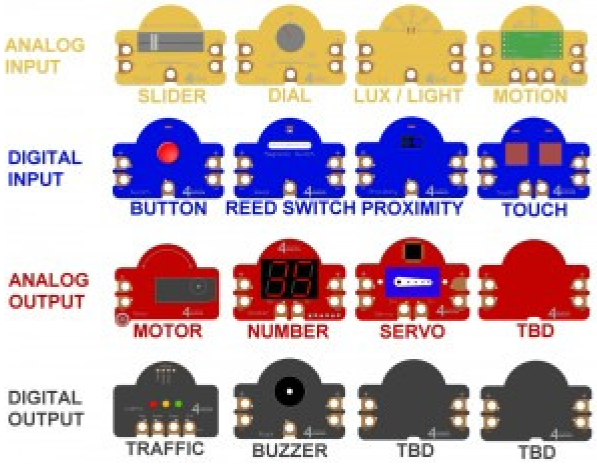
Crumbs - Addon Components for Crumble



4tronix are producing a series of Crumbs to support the Crumble controller. Each Crumb has an associated worksheet within this document that allows you to easily bring a teaching or coding session to life using the Crumbs either singly or in various combinations.

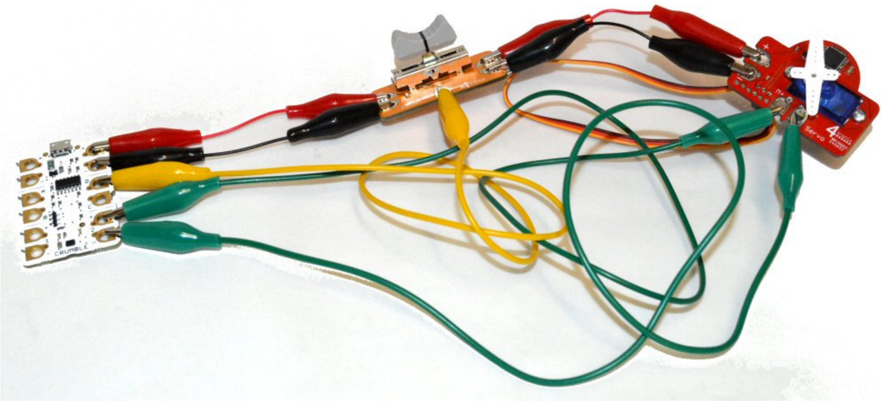
Style of Crumb

- Analog input: These Crumbs are coloured Yellow and provide a continuously varying input for the Crumble which can be read and used with the A. B, C and D connections
  - Slider
  - Dial
  - Light Sensor
  - Motion Sensor
- Digital input: Blue. These Crumbs provide a simple On/Off input to the Crumble controller. Again would be used with the A, B, C and D connections
  - Button
  - Magnetic Reed Switch
  - Proximity Sensor
  - Dual Capacitive Touch Sensor
  - PIR sensor
- Analog output: Red, These Crumbs allow the Crumble to continuously vary the device: speed of the motor, brightness of the Sparkles, Number shown on the display, position of the servo
  - Motor (LH or RH)
  - Number
  - Servo
- Digital output: Black These Crumbs can be set either On or Off by the Crumble
  - Traffic Lights
  - Buzzer
  - Remote Switch (TBC)

Using Crumbs

Most Crumbs require a 5V Power and Ground connection to be made before they work fully. Sometimes this is to power the on-board electronics and sometimes, simply to ensure that the indicator LED works as expected.

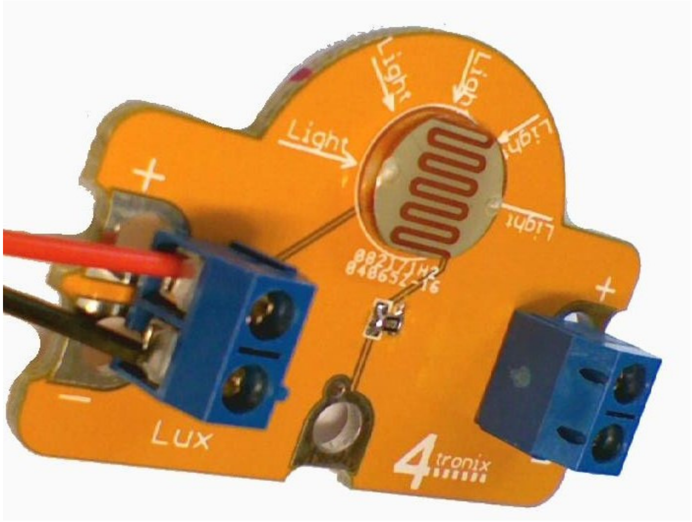
The Crumbs are designed so that the Power and Ground (5V and 0V) can be applied to either the left or the right side. It doesn't matter which you use. You can then use the opposite side to take the power to any other Crumb that you are using, as shown in the picture below:



We recommend using short crocodile clips to join the Crumbs together as it reduces the amount of wiring considerably and the whole experiment becomes clearer to understand

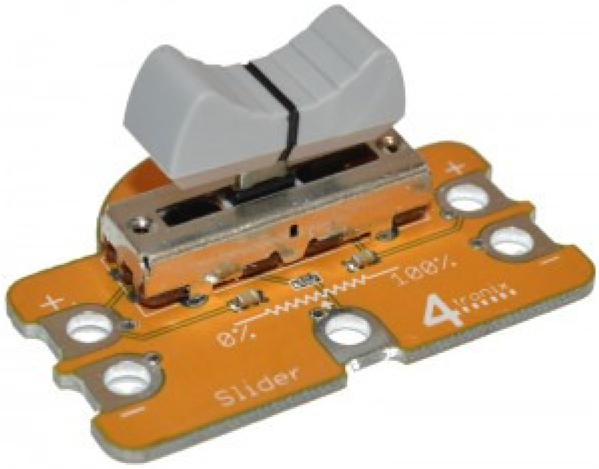
Although the Crumbs are generally protected against connecting power on the wrong way round, or onto the wrong pin, it is recommended that you use some sort of colour coding so that the children can see how the positive power flows (using Red wires) or the negative with Black wires. You can use Green as an alternative to Black if you run out, but Yellow, White and Green are good colours to use for the general purpose inputs/outputs or motor outputs.

Where there are 2 crocodile lead connection pads next to each other on a Crumb (or indeed the Crumble) the two small holes that form part of the pads are designed to be exactly 5mm apart so that a standard 2-pin 5mm screw terminal can be soldered on. This allows you to use standard wires of exactly the correct length that are simply screwed into the terminal blocks as shown below:



Analog Input Crumbs (Yellow)

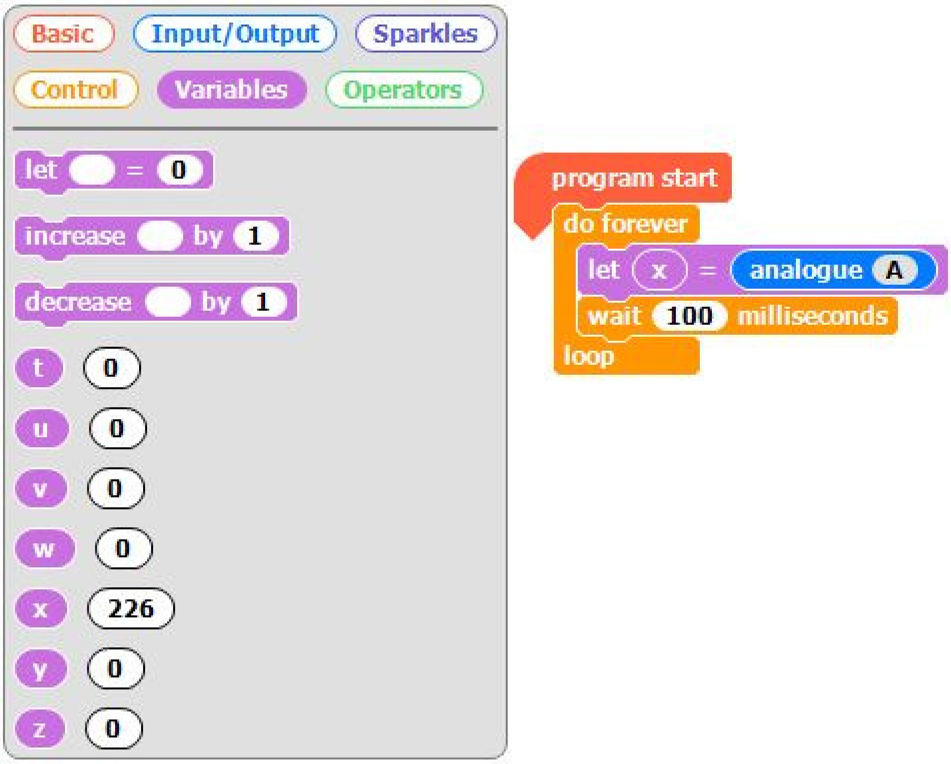
SLIDER



This requires Power and Ground to be connected and the output connected to A, B, C or D. The analog value read will be in the range 0 to 255, though in practice the power is not at 5V so the top end number will be lower

