DPB MICROCONTROLLER FOR PYD1798 DIGITAL PYROELECTRIC INFRARED SENSOR (PIR)

DPB

GLOLAB
CORPORATION

Thank you for buying our DPB RoHS microcontroller

The goal of Glolab is to produce top quality electronic products and components. All of our products are designed by Glolab engineers and tested in our laboratory. Mechanical devices, prototypes and enclosures are fabricated in our precision machine shop. Glolab Corporation has been in business since 1994 and has two locations in New York's Hudson Valley. Our electronics laboratory and packaging and our machine shop are located in Wappingers Falls.

Technical help is available by email from lab@glolab.com.

A note about people counting_____

1. A turnstile is the most accurate people counter because it allows only one person at a time to pass through and relies upon a simple switch closure to produce a count. A treadle switch on a step is the next best counter because the foot of only one person at a time is usually placed on a step. Both turnstile and treadle systems can also be used for direction sensing.

2. Some electronic systems use two beams of light, A and B and a photo detector. When a person passes they are sensed by first A, then both A and B and then just B. This results in a reliable count because any variation in that sequence such as a person standing still in front of the detector or reversing direction and not passing completely by will not produce a count. This system can also sense direction.

3. However, unlike a mechanical turnstile, an electronic system can result in errors due to bunching where two or more people bunch together and are counted as one. Errors can also be caused by a person moving an arm in front or carrying a package that might be counted as a person.

4. An electronic system that uses a pyroelectric infrared sensor (PIR) is the least accurate for people counting because it will only detect a moving body and that body must move at a reasonably predictable rate and then out of view of the sensor in order to produce an accurate count. The type of lens used will also affect accuracy. The DPB-PYD is therefore not recommended for people counting except where its characteristics and limitations are understood and are acceptable for the application. The advantage of a pyroelectric sensor is its very low current drain of less than 35 microamperes which is beneficial in battery powered applications.

Introduction_____

The DPB microcontroller is programmed for use with an Excelitas® PYD1798 digital pyroelectric infrared sensor to detect infrared radiation (IR) from a moving human or animal both in daylight and at night. The PYD1798 sensor will only respond to a moving source of infrared radiation; It will not detect a static IR source. User programming can be done for special applications that require different sensitivity, output on time (dwell) or operating mode. Programming is easy with external resistors*.*

The DPB is available in both 8 pin SOIC for surface mounting and in 8 pin PDIP for plugging into a DIP socket. Order DPB-S for a surface mount package or DPB-P for a DIP package.

Features_____

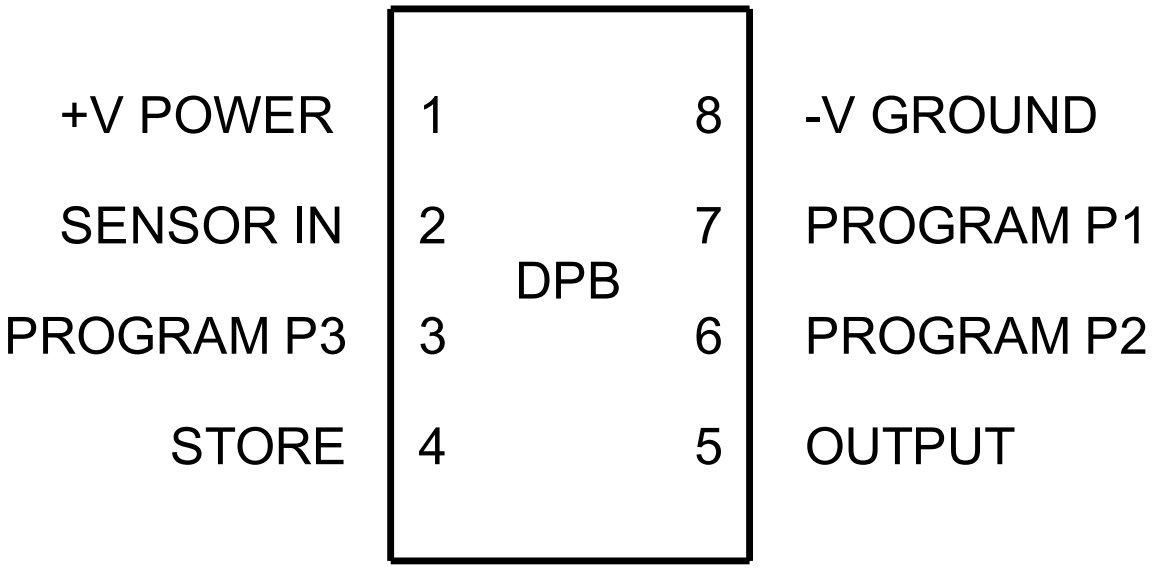
- **For use with Excelitas PYD1798 digital pyroelectric sensor**
- **Can be powered by 2.7 to 3.6 volts DC**
  - **Use a coin cell or AAA batteries**
- **Micropower circuit for low current drain**
  - **Average current 35 microamperes**
  - **Long battery life**
- **0 to VDD logic level output**
  - **Can source and sink 25 milliamperes**
- **Programmable sensitivity setting**
  - **Adjusts detection range**
- **Programmable dwell setting**
  - **Adjusts output ON time from 200 ms to 10 minutes**
- **Programmable mode setting**
  - **Retriggerable**
  - **Single event**
  - **Direction sensing**
- **Only three wire connections needed**
  - **Two for power - VDD, GND**
  - **One for output - OUT**

