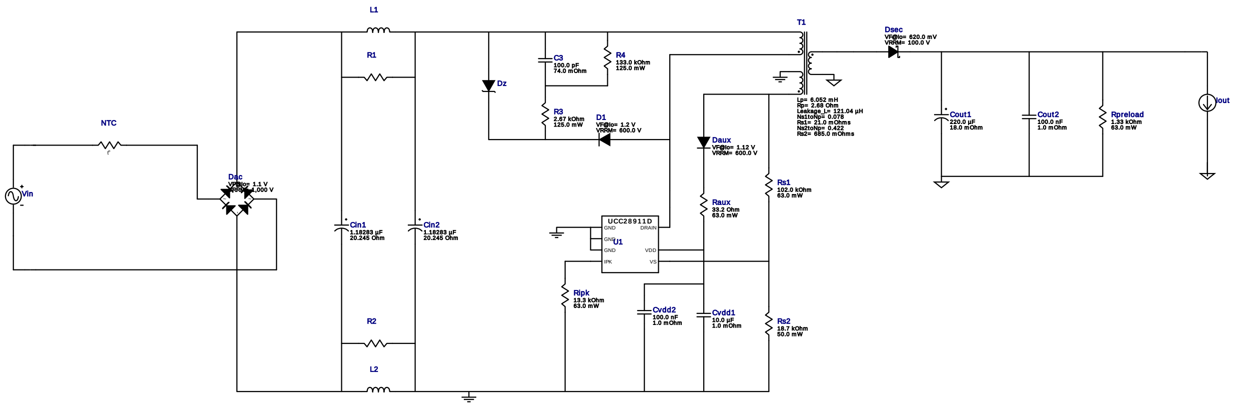
VinMin = 50.0V
VinMax = 300.0V
Vout = 3.3V
Iout = 0.1A

Device = UCC28911D
Topology = Flyback
Created = 2023-06-12 11:30:01.433
BOM Cost = NA
BOM Count = 22
Total Pd = 0.24W

WEBENCH ® Design Report

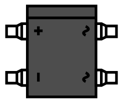
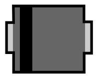
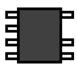
Design : 242 UCC28911D
UCC28911D 50V-300V to 3.30V @ 0.1A



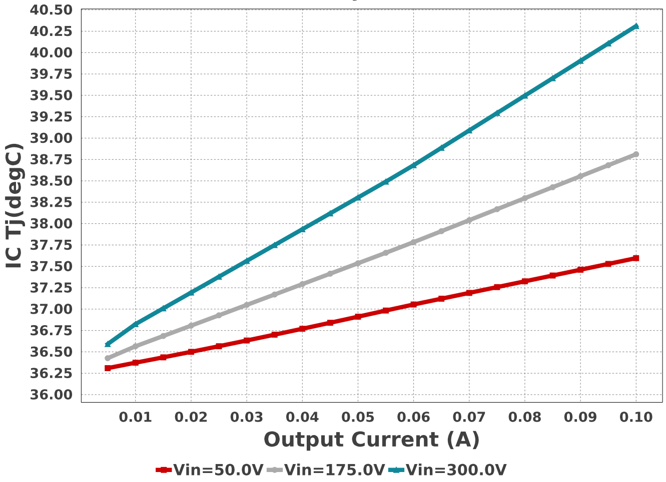
1. The EMI filter shown in the schematic is a placeholder. It has not yet been designed for the application.

Electrical BOM

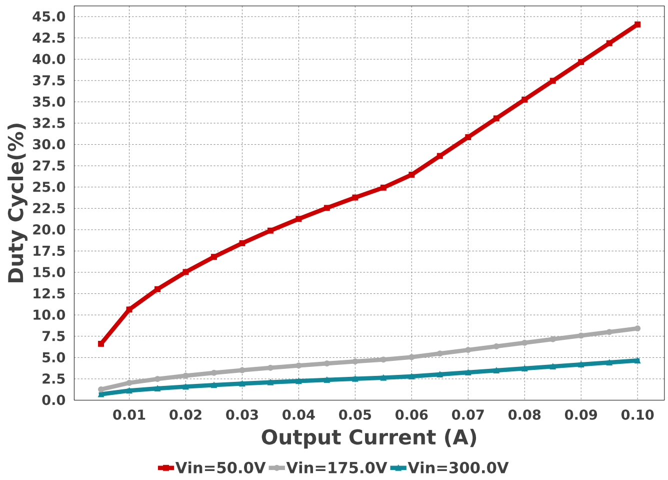
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C3	Kemet	C0805C101J1GACTU Series= C0G/NP0	Cap= 100.0 pF ESR= 74.0 mOhm VDC= 100.0 V IRMS= 524.0 mA	1	$0.02	0805 7 mm^2
Cin1	CUSTOM	CUSTOM Series= ?	Cap= 1.18283 uF ESR= 20.2455 Ohm VDC= 445.47 V IRMS= 8.7343 mA	1	NA	CUSTOM 0 mm^2
Cin2	CUSTOM	CUSTOM Series= ?	Cap= 1.18283 uF ESR= 20.2455 Ohm VDC= 445.47 V IRMS= 8.7343 mA	1	NA	CUSTOM 0 mm^2
Cout1	Panasonic	10TPE220MIL Series= TPE	Cap= 220.0 uF ESR= 18.0 mOhm VDC= 10.0 V IRMS= 2.8 A	1	$0.76	7343-31 59 mm^2
Cout2	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 mm^2
Cvdd1	MuRata	GRT31CR61H106KE01L Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.18	1206_180 11 mm^2
Cvdd2	Yageo	CC0805KRX7R9BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
D1	ON Semiconductor	1N4937G	VF@Io= 1.2 V VRRM= 600.0 V	1	$0.04	DO-41 43 mm^2

