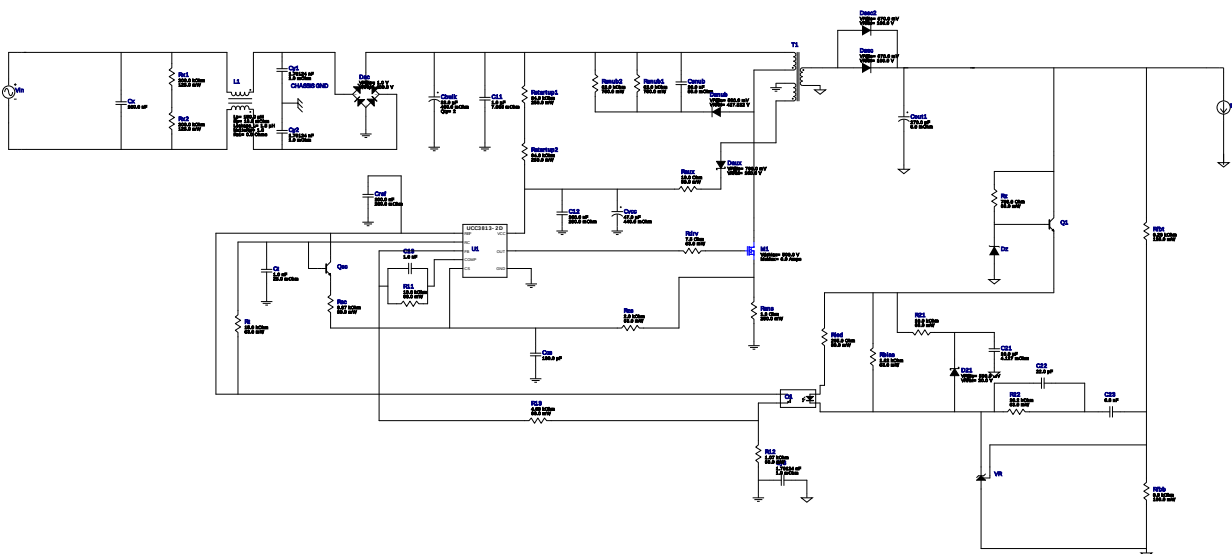


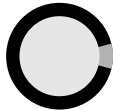
WEBENCH® Design Report

Design : 4551144/153 UCC3813DTR-2
UCC3813DTR-2 70.0V-130.0V to 6.50V @ 2.0A

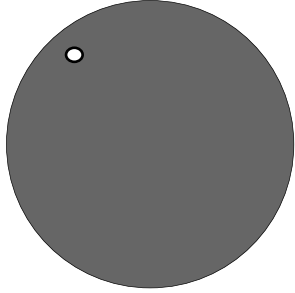


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

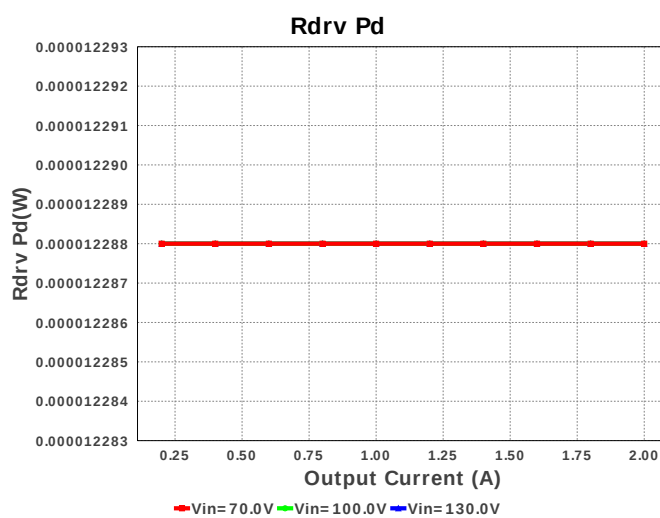
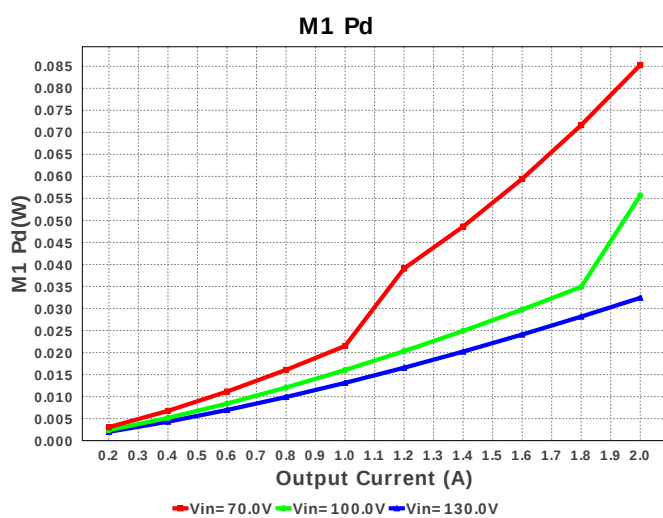
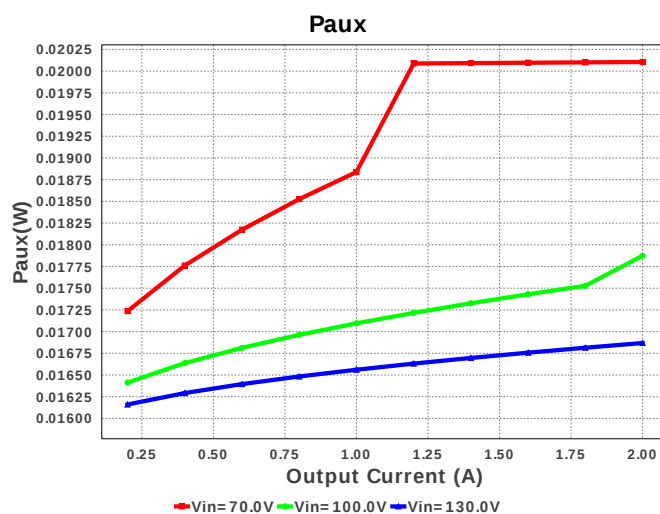
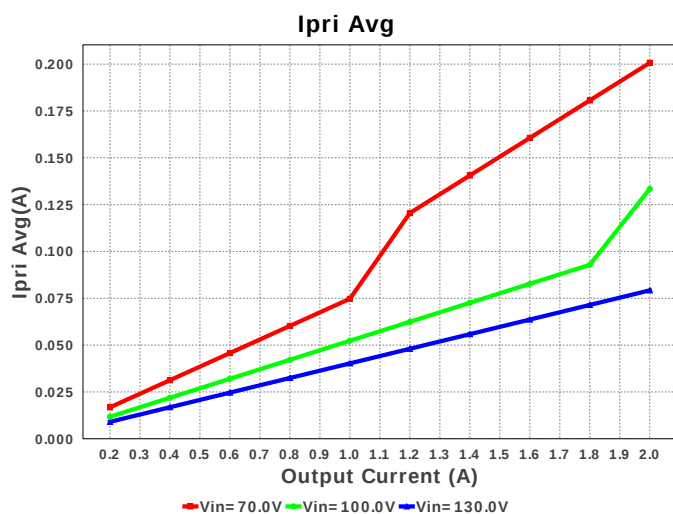
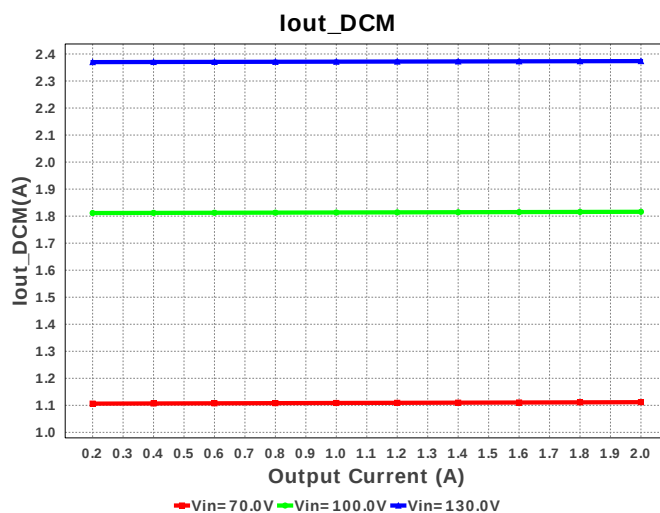
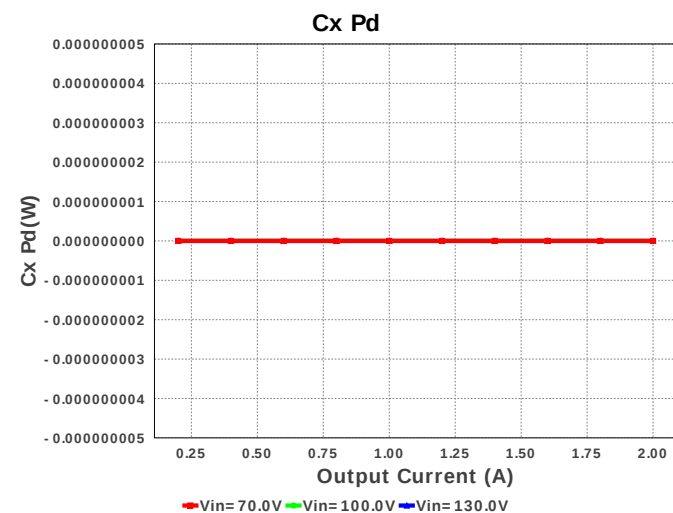
Electrical BOM

