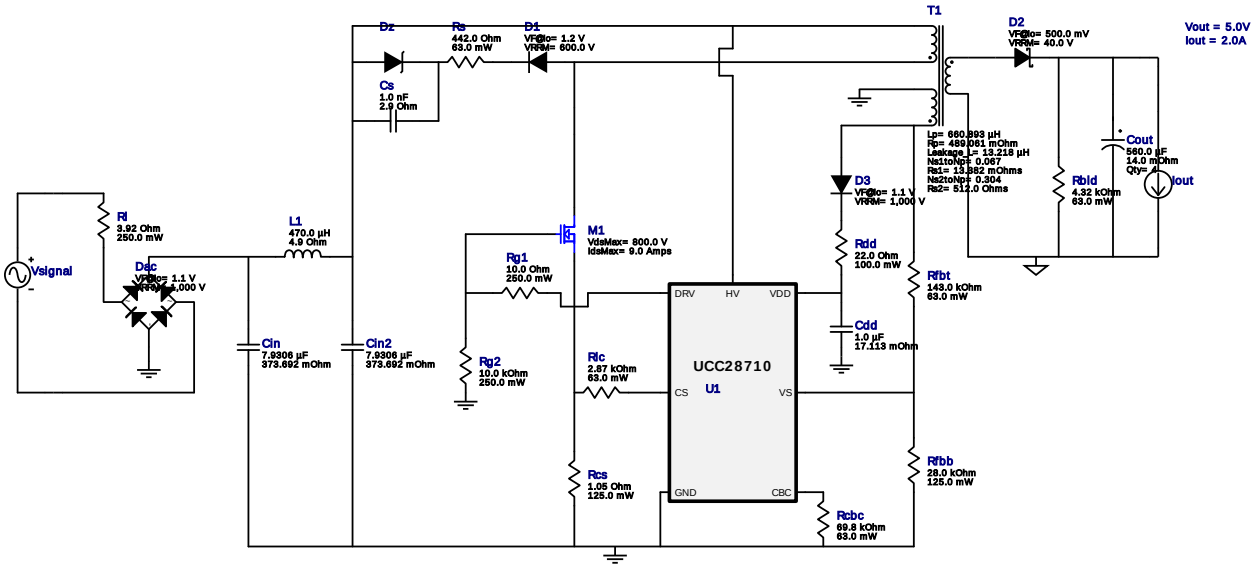
WEBENCH® Design Report

VinMin = 90.0V
VinMax = 220.0V
Vout = 5.0V
Iout = 2.0A

Device = UCC28710DR
Topology = Flyback
Created = 7/12/16 11:10:23 PM
BOM Cost = $0.00
BOM Count = 28
Total Pd = 2.14W

Design : 3893481/9 UCC28710DR
UCC28710DR 90.0V-220.0V to 5.53V @ 2.0A

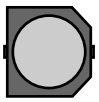


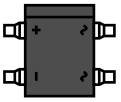
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

