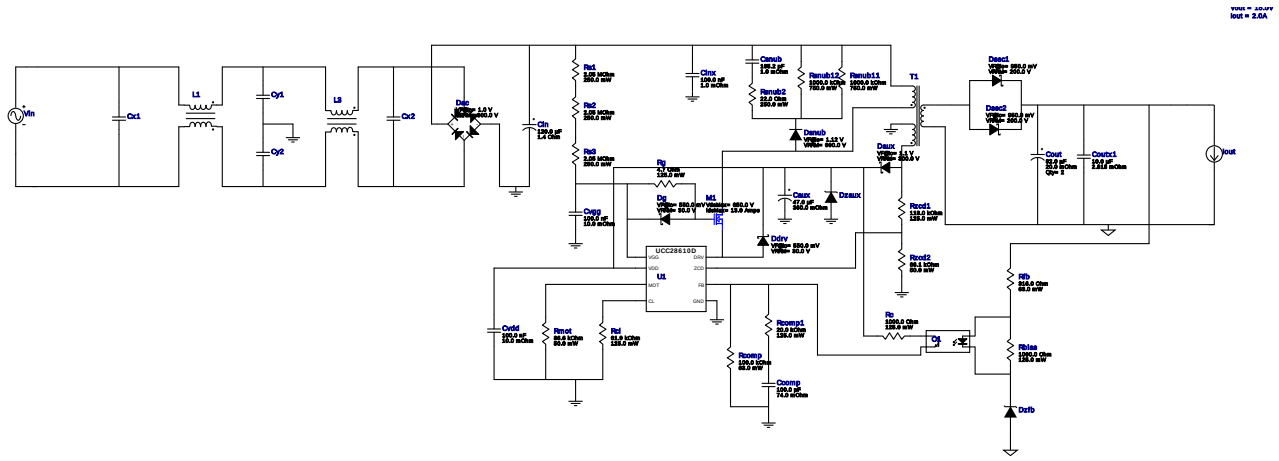
VinMin = 85.0V
VinMax = 265.0V
Vout = 15.0V
Iout = 2.0A

Device = UCC28610DR
Topology = Flyback
Created = 2019-02-21 01:35:00.752
BOM Cost = NA
BOM Count = 42
Total Pd = 5.44W

WEBENCH® Design Report

Design : 12 UCC28610DR
UCC28610DR 85V-265V to 15.00V @ 2A

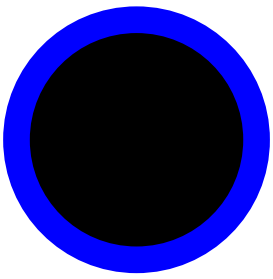
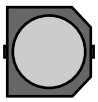


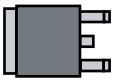
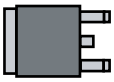
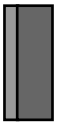
1. The EMI filter shown in the schematic is a placeholder. It has not yet been designed for the application.

Design Alerts

Component Selection Information
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

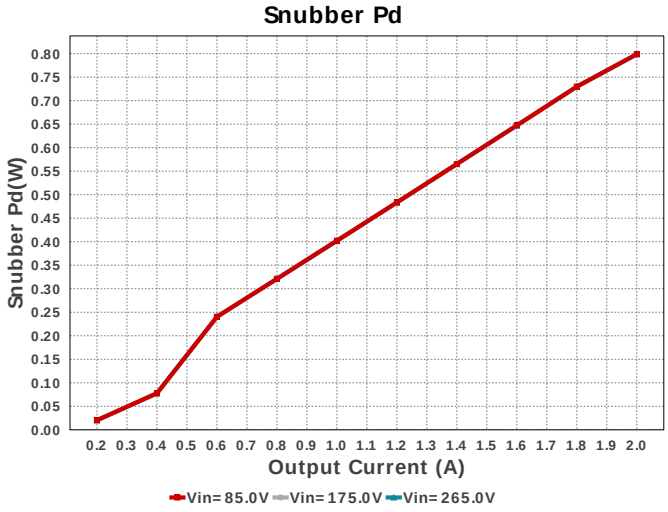
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Caux	Panasonic	EEE-FK1V470P Series= FK	Cap= 47.0 uF ESR= 360.0 mOhm VDC= 35.0 V IRMS= 240.0 mA	1	$0.11	 SM_RADIAL_D 84 mm^2
Ccomp	Kemet	C0805C101J5GACTU Series= C0G/NP0	Cap= 100.0 pF ESR= 74.0 mOhm VDC= 50.0 V IRMS= 524.0 mA	1	$0.01	 0805 7 mm^2
Cin	Vishay-Bccomponents	MAL215749121E3 Series= 2239	Cap= 120.0 uF ESR= 1.4 Ohm VDC= 500.0 V IRMS= 1.23 A	1	$5.29	 157PUM-SI_2500x3500 729 mm^2
Cinx	Kemet	C1210X104KCRACTU Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 500.0 V IRMS= 0.0 A	1	$0.17	 1210_250 15 mm^2
Cout	Panasonic	35SVPF82M Series= SVPF	Cap= 82.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 4.0 A	2	$0.63	 CAPSMT_62_E12 106 mm^2

