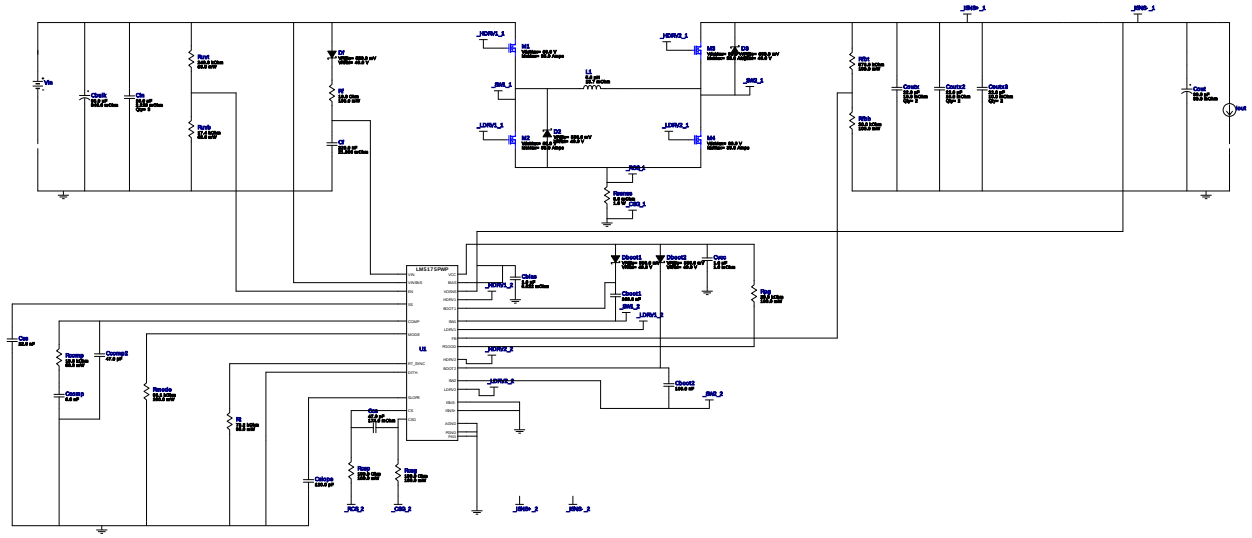
WEBENCH® Design Report

VinMin = 19.0V
VinMax = 28.0V
Vout = 24.0V
Iout = 5.0A

Device = LM5175PWPR
Topology = Buck_Boost
Created = 2017-12-08 07:43:49.491
BOM Cost = $17.84
BOM Count = 44
Total Pd = 1.73W

Design : 4881787/10 LM5175PWPR
LM5175PWPR 19.0V-28.0V to 24.00V @ 5.0A

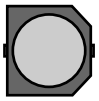


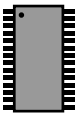
My Comments

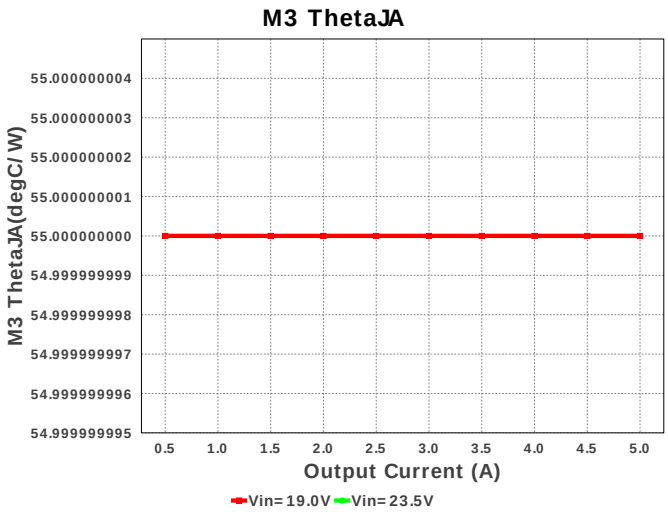
No comments

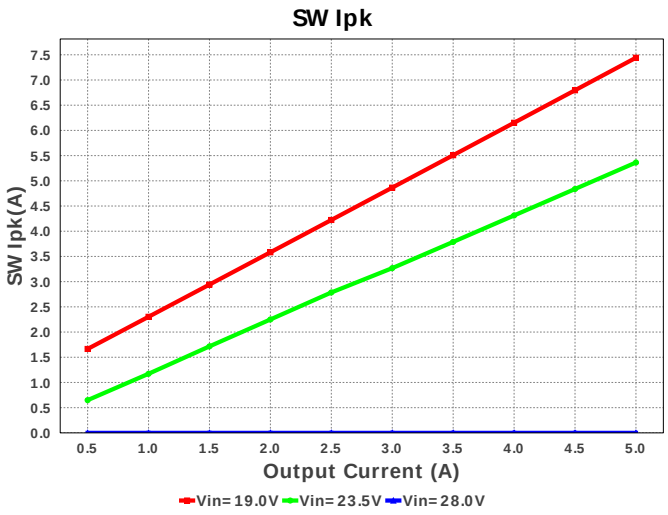
Electrical BOM

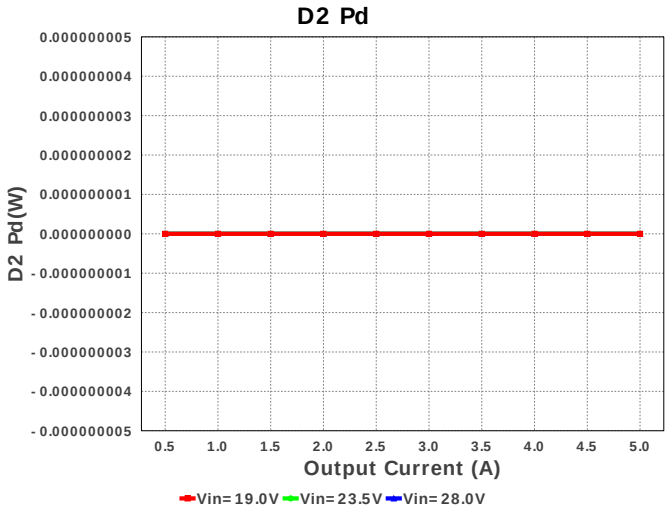
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	$0.03	0603 5 mm²
2.	Cboot1	AVX	0805YA103JAT2A Series= C0G/NP0	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
3.	Cboot2	AVX	0805YA103JAT2A Series= C0G/NP0	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.07	0805 7 mm²
4.	Cbulk	Nichicon	UUD1V680MCL1GS Series= uD	Cap= 68.0 uF ESR= 340.0 mOhm VDC= 35.0 V IRMS= 280.0 mA	1	$0.12	SM_RADIAL_6.3BMM 80 mm²
5.	Ccomp	TDK	C2012C0G1H682J060AA Series= C0G/NP0	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm²
6.	Ccomp2	Kemet	C0805C470K5GACTU Series= C0G/NP0	Cap= 47.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Ccs	AVX	06035A470JAT2A Series= C0G/NP0	Cap= 47.0 pF ESR= 174.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
8.	Cf	TDK	C1608X5R1H224K080AB Series= X5R	Cap= 220.0 nF ESR= 21.699 mOhm VDC= 50.0 V IRMS= 1.125 A	1	$0.03	0603 5 mm²

