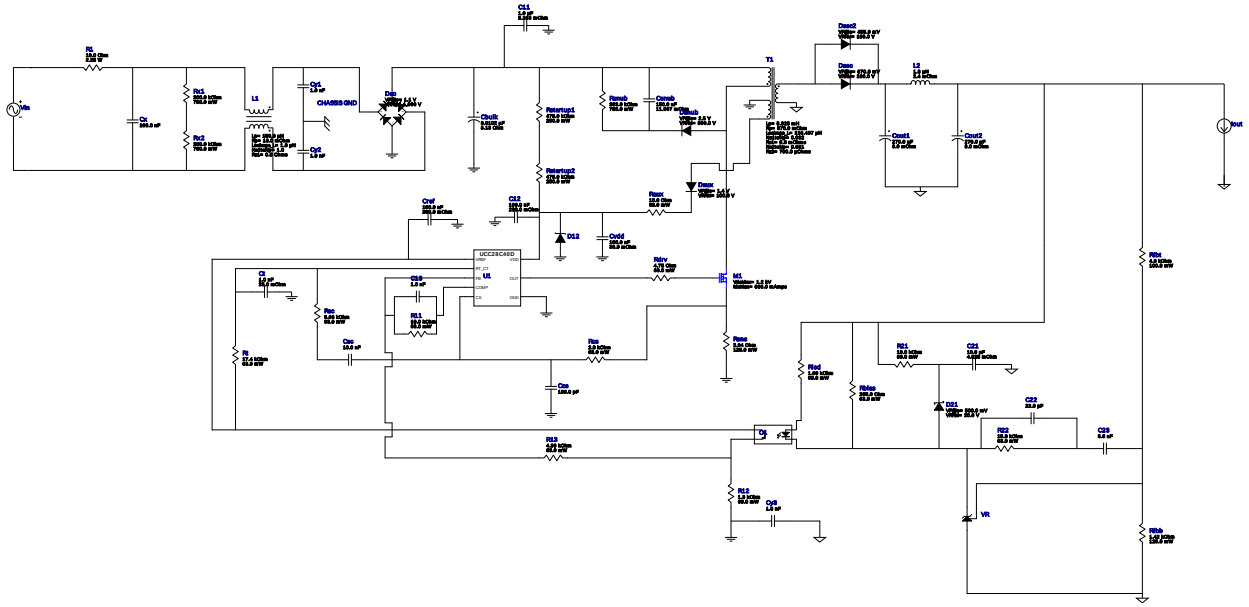
WEBENCH® Design Report

VinMin = 220.0V
VinMax = 245.0V
Vout = 5.0V
Iout = 3.0A

Device = UCC28C40DR
Topology = Flyback
Created = 8/10/16 9:12:00 PM
BOM Cost = $0.00
BOM Count = 54
Total Pd = 3.18W

Design : 3692851/6 UCC28C40DR
UCC28C40DR 220.0V-245.0V to 5.00V @ 3.0A

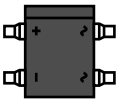
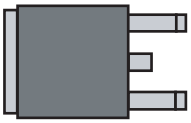
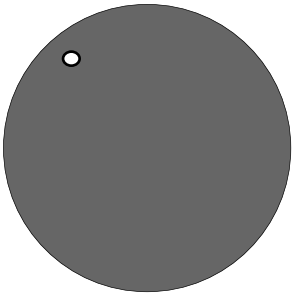
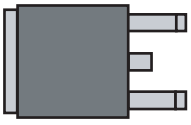


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

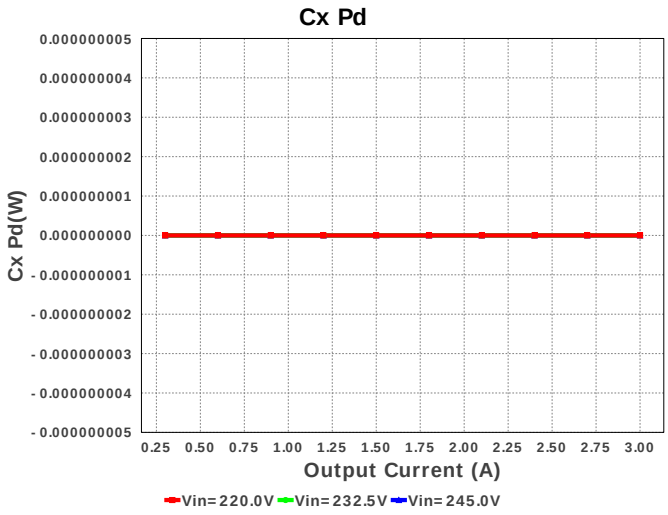
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	$1.19	2220 54 mm²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
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 mm²
5.	C22	Kemet	C0805C220K3GACTU Series= C0G/NP0	Cap= 22.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	C23	Yageo America	CC0805KRX7R9BB562 Series= X7R	Cap= 5.6 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 8.0102 uF ESR= 5.1297 Ohm VDC= 415.77 V IRMS= 165.447 mA	1	NA	CUSTOM 0 mm²
8.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²

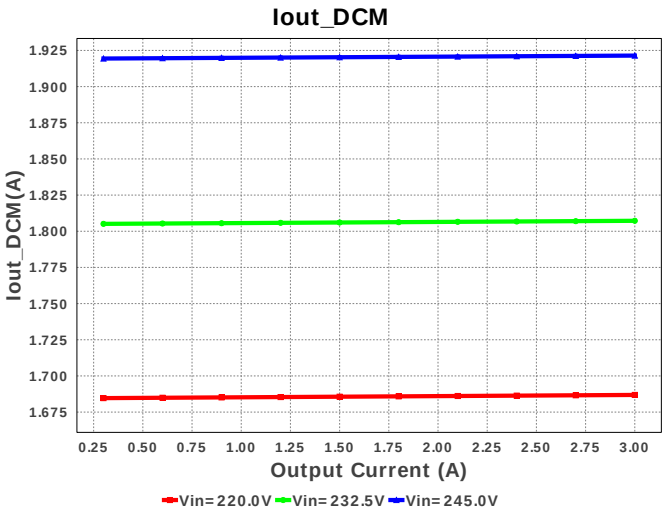
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout1	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	 CAPSMT_62_C10 74 mm^2
10.	Cout2	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	 CAPSMT_62_C10 74 mm^2
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	C3225X7T2J154K Series= X7T	Cap= 150.0 nF ESR= 11.907 mOhm VDC= 630.0 V IRMS= 0.0 A	1	$0.19	 1210 15 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	GRM188R71C104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 16.0 V IRMS= 1.7 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

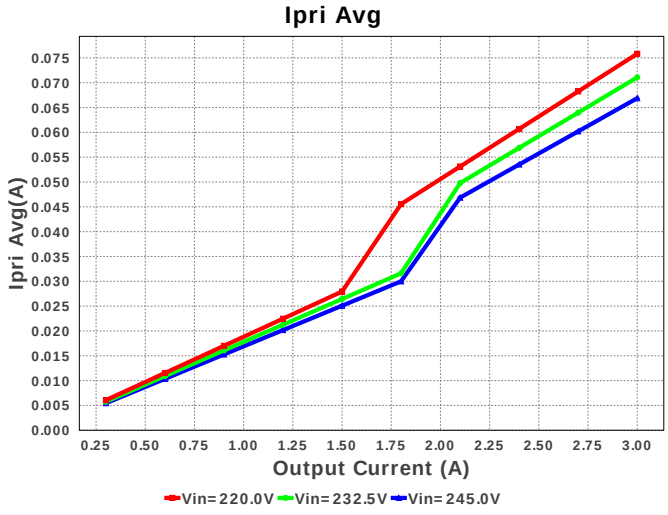
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
19.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	$0.22	 B81123_1800x500x1050 140 mm²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	$0.04	 SOD-123 13 mm²
21.	D21	Diodes Inc.	B220-13-F	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	 SMB 44 mm²
22.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
23.	Daux	NXP Semiconductor	BAS316,115	VF@Io= 1.4 V VRRM= 100.0 V	1	$0.02	 SOD-323 9 mm²
24.	Dsec	Fairchild Semiconductor	FSV8100V	VF@Io= 670.0 mV VRRM= 100.0 V	1	$0.21	 TO-277A 56 mm²
25.	Dsec2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm²
26.	Dsnub	Bourns	CD1408-FU1800	VF@Io= 2.5 V VRRM= 800.0 V	1	$0.13	 Diode_1408 13 mm²
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 mm²
28.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	$0.72	 SER1360 225 mm²
29.	M1	IXYS	IXTA06N120P	VdsMax= 1.2 kV IdsMax= 600.0 mAmps	1	$1.43	 DDPAK 210 mm²
30.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	$0.21	 SOP-4 44 mm²

