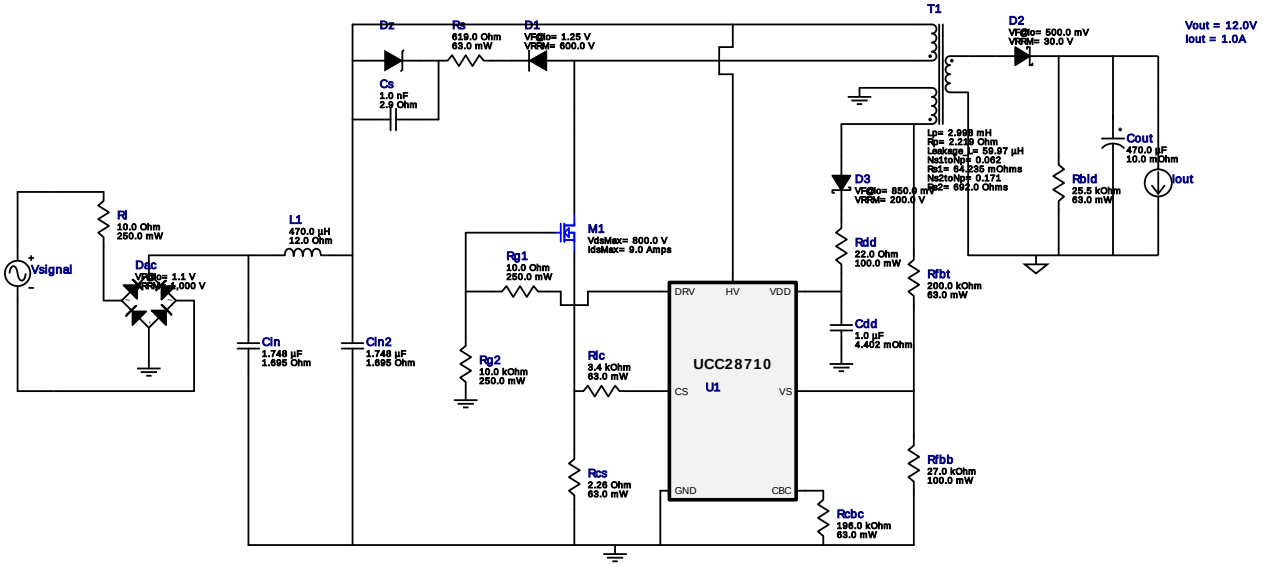
WEBENCH® Design Report

VinMin = 210.0V
VinMax = 240.0V
Vout = 12.0V
Iout = 1.0A

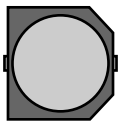
Device = UCC28710DR
Topology = Flyback
Created = 7/17/16 7:51:36 AM
BOM Cost = $0.00
BOM Count = 25
Total Pd = 1.6W

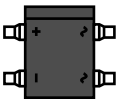
Design : 1194016/2107 UCC28710DR
UCC28710DR 210.0V-240.0V to 12.52V @ 1.0A



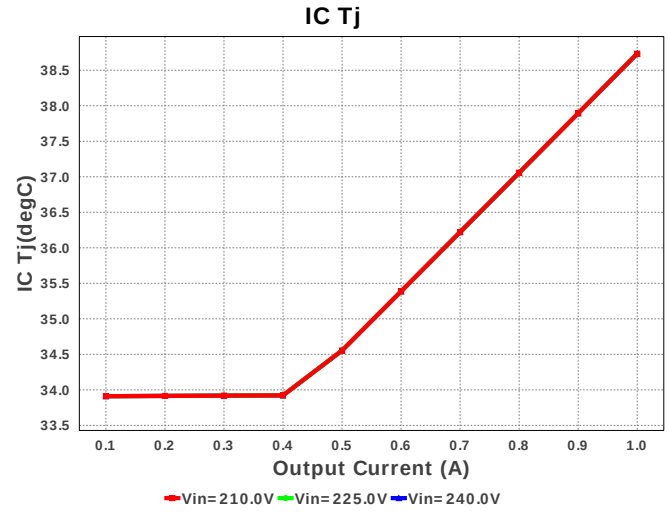
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

