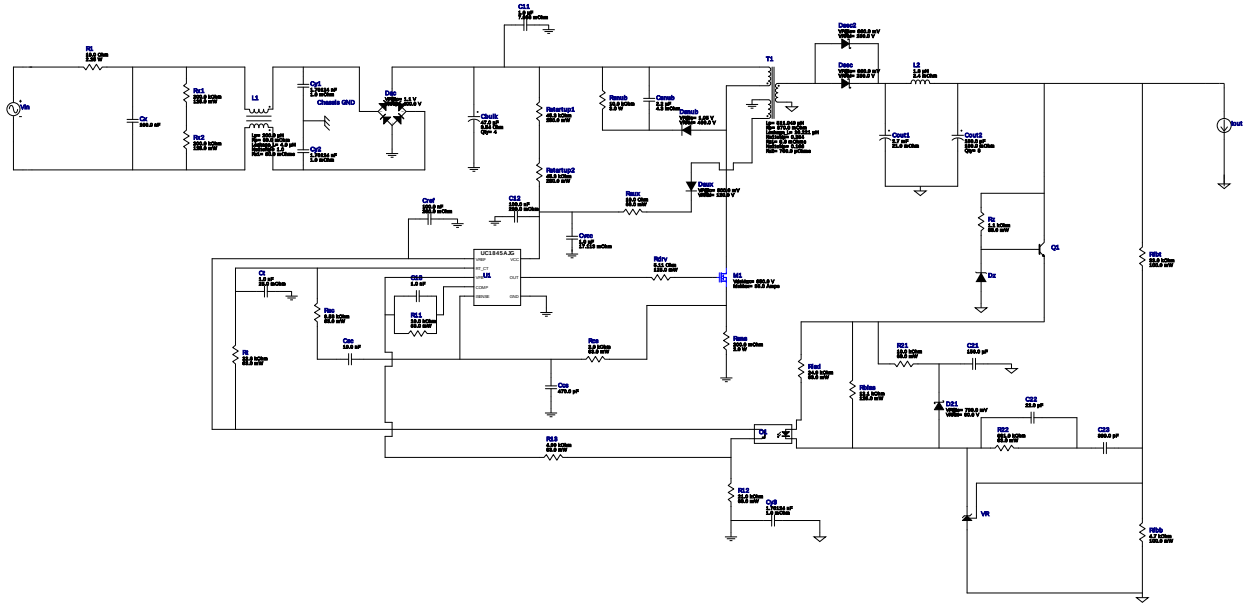
TEXAS INSTRUMENTS

WEBENCH® Design Report

VinMin = 110.0V
VinMax = 130.0V
Vout = 20.0V
Iout = 5.0A

Device = UC1845AJ
Topology = Flyback
Created = 7/12/16 12:20:58 AM
BOM Cost = $0.00
BOM Count = 66
Total Pd = 12.83W

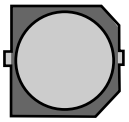
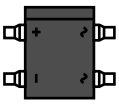
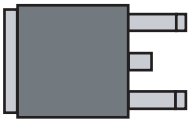
Design : 4737466/20 UC1845AJ
UC1845AJ 110.0V-130.0V to 20.00V @ 5.0A

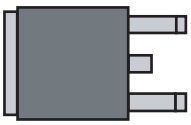
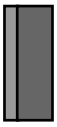


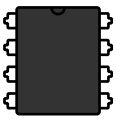
1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

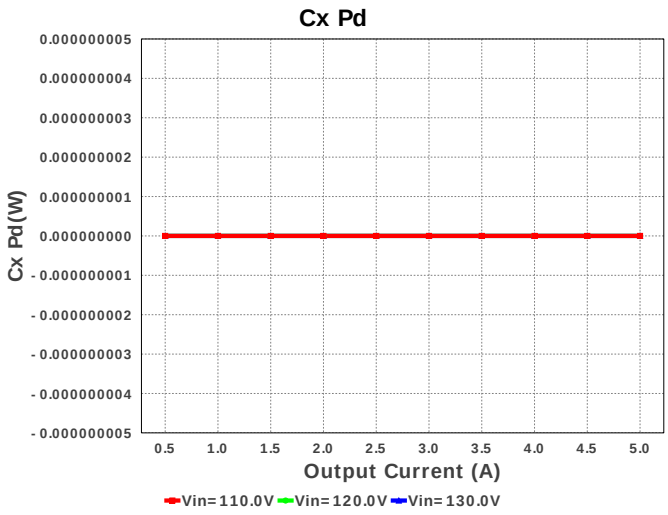
Electrical BOM

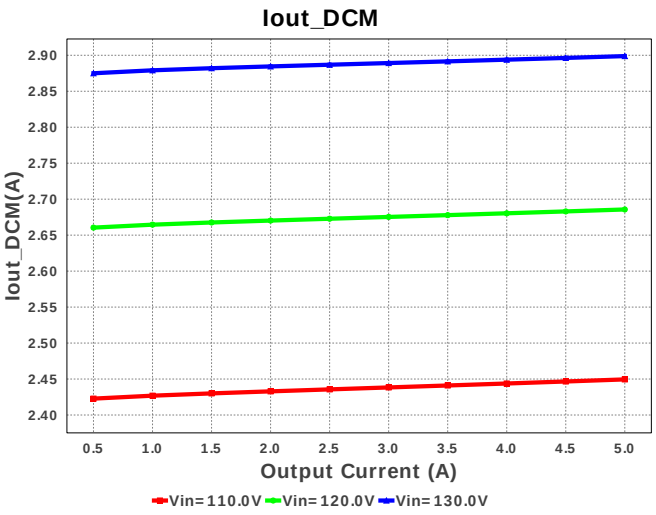
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	MuRata	GRM55DR72E105KW01L Series= X7R	Cap= 1.0 uF ESR= 7.086 mOhm VDC= 250.0 V IRMS= 2.0605 A	1	$0.26	2220_200 54 mm^2
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
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= 156.0 uF VDC= 36.0 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	CL21C331JBANFNC Series= C0G/NP0	Cap= 330.0 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	4	$2.68	157PUM-SI_2200x2500 576 mm^2
8.	Ccs	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2

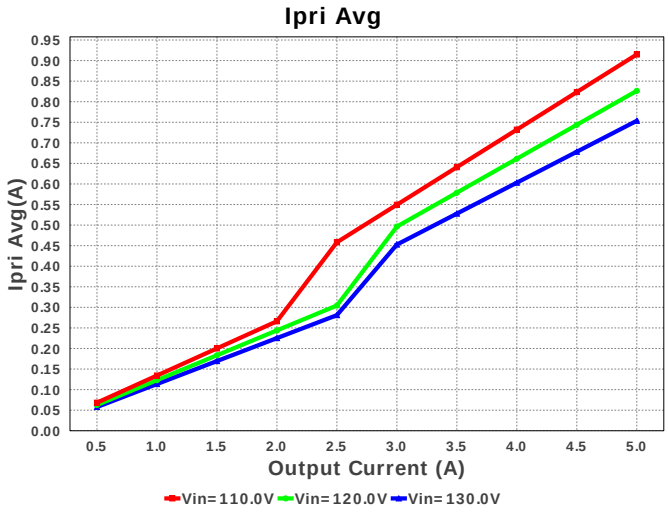
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout1	TDK	B41605A8278M009 Series= 2385	Cap= 2.7 mF ESR= 21.0 mOhm VDC= 63.0 V IRMS= 5.3 A	1	$12.37	B41605_2500x4000_9 729 mm^2
10.	Cout2	Nichicon	UUD1H151MNL1GS Series= uD	Cap= 150.0 uF ESR= 180.0 mOhm VDC= 50.0 V IRMS= 670.0 mA	8	$0.26	 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.	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	C5750X6S2W225K Series= X6S	Cap= 2.2 uF ESR= 4.3 mOhm VDC= 400.0 V IRMS= 0.0 A	1	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.	Cvcc	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	 0603 5 mm^2
16.	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
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 mm^2
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 mm^2
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 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	Vishay-Semiconductor	V12P12-M3/86A	VF@Io= 800.0 mV VRRM= 120.0 V	1	$0.40	 TO-277A 56 mm^2
23.	Dsec	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	$0.94	 DDPAK 210 mm^2