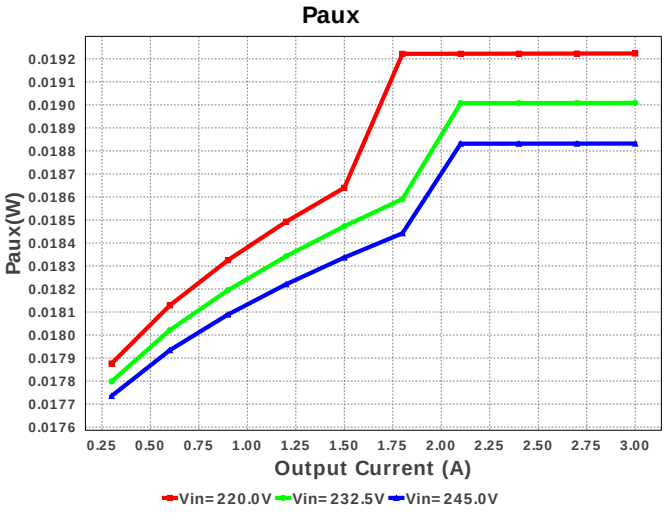
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
31.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	$0.30	AC03 158 mm²
32.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	R12	Vishay-Dale	CRCW04021K30FKED Series= CRCW..e3	Res= 1.3 kOhm 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	CRCW040215K8FKED Series= CRCW..e3	Res= 15.8 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	Vishay-Dale	CRCW04024R75FKED Series= CRCW..e3	Res= 4.75 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 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	CRCW04021K69FKED Series= CRCW..e3	Res= 1.69 kOhm 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	CRCW08052R94FKEA Series= CRCW..e3	Res= 2.94 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
46.	Rsnub	Vishay-Dale	CRCW2010383KFKEF Series= CRCW..e3	Res= 383.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.03	2010 32 mm²
47.	Rstartup1	Panasonic	ERJ-8ENF4753V Series= ERJ-8E	Res= 475.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
48.	Rstartup2	Panasonic	ERJ-8ENF4753V Series= ERJ-8E	Res= 475.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
49.	Rt	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 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

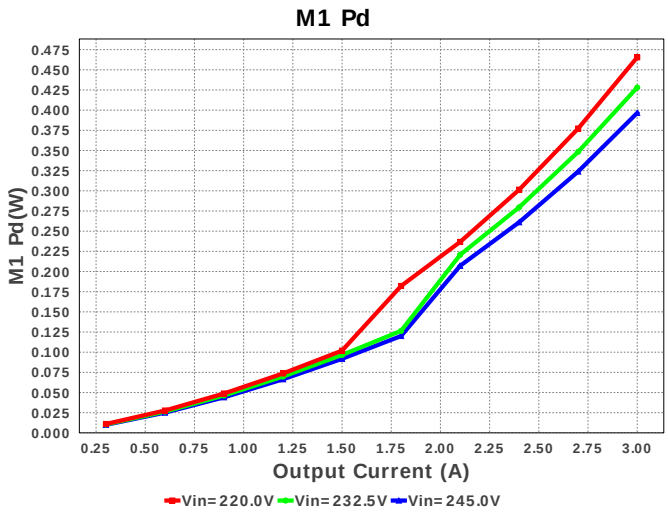
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
52.	T1	CUSTOM	CUSTOM	Lp= 5.825 mH Rp= 870.0 mOhm Leakage_L= 116.497 µH Ns1toNp= 0.032 Rs1= 8.6 mOhms Ns2toNp= 0.061 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm^2
53.	U1	Texas Instruments	UCC28C40DR	Switcher	1	$0.75	 D0008A 57 mm^2
54.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	$0.16	 R-PDSO-G3 16 mm^2

