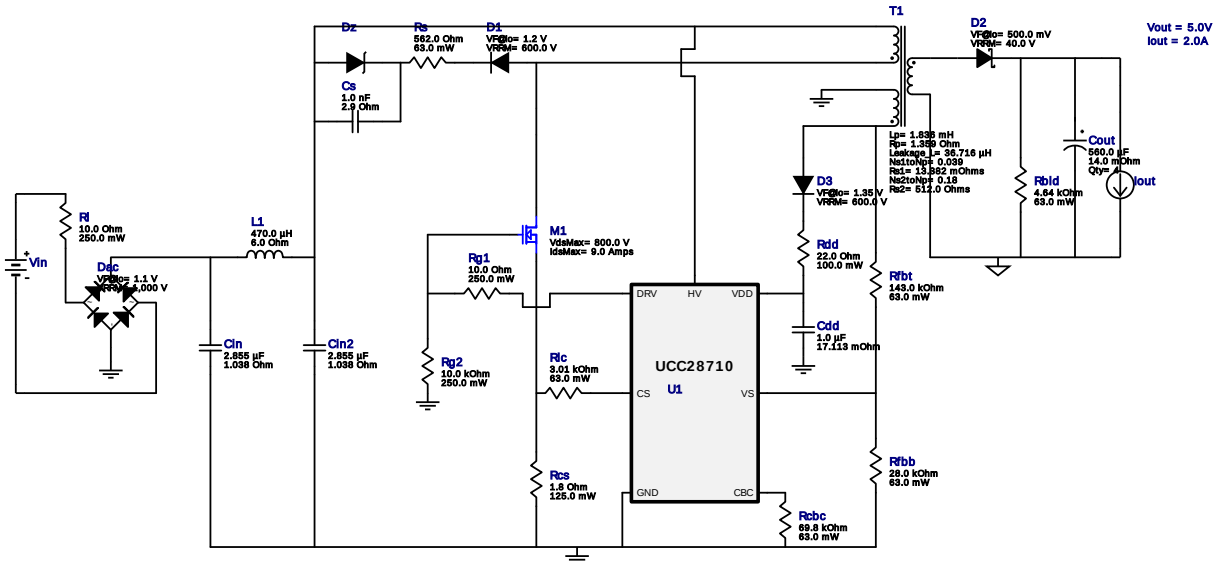


WEBENCH® Design Report

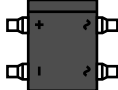
Design : 3876120/16 UCC28710DR
UCC28710DR 150.0V-230.0V to 5.53V @ 2.0A



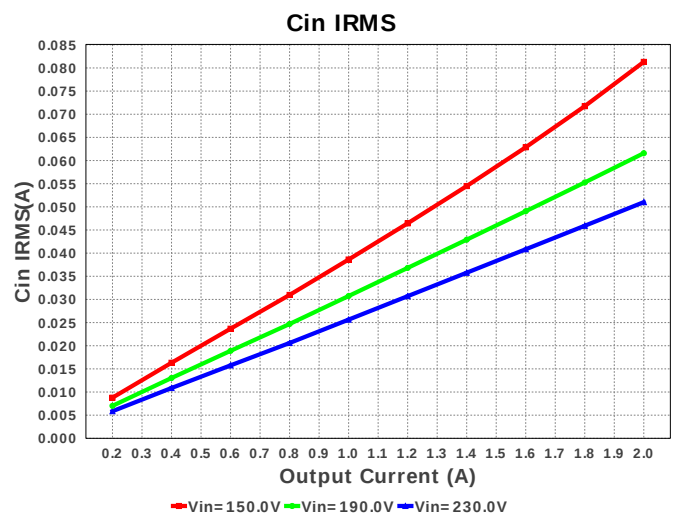
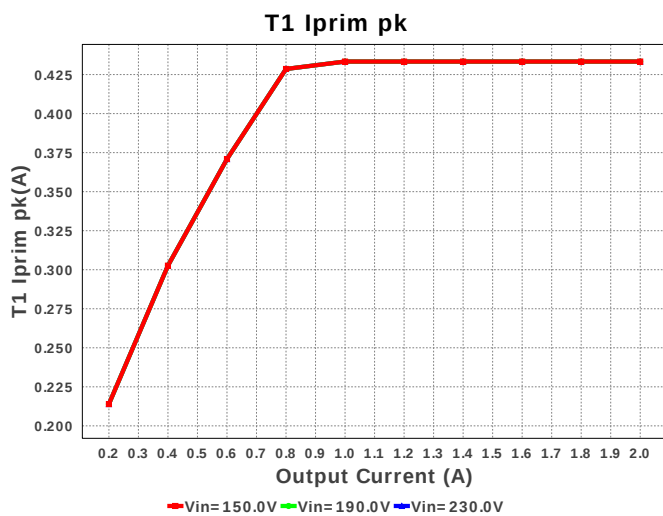
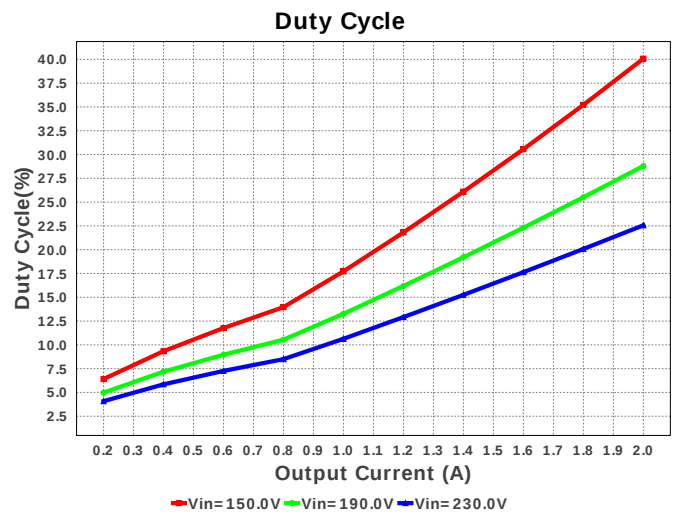
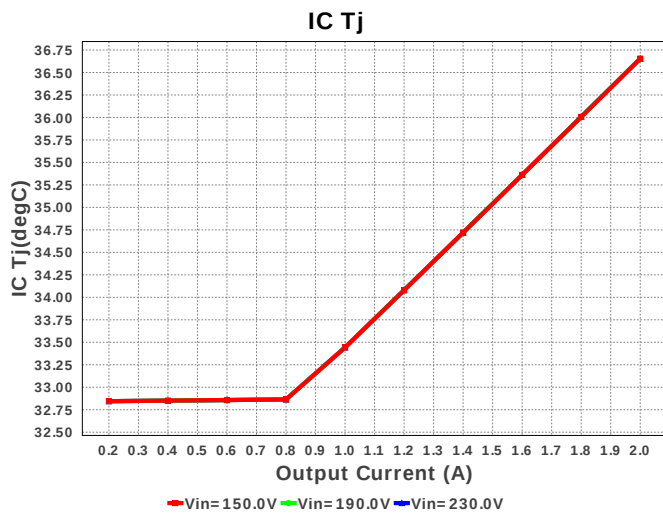
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

