Adding a RTC & fan to CM4

Background

If you are 'doing it yourself' with a WaveShare IO Mini-A or Mini-B board, sourcing your own Compute Module 4, then you will need a 'HAT' for the real time clock and fan controller. RISC OS cannot drive the chips for the clock and fan controller on these IO boards as they sit on an IIC bus invisible to RISC OS.

I have designed a 'hatstand' board which can carry both modules - software for the real time clock is already built in to RISC OS and an application to control the fan is available from !Store as 'FanCon'.

There are two similar circuit boards available, illustrated below, and a set of instructions and list of compoments is given for each. A different board is available for the Pi Foundation IO board and for the GeekPi DeskPi Mini, also known as the PiRO Qube.

Making the hatstand

A soldering iron and a purpose build circuit board are needed, as well as some inexpensive header plugs and sockets. The 'RUN' pad is not brought out on the Waveshare IO board. A switch between pins 29 and 30 on the 40-pin header can be added to select a 'dual boot' option (it allows a different operating system to be selected in 'CONFIG/TXT' by using [gpio5=0] conditional elements).

Headers are provided on the board for a CJE Real Time Clock board, an Adafruit EMC2101 fan controller board and a Waveshare 5V cooling fan.

Versions 1 and 2 - components

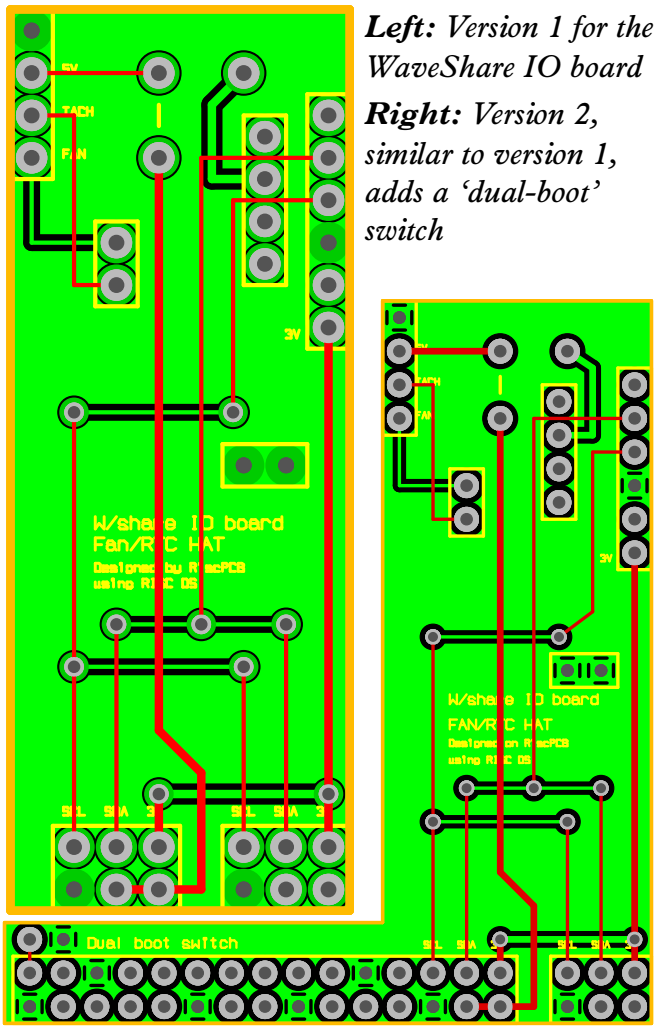
DIL Header socket: version 1 uses a 6-pin DIL header (F) to connect to pins 1 to 6 on the 40-pin header plug on the IO board. Version 2 can either use a 30-pin DIL header or two 6-pin DIL headers (on pins 1 to 6 and 25 to 30). Only pins 1 to 6 and 29 are used.

Header plugs: 6-pin DIL (A) plus optional 2-pin SIL (E) for the RTC board;
2-pin DIL right angle (C, version 2 only) for a dual-boot switch;
4-pin SIL right angle (G) for fan header.

SIL header sockets: 2-pin (B) and 6-pin (H) for EMC2101 board;
4-pin SIL short feather header (D) for fan header on IO board.

Each board is therefore supported in two places such that no mounting pillars are required.