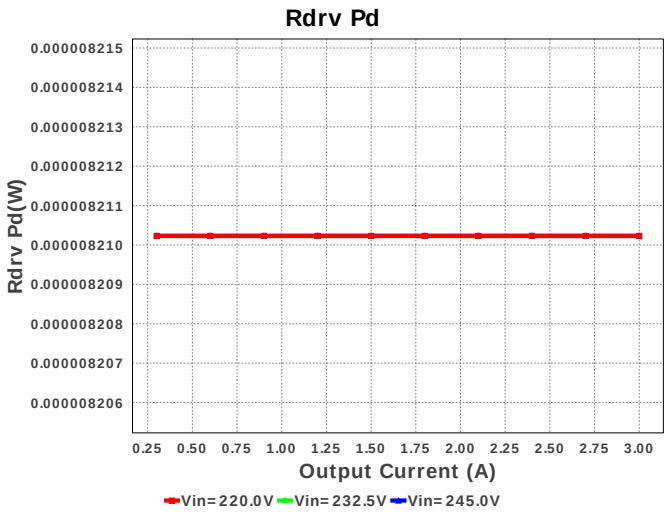


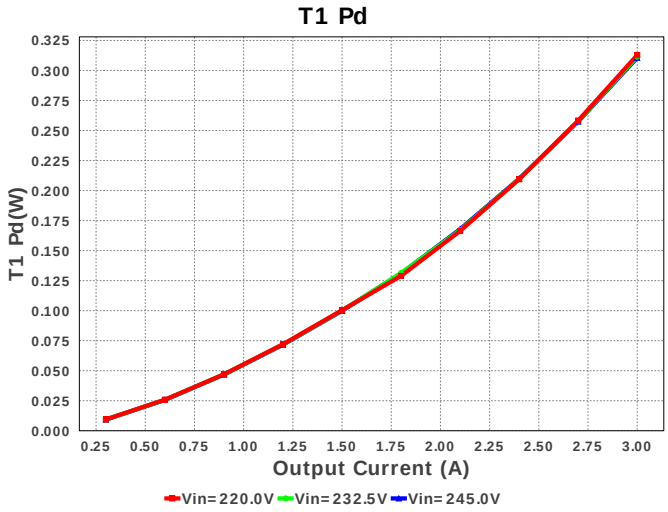


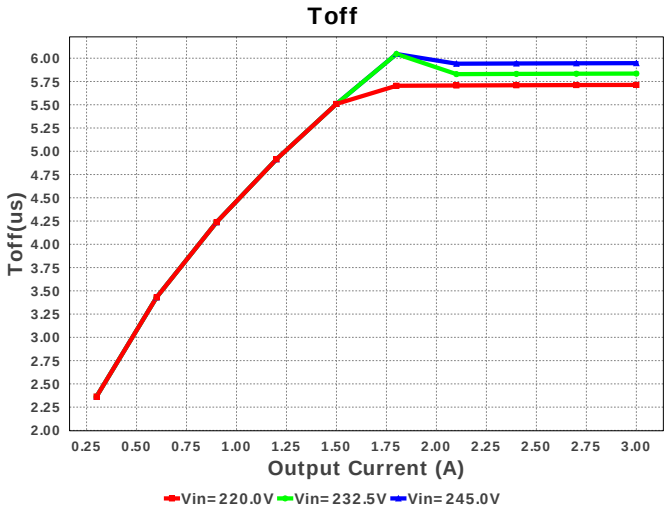


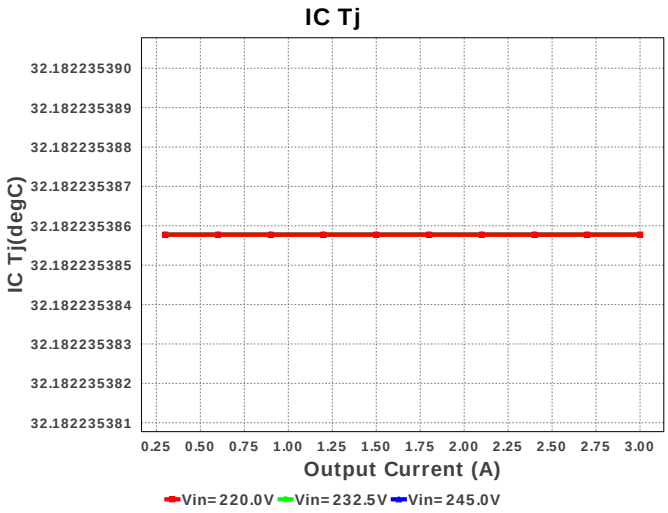


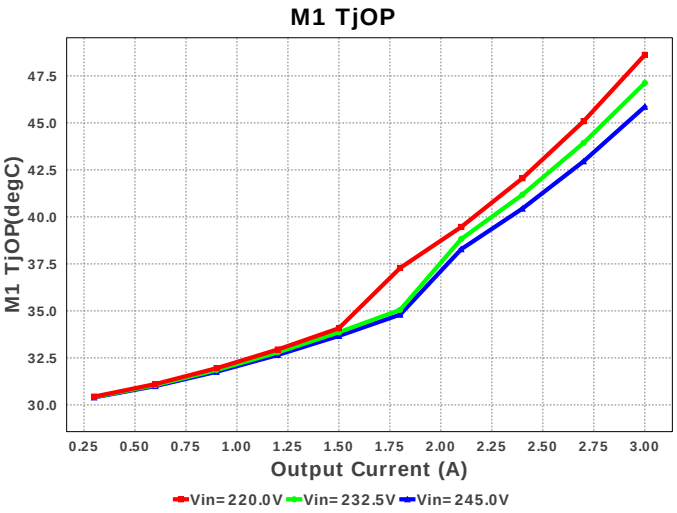


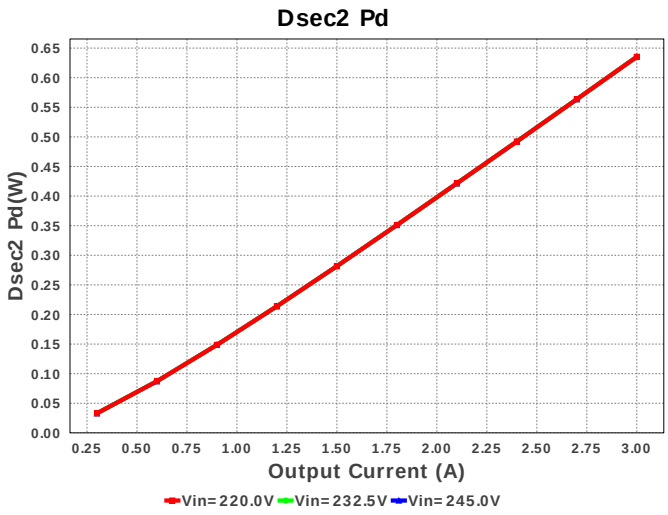


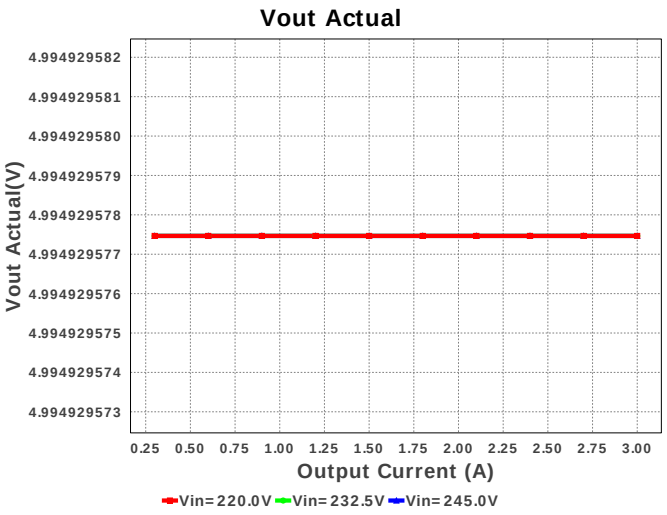


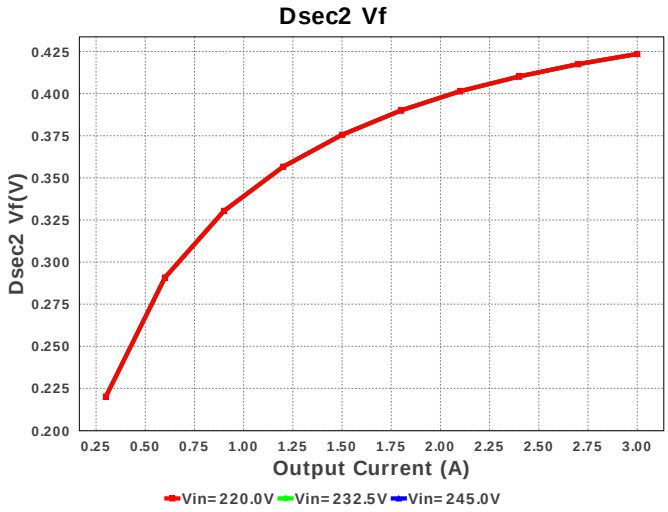


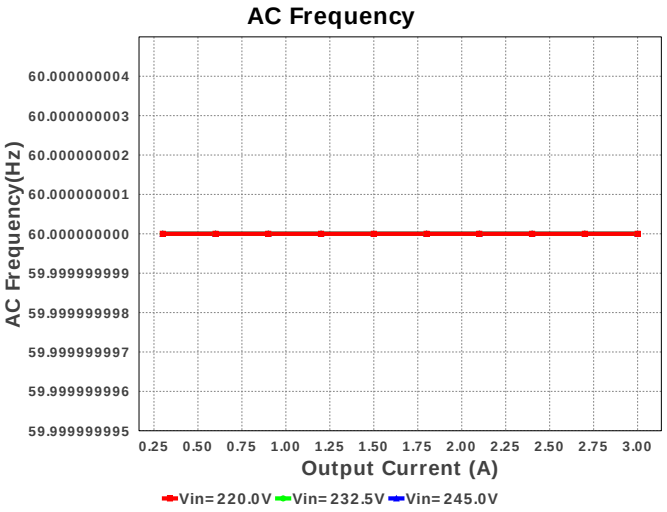


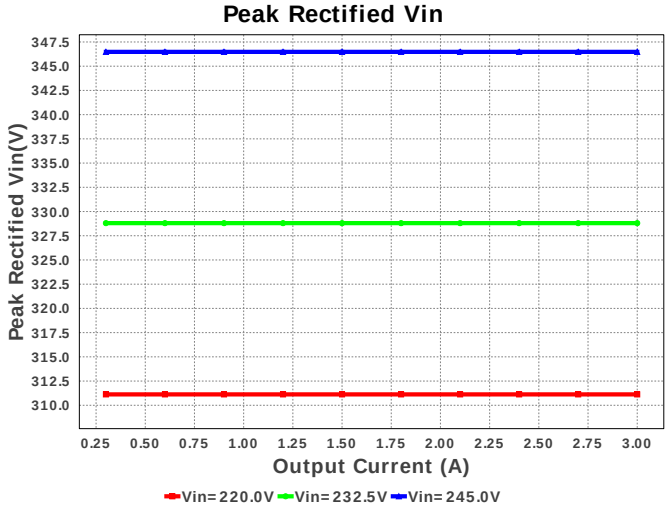


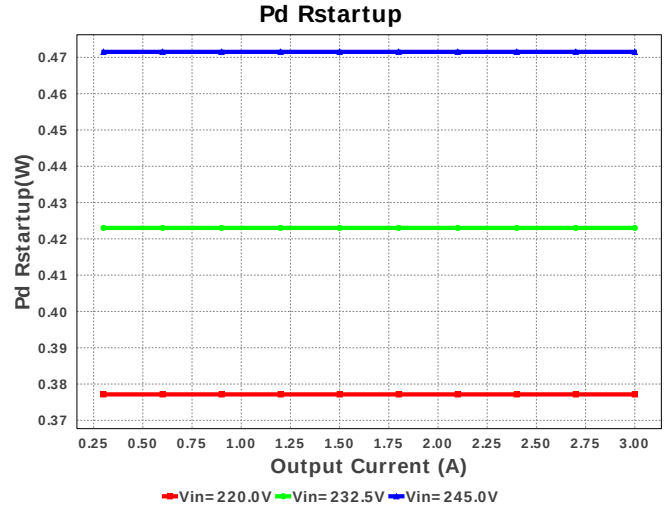


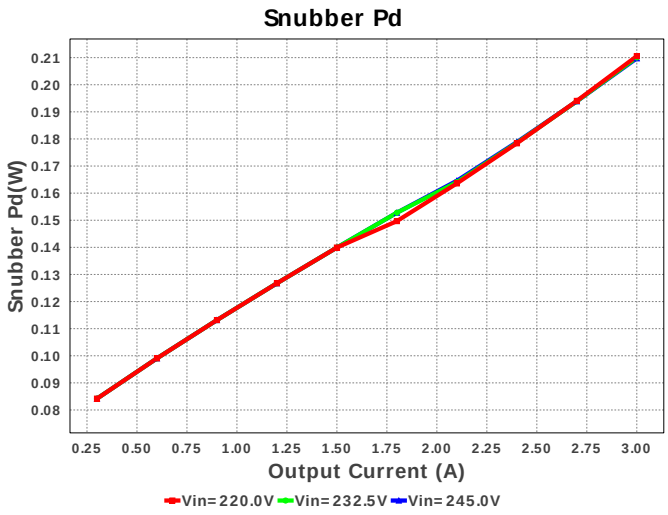


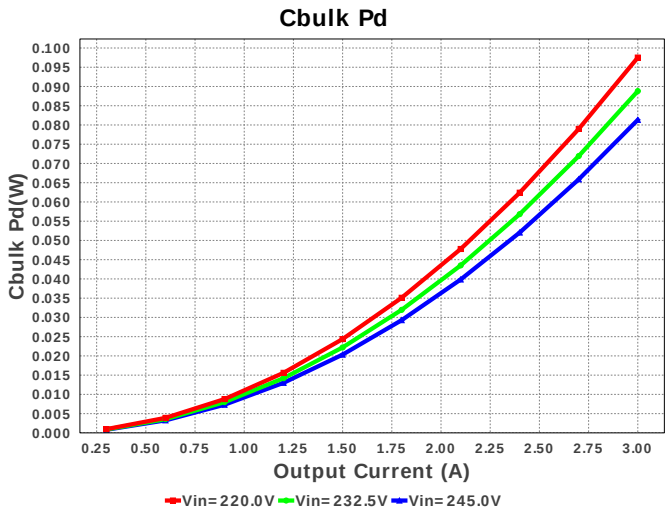


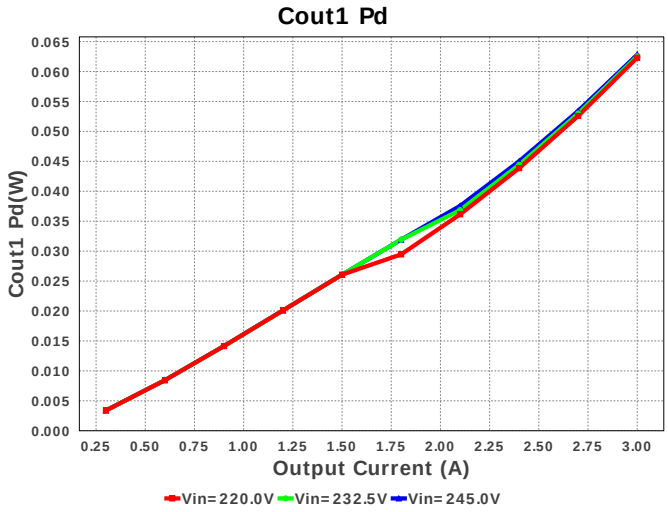


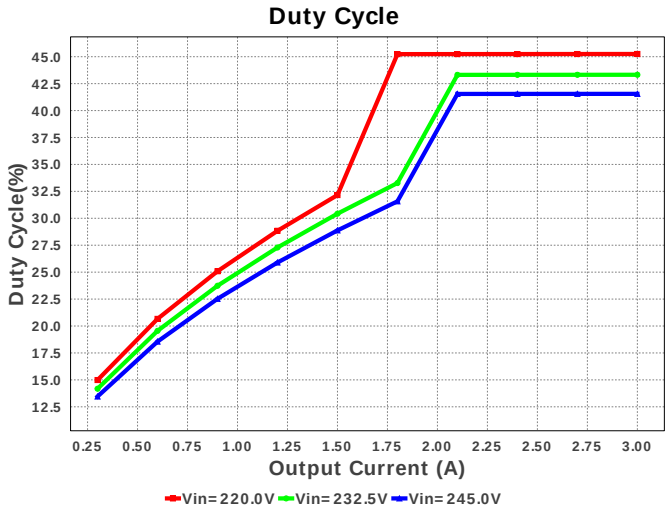


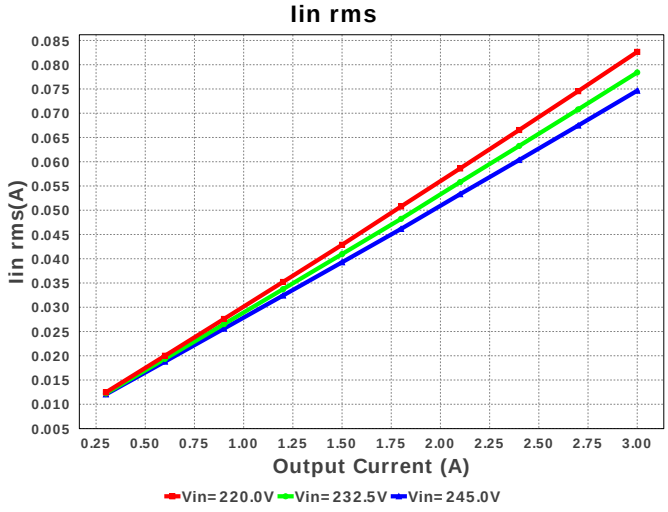


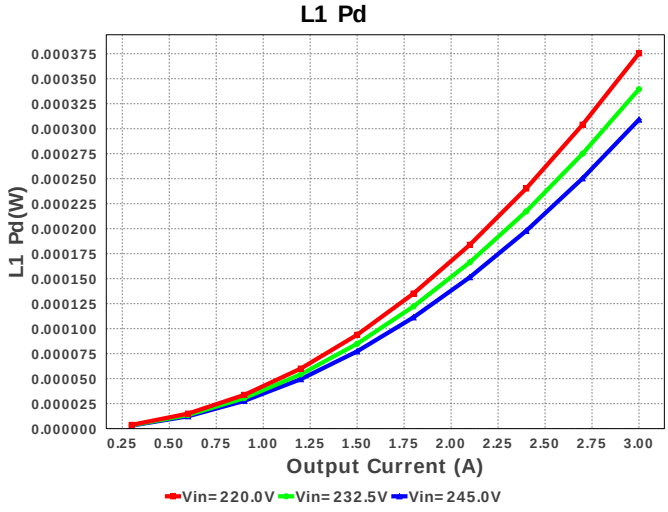


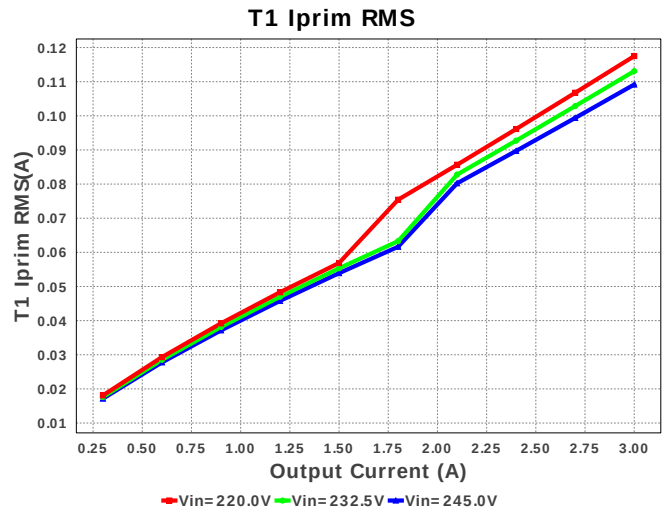


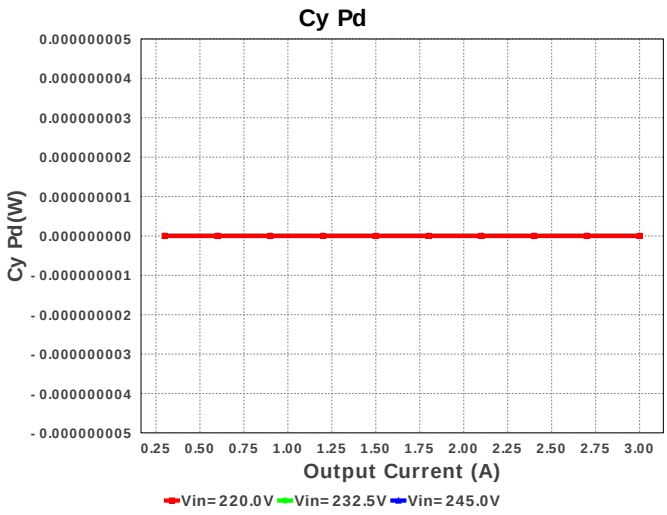


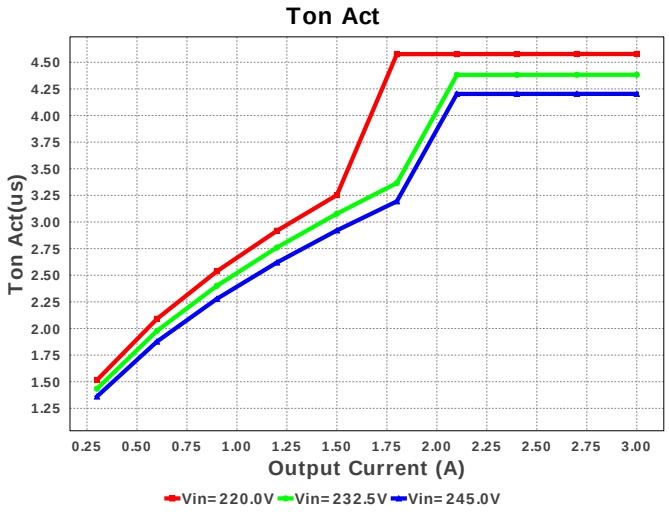


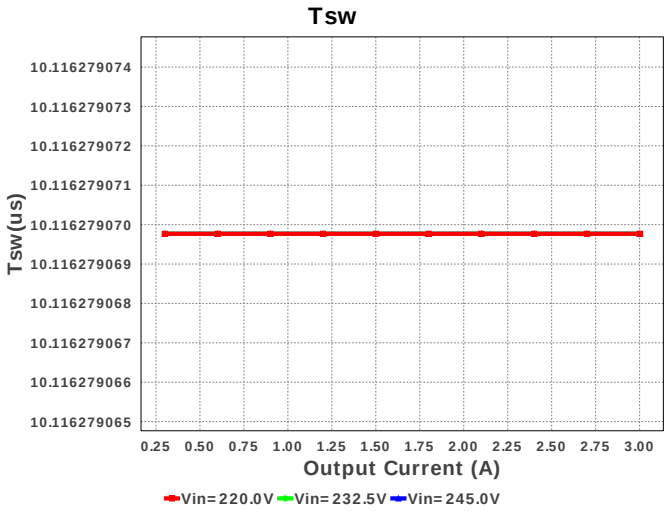


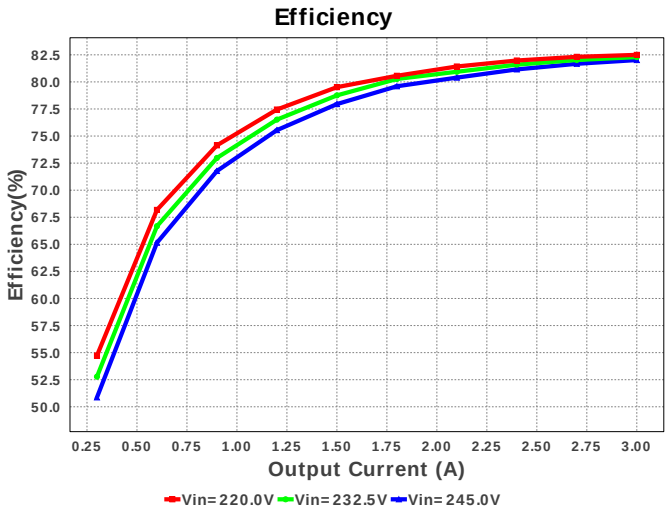


