New Digimac 1+1 encoder for conversion to 2.4g Phil_G

The original PIC based encoder was a one-off project to update an early 1970s Macgregor Digimac 1+1 transmitter bought via ebay. The object was an exact emulation and the PIC encoder operated exactly as the original 27mhz Digimac 1+1 did, giving smooth, proportional rudder and a sequential 3 position throttle. Though originally just a one-off for my own use, it quickly became very popular and many 1+1 sets were converted to 2.4ghz.
Proportional rudder and sequential throttle is a really nice way to fly Single Channel!
This latest version uses a Digispark which is a very small but convenient board with an ATTiny85. Physically its about 3/4" square but the connections are not cramped, they're the usual 0.1" spacing. It has several improvements over the original 1+1 and over the PIC emulation:

Stick calibration:
Calibration no longer involves measuring voltages and adjusting pots as with the old PIC encoder. The new 1+1 has a built-in calibration routine, by switching on with the button held in, & keeping it held in, waggle the stick (& trim if it has one) to its extremes. Then you allow the stick to centre, centre the trim (if there is one) let go of the button, and the set springs to life. Dont switch off before letting the button go. This will set mid-throttle to half, exactly like the original where mid-throttle is always half. To set medium throttle somewhere other than half, at the end of the calibration process, instead of allowing the stick to centre, hold the stick slightly off neutral as you release the button. The amount of offset from neutral will be the new mid-throttle setting, and is saved to flash, so the setting remains in place until you deliberately change it. Calibration only has to be done once, unless you change the stick connections. Calibration also zeros the rudder subtrim.

Servo Reversing:
Reversed rudder is available on receiver channel 4, making servo-reverse unnecessary. This means if you have two models with opposite physical links one might be set up with its rudder servo plugged into channel-1 of its receiver, and the other might have its rudder servo on channel-4 of its receiver, so there is no need to change anything on the transmitter when you fly either model.
On a new model, just try rudder on receiver channel-1, if it goes the wrong way, just move the rudder servo to receiver channel 4 which has reversed rudder. This saves changing the transmitter setup between models if the rudder happens to be opposite.
If you do find some reason to reverse the rudder channel, simply power-on with the rudder stick held right over. The reverse setting is saved to flash.

Throttle:
Exactly like the original 27Mhz 1+1 the throttle is sequential with low, mid, high and back to mid in a continuous cycle. Every brief dab of the button moves the throttle to the next setting. Selecting low sounds one pip. Mid sounds two pips. High sounds three. This lets you know where the throttle is set. The throttle can be instantly cut from any position by holding the button briefly rather than blipping it. (Thanks to Frank for this idea!). The throttle LED is off for low, fast flashing on mid throttle, on for high, then slow flashing for mid throttle – the mid-setting flash rate indicates the next throttle position, so we now have audible and visible throttle indication. All this pipping and flashing is synchronous & doesnt affect the timing. For convenience, I used a 5v LED to avoid the resistor.

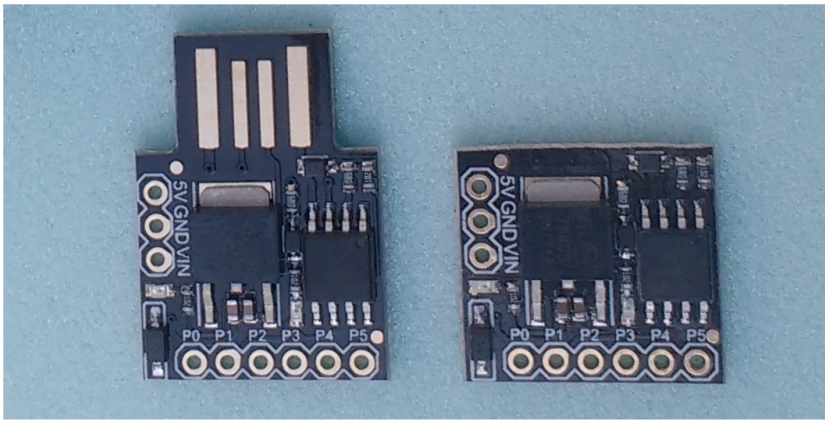
Trim:
Whilst the original Macgregor Digimac 1+1 had no rudder trim at all, this revision does. It gives you fifteen 'digital trim' steps of 10uS in either direction, by holding stick slightly towards the required direction & pressing the button – each trim step 'pips' as you would expect. 10uS is a typical 'trim pip' on most modern sets. Trim changes are saved to flash so they are retained ready for next time you switch on. It might be that 10uS is too small a change, maybe 20uS would be better, lets see how it goes.

