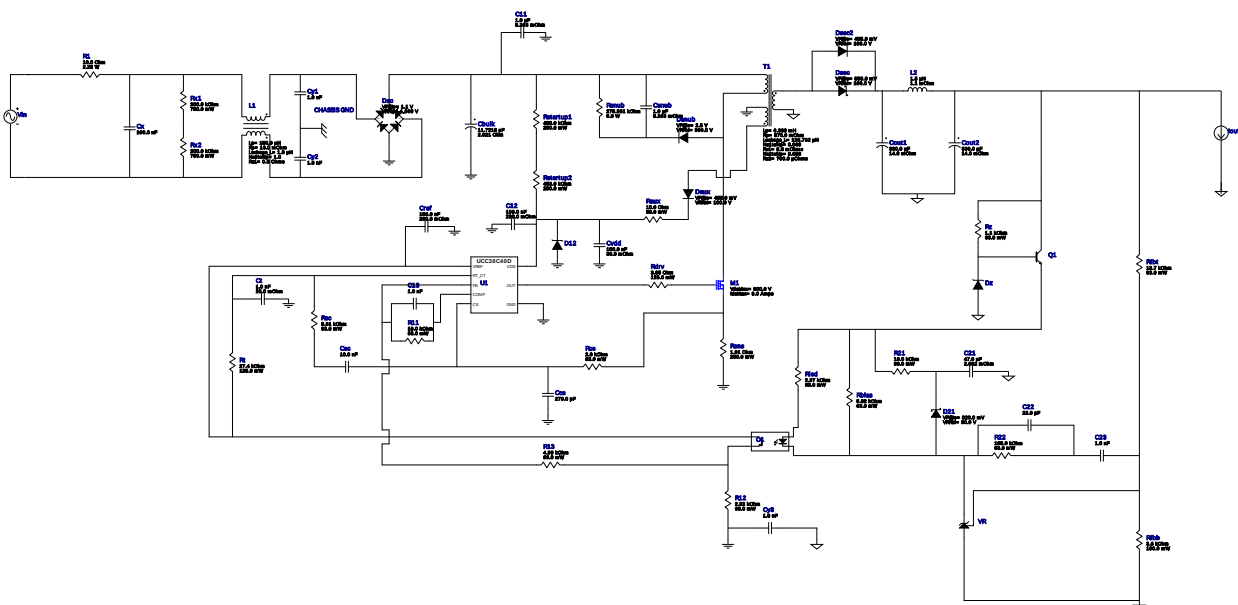


WEBENCH® Design Report

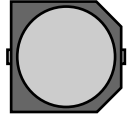
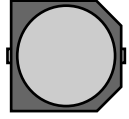
Design : 1194016/2072 UCC38C40DR
UCC38C40DR 210.0V-240.0V to 12.00V @ 2.0A

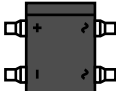
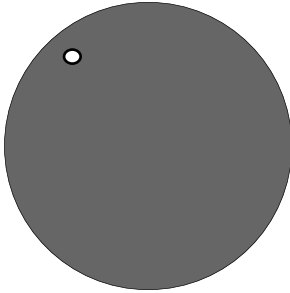
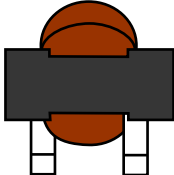


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

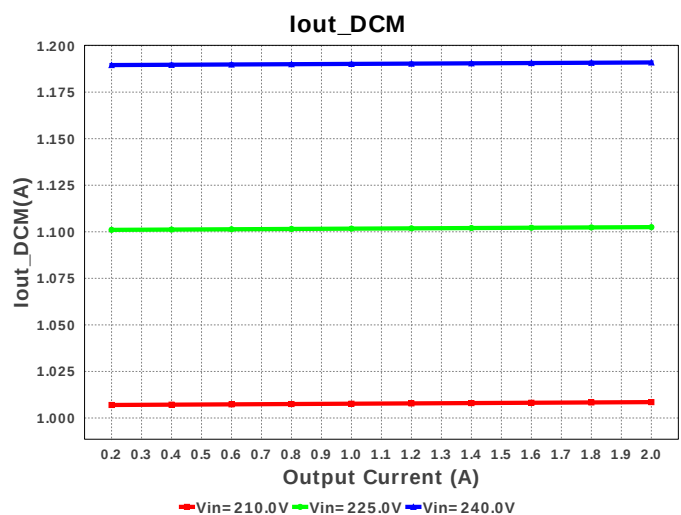
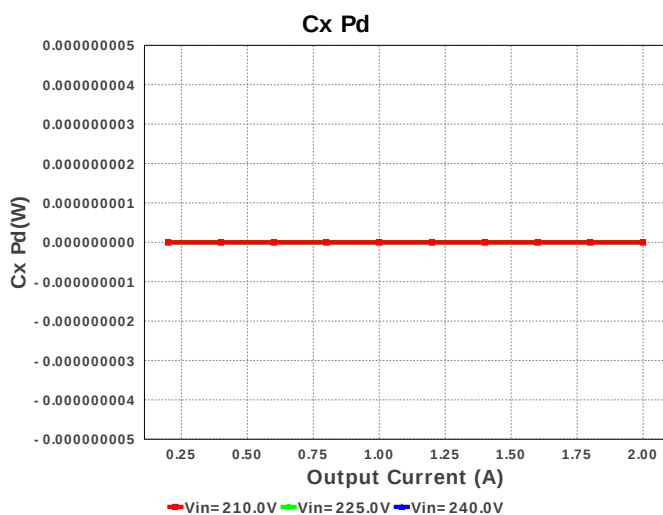
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
4.	C21	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	1	\$0.35	 1206 11 mm ²
5.	C22	Kemet	C0805C220K3GACTU Series= C0G/NP0	Cap= 22.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
6.	C23	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 11.7216 uF ESR= 2.92145 Ohm VDC= 407.29 V IRMS= 277.32 mA	1	NA	CUSTOM 0 mm ²
8.	Ccs	Yageo America	CC0805KRX7R9BB271 Series= X7R	Cap= 270.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

