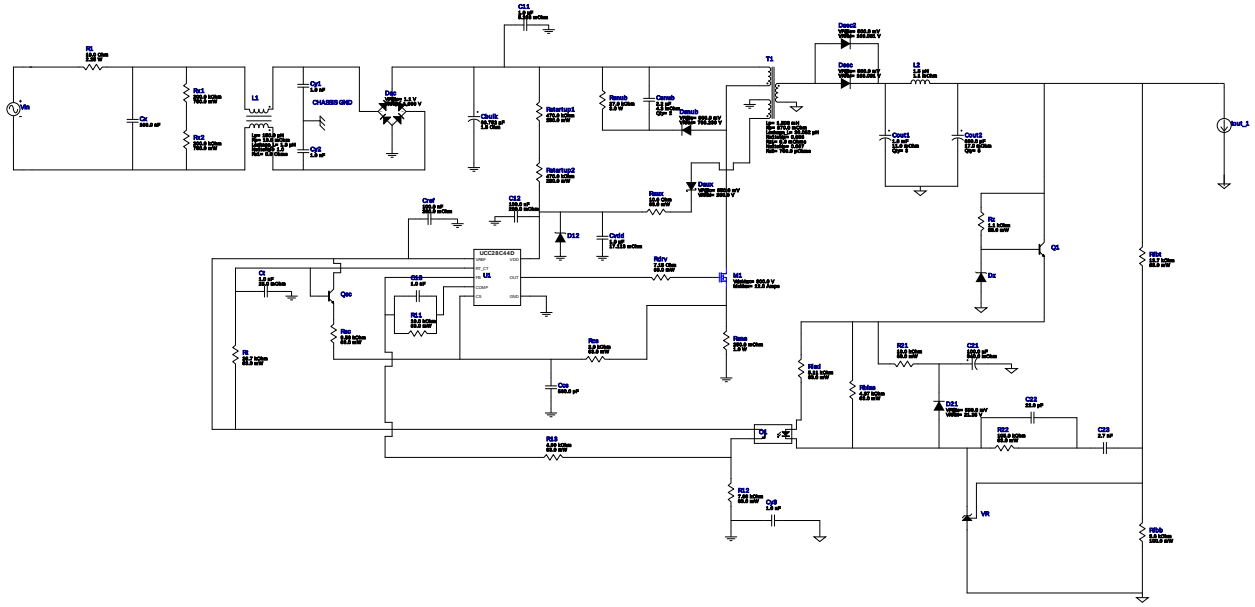
WEBENCH® Design Report

VinMin = 220.0V
VinMax = 240.0V
Vout = 12.0V
Iout = 12.5A

Device = UCC28C44DR
Topology = Flyback
Created = 9/11/16 7:18:26 AM
BOM Cost = $0.00
BOM Count = 64
Total Pd = 15.46W

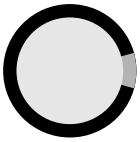
Design : 4790845/1 UCC28C44DR
UCC28C44DR 220.0V-240.0V to 12.00V @ 12.5A

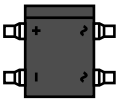
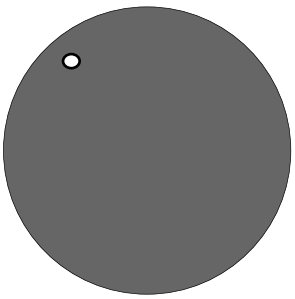
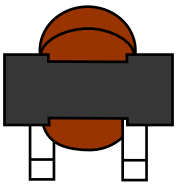


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

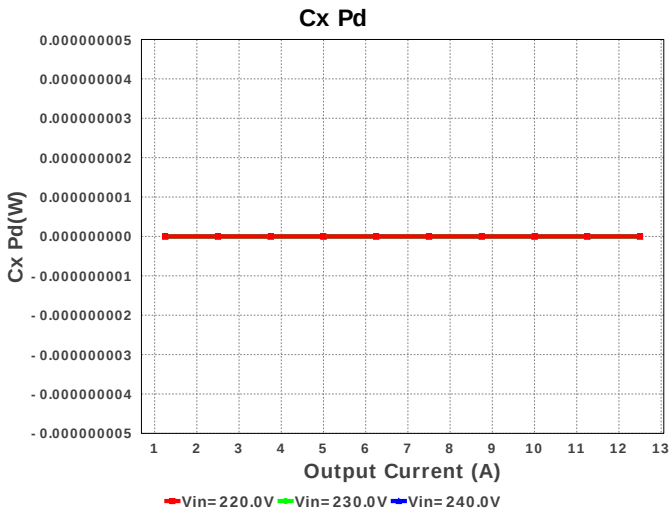
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	$1.19	2220 54 mm^2
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
3.	C13	Samsung 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	Nichicon	UUD1E101MCL1GS Series= uD	Cap= 100.0 uF ESR= 340.0 mOhm VDC= 25.0 V IRMS= 280.0 mA	1	$0.12	SM_RADIAL_6.3BMM 80 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	CC0805KRX7R9BB272 Series= X7R	Cap= 2.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 66.752 uF ESR= 1.5005 Ohm VDC= 407.29 V IRMS= 1.65447 A	1	NA	CUSTOM 0 mm^2
8.	Ccs	Samsung Electro-Mechanics	CL21C561JBANFNC Series= C0G/NP0	Cap= 560.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2

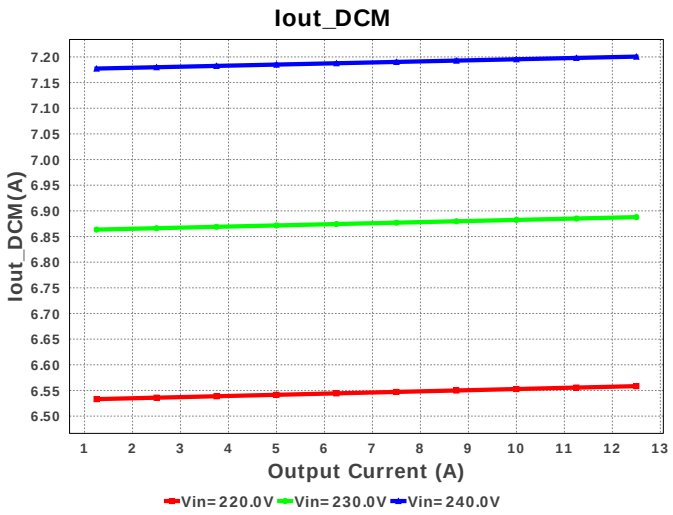
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout1	Nichicon	UHV1V182MHD Series= HV	Cap= 1.8 mF ESR= 11.0 mOhm VDC= 35.0 V IRMS= 3.925 A	3	NA	 CAPPR5-12.5X25 210 mm^2
10.	Cout2	Nichicon	UHV1V681MPD Series= HV	Cap= 680.0 uF ESR= 17.0 mOhm VDC= 35.0 V IRMS= 2.475 A	5	NA	CAPPR7 144 mm^2
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.	Csnub	TDK	C5750X6S2W225K Series= X6S	Cap= 2.2 uF ESR= 4.3 mOhm VDC= 400.0 V IRMS= 0.0 A	2	NA	 2220 54 mm^2
13.	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
14.	Cvdd	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	 0603 5 mm^2
15.	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
16.	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
17.	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

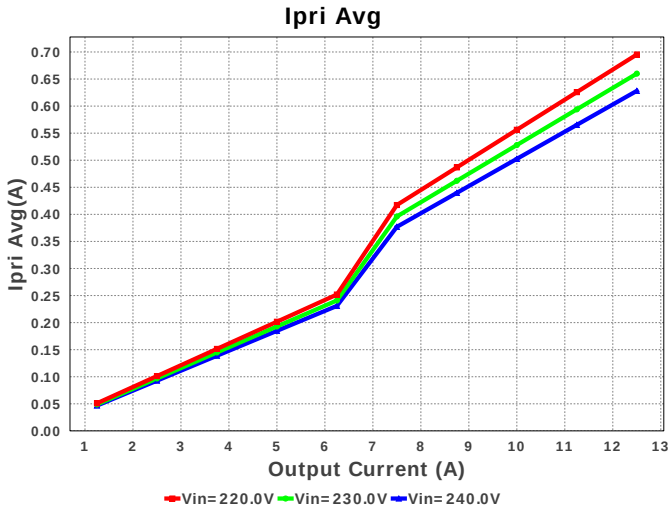
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
18.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	$0.22	 B81123_1800x500x1050 140 mm²
19.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	$0.04	 SOD-123 13 mm²
20.	D21	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 21.25 V	1	NA	CUSTOM 0 mm²
21.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
22.	Daux	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	$0.21	 PowerDI123 13 mm²
23.	Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 103.081 V	1	NA	CUSTOM 0 mm²
24.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 103.081 V	1	NA	CUSTOM 0 mm²
25.	Dsnub	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 708.239 V	1	NA	CUSTOM 0 mm²
26.	Dz	ON Semiconductor	BZX84C9V1LT1G	Zener	1	$0.02	 SOT-23 14 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	$6.32	 CM6296 833 mm²
28.	L2	Coilcraft	SER1590-152MLB	L= 1.5 µH DCR= 1.1 mOhm	1	$1.12	 SER1590 324 mm²
29.	M1	STMicroelectronics	STW13N80K5	VdsMax= 800.0 V IdsMax= 12.0 Amps	1	$2.00	 TO-247 123 mm²
30.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	$0.21	 SOP-4 44 mm²
31.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	$0.02	 SOT-23 14 mm²

