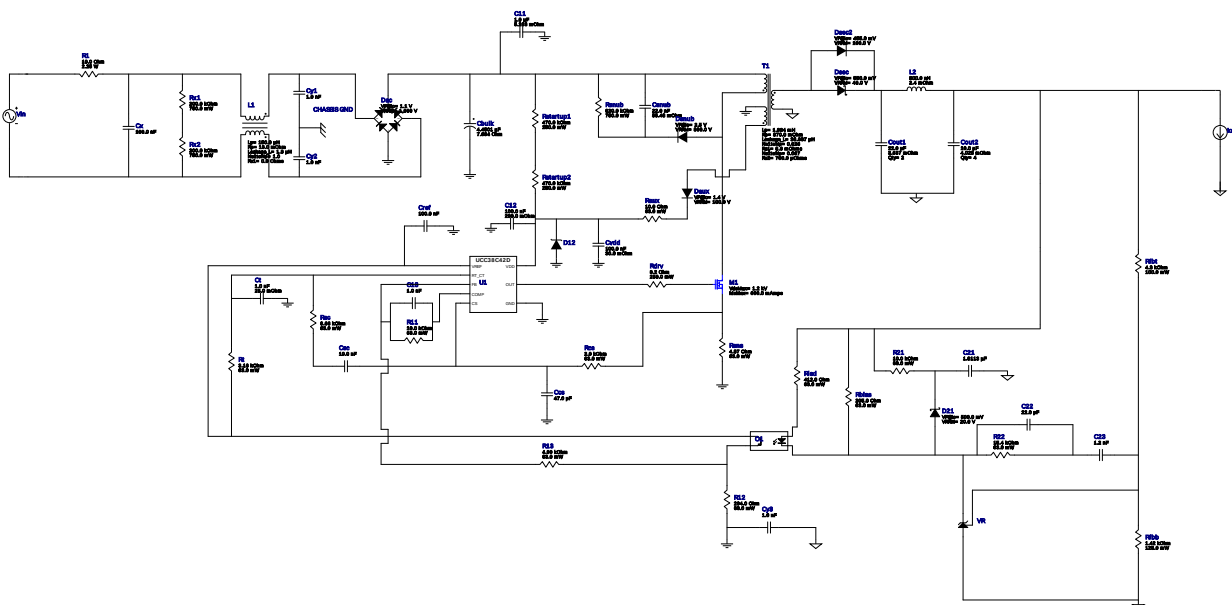


WEBENCH® Design Report

Design : 4743778/8 UCC38C42DR
UCC38C42DR 220.0V-220.0V to 5.00V @ 2.0A

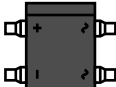
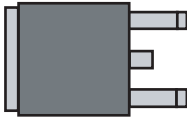
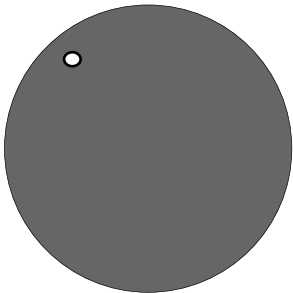
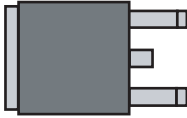


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

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	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
4.	C21	CUSTOM	CUSTOM Series= ?	Cap= 1.8113 uF VDC= 10.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm ²
5.	C22	MuRata	GRM0225C1C220JD05L Series= C0G/NP0	Cap= 22.0 pF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 01005 2 mm ²
6.	C23	MuRata	GRM033R71C122KA01D Series= X7R	Cap= 1.2 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 4.4501 uF ESR= 7.6943 Ohm VDC= 373.349 V IRMS= 110.3 mA	1	NA	CUSTOM 0 mm ²
8.	Ccs	Samsung Electro-Mechanics	CL02C470JO2ANNC Series= C0G/NP0	Cap= 47.0 pF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 01005 2 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout1	MuRata	GRM31CR61A226KE19L Series= X5R	Cap= 22.0 uF ESR= 3.637 mOhm VDC= 10.0 V IRMS= 3.56456 A	2	\$0.07	 1206_190 11 mm ²
10.	Cout2	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 4.025 mOhm VDC= 10.0 V IRMS= 2.445 A	4	\$0.03	 0805 7 mm ²
11.	Cref	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
12.	Csc	MuRata	GRM033R60J103KA01D Series= X5R	Cap= 10.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
13.	Csnub	TDK	C3216X5R2J223K Series= X5R	Cap= 22.0 nF ESR= 55.48 mOhm VDC= 630.0 V IRMS= 0.0 A	1	\$0.03	 1206 11 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

#	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	MLC1250-801MLB	L= 800.0 nH DCR= 2.4 mOhm	1	\$0.79	 MLC1250 165 mm ²
29. M1		IXYS	IXTA06N120P	VdsMax= 1.2 kV IdsMax= 600.0 mAmps	1	\$1.43	 DDPAK 210 mm ²
30. O1		Vishay-Semiconductor	TCMT1109	Optocoupler	1	\$0.21	 SOP-4 44 mm ²

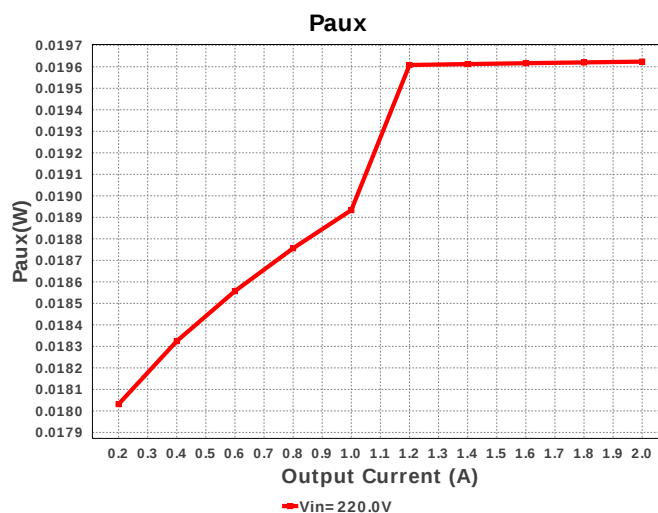
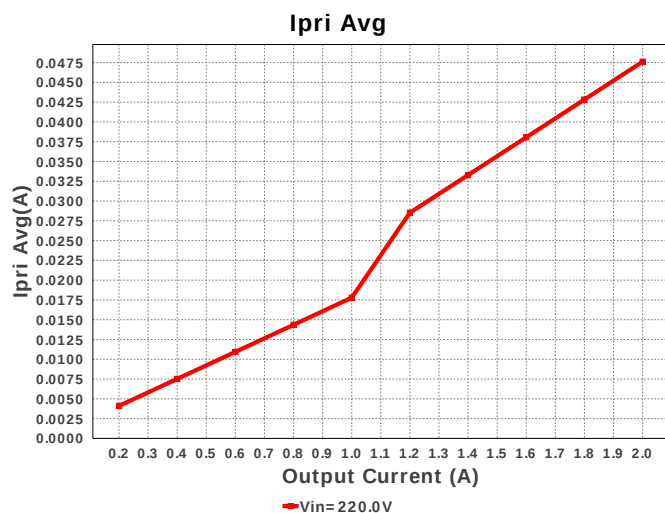
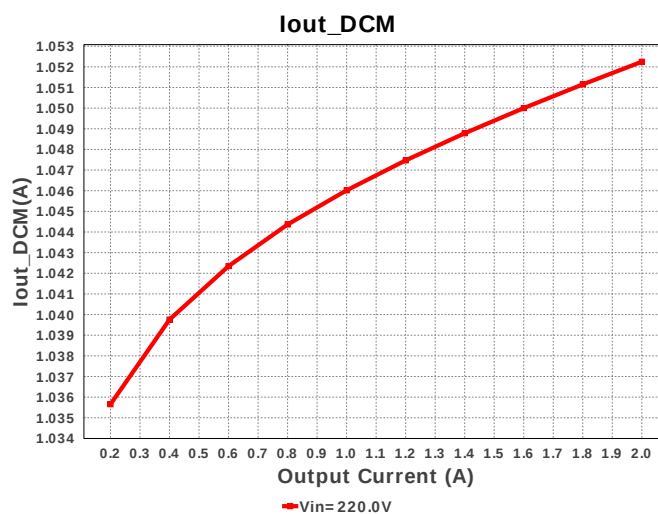
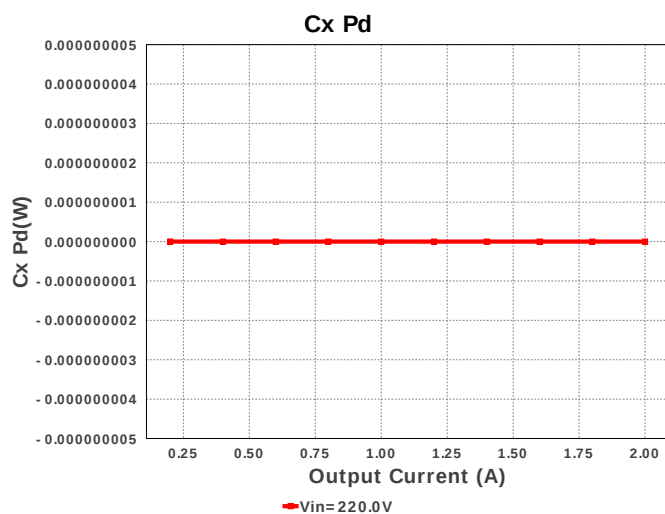
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
31.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm²
32.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
33.	R12	Vishay-Dale	CRCW0402294RFKED Series= CRCW..e3	Res= 294.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
34.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
36.	R22	Vishay-Dale	CRCW040215K4FKED Series= CRCW..e3	Res= 15.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
37.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
38.	Rbias	Vishay-Dale	CRCW0402205RFKED Series= CRCW..e3	Res= 205.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
39.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
40.	Rdrv	Yageo America	RC1206FR-078R2L Series= ?	Res= 8.2 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
41.	Rfbb	Yageo America	RT0805BRD071K42L Series= RT0805	Res= 1.42 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.05	 0805 7 mm²
42.	Rfbt	Yageo America	RC0603FR-074K3L Series= ?	Res= 4.3 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
43.	Rled	Vishay-Dale	CRCW0402412RFKED Series= CRCW..e3	Res= 412.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rsc	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
45.	Rsns	Vishay-Dale	CRCW04024R87FKED Series= CRCW..e3	Res= 4.87 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsnub	Vishay-Dale	CRCW2010820KFKEF Series= ?	Res= 820.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
47.	Rstartup1	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
48.	Rstartup2	Yageo America	RC1206FR-07470KL Series= ?	Res= 470.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
49.	Rt	Vishay-Dale	CRCW04023K16FKED Series= CRCW..e3	Res= 3.16 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
50.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
51.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²

