Off-Line Linear LED Driver

FEATURES

- Adaptive Conduction with TRIAC DIM
- Wide Range, Programmable LED Voltage
- Fixed Current Operation: 20mA, 25mA, 30mA, 35mA, 40mA, 45mA and 50mA
- Can be Paralleled for Higher Current
- 5V to 500V Supply Voltage Range
- High Efficiency
- Stable LED Brightness
- Over Temperature Protection
- SOP-8 Exposed pad Package
- Patent Pending Drive Architecture

APPLICATIONS

- LED Lamps (e.g. E27, GU10)
- General Illumination
- LED Strings (e.g. T-8 Tube)
- Constant Current Sink

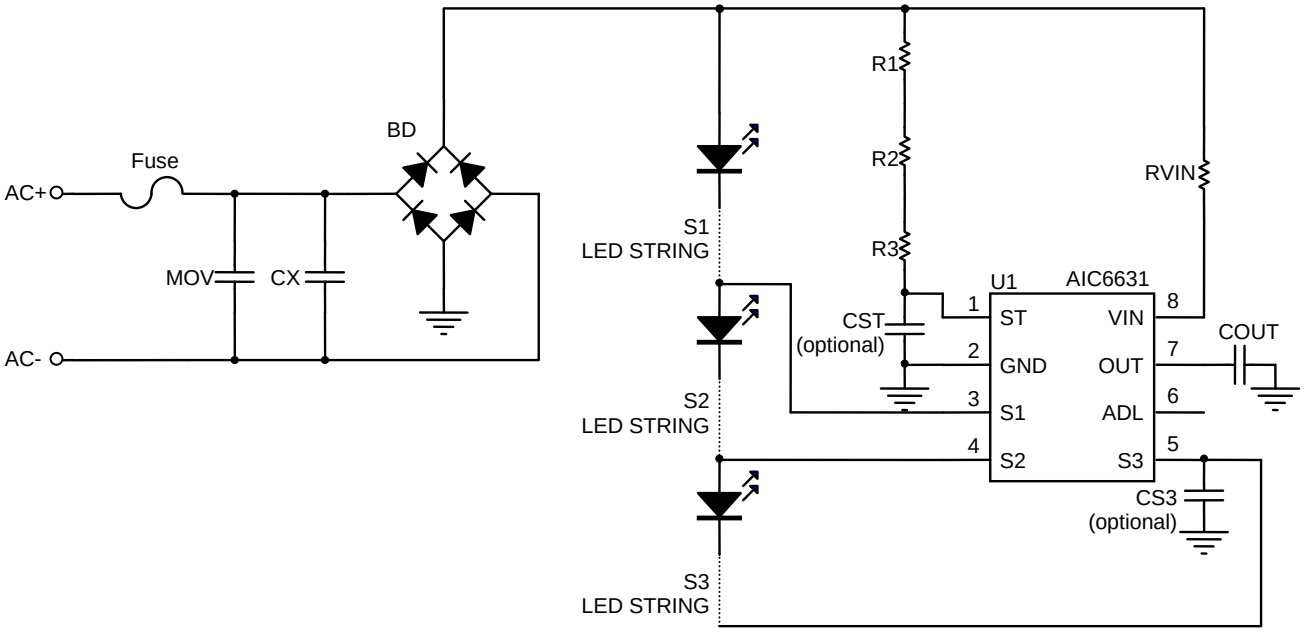
DESCRIPTION

The AIC6631 is an off-line linear LED driver. The application of high bright LED is widely used for general illumination.

The AIC6631 can drive a plurality of LED strings. When the voltage detecting circuit detects the different voltage level of input voltage, it can control the LED strings. If the input voltage is lower that it will bypass some LED strings. And turn on all LED strings when the input voltage is higher. The number of LEDs in LED array is dependent on the voltage level of the AC power source, that includes of ±10% variations. A typical application for the AIC6631 is to drive LEDs with a constant current of 20mA, 25mA, 30mA, 35mA, 40mA, 45mA and 50mA. Multiple AIC6631 can also be used in parallel to provide higher currents.

The AIC6631 is available in a SOP-8 Exposed Pad package.

TYPICAL APPLICATION CIRCUIT



ORDERING INFORMATION

AIC6631-XX X XX XX

- PACKING TYPE
  - TR: TAPE & REEL
  - TB: TUBE
- PACKAGE TYPE
  - R8: SOP-8 Exposed Pad
- G: GREEN PACKAGE
- LED CURRENT VERSION
  - 20:20mA
  - 25:25mA
  - 30:30mA
  - 35:35mA
  - 40:40mA
  - 45:45mA
  - 50:50mA

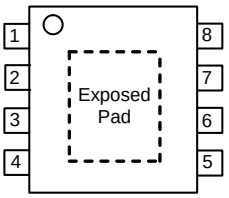
Example: AIC6631-20GR8TR

→ 20mA Version, in SOP-8 Expose Pad Green Package and TAPE & REEL Packing Type.

