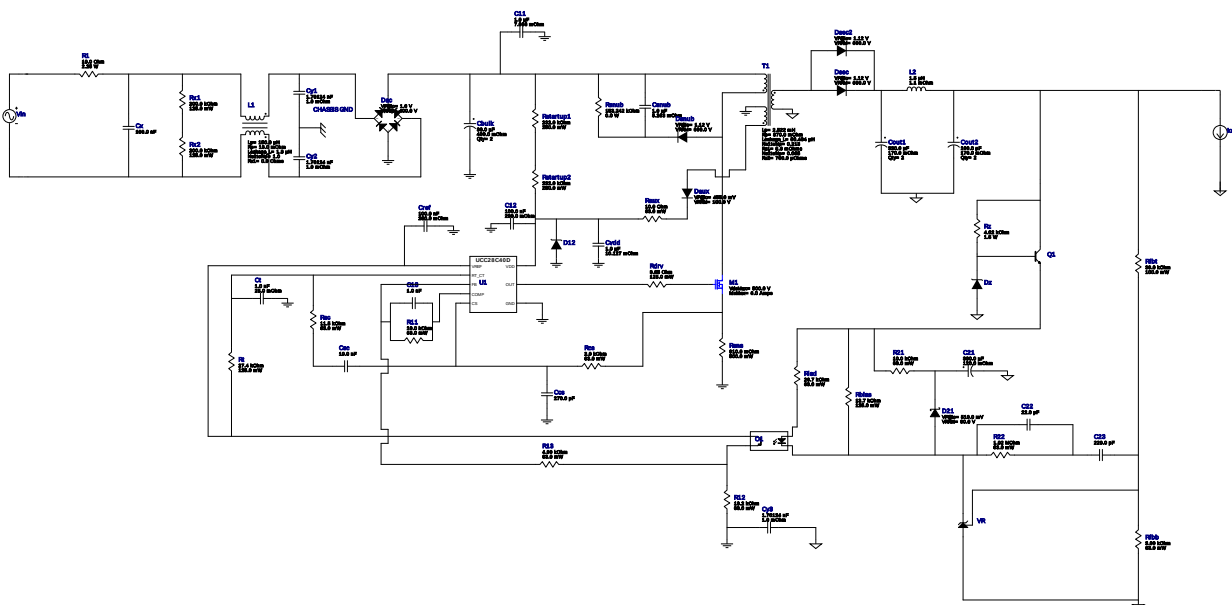


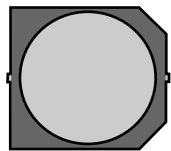
WEBENCH® Design Report

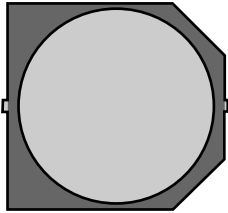
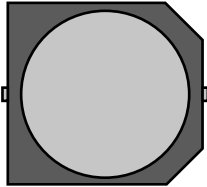
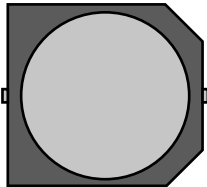
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UCC28C40DR 110.0V-130.0V to 34.00V @ 1.0A

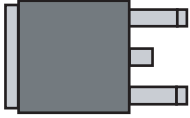
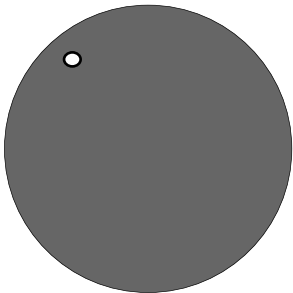
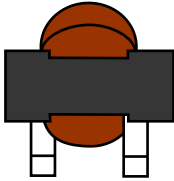


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

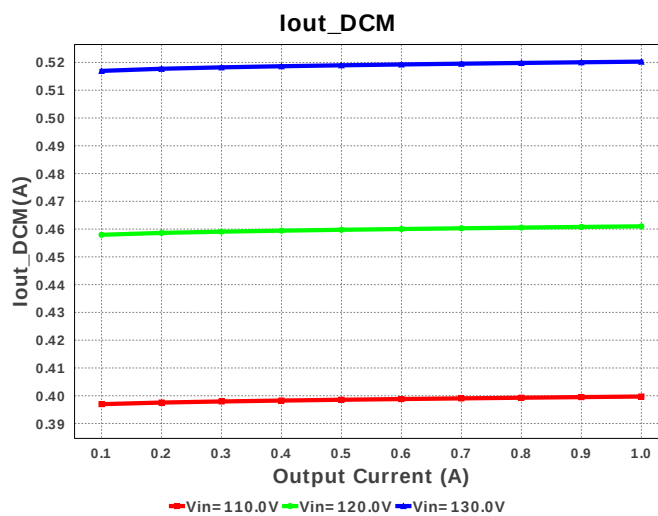
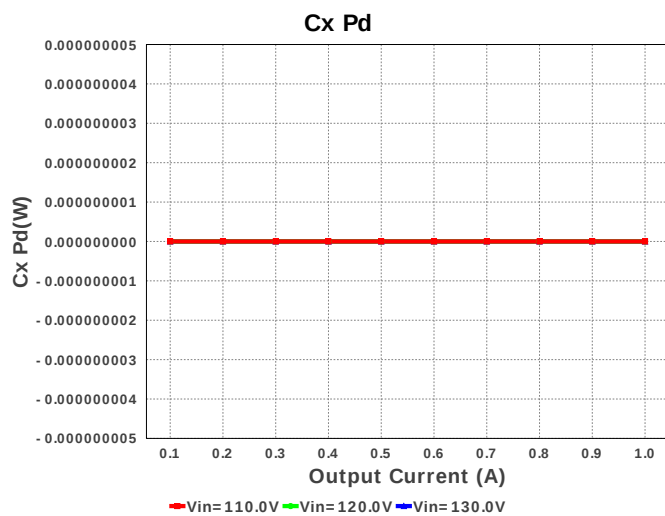
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	MuRata	GRM55DR72E105KW01L Series= X7R	Cap= 1.0 uF ESR= 7.086 mOhm VDC= 250.0 V IRMS= 2.0605 A	1	\$0.26	 2220_200 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm 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	Panasonic	EEV-FK1H331Q Series= FK	Cap= 330.0 uF ESR= 120.0 mOhm VDC= 50.0 V IRMS= 900.0 mA	1	\$0.48	 SM_RADIAL_H13 264 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	CC0805JRNPO9BN221 Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