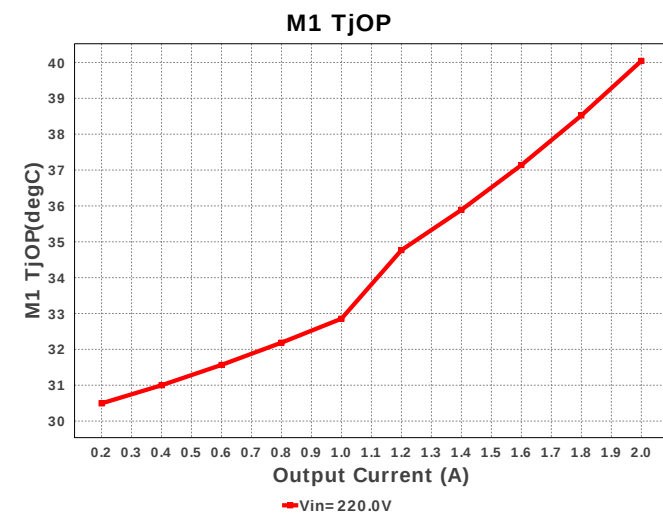
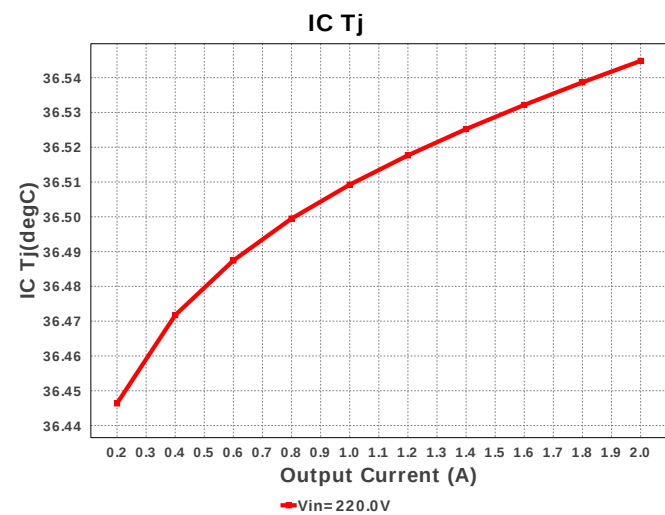
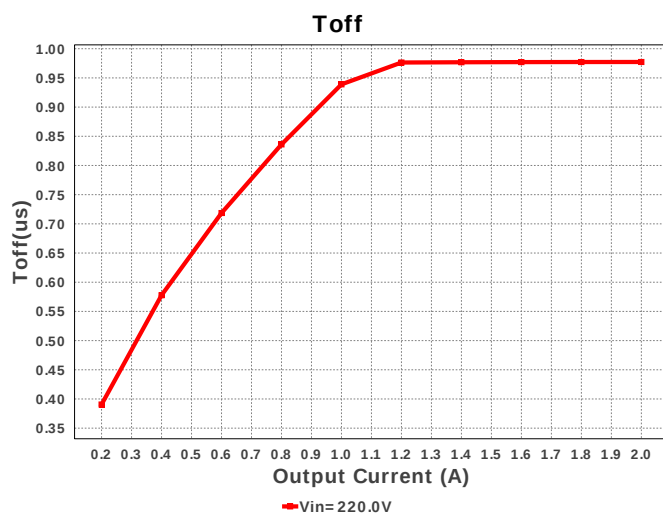
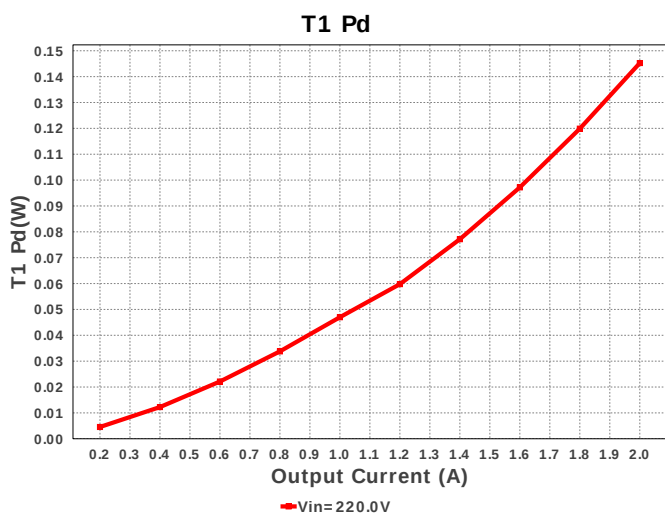
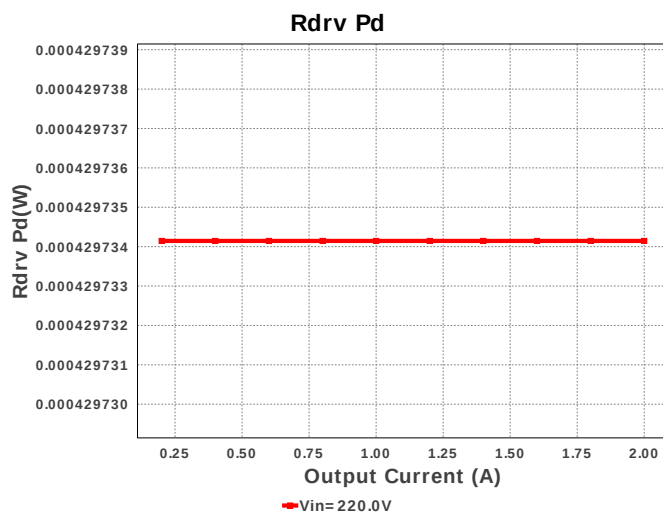
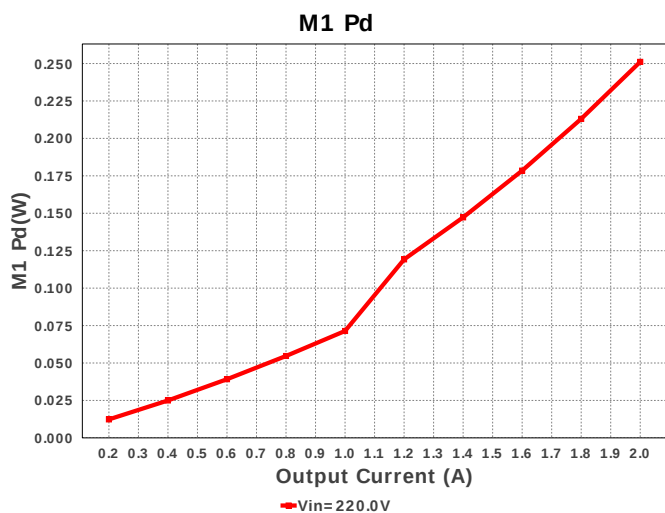
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
52.	T1	CUSTOM	CUSTOM	Lp= 1.934 mH Rp= 870.0 mOhm Leakage_L= 38.687 μ H Ns1toNp= 0.026 Rs1= 8.6 mOhms Ns2toNp= 0.067 Rs2= 700.0 μ Ohms	1	NA	CUSTOM 0 mm ²

