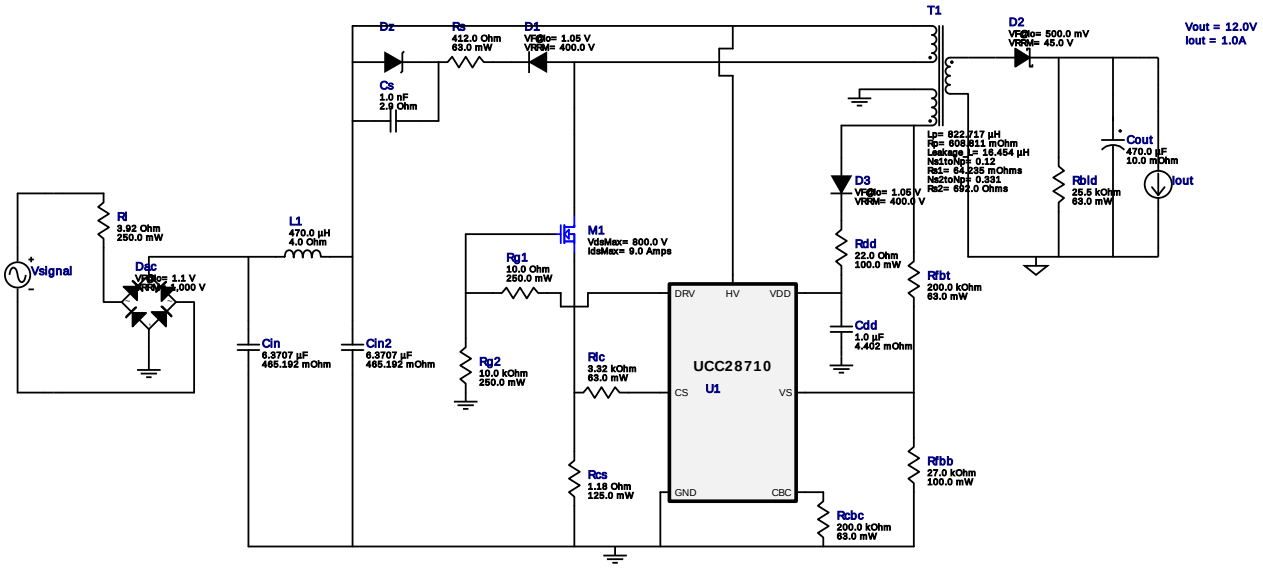
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 220.0V
Vout = 12.0V
Iout = 1.0A

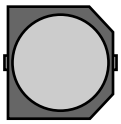
Device = UCC28710DR
Topology = Flyback
Created = 8/28/16 8:16:08 PM
BOM Cost = $0.00
BOM Count = 25
Total Pd = 1.78W

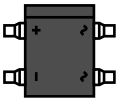
Design : 4108001/17 UCC28710DR
UCC28710DR 110.0V-220.0V to 12.52V @ 1.0A



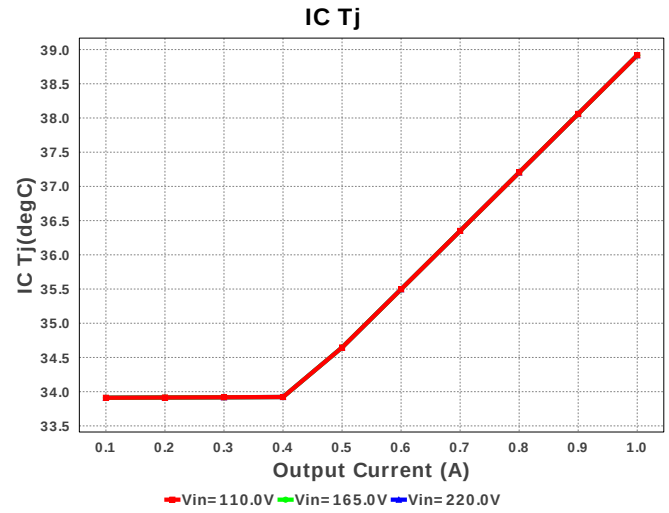
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

