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Innovative LED Solutions

PRODUCT SELECTION GUIDE

LED Lighting Reference Designs

June 2014

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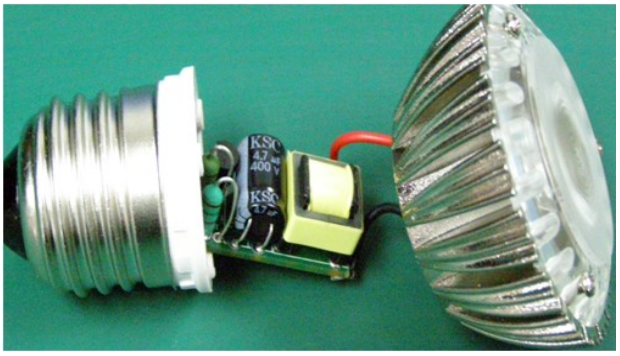
E27 1x1W LED Lighting

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	1	3.5V	1W	Flyback



Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 3.5V, 350mA. This circuit is a typical flyback type power supply which includes the AC rectified circuit (BD1, C1), power drive circuit (BD pin, Q1), secondary rectified circuit (D3, C4) and the IC(ACT364) control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base driver for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers for one (min), or two (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The turn ratio of the primary turn and the secondary turn (N_P/N_S), together with the R7 sets the maximum output current value as shown in formula (1.1). The voltage setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (1.2). $N_P/N_S/N_{AUX}$ (160/10/23) must be designed correctly to make sure it operates in DCM mode and it can supply either one to two LEDs in same circuit. A design value V_{OUTCV} equal to 3.5V and $I_{OUTCC-MIN}$ equal to 350mA are used to do the design.

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.396 \times 0.9}{R_{CS}} \right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCV}} \right) \quad (1.1)$$

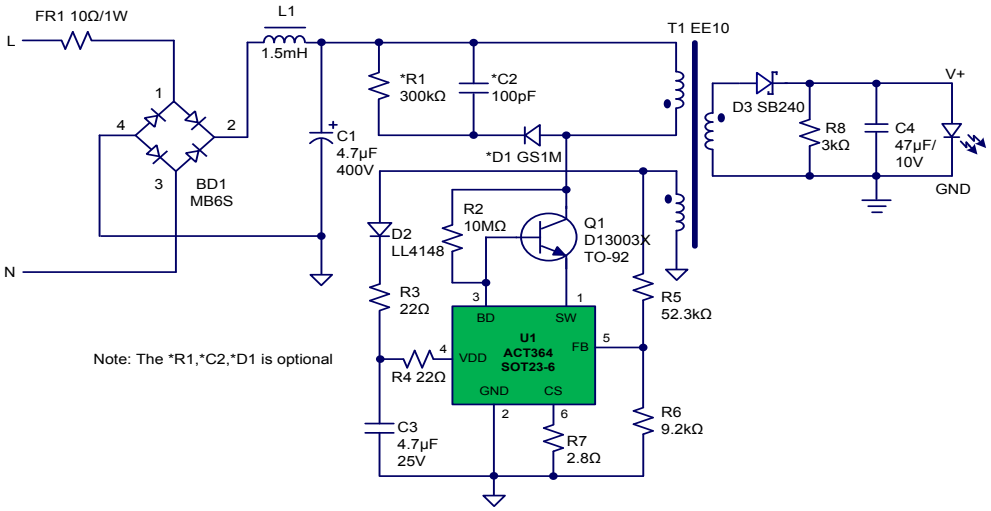
N_S and N_{AUX} are numbers of transformer secondary and auxiliary turns, and V_{SEC-R} is the rectifier diode forward drop voltage at approximately 0.1A bias.

$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \quad (1.2)$$

The peak current limit is set by (0.396×0.9) /R_{CS}.

Figure 1:

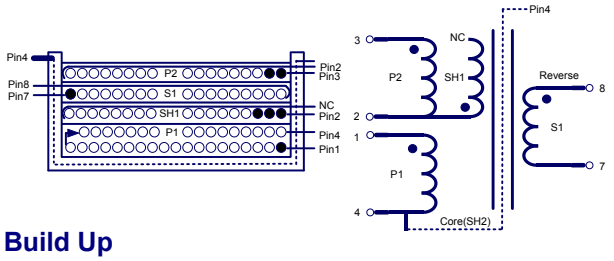
Schematic of LED Lighting Driver



Bill of Materials

REF.	DESCRIPTION	MFTR.
C1	Capacitor,Electrolytic,4.7μF/400V,8×12mm	KSC
C2	Capacitor,Ceramic,100pF/500V,1206,SMD	POE
C3	Capacitor,Ceramic,47μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/10V,1206,SMD	POE
BD1	Bridge Rectifier,600V/0.5A, MBS06, SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier, LL4148, 100V/1A	PANJIT
D3	Diode,schottky,40V/2A,S240,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE 15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor, 00K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,52.3K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.2K ohm,0805,1%	TY-OHM
R7	Chip Resistor,2.8 ohm,1206,5%	TY-OHM
R8	Chip Resistor, 3K ohm, 0805, 5%	TY-OHM
T1	Transformer, Lp=4.2mH, EE10	
U1	IC, ACT364US-T, SOT23-6	ACT

Transformer Specification

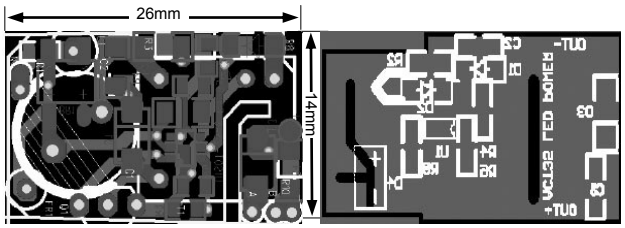


Build Up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	160	2UEW	0.1Φ×1	3	25μ/8.5mm	2
SH2	2	Open	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
S1	8	7	10	TEXE Reverse	0.35Φ×1	1	25μ/8.5mm	2
P2	3	2	23	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

Note: P1 and P2 are Primary, S1 is Secondary (Bobbin: EE-10 Horizontal).

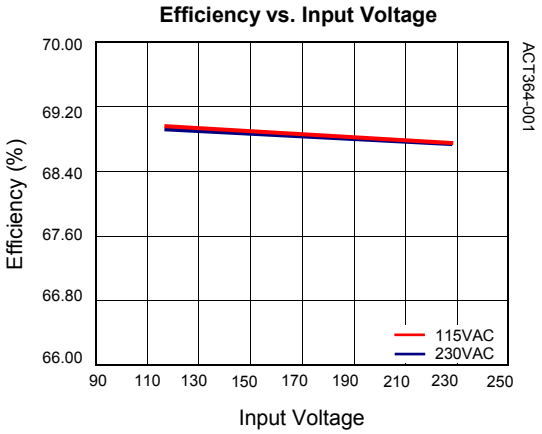
PCB Top and Bottom Layers

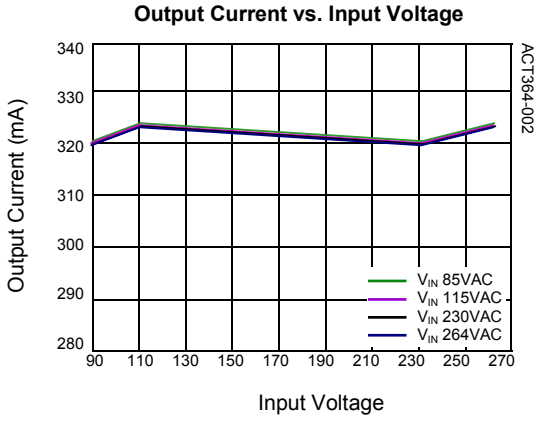


Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1 Inductance	Inductance between pin 4 and pin 1 at 1VAC & 1kHz	4.2mH ± 7%
3	P1 Leakage Inductance	Inductance between pin 4 and pin 1 with pins 3-2 and 8-5 shorted	75μH

Typical performance Characteristics

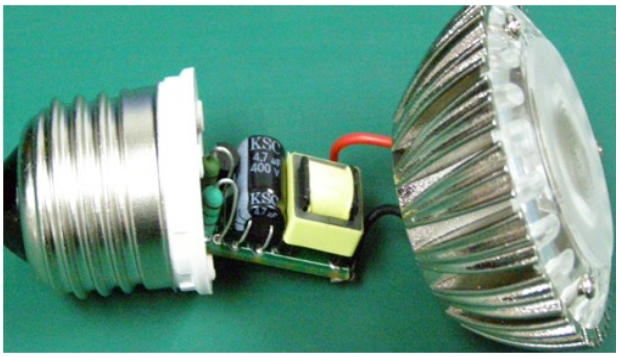




EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED01	85-264VAC	300-350mA	1 or 2

E27 1x1W LED Lighting Non-isolated

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	1	3.5V	1W	buck



Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 3.5V, 350mA. This circuit is tapped buck power supply which includes the AC rectified circuit (BD1, C1), power drive circuit (BD pin, Q1), secondary rectified circuit (D3, C4) and the IC(ACT364) control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base driver for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers for one (min), or two (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The turn ratio of the primary turn and the secondary turn (N_P/N_S), together with the R7 sets the maximum output current value as shown in formula (1.1). The voltage setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (1.2). N_P/N_{AUX} (160/23) must be designed correctly to make sure it operates in DCM mode and it can supply either one to two LEDs in same circuit. A design value V_{OUTCV} equal to 3.5V and $I_{OUTCC-MIN}$ equal to 350mA are used to do the design.

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.396 \times 0.9}{R_{CS}} \right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCV}} \right) \quad (1.1)$$

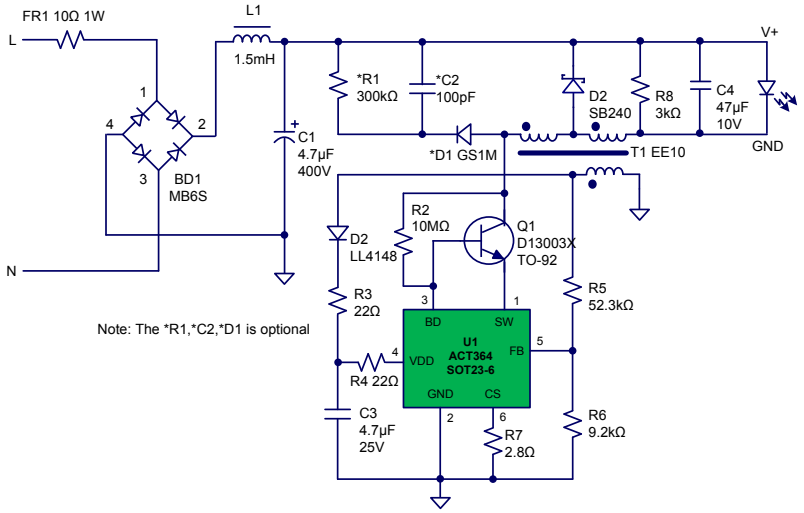
N_S and N_{AUX} are numbers of transformer secondary and auxiliary turns, and V_{SEC-R} is the rectifier diode forward drop voltage at approximately 0.1A bias.

