New Radio Technologies

or, the Wombat flight computer

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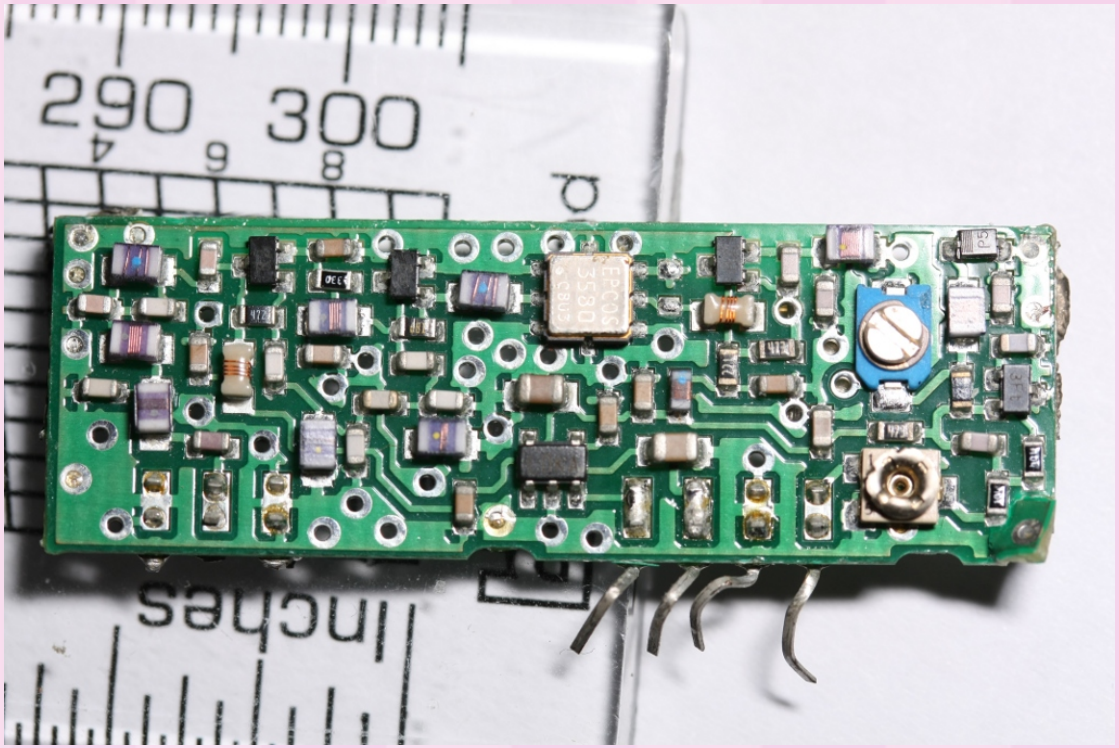
The NTX2

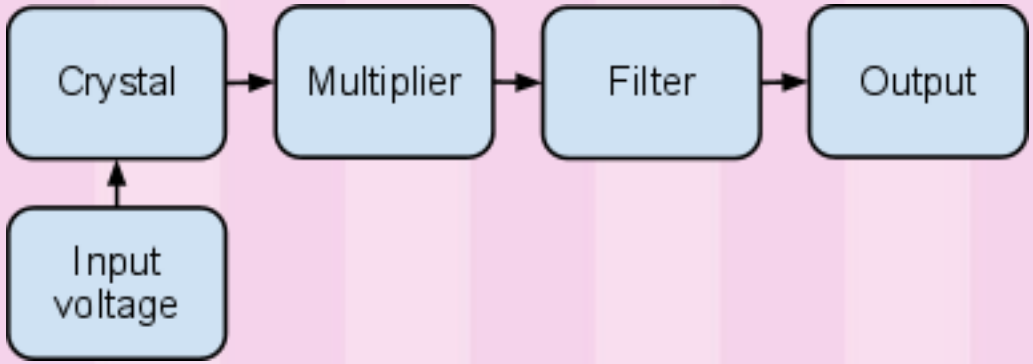
- We've all used this
- It works well
- It's pretty easy to use
- But...