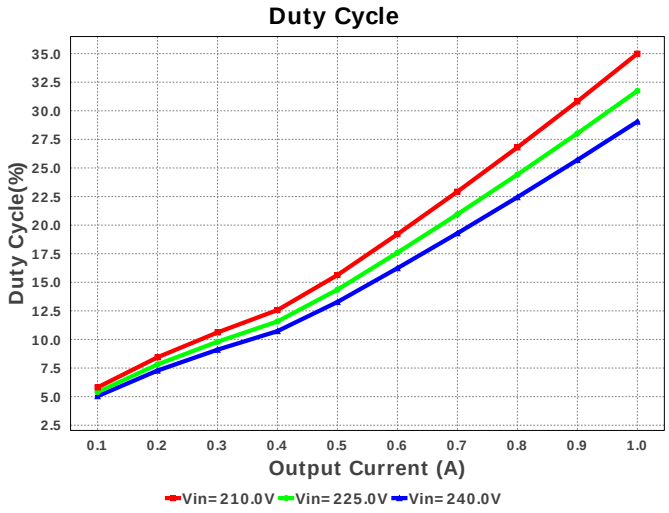
Electrical BOM

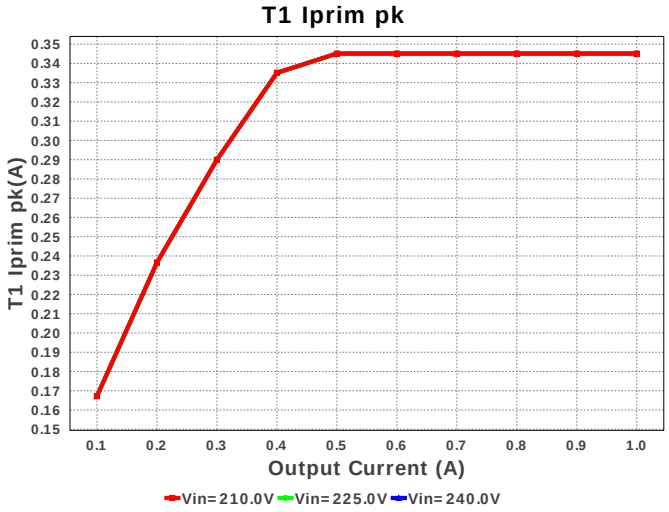
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR71H105KA12L Series= X7R	Cap= 1.0 uF ESR= 4.402 mOhm VDC= 50.0 V IRMS= 1.677 A	1	$0.05	0805 7 mm²
2.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 1.748 uF ESR= 1.69545 Ohm VDC= 509.11 V IRMS= 259.6 mA	1	NA	CUSTOM 0 mm²
3.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 1.748 uF ESR= 1.69545 Ohm VDC= 509.11 V IRMS= 259.6 mA	1	NA	CUSTOM 0 mm²
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 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	Diodes Inc.	MURS160-13-F	VF@Io= 1.25 V VRRM= 600.0 V	1	$0.11	 SMB 44 mm²
7.	D2	Diodes Inc.	B230A-13-F	VF@Io= 500.0 mV VRRM= 30.0 V	1	$0.09	 SMA 37 mm²

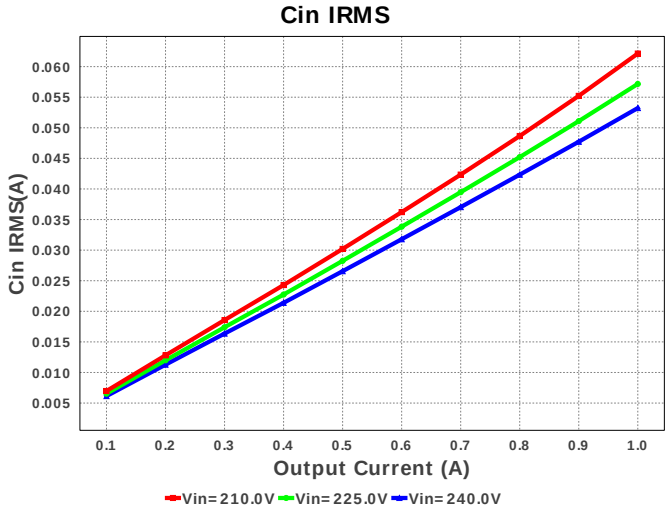
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	D3	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	$0.21	 PowerDI123 13 mm²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
10.	Dz	ON Semiconductor	1SMB5953BT3G	Zener	1	$0.10	 SMB 44 mm²
11.	L1	NIC Components	NPI32C471MTRF	L= 470.0 µH DCR= 12.0 Ohm	1	$0.08	 IND_NPI32C 21 mm²
12.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm²
13.	Rbld	Vishay-Dale	CRCW040225K5FKED Series= CRCW..e3	Res= 25.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
14.	Rcbc	Vishay-Dale	CRCW0402196KFKED Series= CRCW..e3	Res= 196.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
15.	Rcs	Vishay-Dale	CRCW04022R26FKED Series= CRCW..e3	Res= 2.26 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 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	Yageo America	RC0603FR-0727KL Series= ?	Res= 27.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
18.	Rfbt	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 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	Panasonic	ERJ-8ENF10R0V Series= ERJ-8E	Res= 10.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
22.	Rlc	Vishay-Dale	CRCW04023K40FKED Series= CRCW..e3	Res= 3.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
23.	Rs	Vishay-Dale	CRCW0402619RFKED Series= CRCW..e3	Res= 619.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	T1	CUSTOM	CUSTOM	Lp= 2.998 mH Rp= 2.219 Ohm Leakage_L= 59.97 µH Ns1toNp= 0.062 Rs1= 64.235 mOhms Ns2toNp= 0.171 Rs2= 692.0 Ohms	1	NA	CUSTOM 0 mm²

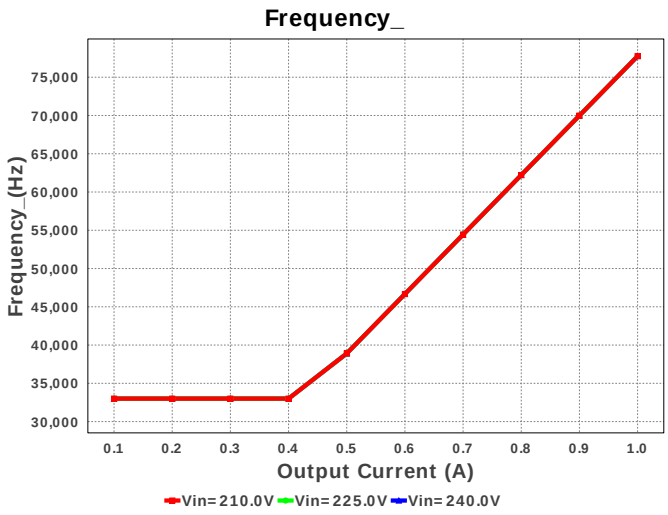
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	U1	Texas Instruments	UCC28710DR	Switcher	1	$0.42	SOIC-7 0 mm²