PIN CONFIGURATION

SOP-8 Exposed Pad
TOP VIEW

1: ST
2: GND
3: S1
4: S2
5: S3
6: ADL
7: OUT
8: VIN



Note:The exposed pad should be connected with GND pin.

ABSOLUTE MAXIMUM RATINGS

VIN Pin Voltage 550V

S1, S2, S3 Pin Voltage..... 550V

ST Pin Voltage 30V

OUT Pin Voltage 6V

ADL Pin Voltage..... 6V

Operating Ambient Temperature Range T_A ..... -40ºC~85ºC

Operating Maximum Junction Temperature T_J 150ºC

Storage Temperature Range T_{STG} ..... -65ºC~150ºC

Lead Temperature (Soldering 10 Sec.)..... 260ºC

Thermal Resistance Junction to Case SOP-8 Exposed Pad* ..... 15ºC /W

Thermal Resistance Junction to Ambient SOP-8 Exposed Pad*…..... 60ºC /W

(Assume no Ambient Airflow)

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

*The package is place on a two layers PCB with 2 ounces copper and 2 square inch, connected by 8 vias.

■ ELECTRICAL CHARACTERISTICS

(T_J=25°C, unless otherwise specified) (Note 1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage Section						
V_{IN} Operation Voltage		V_{IN}	5		500	V
Quiescent Current	V_{IN}=310V	I_{VIN}		350		μA
S1, S2, S3 Driver						
Driver Leakage Current	V_{IN}=V_{S1}=V_{S2}=230V V_{S3}=20V	I_{LK}	0		1	mA
Supply Voltage	V_{S1}, V_{S2}, V_{S3}		0		350	V
Output LED Current (Note 2)						
LED Current Range	I_{S1}, I_{S2}, I_{S3}		15		50	mA
LED Current Tolerance	I_{S3}		-5		+5	%
Over Temperature Protection						
Action Temperature				140		℃

Note 1: Specifications are production tested at T_A=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

Note 2: Output LED Current = peak to peak.

TYPICAL PERFORMANCE CHARACTERISTICS

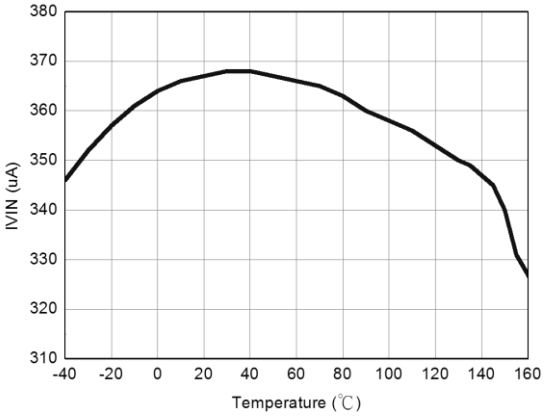


Fig.1 Quiescent Current

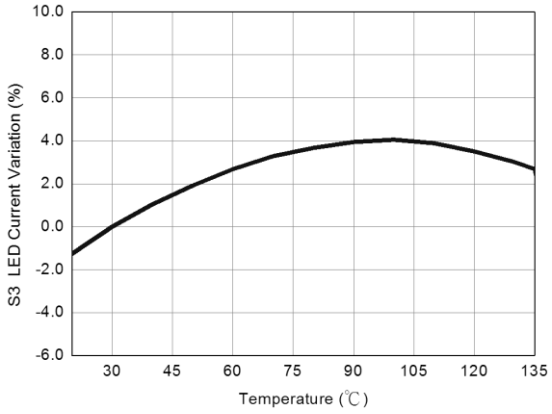
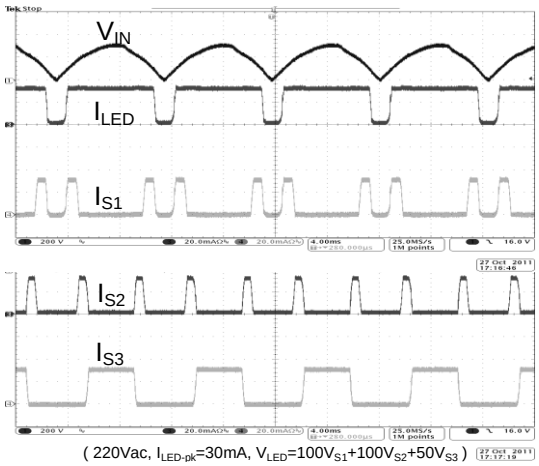


