



# **DIGITAL MOTION DETECTOR MODULE MANUAL**

**DP-003A**

**GLOLAB**  
CORPORATION

Thank you for buying our DP-003A module

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In addition to our RF modules and DP-003A modules, we supply some special and hard to find parts such as our Pyroelectric Infrared Sensor and Infrared Fresnel lens for those of you who want to design and build your own projects.

Technical help is available by email from [lab@glolab.com](mailto:lab@glolab.com).

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## **Introduction**\_\_\_\_\_

The DP-003A digital pyroelectric infrared motion detector module is designed to detect infrared radiation (IR) from a moving human or animal both in daylight and at night. It will only respond to a moving source of infrared radiation. It will not detect a static IR source.

The module is a basic building block designed for use in the construction of a motion detector device. It includes a digital pyroelectric infrared sensor, a microprocessor and a relay driver. An on-board voltage regulator powers the circuits and accepts a 4 to 15.5 volt DC power supply voltage.

The DP-003A eliminates the need to design and build the complex amplifier and comparator circuits that must follow a typical analog pyroelectric infrared sensor. The relay driver within the DP-003A can sink up to 250 milliamperes to directly drive a relay, light emitting diode or other load. An output directly from the microprocessor provides 0 to 3.5 volts that can be fed into a logic or timing circuit to add specific functions such as robot control.

## **Features**\_\_\_\_\_

- **Small 0.65 inch (16.51mm) X 0.65 inch (16.51mm) module**
- **On board voltage regulator**
  - **Can be powered by 4.5 to 15.5 volts DC**
- **Micropower circuits for low current drain**
  - **Average current < 45 microamperes**
  - **Long battery life**
- **High current output driver**
  - **250 milliampere current sink**
  - **Can directly drive a remote relay**
- **Programmable sensitivity setting**
  - **Adjusts detection range**
- **Programmable dwell setting**
  - **Adjusts output ON time from 200 ms to 5 minutes**
- **Only three wire connections needed**
  - **Two for power**
  - **One for output**

## Digital Pyro® Technology

The DP-003A module uses a Digital infrared detector. This new technology incorporates a sensor, amplifier, filter, A/D converter in one TO5 package.

Unlike typical analog pyroelectric sensors, the digital sensor outputs serial data pulses that represent the amplitude of detected infrared radiation. Since all of the amplification and signal processing is done within the sensor package, the detector has very high immunity to RF radiation from cell phones and other sources.

Figure 1 is a block diagram of the DP-003A module. Power is supplied to the digital pyroelectric sensor and the processor through a micropower voltage regulator and includes Schottky diode reverse polarity protection. The processor decodes the serial bits from the sensor and it outputs both a logic level and it turns a relay driver on when motion is detected. The amount of time that the output remains on (dwell) can be programmed by an external resistor and can be set to one of five times from 200 milliseconds to 10 minutes. Detection sensitivity that affects detection range can be programmed by an external resistor to one of five sensitivity levels. The module is supplied with default settings of medium sensitivity and 1 second dwell time. The relay driver includes internal Zener diode load dump protection.