Digital Technology

The Excelitas PYD1798 pyroelectric infrared sensor is a Digital infrared detector. This new technology incorporates a sensor, amplifier, filter, A/D converter in one TO5 package. The PYD1798 must communicate with a microprocessor that is programmed for use with it in order to output data.

Unlike typical analog pyroelectric sensors, the digital sensor outputs serial data pulses that represent the amplitude of detected infrared radiation in digital form. 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 DPB microcontroller to be used with a PYD1798 sensor. The microcontroller decodes the serial bits from the sensor and turns an output on when motion is detected. The amount of time that the output remains on (dwell) can be programmed for one of ten dwell times from 200 milliseconds to 10 minutes. Detection sensitivity that affects detection range can be programmed to one of ten sensitivity levels. The DPB is supplied with default settings of medium sensitivity, 1 second dwell time and retriggerable mode.



Pin connections for SOIC and PDIP

Figure 1

Note:

Absolute maximum ratings are values beyond which permanent damage to the module might result. Care must be taken not to apply reversed polarity voltage to the VDD and GND pads.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNITS
Power supply voltage [1]	3.6	Volts
Logic output source current [2]	25	Milliamperes
Logic output sink current [2]	25	Milliamperes

Notes:

1. Voltage from VDD to GND power terminals on microcontroller
2. External load on output

TYPICAL OPERATION

PARAMETER	MIN	TYPICAL	MAX	UNITS
Power supply voltage [3]	2.7	3.0	3.5	Volts
Circuit current [4]	-	35	-	Microamperes
Logic output source current [5]	-	-	25	Milliamperes
Logic output sink current [5]	-	-	25	Milliamperes
Operating temperature	-40ºC	-	+85ºC	

Notes:

3. Voltage from VDD to GND power terminals on microcontroller
4. When output is at 0 volts
5. External load on output

Ordering information_____

PART NUMBER	DESCRIPTION
DPB-S	SOIC Surface mount digital sensor microcontroller
DPB-P	PDIP plug-in digital sensor microcontroller

Description

The DPB is a Microchip Technologies PIC12LF1822 microprocessor that is special programmed to control an Excelitas® PYD1798 digital pyroelectric infrared sensor. Sensitivity, dwell and mode can be programmed by temporary connections to programming pads. Programming instructions are on page 8.

Sensitivity

Sensitivity and therefore range (detection distance) can be programmed for 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 for one of ten dwell times from 200 milliseconds to 10 minutes. The default dwell is set at 1 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 default mode is set as Retriggerable. 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 before responding to another motion event. This mode is somewhat similar to an inverted version of retriggerable mode.

Direction sensing mode senses motion in only one direction by turning the output ON for 200 milliseconds to show either LEFT or RIGHT motion. Dwell cannot be programmed when in direction sensing mode. The detected direction is programmed by modes 3 or 4 however the actual direction that is sensed might be reversed from that which is programmed depending on the type of lens used.

Direction sensing operates in single event mode so time must be allowed for the sensor to recover from a sensing event before it responds to another. Recovery time will depend on the sensitivity setting, distance from the infrared source and the type of lens used. A single element lens having a narrow field of view or an enclosure with a narrow opening in front of the sensor should be used. A LED and a piezo buzzer can provide visible and audible output and a counter can be used to count events.