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.28	 DF-S 99 mm^2
Daux	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.23	 SMC 83 mm^2
Dsec	Vishay-Semiconductor	SS2PH10-M3	VF@Io= 620.0 mV VRRM= 100.0 V	1	$0.15	 DO-220AA 14 mm^2
Dz	Diodes Inc.	SMBJ78A-13-F	Zener	1	$0.10	 SMB 44 mm^2
NTC	Ametherm	SL0310001 Series= miniAMP	Thermistor	1	$0.26	 SL03 16 mm^2
R3	Panasonic	ERJ-6ENF2671V Series= ERJ-6E	Res= 2.67 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
R4	Vishay-Dale	CRCW0805133KFKEA Series= CRCW..e3	Res= 133.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm^2
Raux	Vishay-Dale	CRCW040233R2FKED Series= CRCW..e3	Res= 33.2 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ripk	Vishay-Dale	CRCW040213K3FKED Series= CRCW..e3	Res= 13.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rpreload	Vishay-Dale	CRCW04021K33FKED Series= CRCW..e3	Res= 1.33 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rs1	Vishay-Dale	CRCW0402102KFKED Series= CRCW..e3	Res= 102.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rs2	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
T1	CUSTOM	CUSTOM	Lp= 6.052 mH Rp= 2.68 Ohm Leakage_L= 121.04 µH Ns1toNp= 77.518 m Rs1= 21.0 mOhms Ns2toNp= 0.422 Rs2= 685.0 mOhms	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	UCC28911D	Switcher	1	$0.58	 D0007A 55 mm^2

