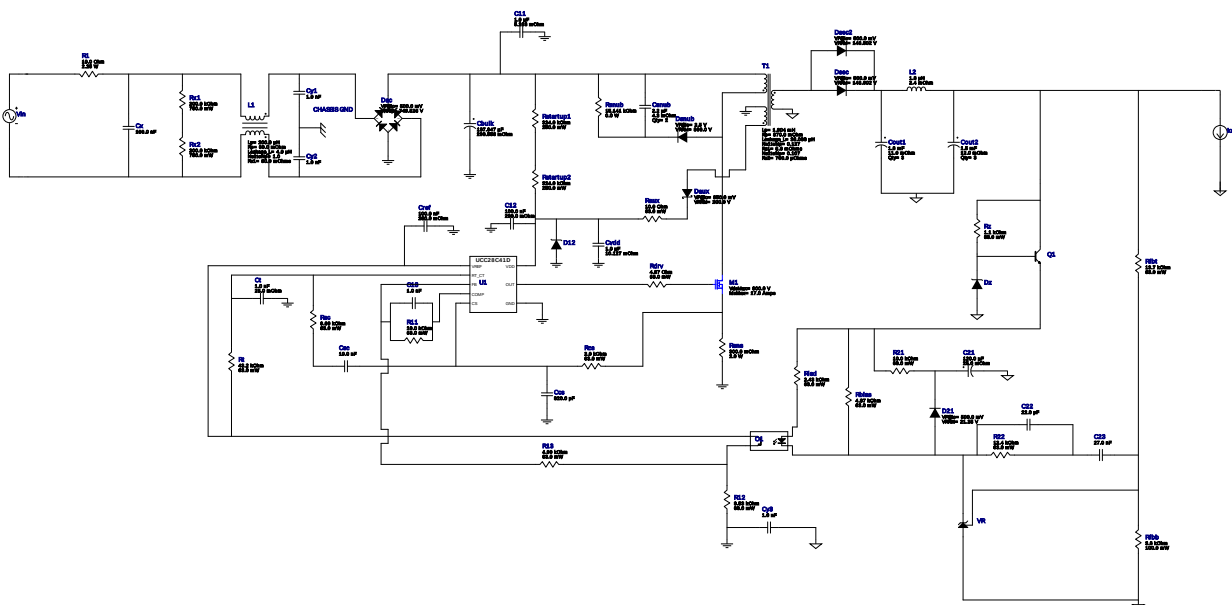


WEBENCH® Design Report

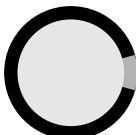
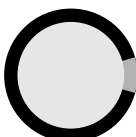
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UCC28C41DR 150.0V-265.0V to 12.00V @ 10.0A

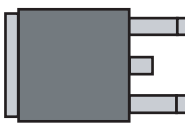


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

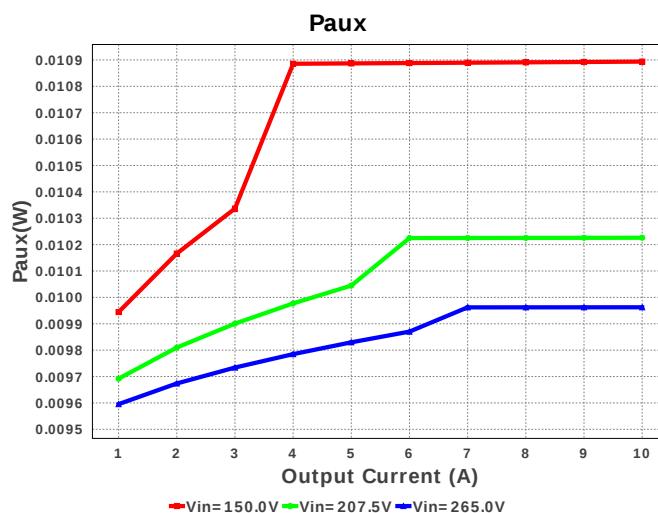
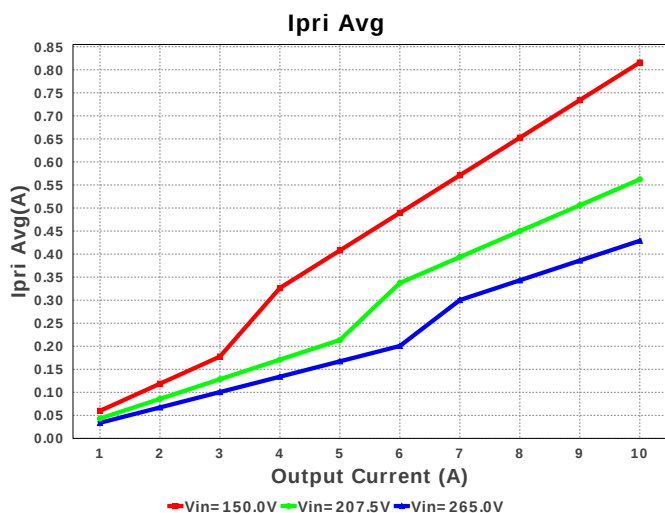
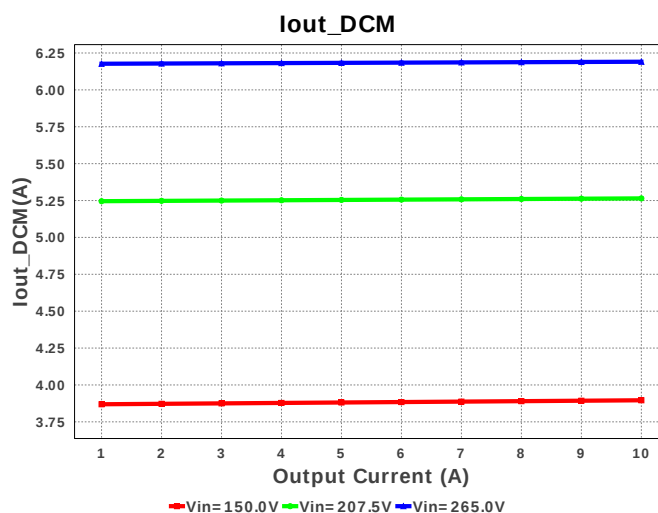
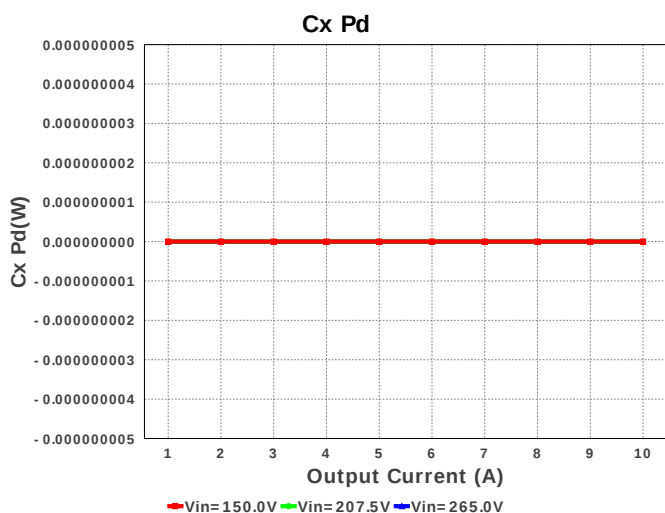
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.19	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	Samsung 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	Panasonic	20SVPF120M Series= SVPF	Cap= 120.0 uF ESR= 25.0 mOhm VDC= 20.0 V IRMS= 3.2 A	1	\$0.43	 CAPSMT_62_F61 74 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	CC0805KRX7R9BB273 Series= X7R	Cap= 27.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	CUSTOM	CUSTOM Series= ?	Cap= 137.847 uF ESR= 298.556 mOhm VDC= 449.72 V IRMS= 2.103 A	1	NA	CUSTOM 0 mm ²
8.	Ccs	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

