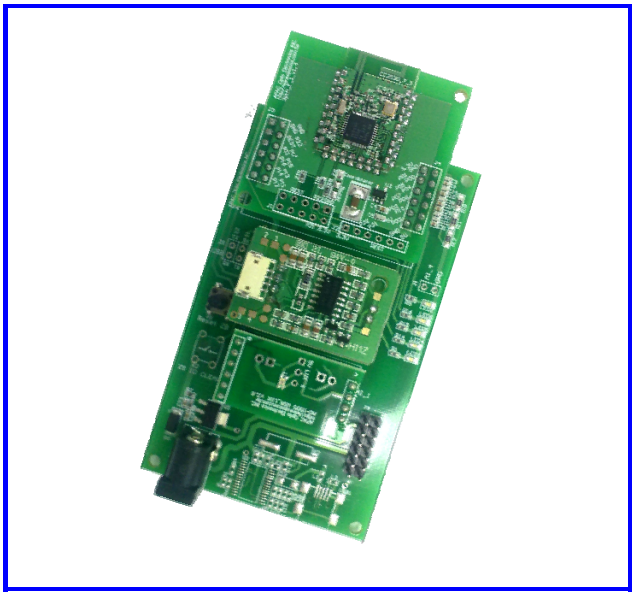
# AO-1505-LUX
## ZigBee Light Sensor



### Features

- Reliable wireless transceiver module.
- Compatible with Peer to Peer, Star, Tree, or Mesh network configurations.
- AO-1501 with on board PCB ANT with 150M range (LOS). AO-1501A with external Antenna.
- -97dBm sensitivity at the receiver.
- The sensor is closed to the human eye's response.
- Good output linearity across wide illumination range and low sensitivity variation across various light sources.

### Applications

- Wireless sensor network (WSN).
- Automatic residential and commercial lighting management.
- Automatic contrast enhancement for electronic signboard.
- Ambient light monitoring device for daylight and artificial light.

### Description

AO-1505-LUX ZigBee light sensor, which uses the latest TI CC2530 ZigBee chip, is designed for smart home and smart building applications. This sensor integrated high efficiency RF transceiver module, ambient light sensor module, and other functional elements to control with various peripheral devices. The biggest advantage of this sensor is that due to the high rejection ratio of infrared radiation, the spectral response of the ambient light sensor is close to that of human eyes.

### Ordering Information

| PART NUMBER | INPUT/OUTPUT | SIGNAL DETECT | VOLTAGE | TEMPERATURE |
|---|---|---|---|---|
| AO-1505-LUX | DC 5V/DC 3.3V | TTL | 3.3V | -30°C to 80 °C |

### Absolute Maximum Ratings

| PARAMETER | SYMBOL | MIN | MAX | UNITS | NOTE |
|---|---|---|---|---|---|
| Storage Temperature | $T_S$ | –40 | 85 | °C | |
| Supply Voltage | *Vcc* | -0.3 | 7 | V | |
| Input Voltage | $V_{IN}$ | 2 | 5 | V | |
| Operating Current | $I_{OP}$ | --- | 40 | mA | |
| Input RF level | $RF_L$ | --- | 10 | dBm | |





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## Recommended Operating Conditions

| PARAMETER | SYMBOL | MIN | MAX | UNITS | NOTE |
|---|---|---|---|---|---|
| Operating ambient temperature range | $T_A$ | -30 | 80 | °C | |
| Supply Voltage | *Vcc* | 1.8 | 5.5 | V | |
| Light Sensor Output Current | $I_{PH}$ | | 5 | mA | |
| Light Sensor Output Voltage | $T_{sol}$ | --- | *Vcc* -0.8 | V | |

