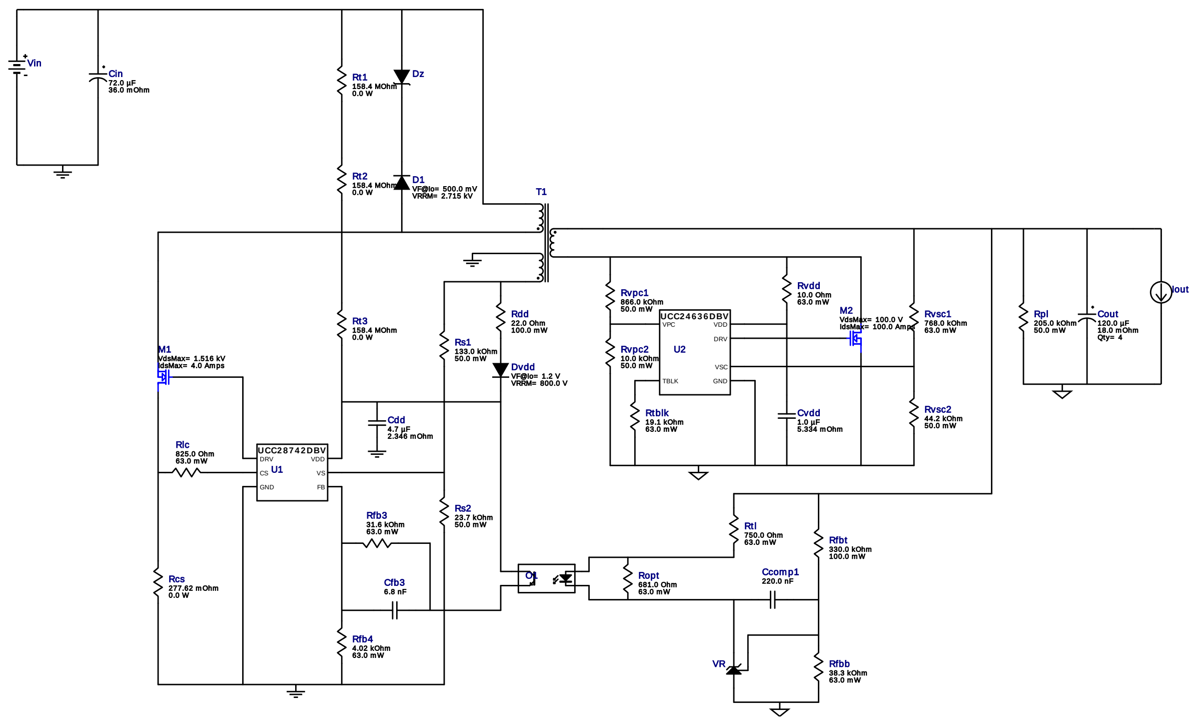
VinMin = 300.0V VinMax = 1200.0V Vout = 24.0V Iout = 6.0A	Device = UCC28742DBVR Topology = Flyback Created = 2023-08-30 19:25:30.512 BOM Cost = NA BOM Count = 40 Total Pd =

WEBENCH ® Design Report

Design : 128 UCC28742DBVR
UCC28742DBVR 300V-1200V to 24.00V @ 6A



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.

2. Click on the transformer symbol and select 'Design Transformer' to design using specific transformer cores and bobbin

Design Alerts

Component Selection Information

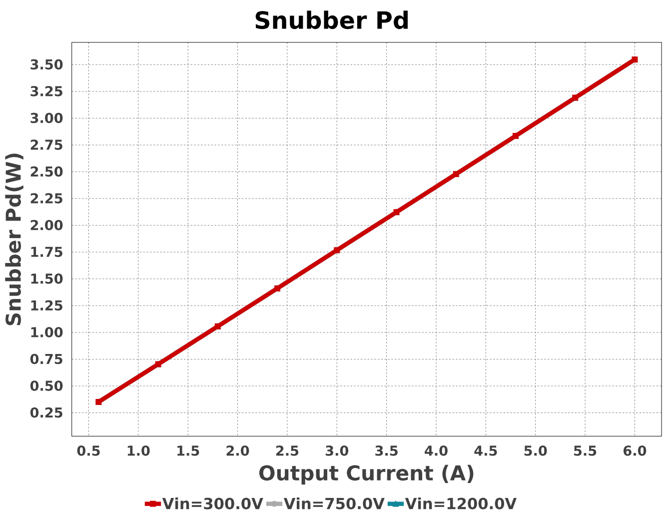
Click on the transformer symbol in the schematic and select "Explore Transformer Core/Bobbin Selection" to design using specific transformer cores and bobbin. With the current design condition, suitable FET could not be found in the current database. Hence, this design is created using an ideal FET. Please note that the resulting FET parameters are ideal, so the efficiency/loss values have been disabled. Also, the schematic/PCB export and Thermal simulations will not work with the ideal FET.

