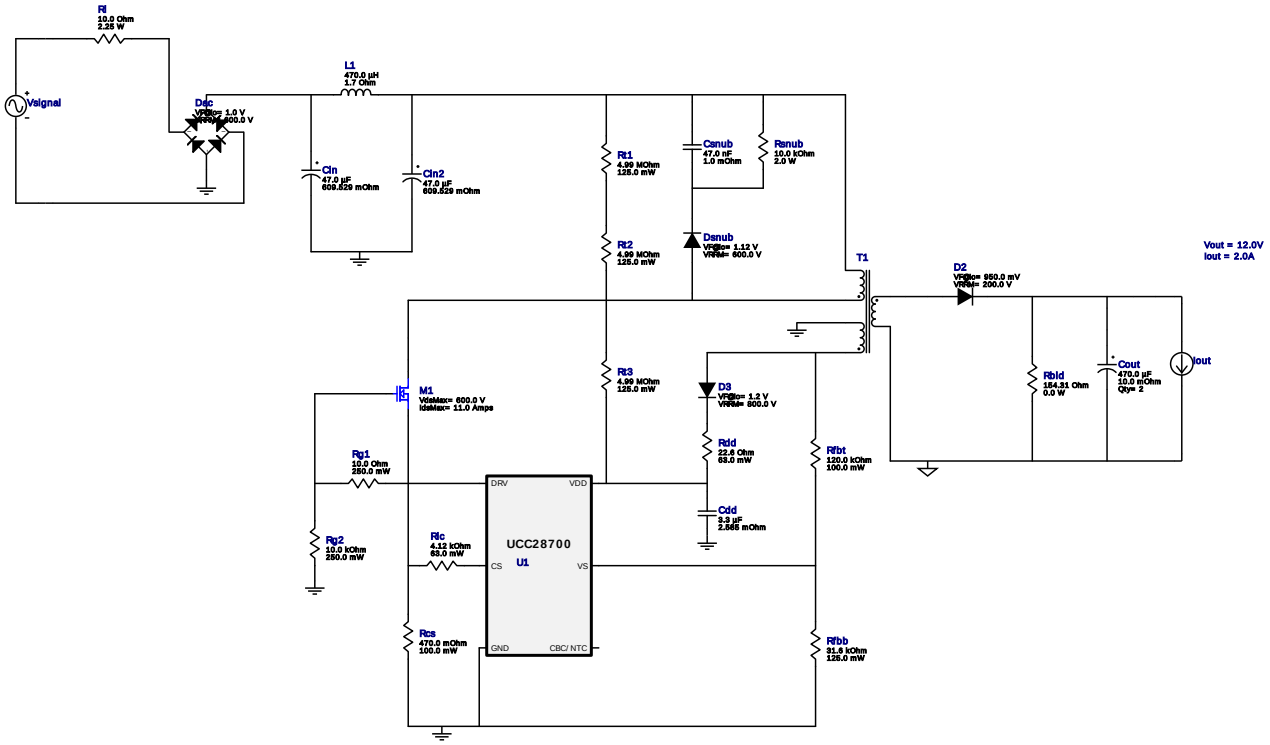
WEBENCH® Design Report

VinMin = 85.0V
VinMax = 265.0V
Vout = 12.0V
Iout = 2.0A

Device = UCC28700DBVR
Topology = Flyback
Created = 2017-11-03 11:30:11.859
BOM Cost = $0.00
BOM Count = 27
Total Pd = 6.12W

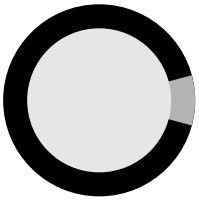
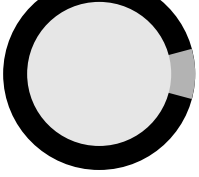
Design : 4899890/28 UCC28700DBVR
UCC28700DBVR 85.0V-265.0V to 9.02V @ 2.0A

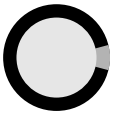
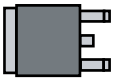


1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

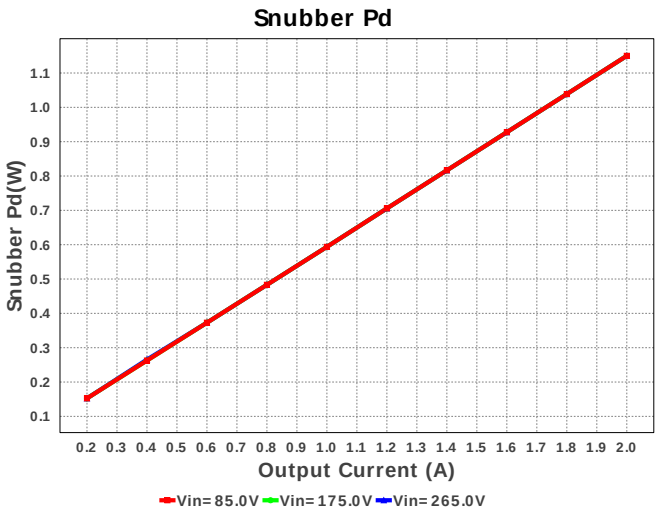
2. Click on the transformer symbol and select 'Design Transformer' to design using specific transformer cores and bobbin