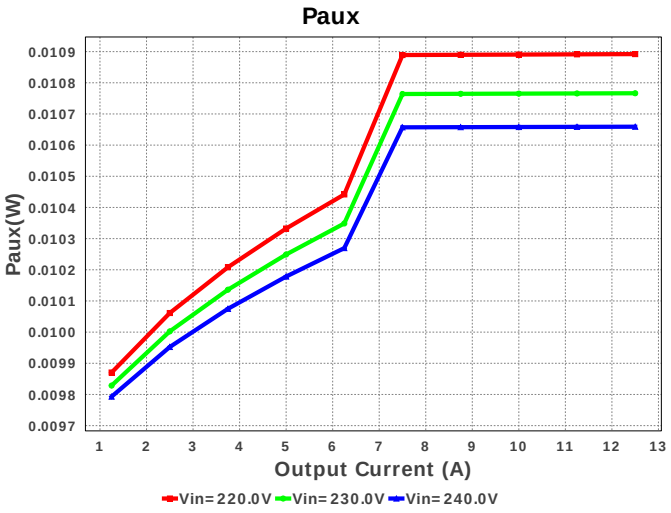
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
32.	Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	NA	 TO-18 57 mm²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	$0.30	 AC03 158 mm²
34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
35.	R12	Vishay-Dale	CRCW04027K68FKED Series= CRCW..e3	Res= 7.68 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	CRCW0402105KFKED Series= CRCW..e3	Res= 105.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
39.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
40.	Rbias	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 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-073K6L Series= ?	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
44.	Rfbt	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
45.	Rled	Vishay-Dale	CRCW04025K11FKED Series= CRCW..e3	Res= 5.11 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
47.	Rsns	Stackpole Electronics Inc	CSRN2010FKR250 Series= ?	Res= 250.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.11	 2010 32 mm²
48.	Rsnub	Vishay-Bccomponents	PR03000202702JAC00 Series= ?	Res= 27.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	$0.19	 PR03 0 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	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

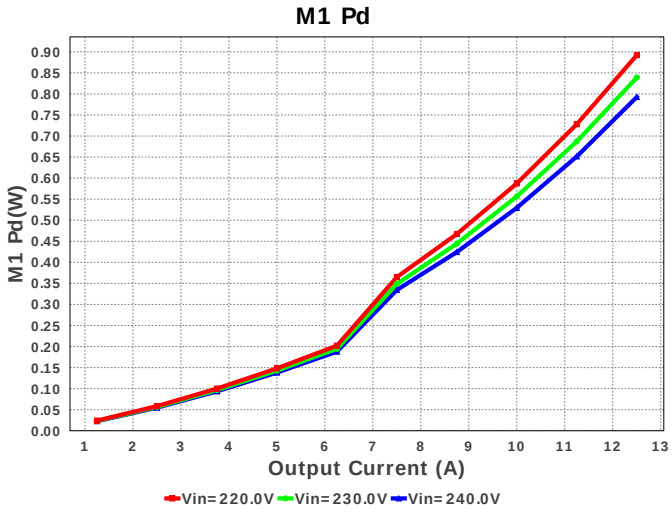
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
52.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.03	 2010 32 mm^2
53.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.03	 2010 32 mm^2
54.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
55.	T1	CUSTOM	CUSTOM	Lp= 1.503 mH Rp= 870.0 mOhm Leakage_L= 30.052 µH Ns1toNp= 0.086 Rs1= 8.6 mOhms Ns2toNp= 0.097 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	TL431AIDBZR	Voltage References	1	$0.08	 DBZ0003A 14 mm^2

