

1	ACDC_TOPSwitchHX_032514; Rev.1.12; Copyright Power Integrations 2014	INPUT	INFO	OUTPUT	UNIT	TOP_HX_032514: TOPSwitch-HX Continuous/Discontinuous Flyback Transformer Design Spreadsheet
2	ENTER APPLICATION VARIABLES					Design title
3	VACMIN	88			Volts	Minimum AC Input Voltage
4	VACMAX	265			Volts	Maximum AC Input Voltage
5	fL	50			Hertz	AC Mains Frequency
6	VO	24.00			Volts	Output Voltage (main)
7	PO_AVG	194.00			Watts	Average Output Power
8	PO_PEAK			194.00	Watts	Peak Output Power
9	n	0.82			%/100	Efficiency Estimate
10	Z	0.50				Loss Allocation Factor
11	VB	15			Volts	Bias Voltage
12	tC	3.00			mSeconds	Bridge Rectifier Conduction Time Estimate
13	CIN	680.0		680.0	uFarads	Input Filter Capacitor
14						
15						
16	ENTER TOPSWITCH-HX VARIABLES					
17	TOPSwitch-HX	TOP260YN			Universal / Peak	115 Doubled/230V
18	Chosen Device		TOP260YN	Power Out	200 W / 200 W	275W
19	KI	1.00				External Ilimit reduction factor (KI=1.0 for default ILIMIT, KI <1.0 for lower ILIMIT)
20	ILIMITMIN_EXT			5.580	Amps	Use 1% resistor in setting external ILIMIT
21	ILIMITMAX_EXT			6.420	Amps	Use 1% resistor in setting external ILIMIT
22	Frequency (F)=132kHz, (H)=66kHz		F	H		Half frequency option is only available for P, G and M packages in addition to TOP259-TOP261YN devices. For full frequency operation choose E package or TOP254-TOP258YN devices.
23	fS			66000	Hertz	TOPSwitch-HX Switching Frequency: Choose between 132 kHz and 66 kHz
24	fSmin			59400	Hertz	TOPSwitch-HX Minimum Switching Frequency
25	fSmax			72600	Hertz	TOPSwitch-HX Maximum Switching Frequency
26	High Line Operating Mode			FF		Full Frequency, Jitter enabled
27	VOR	130.00			Volts	Reflected Output Voltage
28	VDS			10.00	Volts	TOPSwitch on-state Drain to Source Voltage
29	VD	0.50			Volts	Output Winding Diode Forward Voltage Drop
30	VDB	0.70			Volts	Bias Winding Diode Forward Voltage Drop
31	KP	0.50				Ripple to Peak Current Ratio (0.3 < KRP < 1.0 : 1.0 < KDP < 6.0)
32						
33						
34	PROTECTION FEATURES					
35	LINE SENSING					
36	VUV_STARTUP			98.30	Volts	Minimum DC Bus Voltage at which the power supply will start-up
37	VOV_SHUTDOWN			490	Volts	Typical DC Bus Voltage at which power supply will shut-down (Max)
38	RLS			4.4	M-ohms	Use two standard, 2.2 M-Ohm, 5% resistors in series for line sense functionality.
39	OUTPUT OVERVOLTAGE					
40	VZ			27	Volts	Zener Diode rated voltage for Output Overvoltage shutdown protection
41	RZ			5.1	k-ohms	Output OVP resistor. For latching shutdown use 20 ohm resistor instead
42	OVERLOAD POWER LIMITING					
43	Overload Current Ratio at VMAX			1.20		Enter the desired margin to current limit at VMAX. A value of 1.2 indicates that the current limit should be 20% higher than peak primary current at VMAX
44	Overload Current Ratio at VMIN			1.03		Margin to current limit at low line.
45	ILIMIT_EXT_VMIN			5.25	A	Peak primary Current at VMIN
46	ILIMIT_EXT_VMAX			5.00	A	Peak Primary Current at VMAX
47	RIL			6.65	k-ohms	Current limit/Power Limiting resistor.
48	RPL			N/A	M-ohms	Resistor not required. Use RIL resistor only
49						
50						
51	ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
52	Core Type	Custom		PQ35/35		Core Type
53	Custom Core Part Number (Optional)	PQ35/35				If custom core used - Enter part number here
54	Bobbin		#N/A		P/N:	#N/A
55	AE	1.9000		1.9000	cm^2	Core Effective Cross Sectional Area
56	LE	8.6100		8.6100	cm	Core Effective Path Length
57	AL	6000.0		6000.0	nH/T^2	Ungapped Core Effective Inductance
58	BW	21.1		21.1	mm	Bobbin Physical Winding Width
59	M	1.50			mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
60	L	2.00				Number of Primary Layers
61	NS	8		8		Number of Secondary Turns
62						
63						
64	DC INPUT VOLTAGE PARAMETERS					
65	VMIN			103	Volts	Minimum DC Input Voltage
66	VMAX			375	Volts	Maximum DC Input Voltage
67						
68						

