Fairchild Reference Design RD-536

The following reference design supports inclusion of FL7733A in design of an LED Driver with Power Factor Correction. It should be used in conjunction with the FL7733A datasheet as well as Fairchild's application notes and technical support team. Please visit Fairchild's website at www.fairchildsemi.com.

Application	Fairchild Device	Input Voltage Range	Rated Output Power	Output Voltage (Rated Current)	Topology
LED Lighting	FL7733A	100-305 V_{AC}	10.875 W	15 V (0.725 A)	PSR Flyback

Key Features

Performance

- < ±3% Total Constant Current Tolerance Over All Conditions
- < ±1% Over Universal Line Voltage Variation
- < ±1% from 50% to 100% Load Voltage Variation
- < ±1% with ±20% Magnetizing Inductance Variation
- Primary-Side Regulation (PSR) Control for Cost-Effective Solution without Requiring Input Bulk Capacitor and Secondary Feedback Circuitry
- Application Input Voltage Range: 80 V_{AC} – 308 V_{AC}
- High PF of > 0.9, and Low THD of < 10% Over Universal Line Input Range
- Fast < 200 ms Startup (at 85 V_{AC}) using Internal High-Voltage Startup with V_{DD} Regulation
- Adaptive Feedback Loop Control for Startup without Overshoot

Protection

- LED Short / Open Protection
- Output Diode Short Protection
- Sensing Resistor Short / Open Protection
- V_{DD} Over-Voltage Protection (OVP)
- V_{DD} Under-Voltage Lockout (UVLO)
- Over-Temperature Protection (OTP)
- All Protections are Auto Restart (AR)
- Cycle-by-Cycle Current Limit

