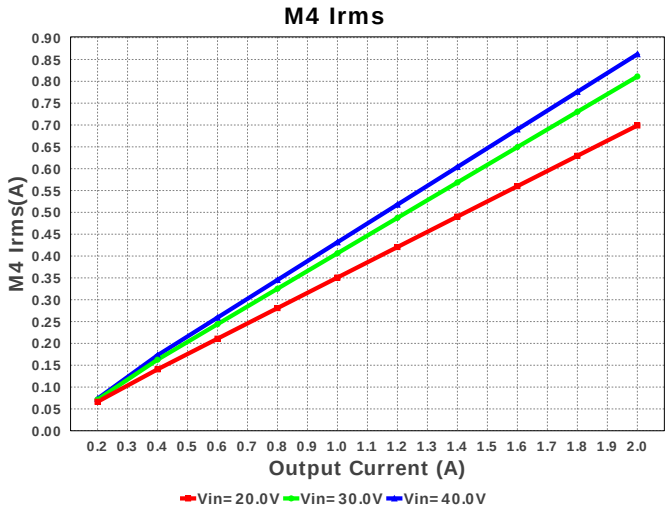


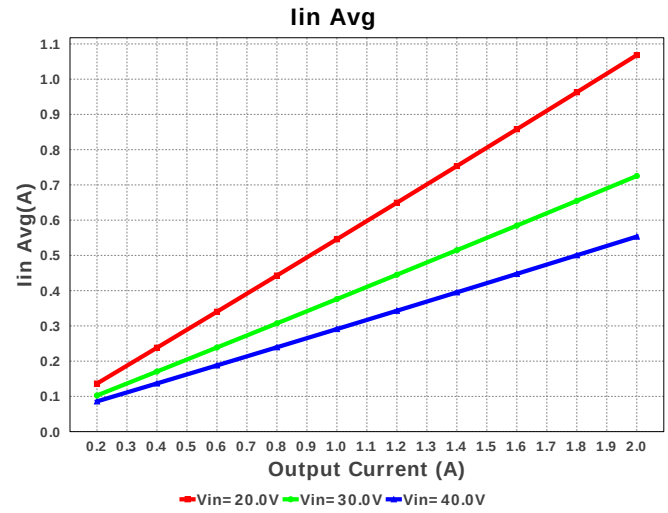


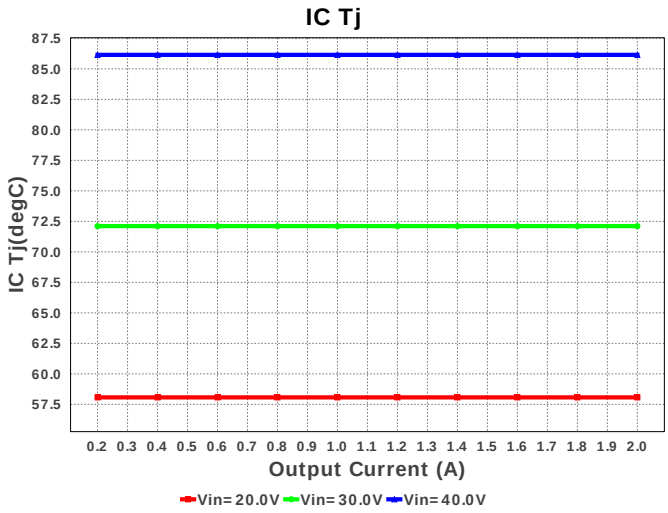


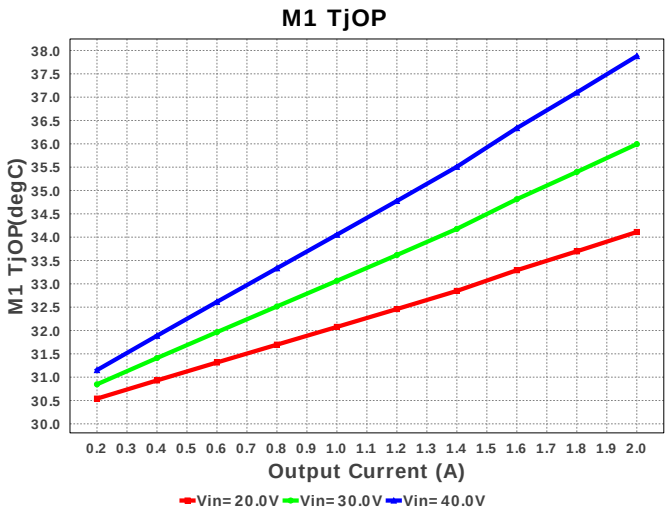


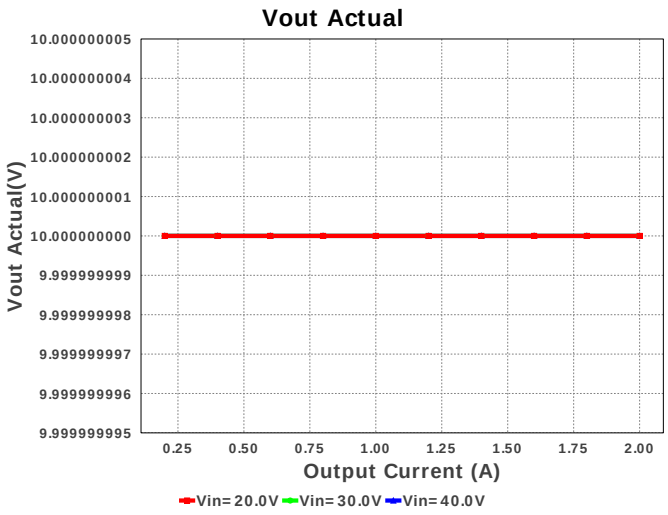


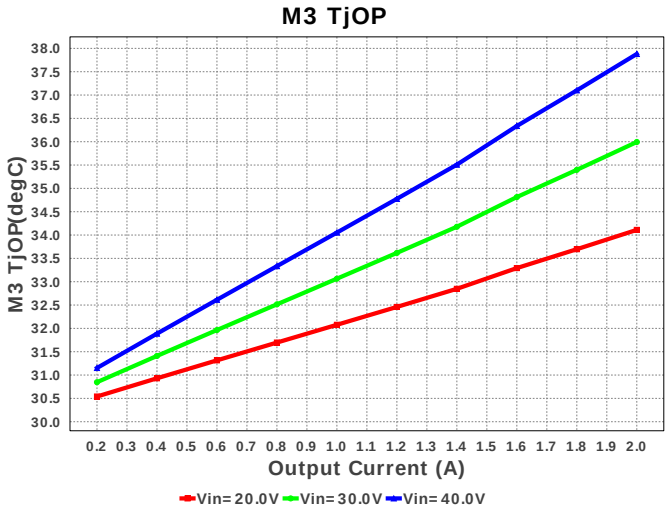


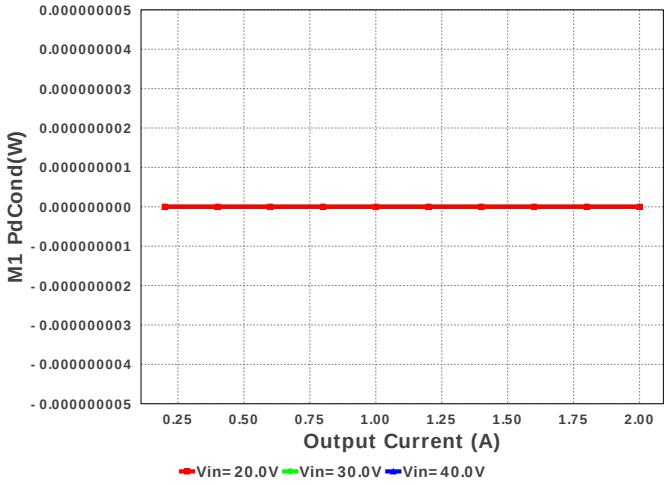


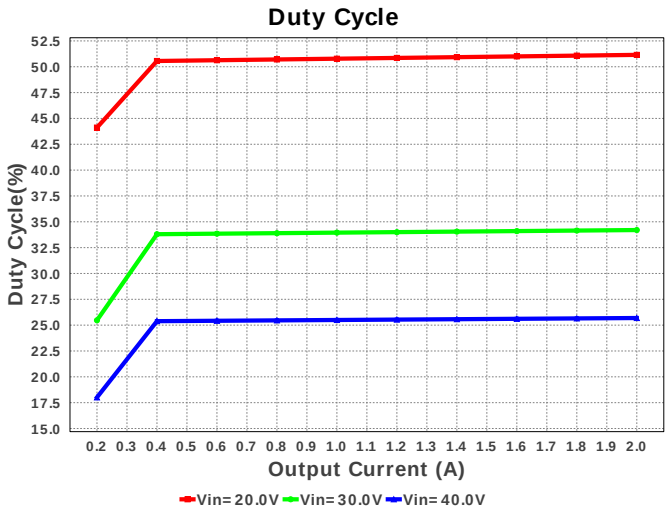


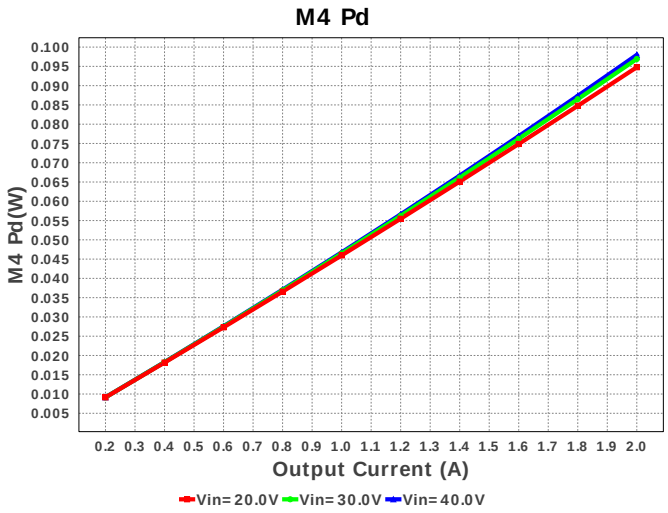


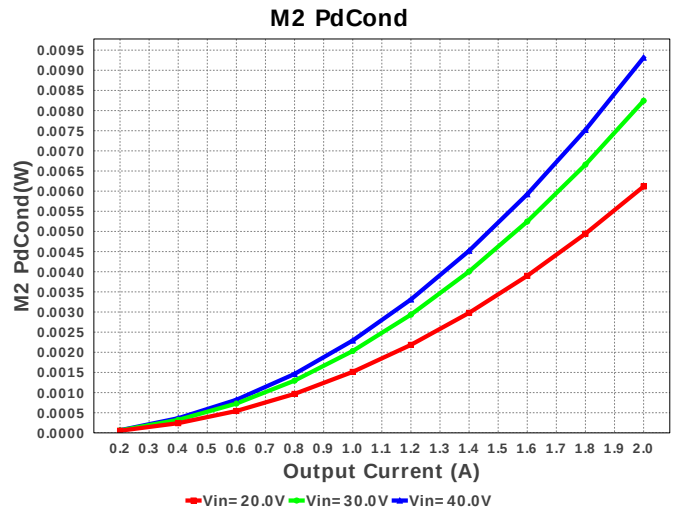


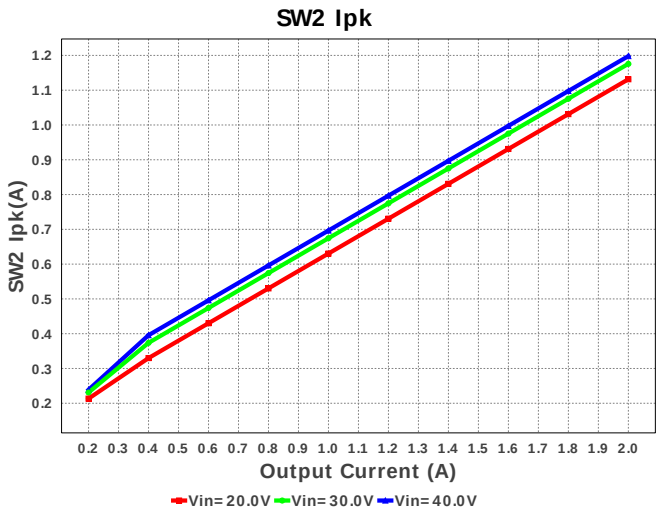


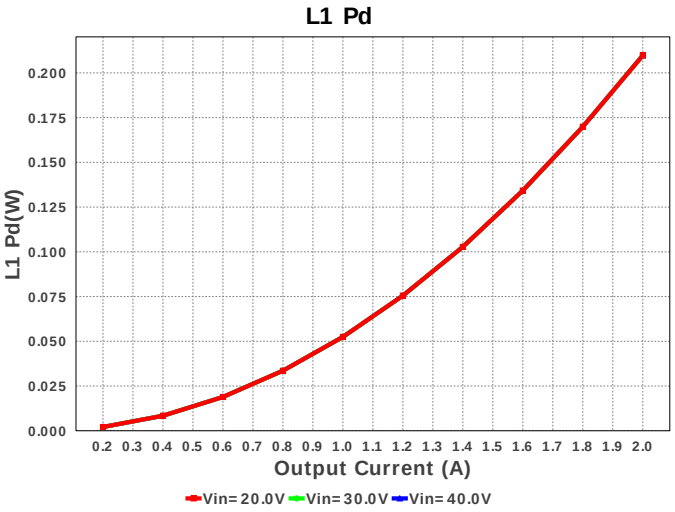


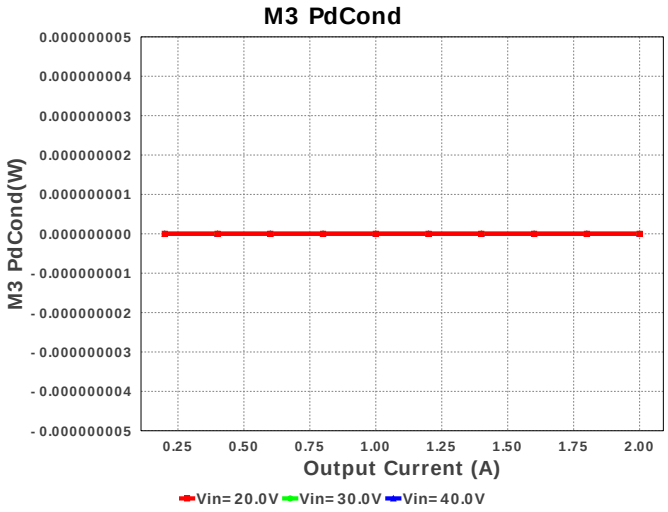


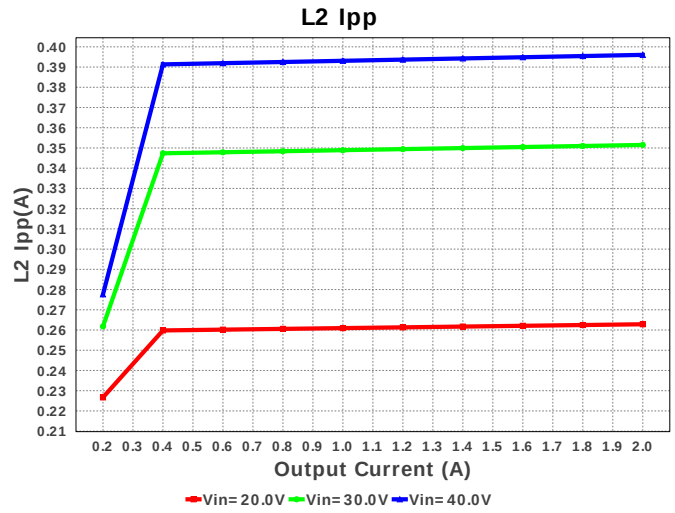


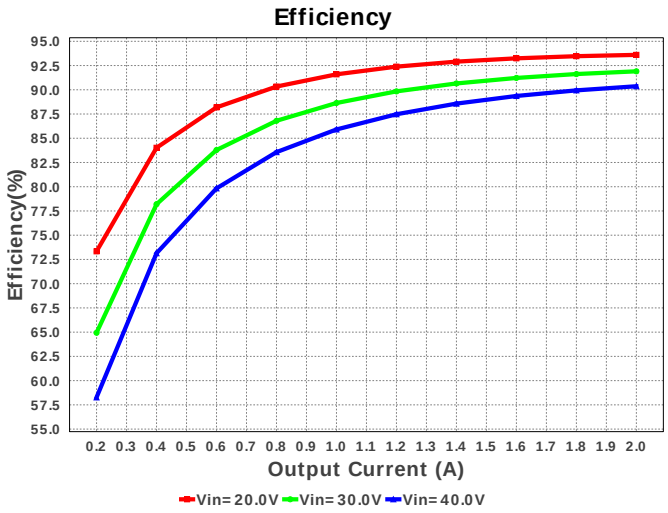