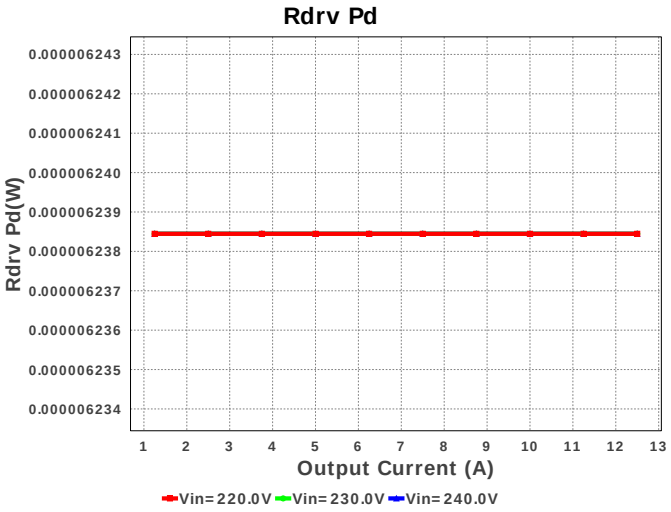


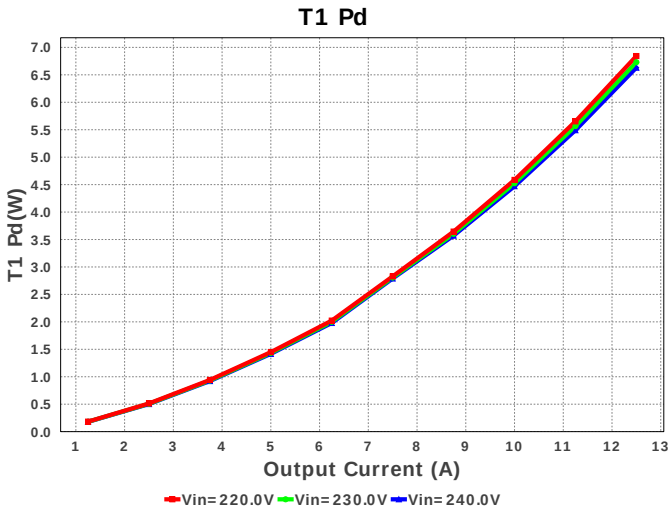


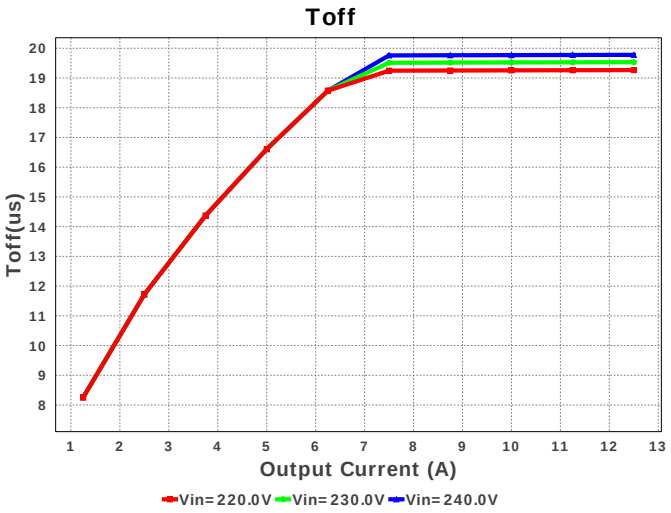


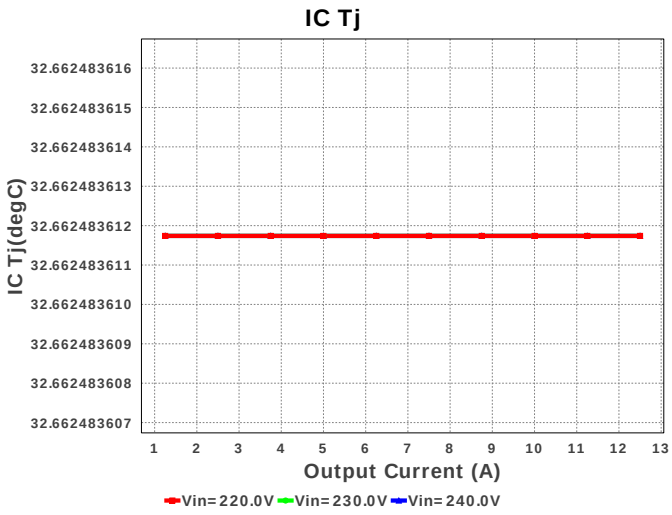


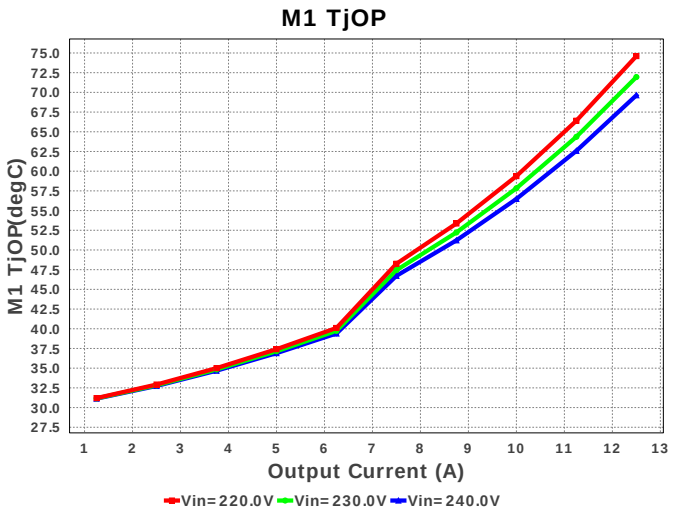


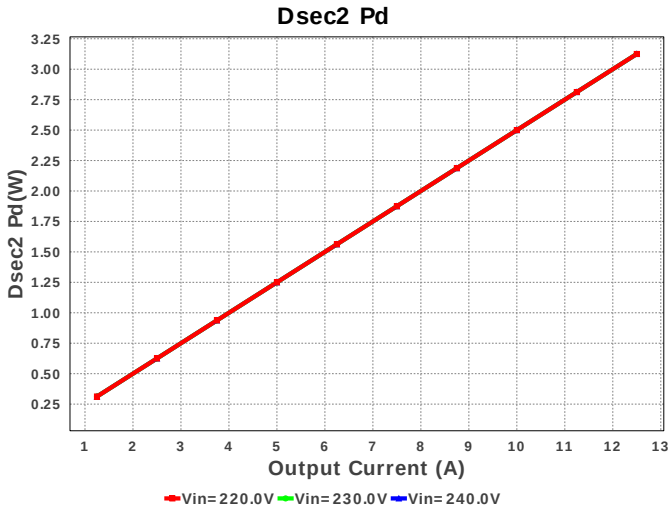


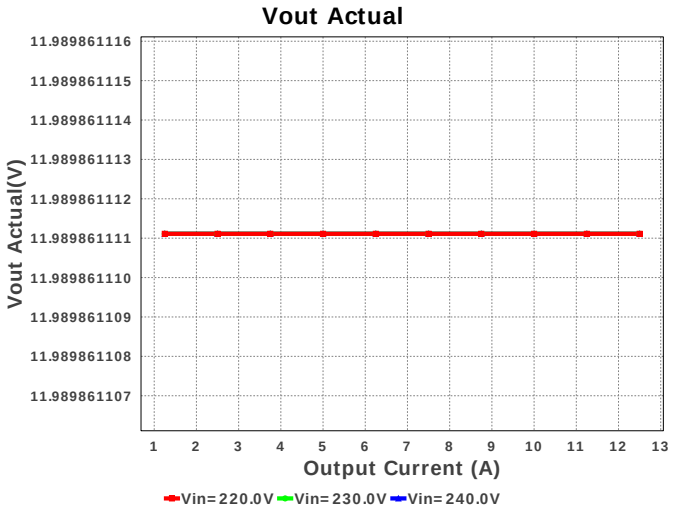


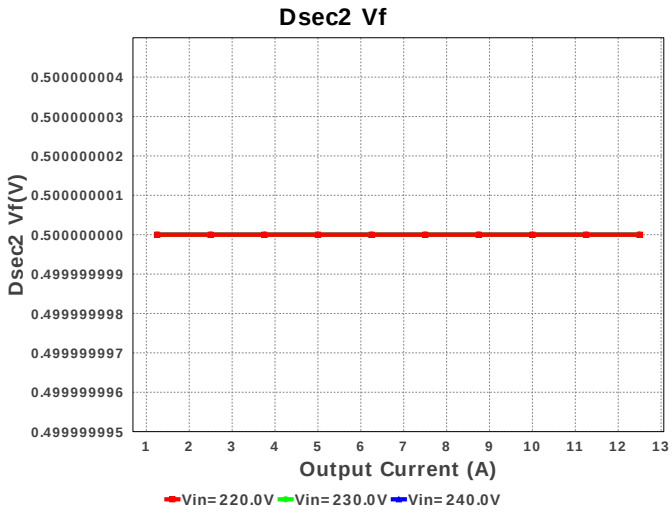


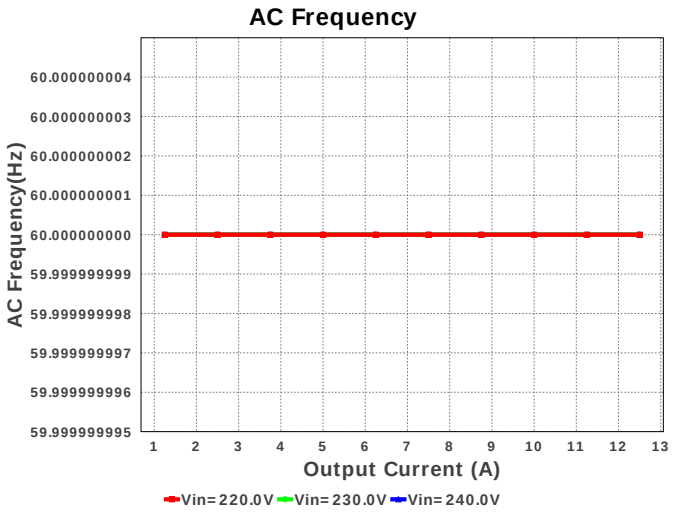


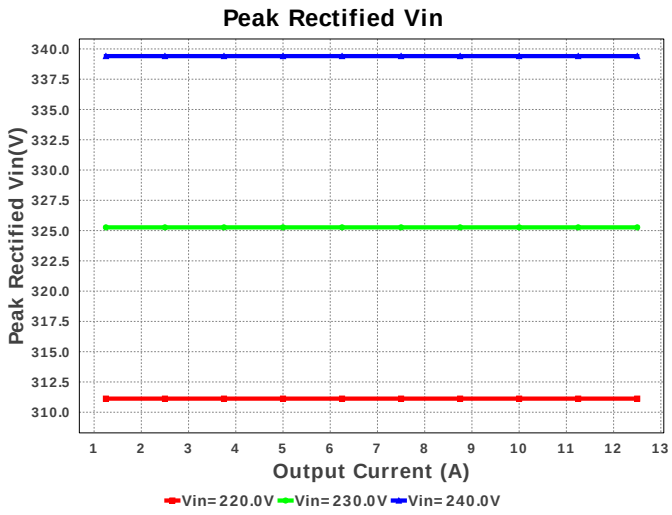


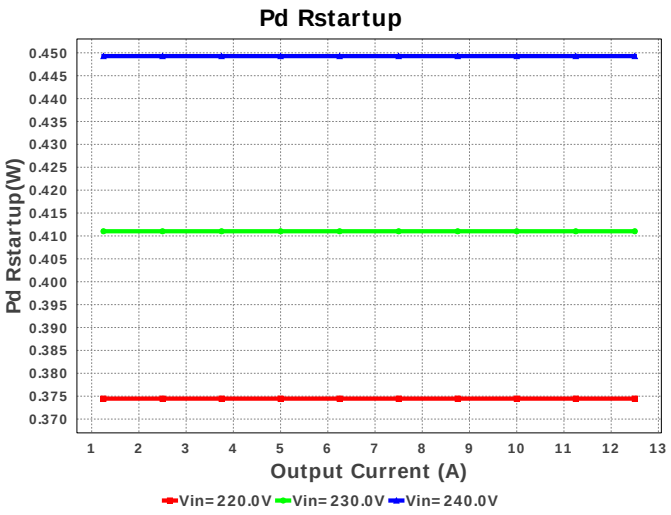


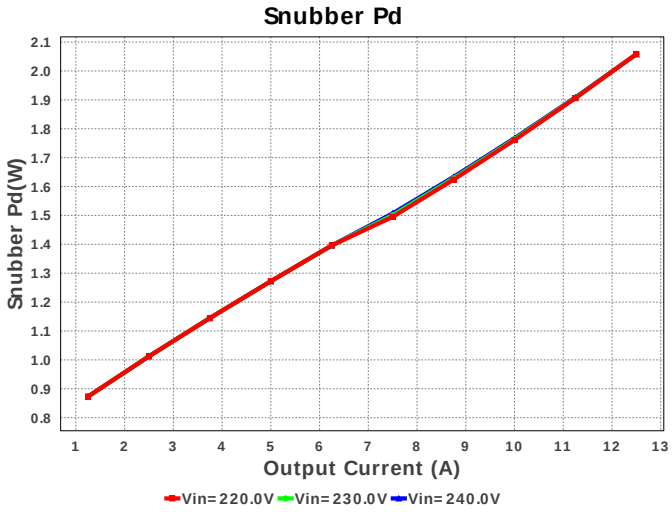


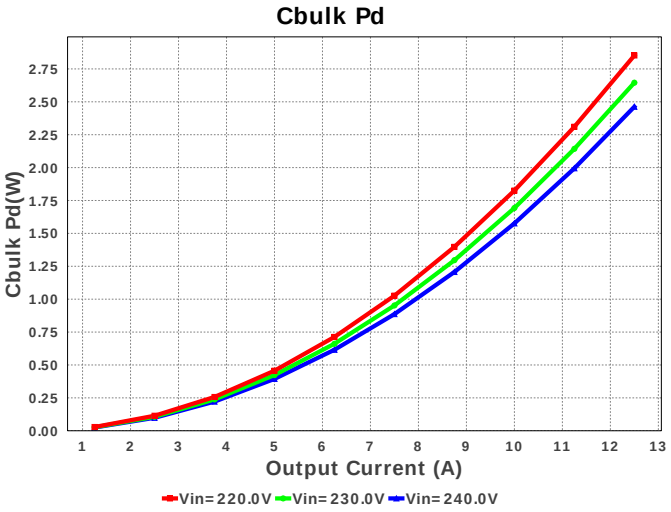


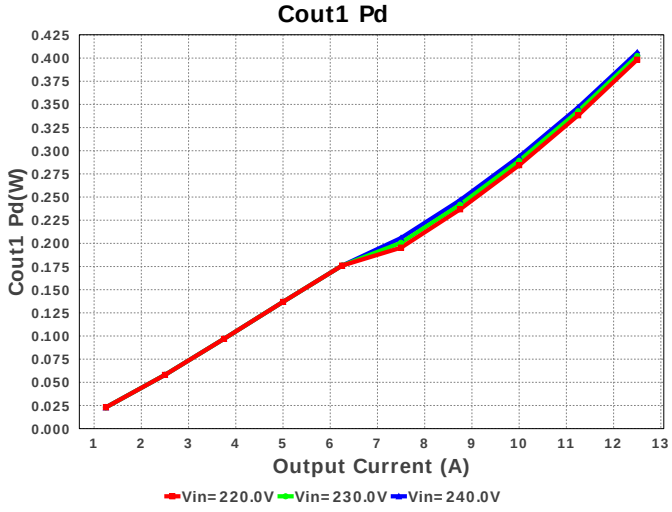


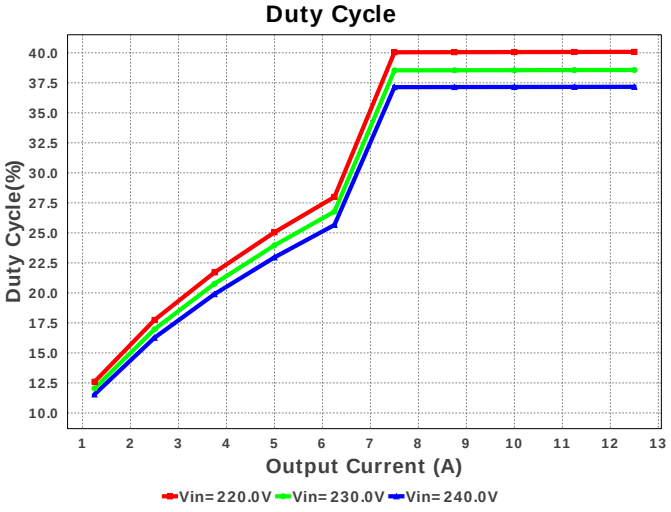


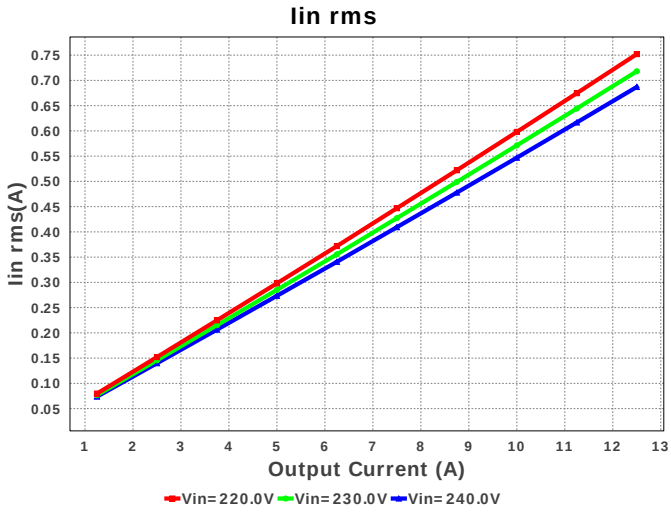


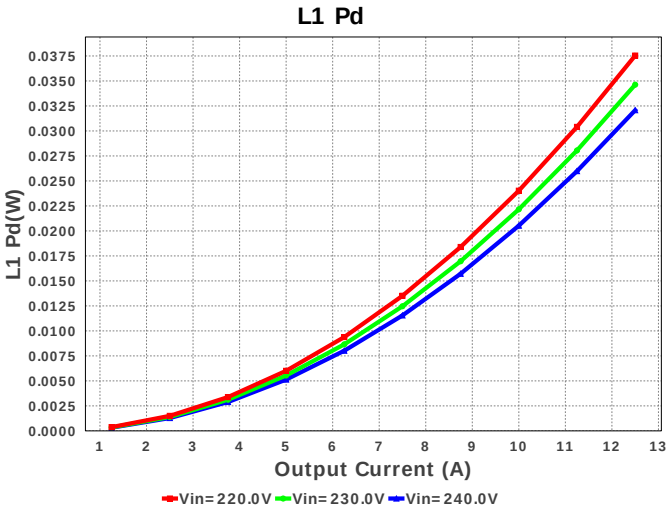


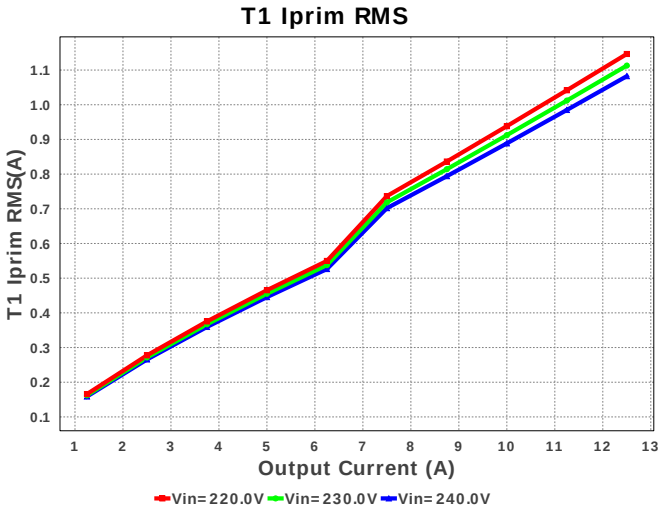


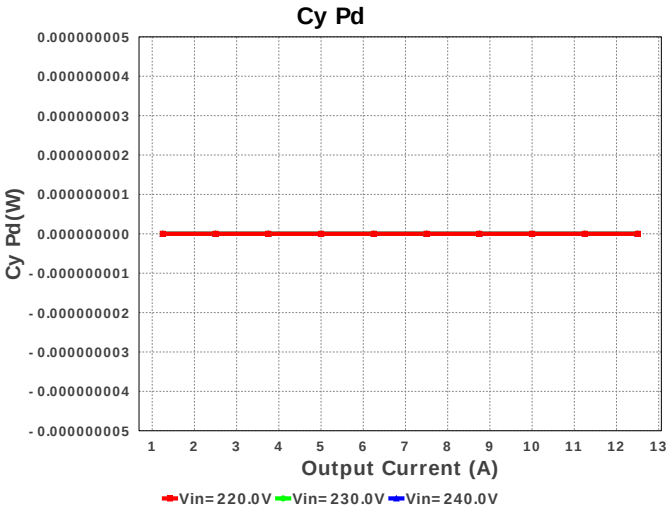


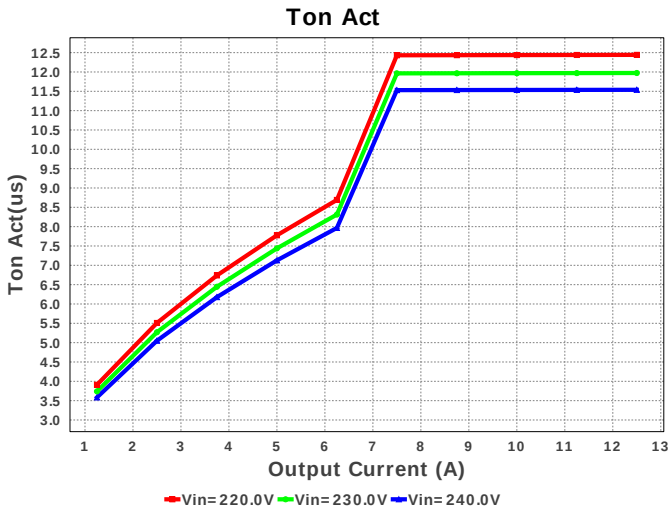


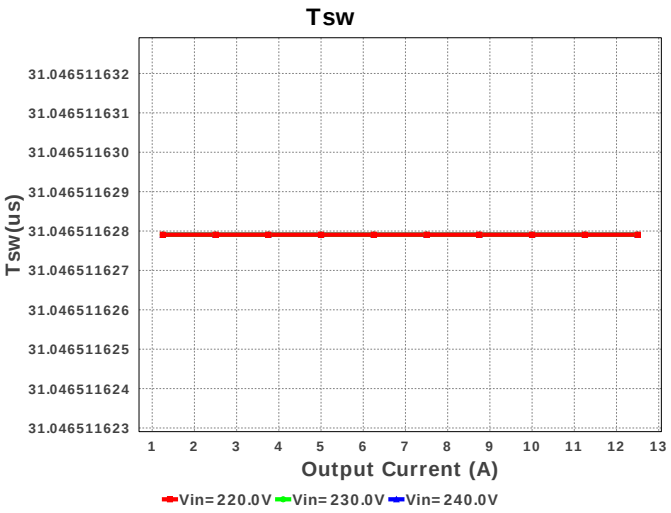