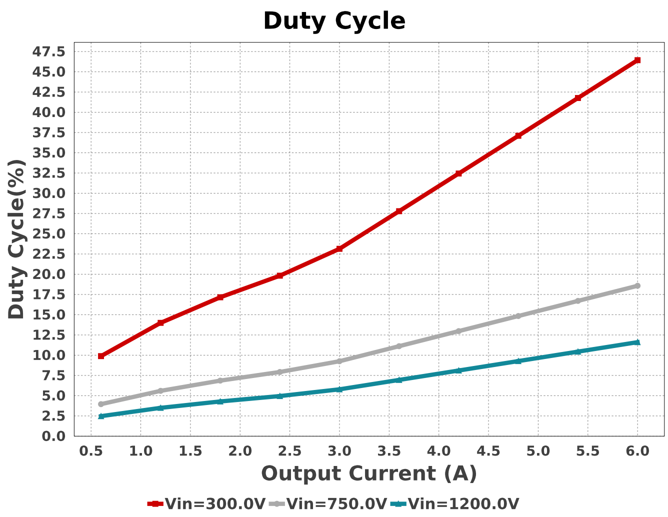
Electrical BOM

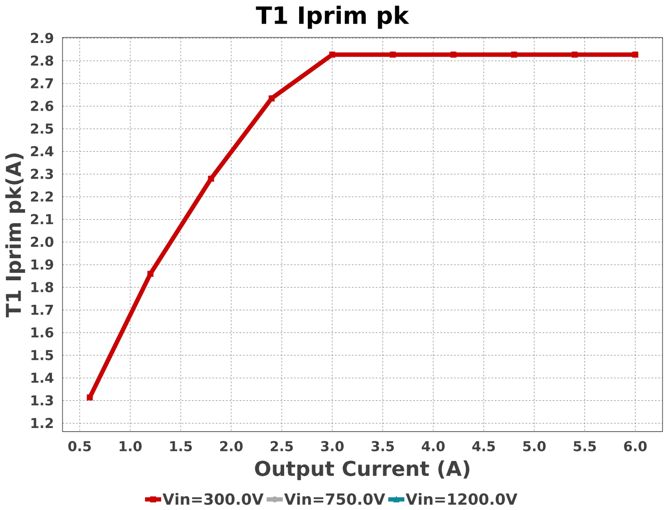
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Ccomp1	CUSTOM	CUSTOM Series= ?	Cap= 220.0 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cdd	TDK	CGA4J1X7R1V475K125AC Series= X7R	Cap= 4.7 uF ESR= 2.346 mOhm VDC= 35.0 V IRMS= 4.2602 A	1	$0.13	0805 7 mm^2
Cfb3	CUSTOM	CUSTOM Series= ?	Cap= 6.8 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cin	CUSTOM	CUSTOM Series= ?	Cap= 72.0 uF ESR= 36.0 mOhm VDC= 1.5 kV IRMS= 3.0 A	1	NA	CUSTOM 0 mm^2

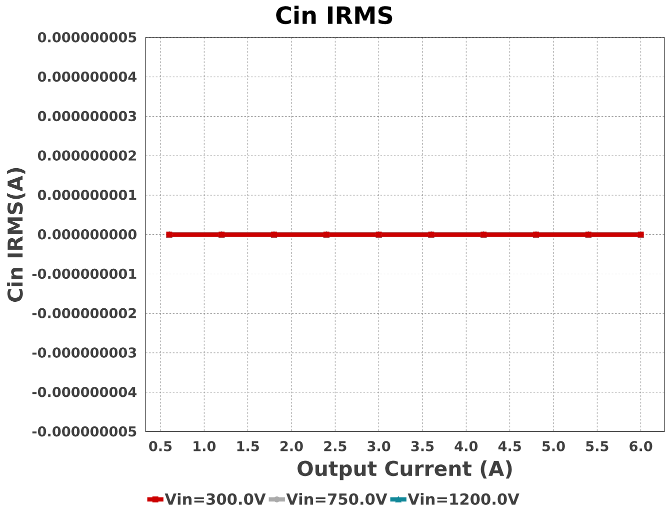
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cout	Panasonic	35SEPF120M Series= SEPF	Cap= 120.0 uF ESR= 18.0 mOhm VDC= 35.0 V IRMS= 4.4 A	4	$0.96	SEPF_F13 144 mm²
Cvdd	MuRata	GRM31CR72A105KA01L Series= X7R	Cap= 1.0 uF ESR= 5.334 mOhm VDC= 100.0 V IRMS= 1.55432 A	1	$0.11	1206_190 11 mm²
D1	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 2.715 kV	1	NA	CUSTOM 0 mm²
Dvdd	Microsemi	UFS180JE3/TR13	VF@Io= 1.2 V VRRM= 800.0 V	1	$0.95	DO-214BA 42 mm²
Dz	CUSTOM	CUSTOM	Zener	1	NA	CUSTOM 0 mm²
M1	NA	IdealFET	VdsMax= 1.516 kV IdsMax= 4.0 Amps	1	NA	KCS0003B 80 mm²
M2	Texas Instruments	CSD19531Q5A	VdsMax= 100.0 V IdsMax= 100.0 Amps	1	$0.57	TRANS_NexFET_Q5A 55 mm²
O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$1.17	SSOP-4 111 mm²
Rcs	CUSTOM	CUSTOM Series= ?	Res= 277.62 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
Rdd	Yageo	RC0603FR-0722RL Series= ?	Res= 22.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rfb3	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfb4	Vishay-Dale	CRCW04024K02FKED Series= CRCW..e3	Res= 4.02 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW040238K3FKED Series= CRCW..e3	Res= 38.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Yageo	RC0603FR-07330KL Series= ?	Res= 330.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rlc	Vishay-Dale	CRCW0402825RFKED Series= CRCW..e3	Res= 825.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Ropt	Vishay-Dale	CRCW0402681RFKED Series= CRCW..e3	Res= 681.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpl	Yageo	RC0201FR-07205KL Series= ?	Res= 205.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rs1	Yageo	RC0201FR-07133KL Series= ?	Res= 133.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rs2	Yageo	RC0201FR-0723K7L Series= ?	Res= 23.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rt1	CUSTOM	CUSTOM Series= ?	Res= 158.4 MOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²