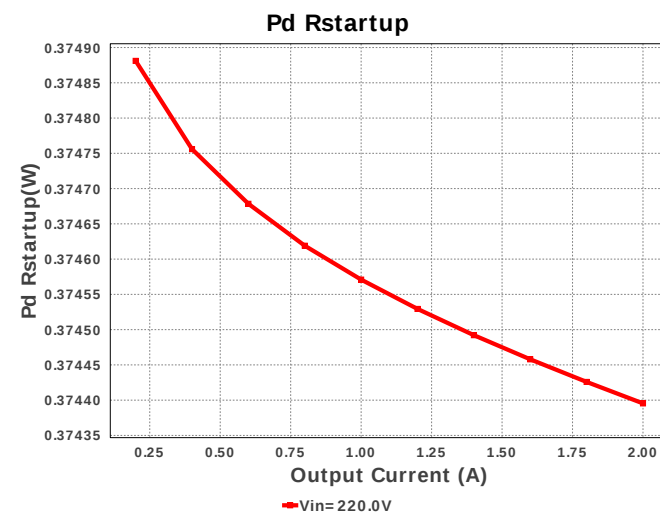
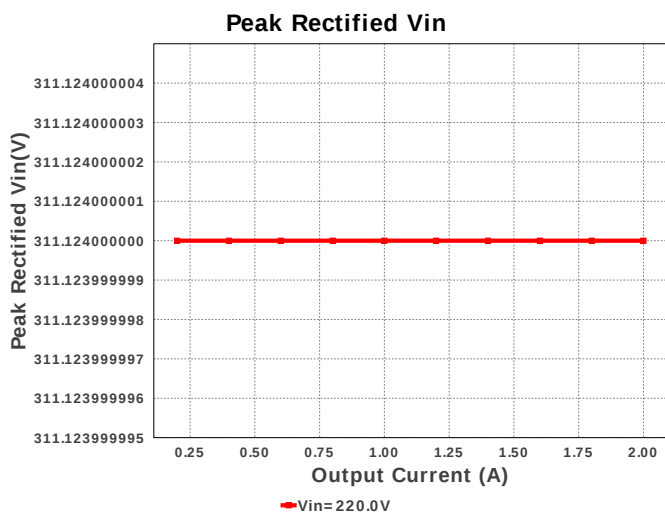
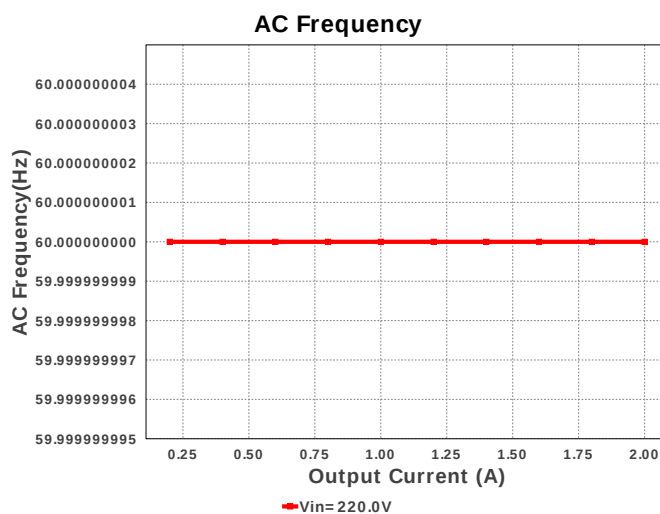
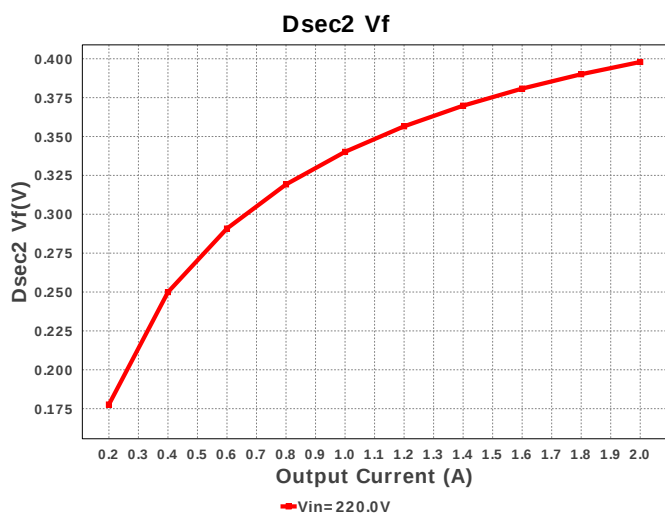
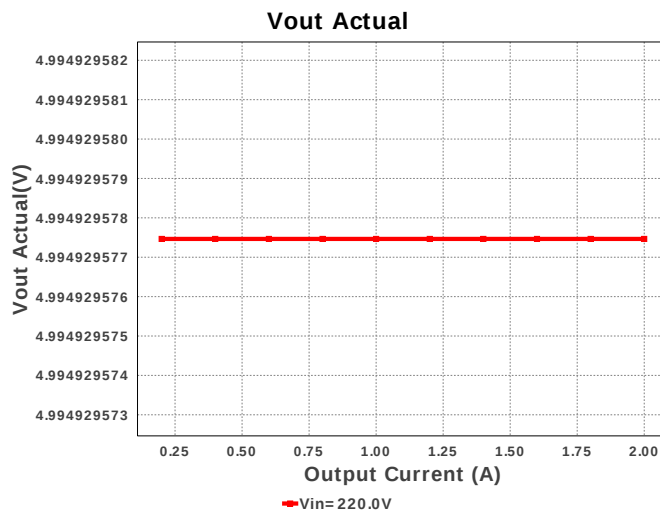
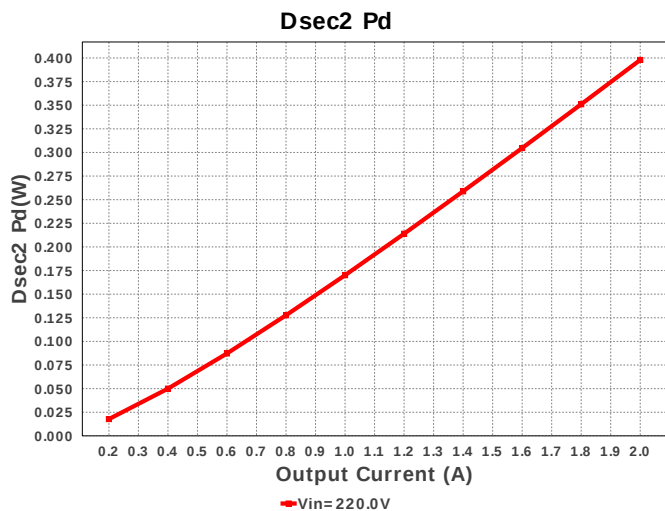
53.	U1	Texas Instruments	UCC38C42DR	Switcher	1	\$0.60	