My Comments

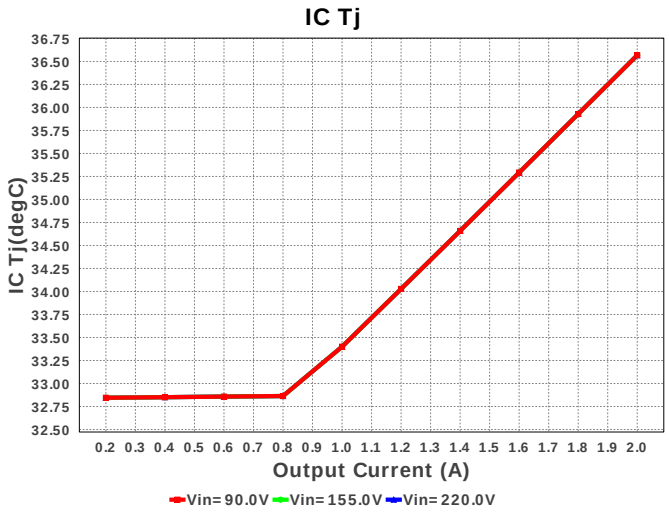
11

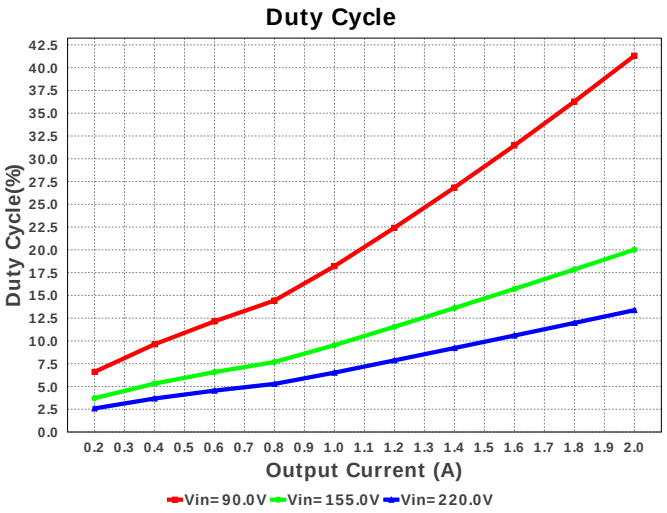
Electrical BOM

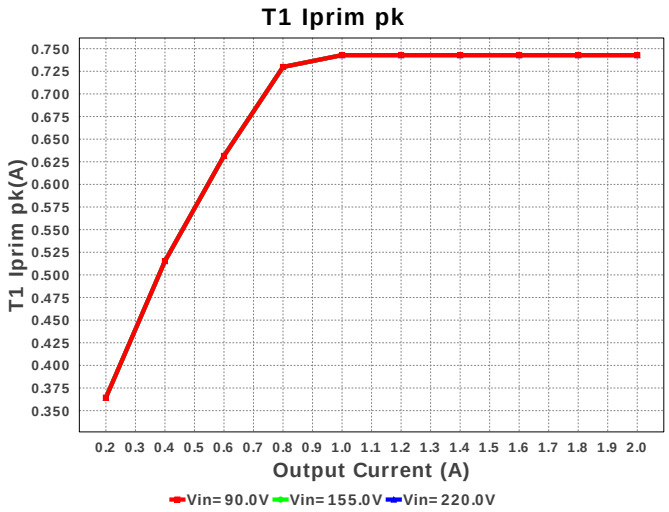
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	0603 5 mm²
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 7.9306 uF ESR= 373.69 mOhm VDC= 466.69 V IRMS= 504.79 mA	1	NA	CUSTOM 0 mm²
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 7.9306 uF ESR= 373.69 mOhm VDC= 466.69 V IRMS= 504.79 mA	1	NA	CUSTOM 0 mm²
4.	Cout	Panasonic	16SVPF560M Series= ?	Cap= 560.0 uF ESR= 14.0 mOhm VDC= 16.0 V IRMS= 4.95 A	4	$0.61	 CAPSMT_62_E12 106 mm²
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 mm²
6.	D1	Bourns	CD214B-F3600	VF@Io= 1.2 V VRRM= 600.0 V	1	$0.14	 SMB 44 mm²
7.	D2	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.11	 SMA 37 mm²

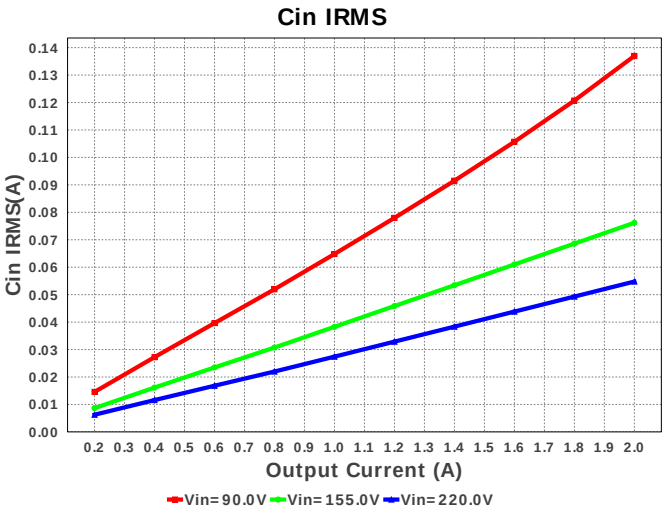
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	D3	Fairchild Semiconductor	1N4007	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.03	 DO-41 43 mm²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
10.	Dz	ON Semiconductor	MMBZ5270BLT1G	Zener	1	$0.03	 SOT-23 14 mm²
11.	L1	Bourns	SDR0503-471KL	L= 470.0 µH DCR= 4.9 Ohm	1	$0.19	 SDR0503 48 mm²
12.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm²
13.	Rbld	Vishay-Dale	CRCW04024K32FKED Series= CRCW..e3	Res= 4.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
14.	Rcbc	Vishay-Dale	CRCW040269K8FKED Series= CRCW..e3	Res= 69.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
15.	Rcs	Yageo America	RC0805FR-071R05L Series= ?	Res= 1.05 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
16.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
17.	Rfbb	Panasonic	ERJ-6ENF2802V Series= ERJ-6E	Res= 28.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
18.	Rfbt	Vishay-Dale	CRCW0402143KFKED Series= CRCW..e3	Res= 143.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
19.	Rg1	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
20.	Rg2	Panasonic	ERJ-8ENF1002V Series= ERJ-8E	Res= 10.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
21.	Rl	Vishay-Dale	CRCW12063R92FKEA Series= CRCW..e3	Res= 3.92 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
22.	Rlc	Vishay-Dale	CRCW04022K87FKED Series= CRCW..e3	Res= 2.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
23.	Rs	Vishay-Dale	CRCW0402442RFKED Series= CRCW..e3	Res= 442.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	T1	CUSTOM	CUSTOM	Lp= 660.893 µH Rp= 489.061 mOhm Leakage_L= 13.218 µH Ns1toNp= 0.067 Rs1= 13.382 mOhms Ns2toNp= 0.304 Rs2= 512.0 Ohms	1	NA	CUSTOM 0 mm²

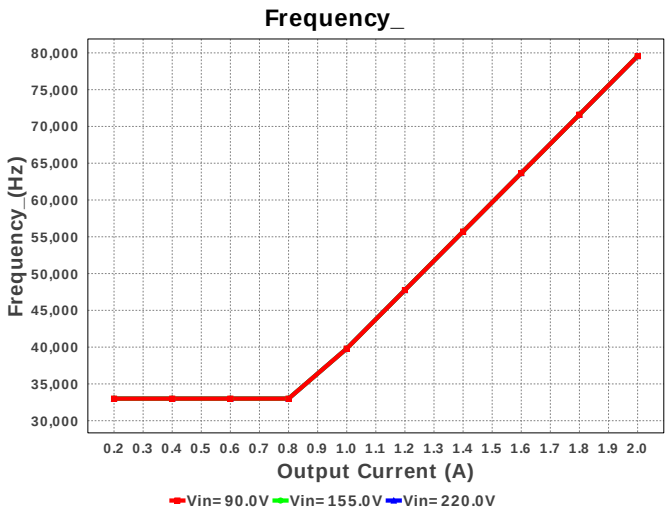
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	U1	Texas Instruments	UCC28710DR	Switcher	1	$0.42	SOIC-7 0 mm²