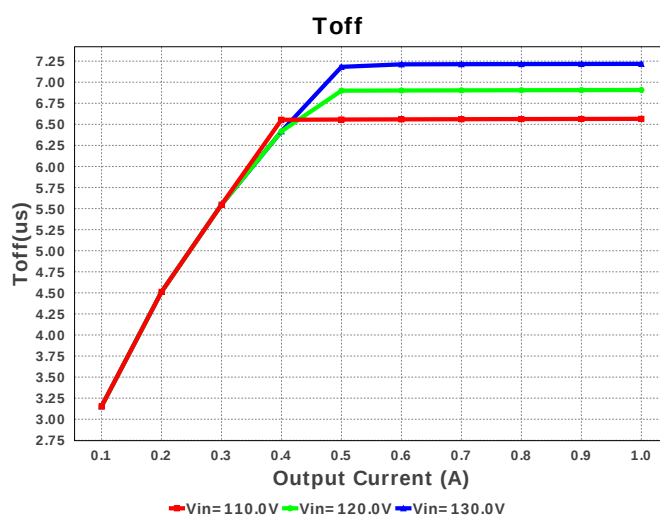
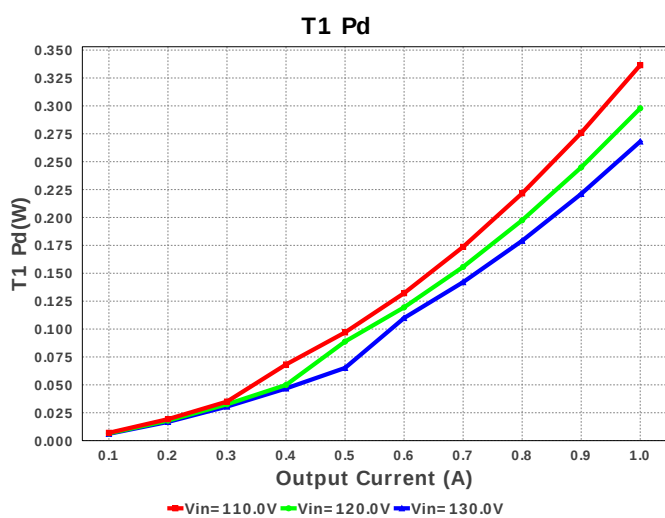
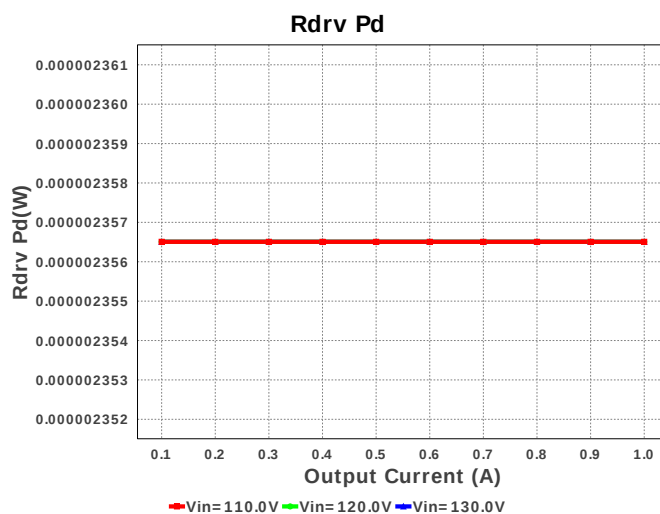
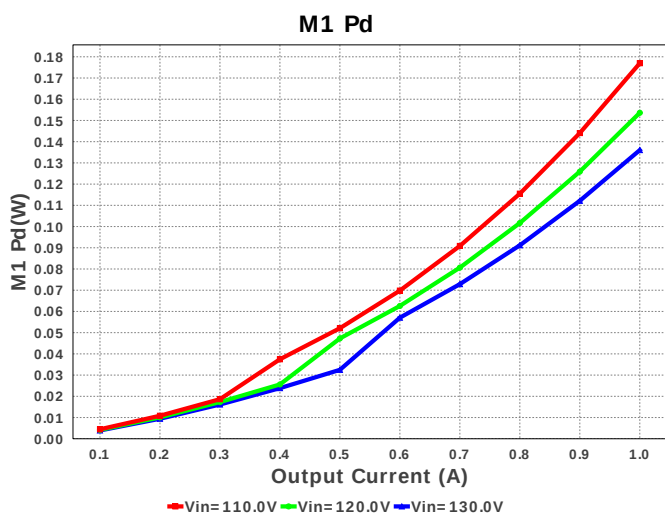
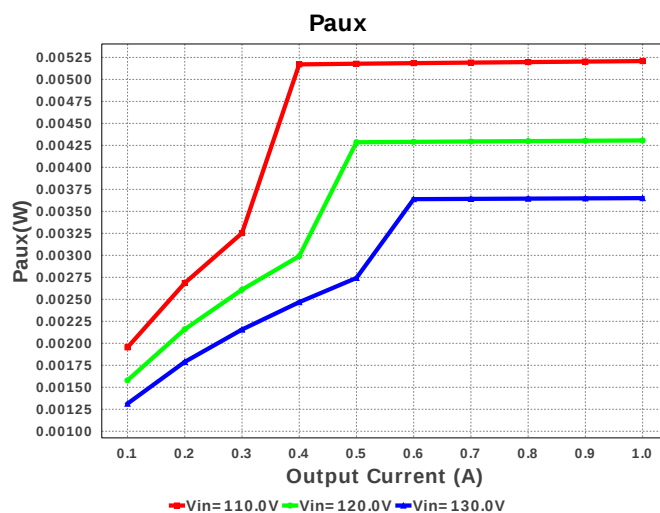
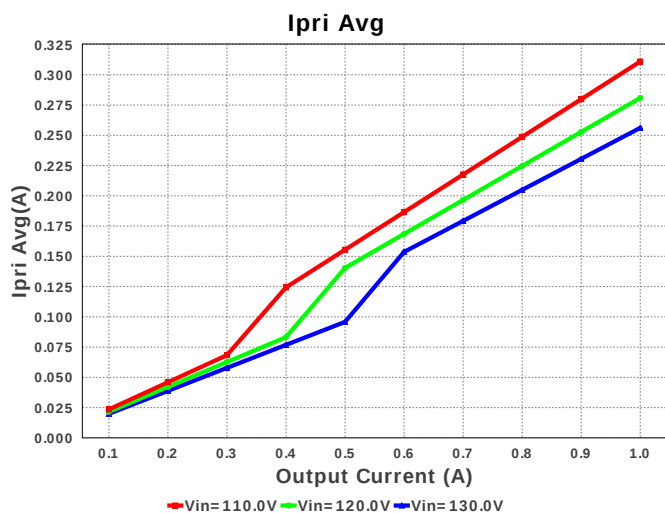
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7.	Cbulk	Panasonic	EEV-EB2E330SM Series= ?	Cap= 33.0 uF ESR= 400.0 mOhm VDC= 250.0 V IRMS= 560.0 mA	2	\$1.25	 EB_K16 483 mm²
8.	Ccs	Yageo America	CC0805KRX7R9BB271 Series= X7R	Cap= 270.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
9.	Cout1	Panasonic	EEV-FK1K331M Series= FK	Cap= 330.0 uF ESR= 170.0 mOhm VDC= 80.0 V IRMS= 793.0 mA	2	\$0.78	 SM_RADIAL_J16 399 mm²
10.	Cout2	Panasonic	EEV-FK2A101M Series= FK	Cap= 100.0 uF ESR= 170.0 mOhm VDC= 100.0 V IRMS= 793.0 mA	2	\$0.79	 SM_RADIAL_J16 399 mm²
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 mm²
12.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
13.	Csnub	TDK	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
14.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	\$0.01	 0805 7 mm²
15.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	 0603 5 mm²
16.	Cx	TDK	B32913A5104M000 Series= 2231	Cap= 100.0 nF VDC= 1000.0 V IRMS= 0.0 A	1	\$0.46	 B32913_2650x600x1500 228 mm²
17.	Cy1	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm²
18.	Cy2	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm²
19.	Cy3	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm²

