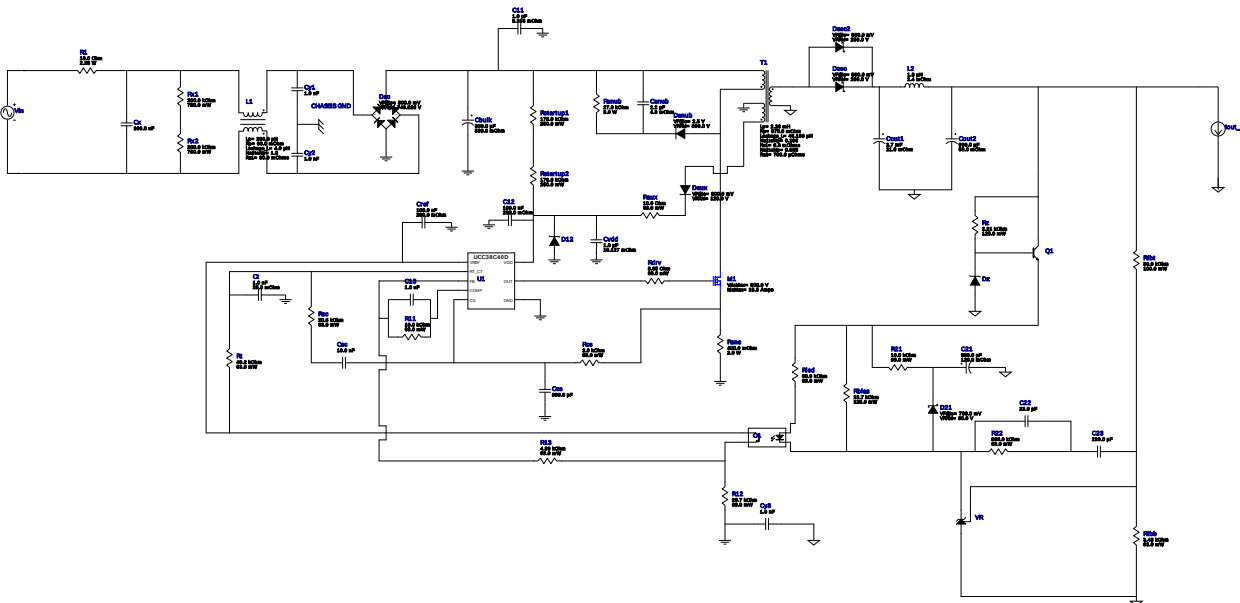


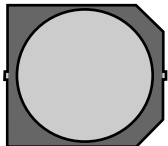
WEBENCH® Design Report

Design : 1831915/13 UCC38C40DR
UCC38C40DR 85.0V-265.0V to 24.00V @ 3.0A



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

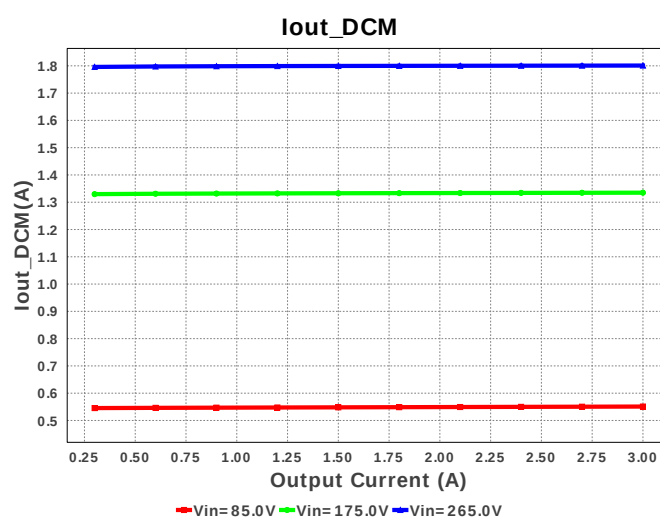
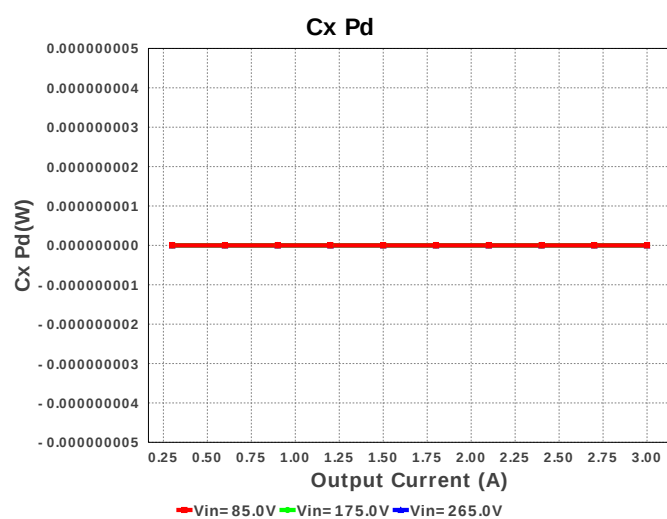
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung 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	Panasonic	EEV-FK1H331Q Series= FK	Cap= 330.0 uF ESR= 120.0 mOhm VDC= 50.0 V IRMS= 900.0 mA	1	\$0.48	 SM_RADIAL_H13 264 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	CC0805JRNPO9BN221 Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	Vishay-Bccomponents	MAL215759331E3 Series= 2239	Cap= 330.0 uF ESR= 530.0 mOhm VDC= 500.0 V IRMS= 2.4 A	1	\$7.43	157PUM-SI_3000x5000 1024 mm ²
8.	Ccs	Yageo America	CC0805KRX7R9BB391 Series= X7R	Cap= 390.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

