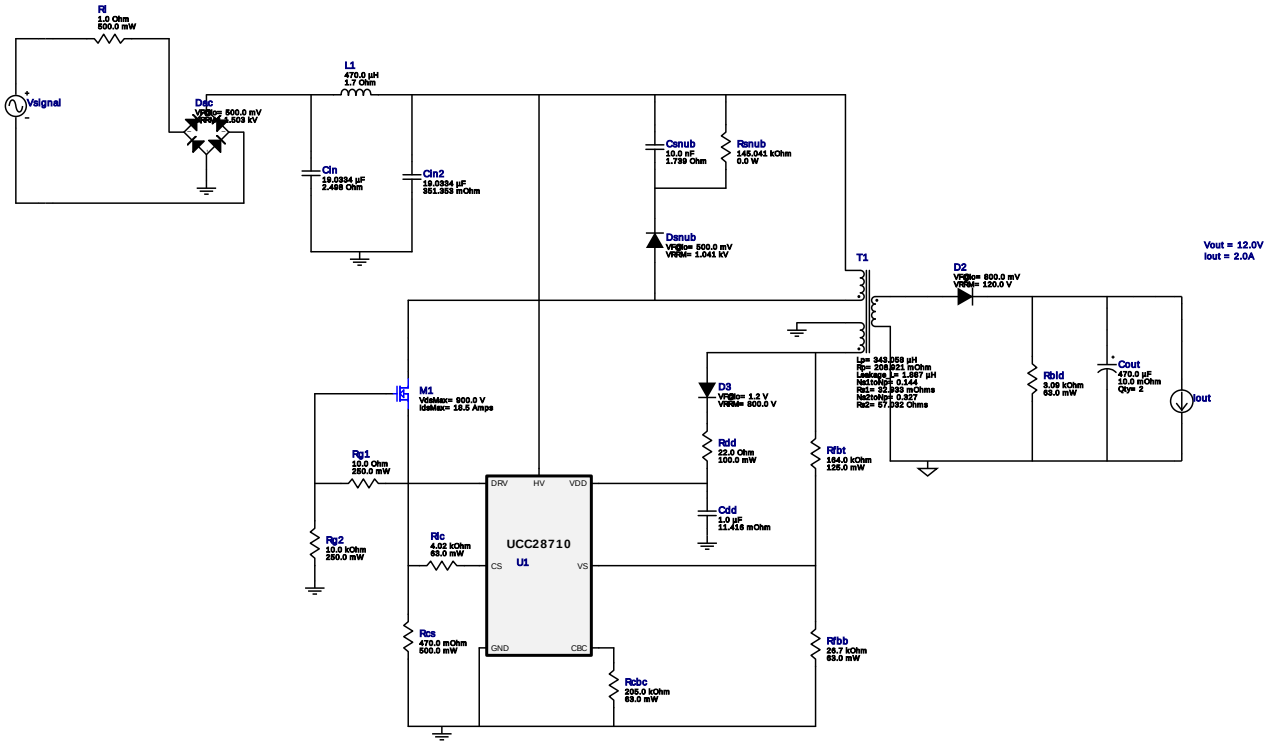
WEBENCH® Design Report

VinMin = 90.0V
VinMax = 460.0V
Vout = 12.0V
Iout = 2.0A

Device = UCC28710DR
Topology = Flyback
Created = 2/27/17 10:25:09 PM
BOM Cost = $0.00
BOM Count = 25
Total Pd = 4.7W

Design : 4344335/13 UCC28710DR
UCC28710DR 90.0V-460.0V to 12.89V @ 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