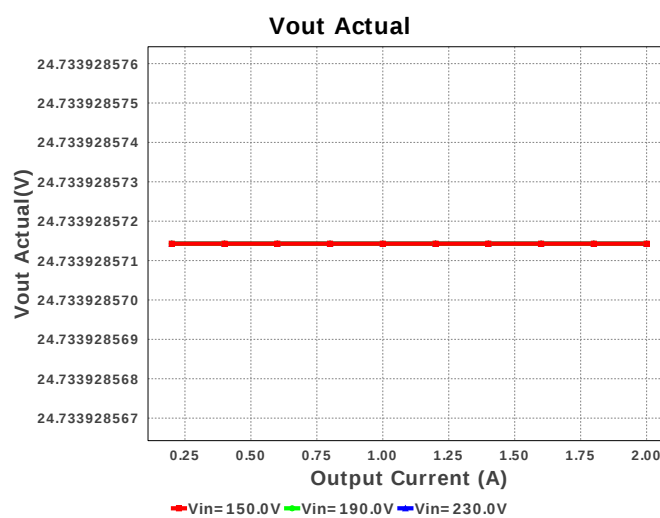
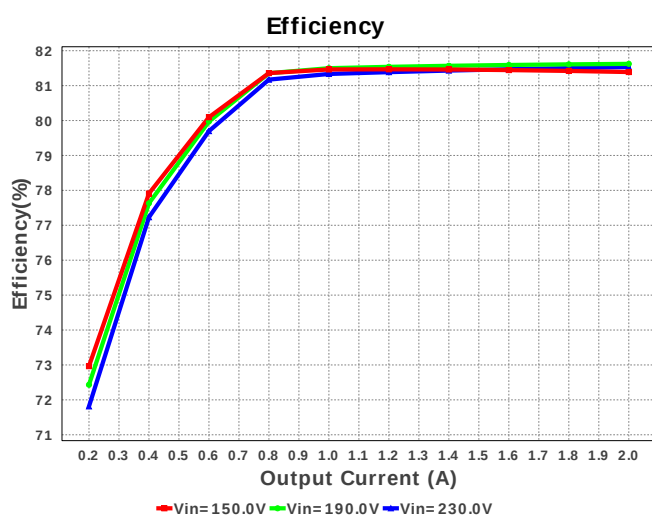
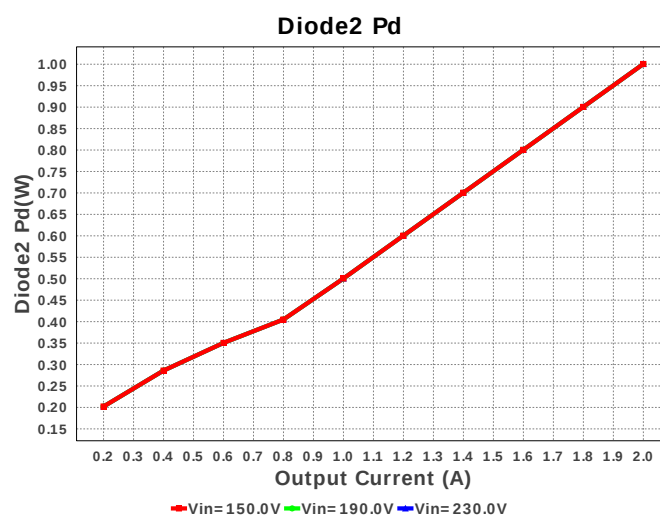
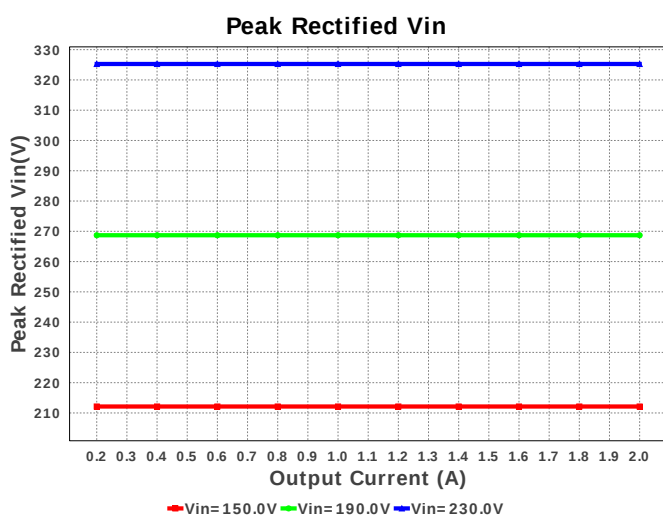
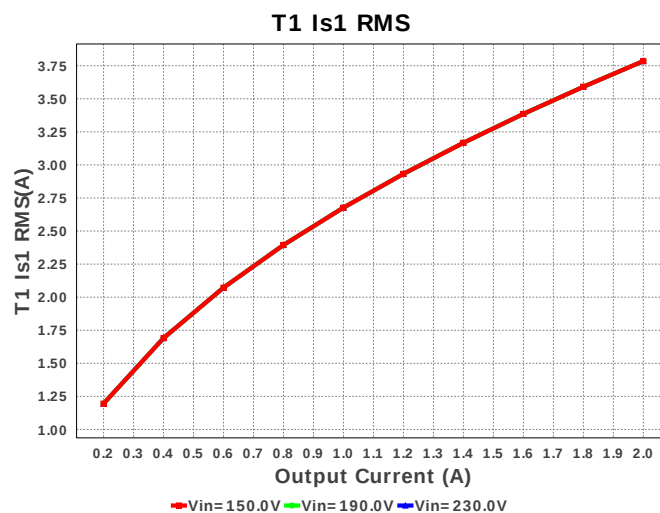
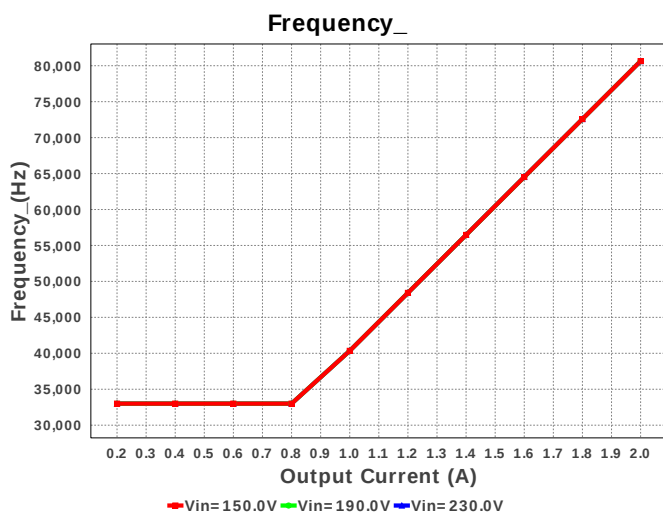
Electrical BOM