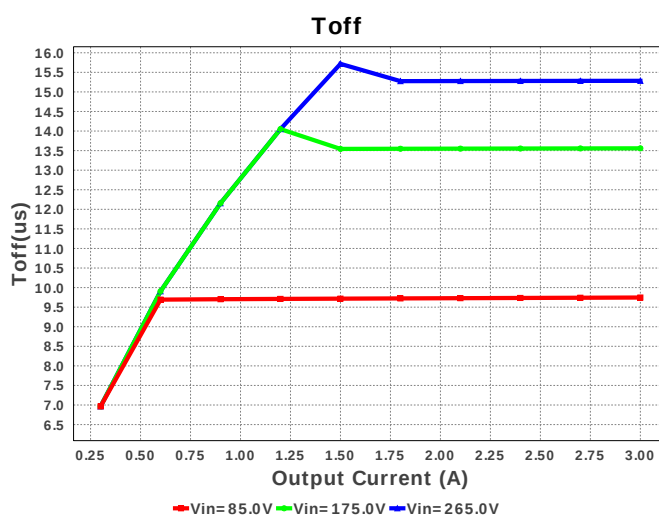
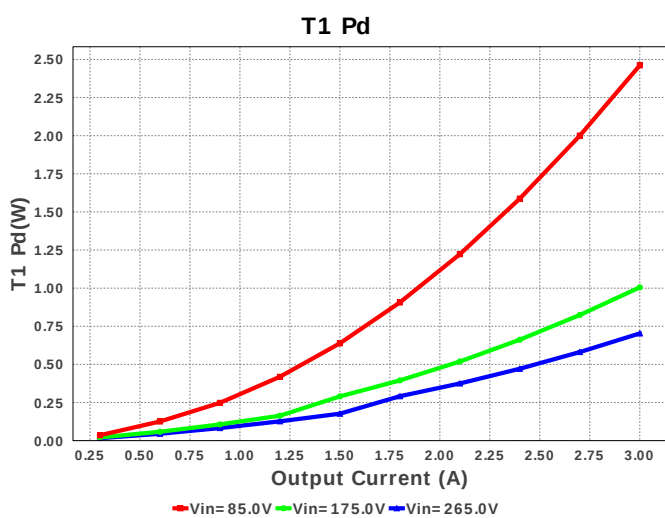
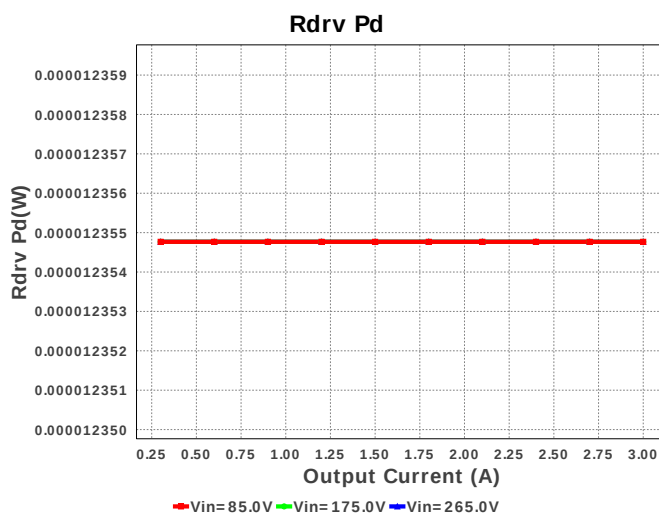
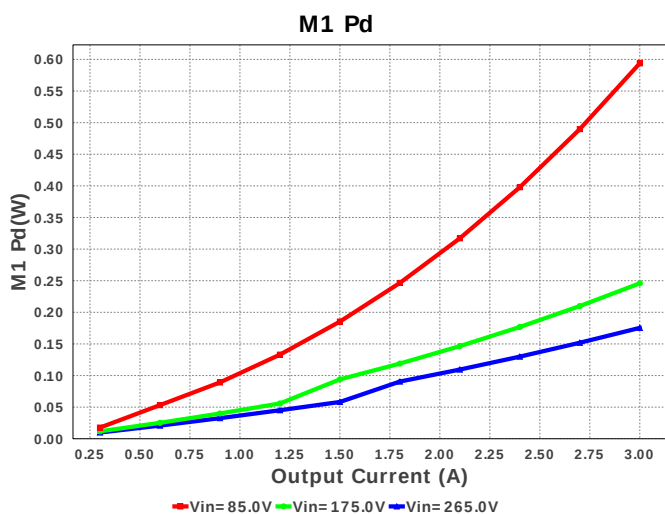
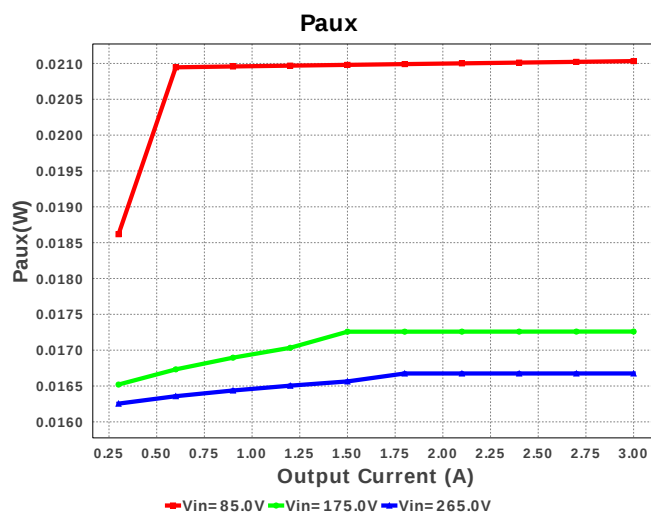
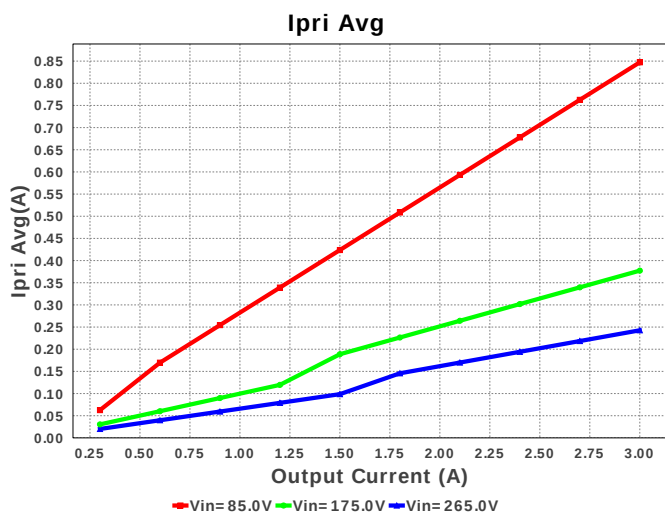
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9.	Cout1	TDK	B41605A8278M009 Series= 2385	Cap= 2.7 mF ESR= 21.0 mOhm VDC= 63.0 V IRMS= 5.3 A	1	\$12.37	B41605_2500x4000_9 729 mm ²
10.	Cout2	TDK	B41607A8907M008 Series= 2360	Cap= 900.0 uF ESR= 50.0 mOhm VDC= 63.0 V IRMS= 10.2 A	1	\$4.84	B41607_2200x4000_8 576 mm ²
11.	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
12.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
13.	Csnub	TDK	C5750X6S2W225K Series= X6S	Cap= 2.2 uF ESR= 4.3 mOhm VDC= 400.0 V IRMS= 0.0 A	1	NA	 2220 54 mm ²
14.	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
15.	Cvdd	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 mm ²
16.	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
17.	Cy1	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²
18.	Cy2	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²