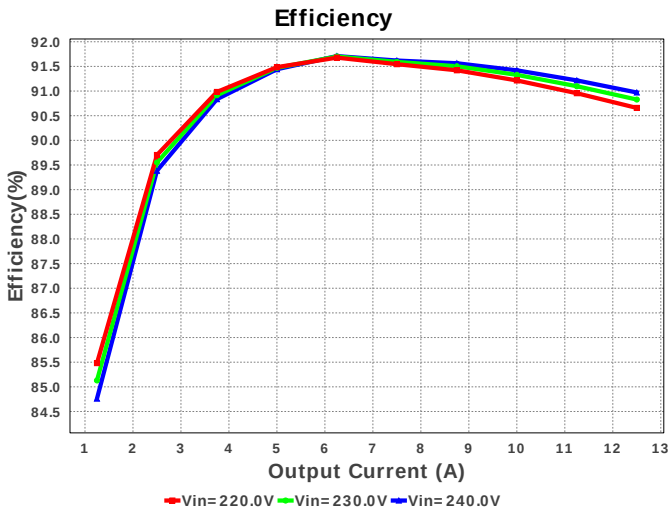


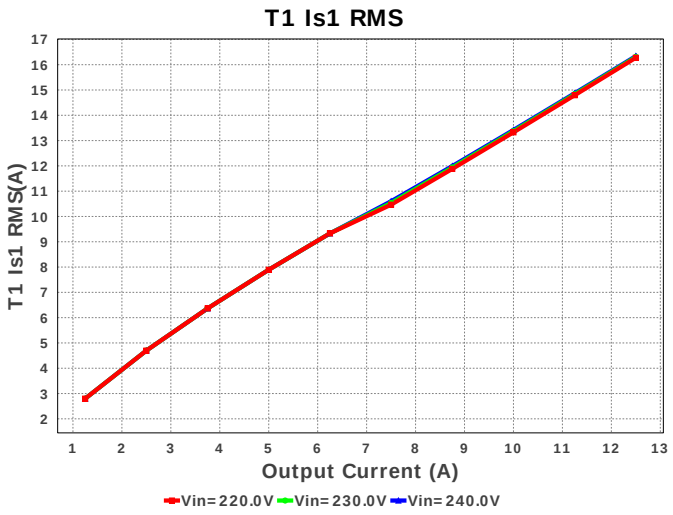


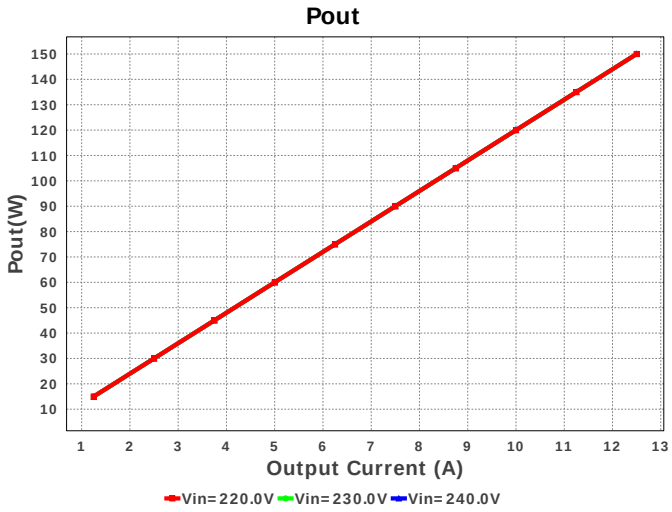


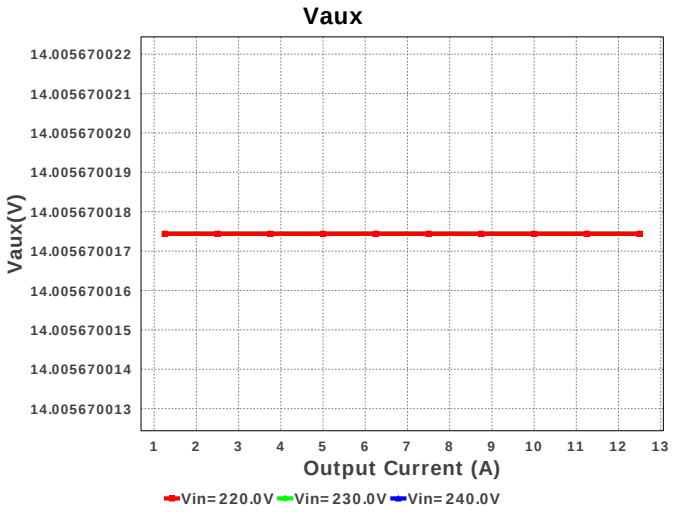


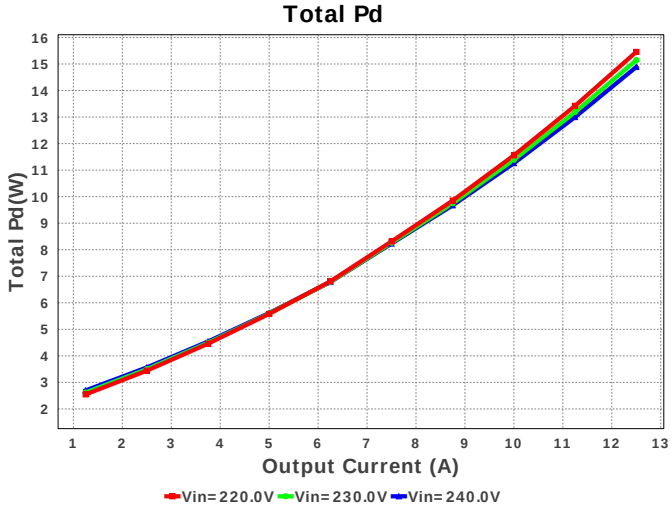


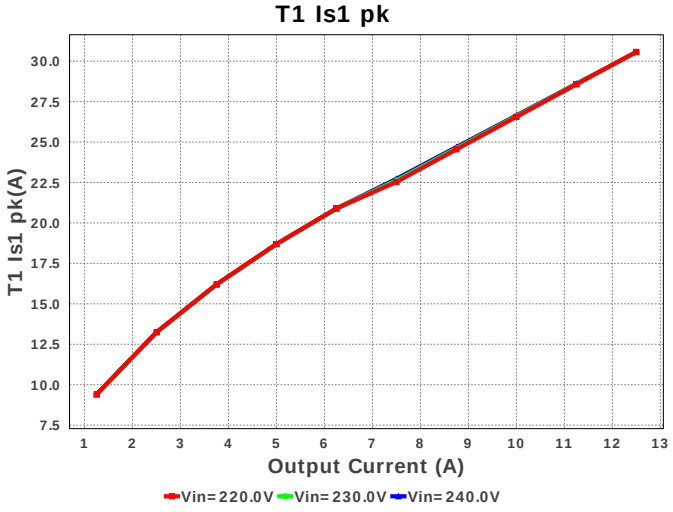


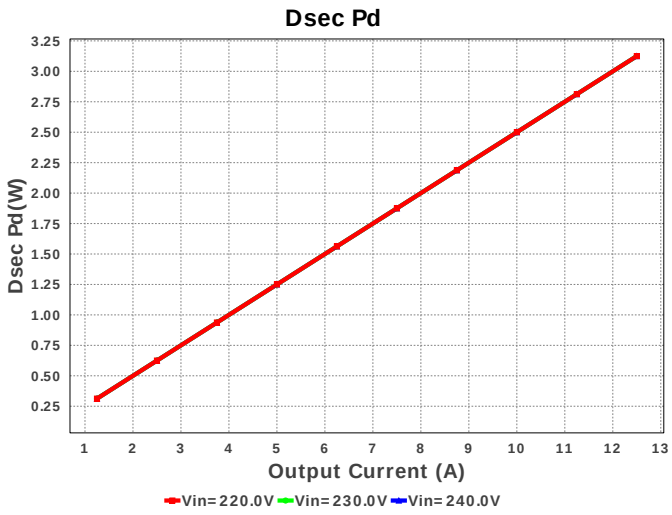


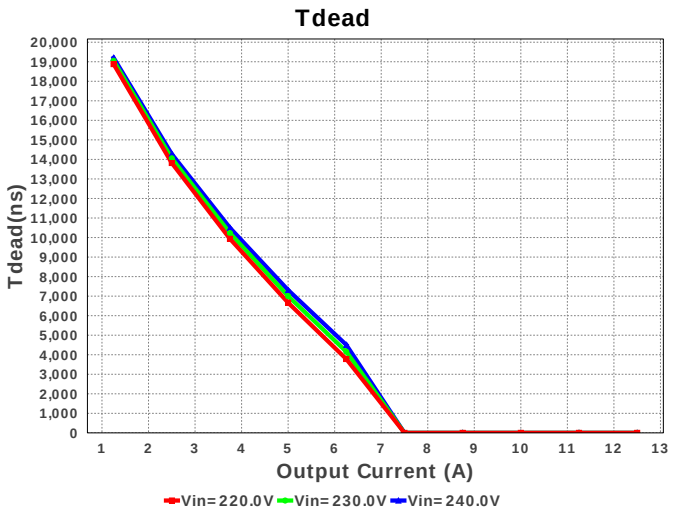


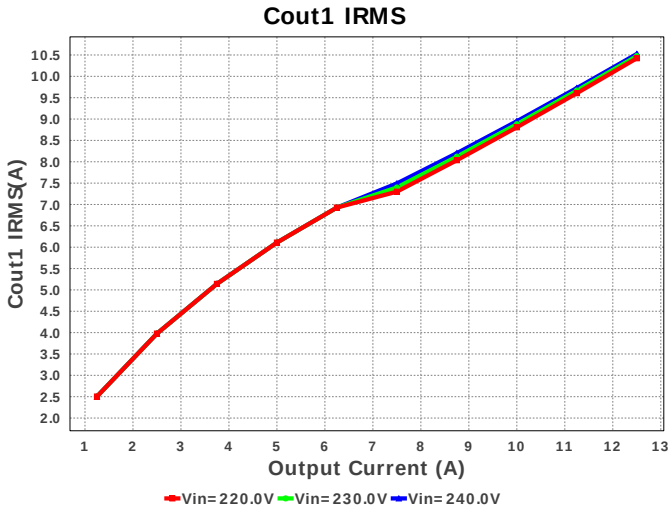


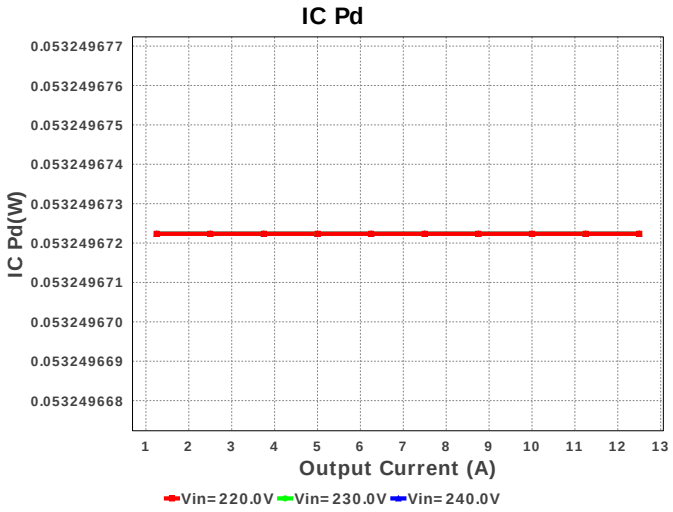


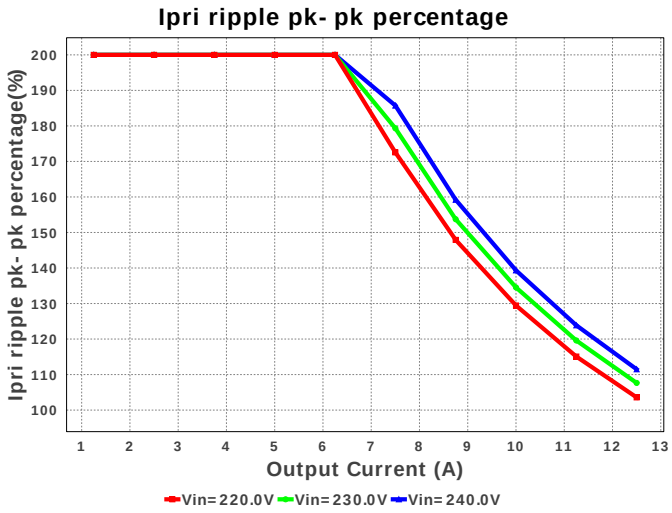


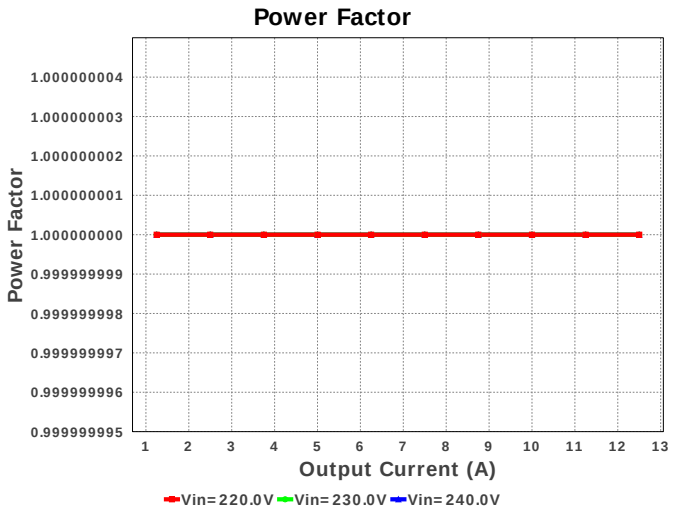


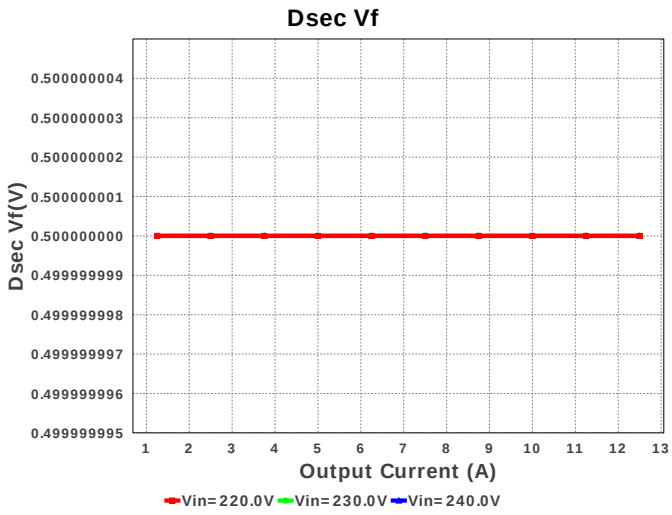


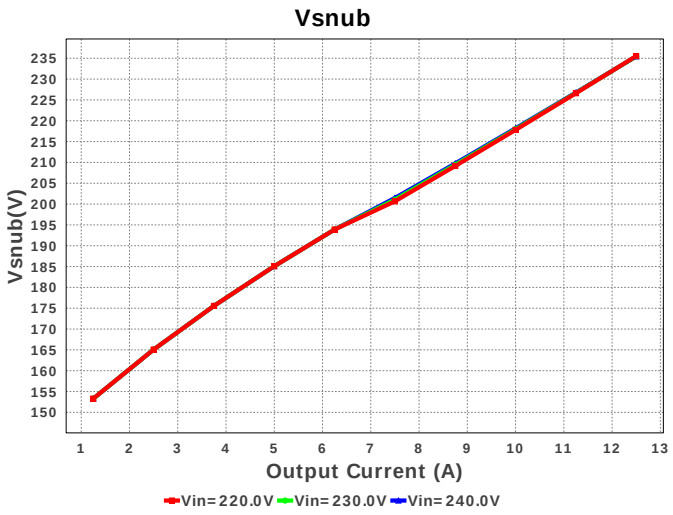


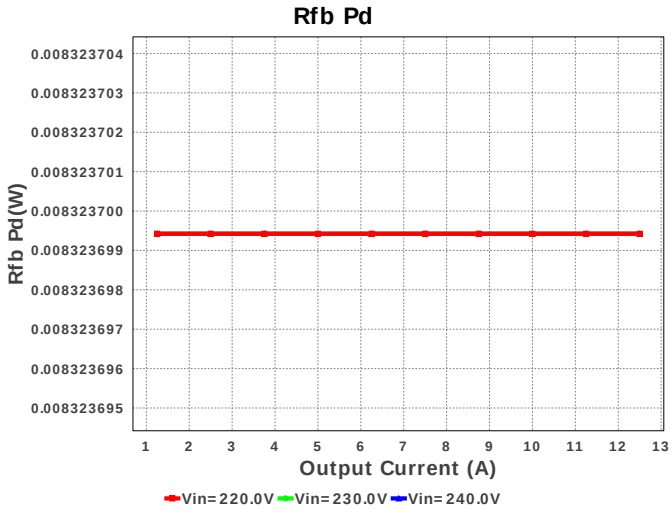


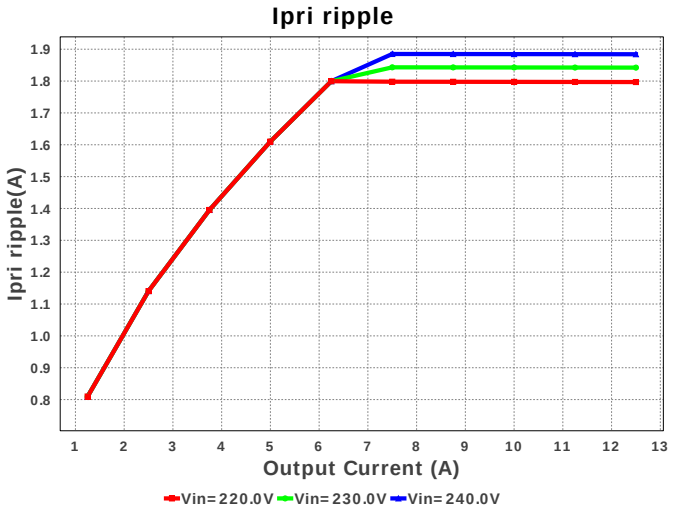


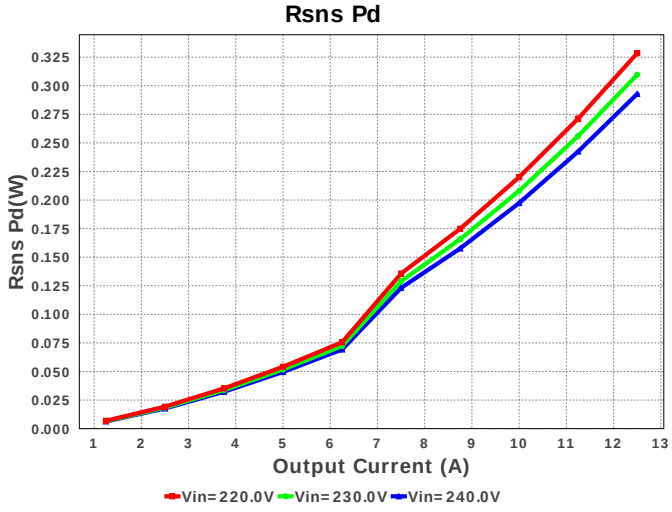


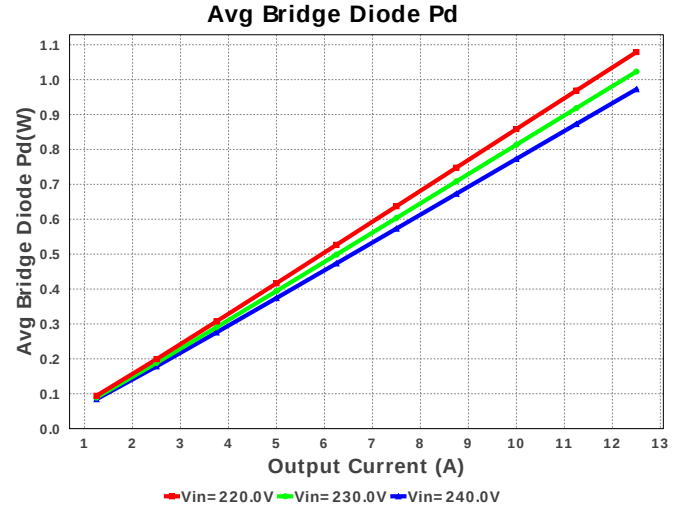


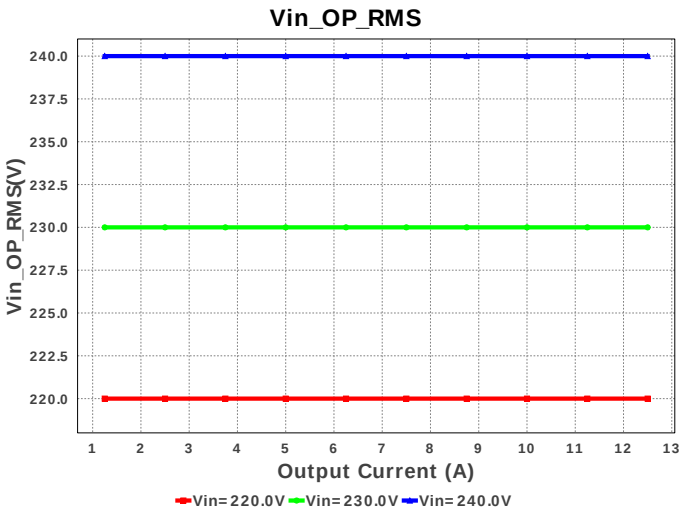


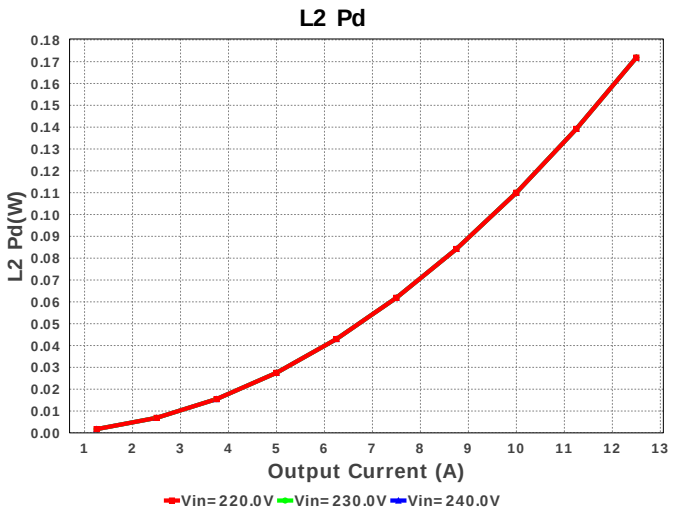


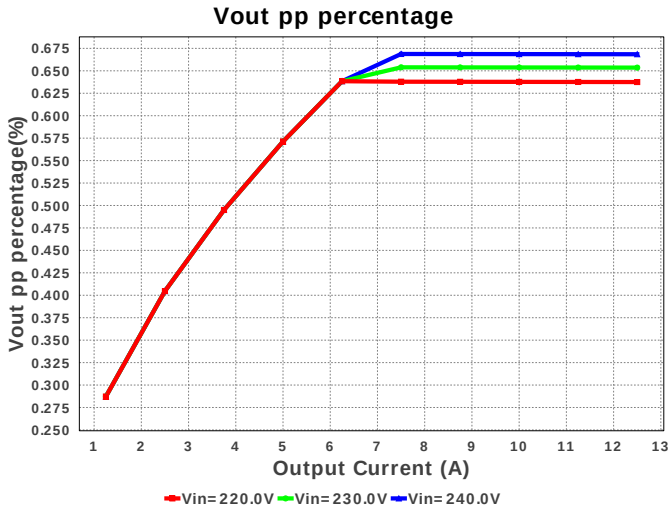


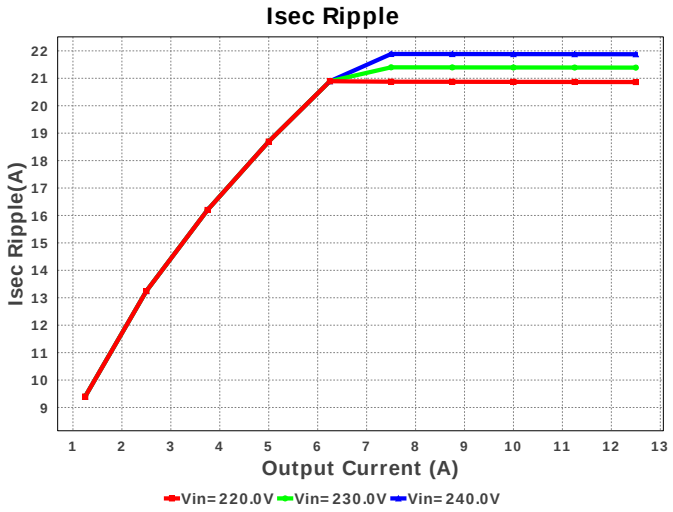


