eLabtronics Pulser

Want to switch something on and off at regular intervals? The eLabtronics Pulser is an incredibly easy way of doing it.

Features:

- Independent setting of frequency and duty cycle
- Frequency adjustable from 10 times a second to once per hour
- Duty cycle adjustable from 0 – 100 per cent
- Can switch a maximum continuous current of 10 amps (up to 100 amps with external solid state relay)
- Operates from 10 – 40V DC
- Fuse and reverse polarity protected
- Can be configured to automatically switch at certain temperature or light level

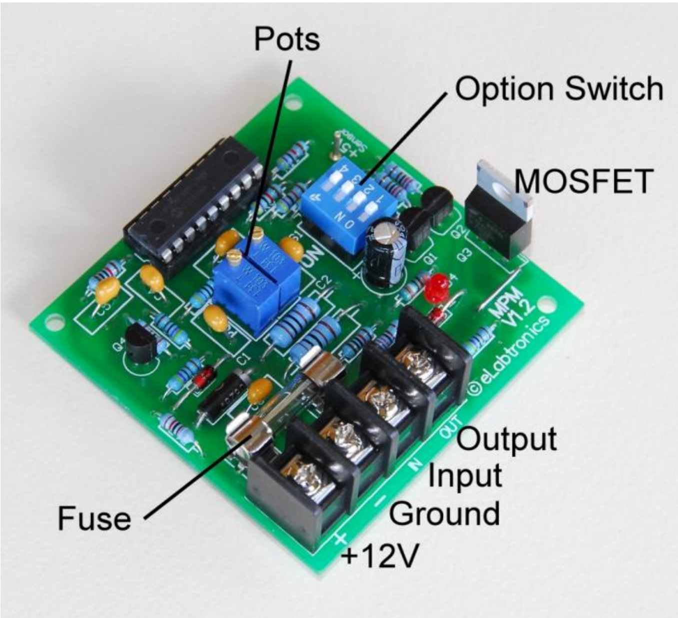
Whether you want to flash low voltage halogen lights in a shop window display, pulse a warning horn or buzzer, or operate a water pump for 15 seconds every hour, the Pulser can do it.

The Pulser is completely self-contained, with its own on-board high output transistor. Wiring the Pulser into place requires only four connections – power, ground, load and input trigger.

The Pulser can work on any DC voltage from 10 – 40V, making it safe to use with battery or plugpack power.

Finally, by adding just a few extra components, the Pulser can be automatically triggered at a certain temperature or light level.

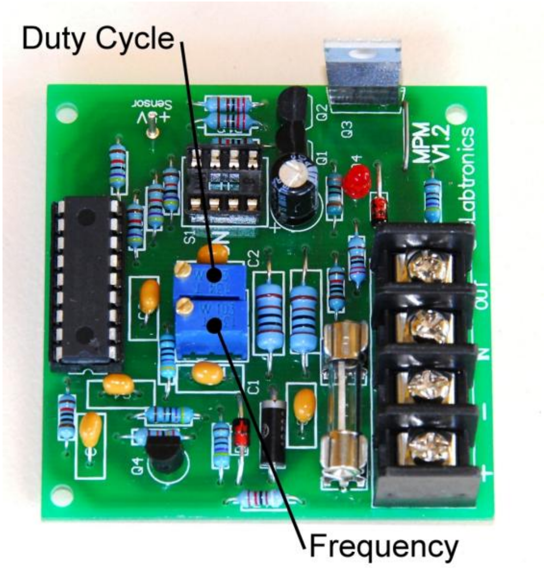
Using It



The Pulser is based on the eLabtronics Multi-Purpose Module. It has a 15 amp output transistor, a fuse, the four wiring connections and two user-adjustable multi-turn pots.

Let's look at the functions of the pots first.

- **Frequency Pot**



If you think of anything that pulses on and off, there are two different factors that can be varied. The first is frequency – how many times per second it turns on. For example, a warning LED might flash 3 times a second – that's pretty fast. On the other hand, a plant irrigation spray might operate once every 10 minutes – that's clearly much slower.

By turning the frequency pot, the pulsing rate can be varied from 10 times a second right through to once per hour. That's a huge range. **Turning the pot clockwise increases the frequency** (ie makes the output pulse faster).

