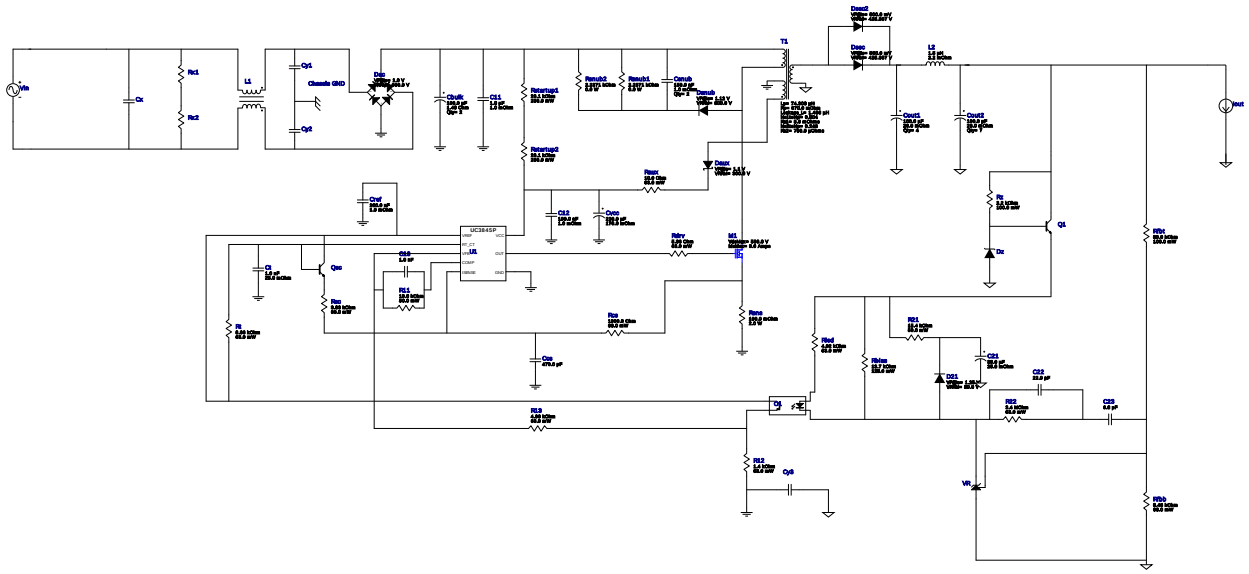
VinMin = 88.0V
VinMax = 265.0V
Vout = 24.0V
Iout = 5.0A

Device = UC3845N
Topology = Flyback
Created = 2020-06-30 06:06:38.399
BOM Cost = NA
BOM Count = 60
Total Pd =

WEBENCH® Design Report

Design : 67 UC3845N
UC3845N 88V-265V to 24.00V @ 5A



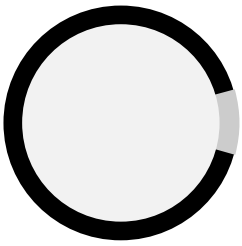
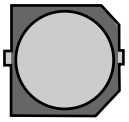
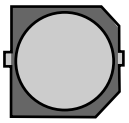
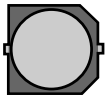
1. The EMI filter shown in the schematic is a placeholder. It has not yet been designed for the application.

Design Alerts

UC3845 Design
With the current design condition, suitable FET could not be found in the current database. Hence, this design is created using an ideal FET. Please note that the resulting FET parameters are ideal, so the efficiency/loss values have been disabled. Also, the schematic/PCB export and Thermal simulations will not work with the ideal FET.

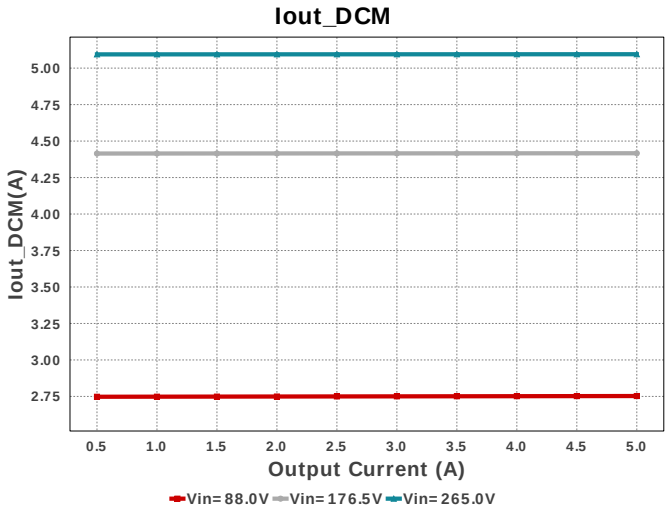
Electrical BOM

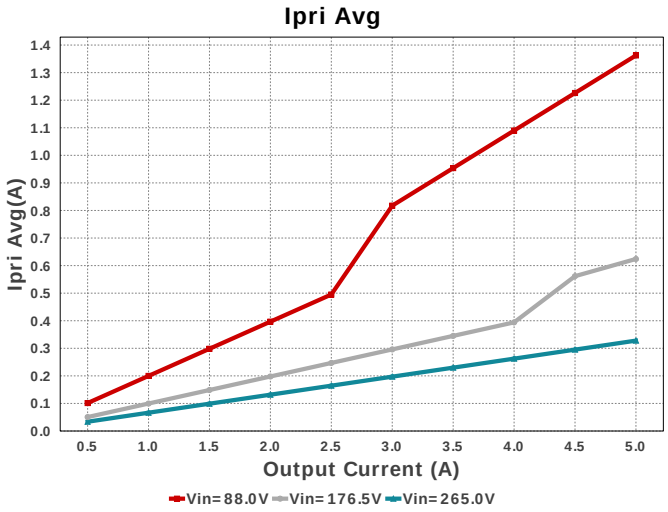
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C11	Knowles Capacitors	2220Y6300105KXTWS2 Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 630.0 V IRMS= 0.0 A	1	$3.38	2220_450 54 mm^2
C12	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
C13	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
C21	Panasonic	50SVPF39M Series= SVPF	Cap= 39.0 uF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 3.8 A	1	$0.74	CAPSMT_62_E12 106 mm^2
C22	Samsung Electro-Mechanics	CL21C220JBANNNC Series= C0G/NP0	Cap= 22.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
C23	AVX	06031U6R8BAT2A Series= C0G/NP0	Cap= 6.8 pF VDC= 100.0 V IRMS= 0.0 A	1	$0.07	0603 5 mm^2