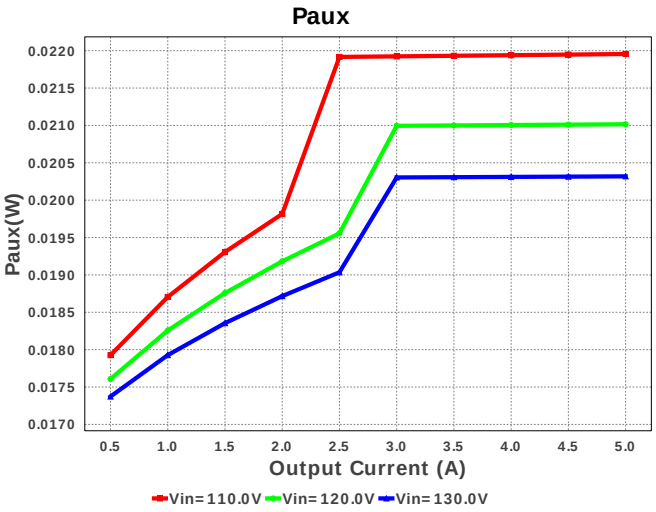
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
24.	Dsec2	ON Semiconductor	MBRB40250TG	VF@Io= 860.0 mV VRRM= 250.0 V	1	$0.94	 DDPAK 210 mm²
25.	Dsnub	Bourns	CD1408-FU1400	VF@Io= 1.05 V VRRM= 400.0 V	1	$0.13	 Diode_1408 13 mm²
26.	Dz	Diodes Inc.	MMSZ5248B-7-F	Zener	1	$0.04	 SOD-123 13 mm²
27.	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 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.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	$0.30	 AC03 158 mm²
33.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
34.	R12	Vishay-Dale	CRCW040221K0FKED Series= CRCW..e3	Res= 21.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
35.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
36.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
37.	R22	Vishay-Dale	CRCW0402681KFKED Series= CRCW..e3	Res= 681.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
38.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
39.	Rbias	Panasonic	ERJ-6ENF1212V Series= ERJ-6E	Res= 12.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
40.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
41.	Rdrv	Vishay-Dale	CRCW08055R11FKEA Series= CRCW..e3	Res= 5.11 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²

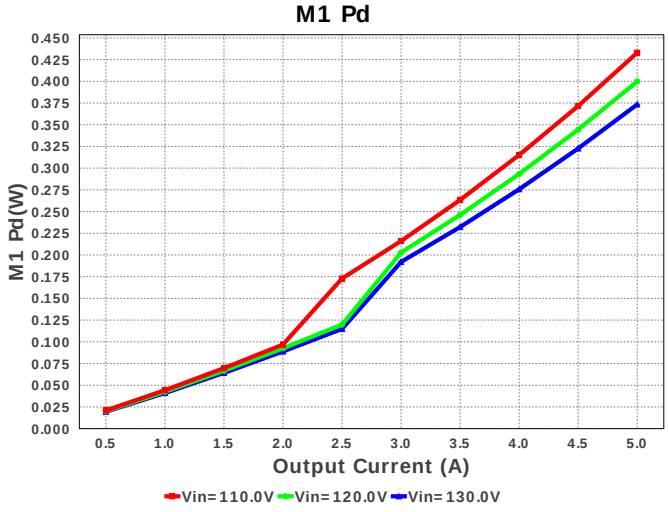
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
42.	Rfbb	Yageo America	RC0603FR-074K7L Series= ?	Res= 4.7 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
43.	Rfbt	Yageo America	RC0603FR-0733KL Series= ?	Res= 33.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
44.	Rled	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
45.	Rsc	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
46.	Rsns	Stackpole Electronics Inc	CSRN2512FKR200 Series= ?	Res= 200.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.13	 2512 43 mm²
47.	Rsnub	Vishay-Bccomponents	PR03000201002JAC00 Series= ?	Res= 10.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	$0.19	 PR03 0 mm²
48.	Rstartup1	Panasonic	ERJ-8ENF4532V Series= ERJ-8E	Res= 45.3 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
49.	Rstartup2	Panasonic	ERJ-8ENF4532V Series= ERJ-8E	Res= 45.3 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
50.	Rt	Vishay-Dale	CRCW040222K6FKED Series= CRCW..e3	Res= 22.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
51.	Rx1	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
52.	Rx2	Panasonic	ERJ-6ENF2003V Series= ERJ-6E	Res= 200.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
53.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
54.	T1	CUSTOM	CUSTOM	Lp= 511.049 µH Rp= 870.0 mOhm Leakage_L= 10.221 µH Ns1toNp= 0.284 Rs1= 8.6 mOhms Ns2toNp= 0.166 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
55.	U1	Texas Instruments	UC1845AJ	Switcher	1	$14.16	 JG0008A 111 mm²
56.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.07	 R-PDSO-G3 16 mm²