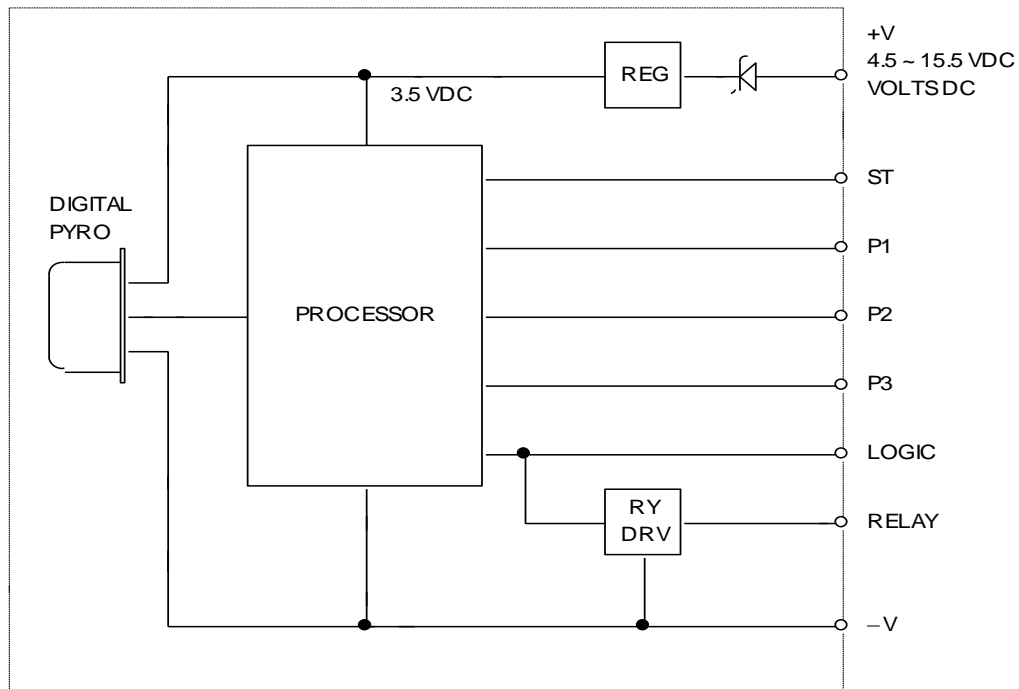


Figure 1

## ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNITS
Power supply voltage <sup>1</sup>	15.5	Volts
Logic output current <sup>2</sup>	25	Milliamperes
Relay output current	200	Milliamperes
Voltage applied to relay output	28	Volts

**Notes:**

1. Voltage from + to – power terminals on PC board
2. Both source and sink

## TYPICAL OPERATION

PARAMETER	MIN	TYPICAL	MAX	UNITS
Power supply voltage <sup>3</sup>	4.0	9.0	15.0	Volts
Module current <sup>4</sup>	-	45	-	Microamperes
Logic output current <sup>5</sup>	-	20	25	Milliamperes
Relay output current <sup>6</sup>	-	100	200	Milliamperes
Relay output voltage <sup>7</sup>	-	12	24	Volts
Operating temperature	-40°C	-	+85°C	
Field of view <sup>8</sup>	-	100	-	Degrees

**Notes:**

3. Voltage from + to – power terminals on PC board
4. Not including external load on output
5. Both source and sink
6. Load connected from positive voltage to output
7. External voltage applied through relay or other load
8. Without a lens

### Ordering information \_\_\_\_\_

PART NUMBER	DESCRIPTION
DP-003A	Digital motion detector module

### Optional accessory parts \_\_\_\_\_

PART NUMBER	DESCRIPTION	SOURCE
FL25	0.25 inch (6.35mm) focal length Fresnel lens	Glolab
FL40	0.4 inch (10.16mm) focal length Fresnel lens	Glolab
FL65	0.65 inch (16.51mm) focal length Fresnel lens	Glolab

## **Description**

The DP-003A is 0.65 inch (16.51mm) wide, 0.65 inch (16.51mm) long and 0.35 inch (8.89mm) high with surface mount circuit components on one side and a digital pyroelectric infrared sensor on the other side. The module has connection pads on two of its edges spaced 0.55 inch (14mm) apart. It should be mounted with the connection pads on top and bottom for best sensitivity to horizontal motion. Solder pads for  $-V$ ,  $+V$ , GND, OUT, RY are provided on one edge of the module to connect power and output wires. Sensitivity, mode and dwell are programmed by temporary connections to programming pads on the other edge. Programming instructions are on page 8.

## **Sensitivity**

Sensitivity and therefore range (detection distance) can be programmed to one of five levels. Sensitivity default is set to medium.

## **Dwell**

Dwell time or the amount of time the output remains on after motion is detected can be programmed to one of ten dwell times from 200 milliseconds to ten minutes. Dwell default is set to one second.

