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RSGB Intermediate Licence Exam Construction Project
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Crystal Calibrator (Frequency Marker Generator)

The circuit and information came via Sean Williams M1ECY from the ARRL Handbook.

A line film was made of the artwork and a PCB etched, this was then drilled out on a pillar drill using a 0.1mm drill bit.

The components were sourced, laid out and construction began. I used the version with a 4MHz crystal and so 3 jumpers were used to utilize the correct parts of the IC's for this value crystal.

The IC's are affixed in IC holders which meant that I did not have to directly solder the IC's.

I used "LS" and "LO" for IC's and voltage regulator components which according to the circuit information will draw much less current and greatly extend battery life.

The reason for usage of a Crystal Calibrator

It is a strict licence condition that transmitted signals stay inside the frequency limits of the bands allocated by our particular licence. There are no tolerences.

We must be sure that our signal stays within these limits. Normally this is fine if we are using a modern transceiver with a PLL synthesised frequency source. All we have to do is to check occasionally against a stable frequency standard such as MSF Rugby or WWV. Older equipment requires simple equipment such as the above calibrator and careful adjustment, this is used through a receiver.

A very simple description of a Crystal Calibrator/Marker Generator

A Crystal Calibrator/Marker Generator in its simplest form is a highly stable oscillator that generates a series of harmonic signals. When an appropriate fundamental is chosen, harmonics fall near the edges of the amateur (in the radio amateur case) frequency allocations. So starting from a stable frequency standard such as above, the idea is to tune in a signal of a known frequency and calibrate the marker generator - this is done by the adjusting the miniature trimmer capacitor. This then generates harmonics (If they are strong enough) throughout the spectrum from this point - in the case of the above piece of equipment - in either 100KHz, 50KHz or 25KHz intervals. It is then a simple matter to count off the points to check or recalibrate accurately the receiver tuning dial.

An extremely simple description of how the circuit works

The 78LO5 is a voltage regulator which takes in this case 9V and makes it 5V as required by the circuit
The Crystal generates a stable 4MHz oscillation through the 74LS00 (quad NAND gate)
This is divided by the 74LS74 by 2 to 2MHz and again by 2 to 1MHz (dual D flip-flop)
This is divided by the 74LS90 by 10 to **100KHz** (decade counter)
This is divided by the second 74LS74 by 2 to **50KHz** and again by 2 to **25KHz** (dual D flip-flop)

In the division process the harmonics of the generator are strengthened so they are useful up to the VHF range, but even so as frequency increases the harmonics weaken.

The equipment has been checked and verified as working correctly by Malcolm G0UYN