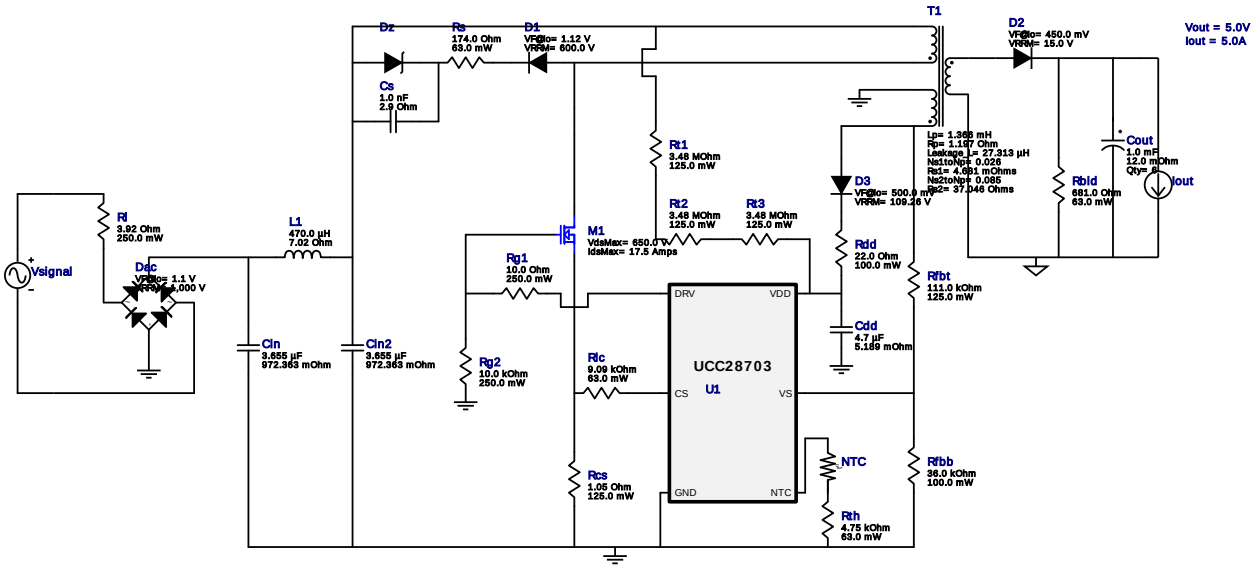
WEBENCH® Design Report

VinMin = 220.0V
VinMax = 220.0V
Vout = 5.0V
Iout = 5.0A

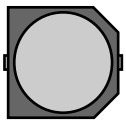
Device = UCC28703DBVR
Topology = Flyback
Created = 8/20/16 6:48:42 AM
BOM Cost = $0.00
BOM Count = 34
Total Pd = 4.73W

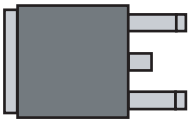
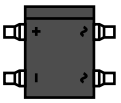
Design : 4215160/10 UCC28703DBVR
UCC28703DBVR 220.0V-220.0V to 5.00V @ 5.0A



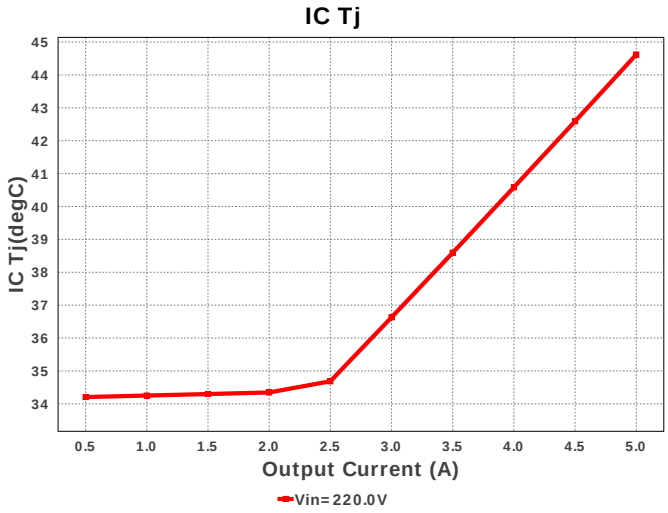
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