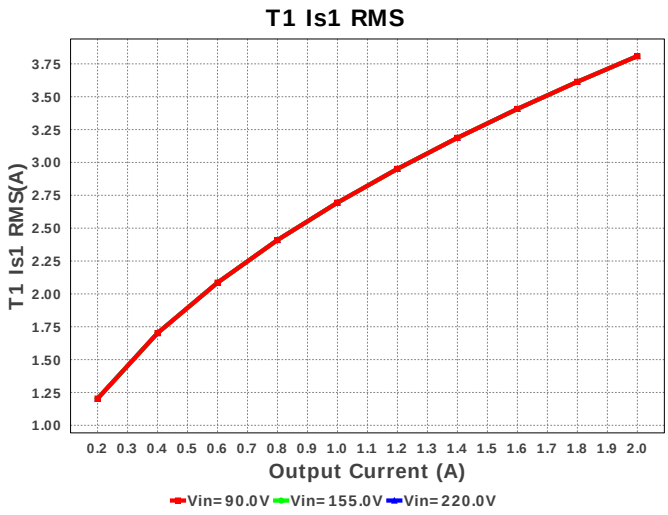


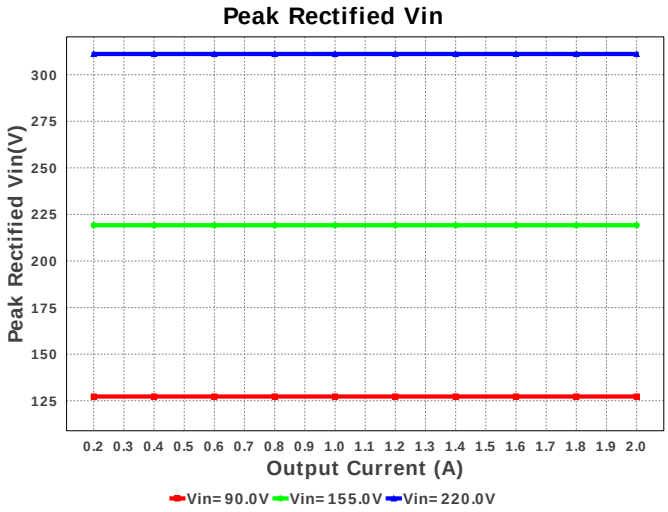


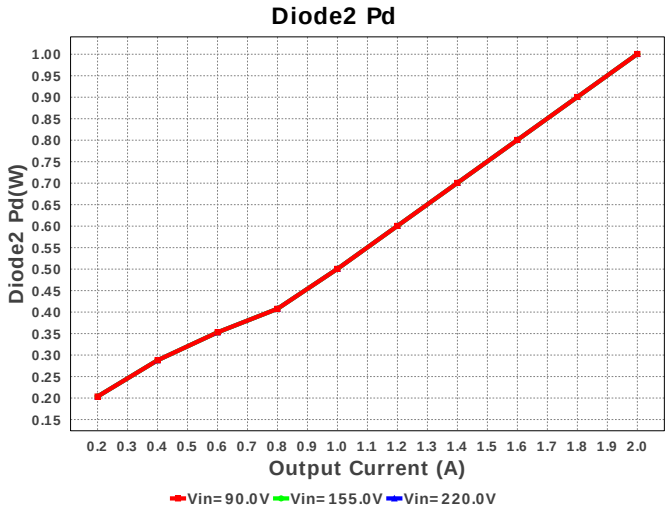


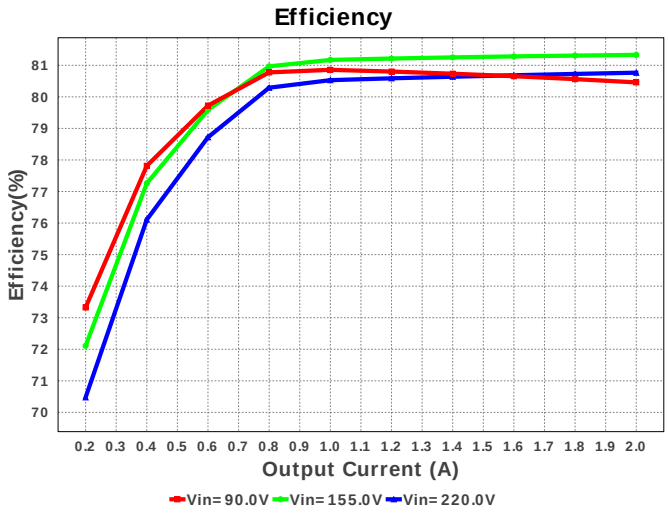


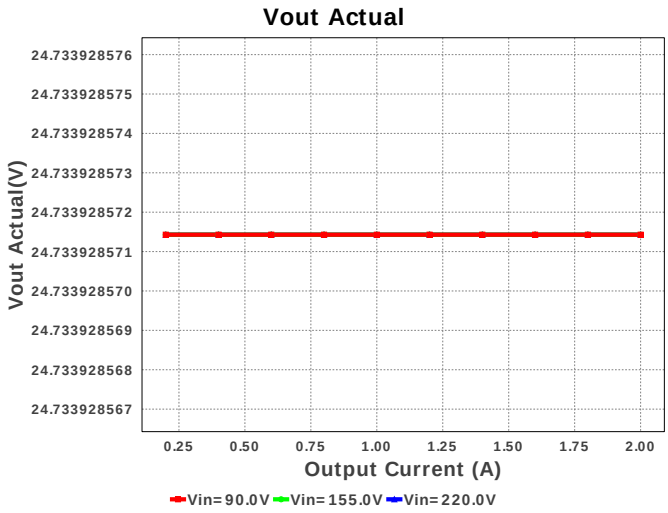


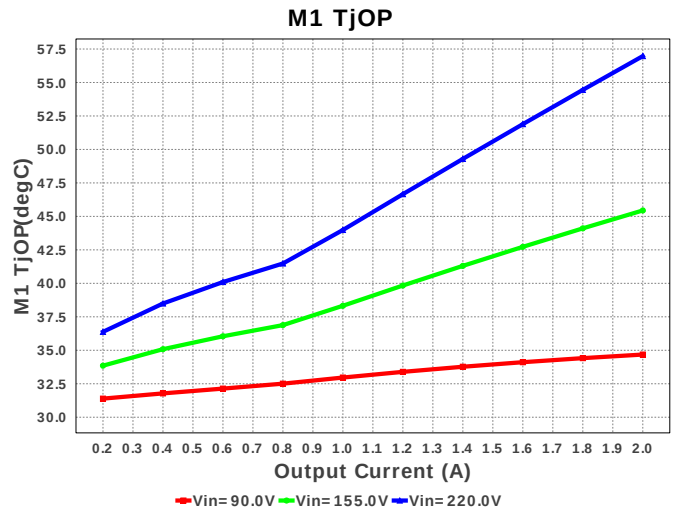


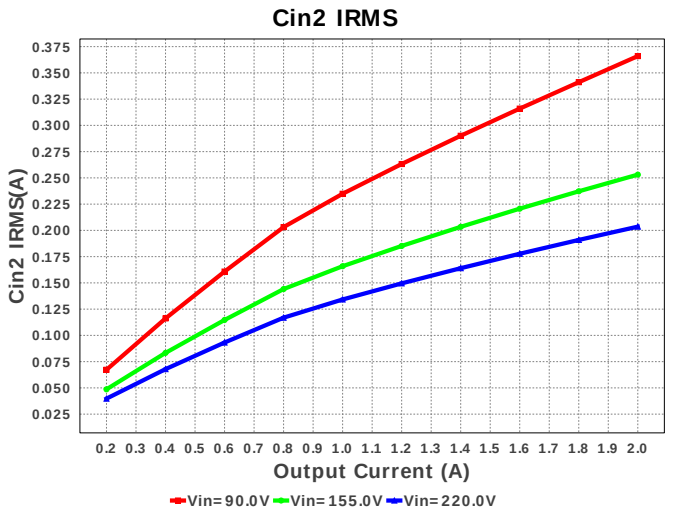


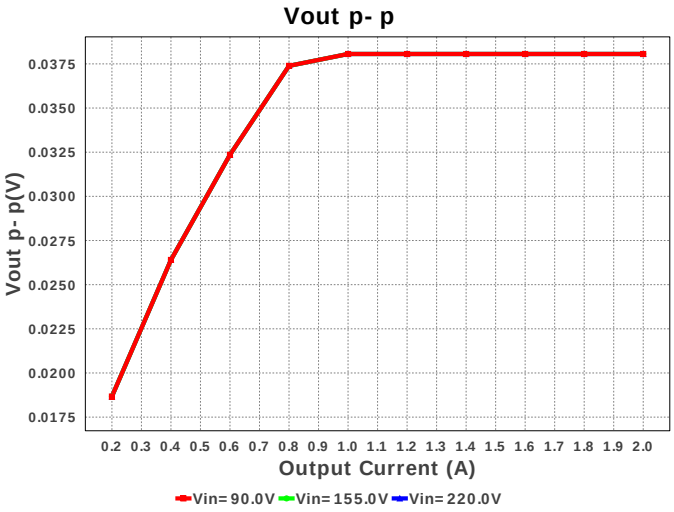


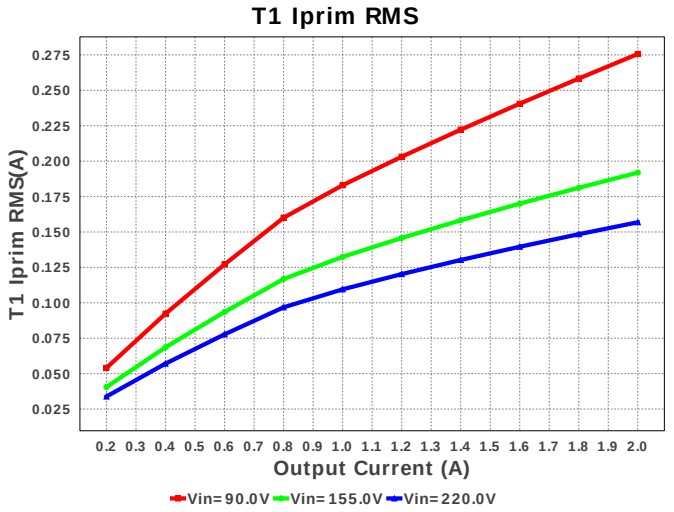


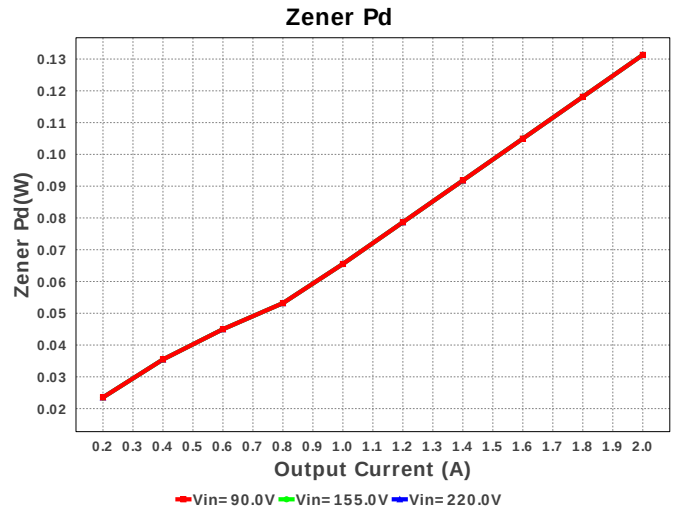


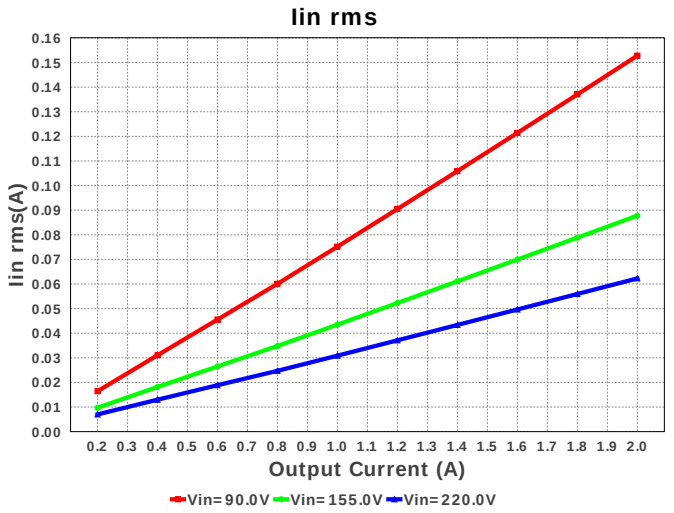


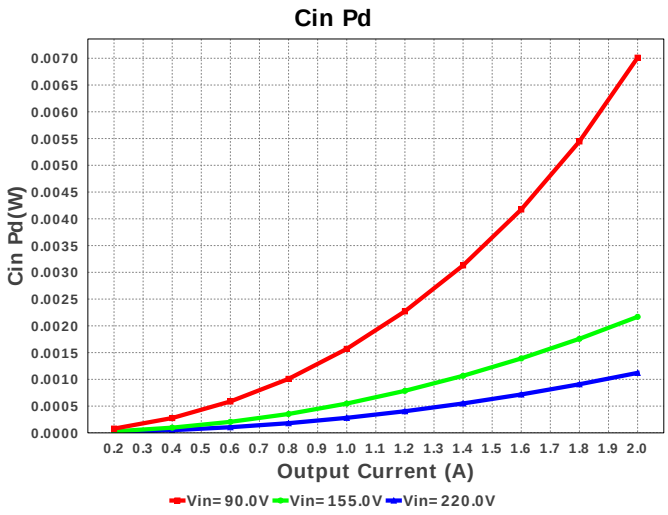


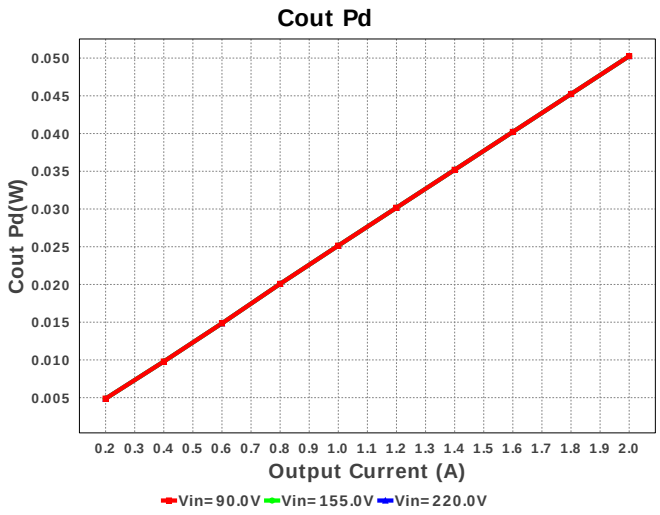


