ACDC_TinySwitch-III_032514; Rev.1.27; Copyright Power Integrations 2014	INPUT	INFO	OUTPUT	UNIT	ACDC_TinySwitch-III_032514_Rev1-27.xls; TinySwitch-III Continuous/Discontinuous Flyback Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					Customer
VACMIN	85			Volts	Minimum AC Input Voltage
VACMAX	265			Volts	Maximum AC Input Voltage
fL	50			Hertz	AC Mains Frequency
VO	12.00			Volts	Output Voltage (at continuous power)
IO	0.80			Amps	Power Supply Output Current (corresponding to peak power)
Power			9.6	Watts	Continuous Output Power
n	0.80				Efficiency Estimate at output terminals. Under 0.7 if no better data available
Z	0.50				Z Factor. Ratio of secondary side losses to the total losses in the power supply. Use 0.5 if no better data available
tC	3.00			mSeconds	Bridge Rectifier Conduction Time Estimate
CIN	33.00		33.00	uFarads	Input Capacitance
ENTER TinySwitch-III VARIABLES					
TinySwitch-III	Auto		TNY276P		Recommended TinySwitch-III
Chosen Device		TNY276P			
Chose Configuration	STD		Standard Current Limit		Enter "RED" for reduced current limit (sealed adapters), "STD" for standard current limit or "INC" for increased current limit (peak or higher power applications)
ILIMITMIN			0.326	Amps	Minimum Current Limit
ILIMITTYP			0.350	Amps	Typical Current Limit
ILIMITMAX			0.374	Amps	Maximum Current Limit
fSmin			124000	Hertz	Minimum Device Switching Frequency
I^2fmin			14.553	A^2kHz	I^2f (product of current limit squared and frequency is trimmed for tighter tolerance)
VOR			120.00	Volts	Reflected Output Voltage (VOR < 135 V Recommended)
VDS			10.00	Volts	TinySwitch-III on-state Drain to Source Voltage
VD			0.70	Volts	Output Winding Diode Forward Voltage Drop
KP			0.69		Ripple to Peak Current Ratio (KP < 6)
KP_TRANSIENT			0.41		Transient Ripple to Peak Current Ratio. Ensure KP_TRANSIENT > 0.25
ENTER BIAS WINDING VARIABLES					
VB			22.00	Volts	Bias Winding Voltage
VDB			0.70	Volts	Bias Winding Diode Forward Voltage Drop
NB			8.66		Bias Winding Number of Turns
VZOV			28.00	Volts	Over Voltage Protection zener diode voltage.
UVLO VARIABLES					
V_UV_TARGET			106.42	Volts	Target DC under-voltage threshold, above which the power supply with start
V_UV_ACTUAL			109.70	Volts	Typical DC start-up voltage based on standard value of RUV_ACTUAL
RUV_IDEAL			4.17	Mohms	Calculated value for UV Lockout resistor
RUV_ACTUAL			4.30	Mohms	Closest standard value of resistor to RUV_IDEAL
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	EE13		EE13		Enter Transformer Core
Core		EE13		P/N:	PC40EE13-Z
Bobbin			EE13_BOBBIN	P/N:	EE13_BOBBIN
AE			0.17	cm^2	Core Effective Cross Sectional Area
LE			3.02	cm	Core Effective Path Length
AL			1130.00	nH/T^2	Ungapped Core Effective Inductance
BW			7.90	mm	Bobbin Physical Winding Width
M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L			3.00		Number of Primary Layers
NS	5		5		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			96.74	Volts	Minimum DC Input Voltage
VMAX			374.77	Volts	Maximum DC Input Voltage
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.58		Duty Ratio at full load, minimum primary inductance and minimum input voltage
IAVG			0.14	Amps	Average Primary Current
IP			0.33	Amps	Minimum Peak Primary Current
IR			0.22	Amps	Primary Ripple Current
IRMS			0.20	Amps	Primary RMS Current
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			1826	uHenries	Typical Primary Inductance. +/- 10% to ensure a minimum primary inductance of 1643 uH
LP_TOLERANCE			10	%	Primary inductance tolerance
NP			47		Primary Winding Number of Turns
ALG			818	nH/T^2	Gapped Core Effective Inductance
BM		Warning	8452	Gauss	!!! Warning. Maximum flux density too high, may cause transformer saturation. REDUCE BP<3000. Increase NS > 15 turns, use larger Core or increase VOR
BAC			2912	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1588		Relative Permeability of Ungapped Core
LG		Warning	0.01	mm	!!! INCREASE GAP>>0.1. Increase NS, increase VOR,bigger Core
BWE			23.7	mm	Effective Bobbin Width
OD			0.50	mm	Maximum Primary Wire Diameter including insulation
INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.44	mm	Bare conductor diameter
AWG			26	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
CM			256	Cmils	Bare conductor effective area in circular mils

