

1	ACDC_TinySwitch-4_110618; Rev.1.2; Copyright Power Integrations 2018	INPUT	INFO	OUTPUT	UNIT	ACDC_TinySwitch-4_110618_Rev1-2.xls; TinySwitch-4 Continuous/Discontinuous Flyback Transformer Design Spreadsheet
2	<b>ENTER APPLICATION VARIABLES</b>					<b>Customer</b>
3	VACMIN			85	Volts	Minimum AC Input Voltage
4	VACMAX			265	Volts	Maximum AC Input Voltage
5	fL			50	Hertz	AC Mains Frequency
6	VO	3.30		3.30	Volts	Output Voltage (at continuous power)
7	IO	1.00		1.00	Amps	Power Supply Output Current (corresponding to peak power)
8	Power			3.30	Watts	Continuous Output Power
9	n			0.70		Efficiency Estimate at output terminals. Under 0.7 if no better data available
10	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
11	tC			3.00	mSeconds	Bridge Rectifier Conduction Time Estimate
12	CIN	11.00		11.00	uFarads	Input Capacitance
13						
14						
15	<b>ENTER TinySwitch-4 VARIABLES</b>					
16	TinySwitch-4	Auto		TNY284P		Recommended TinySwitch-4
17						
18	Chose Configuration	INC		Increased 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)
19	ILIMITMIN			0.196	Amps	Minimum Current Limit
20	ILIMITTYP			0.210	Amps	Typical Current Limit
21	ILIMITMAX			0.233	Amps	Maximum Current Limit
22	fSmin			124000	Hertz	Minimum Device Switching Frequency
23	I^2fmin			5.23908	A^2kHz	I^2f (product of current limit squared and frequency is trimmed for tighter tolerance)
24	VOR			80.0	Volts	Reflected Output Voltage (VOR < 135 V Recommended)
25	VDS			10.0	Volts	TinySwitch-4 on-state Drain to Source Voltage
26	VD			0.50	Volts	Output Winding Diode Forward Voltage Drop
27	KP			0.98		Ripple to Peak Current Ratio (KP < 6)
28	KP_TRANSIENT			0.59		Transient Ripple to Peak Current Ratio. Ensure KP_TRANSIENT > 0.25
29						
30						
31	<b>ENTER BIAS WINDING VARIABLES</b>					
32	VB			22.00	Volts	Bias Winding Voltage
33	VDB			0.70	Volts	Bias Winding Diode Forward Voltage Drop
34	NB			28.95		Bias Winding Number of Turns
35	VZOV			28.00	Volts	Over Voltage Protection zener diode voltage.
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37						
38	<b>UVLO VARIABLES</b>					
39	V_UV_TARGET			101.12	Volts	Target DC under-voltage threshold, above which the power supply will start
40	V_UV_ACTUAL			99.70	Volts	Typical DC start-up voltage based on standard value of RUV_ACTUAL
41	RUV_IDEAL			3.96	Mohms	Calculated value for UV Lockout resistor
42	RUV_ACTUAL			3.90	Mohms	Closest standard value of resistor to RUV_IDEAL
43						
44						
45	<b>ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES</b>					
46	Core Type	Auto		EE13		Enter Transformer Core
47	Core		EE13		P/N:	PC40EE13-Z
48	Custom core				P/N:	EE13_BOBBIN
49	AE			0.17	cm^2	Core Effective Cross Sectional Area
50	LE			3.02	cm	Core Effective Path Length
51	AL			1130	nH/T^2	Ungapped Core Effective Inductance
52	BW			7.9	mm	Bobbin Physical Winding Width
53	M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
54	L			3		Number of Primary Layers
55	NS	5		5		Number of Secondary Turns
56						
57						
58	<b>DC INPUT VOLTAGE PARAMETERS</b>					
59	VMIN			91.9	Volts	Minimum DC Input Voltage
60	VMAX			374.8	Volts	Maximum DC Input Voltage
61						
62						
63	<b>CURRENT WAVEFORM SHAPE PARAMETERS</b>					
64	DMAX			0.49		Duty Ratio at full load, minimum primary inductance and minimum input voltage
65	Iavg			0.06	Amps	Average Primary Current
66	IP			0.20	Amps	Minimum Peak Primary Current
67	IR			0.19	Amps	Primary Ripple Current
68	IRMS			0.10	Amps	Primary RMS Current
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70						
71	<b>TRANSFORMER PRIMARY DESIGN PARAMETERS</b>					
72	LP			1724	uHenries	Typical Primary Inductance. +/- 10% to ensure a minimum primary inductance of 1551 uH