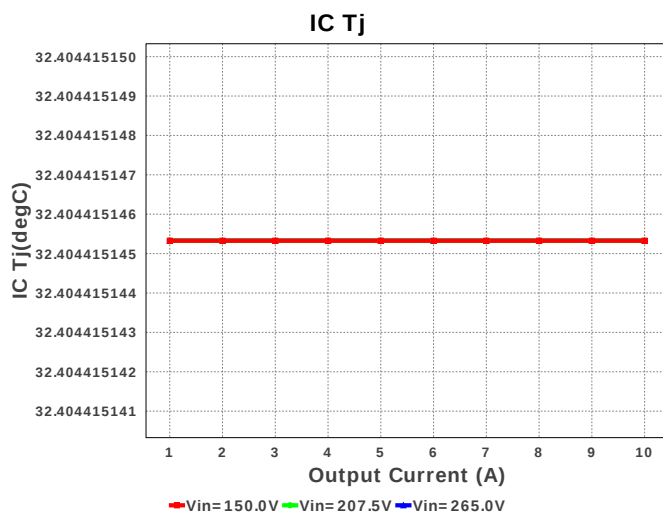
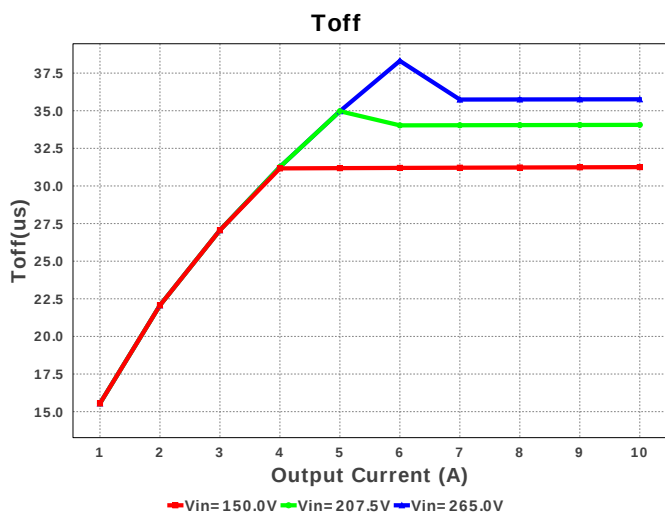
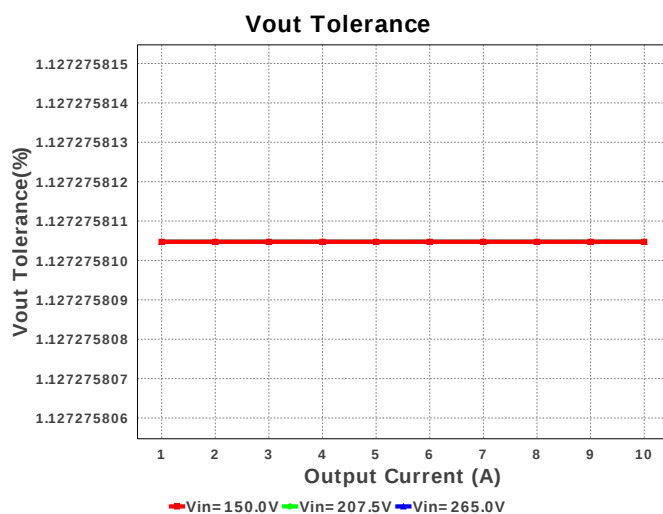
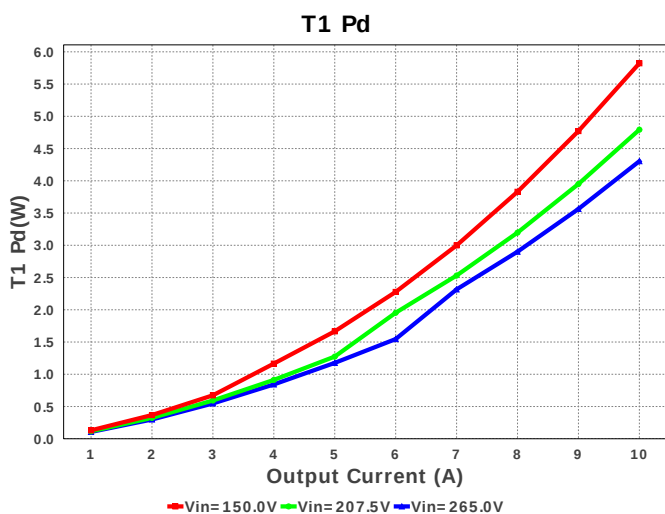
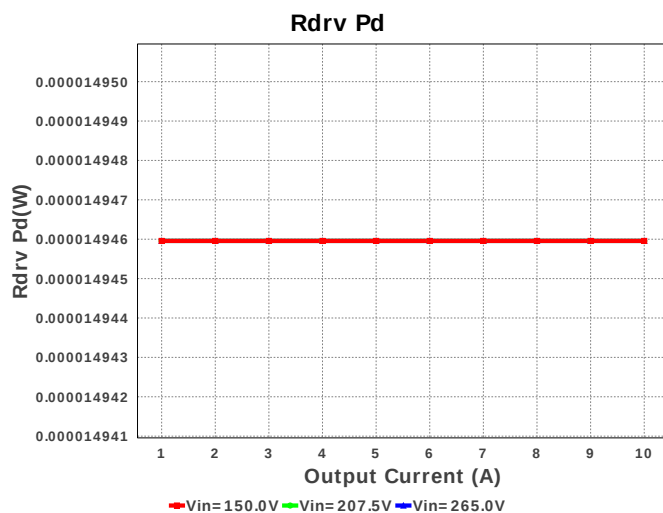
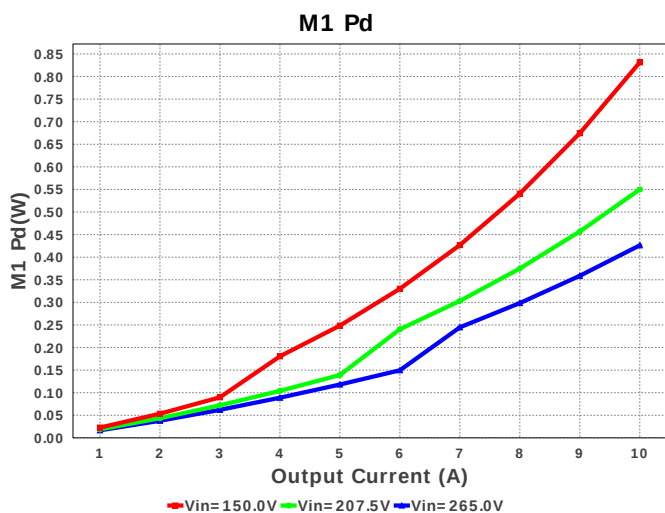
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9.	Cout1	Nichicon	UHV1V182MHD Series= HV	Cap= 1.8 mF ESR= 11.0 mOhm VDC= 35.0 V IRMS= 3.925 A	3	NA	 CAPPR5-12.5X25 210 mm ²
10.	Cout2	Nichicon	UHV1V152MHD Series= HV	Cap= 1.5 mF ESR= 12.0 mOhm VDC= 35.0 V IRMS= 3.795 A	3	NA	 CAPPR5-12.5X25 210 mm ²
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.	Csneb	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
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	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	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

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
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
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	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 21.25 V	1	NA	CUSTOM 0 mm ²
22.	Dac	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 749.526 V	1	NA	CUSTOM 0 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	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 148.602 V	1	NA	CUSTOM 0 mm ²
25.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 148.602 V	1	NA	CUSTOM 0 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	CUSTOM	CUSTOM	Lp= 200.0 µH Rp= 60.0 mOhm Leakage_L= 4.0 µH Ns1toNp= 1.0 Rs1= 60.0 mOhms	1	NA	CUSTOM 0 mm ²
29.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
30.	M1	Infineon Technologies	SPB17N80C3	VdsMax= 800.0 V IdsMax= 17.0 Amps	1	\$1.88	 DDPAK 210 mm ²
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²