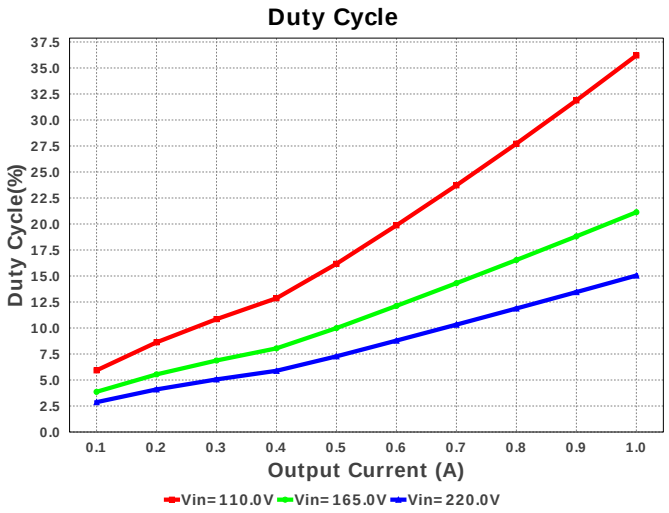
Electrical BOM

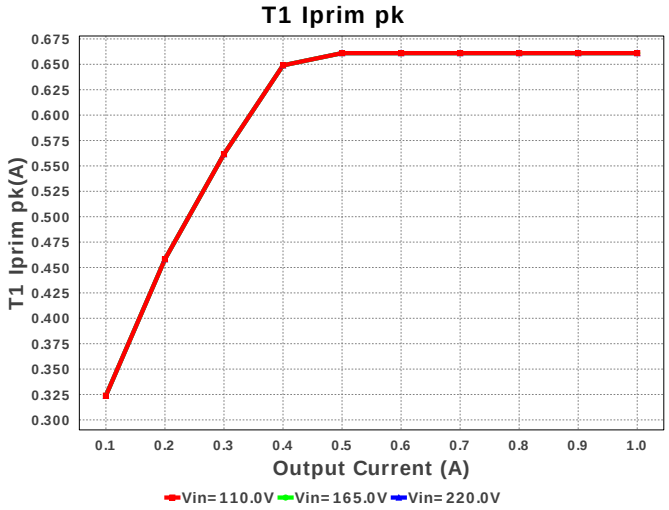
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR71H105KA12L Series= X7R	Cap= 1.0 uF ESR= 4.402 mOhm VDC= 50.0 V IRMS= 1.677 A	1	$0.05	0805 7 mm^2
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 6.3707 uF ESR= 465.19 mOhm VDC= 466.69 V IRMS= 495.61 mA	1	NA	CUSTOM 0 mm^2
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 6.3707 uF ESR= 465.19 mOhm VDC= 466.69 V IRMS= 495.61 mA	1	NA	CUSTOM 0 mm^2
4.	Cout	Panasonic	16SVPE470M Series= SVPE	Cap= 470.0 uF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 6.1 A	1	$0.88	 CAPSMT_62_JC0 156 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	CD1408-FU1400	VF@Io= 1.05 V VRRM= 400.0 V	1	$0.13	Diode_1408 13 mm^2
7.	D2	Vishay-Semiconductor	BYS10-45-E3/TR	VF@Io= 500.0 mV VRRM= 45.0 V	1	$0.10	SMA 37 mm^2
8.	D3	Bourns	CD1408-FU1400	VF@Io= 1.05 V VRRM= 400.0 V	1	$0.13	Diode_1408 13 mm^2

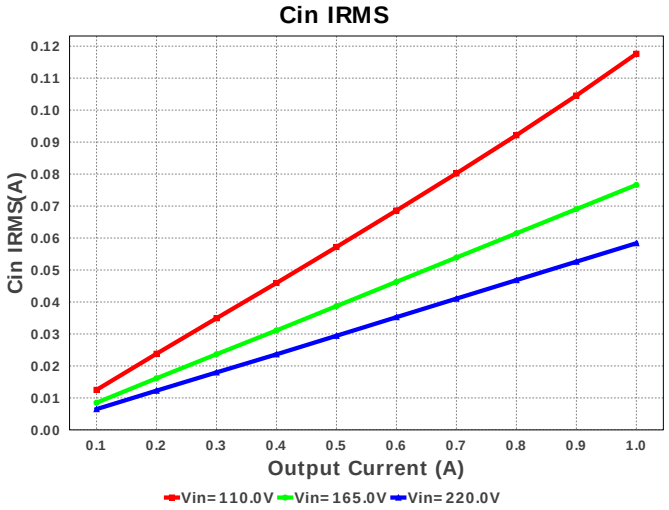
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm^2
10.	Dz	ON Semiconductor	1SMB5951BT3G	Zener	1	$0.10	 SMB 44 mm^2
11.	L1	NIC Components	NPI54C471KTRF	L= 470.0 µH DCR= 4.0 Ohm	1	$0.09	 IND_NPI54C 61 mm^2
12.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm^2
13.	Rbld	Vishay-Dale	CRCW040225K5FKED Series= CRCW..e3	Res= 25.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
14.	Rcbc	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
15.	Rcs	Vishay-Dale	CRCW08051R18FKEA Series= CRCW..e3	Res= 1.18 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
16.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
17.	Rfbb	Yageo America	RC0603FR-0727KL Series= ?	Res= 27.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
18.	Rfbt	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
19.	Rg1	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
20.	Rg2	Panasonic	ERJ-8ENF1002V Series= ERJ-8E	Res= 10.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
21.	Rl	Vishay-Dale	CRCW12063R92FKEA Series= CRCW..e3	Res= 3.92 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
22.	Rlc	Vishay-Dale	CRCW04023K32FKED Series= CRCW..e3	Res= 3.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
23.	Rs	Vishay-Dale	CRCW0402412RFKED Series= CRCW..e3	Res= 412.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
24.	T1	CUSTOM	CUSTOM	Lp= 822.717 µH Rp= 608.811 mOhm Leakage_L= 16.454 µH Ns1toNp= 0.12 Rs1= 64.235 mOhms Ns2toNp= 0.331 Rs2= 692.0 Ohms	1	NA	CUSTOM 0 mm^2