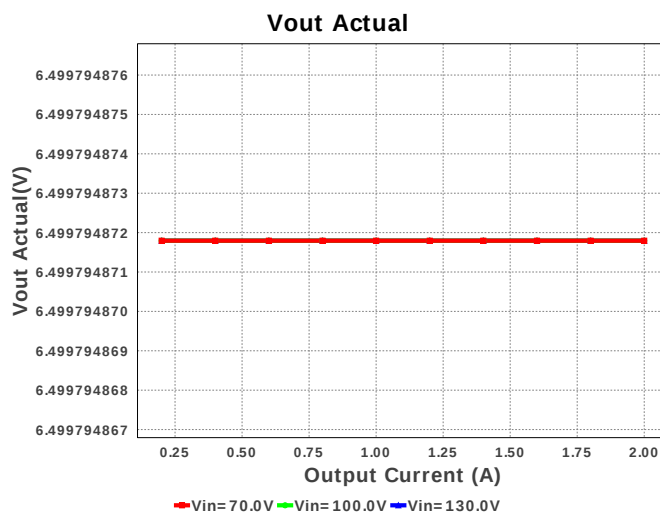
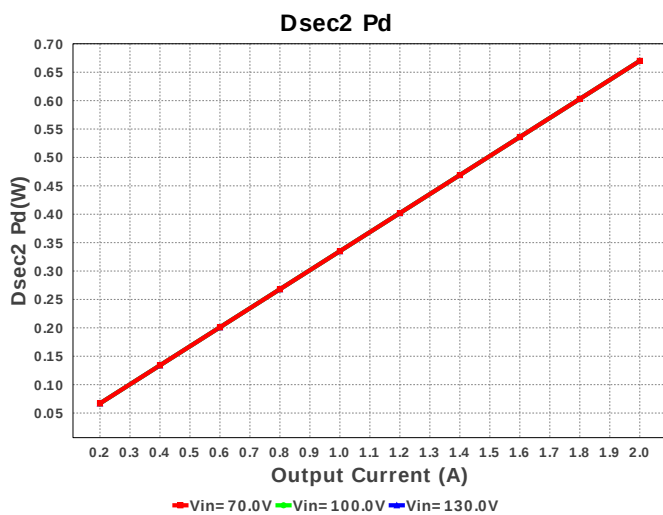
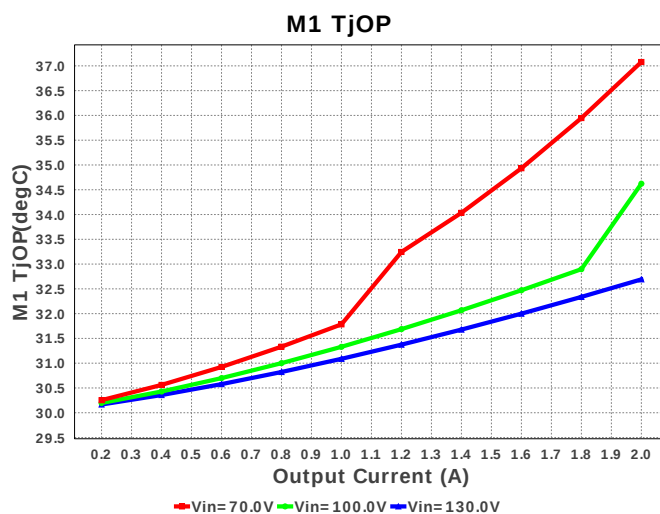
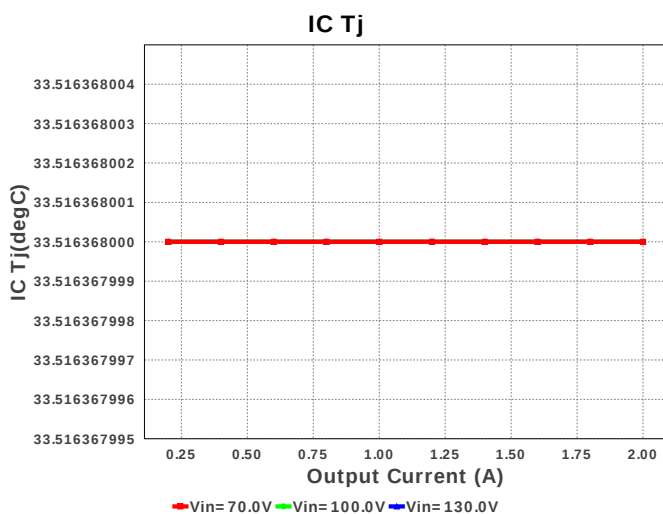
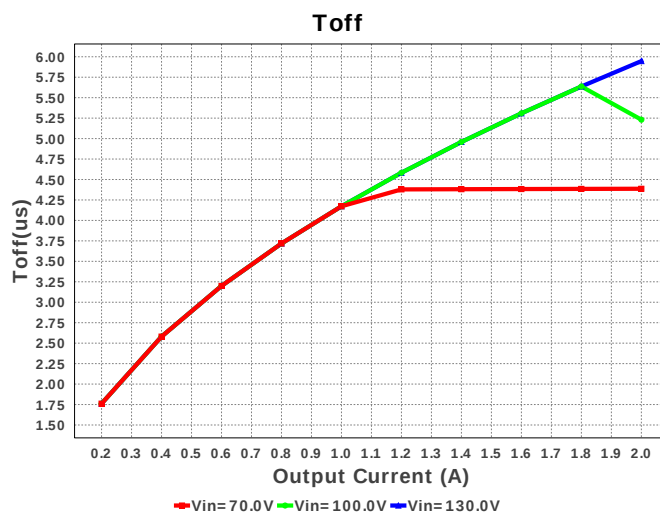
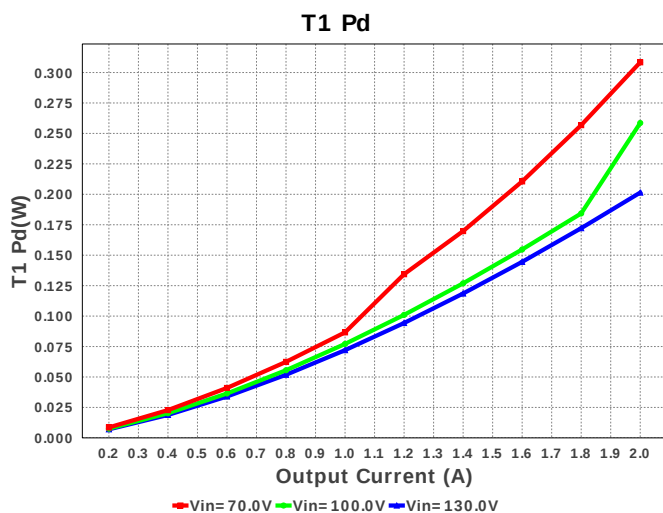
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1.	C11	MuRata	GRM55DR72E105KW01L Series= X7R	Cap= 1.0 uF ESR= 7.086 mOhm VDC= 250.0 V IRMS= 2.0605 A	1	\$0.26	 2220_200 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
4.	C21	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 4.127 mOhm VDC= 16.0 V IRMS= 2.46634 A	1	\$0.03	 0805 7 mm ²
5.	C22	Kemet	C0805C220K3GACTU Series= C0G/NP0	Cap= 22.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
6.	C23	Yageo America	CC0805KRX7R9BB682 Series= X7R	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	Rubycon	200RX3033M10X20 Series= ?	Cap= 33.0 uF ESR= 400.0 mOhm VDC= 200.0 V IRMS= 320.0 mA	2	\$0.28	 RX30_1000x2000 144 mm ²
8.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