Most of the headers are standard parts: a 40-pin DIL header socket can be cut down to the required size. A 10-pin SIL socket can also be cut down into a 6-pin and a 2-pin. The EMC 2101 board comes



Left: *Version 1 for the WaveShare IO board*

Right: *Version 2, similar to version 1, adds a 'dual-boot' switch*

with header plug. Header plugs (DIL or SIL) can be broken off at the correct length. The only unusual components are the following, codes are PiMoroni:
COM1107 - SIL r/a header plug
COM1102 - DIL r/a header plug (v2 only)
ADA2940 - short feather header socket

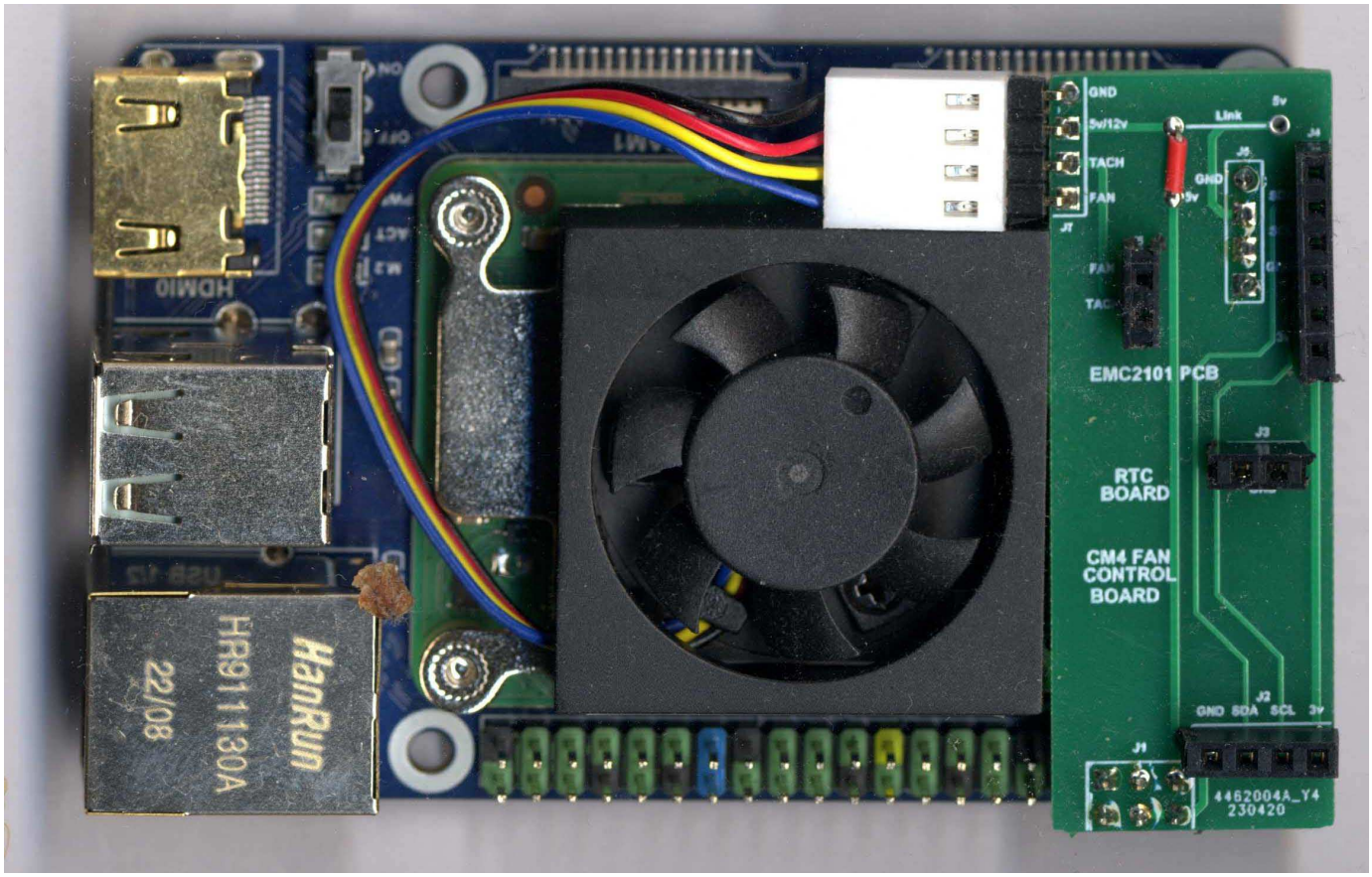
The last item listed allows the 'hatstand' to be supported firmly at each end and to sit parallel.