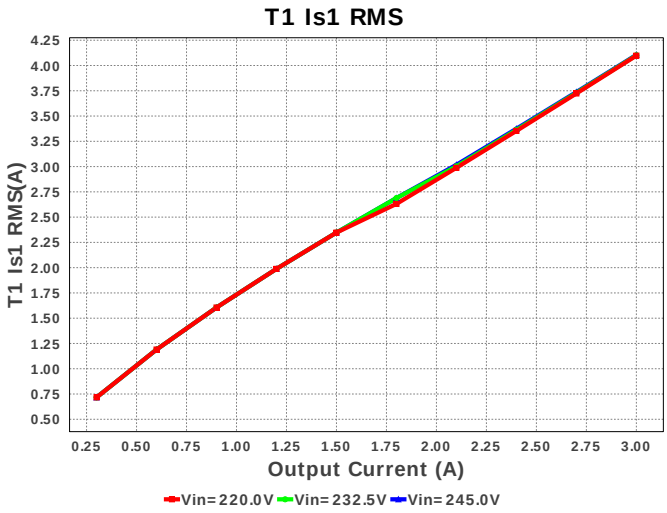


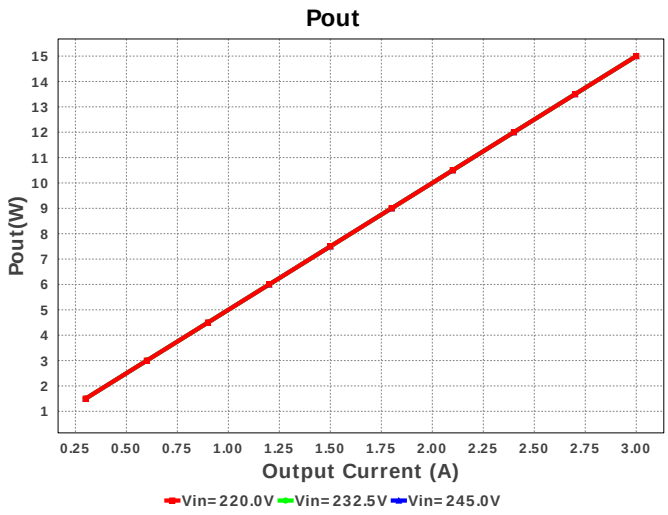


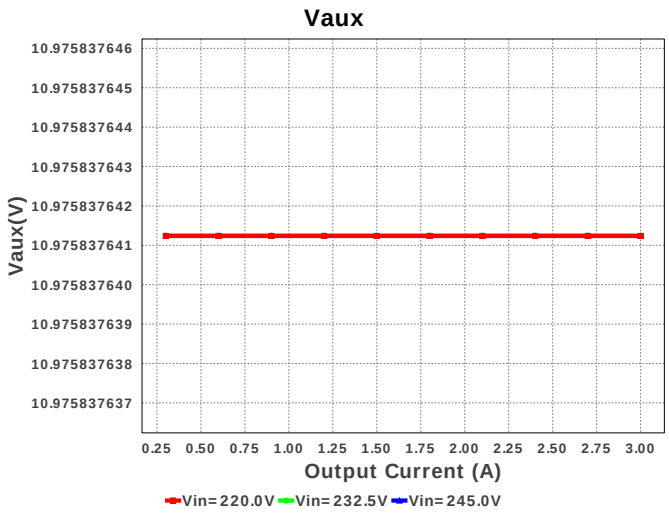


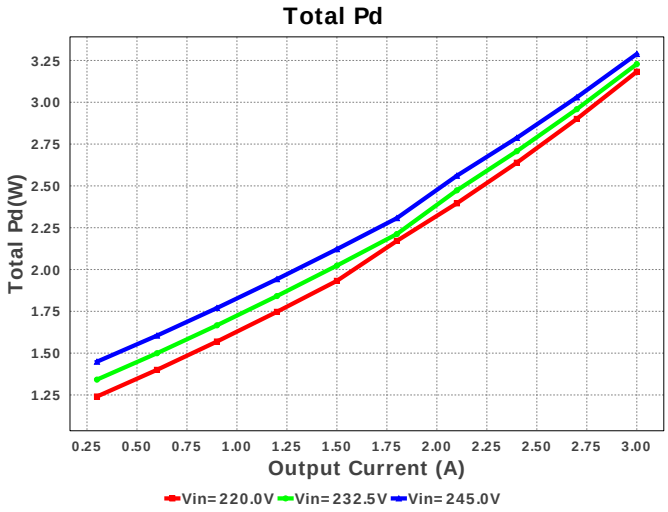


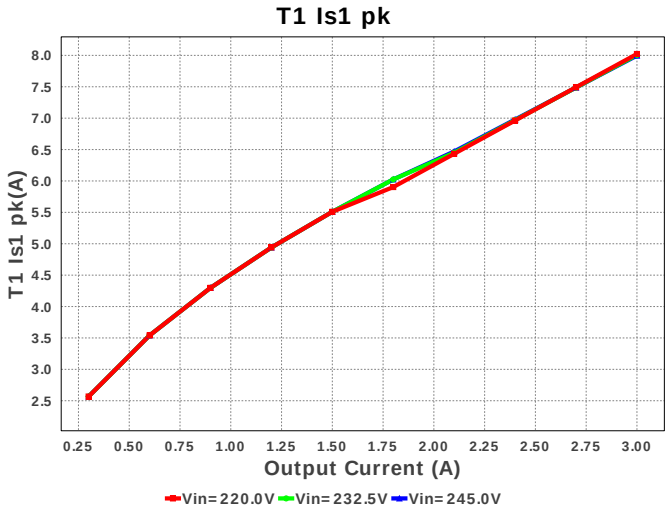


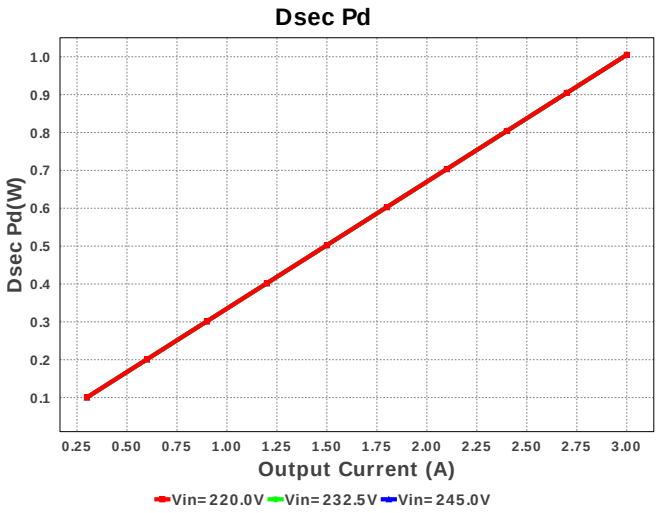


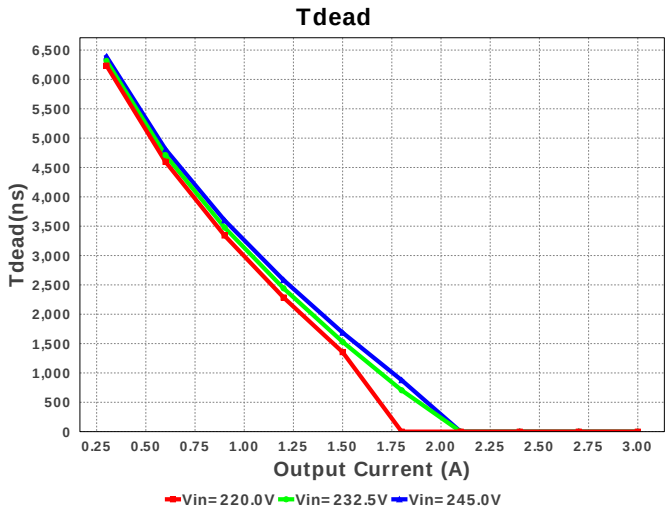


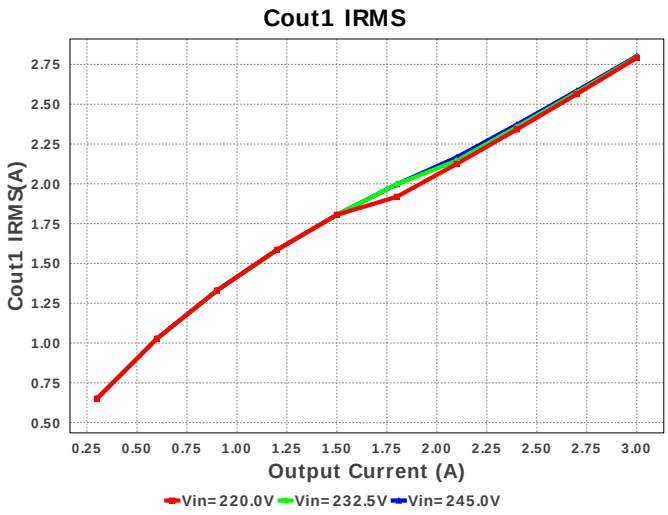


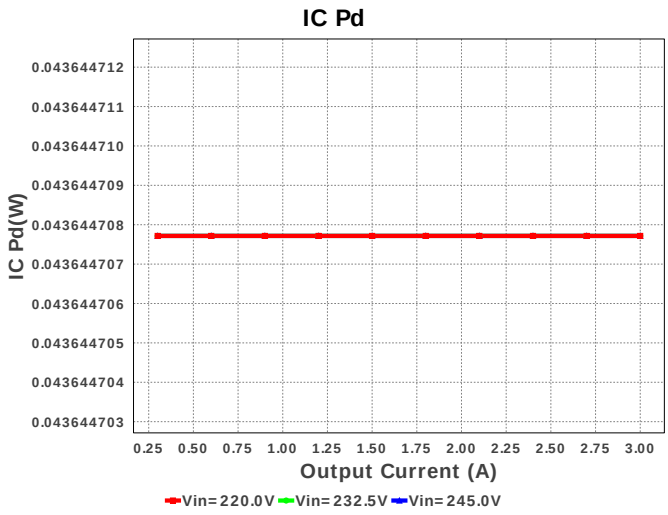


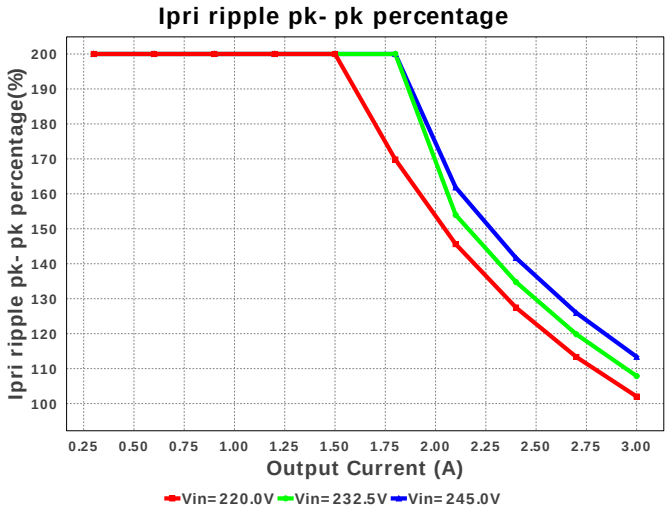


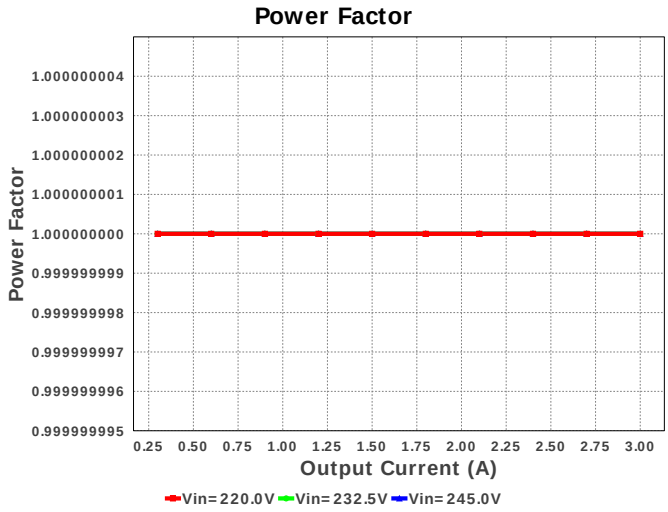


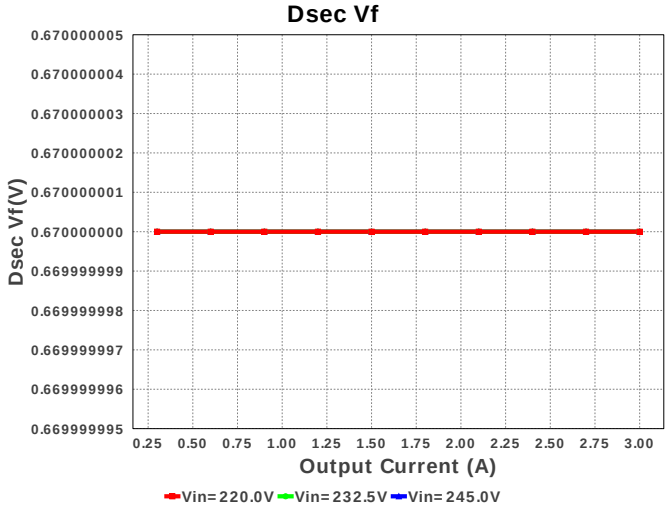


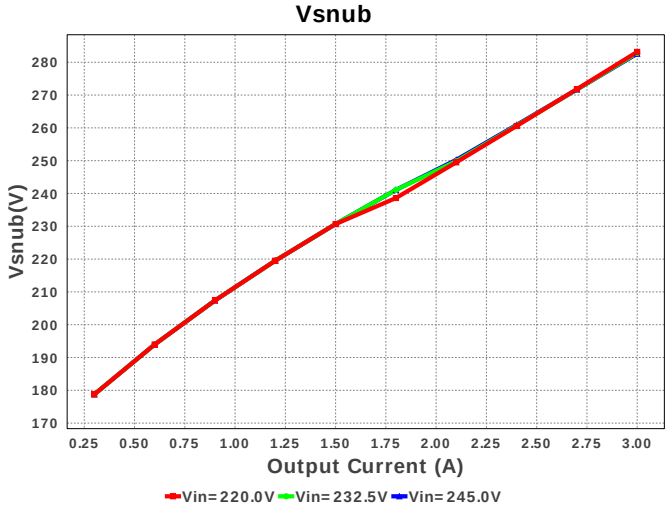


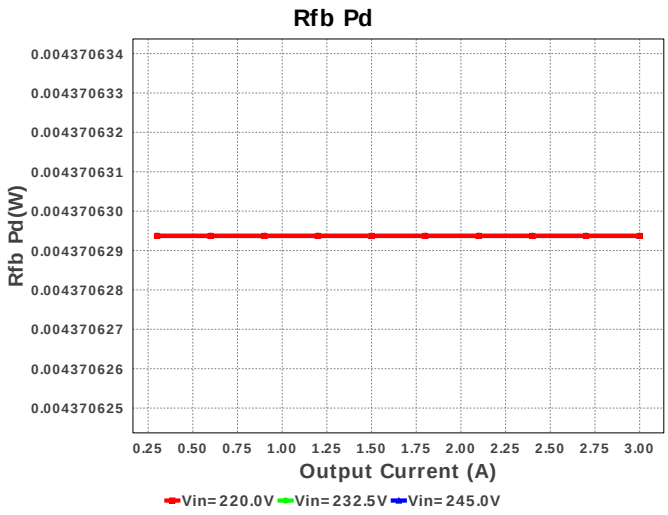


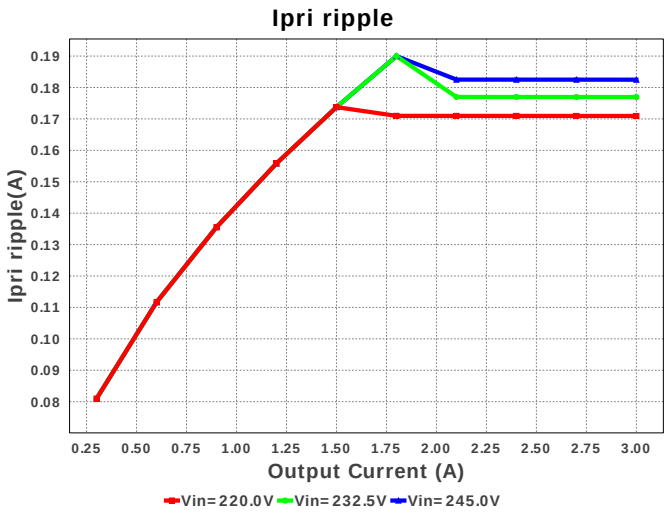


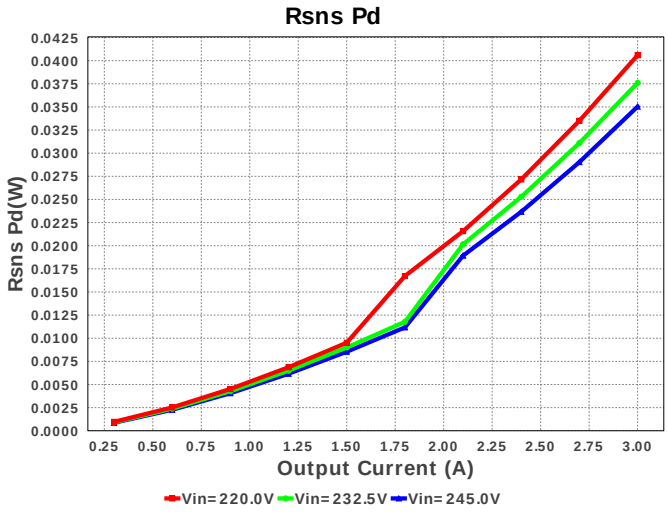


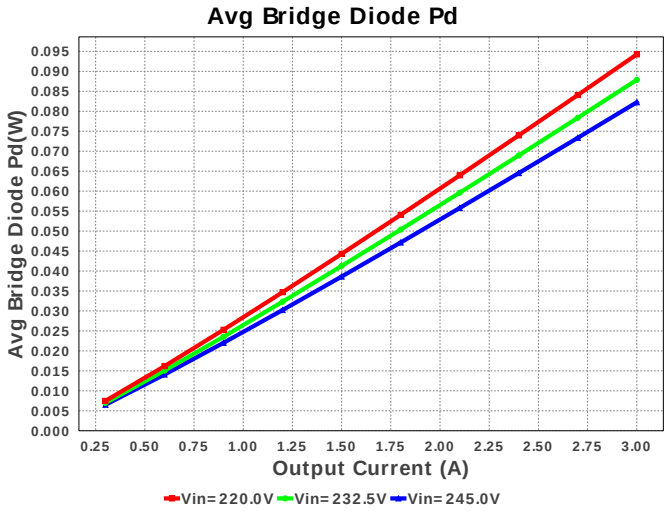


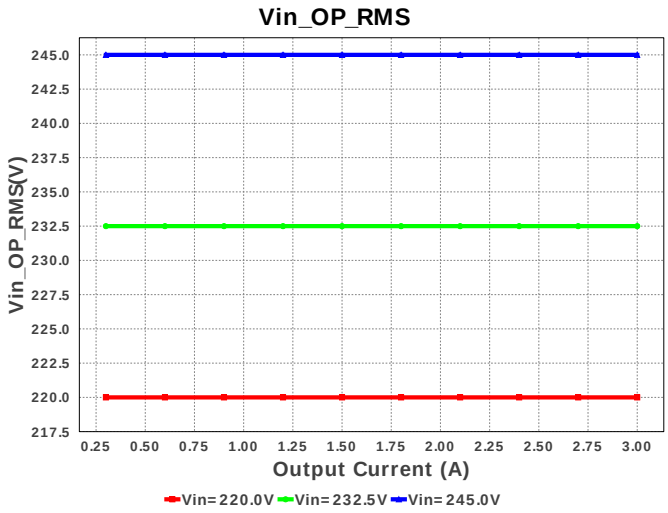


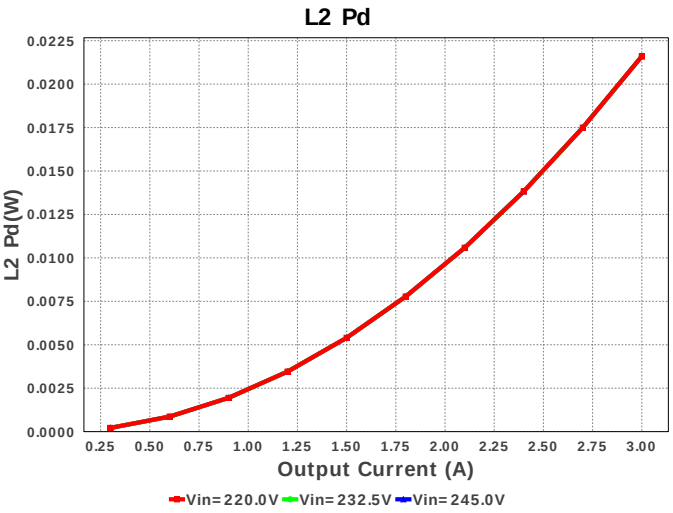


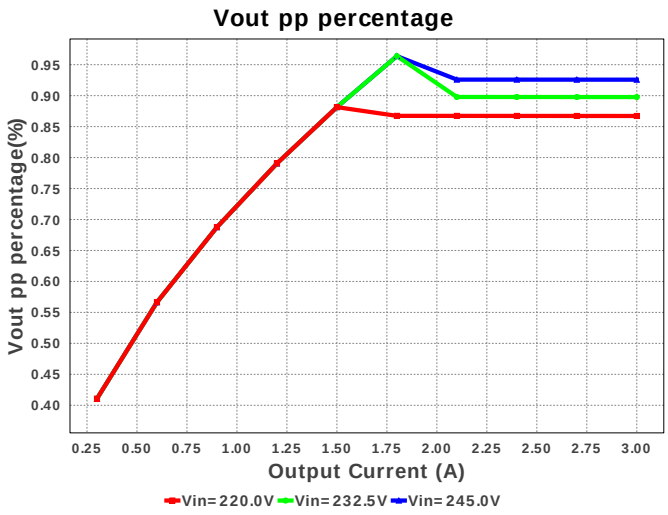


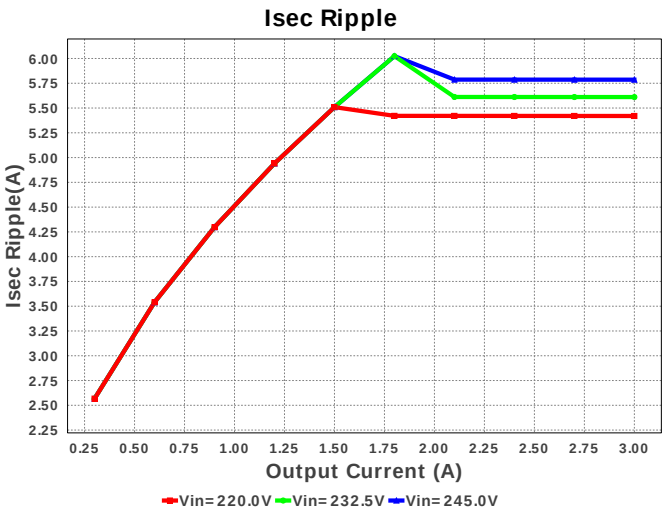


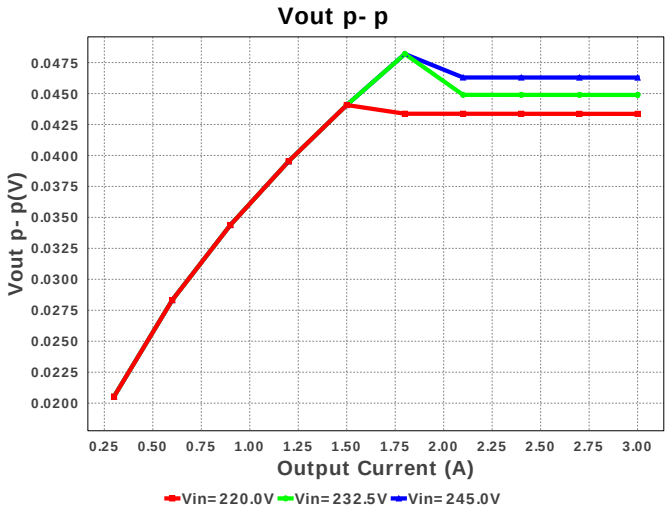


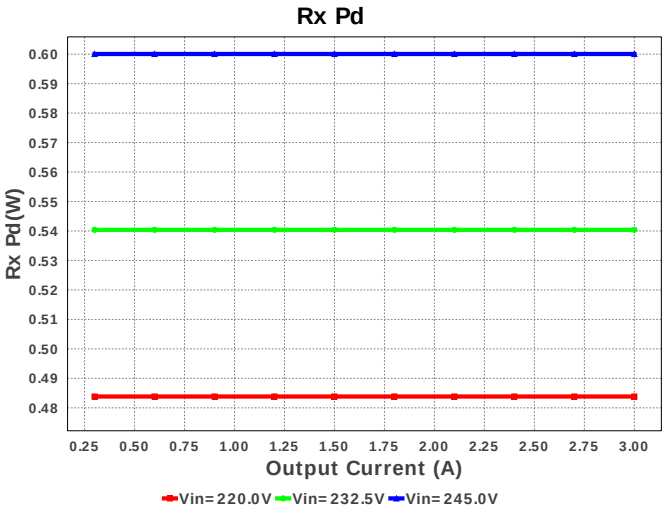


