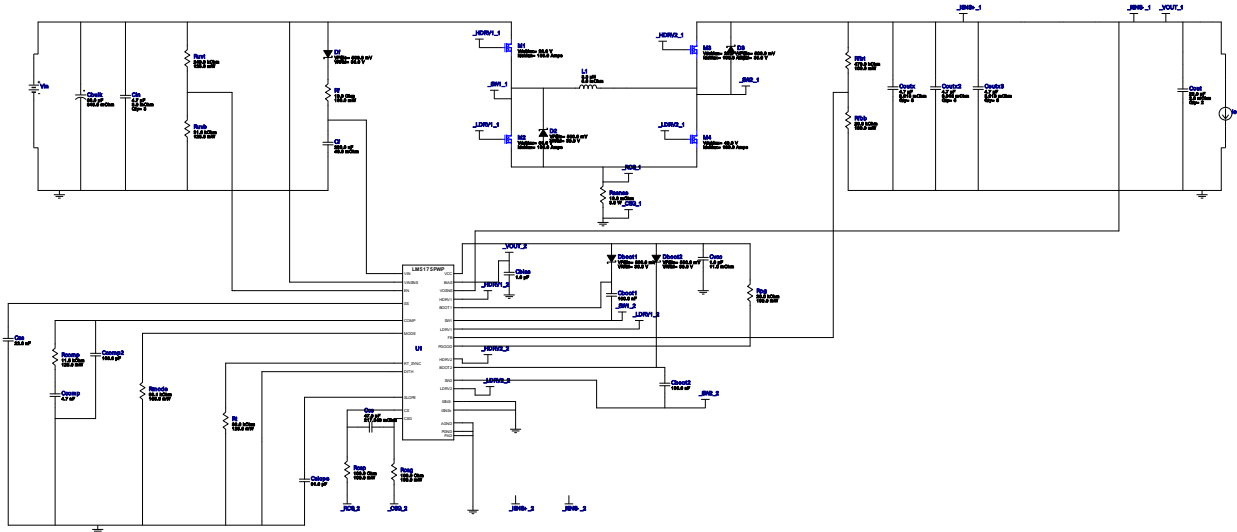



















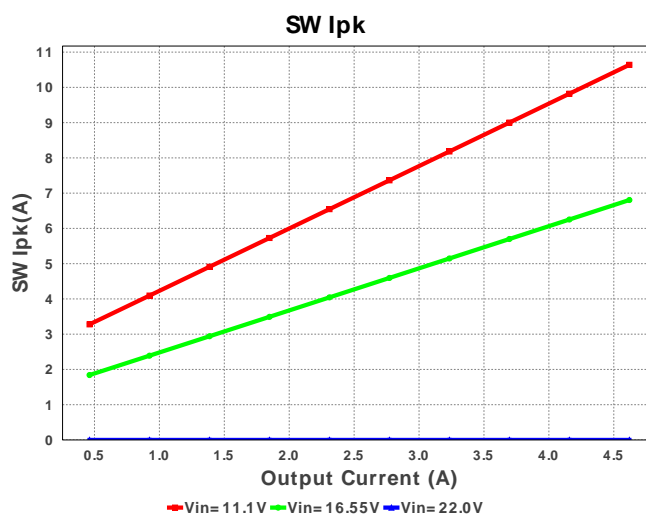
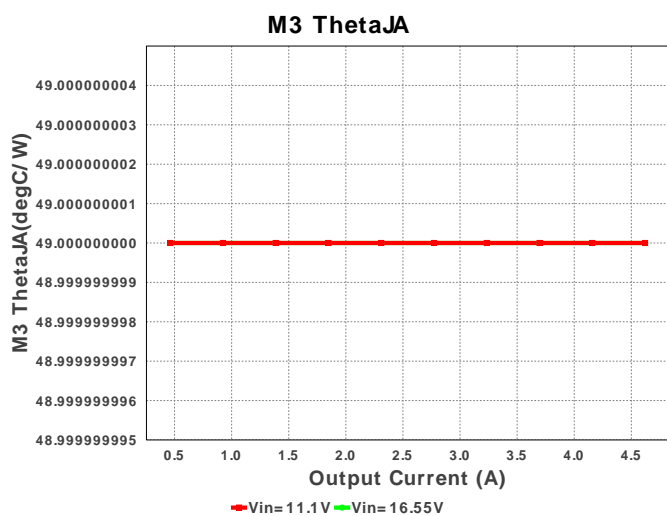
WEBENCH[®] Design Report

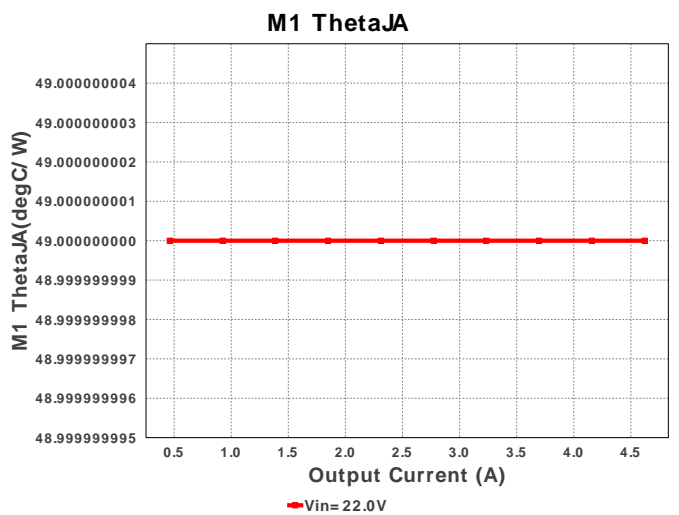
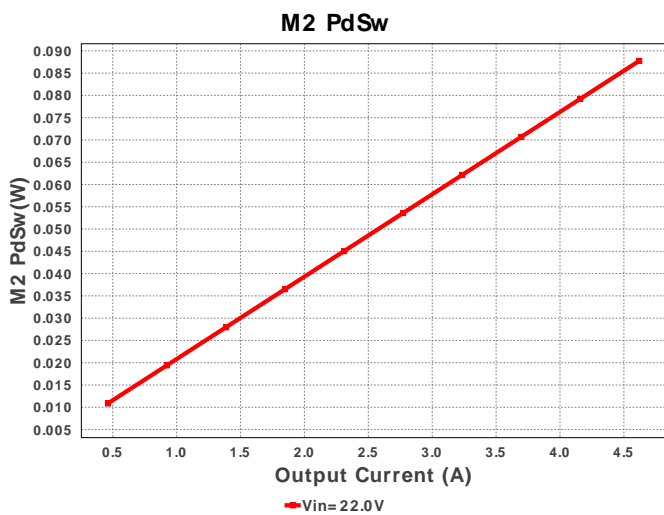
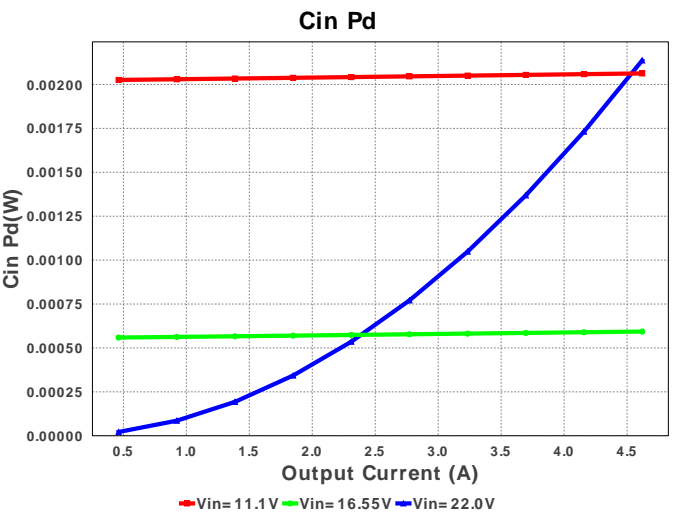
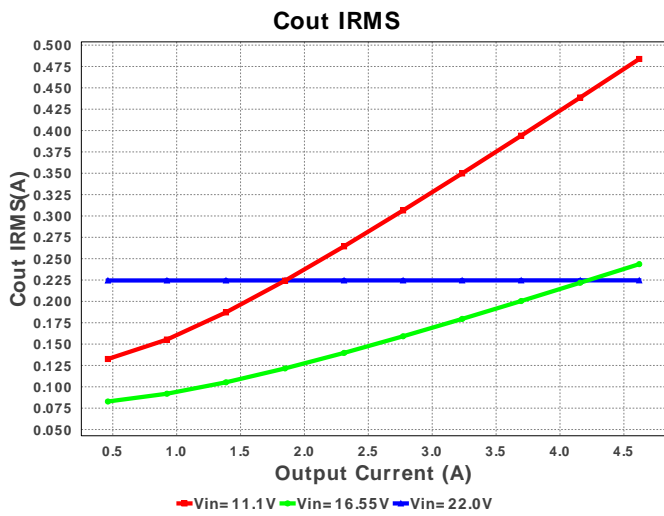
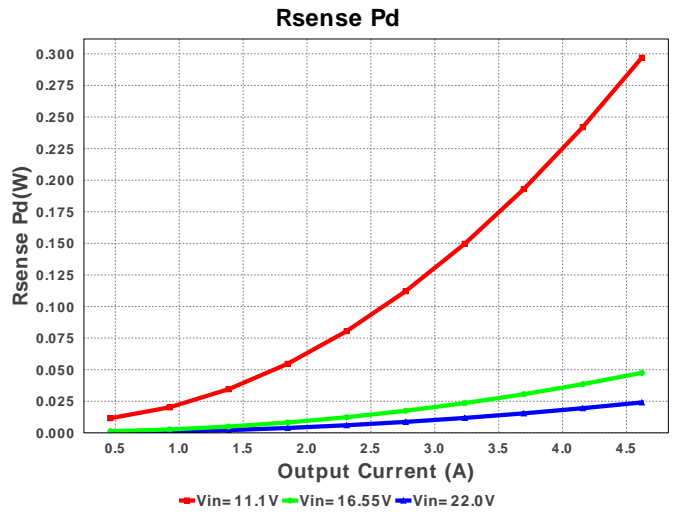
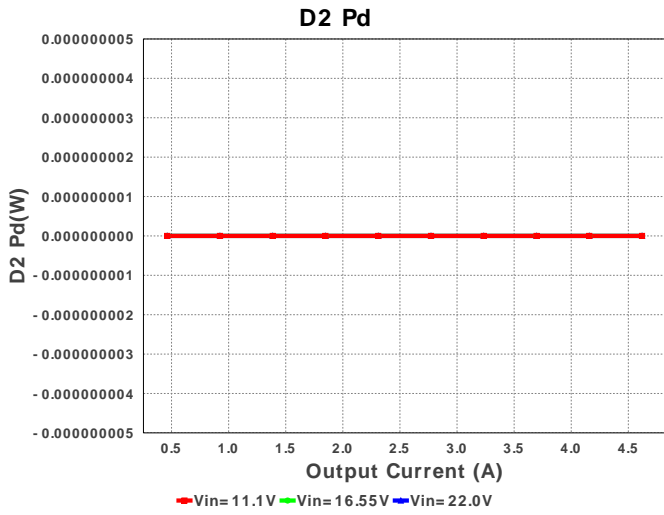
 Design : 1836019/4 LM5175PWPR
 LM5175PWPR 11.1V-22.0V to 19.50V @ 4.62A

Electrical BOM

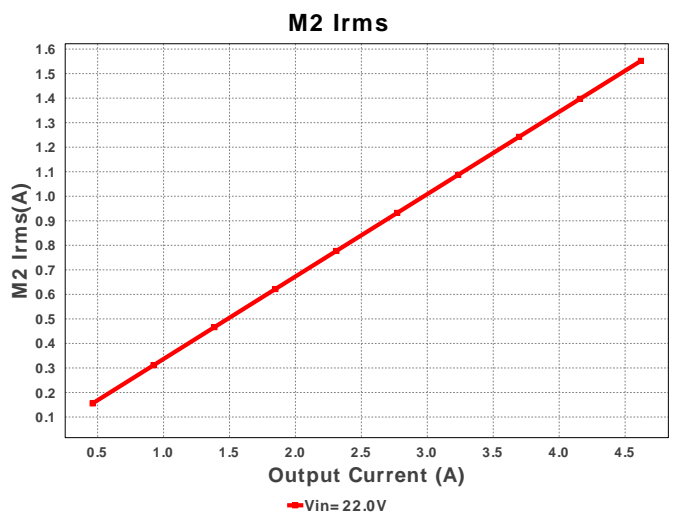
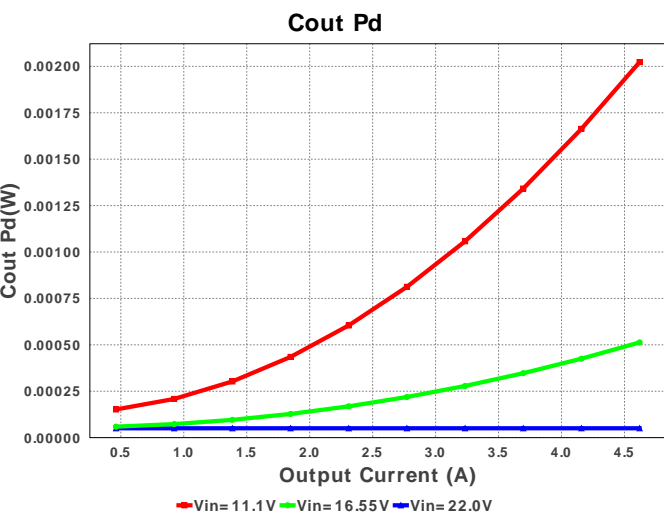
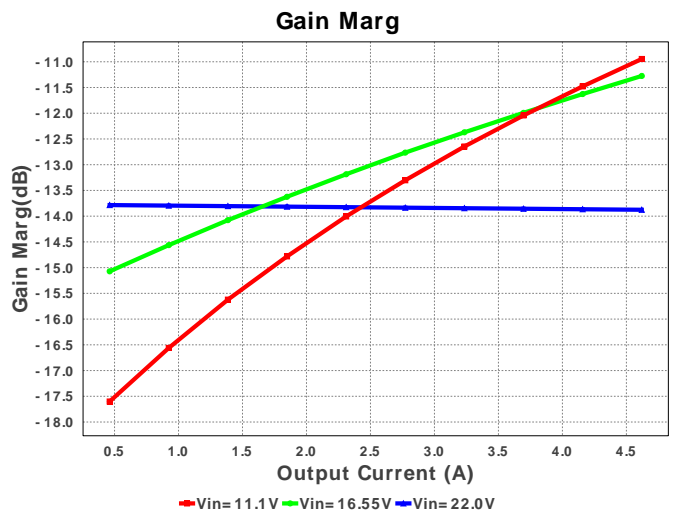
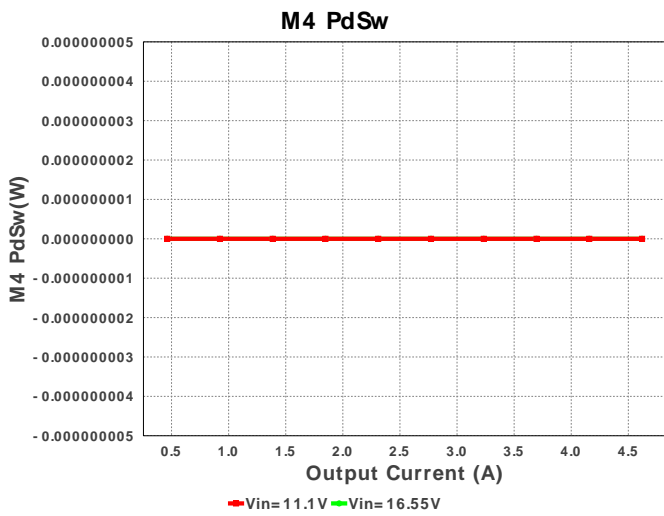
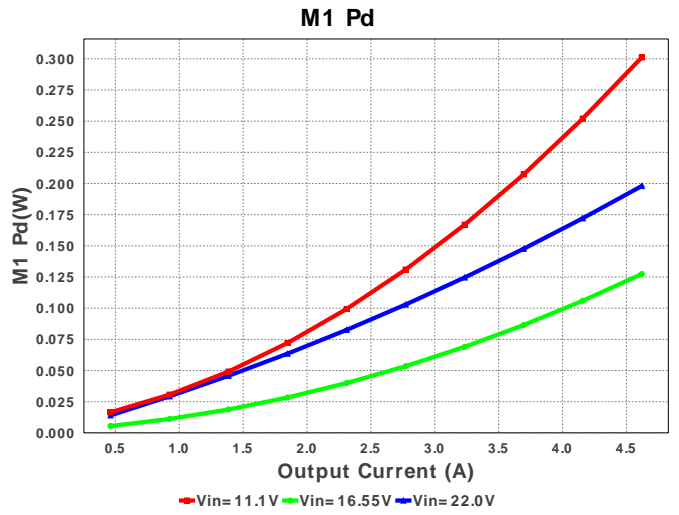
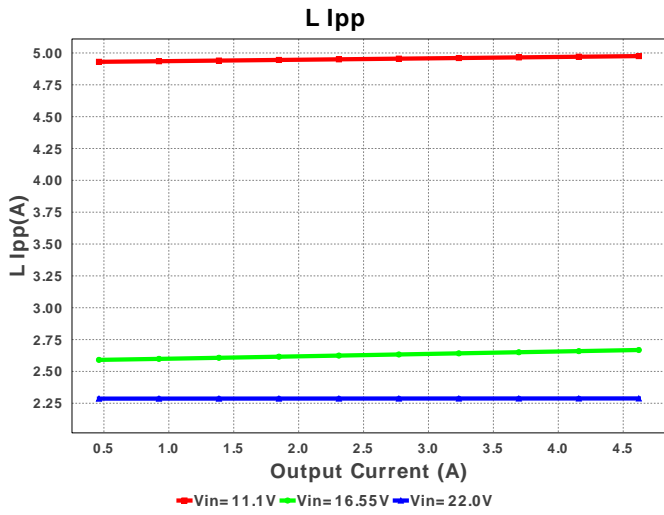
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1.	Cbias	Taiyo Yuden	GMK212B7105KG-T Series= X7R	Cap= 1.0 uF VDC= 35.0 V IRMS= 0.0 A	1	\$0.05	 0805 7 mm ²
2.	Cboot1	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
3.	Cboot2	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
4.	Cbulk	Nichicon	UUD1V680MCL1GS Series= uD	Cap= 68.0 uF ESR= 340.0 mOhm VDC= 35.0 V IRMS= 280.0 mA	1	\$0.11	 SM_RADIAL_6.3BMM 80 mm ²