## ZigBee Module Electrical Characteristics

| PARAMETER | TEST CONDITIONS | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|---|---|---|---|---|
| $I_{core}$ Core current consumption | PM0 DC Current | --- | 5.0 | 8.9 | mA | |
| | PM1 DC Current | --- | 0.2 | 0.3 | mA | |
| | PM2 DC Current | --- | 0.3 | 1 | uA | |
| | 32-MHz XOSC running, radio in RX mode at -100-dBm input power, no peripherals active, CPU idle | --- | 24.1 | 29.6 | mA | |
| | 32-MHz XOSC running, radio in TX mode, 4.5-dBm output power, no peripherals active, CPU idle | --- | 35.4 | 39.6 | mA | |
| **Peripheral Current Consumption** | | | | | | |
| ADC | When converting | --- | 1.2 | --- | mA | |
| Flash | Erase | --- | 1 | --- | mA | |
| | Burst write peak current | --- | 6 | --- | mA | |
| **Radio Part** | | | | | | |
| RF frequency range | Programmable in 1-MHz steps, 5 MHz between channels | 2394 | --- | 2507 | MHz | |
| Radio baud rate | As defined by [1] | --- | 250 | --- | kbps | |
| Radio chip rate | As defined by [1] | --- | 2 | --- | MChip/s | |
| Wireless Distance | | --- | --- | 150 | m | |
| **Communication Interface Part** | | | | | | |
| UART Baud Rate | | 4800 | 9600 | 115200 | bps | |

[1] AO-1503 reference design is suitable for systems targeting compliance with EN 300 328, EN 300 440, FCC CFR47 Part 15 and ARIB STD-T-66.





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## RF Transmitter Electrical Characteristics

**$V_{IN}$= 3.0 V to 3.6 V, $T_C$ = -40 °C to 85 °C, $f_c$ = 2394 MHz to 2507 MHz**

| PARAMETER | TEST CONDITIONS | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|---|---|---|---|---|
| Nominal output power | Delivered to a single-ended 50-Ω load through a balun using maximum-recommended output-power setting requires minimum –3 dBm | 0 | 4.5 | 8 | dBm | |
| Programmable output power 32 dB range | When converting | --- | 32 | --- | dB | |
| Optimum load impedance | | | 69 + j29 | | Ω | |

## RF Receiver Electrical Characteristics

**$V_{IN}$= 3.0 V to 3.6 V, $T_C$ = -40 °C to 85 °C, $f_c$ = 2394 MHz to 2507 MHz**

| PARAMETER | TEST CONDITIONS | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|---|---|---|---|---|
| Receiver sensitivity | PER = 1% | --- | -97 | -92 | dBm | |
| Saturation (maximum input level) | PER = 1% | --- | --- | 10 | dBm | |
| Frequency error tolerance | requires minimum 80 ppm | | ±150 | | ppm | |
| Symbol rate error tolerance | requires minimum 80 ppm | | ±1000 | | ppm | |

## Electro-Optical Characteristics (Ta=25°C, Vcc=3.0V)

| PARAMETER | TEST CONDITIONS | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|---|---|---|---|---|
| Current Consumption | About 1.02 times of $I_{PH}$ | | | | | |
| Photocurrent-1 | Vcc=3V,Ev=10Lx (2,4) | 2.6 | 3.8 | 5.0 | μA | |
| Photocurrent-2 | Vcc=3V, Ev=100Lx (2,4) | 26 | 38 | 50 | μA | |
| Photocurrent-3 | Vcc=3V, Ev=100Lx (1,4) | --- | 38 | --- | μA | |
| Dark current | Vcc=3V, Ev=0Lux | --- | --- | 0.1 | μA | |
| Saturation Output Voltage | Vcc=3.0V, Ev=100Lx, $R_L$=75KΩ (3) | 2.2 | 2.3.5 | --- | V | |





