

ACDC_LYTSwitch-4_080614; Rev.1.5; Copyright Power Integrations 2014	INPUT	INFO	OUTPUT	UNIT	LYTSwitch-4_080614: Flyback Transformer Design Spreadsheet
ENTER APPLICATION VARIABLES					Design Title
Dimming required	YES		YES		Select 'YES' option if dimming is required. Otherwise select 'NO'.
VACMIN	85		85	V	Minimum AC Input Voltage
VACMAX			132	V	Maximum AC input voltage
fL			60	Hz	AC Mains Frequency
VO	30.00		30.00	V	Typical output voltage of LED string at full load
VO_MAX			33.00	V	Maximum expected LED string Voltage.
VO_MIN			27.00	V	Minimum expected LED string Voltage.
V_OVP			36.30	V	Over-voltage protection setpoint
IO	1.000		1.000	A	Typical full load LED current
PO			30.0	W	Output Power
n	0.87		0.87		Estimated efficiency of operation
VB	18.00		18.00	V	Bias Voltage
ENTER LYTSwitch-4 VARIABLES					
LYTSwitch-4	LYT4X16		LYT4316		Selected LYTSwitch-4. Part number will change based on dimming/non-dimming application.
Current Limit Mode	FULL		FULL		Select "RED" for reduced Current Limit mode or "FULL" for Full current limit mode
ILIMITMIN			2.43	A	Minimum current limit
ILIMITMAX			2.83	A	Maximum current limit
fS			132000	Hz	Switching Frequency
fSmin			124000	Hz	Minimum Switching Frequency
fSmax			140000	Hz	Maximum Switching Frequency
IV			79.8	uA	V pin current
RV			2.00	M-ohms	Upper V pin resistor
RV2			1e+012	M-ohms	Lower V pin resistor
IFB			156.35	uA	FB pin current (85 uA < IFB < 210 uA)
RFB1			95.9	k-ohms	FB pin resistor
VDS			10.00	V	LYTSwitch on-state Drain to Source Voltage
VD			0.50	V	Output Winding Diode Forward Voltage Drop (0.5 V for Schottky and 0.8 V for PN diode)
VDB			0.70	V	Bias Winding Diode Forward Voltage Drop
Key Design Parameters					
KP	0.50		0.50		Ripple to Peak Current Ratio (For PF > 0.9, 0.4 < KP < 0.9)
LP			593	uH	Primary Inductance
VOR			80.00	V	Reflected Output Voltage.
Expected IO (average)		Info	0.930	A	Expected Average Output current is outside 5% tolerance band. Change IFB to 168 for better current regulation set-point
KP_VNOM			0.47		Expected ripple current ratio at VACNOM (115VAC)
TON_MIN			2.27	us	Minimum on time at maximum AC input voltage