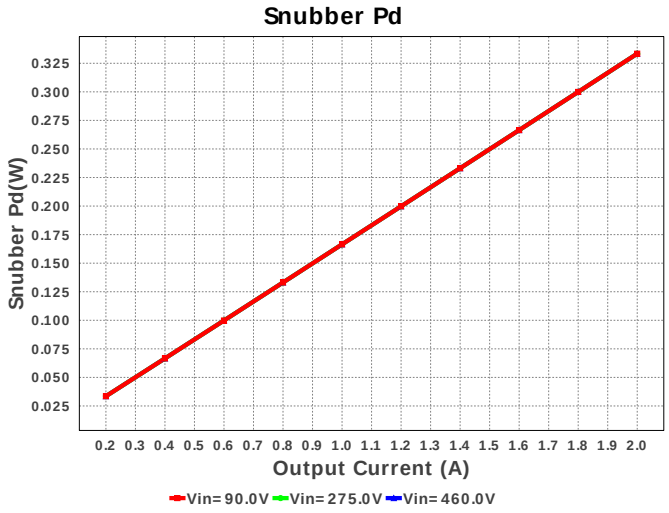
No comments

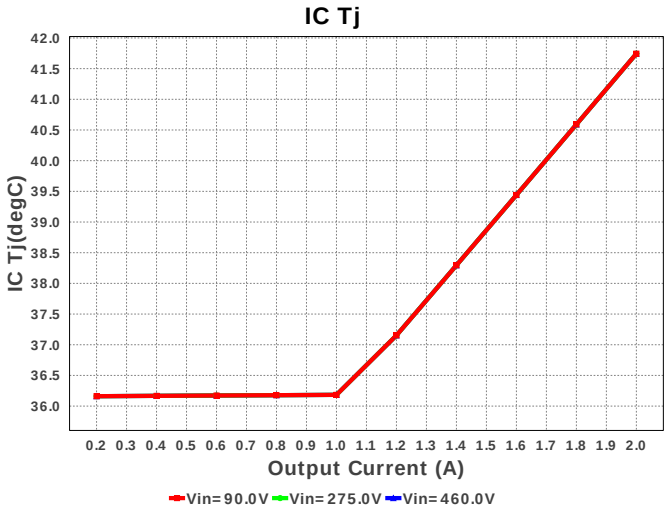
Electrical BOM

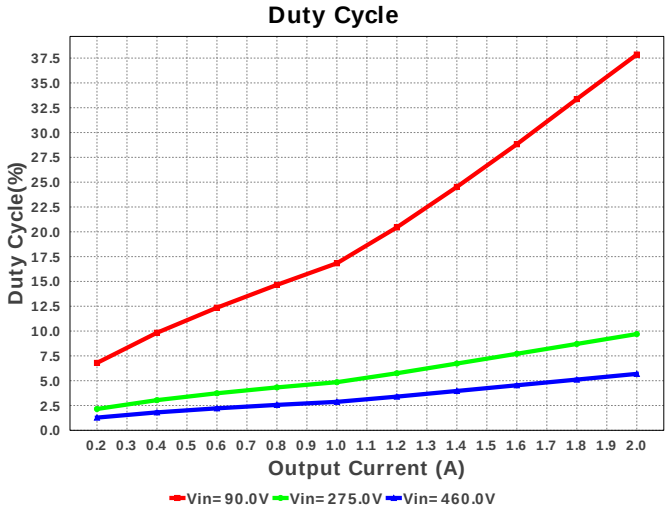
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	TDK	C1005X5R1V105K050BC Series= X5R	Cap= 1.0 uF ESR= 11.416 mOhm VDC= 35.0 V IRMS= 1.483 A	1	$0.03	0402 3 mm^2
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 19.0334 uF ESR= 2.498 Ohm VDC= 650.53 V IRMS= 302.464 mA	1	NA	CUSTOM 0 mm^2
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 19.0334 uF ESR= 351.353 mOhm VDC= 975.8 V IRMS= 302.464 mA	1	NA	CUSTOM 0 mm^2
4.	Cout	Nichicon	RNU1C471MDN1PH Series= ?	Cap= 470.0 uF ESR= 10.0 mOhm VDC= 16.0 V IRMS= 6.1 A	2	$0.42	NU_1000x1250 144 mm^2
5.	Csnub	Kemet	C0805C103K1RACTU Series= X7R	Cap= 10.0 nF ESR= 1.739 Ohm VDC= 500.0 V IRMS= 411.0 mA	1	$0.01	0805 7 mm^2

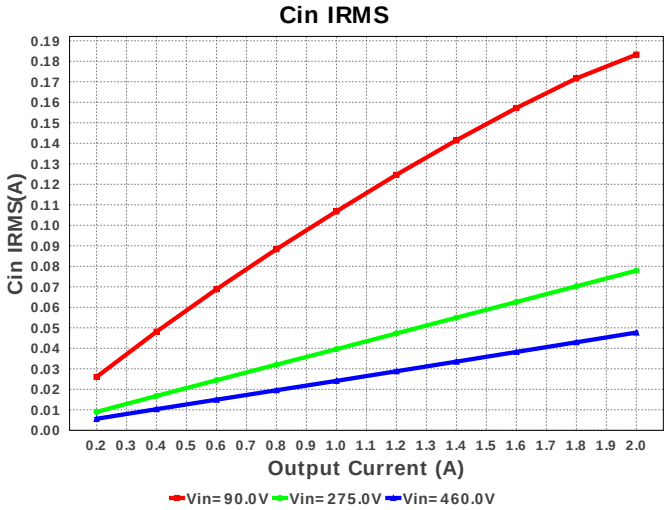
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
6.	D2	Vishay-Semiconductor	V12P12-M3/86A	VF@Io= 800.0 mV VRRM= 120.0 V	1	$0.40	 TO-277A 57 mm²
7.	D3	Microsemi	UFS180JE3/TR13	VF@Io= 1.2 V VRRM= 800.0 V	1	$0.67	 DO-214BA 42 mm²
8.	Dac	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 1.503 kV	1	NA	CUSTOM 0 mm²
9.	Dsnub	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 1.041 kV	1	NA	CUSTOM 0 mm²
10.	L1	TDK	CLF7045T-471M	L= 470.0 µH DCR= 1.7 Ohm	1	$0.42	 CLF7045 86 mm²
11.	M1	STMicroelectronics	STW21N90K5	VdsMax= 900.0 V IdsMax= 18.5 Amps	1	$3.94	 TO-247 123 mm²
12.	Rbld	Vishay-Dale	CRCW04023K09FKED Series= CRCW..e3	Res= 3.09 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
13.	Rcbc	Vishay-Dale	CRCW0402205KFKED Series= CRCW..e3	Res= 205.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
14.	Rcs	Rohm	MCR25JZHFLR470 Series= MCR25	Res= 470.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.03	 1210 15 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	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
17.	Rfbt	Yageo America	RT0805BRD07164KL Series= RT0805	Res= 164.0 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	Stackpole Electronics Inc	CSR1206FT1R00 Series= ?	Res= 1.0 Ohm Power= 500.0 mW Tolerance= 1.0%	1	$0.04	 1206 11 mm²
21.	Rlc	Vishay-Dale	CRCW04024K02FKED Series= CRCW..e3	Res= 4.02 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
22.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 145.041 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
23.	T1	CUSTOM	CUSTOM	Lp= 343.058 µH Rp= 208.921 mOhm Leakage_L= 1.887 µH Ns1toNp= 0.144 Rs1= 32.933 mOhms Ns2toNp= 0.327 Rs2= 57.032 Ohms	1	NA	CUSTOM 0 mm²