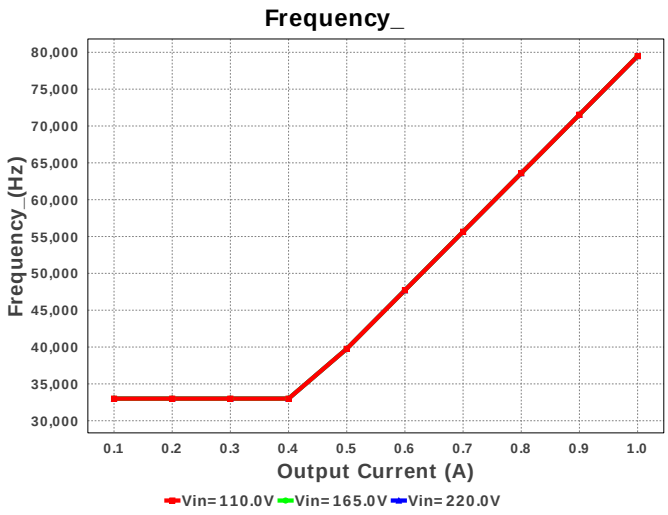
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	U1	Texas Instruments	UCC28710DR	Switcher	1	$0.42	SOIC-7 0 mm²

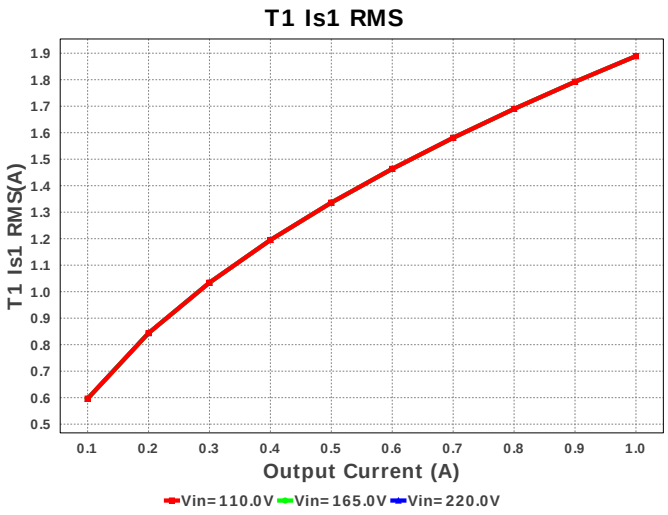


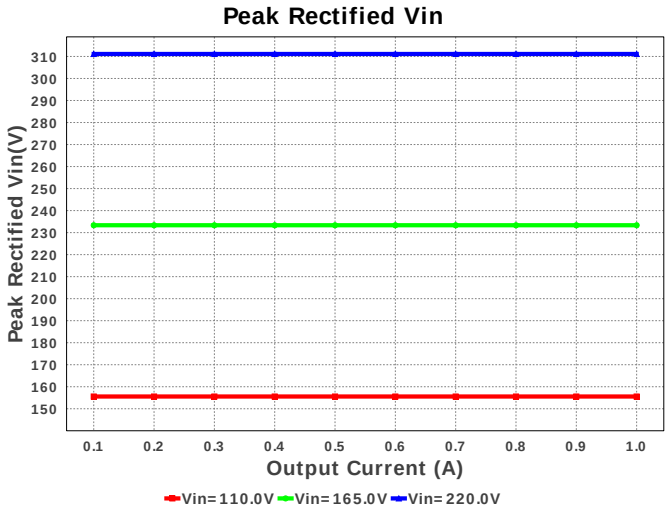


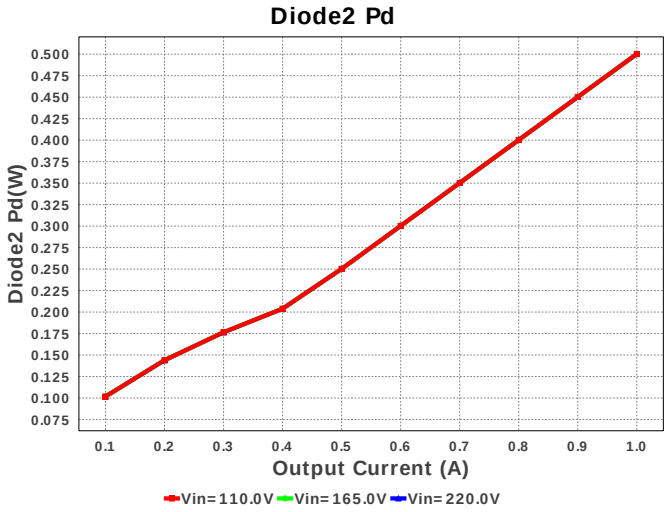


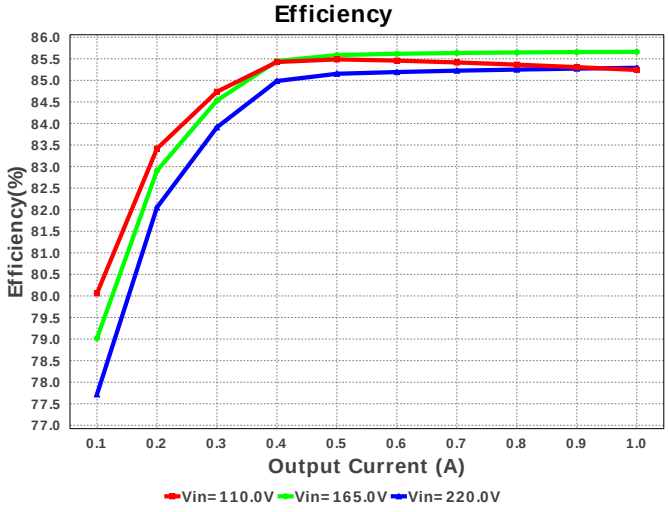


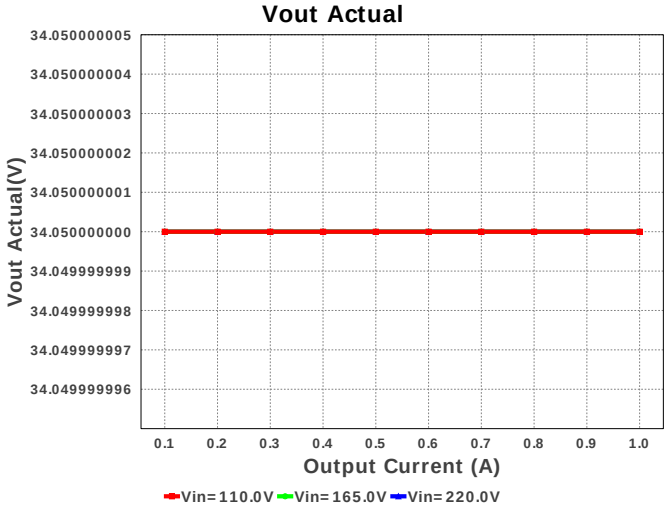


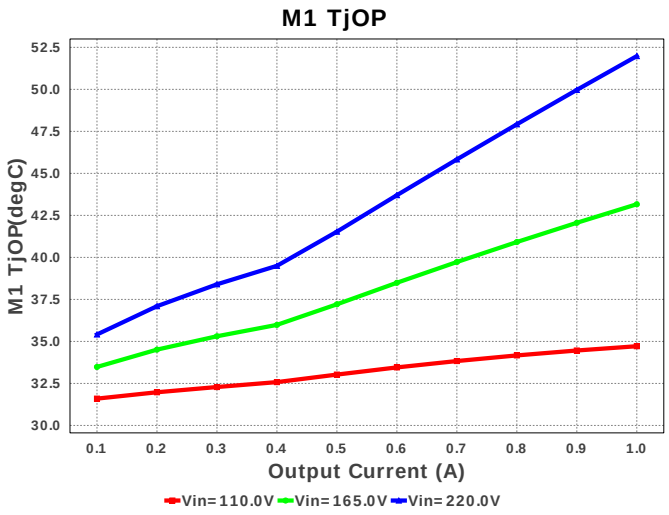


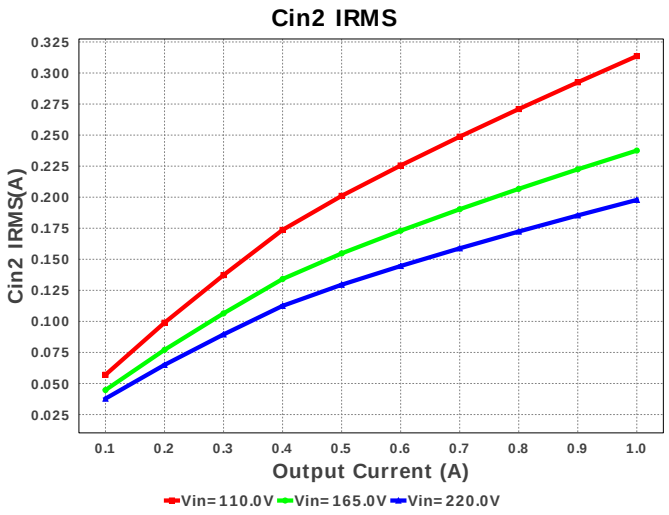


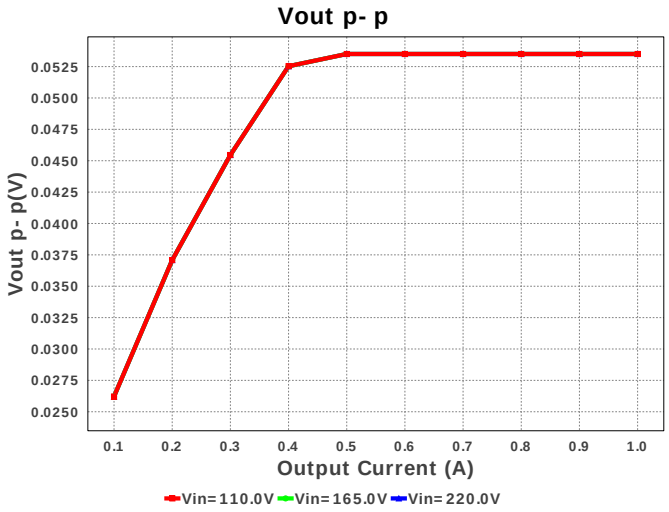


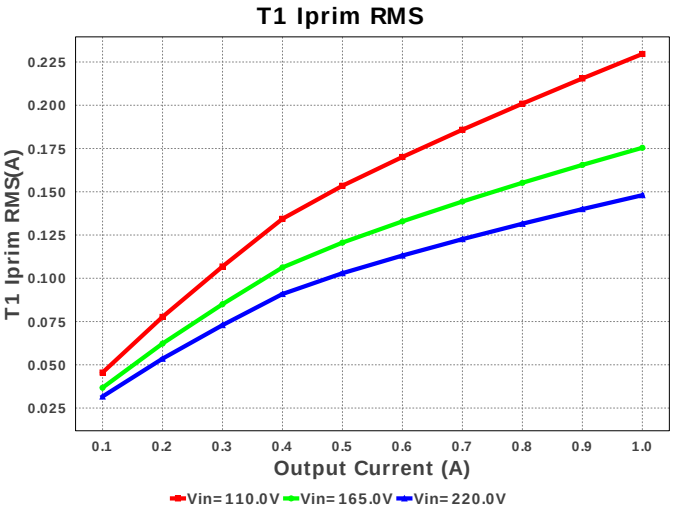


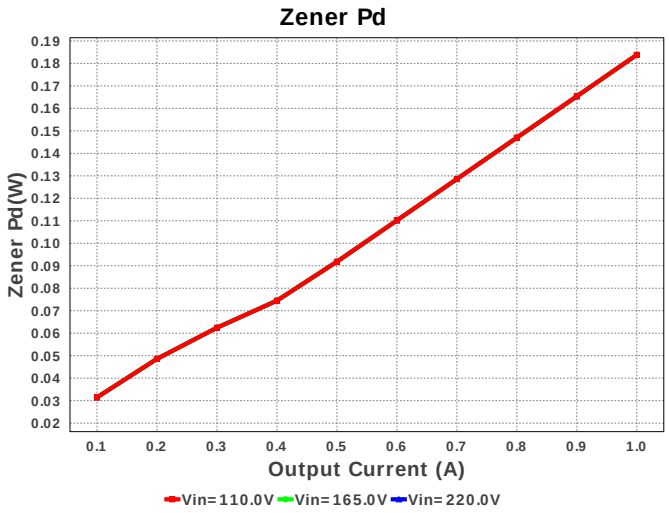


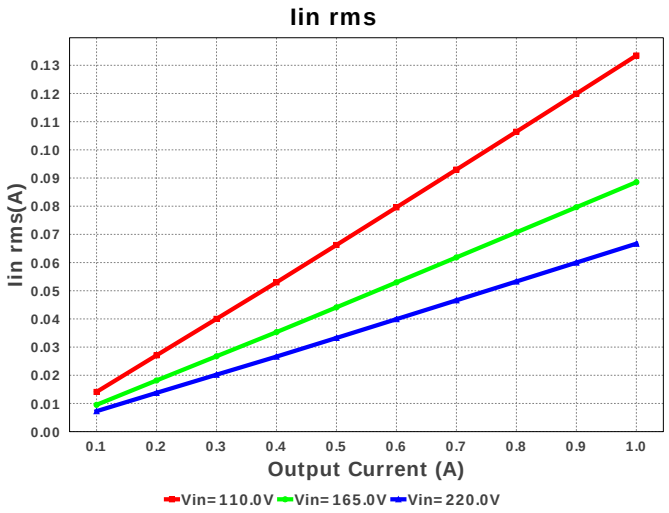


