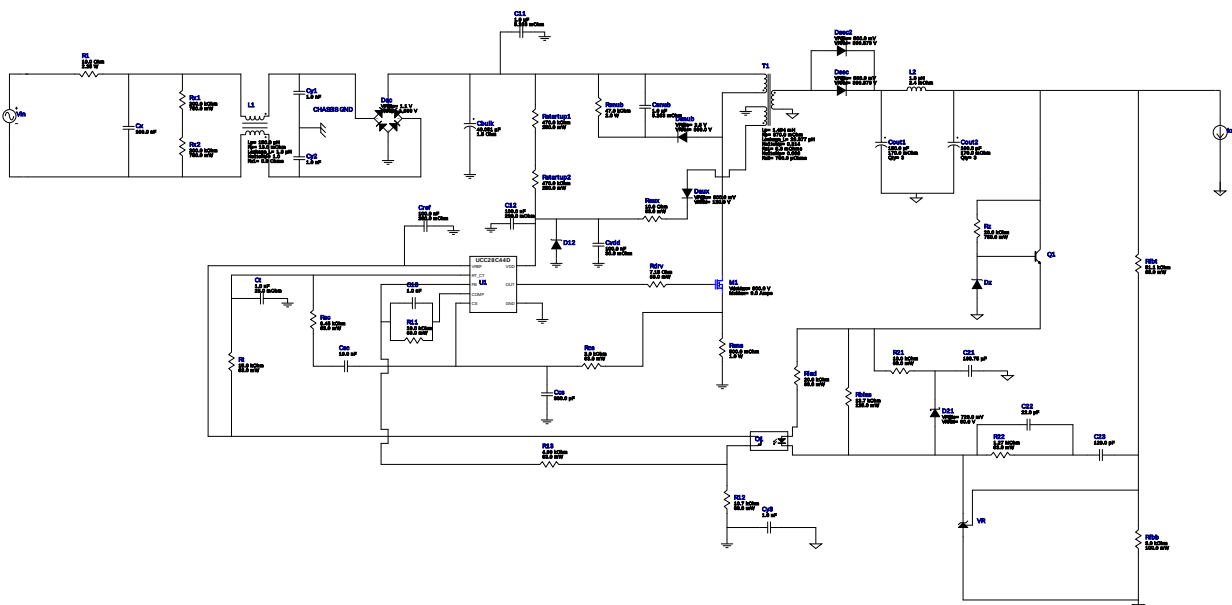


WEBENCH® Design Report

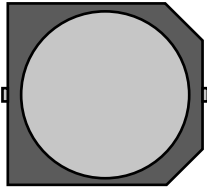
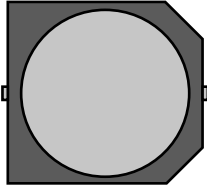
Design : 4738744/13 UCC28C44DR
UCC28C44DR 220.0V-250.0V to 45.00V @ 2.0A

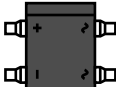
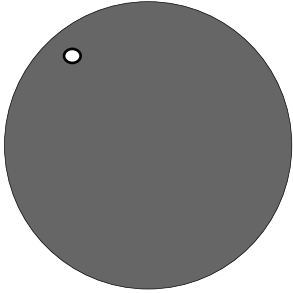


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

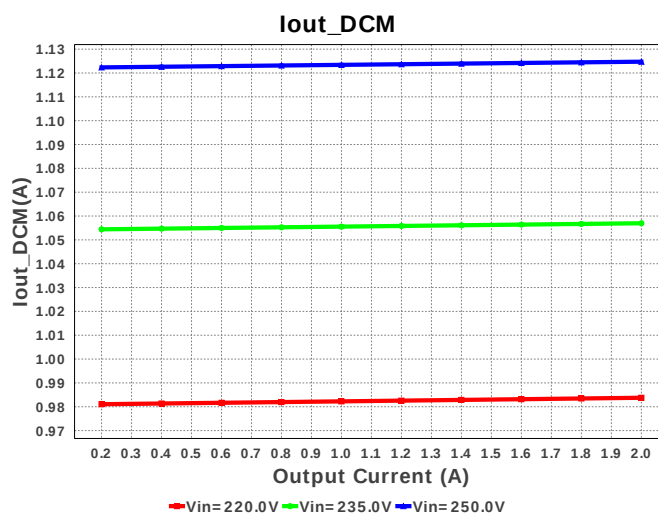
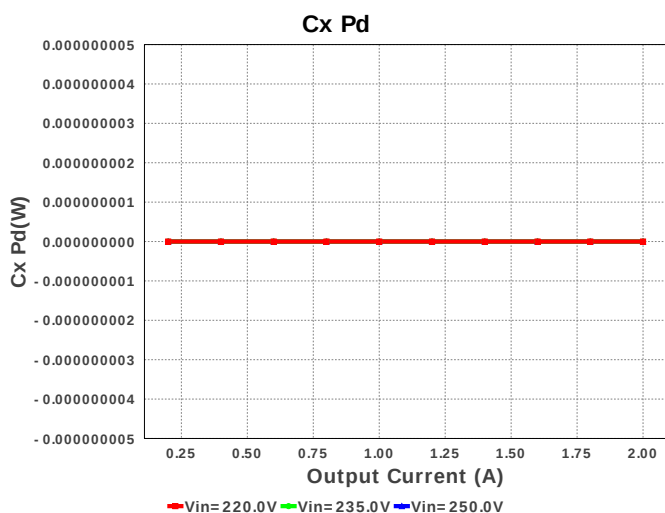
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung 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	CUSTOM	CUSTOM Series= ?	Cap= 168.75 uF VDC= 40.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 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	Samsung Electro-Mechanics	CL21C121JB61PNC Series= C0G/NP0	Cap= 120.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 40.051 uF ESR= 1.5005 Ohm VDC= 424.26 V IRMS= 992.68 mA	1	NA	CUSTOM 0 mm ²
8.	Ccs	Samsung Electro-Mechanics	CL21C331JBANFNC Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

