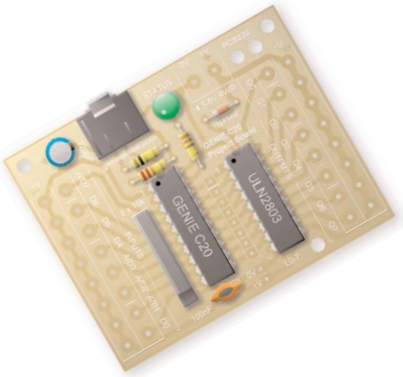
Introduction 1

Welcome to the magical world of GENIE!

The project board is ideal when you want to add intelligence to other design or electronics projects. Simply wire up your inputs and outputs and away you go!



Green status LED, controlled by output signal **ST**

Download socket (the cable plugs in here so that the GENIE microcontroller can talk to the computer)

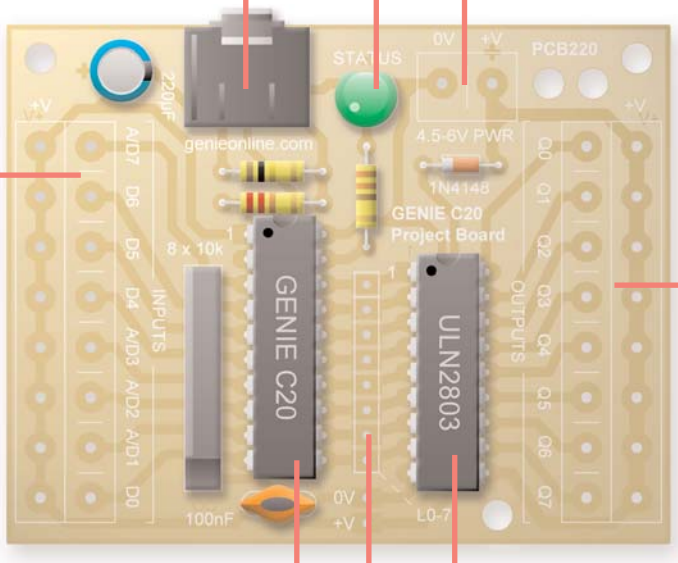
Battery connects here (red wire to '+V', black wire to '0V')

Battery power must be between 4.5 volts and 6 volts...

...that's 3 or 4 AA-sized batteries!

Digital inputs **D0** to **D7**

Four of the inputs (**A/D1**, **A/D2**, **A/D3** and **A/D7**) also allow you to connect an analogue sensor



Medium-power outputs, controlled by signals **Q0** to **Q7**

GENIE C20 microcontroller (the magic bit!)

Driver chip (it contains 8 separate transistors that allow each output to control more powerful things)

Low-power outputs signals (these are the output signals before they are 'beefed-up' by the driver chip)

Making the GENIE 2

Switch on the soldering iron. It will only take a few minutes for the iron to reach operating temperature. Once the soldering iron is hot, clean the soldering iron tip with a moist sponge.

Melt some solder at the chamfered end of the soldering iron tip. This is called 'tinning' and it will aid the flow of solder from the soldering iron to the copper track on the printed circuit board and component pins.

Magic Ingredients!

This is what you will need:

Component	Quantity
GENIE C20 microcontroller	1
GENIE C20 project board (PCB220)	1
ULN2803 driver chip	1
Download (3.5mm stereo) socket	1
18-pin DIL socket	1
20-pin DIL socket	1
Battery clip	1
3 or 4 x AA battery holder	1
Green LED	1
220uF electrolytic capacitor	1
100nF capacitor	1
8-way in-line 10k ohm resistor	1
330 ohm resistor *(orange, orange, brown, gold)*	1
22k ohm resistor *(red, red, orange, gold)*	1
100k ohm resistor *(brown, black, yellow, gold)*	1

Fit each component onto the board. When fitting components such as resistors, you should use long-nosed pliers to bend the legs through 90 degrees. This will make them easier to fit.

Some of the components need to be fitted the correct way around:

- The GENIE microcontroller and driver chip should both be positioned so that the notch points towards the download socket and the dot next to pin 1 is at the same corner as the '1' shown on the board.
- The green LED should be fitted so that the flat edge of the LED lines up with the flat edge shown on the board.
- The diode should be positioned so that the stripe on the diode matches the stripe on the board.
- When fitting the electrolytic capacitor, you need to ensure that the positive side of the capacitor (the side without the stripe) is nearest to the '+' sign on the board.
- The 8-way in-line resistors should be fitted so that the dot on the component is at the bottom of the board (away from the edge on which the download socket sits).