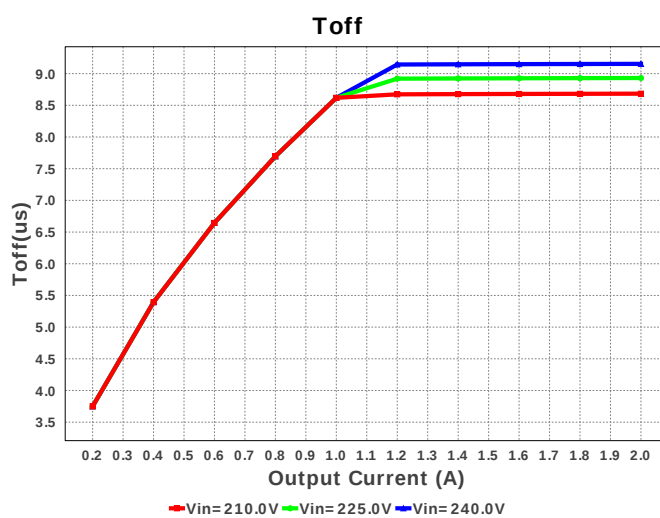
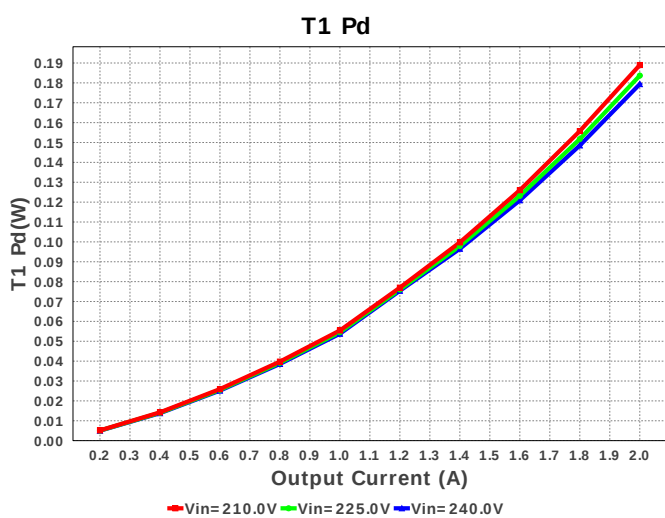
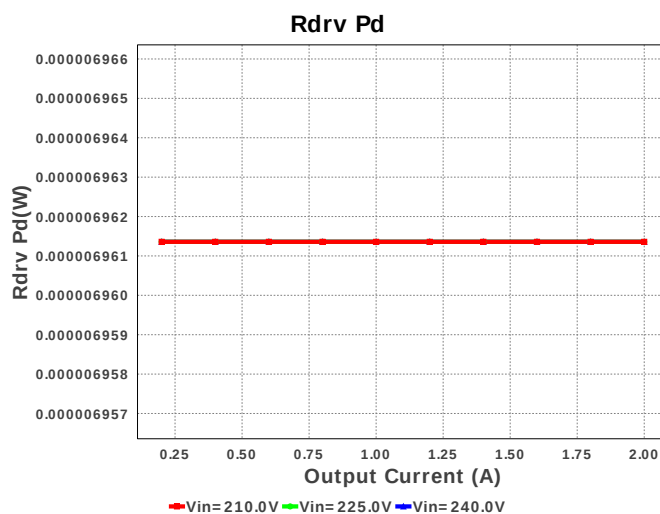
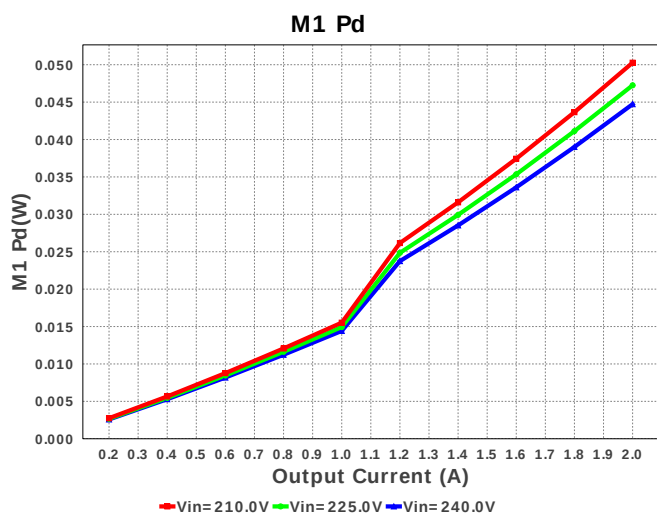
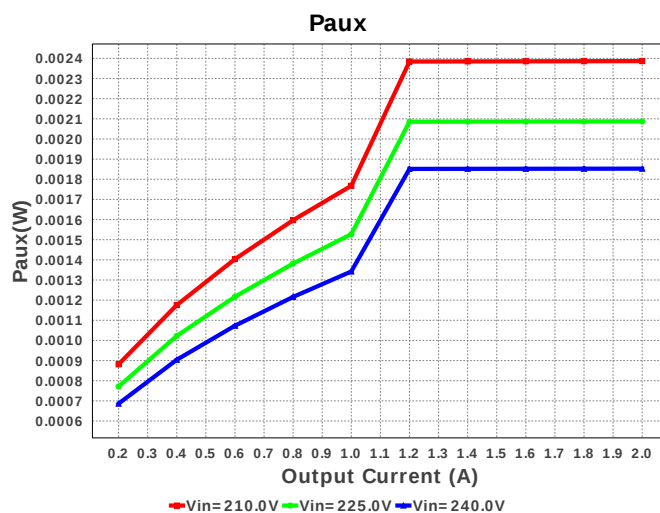
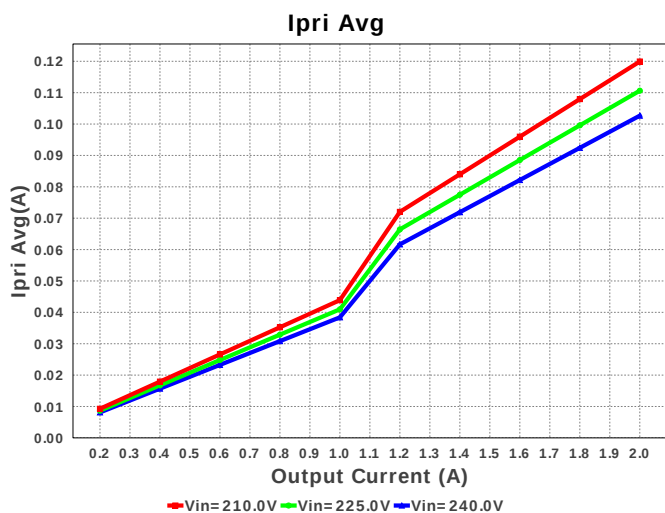
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9.	Cout1	Panasonic	25SVPF330M Series= ?	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	1	\$0.70	 CAPSMT_62_F12 151 mm ²
10.	Cout2	Panasonic	25SVPF330M Series= ?	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	1	\$0.70	 CAPSMT_62_F12 151 mm ²
11.	Cref	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
12.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
13.	Csnub	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
14.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	\$0.01	 0805 7 mm ²
15.	Cvdd	MuRata	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

