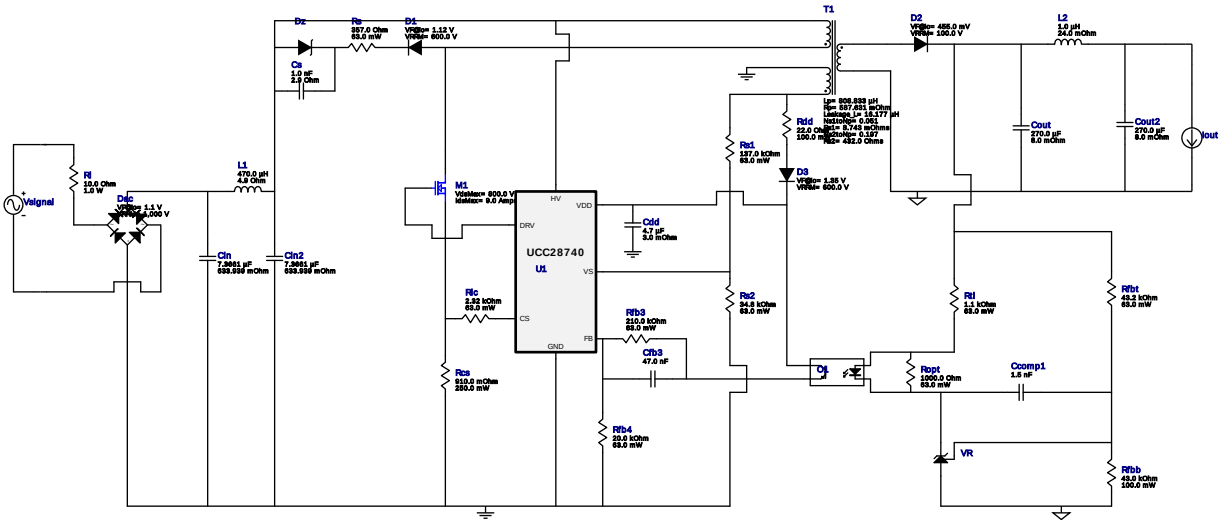
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 220.0V
Vout = 5.0V
Iout = 3.0A

Device = UCC28740DR
Topology = Flyback
Created = 7/19/16 4:28:19 AM
BOM Cost = $0.00
BOM Count = 33
Total Pd = 3.06W

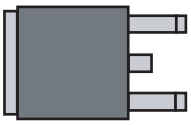
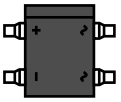
Design : 4077713/33 UCC28740DR
UCC28740DR 110.0V-220.0V to 5.00V @ 3.0A



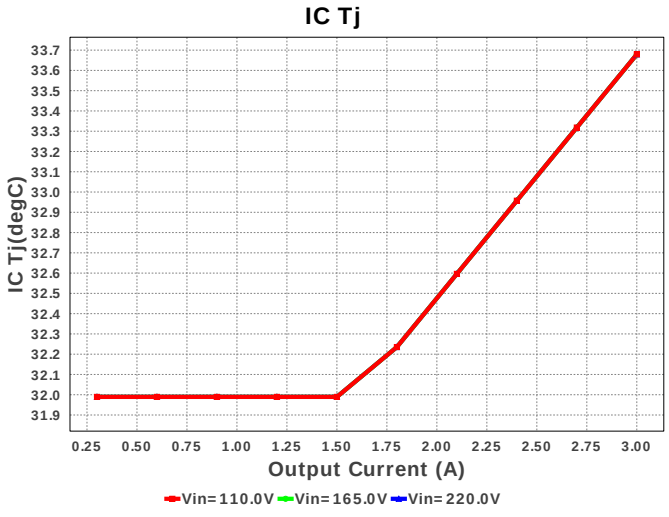
1. Rlc, Rtl and the feedback resistors for this design are a starting point, but may need adjustment based on the actual transformer used. For more information please click the design assistance button.

