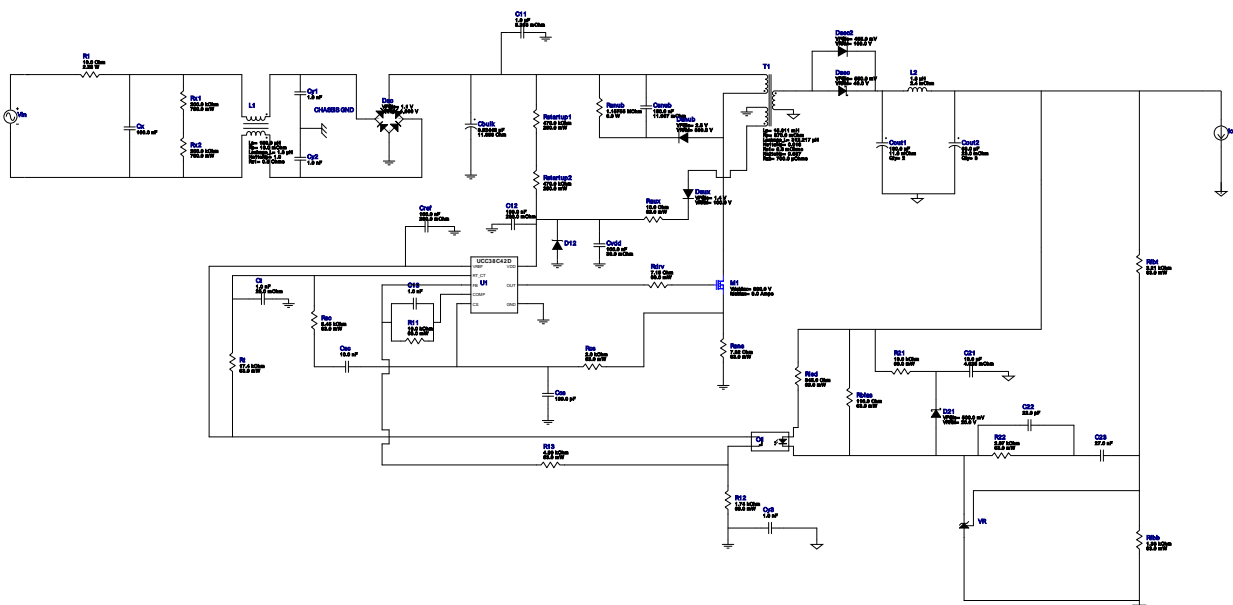


WEBENCH® Design Report











Design : 4466246/63 UCC38C42DR
UCC38C42DR 220.0V-220.0V to 3.30V @ 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

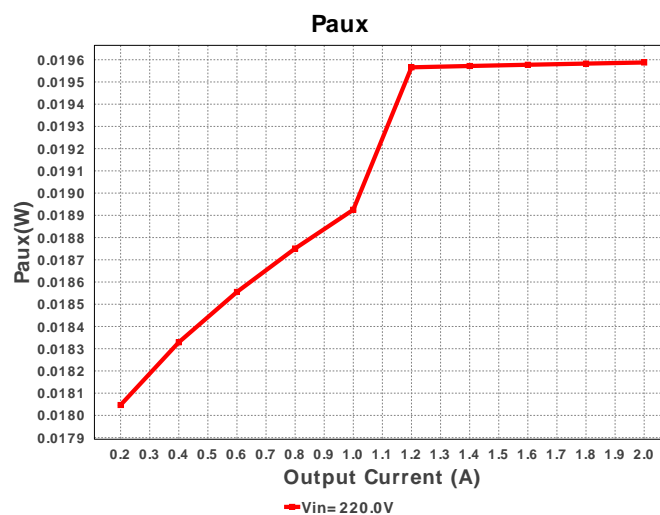
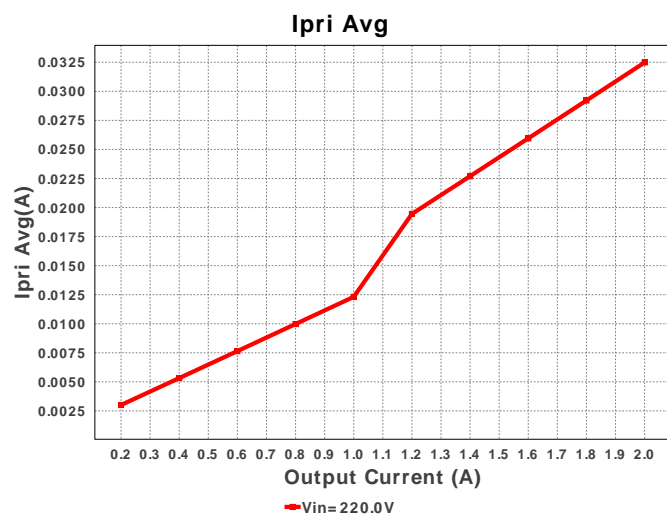
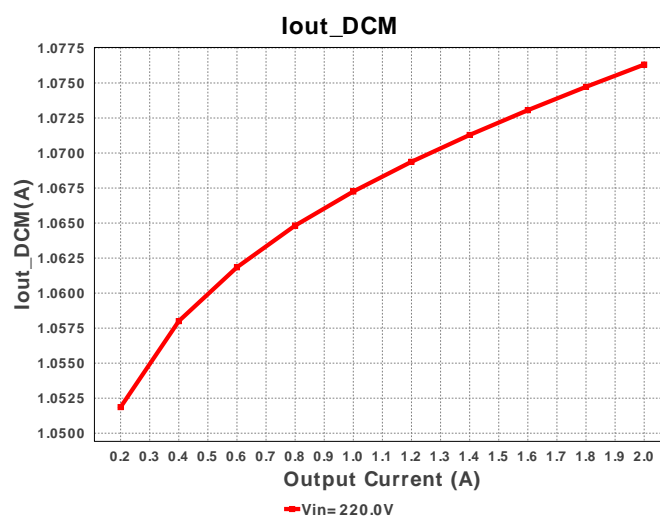
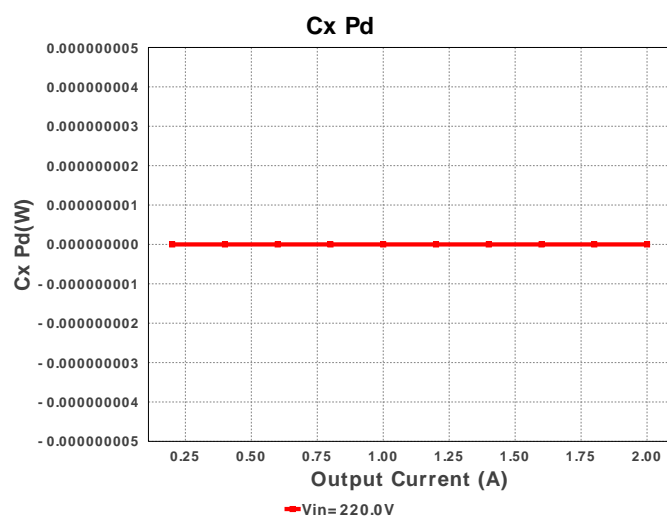
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1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung Electro-Mechanics	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	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 4.025 mOhm VDC= 10.0 V IRMS= 2.445 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	CC0805KRX7R9BB273 Series= X7R	Cap= 27.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 3.52449 uF ESR= 11.6578 Ohm VDC= 373.349 V IRMS= 72.797 mA	1	NA	CUSTOM 0 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

