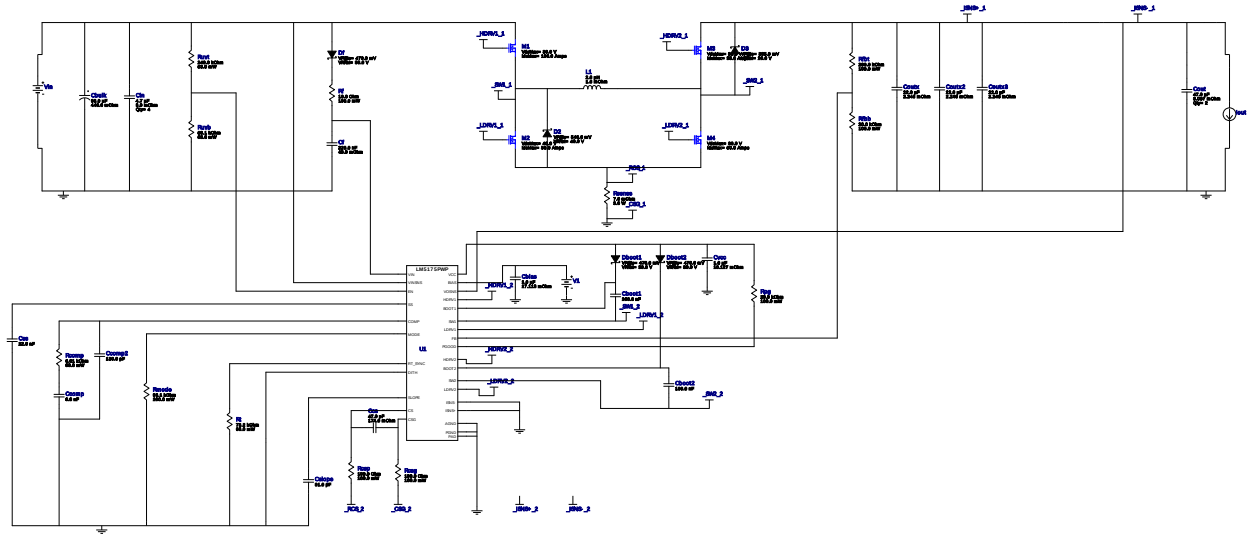
WEBENCH® Design Report

VinMin = 6.0V
VinMax = 20.0V
Vout = 12.0V
Iout = 6.0A

Device = LM5175PWPR
Topology = Buck_Boost
Created = 1/10/17 1:46:39 PM
BOM Cost = $12.67
BOM Count = 43
Total Pd = 0.99W

Design : 4875907/3 LM5175PWPR
LM5175PWPR 6.0V-20.0V to 12.00V @ 6.0A



My Comments

No comments

Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	0603 5 mm²
2.	Cboot1	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
3.	Cboot2	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
4.	Cbulk	Nichicon	UUD1E680MCL1GS Series= uD	Cap= 68.0 uF ESR= 440.0 mOhm VDC= 25.0 V IRMS= 230.0 mA	1	$0.11	SM_RADIAL_6.3AMM 80 mm²
5.	Ccomp	Yageo America	CC0805KRX7R9BB682 Series= X7R	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	Ccomp2	Samsung Electro-Mechanics	CL21C131JBANNNC Series= C0G/NP0	Cap= 130.0 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	Kemet	C0805C224K5RACTU Series= X7R	Cap= 220.0 nF ESR= 46.0 mOhm VDC= 50.0 V IRMS= 2.65 A	1	$0.02	0805 7 mm²

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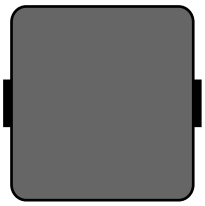
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	4	$0.07	 1206 11 mm²
10.	Cout	MuRata	GRM32ER61C476ME15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	2	$0.24	 1210_280 15 mm²
11.	Coutx	TDK	C3216JB1E226M Series= JB	Cap= 22.0 uF ESR= 2.246 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.55	 1206 11 mm²
12.	Coutx2	TDK	C3216JB1E226M Series= JB	Cap= 22.0 uF ESR= 2.246 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.55	 1206 11 mm²
13.	Coutx3	TDK	C3216JB1E226M Series= JB	Cap= 22.0 uF ESR= 2.246 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.55	 1206 11 mm²
14.	Cslope	Samsung Electro-Mechanics	CL10C910JB8NCNC Series= C0G/NP0	Cap= 91.0 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	Torex USA Corporation	XBS104S13R-G	VF@Io= 540.0 mV VRRM= 40.0 V	1	$0.12	 SOD-323 9 mm²
18.	D3	Comchip Technology	CDBK0520L	VF@Io= 385.0 mV VRRM= 20.0 V	1	$0.07	 SOD-123F 12 mm²
19.	Dboot1	Torex USA Corporation	XBS053V15R-G	VF@Io= 470.0 mV VRRM= 30.0 V	1	$0.12	 SOD-523 5 mm²
20.	Dboot2	Torex USA Corporation	XBS053V15R-G	VF@Io= 470.0 mV VRRM= 30.0 V	1	$0.12	 SOD-523 5 mm²
21.	Df	Torex USA Corporation	XBS053V15R-G	VF@Io= 470.0 mV VRRM= 30.0 V	1	$0.12	 SOD-523 5 mm²
22.	L1	Wurth Elektronik	7443556260	L= 2.6 µH DCR= 1.6 mOhm	1	$4.43	 WE-HCB-18X8.9 410 mm²
23.	M1	Texas Instruments	CSD17310Q5A	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	$0.31	 TRANS_NexFET_Q5A 55 mm²
24.	M2	Texas Instruments	CSD18504Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.33	 TRANS_NexFET_Q5A 55 mm²
25.	M3	Texas Instruments	CSD17577Q3A	VdsMax= 30.0 V IdsMax= 35.0 Amps	1	$0.21	 DNH0008A 18 mm²

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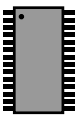
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	M4	Texas Instruments	CSD17575Q3	VdsMax= 30.0 V IdsMax= 60.0 Amps	1	$0.35	 DQG0008A 18 mm^2
27.	Rcomp	Vishay-Dale	CRCW04026K81FKED Series= CRCW..e3	Res= 6.81 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
28.	Rcsg	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
29.	Rcsp	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
30.	Rf	Vishay-Dale	CRCW060310R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
31.	Rfbb	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
32.	Rfbt	Vishay-Dale	CRCW0603280KFKEA Series= CRCW..e3	Res= 280.0 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	Vishay-Dale	CRCW060320K0FKEA Series= CRCW..e3	Res= 20.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
35.	Rsense	Vishay-Dale	WSR37L000FEA Series= WSR	Res= 7.0 mOhm Power= 3.0 W Tolerance= 1.0%	1	$0.64	 4527 122 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	CRCW040268K1FKED Series= CRCW..e3	Res= 68.1 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

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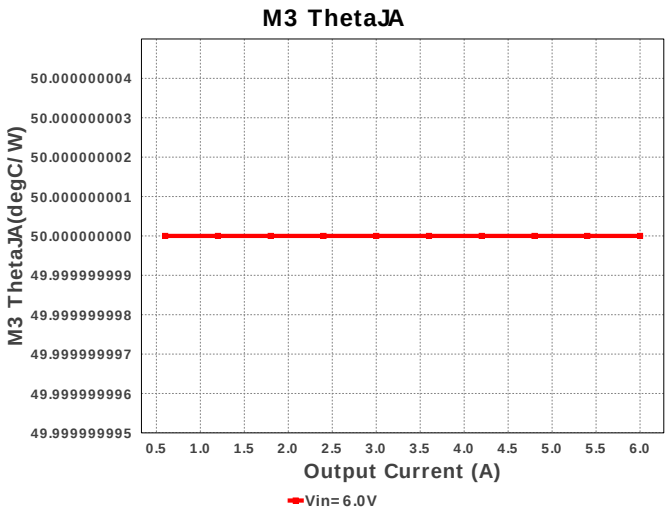