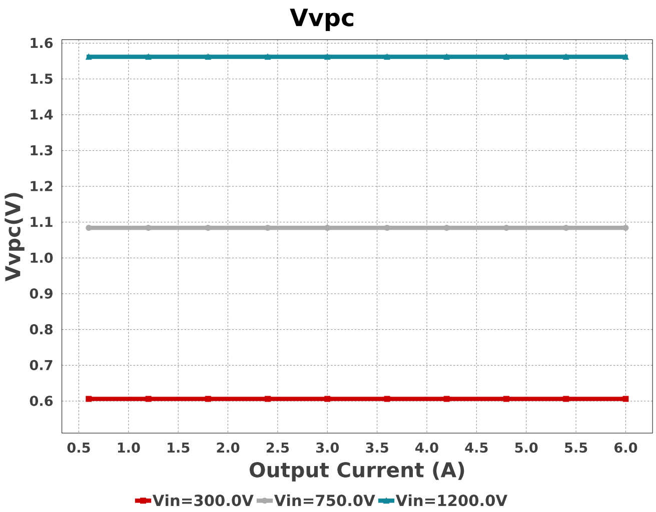
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rt2	CUSTOM	CUSTOM Series= ?	Res= 158.4 MOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rt3	CUSTOM	CUSTOM Series= ?	Res= 158.4 MOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2
Rtblk	Vishay-Dale	CRCW040219K1FKED Series= CRCW..e3	Res= 19.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rtl	Vishay-Dale	CRCW0402750RFKED Series= CRCW..e3	Res= 750.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvdd	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvpc1	Yageo	RC0201FR-7D866KL Series= ?	Res= 866.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rvpc2	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rvsc1	Vishay-Dale	CRCW0402768KFKED Series= CRCW..e3	Res= 768.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rvsc2	Vishay-Dale	CRCW020144K2FNED Series= ?	Res= 44.2 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
T1	Core=Wurth Elektronik , CoilFormer=Wurth Elektronik	Core=150-2449 , CoilFormer=070-5050	Lp= 635.0 µH Turns Ratio(Nas)= 4:4 Turns Ratio(Nps)= 43:4 Npri= 43.0 Naux= 4.0 Nsec= 4.0	1	NA	PQ3220 1478 mm^2
U1	Texas Instruments	UCC28742DBVR	Switcher	1	$0.24	R-PDSO-G6 10 mm^2
U2	Texas Instruments	UCC24636DBVR	Switcher	1	$0.39	DBV0005A 15 mm^2
VR	Texas Instruments	TL431IDBVR	Voltage References	1	$0.05	R-PDSO-G3 16 mm^2