Fig.2 LED current variation vs. Temperature



(220Vac, I_{LED-pk}=30mA, V_{LED}=100V_{S1}+100V_{S2}+50V_{S3})

Fig.3 LED current waveform

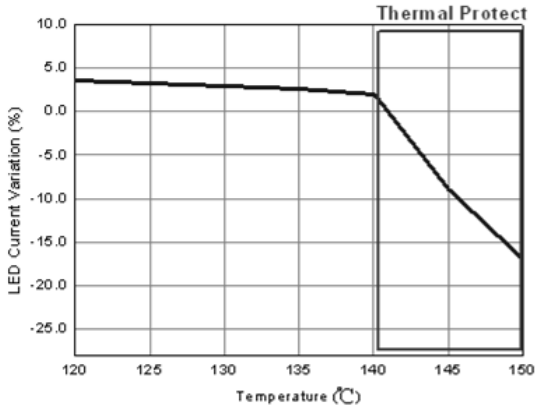
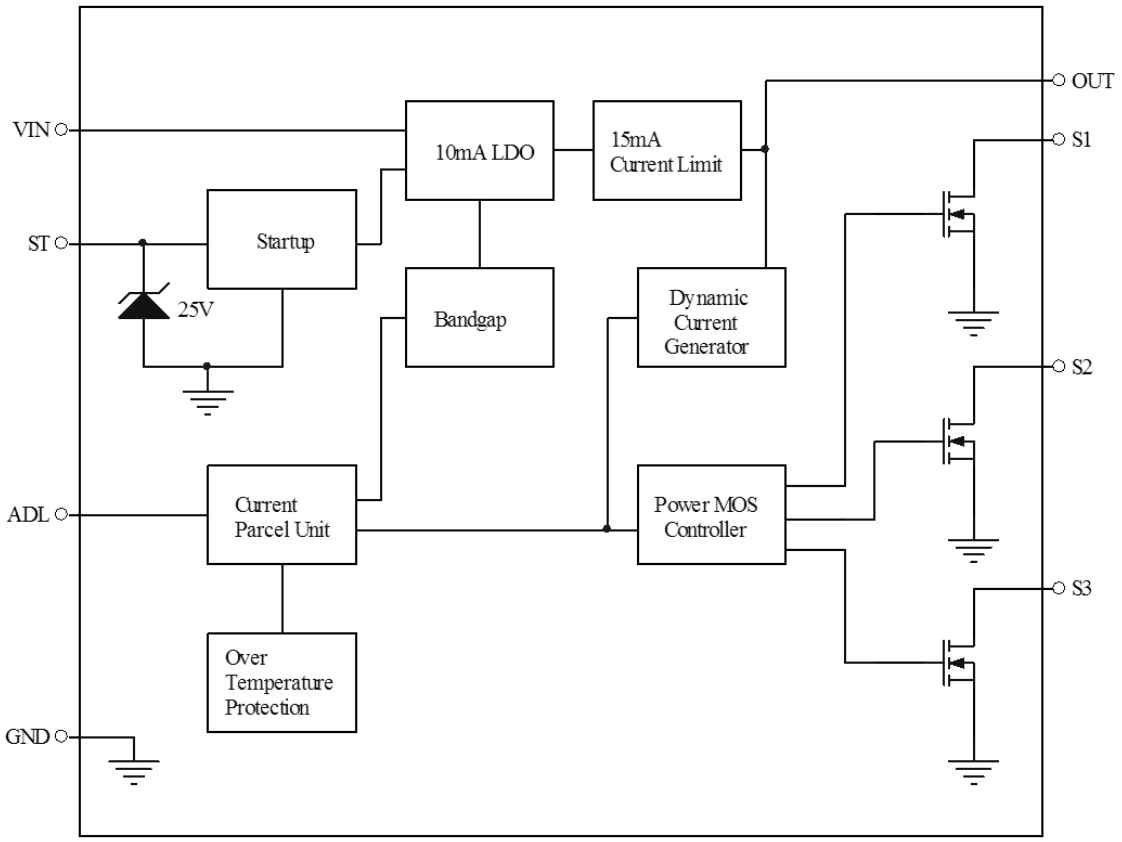


Fig.4 Over Temperature Protection

BLOCK DIAGRAM



PIN DESCRIPTION

ST PIN	-Provide the Startup Current for the Controller.
VIN PIN	- Power Supply Input.
S1PIN	-LED S1 Cathode Connection.
S2PIN	-LED S2 Cathode Connection.
S3 PIN	-LED S3 Cathode Connection.
ADL PIN	-Dummy Load Controller.
OUT PIN	-Output 5V.
GND PIN	-Ground.