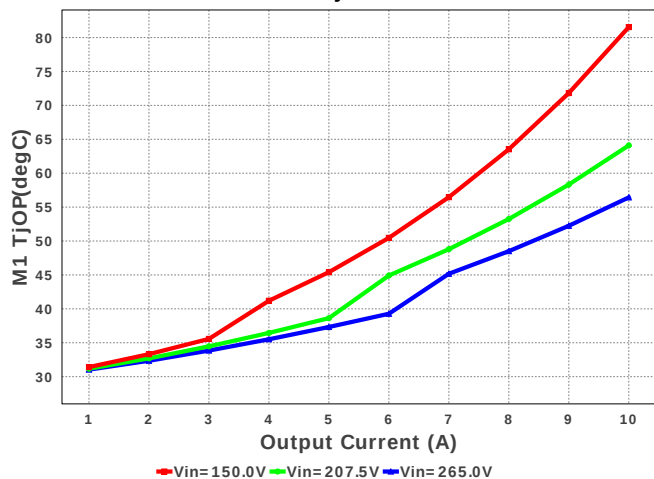
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
32.	Q1	ON Semiconductor	BC848CLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm ²
34.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
35.	R12	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 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	CRCW040212K4FKED Series= CRCW..e3	Res= 12.4 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	CRCW04024R87FKED Series= CRCW..e3	Res= 4.87 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	CRCW04022K43FKED Series= CRCW..e3	Res= 2.43 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	CSRN2512FKR300 Series= ?	Res= 300.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.13	 2512 43 mm ²
48.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 15.141 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	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 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= 1.904 mH Rp= 870.0 mOhm Leakage_L= 38.083 µH Ns1toNp= 0.127 Rs1= 8.6 mOhms Ns2toNp= 0.107 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm ²
56.	U1	Texas Instruments	UCC28C41DR	Switcher	1	\$0.75	
57.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	\$0.08	 D0008A 57 mm ² DBZ0003A 14 mm ²

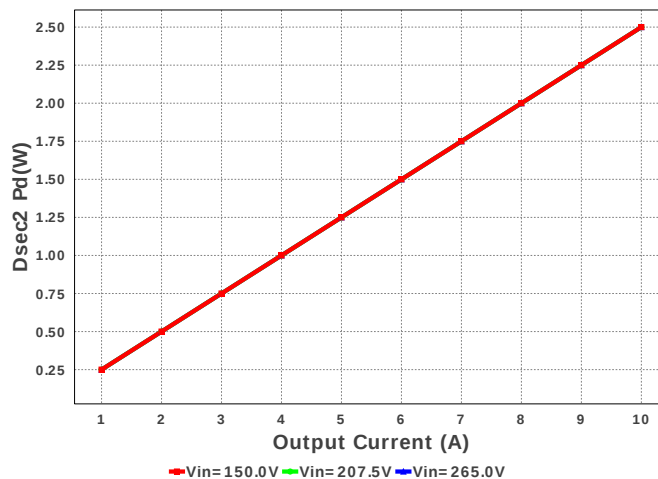




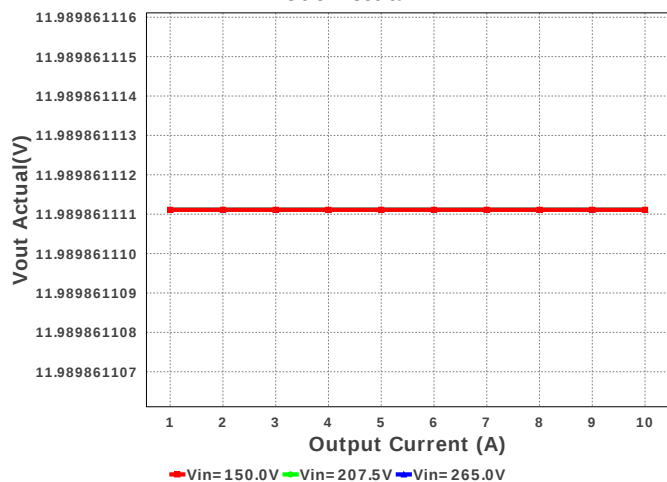
M1 TjOP



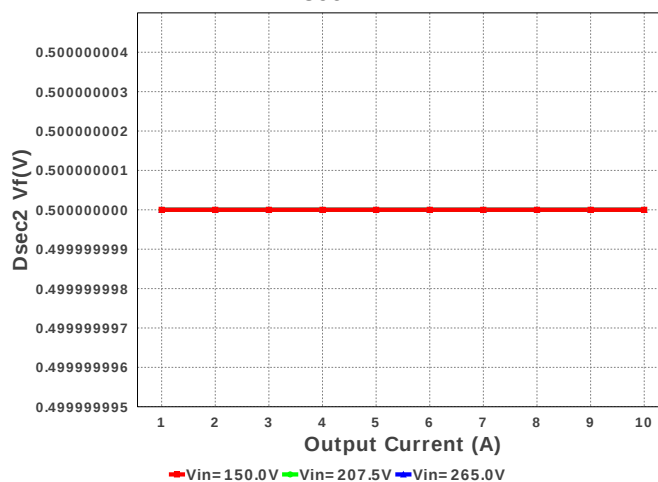
Dsec2 Pd



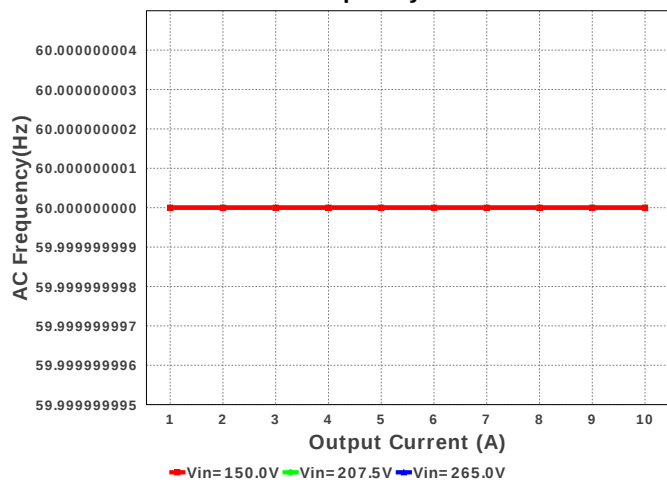
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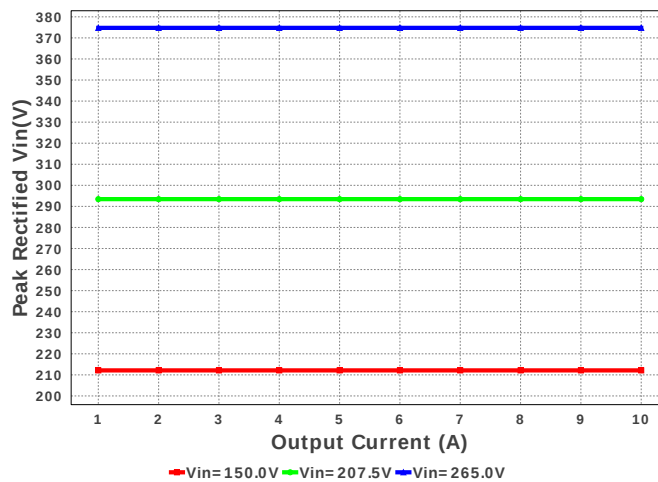
Dsec2 Vf

