

1	ACDC_LinkSwitch-PH_101 612; Rev.1.9; Copyright Power Integrations 2012					LinkSwitch-PH_101612: 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	V	Minimum AC Input Voltage
5	VACMAX			265	V	Maximum AC input voltage
6	fL			50	Hz	AC Mains Frequency
7	VO	40.00		40	V	Typical output voltage of LED string at full load
8	VO_MAX			44.00	V	Maximum expected LED string Voltage.
9	VO_MIN			36.00	V	Minimum expected LED string Voltage.
10	V_OVP			48.40	V	Over-voltage protection setpoint
11	IO	0.70		0.70	A	Typical full load LED current
12	PO			28.0	W	Output Power
13	n			0.8		
14	VB			20	V	Bias Voltage
15						
16						
17	ENTER LinkSwitch-PH VARIABLES					
18	LinkSwitch-PH	LNK419		LNK419	Univers	115 Doubled/230V
19	Chosen Device			LNK419		
20	Current Limit Mode	RED		RED		Select "RED" for reduced Current Limit mode or "FULL" for Full current limit mode
21	ILIMITMIN			2.35	A	Minimum current limit
22	ILIMITMAX			2.73	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	150.00		150.0	uA	FB pin current (85 uA < IFB < 210 uA)
30	RFB1			113.3	k-ohms	FB pin resistor
31	VDS			10	V	LinkSwitch-PH on-state Drain to Source Voltage
32	VD			0.50	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	0.45		0.45		Ripple to Peak Current Ratio (For PF > 0.9, 0.4 < KP < 0.9)
38	LP			1370	uH	Primary Inductance
39	VOR			80	V	Reflected Output Voltage.
40	Expected IO (average)			0.69	A	Expected Average Output Current
41	KP_VACMAX			0.64		Expected ripple current ratio at VACMAX
42	TON_MIN			2.67	us	Minimum on time at maximum AC input voltage
43	PCLAMP			0.36	W	Estimated dissipation in primary clamp
44						
45	ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
46	Core Type	EF30		EF30		Transformer core
47	Custom Core					If using a custom core - Enter part number here
48	AE			0.6	cm^2	Core Effective Cross Sectional Area

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49	LE			6.7	cm	Core Effective Path Length
50	AL			1410	nH/T^2	Ungapped Core Effective Inductance
51	BW			17.3	mm	Bobbin Physical Winding Width
52	M			0	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
53	L			3		Number of Primary Layers
54	NS			62		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			0.37	A	Average Primary Current
65	IP			1.54	A	Peak Primary Current (calculated at minimum input voltage VACMIN)
66	IRMS			0.59	A	Primary RMS Current (calculated at minimum input voltage VACMIN)
67						
68						
69	TRANSFORMER PRIMARY DESIGN PARAMETERS					
70	LP			1370	uH	Primary Inductance
71	NP			122		Primary Winding Number of Turns
72	NB			32		Bias Winding Number of Turns
73	ALG			91	nH/T^2	Gapped Core Effective Inductance
74	BM			2863	Gauss	Maximum Flux Density at PO, VMIN (BM<3100)
75	BP			3464	Gauss	Peak Flux Density (BP<3700)
76	BAC			644	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
77	ur			1253		Relative Permeability of Ungapped Core
78	LG			0.77	mm	Gap Length (Lg > 0.1 mm)
79	BWE			51.9	mm	Effective Bobbin Width
80	OD			0.42	mm	Maximum Primary Wire Diameter including insulation
81	INS			0.06	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
82	DIA			0.36	mm	Bare conductor diameter
83	AWG			28	AWG	Primary Wire Gauge (Rounded to next smaller standard AWG value)
84	CM			161	Cmils	Bare conductor effective area in circular mils
85	CMA			272	Cmils/	Primary Winding Current Capacity (200 < CMA < 600)
86	LP_TOL			10		Tolerance of primary inductance
87						
88	TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)					
89	Lumped parameters					
90	ISP			3.03	A	Peak Secondary Current
91	ISRMS			1.34	A	Secondary RMS Current
92	IRIPPLE			1.14	A	Output Capacitor RMS Ripple Current

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93	CMS			268	Cmils	Secondary Bare Conductor minimum circular mils
94	AWGS			25	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
95	DIAS			0.46	mm	Secondary Minimum Bare Conductor Diameter
96	ODS			0.28	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
97						
98						
99	VOLTAGE STRESS PARAMETERS					
100	VDRAIN			544	V	Estimated Maximum Drain Voltage assuming maximum LED string voltage (Includes Effect of Leakage Inductance)
101	PIVS			238	V	Output Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
102	PIVB			121	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			3.91	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			0.70	A	Measured Output Current at VAC1
112	IO_VAC2			0.70	A	Measured Output Current at VAC2
113	RV1 (new)			3.91	M-ohm	New RV1
114	RV2 (new)			1.40	M-ohm	New RV2
115	V_OV			318.3	V	Typical AC input voltage at which OV shutdown will be triggered
116	V_UV			70.8	V	Typical AC input voltage beyond which power supply can startup
117						
118	FB pin resistor Fine Tuning					
119	RFB1			113	k-ohms	Upper FB Pin Resistor Value
120	RFB2			1E+012	k-ohms	Lower FB Pin Resistor Value
121	VB1			18.0	V	Test Bias Voltage Condition1
122	VB2			22.0	V	Test Bias Voltage Condition2
123	IO1			0.70	A	Measured Output Current at Vb1
124	IO2			0.70	A	Measured Output Current at Vb2
125	RFB1 (new)			113.3	k-ohms	New RFB1
126	RFB2(new)			1.00E+1 2	k-ohms	New RFB2
127						
128						
129	Input Current Harmonic Analysis					
130	Harmonic			% of Fund	Limit(%)	
131	1st Harmonic					

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132	3rd Harmonic			21.17	27.00	PASS. %age of 3rd Harmonic is lower than the limit
133	5th Harmonic			9.1	10.00	PASS. %age of 5th Harmonic is lower than the limit
134	7th Harmonic			5.0	7.00	PASS. %age of 7th Harmonic is lower than the limit
135	9th Harmonic			3.31	5.00	PASS. %age of 9th Harmonic is lower than the limit
136	11th Harmonic			2.42	3.00	PASS. %age of 11th Harmonic is lower than the limit
137	13th Harmonic			1.90	3.00	PASS. %age of 13th Harmonic is lower than the limit
138	15th Harmonic			1.54	3.00	PASS. %age of 15th Harmonic is lower than the limit
139						
140	THD			23.5	%	Estimated total Harmonic Distortion (THD)
141						