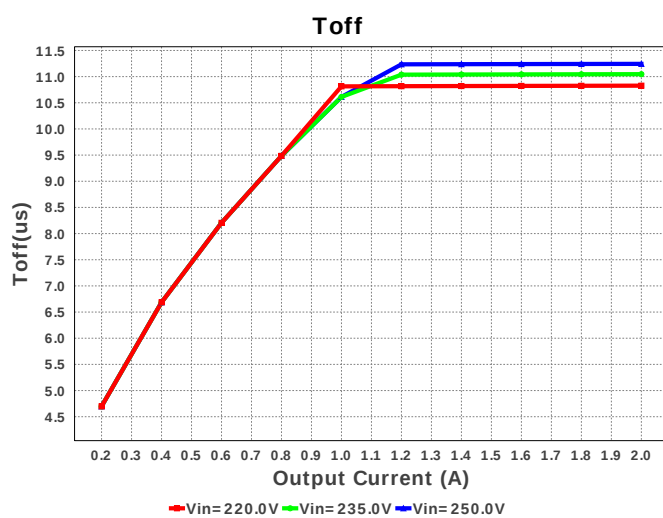
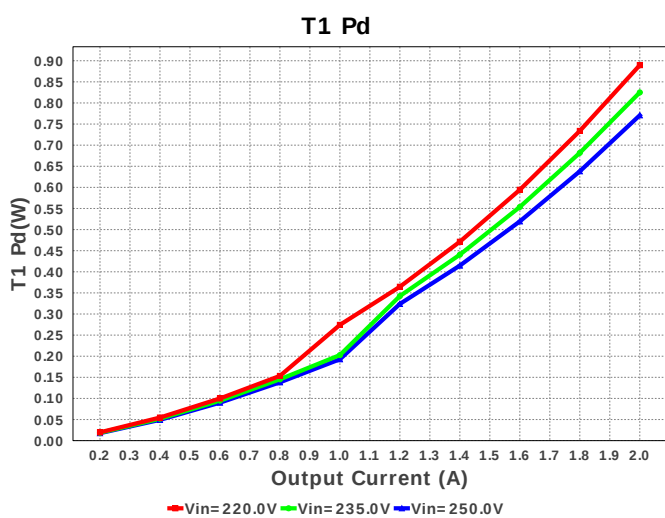
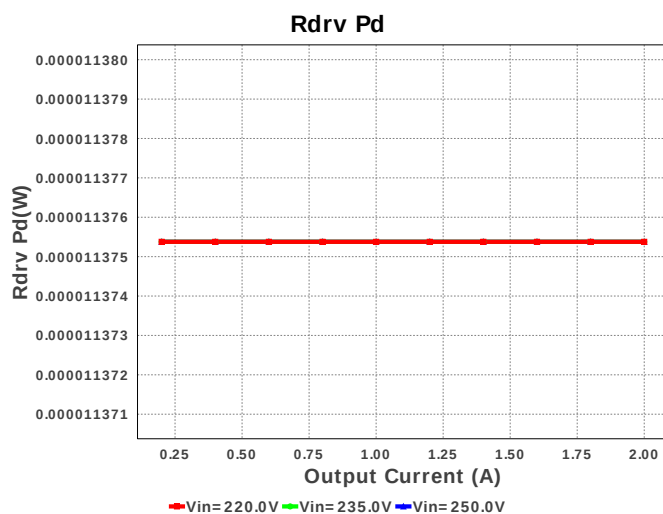
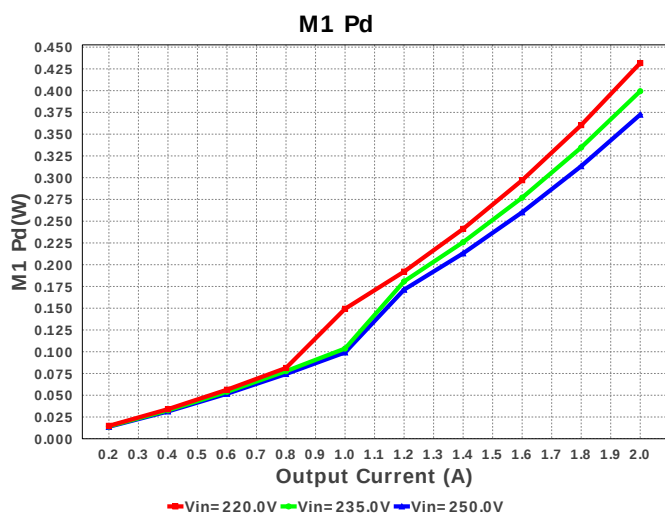
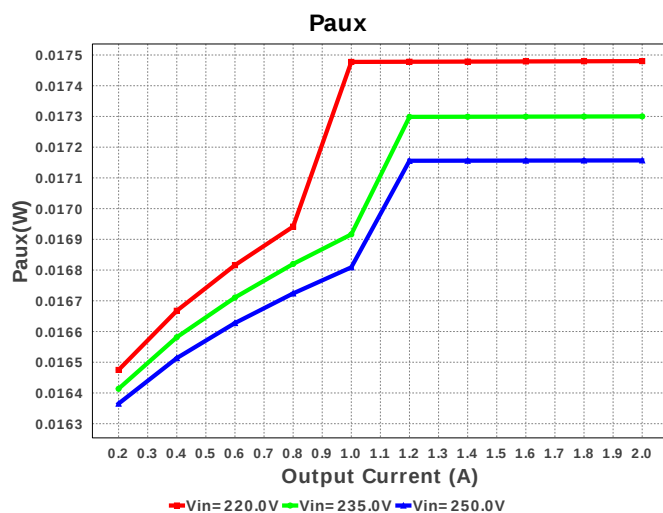
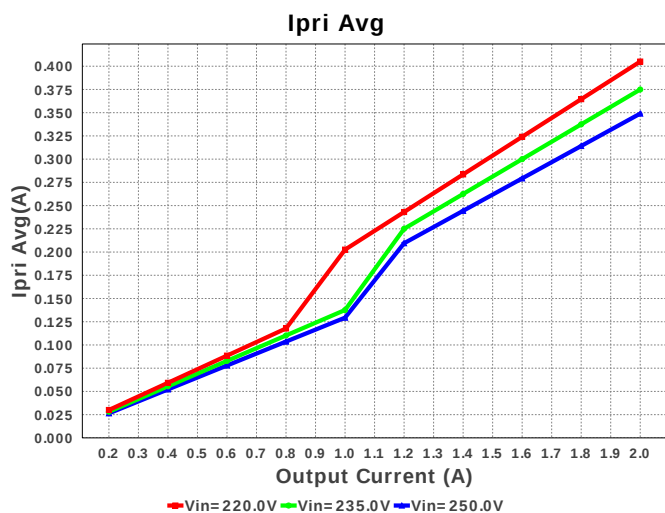
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9.	Cout1	Panasonic	EEV-FK2A151M Series= FK	Cap= 150.0 uF ESR= 170.0 mOhm VDC= 100.0 V IRMS= 793.0 mA	3	\$0.78	 SM_RADIAL_J16 399 mm ²
10.	Cout2	Panasonic	EEV-FK2A101M Series= FK	Cap= 100.0 uF ESR= 170.0 mOhm VDC= 100.0 V IRMS= 793.0 mA	3	\$0.79	 SM_RADIAL_J16 399 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	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
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	GRM188R71E104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 1.51 A	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

