DORHEA HC-SR501

DORHEA HC-SR501 PIR Motion Infrared Human Body Sensor Module

Model: HC-SR501

1. Introduction

The DORHEA HC-SR501 PIR (Passive Infrared) Motion Infrared Human Body Sensor Module is a pyroelectric infrared sensor designed to detect motion based on changes in infrared radiation. This module is widely utilized in security systems, automated lighting, and various microcontroller-based projects due to its reliability and adjustable parameters.

2. Product Features

- **Operating Voltage Range:** DC 4.5V to 20V
- **Quiescent Current:** Less than 50uA
- **Trigger Modes:** L (non-repeatable trigger) / H (repeatable trigger, default setting)
- **Adjustable Delay Time:** From 5 seconds to 180 seconds (via potentiometer)
- **Block Time:** 2.5 seconds (default, adjustable via potentiometer)
- **Detection Angle:** Less than 100° cone angle
- **Operating Temperature:** -15°C to +70°C
- **Adjustable Sensitivity:** Detection distance can be adjusted via potentiometer

3. Package Contents

- 4 x HC-SR501 IR Pyroelectric Infrared Modules

4. Specifications

Specification	Value
Brand	DORHEA

Specification	Value
Model Number	12951-1
Operating Voltage	DC 4.5-20V
Quiescent Current	<50uA
Board Dimensions	32mm x 24mm
Sensor Diameter	23mm
Operating Temperature	-15°C to +70°C
Detection Angle	<100° cone angle
Item Weight	1.13 ounces (per module)

5. Component Identification

The HC-SR501 module consists of several key components:

- **Fresnel Lens:** The white, dome-shaped cover on the top of the module. This lens focuses infrared radiation onto the pyroelectric sensor and creates multiple detection zones.
- **Pyroelectric Sensor:** Located beneath the Fresnel lens, this sensor detects changes in infrared radiation.
- **Control Chip (BISS0001):** The main integrated circuit responsible for processing the sensor's output and controlling the module's behavior.
- **Potentiometers:** Two orange potentiometers are present for adjusting delay time and sensitivity.
- **Jumper Pins:** A set of three pins used to select the trigger mode (L or H).
- **Power and Output Pins:** VCC (power input), GND (ground), and OUT (digital output signal).

Figure 1: Top view of the HC-SR501 module showing the Fresnel lens.