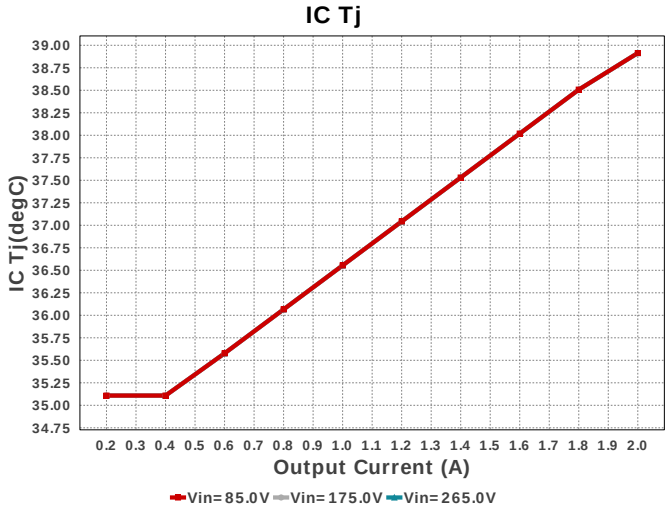
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Coutx1	TDK	C2012X5R1V106K085AC Series= X5R	Cap= 10.0 uF ESR= 2.818 mOhm VDC= 35.0 V IRMS= 3.8868 A	1	$0.19	 0805 7 mm²
Csnub	CUSTOM	CUSTOM Series= ?	Cap= 165.2 pF ESR= 1.0 mOhm VDC= 100.827 V IRMS= 1.0 A	1	NA	CUSTOM 0 mm²
Cvdd	MuRata	GRM319R71H104KA01D Series= X7R	Cap= 100.0 nF ESR= 10.0 mOhm VDC= 50.0 V IRMS= 900.0 mA	1	$0.04	 1206 11 mm²
Cvgg	MuRata	GRM319R71H104KA01D Series= X7R	Cap= 100.0 nF ESR= 10.0 mOhm VDC= 50.0 V IRMS= 900.0 mA	1	$0.04	 1206 11 mm²
Dac	Vishay-Semiconductor	GBU4K-E3/45	VF@Io= 1.0 V VRRM= 800.0 V	1	$0.73	 GBU 131 mm²
Daux	SMC Diode Solutions	ST1300ATR	VF@Io= 1.1 V VRRM= 300.0 V	1	$0.07	 SMA 37 mm²
Ddrv	Panasonic	DB2S31600L	VF@Io= 550.0 mV VRRM= 30.0 V	1	$0.04	 SOD-523 5 mm²
Dg	Panasonic	DB2S31600L	VF@Io= 550.0 mV VRRM= 30.0 V	1	$0.04	 SOD-523 5 mm²
Dsec1	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.12	 DPAK 102 mm²
Dsec2	SMC Diode Solutions	SBRD10200TR	VF@Io= 950.0 mV VRRM= 200.0 V	1	$0.12	 DPAK 102 mm²
Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	$0.23	 SMC 83 mm²
Dzaux	Nexperia	BZX585-C22,115	Zener	1	$0.02	 SOD-523 5 mm²
Dzfb	ON Semiconductor	MMBZ5243BLT1G	Zener	1	$0.03	 SOT-23 14 mm²
Dzfb	ON Semiconductor	MMBZ5243BLT1G	Zener	1	$0.03	 SOT-23 14 mm²
M1	Infineon Technologies	IPP65R190C7	VdsMax= 650.0 V IdsMax= 13.0 Amps	1	$1.57	 TO-220AB 79 mm²
O1	Fairchild Semiconductor	FOD817A	Optocoupler	1	$0.13	 DIP-4 71 mm²
Rbias	Panasonic	ERJ-6ENF1001V Series= ERJ-6E	Res= 1000.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²
Rbias	Panasonic	ERJ-6ENF1001V Series= ERJ-6E	Res= 1000.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm²

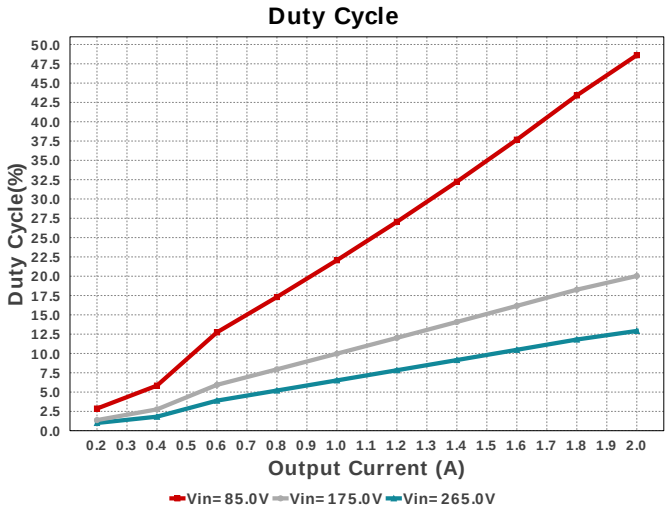
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rc	Panasonic	ERJ-6ENF1001V Series= ERJ-6E	Res= 1000.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rcl	Panasonic	ERJ-6ENF6192V Series= ERJ-6E	Res= 61.9 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rcomp	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rcomp1	Panasonic	ERJ-6ENF2002V Series= ERJ-6E	Res= 20.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rfb	Vishay-Dale	CRCW0402316RFKED Series= CRCW..e3	Res= 316.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfb	Vishay-Dale	CRCW0402316RFKED Series= CRCW..e3	Res= 316.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rg	Yageo	RC0805FR-074R7L Series= ?	Res= 4.7 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rmot	Yageo	RC0201FR-0786K6L Series= ?	Res= 86.6 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rs1	Vishay-Dale	CRCW12062M05FKEA Series= CRCW..e3	Res= 2.05 MOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rs2	Vishay-Dale	CRCW12062M05FKEA Series= CRCW..e3	Res= 2.05 MOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rs3	Vishay-Dale	CRCW12062M05FKEA Series= CRCW..e3	Res= 2.05 MOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rsnub11	Vishay-Dale	CRCW20101M00FKEF Series= CRCW..e3	Res= 1000.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.04	2010 32 mm²
Rsnub12	Vishay-Dale	CRCW20101M00FKEF Series= CRCW..e3	Res= 1000.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.04	2010 32 mm²
Rsnub2	Yageo	RC1206FR-0722RL Series= ?	Res= 22.0 Ohm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
Rzcd1	Panasonic	ERJ-6ENF1183V Series= ERJ-6E	Res= 118.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
Rzcd2	Yageo	RC0201FR-0768K1L Series= ?	Res= 68.1 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
T1	Core=Wurth Elektronik , CoilFormer=Wurth Elektronik	Core=150-1945 , CoilFormer=070-5643	Lp= 232.0 µH Turns Ratio(Nas)= 15:14 Turns Ratio(Nps)= 59:14 Npri= 59.0 Naux= 15.0 Nsec= 14.0	1	NA	EE20/10/6 555 mm²