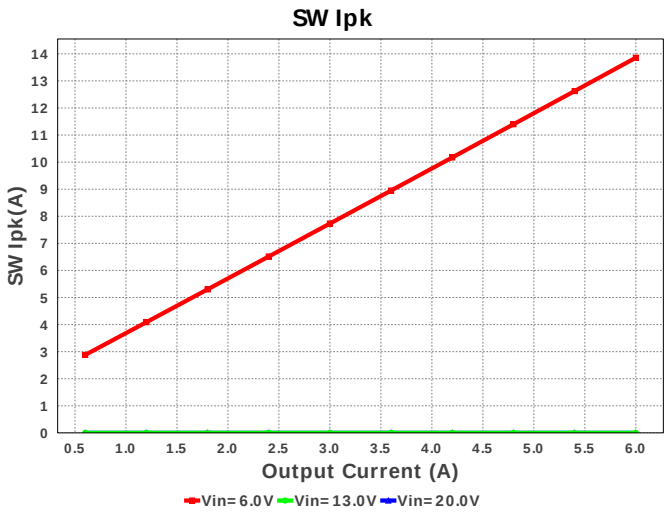

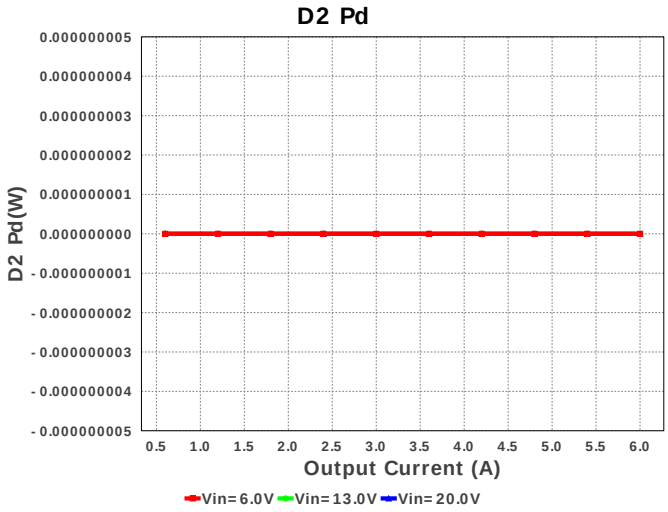

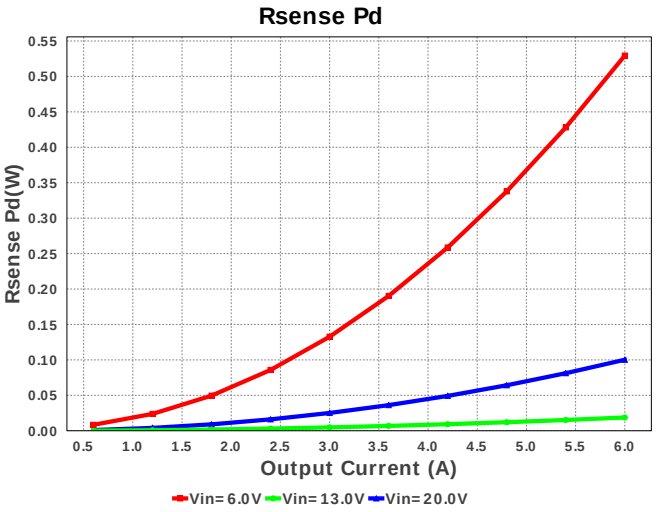

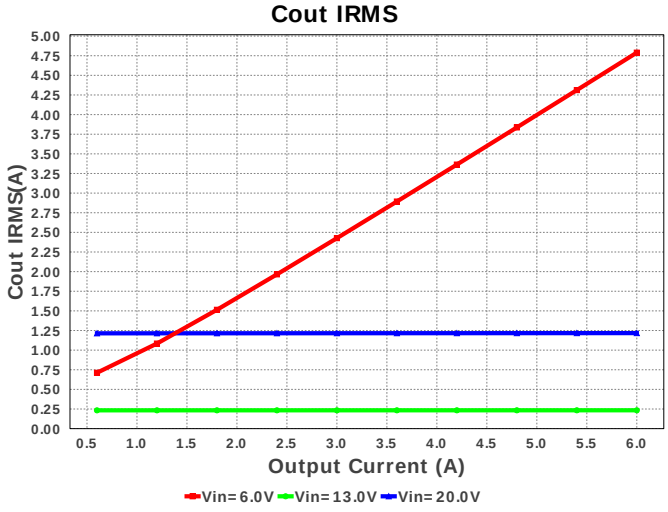

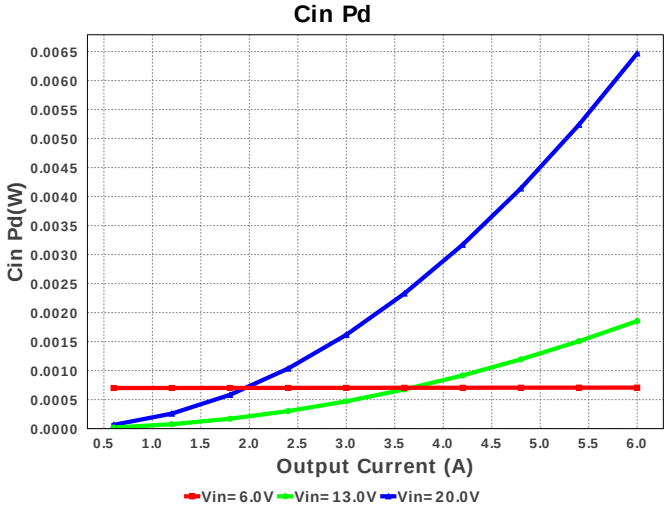

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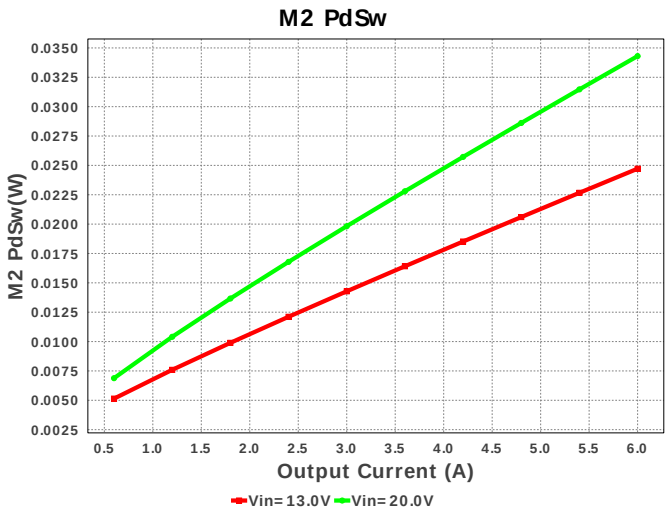