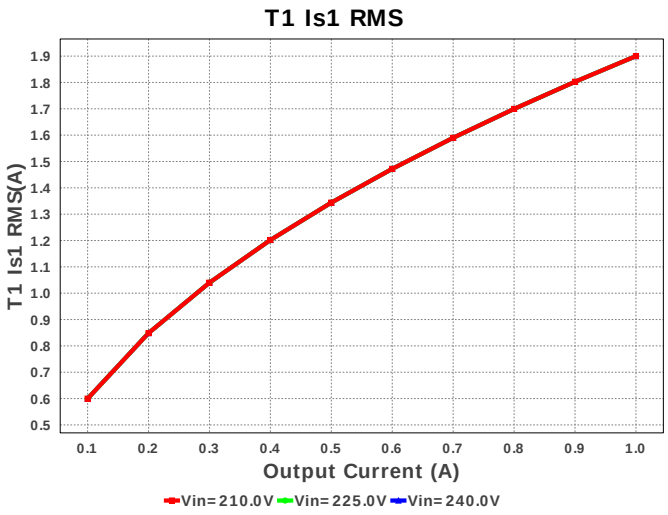


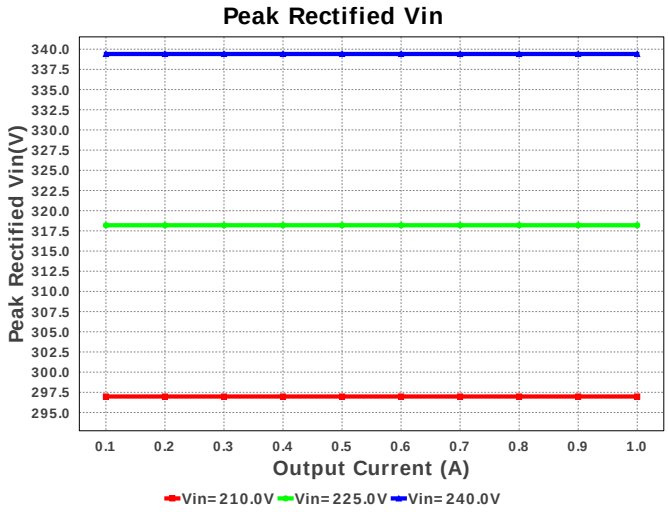


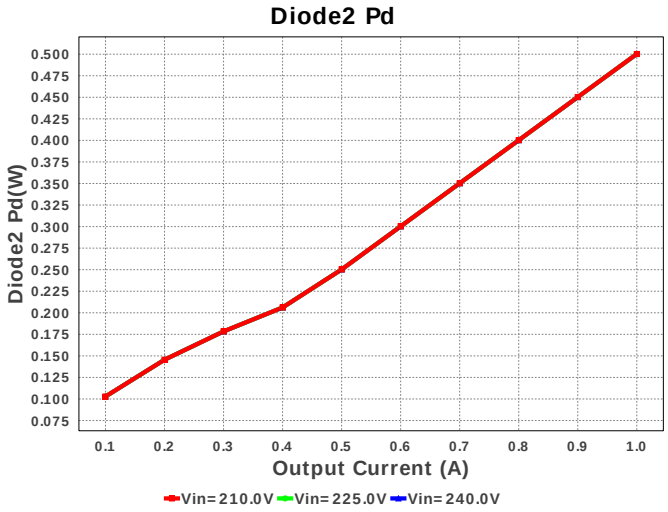


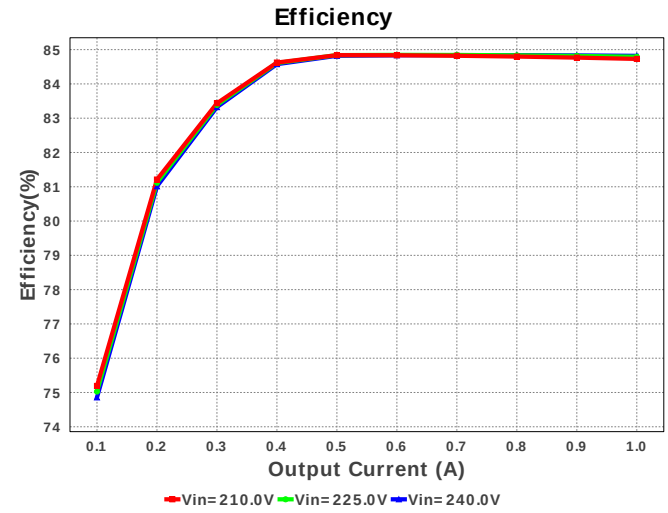


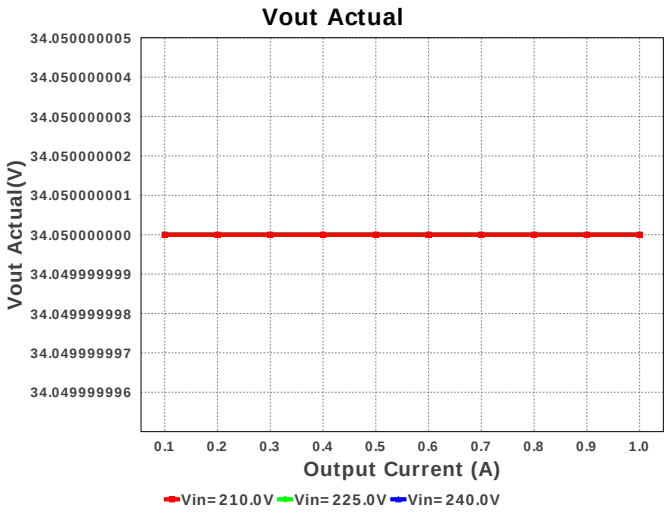


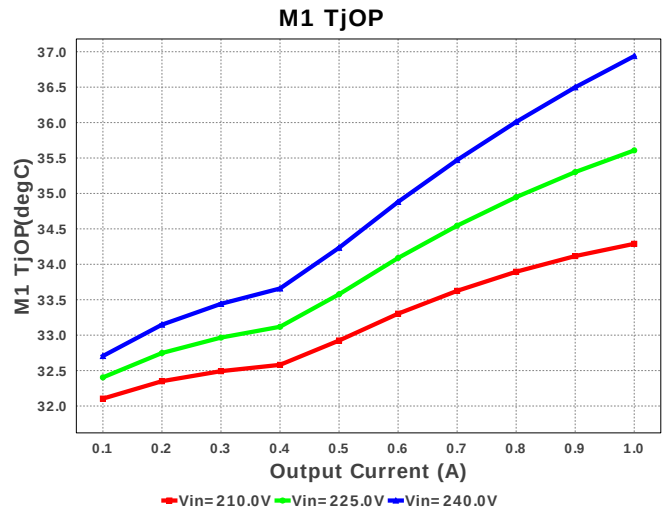


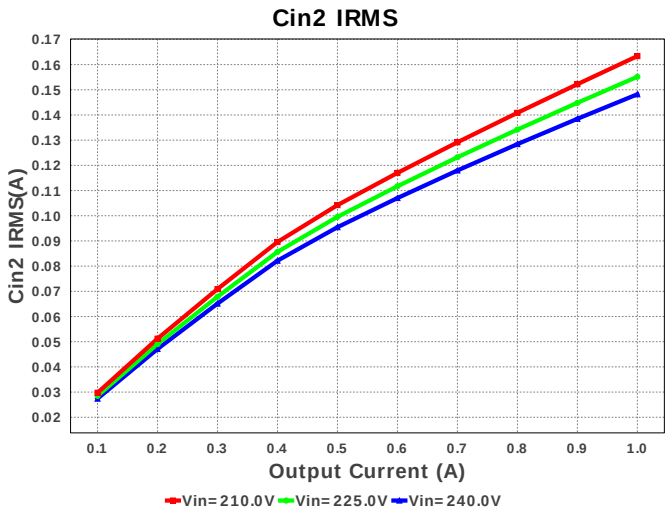


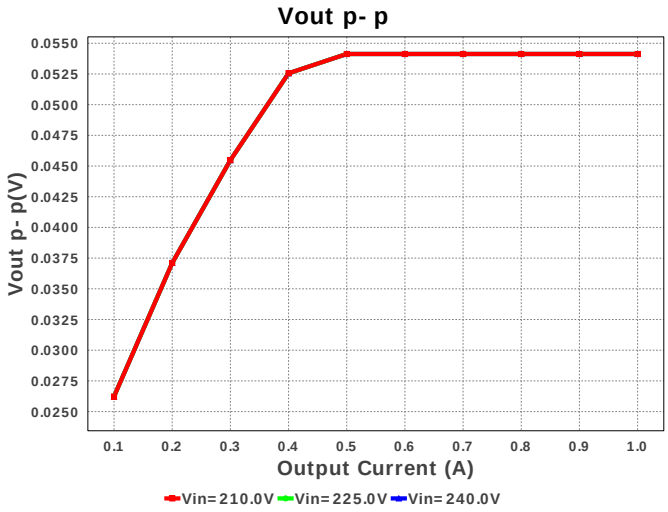


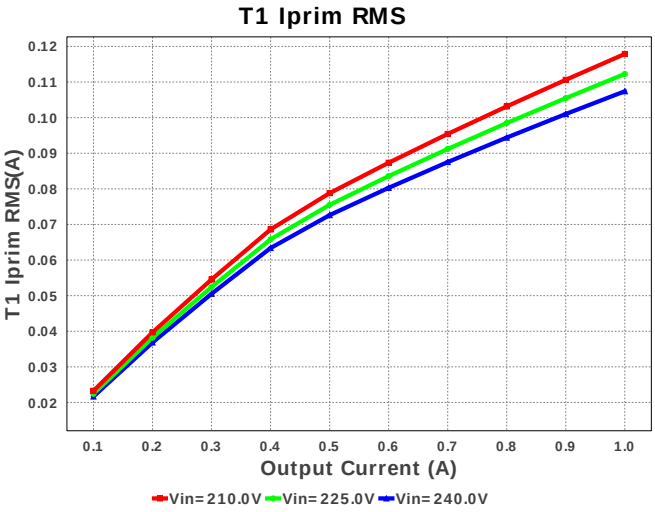


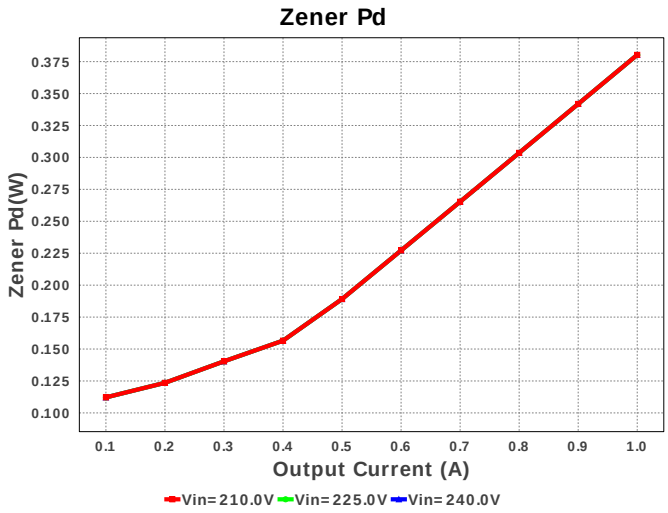


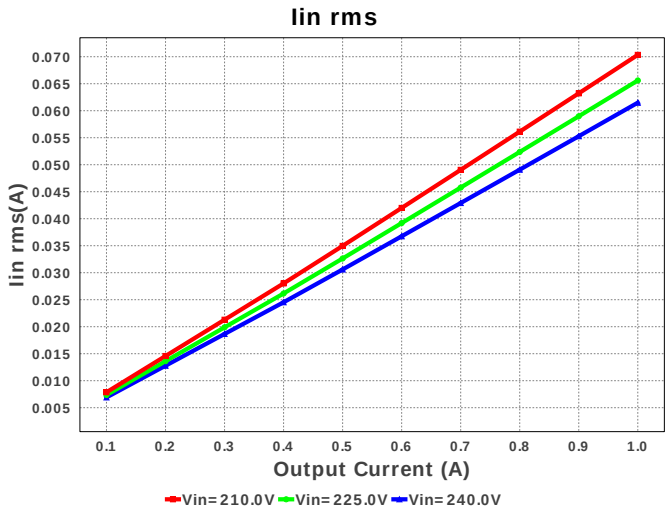




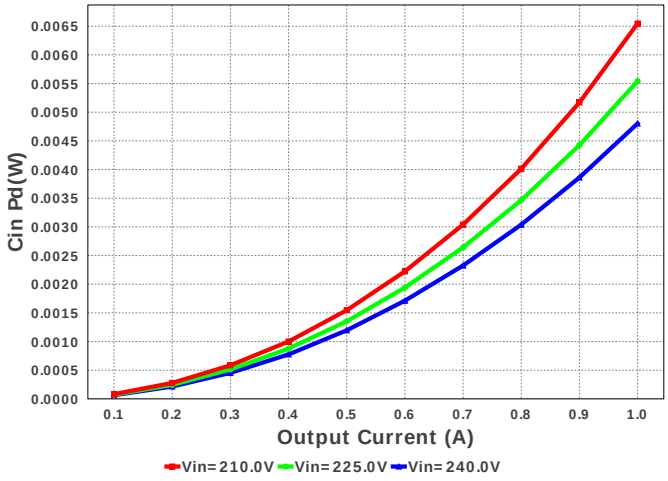




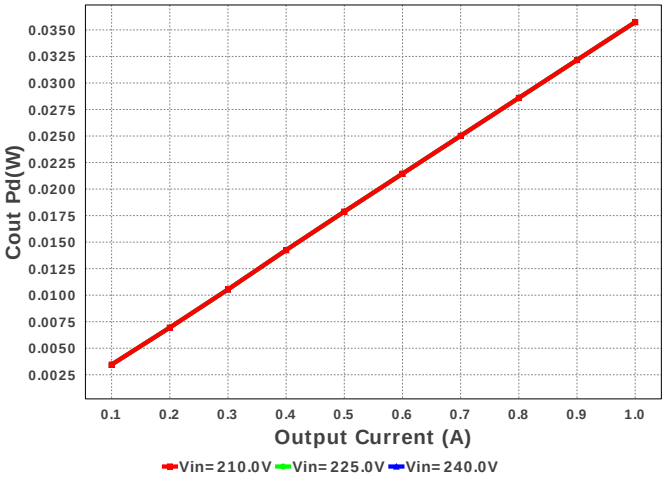