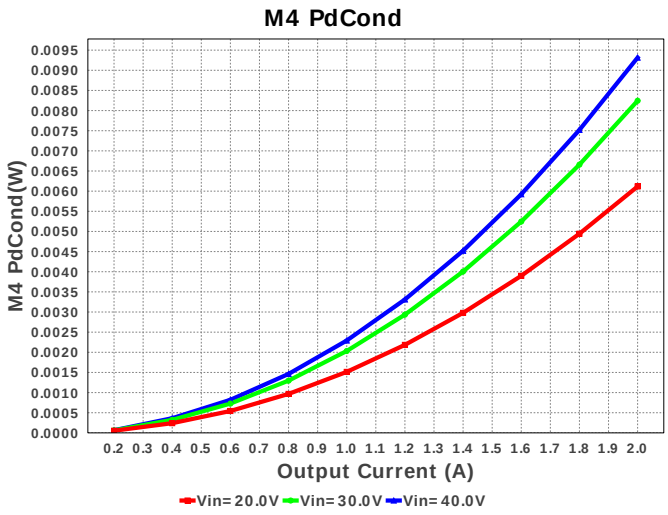


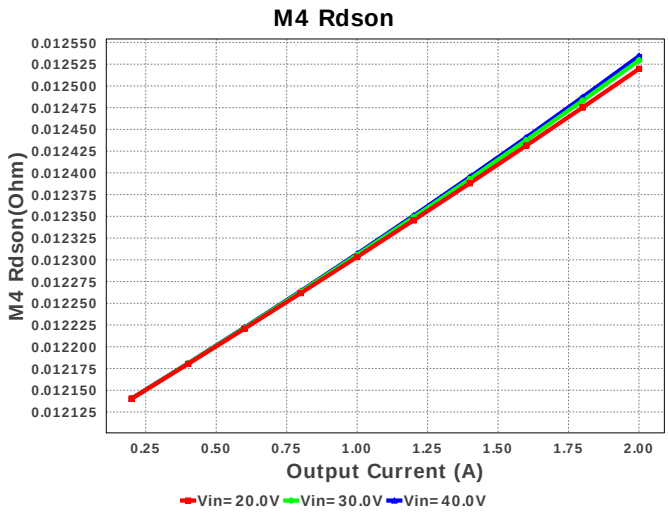


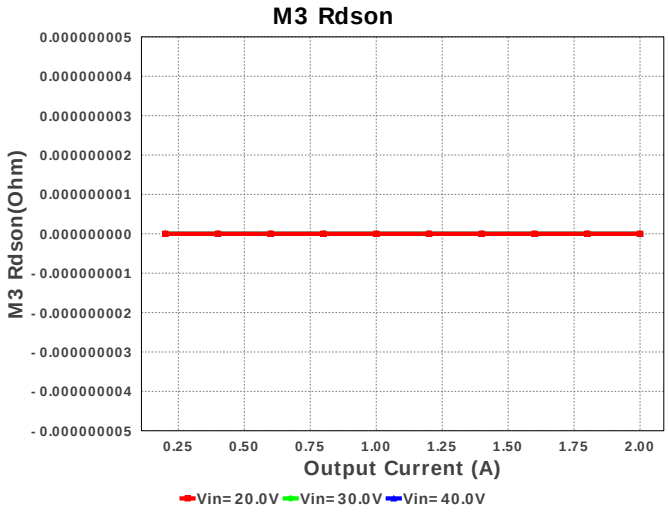


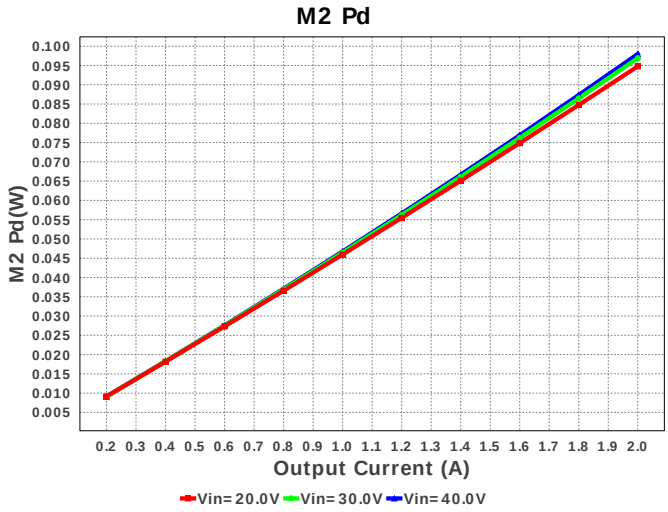


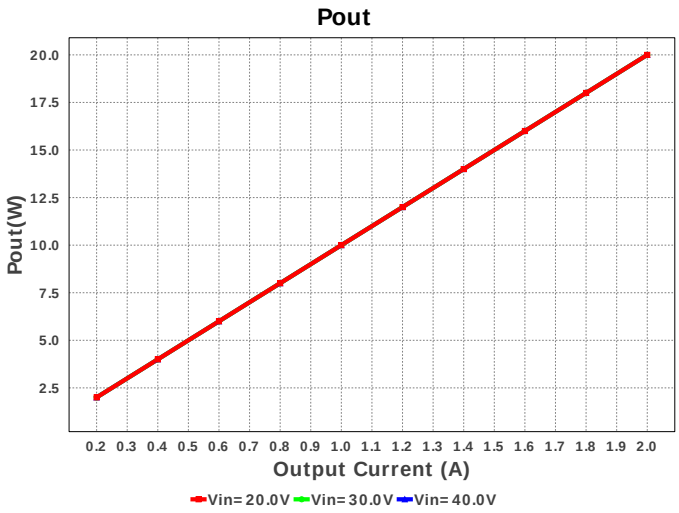


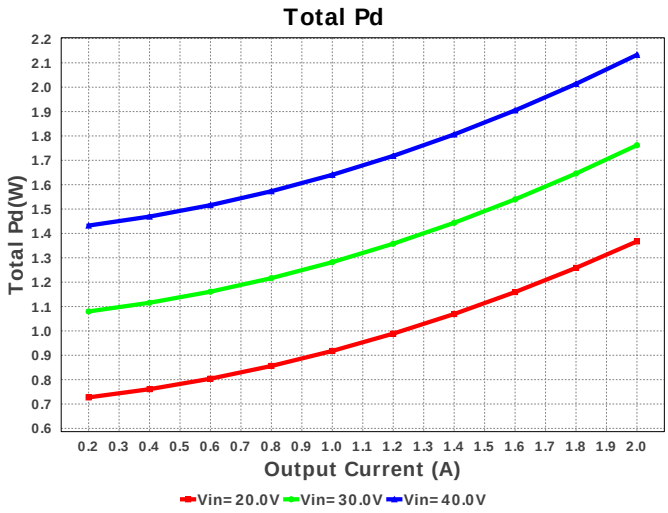


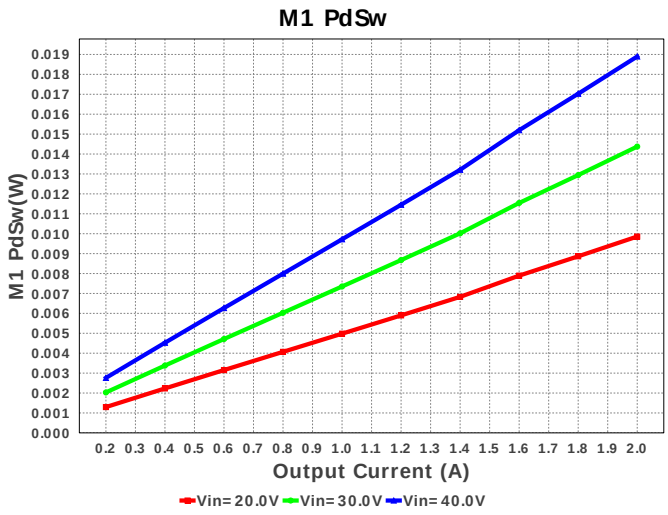


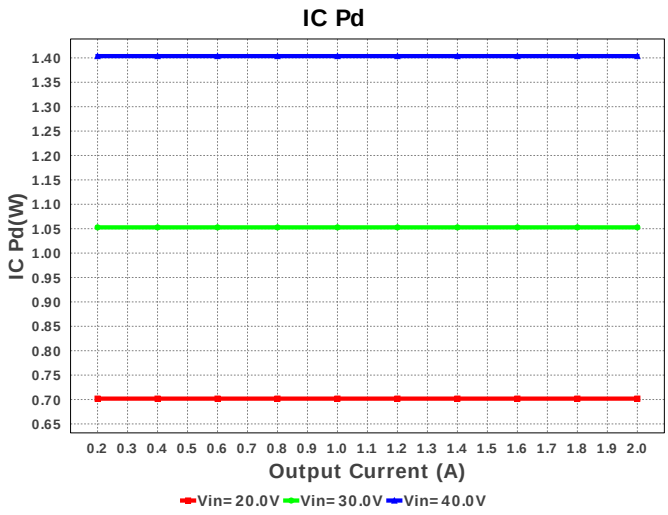


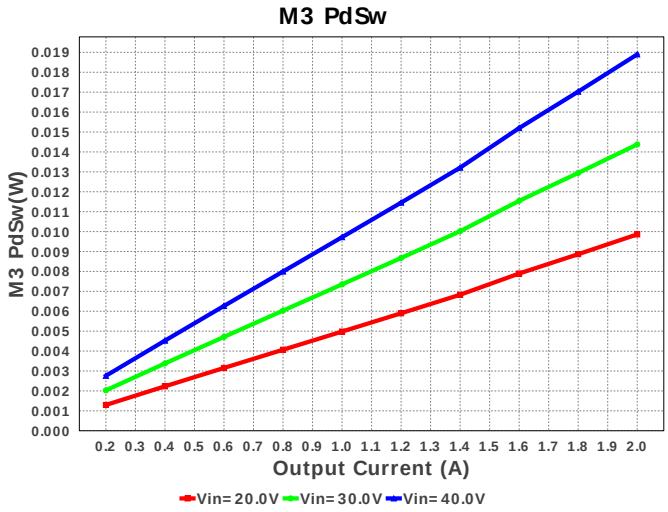


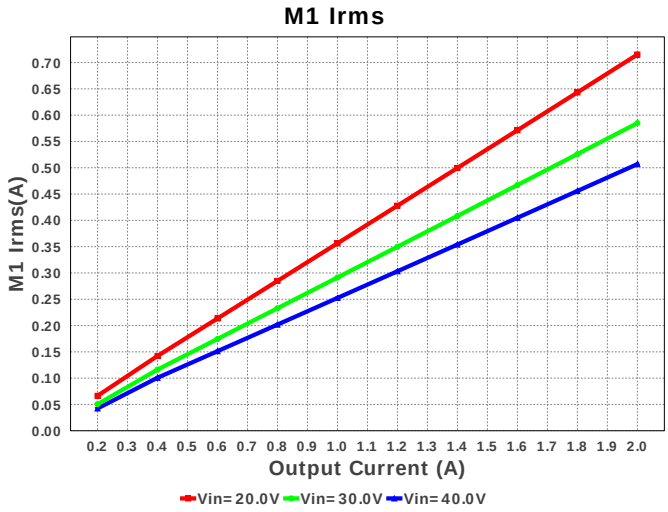


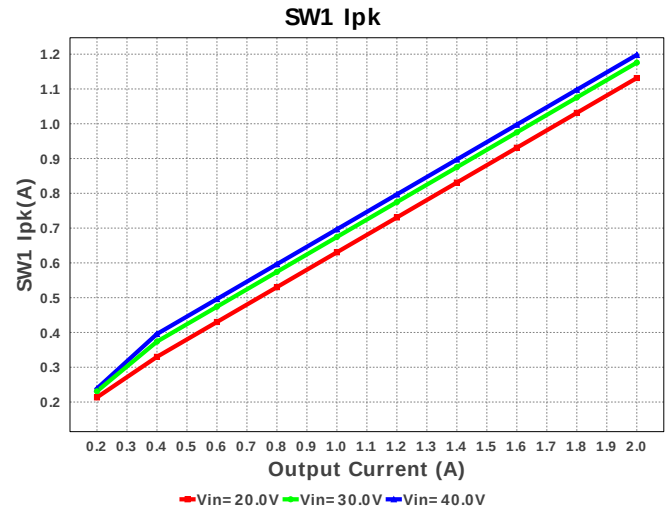


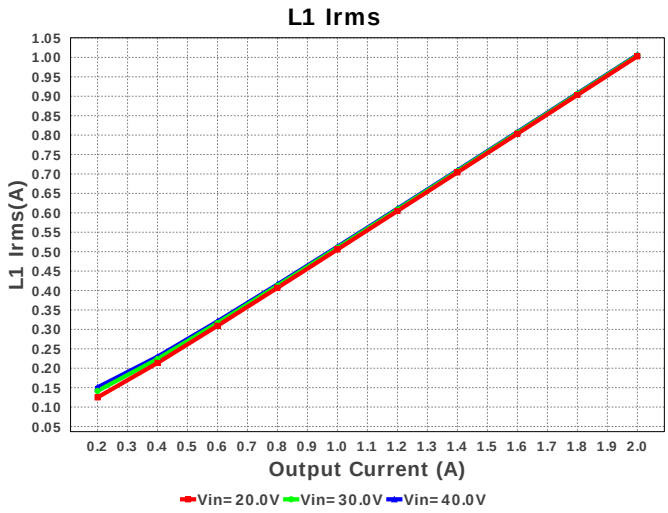


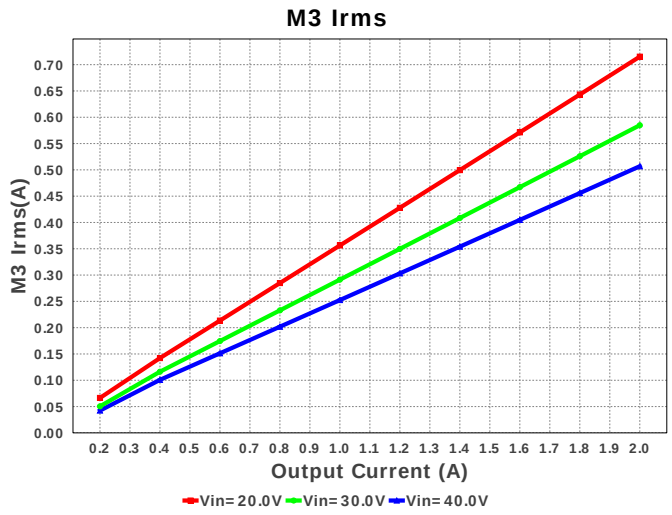


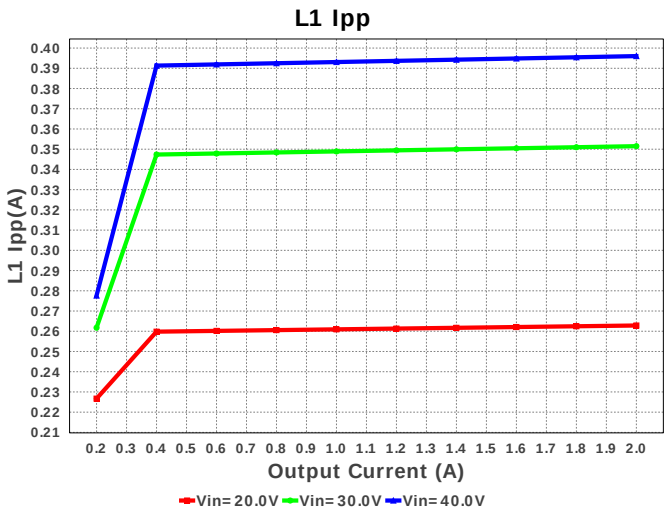


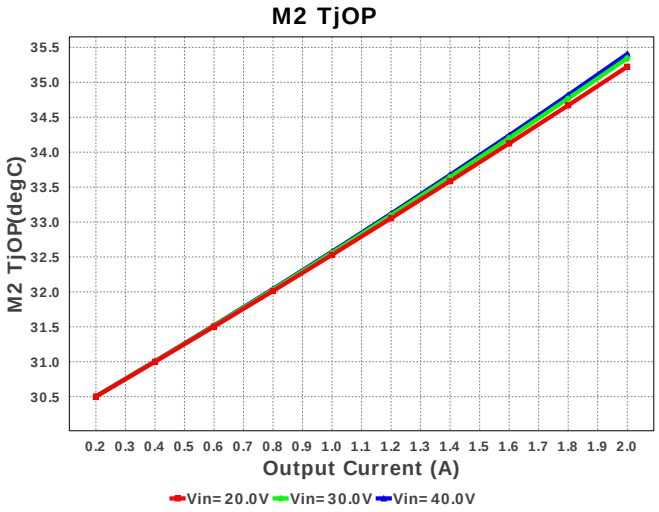