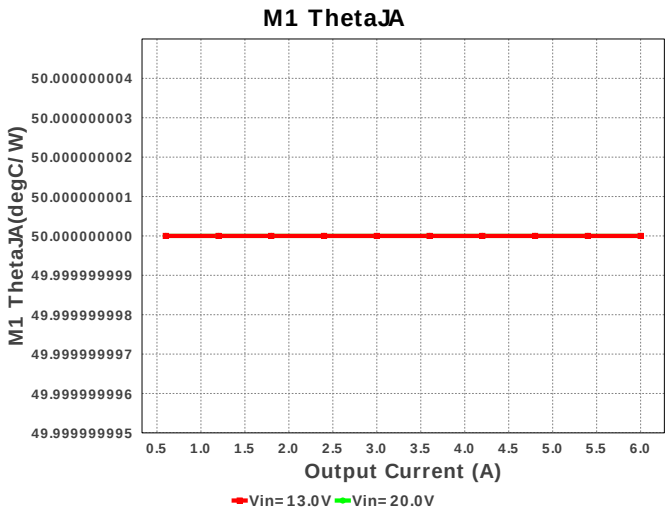

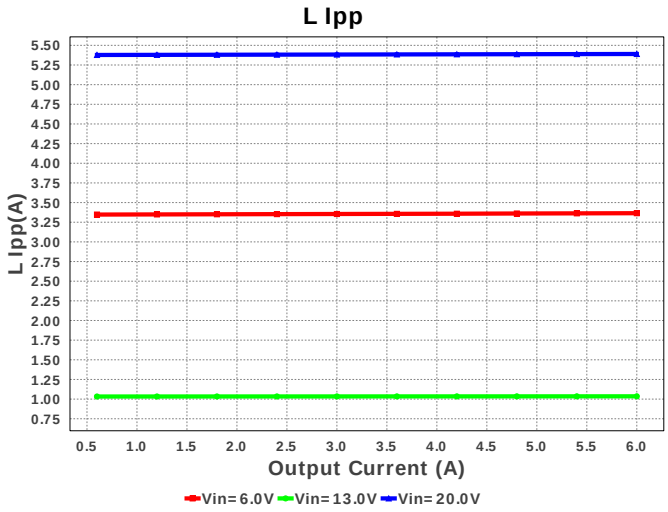

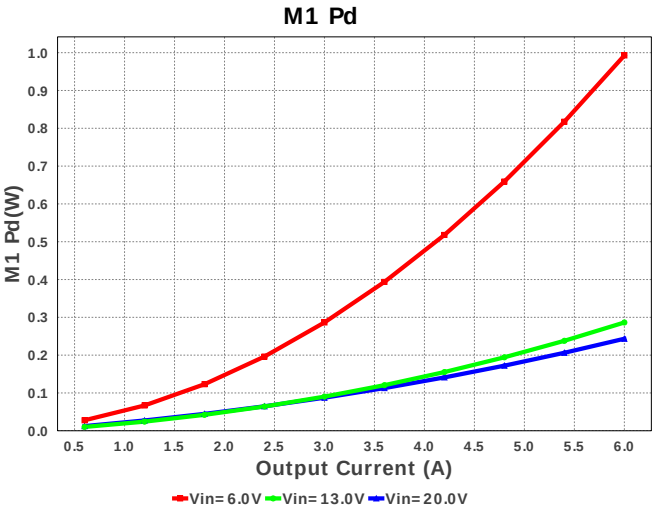

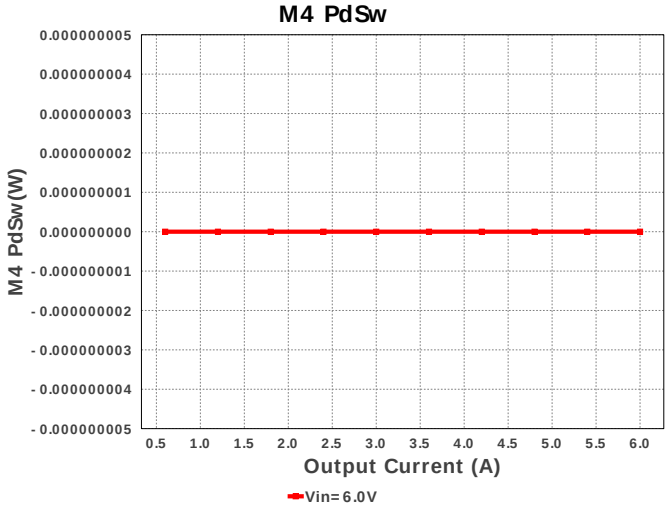

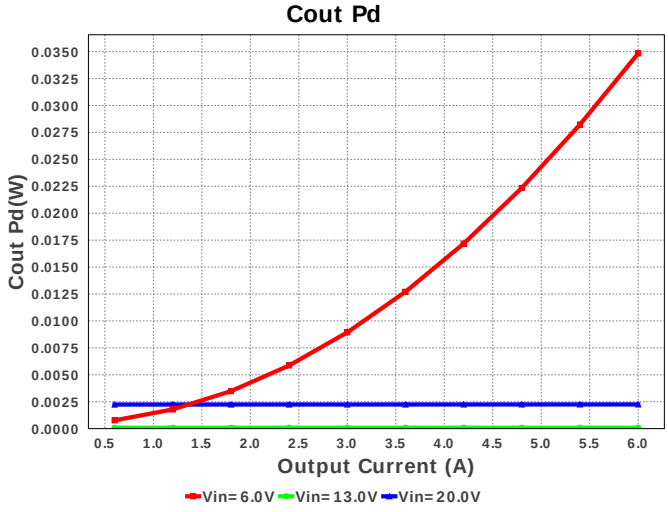

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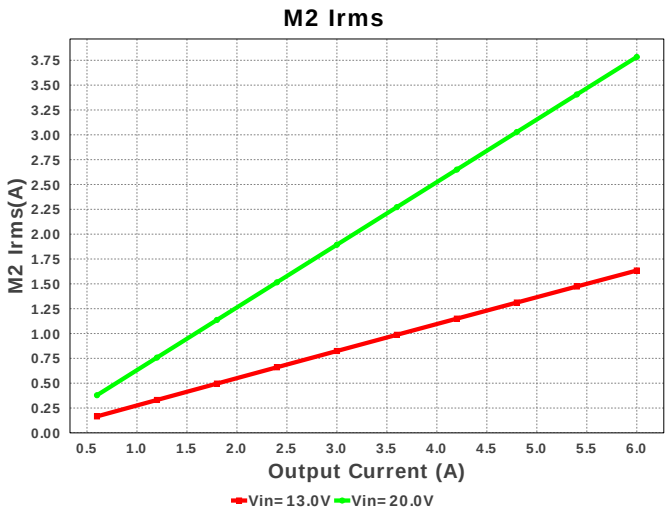