The Waveshare 3007 cooling fan is available in 5V and 12V versions and mounts directly on the CM4 with thermal pads. The CJE RTC board mounts on the hatstand so that it just clears the body of the cooling fan. The Adafruit EMC2101 board (PiMoroni code ADA4808) mounts on two SIL headers.

Construction

Seven headers (nine on version 2) are soldered on to the 'hatstand' board, which then plugs onto the Waveshare IO board. The RTC board, the EMC 2101 board and the fan socket then just plug on to the headers. You just need to be careful to solder the headers in the correct place - some fit underneath and some on top. The photo shows the prototype board - on the final version the 4-pin SIL socket (J2) is now a six-pin DIL plug to fit the standard CJE RTC board, which has a 6-pin DIL header plug. If you want the RTC board to be supported at two points, then fit a two-pin SIL header plug to the hatstand and a two-pin SIL header socket to the RTC board.

The WaveShare IO board allows an NVMe drive to be plugged in underneath so version 3 includes provision for a 'dual-boot' switch so that pressing the switch will cause a boot into Linux on the NVMe drive.



The two modules that sit on the circuit board are quite inexpensive: £13 for the CJE module and £5.40 for the Adafruit EMC2101 board. Although some GPIO pins on the Pi Foundation header are dedicated to functions on the IO board, pin 29 (GPIO 5) and pins 3 and 5 (SDA and SDL respectively) work OK.

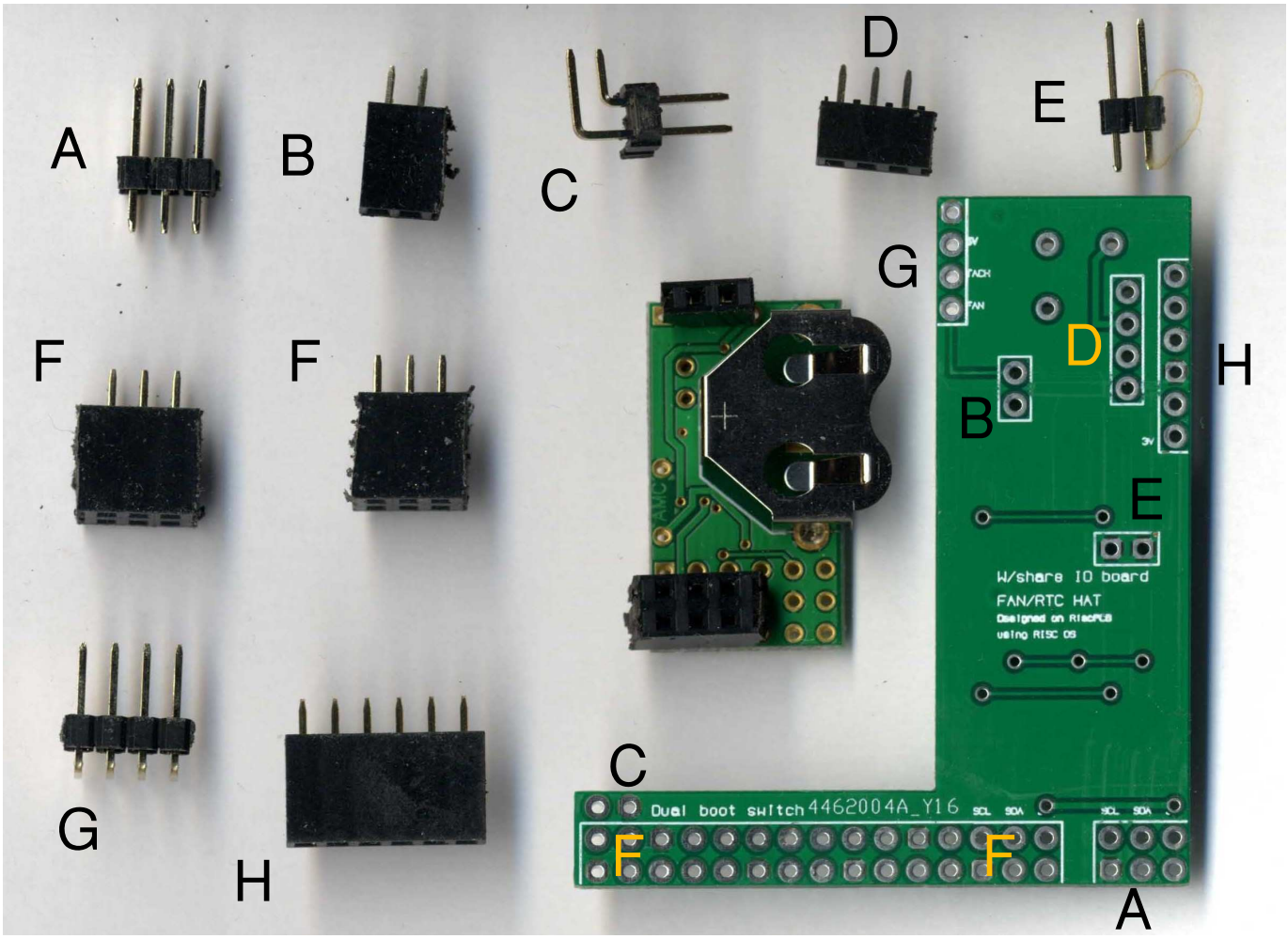
Once constructed simply plug in the two daughter boards and fan lead and the fan and RTC should 'just work'. Fan speed control can be added by using the application 'FanCon' from !Store.