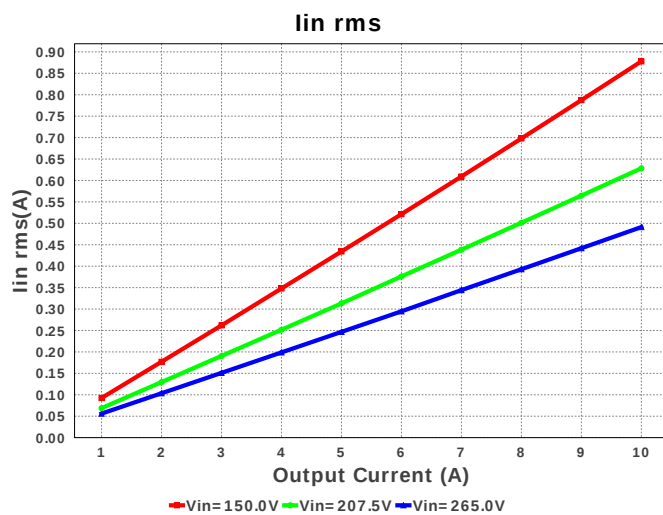
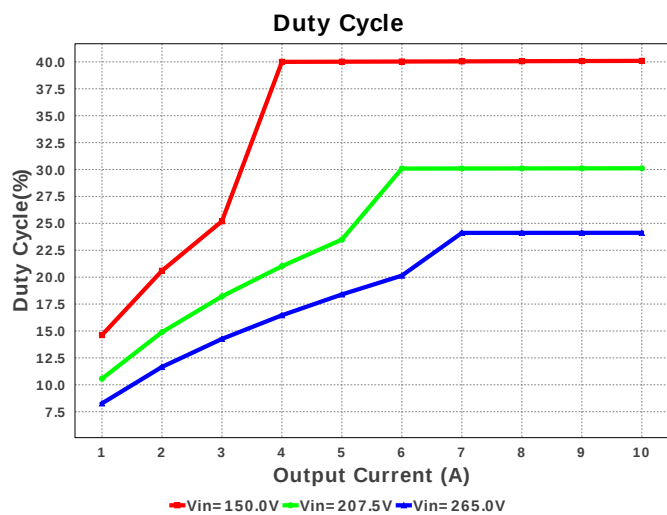
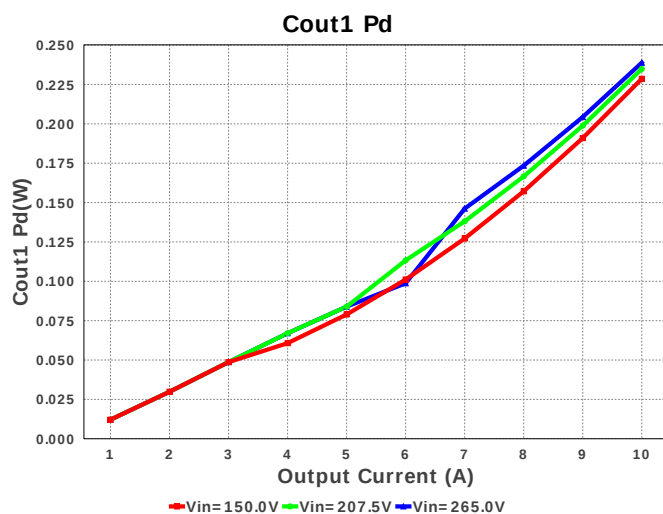
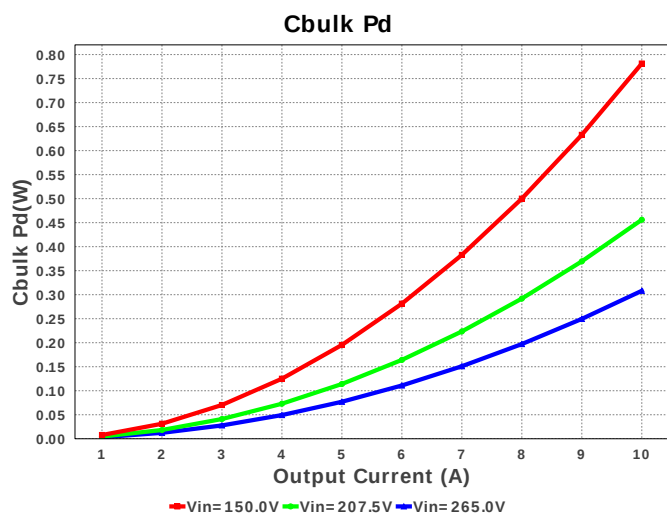
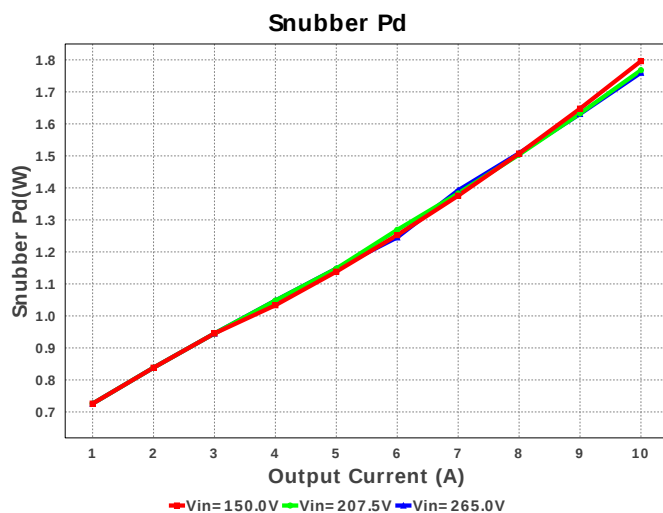
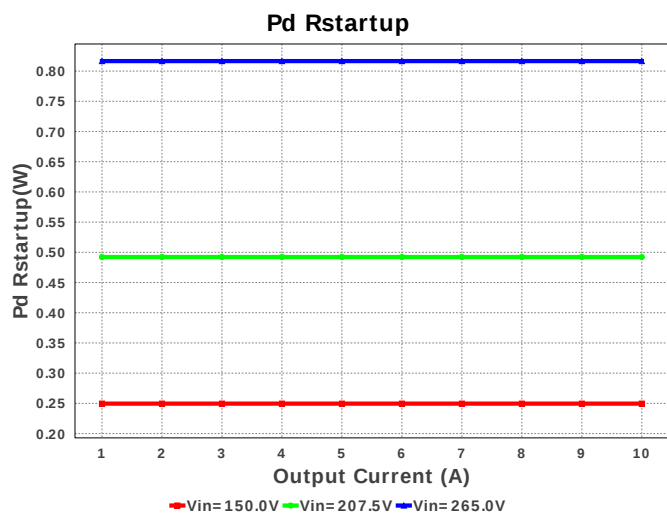