## **Mode**

Retriggerable mode will reset the dwell timer to zero whenever more motion is detected during dwell timeout. This will cause the output to remain ON for an additional dwell period. Retriggering will continue and the output will remain ON as long as motion is detected before the dwell timeout expires. The 200 millisecond dwell time will not retrigger even if retriggerable mode is programmed.

Single event mode will inhibit multiple outputs from occurring in rapid succession. The output will turn ON when motion is detected and will stay ON for only the dwell timeout. The output will then turn OFF and remain OFF until no more motion is detected for about one second or more. The OFF time will be longer at higher sensitivity settings. This mode is somewhat similar to an inverted version of retriggerable mode.

## Logic output

The DP-003A logic output (OUT) is directly from a microprocessor that is capable of sourcing up to 20 milliamperes and sinking up to 25 milliamperes. The output voltage level will be at 0 volts when no motion is detected will go to + 3.5 volts when motion is detected. The output can directly drive a light emitting diode, piezo buzzer and logic or microprocessor circuits.

## Relay output

The DP-003A relay output (RY) is from a relay driver that is capable of sinking up to 200 milliamperes. The output of the driver will be an open circuit when no motion is detected and will conduct up to 200 milliamperes to circuit board ground when motion is detected. The driver is protected by Zener diodes from load dump by inductive loads.

## Power

A 4 to 15 volt battery will power the DP-003A at less than 50 microamperes current draw when no motion is detected. The power system is reverse polarity protected by a series connected Schottky diode. A DC wall transformer may also power the DP-003A, however most wall transformers output much higher than their rated voltage when lightly loaded so the transformer output should be measured to be sure that the 15.5 volt maximum power supply input is not exceeded.

## Programming resistors \_\_\_\_\_

Programming of sensitivity, mode and dwell is done by temporarily connecting P1 and/or P2 to ground and an external resistor from P3 to ground and then grounding the store pad ST for one second. Sensitivity programming needs only a resistor from P3 to ground while other program functions also need either P1 or P2, or both P1 and P2 grounded.

A programmed function is stored in non-volatile memory when the store pad ST is grounded for one second and then opened. A programmed function will not change until re-programmed and will not be lost when power is removed from the module. Sensitivity, mode and dwell are independent of each other and must be individually programmed.

The programming resistor can be any size or wattage and can have a 5% resistance tolerance. Ground connections should be removed from P1, P2 and the resistor from P3 after programming has been completed in order to avoid unnecessary current drain from the power source.

Sensitivity, Mode and Dwell are all simultaneously reset to defaults by grounding P1, P2 and P3 and then grounding ST for one second. This is useful as a quick way to return to defaults when existing programming is unknown.

## Programming sensitivity, mode and dwell

One of five sensitivity levels, one of ten dwell times and one of two output modes can be programmed. Follow the steps below for table 1 to program sensitivity. Repeat the steps below for table 2 to program dwell time and for table 3 to program mode. A power source must be connected before programming. Ground (GND) is the –V terminal.70

1. Leave P1, P2 open or connect to ground (GND) as shown in the table
2. Connect a resistor of the value shown in the table to P3 and to ground
3. Ground ST for 1 second (stores data in memory)
4. Remove ground and resistor from P1, P2, P3

TABLE 1 SENSITIVITY LEVEL	P1	P2	P3	ST
MINIMUM	OPEN	OPEN	2.7 KOHMS TO GND	GND-OPEN
LOW	OPEN	OPEN	6.8 KOHMS TO GND	GND-OPEN
MEDIUM (DEFAULT)	OPEN	OPEN	GND	GND-OPEN
HIGH	OPEN	OPEN	15 KOHMS TO GND	GND-OPEN
MAXIMUM	OPEN	OPEN	39 KOHMS TO GND	GND-OPEN

