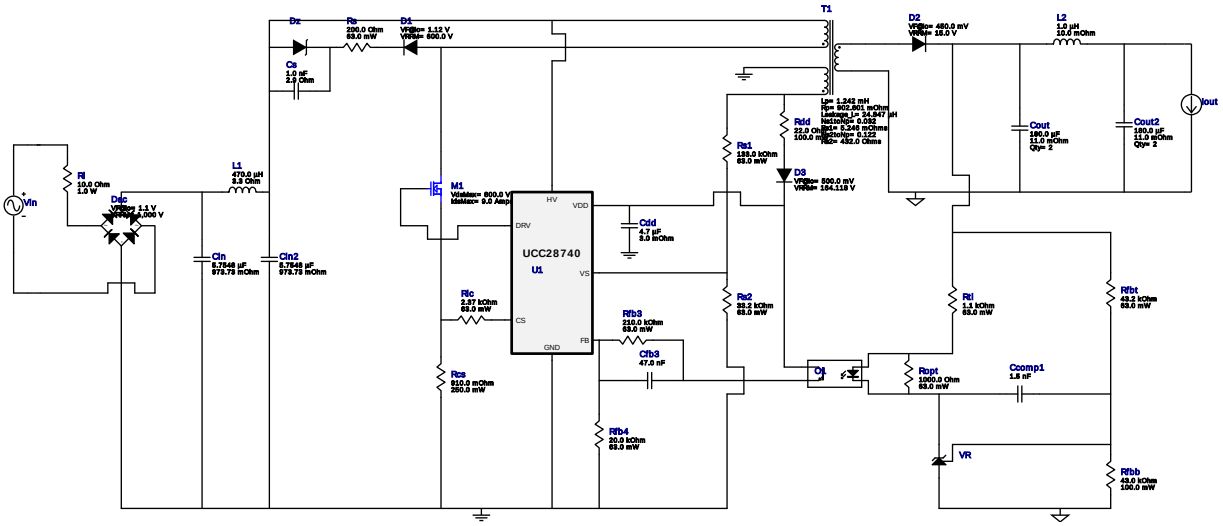
WEBENCH® Design Report

VinMin = 176.0V
VinMax = 264.0V
Vout = 5.0V
Iout = 5.0A

Device = UCC28740DR
Topology = Flyback
Created = 8/12/16 4:40:33 AM
BOM Cost = $0.00
BOM Count = 35
Total Pd = 4.12W

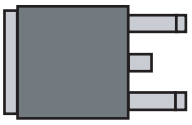
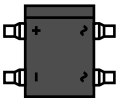
Design : 1754593/9 UCC28740DR
UCC28740DR 176.0V-264.0V to 5.00V @ 5.0A



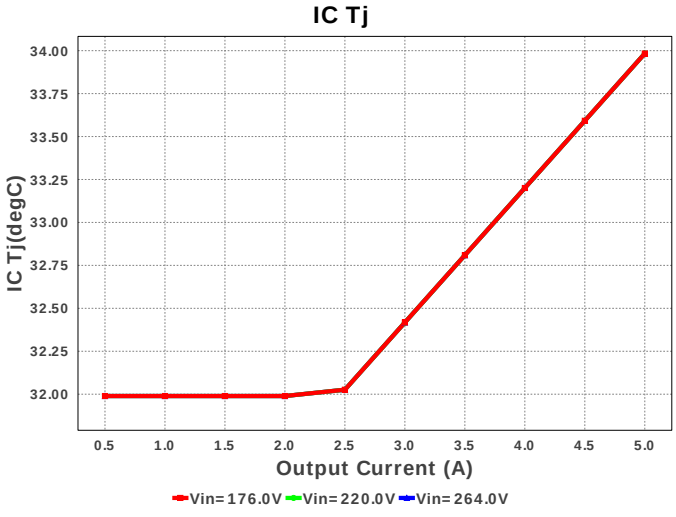
1. Rlc, Rtl and the feedback resistors for this design are a starting point, but may need adjustment based on the actual transformer used. For more information please click the design assistance button.

