Ultra-high Voltage Linear LED Driver

FEATURES

- Excellent line regulation
- Input constant power
- ± 5% output current accuracy
- Multiple ICs can be used in parallel to meet large current output
- High power factor and ultra-low THD
- Very few external components
- Over temperature protection function
- ESOP8 package

APPLICATIONS

- LED Bulb Light
- LED Flood Light
- Other LED Lights

DESCRIPTION

XT3377FA is an ultra-high-voltage 3-string linear constant-power LED driver with a maximum input voltage of 700V, which is suitable for driving high-voltage low-current LED loads. The application solution has very few external components and compact layout, and can be easily and flexibly applied to various small-size or flat LED products. XT3377FA greatly improved the power factor and THD of the system (meeting the IEC61000-3-2 standard). At the same time, the simple linear drive method does not require magnetic components, which can effectively avoid the problem of EMI.

In order to prevent the IC from overheating, the XT3377FA integrates temperature control function. When temperature inside chip exceeds T_{OTP}, XT3377FA deceases LED current, which can help chip cooling.

TYPICAL APPLICATION

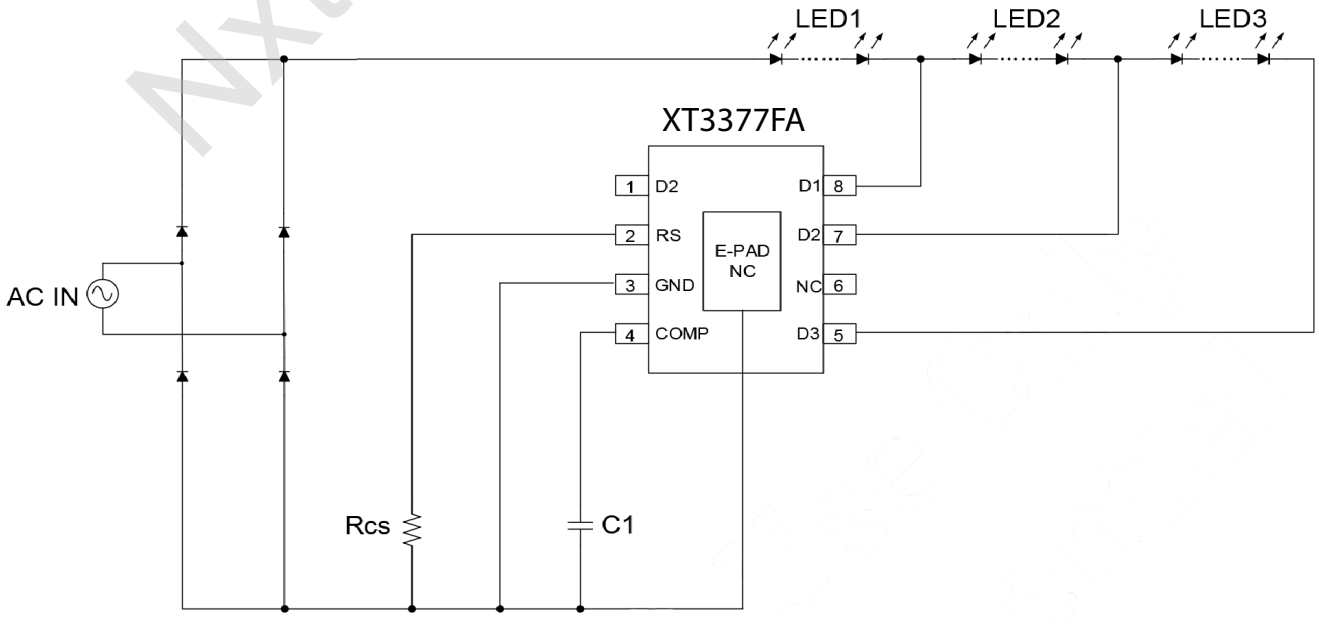


FIG.1 Schematic Diagram of Flood Light

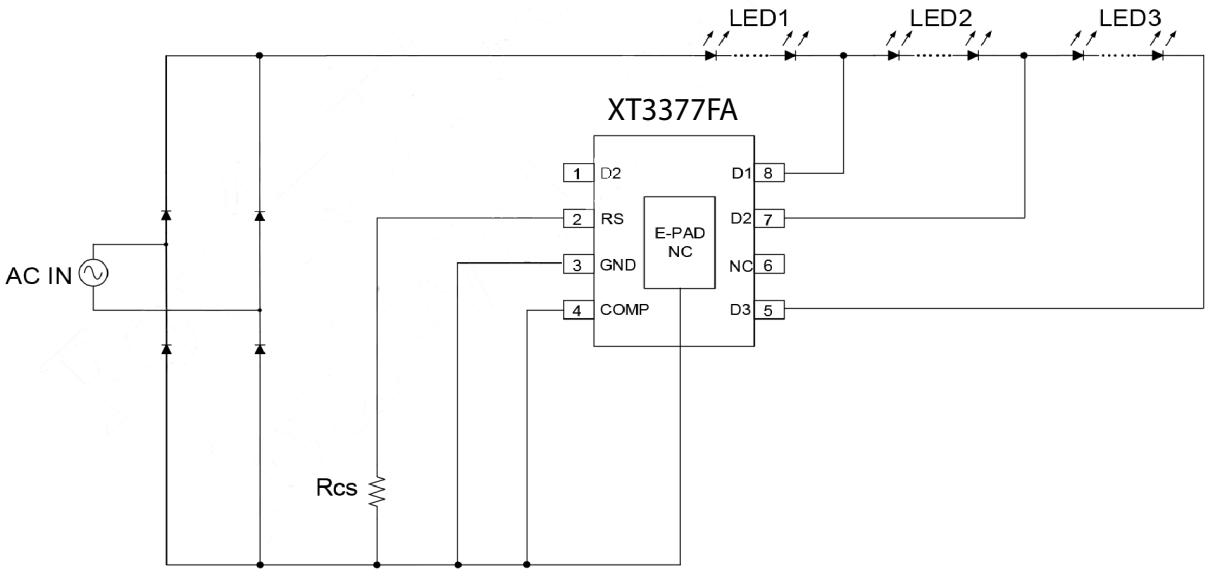


FIG.2 Schematic Diagram of Indian Bulb Light

ORDER INFORMATION

DEVICE	PACKAGE	TOP MARKING	ENVIORNMENTAL
XT3377FA	ESOP8	XT3377FA | YW□□□□□	Green

Notes

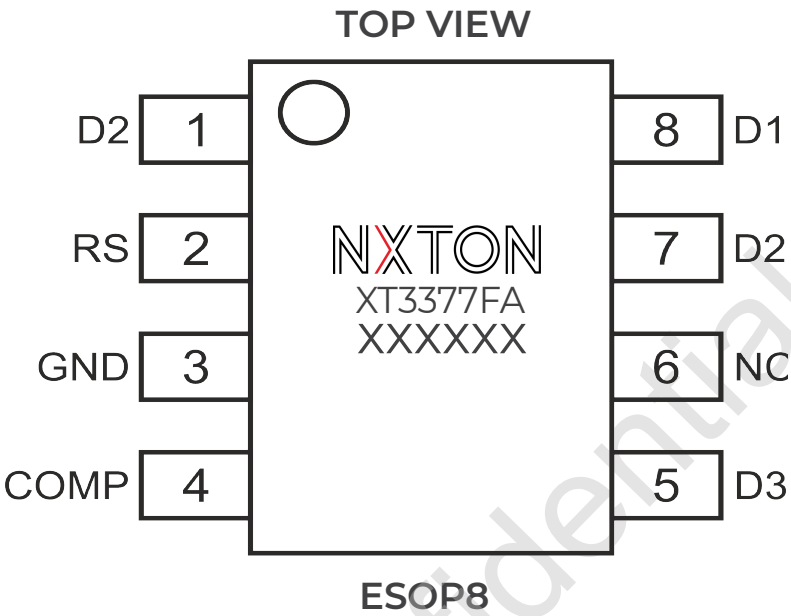
1) XT □□ #TR
- Tape and Reel (If TR is not shown, it means Tube)
- Package Code
- Part No. : XT3377FA

2) Line1: XT □□□□
- Product code
- Nxton

Line2: YW □□□□
- Lot number
- Week code
- Year code

3) All Nxton products are packed with Pb-free and Halogen-free materials and compliant to RoHS Standards.