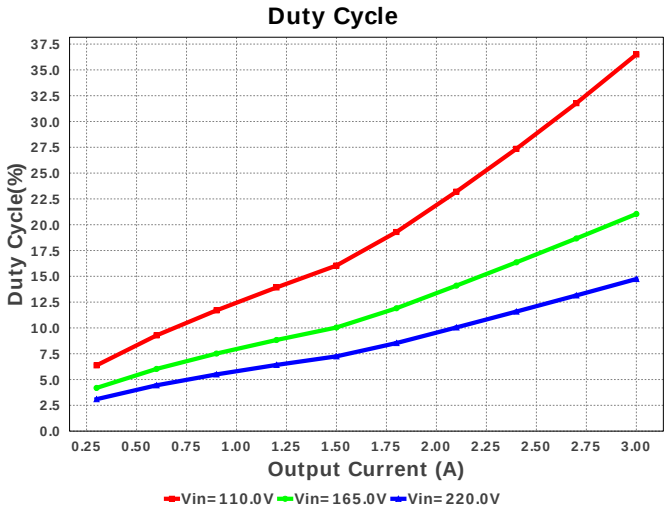
Electrical BOM

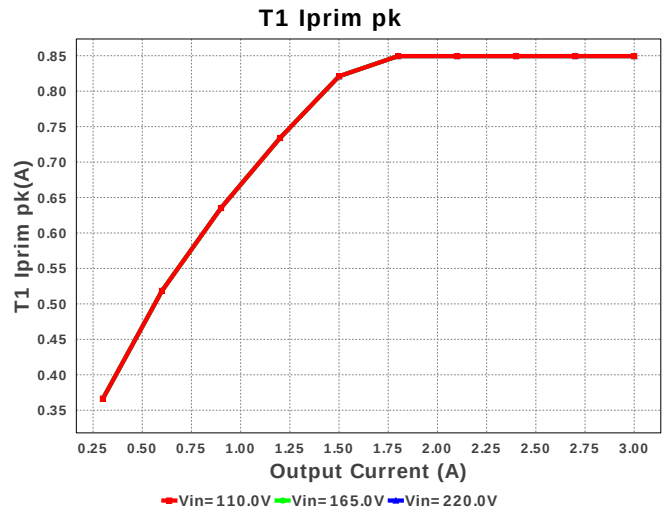
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp1	Yageo America	CC0805KRX7R9BB152 Series= X7R	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cdd	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	1206 11 mm²
3.	Cfb3	Taiyo Yuden	TMK212B7473KD-T Series= X7R	Cap= 47.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 7.3661 uF ESR= 633.94 mOhm VDC= 466.69 V IRMS= 212.276 mA	1	NA	CUSTOM 0 mm²
5.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 7.3661 uF ESR= 633.94 mOhm VDC= 466.69 V IRMS= 212.276 mA	1	NA	CUSTOM 0 mm²
6.	Cout	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	CAPSMT_62_C10 74 mm²
7.	Cout2	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	CAPSMT_62_C10 74 mm²
8.	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

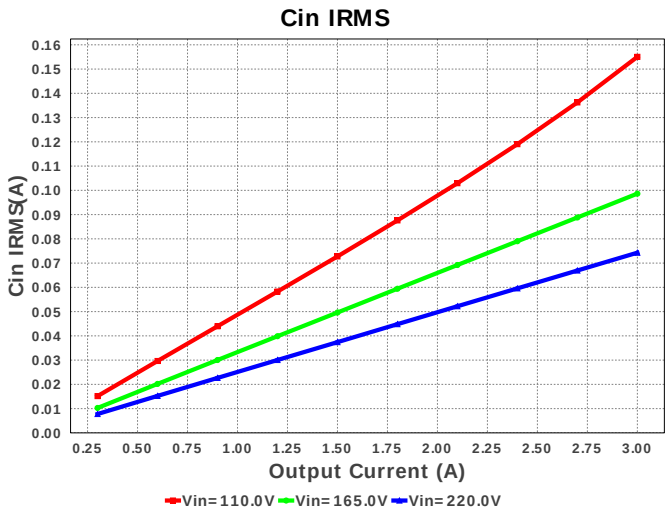
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	D1	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm²
10.	D2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm²
11.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm²
12.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm²
13.	Dz	ON Semiconductor	1SMB5952BT3G	Zener	1	$0.10	 SMB 44 mm²
14.	L1	Bourns	SDR0503-471KL	L= 470.0 µH DCR= 4.9 Ohm	1	$0.19	 SDR0503 48 mm²
15.	L2	Vishay-Dale	IHLP1212BZER1R0M11	L= 1.0 µH DCR= 24.0 mOhm	1	$0.56	 IHLP-1212BZ 19 mm²
16.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm²
17.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.38	 SSOP-4 111 mm²
18.	Rcs	Bourns	CRM0805-FX-R910ELF Series= ?	Res= 910.0 mOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.03	 0805 7 mm²
19.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
20.	Rfb3	Vishay-Dale	CRCW0402210KFKED Series= CRCW..e3	Res= 210.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
21.	Rfb4	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
22.	Rfbb	Yageo America	RC0603FR-0743KL Series= ?	Res= 43.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
23.	Rfbt	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	Rl	Vishay-Dale	CRCW121810R0FKEK Series= CRCW..e3	Res= 10.0 Ohm Power= 1.0 W Tolerance= 1.0%	1	$0.13	 1218 24 mm²
25.	Rlc	Vishay-Dale	CRCW04022K32FKED Series= CRCW..e3	Res= 2.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
26.	Ropt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

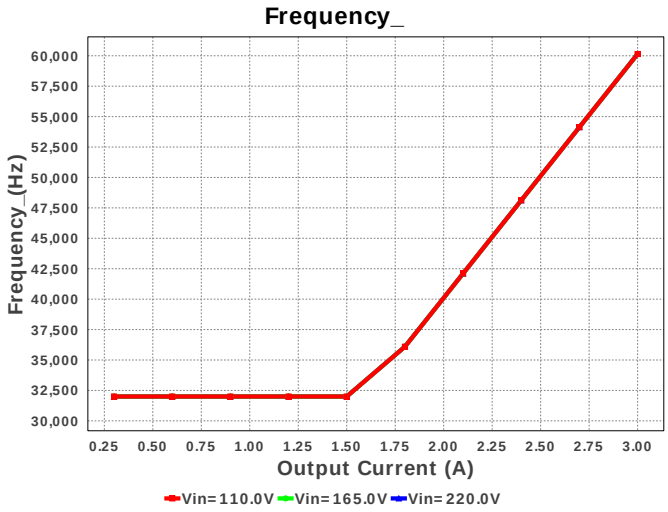
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rs	Vishay-Dale	CRCW0402357RFKED Series= CRCW..e3	Res= 357.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
28.	Rs1	Vishay-Dale	CRCW0402137KFKED Series= CRCW..e3	Res= 137.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
29.	Rs2	Vishay-Dale	CRCW040234K8FKED Series= CRCW..e3	Res= 34.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
30.	Rtl	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
31.	T1	CUSTOM	CUSTOM	Lp= 808.833 µH Rp= 587.631 mOhm Leakage_L= 16.177 µH Ns1toNp= 0.051 Rs1= 8.743 mOhms Ns2toNp= 0.197 Rs2= 432.0 Ohms	1	NA	CUSTOM 0 mm^2
32.	U1	Texas Instruments	UCC28740DR	Switcher	1	$0.42	 R-PDSO-G7 55 mm^2
33.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.07	 R-PDSO-G3 16 mm^2