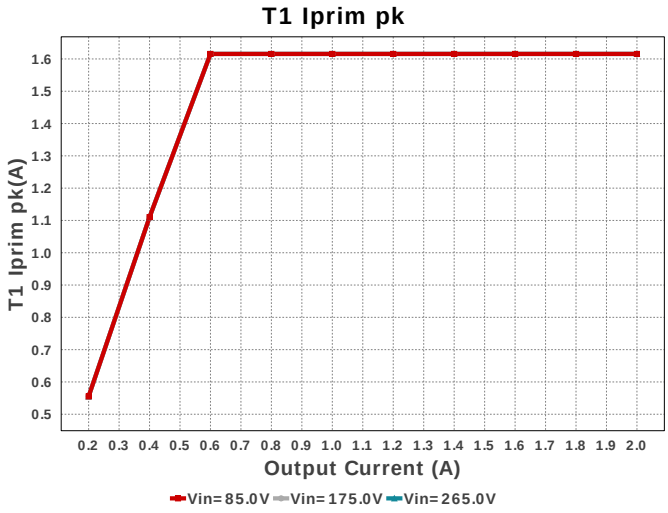
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
U1	Texas Instruments	UCC28610DR	Switcher	1	$0.46	

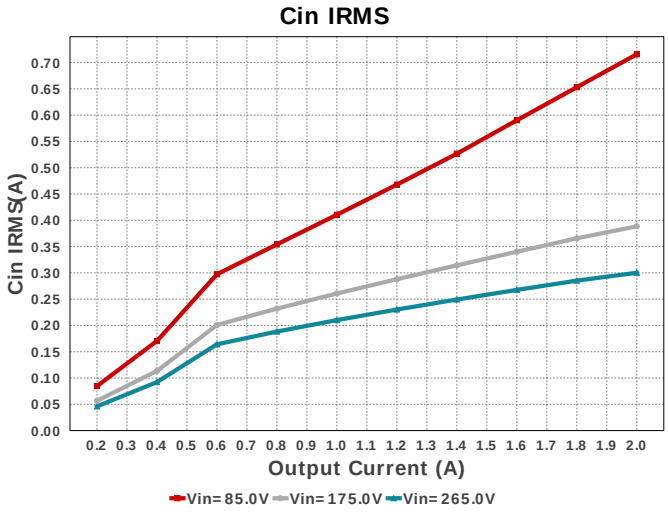
D0008A 57 mm^2

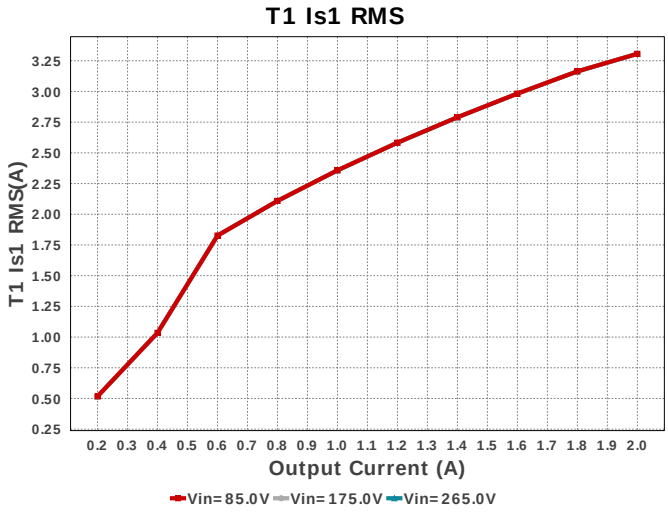




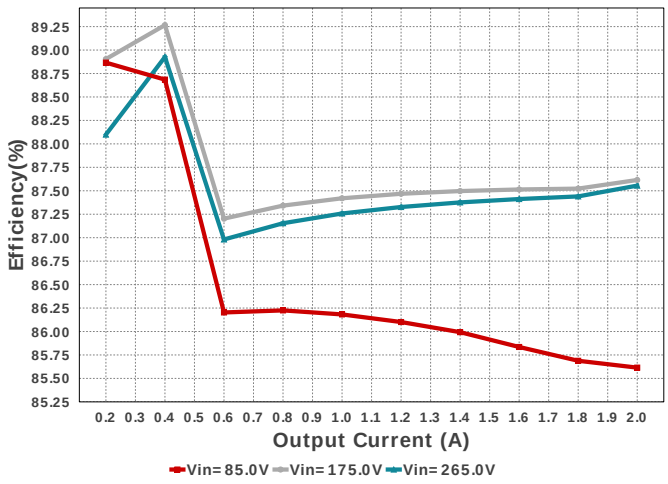




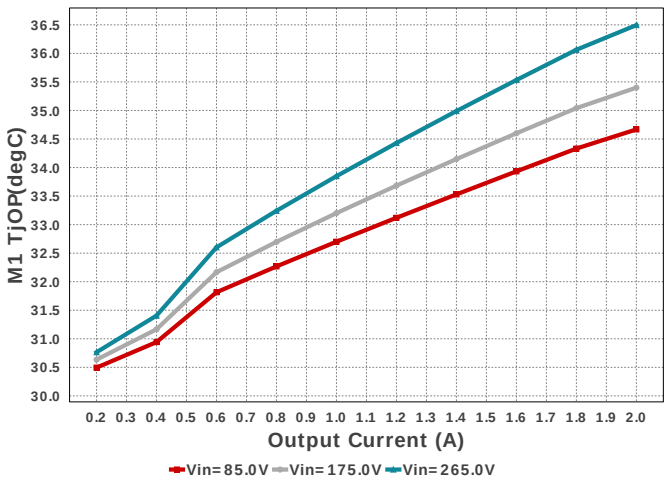




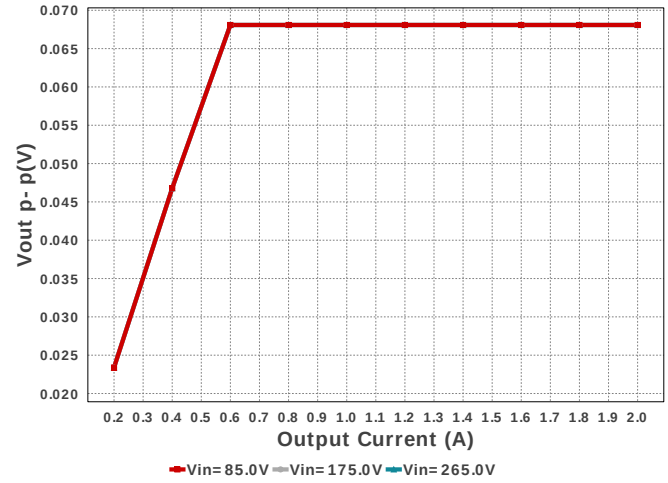
Efficiency



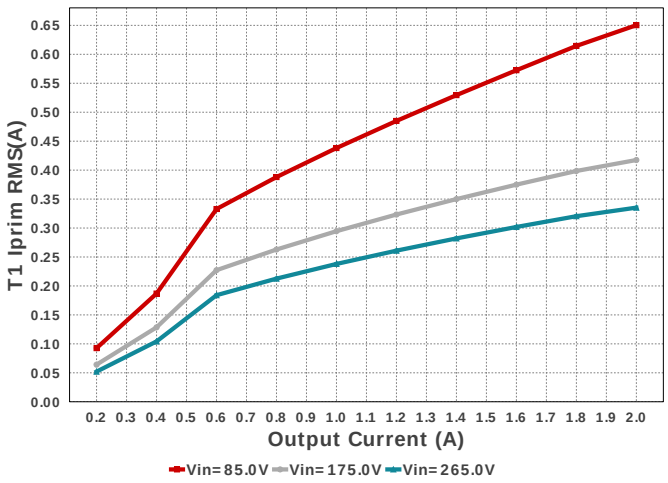
M1 TjOP



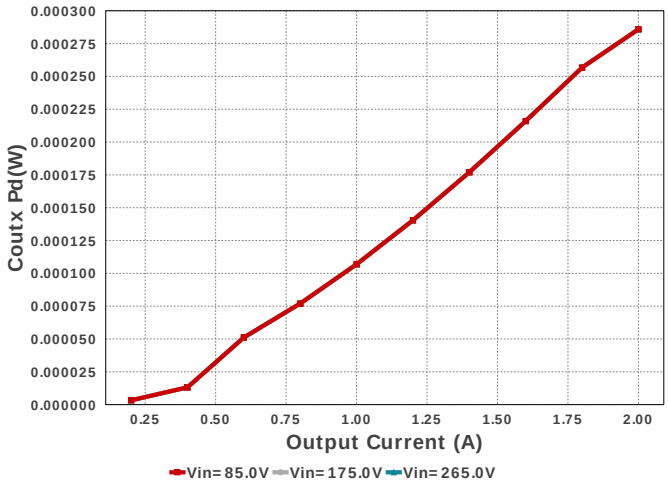
Vout p- p



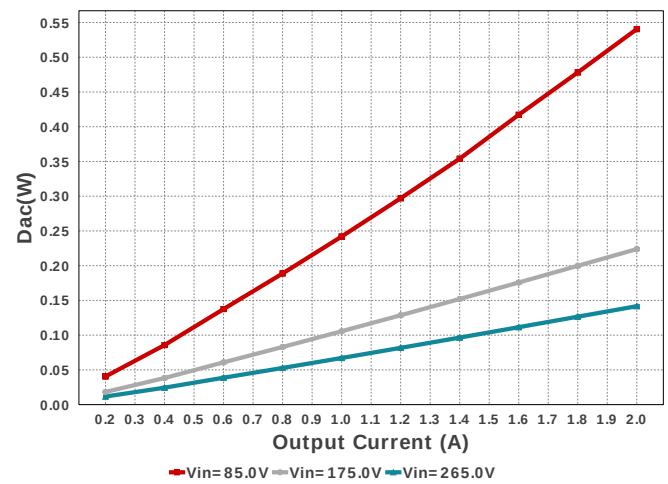
T1 Iprim RMS

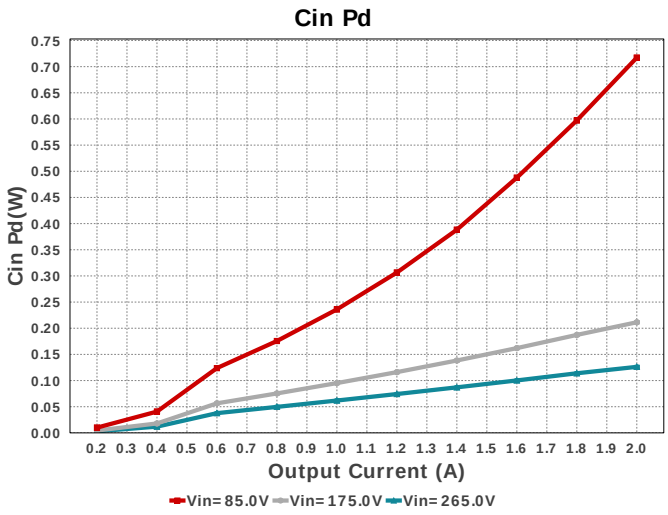


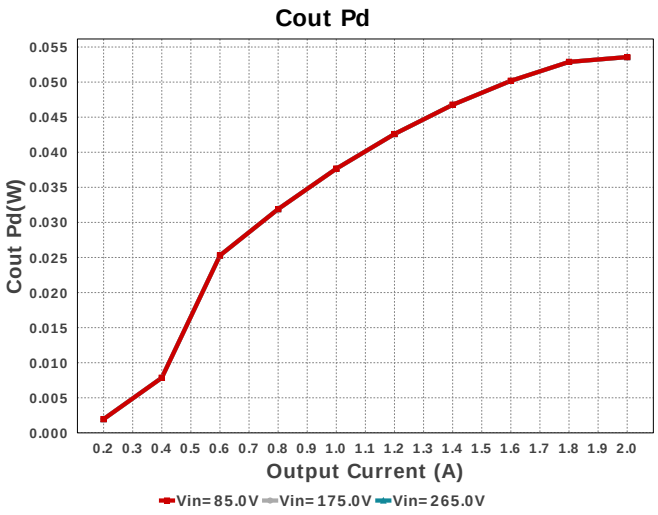
Coutx Pd

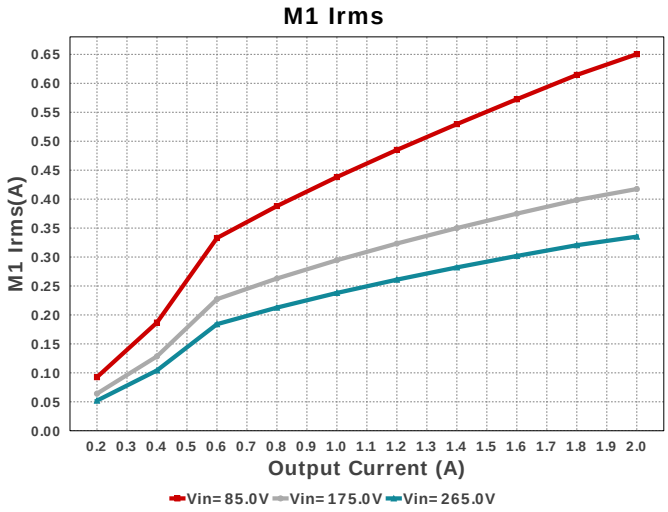


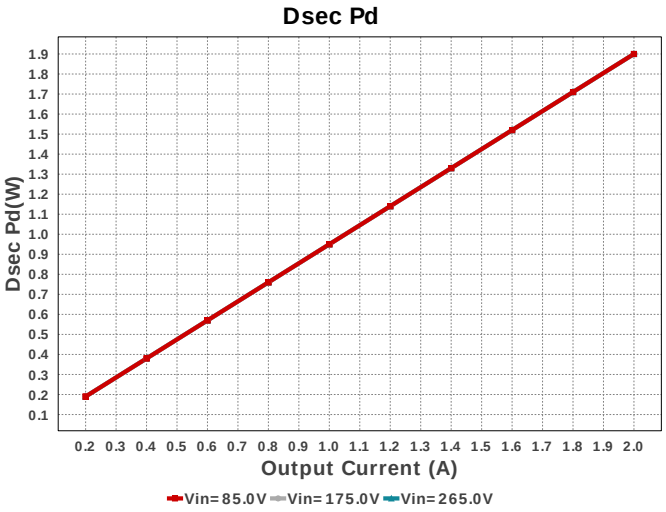
Dac

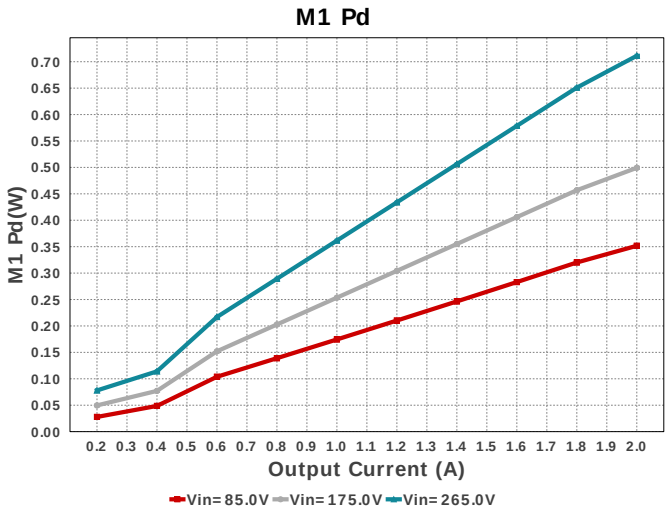


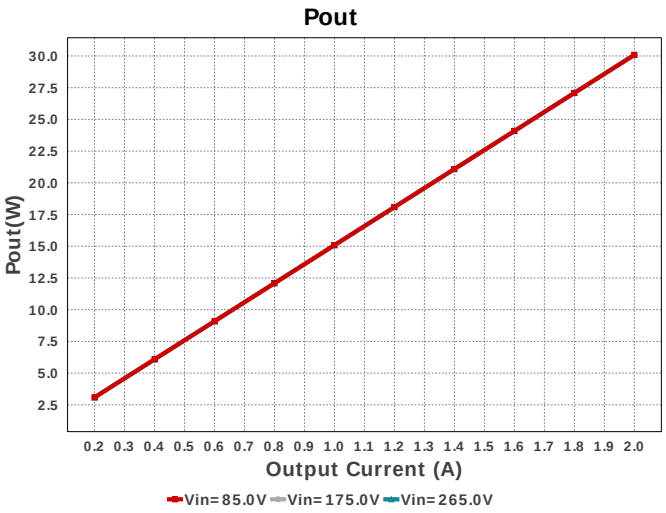


