



# Colour MMBasic on the UBW32 Board Implementation Manual

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For updates to this manual and more information on MMBasic for the UBW32  
go to <http://geoffg.net/ubw32.html>

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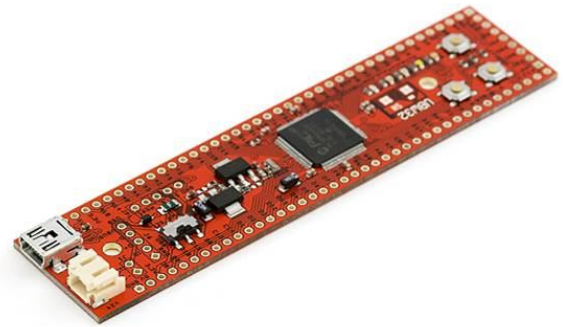
# UBW32 and Colour MMBasic

This is the user manual describing the technical details of running Colour MMBasic on the UBW32 experimenter board.

For details of the language download the MMBasic Language Manual from <http://geoffg.net/maximate.html>

The UB32 is a small board holding a PIC32 microcontroller from Microchip. Almost all of the connections to the microcontroller are brought out as solder pads on the edge of the board making it easy to use the board as a high performance embedded controller.

UBW32 board can be purchased from <http://sparkfun.com>.



## MMBasic

MMBasic is a full featured BASIC interpreter with floating point and string variables, long variable names, arrays of floats or strings with multiple dimensions, extensive string handling and full file I/O features.

MMBasic runs on the UBW32 and using the USB interface (or Colour VGA monitor and keyboard) you edit and test your program on the UBW32. When you are ready you can save the program to the internal flash and it will be automatically run whenever power is applied. This makes a complete embedded computer running a high level language.

Features of Colour MMBasic on the UBW32 include:

- Colour VGA output. 480x432 pixels with eight colours (**black**, **red**, **green**, **blue**, **cyan**, **yellow**, **purple** and white). 240x216 pixels with eight colours high performance mode)
- Standard PS2 style keyboard input.
- Stereo audio with support for playing MOD music files and sound effects. Can also be used as a 2 channel PWM analog output.
- Battery backed real time clock (optional).
- 40 external I/O lines which can be configured as analog inputs, digital inputs/outputs, frequency measurement, etc.
- SD card support with capacities of up to 32GB for storing programs and files.
- USB for connecting to a personal computer (Windows, Mac or Linux) as a terminal or for file transfer.
- Extensive communications protocols including Serial, I<sup>2</sup>C, SPI and 1-wire.
- Graphic capability includes selectable fonts, user designed fonts, drawing lines, circles, squares and control over any pixel with any colour.
- Firmware upgrades via USB using a standard bootloader.
- Full featured BASIC interpreter and operating system. Instant on, ready for you to type in and test your programs.

For details of the UBW32 go to: [www.schmalzhaus.com/UBW32](http://www.schmalzhaus.com/UBW32)

Further resources can be found at: [sparkfun.com/products/9713](http://sparkfun.com/products/9713)

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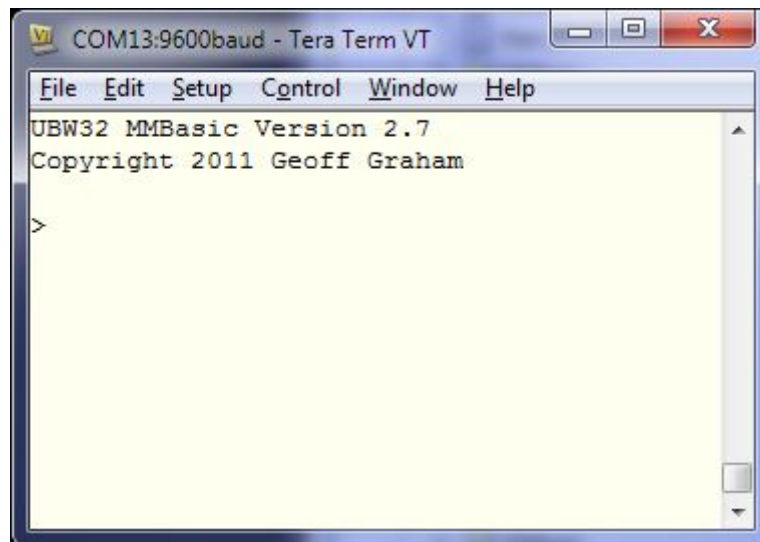
The compiled object code (the .hex file) is free software: you can use or redistribute it as you please.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