1. Schematic

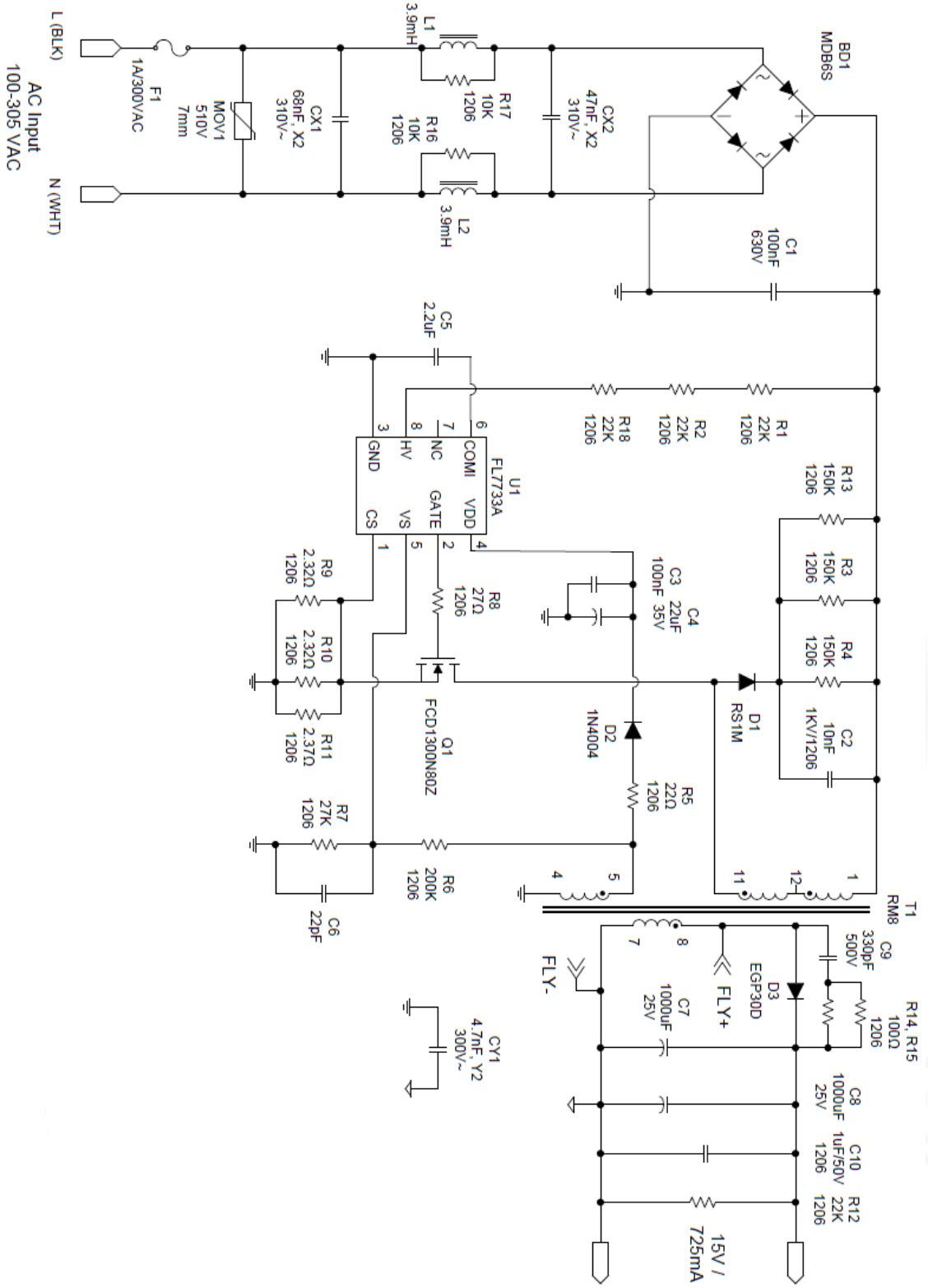

Figure 1. Schematic

2. Transformer

2.1. Transformer Schematic Diagram

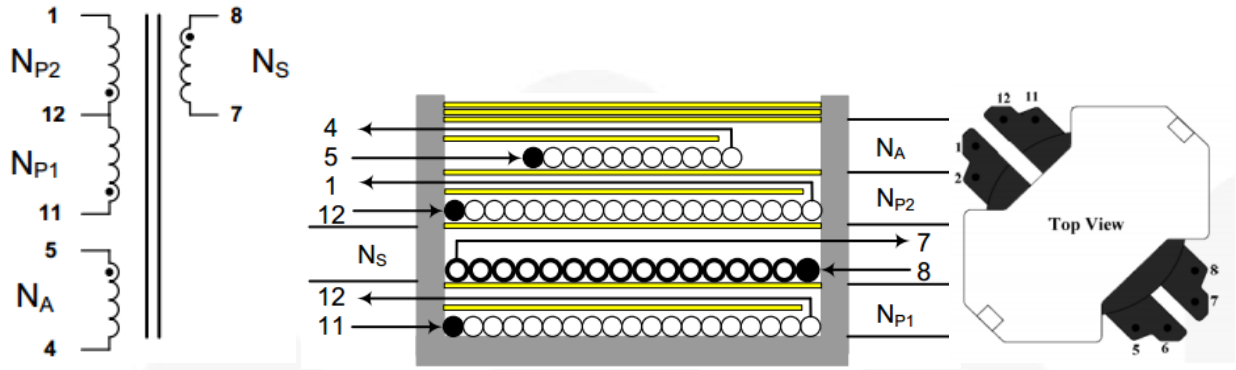

Figure 2. Transformer Bobbing Structure and Pin Configuration

2.2. Winding Specification

Windings	Pins (S→F)	Wire (AWG)	Turns	Layers	Winding Direction	Winding Method
N_{p1}	11→12	30	30	1	Forward	Solenoid
Insulation: 1 tape layer between coil and finish lead, 1 tape layer after winding						
N_S	8→7	25 TIW	12	1	Forward	Solenoid
Insulation: 1 tape layer after winding						
N_{p2}	12→1	30	30	1	Forward	Solenoid
Insulation: 1 tape layer between coil and finish lead, 1 tape layer after winding						
N_A	5→4	30	15	1	Forward	Ctr. Solenoid
Insulation: 1 tape layer between coil and finish lead, 3 tape layer after winding						

Required Components

MFG: TDK
Material: PC47
Core: RM8
Bobbin: 12-pin, remove pins 2,3,10
Insulation Tape: Polyester, .050mm, 3M 1350 or Eq.

