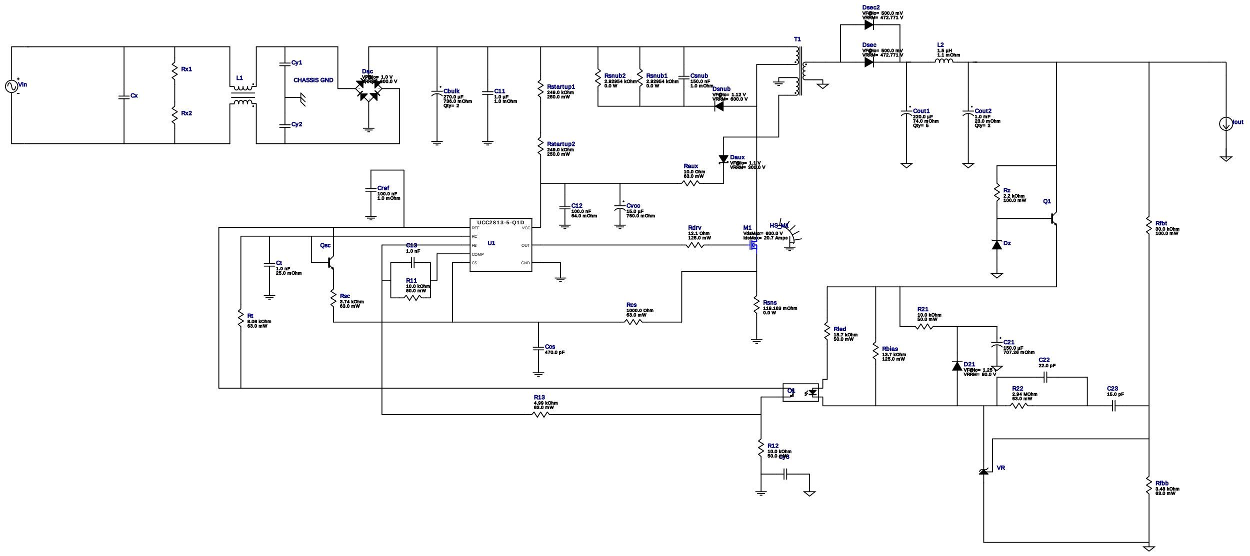
VinMin = 85.0V
VinMax = 265.0V
Vout = 24.0V
Iout = 5.0A

Device = UCC2813QDR-5Q1
Topology = Flyback
Created = 2022-02-15 08:54:29.292
BOM Cost = NA
BOM Count = 56
Total Pd = 11.72W

WEBENCH ® Design Report

Design : 1 UCC2813QDR-5Q1
UCC2813QDR-5Q1 85V-265V to 24.00V @ 5A



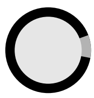
1. The EMI filter shown in the schematic is a placeholder. It has not yet been designed for the application.

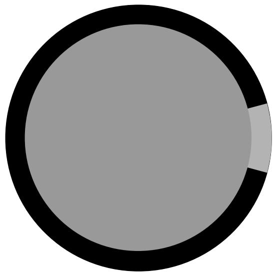
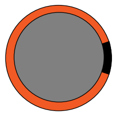
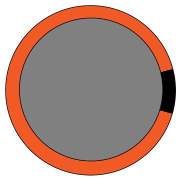
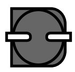
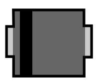
Design Alerts

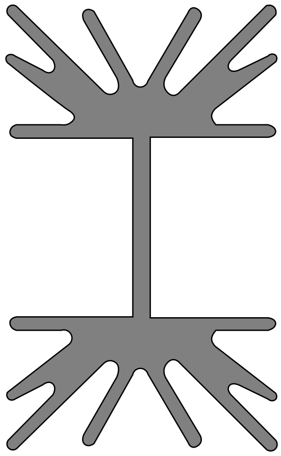
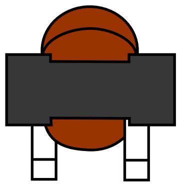
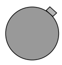
Component Selection Information

The UCC2813-5-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. Click on the transformer symbol in the schematic and select "Explore Transformer Core/Bobbin Selection" to design using specific transformer cores and bobbin.

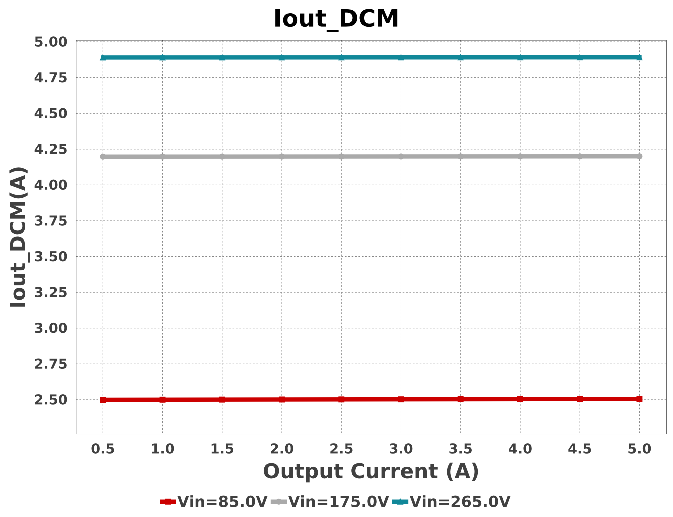
Electrical BOM

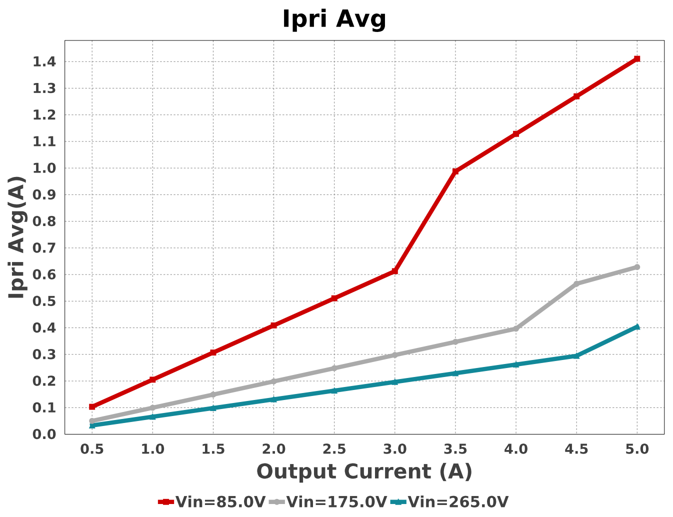
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C11	Knowles Capacitors	2220Y6300105KXTWS2 Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 630.0 V IRMS= 0.0 A	1	$3.38	2220_450 54 mm^2
C12	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
C13	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
C21	Chemi-Con	ELXZ630ELL151MH20D Series= LXZ	Cap= 150.0 uF ESR= 707.26 mOhm VDC= 63.0 V IRMS= 690.0 mA	1	$0.12	 Chemi-Con_800x2000 100 mm^2
C22	Samsung Electro-Mechanics	CL21C220JBANNNC Series= C0G/NP0	Cap= 22.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
C23	Samsung Electro-Mechanics	CL21C150JBANNNC Series= C0G/NP0	Cap= 15.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2

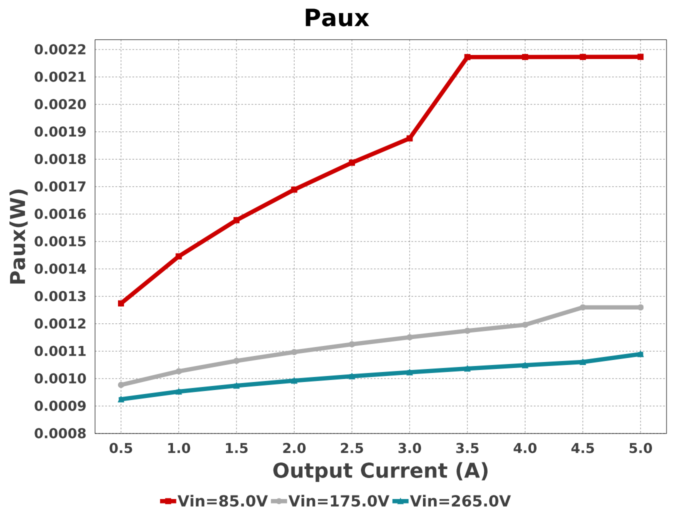
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbulk	Nichicon	LLS2G271MELA Series= 2387	Cap= 270.0 uF ESR= 736.0 mOhm VDC= 400.0 V IRMS= 1.79 A	2	$1.91	 Nichicon_2500x4000_Snap 729 mm²
Ccs	AVX	04025A471JAT2A Series= C0G/NP0	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cout1	TDK	B41896C6227M000 Series= 2355	Cap= 220.0 uF ESR= 74.0 mOhm VDC= 50.0 V IRMS= 1.205 A	5	$0.33	 B41896_1000x2000 144 mm²
Cout2	TDK	B41896C6108M000 Series= 2355	Cap= 1.0 mF ESR= 23.0 mOhm VDC= 50.0 V IRMS= 3.16 A	2	$1.03	 B41896_1600x3150 324 mm²
Cref	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Csnub	MuRata	GRM43QR72E154KW01L Series= X7R	Cap= 150.0 nF ESR= 1.0 mOhm VDC= 250.0 V IRMS= 0.0 A	1	$0.63	 1812 23 mm²
Ct	Kemet	C0805C102J1GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 100.0 V IRMS= 1.71 A	1	$0.09	0805 7 mm²
Cvcc	Nichicon	UUD1V150MCL1GS Series= uD	Cap= 15.0 uF ESR= 760.0 mOhm VDC= 35.0 V IRMS= 150.0 mA	1	$0.11	 SM_RADIAL_5MM 58 mm²
D21	Infineon Technologies	BAS1602VH6327XTSA1	VF@Io= 1.25 V VRRM= 80.0 V	1	$0.04	SOD-523 5 mm²
Dac	Fairchild Semiconductor	GBU6J	VF@Io= 1.0 V VRRM= 600.0 V	1	$0.43	 GBU 131 mm²
Daux	SMC Diode Solutions	ST1300ATR	VF@Io= 1.1 V VRRM= 300.0 V	1	$0.07	 SMA 37 mm²
Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 472.771 V	1	NA	CUSTOM 0 mm²
Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 472.771 V	1	NA	CUSTOM 0 mm²
Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.23	 SMC 83 mm²