APPLICATION INFORMATION

The AIC6631 is off-line constant current LED driver. It can drive a plurality of LED strings. The AIC6631 can flexibly control the LED strings according to the variance of input voltage. If the input voltage is lower, it will bypass some LED strings. When the input voltage is higher than the total forward voltage of all LED strings, all LED strings will be turned on. The number of LEDs in LED array is dependent on the voltage level of the AC power source. Multiple AIC6631 can also be used in parallel to provide higher LED current.

SOFT START FOR ST PIN

The AIC6631 has soft start function to reduce the inrush current during the start-up period. According to the different AC input voltage, the Table 01 provides the commanded component value for soft start resistor R_{ST} (R_1~R_3).

Table 01

Input Voltage	Estimated R_{ST} Resistor Value
AC110V	12MΩ
AC120V	13MΩ
AC220V	24MΩ
AC240V	26MΩ

THE CAPACITOR FOR OUT PIN & THE RESISTANCE FOR VIN PIN

By connecting an output capacitor to the OUT pin and an input resistor to the VIN pin, a stable voltage can be provided for the internal circuit of AIC6631. A 1μF~10μF output ceramic capacitor is commanded for most AIC6631 applications. When choosing the output ceramic capacitor, X5R and X7R types are recommended because they retain their capacitance over wider ranges of voltage and temperature than other types. In addition, the input resistance of R_{VIN} must be larger than 33kΩ. When choosing the SMD input resistor, the SMD input resistor size must be bigger than 0805 size.

DUMMY LOAD CONTROLLER FOR ADL PIN

In order to achieve stable light output when the TRIAC dimmer is used, AIC6631 designs the dummy load control function. By using a suitable dummy load R_{ADL}, the stability of light output can be improved when using the TRIAC dimmer. However, the electrical characteristics of all kinds of TRICA dimmer are not the same. When the different TRIAC dimmer is used, the suitable dummy load may be different. In order to achieve more stable light output, the dummy load should be adjusted in accordance with the used TRIAC dimmer.

OUTPUT RESISTOR

When using the TRIAC dimmer, the stability of light output can be improved by using a suitable output resistor, R_{OUT}, in parallel with output capacitor. However, when the different TRIAC dimmer or LED string is used, the suitable output resistor may be different. In order to achieve more stable light output, the output resistor should be adjusted in accordance with the used TRIAC dimmer or LED string.

THERMAL REGULATION

The AIC6631 includes the thermal-regulation circuit, which are designed to protect the device from excessive temperature. The internal thermal-regulation circuit adjusts the LED current if the junction temperature rises above the preset value of about 140ºC.

POWER DISSIPATION

The maximum power dissipation of AIC6631 depends on the thermal resistance of its case

and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting with good thermal conductivity is used, the junction temperature will be low even when large power dissipation applies.

As a general rule, the lower temperature is, the better reliability of the device is. So the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

