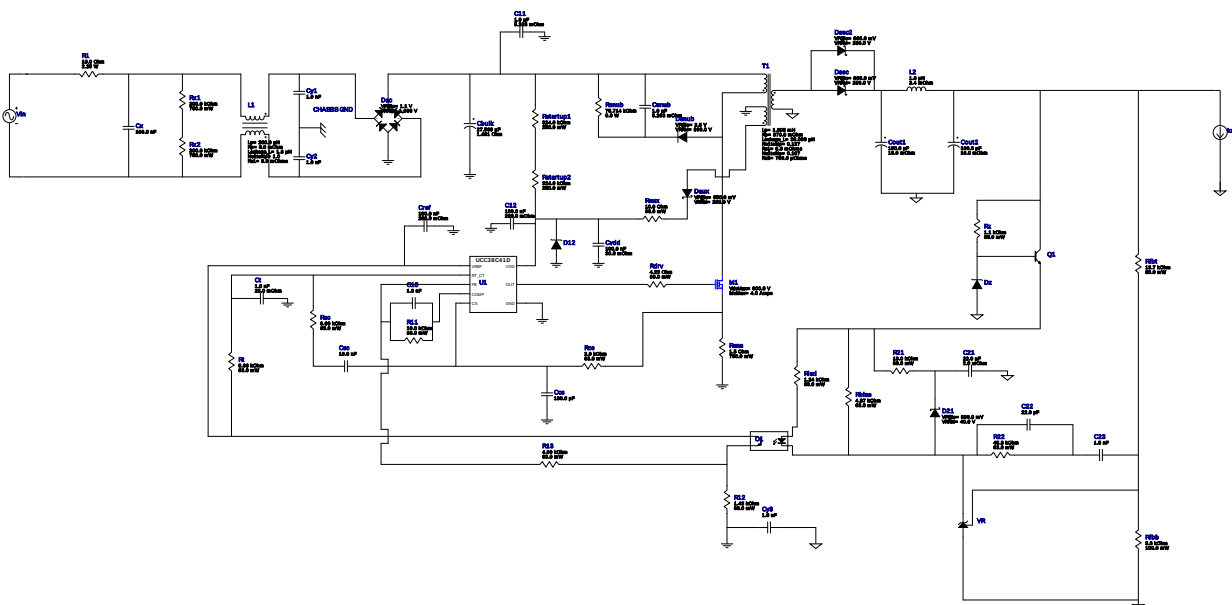


WEBENCH® Design Report

Design : 4161985/9 UCC38C41DR
UCC38C41DR 150.0V-265.0V to 12.00V @ 2.0A

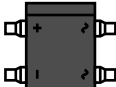
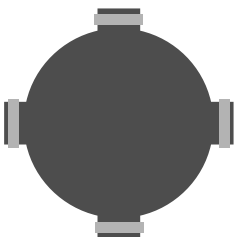


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

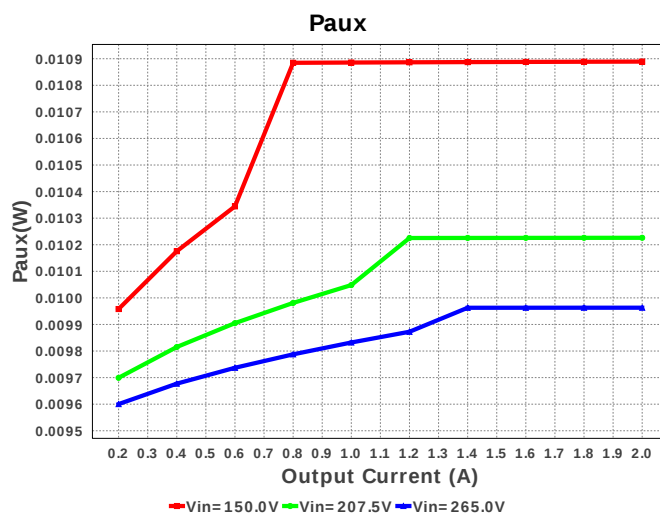
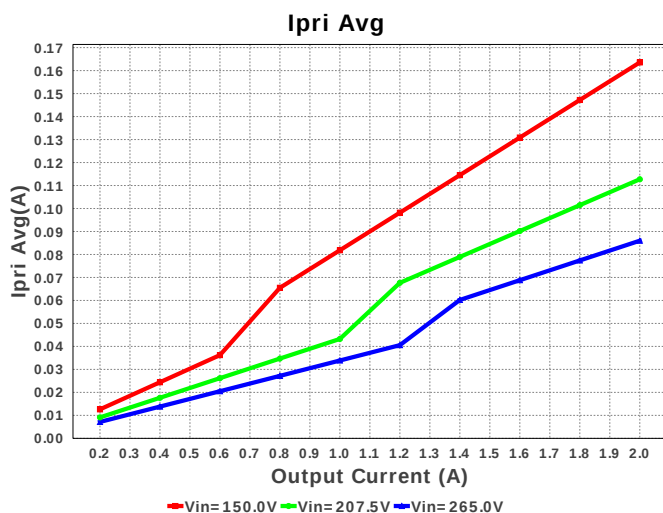
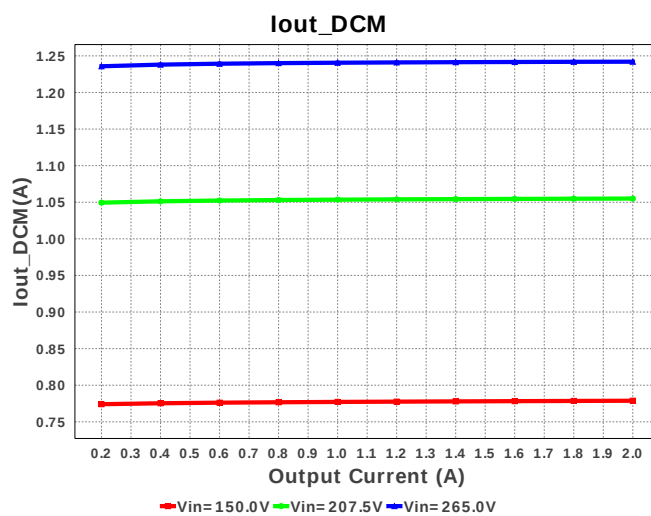
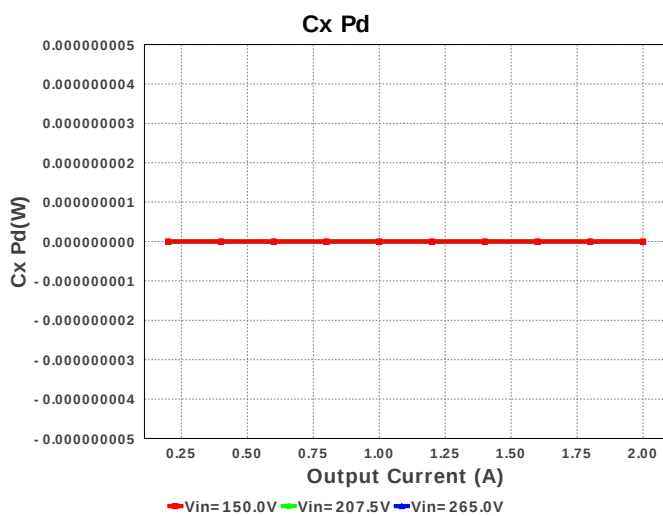
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung 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	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	 1210 15 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	CC0805KRX7R9BB152 Series= X7R	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 27.569 uF ESR= 1.49078 Ohm VDC= 449.72 V IRMS= 420.6 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