- **Duty Cycle Pot**

The other aspect that can be varied is duty cycle.

Think about that plant irrigation spray that we described above as coming on once every 10 minutes. If it sprayed for half the time (ie 5 minutes) it would be said to have a 50 per cent duty cycle. If it sprayed for three-quarters of the available time (ie 7.5 minutes) it would be said to have a 75 per cent duty cycle.

If you want to give time for the water to infiltrate into the soil, you might set the output for 1 minute every 10 minutes. That's a 10 per cent duty cycle.

By turning the duty cycle pot, duty cycle can be adjusted from 0 per cent (ie the output is never on) right through to 100 per cent (ie output always on). Normally, of course, you wouldn't have this pot set to either extreme.

Turning the pot clockwise decreases the duty cycle (ie makes the output pulse a smaller percentage).

Varying Frequency and Duty Cycle

One of the huge advantages of the eLabtronics Pulser is that frequency and duty cycle can be varied independently.

For example, if you have a battery-powered system that's going to flash a high power LED, you'll want to use as little battery power as possible. By setting the duty cycle very short (eg 20 per cent) and running at a high frequency (eg 3 or 4 times a second) you can create an attention-getting flasher that uses about 80 per cent less power than if the LED was on all the time. That'll save your battery from going flat!

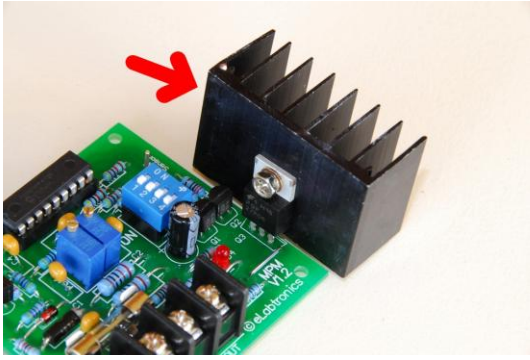
Or perhaps you have a chemistry experiment where a pump needs to occasionally circulate fluid. By setting the Pulser to switch on for 15 seconds every minute, you can keep the fluid circulating without wearing out the pump.

Note that in most applications there won't be any 'right' frequency and duty cycle – you simply adjust the pots to alter the output to achieve what you want for the application. You don't even need to know what the resulting frequency and duty cycle actually are – just change the pots until the system is working correctly.

Output Power

The output MOSFET (transistor) is rated to handle a continuous 10 amps – but that's when it is fitted with a big heatsink.

How hot the MOSFET (and the circuit board) gets depends not only on the output current but also the duty cycle. If the current is high but the duty cycle is short (eg 20 per cent) then the MOSFET will be able to cool down between each pulse. But if the duty cycle and current are both high, the device will get hot and need plenty of heatsinking.



As a general rule of thumb, no heatsink will be needed if you're operating warning globes, LEDs or beepers. If you're pulsing a pump, a medium sized heatsink like the one pictured will be needed. If you're pulsing high powered lights or horns, a large heatsink will be needed. Remember, in each case, the longer the 'on' time, the greater the need for a heatsink.

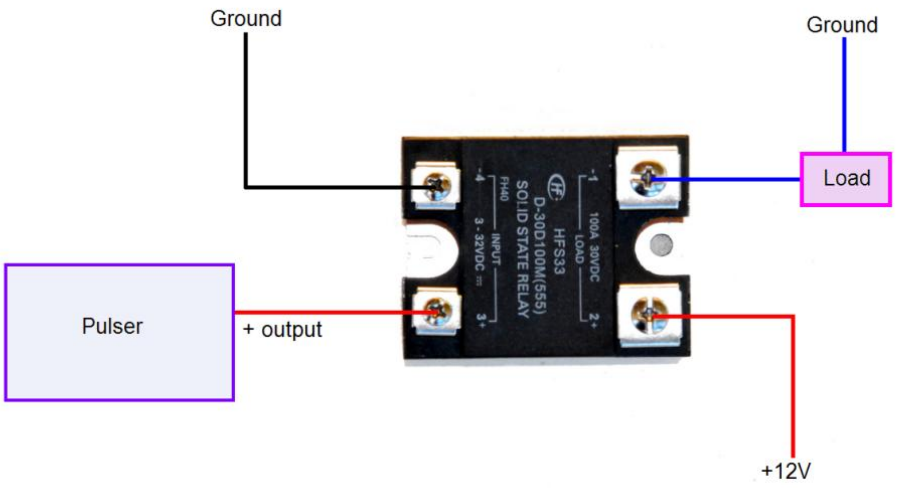
The heatsink needs to be isolated from ground and positive supplies, so either mount it so it fits inside a box (and can't touch anything metallic!) or mount the heatsink to the MOSFET using an insulating spacer and nylon nut and bolt.

