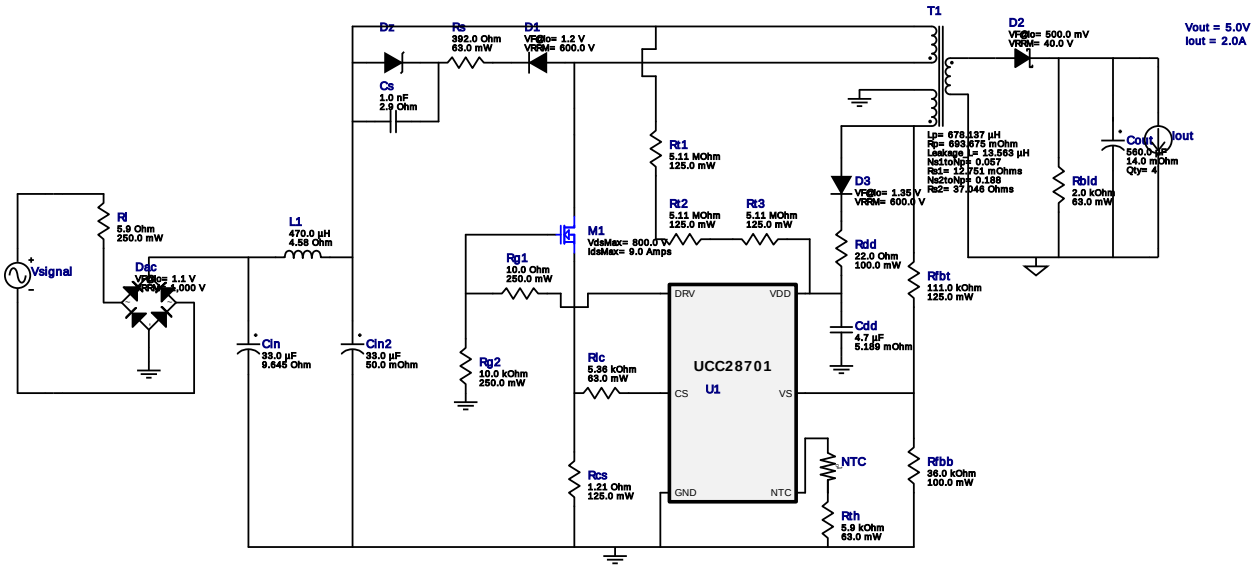
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 265.0V
Vout = 5.0V
Iout = 2.0A

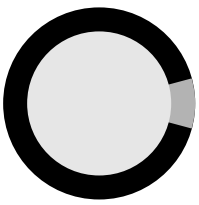
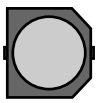
Device = UCC28701DBVR
Topology = Flyback
Created = 9/6/16 10:24:33 PM
BOM Cost = $0.00
BOM Count = 32
Total Pd = 2.3W

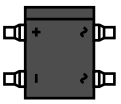
Design : 3876120/7 UCC28701DBVR
UCC28701DBVR 110.0V-265.0V to 5.00V @ 2.0A



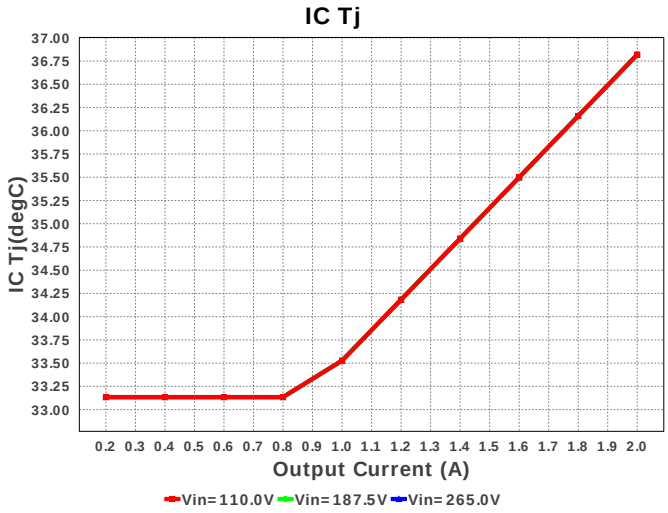
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

