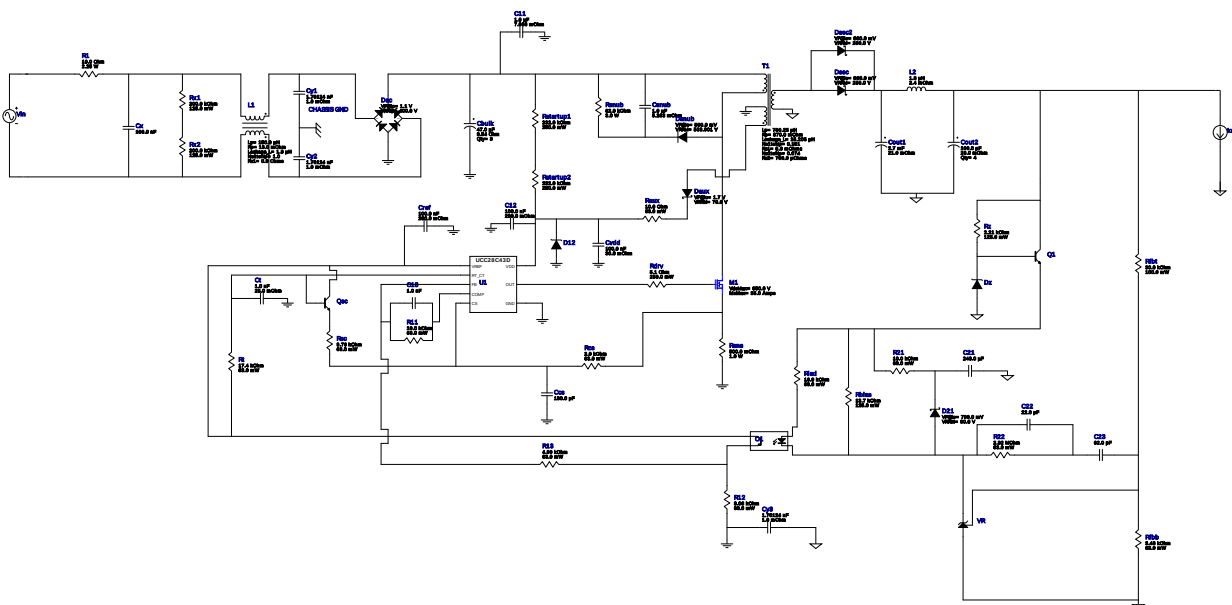


WEBENCH® Design Report

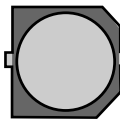
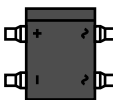
Design : 4108001/14 UCC28C43DR
UCC28C43DR 110.0V-130.0V to 24.00V @ 3.0A

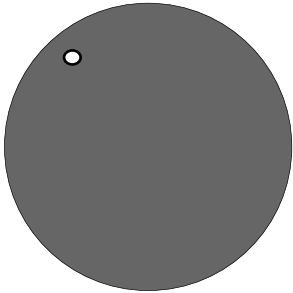


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

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	CUSTOM	CUSTOM Series= ?	Cap= 248.0 uF VDC= 40.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 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	CL21C620JBANNNC Series= C0G/NP0	Cap= 62.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
7.	Cbulk	Vishay-Bccomponents	MAL215759479E3 Series= 2239	Cap= 47.0 uF ESR= 3.54 Ohm VDC= 500.0 V IRMS= 680.0 mA	3	\$2.68	157PUM-SI_2200x2500 576 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

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout1	TDK	B41605A8278M009 Series= 2385	Cap= 2.7 mF ESR= 21.0 mOhm VDC= 63.0 V IRMS= 5.3 A	1	\$12.37	B41605_2500x4000_9 729 mm ²
10.	Cout2	Panasonic	EEHZA1H101P Series= ?	Cap= 100.0 uF ESR= 28.0 mOhm VDC= 50.0 V IRMS= 2.0 A	4	\$2.54	 SM_RADIAL_10BMM 160 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.	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
13.	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
14.	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 mm ²
15.	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
16.	Cy1	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
17.	Cy2	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
18.	Cy3	CUSTOM	CUSTOM Series= ?	Cap= 1.70124 nF ESR= 1.0 mOhm VDC= 220.62 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
19.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
20.	D21	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	\$0.09	 SMA 37 mm ²
21.	Dac	Diodes Inc.	DF1504S-T	VF@Io= 1.1 V VRRM= 400.0 V	1	\$0.20	 DF-S 99 mm ²
22.	Daux	Diodes Inc.	BAS70W-7-F	VF@Io= 1.7 V VRRM= 70.0 V	1	\$0.08	 SOT-323 10 mm ²
23.	Dsec	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 DDPAK 210 mm ²

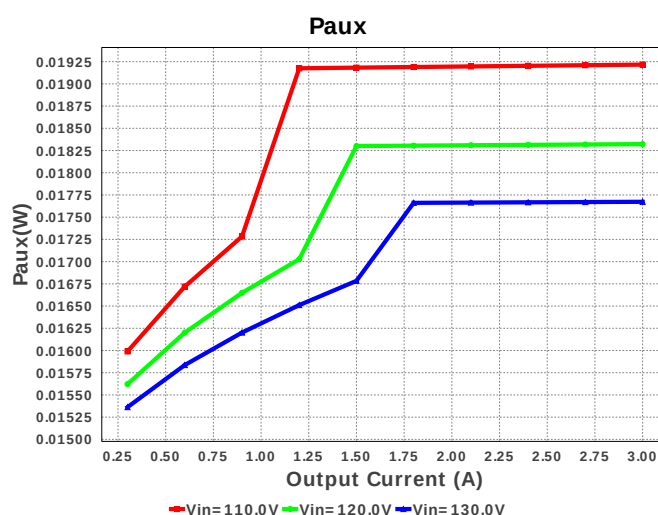
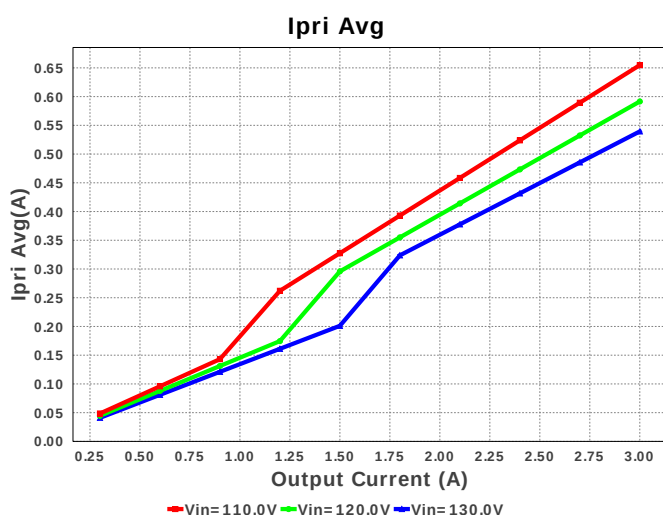
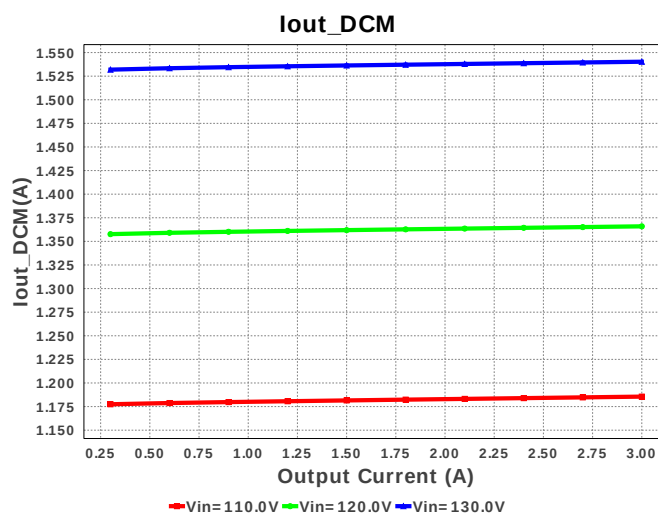
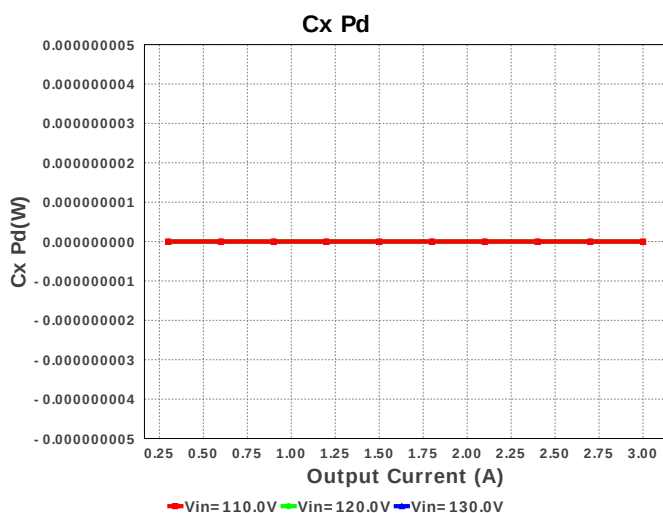
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
24.	Dsec2	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	\$0.94	 DDPAK 210 mm²
25.	Dsnub	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 563.901 V	1	NA	CUSTOM 0 mm²
26.	Dz	Diodes Inc.	MMSZ5250B-7-F	Zener	1	\$0.03	 SOD-123 13 mm²
27.	L1	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 mm²
28.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm²
29.	M1	STMicroelectronics	STP45N65M5	VdsMax= 650.0 V IdsMax= 35.0 Amps	1	\$3.85	 TO-220AB 397 mm²
30.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm²
31.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm²
32.	Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	NA	 TO-18 57 mm²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm²
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	CRCW04028K06FKED Series= CRCW..e3	Res= 8.06 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	CRCW04022M32FKED Series= CRCW..e3	Res= 2.32 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