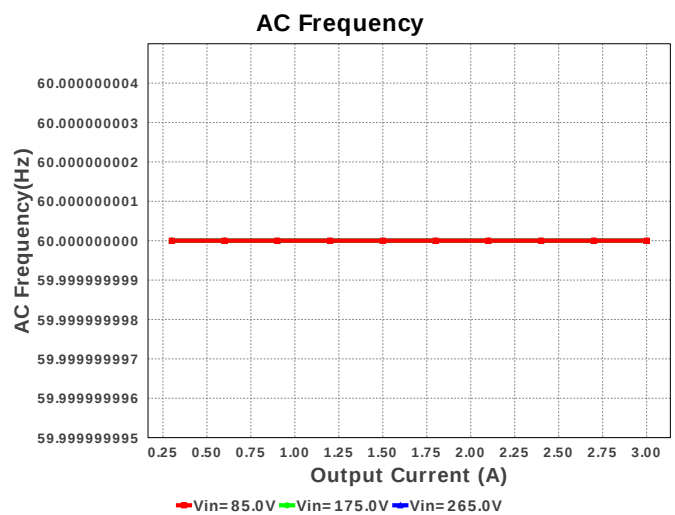
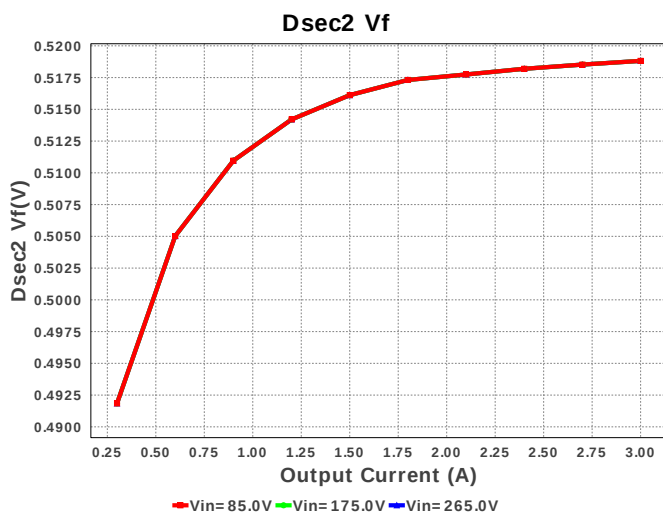
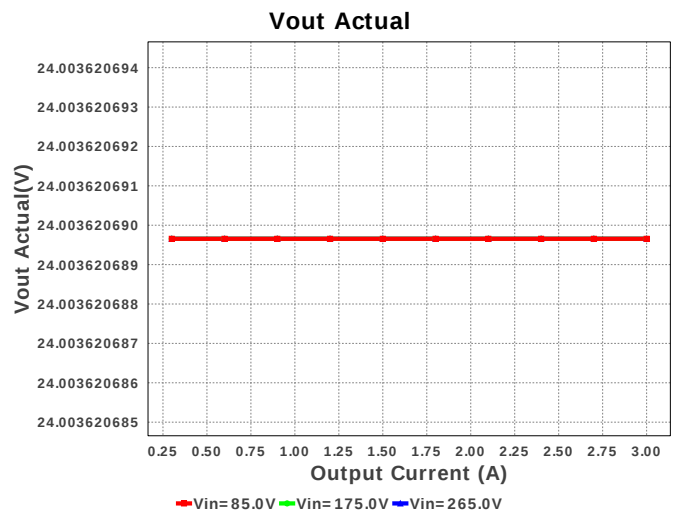
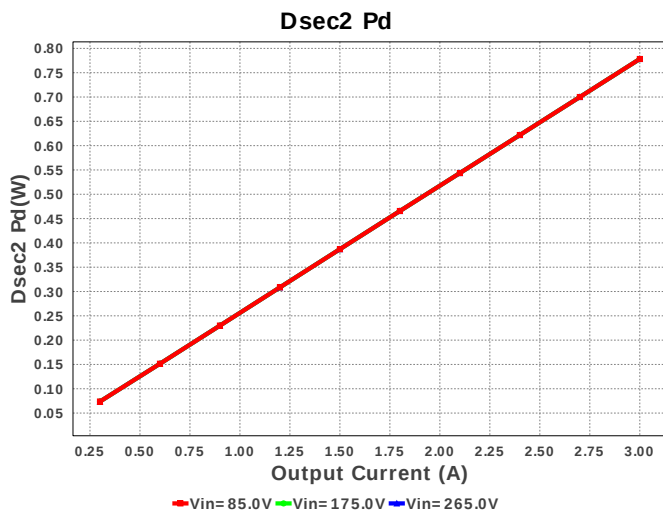
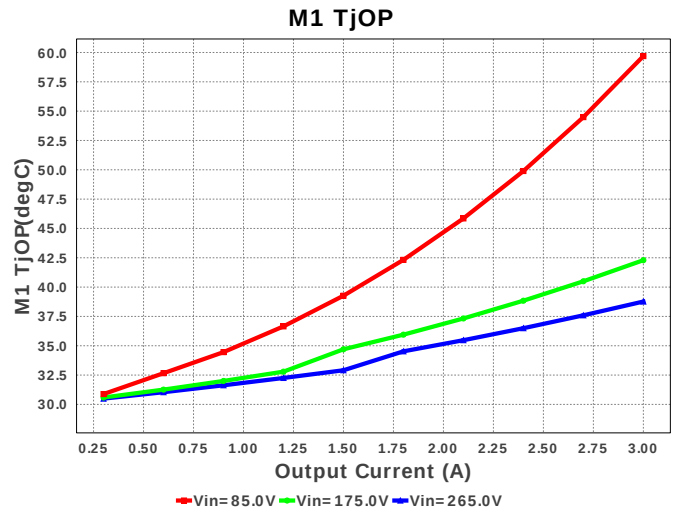
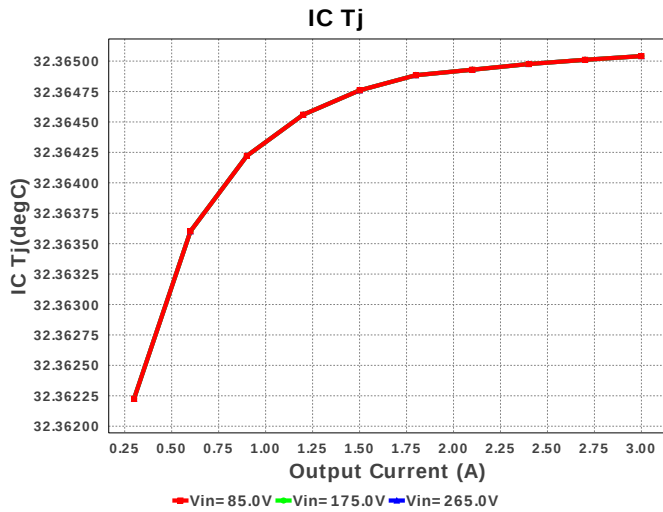
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19.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
21.	D21	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	\$0.09	 SMA 37 mm ²
22.	Dac	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 749.526 V	1	NA	CUSTOM 0 mm ²
23.	Daux	Fairchild Semiconductor	FSV10120V	VF@Io= 800.0 mV VRRM= 120.0 V	1	\$0.21	 TO-277A 56 mm ²
24.	Dsec	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 DDPAK 210 mm ²
25.	Dsec2	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 DDPAK 210 mm ²
26.	Dsnub	Bourns	CD1408-FU1800	VF@Io= 2.5 V VRRM= 800.0 V	1	\$0.13	 Diode_1408 13 mm ²
27.	Dz	Diodes Inc.	MMSZ5250B-7-F	Zener	1	\$0.03	 SOD-123 13 mm ²
28.	L1	CUSTOM	CUSTOM	Lp= 200.0 µH Rp= 60.0 mOhm Leakage_L= 4.0 µH Ns1toNp= 1.0 Rs1= 60.0 mOhms	1	NA	CUSTOM 0 mm ²
29.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
30.	M1	STMicroelectronics	STW21N90K5	VdsMax= 900.0 V IdsMax= 18.5 Amps	1	\$3.94	 TO-247 123 mm ²
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
32.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm ²