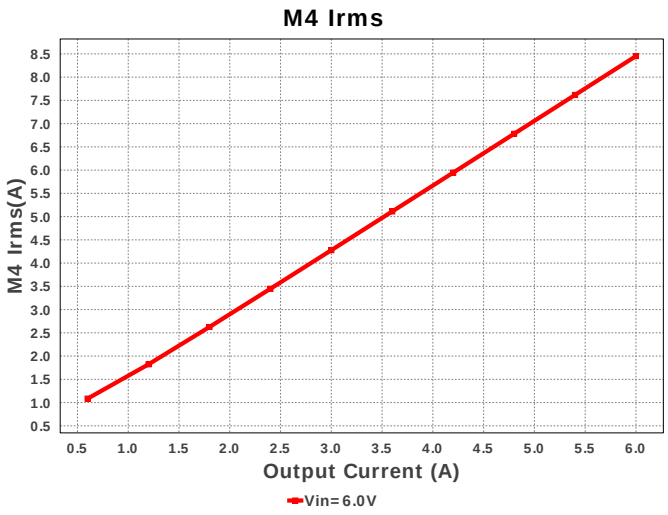

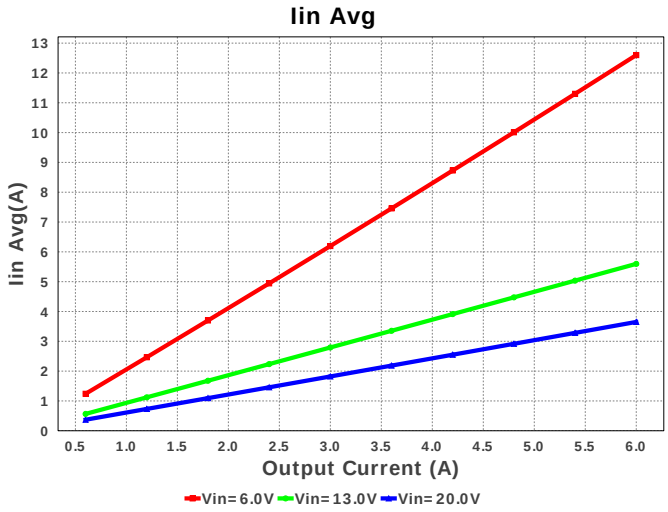

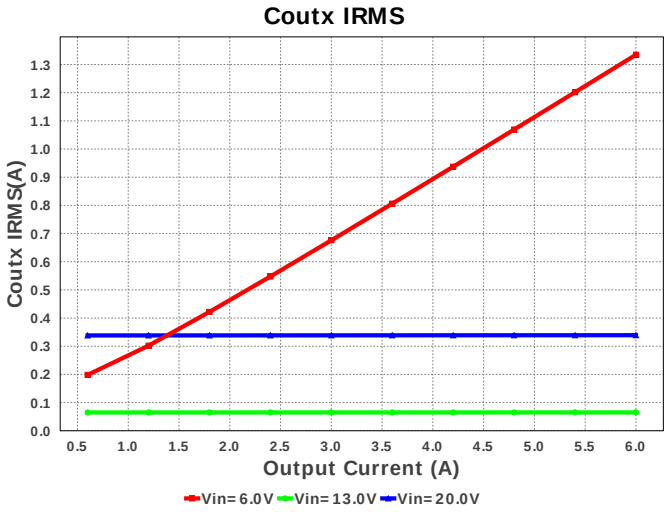

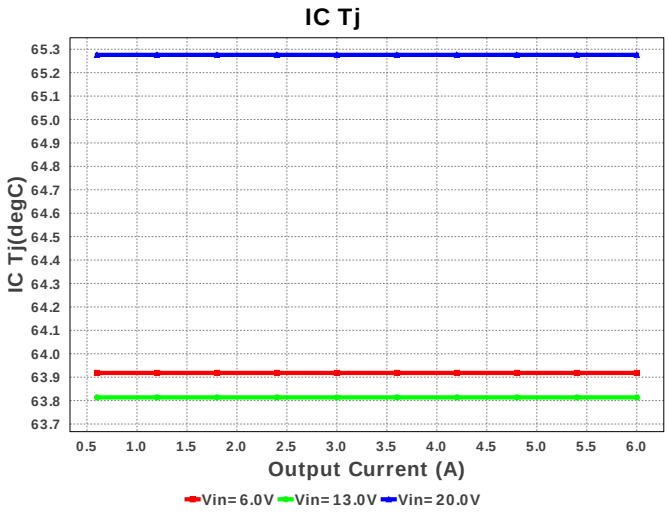

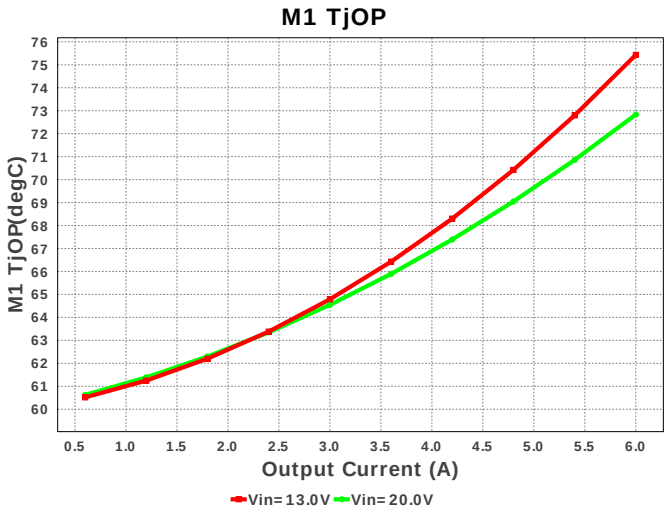

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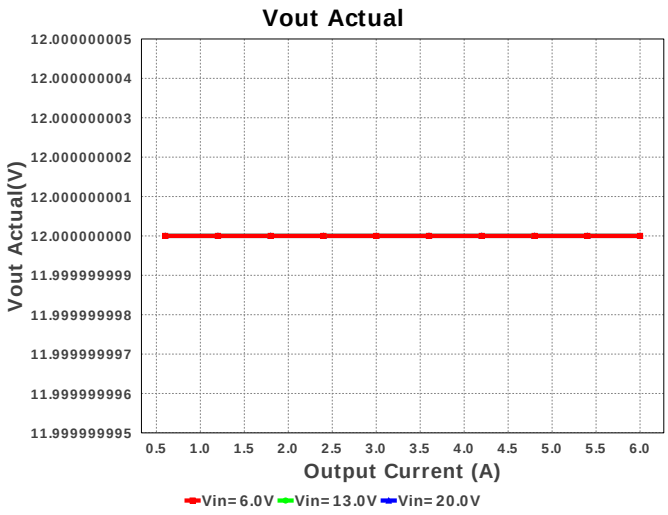

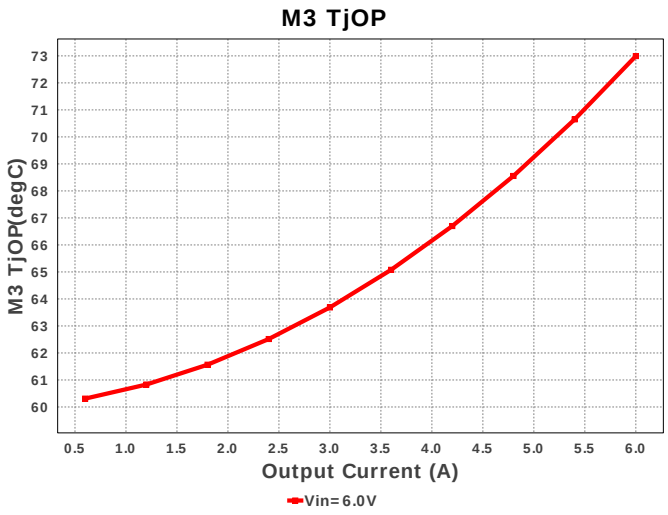

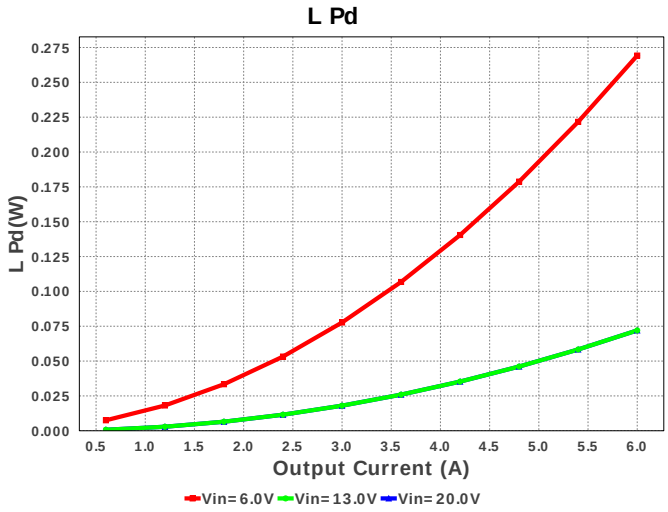

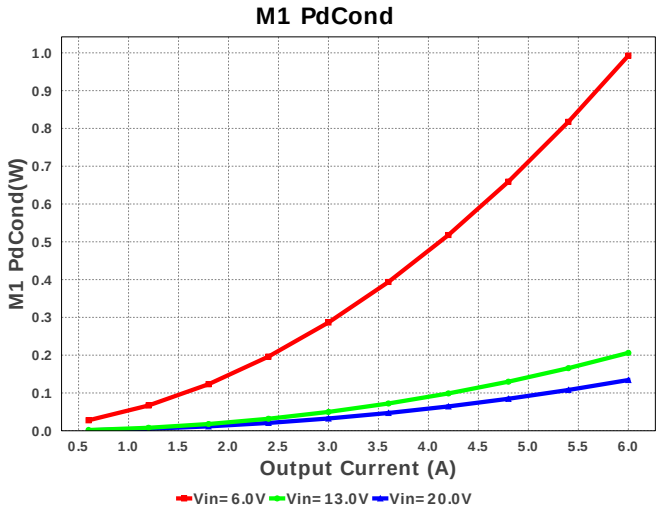

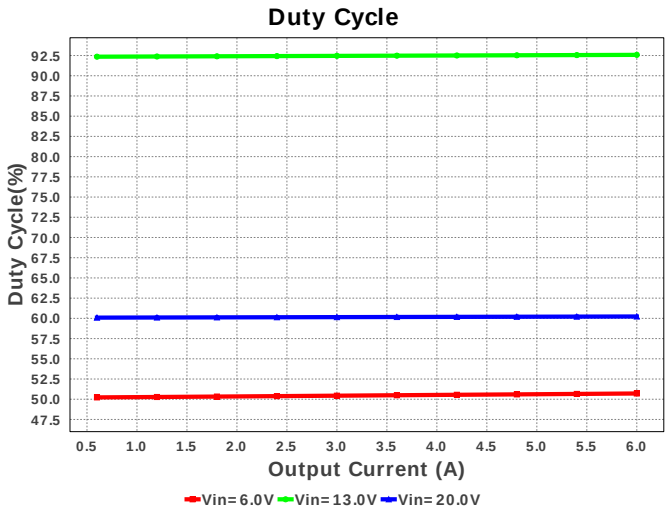

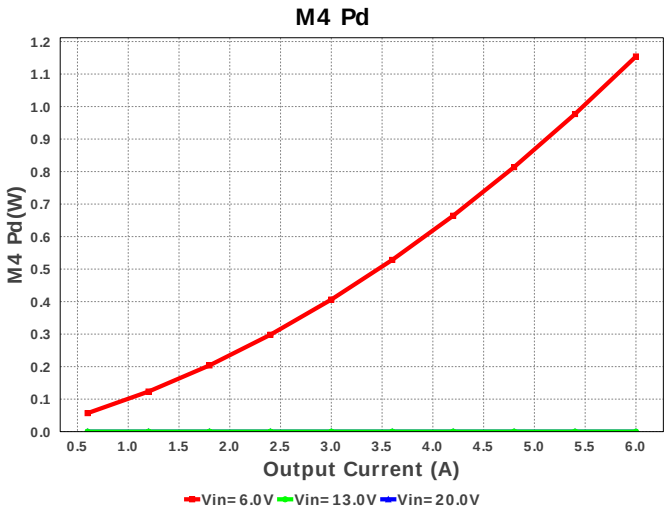

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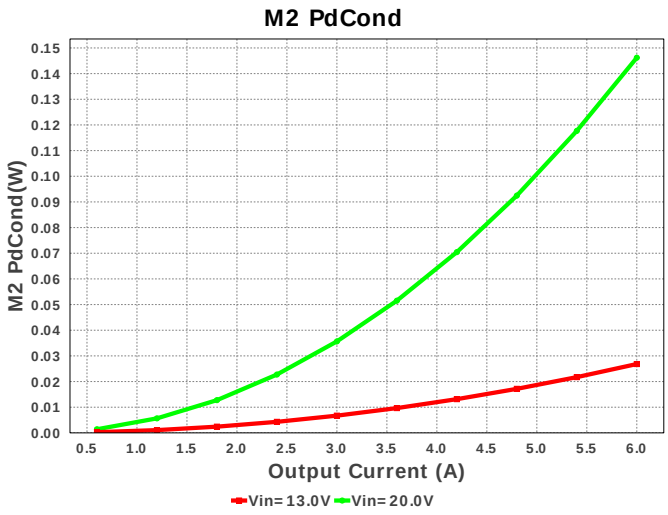