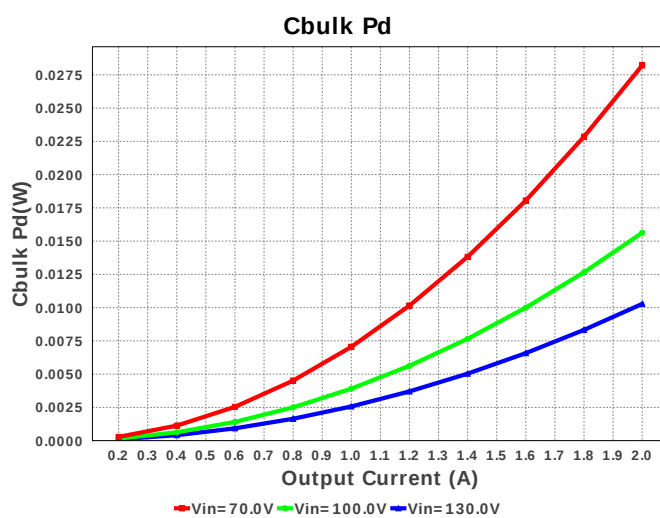
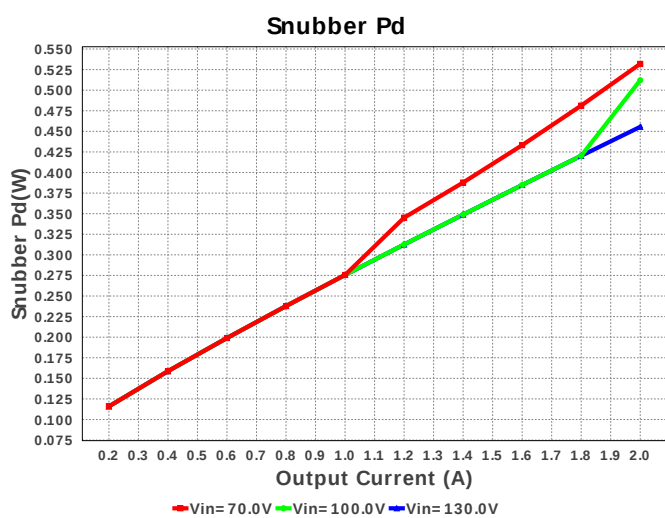
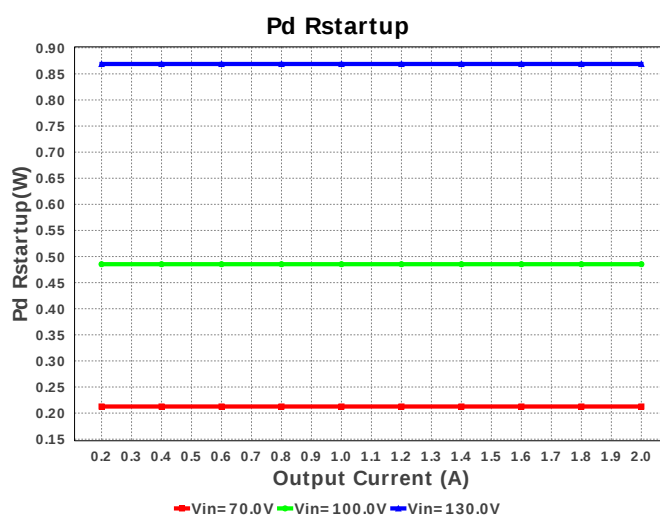
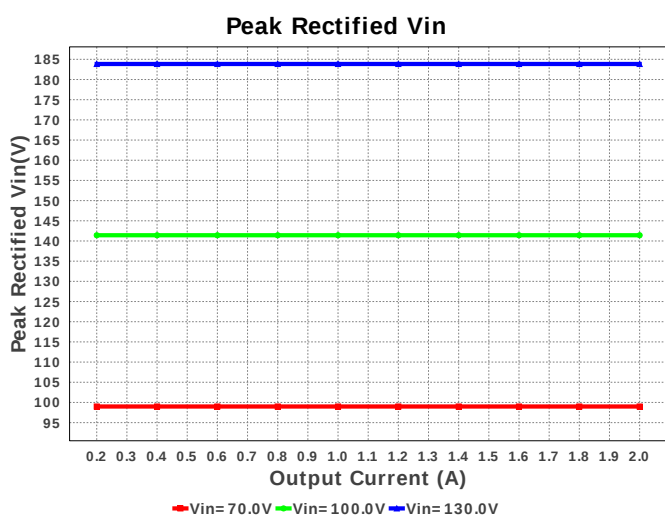
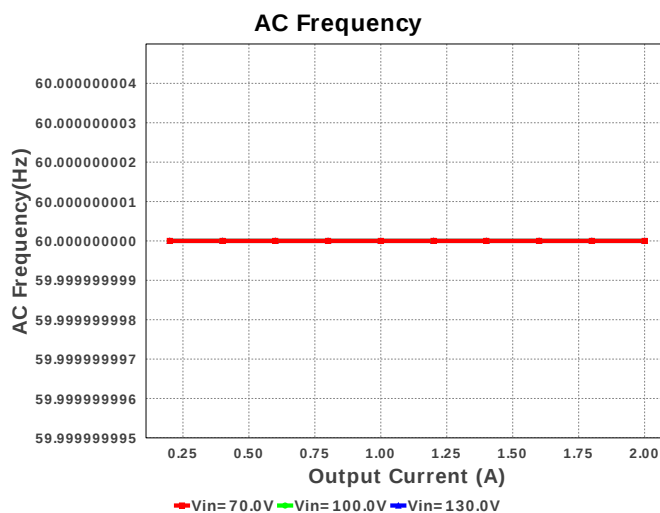
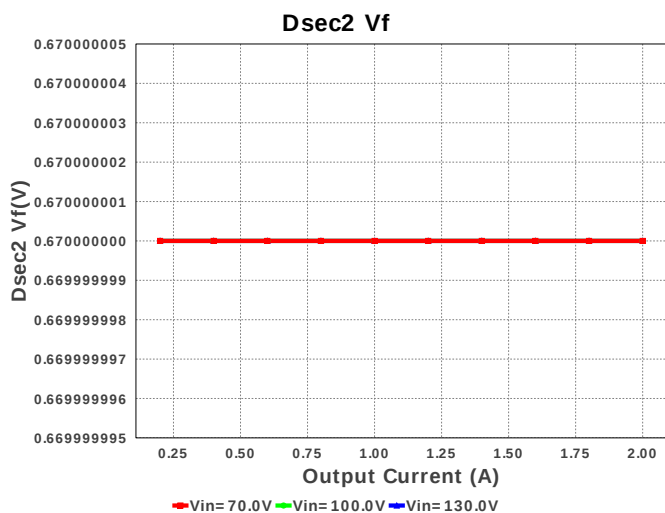
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9.	Cout1	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	\$0.70	 CAPSMT_62_C10 74 mm ²
10.	Cref	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
11.	Csnub	AVX	1812SC103KAT1A Series= X7R	Cap= 10.0 nF ESR= 50.0 mOhm VDC= 1.5 kV IRMS= 0.0 A	1	\$0.37	 1812 23 mm ²
12.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	\$0.01	 0805 7 mm ²
13.	Cvcc	Nichicon	UUD1E470MCL1GS Series= uD	Cap= 47.0 uF ESR= 440.0 mOhm VDC= 25.0 V IRMS= 230.0 mA	1	\$0.11	 SM_RADIAL_6.3AMM 80 mm ²
14.	Cx	TDK	B32913A5104M000 Series= 2231	Cap= 100.0 nF VDC= 1000.0 V IRMS= 0.0 A	1	\$0.46	 B32913_2650x600x1500 228 mm ²
15.	Cy1	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
16.	Cy2	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
17.	Cy3	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
18.	D21	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	\$0.08	 SMA 37 mm ²
19.	Dac	Diodes Inc.	HD04-T	VF@Io= 1.0 V VRRM= 400.0 V	1	\$0.12	 MiniDIP 62 mm ²
20.	Daux	Diodes Inc.	B1100-13-F	VF@Io= 790.0 mV VRRM= 100.0 V	1	\$0.10	 SMA 37 mm ²
21.	Dsec	Fairchild Semiconductor	FSV8100V	VF@Io= 670.0 mV VRRM= 100.0 V	1	\$0.21	 TO-277A 56 mm ²
22.	Dsec2	Fairchild Semiconductor	FSV8100V	VF@Io= 670.0 mV VRRM= 100.0 V	1	\$0.21	 TO-277A 56 mm ²
23.	Dsnub	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 427.822 V	1	NA	CUSTOM 0 mm ²
24.	Dz	Diodes Inc.	MMSZ5231B-7-F	Zener	1	\$0.03	 SOD-123 13 mm ²

