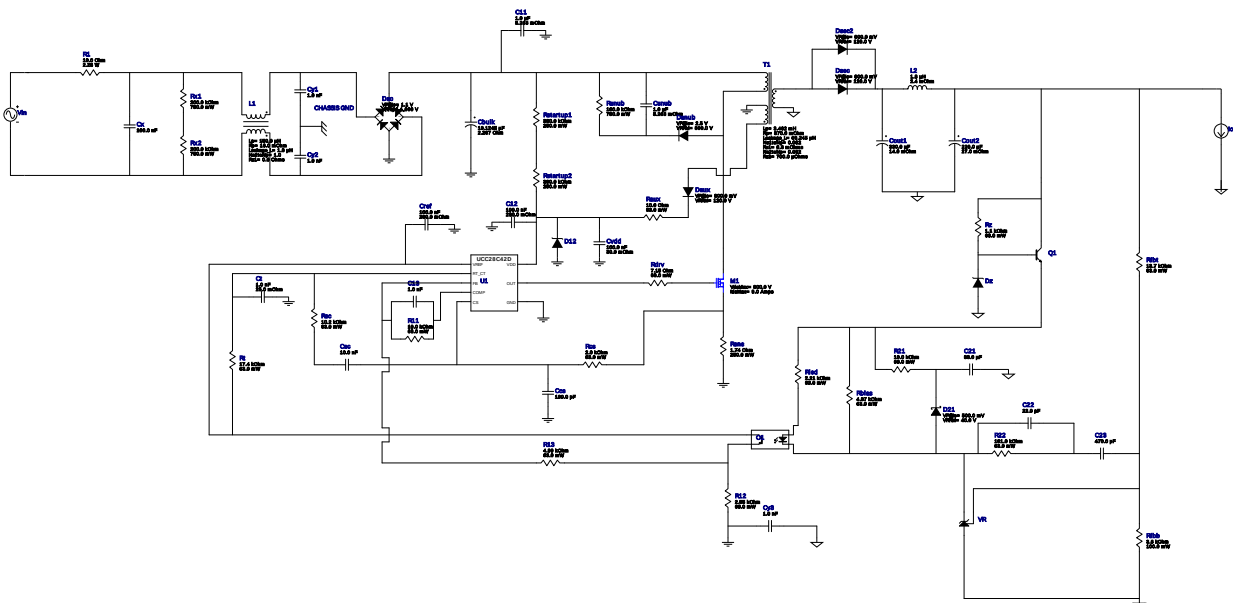


WEBENCH® Design Report

Design : 3772139/23 UCC28C42DR
UCC28C42DR 185.0V-260.0V to 12.00V @ 2.0A



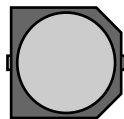
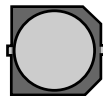
1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

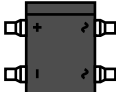
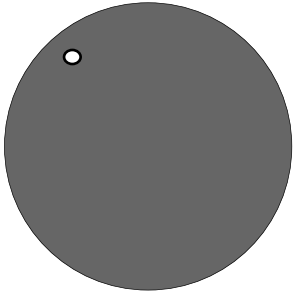
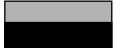
My Comments

No comments

Electrical BOM

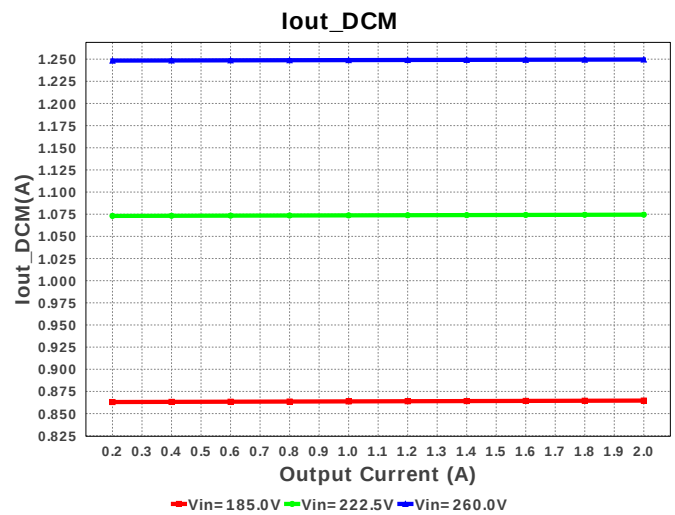
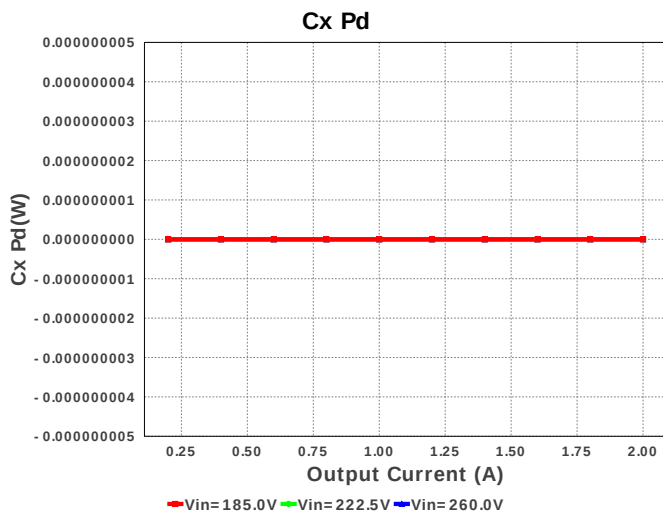
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung 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	MuRata	KCM55WR7YA336MH01K Series= X7R	Cap= 33.0 uF VDC= 35.0 V IRMS= 0.0 A	1	\$1.51	 KCM55W 59 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	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 18.1245 uF ESR= 2.26738 Ohm VDC= 441.23 V IRMS= 314.8 mA	1	NA	CUSTOM 0 mm ²
8.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