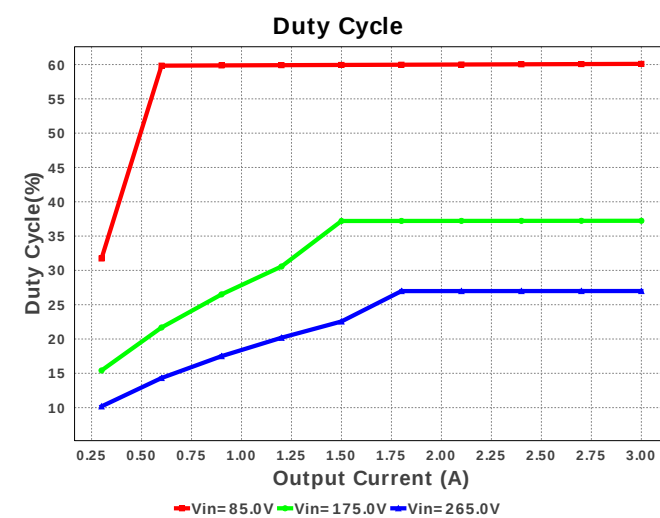
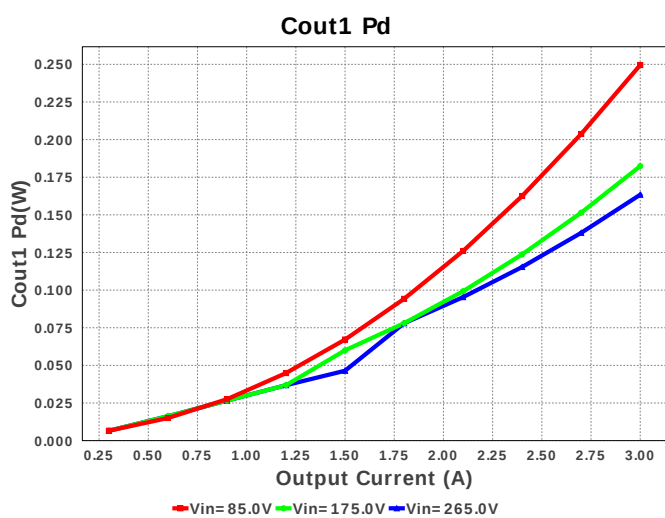
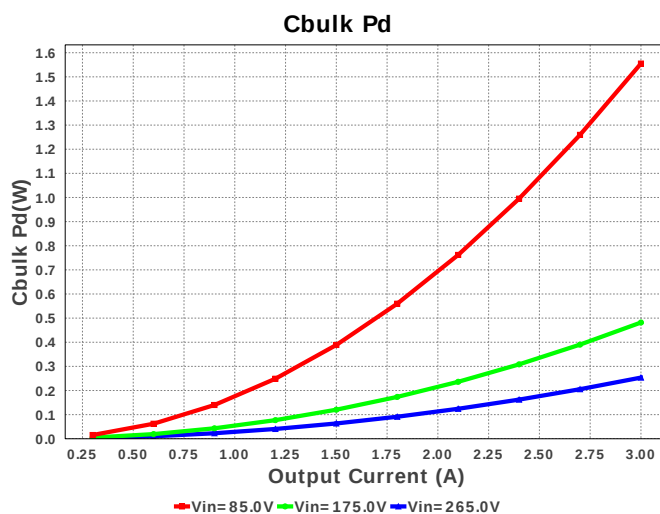
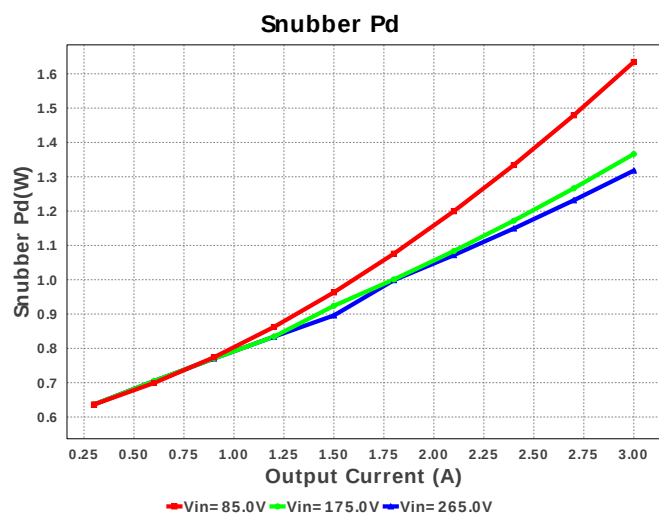
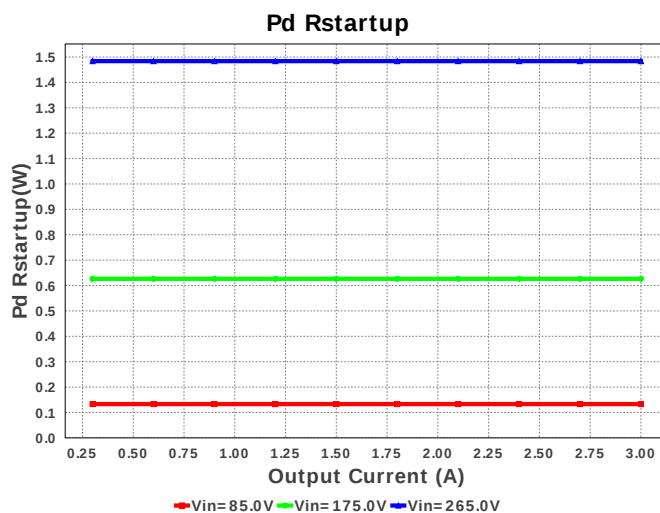
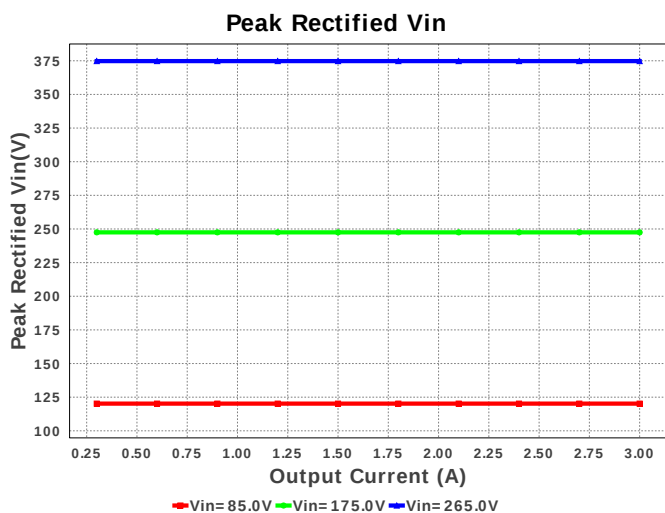
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34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	R12	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
36.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
37.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
38.	R22	Vishay-Dale	CRCW0402866KFKED Series= CRCW..e3	Res= 866.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
39.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
40.	Rbias	Panasonic	ERJ-6ENF1372V Series= ERJ-6E	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
41.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
42.	Rdrv	Vishay-Dale	CRCW04023R65FKED Series= CRCW..e3	Res= 3.65 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
43.	Rfbb	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rfbt	Yageo America	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
45.	Rled	Vishay-Dale	CRCW040230K9FKED Series= CRCW..e3	Res= 30.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW040220K5FKED Series= CRCW..e3	Res= 20.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
47.	Rsns	Stackpole Electronics Inc	CSRN2512FKR400 Series= ?	Res= 400.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.13	 2512 43 mm²
48.	Rsns	Vishay-Bccomponents	PR03000202702JAC00 Series= ?	Res= 27.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	\$0.19	 PR03 0 mm²
49.	Rstartup1	Panasonic	ERJ-8ENF1783V Series= ERJ-8E	Res= 178.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
50.	Rstartup2	Panasonic	ERJ-8ENF1783V Series= ERJ-8E	Res= 178.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
51.	Rt	Vishay-Dale	CRCW040240K2FKED Series= CRCW..e3	Res= 40.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
52.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
53.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²

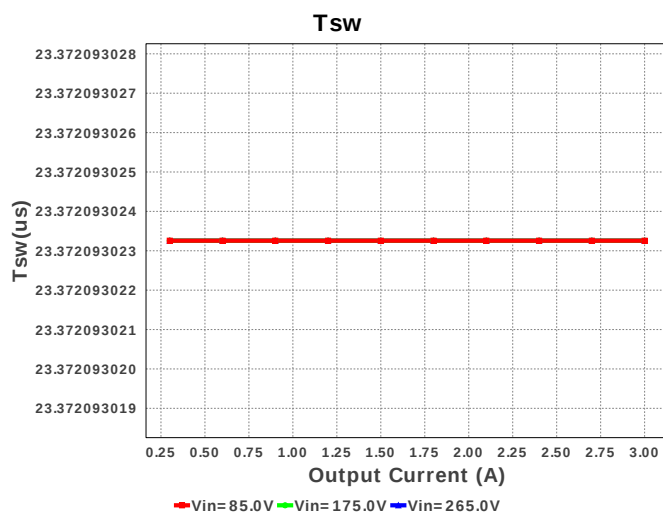
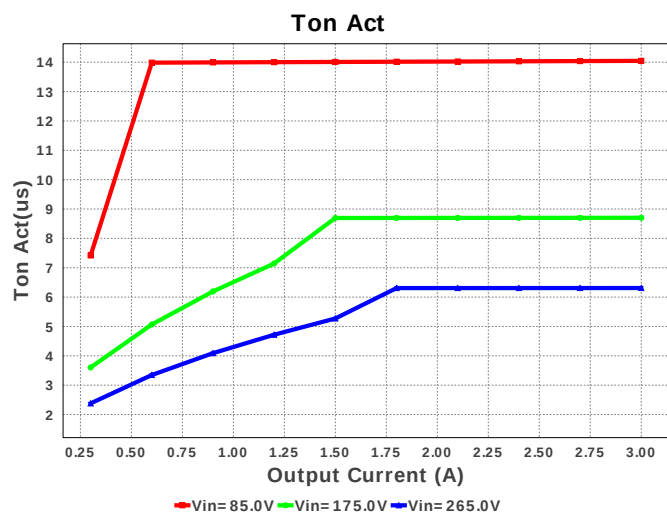
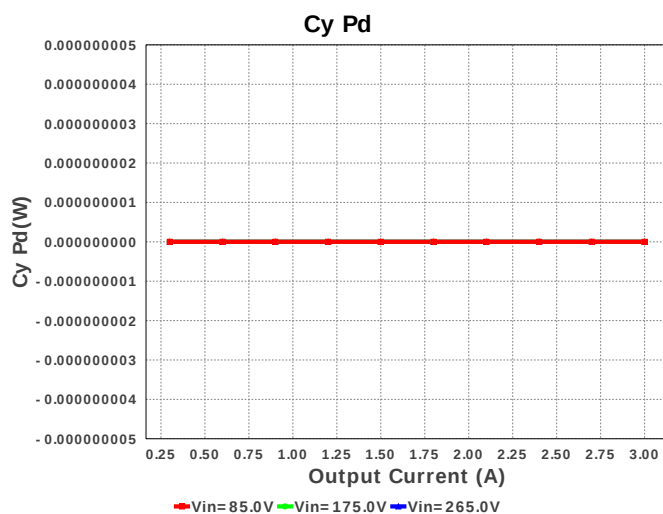
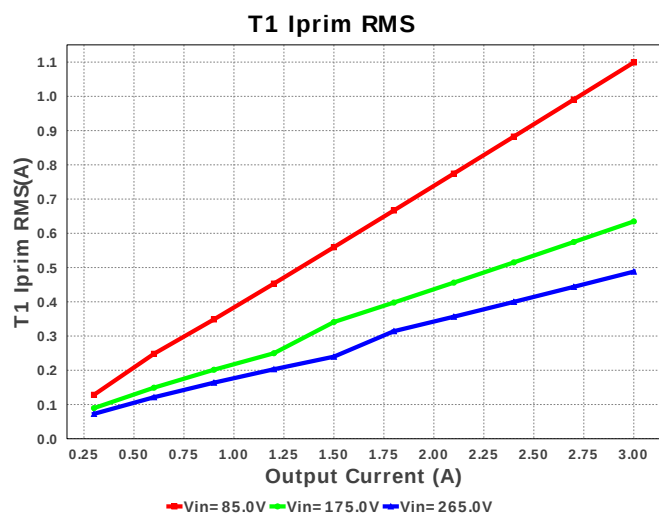
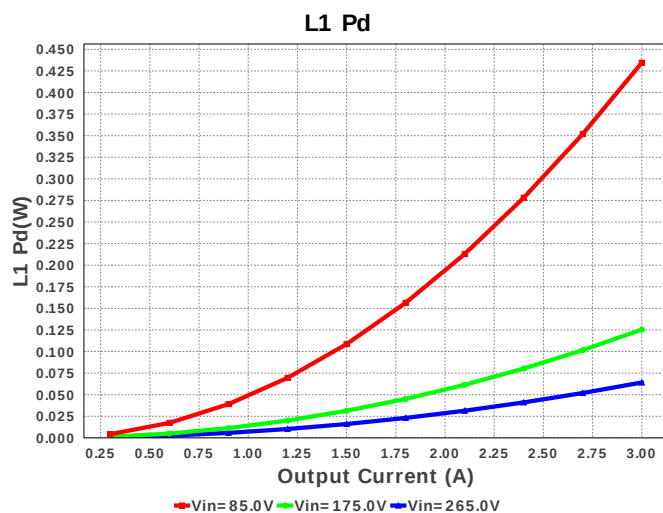
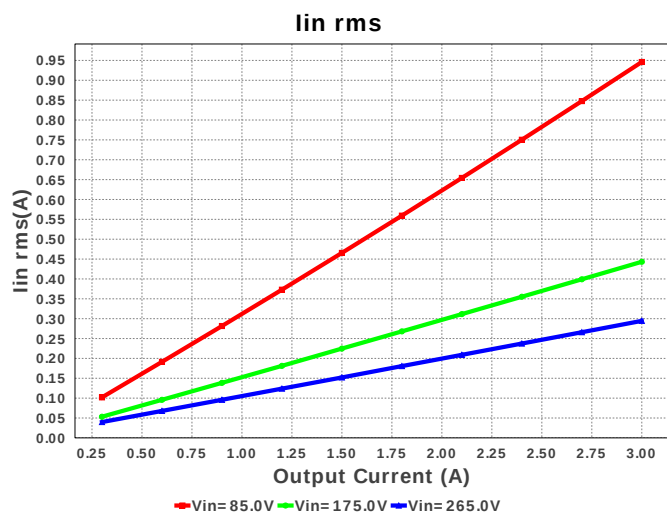
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
54.	Rz	Panasonic	ERJ-6ENF2211V Series= ERJ-6E	Res= 2.21 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
55.	T1	CUSTOM	CUSTOM	Lp= 2.26 mH Rp= 870.0 mOhm Leakage_L= 45.196 μH Ns1toNp= 0.196 Rs1= 8.6 mOhms Ns2toNp= 0.085 Rs2= 700.0 μOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC38C40DR	Switcher	1	\$0.70	
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 D0008A 57 mm ² R-PDSO-G3 16 mm ²