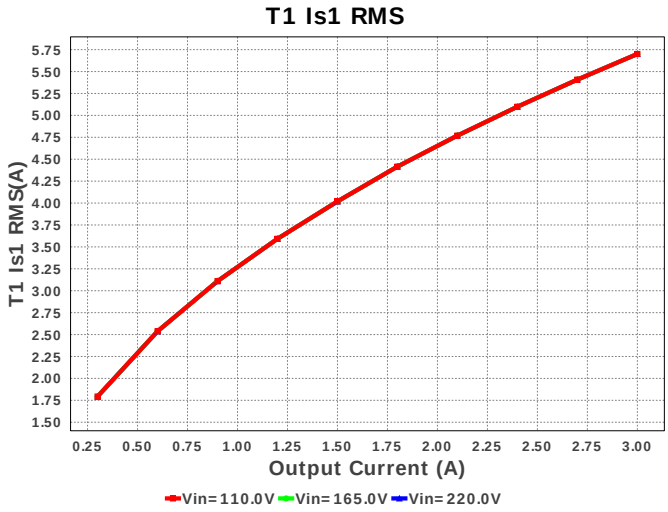


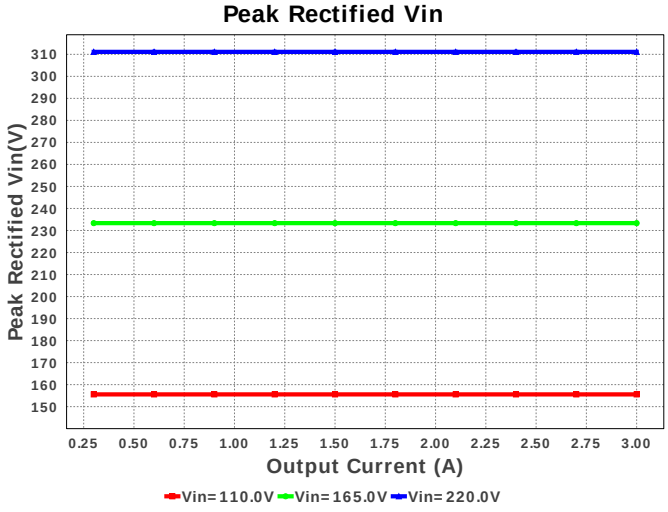


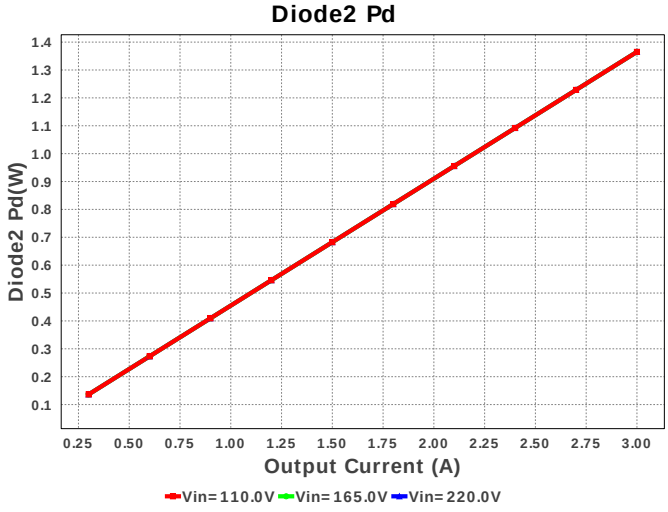




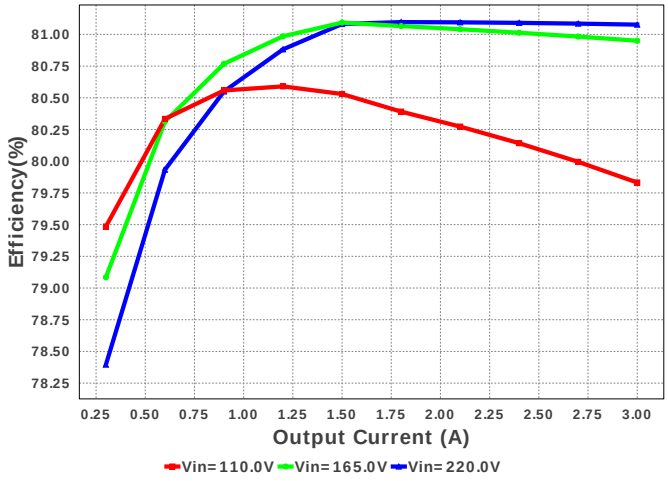




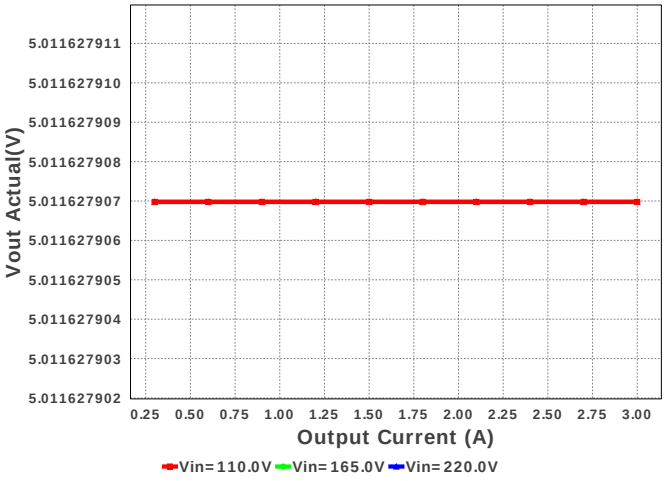




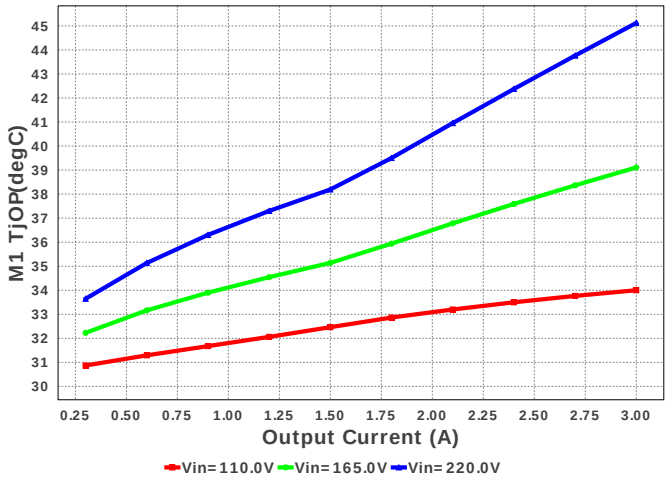
Efficiency



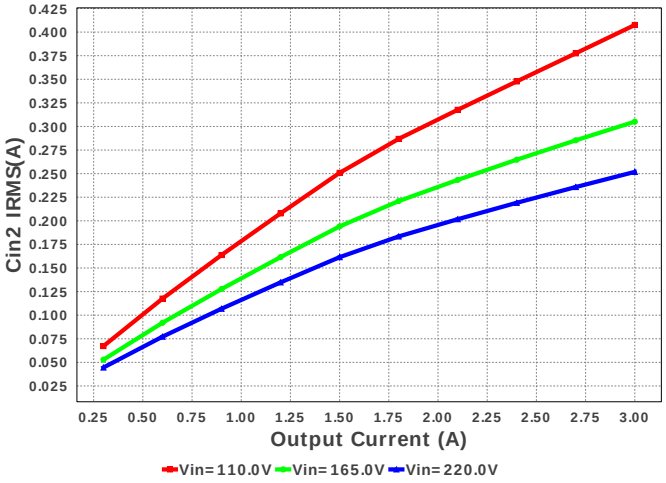
Vout Actual



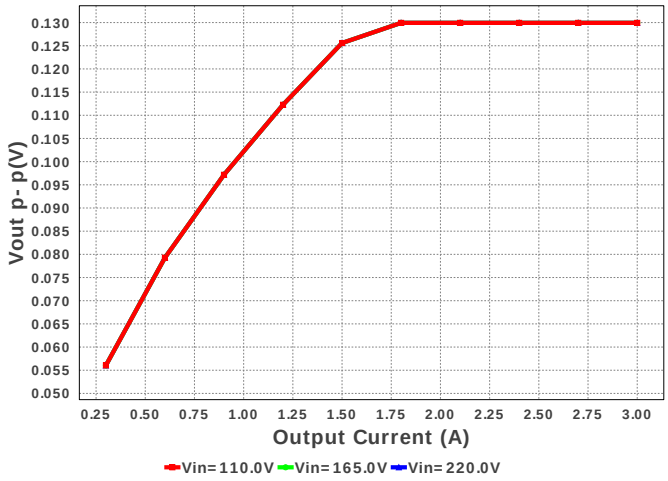
M1 TjOP



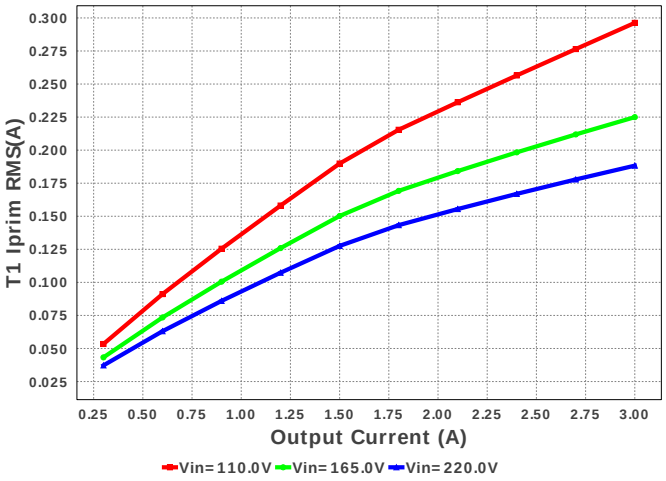
Cin2 IRMS

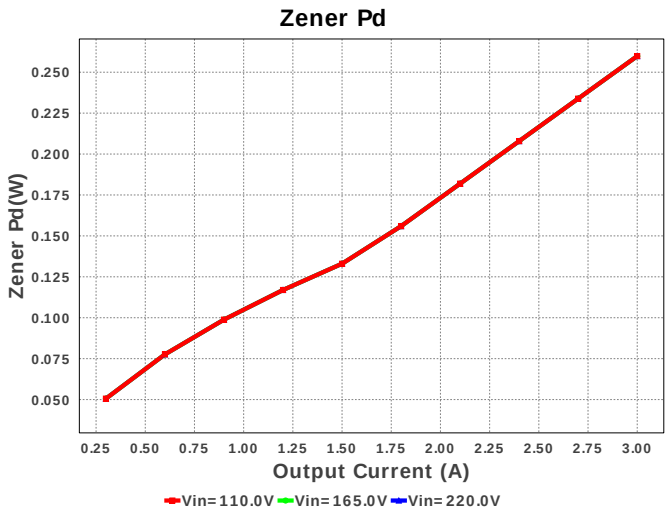


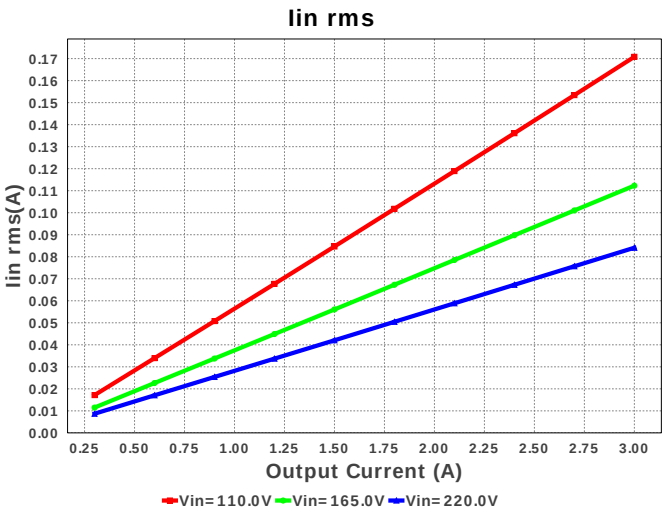
Vout p-p

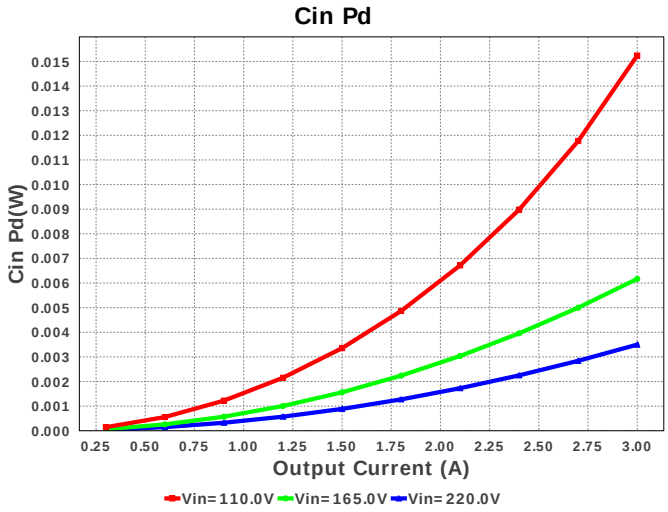


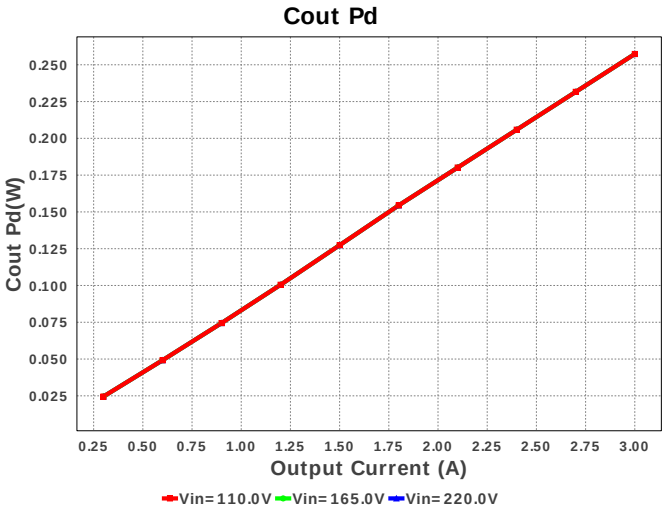
T1 Iprim RMS

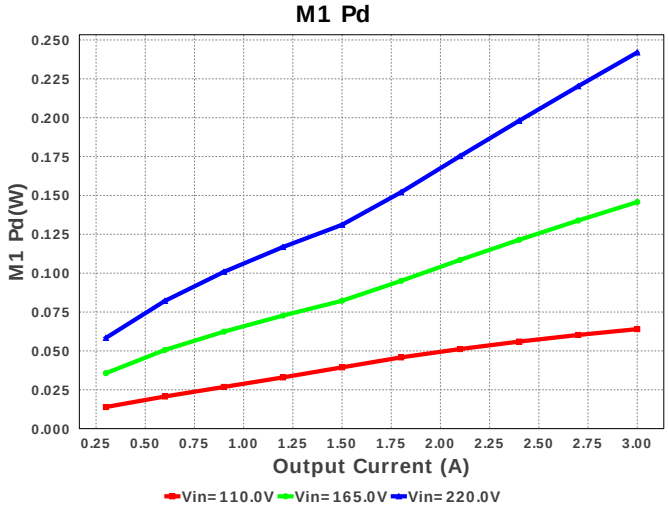


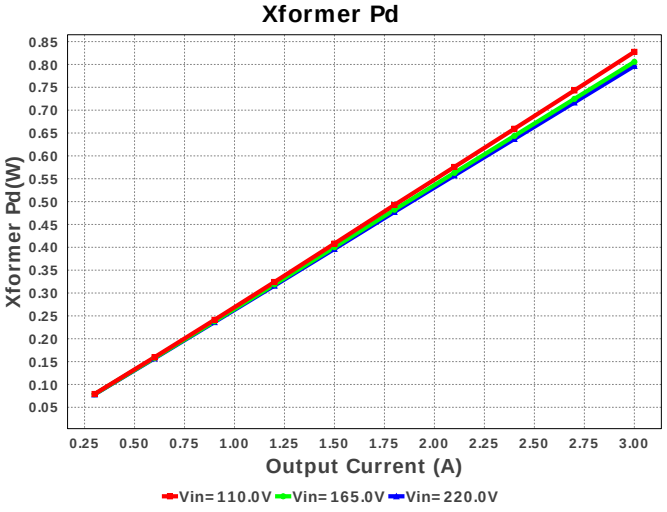


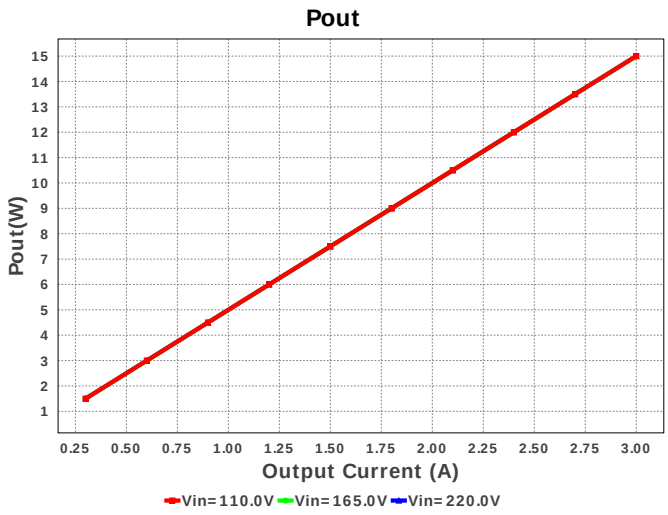


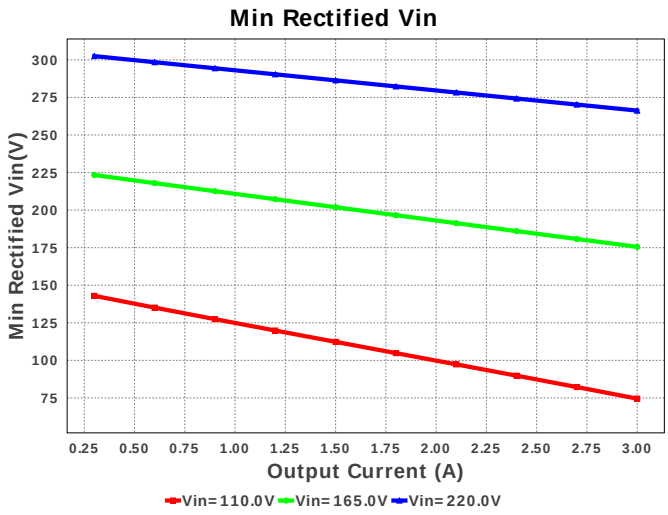


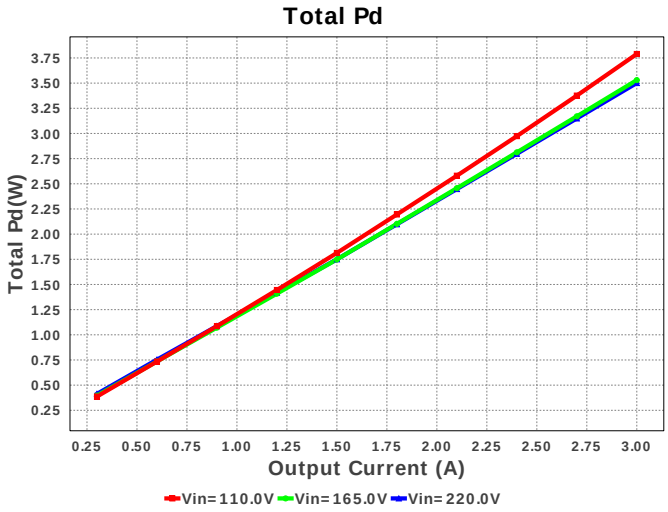