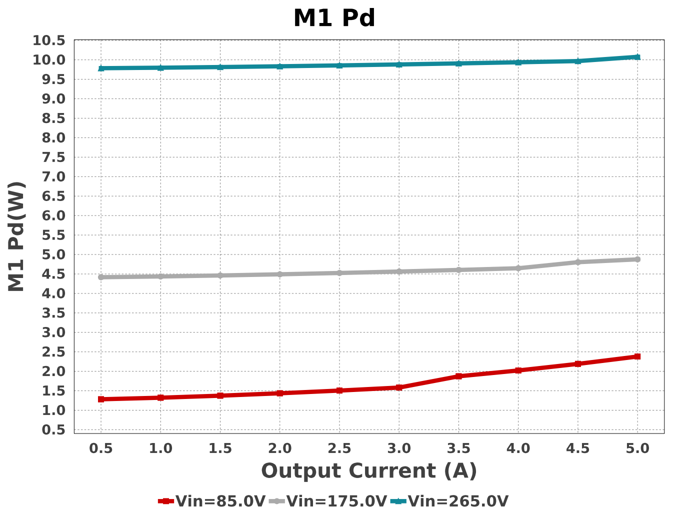
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Dz	Micro Commercial Components	3SMAJ5932B-TP	Zener	1	$0.12	 SMA 37 mm²
HS_M1	Aavid	529802B02500G	Heatsink	1	$0.91	 529802 1203 mm²
L2	Coilcraft	SER1590-152MLB	L= 1.5 µH 1.1 mOhm	1	$1.12	 SER1590 324 mm²
M1	Infineon Technologies	SPA20N60C3XKSA1	VdsMax= 600.0 V IdsMax= 20.7 Amps	1	$2.49	 TO-220FP 79 mm²
O1	Fairchild Semiconductor	FOD817A	Optocoupler	1	$0.11	 DIP-4 71 mm²
Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	$0.02	 SOT-23 14 mm²
Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	$1.11	 TO-18 57 mm²
R11	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
R12	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
R21	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
R22	Vishay-Dale	CRCW04022M94FKED Series= CRCW..e3	Res= 2.94 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rbias	Vishay-Dale	CRCW080513K7FKEA Series= CRCW..e3	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²

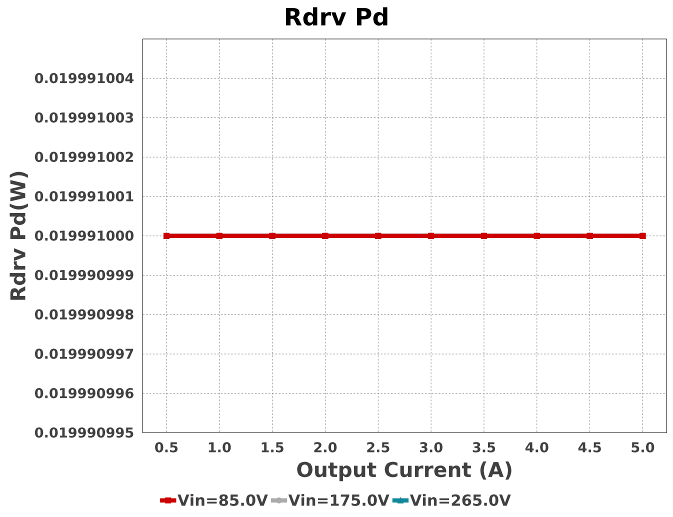
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rcs	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rdrv	Vishay-Dale	CRCW080512R1FKEA Series= CRCW..e3	Res= 12.1 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Rfbb	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rled	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rsc	Vishay-Dale	CRCW04023K74FKED Series= CRCW..e3	Res= 3.74 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsns	CUSTOM	CUSTOM Series= ?	Res= 118.163 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rsnub1	CUSTOM	CUSTOM Series= ?	Res= 2.92954 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rsnub2	CUSTOM	CUSTOM Series= ?	Res= 2.92954 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rstartup1	Vishay-Dale	CRCW1206249KFKEA Series= CRCW..e3	Res= 249.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rstartup2	Vishay-Dale	CRCW1206249KFKEA Series= CRCW..e3	Res= 249.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rt	Vishay-Dale	CRCW04028K06FKED Series= CRCW..e3	Res= 8.06 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rz	Yageo	RC0603FR-072K2L Series= ?	Res= 2.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
T1	Core=Wurth Elektronik , CoilFormer=Wurth Elektronik	Core=150-2449 , CoilFormer=070-5050	Lp= 137.0 µH Turns Ratio(Nas)= 4:10 Turns Ratio(Nps)= 21:10 Npri= 21.0 Naux= 4.0 Nsec= 10.0	1	NA	PQ3220 1478 mm^2
U1	Texas Instruments	UCC2813QDR-5Q1	Switcher	1	$1.04	D0008A 57 mm^2
VR	Texas Instruments	TL431IDBVR	Voltage References	1	$0.07	R-PDSO-G3 16 mm^2

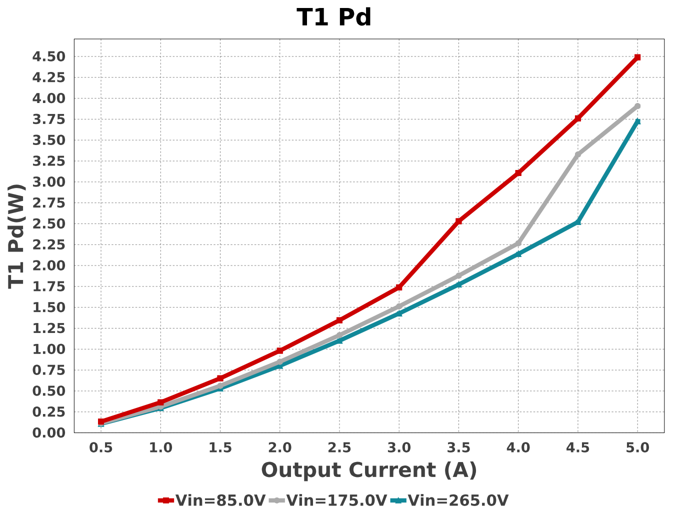

Iout_DCM
Iout_DCM(A)
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

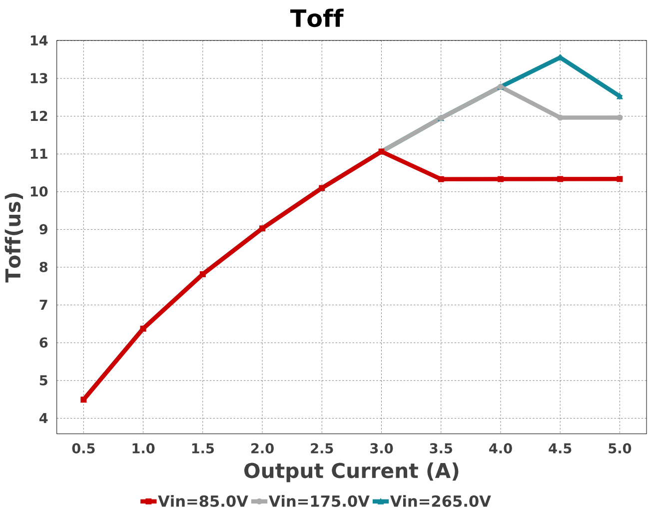

Ipri Avg
Ipri Avg(A)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

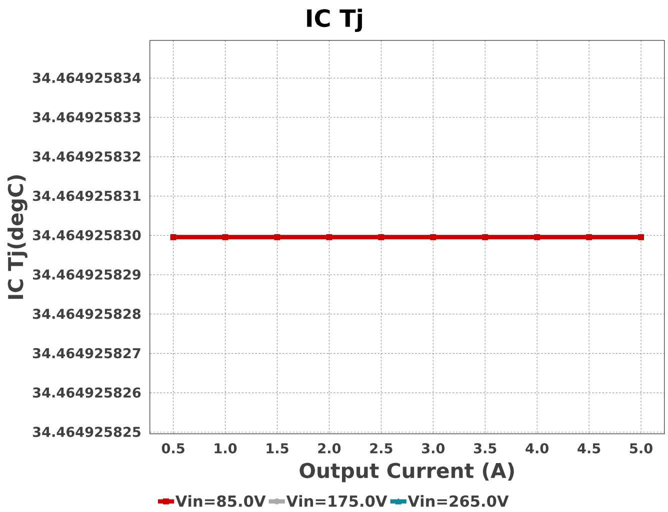

Paux
Paux(W)
0.0022
0.0021
0.0020
0.0019
0.0018
0.0017
0.0016
0.0015
0.0014
0.0013
0.0012
0.0011
0.0010
0.0009
0.0008
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