5.	Ccomp	Yageo America	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
6.	Ccomp2	Samsung Electro-Mechanics	CL21C101JBANNNC Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Ccs	TDK	C1608C0G1H470J Series= C0G/NP0	Cap= 47.0 pF ESR= 217.348 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
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 mm ²
9.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	3	\$0.07	 1206 11 mm ²

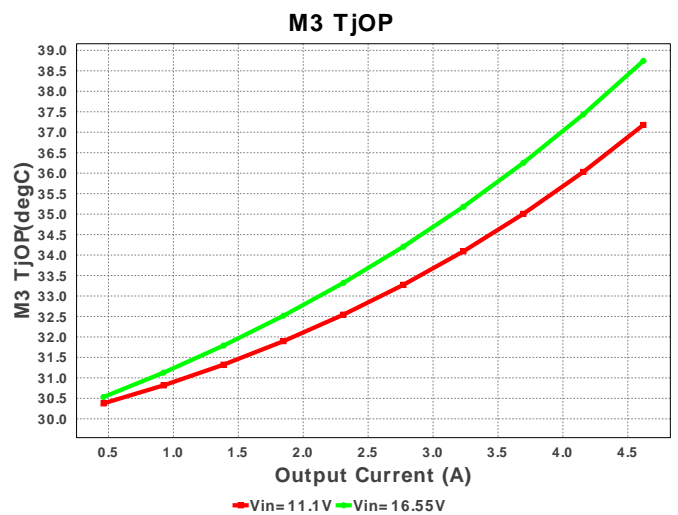
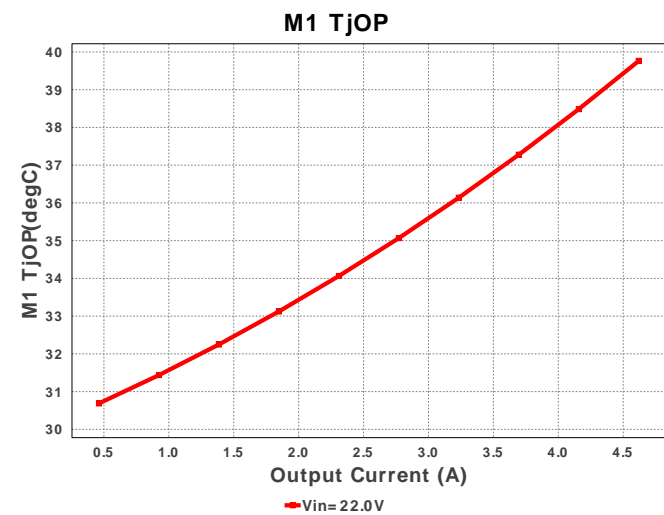
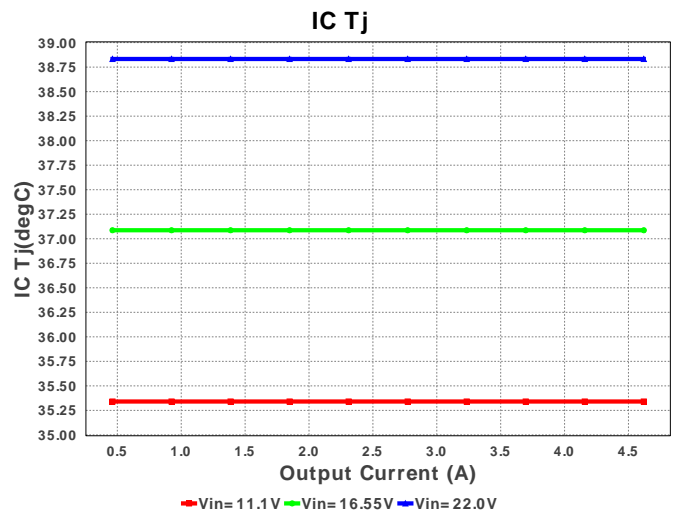
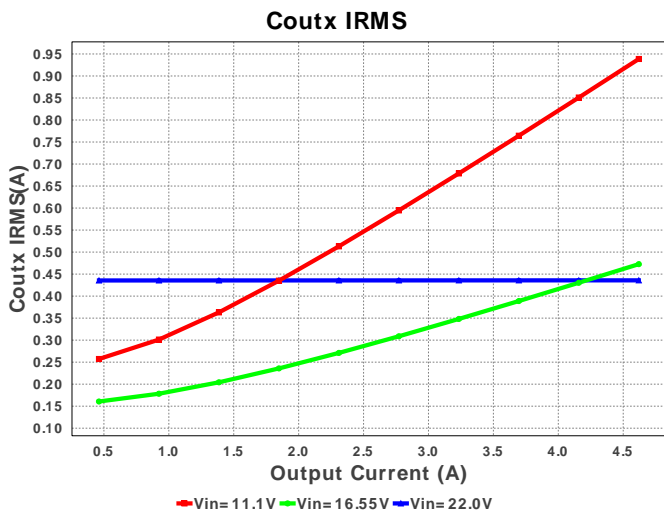
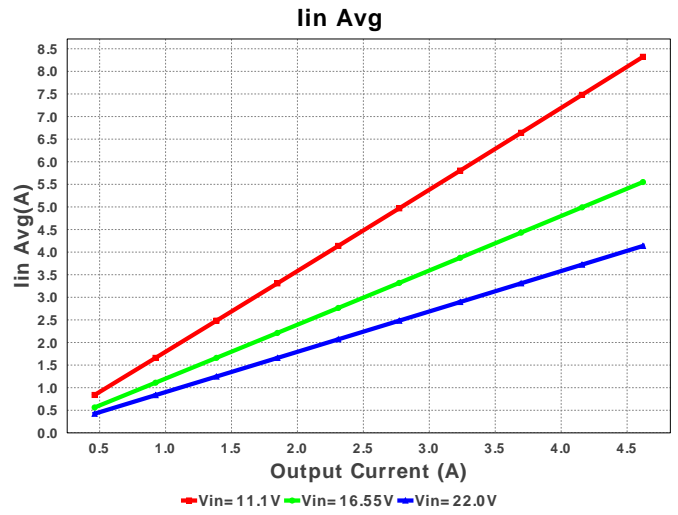
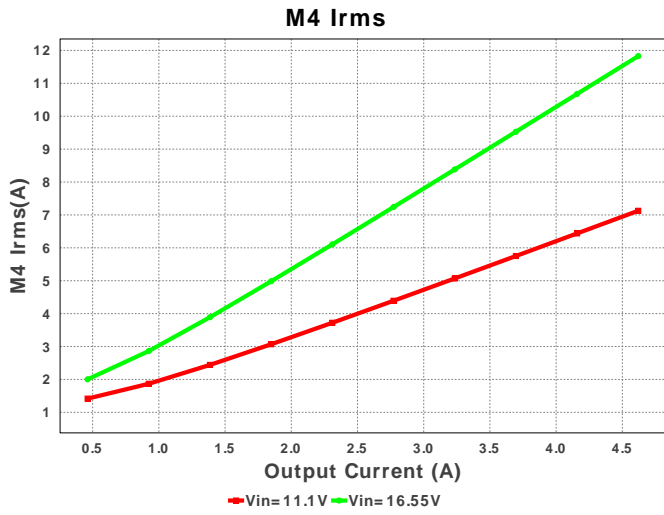
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Cout	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	2	\$0.16	 1210 15 mm ²
11.	Coutx	TDK	C3216JB1H475K Series= 274	Cap= 4.7 uF ESR= 3.918 mOhm VDC= 50.0 V IRMS= 0.0 A	5	\$0.21	 1206 11 mm ²
12.	Coutx2	TDK	C3216JB1H475K Series= 274	Cap= 4.7 uF ESR= 3.918 mOhm VDC= 50.0 V IRMS= 0.0 A	5	\$0.21	 1206 11 mm ²
13.	Coutx3	TDK	C3216JB1H475K Series= 274	Cap= 4.7 uF ESR= 3.918 mOhm VDC= 50.0 V IRMS= 0.0 A	5	\$0.21	 1206 11 mm ²
