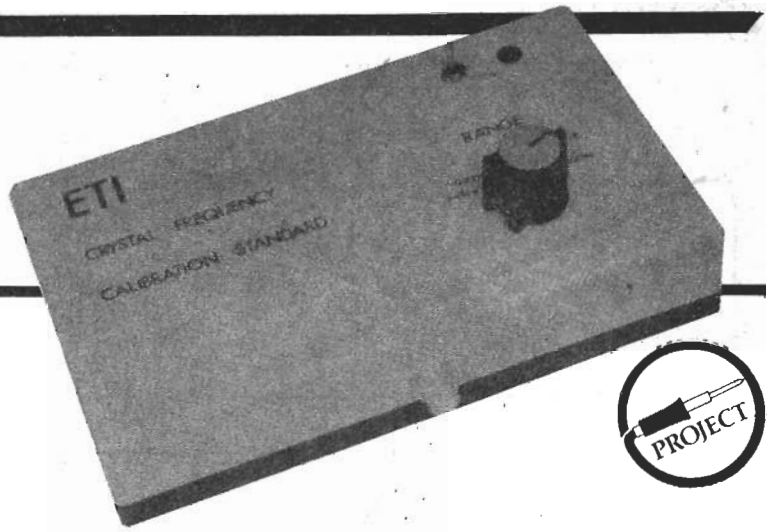
Crystal Marker



A simple but useful piece of test gear. Ideal for spot calibrating radio dials, 'scope timebases, etc.

THIS SIMPLE piece of test gear produces a square wave output with any one of six selected frequencies or periods. The outputs which range from 100 Hz (10 mS) to 1 MHz (1 uS), are derived from a crystal oscillator via decade divider stages and thus have a high degree of frequency/period precision. The instrument is thus specifically intended to be used as a precision frequency/period standard, for calibrating items such a radio dials, 'scope timebases, etc.

To calibrate a radio dial, loosely couple the output of the instrument to the radio antenna (i.e., dangle a bit of wire near to the aerial), switch to the 1 MHz range and then tune the radio through its ranges, marking off the dial points at which the 1 MHz signal and its harmonics (up to about 30 MHz) are heard as a heterodyned 'zero beat' audio signal. Then repeat the procedure at lower standard frequencies (100 kHz, 10 kHz, etc) until the dial is adequately calibrated.

To calibrate a 'scope timebase, simply connect the output of the calibration standard to the Y amplifier of the 'scope and then run through the timebase ranges, checking that the indicated periods agree with those of the calibrator.

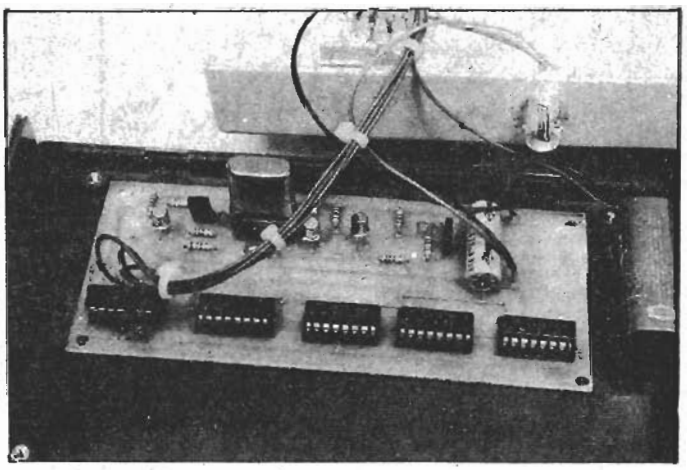
Construction

This is a fairly simple project and construction should present few problems. Most components are mounted on a single PCB. Note here that five links are used on top of the PCB and that the crystal and the five ICs must all be mounted in suitable sockets.

When the PCB construction is complete, mount it in a suitable box and make the interconnections to SW1, SW2 SK1 LED1-R9 and B1. The unit is then ready for use.