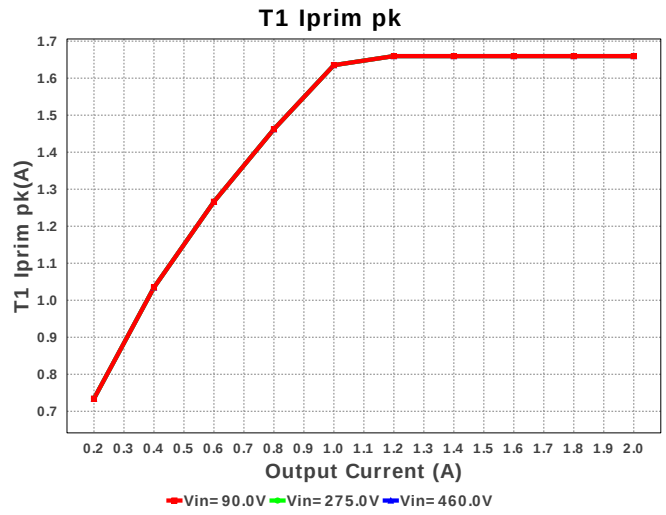
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
24.	U1	Texas Instruments	UCC28710DR	Switcher	1	$0.42	SOIC-7 0 mm²

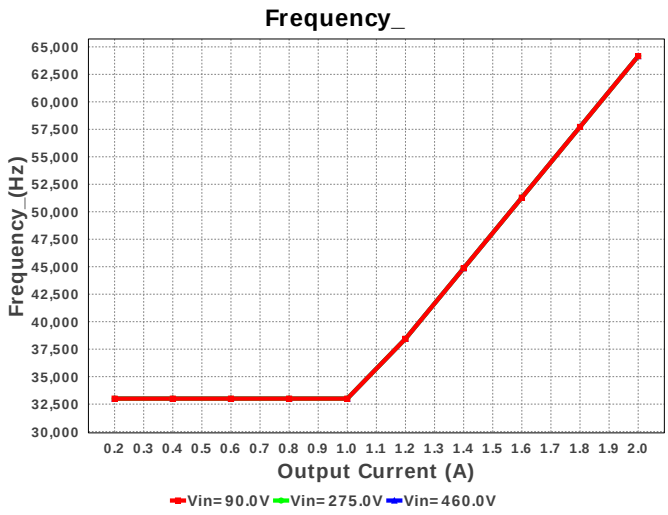


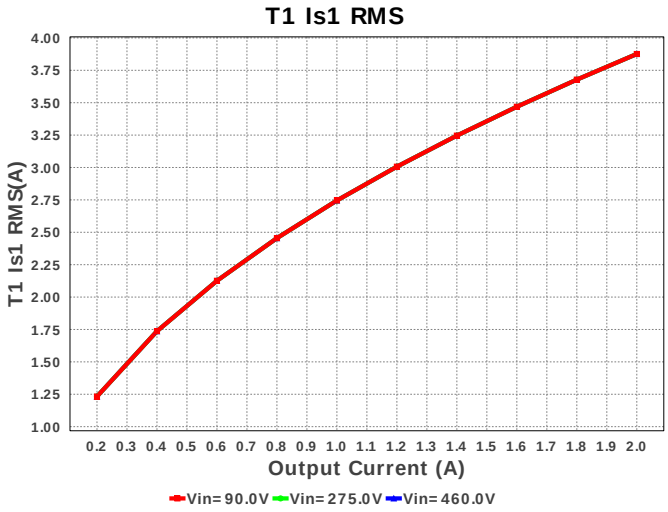


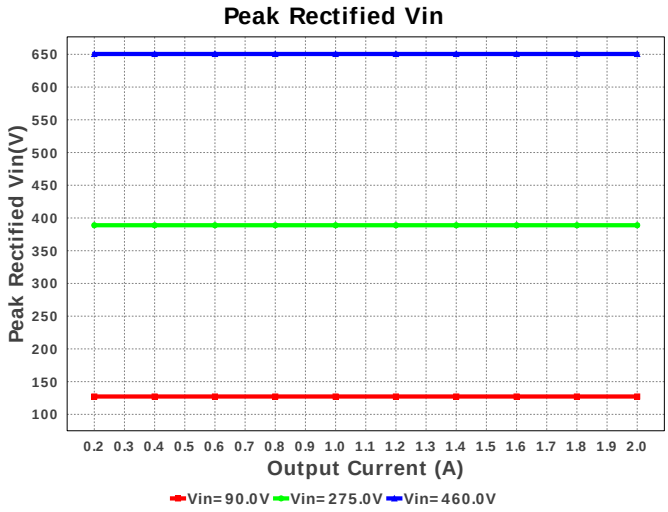


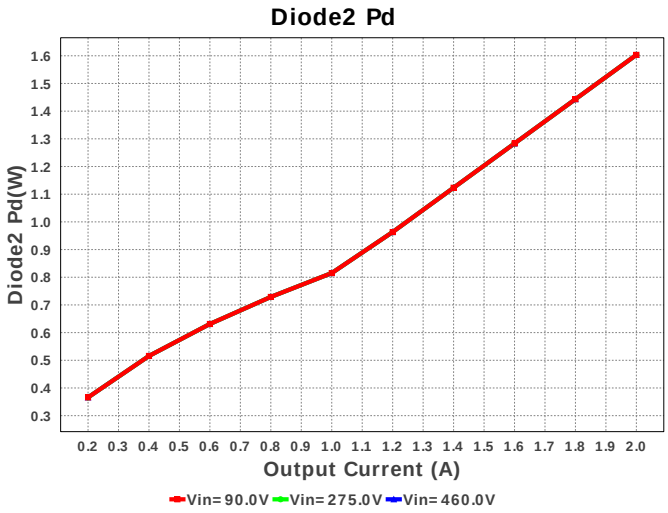


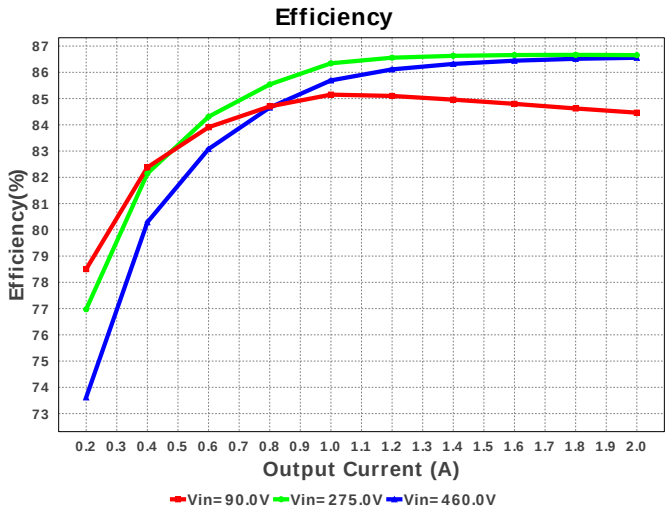


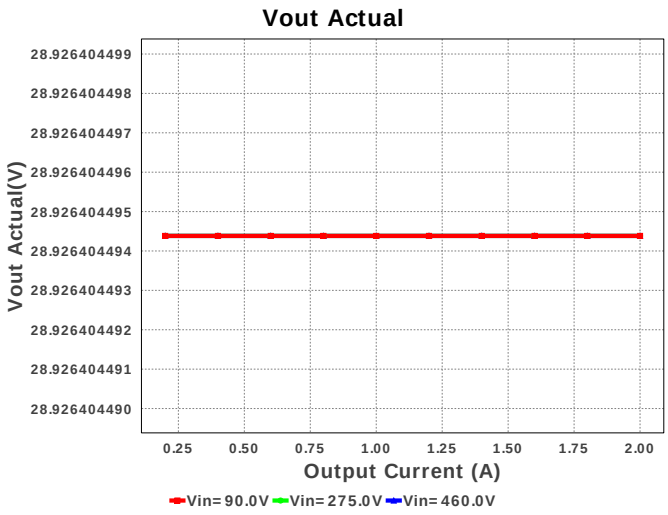


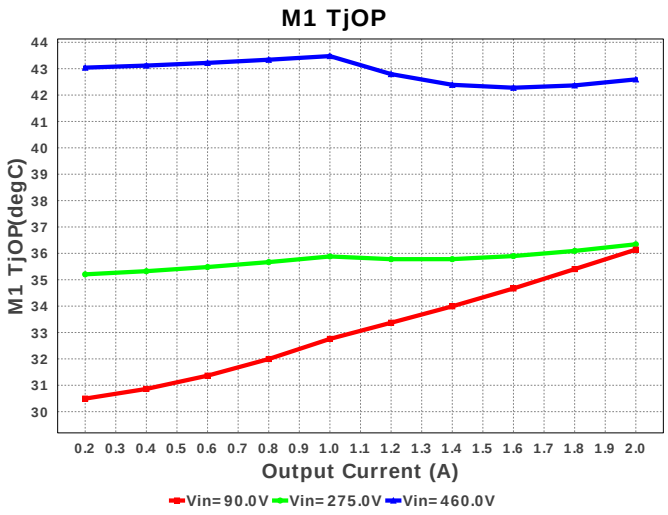


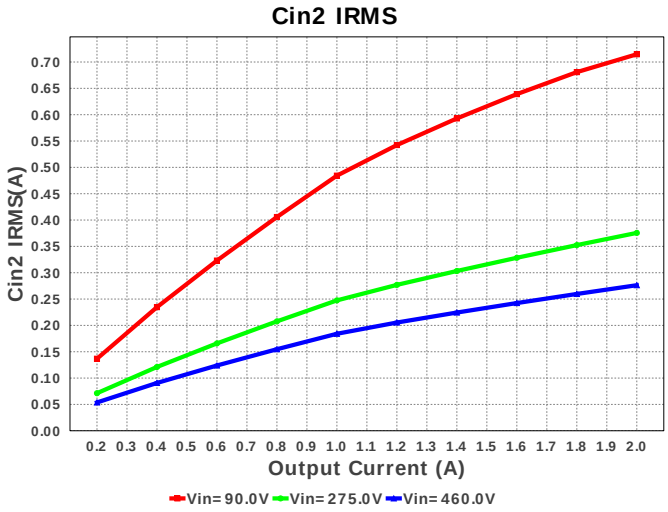


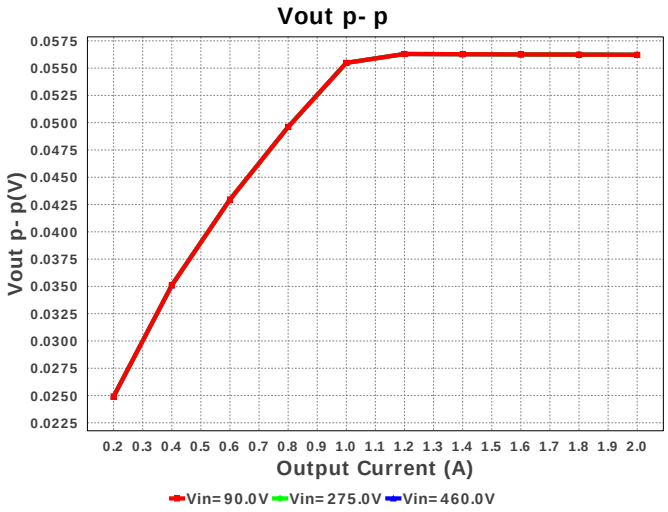


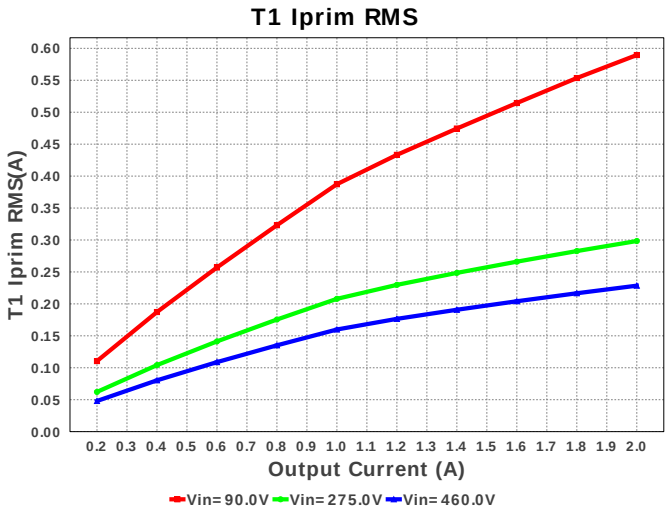


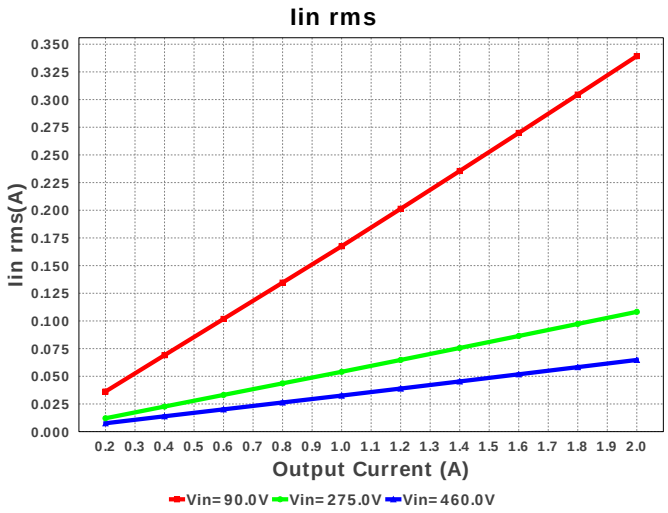