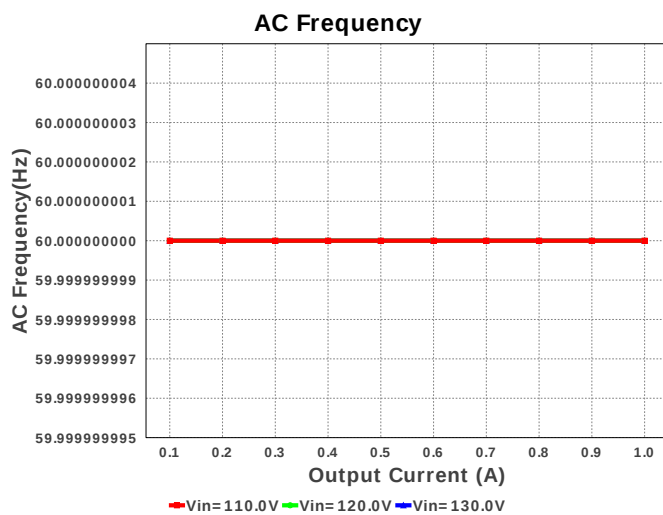
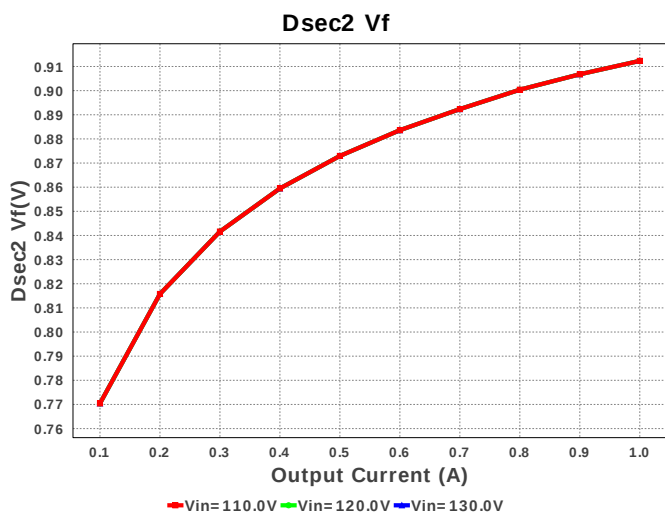
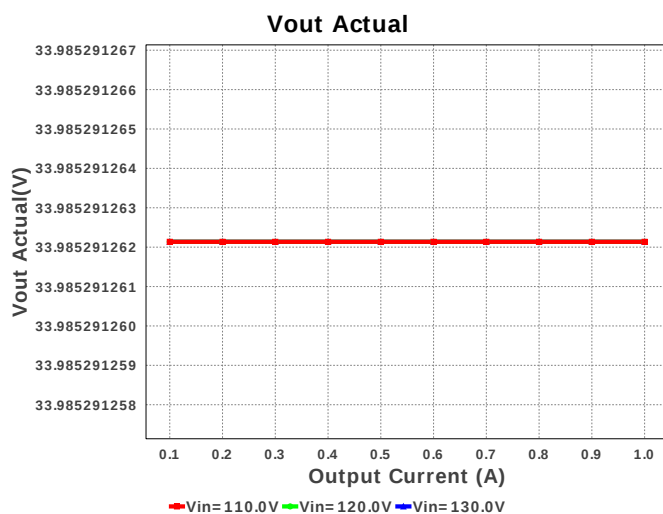
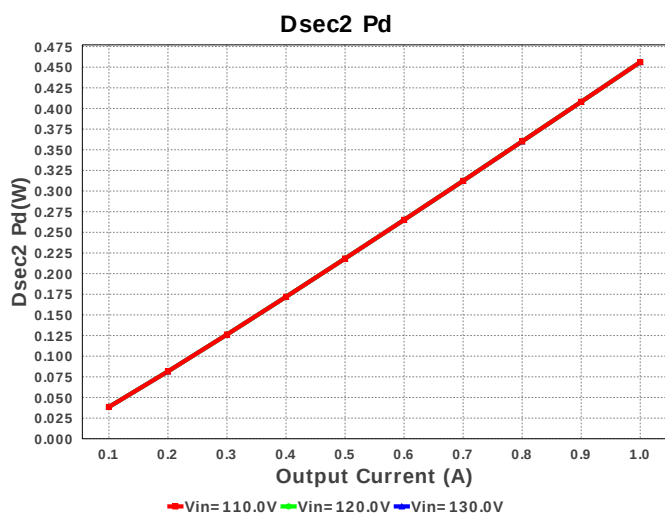
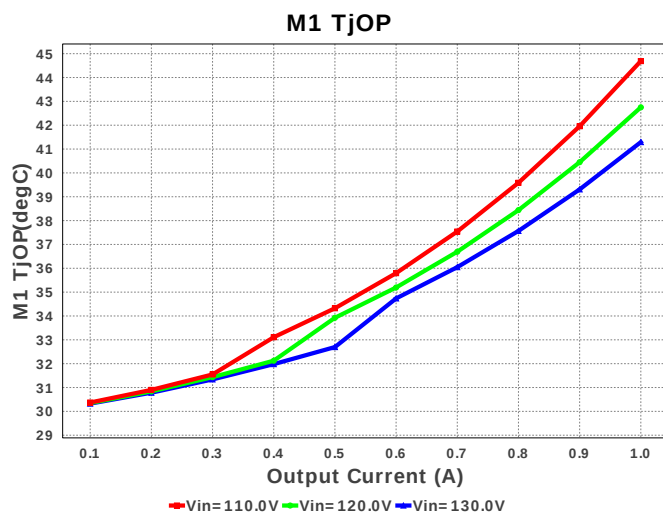
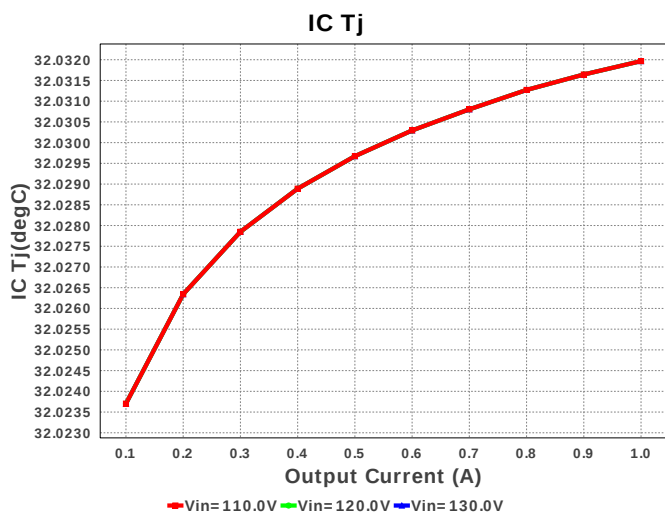
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20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
21.	D21	ON Semiconductor	MBRA160T3G	VF@Io= 510.0 mV VRRM= 60.0 V	1	\$0.12	 SMA 37 mm ²
22.	Dac	Diodes Inc.	HD04-T	VF@Io= 1.0 V VRRM= 400.0 V	1	\$0.12	 MiniDIP 62 mm ²
23.	Daux	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	 DDPAK 210 mm ²
24.	Dsec	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	\$0.18	 SMC 83 mm ²
25.	Dsec2	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	\$0.18	 SMC 83 mm ²
26.	Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	\$0.18	 SMC 83 mm ²
27.	Dz	Micro Commercial Components	3SMAJ5932B-TP	Zener	1	\$0.12	 SMA 37 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	Fairchild Semiconductor	FDD6N50TM	VdsMax= 500.0 V IdsMax= 6.0 Amps	1	\$0.47	 DPAK 102 mm ²
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