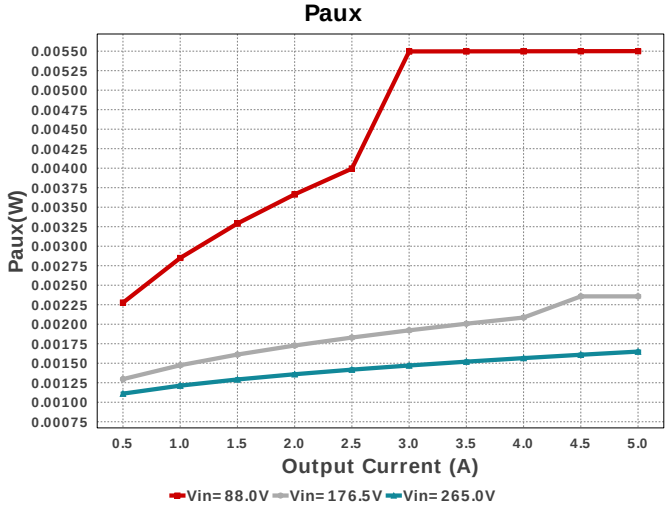
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbulk	Rubycon	450HXG180MEFCSN22X45 Series= HXG	Cap= 180.0 uF ESR= 1.48 Ohm VDC= 450.0 V IRMS= 1.8 A	2	$2.70	 HXG_2200x4500 576 mm²
Ccs	AVX	04025A471JAT2A Series= C0G/NP0	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
Cout1	Panasonic	EEHZA1H101P Series= ZA	Cap= 100.0 uF ESR= 28.0 mOhm VDC= 50.0 V IRMS= 2.0 A	4	$1.00	 SM_RADIAL_10BMM 160 mm²
Cout2	Panasonic	EEHZA1H101P Series= ZA	Cap= 100.0 uF ESR= 28.0 mOhm VDC= 50.0 V IRMS= 2.0 A	7	$1.00	 SM_RADIAL_10BMM 160 mm²
Cref	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
Csnub	MuRata	GRM55DR72J154KW01L Series= X7R	Cap= 150.0 nF ESR= 1.0 mOhm VDC= 630.0 V IRMS= 0.0 A	2	$0.52	 2220 54 mm²
Ct	Kemet	C0805C102J1GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 100.0 V IRMS= 1.71 A	1	$0.09	 0805 7 mm²
Cvcc	Nichicon	UUD1E221MNL1GS Series= uD	Cap= 220.0 uF ESR= 170.0 mOhm VDC= 25.0 V IRMS= 450.0 mA	1	$0.17	 SM_RADIAL_8MM 113 mm²
D21	Infineon Technologies	BAS1602VH6327XTSA1	VF@Io= 1.25 V VRRM= 80.0 V	1	$0.04	 SOD-523 5 mm²
Dac	Fairchild Semiconductor	GBU6J	VF@Io= 1.0 V VRRM= 600.0 V	1	$0.43	 GBU 131 mm²
Daux	SMC Diode Solutions	ST1300ATR	VF@Io= 1.1 V VRRM= 300.0 V	1	$0.07	 SMA 37 mm²
Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 425.887 V	1	NA	CUSTOM 0 mm²
Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 425.887 V	1	NA	CUSTOM 0 mm²
Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.23	 SMC 83 mm²
Dz	Diodes Inc.	MMSZ5250B-7-F	Zener	1	$0.03	 SOD-123 13 mm²
L2	Sumida	CEP125NP-1R5MC-D	L= 1.5 µH 2.2 mOhm	1	$1.13	 CEP125 210 mm²

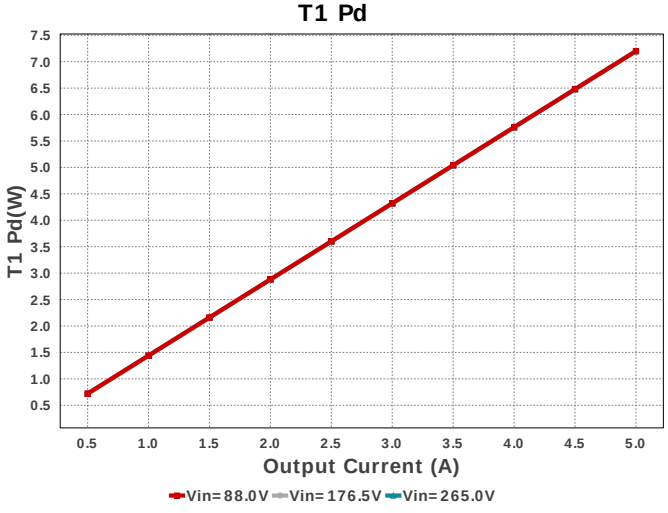
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
M1	NA	IdealFET	VdsMax= 530.0 V IdsMax= 9.0 Amps	1	NA	NA 0 mm²
O1	Fairchild Semiconductor	FOD817A	Optocoupler	1	$0.11	 DIP-4 71 mm²
Q1	Diodes Inc.	MMBT4401-7-F	Bipolar Transistor	1	$0.02	 SOT-23 14 mm²
Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	$1.11	 TO-18 57 mm²
R11	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm²
R12	Vishay-Dale	CRCW04021K40FKED Series= CRCW..e3	Res= 1.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
R21	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm²
R22	Vishay-Dale	CRCW04023M40FKED Series= CRCW..e3	Res= 3.4 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rbias	Vishay-Dale	CRCW080513K7FKEA Series= CRCW..e3	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
Rcs	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rdrv	Vishay-Dale	CRCW04025R36FKED Series= CRCW..e3	Res= 5.36 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rfbb	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rfbt	Yageo	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
Rled	Vishay-Dale	CRCW04024K02FKED Series= CRCW..e3	Res= 4.02 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rsc	Vishay-Dale	CRCW04023K83FKED Series= CRCW..e3	Res= 3.83 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
Rsns	Stackpole Electronics Inc	CSRN2512FKR100 Series= ?	Res= 100.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.13	 2512 43 mm²
Rsnub1	CUSTOM	CUSTOM Series= ?	Res= 2.2371 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
Rsnub2	CUSTOM	CUSTOM Series= ?	Res= 2.2371 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
Rstartup1	Vishay-Dale	CRCW120626K1FKEA Series= CRCW..e3	Res= 26.1 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²

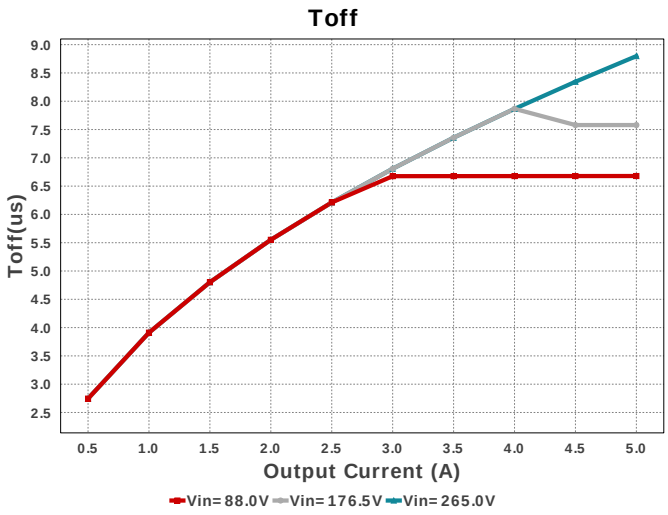
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rstartup2	Vishay-Dale	CRCW120626K1FKEA Series= CRCW..e3	Res= 26.1 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rz	Yageo	RC0603FR-072K2L Series= ?	Res= 2.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
T1	CUSTOM	CUSTOM	Lp= 74.308 µH Rp= 870.0 mOhm Leakage_L= 1.486 µH Ns1toNp= 504.168 m Rs1= 8.6 mOhms Ns2toNp= 0.246 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
U1	Texas Instruments	UC3845N	Switcher	1	$0.48	P0008A 116 mm²
VR	Texas Instruments	TL431IDBVR	Voltage References	1	$0.06	R-PDSO-G3 16 mm²