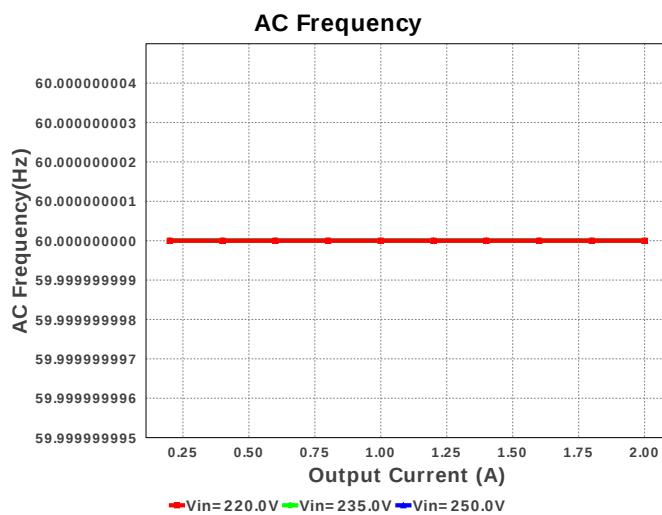
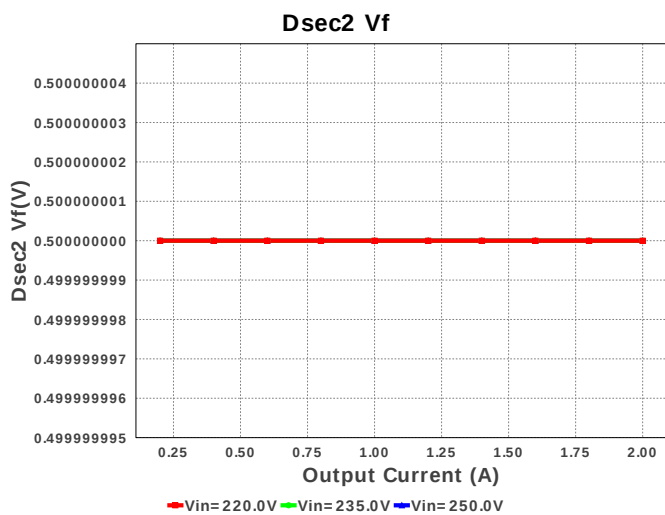
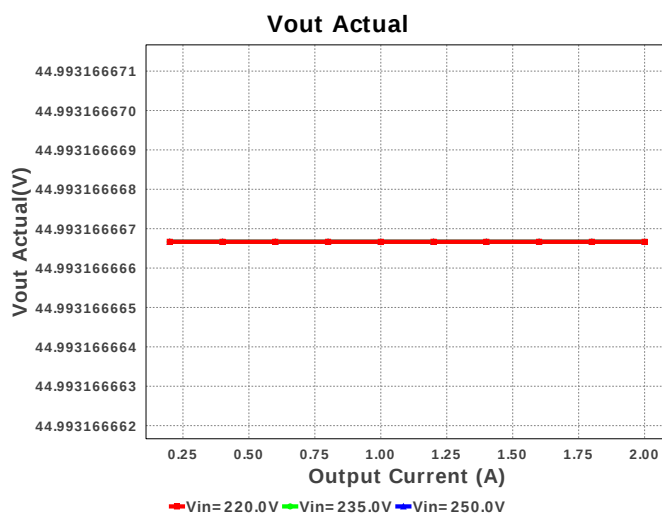
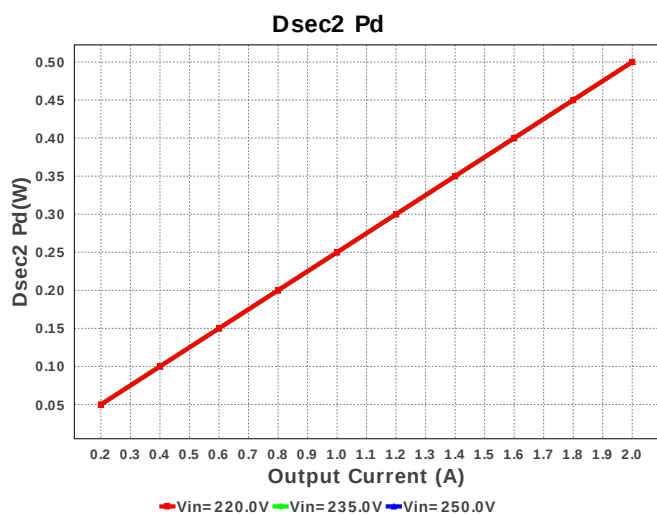
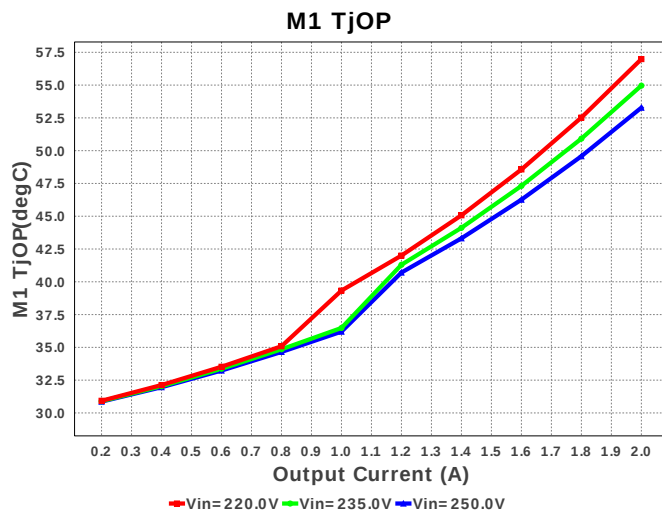
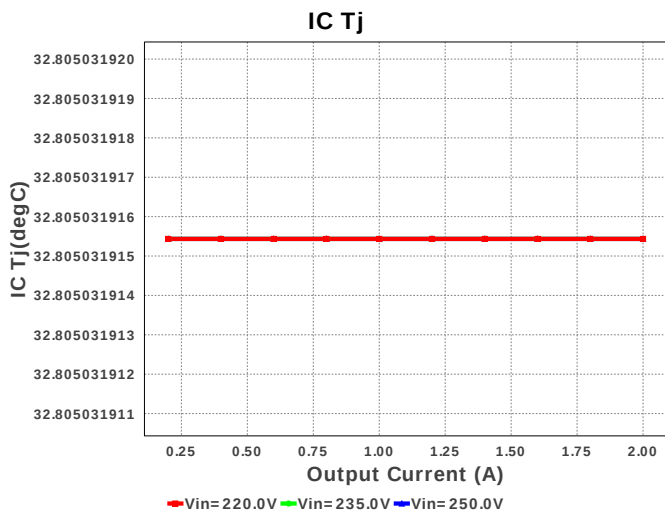
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19.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
21.	D21	ON Semiconductor	SS16T3G	VF@Io= 720.0 mV VRRM= 60.0 V	1	\$0.08	 SMA 37 mm ²
22.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	\$0.24	 DF-S 99 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	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 390.376 V	1	NA	CUSTOM 0 mm ²
25.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 390.376 V	1	NA	CUSTOM 0 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	API Delevan	CM6296R-154	Lp= 150.0 µH Rp= 16.0 mOhm Leakage_L= 1.8 µH Ns1toNp= 1.0 Rs1= 0.0 Ohms	1	\$5.95	 CM6296 833 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	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	\$2.52	 TO-220FP 79 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

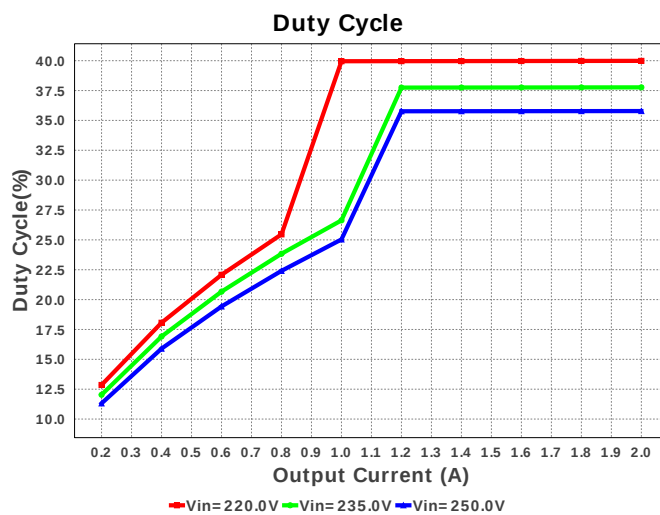
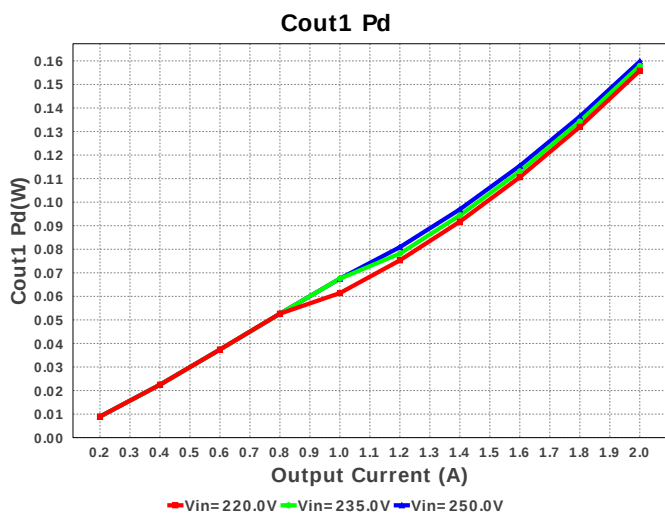
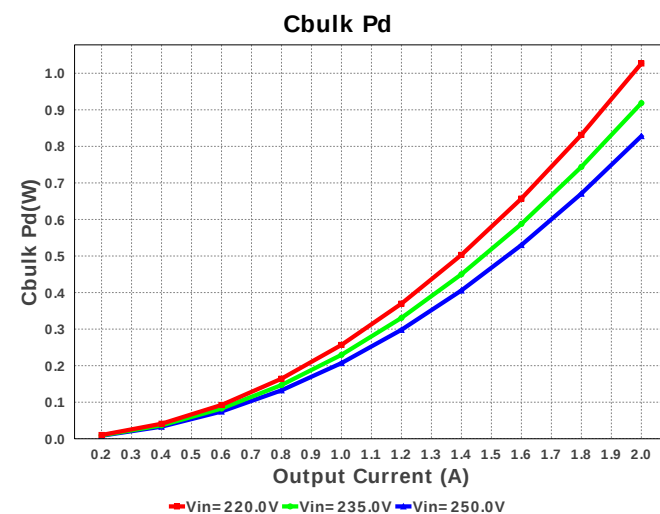
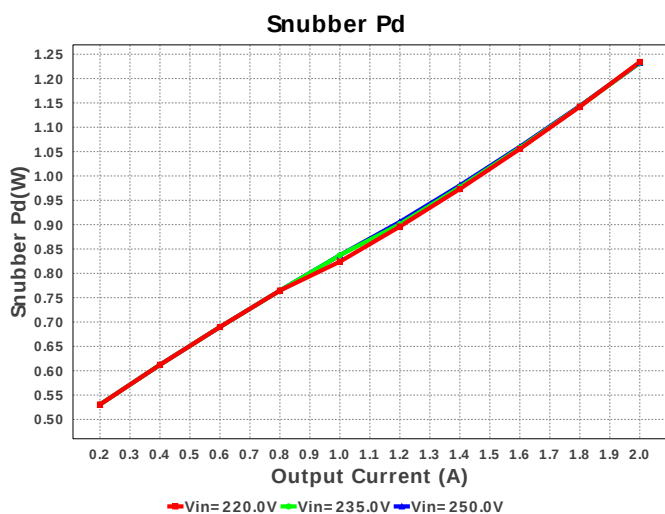
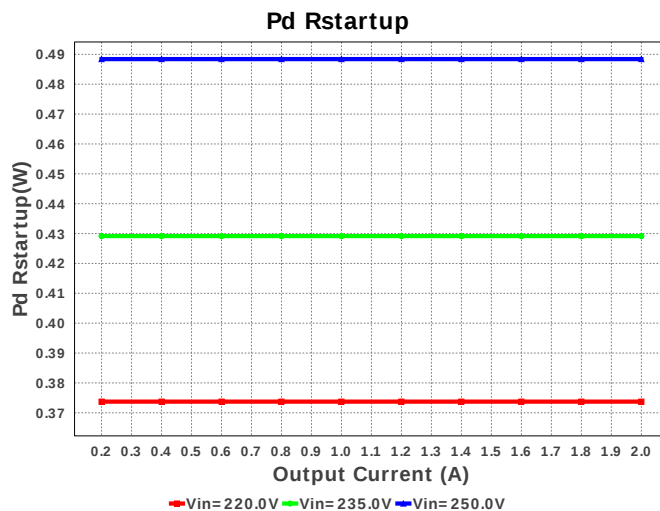
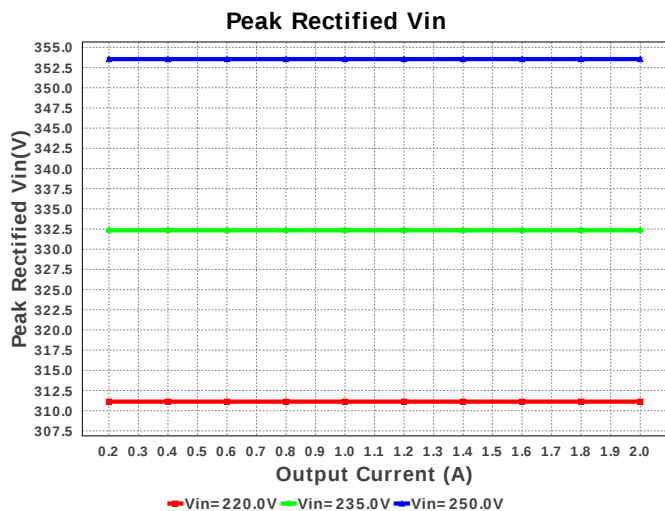
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm²
34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	R12	Vishay-Dale	CRCW040210K7FKED Series= CRCW..e3	Res= 10.7 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	CRCW04021M27FKED Series= CRCW..e3	Res= 1.27 MOhm 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	CRCW04027R15FKED Series= CRCW..e3	Res= 7.15 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
43.	Rfbb	Yageo America	RC0603FR-073KL Series= ?	Res= 3.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
44.	Rfbt	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
45.	Rled	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW04028K45FKED Series= CRCW..e3	Res= 8.45 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
47.	Rsns	Stackpole Electronics Inc	CSRN2010FKR500 Series= ?	Res= 500.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.10	 2010 32 mm²
48.	Rsns	Vishay-Bccomponents	PR02000204702JR500 Series= ?	Res= 47.0 kOhm Power= 2.0 W Tolerance= 5.0%	1	\$0.05	 PR02 113 mm²
49.	Rstartup1	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
50.	Rstartup2	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
51.	Rt	Vishay-Dale	CRCW040215K0FKED Series= CRCW..e3	Res= 15.0 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