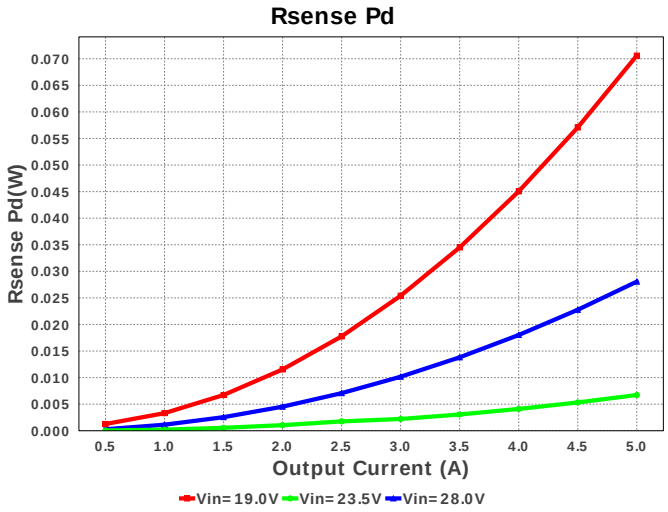
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cin	TDK	C3216X5R1H106K160AB Series= X5R	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 50.0 V IRMS= 4.8593 A	3	$0.29	 1206_180 11 mm²
10.	Cout	Panasonic	35SVPF39M Series= SVPF	Cap= 39.0 uF ESR= 30.0 mOhm VDC= 35.0 V IRMS= 2.8 A	1	$0.53	 CAPSMT_62_E7 106 mm²
11.	Coutx	MuRata	KCM55WR71J226MH01K Series= X7R	Cap= 22.0 uF ESR= 10.0 mOhm VDC= 63.0 V IRMS= 0.0 A	2	$1.66	 KCM55W 59 mm²
12.	Coutx2	MuRata	KCM55WR71J226MH01K Series= X7R	Cap= 22.0 uF ESR= 10.0 mOhm VDC= 63.0 V IRMS= 0.0 A	2	$1.66	 KCM55W 59 mm²
13.	Coutx3	MuRata	KCM55WR71J226MH01K Series= X7R	Cap= 22.0 uF ESR= 10.0 mOhm VDC= 63.0 V IRMS= 0.0 A	2	$1.66	 KCM55W 59 mm²
14.	Cslope	Yageo America	CC0603JRNPO9BN121 Series= C0G/NP0	Cap= 120.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
15.	Css	MuRata	GCM21B5C1H223JA16L Series= C0G/NP0	Cap= 22.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.07	 0805 7 mm²
16.	Cvcc	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
17.	D2	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.07	 SOD-123F 12 mm²
18.	D3	Micro Commercial Components	1N5819-TP	VF@Io= 600.0 mV VRRM= 40.0 V	1	$0.06	 DO-41 43 mm²
19.	Dboot1	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.07	 SOD-123F 12 mm²
20.	Dboot2	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.07	 SOD-123F 12 mm²
21.	Df	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.07	 SOD-123F 12 mm²
22.	L1	Coilcraft	XAL7070-562MEB	L= 5.6 µH DCR= 13.7 mOhm	1	$1.19	 XAL7070 87 mm²
23.	M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.27	 DNH0008A 18 mm²
24.	M2	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.27	 DNH0008A 18 mm²
25.	M3	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.27	 DNH0008A 18 mm²
26.	M4	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.27	 DNH0008A 18 mm²
27.	Rcomp	Vishay-Dale	CRCW040219K6FKED Series= CRCW..e3	Res= 19.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

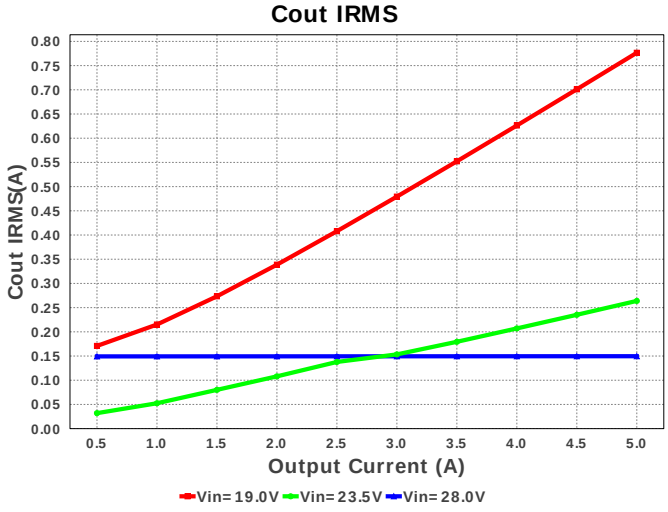
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Rcsg	Yageo America	RC0603FR-07100RL Series= ?	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
29.	Rcsp	Yageo America	RC0603FR-07100RL Series= ?	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
30.	Rf	Yageo America	RC0603FR-0710RL Series= ?	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
31.	Rfbb	Yageo America	RC0603FR-0720KL Series= ?	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
32.	Rfbt	Vishay-Dale	CRCW0603576KFKEA Series= CRCW..e3	Res= 576.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
33.	Rmode	Vishay-Dale	CRCW060393K1FKEA Series= CRCW..e3	Res= 93.1 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
34.	Rpg	Yageo America	RC0603FR-0720KL Series= ?	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
35.	Rsense	Susumu Co Ltd	PRL1632-R008-F-T1 Series= PRL1632	Res= 8.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 0612 11 mm^2
36.	Rt	Vishay-Dale	CRCW040273K2FKED Series= CRCW..e3	Res= 73.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
37.	Ruvb	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
38.	Ruvt	Vishay-Dale	CRCW0402249KFKED Series= CRCW..e3	Res= 249.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
39.	U1	Texas Instruments	LM5175PWPR	Switcher	1	$3.10	 PWP0028F_N 98 mm^2