Ultra-High Currents

But what if you want to pulse really big loads – like multiple 12V halogen lights, high-powered sirens or the like? There's no problem – you'll just need to buy a solid state relay.

The Jaycar SY4086 is one example of a solid state relay suitable for switching DC current. It costs about AUD$40.

The relay is rated at 25 amps without any heatsink, and up to 100 amps with a large heatsink. This current handling means that, for example, you could pulse on and off twenty 50-watt halogen lamps – although you'd need a pretty big power supply to run that lot!



To wire the solid state relay to the Pulser, the positive input lead of the relay connects to the output of the Pulser. The negative input lead of the relay connects to the negative terminal of the Pulser power supply.

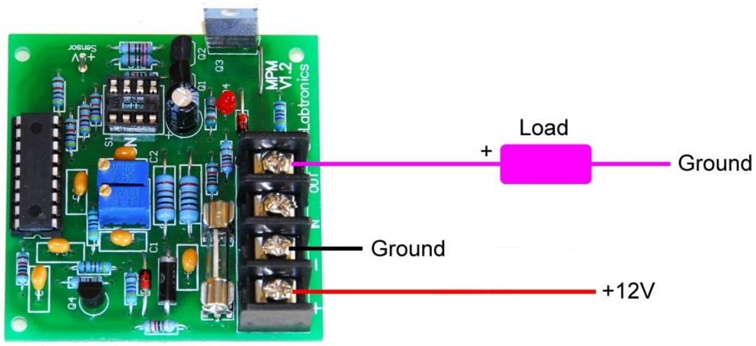
The output connections of the relay are also straightforward. The positive output terminal of the relay connects to a power supply (it doesn't have to be the same one you're using to run the Pulser) and the negative output terminal of the relay connects to the load, eg those halogen lights. The other side of the load connects to the negative lead of the load's power supply.

The solid state relay is limited in operating voltage to about 30V DC.

We suggest that whenever high currents need to be switched, a solid state relay is used - rather than a large heatsink on the Pulser's MOSFET. Note that when the solid state relay is being used, the Pulser MOSFET doesn't need a heatsink.

Connections

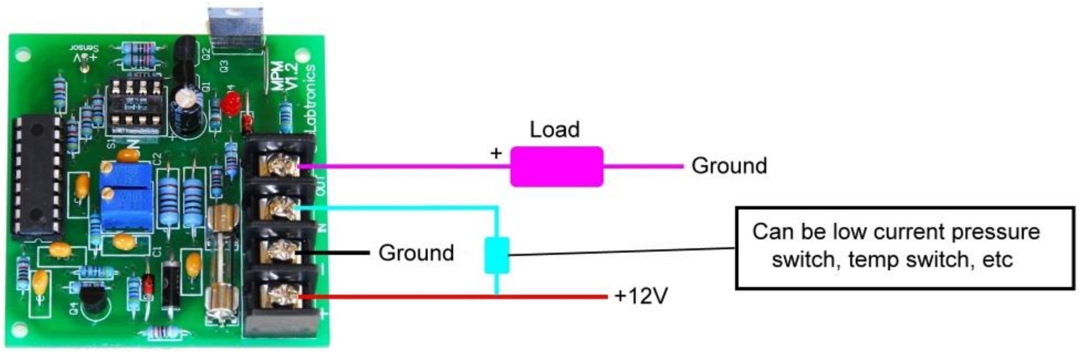
The eLabtronics Pulser has just four connections. These are power (anything from 10 - 40V), ground (chassis earth or negative terminal of battery), input and output. Let's take a look at the 'input' and 'output' terminals in more detail.