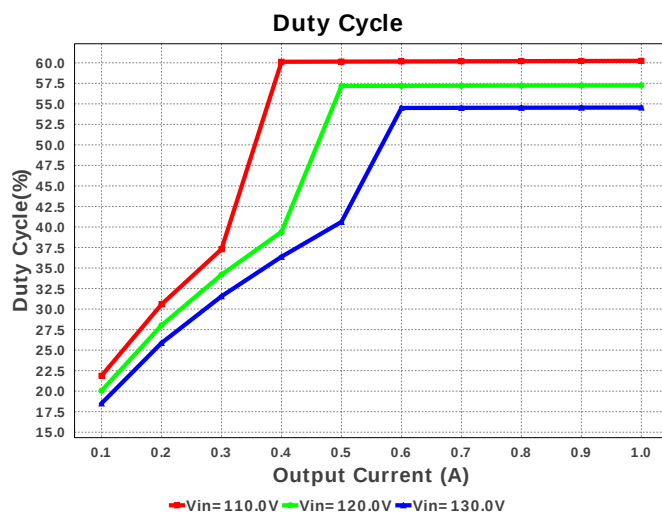
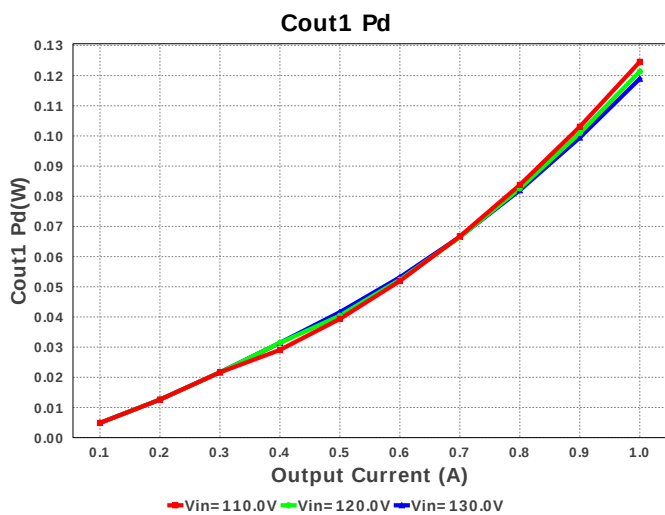
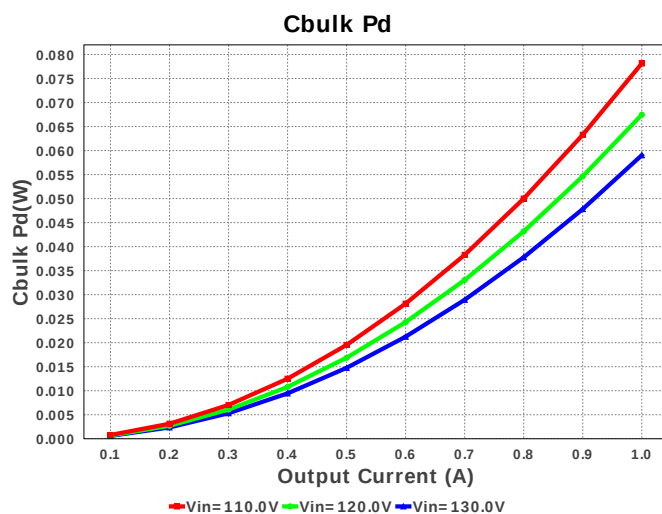
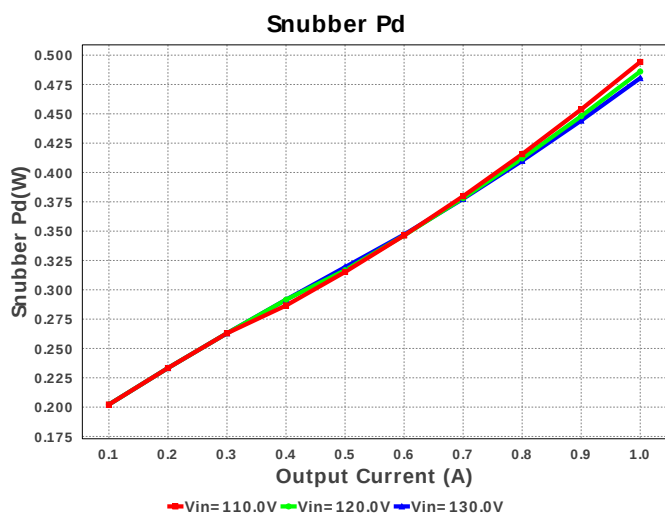
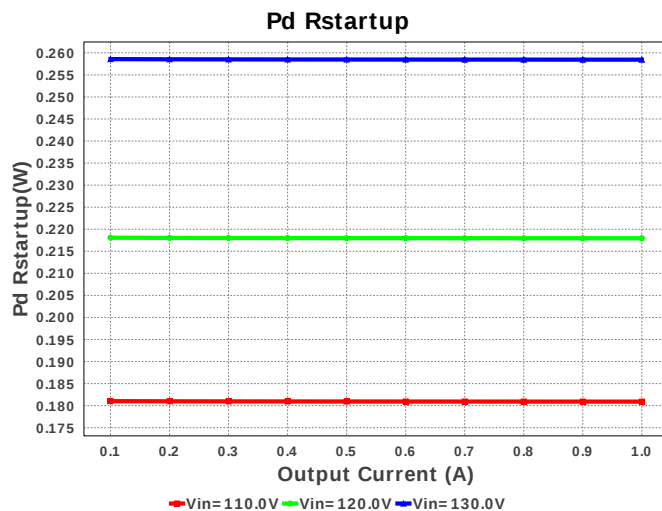
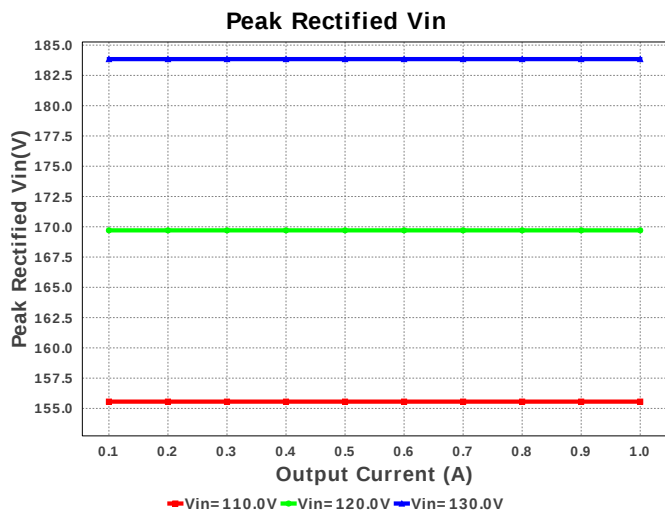
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34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	R12	Vishay-Dale	CRCW040218K2FKED Series= CRCW..e3	Res= 18.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
36.	R13	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	CRCW04021M02FKED Series= CRCW..e3	Res= 1.02 MOhm 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	Panasonic	ERJ-6ENF1372V Series= ERJ-6E	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 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	CRCW08053R65FKEA Series= CRCW..e3	Res= 3.65 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
43.	Rfbb	Vishay-Dale	CRCW04023K09FKED Series= CRCW..e3	Res= 3.09 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rfbt	Yageo America	RC0603FR-0739KL Series= ?	Res= 39.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
45.	Rled	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW040211K5FKED Series= CRCW..e3	Res= 11.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
47.	Rsns	Bourns	CRM1206-FX-R910ELF Series= ?	Res= 910.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	\$0.03	 1206 11 mm²
48.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 153.242 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
49.	Rstartup1	Panasonic	ERJ-8ENF2323V Series= ERJ-8E	Res= 232.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
50.	Rstartup2	Panasonic	ERJ-8ENF2323V Series= ERJ-8E	Res= 232.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
51.	Rt	Panasonic	ERJ-6ENF2742V Series= ERJ-6E	Res= 27.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
52.	Rx1	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
53.	Rx2	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²

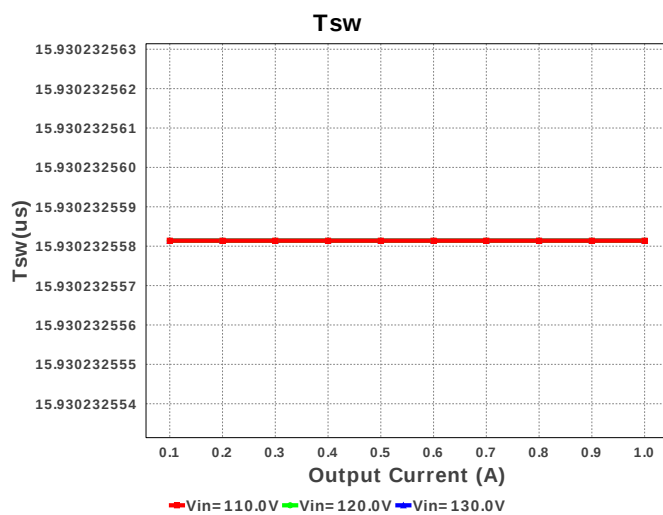
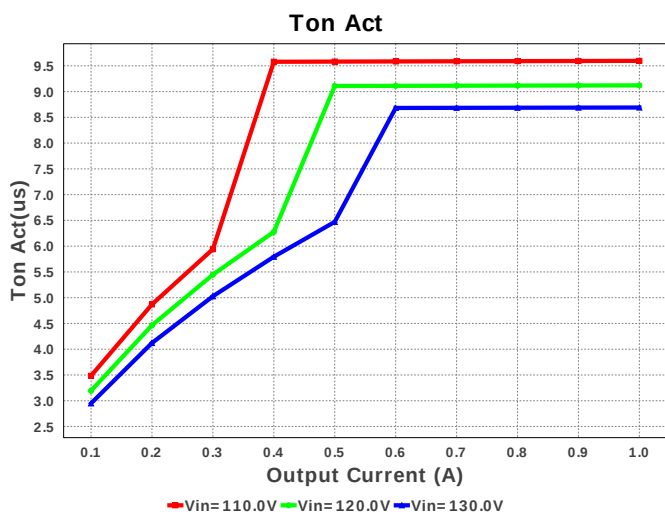
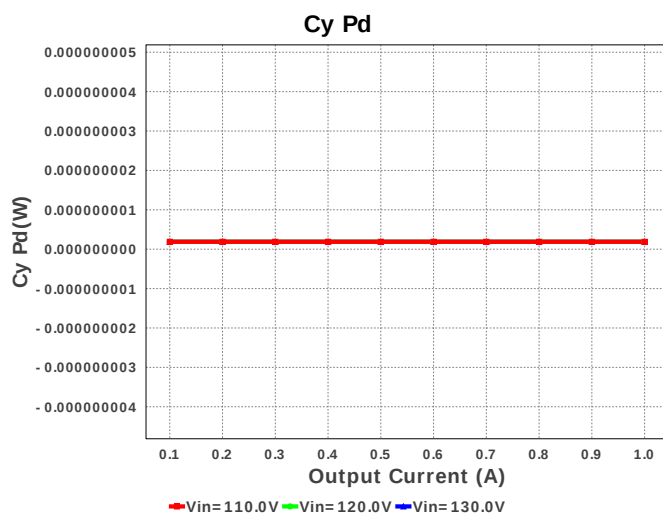
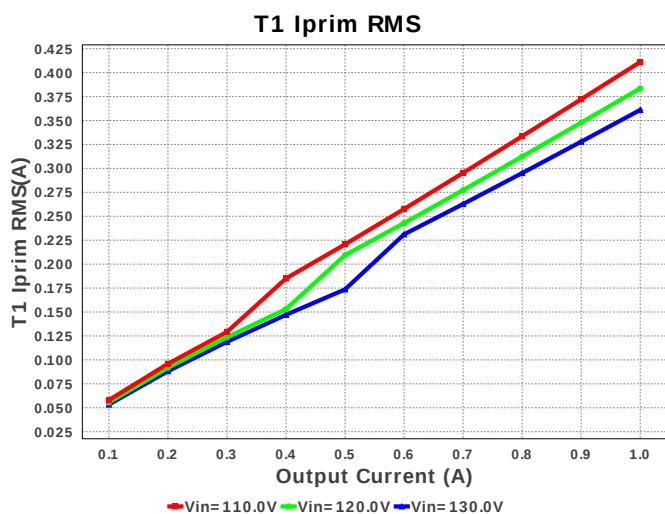
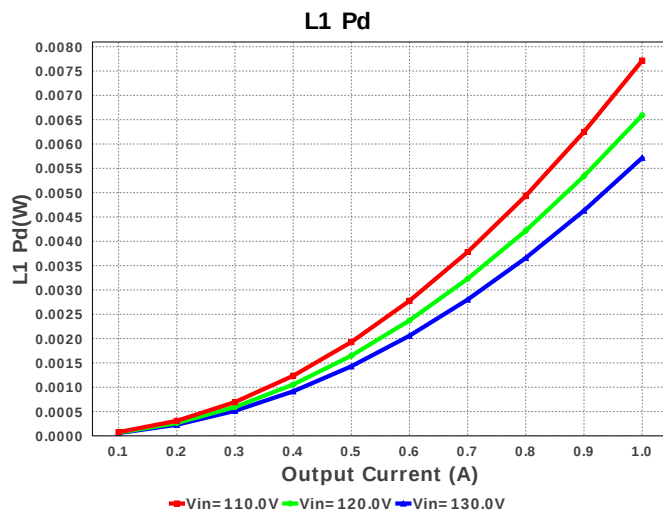
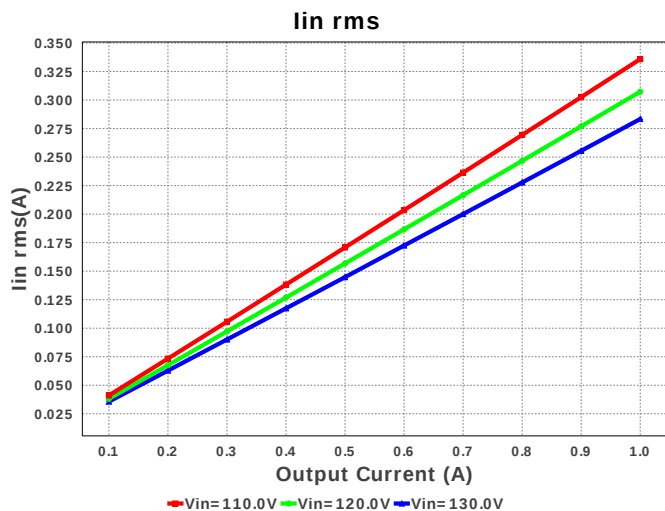
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
54.	Rz	Vishay Draloric	CRCW25124K02FKEGHP Series= ?	Res= 4.02 kOhm Power= 1.5 W Tolerance= 1.0%	1	\$0.44	 2512 43 mm ²
55.	T1	CUSTOM	CUSTOM	Lp= 2.522 mH Rp= 870.0 mOhm Leakage_L= 50.434 μH Ns1toNp= 0.213 Rs1= 8.6 mOhms Ns2toNp= 0.065 Rs2= 700.0 μOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC28C40DR	Switcher	1	\$0.75	 D0008A 57 mm ²
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²

