Simple "fast" Huff & Puff VFO Stabilisers

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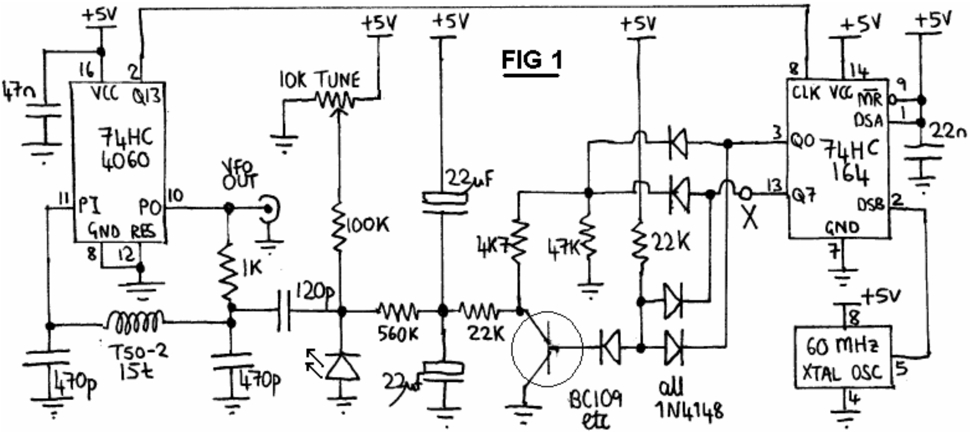
In my article in SPRAT 122 titled "Simple Huff & Puff VFO Stabilisers" I remarked that for the ultimate stabilisation performance, nothing beats Peter Lawton's "fast" stabiliser architecture, which he described in a QEX article in November 1998. I have now developed a simplified version of the "fast" circuit which uses just two logic IC's. It can stabilise a worse VFO, or stabilise a good VFO with much less frequency ripple. This also implies that it can stabilise much higher frequency VFO's, potentially even up to VHF!

The "fast" design incorporates a shift-register delay line and compares the current latched state of a crystal reference oscillator against its state Z periods previously. These two states are combined in a logical Exclusive OR gate (XOR) and integrated, which produces the feedback signal to control and stabilise the VFO. Note: a XOR gate produces a logic 1 output if either of its inputs are 1; but a 0 output if both inputs are 0 or both are 1.

This style of stabiliser provides a kind of statistical averaging of the up/down pulses from the XOR gate, compared to the standard Huff Puff stabiliser method. The correction pulses arrive Z times more frequently and therefore the accumulated error in the VFO before it is corrected, is much less. In other words, the stabilisation loop operates much more quickly. The "fast" stabiliser has been likened to a whole collection of Z ordinary stabilisers operating simultaneously on the same VFO. The formula for step size is:

Step = 10^6 x VFO^2 / (Z x M x xtal)   where

VFO is the VFO frequency in MHz,
Z is the number of stages of delay,
xtal is the crystal reference frequency in MHz, and
M = 2^n where n is the number of divide-by-2 stages in the VFO divider.



NOTE: Use an onboard regulated (e.g. 7805) supply, dedicated just to this circuit!
In Fig. 1, I use the internal oscillator of the 74HC4060 as a VFO on about 10MHz. Varicap tuning is accomplished with a standard 5mm red LED as before. In this circuit I used a transistor with a few diodes and resistors to implement the function of XOR gate! The 1st and 8th outputs of the shift register are compared therefore the effective length of the delay line is 7 stages. The crystal reference frequency should be as high as possible: I used a canned oscillator. They can often be recovered from old computer boards.

An alternative implementation is shown in Fig. 2, in which a real XOR gate (74HC86) is used in place of my transistor-diode-resistor version. This adds a 3rd IC but allows use of one of the XOR gates as the VFO: my feeling is that this produces a superior oscillator to the internal 74HC4060 oscillator. Spare XOR gates can be used as VFO buffers.

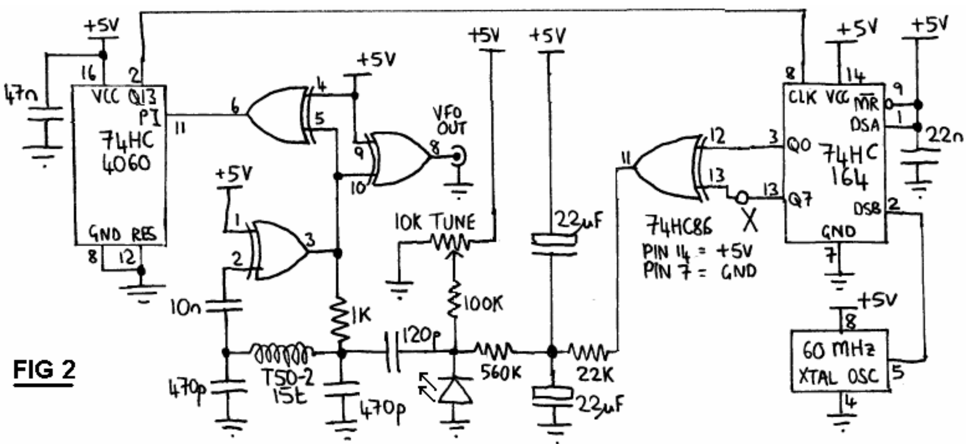


FIG 2

If an existing external VFO is to be stabilised, the input circuit in Fig. 3 can be used as a suitable buffer and should feed the 74HC4060 divider directly at pin 11, omitting the oscillator tank.

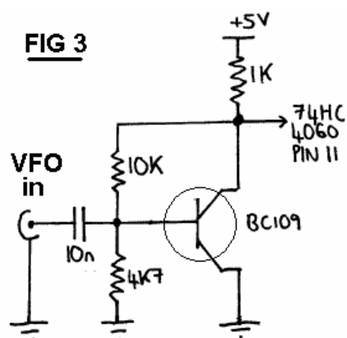
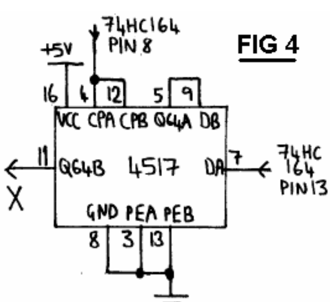
FIG 3


FIG 4


To increase the number of delay stages, more shift registers can be inserted in series at point X, clocked by the same output from the 74HC4060. An ideal candidate is the 4517 (sometimes called CD4517, or HEF4517 etc.) which provides 128 shift register stages. Note that this IC is not available in the modern high speed 74HC-family so it must come AFTER the 74HC164, such that the '164 faces the high speed edges of the 60MHz signal.

References: http://www.HansSummers.com/radio/huffpuff