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Simplifying Electricity

PICmicro getting started guide
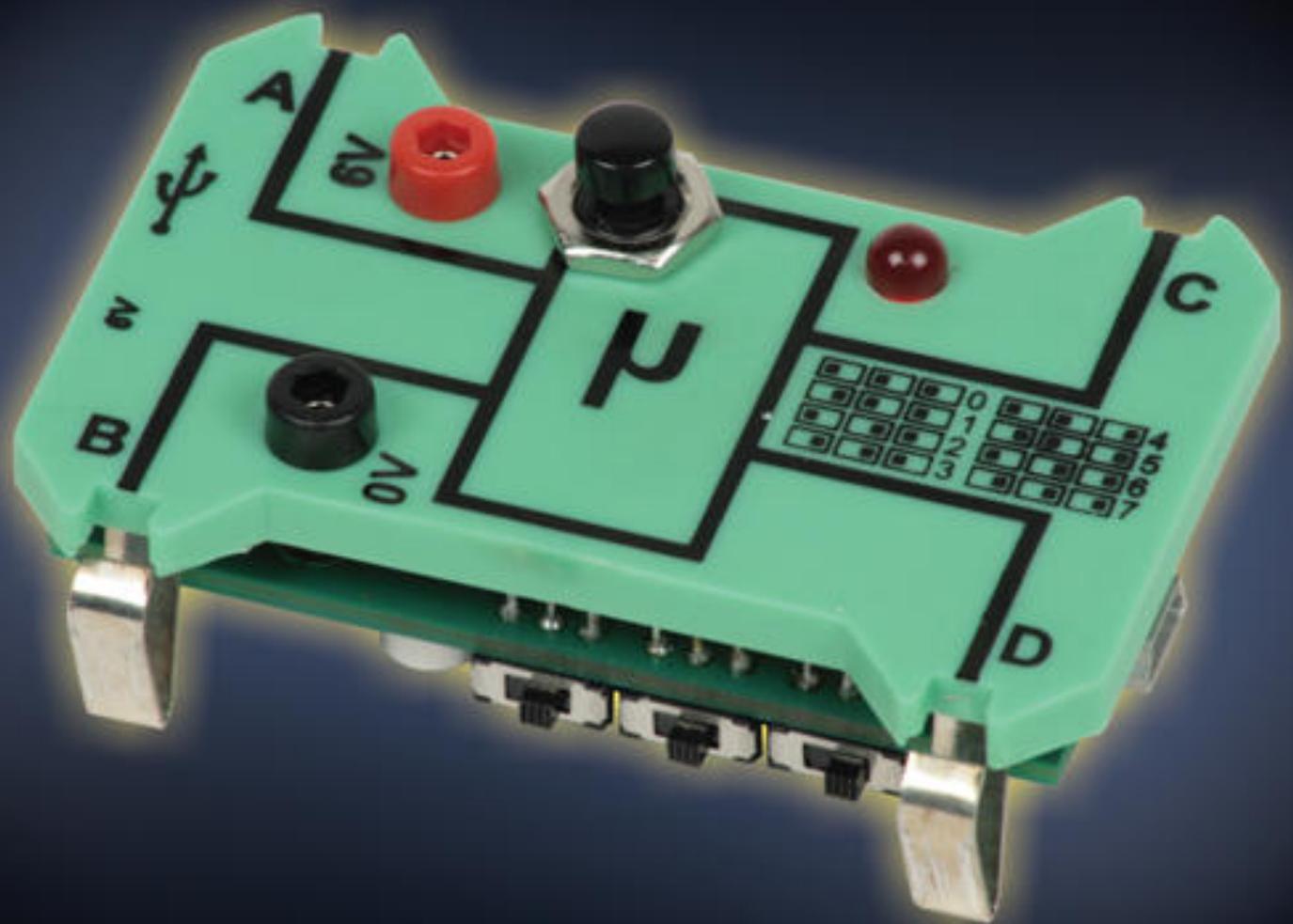
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Locktronics PICmicro getting started guide

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What you need	Locktronics PICmicro getting started guide

What you need to follow the examples in this document:

1. **The Locktronics microcontroller carrier and USB cable:**

    This uses a PIC 18F2455 microcontroller. It behaves just like a normal microcontroller - but when you plug the USB lead in and press the reset switch you can send a new program to the device.

    p2b

2. **A Locktronics baseboard, and the following component carriers:**
    - 1 x power-supply carrier
    - 2 x slide switch carriers
    - 2 x LED (5V) carriers
    - 1 x 10k variable resistor carrier
    - 2 x 10k resistor carriers

3. **A DC Power supply:**
    The mains-powered DC power supply can be adjusted to give output voltages of 3V, 4.5V, 6V, 7.5V, 9V or 13.5V, with currents typically up to 1A.