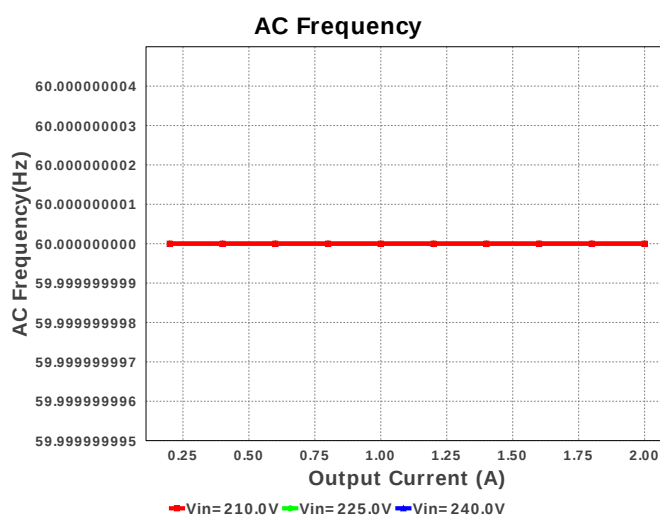
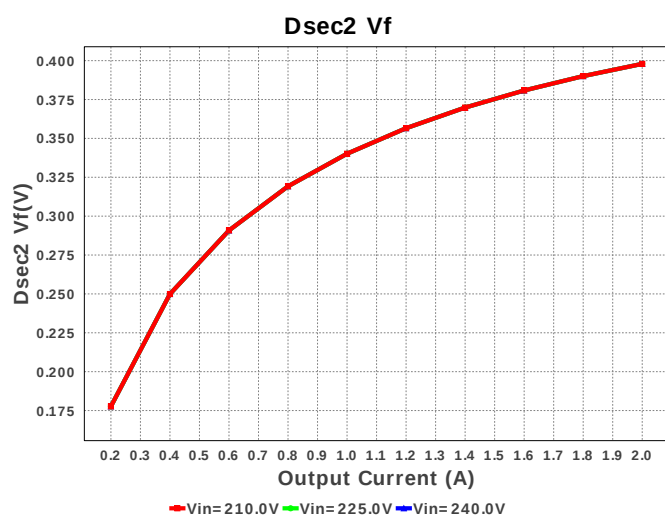
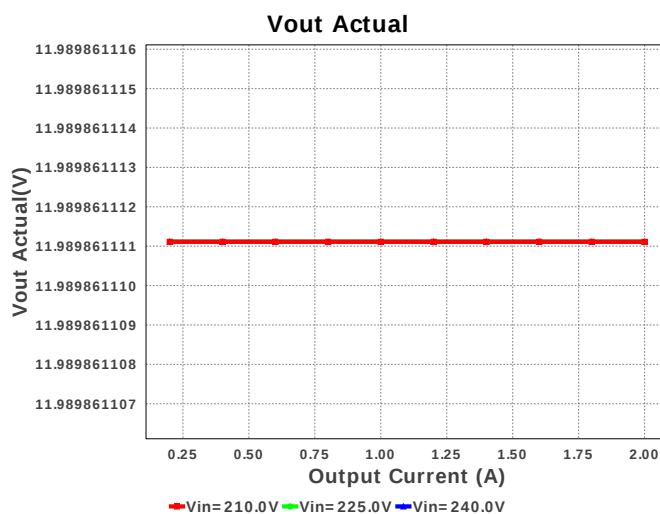
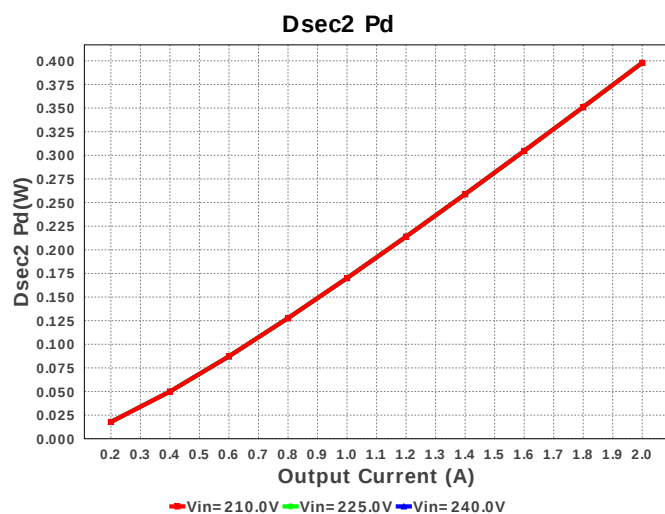
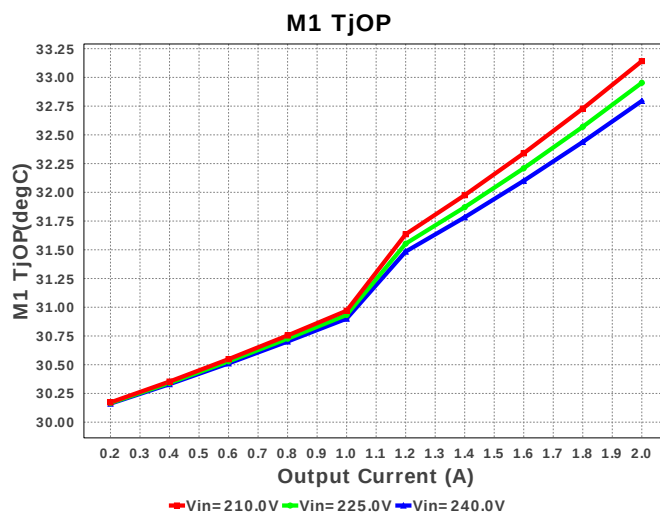
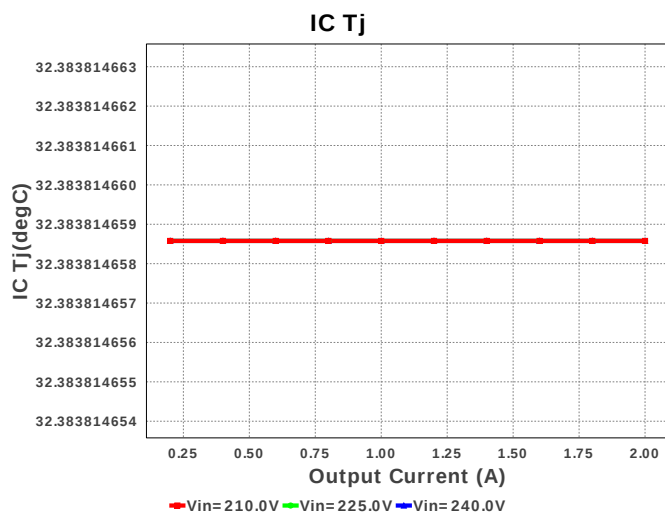
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
19.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
21.	D21	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	\$0.19	 M-FLAT 19 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	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	 DDPAK 210 mm ²
24.	Dsec	Comchip Technology	CDBC5100-G	VF@Io= 850.0 mV VRRM= 100.0 V	1	\$0.26	 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.	Dz	Diodes Inc.	DFLZ10-7	Zener	1	\$0.13	 PowerDI123 13 mm ²
28.	L1	API Delevan	CM6296R-154	Lp= 150.0 µH Rp= 16.0 mOhm Leakage_L= 1.8 µH Ns1toNp= 1.0 Rs1= 0.0 Ohms	1	\$5.95	 CM6296 833 mm ²
29.	L2	Coilcraft	SER1590-152MLB	L= 1.5 µH DCR= 1.1 mOhm	1	\$1.12	 SER1590 324 mm ²
30.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	\$2.52	 TO-220FP 79 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
32.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	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
34.	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
35.	R12	Vishay-Dale	CRCW04022K32FKED Series= CRCW..e3	Res= 2.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	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
37.	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
38.	R22	Vishay-Dale	CRCW0402165KFKED Series= CRCW..e3	Res= 165.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	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
40.	Rbias	Vishay-Dale	CRCW04025K62FKED Series= CRCW..e3	Res= 5.62 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
41.	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
42.	Rdrv	Vishay-Dale	CRCW08053R65FKEA Series= CRCW..e3	Res= 3.65 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
43.	Rfbb	Yageo America	RC0603FR-073K6L Series= ?	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
44.	Rfbt	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
45.	Rled	Vishay-Dale	CRCW04022K37FKED Series= CRCW..e3	Res= 2.37 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
46.	Rsc	Vishay-Dale	CRCW04029K31FKED Series= CRCW..e3	Res= 9.31 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
47.	Rsns	Vishay-Dale	CRCW12061R91FKEA Series= CRCW..e3	Res= 1.91 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
48.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 275.951 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
49.	Rstartup1	Panasonic	ERJ-8ENF4533V Series= ERJ-8E	Res= 453.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
50.	Rstartup2	Panasonic	ERJ-8ENF4533V Series= ERJ-8E	Res= 453.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
51.	Rt	Panasonic	ERJ-6ENF2742V Series= ERJ-6E	Res= 27.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²

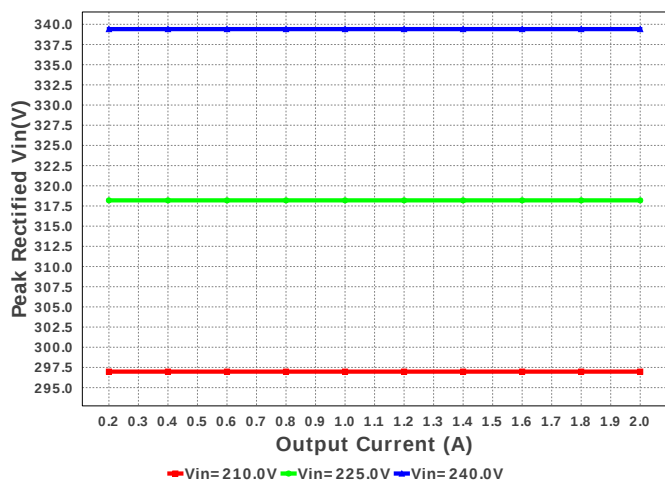
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
52.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
53.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 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= 6.338 mH Rp= 870.0 mOhm Leakage_L= 126.762 μH Ns1toNp= 0.069 Rs1= 8.6 mOhms Ns2toNp= 0.059 Rs2= 700.0 μOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC38C40DR	Switcher	1	\$0.70	 D0008A 57 mm ²
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²