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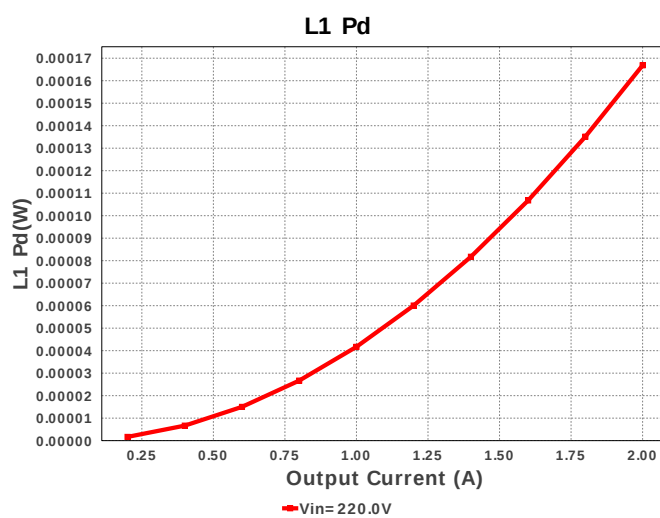
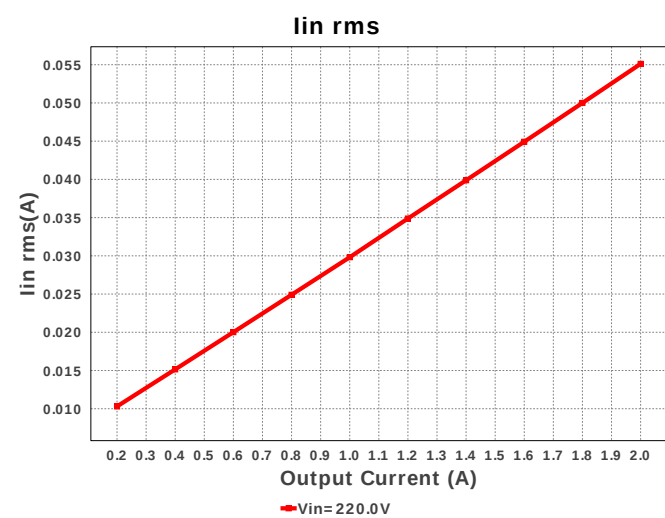
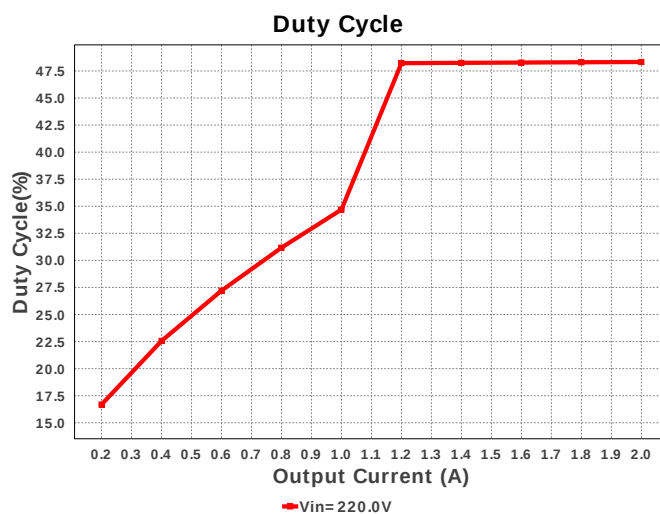
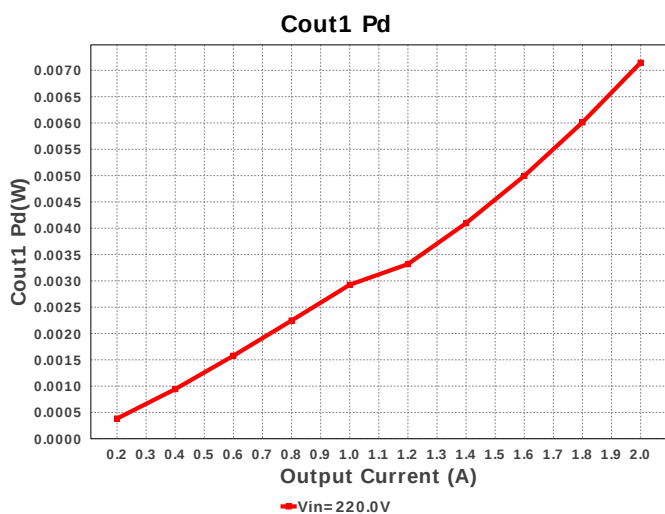
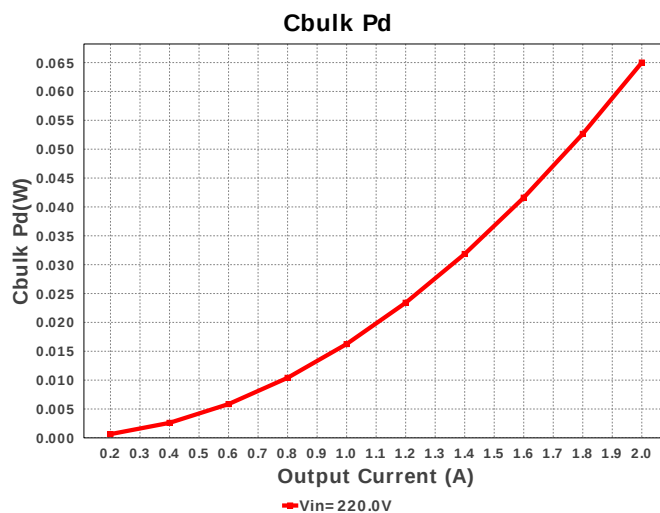
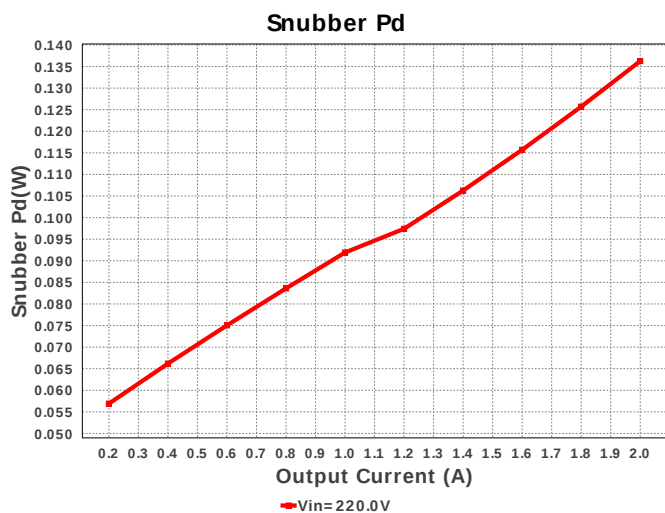
D0008A 57 mm²