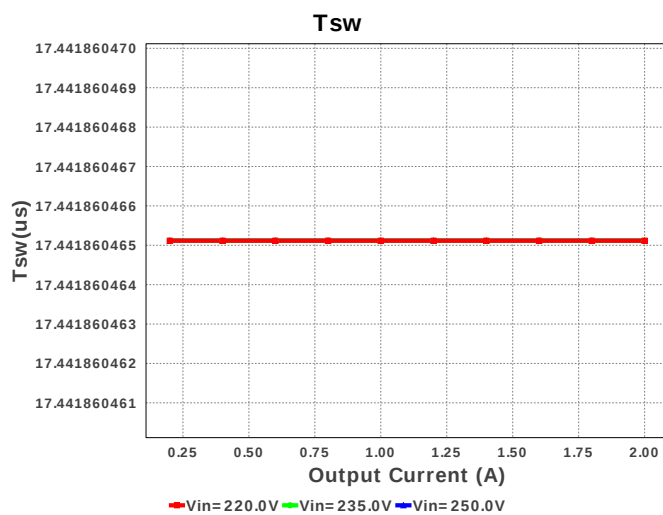
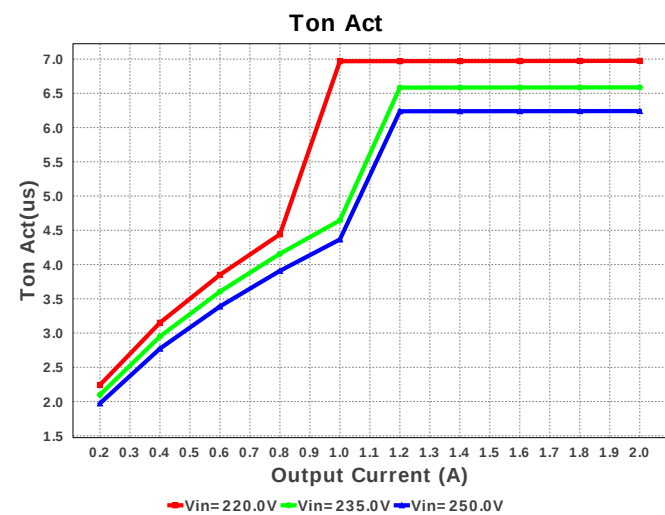
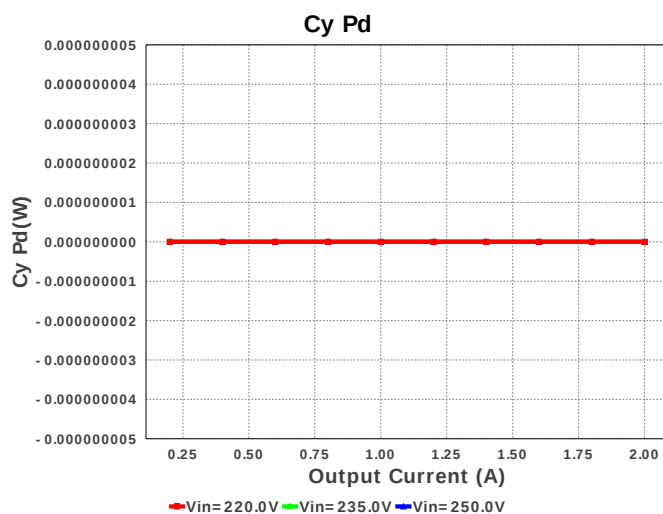
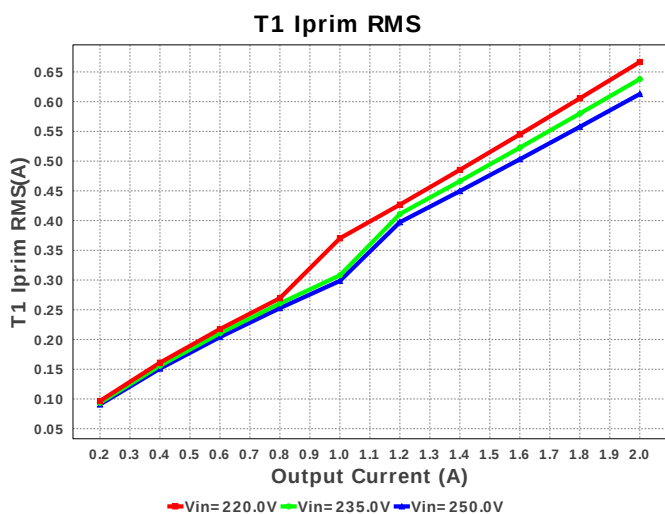
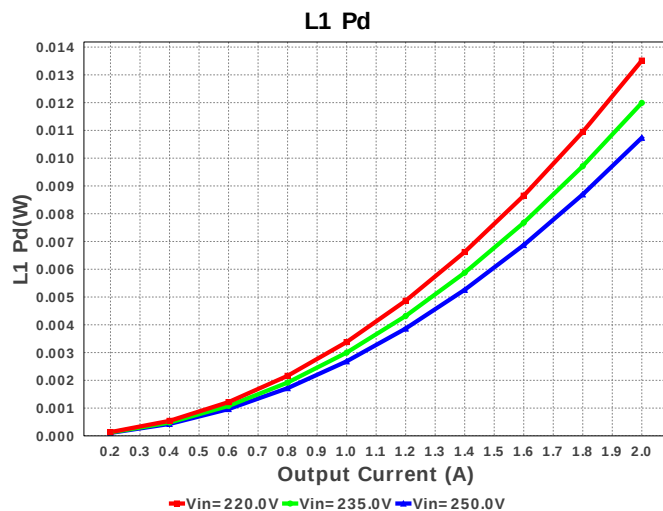
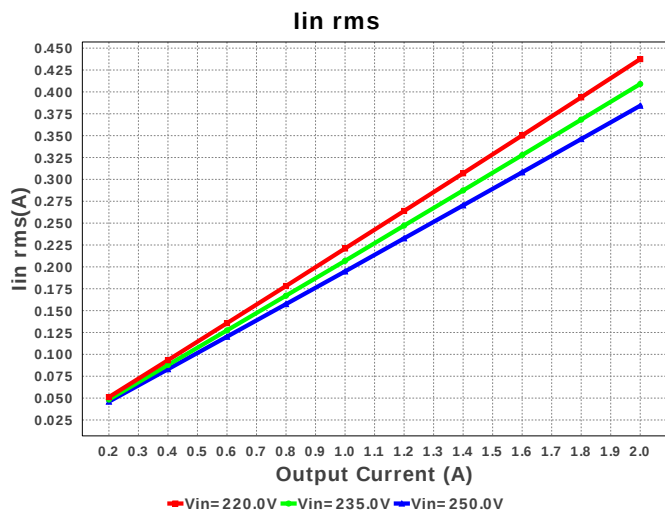
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
54.	Rz	Vishay-Dale	CRCW201020K0FKEF Series= CRCW..e3	Res= 20.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
55.	T1	CUSTOM	CUSTOM	Lp= 1.494 mH Rp= 870.0 mOhm Leakage_L= 29.877 μH Ns1toNp= 0.314 Rs1= 8.6 mOhms Ns2toNp= 0.096 Rs2= 700.0 μOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC28C44DR	Switcher	1	\$0.60	 D0008A 57 mm ²
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²