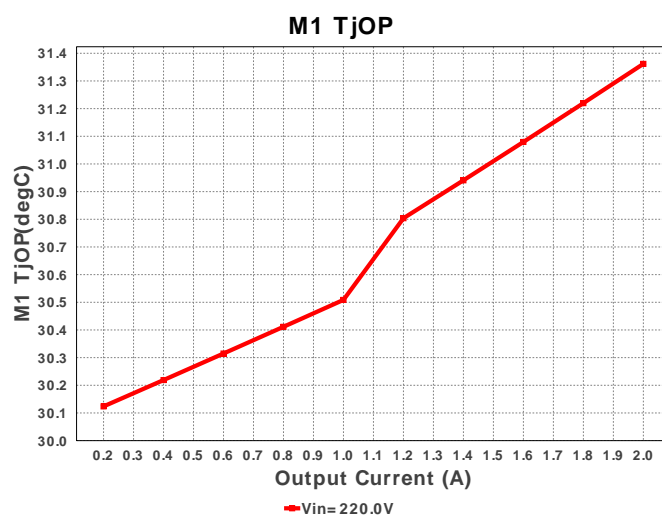
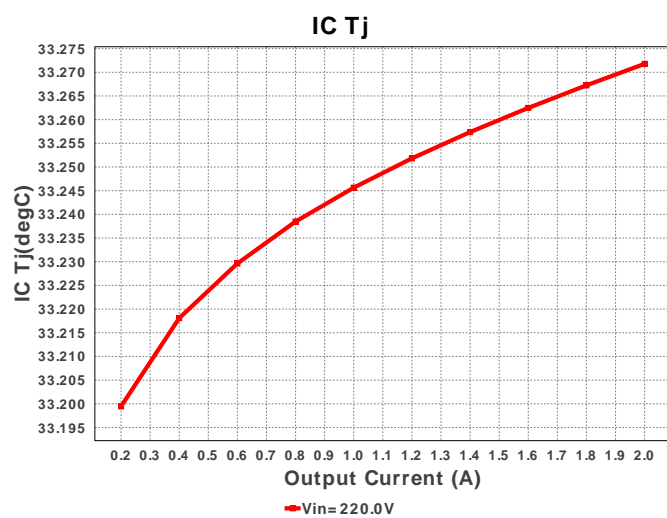
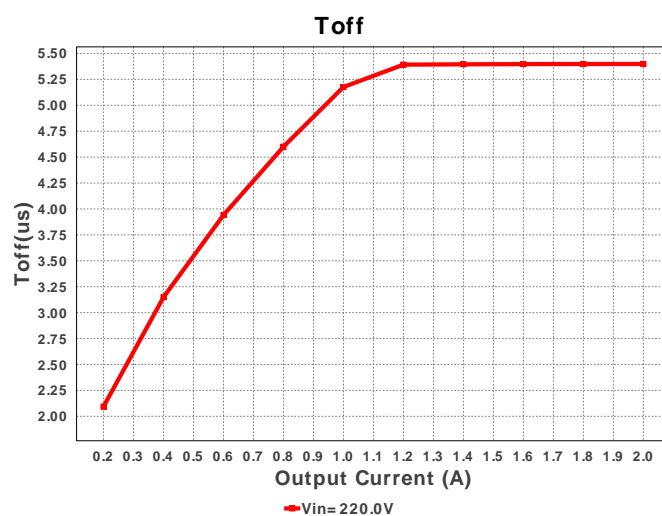
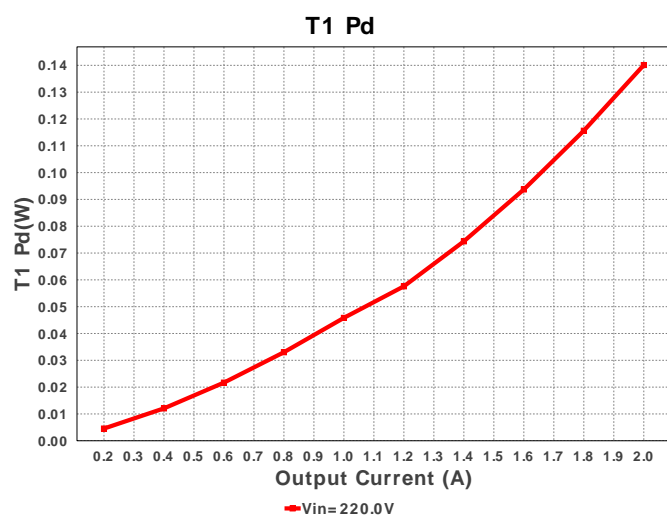
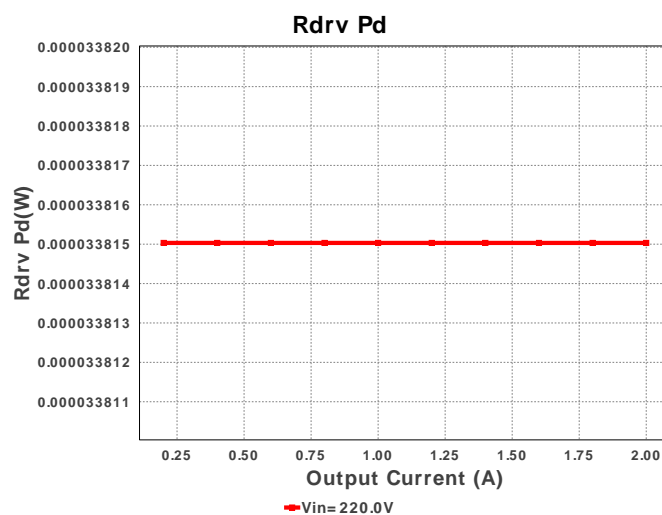
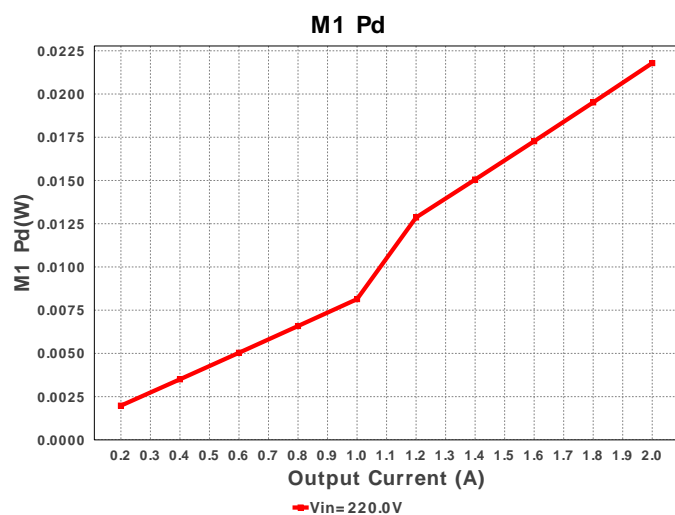
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9.	Cout1	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	2	\$0.49	 CAPSMT_62_C10 74 mm²
10.	Cout2	Panasonic	10SVPC68MV Series= SVPC	Cap= 68.0 uF ESR= 23.0 mOhm VDC= 10.0 V IRMS= 2.54 A	3	\$0.55	 SM_RADIAL_5MM 58 mm²
11.	Cref	AVX	0805C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
12.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
13.	Csnub	TDK	C3225X7T2J154K Series= X7T	Cap= 150.0 nF ESR= 11.907 mOhm VDC= 630.0 V IRMS= 0.0 A	1	\$0.19	 1210 15 mm²
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 mm²
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 mm²
16.	Cx	TDK	B32913A5104M000 Series= 2231	Cap= 100.0 nF VDC= 1000.0 V IRMS= 0.0 A	1	\$0.46	 B32913_2650x600x1500 228 mm²
17.	Cy1	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm²
18.	Cy2	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
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	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 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	NXP Semiconductor	BAS316,115	VF@Io= 1.4 V VRRM= 100.0 V	1	\$0.02	 SOD-323 9 mm ²
24.	Dsec	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	\$0.17	 SMC 83 mm ²
25.	Dsec2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	 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.	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
28.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
29.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	\$2.52	 TO-220FP 79 mm ²
30.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
31.	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