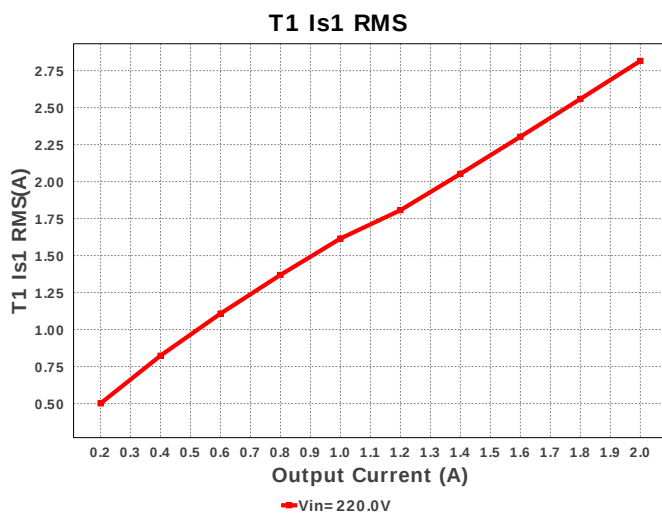
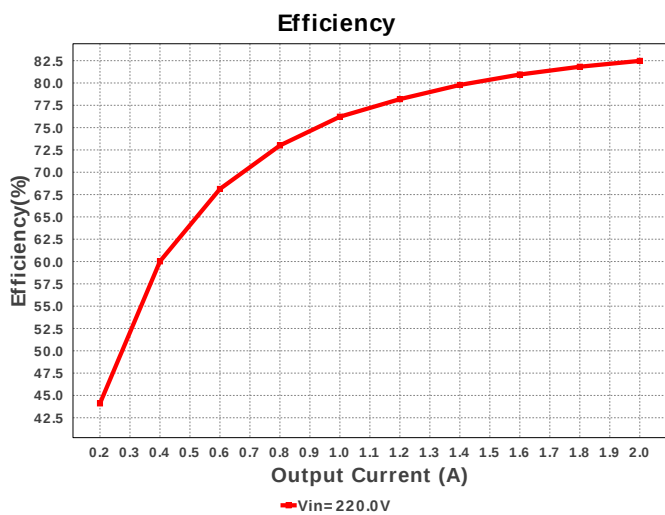
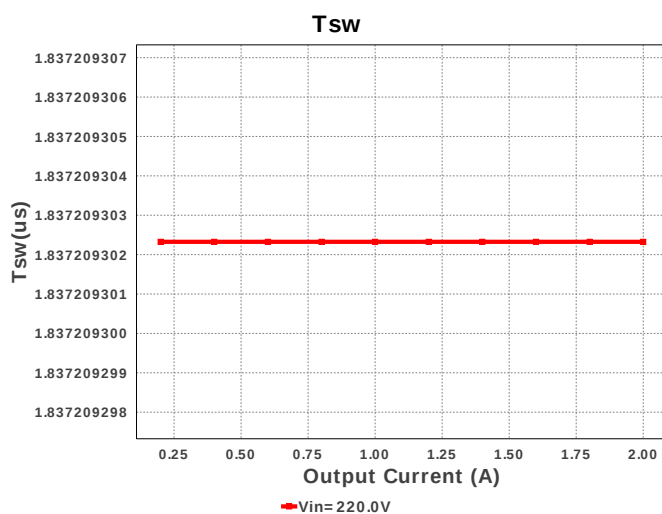
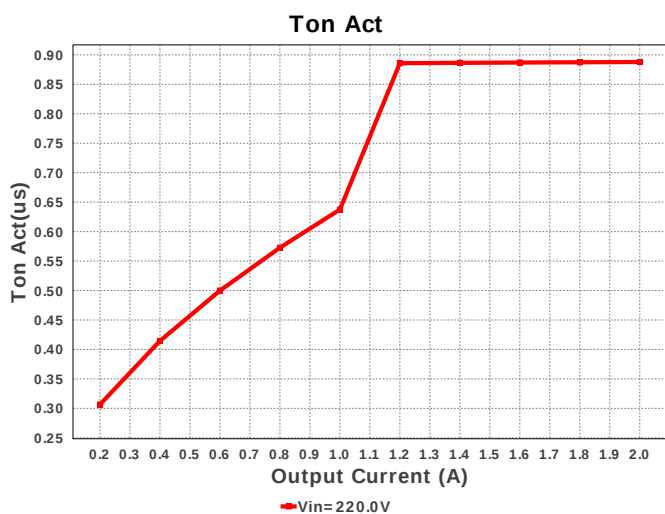
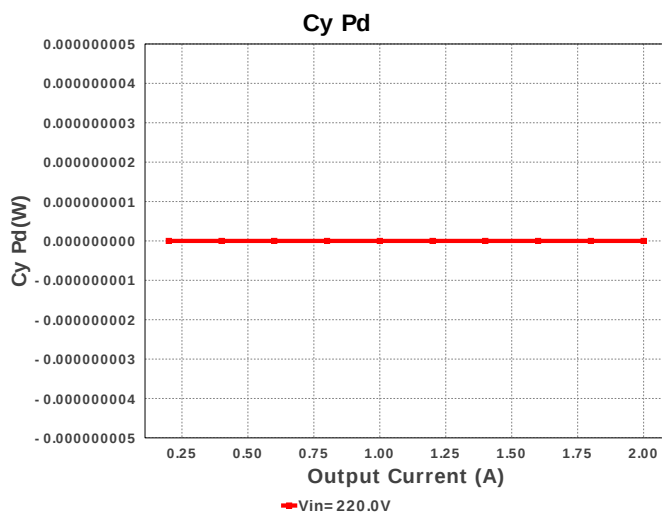
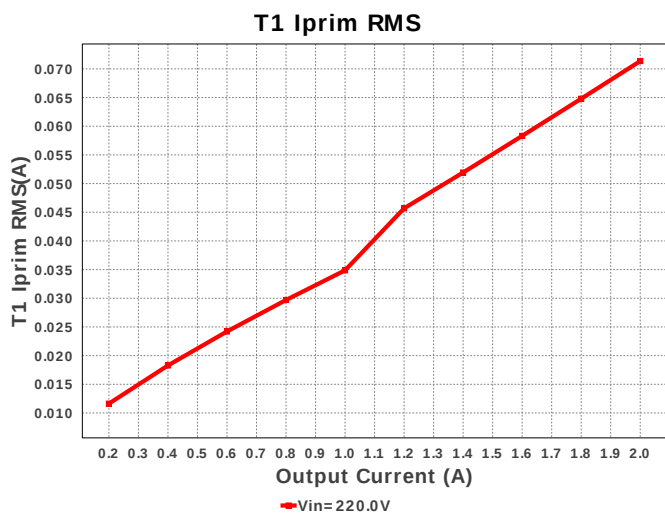
54.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	\$0.16	
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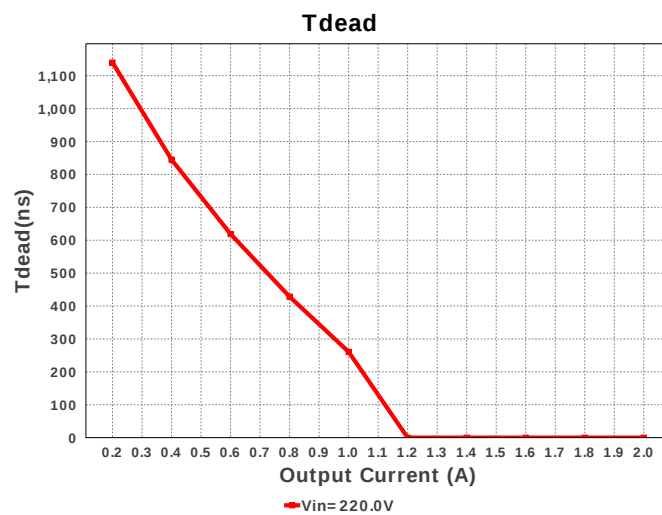
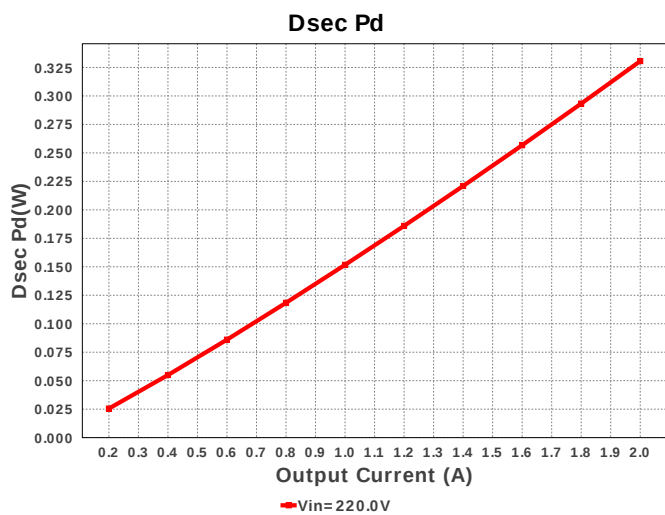
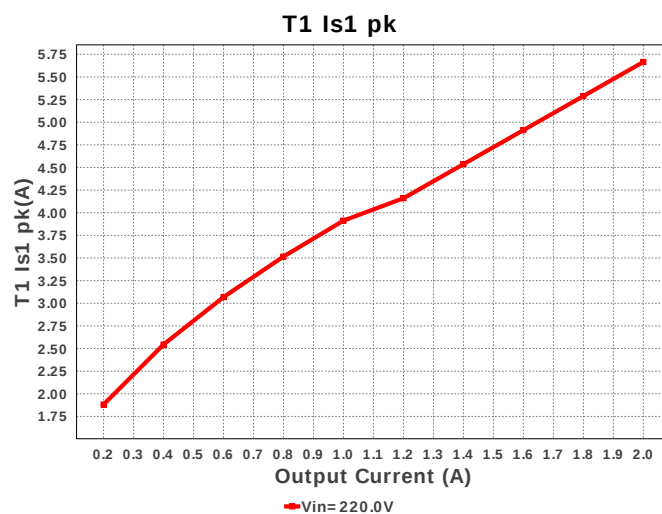
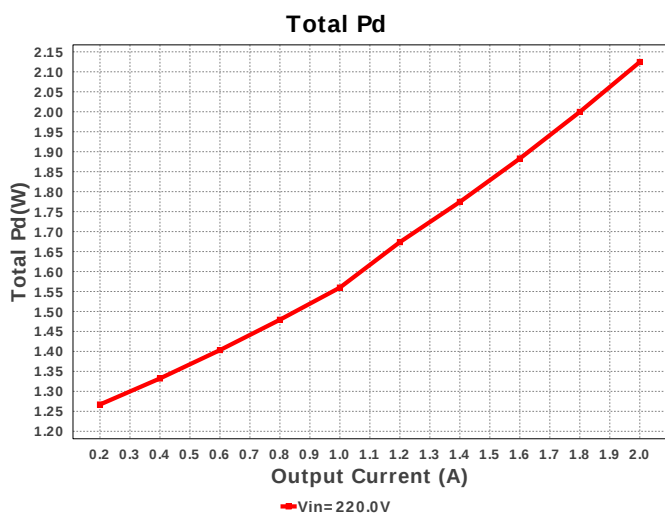
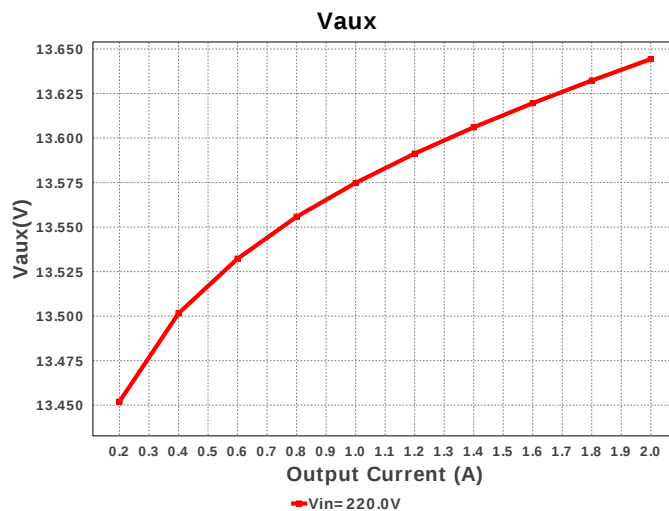
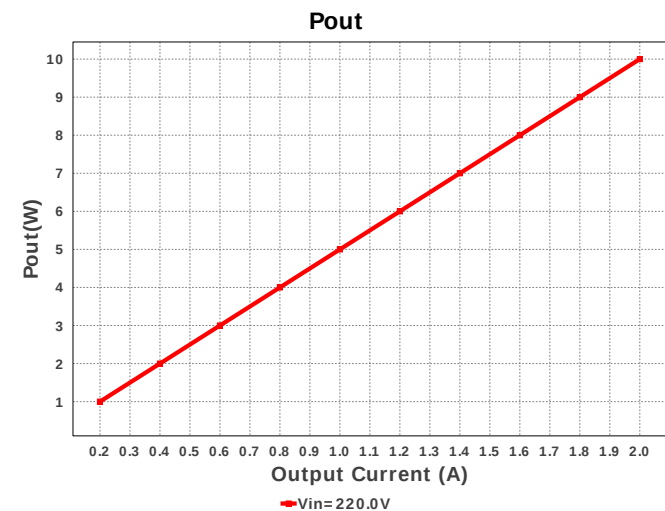
R-PDSO-G3 16 mm²



