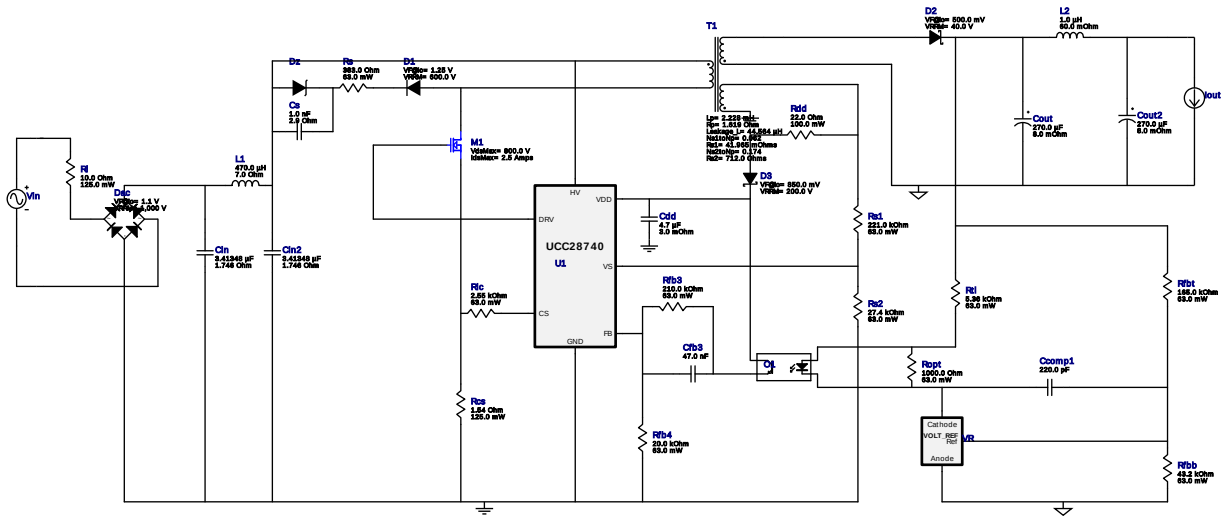
WEBENCH® Design Report

VinMin = 200.0V
VinMax = 240.0V
Vout = 12.0V
Iout = 1.5A

Device = UCC28740DR
Topology = Flyback
Created = 6/11/15 3:51:09 AM
BOM Cost = $0.00
Footprint = 861.0 mm^2
BOM Count = 33
Total Pd = 3.84W

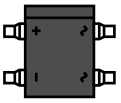
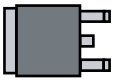
Design : 4360026/1 UCC28740DR
UCC28740DR 200.0V-240.0V to 12.00V @ 1.5A



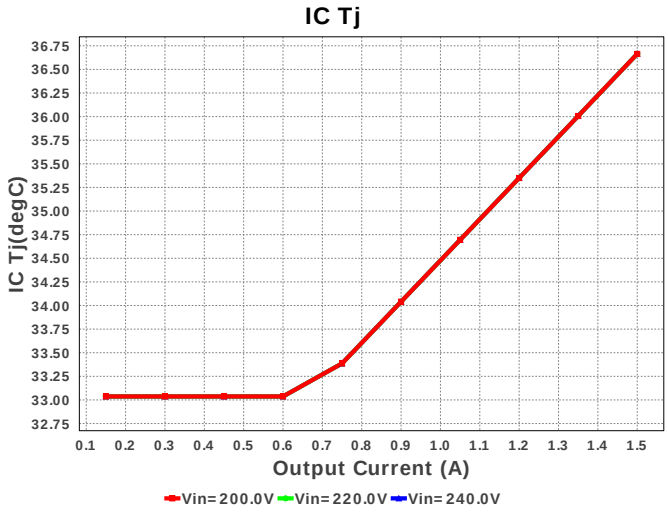
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