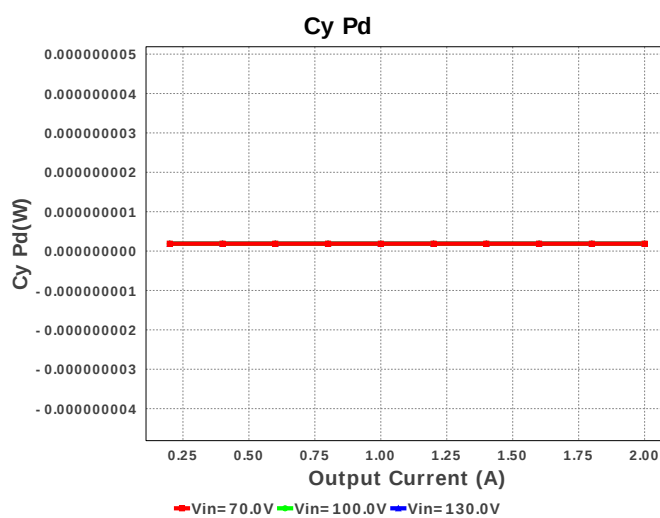
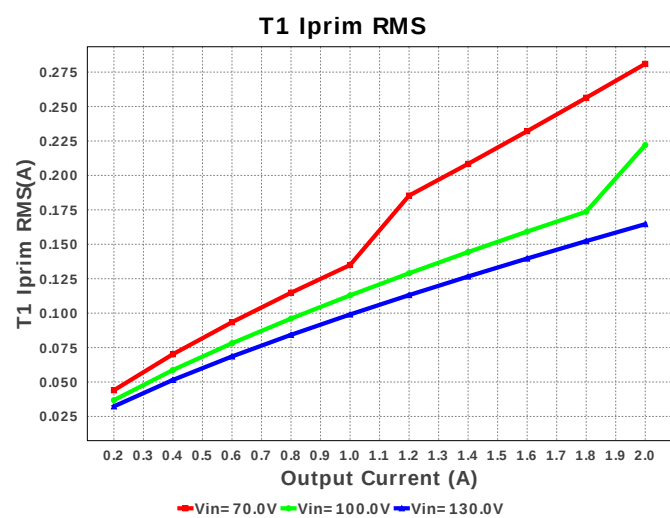
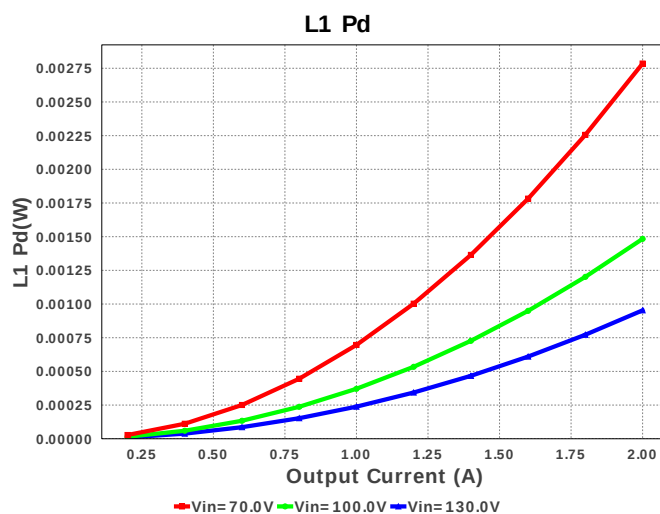
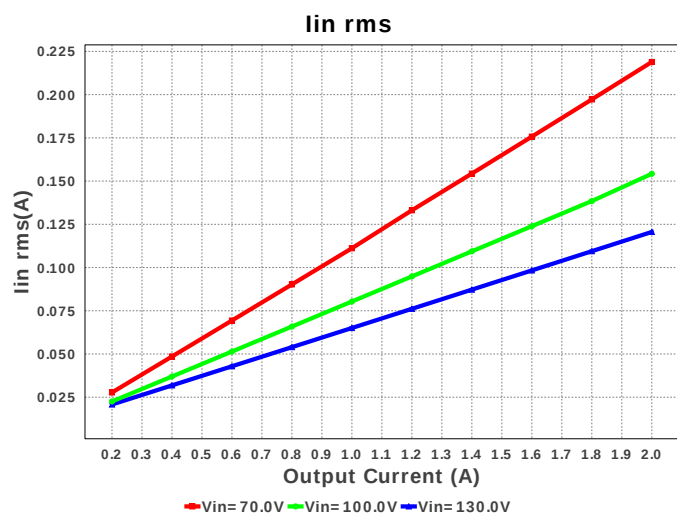
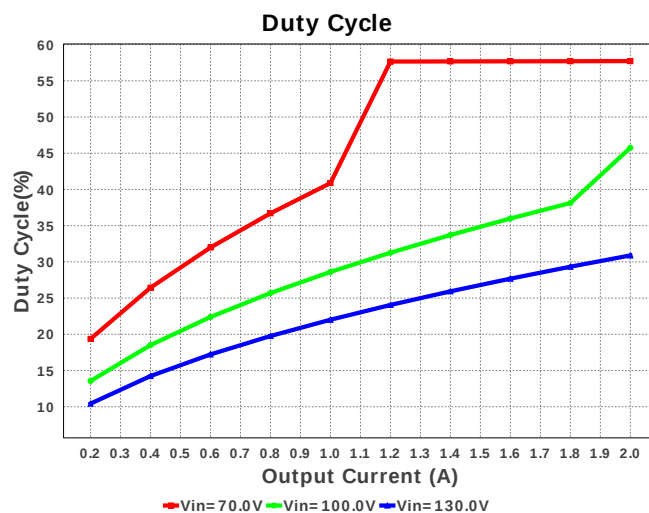
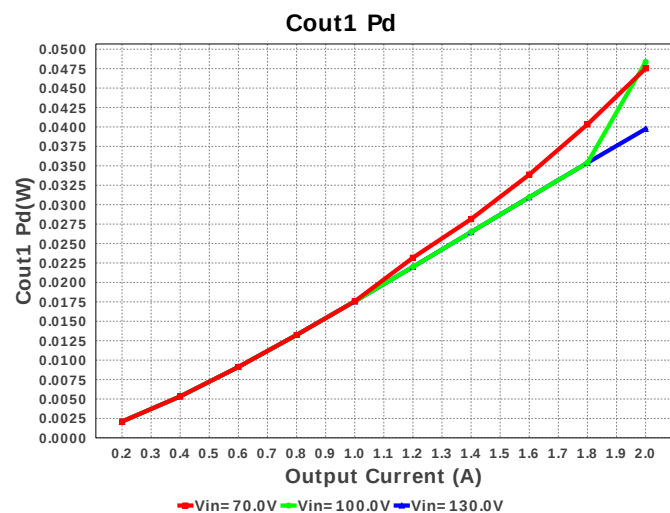
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	L1	API Delevan	CM6296R-154	Lp= 150.0 μ H Rp= 16.0 mOhm Leakage_L= 1.8 μ H Ns1toNp= 1.0 Rs1= 0.0 Ohms	1	\$6.32	 CM6296 833 mm ²
26.	M1	Fairchild Semiconductor	FDD6N50TM	VdsMax= 500.0 V IdsMax= 6.0 Amps	1	\$0.47	 DPAK 102 mm ²
27.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
28.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
29.	Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	NA	 TO-18 57 mm ²
30.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
31.	R12	Vishay-Dale	CRCW04021K07FKED Series= CRCW..e3	Res= 1.07 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
32.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
33.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
34.	R22	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
35.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	Rbias	Vishay-Dale	CRCW04021K62FKED Series= CRCW..e3	Res= 1.62 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
38.	Rdrv	Vishay-Dale	CRCW04027R50FKED Series= CRCW..e3	Res= 7.5 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	Rfbb	Yageo America	RC0603FR-073K9L Series= ?	Res= 3.9 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
40.	Rfbt	Yageo America	RT0805BRD076K26L Series= ?	Res= 6.26 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.04	 0805 7 mm ²
41.	Rled	Vishay-Dale	CRCW0402205RFBKED Series= CRCW..e3	Res= 205.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