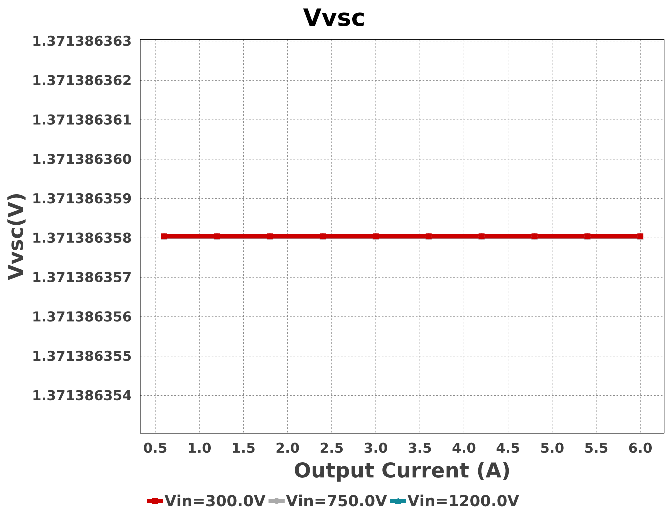


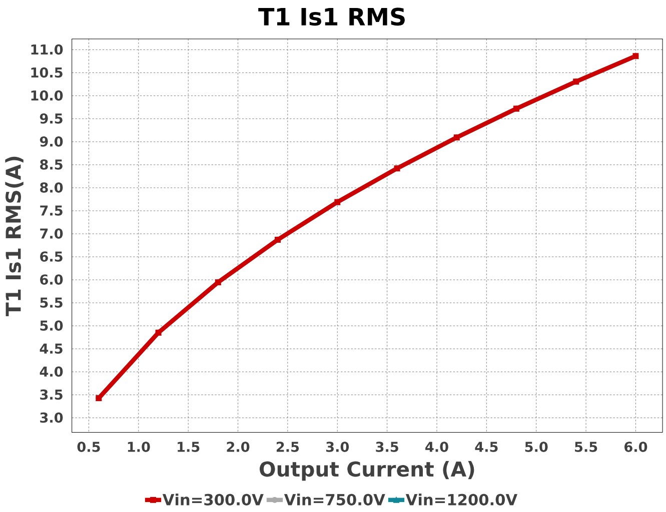


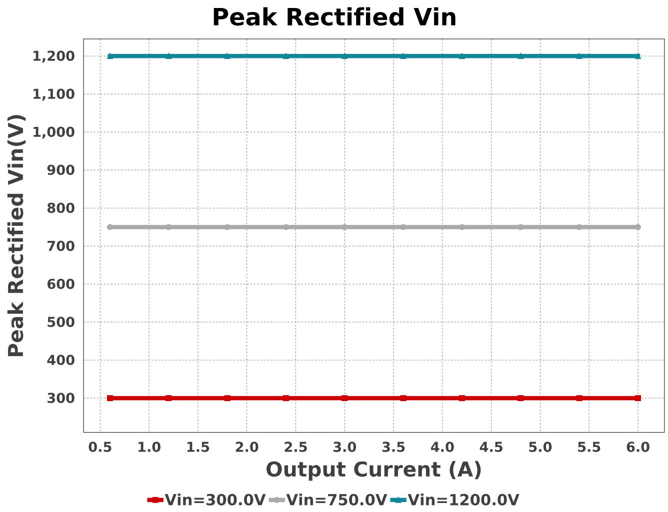

T1 Iprim pk
T1 Iprim pk(A)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

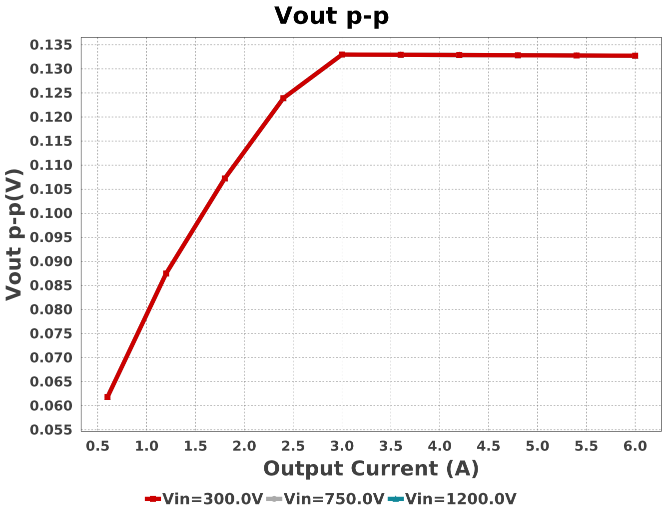

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

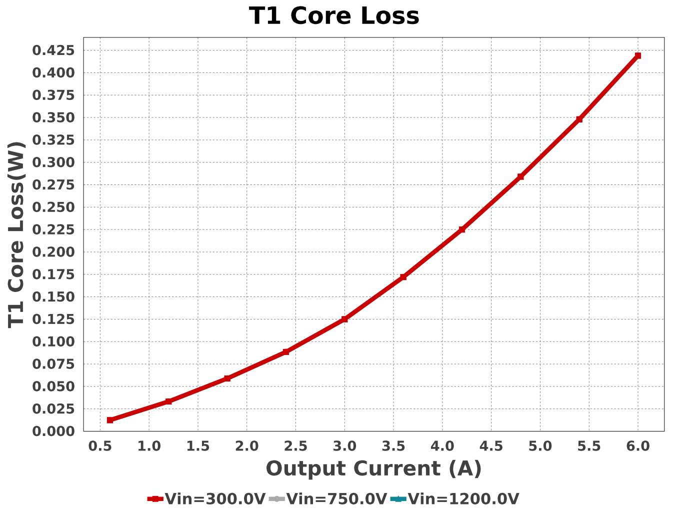

Vvpc
Vvpc(V)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

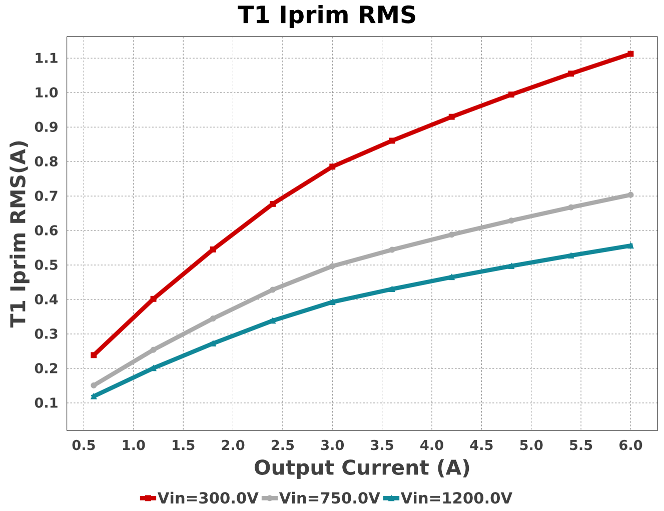

Vvsc
Vvsc(V)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

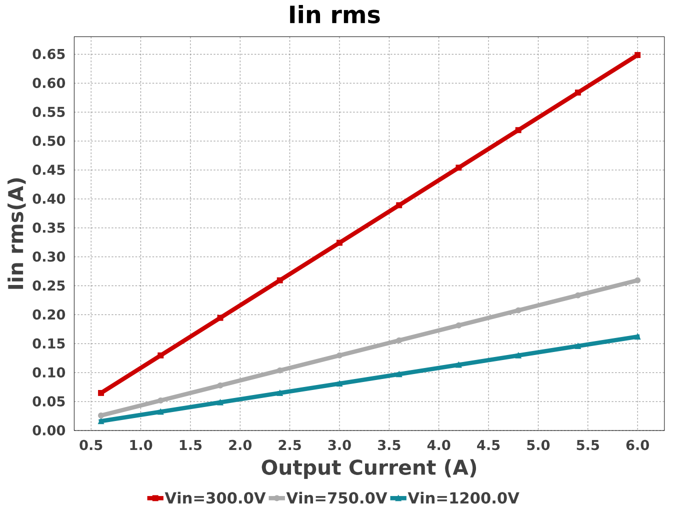