To solder a pin, hold the soldering iron onto the board for a few seconds, then quickly touch the tip with a small amount of solder.

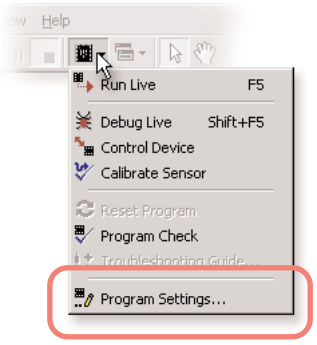
You should always remember to replace the soldering iron back into the stand after soldering and repeat cleaning the tip of the iron with the moist sponge before the start of each soldering operation.

Finally, cut off any excess wire or component legs for a tidy finish.

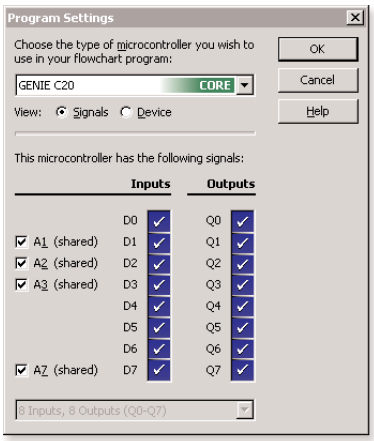
Telling the GENIE your wishes 3

For your project to work, you need to tell the GENIE microcontroller what it should do.

This involves writing a sequence of commands in a **flowchart**. Your flowchart is then sent down the cable and stored on the GENIE chip. By changing the flowchart, you can vary how the GENIE behaves.



First of all, you need to tell GENIE which type of chip you are using. To do this, click on the **Microcontroller** button on the toolbar and choose **Program Settings**.



Select a **GENIE C20** chip.

The inputs and output signals for this type of microcontroller are fixed, so click on **OK** when you are ready to continue.

Magical Effects!

These are the **input and output signals** available in your flowchart:

Input	Description
D0	Digital
A/D1 to A/D3	Analogue or digital
D4 to D6	Digital
A/D7	Analogue or digital

Output	Description
Q0 to Q7	Medium-power

You can now decide which commands you want your GENIE to perform. To do this, drag commands from the **Gallery**.

See the next worksheet for flowchart ideas.

Turning outputs on and off

You can use GENIE to turn outputs on and off.

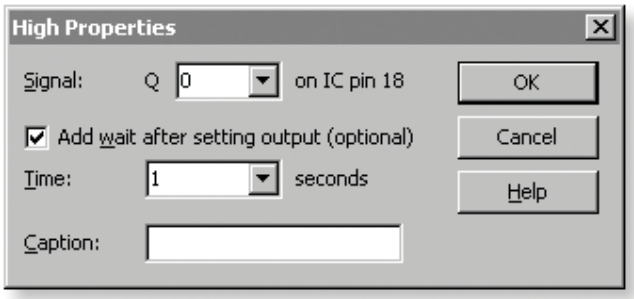
Use the **HIGH** command to turn a single output on.

Use the **LOW** command to turn a single output off.

Use the **OUTPUTS** command to control several outputs.

There are eight medium-power outputs on the project board (plus a green LED on output **ST**).

Double-clicking on an output command allows you to control these signals, for example:

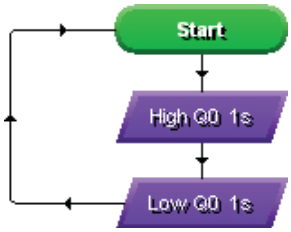


This will make the output connected to Q0 go high (if a bulb was connected, for example, the bulb would light up).

In addition to changing the output, you can also add a delay (GENIE programs run very quickly and without a wait, sometimes signals change too fast for you to see!).

The flowchart on the right uses the HIGH and LOW commands to make output Q0 flash on and off.

It loops back to make the flashing repeat.



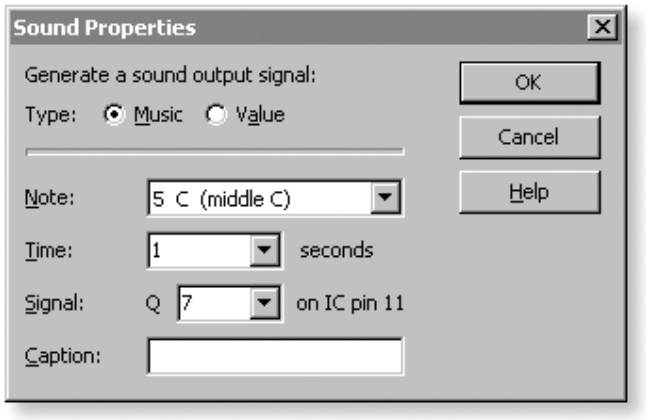
Making sounds or playing tunes

GENIE microcontrollers can make sounds and also play musical tunes.