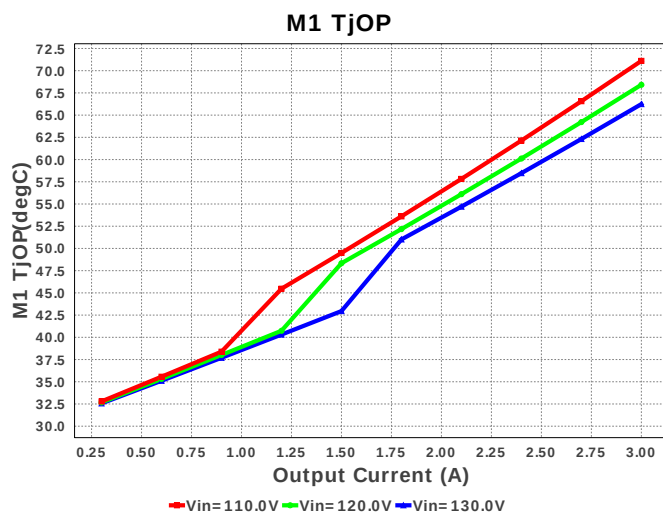
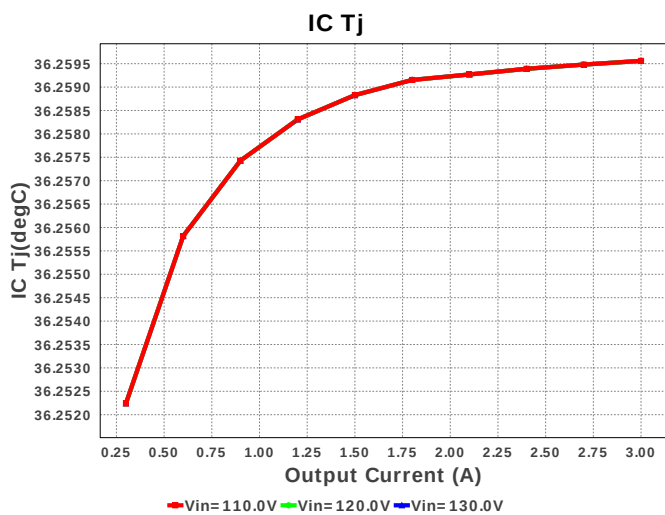
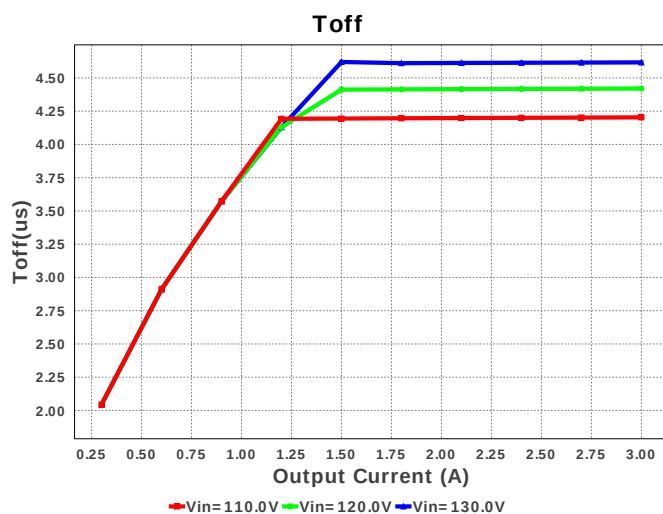
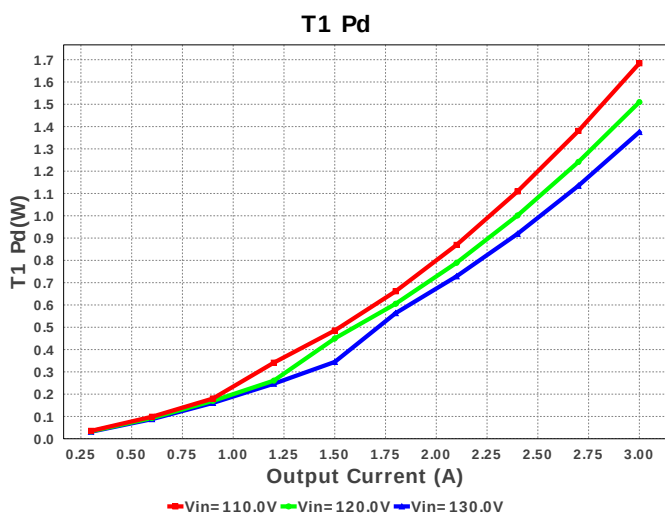
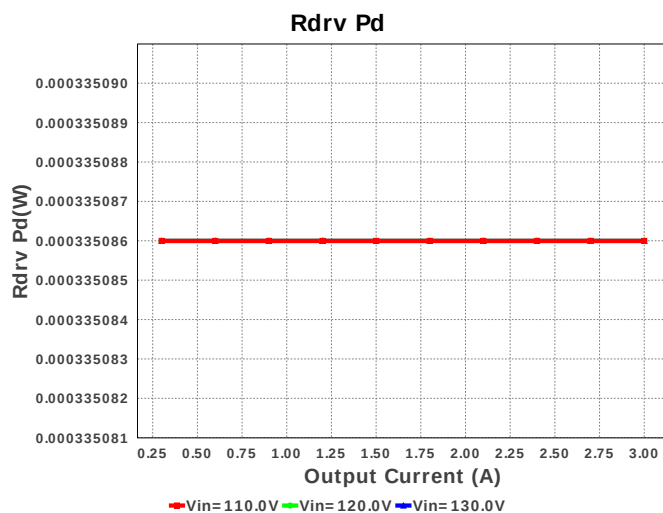
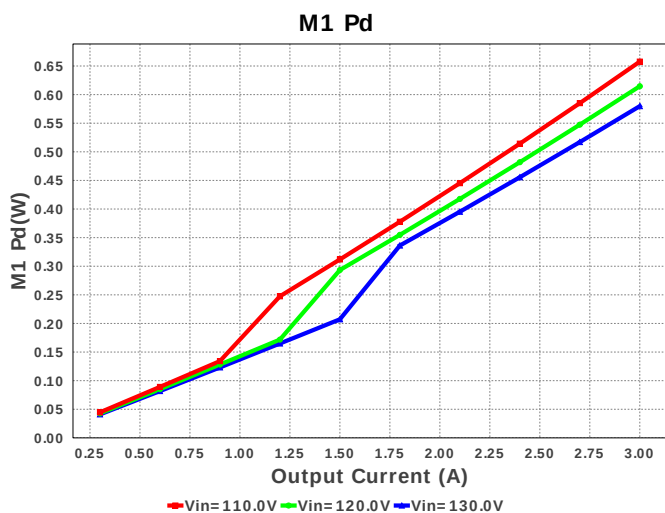
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
39.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
40.	Rbias	Panasonic	ERJ-6ENF1372V Series= ERJ-6E	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
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	Yageo America	RC1206FR-075R1L Series= ?	Res= 5.1 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
43.	Rfbb	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rfbt	Yageo America	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
45.	Rled	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW04029K76FKED Series= CRCW..e3	Res= 9.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
47.	Rsns	Stackpole Electronics Inc	CSRN2010FKR500 Series= ?	Res= 500.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.10	 2010 32 mm²
48.	Rsnu	Vishay-Bcomponents	PR03000206202JAC00 Series= ?	Res= 62.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	\$0.19	 PR03 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	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 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
54.	Rz	Panasonic	ERJ-6ENF2211V Series= ERJ-6E	Res= 2.21 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
55.	T1	CUSTOM	CUSTOM	Lp= 760.25 µH Rp= 870.0 mOhm Leakage_L= 15.205 µH Ns1toNp= 0.151 Rs1= 8.6 mOhms Ns2toNp= 0.074 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²

