1	ACDC_LinkSwitch-PH_071112; Rev.1.8; Copyright Power Integrations 2012	INPUT	INFO	OUTP	UNIT	LinkSwitch-PH_071112: Flyback Transformer Design Spreadsheet
2	**ENTER APPLICATION VARIABLES**					**Design Title**
3	Dimming required	**NO**		**NO**		Select 'YES' option if dimming is required. Otherwise select 'NO'.
4	VACMIN	90		90	V	Minimum AC Input Voltage
5	VACMAX			265	V	Maximum AC input voltage
6	fL			50	Hz	AC Mains Frequency
7	VO	48.00		48	V	Typical output voltage of LED string at full load
8	VO_MAX	48.50		48.50	V	Maximum expected LED string Voltage.
9	VO_MIN	47.50		47.50	V	Minimum expected LED string Voltage.
10	V_OVP			53.35	V	Over-voltage protection setpoint
11	IO	1.10		1.10	A	Typical full load LED current
12	PO			52.8	W	!!! For Universal Input reduce Continuous Output Power PO_CONT below 18W (or use larger LinkSwitch-PH)
13	n	0.88		0.88		
14	VB			20	V	Bias Voltage
15						
16						
17	**ENTER LinkSwitch-PH VARIABLES**					
18	**LinkSwitch-PH**	**Auto**		**LNK419**	Univers	115 Doubled/230V
19	Chosen Device		LNK419			
20	Current Limit Mode	**FULL**		**FULL**		Select "RED" for reduced Current Limit mode or "FULL" for Full current limit mode
21	ILIMITMIN			3.12	A	Minimum current limit
22	ILIMITMAX			3.63	A	Maximum current limit
23	fS			66000	Hz	Switching Frequency
24	fSmin			62000	Hz	Minimum Switching Frequency
25	fSmax			70000	Hz	Maximum Switching Frequency
26	IV			38.7	uA	V pin current
27	RV			3.909	M-ohm	Upper V pin resistor
28	RV2			1.402	M-ohm	Lower V pin resistor
29	IFB	170.00		170.0	uA	FB pin current (85 uA < IFB < 210 uA)
30	RFB1			100.0	k-ohms	FB pin resistor
31	VDS			10	V	LinkSwitch-PH on-state Drain to Source Voltage
32	VD	1.00		1.00	V	Output Winding Diode Forward Voltage Drop (0.5 V for Schottky and 0.8 V for PN diode)
33	VDB			0.70	V	Bias Winding Diode Forward Voltage Drop
34						
35						
36	**Key Design Parameters**					
37	KP	0.55		0.55		Ripple to Peak Current Ratio (For PF > 0.9, 0.4 < KP < 0.9)
38	LP			584	uH	Primary Inductance
39	VOR	80.00		80	V	Reflected Output Voltage.
40	Expected IO (average)			1.11	A	Expected Average Output Current
41	KP_VACMAX			0.78		Expected ripple current ratio at VACMAX
42	TON_MIN			2.67	us	Minimum on time at maximum AC input voltage
43	PCLAMP			0.53	W	Estimated dissipation in primary clamp
44						
45	**ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES**					
46	**Core Type**	**Auto**		**EI35**		Transformer core
47	Custom Core					If using a custom core - Enter part number here
48	AE	1.1900		1.19	cm^2	Core Effective Cross Sectional Area
49	LE			6.71	cm	Core Effective Path Length
50	AL	5200.0		5200	nH/T^2	Ungapped Core Effective Inductance

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51	BW	14.5		14.5	mm	Bobbin Physical Winding Width
52	M			0	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
53	L	2.00		2		Number of Primary Layers
54	NS	32		32		Number of Secondary Turns
55						
56						
57	**DC INPUT VOLTAGE PARAMETERS**					
58	VMIN			127	V	Peak input voltage at VACMIN
59	VMAX			375	V	Peak input voltage at VACMAX
60						
61						
62	**CURRENT WAVEFORM SHAPE PARAMETERS**					
63	DMAX			0.41		Minimum duty cycle at peak of VACMIN
64	IAVG			0.65	A	Average Primary Current
65	IP			2.85	A	Peak Primary Current (calculated at minimum input voltage VACMIN)
66	IRMS			1.05	A	Primary RMS Current (calculated at minimum input voltage VACMIN)
67						
68						
69	**TRANSFORMER PRIMARY DESIGN PARAMETERS**					
70	LP			584	uH	Primary Inductance
71	NP			52		Primary Winding Number of Turns
72	NB			14		Bias Winding Number of Turns