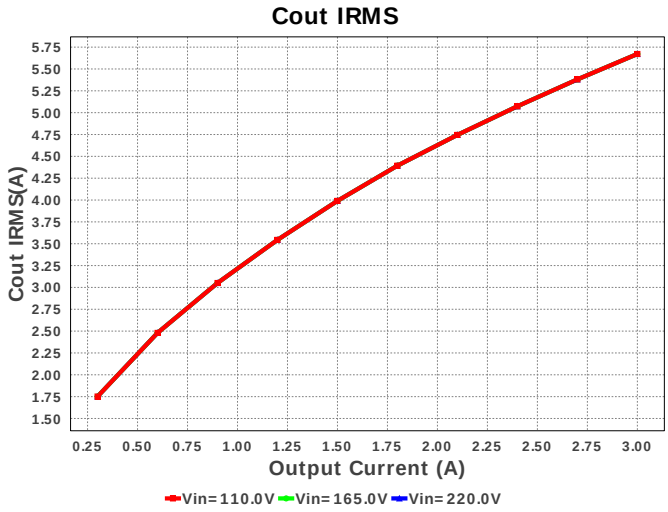


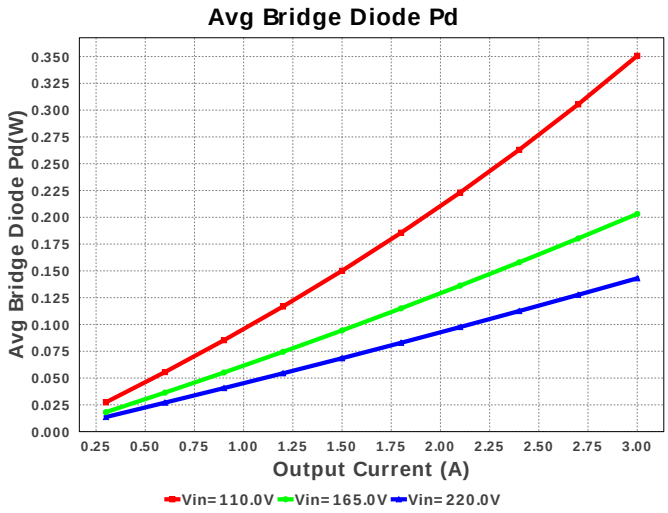


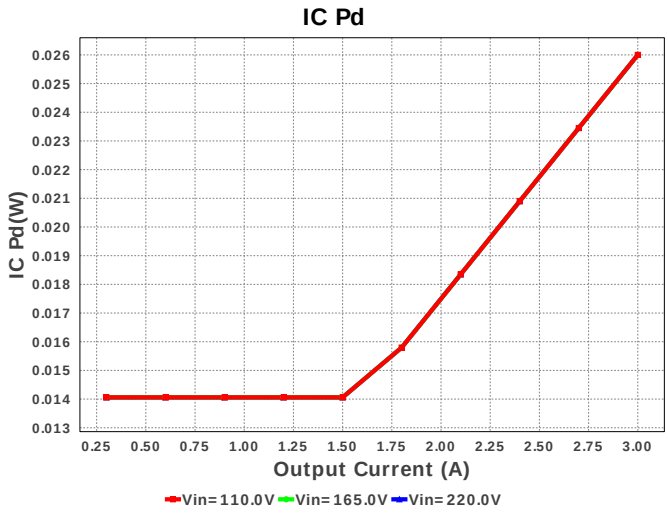


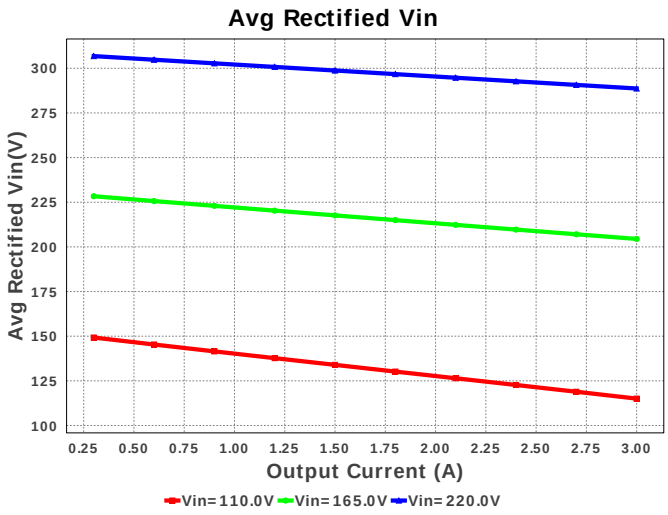


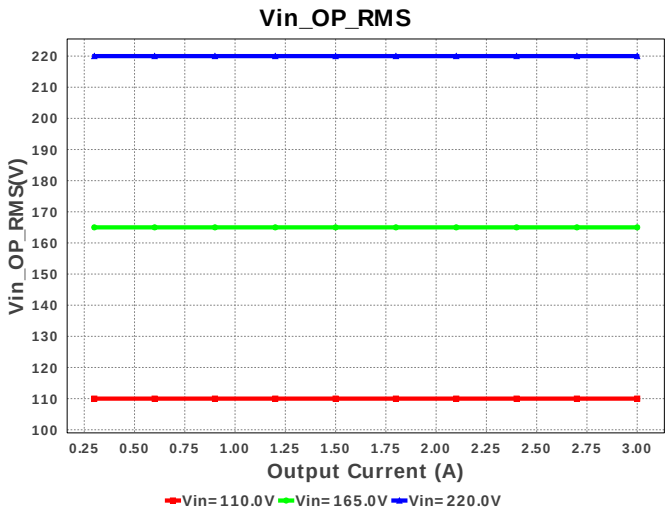


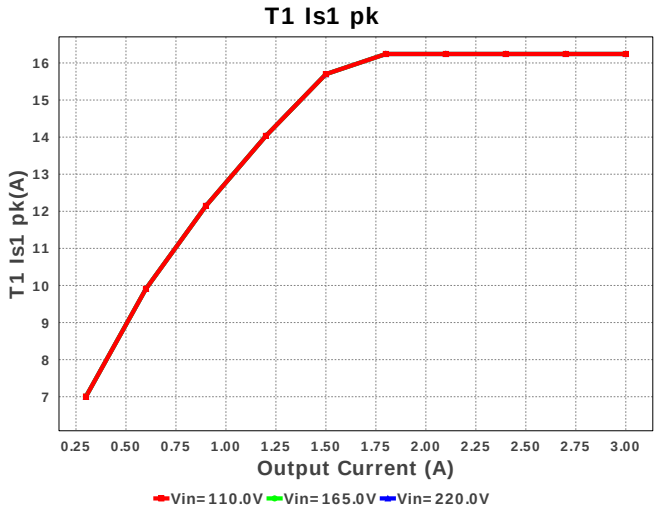












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	73.133 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	248.472 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	5.692 A	Current	Output capacitor RMS ripple current
4.	Iin rms	82.094 mA	Current	RMS Input Current
5.	T1 Iprim RMS	185.588 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	849.451 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	5.721 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	16.362 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	291.914 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	33	General	Total Design BOM count