    The voltage is changed by turning the selector dial on the back of the supply until the arrow points to the required voltage. The Locktronics PICmicro device must use the 6V supply setting.

    p2a
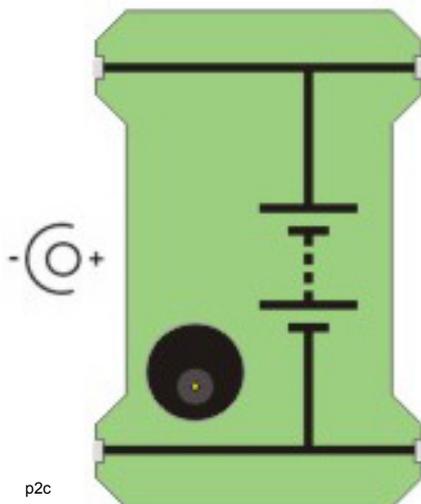
    The Locktronics DC power supply carrier requires a polarity of a positive inner and negative outer.

    p2c

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<table>
<tr><td>

Accessing the built in programs

</td><td>

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</td></tr>
</table>

Using the built-in programs:

The Locktronics microcontroller comes with eight programs already written into its memory. (Actually, this is **one** program which starts with a menu that allows you to select from what amounts to eight programs.)

Reset switch

Selector switches

The programs are numbered from 0 to 7 (rather than from 1 to 8) to correspond with the positions of the three selector switches. The table opposite makes this clearer:

The built-in programs are:

 Program 0 - Burglar alarm (3-inputAND gate)

 Program 1 - The bank problem (Programmable logic gate)

 Program 2 - Fridge alarm (Thermistor control)

 Program 3 - Keep cool! (Motor speed control)

 Program 4 - Car alarm (Monostable and Astable functions)

 Program 5 - Decorative lights (Sequence generator)

 Program 6 - General purpose timer

 Program 7 - General purpose signal generator.
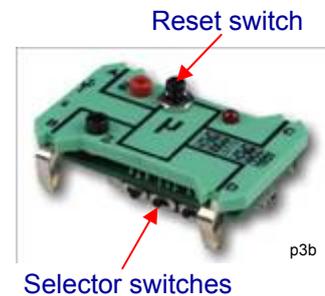
To select one of these programs:

- set the switches to the correct position for the program you require, (using the table as a guide);
- connect a 6V power supply to the power sockets on the carrier, as shown in the picture below;
- press the Reset switch.
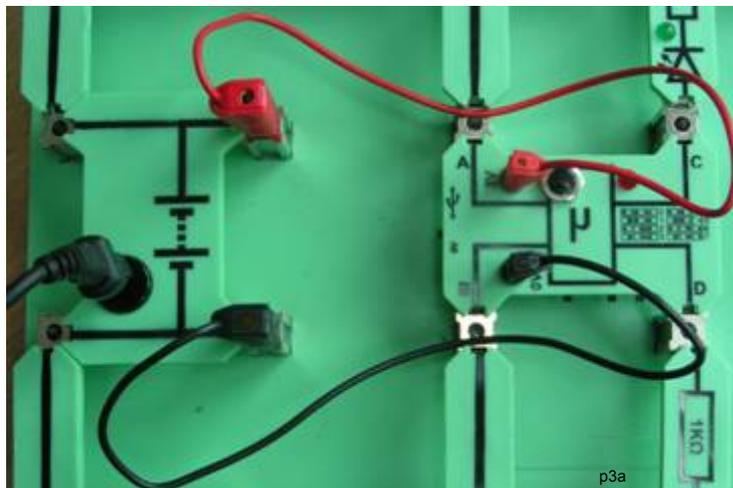
How to connect the power supply to the Locktronics microcontroller carrier.

