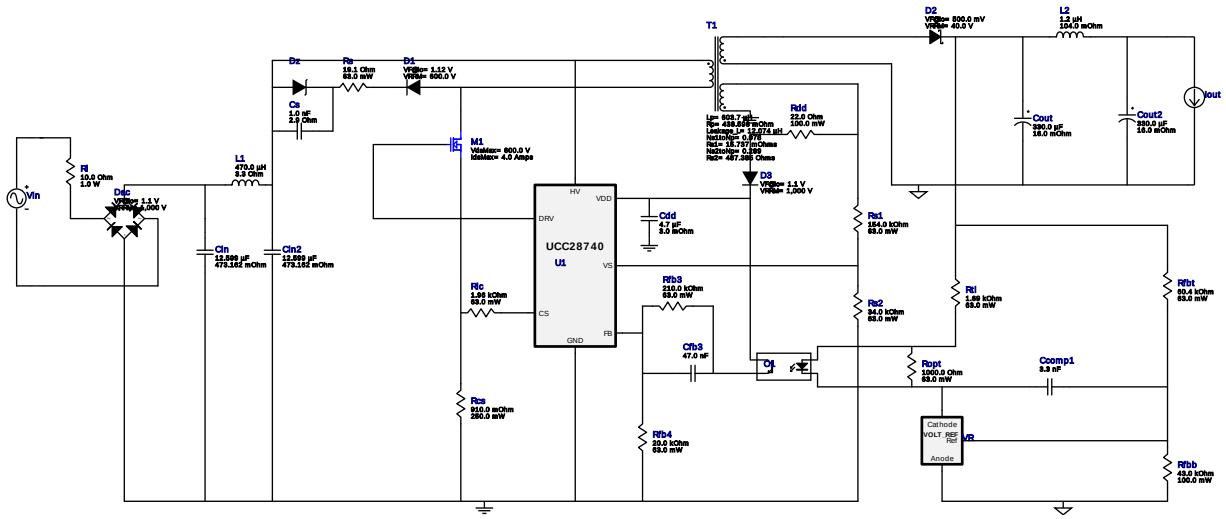
WEBENCH® Design Report

VinMin = 85.0V
VinMax = 264.0V
Vout = 6.0V
Iout = 2.0A

Device = UCC28740DR
Topology = Flyback
Created = 7/16/15 5:19:45 AM
BOM Cost = $0.00
Footprint = 1,303.0 mm^2
BOM Count = 33
Total Pd = 3.29W

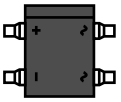
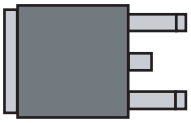
Design : 3555015/10 UCC28740DR
UCC28740DR 85.0V-264.0V to 6.00V @ 2.0A



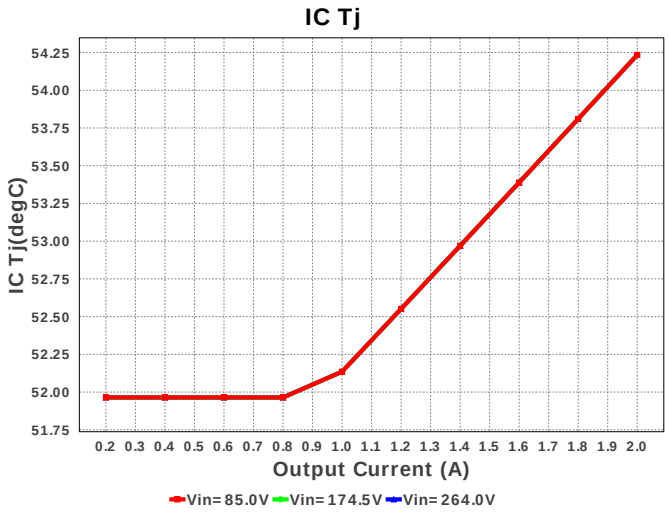
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