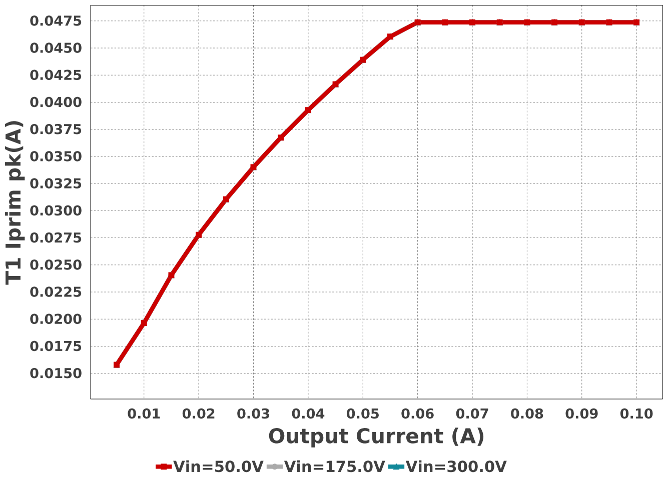
IC Tj



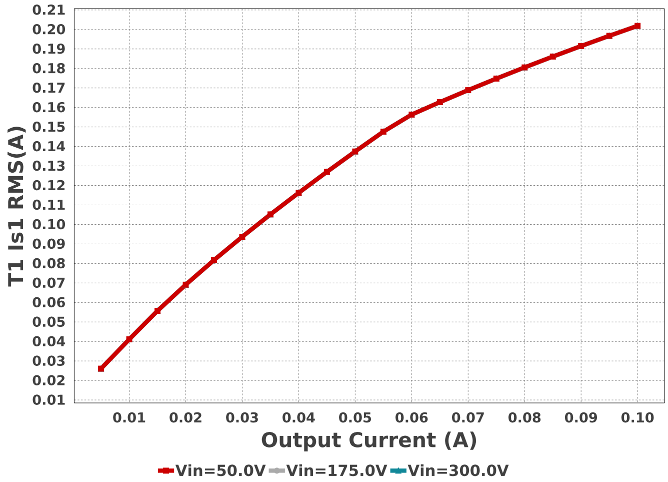
Duty Cycle



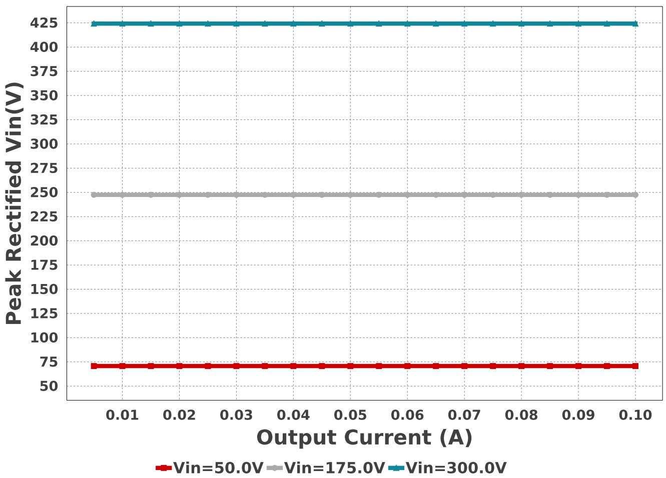
T1 Iprim pk



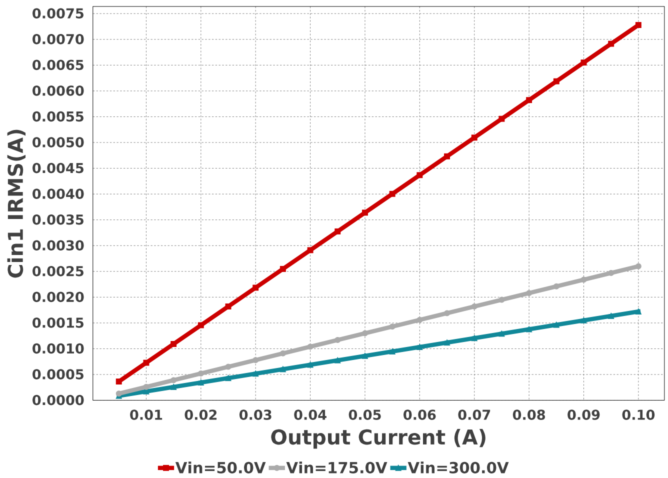
T1 Is1 RMS

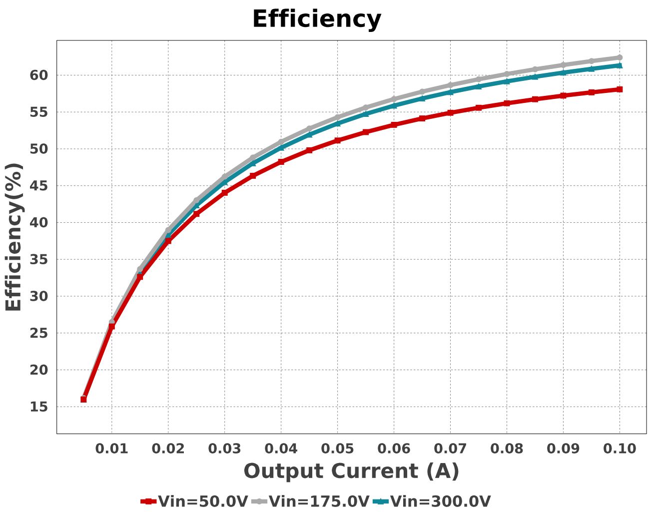


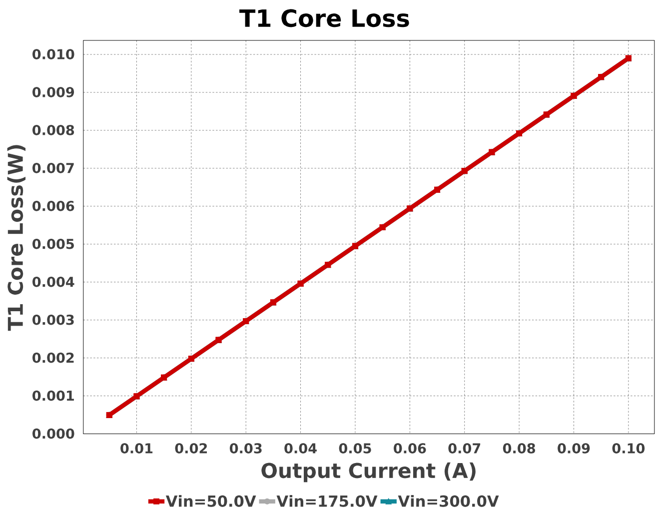
Peak Rectified Vin

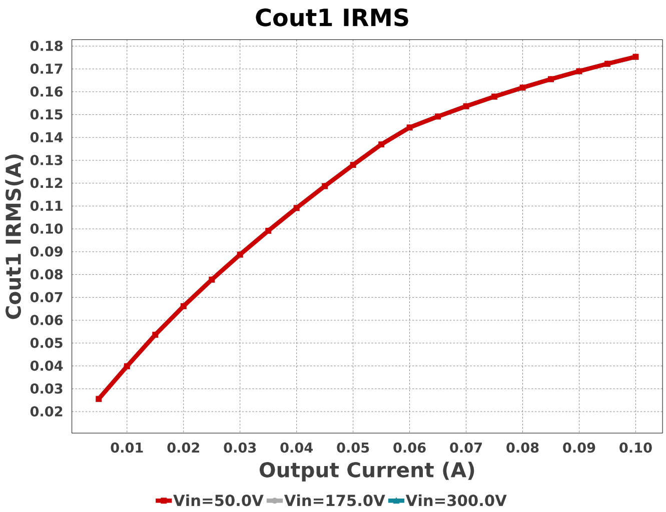