The 6-pin header socket is soldered underneath as is the 4-pin (or 3-pin) SIL short feather header. The other components are soldered on top.

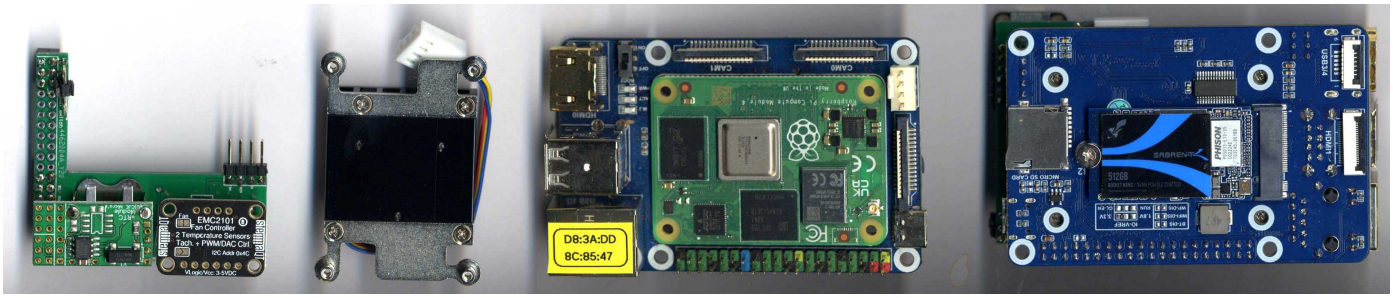
The CJE RTC board comes with a 6-pin DIL header socket soldered in place but the EMC2101 Adafruit fan controller comes with a separate header plug which needs to be split up into 6-pin, and two 2-pin plugs and soldered in place on the underside of that board.

The 5V power supply for the fan is provided by a link from pins 2 and 4 of the 40-pin header (an alternative link is provided from the fan header itself).

A flying lead to a switch for dual booting may also be connected. Once complete, it should look like the picture below.