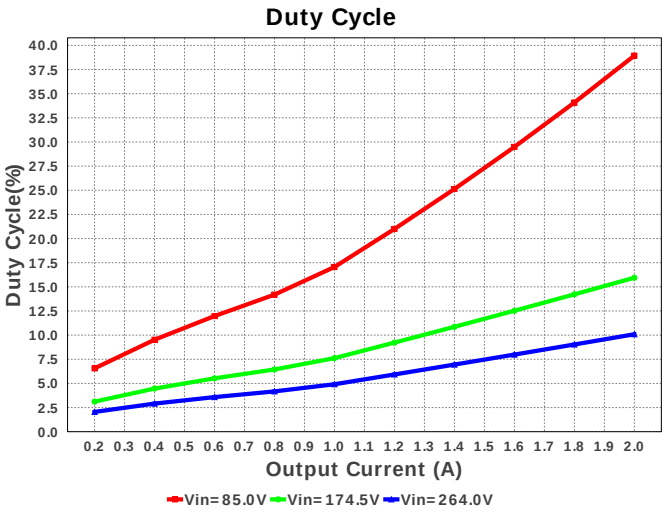
Electrical BOM

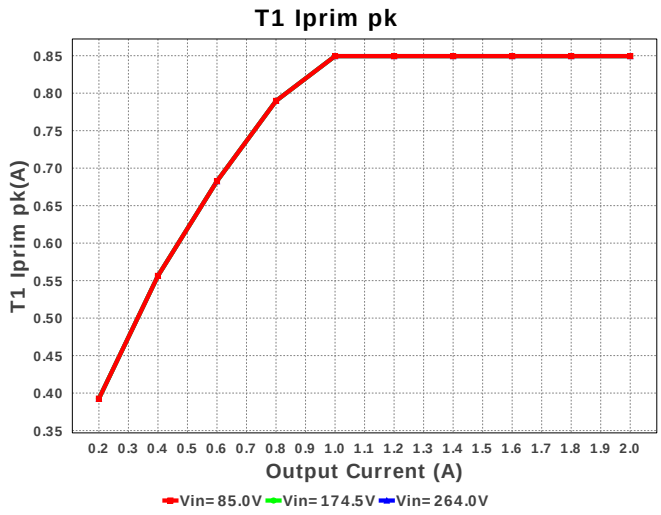
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp1	Yageo America	CC0805KRX7R9BB332 Series= X7R	Cap= 3.3 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
2.	Cdd	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	1206 11 mm^2
3.	Cfb3	Taiyo Yuden	TMK212B7473KD-T Series= X7R	Cap= 47.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Cin	CUSTOM	CUSTOM Series= ?	Cap= 12.599 uF ESR= 473.16 mOhm VDC= 560.02 V IRMS= 219.768 mA	1	NA	CUSTOM 0 mm^2
5.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 12.599 uF ESR= 473.16 mOhm VDC= 560.02 V IRMS= 219.768 mA	1	NA	CUSTOM 0 mm^2
6.	Cout	Panasonic	16SVP330M Series= SVP	Cap= 330.0 uF ESR= 16.0 mOhm VDC= 16.0 V IRMS= 4.72 A	1	$0.39	SM_RADIAL_10AMM 160 mm^2
7.	Cout2	Panasonic	16SVP330M Series= SVP	Cap= 330.0 uF ESR= 16.0 mOhm VDC= 16.0 V IRMS= 4.72 A	1	$0.39	SM_RADIAL_10AMM 160 mm^2

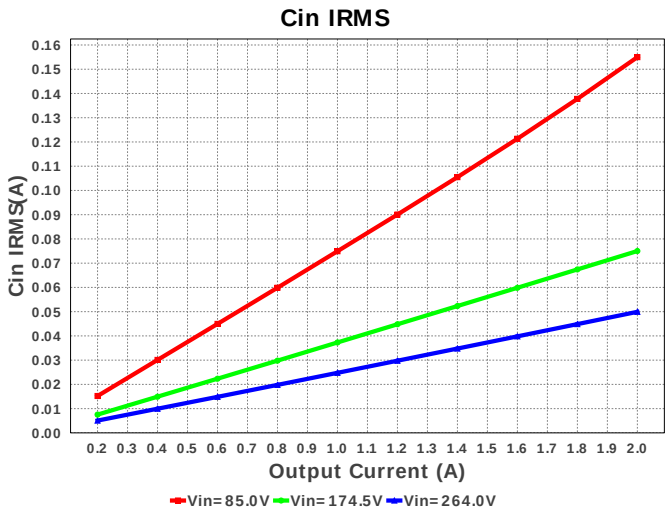
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cs	MuRata	GRM188R72E102KW07D Series= X7R	Cap= 1.0 nF ESR= 2.9 Ohm VDC= 250.0 V IRMS= 90.0 mA	1	$0.02	 0603 5 mm²
9.	D1	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm²
10.	D2	Vishay-Semiconductor	SS34-E3/57T	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.18	 SMC 83 mm²
11.	D3	Fairchild Semiconductor	1N4007	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.02	 DO-41 43 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	BZG03C150G	Zener	1	$0.12	 SMA 37 mm²
14.	L1	Bourns	SDR0604-471KL	L= 470.0 µH DCR= 3.3 Ohm	1	$0.18	 SDR0604 61 mm²
15.	L2	TDK	MLP2520S1R0ST0S1	L= 1.2 µH DCR= 104.0 mOhm	1	$0.14	 MLP2520S-S 12 mm²
16.	M1	STMicroelectronics	STB4NK60ZT4	VdsMax= 600.0 V IdsMax= 4.0 Amps	1	$0.53	 DDPAK 210 mm²
17.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.35	 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	Susumu Co Ltd	RR1220Q-220-D Series= RR12	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	 0805 7 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	Susumu Co Ltd	RR1220P-433-D Series= RR12	Res= 43.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	 0805 7 mm²
23.	Rfbt	Vishay-Dale	CRCW040260K4FKED Series= CRCW..e3	Res= 60.4 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	$0.09	 1218 24 mm²
25.	Rlc	Vishay-Dale	CRCW04021K96FKED Series= CRCW..e3	Res= 1.96 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