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Developing your own programs

Create your own programs:

You can create your own programs, download them to the Locktronics microcontroller carrier, and use them in a circuit. You will need Flowcode (v3.6, v4.2 or later) loaded onto your computer. This is used to design your PIC program, and simulate it on-screen. There is a free version of the program that you can use to develop and download programs. The free version is limited to 50 flowchart icons.

When the program does what you want, you download the program to the Locktronics microcontroller, via a USB cable.

Flowcode converts the program into code for the PIC microcontroller on the Locktronics microcontroller carrier, which is pre-programmed with software that allows you to send a new program via USB. You will find detailed instructions on how to install Flowcode in the Flowcode 'Getting Started' guide at www.matrixmultimedia.com. Note that if you want to use the PIC for the Microcontrolelr systems course again you will need to reload the original program.
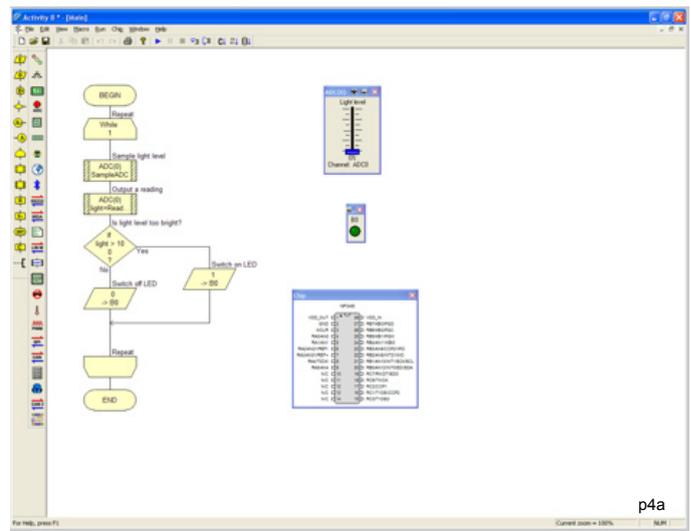
p4a

The PIC microcontroller:

Here is the pin-out for the 28 pin 18F2455 microcontroller. The Locktronics microcontroller uses only four of the Input / Output terminals on the PIC chip, marked as A, B, C and D on the pinout. Any of these can be configured to act as an input, to transfer information from sensors in the outside world to the microcontroller, or to act as an output, and transfer the results of a program from the microprocessor to actuators in the outside world.

p4b
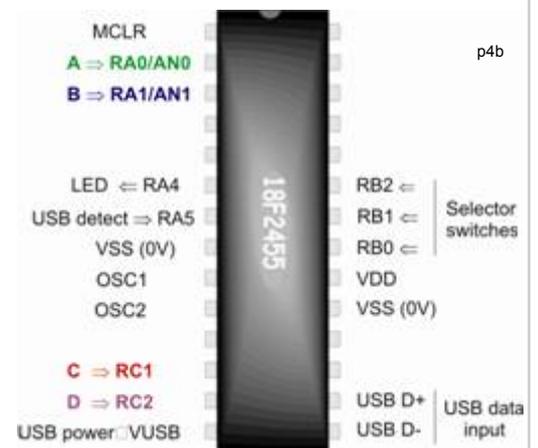
However, the Locktronics carrier is designed with certain functions in mind:

- Terminals A and B are connected to two of the analogue-capable inputs, AN0 and AN1 on Port A. The built-in analogue-to-digital converter (ADC) generates a digital signal from the analogue voltage applied to these inputs.

- Terminals C and D can be used to send pulse-width modulated (PWM) signals (alternating rapidly between 'on' and 'off',) to devices such as motors and bulbs, to control their speed / brightness, respectively.

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Using Flowcode

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Using Flowcode:

You will find step-by-step instructions on how to use Flowcode in the Flowcode 'Getting Started' guide at www.matrixmultimedia.com

Your first program:

We start with a simple program, to light a LED when a switch is pressed.