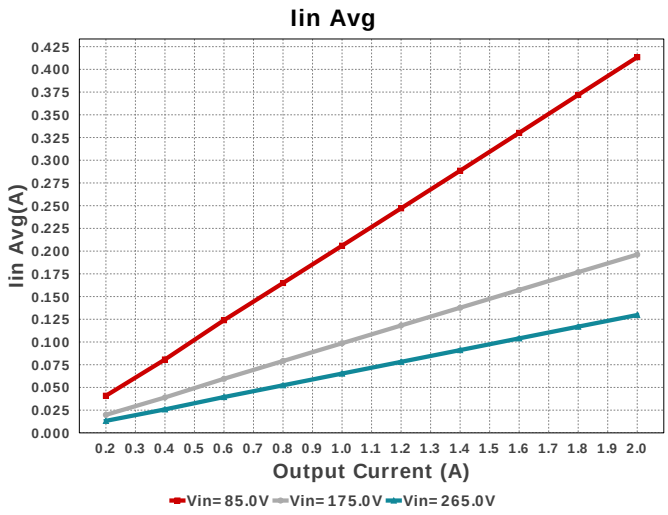


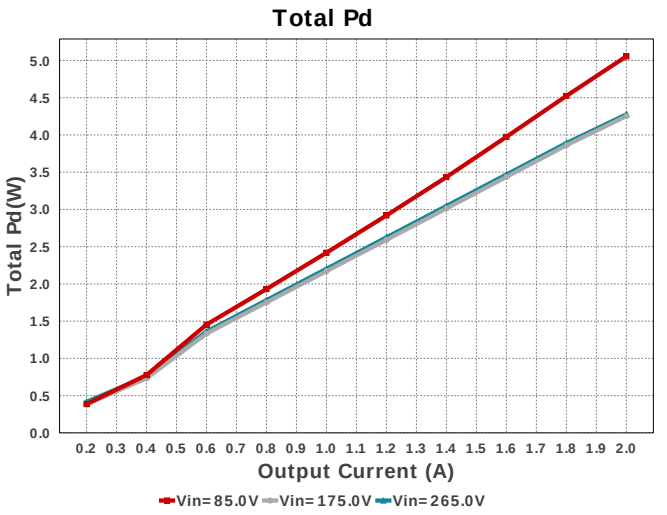


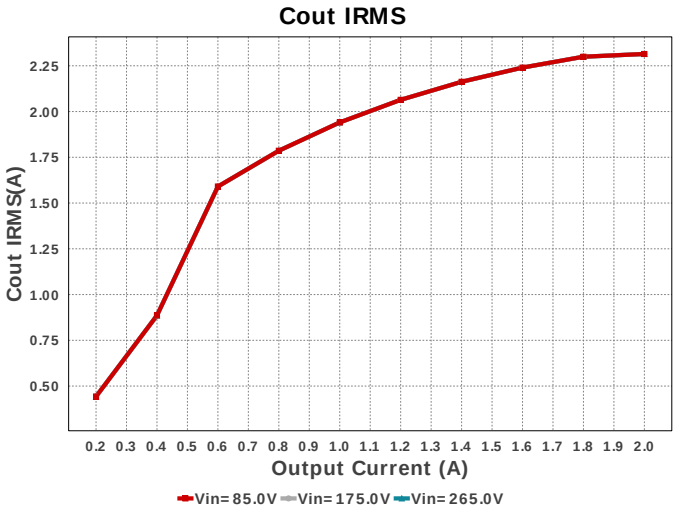


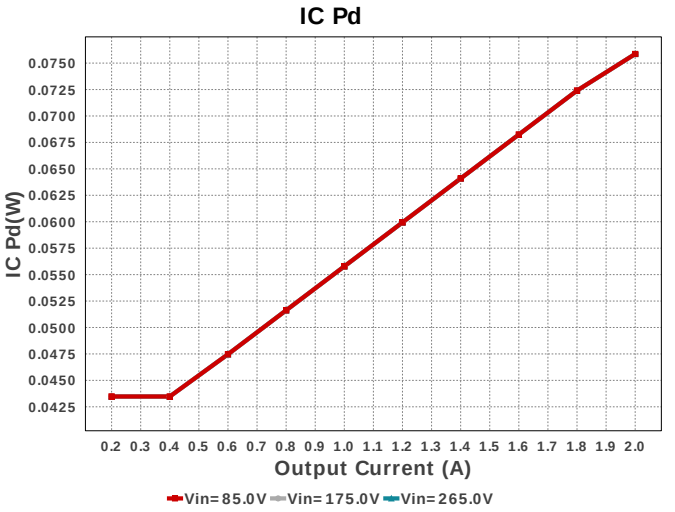


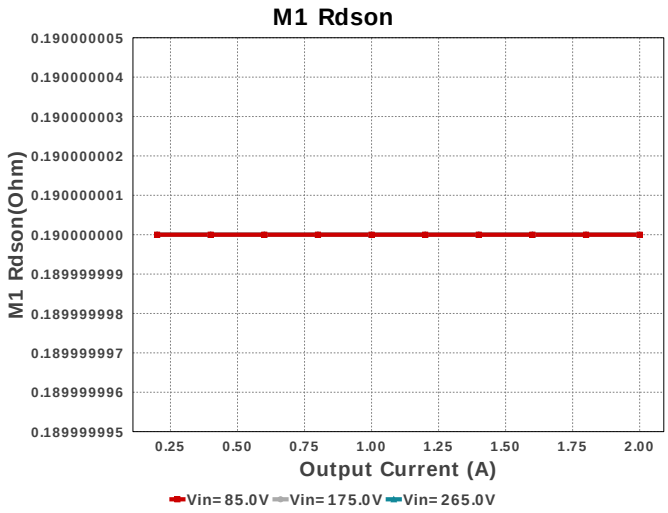


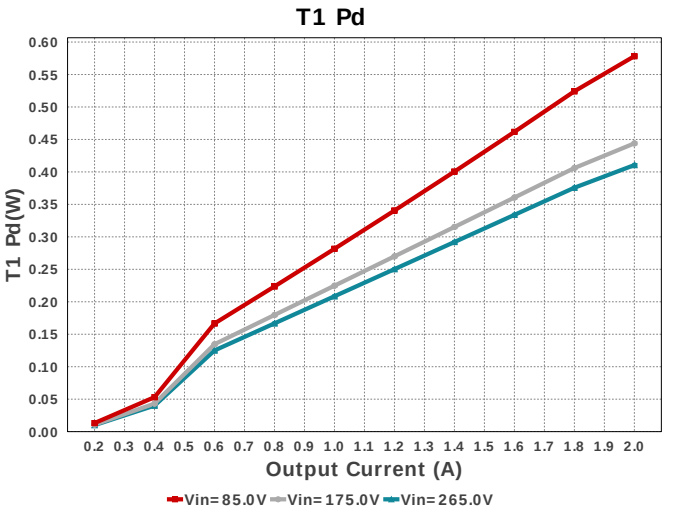


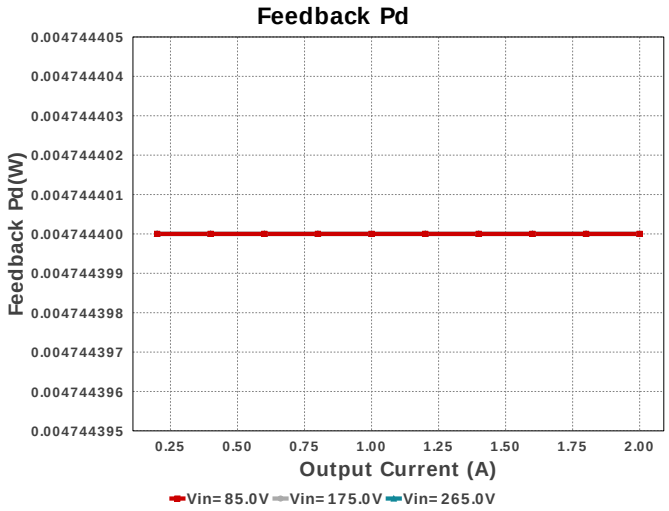












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	715.356 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	716.43 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	2.314 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	53.531 mW	Capacitor	Output capacitor power dissipation
5.	Coutx Pd	285.69 µW	Capacitor	Output capacitor_x power loss
6.	Dsec Pd	1.9 W	Diode	Secondary Diode Power Dissipation
7.	IC Pd	75.862 mW	IC	IC power dissipation
8.	IC Tj	38.914 degC	IC	IC junction temperature