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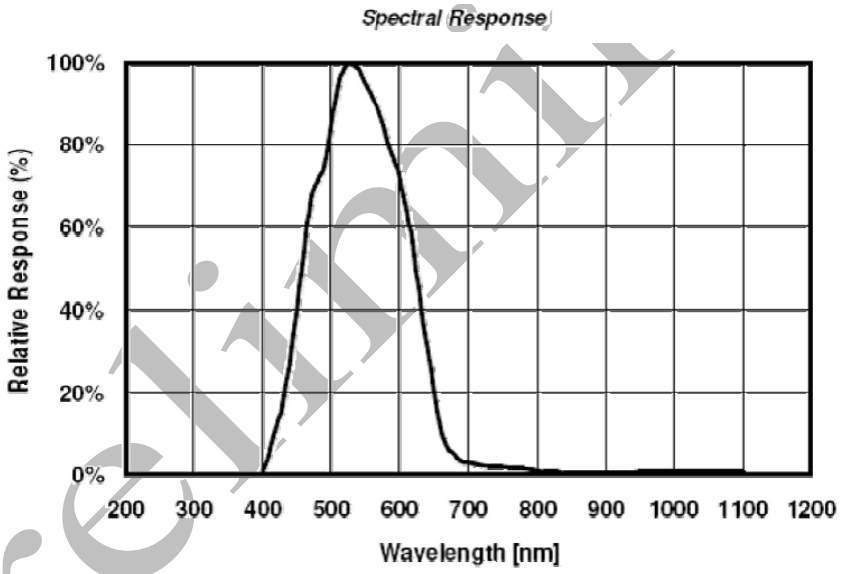
| | | | | | |
|---|---|---|---|---|---|
| Temperature Coefficient | T=-20℃~80℃,Ev=100Lx (2) | --- | 0.23 | --- | %/℃ |
| Power Supply Rejection Ratio | Vcc=1.8 - 6.5V, Ev=100Lx (2) | --- | 8.5 | --- | %/V |
| Photocurrent Ratio | - | --- | 1 | --- | --- |

Note

1. Illuminance by CIE standard illuminant-A / 2856K, incandescent lamp.
2. Fluorescent light is used as light source. White LED is substituted in mass production.
3. White LED is used as light source.
4. The actual photocurrent depends on the package and optical designs.

## Typical Electrical / Optical Characteristics Curves




## Application Circuit

1. Fluorescent light maybe consists of AC noise about 60Hz (AC Frequency). Thus, a capacitor of 3.3 μF, which acts as a low-pass filter, is recommended to add in parallel with resistor to by-pass the ripples if possible.
2. Analog signal $V_{OUT}$ is used directly. This circuit is suitable for Ev = 1 Lx to 10,000 Lx; Increasing the brightness of the light and/or the load resistor will increase the output voltage.

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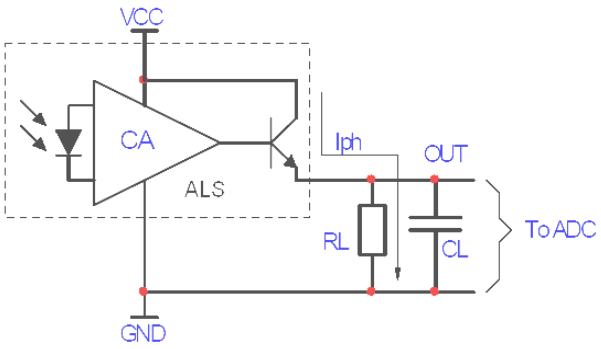






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## Debug Interface Characteristics

TA = –40°C to 85°C, VDD = 2 V to 3.6 V, unless otherwise noted.

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP. | MAX | UNITS | NOTE |
|---|---|---|---|---|---|---|---|
| Debug clock frequency | fclk_dbg | | --- | --- | 12 | MHz | (see Figure 1) |
| Allowed high pulse on clock | t1 | | 35 | --- | --- | ns | (see Figure 1) |
| Allowed low pulse on clock | t2 | | 35 | --- | --- | ns | (see Figure 1) |
| EXT_RESET_N low to first falling edge on debug clock | t3 | | 167 | --- | --- | ns | (see Figure 2) |
| Falling edge on clock to EXT_RESET_N high | t4 | | 83 | --- | --- | ns | (see Figure 2) |
| EXT_RESET_N high to first debug command | t5 | | 83 | --- | --- | ns | (see Figure 2) |
| Debug data setup | t6 | | 2 | --- | --- | ns | (see Figure 3) |
| Debug data hold | t7 | | 4 | --- | --- | ns | (see Figure 3) |
| Clock-to-data delay | t8 | Load = 10 pF | --- | --- | 30 | ns | (see Figure 3) |