#	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 mm ²
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 2.855 uF ESR= 1.038 Ohm VDC= 487.9 V IRMS= 302.87 mA	1	NA	CUSTOM 0 mm ²
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 2.855 uF ESR= 1.038 Ohm VDC= 487.9 V IRMS= 302.87 mA	1	NA	CUSTOM 0 mm ²
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 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	CD214B-F3600	VF@Io= 1.2 V VRRM= 600.0 V	1	\$0.14	 SMB 44 mm ²
7.	D2	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.11	 SMA 37 mm ²

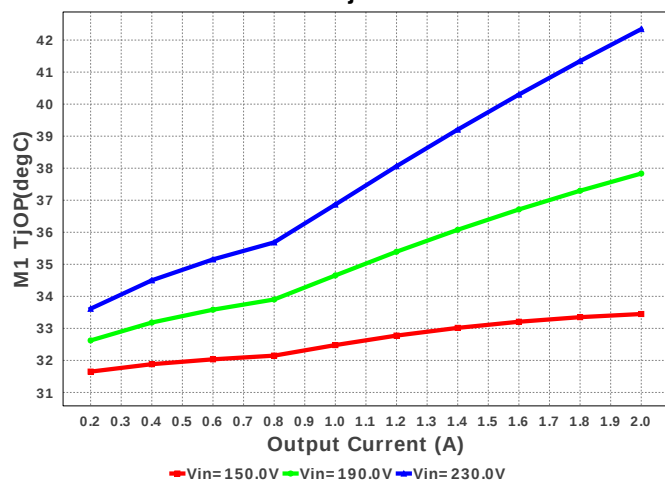
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	\$0.08	 SMA 37 mm ²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	\$0.24	 DF-S 99 mm ²
10.	Dz	ON Semiconductor	1SMB5953BT3G	Zener	1	\$0.10	 SMB 44 mm ²
11.	L1	NIC Components	NPI43C471MTRF	L= 470.0 µH DCR= 6.0 Ohm	1	\$0.07	 IND_NPI43C 31 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	CRCW04024K64FKED Series= CRCW..e3	Res= 4.64 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
14.	Rcbc	Vishay-Dale	CRCW040269K8FKED Series= CRCW..e3	Res= 69.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
15.	Rcs	Yageo America	RC0805FR-071R8L Series= ?	Res= 1.8 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	Vishay-Dale	CRCW040228K0FKED Series= CRCW..e3	Res= 28.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
18.	Rfbt	Vishay-Dale	CRCW0402143KFKED Series= CRCW..e3	Res= 143.0 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.	RI	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
22.	Rlc	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
23.	Rs	Vishay-Dale	CRCW0402562RFKED Series= CRCW..e3	Res= 562.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
24.	T1	CUSTOM	CUSTOM	Lp= 1.836 mH Rp= 1.359 Ohm Leakage_L= 36.716 µH Ns1toNp= 0.039 Rs1= 13.382 mOhms Ns2toNp= 0.18 Rs2= 512.0 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

