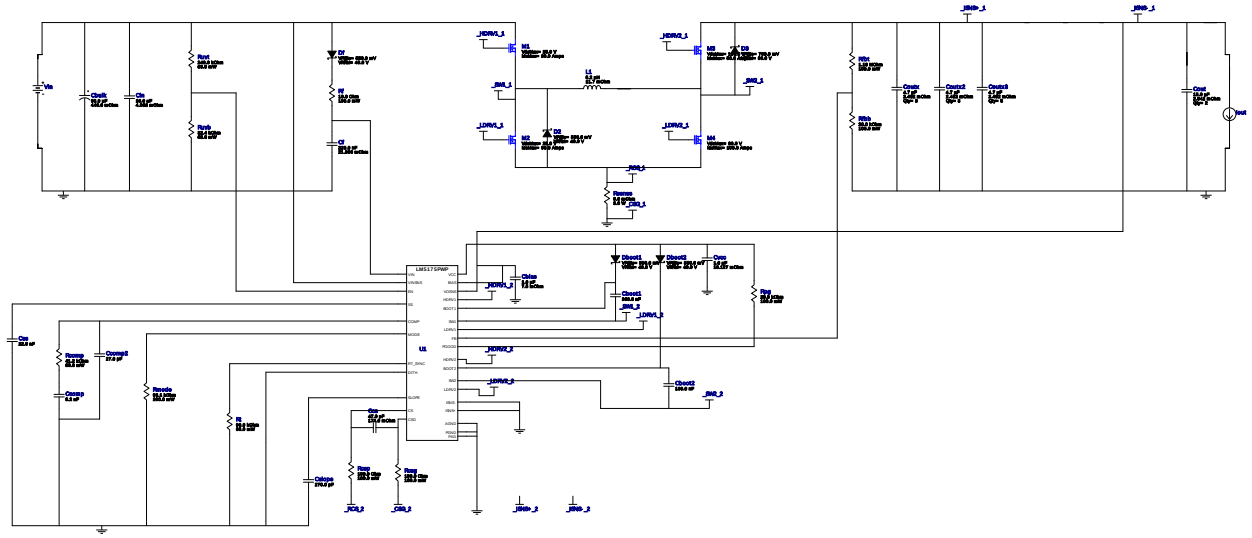
WEBENCH® Design Report

VinMin = 11.0V
VinMax = 13.0V
Vout = 48.0V
Iout = 2.0A

Device = LM5175PWPR
Topology = Buck_Boost
Created = 2/9/17 3:32:44 AM
BOM Cost = $20.48
BOM Count = 52
Total Pd = 2.98W

Design : 4861364/2 LM5175PWPR
Design 30fromste.maragno@gmail.com



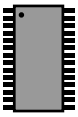
My Comments

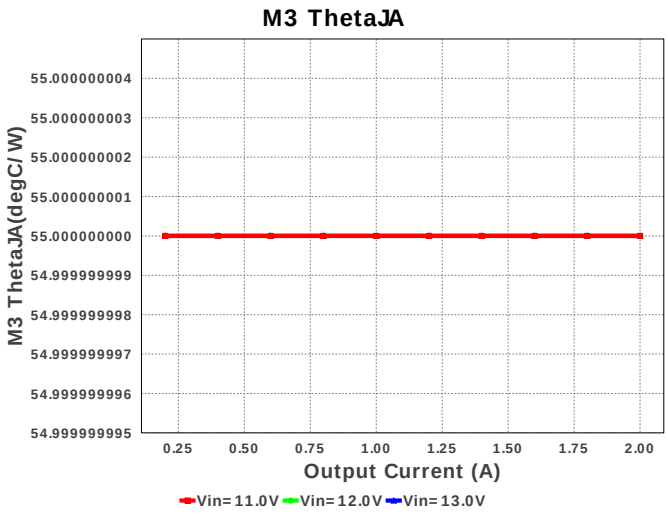
No comments

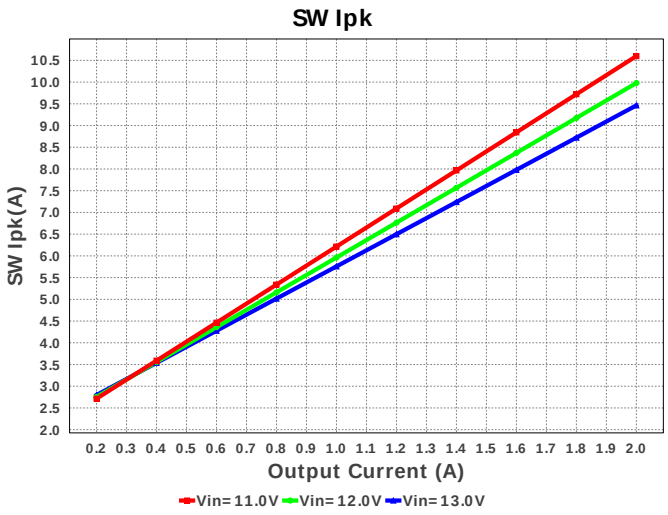
Electrical BOM

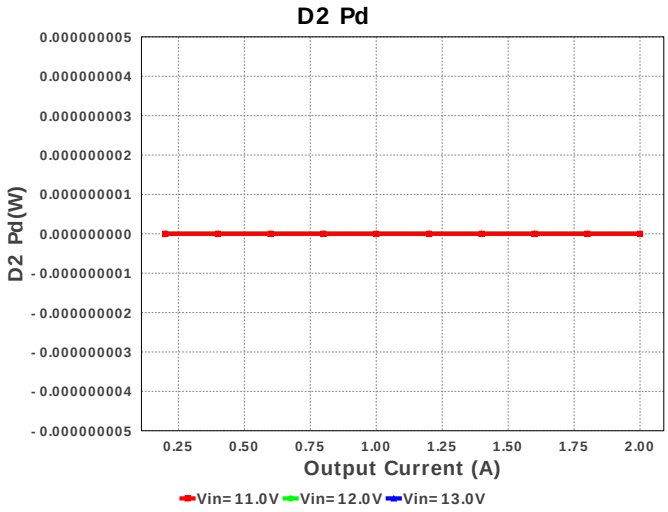
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 uF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.9235 A	1	$0.11	1206 11 mm^2
2.	Cboot1	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
3.	Cboot2	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
4.	Cbulk	Nichicon	UUD1C680MCL1GS Series= uD	Cap= 68.0 uF ESR= 440.0 mOhm VDC= 16.0 V IRMS= 230.0 mA	1	$0.11	SM_RADIAL_6.3AMM 80 mm^2
5.	Ccomp	MuRata	GRM033R61A822KA01D Series= X5R	Cap= 8.2 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
6.	Ccomp2	Kemet	C0805C270K5GACTU Series= C0G/NP0	Cap= 27.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
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 mm^2
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 mm^2