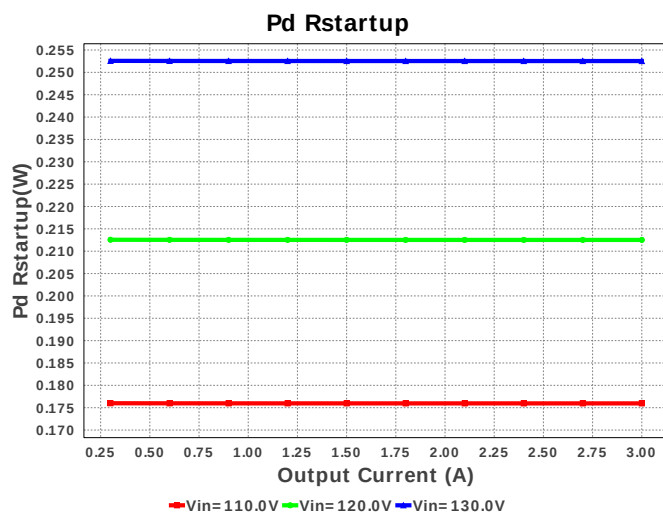
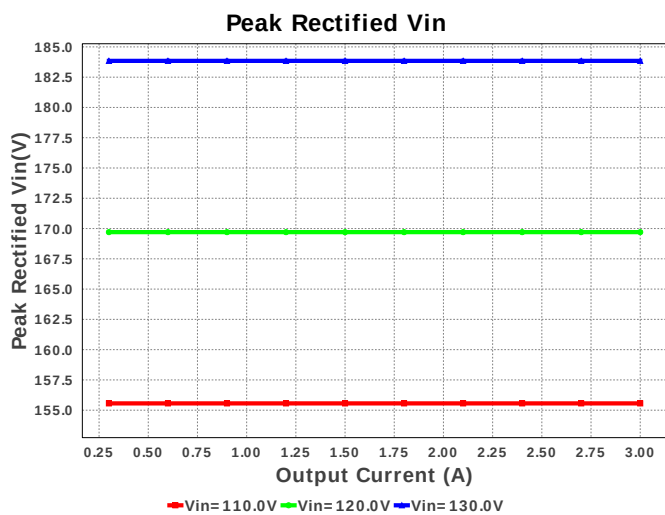
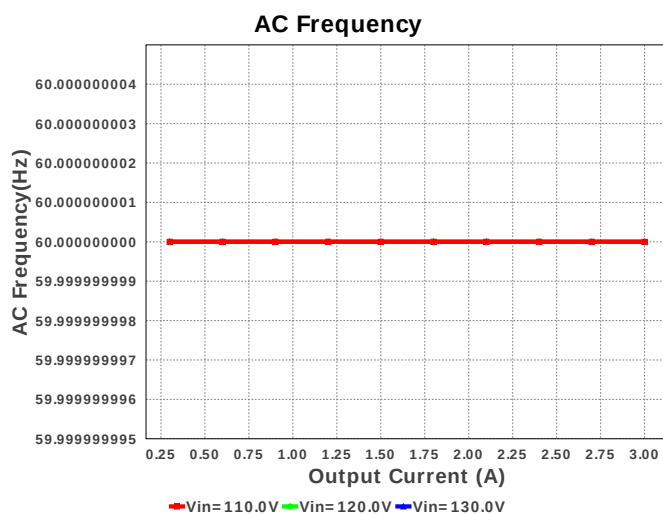
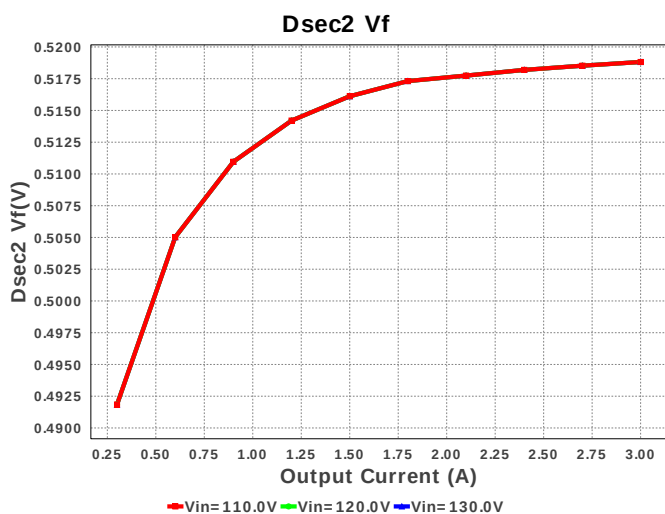
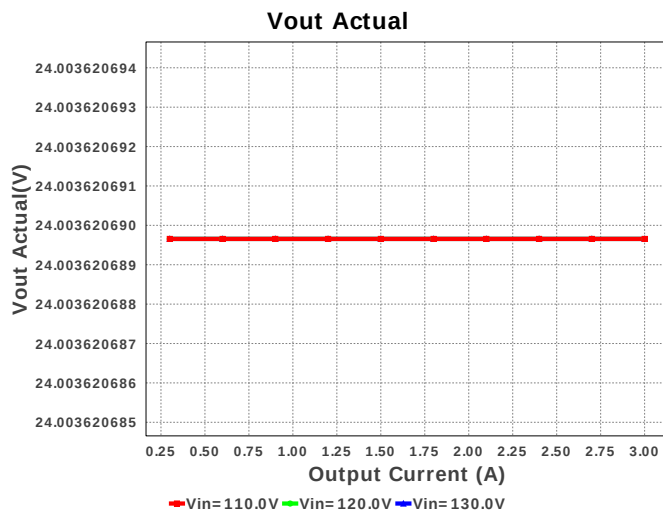
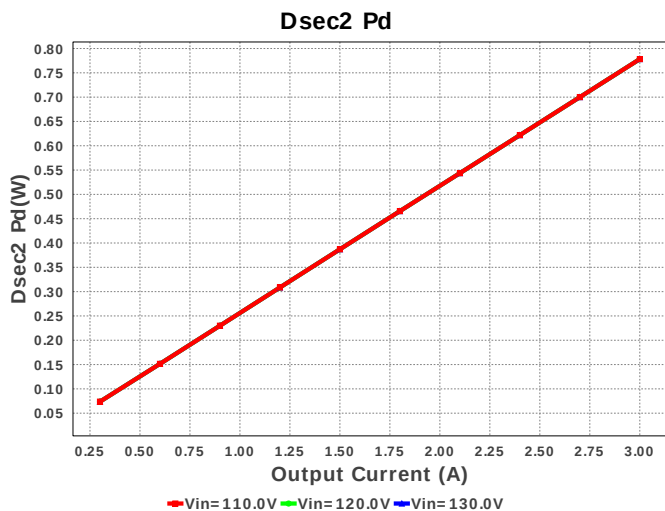
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
56.	U1	Texas Instruments	UCC28C43DR	Switcher	1	\$0.60	