- Open the Flowcode application.
- Click on the 'New' program icon, at the left-hand end of the toolbar.
- The 'Choose a Target' dialogue box opens.
- Scroll down the list of PIC targets and select 'LocktronicsPIC'.
- V3 components can be found in the component toolbar.
- V4 components can be found under the common toolbar item.

p5a

p5b

V3

p5e

V4

p5c
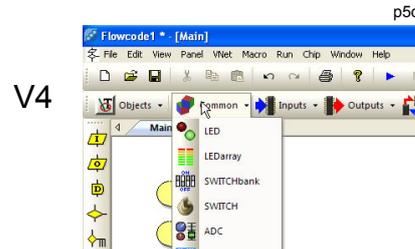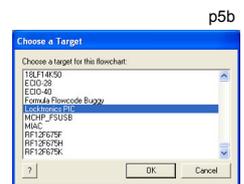
Set up the components in the panel:

1. The switch:
- Add a switch component to the program.
- Right click the switch component and choose 'component connections' from the pop up menu.
- Use this to connect the switch to PORT A bit 0, (which is terminal A on the Locktronics carrier.)

p5f
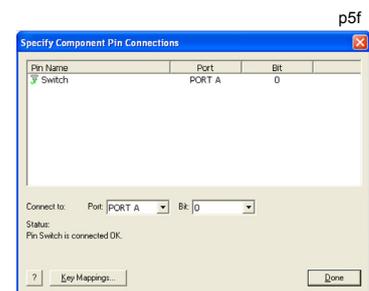
2. The LED:
- Add a LED component to the program.
- Right click the LED component and choose 'component connections' from the pop up menu.
- Use this to connect the LED to PORT C bit 1 (terminal C on the Locktronics carrier.)

p5d

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Using Flowcode

Drag a loop icon onto the program panel between the Begin and End icons. Then drag an input icon below the loop icon and an output icon below that.

p6b

Configuring the icons:

- Click on 'Edit' in the menu at the top of the Flowcode window.
- Click on 'Variables...' to open the 'Variable Manager' dialogue box.
- Click on 'Add New Variable...'. A new dialogue box opens.
- Type in the name *input* for the new variable, and accept the 'Byte' type. Click 'OK', and close the 'Variable Manager' box.
- Double-click on each of the icons in turn to open the 'Properties' dialogue boxes.
- Configure the icons as follows:
- Save the Flowcode program.

Display name	Repeat
Loop while	1
Test Loop at the	Start

Display name	Read the switch
Variable	input
Port	PORT A
Input from	Single Bit 0

Display name	Make it control the LED
Variable	input
Port	PORT C
Output to	Single Bit 1

p6a

BEGIN
Repeat
While 1
Read the switch
A0 -> input
Make it control the LED
input -> C1
Repeat
END
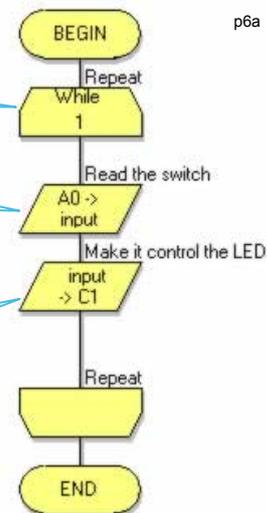
Simulate the program:

- Click on 'Run' in the menu, and select the 'Step Into' option.
- The 'Begin' icon has a red box around it. Each time you press the F8 key, the red box moves down to the next icon. In this way, the program is simulated step-by-step.
- When the red box returns to the top of the 'While' loop, click on the switch image to switch it on.
- Continue pressing the F8 key to see the effect of this change.
- Then click on the switch again to switch it off, and see what effect this has when you simulate the program.
- Stop the simulation using either the blue square on the Tools menu, or the 'Stop' option in the 'Run' menu.

Compile the program:

- Connect the Locktronics microcontroller to the computer using the USB lead.
- Click on 'Chip' in the menu.
- Select the 'Compile to chip...' option. First of all, this converts the program into the 'C' programming language, and from there into 'Assembler'. Finally it produces the binary code needed by the PIC microcontroller, and passes this via the USB lead to the chip.
- The program can now be tested on the Locktronics baseboard.