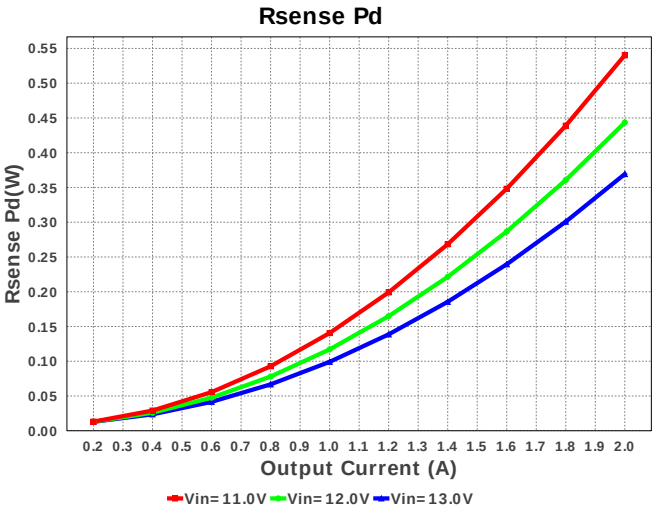
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cin	MuRata	GRM31CR71E106KA12L Series= X7R	Cap= 10.0 uF ESR= 4.366 mOhm VDC= 25.0 V IRMS= 2.8022 A	1	$0.05	 1206_190 11 mm²
10.	Cout	TDK	CGA9P3X7S2A156M250KB Series= X7S	Cap= 15.0 uF ESR= 2.642 mOhm VDC= 100.0 V IRMS= 5.6162 A	2	$1.24	 2220_280 54 mm²
11.	Coutx	TDK	C5750X7R2A475M Series= X7R	Cap= 4.7 uF ESR= 2.482 mOhm VDC= 100.0 V IRMS= 0.0 A	5	$0.67	 2220 54 mm²
12.	Coutx2	TDK	C5750X7R2A475M Series= X7R	Cap= 4.7 uF ESR= 2.482 mOhm VDC= 100.0 V IRMS= 0.0 A	5	$0.67	 2220 54 mm²
13.	Coutx3	TDK	C5750X7R2A475M Series= X7R	Cap= 4.7 uF ESR= 2.482 mOhm VDC= 100.0 V IRMS= 0.0 A	5	$0.67	 2220 54 mm²
14.	Cslope	Yageo America	CC0603JRNPO9BN271 Series= C0G/NP0	Cap= 270.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
15.	Css	Kemet	C0603C223K3RACTU Series= X7R	Cap= 22.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0603 5 mm²
16.	Cvcc	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	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	Diodes Inc.	B260-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.09	 SMB 44 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	XAL1010-822MEB	L= 8.2 µH DCR= 11.7 mOhm	1	$1.71	 XAL1010 160 mm²
23.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.36	 DQG0008A 18 mm²
24.	M2	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	$0.36	 DQG0008A 18 mm²
25.	M3	Texas Instruments	CSD19534Q5A	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.34	 TRANS_NexFET_Q5A 55 mm²
26.	M4	Texas Instruments	CSD18531Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.58	 TRANS_NexFET_Q5A 55 mm²

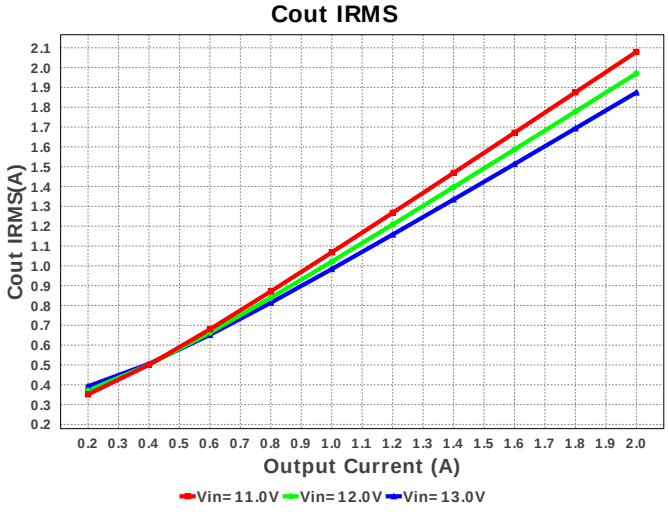
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rcomp	Vishay-Dale	CRCW040241K2FKED Series= CRCW..e3	Res= 41.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
28.	Rcsg	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
29.	Rcsp	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
30.	Rf	Vishay-Dale	CRCW060310R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
31.	Rfbb	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
32.	Rfbt	Vishay-Dale	CRCW06031M18FKEA Series= CRCW..e3	Res= 1.18 MOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
33.	Rmode	Vishay-Dale	CRCW060393K1FKEA Series= CRCW..e3	Res= 93.1 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
34.	Rpg	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
35.	Rsense	Vishay-Dale	WSR39L000FEA Series= WSR	Res= 9.0 mOhm Power= 3.0 W Tolerance= 1.0%	1	$0.64	 4527 122 mm²
36.	Rt	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
37.	Ruvb	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
38.	Ruvt	Vishay-Dale	CRCW0402249KFKED Series= CRCW..e3	Res= 249.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
39.	U1	Texas Instruments	LM5175PWPR	Switcher	1	$3.10	 PWP0028F_N 98 mm²

