Crystal Calibrator.

A radio receiver able to receive radio signals in the range of 100kHz to 30MHz is all very well but to be able to find stations at a particular frequency, it needs to be calibrated - i.e. have a scale indicating the frequency it is tuned to.
With such a wide range of frequencies covered, the tuning scale could be very large and complicated. To overcome this problem, the scale on the tuning control panel is marked from 0 to 100 and the waveband control is marked from 1 to 12.
(templates for suitable scales are shown at the end.)
A calibration table can then be made for the receiver as shown at the end.
Without any extra equipment, sections of the calibration table can be filled in by identifying the radio stations heard and then either listening to when they anounce their transmission frequency or looking up their frequency on the internet.
While this can be entertaining (at least for a while) only certain frequencies can be calibrated.

A reliable method of calibrating the whole frequency range is to use a Crystal Calibrator.
A crystal is a piece of quartz manufactured to have a specific and very stable resonant frequency.
Traditionally, a crystal calibrator would have either a 1MHz or 100kHz crystal, oscillating in a circuit and producing harmonics which extend throughout the radio spectrum.
By connecting the crystal calibrator to the receiver, the position of these harmonics on the tuning dial could be recorded, and so the dial calibrated.
A problem arises with this system on the higher frequency bands - e.g. is the harmonic at 24 or 25MHz?

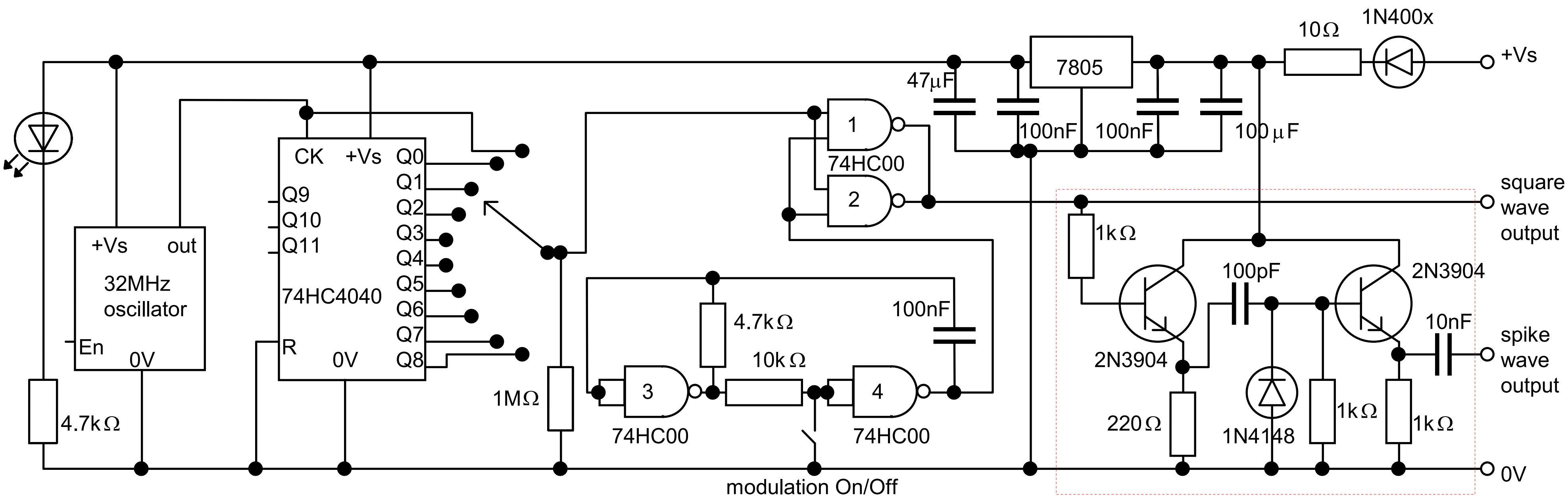
The problem can be solved by having more higher frequencies, e.g. 8MHz. With the calibrator set to 8MHz, the 24MHz position could be noted, and then when the calibrator is set to 1MHz, it is easy to determine whether the position is 24 or 25MHz.

High frequency crystal oscillator modules are available cheaply, as are high frequency logic ICs.
The crystal calibrator described here uses a 32MHz crystal oscillator module (liberated from an old PC, though readily available from Farnel and RS Components) and a 12 stage frequency divider.
The table below shows the fundamental frequencies available.

Fundamental output frequencies (MHz)	Fundamental output frequencies (kHz)
32	500
16	250
8	125
4	62.5
2	31.25
1	15.625

A 10-way switch is used to select the fundamental frequency (this was available and the lowest frequencies are of limited use anyway).
Harmonics of all of the fundamental frequencies extend to well beyond of 30MHz.
To aid reception of the signals from the Crystal Calibrator, the output is modulated at a frequency of 1kHz, and so can be heard as a tone in the receiver.

Circuit diagram



How it works.

The 7805 and its associated components form a 5V regulated power supply.

The 32MHz oscillator unit provides the input for the 74HC4040. The selector switch enables selection of the required frequency which is then buffered by gates 1 and 2 of the 74HC00. Gates 3 and 4 of the 74HC00 form a ~1kHz astable which controls the output from gates 1 and 2 when the modulation switch is open.