So the throttle button now has two functions - when the stick is at or near neutral, it acts as the sequential throttle just like the 1+1 always did, with Franks immediate throttle cut by holding it down - ideal for an unplanned arrival, or if you forget whether your 'mid setting' was on the way up or down.

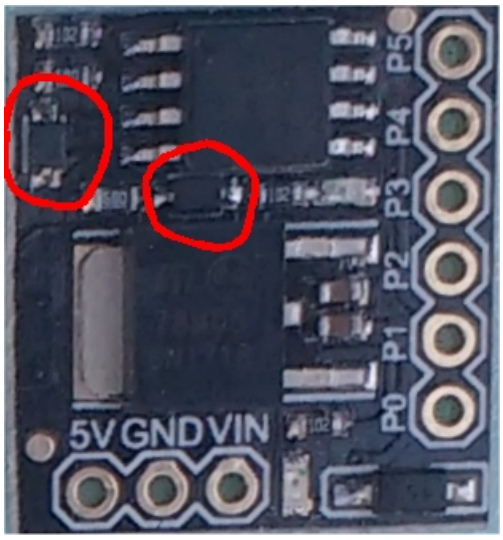
If the stick is thrown partly either way, then the throttle button becomes the 'trim' button. In practise its easy to flick the stick over & press in one quick movement, and if the trim is a long way out, you can rapidly press several times to get several steps of trim. Even so, I expect the trim facility will be used more on the ground for initial setting up than in the air.
It also has the usual inactivity timer which sounds if there's no stick movement for 10 minutes.

Pre-wired boards, ready to go:
I've been sending these out pre-wired as that makes the installation much easier, with just a few wires to connect to the pot, button, and battery. The throttle LED & buzzer are pre-wired. If you ask me for a pre-wired board then you can ignore the mods and programming paragraphs!

Digispark mods :
I prefer to remove the redundant USB connector with a junior hacksaw, a couple of strokes of the permagrit block gets the edge of the board smooth, and then its programmed using a USBASP.



As supplied the board has two schottky diodes D3 and D4 which interfere with the expected operation of port pins P3 & P4. The diodes are easily removed by gently prising with a small screwdriver:

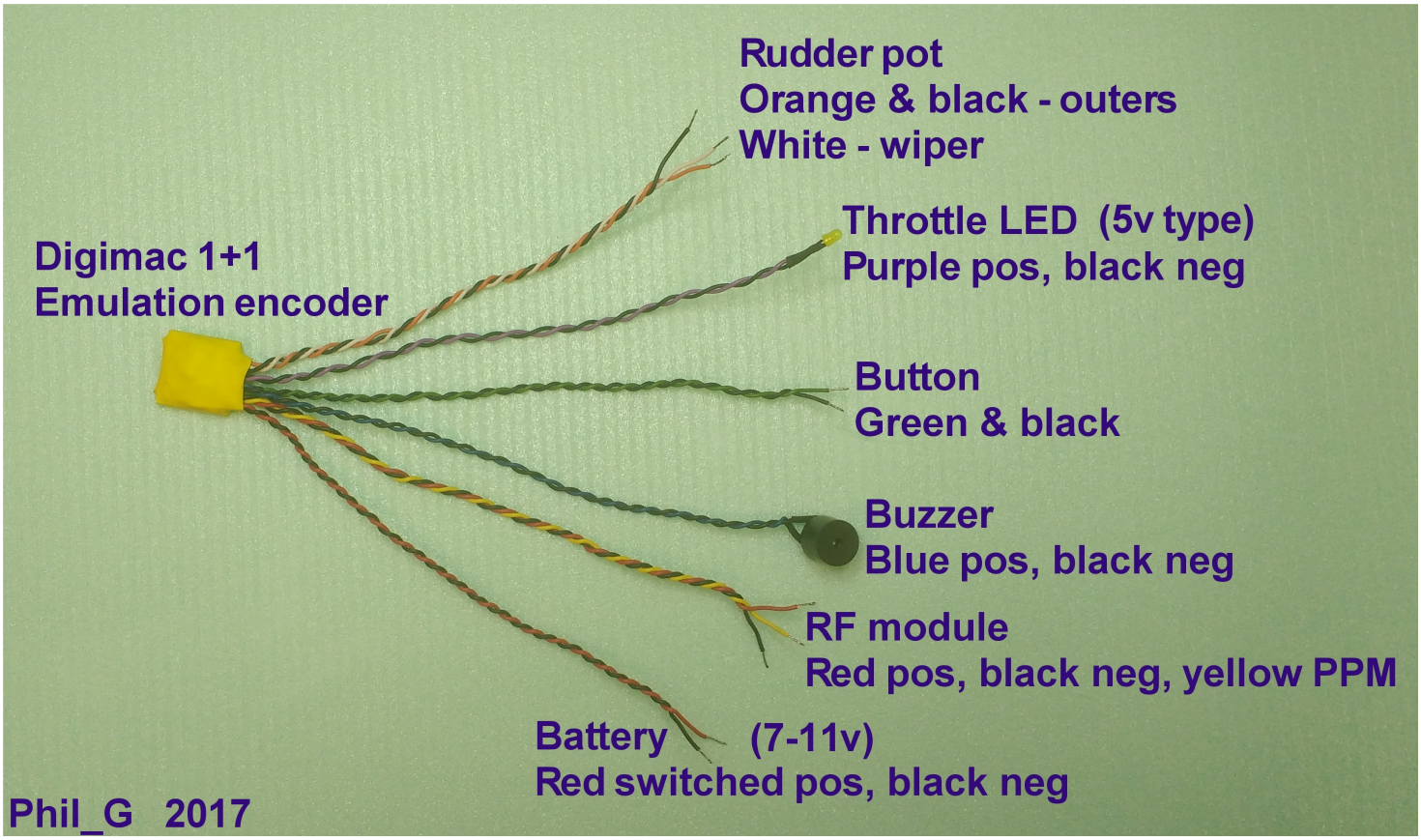


Programming:
Programming the Digispark needs the home-made ICSP adapter, you cant use the USB bootloader as it has a 5 second startup delay (yes, five seconds!). Details are on the Single Channel forum.
One thing I've noticed about the Digisparks is that the clock frequency (nominally 16mhz) is stable but can be anything up to 10% out. In the datasheet the manufacturer states that the clock is factory calibrated to within 10% but can be further calibrated by the end user to within 1% using an oscillator calibration register.
Out of dozens of Digisparks I've only found a couple that were significantly out on timing. If yours is badly out, then in setup() I've included an optional OSCCAL setting where this can be compensated - though its a bit trial-&-error. To avoid recalibrating every time its easier to check the elevator channel