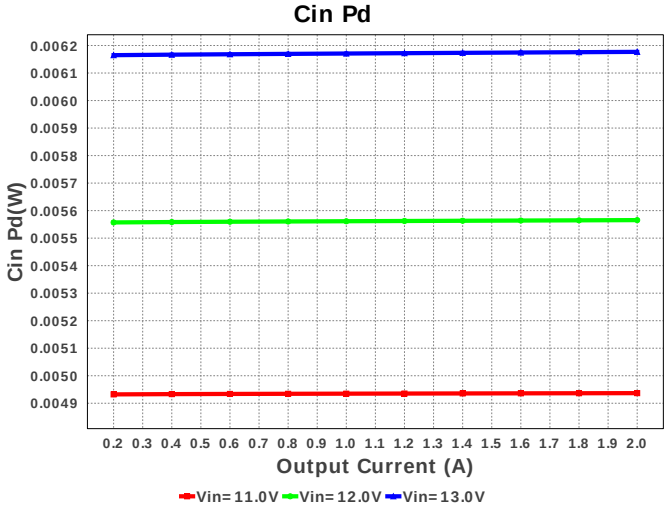


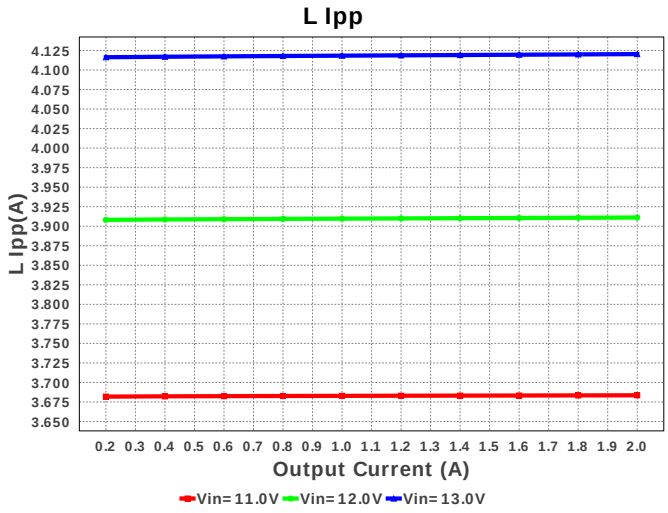


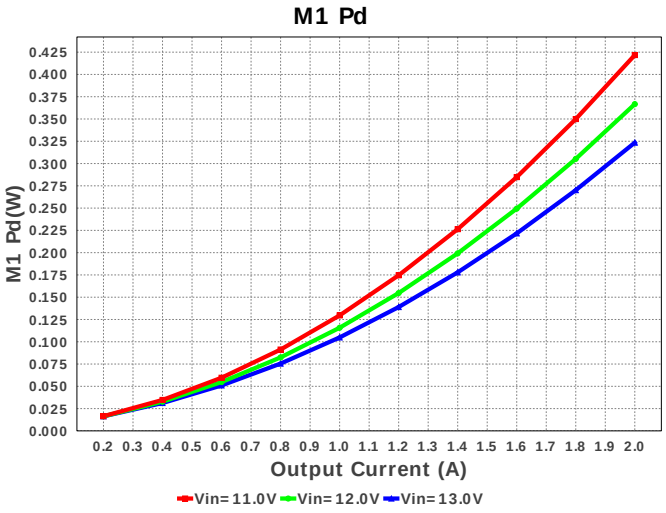


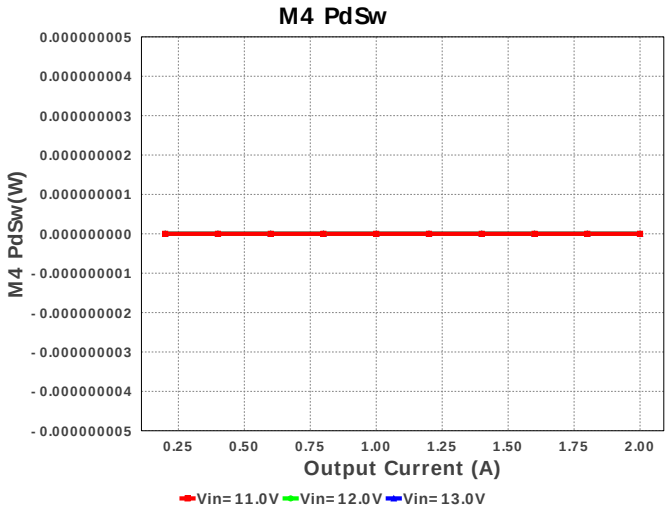


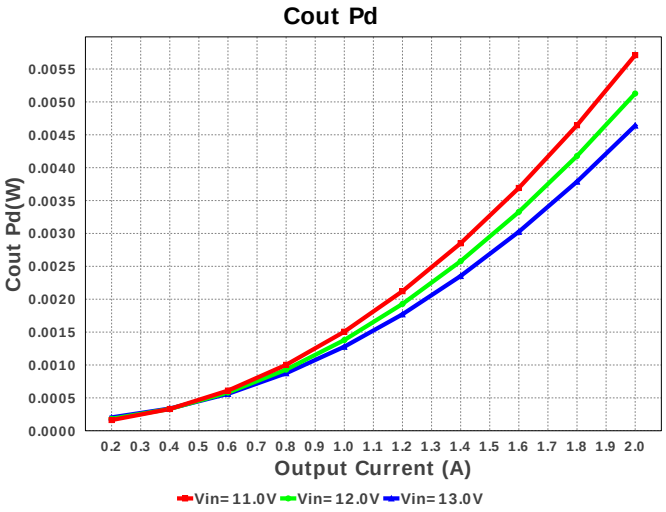


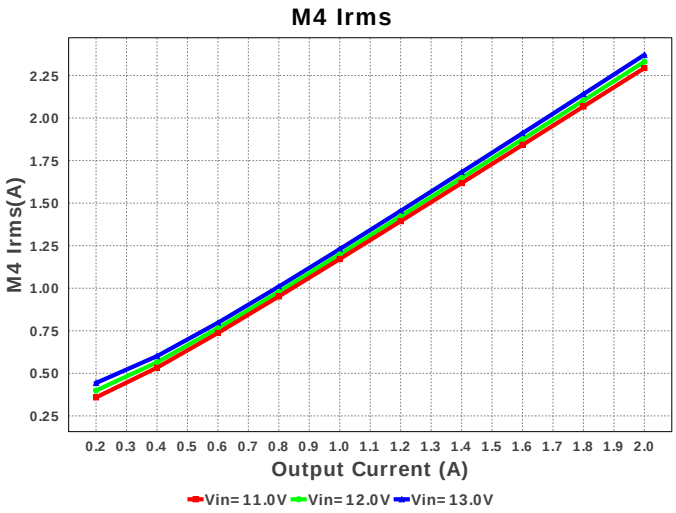


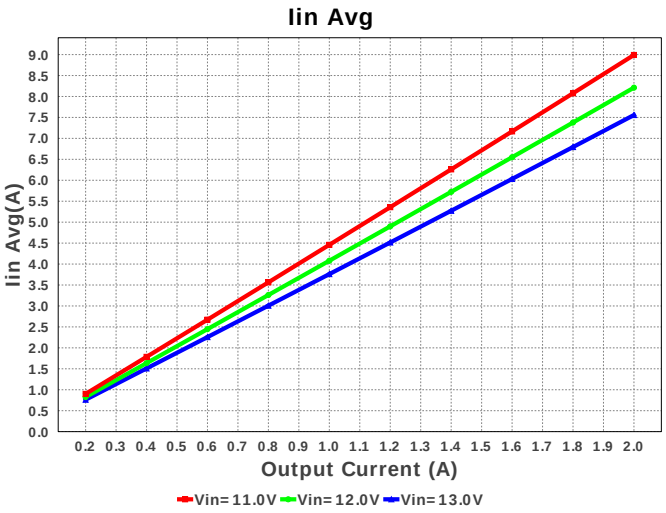


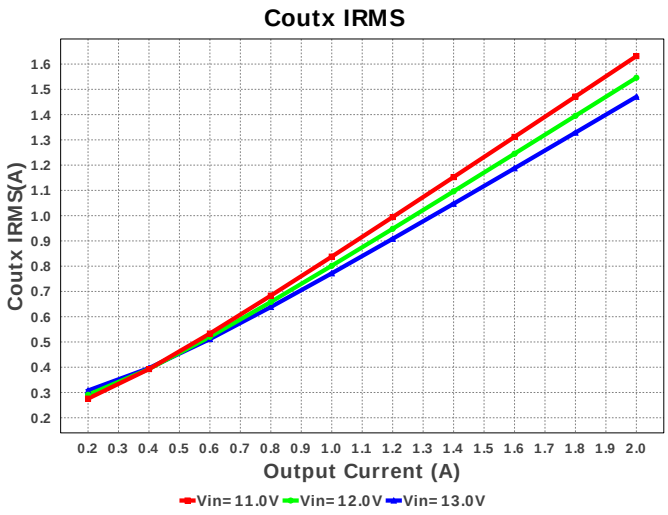


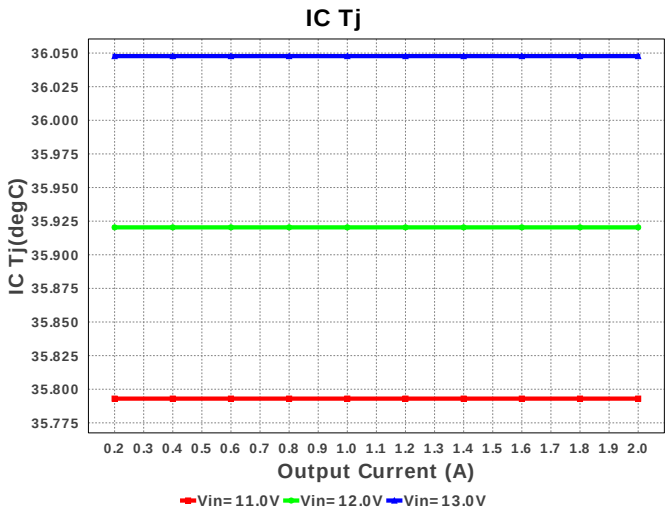


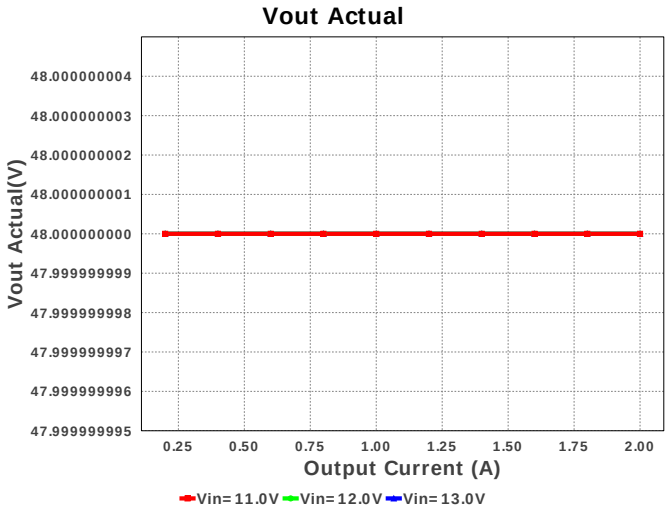


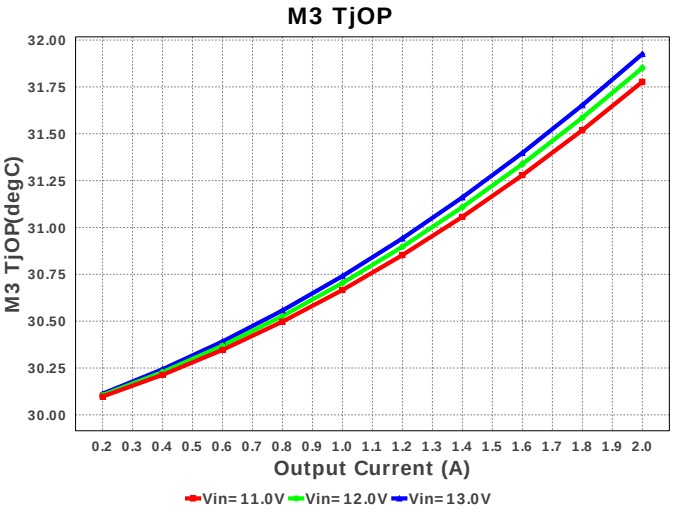


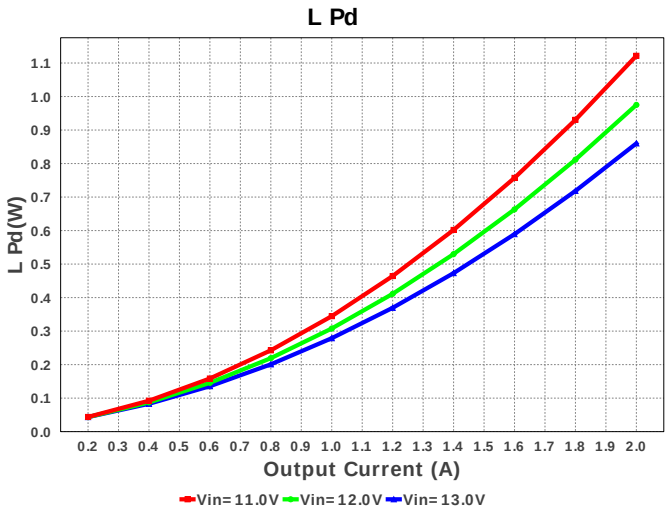


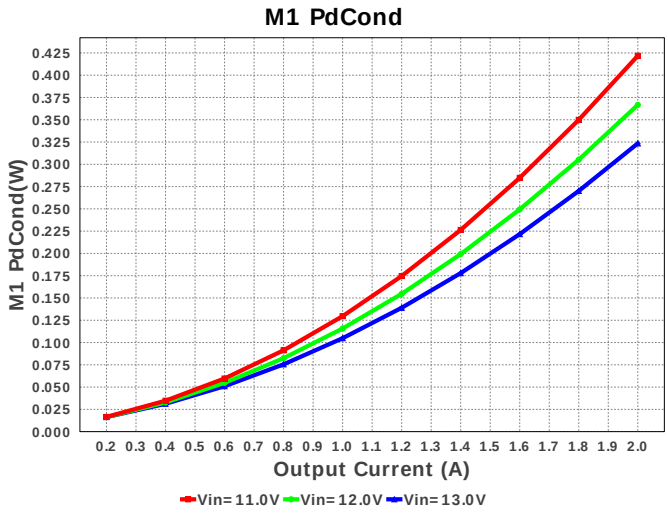


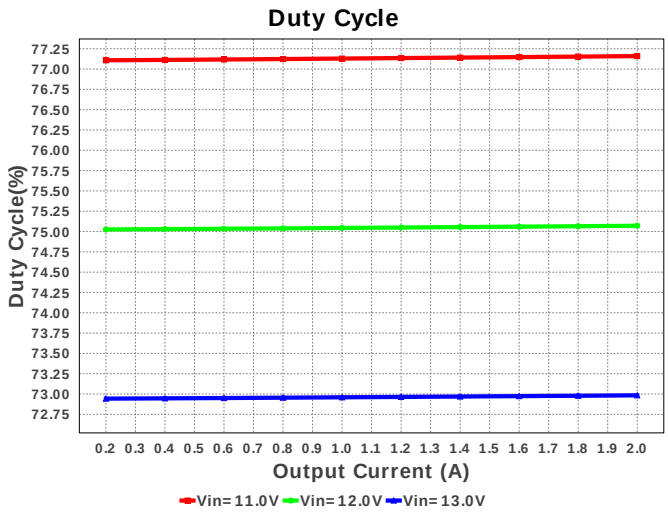


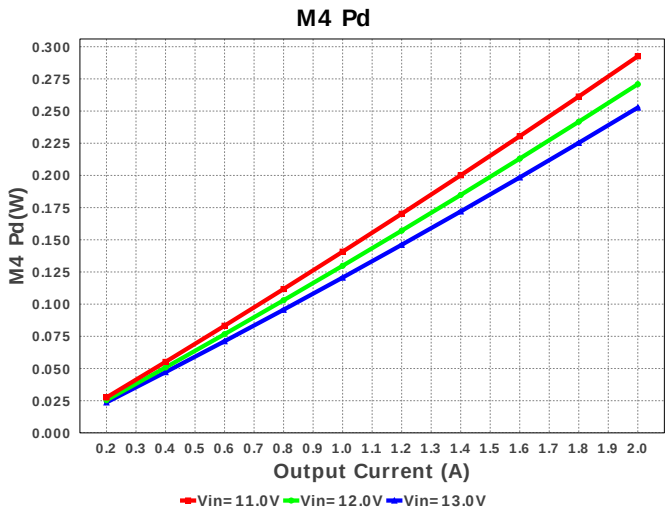


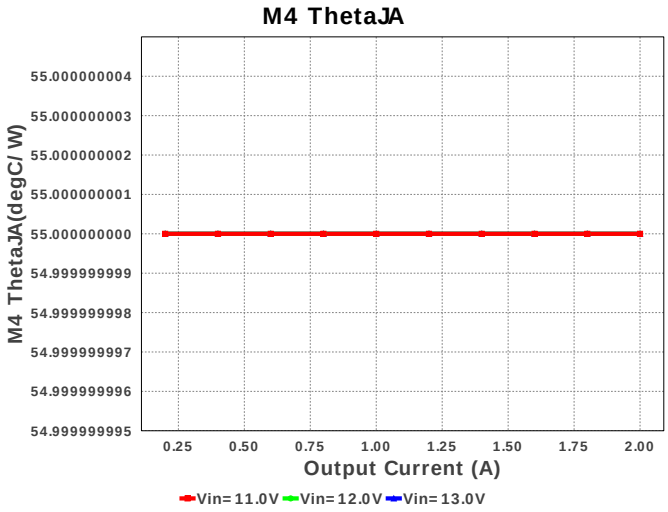


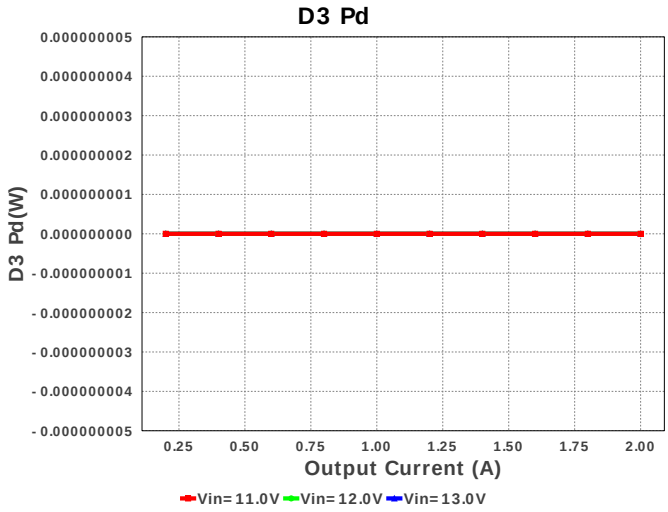


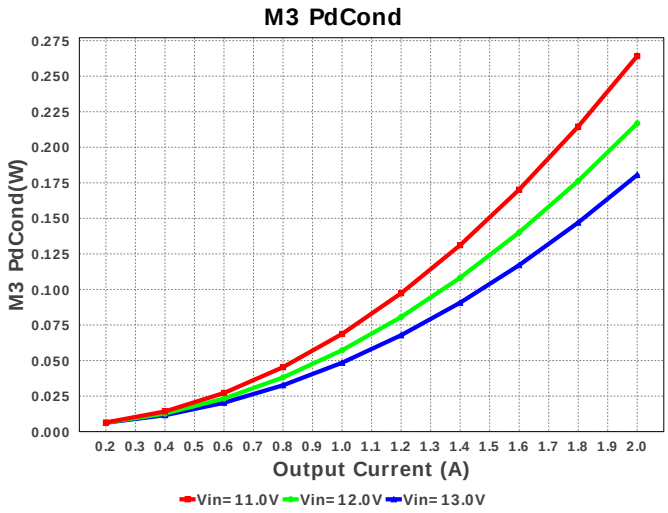


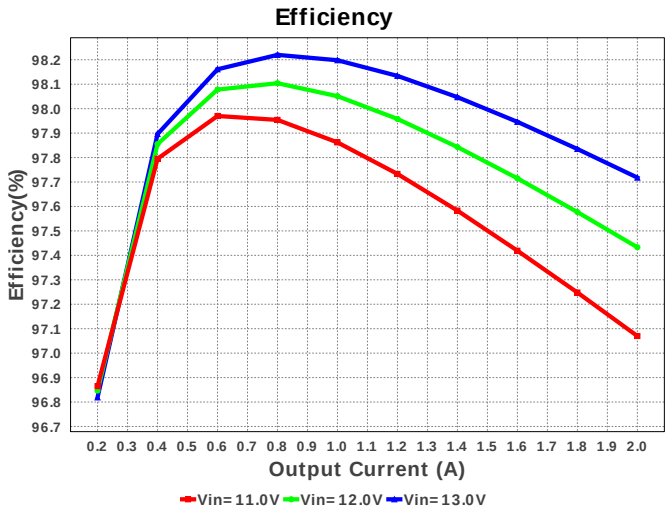