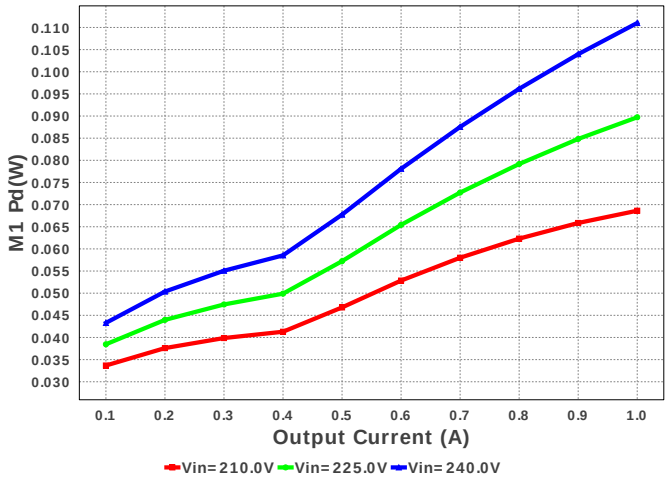
Cin Pd



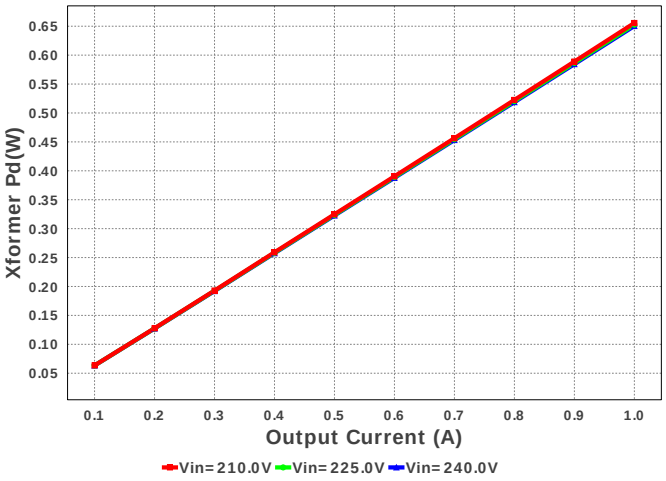
Cout Pd



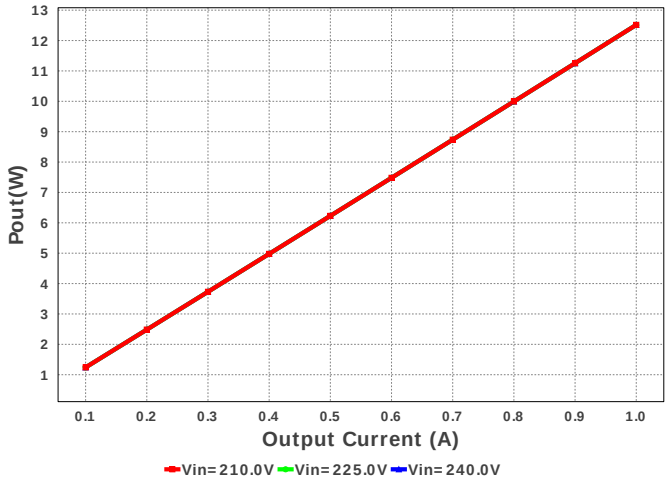
M1 Pd



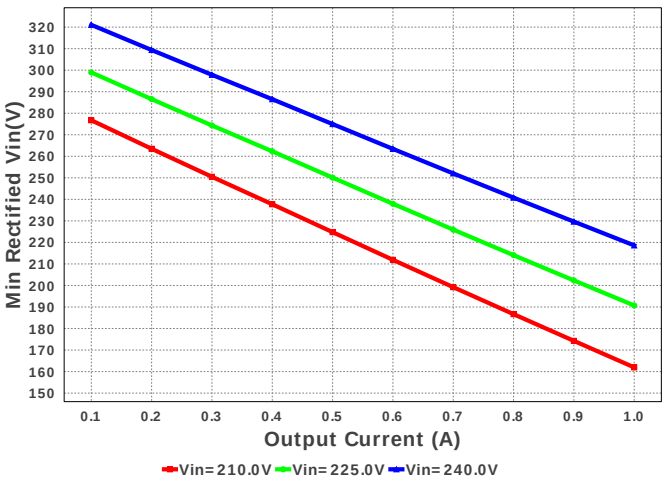
Xformer Pd

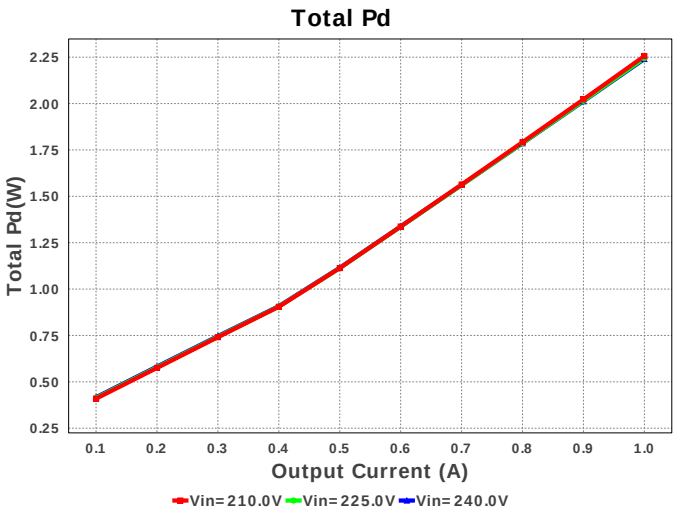


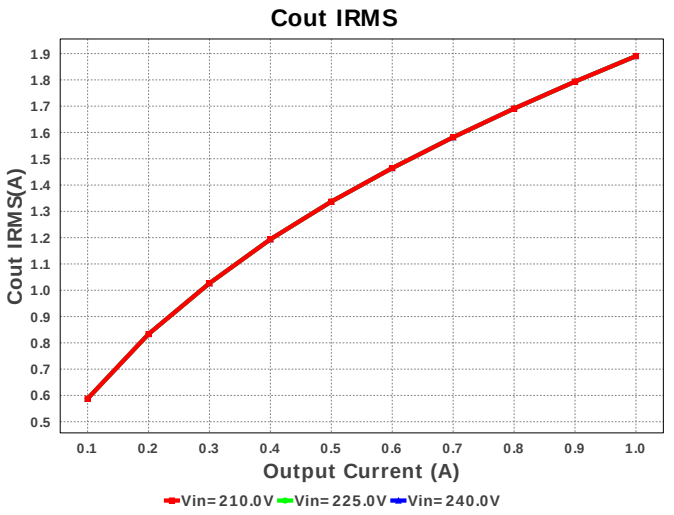
Pout

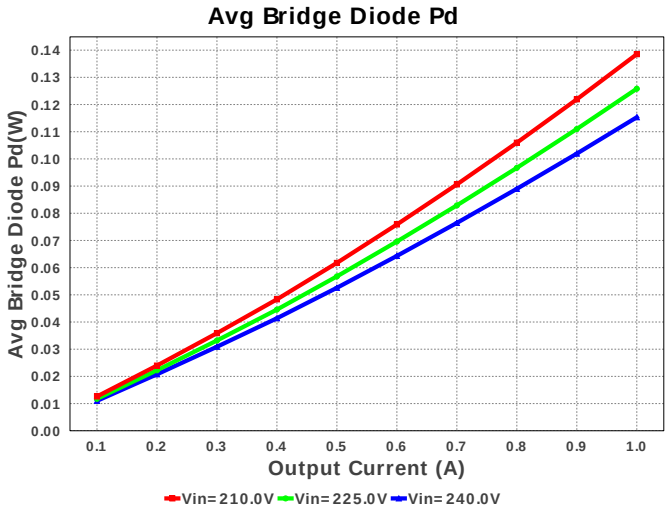


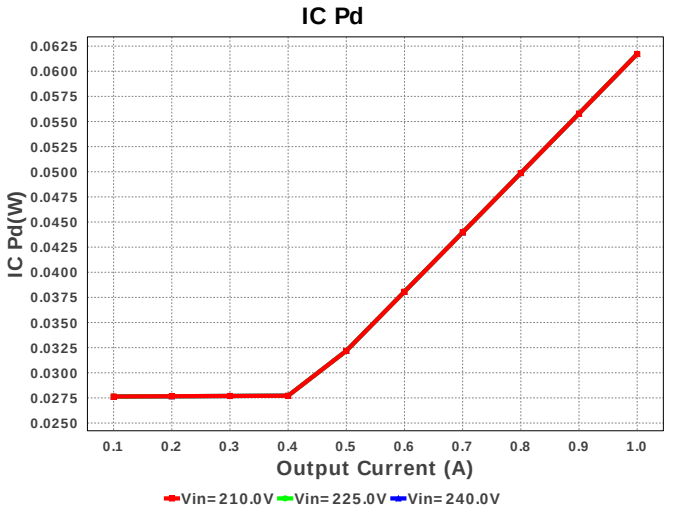
Min Rectified Vin

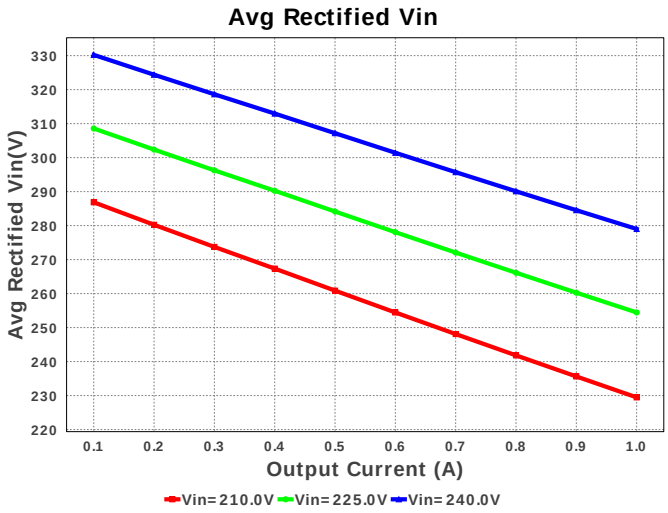


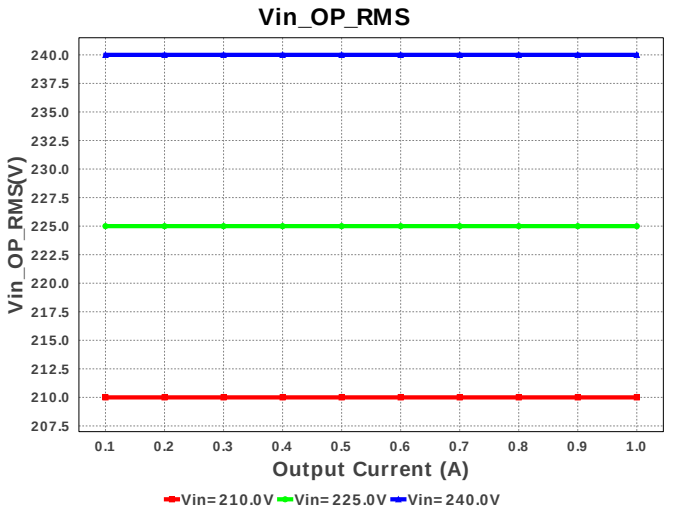


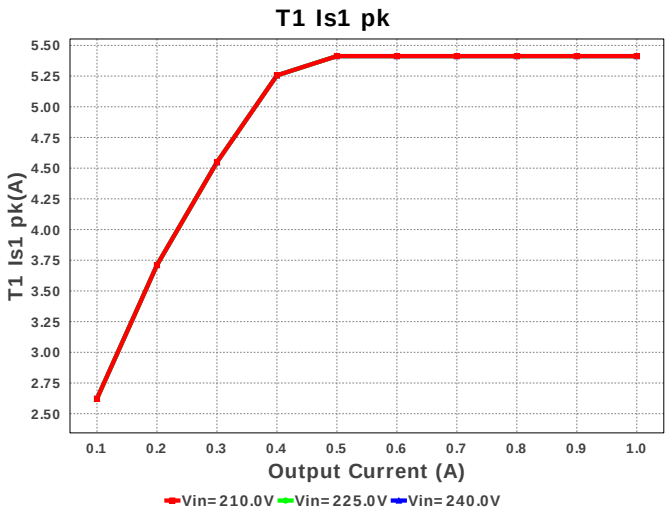


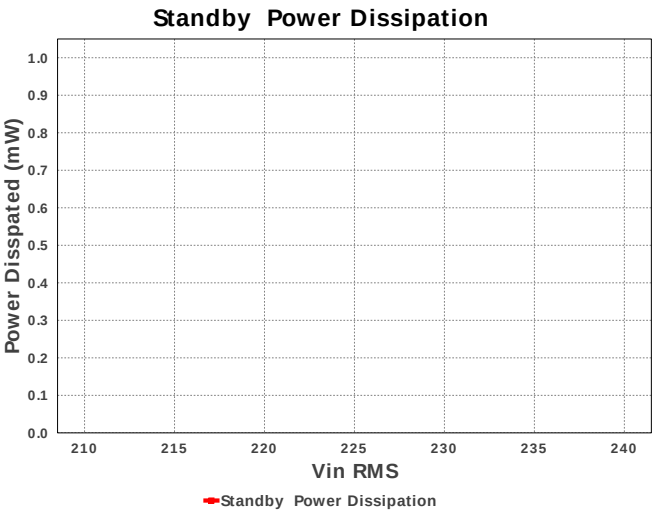


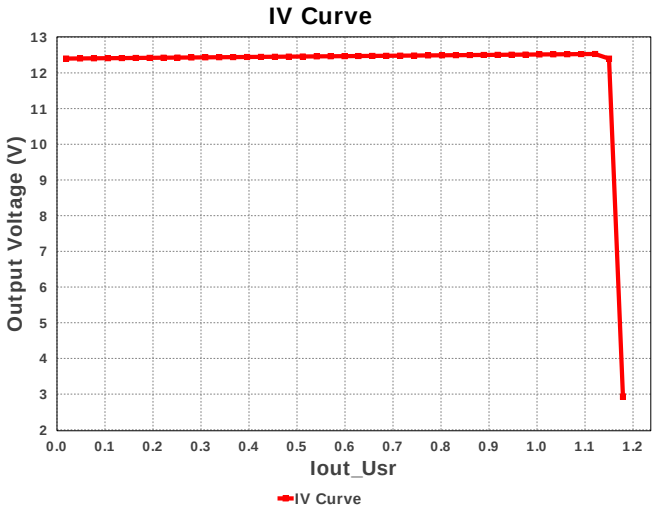