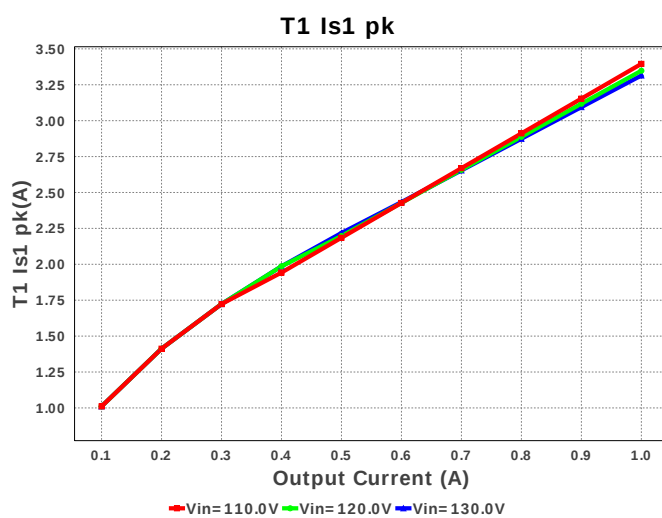
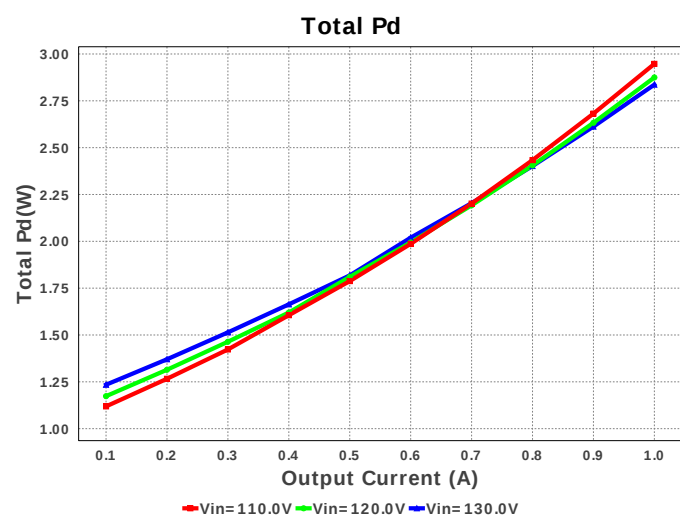
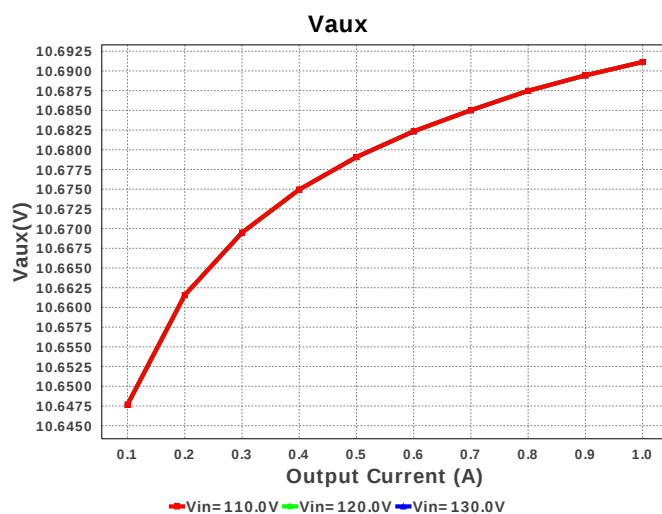
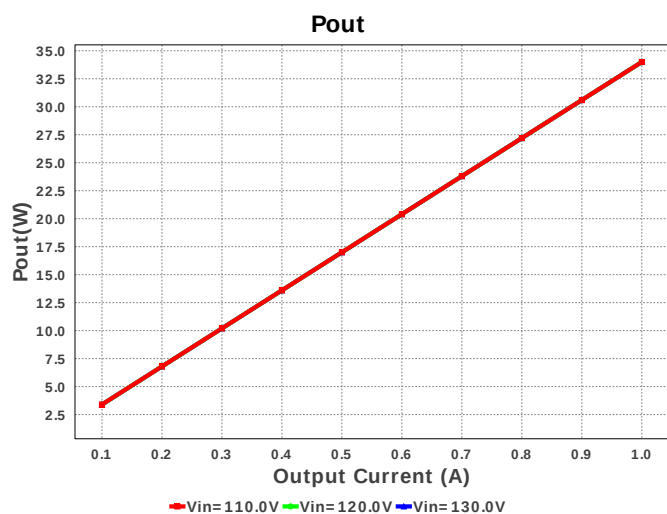
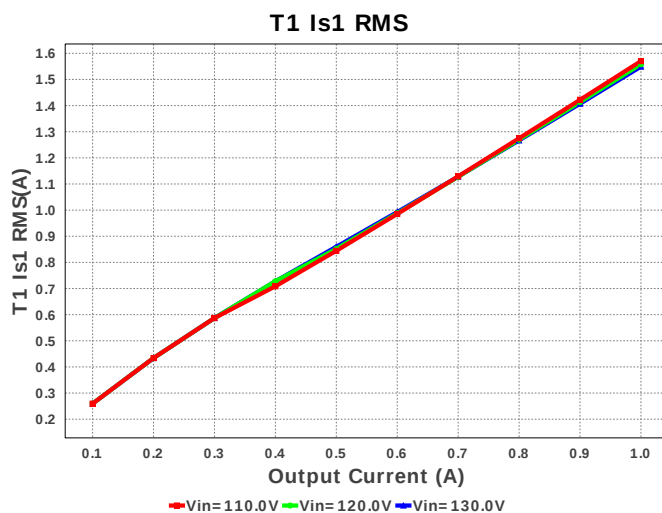
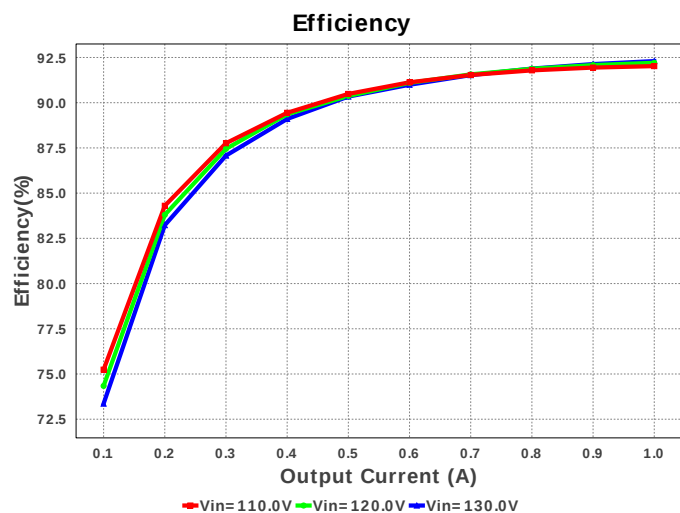