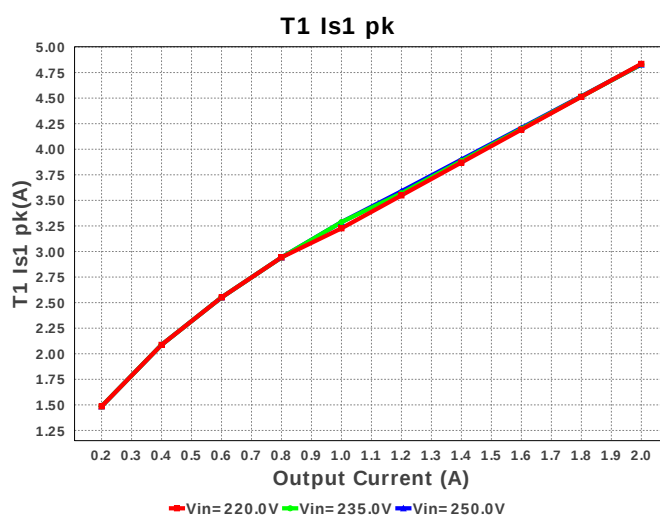
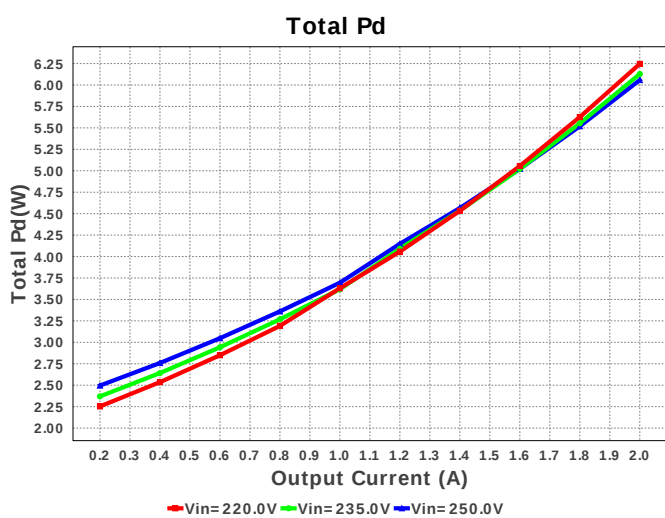
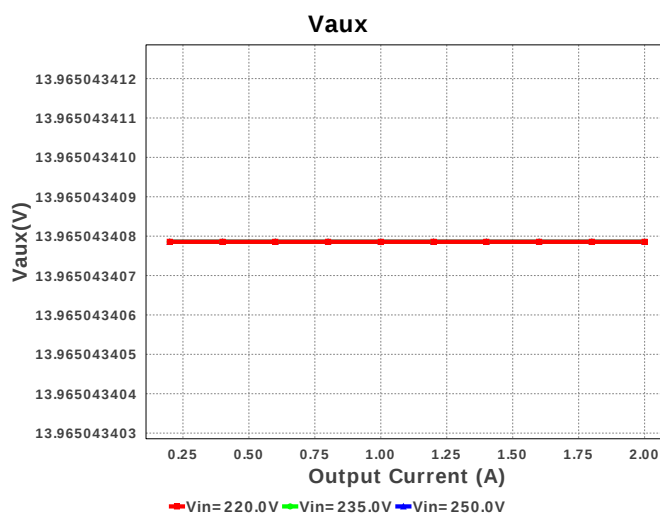
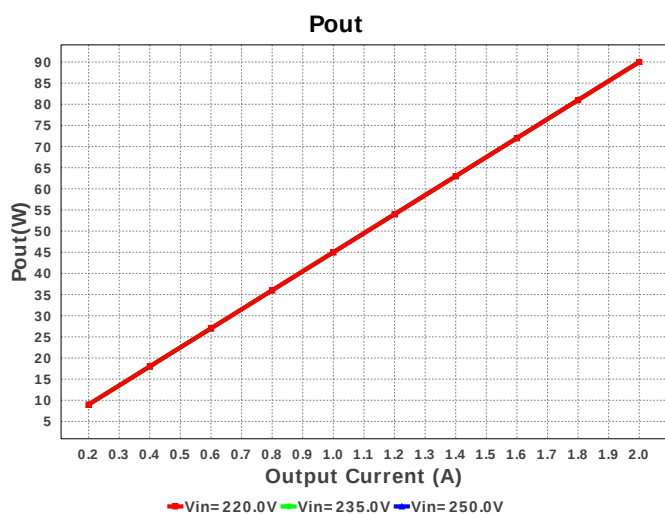
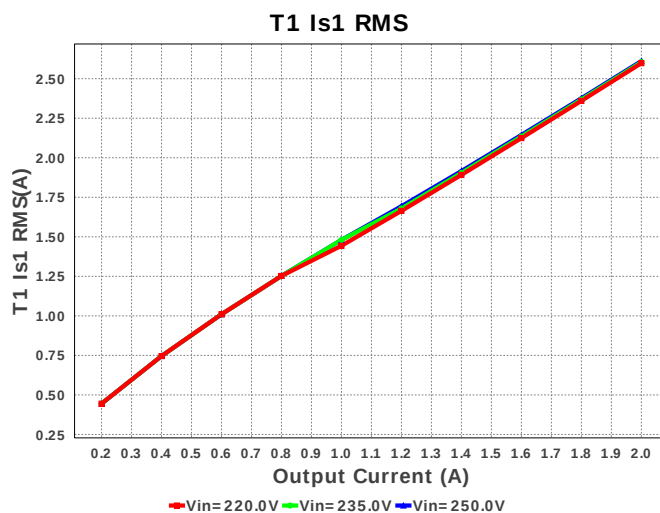
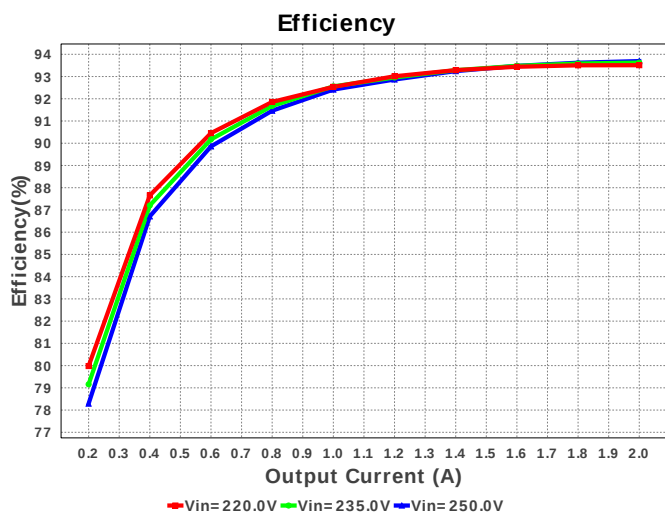