# Quick Start

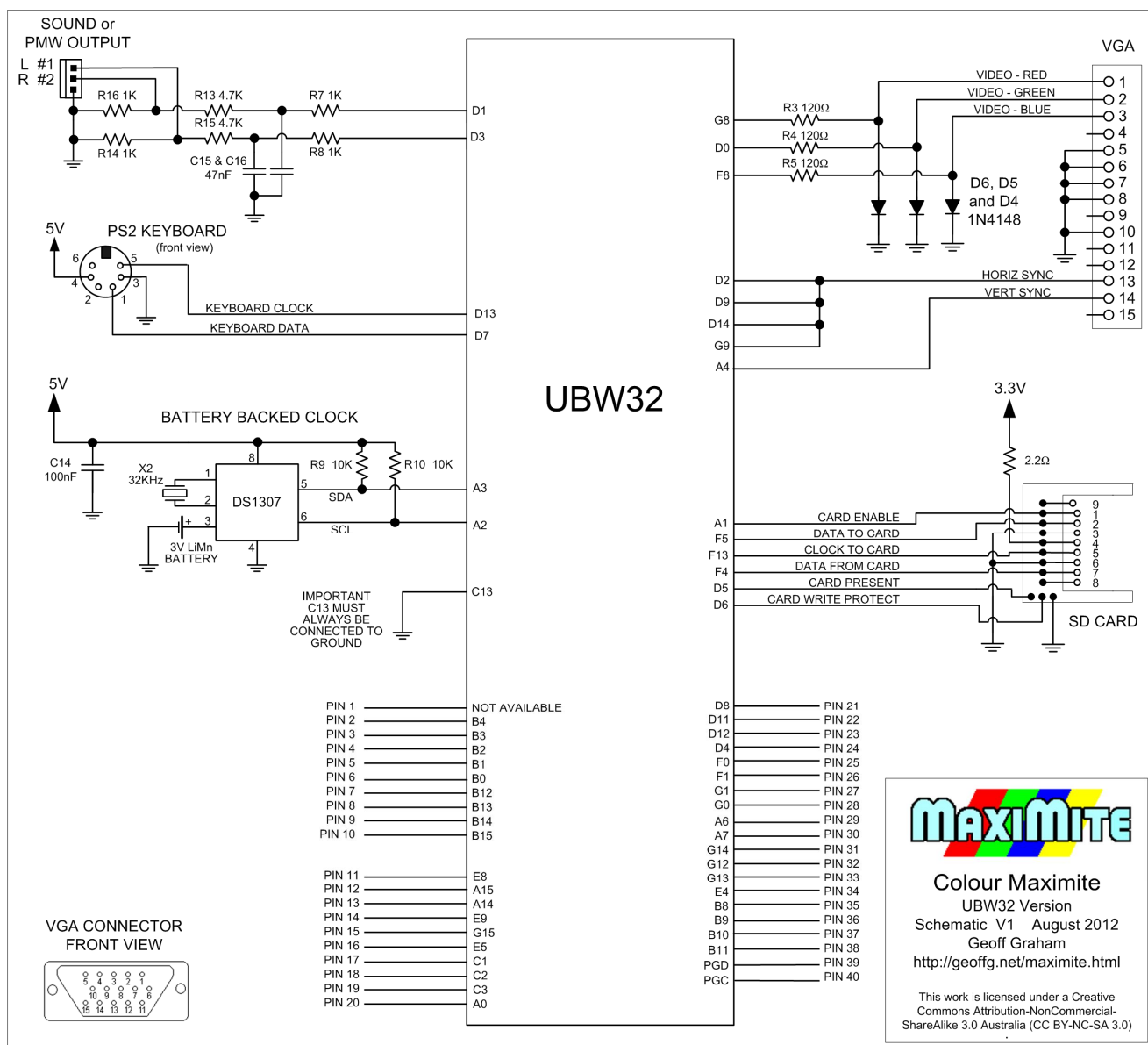
These instructions will get the UBW32 running Colour MMBasic and connected to your PC via a virtual serial port over USB. Using USB you can enter and run BASIC programs and get a good feel for MMBBasic. Later, if you want to, you experiment with a more complicated setup by connecting a keyboard and Colour VGA monitor.