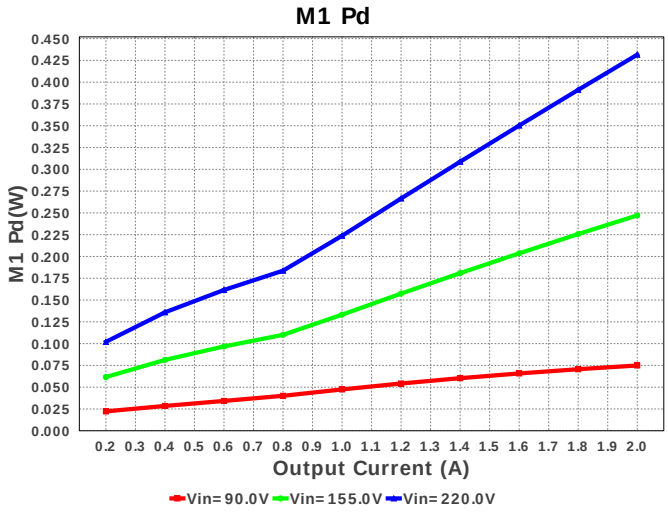


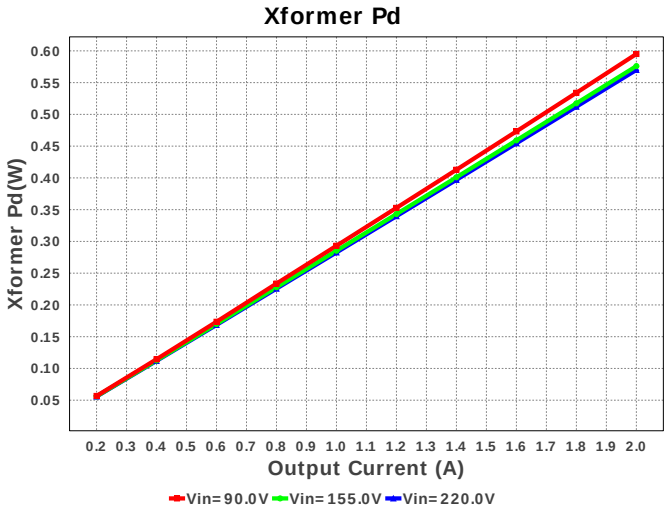


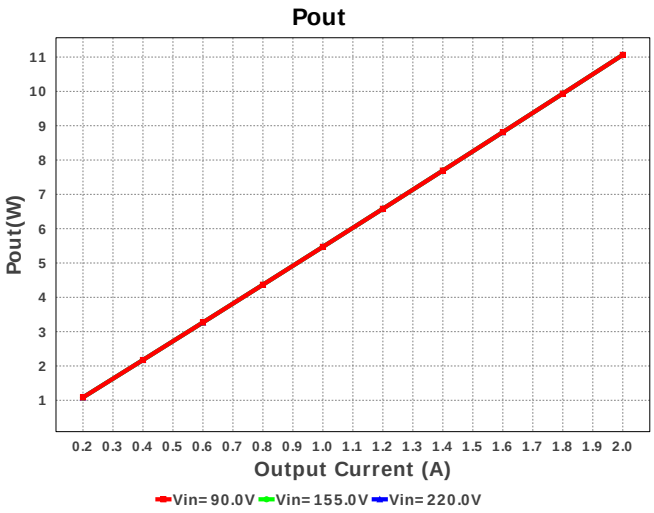


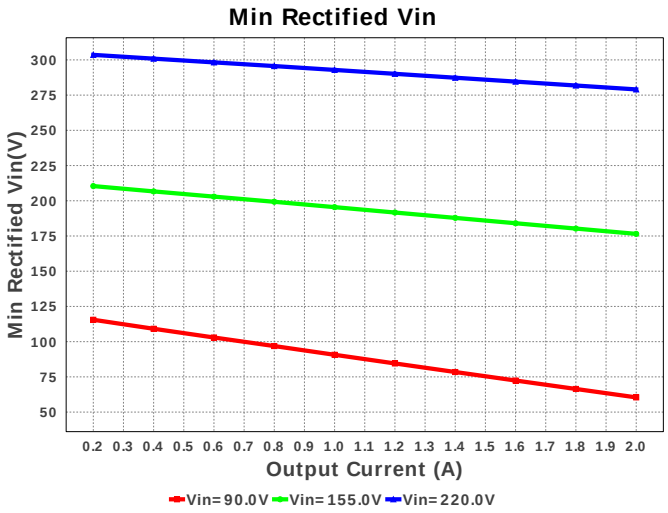


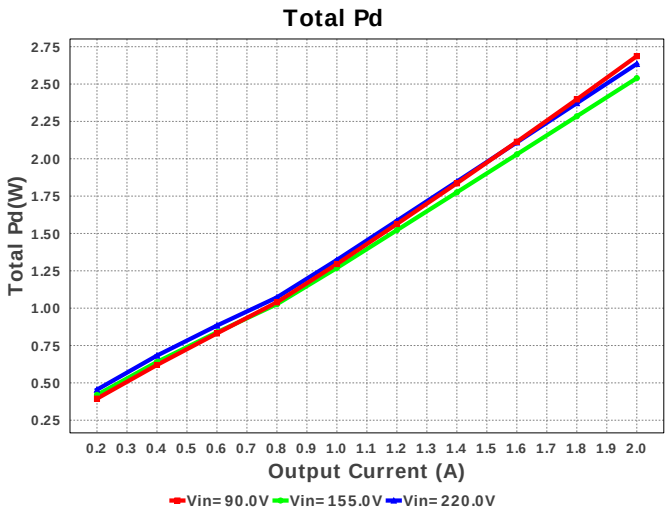


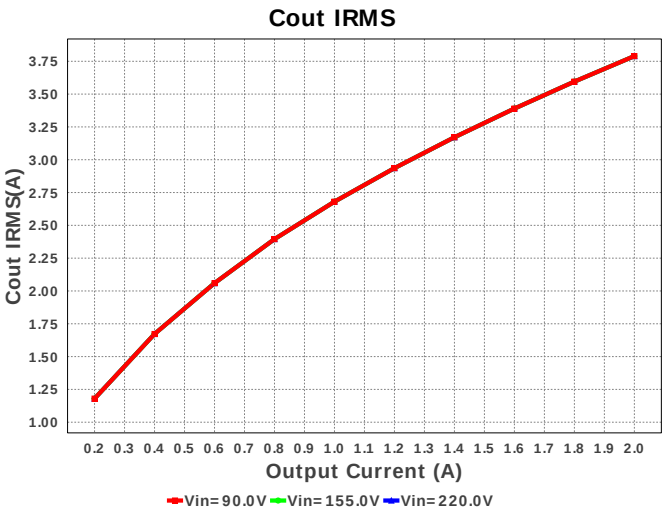


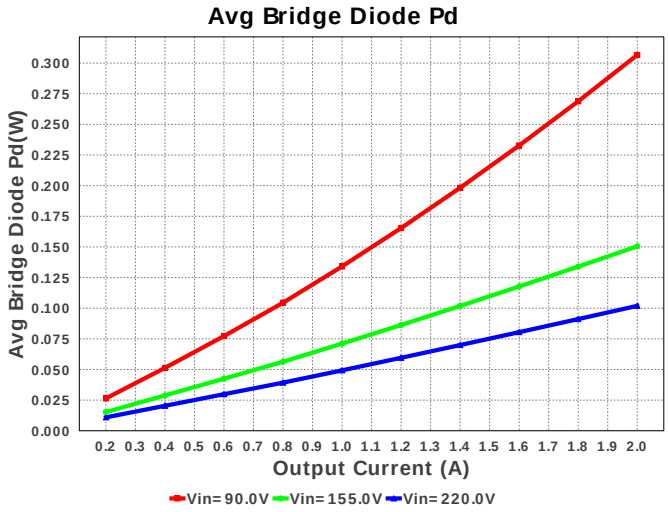


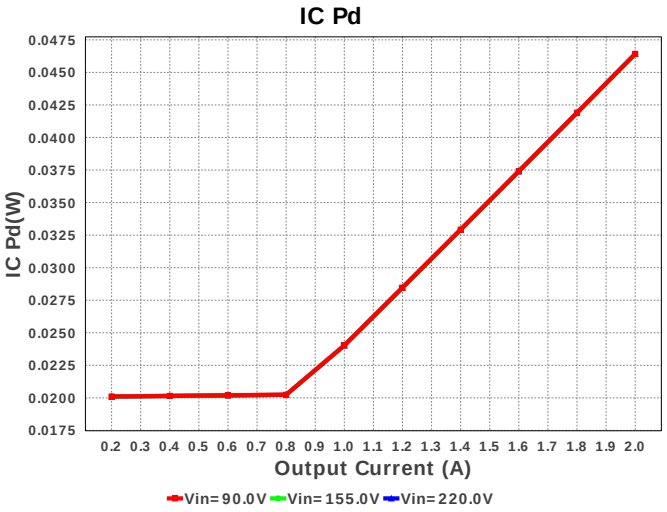


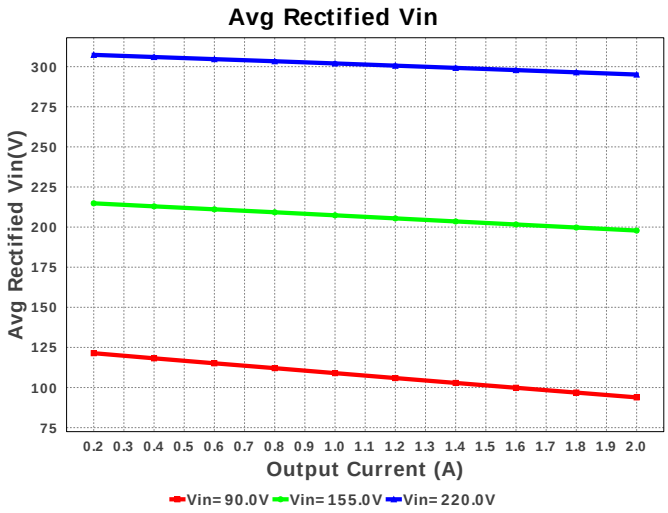


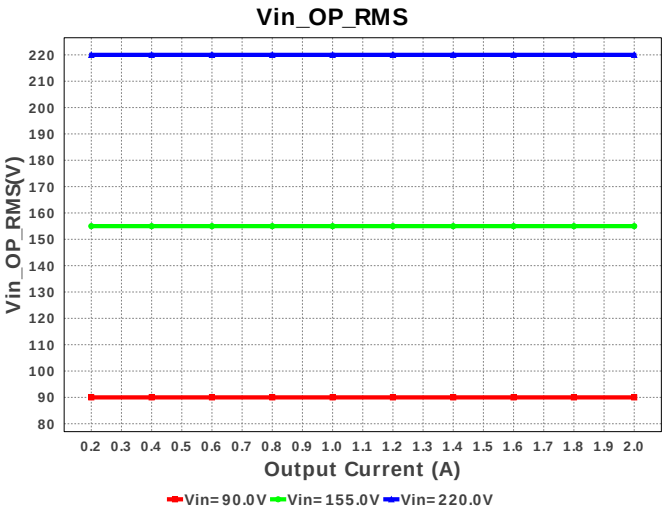


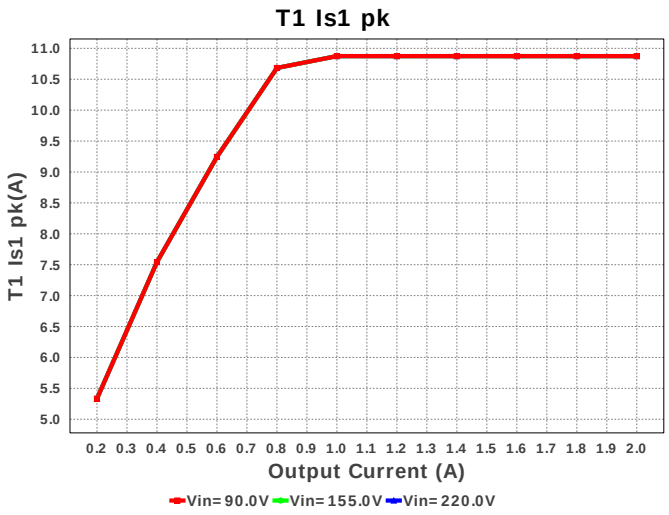


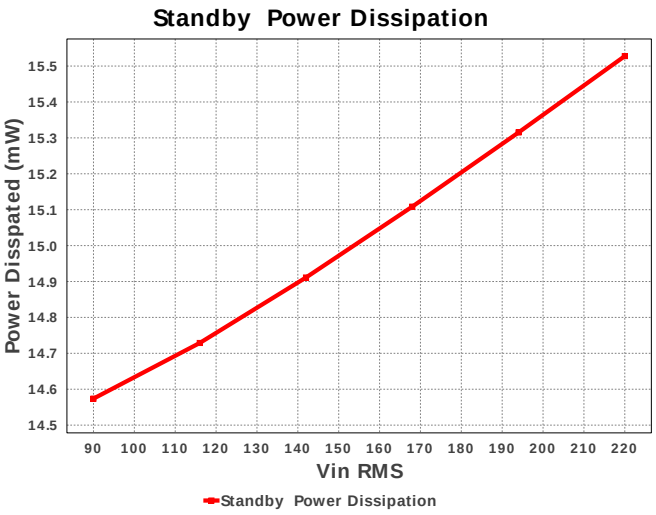


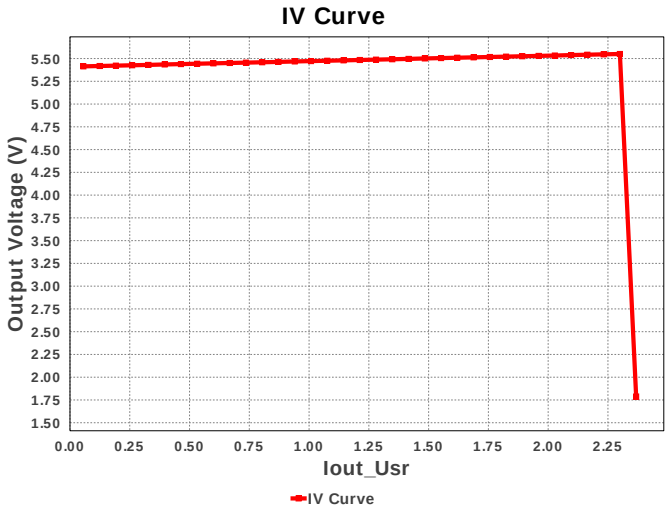