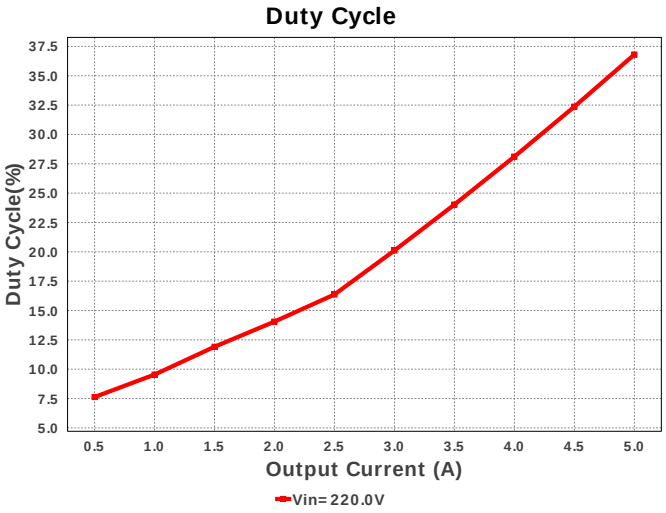
Electrical BOM

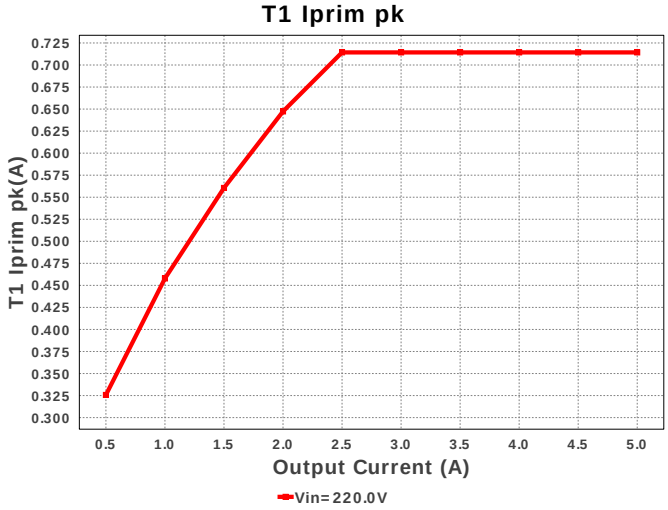
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	 0805 7 mm^2
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 3.655 uF ESR= 972.36 mOhm VDC= 466.69 V IRMS= 494.79 mA	1	NA	CUSTOM 0 mm^2
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 3.655 uF ESR= 972.36 mOhm VDC= 466.69 V IRMS= 494.79 mA	1	NA	CUSTOM 0 mm^2
4.	Cout	Panasonic	16SVPF1000M Series= ?	Cap= 1.0 mF ESR= 12.0 mOhm VDC= 16.0 V IRMS= 5.4 A	6	$0.74	 CAPSMT_62_F12 151 mm^2
5.	Cs	MuRata	GRM188R72E102KW07D Series= X7R	Cap= 1.0 nF ESR= 2.9 Ohm VDC= 250.0 V IRMS= 90.0 mA	1	$0.01	 0603 5 mm^2
6.	D1	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm^2

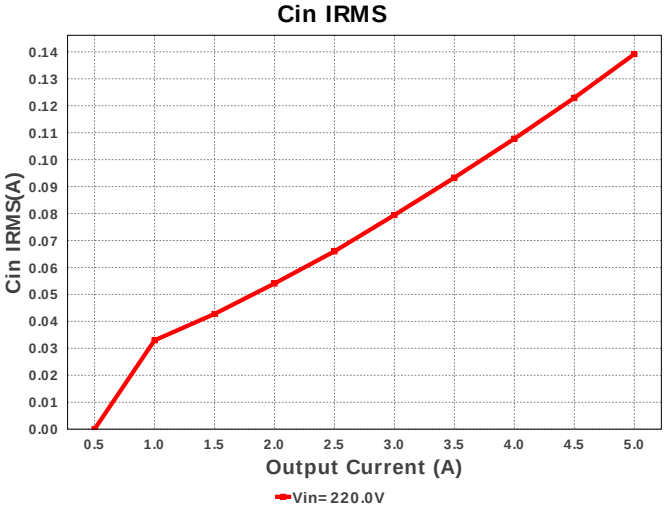
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	D2	ON Semiconductor	MBRB2515LT4G	VF@Io= 450.0 mV VRRM= 15.0 V	1	$1.00	 DDPAK 210 mm²
8.	D3	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 109.26 V	1	NA	CUSTOM 0 mm²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
10.	Dz	ON Semiconductor	1SMB5953BT3G	Zener	1	$0.10	 SMB 44 mm²
11.	L1	Coilcraft	LPS4018-474MRB	L= 470.0 µH DCR= 7.02 Ohm	1	$0.35	 LPS4018 24 mm²
12.	M1	Infineon Technologies	IPP65R190CFD	VdsMax= 650.0 V IdsMax= 17.5 Amps	1	$2.34	TO-220 0 mm²
13.	Rbld	Vishay-Dale	CRCW0402681RFKED Series= CRCW..e3	Res= 681.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
14.	Rcs	Yageo America	RC0805FR-071R05L Series= ?	Res= 1.05 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
15.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
16.	Rfbb	Yageo America	RC0603FR-0736KL Series= ?	Res= 36.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
17.	Rfbt	Yageo America	RT0805BRD07111KL Series= RT0805	Res= 111.0 kOhm Power= 125.0 mW Tolerance= 0.1%	1	$0.05	0805 7 mm²
18.	Rg1	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
19.	Rg2	Panasonic	ERJ-8ENF1002V Series= ERJ-8E	Res= 10.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
20.	Rl	Vishay-Dale	CRCW12063R92FKEA Series= CRCW..e3	Res= 3.92 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
21.	Rlc	Vishay-Dale	CRCW04029K09FKED Series= CRCW..e3	Res= 9.09 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
22.	Rs	Vishay-Dale	CRCW0402174RFKED Series= CRCW..e3	Res= 174.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
23.	Rt1	Vishay-Dale	CRCW08053M48FKEA Series= CRCW..e3	Res= 3.48 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
24.	Rt2	Vishay-Dale	CRCW08053M48FKEA Series= CRCW..e3	Res= 3.48 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
25.	Rt3	Vishay-Dale	CRCW08053M48FKEA Series= CRCW..e3	Res= 3.48 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