- Can't really change frequency
- Can't change power
- Requires analogue circuitry to obtain useful voltage shifts
- Relatively expensive



NTX2 Theory of Operation

- Crystal makes a stable frequency base
- The input voltage changes its frequency very slightly
- This low frequency is multiplied up to the required output, then filtered and sent out into the world



The Search for Alternatives

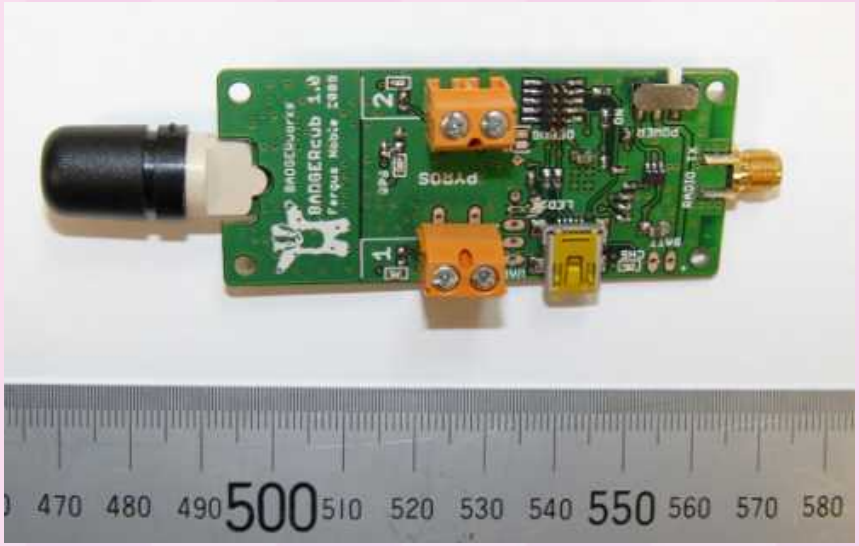
- It's always nice to have options
- There are a wide variety of microchips for doing short range radio, for example in car keys, garage door openers, and so on
- However many are designed for very large shifts (25kHz) which won't work for us
- Some can be hacked into giving small shifts, others actually work with it

Three Competitors

- CC1111 from Texas Instruments
  - can't do small RTTY shifts, but can change its carrier frequency by small amounts to fake it
  - builtin 8051 microcontroller
  - programmable frequency
  - uplink and downlink
- ADF7012 from Analog Devices
  - can do small RTTY shifts directly
  - programmable frequency & power
- MICRF112 from Micrel
  - continuous frequency shift using an analogue input voltage
  - change centre frequency a bit using onboard varicap
  - nothing programmable

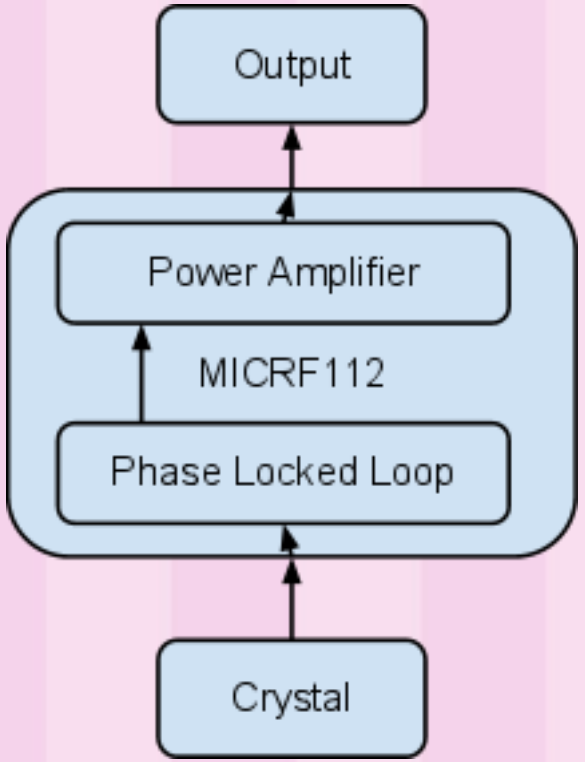
CC1111

- As used in CUSF's Badger & BadgerCub flight computers
- Builtin microcontroller works, but is an 8051 :(
- Small RTTY shifts by changing the transmitter's centre frequency is a little hacky
- Uplink by integrating RSSI over time periods - still not got a good replacement for this, though



