



AK9710AEF01

IR Sensor for NDIR CO₂ Sensing

1. General Description

The AK9710AEF01 is a small mid-infrared quantum photo diode made of InSb. It can work at room temperature by AKM unique compound semiconductor technology, which realizes the high sensitivity, high speed response, and high reliability. The AK9710AEF01 has a built in an optical band pass filter. This sensor is optimized to NDIR CO₂ Sensing application.

2. Features

- ☐ High Sensitivity
Signal-to-noise ratio is three times higher than conventional thermopiles.
- ☐ High Speed Response (~100kHz)
- ☐ High Reliability
- ☐ No bias voltage needed
- ☐ Built in an Optical Band Pass Filter for CO₂ Sensing
- ☐ 3mm x 3mm small surface mount type plastic package
- ☐ Application
 - HVAC
 - CO₂ refrigerant leakage detection
 - Flame detection

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4. Block Diagram and Functions

4.1. Block Diagram

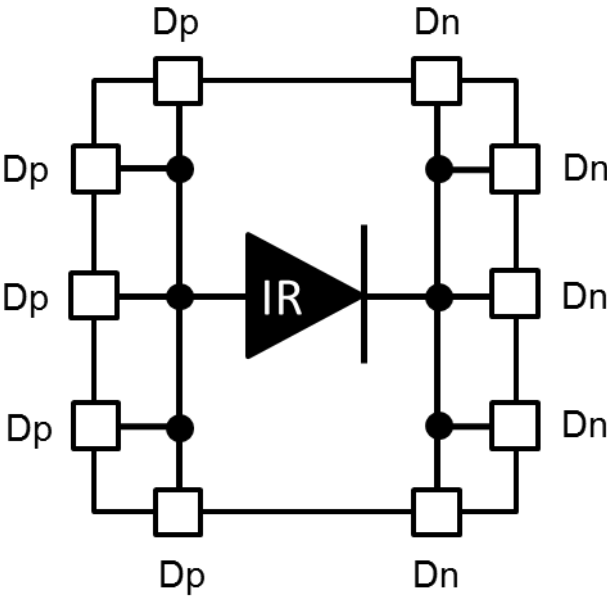


Figure 4.1 Block Diagram

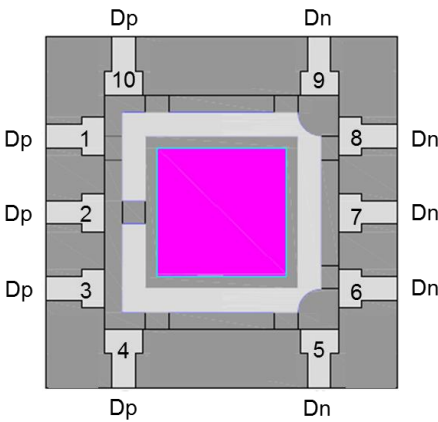
4.2. Functions

Table 4.1 Block Functions

| Block | Function |
|-------|----------------------------------|
| IR | 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, 2, 3, 4, 10 | Dp | — | p-type output pin |
| 5, 6, 7, 8, 9 | Dn | — | n-type output pin |

6. Absolute Maximum Ratings

Table 6.1 Absolute Maximum Ratings

| Parameter | Symbol | Min. | Max. | Unit |
|-----------------------|--------|------|------|------|
| Operating Temperature | Ta | -40 | 85 | °C |
| Storage Temperature | Tstg | -40 | 85 | °C |

Notes

Operation exceeding these ratings may cause permanent damage to device.
Do not apply a bias voltage.

7. Recommended Operating Conditions

Table 7.1 Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|-----------------------|--------|------|------|------|------|
| Input Voltage (*1) | Vin | -10 | 0 | 10 | μV |
| Operating Temperature | Ta | -40 | | 85 | °C |

Note

*1: Do not apply a bias voltage between Dp and Dn.
Refer to the recommended external circuits.

8. Electrical Characteristics

Table 8.1 Electrical Characteristics

Unless otherwise specified, Ta = 25°C

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------|--------|------|------|------|------|
| Output Current (*2) | Ip | 1.04 | 2.97 | 4.90 | nA |
| Internal Resistance (*3) | Ro | 75 | | 188 | kΩ |

Notes:

*2: Measurement conditions:

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

- Light source

Blackbody furnace with diameter = 22.2mm

Surface temperature = 500°C

- Distance

AK9710AEF01 to blackbody = 10cm.