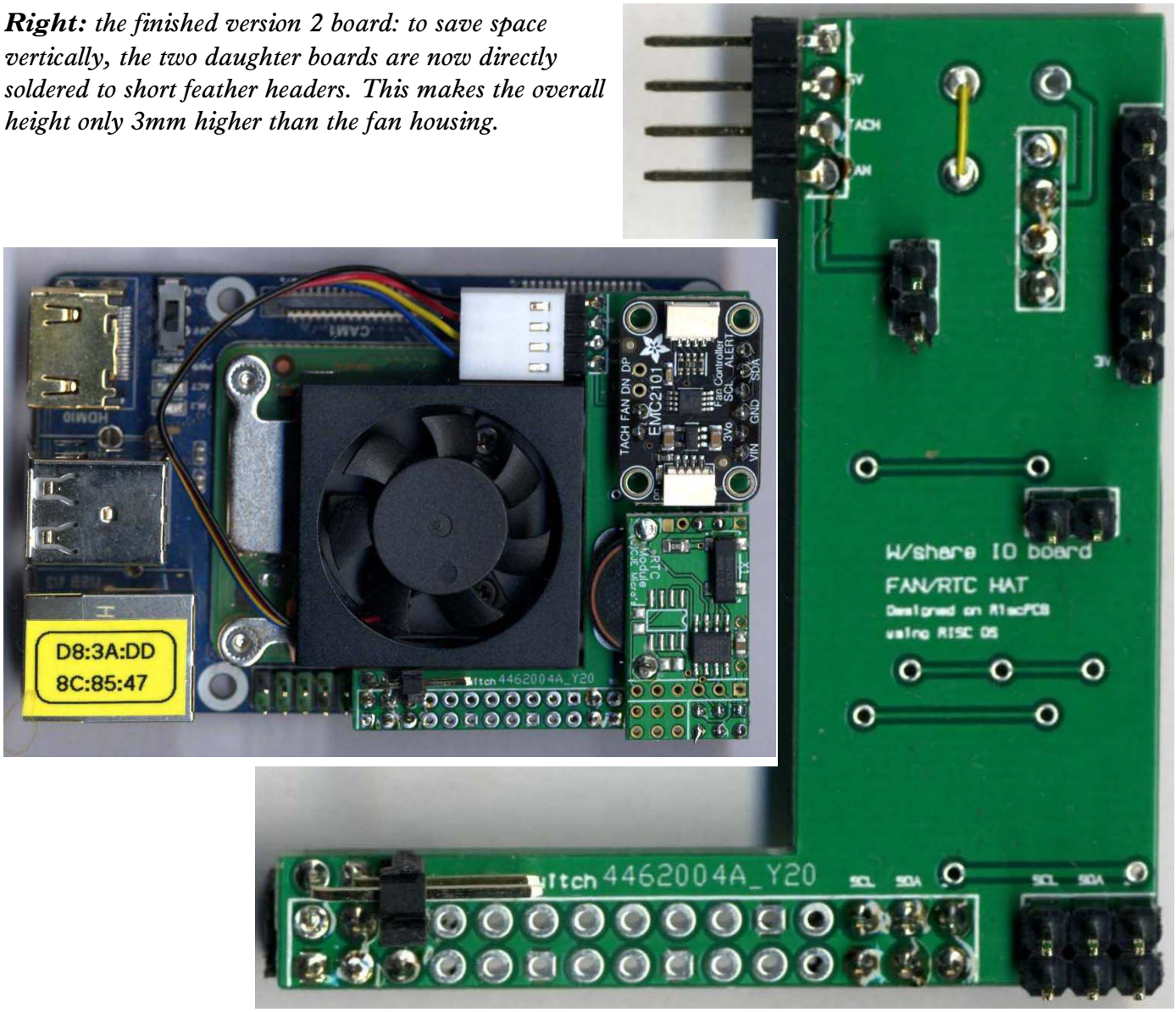
The complete set of parts: an extra 2-pin SIL socket (B) has been soldered to the CJE RTC board to provide extra support. Letters shown in orange indicate components soldered to the underside. Header plugs for B and H are provided with the Adafruit EMC2101 board and are soldered to that board.