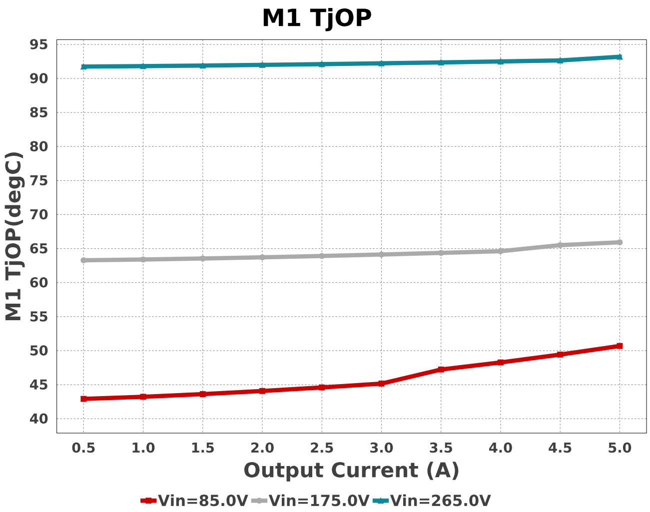

M1 Pd
M1 Pd(W)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

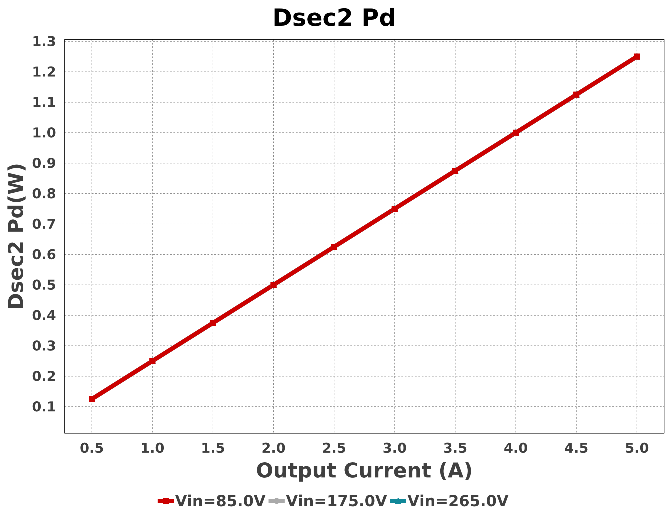

Rdrv Pd
Rdrv Pd(W)
0.019991004
0.019991003
0.019991002
0.019991001
0.019991000
0.019990999
0.019990998
0.019990997
0.019990996
0.019990995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

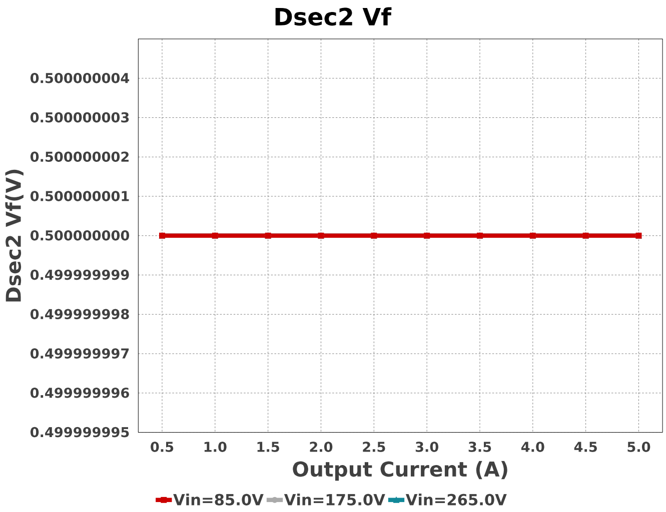

T1 Pd
T1 Pd(W)
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

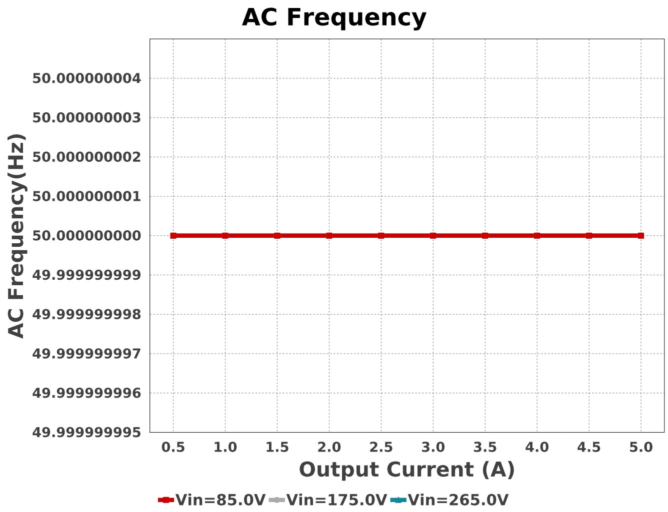

Toff
Toff(us)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


IC Tj
IC Tj(degC)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

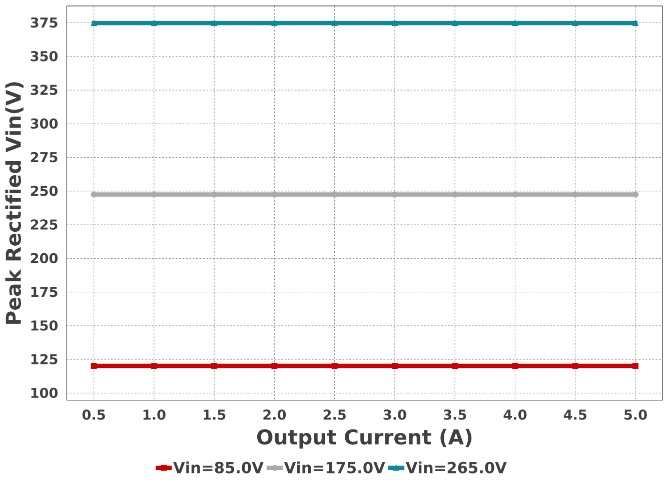

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Dsec2 Pd
Dsec2 Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

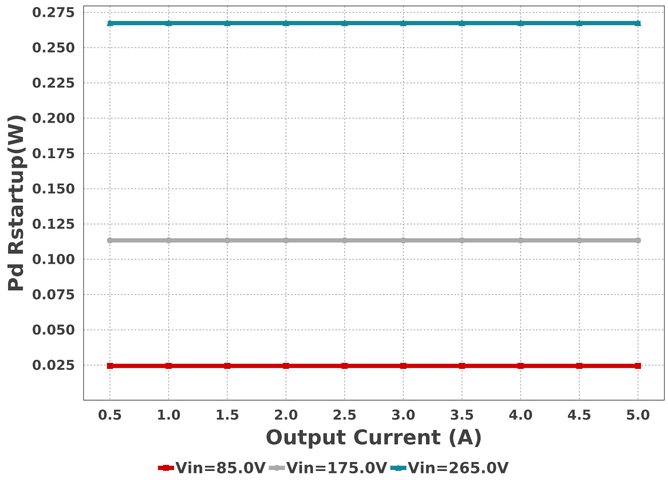

Dsec2 Vf
Dsec2 Vf(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


AC Frequency
AC Frequency(Hz)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