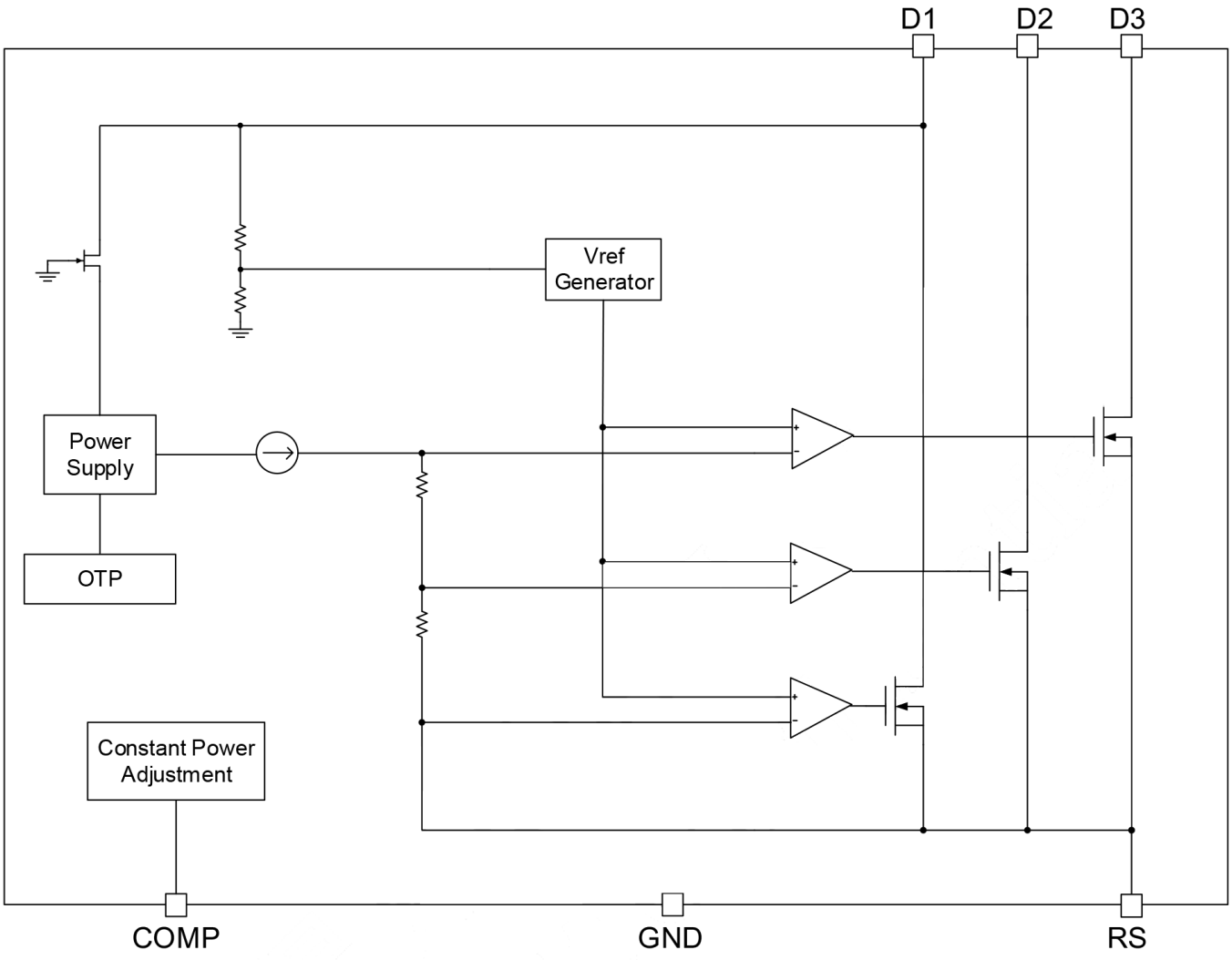
PIN CONFIGURATION



PIN DESCRIPTION

Pin ESOP8	Name	Description
1	D2	DRAIN of the Channel 2(CH2)
2	RS	Current sensing pin
3	GND	Chip ground
4	COMP	Constant power adjustment
5	D3	DRAIN of the Channel 3(CH3)
6	NC	Not Connected
7	D2	DRAIN of the Channel 2(CH2)
8	D1	DRAIN of the Channel 1(CH1)
E-PAD	NC	Not Connected

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING	
D1 D2	-0.3V to +700V
D3	-0.3V to +650V
COMP	-0.3V to +5.5V
RS	-0.3V to +5.5V
Junction Temperature	-40°C to +150°C
Storage Temperature	-40°C to +150°C

RECOMMENDED OPERATING CONDITIONS	
D1 D2	-0.3V to +630V
D3	-0.3V to +600V
Junction Temperature (TJ)	-40°C to 125°C

THERMAL PERFORMANCE	θ_{JA}	θ_{JC}
ESOP8	50	10°C/W

Notes:

1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDE OPERATING CONDITIONS.

2) The XT3377FA includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

3) The device is not guaranteed to function outside of its operating conditions.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARATERISTICS

Ta= 25°C , unless otherwise stated						