When the Pulser's output MOSFET is turned on, battery power is available at the output terminal. So all you need to do is to wire your load (lights, buzzers, horns, solenoid, etc) between the output terminal and chassis ground.

If the load has a polarity, the positive terminal goes to the Pulser.

(Note that as with all MOSFETs, there is a slight voltage drop across it, so a little less than battery voltage will be available at the output.)



To switch the Pulser on, the input wire needs to be connected to power. Therefore, at its simplest, you just connect the input wire to the power supply – putting a switch in that wire to turn the Pulser on and off.

The input wire takes only a tiny current, so even if you have the Pulser operating something that's pretty current-hungry (like a horn or pump), the input wire switch can be rated for nearly no current. This function is really good because it means the Pulser acts like a high power electronic relay – you can switch the input using a low current micro-switch, pressure switch, etc.

Setting Up

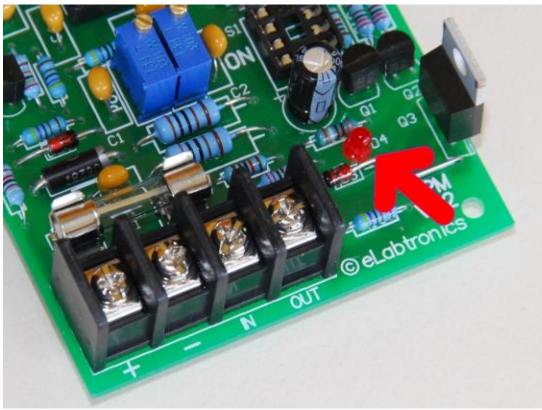
OK, so how do you set up and test the system? Firstly, place the module so that its underside tracks can't short-out – put it on an insulating surface or in its optional box.

Then complete this checklist:

- Power connected
- Ground connected
- Load connected between ‘Output’ and ground
- Input connected (perhaps via a switch) to Power

Frequency pot set half a turn anticlockwise from the fully clockwise position. (Note: These pots are multi-turn so don’t expect to make only one rotation when setting them. Multi-turn pots also don’t have clear end-stops [although they can sometimes be heard clicking when they’ve reached the end of their adjustment]).

Duty cycle pot set to roughly the middle position.



When the input is connected to power, the on-board red LED will light, showing that the module is triggered. The output pulse will also immediately start. (This is very useful because if you have the output set to pulse for 15 seconds every hour, you don’t want to wait an hour to see if the wiring is right!)

If nothing happens, check your wiring and then the module’s fuse. If all is working correctly, adjust the frequency and duty cycle pots (in that order) to gain the results you’re after. You can adjust the pots with the system working.

With the settings finalised, make sure that the output MOSFET isn’t getting too hot – it’s OK if it grows very warm but it shouldn’t be too hot to touch. If it is hot, use a multimeter to check the pulse current and if it’s below 10 amps, increase the size of the heatsink. If it is above 10 amps, you’re overloading the system.

If no heatsink (or only a small one) is fitted, the module will fit into the Jaycar box cat no HB6075.

Triggering From Light and Temperature Sensors

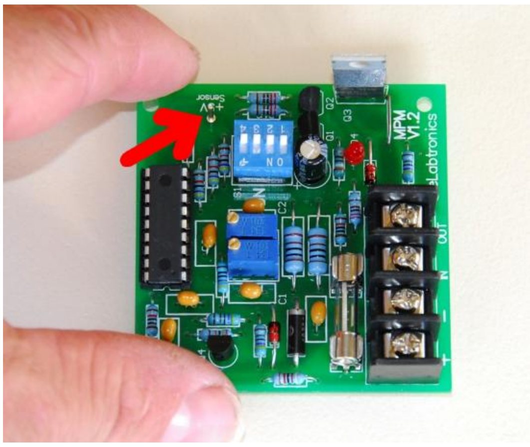
As mentioned above, while the Pulser is normally switched on by connecting its Input terminal to power, the Pulser actually turns on when the voltage on the Input rises above about 2.6V.

This seemingly minor point is very important, as it allows the Pulser to be automatically triggered by changing light levels, temperature or even the output of an engine management sensor.