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Using Flowcode

Build the circuit:

The picture shows one way to build the circuit. Notice the red and black leads that connect the microcontroller to the power supply. The switch is connected to the 0V power rail by a 10kΩ resistor, (though the actual value is not important - any value of a few kΩ will do.)
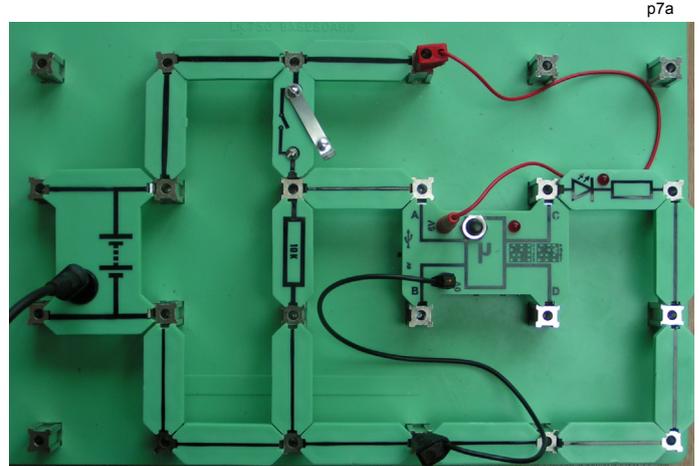
Try this:

Modify the program so that the switch lights two LEDs, connected to Port C bit 1 (terminal C) and Port C bit 2 (terminal D).

A second program:

This time, your program will make the LED flash.
The Flowcode program is shown on the right.
Some of the icon configuration is the same as last time and is not listed below. The new icons are configured in the same way, using the details given below:

Display name	Is it on?
If:	input=1

Display name	Switch LED on
Value	1
Port	PORT C
Output to	Single Bit 1

Display name	Wait 1 sec
Delay value	1 second

Display name	Switch LED off
Value	0
Port	PORT C
Output to	Single Bit 1
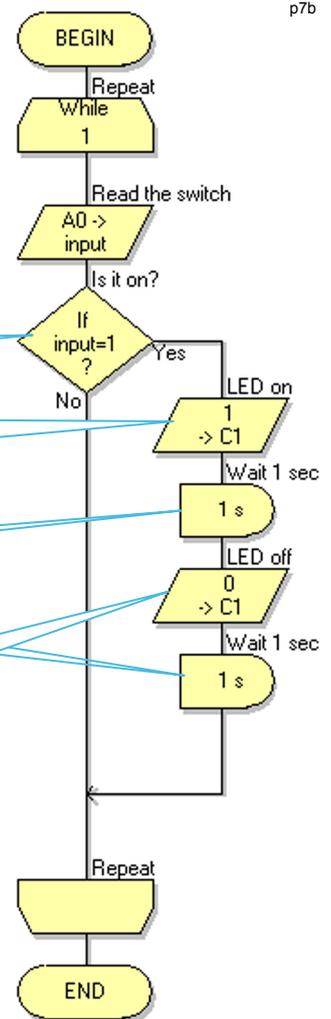
Simulate and compile the program in the same way as before.
The circuit layout is exactly the same.

Try this:
Modify the program so that:
- the LED flashes twice as fast;
- the LED turns on and stays on for 5 seconds when the switch is closed, (but does not flash.)

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Using Flowcode

A third program:

The aim is to make the microcontroller behave as an AND gate, and so output a logic 1 signal (and light the LED) only when both switch A AND switch B are closed.

The Flowcode program is shown on the right. You need to create three new variables, called *switchA*, *switchB* and *result*. Look back at page 6 if you can't remember how to do this.

The new icons are configured in the same way as before.
The text boxes that follow should help with the configuration:

Display name	Read switch A
Variable	switchA
Port	PORT A
Input from	Single Bit 0

Display name	Read switch B
Variable	switchB
Port	PORT A
Input from	Single Bit 1

Display name	Check for AND
Calculation	result = switchA AND switchB

Display name	Output
Variable	result
Port	PORT C
Output to	Single Bit 1
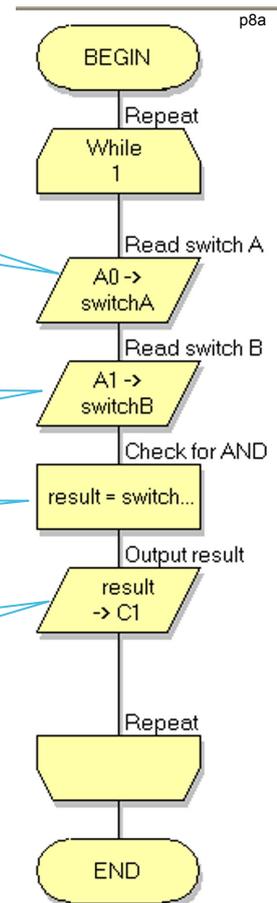
Simulate and compile the program in the same way as before.