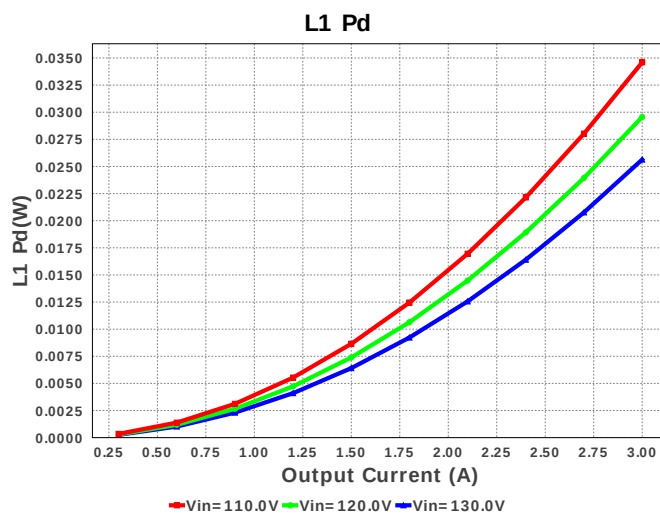
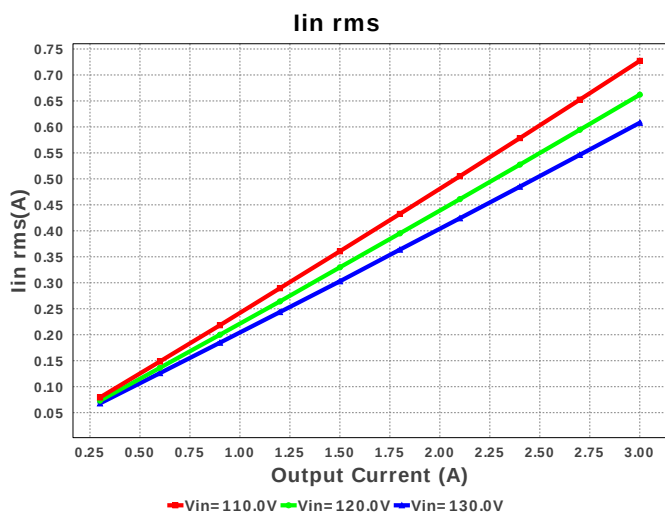
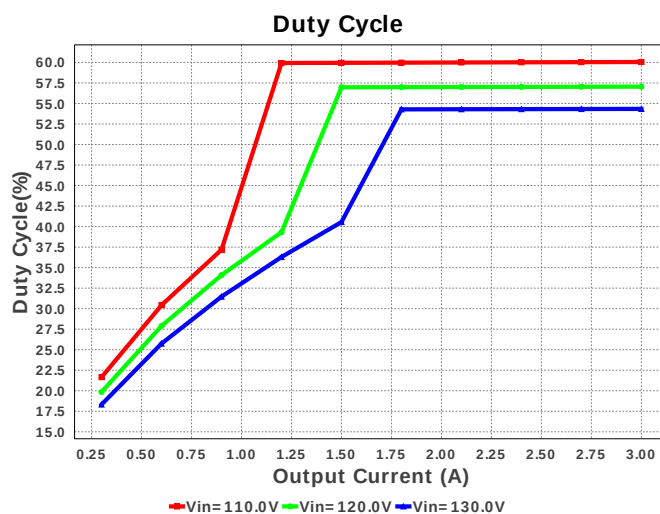
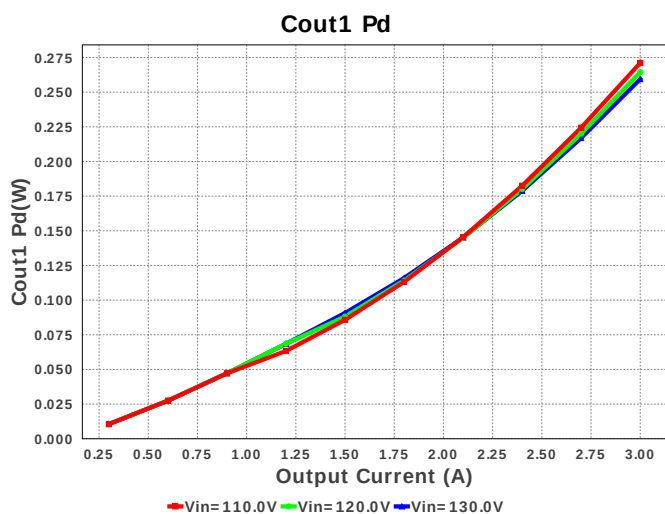
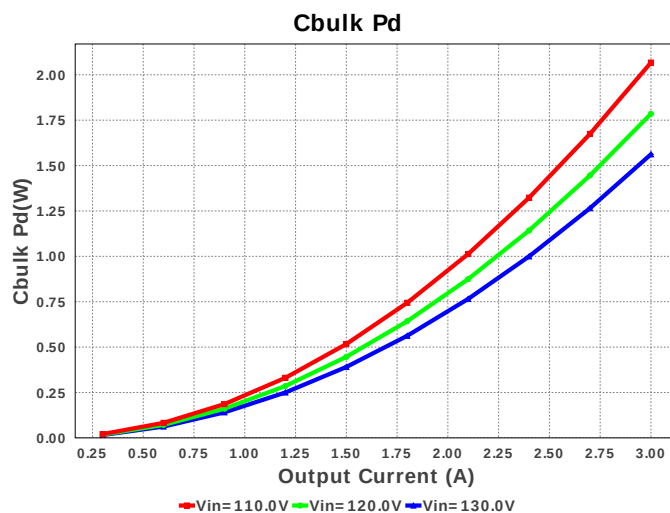
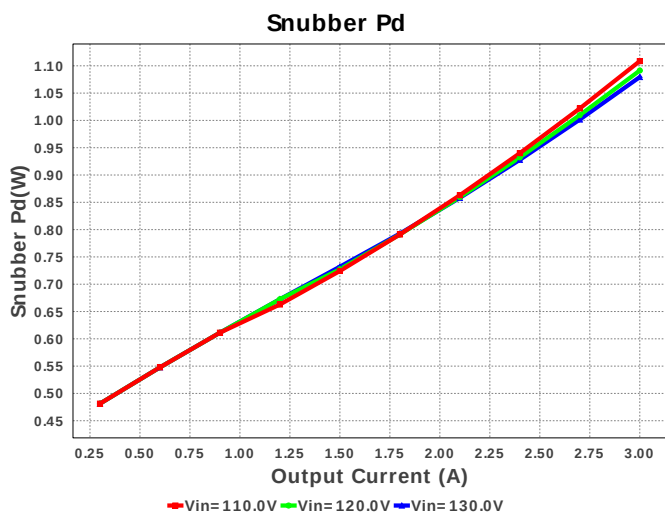
D0008A 57 mm²