T1 Is1 RMS
T1 Is1 RMS(A)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

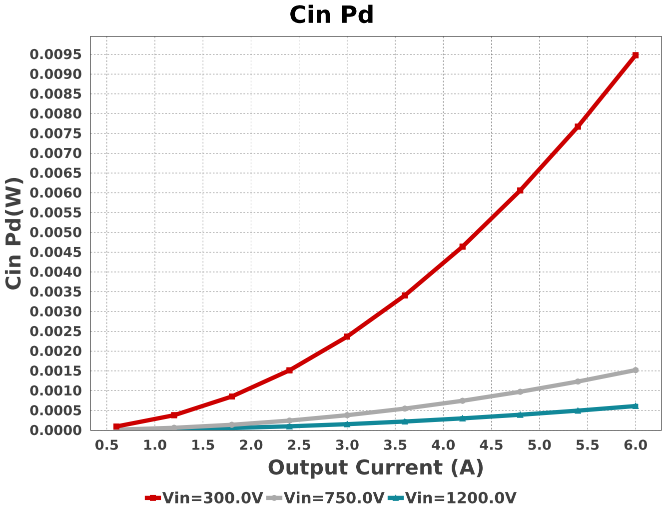

Peak Rectified Vin
Peak Rectified Vin(V)
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

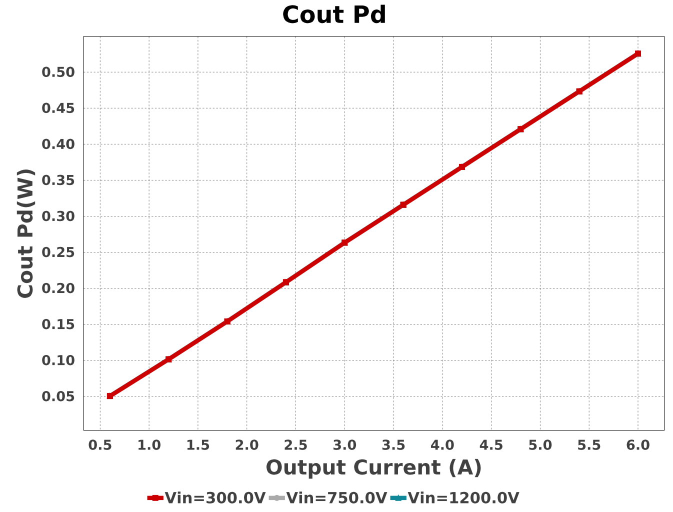

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

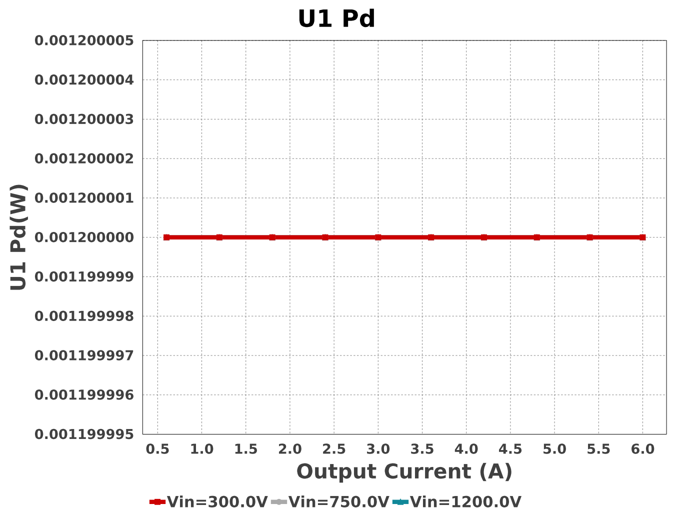

T1 Core Loss
T1 Core Loss(W)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

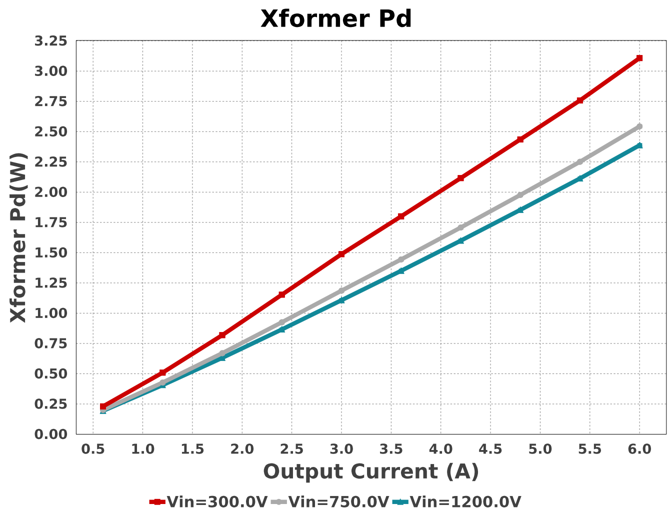

T1 Iprim RMS
T1 Iprim RMS(A)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