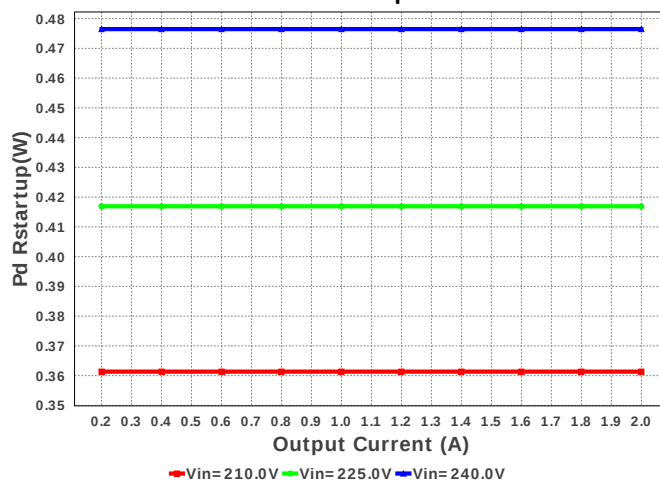




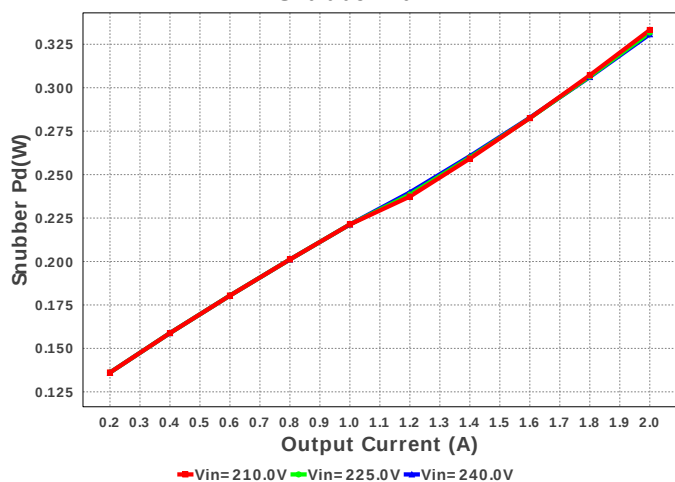
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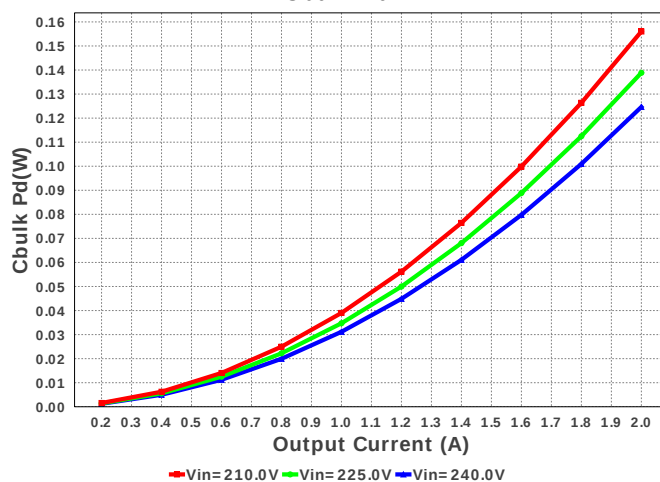
Pd Rstartup



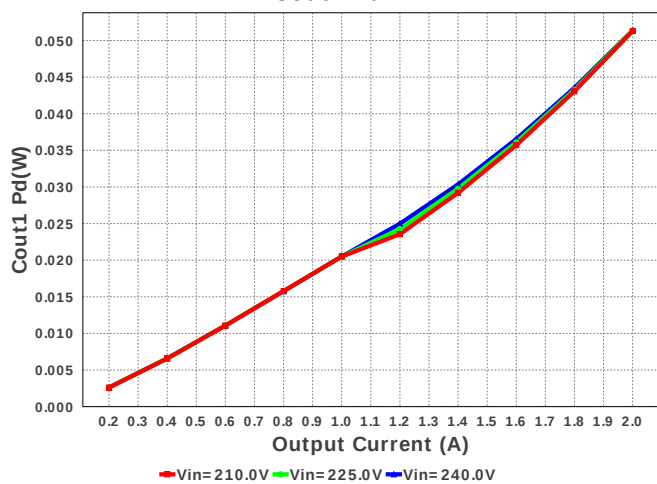
Snubber Pd



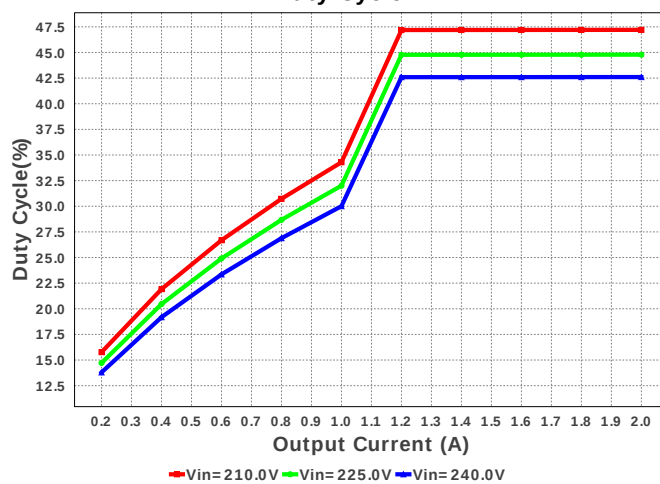
Cbulk Pd

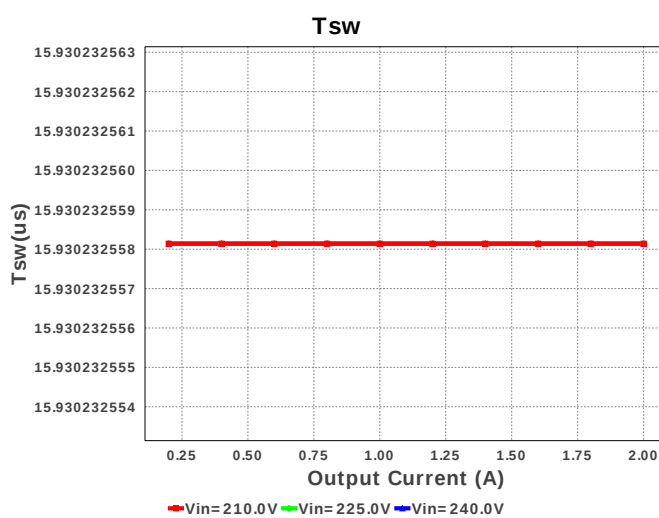
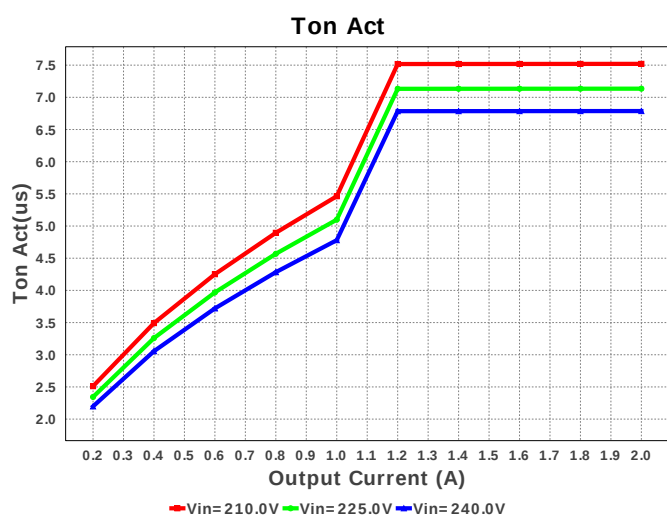
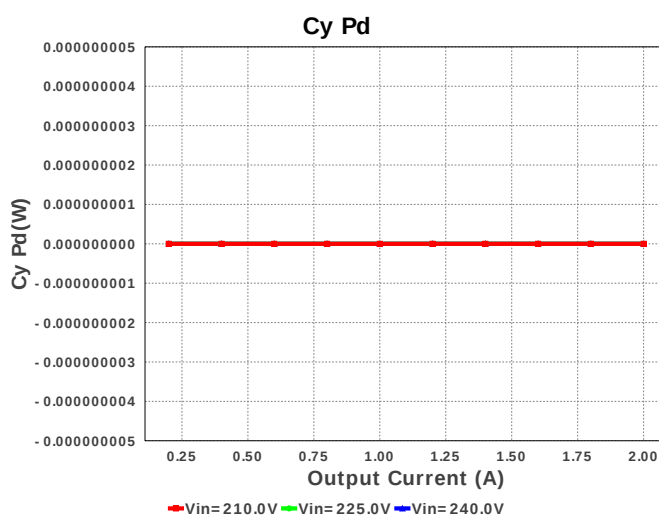
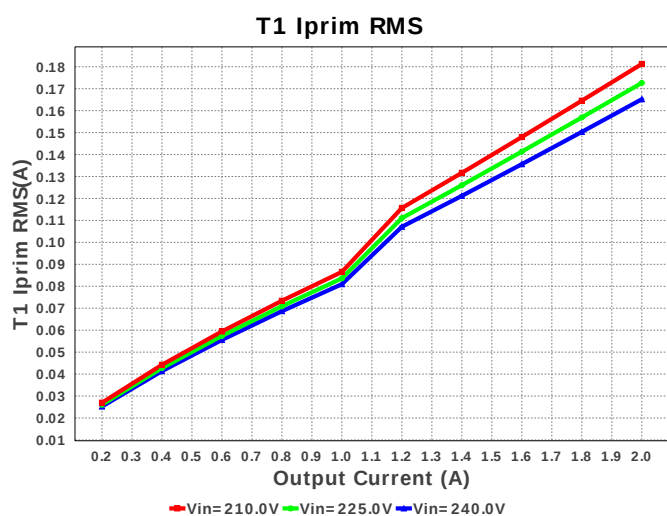
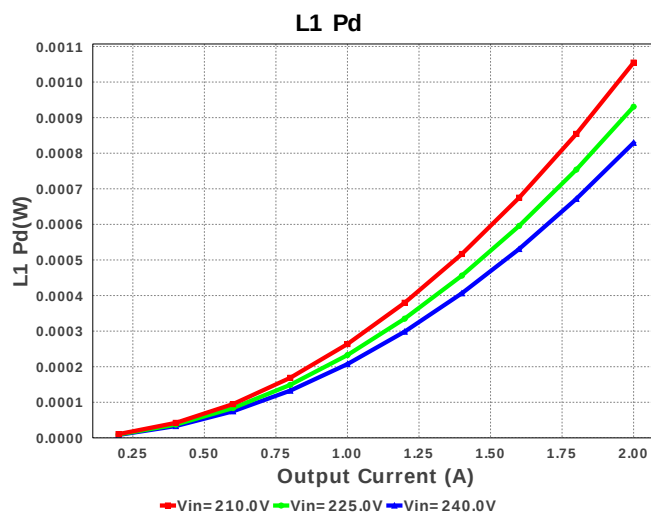
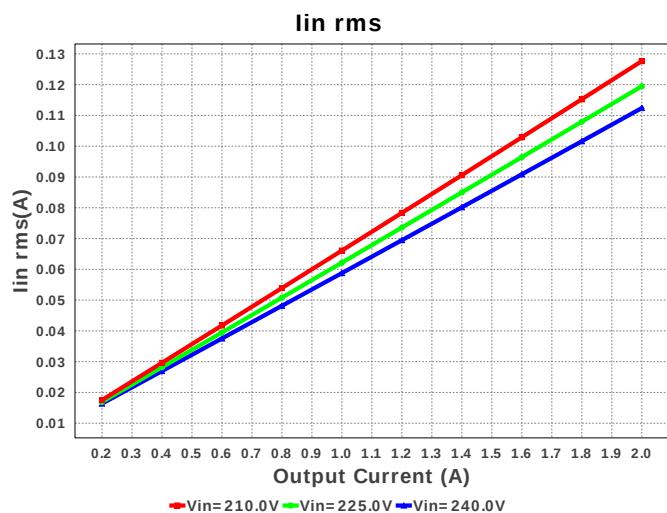


