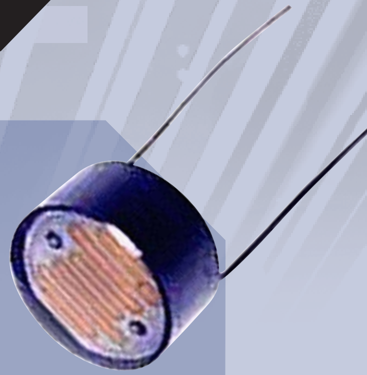
PRACTICAL PICAXE

PART 5

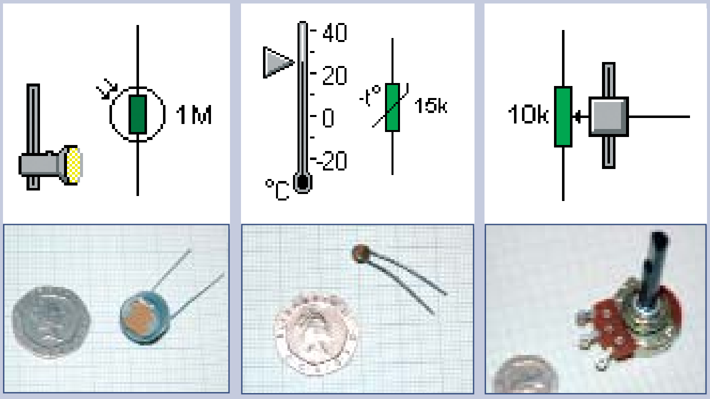


Using and understanding Analogue inputs

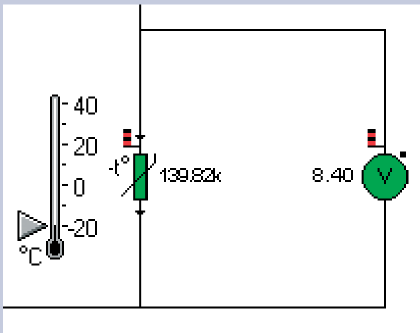
All the inputs used in the PICAXE Circuits in the preceding articles have been digital, basically switches with two states on or off. This article is going to introduce analogue sensors and how they can be incorporated into PICAXE Projects. The circuits from this article can be downloaded from the TEP website

Inputs

Analogue sensors are inputs that have resistances that vary within certain conditions; for example a Light Dependent Resistor has a dramatic change of resistance from light to dark. The three analogue sensors that are common and suitable for use in schools are **LDRs** (light sensor), **thermistors** (heat sensors) and **potentiometers** (position sensor).

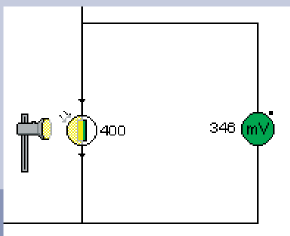


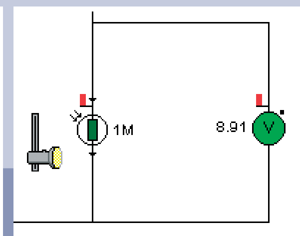
The most common input arrangement for LDRs and thermistors, is a potential divider arrangement. Potential dividers are made from resistors connected in series between the +V and 0V supply lines of a circuit.



In this example, using Crocodile Technology, the thermistor has a resistance of 8.22k at 40°C producing a signal output of 4.06V, at -20°C the output signal is 8.40V. Between 40°C and -20°C the thermistor produces a varying voltage signal.

A Light Dependent Resistor behaves in the same way.





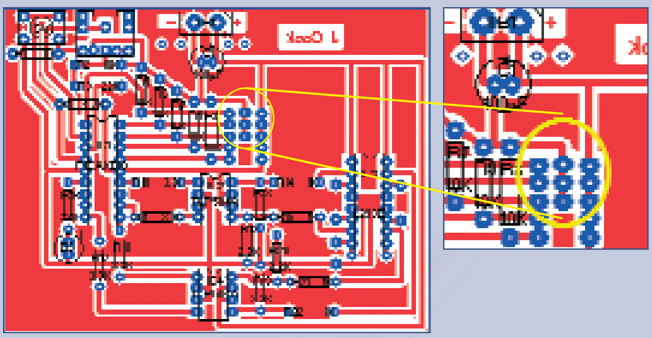
When illuminated the LDR has a resistance of approximately 400 ohms, producing a signal of 346 mV. In the dark the LDR has a resistance of 1,000,000 ohms, producing a signal of 8.91 V. This huge change of resistance and corresponding signal makes LDRs ideal analogue inputs.

The voltage signal can be represented by a number in the range of 0 and 255 (e.g. very dark = 0, bright light = 255). All PICAXE Chips have an analogue input, but the PICAXE-08 and PICAXE-18 have only low-resolution readings. A low-resolution analogue input will only provide 16 discrete readings over the lower two-thirds of the voltage range. So in the decimal standard range 0-255 you can obtain values 0-160 in steps of 10 providing sixteen readings. For values 160-255 the reading will simply be the highest threshold value 160. No accurate readings are therefore available in the upper third of the voltage range.

The easiest way of determining the correct analogue value for a potential divider analogue input is to use an Analogue Calibration Board.

The potential divider arrangement is connected via the three screw terminal blocks, The display shows the value 0 – 225; by altering the input condition (e.g. light level for an LDR sensor) the value of the threshold input can be noted and used within the programme. By experiment you can vary expected light levels or temperature levels and even mark rotary positions on a potentiometer. There are other methods that can be used if an Analogue Calibration Board is not available, including trial and error. Try a particular value, download it to the circuit, test the circuit and change the value in the program accordingly until the desired outcome is achieved. The designer can elect to use a fixed or variable resistor on the PCB to 'steer' the value of the input voltage from the sensor.