PCLAMP			0.31	W	Estimated dissipation in primary clamp
ENTER TRANSFORMER CORE/CONSTRUCTION VARIABLES					
Core Type	PQ20/20		PQ20/20		Core Size
Custom Core					Enter custom core part number
AE			0.62	cm <sup>2</sup>	Core Effective Cross Sectional Area
LE			4.54	cm	Core Effective Path Length
AL			3150	nH/T <sup>2</sup>	Ungapped Core Effective Inductance
BW			12.0	mm	Bobbin Physical Winding Width
M			0.00	mm	Safety Margin Width (Half the Primary to Secondary Creepage Distance)
L			3		Number of Primary Layers
NS	28		28		Number of Secondary Turns
DC INPUT VOLTAGE PARAMETERS					
VMIN			120	V	Peak input voltage at VACMIN
VMAX			187	V	Peak input voltage at VACMAX
CURRENT WAVEFORM SHAPE PARAMETERS					
DMAX			0.42		Minimum duty cycle at peak of VACMIN
I AVG			0.36	A	Average Primary Current
IP			1.50	A	Peak Primary Current (calculated at minimum input voltage VACMIN)
IRMS			0.54	A	Primary RMS Current (calculated at minimum input voltage VACMIN)
TRANSFORMER PRIMARY DESIGN PARAMETERS					
LP			593	uH	Primary Inductance
LP_TOL			10		Tolerance of primary inductance
NP			73		Primary Winding Number of Turns
NB			17		Bias Winding Number of Turns
ALG			110	nH/T <sup>2</sup>	Gapped Core Effective Inductance
BM			1954	Gauss	Maximum Flux Density at PO, VMIN (BM<3100)
BP			3688	Gauss	Peak Flux Density (BP<3700)
BAC			489	Gauss	AC Flux Density for Core Loss Curves (0.5 X Peak to Peak)
ur			1836		Relative Permeability of Ungapped Core
LG			0.68	mm	Gap Length (Lg > 0.1 mm)
BWE			36	mm	Effective Bobbin Width
OD			0.49	mm	Maximum Primary Wire Diameter including insulation
INS			0.07	mm	Estimated Total Insulation Thickness (= 2 * film thickness)
DIA			0.43	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			475	Cmils/Amp	Primary Winding Current Capacity (200 < CMA < 600)
<b>TRANSFORMER SECONDARY DESIGN PARAMETERS (SINGLE OUTPUT EQUIVALENT)</b>					
<i>Lumped parameters</i>					
ISP			3.93	A	Peak Secondary Current
ISRMS			1.55	A	Secondary RMS Current
IRIPPLE			1.18	A	Output Capacitor RMS Ripple Current
CMS			310	Cmils	Secondary Bare Conductor minimum circular mils
AWGS			25	AWG	Secondary Wire Gauge (Rounded up to next larger standard AWG value)
DIAS			0.46	mm	Secondary Minimum Bare Conductor Diameter
ODS			0.43	mm	Secondary Maximum Outside Diameter for Triple Insulated Wire
<b>VOLTAGE STRESS PARAMETERS</b>					
VDRAIN			356	V	Estimated Maximum Drain Voltage assuming maximum LED string voltage (Includes Effect of Leakage Inductance)
PIVS			107	V	Output Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
PIVB			65	V	Bias Rectifier Maximum Peak Inverse Voltage (calculated at VOVP, excludes leakage inductance spike)
<b>FINE TUNING (Enter measured values from prototype)</b>					
<i>V pin Resistor Fine Tuning</i>					
RV1			2.00	M-ohms	Upper V Pin Resistor Value
RV2			1e+012	M-ohms	Lower V Pin Resistor Value
VAC1			115	V	Test Input Voltage Condition1
VAC2			230	V	Test Input Voltage Condition2
IO_VAC1			1.000	A	Measured Output Current at VAC1
IO_VAC2			1.000	A	Measured Output Current at VAC2
RV1 (new)			2.00	M-ohms	New RV1
RV2 (new)			10455.82	M-ohms	New RV2
V_OV			161.1	V	Typical AC input voltage at which OV shutdown will be triggered
V_UV			34.5	V	Typical AC input voltage beyond which power supply can startup
<b>FB pin resistor Fine Tuning</b>					
RFB1			95.94	k-ohms	Upper FB Pin Resistor Value
RFB2			1e+012	k-ohms	Lower FB Pin Resistor Value
VB1			16.16	V	Test Bias Voltage Condition1
VB2			19.84	V	Test Bias Voltage Condition2
IO1			1.000	A	Measured Output Current at Vb1
IO2			1.000	A	Measured Output Current at Vb2
RFB1 (new)			95.9	k-ohms	New RFB1
RFB2(new)			1e+012	k-ohms	New RFB2

<i>Input Current Harmonic Analysis</i>					
<i>Harmonic</i>		<i>Max Current</i>	<i>Limit</i>		<i>N/A</i>
<i>1st Harmonic</i>		298.53	<i>N/A</i>	<i>mA</i>	<i>N/A</i>
<i>3rd Harmonic</i>		15.79	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>5th Harmonic</i>		5.41	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>7th Harmonic</i>		2.45	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>9th Harmonic</i>		1.30	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>11th Harmonic</i>		0.76	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>13th Harmonic</i>		0.47	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>15th Harmonic</i>		0.31	<i>N/A</i>	<i>%</i>	<i>N/A</i>
<i>THD</i>		16.7	<i>%</i>		<i>N/A</i>