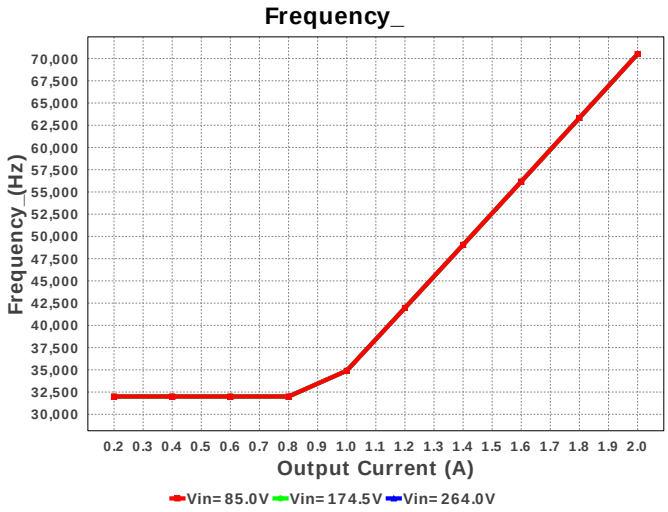
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	Ropt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	Rs	Vishay-Dale	CRCW040219R1FKED Series= CRCW..e3	Res= 19.1 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
28.	Rs1	Vishay-Dale	CRCW0402154KFKED Series= CRCW..e3	Res= 154.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
29.	Rs2	Vishay-Dale	CRCW040234K0FKED Series= CRCW..e3	Res= 34.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
30.	Rtl	Vishay-Dale	CRCW04021K69FKED Series= CRCW..e3	Res= 1.69 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
31.	T1	CUSTOM	CUSTOM	Lp= 603.7 µH Rp= 438.598 mOhm Leakage_L= 12.074 µH Ns1toNp= 0.078 Rs1= 15.737 mOhms Ns2toNp= 0.289 Rs2= 487.385 Ohms	1	NA	CUSTOM 0 mm²
32.	U1	Texas Instruments	UCC28740DR	Switcher	1	$0.42	 R-PDSO-G7 55 mm²
33.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.09	 R-PDSO-G3 16 mm²