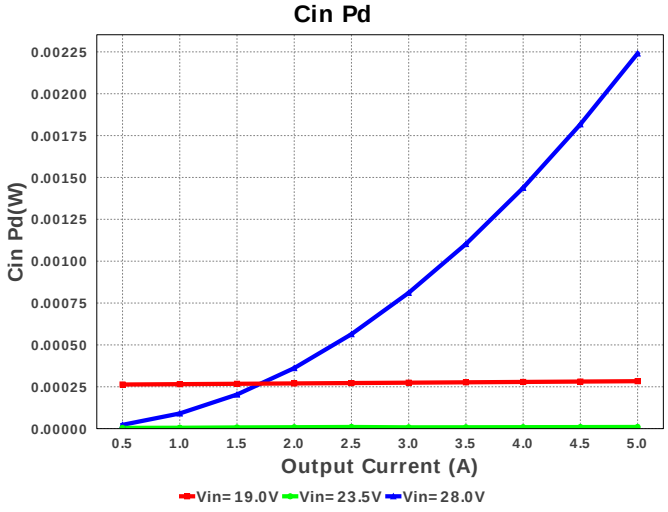


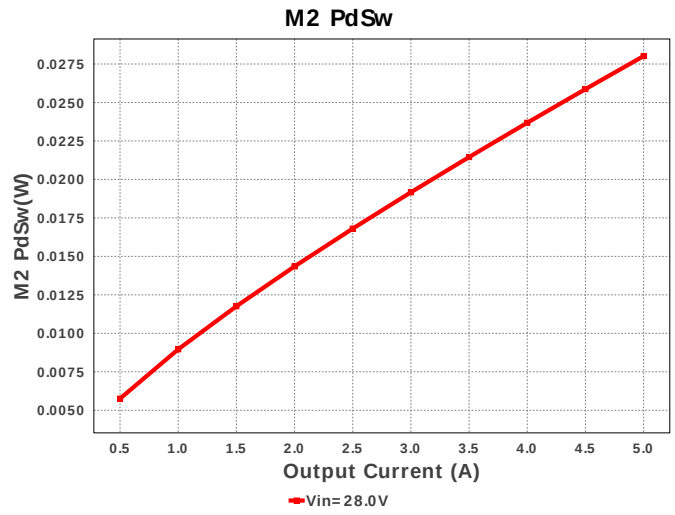


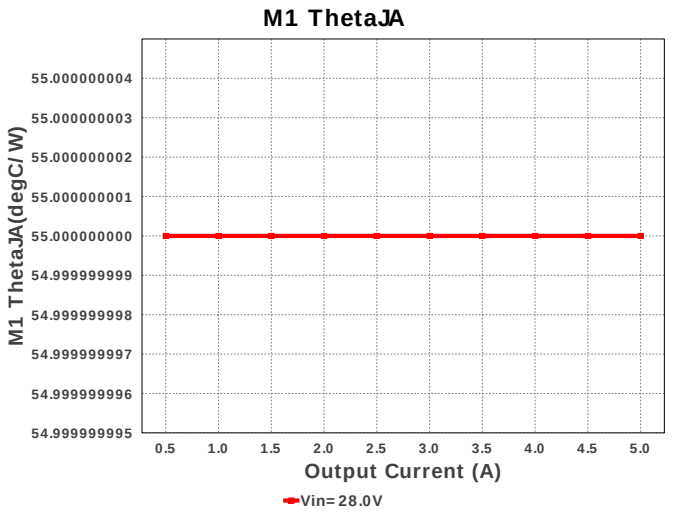


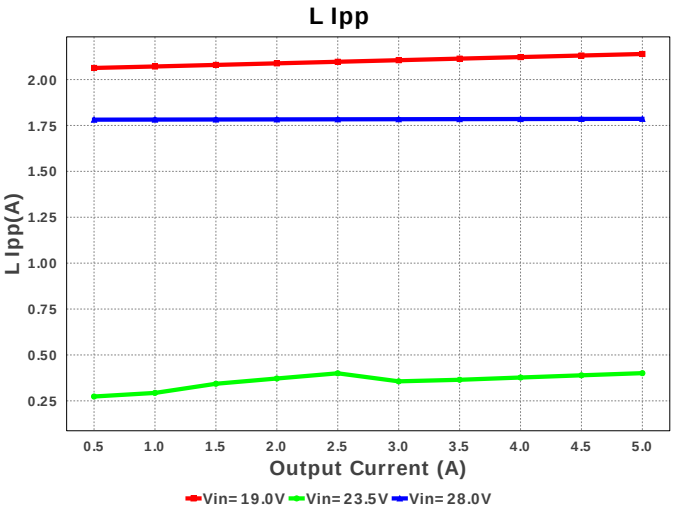


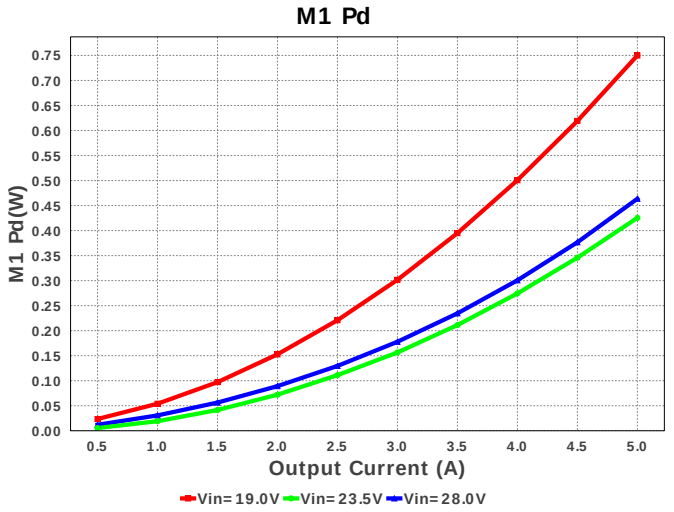


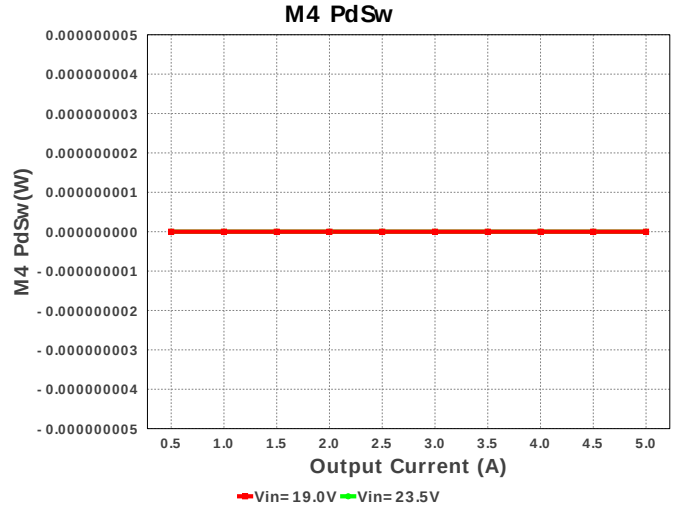


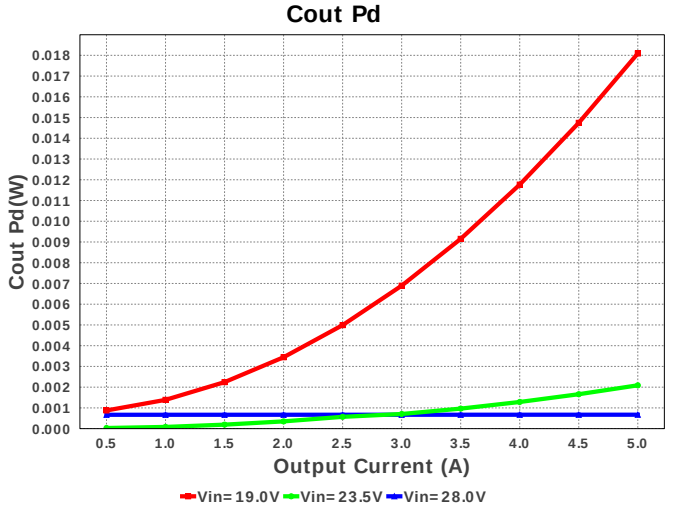


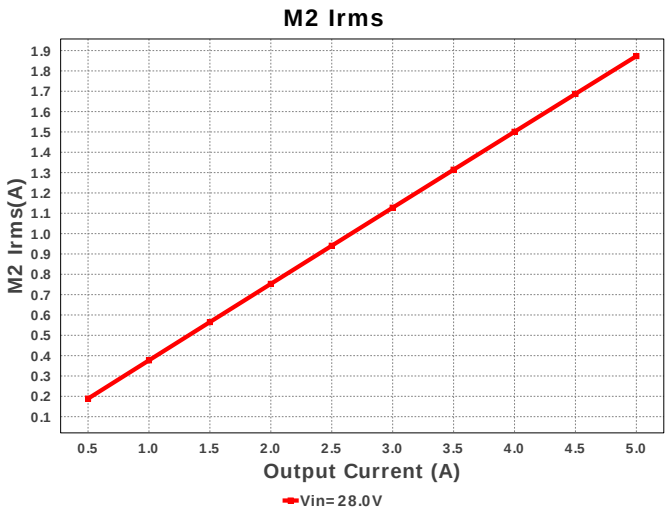


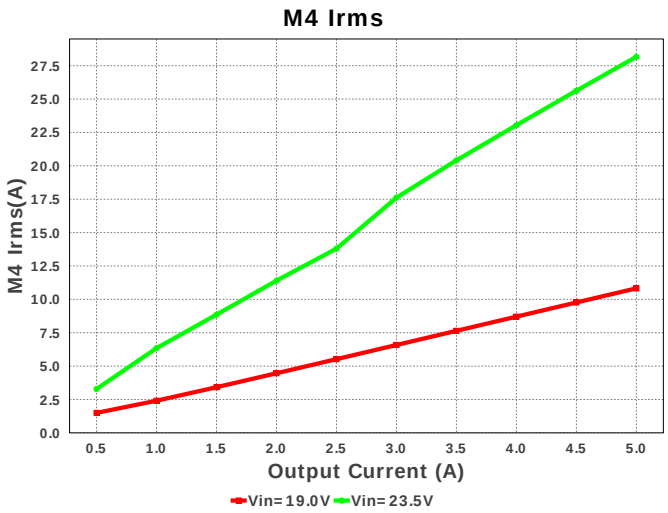


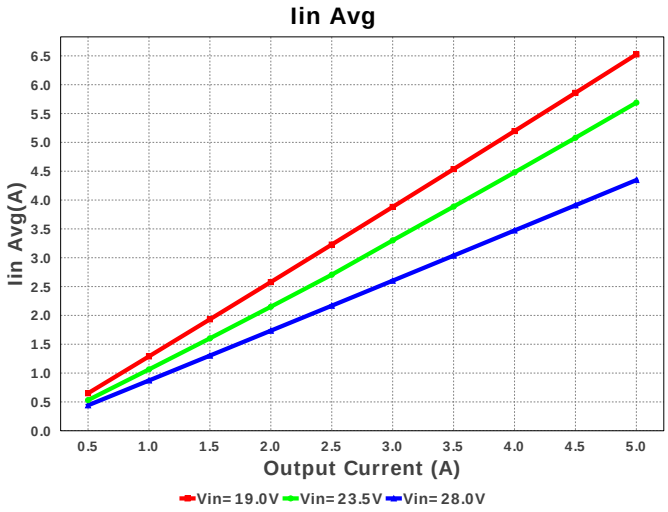


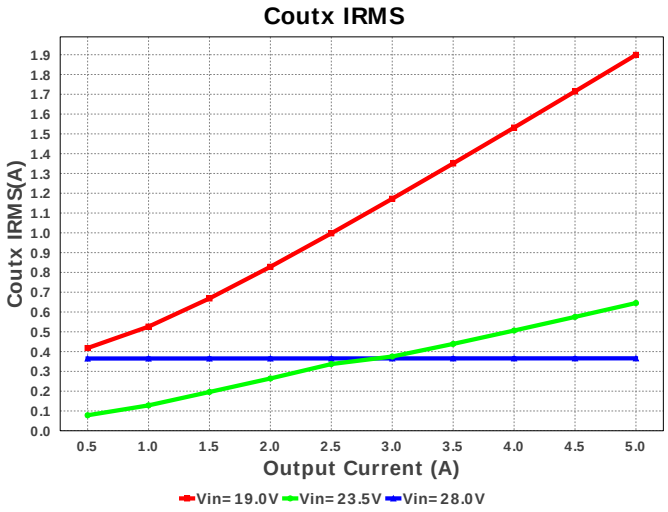


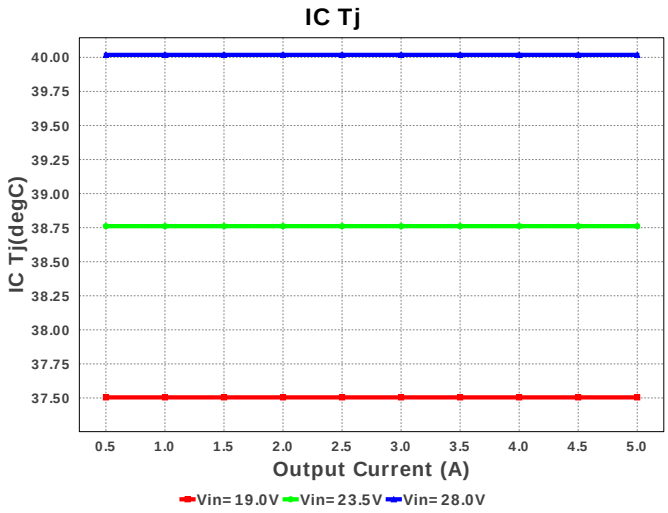


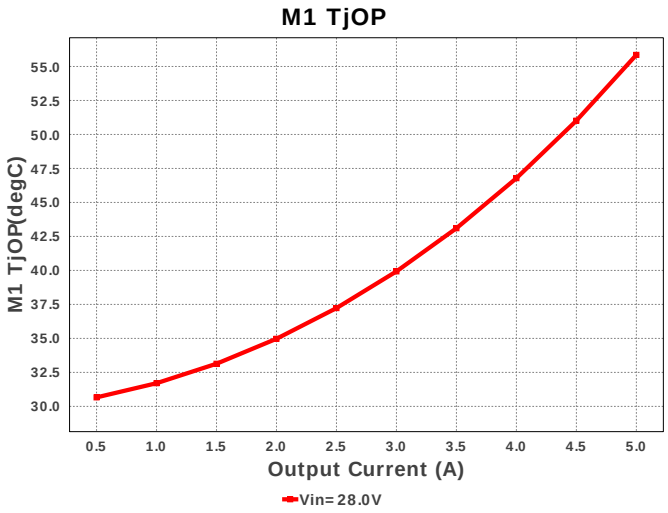




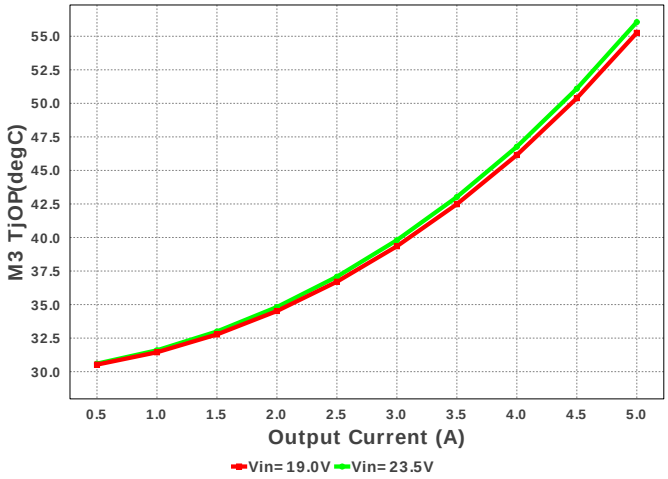




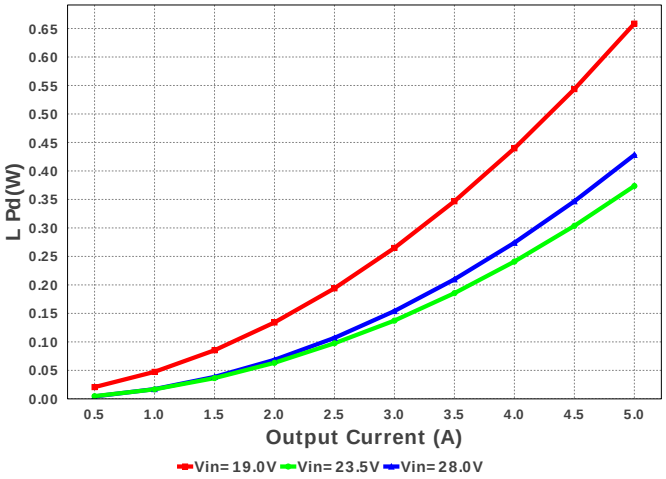




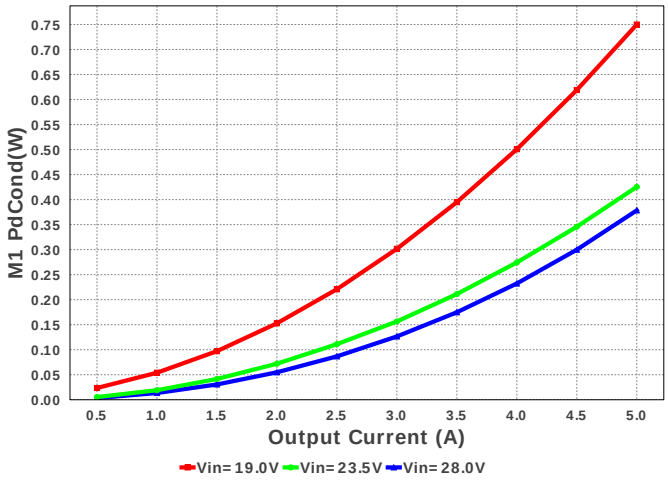
M3 TjOP



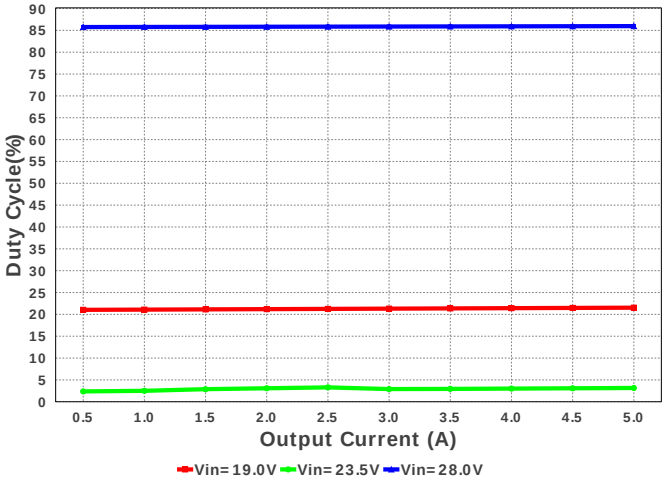
L Pd



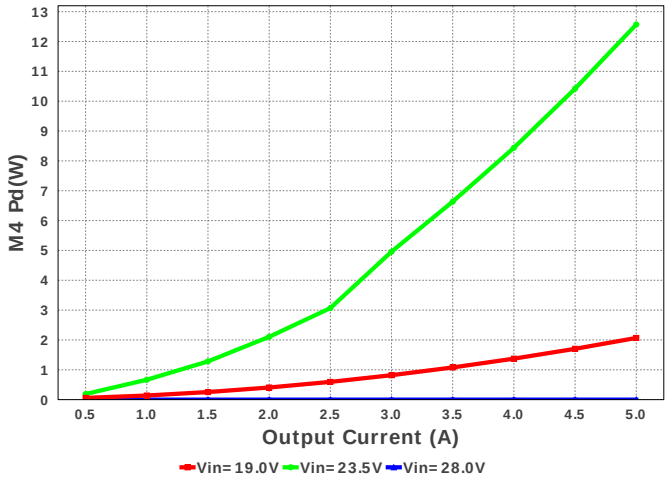
M1 PdCond



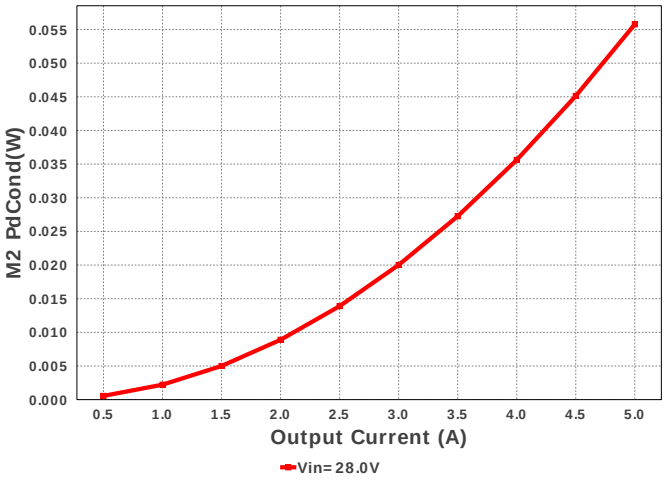
Duty Cycle

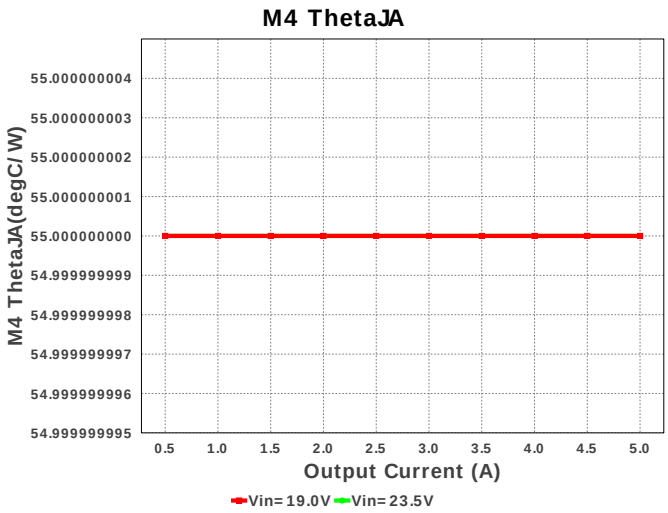


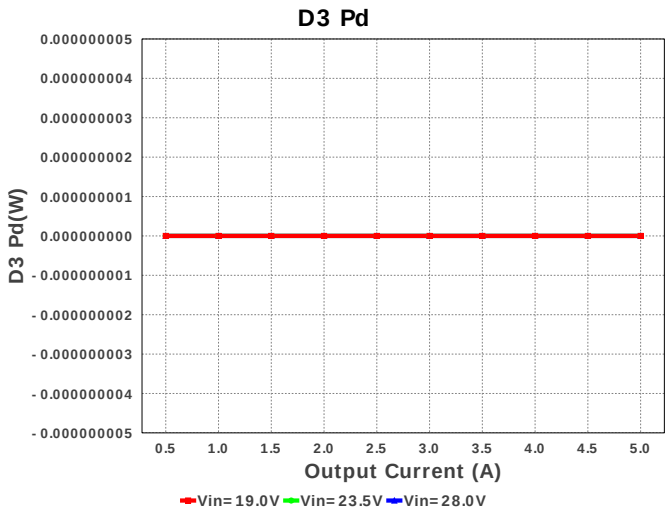
M4 Pd