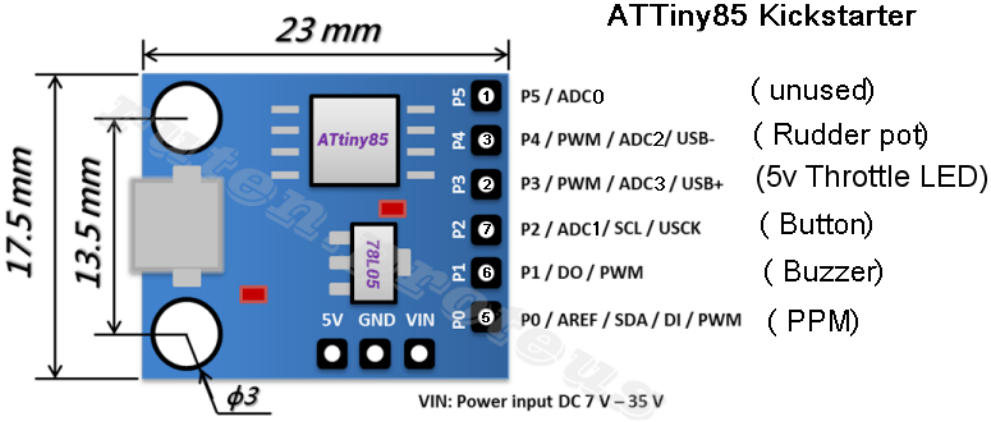
and adjust OSCCAL in units of say 5, until the elevator is near enough 1500uS. If you've not yet built a PPM tester (here, or here) then comment out the OSCCAL line, it won't be that far off without it, whereas a 'wrong' or guessed OSCCAL value could be way out. And once you've 'osccaled' a chip, the factory value is gone, overwritten - theres no 'restore factory defaults' :-)

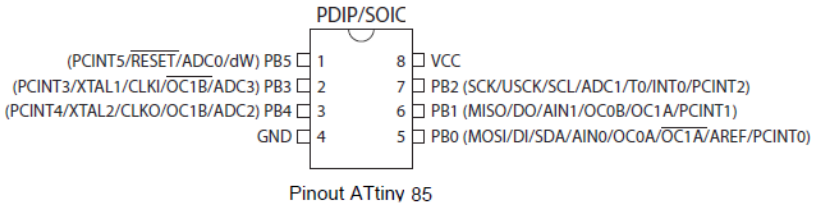
Connections:
The stick pot is wired with the outers connected to neg and 5v (from the Digispark) with the wiper connected to P4. PPM out is on P0, and the DC buzzer is directly wired to P1. The button is wired between neg and P2. Power is 7-10v (a small 2S lipo or Duracel PP3 is ideal) to Vin on the Digispark and also the RF module positive. The throttle LED is a 5v type to avoid a resistor, and is wired long-lead to P3 and short lead to negative. Neg (ground) is common to 6 wired connections so will need a 6-into-1 joint near the PCB.

So far I've been sending these encoders out pre-wired with flyleads and shrink-wrapped, as per the following photo - but the files are items P20 and P21 on the Archive page of http://www.singlechannel.co.uk if anyone fancies DIY.
I'll do a demo video as soon as I get chance.
I'll stick to these colours for any pre-wired requests.

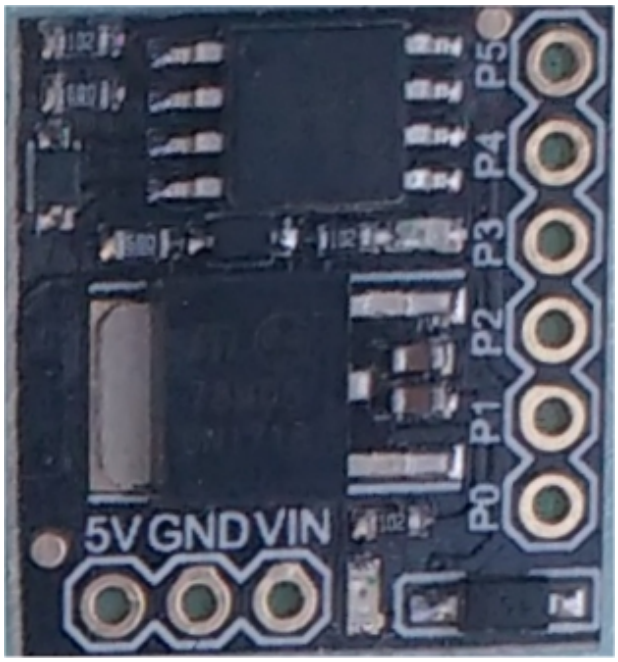


ATTiny85 Kickstarter





Pinout ATtiny 85



Phil_G philg@talk21.com 11/10/2017