

MMBasic for 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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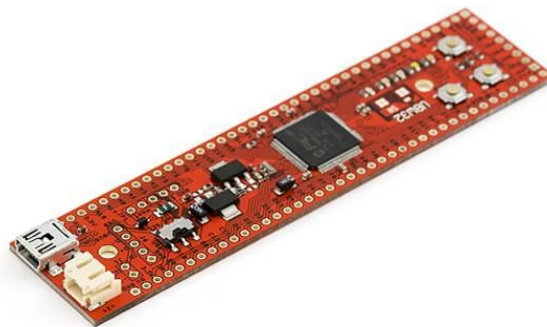
UBW32 and MMBasic

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

For details of the language download the [MMBasic Language Manual](http://geoffg.net/ubw32.html) from <http://geoffg.net/ubw32.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 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.

Other features of MMBasic include:

- The language mimics the original Microsoft BASIC (also known as MBASIC, BASICA or GW-BASIC). This makes learning the language easier and there is a wide range of resources available on the Internet.
- Support for 50 input/output lines (or pins as they are referred to in MMBasic) that can be independently configured as digital input or output, analog input, frequency or period measurement and counting. 10 of the pins can be used to measure voltages and 4 can measure frequency/period. Most pins can be set to open collector output and can be used to interface with 5V systems.
- Communication support includes two asynchronous serial ports (up to 19200 baud with hardware flow control), a full featured implementation of the I²C protocol (master and/or slave at up to 400Kb/s) and the SPI protocol.
- MMBasic creates a 212KB virtual drive in the flash memory of the PIC32. This virtual drive can be used for saving and loading programs and data. A program can be configured to start automatically from this drive on power up making the system a complete embedded controller. Data can be copied off this drive using the XModem protocol.
- For larger capacity storage a SD/MMC/SDHC memory card connector can be attached. Using this facility you can save and load programs and data in a format compatible with Windows, Apple and Linux. The file system can be FAT16 or FAT32 with a capacity of over 32GB.
- MMBasic supports an optional VGA display or composite TV set (50Hz PAL compatible) connected to the UBW32. The character set is the full upper and lower case ASCII character set with 80 characters by 33 lines in VGA mode and 50 by 18 in composite video mode. Both are monochrome. Video graphics commands in MMBasic provide the ability to turn any pixel on or off, draw lines, boxes, filled rectangles, circles and position text anywhere on the video monitor (if connected).
- Another option is to connect a standard IBM PS2 keyboard for program and data entry.
- The USB interface is used for connection to a desktop computer. MMBasic appears as a virtual serial port to the bigger computer and anything typed onto this port will be used by the interpreter just as if it has been typed on the keyboard. Similarly, any output from the interpreter will be sent to both the video and USB outputs. This facility can be used to edit/upload/download programs and data.
- MMBasic is loaded onto the UBW32 using the standard UBW32 bootloader. If you don't like MMBasic you can always use this bootloader to revert to the original firmware delivered with the UBW32.

MMBasic can typically handle a program of over 1000 lines and will execute it at up to 40,000 lines per second. Because it is an interpreter MMBasic does not run as fast as compiled code but it makes for a much easier development environment - you do not need a PC and you can experiment and modify your program on the UBW32 in an interactive way.

Quick Start

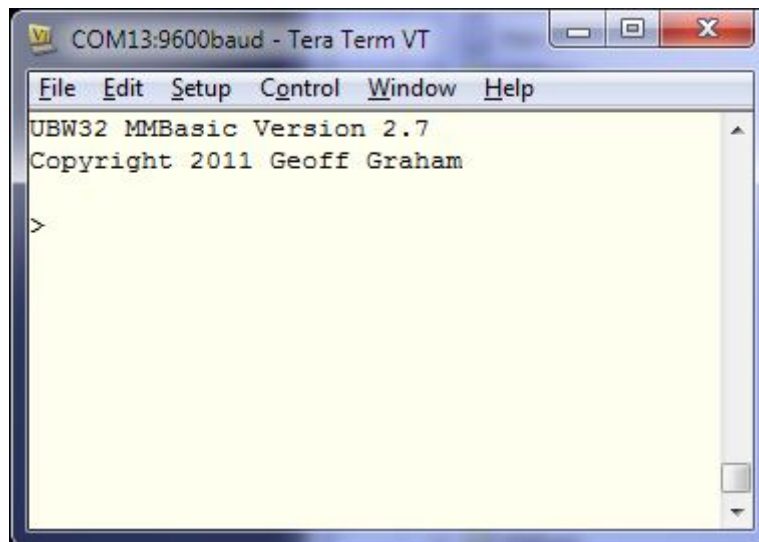
Download the MMBasic Language Manual from: <http://geoffg.net/ubw32.html>

For details of the UBW32 go to: <http://www.schmalzhaus.com/UBW32>

Further resources can be found at: <http://www.sparkfun.com/products/9713>

These instructions will get the UBW32 running 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 MMBasic. Later, if you want to, you experiment with a more complicated setup by connecting a keyboard and VGA monitor.