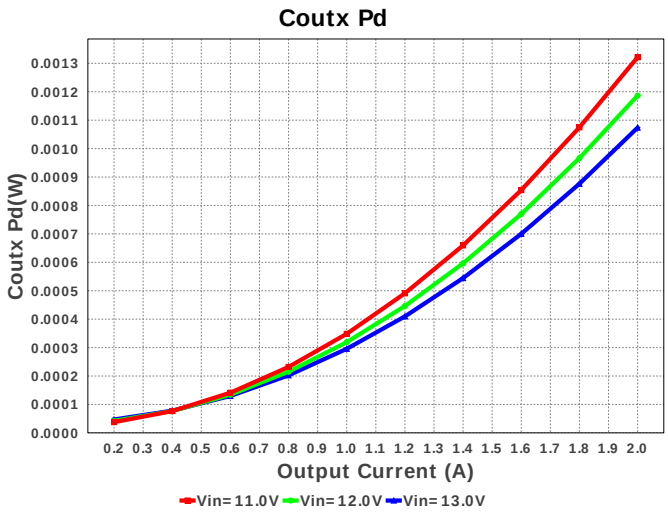


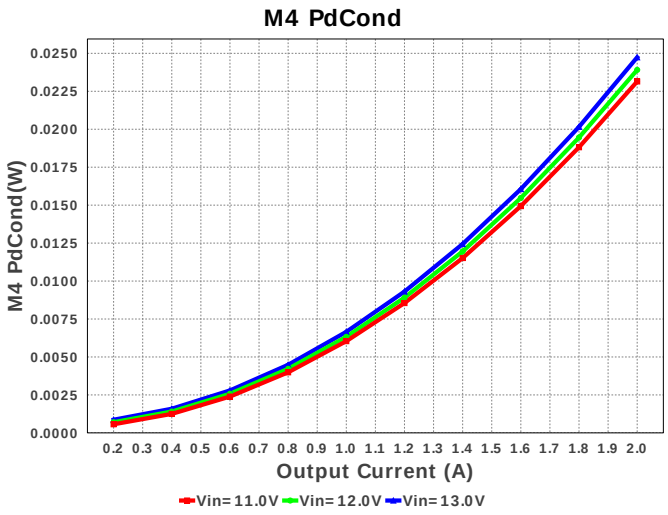


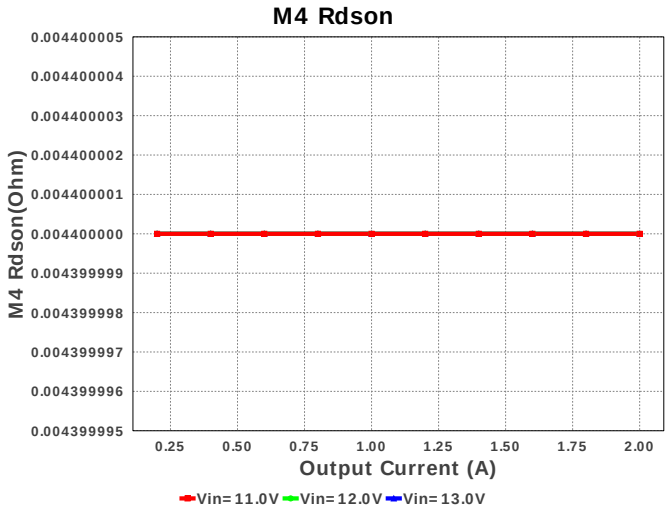


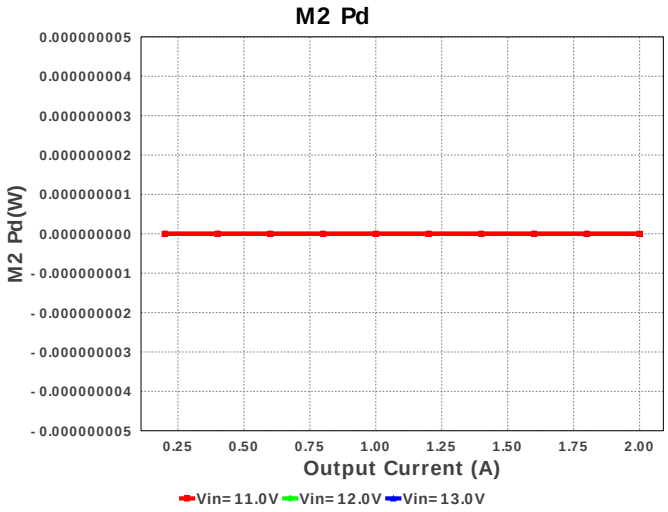


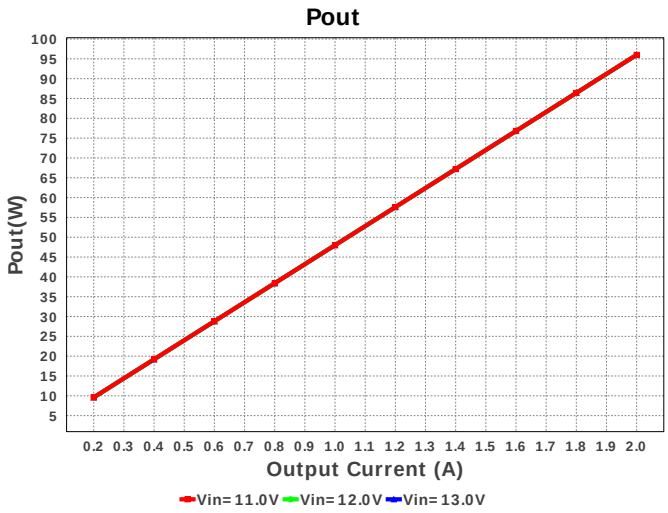


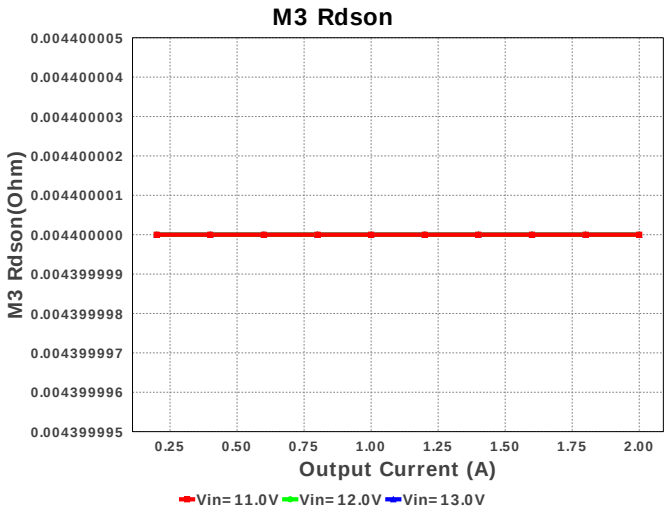


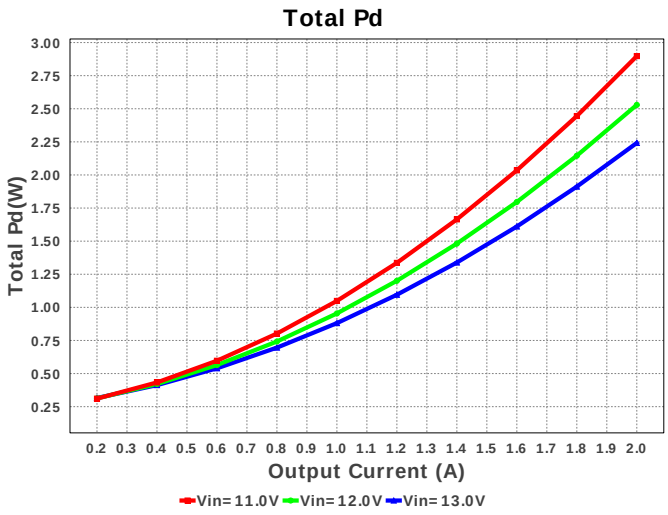


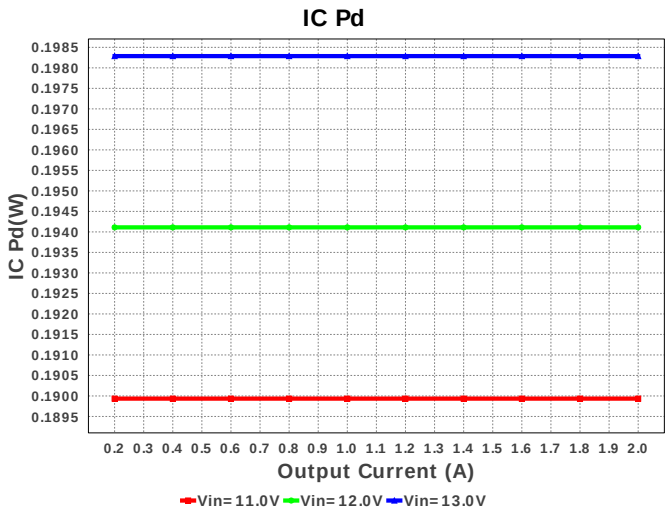


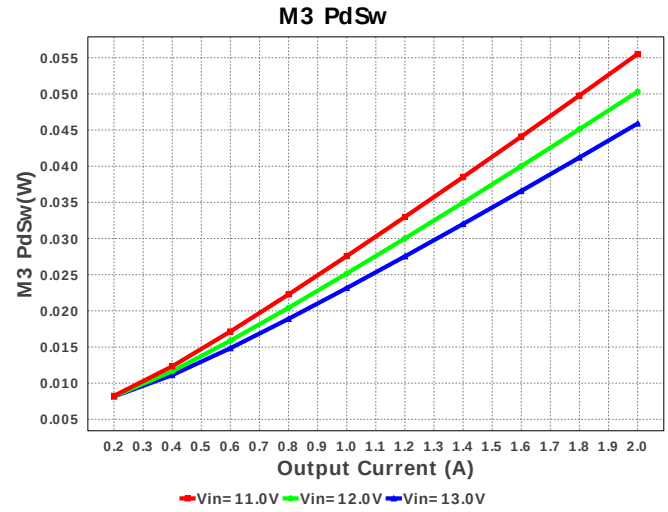


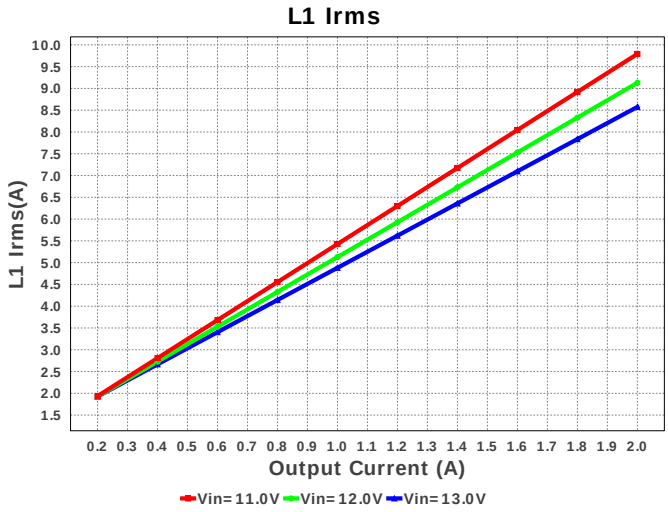


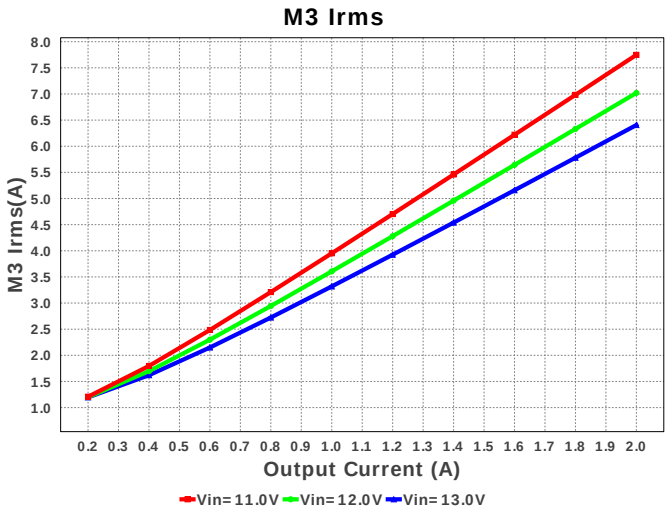


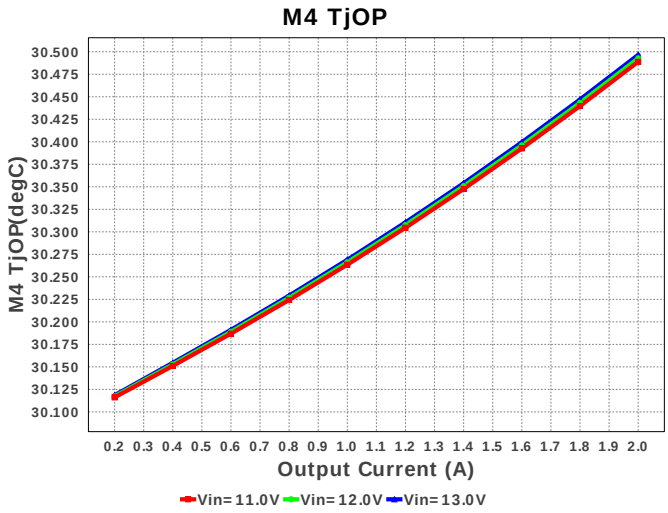


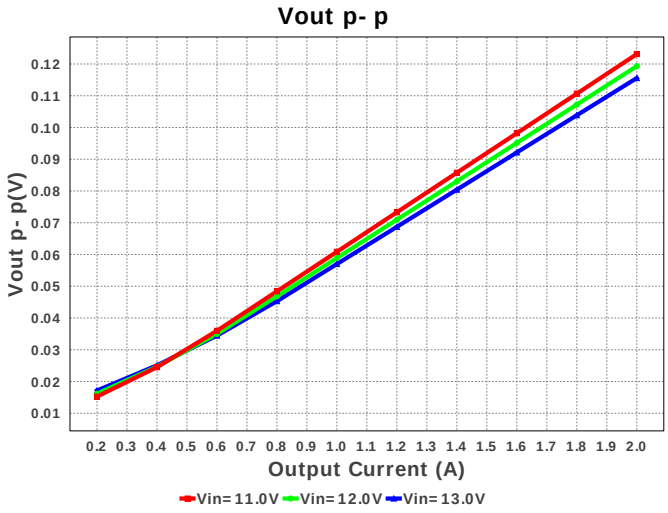


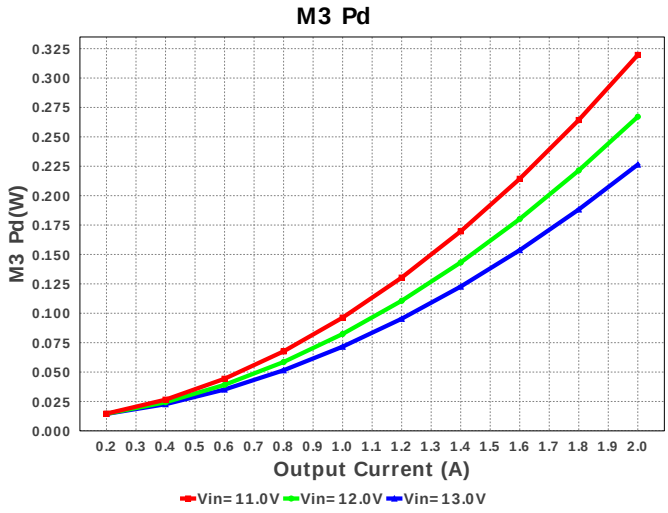


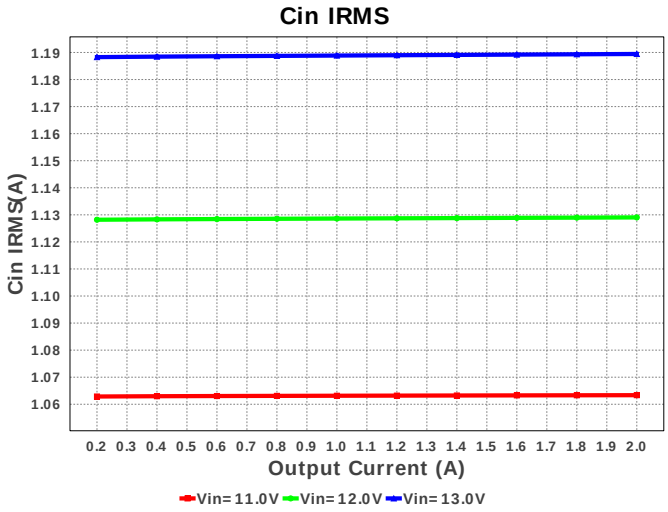


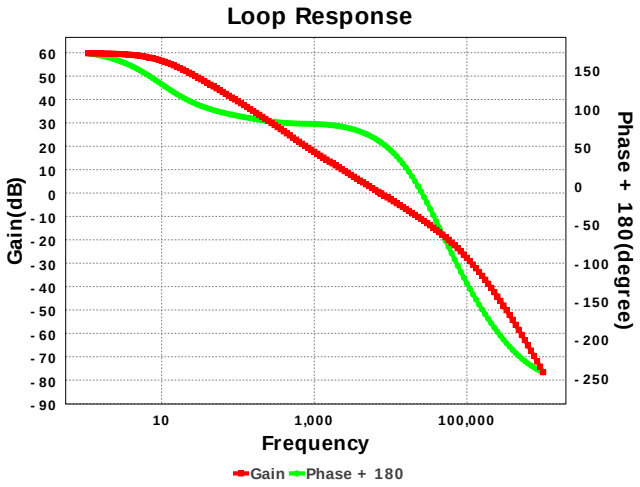