14.	Cslope	MuRata	GRM1885C1H910JA01D Series= C0G/NP0	Cap= 91.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
15.	Css	Kemet	C0603C223K3RACTU Series= X7R	Cap= 22.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
16.	Cvcc	MuRata	GRM188R71C105KA12D Series= X7R	Cap= 1.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 2.72 A	1	\$0.01	 0603 5 mm ²
17.	D2	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.09	 SMA 37 mm ²
18.	D3	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.09	 SMA 37 mm ²
19.	Dboot1	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.09	 SMA 37 mm ²
20.	Dboot2	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.09	 SMA 37 mm ²
21.	Df	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.09	 SMA 37 mm ²
22.	L1	Coilcraft	XAL7070-332MEB	L= 3.3 uH DCR= 8.6 mOhm	1	\$1.05	 XAL7070 87 mm ²
23.	M1	Texas Instruments	CSD17306Q5A	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	\$0.56	 TRANS_NexFET_Q5A 55 mm ²
24.	M2	Texas Instruments	CSD18531Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	\$0.90	 TRANS_NexFET_Q5A 55 mm ²
25.	M3	Texas Instruments	CSD16321Q5	VdsMax= 25.0 V IdsMax= 100.0 Amps	1	\$0.73	 TRANS_NexFET_Q5 55 mm ²