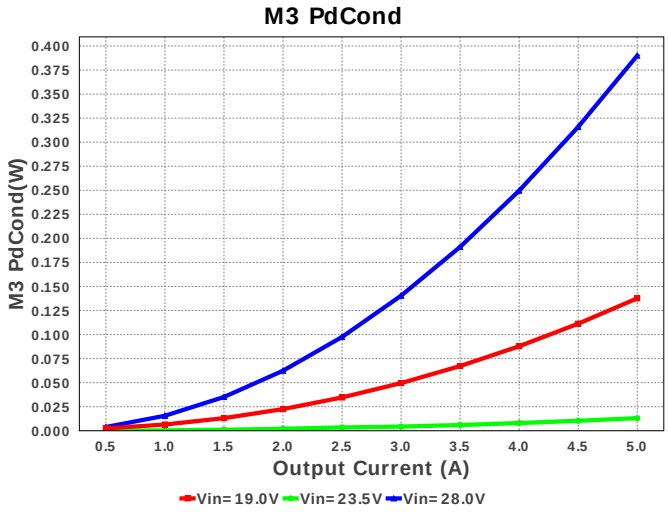


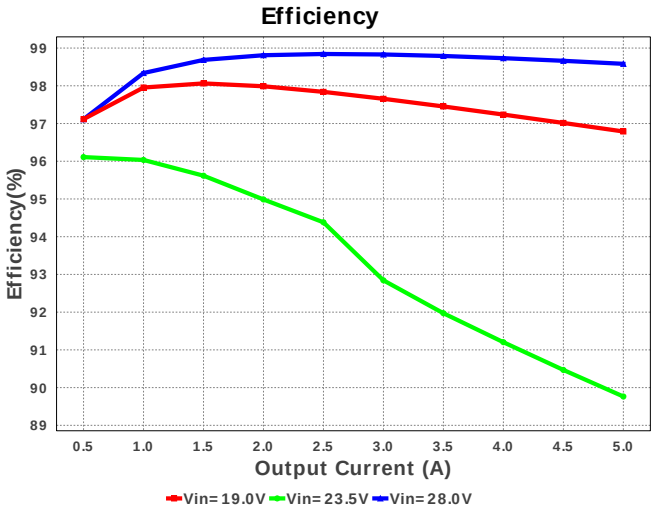
M2 PdCond

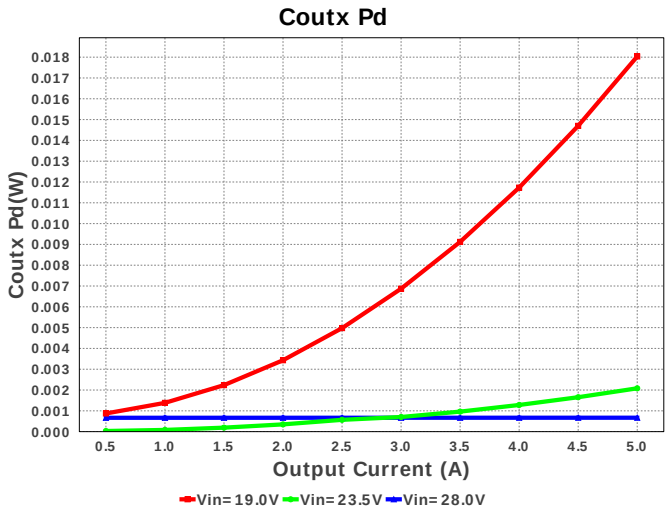


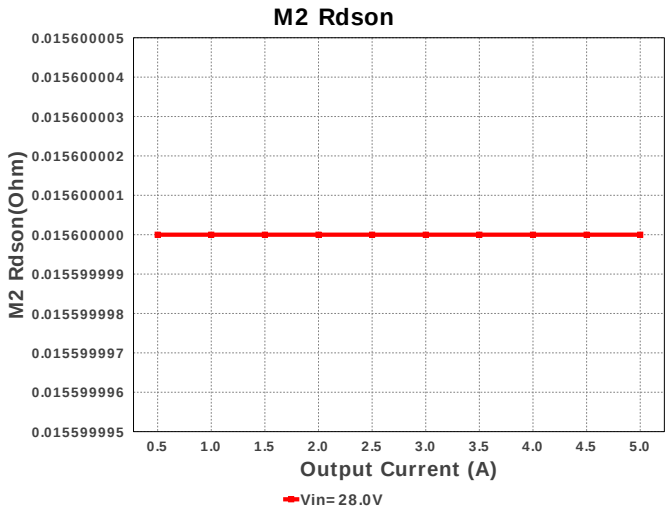


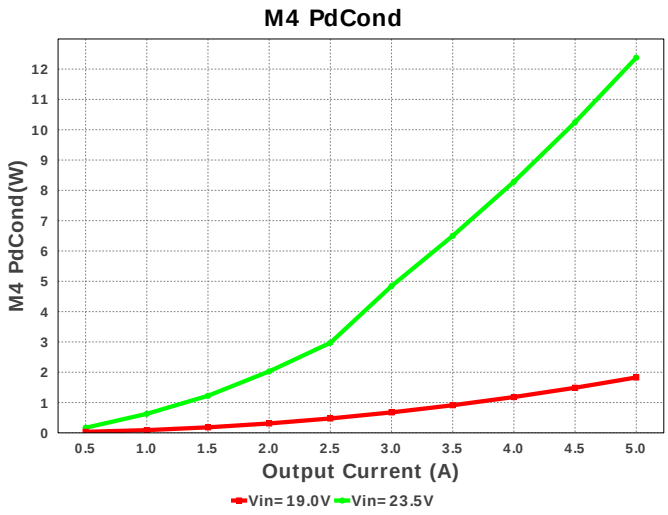


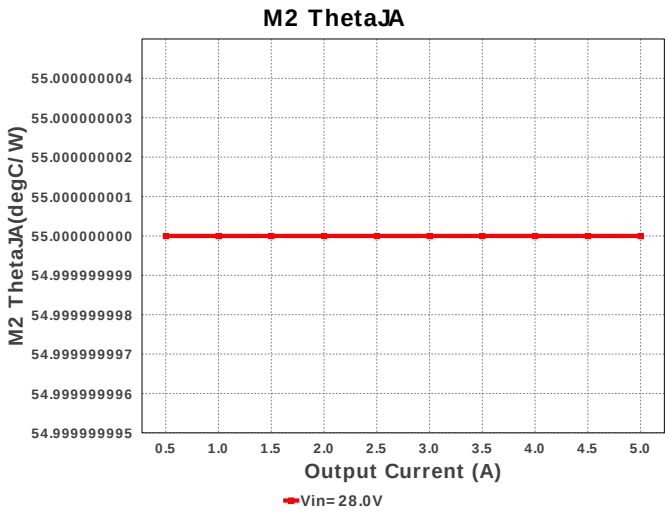


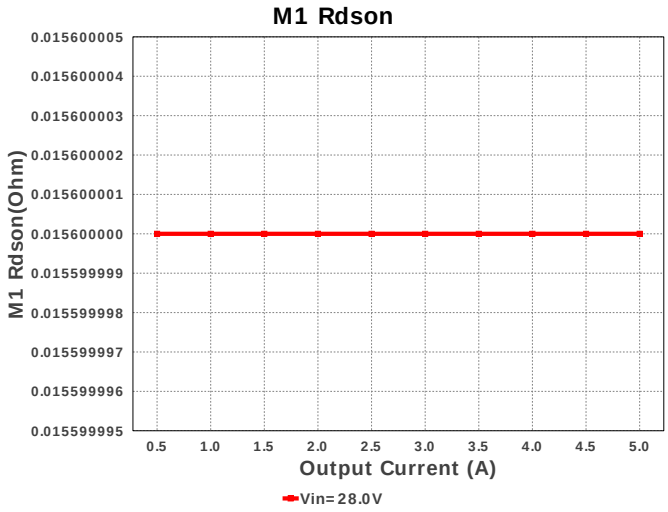


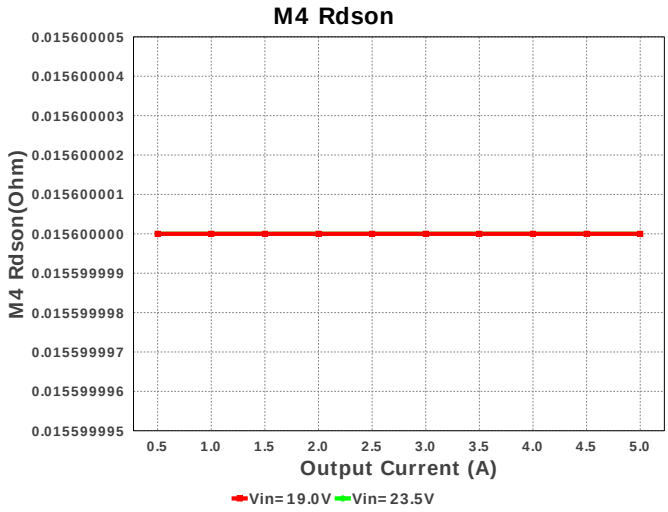


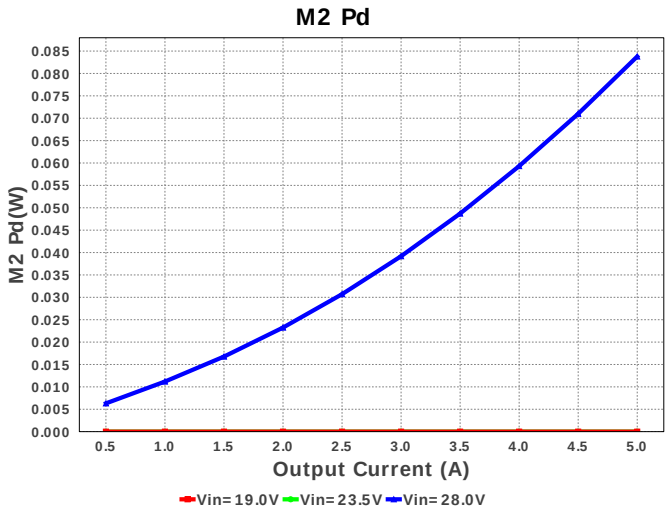


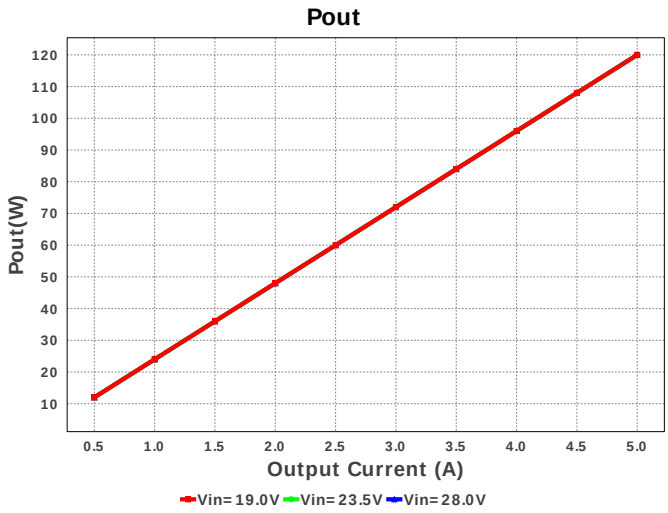


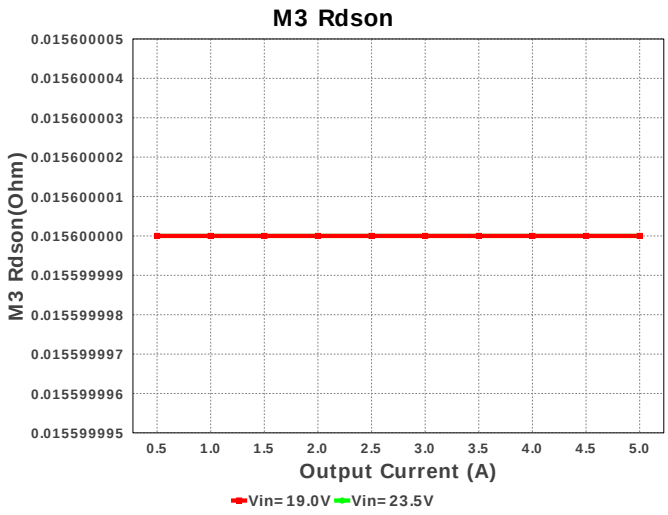


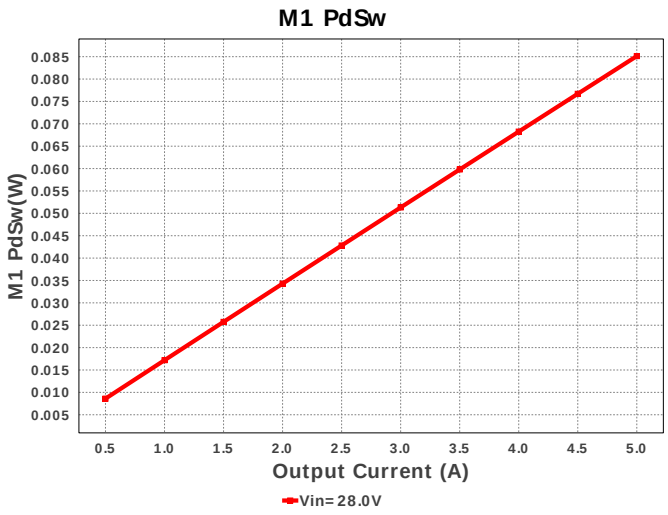


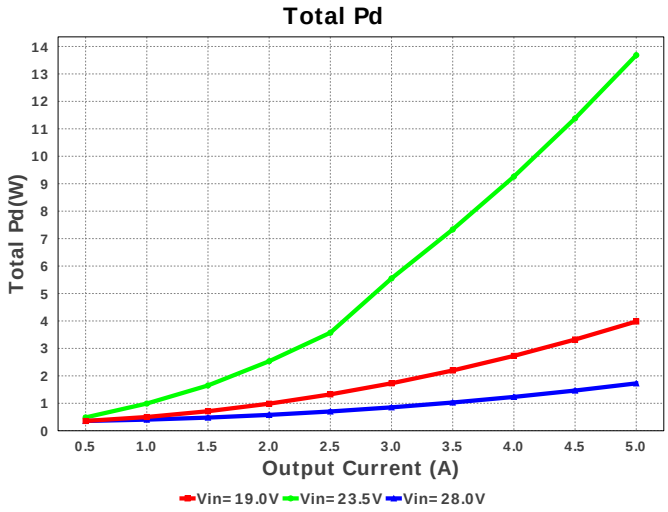


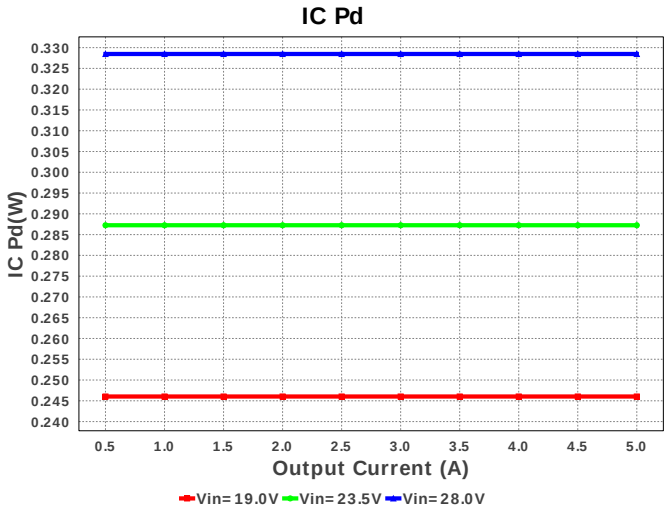


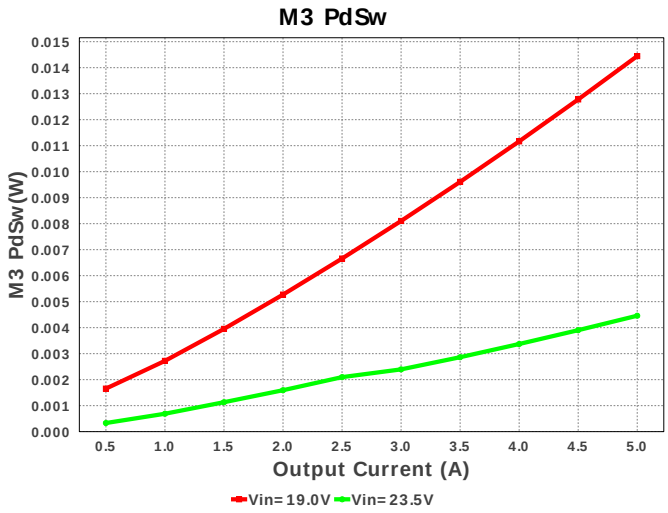


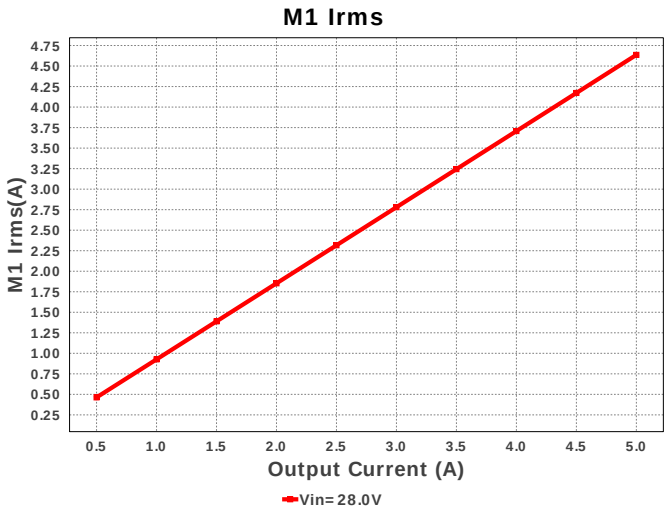


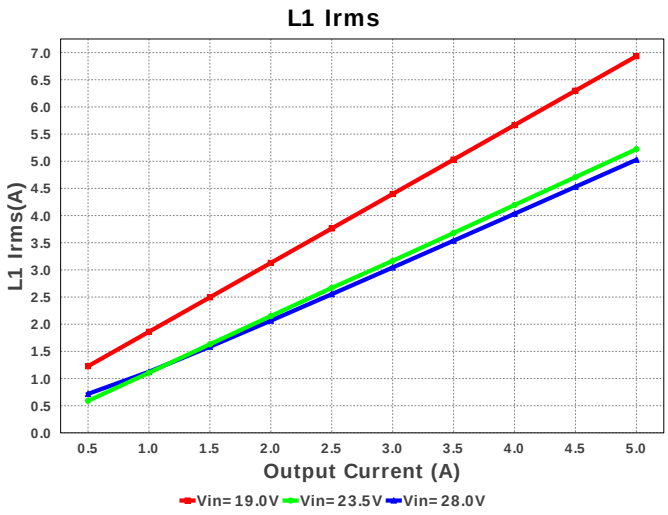


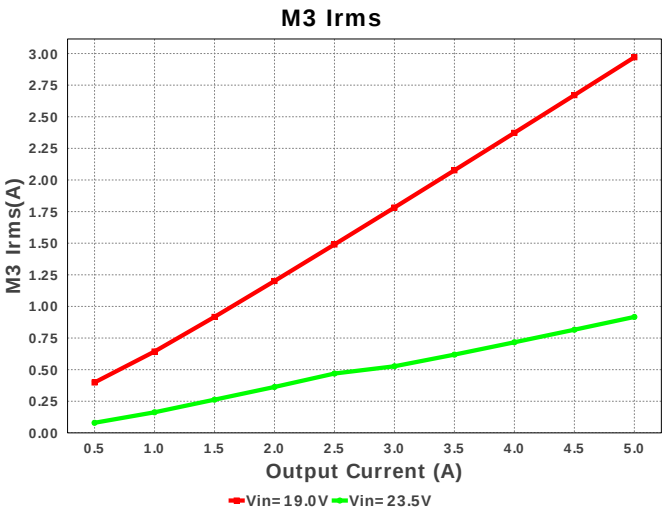


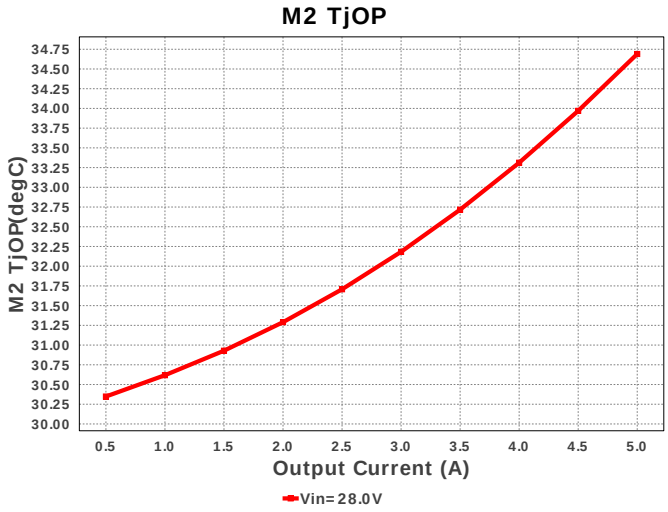


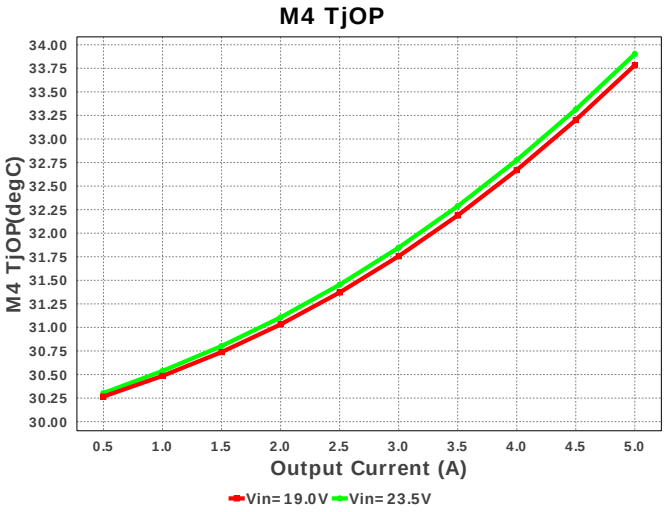


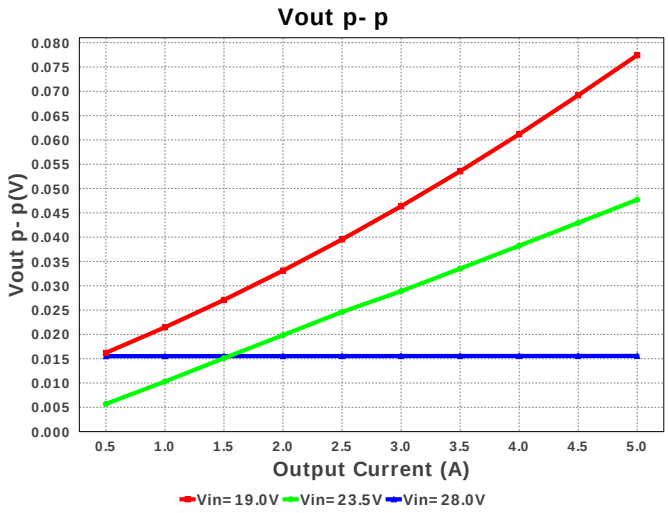


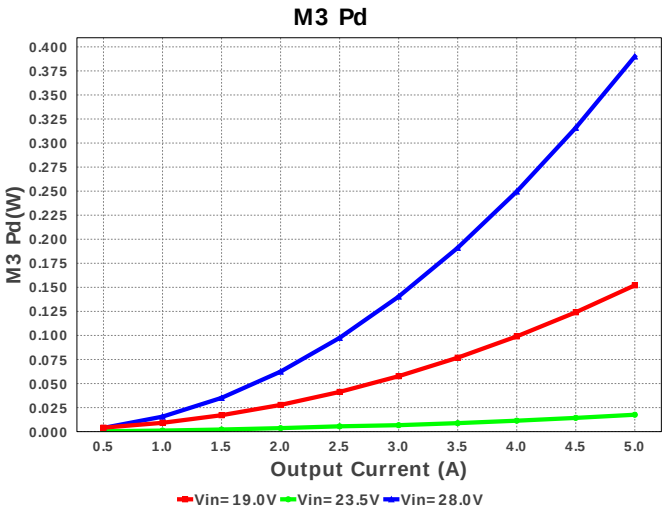