Outputs

The DPB output is directly from a PIC12LF1822 microprocessor that is capable of sourcing and sinking up to 25 milliamperes. The output voltage level will be at 0 volts when no motion is detected will go to + Vdd when motion is detected. The output can directly drive a light emitting diode, piezo buzzer and logic or microprocessor circuits.

Power

2.7 to 3.6 volts will power the DPB at a current of 35 microamperes when no motion is detected. An AC mains power source should be filtered and regulated, however the DPB can be powered directly from a 3 volt coin cell or from two 1.5 volt AAA cells. Reversed polarity can damage the DPB so care must be taken not to apply a reversed polarity power connection. A battery holder that prevents incorrect insertion is recommended if batteries power the module.

Programming resistors _____

Programming of sensitivity, dwell time and output mode is done by temporarily connecting P1, P2 to ground and an external resistor from P3 to ground as shown in the tables on page 8 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 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, dwell time and output mode programming 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 to avoid unnecessary power drain.

Sensitivity, Dwell and Mode 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 four 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.

1. **Connect a power source and apply power**
2. **Leave P1, P2 open or connect to ground (GND) as shown in the table**
3. **Connect a resistor of the value shown in the table to P3 and to ground**
4. **Ground ST for 1 second (stores data in memory)**
5. **Remove ground from P1, P2 and resistor from 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
0.3 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
LEFT MOTION ONLY	GND	GND	15 KOHMS TO GND	GND-OPEN
RIGHT MOTION ONLY	GND	GND	39 KOHMS TO GND	GND-OPEN
RESTORE ALL DEFAULTS	**GND**	**GND**	**GND**	**GND-OPEN**

Assembly

The DPB is default programmed for retriggerable output and 1 second dwell. Connect a PYD1798 sensor and a power source to the circuit. Keep the lead from sensor pin 2 to DPB pin 2 as short as possible to minimize capacitance to ground. A 10K 1% resistor must be connected from power source positive VDD to DPB pin 3, and VDD should be bypassed to power source negative VSS with a 0.1 microfarad capacitor. The capacitor should be placed close to DPB pins 1 and 8.

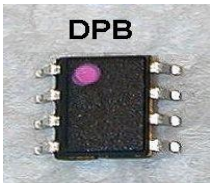
No other components are required, however a 3.3 volt regulator can be added to allow operation at higher power supply voltages, and a high current driver transistor or driver circuit can be added at the output to allow driving a relay or other device.

Testing

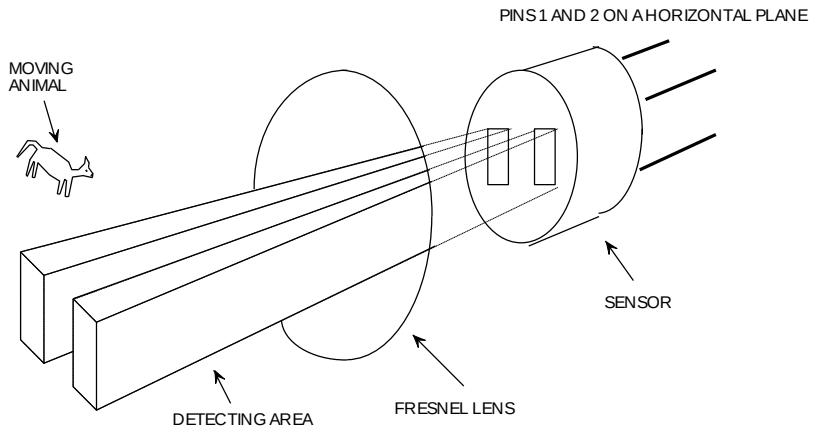
Connect the anode lead of a light emitting diode in series with a 510 ohm resistor to the DPB output and connect the cathode lead of the light emitting diode to the power source negative VSS. The LED will light when motion is sensed. Allow at least 15 seconds for the circuits to stabilize after applying power. The sensor will detect a hand moving toward either side of center at a distance of about eight inches without a lens and with sensitivity at medium (default).