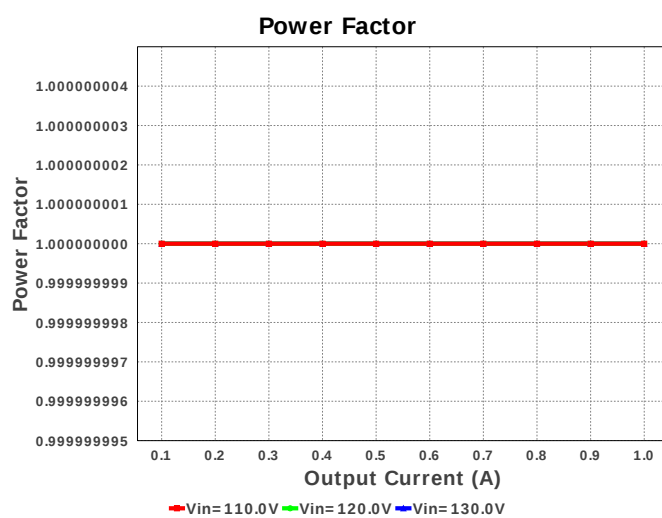
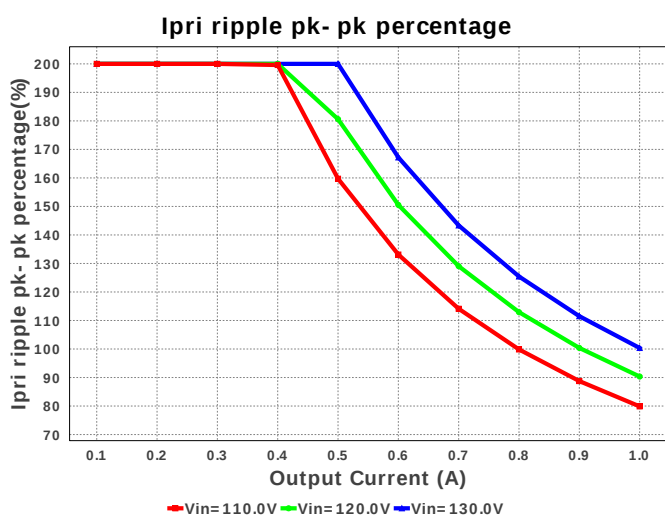
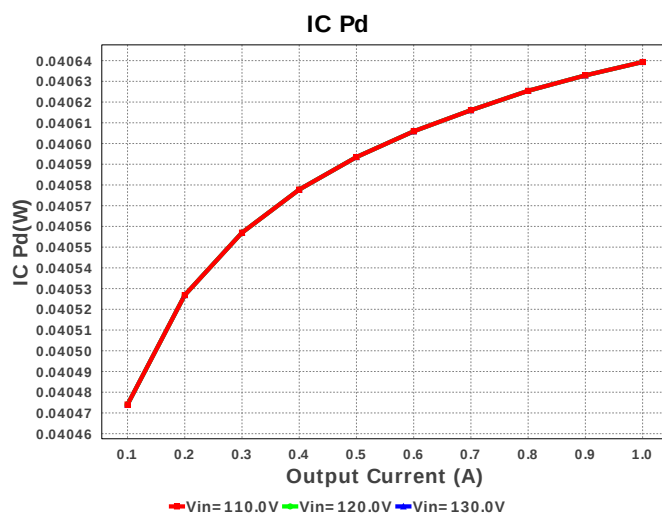
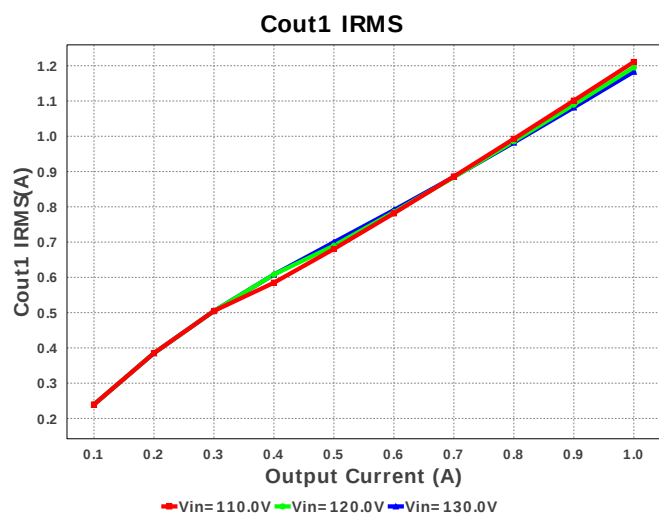
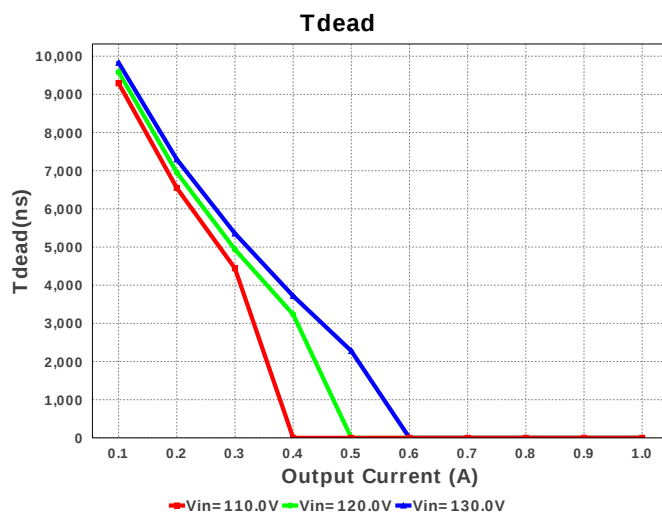
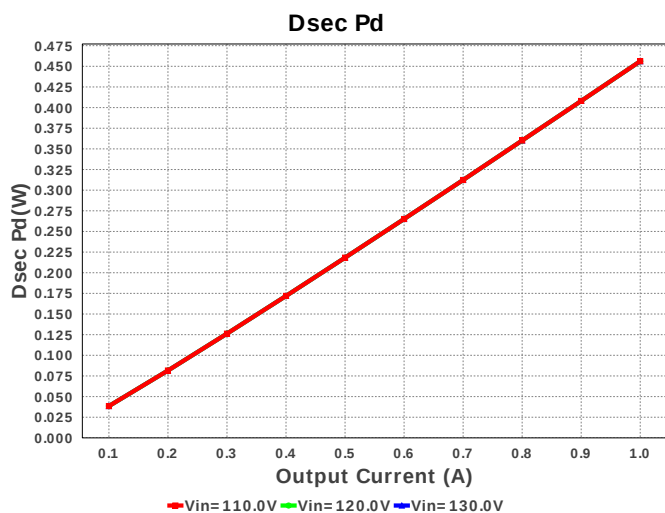