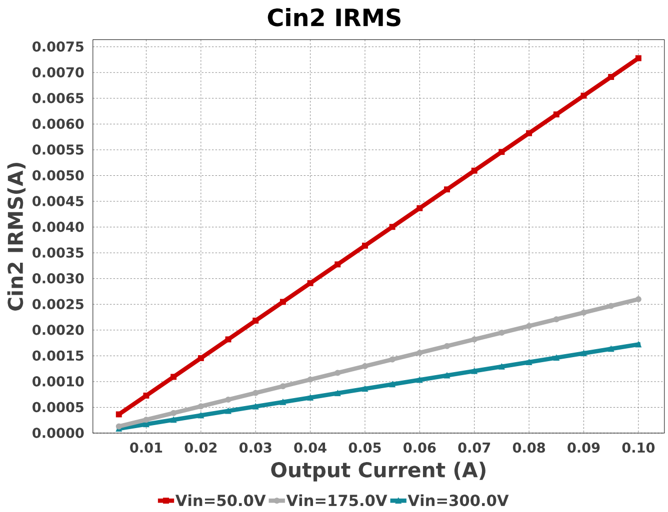
Cin1 IRMS

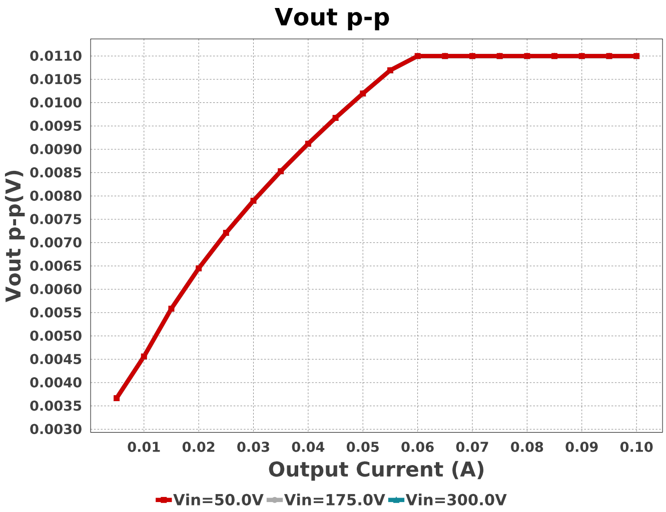


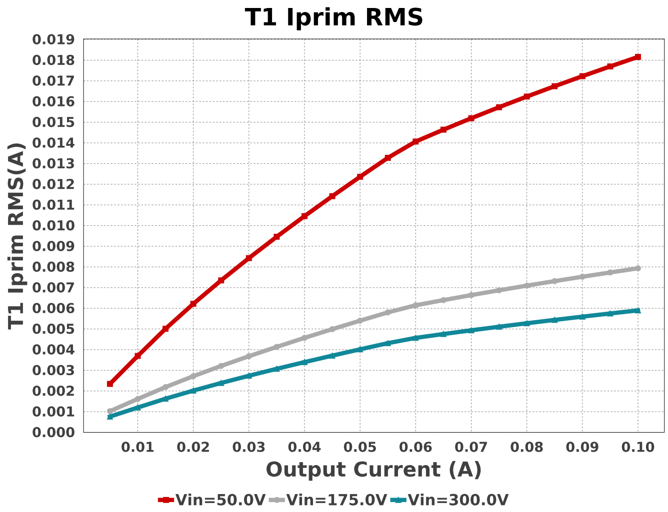

Efficiency
Efficiency(%)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

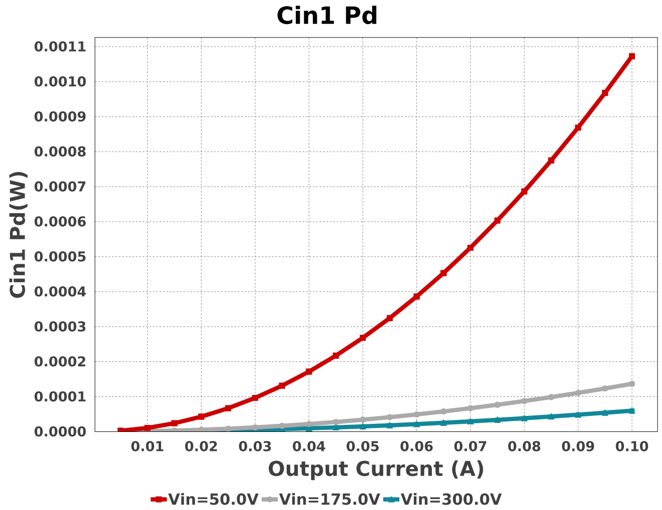

T1 Core Loss
T1 Core Loss(W)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