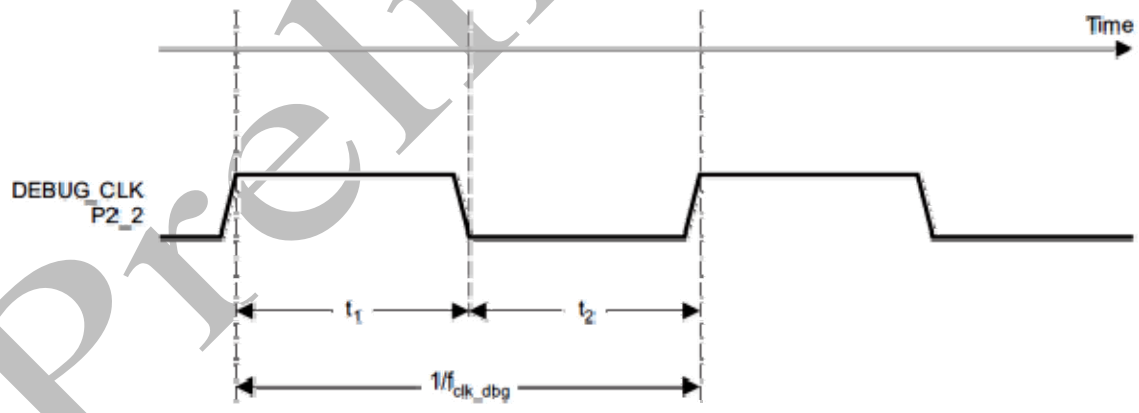


Figure 1 **Debug Clock – Basic Timing**





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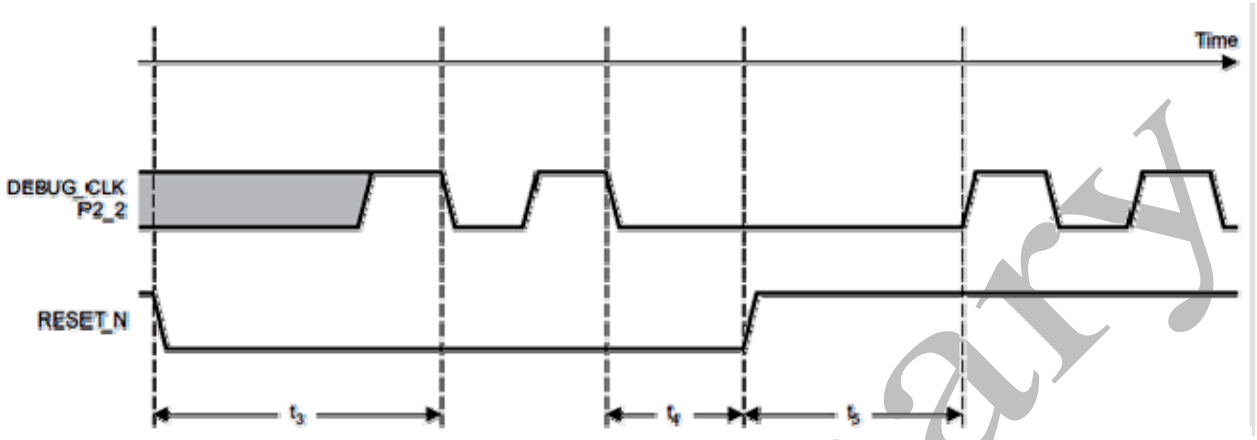