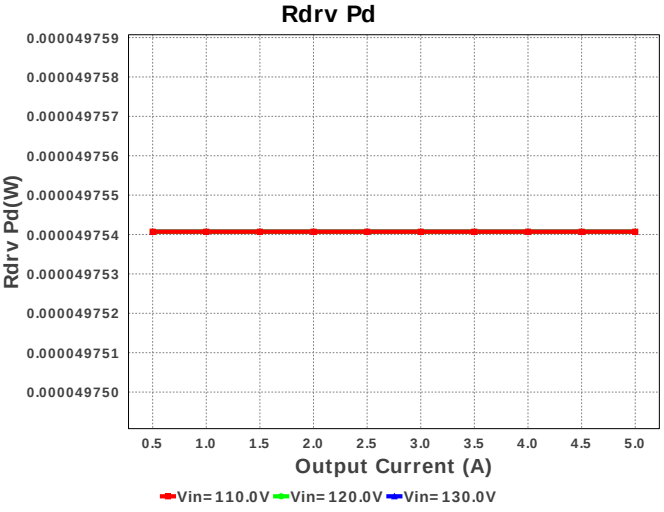


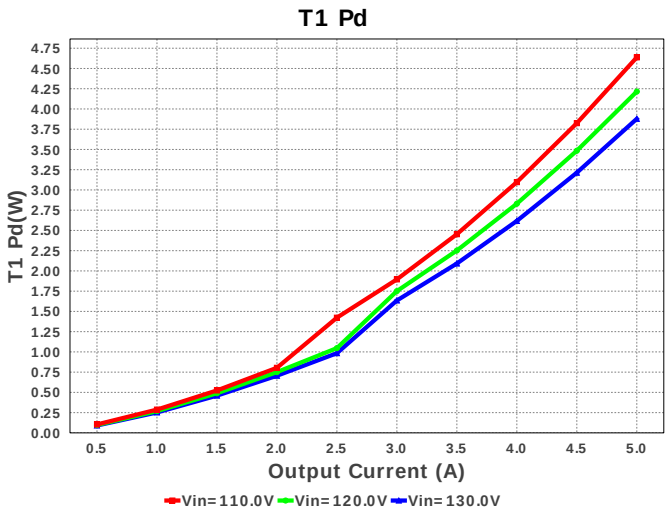


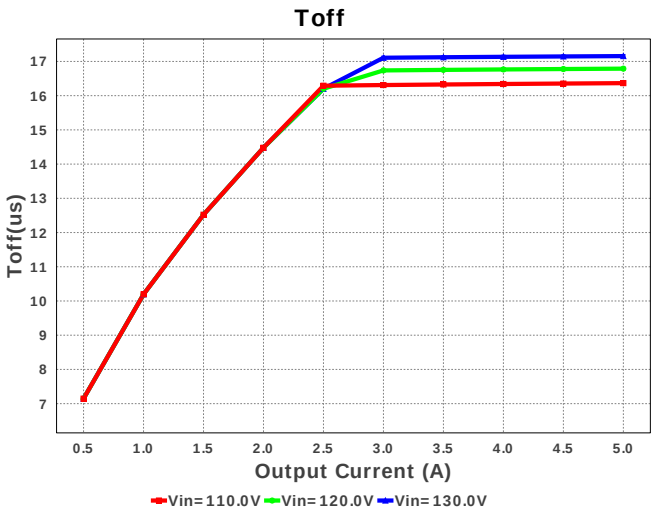


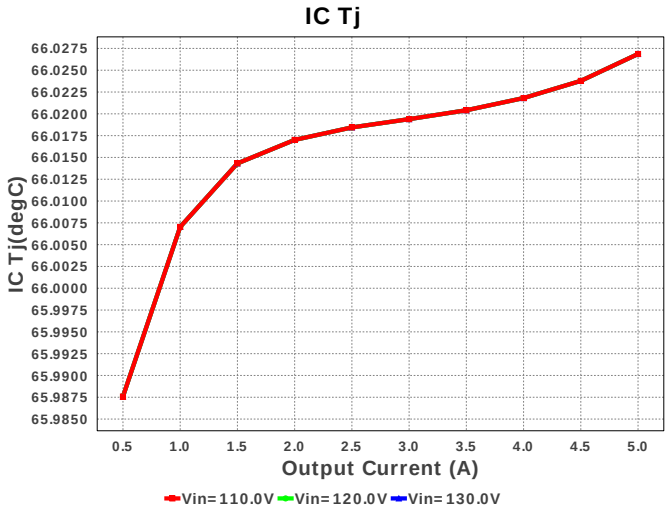


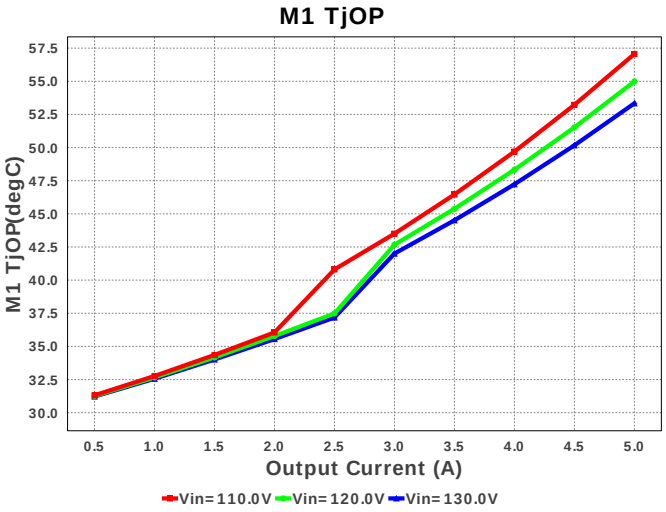


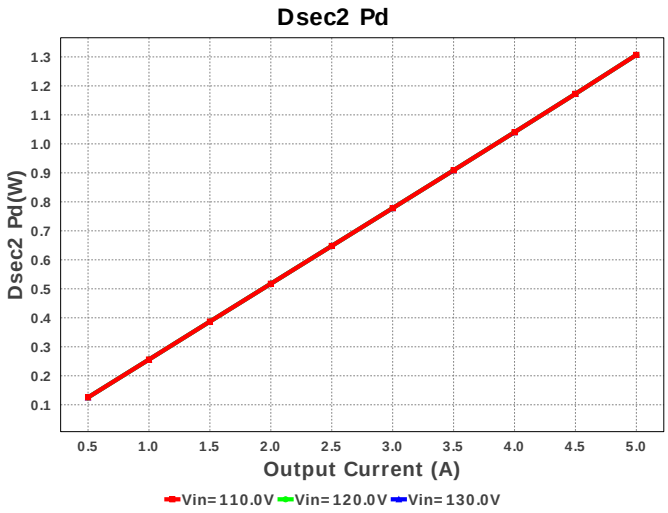


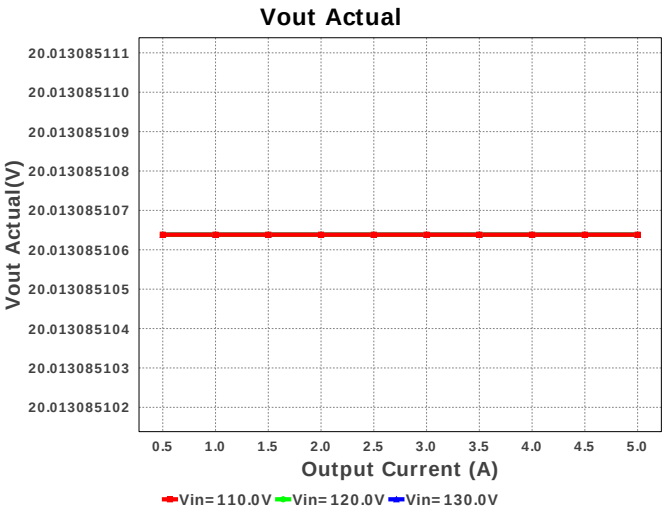


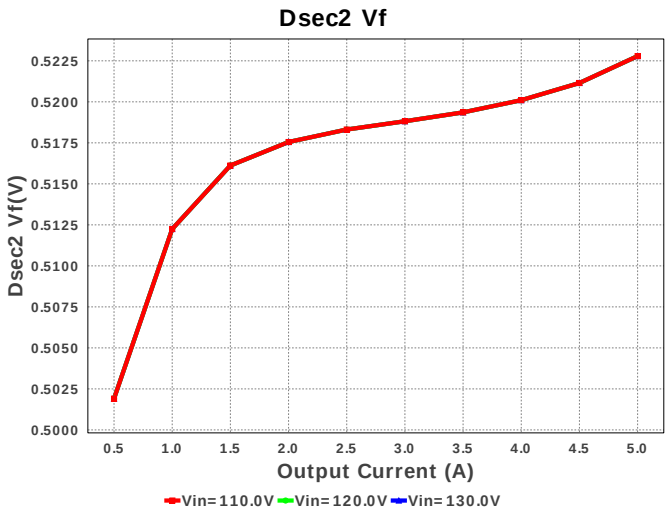


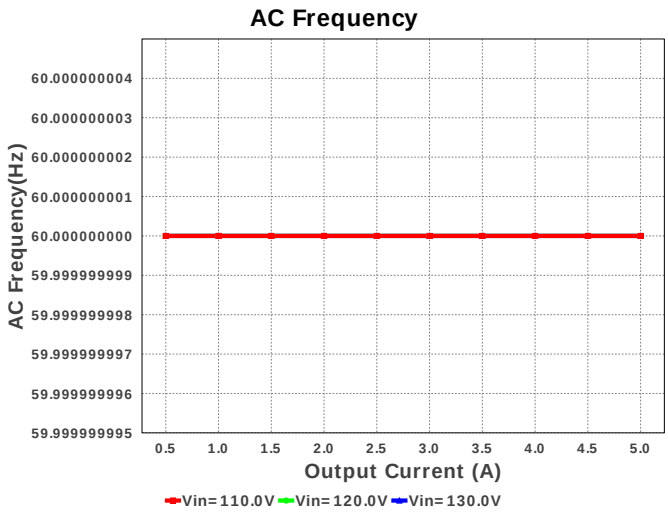


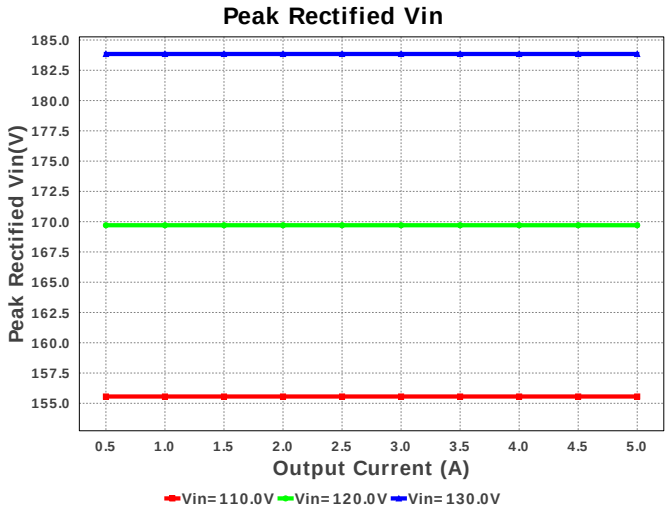


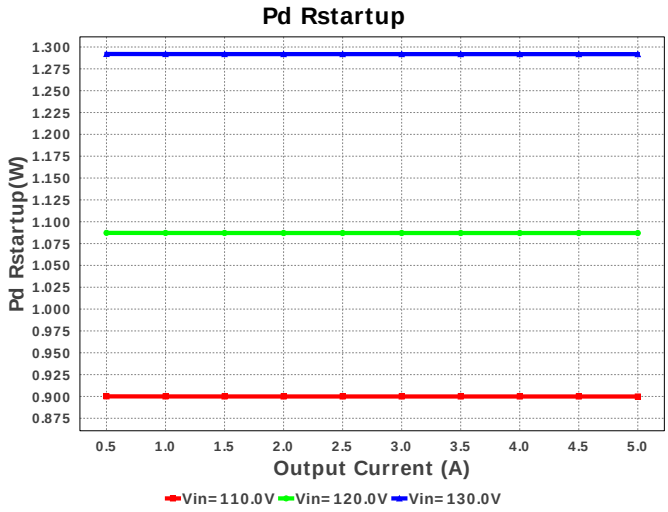


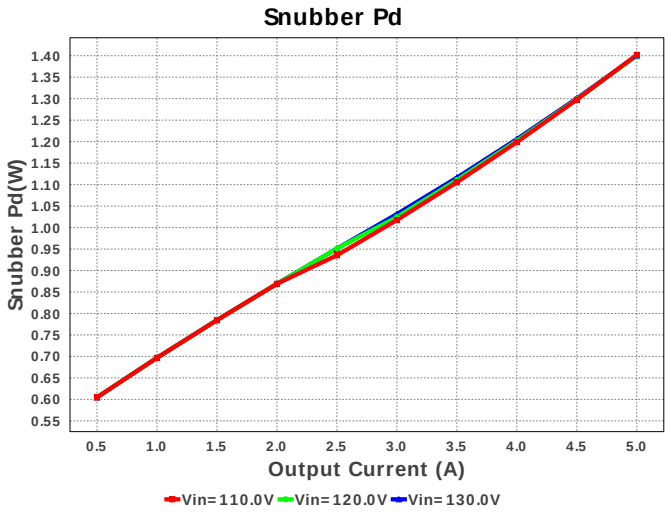


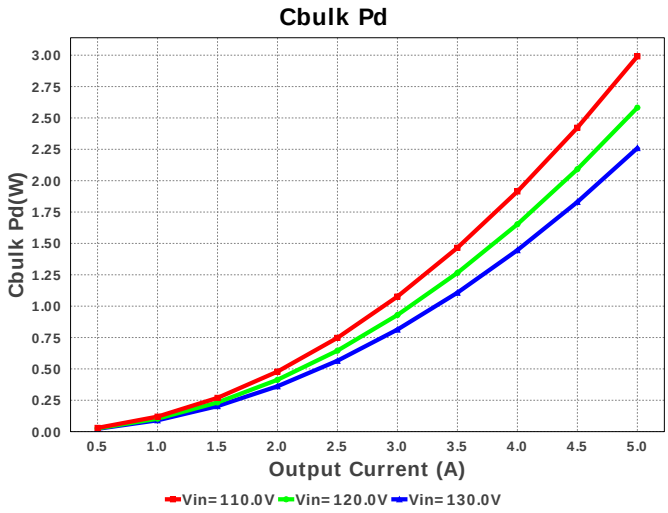


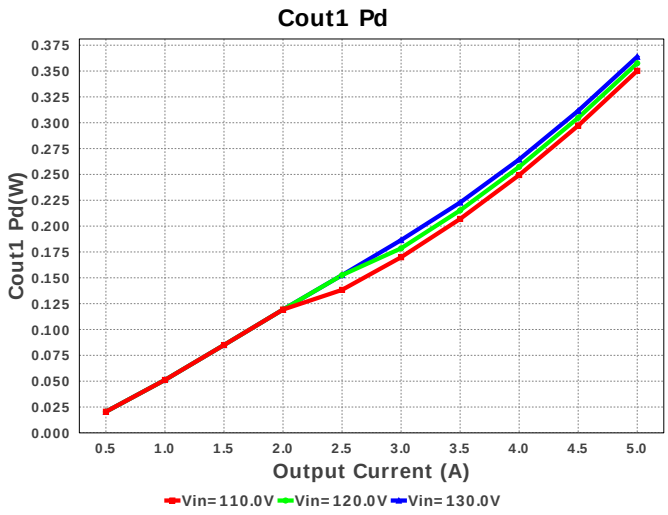


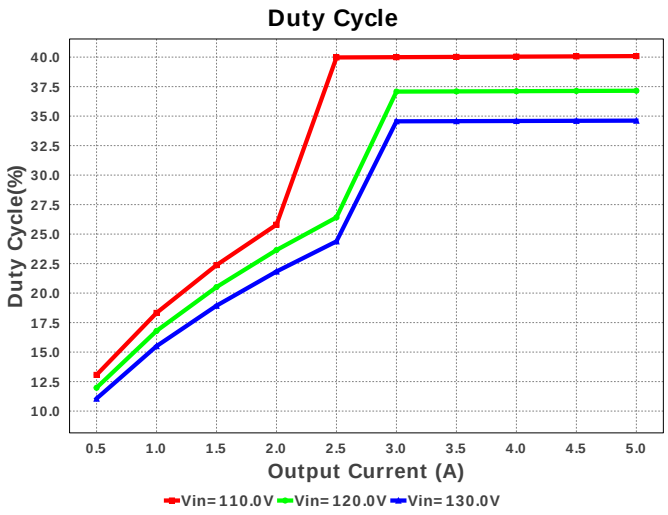


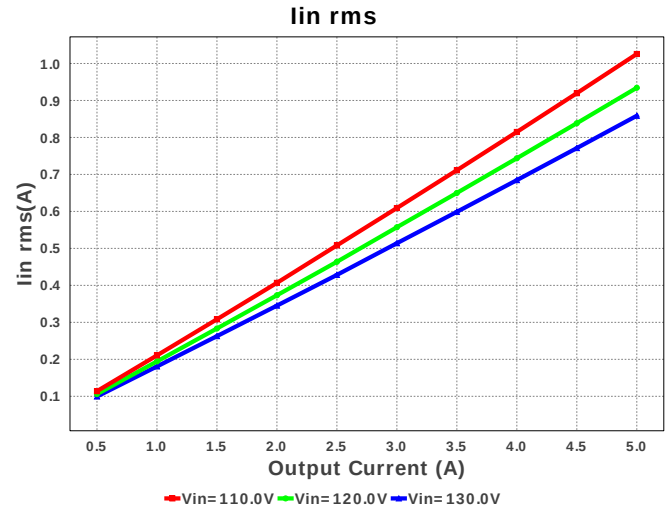


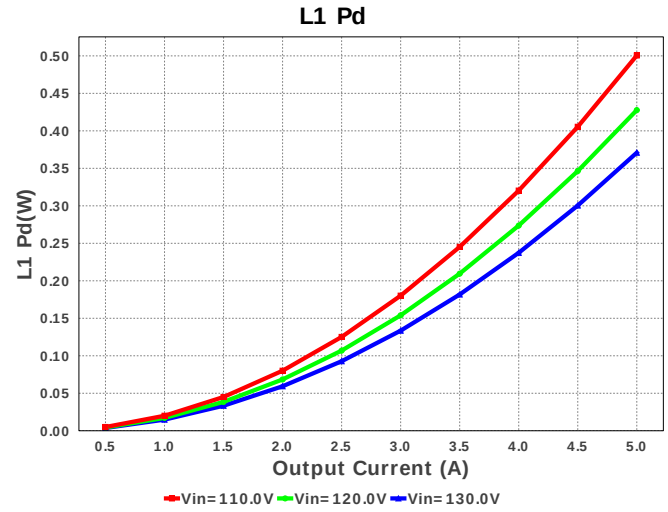


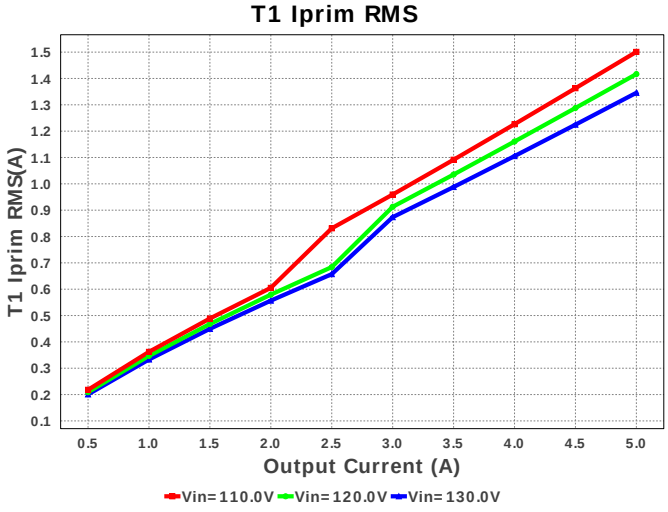


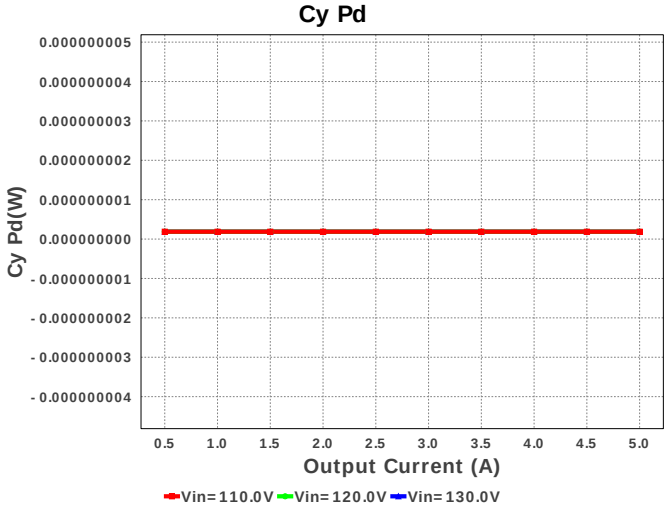


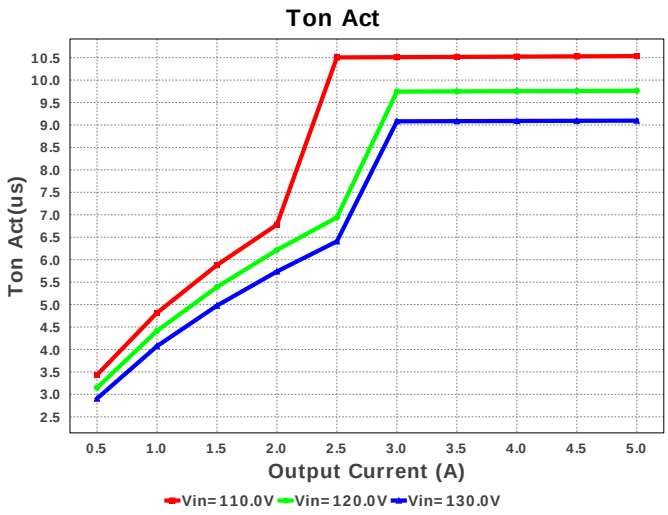


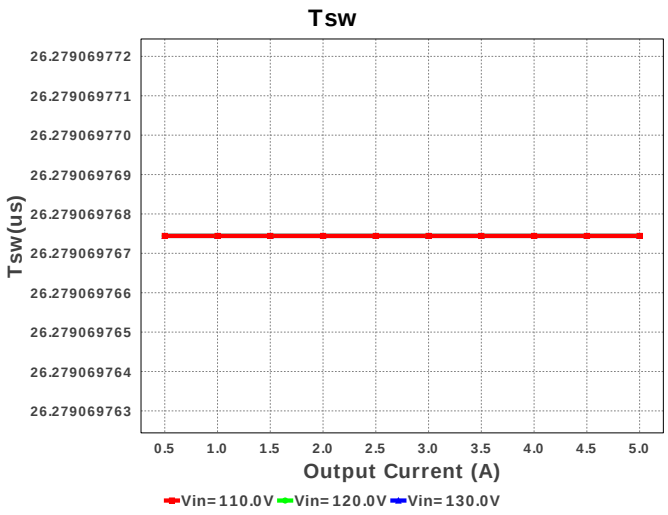