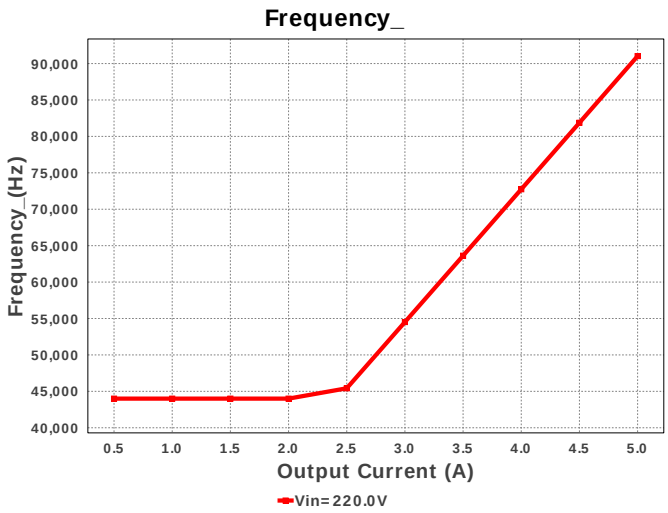
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	Rth	Vishay-Dale	CRCW04024K75FKED Series= CRCW..e3	Res= 4.75 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
27.	T1	CUSTOM	CUSTOM	Lp= 1.366 mH Rp= 1.197 Ohm Leakage_L= 27.313 µH Ns1toNp= 0.026 Rs1= 4.681 mOhms Ns2toNp= 0.085 Rs2= 37.046 Ohms	1	NA	CUSTOM 0 mm^2
28.	U1	Texas Instruments	UCC28703DBVR	Switcher	1	$0.35	SOT-23-6 15 mm^2

