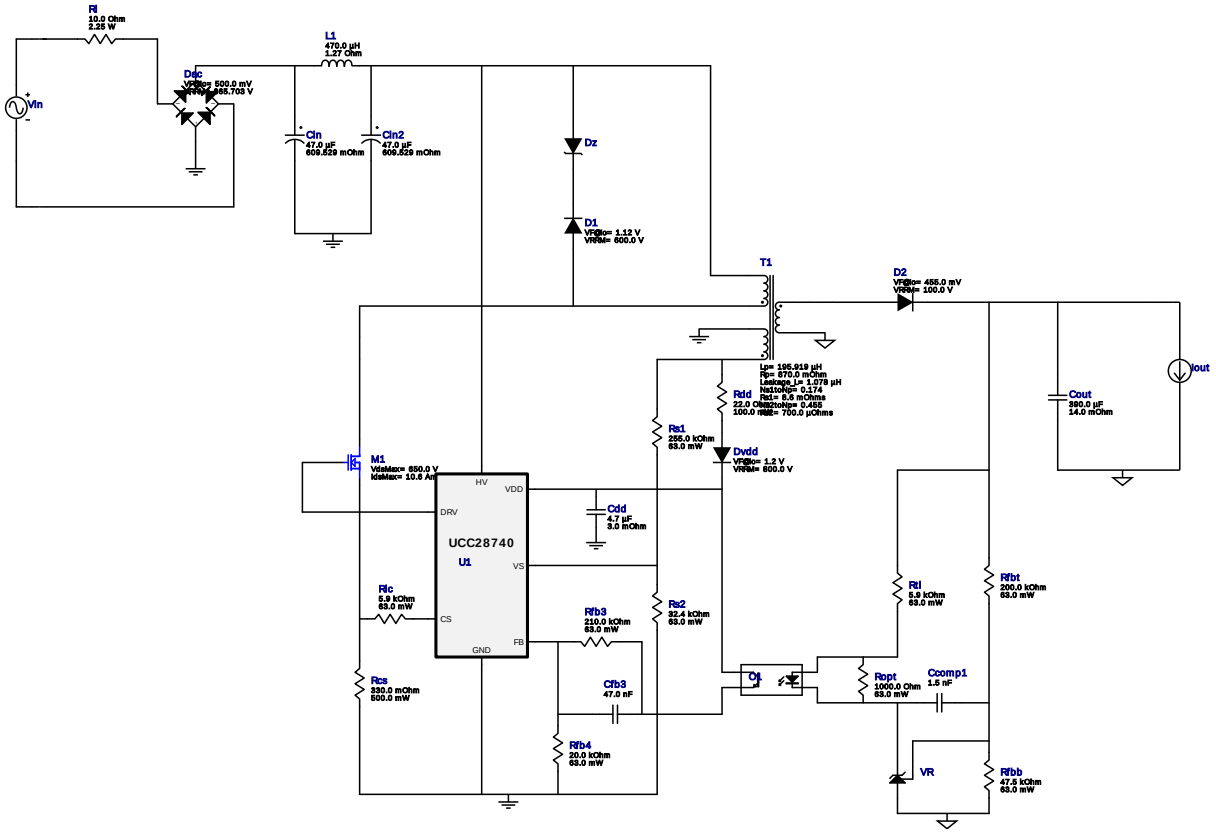
WEBENCH® Design Report

VinMin = 90.0V
VinMax = 265.0V
Vout = 13.0V
Iout = 2.5A

Device = UCC28740DR
Topology = Flyback
Created = 2/7/17 3:21:42 AM
BOM Cost = $0.00
BOM Count = 29
Total Pd = 6.41W

Design : 4722472/8 UCC28740DR
UCC28740DR 90.0V-265.0V to 13.00V @ 2.5A



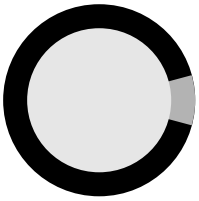
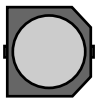
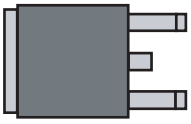
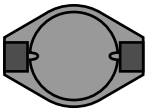
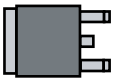
1. Rlc, Rtl and the feedback resistors for this design are a starting point, but may need adjustment based on the actual transformer used. For more information please click the design assistance button.