- Download the Windows USB Serial Port Driver from <http://geoffg.net/ubw32.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.
- Load the MMBasic hex file onto the PIC32 using the standard UBW32 bootloader (MMBasic was tested using version 2.3 of the bootloader). For instructions and to download the bootloader go to: <http://www.schmalzhaus.com/UBW32/doc/UBW32BootloaderDocumentation.html>.
- 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.

License

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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.

UBW32 Connections

MMBasic Pin Numbers

MMBasic uses "pin" numbers to address the I/O lines on the PIC32 and UBW32.

The following table lists the MMBasic pin numbers and the corresponding I/O pad on the edge of the UBW32 board (these designations are printed next to the solder pads).

Pin 0 Output	Yellow LED (E0)	Pin 25	A4	
Pin 0 Input	PROGRAM Button (E7)	Pin 26	A5	
Pin 1	B4	Pin 27	A6	
Pin 2	B3	Pin 28	A7	
Pin 3	B2	Pin 29	A9	
Pin 4	B1	Pin 30	A10	
Pin 5	B9	Pin 31	D10	
Pin 6	B10	Pin 32	D9	
Pin 7	B11	Pin 33	C1	
Pin 8	B12	Pin 34	C2	
Pin 9	B13	Pin 35	C3	
Pin 10	B15	Pin 36	C4	
Pin 11	E8	Pin 37	D11	
Pin 12	A15	Pin 38	F8	
Pin 13	A14	Pin 39	F12	
Pin 14	E9	Pin 40	B14	
Pin 15	D12	Pin 41	G0	
Pin 16	D13	Pin 42	G1	
Pin 17	E4	Pin 43	G12	
Pin 18	E5	Pin 44	G13	
Pin 19	D14	Pin 45	G14	
Pin 20	D15	Pin 46	G15	
Pin 21	A0	Pin 47	F2	
Pin 22	A1	Pin 48	E2	White LED
Pin 23	A2	Pin 49	E3	Green LED
Pin 24	A3	Pin 50	E6	USER Button

All I/O pins operate as described in the MMBasic Language Manual. Note that not all pins above pin number 20 are 5 volt tolerant and support open collector output. Refer to the PIC32 documentation for details.

PWM Output

MMBasic implements a single PWM channel (see the SOUND command). The output is on D1.

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).
WHITE	User controlled using Pin 48. Illuminated when PIN(48) = 0.
GREEN	User controlled using Pin 49. Illuminated when PIN(49) = 0.

USB

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.

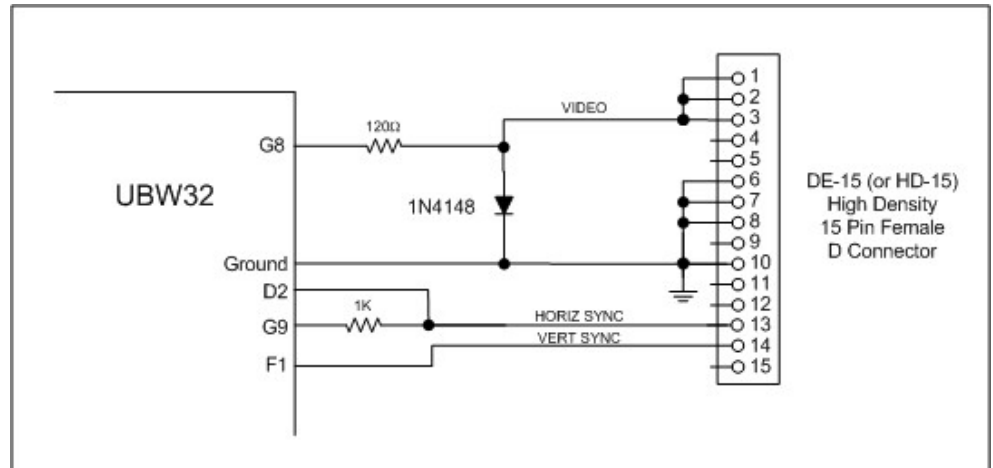
The Windows driver is available from <http://geoffg.net/maximite.html>. There is native support for the CDC protocol in Linux (the cdc-acm driver) and Apple OS/X.

Adding Peripherals

VGA Video Monitor

Standard monochrome VGA (31.5KHz horizontal scanning with 60Hz vertical refresh).