26.	M4	Texas Instruments	CSD18501Q5A	VdsMax= 40.0 V IdsMax= 100.0 Amps	1	\$0.90	 TRANS_NexFET_Q5A 55 mm ²

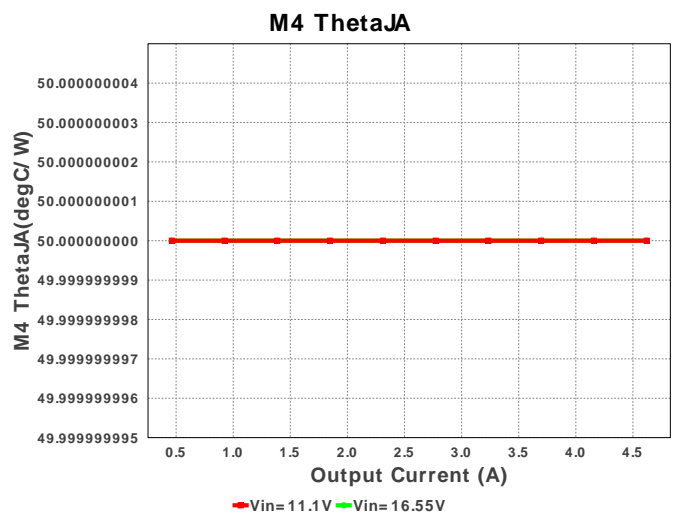
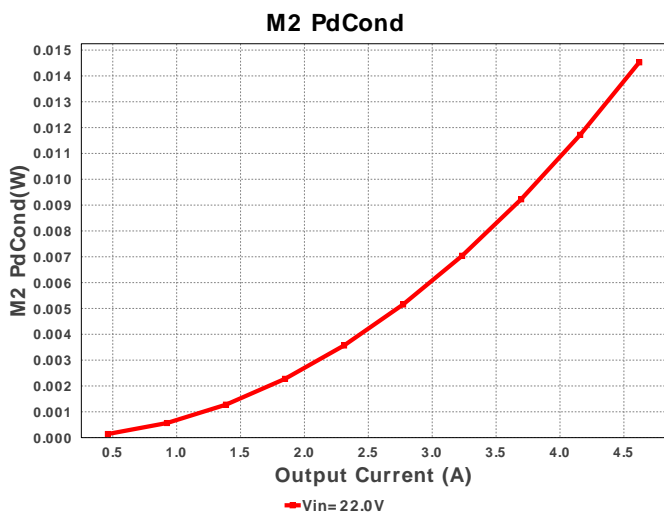
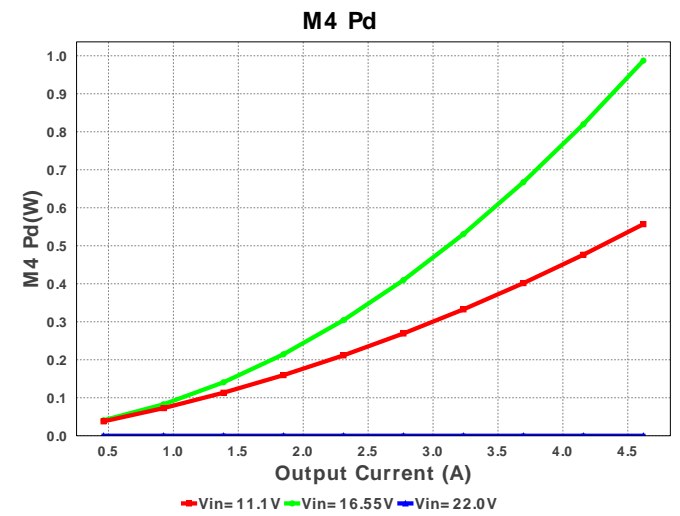
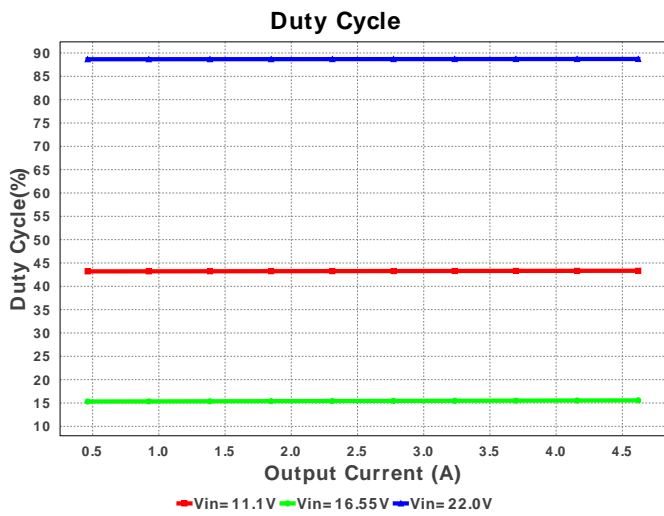
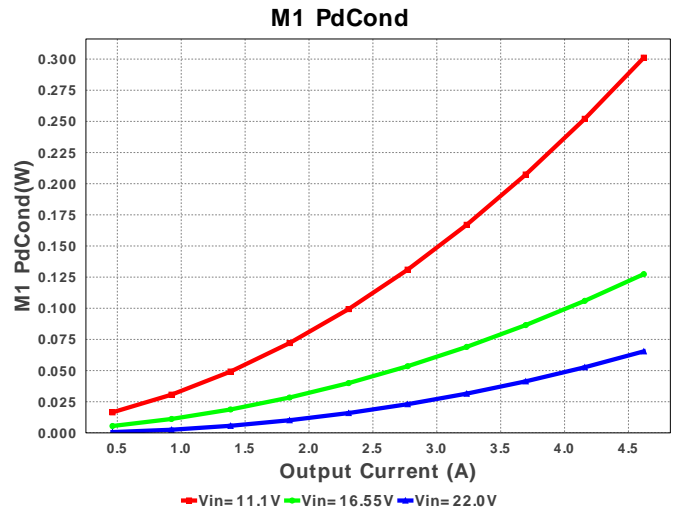
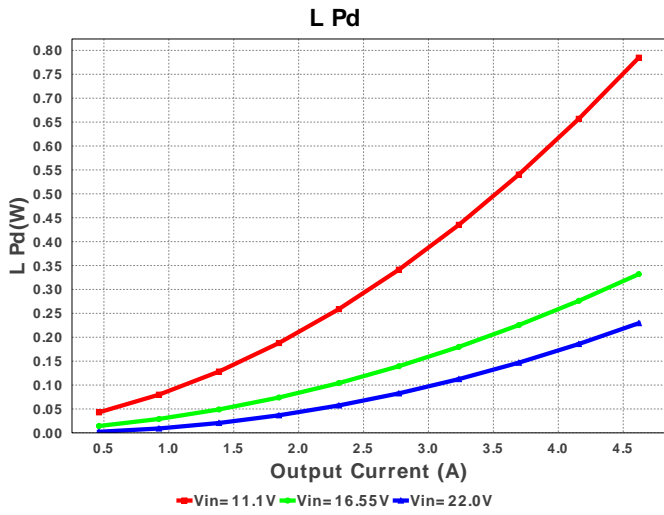
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rcomp	Panasonic	ERJ-6ENF1152V Series= 225	Res= 11.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
28.	Rcsg	Vishay-Dale	CRCW0603100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
29.	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	Yageo America	RC0603FR-07470KL Series= ?	Res= 470.0 kOhm Power= 100.0 mW Tolerance= 0.01%	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	Bourns	CRA2512-FZ-R010ELF Series= 385	Res= 10.0 mOhm Power= 3.0 W Tolerance= 1.0%	1	\$0.17	 2512 43 mm²
36.	Rt	Panasonic	ERJ-6ENF8662V Series= 225	Res= 86.6 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
37.	Ruvb	Panasonic	ERJ-6ENF3162V Series= 225	Res= 31.6 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