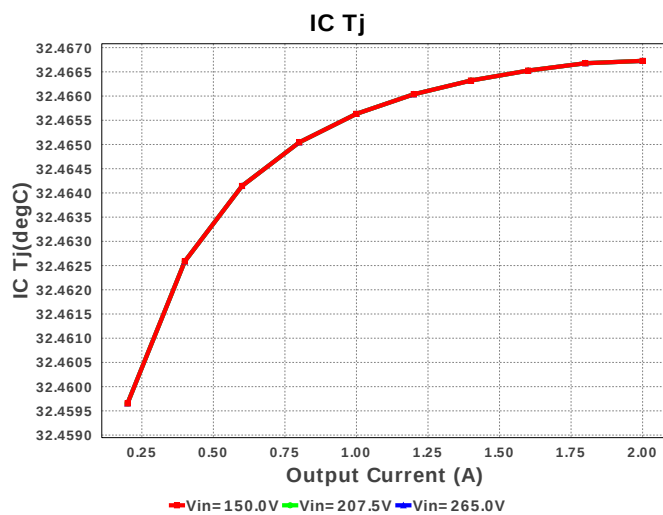
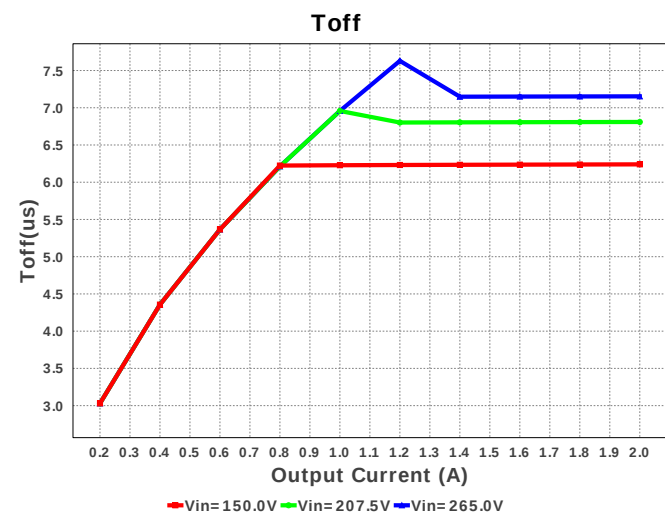
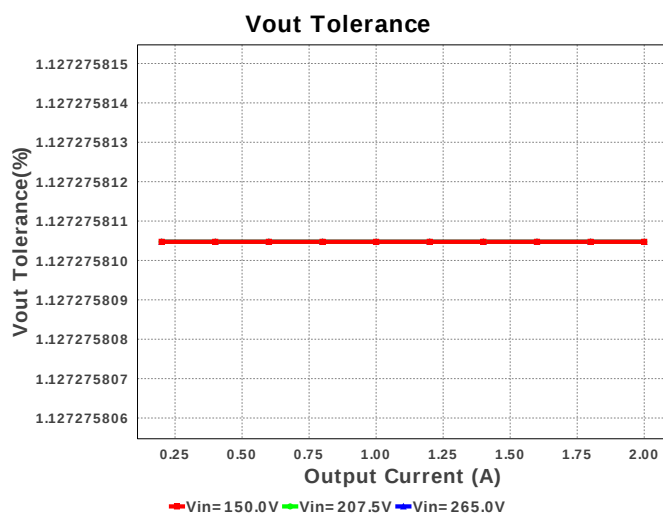
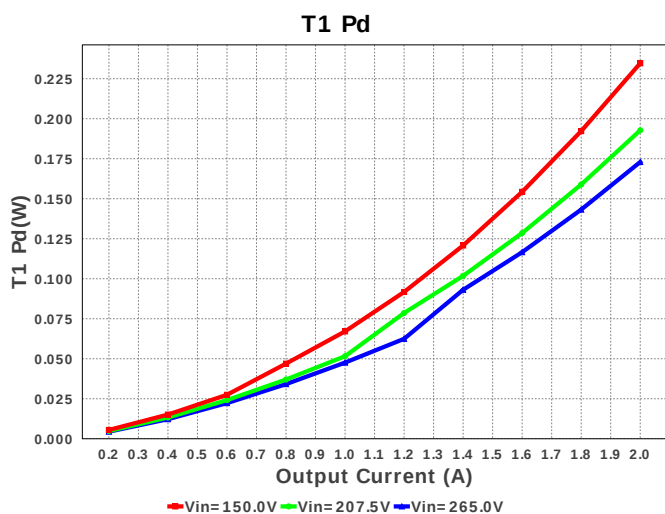
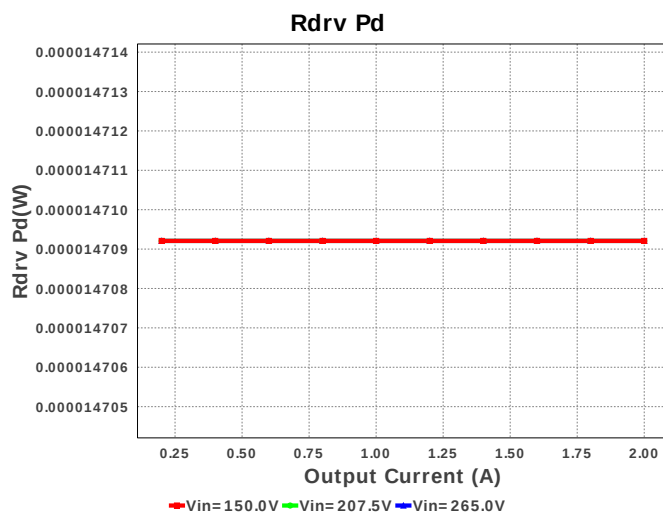
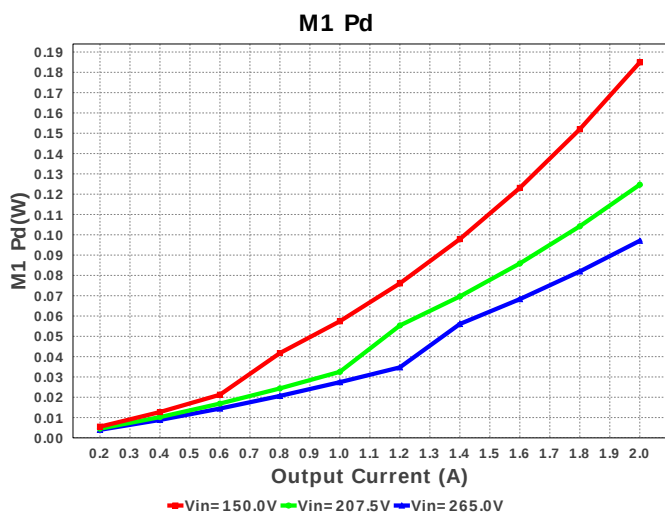
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9.	Cout1	Panasonic	25SVPF180M Series= SVPF	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	1	\$0.61	 CAPSMT_62_E12 106 mm ²
10.	Cout2	Panasonic	25SVPF180M Series= SVPF	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	1	\$0.61	 CAPSMT_62_E12 106 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	Kemet	F845FE104M760A Series= 2231	Cap= 100.0 nF VDC= 1.5 kV IRMS= 0.0 A	1	\$1.16	 F845FE 419 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	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	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	\$0.21	 PowerDI123 13 mm ²
24.	Dsec	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 DDPAK 210 mm ²
25.	Dsec2	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 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	ON Semiconductor	BZX84C9V1LT1G	Zener	1	\$0.02	 SOT-23 14 mm ²
28.	L1	Bourns	PM3700-10-RC	Lp= 200.0 µH Rp= 8.0 mOhm Leakage_L= 1.6 µH Ns1toNp= 1.0 Rs1= 8.0 mOhms	1	\$1.26	 PM3700 557 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	STB4NK60ZT4	VdsMax= 600.0 V IdsMax= 4.0 Amps	1	\$0.53	 DDPAK 210 mm ²