- The soda glass is placed between the sensor and the blackbody furnace.

- Measured by a 10Hz lock-in amplifier.

*3: Measurement conditions:

- Average value at ±500nA output.

9. Optical Filter Specification

Table 9.1 Optical Filter Specification

Angle of incidence = 0°

Ta = 25°C

| Parameter | Symbol | Min | Typ | Max | Unit |
|-----------------------------|--------|------|------|------|------|
| Center wavelength | CWL | 4240 | 4280 | 4320 | nm |
| Full width at half maximum | FWHM | 243 | 270 | 297 | nm |
| Peak transmission intensity | Tpeak | 75 | | | % |

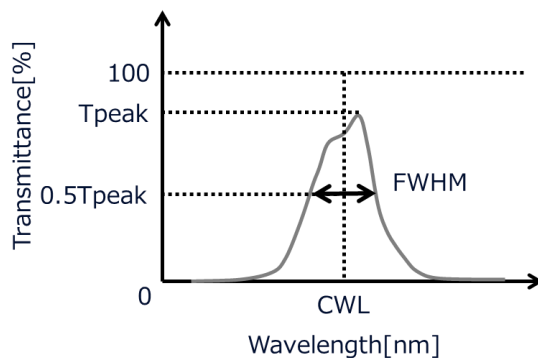


Figure 9.1 Definition of CWL, FWHM and Tpeak

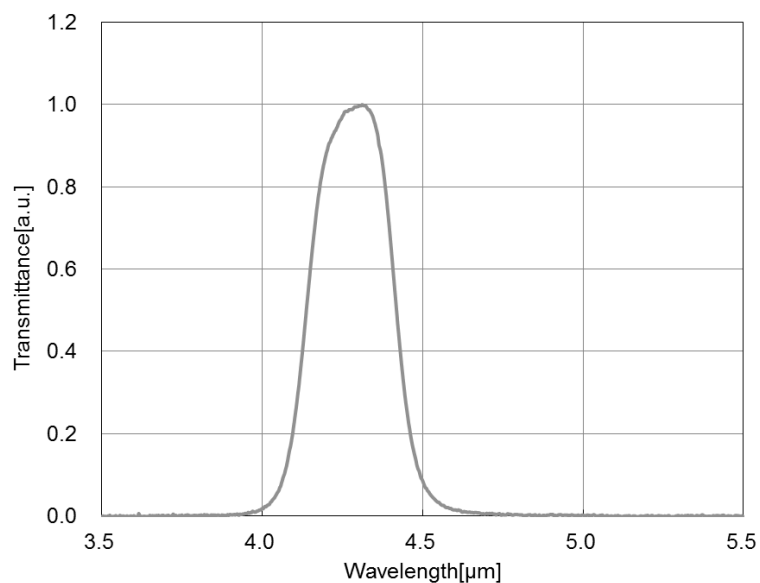


Figure 9.2 Optical filter transmittance (Reference)

10. Field of view (Reference)

Ta = 25°C

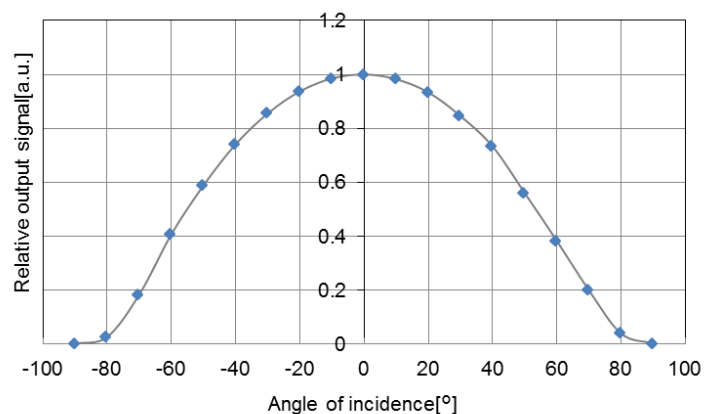


Figure 10.1 Field of view

Measurement conditions: Distance between AK9710AEF01 and light source is 10cm.
Light source: Blackbody diameter=22.2mm, Surface temperature=550°C