73	LP_TOLERANCE		10	%	Primary inductance tolerance
74	NP		105		Primary Winding Number of Turns
75	ALG		156	nH/T^2	Gapped Core Effective Inductance
76	BM		2231	Gauss	Maximum Operating Flux Density, BM<3100 is recommended
77	BAC		1097	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
78	ur		1588		Relative Permeability of Ungapped Core
79	LG		0.12	mm	Gap Length (Lg > 0.1 mm)
80	BWE		23.7	mm	Effective Bobbin Width
81	OD		0.225	mm	Maximum Primary Wire Diameter including insulation
82	INS		0.04	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
83	DIA		0.18	mm	Bare conductor diameter
84	AWG		34	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
85	CM		40	Cmils	Bare conductor effective area in circular mils
86	CMA		423	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 500)
87					
88					
89	<b>TRANSFORMER SECONDARY DESIGN PARAMETERS</b>				
90	<b>Lumped parameters</b>				
91	ISP		4.13	Amps	Peak Secondary Current
92	ISRMS		2.03	Amps	Secondary RMS Current
93	IRIPPLE		1.77	Amps	Output Capacitor RMS Ripple Current
94	CMS		406	Cmils	Secondary Bare Conductor minimum circular mils
95	AWGS		24	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
96					
97					
98	<b>VOLTAGE STRESS PARAMETERS</b>				
99	VDRAIN		563	Volts	Maximum Drain Voltage Estimate (Assumes 20% zener clamp tolerance and an additional 10% temperature tolerance)
100	PIVS		21	Volts	Output Rectifier Maximum Peak Inverse Voltage
101					
102					
103	<b>TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)</b>				
104					
105	<b>1st output</b>				
106	VO1		3.30	Volts	Main Output Voltage (if unused, defaults to single output design)
107	IO1		1.00	Amps	Output DC Current
108	PO1		3.30	Watts	Output Power
109	VD1		0.50	Volts	Output Diode Forward Voltage Drop
110	NS1		5.00		Output Winding Number of Turns
111	ISRMS1		2.032	Amps	Output Winding RMS Current
112	IRIPPLE1		1.77	Amps	Output Capacitor RMS Ripple Current
113	PIVS1		21	Volts	Output Rectifier Maximum Peak Inverse Voltage
114	Recommended Diodes		1N5820, SB320		Recommended Diodes for this output
115	CMS1		406	Cmils	Output Winding Bare Conductor minimum circular mils
116	AWGS1		24	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
117	DIAS1		0.51	mm	Minimum Bare Conductor Diameter
118	ODS1		1.58	mm	Maximum Outside Diameter for Triple Insulated Wire
119					
120					
121	<b>2nd output</b>				
122	VO2			Volts	Output Voltage
123	IO2			Amps	Output DC Current
124	PO2		0.00	Watts	Output Power
125	VD2		0.70	Volts	Output Diode Forward Voltage Drop
126	NS2		0.92		Output Winding Number of Turns
127	ISRMS2		0.000	Amps	Output Winding RMS Current
128	IRIPPLE2		0.00	Amps	Output Capacitor RMS Ripple Current
129	PIVS2		3	Volts	Output Rectifier Maximum Peak Inverse Voltage
130	Recommended Diode				Recommended Diodes for this output
131	CMS2		0	Cmils	Output Winding Bare Conductor minimum circular mils
132	AWGS2		N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
133	DIAS2		N/A	mm	Minimum Bare Conductor Diameter
134	ODS2		N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
135					
136					
137	<b>3rd output</b>				
138	VO3			Volts	Output Voltage
139	IO3			Amps	Output DC Current
140	PO3		0.00	Watts	Output Power
141	VD3		0.70	Volts	Output Diode Forward Voltage Drop
142	NS3		0.92		Output Winding Number of Turns
143	ISRMS3		0.000	Amps	Output Winding RMS Current
144	IRIPPLE3		0.00	Amps	Output Capacitor RMS Ripple Current
145	PIVS3		3	Volts	Output Rectifier Maximum Peak Inverse Voltage
146	Recommended Diode				Recommended Diodes for this output
147	CMS3		0	Cmils	Output Winding Bare Conductor minimum circular mils
148	AWGS3		N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
149	DIAS3		N/A	mm	Minimum Bare Conductor Diameter

150	ODS3			N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
151						
152						
153						
154	<b>Total power</b>			3.3	Watts	Total Output Power
155						
156	Negative Output	N/A		N/A		If negative output exists enter Output number; eg: If VO2 is negative output, enter 2
157						