69	CURRENT WAVEFORM SHAPE PARAMETERS				
70	DMAX		0.58		Maximum Duty Cycle (calculated at PO_PEAK)
71	IAVG		2.30	Amps	Average Primary Current (calculated at average output power)
72	IP		5.25	Amps	Peak Primary Current (calculated at Peak output power)
73	IR		2.63	Amps	Primary Ripple Current (calculated at average output power)
74	IRMS		3.06	Amps	Primary RMS Current (calculated at average output power)
75					
76					
77	TRANSFORMER PRIMARY DESIGN PARAMETERS				
78	LP		337	uHenries	Primary Inductance
79	LP Tolerance		10		Tolerance of Primary Inductance
80	NP		42		Primary Winding Number of Turns
81	NB		5		Bias Winding Number of Turns
82	ALG		187	nH/T^2	Gapped Core Effective Inductance
83	BM		2193	Gauss	Maximum Flux Density at PO, VMIN (BM<3000)
84	BP		2948	Gauss	Peak Flux Density (BP<4200) at ILIMITMAX and LP_MAX. Note: Recommended values for adapters and external power supplies <=3600 Gauss
85	BAC		548	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
86	ur		2164		Relative Permeability of Ungapped Core
87	LG		1.24	mm	Gap Length (Lg > 0.1 mm)
88	BWE		36.2	mm	Effective Bobbin Width
89	OD		0.85	mm	Maximum Primary Wire Diameter including insulation
90	INS		0.08	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
91	DIA		0.77	mm	Bare conductor diameter
92	AWG		21	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
93	CM		813	Cmils	Bare conductor effective area in circular mils
94	CMA		265	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 500)
95	Primary Current Density (J)		7.44	Amps/mm^2	Primary Winding Current density (3.8 < J < 9.75)
96					
97					
98	TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)				
99	Lumped parameters				
100	ISP		27.87	Amps	Peak Secondary Current
101	ISRMS		13.75	Amps	Secondary RMS Current
102	IO_PEAK		8.08	Amps	Secondary Peak Output Current
103	IO		8.08	Amps	Average Power Supply Output Current
104	IRIPPLE		11.12	Amps	Output Capacitor RMS Ripple Current
105	CMS		2750	Cmils	Secondary Bare Conductor minimum circular mils
106	AWGS		15	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
107	DIAS		1.45	mm	Secondary Minimum Bare Conductor Diameter
108	ODS		2.26	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
109	INSS		0.41	mm	Maximum Secondary Insulation Wall Thickness
110					
111					
112	VOLTAGE STRESS PARAMETERS				
113	VDRAIN		629	Volts	Maximum Drain Voltage Estimate (Includes Effect of Leakage Inductance)
114	PIVS		95	Volts	Output Rectifier Maximum Peak Inverse Voltage
115	PIVB		60	Volts	Bias Rectifier Maximum Peak Inverse Voltage
116					
117					
118	TRANSFORMER SECONDARY DESIGN PARAMETERS (MULTIPLE OUTPUTS)				
119	1st output				
120	VO1	24.00	24.00	Volts	Output Voltage
121	IO1_AVG	4.00	4.00	Amps	Average DC Output Current
122	PO1_AVG		96.00	Watts	Average Output Power
123	VD1		0.50	Volts	Output Diode Forward Voltage Drop
124	NS1		8.00		Output Winding Number of Turns
125	ISRMS1		6.803	Amps	Output Winding RMS Current
126	IRIPPLE1		5.50	Amps	Output Capacitor RMS Ripple Current
127	PIVS1		95	Volts	Output Rectifier Maximum Peak Inverse Voltage
128	CMS1		1361	Cmils	Output Winding Bare Conductor minimum circular mils
129	AWGS1		18	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
130	DIAS1		1.03	mm	Minimum Bare Conductor Diameter
131	ODS1		2.26	mm	Maximum Outside Diameter for Triple Insulated Wire
132					
133					
134	2nd output				
135	VO2	15.00		Volts	Output Voltage
136	IO2_AVG	6.50		Amps	Average DC Output Current
137	PO2_AVG		97.50	Watts	Average Output Power
138	VD2		0.70	Volts	Output Diode Forward Voltage Drop
139	NS2		5.13		Output Winding Number of Turns
140	ISRMS2		11.055	Amps	Output Winding RMS Current
141	IRIPPLE2		8.94	Amps	Output Capacitor RMS Ripple Current

142	PIVS2		60	Volts	Output Rectifier Maximum Peak Inverse Voltage
143	CMS2		2211	Cmils	Output Winding Bare Conductor minimum circular mils
144	AWGS2		16	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
145	DIAS2		1.29	mm	Minimum Bare Conductor Diameter
146	ODS2		3.53	mm	Maximum Outside Diameter for Triple Insulated Wire
147					
148					
149	3rd output				
150	VO3			Volts	Output Voltage
151	IO3_AVG			Amps	Average DC Output Current
152	PO3_AVG		0.00	Watts	Average Output Power
153	VD3		0.70	Volts	Output Diode Forward Voltage Drop
154	NS3		0.23		Output Winding Number of Turns
155	ISRMS3		0.000	Amps	Output Winding RMS Current
156	IRIPPLE3		0.00	Amps	Output Capacitor RMS Ripple Current
157	PIVS3		2	Volts	Output Rectifier Maximum Peak Inverse Voltage
158	CMS3		0	Cmils	Output Winding Bare Conductor minimum circular mils
159	AWGS3		N/A	AWG	Wire Gauge (Rounded up to next larger standard AWG value)
160	DIAS3		N/A	mm	Minimum Bare Conductor Diameter
161	ODS3		N/A	mm	Maximum Outside Diameter for Triple Insulated Wire
162					
163					
164	Total Continuous Output Power		193.5	Watts	Total Continuous Output Power
165					
166	Negative Output	N/A	N/A		If negative output exists enter Output number; e.g.: If VO2 is negative output, enter 2