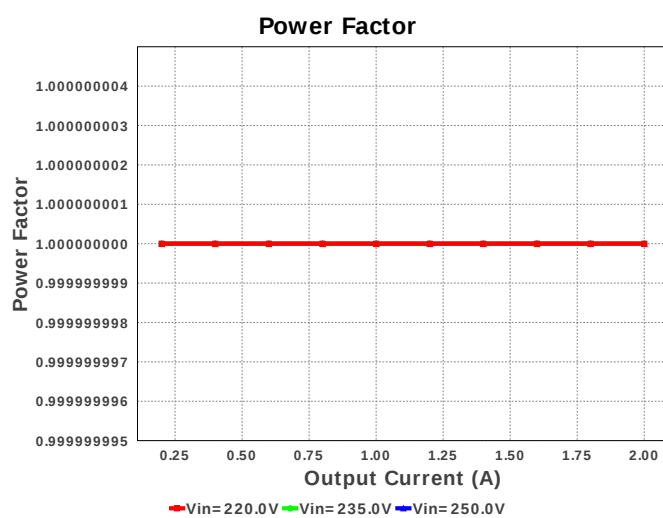
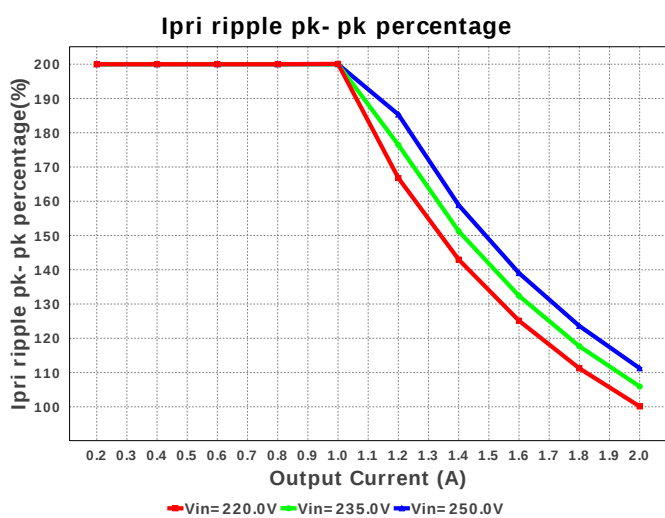
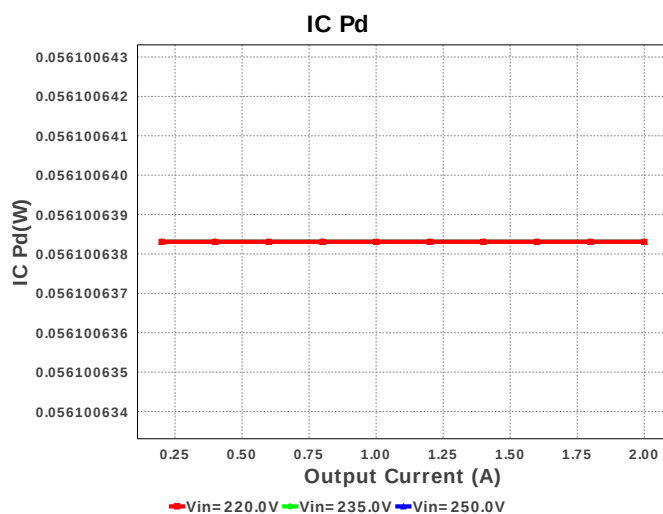
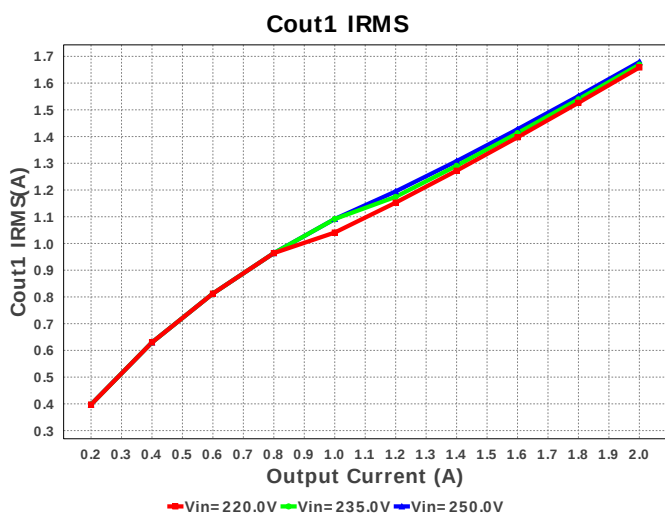
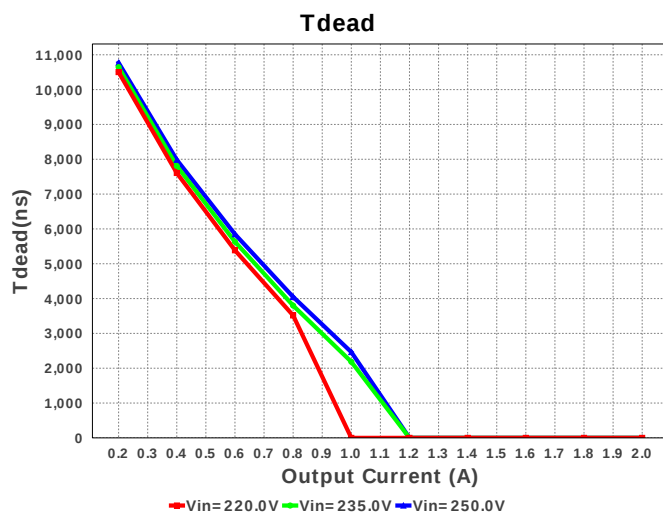
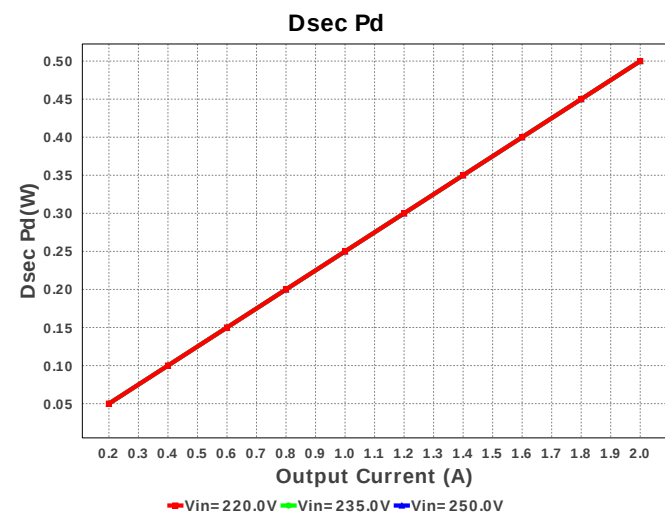