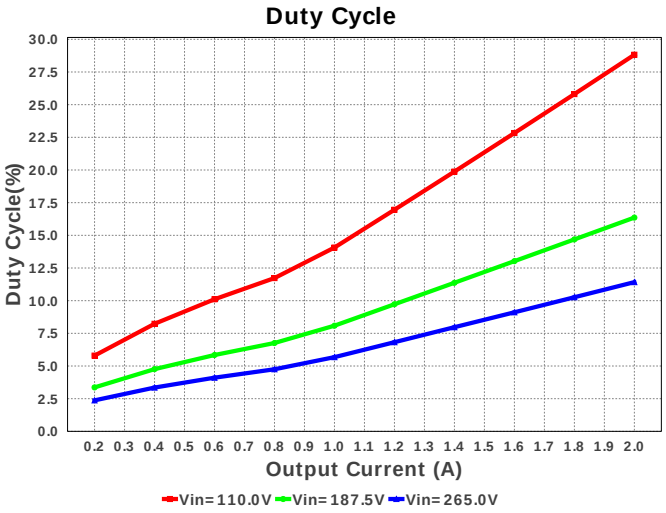
Electrical BOM

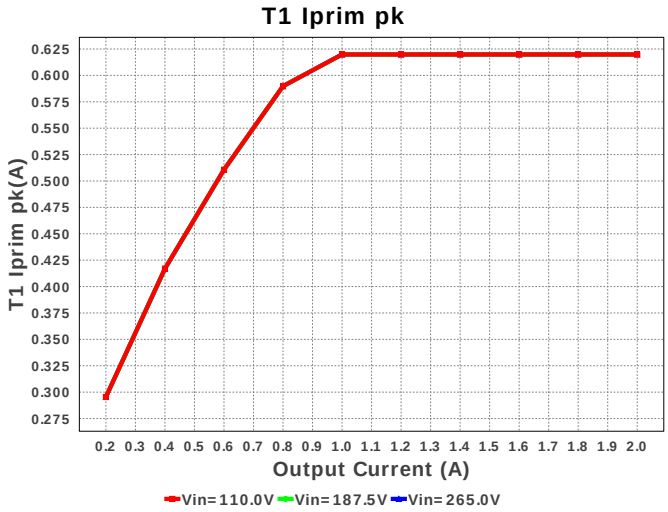
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cdd	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	 0805 7 mm²
2.	Cin	Nichicon	UCS2W330MHD6 Series= 2234	Cap= 33.0 uF ESR= 9.645 Ohm VDC= 450.0 V IRMS= 490.0 mA	1	$0.58	UCS_1800x2000 0 mm²
3.	Cin2	Nichicon	UPW2W330MHD Series= PW	Cap= 33.0 uF ESR= 50.0 mOhm VDC= 450.0 V IRMS= 145.0 mA	1	$0.80	 CAPPR7.5-18X40 400 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

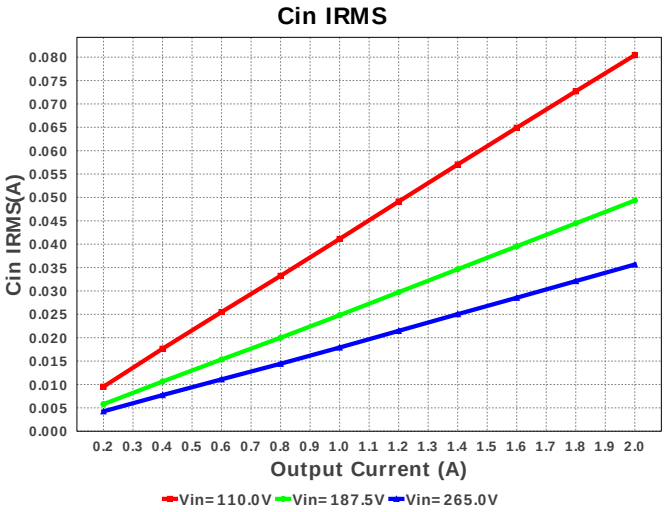
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	D2	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.11	 SMA 37 mm²
8.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm²
9.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
10.	Dz	ON Semiconductor	1SMB5949BT3G	Zener	1	$0.10	 SMB 44 mm²
11.	L1	TDK	VLCF4028T-471MR14-2	L= 470.0 µH DCR= 4.58 Ohm	1	$0.36	 VLCF4028 25 mm²
12.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm²
13.	Rbld	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
14.	Rcs	Vishay-Dale	CRCW08051R21FKEA Series= CRCW..e3	Res= 1.21 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	Yageo America	RC0603FR-0736KL Series= ?	Res= 36.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
17.	Rfbt	Yageo America	RT0805BRD07111KL Series= RT0805	Res= 111.0 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	Vishay-Dale	CRCW12065R90FKEA Series= CRCW..e3	Res= 5.9 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm²
21.	Rlc	Vishay-Dale	CRCW04025K36FKED Series= CRCW..e3	Res= 5.36 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
22.	Rs	Vishay-Dale	CRCW0402392RFKED Series= CRCW..e3	Res= 392.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
23.	Rt1	Vishay-Dale	CRCW08055M11FKEA Series= CRCW..e3	Res= 5.11 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
24.	Rt2	Vishay-Dale	CRCW08055M11FKEA Series= CRCW..e3	Res= 5.11 MOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
25.	Rt3	Vishay-Dale	CRCW08055M11FKEA Series= CRCW..e3	Res= 5.11 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

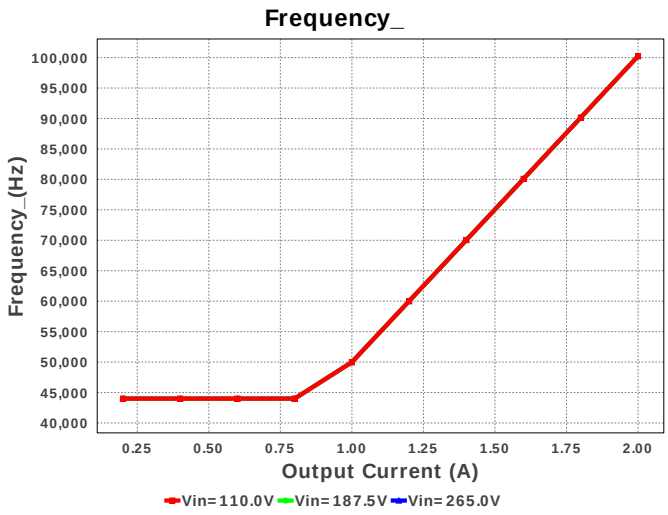
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	T1	CUSTOM	CUSTOM	Lp= 678.137 µH Rp= 693.675 mOhm Leakage_L= 13.563 µH Ns1toNp= 0.057 Rs1= 12.751 mOhms Ns2toNp= 0.188 Rs2= 37.046 Ohms	1	NA	CUSTOM 0 mm^2
28.	U1	Texas Instruments	UCC28701DBVR	Switcher	1	$0.35	SOT-23-6 15 mm^2