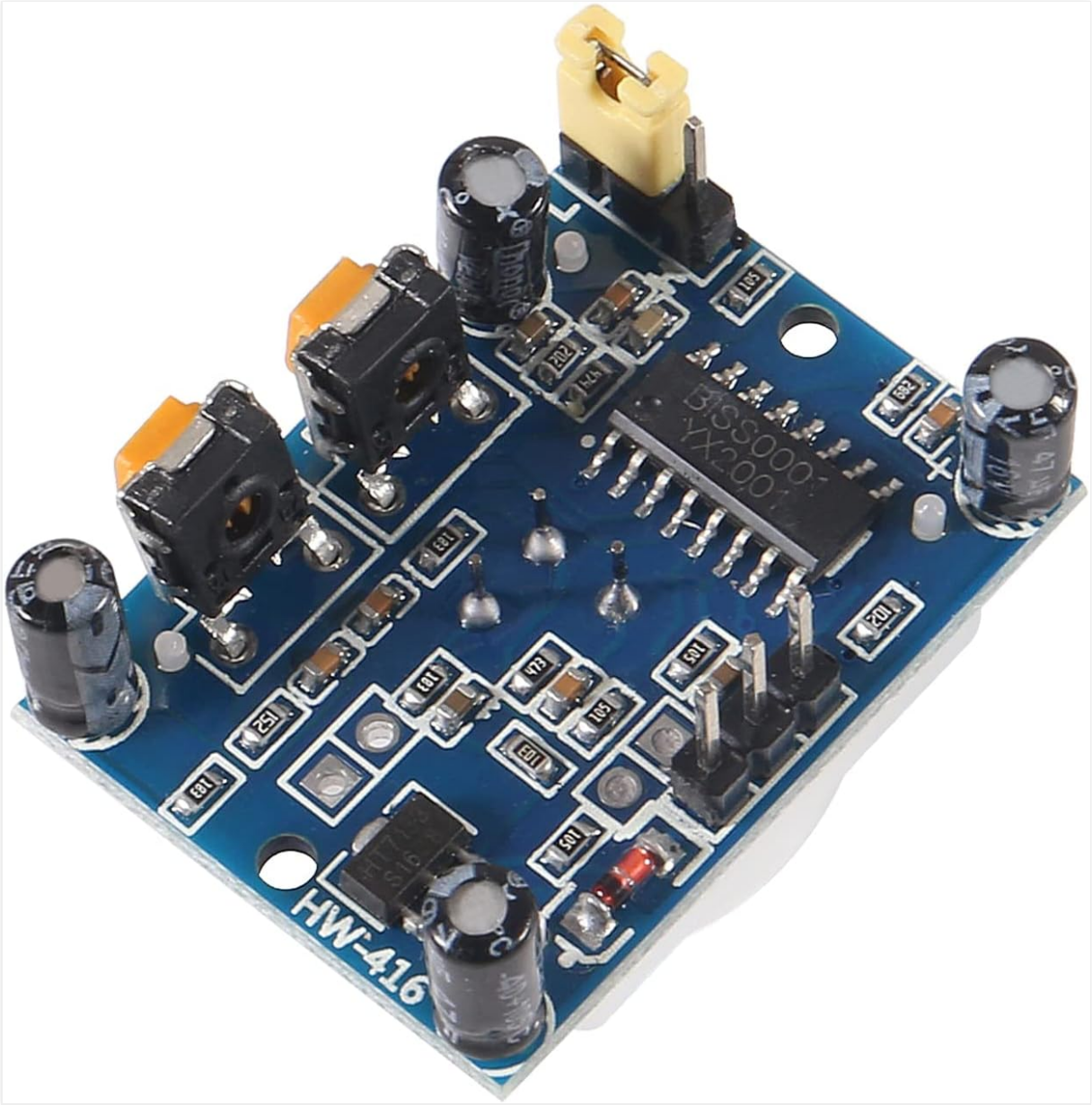

Figure 2: Bottom view of the HC-SR501 module with circuit board components.

Figure 3: HC-SR501 module with lens removed, showing the pyroelectric sensor.

6. Setup and Configuration

6.1. Wiring

Connect the module to your power supply and microcontroller as follows:

- **VCC:** Connect to a DC power source between 4.5V and 20V.
- **GND:** Connect to the ground of your power supply and microcontroller.
- **OUT:** Connect to a digital input pin on your microcontroller. This pin will output a HIGH signal when motion is detected.

6.2. Trigger Mode Selection

The HC-SR501 has a 3-pin jumper for selecting the trigger mode:

- **L (Non-Repeatable Trigger):** When motion is detected, the output goes HIGH for the set delay time, then goes LOW. It will not re-trigger until the delay time has fully elapsed and motion is detected again.
- **H (Repeatable Trigger - Default):** When motion is detected, the output goes HIGH. If motion is detected again during the delay time, the delay timer resets, keeping the output HIGH. The output goes LOW only after no motion is detected for the entire delay period.

To change the mode, move the jumper cap to the desired position. The default setting is 'H'.

6.3. Adjusting Delay Time and Sensitivity

Two potentiometers on the module allow for fine-tuning:

- **Delay Time Potentiometer:** Typically marked 'TIME' or with a clock symbol. Turning it clockwise increases the output HIGH duration (5 to 180 seconds).
- **Sensitivity Potentiometer:** Typically marked 'SENS' or with a distance symbol. Turning it clockwise increases the detection distance (up to approximately 7 meters).

Figure 4: Potentiometers for adjusting delay time and sensitivity, and the trigger mode jumper.