Figure 2 **Data Setup and Hold Timing**

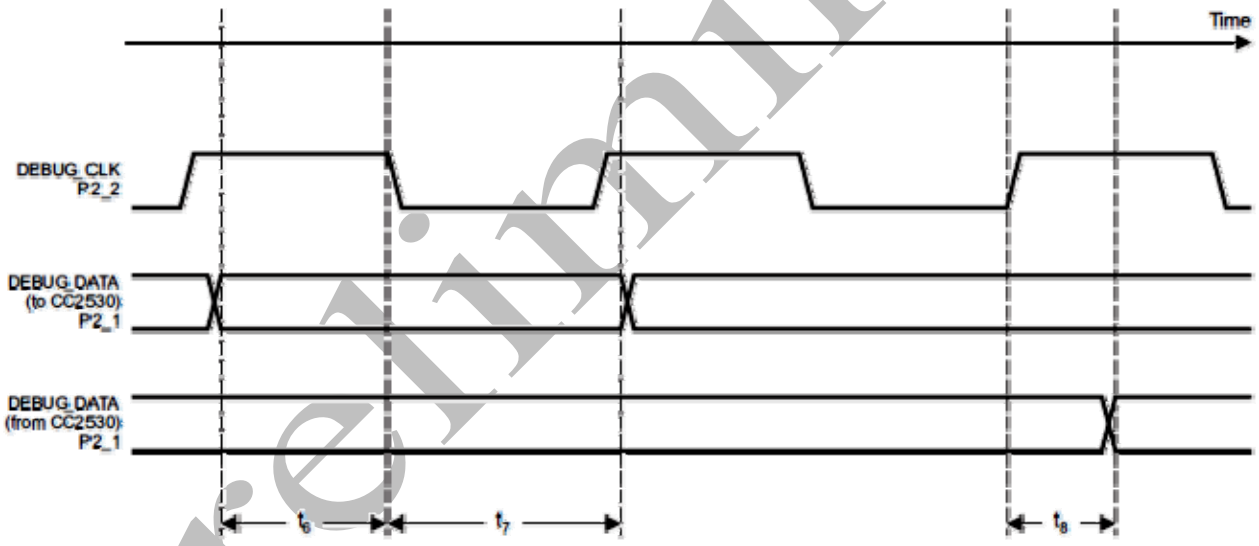


Figure 3 **Debug Enable Timing**





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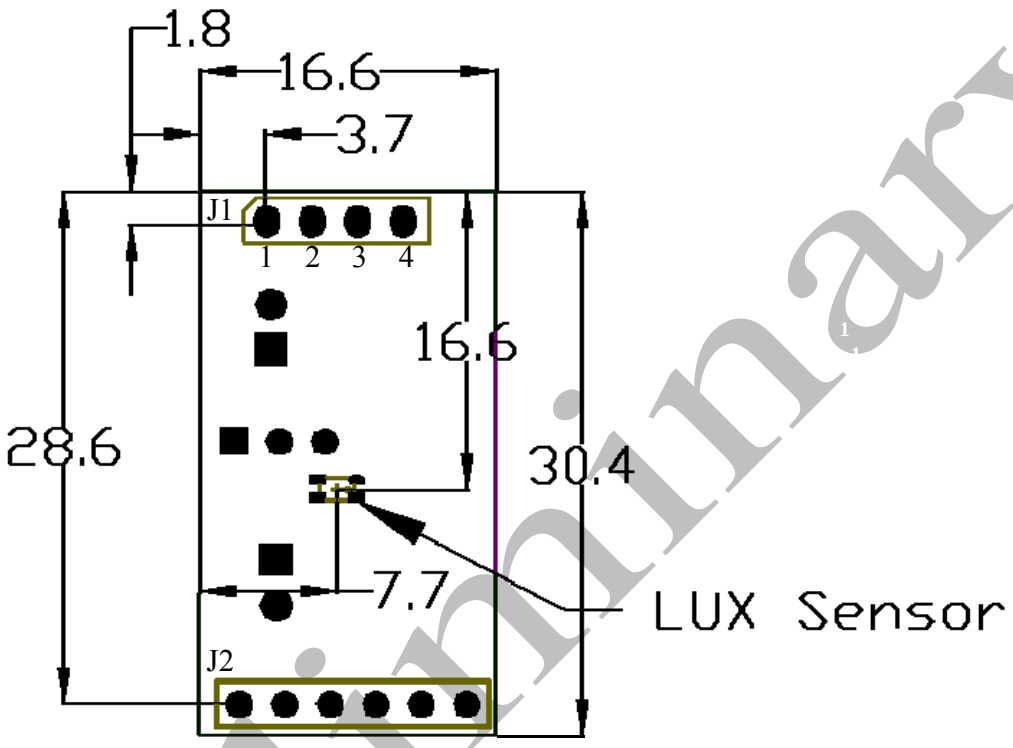
## Sensor module Dimensions and Terminals