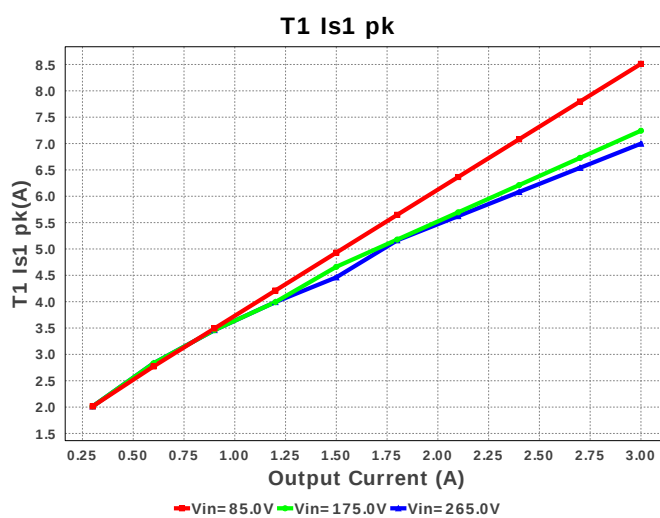
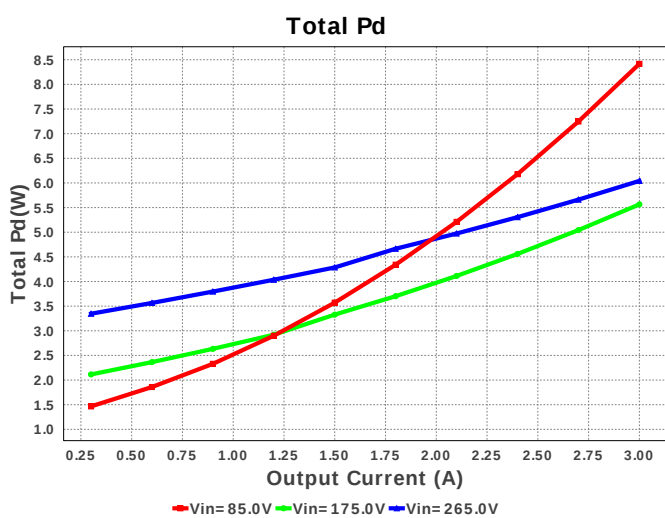
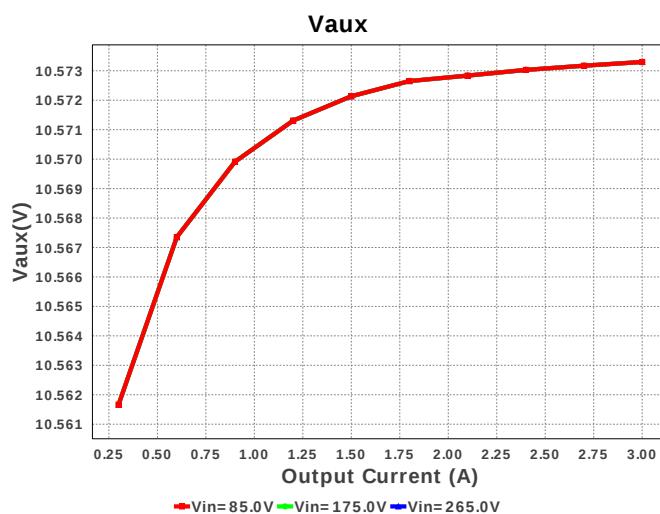
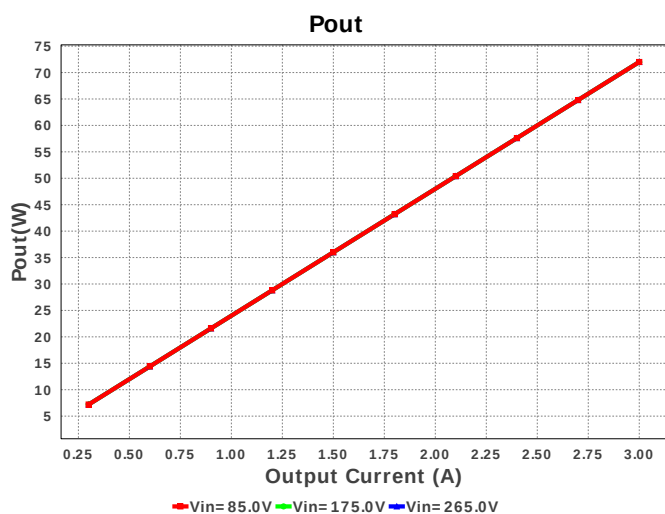
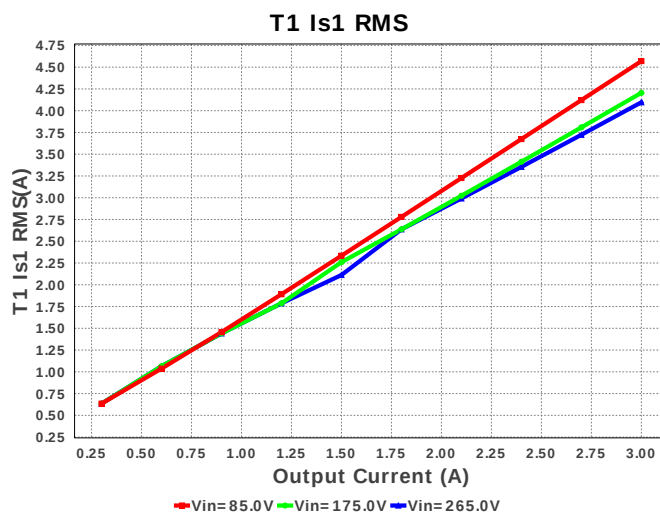
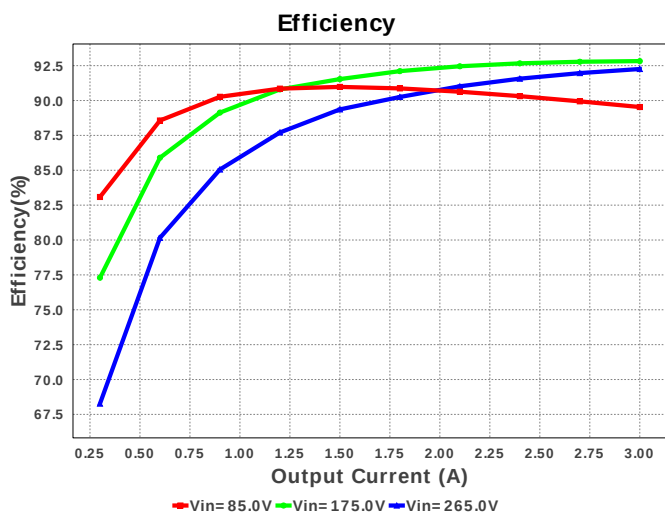