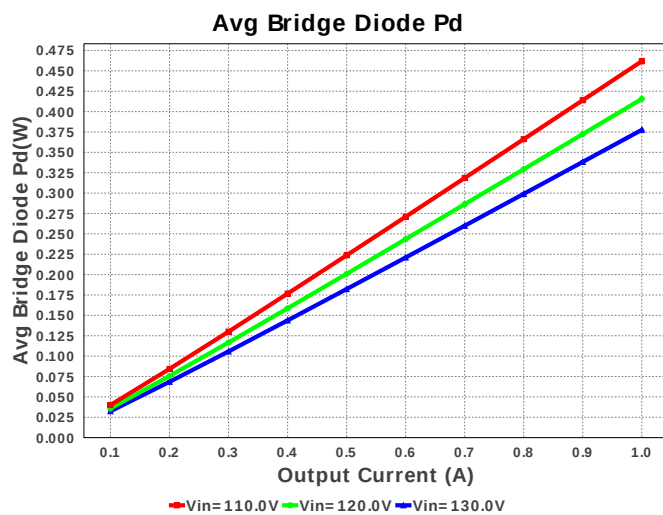
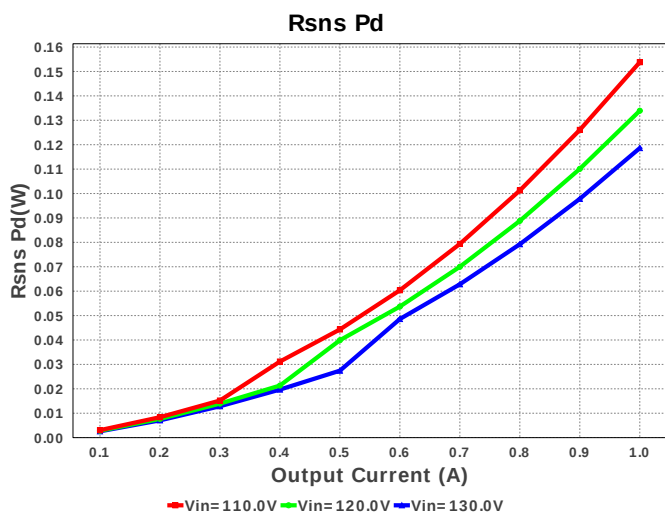
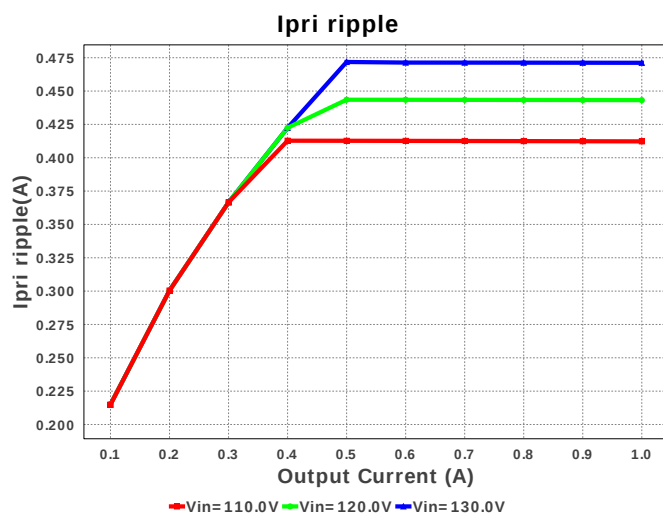
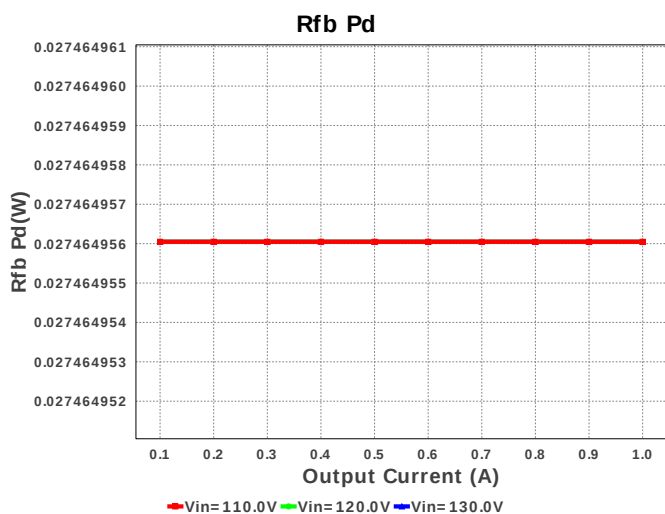
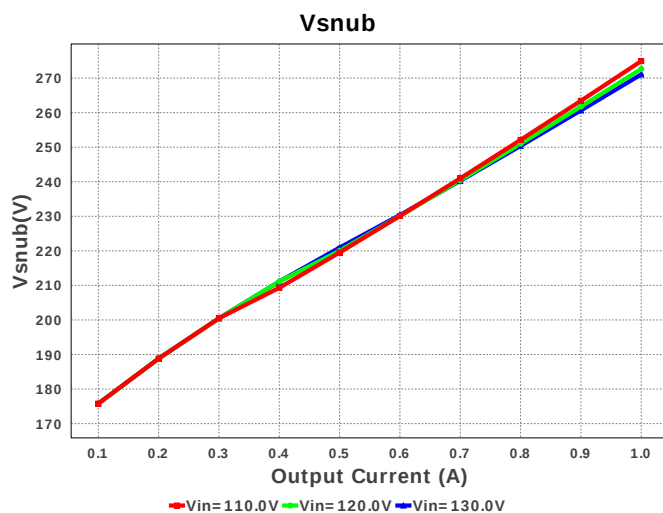
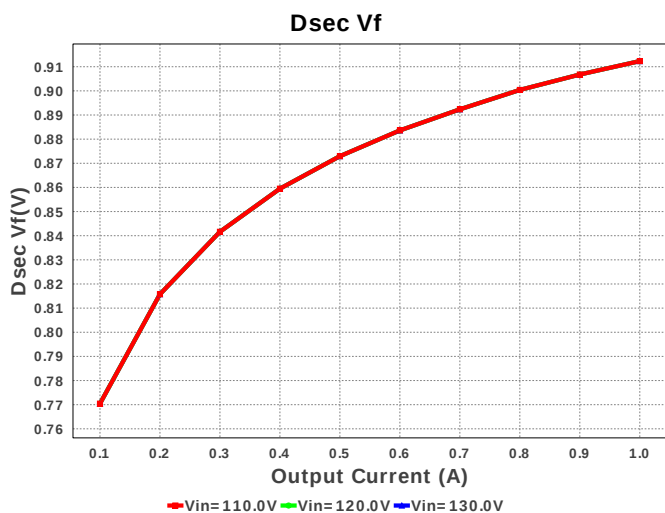