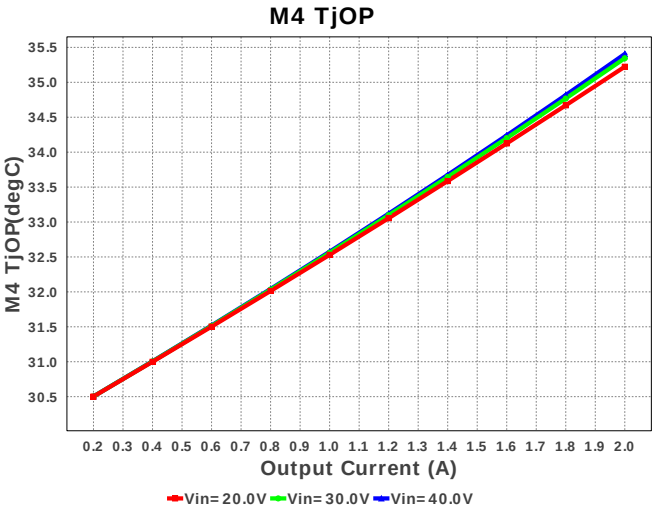


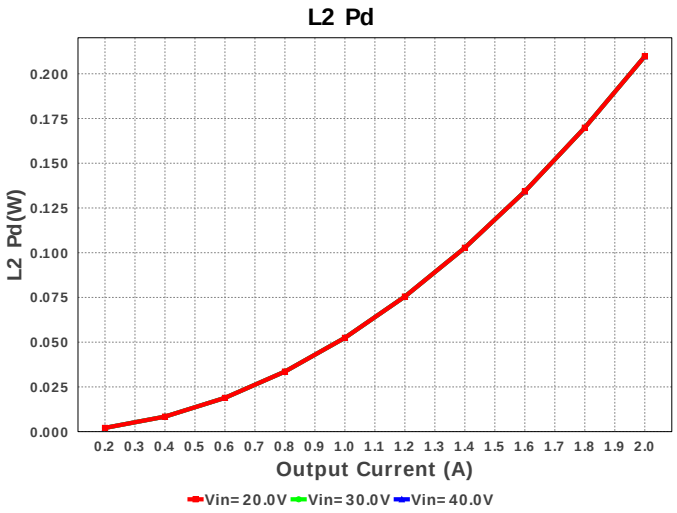


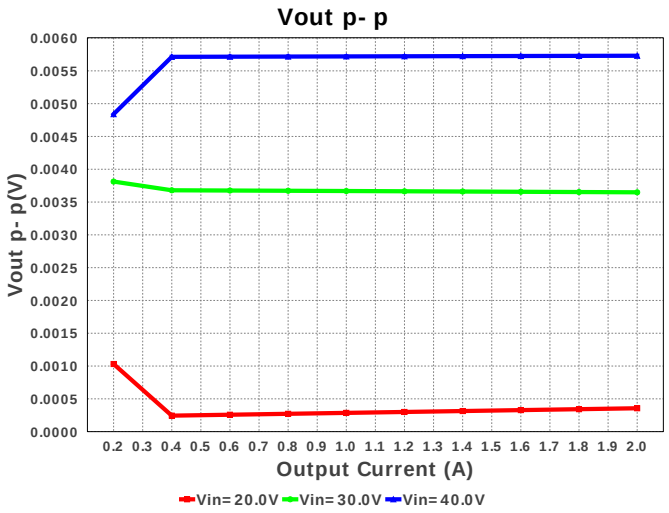


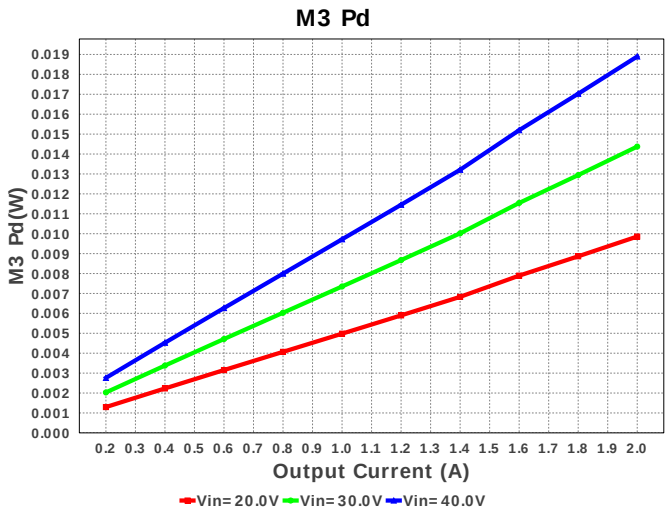


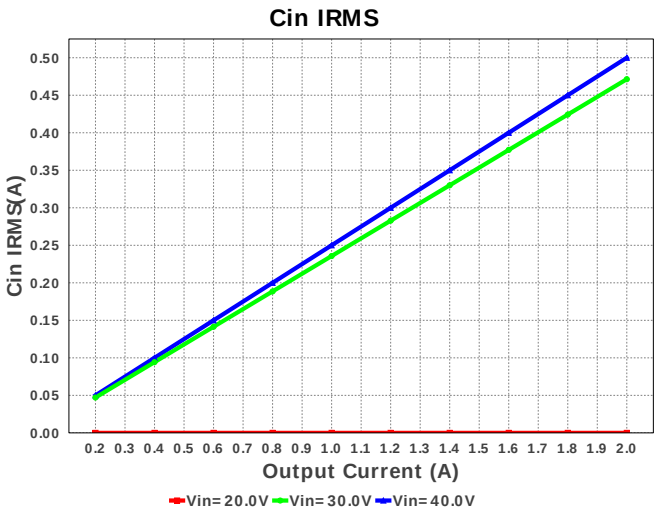












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	500.0 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	76.332 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	554.69 mA	Current	Average input current
4.	L1 Ipp	396.029 mA	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	1.007 A	Current	Inductor ripple current
6.	L2 Ipp	396.029 mA	Current	Inductor 2 peak to peak current
7.	L2 Irms	1.007 A	Current	Inductor ripple current