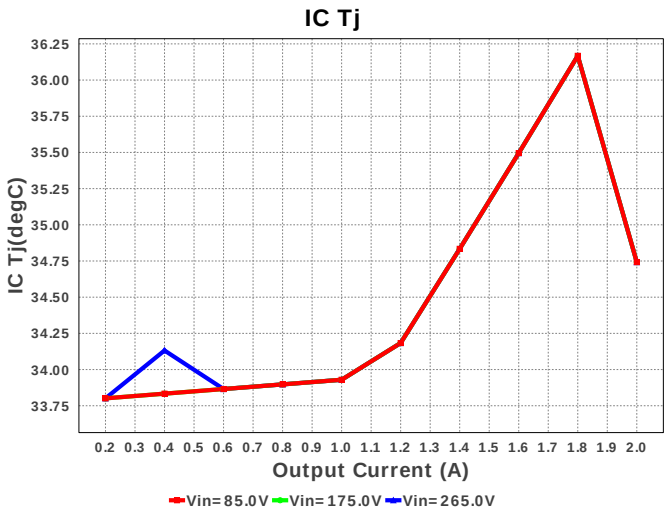
Electrical BOM

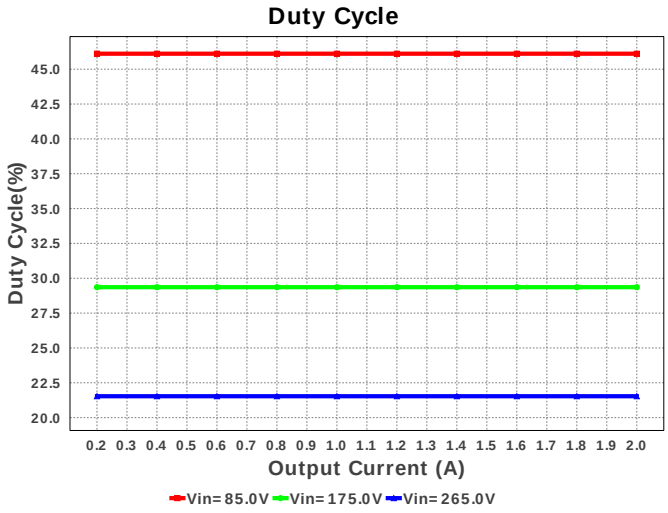
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	TDK	C5750X5R2A335K230KA Series= X5R	Cap= 3.3 uF ESR= 2.585 mOhm VDC= 100.0 V IRMS= 5.6803 A	1	$0.92	 2220_250 54 mm^2
2.	Cin	Panasonic	EEUED2G470S Series= ED	Cap= 47.0 uF ESR= 609.53 mOhm VDC= 400.0 V IRMS= 840.0 mA	1	$0.71	 CAPPR7.5-18X20 400 mm^2
3.	Cin2	Panasonic	EEUED2G470S Series= ED	Cap= 47.0 uF ESR= 609.53 mOhm VDC= 400.0 V IRMS= 840.0 mA	1	$0.71	 CAPPR7.5-18X20 400 mm^2

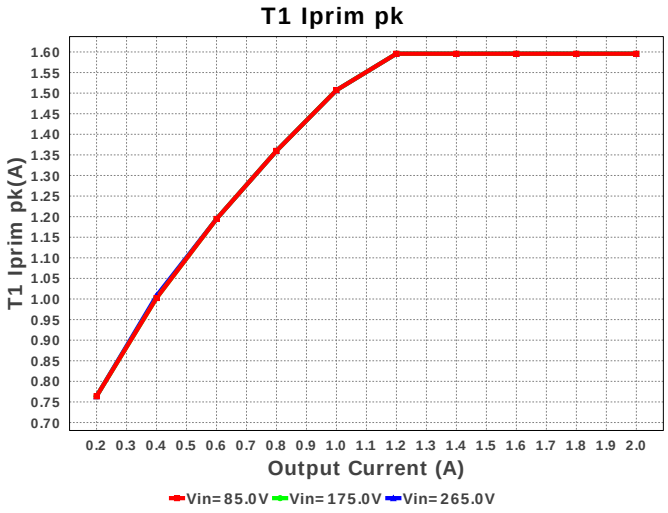
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
4.	Cout	Nichicon	RNU1C471MDN1PH Series= ?	Cap= 470.0 uF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 6.1 A	2	$0.50	 NU_1000x1250 144 mm²
5.	Csnub	MuRata	GRM31CR72E473KW03L Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 250.0 V IRMS= 0.0 A	1	$0.08	 1206 11 mm²
6.	D2	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.11	 DPAK 102 mm²
7.	D3	Microsemi	UFS180JE3/TR13	VF@Io= 1.2 V VRRM= 800.0 V	1	$0.71	 DO-214BA 42 mm²
8.	Dac	Diodes Inc.	HD06-T	VF@Io= 1.0 V VRRM= 600.0 V	1	$0.15	 MiniDIP 62 mm²
9.	Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm²
10.	L1	TDK	CLF7045T-471M	L= 470.0 µH DCR= 1.7 Ohm	1	$0.42	 CLF7045 85 mm²
11.	M1	STMicroelectronics	STF13NM60ND	VdsMax= 600.0 V IdsMax= 11.0 Amps	1	$1.99	 TO-220FP 79 mm²
12.	Rbld	CUSTOM	CUSTOM Series= ?	Res= 154.31 Ohm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
13.	Rcs	Panasonic	ERJ-3RQFR47V Series= ERJ-3R	Res= 470.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.02	 0603 5 mm²
14.	Rdd	Vishay-Dale	CRCW040222R6FKED Series= CRCW..e3	Res= 22.6 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
15.	Rfbb	Panasonic	ERJ-6ENF3162V Series= ERJ-6E	Res= 31.6 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
16.	Rfbt	Yageo America	RC0603FR-07120KL Series= ?	Res= 120.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
17.	Rg1	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
18.	Rg2	Panasonic	ERJ-8ENF1002V Series= ERJ-8E	Res= 10.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
19.	Rl	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	$0.29	 AC03 158 mm²
20.	Rlc	Vishay-Dale	CRCW04024K12FKED Series= CRCW..e3	Res= 4.12 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
21.	Rsnub	TE Connectivity	352110KFT Series= ?	Res= 10.0 kOhm Power= 2.0 W Tolerance= 1.0%	1	$0.12	 2512 43 mm²