38.	Ruvt	Panasonic	ERJ-6ENF2493V Series= 225	Res= 249.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
39.	U1	Texas Instruments	LM5175PWPR	Switcher	1	\$4.25	 PWP0028F_N 98 mm²

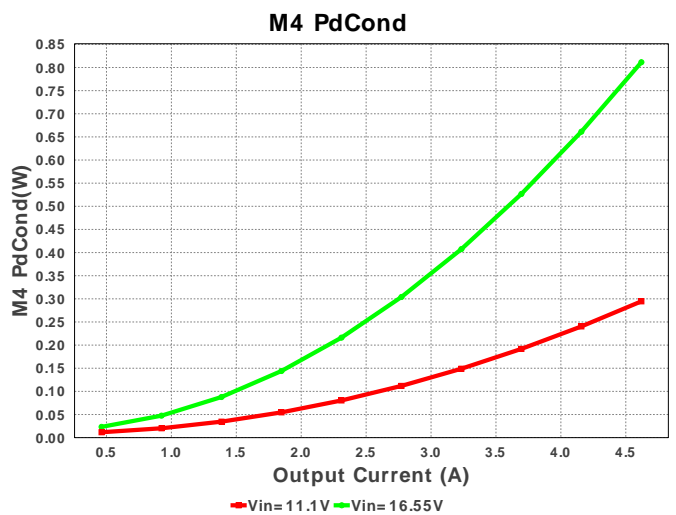
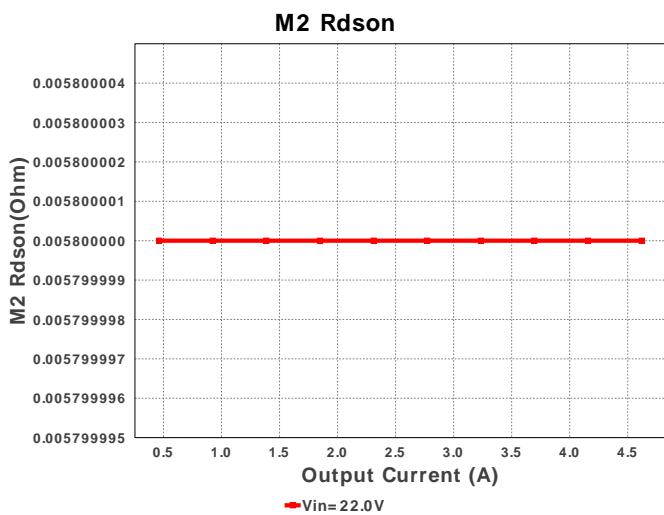
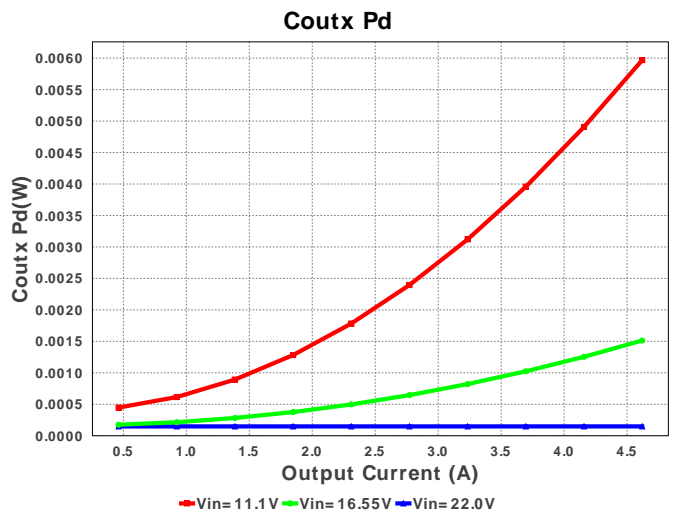
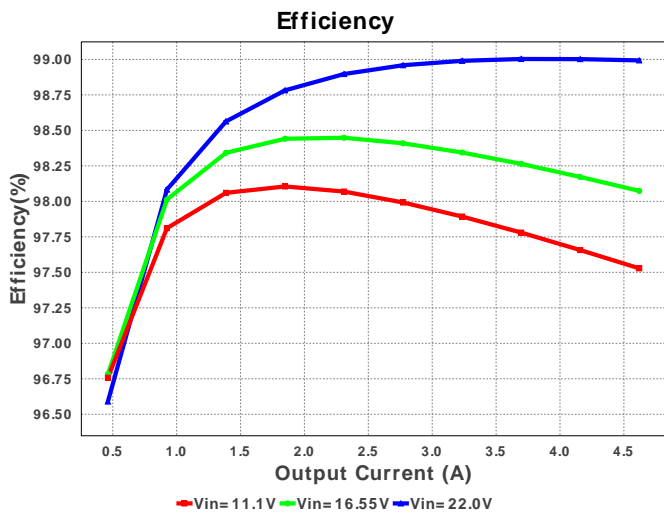
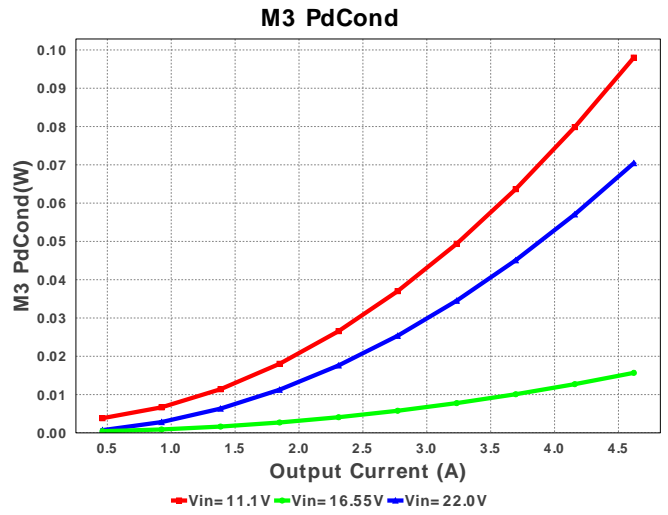
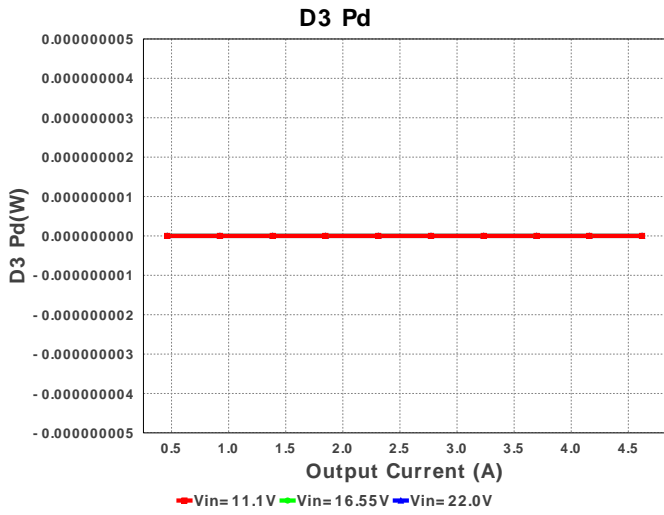


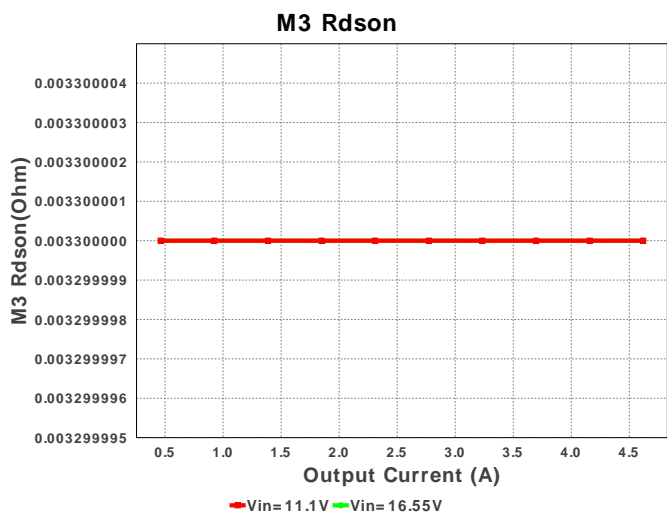
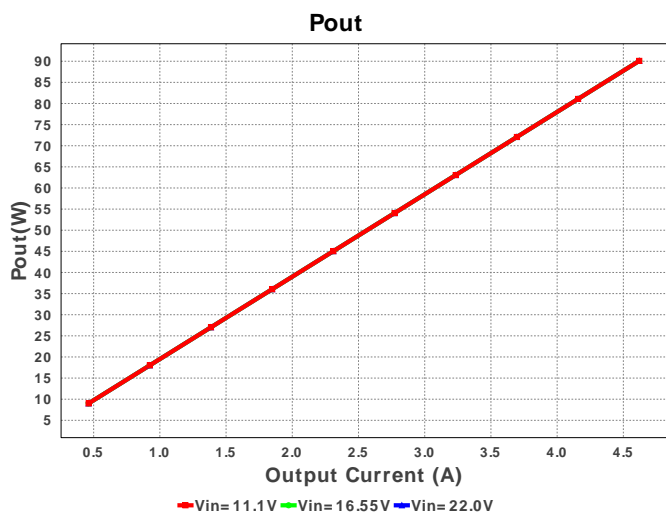
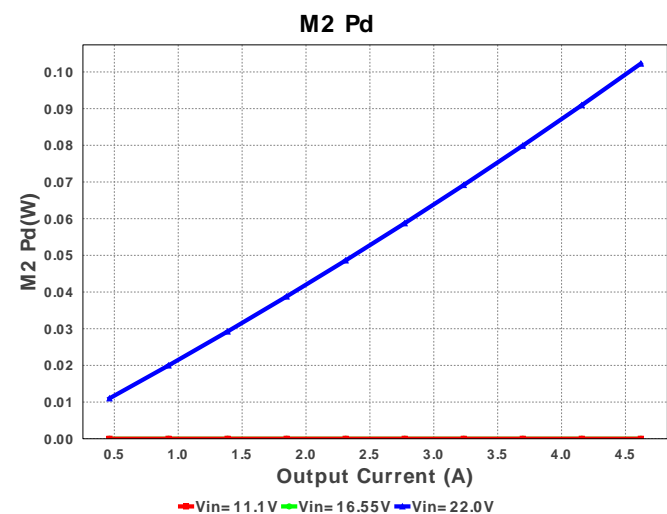
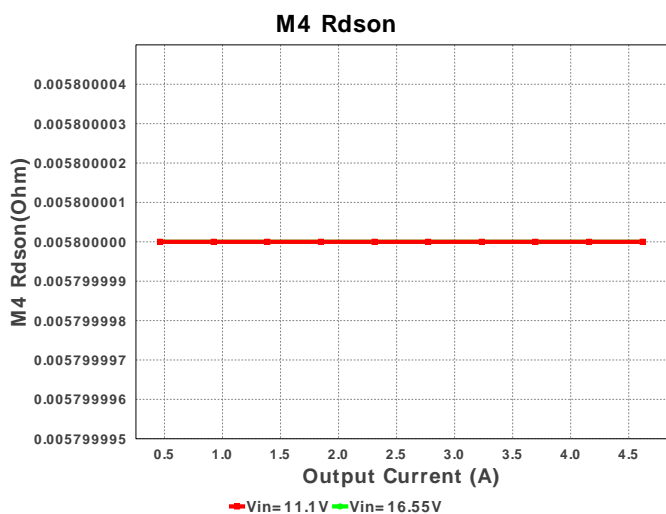
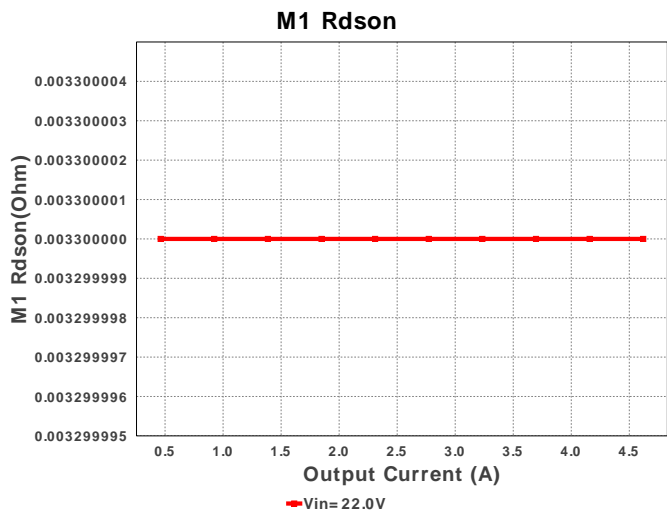
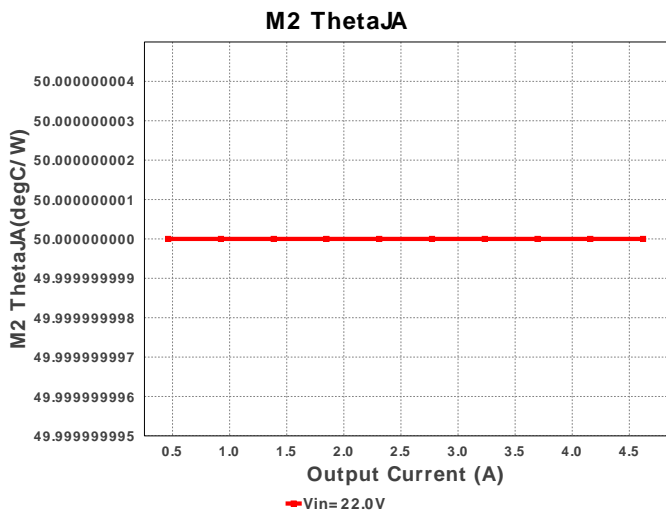


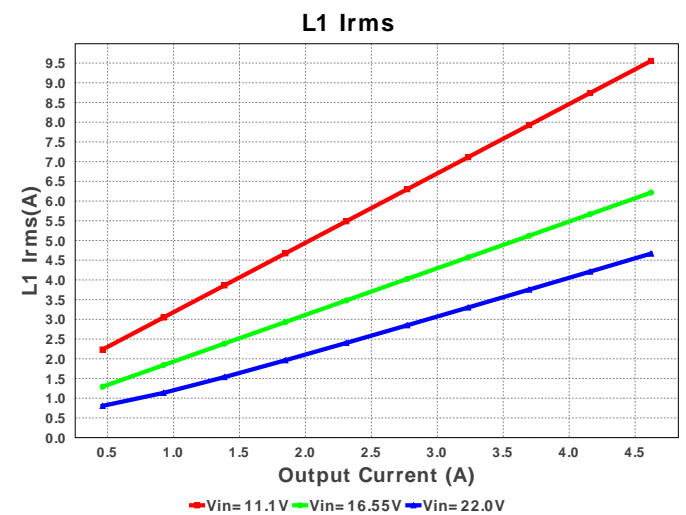
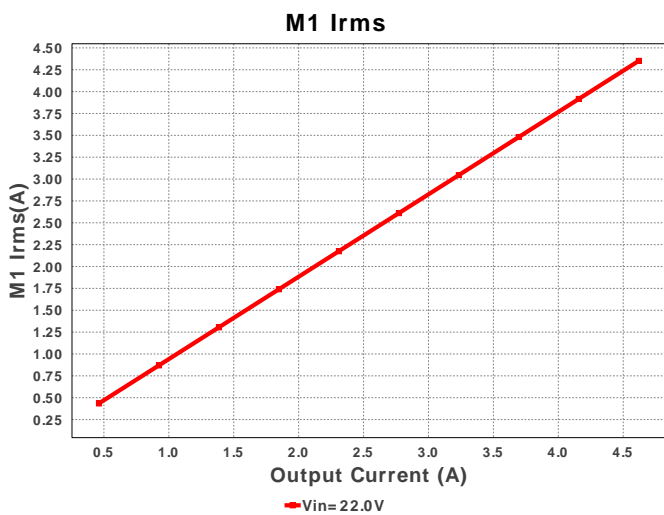
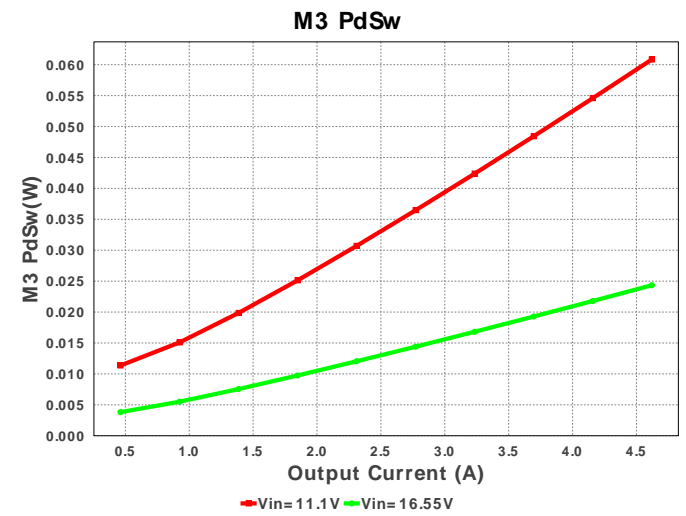
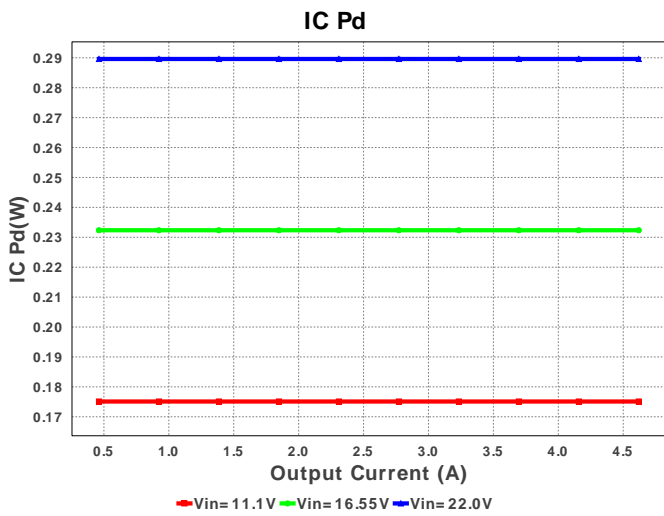
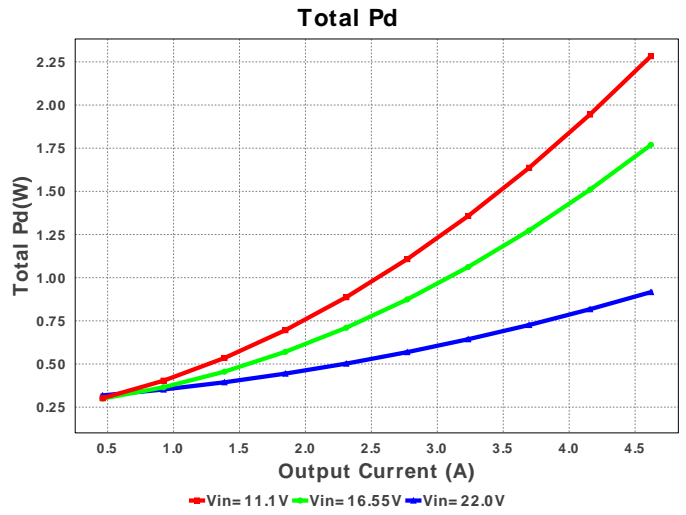
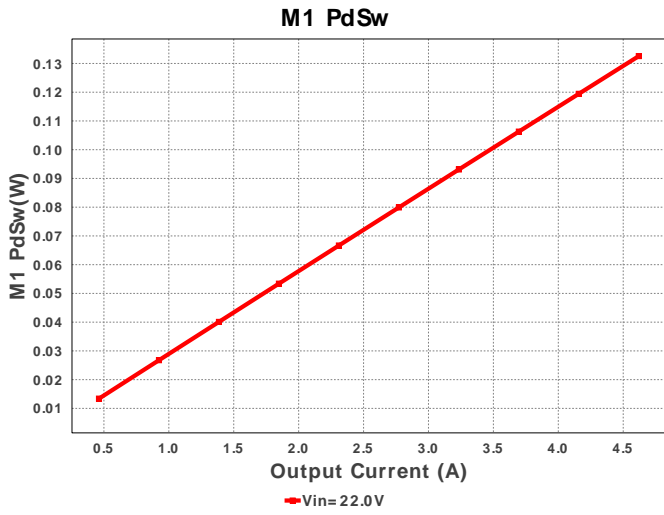


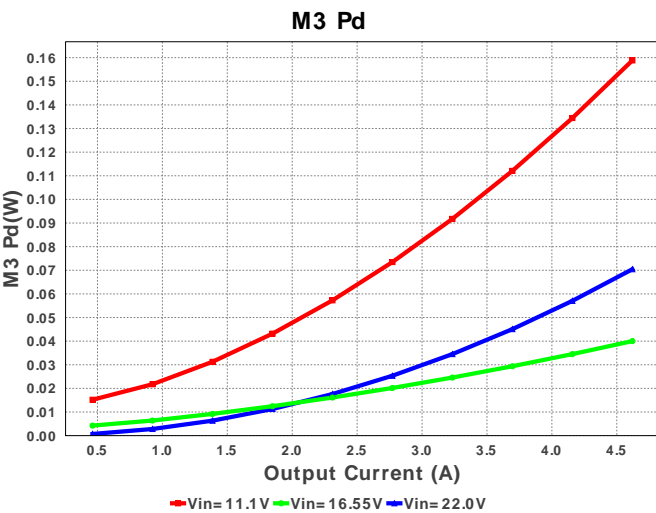
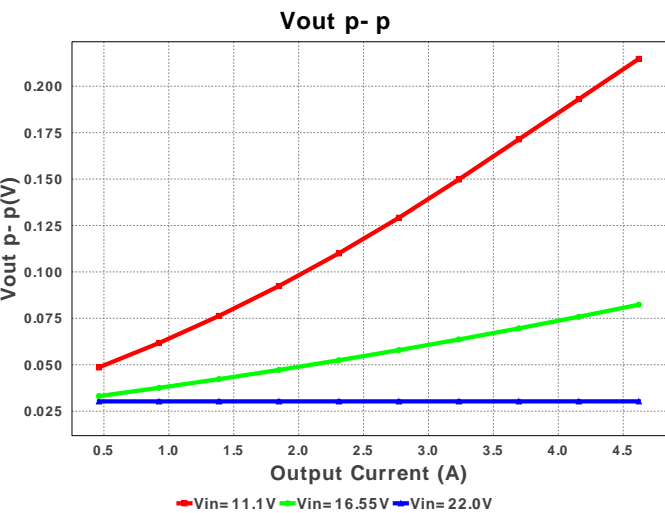
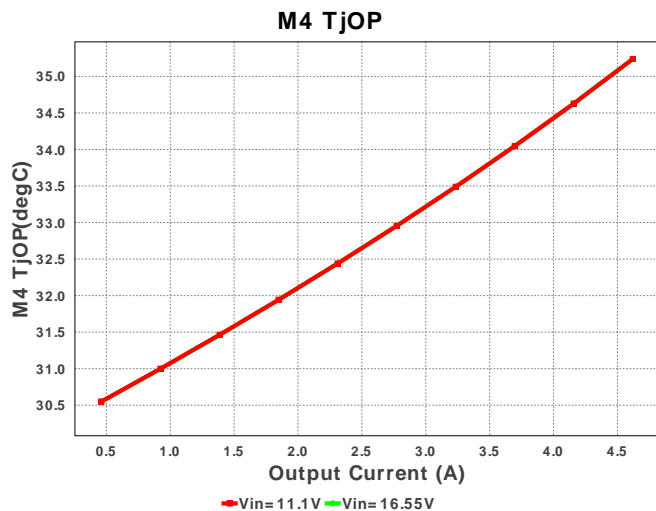
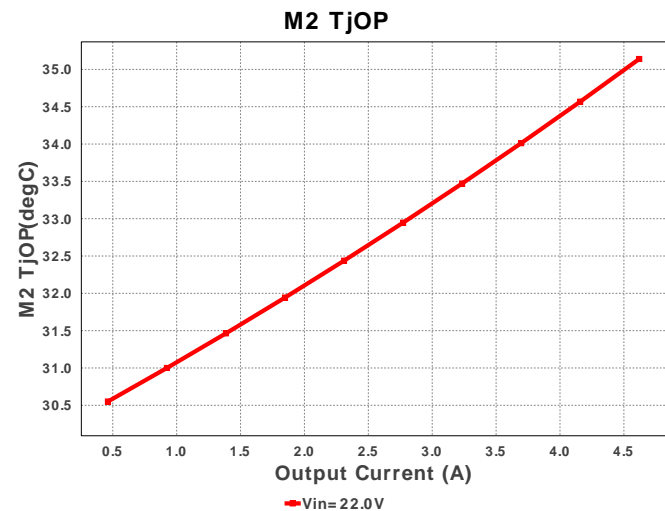
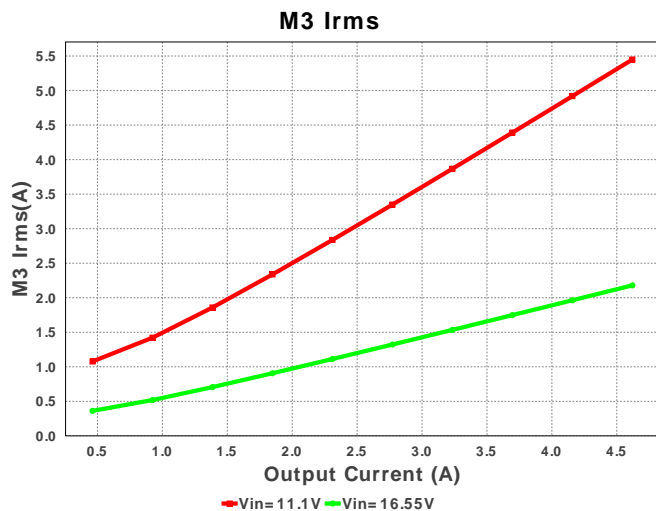
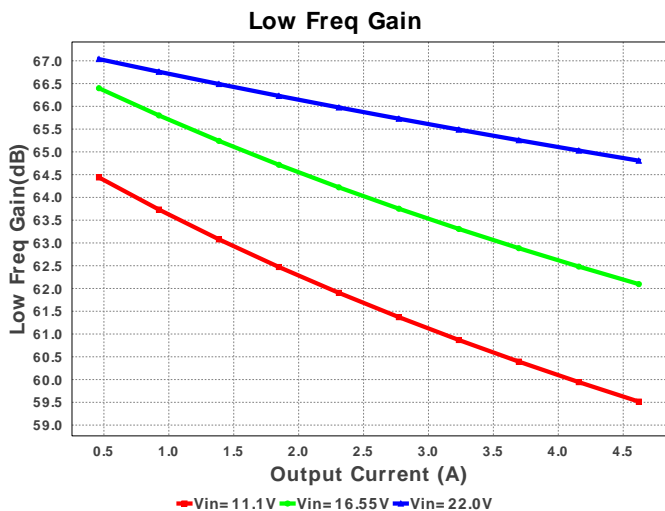