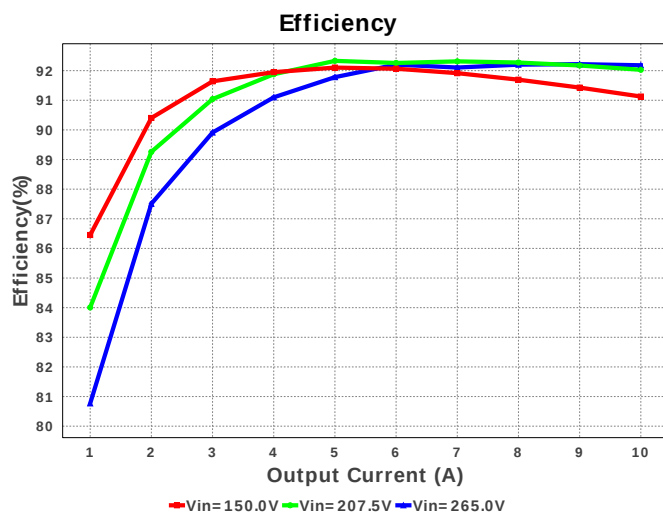
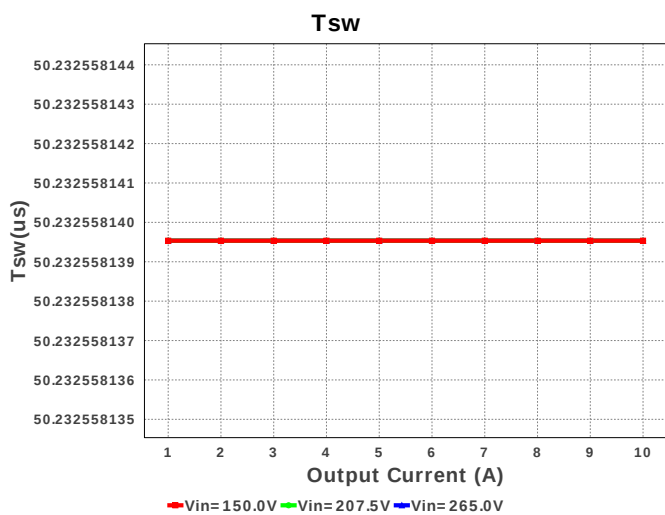
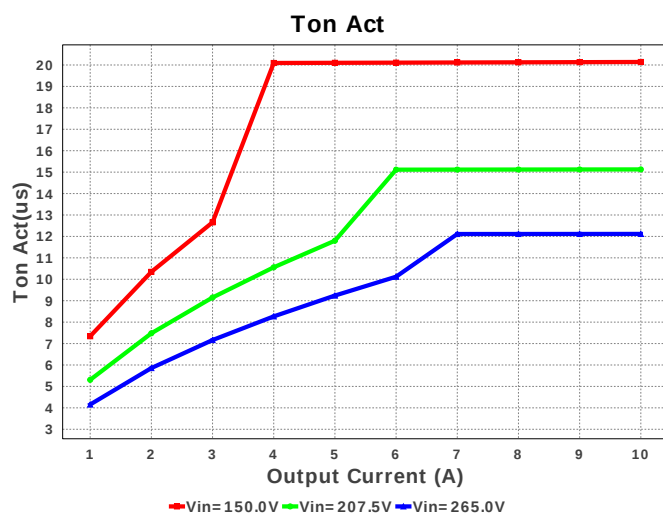
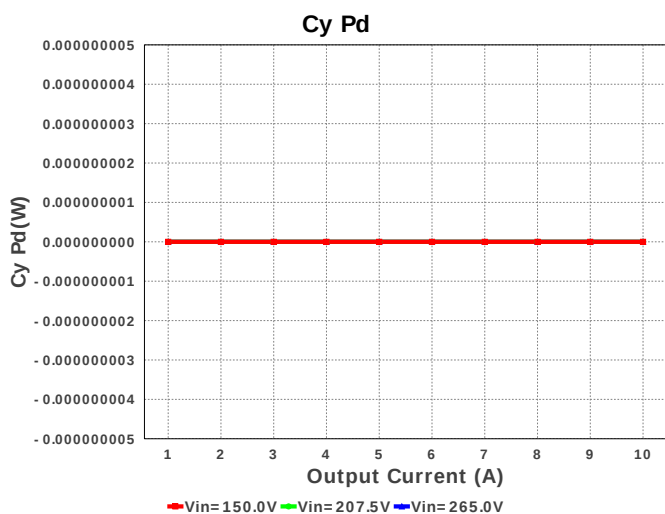
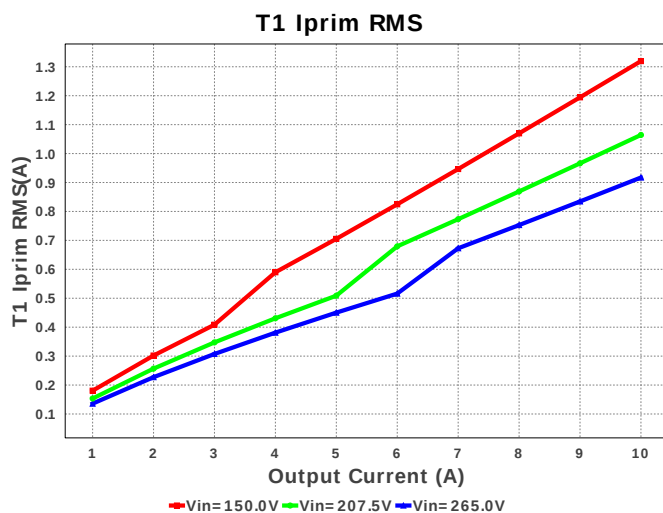
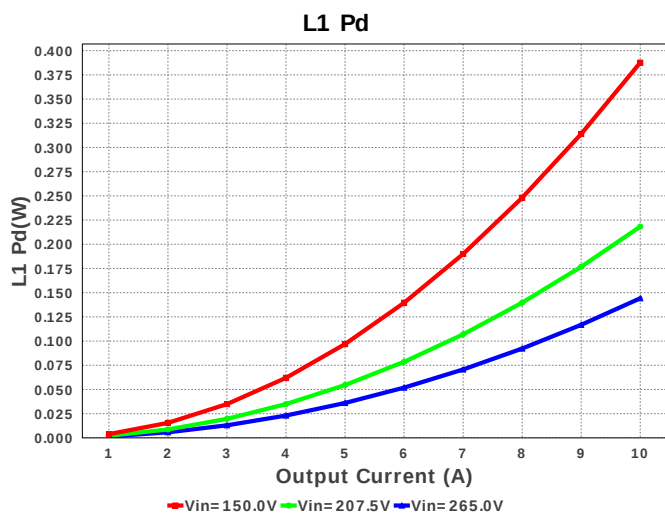
AC Frequency