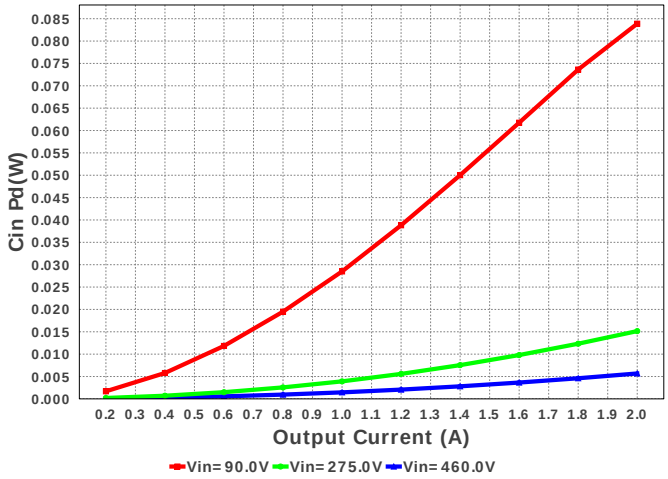




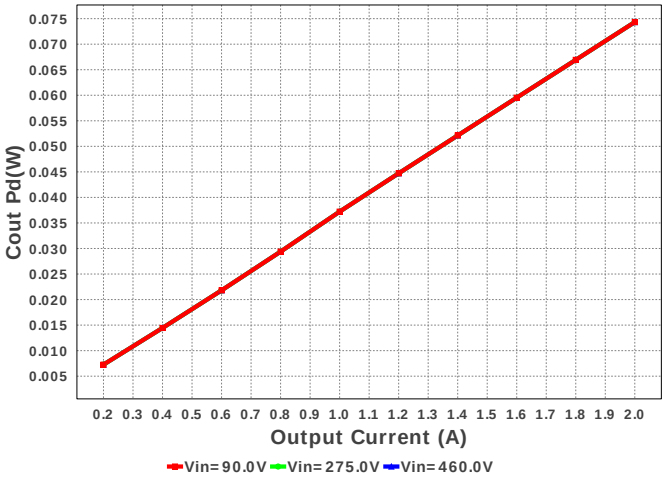




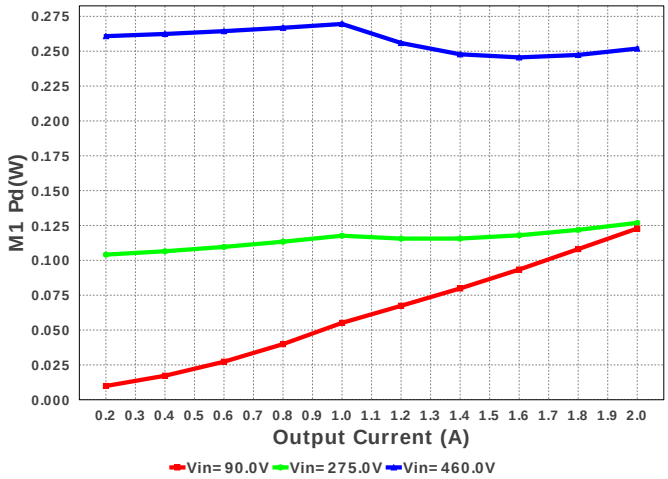
Cin Pd



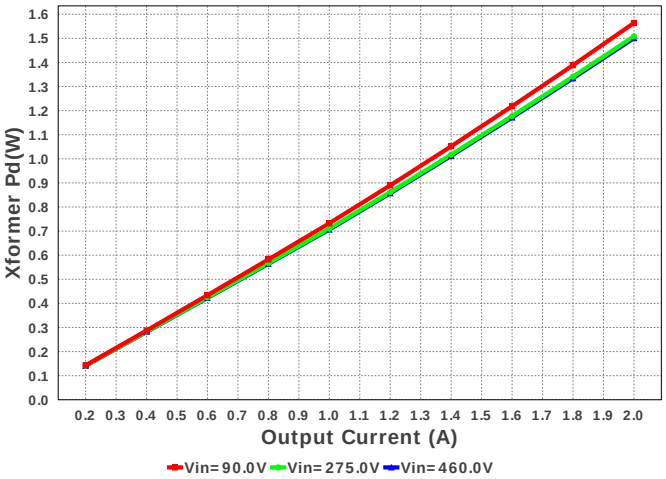
Cout Pd



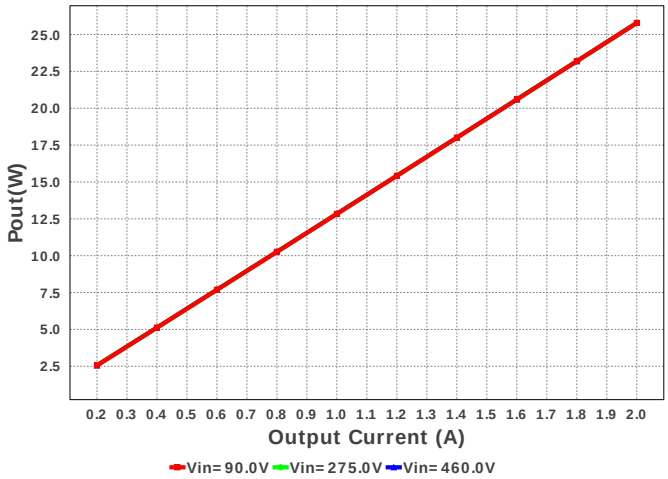
M1 Pd



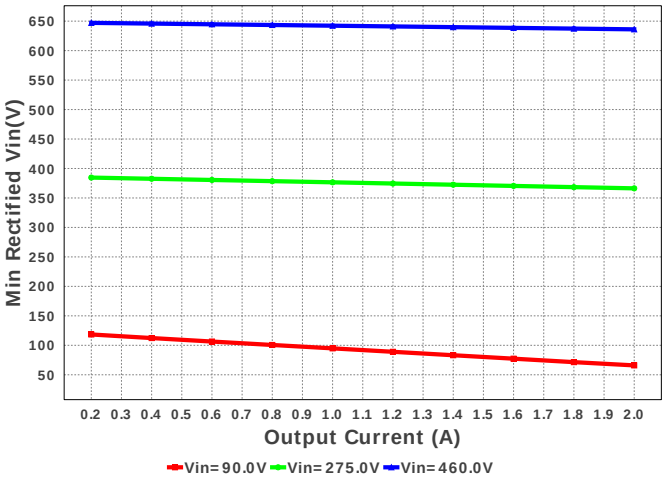
Xformer Pd



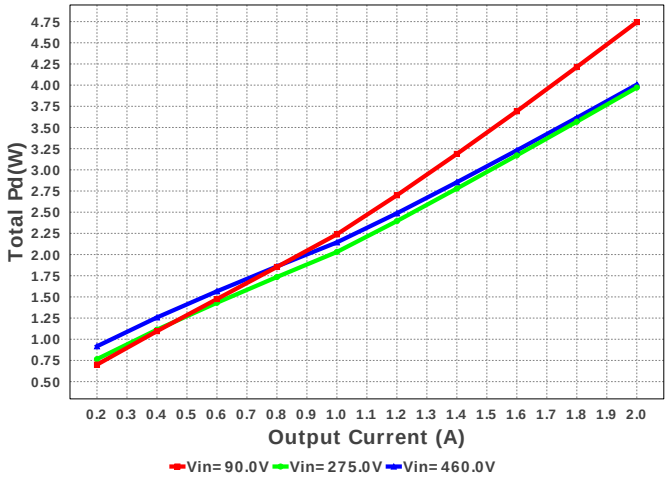
Pout



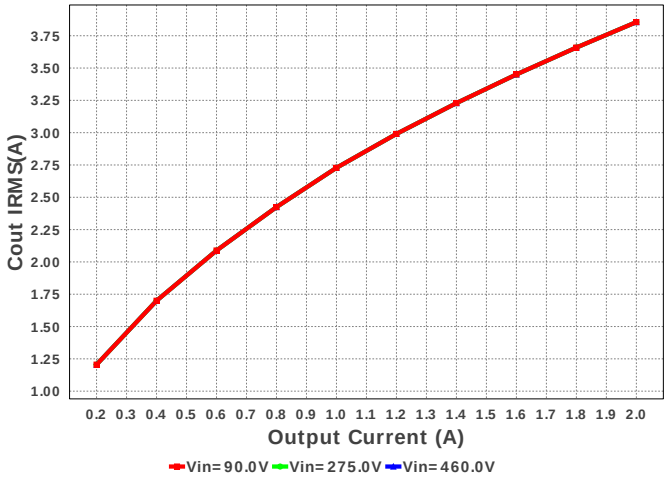
Min Rectified Vin



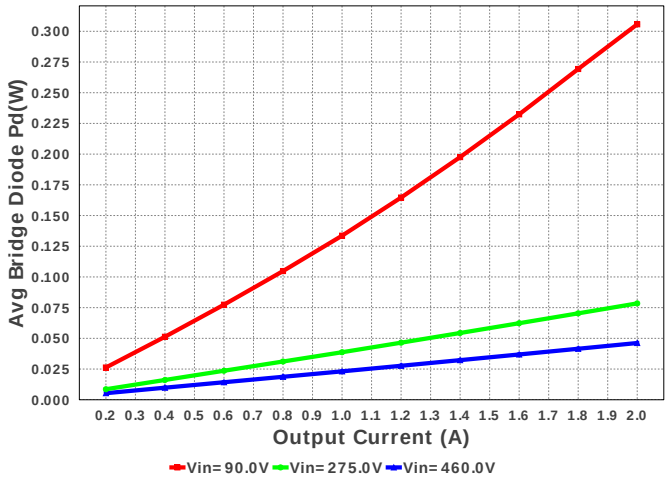
Total Pd



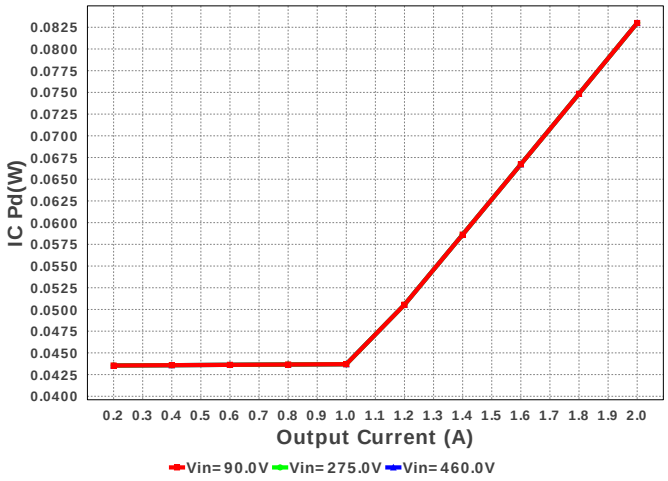
Cout IRMS



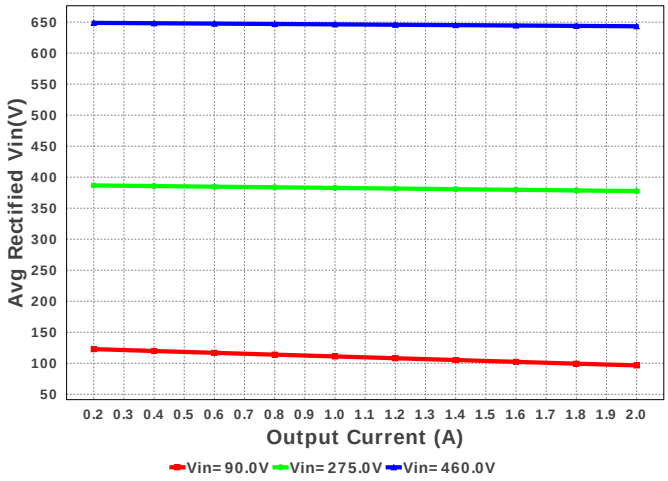
Avg Bridge Diode Pd