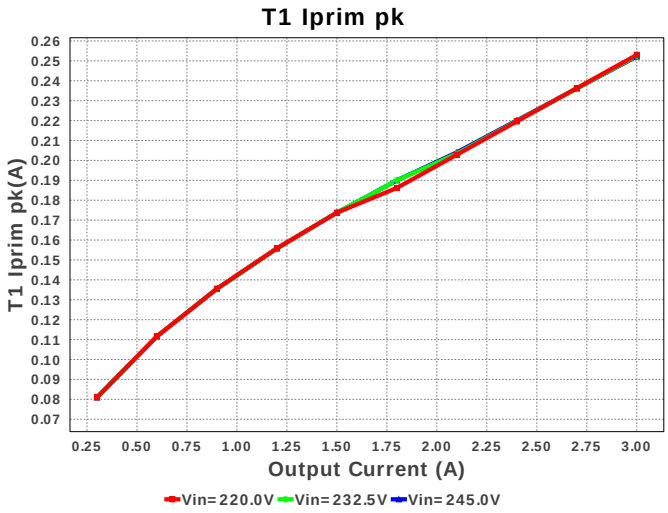












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	2.791 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	82.649 mA	Current	RMS Input Current
3.	Iout_DCM	1.687 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	75.818 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	170.935 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	102.023 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	5.42 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	117.494 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	253.013 mA	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	4.098 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	8.022 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	50.0 Hz	General	Input AC frequency
13.	BOM Count	54	General	Total Design BOM count
14.	Daux trr	4.0 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	423.539 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.096 k mm^2	General	Total Foot Print Area of BOM components
