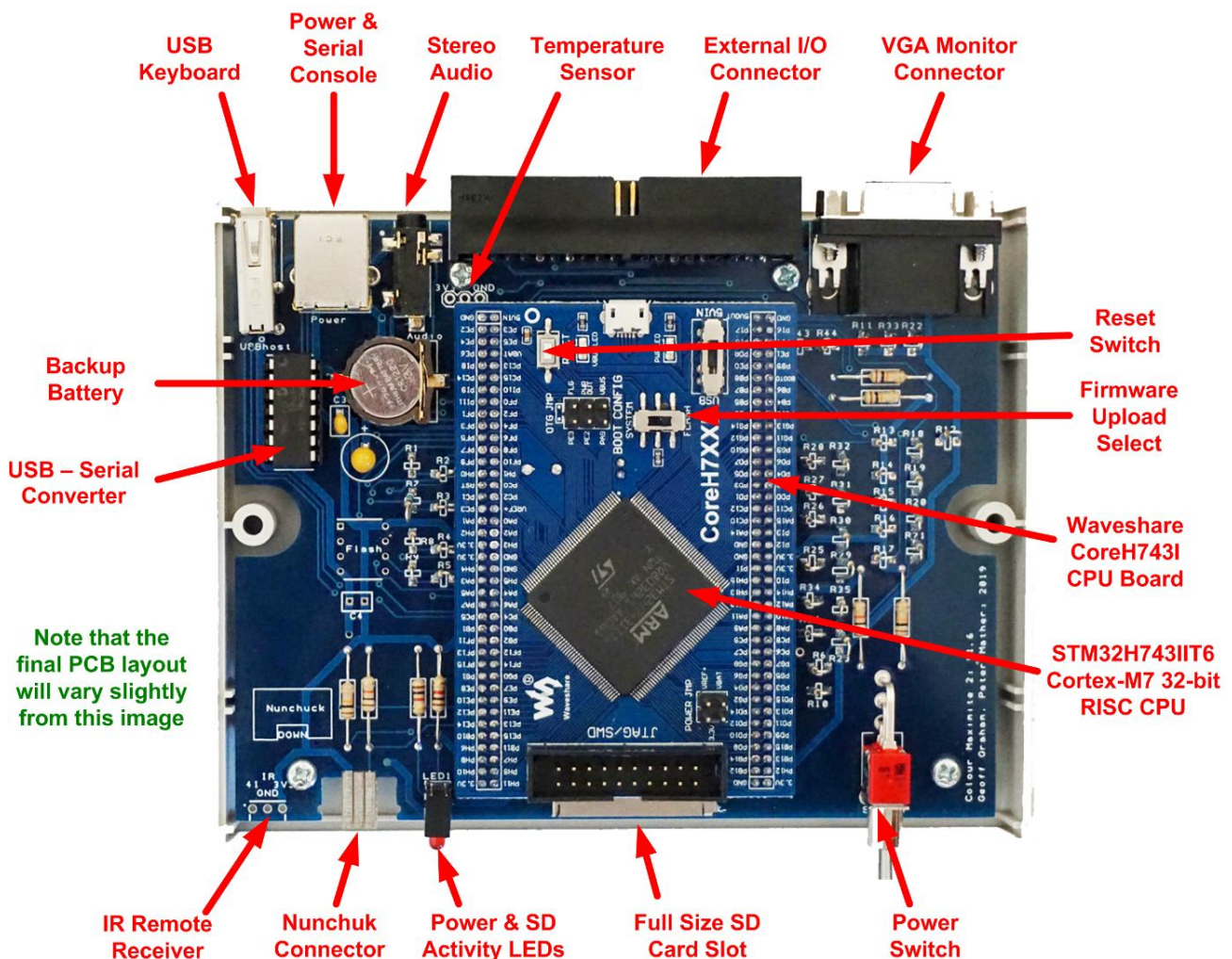# Generation 1 Colour Maximite 2 Construction Pack

The Colour Maximite 2 is a small self contained computer inspired by the home computers of the early 80's such as the Tandy TRS-80, Commodore 64 and Apple II. It includes its own BASIC interpreter and powers up in under a second into the BASIC interpreter (there is no operating system to boot). The emphasis is on ease of use and, as a result, a first time user could enter a small program and have it running within minutes.