My Comments

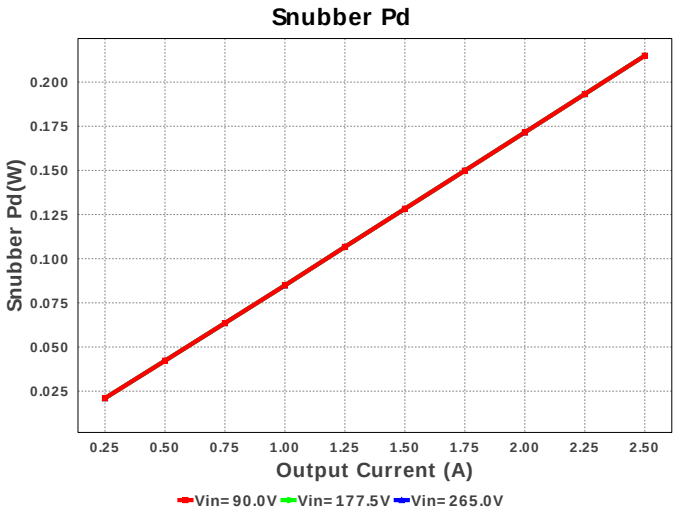
No comments

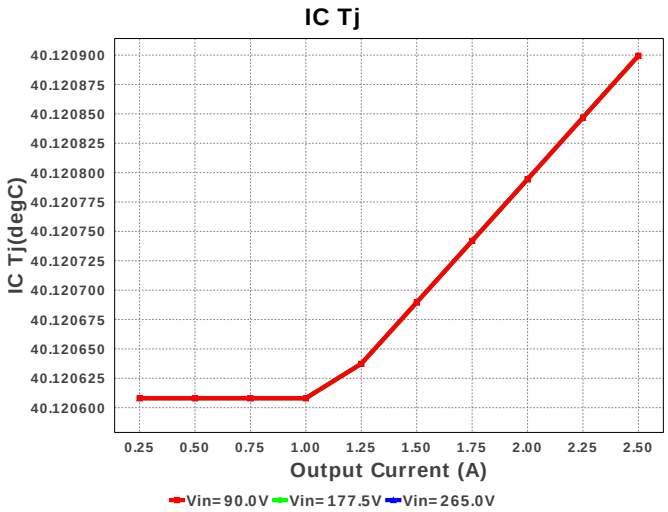
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp1	MuRata	GRM033R71C152KA01D Series= X7R	Cap= 1.5 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 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	MuRata	GRM155R71A473KA01D Series= X7R	Cap= 47.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
4.	Cin	Panasonic	EEUED2G470S Series= ED	Cap= 47.0 uF ESR= 609.53 mOhm VDC= 400.0 V IRMS= 840.0 mA	1	$0.68	CAPPR7.5-18X20 400 mm²

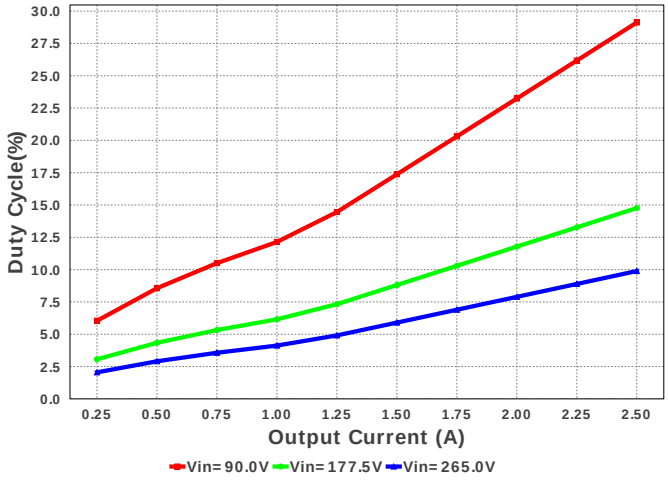
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
5.	Cin2	Panasonic	EEUED2G470S Series= ED	Cap= 47.0 uF ESR= 609.53 mOhm VDC= 400.0 V IRMS= 840.0 mA	1	$0.68	 CAPPR7.5-18X20 400 mm^2
6.	Cout	Panasonic	20SVPF390M Series= ?	Cap= 390.0 uF ESR= 14.0 mOhm VDC= 20.0 V IRMS= 4.95 A	1	$0.63	 CAPSMT_62_E12 106 mm^2
7.	D1	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.18	 SMC 83 mm^2
8.	D2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm^2
9.	Dac	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 865.703 V	1	NA	CUSTOM 0 mm^2
10.	Dvdd	Microsemi	UFS180JE3/TR13	VF@Io= 1.2 V VRRM= 800.0 V	1	$0.67	 DO-214BA 42 mm^2
11.	Dz	Diodes Inc.	SMBJ100A-13-F	Zener	1	$0.09	 SMB 44 mm^2
12.	L1	NIC Components	NPI31W471MTRF	L= 470.0 µH DCR= 1.27 Ohm	1	$0.18	 IND_NPI31W 172 mm^2
13.	M1	Infineon Technologies	IPD65R380C6	VdsMax= 650.0 V IdsMax= 10.6 Amps	1	$0.77	 DPAK 102 mm^2
14.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.41	 SSOP-4 111 mm^2
15.	Rcs	Rohm	MCR25JZHFLR330 Series= MCR25	Res= 330.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.03	 1210 15 mm^2
16.	Rdd	Yageo America	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
17.	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
18.	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
19.	Rfbb	Vishay-Dale	CRCW040247K5FKED Series= CRCW..e3	Res= 47.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
20.	Rfbt	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
21.	Rl	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	$0.29	AC03 158 mm²
22.	Rlc	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
23.	Ropt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
24.	Rs1	Vishay-Dale	CRCW0402255KFKED Series= CRCW..e3	Res= 255.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
25.	Rs2	Vishay-Dale	CRCW040232K4FKED Series= CRCW..e3	Res= 32.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
26.	Rtl	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	T1	CUSTOM	CUSTOM	Lp= 195.919 µH Rp= 870.0 mOhm Leakage_L= 1.078 µH Ns1toNp= 0.174 Rs1= 8.6 mOhms Ns2toNp= 0.455 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
28.	U1	Texas Instruments	UCC28740DR	Switcher	1	$0.37	R-PDSO-G7 55 mm²
29.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	$0.08	DBZ0003A 14 mm²