8.	M1 Irms	506.846 mA	Current	MOSFET RMS ripple current
9.	M2 Irms	862.036 mA	Current	MOSFET RMS ripple current
10.	M3 Irms	506.846 mA	Current	MOSFET RMS ripple current
11.	M4 Irms	862.036 mA	Current	MOSFET RMS ripple current
12.	SW1 Ipk	1.198 A	Current	Peak switch current
13.	SW2 Ipk	1.198 A	Current	Peak switch current
14.	BOM Count	33	General	Total Design BOM count
15.	FootPrint	547.0 mm^2	General	Total Foot Print Area of BOM components
16.	Frequency	589.703 kHz	General	Switching frequency
17.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
18.	Pout	20.0 W	General	Total output power
19.	Total BOM	$6.16	General	Total BOM Cost
20.	M3 TjOP	37.69 degC	Op_Point	M3 MOSFET junction temperature
21.	M4 TjOP	35.406 degC	Op_Point	M4 MOSFET junction temperature
22.	Vout Actual	10.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	10.0 V	Op_Point	Operational Output Voltage
24.	Duty Cycle	25.689 %	Op_point	Duty cycle
25.	Efficiency	90.141 %	Op_point	Steady state efficiency
26.	IC Tj	86.146 degC	Op_point	IC junction temperature
27.	IOUT_OP	2.0 A	Op_point	Iout operating point
28.	M1 TjOP	37.69 degC	Op_point	M1 MOSFET junction temperature
29.	M2 TjOP	35.406 degC	Op_point	M2 MOSFET junction temperature
30.	VIN_OP	40.0 V	Op_point	Vin operating point