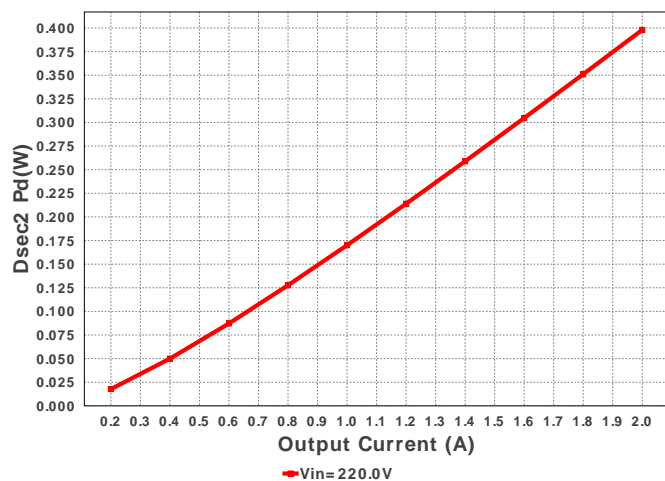
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
32.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
33.	R12	Vishay-Dale	CRCW04021K74FKED Series= CRCW..e3	Res= 1.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
34.	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
35.	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
36.	R22	Vishay-Dale	CRCW04022K67FKED Series= CRCW..e3	Res= 2.67 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	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
38.	Rbias	Vishay-Dale	CRCW0402110RFKED Series= CRCW..e3	Res= 110.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	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
40.	Rdrv	Vishay-Dale	CRCW04027R15FKED Series= CRCW..e3	Res= 7.15 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
41.	Rfbb	Vishay-Dale	CRCW04021K33FKED Series= CRCW..e3	Res= 1.33 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
42.	Rfbt	Vishay-Dale	CRCW04022K21FKED Series= CRCW..e3	Res= 2.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
43.	Rled	Vishay-Dale	CRCW0402845RFKED Series= CRCW..e3	Res= 845.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
44.	Rsc	Vishay-Dale	CRCW04028K45FKED Series= CRCW..e3	Res= 8.45 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
45.	Rsns	Vishay-Dale	CRCW04027R32FKED Series= CRCW..e3	Res= 7.32 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
46.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 1.15755 MOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
47.	Rstartup1	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
48.	Rstartup2	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
49.	Rt	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
50.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
51.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
52.	T1	CUSTOM	CUSTOM	Lp= 15.611 mH Rp= 870.0 mOhm Leakage_L= 312.217 μ H Ns1toNp= 0.018 Rs1= 8.6 mOhms Ns2toNp= 0.067 Rs2= 700.0 μ Ohms	1	NA	CUSTOM 0 mm ²
53.	U1	Texas Instruments	UCC38C42DR	Switcher	1	\$0.60	
54.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	\$0.16	 D0008A 57 mm ² R-PDSO-G3 16 mm ²