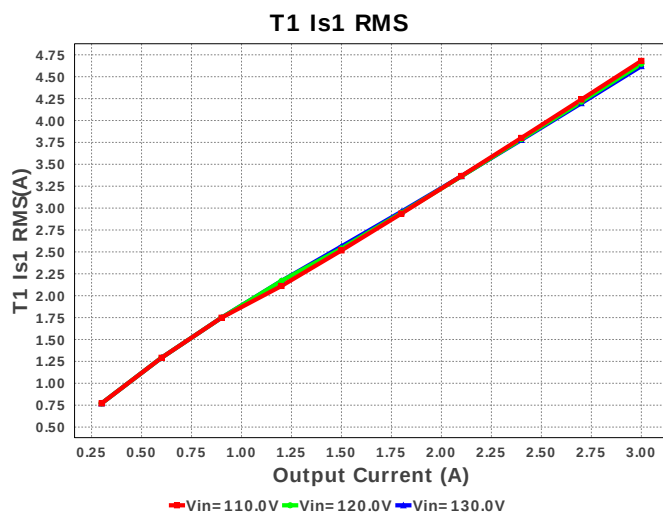
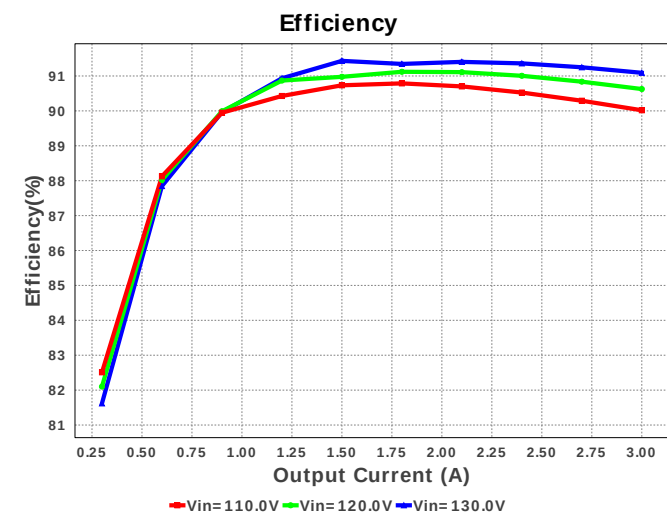
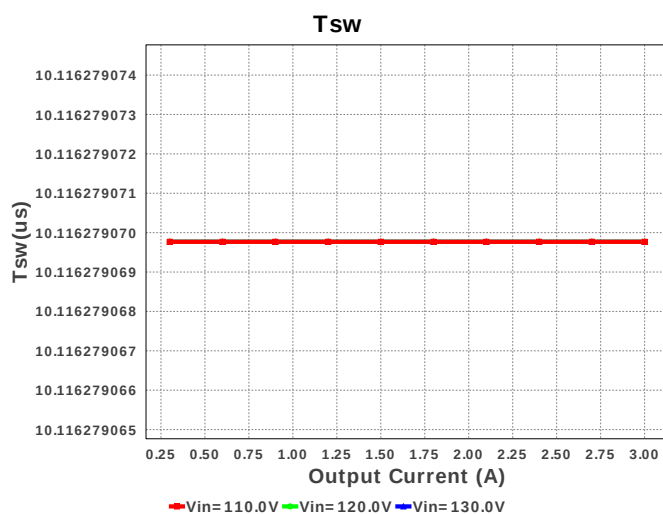
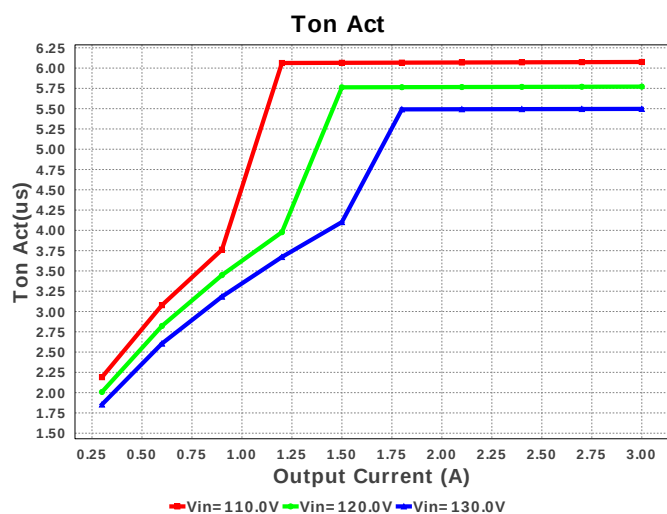
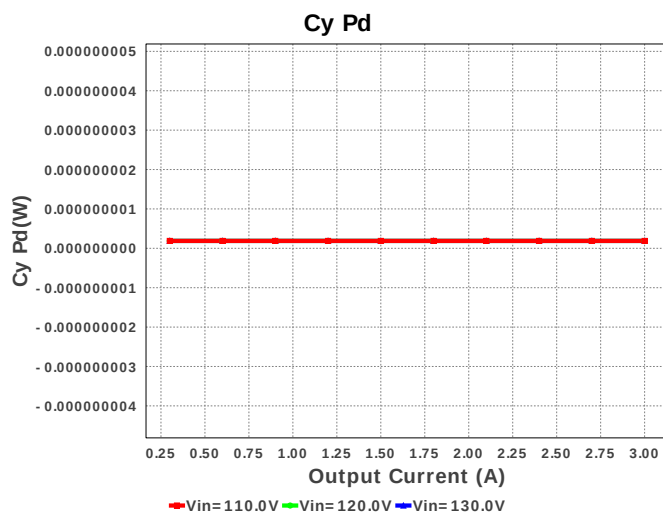
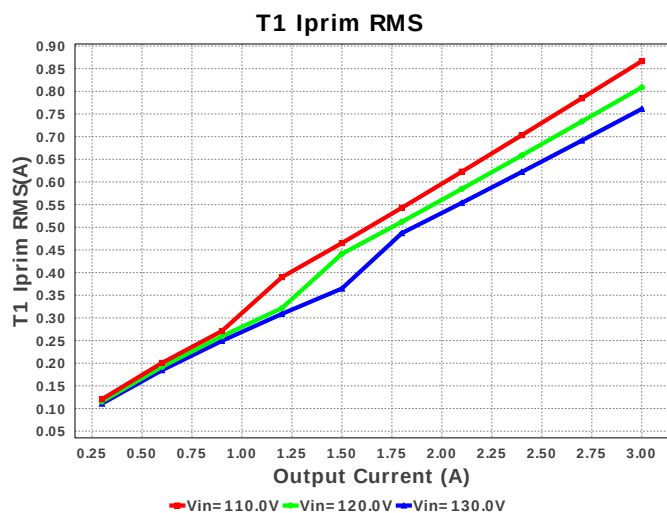
57.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	\$0.08	
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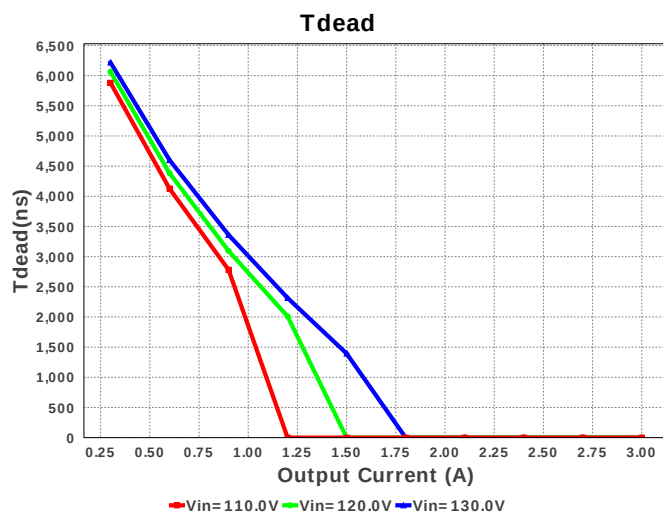
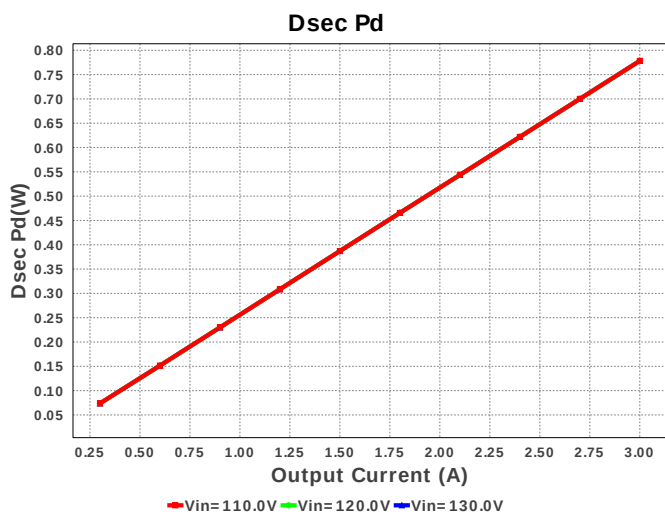
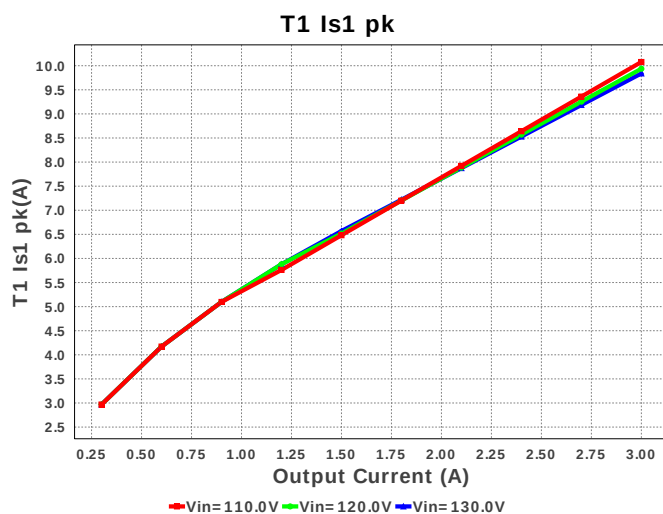
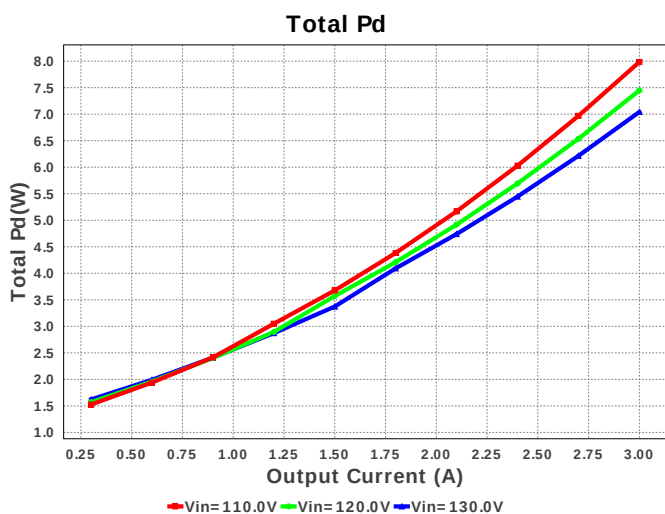
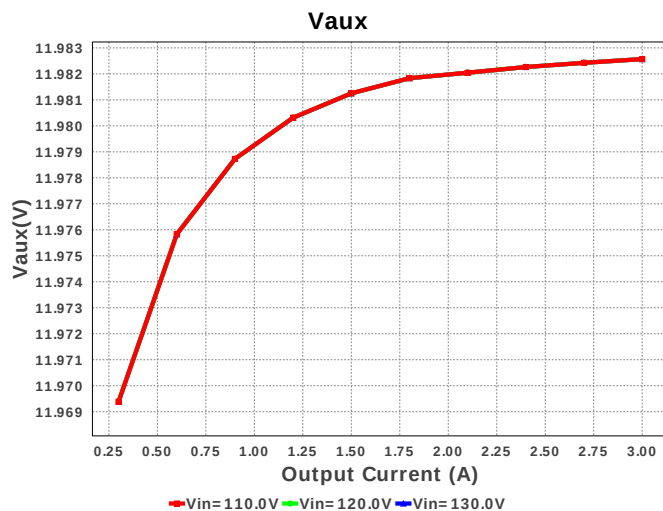
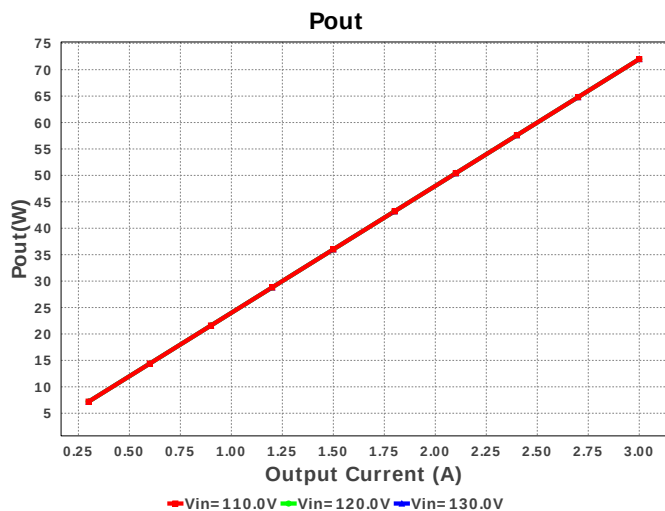
DBZ0003A 14 mm²