2.3. Electrical Characteristics

	Pin	Specification	Remark
Inductance	11→1	1000 µH ± 5%	50 kHz, 1 V
Leakage	11→1	< 6 µH	Short all other pins

3. Bill of Materials

Ref Des	Manf. P/N	Description	Qty	Manufacturer	Package
F1	36911000440	Fuse, 1.0A, 300VAC, time lag	1	Littelfuse	TE5
MOV1	SIOV-S07K320	Varistor, MOV, leaded, 7mm, 510V	1	Epcos	d=7mm
CX1	BFC233820683	Capacitor, X2, met. PP film, 68nF, 310VAC, 20%	1	Vishay	6x13mm
CX2	F861AE473M310C	Capacitor, X2, met. PP film, 47nF, 310VAC, 20%	1	Kemet	
C1	ECQE6104KF3	Capacitor, met. PE film, 100nF, 630V, 10%	1	Panasonic	ls=5mm
C2		Capacitor, MLCC, 10nF, 1KV, 10%, X7R, 1206	1		1206
C3		Capacitor, MLCC, 100nF, 50V, 10%, X7R, 0805	1		0805
C4	KMG series	Capacitor, Al. El., 22uF, 35V, 105C, 20%	1	Chemi-Con	5x11mm
C5		Capacitor, MLCC, 2.2uF, 25V, 10%, X7R, 0805	1		0805
C6		Capacitor, MLCC, 22pF, 50V, 10%, NP0, 0805	1		0805
C7, C8	UVY1E102MPD	Capacitor, Al. El., 1000uF, 25V, 105C, 20%	2	Nichicon	10x16mm
C9		Capacitor, MLCC, 330pF, 500V, 10%, X7R, 1206	1		1206
C10		Capacitor, MLCC, 1uF, 50V, 10%, X7R, 1206	1		1206
CY1	DE2E3KY472MA3BU02F	Capacitor, Y2, ceramic disc, 4.7nF, 300VAC, 20%	1	Murata	d=10mm
R1,R2, R12,R18		Resistor, SMT, 1206, 22K, 5%	4		1206
R3, R4, R13		Resistor, SMT, 1206, 150K, 5%	3		1206
R5		Resistor, SMT, 1206, 22ohm, 5%	1		1206
R6		Resistor, SMT, 1206, 200K, 5%	1		1206
R7		Resistor, SMT, 1206, 27K, 5%	1		1206
R8		Resistor, SMT, 1206, 27ohm, 5%	1		1206
R9, R10		Resistor, SMT, 1206, 2.32 ohm, 1%	2		1206
R11		Resistor, SMT, 1206, 2.37 ohm, 1%	1		1206
R14, R15		Resistor, SMT, 1206, 100ohm, 5%	2		1206
R16, R17		Resistor, SMT, 1206, 10K, 5%	2		1206
L1, L2	RLB9012-392KL	Inductor, radial, 3.9mH, 240mA, 9mm	2	Bourns	9mm
T1		Transformer, custom, RM8	1		RM8
BD1	MDB6S	Bridge rectifier, 1A, 600V	1	Fairchild	microSMT
D1	RS1M	Diode, fast rectifier, 1A, 1000V	1	Fairchild	SMA
D2	1N4004	Diode, general purpose rectifier, 1A, 400V	1	Fairchild	DO-41
D3	EGP30D	Diode, ultrafast rectifier, 3A, 200V	1	Fairchild	DO-201AD
Q1	FCD1300N80Z	MOSFET, N-ch, 800V, 1.3 ohm, D-PAK	1	Fairchild	D-PAK
U1	FL7733AMX	IC, single-stage PFC, PSR LED driver	1	Fairchild	SOIC-8