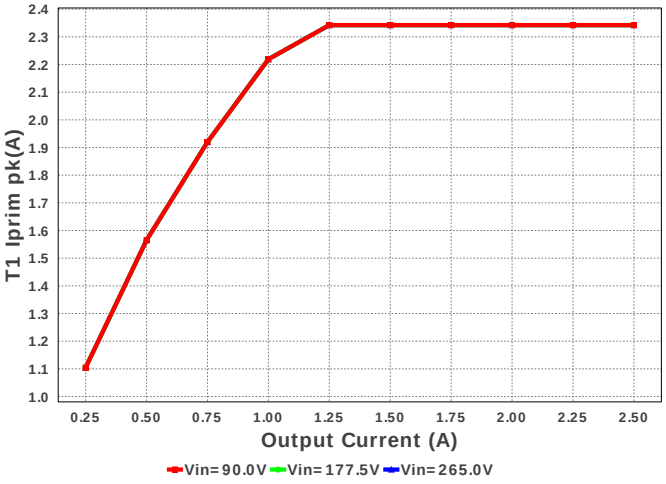




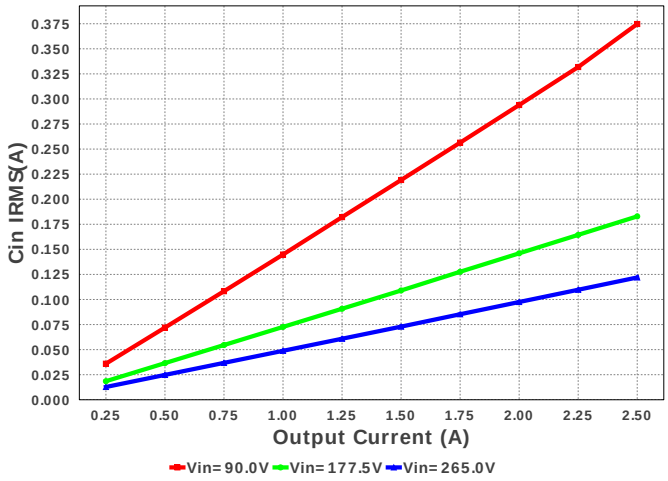
Duty Cycle



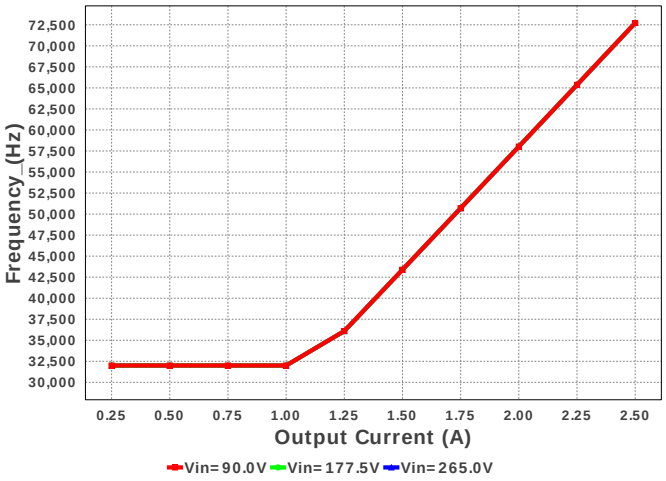
T1 Iprim pk



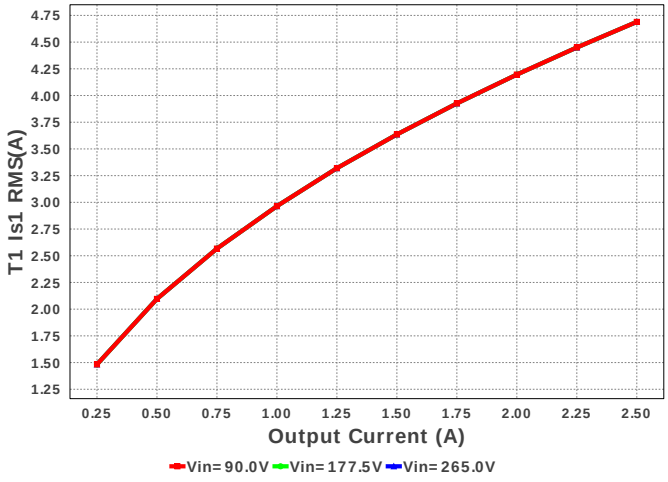
Cin IRMS



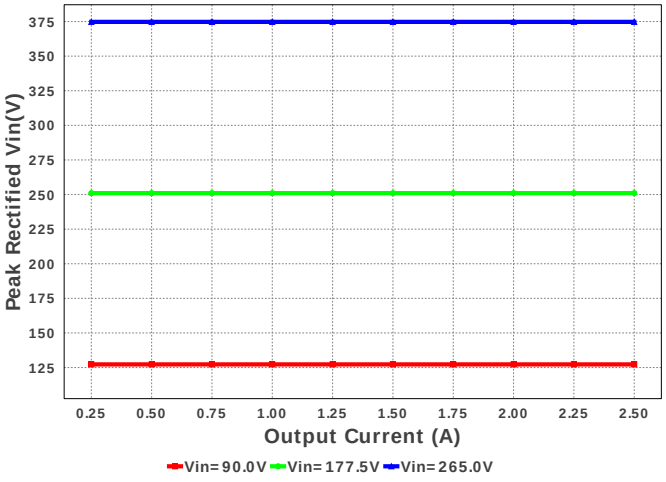
Frequency_

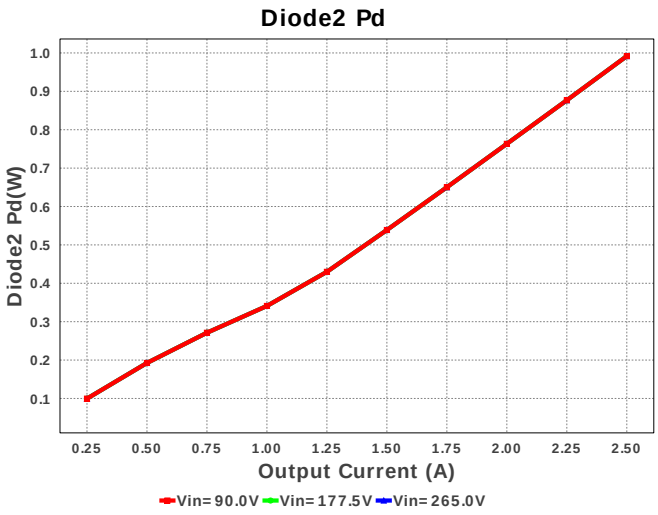


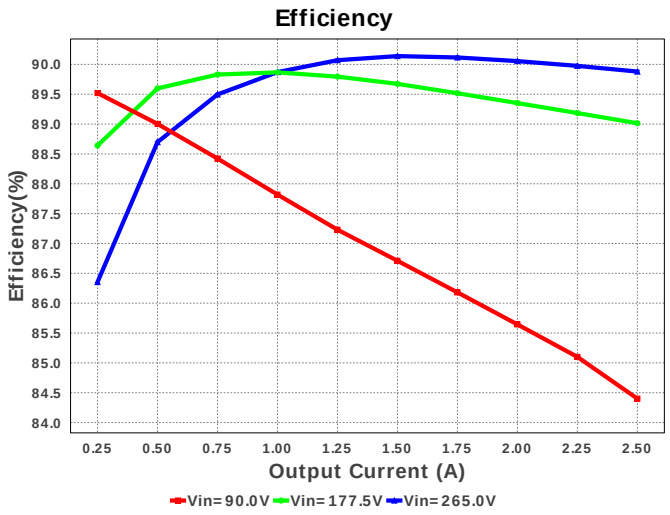
T1 Is1 RMS

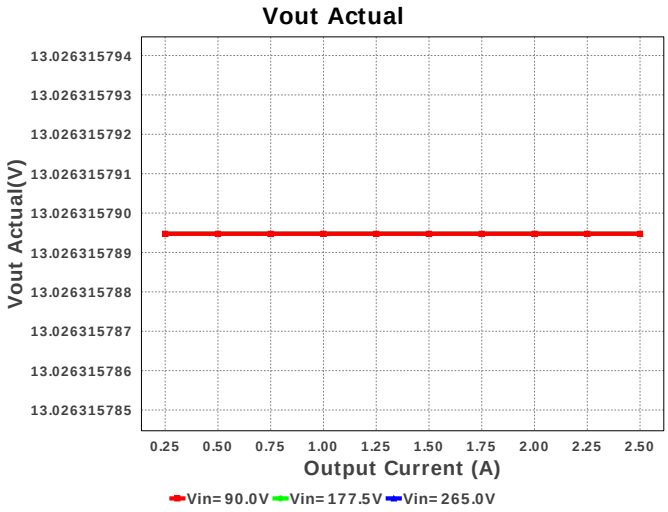


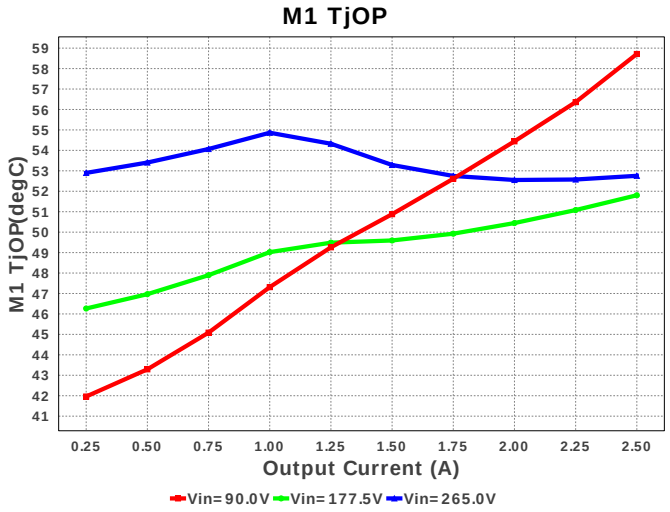
Peak Rectified Vin

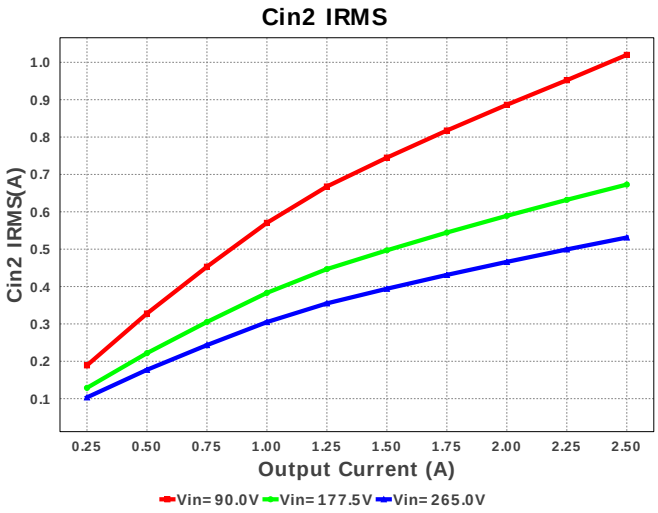


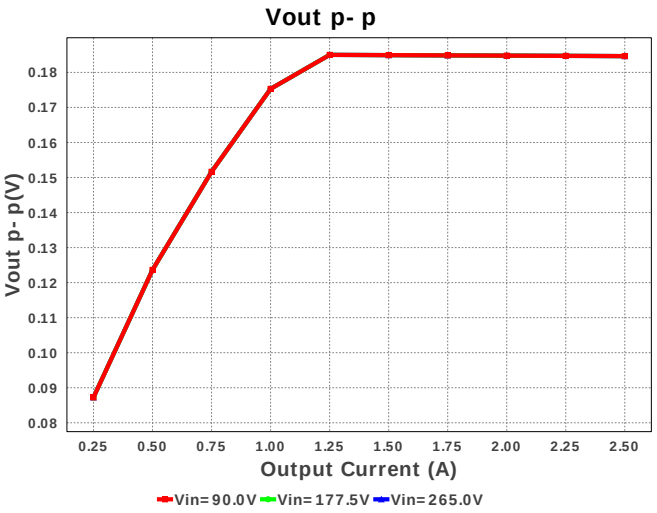


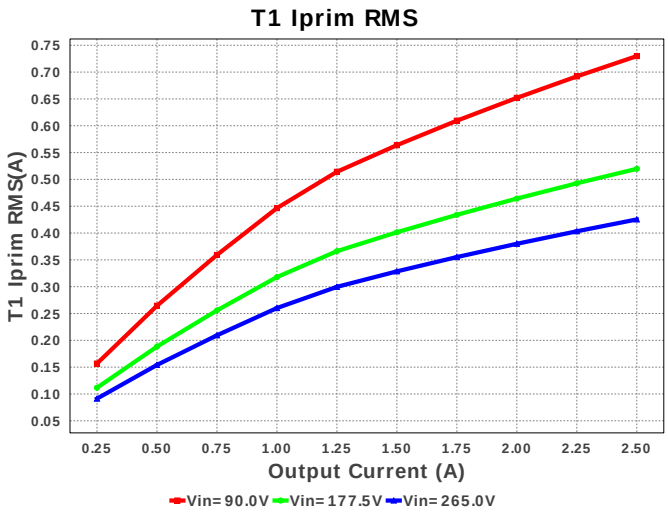


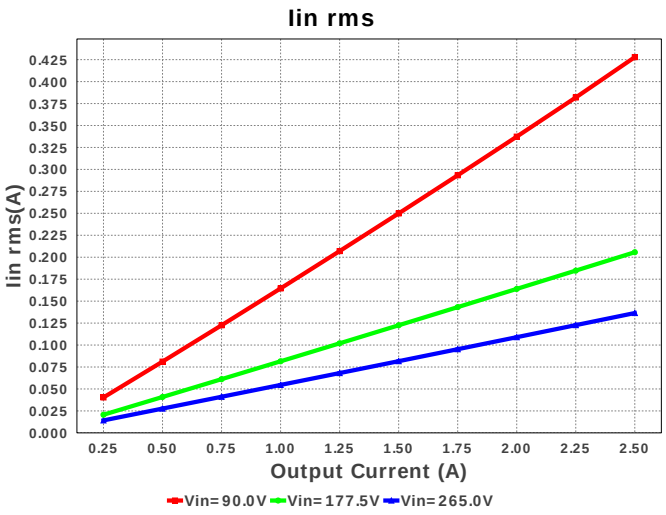