9.	ICThetaJA	117.5 degC/W	IC	IC junction-to-ambient thermal resistance
10.	Iin Avg	417.75 mA	IC	Average input current
11.	M1 Irms	650.182 mA	Mosfet	Q Iavg
12.	M1 Pd	351.64 mW	Mosfet	MOSFET power dissipation
13.	M1 Rdson	190.0 mOhm	Mosfet	Drain-Source On-resistance
14.	M1 TjOP	53.385 degC	Mosfet	M1 MOSFET junction temperature
15.	Cin Pd	716.43 mW	Power	Input capacitor power dissipation
16.	Cout Pd	53.531 mW	Power	Output capacitor power dissipation
17.	Coutx Pd	285.69 µW	Power	Output capacitor_x power loss
18.	Avg Bridge Diode Pd	540.06 mW	Power	Power Dissipation in Feedback Resistors
19.	Dsec Pd	1.9 W	Power	Secondary Diode Power Dissipation
20.	Feedback Pd	4.744 mW	Power	Power Dissipation in Feedback Resistors
21.	IC Pd	75.862 mW	Power	IC power dissipation
22.	M1 Pd	351.64 mW	Power	MOSFET power dissipation
23.	Snubber Pd	1.185 W	Power	Snubber Power Dissipation
24.	T1 Pd	577.97 mW	Power	Estimated Losses in Transformer
25.	Total Pd	5.44 W	Power	Total Power Dissipation
26.	Avg Bridge Diode Pd	540.06 mW	Resistor	Power Dissipation in Feedback Resistors
27.	Feedback Pd	4.744 mW	Resistor	Power Dissipation in Feedback Resistors
28.	BOM Count	42	System Information	Total Design BOM count
29.	Duty Cycle	48.593 %	System Information	Duty cycle
30.	Efficiency	84.679 %	System Information	Steady state efficiency
31.	FootPrint	2.508 k mm^2	System Information	Total Foot Print Area of BOM components
32.	Frequency	126.9 kHz	System Information	Switching frequency
33.	Iout	2.0 A	System Information	Iout operating point
34.	Mode	DCM	System Information	Conduction Mode
35.	Pout	30.068 W	System Information	Total output power
36.	Total BOM	NA	System Information	Total BOM Cost
37.	Vin	85.0 V	System Information	Vin operating point
38.	Vout	15.0 V	System Information	Operational Output Voltage
39.	Vout p-p	68.082 mV	System Information	Peak-to-peak output ripple voltage
40.	T1 Iprim RMS	650.182 mA	Transformer	Transformer Primary RMS Current

#	Name	Value	Category	Description
41.	T1 Iprim pk	1.616 A	Transformer	Transformer Primary Peak Current
42.	T1 Is1 RMS	3.306 A	Transformer	Transformer Secondary1 RMS Current
43.	T1 Pd	577.97 mW	Transformer	Estimated Losses in Transformer

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	265.0	Maximum input voltage
VinMin	85.0	Minimum input voltage
Vout	15.0	Output Voltage
acFrequency	50.0	AC Frequency
base_pn	UCC28610	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