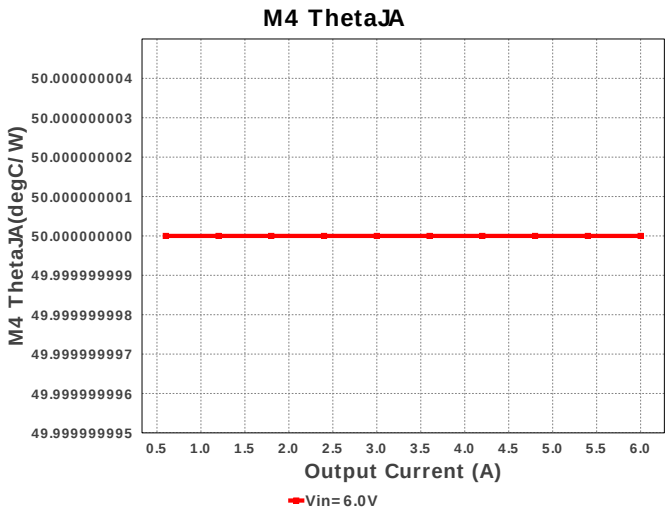

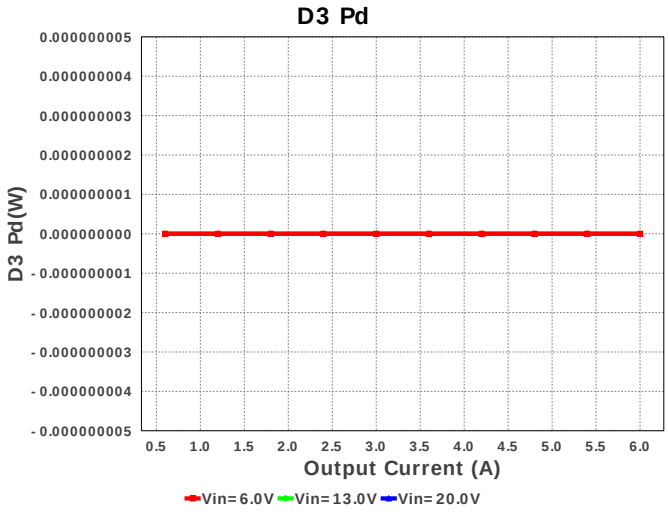

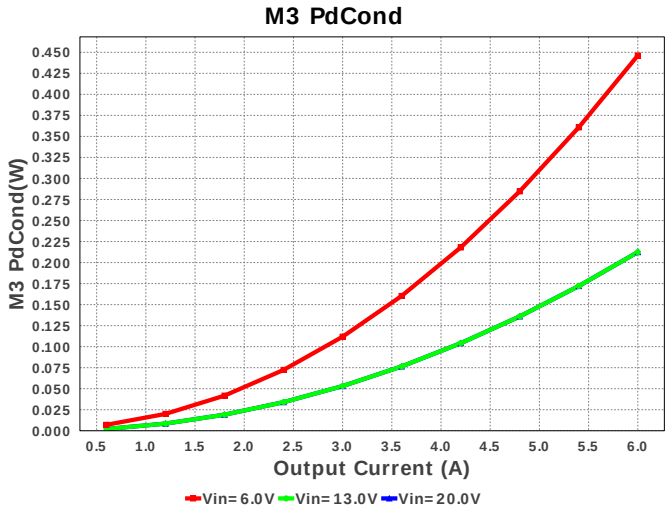

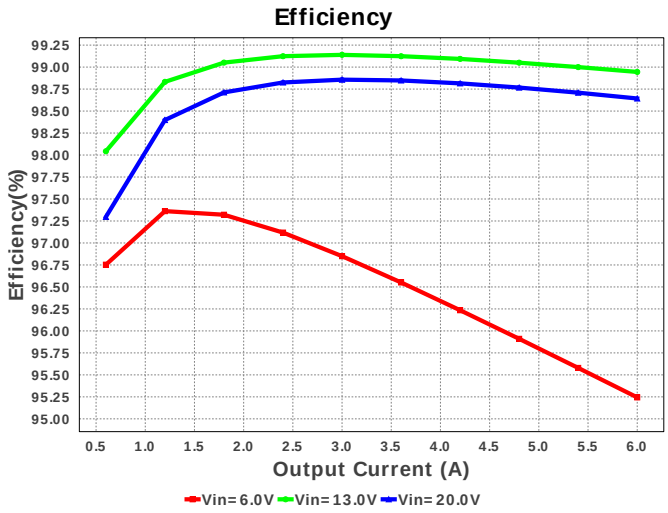

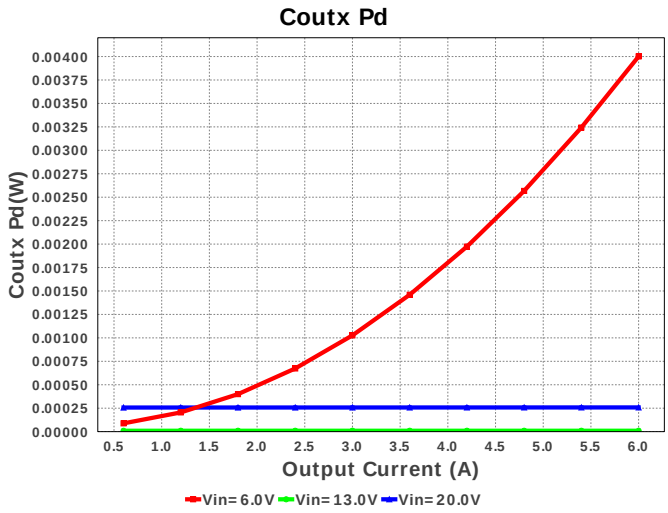

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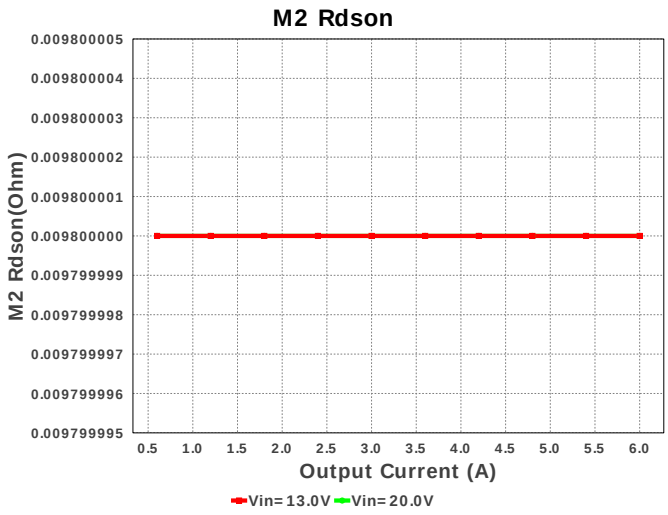