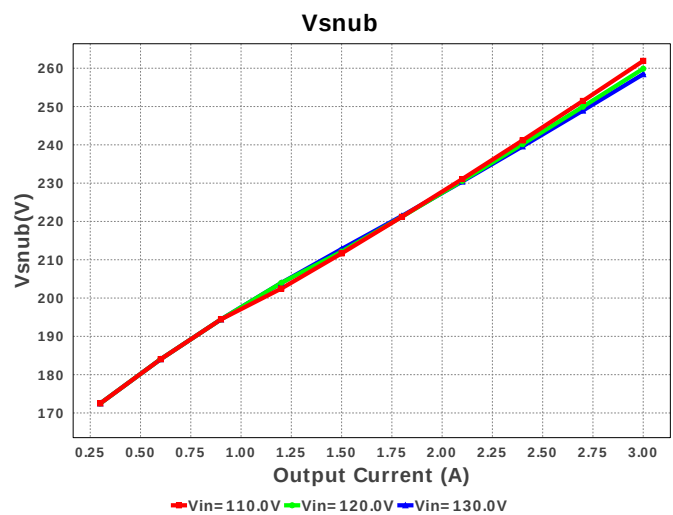
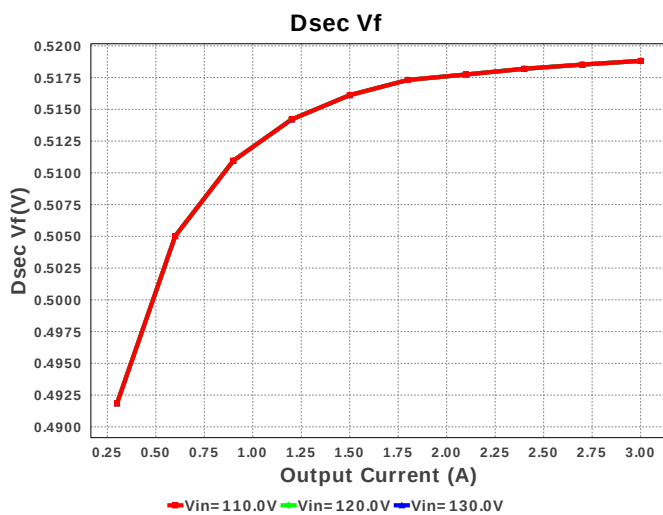
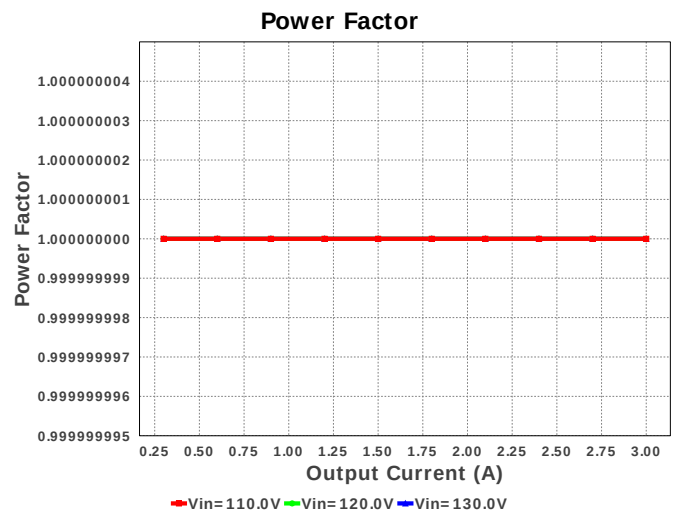
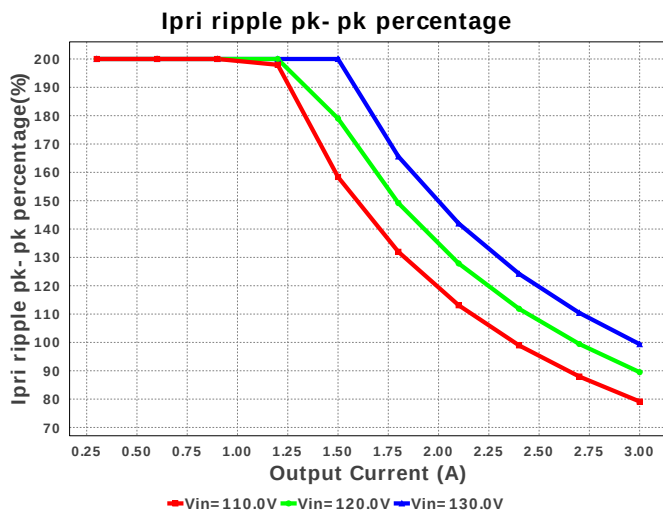
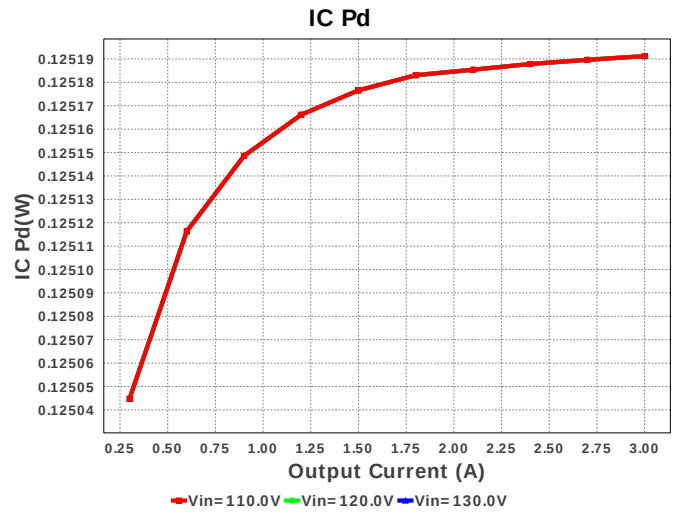
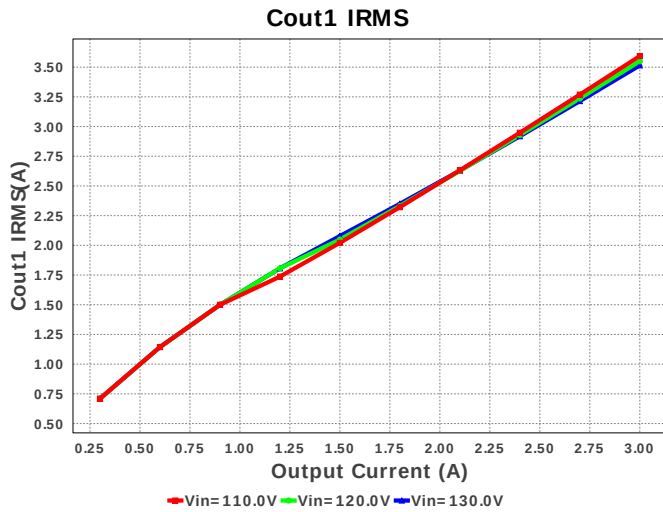