APPLICATION EXAMPLES

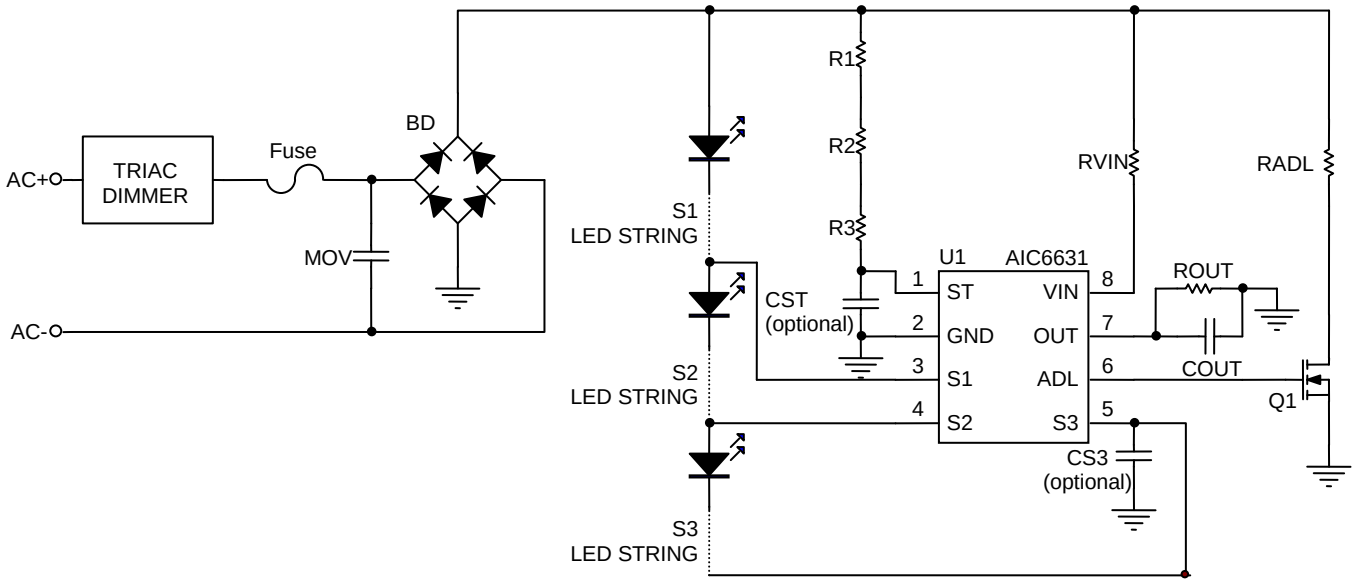
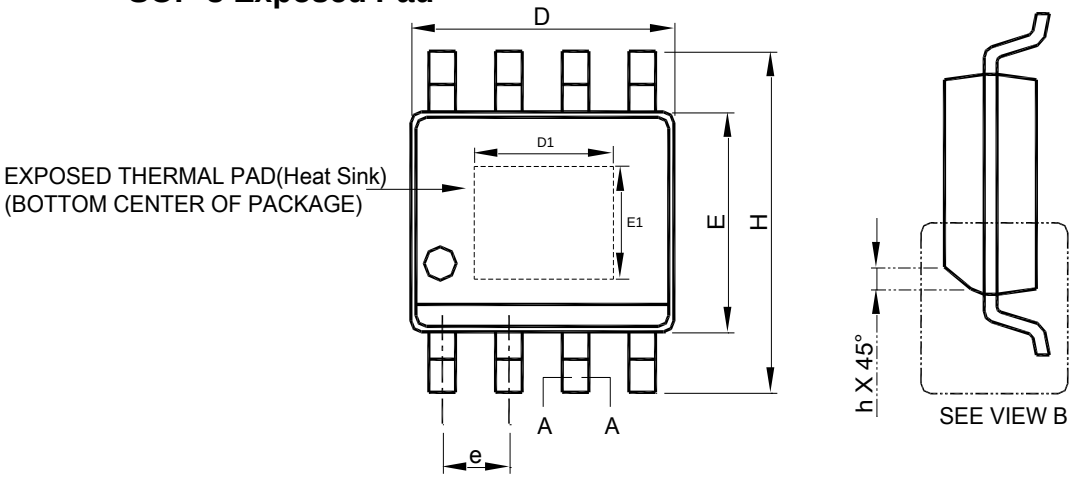
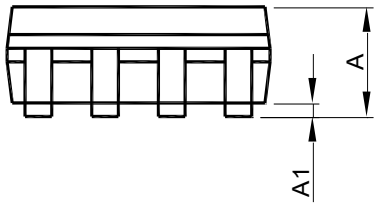


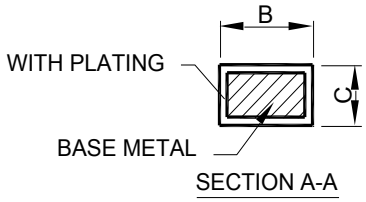
Fig.5 AIC6631 Application Circuit with TRIAC Dimmer

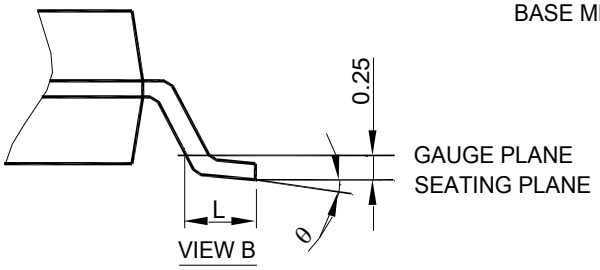
PHYSICAL DIMENSIONS

- **SOP-8 Exposed Pad**









SYMBOL	SOP-8 Exposed Pad	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.75
A1	0.00	0.15
B	0.31	0.51
C	0.17	0.25
D	4.80	5.00
D1	1.50	3.50
E	3.80	4.00
E1	1.0	2.55
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°

Note : 1. Refer to JEDEC MS-012E.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.