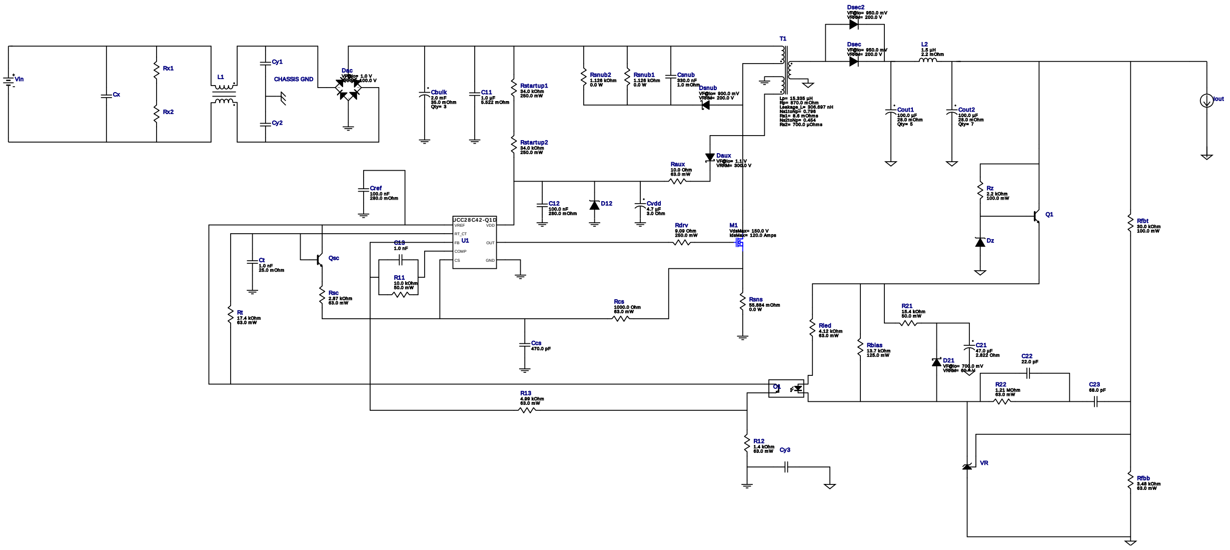
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 21.6V
VinMax = 30.0V
Vout = 24.0V
Iout = 4.0A

Device = UCC28C42QDRQ1
Topology = Flyback
Created = 2024-07-02 07:28:44.001
BOM Cost = NA
BOM Count = 62
Total Pd = 15.5W

Design : 5 UCC28C42QDRQ1
UCC28C42QDRQ1 21.6V-30V to 24.00V @ 4A



1. The EMI filter shown in the schematic is a placeholder. It has not yet been designed for the application.This regulator device 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.View WEBENCH(R) Disclaimer.

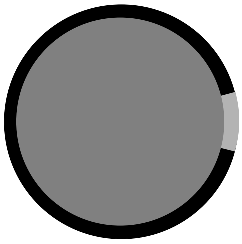
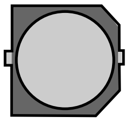
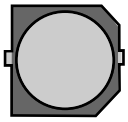
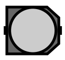
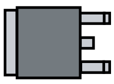
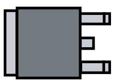
Design Alerts

Component Selection Information

The UCC28C42-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.

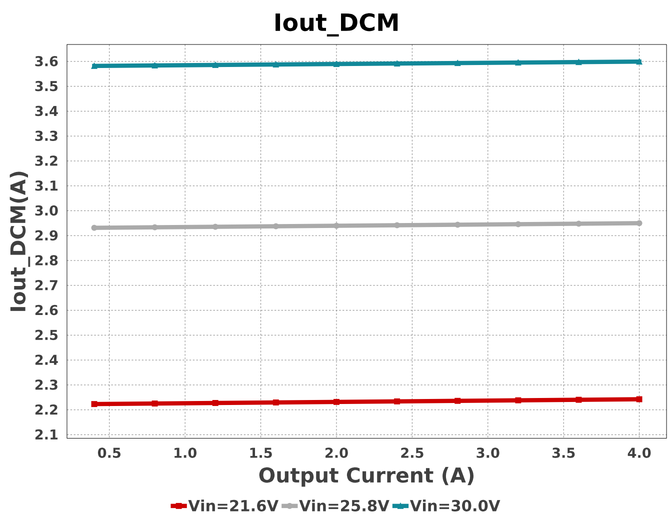
Electrical BOM

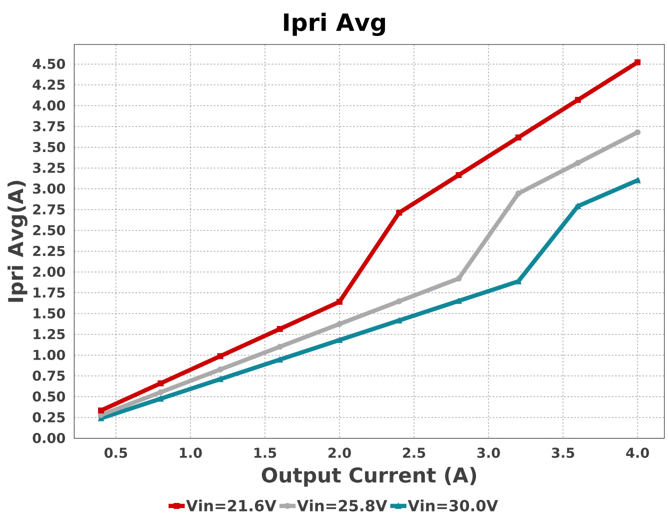
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C11	TDK	C1608X5R1H105K080AB Series= X5R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 50.0 V IRMS= 2.2162 A	1	$0.03	0603 5 mm^2
C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
C13	MuRata	GRM1555C1H102JA01J 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	ELXZ500ELL470MFB5D Series= LXZ	Cap= 47.0 uF ESR= 2.8215 Ohm VDC= 50.0 V IRMS= 260.0 mA	1	$0.12	Chemi-Con_630x1150 69 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	Yageo	CC0805JRNPO9BN680 Series= C0G/NP0	Cap= 68.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2

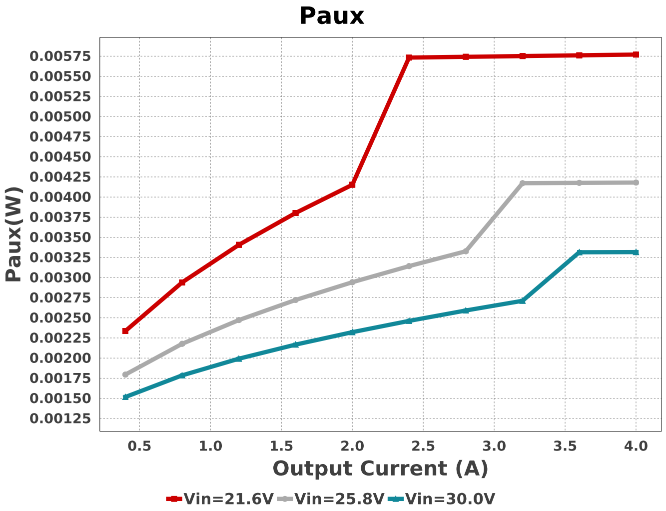
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbulk	TDK	B41605A8208M002 Series= 2361	Cap= 2.0 mF ESR= 35.0 mOhm VDC= 63.0 V IRMS= 9.5 A	3	$3.79	 B41605_2200x4000_2 576 mm²
Ccs	Samsung Electro-Mechanics	CL21C471JBANNNC Series= C0G/NP0	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
Cout1	Panasonic	EEHZA1H101P Series= ZA	Cap= 100.0 uF ESR= 28.0 mOhm VDC= 50.0 V IRMS= 2.0 A	5	$1.43	 SM_RADIAL_10BMM 160 mm²
Cout2	Panasonic	EEHZA1H101P Series= ZA	Cap= 100.0 uF ESR= 28.0 mOhm VDC= 50.0 V IRMS= 2.0 A	7	$1.43	 SM_RADIAL_10BMM 160 mm²
Cref	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
Csnub	MuRata	GRM21AR72A334KAC5L Series= X7R	Cap= 330.0 nF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	$0.12	 0805 7 mm²
Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	$0.02	 0805 7 mm²
Cvdd	Chemi-Con	EMVY350ADA4R7MD55G Series= MVY	Cap= 4.7 uF ESR= 3.0 Ohm VDC= 35.0 V IRMS= 60.0 mA	1	$0.10	 CAPSMT_62_D55 28 mm²
D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	$0.04	 SOD-123 13 mm²
D21	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.10	 SMA 37 mm²
Dac	Diodes Inc.	GBU801	VF@Io= 1.0 V VRRM= 100.0 V	1	$0.63	 GBU 131 mm²
Daux	SMC Diode Solutions	ST1300ATR	VF@Io= 1.1 V VRRM= 300.0 V	1	$0.12	 SMA 37 mm²
Dsec	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm²
Dsec2	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.18	 DPAK 102 mm²