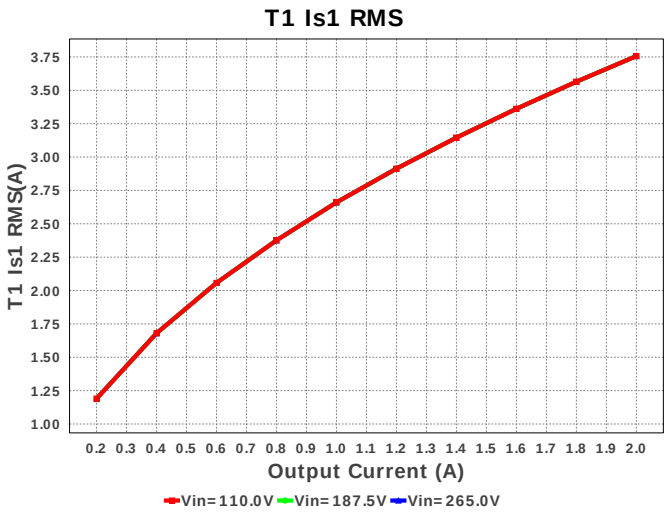


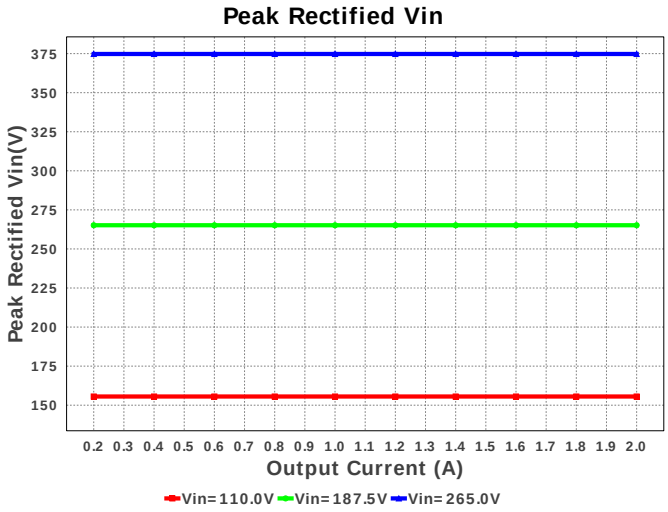


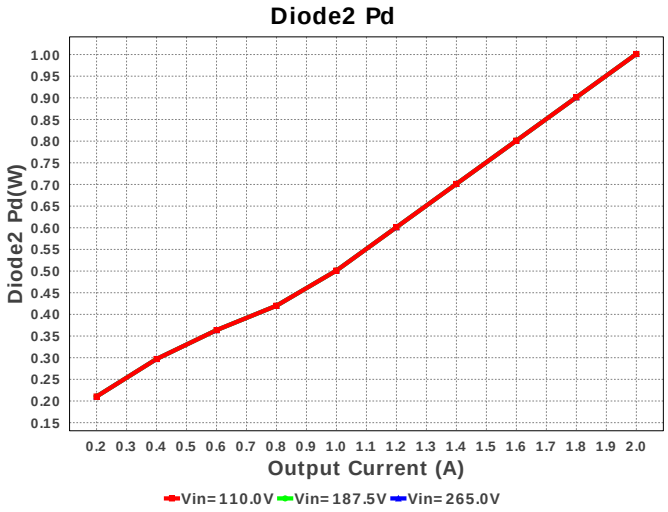


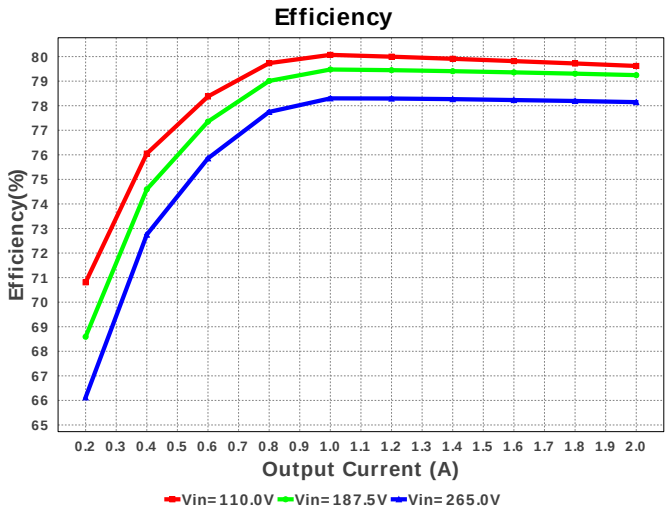


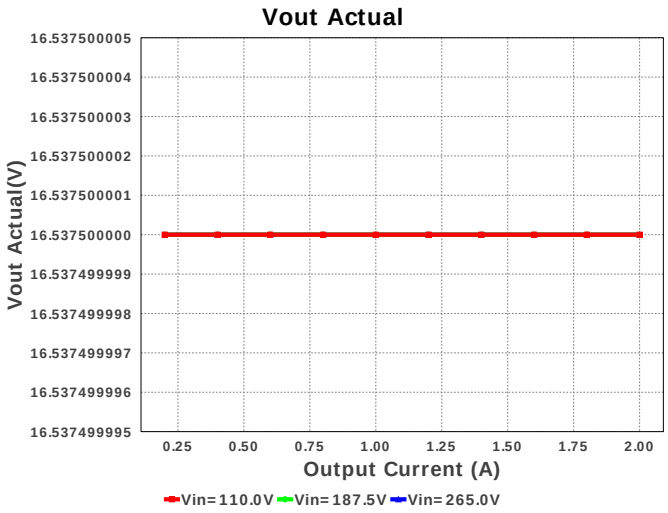


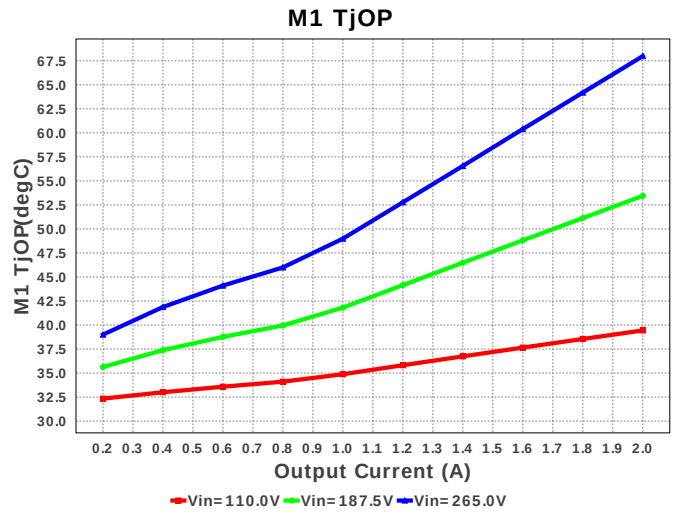


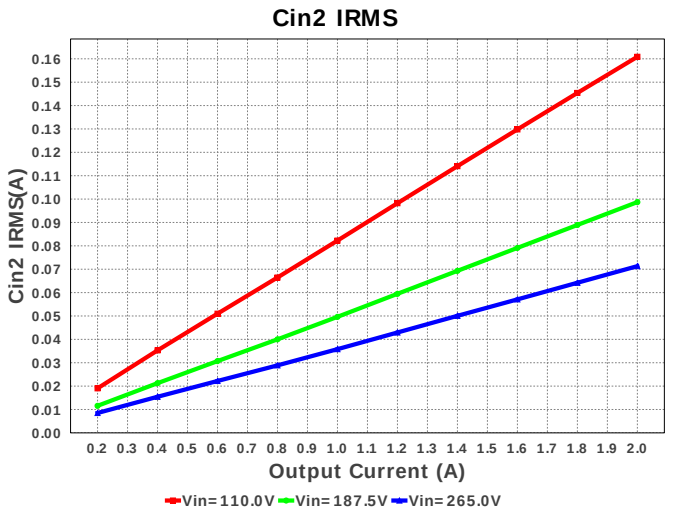


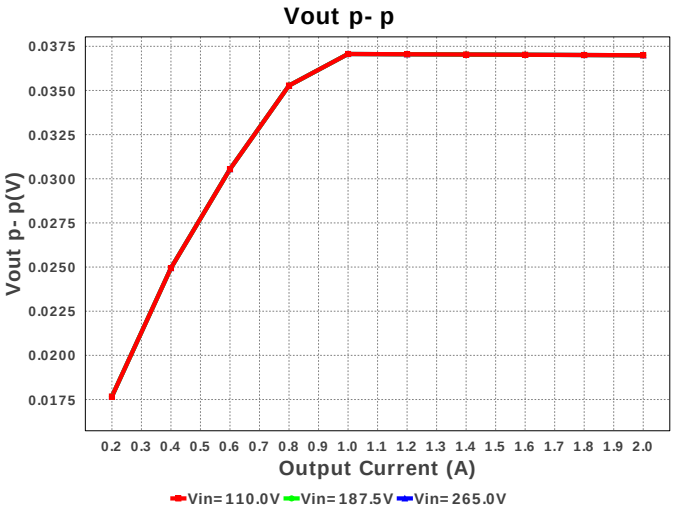


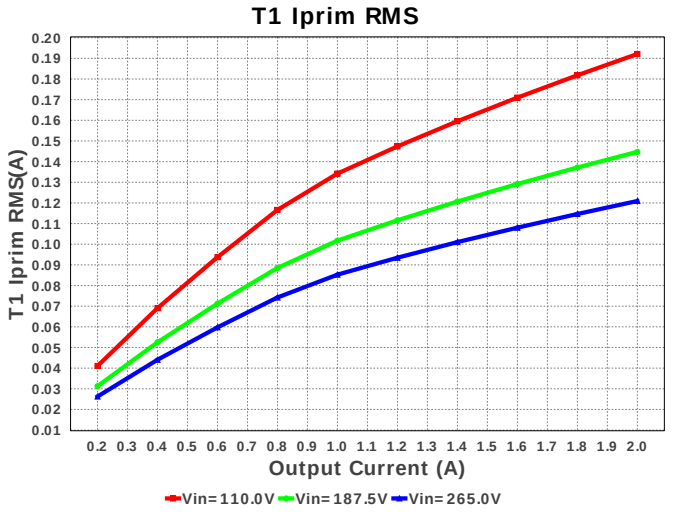


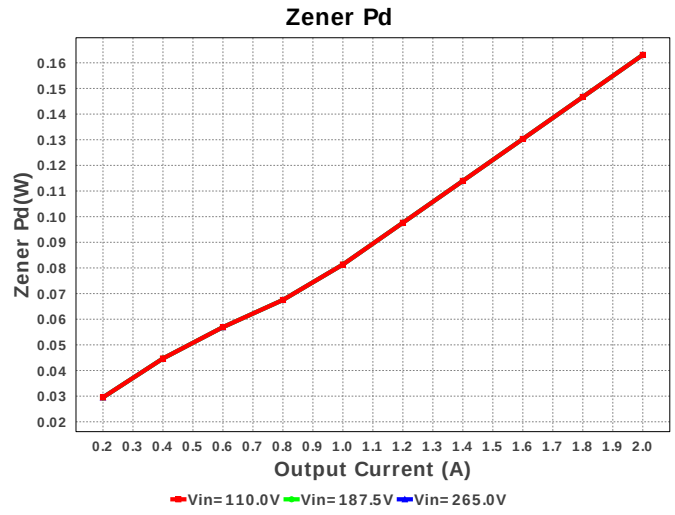


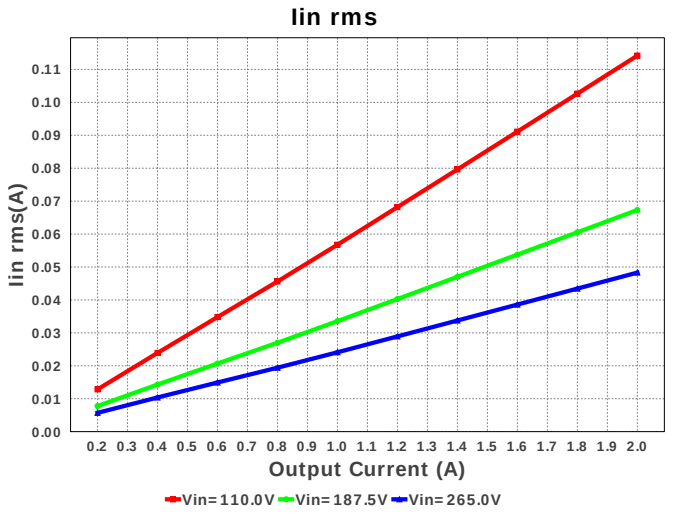


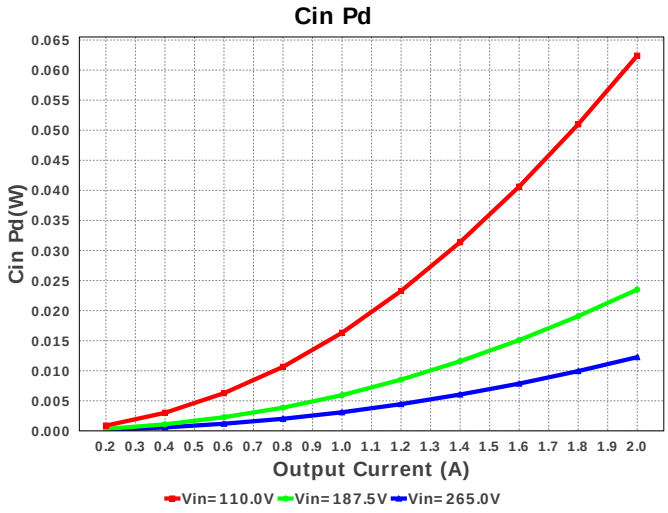


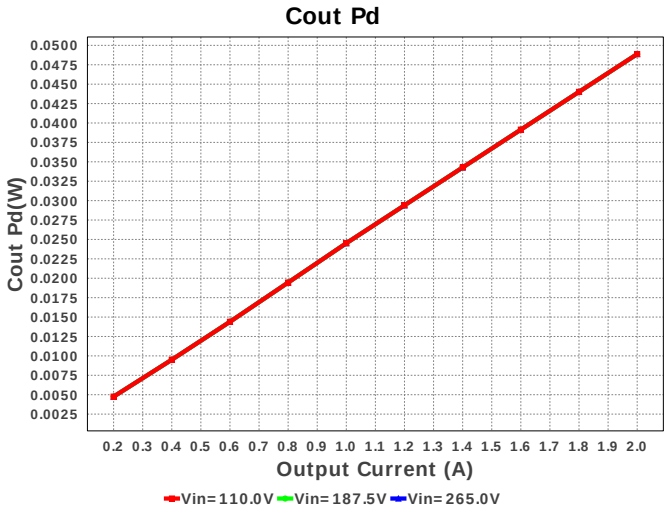