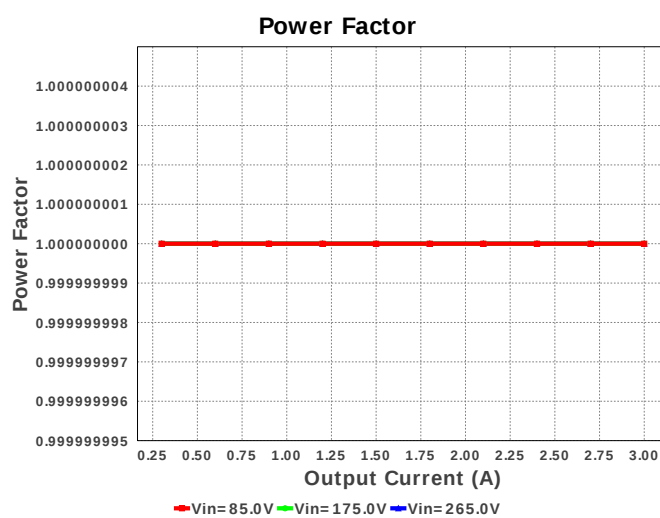
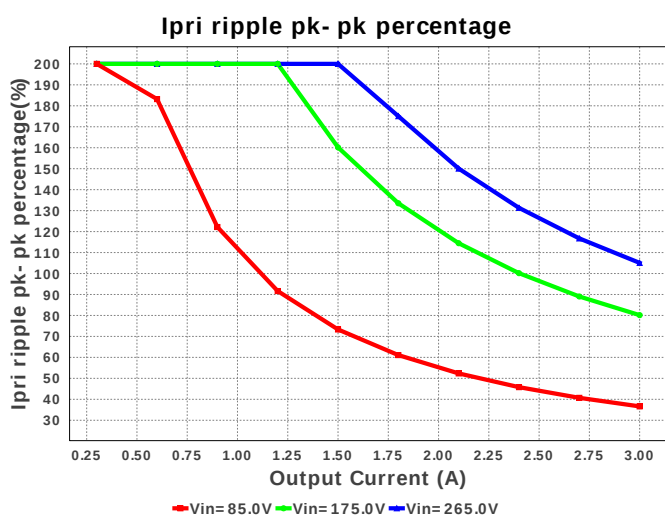
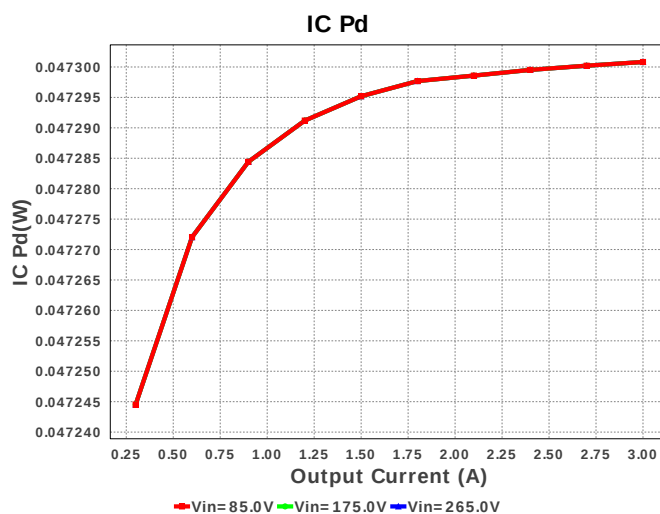
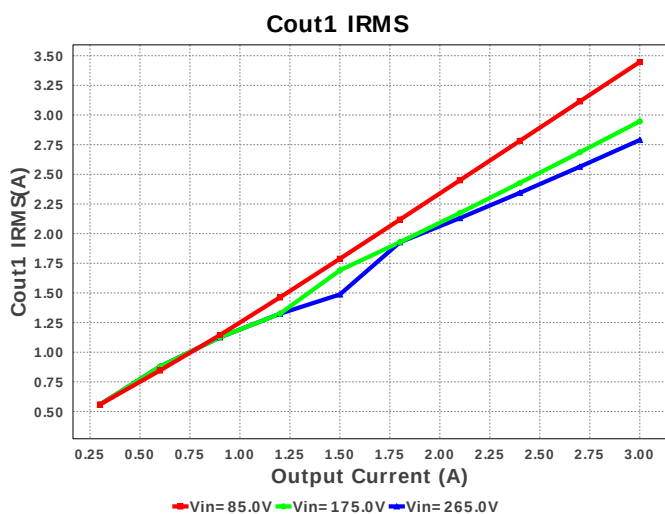
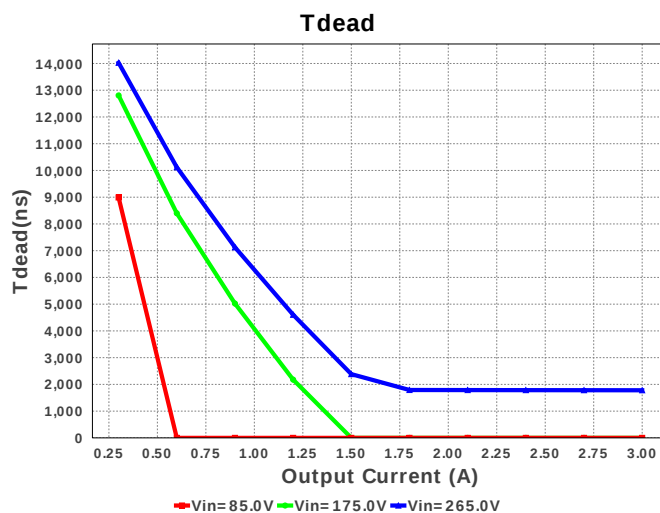
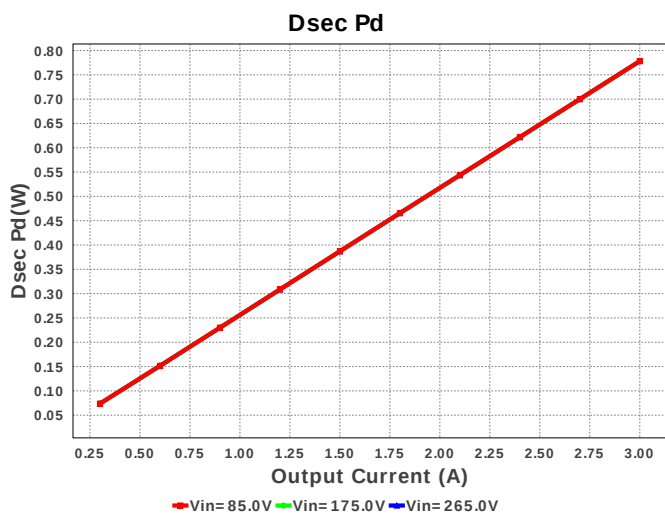