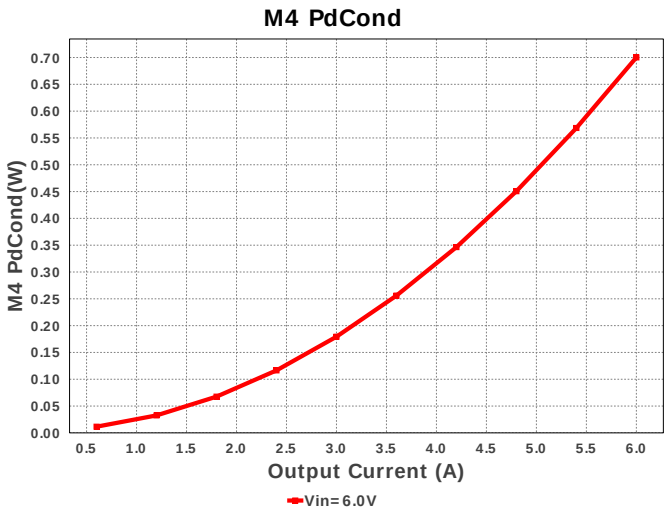

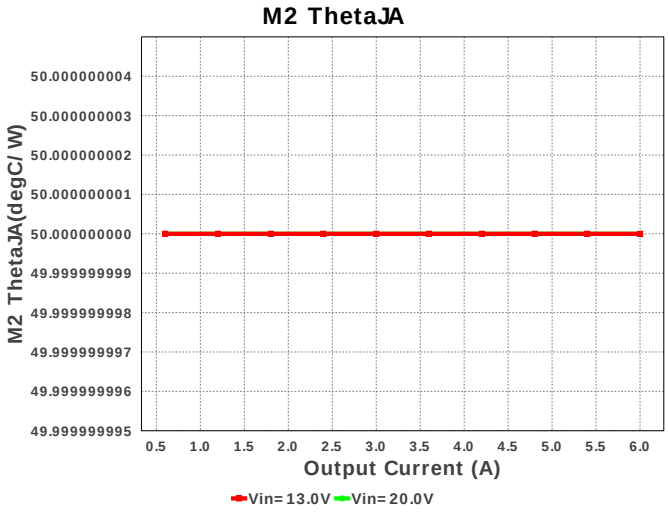

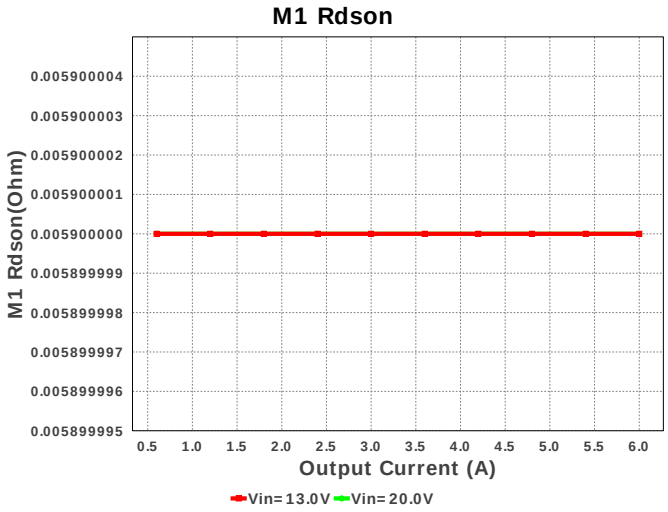

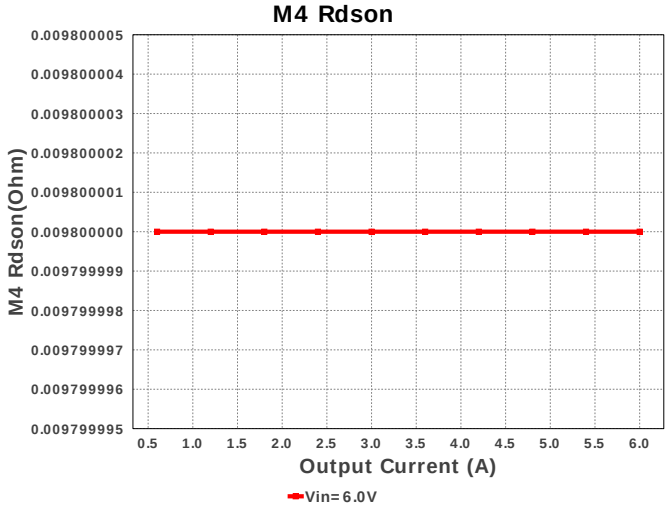

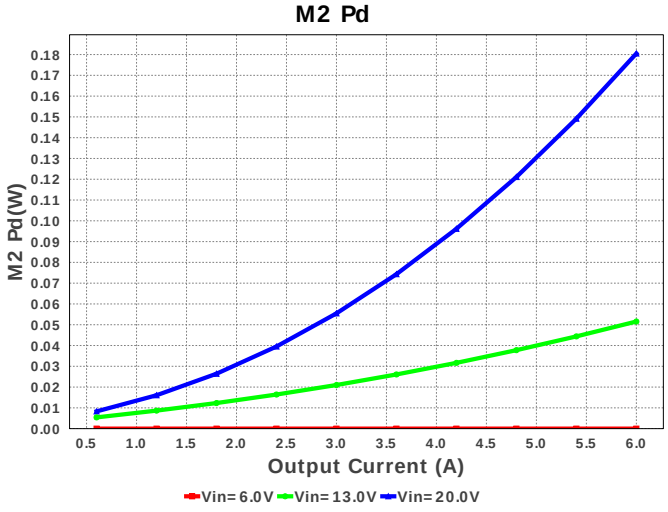

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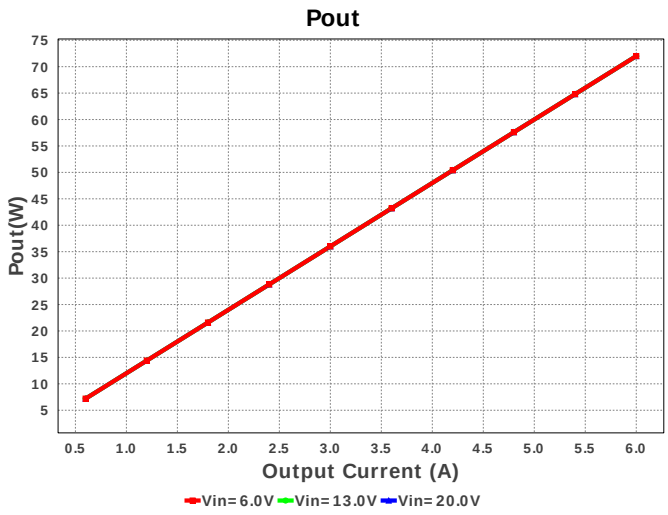