$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \quad (1.2)$$

The peak current limit is set by (0.396×0.9) /R_{CS}.

Figure 1:

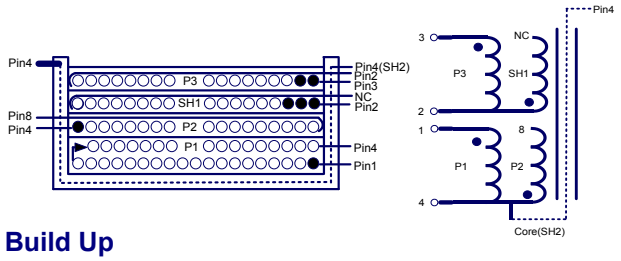
Schematic of LED Lighting Driver



Bill of Materials

REF.	DESCRIPTION	MFTR.
C1	Capacitor,Electrolytic,4.7μF/400V,8×12mm	KSC
C2	Capacitor,Ceramic,100pF/500V,1206,SMD	POE
C3	Capacitor,Ceramic,47μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/10V,1206,SMD	POE
BD1	Bridge Rectifier,600V/0.5A, MBS06, SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier, LL4148, 100V/1A	PANJIT
D3	Diode,schottky,40V/2A,S240,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE 15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor, 00K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,52.3K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.2K ohm,0805,1%	TY-OHM
R7	Chip Resistor,2.8 ohm,1206,5%	TY-OHM
R8	Chip Resistor, 3K ohm, 0805, 5%	TY-OHM
T1	Transformer, Lp=4.2mH, EE10	
U1	IC, ACT364US-T, SOT23-6	ACT

Transformer Specification

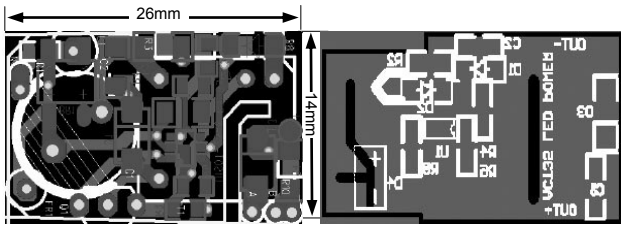


Build Up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	150	2UEW	0.1Φ×1	3	25μ/8.5mm	2
P2	4	8	10	2UEW	0.3Φ×1	1	25μ/8.5mm	2
SH1	2	NC	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
P3	3	2	23	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

Note: P1,P2 ,and P3 are Primary (Bobbin: EE-10 ;Vertical).

PCB Top and Bottom Layers



Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1+P2 Inductance	Inductance between pin 8 and pin 1 at 1VAC & 1kHz	4.2mH ± 7%
3	P1+P2 Leakage Inductance	Inductance between pin 4 and pin 8 with pins 3-2 .	75μH

Typical performance Characteristics

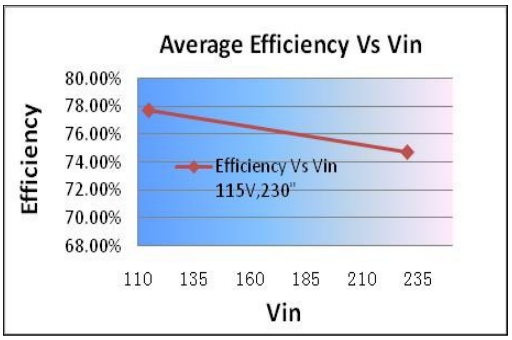


Figure 1

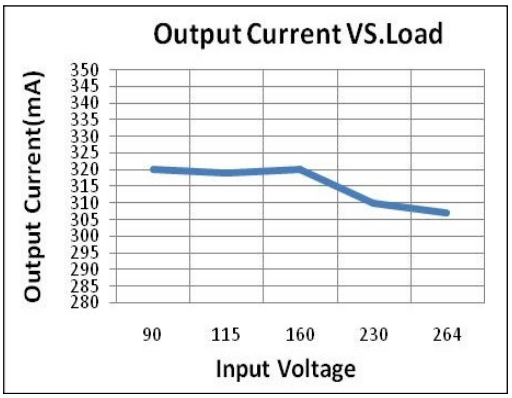


Figure 2

EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED02	85-264VAC	300-350mA	1 or 2

GU10 1x3W LED Lighting

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	1	4V	3W	Flyback

Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 4V, 650mA. This circuit is a typical flyback type power supply which includes the AC rectified circuit (BD1, L1, C1), primary snubber circuit (D1, R1, C2), power drive circuit (BD pin ,Q1), secondary rectified circuit (D3, C4) and the IC control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-couple. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers one 3W LED lights in series due to the wide VDD operation ranges.

Key Component Selection

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$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.396 \times 0.9}{R_{CS}}\right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCV}}\right) \qquad (1.1)$$

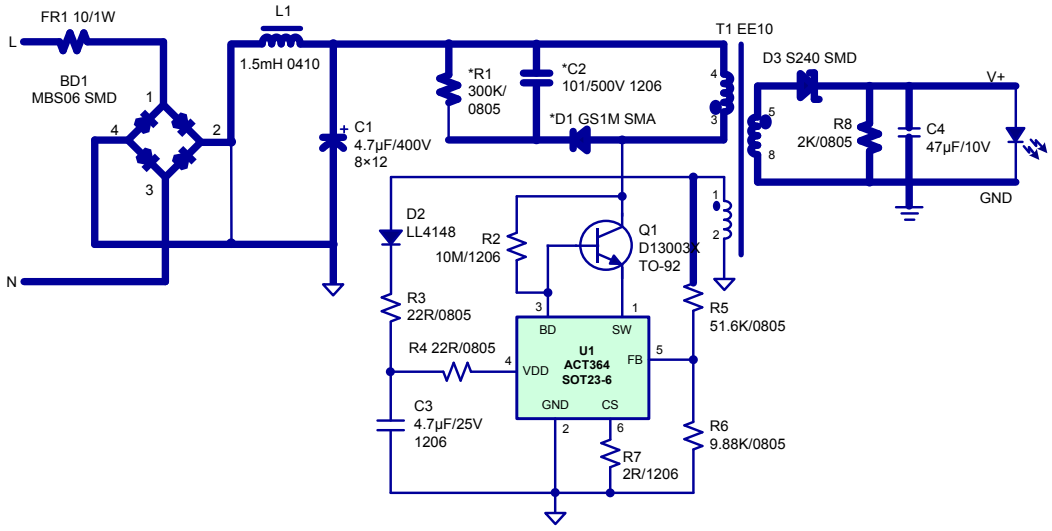
N_S and N_{AUX} are numbers of transformer secondary and auxiliary turns, and V_{SEC-R} is the rectifier diode forward drop voltage at approximately 0.1A bias.

$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \qquad (1.2)$$

The peak current limit is set by (0.396×0.9) /R_{CS}.

Figure 1:

Typical Application Circuit



Bill of Materials

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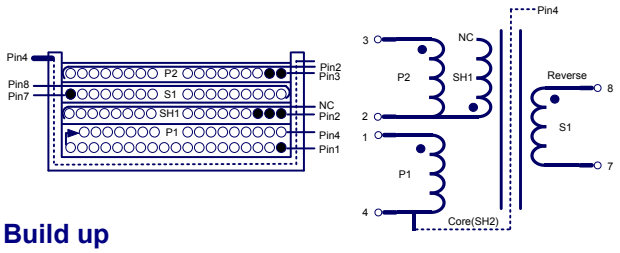
C3	Capacitor,Ceramic,4.7μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/10V,1206,SMD	POE
BD1	Bridge Rectifier,600V/0.5A,MBS06,SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier,LL4148,100V/1A	PANJIT
D3	Diode,schottky,40V/2A,S240,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB 1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE 15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor,300K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,51.6K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.88K ohm,0805,1%	TY-OHM
R7	Chip Resistor,2 ohm,1206,5%	TY-OHM
R8	Chip Resistor,2K ohm,0805,5%	TY-OHM
T1	Transformer,Lp=3.2mH,EE10	
U1	IC,ACT364US-T,SOT23-6	ACT

Transformer Specification

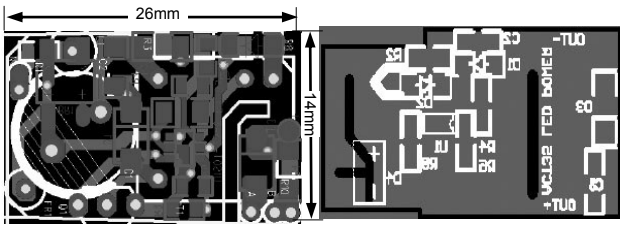


Build up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	160	2UEW	0.1Φ×1	3	25μ/8.5mm	2
SH2	2	NC	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
S1	8	7	7	TEXE Reverse	0.35Φ×1	1	25μ/8.5mm	2
P2	3	2	22	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

P1 and P2 are Primary, S1 is Secondary (Bobbin: EE-10 Vertical)

PCB Top and Bottom Layers



Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1 Inductance	Inductance between pin 1 and pin 4 at 1VAC & 1kHz	3.2mH ± 7%
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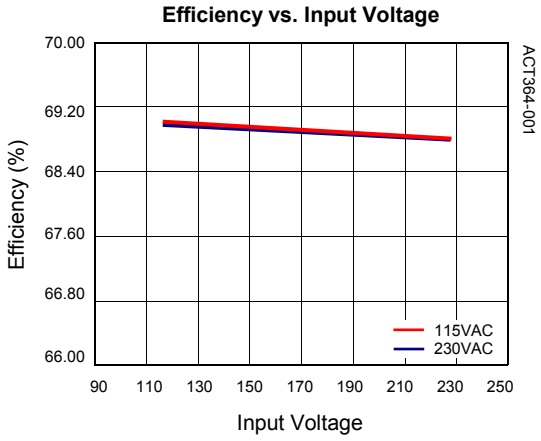
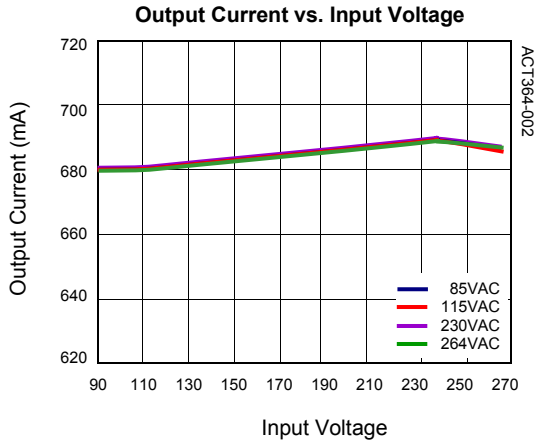
Typical Performance Characteristics





EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED03	85-264VAC	650-750mA	1

GU10 1x3W LED Lighting Non-isolated

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	1	4V	3W	buck

Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 4V, 650mA. This circuit is tapped buck power supply which includes the AC rectified circuit (BD1, L1, C1), primary snubber circuit (D1, R1, C2), power drive circuit (BD pin ,Q1), secondary rectified circuit (D3, C4) and the IC control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-couple. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers one 3W LED lights in series due to the wide VDD operation ranges.