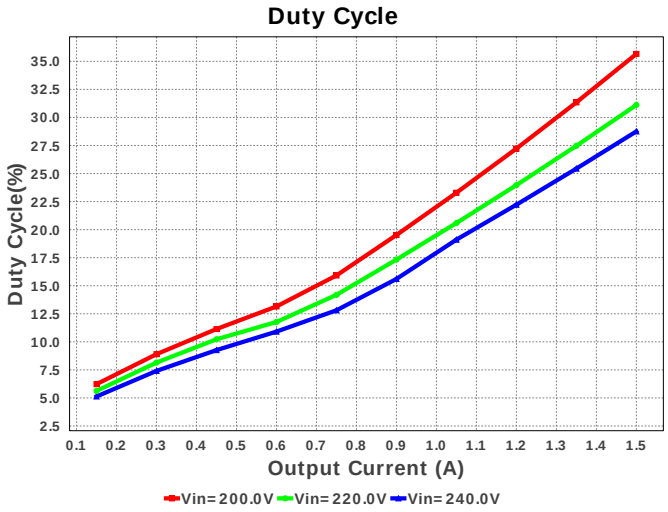
Electrical BOM

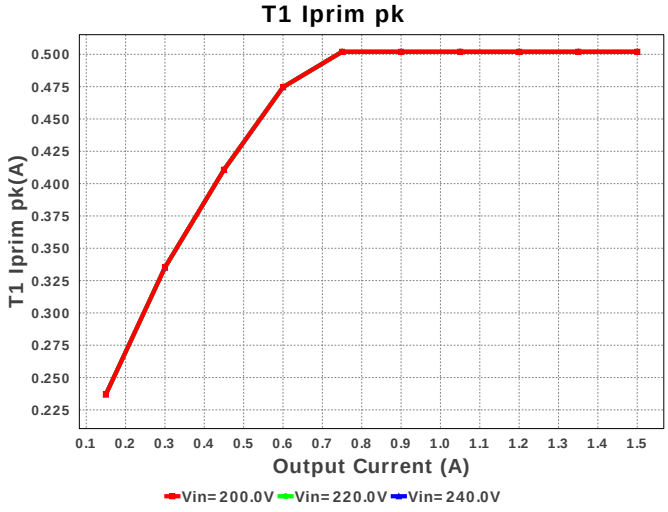
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp1	Yageo America	CC0805JRNPO9BN221 Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
2.	Cdd	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	1206 11 mm^2
3.	Cfb3	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= 3.41348 uF ESR= 1.74639 Ohm VDC= 509.11 V IRMS= 140.1 mA	1	NA	CUSTOM 0 mm^2
5.	Cin2	CUSTOM	CUSTOM Series= ?	Cap= 3.41348 uF ESR= 1.74639 Ohm VDC= 509.11 V IRMS= 140.1 mA	1	NA	CUSTOM 0 mm^2
6.	Cout	Panasonic	16SVPG270M Series= 2136	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	CAPSMT_62_C10 74 mm^2
7.	Cout2	Panasonic	16SVPG270M Series= 2136	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	1	$0.70	CAPSMT_62_C10 74 mm^2
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 mm^2

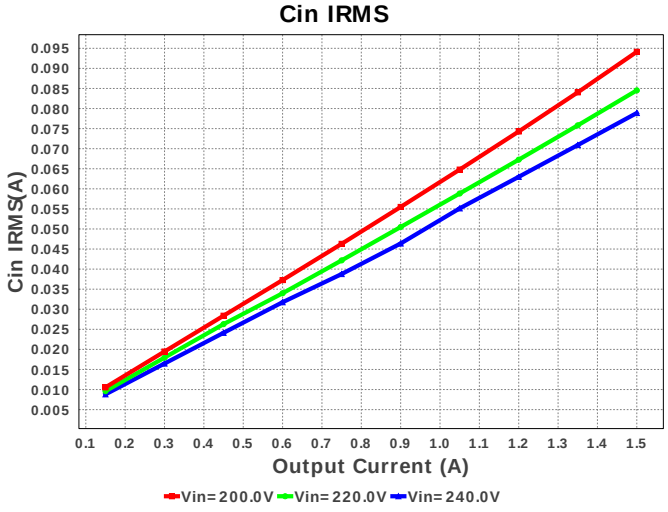
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	D1	Diodes Inc.	MURS160-13-F	VF@Io= 1.25 V VRRM= 600.0 V	1	$0.11	 SMB 44 mm^2
10.	D2	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.11	 SMA 37 mm^2
11.	D3	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	$0.21	 PowerDI123 13 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	$0.11	 SMB 44 mm^2
14.	L1	Bourns	SDR0403-471KL	L= 470.0 µH DCR= 7.0 Ohm	1	$0.18	 SDR0403 28 mm^2
15.	L2	TDK	MLP2520K1R0ST	L= 1.0 µH DCR= 60.0 mOhm	1	$0.14	 MLP2520K-M 11 mm^2
16.	M1	STMicroelectronics	STD3NK80ZT4	VdsMax= 800.0 V IdsMax= 2.5 Amps	1	$0.46	 DPAK 102 mm^2
17.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.35	 SSOP-4 111 mm^2
18.	Rcs	Vishay-Dale	CRCW08051R54FKEA Series= CRCW..e3	Res= 1.54 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
19.	Rdd	Susumu Co Ltd	RR1220Q-220-D Series= 264	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	 0805 7 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	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
23.	Rfbt	Vishay-Dale	CRCW0402165KFKED Series= CRCW..e3	Res= 165.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
24.	Rl	Vishay-Dale	CRCW080510R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
25.	Rlc	Vishay-Dale	CRCW04022K55FKED Series= CRCW..e3	Res= 2.55 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
27.	Rs	Vishay-Dale	CRCW0402383RFKED Series= CRCW..e3	Res= 383.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
28.	Rs1	Vishay-Dale	CRCW0402221KFKED Series= CRCW..e3	Res= 221.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