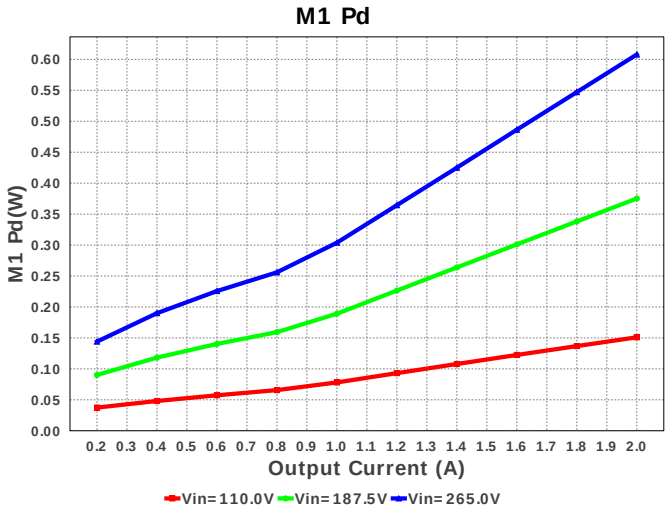


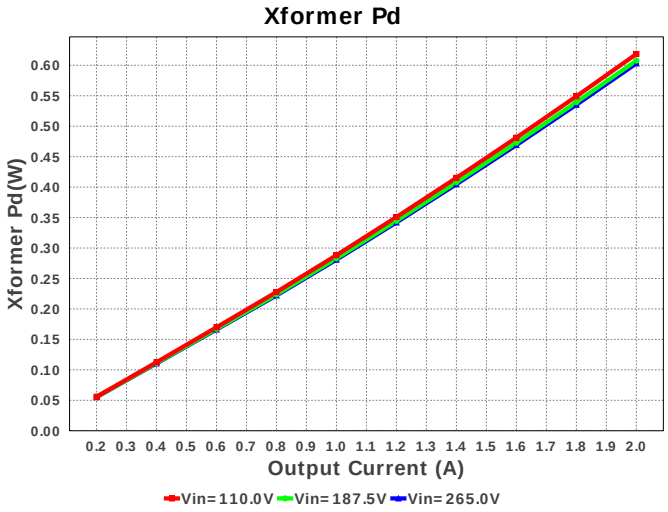


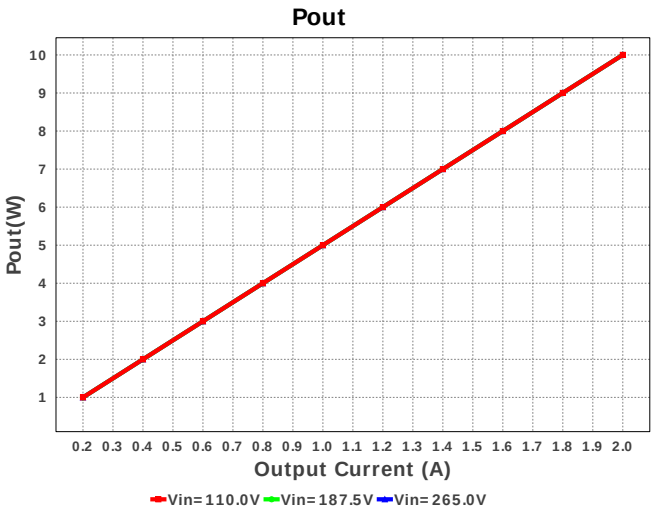


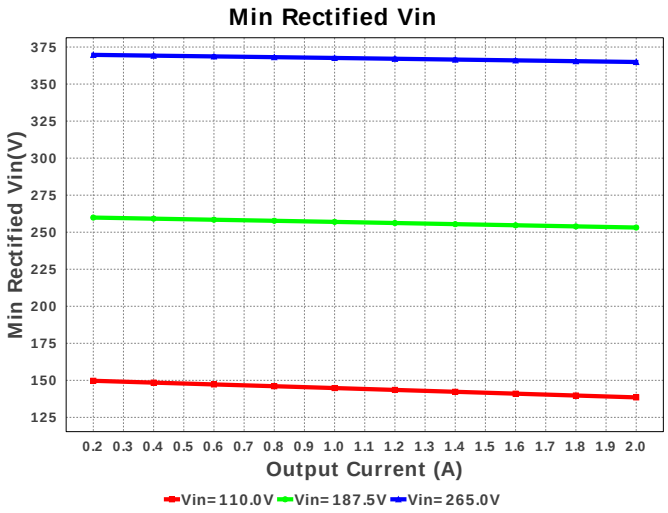


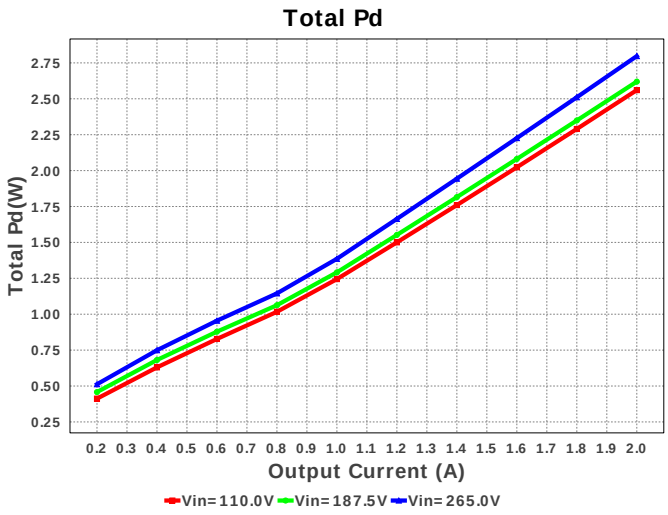


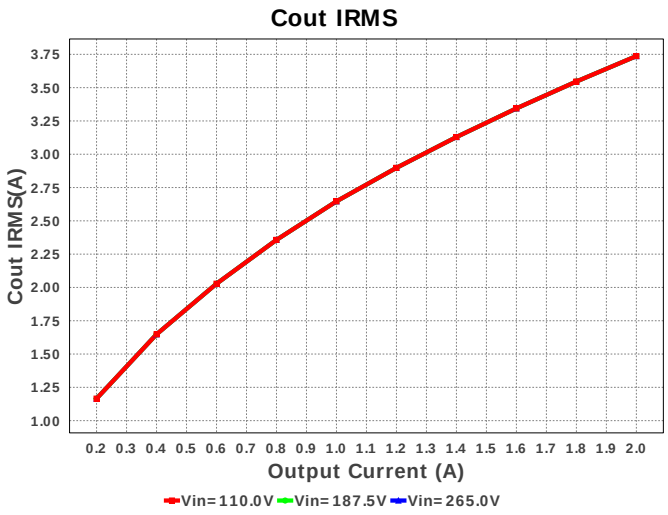


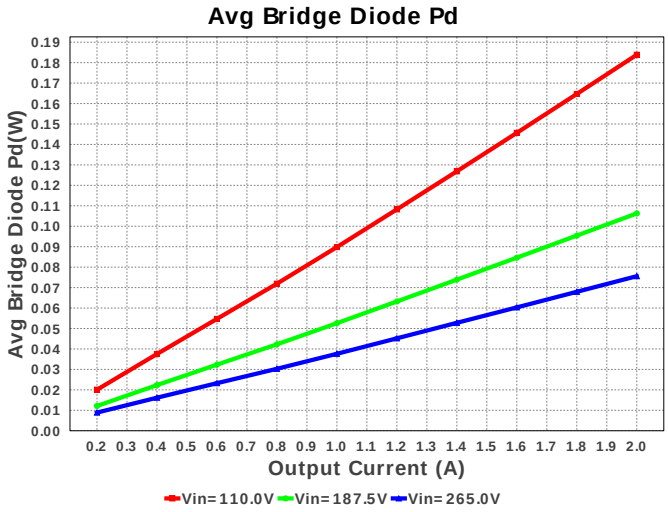


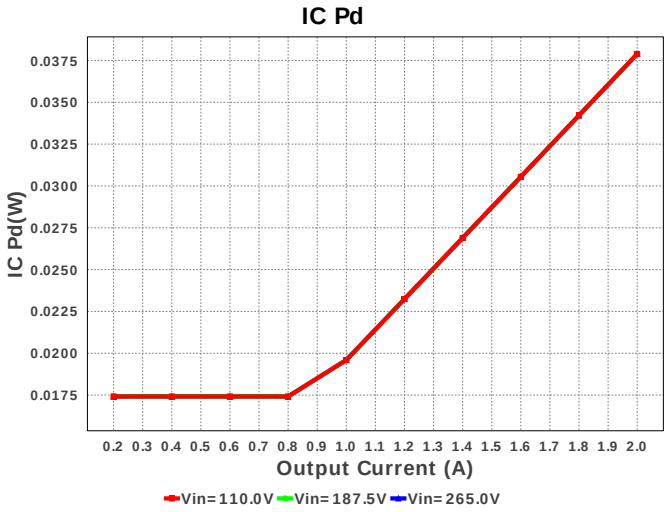


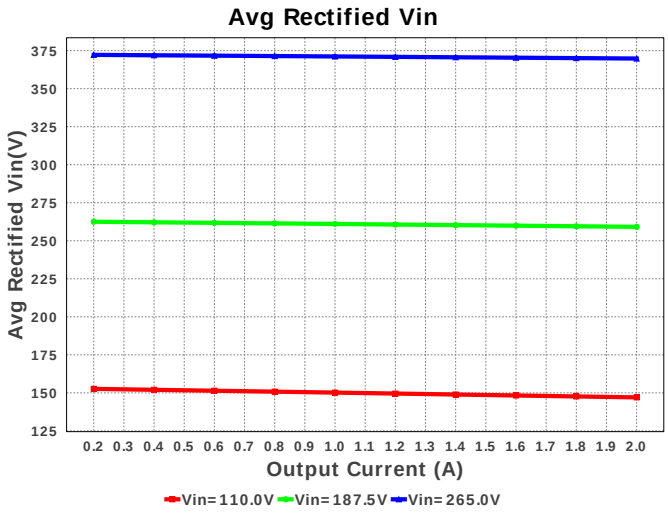


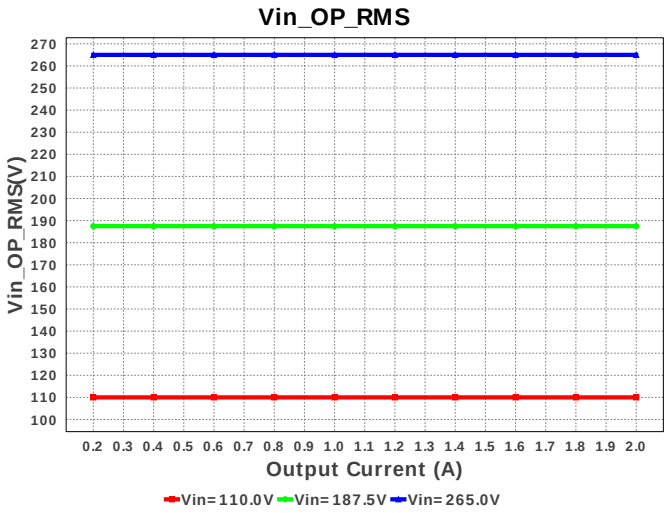


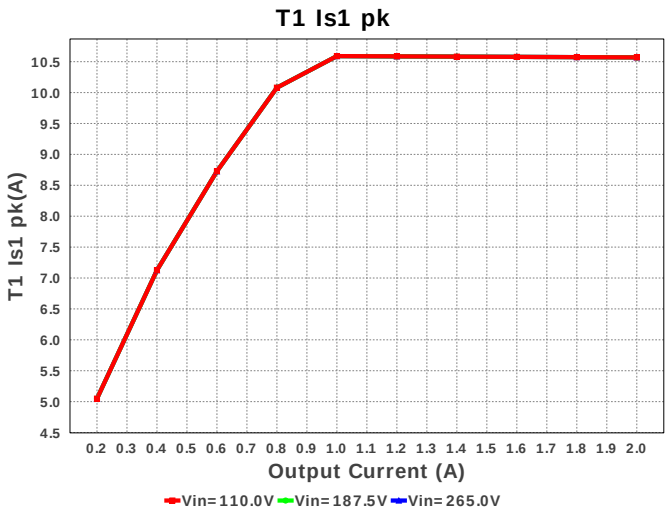


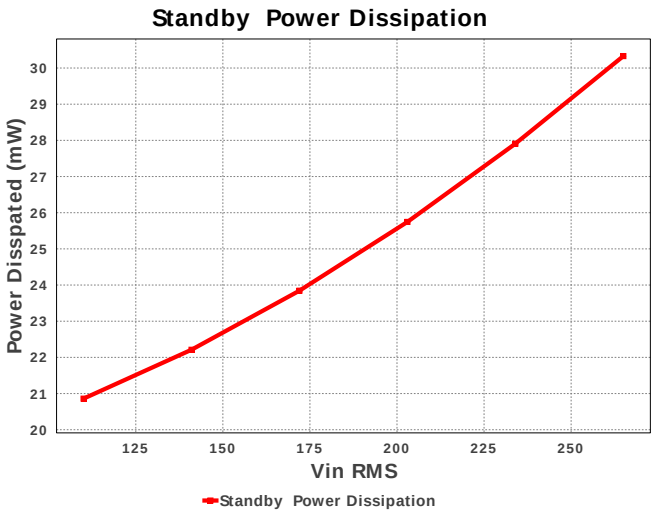


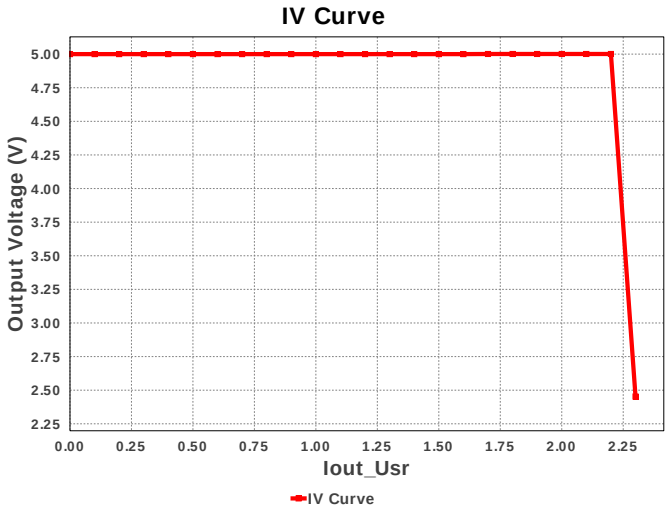