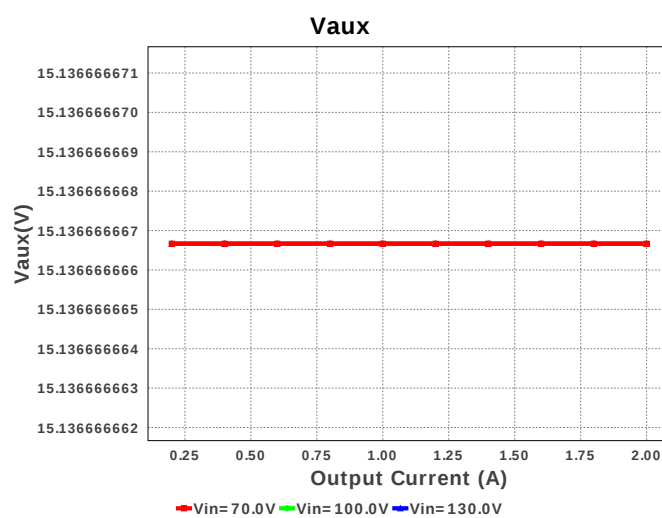
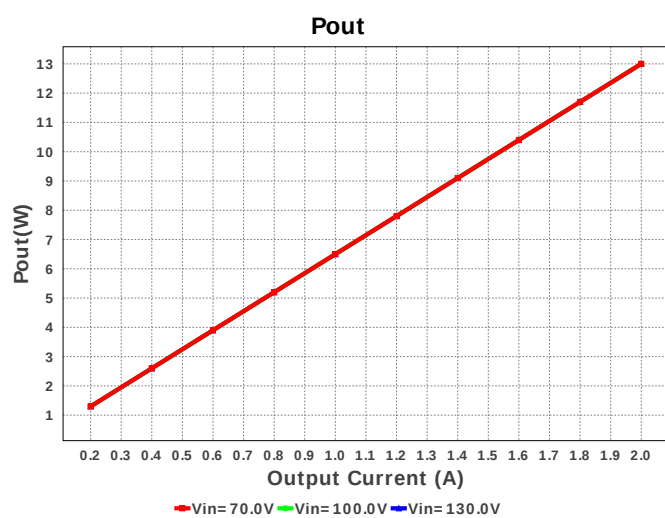
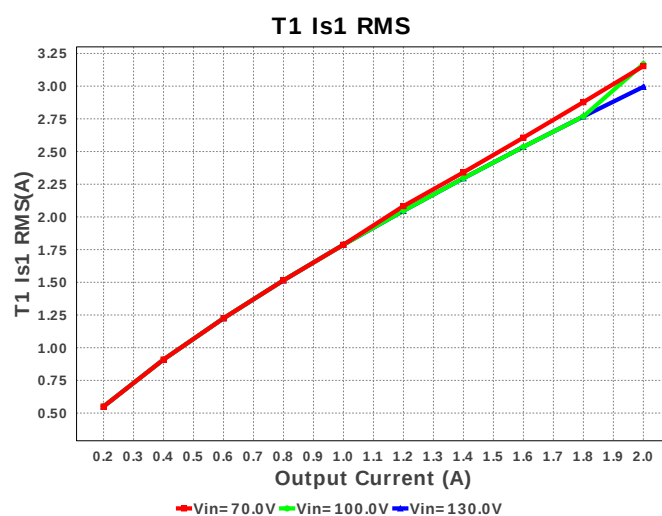
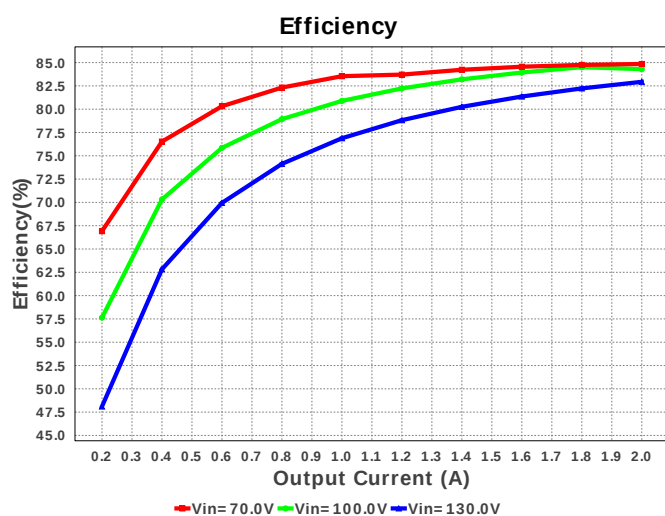
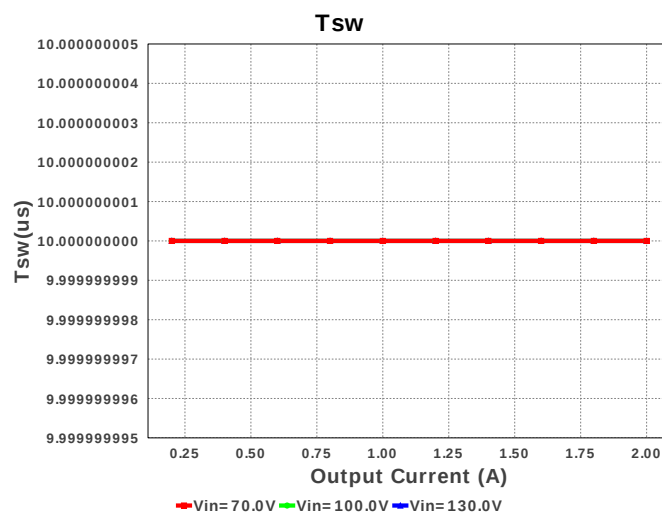
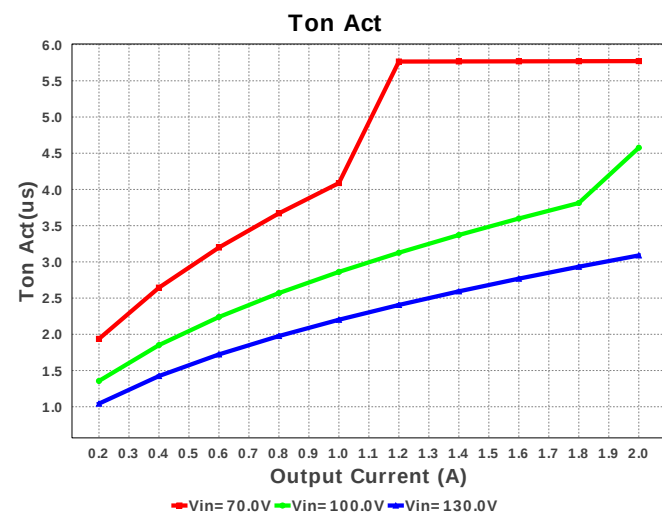
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
42.	Rsc	Vishay-Dale	CRCW04028K87FKED Series= CRCW..e3	Res= 8.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
43.	Rsns	Vishay-Dale	CRCW12061R30FKEA Series= CRCW..e3	Res= 1.3 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
44.	Rsnub1	Vishay-Dale	CRCW201062K0FKEF Series= ?	Res= 62.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
45.	Rsnub2	Vishay-Dale	CRCW201062K0FKEF Series= ?	Res= 62.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
46.	Rstartup1	Panasonic	ERJ-8ENF6492V Series= ERJ-8E	Res= 64.9 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
47.	Rstartup2	Panasonic	ERJ-8ENF6492V Series= ERJ-8E	Res= 64.9 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
48.	Rt	Vishay-Dale	CRCW040215K0FKED Series= CRCW..e3	Res= 15.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
49.	Rx1	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
50.	Rx2	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
51.	Rz	Vishay-Dale	CRCW0402768RFKED Series= CRCW..e3	Res= 768.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
52.	T1	Core=TDK , CoilFormer=TDK	Core=B66307G0000X127 , CoilFormer=B66308B1108T001	Lp= 1.107 mH Turns Ratio(Nas)= 19:9 Turns Ratio(Nps)= 118:9 Npri= 118.0 Naux= 19.0 Nsec= 9.0	1	\$0.66	 TDK_B66305 199 mm²
53.	U1	Texas Instruments	UCC3813DTR-2	Switcher	1	\$0.99	 D0008A 57 mm²
54.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	\$0.08	 DBZ0003A 14 mm²