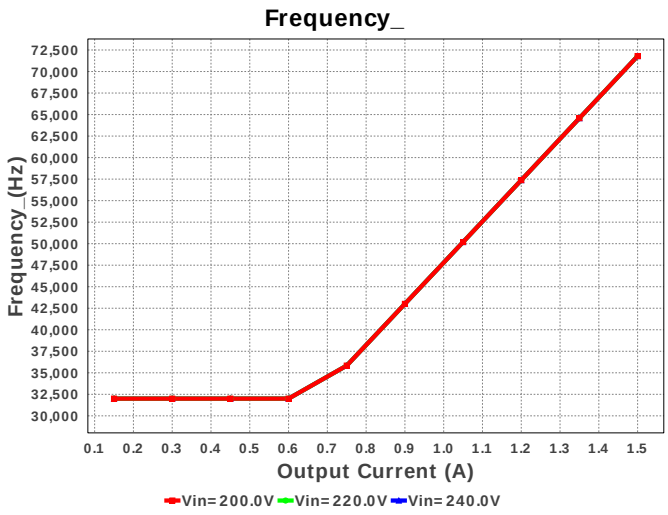
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
29.	Rs2	Vishay-Dale	CRCW040227K4FKED Series= CRCW..e3	Res= 27.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
30.	Rtl	Vishay-Dale	CRCW04025K36FKED Series= CRCW..e3	Res= 5.36 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
31.	T1	CUSTOM	CUSTOM	Lp= 2.228 mH Rp= 1.619 Ohm Leakage_L= 44.564 µH Ns1toNp= 0.062 Rs1= 41.965 mOhms Ns2toNp= 0.174 Rs2= 712.0 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	$0.09	R-PDSO-G3 16 mm^2