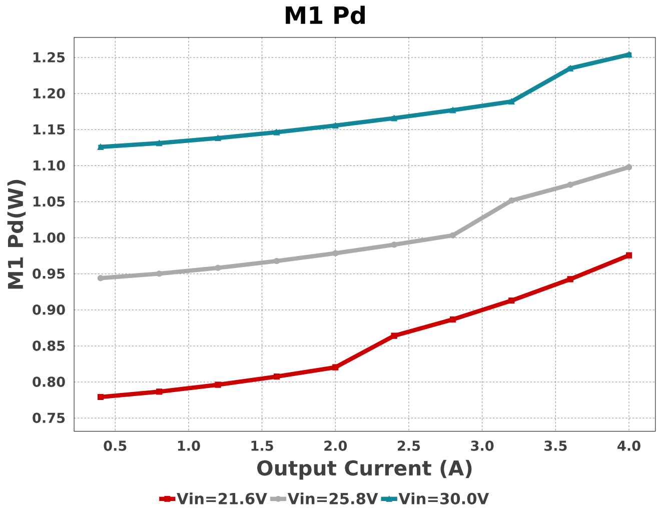
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Dsnub	Fairchild Semiconductor	S320	VF@Io= 900.0 mV VRRM= 200.0 V	1	$0.33	SMB 44 mm^2
Dz	Diodes Inc.	MMSZ5250B-7-F	Zener	1	$0.04	SOD-123 13 mm^2
L2	Sumida	CEP125NP-1R5MC-D	L= 1.5 µH 2.2 mOhm	1	$1.29	CEP125 210 mm^2
M1	Infineon Technologies	IPP051N15N5AKSA1	VdsMax= 150.0 V IdsMax= 120.0 Amps	1	$4.57	TO-220-3 127 mm^2
O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	$0.19	SOP-4 44 mm^2
Q1	Diodes Inc.	MMBT3904-7-F	Bipolar Transistor	1	$0.02	SOT-23 14 mm^2
Qsc	ON Semiconductor	MMBT2222ALT3G	Bipolar Transistor	1	NA	SOT-23-3 13 mm^2
R11	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
R12	Vishay-Dale	CRCW04021K40FKED Series= CRCW..e3	Res= 1.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
R21	Yageo	RC0201FR-0715K4L Series= ?	Res= 15.4 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
R22	Vishay-Dale	CRCW04021M21FKED Series= CRCW..e3	Res= 1.21 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rbias	Vishay-Dale	CRCW080513K7FKEA Series= CRCW..e3	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
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	CRCW12069R09FKEA Series= CRCW..e3	Res= 9.09 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 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	Vishay-Dale	CRCW04024K12FKED Series= CRCW..e3	Res= 4.12 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsc	Vishay-Dale	CRCW04022K87FKED Series= CRCW..e3	Res= 2.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rsns	CUSTOM	CUSTOM Series= ?	Res= 55.884 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2

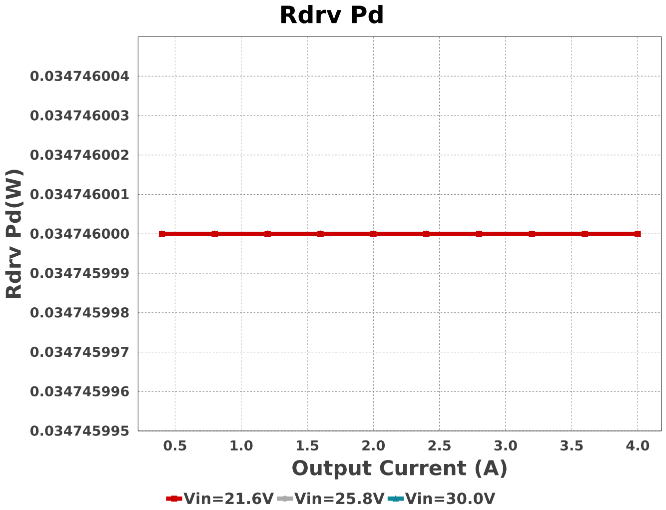
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rsnub1	CUSTOM	CUSTOM Series= ?	Res= 1.126 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rsnub2	CUSTOM	CUSTOM Series= ?	Res= 1.126 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rstartup1	Vishay-Dale	CRCW120634K0FKEA Series= CRCW..e3	Res= 34.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rstartup2	Vishay-Dale	CRCW120634K0FKEA Series= CRCW..e3	Res= 34.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rt	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 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	CUSTOM	CUSTOM	Lp= 15.335 µH Rp= 870.0 mOhm Leakage_L= 306.697 nH Ns1toNp= 795.793 m Rs1= 8.6 mOhms Ns2toNp= 0.454 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	UCC28C42QDRQ1	Switcher	1	$0.63	D0008A 57 mm^2
VR	Texas Instruments	TL431IDBVR	Voltage References	1	$0.05	R-PDSO-G3 16 mm^2