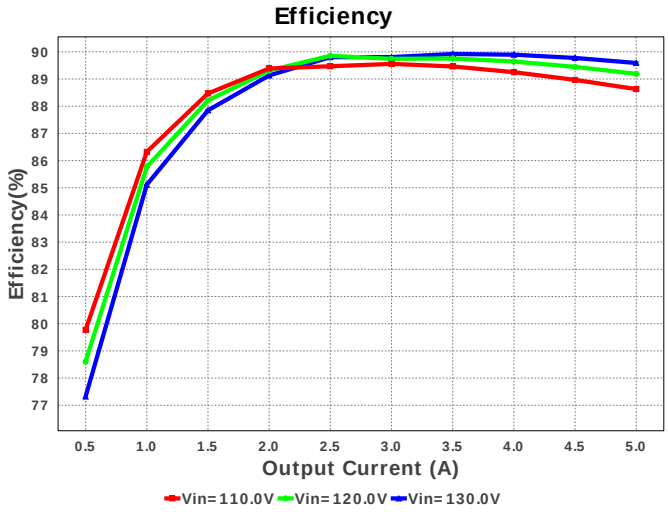


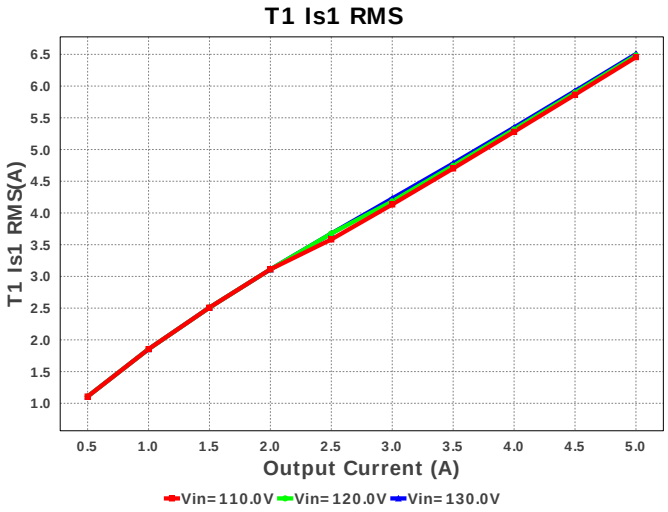


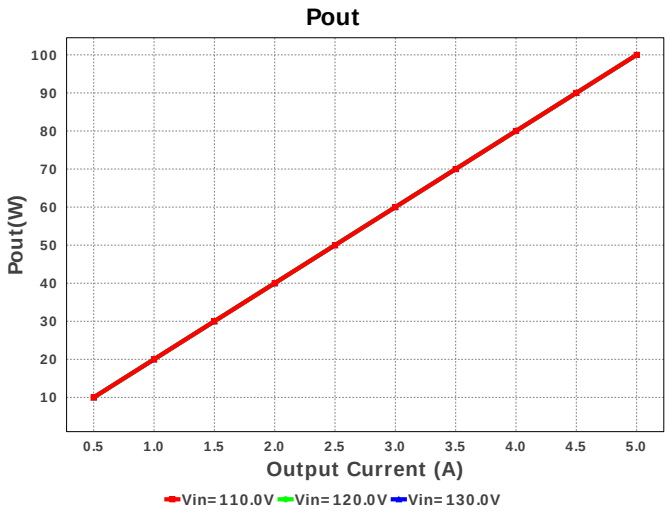


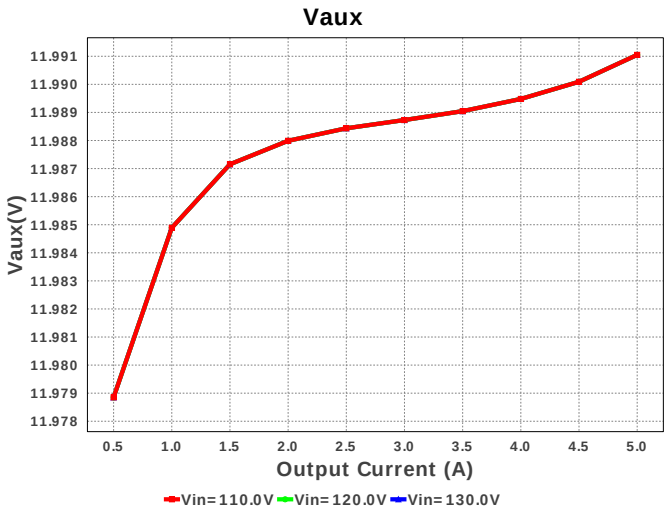


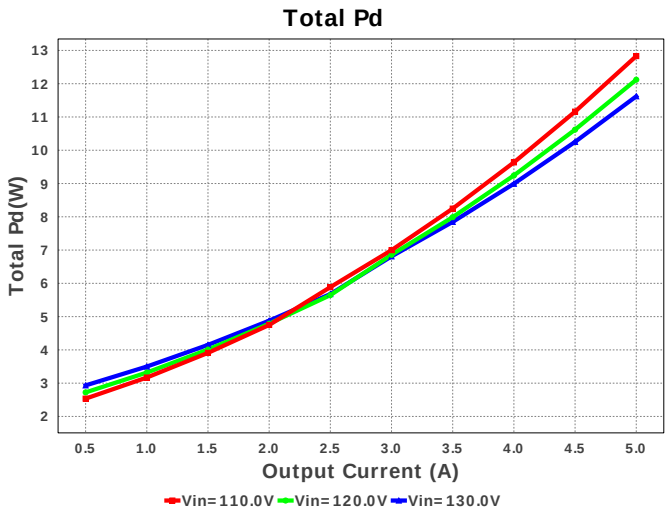


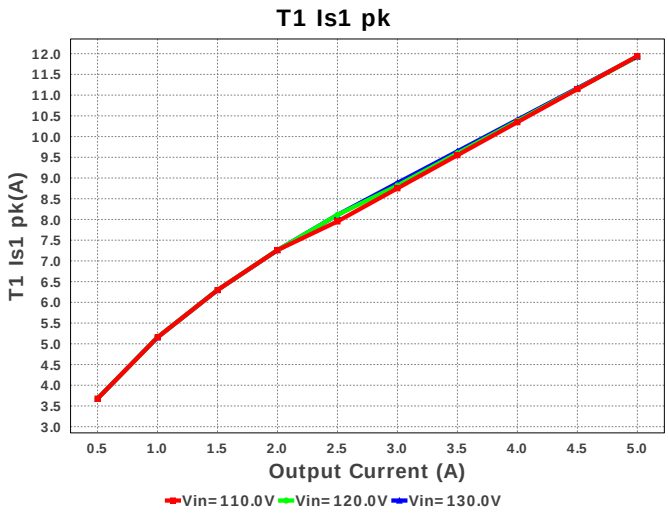


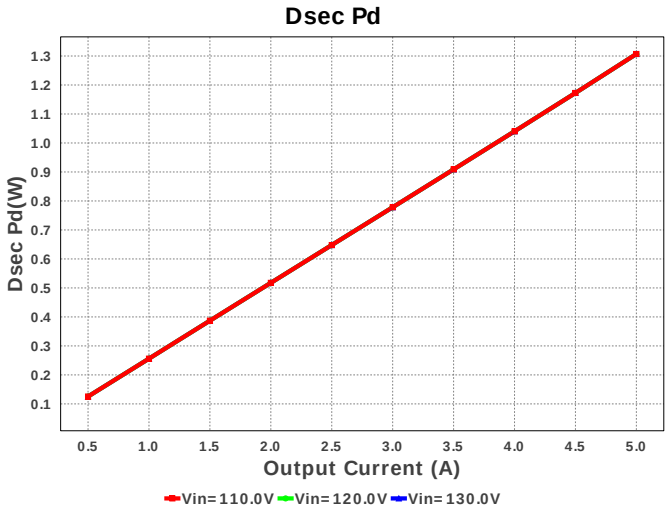


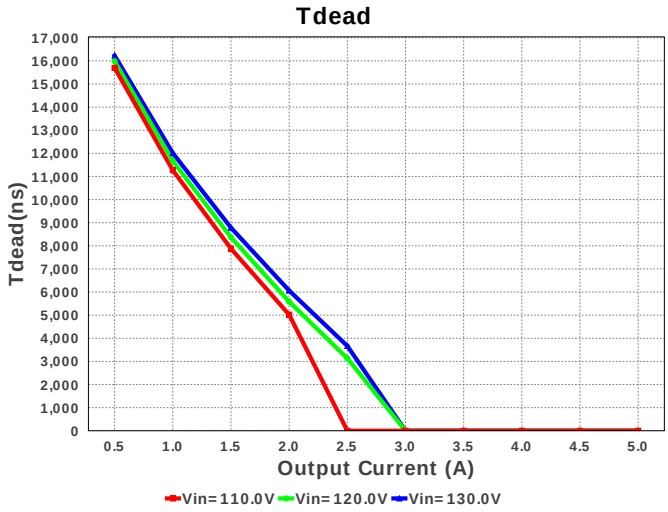


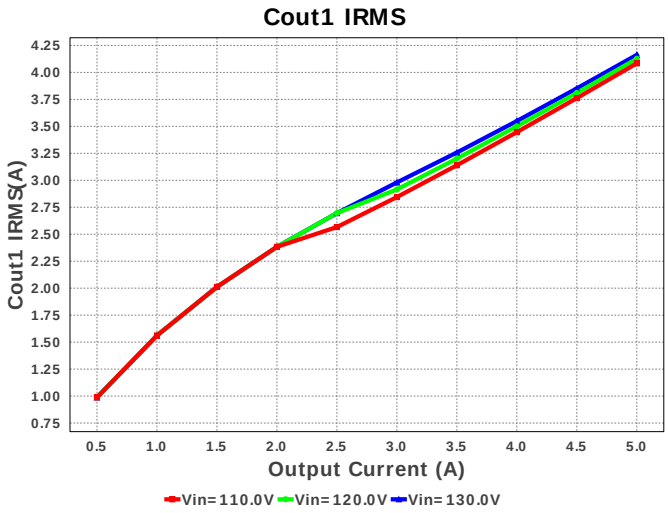


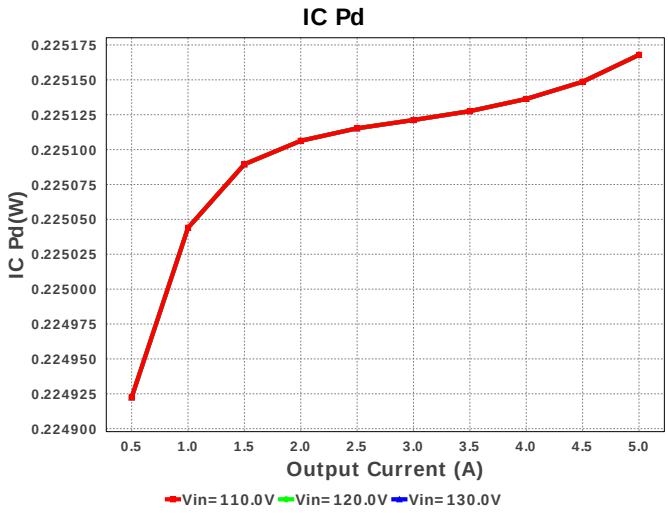


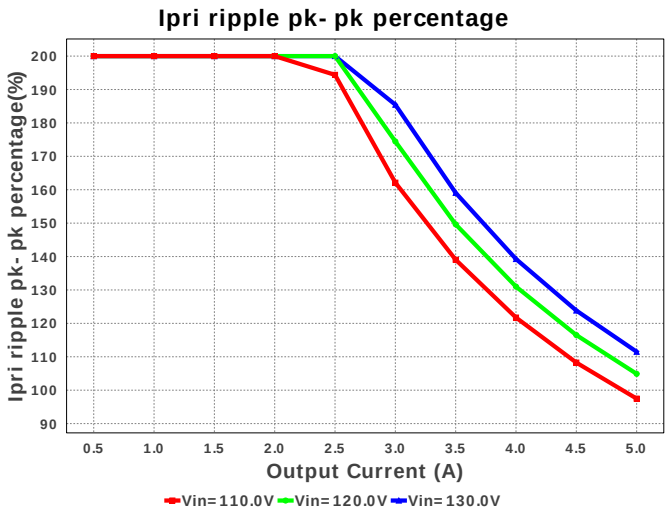


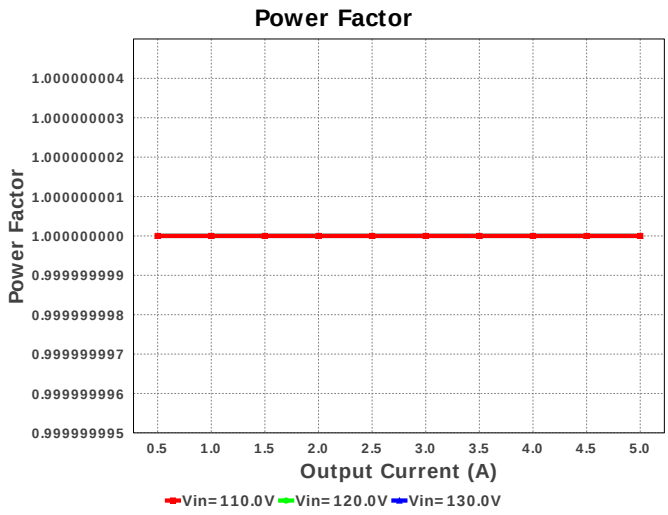


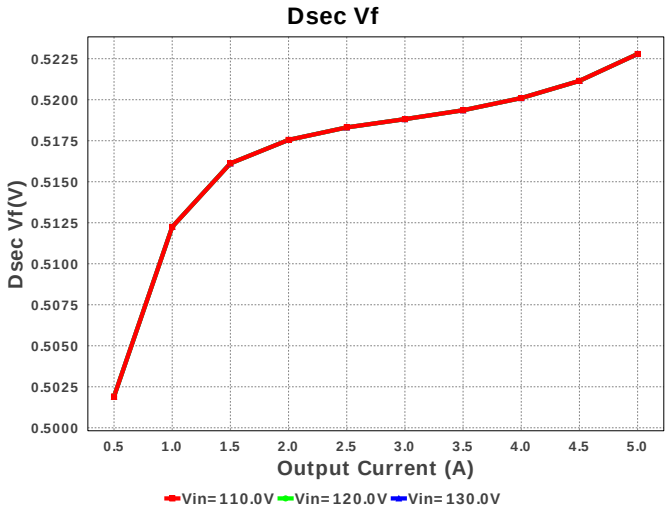


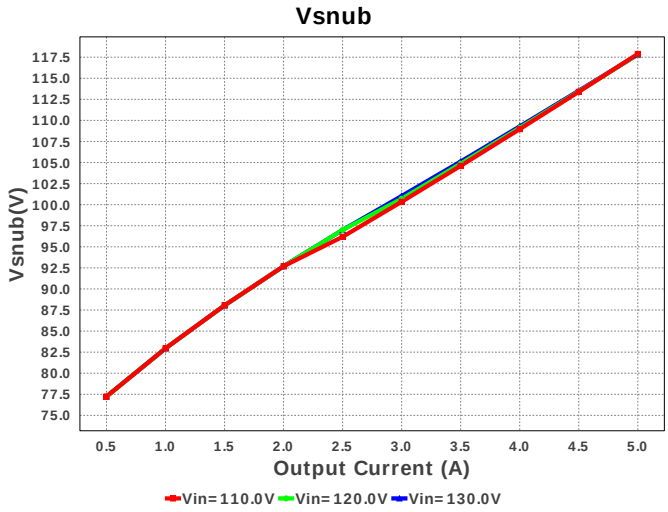


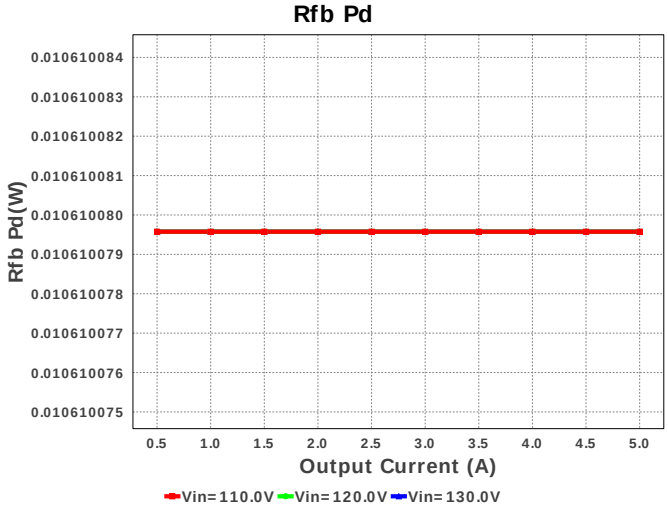


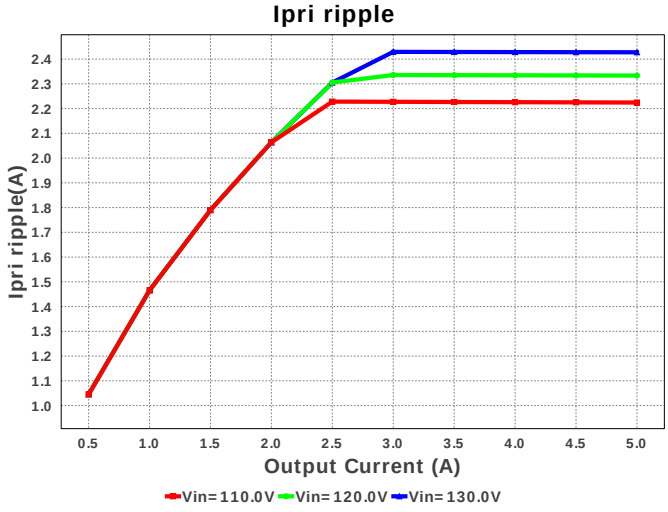


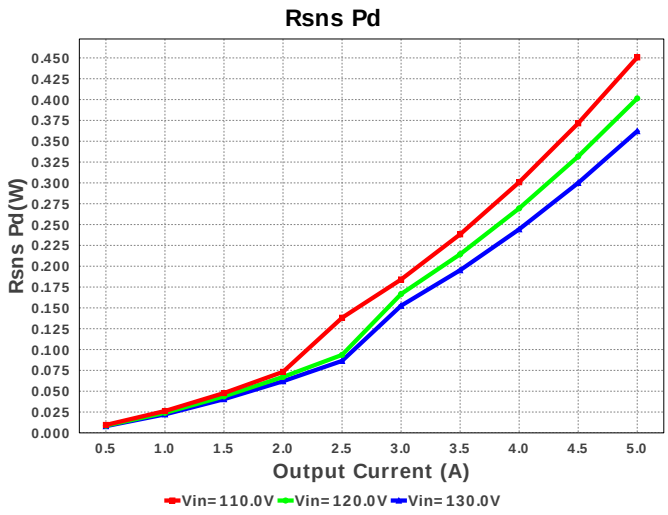


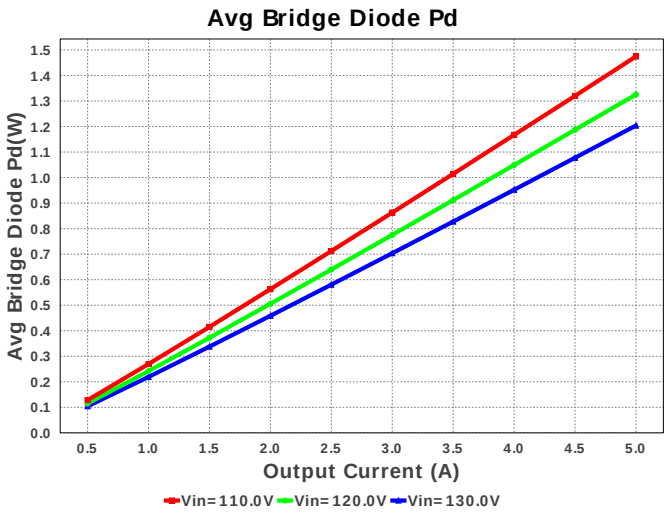


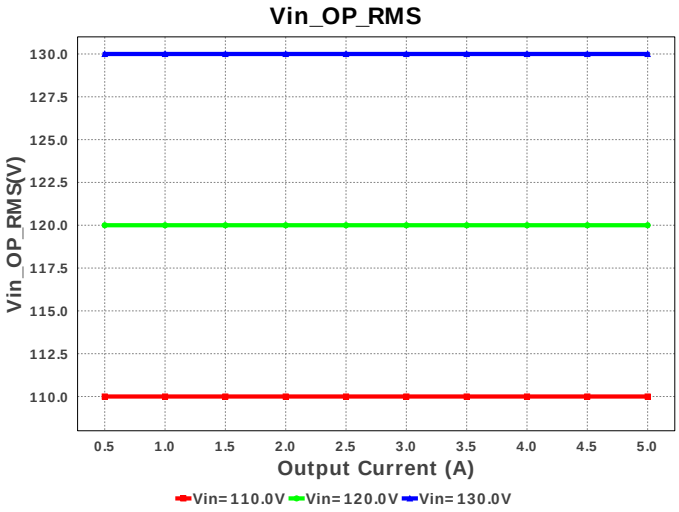


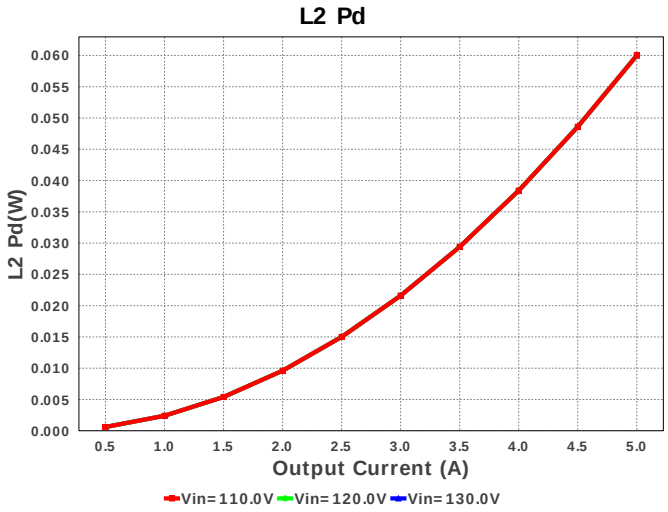


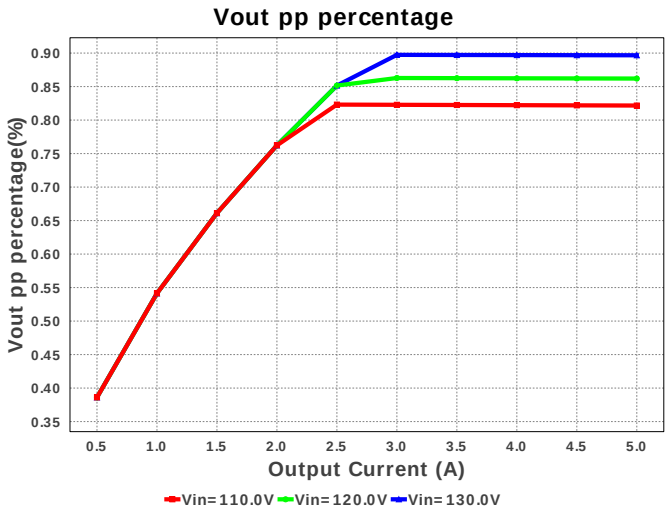