The firmware (including the BASIC interpreter) is completely free. The main PCB is easy to assemble with thru hole components. The CPU and support circuits are contained on a low cost fully assembled plug in board. The firmware can be loaded using free software so a programmer or special equipment is not required to get started.

This pack contains the design files, firmware and construction notes for building the Colour Maximite 2 by yourself. Fully assembled versions will also be available from various vendors.

For an introduction to the Colour Maximite 2 go to: http://geoffg.net/maximite.html

Parts List

1 PC board, 103x130mm.

1 15 Pin D-Sub Socket (RS 481-443, AMP 1-1734530-1, MULTICOMP SPC15430, Element14 1557991).

1 3.5mm Stereo Socket. Switchcraft 35RASMT4BHNTRX (RS 705-1490, Mouser 502-35RASMT4BHNTRX).

1 3mm Dual LED Assembly. Dialight 553-0112F (RS 546-0570, Mouser 645-553-0112F).

1 USB Type-A Upright PCB Socket Right Angle. Amphenol FCI 73725-0110BLF (RS 771-0048, Mouser 649-73725-0110BLF).

1 USB V2.0 Type B Connector Amphenol FCI 61729-0010BLF (RS 771-0035).

1 Right-angle vertical PCB-mount SPDT toggle switch [Altronics S1320, RS 734-7107, element14 9473297, Digi-key EG2364-ND, Mouser 706-34ASP11B2M7QT.

1 SD Card Socket. Hirose DM1AA-SF-PEJ(21) (RS 502-5004, Mouser 798-DM1AA-SF-PEJ21).

1 40 Way, 2 Row, Right Angle PCB Header, 2.54mm Pitch. Hirose HIF3F-40PA-2.54DS(71) (RS 896-1067, Mouser 798-HIF3F40PA254DS71).

2 80 Way, 2 Row, PCB Header Socket, 2mm Pitch. SAMTEC MMS-140-01-L-DV (eBay 292145372983).

1 Coin Cell Holder for CR1220 Battery. HARWIN S8411-45R (RS 161-3710, Mouser 855-S8411-45R).

1 CR1220 Battery

1 14-pin IC Socket

1 Multicomp Pro G738 or G748A Instrument Case 140x110x35 mm (Jaycar HB5970, Altronics H0472, Element14 1526699, Farnell 1526699)

Semiconductors

1 Waveshare CoreH743I STM32H743IIT6 MCU core board https://www.waveshare.com/coreh743i.htm

1 Microchip MCP2221A-I/P USB to Serial Bridge 14-pin DIP (RS 171-7828, Farnell 2678459).

   -or-

1 Microchip PIC16F1455-I/P microcontroller (14-pin DIP package) programmed with the Microbridge firmware http://geoffg.net/microbridge.html Also suitable are the PIC16LF1455-I/P, PIC16F1454-I/P or PIC16LF1454-I/P.

Capacitors

2 100nF Multilayer Ceramic Capacitor (MLCC) 50VW

1 1µF Tantalum Capacitor 16VW

2 10µF Tantalum Capacitor 16VW

Resistors (metal film, 0.25W, 1%)

3 75Ω   13 120Ω   19 240Ω

Resistors (carbon, 0.25W, 10%)

1 2.2Ω   1   10Ω   2   1KΩ   6   10KΩ

Optional

1 Optional Dallas DS18B20+ temperature sensor. TO92 package. (RS 540-2805)

1 Optional Vishay TSOP4838 IR Remote Receiver 38KHz. (RS 708-5115)

1 4.7KΩ (required if the optional DS10B20 temperature sensor is fitted)

Sourcing the Parts

- The Waveshare CoreH743I CPU Board can be purchased direct from Waveshare or on eBay and AliExpress. The Waveshare WEB page is: https://www.waveshare.com/coreh743i.htm

- The two 80-pin sockets used for the plug-in Waveshare board have a pin spacing of 2mm. They can be purchased from the usual suppliers (Mouser, RS Components, etc) or on eBay (search eBay for "2mm 2x40 Pin Female PCB Header").