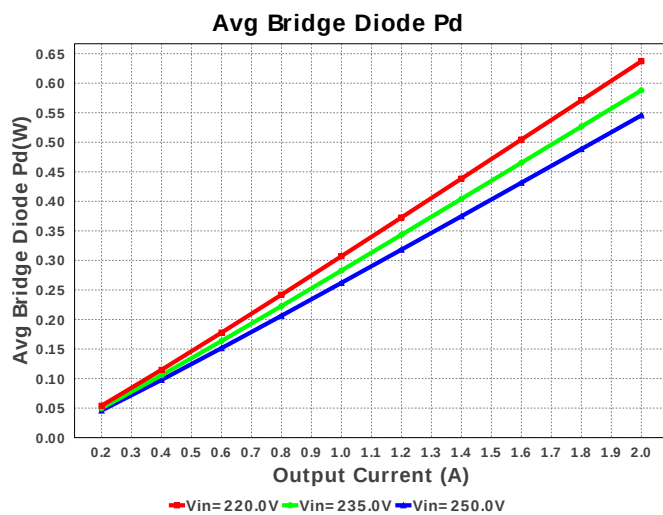
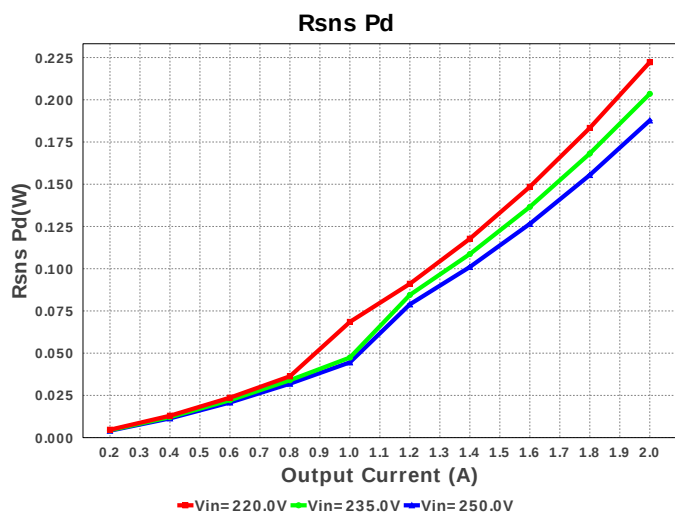
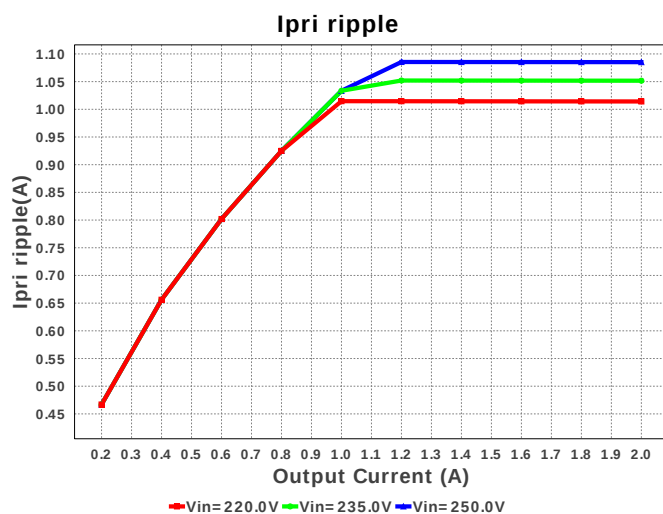
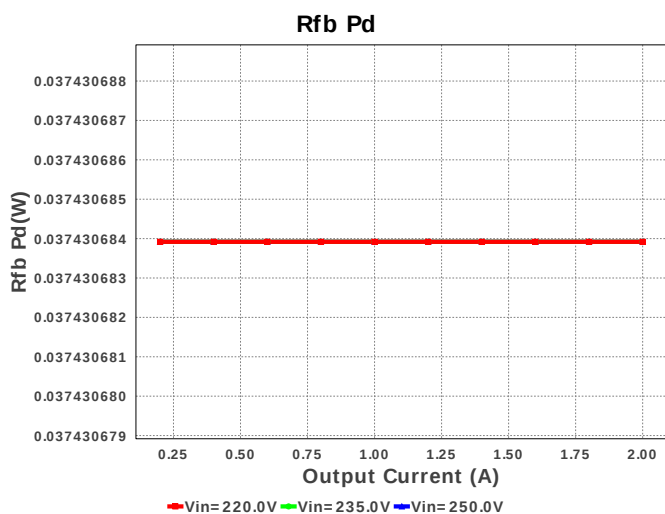
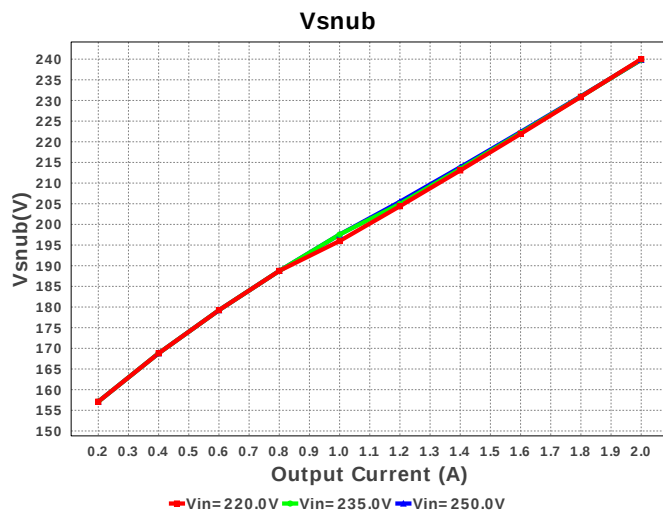
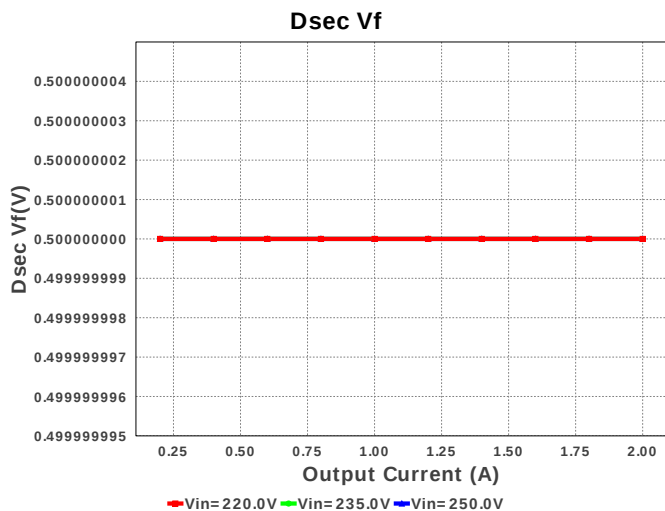