Advance Information, not production data, subject to change without notice.						
Item	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit.**
Power Supply						
Quiescent Current	I_Q	VD1=VD3=100V, COMP =100nF		190	250	μA
Reference						
RS Voltage_1	V_{RS1}	VD1=VD3=100V,COMP =100nF	466	491	516	mV
RS Voltage_2	V_{RS2}	VD1=VD3=100V,COMP =100nF	323	341	360	mV
RS Voltage_3	V_{RS3}	VD1=VD3=100V, COMP to GND	414	437	460	mV
RS Voltage_4	V_{RS4}	VD1=VD3=200V, COMP to GND	631	665	699	mV
Protections						
OTP Point	T_{OTP}		135	145	155	℃
OTP Slope_1	K_{T_1}	COMP=100nF		-35%		10℃
OTP Slope_2	K_{T_2}	COMP to GND		-20%		10℃
D1 Over Voltage Protection	D_{1_ovp}	COMP=100nF	330	360	390	V
Power MOSFET						
BV of D1	V_{BV_1}	Id=250uA	700			V
BV of D2	V_{BV_2}	Id=250uA	700			V
BV of D3	V_{BV_3}	Id=250uA	650			V
Saturation Current of D1	I_{SAT_1}	VG=5V,V_{out1}=20V	58			mA
Saturation Current of D2	I_{SAT_2}	VG=5V,V_{out2}=20V	98			mA
Saturation Current of D3	I_{SAT_3}	VG=5V,V_{out2}=20V	128			mA

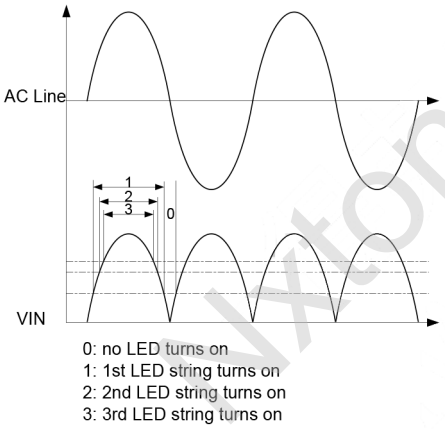
FUNCTIONAL DESCRIPTION

XT3377FA is an ultra-high-voltage 3-string linear LED driver for direct line operation.