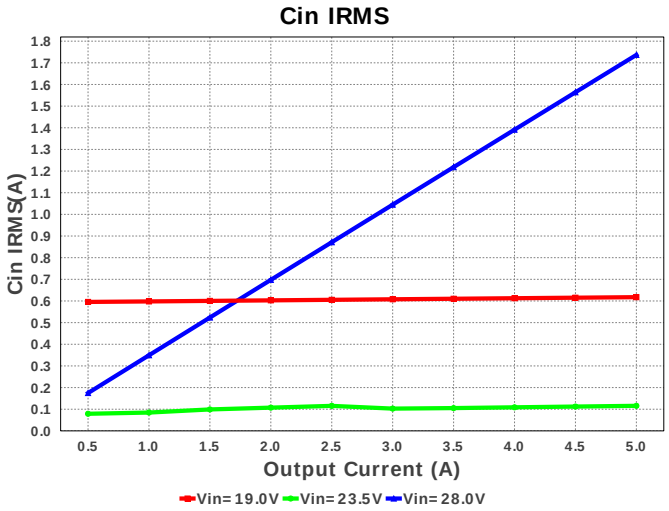


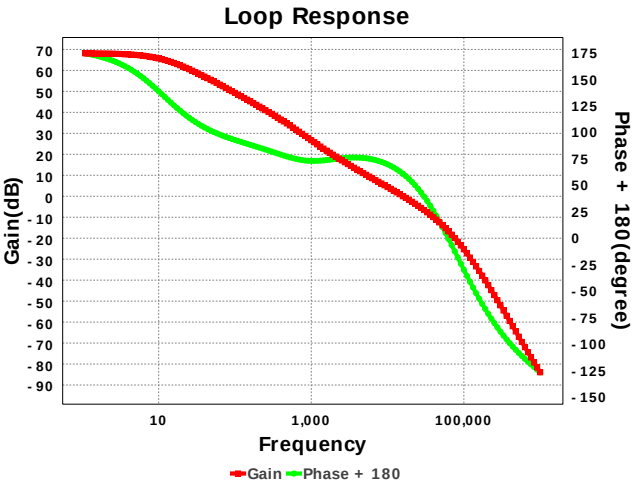












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.736 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	149.627 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	365.937 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	4.348 A	Current	Average input current
5.	L Ipp	1.786 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	5.027 A	Current	Inductor ripple current
7.	M1 Irms	4.636 A	Current	MOSFET RMS ripple current
8.	M2 Irms	1.873 A	Current	MOSFET RMS ripple current
9.	SW Ipk	0.0 A	Current	Peak switch current
10.	BOM Count	44	General	Total Design BOM count
11.	FootPrint	1.036 k mm^2	General	Total Foot Print Area of BOM components
12.	Frequency	343.832 kHz	General	Switching frequency
13.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
14.	M1 Rdson	15.6 mOhm	General	Drain-Source On-resistance