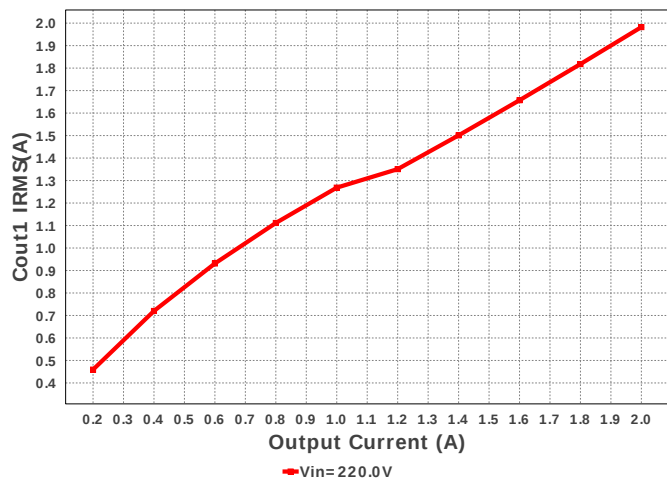




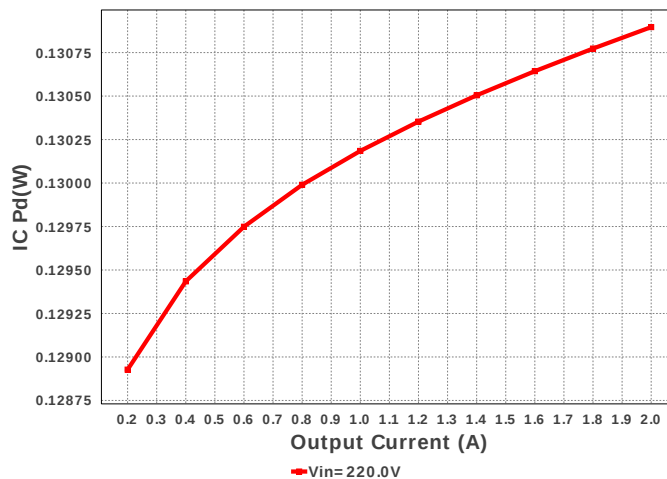




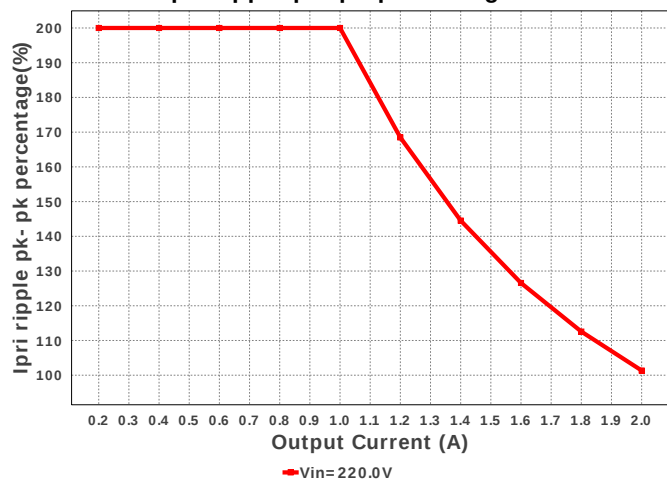
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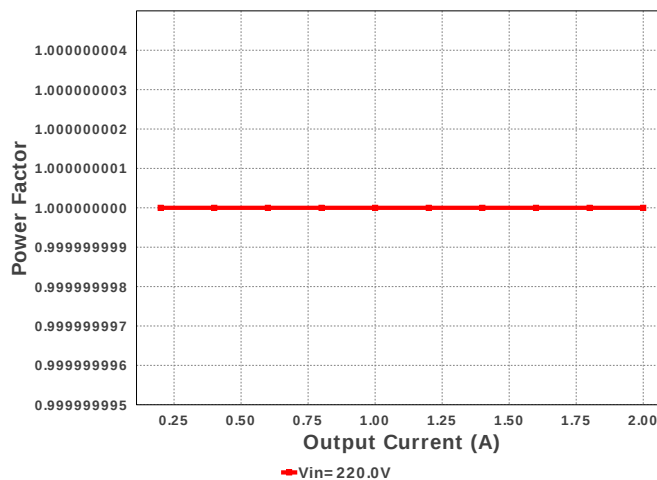
IC Pd