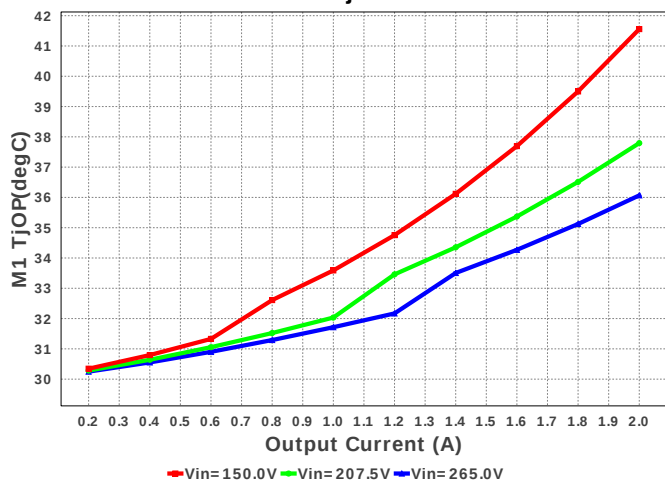
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
32.	Q1	ON Semiconductor	BC848CLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 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	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 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	CRCW040245K3FKED Series= CRCW..e3	Res= 45.3 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	CRCW04024R22FKED Series= CRCW..e3	Res= 4.22 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	CRCW04021K24FKED Series= CRCW..e3	Res= 1.24 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
46.	Rsc	Vishay-Dale	CRCW04029K09FKED Series= CRCW..e3	Res= 9.09 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
47.	Rsns	Stackpole Electronics Inc	RMCF2010FT1R50 Series= ?	Res= 1.5 Ohm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm ²
48.	Rsnu	CUSTOM	CUSTOM Series= ?	Res= 75.714 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
49.	Rstartup1	Panasonic	ERJ-8ENF3243V Series= ERJ-8E	Res= 324.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
50.	Rstartup2	Panasonic	ERJ-8ENF3243V Series= ERJ-8E	Res= 324.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
51.	Rt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 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 mm²
53.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.03	 2010 32 mm²
54.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
55.	T1	CUSTOM	CUSTOM	Lp= 1.905 mH Rp= 870.0 mOhm Leakage_L= 38.098 µH Ns1toNp= 0.127 Rs1= 8.6 mOhms Ns2toNp= 0.107 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
56.	U1	Texas Instruments	UCC38C41DR	Switcher	1	\$0.70	
57.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	\$0.08	 D0008A 57 mm² DBZ0003A 14 mm²

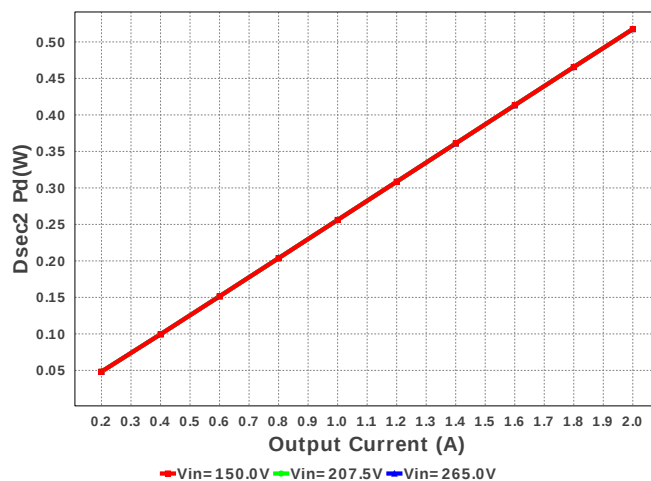




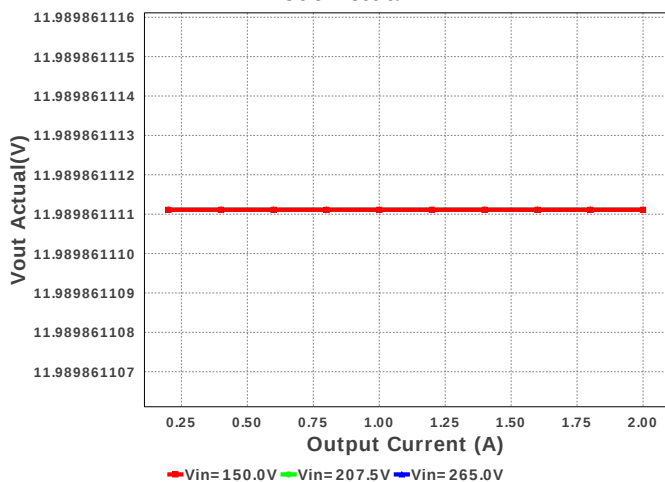
M1 TjOP



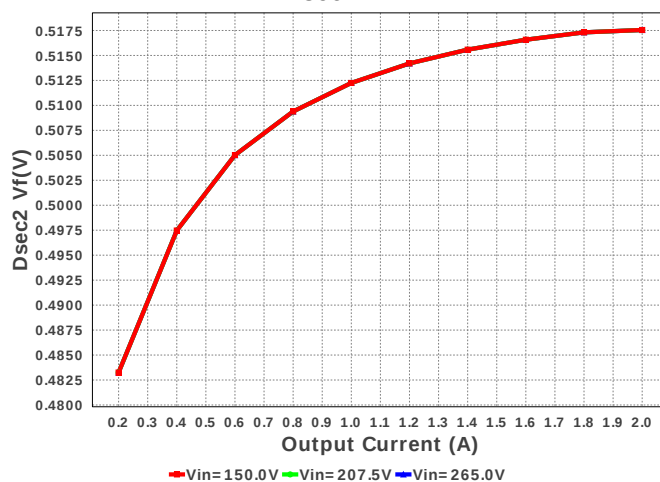
Dsec2 Pd



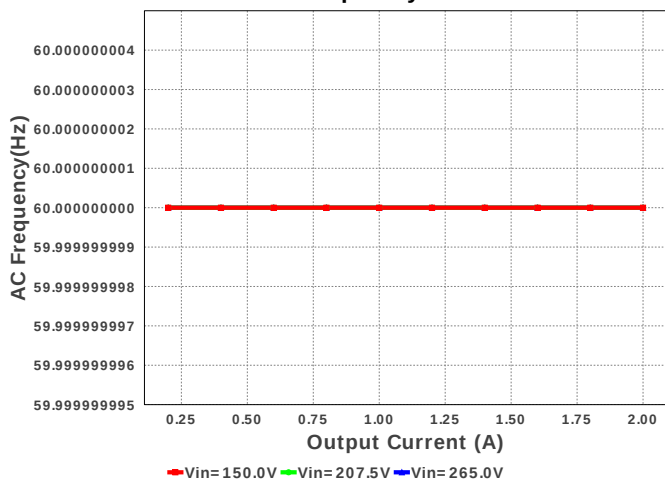
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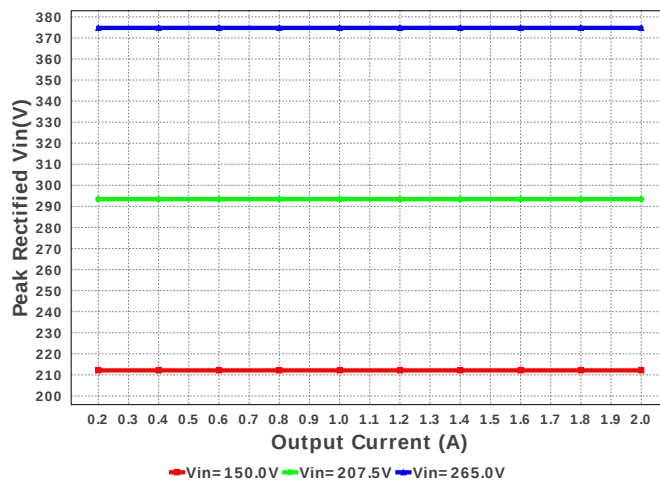
Dsec2 Vf