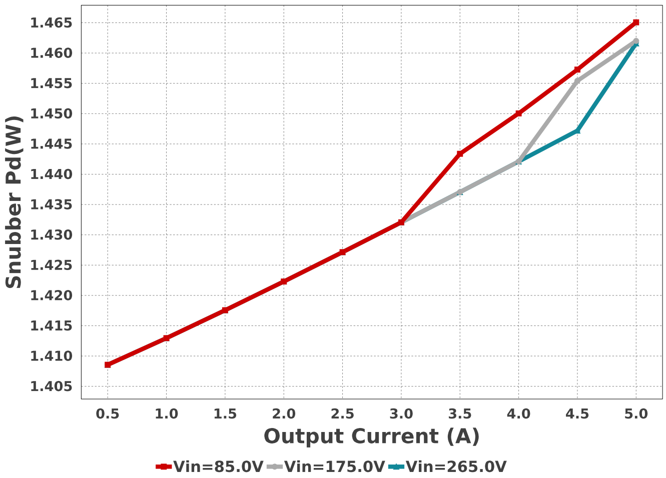
Peak Rectified Vin



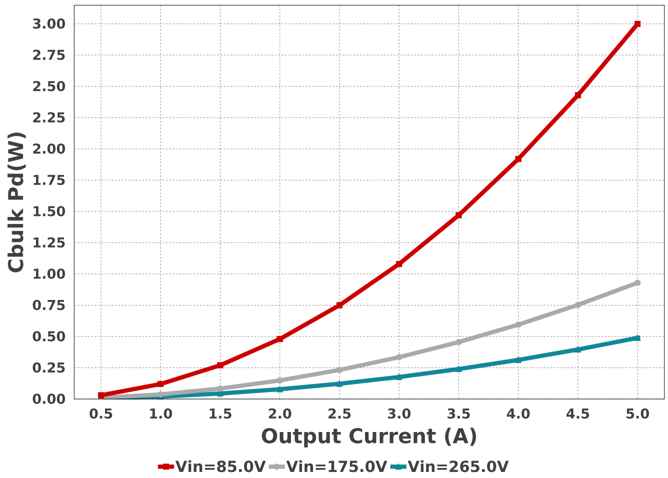
Pd Rstartup



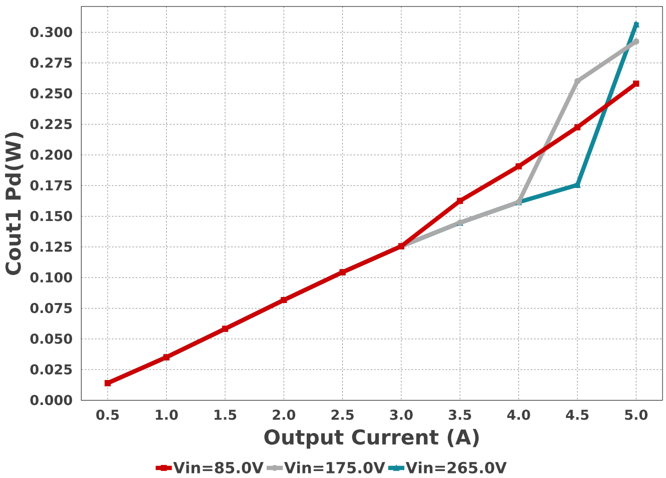
Snubber Pd



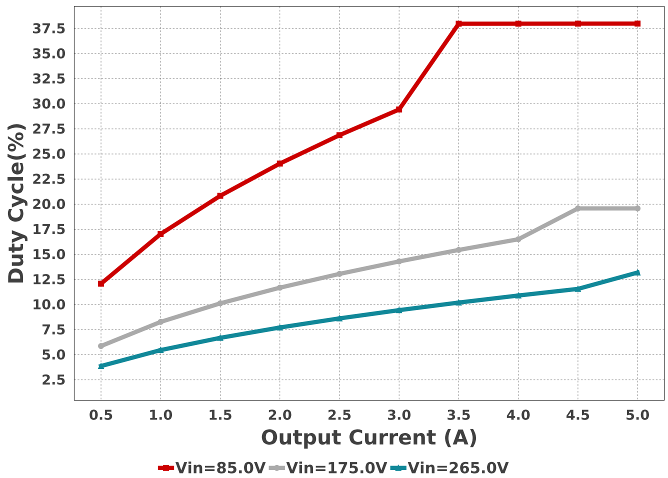
Cbulk Pd

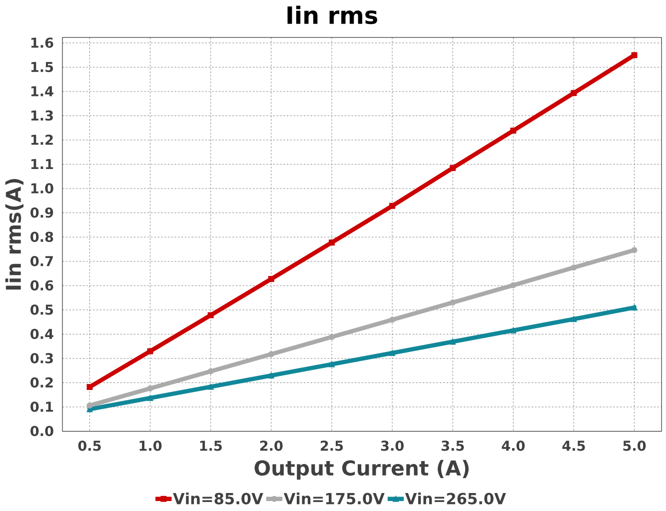


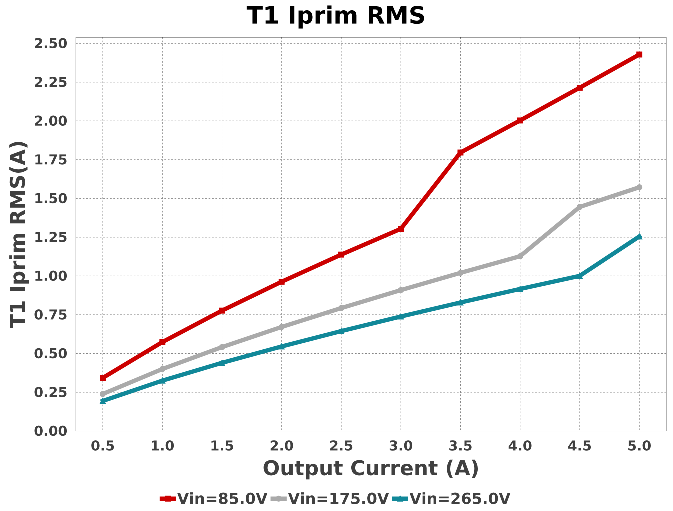
Cout1 Pd

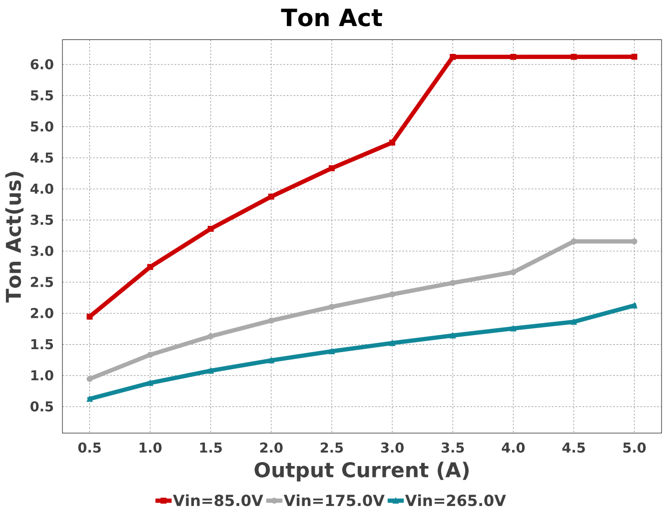


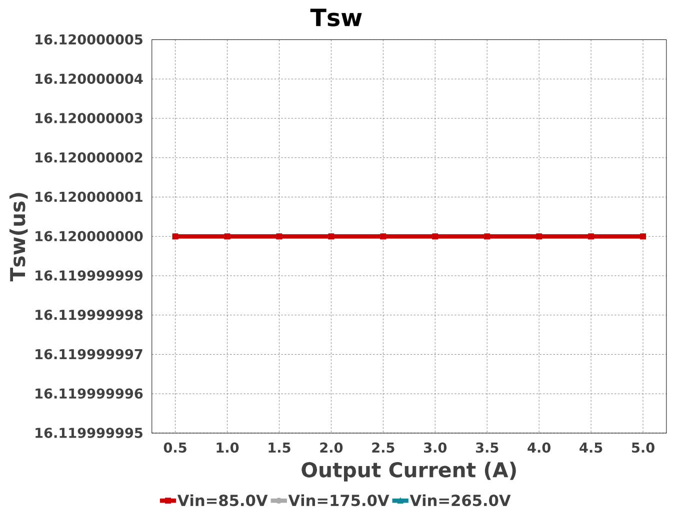
Duty Cycle

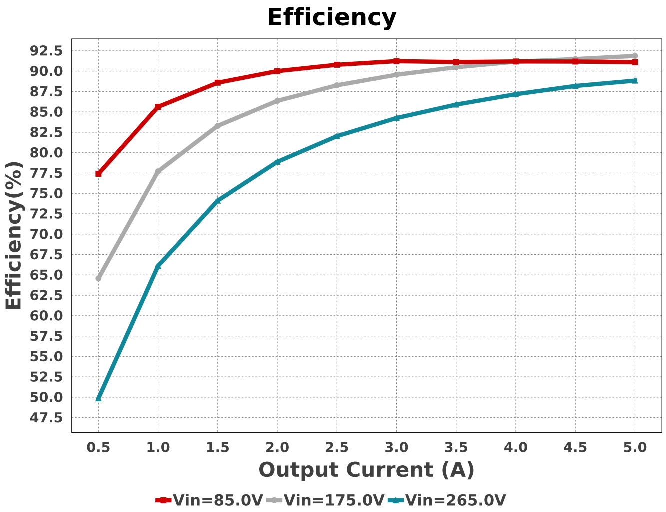


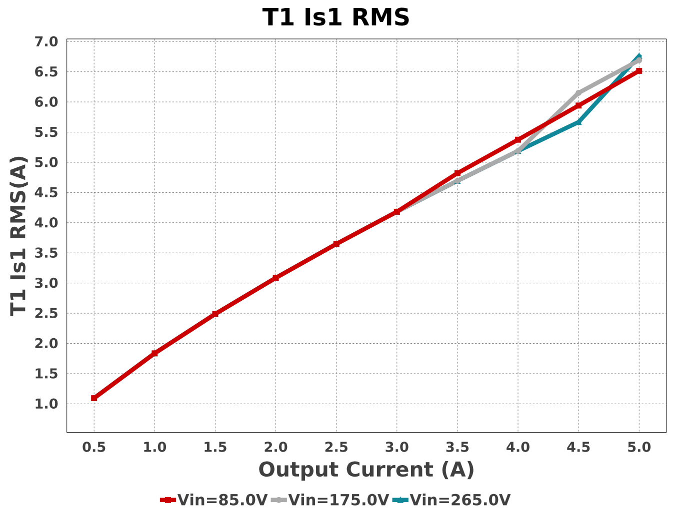

Iin rms
Iin rms(A)
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

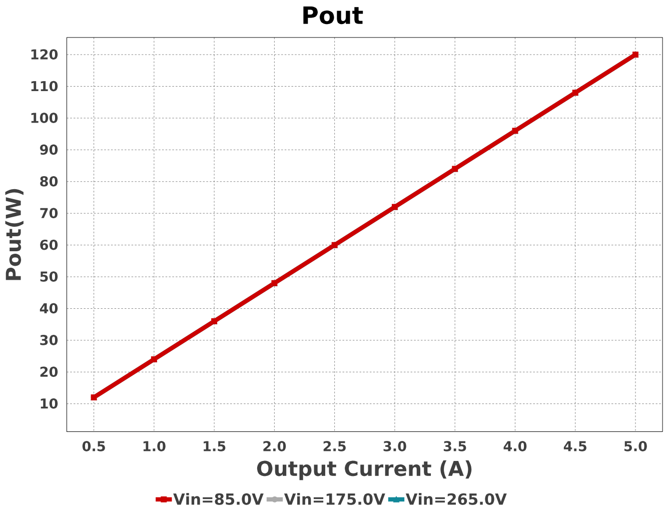

T1 Iprim RMS
T1 Iprim RMS(A)
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