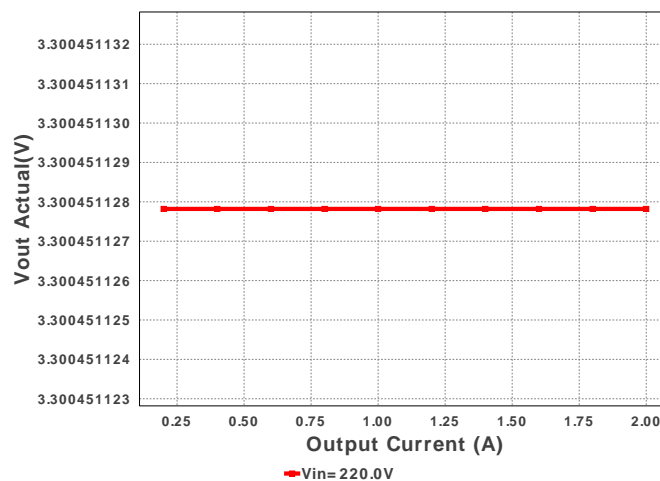




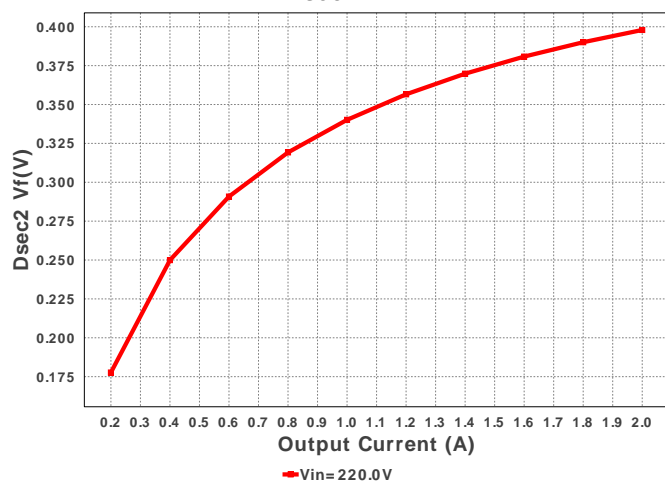
Dsec2 Pd



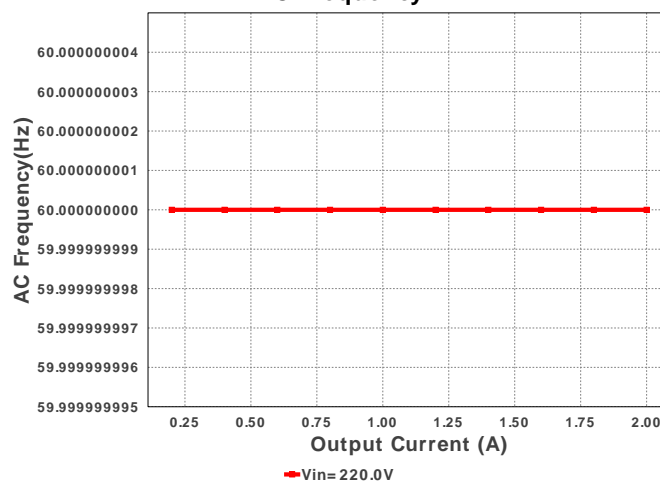
Vout Actual



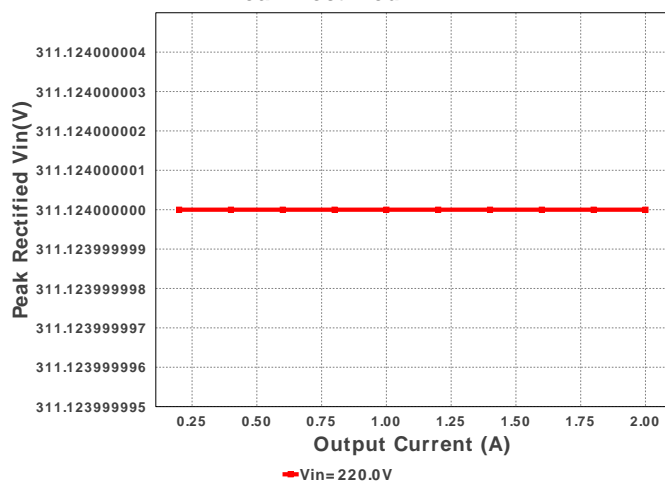
Dsec2 Vf



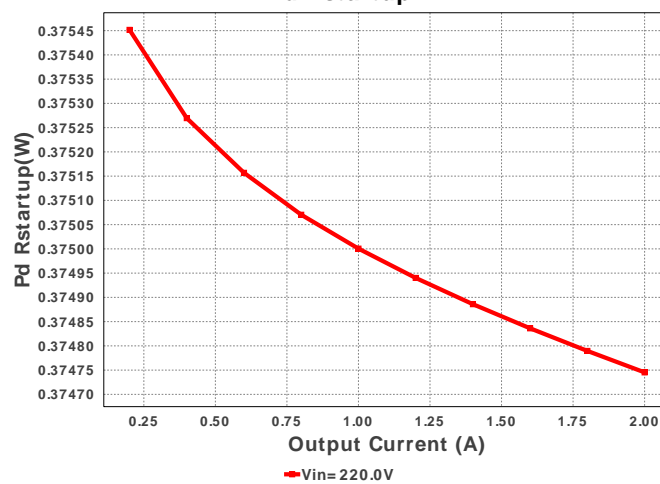
AC Frequency



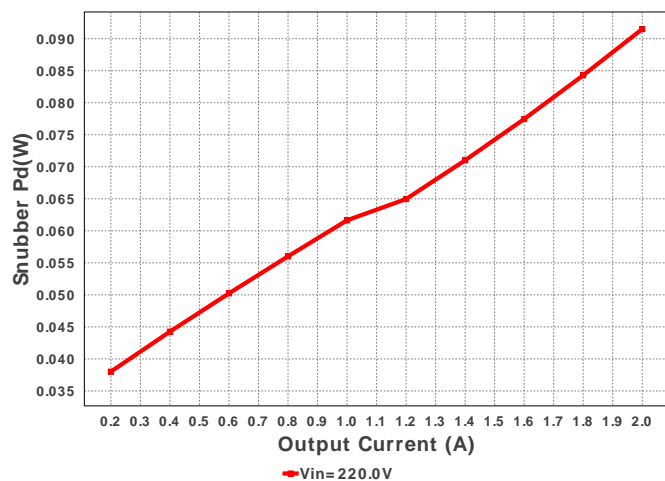
Peak Rectified Vin



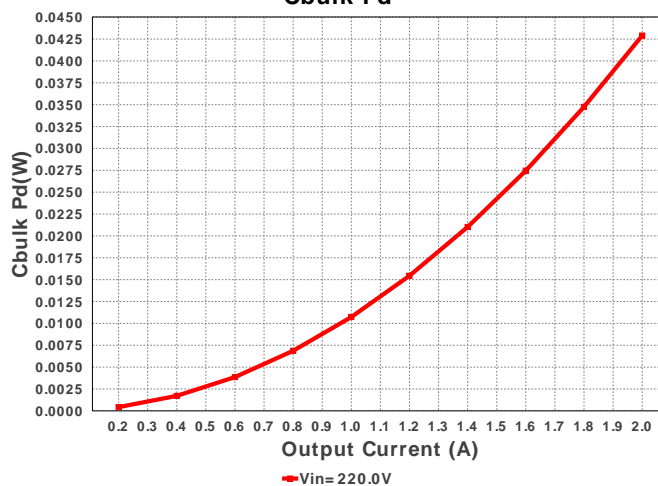
Pd Rstartup



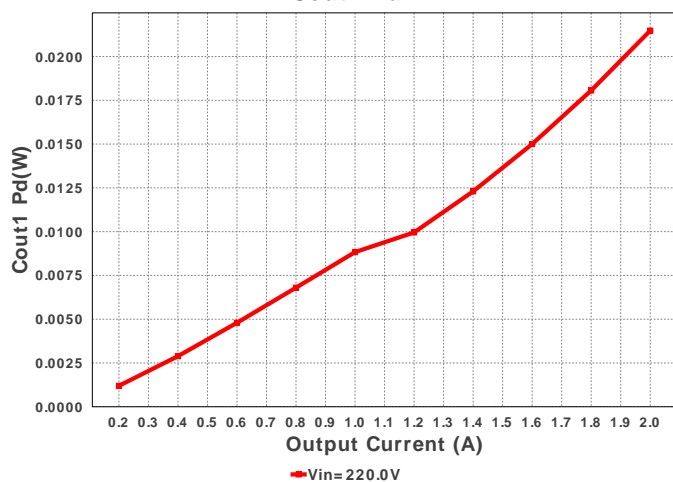