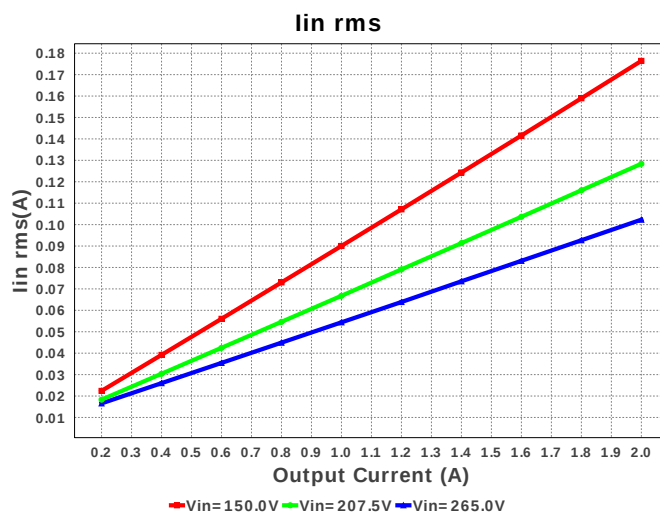
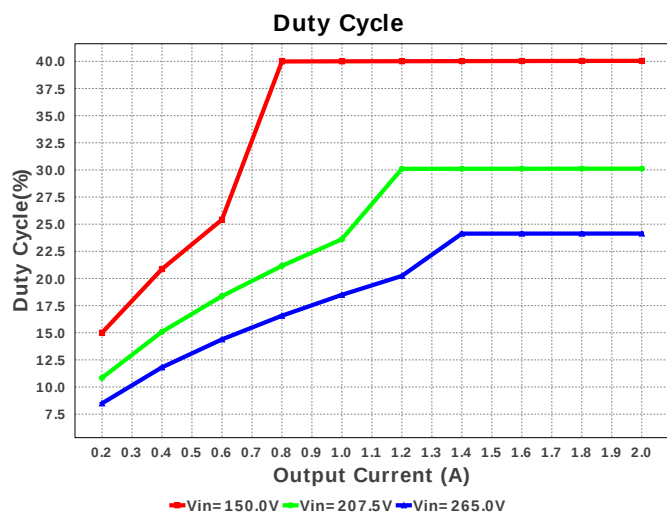
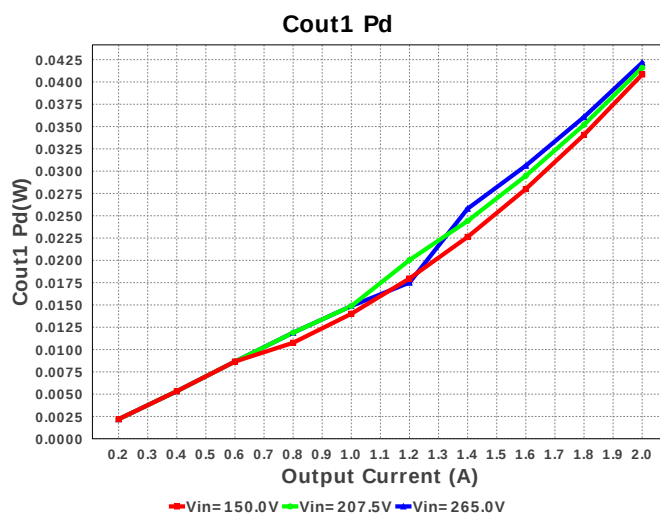
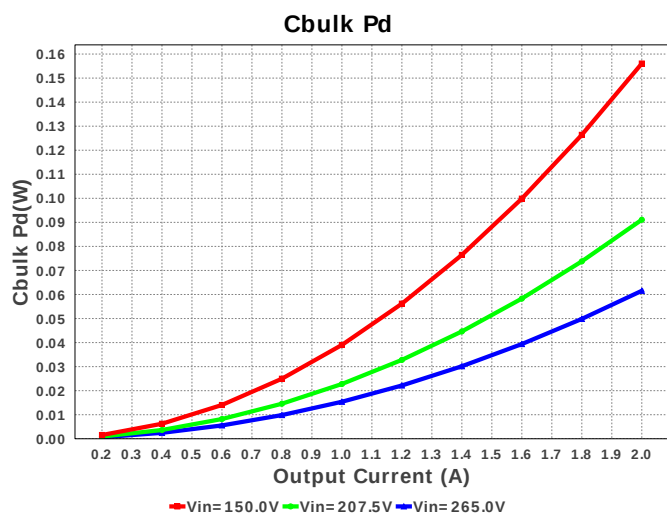
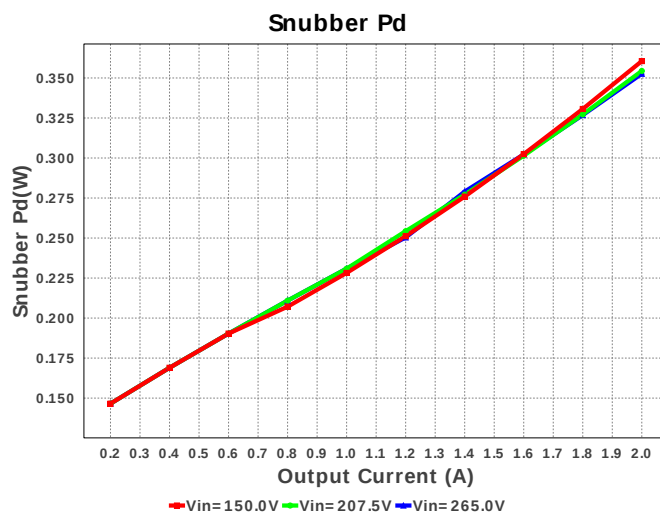
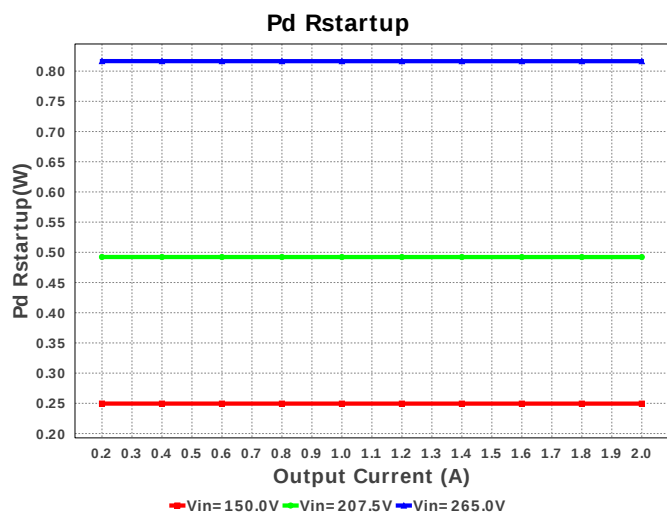