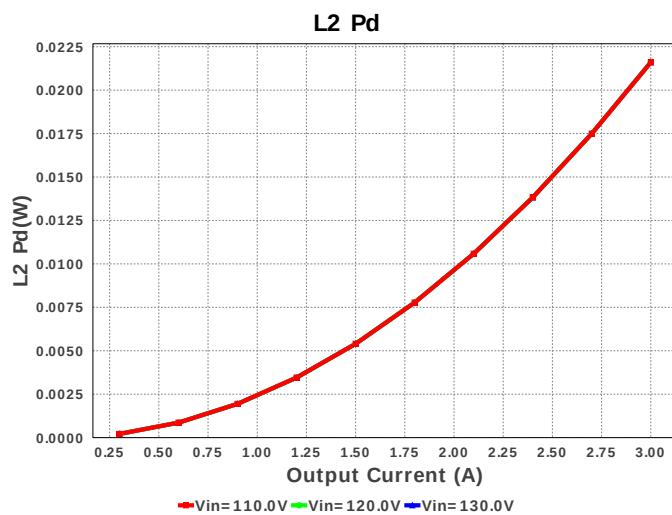
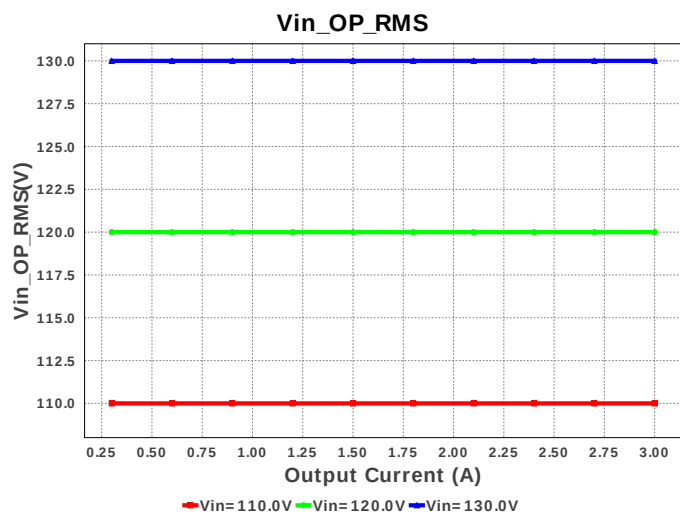
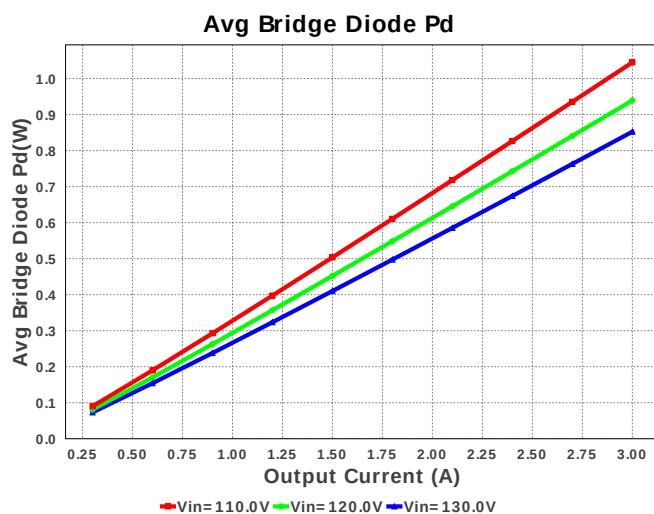
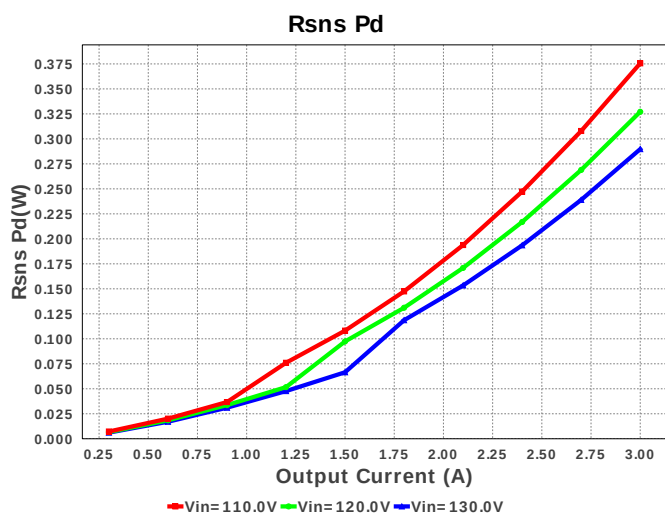
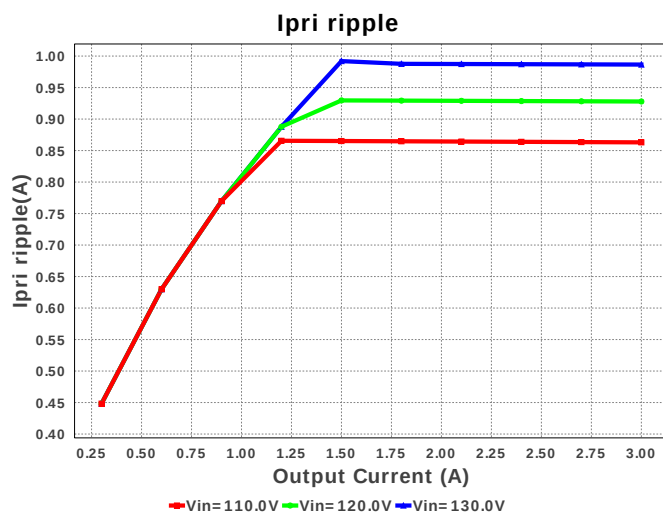
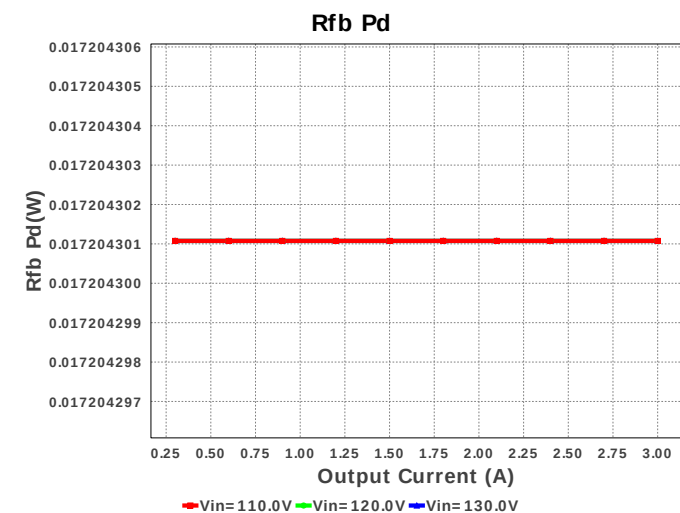