11. Recommended External Circuits

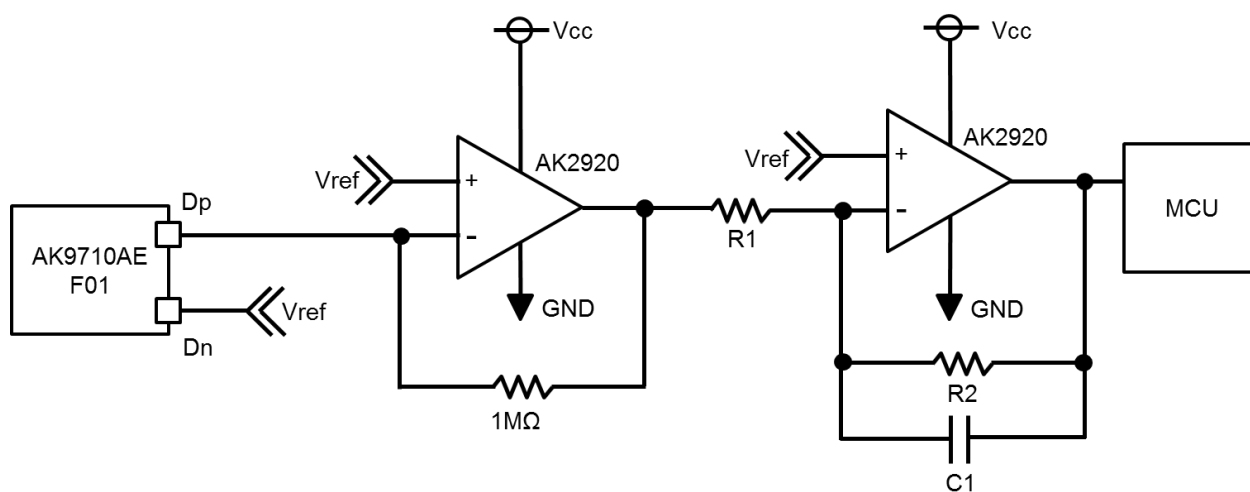


Figure 11.1 Recommended external circuits

*Vref level is between Vcc level and GND level.

*R1, R2, and C1 should be optimized for the application.