Sliding the slider to the left will give a value of 0, to the right will give the maximum number (around 220)

The program below reads the value from the Slider Crumb connected to Input A, into the variable X. You can see the value being displayed on the left: x = 226



```
program start
  do forever
    let x = analogue A
    wait 100 milliseconds
  loop
```

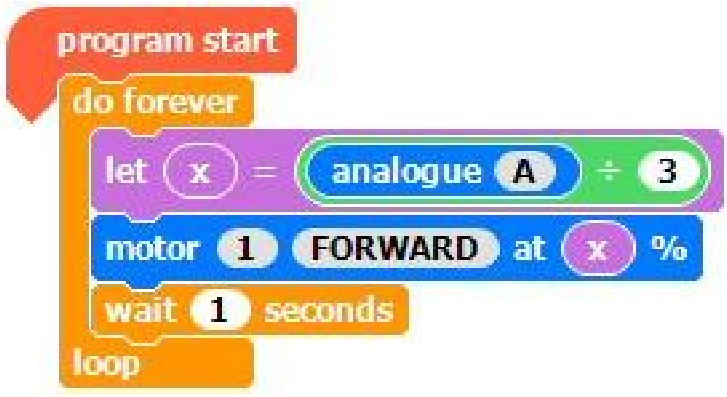
t 0
u 0
v 0
w 0
x 226
y 0
z 0

DIAL

This requires Power and Ground to be connected and the output connected to A, B, C or D. The analog value read will be in the range 0 to 255, though in practice the power is not at 5V so the top end number will be lower

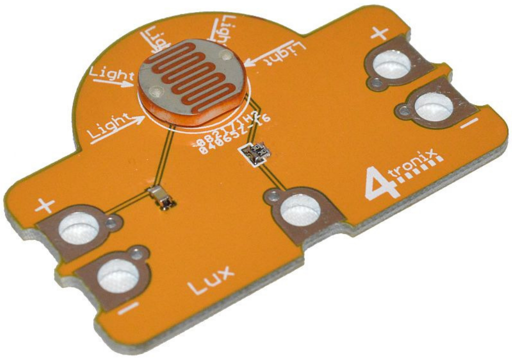
Turning the Dial fully anti-clockwise will give a value of 0, turning it fully clockwise will give the maximum number (around 220)

The program below uses the value read from the Dial Crumb connected to Input A to set the speed of Motor 1. Note that the maximum value for motor speed is 100, so we divide the value from the Dial Crumb by 3 to be sure it fits into this range.



```
program start
  do forever
    let x = analogue A ÷ 3
    motor 1 FORWARD at x %
    wait 1 seconds
  loop
```

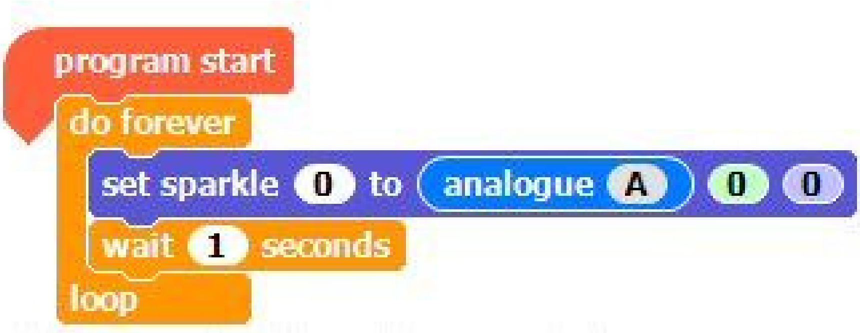
LUX/LIGHT



This requires Power and Ground to be connected and the output connected to A, B, C or D. The analog value read will be in the range 0 to 255, with 0 being total darkness and 255 being extremely bright.

