ACL406AS - Direct AC Line LED Driver
UP TO 6W OUTPUT

ACL406AS-DS-V1.1 – February 2022

Datasheet

EASii IC

1. FEATURES

ACL406AS up to 6W output,

- Direct AC Line LED Driver requiring few external components,
- Wide AC Input Range: 50 to 280V AC,
- High Power Factor: > 0.98 with optimized LED configuration,
- Low harmonic content: THD < 15% (typ.),
- Low quiescent current: 120µA,
- High Efficiency: 85% typical,
- Ultra-Flexible LED Forward Voltage Configuration,
- Up to 4 LED stages capability,
- flicker index: 10%,
- Over Temperature Power derating.

2. APPLICATIONS

- General Solid State Lighting,
- Medium Power LED Lamp,
- Connected Medium Power Led Lamp,
- Industrial high power LED Lamp.

3. DESCRIPTION

The ACL406AS is an AC direct LED driver requiring few external components: a diode bridge to rectify the AC voltage and a resistor to tune the LED current.

Multiple ACL406AS AC line drivers may be used in parallel to drive high power LED systems for industrial applications.
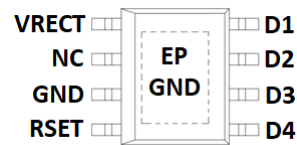
4. PIN CONNECTIONS

Figure 1: SO8 with Exposed Pad (TOP VIEW)

5. TYPICAL APPLICATIONS

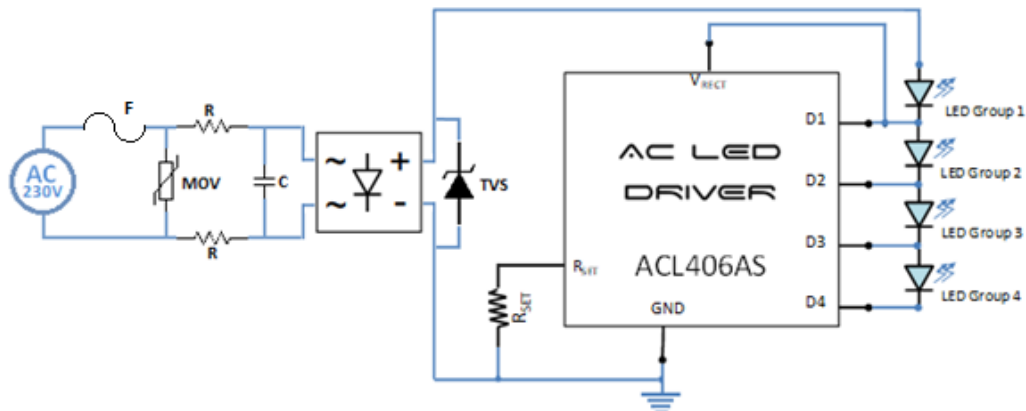### Recommended design for 230V$_{AC}$ Low-Cost Bulbs with protections

Figure 2: Recommended application with protection

6.   REVISION HISTORY

Version	Date	Changes
1.0	22/06/2021	1st public release

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

7. PIN CONFIGURATION

Pin descriptions and Functions

Symbol	Pin #	Type	Function
V_{RECT}	1	PWR	Power supply
NC	2	-	Not Connected
GND	3	GND	Ground
R_{SET}	4	IO	Resistor to set the LED current
D4	5	IO	Cathode LED group 4
D3	6	IO	Cathode LED group 3
D2	7	IO	Cathode LED group 2
D1	8	IO	Cathode LED group 1
EP	9	GND	Exposed Pad connected to the GND

Table 1: Pin description and functions
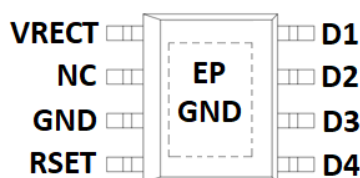
ACL406AS Pin Mapping (with exposed pad)

Figure 3: ACL406AS SO8 Pin-out with Exposed Pad (TOP VIEW)

8. ABSOLUTE MAXIMUM RATINGS

Parameter	Min	Typ	Max	Units
Input power supply V_{RECT}	- 0.3		650	V
Output R_{SET}	- 0.3		5	V
Output LED Voltage D1	- 0.3		650	V
Output LED Voltage D2	- 0.3		650	V
Output LED Voltage D3	- 0.3		650	V
Output LED Voltage D4	- 0.3		650	V
$T°_{junction}$	-55°C		175°C	°C
$T°_{storage}$	-55°C		150°C	°C
ESD-HBM			TBD	kV
ESD-FCDM			TBD	V