TABLE 2 DWELL TIME	P1	P2	P3	ST
0.2 SECOND	GND	OPEN	2.7 KOHMS TO GND	GND-OPEN
1 SECOND (DEFAULT)	GND	OPEN	GND	GND-OPEN
2 SECOND	GND	OPEN	6.8 KOHMS TO GND	GND-OPEN
5 SECOND	GND	OPEN	15 KOHMS TO GND	GND-OPEN
10 SECOND	GND	OPEN	39 KOHMS TO GND	GND-OPEN
30 SECOND	OPEN	GND	GND	GND-OPEN
1 MINUTE	OPEN	GND	2.7 KOHMS TO GND	GND-OPEN
2 MINUTE	OPEN	GND	6.8 KOHMS TO GND	GND-OPEN
5 MINUTE	OPEN	GND	15 KOHMS TO GND	GND-OPEN
10 MINUTE	OPEN	GND	39 KOHMS TO GND	GND-OPEN

TABLE 3 MODE	P1	P2	P3	ST
RETRIGGERABLE (DEFAULT)	GND	GND	2.7 KOHMS TO GND	GND-OPEN
SINGLE PULSE	GND	GND	6.8 KOHMS TO GND	GND-OPEN
RESTORE ALL DEFAULTS	GND	GND	GND	GND-OPEN



## Power, output and programming pads

The DP-003A should be mounted with its connection pads on the top and bottom. This positions the sensor elements for best sensitivity to horizontal motion.

Power and output connections are made to the solder pads on the bottom edge of the module when looking at figure 2. Programming pads are on the top edge of the module. This is a component side view. The sensor is mounted on the back side of the PC board.

Pads are spaced 0.1 inch apart. Top and bottom rows of pads are spaced 0.55 inch apart. Standard pin headers with 0.025 inch square pins on 0.1 inch centers will fit in the pad holes.