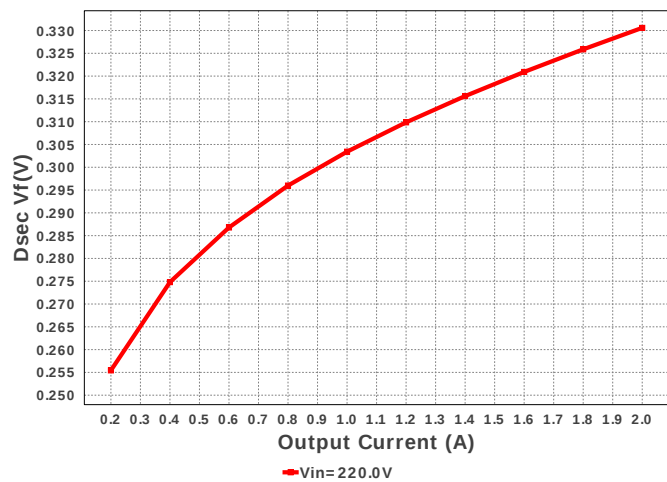
Ipri ripple pk- pk percentage



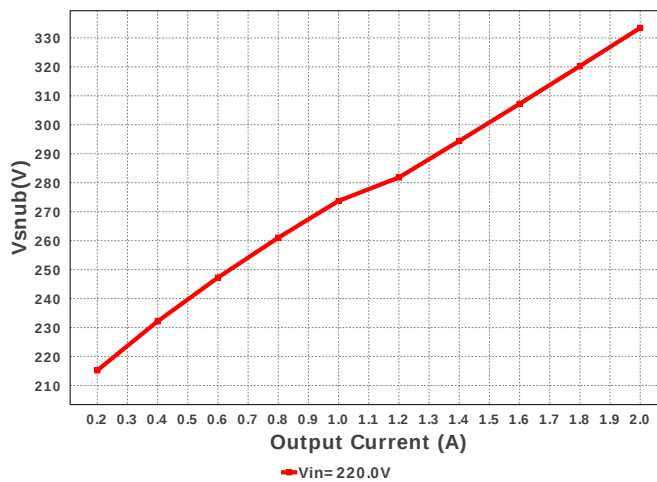
Power Factor

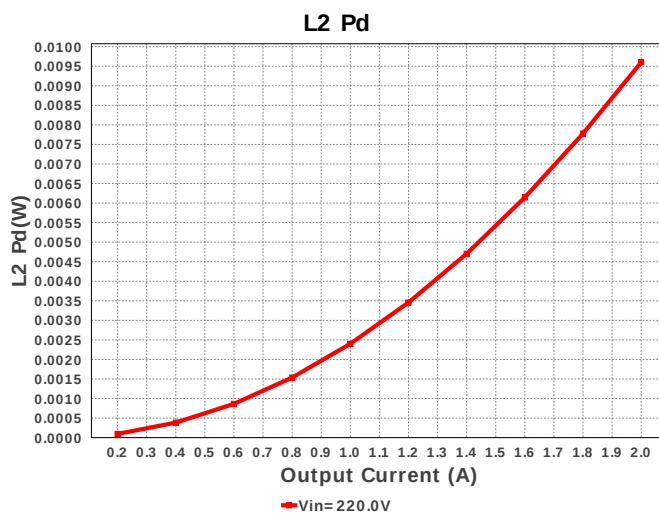
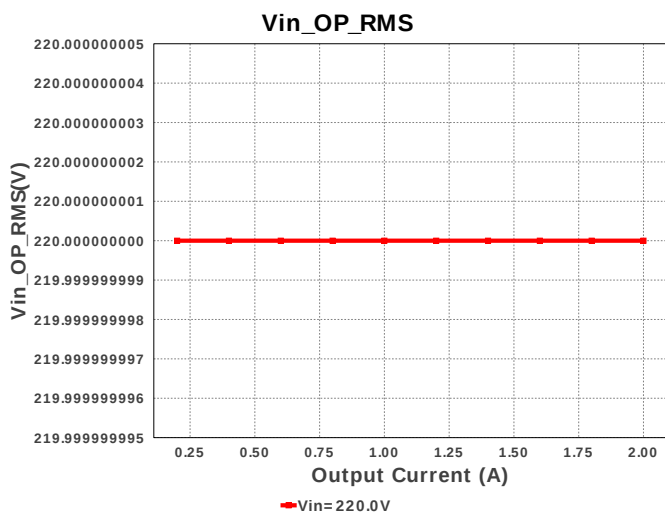
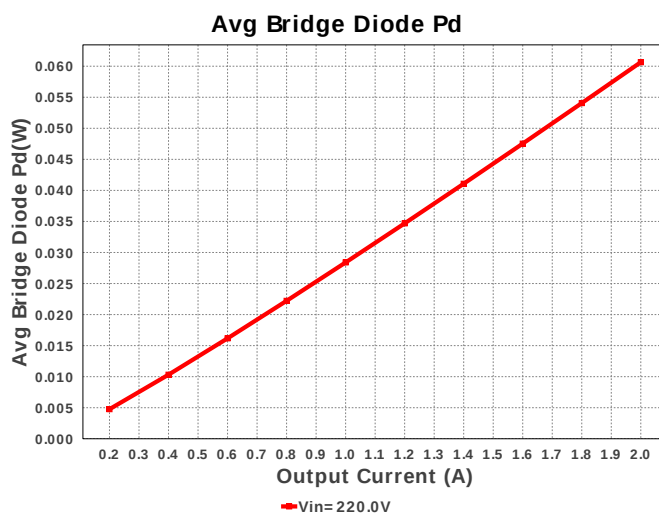
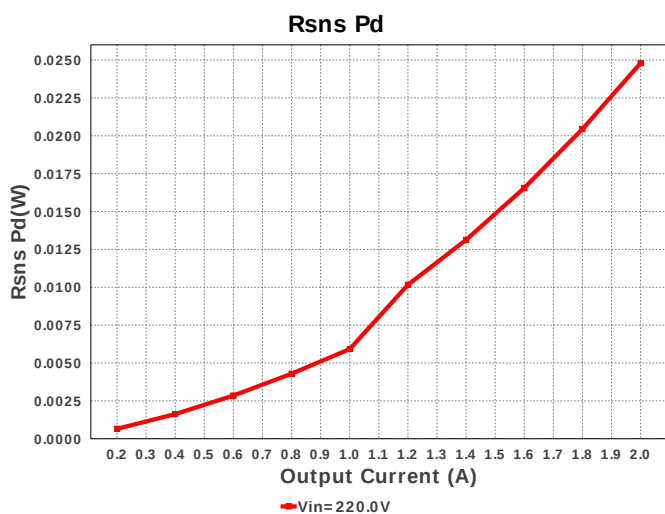
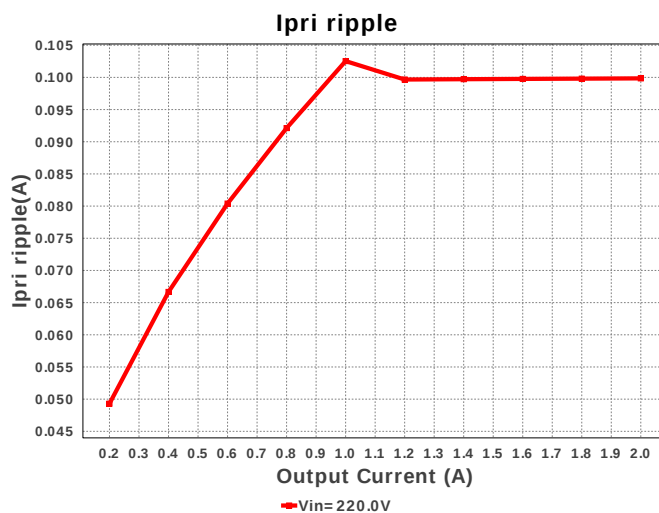
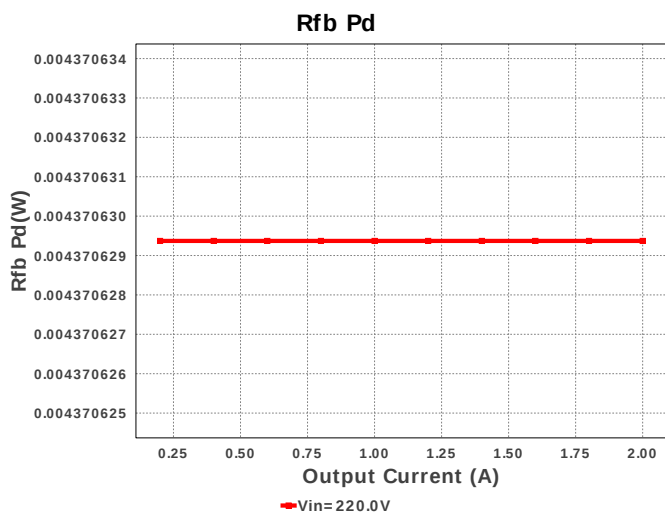