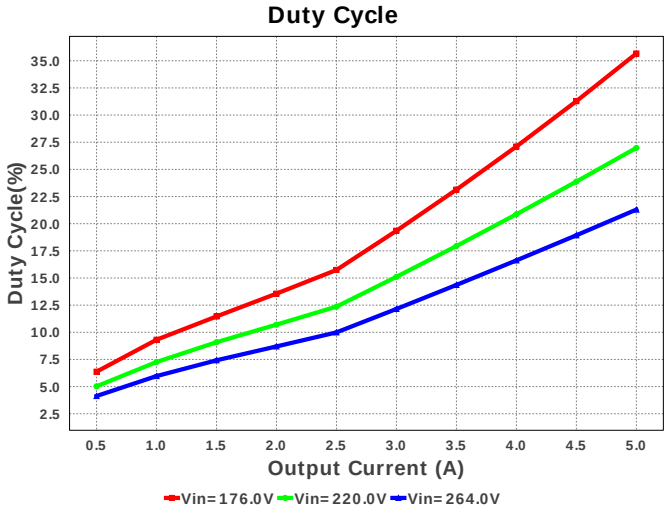
Electrical BOM

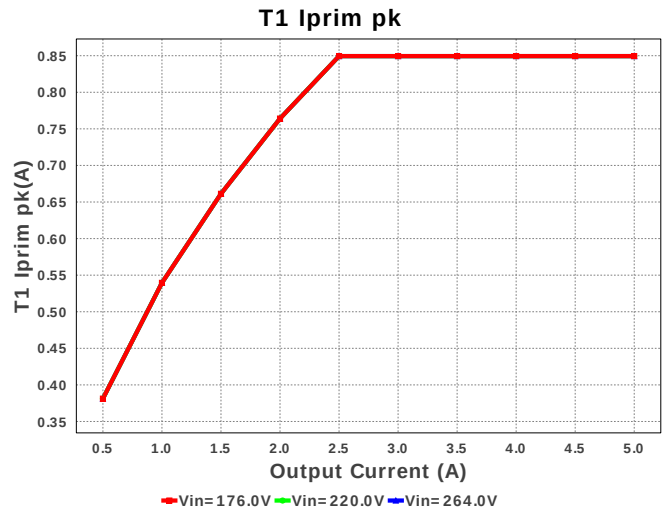
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp1	Yageo America	CC0805KRX7R9BB152 Series= X7R	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cdd	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	1206 11 mm²
3.	Cfb3	Taiyo 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= 5.7548 uF ESR= 973.73 mOhm VDC= 560.02 V IRMS= 221.12 mA	1	NA	CUSTOM 0 mm²
5.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 5.7548 uF ESR= 973.73 mOhm VDC= 560.02 V IRMS= 221.12 mA	1	NA	CUSTOM 0 mm²
6.	Cout	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	2	$0.49	CAPSMT_62_C10 74 mm²
7.	Cout2	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	2	$0.49	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

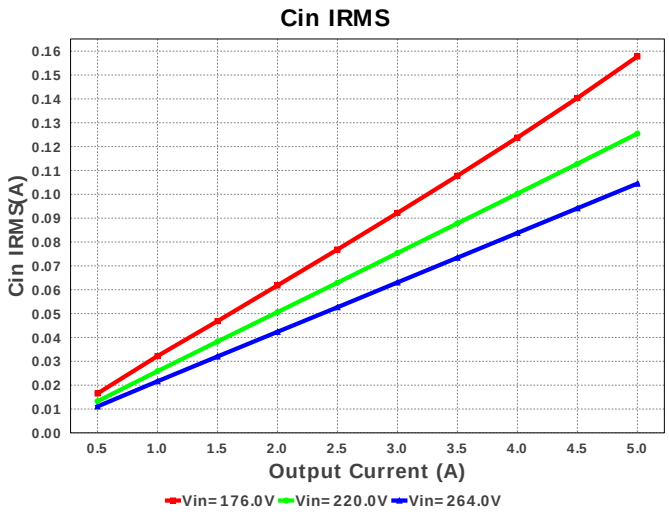
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	D1	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm^2
10.	D2	ON Semiconductor	MBRB2515LT4G	VF@Io= 450.0 mV VRRM= 15.0 V	1	$1.00	 DDPAK 210 mm^2
11.	D3	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 164.118 V	1	NA	CUSTOM 0 mm^2
12.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm^2
13.	Dz	ON Semiconductor	1SMB5955BT3G	Zener	1	$0.10	 SMB 44 mm^2
14.	L1	Bourns	SDR0604-471KL	L= 470.0 µH DCR= 3.3 Ohm	1	$0.18	 SDR0604 61 mm^2
15.	L2	Bourns	SRN8040-1R0Y	L= 1.0 µH DCR= 10.0 mOhm	1	$0.22	 SRN8040 100 mm^2
16.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm^2
17.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.38	 SSOP-4 111 mm^2
18.	Rcs	Bourns	CRM0805-FX-R910ELF Series= ?	Res= 910.0 mOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.03	 0805 7 mm^2
19.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
20.	Rfb3	Vishay-Dale	CRCW0402210KFKED Series= CRCW..e3	Res= 210.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
21.	Rfb4	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
22.	Rfbb	Yageo America	RC0603FR-0743KL Series= ?	Res= 43.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
23.	Rfbt	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
24.	Rl	Vishay-Dale	CRCW121810R0FKEK Series= CRCW..e3	Res= 10.0 Ohm Power= 1.0 W Tolerance= 1.0%	1	$0.13	 1218 24 mm^2
25.	Rlc	Vishay-Dale	CRCW04022K37FKED Series= CRCW..e3	Res= 2.37 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
26.	Ropt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