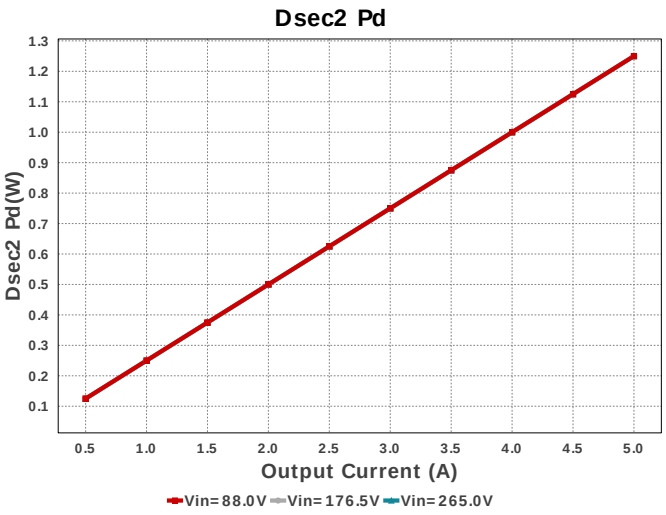


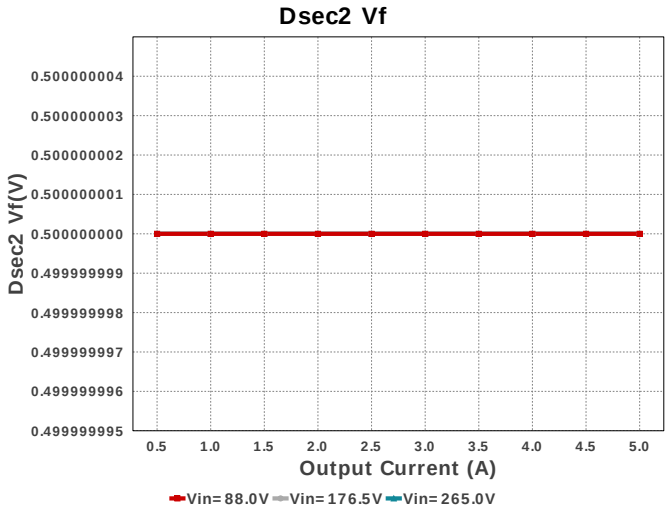


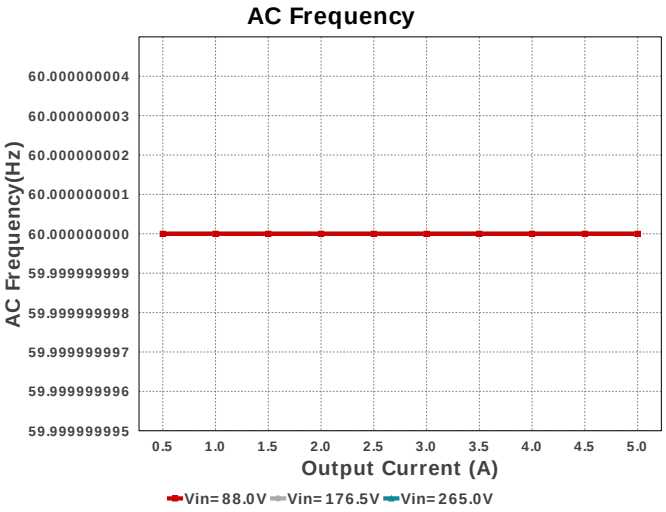


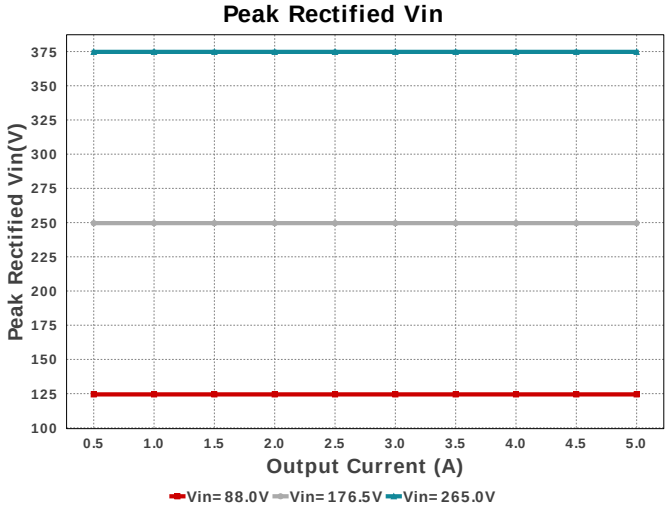


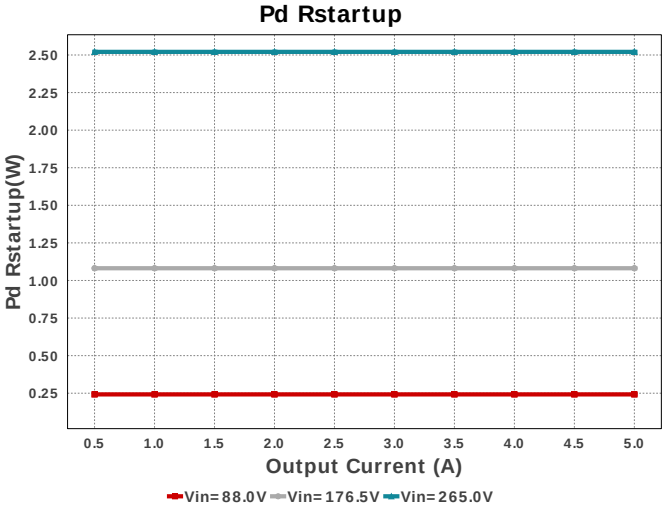


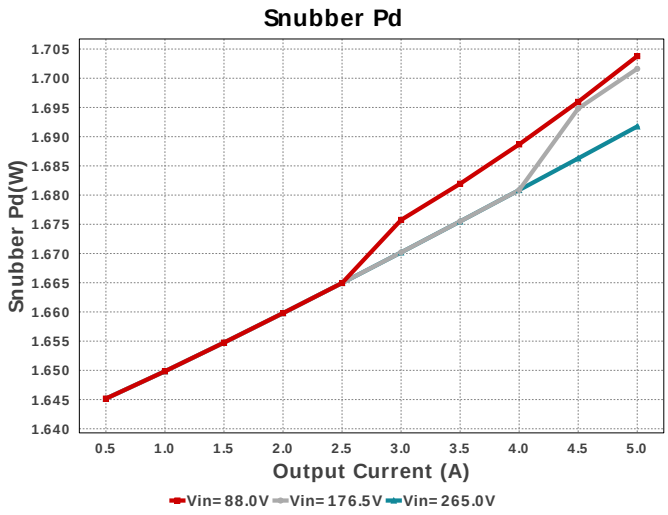


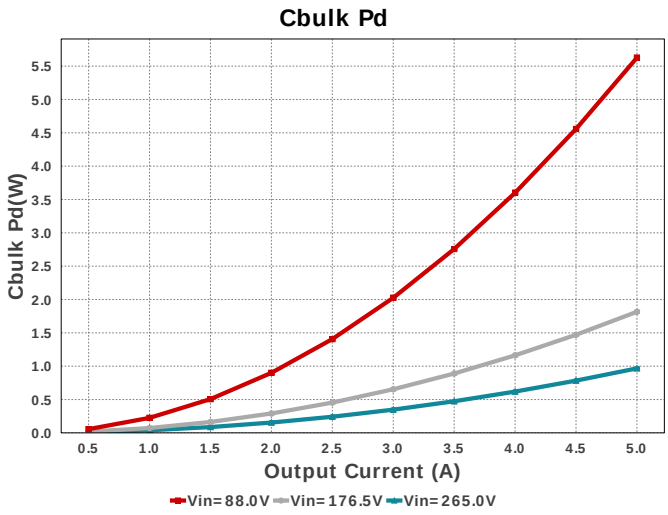


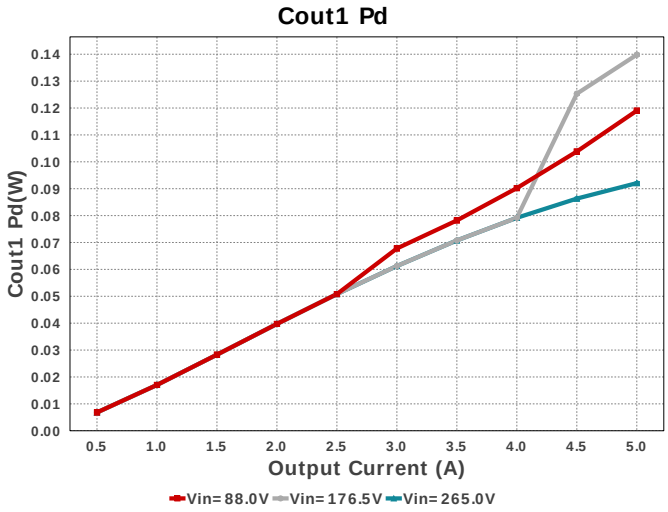


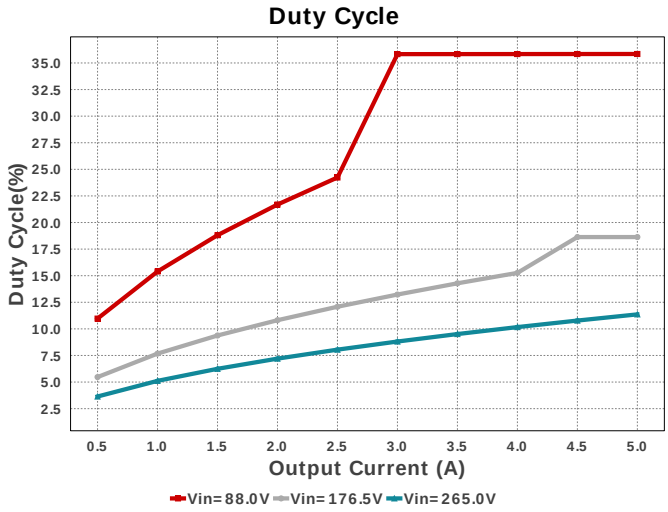


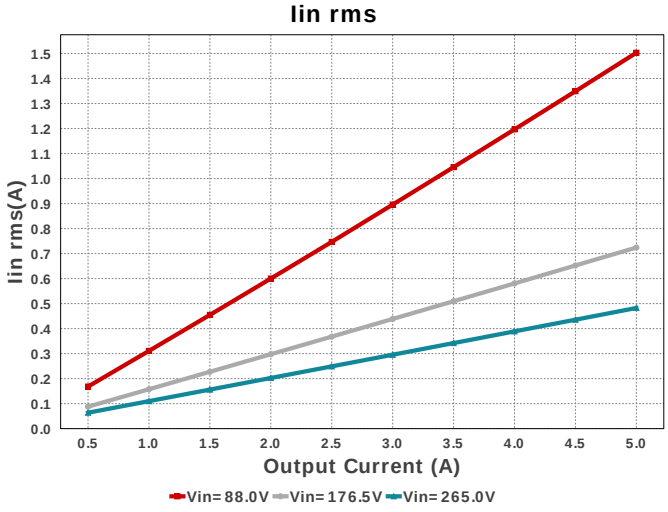


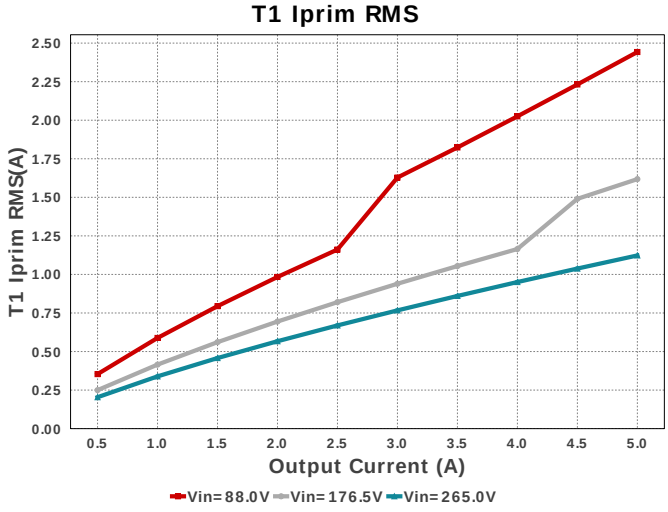


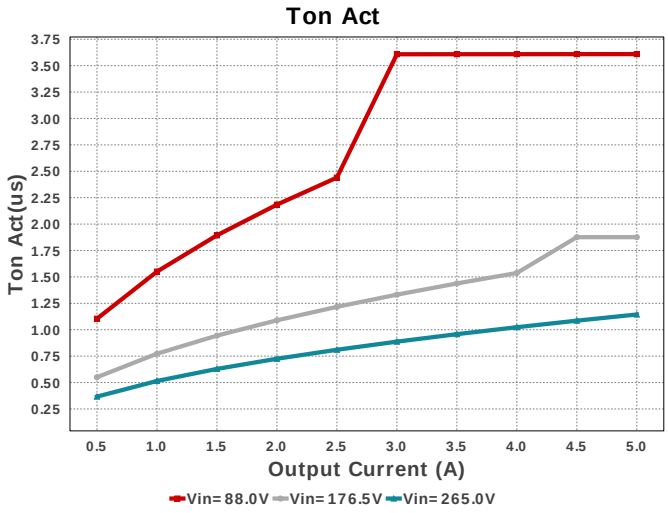


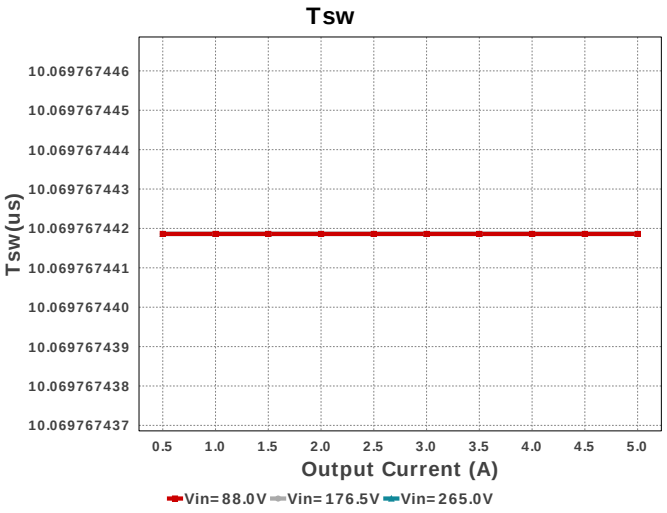


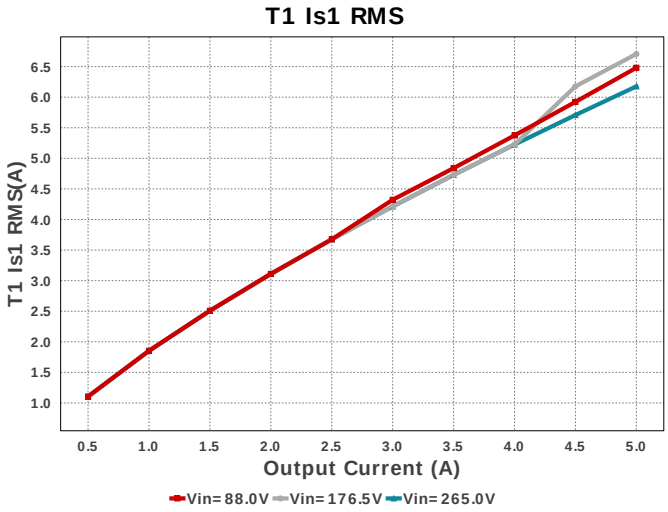


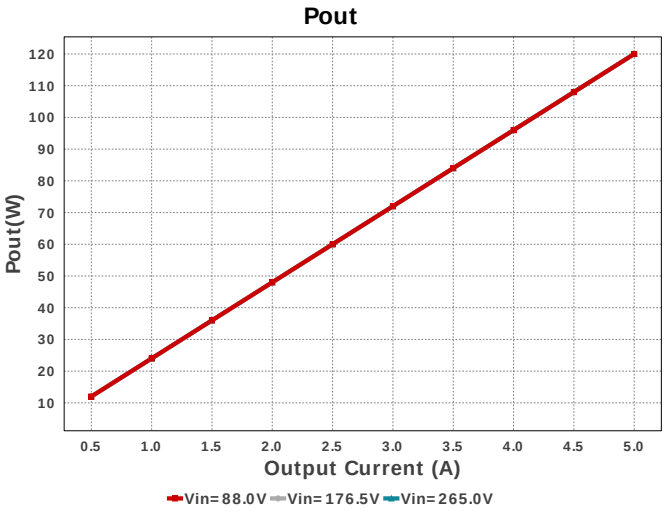


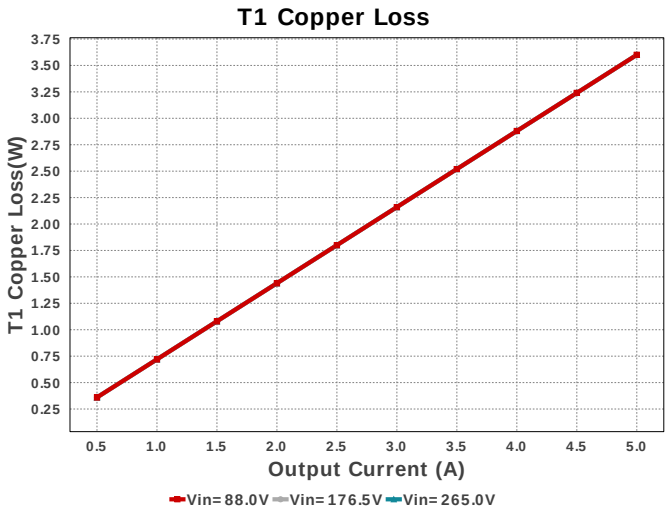


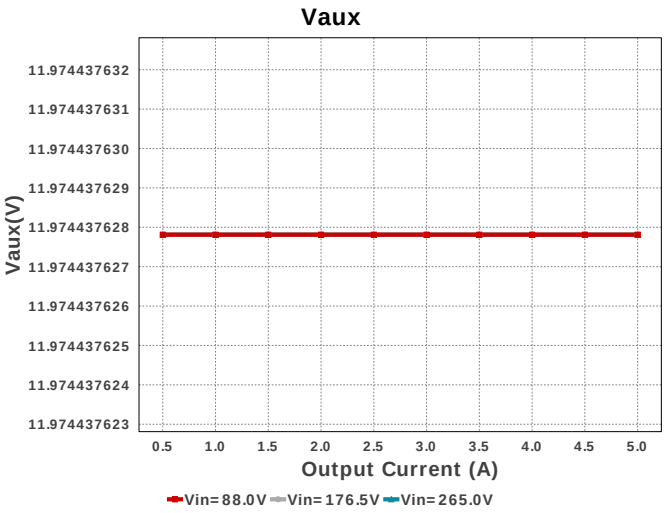


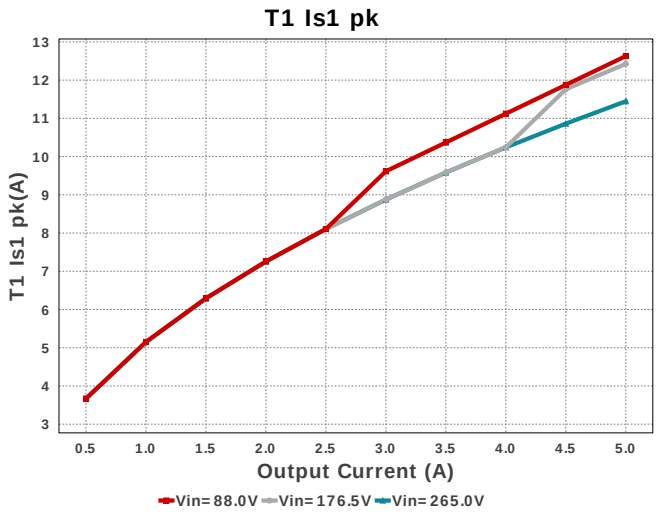


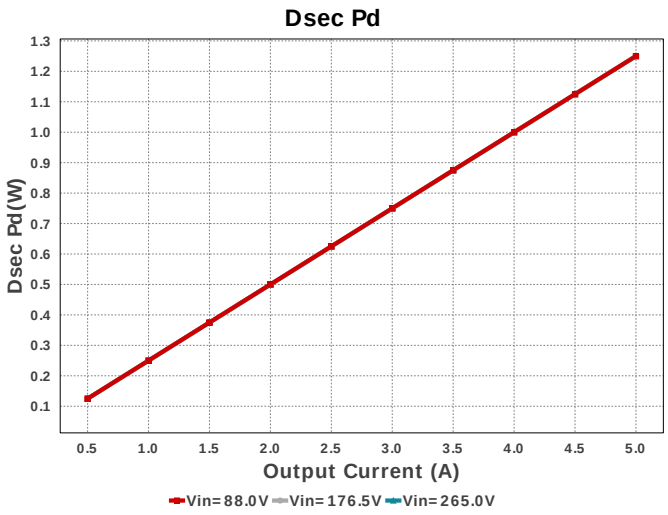


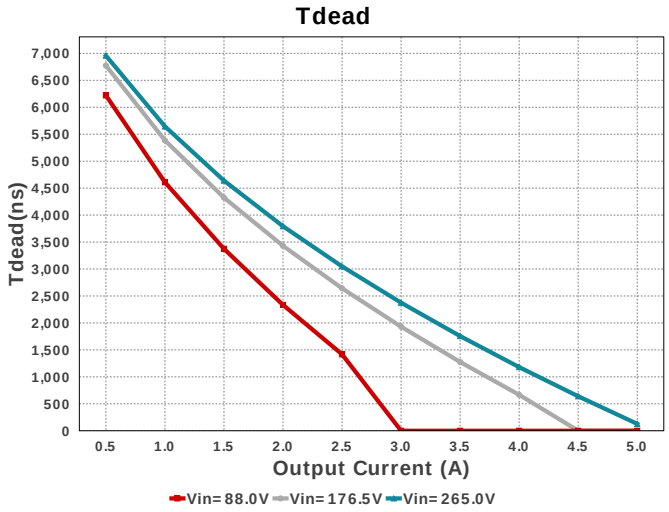


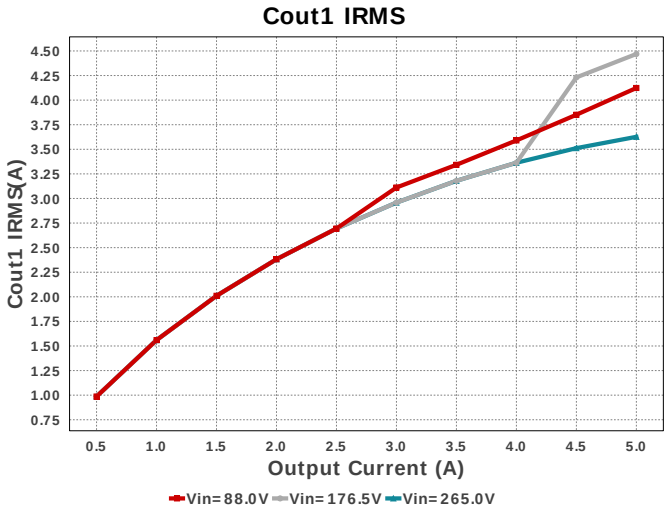


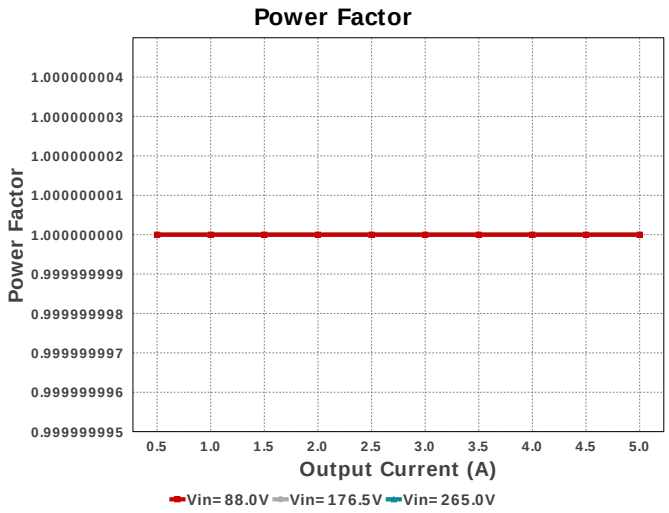


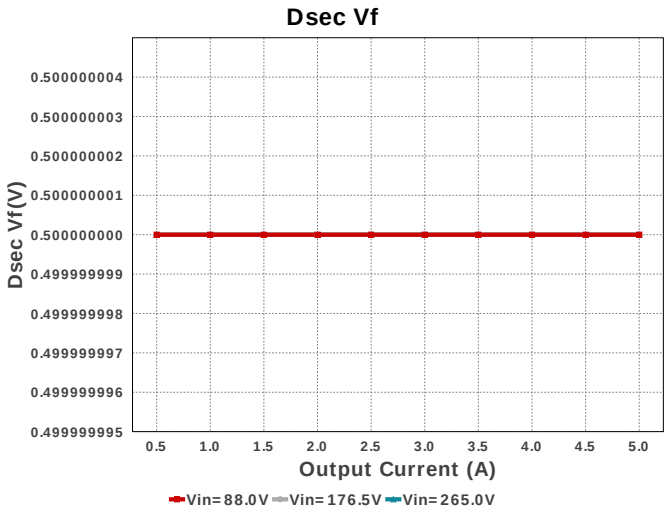


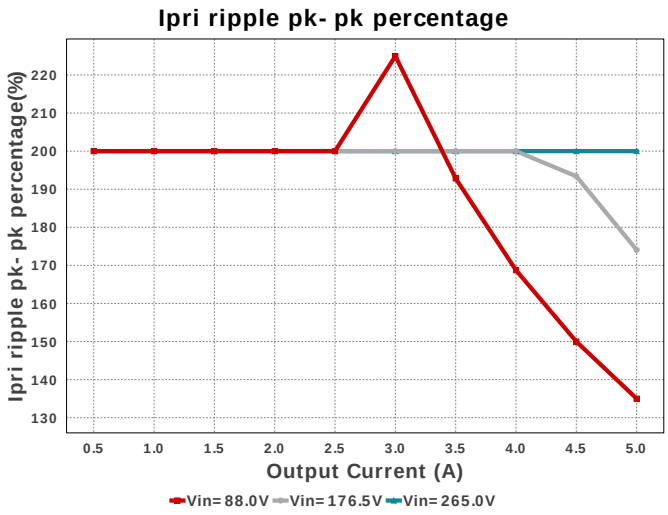


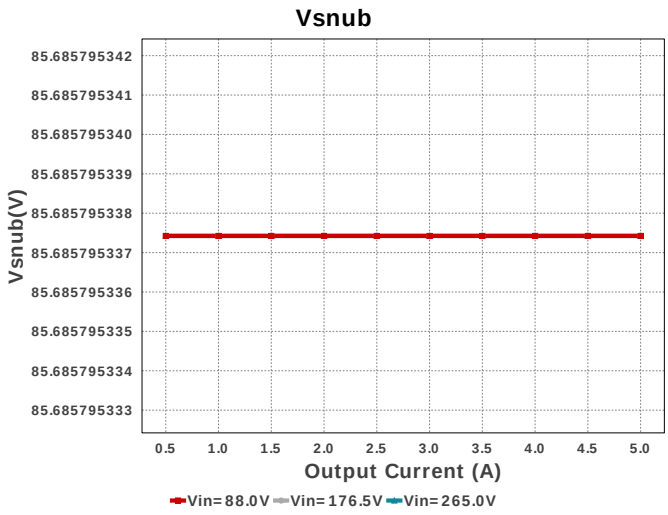


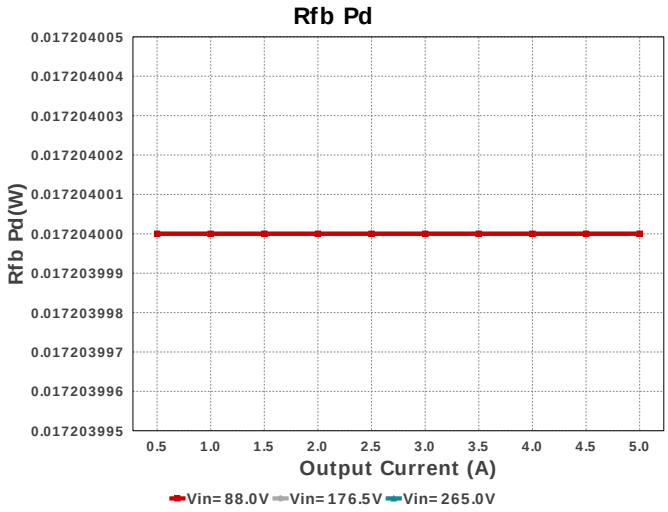


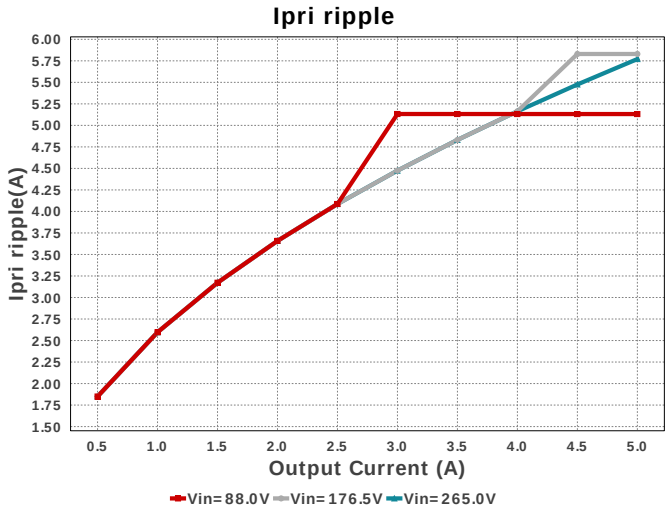