CMA		Info	1312	Cmils/Amp	CAN DECREASE CMA < 500 (decrease L(primary layers),increase NS,use smaller Core)
TRANSFORMER SECONDARY DESIGN PARAMETERS					
Lumped parameters					
ISP			3.08	Amps	Peak Secondary Current
ISRMS			1.57	Amps	Secondary RMS Current
IRIPPLE			1.35	Amps	Output Capacitor RMS Ripple Current
CMS			314	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			25	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
VOLTAGE STRESS PARAMETERS					
VDRAIN			647	Volts	Maximum Drain Voltage Estimate (Assumes 20% zener clamp tolerance and an additional 10% temperature tolerance)
PIVS			52	Volts	Output Rectifier Maximum Peak Inverse Voltage
TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)					
1st output					
VO1			12.00	Volts	Main Output Voltage (if unused, defaults to single output design)
IO1			0.80	Amps	Output DC Current
PO1			9.60	Watts	Output Power
VD1			0.70	Volts	Output Diode Forward Voltage Drop
NS1			5.00		Output Winding Number of Turns
ISRMS1			1.568	Amps	Output Winding RMS Current
IRIPPLE1			1.35	Amps	Output Capacitor RMS Ripple Current
PIVS1			52	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diodes			SB380		Recommended Diodes for this output
CMS1			314	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS1			25	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS1			0.46	mm	Minimum Bare Conductor Diameter
ODS1			1.58	mm	Maximum Outside Diameter for Triple Insulated Wire
2nd output					
VO2				Volts	Output Voltage
IO2				Amps	Output DC Current
PO2			0.00	Watts	Output Power
VD2			0.70	Volts	Output Diode Forward Voltage Drop
NS2			0.28		Output Winding Number of Turns
ISRMS2			0.000	Amps	Output Winding RMS Current
IRIPPLE2			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS2			2	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode					Recommended Diodes for this output
CMS2			0	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS2			N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS2			N/A	mm	Minimum Bare Conductor Diameter
ODS2			N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
3rd output					
VO3				Volts	Output Voltage
IO3				Amps	Output DC Current
PO3			0.00	Watts	Output Power
VD3			0.70	Volts	Output Diode Forward Voltage Drop
NS3			0.28		Output Winding Number of Turns
ISRMS3			0.000	Amps	Output Winding RMS Current
IRIPPLE3			0.00	Amps	Output Capacitor RMS Ripple Current
PIVS3			2	Volts	Output Rectifier Maximum Peak Inverse Voltage
Recommended Diode					Recommended Diodes for this output
CMS3			0	Cmils	Output Winding Bare Conductor minimum circular mils
AWGS3			N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
DIAS3			N/A	mm	Minimum Bare Conductor Diameter
ODS3			N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
Total power			9.6	Watts	Total Output Power
Negative Output	N/A		N/A		If negative output exists enter Output number; eg: If VO2 is negative output, enter 2

变压器构造参数

变量	值	单位	说明
磁芯类型	EE13		磁芯类型
磁芯材料	NC-2H (Nicera)或同等规格		磁芯材料
骨架参考	Generic, 4 pri. + 2 sec.		骨架参考
骨架方位	水平		骨架类型
初级引脚	4		使用的初级引脚数
次级引脚	2		使用的次级引脚数
LP	1826	µH	额定初级电感量
ML	0.00	mm	左侧安全边距宽度
MR	0.00	mm	右侧安全边距宽度
LG	0.007	mm	估计气隙长度

偏置变量

变量	值	单位	说明
NB	9		偏置绕组圈数
线径尺寸	26	AWG	偏置绕组线径尺寸
绕组类型	单线(x1)		偏置绕组线类型
层数	0.52		偏置绕组层数
起始引脚	4		偏置绕组起始引脚
终止引脚	3		偏置绕组终止引脚

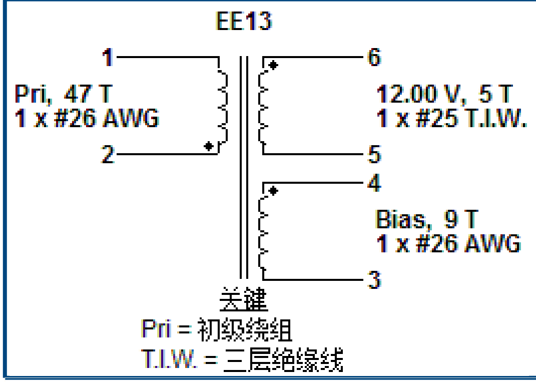
初级绕组第1部分

变量	值	单位	说明
NP1	47		初级绕组第1部分初级绕组的取整（整数）圈数
线径尺寸	26	AWG	初级绕组线径尺寸
绕组类型	单线(x1)		初级绕组多股并绕时所用线的股数
L	2.69		初级绕组层数
起始引脚	2		初级绕组第1部分起始引脚
终止引脚	1		初级绕组第1部分终止引脚