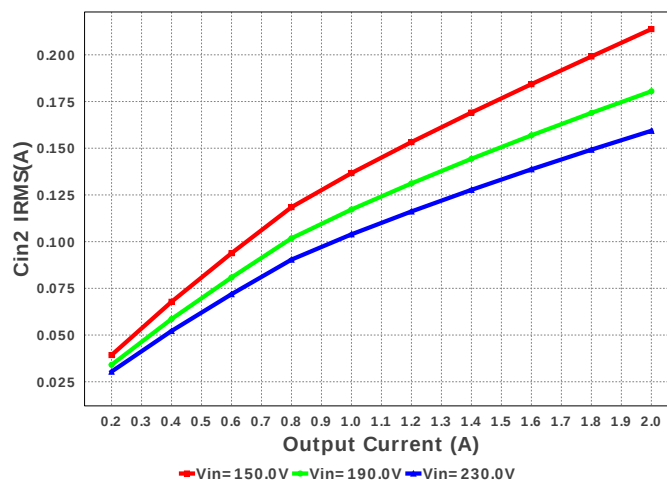




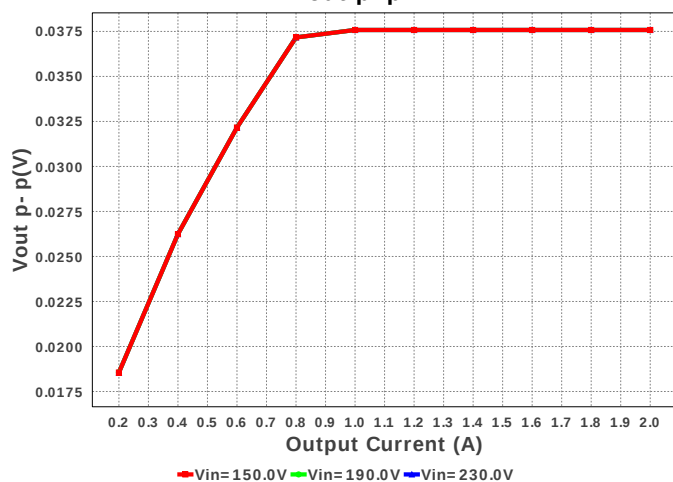
M1 TjOP



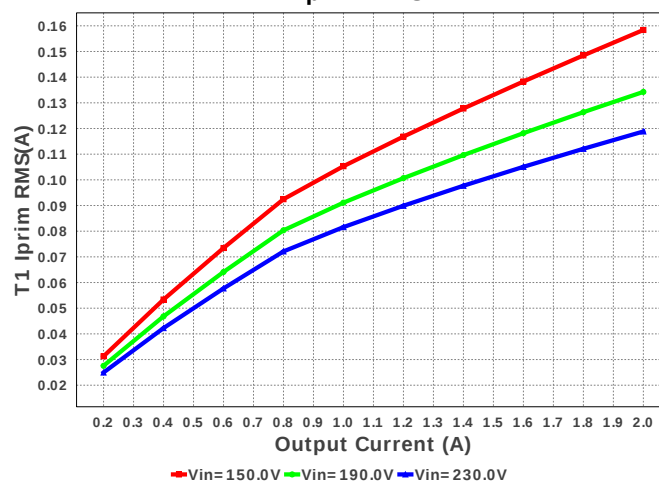
Cin2 IRMS