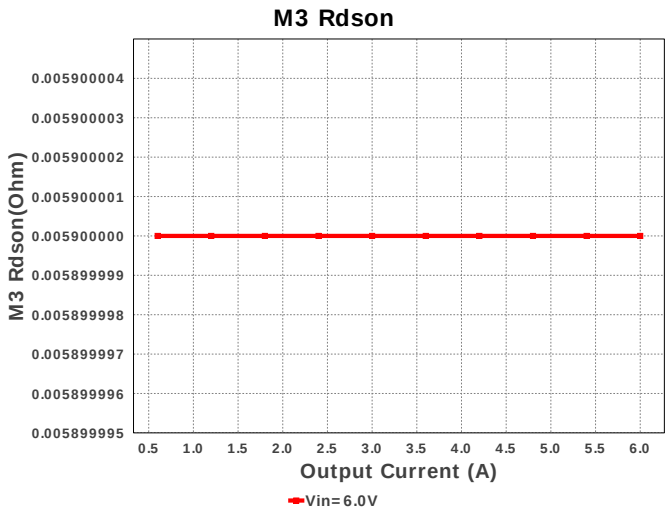

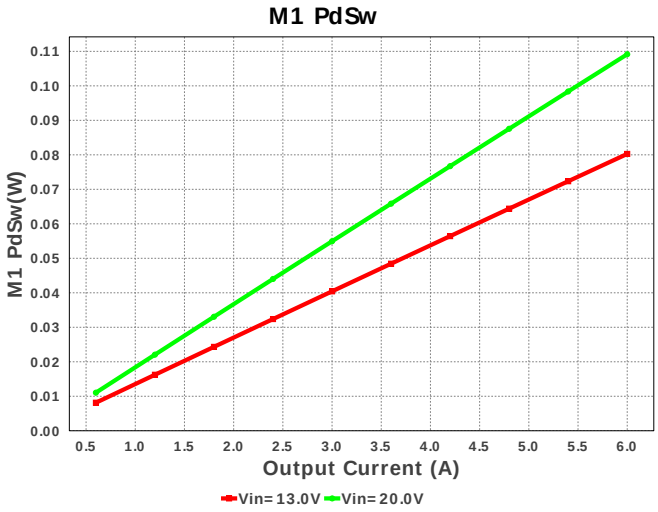

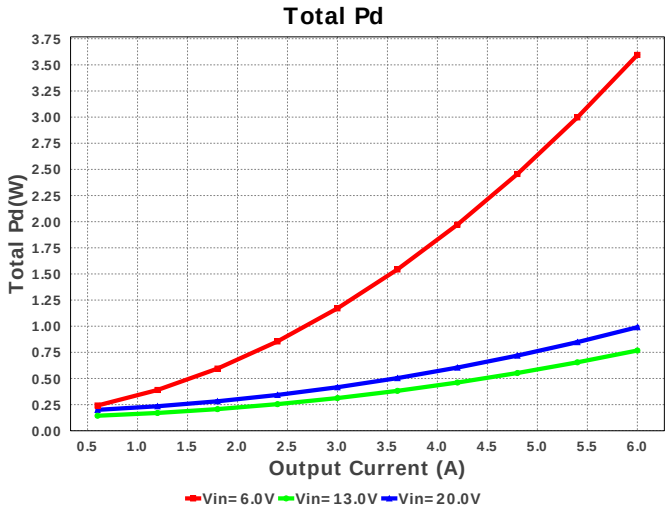

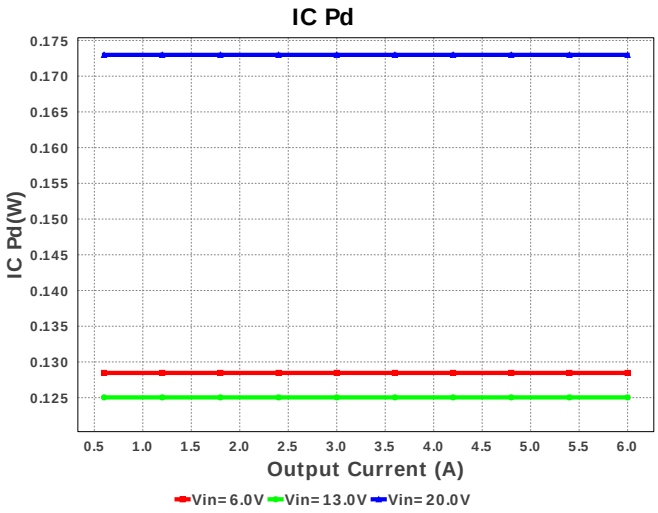

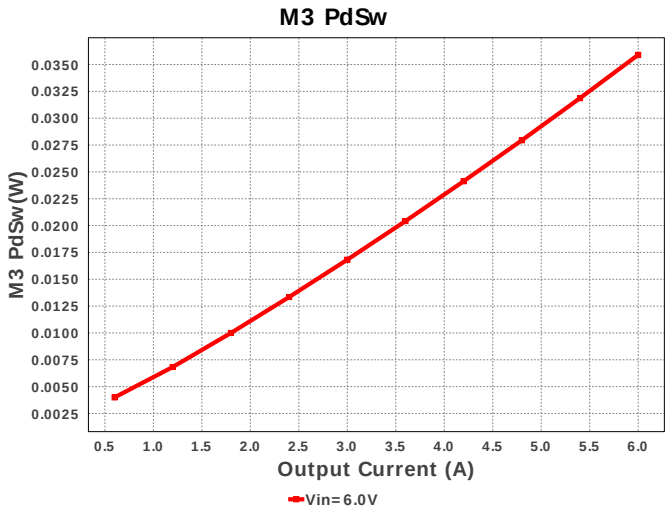

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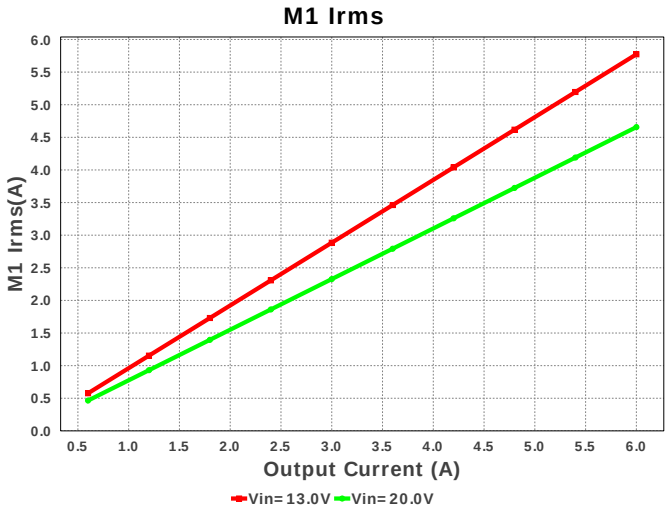