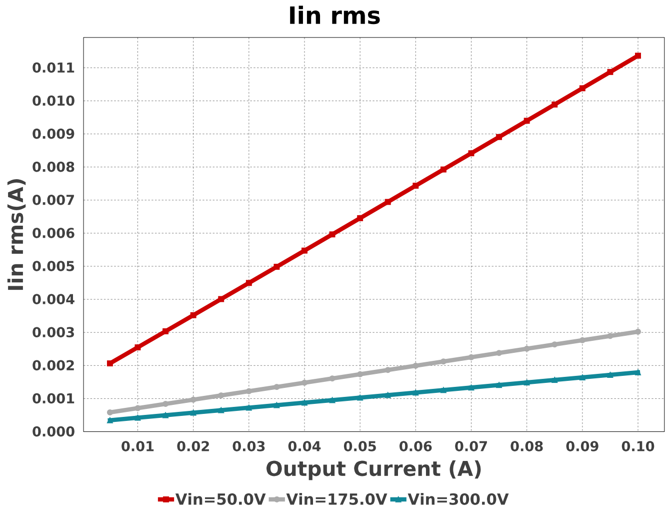

Cout1 IRMS
Cout1 IRMS(A)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

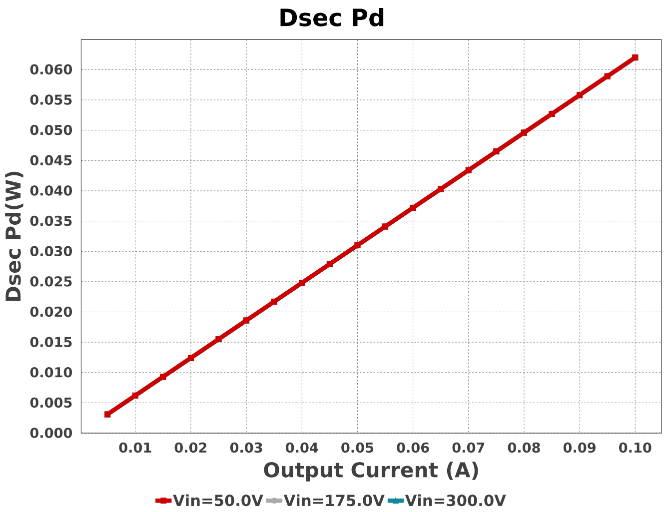

Cin2 IRMS
Cin2 IRMS(A)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

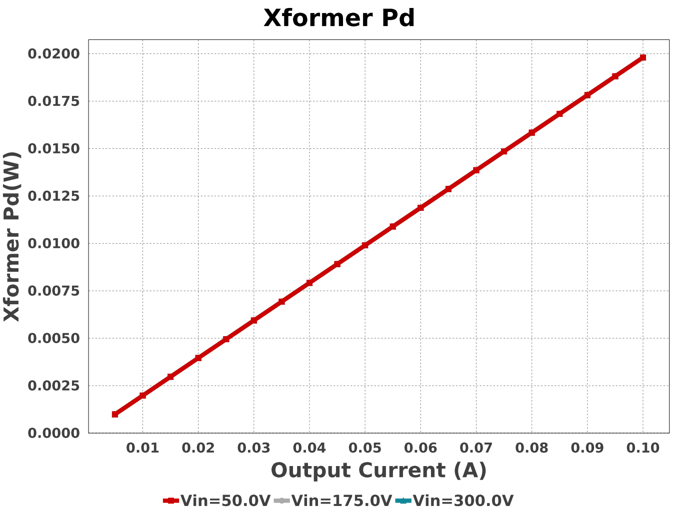

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

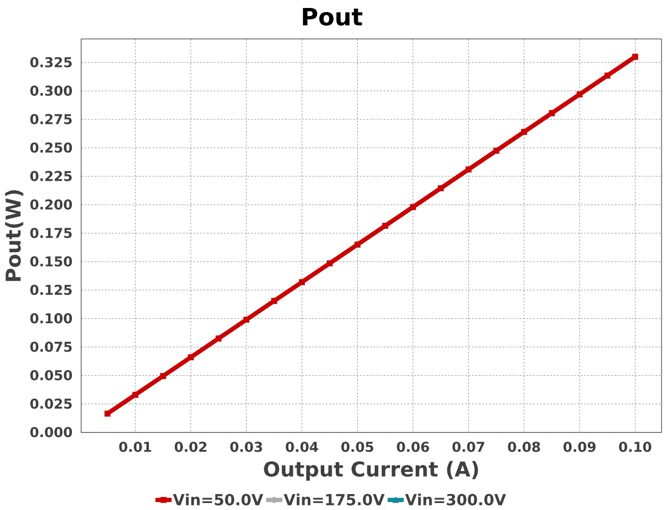

T1 Iprim RMS
T1 Iprim RMS(A)
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