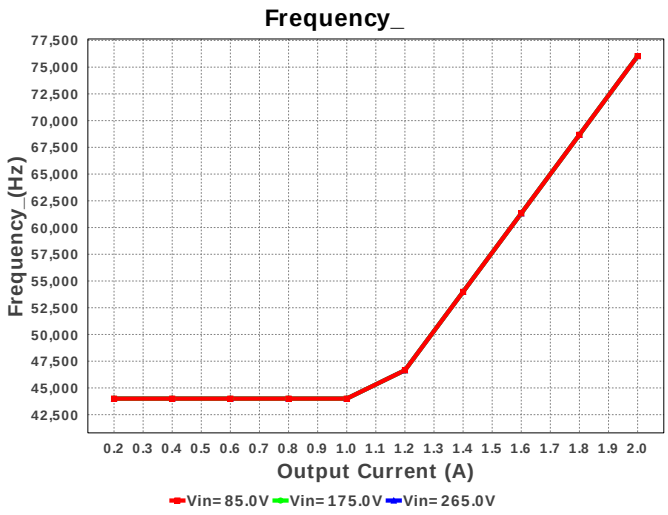
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	Rt1	Vishay-Dale	CRCW08054M99FKEA Series= CRCW..e3	Res= 4.99 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
23.	Rt2	Vishay-Dale	CRCW08054M99FKEA Series= CRCW..e3	Res= 4.99 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
24.	Rt3	Vishay-Dale	CRCW08054M99FKEA Series= CRCW..e3	Res= 4.99 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
25.	T1	Core=TDK , CoilFormer=TDK	Core=B66229G0000X127 , CoilFormer=B66230A1114T001	Lp= 297.0 µH Turns Ratio(Nas)= 6:4 Turns Ratio(Nps)= 24:4 Npri= 24.0 Naux= 6.0 Nsec= 4.0	1	$3.22	1313 mm²
26.	U1	Texas Instruments	UCC28700DBVR	Switcher	1	$0.35	SOT-23-6 15 mm²