Theory of Operation

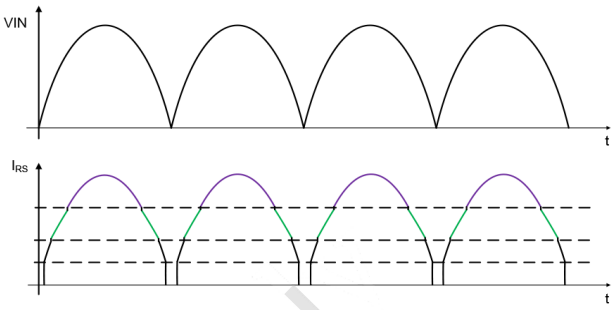
The input is the rectified voltage from AC mains by bridge rectifier. When VIN is higher than the forward voltage of the 1st LED string, XT3377FA can detect it and turn on the 1st MOSFET to lighten the 1st LED string. When VIN keeps increasing and exceeds the total forward voltage of the 1st and 2nd LED strings, XT3377FA turns on the 2nd MOSFET to lighten the 1st and 2nd LED strings. In the same way, all LED strings are lightened as VIN increases.

During the VIN decrease, XT3377FA shuts down the MOSFET as the reverse sequence.



Sine Wave Current Control

The IC introduces BUS voltage into the linear IC to modulate the output LED current waveform, so that the input current has a sinusoidal waveform to achieve high PF value and ultra-low THD, which can meet the IEC6100-3-2 harmonic standard. The VIN voltage waveform and current waveform are shown below.



LED Current Control

XT3377FA adopts a mathematical calculation method for the LED current control. The input constant power can be set by COMP pin. Different constant power modes are realized by whether the COMP pin is grounded or not. When a capacitor about 100nF is connected to the COMP, the reference voltage can be calculated as:

$$V_{REF1}(\theta) \sim \frac{1.6V - 2.25 * \frac{1}{\pi}\int_0^{\pi} \frac{VD1(\theta)}{200} d(\theta) + \frac{VD1(\theta)}{200}}{2}$$

$$V_{REF2}(\theta) \sim \frac{1.6V + 10uA * 1.6K - 2.25 * \frac{1}{\pi}\int_0^{\pi} \frac{VD1(\theta)}{200} d(\theta) + \frac{VD1(\theta)}{200}}{2}$$

$$V_{REF3}(\theta) \sim \frac{1.6V + 10uA * 3.2K - 2.25 * \frac{1}{\pi}\int_0^{\pi} \frac{VD1(\theta)}{200} d(\theta) + \frac{VD1(\theta)}{200}}{2}$$

Where

$V_{REFn}(\theta)$ is the reference voltage;

VD1(θ) is Drain voltage of the Channel 1.

When COMP short to GND pin, can be calculated as:

$V_{REF1}(\theta)$

$$\sim \frac{0.4V - 4*(\frac{VD1(\theta)}{200} - 1.0) + \frac{VD1(\theta)}{200}}{2}$$

V_{REF2}（θ）

$$\sim \frac{0.4V + 10uA*1.6K - 4*(\frac{VD1(\theta)}{200} - 1.0) + \frac{VD1(\theta)}{200}}{2}$$

V_{REF3}（θ）

$$\sim \frac{0.4V + 10uA*3.2K - 4*(\frac{VD1(\theta)}{200} - 1.0) + \frac{VD1(\theta)}{200}}{2}$$

Where

V_{REFn}(θ) is the reference voltage;

VD1(θ) is Drain voltage of the Channel 1.

The instantaneous current of LED is calculated as follows:

$$I_{LED}(\theta) = V_{REFn}(\theta)/Rcs$$

Where

I_{LED}(θ) is the instantaneous current;

V_{REFn}(θ) is the reference voltage;

R_{CS} is the current sensing resistor connected between RS pin and GND pin.

Over Temperature Protection

XT3377FA incorporates a thermal protection mechanism. When the internal junction temperature is higher than T_{OTP}, the internal reference voltage decreases by K_T, and the output current decreases.