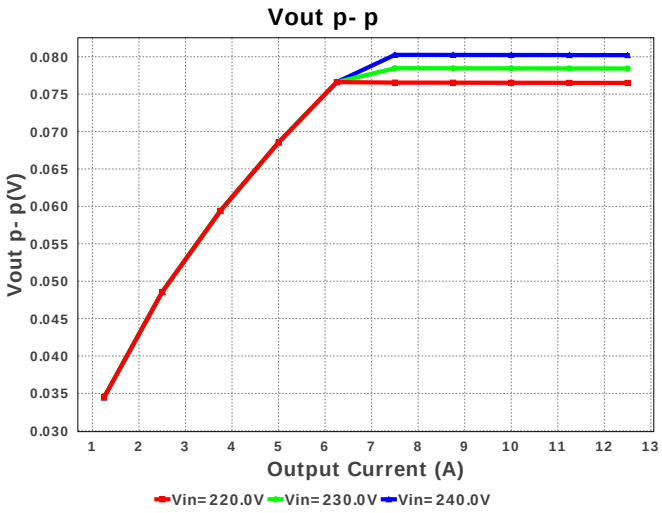


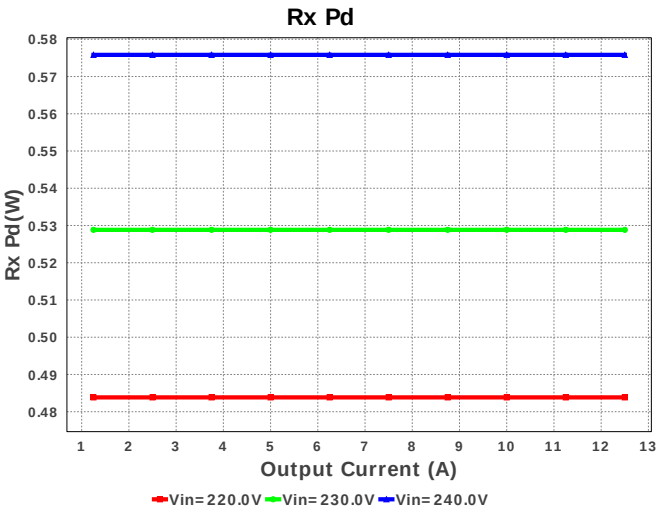


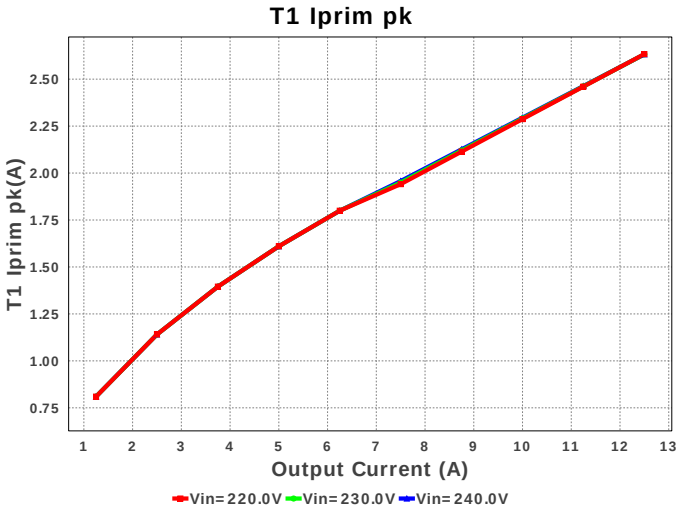












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	10.423 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	752.08 mA	Current	RMS Input Current
3.	Iout_DCM	6.558 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	695.289 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.797 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	103.575 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	20.864 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.146 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	2.633 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	16.275 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	30.575 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	64	General	Total Design BOM count
