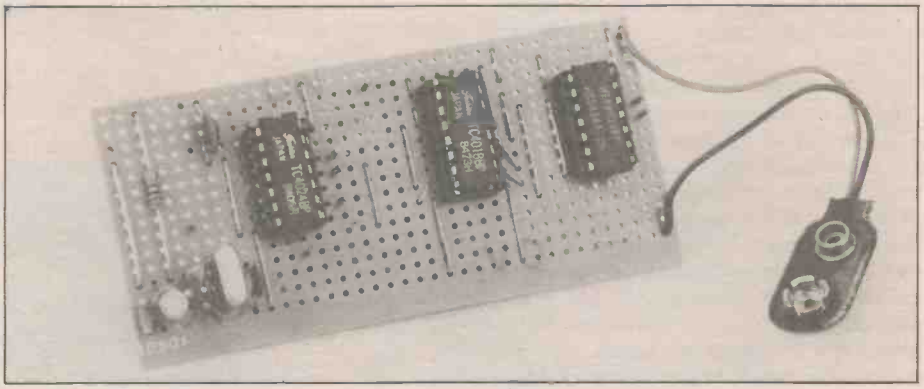
Crystal Calibrator

Some years ago a crystal calibrator offering a wide range of fundamental frequencies was a costly piece of equipment. Things have gradually changed, with the more popular crystals now costing what is in real terms probably less than one tenth of their cost ten or more years ago. Also, logic integrated circuits are now at virtually give away prices, and with digital dividers it is possible to generate a wide range of output frequencies from a single crystal oscillator.

This unit has a fundamental output at 4MHz, with additional outputs at 2MHz, 1MHz, 500kHz, 250kHz, 100kHz, 50kHz, and 25kHz. This may seem of limited value if the unit is to be used as a calibration oscillator for a shortwave radio, but bear in mind that these are only the fundamental signals, and that harmonics are available at frequencies to beyond 30MHz. Thus, for example, the 1MHz output also provides signals at 2MHz, 3MHz, 4MHz, 5MHz and so on. The outputs from 25kHz to 2MHz are all good quality squarewave types. In theory, the even harmonics (e.g. 2MHz, 4MHz, 6MHz with a 1MHz fundamental) are absent from a squarewave signal, but in practice these frequencies are generally relatively weak rather than absent, due to slight imperfections in the waveform. A pulse shaper could be added at the output in order to give a better spectrum of harmonics, but this is probably not worthwhile. The even harmonics will be of more than adequate strength without the aid of any pulse shaping. Because the output is a squarewave, the unit is also well suited to use as a timebase calibrator for an oscilloscope. It gives times ranging from 500ns per cycle at the 2MHz output to 40ms per cycle at the 25kHz output.



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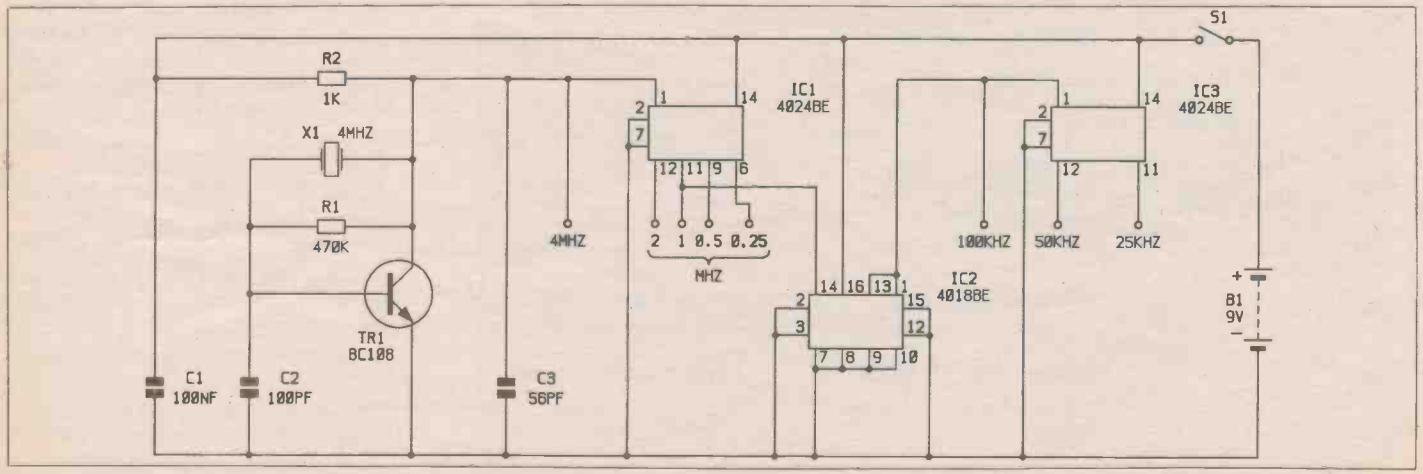

Crystal Calibrator Circuit.

The circuit is quite conventional, and has TR1 as a crystal oscillator operating at 4MHz. A non-buffered 4MHz signal is available direct from the collector of TR1. C2 could be changed to a preset type to permit trimming of the output frequency. For most purposes this is unnecessary, as the frequency error is likely to be no more than a couple of Hertz if no trimming is used, and few applications genuinely require even this degree of accuracy. The 4MHz signal is fed to a CMOS 4024BE seven stage binary ripple counter (IC1). Only four stages are actually used in this circuit, and these produce outputs at 2MHz, 1MHz, 500kHz, and 250kHz. The 1MHz output is fed to the input of IC2. This is a CMOS 4018BE divide by 'N' counter, and in this circuit it is connected to give divide by ten operation. This gives the 100kHz output signal. This signal is also fed to the input of another 4024BE ripple counter (IC3). Only the first two stages of this are used here, and these provide the 50kHz and 25kHz output signals. Of course, the other outputs of IC3 could be used if desired, and they give output frequencies of 12.5kHz, 6.25kHz, etc. However, in practice these lower frequencies are likely to be of limited value. The eight outputs can be taken to separate sockets, or for greater convenience can be taken to a single socket via an eight way switch (which must be a break before make type).

Construction of the unit should not prove to be particularly difficult, but remember that all three integrated circuits are CMOS types, and that as such they require the standard anti-static handling precautions to be observed. Also, care should be taken when connecting X1, as overheating due to keeping the bit in place on the joints too long could impair the accuracy of the unit.

When coupling the output to a shortwave radio no direct connection should be made between the two units. Apart from possibly overheating the output of the unit, this would almost certainly give an excessive signal level at the receiver. An adequate signal transfer can usually be obtained by connecting a short lead to the output of the calibrator, and placing this close to another lead connected to the aerial input of the receiver.

CRYSTAL CALIBRATOR PARTS LIST

RESISTORS: All 0.6W 1% Metal Film			
R1	470k	1	(M470K)
R2	1k	1	(M1K)
CAPACITORS			
C1	100nF Ceramic	1	(YR75S)
C2	100pF Ceramic	1	(WX56L)
C3	56pF Ceramic	1	(WX53H)
SEMICONDUCTORS			
IC1,3	4024BE	2	(QX13P)
IC2	4018BE	1	(QX10L)
TR1	BC108C	1	(QB32K)
MISCELLANEOUS			
B1	9 volt PP3 Battery	1	(FK58N)
S1	SPST Ultra-min Toggle	1	(FH97F)
X1	4MHz HC-18/U	1	(FY82D)
	Battery Connector	1	(HF28F)
	DIL IC Holder 14 pin	2	(BL18U)
	DIL IC Holder 16 pin	1	(BL19V)