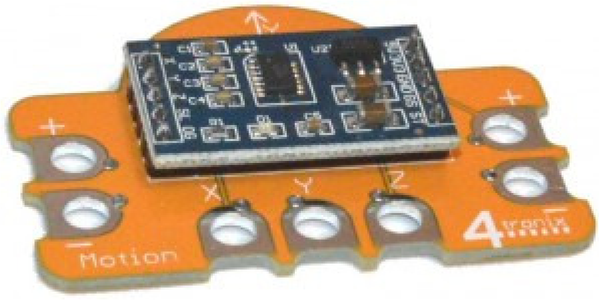
Covering the light sensor completely will reduce to the minimum value and shining a bright light on it will achieve the maximum

The program below uses the value from the Light Sensor Crumb to set the brightness of the Red element of Sparkle 0. So in a dark room, the Sparkle won't be as bright as in a bright room.



```
program start
  do forever
    set sparkle 0 to analogue A 0 0
    wait 1 seconds
  loop
```

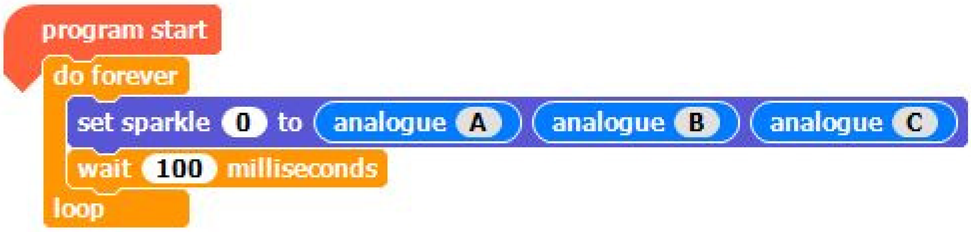
MOTION



This requires Power and Ground to be connected and the outputs connected to A, B, C or D. The analog values read will be in the range 0 to approximately 125

You can tilt the board in X, Y or Z axis and the appropriate output will change its value. Maybe you can use this to steer a robot?

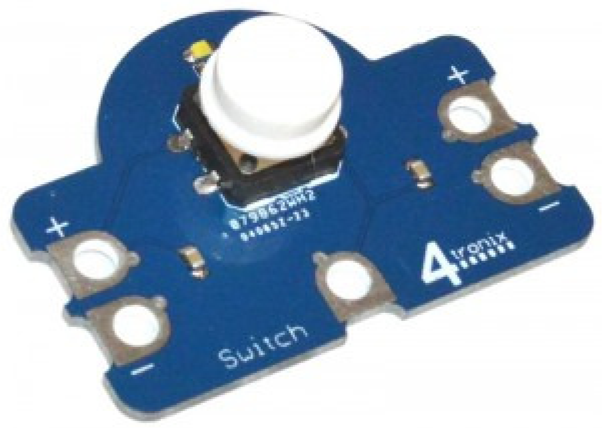
The program below extends the program for the Light Sensor Crumb by using all three axes of the Motion Sensor to set the three colour elements (Red, Green and Blue) of the Sparkle. So twisting and turning the Motion Crumb will change the brightness and colour of the Sparkle.



```
program start
  do forever
    set sparkle 0 to analogue A analogue B analogue C
    wait 100 milliseconds
  loop
```

Digital Input Crumbs (Blue)

BUTTON

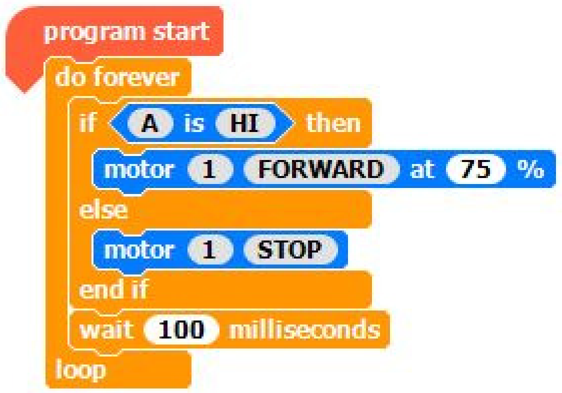


This requires the Power to be connected in order for the button to operate. In addition, you should connect the Ground so that the indicator LED operates.