Snubber Pd



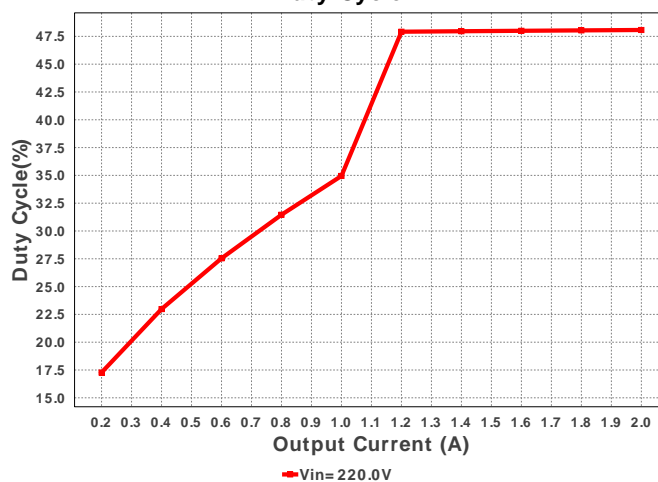
Cbulk Pd



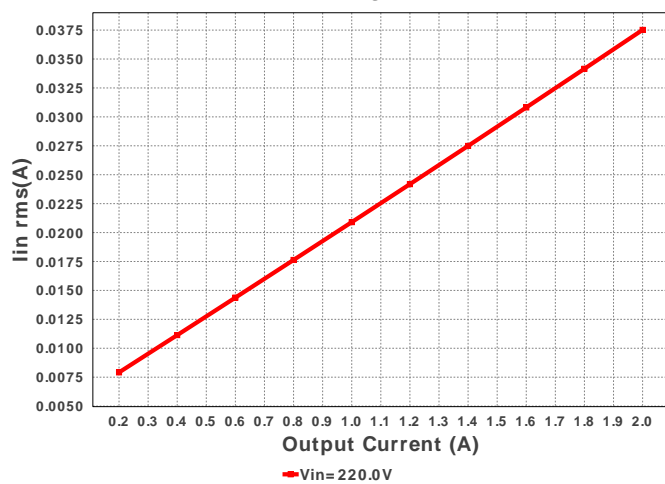
Cout1 Pd



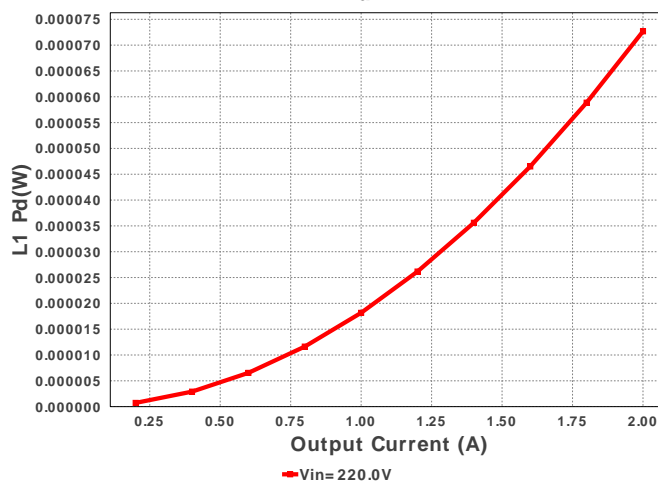
Duty Cycle

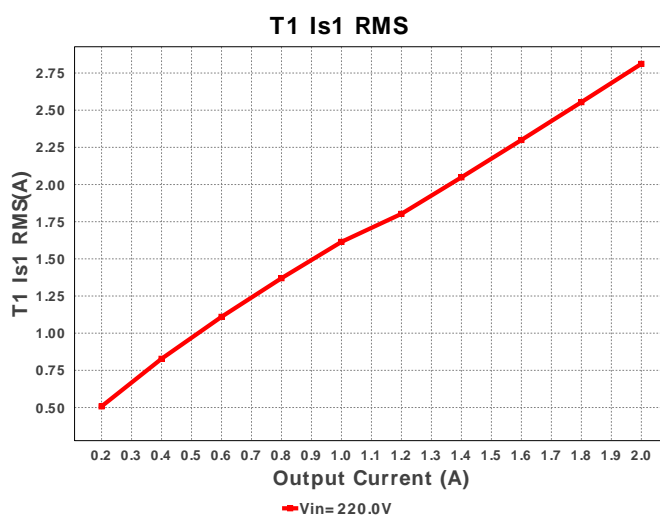
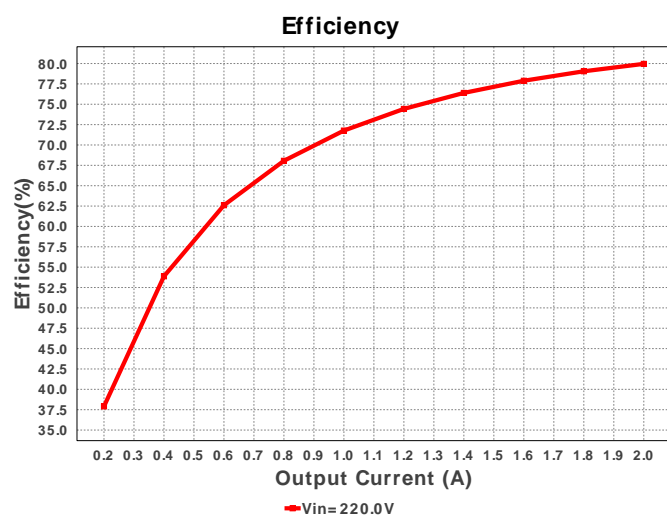
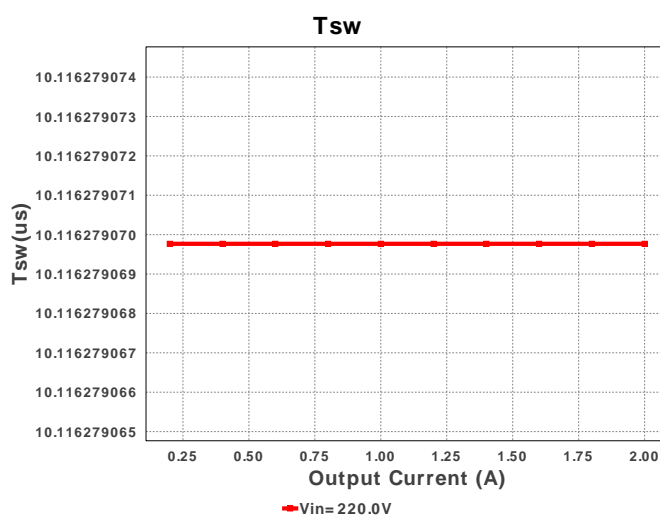
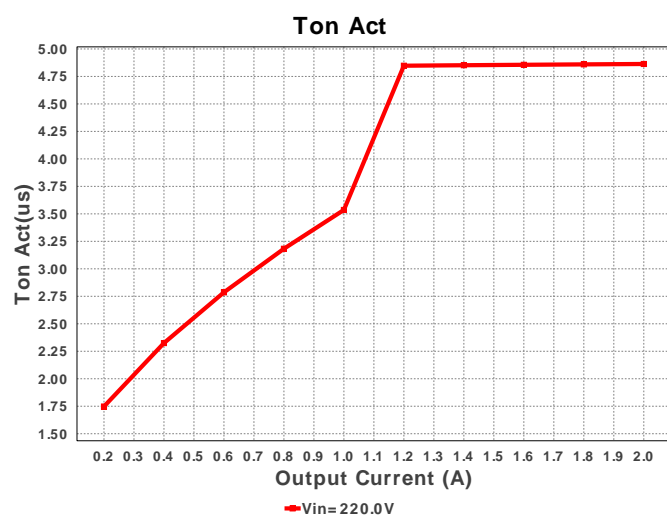
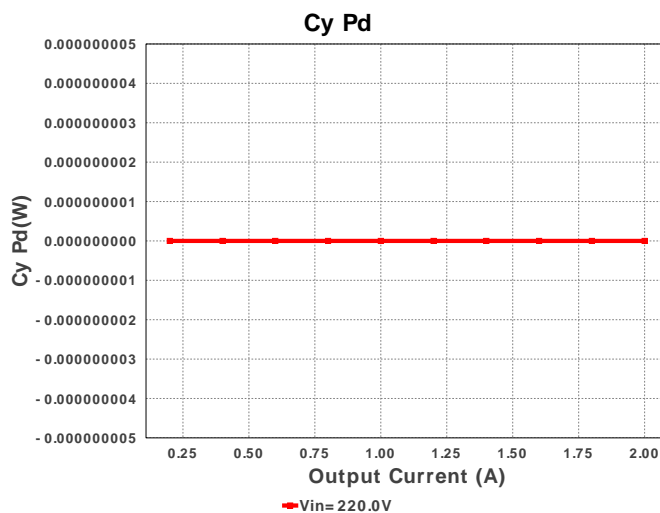
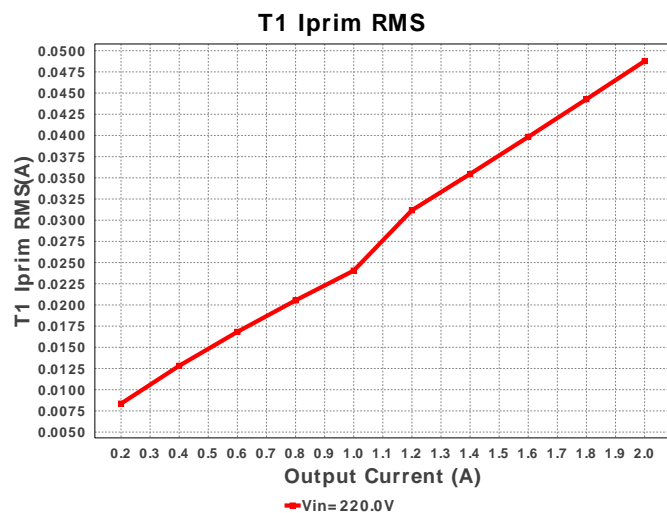