The basic instrument has a typical accuracy of better than 0.01% with the C2 value shown. If you want better accuracy than this and have access to a precision frequency standard , replace C2 with a 100pF trimmer and adjust it to give a precise 1 MHz crystal oscillator frequency.

If you liked this project, please circle Reader Service Card number 57. If you didn't, circle number 58.



For those of you who have always wanted to know what the inside of a crystal calibrator looks like but were too bashful to ask, here it is. You could go mad with a power drill (or sharpened boy scout) drilling holes for PCB bolts and battery clips. We've found sticky pads to be perfectly adequate.

HOW IT WORKS

The heart of the instrument is the crystal oscillator designed around Q2-Q3. Q3 is wired as a common base amplifier. Its collecter signal is buffered by emitter follower Q2 and then coupled back to Q3 emitter via the series-resonant 1 MHz crystal, thereby causing Q2-Q3 to oscillate at the crystal frequency. The oscillator output signal is then amplified by Q1 and converted to a clean square wave by Schmitt trigger IC1a.

The 1 MHz square wave from IC1a is used to clock a chain of cascaded decade dividers to generate standard frequencies of 100 kHz, 10 kHz and 100 Hz. All of these signals are made available at output socket SK1 via SW2 and are individually buffered by Schmitt inverters (IC1b to IC1f).

The instrument is powered from a single 9V battery. LED 1 illuminates while SW1 is closed.