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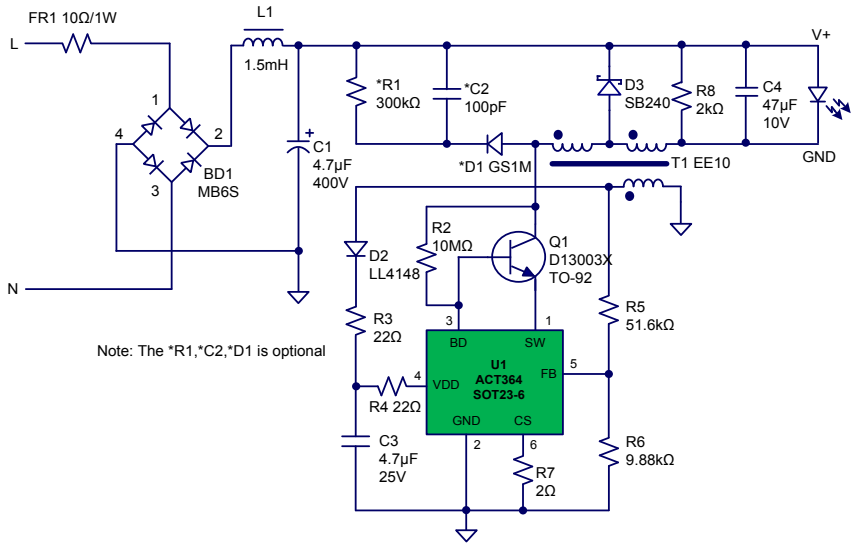
$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \quad (1.2)$$

The peak current limit is set by (0.396×0.9) /R_{CS}.

Figure 1:

Typical Application Circuit



Bill of Materials

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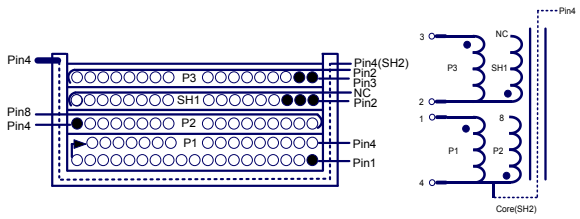
C3	Capacitor,Ceramic,4.7μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/10V,1206,SMD	POE
BD1	Bridge Rectifier,600V/0.5A,MBS06,SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier,LL4148,100V/1A	PANJIT
D3	Diode,schottky,40V/2A,SB240,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE 15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor,300K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,51.6K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.88K ohm,0805,1%	TY-OHM
R7	Chip Resistor,2 ohm,1206,5%	TY-OHM
R8	Chip Resistor,2K ohm,0805,5%	TY-OHM
T1	Transformer,Lp=3.2mH,EE10	
U1	IC,ACT364US-T,SOT23-6	ACT

Transformer Specification

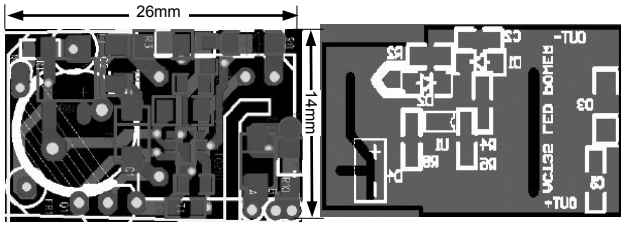


Build up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	153	2UEW	0.1Φ×1	3	25μ/8.5mm	2
P2	4	8	7	2UEW	0.35Φ×1	1	25μ/8.5mm	2
SH1	2	NC	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
P3	3	2	22	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

Note: P1,P2, and P3 are Primary (Bobbin: EE-10; Vertical).

PCB Top and Bottom Layers



Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1+P2 Inductance	Inductance between pin 1 and pin 8 at 1VAC & 1kHz	3.2mH ± 7%
3	P1+P2 Leakage Inductance	Inductance between pin 1 and pin 8 with pins 2-3	75μH

Typical Performance Characteristics

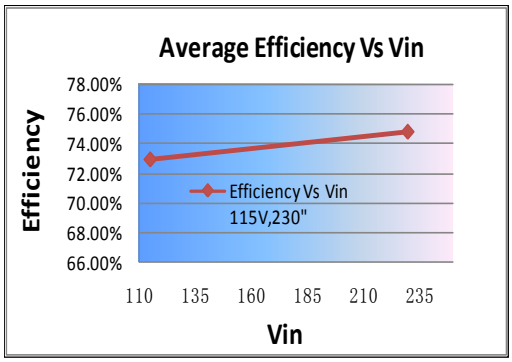


Figure 1

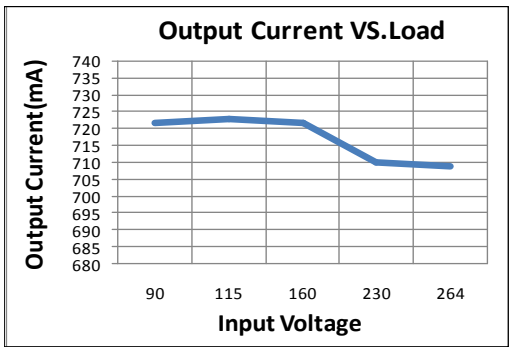


Figure 2

EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED04	85-264VAC	650-750mA	1

GU10 3x1W LED Lighting

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	3	12V	3W	Flyback

Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 12V, 350mA. This circuit is a typical flyback type power supply which includes the AC rectified circuit (BD1, C1, L1), primary snubber circuit (D1, R1, C2), power drive circuit (BD pin, Q1), secondary rectified circuit (D3, C4) and the IC control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers for two (min), or three (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The turn ratio of the primary turn and the secondary turn (N_P/N_S), together with the R7 sets the maximum output current value as shown in formula (1.1). The voltage setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (1.2). $N_P/N_S/N_{AUX}$ (160/20/24) must be designed correctly to make sure it operates in DCM mode and it can supply either two or three LEDs in same circuit. A design value V_{OUTCV} equal to 12V and $I_{OUTCC\ MIN}$ equal to 300mA are used to do the design.

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.396 \times 0.9}{R_{CS}}\right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCV}}\right) \qquad (1.1)$$

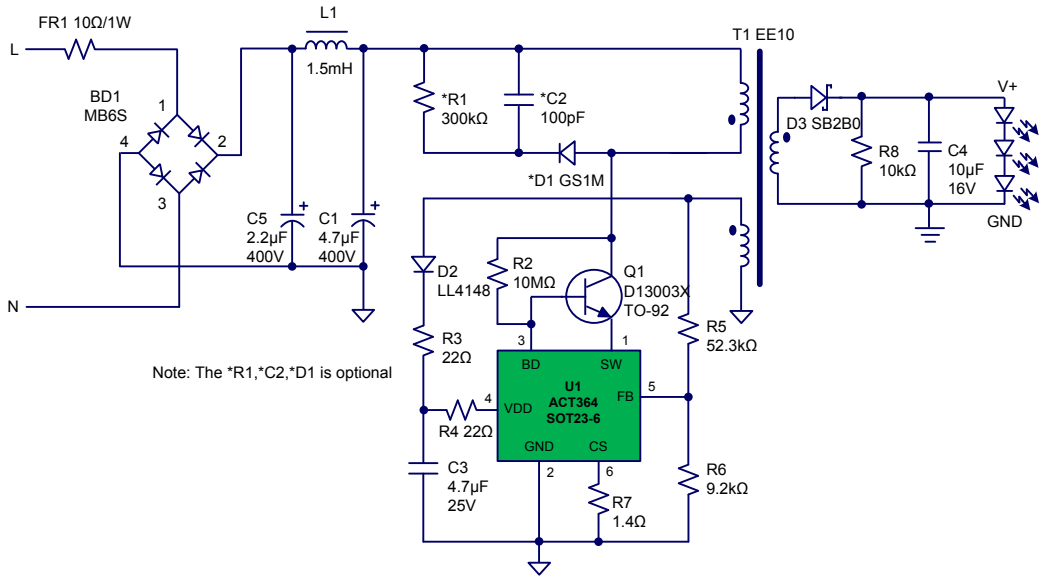
N_S and N_{AUX} are numbers of transformer secondary and auxiliary turns, and $V_{SEC\ R}$ is the rectifier diode forward drop voltage at approximately 0.1A bias.

$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \qquad (1.2)$$

The peak current limit is set by $(0.396 \times 0.9)/R_{CS}$.