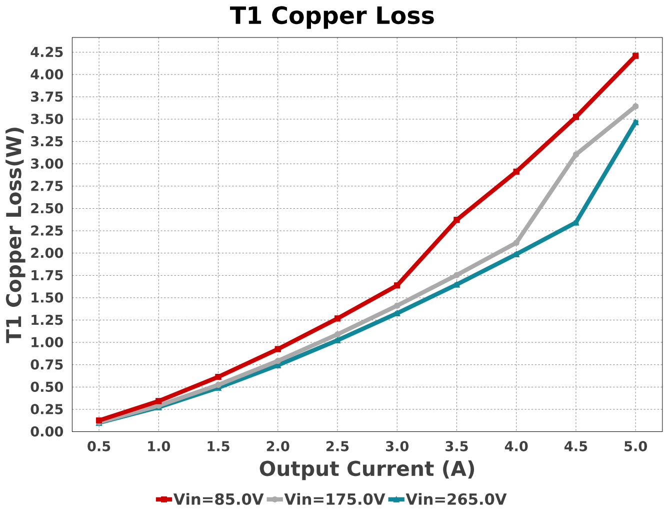

Ton Act
Ton Act(us)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

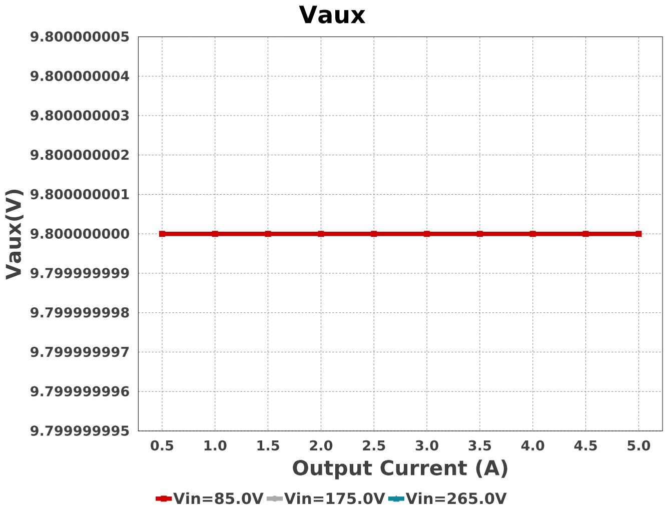

Tsw
Tsw(us)
16.120000005
16.120000004
16.120000003
16.120000002
16.120000001
16.120000000
16.119999999
16.119999998
16.119999997
16.119999996
16.119999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

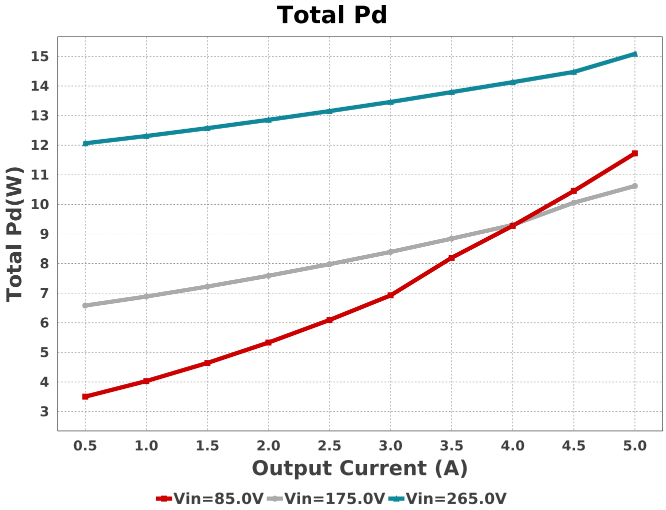

Efficiency
Efficiency(%)
92.5
90.0
87.5
85.0
82.5
80.0
77.5
75.0
72.5
70.0
67.5
65.0
62.5
60.0
57.5
55.0
52.5
50.0
47.5
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

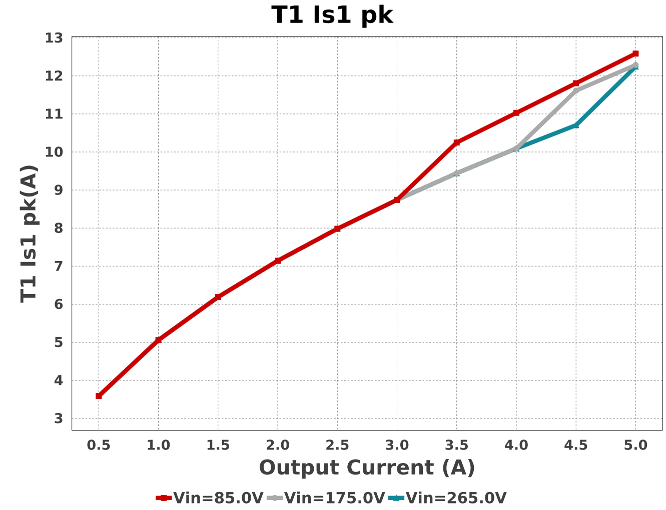

T1 Is1 RMS
T1 Is1 RMS(A)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

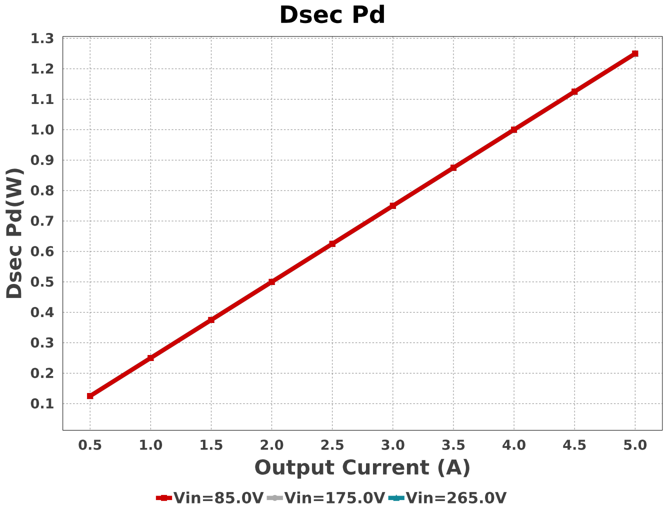

Pout
Pout(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


T1 Copper Loss
T1 Copper Loss(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

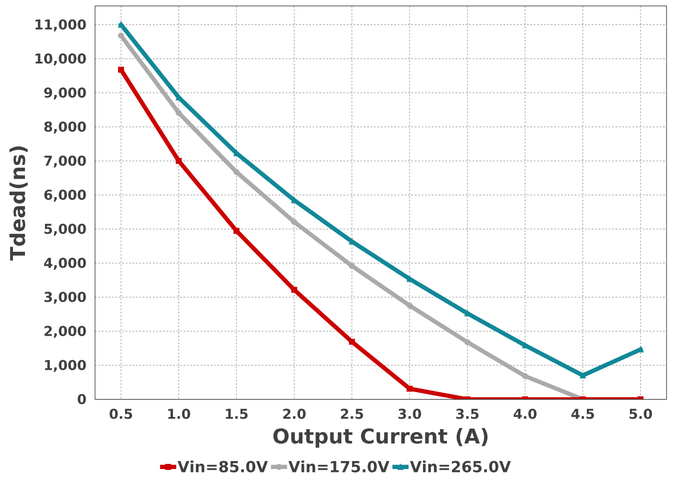

Vaux
Vaux(V)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

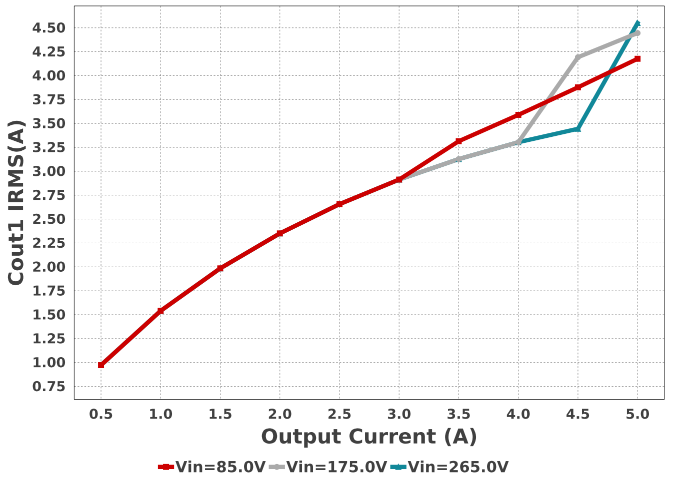

T1 Is1 pk
T1 Is1 pk(A)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Dsec Pd
Dsec Pd(W)
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