- Download the current version of Colour MMBasic and the MMBasic Language Manual from: [geoffg.net/maximite.html](http://geoffg.net/maximite.html)
- Load the MMBasic hex file onto the PIC32 using the universal bootloader application (BootLoade.exe) supplied with the upgrade. See the file "Loading New Firmware.pdf" for details. You can also use the standard UBW32 boot load application if you wish.
- Download the Windows USB Serial Port Driver from <http://geoffg.net/maximite.html> and install it. This driver has been tested on XP, Vista and Win7 both 32 bit and 64 bit. Full instructions are included in the download.
- Cycle the power on the UBW32 and connect it to your computer via USB.
- Start your terminal emulator (Terra Term is a good choice), connect it to the virtual USB serial port that MMBasic created on your system (use any baud rate) and you should be greeted by the initial prompt:



- You can now start experimenting with MMBasic commands. Try typing in something like: `PRINT "Hello World"`
- When you enter your program you can save it to the internal flash drive (A:) as AUTORUN.BAS and it will be automatically run every time the UBW32 is powered up – even if it is not connected to the USB.
- To enjoy colour output you will need to install the VGA output circuit (see the next section).

# UBW32 Connections



Except for C13 all connections to the UBW32 are optional; when a peripheral is omitted Colour MMBasic will ignore it. You can leave all of them out and still use the UBW32 as a BASIC computer via the USB port.

## Parts List

|                      |   |
|----------------------|---|
| VGA Connector        | DE-15 (or HD-15) High Density 15 Pin Female D Connector (AMP 1-1734530-1, MULTICOMP SPC15430, Element14 1557991 or 1564252)   |
| PS2 Connector        | 6 Pin Mini DIN Female Socket (example: <a href="http://sparkfun.com/products/8509">sparkfun.com/products/8509</a> )   |
| SD Card Connector    | SD Card holder preferably mounted on a PCB (example: <a href="http://sparkfun.com/products/204">sparkfun.com/products/204</a> ).  |
| Battery Backed Clock | SparkFun BOB-00099 Real Time Clock Module ( <a href="http://sparkfun.com/products/99">sparkfun.com/products/99</a> ) Or the parts can be purchased individually from <a href="http://futuralec.com">futuralec.com</a> . |

While example suppliers have been provided you can also find these components in many other places on the Internet.

# Using Colour MMBasic on the UBW32

The MMBasic Language Manual covers most of the details of running Colour MMBasic. These notes cover specific UBW32 subjects.

## Compatibility

The UBW32 runs exactly the same hex file (loadable firmware image) as the Colour Maximate. So, when you are looking for upgraded versions of the firmware look for a version that runs on the Colour Maximate.

If you install all the external connectors and components listed in the previous section the UBW32 will run exactly the same as the Colour Maximate.

There is only one exception, due to the design of the board I/O pin 1 is not available on the UBW32.

## Battery Backed Clock

If you have installed the battery backed clock the firmware will recognise that the clock is present and will display a message under the Maximate logo saying that the clock is not set. To set it you use the standard commands in MMBasic for setting the time (TIME\$ and DATE\$).

From then on MMBasic will automatically retrieve the current time and date on power up and display it under the Maximate logo— just to let you know that your battery backed clock is working correctly.

If you do not install the components Colour MMBasic will use its internal clock (which is reset to zero on power up).

## UBW32 Indicator LEDs

|        |  |
|--------|--|
| BLUE   | Not controlled by MMBasic – illuminated when power is applied          |
| YELLOW | Indicates that MMBasic is running. Can be user controlled using Pin 0. |
| RED    | SD card activity (reading/writing).                                    |

## Input/Output Pins

Colour MMBasic on the UBW32 provides for 40 I/O pins.

Pins 1 to 20 operate the same as the standard I/O connector on the Maximate.

Pins 21 to 34 operate the same as the Arduino I/O pins D0 to D13 on the Colour Maximate.

Pins 35 to 40 operate the same as the Arduino I/O pins A0 to A5 on the Colour Maximate.

The serial port COM2 uses pin 21 for receive data and 22 for transmit data. COM1 uses the same pins as the Maximate.

See "Input/Output" in the MMBasic Language Manual for more details.

## USB Communications

Implements the CDC (Communication Device Class) protocol over USB 2.0. This is a serial interface to the BASIC interpreter so, by using a terminal emulator on the host, programs can be entered, edited and run. Using this interface you can upload programs by streaming the text with a suitable terminal editor.

The Windows driver is available from <http://geoffg.net/maximate.html>. There is native support for the CDC protocol in Linux (the cdc-acm driver) and Apple OS/X.

## Sound Output

The audio generated by MMBasic is output as a pulse width modulated (PWM) signal. The pulse repetition rate is approx 100KHz and MMBasic can modulate the output by varying the duty cycle.

The sound output circuit is a low pass filter intended for driving an audio amplifier but you can easily drive headphones or even a small speaker. In that case remove all components and connect the speaker or headphones direct to the outputs of the PIC32. You do not need a low pass filter as the speaker/headphone coil will do that for you.

See "Audio and PWM Output" in the MMBasic Language Manual for more details.