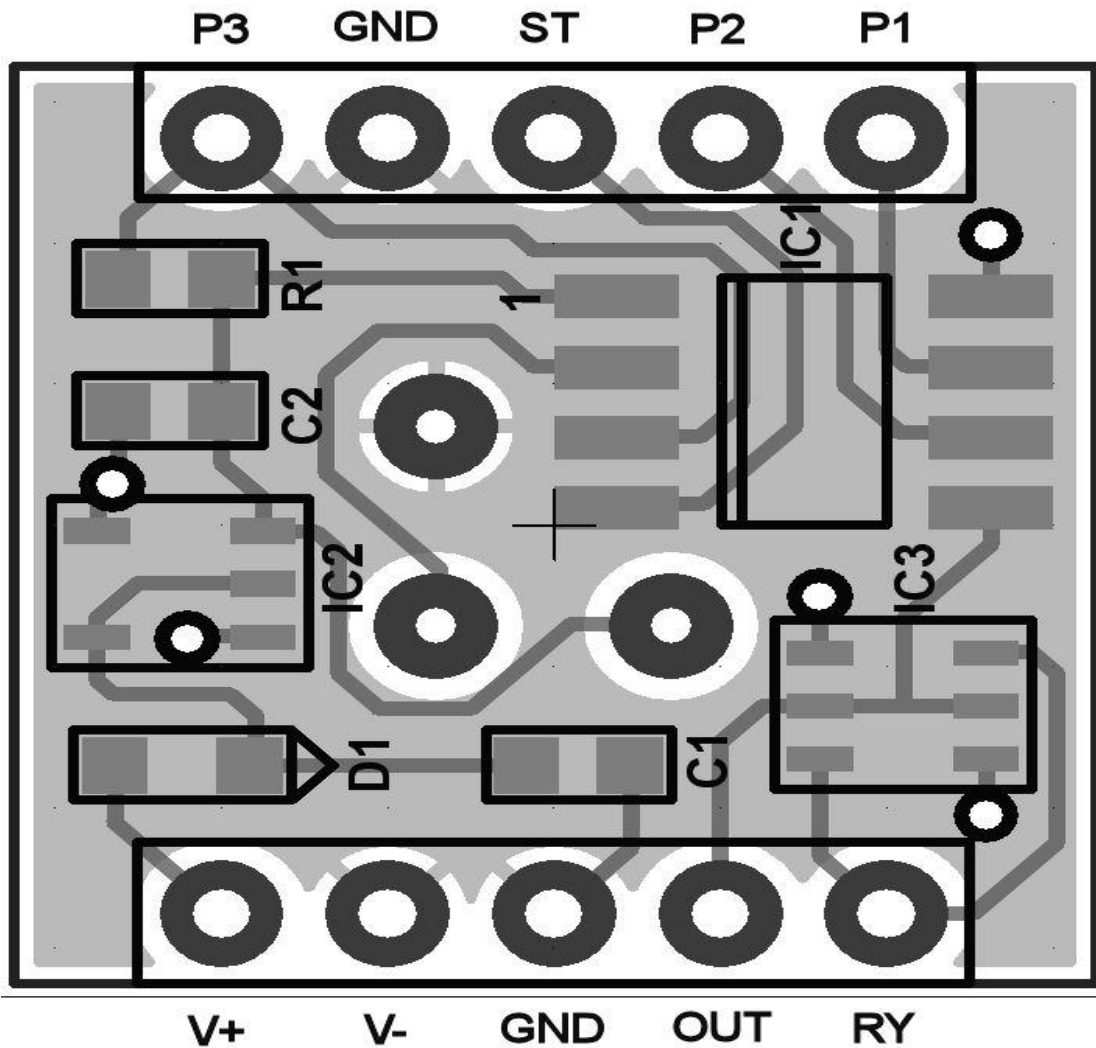


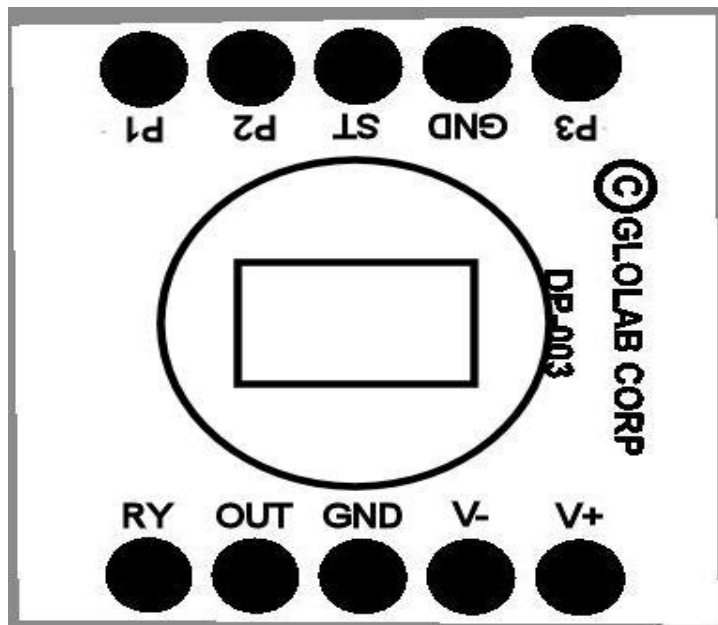
Figure 2 Component side view

## Soldering\_\_\_\_\_

When soldering to the PC board, use a small soldering iron of about 25 watts and small diameter rosin core solder. Touch the tip of the iron against both the wire and the board metal where the wire touches the metal and apply solder between the tip of the iron and the board metal. The solder will melt where it touches the iron and immediately flow onto the wire and the board metal and it will then help to transfer heat to the joint. You can now apply a little more solder to other areas of the joint if necessary.

Do not apply just heat to one side of the joint and solder to other side as some soldering instructions tell you to do as this will result in overheating of the joint before the solder melts, burning the flux and oxidizing the solder.

## Assembly instructions \_\_\_\_\_



The backside of the module where the sensor is placed is shown in figure 3 with the pads on the top and bottom.