20.	Frequency	98.851 kHz	General	Switching frequency
21.	Mode	CCM	General	Conduction Mode
22.	Pout	15.0 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	5.713 us	General	Approximate Converter Off Time
26.	Ton Act	4.578 us	General	Approximate Converter On Time
27.	Total BOM	$0.0	General	Total BOM Cost
28.	Tsw	10.116 us	General	Switching Time Period
29.	Vaux	10.976 V	General	Auxiliary Voltage
30.	Vsnub	283.168 V	General	Voltage Across the Snubber
31.	Vout Actual	4.995 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
32.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
33.	Duty Cycle	45.252 %	Op_point	Duty cycle
34.	Efficiency	82.496 %	Op_point	Steady state efficiency
35.	IC Tj	32.182 degC	Op_point	IC junction temperature
36.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
37.	IOUT_OP	3.0 A	Op_point	Iout operating point
38.	M1 TjOP	48.618 degC	Op_point	M1 MOSFET junction temperature
39.	Peak Rectified Vin	311.124 V	Op_point	Peak voltage seen at rectified input
40.	Vin_OP_RMS	220.0 V	Op_point	AC Input RMS Voltage
41.	Vout p-p	43.358 mV	Op_point	Peak-to-peak output ripple voltage
42.	Avg Bridge Diode Pd	94.25 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
43.	Cbulk Pd	97.51 mW	Power	Bulk capacitor power dissipation
44.	Cout1 Pd	62.319 mW	Power	Output capacitor1 power dissipation
45.	Cx Pd	0.0 W	Power	X-cap Power Dissipation
46.	Cy Pd	0.0 W	Power	Y-caps Power Dissipation
47.	Dsec Pd	1.005 W	Power	Secondary Diode Power Dissipation
48.	Dsec2 Pd	635.309 mW	Power	Secondary Diode Power Dissipation
49.	IC Pd	43.645 mW	Power	IC power dissipation
50.	L1 Pd	375.386 µW	Power	Power Dissipation in the Inductor
51.	L2 Pd	21.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
52.	M1 Pd	465.445 mW	Power	M1 MOSFET total power dissipation
53.	Paux	19.223 mW	Power	Power Dissipation in Raux and Daux
54.	Pd Rstartup	377.15 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
55.	Rdrv Pd	8.21 µW	Power	Power Dissipation in Gate Drive Resistor
56.	Rfb Pd	4.371 mW	Power	Rfb Power Dissipation
57.	Rsns Pd	40.586 mW	Power	Current Limit Sense Resistor Power Dissipation
58.	Rx Pd	483.845 mW	Power	Total Power Dissipation in Rx1 and Rx2
59.	Snubber Pd	210.565 mW	Power	Snubber Power Dissipation
60.	T1 Pd	312.807 mW	Power	Estimated Losses in Transformer
61.	Total Pd	3.183 W	Power	Total Power Dissipation
62.	Vout Tolerance	1.478 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
63.	Vout pp percentage	867.155 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	245.0	Maximum input voltage
3.	VinMin	220.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	line_fsw	50.0	Light Output in Lumen
6.	base_pn	UCC28C40	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC28C40** Product Folder : http://www.ti.com/product/UCC28C40 : contains the data sheet and other resources.