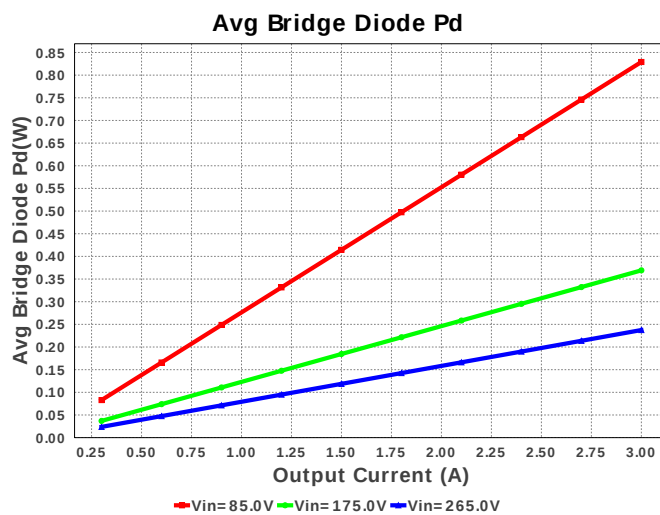
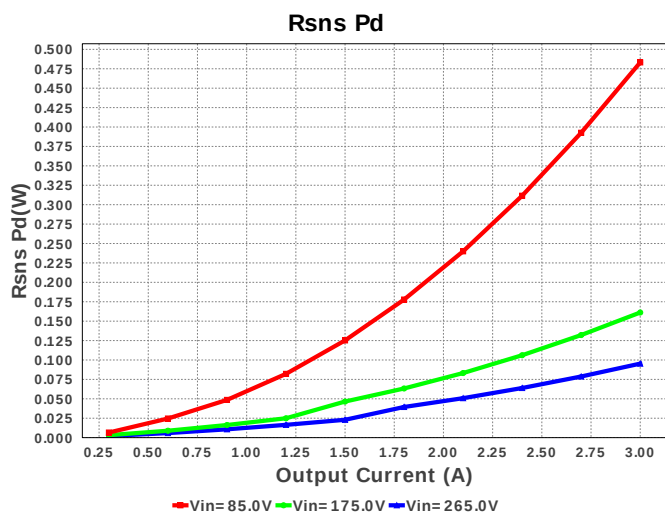
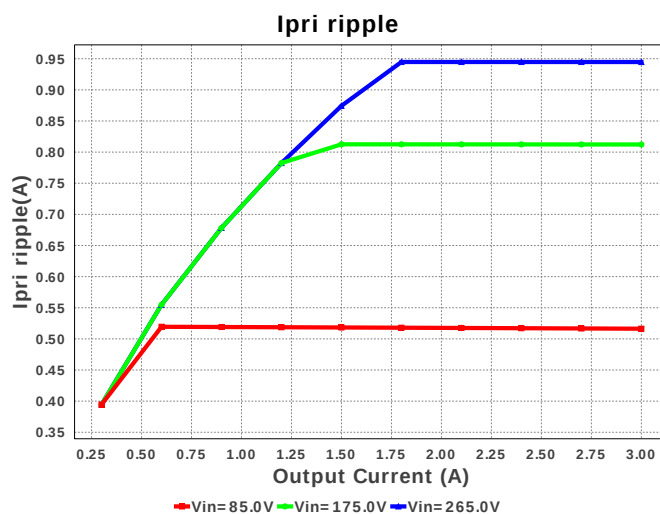
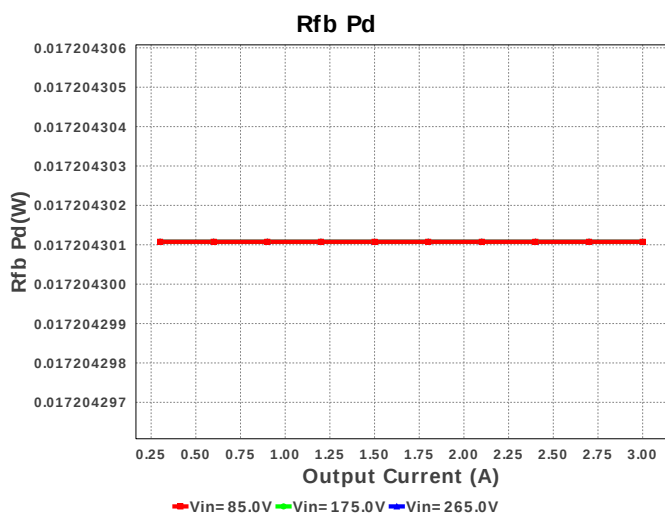
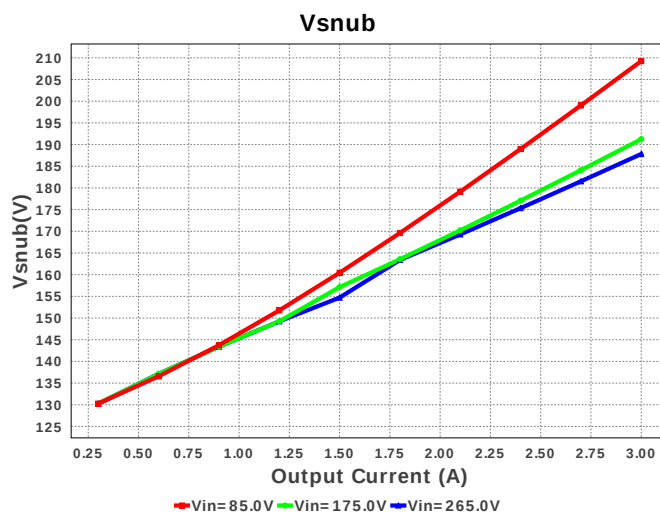
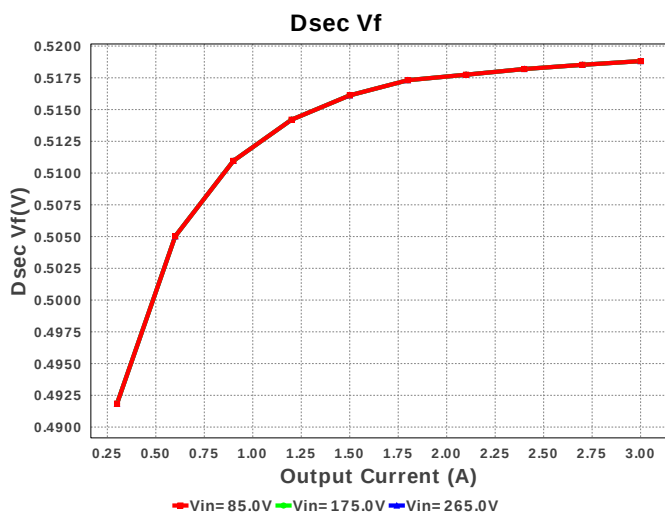