4. Performance

4.1. Output Current Regulation

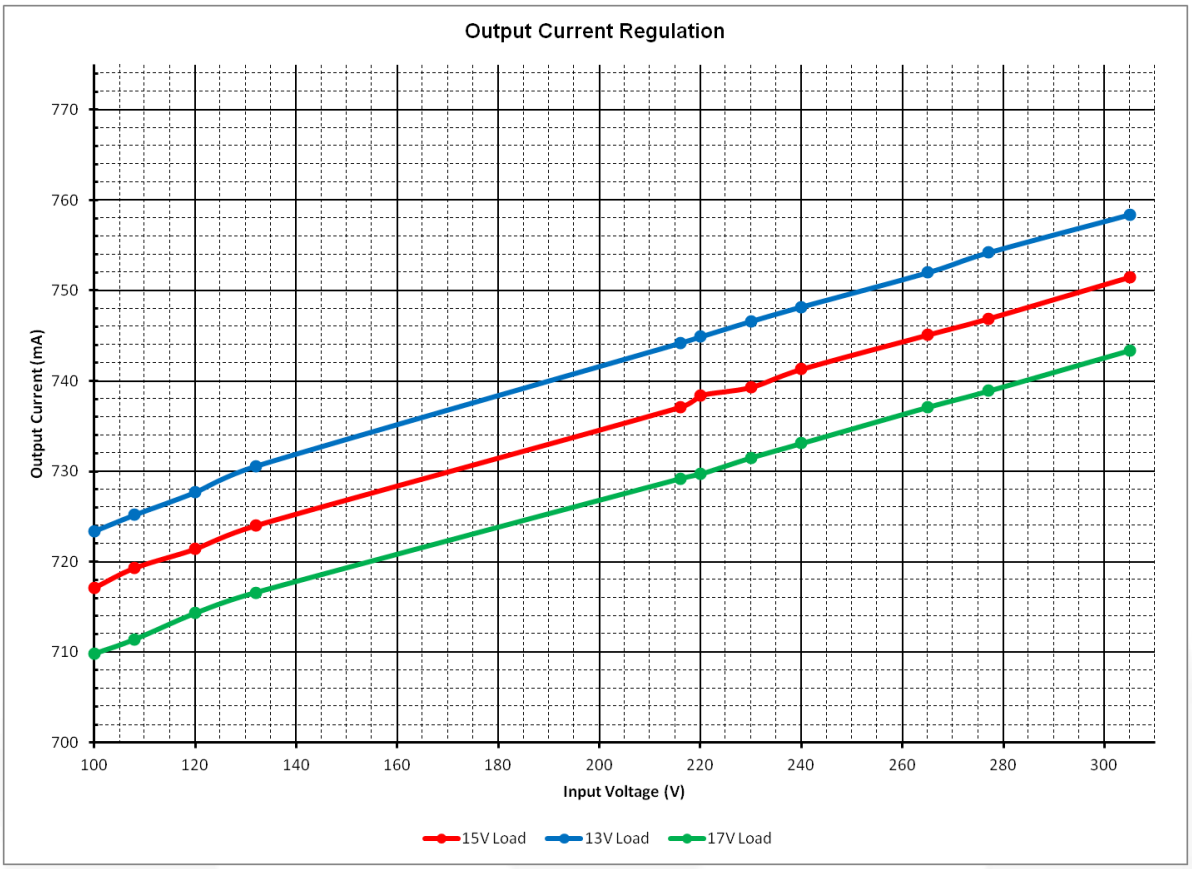

Figure 3. Output Current Regulation Data Plotted against Line Variation

Table 1. Output Current Regulation, Spec. = Set I_{OUT} at 725 mA with 15 V Load and 120 V_{AC} Input