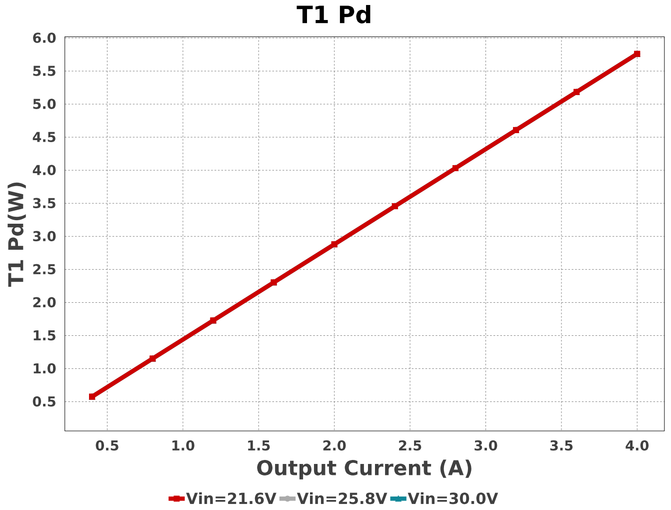


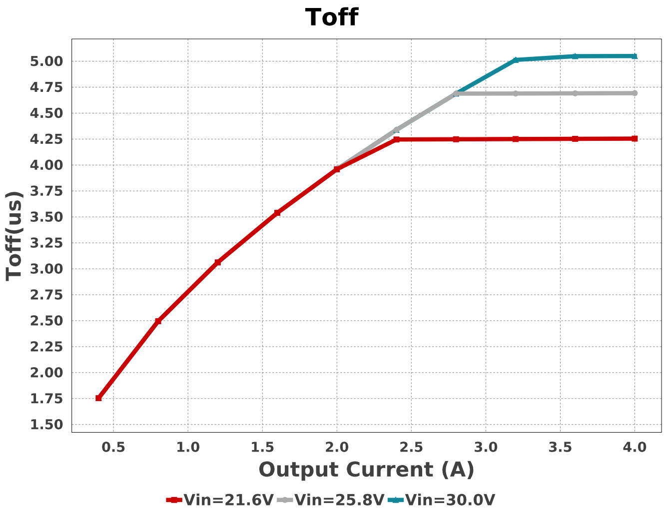


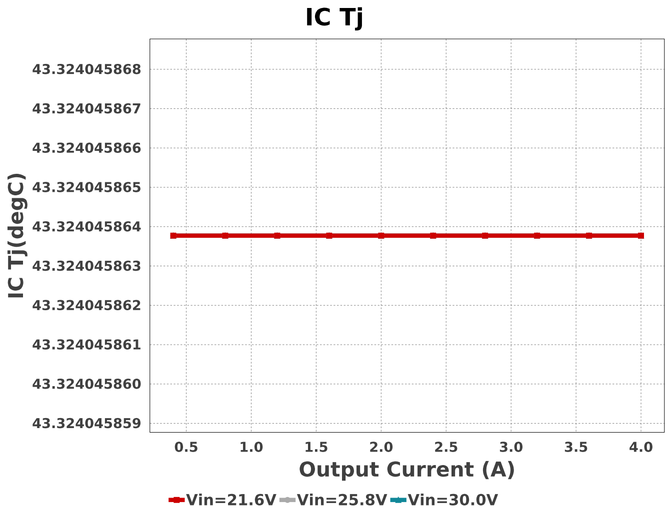

Paux
Paux(W)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


M1 Pd
M1 Pd(W)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

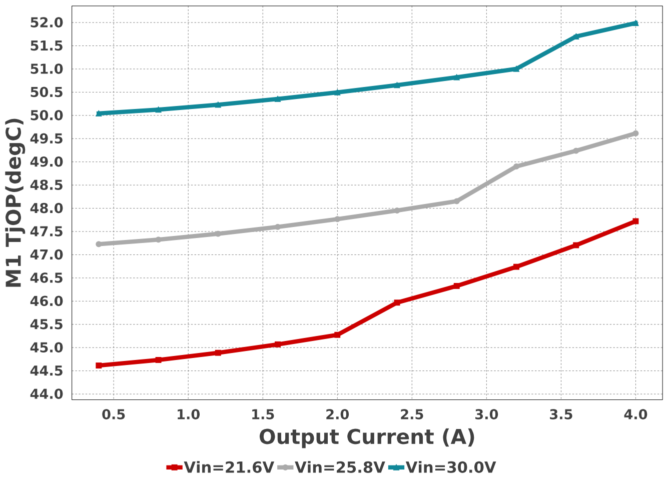

Rdrv Pd
Rdrv Pd(W)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


T1 Pd
T1 Pd(W)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

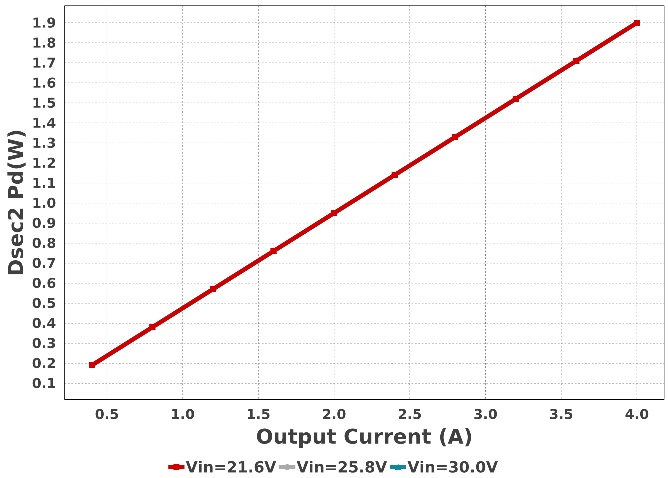

Toff
Toff(us)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


IC Tj
IC Tj(degC)
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

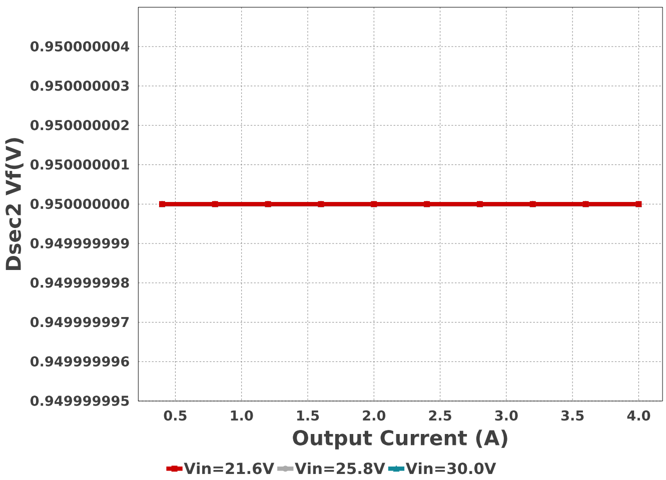
M1 TjOP



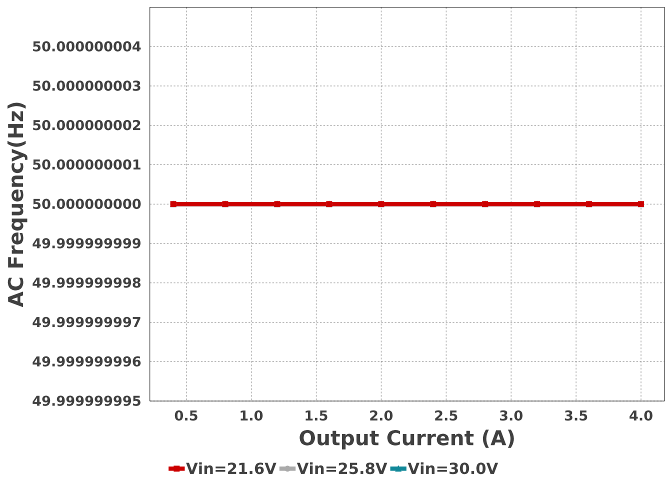
Dsec2 Pd



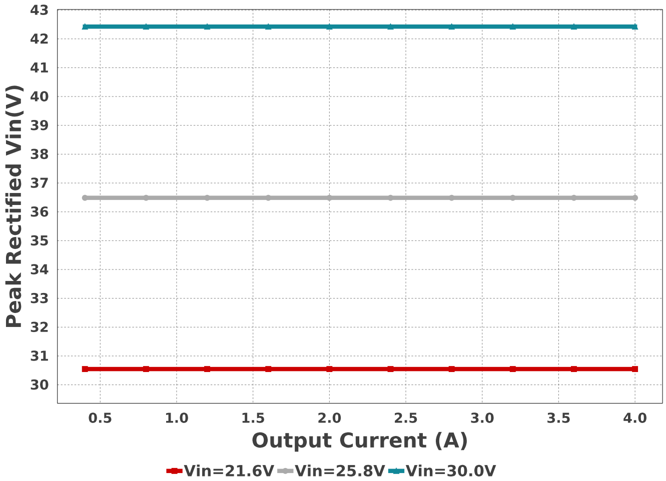
Dsec2 Vf



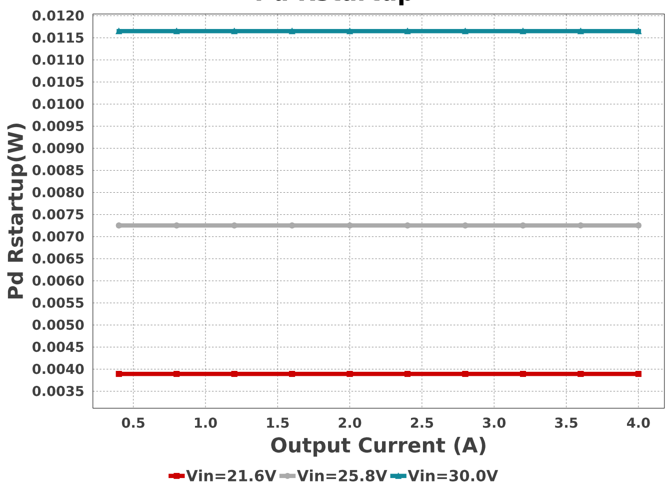
AC Frequency

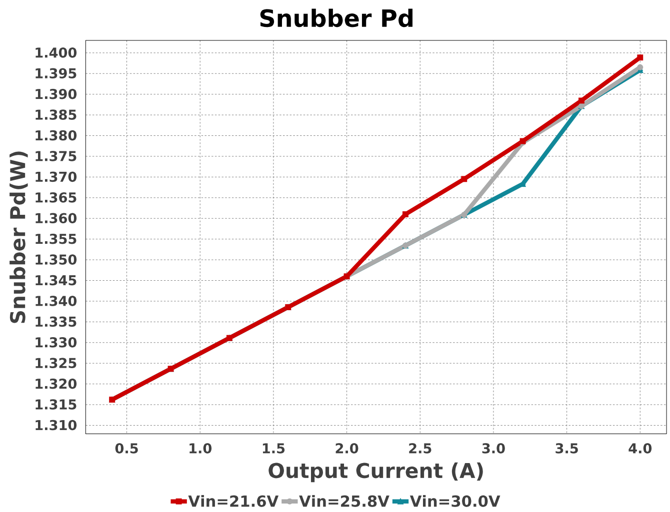


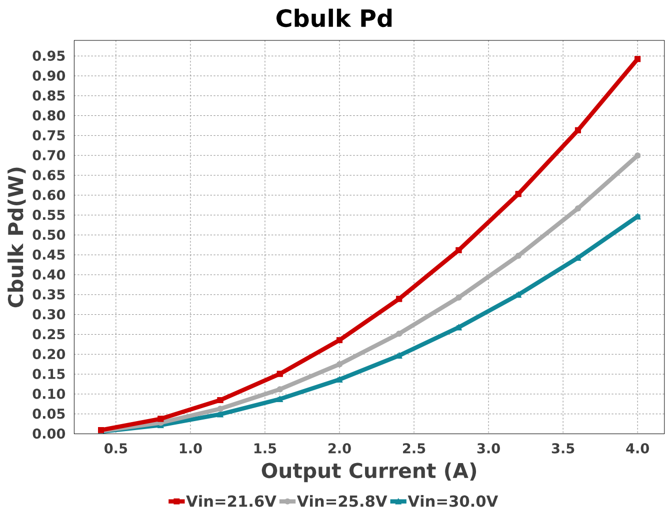
Peak Rectified Vin

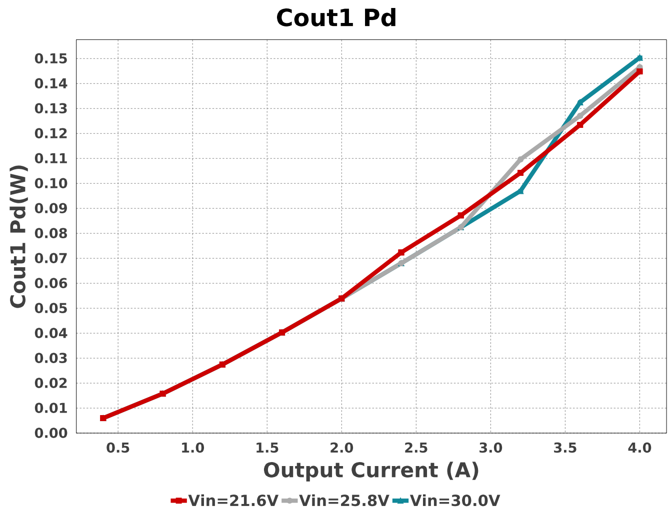