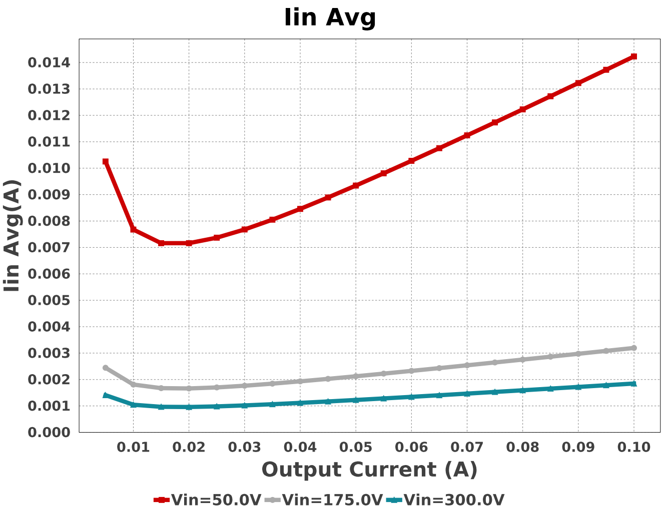

Cin1 Pd
Cin1 Pd(W)
0.0011
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

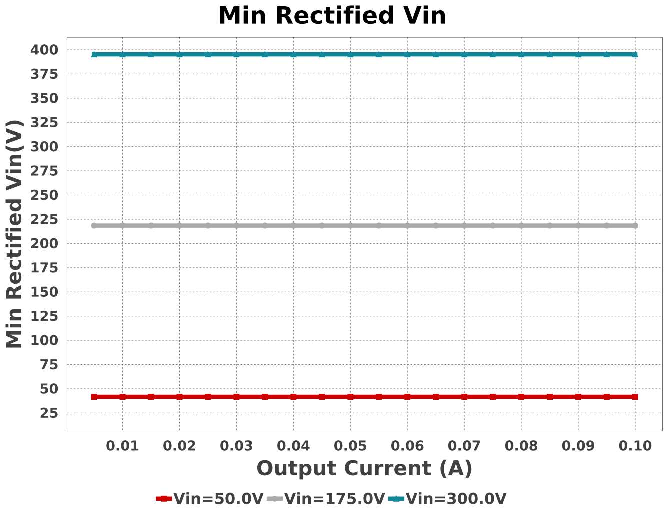

Iin rms
Iin rms(A)
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

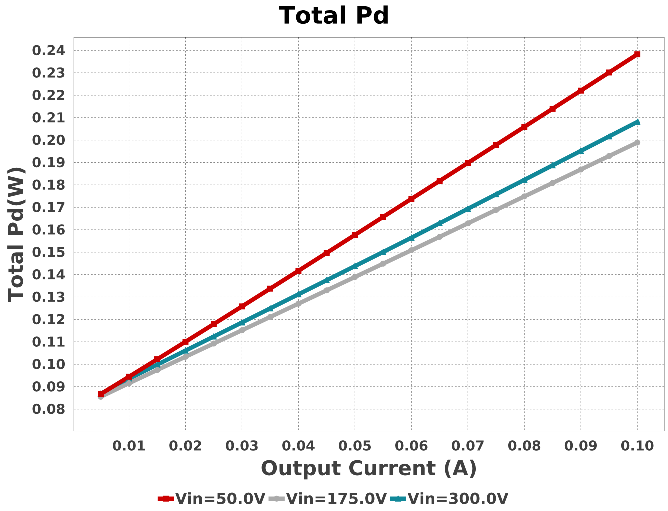

Dsec Pd
Dsec Pd(W)
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

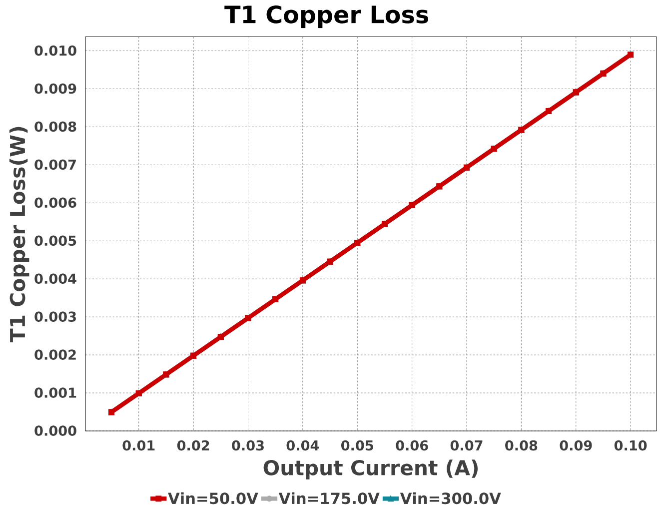

Xformer Pd
Xformer Pd(W)
0.0200
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