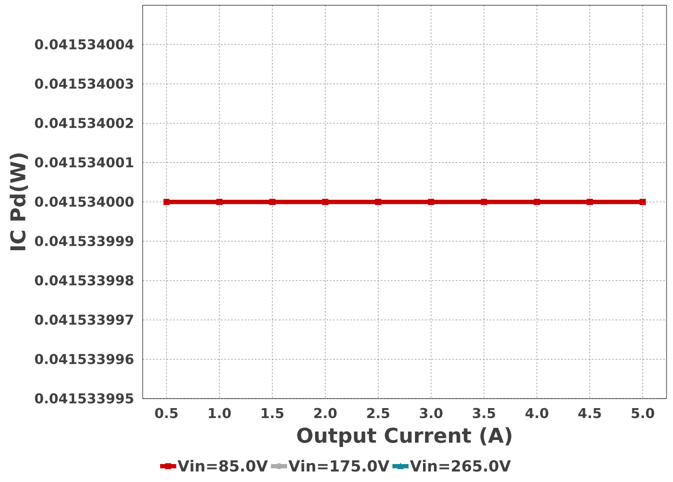
Tdead



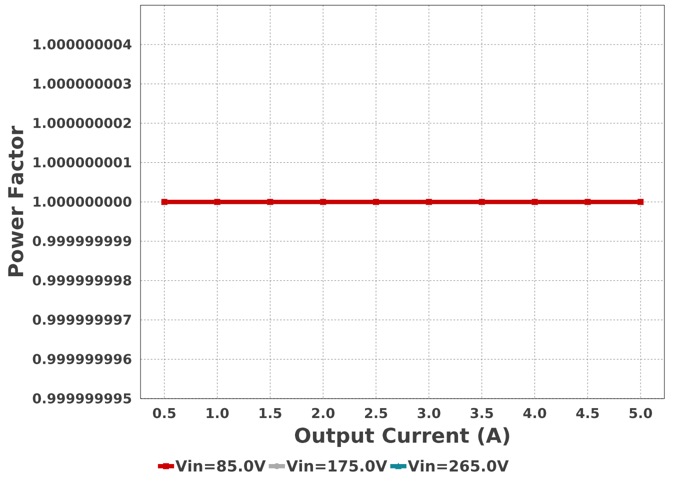
Cout1 IRMS



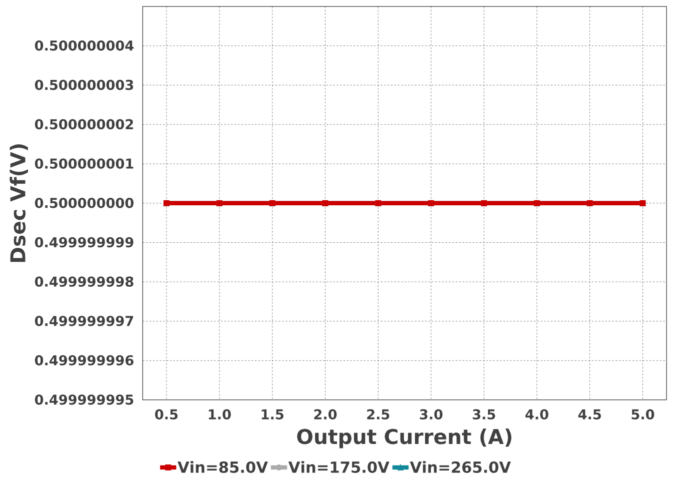
IC Pd



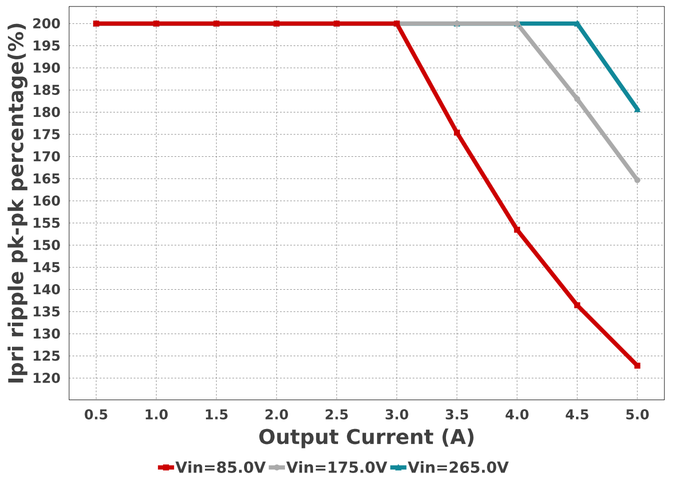
Power Factor

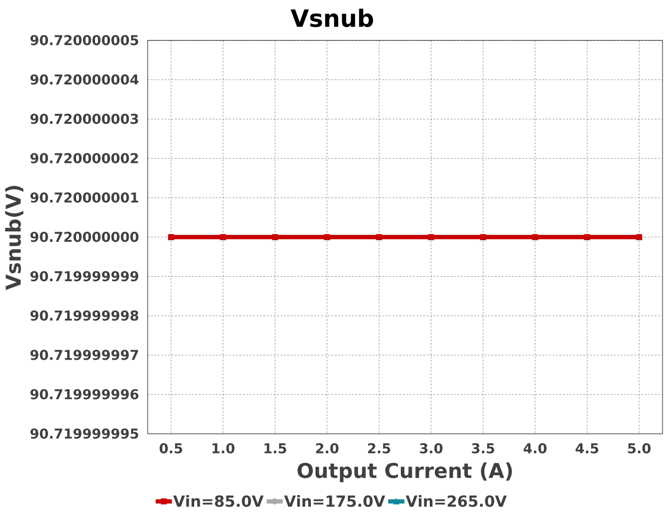


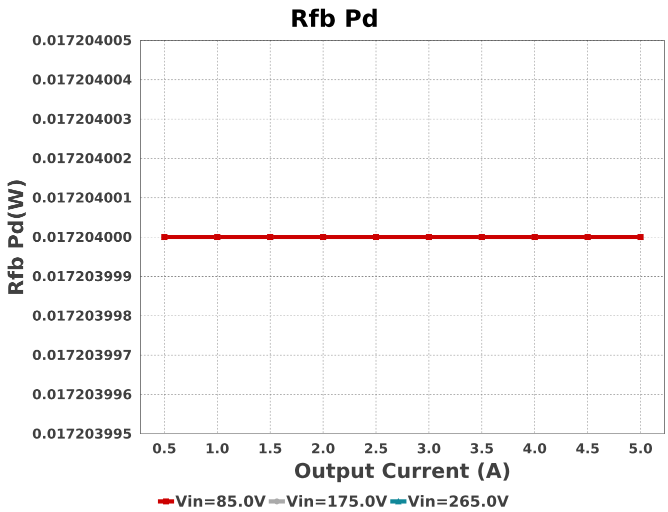
Dsec Vf

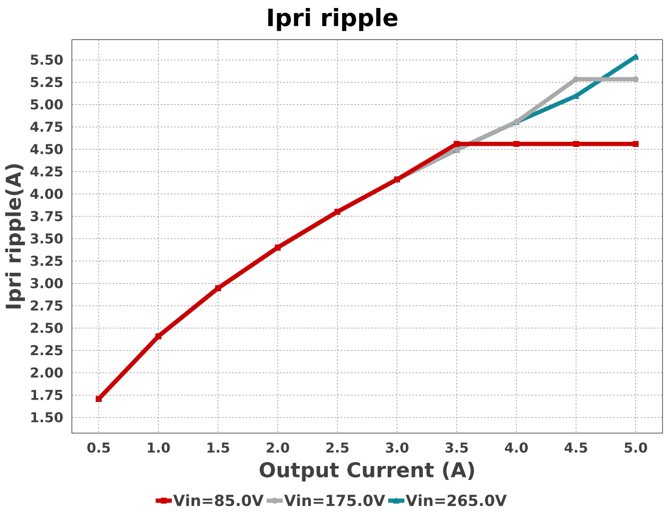


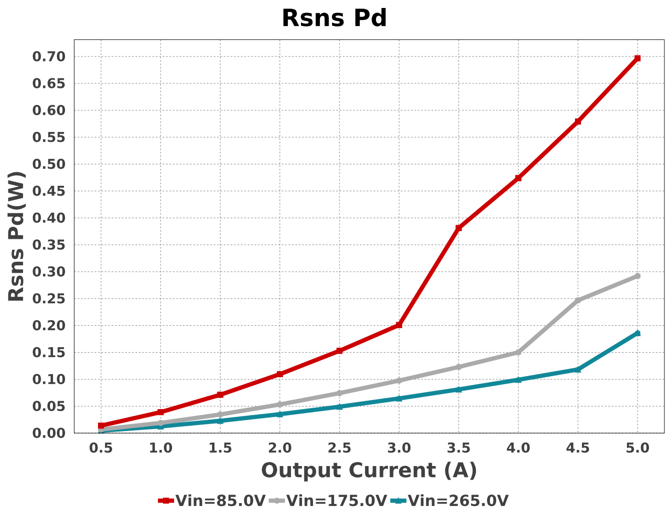
Ipri ripple pk-pk percentage

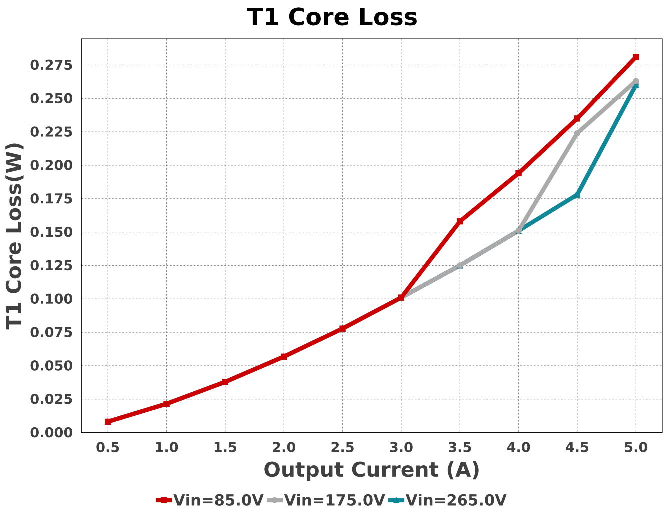


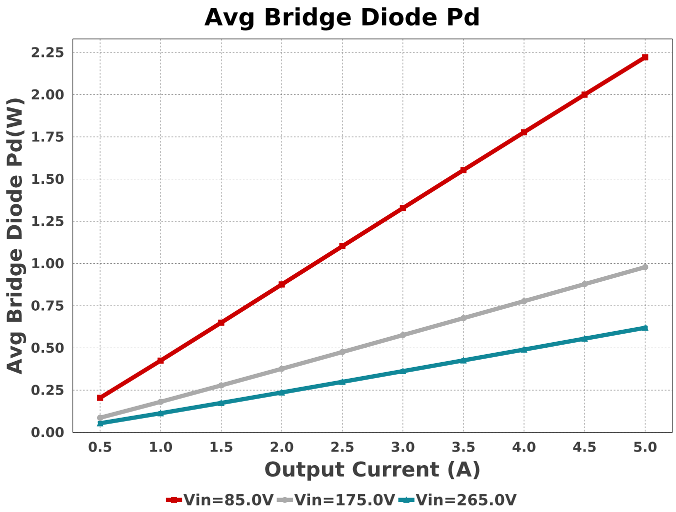

Vsnub
Vsnub(V)
90.720000005
90.720000004
90.720000003
90.720000002
90.720000001
90.720000000
90.719999999
90.719999998
90.719999997
90.719999996
90.719999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Rfb Pd
Rfb Pd(W)
0.017204005
0.017204004
0.017204003
0.017204002
0.017204001
0.017204000
0.017203999
0.017203998
0.017203997
0.017203996
0.017203995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

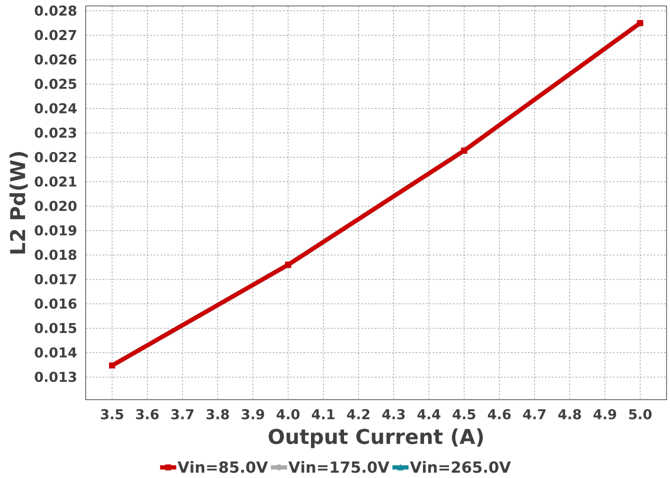

Ipri ripple
Ipri ripple(A)
5.50 5.25 5.00 4.75 4.50 4.25 4.00 3.75 3.50 3.25 3.00 2.75 2.50 2.25 2.00 1.75 1.50
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Rsns Pd
Rsns Pd(W)
0.70 0.65 0.60 0.55 0.50 0.45 0.40 0.35 0.30 0.25 0.20 0.15 0.10 0.05 0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

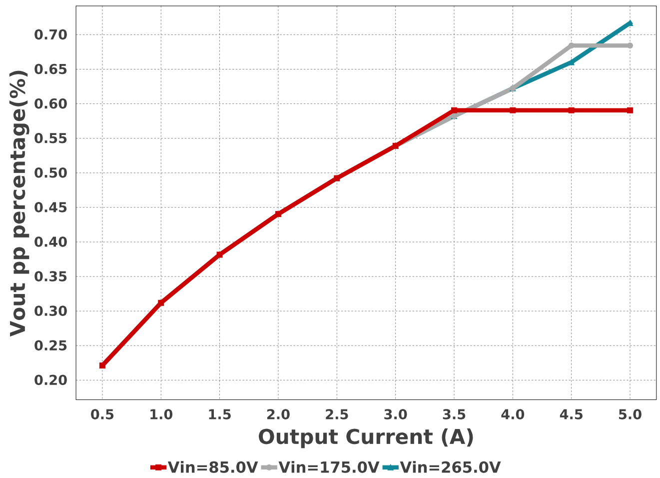

T1 Core Loss