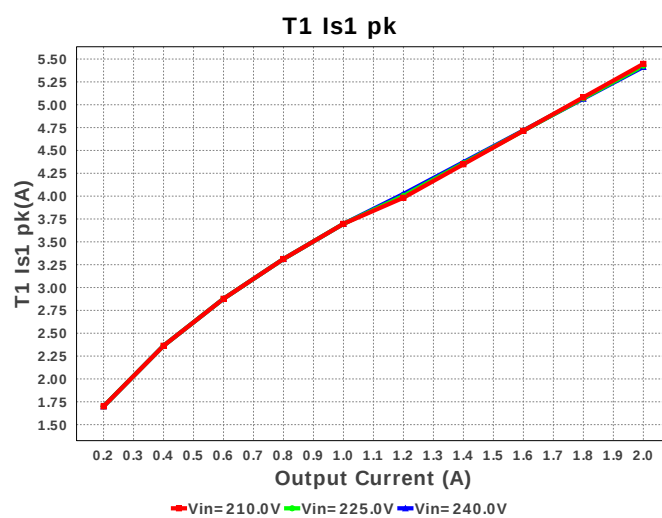
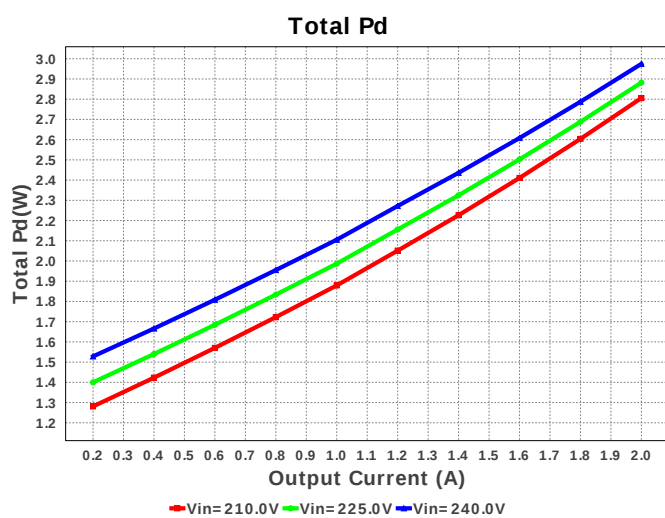
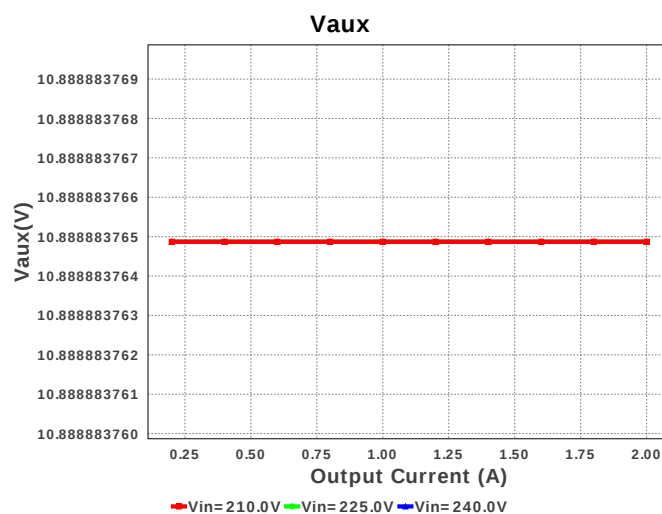
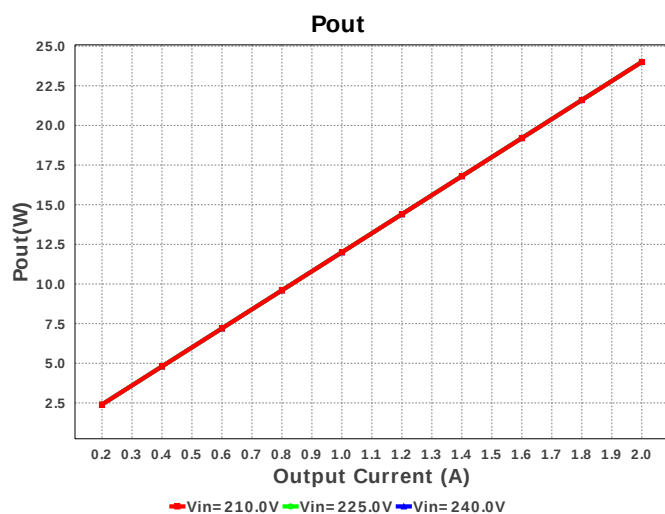
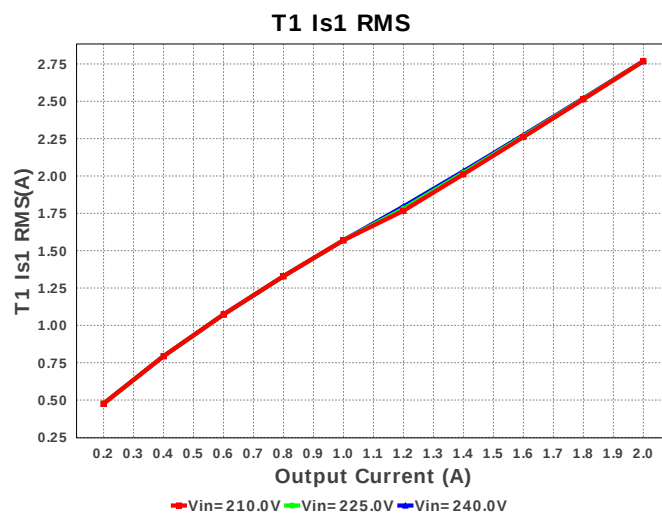
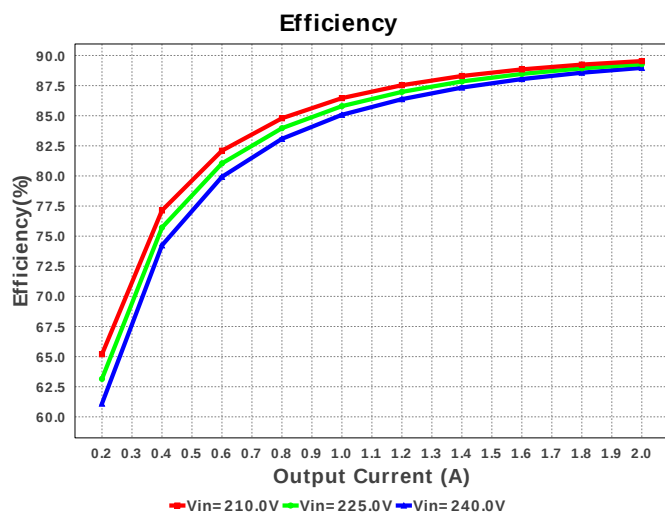
Cout1 Pd