12. Package

12.1. Outline Dimensions

Unit: mm

Unless otherwise specified: $\pm 0.1\text{mm}$

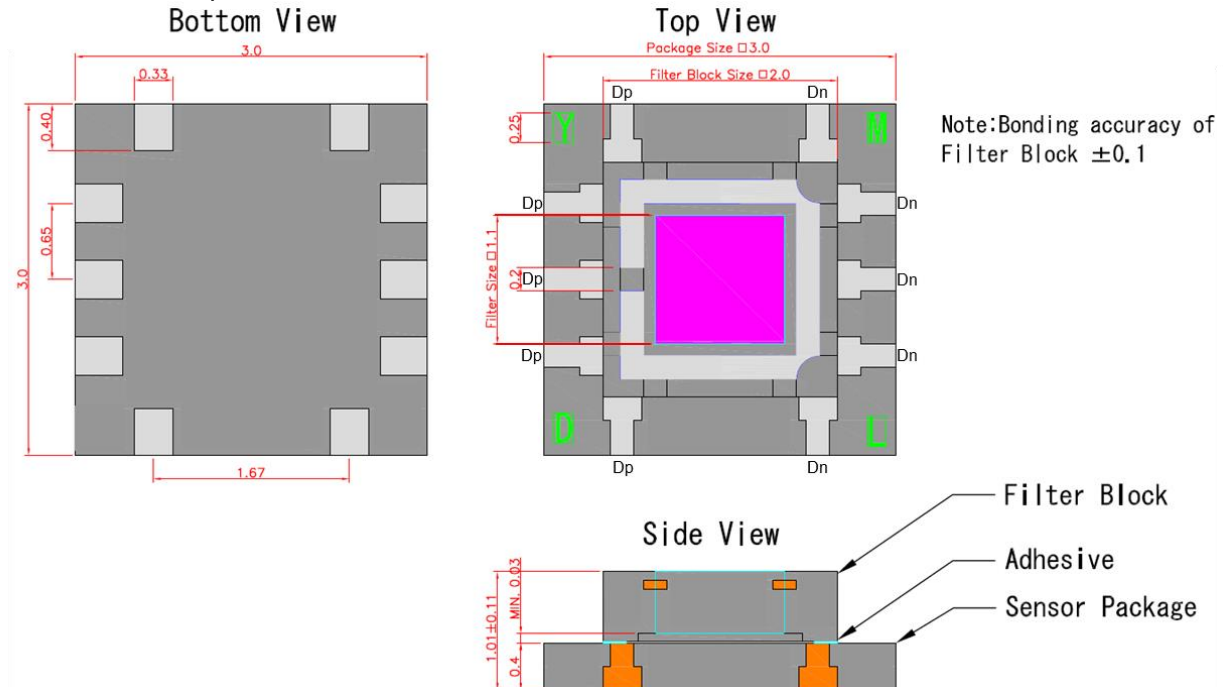


Figure 12.1 Outline Dimensions

12.2. Pad Dimensions

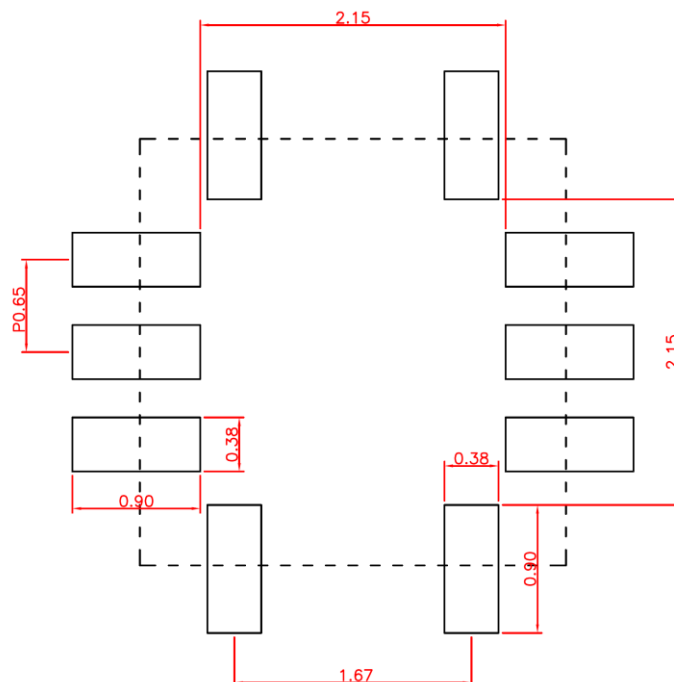
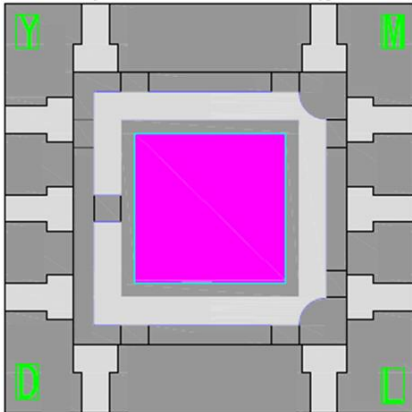


Figure 12.2 Pad Dimensions

12.3. Marking



| Y (Year) | | M (Month) | | D (Day) | | L (Lot) | |
|----------|------|-----------|-------|---------|-----|---------|-----|
| Mark | Year | Mark | Month | Mark | Day | Mark | Lot |
| 0 | 2020 | C | Jan. | 1 | 1 | 1 | 1 |
| 1 | 2021 | D | Feb. | 2 | 2 | 2 | 2 |
| 2 | 2022 | E | Mar. | 3 | 3 | 3 | 3 |
| 3 | 2023 | F | Apr. | 4 | 4 | 4 | 4 |
| 4 | 2024 | G | May. | 5 | 5 | 5 | 5 |
| 5 | 2015 | H | Jun. | 6 | 6 | 6 | 6 |
| 6 | 2016 | J | Jul. | 7 | 7 | 7 | 7 |
| 7 | 2017 | K | Aug. | 8 | 8 | 8 | 8 |
| 8 | 2018 | L | Sep. | 9 | 9 | 9 | 9 |
| 9 | 2019 | M | Oct. | 0 | 10 | 0 | 10 |
| | | N | Nov. | A | 11 | A | 11 |
| | | P | Dec. | 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 |

13. 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 Indium Antimonide (InSb) 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.

14. Ordering Guide

| | | | |
|-------------|------------------|------------|----------------|
| AK9710AEF01 | -40 ~ 85°C | 10-pin SON | Consumer Grade |
| AKD9710 | Evaluation Board | | |

15. Revision History

| Date (Y/M/D) | Revision | Reason | Page | Contents |
|--------------|----------|---------------|------|--|
| 16/10/24 | 00 | First Edition | | |
| 16/12/20 | 01 | Correction | 4 | Corrected Final Test Condition of Electrical Characteristics |
| | | | | |

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