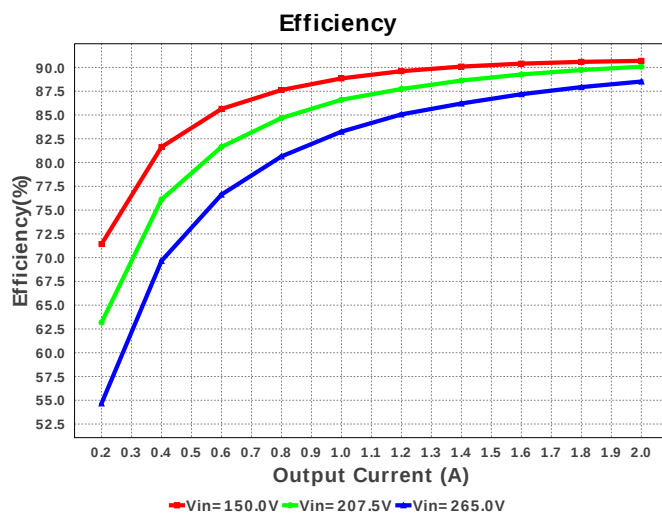
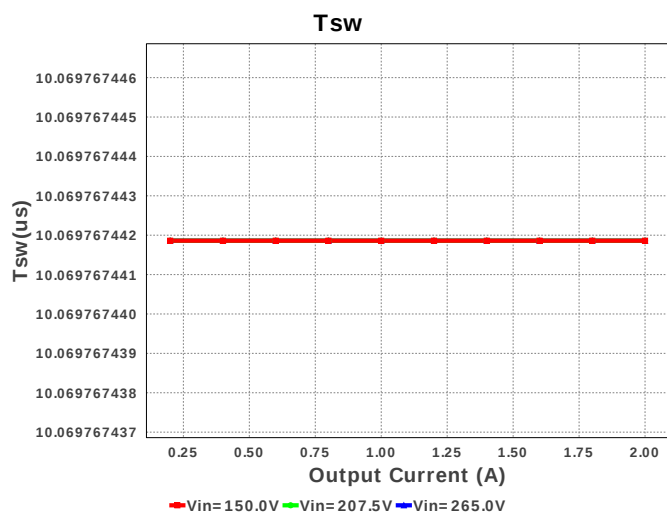
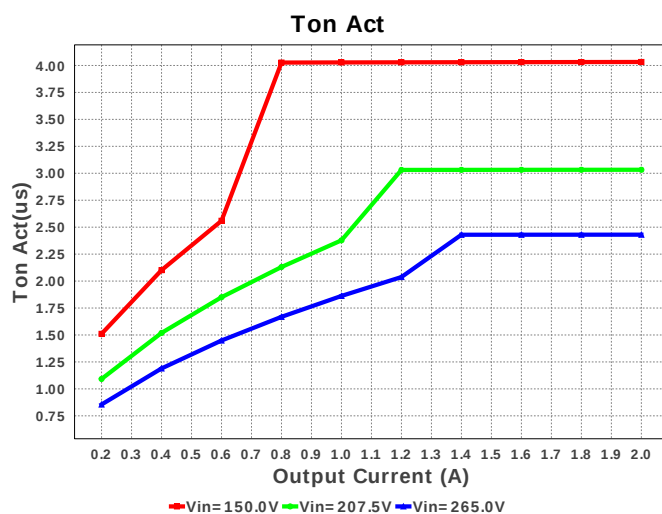
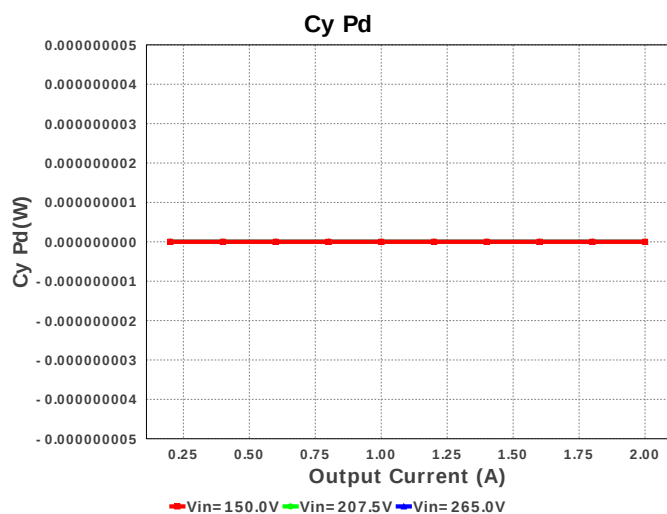
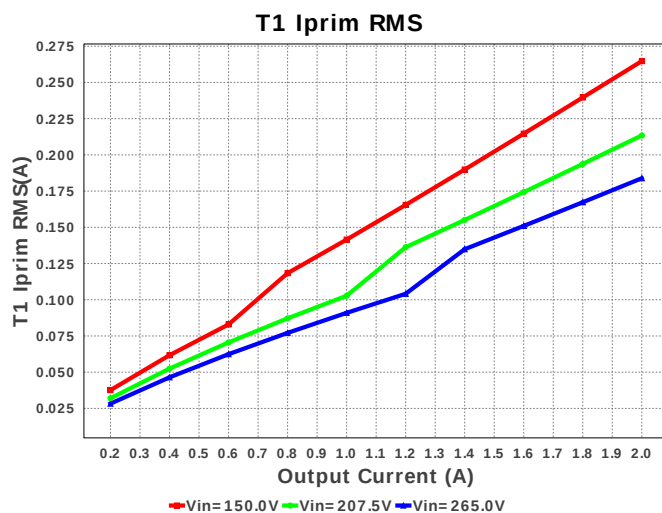
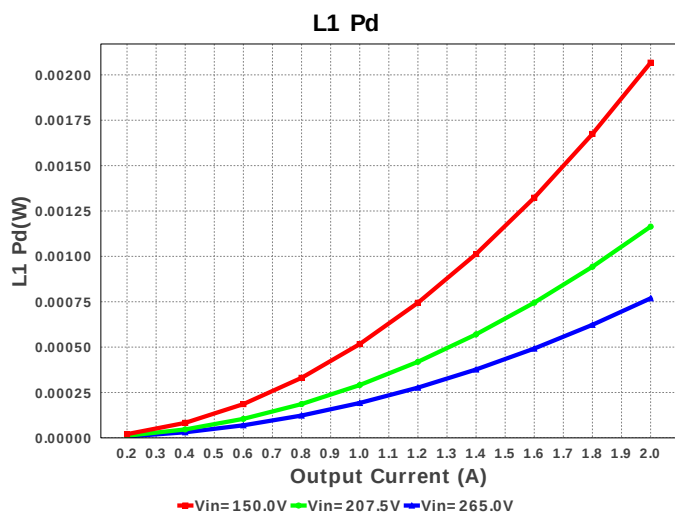
AC Frequency

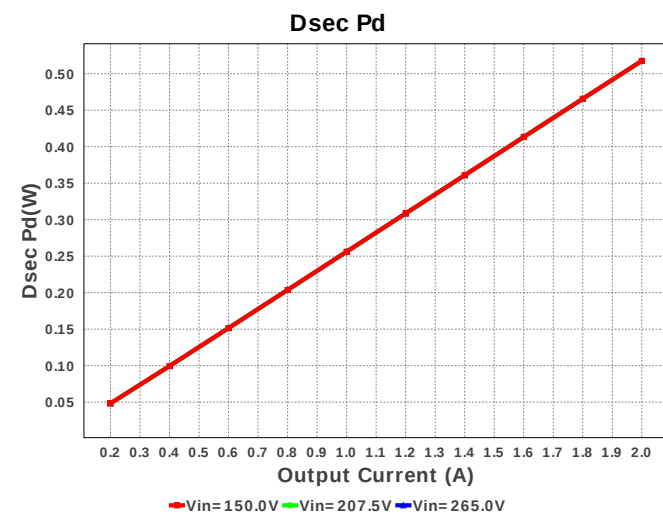
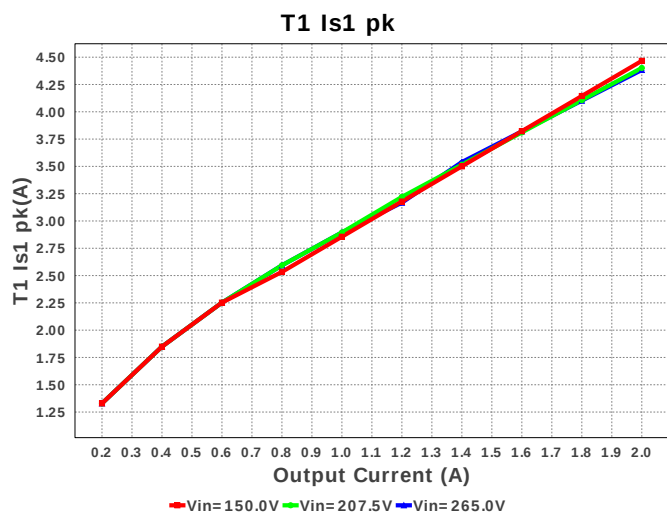
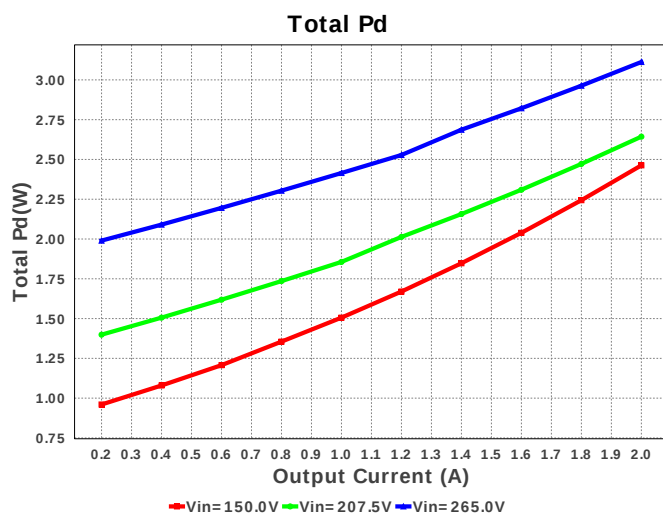
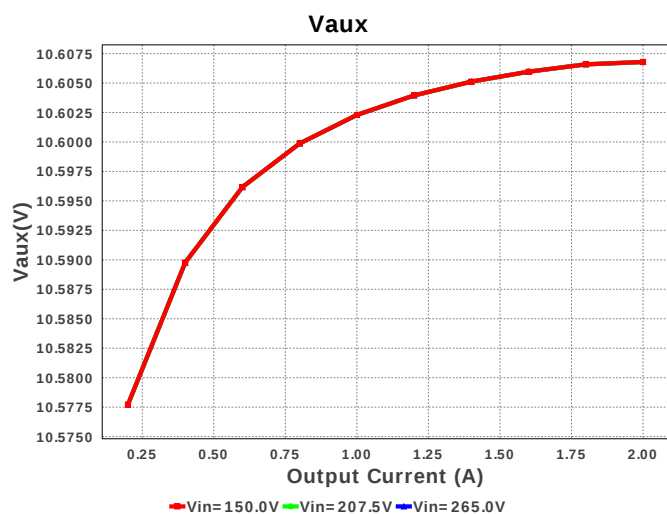
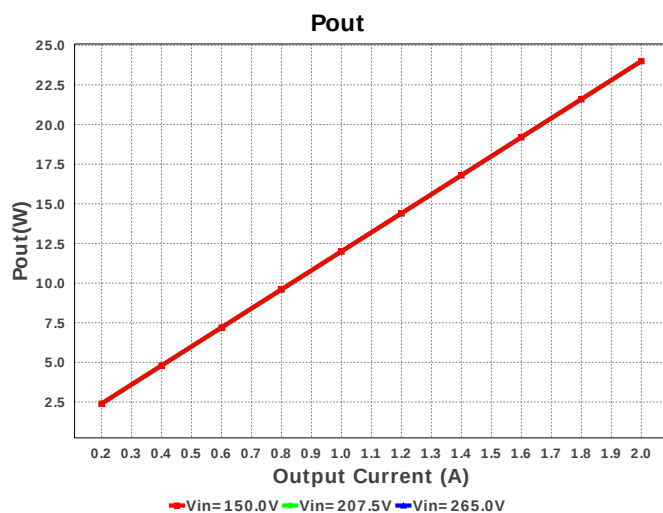
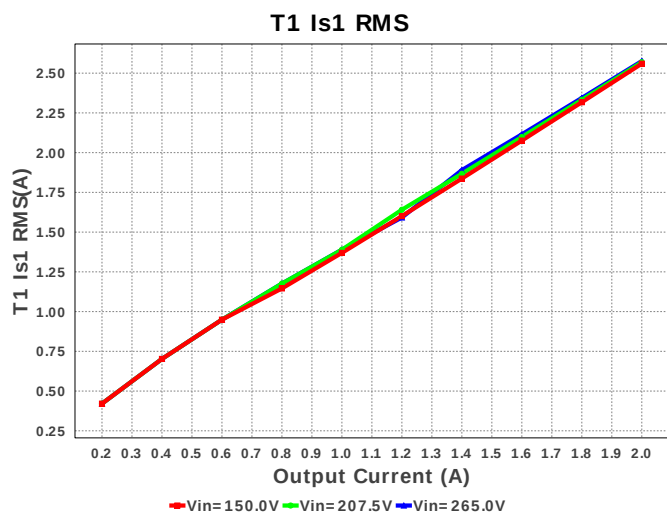