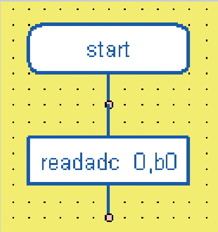
Design of circuit boards needs to have provision for analogue inputs as shown here:



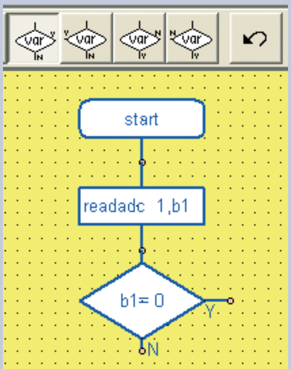
The three holes allows two resistors (that form a potential divider) to be connected between the positive and zero voltage rails. The inputs can also be used as digital inputs by ignoring the centre zero voltage holes in the middle. There are three analogue inputs on PICAXE 18 as shown previous and just one input for PICAXE 08.

Programming

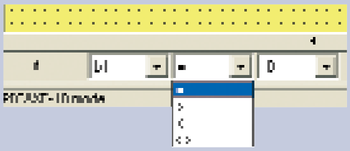
In order for the programme to react to changes to an analogue sensor the programme has to be constructed in such a way that the sensor is being read at regular, preferably short intervals.

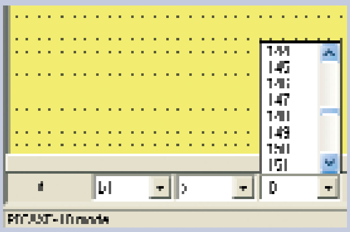


The ***readadc*** needs to be set to the correct input to look at, and the variable that is going to be changing.

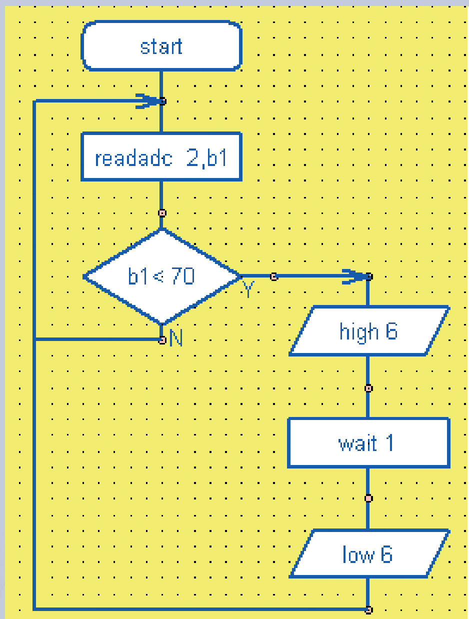


A suitable ***if*** variable is selected and the variable parameters set followed by the threshold value from 0 – 255.

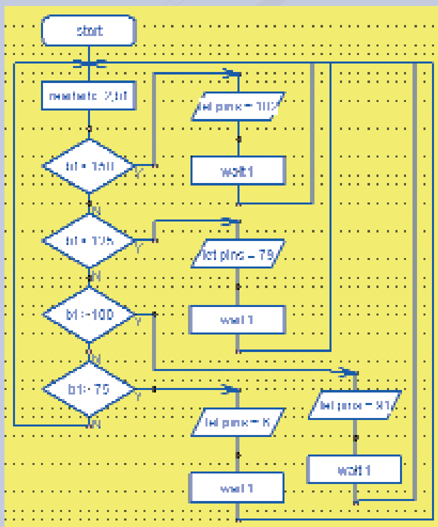




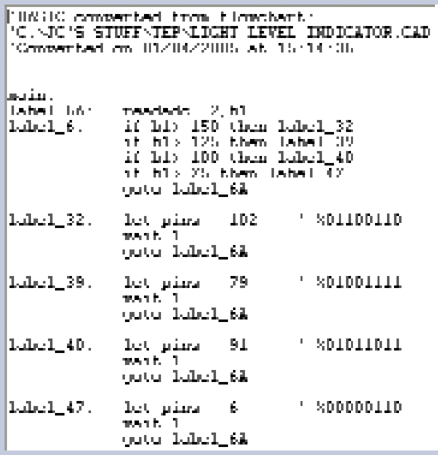
In this simple example if the value of the analogue sensor on input 2 is less than 70, output 6 is turned on for 1 second and then the sensor is read again.



In this example as a light sensor reading on input 2 increases the number on a seven segment display changes from 1 to 4.



The programme can then be converted to basic and downloaded to a tutorial board.



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'BASIC converted from flowchart:
'C:\JC'S STUFF\TEP\LIGHT LEVEL INDICATOR.CAD
'Converted on 01/04/2005 at 15:14:36

main:
label_6A:   readadc  2,b1
label_6:    if b1 > 150 then label_32
            if b1 > 125 then label_39
            if b1 > 100 then label_40
            if b1 > 75 then label_47
            goto label_6A

label_32:   let pins = 102      ' %01100110
            wait 1
            goto label_6A

label_39:   let pins = 79       ' %01001111
            wait 1
            goto label_6A

label_40:   let pins = 91       ' %01011011
            wait 1
            goto label_6A

label_47:   let pins = 6        ' %00000110
            wait 1
            goto label_6A
```

This article is not intended to be a definitive piece of work but just a starting point. Whilst PICs do produce tidy and flexible solutions to problems, do not forget the past; the last example could have been produced using a quad operational amplifier for a lot less than the cost of a PIC.

The Analogue Calibration Board featured is available from Teaching Resources: **Stock code BAS 810**

➡ For further help or assistance you can email John Cook at: jcooklggs@hotmail.com