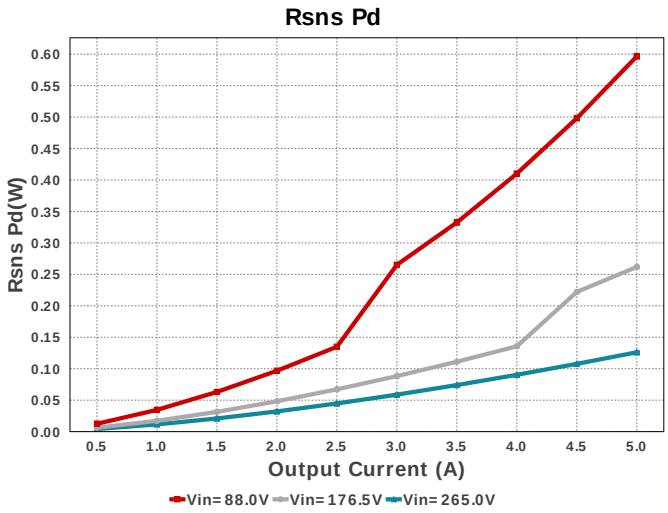


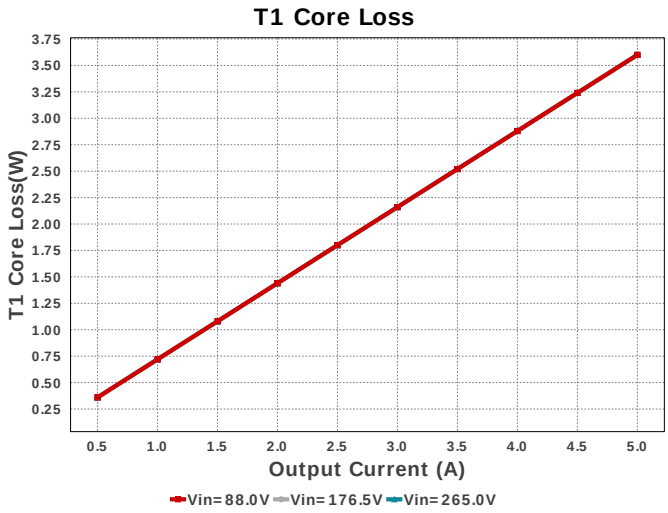


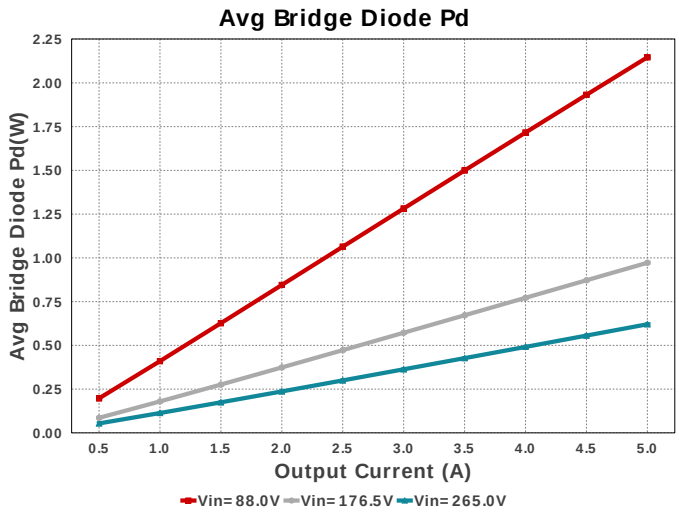


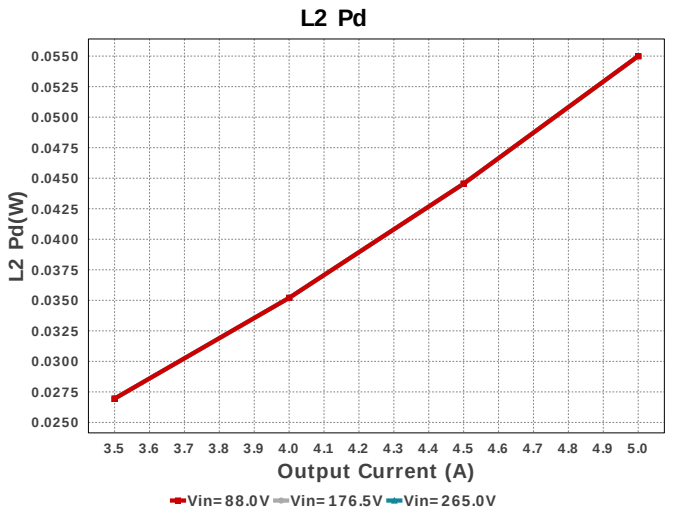


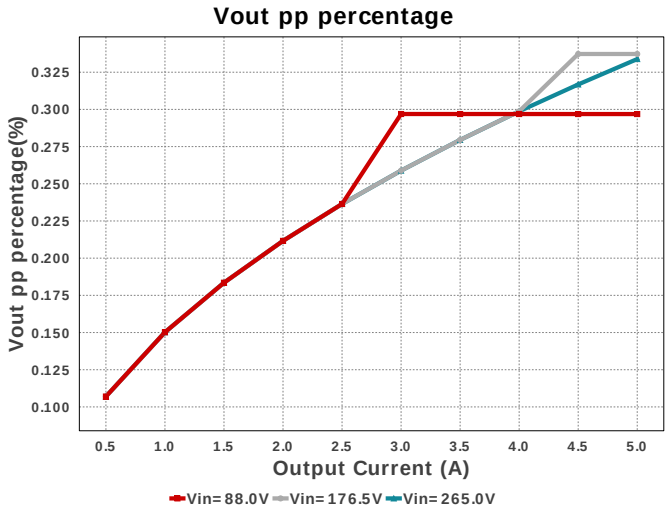


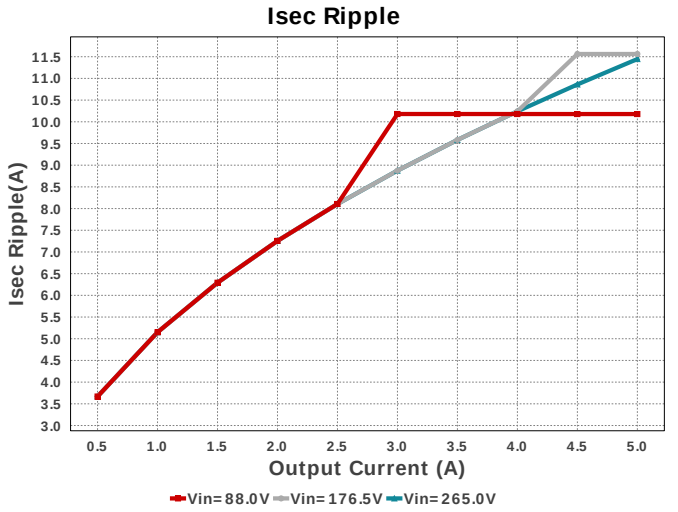


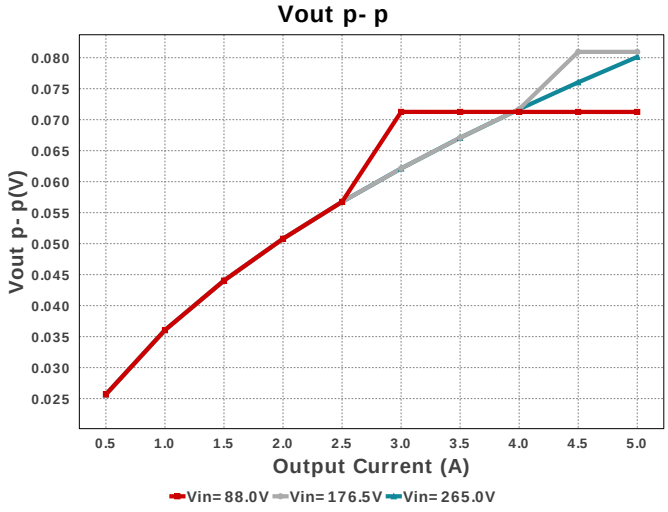


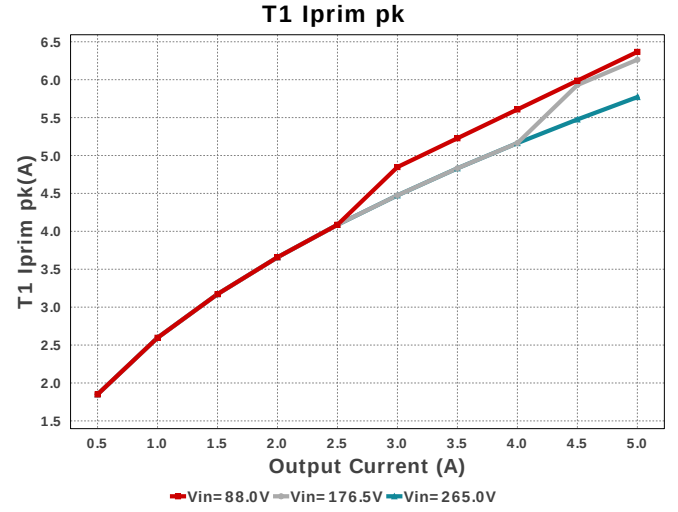












Operating Values

#	Name	Value	Category	Description
1.	Cbulk Pd	5.627 W	Capacitor	Bulk capacitor power dissipation
2.	Cout1 IRMS	4.123 A	Capacitor	Output capacitor1 RMS ripple current
3.	Cout1 Pd	119.02 mW	Capacitor	Output capacitor1 power dissipation
4.	Avg Bridge Diode Pd	2.146 W	Diode	Average Power Dissipation in the Bridge Diode over the AC Line Period
5.	Daux trr	35.0 ns	Diode	Auxiliary Diode Reverse Recovery Time
6.	Dsec Pd	1.25 W	Diode	Secondary Diode Power Dissipation
7.	Dsec Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
8.	Dsec trr	0.0 ns	Diode	Output Diode Reverse Recovery Time
9.	Dsec2 Pd	1.25 W	Diode	Secondary Diode Power Dissipation
10.	Dsec2 Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
11.	Dsnub trr	30.0 ns	Diode	Snubber Diode Reverse Recovery Time