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	53.068 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	198.936 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.806 A	Current	Output capacitor RMS ripple current
4.	Iin rms	60.008 mA	Current	RMS Input Current
5.	T1 Iprim RMS	153.415 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	742.857 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.825 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	10.966 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	298.527 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	28	General	Total Design BOM count
11.	FootPrint	962.0 mm^2	General	Total Foot Print Area of BOM components
12.	Pout	11.06 W	General	Total output power
13.	Total BOM	$0.0	General	Total BOM Cost
14.	Vout Actual	24.734 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	5.53 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	12.795 %	Op_point	Duty cycle
17.	Efficiency	83.776 %	Op_point	Steady state efficiency
18.	Frequency_	77.079 kHz	Op_point	Switching frequency
19.	IC Tj	33.151 degC	Op_point	IC junction temperature
20.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	2.0 A	Op_point	Iout operating point
22.	M1 TjOP	56.712 degC	Op_point	M1 MOSFET junction temperature
23.	Min Rectified Vin	285.93 V	Op_point	Minimum voltage seen at rectified input
24.	Peak Rectified Vin	311.124 V	Op_point	Peak voltage seen at rectified input
25.	Vin_OP_RMS	220.0 V	Op_point	AC Input RMS Voltage
26.	Vout p-p	38.382 mV	Op_point	Peak-to-peak output ripple voltage
27.	Avg Bridge Diode Pd	64.055 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
28.	Cin Pd	1.052 mW	Power	Input capacitor power dissipation
29.	Cout Pd	50.687 mW	Power	Output capacitor power dissipation
30.	Diode2 Pd	822.066 mW	Power	Diode2 power dissipation
31.	IC Pd	45.017 mW	Power	IC power dissipation

#	Name	Value	Category	Description
32.	M1 Pd	427.396 mW	Power	M1 MOSFET total power dissipation
33.	Total Pd	2.142 W	Power	Total Power Dissipation
34.	Xformer Pd	565.526 mW	Power	Transformer power dissipation
35.	Zener Pd	34.841 mW	Power	Zener power dissipation
36.	Vout Tolerance	2.694 %		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	220.0	Maximum input voltage
3.	VinMin	90.0	Minimum input voltage
4.	Vout	5.0	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.