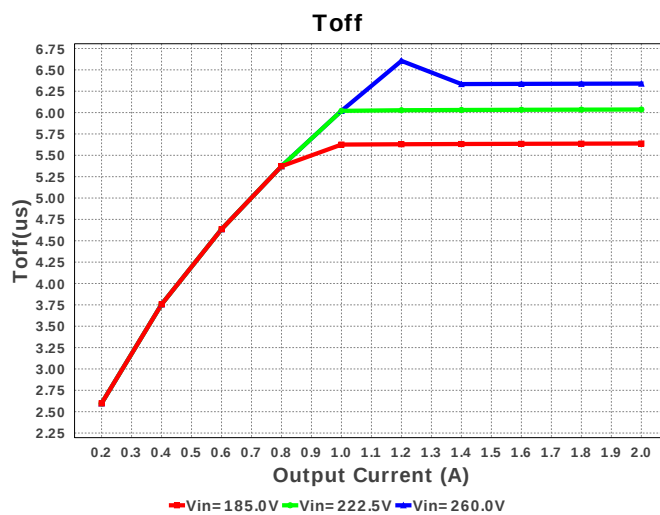
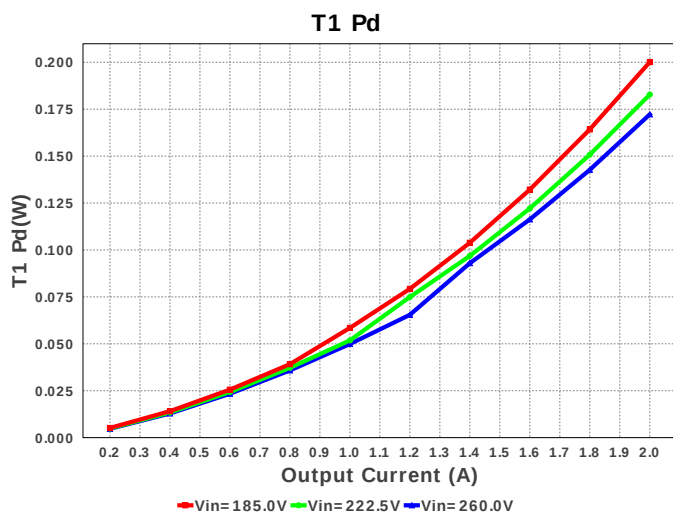
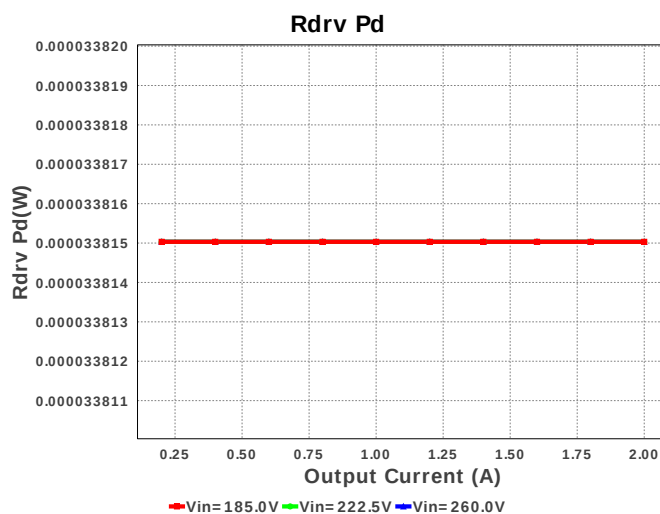
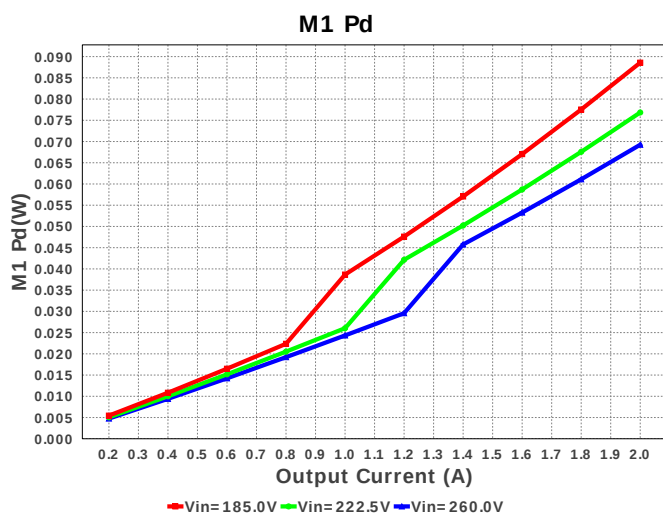
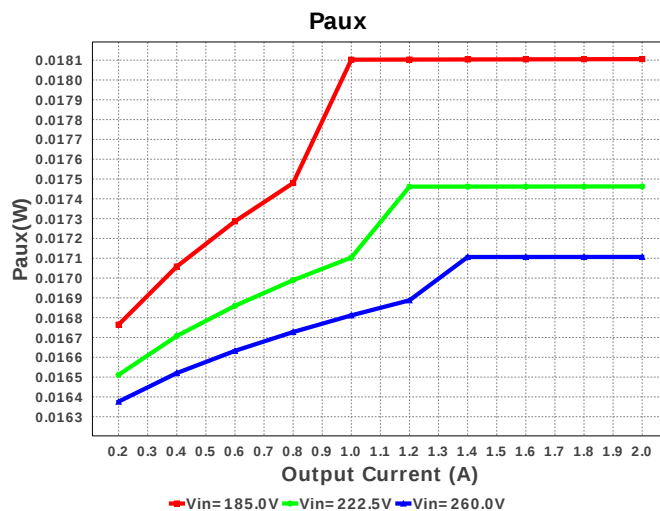
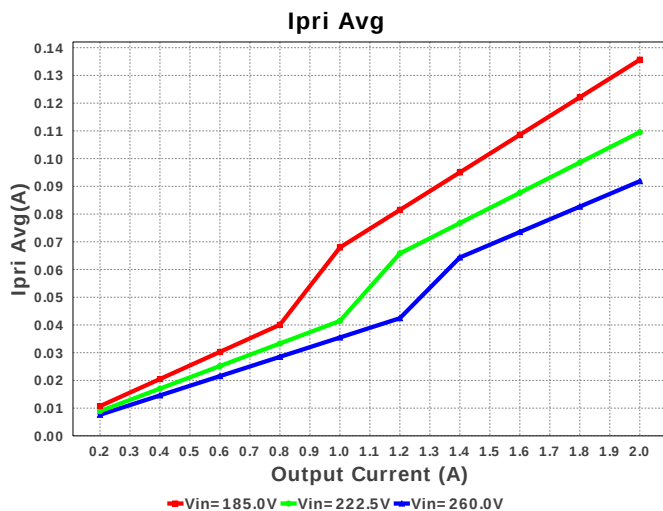
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9.	Cout1	Panasonic	25SVPF330M Series= ?	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	1	\$0.70	 CAPSMT_62_F12 151 mm²
10.	Cout2	Panasonic	EEHZA1E221P Series= ?	Cap= 220.0 uF ESR= 27.0 mOhm VDC= 25.0 V IRMS= 2.3 A	1	\$1.12	 SM_RADIAL_8MM 113 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	GRM188R71E104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 1.51 A	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	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm²
18.	Cy2	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm²