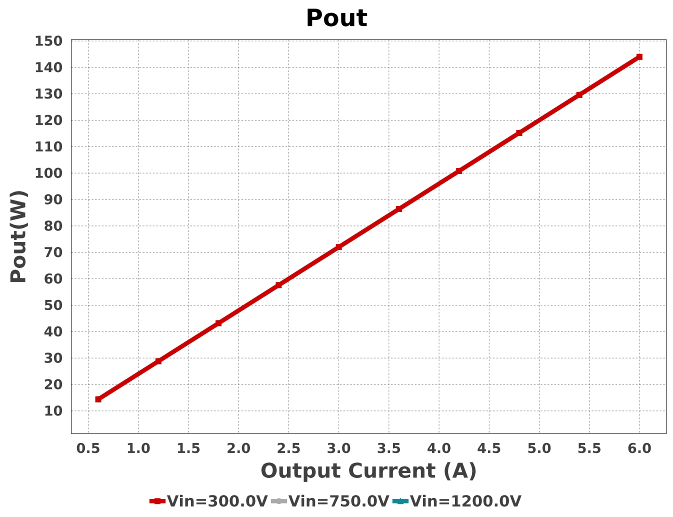

Iin rms
Iin rms(A)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

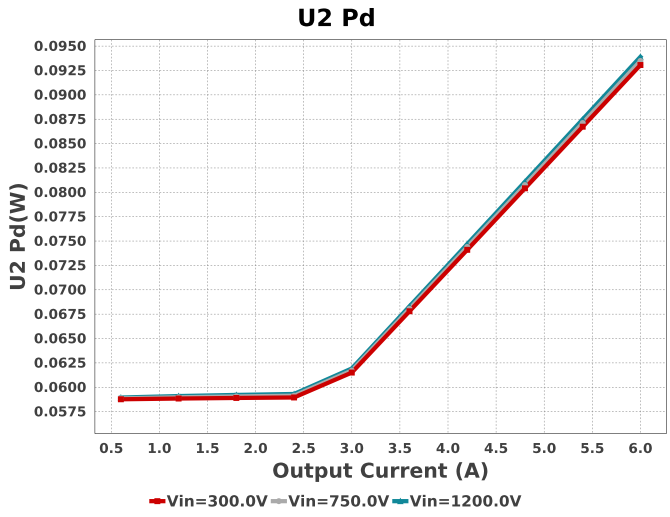

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

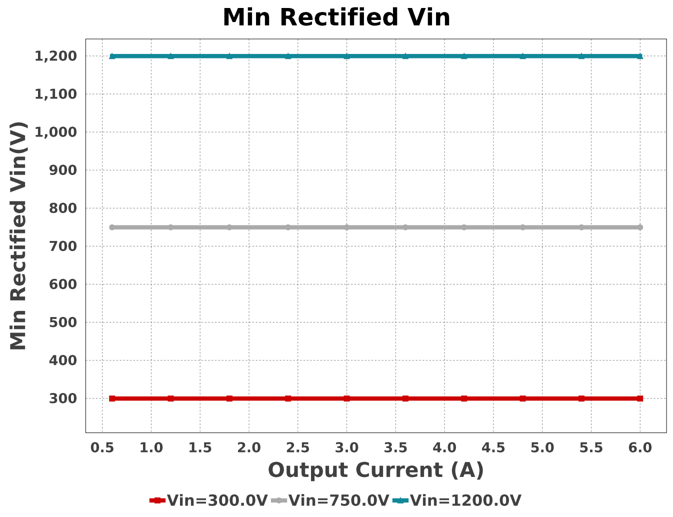

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=300.0V
Vin=750.0V
Vin=1200.0V

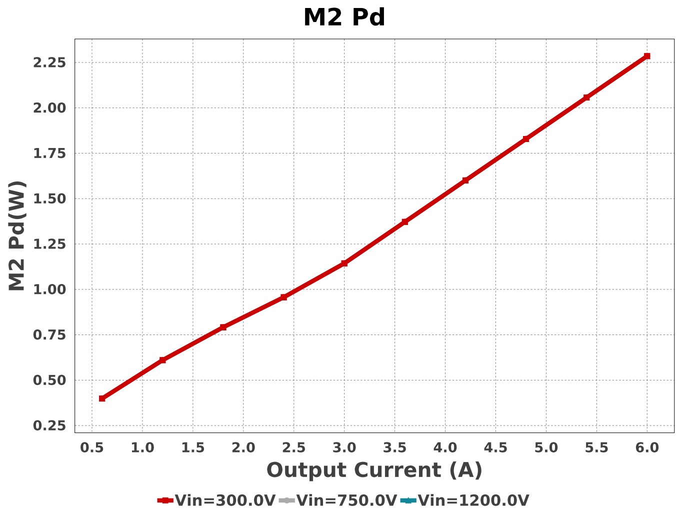

U1 Pd
U1 Pd(W)
0.001200005
0.001200004
0.001200003
0.001200002
0.001200001
0.001200000
0.001199999
0.001199998
0.001199997
0.001199996
0.001199995
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

