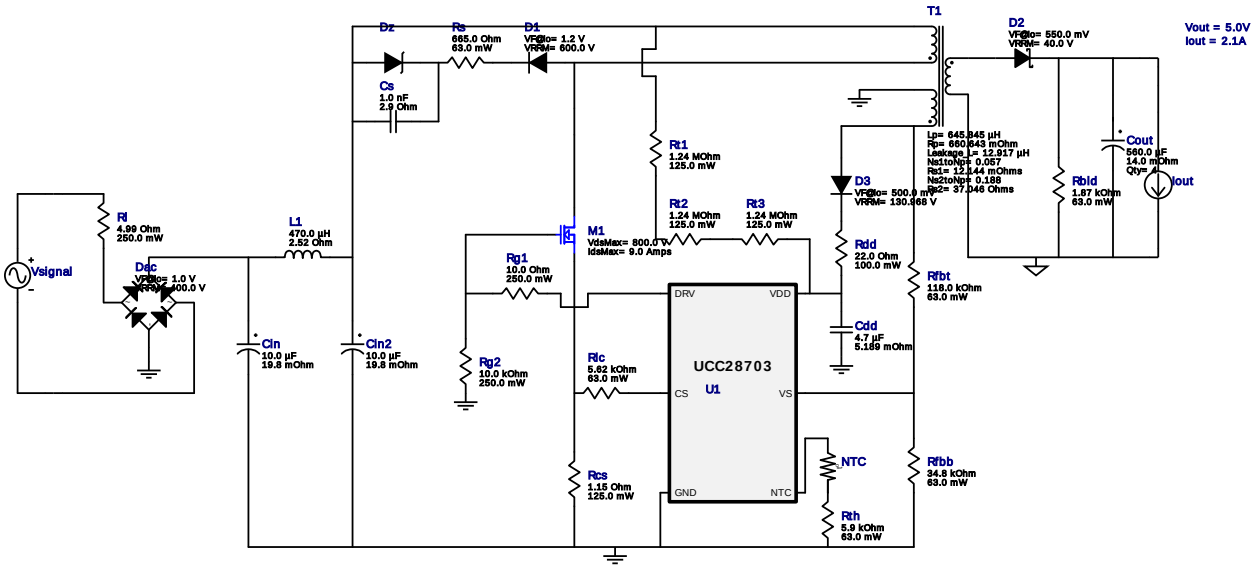
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 130.0V
Vout = 5.0V
Iout = 2.1A

Device = UCC28703DBVR
Topology = Flyback
Created = 9/27/16 6:41:25 AM
BOM Cost = $0.00
BOM Count = 32
Total Pd = 2.11W

Design : 4652143/3 UCC28703DBVR
UCC28703DBVR 110.0V-130.0V to 5.00V @ 2.1A



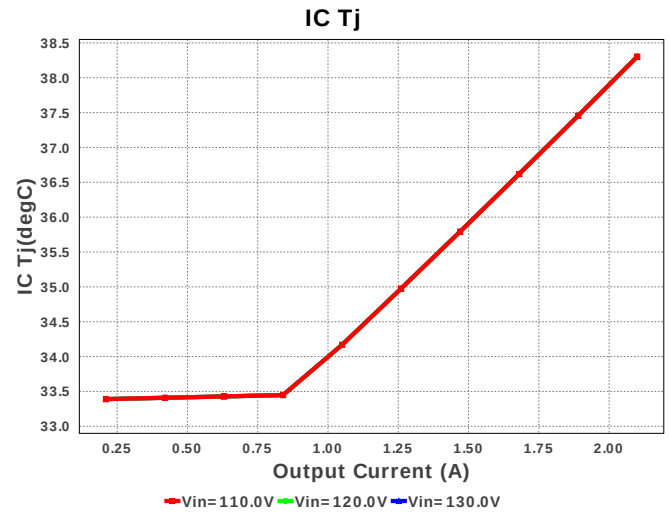
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