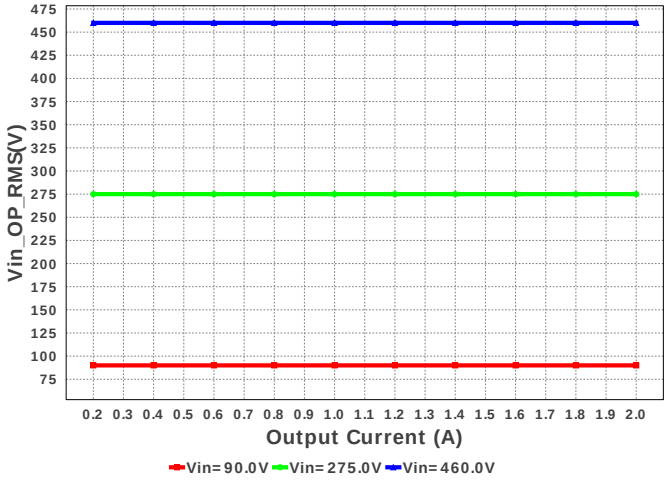
IC Pd

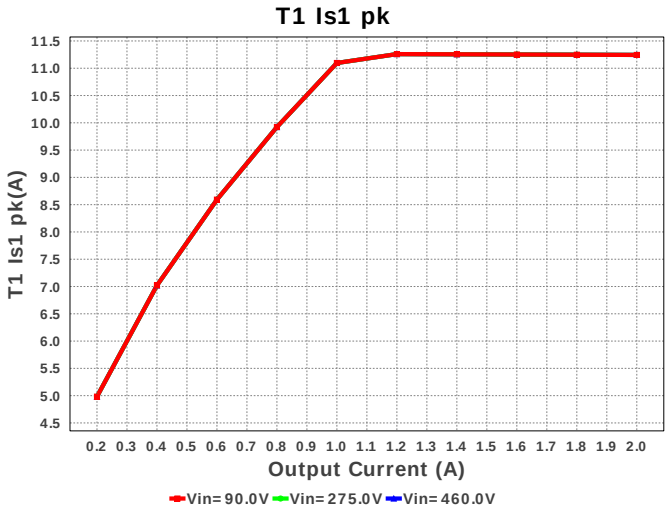


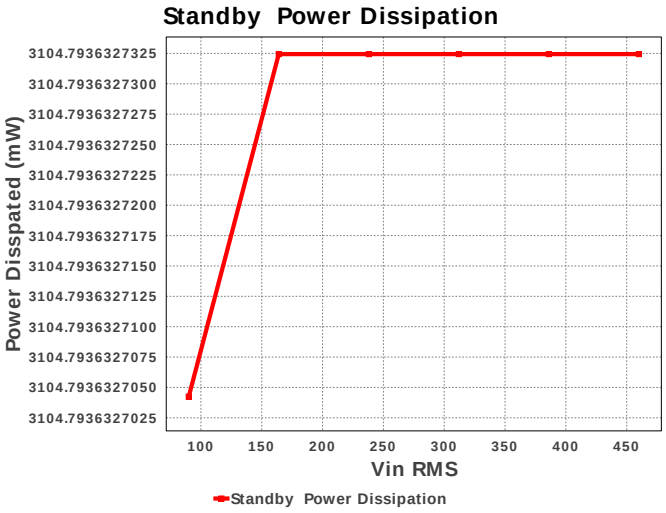
Avg Rectified Vin

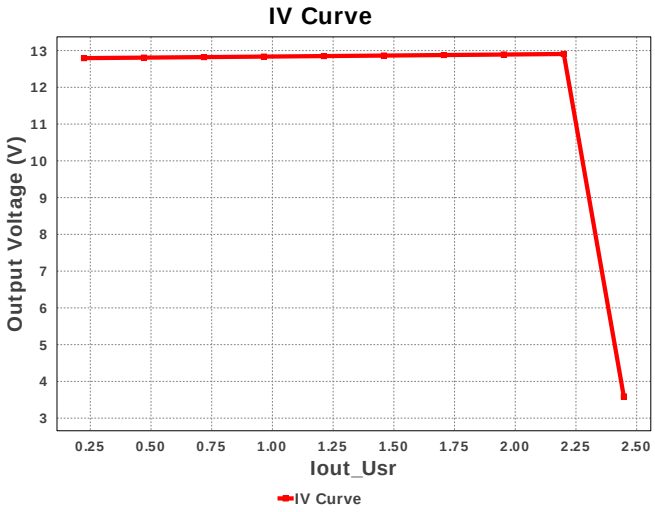


Vin_OP_RMS









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	198.212 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	727.94 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.855 A	Current	Output capacitor RMS ripple current
4.	Iin rms	338.78 mA	Current	RMS Input Current
5.	T1 Iprim RMS	575.002 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	1.66 A	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.876 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	11.244 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	102.423 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	25	General	Total Design BOM count
11.	FootPrint	789.0 mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	25.79 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	28.926 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	12.895 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	36.014 %	Op_point	Duty cycle
18.	Efficiency	84.585 %	Op_point	Steady state efficiency
19.	Frequency	64.158 kHz	Op_point	Switching frequency
20.	IC Tj	41.743 degC	Op_point	IC junction temperature
21.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	2.0 A	Op_point	Iout operating point
23.	M1 TjOP	35.833 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	77.567 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	127.278 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	90.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	56.221 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	290.801 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	98.141 mW	Power	Input capacitor power dissipation
30.	Cout Pd	74.323 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	1.603 W	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	82.992 mW	Power	IC power dissipation
33.	M1 Pd	116.661 mW	Power	M1 MOSFET total power dissipation
34.	Snubber Pd	333.407 mW	Power	Snubber Power Dissipation
35.	Total Pd	4.7 W	Power	Total Power Dissipation
36.	Xformer Pd	1.559 W	Power	Transformer power dissipation
37.	Vout Tolerance	1.953 %		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	460.0	Maximum input voltage
3.	VinMin	90.0	Minimum input voltage
4.	Vout	12.0	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. 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.