6.4. Warm-up Period

Upon initial power-up, the HC-SR501 module requires a warm-up period of approximately 30-60 seconds to stabilize. During this time, the output may fluctuate or trigger falsely. Allow the module to stabilize before expecting accurate readings.

7. Operating Principles

The HC-SR501 operates by detecting changes in infrared radiation within its field of view. All objects with a temperature above absolute zero emit infrared energy. When a warm body, such as a human, moves into the sensor's detection zone, it causes a rapid change in the detected infrared pattern. The pyroelectric sensor converts this change into an electrical signal, which is then processed by the control chip. If the signal exceeds a certain threshold, the module's output pin goes HIGH, indicating motion. The output remains HIGH for the duration set by the delay time potentiometer, subject to the selected trigger mode.

8. Applications

The versatility of the HC-SR501 module makes it suitable for a wide range of applications, including:

- Security systems and alarms
- Automated lighting control (e.g., for incandescent, fluorescent lamps)
- Automatic doors and gates
- Control of electric fans, washing machines, and dryers
- Industrial automation and control systems
- Human body sensor toys and interactive displays
- Lighting for aisles, corridors, warehouses, and family spaces

9. Maintenance

To ensure optimal performance and longevity of your HC-SR501 module, consider the following maintenance guidelines:

- **Keep the Lens Clean:** Dust or smudges on the Fresnel lens can impair detection accuracy. Gently clean the lens with a soft, dry cloth if necessary.
- **Avoid Environmental Extremes:** Do not expose the module to direct sunlight, strong artificial light sources, or rapid temperature changes, as these can cause false triggers or damage.
- **Optimal Placement:** Avoid mounting the sensor near heat sources (e.g., heaters, vents) or areas with strong air currents, which can interfere with infrared detection.

10. Troubleshooting

If you encounter issues with your HC-SR501 module, refer to the following troubleshooting steps:

- **No Detection:**
  - Verify that the module is correctly wired to VCC, GND, and OUT.
  - Ensure the power supply voltage is within the 4.5V-20V range.
  - Check the sensitivity potentiometer; try increasing sensitivity by turning it clockwise.
  - Confirm that the warm-up period has elapsed after power-up.
  - Ensure there are no obstructions blocking the sensor's field of view.
- **False Triggers / Constant HIGH Output:**
  - Reduce sensitivity by turning the sensitivity potentiometer counter-clockwise.
  - Relocate the module away from heat sources (e.g., heating vents, direct sunlight) or strong air currents.
  - Check for electromagnetic interference from nearby electronics.
  - Ensure the block time is not set excessively long, which can make it appear constantly HIGH.
  - If the output remains constantly HIGH after warm-up and adjustments, the module may be faulty.
- **Inconsistent Triggering:**
  - Verify the stability of your power supply. Fluctuations can affect performance.
  - Ensure the detection area is clear and motion is distinct.
  - Check the trigger mode jumper setting (L vs. H) to ensure it matches your application's requirements.
- **Jumper Issues:** Some modules may have tiny pads for soldering instead of a standard jumper. If a jumper cap is not provided, you may need to solder a connection or use a custom solution for mode selection.

11. Safety Information

Observe the following safety precautions when working with the HC-SR501 module:

- **Correct Voltage:** Always ensure the power supply voltage is within the specified range (DC 4.5-20V). Applying incorrect voltage can damage the module.
- **Avoid Short Circuits:** Be careful during wiring to prevent short circuits between pins or components.
- **Handle with Care:** Electronic components are sensitive. Handle the module by its edges to avoid damaging components or creating static discharge.
- **Power Off During Wiring:** Always disconnect power before making or changing any electrical connections.

12. Warranty and Support

For warranty information, technical support, or further assistance with your DORHEA HC-SR501 PIR Motion Infrared Human Body Sensor Module, please refer to the seller or manufacturer's official support channels. Keep your purchase receipt for any warranty claims.