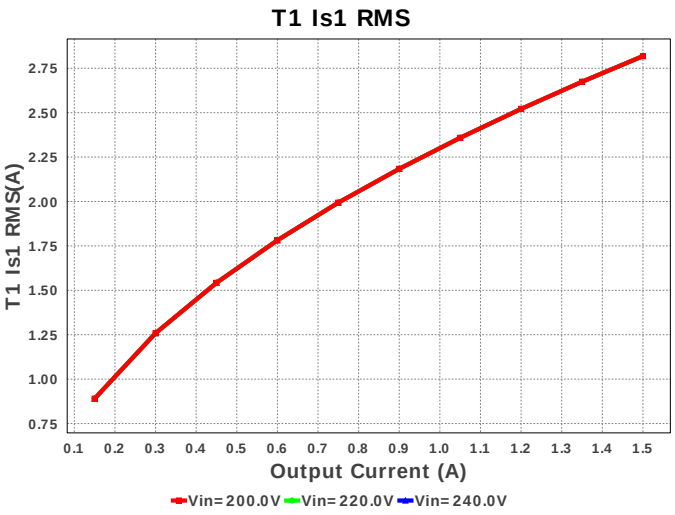


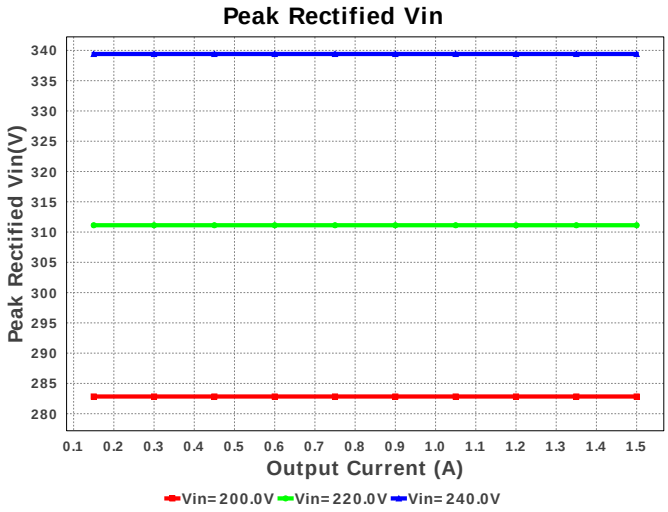


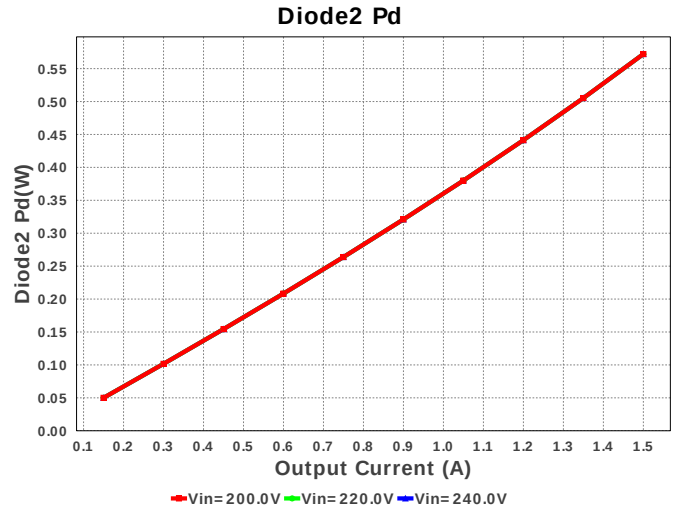


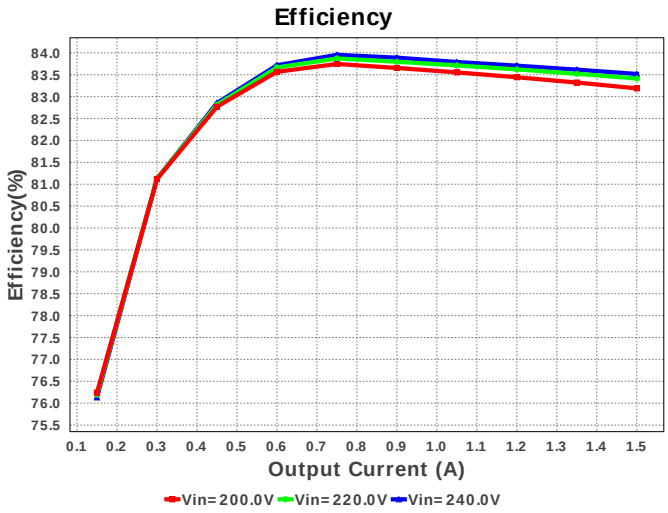


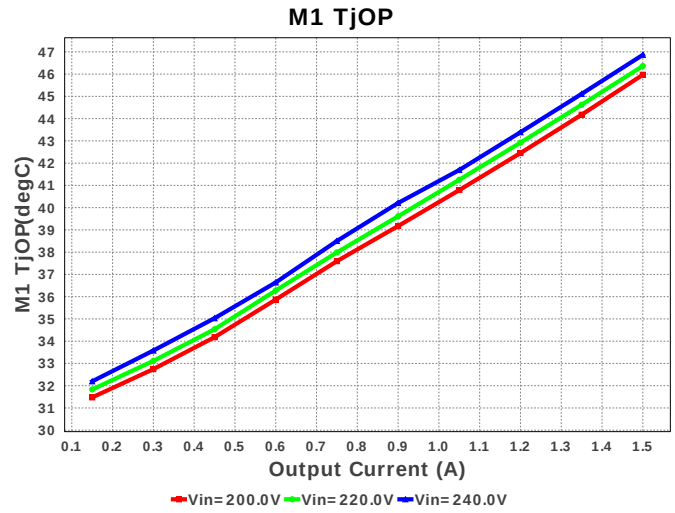


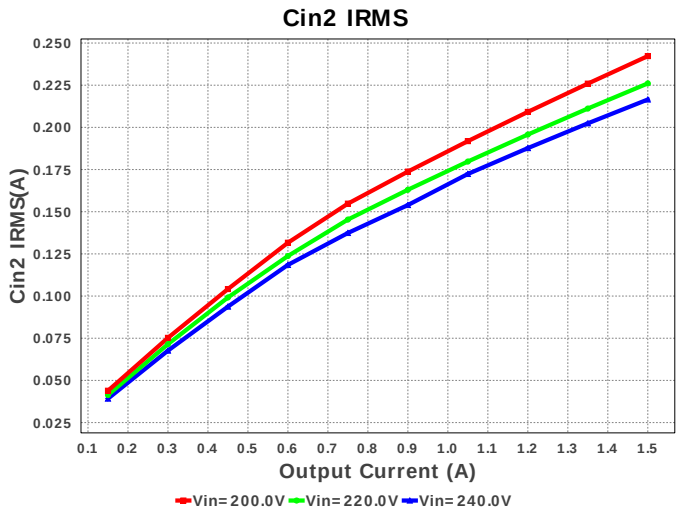


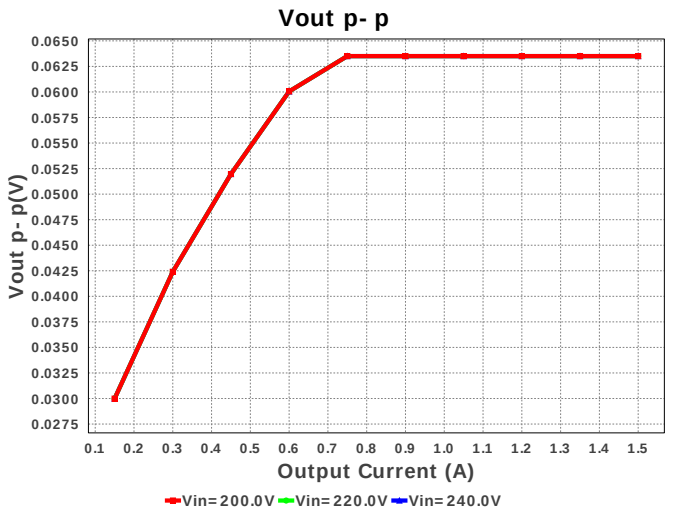


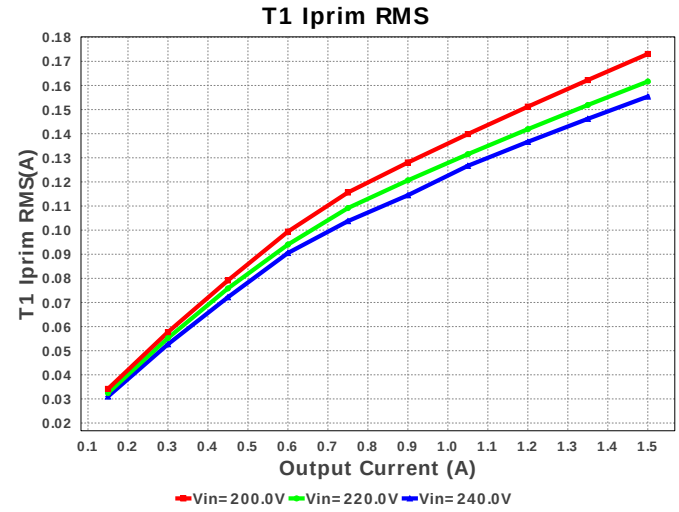


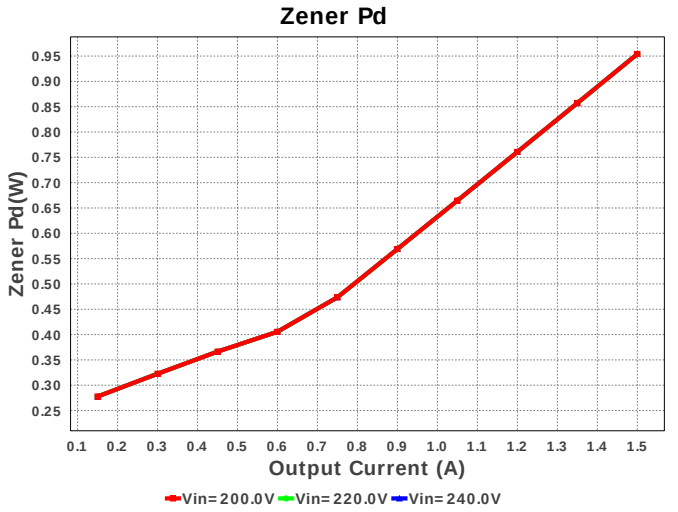


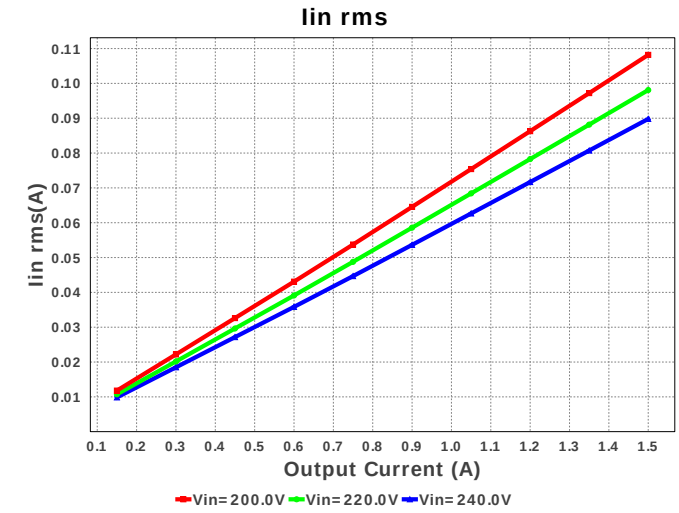


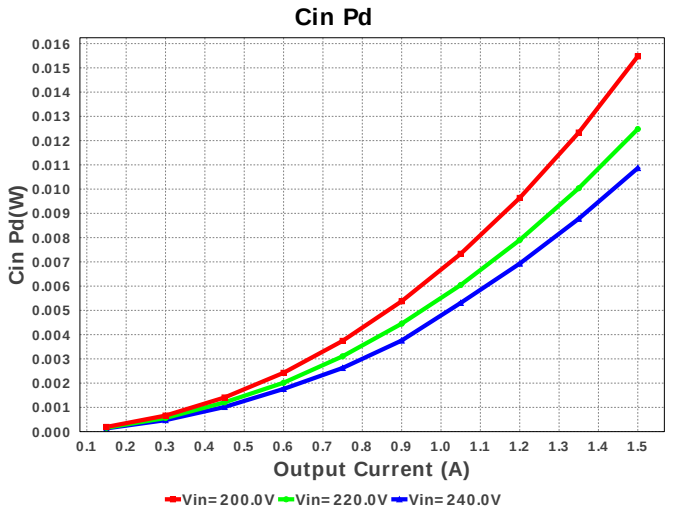


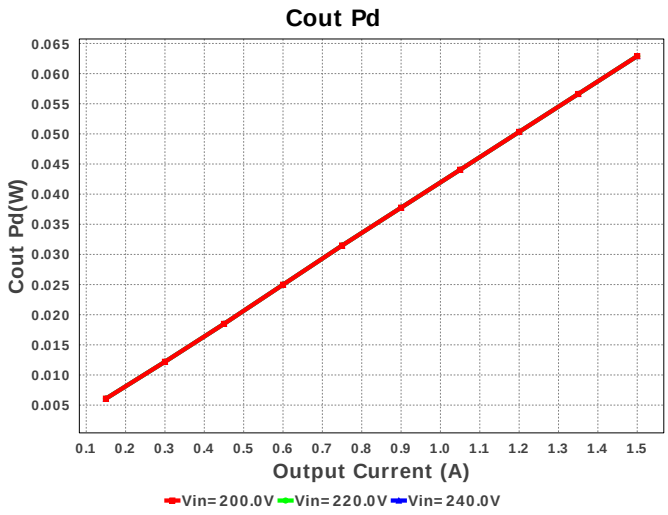


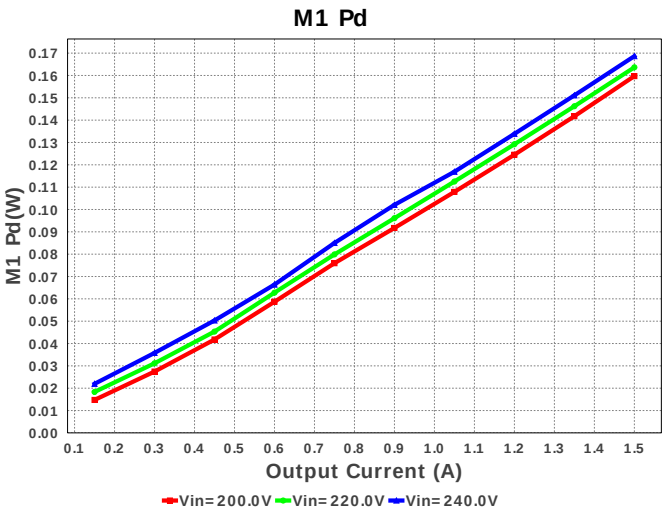


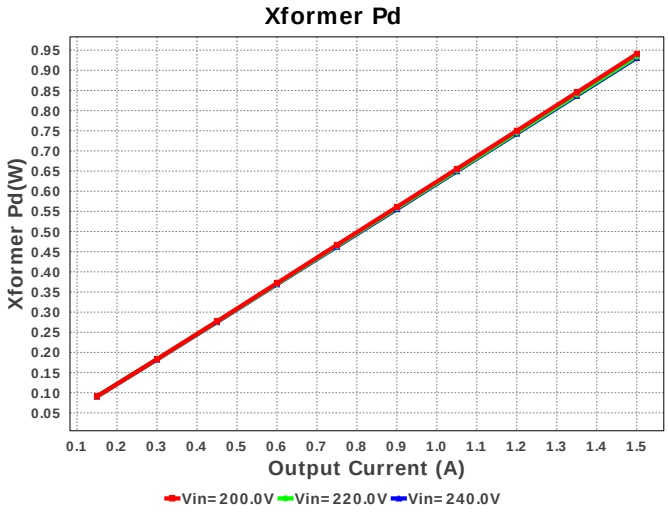


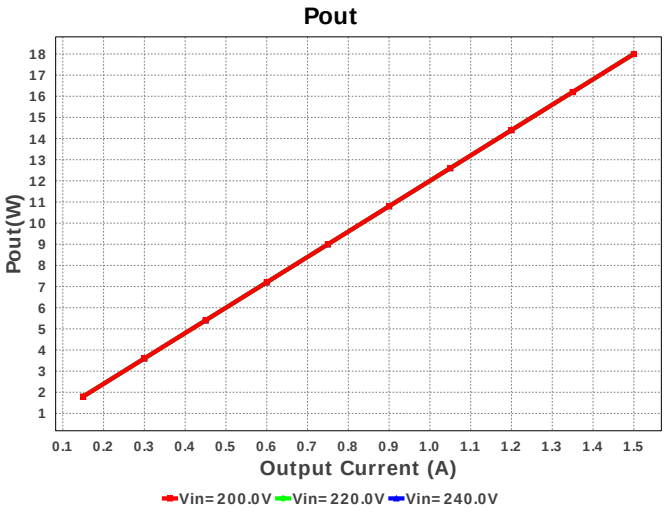


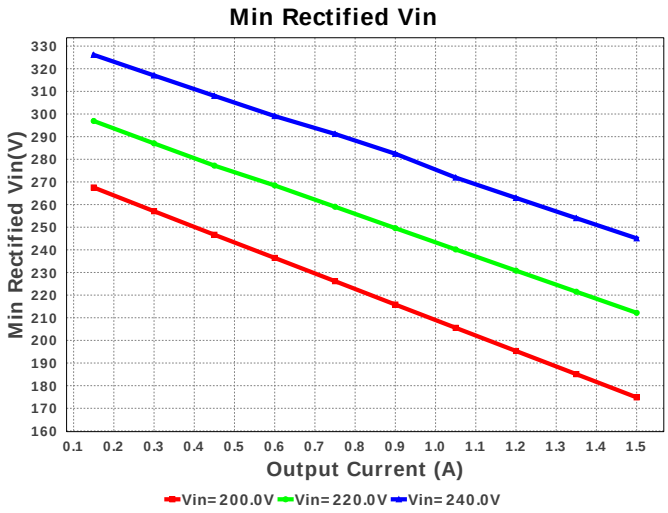