- Be careful with the vertical Type-A USB connector used for the keyboard. There are two variants that look identical but have their PCB pins reversed. The correct type is manufactured by Amphenol FCI with their part number 73725-0110BLF. Mouser sells this as their part number 649-73725-0110BLF and RS Components as stock number 771-0048.

- The resistors used in the R-2R network to generate the analog VGA output are mounted vertically to save space. To make this easy it is best if they are ¼ watt metal film resistors. The tolerance is not critical. 1206 surface mount resistors can also be used here – the board will accept either

- The vertically mounted LED module for the power and SD activity LEDs makes it easy to get the correct alignment however you can use discrete 3mm coloured LEDs if you wish. If you do this you will have to bend their leads to get the correct alignment.

- The USB/Serial converter can be a Microchip MCP2221A-I/P Microcontroller 14-pin DIP (RS 171-7828) or a Microchip PIC16F1455-I/P microcontroller (14-pin DIP package) programmed with the Microbridge firmware (see http://geoffg.net/microbridge.html).

Assembly Notes

- Refer to the high res photo in this pack for component placement. Note that this photo is of an early prototype and that the final PCB will be a little different.

- Start by soldering the two 80-pin connectors used for the plug in CPU module. Some beta testers found that the solder can wick up the pins and this prevented the CPU module from being properly inserted. So insert the CPU board into the connectors while soldering them but **use very little solder** - you do not want the solder to reach the CPU board's pins and prevent it from being removed..

- Do the audio socket next (if you leave the audio socket to last it will be difficult to get your soldering iron in without causing damage).

- The SD socket has two small posts on the underside which click into two matching holes in the PCB to ensure perfect alignment. There are seven pins around the sides and nine on the back – check that you have soldered all of them. Keep an eye out for solder bridges between pins and/or the socket's frame. Also make sure that the socket is held flat to the PCB while soldering otherwise SD cards will not make correct contact when inserted.

- Following this it is worth soldering the high profile connectors and the power switch. The reason for doing this now is that they will hold the PCB off the bench when you later place it upside down to solder the capacitors and vertically mounted resistors.

- Three capacitors are situated under the CPU module and they should be mounted flat on their side to not obstruct the CPU module.

- 35 resistors are used in the R-2R ladders for the VGA analog outputs. These can be vertically mounted through hole ¼ watt metal film resistors or 1206 surface mount resistors – the board will accept either.

- Prepare the Waveshare CPU module by removing all jumpers, set the power switch to "5VIN" and the BOOT CONFIG switch to "Flash". Then plug the module into the motherboard. The USB socket on the top of the module should be to the rear of the computer and the 20-pin IDC connector to the front.

- The motherboard will fit in a standard ABS box manufactured by Multicomp Pro as G738 or G748A. It should be fastened to the pillars in the enclosure using four ordinary 8mm M3 screws (self tappers are not required) with a 5mm spacer between the PCB and pillar. These are required to elevate the PCB and its connectors to match the cut-outs in the front and rear panels.

- Rather than manually making the cut-outs for the front and back panels of the case you can send the Gerber files included in this pack to a PCB fabricator and have them produce these panels (much easier).

Printed Circuit Board

Send the Gerber files in this bundle to a PCB fabrication house to get the motherboard made. The fabrication house should be told that "drill output is 3,5 leading in inches".

The copper pour in the PCB is complex and can confuse some Gerber viewers. The best tool to view the PCB design is: https://www.pcbway.com/project/OnlineGerberViewer.html
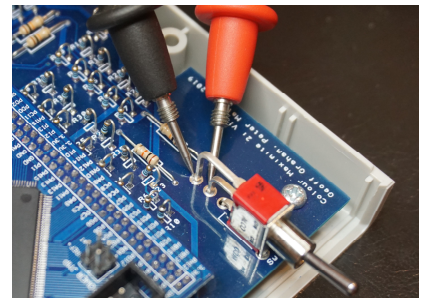
Loading the Firmware

A copy of the firmware is included in this pack but it would be worth checking if a later version has been released. To load the firmware refer to Appendix G of the *Colour Maximite 2 User Manual* for the procedure. Both can be downloaded from http://geoffg.net/maximite.html.