T1 Core Loss(W)
0.275 0.250 0.225 0.200 0.175 0.150 0.125 0.100 0.075 0.050 0.025 0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V


Avg Bridge Diode Pd
Avg Bridge Diode Pd(W)
2.25 2.00 1.75 1.50 1.25 1.00 0.75 0.50 0.25 0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
Output Current (A)
Vin=85.0V Vin=175.0V Vin=265.0V

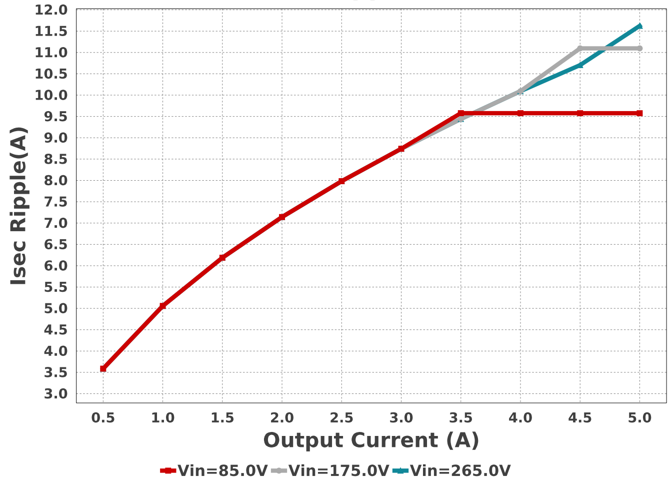
L2 Pd



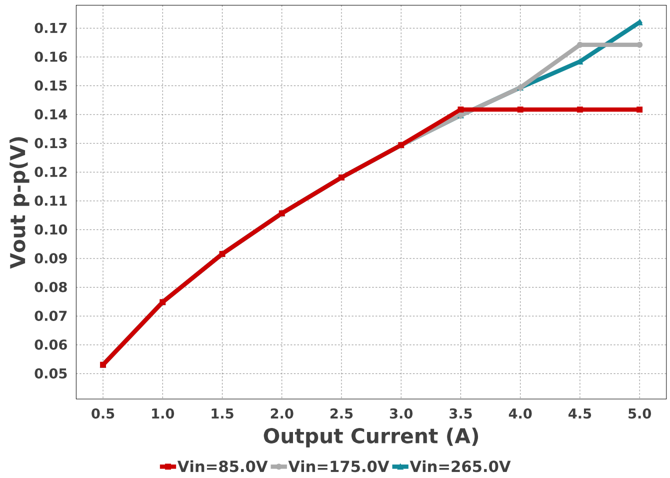
Vout pp percentage



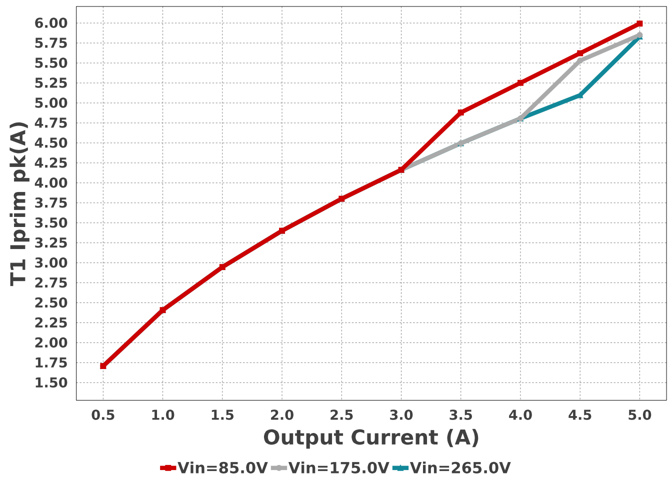
Isec Ripple



Vout p-p



T1 Iprim pk



Operating Values

#	Name	Value	Category	Description
1.	Cbulk Pd	2.999 W	Capacitor	Bulk capacitor power dissipation
2.	Cout1 IRMS	4.176 A	Capacitor	Output capacitor1 RMS ripple current
3.	Cout1 Pd	258.1 mW	Capacitor	Output capacitor1 power dissipation
4.	Avg Bridge Diode Pd	2.222 W	Diode	Average Power Dissipation in the Bridge Diode over the AC Line Period
5.	Daux trr	35.0 ns	Diode	Auxiliary Diode Reverse Recovery Time
6.	Dsec Pd	1.25 W	Diode	Secondary Diode Power Dissipation
7.	Dsec Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
8.	Dsec trr	0.0 ns	Diode	Output Diode Reverse Recovery Time
9.	Dsec2 Pd	1.25 W	Diode	Secondary Diode Power Dissipation
10.	Dsec2 Vf	500.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
11.	Dsnub trr	30.0 ns	Diode	Snubber Diode Reverse Recovery Time