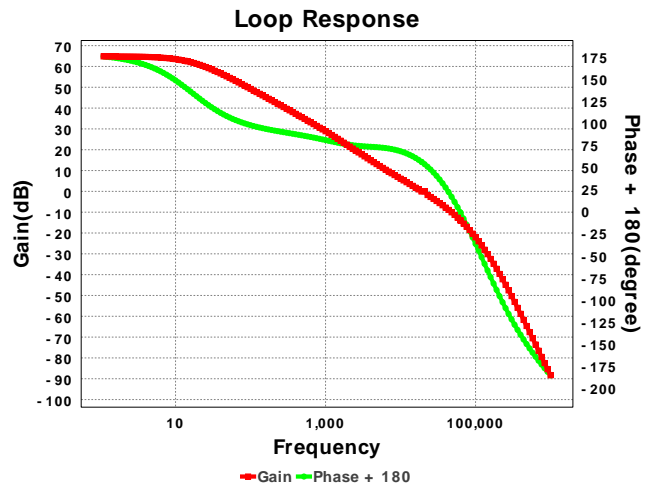
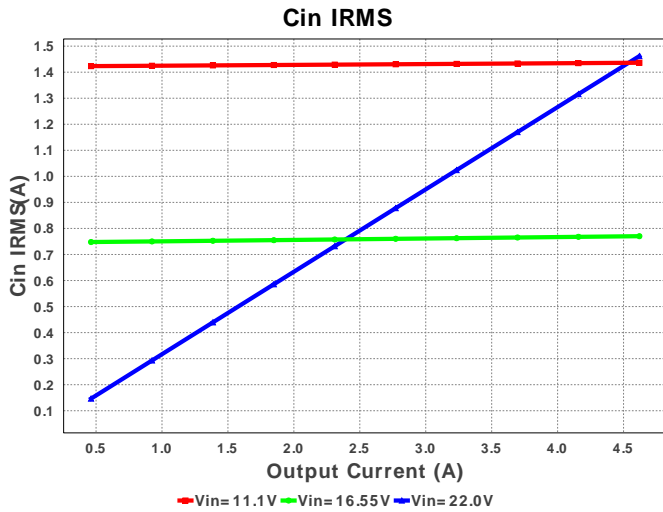












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.462 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	109.981 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	213.377 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	4.137 A	Current	Average input current
5.	L Ipp	1.12 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	4.631 A	Current	Inductor ripple current
7.	M1 Irms	4.352 A	Current	MOSFET RMS ripple current
8.	M2 Irms	1.552 A	Current	MOSFET RMS ripple current
9.	SW Ipk	0.0 A	Current	Peak switch current
10.	BOM Count	54	General	Total Design BOM count
11.	FootPrint	1.057 k mm ²	General	Total Foot Print Area of BOM components
12.	Frequency	293.755 kHz	General	Switching frequency
13.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
14.	M1 Rdson	3.3 mOhm	General	Drain-Source On-resistance
15.	M1 ThetaJA	49.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
16.	M2 Rdson	5.8 mOhm	General	Drain-Source On-resistance
17.	M2 ThetaJA	50.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
18.	Pout	90.09 W	General	Total output power
19.	Total BOM	\$13.06	General	Total BOM Cost