Figure 1:

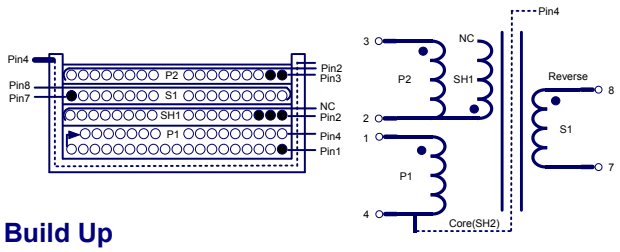
Schematic of LED Lighting Driver



Bill of Materials

REF.	DESCRIPTION	MFTR.
C1	Capacitor,Electrolytic,4.7μF/400V,8×12mm	KSC
C2	Capacitor,Ceramic,100pF/500V,1206,SMD	POE
C3	Capacitor,Ceramic,4.7μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/16V,1206,SMD	POE
C5	Capacitor,Electrolytic,2.2μF/400V,6.2×12mm	KSC
BD1	Bridge Rectifier,600V/0.5A,MBS06,SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier, LL4148, 100V/1A	PANJIT
D3	Diode,schottky,100V/1A,S100,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor,300K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,52.3K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.2K ohm,0805,1%	TY-OHM
R7	Chip Resistor,1.4 ohm,1206,5%	TY-OHM
R8	Chip Resistor,10K ohm,0805,5%	TY-OHM
T1	Transformer,Lp=2.1mH,EE10	
U1	IC, ACT364US-T, SOT23-6	ACT

Transformer Specification

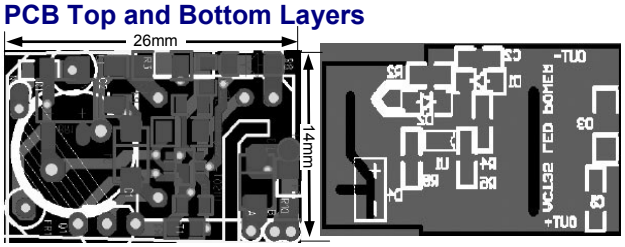


Build Up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	160	2UEW	0.1Φ×1	3	25μ/8.5mm	2
SH1	2	Open	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
S1	8	7	20	TEXE Reverse	0.25Φ×1	1	25μ/8.5mm	2
P2	3	2	24	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

Note: P1 and P2 are Primary, S1 is Secondary (Bobbin: EE-10 Vertical).

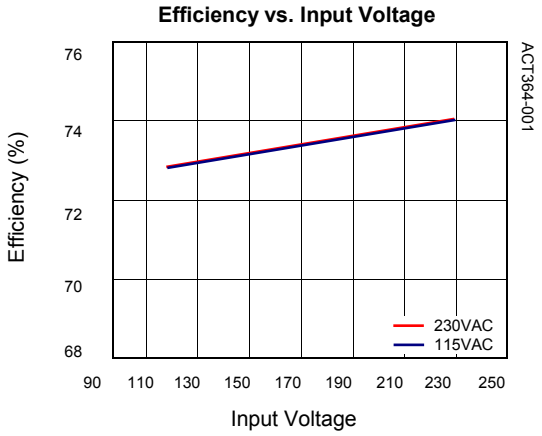
PCB Top and Bottom Layers

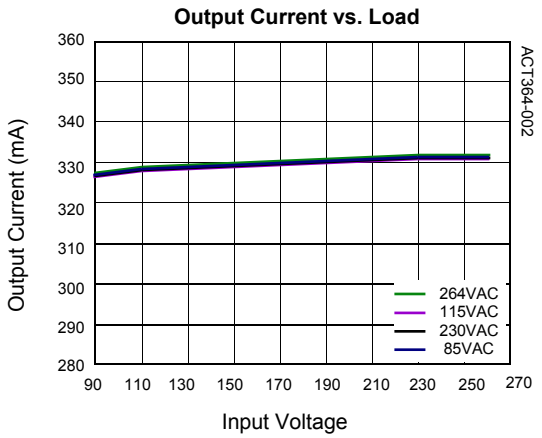


Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1 Inductance	Inductance between pin 1 and pin 4 at 1VAC & 1kHz	2.1mH ± 7%
3	P1 Leakage Inductance	Inductance between pin 1 and pin 4 with pins 2-3 and 7-8 shorted	75μH

Typical Performance Characteristics

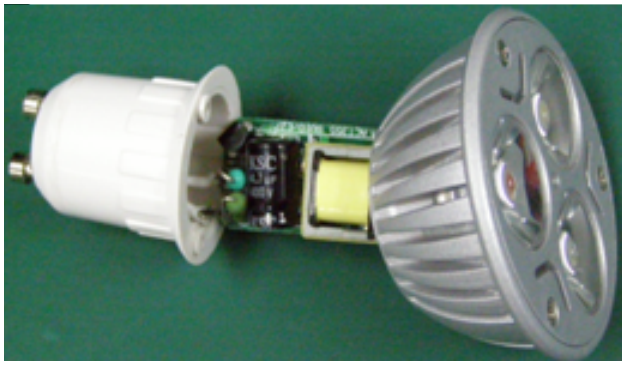




EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED05	85-264VAC	280-350mA	2 or 3

GU10 3x1W LED Lighting No-isolated

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Topology
85 - 264VAC	ACT364	3	12V	3W	buck



Operation and Application

Figure 1 is the schematic of an offline LED driver using ACT364 to provide a power output of 12V, 350mA. This circuit is tapped buck power supply which includes the AC rectified circuit (BD1, C1, L1), primary snubber circuit (D1, R1, C2), power drive circuit (BD pin, Q1), secondary rectified circuit (D3, C4) and the IC control circuit. ACT364 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Through a patented PSR technology, this circuit can provide drivers for two (min), or three (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The turn ratio of the primary turn and the secondary turn (N_P/N_{AUX}), together with the R7 sets the maximum output current value as shown in formula (1.1). The voltage setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (1.2). N_P/N_{AUX} (160/24) must be designed correctly to make sure it operates in DCM mode and it can supply either two or three LEDs in same circuit. A design value V_{OUT-CV} equal to 12V and $I_{OUTCC\ MIN}$ equal to 300mA are used to do the design.

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.396 \times 0.9}{R_{CS}}\right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCV}}\right) \qquad (1.1)$$

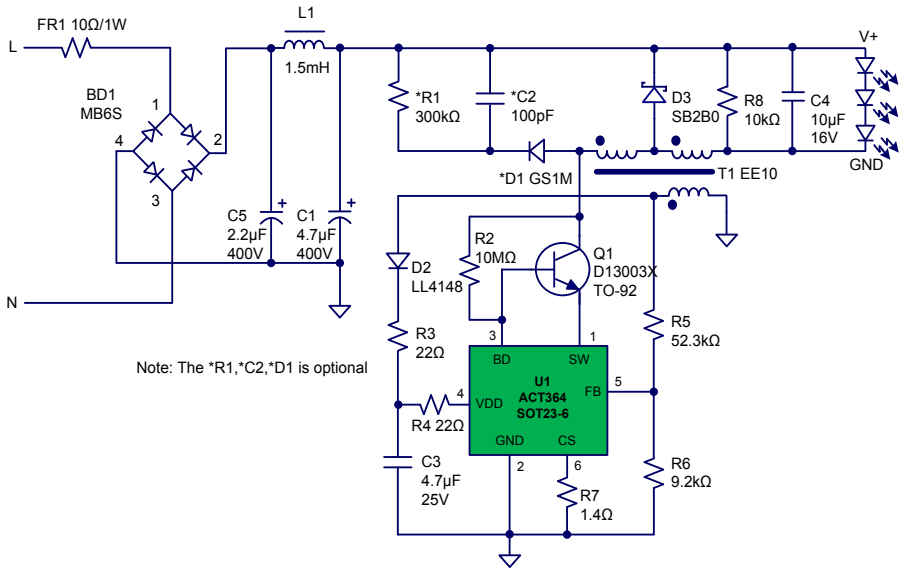
N_S and N_{AUX} are numbers of transformer secondary and auxiliary turns, and $V_{SEC\ R}$ is the rectifier diode forward drop voltage at approximately 0.1A bias.

$$V_{OUTCV} = V_{REF} \times (1 + \frac{R5}{R6}) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \qquad (1.2)$$

The peak current limit is set by $(0.396 \times 0.9)/R_{CS}$.

Figure 1:

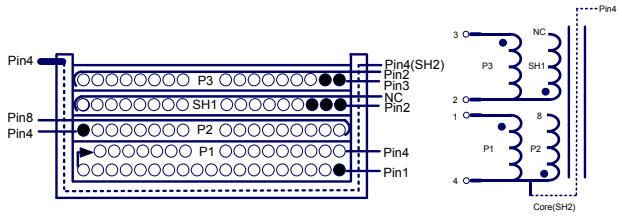
Schematic of LED Lighting Driver



Bill of Materials

REF.	DESCRIPTION	MFTR.
C1	Capacitor,Electrolytic,4.7μF/400V,8×12mm	KSC
C2	Capacitor,Ceramic,100pF/500V,1206,SMD	POE
C3	Capacitor,Ceramic,4.7μF/25V,1206,SMD	POE
C4	Capacitor,Ceramic,10μF/16V,1206,SMD	POE
C5	Capacitor,Electrolytic,2.2μF/400V,6.2×12mm	KSC
BD1	Bridge Rectifier,600V/0.5A,MBS06,SDIP	PANJIT
D1	Diode,U1tra Fast,GS1M,1000V/1.0A,SMA	PANJIT
D2	General Rectifier, LL4148, 100V/1A	PANJIT
D3	Diode,schottky,200V/1A,SB2B0,SMA	PANJIT
L1	Axial Inductor,1.5mH,0410,Dip	SoKa
PCB1	PCB,L*W*T=25.5×14×1. 6mm,Rev:A	Jintong
FR1	Wire Round Resistor,1W,10ohm,KNP,5%	TY-OHM
Q1	Transistor,HFE15-25,NPN,D13003,TO-92	Huawai
R1	Chip Resistor,300K ohm,0805,5%	TY-OHM
R2	Chip Resistor,10M ohm,1206,5%	TY-OHM
R3,4	Chip Resistor,22 ohm,0805,5%	TY-OHM
R5	Chip Resistor,52.3K ohm,0805,1%	TY-OHM
R6	Chip Resistor,9.2K ohm,0805,1%	TY-OHM
R7	Chip Resistor,1.4 ohm,1206,5%	TY-OHM
R8	Chip Resistor,10K ohm,0805,5%	TY-OHM
T1	Transformer,Lp=2.1mH,EE10	
U1	IC, ACT364US-T, SOT23-6	ACT

Transformer Specification

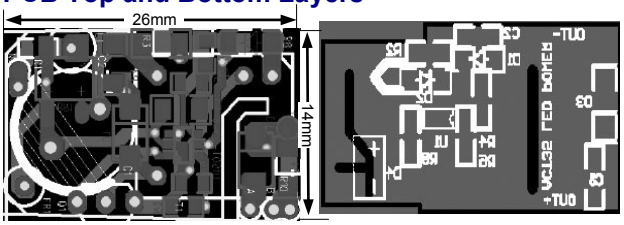


Build Up

WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	1	4	140	2UEW	0.1Φ×1	3	25μ/8.5mm	2
P2	4	8	20	2UEW	0.3Φ×1	1	25μ/8.5mm	2
SH1	2	NC	16	2UEW	0.1Φ×3	1	25μ/8.5mm	2
P3	3	2	24	2UEW	0.1Φ×2	2	25μ/8.5mm	2
SH2	Core	4	1	Copper Wire	0.18Φ×1	1	25μ/8.5mm	2

Note: P1 and P2 and P3 are Primary (Bobbin: EE-10 ;Vertical).