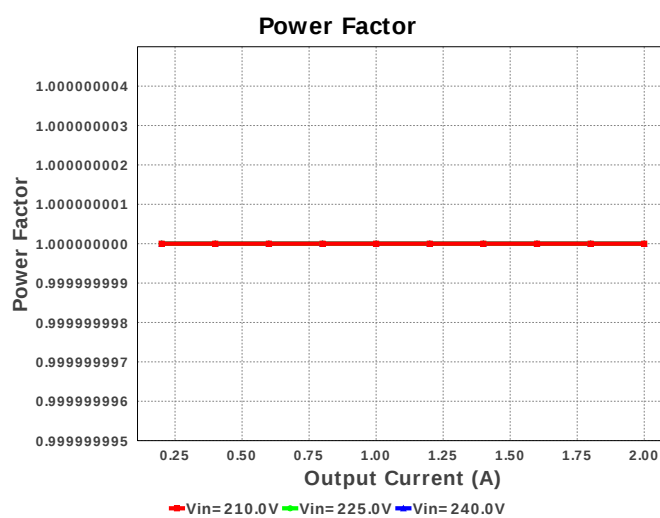
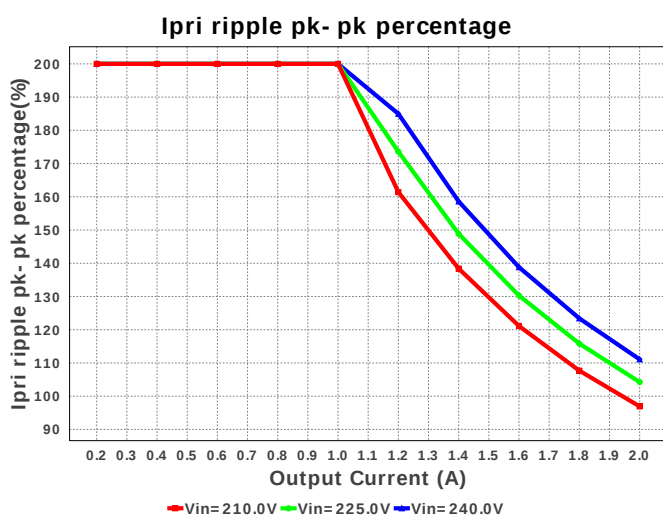
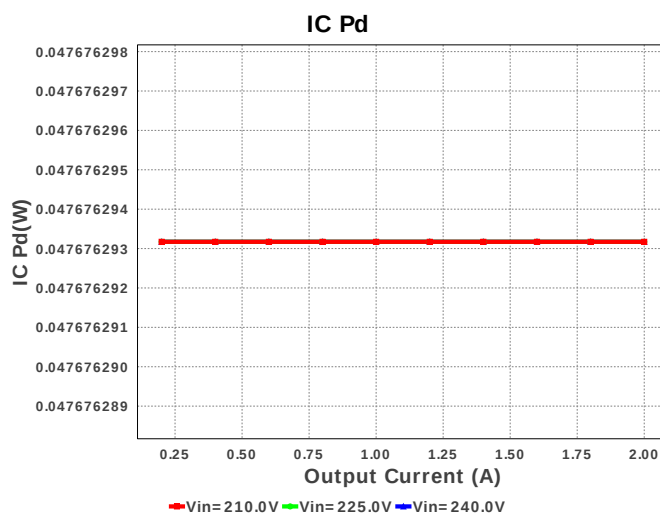
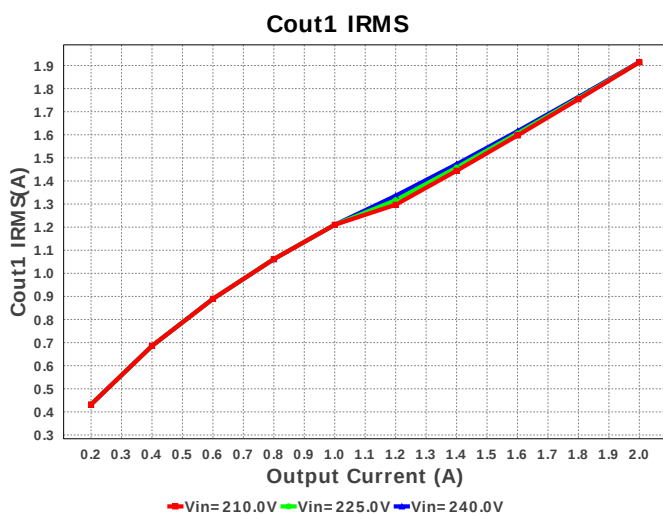
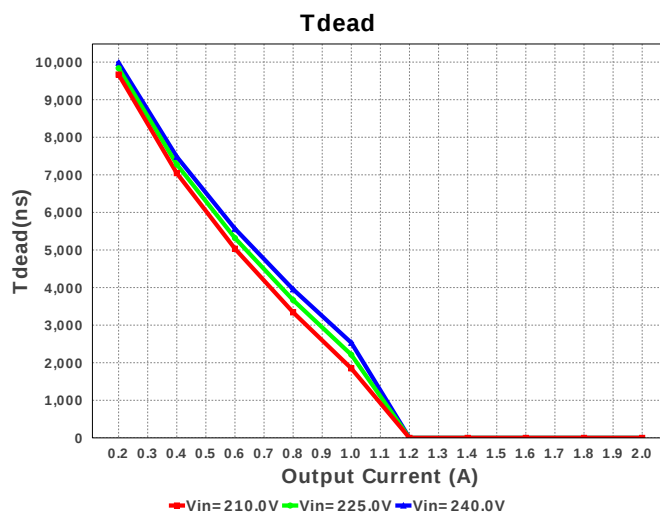
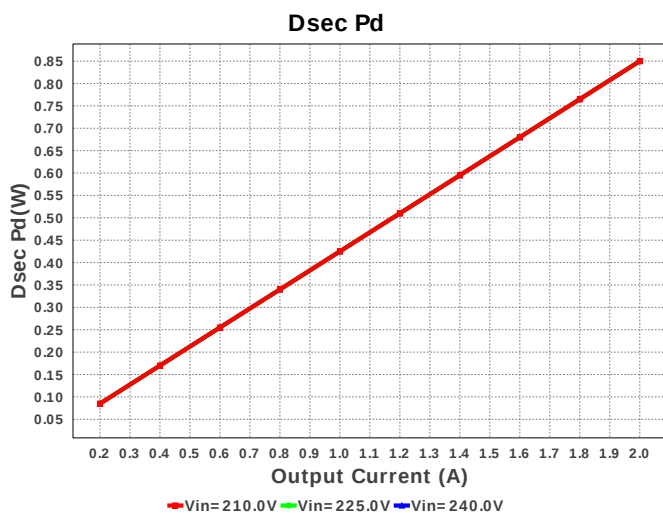