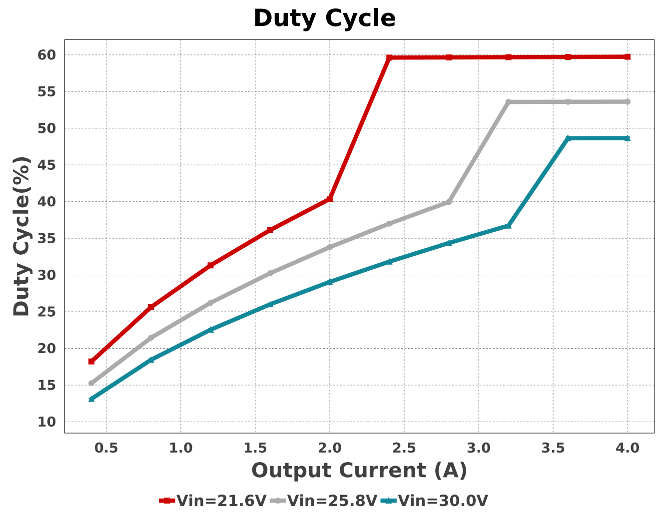
Pd Rstartup

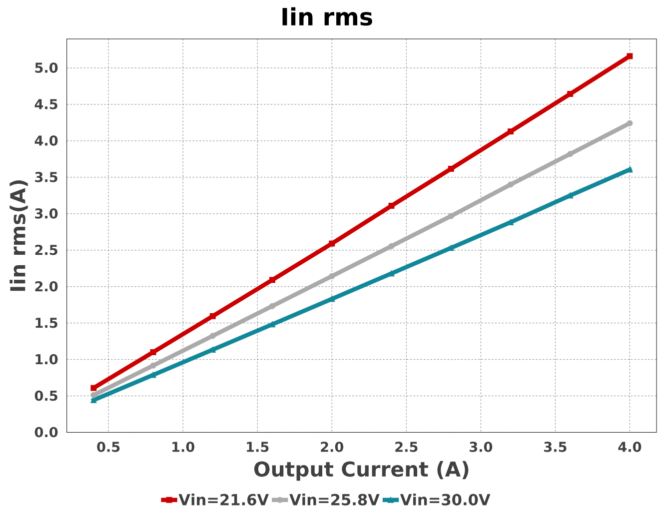


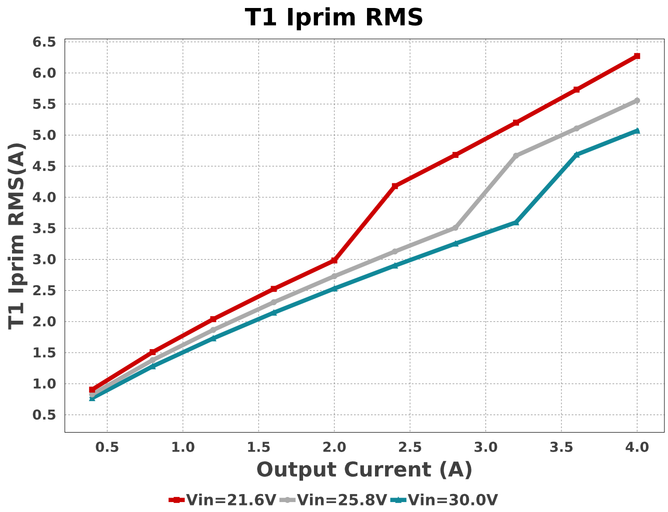

Snubber Pd
Snubber Pd(W)
1.400
1.395
1.390
1.385
1.380
1.375
1.370
1.365
1.360
1.355
1.350
1.345
1.340
1.335
1.330
1.325
1.320
1.315
1.310
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


Cbulk Pd
Cbulk Pd(W)
0.95
0.90
0.85
0.80
0.75
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
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

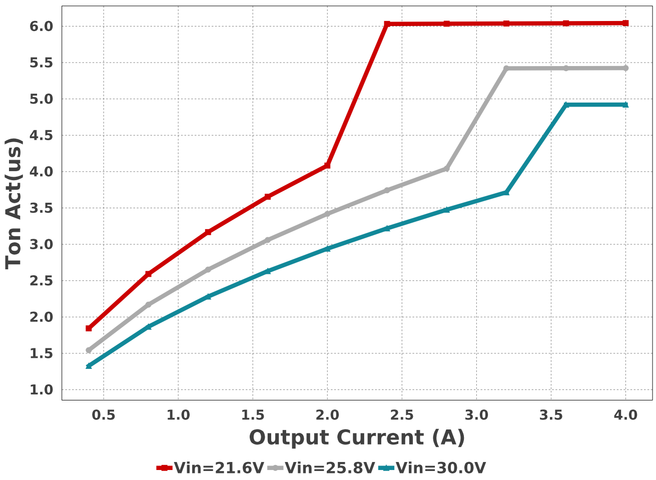

Cout1 Pd
Cout1 Pd(W)
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


Duty Cycle
Duty Cycle(%)
60
55
50
45
40
35
30
25
20
15
10
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

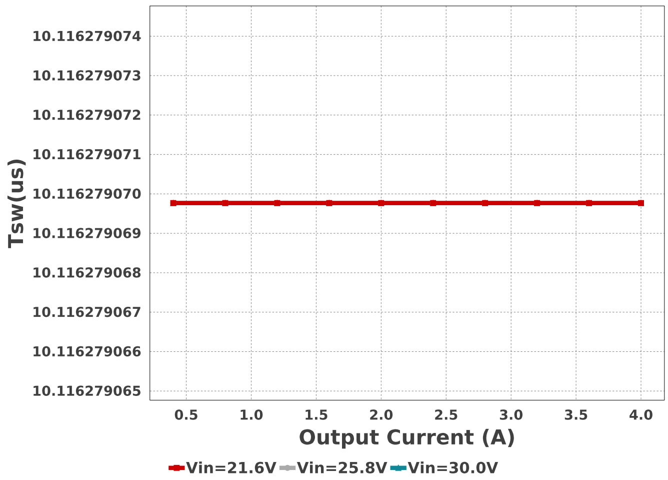

Iin rms
Iin rms(A)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


T1 Iprim RMS
T1 Iprim RMS(A)
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
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