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	50.826 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	143.548 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	1.897 A	Current	Output capacitor RMS ripple current
4.	Iin rms	58.83 mA	Current	RMS Input Current
5.	T1 Iprim RMS	103.929 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	345.133 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	1.907 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	5.453 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	292.158 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	25	General	Total Design BOM count
11.	FootPrint	663.0 mm^2	General	Total Foot Print Area of BOM components
12.	Pout	12.515 W	General	Total output power
13.	Total BOM	$0.0	General	Total BOM Cost
14.	Vout Actual	34.05 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	12.515 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	27.203 %	Op_point	Duty cycle
17.	Efficiency	88.638 %	Op_point	Steady state efficiency
18.	Frequency	75.899 kHz	Op_point	Switching frequency
19.	IC Tj	34.221 degC	Op_point	IC junction temperature
20.	ICThetaJA	70.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	1.0 A	Op_point	Iout operating point
22.	M1 TjOP	37.514 degC	Op_point	M1 MOSFET junction temperature
23.	Min Rectified Vin	244.909 V	Op_point	Minimum voltage seen at rectified input
24.	Peak Rectified Vin	339.408 V	Op_point	Peak voltage seen at rectified input
25.	Vin_OP_RMS	240.0 V	Op_point	AC Input RMS Voltage
26.	Vout p-p	54.529 mV	Op_point	Peak-to-peak output ripple voltage
27.	Avg Bridge Diode Pd	66.067 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
28.	Cin Pd	4.38 mW	Power	Input capacitor power dissipation
29.	Cout Pd	36.002 mW	Power	Output capacitor power dissipation
30.	Diode2 Pd	375.653 mW	Power	Diode2 power dissipation
31.	IC Pd	60.306 mW	Power	IC power dissipation

#	Name	Value	Category	Description
32.	M1 Pd	120.223 mW	Power	M1 MOSFET total power dissipation
33.	Total Pd	1.604 W	Power	Total Power Dissipation
34.	Xformer Pd	646.595 mW	Power	Transformer power dissipation
35.	Zener Pd	100.761 mW	Power	Zener power dissipation
36.	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	240.0	Maximum input voltage
3.	VinMin	210.0	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.