Use the **SOUND** command to play a single note.

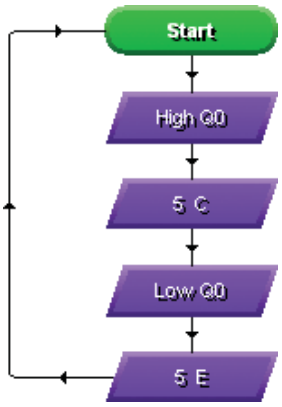
Use the **TUNE** command to play a whole musical tune.

To make a sound, you should connect up a sounder or loudspeaker to an output (**Q0** to **Q7**) and then use the SOUND command as follows:



This would play the note middle C for one second.

By playing two different notes (one after the other, as shown on the right), you can create an alarm. In this flowchart, output Q0 is also made high and low (to flash a light for example).



You can use the TUNE command to play a whole tune such as a mobile telephone ring tone (see the GENIE C08 jukebox kit to learn how you can play 2-channel polyphonic music).

Responding to digital signals

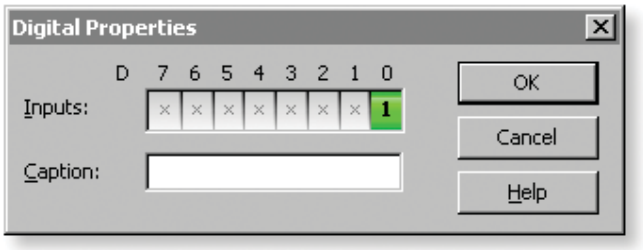
Some types of signal, such as push switches, can only be either on or off. These are known as **digital** signals.

Use the **DIGITAL** command to respond to a digital signals.

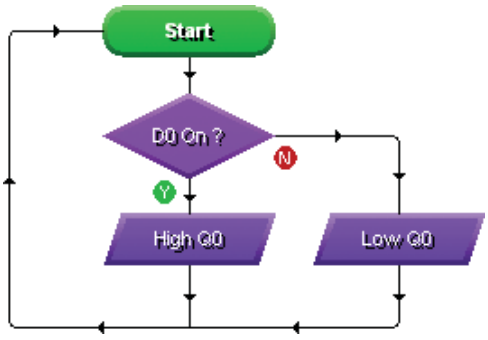
The DIGITAL command allows you to make a decision based on whether a digital signal is either on (high) or off (low).

When a digital signal is on, it has the value '**1**' whereas when it is off, it has the value '**0**'.

Double-click on the command to select which digital inputs you wish to check. GENIE will follow the '**Y**' (yes) path when the digital signal matches the chosen pattern, otherwise it will follow the '**N**' (no) path.



The above pattern will test if, for example, a push switch on digital input D0 is on (pressed). Similarly, you can see below how to make the output Q0 high whenever the switch is pressed:



Responding to analogue signals

Other types of signal, such as temperature or light, can be at a number of different levels. These are known as **analogue** signals.

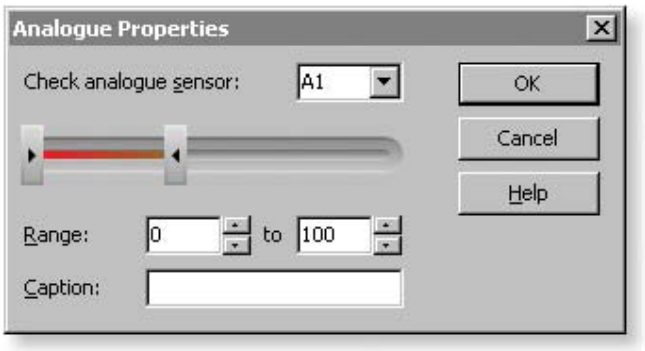
Use the **ANALOGUE** command to respond to analogue signals.

The ANALOGUE command allows you to check if a signal lies within a given range.

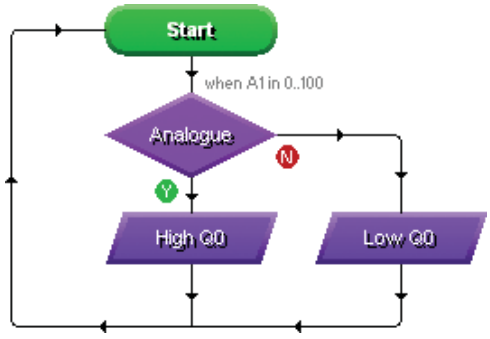
With GENIE, analogue levels can vary between **0** (the lowest level) and **255** (the highest).