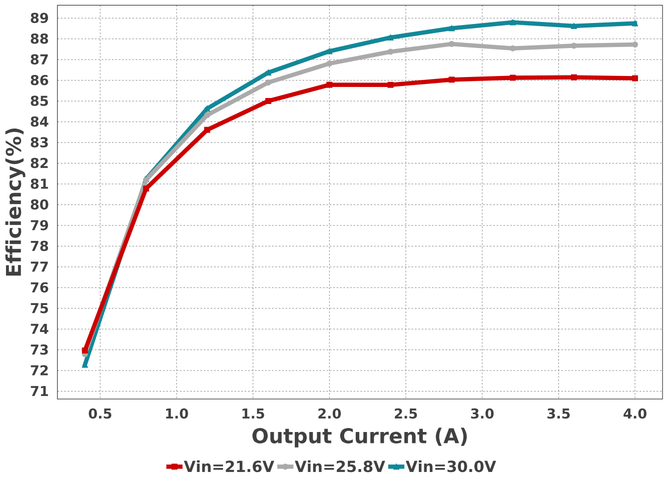
Ton Act



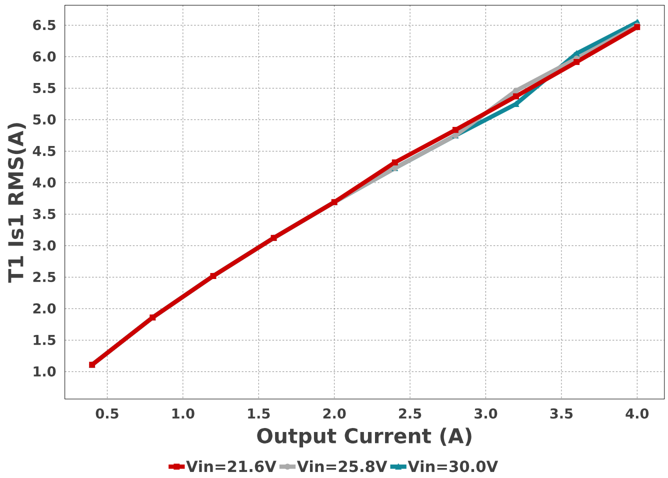
Tsw



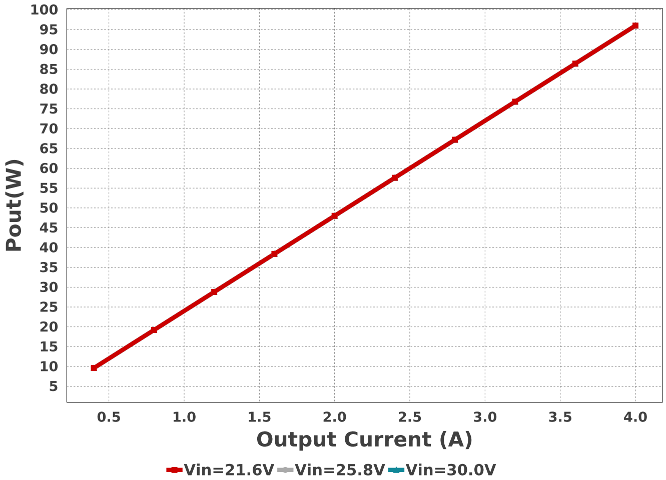
Efficiency



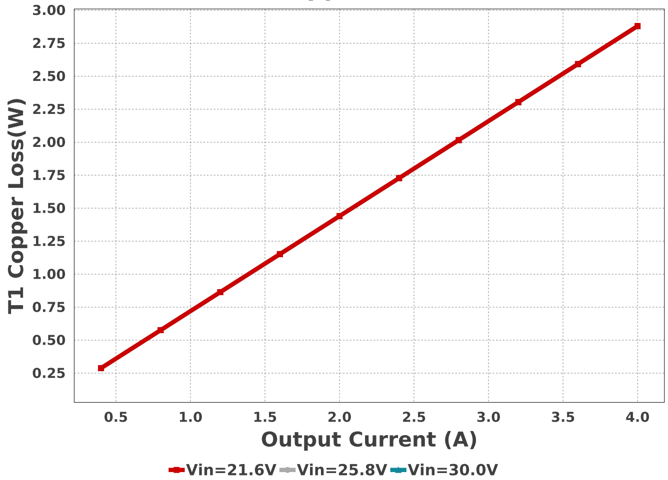
T1 Is1 RMS

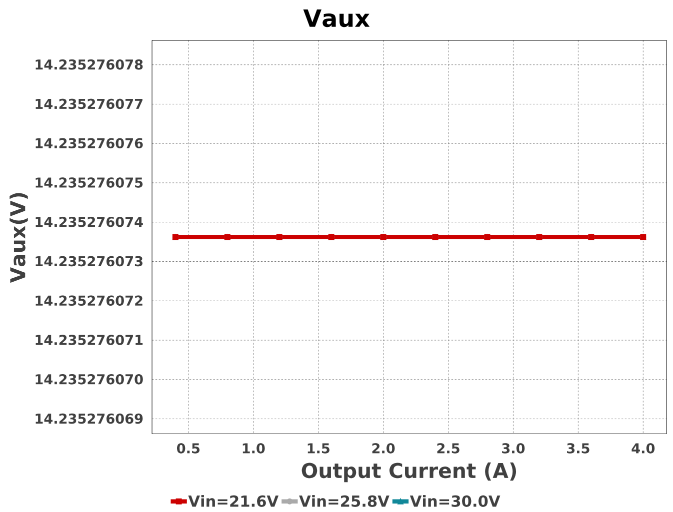


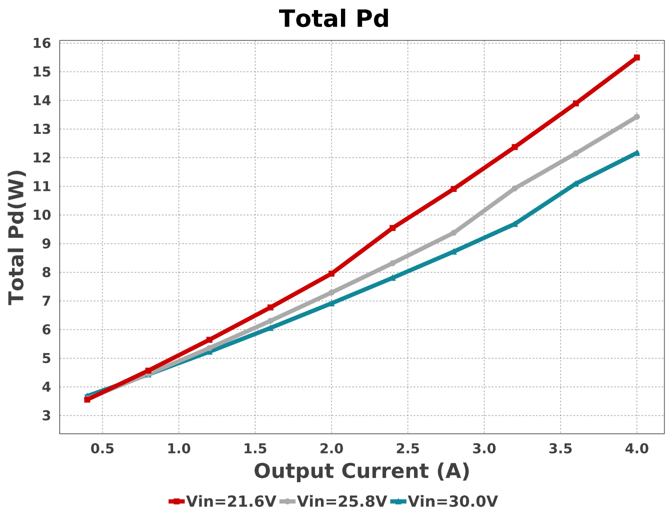
Pout

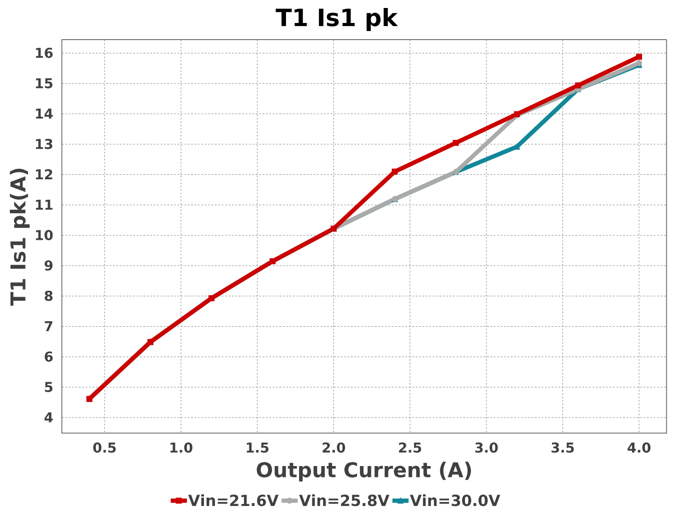


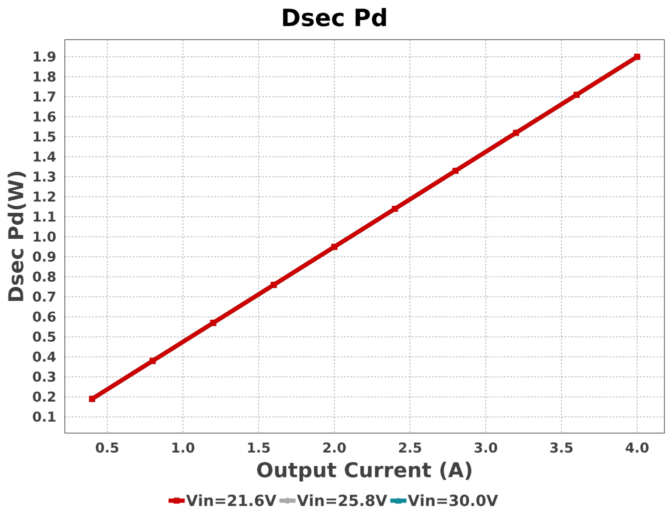
T1 Copper Loss

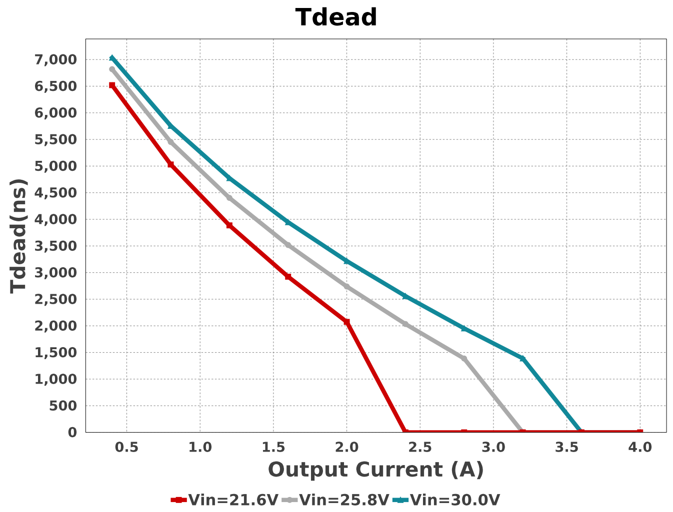


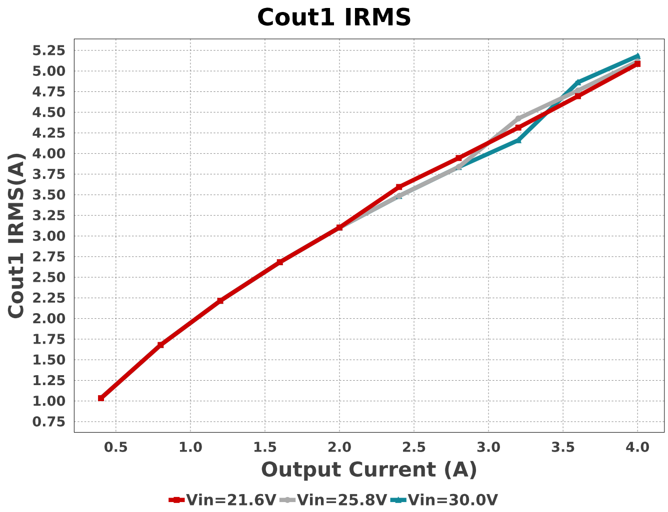

Vaux
Vaux(V)
14.235276078
14.235276077
14.235276076
14.235276075
14.235276074
14.235276073
14.235276072
14.235276071
14.235276070
14.235276069
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

