

# Build a multi-colour display

There are a lot of times when you may want to indicate the status of a number of inputs or devices, and would like to have more than just an on or off indicator for each one. This kit allows you to display indication for up to 16 channels.

This kit makes use of a surplus (removed from new equipment) display panel that features 80 bi-colour (red/green) LEDs. The LEDs are wired in groups of five in common anode configuration. This gives you 16 individual groups that can be either red, green, or both. The display measures 156mm long by 23mm high by 7mm thick, not including the connector on the back.

If you so desire, the diffuser over the LEDs can be removed if you are careful. It is glued into place, so start by taking off the diffuser sheet, which just peels off. Then, break the diffuser surround off piece by piece, being careful not to damage the LEDs.

The display is not much use on its own, as its connector uses the tiny pin spacing of just 1mm! However, the kit comes with a circuit board that the display can be plugged into. The board includes provision for a LED driver IC (ST M5450 or M5451, or the Micrel equivalents MM5450 and MM5451), 5 volt power supply, and two sizes of Pic/Picaxe ICs—8 and 18 pin devices.

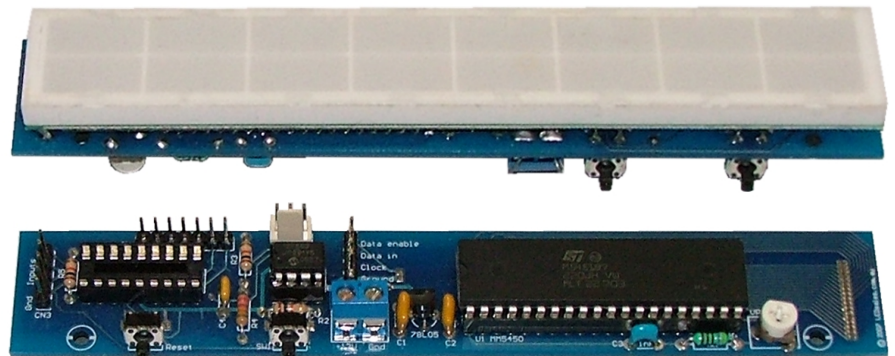
Using an 8 pin device, you can make the display do all sorts of things, such as changing colours, flashing, etc. Depending on the IC you use, you will be able to do more complex displays if you have the programming skill.

The 18 pin IC allows you to also monitor up to four inputs. This allows you to read four data lines from another device (such as a 16 to 4 line encoder), so you can actually monitor 16 digital channels.

Of course, you can choose to use your own drive circuitry, just using the PCB to allow easier connection to the display panel.

## The driver IC

The LED display is driven by a LED driver IC, the M5451. This IC accepts serial data over a 2-wire interface, and once the appropriate length of data



Here you can see both the front and back of the finished kit.

stream has been received, it places that data on the output port. In fact, the IC uses open collector outputs, so the data is actually inverted. So, a '1' data bit causes the corresponding output to go low, turning on that segment of the display.

The IC actually has 35 outputs (we only use 32 for this project of course), so you need to clock in a full 36 bit data set (there is also a single start bit, which must always be a '1').

The IC also features built-in adjustable current limiting, eliminating the need for using any resistors with the display. However, as the power dissipation must be limited to prevent overheating of the IC, care has to be taken to match the power supply voltage to the LED forward voltage. In our situation, the combined  $V_f$  of the 5 LEDs in each string is around 10 volts. This means the IC only has to dissipate  $2 \times 32 \times 0.015 = 0.96$  watts maximum when all LEDs are lit and current control is turned to maximum (the IC limits current to no more than 15mA).

LED current is set by the 100k trimpot, VR1, and R1, which limits the minimum resistance of the trimpot. The top end of VR1 is connected to +5 volts, and the current flowing into pin 19 of the IC through VR1/R1 determines LED current. LED current is 20 times the current into pin 19. So, if 500uA flows into pin 19, then the LED current will be 10mA.

## The circuit

There is actually not a lot to the circuit, as can be seen from the schematic. The LED display connects directly to the driver IC. There is also

a 5 volt regulator (a 78L05 or equivalent) and of course, the Picaxe and its associated components, such as the programming header and resistors, the pushbutton switches etc. Provision is made for an 18 pin Pic/Picaxe, but the standard kit comes with the 8 pin device as an option.

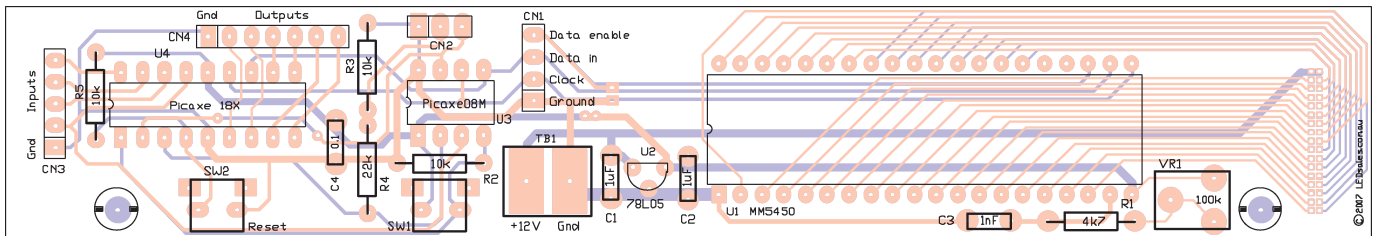
There is also a reset switch for the 18 pin Picaxe, as well as header connectors for the extra IO pins on the 18 pin IC. Note that the two output pins that drive the MM5451 clock/data lines from both Picaxe positions are connected, so you should never have Picaxe ICs in both 8 and 18 pin sockets at the same time! Also note that the spare input pin on the 8 pin Picaxe is also connected to one of the input header pins.