For example, the Pulser can be configured to automatically start flashing lights when it gets dark, or turn on a fan or pump when it gets hot. It can even be triggered when the **difference** between two temperatures exceeds a certain amount!

Some soldering and component recognition skills are required when configuring the Pulser for automatic switch-on, so the electronic skills needed are a little higher than when wiring-in the Pulser for normal manual use. However, the wiring is still very straightforward.

5V supply



To automatically trigger the Pulser on the basis of temperature or light intensity, use is made of a regulated 5V supply sourced from the module. This is available on the pin shown here.

Note that while a regulated 5V is available on this pin, the amount of current that can be drawn is strictly limited. There is sufficient current available to operate the temperature and light sensor circuits described here, but there is **not** enough current available to run other sensors (eg automotive MAP sensors). In fact, the output current rating of this source is only 2 milliamps.

Effectively, the 5V pin supplies a fixed voltage that is them modified by the action of the specific sensor (temp or light) and adjustment pot before being fed to the Input.

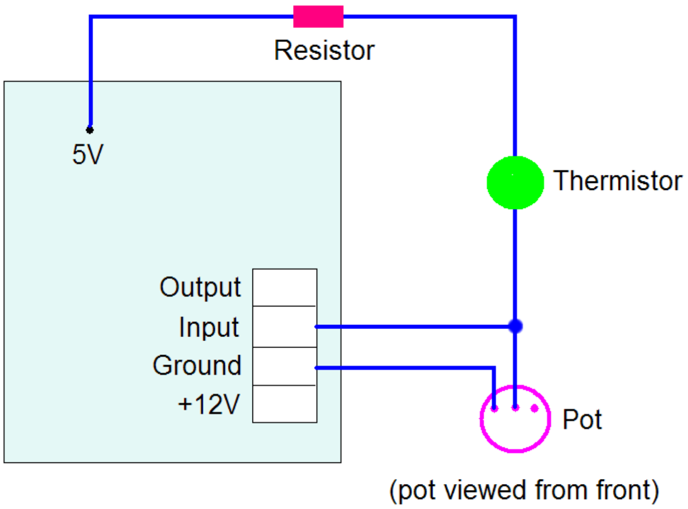
So how is the Pulser wired for auto operation? Let's look at temperature first.

Temperature

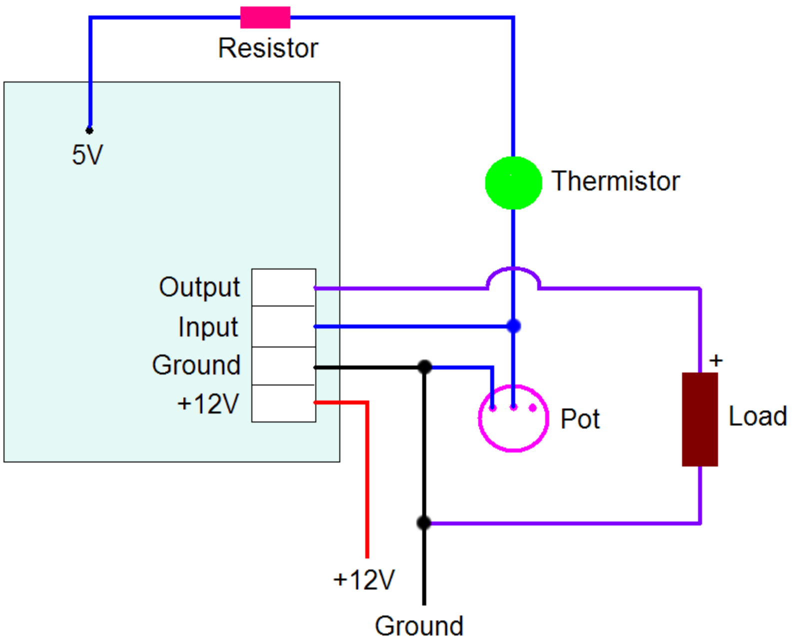
By using one or two low cost temperature sensors (thermistors) and a few other components, the Pulser can be configured to switch itself on the basis of temperature. The switching point is adjustable and a number of different configurations can be used.