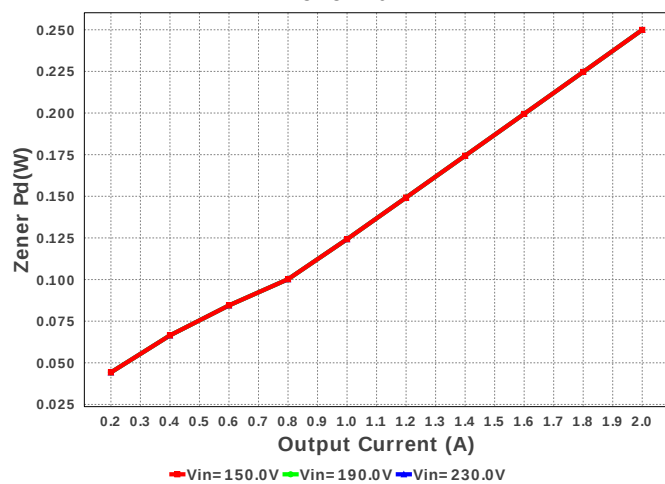
Vout p- p



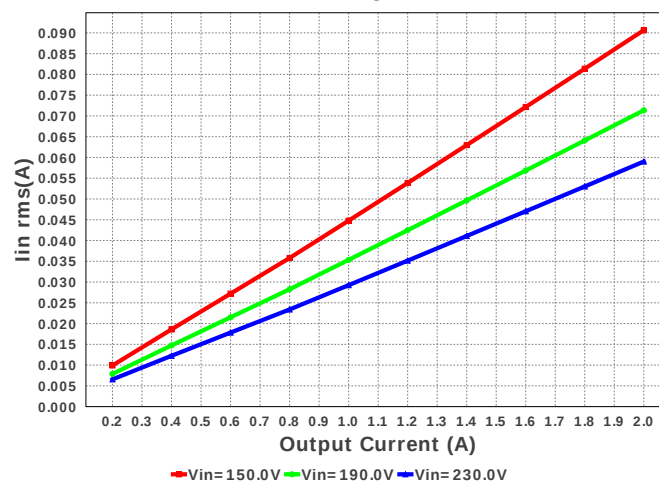
T1 Iprim RMS

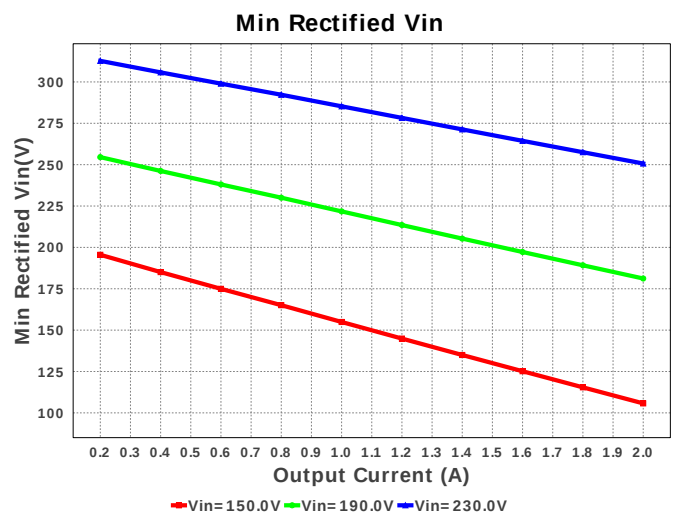
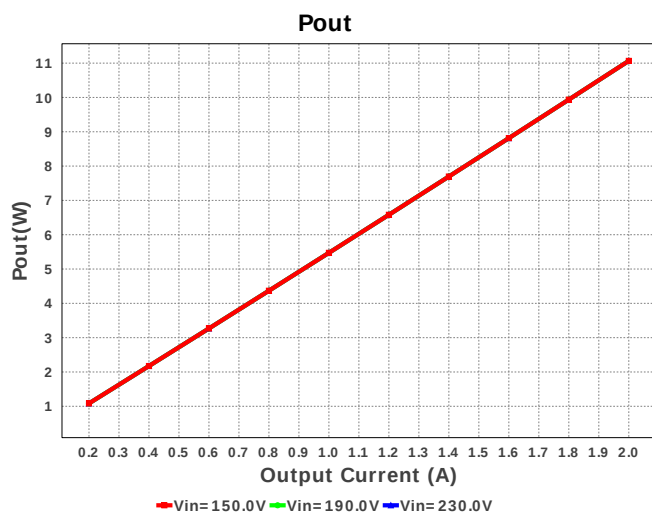