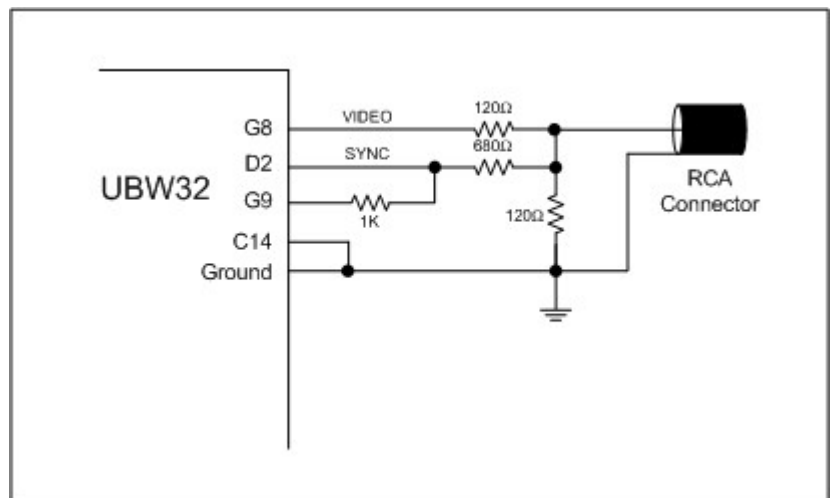
480x432 pixel graphic screen. 80 characters per line and 36 lines per screen.



Composite Video Monitor

Standard monochrome PAL (15.625KHz horizontal scanning with 50Hz vertical refresh non interlaced). 304x216 pixel graphic screen. 50 characters per line and 18 lines per screen

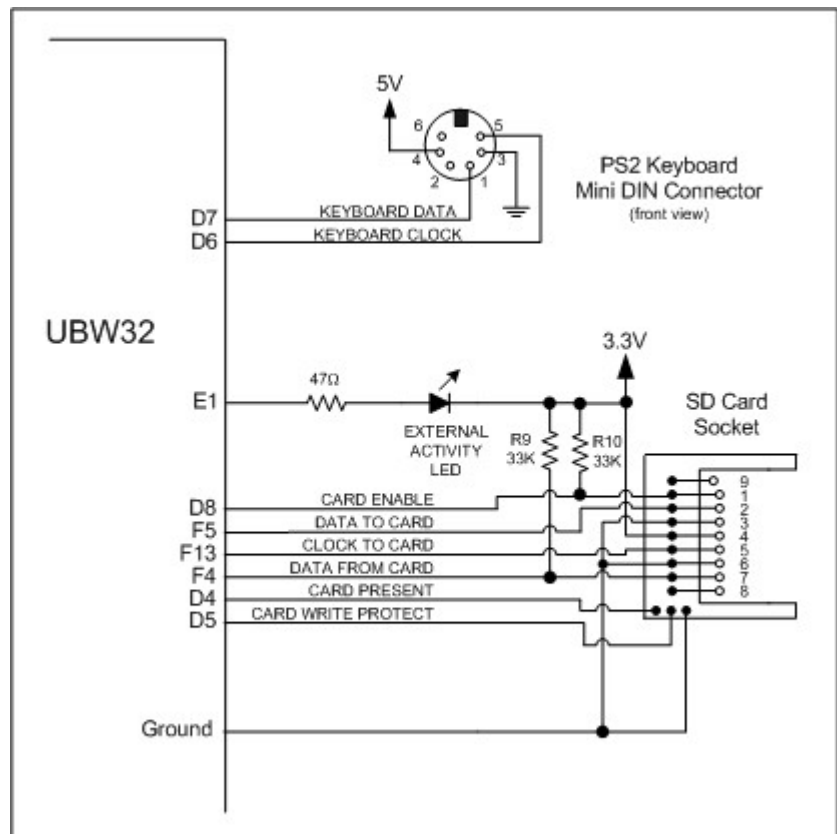
Or, standard monochrome NTSC (15.73426KHz horizontal scanning with 60Hz vertical refresh non interlaced). 304x180 pixel graphic screen. 50 characters per line and 15 lines per screen. See the OPTION CONFIG NTSC command



PS2 Keyboard

Standard IBM compatible PS2 keyboard with mini-DIN connector or a USB/mini-DIN adapter.

Non ASCII keys (such as the function keys) generate special codes. See Appendix E for details.



SD/MMC Memory Card

The SD card interface will accept MMC, SD or SDHC memory cards formatted as FAT16 or FAT32. Note that there is no advantage in using a fast SD card as the card is clocked at a fixed 20MHz, regardless of its speed rating.

NOTE: This diagram corrects errors in the connection to the SD Card clock line and the Card Enable.