When the button is not pressed, the output is 0 (Low) and the indicator is Off

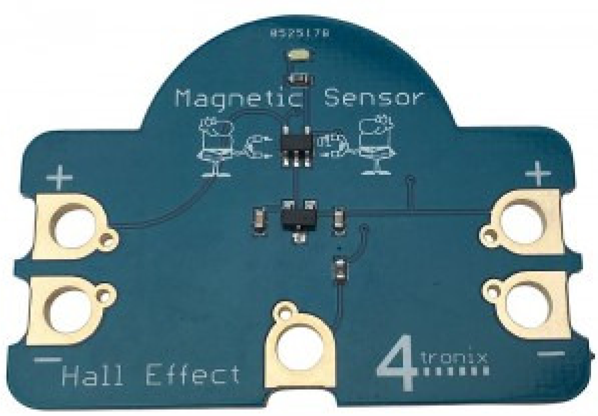
When the button is pressed, the output is 1 (High) and the indicator is On

The program below starts Motor 1 running when the button is pressed and stops it when the button is released:



```
program start
do forever
    if A is HI then
        motor 1 FORWARD at 75 %
    else
        motor 1 STOP
    end if
    wait 100 milliseconds
loop
```

MAGNETIC HALL EFFECT SWITCH

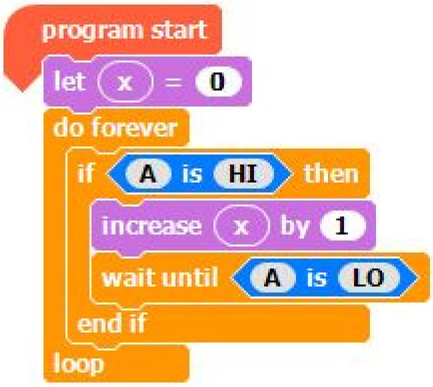


This requires the Power to be connected in order for the Hall Effect switch to operate. In addition, you should connect the Ground so that the indicator LED operates.

When a magnet is not present, the output is Low) and the indicator is Off

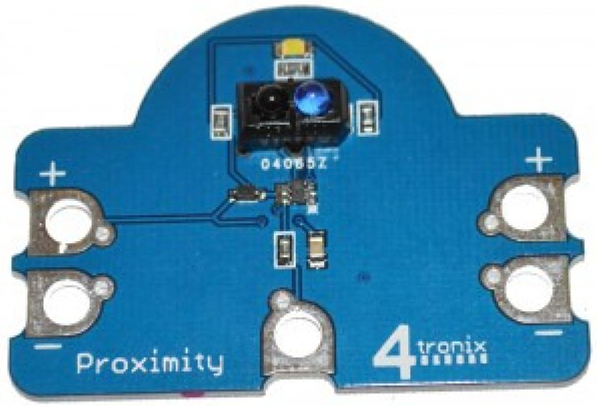
When a magnet (eg. a fridge magnet) is brought towards the sensor, the output is High and the indicator is On

The program below counts the number of pulses received from the Magnetic Switch Crumb. Maybe the magnet is on a wheel spinning round past the Crumb and this is counting the revolutions of the wheel?



```
program start
let x = 0
do forever
    if A is HI then
        increase x by 1
        wait until A is LO
    end if
loop
```

PROXIMITY SWITCH



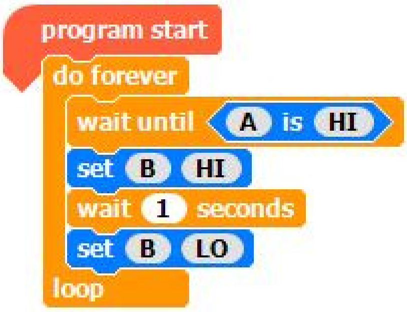
This requires the Power and Ground to be connected in order to operate.

When there is no object near the sensor, the output is 0 (Low) and the indicator is Off

When an object (eg. a hand) is brought above the sensor, the output is 1 (High) and the indicator is On

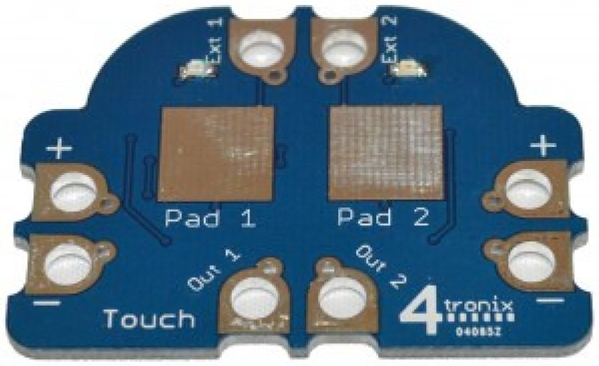
The sensitivity is set such that a finger or hand would trigger it within about 2 to 3 cm. A reflective white card would be about 10cm