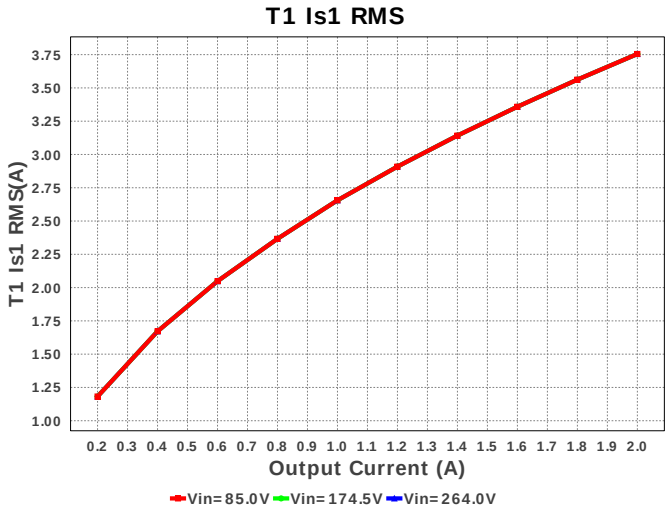


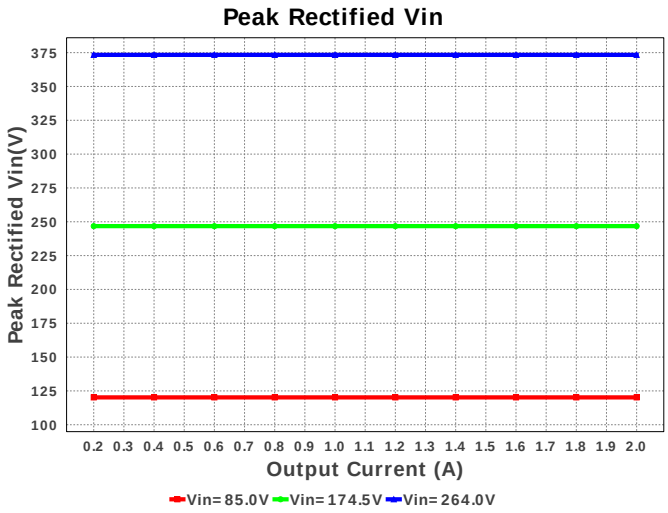


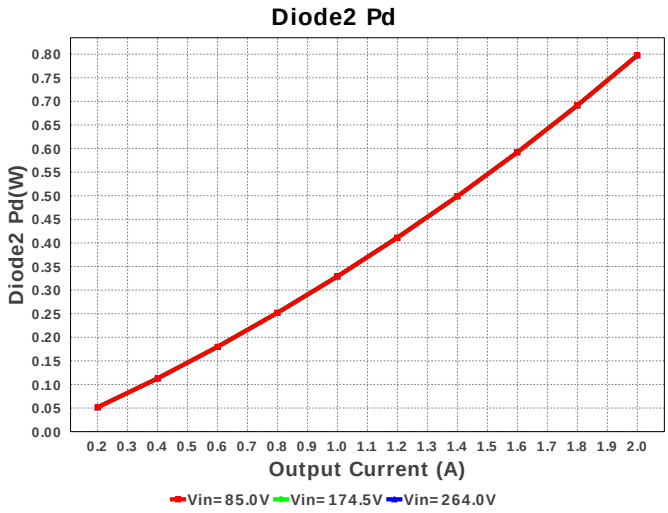


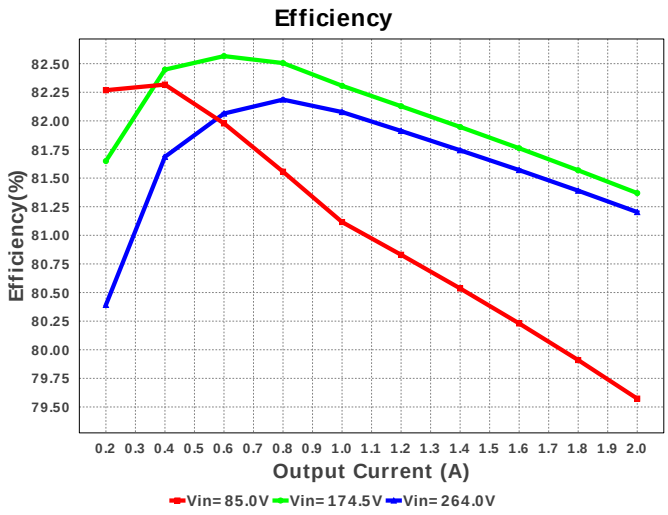


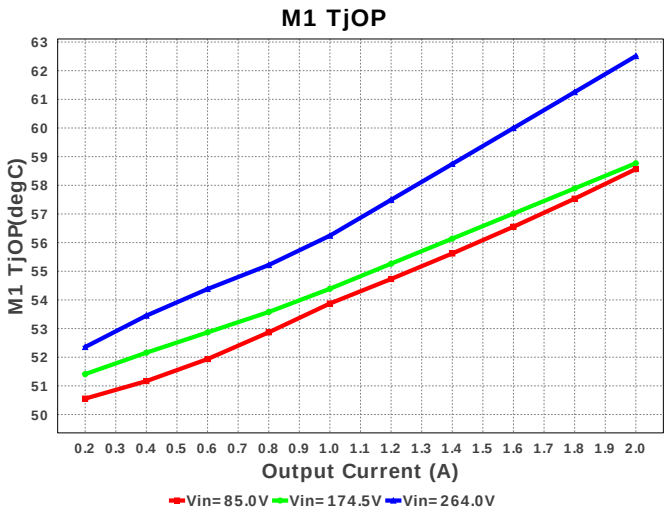


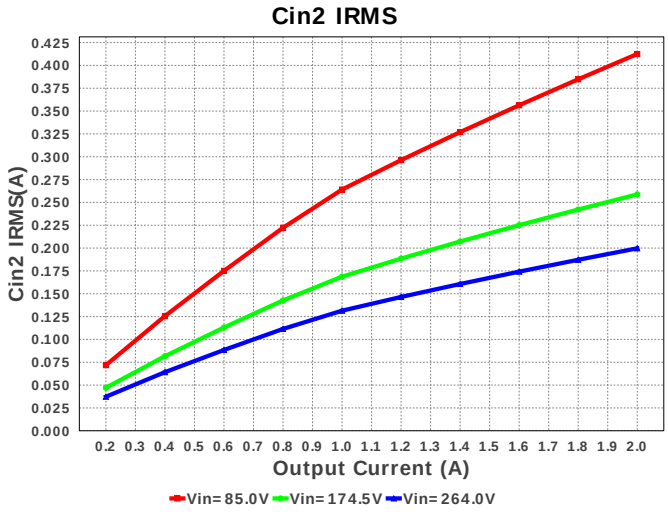


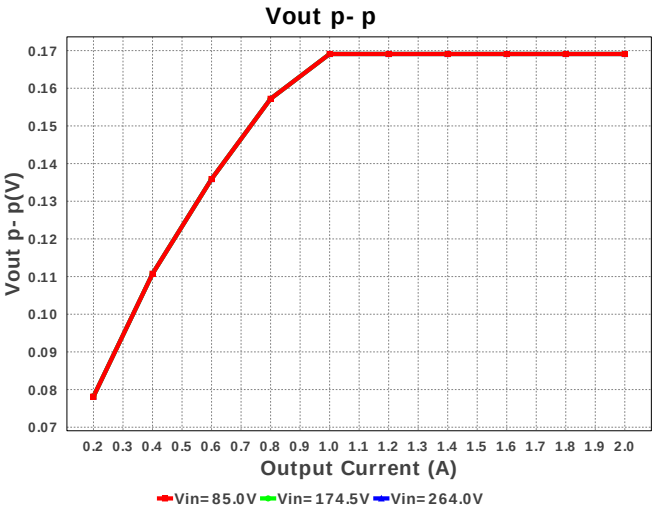


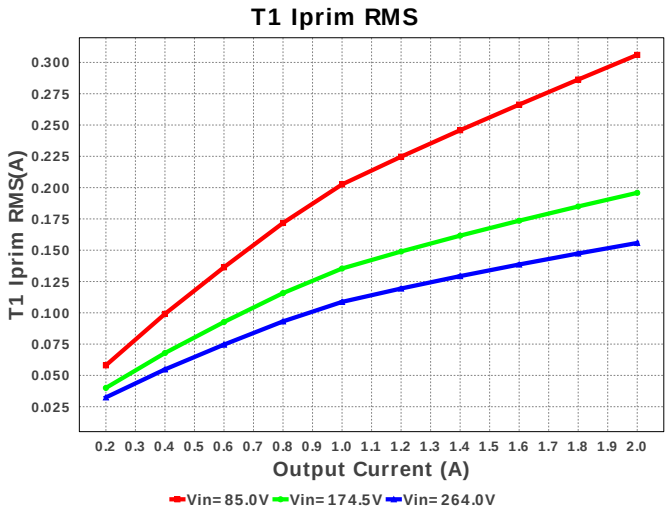


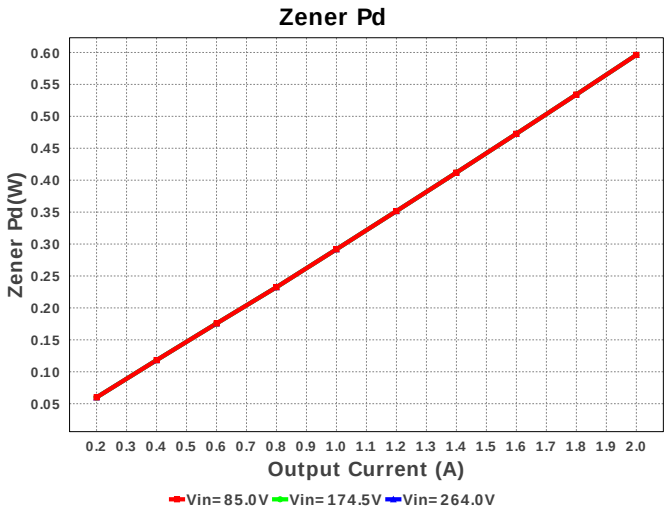


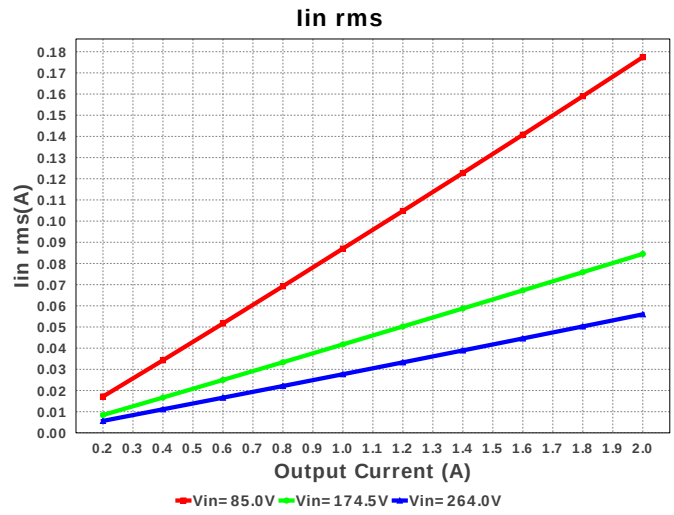


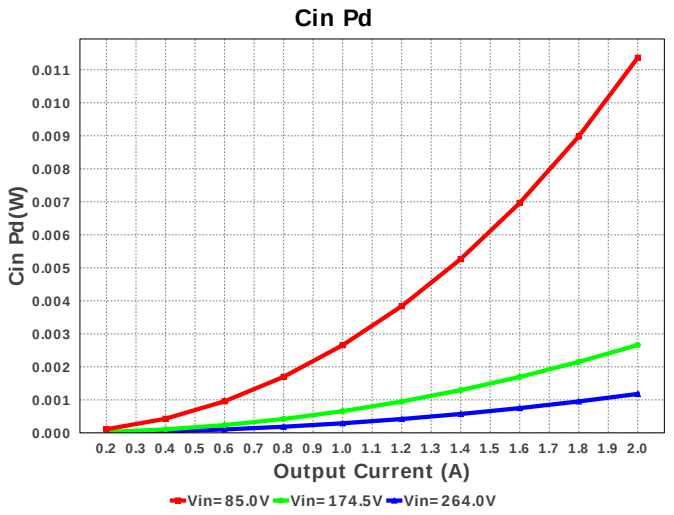


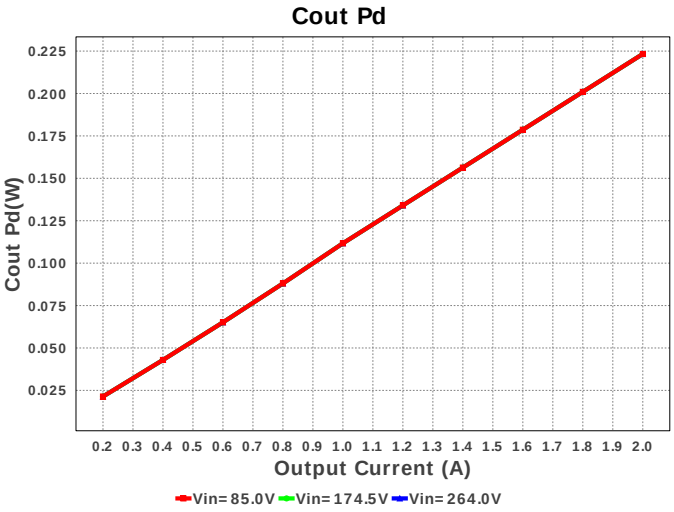


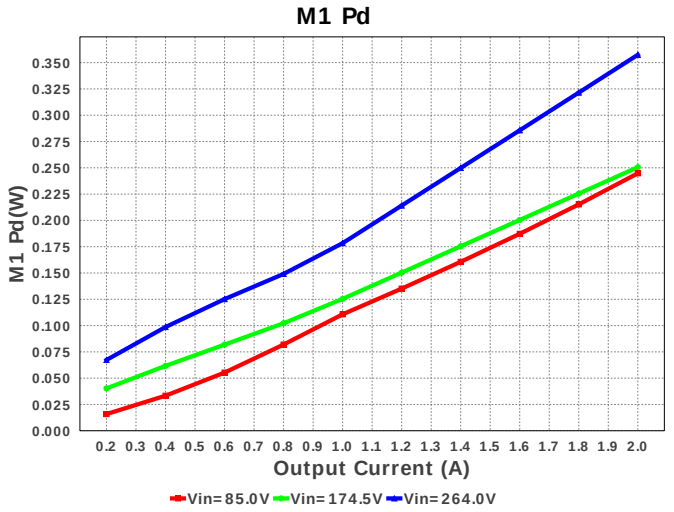


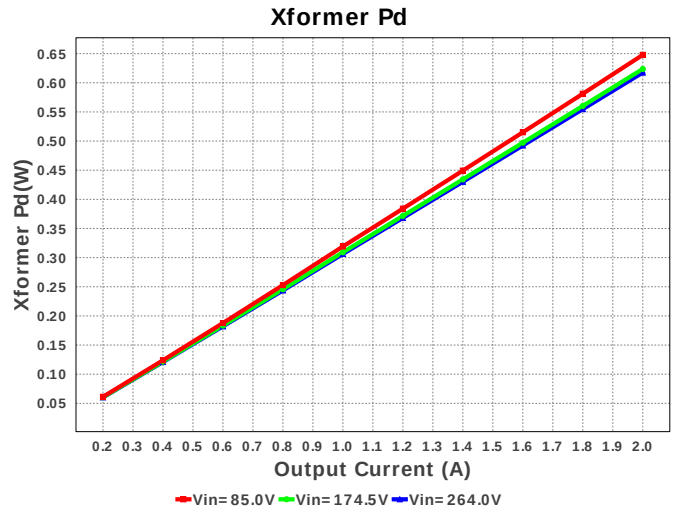


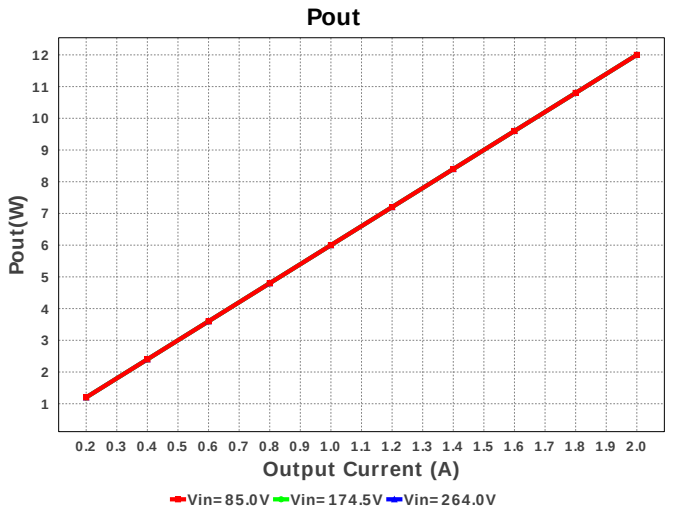


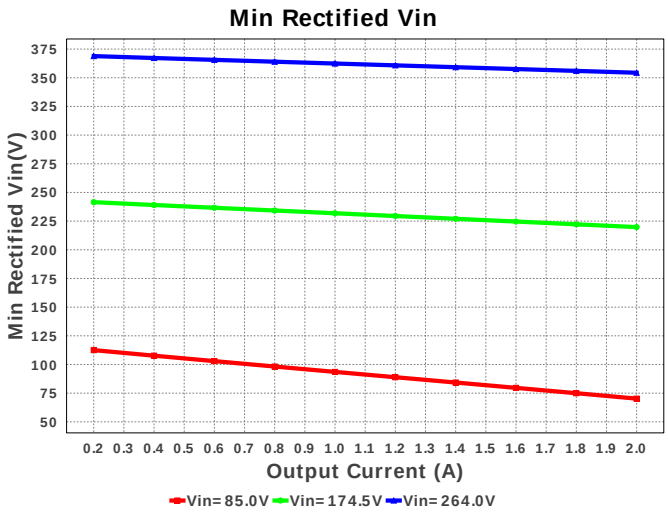