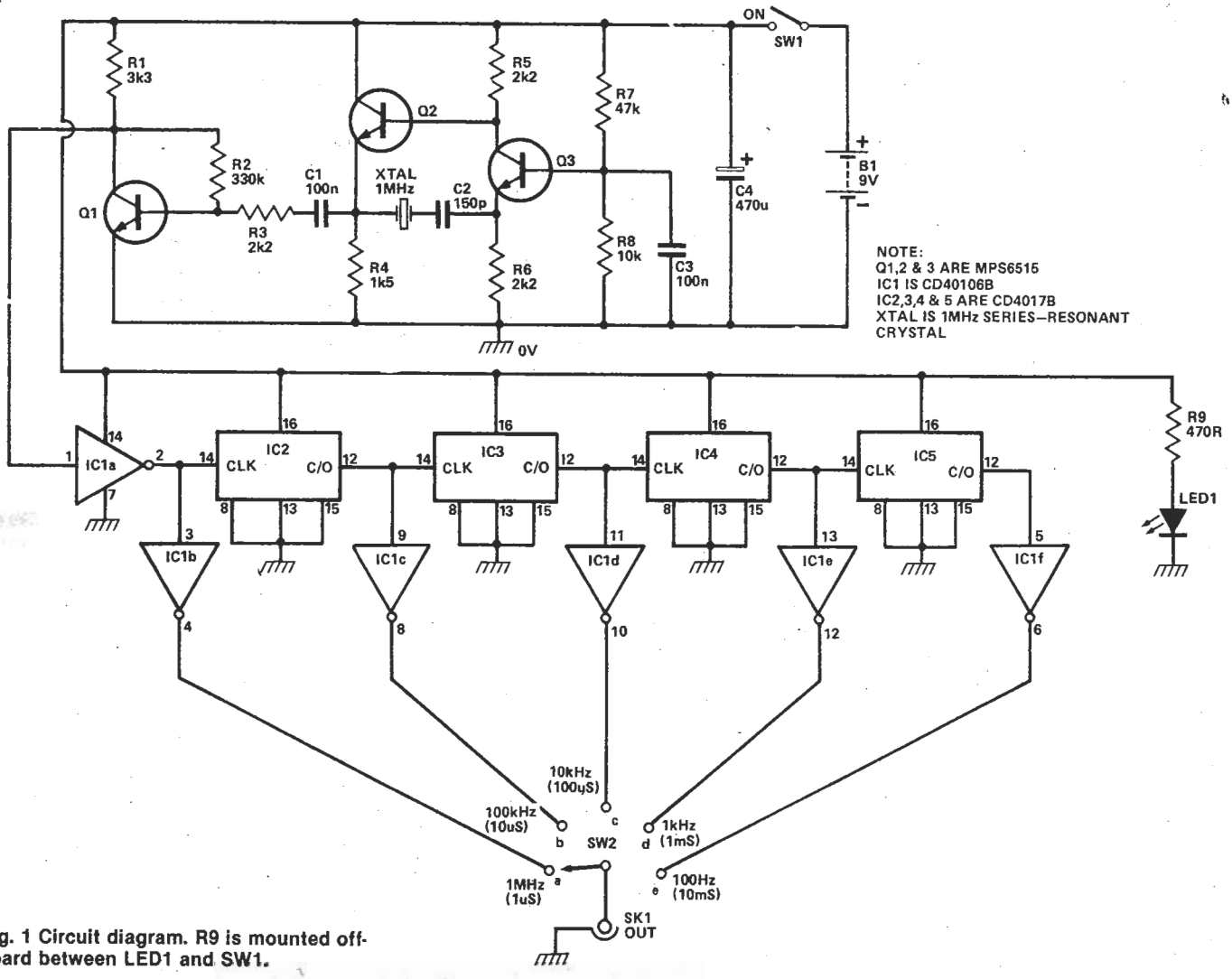
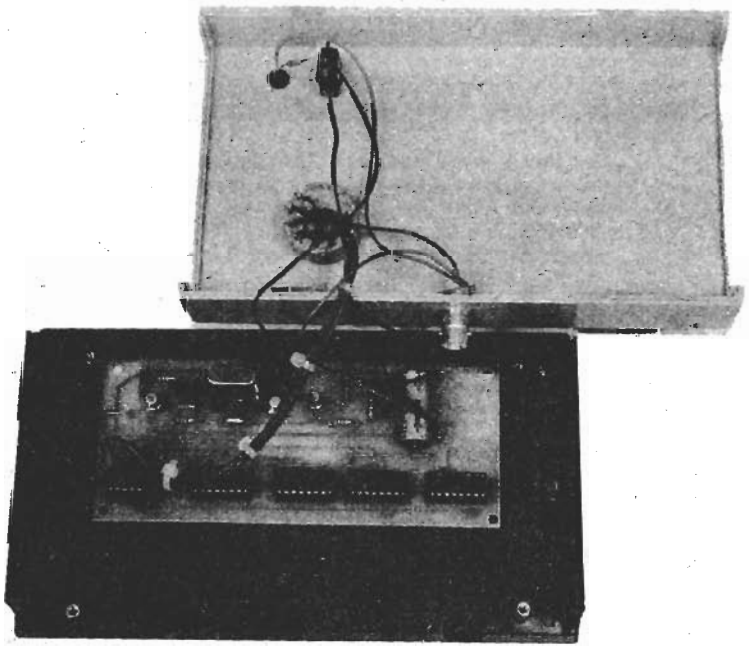


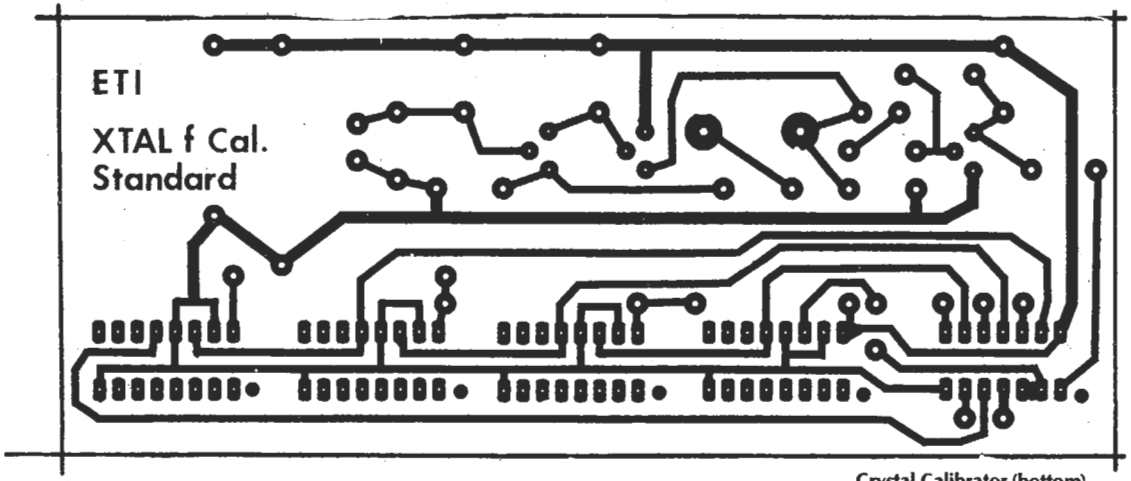
Fig. 1 Circuit diagram. R9 is mounted off-board between LED1 and SW1.