	I_{OUT} (mA)		
V_{IN} (V_{AC})	15 V	13 V	17 V
100	717.1	723.4	709.8
120	721.4	727.7	714.3
220	738.4	744.9	729.7
240	741.3	748.2	733.1
277	746.9	754.2	754.2
305	751.5	758.4	758.4

4.2. Efficiency

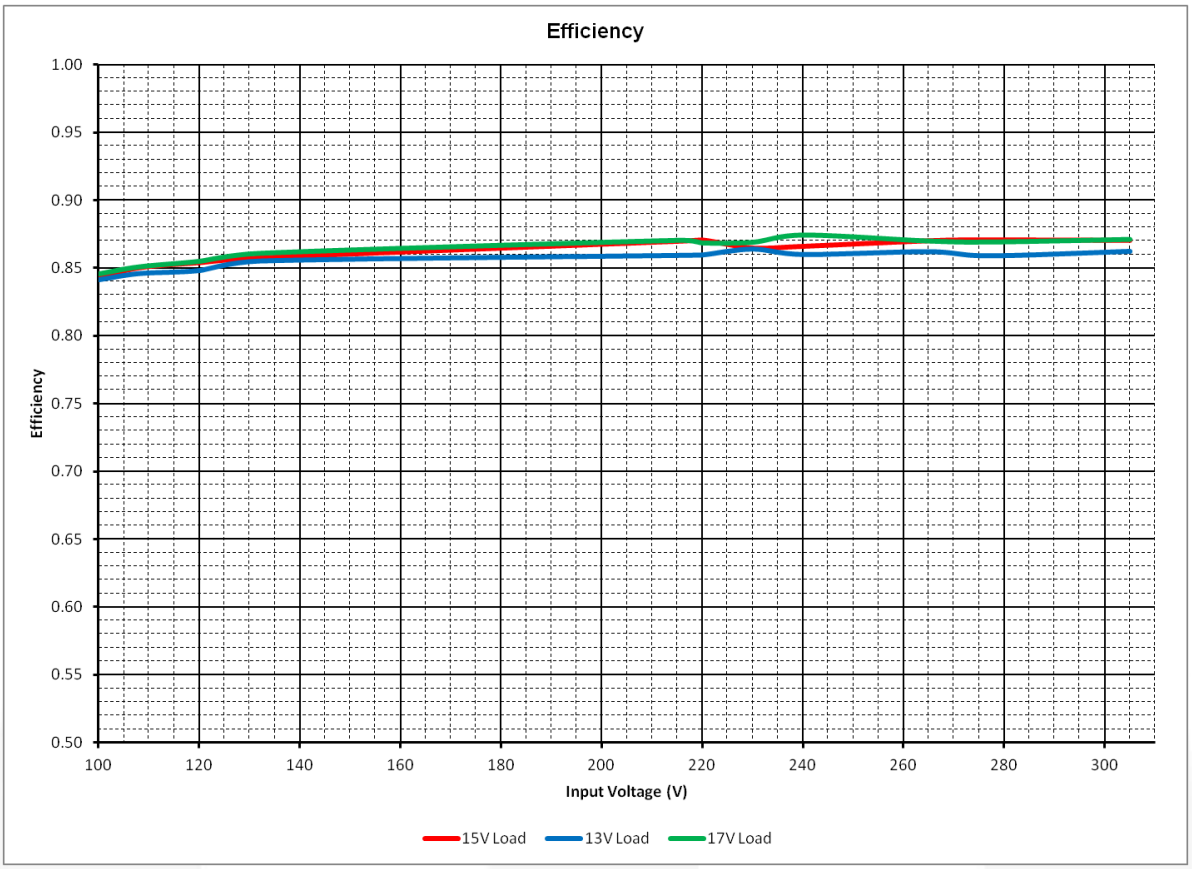

Figure 4. Efficiency Data Plotted against Line Variation

Table 2. Efficiency Summary

	Efficiency (%)		
V_{IN} (V_{AC})	15 V	13 V	17 V
100	84.2	84.1	84.6
120	85.4	84.8	85.5
220	87.1	86.0	86.9
240	86.6	86.0	87.4
277	87.1	85.9	86.9
305	87.0	86.2	87.1