For wire connections use #22 or smaller wire. Solid wires can be used for short interconnects to another circuit board. Stranded wire is preferred for longer cables and remote mounting of the module.

Connections to program terminals P1, P2, P3 and ST on the top are required only during programming.

Figure 3

## Installation

Wires can be soldered to the through-hole pads on the module or standard pin headers with 0.025 inch square (0.635mm) pins on 0.1 inch (2.54mm) centers can be inserted in the pad holes. Lead free solder should be used where RoHS compliance is required. The module should be mounted with its I/O pads on its top and bottom so that the sensor window is horizontal for best sensitivity to horizontal motion. The power and output wires carry only DC levels and not high-speed data so the DP-003A can be located remotely from the load or circuit that it drives. A thin plastic Fresnel lens that can be purchased separately will extend detection range

Power and output can be through a cable with a minimum of three conductors; two for power and one for output.

## Testing

Connect a power source to the PC board power terminals +V and -V. Connect a light emitting diode in series with a 510 ohm resistor from -V (GND) to the output terminal (OUT). The LED will light when motion is sensed. Allow at least 30 seconds for the circuits to stabilize after applying power. The sensor will detect a hand moving toward either side of center at a distance of one foot without a lens and with sensitivity at medium (default). Range can be extended with a Fresnel lens. See [www.gloolab.com/focusdevices/focus.html](http://www.gloolab.com/focusdevices/focus.html).

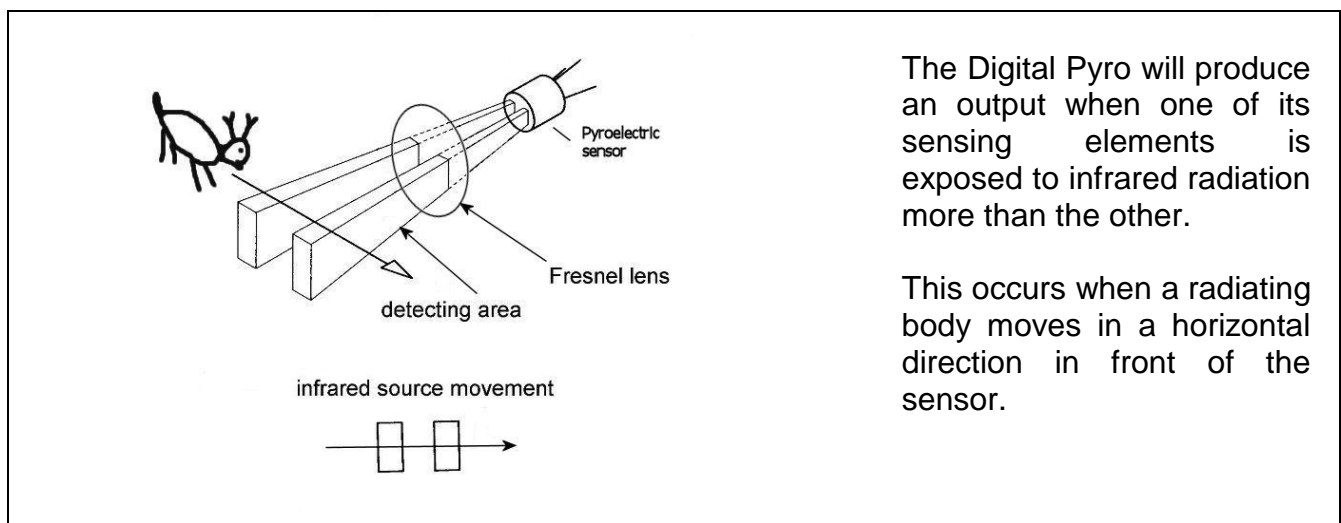
**The PIR sensor is sensitive to fast temperature changes especially at high sensitivity settings and will produce multiple outputs after it is touched or otherwise exposed to heat or cold.** It should be protected from warm or cold air movement from an air conditioner, heating system, open window or other moving air sources. The sensor will stabilize in about one minute after the source of temperature change has been removed.