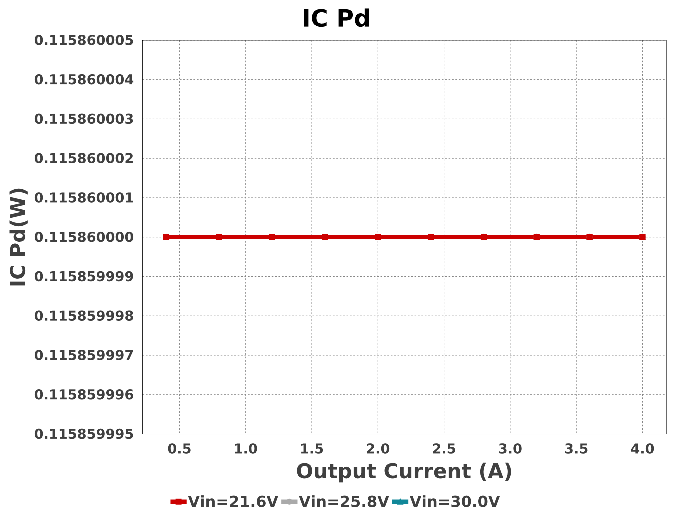

Total Pd
Total Pd(W)
16 15 14 13 12 11 10 9 8 7 6 5 4 3
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

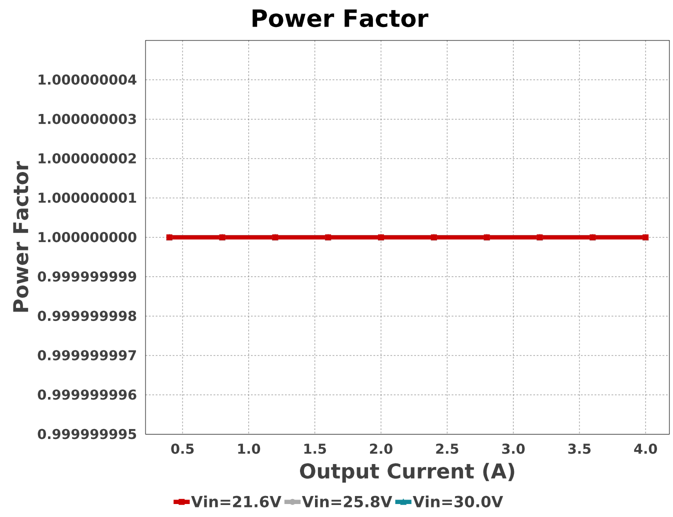

T1 Is1 pk
T1 Is1 pk(A)
16 15 14 13 12 11 10 9 8 7 6 5 4
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

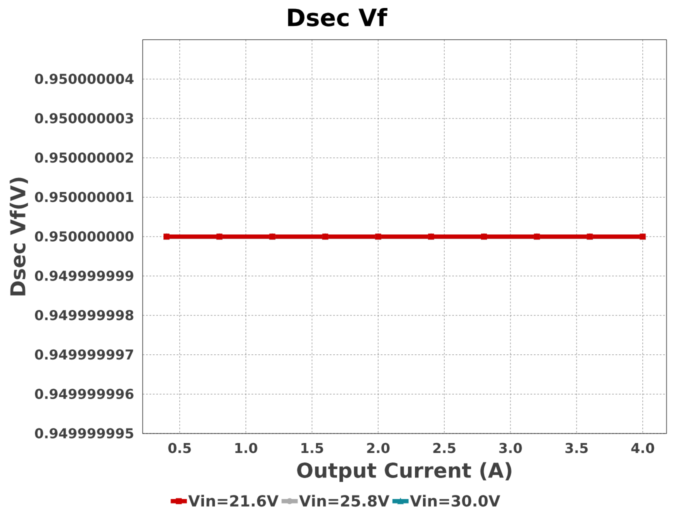

Dsec Pd
Dsec Pd(W)
1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

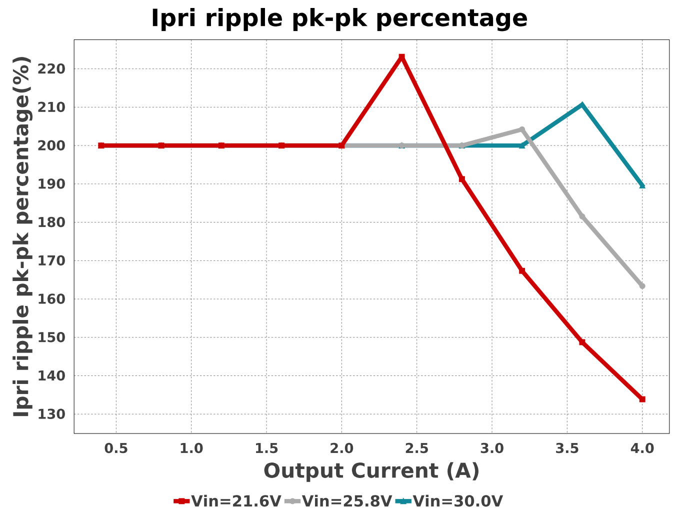

Tdead
Tdead(ns)
7,000 6,500 6,000 5,500 5,000 4,500 4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

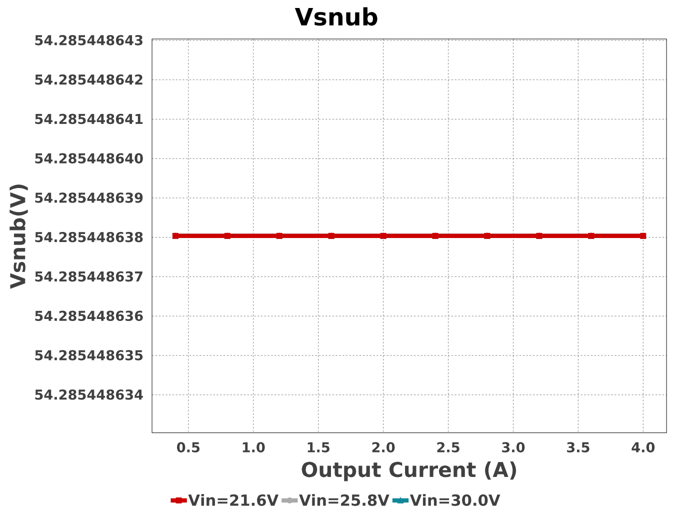

Cout1 IRMS
Cout1 IRMS(A)
5.25 5.00 4.75 4.50 4.25 4.00 3.75 3.50 3.25 3.00 2.75 2.50 2.25 2.00 1.75 1.50 1.25 1.00 0.75
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

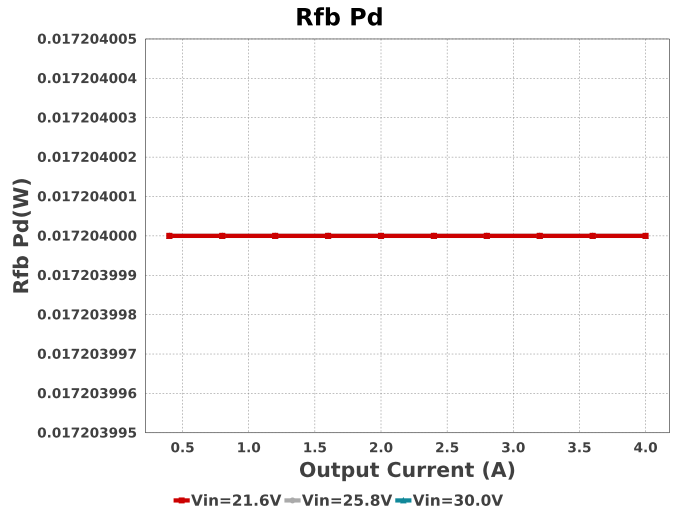

IC Pd
IC Pd(W)
0.115860005
0.115860004
0.115860003
0.115860002
0.115860001
0.115860000
0.115859999
0.115859998
0.115859997
0.115859996
0.115859995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


Power Factor
Power Factor
1.000000004
1.000000003
1.000000002
1.000000001
1.000000000
0.999999999
0.999999998
0.999999997
0.999999996
0.999999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