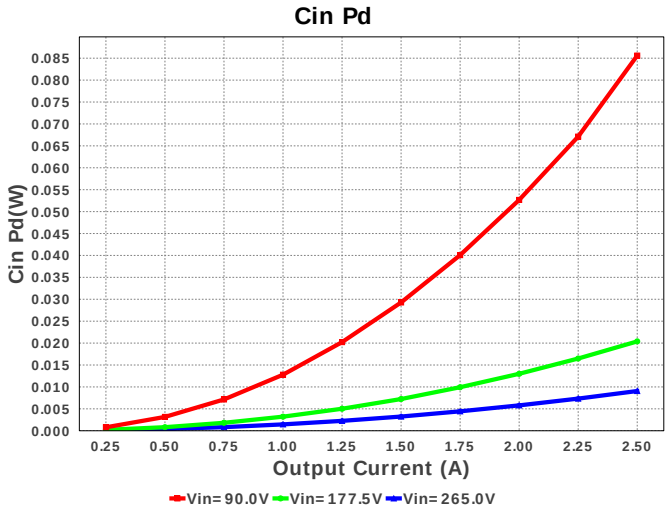


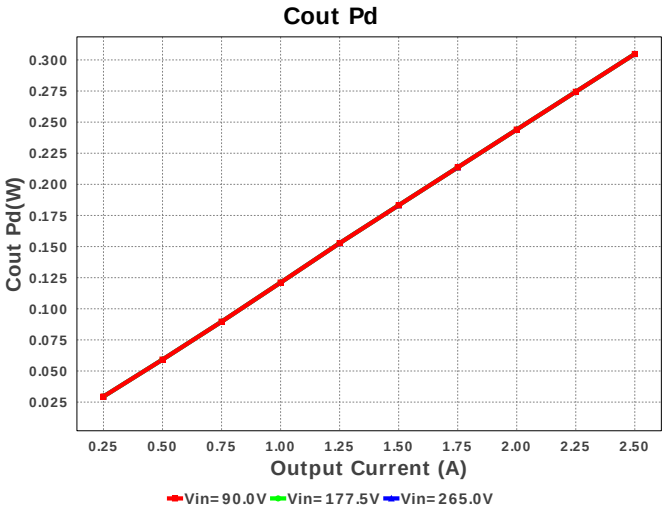


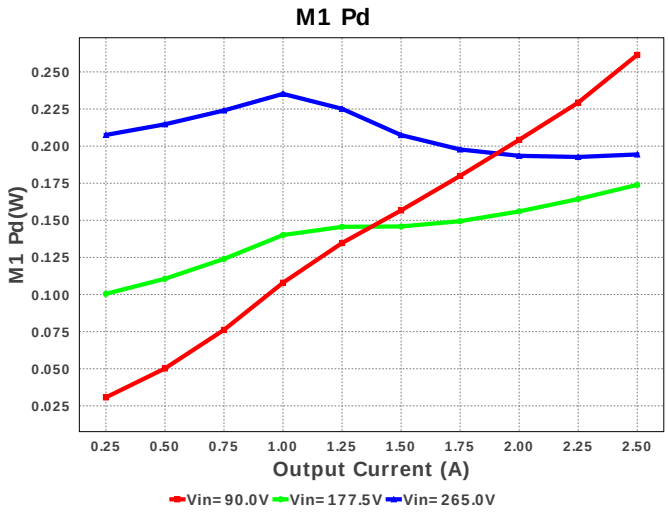


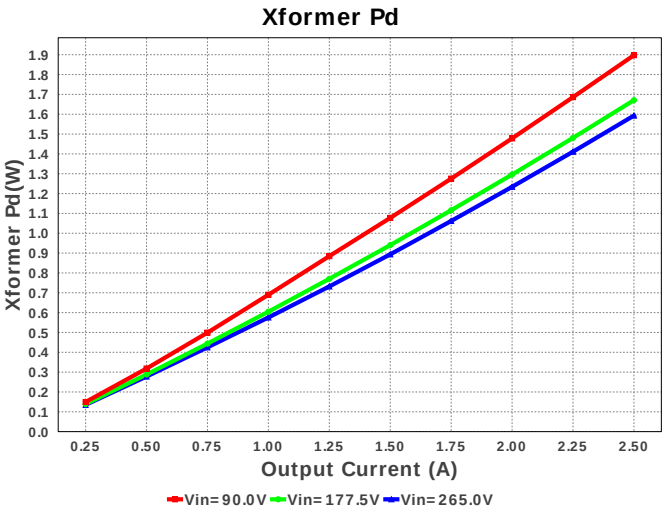


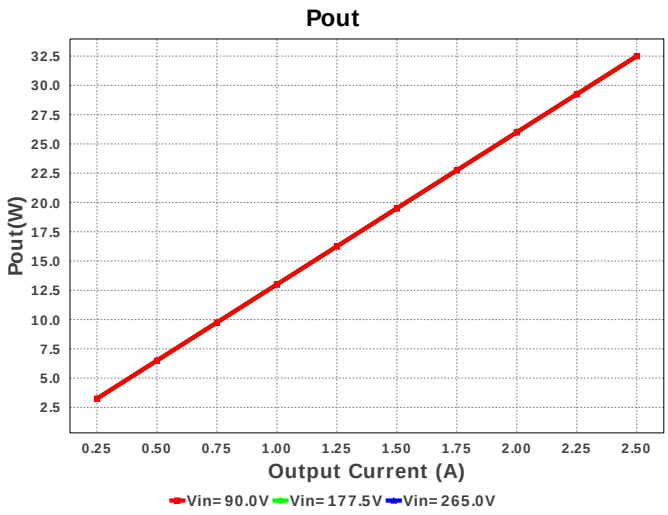


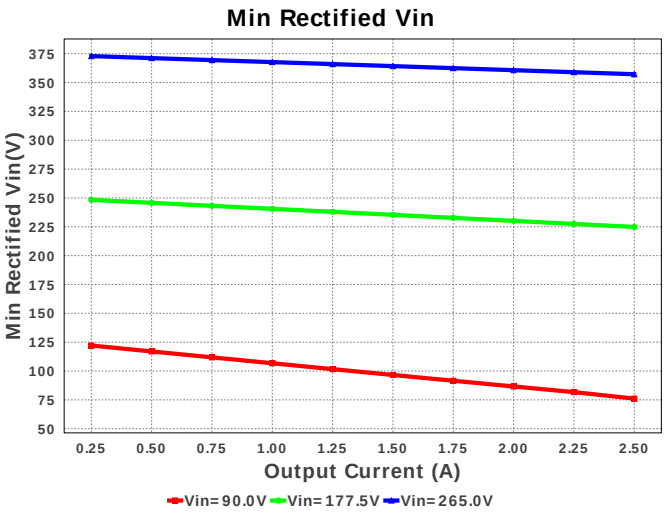


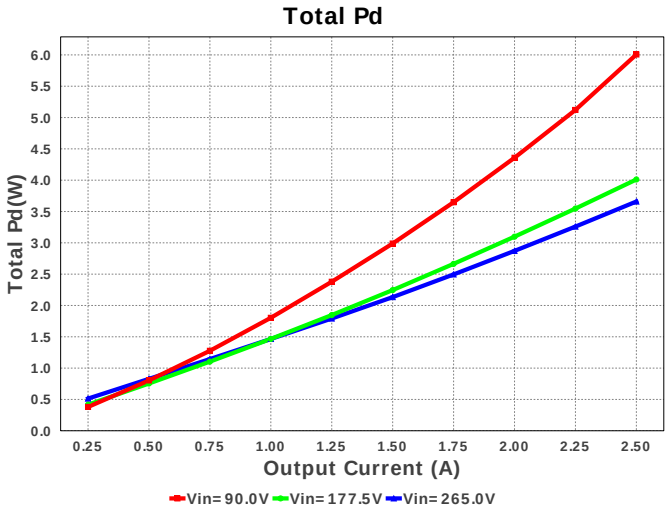


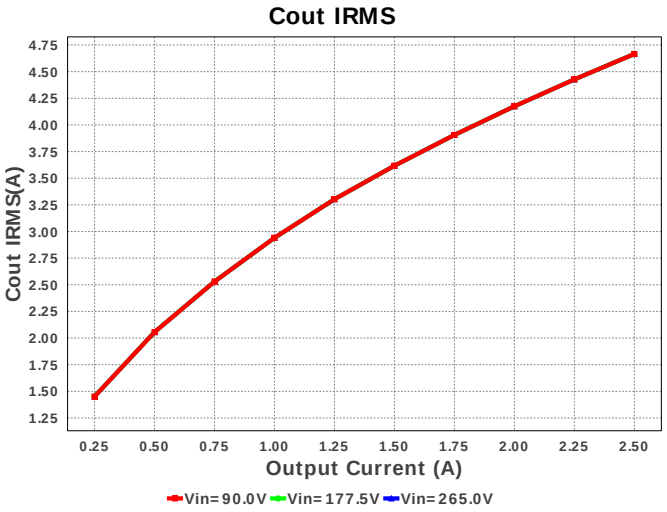


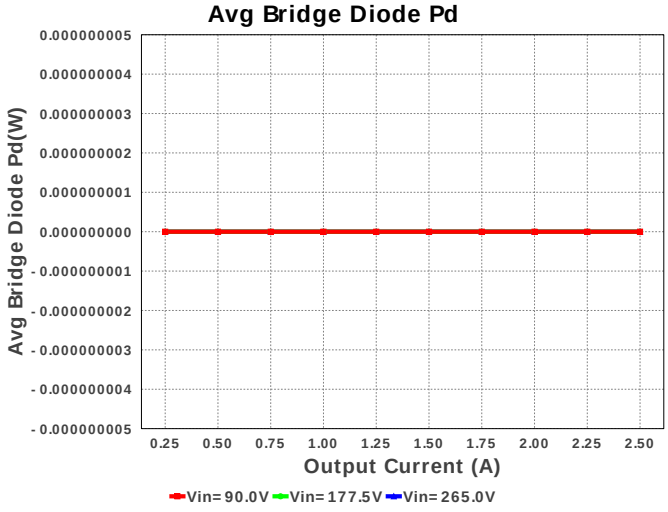


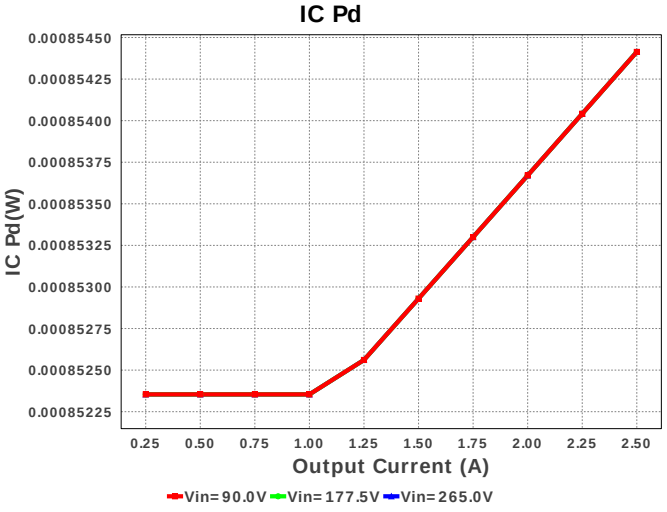


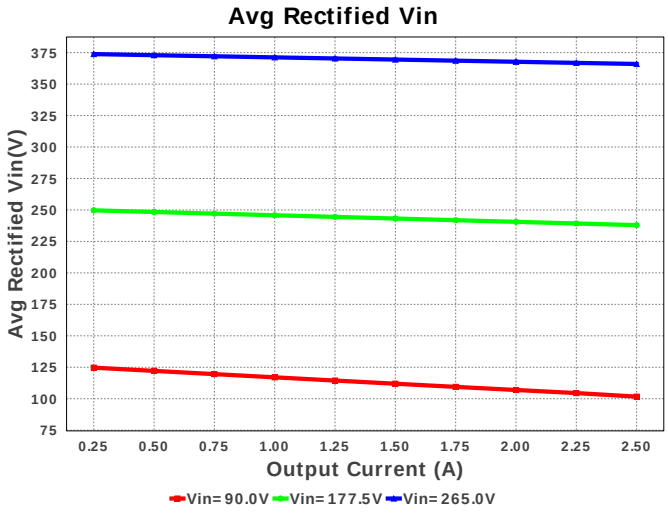


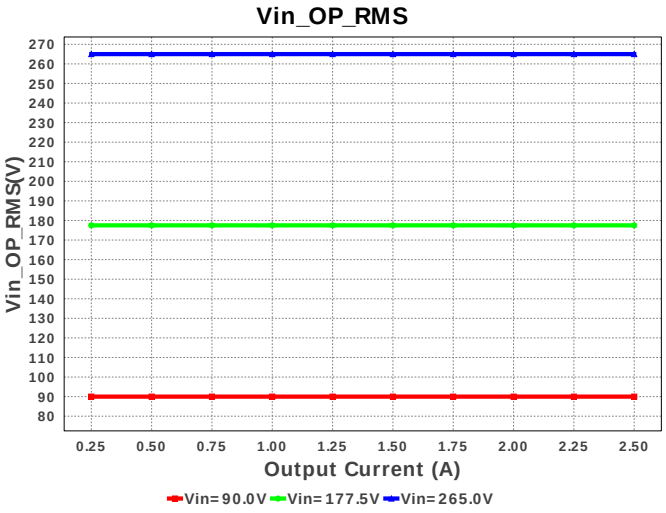


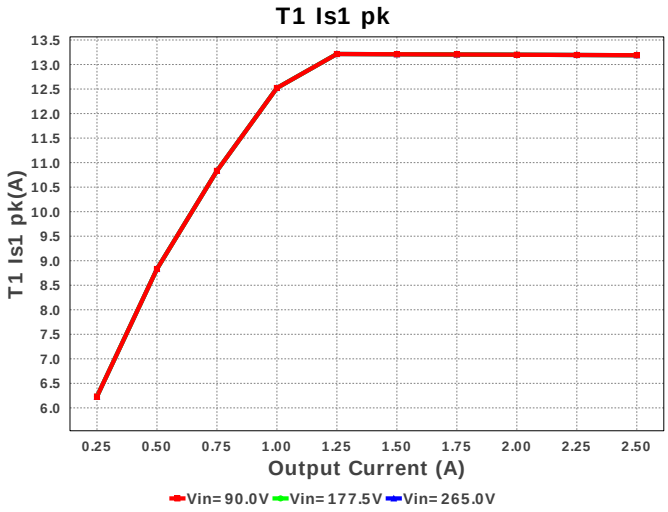