The following program waits for the trigger from the Proximity Crumb connected to input A then switches on the Buzzer connected to output B for 1 second



```
program start
  do forever
    wait until A is HI
    set B HI
    wait 1 seconds
    set B LO
  loop
```

CAPACITIVE TOUCH SWITCH



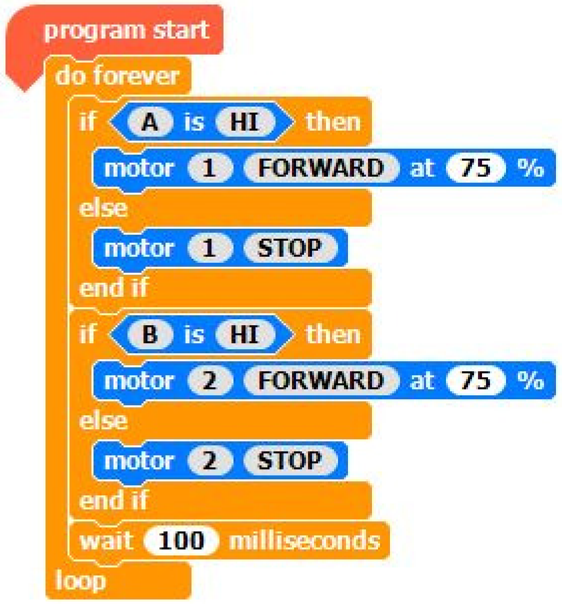
This requires the Power and Ground to be connected in order to operate.

When nothing is touching the sensor pads, the outputs are 0 (Low) and the indicator is Off

When a finger touches the sensor, the output is 1 (High) and the indicator is On

You can attach other objects such as pieces of fruit to the external inputs - give the system a minute or so to settle down (or remove and replace the power to reset it) after you change the connections

The program below uses the 2 outputs from the Touch Sensor Crumb connected to Inputs A and B to control 2 motors and steer a robot left or right



```
program start
  do forever
    if A is HI then
      motor 1 FORWARD at 75 %
    else
      motor 1 STOP
    end if
    if B is HI then
      motor 2 FORWARD at 75 %
    else
      motor 2 STOP
    end if
    wait 100 milliseconds
  loop
```

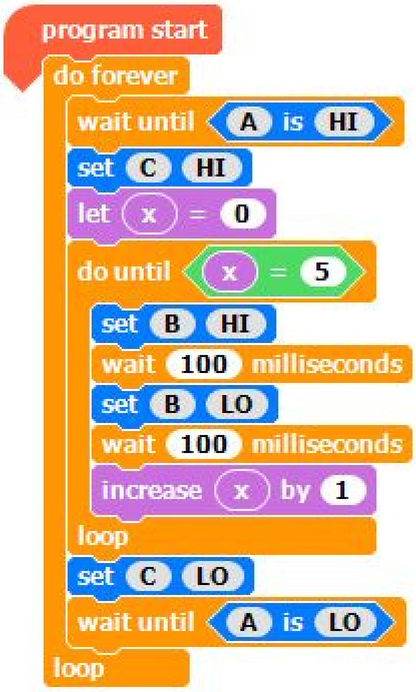
PIR (PASSIVE INFRARED) SENSOR

This requires the Power and Ground to be connected in order to operate.

When nothing moving is detected, the outputs are 0 (Low) and the indicator is Off

When movement is detected, the output is 1 (High) and the indicator is On

The program below flashes lights (on Output B) and Sounds a Buzzer (on Output C) when movement is detected



```
program start
  do forever
    wait until A is HI
    set C HI
    let x = 0
    do until x = 5
      set B HI
      wait 100 milliseconds
      set B LO
      wait 100 milliseconds
      increase x by 1
    loop
    set C LO
    wait until A is LO
  loop
```