- **Turns on when it gets hot**

This is the approach to go for when things need to be pulsed once the temperature **rises above** a certain point. One example use is to sound an over-temp alarm – eg pulse a buzzer or light.



Here is the wiring diagram. Note that for the sake of simplicity, the power and load connections for the Pulser are not shown here (or in most of the wiring diagrams in this story).



However, as a special once-off, here is a full working system, complete with ground, +12V and the load connections.

To trigger the Pulser on the basis of temperature, the required additional components are:

- 200 kilo-ohm resistor
- 100 kilo-ohm thermistor
- 1 meg-ohm kilo-ohm potentiometer ("pot")

The circuit is wired as shown here. Note that the pot is shown from the front view (if you wire the pot in reverse, the adjustment will just work in the opposite direction). You can use any type of 1 meg-ohm pot, including a multi-turn design that will allow finer adjustment of the temperature set-point. The thermistor and resistor have no polarity so they can go into the circuit either way around.

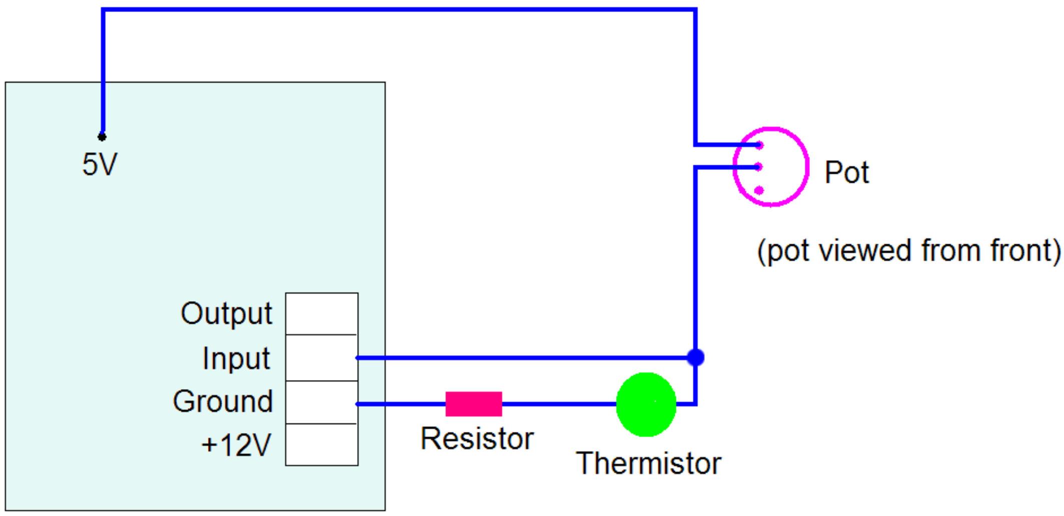
In this circuit, turning the pot clockwise **increases the temp** at which the Pulser turns on. With the depicted components, the selectable temp range is from about 0 degrees C to about 100 degrees C.

- **Turns on when it gets cold**

This is the approach to go for when things need to be pulsed once the temperature **falls below** a certain point.

For example, to be warned of the potential presence of black ice on the road, you'd set the system to pulse a dashboard light when the outside temp falls below about 3 degrees C.

Another way of looking at this is to say that the output will be on when it is cold, and off when it is hot. An additional example use is a warning light that stays on when the engine oil temp is still cold. Place the sensor so that it can detect engine oil temp and as soon as the cold car is started, the light will flash. Once the oil temp reaches your pre-set value, the light will stop flashing.



The required components are again:

- 200 kilo-ohm resistor
- 100 kilo-ohm thermistor
- 1 meg-ohm kilo-ohm potentiometer ("pot")

The circuit is wired as shown here. Note that the pot is shown from the front view (if you wire the pot in reverse, the adjustment will just work in the opposite direction). As before, you can use any type of 1 meg-ohm pot, including a multi-turn design. The thermistor and resistor have no polarity so they can go into the circuit either way around.

In this circuit, turning the pot **anti-clockwise decreases the temp** at which the Pulser turns on. With the depicted components, the selectable temp range is from about 0 degrees C to about 100 degrees C.