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	34.362 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	234.747 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.752 A	Current	Output capacitor RMS ripple current
4.	Iin rms	46.441 mA	Current	RMS Input Current
5.	T1 Iprim RMS	118.934 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	619.835 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.772 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	10.656 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	370.137 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	32	General	Total Design BOM count
11.	FootPrint	1.347 k mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	10.002 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	16.538 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.001 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	11.045 %	Op_point	Duty cycle
18.	Efficiency	81.272 %	Op_point	Steady state efficiency
19.	Frequency	97.048 kHz	Op_point	Switching frequency
20.	IC Tj	32.571 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	67.004 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	365.512 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	374.763 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	265.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	37.297 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	47.146 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	11.388 mW	Power	Input capacitor power dissipation
30.	Cout Pd	49.277 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	822.579 mW	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	36.724 mW	Power	IC power dissipation
33.	M1 Pd	592.065 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	2.305 W	Power	Total Power Dissipation
35.	Xformer Pd	594.868 mW	Power	Transformer power dissipation
36.	Zener Pd	43.148 mW	Power	Zener power dissipation
37.	Vout Tolerance	1.038 %		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	265.0	Maximum input voltage
3.	VinMin	110.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	line_fsw	50.0	Light Output in Lumen
6.	base_pn	UCC28701	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. **UCC28701** Product Folder : http://www.ti.com/product/UCC28701 : contains the data sheet and other resources.