A lens or other focusing scheme must be used for long range detection. You can find information about focusing devices at www.glolab.com/focusdevices/focus.html. Direction sensing applications might require some experimenting to find the optimum lens.

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 when not covered by an enclosure. The sensor will stabilize in about one minute after the source of temperature change has been removed.



Sensor position for sensing horizontal motion



The Digital Pyro will produce an output when one of its sensing elements is exposed to infrared radiation more than the other.

This occurs when a radiating body moves in a horizontal direction in front of the sensor and the sensor is placed with pins 1 and 2 on a horizontal plane.

FIGURE 2

The PYD1798 Digital Pyro® pyroelectric infrared sensor has two elements connected in a voltage-bucking configuration. This arrangement cancels signals caused by vibration, sunlight and slow temperature changes within the sensor. 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.

Placing an infrared Fresnel lens in front of the sensor will extend detection range. The lens can be mounted in an enclosure with its Fresnel grooves facing inside. **The front of the sensing elements within the TO5 housing are spaced an optical distance of 0.026 inch (0.7mm) from the outside face of the sensor window**.

Detection range depends partly on environmental conditions. The PYD1798 pyroelectric sensor 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.

Digital Pyroelectric Infrared Sensor

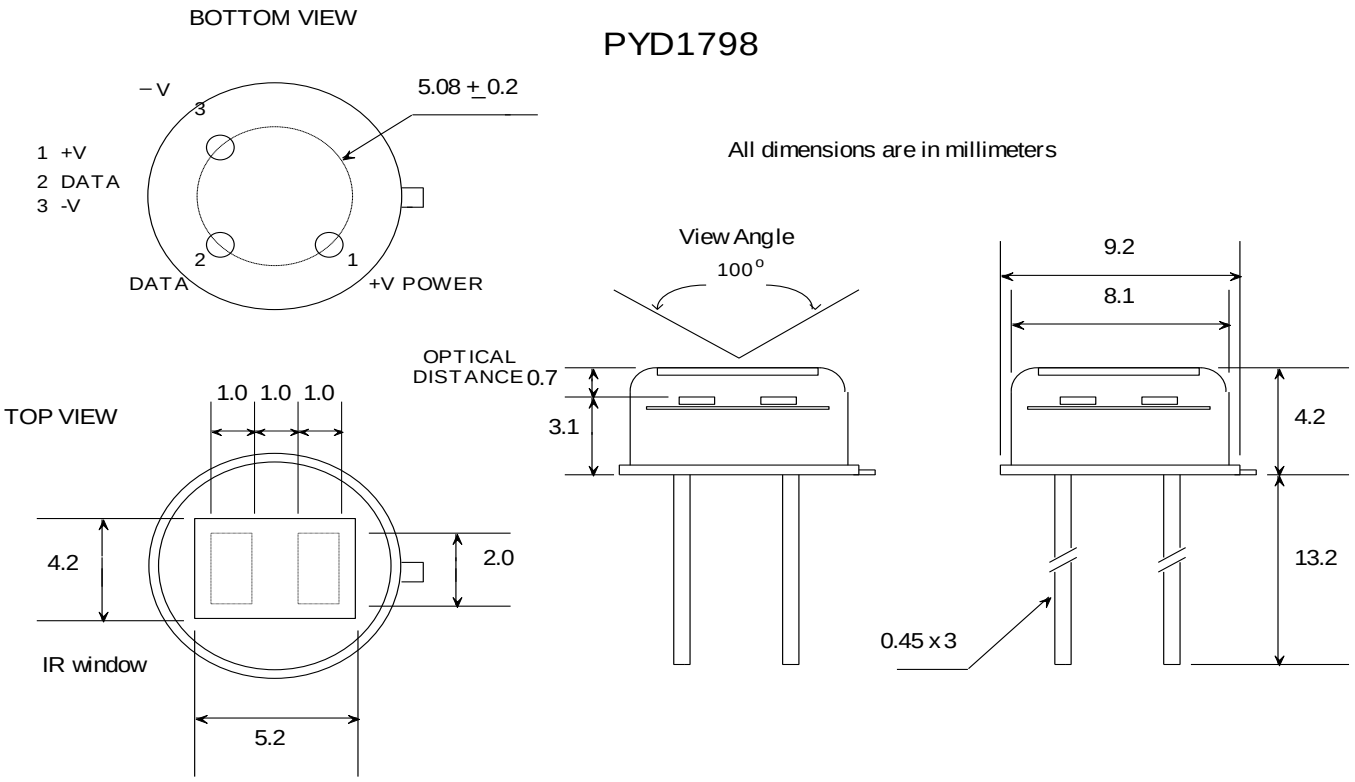


Figure 3

Figure 4 shows typical components and wiring. A basic motion detector circuit has only four components. A PYD1798 sensor, DPB microcontroller, 0.1 microfarad bypass capacitor and 10K 1% resistor that provides pull-up current for the P3 programming input.