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.257 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.878 A	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	1.474 A	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	8.998 A	Current	Average input current
5.	L Ipp	4.354 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	9.984 A	Current	Inductor ripple current
7.	M3 Irms	7.802 A	Current	MOSFET RMS ripple current
8.	M4 Irms	2.309 A	Current	MOSFET RMS ripple current
9.	SW Ipk	9.582 A	Current	Peak switch current
10.	BOM Count	52	General	Total Design BOM count
11.	FootPrint	1.722 k mm^2	General	Total Foot Print Area of BOM components
12.	Frequency	280.639 kHz	General	Switching frequency
13.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
14.	M3 ThetaJA	55.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
15.	M4 ThetaJA	55.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
16.	Mode	CCM	General	Conduction Mode
17.	Pout	96.0 W	General	Total output power
18.	Total BOM	$20.48	General	Total BOM Cost
19.	Low Freq Gain	59.743 dB	Op_Point	Gain at 10Hz
20.	M3 TjOP	32.026 degC	Op_Point	MOSFET junction temperature
21.	M4 TjOP	30.596 degC	Op_Point	MOSFET junction temperature
22.	Vout Actual	48.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	48.0 V	Op_Point	Operational Output Voltage
24.	Cross Freq	7.353 kHz	Op_point	Bode plot crossover frequency
25.	Duty Cycle	72.994 %	Op_point	Duty cycle
26.	Efficiency	96.989 %	Op_point	Steady state efficiency
27.	Gain Marg	-10.273 dB	Op_point	Bode Plot Gain Margin
28.	IC Tj	36.048 degC	Op_point	IC junction temperature
29.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
30.	IOUT_OP	2.0 A	Op_point	Iout operating point