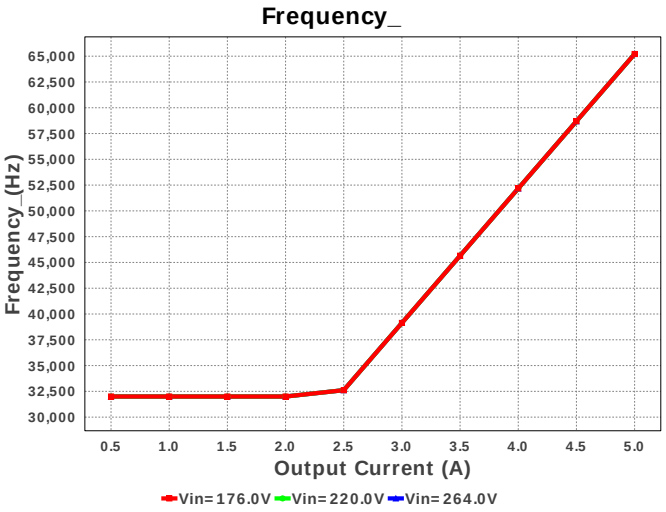
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rs	Vishay-Dale	CRCW0402200RFKED Series= CRCW..e3	Res= 200.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
28.	Rs1	Vishay-Dale	CRCW0402133KFKED Series= CRCW..e3	Res= 133.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
29.	Rs2	Vishay-Dale	CRCW040233K2FKED Series= CRCW..e3	Res= 33.2 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= 1.242 mH Rp= 902.601 mOhm Leakage_L= 24.847 µH Ns1toNp= 0.032 Rs1= 5.246 mOhms Ns2toNp= 0.122 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	TL431AIDBZR	Voltage References	1	$0.08	DBZ0003A 14 mm^2