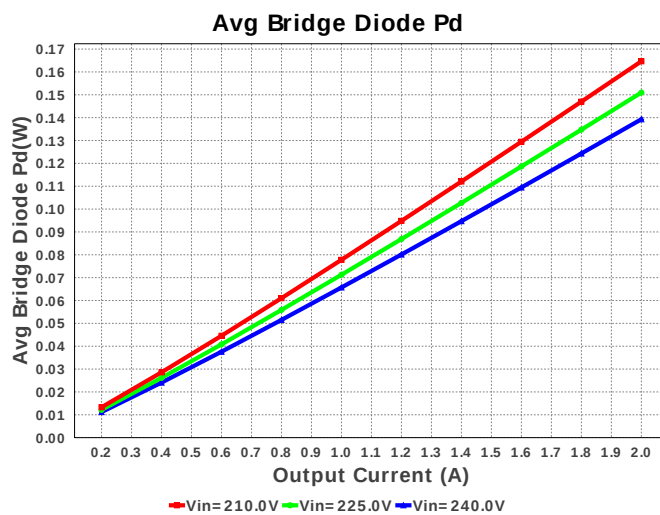
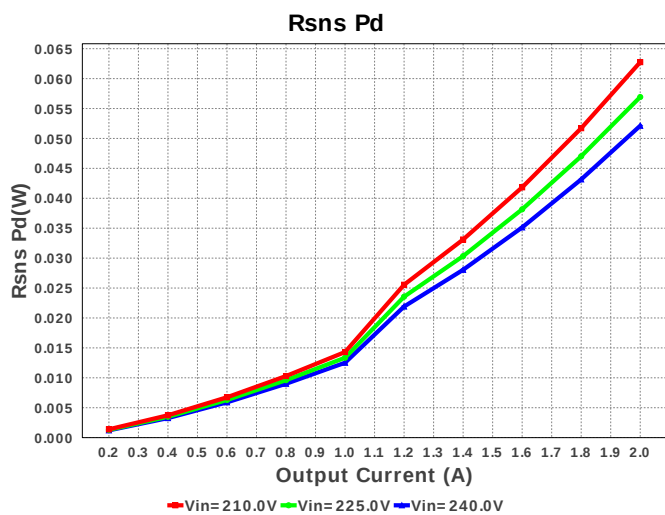
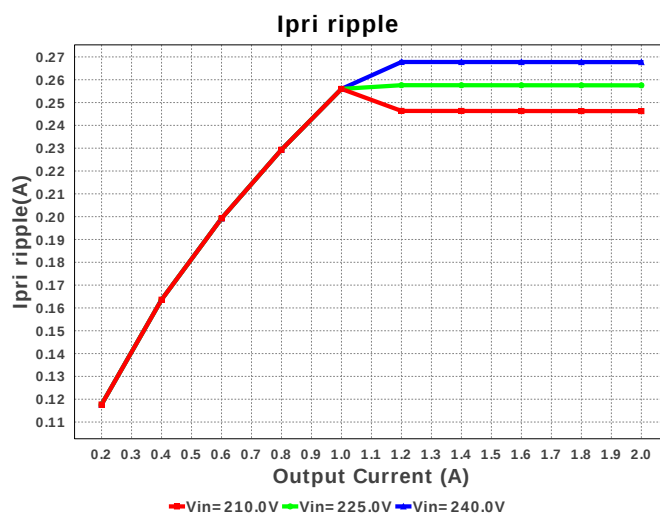
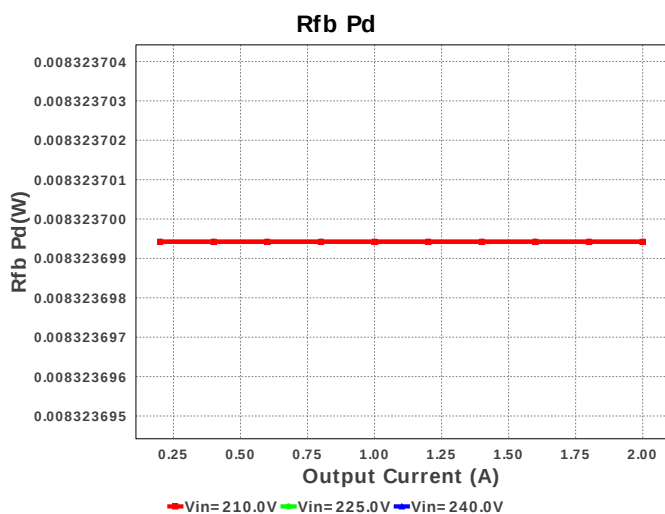
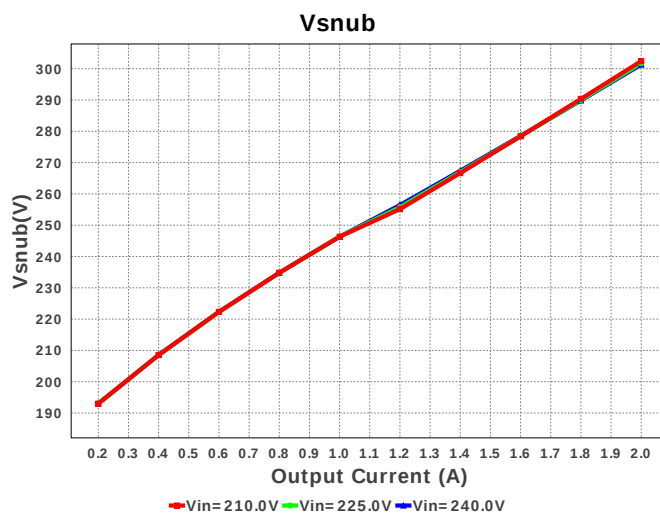
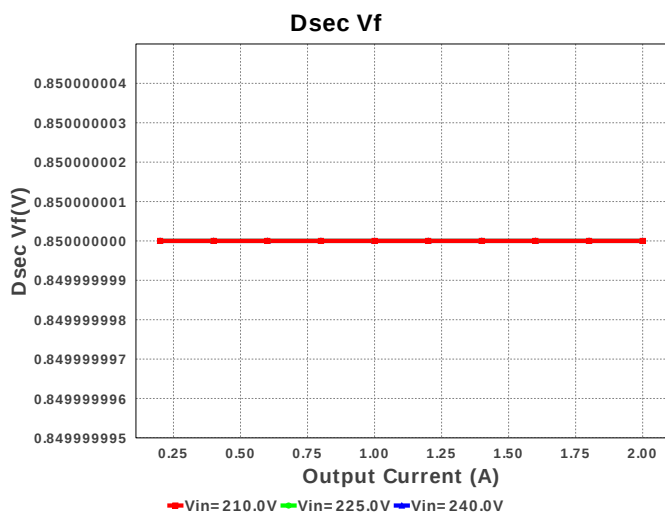
Duty Cycle