We can confidently predict that you won't have any trouble fitting the specified components into the case used!

PARTS LIST

Resistors all ¼W, 10%	
R1	3k3
R2	330k
R3,5,6	2k2
R4	1k5
R7	47k
R8	10k
Capacitors	
C1,3	100n ceramic
C2	150p polystyrene
C4	470u 25V electrolytic
Semiconductors	
IC1	CD40106B
IC2,3,4,5	CD4017B
Q1,2,3	MPS6515
XTAL	1 MHz
LED1	TIL 220
Miscellaneous	
SW1	SPST miniature toggle
SW2	1 pole 5 way rotary switch
Case	
SK1	BNC (50R) Socket
knob to suit	



Crystal Calibrator (bottom).

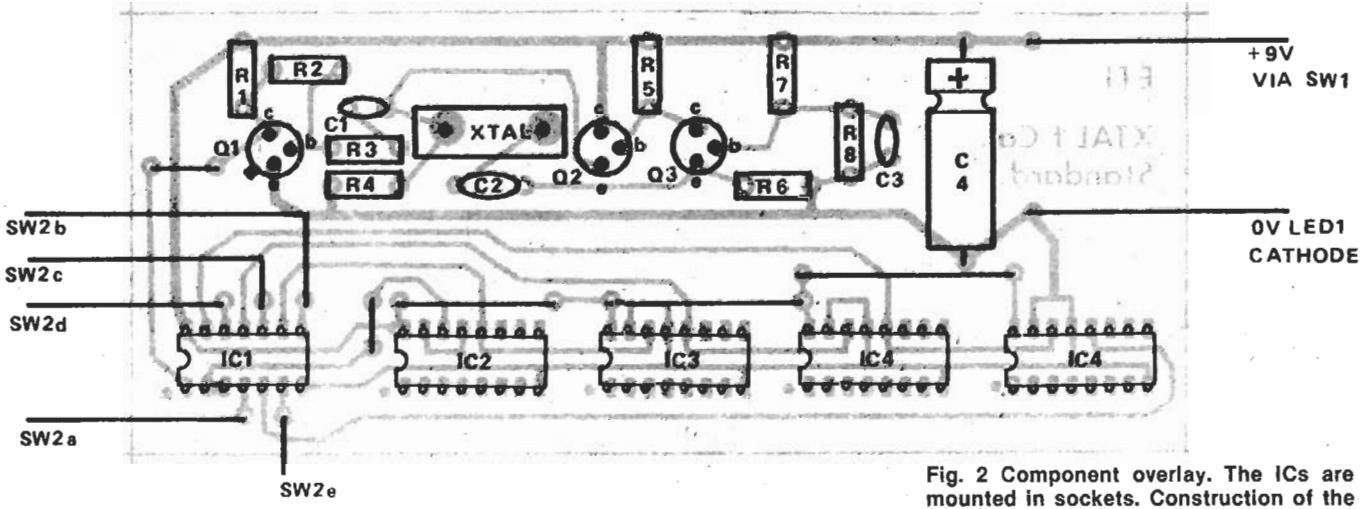


Fig. 2 Component overlay. The ICs are mounted in sockets. Construction of the board is fairly straightforward.