PCB Top and Bottom Layers



Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1+P2 Inductance	Inductance between pin 1 and pin 8 at 1VAC & 1kHz	2.1mH ± 7%
3	P1+P2 Leakage Inductance	Inductance between pin 1 and pin 8 with pins 2-3 . shorted	75μH

Typical Performance Characteristics

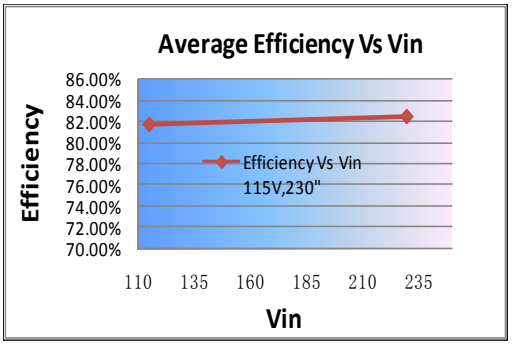


Figure 1

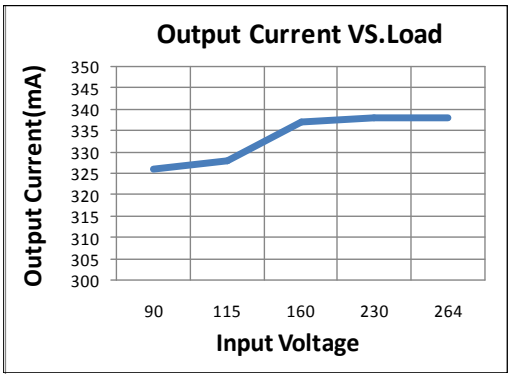
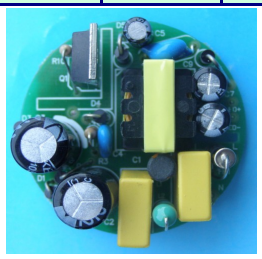


Figure 2

EVALUATION KITS	V_{IN}	I_O	LED(s)
ACT364-LED06	85-264VAC	280-350mA	2 or 3

PAR30 7x1W LED Lighting

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Transformer	Topology
85 - 264VAC	ACT365	7	26V	7.8W	EE16	Flyback



Operation and Application

Figure 1 is the schematic of LED lighting using ACT365 to provide output power of 26V300mA with PF>0.77.This circuit is a typical flyback power supply which includes the AC rectified circuit(BD1,C2, C3),power drive circuit (BD pin, Q1),power factor rectified circuit (D1-D3,C2,C3),secondary rectified circuit (D6, C7,C8) and the IC control circuit. ACT365 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Resistance of R10 determines the output DC cord compensation percentage.

Through a patented PSR technology, this circuit can provide drivers for five(min), or seven (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The maximum output current is decided by formula (1).

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.9 * 0.396}{R_{CS}}\right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCC}}\right) \quad (1)$$

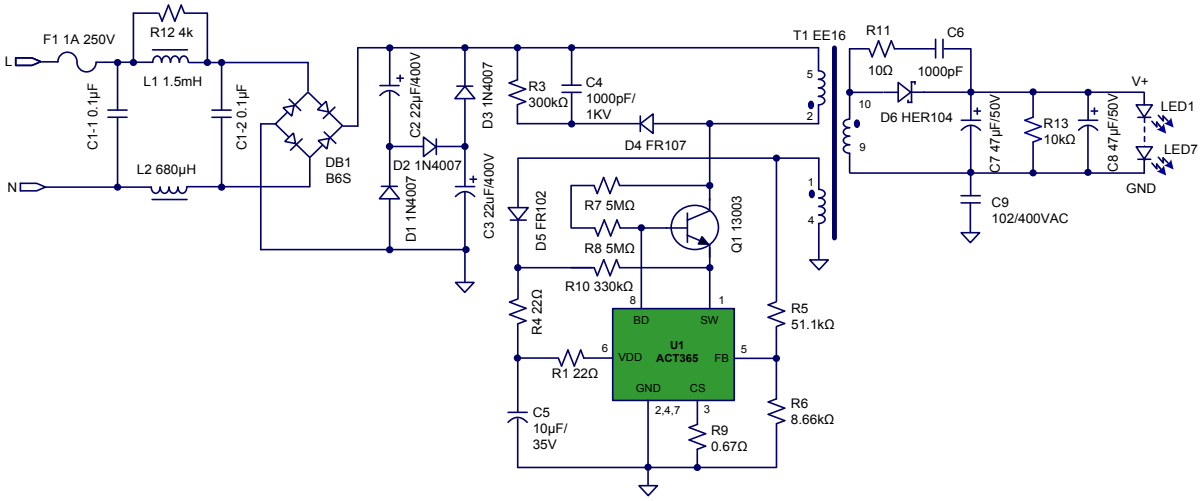
Lp is the transformer inductance value, Rcs is the current sense resistor, which is shown as R9 in the schematic. Fsw is the switching frequency, which design value is 75kHz. η is the overall system efficiency, which value is approximately equal to 75%. Voutcc is the output voltage, which setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (2).

$$V_{OUTCC} = V_{REF} \times \left(1 + \frac{R_5}{R_6}\right) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \quad (2)$$

Np/Ns/Naux (102/23/13) must be designed correctly to ensure it operates in DCM in all conditions. A design value Voutcc equal to 26V and Ioutcc_min equal to 300mA are used to do the design. Ns and Naux are number of turns of secondary and auxiliary of the transformer. VSEC_R is the forward voltage drop of the output rectifier diode at approximately 0.1A bias. The peak current limit is set by (0.396×0.9)/Rcs.

Figure 1:

Schematic of LED Lighting Driver

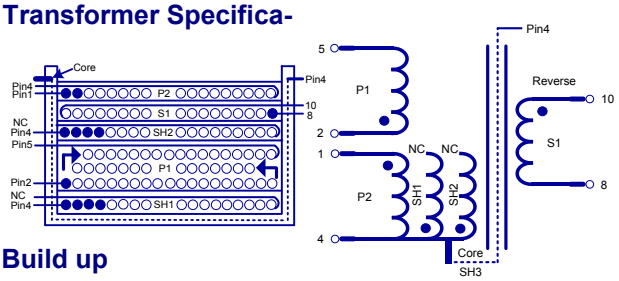


ACT365 DESIGN GUIDE

Bill of Materials

REF	DESCRIPTION	MFTR
C1-1/2	X1 Capacitor,0.1μF/400V,13x6x11mm	USE
C2,C3	Capacitor,Electrolytic, 22μF/250V, 10x14mm	KSC
C4	Capacitor,Ceramic,1000pF/1KV, DIP	POE
C5	Capacitor,Electrolytic,10μF/35V, 5x11mm	KSC
C6	Capacitor,Ceramic,1000pF/50V,1206	POE
C7,C8	Capacitor,Electrolytic, 47μF/50V, 6.3x12mm	KSC
C9	Y cap,1000pF/275V,Dip	USE
BD1	Bridge,B6S,600V/0.5A,MDI,SMD	PANJIT
D1~D3	Fast Recovery Rectifiers,1N4007, DO-41	Good-Ark
D4	Fast Recovery Rectifier ,FR107,DO-41	Good-Ark
D5	Fast Recovery Rectifier ,FR102,DO-41	Good-Ark
D6	Efficiency Rectifiers, 300V/1A ,HER104, DO-41	Good-Ark
L1	Axial Inductor,1.5mH, ¢5x7mm,Dip	SoKa
L2	I-shaped Inductor,680μH,0410,Dip	SoKa
Q1	Transistor, HFE 20-25 NPN, D13003, TO-126	Huawei
PCB1	PCB, ACT365_LED_01,Rev:A	Jintong
F1	Fuse:3.15A 250V 3.6*10mm With Pigtail	walter
R1,R4	Chip Resistor, 22Ω, 0805, 5%	TY-OHM
R3	Chip Resistor, 300kΩ, 1W, 5%	TY-OHM
R5	Chip Resistor, 51.1kΩ, 0805,1%	TY-OHM
R6	Chip Resistor, 8.66kΩ, 0805, 1%	TY-OHM
R7,R8	Chip Resistor, 5MΩ, 0805 , 5%	TY-OHM
R9	Chip Resistor, 0.67Ω, 1206,1%	TY-OHM
R10	Chip Resistor, 330kΩ, 1/4W, 5%	TY-OHM
R11	Chip Resistor, 10Ω, 0805, 5%	TY-OHM
R12	Chip Resistor, 4.0kΩ, 0805, 5%	TY-OHM
R13	Chip Resistor, 10kΩ, 0805, 5%	TY-OHM
T1	Transformer, Lp=1.0mH, EE16, Vertical	
U1	IC, ACT365SH-T ,SOP-8	

Transformer Specifica-



Build up

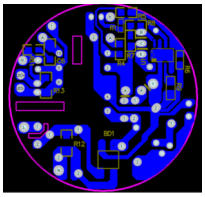
WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
SH1	4	NC	14	2UEW	0.12Φ*4	1	0.025*8.5W	2
P1	2	5	102	2UEW	0.23Φ*1	3	0.025*8.5W	2
SH2	4	NC	14	2UEW Reverse	0.12Φ*4	1	0.025*8.5W	2
S1	8	10	23	TEX-E	0.35Φ*1	1	0.025*8.5W	2
P2	1	4	13	2UEW	0.12Φ*2	1	0.025*8.5W	2
SH3	core	4	3	conductor	0.15Φ*1	1	0.025*10	8

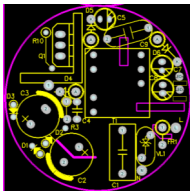
Note: SH1,SH2,and SH3 are shielding; P1 and P2 are Primary, S1 is Secondary (Bobbin: EE-16, Vertical).