11.	FootPrint	1.118 k mm^2	General	Total Foot Print Area of BOM components
12.	Pout	15.0 W	General	Total output power
13.	Total BOM	$0.0	General	Total BOM Cost
14.	Vout Actual	5.012 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	14.32 %	Op_point	Duty cycle
17.	Efficiency	83.054 %	Op_point	Steady state efficiency
18.	Frequency	59.22 kHz	Op_point	Switching frequency
19.	IC Tj	33.624 degC	Op_point	IC junction temperature
20.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	3.0 A	Op_point	Iout operating point
22.	M1 TjOP	45.167 degC	Op_point	M1 MOSFET junction temperature
23.	Min Rectified Vin	272.705 V	Op_point	Minimum voltage seen at rectified input
24.	Peak Rectified Vin	311.124 V	Op_point	Peak voltage seen at rectified input
25.	Vin_OP_RMS	220.0 V	Op_point	AC Input RMS Voltage
26.	Vout p-p	130.894 mV	Op_point	Peak-to-peak output ripple voltage
27.	Avg Bridge Diode Pd	91.776 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
28.	Cin Pd	3.391 mW	Power	Input capacitor power dissipation
29.	Cout Pd	259.232 mW	Power	Output capacitor power dissipation
30.	Diode2 Pd	1.349 W	Power	Diode2 power dissipation
31.	IC Pd	25.608 mW	Power	IC power dissipation

#	Name	Value	Category	Description
32.	M1 Pd	242.678 mW	Power	M1 MOSFET total power dissipation
33.	Total Pd	3.061 W	Power	Total Power Dissipation
34.	Xformer Pd	797.821 mW	Power	Transformer power dissipation
35.	Zener Pd	70.315 mW	Power	Zener power dissipation
36.	Vout Tolerance	1.336 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	220.0	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	UCC28740	