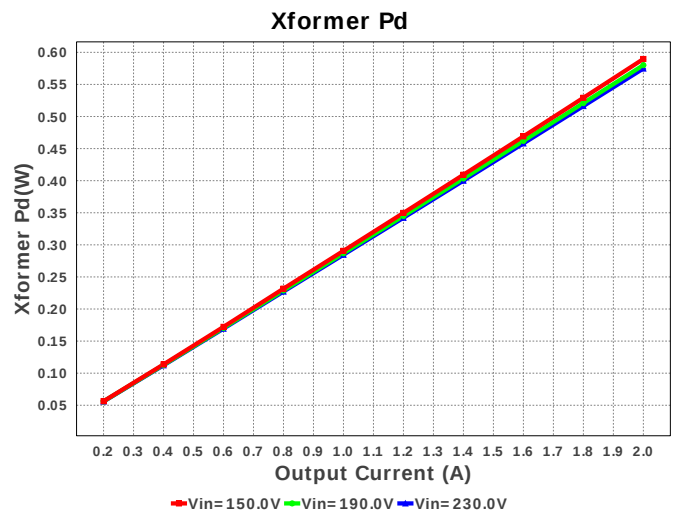
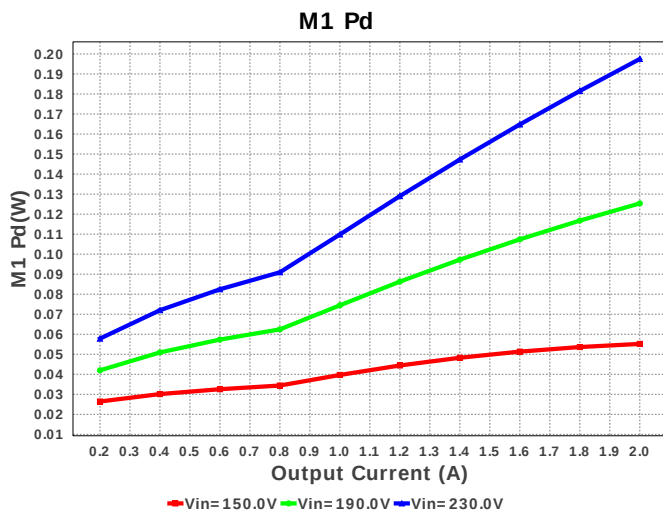
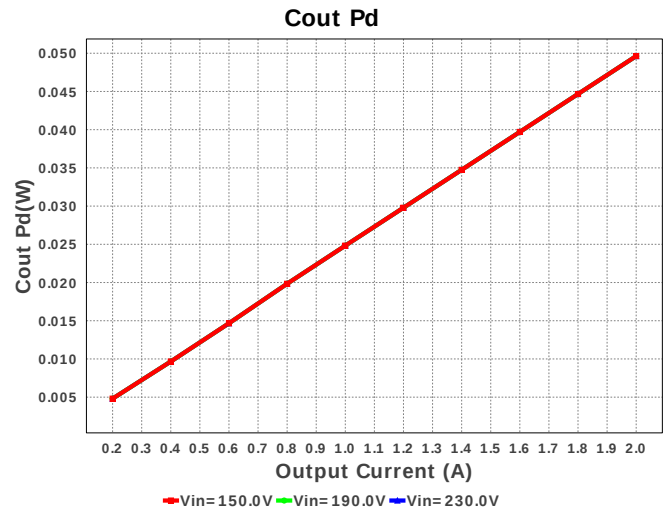
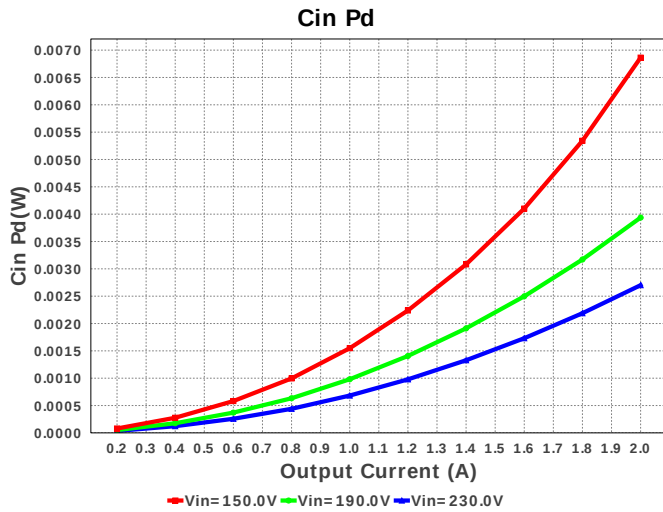