Electrical Specifications

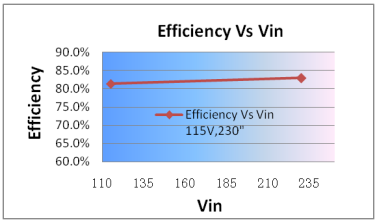
ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1 Inductance	Inductance between pin 2 and pin 5 at 1VAC & 1kHz	1.0mH ± 7%
3	P1 Leakage Inductance	Inductance between pins 2 and pin 5 with pins 4-1 and 8-10 shorted	75μH

PCB Layout

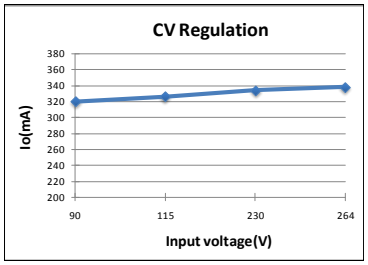




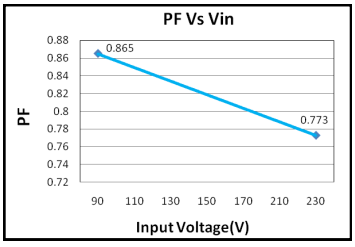
Typical performance Characteristics



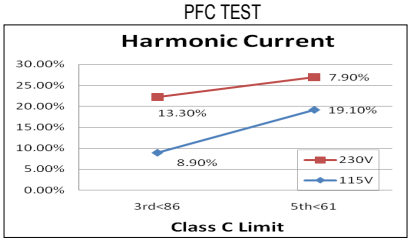
EFFICIENCY



LINE AND LOAD REGULATION



PFC TEST

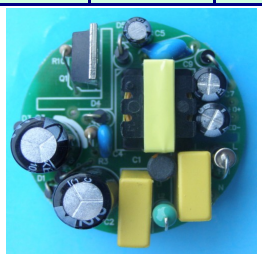


HARMONIC CURRENT

EVALUATION KITS	V_{IN}	V_O	Io
ACT365-LED01	85-264VAC	26V	300-400mA

PAR30 7x1W LED Lighting Non-isolated

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Transformer	Topology
85 - 264VAC	ACT365	7	26V	7.8W	EE16	Flyback



Operation and Application

Figure 1 is the schematic of LED lighting using ACT365 to provide output power of 26V300mA with PF>0.77.This circuit is a typical flyback power supply which includes the AC rectified circuit(BD1,C2, C3),power drive circuit (BD pin, Q1),power factor rectified circuit (D1-D3,C2,C3),secondary rectified circuit (D6, C7,C8) and the IC control circuit. ACT365 is a Primary Side Regulator (PSR) so that the power supply unit can regulate current and voltage without Opto-coupler. Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the base drive for the NPN transistor. Pin 1 is the switching pin. Pin 5 is the feedback pin that senses the output current and output voltage. Pin 6 is the peak current sense pin. Resistance of R10 determines the output DC cord compensation percentage.

Through a patented PSR technology, this circuit can provide drivers for five(min), or seven (max) LED lights in series due to the wide VDD operation ranges.

Key Component Selection

The maximum output current is decided by formula (1).

$$I_{OUTCC} = \frac{1}{2} \times L_P \times \left(\frac{0.9 * 0.396}{R_{CS}}\right)^2 \times \left(\frac{\eta \times F_{SW}}{V_{OUTCC}}\right) \quad (1)$$

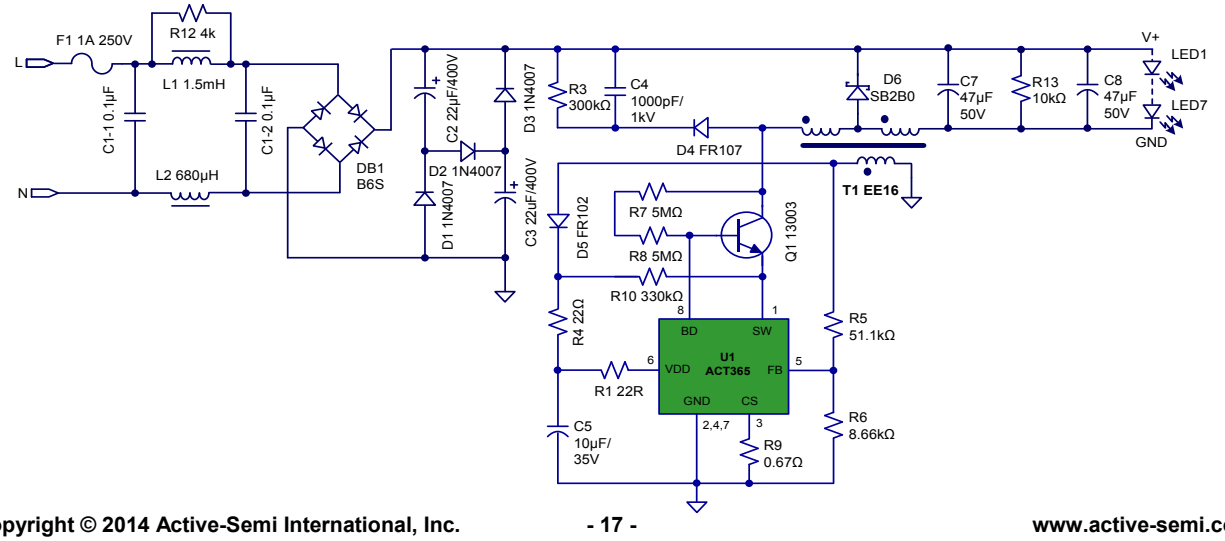
Lp is the transformer inductance value, Rcs is the current sense resistor, which is shown as R9 in the schematic. Fsw is the switching frequency, which design value is 75kHz. η is the overall system efficiency, which value is approximately equal to 75%. Voutcc is the output voltage, which setting is through the flyback voltage of auxiliary winding and the feedback resistor R5, R6 as shown in formula (2).

$$V_{OUTCC} = V_{REF} \times \left(1 + \frac{R_5}{R_6}\right) \times \frac{N_S}{N_{AUX}} - V_{SEC\_R} \quad (2)$$

Np/Ns/Naux (102/23/13) must be designed correctly to ensure it operates in DCM in all conditions. A design value Voutcc equal to 26V and Ioutcc_min equal to 300mA are used to do the design. Ns and Naux are number of turns of secondary and auxiliary of the transformer. VSEC_R is the forward voltage drop of the output rectifier diode at approximately 0.1A bias. The peak current limit is set by (0.396×0.9)/Rcs.

Figure 1:

Schematic of LED Lighting Driver

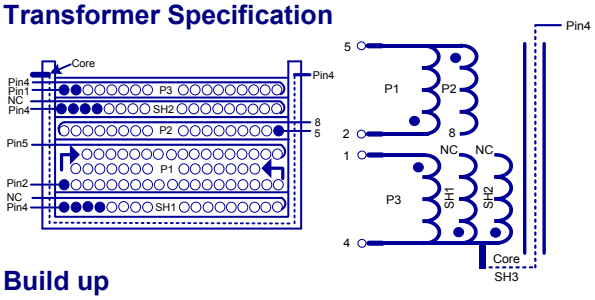


ACT365 DESIGN GUIDE

Bill of Materials

REF	DESCRIPTION	MFTR
C1-1/2	X1 Capacitor,0.1μF/400V,13x6x11mm	USE
C2,C3	Capacitor,Electrolytic, 22μF/250V, 10x14mm	KSC
C4	Capacitor,Ceramic,1000pF/1KV, DIP	POE
C5	Capacitor,Electrolytic,10μF/35V, 5x11mm	KSC
C6	Capacitor,Ceramic,1000pF/50V,1206	POE
C7,C8	Capacitor,Electrolytic, 47μF/50V, 6.3x12mm	KSC
C9	Y cap,1000pF/275V,Dip	USE
BD1	Bridge,B6S,600V/0.5A,MDI,SMD	PANJIT
D1~D3	Fast Recovery Rectifiers,1N4007, DO-41	Good-Ark
D4	Fast Recovery Rectifier ,FR107,DO-41	Good-Ark
D5	Fast Recovery Rectifier ,FR102,DO-41	Good-Ark
D6	Efficiency Rectifiers, 300V/1A ,HER104, DO-41	Good-Ark
L1	Axial Inductor,1.5mH, ¢5x7mm,Dip	SoKa
L2	I-shaped Inductor,680μH,0410,Dip	SoKa
Q1	Transistor, HFE 20-25 NPN, D13003, TO-126	Huawei
PCB1	PCB, ACT365_LED_01,Rev:A	Jintong
F1	Fuse:3.15A 250V 3.6*10mm With Pigtail	walter
R1,R4	Chip Resistor, 22Ω, 0805, 5%	TY-OHM
R3	Chip Resistor, 300kΩ, 1W, 5%	TY-OHM
R5	Chip Resistor, 51.1kΩ, 0805,1%	TY-OHM
R6	Chip Resistor, 8.66kΩ, 0805, 1%	TY-OHM
R7,R8	Chip Resistor, 5MΩ, 0805 , 5%	TY-OHM
R9	Chip Resistor, 0.67Ω, 1206,1%	TY-OHM
R10	Chip Resistor, 330kΩ, 1/4W, 5%	TY-OHM
R11	Chip Resistor, 10Ω, 0805, 5%	TY-OHM
R12	Chip Resistor, 4.0kΩ, 0805, 5%	TY-OHM
R13	Chip Resistor, 10kΩ, 0805, 5%	TY-OHM
T1	Transformer, Lp=1.0mH, EE16, Vertical	
U1	IC, ACT365SH-T ,SOP-8	

Transformer Specification



Build up

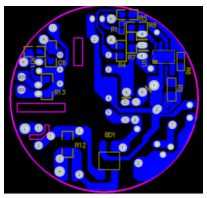
WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
SH1	4	NC	14	2UEW	0.12Φ*4	1	0.025*8.5W	2
P1	2	5	80	2UEW	0.2Φ*1	2	0.025*8.5W	2
P2	5	8	23	2UEW	0.35Φ*1	1	0.025*8.5W	2
SH2	4	NC	14	2UEW	0.12Φ*4	1	0.025*8.5W	2
S1	8	10	23	2UEW	0.35Φ*1	1	0.025*8.5W	2
P3	1	4	13	2UEW	0.12Φ*2	1	0.025*8.5W	2
SH3	core	4	3	conductor	0.15Φ*1	1	0.025*10	8

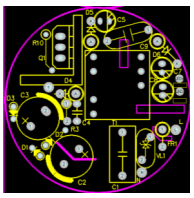
Note: SH1,SH2,and SH3 are shielding; P1,P2 and P3 are Primary, (Bobbin: EE-16, Vertical).