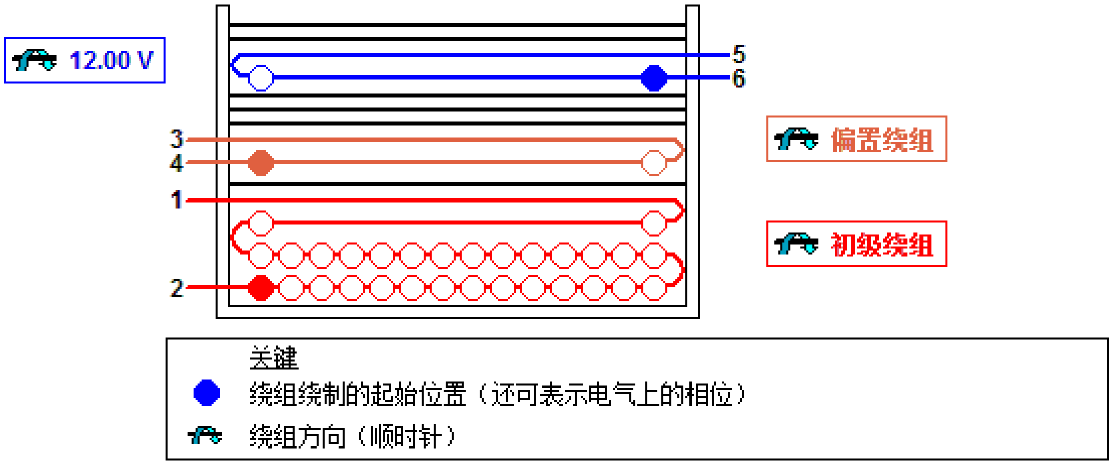
输出 1

变量	值	单位	说明
VO	12.00	V	输出电压
IO	0.80	A	输出电流
VOUT_ACTUAL	12.00	V	实际输出电压
NS	5		次级绕组圈数
线径尺寸	25	AWG	次级绕组线径尺寸
绕组类型	单线(x1)		输出绕组多股并绕时所用线的股数
L_S_OUT	0.41		次级输出绕组层数
起始引脚	6		输出绕组起始引脚
终止引脚	5		输出绕组终止引脚

电特性原理图



绕制结构图



绕组说明

初级绕组

从引脚2开始，使用材料项[5]绕47圈（x 1线）。 在3层中从左向右。 在第1层结束时，继续从右向左绕下一层。 在第2层结束时，继续从左向右绕下一层。 在最后一层上，使绕组均匀分布在整个骨架上。 在引脚1结束该绕组。
添加1层胶带（材料项[3]）以进行绝缘。

偏置绕组

从引脚4开始，使用材料项[5]绕9圈（x 1线）。 沿与初级绕组相同的旋转方向进行绕制。 使绕组均匀分布在整个骨架上。 在引脚3结束该绕组。
添加3层胶带（材料项[3]）以进行绝缘。

次级绕组

从引脚6开始，使用材料项[6]绕5圈（x 1线）。 使绕组均匀分布在整个骨架上。 沿与初级绕组相同的旋转方向进行绕制。 在引脚5结束该绕组。
添加2层胶带（材料项[3]）以进行绝缘。

磁芯装配

装配并固定两半磁芯。材料项[1]。

浸渍

在材料项[4]中均匀浸渍。不要采用真空浸渍。

备注

1. 对无挡墙变压器而言，所有次级绕组均采用三层绝缘线。

材料

项	说明
[1]	磁芯：EE13，NC-2H (Nicera)或同等规格，开气隙，使ALG为818 nH/T²
[2]	骨架：Generic, 4 pri. + 2 sec.
[3]	隔离带：聚酯薄膜（1 mil轴向厚度），宽7.90 mm
[4]	浸渍
[5]	磁线：26 AWG，可焊接，双面涂层
[6]	三层绝缘线：25 AWG

电特性测试规格

参数	条件	规格
绝缘强度，VAC	60 Hz，持续1秒钟，自引脚1,2,3,4 到引脚5,6。	3000
额定初级电感量，μH	于1 V pk-pk、典型开关频率、在引脚1到引脚2之间测量，此时所有其他绕组均开路。	1826
容差， ±%	初级电感量容差	10.0
最大初级漏感，μH	在引脚1到引脚2之间测量，此时所有其他绕组均短路。	54.77

虽然软件设计已考虑到安全原则，但用户有责任确保其电源设计满足产品适用的所有安全要求。