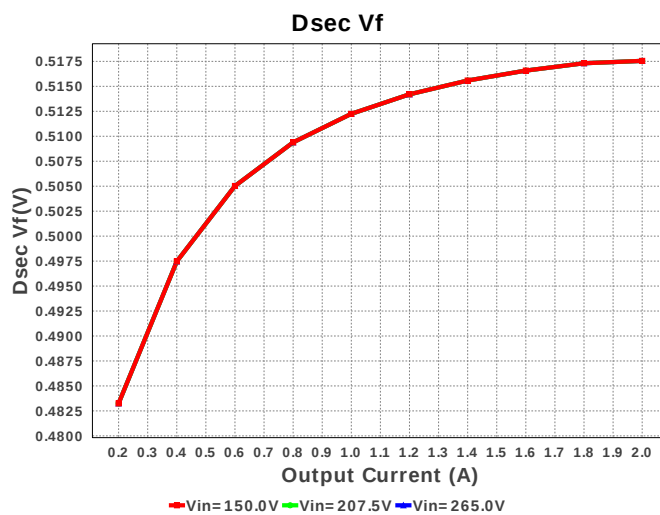
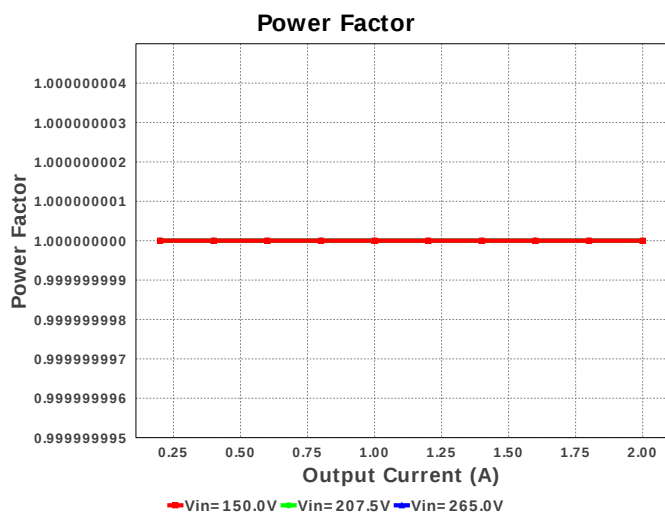
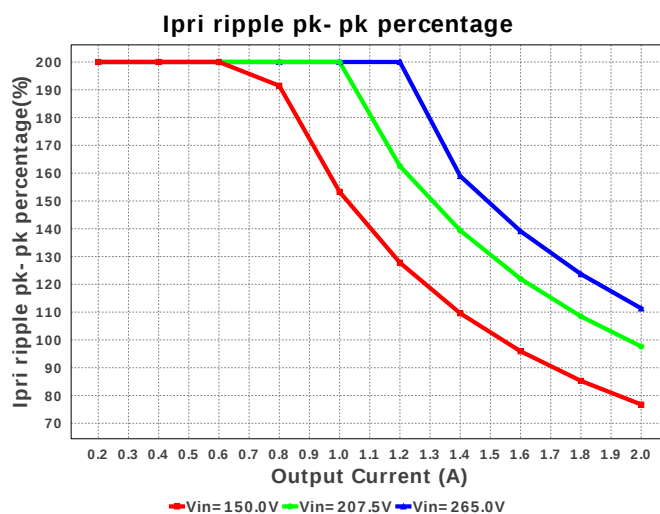
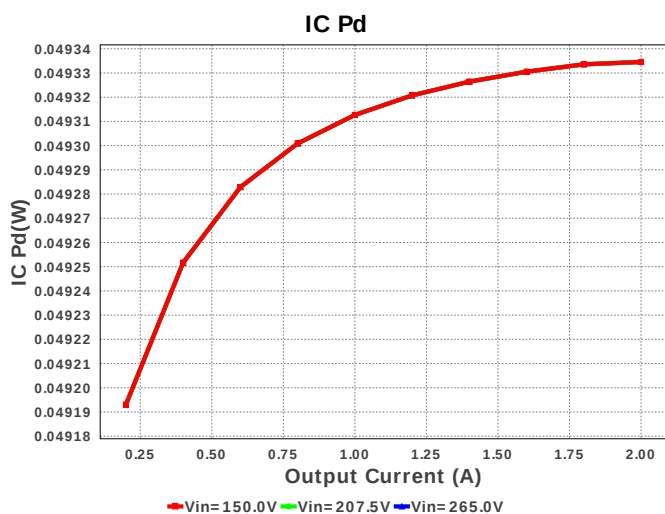
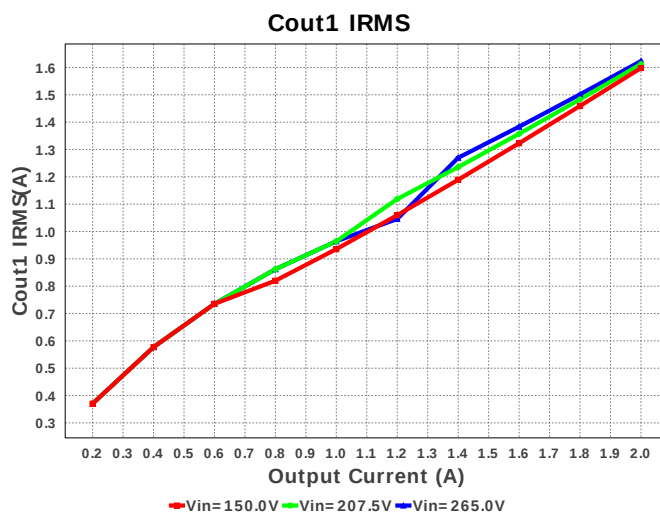
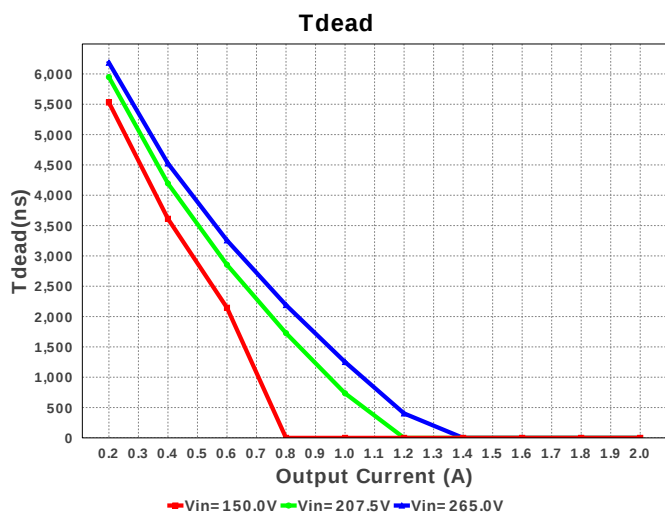
Peak Rectified Vin