Table 2: Absolute maximum ratings

Notes (TBC):
1. The **ACL406AS** product type has been submitted to and conforms with HTOL, PCON/MSL1/TMCL, PCON/MSL1/UHAST and HTSL qualification tests. Stress tests have been completed without rejects and were performed according to the requirements of the test reference.
2. HTOL test reference is **JESD22-A108.** PCON/MSL1/TMCL test reference is according to the **JESD22-A113, JESD22-A104** standard**.** PCON/MSL1/UHAST test reference is according to the **JESD22-A113, JESD22-A118** standard**.** HTSL test reference is according to the **JESD22-A103** standard.
3. The ACL406AS product withstands class I with immunity level A of latch-up **JESD78E** standard.
4. The ACL406AS product passes ESD-HBM according to ANSI/ESDA/JEDEC JS-001-2014.
5. The ACL406AS product passes ESD-FCDM according to ANSI /ESDA /JEDEC JS-002-2014.

9. ELECTRICAL CHARACTERISTICS

Operating Conditions

Parameter	Min	Typ	Max	Units
Input power supply V_{RECT}			400	V
dV/dt			10	V.µs⁻¹
V_{D1}	0		400	V
Voltage difference D_{n-1}-D_n (2≤n≤4)	0	75	100	V
V_{D4}	0	75	100	V
R_{SET}	10		100	Ω
$T°_{junction}$	-40		125	°C

Table 3: Operating conditions

* If external V_{DD} is used to supply another device

Electrical Parameters

Parameter	Conditions	Min	Typ	Max	Units
$I_{QUIESCENT}$	ACL406AS @ V_{RECT} = 20V	84	120	156	µA
P_{LED}*	@25°C, VRECT=230Vac, RSET = 12 Ω	-10%	8.22	+10%	W
Output power derating** from -40°C to 100°C			*0.1*		*%/°C*
Output power derating Curie point ($P_T = P_{25°C}$/2)			*175*		*°C*
Package Thermal Resistance $Θ_{JA}$*** ACL406AS			TBD		°C/W
Package Thermal Resistance $Θ_{JC}$ (JESD15-3 norm)	ACL406AS		TBD		°C/W

Table 4: Electrical parameters

$$* P_{LED} = \frac{15.7*ID1*75+18.3*ID2*150+27*ID3*225+23*ID4*300}{100}$$

** Power derating acts as a soft over temperature protection. LED current decreases with excessive IC temperature.

*** Warning: Junction-to-air thermal resistance depends greatly on user application and PCB layout. Thermal management of the lighting system has to be carefully managed and taken into account.

10. FONCTIONAL DESCRIPTION

LED Current Setting

For the ACL406AS, the LED current is set by an external resistor R_{SET}. Each channel's current sink level is calculated as follows:

Parameter	Conditions	value	Units
ILED	ACL406AS @25°C	$I_{D1}=0.88/(10+R_{SET})$	A
		$I_{D2}=0.93/(10+R_{SET})$	
		$I_{D3}=1.02/(10+R_{SET})$	
		$I_{D4}=1.20/(10+R_{SET})$	

Table 5: LED current setting

Over temperature and LED failure Protection.

- In case of excessive temperature in the IC, thermal regulation is managed by regulating the delivered power and the associated temperature. The implemented output power acts as soft temperature protection. The LED current is decreased to regulate the junction temperature until a safe state is found.
- In case of LED failure, the output power derating acts also as a protection. If the group of LED n is broken (open circuit), the LED current will flow in the previous pin D_{n-1} of the IC. This will increase dissipated power and temperature too. The output power derating will activate to decrease temperature until a safe state is reached again.
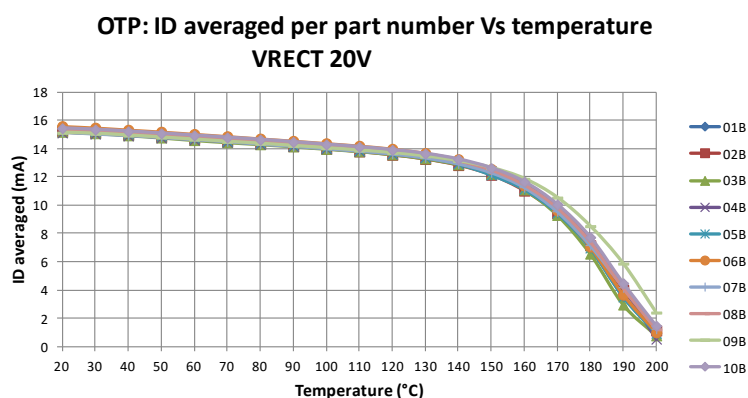

Figure 4: Output LED current derating vs temperature

R_{SET} open/short Protection.