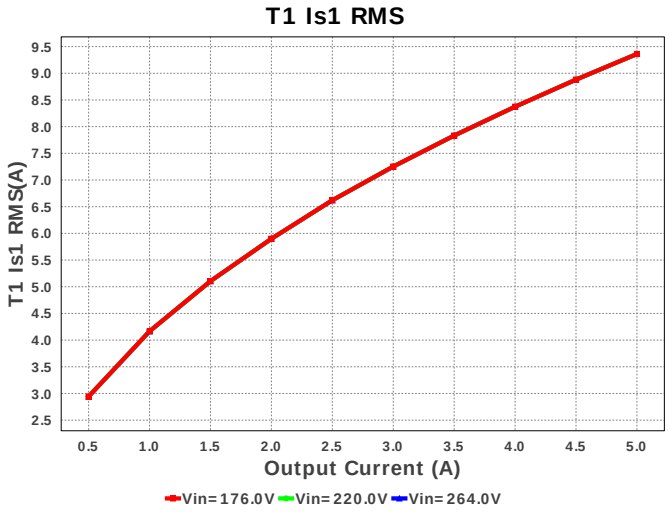


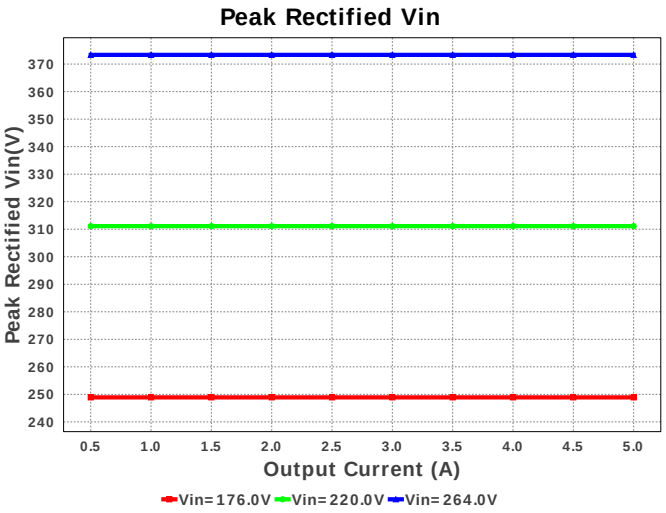


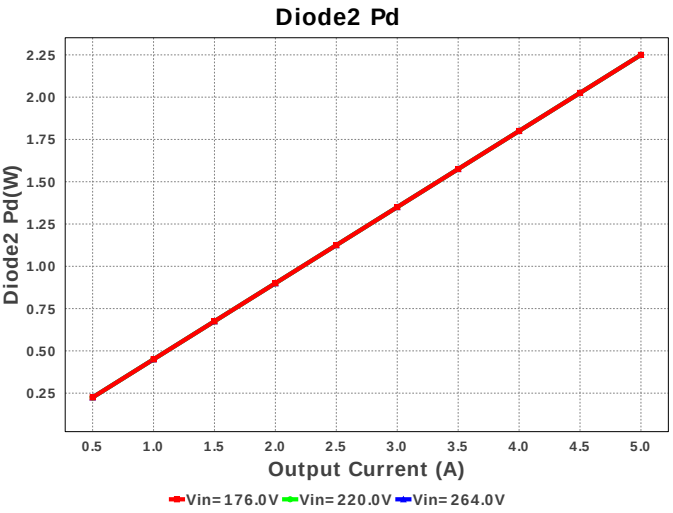




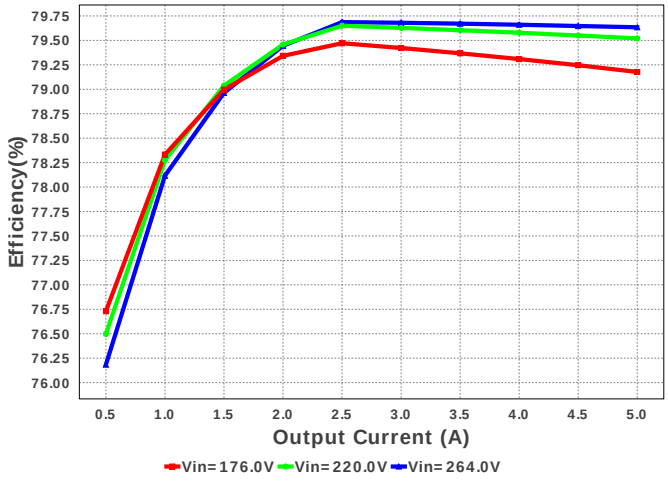




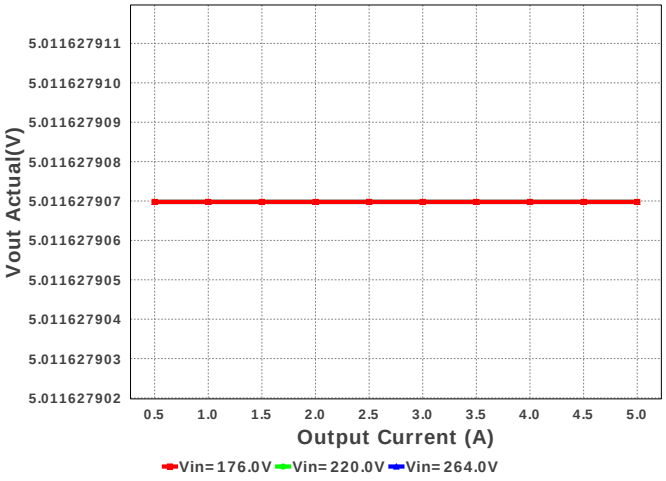




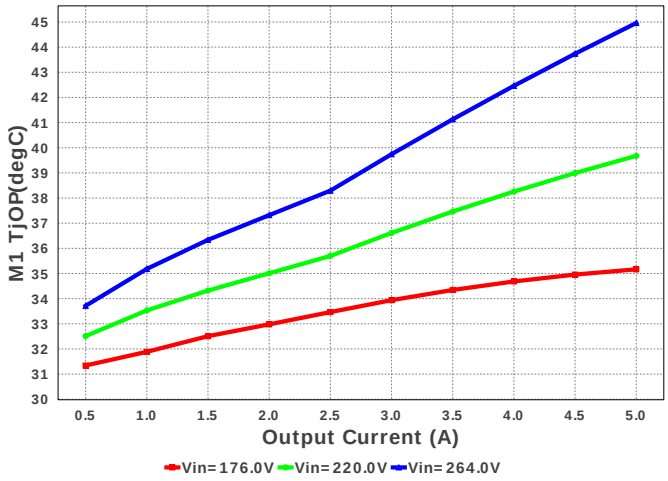
Efficiency



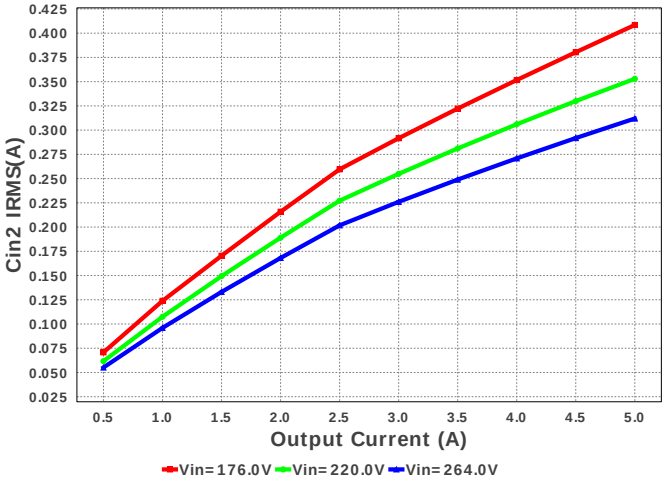
Vout Actual



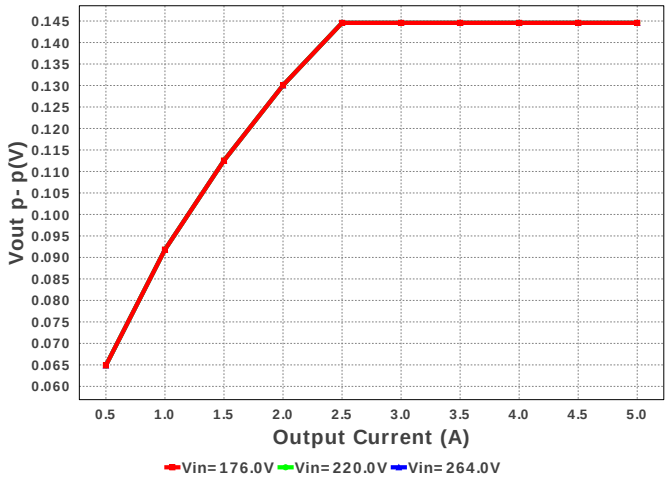
M1 TjOP



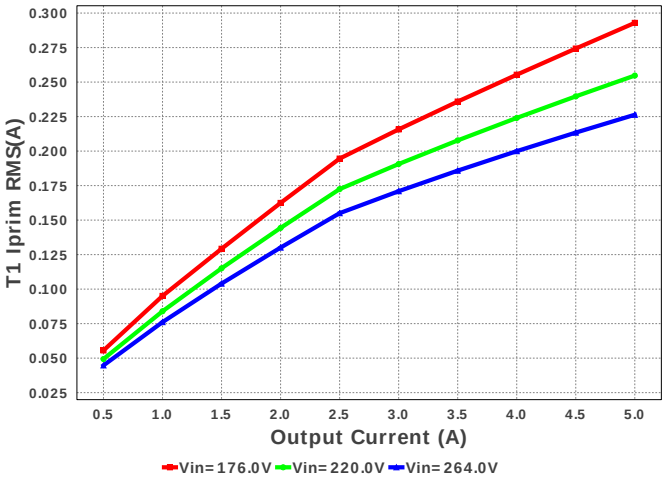
Cin2 IRMS

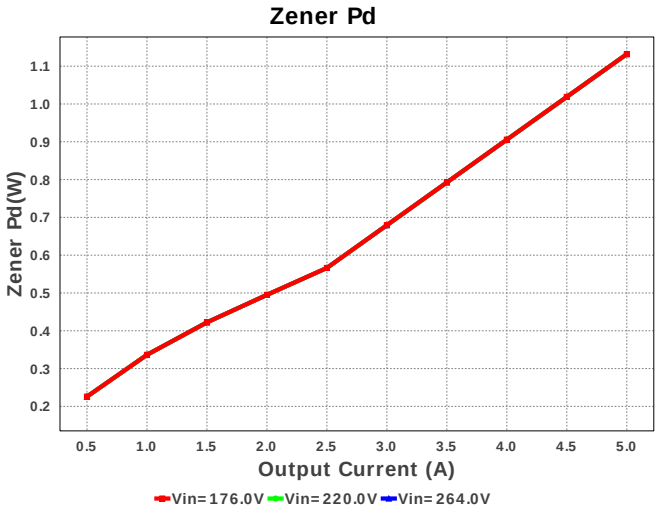


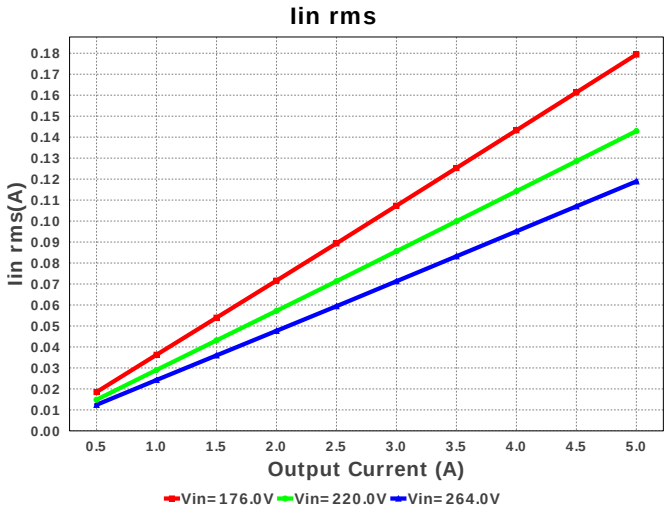
Vout p- p

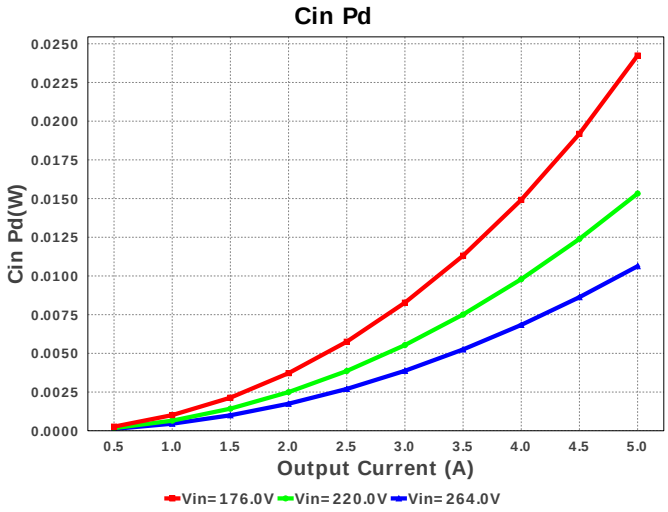


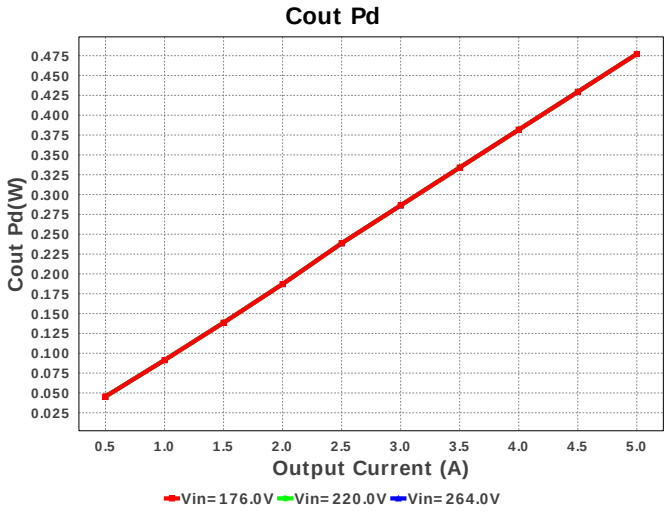
T1 Iprim RMS

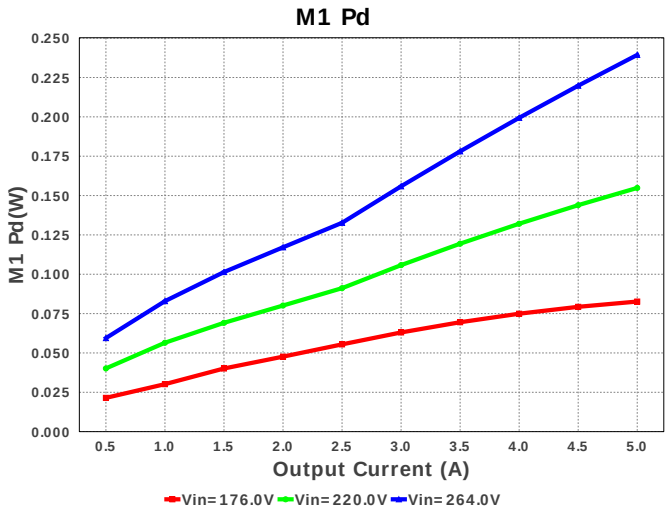