Double-click on the command to select a sensor to check and a range. GENIE will follow the '**Y**' (yes) path when the signal is in range, otherwise it will follow the '**N**' (no) path.

For example, to test if a light sensor on analogue signal A1 is between 0 and 100, you should enter the following:



In a flowchart, this would look like:

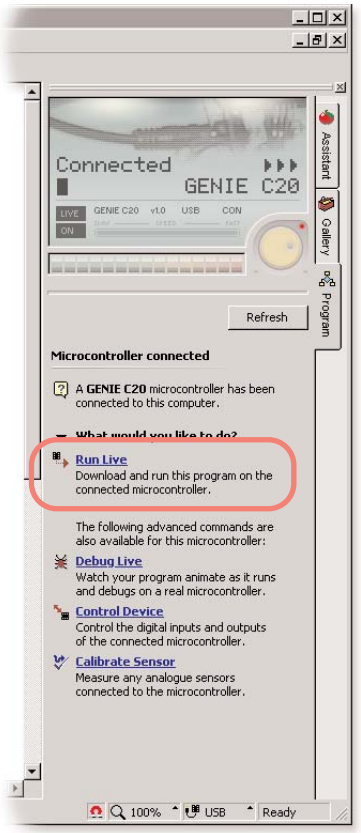


Bringing the GENIE to life 6

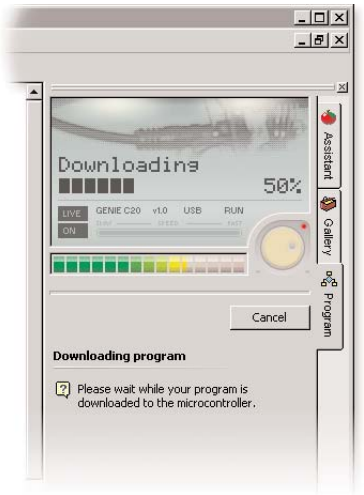
Once you have written your flowchart program, you need to store it on the GENIE chip. Here's how you do it:

1. Wire-up the built GENIE circuit board and connect up a suitable battery power supply.
2. Plug the GENIE cable into the download socket on the GENIE circuit board.
3. Once done, the **Program** panel in **Circuit Wizard** or **GENIE Design Studio** will then show a 'Connected' message (see picture a).
4. Click on the **Run Live** option. Your flowchart will be transferred onto the GENIE chip—this is known as **downloading** (see picture b).

(a)



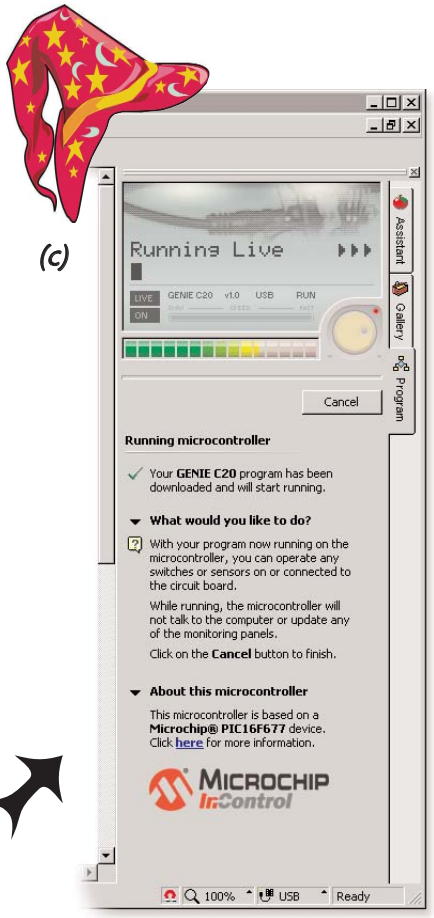
(b)



The green status LED on the project board will flash as the download takes place.

It tells you everything is OK!

(c)



As soon as the program has been downloaded you will see the above screen (c) and GENIE will start running your flowchart.

Your GENIE project is now ready to go! You can disconnect the cable and use your GENIE board away from the computer.

✓ Finished!

More information 7

The technical bit... it's only needed if you want to learn more!

This is the **circuit diagram**. It shows how all of the components in the circuit are connected. You can compare it to the layout of the components on the actual circuit board (shown below it).