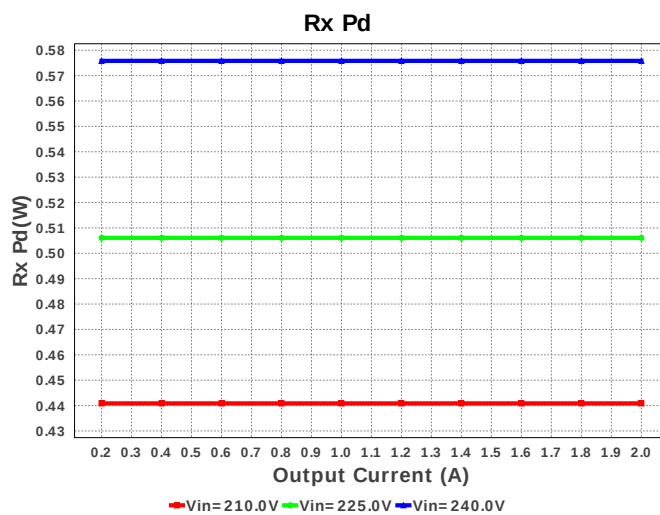
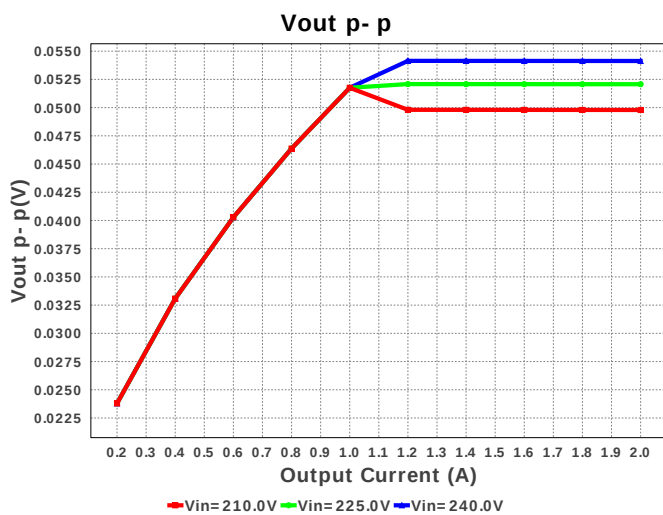
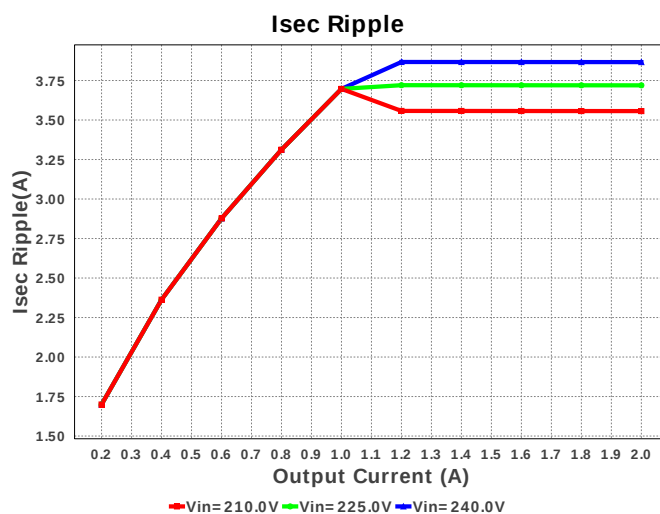
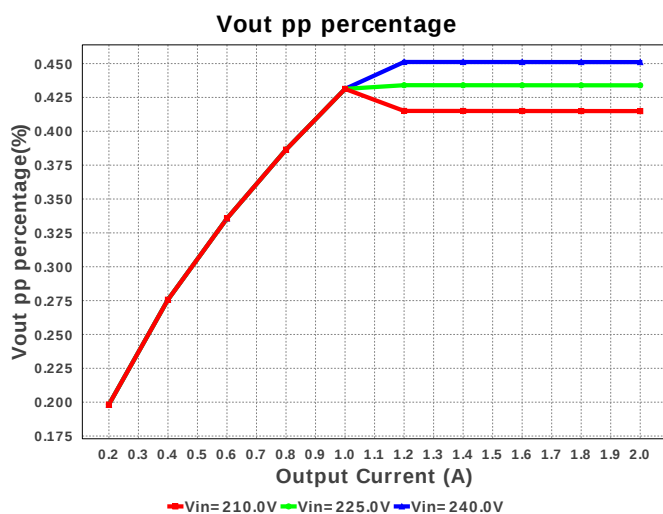
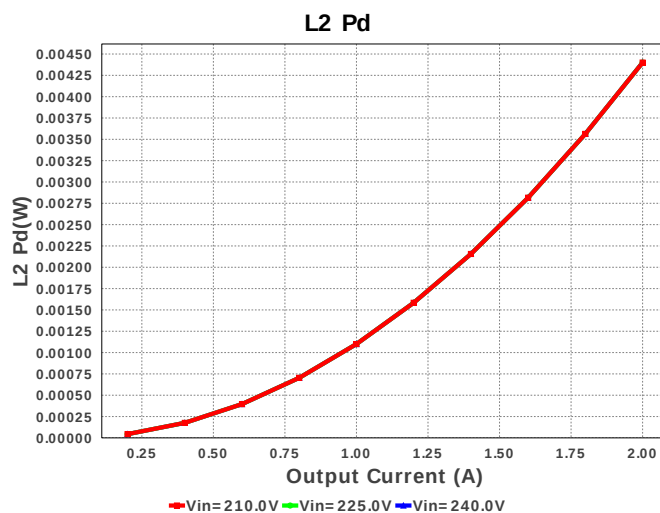
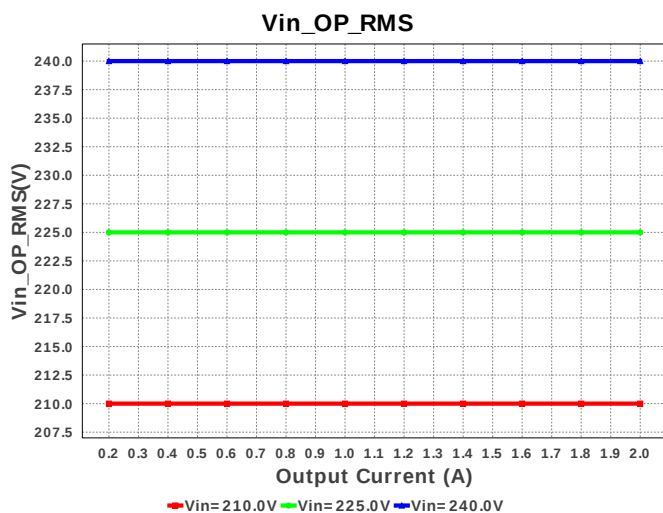


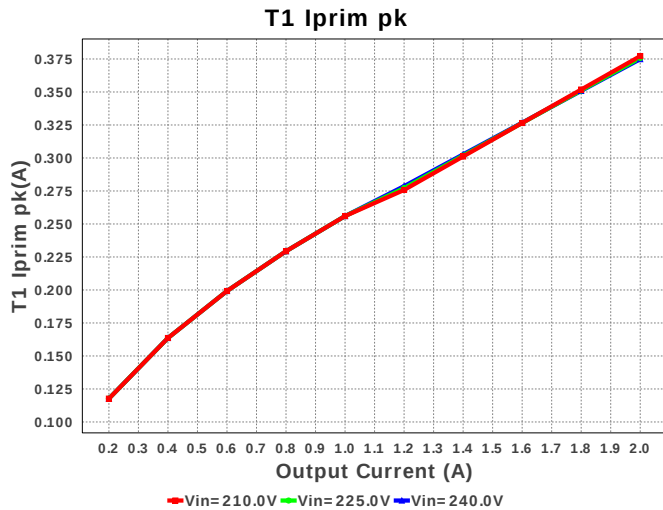












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.914 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	127.65 mA	Current	RMS Input Current
3.	Iout_DCM	1.009 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	119.927 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	246.254 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	96.929 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.556 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	181.255 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	377.182 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	2.768 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.447 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	57	General	Total Design BOM count
14.	Daux trr	0.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	850.0 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	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	3.478 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	62.774 kHz	General	Switching frequency
21.	Pout	24.0 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	8.684 us	General	Approximate Converter Off Time
25.	Ton Act	7.52 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	15.93 us	General	Switching Time Period
28.	Vaux	10.889 V	General	Auxiliary Voltage
29.	Vsnub	302.424 V	General	Voltage Across the Snubber
30.	Vout Actual	11.99 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	47.205 %	Op_point	Duty cycle
33.	Efficiency	89.534 %	Op_point	Steady state efficiency
34.	IC Tj	32.384 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	33.142 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	296.982 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	210.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	49.789 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	164.661 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	156.027 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	51.291 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	850.0 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	47.676 mW	Power	IC power dissipation
49.	L1 Pd	1.055 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	4.4 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period

#	Name	Value	Category	Description
51.	M1 Pd	50.269 mW	Power	M1 MOSFET total power dissipation
52.	Paux	2.387 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	361.349 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	6.961 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	62.75 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	440.858 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	333.228 mW	Power	Snubber Power Dissipation
59.	T1 Pd	188.98 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.806 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.926 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	414.912 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	240.0	Maximum input voltage
3.	VinMin	210.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC38C40	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC38C40** Product Folder : <http://www.ti.com/product/UCC38C40> : contains the data sheet and other resources.

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