



AK9700AD

IR LED for NDIR Gas Sensing

1. General Description

The AK9700AD is a small mid-infrared light emitting diode made of AlInSb and optimized for NDIR gas sensing applications. It uses AKM's unique compound semiconductor technology which realizes, at room temperature operation, high radiant intensity, high speed response, and high reliability. AK9700AD also includes an internal mid-infrared photo diode for thermal compensations purposes. This LED is optimized to NDIR CO₂ Sensing application for automotive.

2. Features

- High Radiant Intensity
- Peak Wavelength: $\lambda_p = 4.3\mu\text{m}$
- Angle of Half Intensity: $\Phi = 60^\circ$
- Suitable for High Speed Pulse Current Operation
- High Reliability
- 2.6mm x 1.9mm x 0.4mm Small surface mount type package
- AEC-Q101 qualified
- Application
 - HVAC for automotive
 - CO₂ refrigerant leakage detection for automotive

3. Table of Contents

1. General Description	1
2. Features	1
3. Table of Contents.....	2
4. Block Diagram and Functions	3
4.1. Block Diagram.....	3
4.2. Functions	3
5. Pin Configurations and Functions.....	4
5.1. Pin Configurations	4
5.2. Functions	4
6. Absolute Maximum Ratings	5
7. Recommended Operating Conditions.....	5
8. Electrical Characteristics.....	6
9. Recommended External Circuits	8
10. Package.....	9
10.1. Outline Dimensions	9
10.2. Pad Dimensions.....	9
10.3. Marking	10
11. Precautions.....	11
12. Ordering Guide	11
13. Revision History.....	11
IMPORTANT NOTICE	12

4. Block Diagram and Functions

4.1. Block Diagram

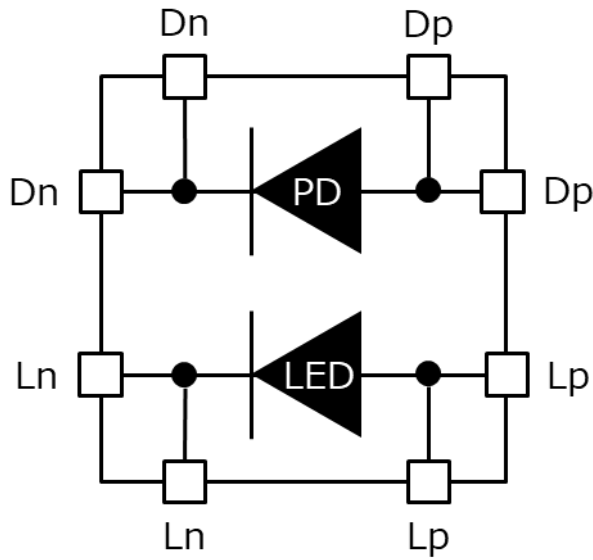


Figure 4.1 Block Diagram

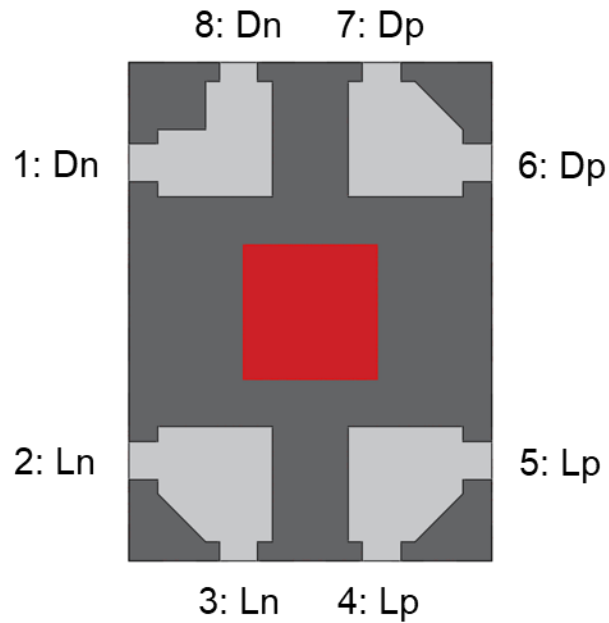
4.2. Functions

Table 4.1 Block Functions

Block	Functions
LED	Mid-infrared quantum light emitting diode
PD	Mid-infrared quantum photo diode