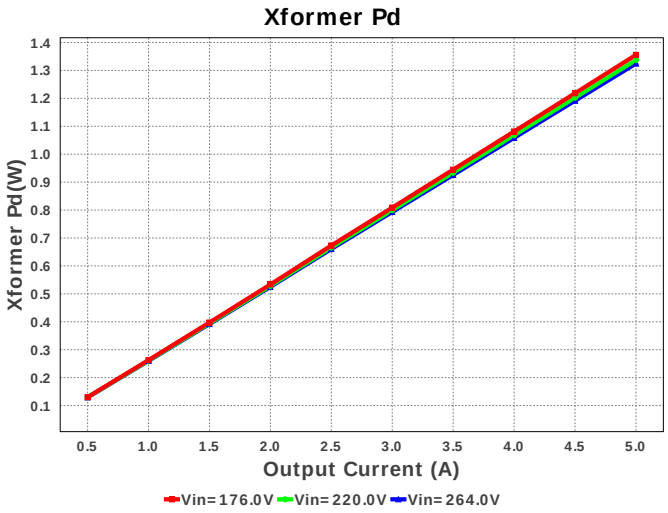


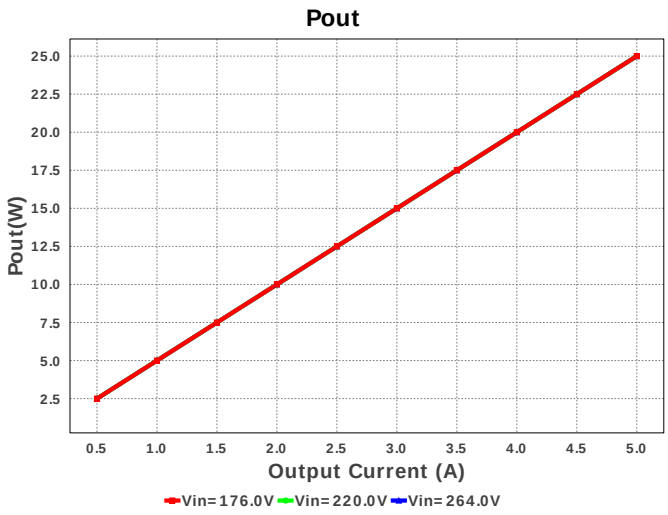


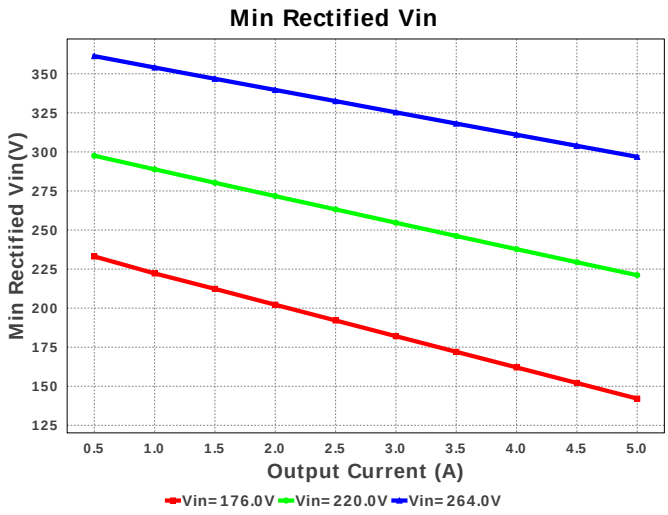


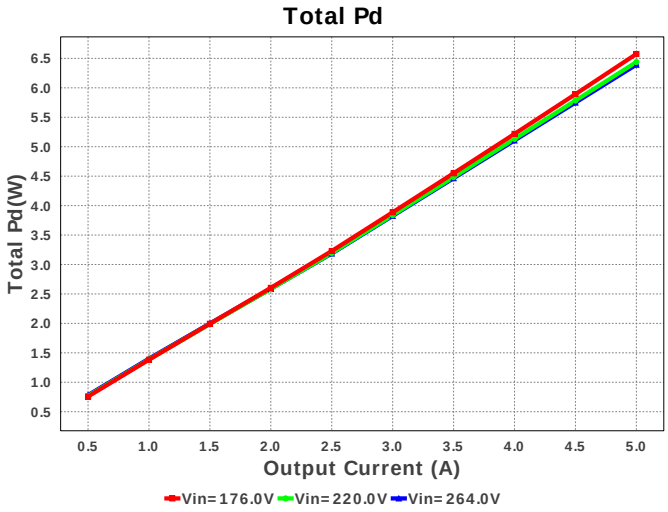


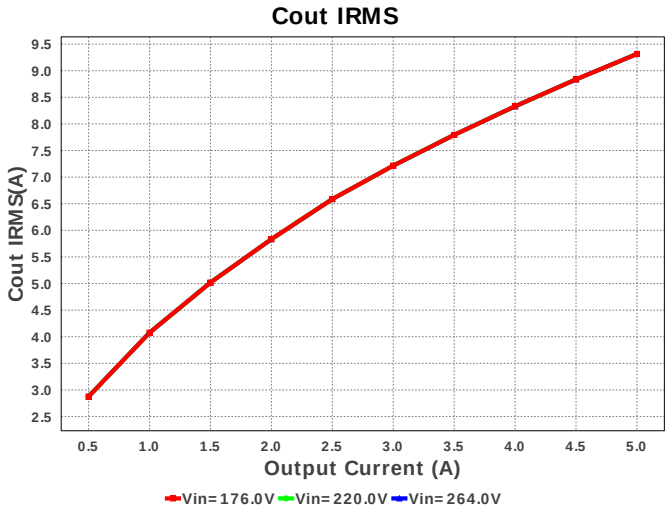


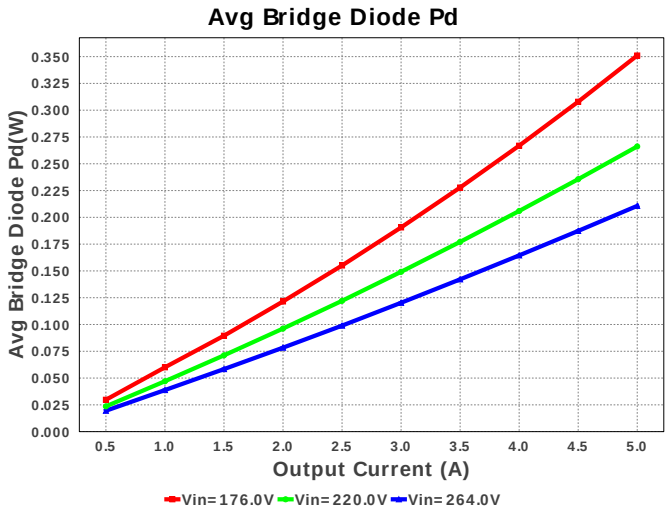


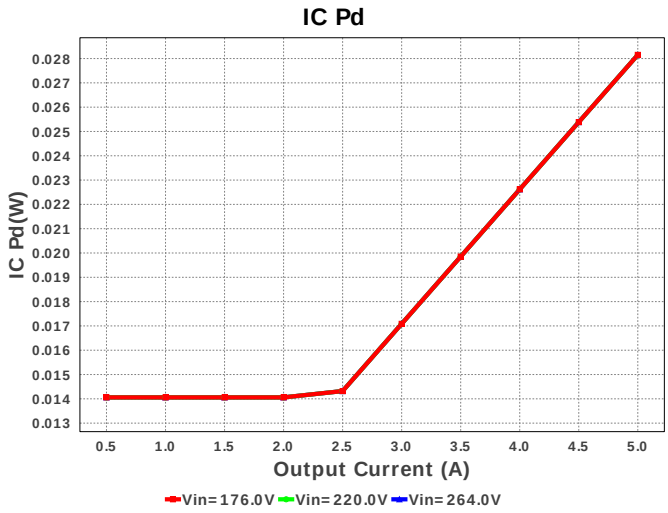


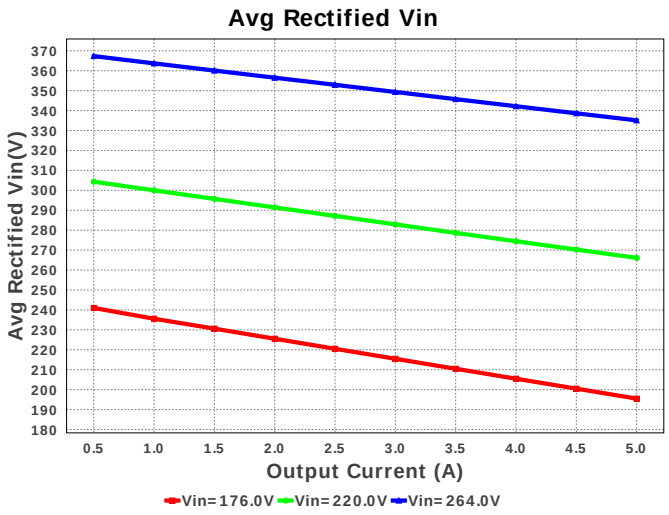


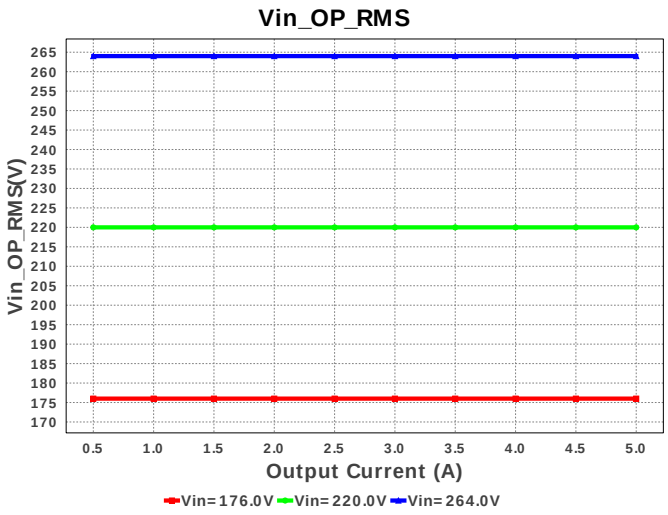


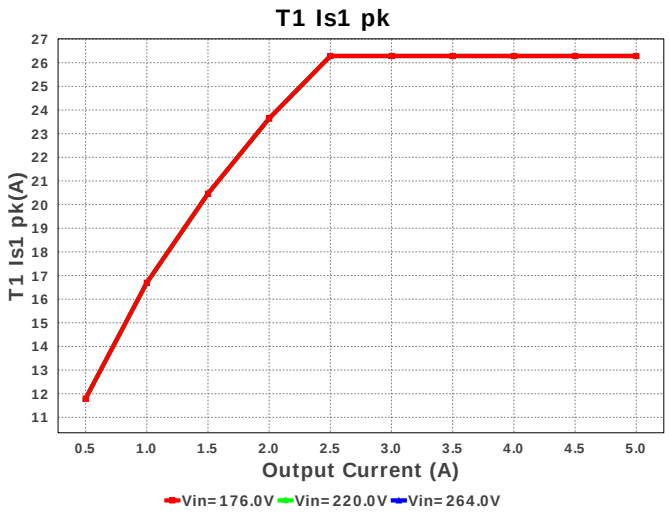












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	97.532 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	300.151 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	9.348 A	Current	Output capacitor RMS ripple current