The circuit layout needs a second switch unit (i.e. switch and 10kΩ resistor,) with the junction between them connected to terminal B (Port A bit 1.) One way to do this is shown in the picture.
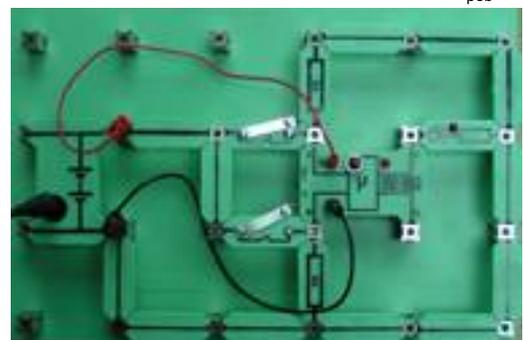
Try this:

Modify the program so that:
- the microcontroller behaves as an OR gate, which lights the LED when either switch A OR switch B is closed;
- the microcontroller behaves as:
    - a NOR gate, which lights the LED when neither switch A NOR switch B is closed;
    - a NAND gate, which lights the LED until both switch A and switch B are closed.

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Using Flowcode

Other programming issues:

Flowcode can control a range of devices more complex than simple switches and LEDs.

In version 4 these are grouped under the tabs labelled 'Common', 'Peripheral' etc. They are added to the Flowcode program in the same way as switches and LEDs by clicking on their name. IN version 3 the components are all listed in the component toolbar.

The Flowcode program provides some built-in routines, called Component Macros, that control these devices.

For example, open a new Flowcode program, in the usual way, directed at the Locktronics PIC target. Add an ADC component to the program like you did previously for the LED and Switch components.

p9a

Drag a Component Macro icon into the gap between BEGIN and END, and double-click on it. A Properties dialogue box like the one shown opens. It lists a number of macros which can be used to control the device. In the case of the ADC component, these include sampling the analogue channel as a byte, sampling the analogue channel as a integer, sampling the analogue channel as a floating point voltage or sampling the analogue channel as a string voltage.
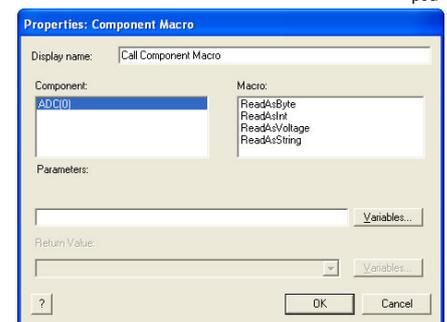
After choosing one of the component macros you may have to supply parameter and or return values. Parameters are information that is passed to the hardware macro and return values are information passed from the component macro back to your program. In the case of the ADC component there is only a return value so here you would reference a variable to store the analogue reading.

Experiment with a range of devices and their Component Macros to see what is possible.

The MatrixMultimedia website (www.matrixmultimedia.com) offers a wide variety of sample programs which you can download and investigate. Click on 'Flowcode' in the 'Products' box on the Home page, and then look at 'Flowcode V3 Examples' or 'Flowcode V4 Examples' depending on your version in the 'Flowcode Help and Support' section.

Good luck with the PICmicro course!