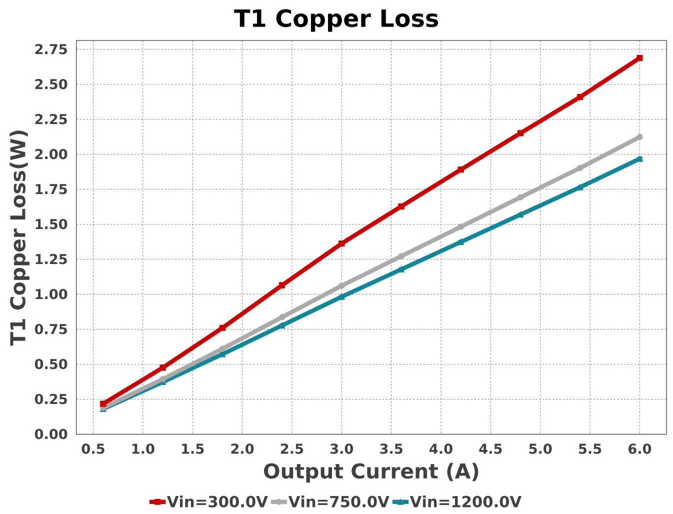

Xformer Pd
Xformer Pd(W)
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

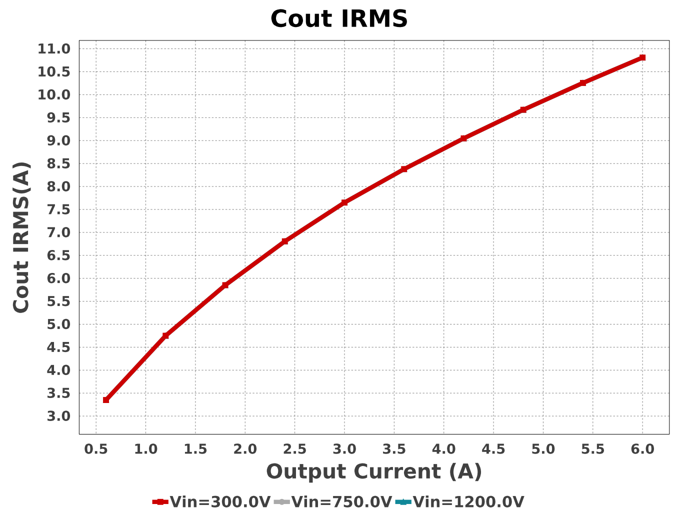

Pout
Pout(W)
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

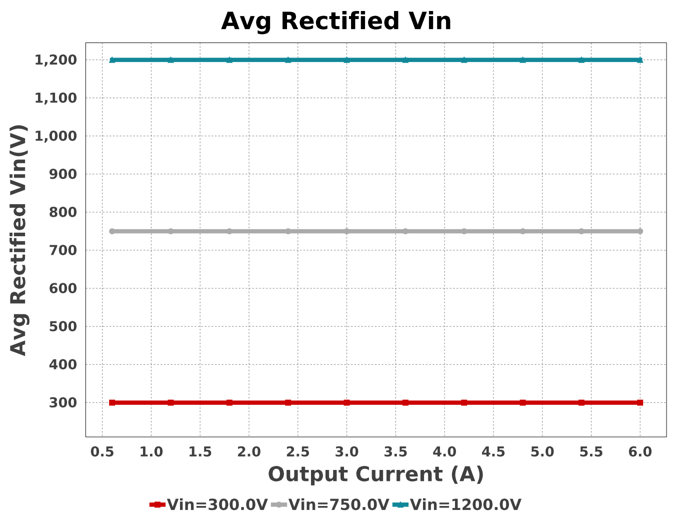

U2 Pd
U2 Pd(W)
0.0950
0.0925
0.0900
0.0875
0.0850
0.0825
0.0800
0.0775
0.0750
0.0725
0.0700
0.0675
0.0650
0.0625
0.0600
0.0575
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V

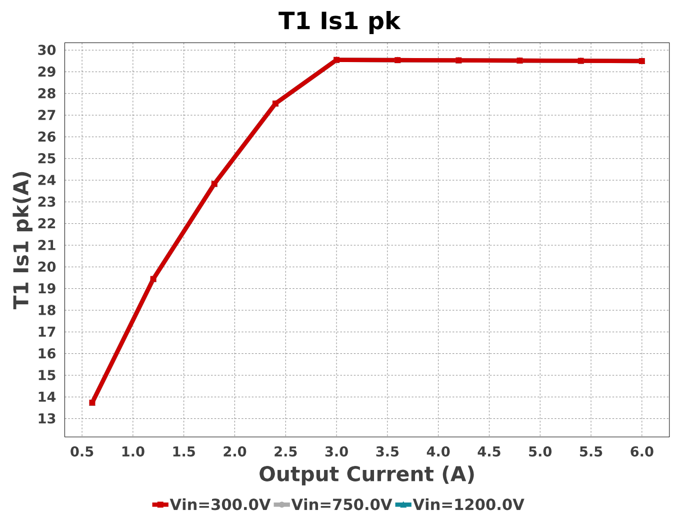

Min Rectified Vin
Min Rectified Vin(V)
1,200
1,100
1,000
900
800
700
600
500
400
300
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V


M2 Pd
M2 Pd(W)
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Output Current (A)
Vin=300.0V Vin=750.0V Vin=1200.0V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	3.0 A	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	9.526 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	10.808 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	525.7 mW	Capacitor	Output capacitor power dissipation
5.	ICThetaJA	150.0 degC/W	IC	IC junction-to-ambient thermal resistance
6.	M2 Pd	2.285 W	Mosfet	M2 MOSFET total power dissipation
7.	Cin Pd	9.526 mW	Power	Input capacitor power dissipation
8.	Cout Pd	525.7 mW	Power	Output capacitor power dissipation
9.	M2 Pd	2.285 W	Power	M2 MOSFET total power dissipation
10.	Snubber Pd	3.546 W	Power	Snubber Power Dissipation
11.	T1 Copper Loss	3.155 W	Power	Transformer Copper Loss Power Dissipation
12.	T1 Core Loss	348.0 mW	Power	Transformer Core Loss Power Dissipation
13.	U1 Pd	1.2 mW	Power	U1 Power Dissipation
14.	U2 Pd	93.06 mW	Power	Synchronous Rectifier Circuit Power Dissipation
15.	Xformer Pd	3.503 W	Power	Transformer power dissipation
16.	Avg Rectified Vin	299.8 V	System Information	Average Rectified Voltage for the AC Line Period
17.	BOM Count	40	System Information	Total Design BOM count
18.	Duty Cycle	46.436 %	System Information	Duty cycle
19.	FootPrint	2.617 k mm^2	System Information	Total Foot Print Area of BOM components
20.	Frequency	69.852 kHz	System Information	Switching frequency
21.	Frequency	69.852 kHz	System Information	Switching frequency
22.	Iin rms	648.649 mA	System Information	RMS Input Current
23.	Iout	6.0 A	System Information	Iout operating point