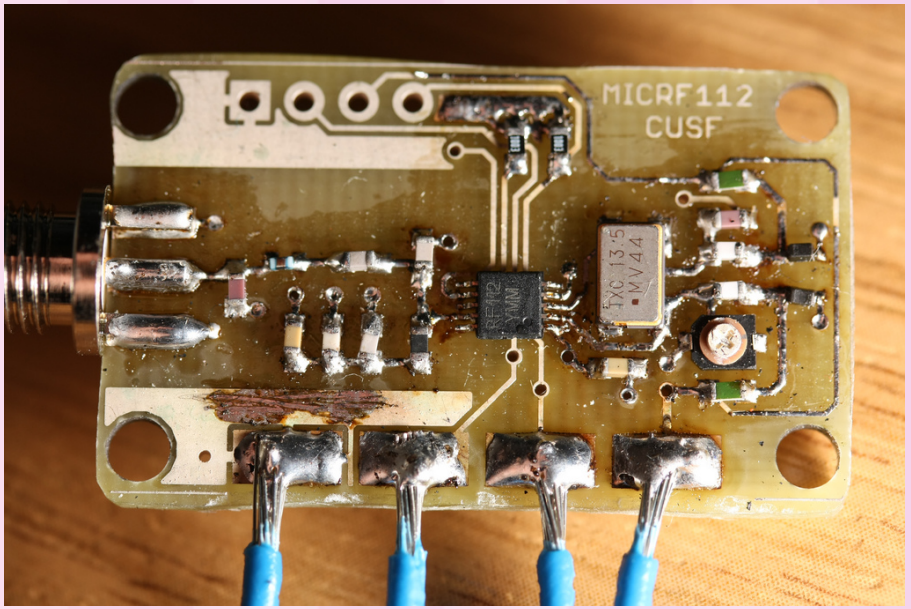
Micrel's MICRF112

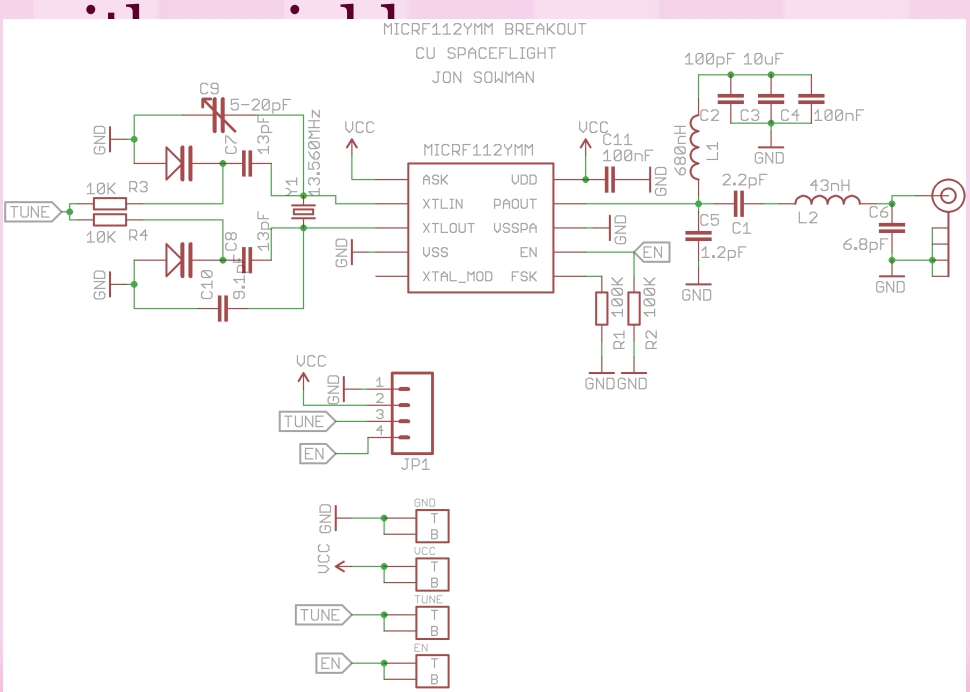
- A lot like an NTX2 in a single microchip
- Crystal input, it multiplies it up to 434MHz and amplifies
- By itself it can just transmit a single frequency tone
- But we can do the same crystal pulling the NTX2 does to get small frequency shifts



Trying the MICRF112

- We made a small test PCB for it with varactors to do the crystal pulling
- It worked! tiny shifts, continuous tuning, super simple
- Can change centre freq a bit