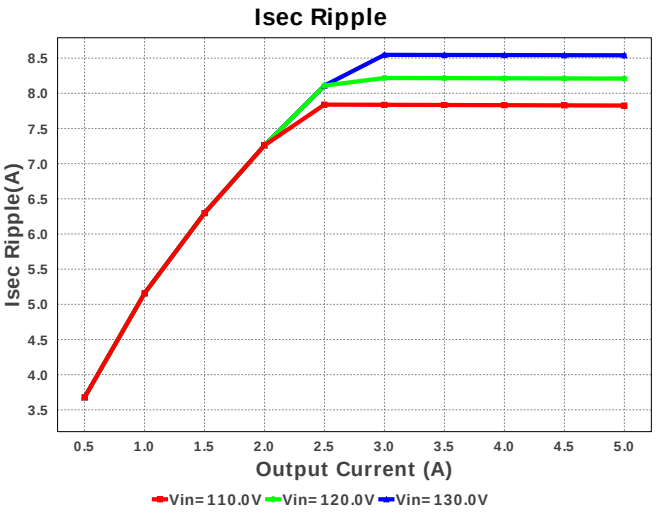


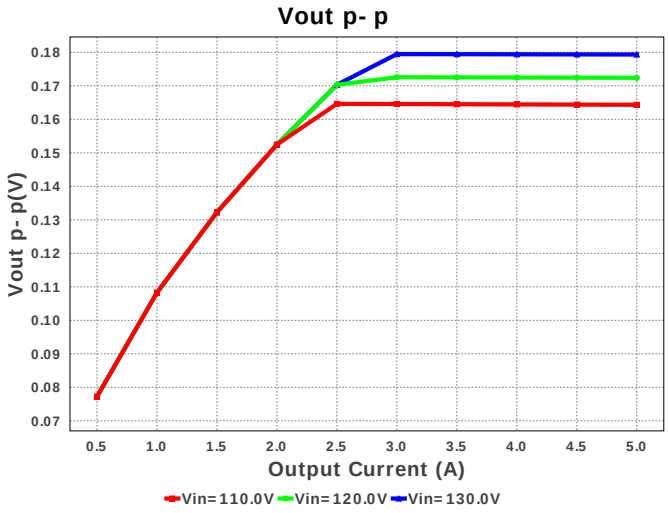


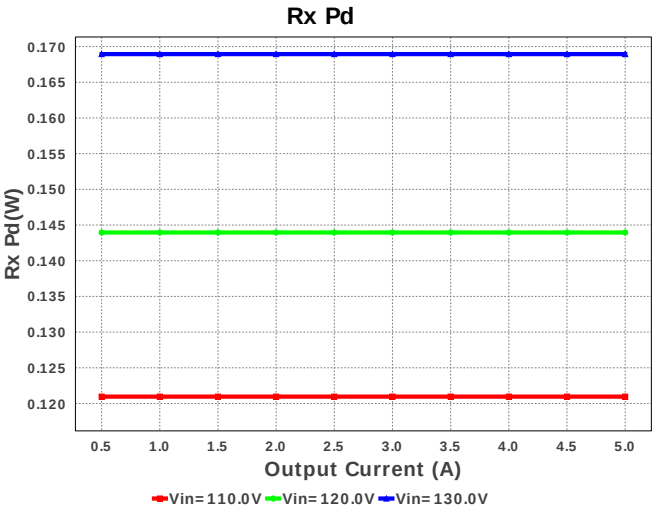


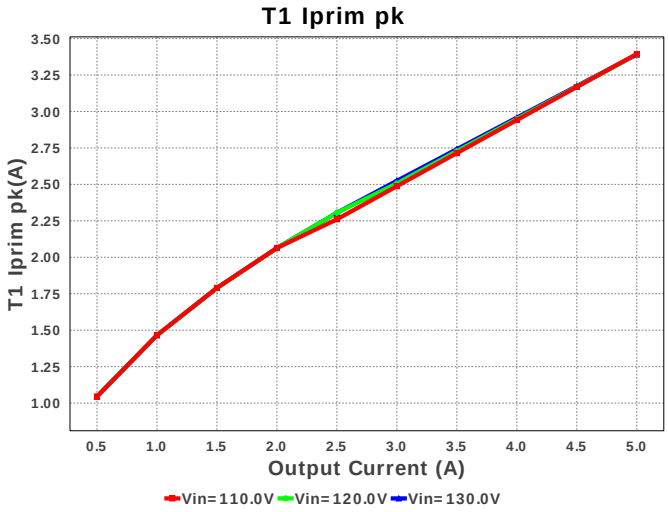












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	4.084 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	1.026 A	Current	RMS Input Current
3.	Iout_DCM	2.449 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	914.802 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	2.224 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	97.473 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	7.826 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.501 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	3.394 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	6.456 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	11.942 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	66	General	Total Design BOM count