#	Name	Value	Category	Description
24.	Min Rectified Vin	299.6 V	System Information	Minimum voltage seen at rectified input
25.	Mode	DCM	System Information	Conduction Mode
26.	Peak Rectified Vin	300.0 V	System Information	Peak voltage seen at rectified input
27.	Pout	144.0 W	System Information	Total output power
28.	Total BOM	NA	System Information	Total BOM Cost
29.	Vin_RMS	300.0 V	System Information	Vin operating point
30.	Vout	24.0 V	System Information	Operational Output Voltage
31.	Vout Actual	24.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
32.	Vout Tolerance	2.14 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
33.	Vout p-p	132.737 mV	System Information	Peak-to-peak output ripple voltage
34.	T1 Copper Loss	3.155 W	Transformer	Transformer Copper Loss Power Dissipation
35.	T1 Core Loss	348.0 mW	Transformer	Transformer Core Loss Power Dissipation
36.	T1 Iprim RMS	1.112 A	Transformer	Transformer Primary RMS Current
37.	T1 Iprim pk	2.828 A	Transformer	Transformer Primary Peak Current
38.	T1 Is1 RMS	10.863 A	Transformer	Transformer Secondary1 RMS Current
39.	T1 Is1 pk	29.497 A	Transformer	Transformer Secondary1 Peak Current
40.	Vvpc	606.244 mV	Transformer	Voltage during Primary Conduction for SR circuit
41.	Vvsc	1.371 V	Transformer	Voltage during Secondary Conduction for SR circuit
42.	Xformer Pd	3.503 W	Transformer	Transformer power dissipation

Design Inputs

Name	Value	Description
Iout	6.0	Maximum Output Current
VinMax	1.2 k	Maximum input voltage
VinMin	300.0	Minimum input voltage
Vout	24.0	Output Voltage
base_pn	UCC28742	Base Product Number
source	DC	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

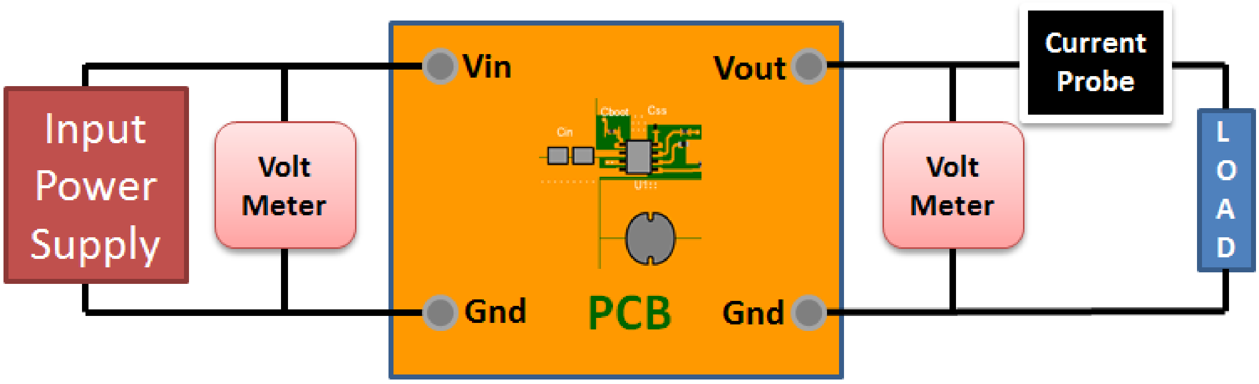
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 300.0V 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	43.0
AWG	28.0
Layers	2.0
Strands	1.0
Insulation Type	Heavy Insulated Magnet Wire

Secondary

Turns	4.0
AWG	27.0
Layers	1.0
Strands	3.0
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 1/2.0	28.0	22	Clockwise
Auxiliary	28.0	4.0	Counter Clockwise
Triple Insulated Secondary	27.0	4.0	Counter Clockwise
Primary Second 1/2.0	28.0	21	Clockwise

Transformer Parameters

#	Name	Value
1.	Lpri	6.35E-4H
2.	Inductance Factor(Al)	344.0nH
3.	Npri	43.0
4.	Nsec	4.0
5.	Naux	4.0
6.	Core Type	PQ3220
7.	Core Material	TP4A

#	Name	Value
8.	Bmax	0.25T
9.	Switching Frequency	63.00kHz
10.	DMax	0.46
11.	Ipk(Primary)	2.83A
12.	Irms(Primary)	1.11A
13.	Ipk(Secondary)	30.4A
14.	Irms(Secondary)	12.1A

Design Assistance

1. Master key : 144FDD8851F35ECA[v1]
2. **UCC28742** Product Folder : http://www.ti.com/product/UCC28742 : contains the data sheet and other resources.