31.	Operating Topology	Boost	Op_point	The current operating topology of the device

#	Name	Value	Category	Description
32.	Phase Marg	58.108 deg	Op_point	Bode Plot Phase Margin
33.	VIN_OP	11.0 V	Op_point	Vin operating point
34.	Vout p-p	115.495 mV	Op_point	Peak-to-peak output ripple voltage
35.	Cin Pd	6.896 mW	Power	Input capacitor power dissipation
36.	Cout Pd	4.661 mW	Power	Output capacitor power dissipation
37.	Coutx Pd	1.078 mW	Power	Output capacitor_x power loss
38.	D2 Pd	0.0 W	Power	Diode power dissipation
39.	D3 Pd	0.0 W	Power	Diode power dissipation
40.	IC Pd	198.287 mW	Power	IC power dissipation
41.	L Pd	1.166 W	Power	Inductor power dissipation
42.	M1 Pd	438.596 mW	Power	M1 MOSFET total power dissipation
43.	M1 PdCond	438.596 mW	Power	M1 MOSFET conduction losses
44.	M2 Pd	0.0 W	Power	M2 MOSFET total power dissipation
45.	M3 Pd	323.715 mW	Power	MOSFET power dissipation
46.	M3 PdCond	267.814 mW	Power	M1 MOSFET conduction losses
47.	M3 PdSw	55.901 mW	Power	M1 MOSFET switching losses
48.	M3 Rdson	4.4 mOhm	Power	Drain-Source On-resistance
49.	M4 Pd	292.88 mW	Power	MOSFET power dissipation
50.	M4 PdCond	23.467 mW	Power	M2 MOSFET conduction losses
51.	M4 PdSw	0.0 W	Power	M2 MOSFET switching losses
52.	M4 Rdson	4.4 mOhm	Power	Drain-Source On-resistance
53.	Rsense Pd	547.801 mW	Power	LED Current Rsns Power Dissipation
54.	Total Pd	2.98 W	Power	Total Power Dissipation
55.	Vout Tolerance	1.986 %		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	13.0	Maximum input voltage
3.	VinMin	11.0	Minimum input voltage
4.	Vout	48.0	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.