20.	Low Freq Gain	64.807 dB	Op_Point	Gain at 10Hz
21.	Vout OP	19.5 V	Op_Point	Operational Output Voltage
22.	Cross Freq	19.122 kHz	Op_point	Bode plot crossover frequency
23.	Duty Cycle	88.715 %	Op_point	Duty cycle
24.	Efficiency	98.993 %	Op_point	Steady state efficiency
25.	Gain Marg	-13.876 dB	Op_point	Bode Plot Gain Margin
26.	IC Tj	38.833 degC	Op_point	IC junction temperature
27.	ICThetaJA	30.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
28.	IOUT_OP	4.62 A	Op_point	Iout operating point
29.	M1 TjOP	39.764 degC	Op_point	MOSFET junction temperature
30.	M2 TjOP	35.14 degC	Op_point	MOSFET junction temperature
31.	Phase Marg	56.906 deg	Op_point	Bode Plot Phase Margin
32.	VIN_OP	22.0 V	Op_point	Vin operating point
33.	Vout p-p	14.825 mV	Op_point	Peak-to-peak output ripple voltage
34.	Cin Pd	2.137 mW	Power	Input capacitor power dissipation
35.	Cout Pd	12.096 μW	Power	Output capacitor power dissipation
36.	Coutx Pd	35.677 μW	Power	Output capacitor_x power loss
37.	D2 Pd	0.0 W	Power	Diode power dissipation
38.	D3 Pd	0.0 W	Power	Diode power dissipation
39.	IC Pd	289.603 mW	Power	IC power dissipation
40.	L Pd	229.452 mW	Power	Inductor power dissipation