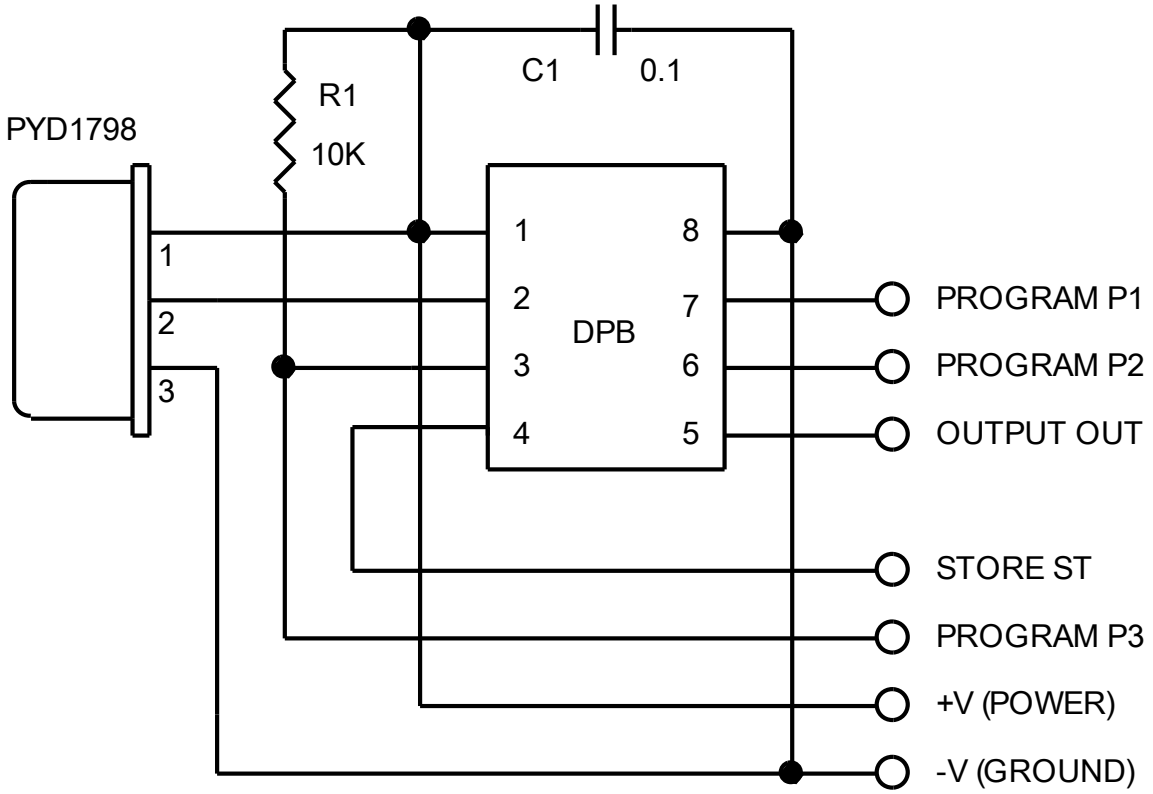


FIGURE 4 APPLICATION DIAGRAM

Figure 5 shows how DIP switches and resistors can be wired for easy programming. Switch labels are for sensitivity programming.