Electrical Specifications

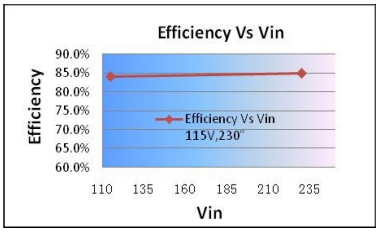
ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1+P2 Inductance	Inductance between pin 2 and pin 8 at 1VAC & 1kHz	2.0mH ± 7%
3	P1+P2 Leakage Inductance	Inductance between pins 2 and pin8 with pins 4-1 shorted	75μH

PCB Layout

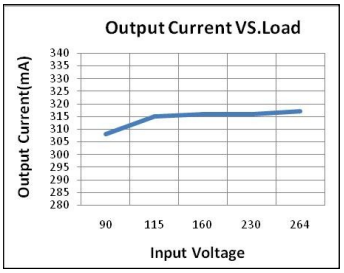




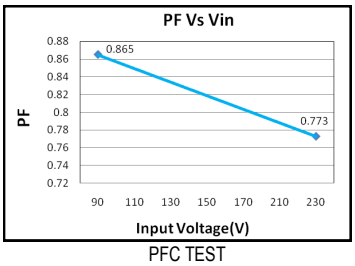
Typical performance Characteristics



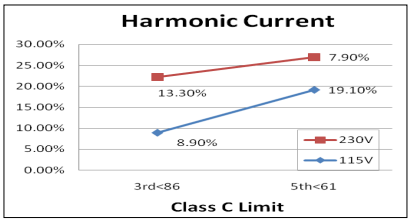
EFFICIENCY



LINE AND LOAD REGULATION



PFC TEST

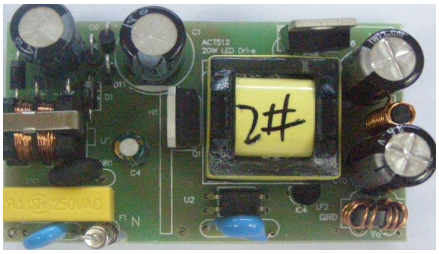


HARMONIC CURRENT

EVALUATION KITS	V_{IN}	V_O	Io
ACT365-LED02	85-264VAC	26V	300-400mA

PAR38 7x3W LED Lighting

Input Voltage	Device	LED(s)	Output Voltage	Power Output	Transformer	Topology
85 - 264VAC	ACT512	7	24V	16.8W	EF20	Flyback



Operation and Application

Figure 1 is the schematic of LED lighting using ACT512 to provide output power of 24V700mA with PF>0.9.This circuit is a typical flyback power supply which includes the AC rectified circuit(D1-D4,C1A, C1),power drive circuit (GATE pin, Q1),power factor rectified circuit (D9-D11,C1A,C1),secondary rectified circuit (D8, C9,C10) and the IC control circuit. ACT512 is a CCM & Quasi-Resonant PWM Controller . Pin 4 and Pin 2 are the VDD and ground pins to provide power for the IC. Pin 3 is the gate drive pin for the MOSFET. Pin 1 is the Current Sense Pin. Pin 5 is the Valley Detector Pin. Pin 6 is the Feedback Pin.

This circuit can provide drivers for five (min), or seven (max) LED lights in series due to the wide VDD operation ranges. Accurate current control is through R12/R13 and LM358 control circuit.

Key Component Selection

The maximum output current is decided by formula (1).

$$I_{outcc} = 2.5 + \times \frac{R16}{R15 \times (R12 // R13)} \qquad (1)$$

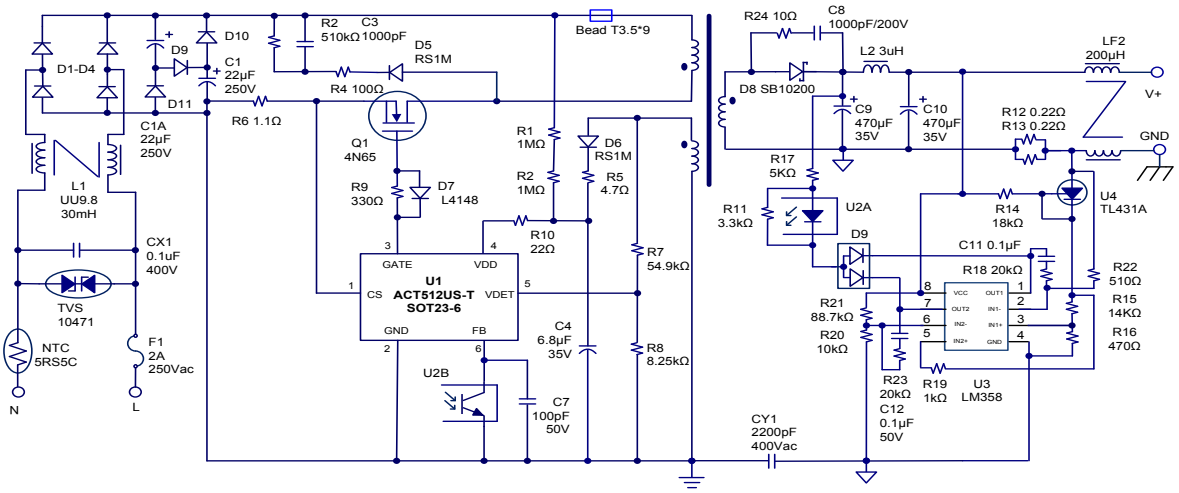
Its output voltage or number of LED is roughly decided by formula (2).

$$V_{outcv} = \left(2.5 * \frac{R21 + R20}{R20}\right) + \left(\frac{R21}{R20} * Io * (R12 // R13)\right) \qquad (2)$$

The transformer design procedure can refer to the design example section of ACT512 DS. In this design, Np/Ns/Naux is set as 80/36/25 to ensure it operates in CCM to improve efficiency. Independent Output Short Protection, OTP, OVP, Brown Out Protection, Rcs Short/Open Protection, Transformer Winding Short Protection, Output Diode Short/Open Protection, Open Loop Protection, are integrated to protect damage on circuits and LED die itself.

Figure 1:

Schematic of LED Lighting Driver

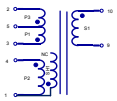


ACT512 DESIGN GUIDE

Bill of Materials

REF	DESCRIPTION	MFTR
IC1	IC, ACT512, SOT23-6	Active-Semi
C1A	Capacitor, Electrolytic, 22μF/250V, 10 × 16mm	KSC
C1	Capacitor, Electrolytic,22μF/250V, 10 × 16mm	KSC
C3	Capacitor, Ceramic,1000pF/0.5KV,SMD	POE
C4	Capacitor, Electrolytic,6.8μF/35V,5*11mm	KSC
C7	Capacitor, Ceramic, 1000PF/50V,0805,SMD	POE
C8	Capacitor, Ceramic, 1000PF/100V,0805,SMD	POE
C9,C10	Capacitor, Electrolytic,470μF/35V,8*16mm	POE
C11,C12	Capacitor, Ceramic,0.1uF/50V,0805,SMD	POE
D1-D4,D9-D11	Diode, 1N4007,1A1000V DO-41	Good-Ark
D5,D6	RS1M SMD	Good-Ark
D7	Diode L4148 SMD	Good-Ark
D8	Diode, Schottky, 200V/10A, SBR10200, DO-220	Good-Ark
LF1	CM Inductor, 20mH, UU9.8	SoKa
LF2	Axial Inductor, 0.55*5T, 5*7,Dip 200uH	SoKa
L2	DM Inductor, 3μH, R5	SoKa
Q1	Mosfet Transisor, 04N65, TO-220	ST
PCB1	PCB, L*W*T =49x68x1.6mm, Cem-1, Rev:A	Jintong
F1	Fusible, 2A/250V	TY-OHM
R1,R2	Chip Resistor,1M, SMD 0805, 5%	TY-OHM
R3	metal Resistor,400K Ω,1206,5%	TY-OHM
R4	Chip Resistor, 100Ω, 0805, 5%	TY-OHM
R5	Chip Resistor,4.7Ω, 0805, 5%	TY-OHM
R6	Chip Resistor,1Ω,1206, 1%	TY-OHM
R7	Chip Resistor, 78KΩ, 0805, 1%	TY-OHM
R8	Chip Resistor, 11.7KΩ, 0805, 1%	TY-OHM
R9	Chip Resistor, 330Ω,0805, 5%	TY-OHM
R10	Chip Resistor, 22Ω,0805, 5%	TY-OHM
R11	Chip Resistor, 6KΩ,0805, 5%	TY-OHM
R12,R13	Chip Resistor, 0.22Ω, 1206, 5%	TY-OHM
R14	Chip Resistor, 18KΩ, 0805, 5%	TY-OHM
R15	Chip Resistor,14KΩ, 0805,5%	TY-OHM
R16	Chip Resistor,510Ω, 0805,1%	TY-OHM
R17	Chip Resistor,5KΩ, 0805, 5%	TY-OHM
R18,R23	Chip Resistor,20KΩ, 0805, 5%	TY-OHM
R19	Chip Resistor,1KΩ, 0805, 5%	TY-OHM
R20	Chip Resistor,10KΩ, 0805,1%	TY-OHM
R21	Chip Resistor,86KΩ, 0805,1%	TY-OHM
R22	Chip Resistor,510Ω, 0805,5%	TY-OHM
R24	Chip Resistor,22Ω, 1206,5%	TY-OHM
T1	EF20	ACT
CX1	X capacitance, 0.1μF/400V,X1	
NTC	Thermistor, SC053	
TVS	Varistor, 7D471	
CY1	Y capacitance, 1000pF/400V,Y1	SEC
IC2	Opto-coupler, PC817C CTR=200 dip-4	Sharp
IC3	IC LM358 SOP-8	ST
IC4	Voltage Regulator, TL431A, Vref=2.5V TO-92	ST

Transformer Specification



Build up

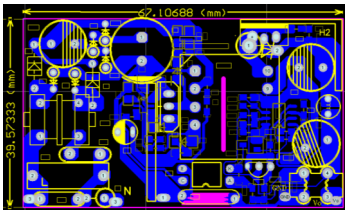
WINDING	TERMINAL		TURNS	WIRE			INSULATION	
	START	FINISH		TYPE	SIZE × QTY	LAYER	THICK/WIDE	LAYER
P1	3	5	40	2UEW	0.28Φ*1	1	0.025*11W	2
SH1	NC	1	0.9	copper	10mm	1	0.025*11W	
S1	9	10	36	TEX-E	0.4Φ*1	2	0.025*11W	2
P2	4	1	25	2UEW	0.15Φ*2	1	0.025*11W	2
P3	5	2	40	2UEW	0.28Φ*1	1	0.025*11W	2
SH2	core	1	3	conductor	0.15Φ*1	1	0.025*10	8

Note: SH1,SH2are shielding; P1,P2 and P3 are Primary, (Bobbin: EF-20, level).