41.	M1 Pd	197.949 mW	Power	MOSFET power dissipation
42.	M1 PdCond	65.388 mW	Power	M1 MOSFET conduction losses
43.	M1 PdSw	132.561 mW	Power	M1 MOSFET switching losses
44.	M2 Pd	102.33 mW	Power	MOSFET power dissipation
45.	M2 PdCond	14.586 mW	Power	M2 MOSFET conduction losses
46.	M2 PdSw	87.744 mW	Power	M2 MOSFET switching losses
47.	M3 Pd	70.437 mW	Power	M3 MOSFET total power dissipation
48.	M3 PdCond	70.437 mW	Power	M3 MOSFET conduction losses
49.	M4 Pd	0.0 W	Power	M4 MOSFET total power dissipation
50.	Rsense Pd	24.086 mW	Power	Rsense Power Dissipation
51.	Total Pd	916.422 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	4.62	Maximum Output Current
2.	Iout1	4.62	Output Current #1
3.	SoftStart	3.0 ms	Soft Start Time (ms)
4.	VinMax	22.0	Maximum input voltage
5.	VinMin	11.1	Minimum input voltage
6.	Vout	19.5	Output Voltage
7.	Vout1	19.5	Output Voltage #1
8.	base_pn	LM5175	Texas Instruments Base Part Number
9.	source	DC	Input Source Type
10.	ta	30.0	Ambient temperature
11.	userfsw	392.804 k	Customer Selected Frequency

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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