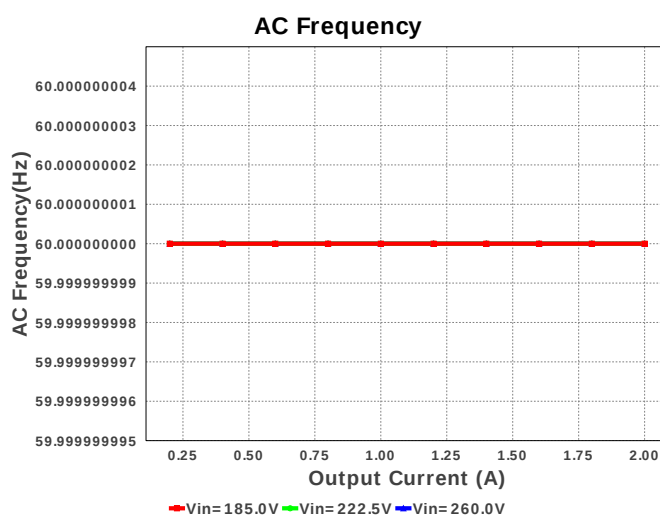
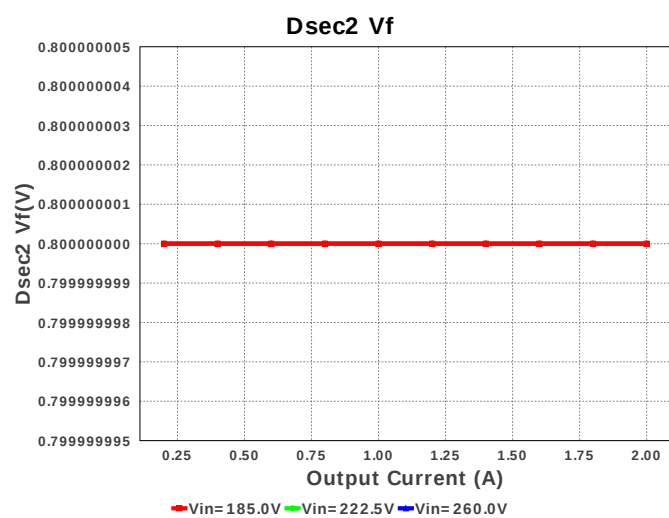
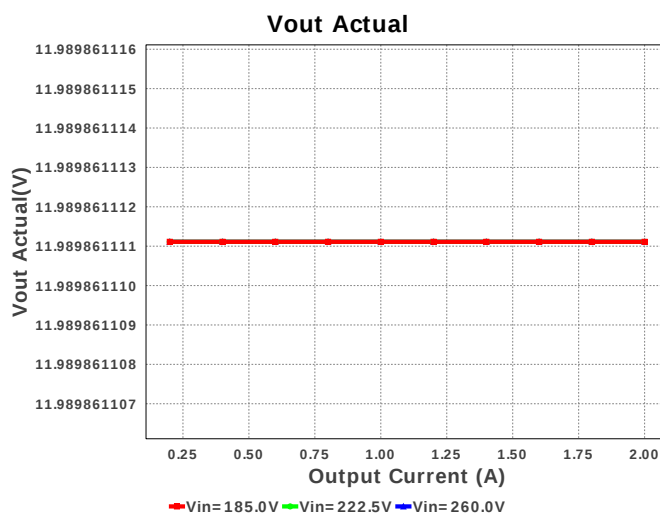
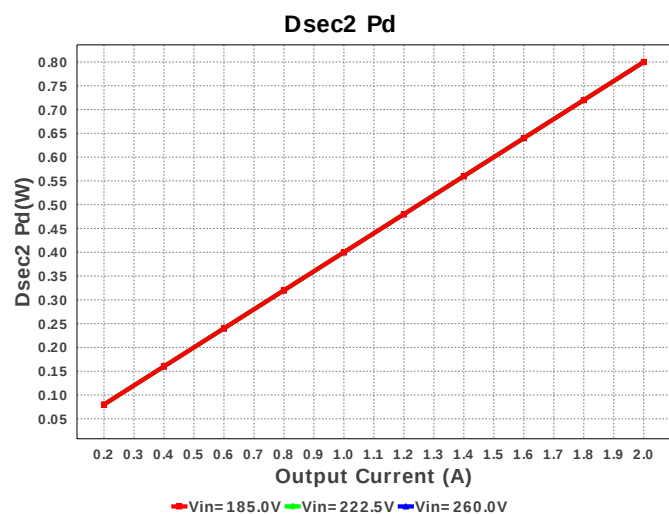
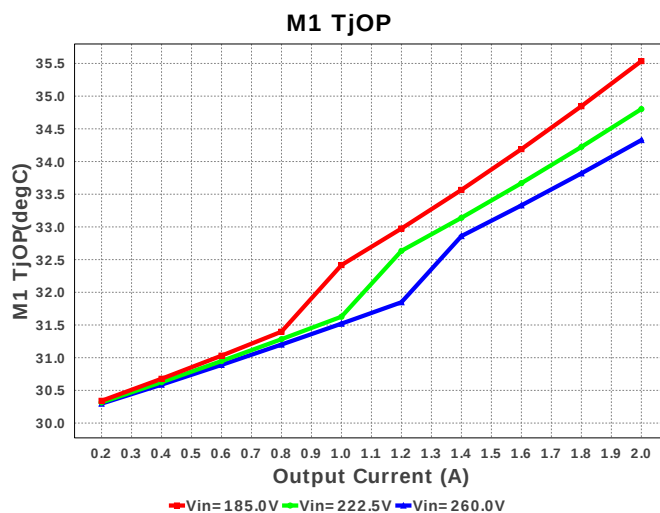
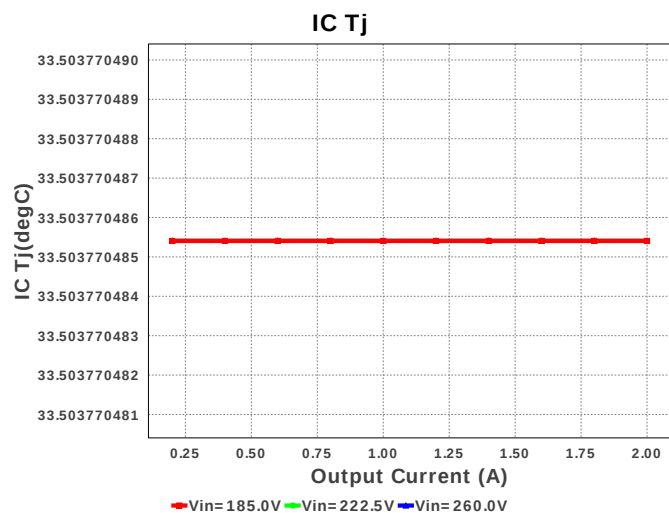
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
19.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF VDC= 3.0 kV IRMS= 0.0 A	1	\$0.22	 B81123_1800x500x1050 140 mm ²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
21.	D21	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.08	 SMA 37 mm ²
22.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	\$0.24	 DF-S 99 mm ²
23.	Daux	Vishay-Semiconductor	V12P12-M3/86A	VF@Io= 800.0 mV VRRM= 120.0 V	1	\$0.40	 TO-277A 56 mm ²
24.	Dsec	Vishay-Semiconductor	V12P12-M3/86A	VF@Io= 800.0 mV VRRM= 120.0 V	1	\$0.40	 TO-277A 56 mm ²
25.	Dsec2	Vishay-Semiconductor	V12P12-M3/86A	VF@Io= 800.0 mV VRRM= 120.0 V	1	\$0.40	 TO-277A 56 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	ON Semiconductor	BZX84C9V1LT1G	Zener	1	\$0.02	 SOT-23 14 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	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
30.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	\$2.52	 TO-220FP 79 mm ²
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²