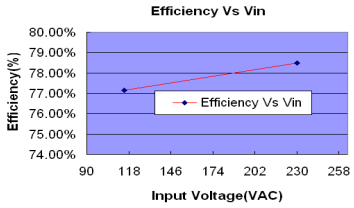
Electrical Specifications

ITEM	DESCRIPTION	CONDITION	LIMITS
1	Electrical Strength	50Hz, 1 minute, from Primary and Secondary	3kVAC
2	P1 Inductance	Inductance between pin 2 and pin 3 at 1VAC & 1kHz	0.82mH ± 7%
3	P1 Leakage Inductance	Inductance between pins 2 and pin3 with pins 4-1 shorted	75μH

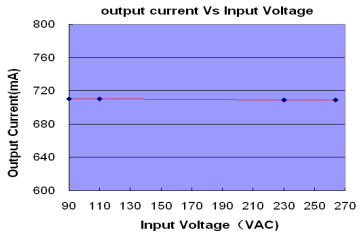
PCB Layout



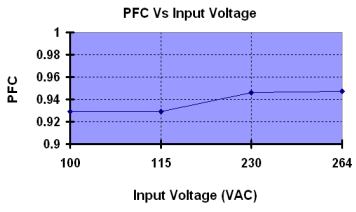
Typical performance Characteristics



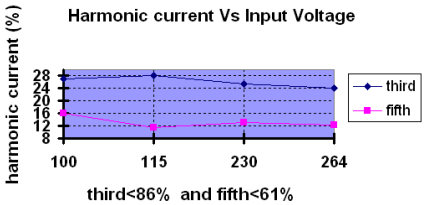
EFFICIENCY



LINE AND LOAD REGULATION



PFC TEST



third<86% and fifth<61%

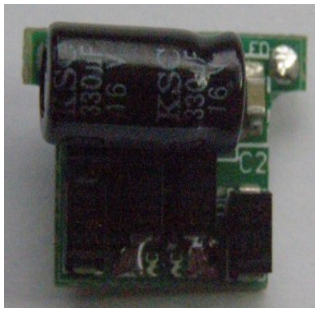
HARMONIC CURRENT

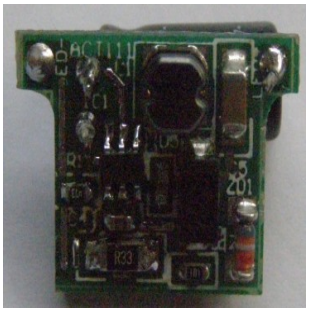
EVALUATION KITS	V_{IN}	V_O	Io
ACT512-LED01	85-264VAC	24V	700-720mA

ACT111A High Efficiency, Low Cost HB LED Lighting

Input Voltage	LED #	Output Current	V_{FB}	Topology
4.8 – 30VDC	1-6	1.5A	100mV	Buck

Circuit Bottom View ***Circuit Top View***





Design Features

- 95% Efficiency
- 4.8V to 30V Input and up to 1.5A Output
- 1.4 MHz Switching & Small SOT23-6 Package
- PWM (0-100%, 0.1-10kHz) Dimming
- **Thermal Shutdown & Short Circuit Protection**

Operation and Application

The bridge rectifier is for AC input only. The DC input is directly connected to IN and ground. The ACT111A has an under-voltage lockout (UVLO) at 4.0V with 250mV hysteresis. When input voltage falls below 4.0V, SW stops switching. The device is activated as input voltage goes higher than 4.2V.

The LED output current is sensed by a resistor in series with the LED. The ACT111A precisely regulates the LED current by the internal EA and 0.1V reference. The average LED current is determined by the equation: I_{LED} **=0.1V/** R_{SENSE}.

The ACT111A allows dimming with a PWM signal at the DIM pin. A signal level above 1.5V enables switching and turns LED on. To turn off the LED current, the signal level has to be below 1.52V. The dimming signal frequency range is from 100Hz to 10kHz.A 200kΩ resistor is needed to connect between FB pin R_{SENSE}. A 100pF capacitor is recommended to connect from the FB pin to ground.

Key Component Selection

An inductor with RMS rating greater than load current and its saturation current at least 30% higher should be used. Inductance value is selected to make its ripple current 20-30% of the load current. A Schottky diode (D5) is usually used for better efficiency as long as the breakdown voltage can withstand the maximum output voltage. The forward current rating of the diode must be at least equal to the maximum LED current.

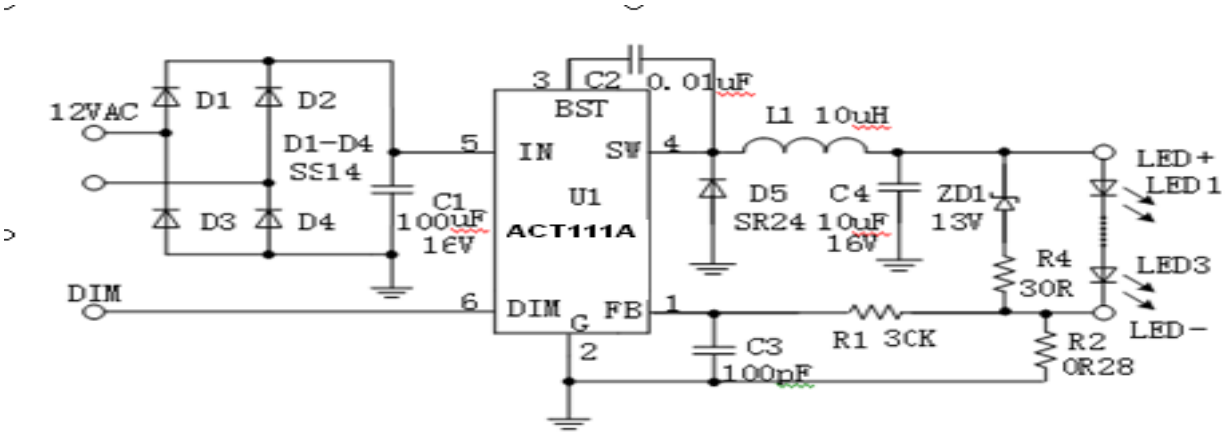
For AC input, if a conventional step-down line transformer is used, a low cost IN4001can be used for D1-D4. However, if a high frequency electronic transformer is used, a Schottky diode such as SS14 should be used for high efficiency operation. For input and output capacitors, small size and low ESR ceramic capacitor is preferred.

PC Board Layout Guidance

Place input capacitor (C1) to IN pin, inductor (L1) and diode (D5) to SW pin as close as possible to reduce the voltage ringing at these pins. Place the current sense resistor (R2) close to FB pin. Minimize ground noise by connecting high current ground returns, the input capacitor ground lead, and the output filter ground lead to a single point (star ground configuration). There are two power loops in normal operation, one is formed when the SW is high and the high current flows through input capacitor (C1), internal MOSFET, inductor(L1), LEDs, R_{SENSE}(R2) to ground. The other loop is through inductor (L1), LEDs, R_{SENSE}(R2), ground to diode(D5). Make these loop areas as small as possible to minimize noise interaction.

ACT111A High Efficiency, Low Cost HB LED Lighting

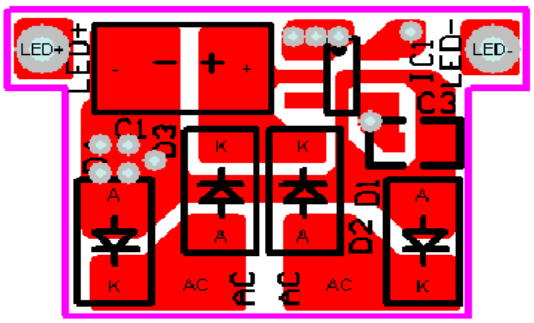
Schematic (VIN=12VDC or AC, 3x350mA LEDs)



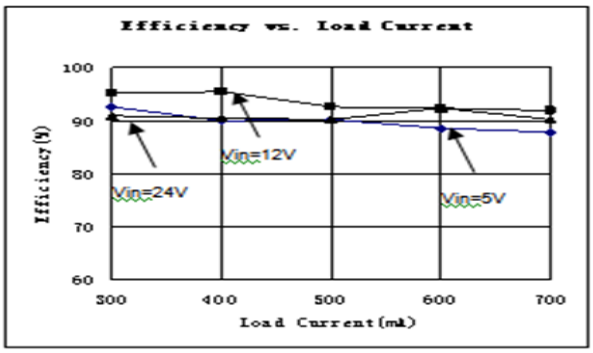
Bill of Materials

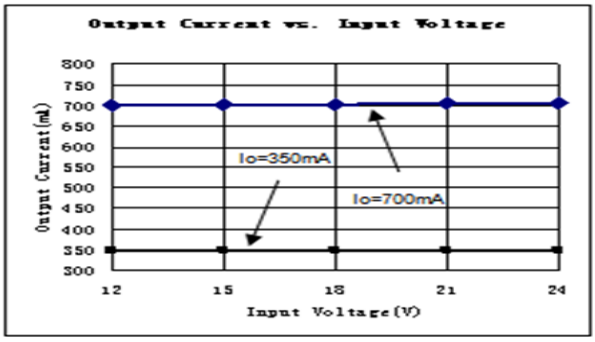
Ref.	Description	Mftr
C1	Capacitor Tantalum,100uF/16V, D Case	AVX
C2	Capacitor, Ceramic,0.01uF/50V,0603	POE
C3	Capacitor, Ceramic,100pF/25V,0603	POE
C4	Capacitor Ceramic,10uF/16V,1206	AVX
D1-D4	Diode shottoky, 40V/1A, SS14, SMA	PANJIT
D5	Schottky Barrier Rectifier,SR24,40V/2.0A,SMB	PANJIT
ZD1	Diode Zener,GLZ13A,13V, 0.5W, MINI-MELF	PANJIT
R1	Meter Film Resistor, 30KΩ,0603, 5%	TY-OHM
R2	Meter Film Resistor, 0.28Ω,1206, 1%	TY-OHM
R4	Meter Film Resistor, 510Ω,1206, 5%	TY-OHM
L1	SMD Power Inductor,SR0604220ML,10uH,±20%	QianRu
U1	IC,ACT111,SOT23-6	Active

PCB Top Layer



Typical performance characteristics





PCB Bottom Layer