When R_{SET} Pin is opened, the LED output current becomes zero.
When R_{SET} Pin is shorted to GND, a current limitation is enabled. It is set to a hundred of milliamperes and prevents damage to the IC.

11. PACKAGE DESCRIPTION
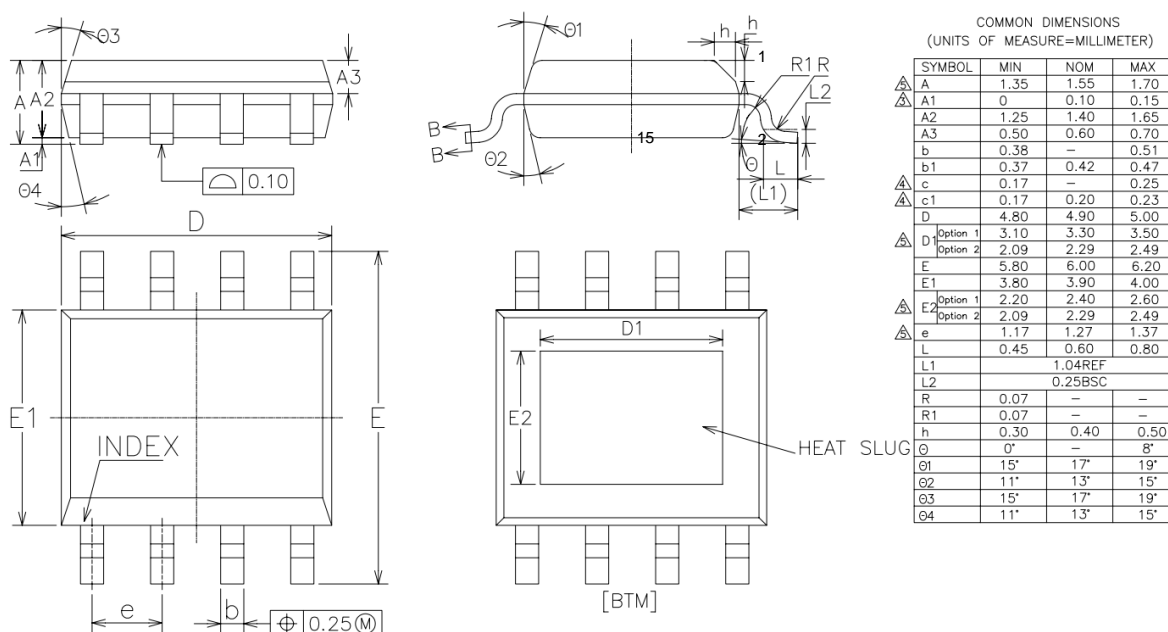
ACL406AS: SO8 with exposed pad

COMMON DIMENSIONS (UNITS OF MEASURE=MILLIMETER)			
SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.70
A1	0	0.10	0.15
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	–	0.51
b1	0.37	0.42	0.47
c	0.17	–	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
D1 Option 1	3.10	3.30	3.50
D1 Option 2	2.09	2.29	2.49
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
E2 Option 1	2.20	2.40	2.60
E2 Option 2	2.09	2.29	2.49
e	1.17	1.27	1.37
L	0.45	0.60	0.80
L1		1.04REF	
L2		0.25BSC	
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
Θ	0°	–	8°
$\Theta 1$	15°	17°	19°
$\Theta 2$	11°	13°	15°
$\Theta 3$	15°	17°	19°
$\Theta 4$	11°	13°	15°

Figure 5: Package outline drawing

PCB Footprint ACL406AS:
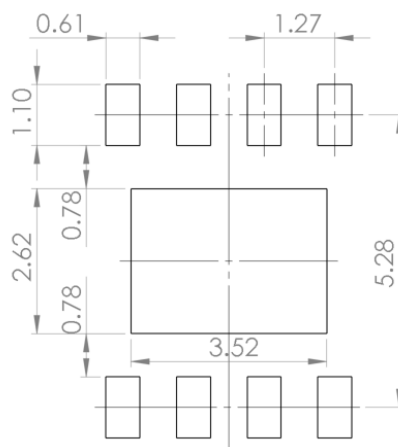
Figure 6: PCB footprint (TOP view). Size in mm.

Remark: the size 3.52 mm for the Exposed Pad is a minimum but could be increase to have a better thermal dissipation.

12. ORDERING INFORMATION

Device	Package	Shipping*
ACL406AS	SO8	Tape & Reel

Table 6: Ordering reference

* Please, ask EASii IC for details of the quantity per reel with the part orientation.

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