4.	Iin rms	110.29 mA	Current	RMS Input Current
5.	T1 Iprim RMS	219.866 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	849.451 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	9.396 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	26.479 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	337.515 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	35	General	Total Design BOM count
11.	FootPrint	1.421 k mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	25.0 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	5.012 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	20.098 %	Op_point	Duty cycle
18.	Efficiency	85.864 %	Op_point	Steady state efficiency
19.	Frequency_	62.029 kHz	Op_point	Switching frequency
20.	IC Tj	33.792 degC	Op_point	IC junction temperature
21.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	5.0 A	Op_point	Iout operating point
23.	M1 TjOP	44.917 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	301.681 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	373.349 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	264.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	145.636 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	129.389 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	9.263 mW	Power	Input capacitor power dissipation
30.	Cout Pd	480.668 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	1.281 W	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	26.8 mW	Power	IC power dissipation
33.	M1 Pd	238.669 mW	Power	M1 MOSFET total power dissipation
34.	Total Pd	4.116 W	Power	Total Power Dissipation
35.	Xformer Pd	1.296 W	Power	Transformer power dissipation
36.	Zener Pd	277.712 mW	Power	Zener power dissipation
37.	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	5.0	Maximum Output Current
2.	VinMax	264.0	Maximum input voltage
3.	VinMin	176.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	acFrequency	50.0	Light Output in Lumen
6.	base_pn	UCC28740	Texas Instruments Base Part 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.