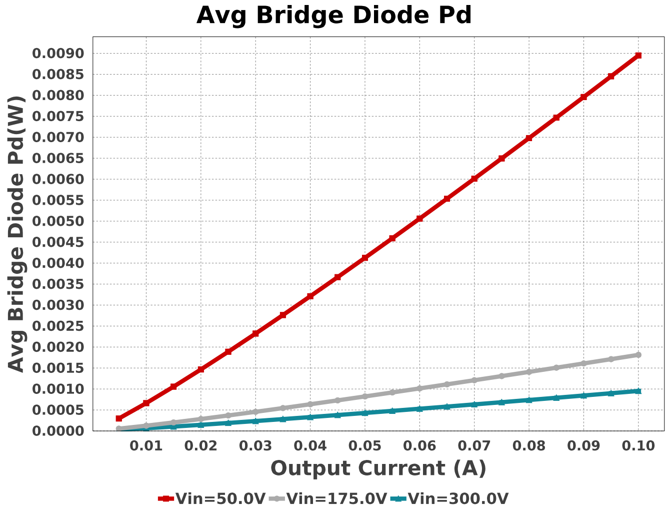

Pout
Pout(W)
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

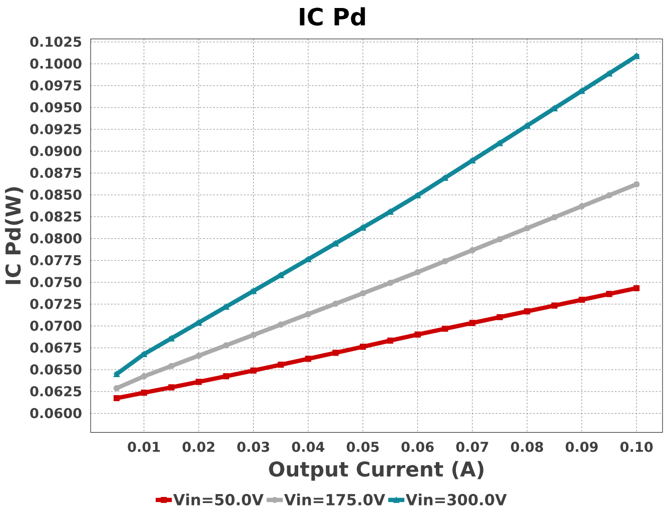

Iin Avg
Iin Avg(A)
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

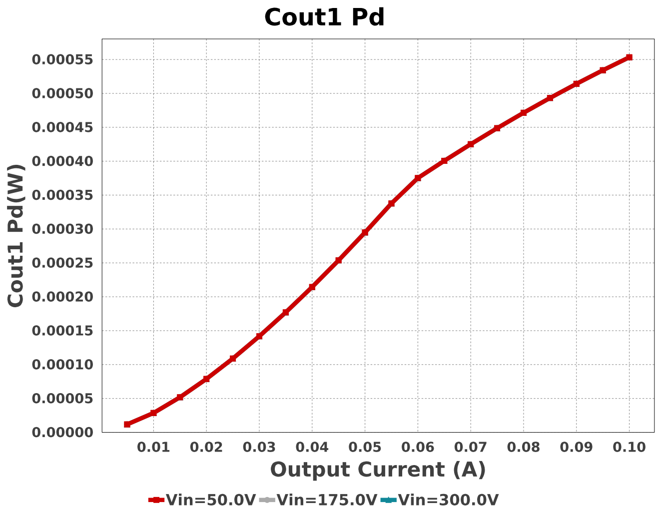

Min Rectified Vin
Min Rectified Vin(V)
400 375 350 325 300 275 250 225 200 175 150 125 100 75 50 25
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

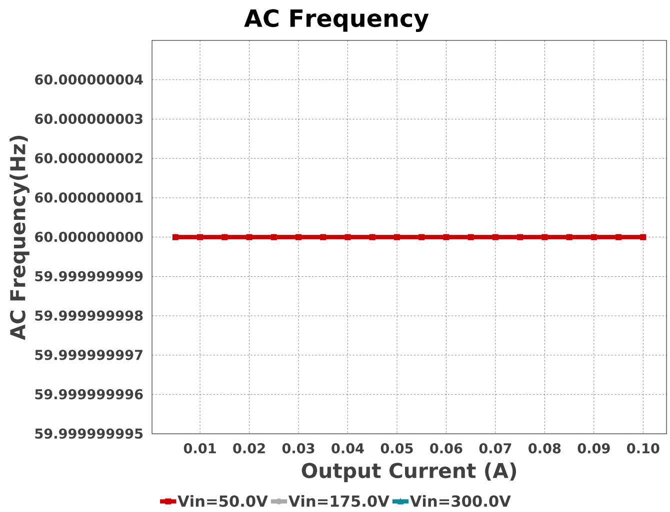

Total Pd
Total Pd(W)
0.24 0.23 0.22 0.21 0.20 0.19 0.18 0.17 0.16 0.15 0.14 0.13 0.12 0.11 0.10 0.09 0.08
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V

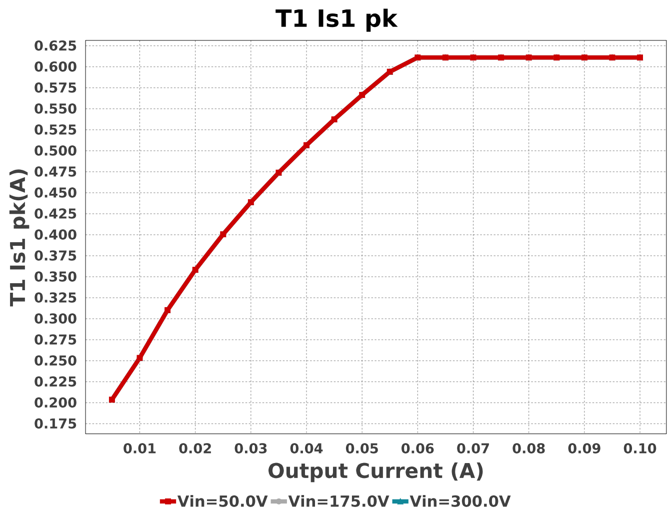

T1 Copper Loss
T1 Copper Loss(W)
0.010 0.009 0.008 0.007 0.006 0.005 0.004 0.003 0.002 0.001 0.000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V


Avg Bridge Diode Pd
Avg Bridge Diode Pd(W)
0.0090 0.0085 0.0080 0.0075 0.0070 0.0065 0.0060 0.0055 0.0050 0.0045 0.0040 0.0035 0.0030 0.0025 0.0020 0.0015 0.0010 0.0005 0.0000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V


IC Pd
IC Pd(W)
0.1025 0.1000 0.0975 0.0950 0.0925 0.0900 0.0875 0.0850 0.0825 0.0800 0.0775 0.0750 0.0725 0.0700 0.0675 0.0650 0.0625 0.0600
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V