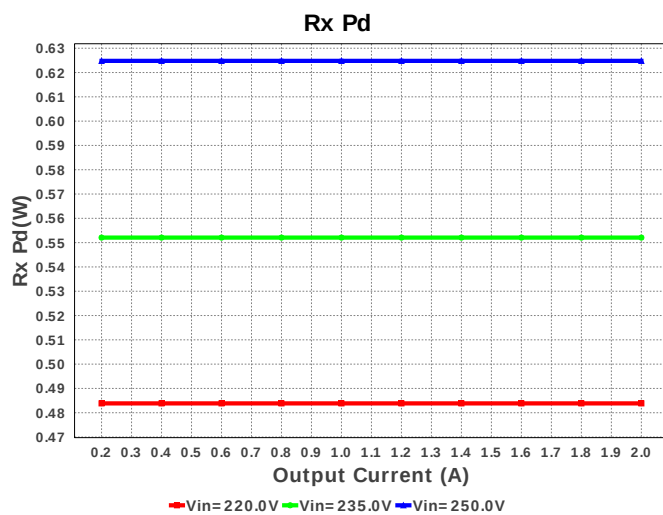
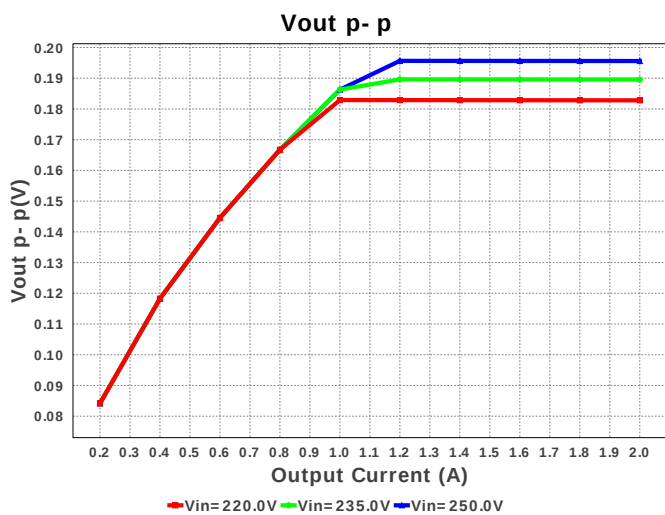
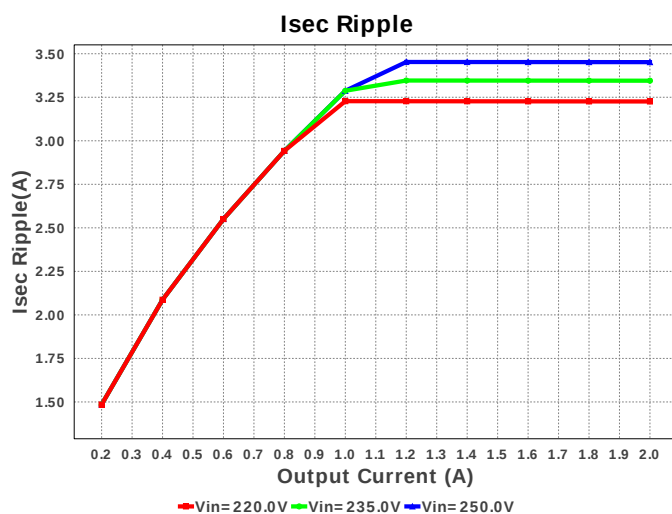
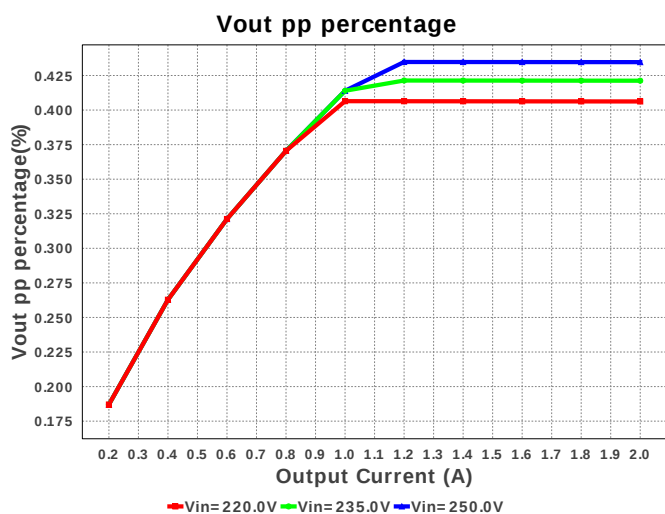
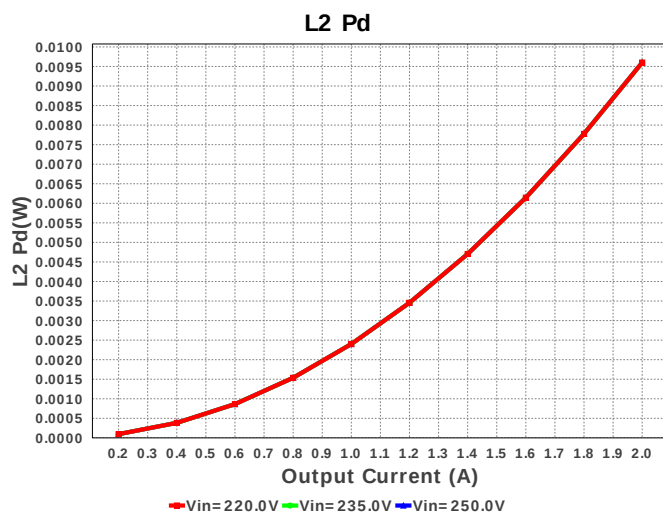
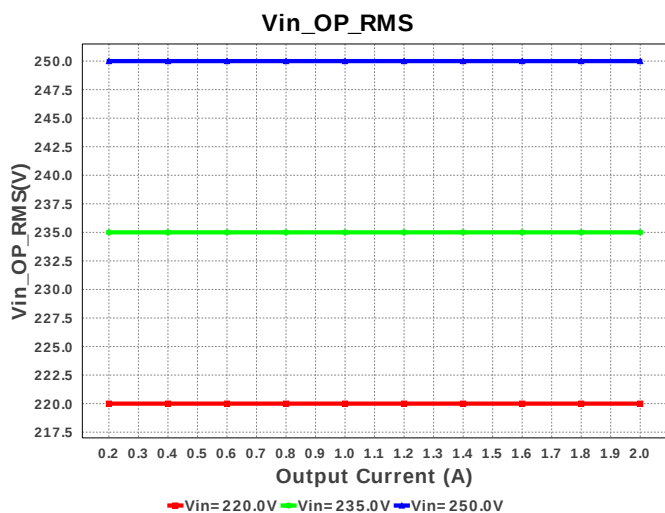


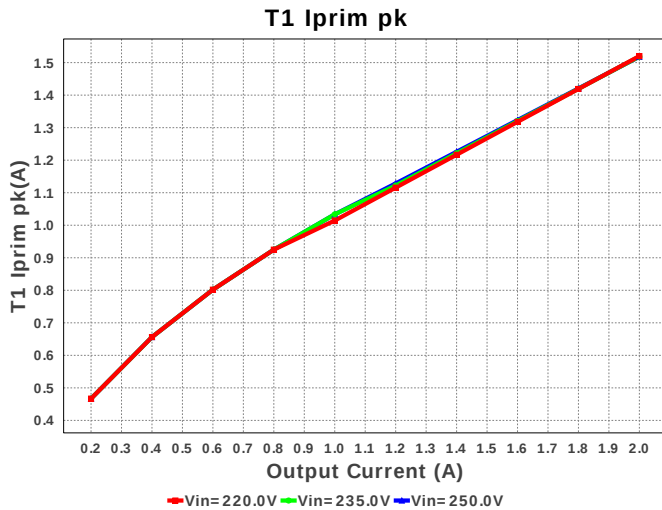












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.659 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	437.48 mA	Current	RMS Input Current
3.	Iout_DCM	983.769 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	405.014 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.014 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	100.121 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.226 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	666.724 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	1.52 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	2.598 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	4.835 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	61	General	Total Design BOM count
14.	Daux trr	16.7 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	500.0 mV	General	Effective Forward Voltage Drop at the Operating Current
16.	Dsec trr	60.0 ns	General	Output Diode Reverse Recovery Time
17.	Dsec2 Vf	500.0 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	5.199 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	57.333 kHz	General	Switching frequency
21.	Pout	90.0 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	10.827 us	General	Approximate Converter Off Time
25.	Ton Act	6.974 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	17.442 us	General	Switching Time Period
28.	Vaux	13.965 V	General	Auxiliary Voltage
29.	Vsnub	240.011 V	General	Voltage Across the Snubber
30.	Vout Actual	44.993 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	45.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	39.984 %	Op_point	Duty cycle
33.	Efficiency	93.51 %	Op_point	Steady state efficiency
34.	IC Tj	32.805 degC	Op_point	IC junction temperature
35.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	2.0 A	Op_point	Iout operating point
37.	M1 TJOP	56.982 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	311.124 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	220.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	182.798 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	637.217 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	1.027 W	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	155.869 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	500.0 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	500.0 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	56.101 mW	Power	IC power dissipation
49.	L1 Pd	13.514 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	9.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period

#	Name	Value	Category	Description
51.	M1 Pd	431.718 mW	Power	M1 MOSFET total power dissipation
52.	Paux	17.48 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	373.739 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	11.375 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	37.431 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	222.26 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	483.845 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	1.234 W	Power	Snubber Power Dissipation
59.	T1 Pd	889.577 mW	Power	Estimated Losses in Transformer
60.	Total Pd	6.246 W	Power	Total Power Dissipation
61.	Vout Tolerance	2.235 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	406.219 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	Iout2	3.0	Output Current #2
4.	Iout3	2.0	Output Current #3
5.	VinMax	250.0	Maximum input voltage
6.	VinMin	220.0	Minimum input voltage
7.	Vout	45.0	Output Voltage
8.	Vout1	45.0	Output Voltage #1
9.	Vout2	5.0	Output Voltage #2
10.	Vout3	5.0	Output Voltage #3
11.	acFrequency	60.0	Light Output in Lumen
12.	base_pn	UCC28C44	Texas Instruments Base Part Number
13.	source	AC	Input Source Type
14.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C44 Product Folder : <http://www.ti.com/product/UCC28C44> : contains the data sheet and other resources.

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