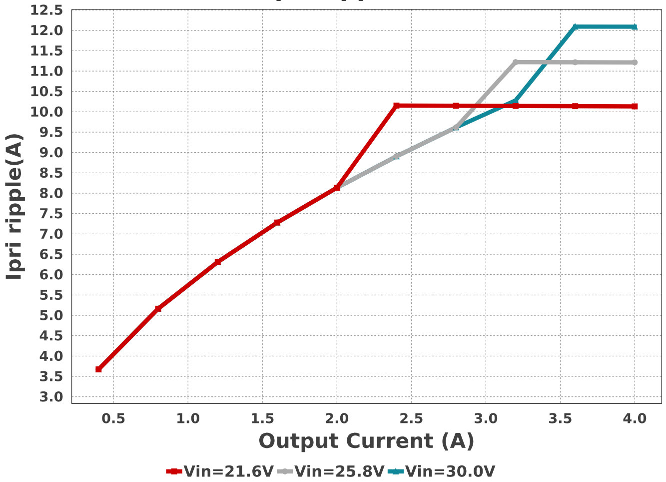

Dsec Vf
Dsec Vf(V)
0.950000004
0.950000003
0.950000002
0.950000001
0.950000000
0.949999999
0.949999998
0.949999997
0.949999996
0.949999995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


Ipri ripple pk-pk percentage
Ipri ripple pk-pk percentage(%)
220
210
200
190
180
170
160
150
140
130
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

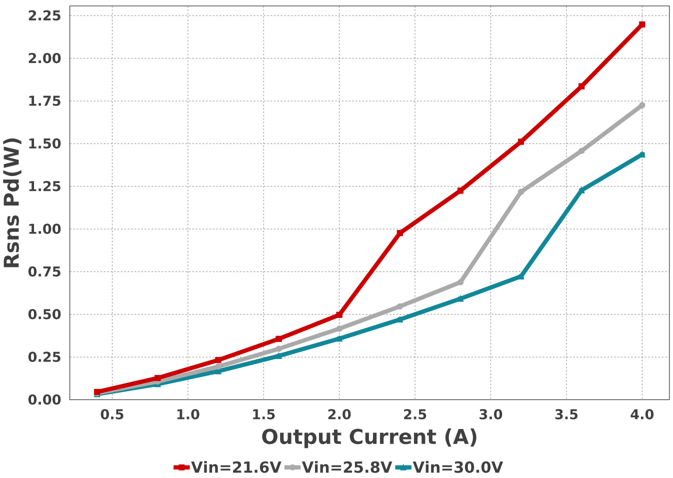

Vsnub
Vsnub(V)
54.285448643
54.285448642
54.285448641
54.285448640
54.285448639
54.285448638
54.285448637
54.285448636
54.285448635
54.285448634
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V


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
Output Current (A)
Vin=21.6V Vin=25.8V Vin=30.0V