#	Name	Value	Category	Description
12.	ICThetaJA	53.5 degC/W	IC	IC junction-to-ambient thermal resistance
13.	L2 Pd	55.0 mW	Inductor	Average Power Dissipation in the Inductor Over the AC Line Period
14.	Avg Bridge Diode Pd	2.146 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
15.	Cbulk Pd	5.627 W	Power	Bulk capacitor power dissipation
16.	Cout1 Pd	119.02 mW	Power	Output capacitor1 power dissipation
17.	Dsec Pd	1.25 W	Power	Secondary Diode Power Dissipation
18.	Dsec2 Pd	1.25 W	Power	Secondary Diode Power Dissipation
19.	L2 Pd	55.0 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
20.	Paux	5.501 mW	Power	Power Dissipation in Raux and Daux
21.	Pd Rstartup	242.17 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
22.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
23.	Rsns Pd	596.5 mW	Power	Current Limit Sense Resistor Power Dissipation
24.	Snubber Pd	1.704 W	Power	Snubber Power Dissipation
25.	T1 Copper Loss	3.6 W	Power	Transformer Copper Loss Power Dissipation
26.	T1 Core Loss	3.6 W	Power	Transformer Core Loss Power Dissipation
27.	T1 Pd	7.2 W	Power	Estimated Losses in Transformer