4.3. Power Factor

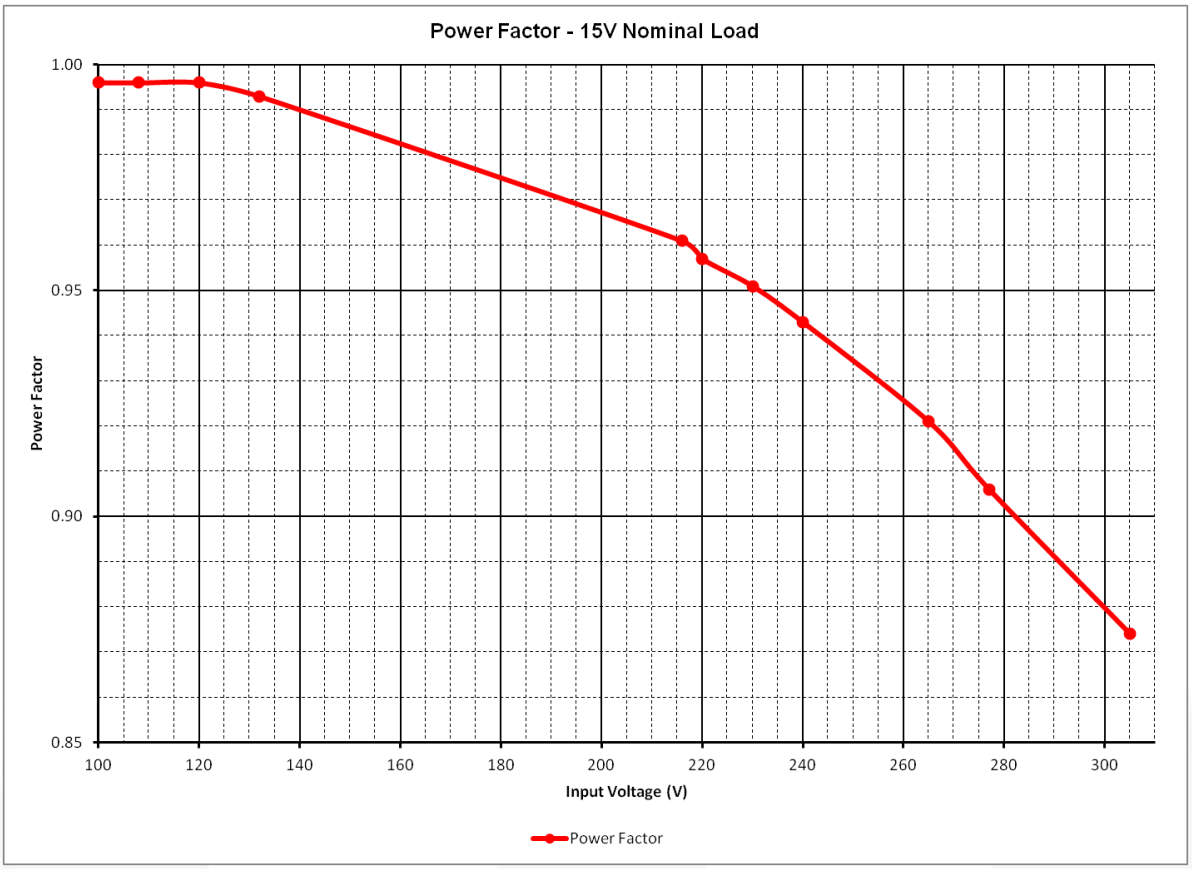

Figure 5. Power Factor Data plotted against Line Variation

Table 3. Power Factor Summary, Spec.: >0.90 at Nominal Line Voltages

V_{IN} (V_{AC})	P.F.
120	.996
220	.957
240	.943
277	.906

5. Related Resources

FL7733A – Product Folder