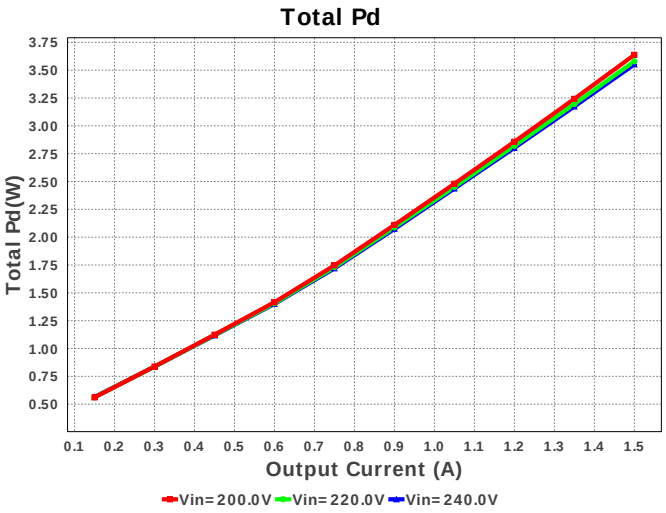


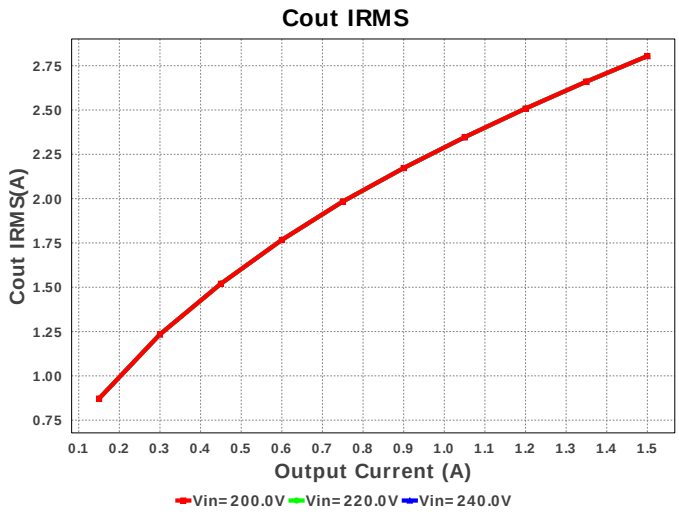


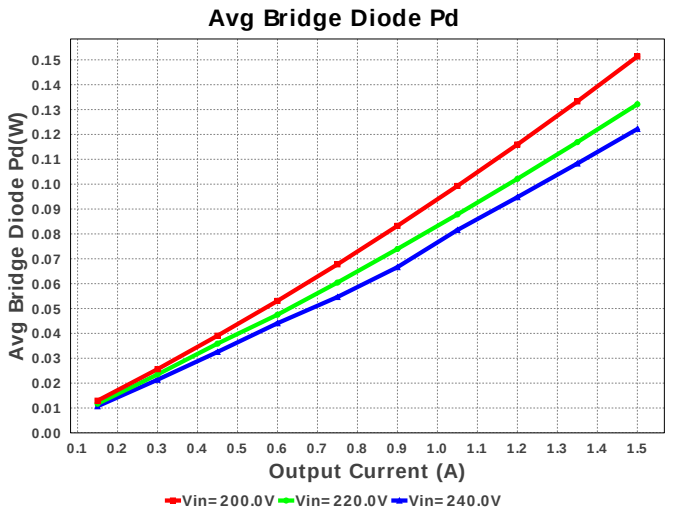


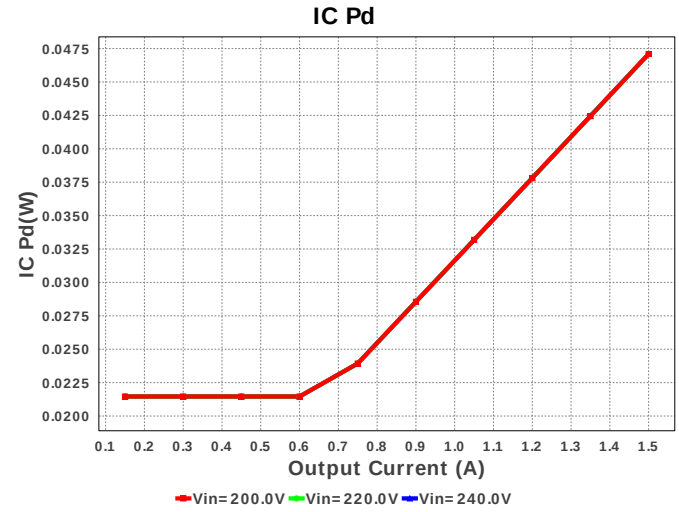


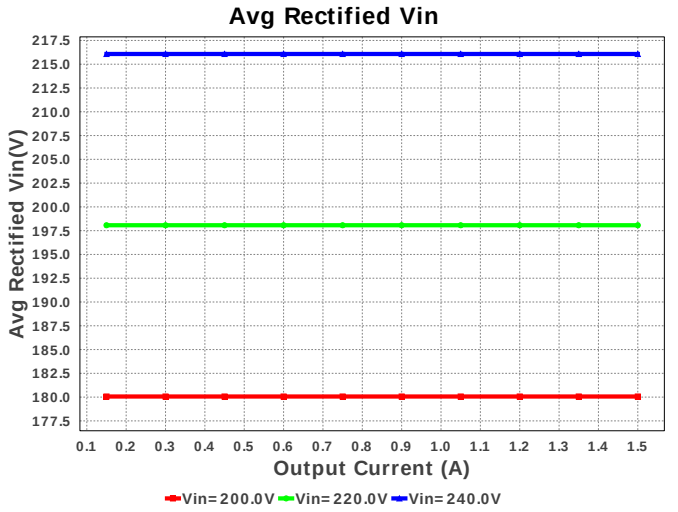


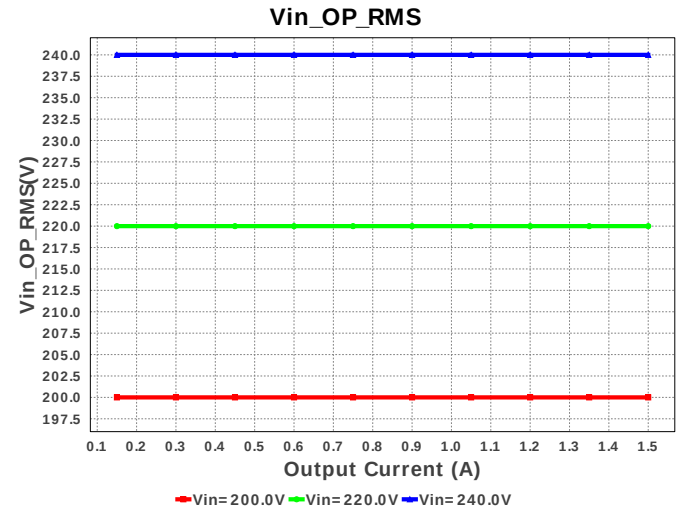


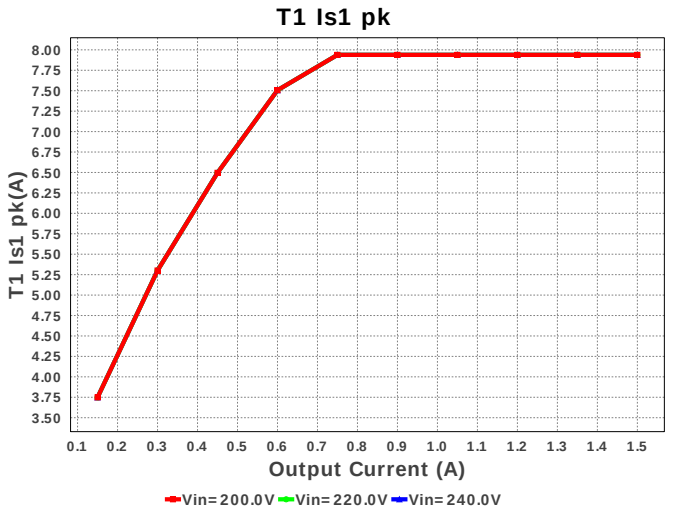












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	78.444 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	215.097 mA	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	2.804 A	Current	Output capacitor RMS ripple current
4.	Iin rms	91.012 mA	Current	RMS Input Current