73	ALG			214	nH/T^2	Gapped Core Effective Inductance
74	BM			2682	Gauss	Maximum Flux Density at PO, VMIN (BM<3100)
75	BP			2981	Gauss	Peak Flux Density (BP<3700)
76	BAC			738	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
77	ur			2333		Relative Permeability of Ungapped Core
78	LG			0.67	mm	Gap Length (Lg > 0.1 mm)
79	BWE			29	mm	Effective Bobbin Width
80	OD			0.56	mm	Maximum Primary Wire Diameter including insulation
81	INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
82	DIA			0.49	mm	Bare conductor diameter
83	AWG			25	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
84	CM			323	Cmils	Bare conductor effective area in circular mils
85	CMA			307	Cmils/A	Primary Winding Current Capacity (200 < CMA < 600)
86	LP_TOL	10		10		Tolerance of primary inductance
87						
88	**TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)**					
89	**Lumped parameters**					
90	ISP			4.66	A	Peak Secondary Current
91	ISRMS			1.96	A	Secondary RMS Current
92	IRIPPLE			1.62	A	Output Capacitor RMS Ripple Current
93	CMS			392	Cmils	Secondary Bare Conductor minimum circular mils
94	AWGS			24	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
95	DIAS			0.51	mm	Secondary Minimum Bare Conductor Diameter
96	ODS			0.45	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire

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97						
98						
99	**VOLTAGE STRESS PARAMETERS**					
100	VDRAIN			532	V	Estimated Maximum Drain Voltage assuming maximum LED string voltage (Includes Effect of Leakage Inductance)
101	PIVS			283	V	Output Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
102	PIVB			119	V	Bias Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
103						
104						
105	**FINE TUNING (Enter measured values from prototype)**					
106	**V pin Resistor Fine Tuning**					
107	RV1	4		4.00	M-ohm	Upper V Pin Resistor Value
108	RV2			1.40	M-ohm	Lower V Pin Resistor Value
109	VAC1			115.0	V	Test Input Voltage Condition1
110	VAC2			230.0	V	Test Input Voltage Condition2
111	IO_VAC1			1.10	A	Measured Output Current at VAC1
112	IO_VAC2			1.10	A	Measured Output Current at VAC2
113	RV1 (new)			4.00	M-ohm	New RV1
114	RV2 (new)			1.40	M-ohm	New RV2
115	V_OV			325.6	V	Typical AC input voltage at which OV shutdown will be triggered
116	V_UV			72.4	V	Typical AC input voltage beyond which power supply can startup
117						
118	**FB pin resistor Fine Tuning**					
119	RFB1			100	k-ohms	Upper FB Pin Resistor Value
120	RFB2			1E+012	k-ohms	Lower FB Pin Resistor Value
121	VB1			19.8	V	Test Bias Voltage Condition1
122	VB2			20.2	V	Test Bias Voltage Condition2
123	IO1			1.10	A	Measured Output Current at Vb1
124	IO2			1.10	A	Measured Output Current at Vb2
125	RFB1 (new)			100.0	k-ohms	New RFB1
126	RFB2(new)			1.00E+12	k-ohms	New RFB2
127						
128						
129	**Input Current Harmonic Analysis**					
130	**Harmonic**			% of Fund	Limit(%)	
131	1st Harmonic					
132	3rd Harmonic			22.19	27.00	PASS. %age of 3rd Harmonic is lower than the limit
133	5th Harmonic			10.6	10.00	FAIL. %age of 5th Harmonic exceeds the limit
134	7th Harmonic			6.7	7.00	PASS. %age of 7th Harmonic is lower than the limit
135	9th Harmonic			4.82	5.00	PASS. %age of 9th Harmonic is lower than the limit
136	11th Harmonic			3.57	3.00	FAIL. %age of 11th Harmonic exceeds the limit
137	13th Harmonic			2.65	3.00	PASS. %age of 13th Harmonic is lower than the limit
138	15th Harmonic			1.96	3.00	PASS. %age of 15th Harmonic is lower than the limit
139						
140	THD			25.6	%	Estimated total Harmonic Distortion (THD)
141						