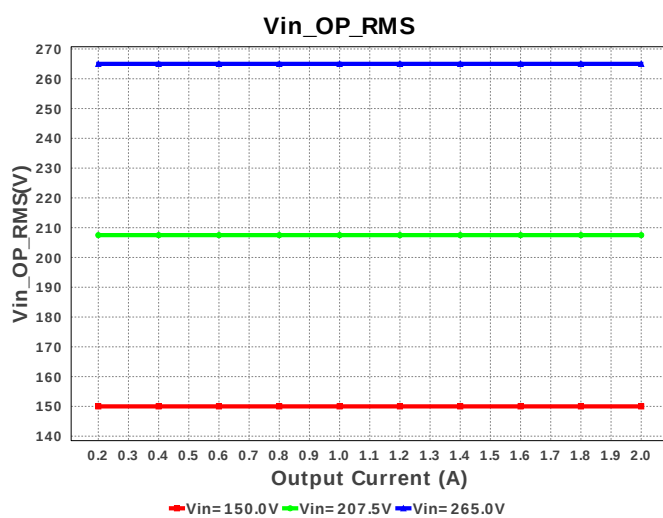
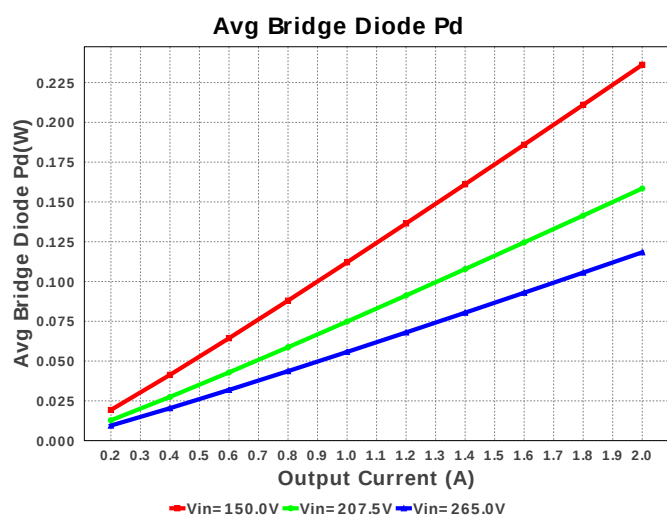
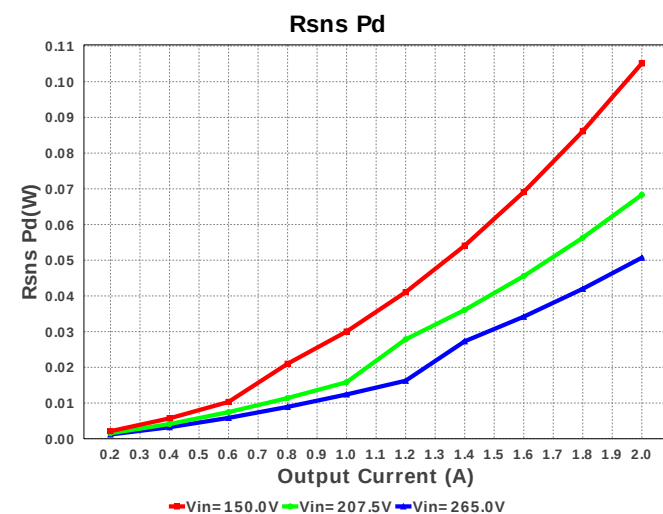
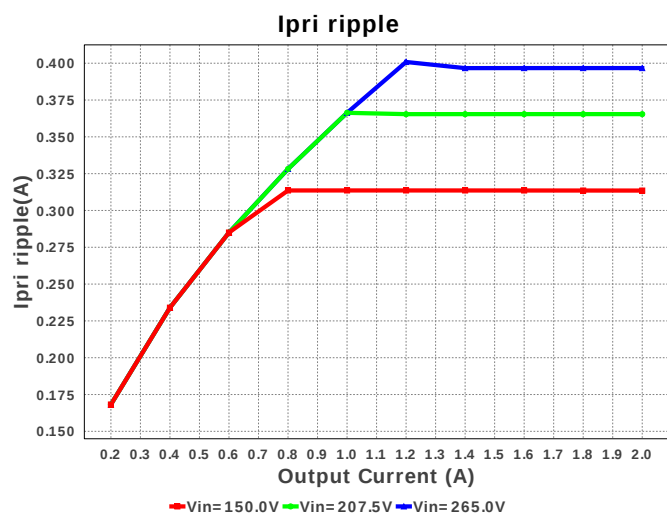
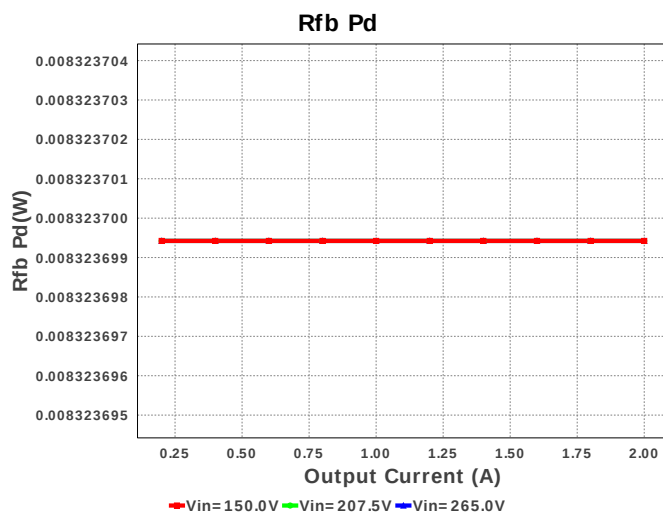
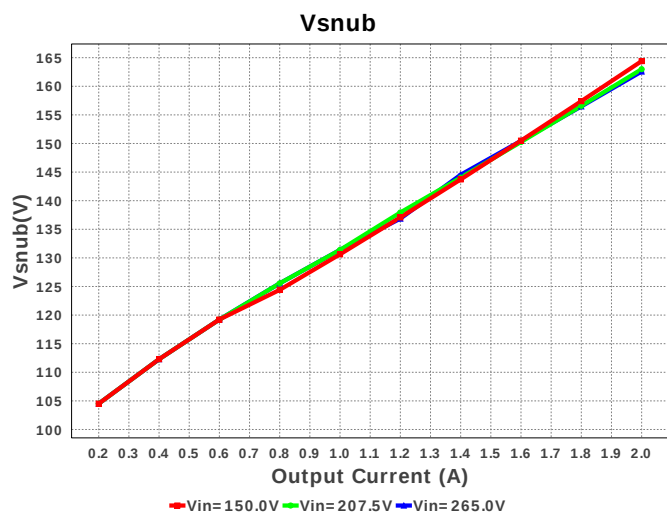