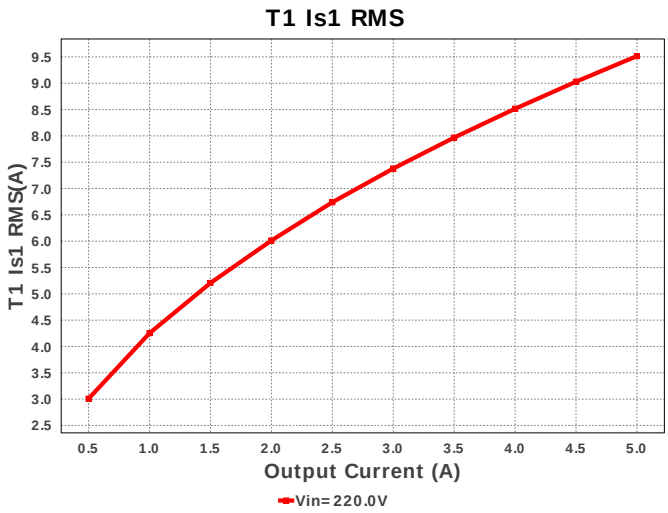


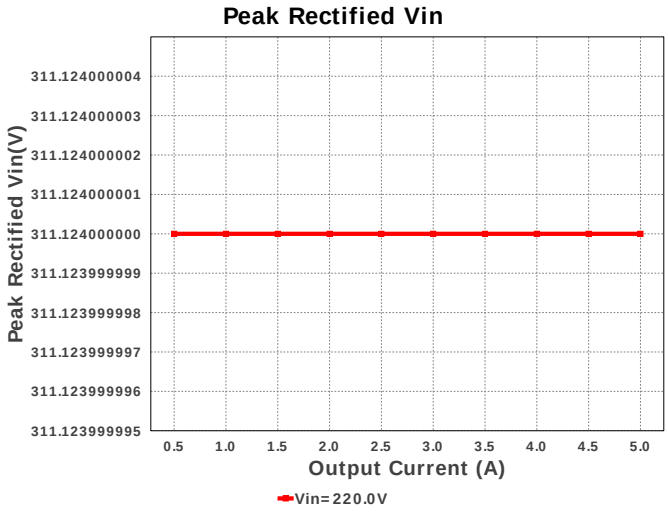


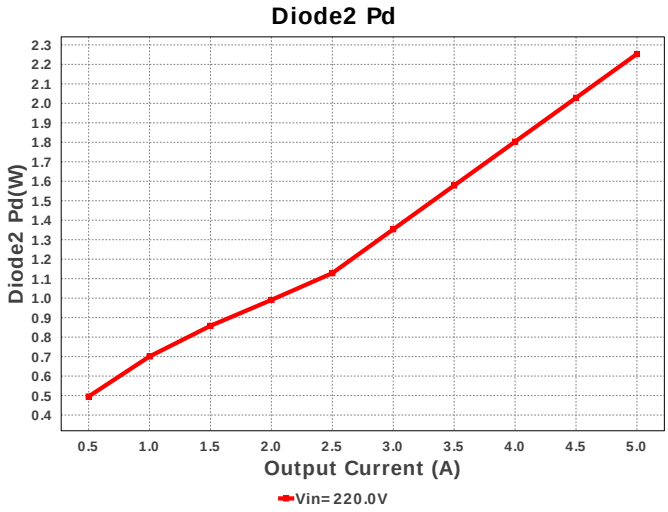


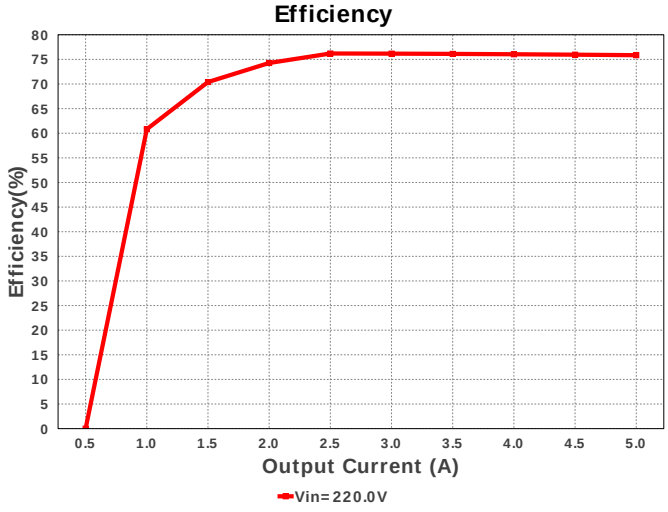


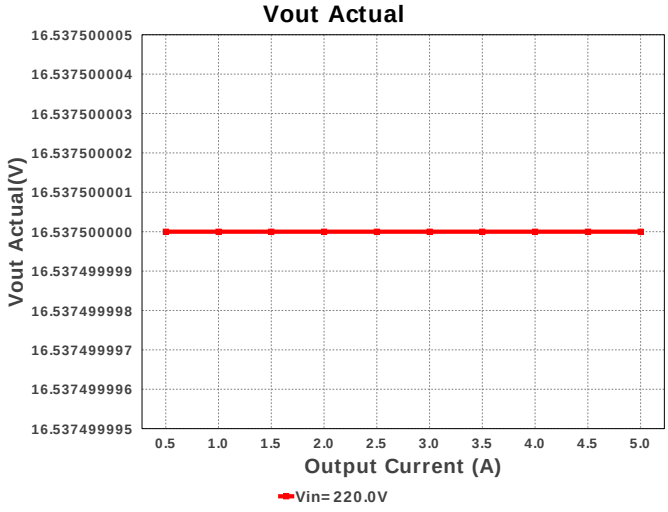


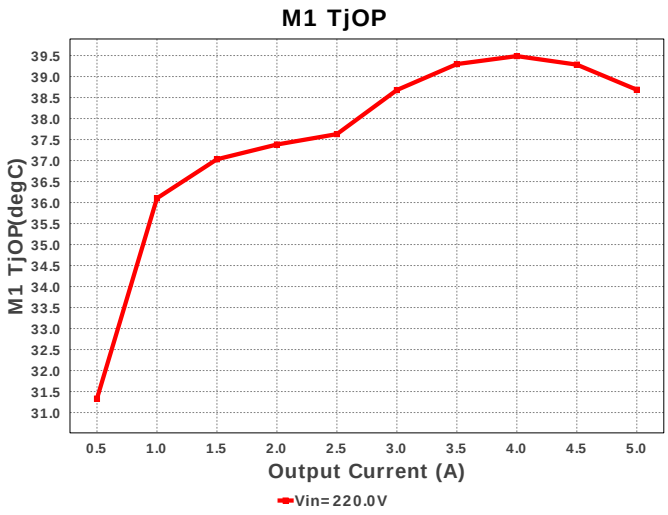


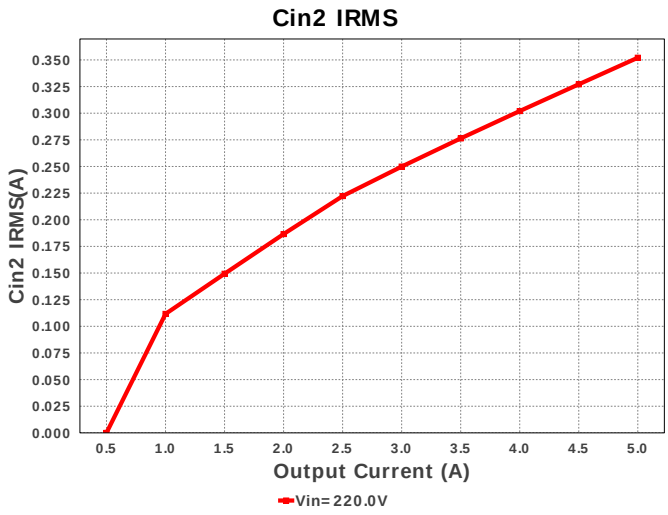


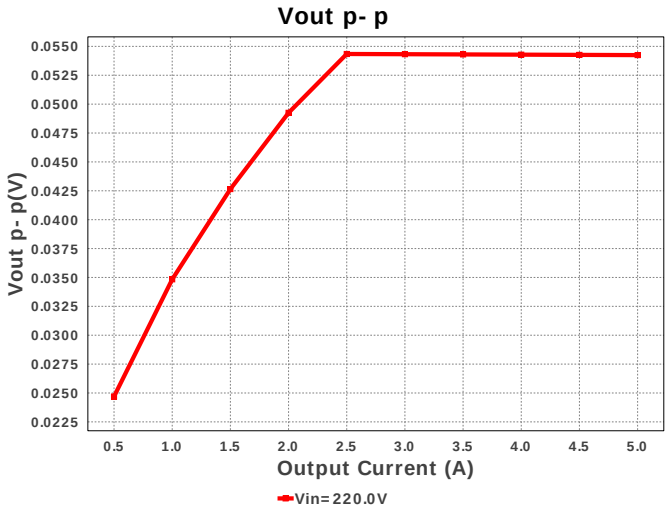


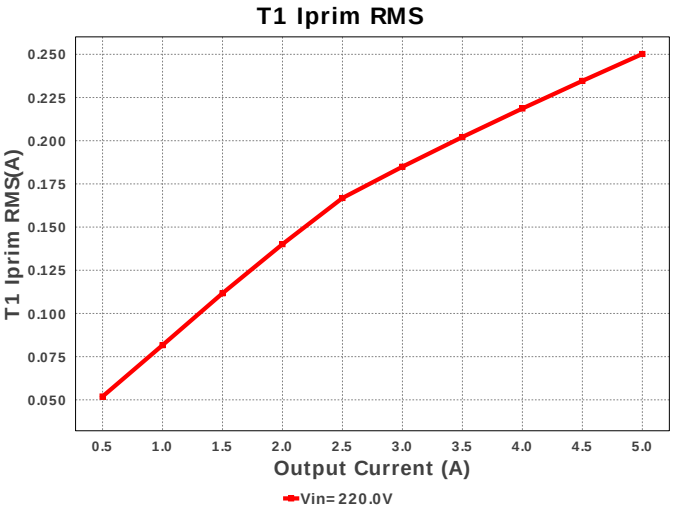


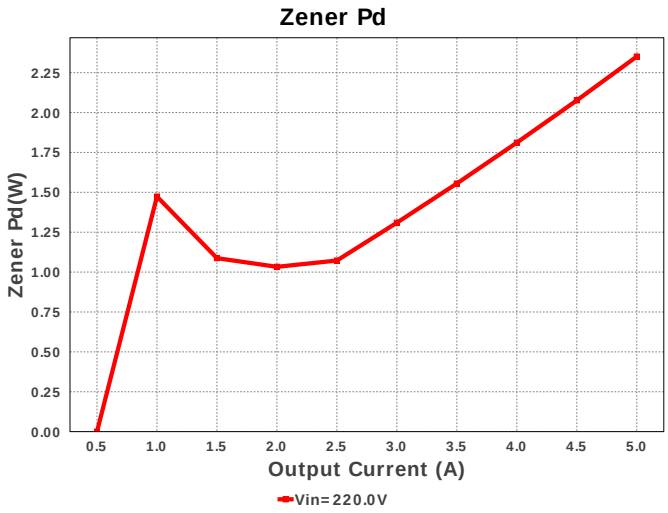


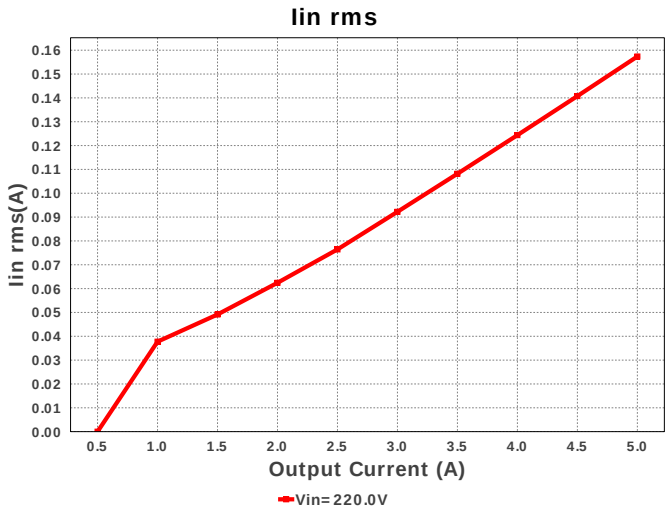


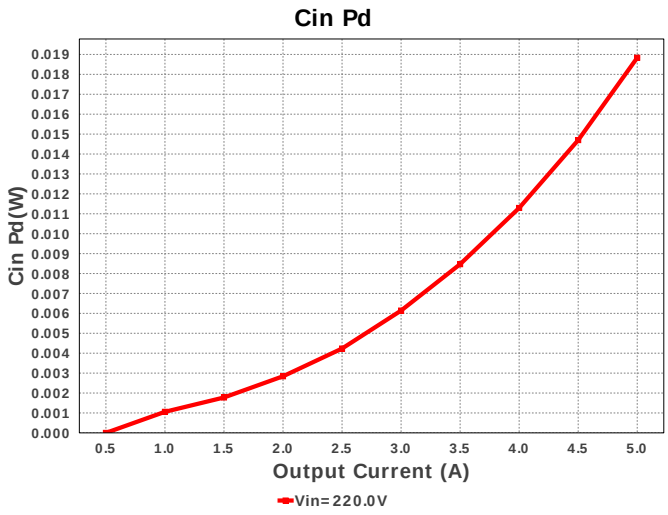


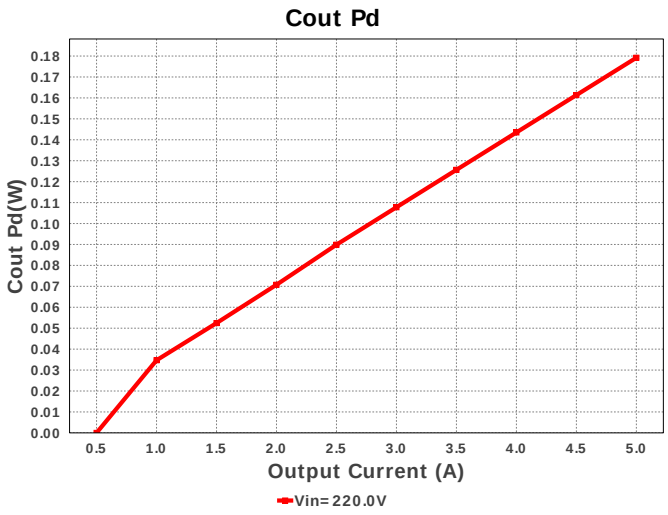


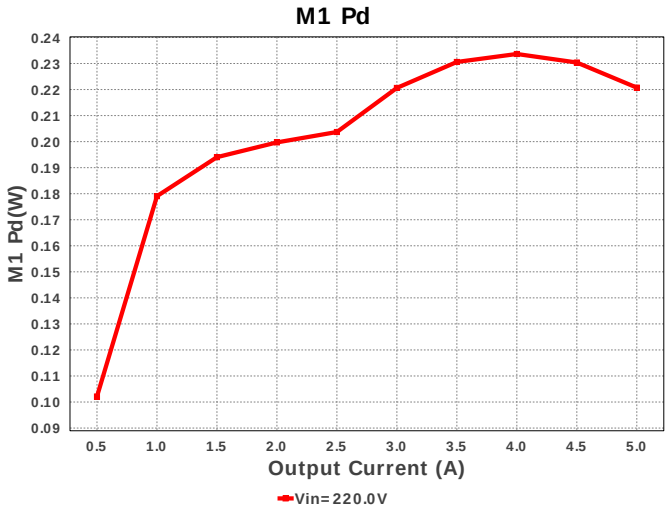


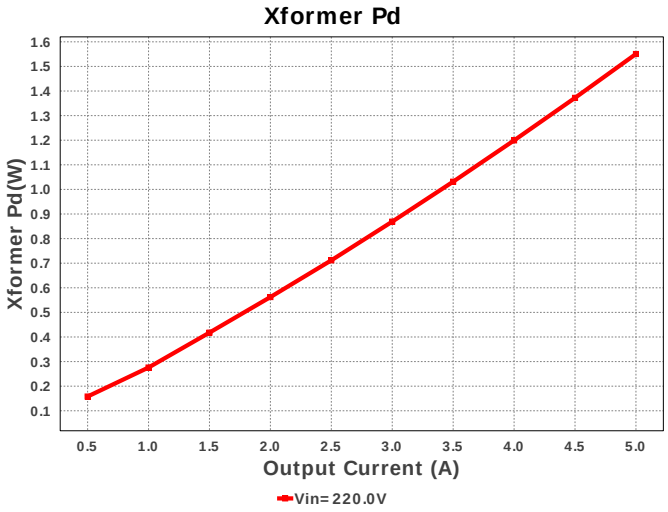


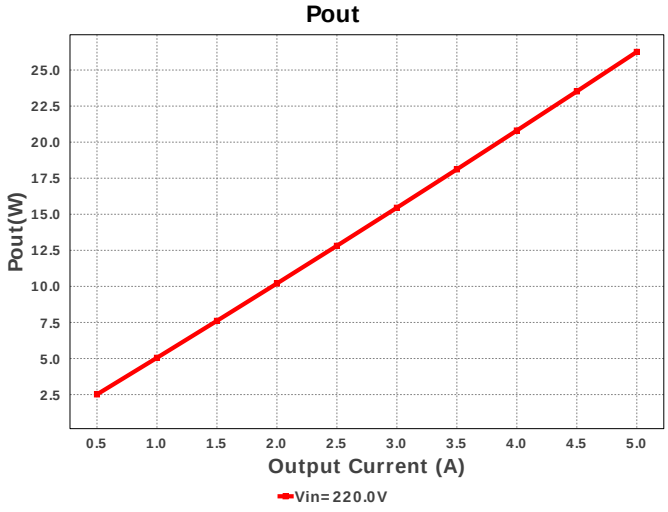


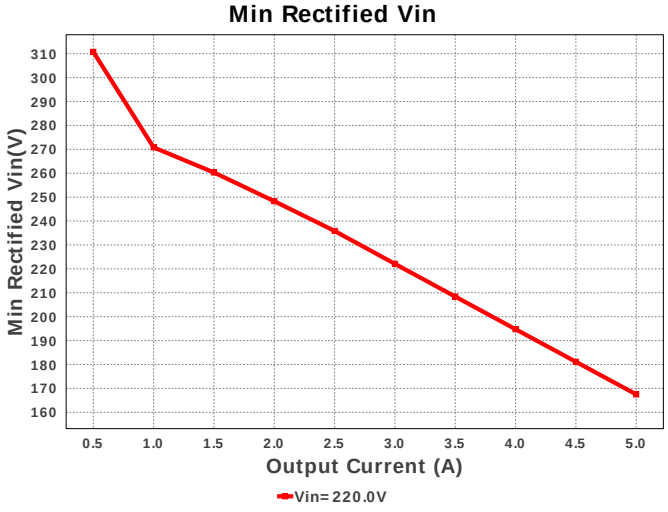