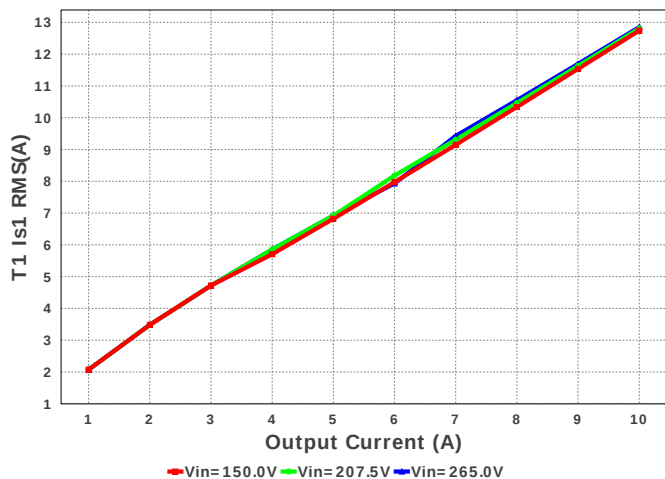
Peak Rectified Vin



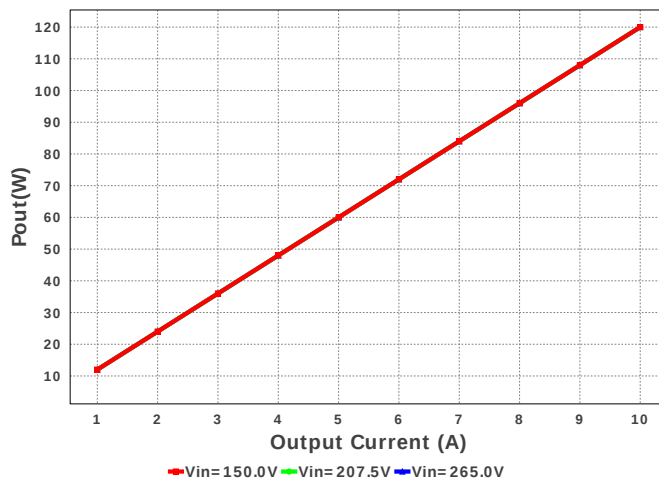




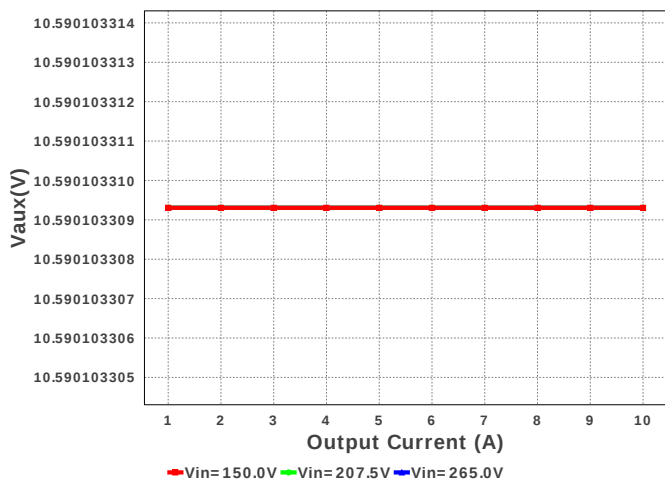
T1 Is1 RMS



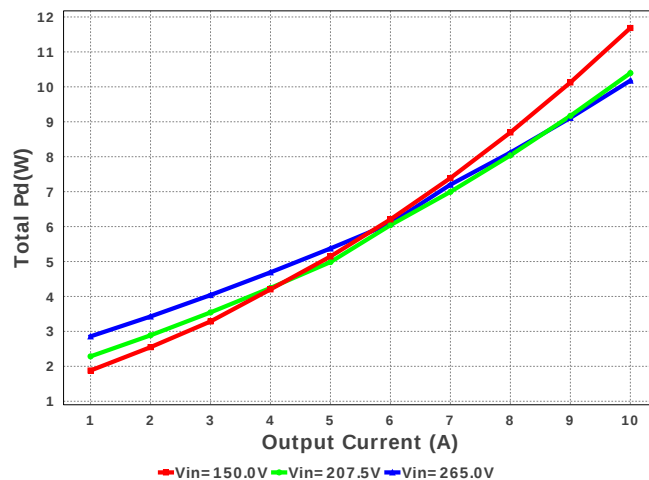
Pout



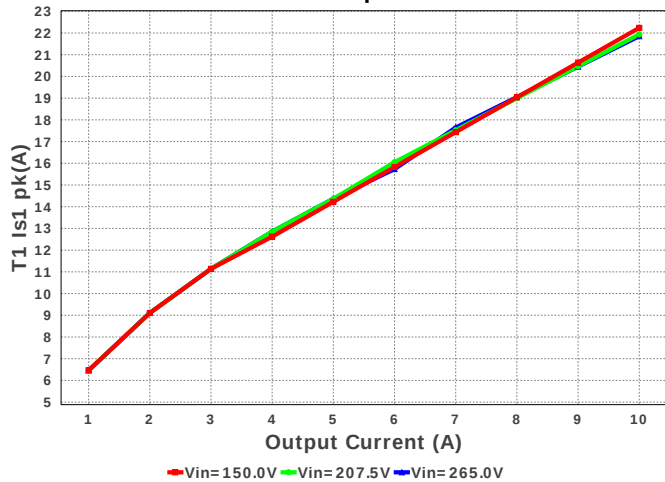
Vaux



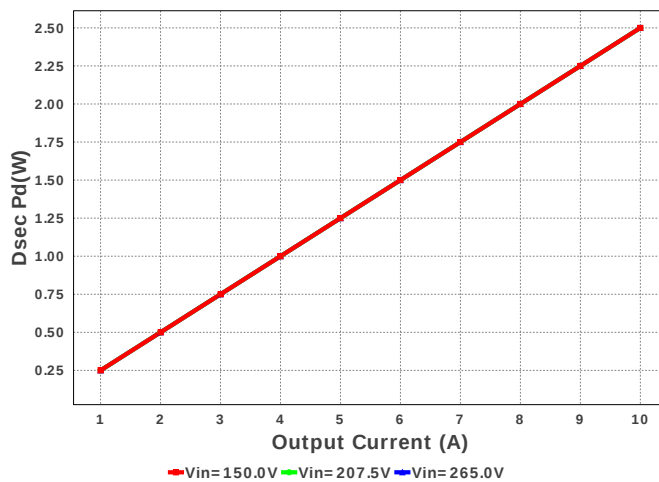
Total Pd

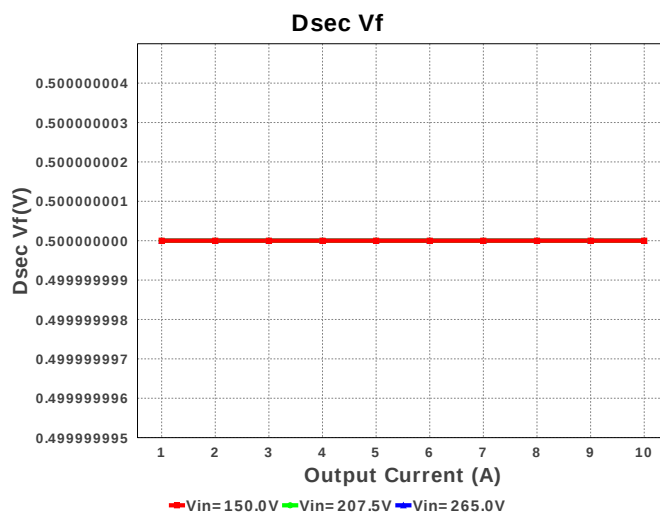
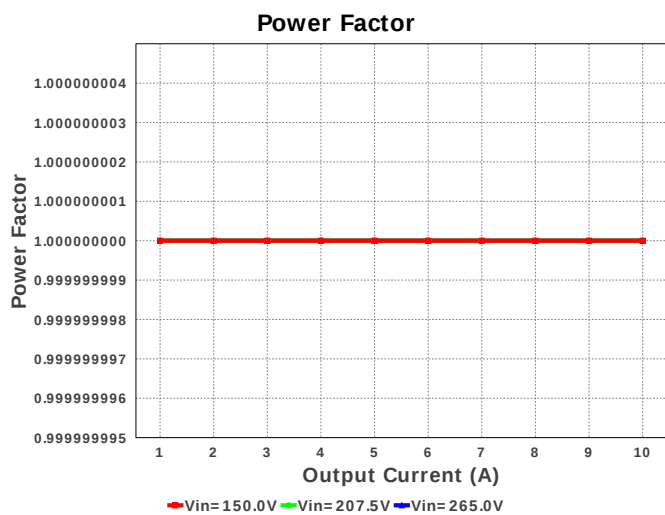
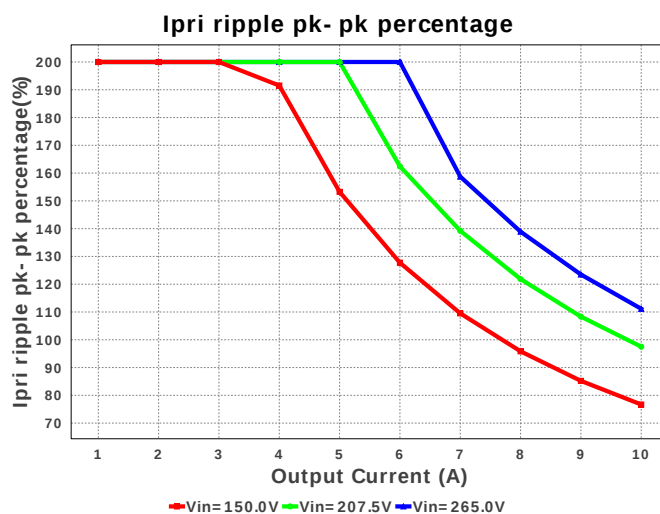
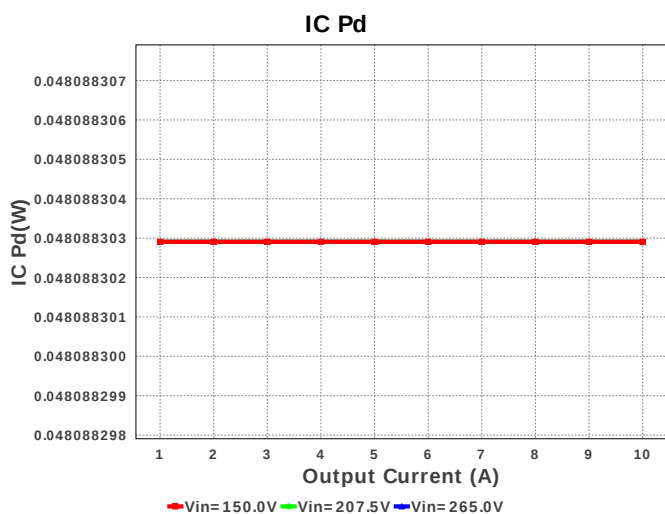
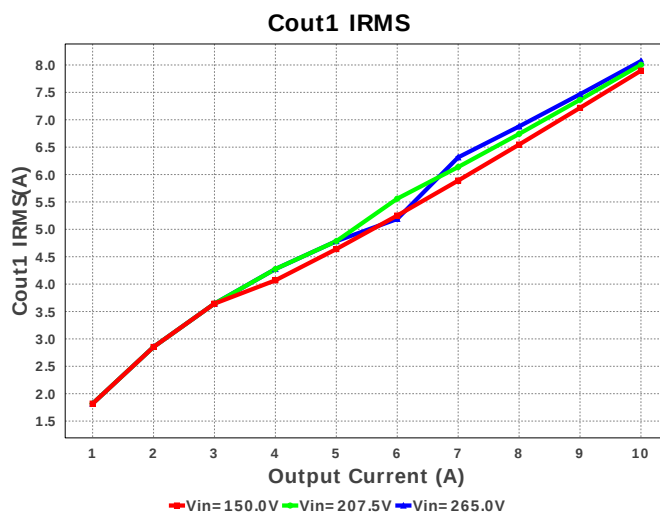
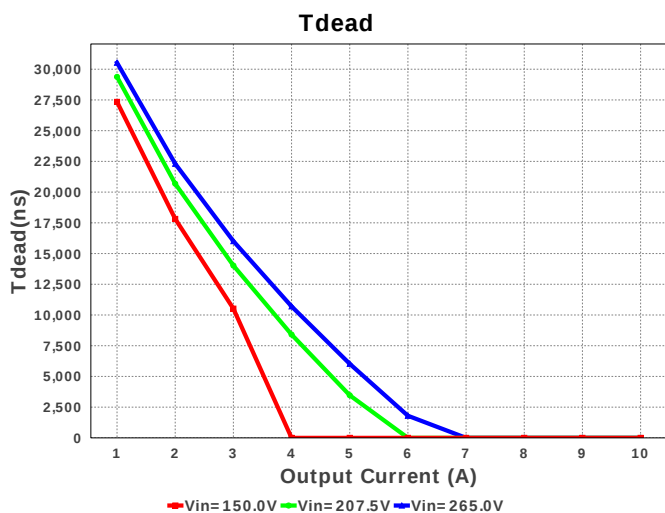