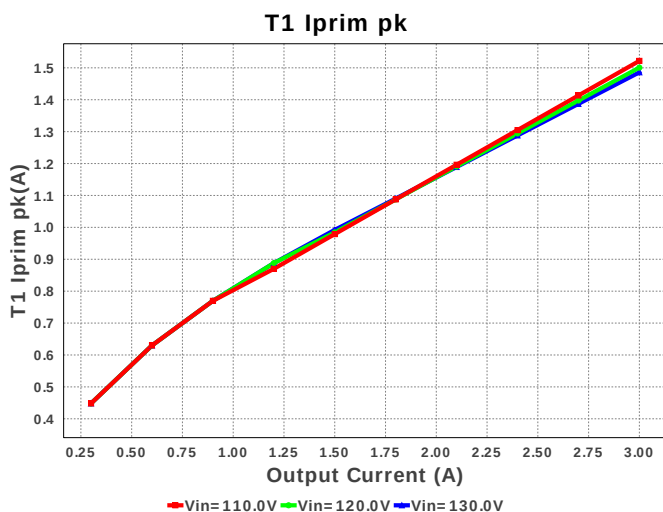
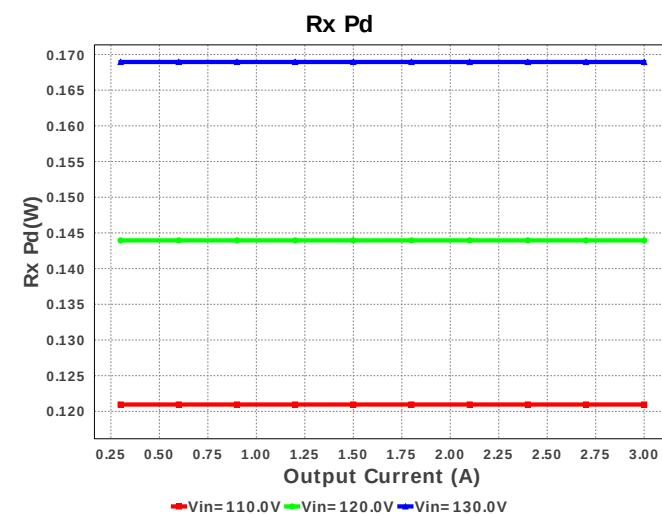
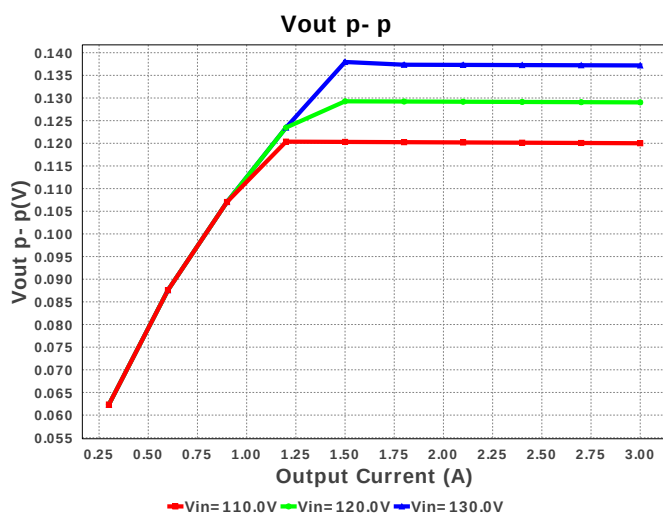
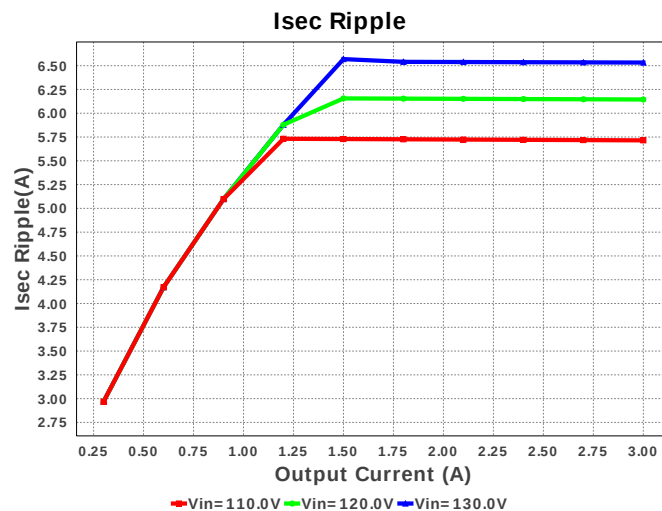
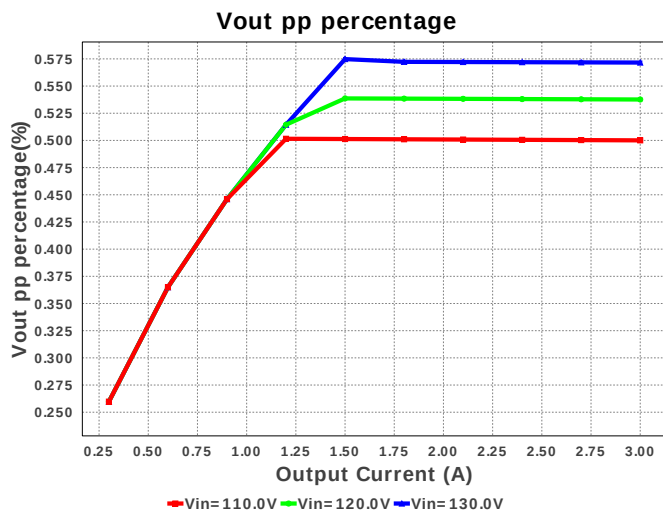












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	3.593 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	727.13 mA	Current	RMS Input Current
3.	Iout_DCM	1.186 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	654.774 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	863.019 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	79.154 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	5.715 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	866.702 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	1.522 A	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	4.681 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	10.077 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 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	518.816 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	518.816 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	6.039 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	98.851 kHz	General	Switching frequency
21.	Mode	CCM	General	Conduction Mode
22.	Pout	72.0 W	General	Total output power
23.	Power Factor	1.0	General	Assumed Power Factor for the Application
24.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
25.	Toff	4.203 us	General	Approximate Converter Off Time
26.	Ton Act	6.075 us	General	Approximate Converter On Time
27.	Total BOM	\$0.0	General	Total BOM Cost
28.	Tsw	10.116 us	General	Switching Time Period
29.	Vaux	11.983 V	General	Auxiliary Voltage
30.	Vsnub	261.923 V	General	Voltage Across the Snubber
31.	Vout Actual	24.004 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
32.	Vout OP	24.0 V	Op_Point	Operational Output Voltage
33.	Duty Cycle	60.055 %	Op_point	Duty cycle
34.	Efficiency	90.018 %	Op_point	Steady state efficiency
35.	IC Tj	36.26 degC	Op_point	IC junction temperature
36.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
37.	IOUT_OP	3.0 A	Op_point	Iout operating point
38.	M1 TJOP	71.105 degC	Op_point	M1 MOSFET junction temperature
39.	Peak Rectified Vin	155.562 V	Op_point	Peak voltage seen at rectified input
40.	Vin_OP_RMS	110.0 V	Op_point	AC Input RMS Voltage
41.	Vout p-p	120.013 mV	Op_point	Peak-to-peak output ripple voltage
42.	Avg Bridge Diode Pd	1.045 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
43.	Cbulk Pd	2.067 W	Power	Bulk capacitor power dissipation
44.	Cout1 Pd	271.107 mW	Power	Output capacitor1 power dissipation
45.	Cx Pd	0.0 W	Power	X-cap Power Dissipation
46.	Cy Pd	187.5 pW	Power	Y-caps Power Dissipation
47.	Dsec Pd	778.224 mW	Power	Secondary Diode Power Dissipation
48.	Dsec2 Pd	778.224 mW	Power	Secondary Diode Power Dissipation
49.	IC Pd	125.191 mW	Power	IC power dissipation
50.	L1 Pd	34.596 mW	Power	Power Dissipation in the Inductor
51.	L2 Pd	21.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
52.	M1 Pd	657.675 mW	Power	M1 MOSFET total power dissipation
53.	Paux	19.217 mW	Power	Power Dissipation in Raux and Daux
54.	Pd Rstartup	175.963 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
55.	Rdrv Pd	335.086 μW	Power	Power Dissipation in Gate Drive Resistor
56.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
57.	Rsns Pd	375.586 mW	Power	Current Limit Sense Resistor Power Dissipation
58.	Rx Pd	120.961 mW	Power	Total Power Dissipation in Rx1 and Rx2
59.	Snubber Pd	1.109 W	Power	Snubber Power Dissipation
60.	T1 Pd	1.684 W	Power	Estimated Losses in Transformer
61.	Total Pd	7.984 W	Power	Total Power Dissipation
62.	Vout Tolerance	2.137 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
63.	Vout pp percentage	500.056 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	130.0	Maximum input voltage
3.	VinMin	110.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	acFrequency	60.0	Light Output in Lumen
6.	base_pn	UCC28C43	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C43 Product Folder : <http://www.ti.com/product/UCC28C43> : contains the data sheet and other resources.

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