## DP-003A applications

1. General security devices
2. Automatic lighting
3. Camera shutter trigger
4. Child or animal monitoring
5. Video recorder activation
6. Annunciation

## Pyroelectric Sensor

The Digital Pyro® pyroelectric infrared sensor in the DP-003A has two elements connected in a voltage-bucking configuration. This arrangement cancels signals caused by vibration, temperature changes within the sensor and sunlight. An animal or human passing in front of the sensor will activate first one and then the other element as shown in figure 1 whereas other sources will affect both elements simultaneously and be cancelled. The radiation source should pass in a horizontal direction so the elements are sequentially exposed to the IR source. The sensor also has a built-in infrared filter window. Detection angle without a lens is 100 degrees. A lens will reduce or increase this angle, depending on the type used.



**FIGURE 4**

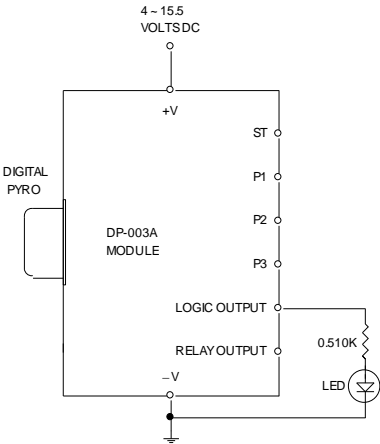
The sensor will respond to a moving body only; it will not detect a stationary infrared source, however it is sensitive to fast temperature changes and might produce false responses if not covered by a lens or IR transparent window. The detection range of the DP-003A is about three feet toward each side without a lens but can be extended by placing an infrared Fresnel lens in front of the sensor. The lens can be mounted in an enclosure with its grooves facing inside. **The front of the sensing elements within the PYD1998 TO5 housing are spaced 0.026 inch (0.7mm) from the outside face of the sensor window.** A lens should be spaced its specified focal length from the sensor elements for best focusing.

Detection range depends partly on environmental conditions. The pyroelectric sensor in the DP-003A will detect a human or animal more easily at lower ambient temperatures when there is a greater difference between the human or animal body temperature and surrounding objects. Sensitivity can be programmed to meet application requirements.

# Application circuits \_\_\_\_\_

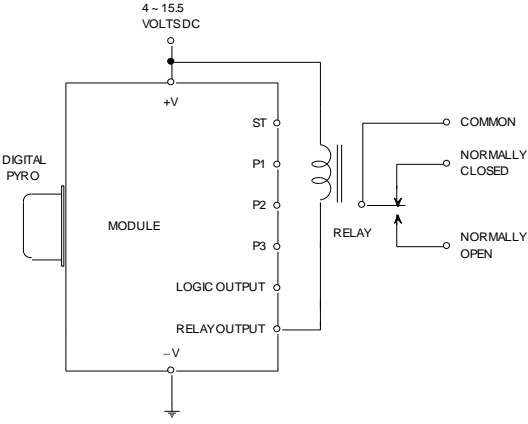
## FIGURE APP1 Driving a light emitting diode

A resistor is required in series with the LED to limit current. The resistor value can be chosen for the power supply voltage and the desired LED intensity.



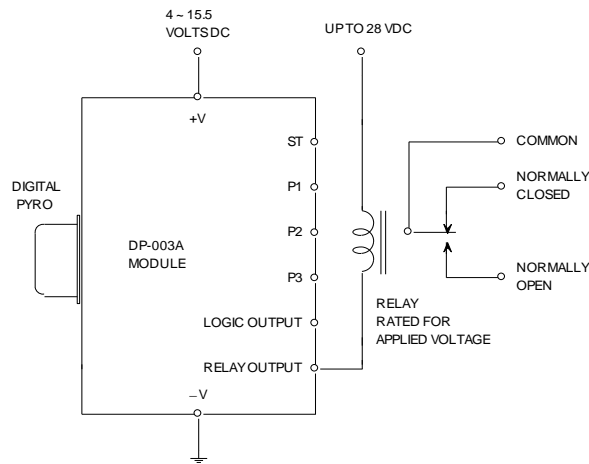
## FIGURE APP2 Driving a relay

The DP-003A relay driver has an internal suppressor for inductive loads. The relay coil voltage rating should match the power supply voltage used. A solid state relay can also be used.