28.	Pd Rstartup	242.17 mW	Resistor	Power Dissipation in Rstartup1 and Rstartup2
29.	Rfb Pd	17.204 mW	Resistor	Rfb Power Dissipation
30.	Rsns Pd	596.5 mW	Resistor	Current Limit Sense Resistor Power Dissipation
31.	AC Frequency	60.0 Hz	System Information	Input AC frequency
32.	BOM Count	60	System Information	Total Design BOM count
33.	Duty Cycle	35.844 %	System Information	Duty cycle
34.	FootPrint	4.316 k mm^2	System Information	Total Foot Print Area of BOM components
35.	Frequency	99.307 kHz	System Information	Switching frequency
36.	Iin rms	1.509 A	System Information	RMS Input Current
37.	Iout	5.0 A	System Information	Iout operating point
38.	Iout_DCM	2.753 A	System Information	Approximate Current below which DCM mode of operation will begin
39.	Mode	CCM	System Information	Conduction Mode
40.	Peak Rectified Vin	124.45 V	System Information	Peak voltage seen at rectified input
41.	Pout	120.0 W	System Information	Total output power
42.	Power Factor	1.0	System Information	Assumed Power Factor for the Application
43.	Tdead	0.0 ns	System Information	Approximate Dead Time of the Regulator
44.	Toff	6.678 us	System Information	Approximate Converter Off Time