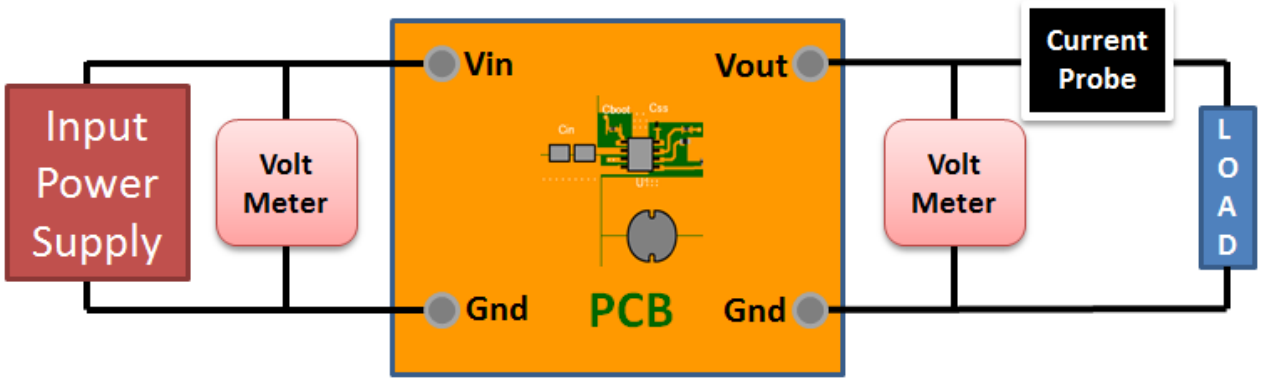
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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	150-1945
2.	Core Manufacturer	Wurth Elektronik
3.	Coil Former Part Number	070-5643
4.	Coil Former Manufacturer	Wurth Elektronik

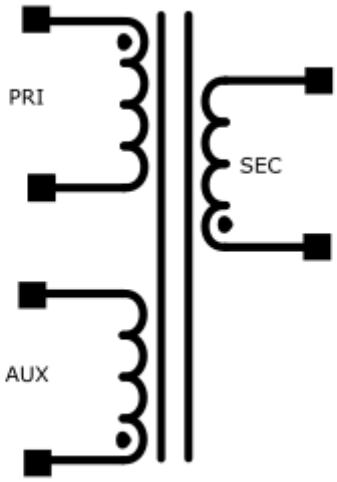
Transformer Electrical Diagram

Primary

Turns	59.0
AWG	36.0
Layers	2.0
Strands	2.0
Insulation Type	Heavy Insulated Magnet Wire

Auxiliary

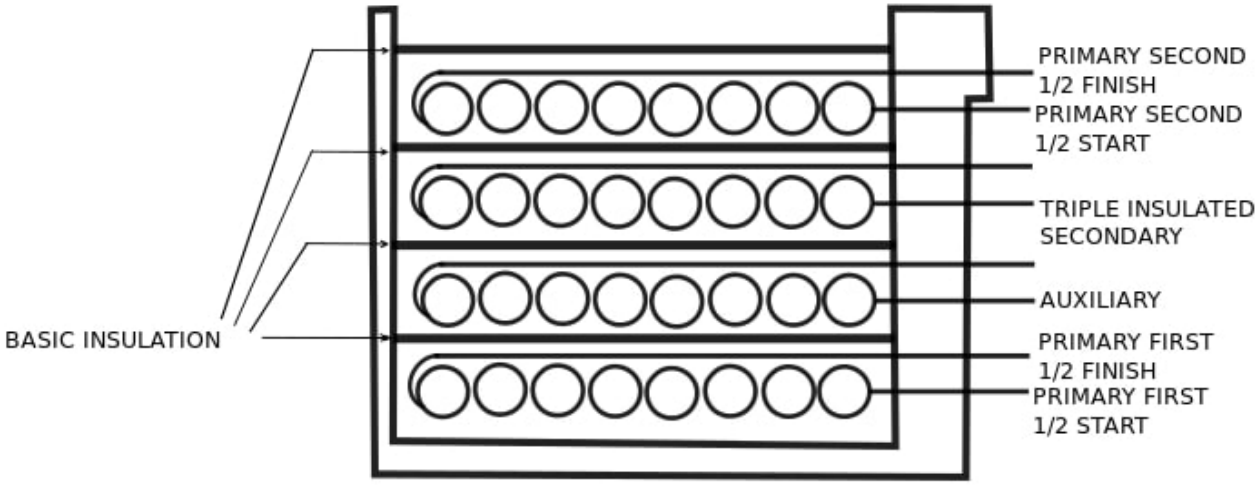
Turns	15.0
AWG	28.0
Layers	1.0
Strands	1.0
Insulation Type	Heavy Insulated Magnet Wire



Secondary

Turns	14.0
AWG	26.0
Layers	1.0
Strands	1.0
Insulation Type	Triple Insulated

Transformer Construction Diagram



Winding Instruction

Winding	AWG	Turns	Winding Orientation
Primary First 1/2.0	36.0	30	Clockwise

Winding	AWG	Turns	Winding Orientation
Auxiliary	28.0	15.0	Counter Clockwise
Triple Insulated Secondary	26.0	14.0	Counter Clockwise
Primary Second 1/2.0	36.0	29	Clockwise

Transformer Parameters

#	Name	Value
1.	Lpri	2.32E-4H
2.	Inductance Factor(Al)	67.0nH
3.	Npri	59.0
4.	Nsec	14.0
5.	Naux	15.0
6.	Core Type	EE20/10/6
7.	Core Material	TP4A
8.	Bmax	0.20T
9.	Switching Frequency	77.30kHz
10.	DMax	0.39
11.	Ipk(Primary)	1.62A
12.	Irms(Primary)	0.5A
13.	Ipk(Secondary)	6.81A
14.	Irms(Secondary)	3.07A

Design Assistance

1. Isolated feedback, AC-DC Flyback controller with wide Vin range
2. Master key : 799E36AE94D7ADB1[v1]
3. **UCC28610** Product Folder : http://www.ti.com/product/UCC28610 : contains the data sheet and other resources.