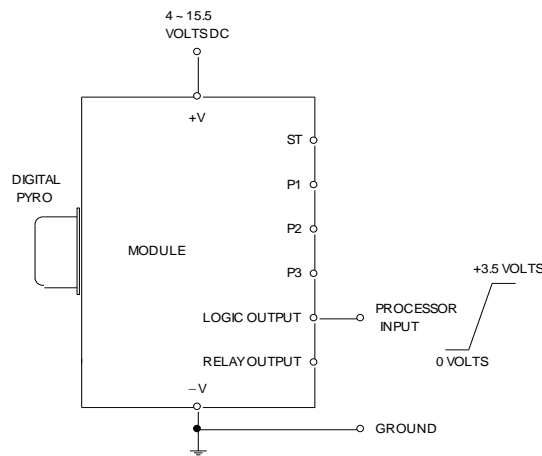
### FIGURE APP3 Driving a high voltage relay

A relay that operates at up to 28 volts DC can be directly driven by the DP-003A. The relay coil voltage rating should match the relay power supply voltage used..



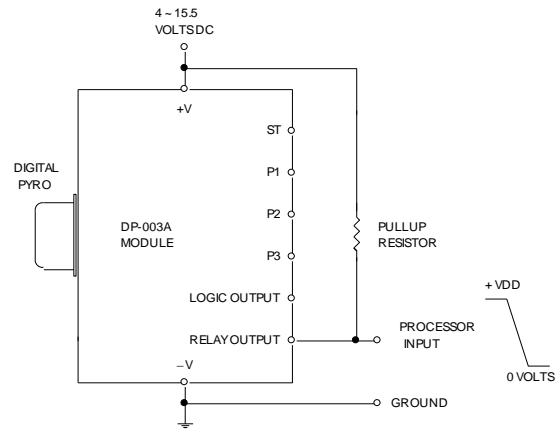
### FIGURE APP4 Driving a microprocessor from the logic output

The DP-003A can be powered with +4 to +15.5 volts from a microprocessor board or other power source. The levels from the logic output will be 0 volts with no motion and will go to +3.5 volts when motion is sensed. The logic output can both source and sink up to 25 milliamperes.



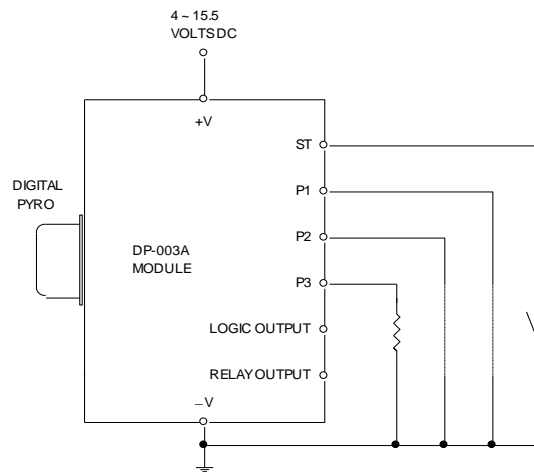
## FIGURE APP5 Driving a microprocessor from the relay output

The DP-003A can be powered with +4 to +15.5 volts (VDD) from a microprocessor board. The inverted levels from the relay output will be +VDD volts with no motion and will go to 0 volts when motion is sensed.



## FIGURE APP5 6 Programming sensitivity and dwell

The DP-003A can be programmed by connecting a resistor from P3 to ground only while programming. P1 and P2 are also selectively connected to ground as shown on page 8. Program data is stored in non-volatile memory when ST is grounded and then opened.





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