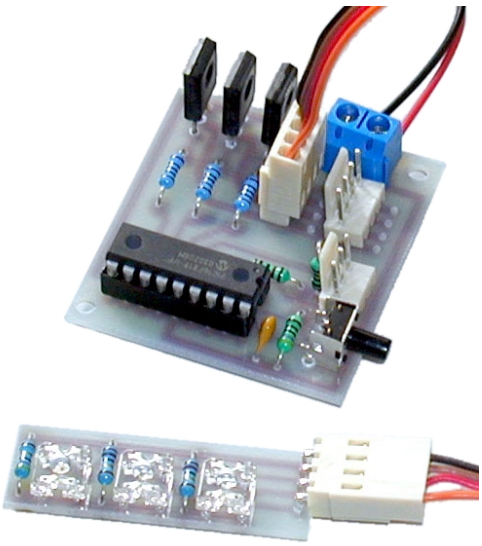
Build this tiny micro-controller driven lightshow



Micro-controller driven LED displays are popping up everywhere nowadays, from shop windows, to tiny belly-button raver lights. However, most of these have a few problems. Firstly, the cheap ones are usually just that—so cheap that they are basically a throw-away item.

Secondly, most of these lights are not programmable, so you are stuck with the basic program and sequence they are built with.

This kit allows you to build a high-quality, fully programmable light display capable of producing any colour you desire. What's more, it can drive not one set of LEDs, but up to four sets of LEDs on separate boards, making it a very versatile little device.

With careful programming, you can even program it with more than one sequence, and use the switch to flip between them!

The brain behind the colours

The brain of the circuit is the Picaxe18A pre-programmed microcontroller from Revolution Education in the UK. This company provides a range of microcontroller and micro-based boards and products, and one of those is the Picaxe series.

These consist of various Pic microcontrollers that have been programmed with a bootstrap program that allows them to be connected directly to a serial port on your PC without the need for special programmer boards. Just two resistors are required for the three-wire interface. This makes it possible to produce projects where the micro can be reprogrammed in-situ in seconds.

If you look at the circuit board, you will notice the three-pin connector and the resistors R1 and R2—they are all that is needed to connect the microcontroller to the serial port of a PC or other device. No other microcontroller is this simple to use. This reason, and the availability of a free basic interpreter for this range of micros, are why these micros were chosen for this and similar kits. They are simply easier to use and far cheaper than anything else on the market. However, they do have programming space and speed limitations, but in most cases, unless you are trying to sample or switch at radio frequencies or whatever, this generally doesn't cause problems

The circuit

As already mentioned, all of the hard work is done by the microcontroller, and there is not much else to the rest of the circuit. The micro drives three transistors, Q1 to Q3, using three of its output pins, via resistors R4 to R6. A fourth pin on the micro is used to monitor the state of the control switch SW2, and there is also a reset switch, SW1, in case the micro needs to be reset, which is very rare with these devices, but is ideal for restarting a light sequence from the beginning again.

The 4k7 resistors, R3 and R7, are used to tie the switches SW1 and SW2's inputs to V+ when the switches are not being pressed, rather than letting them float. Capacitor C1 provides decoupling of the power supply for the micro, and that's it!

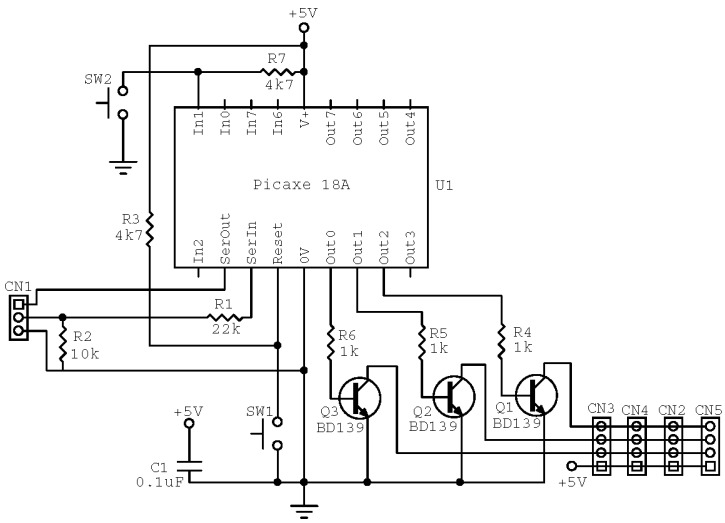
Satellite boards

The LEDs are mounted on one or more tiny (42 x 14mm) satellite boards that plug into the microcontroller board at points CN3 to CN6. These points are all paralleled, so it doesn't matter which ones you use. Also, this means that the respective LEDs on each board will run in sync—all reds will be in sync, all blues etc. The result is that you can have several satellite boards inside a computer case, in a room or whatever that all run together to produce the same effect in unison.

Of course, you don't have to use the satellite boards, but instead can use any device that is suitable to be driven from the 5 volt output of the controller board, such as small bulbs, relays (with appropriate protection diodes) or even other circuits. You could even drive higher voltage loads providing their grounds are commoned, but the microcontroller board must be driven from a voltage source not exceeding 6 volts.