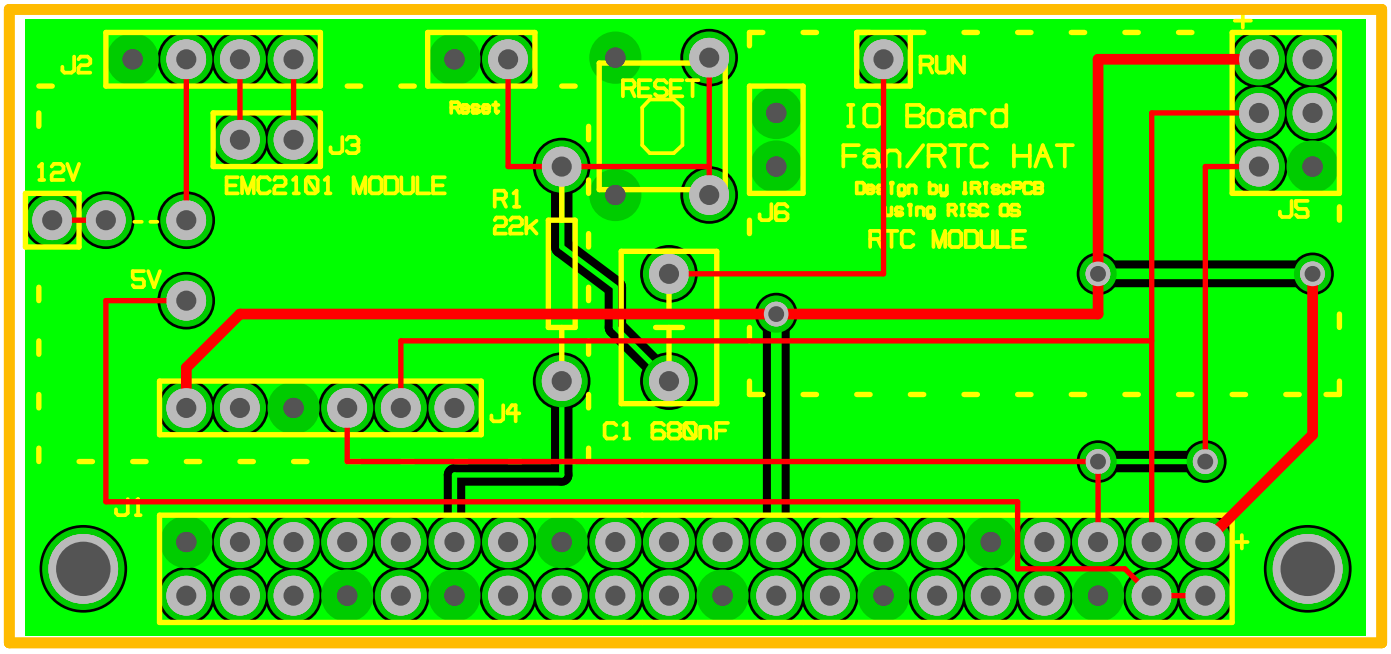


Above: *the various bits before assembly.*

Below left: *Version 2 fits neatly onto the Waveshare IO board with just sufficient clearance. The CJE RTC board is offset from its normal position to clear the fan housing. The 3-pin socket underneath connects to the fan header but it is not really required as the fan just requires a 5V power supply.*

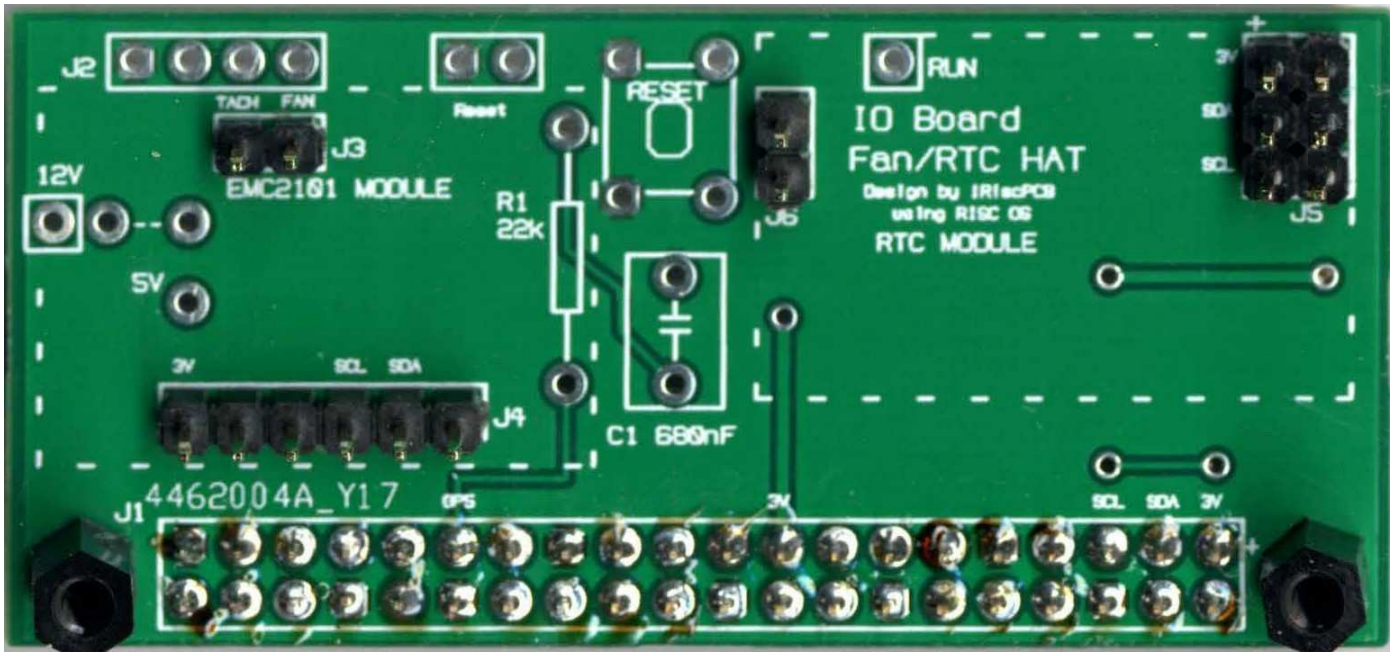
Right: *the finished version 2 board: to save space vertically, the two daughter boards are now directly soldered to short feather headers. This makes the overall height only 3mm higher than the fan housing.*