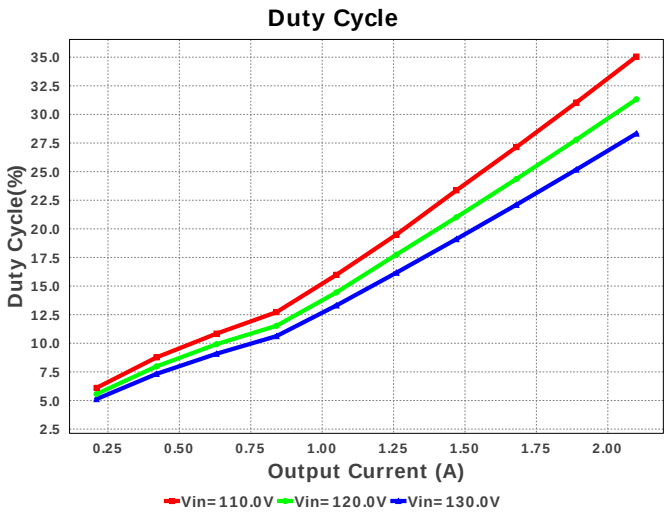
Electrical BOM

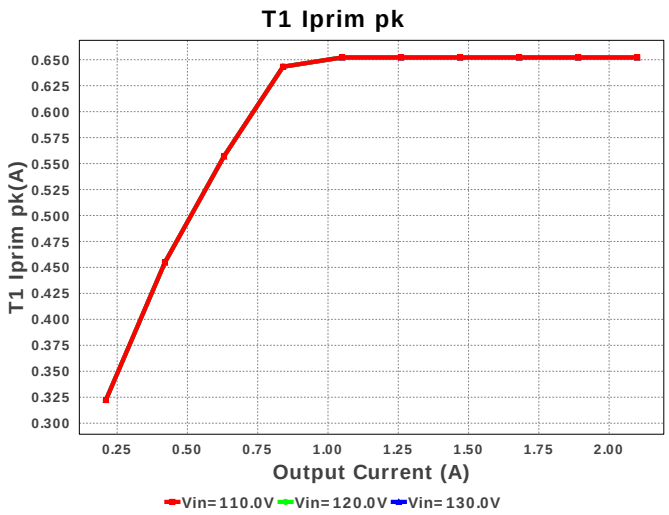
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	0805 7 mm²
2.	Cin	Rubycon	200RX3010M8X16 Series= ?	Cap= 10.0 uF ESR= 19.8 mOhm VDC= 200.0 V IRMS= 200.0 mA	1	$0.18	RX30_800x1600 100 mm²
3.	Cin2	Rubycon	200RX3010M8X16 Series= ?	Cap= 10.0 uF ESR= 19.8 mOhm VDC= 200.0 V IRMS= 200.0 mA	1	$0.18	RX30_800x1600 100 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

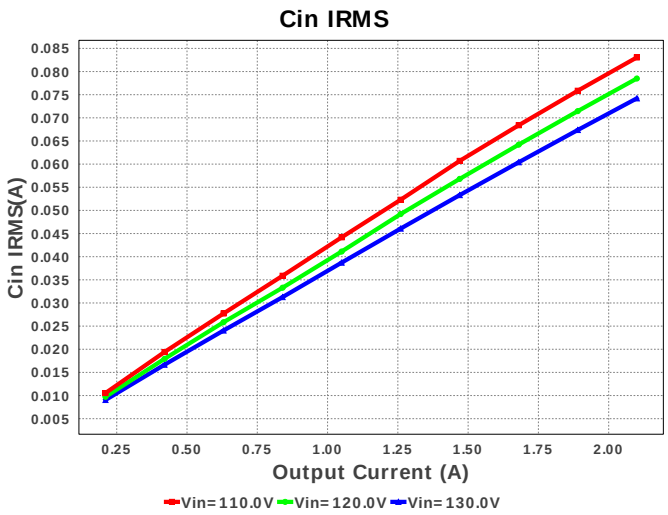
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	D2	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.17	 SMC 83 mm²
8.	D3	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 130.968 V	1	NA	CUSTOM 0 mm²
9.	Dac	Diodes Inc.	HD04-T	VF@Io= 1.0 V VRRM= 400.0 V	1	$0.12	 MiniDIP 62 mm²
10.	Dz	ON Semiconductor	1SMB5949BT3G	Zener	1	$0.10	 SMB 44 mm²
11.	L1	Coilcraft	LPS5030-474MRB	L= 470.0 µH DCR= 2.52 Ohm	1	$0.44	 LPS5030 34 mm²
12.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm²
13.	Rbld	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
14.	Rcs	Vishay-Dale	CRCW08051R15FKEA Series= CRCW..e3	Res= 1.15 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	Vishay-Dale	CRCW040234K8FKED Series= CRCW..e3	Res= 34.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
17.	Rfbt	Vishay-Dale	CRCW0402118KFKED Series= CRCW..e3	Res= 118.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 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	CRCW12064R99FKEA Series= CRCW..e3	Res= 4.99 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
21.	Rlc	Vishay-Dale	CRCW04025K62FKED Series= CRCW..e3	Res= 5.62 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
22.	Rs	Vishay-Dale	CRCW0402665RFKED Series= CRCW..e3	Res= 665.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
23.	Rt1	Vishay-Dale	CRCW08051M24FKEA Series= CRCW..e3	Res= 1.24 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
24.	Rt2	Vishay-Dale	CRCW08051M24FKEA Series= CRCW..e3	Res= 1.24 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
25.	Rt3	Vishay-Dale	CRCW08051M24FKEA Series= CRCW..e3	Res= 1.24 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
26.	Rth	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

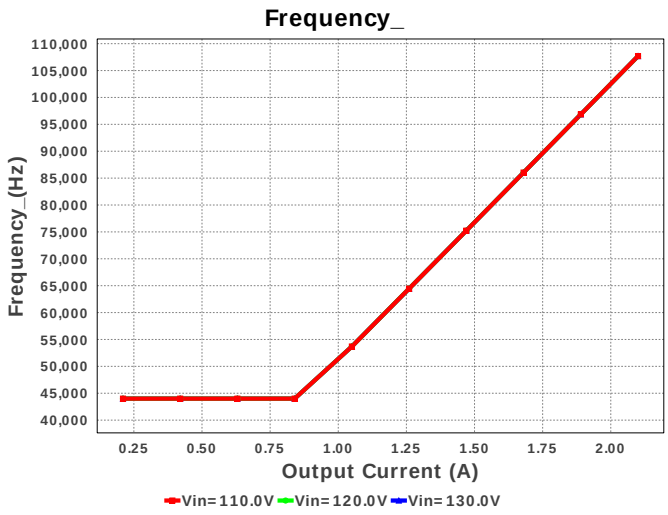
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	T1	CUSTOM	CUSTOM	Lp= 645.845 µH Rp= 660.643 mOhm Leakage_L= 12.917 µH Ns1toNp= 0.057 Rs1= 12.144 mOhms Ns2toNp= 0.188 Rs2= 37.046 Ohms	1	NA	CUSTOM 0 mm^2
28.	U1	Texas Instruments	UCC28703DBVR	Switcher	1	$0.35	SOT-23-6 15 mm^2