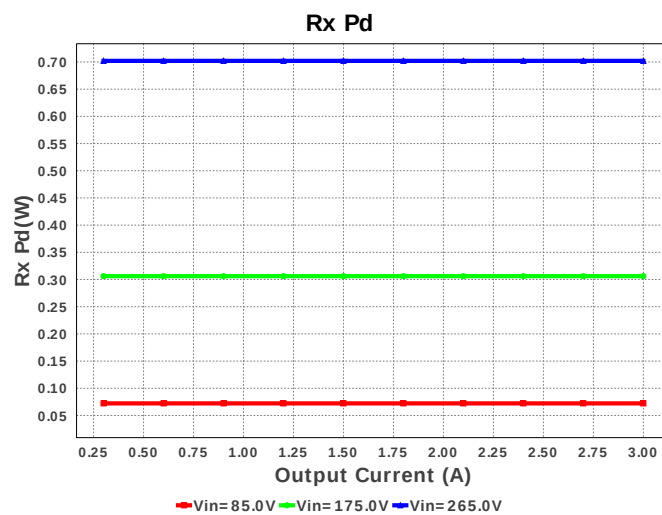
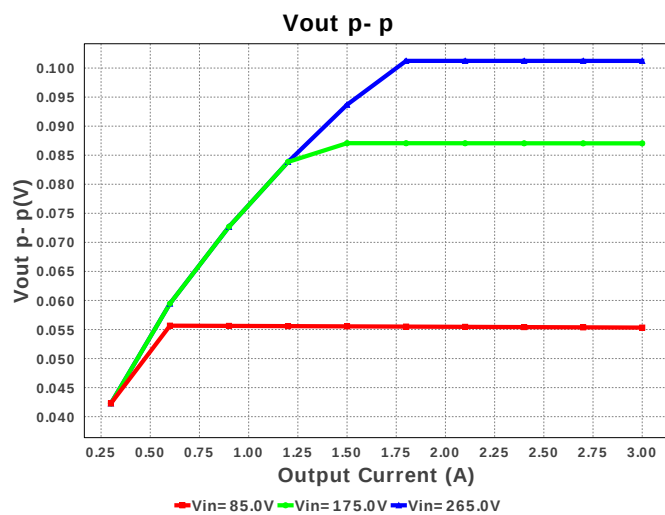
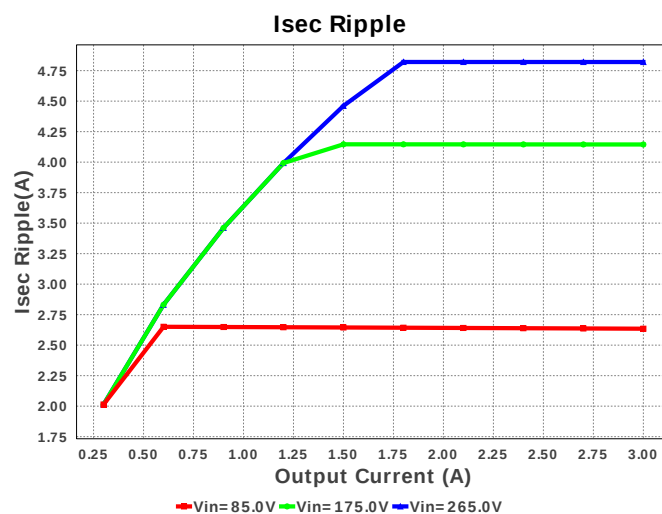
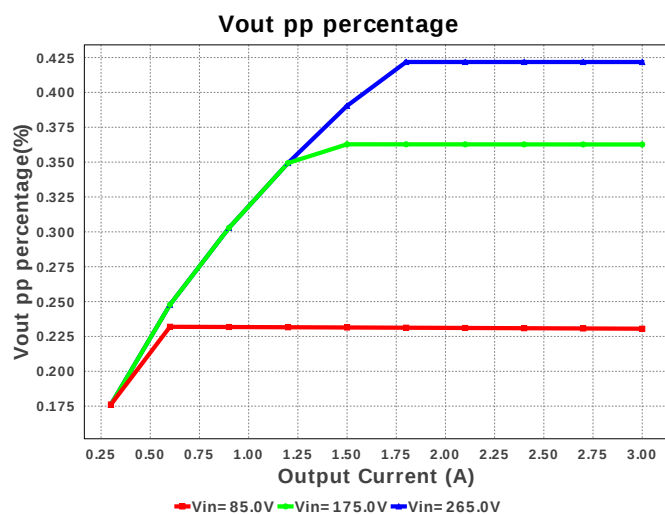
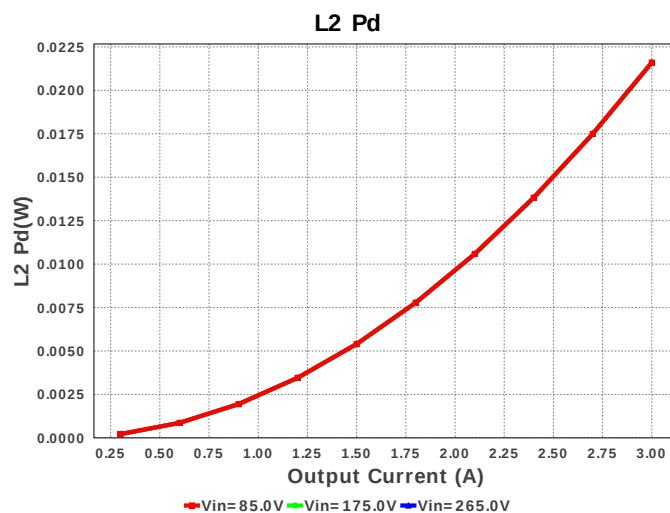
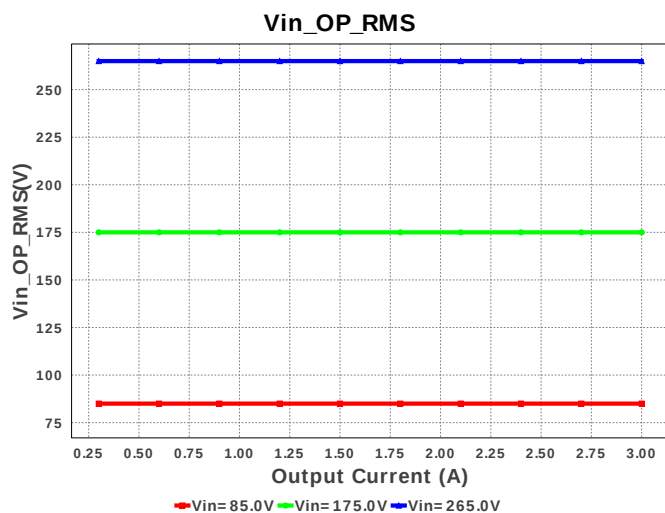


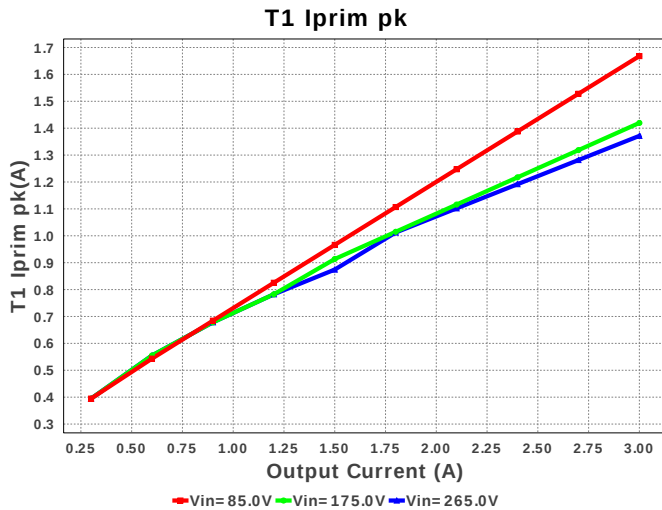












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	3.447 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	946.07 mA	Current	RMS Input Current
3.	Iout_DCM	551.017 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	847.306 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	516.333 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	36.623 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	2.635 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.099 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	1.668 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	4.57 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	8.512 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	50.0 Hz	General	Input AC frequency
13.	BOM Count	57	General	Total Design BOM count
14.	Daux trr	16.7 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	518.816 mV	General	Effective Forward Voltage Drop at the Operating Current
16.	Dsec trr	0.0 ns	General	Output Diode Reverse Recovery Time
17.	Dsec2 Vf	518.816 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	4.992 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	42.786 kHz	General	Switching frequency
21.	Pout	72.0 W	General	Total output power
22.	Power Factor	1.0	General	Assumed Power Factor for the Application
23.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
24.	Toff	9.746 us	General	Approximate Converter Off Time
25.	Ton Act	14.046 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	23.372 us	General	Switching Time Period
28.	Vaux	10.573 V	General	Auxiliary Voltage
29.	Vsnub	209.247 V	General	Voltage Across the Snubber
30.	Vout Actual	24.004 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	24.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	60.098 %	Op_point	Duty cycle
33.	Efficiency	89.534 %	Op_point	Steady state efficiency
34.	IC Tj	32.365 degC	Op_point	IC junction temperature
35.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	3.0 A	Op_point	Iout operating point
37.	M1 TJOP	59.692 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	120.207 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	85.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	55.329 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	829.02 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	1.555 W	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	249.539 mW	Power	Output capacitor1 power dissipation
44.	Cx Pd	0.0 W	Power	X-cap Power Dissipation
45.	Cy Pd	0.0 W	Power	Y-caps Power Dissipation
46.	Dsec Pd	778.224 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	778.224 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	47.301 mW	Power	IC power dissipation
49.	L1 Pd	434.54 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	21.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period

#	Name	Value	Category	Description
51.	M1 Pd	593.843 mW	Power	M1 MOSFET total power dissipation
52.	Paux	21.033 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	133.087 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	12.355 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	483.18 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	72.227 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	1.634 W	Power	Snubber Power Dissipation
59.	T1 Pd	2.461 W	Power	Estimated Losses in Transformer
60.	Total Pd	8.416 W	Power	Total Power Dissipation
61.	Vout Tolerance	2.137 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	230.537 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	85.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	line_fsw	50.0	Light Output in Lumen
6.	base_pn	UCC38C40	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC38C40** Product Folder : <http://www.ti.com/product/UCC38C40> : contains the data sheet and other resources.

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