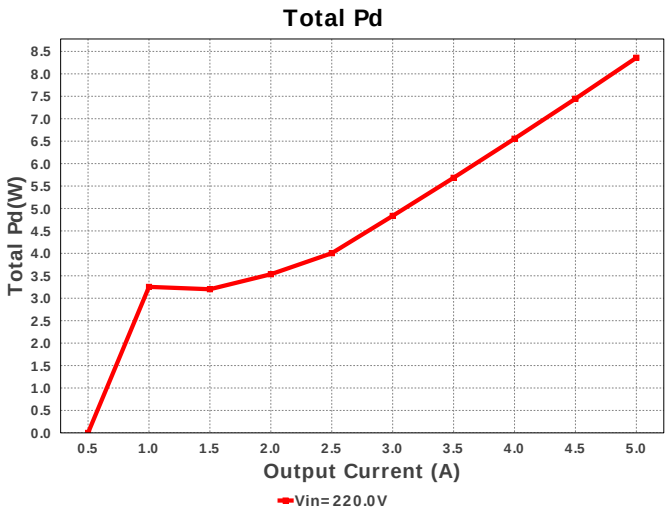


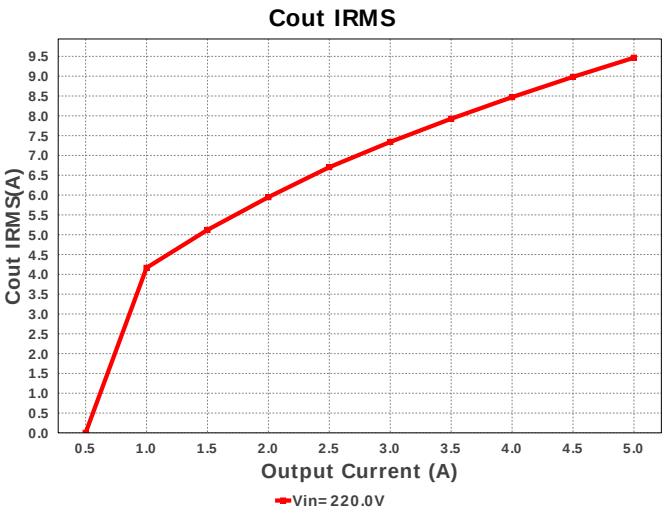


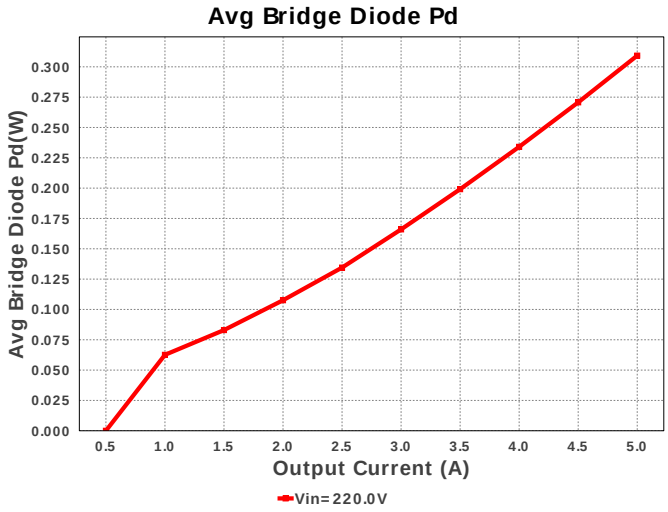


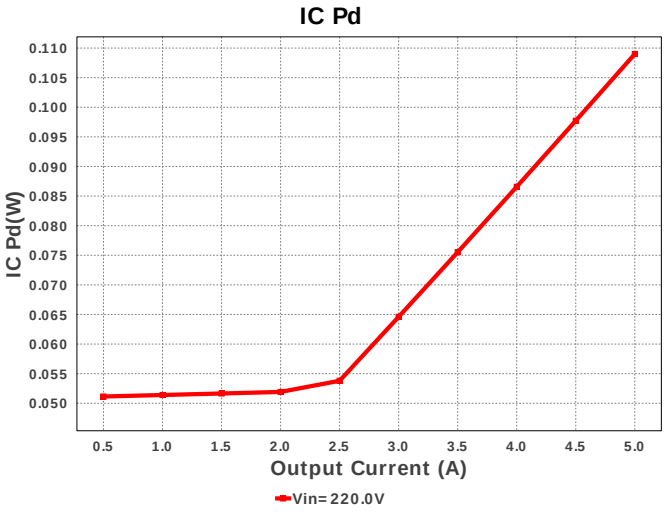


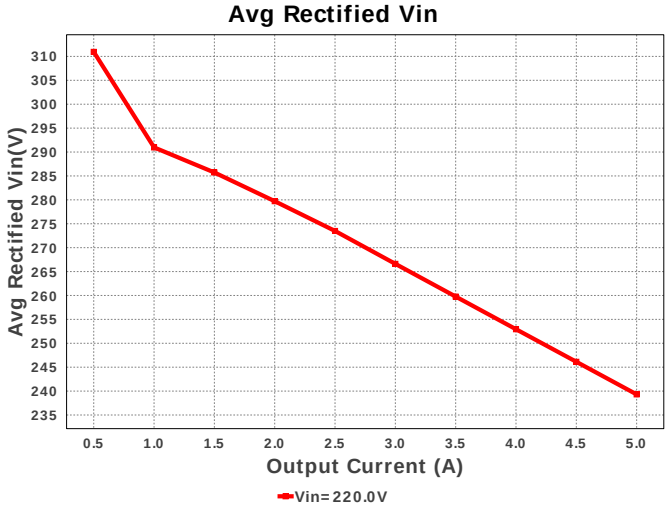


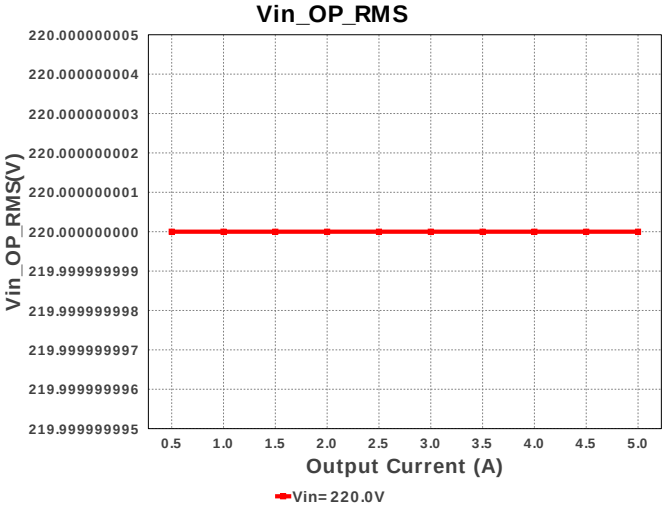


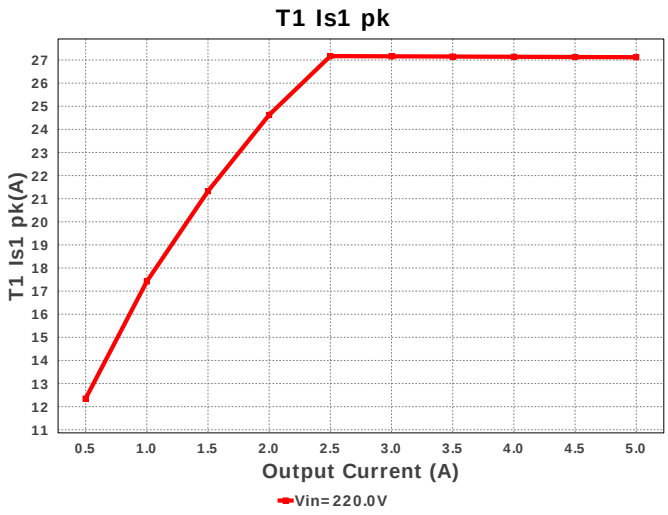


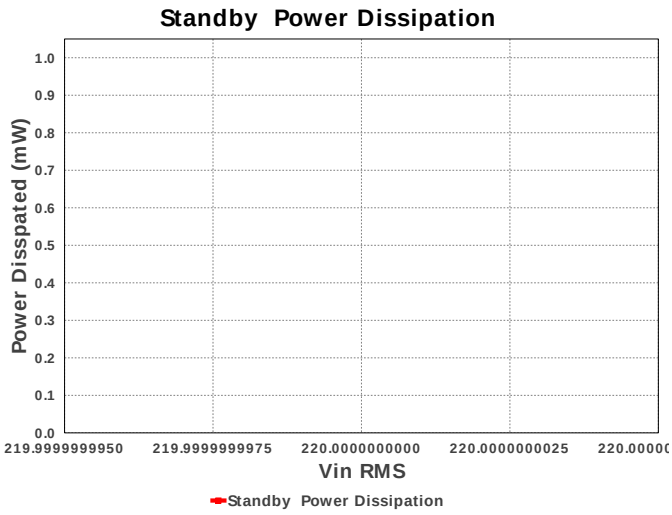


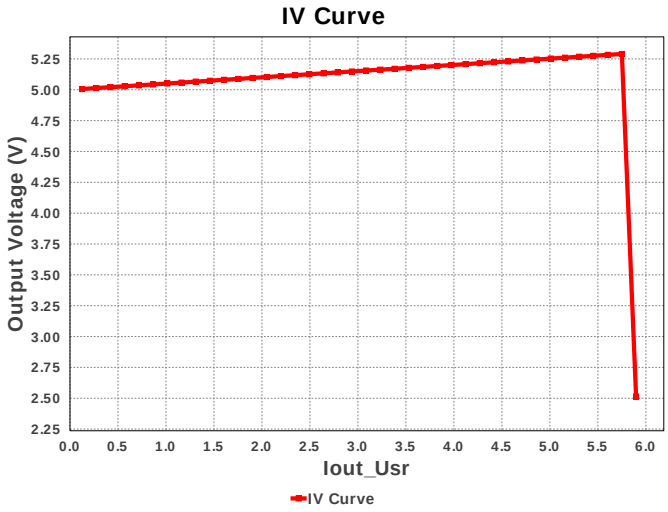












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	121.609 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	326.745 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	9.504 A	Current	Output capacitor RMS ripple current
4.	Iin rms	140.85 mA	Current	RMS Input Current