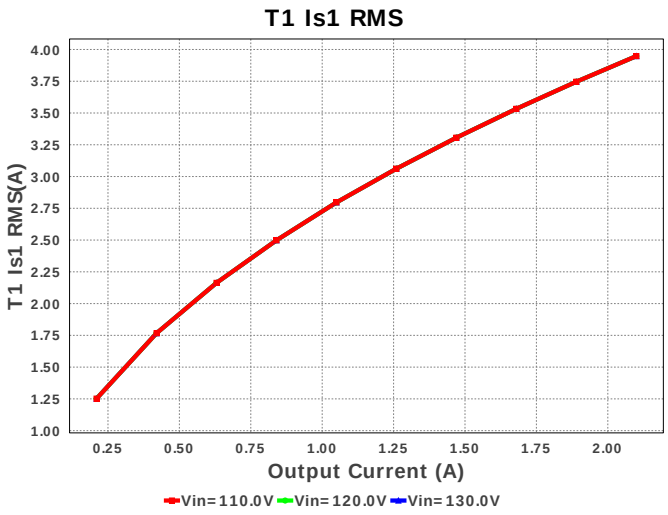


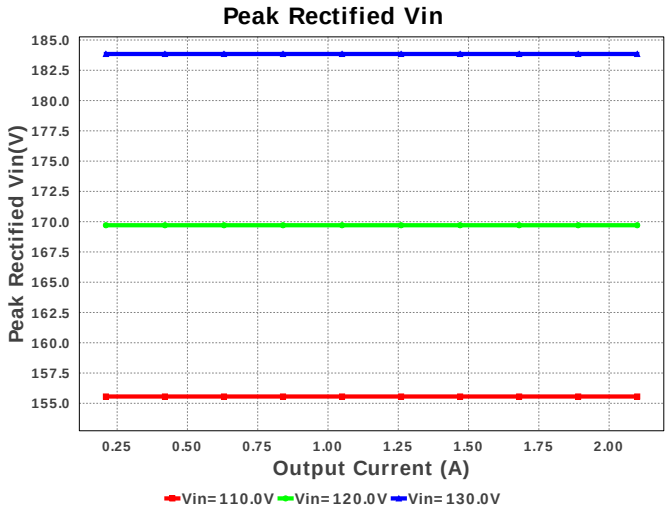


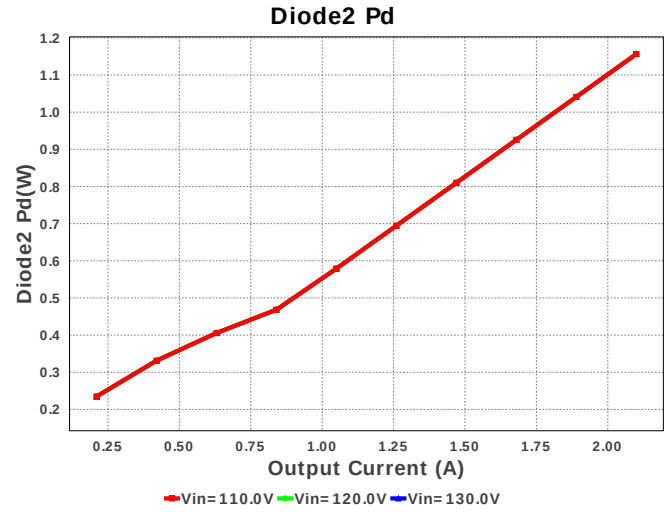


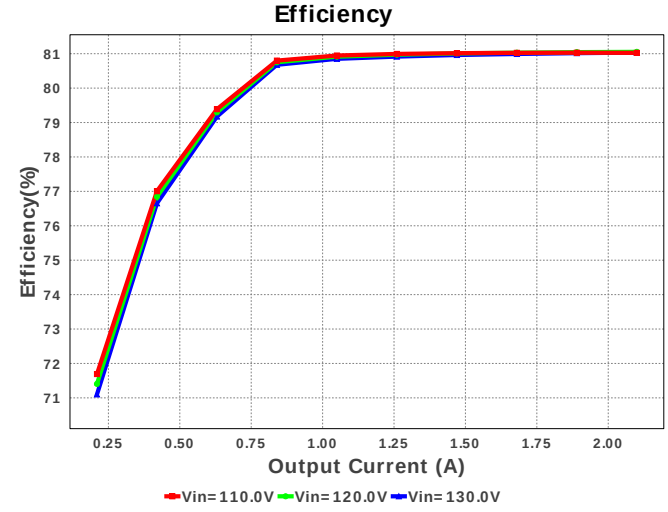


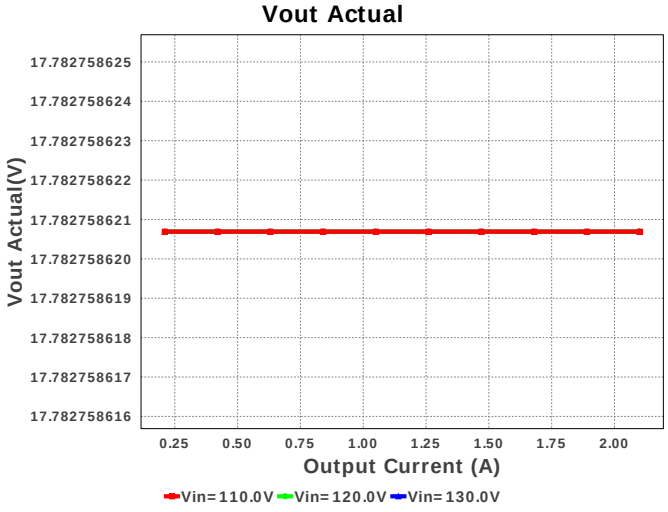


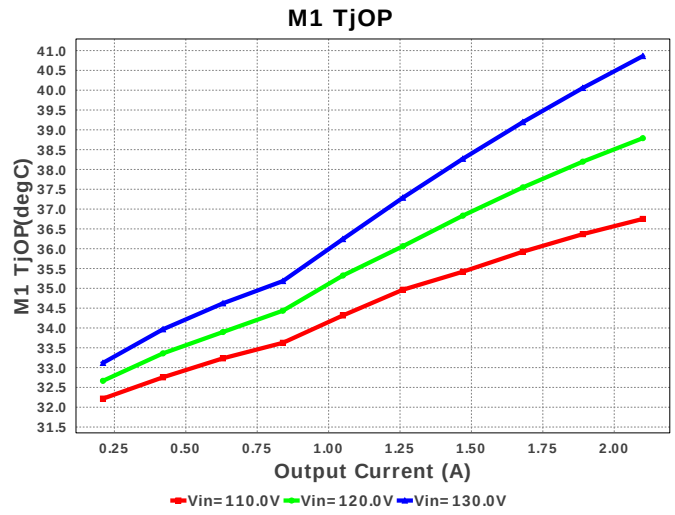


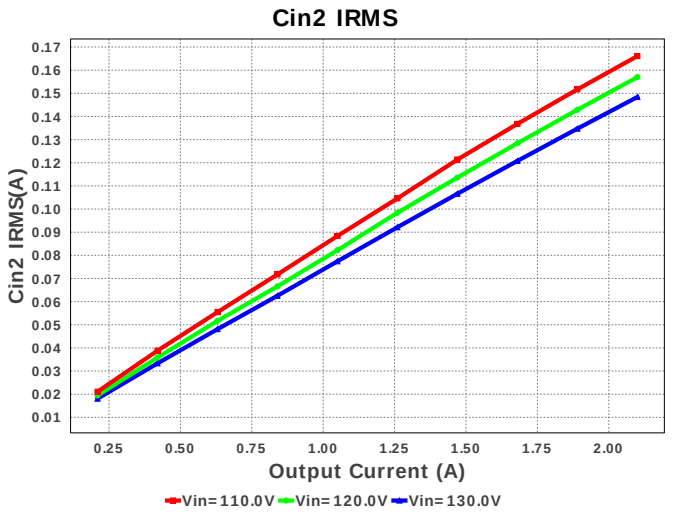


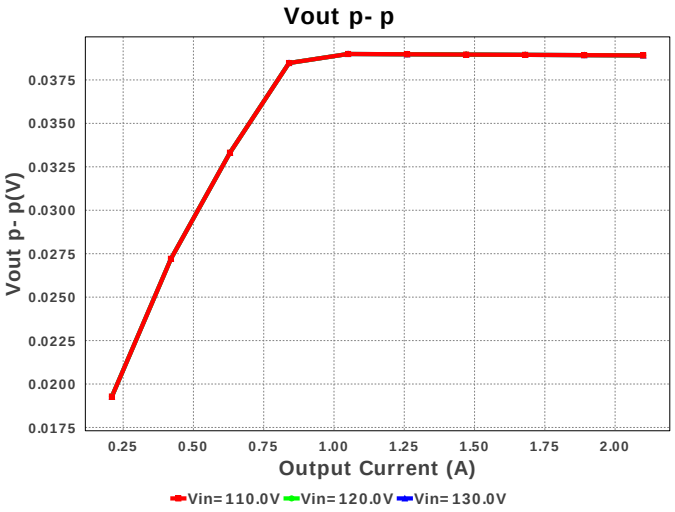


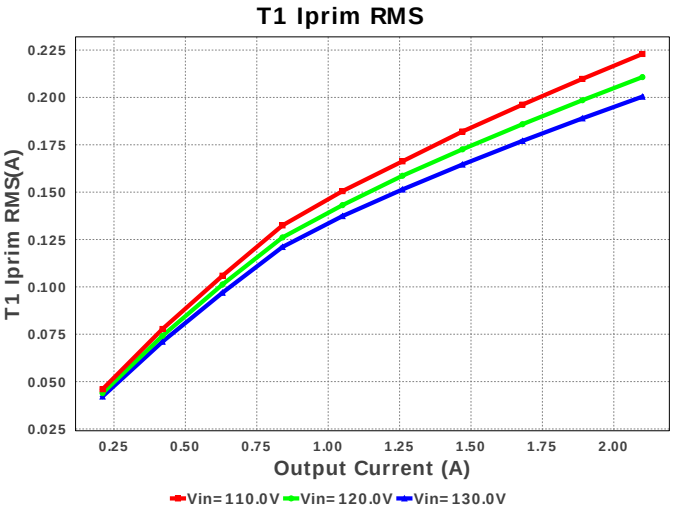


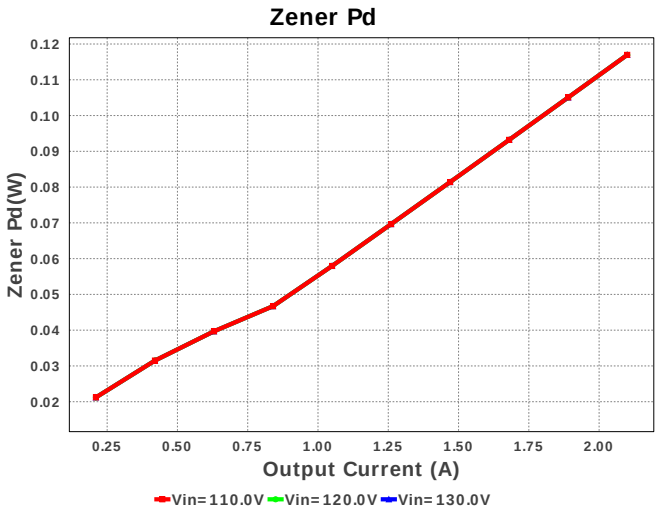


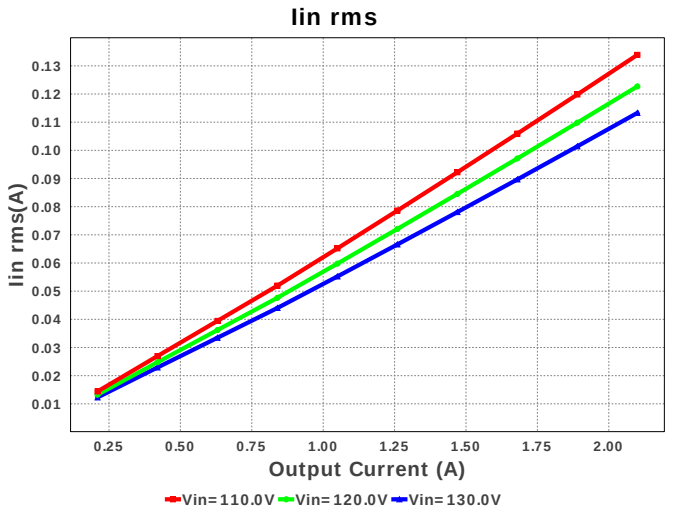




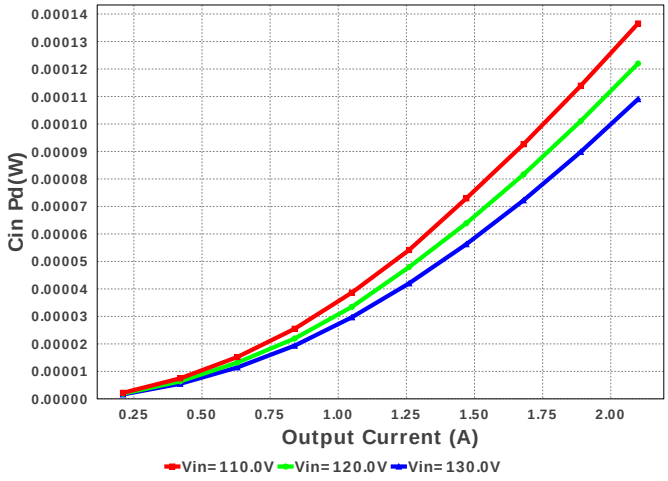




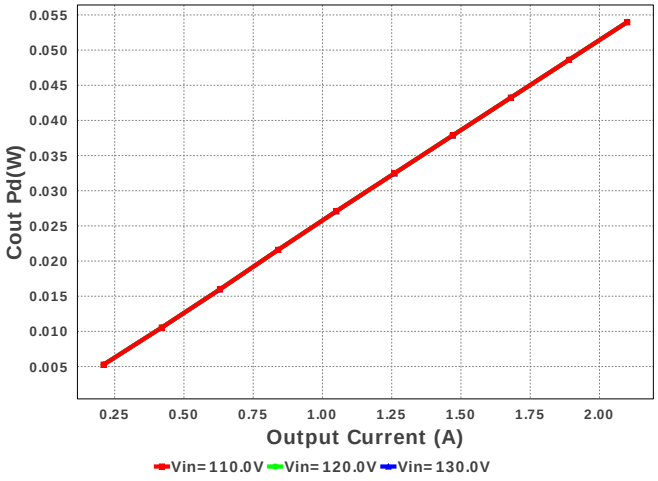




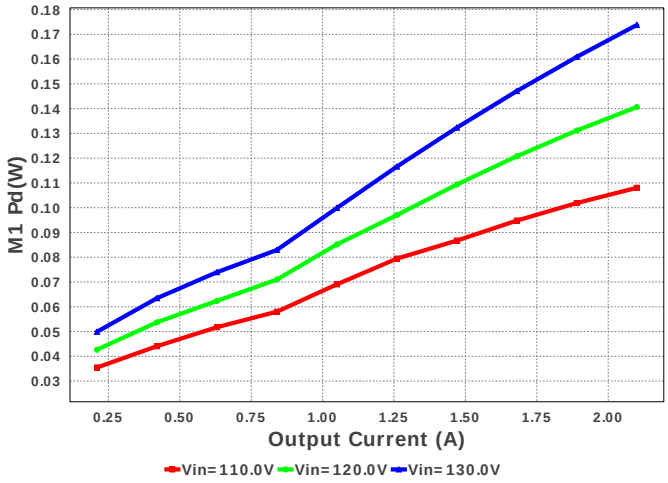