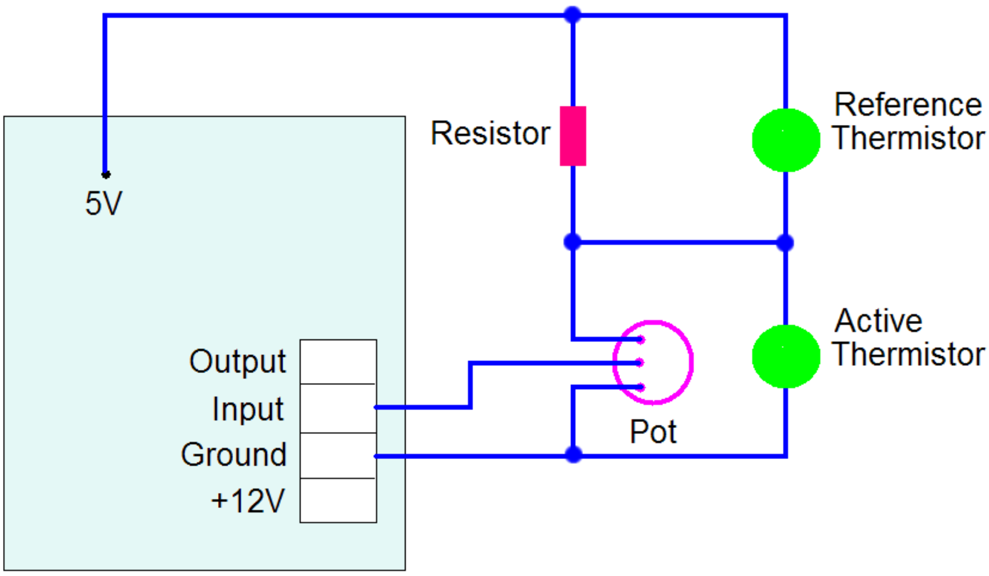
- **Turns on when temperature difference is high**

This is the approach to go for when things need to be pulsed once the **temperature difference** between two sensors **increases above** a certain point.

The benefit of using two sensors is that it takes into account different ambient temp levels that might exist. An example makes it clearer.

Suppose you want to turn on an intercooler water spray when the core temp exceeds 50 degrees C. Trouble is, if the intercooler is under the bonnet, that will happen most times you're stopped in traffic and the day is hot! The result is an empty water tank.

Now change that set-up to using two sensors – one positioned in the general area of the intercooler core and the other actually buried in the fins of the intercooler core. If the spray is set to trip when the intercooler core sensor is (say) 15 degrees C hotter than the other sensor, the spray will come on only when the core is not working sufficiently well – in fact, when it is working as a pre-heater! Tricky, eh?



The wiring is carried out as shown here. The 'reference sensor' is placed so that it will be the cooler of the two sensors. When the 'active sensor' is (say) 15 degrees C higher in temp than the reference, the Pulser will be switched on. This temp difference can be set by the pot.

The required components are:

- 1 x 200 kilo-ohm resistor
- 2 x 100 kilo-ohm thermistors
- 1 x 500 kilo-ohm potentiometer ("pot")

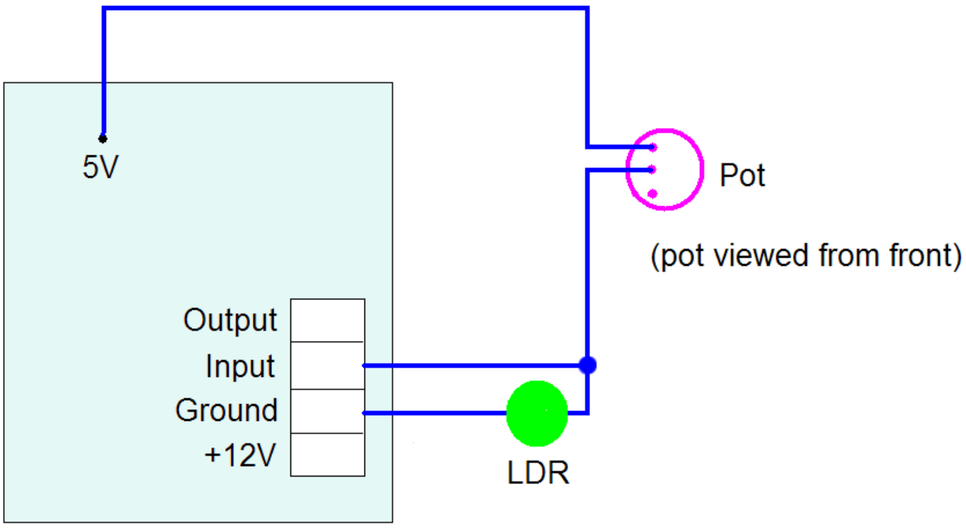
In this circuit, turning the pot **clockwise increases the temp difference** at which the Pulser turns on. With the depicted components, the selectable temp range is from about 0 degrees C to about 100 degrees C.