#	Name	Value	Category	Description
12.	IC Pd	41.534 mW	IC	IC power dissipation
13.	IC Tj	34.465 degC	IC	IC junction temperature
14.	ICThetaJA	107.5 degC/W	IC	IC junction-to-ambient thermal resistance
15.	L2 Pd	27.5 mW	Inductor	Average Power Dissipation in the Inductor Over the AC Line Period
16.	M1 Pd	2.38 W	Mosfet	M1 MOSFET total power dissipation
17.	M1 TjOP	50.692 degC	Mosfet	M1 MOSFET junction temperature
18.	Avg Bridge Diode Pd	2.222 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
19.	Cbulk Pd	2.999 W	Power	Bulk capacitor power dissipation
20.	Cout1 Pd	258.1 mW	Power	Output capacitor1 power dissipation
21.	Dsec Pd	1.25 W	Power	Secondary Diode Power Dissipation
22.	Dsec2 Pd	1.25 W	Power	Secondary Diode Power Dissipation
23.	IC Pd	41.534 mW	Power	IC power dissipation
24.	L2 Pd	27.5 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
25.	M1 Pd	2.38 W	Power	M1 MOSFET total power dissipation
26.	Paux	2.173 mW	Power	Power Dissipation in Raux and Daux
27.	Pd Rstartup	24.458 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
28.	Rdrv Pd	19.991 mW	Power	Power Dissipation in Gate Drive Resistor
29.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
30.	Rsns Pd	696.67 mW	Power	Current Limit Sense Resistor Power Dissipation
31.	Snubber Pd	1.465 W	Power	Snubber Power Dissipation
32.	T1 Copper Loss	3.502 W	Power	Transformer Copper Loss Power Dissipation
33.	T1 Core Loss	264.0 mW	Power	Transformer Core Loss Power Dissipation
34.	T1 Pd	3.766 W	Power	Estimated Losses in Transformer
35.	Total Pd	11.725 W	Power	Total Power Dissipation
36.	Pd Rstartup	24.458 mW	Resistor	Power Dissipation in Rstartup1 and Rstartup2
37.	Rdrv Pd	19.991 mW	Resistor	Power Dissipation in Gate Drive Resistor
38.	Rfb Pd	17.204 mW	Resistor	Rfb Power Dissipation
39.	Rsns Pd	696.67 mW	Resistor	Current Limit Sense Resistor Power Dissipation
40.	AC Frequency	50.0 Hz	System Information	Input AC frequency
41.	BOM Count	56	System Information	Total Design BOM count
42.	Duty Cycle	37.991 %	System Information	Duty cycle
43.	Efficiency	91.099 %	System Information	Steady state efficiency
44.	FootPrint	6.79 k mm^2	System Information	Total Foot Print Area of BOM components
45.	Frequency	62.035 kHz	System Information	Switching frequency
46.	Iin rms	1.55 A	System Information	RMS Input Current
47.	Iout	5.0 A	System Information	Iout operating point
48.	Iout_DCM	2.505 A	System Information	Approximate Current below which DCM mode of operation will begin
49.	Mode	CCM	System Information	Conduction Mode
50.	Peak Rectified Vin	120.207 V	System Information	Peak voltage seen at rectified input
51.	Pout	120.0 W	System Information	Total output power
52.	Power Factor	1.0	System Information	Assumed Power Factor for the Application
53.	Tdead	0.0 ns	System Information	Approximate Dead Time of the Regulator
54.	Toff	10.337 us	System Information	Approximate Converter Off Time
55.	Ton Act	6.124 us	System Information	Approximate Converter On Time
56.	Total BOM	NA	System Information	Total BOM Cost
57.	Tsw	16.12 us	System Information	Switching Time Period
58.	Vin_RMS	85.0 V	System Information	Vin operating point
59.	Vout	24.0 V	System Information	Operational Output Voltage
60.	Vout Actual	24.004 V	System Information	Vout Actual calculated based on selected voltage divider resistors
61.	Vout Tolerance	2.137 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout p-p	141.723 mV	System Information	Peak-to-peak output ripple voltage
63.	Vout pp percentage	590.514 m%	System Information	Output Voltage ripple percentage

#	Name	Value	Category	Description
64.	Vsnub	90.72 V	System Information	Voltage Across the Snubber
65.	Ipri Avg	1.411 A	Transformer	Average Current in Primary Winding over the complete Switching Period
66.	Ipri ripple	4.56 A	Transformer	Ripple Current in the Primary Winding
67.	Ipri ripple pk-pk percentage	122.81 %	Transformer	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
68.	Isec Ripple	9.576 A	Transformer	Ripple Current in the Secondary Winding
69.	Paux	2.173 mW	Transformer	Power Dissipation in Raux and Daux
70.	T1 Copper Loss	3.502 W	Transformer	Transformer Copper Loss Power Dissipation
71.	T1 Core Loss	264.0 mW	Transformer	Transformer Core Loss Power Dissipation
72.	T1 Iprim RMS	2.428 A	Transformer	Transformer Primary RMS Current
73.	T1 Iprim pk	5.993 A	Transformer	Transformer Primary Peak Current
74.	T1 Is1 RMS	6.515 A	Transformer	Transformer Secondary1 RMS Current
75.	T1 Is1 pk	12.585 A	Transformer	Transformer Secondary1 Peak Current
76.	T1 Pd	3.766 W	Transformer	Estimated Losses in Transformer
77.	Vaux	9.8 V	Transformer	Auxiliary Voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	265.0	Maximum input voltage
VinMin	85.0	Minimum input voltage
Vout	24.0	Output Voltage
acFrequency	50.0	AC Frequency
base_pn	UCC2813-5-Q1	Base Product Number
source	AC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

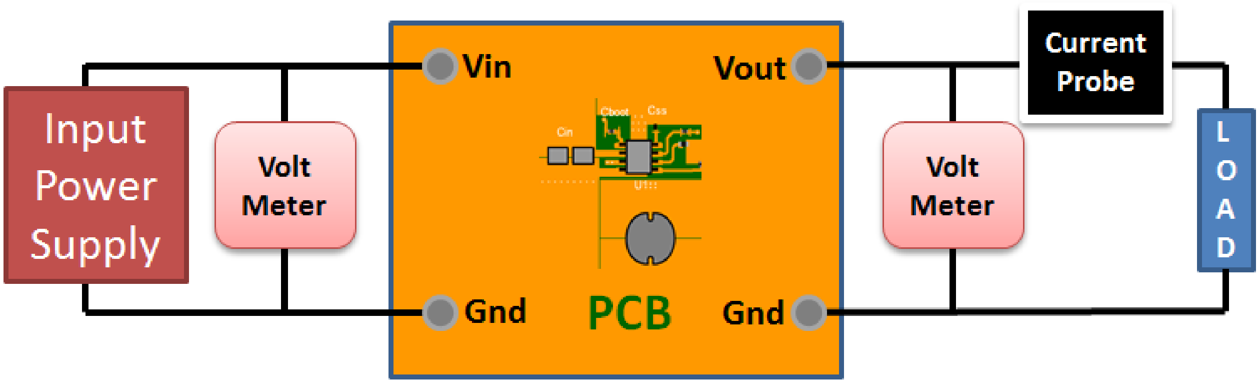
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 85.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



WEBENCH® Transformer Report

#	Name	Value
1.	Core Part Number	150-2449
2.	Core Manufacturer	Wurth Elektronik
3.	Coil Former Part Number	070-5050
4.	Coil Former Manufacturer	Wurth Elektronik

Transformer Electrical Diagram

Primary

Turns	21.0
AWG	24.0
Layers	3.0
Strands	2.0
Insulation Type	Heavy Insulated Magnet Wire

Secondary

Turns	10.0
AWG	24.0
Layers	1.0
Strands	1.0
Insulation Type	Triple Insulated

Auxiliary

Turns	4.0
AWG	28.0
Layers	1.0
Strands	4.0
Insulation Type	Heavy Insulated Magnet Wire

Transformer Construction Diagram

Winding Instruction

Winding	AWG	Turns	Winding Orientation
Primary First 2/3.0	24.0	14	Clockwise
Auxiliary	28.0	4.0	Counter Clockwise
Triple Insulated Secondary	24.0	10.0	Counter Clockwise
Primary Second 1/3.0	24.0	7	Clockwise

Transformer Parameters

#	Name	Value
1.	Lpri	1.37E-4H
2.	Inductance Factor(Al)	311.0nH
3.	Npri	21.0
4.	Nsec	10.0
5.	Naux	4.0
6.	Core Type	PQ3220
7.	Core Material	TP4A

#	Name	Value
8.	Bmax	0.23T
9.	Switching Frequency	62.03kHz
10.	DMax	0.4
11.	Ipk(Primary)	5.86A
12.	Irms(Primary)	2.35A
13.	Ipk(Secondary)	12.3A
14.	Irms(Secondary)	6.06A

Design Assistance

1. Feature Highlights: This device provides the features that are necessary to implement off-line or dc-to-dc fixed-frequency current-mode control schemes, with a minimum number of external components.

2. The UCC2813-5-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application

3. Master key : 031661096C45171E[v1]

4. **UCC2813-5-Q1** Product Folder : http://www.ti.com/product/UCC2813%2D5%2DQ1 : contains the data sheet and other resources.