REFERENCE DESIGN

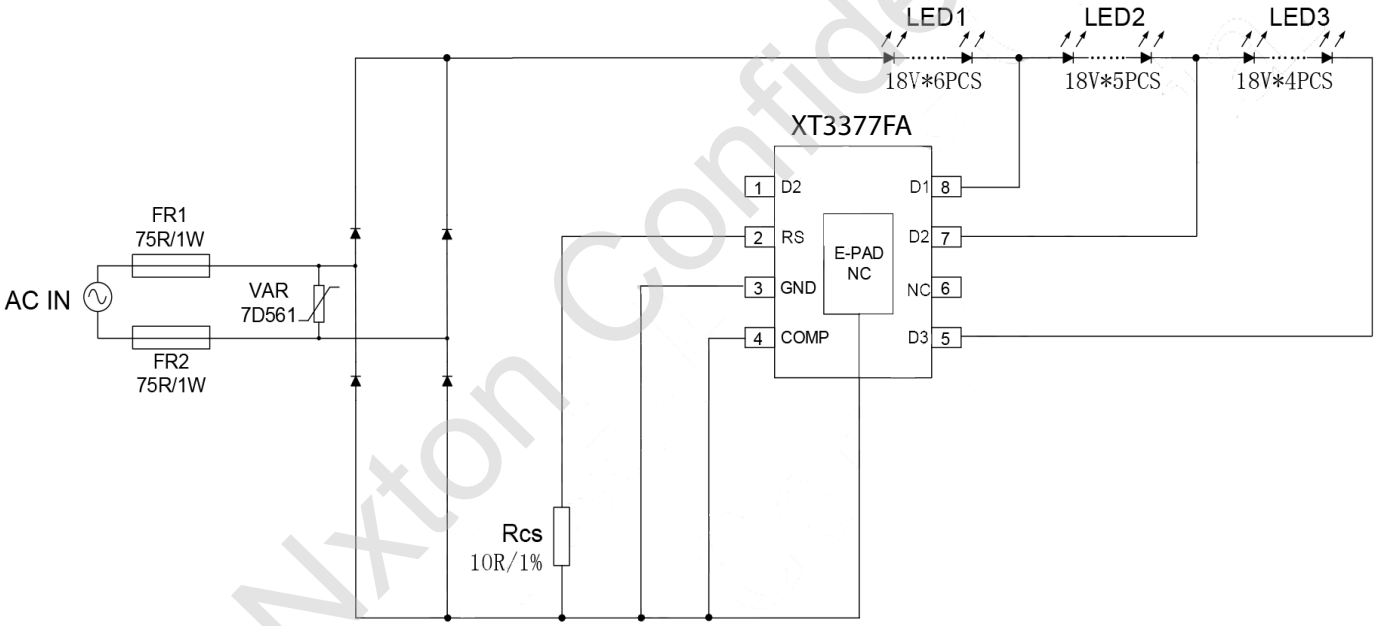
Note: Information in the following reference design sections is not part of NXTON component specification. Customers are responsible for determining suitability of components chosen for their purposes and should validate their design implementation to make sure the proper system functionality.