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. Application Hints 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. Rtl Rtl is added to prevent excessive diode current and limit Iopt to the maximum value necessary for regulationThe Rtl value may be adjusted for optimal limiting later during the porotype evaluation process. 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. Rfb3 & Cfb3 Rfb3 is necessary to limit the current into FB and to avoid excess draining of Cvdd during this type of transient situation.The value of Rfb3 is chosen to limit the excess Ifb and Rfb4 current to an acceptable level when the optocoupler is saturatedCfb3 helps improve the transient response and is estimated initially by equating the time constant to 1ms. This can later beadjusted for optimal performance during prototype evaluation Rfb4 Rfb4 speeds up the turnoff time of the optocoupler in the case of a heavy load-step transient condition. This value tends to fallwithin the range of 10k and 100k. A tradeoff must be made between a lower value for faster transient response and a higher value forlower standby power. Rfb4 also serves to set a minimum bias current for the optocoupler and to drain dark current Part Description The UCC28740 isolated-flyback controller provides Constant-Voltage (CV) using an optical coupler toimprove transient response. Constant-Current (CC) regulation is accomplished through Primary Side Regulation (PSR) techniques. Please see the datasheet for further design guidance. http://www.ti.com/lit/ds/symlink/ucc28740.pdf

2. **UCC28740** Product Folder : http://www.ti.com/product/UCC28740 : contains the data sheet and other resources.