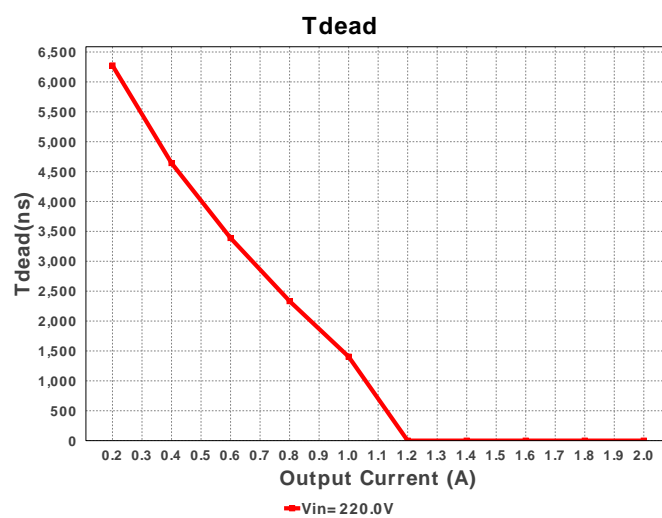
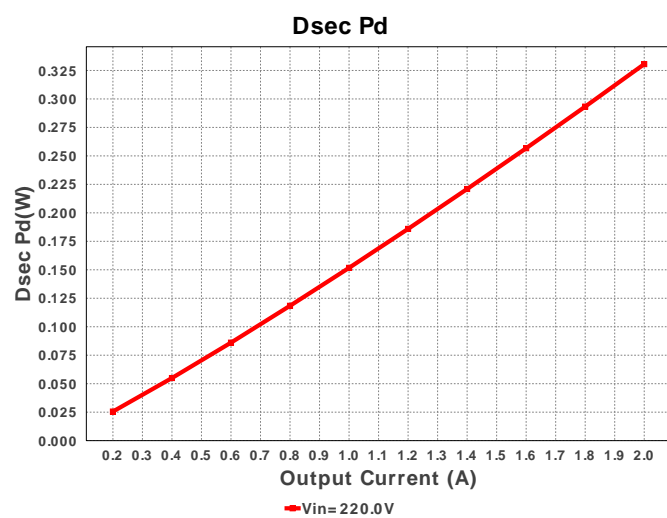
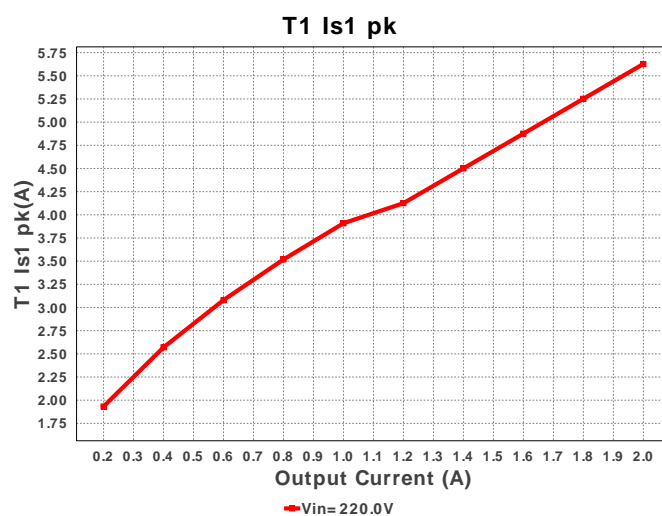
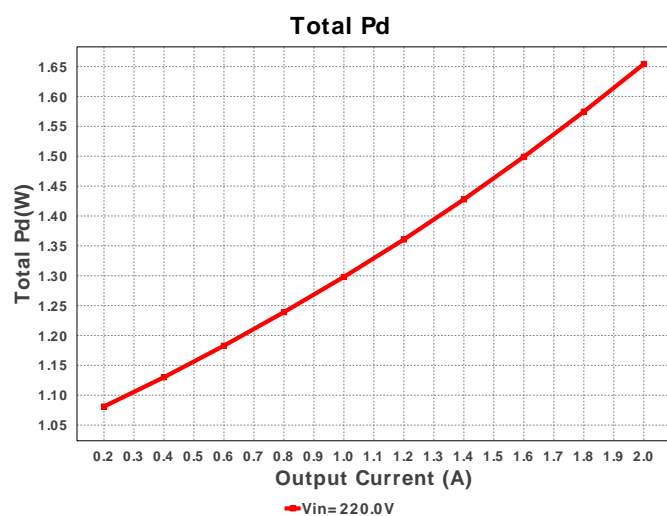
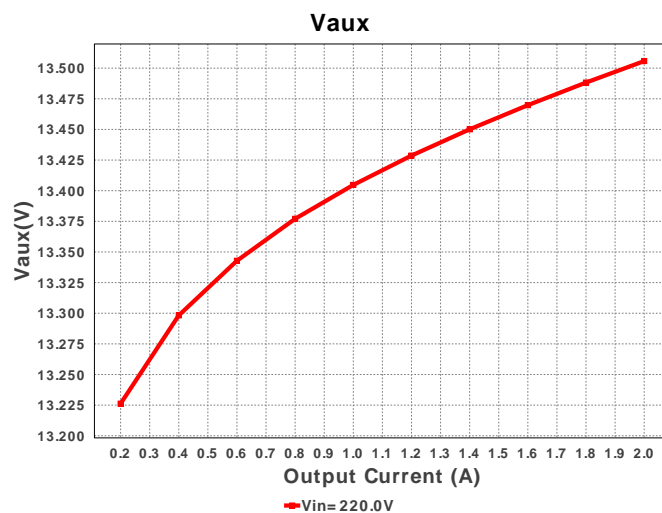
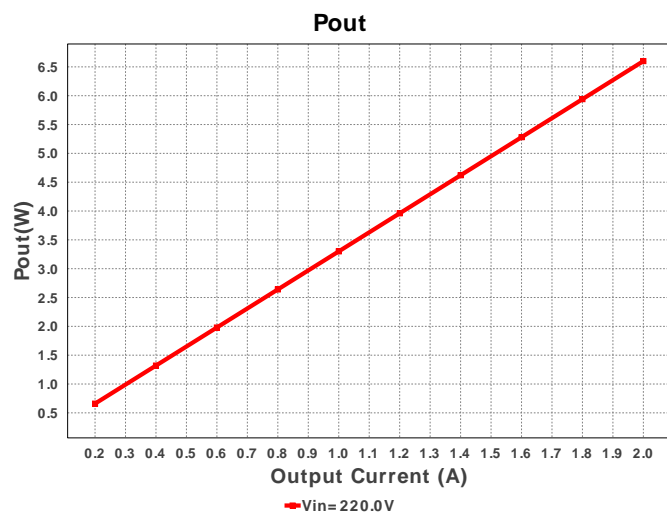
Iin rms