5. Pin Configurations and Functions

5.1. Pin Configurations



Top View

Figure 5.1 Pin Configurations

5.2. Functions

Table 5.1 Pin/Functions

Pin No.	Name	I/O	Functions
1, 8	Dn	O	n-type output pin of PD
2, 3	Ln	I	n-type input pin of LED
4, 5	Lp	I	p-type input pin of LED
6, 7	Dp	O	p-type output pin of PD

6. Absolute Maximum Ratings

Table 6.1 Absolute Maximum Ratings

Unless otherwise specified, Ta = 25°C

Parameter	Symbol	Min.	Max.	Unit	Note
Reverse Voltage	VR	-	1	V	
Forward Current (Pulse mode)	IF	-	0.5	A	Pulse width: 1ms Duty cycle < 1%
Power dissipation	PV	-	110	mW	
Storage Temperature	Tst	-40	110	°C	

Notes:

Operation exceeding the absolute maximum ratings may result in permanent damage to the device.
Normal operation is not guaranteed at these extremes.

7. Recommended Operating Conditions

Table 7.1 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	IF	-	100	125	mA	Duty cycle = 0.13% Pulse width: 0.32ms
Operating Temperature	Ta	-40	-	90	°C	

8. Electrical Characteristics

Table 8.1 Electrical Characteristics

Unless otherwise specified, Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Radiant intensity	Ie	0.46	0.89	2.52	nA	Distance between AK9700AD and the sensor: 2mm (*1)
Forward voltage	VF	1.03	1.3	1.82	V	IF = 100mA Pulse width: 1ms
Reverse current	IR	-	2300	7638	μA	VR = 1V
Internal resistance of PD	R0	3.9	23	69	kΩ	(*2)
Output current of PD	Ip	928	2800	7705	nA	IF = 100mA Pulse width: 1ms

Notes:

*1: Radiant intensity is measured by the calibrated infrared sensor whose electrical characteristic written in table 8.2

*2: Measurement conditions:

- Average value at ±500nA output.

Table 8.2 Electrical Characteristics of Calibrated Infrared Sensor

Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit
Output Current (*3)	Ip	1.56	1.61	1.66	nA

Notes:

Calibrated infrared sensor has a built in an optical band pass filter with the following features.

- Center wavelength: 4260nm
- Full width at half maximum: 150nm

*3: Measurement conditions:

The test is done by the equivalent light source as below.

- Light source
 - Blackbody furnace with diameter = 22.2mm
 - Surface temperature = 500°C
- Distance
 - The sensor to blackbody = 100mm.
- The soda glass is placed between the sensor and the blackbody furnace.
- Measured by a 10Hz lock-in amplifier.
- CO₂ Concentration: 300ppm to 1000ppm
- Humidity: Out of control
- Atmospheric Pressure: Out of control

Table 8.3 Electrical Characteristics (Reference)

Unless otherwise specified, Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Forward voltage	V _F	0.55	-	2.5	V	Ta = -40 ~ 90°C IF = 100mA Pulse width: 1ms
Internal resistance of PD	R ₀	1	-	-	kΩ	Ta = -40 ~ 90°C (*4)
Output current of PD	I _p	500	-	10000	nA	Ta = -40 ~ 90°C IF = 100mA Pulse width: 1ms
Temperature coefficient of I _e	TKI _e	-	0.9	-	%/K	
Angle of half intensity	Φ	-	60	-	°	
Peak wavelength	λ _p	-	4.3	-	μm	
Spectral bandwidth	Δλ	-	1.0	-	μm	FWHM
Temperature coefficient of λ _p	TKλ _p	-	0.0022	-	μm/K	
Rise time	T _r	-	2	-	μs	IF = 100mA 10%IF ~ 90%IF
Fall time	T _f	-	2	-	μs	IF = 100mA 90%IF ~ 10%IF

Notes:

Pre-shipment inspection is not performed.

*4: Measurement conditions:

- Average value at ±500nA output.