Cout1 Pd
Cout1 Pd(W)
0.00055 0.00050 0.00045 0.00040 0.00035 0.00030 0.00025 0.00020 0.00015 0.00010 0.00005 0.00000
0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10
Output Current (A)
Vin=50.0V Vin=175.0V Vin=300.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin1 IRMS	7.279 mA	Capacitor	Input Capacitor Cin1 RMS Ripple Current
2.	Cin1 Pd	1.073 mW	Capacitor	Average Power Dissipation in the Input Capacitor Cin1
3.	Cin2 IRMS	7.279 mA	Capacitor	Input Capacitor Cin2 RMS Ripple Current
4.	Cout1 IRMS	175.321 mA	Capacitor	Output capacitor1 RMS ripple current
5.	Cout1 Pd	553.27 µW	Capacitor	Output capacitor1 power dissipation
6.	Avg Bridge Diode Pd	8.949 mW	Diode	Average Power Dissipation in the Bridge Diode over the AC Line Period
7.	D1 trr	300.0 ns	Diode	D1 Reverse Recovery Time
8.	Daux trr	30.0 ns	Diode	Auxiliary Diode Reverse Recovery Time
9.	Dsec Pd	62.0 mW	Diode	Secondary Diode Power Dissipation
10.	Dsec trr	0.0 ns	Diode	Output Diode Reverse Recovery Time
11.	IC Pd	74.326 mW	IC	IC power dissipation
12.	IC Tj	37.596 degC	IC	IC junction temperature
13.	ICThetaJA	102.2 degC/W	IC	IC junction-to-ambient thermal resistance
14.	Iin Avg	14.23 mA	IC	Average input current
15.	Avg Bridge Diode Pd	8.949 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
16.	Cin1 Pd	1.073 mW	Power	Average Power Dissipation in the Input Capacitor Cin1
17.	Cout1 Pd	553.27 µW	Power	Output capacitor1 power dissipation
18.	Dsec Pd	62.0 mW	Power	Secondary Diode Power Dissipation
19.	IC Pd	74.326 mW	Power	IC power dissipation
20.	T1 Copper Loss	9.9 mW	Power	Transformer Copper Loss Power Dissipation
21.	T1 Core Loss	9.9 mW	Power	Transformer Core Loss Power Dissipation
22.	Total Pd	238.244 mW	Power	Total Power Dissipation
23.	Xformer Pd	19.8 mW	Power	Transformer power dissipation
24.	AC Frequency	60.0 Hz	System Information	Input AC frequency
25.	BOM Count	22	System Information	Total Design BOM count
26.	Duty Cycle	44.081 %	System Information	Duty cycle at the Minimum voltage seen at the rectified input
27.	Efficiency	58.074 %	System Information	Steady state efficiency
28.	FootPrint	542.0 mm^2	System Information	Total Foot Print Area of BOM components
29.	Frequency	64.15 kHz	System Information	Approximate switching frequency
30.	Iin rms	11.365 mA	System Information	RMS Input Current
31.	Iout	100.0 mA	System Information	Iout operating point
32.	Min Rectified Vin	41.719 V	System Information	Minimum voltage seen at rectified input
33.	Mode	DCM	System Information	Conduction Mode
34.	Peak Rectified Vin	70.71 V	System Information	Peak voltage seen at rectified input
35.	Pout	330.0 mW	System Information	Total output power
36.	Total BOM	NA	System Information	Total BOM Cost
37.	Vin_RMS	50.0 V	System Information	Vin operating point

#	Name	Value	Category	Description
38.	Vout	3.3 V	System Information	Operational Output Voltage
39.	Vout Tolerance	242.42 m%	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
40.	Vout p-p	10.999 mV	System Information	Peak-to-peak output ripple voltage
41.	T1 Copper Loss	9.9 mW	Transformer	Transformer Copper Loss Power Dissipation
42.	T1 Core Loss	9.9 mW	Transformer	Transformer Core Loss Power Dissipation
43.	T1 Iprim RMS	18.157 mA	Transformer	Transformer Primary RMS Current
44.	T1 Iprim pk	47.368 mA	Transformer	Transformer Primary Peak Current
45.	T1 Is1 RMS	201.835 mA	Transformer	Transformer Secondary1 RMS Current
46.	T1 Is1 pk	611.061 mA	Transformer	Transformer Secondary1 Peak Current
47.	Xformer Pd	19.8 mW	Transformer	Transformer power dissipation

Design Inputs

Name	Value	Description
Iout	100.0 m	Maximum Output Current
VinMax	300.0	Maximum input voltage
VinMin	50.0	Minimum input voltage
Vout	3.3	Output Voltage
acFrequency	60.0	AC Frequency
base_pn	UCC28911	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

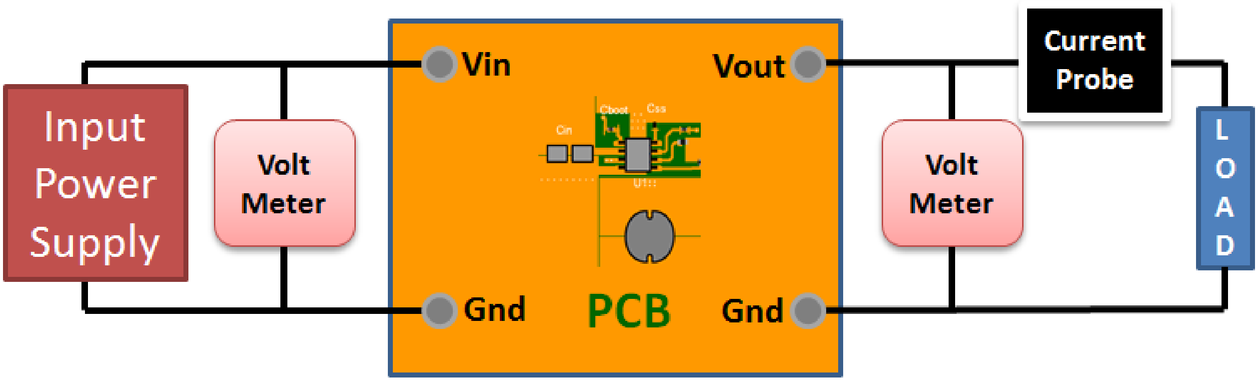
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 50.0V 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.



Design Assistance

1. Master key : 93728AD00F2D205F[v1]

2. **UCC28911** Product Folder : http://www.ti.com/product/UCC28911 : contains the data sheet and other resources.

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