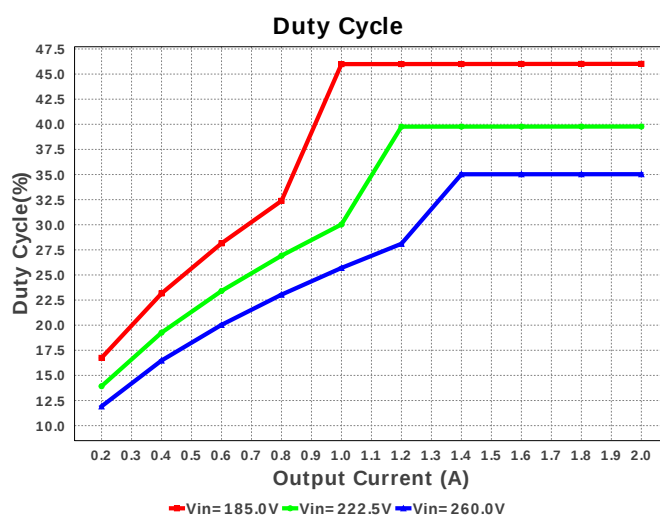
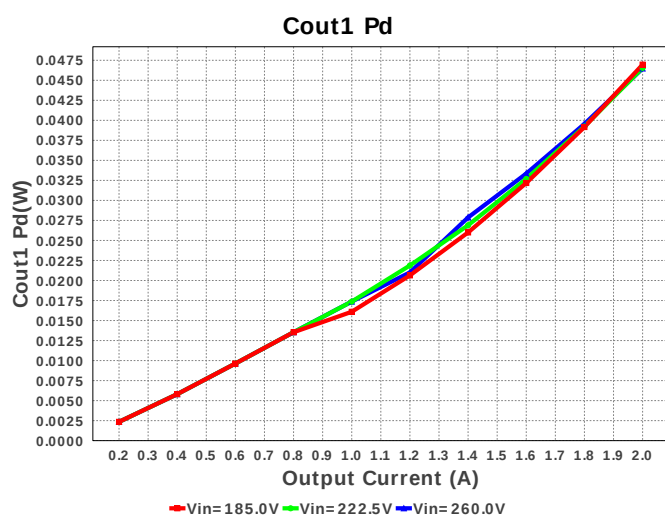
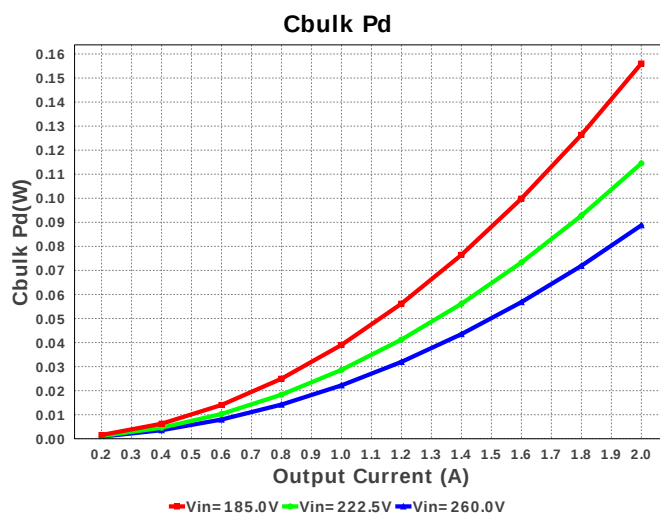
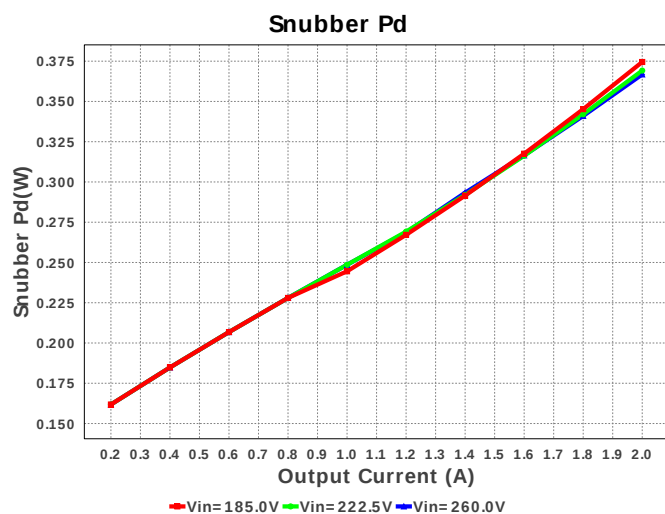
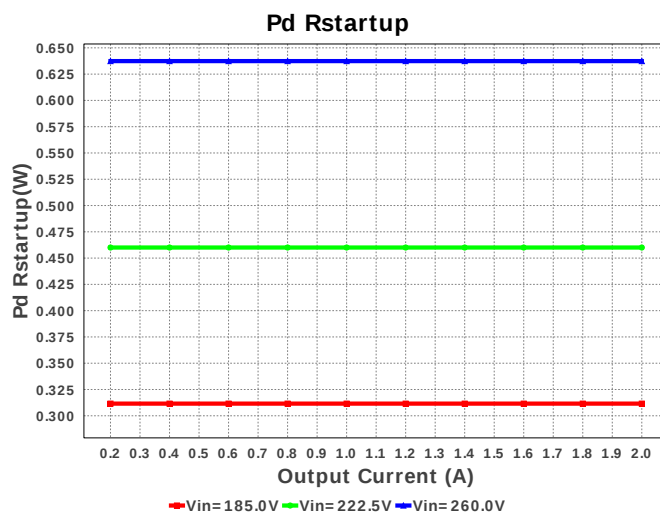
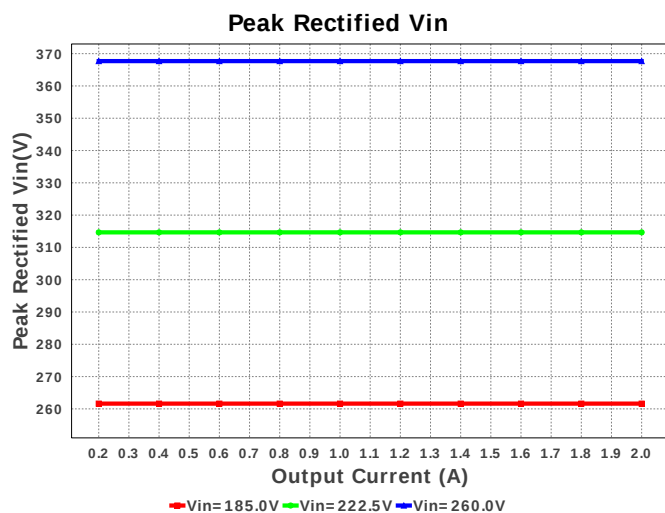
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
32.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm ²
34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
35.	R12	Vishay-Dale	CRCW04022K55FKED Series= CRCW..e3	Res= 2.55 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	CRCW0402191KFKED Series= CRCW..e3	Res= 191.0 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	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 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	CRCW04027R15FKED Series= CRCW..e3	Res= 7.15 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 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	CRCW04022K21FKED Series= CRCW..e3	Res= 2.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
46.	Rsc	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
47.	Rsns	Vishay-Dale	CRCW12061R74FKEA Series= CRCW..e3	Res= 1.74 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
48.	Rsnu	Vishay-Dale	CRCW2010160KFKEF Series= ?	Res= 160.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
49.	Rstartup1	Yageo America	RC1206FR-07390KL Series= ?	Res= 390.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
50.	Rstartup2	Yageo America	RC1206FR-07390KL Series= ?	Res= 390.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
51.	Rt	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
52.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²

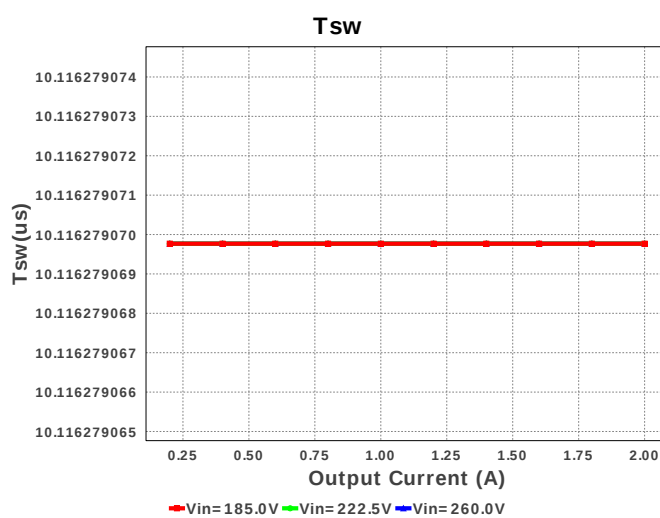
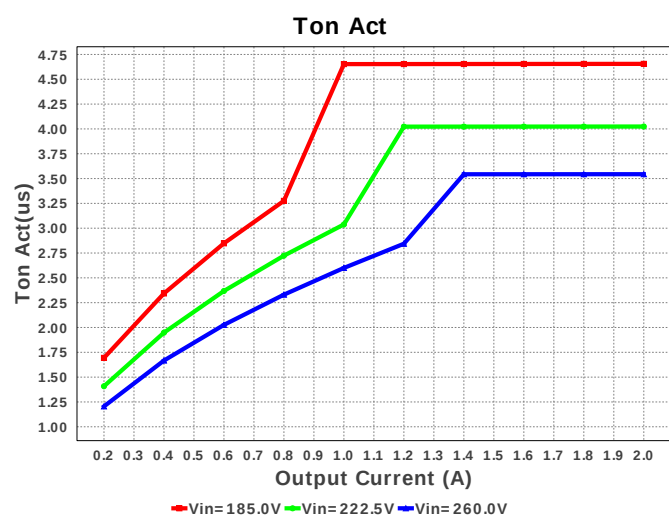
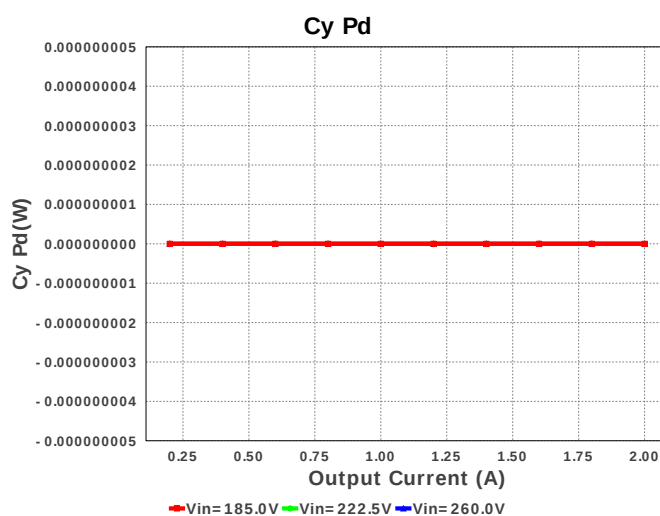
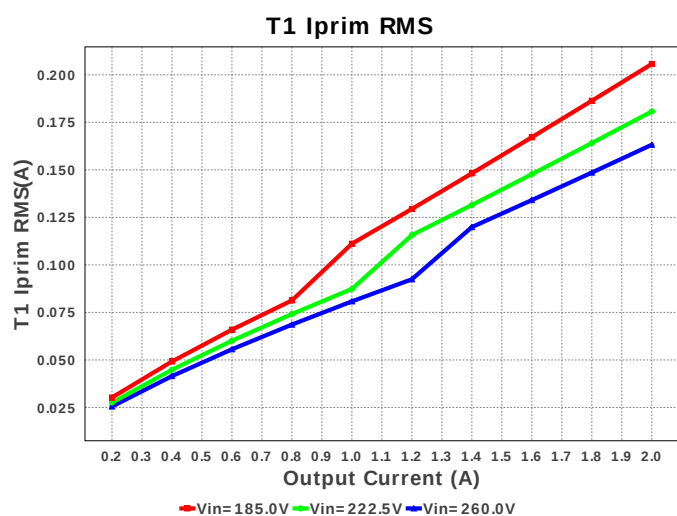
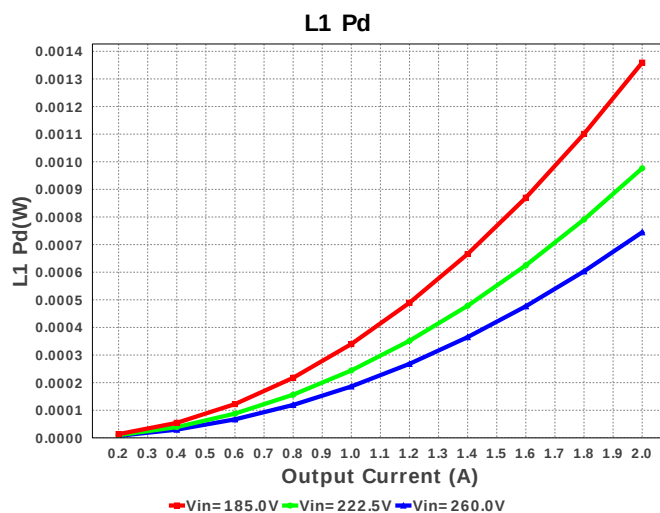
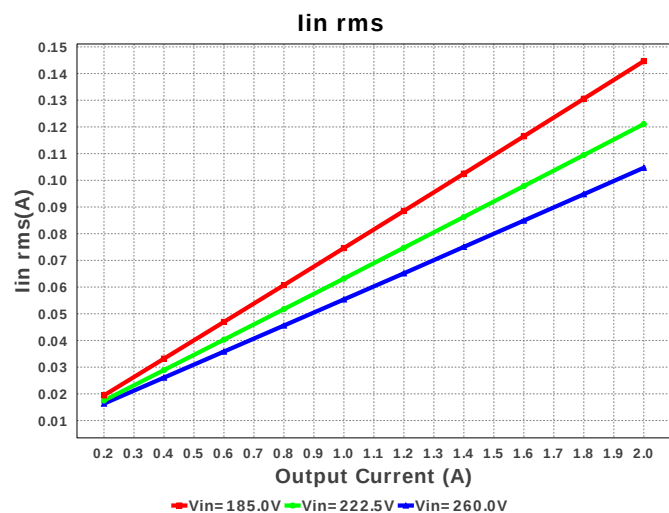
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
53.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
54.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW...e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
55.	T1	CUSTOM	CUSTOM	Lp= 3.462 mH Rp= 870.0 mOhm Leakage_L= 69.245 μH Ns1toNp= 0.082 Rs1= 8.6 mOhms Ns2toNp= 0.092 Rs2= 700.0 μOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC28C42DR	Switcher	1	\$0.60	 D0008A 57 mm ²
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²