9. Recommended External Circuits

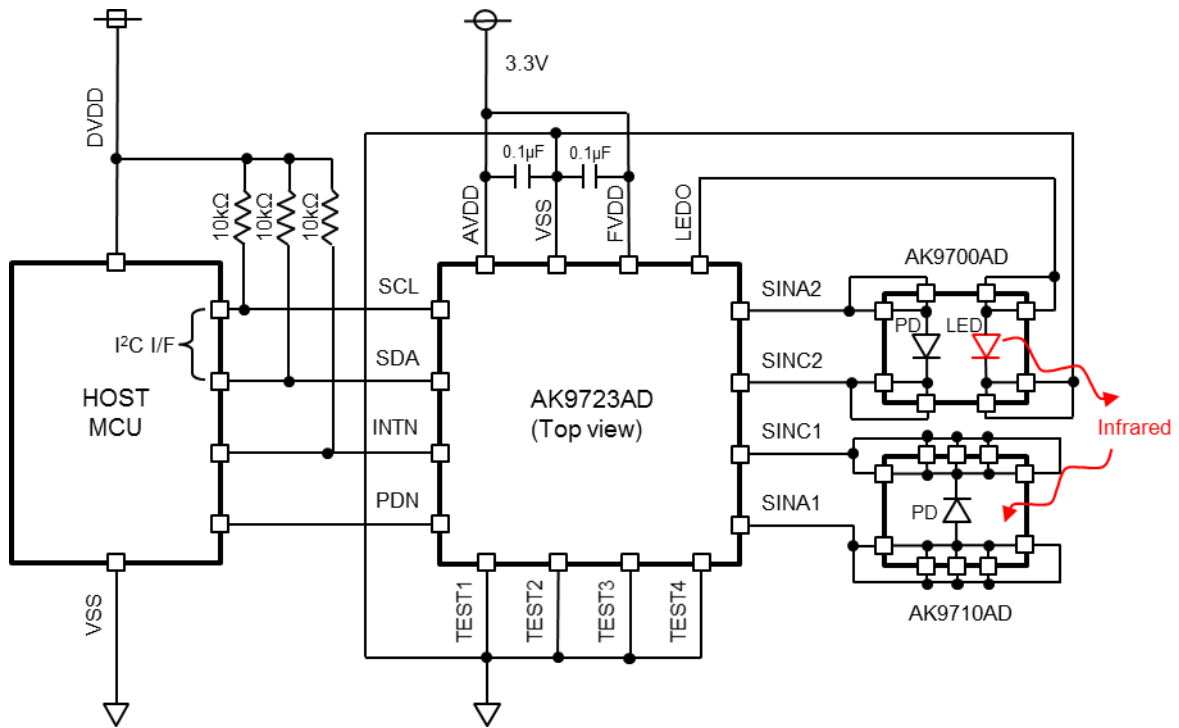


Figure 9.1 Recommended External Circuits

10. Package

10.1. Outline Dimensions

Unit: mm

Unless otherwise specified: ± 0.1 mm

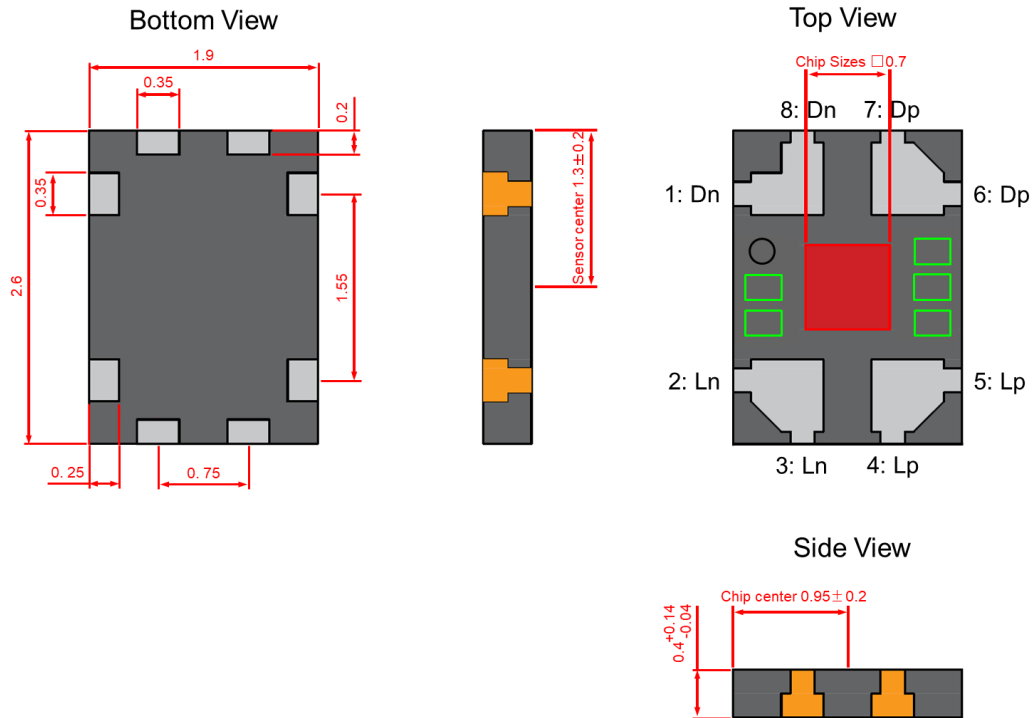


Figure 10.1 Outline Dimensions

10.2. Pad Dimensions

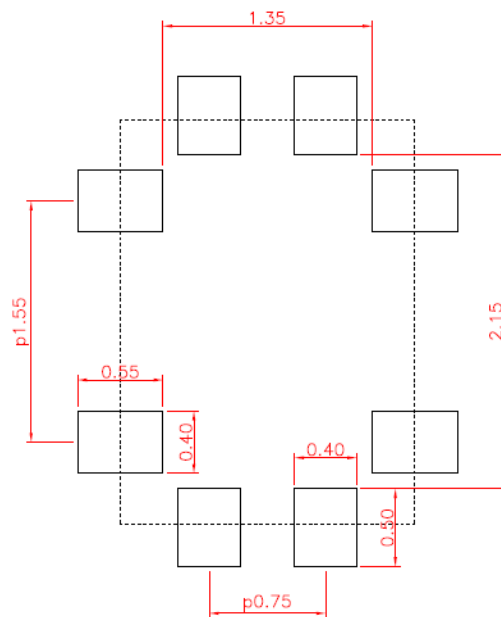
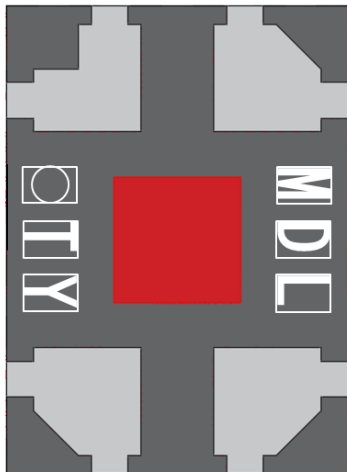


Figure 10.2 Pad Dimensions

10.3. Marking

T (Product ID)		Y (Year)		M (Month)		D (Day)		L (Lot)	
Mark	Product ID	Mark	Year	Mark	Month	Mark	Day	Mark	Lot
1	AK9700AE	0	2020	C	1	1	1	1	1
2	AK9700AD	1	2021	D	2	2	2	2	2
3	AK9703AJ	2	2022	E	3	3	3	3	3
		3	2023	F	4	4	4	4	4
		4	2024	G	5	5	5	5	5
		5	2025	H	6	6	6	6	6
		6	2026	J	7	7	7	7	7
		7	2027	K	8	8	8	8	8
		8	2018	L	9	9	9	9	9
		9	2019	M	10	0	10	0	10
				N	11	A	11	A	11
				P	12	B	12	B	12
						C	13	C	13
						D	14	D	14
						E	15	E	15
						F	16	F	16
						G	17	G	17
						H	18	H	18
						J	19	J	19
						K	20	K	20
						L	21	L	21
						N	22	M	22
						P	23	N	23
						R	24	P	24
						S	25	R	25
						T	26	S	26
						U	27	T	27
						V	28	U	28
						W	29	V	29
						X	30	W	30
						Y	31	X	31
								Y	32
								Z	33



11. Precautions

<Electrostatic Discharge (ESD)>

This product is sensitive to Electrostatic Discharge (ESD). When handling the product, please be careful about the following matters.

- When you handle the product, please work in the environment to protect against static electricity (ex. more than 40%RH).
- Always use an ESD wrist strap and wear antistatic clothes.
- Please take electrostatic measures of the container etc. where the product touches directly.

<Storage Environment>

Please avoid exposed to direct sunlight. Please keep it as much as possible at room temperature and normal humidity. The desirable condition is 5 ~ 35 °C and 40 ~ 85%RH. In addition, please keep the product away from the chlorine gas and the causticity gas. When this product is kept in inappropriate environment, it may influence product properties.

<Other Precautions>

As Gallium Arsenide (GaAs) and Aluminum Indium Antimonide (AlInSb) are used for this product, please be careful about the following matters.

- 1)Please do not take this product to burning and melting and destroys, chemical processing etc.
- 2)When you discard this product, please handle it according to related laws and your regulations on waste disposal.

Please be careful not to damage and pollute the sensor surface because the sensor properties may change.

12. Ordering Guide

AK9700AD -40 ~ 90°C 8-pin SON Automotive Grade

13. Revision History

Date (Y/M/D)	Revision	Reason	Page	Contents
18/12/21	0.0	First Edition		