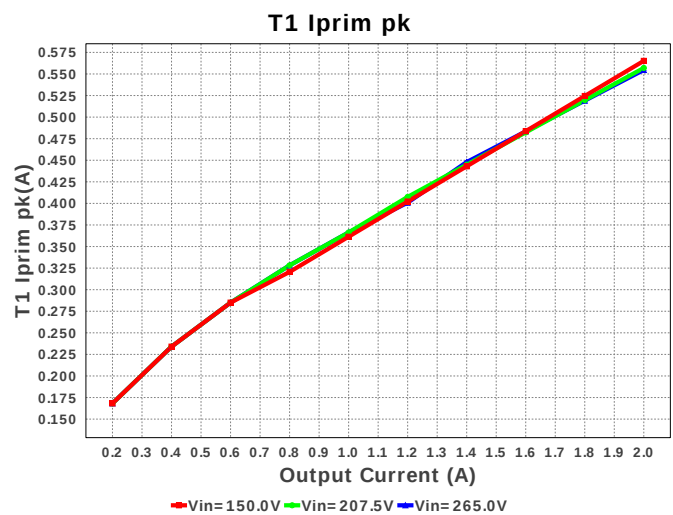
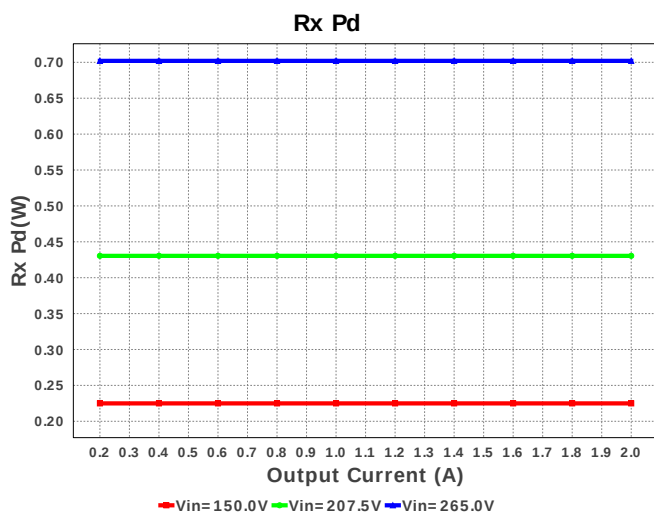
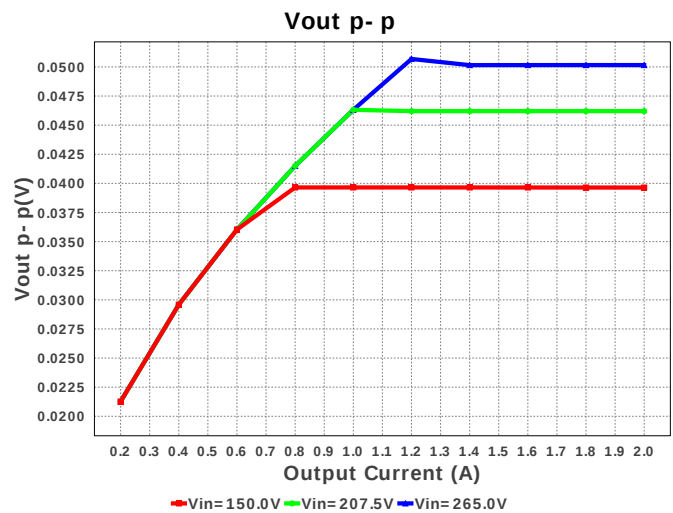
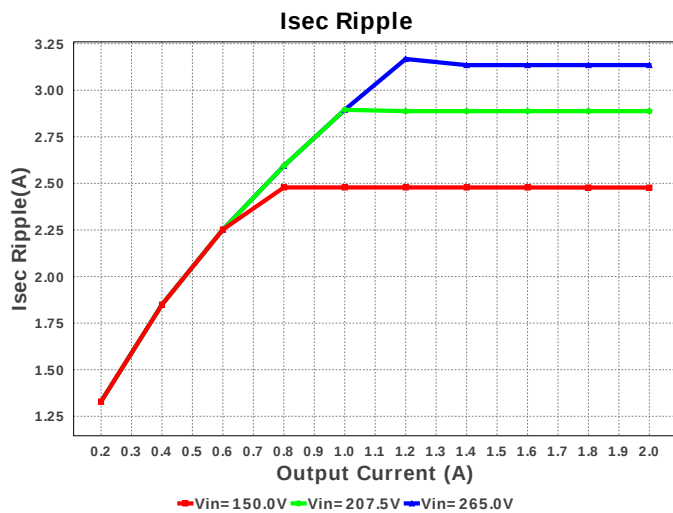
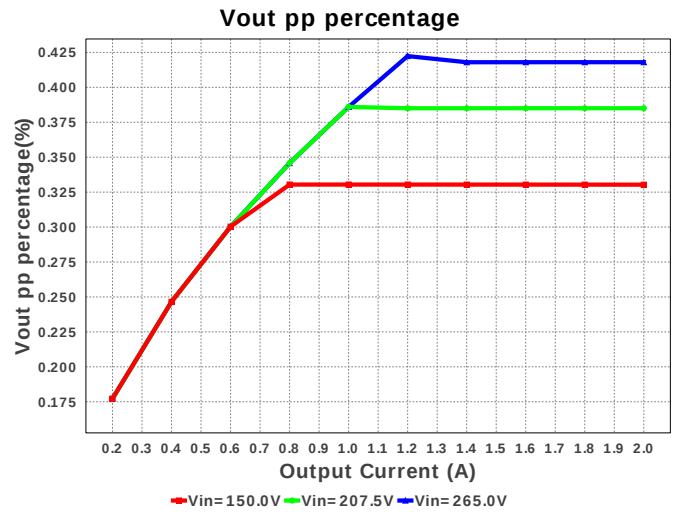
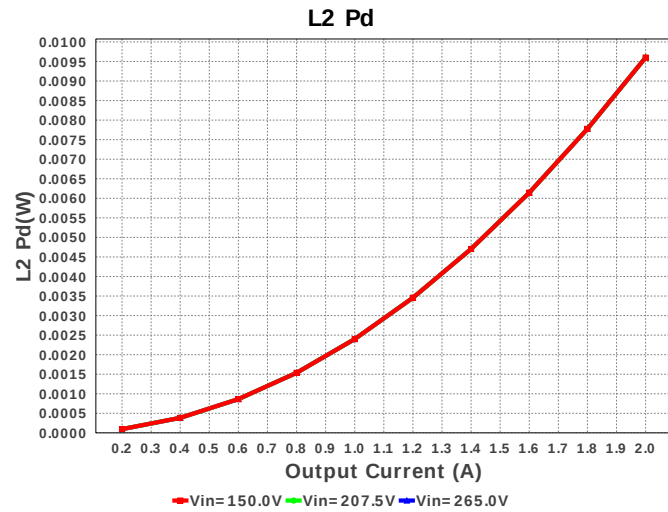












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.598 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	176.42 mA	Current	RMS Input Current
3.	Iout_DCM	778.791 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	163.554 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	313.511 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	76.76 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	2.477 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	264.727 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	565.186 mA	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	2.56 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	4.466 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	517.55 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	517.55 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.296 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	99.307 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	6.24 us	General	Approximate Converter Off Time
25.	Ton Act	4.032 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	10.07 us	General	Switching Time Period
28.	Vaux	10.607 V	General	Auxiliary Voltage
29.	Vsnub	164.403 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	40.045 %	Op_point	Duty cycle
33.	Efficiency	90.693 %	Op_point	Steady state efficiency
34.	IC Tj	32.467 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	41.557 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	212.13 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	150.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	39.64 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	236.179 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	156.052 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	40.839 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	517.55 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	517.55 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	49.335 mW	Power	IC power dissipation
49.	L1 Pd	2.067 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
51.	M1 Pd	184.915 mW	Power	M1 MOSFET total power dissipation
52.	Paux	10.889 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	249.52 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	14.709 μW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	105.12 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	224.928 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	360.541 mW	Power	Snubber Power Dissipation
59.	T1 Pd	234.642 mW	Power	Estimated Losses in Transformer
60.	Total Pd	2.463 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.127 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable
62.	Vout pp percentage	330.333 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	150.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	acFrequency	50.0	Light Output in Lumen
6.	base_pn	UCC38C41	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. UCC38C41 Product Folder : <http://www.ti.com/product/UCC38C41> : contains the data sheet and other resources.

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