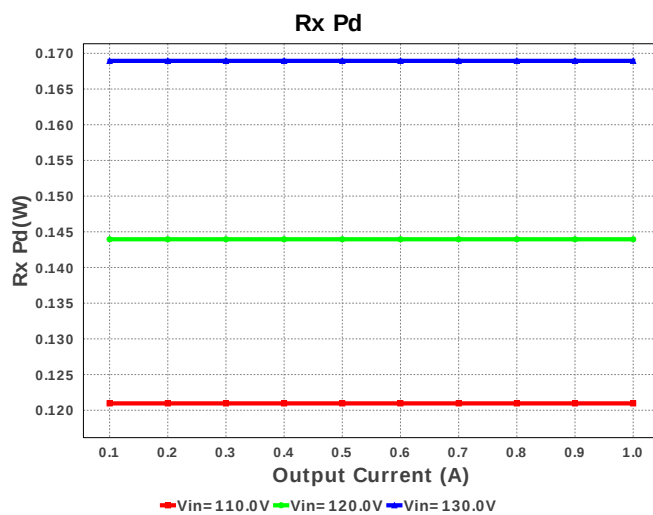
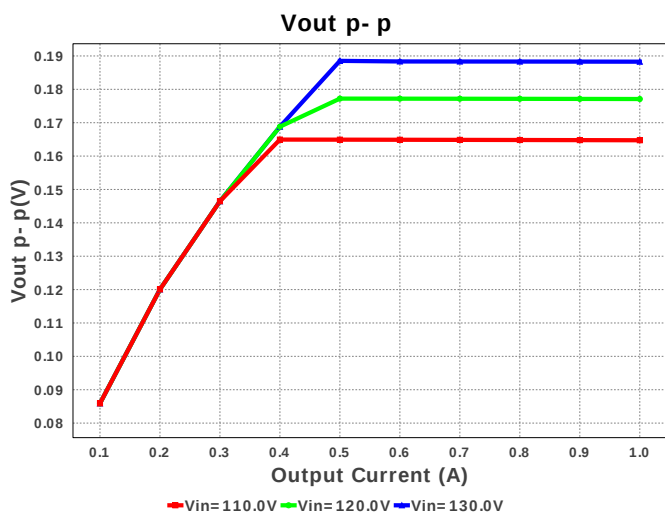
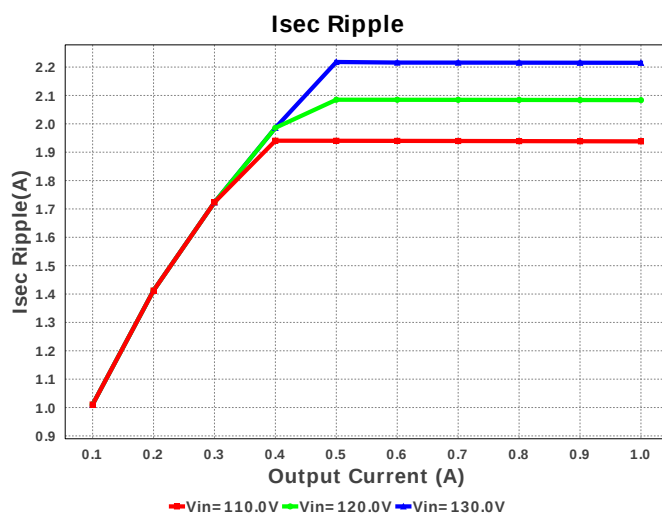
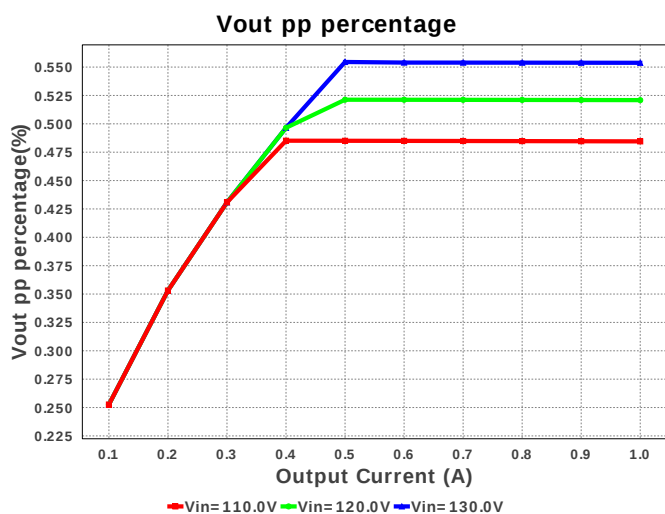
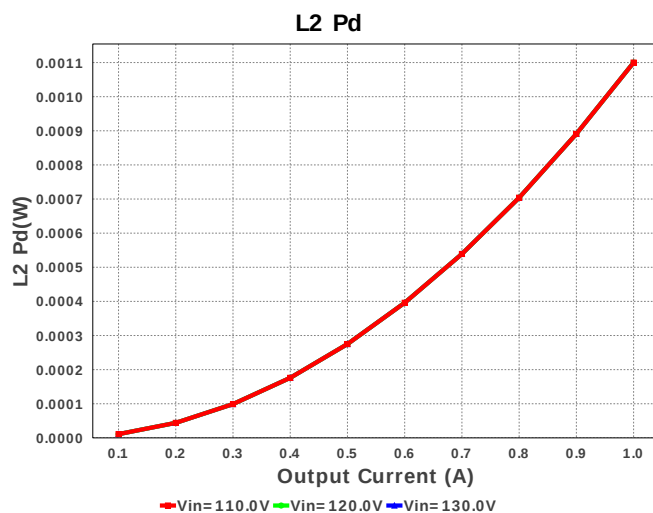
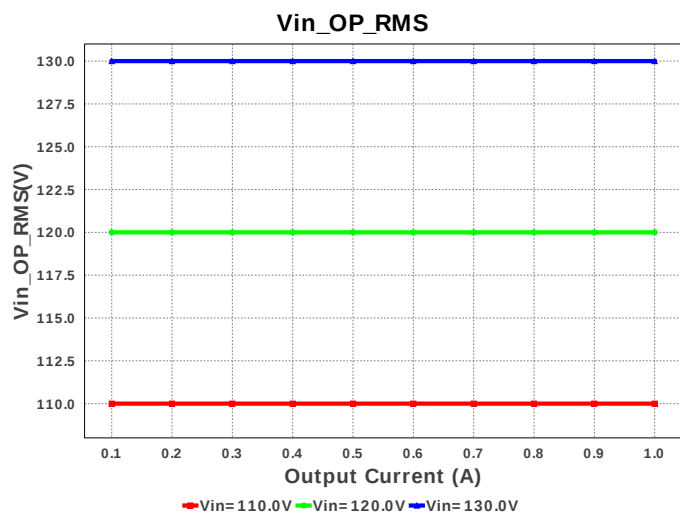


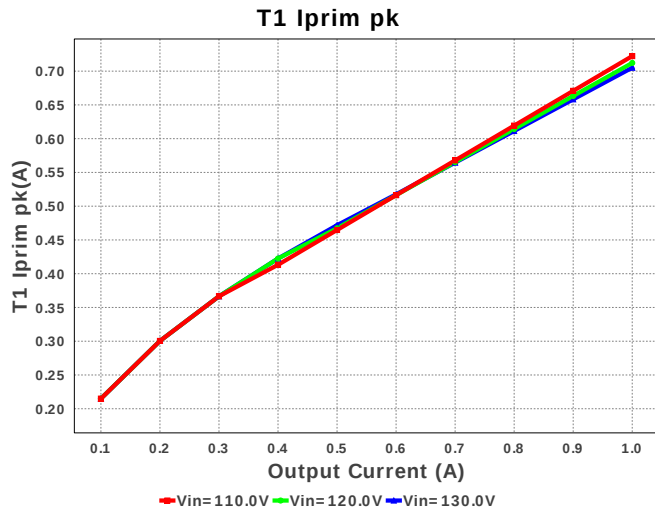












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.211 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	335.88 mA	Current	RMS Input Current
3.	Iout_DCM	399.719 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	310.911 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	412.273 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	79.875 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	1.938 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	411.105 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	722.282 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	1.57 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	3.395 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	60	General	Total Design BOM count
14.	Daux trr	0.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	912.33 mV	General	Effective Forward Voltage Drop at the Operating Current
16.	Dsec trr	30.0 ns	General	Output Diode Reverse Recovery Time
17.	Dsec2 Vf	912.33 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	30.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	5.546 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	62.774 kHz	General	Switching frequency
21.	Pout	34.0 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	6.565 us	General	Approximate Converter Off Time
25.	Ton Act	9.596 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	10.691 V	General	Auxiliary Voltage
29.	Vsnub	274.916 V	General	Voltage Across the Snubber
30.	Vout Actual	33.985 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	34.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	60.237 %	Op_point	Duty cycle
33.	Efficiency	92.023 %	Op_point	Steady state efficiency
34.	IC Tj	32.032 degC	Op_point	IC junction temperature
35.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	1.0 A	Op_point	Iout operating point
37.	M1 TJOP	44.689 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	155.562 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	110.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	164.74 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	461.759 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	78.13 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	124.571 mW	Power	Output capacitor1 power dissipation
44.	Cx Pd	0.0 W	Power	X-cap Power Dissipation
45.	Cy Pd	187.5 pW	Power	Y-caps Power Dissipation
46.	Dsec Pd	456.165 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	456.165 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	40.639 mW	Power	IC power dissipation
49.	L1 Pd	7.715 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	1.1 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period

#	Name	Value	Category	Description
51.	M1 Pd	176.97 mW	Power	M1 MOSFET total power dissipation
52.	Paux	5.208 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	180.911 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	2.357 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	27.465 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	153.797 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	120.961 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	494.181 mW	Power	Snubber Power Dissipation
59.	T1 Pd	336.481 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.947 W	Power	Total Power Dissipation
61.	Vout Tolerance	2.199 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	484.53 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	Iout1	1.0	Output Current #1
3.	Iout2	1.0	Output Current #2
4.	Iout3	2.0	Output Current #3
5.	VinMax	130.0	Maximum input voltage
6.	VinMin	110.0	Minimum input voltage
7.	Vout	34.0	Output Voltage
8.	Vout1	34.0	Output Voltage #1
9.	Vout2	3.0	Output Voltage #2
10.	Vout3	2.0	Output Voltage #3
11.	acFrequency	60.0	Light Output in Lumen
12.	base_pn	UCC28C40	Texas Instruments Base Part Number
13.	source	AC	Input Source Type
14.	ta	30.0	Ambient temperature

Design Assistance

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

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