Cin Pd



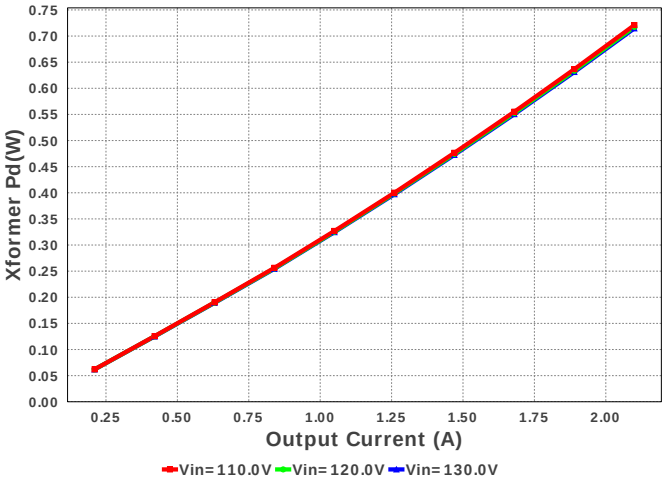
Cout Pd



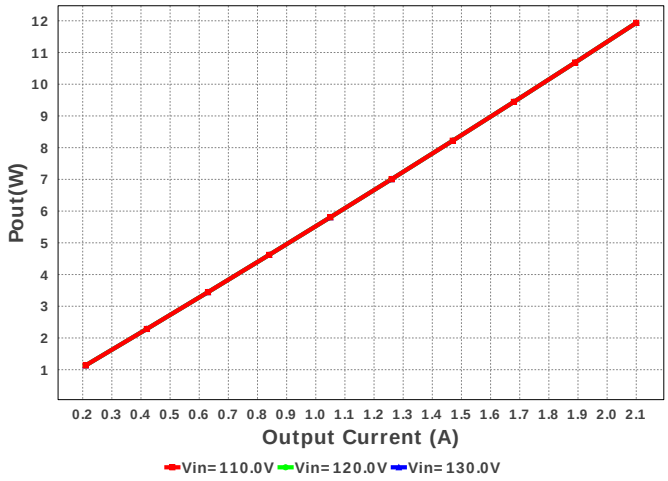
M1 Pd



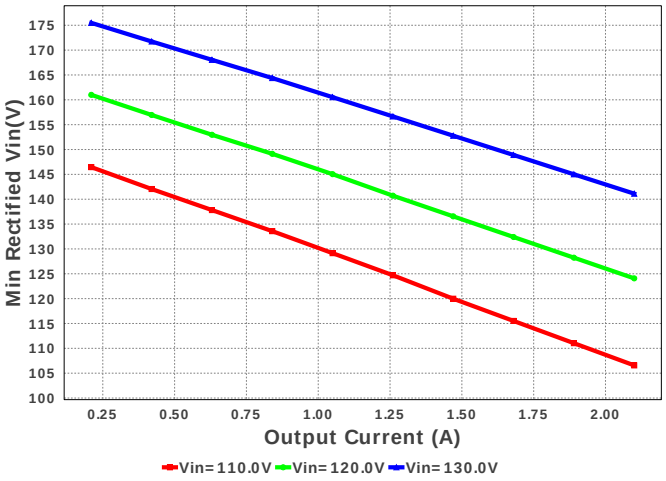
Xformer Pd

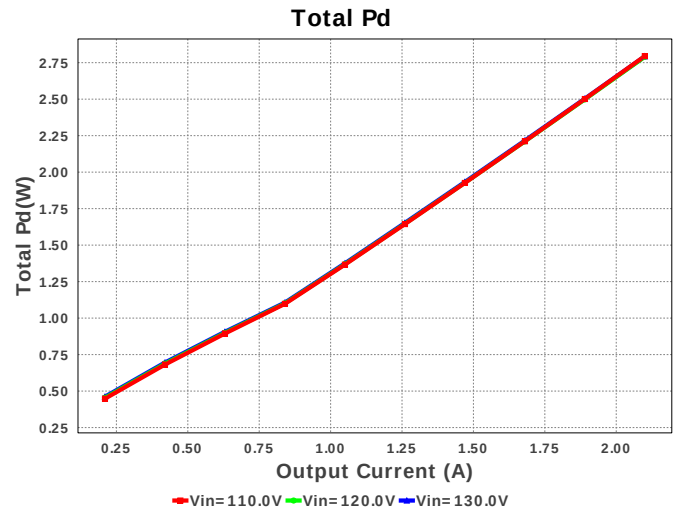


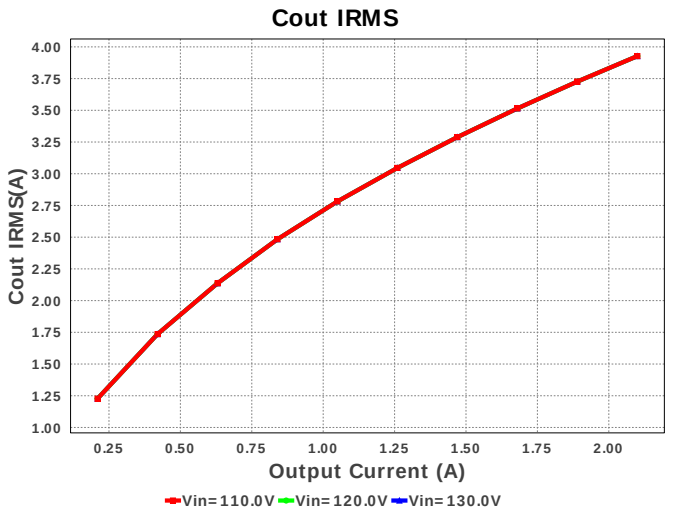
Pout

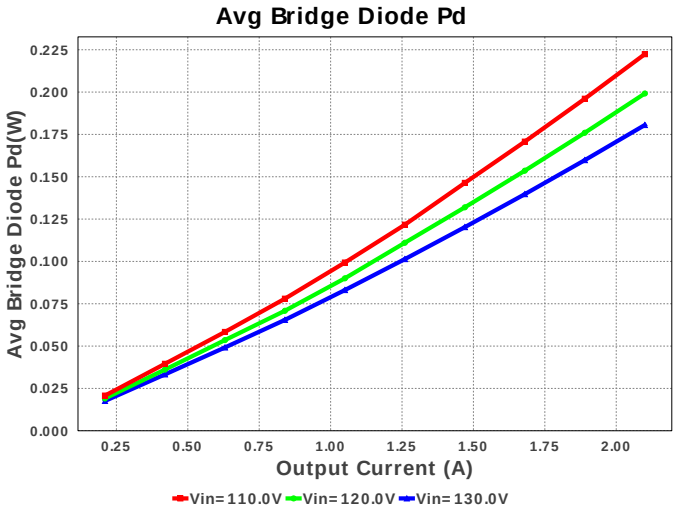


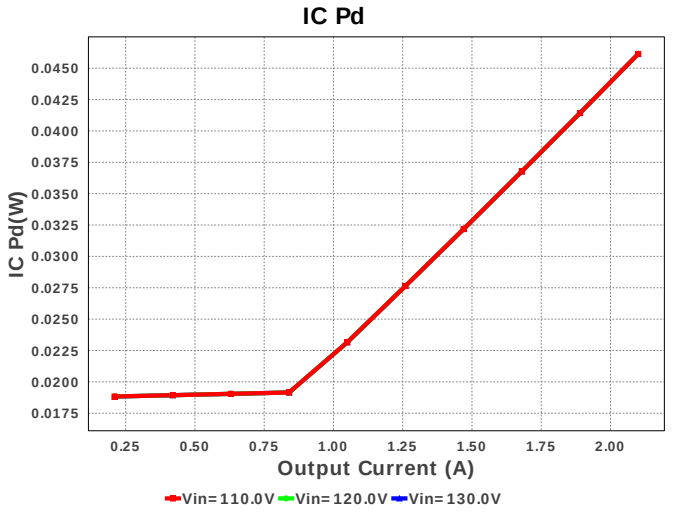
Min Rectified Vin

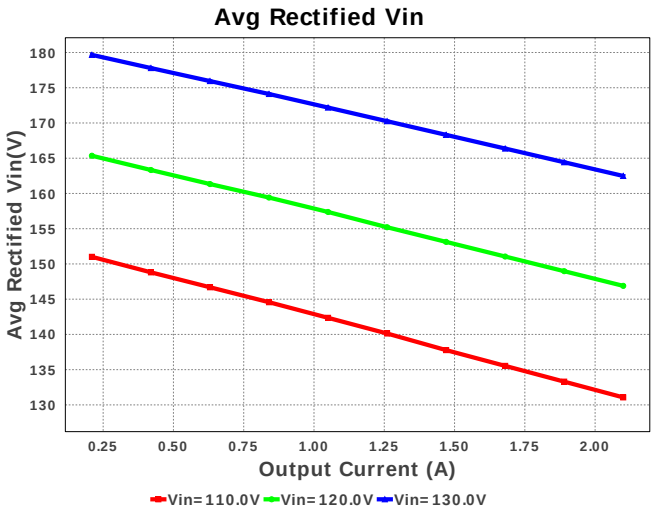


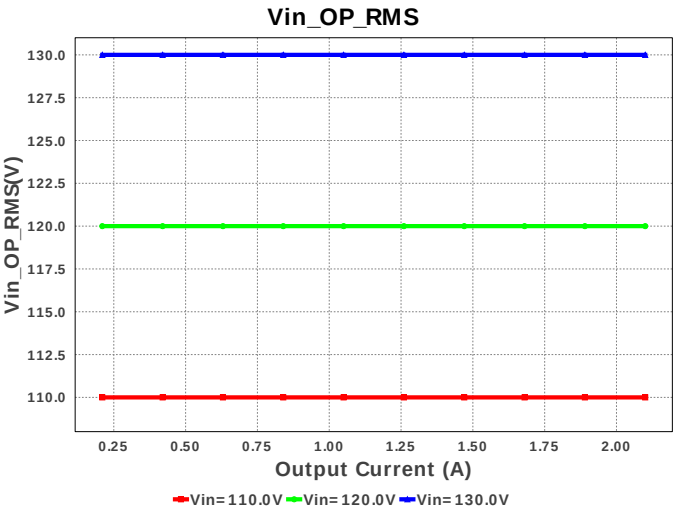


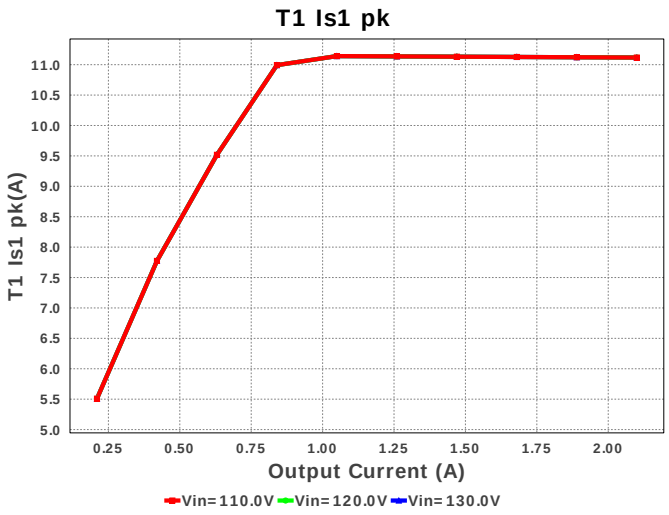


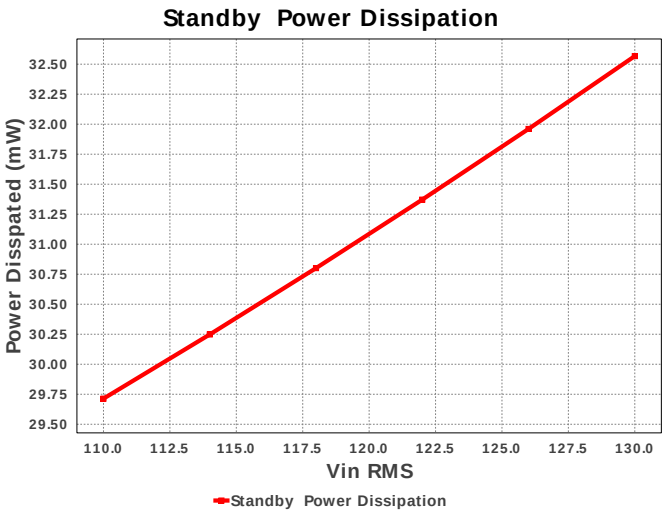


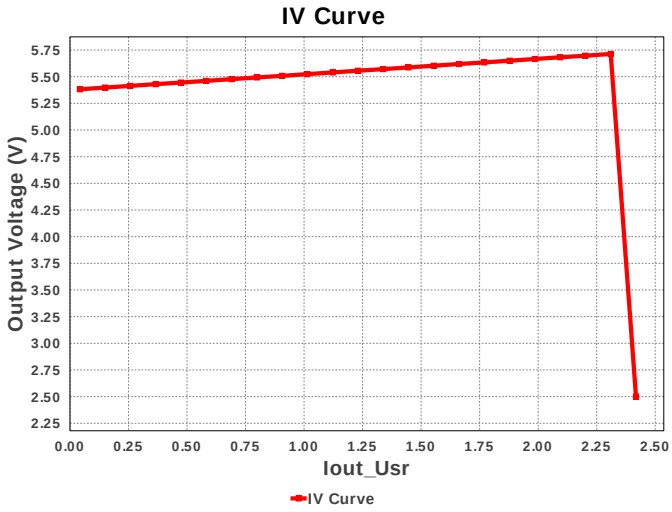