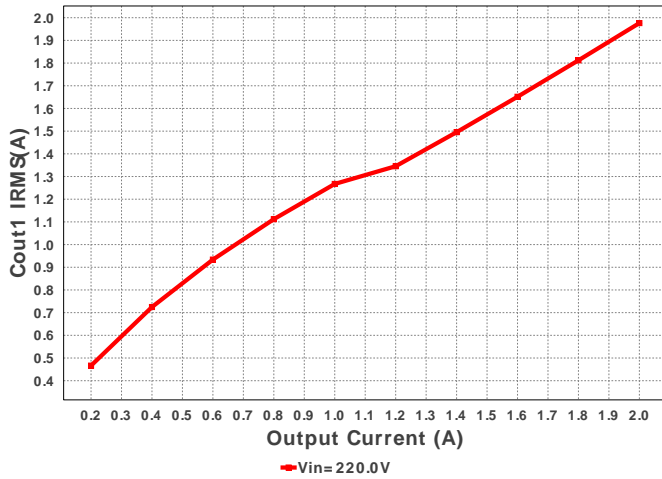
L1 Pd



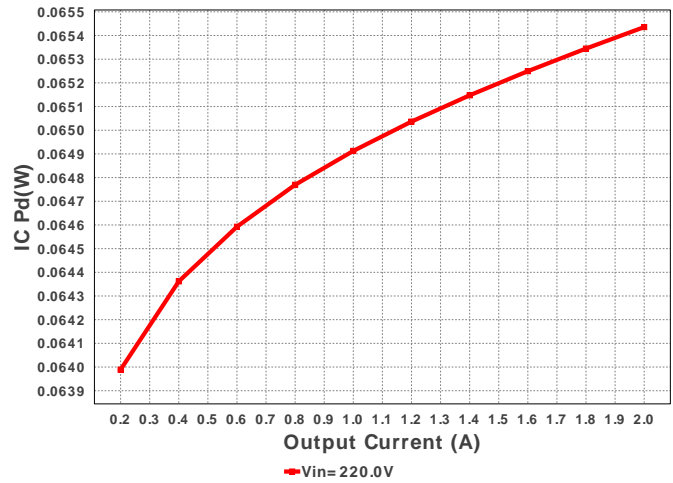




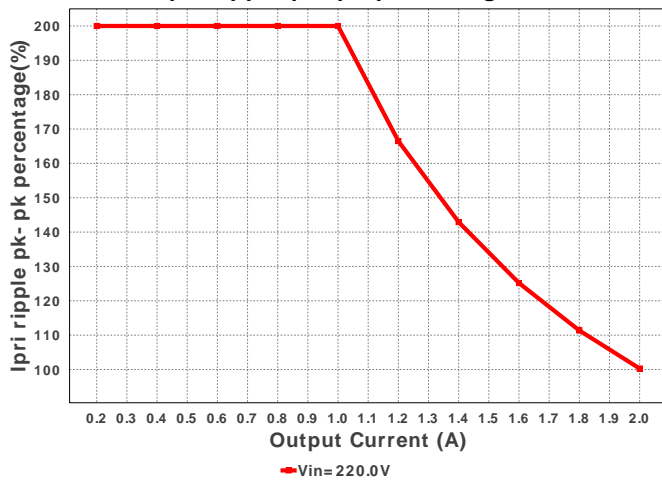
Cout1 IRMS



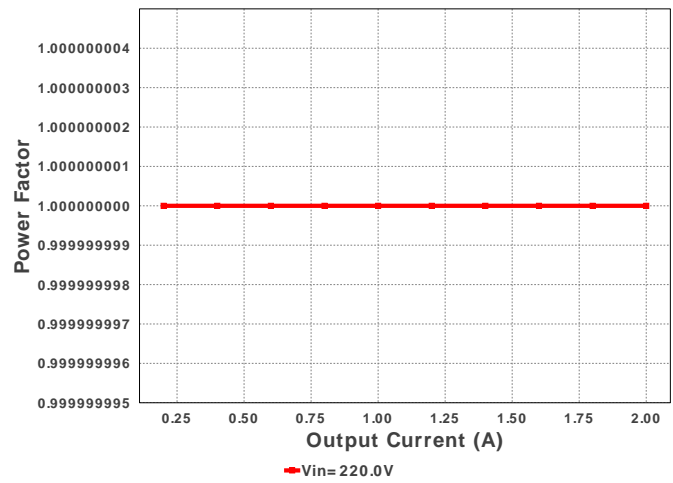
IC Pd



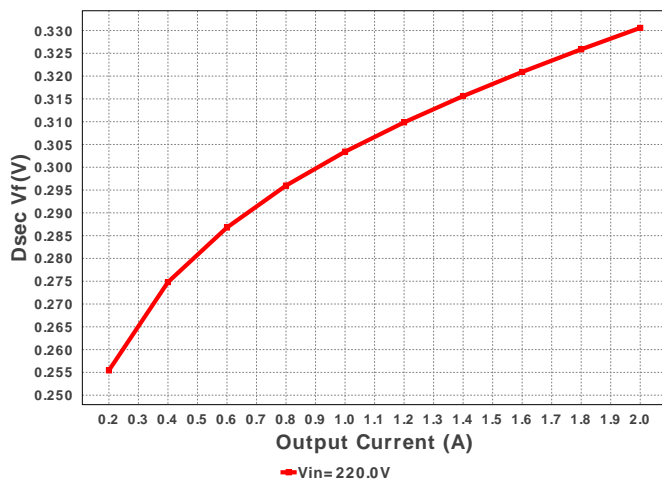
Ipri ripple pk- pk percentage



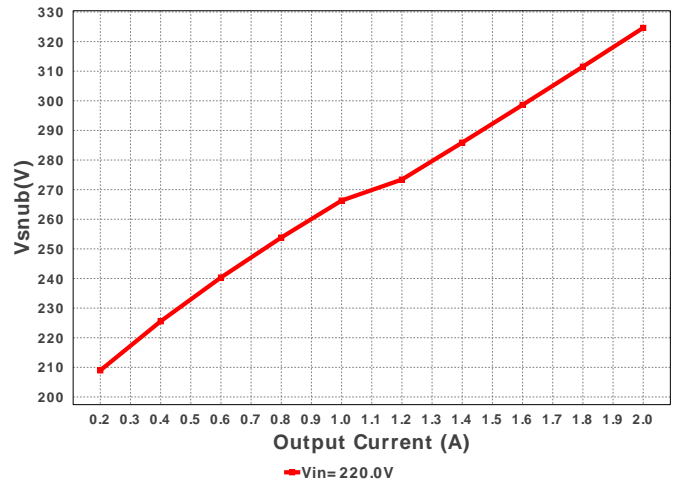
Power Factor

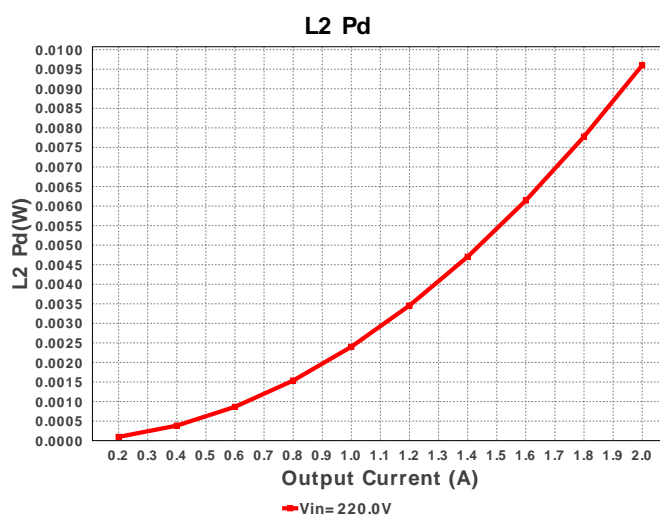
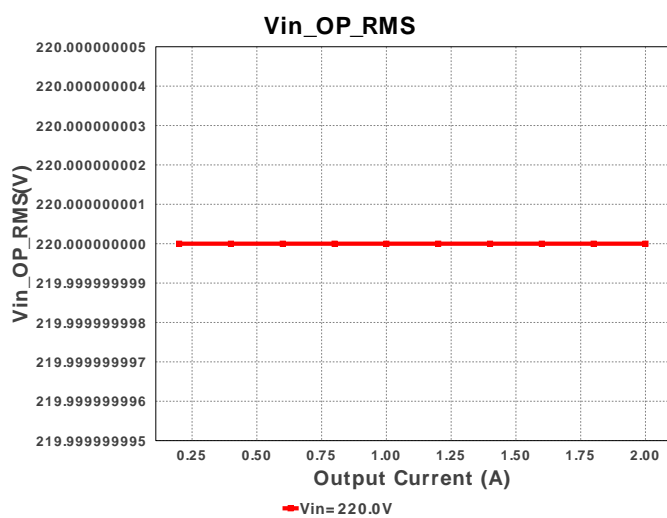
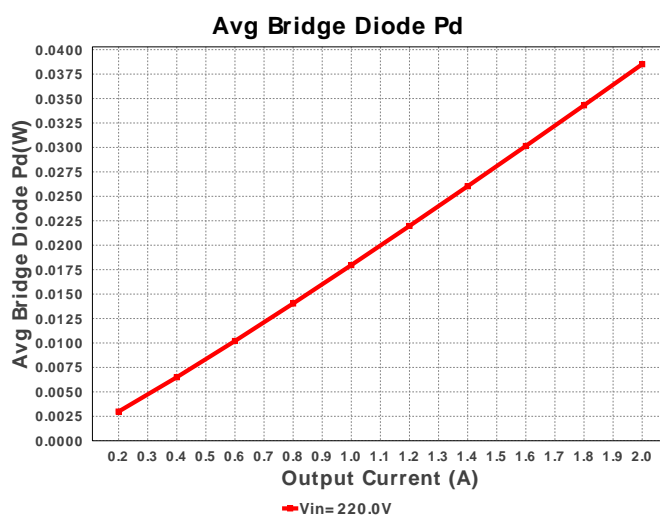
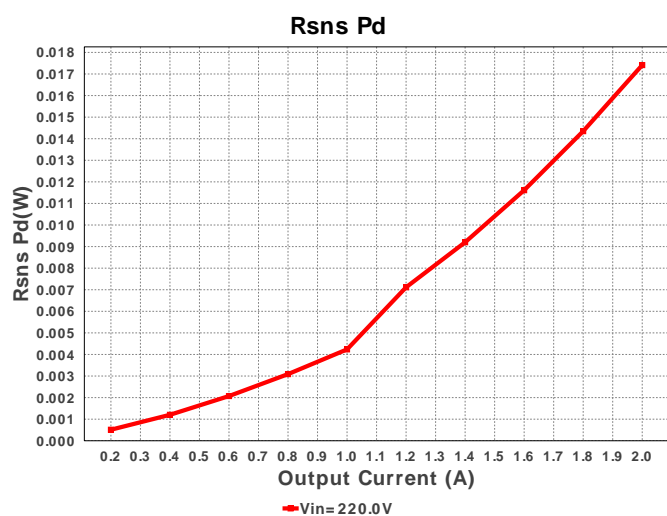
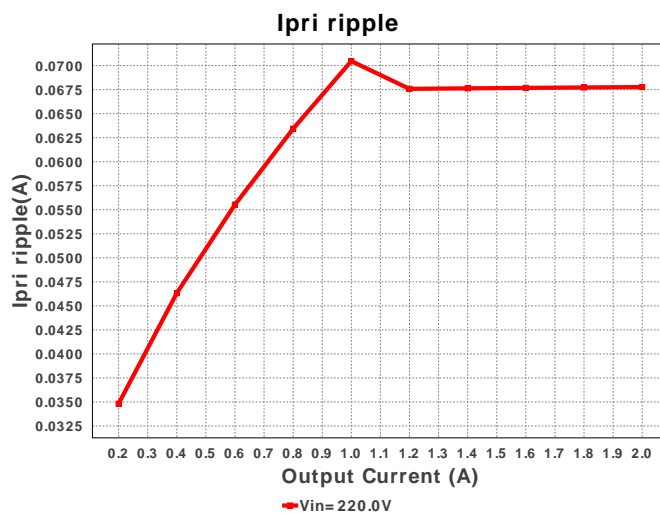
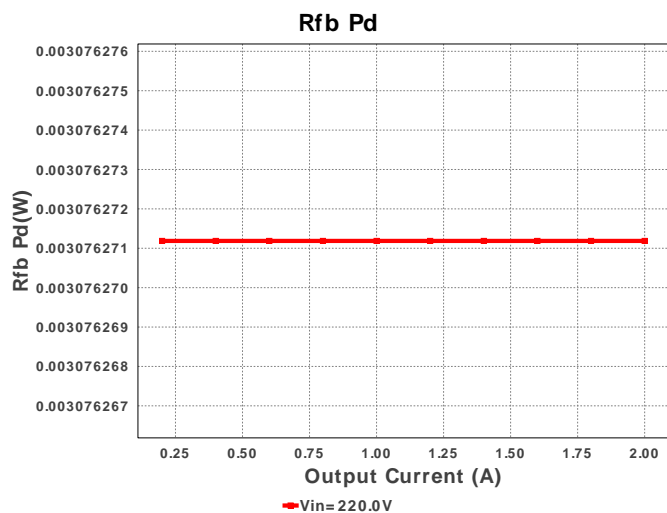