Above: *The Pi Foundation IO board needs a 12V supply if a PCIe to SATA adapter board is fitted but may be run from a 5V supply otherwise. Provision is made therefore for either a 5V or 12V fan to be fitted, the 12V supply is obtained via a flying lead to the fan header on the IO board. The button will reset the CM4 and either start up in RISC OS (momentary press) or in Linux (press and hold). A flying lead to a button mounted on the case is also provided for.*

Below: *the part-assembled board ready for the components to be added.*

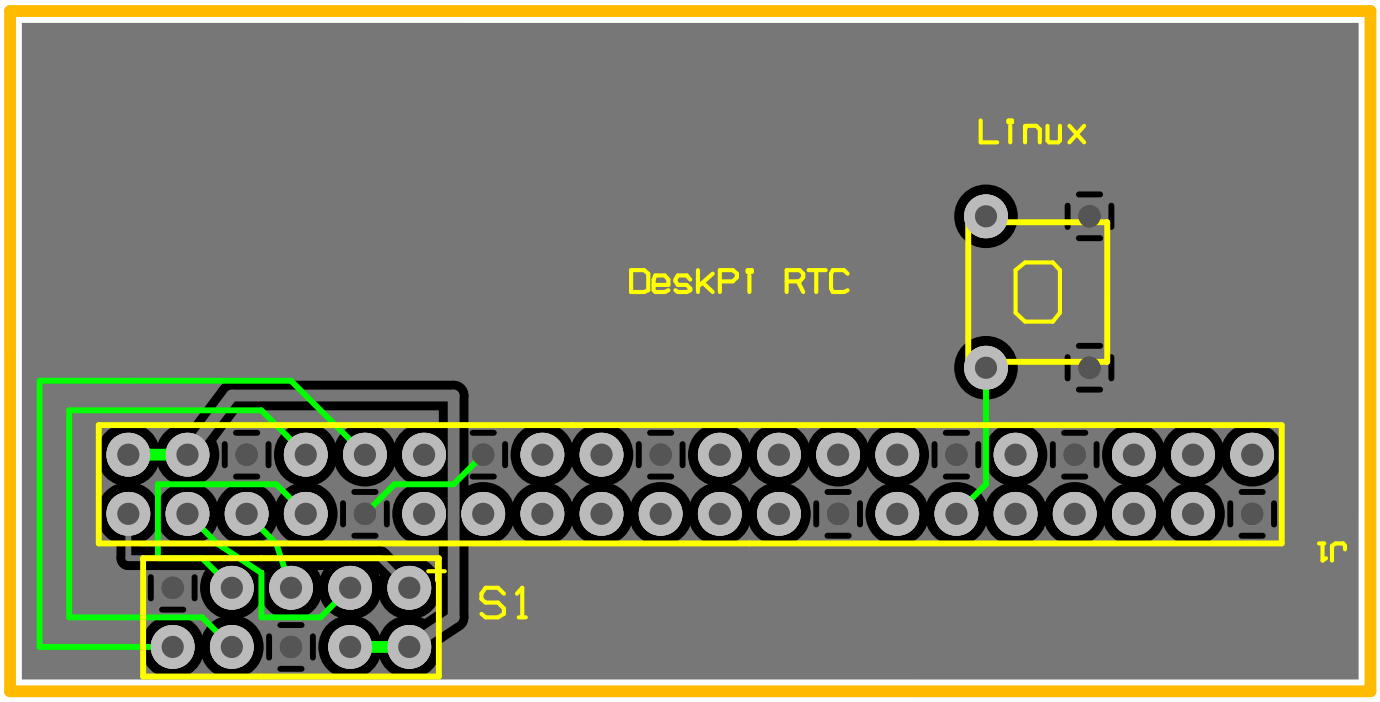


Pi Foundation IO board

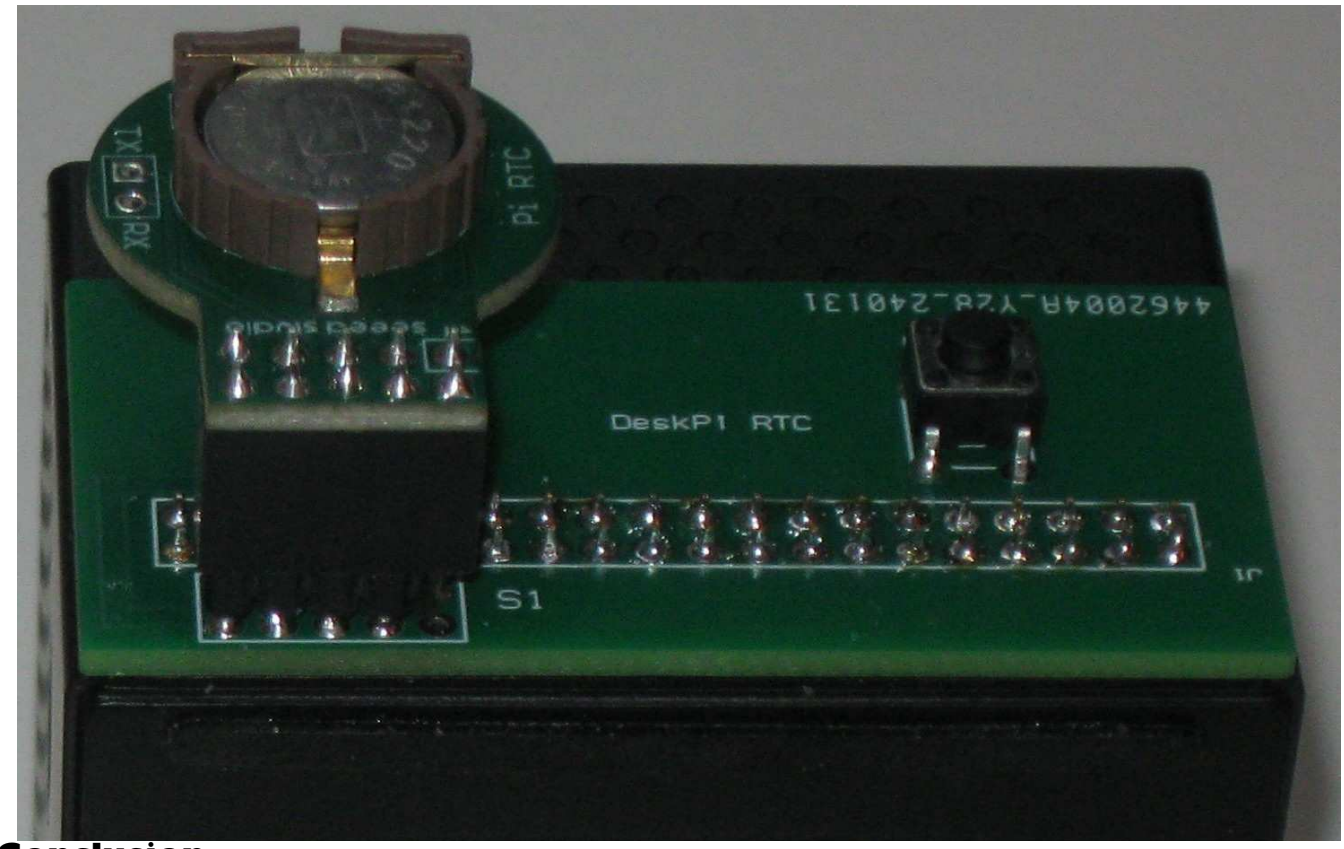
The geometry here is different and convenient access is provided to the 'RUN' pad allowing a two pin right angle header to be soldered to the pad. The dual boot switch can therefore double as a reset switch. The fan header also needs to be positioned so that the fan lead will reach.

GeekPi DeskPi Mini (PiRO Qube)

This IO board comes with a case and fan, controlled directly by CPUSpeed using pin 6 (TXDATA) of the 40-pin header. The 40 pin header is brought out to the rear of the case. The orientation is wrong to allow either the CJE RTC or the Pi Hut RTC boards to be fitted.



A rather simpler board: it just turns the header pins through 180° so that either the CJE RTC board or the Pi Hut RTC board can be mounted on the back of the unit without protruding beneath it.



Conclusion

These boards overcome the problem (using a hardware solution) that the on-board RTC and/or fan controller chips are invisible (in current software) to RISC OS.

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