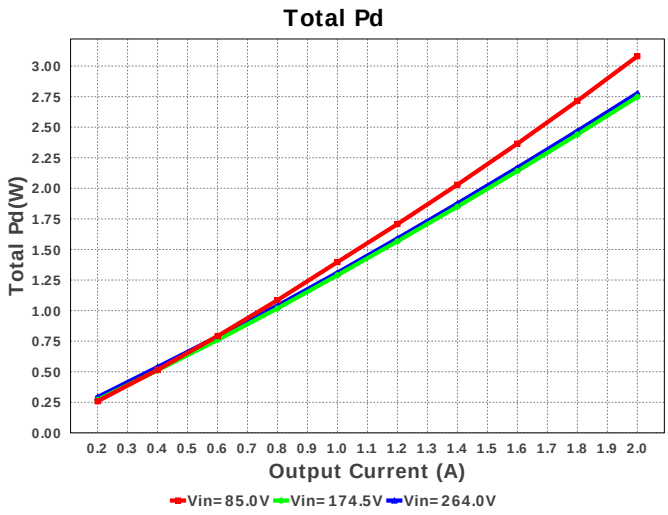


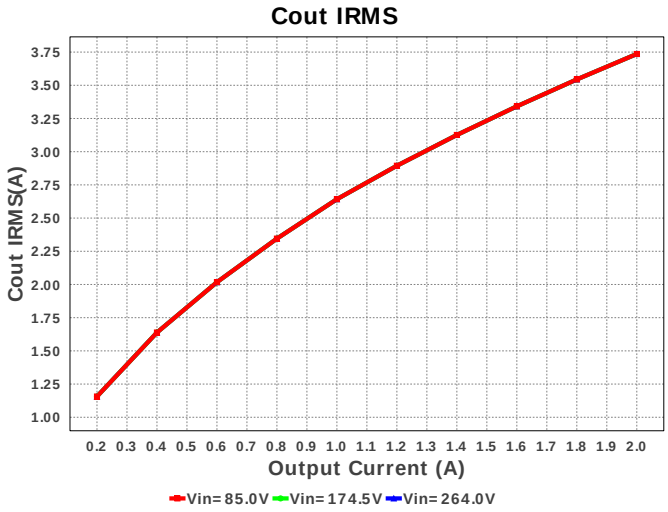


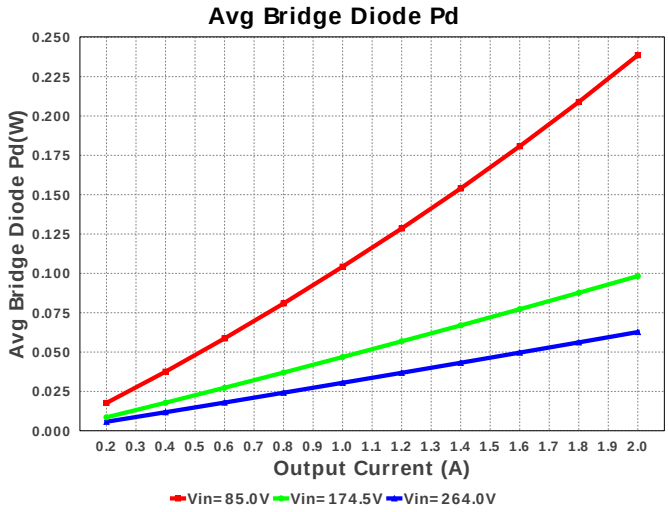


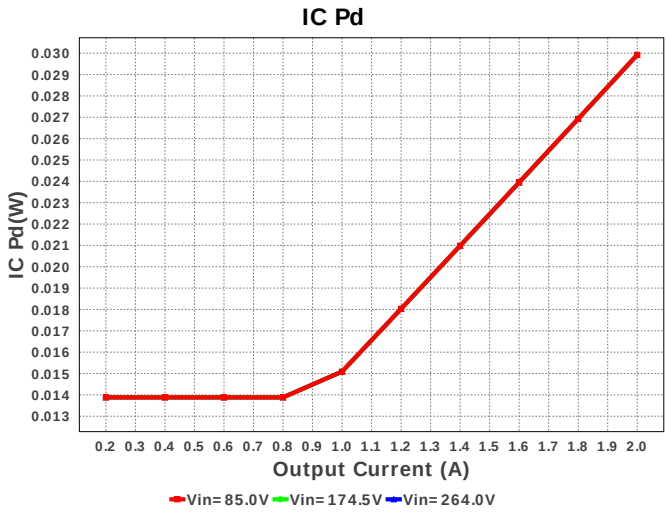


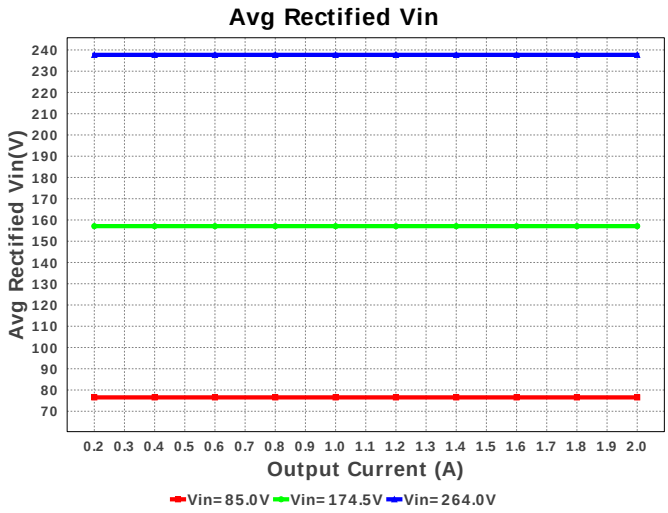


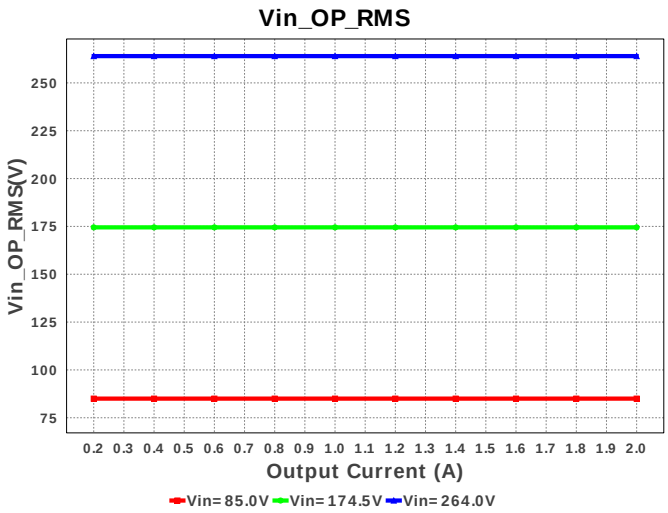


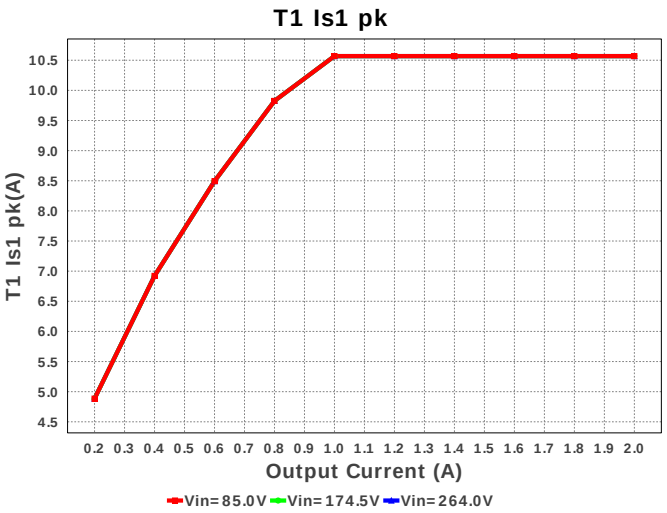












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	51.855 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	204.35 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	3.736 A	Current	Output capacitor RMS ripple current
4.	Iin rms	57.926 mA	Current	RMS Input Current