31.	Vout p-p	5.731 mV	Op_point	Peak-to-peak output ripple voltage
32.	Cin Pd	20.0 mW	Power	Input capacitor power dissipation
33.	Cout Pd	13.145 µW	Power	Output capacitor power dissipation
34.	IC Pd	1.404 W	Power	IC power dissipation
35.	L1 Pd	209.752 mW	Power	Inductor power dissipation
36.	L2 Pd	209.752 mW	Power	Inductor power dissipation
37.	M1 Pd	18.442 mW	Power	M1 MOSFET total power dissipation
38.	M1 PdCond	0.0 W	Power	M1 MOSFET conduction losses
39.	M1 PdSw	18.442 mW	Power	M1 MOSFET switching losses
40.	M2 Pd	97.984 mW	Power	M2 MOSFET total power dissipation
41.	M2 PdCond	9.314 mW	Power	M2 MOSFET conduction losses
42.	M2 PdSw	88.67 mW	Power	M2 MOSFET switching losses
43.	M3 Pd	18.442 mW	Power	M3 MOSFET total power dissipation
44.	M3 PdCond	0.0 W	Power	M3 MOSFET conduction losses
45.	M3 PdSw	18.442 mW	Power	M3 MOSFET switching losses
46.	M3 Rdson	0.0 Ohm	Power	Drain-Source On-resistance
47.	M3 Rdson	0.0 Ohm	Power	Drain-Source On-resistance
48.	M4 Pd	97.984 mW	Power	M4 MOSFET total power dissipation
49.	M4 PdCond	9.314 mW	Power	M4 MOSFET conduction losses
50.	M4 PdSw	88.67 mW	Power	M4 MOSFET switching losses
51.	M4 Rdson	12.534 mOhm	Power	Drain-Source On-resistance
52.	M4 Rdson	12.534 mOhm	Power	Drain-Source On-resistance

#	Name	Value	Category	Description
53.	Rsense1 Pd	55.733 mW	Power	Current Limit Sense Resistor Power Dissipation
54.	Rsense2 Pd	55.733 mW	Power	Current Limit Sense Resistor Power Dissipation
55.	Total Pd	2.188 W	Power	Total Power Dissipation
56.	Cross Freq Ch1	54.598 kHz		Bode plot crossover frequency
57.	Phase Marg Ch1	59.279 deg		Bode Plot Phase Margin
58.	Vout Tolerance	3.386 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	40.0	Maximum input voltage
3.	VinMin	20.0	Minimum input voltage
4.	Vout	10.0	Output Voltage
5.	base_pn	LM5119	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. LM5119 Product Folder : http://www.ti.com/product/LM5119 : contains the data sheet and other resources.