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	73.486 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	293.818 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.944 A	Current	Output capacitor RMS ripple current
4.	Iin rms	107.89 mA	Current	RMS Input Current
5.	T1 Iprim RMS	193.59 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	652.174 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.964 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	11.21 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	166.433 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	32	General	Total Design BOM count
11.	FootPrint	1.188 k mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	11.915 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	17.783 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.674 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	26.434 %	Op_point	Duty cycle
18.	Efficiency	84.952 %	Op_point	Steady state efficiency
19.	Frequency	102.894 kHz	Op_point	Switching frequency
20.	IC Tj	37.934 degC	Op_point	IC junction temperature
21.	ICThetaJA	180.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	2.1 A	Op_point	Iout operating point
23.	M1 TjOP	41.275 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	149.02 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	183.846 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	130.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	39.234 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	119.369 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	106.923 µW	Power	Input capacitor power dissipation
30.	Cout Pd	54.431 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	793.891 mW	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	44.08 mW	Power	IC power dissipation
33.	M1 Pd	180.396 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	2.111 W	Power	Total Power Dissipation
35.	Xformer Pd	695.385 mW	Power	Transformer power dissipation
36.	Zener Pd	30.505 mW	Power	Zener power dissipation
37.	Vout Tolerance	1.761 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.1	Maximum Output Current
2.	VinMax	130.0	Maximum input voltage
3.	VinMin	110.0	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	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 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.