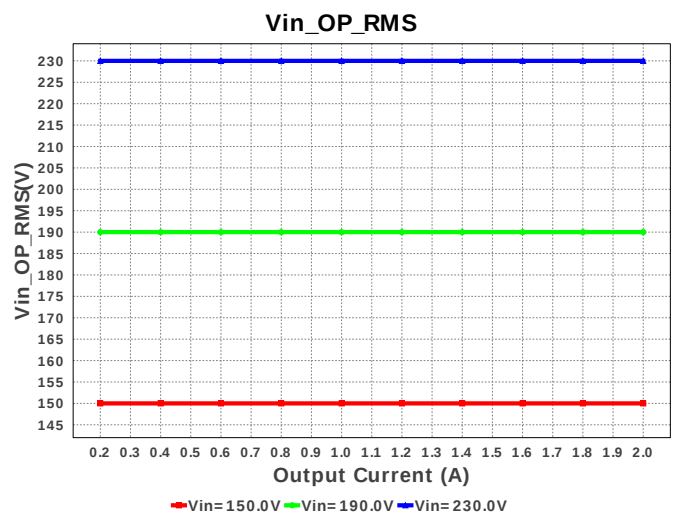
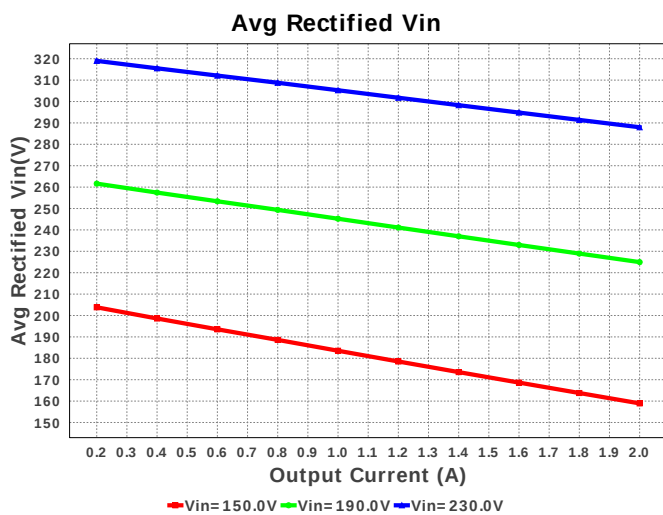
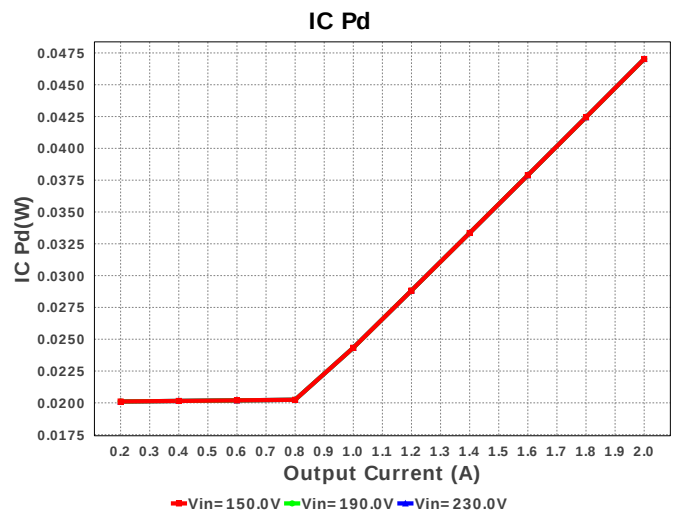
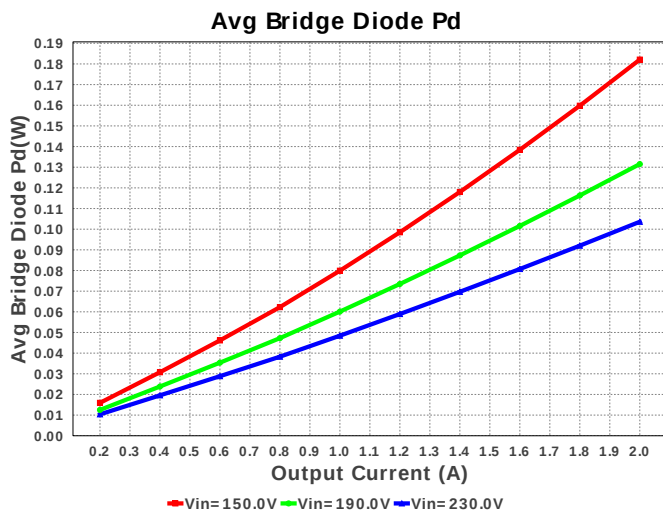
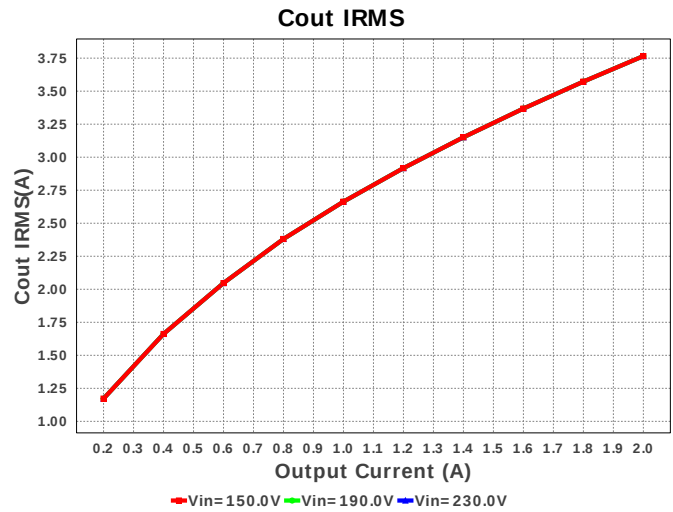
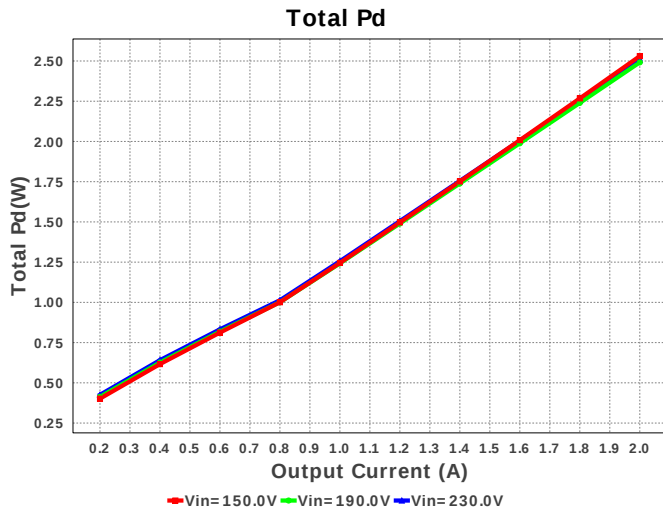
Zener Pd