Assembly

Well, being so simple, there isn't much to say here, other than make sure you get the microcontroller and transistors the correct way around, and be sure to use the supplied IC socket for the microcontroller.



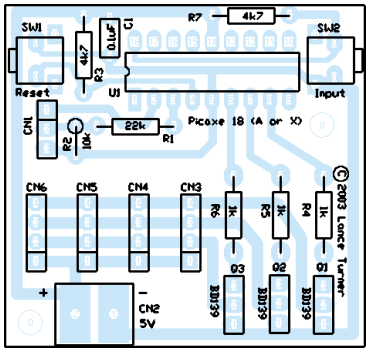
The circuit diagram for the Picaxe 18A controller board. Note that the satellite board is not shown due to its simplicity.

The satellite boards (which are not included in this kit, but are available sparately) are very simple–just use the right value resistors in the right places, and get the LEDs the right way around and in the right spots. The LEDs have a small bevel on one corner and this must line up with the bevel on the board overlay.

The interconnecting cables are simple enough–you can choose to have connectors on both ends, or hard wire the cable to the satellite board. If doing the latter, pass the cable ends through the respective holes in the satellite board before soldering into place–this acts to prevent the cable from breaking with repeated movement. To attach the header to the other end of the cable, do as follows:

Separate the four conductors for about 25mm along the cable and strip 5mm of insulation from the end of each one. Then fold the bare conductor back along the insulation, place in the crimp terminal and crimp with a suitable crimping tool. The ones used to terminate telephone crimp terminals work well, or if you are careful you can use a pair of long-nosed pliers. Just make sure the terminal is gripping the cable well. When fitting the terminated cable ends to the plastic header, make sure you get them the right way around, so that the +5 volt line is in the correct place, otherwise the LEDs will not flash correctly.

Once everything is in place, apply a **regulated** (ie, from a three or four cell battery pack, the 5 volt line in a computer power supply or a regulated plugpack) DC voltage of up to 6 volts and press the input switch. The LEDs should start going through an animated sequence (the microcontroller is supplied with a sequencing program already programmed in). If nothing happens, check your work, making sure there are no shorts between tracks or pads anywhere, and the micro is the correct way around. Also check that the input pin on the micro changes from 5 volts (or whatever the supply voltage is) to 0 volts when you press SW2. Another test is to measure the voltages on the output pins. If they are changing, but the LEDs are not glowing, then the LEDs are most likely in the wrong way around or the wiring of the cables is incorrect.



The layout of the circuit board, reproduced approximately full size. It is small enough to use as the basis for a bike light, party light, strobe or anything else you can think up!

Programming

If you get bored with the pre-programmed fade sequence, you can program your micro with any sequence that will fit into the 256 byte program space. A number of sample programs are available for download from my website at www.alphalink.com.au/~spod/kit_examples/ Programming cables are available from my website also. However, you can make your own by using an old 9-pin serial cable (an old mouse is ideal for this) and a 3-pin header socket. Instructions for making the cable, as well as the programming software, are available on the Revolution Education website at www.rev-ed.co.uk

Parts list

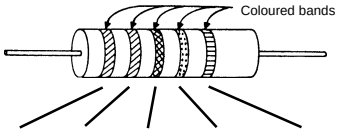
R1 ..... 22k
R2 ..... 10k
R3, R7 ..... 4k7
R4-R6 ..... 1k
C1 ..... 0.1uF ceramic
Q1-Q3 ..... BD139
U1 ..... Picaxe18A
SW1, SW2 ..... Pushbutton switch
CN1 ..... 3 way header
CN2 ..... 2 way terminal block
CN3-CN6 ..... 4 way header
SOC1 ..... IC socket

Identifying the parts of your Picaxe controller kit

The following guide should help you to identify the parts and assemble it successfully.

Resistors

The coloured bands represent numbers and multipliers as shown in the table. Some resistors have four bands (two digits, a multiplier band and a tolerance band) while some resistors have five bands. Five-band resistors are read in the same manner as four-band resistors, except that the first three bands are digits, the fourth a multiplier and the fifth the tolerance band.



Colour	Hundreds	Tens	Units	Multiplier	Tolerance
Black	0	0	0	1	20%
Brown	1	1	1	10	1%
Red	2	2	2	100	2%
Orange	3	3	3	1000	
Yellow	4	4	4	10,000	
Green	5	5	5	100,000	
Blue	6	6	6	1,000,000	
Violet	7	7	7		
Grey	8	8	8		
White	9	9	9		
Gold				0.1	5%
Silver				0.01	10%

The Picaxe18A

This is the 18 pin device. Note that it must be installed the correct way around. Pin 1 is marked with a small dot, and the pin 1 end of the chip will have a semicircular notch or mark. The IC socket also has this notch, so make sure it is installed the correct way around also, as this notch is used to indicate device polarity.