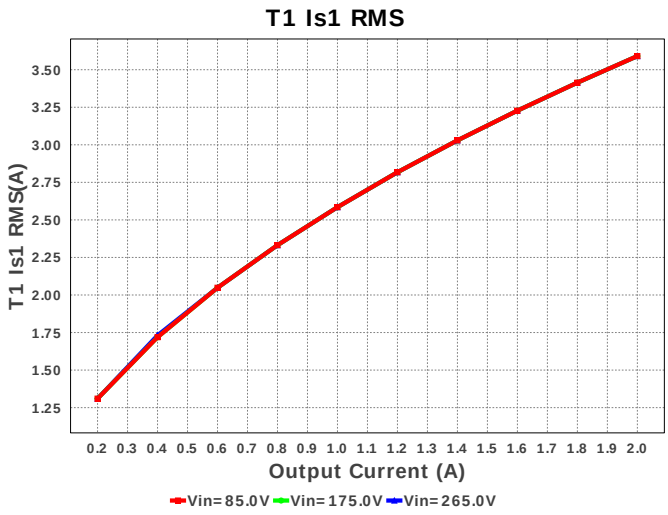


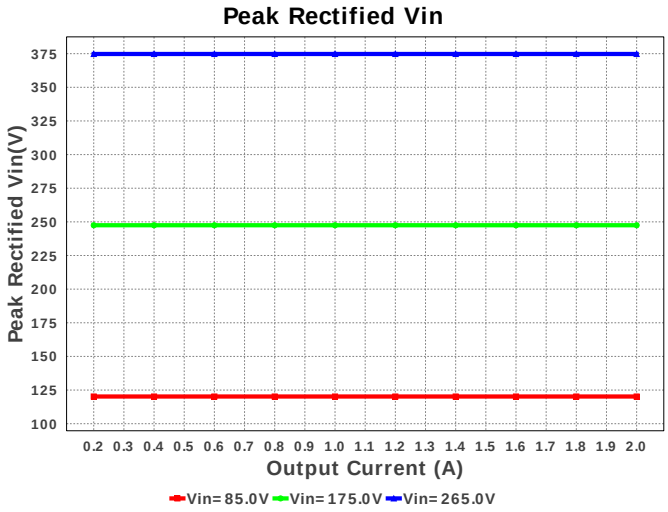


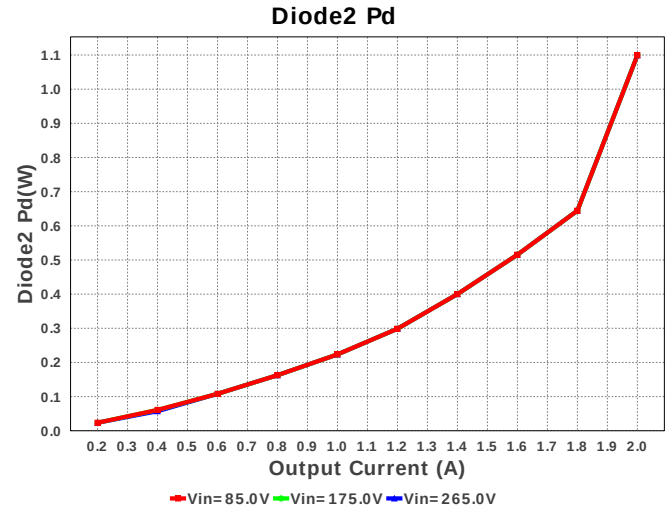


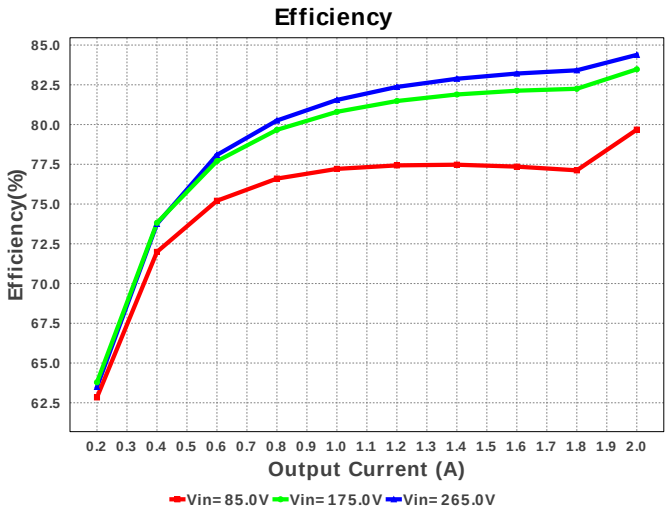


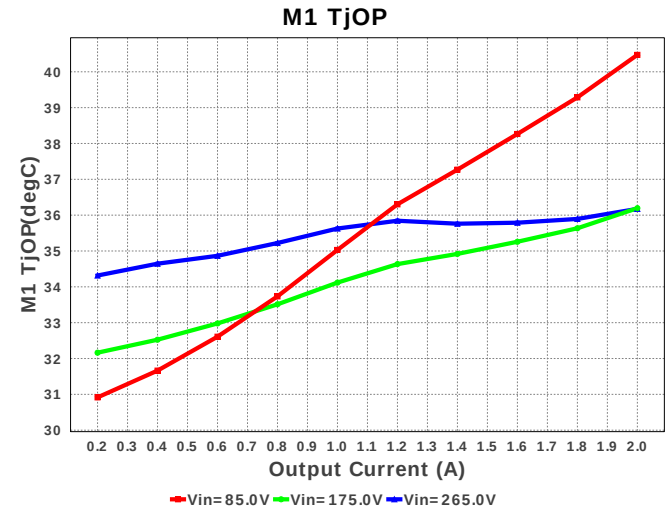


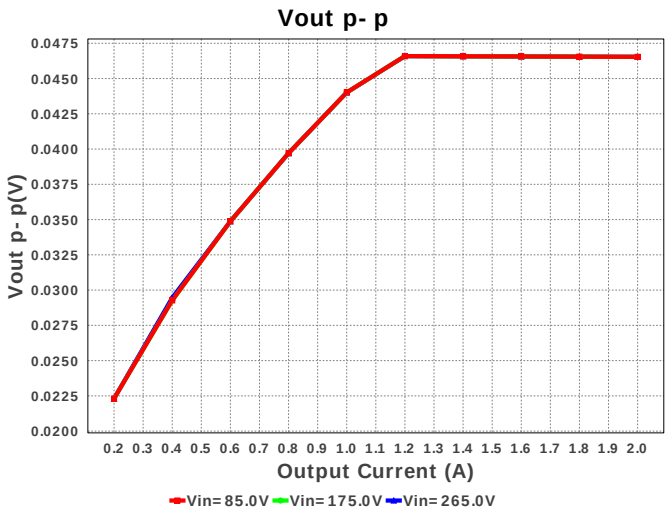


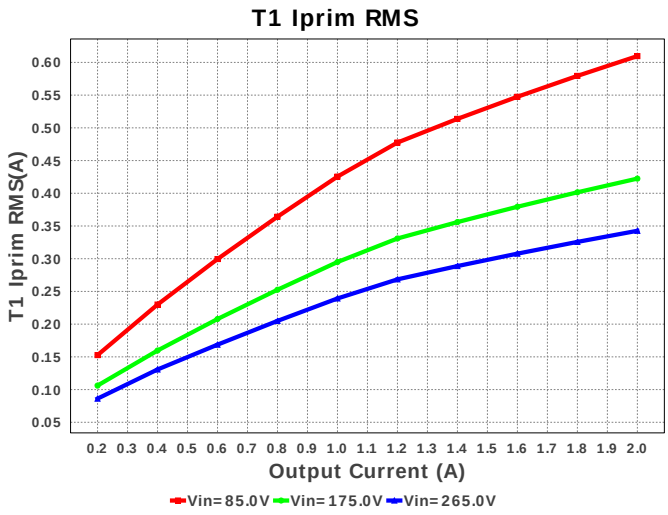


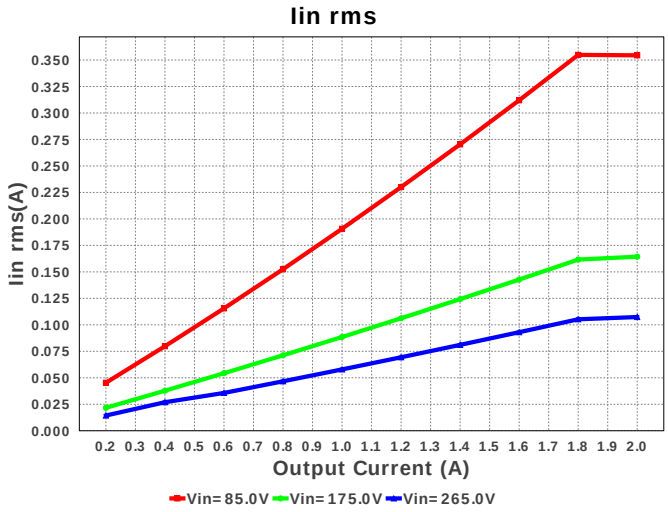


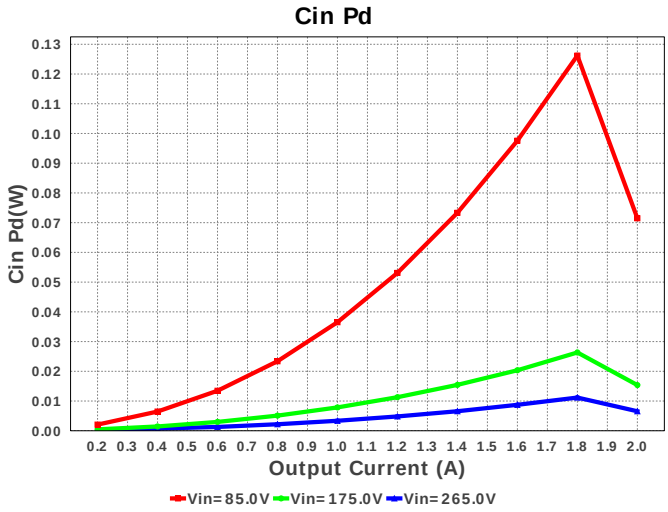


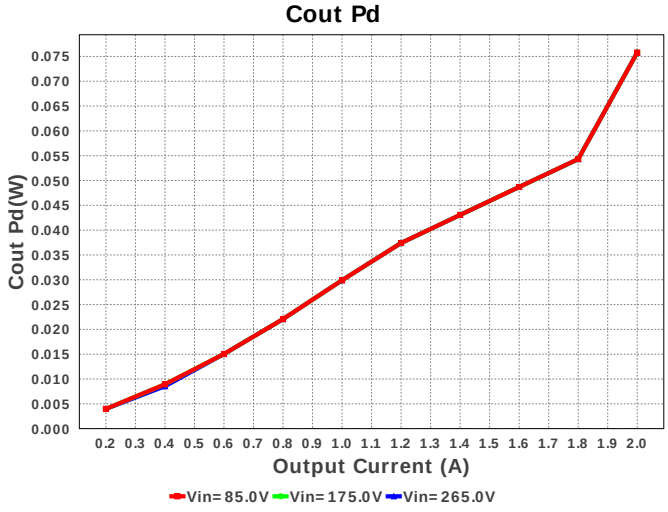


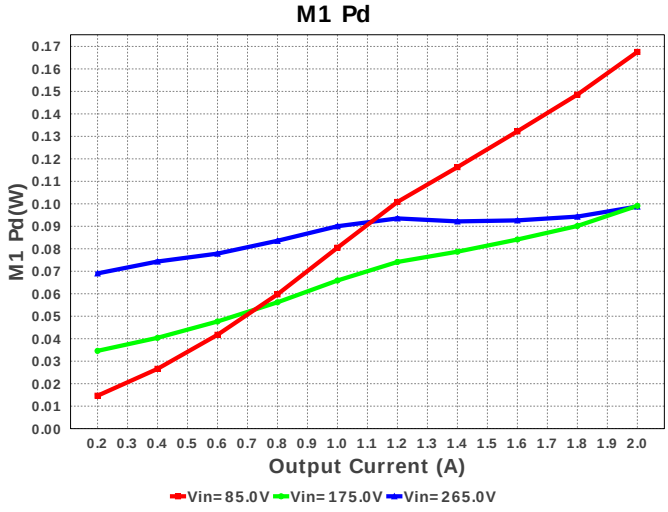


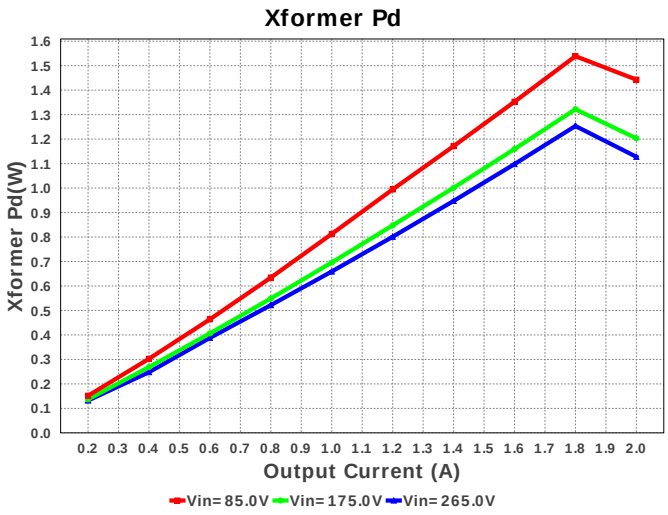


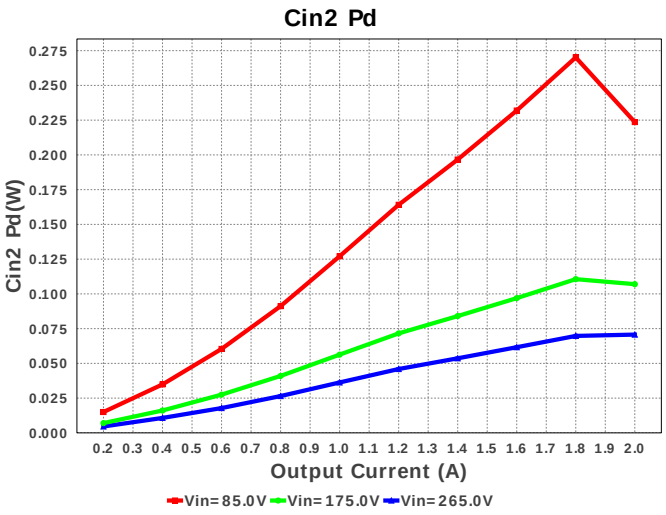


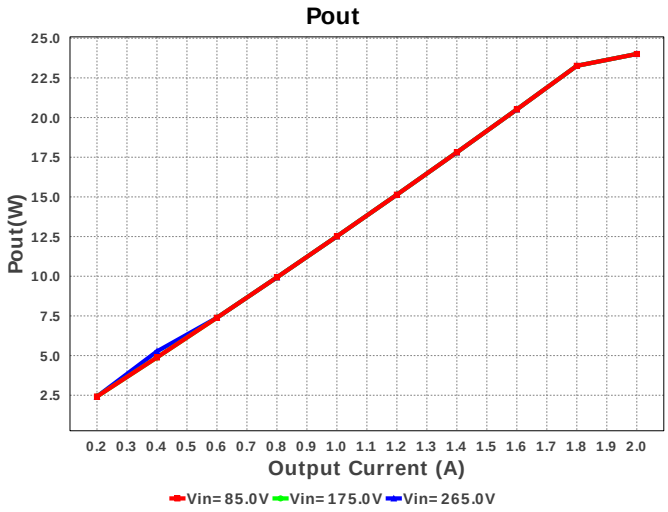


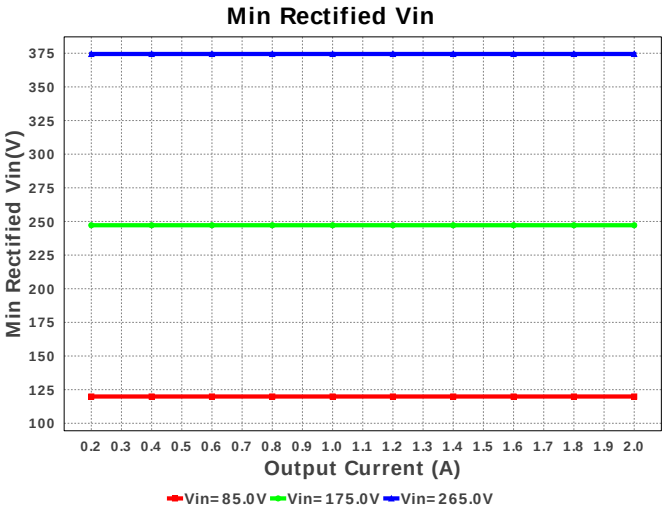


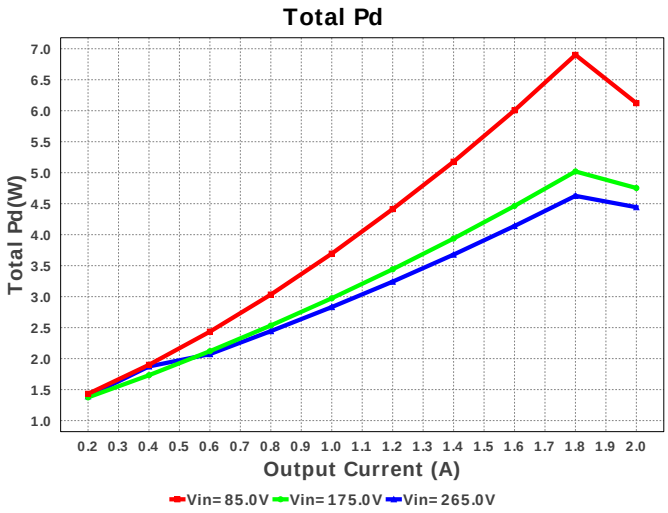


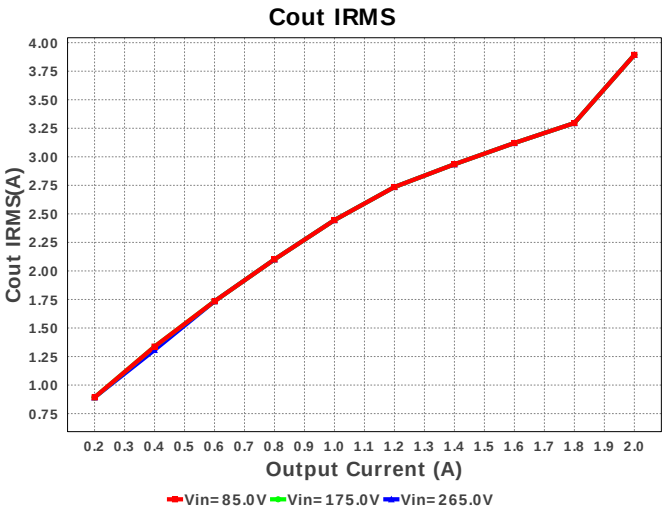


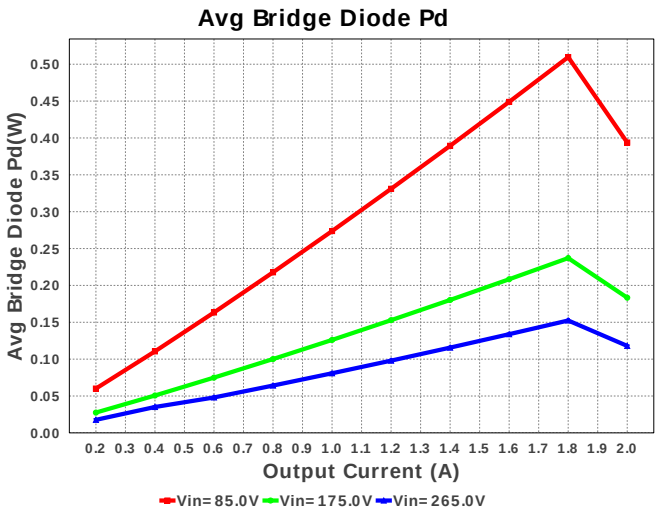


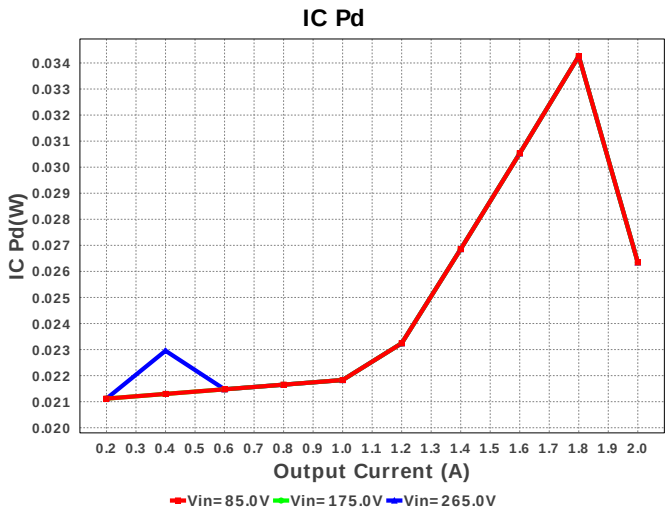


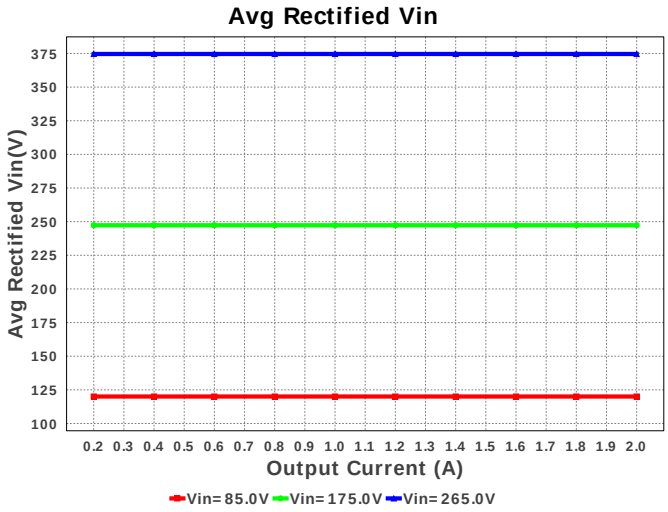


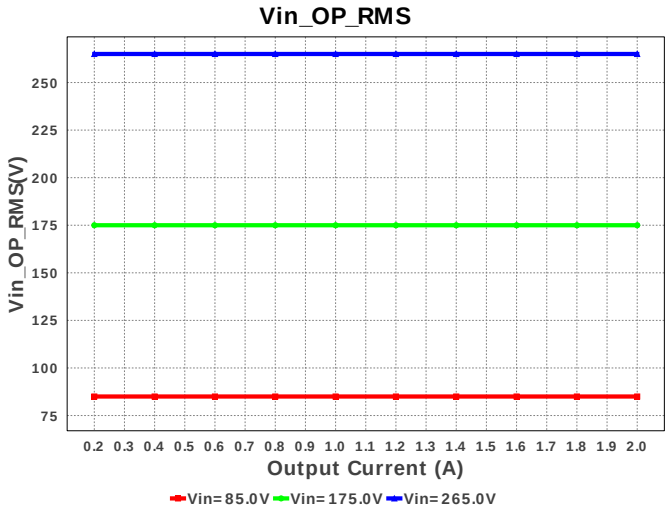


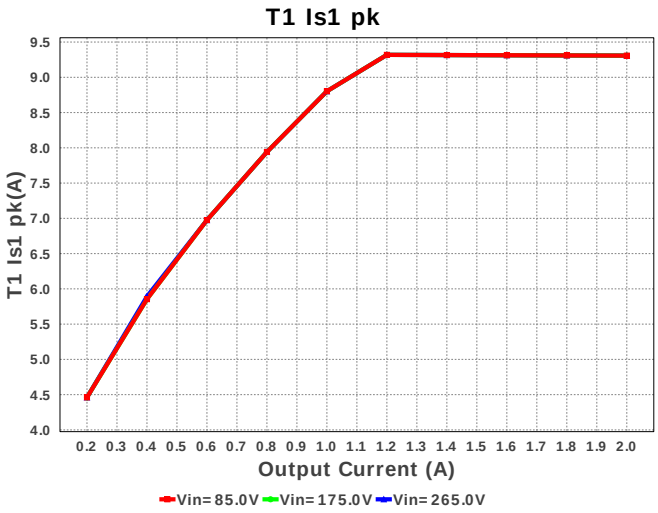


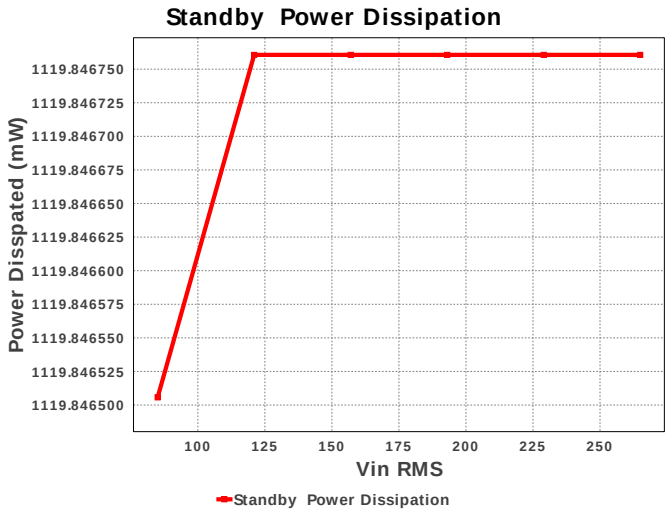


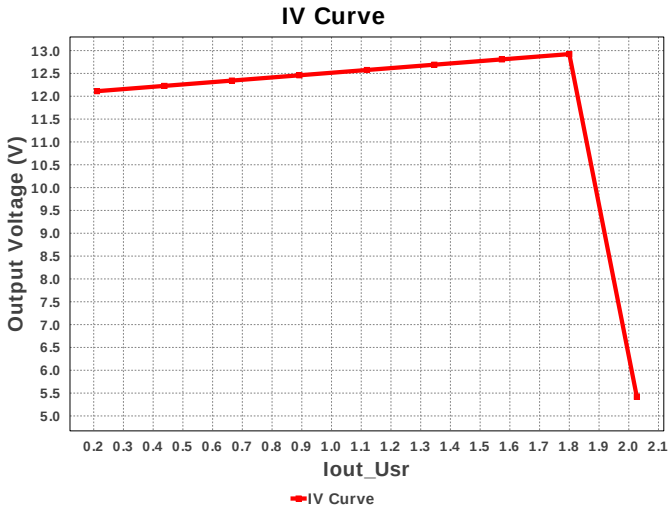












Operating Values