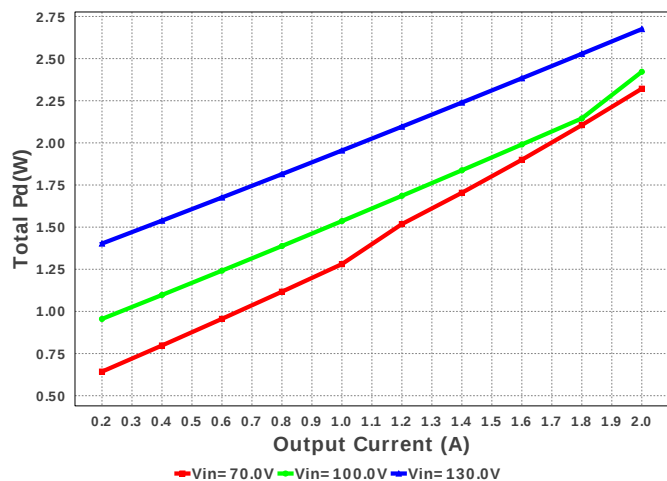




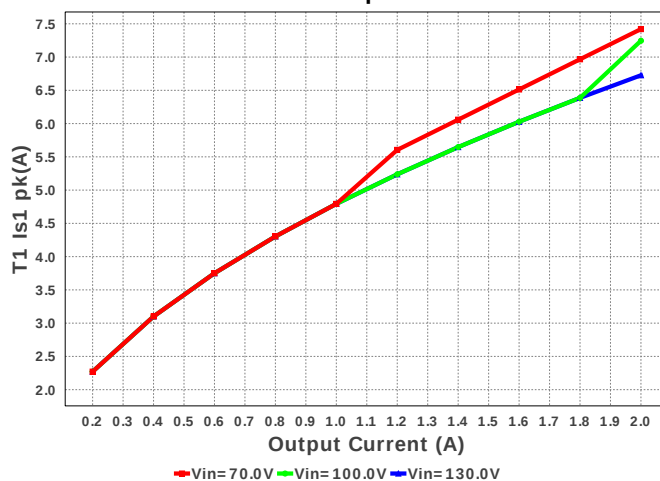




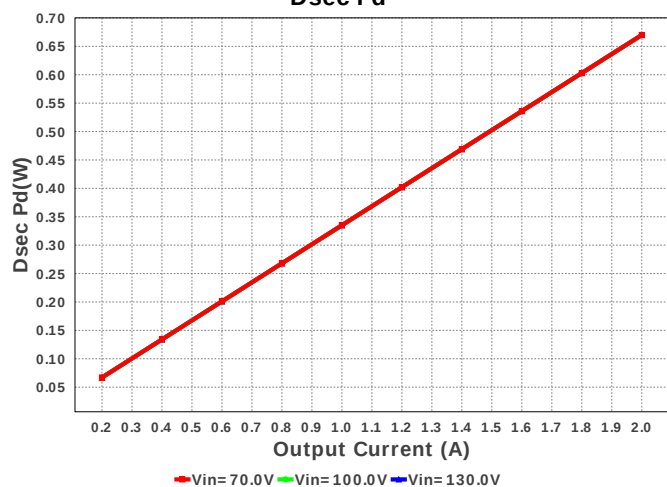
Total Pd



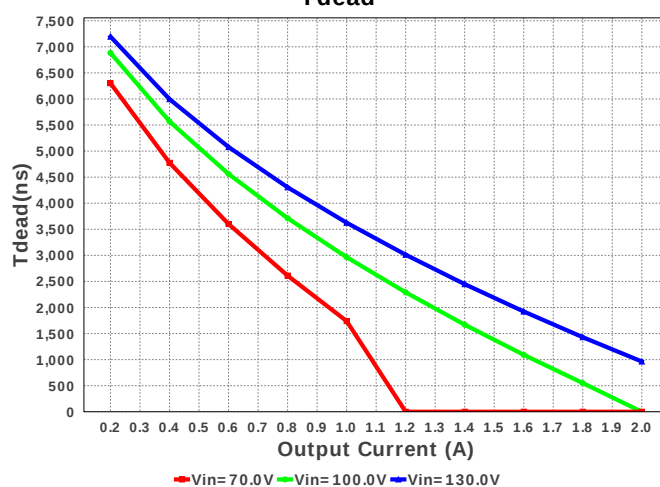
T1 Is1 pk



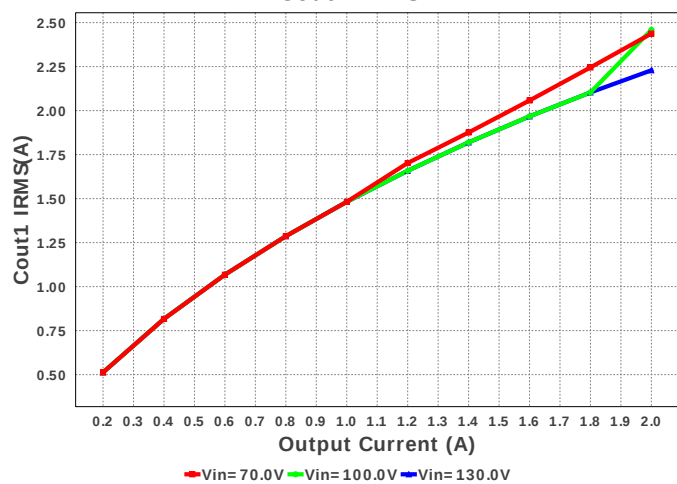
Dsec Pd



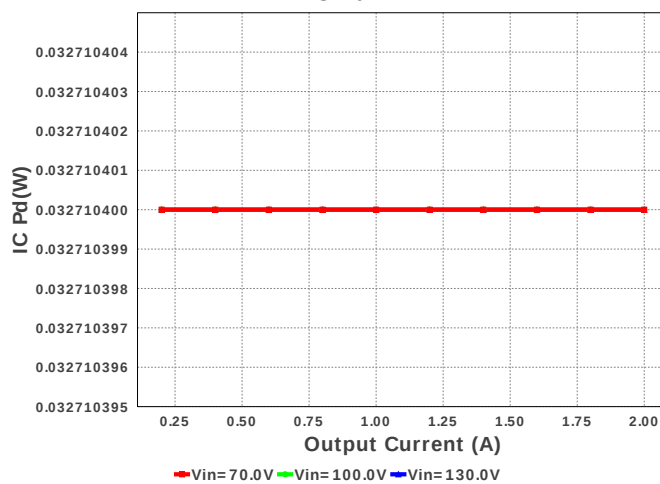
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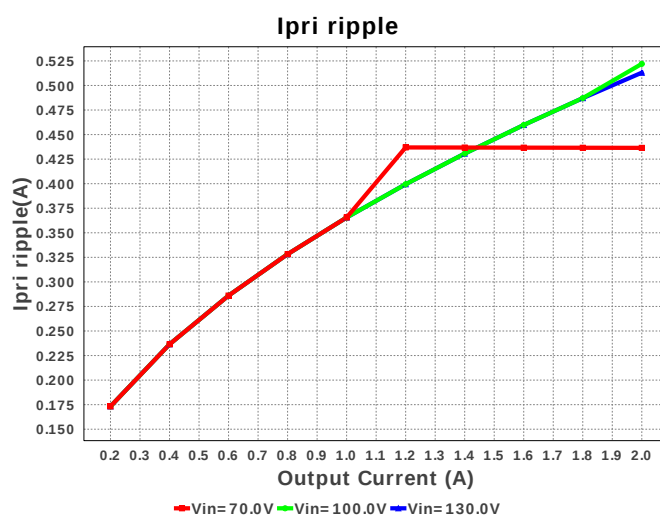
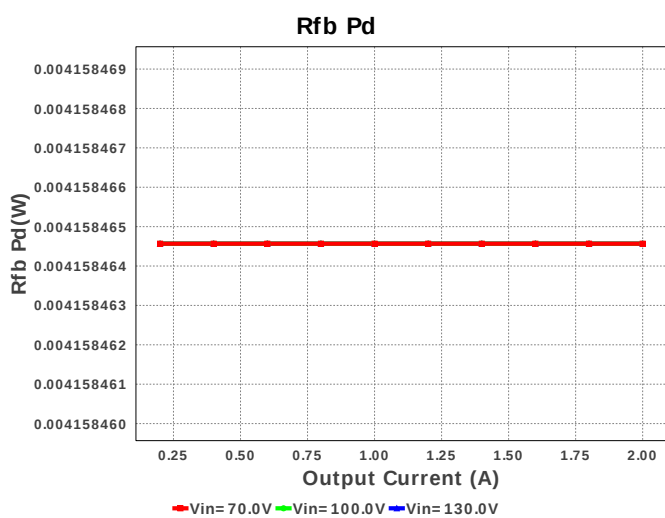