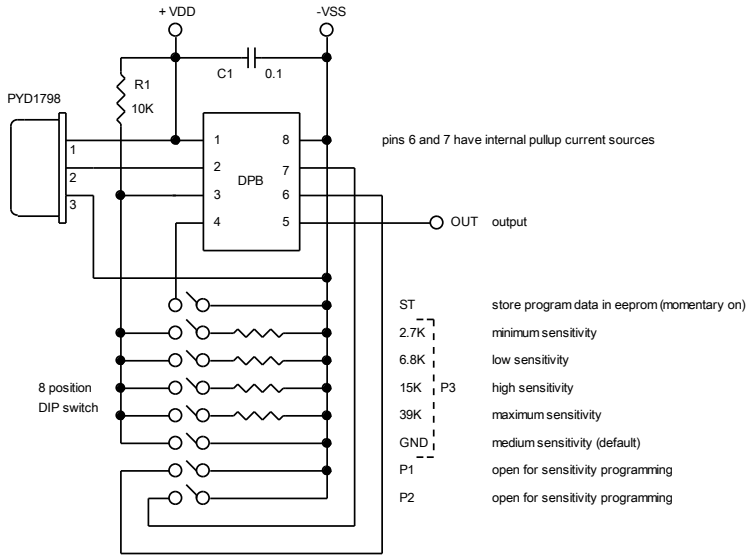


Figure 6 shows DIP switches labeled for 0.2 second to 10 second dwell programming.

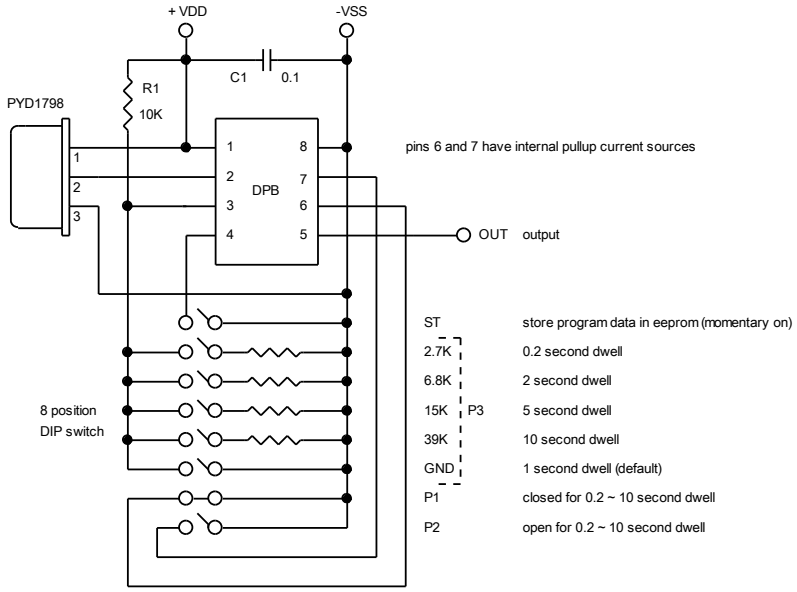


Figure 7 shows DIP switches labeled for 30 seconds to 10 minutes dwell programming.

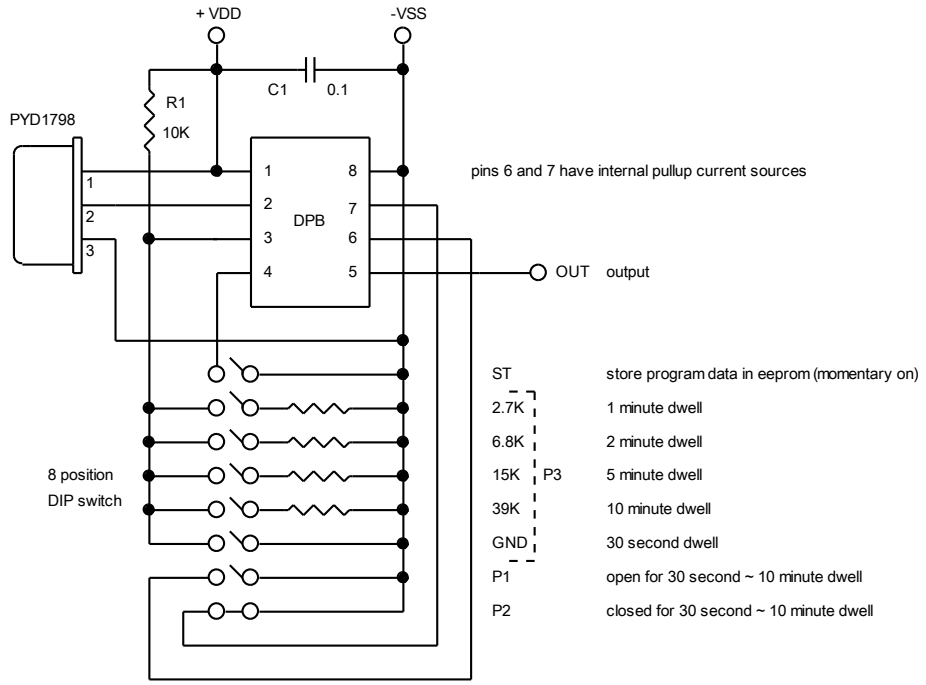


Figure 8 shows DIP switches labeled for mode programming.