15.	M1 ThetaJA	55.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
16.	M2 Rdson	15.6 mOhm	General	Drain-Source On-resistance
17.	M2 ThetaJA	55.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
18.	Mode	CCM	General	Conduction Mode
19.	Pout	120.0 W	General	Total output power
20.	Total BOM	$17.84	General	Total BOM Cost
21.	Low Freq Gain	68.093 dB	Op_Point	Gain at 1Hz
22.	Vout Actual	23.84 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	24.0 V	Op_Point	Operational Output Voltage
24.	Cross Freq	16.03 kHz	Op_point	Bode plot crossover frequency
25.	Duty Cycle	85.97 %	Op_point	Duty cycle
26.	Efficiency	98.578 %	Op_point	Steady state efficiency
27.	Gain Marg	-16.576 dB	Op_point	Bode Plot Gain Margin
28.	IC Tj	40.018 degC	Op_point	IC junction temperature
29.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
30.	IOUT_OP	5.0 A	Op_point	Iout operating point
31.	M1 TjOP	55.854 degC	Op_point	MOSFET junction temperature
32.	M2 TjOP	34.69 degC	Op_point	MOSFET junction temperature
33.	Operating Topology	Buck	Op_point	The current operating topology of the device
34.	Phase Marg	60.782 deg	Op_point	Bode Plot Phase Margin
35.	VIN_OP	28.0 V	Op_point	Vin operating point
36.	Vout p-p	15.567 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	2.24 mW	Power	Input capacitor power dissipation
38.	Cout Pd	671.645 µW	Power	Output capacitor power dissipation
39.	Coutx Pd	669.548 µW	Power	Output capacitor_x power loss
40.	D2 Pd	0.0 W	Power	Diode power dissipation
41.	D3 Pd	0.0 W	Power	Diode power dissipation
42.	IC Pd	328.471 mW	Power	IC power dissipation
43.	L Pd	428.125 mW	Power	Inductor power dissipation
44.	M1 Pd	468.102 mW	Power	MOSFET power dissipation
45.	M1 PdCond	382.974 mW	Power	M1 MOSFET conduction losses
46.	M1 PdSw	85.129 mW	Power	M1 MOSFET switching losses
47.	M2 Pd	84.392 mW	Power	MOSFET power dissipation
48.	M2 PdCond	56.379 mW	Power	M2 MOSFET conduction losses
49.	M2 PdSw	28.013 mW	Power	M2 MOSFET switching losses
50.	M3 Pd	390.0 mW	Power	M3 MOSFET total power dissipation
51.	M3 PdCond	390.0 mW	Power	M3 MOSFET conduction losses
52.	M4 Pd	0.0 W	Power	M4 MOSFET total power dissipation

#	Name	Value	Category	Description
53.	Rsense Pd	28.06 mW	Power	LED Current Rsns Power Dissipation
54.	Total Pd	1.731 W	Power	Total Power Dissipation
55.	Vout Tolerance	1.952 %		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	28.0	Maximum input voltage
3.	VinMin	19.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	base_pn	LM5175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. Tip: Snubbers and/or gate resistors may be required to limit the SW1,2 node switching spikes below the IC and FET abs max ratings.

2. Tip: Slope Capacitor: smaller slope capacitors provide better transition region behavior.

3. **LM5175** Product Folder : http://www.ti.com/product/LM5175 : contains the data sheet and other resources.