5.	T1 Iprim RMS	153.891 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	501.948 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	2.818 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	7.939 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	216.076 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	33	General	Total Design BOM count
11.	FootPrint	861.0 mm^2	General	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
12.	Pout	18.0 W	General	Total output power
13.	Total BOM	$0.0	General	Total BOM Cost
14.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	28.199 %	Op_point	Duty cycle
16.	Efficiency	82.407 %	Op_point	Steady state efficiency
17.	Frequency	72.515 kHz	Op_point	Switching frequency
18.	IC Tj	36.73 degC	Op_point	IC junction temperature
19.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	1.5 A	Op_point	Iout operating point
21.	M1 TjOP	47.144 degC	Op_point	M1 MOSFET junction temperature
22.	Min Rectified Vin	242.901 V	Op_point	Minimum voltage seen at rectified input
23.	Peak Rectified Vin	339.408 V	Op_point	Peak voltage seen at rectified input
24.	Vin_OP_RMS	240.0 V	Op_point	AC Input RMS Voltage
25.	Vout p-p	63.509 mV	Op_point	Peak-to-peak output ripple voltage
26.	Avg Bridge Diode Pd	105.365 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
27.	Cin Pd	10.746 mW	Power	Input capacitor power dissipation
28.	Cout Pd	62.903 mW	Power	Output capacitor power dissipation
29.	Diode2 Pd	762.343 mW	Power	Diode2 power dissipation
30.	IC Pd	47.561 mW	Power	IC power dissipation
31.	M1 Pd	171.44 mW	Power	M1 MOSFET total power dissipation
32.	Total Pd	3.843 W	Power	Total Power Dissipation
33.	Xformer Pd	936.118 mW	Power	Transformer power dissipation
34.	Zener Pd	991.437 mW	Power	Zener power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	1.5	Maximum Output Current
2.	Iout1	1.5	Output Current #1
3.	VinMax	240.0	Maximum input voltage
4.	VinMin	200.0	Minimum input voltage
5.	Vout	12.0	Output Voltage
6.	Vout1	12.0	Output Voltage #1
7.	base_pn	UCC28740	Base Product Number
8.	source	DC	Input Source Type
9.	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.