5.	T1 Iprim RMS	236.269 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	714.286 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	9.554 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	27.342 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	258.212 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	34	General	Total Design BOM count
11.	FootPrint	1.764 k mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	26.26 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	16.538 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.252 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	32.824 %	Op_point	Duty cycle
18.	Efficiency	84.744 %	Op_point	Steady state efficiency
19.	Frequency	86.478 kHz	Op_point	Switching frequency
20.	IC Tj	32.254 degC	Op_point	IC junction temperature
21.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	5.0 A	Op_point	Iout operating point
23.	M1 TjOP	45.429 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	205.301 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	311.124 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	220.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	54.685 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	171.999 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	14.38 mW	Power	Input capacitor power dissipation
30.	Cout Pd	180.652 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	1.295 W	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	103.633 mW	Power	IC power dissipation
33.	M1 Pd	329.495 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	4.727 W	Power	Total Power Dissipation
35.	Xformer Pd	1.501 W	Power	Transformer power dissipation
36.	Zener Pd	537.316 mW	Power	Zener power dissipation
37.	Vout Tolerance	1.038 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	5.0	Maximum Output Current
2.	VinMax	220.0	Maximum input voltage
3.	VinMin	220.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC28703	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	25.0	Ambient temperature

Design Assistance

1. Application Hints Rbld 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. http://www.ti.com/lit/ds/symlink/ucc28700.pdf

2. **UCC28703** Product Folder : http://www.ti.com/product/UCC28703 : contains the data sheet and other resources.