## Talking to the M5451

So just what are the requirements for talking to the LED driver IC? Its basic interface is very simple—you send it a single high start bit, followed by 35 data bits, which can obviously be either high or low, depending on what you want the outputs to be. The final 36th bit causes the data to be latched to the output buffers, thus turning the LEDs on or off.

While the smaller Picaxe ICs don't have neat protocol commands for sending SPI (the type of serial communications used) data, a simple 'bit banger' program does the job nicely. An example of a simple program, for the Picaxe 08M, to set all of the outputs high can be seen opposite.

Any combination can be achieved by changing whether you use a high or a low command on the Output 2 pin. In-



The board overlay can be seen here. The top copper layer is in red, the bottom layer in blue.

ciently, the first 16 bits of the data stream (after the start bit) control the red LEDs, the second 16 bits control the green LEDs.

One quirk of this IC is that, when you first power up the circuit, before you send the first start bit, you should send it a single clock cycle with the data line held low. The IC ignores clock cycles if the data line is low until it receives the first start bit, but this single clock cycle readies the chip to receive data. Not doing this results in a confused output for the first few sets of

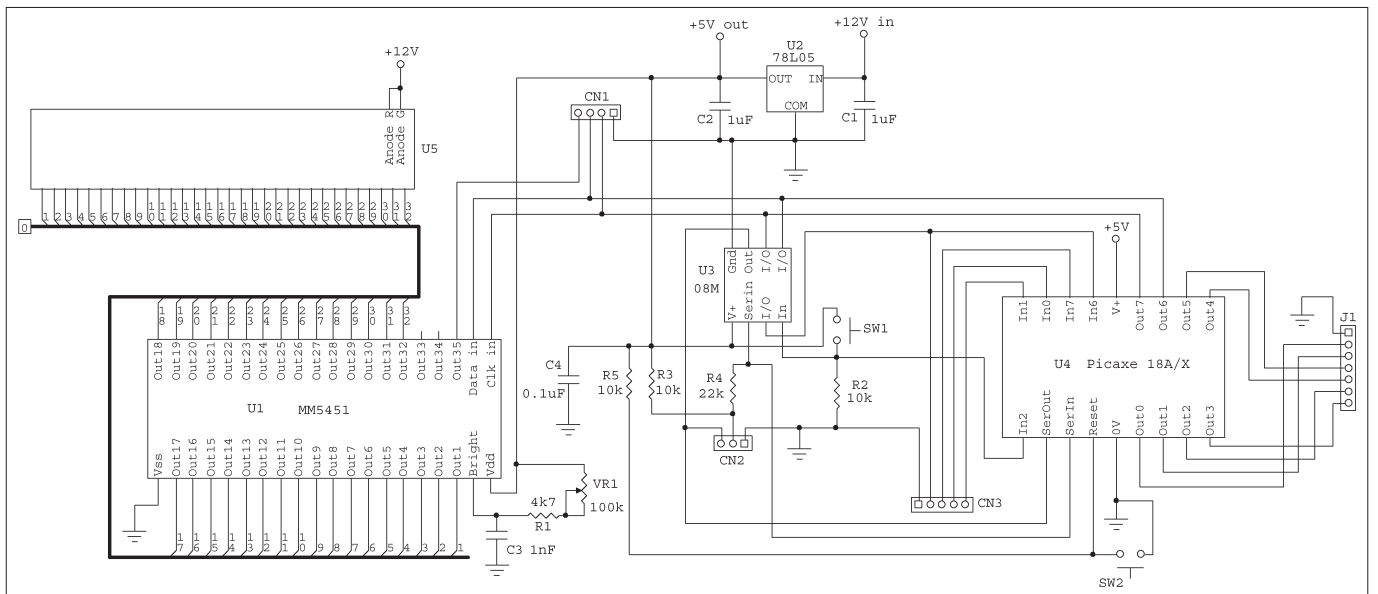
data sent to the IC as the data gets one bit behind, and it only catches up when you send a set of 35 low data bits.

Code examples will be available on the LEDsales website, and the Picaxe 08M comes preprogrammed to allow you to flip between the following states with each button press: Red LEDs on; Green LEDs on; Both colours on (gives orange); All LEDs off. For more information on the M5451 IC, just download a datasheet from websites such as [www.datasheetarchive.com](http://www.datasheetarchive.com)

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Sample program

for temploop=1 to 36
  high 2
  pause 1
  high 1
  pause 1
  low 1
  pause 1
next temploop
  
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The schematic for the display kit.

## Parts list

Part #	Description		
U1	MM5451	VR1	100k trimpot
U2	78L05	SW1, SW2	Pushbutton switches
U3 (optional)	Picaxe08M or 8 pin PIC	CN1	4-way male header
U4 (optional)	Picaxe18X or 18 pin PIC	CN2	3-way male polarised header
R1	4k7 resistor	CN3	5-way male header
R2, R3, R5	10k resistor	CN4	7-way male header
R4	22k resistor	SOC1	8 pin IC socket
C1, C2	1uF mono ceramic	SOC2	40 pin IC socket
C3	1nF mono ceramic	TB1	2 way term block
C4	0.1uF mono ceramic	DISP1	Red/green backlight module