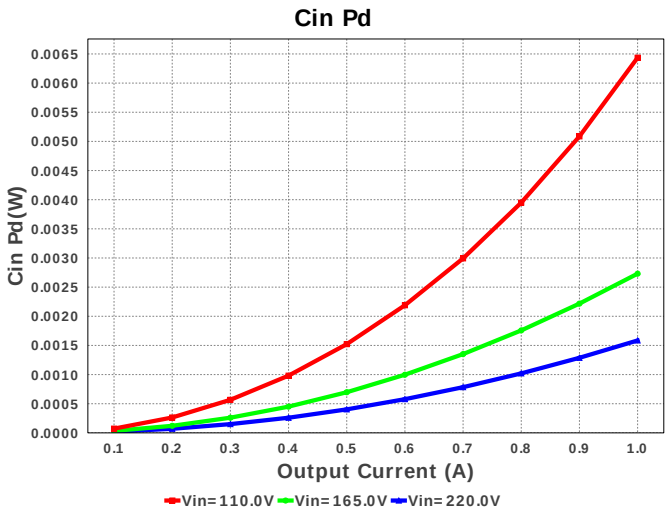


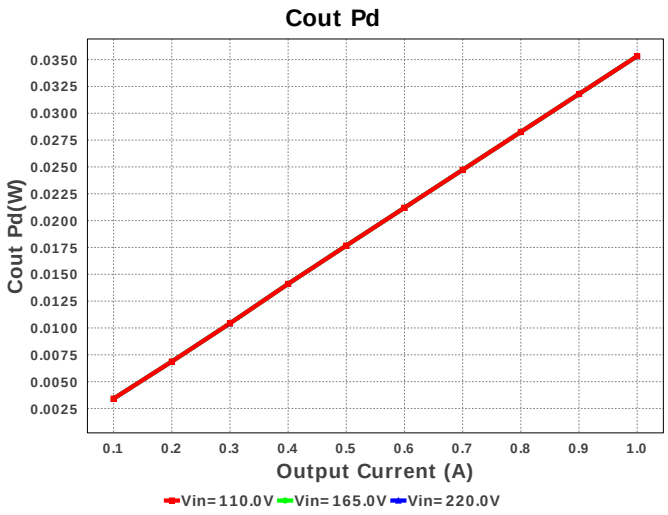


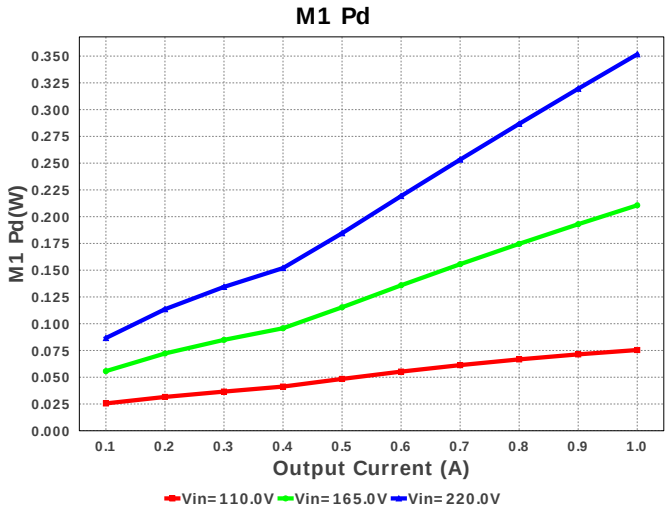


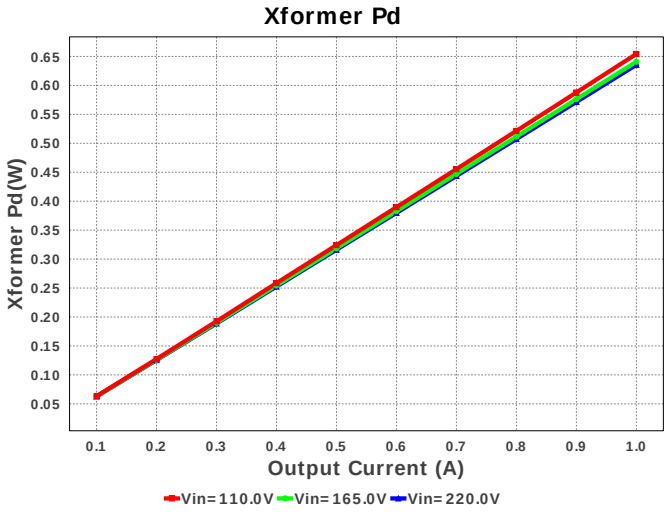


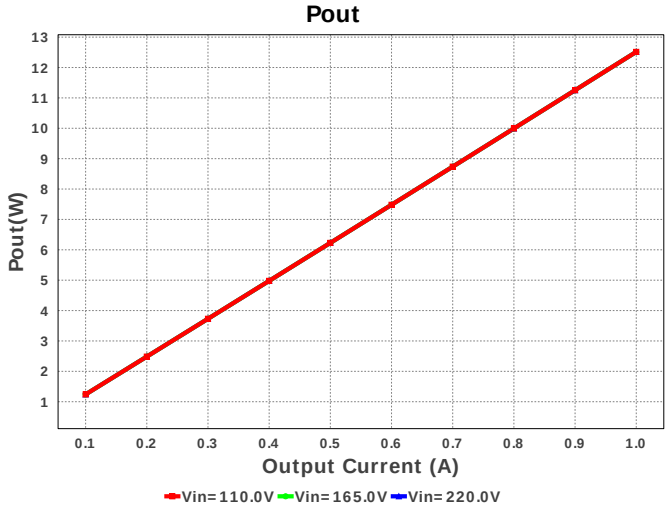


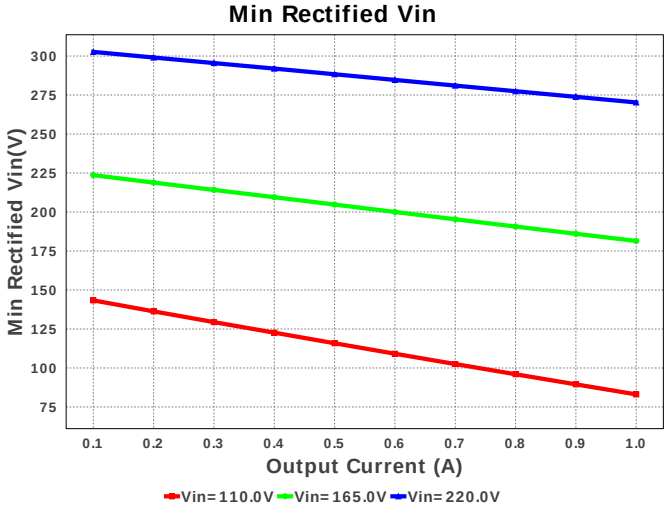


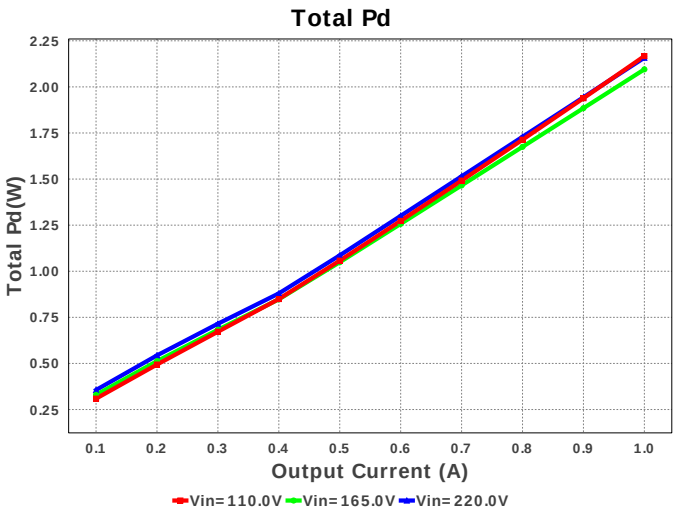


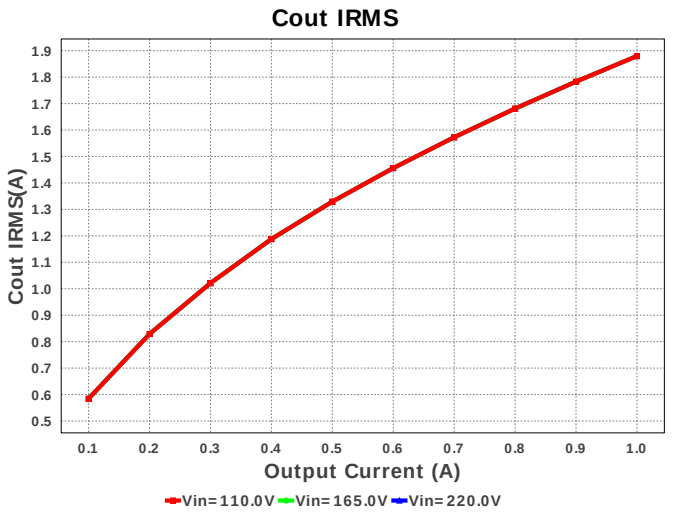


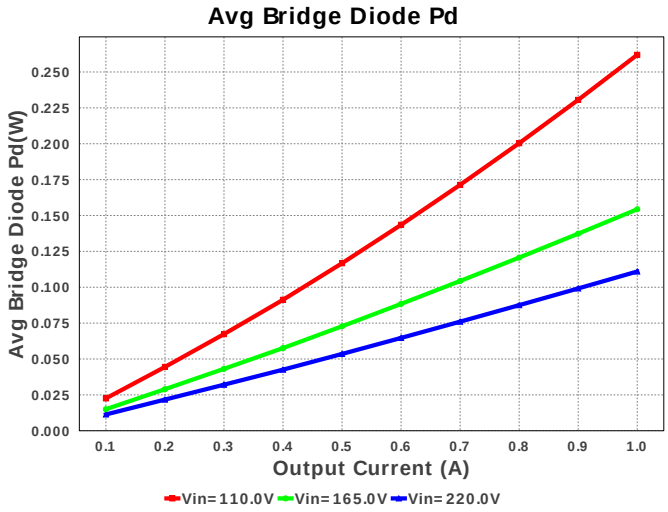


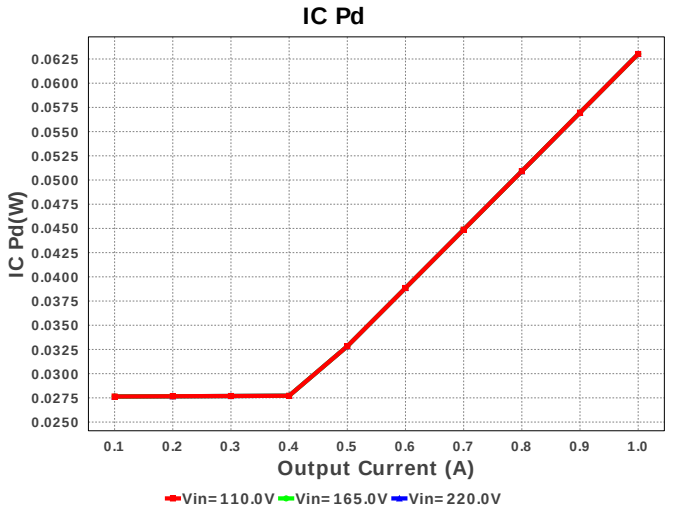


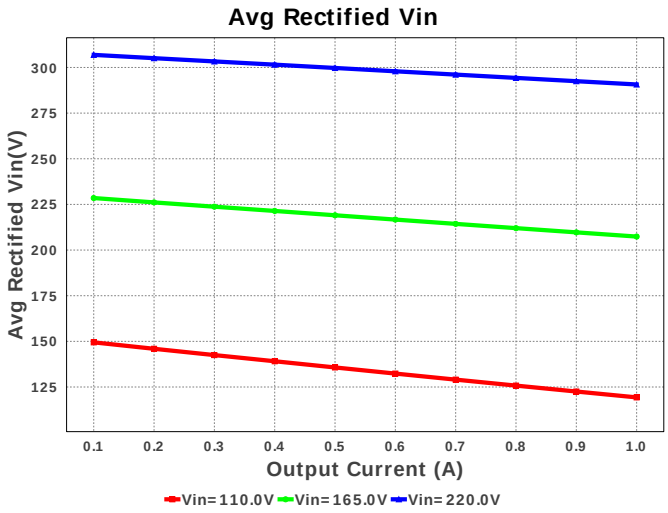


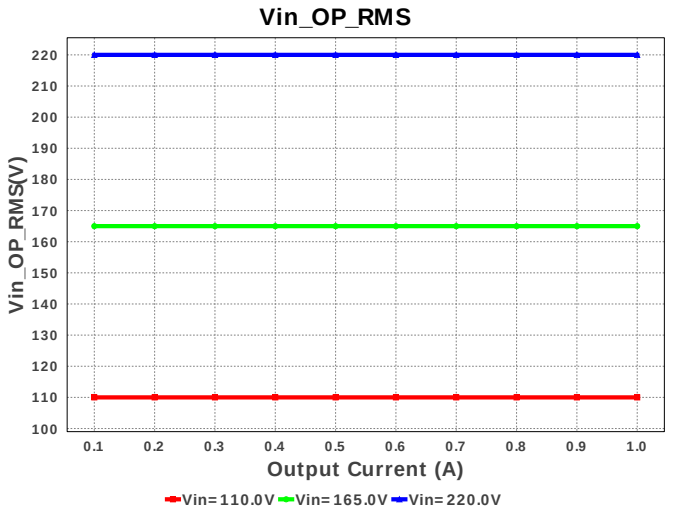


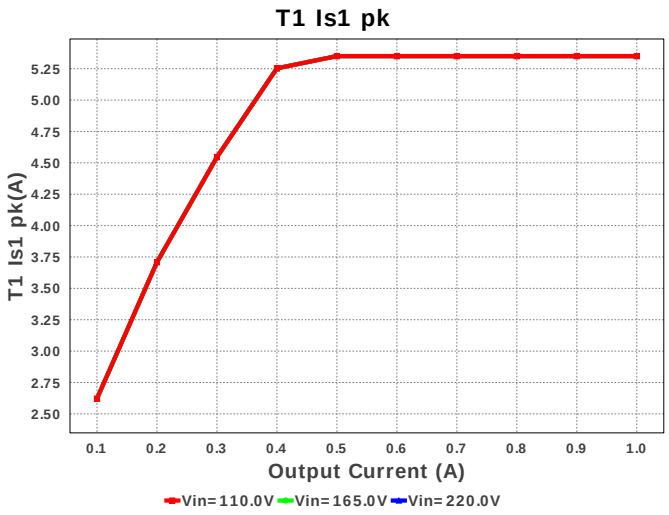


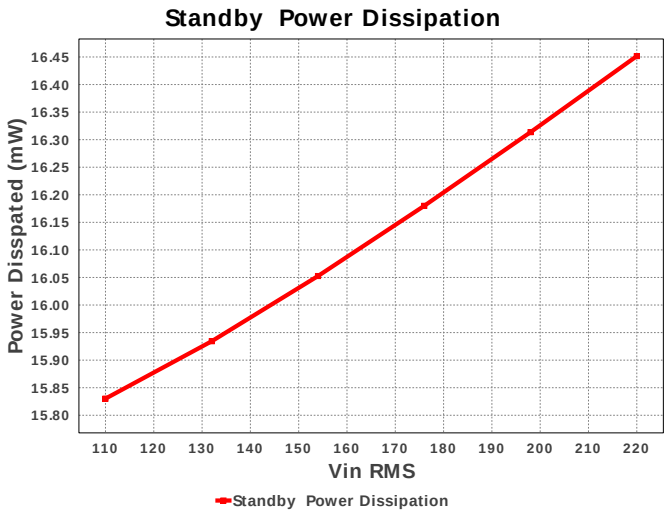