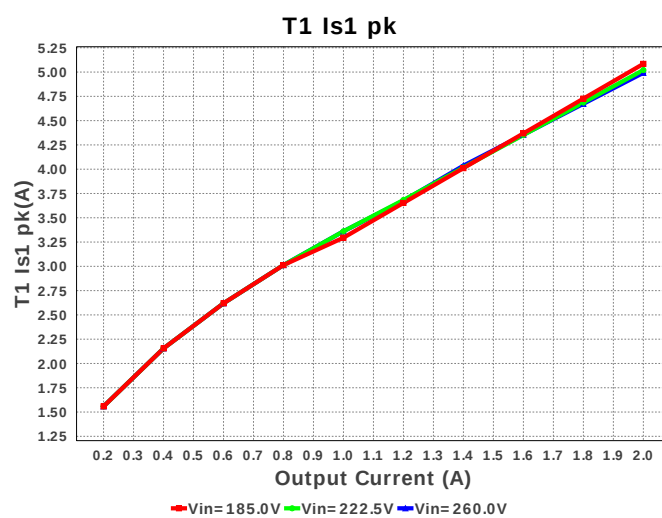
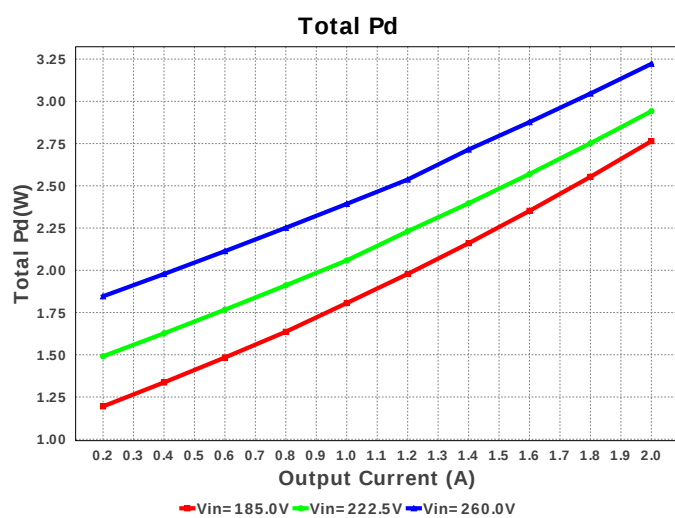
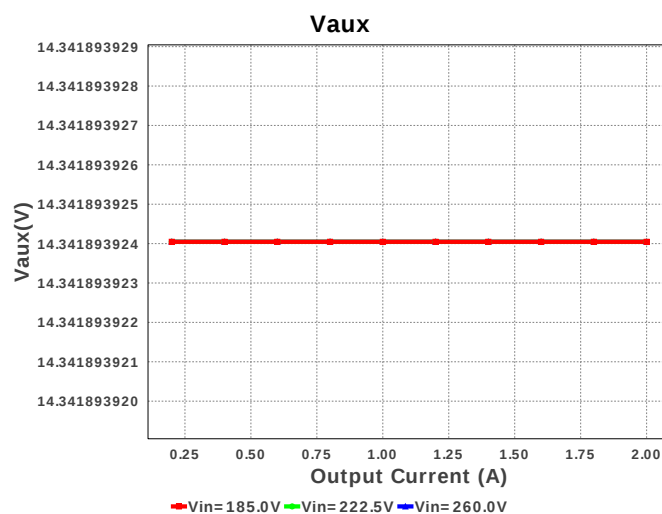
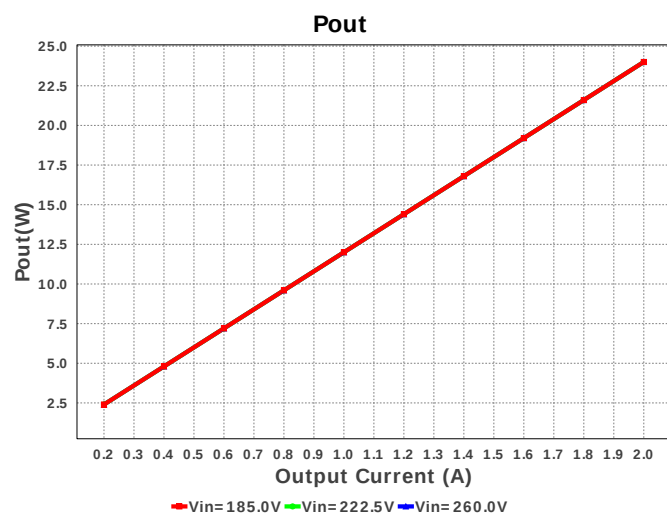
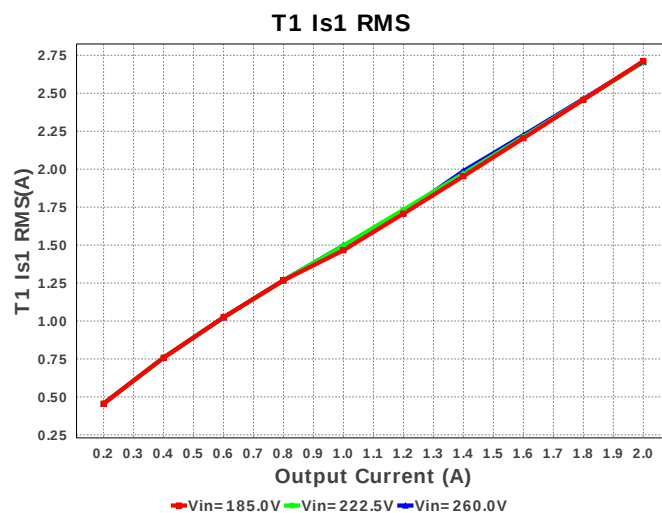
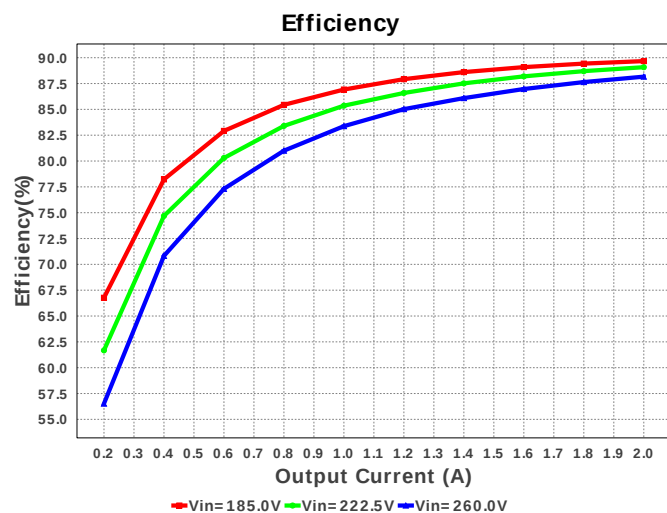