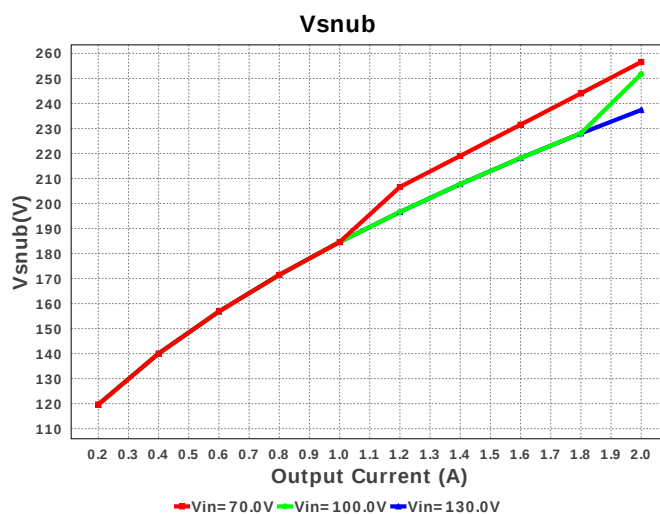
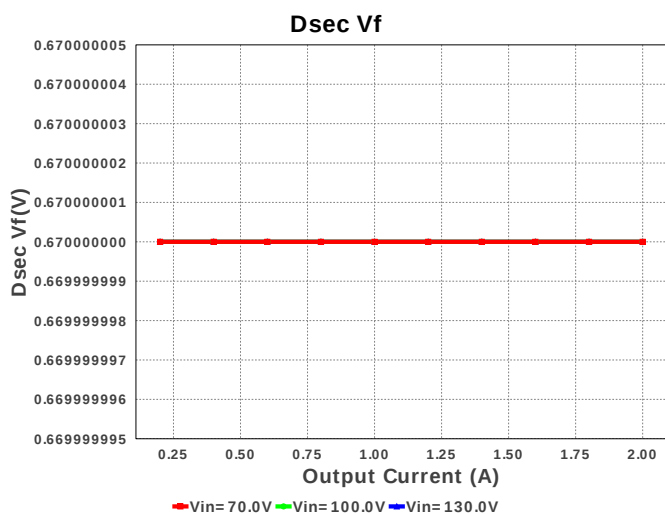
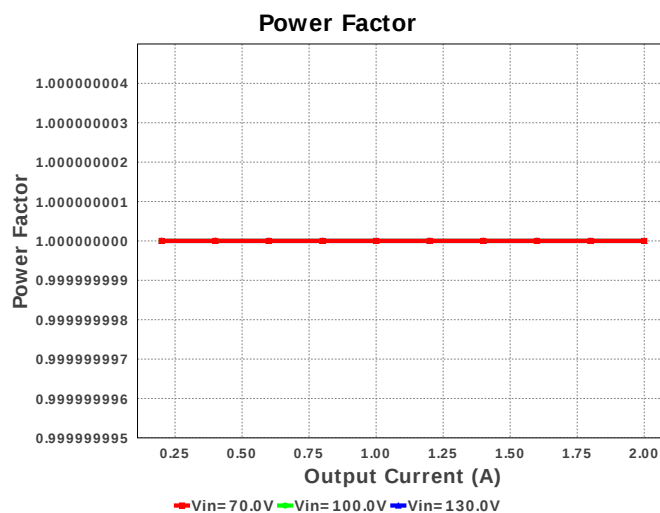
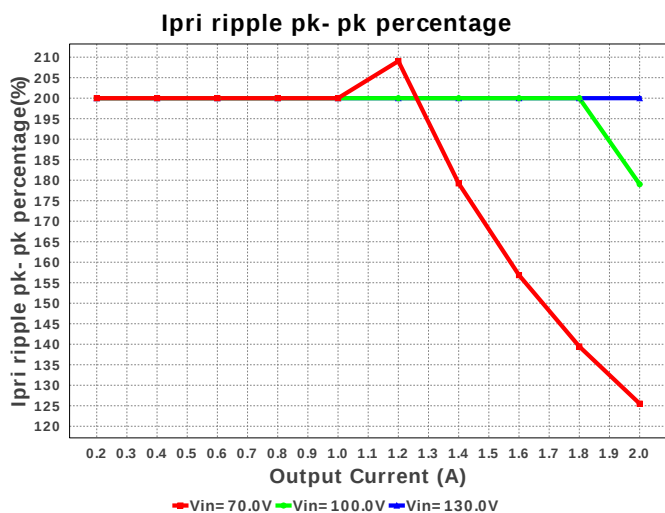


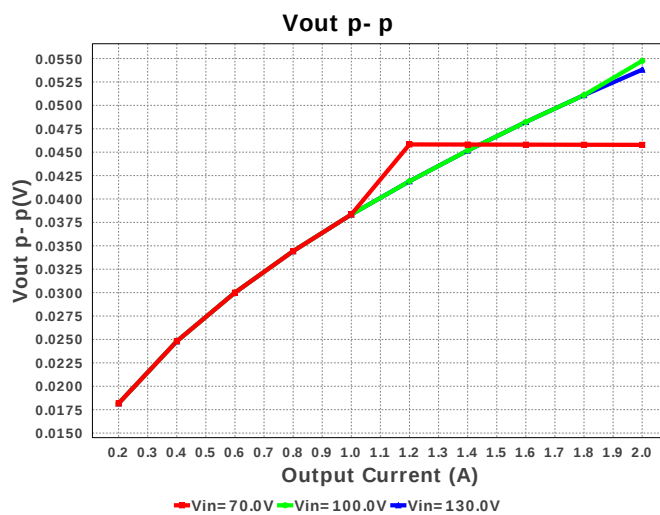
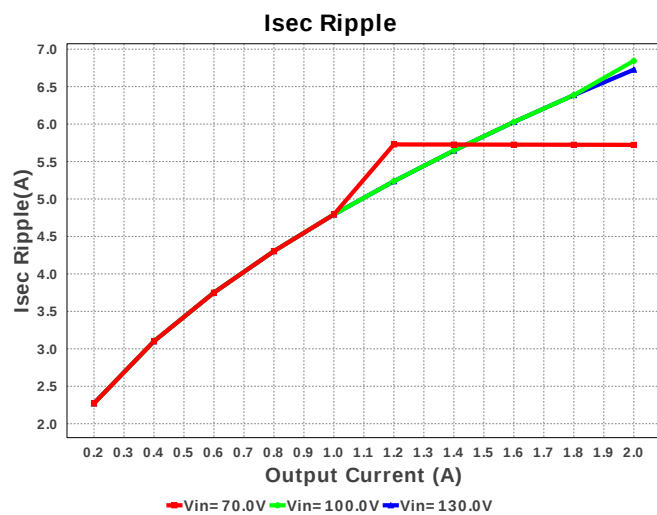
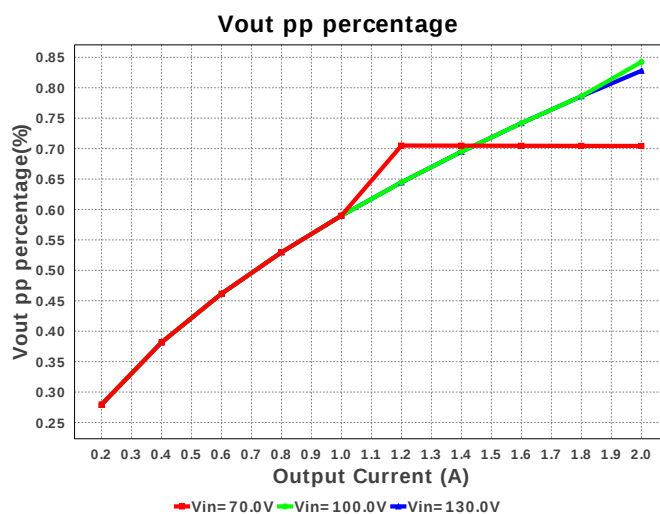
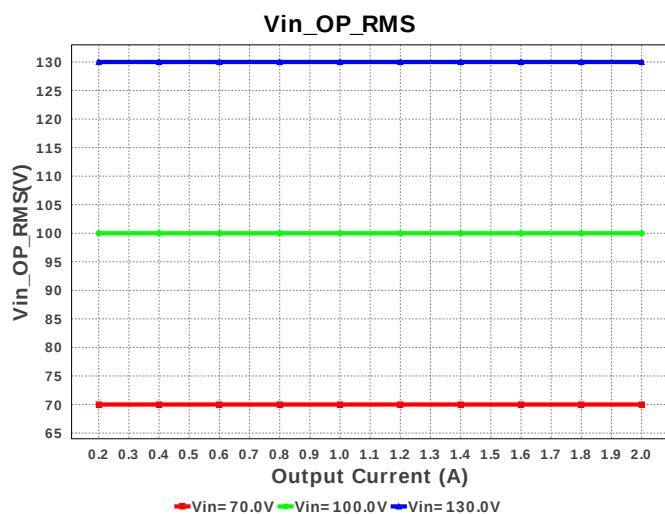
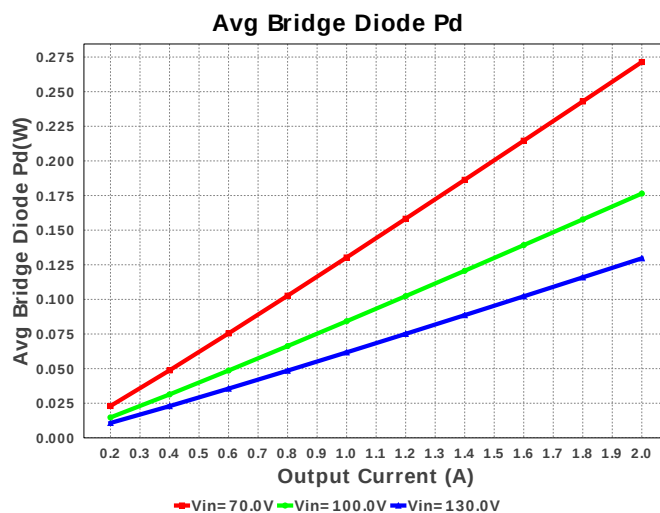
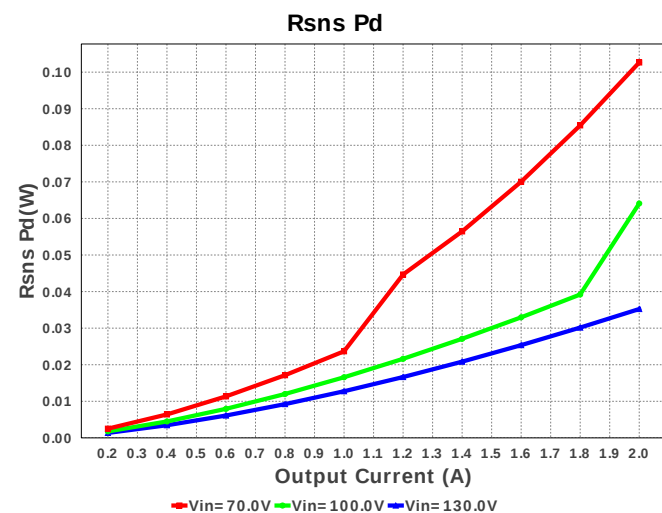
Cout1 IRMS