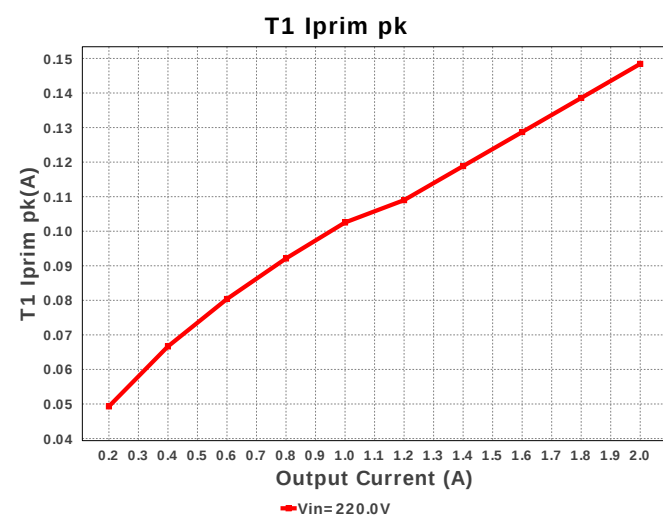
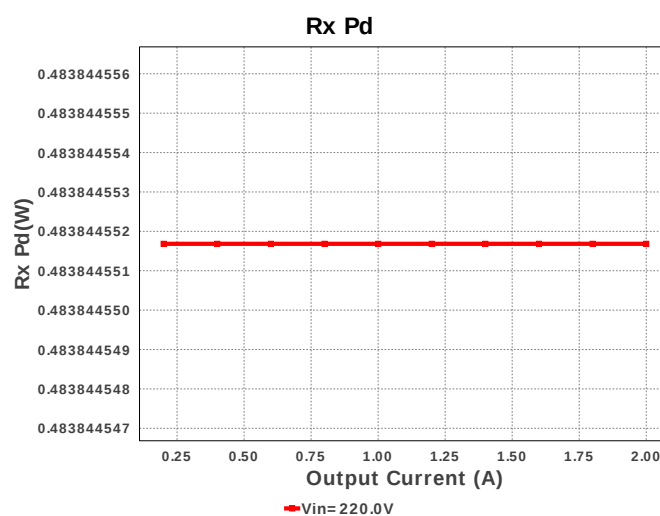
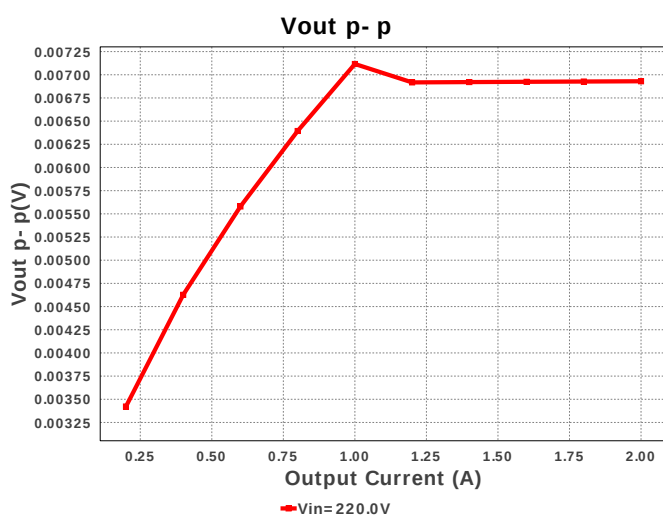
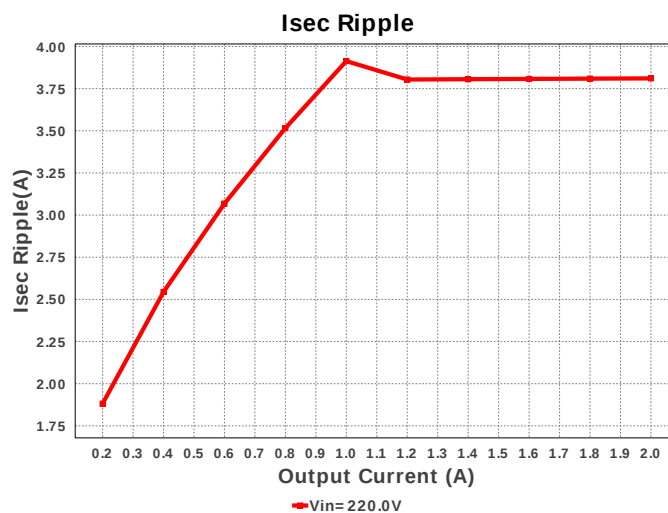
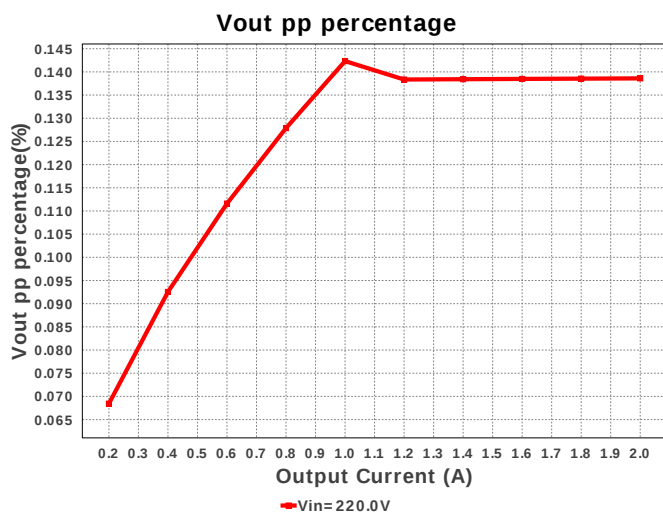
Dsec Vf



VsnuB







Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.982 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	55.111 mA	Current	RMS Input Current
3.	Iout_DCM	1.052 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	47.61 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	99.845 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	101.355 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.811 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	71.355 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	148.433 mA	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	2.816 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.665 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	58	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	2.928 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	544.304 kHz	General	Switching frequency
21.	Pout	10.0 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	977.282 mus	General	Approximate Converter Off Time
25.	Ton Act	887.919 mus	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	1.837 us	General	Switching Time Period
28.	Vaux	13.644 V	General	Auxiliary Voltage
29.	Vsnub	333.448 V	General	Voltage Across the Snubber
30.	Vout Actual	4.995 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	48.33 %	Op_point	Duty cycle
33.	Efficiency	82.477 %	Op_point	Steady state efficiency
34.	IC Tj	36.545 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	40.045 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	6.93 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	60.646 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	65.004 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	7.146 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	130.897 mW	Power	IC power dissipation
49.	L1 Pd	166.838 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	251.117 mW	Power	M1 MOSFET total power dissipation
52.	Paux	19.624 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	374.395 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	429.734 μW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	4.371 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	24.796 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	136.257 mW	Power	Snubber Power Dissipation
59.	T1 Pd	145.248 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.125 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.478 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	138.598 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	5.0	Output Voltage
5.	acFrequency	0.0	Light Output in Lumen
6.	base_pn	UCC38C42	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature
9.	userfsw	98.851 k	Customer Selected Frequency

Design Assistance

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

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