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	378.556 mA	Current	Input capacitor RMS ripple current
2.	Cin2 IRMS	1.024 A	Current	Input Capacitor Cin2 RMS Ripple Current
3.	Cout IRMS	4.666 A	Current	Output capacitor RMS ripple current
4.	Iin rms	432.31 mA	Current	RMS Input Current
5.	T1 Iprim RMS	729.807 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	2.342 A	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	4.69 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	13.19 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	100.433 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	29	General	Total Design BOM count
11.	FootPrint	1.969 k mm^2	General	Total Foot Print Area of BOM components
12.	Mode	DCM	General	Conduction Mode
13.	Pout	32.5 W	General	Total output power
14.	Total BOM	$0.0	General	Total BOM Cost
15.	Vout Actual	13.026 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	13.0 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	29.121 %	Op_point	Duty cycle
18.	Efficiency	83.531 %	Op_point	Steady state efficiency
19.	Frequency	72.713 kHz	Op_point	Switching frequency
20.	IC Tj	40.121 degC	Op_point	IC junction temperature
21.	ICThetaJA	141.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	2.5 A	Op_point	Iout operating point
23.	M1 TjOP	58.714 degC	Op_point	M1 MOSFET junction temperature
24.	Min Rectified Vin	73.589 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	127.278 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	90.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	184.654 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	360.471 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	87.348 mW	Power	Input capacitor power dissipation
30.	Cout Pd	304.766 mW	Power	Output capacitor power dissipation
31.	Diode2 Pd	991.773 mW	Power	Diode2 power dissipation

#	Name	Value	Category	Description
32.	IC Pd	854.413 µW	Power	IC power dissipation
33.	M1 Pd	261.456 mW	Power	M1 MOSFET total power dissipation
34.	Snubber Pd	214.958 mW	Power	Snubber Power Dissipation
35.	Total Pd	6.408 W	Power	Total Power Dissipation
36.	Xformer Pd	1.897 W	Power	Transformer power dissipation
37.	Vout Tolerance	1.958 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.5	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	90.0	Minimum input voltage
4.	Vout	13.0	Output Voltage
5.	base_pn	UCC28740	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	40.0	Ambient temperature
8.	UserFsw	63.0 k	Customer Selected Frequency

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.