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Driver installation procedure

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Installing device drivers onto Windows Vista or Windows 7

Drivers are available on the Matrix ELSAM CD Rom or at www.matrixmultimedia.com

1. Set power switch to "USB"
2. Insert USB cable
3. Follow any onscreen instructions

Installing device drivers onto Windows XP
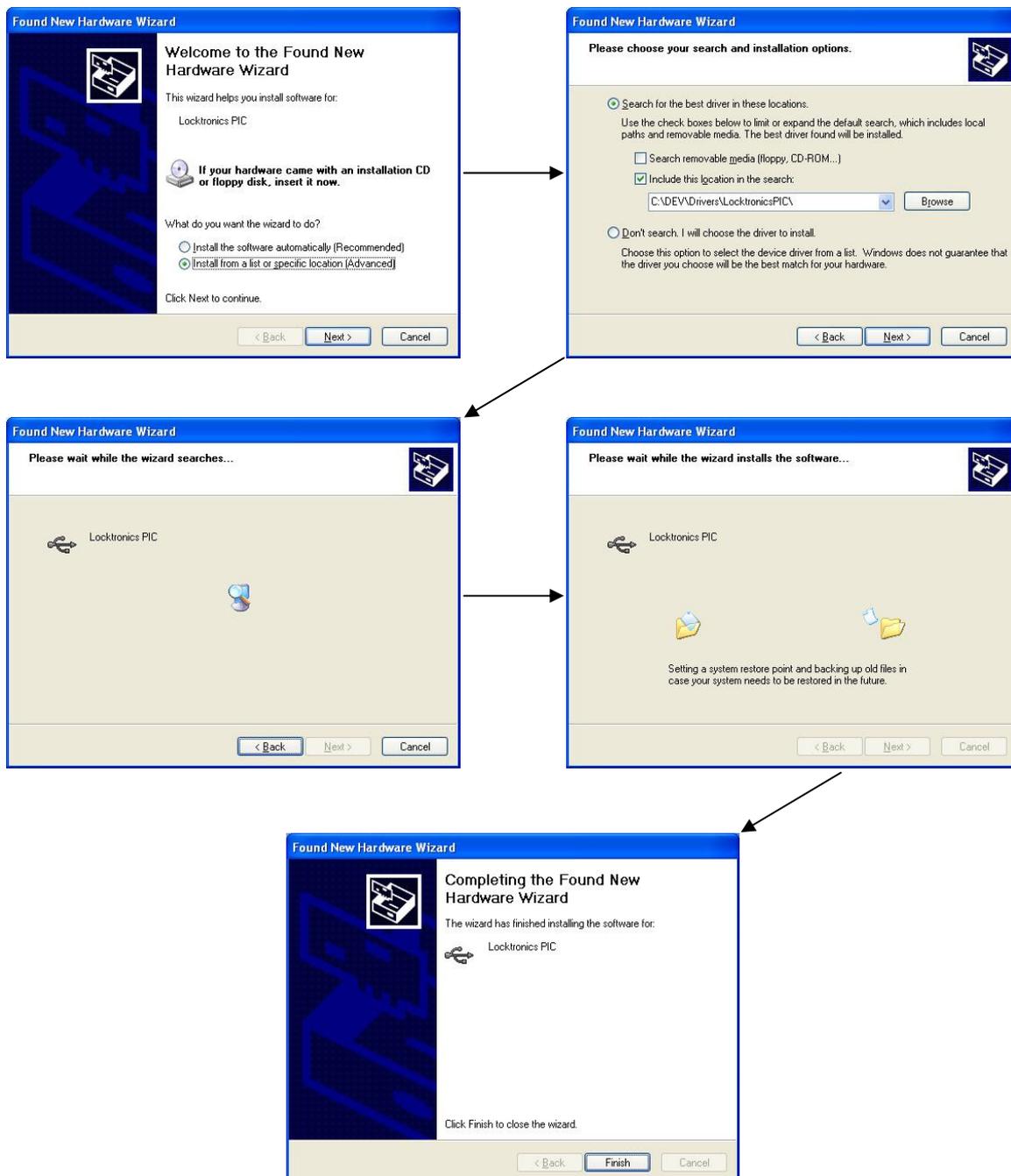
Device specification

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Locktronics PIC features and details

PICmicro
The PICmicro device used onboard the PICmicro board is a PIC18F2455 USB enabled microcontroller. The PIC uses a 4MHz crystal to drive the onboard phase locked loop oscillator, which supplies the PICmicro device with a fixed clock speed of 48MHz.

Voltage Supply
The voltage supply is either taken directly from the 5V USB or can also be provided by supplying the on-board 2mm sockets with 6V. The switch SW5 is used to switch between power sources.

USB
The USB circuitry is used to reprogram the device but can also be accessed via the users source code. To reprogram the device load the LocktronicsProg software, ensure the PICmicro board is powered up and connected to the USB and then press the reset button on the carrier.