45.	Ton Act	3.609 us	System Information	Approximate Converter On Time
46.	Total BOM	NA	System Information	Total BOM Cost
47.	Tsw	10.07 us	System Information	Switching Time Period
48.	Vin_RMS	88.0 V	System Information	Vin operating point
49.	Vout	24.0 V	System Information	Operational Output Voltage
50.	Vout Actual	24.004 V	System Information	Vout Actual calculated based on selected voltage divider resistors
51.	Vout Tolerance	2.137 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
52.	Vout p-p	71.249 mV	System Information	Peak-to-peak output ripple voltage
53.	Vout pp percentage	296.871 m%	System Information	Output Voltage ripple percentage
54.	Vsnub	85.686 V	System Information	Voltage Across the Snubber
55.	Ipri Avg	1.362 A	Transformer	Average Current in Primary Winding over the complete Switching Period
56.	Ipri ripple	5.132 A	Transformer	Ripple Current in the Primary Winding
57.	Ipri ripple pk-pk percentage	135.01 %	Transformer	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
58.	Isec Ripple	10.178 A	Transformer	Ripple Current in the Secondary Winding
59.	Paux	5.501 mW	Transformer	Power Dissipation in Raux and Daux
60.	T1 Copper Loss	3.6 W	Transformer	Transformer Copper Loss Power Dissipation
61.	T1 Core Loss	3.6 W	Transformer	Transformer Core Loss Power Dissipation

#	Name	Value	Category	Description
62.	T1 Iprim RMS	2.442 A	Transformer	Transformer Primary RMS Current
63.	T1 Iprim pk	6.367 A	Transformer	Transformer Primary Peak Current
64.	T1 Is1 RMS	6.481 A	Transformer	Transformer Secondary1 RMS Current
65.	T1 Is1 pk	12.628 A	Transformer	Transformer Secondary1 Peak Current
66.	T1 Pd	7.2 W	Transformer	Estimated Losses in Transformer
67.	Vaux	11.974 V	Transformer	Auxiliary Voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	265.0	Maximum input voltage
VinMin	88.0	Minimum input voltage
Vout	24.0	Output Voltage
acFrequency	60.0	AC Frequency
base_pn	UC3845	Base Product Number
source	AC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

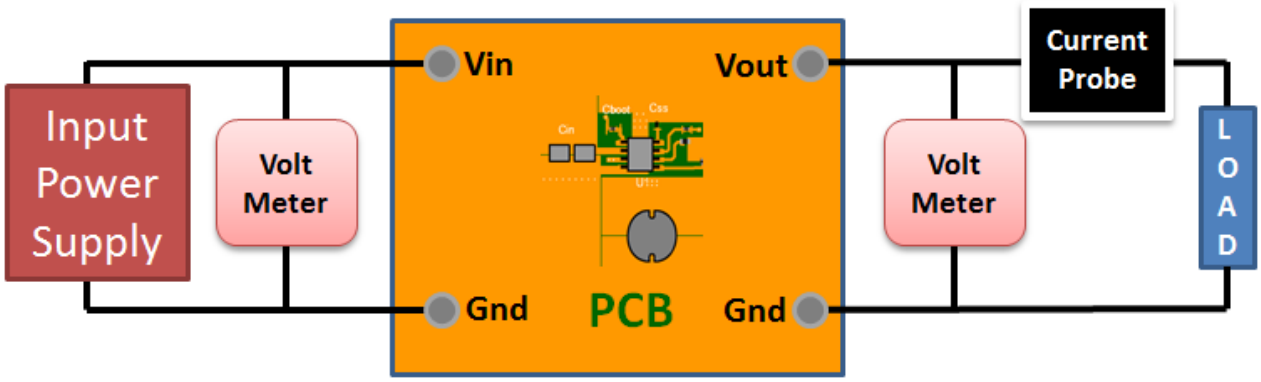
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 88.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Master key : 6878826BA1908800[v1]
2. **UC3845** Product Folder : http://www.ti.com/product/UC3845 : contains the data sheet and other resources.