**Units: mm**

| J1 Terminal | Description |
|---|---|
| **Pin 1** | Power source 5V DC |
| **Pin 2** | Light voltage output |
| **Pin 3** | GND |
| **Pin 4** | Unused |

| J2 Terminal | Description |
|---|---|
| | Module fixing |





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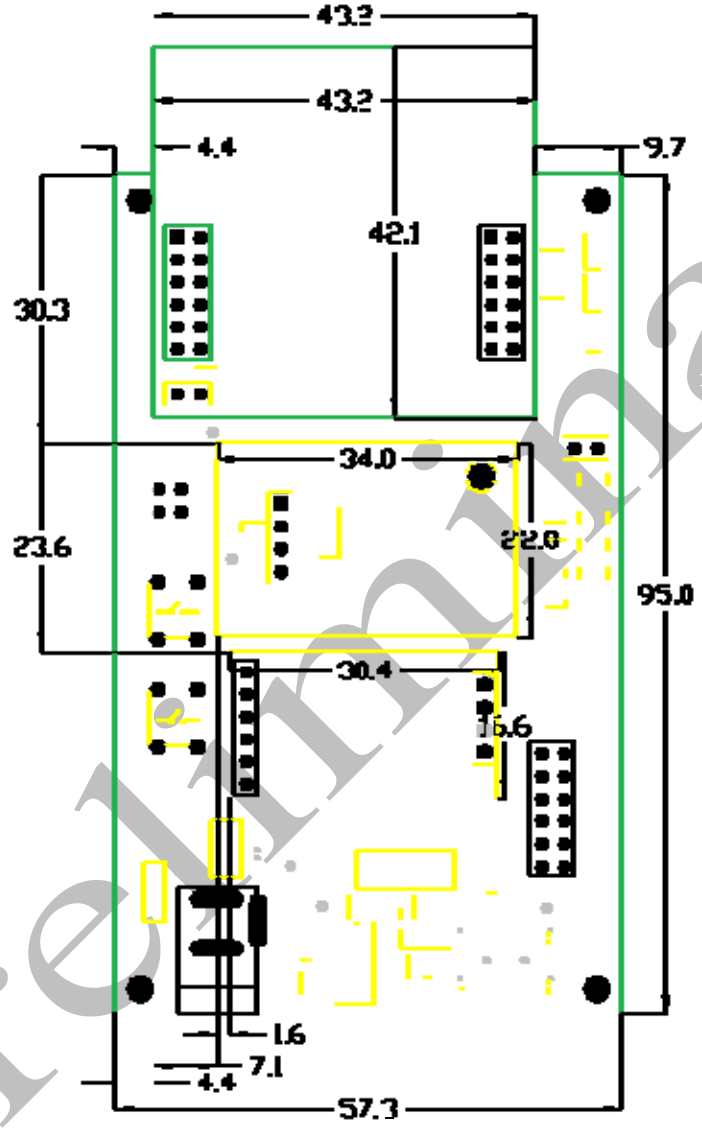
## Sensor board Dimensions