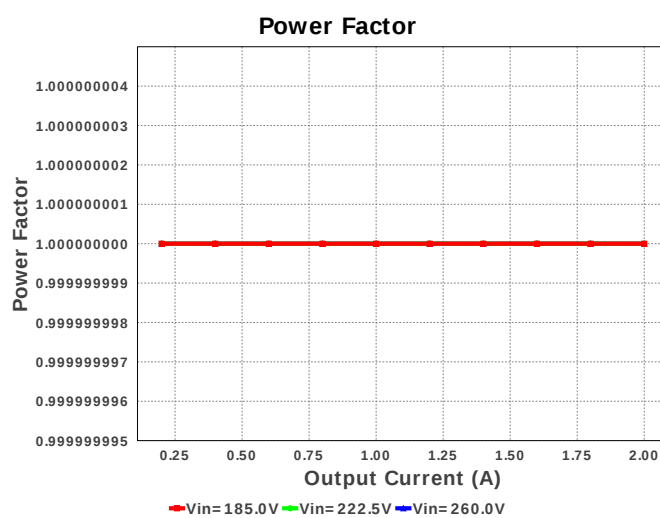
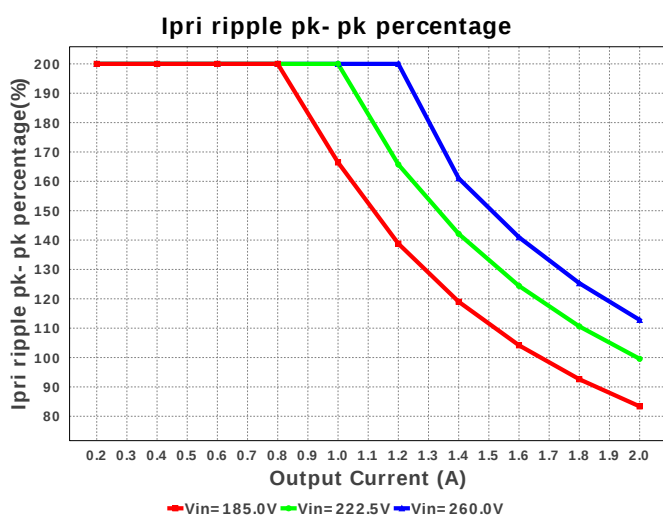
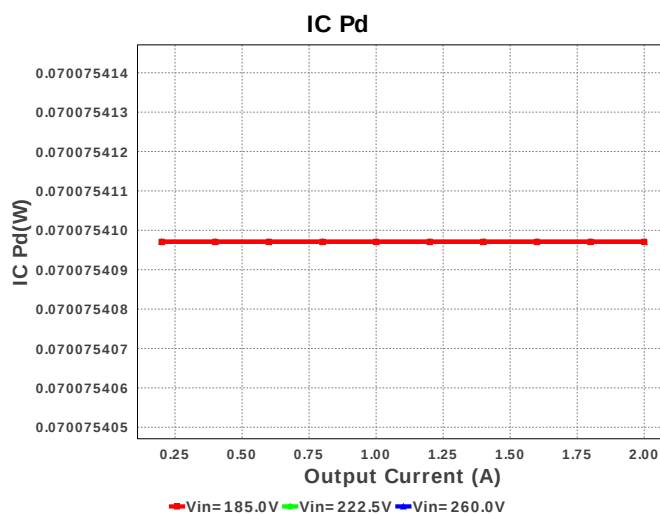
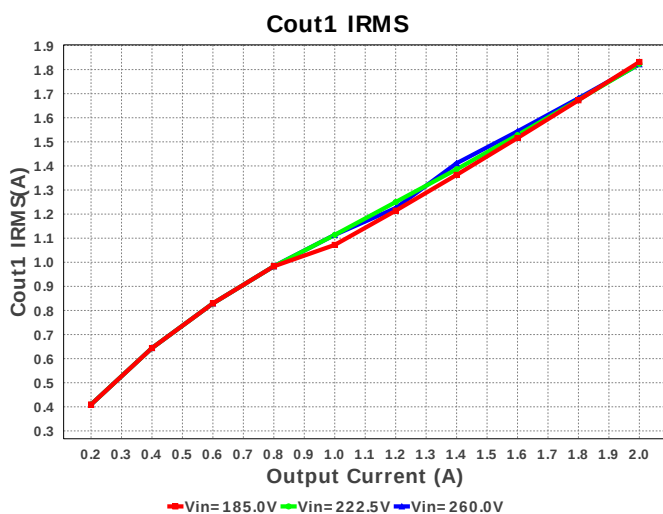
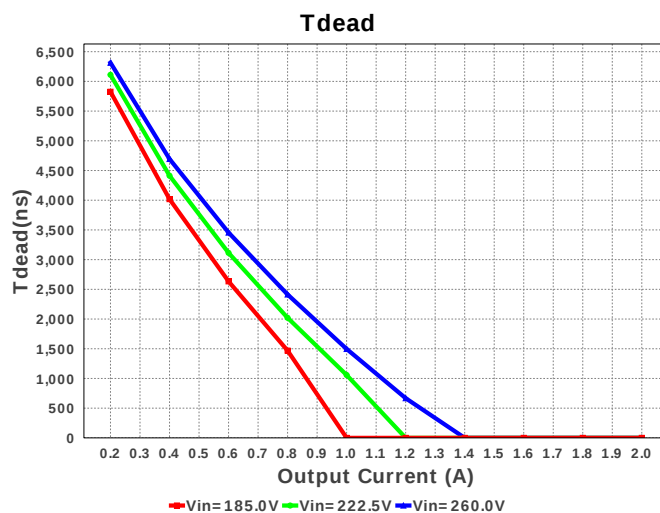
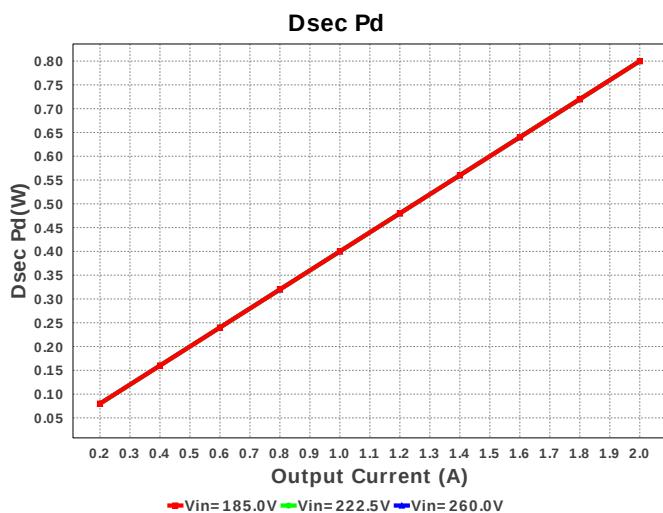