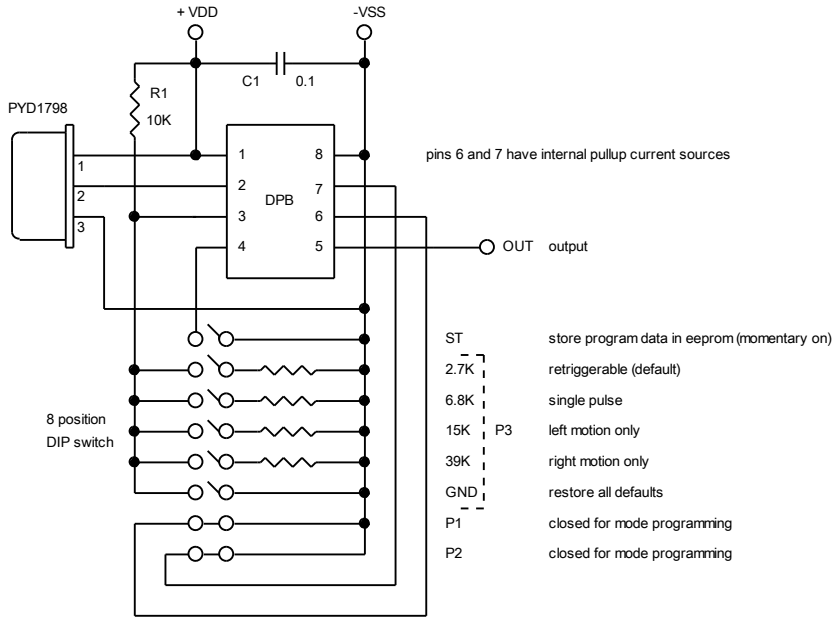
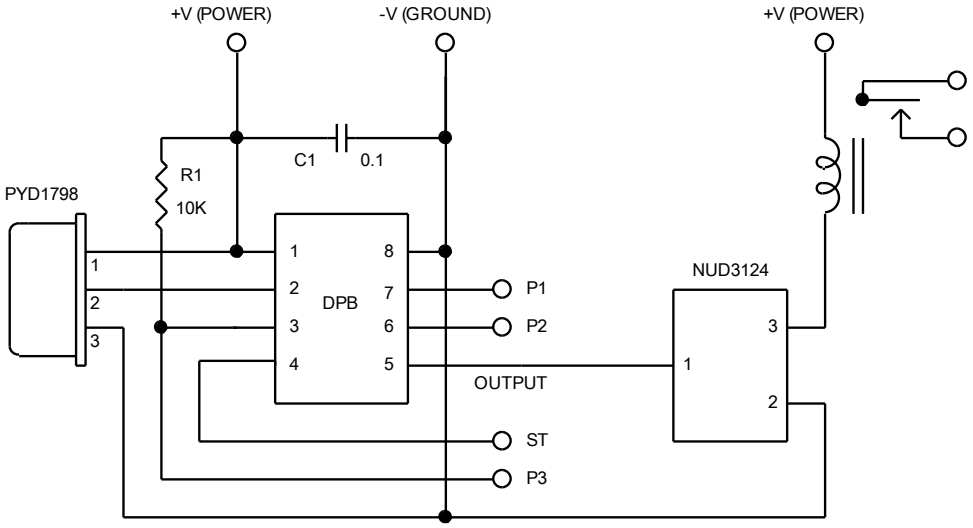


Figure 9 shows a driver for driving a relay or other high current load. The load can also be powered by a voltage source that is different from the source used to power the motion detector circuits. The ON Semiconductor NUD3124 can be powered with up to 28 volts. It has built-in zener diode load dump protection for inductive loads and is available in a SOT23 surface mount package.



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