**Units: mm**





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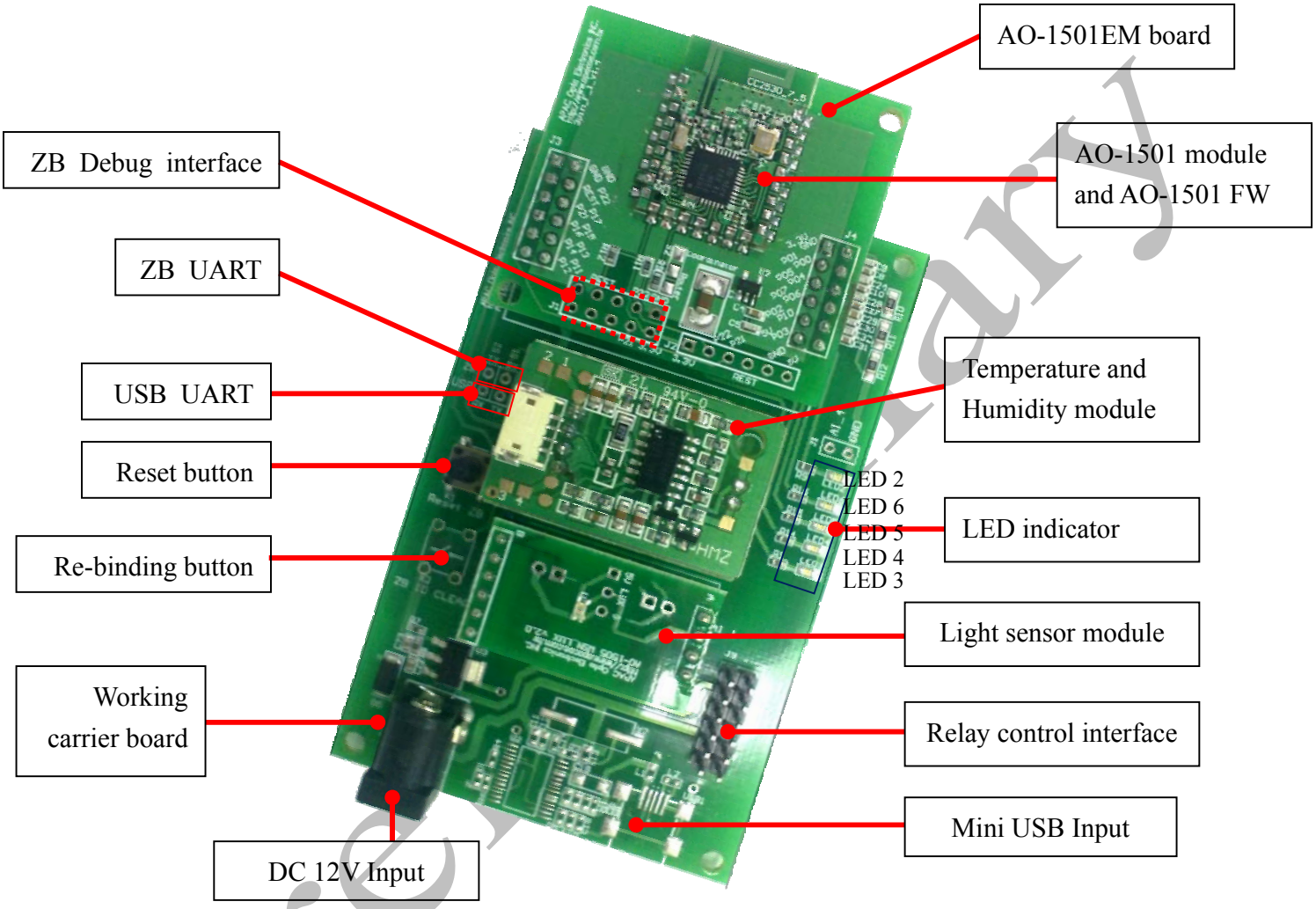
**Sensor Board**

**Peripherals:**




| LED Indicator | Description |
|---|---|
| **LED 2** | ZigBee Network ready: LED ON |
| **LED 6** | Output 4 (1: LED ON; 0: LED OFF) |
| **LED 5** | Output 3 (1: LED ON; 0: LED OFF) |
| **LED 4** | Output 2 (1: LED ON; 0: LED OFF) |
| **LED 3** | Output 1 (1: LED ON; 0: LED OFF) |





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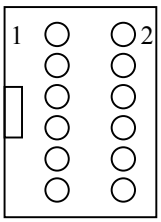
### Relay Control Interface




| PIN Terminals | Description |
|---|---|
| **PIN 1** | Relay +$V_{CC}$ |
| **PIN 2** | Relay +$V_{CC}$ |
| **PIN 3** | Relay +$V_{CC}$ |
| **PIN 4** | Relay +$V_{CC}$ |
| **PIN 5** | GND |
| **PIN 6** | IO_1 (output control) |
| **PIN 7** | GND |
| **PIN 8** | IO_2 (output control) |
| **PIN 9** | GND |
| **PIN 10** | IO_3 (output control) |
| **PIN 11** | GND |
| **PIN 12** | IO_4 (output control) |





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