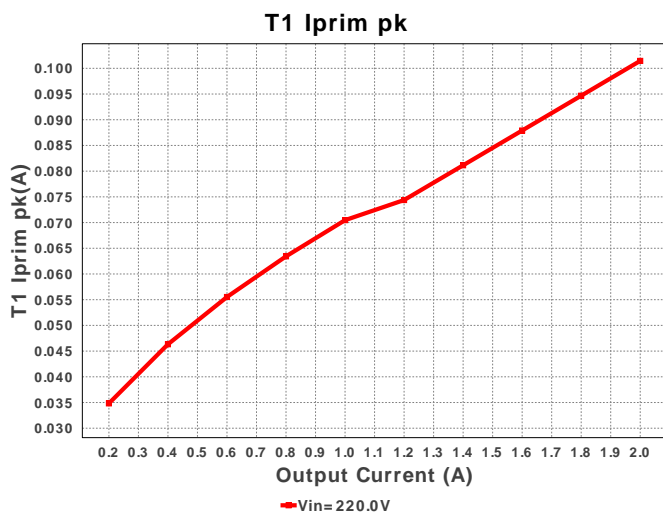
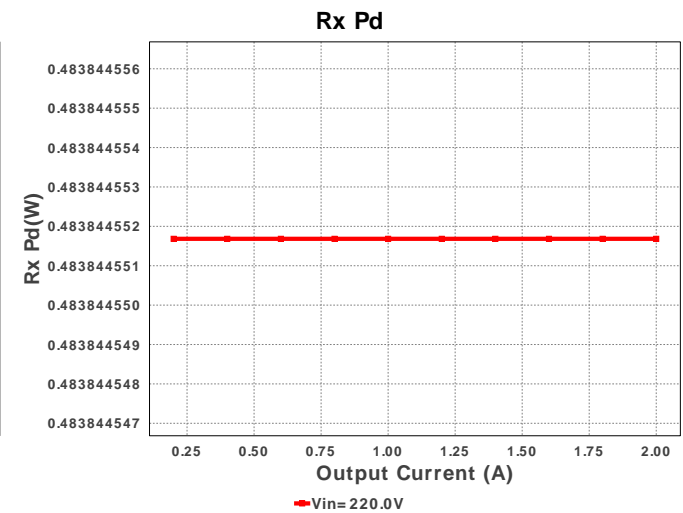
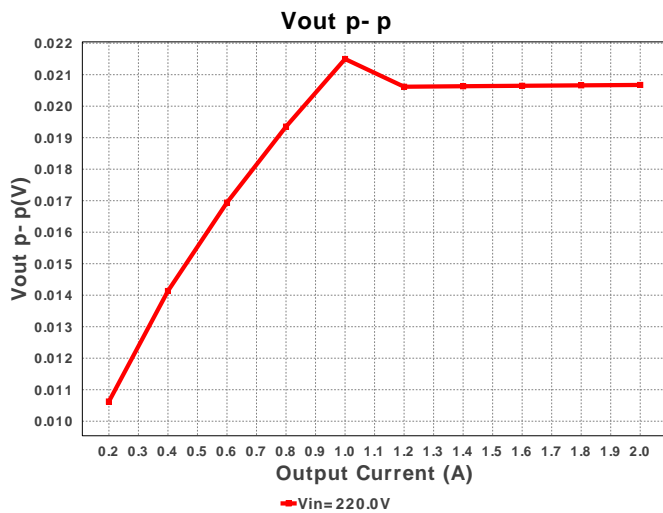
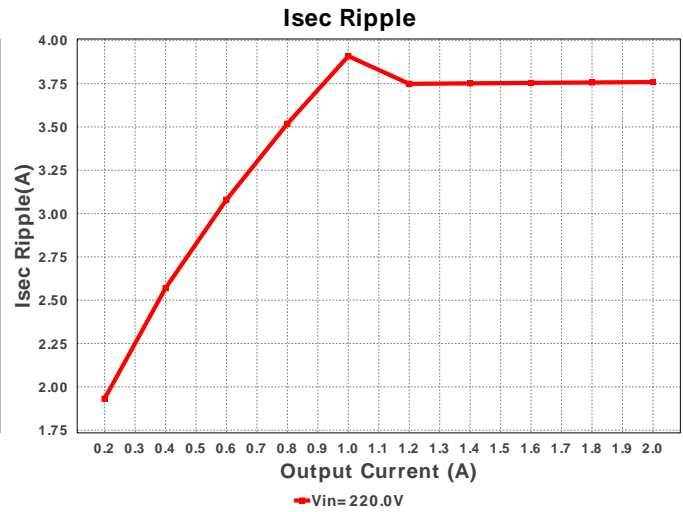
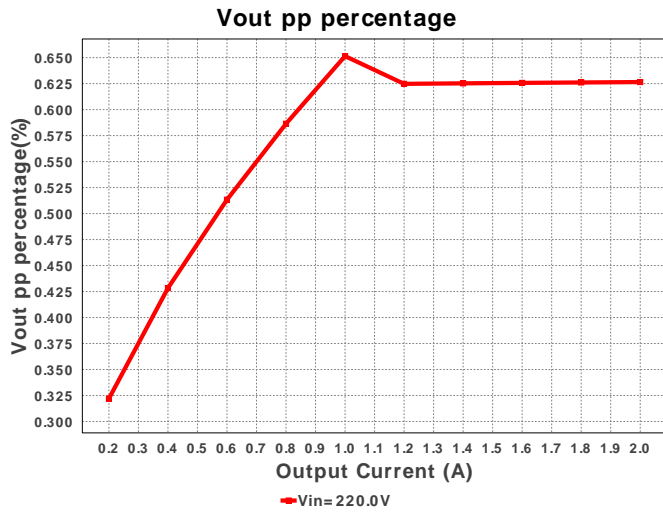
Dsec Vf



Vsnub







Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.976 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	37.52 mA	Current	RMS Input Current
3.	Iout_DCM	1.076 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	32.483 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	67.765 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	100.293 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.759 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	48.772 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	101.45 mA	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	2.812 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.627 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	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	330.58 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	397.923 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.126 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	98.851 kHz	General	Switching frequency
21.	Pout	6.6 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	5.398 us	General	Approximate Converter Off Time
25.	Ton Act	4.863 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	10.116 us	General	Switching Time Period
28.	Vaux	13.506 V	General	Auxiliary Voltage
29.	Vsnub	324.63 V	General	Voltage Across the Snubber
30.	Vout Actual	3.3 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	48.074 %	Op_point	Duty cycle
33.	Efficiency	79.958 %	Op_point	Steady state efficiency
34.	IC Tj	33.272 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	31.362 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	20.674 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	38.51 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	42.902 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	21.48 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	330.58 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	65.435 mW	Power	IC power dissipation
49.	L1 Pd	72.675 μW	Power	Power Dissipation in the Inductor
50.	L2 Pd	9.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
51.	M1 Pd	21.788 mW	Power	M1 MOSFET total power dissipation
52.	Paux	19.588 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	374.745 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	33.815 μW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	3.076 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	17.412 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	91.497 mW	Power	Snubber Power Dissipation
59.	T1 Pd	140.113 mW	Power	Estimated Losses in Transformer
60.	Total Pd	1.654 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.914 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	626.485 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	220.0	Maximum input voltage
3.	VinMin	220.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	line_fsw	50.0	Light Output in Lumen
6.	base_pn	UCC38C42	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC38C42** Product Folder : <http://www.ti.com/product/UCC38C42> : contains the data sheet and other resources.

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