The section in the dotted red box produces a 'spike' output for the lower frequencies. The spikes are rich in harmonics which extend beyond 30MHz.

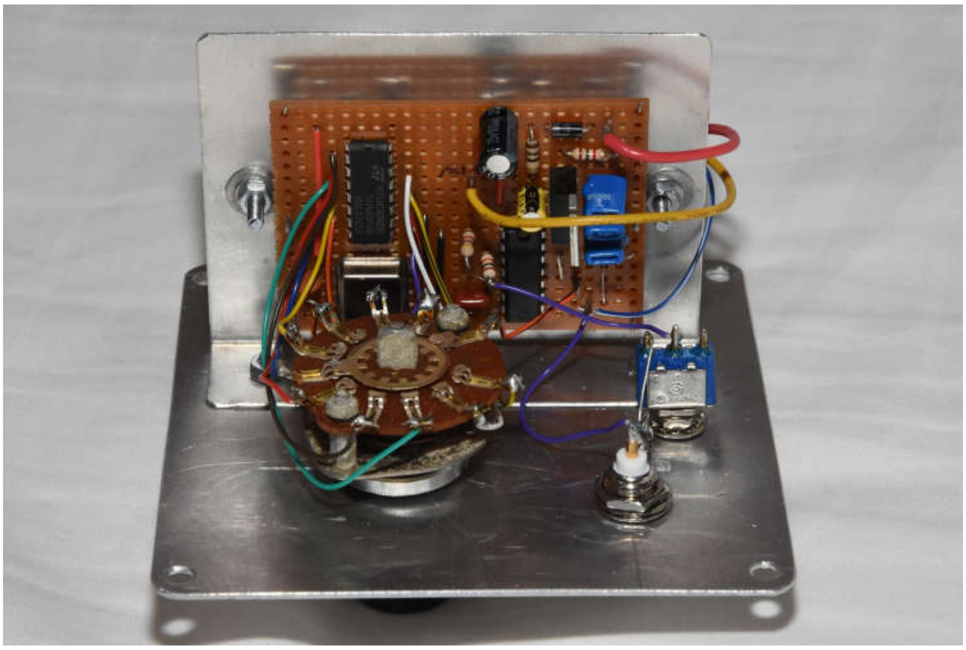
For the higher frequencies (16 and 32MHz) the pulses pass through largely unaffected.

This section was built on a separate board and may well be replaced in the future with a logic gate version which may produce narrower spikes (more harmonics).

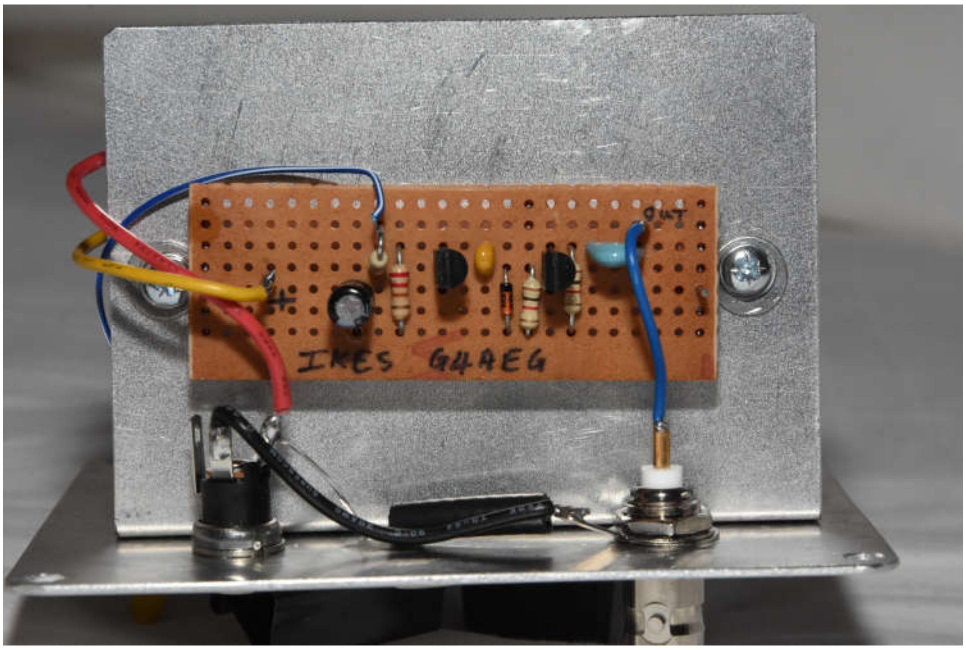
Construction

The layout is not critical, but long wires should be avoided as they will increase the rise and fall time of the pulses, which will reduce the number of harmonics produced.
The original was built onto a 10.2cm (4 inch) square panel which fitted into an old metal box.

The main board was a standard Project 60 subsystem strip board and is shown in the picture below along with the main selector switch, modulator switch and square wave output socket.



The 'spike' board was built on an offcut of strip board, but with the same type of ground connections as the standard Project 60 subsystem strip boards.
The picture below shows the 'spike' board mounted on the rear of the aluminium sub-panel and also shows the power input socket, a LED 'on' indicator and the spike output socket.



Scale	1	2	3	4	5	6	7	8	9	10	11	12
0												
10												
20												
30												
40												
50												
60												
70												
80												
90												
100												