Light Intensity

- **Turns on when it gets dark**

Wired in this form, the Pulser switches itself **on when it gets dark.**

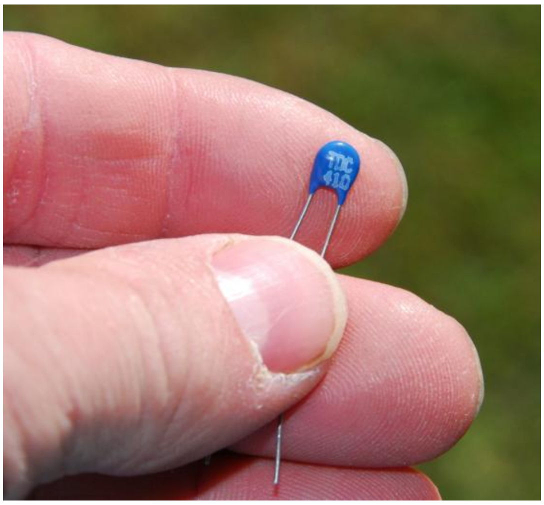
An example use is to automatically turn on an in-cabin 'alarm armed' flasher LED whenever it's dark. (If the sensor is placed near the dashboard lights, the flashing LED will stay off until it is dark **and** the dash lights are off!)



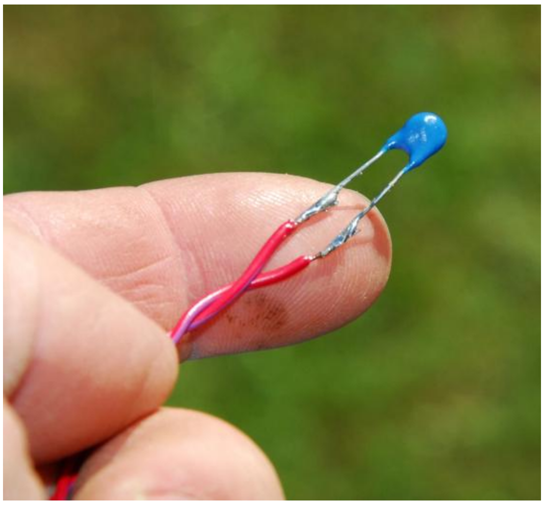
The wiring requires a Light Dependent Resistor (LDR) with a nominal 48 – 140 kilo-ohm response and a 1 meg-ohm pot. Turning the pot clockwise increases the level of darkness needed to trigger the Pulser.

Mounting the Sensors

Both the thermistors and LDR come as bare electronic components. To wire them into place, you'll need to do two things: solder them to extension wiring and mount them.



Here's a bare thermistor



Shorten the leads and then solder two insulted wires to the leads.

Use insulation tape (when working with relatively low temps) or good quality heatshrink (high temp sensing) to insulate the connections.

The Light Dependent Resistor (LDR) can be handled in the same way.

If the sensor is detecting just ambient conditions (eg in-cabin temperature or light intensity), the sensor can simply be positioned appropriately and held in place with a cable tie. However, if the sensor is working in a much tougher environment, use high-temp epoxy to mount the sensor in a threaded brass fitting so that it can be securely mounted.

Conclusion

The Pulser achieves a very simple aim – switching things on and off. The beauty of the design is in its compactness, power handling ability and the ease with which a wide range of pulsing behaviour can be attained.