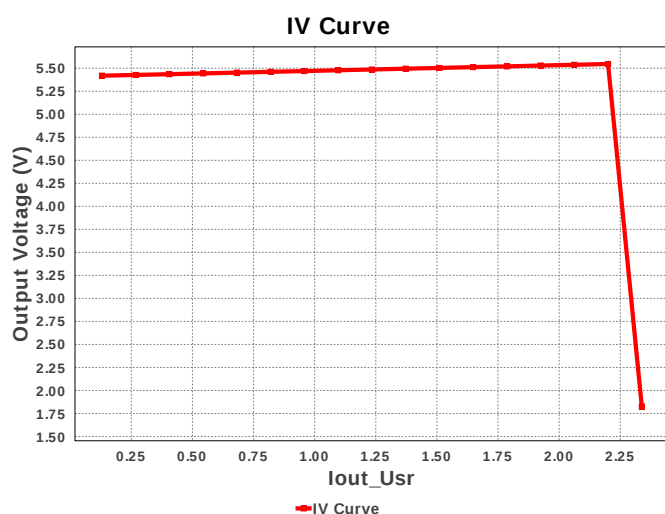
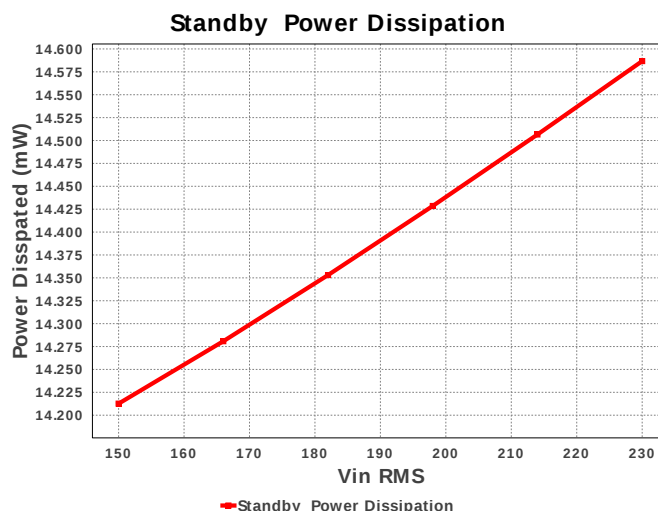
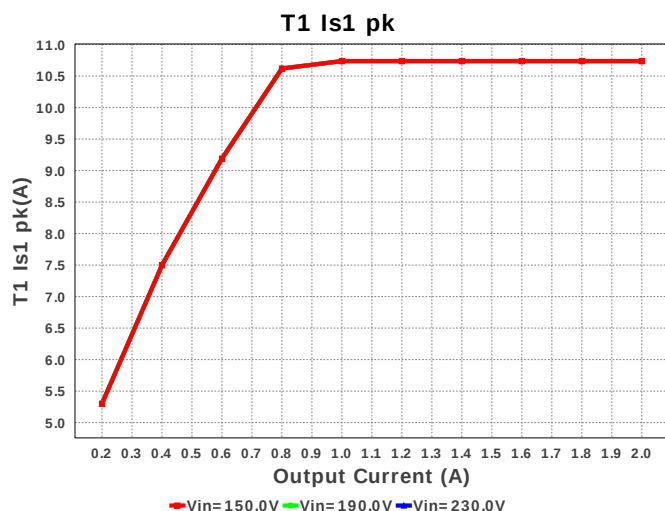


lin rms









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	49.33 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	155.189 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.781 A	Current	Output capacitor RMS ripple current
4.	Iin rms	56.647 mA	Current	RMS Input Current
5.	T1 Iprim RMS	115.489 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	433.333 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.8 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	10.824 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	295.732 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	28	General	Total Design BOM count
11.	FootPrint	966.0 mm ²	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	11.064 W	General	Total output power
14.	Total BOM	\$0.0	General	Total BOM Cost
15.	Vout Actual	24.734 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.532 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	21.309 %	Op_point	Duty cycle
18.	Efficiency	84.92 %	Op_point	Steady state efficiency
19.	Frequency	78.18 kHz	Op_point	Switching frequency
20.	IC Tj	33.195 degC	Op_point	IC junction temperature
21.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	2.0 A	Op_point	Iout operating point
23.	M1 TJOP	42.651 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	266.199 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	325.266 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	230.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	37.885 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	61.267 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	2.526 mW	Power	Input capacitor power dissipation
30.	Cout Pd	50.029 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	822.031 mW	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	45.646 mW	Power	IC power dissipation
33.	M1 Pd	202.422 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	1.965 W	Power	Total Power Dissipation
35.	Xformer Pd	569.742 mW	Power	Transformer power dissipation
36.	Zener Pd	66.008 mW	Power	Zener power dissipation
37.	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	230.0	Maximum input voltage
3.	VinMin	150.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC28710	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. Rfbl & Rfbb The feedback resistors will set the output voltage of the circuit. The values chosen may need to be finely 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 achieved, 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.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

Use of Texas Instruments' WEBENCH simulation tools is subject to [Texas Instruments' Site Terms and Conditions of Use](#). Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the [Evaluation License Agreement](#).