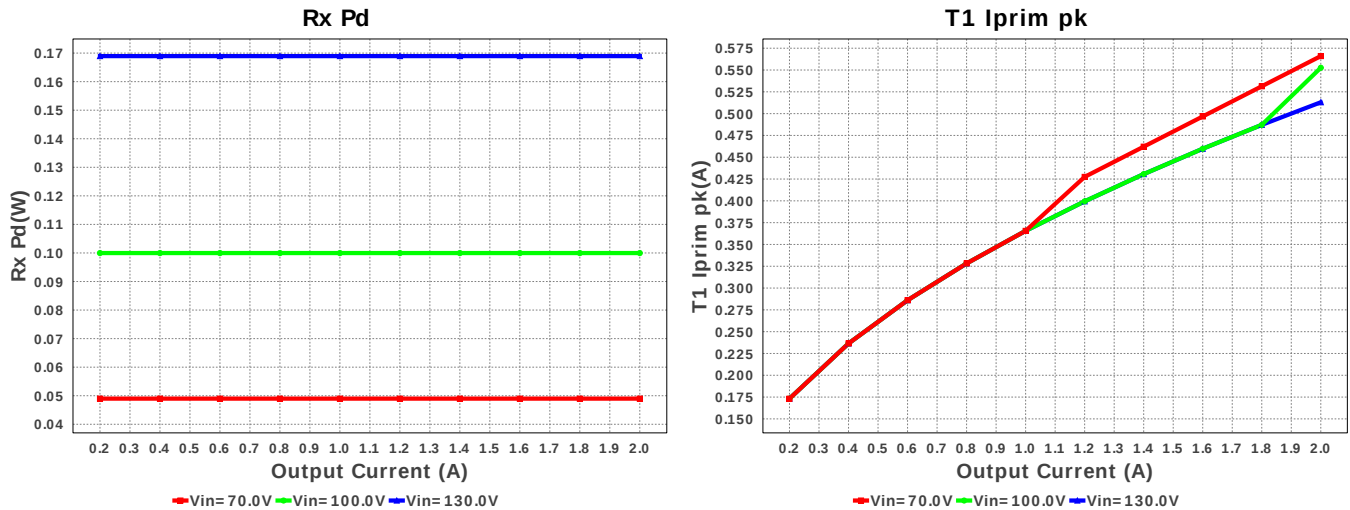


IC Pd









Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	2.438 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	218.88 mA	Current	RMS Input Current
3.	Iout_DCM	1.112 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	200.706 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	436.51 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	125.533 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	5.723 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	280.99 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	565.979 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	3.153 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	7.421 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	55	General	Total Design BOM count
14.	Daux trr	0.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	670.0 mV	General	Effective Forward Voltage Drop at the Operating Current
16.	Dsec trr	19.64 ns	General	Output Diode Reverse Recovery Time
17.	Dsec2 Vf	670.0 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	2.562 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	100.0 kHz	General	Switching frequency
21.	Mode	CCM	General	Conduction Mode
22.	Pout	13.0 W	General	Total output power
23.	Power Factor	1.0	General	Assumed Power Factor for the Application
24.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
25.	Toff	4.387 us	General	Approximate Converter Off Time
26.	Ton Act	5.772 us	General	Approximate Converter On Time
27.	Total BOM	\$0.0	General	Total BOM Cost
28.	Tsw	10.0 us	General	Switching Time Period
29.	Vaux	15.137 V	General	Auxiliary Voltage
30.	Vsnub	256.58 V	General	Voltage Across the Snubber
31.	Vout Actual	6.5 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
32.	Vout OP	6.5 V	Op_Point	Operational Output Voltage
33.	Duty Cycle	57.72 %	Op_point	Duty cycle
34.	Efficiency	84.849 %	Op_point	Steady state efficiency
35.	IC Tj	33.516 degC	Op_point	IC junction temperature
36.	ICThetaJA	107.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
37.	IOUT_OP	2.0 A	Op_point	Iout operating point
38.	M1 TJOP	37.078 degC	Op_point	M1 MOSFET junction temperature
39.	Peak Rectified Vin	98.994 V	Op_point	Peak voltage seen at rectified input
40.	Vin_OP_RMS	70.0 V	Op_point	AC Input RMS Voltage
41.	Vout p-p	45.785 mV	Op_point	Peak-to-peak output ripple voltage
42.	Avg Bridge Diode Pd	271.408 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
43.	Cbulk Pd	28.206 mW	Power	Bulk capacitor power dissipation
44.	Cout1 Pd	47.535 mW	Power	Output capacitor1 power dissipation
45.	Cx Pd	0.0 W	Power	X-cap Power Dissipation
46.	Cy Pd	187.5 pW	Power	Y-caps Power Dissipation
47.	Dsec Pd	670.0 mW	Power	Secondary Diode Power Dissipation
48.	Dsec2 Pd	670.0 mW	Power	Secondary Diode Power Dissipation
49.	IC Pd	32.71 mW	Power	IC power dissipation
50.	L1 Pd	2.785 mW	Power	Power Dissipation in the Inductor

#	Name	Value	Category	Description
51.	M1 Pd	85.282 mW	Power	M1 MOSFET total power dissipation
52.	Paux	20.105 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	212.64 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	12.288 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	4.158 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	102.642 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	48.984 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	531.95 mW	Power	Snubber Power Dissipation
59.	T1 Pd	308.384 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.321 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.007 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	704.386 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	130.0	Maximum input voltage
3.	VinMin	70.0	Minimum input voltage
4.	Vout	6.5	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC3813-2	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC3813-2** Product Folder : <http://www.ti.com/product/UCC3813%2D2> : contains the data sheet and other resources.

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