14.	Daux trr	0.0 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	0.0 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	0.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	4.348 k mm^2	General	Total Foot Print Area of BOM components
20.	Frequency	32.21 kHz	General	Switching frequency
21.	Mode	CCM	General	Conduction Mode
22.	Pout	150.0 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	19.266 us	General	Approximate Converter Off Time
26.	Ton Act	12.442 us	General	Approximate Converter On Time
27.	Total BOM	$0.0	General	Total BOM Cost
28.	Tsw	31.047 us	General	Switching Time Period
29.	Vaux	14.006 V	General	Auxiliary Voltage
30.	Vsnub	235.52 V	General	Voltage Across the Snubber
31.	Vout Actual	11.99 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
32.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
33.	Duty Cycle	40.077 %	Op_point	Duty cycle
34.	Efficiency	90.658 %	Op_point	Steady state efficiency
35.	IC Tj	32.662 degC	Op_point	IC junction temperature
36.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
37.	IOUT_OP	12.5 A	Op_point	Iout operating point
38.	M1 TjOP	74.604 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	76.5 mV	Op_point	Peak-to-peak output ripple voltage
42.	Avg Bridge Diode Pd	1.079 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
43.	Cbulk Pd	2.852 W	Power	Bulk capacitor power dissipation
44.	Cout1 Pd	398.318 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	3.125 W	Power	Secondary Diode Power Dissipation
48.	Dsec2 Pd	3.125 W	Power	Secondary Diode Power Dissipation
49.	IC Pd	53.25 mW	Power	IC power dissipation
50.	L1 Pd	37.539 mW	Power	Power Dissipation in the Inductor

#	Name	Value	Category	Description
51.	L2 Pd	171.875 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
52.	M1 Pd	892.077 mW	Power	M1 MOSFET total power dissipation
53.	Paux	10.892 mW	Power	Power Dissipation in Raux and Daux
54.	Pd Rstartup	374.469 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
55.	Rdrv Pd	6.238 µW	Power	Power Dissipation in Gate Drive Resistor
56.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
57.	Rsns Pd	328.525 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	2.059 W	Power	Snubber Power Dissipation
60.	T1 Pd	6.843 W	Power	Estimated Losses in Transformer
61.	Total Pd	15.457 W	Power	Total Power Dissipation
62.	Vout Tolerance	1.926 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
63.	Vout pp percentage	637.502 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	12.5	Maximum Output Current
2.	VinMax	240.0	Maximum input voltage
3.	VinMin	220.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	acFrequency	60.0	Light Output in Lumen
6.	base_pn	UCC28C44	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

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