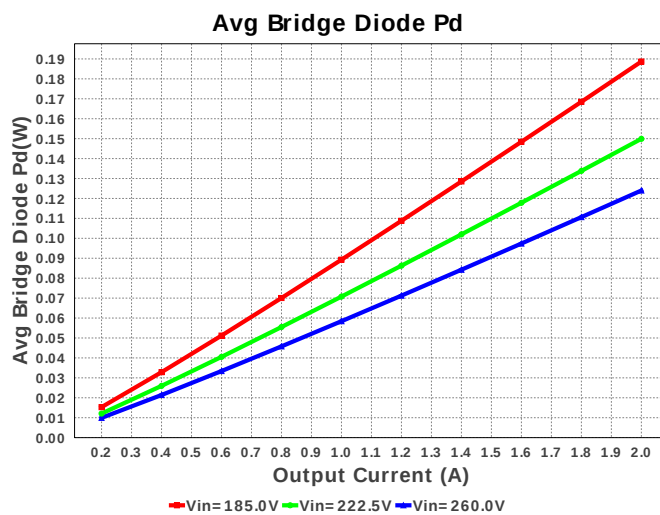
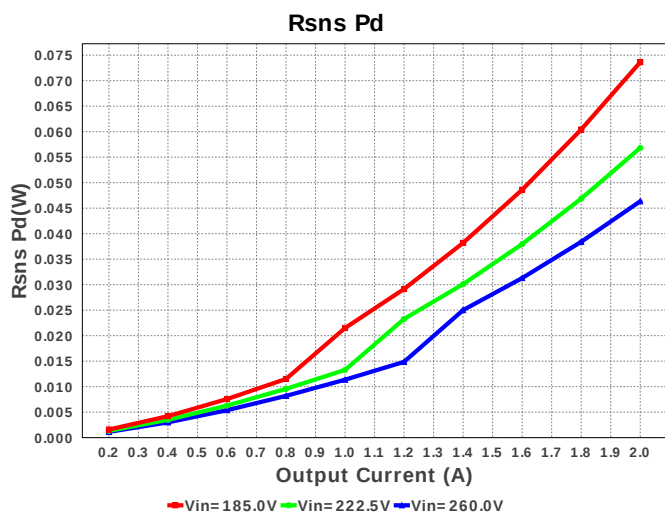
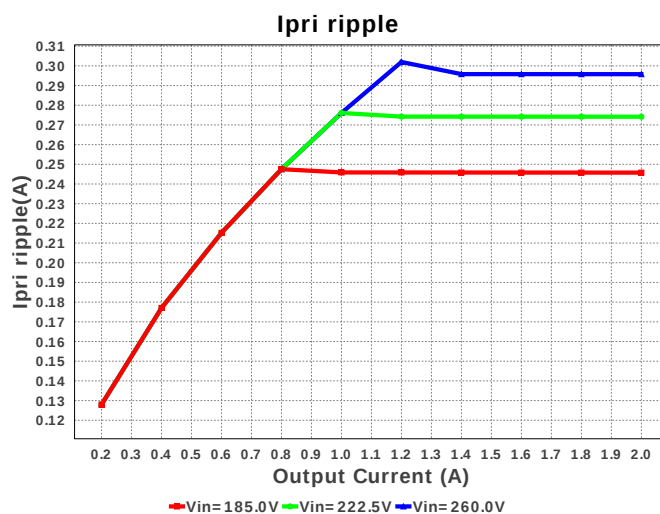
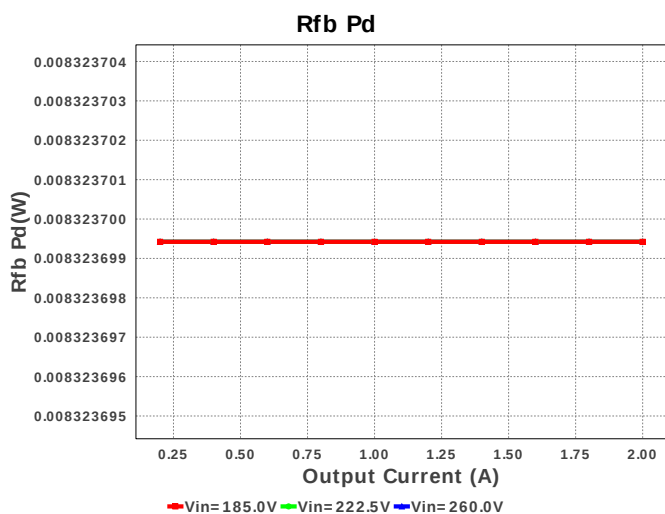
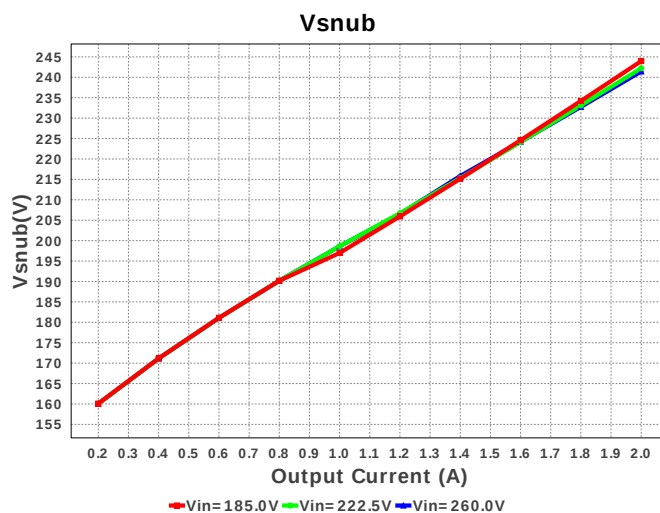
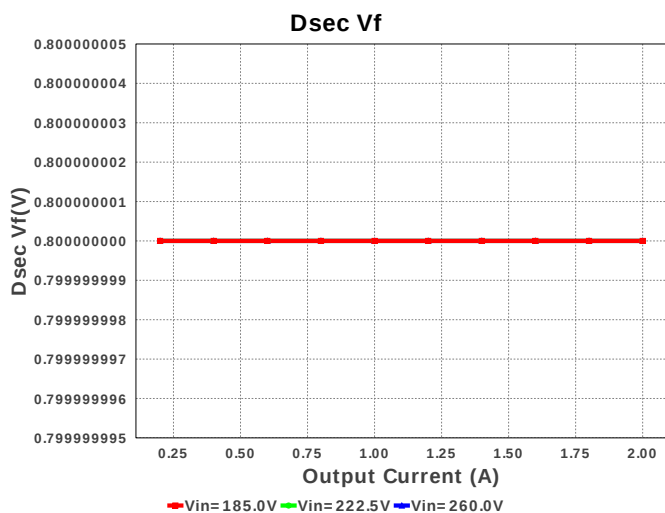