#	Name	Value	Category	Description
1.	Cin Pd	71.532 mW	Capacitors	Input capacitor power dissipation
2.	Cin2 Pd	223.677 mW	Capacitors	Average Power Dissipation in the Input Capacitor Cin2
3.	Cout IRMS	3.893 A	Capacitors	Output capacitor RMS ripple current
4.	Cout Pd	75.788 mW	Capacitors	Output capacitor power dissipation
5.	Iin rms	354.45 mA	Current	RMS Input Current
6.	Diode2 Pd	1.1 W	Diodes	Diode2 power dissipation
7.	Avg Rectified Vin	120.057 V	General	Average Rectified Voltage for the AC Line Period
8.	BOM Count	27	General	Total Design BOM count
9.	FootPrint	3.203 k mm^2	General	Total Foot Print Area of BOM components
10.	Mode	DCM	General	Conduction Mode
11.	Pout	24.006 W	General	Total output power
12.	Total BOM	$0.0	General	Total BOM Cost
13.	M1 Pd	167.526 mW	Mosfet	M1 MOSFET total power dissipation
14.	M1 TjOP	40.47 degC	Mosfet	M1 MOSFET junction temperature
15.	Vout Actual	19.43 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	9.016 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	46.111 %	Op_point	Duty cycle
18.	Efficiency	79.68 %	Op_point	Steady state efficiency
19.	Frequency	76.026 kHz	Op_point	Switching frequency
20.	IC Tj	34.741 degC	Op_point	IC junction temperature
21.	ICThetaJA	180.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	2.0 A	Op_point	Iout operating point
23.	Min Rectified Vin	119.907 V	Op_point	Minimum voltage seen at rectified input
24.	Peak Rectified Vin	120.207 V	Op_point	Peak voltage seen at rectified input
25.	Vin_OP_RMS	85.0 V	Op_point	AC Input RMS Voltage
26.	Vout p-p	46.538 mV	Op_point	Peak-to-peak output ripple voltage
27.	Avg Bridge Diode Pd	393.774 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
28.	IC Pd	26.34 mW	Power	IC power dissipation
29.	Snubber Pd	1.15 W	Power	Snubber Power Dissipation
30.	Total Pd	6.122 W	Power	Total Power Dissipation
31.	T1 Iprim RMS	609.647 mA	Transformer	Transformer Primary RMS Current
32.	T1 Iprim pk	1.596 A	Transformer	Transformer Primary Peak Current
33.	T1 Is1 RMS	3.591 A	Transformer	Transformer Secondary1 RMS Current
34.	T1 Is1 pk	9.308 A	Transformer	Transformer Secondary1 Peak Current