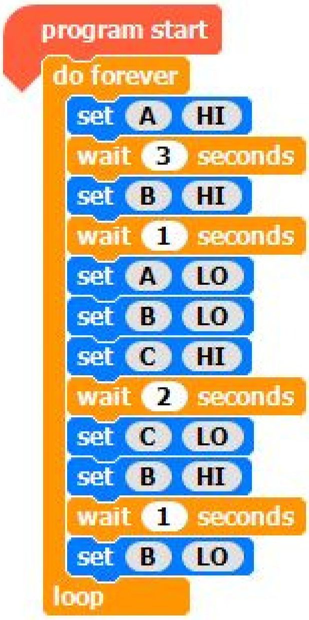
Digital Output Crumbs (Black)

TRAFFIC LIGHTS

This requires the Ground to be connected and the Red, Amber and Green connections made to your choice of A, B, C or D on the Crumble

Setting the appropriate output on the Crumble to Hi will light the LED on the Crumb as well as the related LED on the Pi-Stop if one is plugged in

The following program runs a basic traffic light sequence with Red connected to A, Amber to B and Green to C



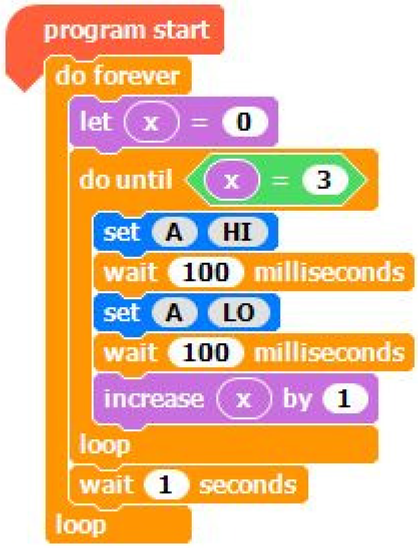
```
program start
  do forever
    set A HI
    wait 3 seconds
    set B HI
    wait 1 seconds
    set A LO
    set B LO
    set C HI
    wait 2 seconds
    set C LO
    set B HI
    wait 1 seconds
    set B LO
  loop
```

BUZZER

This requires the Ground to be connected and the input connection made to A, B, C or D on the Crumble

Setting the output on the Crumble to Hi, will sound the Buzzer and light the indicator LED

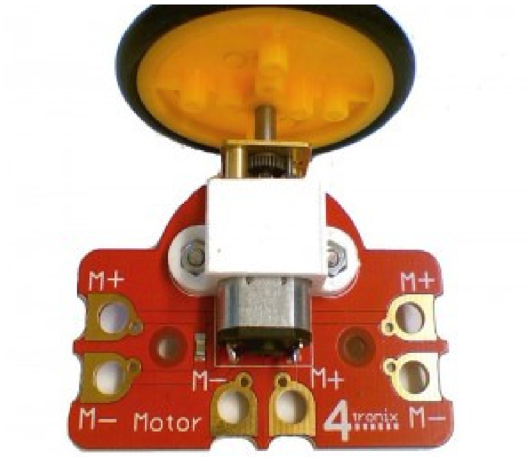
The follow program plays a sort of Morse code SOS on the Buzzer Crumb connected to output A. (in fact it just does the first 'S' otherwise it would be a bit long)



```
program start
do forever
    let x = 0
    do until x = 3
        set A HI
        wait 100 milliseconds
        set A LO
        wait 100 milliseconds
        increase x by 1
    loop
    wait 1 seconds
loop
```

Analog Output Crumbs (Red)

MOTOR

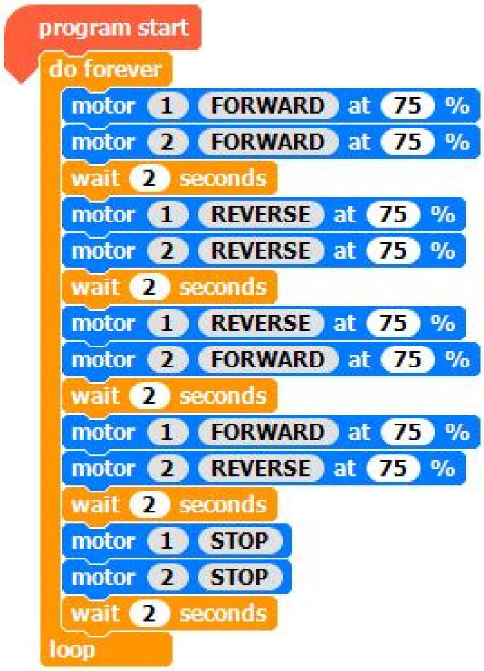


This requires the two terminals on the Crumb to be connected to the Motor1 or Motor2 outputs on the Crumble