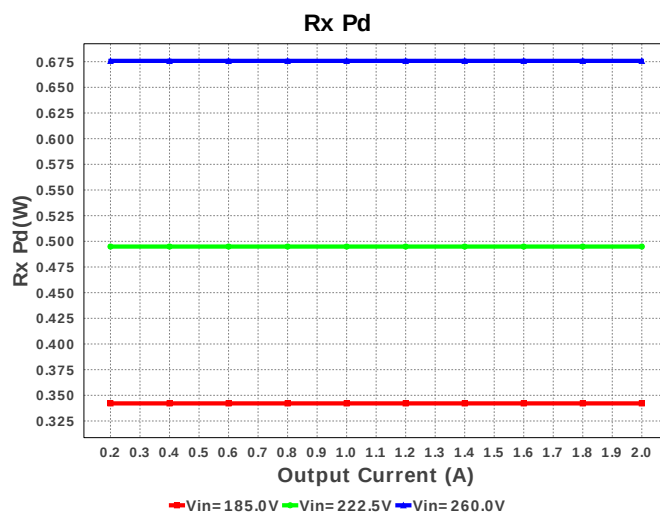
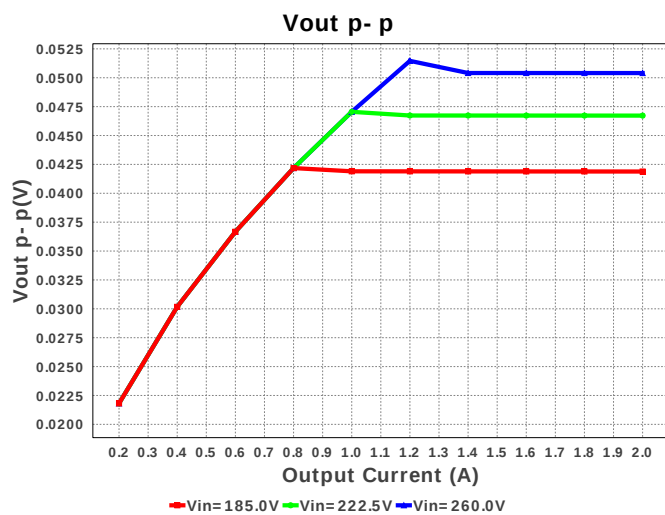
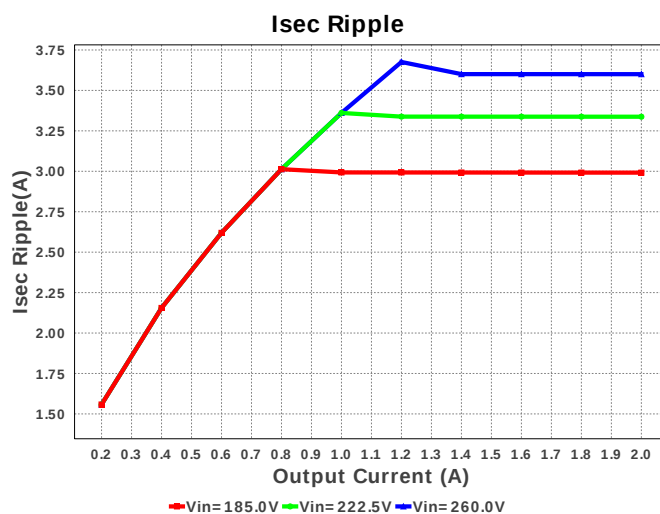
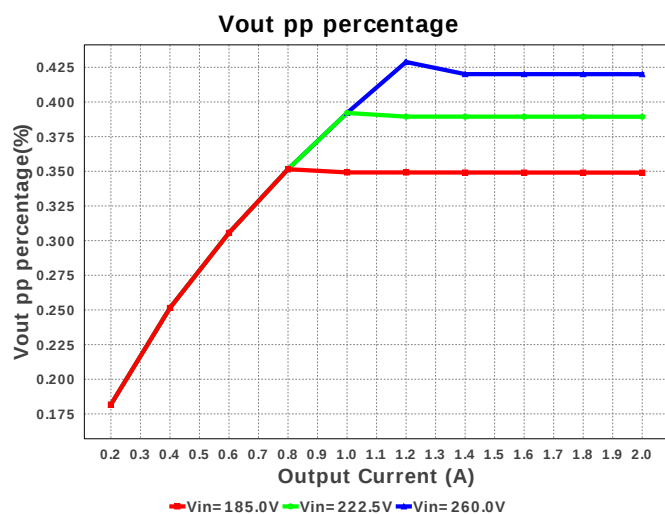
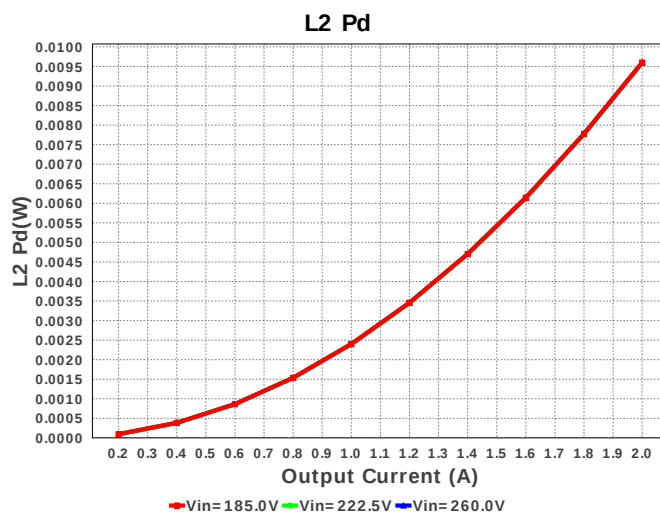
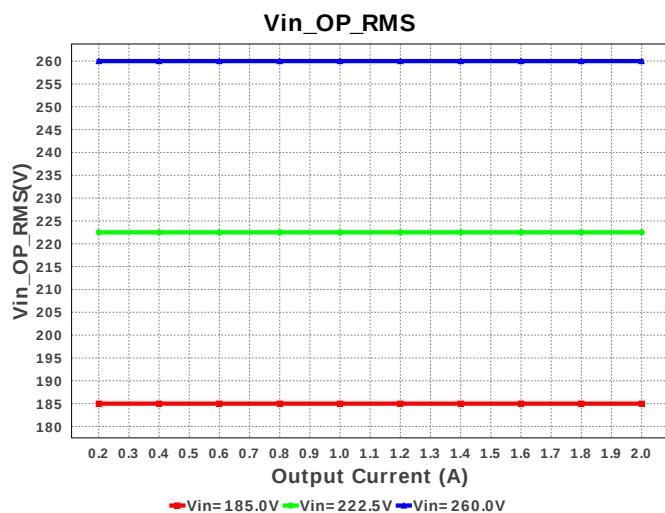


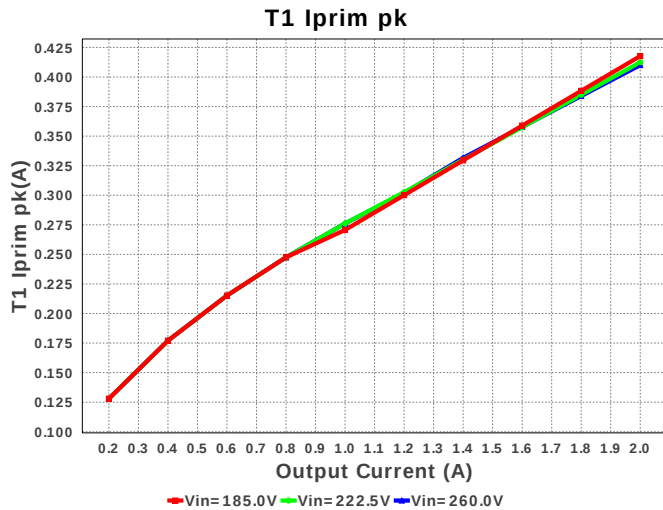












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.832 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	144.67 mA	Current	RMS Input Current
3.	Iout_DCM	864.662 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	135.659 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	245.765 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	83.366 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	2.992 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	205.691 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	417.686 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	2.712 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.084 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	50.0 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	800.0 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	800.0 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.092 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	98.851 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	5.638 us	General	Approximate Converter Off Time
25.	Ton Act	4.655 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	10.116 us	General	Switching Time Period
28.	Vaux	14.342 V	General	Auxiliary Voltage
29.	Vsnub	243.968 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	46.017 %	Op_point	Duty cycle
33.	Efficiency	89.671 %	Op_point	Steady state efficiency
34.	IC Tj	33.504 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	35.536 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	261.627 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	185.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	41.883 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	188.681 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	156.034 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	46.962 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	800.0 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	800.0 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	70.075 mW	Power	IC power dissipation
49.	L1 Pd	1.359 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	9.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period

#	Name	Value	Category	Description
51.	M1 Pd	88.574 mW	Power	M1 MOSFET total power dissipation
52.	Paux	18.105 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	311.564 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	33.815 μ W	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	73.618 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	342.14 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	374.501 mW	Power	Snubber Power Dissipation
59.	T1 Pd	200.114 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.764 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	349.024 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	260.0	Maximum input voltage
3.	VinMin	185.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	line_fsw	50.0	Light Output in Lumen
6.	base_pn	UCC28C42	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC28C42** Product Folder : <http://www.ti.com/product/UCC28C42> : contains the data sheet and other resources.

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