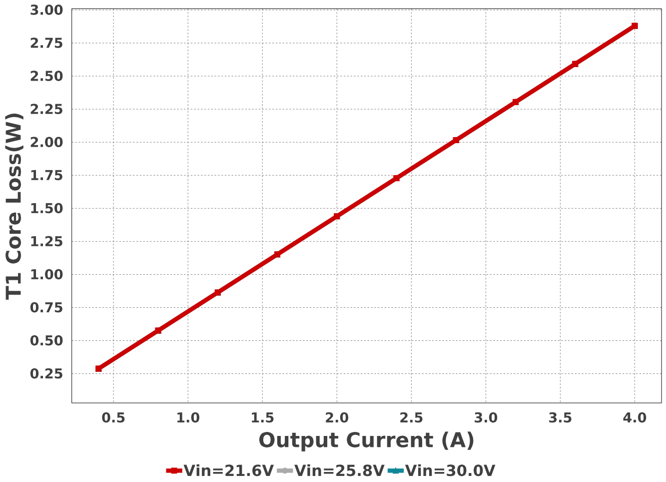
Ipri ripple



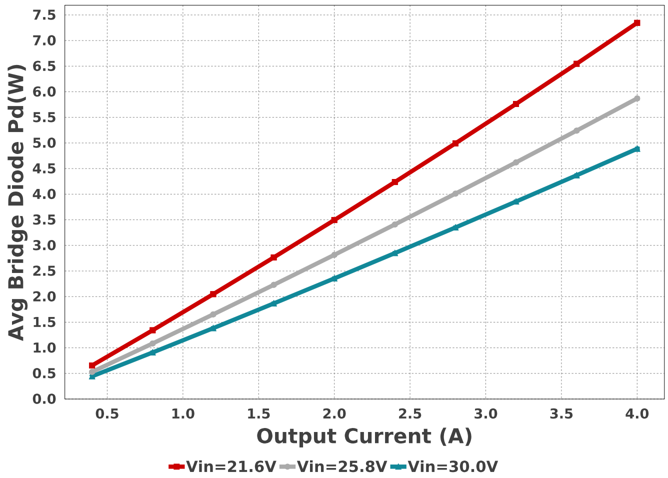
Rsns Pd



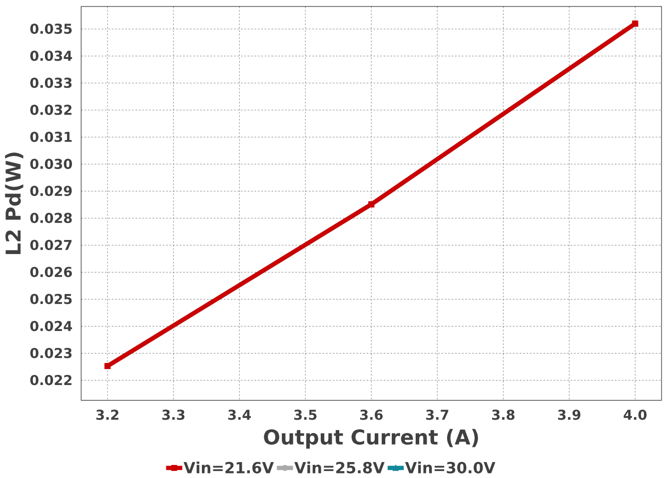
T1 Core Loss



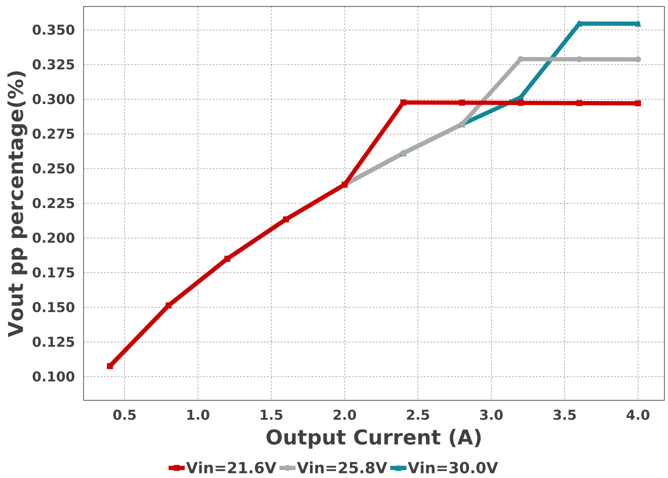
Avg Bridge Diode Pd

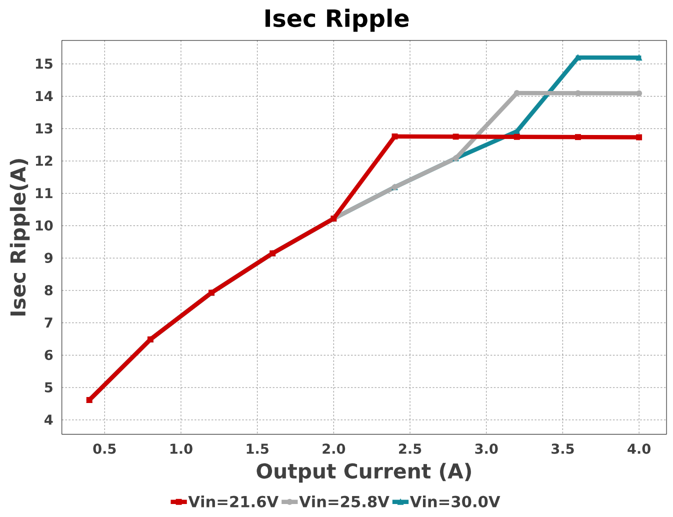


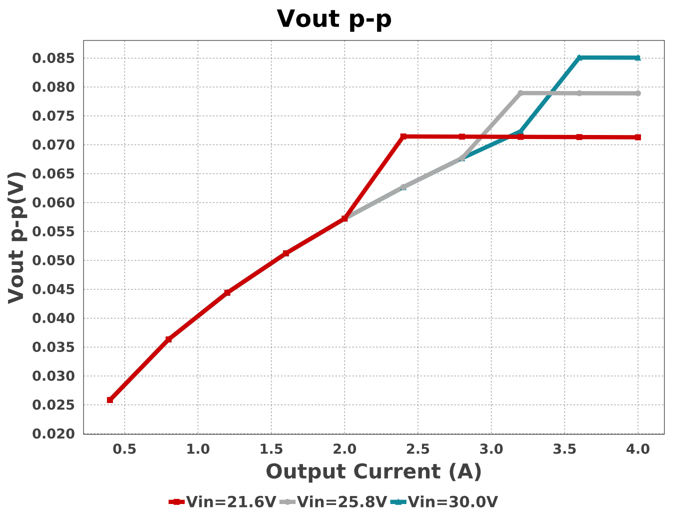
L2 Pd

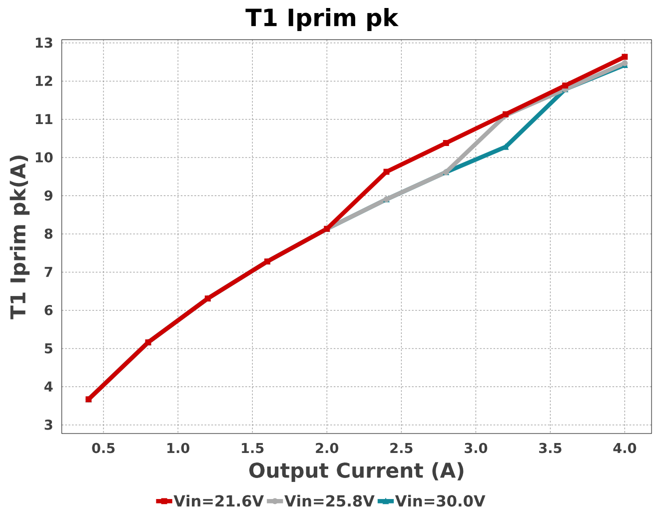


Vout pp percentage









Operating Values

#	Name	Value	Category	Description
1.	Cbulk Pd	942.32 mW	Capacitor	Bulk capacitor power dissipation
2.	Cout1 IRMS	5.086 A	Capacitor	Output capacitor1 RMS ripple current
3.	Cout1 Pd	144.86 mW	Capacitor	Output capacitor1 power dissipation
4.	Avg Bridge Diode Pd	7.345 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	1.9 W	Diode	Secondary Diode Power Dissipation
7.	Dsec Vf	950.0 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	1.9 W	Diode	Secondary Diode Power Dissipation
10.	Dsec2 Vf	950.0 mV	Diode	Effective Forward Voltage Drop at the Operating Current
11.	Dsnub trr	30.0 ns	Diode	Snubber Diode Reverse Recovery Time
12.	IC Pd	115.86 mW	IC	IC power dissipation
13.	IC Tj	43.324 degC	IC	IC junction temperature
14.	ICThetaJA	115.0 degC/W	IC	IC junction-to-ambient thermal resistance
15.	L2 Pd	35.2 mW	Inductor	Average Power Dissipation in the Inductor Over the AC Line Period
16.	M1 Pd	975.69 mW	Mosfet	M1 MOSFET total power dissipation
17.	M1 TjOP	90.501 degC	Mosfet	M1 MOSFET junction temperature
18.	Avg Bridge Diode Pd	7.345 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
19.	Cbulk Pd	942.32 mW	Power	Bulk capacitor power dissipation
20.	Cout1 Pd	144.86 mW	Power	Output capacitor1 power dissipation
21.	Dsec Pd	1.9 W	Power	Secondary Diode Power Dissipation
22.	Dsec2 Pd	1.9 W	Power	Secondary Diode Power Dissipation
23.	IC Pd	115.86 mW	Power	IC power dissipation
24.	L2 Pd	35.2 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
25.	M1 Pd	975.69 mW	Power	M1 MOSFET total power dissipation
26.	Paux	5.77 mW	Power	Power Dissipation in Raux and Daux
27.	Pd Rstartup	3.892 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
28.	Rdrv Pd	34.746 mW	Power	Power Dissipation in Gate Drive Resistor
29.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
30.	Rsns Pd	2.198 W	Power	Current Limit Sense Resistor Power Dissipation
31.	Snubber Pd	1.399 W	Power	Snubber Power Dissipation
32.	T1 Copper Loss	2.88 W	Power	Transformer Copper Loss Power Dissipation

#	Name	Value	Category	Description
33.	T1 Core Loss	2.88 W	Power	Transformer Core Loss Power Dissipation
34.	T1 Pd	5.76 W	Power	Estimated Losses in Transformer
35.	Total Pd	15.498 W	Power	Total Power Dissipation
36.	Pd Rstartup	3.892 mW	Resistor	Power Dissipation in Rstartup1 and Rstartup2
37.	Rdrv Pd	34.746 mW	Resistor	Power Dissipation in Gate Drive Resistor
38.	Rfb Pd	17.204 mW	Resistor	Rfb Power Dissipation
39.	Rsns Pd	2.198 W	Resistor	Current Limit Sense Resistor Power Dissipation
40.	AC Frequency	50.0 Hz	System Information	Input AC frequency
41.	BOM Count	62	System Information	Total Design BOM count
42.	Duty Cycle	59.739 %	System Information	Duty cycle
43.	Efficiency	86.1 %	System Information	Steady state efficiency
44.	FootPrint	4.859 k mm^2	System Information	Total Foot Print Area of BOM components
45.	Frequency	98.851 kHz	System Information	Switching frequency
46.	Iin rms	5.162 A	System Information	RMS Input Current
47.	Iout	4.0 A	System Information	Iout operating point
48.	Iout_DCM	2.243 A	System Information	Approximate Current below which DCM mode of operation will begin
49.	Mode	CCM	System Information	Conduction Mode
50.	Peak Rectified Vin	30.547 V	System Information	Peak voltage seen at rectified input
51.	Pout	96.0 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	4.254 us	System Information	Approximate Converter Off Time
55.	Ton Act	6.043 us	System Information	Approximate Converter On Time
56.	Total BOM	NA	System Information	Total BOM Cost
57.	Tsw	10.116 us	System Information	Switching Time Period
58.	Vin_RMS	21.6 V	System Information	Vin operating point
59.	Vout	24.0 V	System Information	Operational Output Voltage
60.	Vout p-p	71.305 mV	System Information	Peak-to-peak output ripple voltage
61.	Vout pp percentage	297.105 m%	System Information	Output Voltage ripple percentage
62.	Vsnub	54.285 V	System Information	Voltage Across the Snubber
63.	Ipri Avg	4.522 A	Transformer	Average Current in Primary Winding over the complete Switching Period
64.	Ipri ripple	10.133 A	Transformer	Ripple Current in the Primary Winding
65.	Ipri ripple pk-pk percentage	133.864 %	Transformer	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
66.	Isec Ripple	12.733 A	Transformer	Ripple Current in the Secondary Winding
67.	Paux	5.77 mW	Transformer	Power Dissipation in Raux and Daux
68.	T1 Copper Loss	2.88 W	Transformer	Transformer Copper Loss Power Dissipation
69.	T1 Core Loss	2.88 W	Transformer	Transformer Core Loss Power Dissipation
70.	T1 Iprim RMS	6.272 A	Transformer	Transformer Primary RMS Current
71.	T1 Iprim pk	12.636 A	Transformer	Transformer Primary Peak Current
72.	T1 Is1 RMS	6.47 A	Transformer	Transformer Secondary1 RMS Current
73.	T1 Is1 pk	15.879 A	Transformer	Transformer Secondary1 Peak Current
74.	T1 Pd	5.76 W	Transformer	Estimated Losses in Transformer
75.	Vaux	14.235 V	Transformer	Auxiliary Voltage

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	21.6	Minimum input voltage
Vout	24.0	Output Voltage

Name	Value	Description
acFrequency	50.0	AC Frequency
base_pn	UCC28C42-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

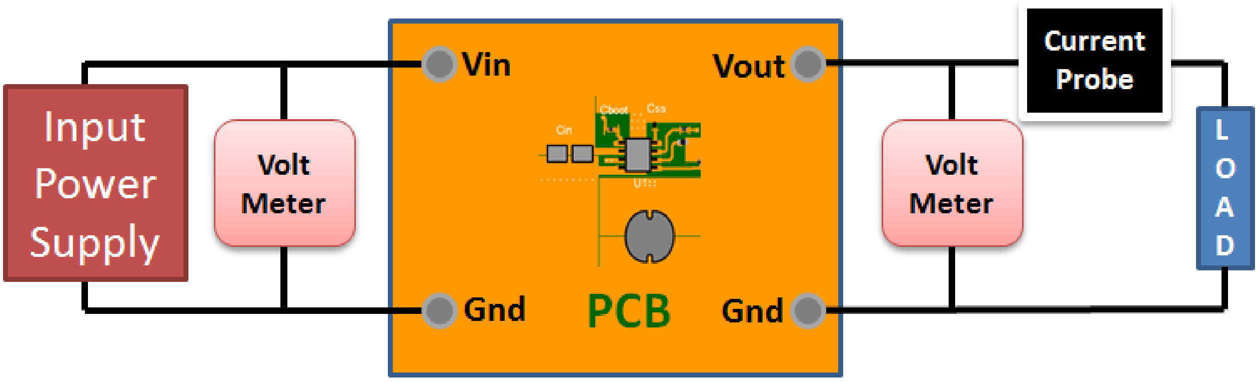
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 21.6V 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.



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 UCC28C42-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 : 0D05F4957D308205F4803E9B2B5DA366[v1]

4. **UCC28C42-Q1** Product Folder : http://www.ti.com/product/UCC28C42%2DQ1 : contains the data sheet and other resources.