Program selection switches
The program selection switches act as a simple way to switch between programs or behaviors of the board.

Locktronics PIC Carrier Schematic
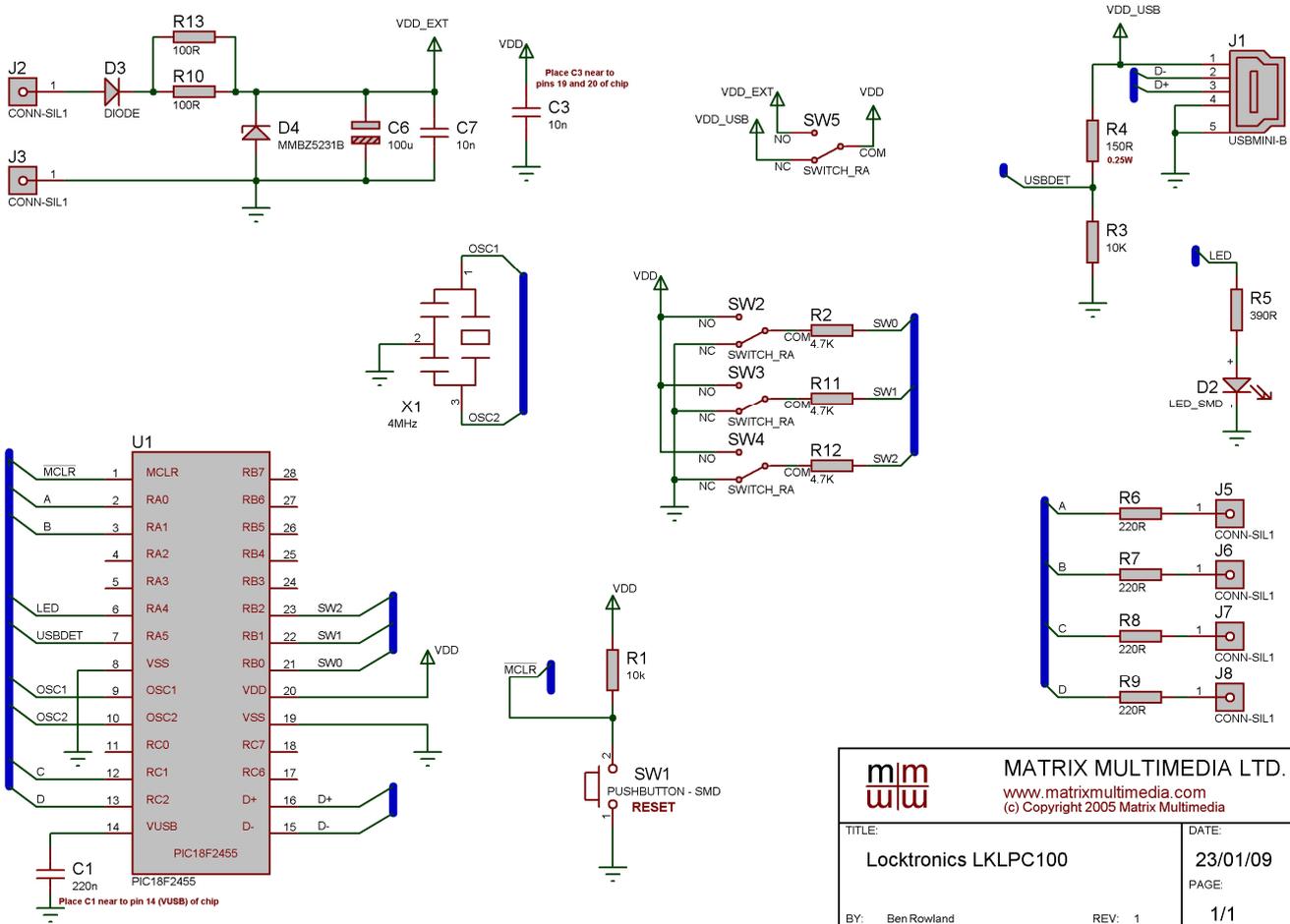
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Locktronics LKLPC100	23/01/09
	PAGE:
BY: Ben Rowland REV: 1	1/1