Fault Finding

The current drawn by the motherboard and the STM32 processor is a good indication of the health of the CMM2. Using a Type-A to Type-B USB cable plug the motherboard into a 5V source but leave the front panel power switch off. Measure the current across the switch contacts as shown.

- With the Waveshare CPU module not plugged in the current should be zero.
- With the Waveshare CPU module inserted in its sockets the current should be about 45mA.
- With the Waveshare CPU module inserted and the correct firmware loaded the current with no keyboard, monitor or SD card connected should be about 180mA to 200mA.

Many USB chargers and other sources of USB 5V have noisy outputs so if your Colour Maximite 2 is suffering from intermittent issues such as reboots, errors reading the SD card, etc then you should try sources with better power (ie, a regulated supply, PC or a charger with a with a much higher capacity (eg, 2 amps or more). You should also check the USB Type-A to Type-B cable used for power as that has caused trouble for some people.

Testing the Waveshare Module

You can test the Waveshare CPU module by removing it from the motherboard, placing shorting jumpers on all header pins except PA9-VBUS, set the power switch to "USB" and the BOOT CONFIG switch to "SYSTEM". Plug a USB cable into the micro USB connector on the top of the Waveshare module and the other end into a desktop computer - both LEDs on the module should illuminate and it should connect to your computer.

Then, using the steps listed in Appendix G of the *Colour Maximite 2 User Manual* try loading the Colour Maximite 2 firmware using this USB cable and your desktop computer. If this completes without fault you can be assured that the STM32H743IIT6 MCU is working correctly.

External Oscillator

The latest PCB has provision for an external 8 MHz crystal oscillator to replace the 8 MHz crystal on the Waveshare CPU board. This may be needed in some <u>rare</u> cases where a monitor has difficulty with some VGA modes (such as 800x600 pixel 16-bit colour).

Most people will not need this modification however, if it is required, it can be implemented by installing the external oscillator and a capacitor on the motherboard (under the Waveshare CPU board). The 8MHz crystal on the Waveshare board does not have to be removed.

The parts required are:

1   SMD 1206 100nF ceramic capacitor
1   8MHz oscillator in 5.0 x 7.0 mm SMD package (QX7 XO 25ppm). Eg, RS Stock Nbr 813-6194 .

Loading the Microbridge Firmware

The USB/Serial converter can be a Microchip PIC16F1455-I/P microcontroller. On the PCB next to this chip there is a six pin ICSP header for a PIC programmer (eg, PICKit3) which can be used to load the Microbridge firmware into a PIC16F1455-I/P if it that chip is used in this position.

MCP2221A Current Setting

The USB/Serial converter can also be a Microchip MCP2221A-I/P. By default this chip tells the host (ie, your desktop or laptop computer) that it only needs 100mA on the 5V pin. Most computers will ignore this and supply up to 500mA regardless but some older laptops can honour the request and limit the current supplied to 100mA. This will be a problem as the Colour Maximite 2 needs a minimum of 180mA and probably more depending on how it is used.

There are very few laptops that cause this issue but if it does happen the symptom will be that the CMM2 works with a normal 5V supply (USB charger, other computers, etc) but will not start up or has intermittent issues (restarts, SD card errors, keyboard errors, etc) when plugged into a particular computer's USB port. The fix is to go to https://www.microchip.com/wwwproducts/en/MCP2221A and download the "MCP2221 Utility" (it is under the Documents tab) and use that to change the MCP2221A to request 500mA by default. This setting is stored within the chip so it only needs to be set once.

The PIC16F1455-I/P (ie, the Microbridge) does not have this issue as it always requests 500mA by default.

Keyboards

Keyboards with a built in mouse function (ie, track pad) will not work, the reason is that they have a built in USB hub and the CMM2 keyboard port does not support hubs. A typical keyboard that works well is the Logitech K270 which is wireless and low cost.

It is possible that some normal keyboards will not work. The reason for this is not clear so it would be worth while trying a few different ones.

VGA Monitor

The CMM2 uses a variety of VGA resolutions and most monitors will sync correctly. Use the monitor's auto sync feature if the image shows instability or part of the image is cut off.