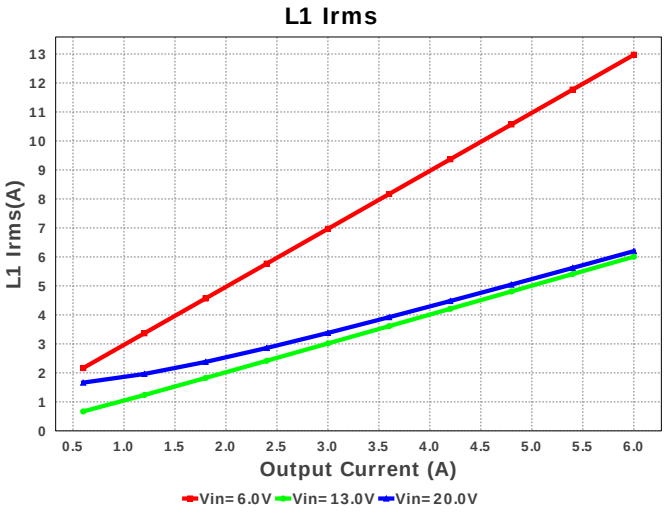

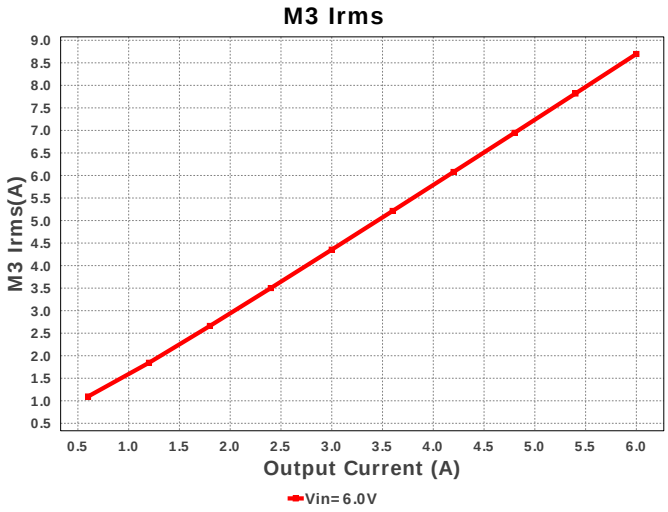

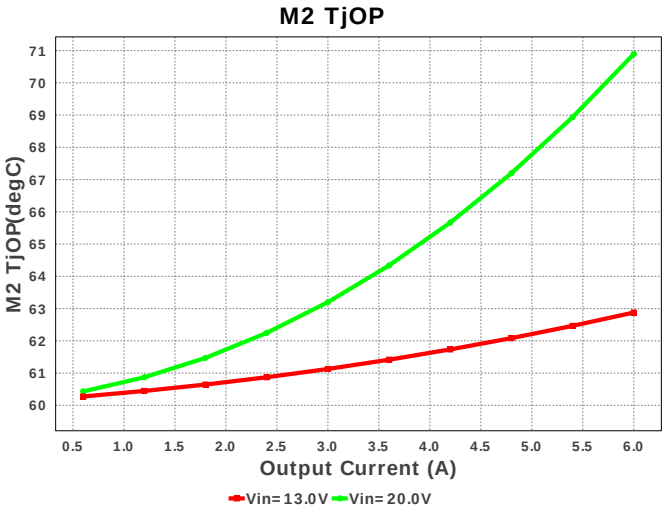

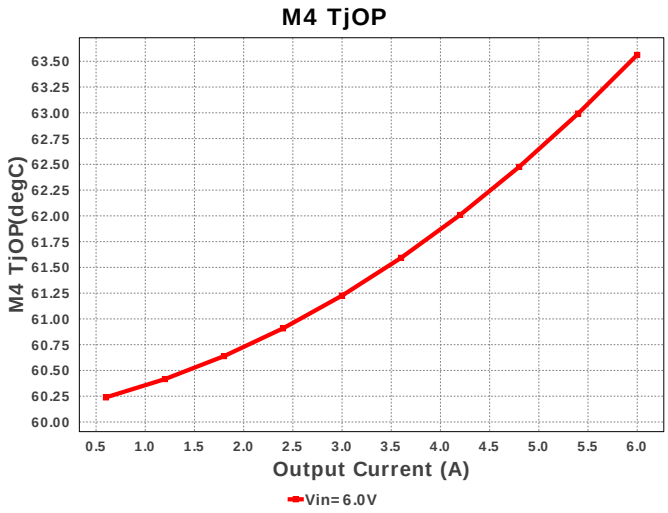

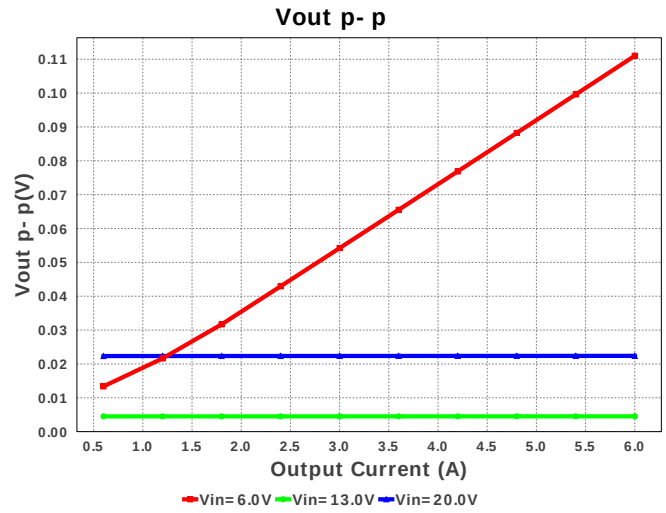

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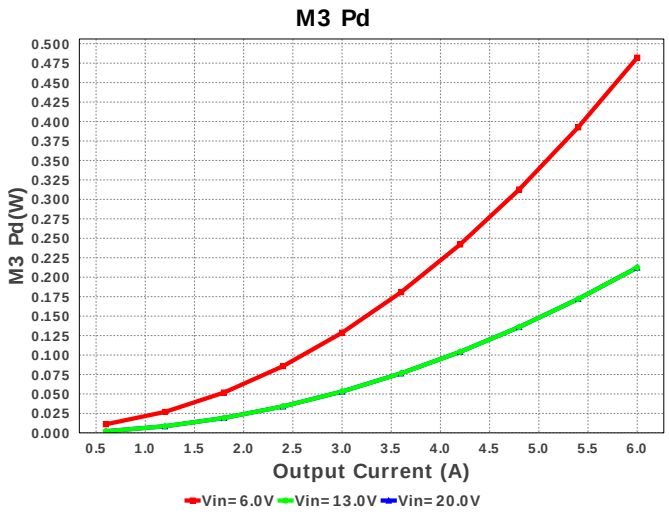

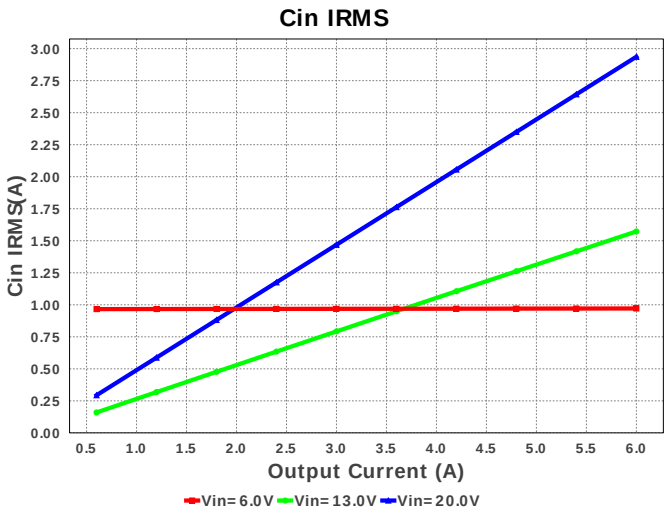

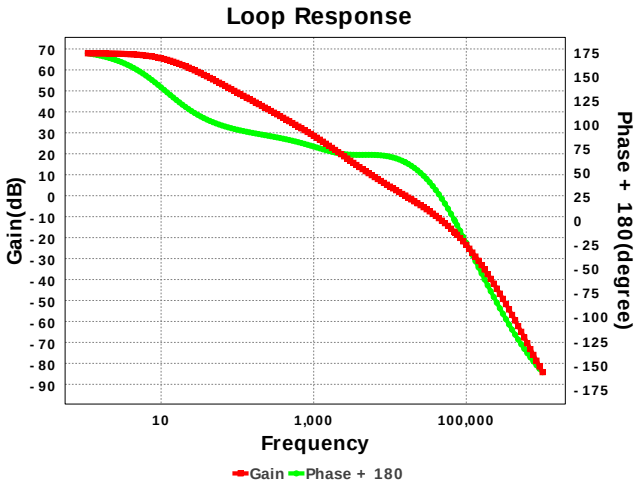

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.937 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	697.331 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	194.33 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	3.65 A	Current	Average input current
5.	L Ipp	3.089 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	6.066 A	Current	Inductor ripple current
7.	M1 Irms	4.657 A	Current	MOSFET RMS ripple current
8.	M2 Irms	3.784 A	Current	MOSFET RMS ripple current
9.	SW Ipk	0.0 A	Current	Peak switch current
10.	BOM Count	43	General	Total Design BOM count
11.	FootPrint	1.097 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	5.9 mOhm	General	Drain-Source On-resistance
15.	M1 ThetaJA	50.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
16.	M2 Rdson	9.8 mOhm	General	Drain-Source On-resistance
17.	M2 ThetaJA	50.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
18.	Mode	CCM	General	Conduction Mode
19.	Pout	72.0 W	General	Total output power
20.	Total BOM	$12.67	General	Total BOM Cost
21.	Low Freq Gain	67.914 dB	Op_Point	Gain at 10Hz
22.	Vout Actual	12.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
24.	Cross Freq	15.802 kHz	Op_point	Bode plot crossover frequency
25.	Duty Cycle	60.232 %	Op_point	Duty cycle
26.	Efficiency	98.637 %	Op_point	Steady state efficiency
27.	Gain Marg	-17.641 dB	Op_point	Bode Plot Gain Margin
28.	IC Tj	65.276 degC	Op_point	IC junction temperature
29.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
30.	IOUT_OP	6.0 A	Op_point	Iout operating point
31.	M1 TjOP	73.439 degC	Op_point	MOSFET junction temperature

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#	Name	Value	Category	Description
32.	M2 TjOP	70.558 degC	Op_point	MOSFET junction temperature
33.	Operating Topology	Buck	Op_point	The current operating topology of the device
34.	Phase Marg	61.42 deg	Op_point	Bode Plot Phase Margin
35.	VIN_OP	20.0 V	Op_point	Vin operating point
36.	Vout p-p	12.827 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	6.467 mW	Power	Input capacitor power dissipation
38.	Cout Pd	738.401 µW	Power	Output capacitor power dissipation
39.	Coutx Pd	84.819 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	172.983 mW	Power	IC power dissipation
43.	L Pd	72.0 mW	Power	Inductor power dissipation
44.	M1 Pd	256.509 mW	Power	MOSFET power dissipation
45.	M1 PdCond	135.488 mW	Power	M1 MOSFET conduction losses
46.	M1 PdSw	121.021 mW	Power	M1 MOSFET switching losses
47.	M2 Pd	173.793 mW	Power	MOSFET power dissipation
48.	M2 PdCond	145.891 mW	Power	M2 MOSFET conduction losses
49.	M2 PdSw	27.902 mW	Power	M2 MOSFET switching losses
50.	M3 Pd	212.4 mW	Power	M3 MOSFET total power dissipation
51.	M3 PdCond	212.4 mW	Power	M3 MOSFET conduction losses
52.	M4 Pd	0.0 W	Power	M4 MOSFET total power dissipation
53.	Rsense Pd	100.216 mW	Power	LED Current Rsns Power Dissipation
54.	Total Pd	994.935 mW	Power	Total Power Dissipation
55.	Vout Tolerance	1.886 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	6.0	Maximum Output Current
2.	VinMax	20.0	Maximum input voltage
3.	VinMin	6.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	LM5175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	60.0	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.

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