Setting the Motor Speed to 100 will turn the motor approximately 2 turns per second (120 rpm). The motor will stop turning if the speed setting is below about 20

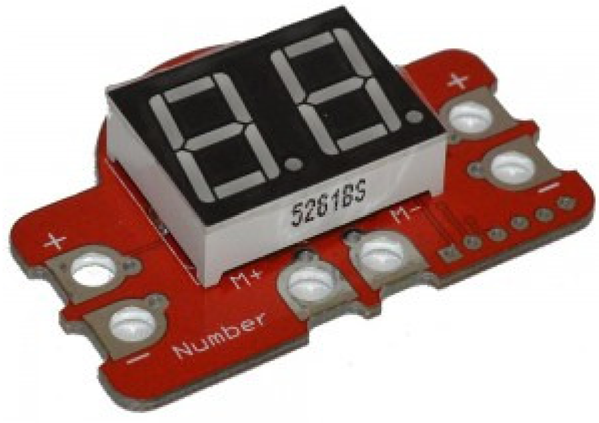
If you connect + to + and - to - from Crumble to Motor Crumb, then FORWARDS = anticlockwise and REVERSE = clockwise.

The following program controls 2 motors to move a vehicle Forwards, Backwards, Spin Left, Spin Right and Stop continuously.



```
program start
 do forever
   motor 1 FORWARD at 75 %
   motor 2 FORWARD at 75 %
   wait 2 seconds
   motor 1 REVERSE at 75 %
   motor 2 REVERSE at 75 %
   wait 2 seconds
   motor 1 REVERSE at 75 %
   motor 2 FORWARD at 75 %
   wait 2 seconds
   motor 1 FORWARD at 75 %
   motor 2 REVERSE at 75 %
   wait 2 seconds
   motor 1 STOP
   motor 2 STOP
   wait 2 seconds
 loop
```

NUMBER



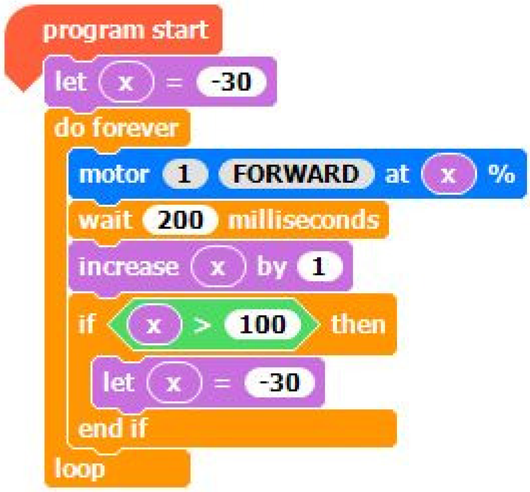
This requires Power and Ground to be connected as well as M+ and M- to be connected to the Motor1 or Motor2 outputs on the Crumble

Setting the motor speed to any number will cause that number to be shown on the display

Forward is shown directly (eg "75") but Reverse adds the decimal points so will show "7.5."

See this blog entry for more information on using this Crumb

The program below simply counts up from -30 to +100 continuously:



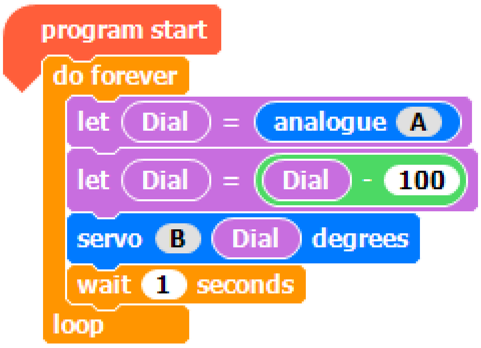
```
program start
let x = -30
do forever
  motor 1 FORWARD at x %
  wait 200 milliseconds
  increase x by 1
  if x > 100 then
    let x = -30
  end if
loop
```

SERVO

This requires Power and Ground to be connected as well as the centre connection to one of the outputs on the Crumble

Use the Servo command in the Crumble software to set the position of the servo

The following program uses the Slider or Dial Crumb connected to input A to adjust the position of the servo on Output B:



```
program start
  do forever
    let Dial = analogue A
    let Dial = Dial - 100
    servo B Dial degrees
    wait 1 seconds
  loop
```