Reference 1: Indian Bulb

V_{IN}: 100V~300V

V_{OUT}: 18V*15PCS, LED Voltage Ratio: 6:5:4

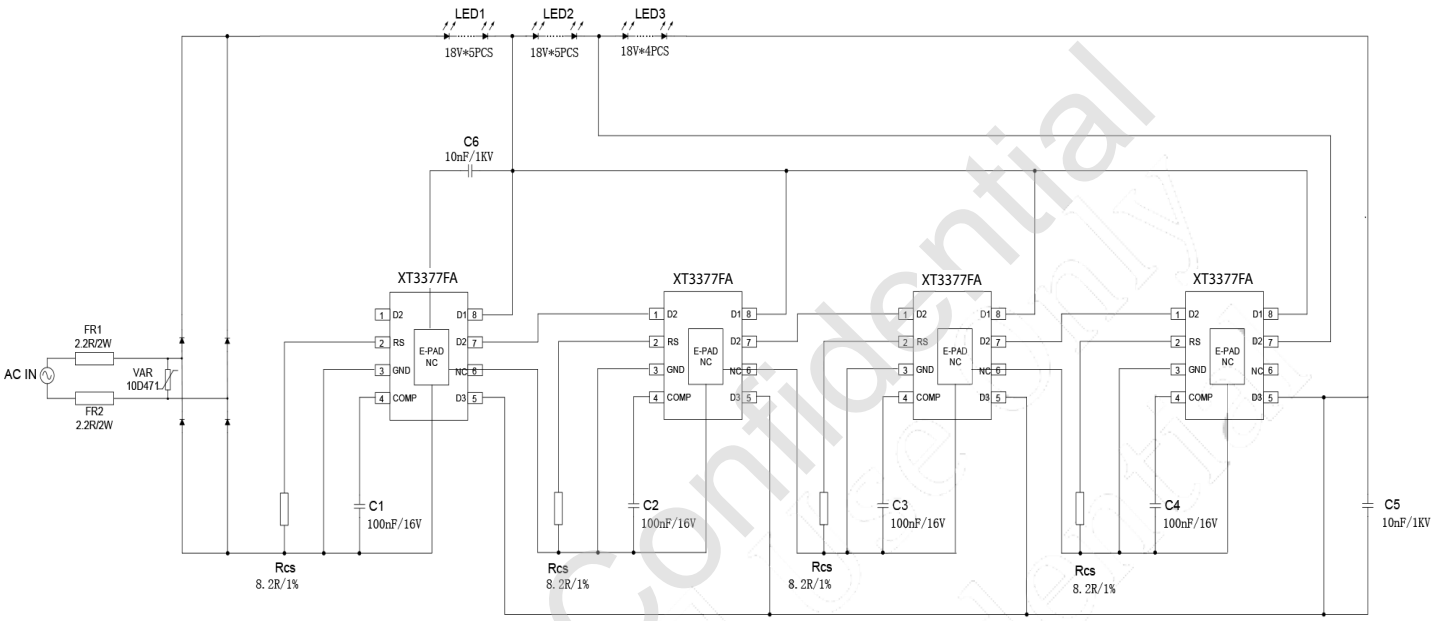
I_{LED}: ~38mA



REFERENCE 2 : FLOOD LIGHT

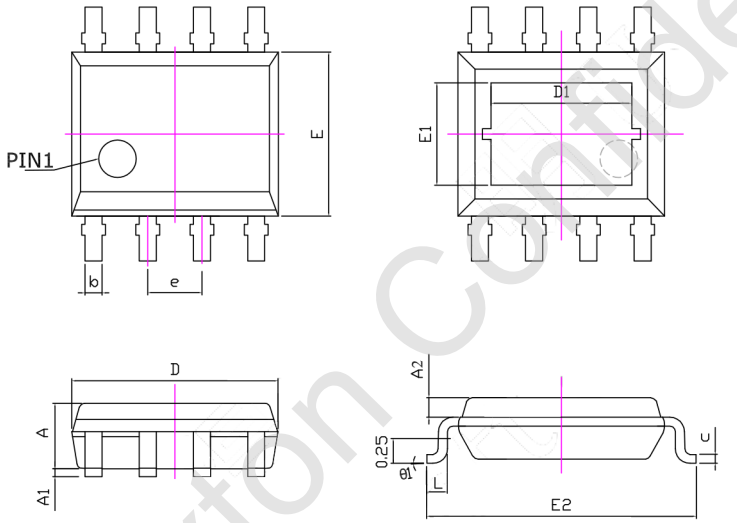
V_{IN}: 200V~270V

V_{OUT}: 18V*14PCS, LED Voltage Ratio: 5:5:4



PACKAGE OUTLINE

ESOP8 UNIT：mm



SYMBOL	MIN	NOM	MAX
A	1.35	1.45	1.55
A1	0.00	0.05	0.10
A2	0.60	0.70	0.80
D	4.80	4.90	5.00
D1	3.20	3.30	3.40
E	3.80	3.90	4.00
E1	2.30	2.40	2.50
E2	5.80	6.00	6.20
L	0.45	0.60	0.75
b	0.33	0.40	0.47
c	0.17	0.203	0.25
e	1.27 BSC		
θ1	0°	-	8°

REFERENCE DESIGN

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