35.	Xformer Pd	1.443 W	Transformer	Transformer power dissipation
36.	Vout Tolerance	1.8 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	85.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC28700	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. Application Hints Rbld Rdd is set to 22 Ohms by default. it can be varied between 1 Ohm to 47 Ohms depending on transformer selected and Vdd expected Rg1 is set to 10 Ohms by default, it can be adjusted according to mosfet selected Rbld is used to to set a minimum load for the circuit, so that in standby the output voltage does not float up. The value chosen by WEBENCH should be a good starting point but may need to be adjusted to achieve minimum power dissipation at standby as well. Rlc Rlc provides the function of feed-forward line compensation to eliminate change in IPP due to change in di/dt and the propagation delay of the internal comparator and MOSFET turn-off time. For best results the chosen value may need to be adjusted based on board, FET and transformer parasitics. Rfbt & Rfbb The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fined tuned based on the final Transformer turns ratios and the voltage across the output diode at close to zero current. Cdd Cdd supplies the device operating current until the output of the converter reaches the target minimum operating voltage. The value calculated by WEBENCH for Cdd is a good starting point since it assumes that the output current of the Flyback is available to charge the output capacitance until the minimum output voltage is acheived, but may need to be adjusted. Part Description The UCC28700 family of flyback power supply controllers provides Constant-Voltage (CV) and Constant-Current (CC) output regulation. Primary-Side Regulation (PSR) eliminates the use of an Opto-Coupler. Please see the datasheet for further design guidance(For non Q1 parts). http://www.ti.com/lit/ds/symlink/ucc28700.pdfFor non Q1 partshttp://www.ti.com/lit/ds/symlink/ucc28700-q1.pdf

2. **UCC28700** Product Folder : http://www.ti.com/product/UCC28700 : contains the data sheet and other resources.