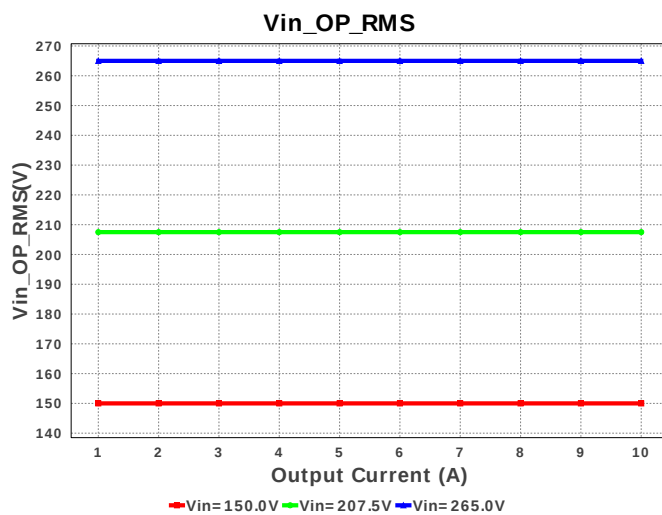
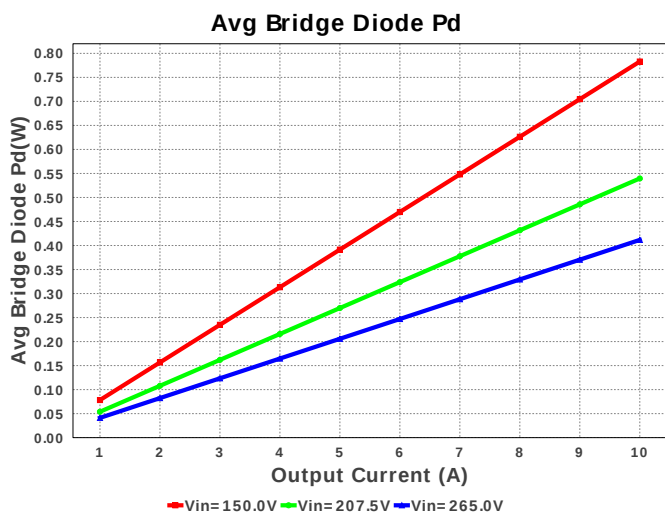
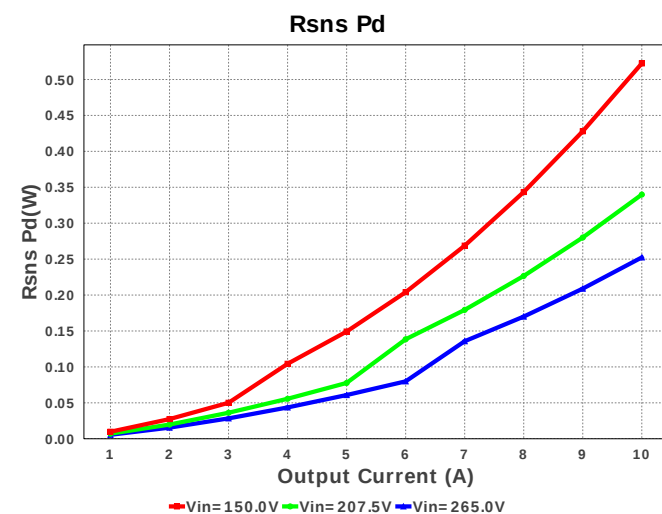
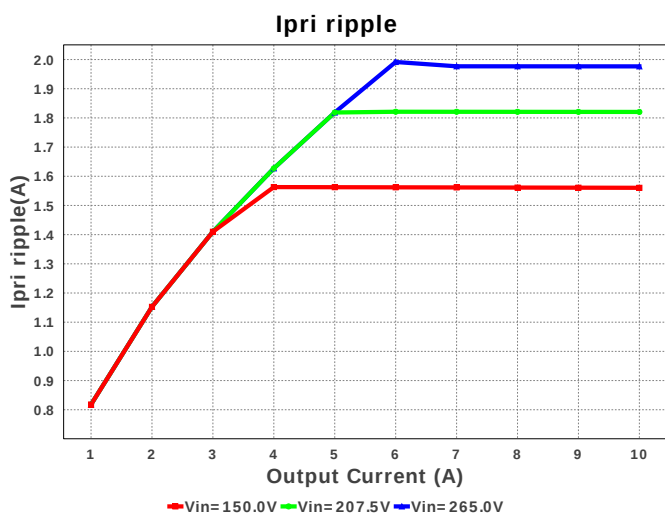
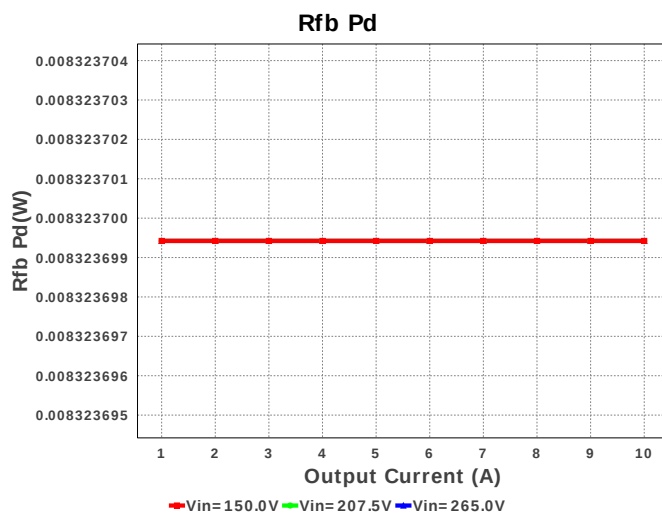
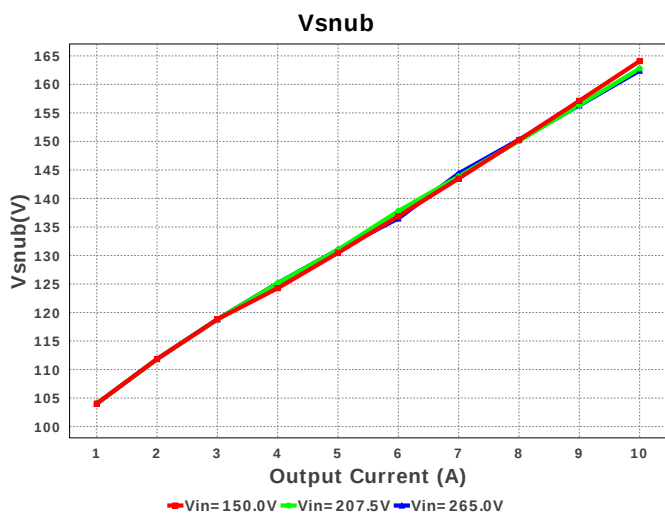
T1 Is1 pk