5.	T1 Iprim RMS	158.876 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	849.451 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	3.755 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	10.569 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	237.684 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	33	General	Total Design BOM count
11.	FootPrint	1.303 k mm^2	General	Total Foot Print Area of BOM components
12.	Pout	12.0 W	General	Total output power
13.	Total BOM	$0.0	General	Total BOM Cost
14.	Vout OP	6.0 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	10.494 %	Op_point	Duty cycle
16.	Efficiency	78.47 %	Op_point	Steady state efficiency
17.	Frequency_	72.833 kHz	Op_point	Switching frequency
18.	IC Tj	54.371 degC	Op_point	IC junction temperature
19.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	2.0 A	Op_point	Iout operating point
21.	M1 TjOP	62.74 degC	Op_point	M1 MOSFET junction temperature
22.	Min Rectified Vin	350.869 V	Op_point	Minimum voltage seen at rectified input
23.	Peak Rectified Vin	373.349 V	Op_point	Peak voltage seen at rectified input
24.	Vin_OP_RMS	264.0 V	Op_point	AC Input RMS Voltage
25.	Vout p-p	169.1 mV	Op_point	Peak-to-peak output ripple voltage
26.	Avg Bridge Diode Pd	62.349 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
27.	Cin Pd	1.272 mW	Power	Input capacitor power dissipation
28.	Cout Pd	223.292 mW	Power	Output capacitor power dissipation
29.	Diode2 Pd	1.226 W	Power	Diode2 power dissipation
30.	IC Pd	30.888 mW	Power	IC power dissipation
31.	M1 Pd	363.992 mW	Power	M1 MOSFET total power dissipation
32.	Total Pd	3.292 W	Power	Total Power Dissipation
33.	Xformer Pd	630.904 mW	Power	Transformer power dissipation
34.	Zener Pd	638.646 mW	Power	Zener power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	VinMax	264.0	Maximum input voltage
4.	VinMin	85.0	Minimum input voltage
5.	Vout	6.0	Output Voltage
6.	Vout1	6.0	Output Voltage #1
7.	base_pn	UCC28740	Texas Instruments Base Part Number
8.	source	DC	Input Source Type
9.	ta	50.0	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.