14.	Daux trr	0.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	522.788 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	522.788 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	6.674 k mm^2	General	Total Foot Print Area of BOM components
20.	Frequency	38.053 kHz	General	Switching frequency
21.	Pout	100.0 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	16.366 us	General	Approximate Converter Off Time
25.	Ton Act	10.534 us	General	Approximate Converter On Time
26.	Total BOM	$0.0	General	Total BOM Cost
27.	Tsw	26.279 us	General	Switching Time Period
28.	Vaux	11.991 V	General	Auxiliary Voltage
29.	Vsnub	117.88 V	General	Voltage Across the Snubber

#	Name	Value	Category	Description
30.	Vout Actual	20.013 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	20.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	40.086 %	Op_point	Duty cycle
33.	Efficiency	88.629 %	Op_point	Steady state efficiency
34.	IC Tj	66.027 degC	Op_point	IC junction temperature
35.	ICThetaJA	160.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	5.0 A	Op_point	Iout operating point
37.	M1 TjOP	57.059 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	164.341 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	1.474 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	2.991 W	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	350.234 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	1.307 W	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	1.307 W	Power	Secondary Diode Power Dissipation
48.	IC Pd	225.168 mW	Power	IC power dissipation
49.	L1 Pd	500.515 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	60.0 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
51.	M1 Pd	432.947 mW	Power	M1 MOSFET total power dissipation
52.	Paux	21.956 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	899.936 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	49.754 µW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	10.61 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	450.592 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	1.402 W	Power	Snubber Power Dissipation
59.	T1 Pd	4.637 W	Power	Estimated Losses in Transformer
60.	Total Pd	12.83 W	Power	Total Power Dissipation
61.	Vout Tolerance	2.095 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	821.707 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	5.0	Maximum Output Current
2.	VinMax	130.0	Maximum input voltage
3.	VinMin	110.0	Minimum input voltage
4.	Vout	20.0	Output Voltage
5.	acFrequency	60.0	Light Output in Lumen
6.	base_pn	UC1845A	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. UC1845A Product Folder : http://www.ti.com/product/UC1845A : contains the data sheet and other resources.