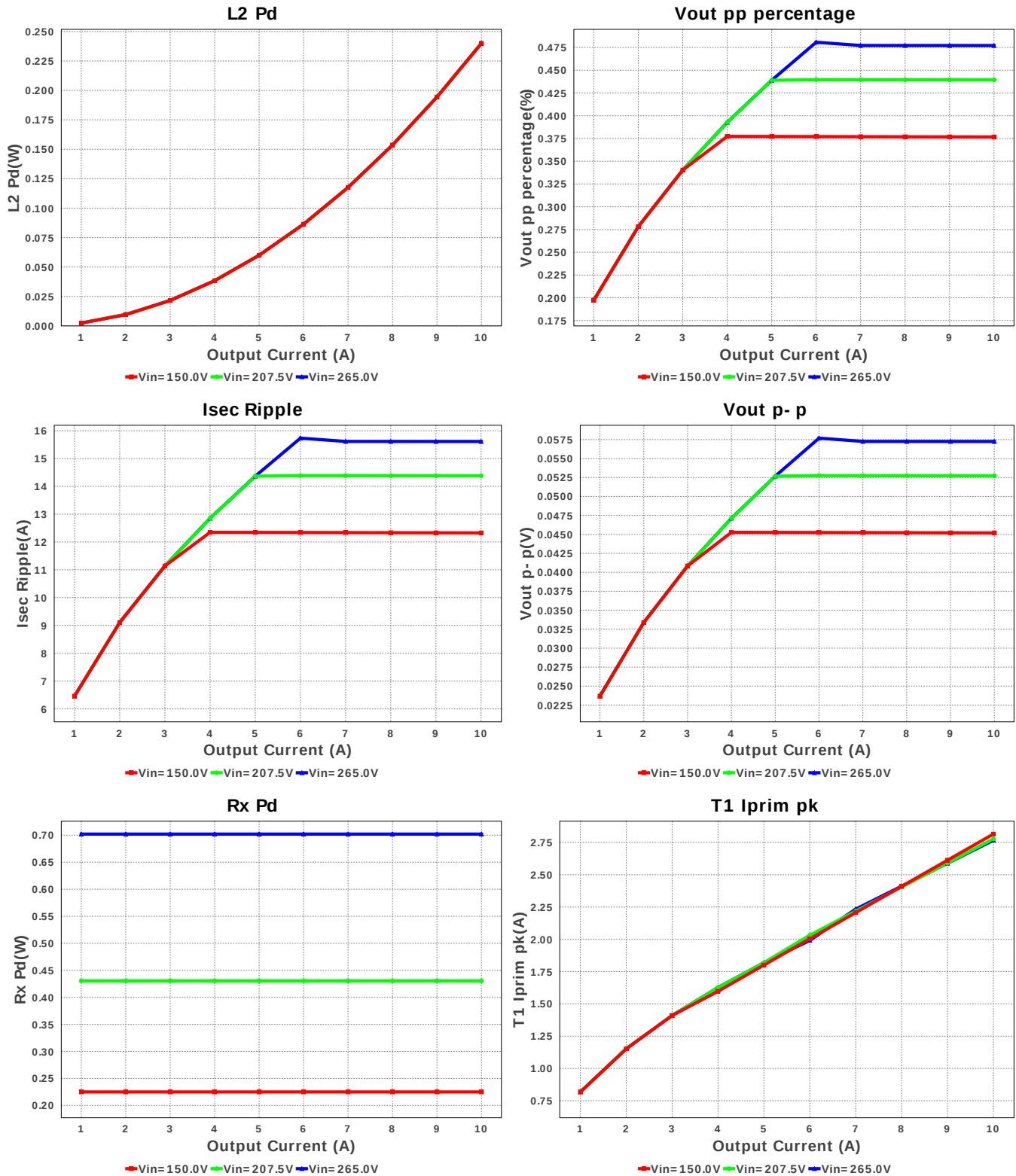


Dsec Pd









Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	7.896 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	877.9 mA	Current	RMS Input Current
3.	Iout_DCM	3.896 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	815.794 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.561 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	76.695 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	12.327 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.32 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	2.815 A	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	12.742 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	22.237 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	50.0 Hz	General	Input AC frequency
13.	BOM Count	62	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	60.0 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	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.673 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	19.907 kHz	General	Switching frequency
21.	Pout	120.0 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	31.252 us	General	Approximate Converter Off Time
25.	Ton Act	20.14 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	50.233 us	General	Switching Time Period
28.	Vaux	10.59 V	General	Auxiliary Voltage
29.	Vsnub	164.087 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	40.094 %	Op_point	Duty cycle
33.	Efficiency	91.127 %	Op_point	Steady state efficiency
34.	IC Tj	32.404 degC	Op_point	IC junction temperature
35.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	10.0 A	Op_point	Iout operating point
37.	M1 TjOP	81.541 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	45.2 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	782.963 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	781.308 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	228.619 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	2.5 W	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	2.5 W	Power	Secondary Diode Power Dissipation
48.	IC Pd	48.088 mW	Power	IC power dissipation
49.	L1 Pd	387.599 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	240.0 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
51.	M1 Pd	831.314 mW	Power	M1 MOSFET total power dissipation
52.	Paux	10.894 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	249.562 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	14.946 μW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	522.375 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	1.796 W	Power	Snubber Power Dissipation
59.	T1 Pd	5.822 W	Power	Estimated Losses in Transformer
60.	Total Pd	11.684 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	376.667 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	10.0	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	UCC28C41	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C41 Product Folder : <http://www.ti.com/product/UCC28C41> : contains the data sheet and other resources.

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