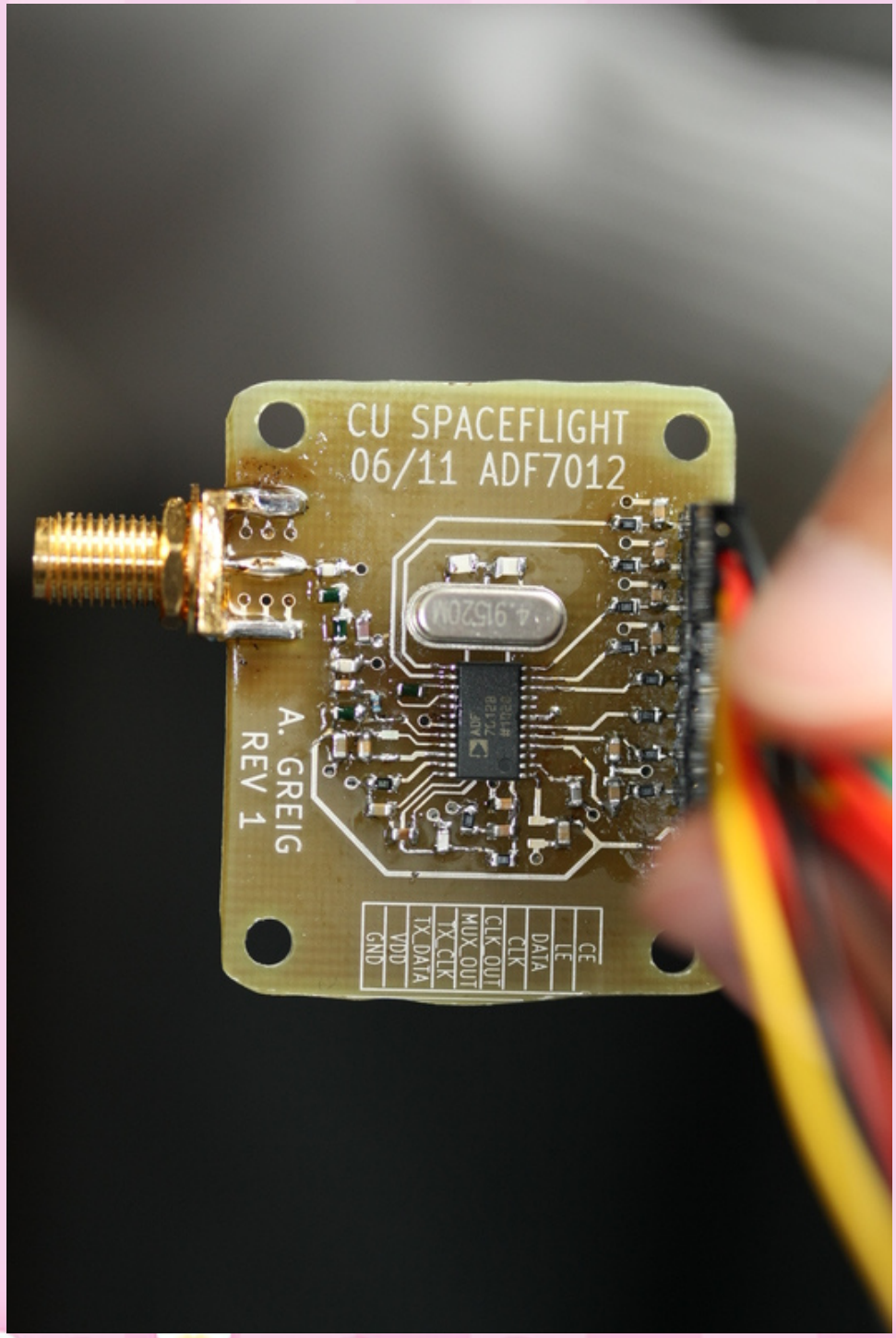


Analog Devices' ADF7012

- Somewhat more complicated
- Has a fractional-N PLL allowing a lot of control over frequency output
- 75MHz to 1GHz output (though hardware filters have to be changed)
- At 434MHz, 300Hz shift possible directly
- Programmable frequency over 433-435MHz+
- Programmable output power 0.02mW to 25mW
- Digital input to toggle RTTY output (just wire it direct to your microcontroller)

Trying the ADF7012

- Made up another evaluation PCB
- Requires somewhat more parts, but still fairly easy to solder up
- Requires a microcontroller writing various onboard registers to configure the radio, turn on the PLL and PA, setting the fractional-N PLL, setting the shift, and so on
- still worked in the end! super duper easy 300Hz RTTY, plus program your own frequency



Wombat

- A flight computer in two parts
- Radio module
  - AD7012 Radio
  - AVR to interface it
  - Simple six-pin interface to configure the radio and transmit data
  - Simpler, smaller, more flexible and more powerful replacement for an NTX2
- GPS module
  - uBlox6 GPS and LiPo+charger
  - Connects to the radio module to turn the combination into a full flight computer, running different software on the AVR

That's it!

- Watch out for more news on Wombat and the radio module soon
- Any questions?
- Thanks!