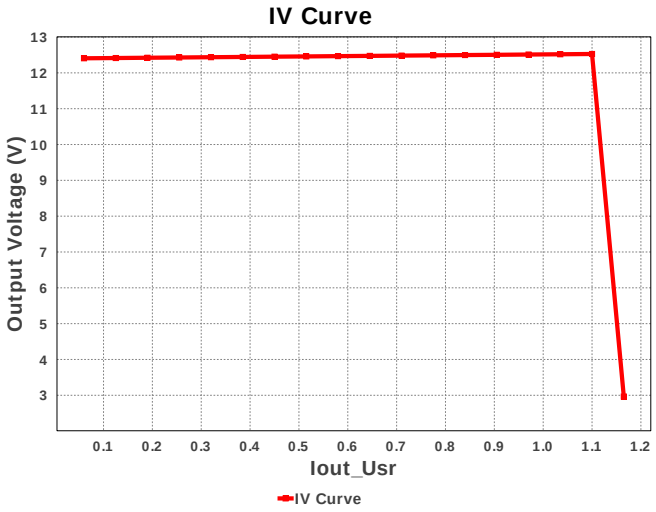












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	57.202 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	194.488 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	1.887 A	Current	Output capacitor RMS ripple current
4.	Iin rms	64.959 mA	Current	RMS Input Current
5.	T1 Iprim RMS	145.435 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	661.017 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	1.896 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	5.391 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	294.988 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	25	General	Total Design BOM count
11.	FootPrint	675.0 mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	12.515 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	34.05 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	12.515 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	14.522 %	Op_point	Duty cycle
18.	Efficiency	87.573 %	Op_point	Steady state efficiency
19.	Frequency_	77.933 kHz	Op_point	Switching frequency
20.	IC Tj	34.329 degC	Op_point	IC junction temperature
21.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	1.0 A	Op_point	Iout operating point
23.	M1 TjOP	52.077 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	278.853 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	53.913 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	70.152 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	1.522 mW	Power	Input capacitor power dissipation
30.	Cout Pd	35.595 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	439.755 mW	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	61.844 mW	Power	IC power dissipation
33.	M1 Pd	353.226 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	1.776 W	Power	Total Power Dissipation
35.	Xformer Pd	634.925 mW	Power	Transformer power dissipation
36.	Zener Pd	49.473 mW	Power	Zener power dissipation
37.	Vout Tolerance	2.785 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	220.0	Maximum input voltage
3.	VinMin	110.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	acFrequency	60.0	Light Output in Lumen
6.	base_pn	UCC28710	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	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 UCC28710 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/ucc28710.pdf

2. UCC28710 Product Folder : http://www.ti.com/product/UCC28710 : contains the data sheet and other resources.