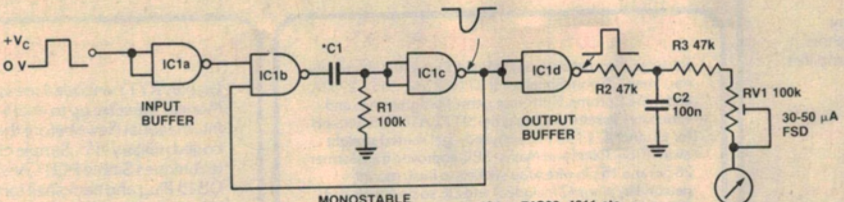
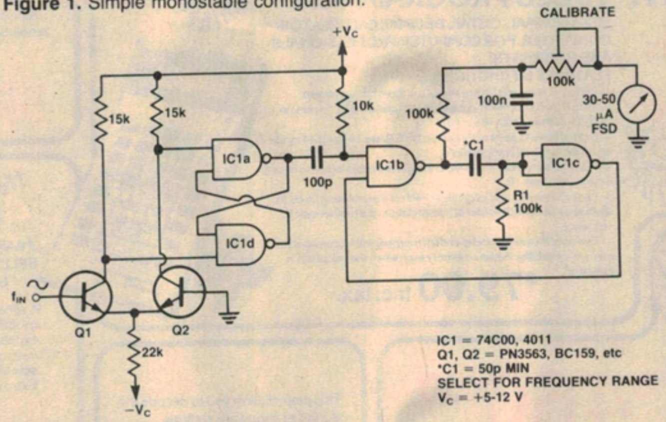
Economy analogue frequency meter



IC1 = 74C00, 4011 etc.
V_C = +5 V to +12 V REG.
PIN 14, IC1 = $+V_C$
PIN 7, IC1 = 0 V (GND)
*SELECT C1 FOR FREQUENCY RANGE.
e.g: C1 = $1/R_1 \times f_{MAX}$

Figure 1. Simple monostable configuration.



IC1 = 74C00, 4011
Q1, Q2 = PN3563, BC159, etc
*C1 = 50p MIN
SELECT FOR FREQUENCY RANGE
V_C = +5-12 V

Figure 2. Modified frequency meter.

R1	C1	Theoretical max. frequency of measurement	Recomm. calibration FSD
100k	100n	143 Hz	100 Hz
100k	10n	1.43 kHz	1 kHz
100k	1n	14.3 kHz	10 kHz
100k	100p	143 kHz	100 kHz

H. Nacinovich of **Gulgong NSW** says that this circuit is simple, easy to build and get going, and uses very little standby power.

There is no reason why it could not run off a 9 V radio battery but some form of power supply voltage regulation is recommended.

The circuit might be built into a suitable case, complete with a meter, or it could be used as an outboard adaptor (i.e: minus meter movement) which can be plugged into an ordinary multimeter.

Alternatively, although I have not tried this, it could be built into an existing multimeter case. For example, if a spare multimeter is on hand one might be willing to sacrifice, say, the 'Ohms' ranges and convert the associated switch positions to 'Frequency' ranges. The modification should not be beyond the ingenuity of most hobbyists.

Another possibility is to incorporate it into an audio signal generator.

I must confess that the circuit does not involve any new ideas. However, I have not seen any analogue frequency meter projects published recently. So, I thought that this project might be appreciated, if not by the advanced enthusiast, then at least by the newcomer or one with limited cash and limited spare time.

There have been plenty of digital frequency meter circuits published recently. Bearing in mind the performance capability of such circuits and the relatively low cost of digital ICs these days, the popularity of DMFs is not surprising. Even so, I would not consider a DFM either a simple or a cheap project to build.

Despite all the obvious advantages of a DFM there are many situations in which one might get by quite happily with an analogue meter which covers the audio to sub-radio spectrum and has about the same order of accuracy as, say, an ordinary multimeter. Now, if such a device could be built using a single, low cost IC, a few passive components, a simple power supply and, possibly, a meter which is already on the workbench or lying idle in a cupboard somewhere, well . . .

The circuit described has the best balance of the desired features. I incorporated it into a Wien bridge-type audio oscillator which I had previously built and used the meter to monitor the output frequency.

The obvious advantage of this arrangement is that I need not rely on the dial calibration which is subject to too many sources of error. From tests I have made to date, the linearity and stability which can be obtained with the circuit are surprisingly good over the entire range of my oscillator, 20 Hz to 200 kHz.

The circuit shown in Figure 1 is based on the use of CMOS NAND gates in a simple monostable configuration. It produces an output current signal which is linearly proportional to the input frequency.

Two gates, IC1b and IC1c of a quad package form the heart of the monostable. IC1a and IC1d are employed as input and output buffers respectively. Their purpose is mainly to square up any rounded corners on the input and output signals.

The output from IC1d is in the form of a series of positive rectangular pulses of constant width (determined by the time constant R1C1) and a frequency equal to the input frequency. These pulses are integrated and the resultant signal is applied to a meter movement of suitable sensitivity.

I used an ordinary multimeter movement with 30 µA FSD sensitivity but there seems to be no reason why a less sensitive movement (e.g: 1 mA FSD) could not be used provided that the values of R2, R3 and VR1 are adjusted accordingly.

Calibration will depend on the choice of component values, the meter sensitivity and on variations between ICs from different manufacturers. Thus some experimentation with component values may be necessary and the values shown are therefore meant as a guide only.

With any combination of R1 and C1, the upper limit of frequency which can be measured will depend on the product R1 C1. As a rough rule of thumb choose R1 C1 to be equal to $1/f_{max}$, where f_{max} corresponds to the chosen input frequency for full scale deflection.

Then, with an input signal of known frequency adjust VR1 for a suitable meter deflection. It is possible to cover different frequency ranges simply by switching in different values for C1, leaving all other component values as they are. For example, to increase the range by 10, reduce the value of C1 by 10, and vice versa. Some trimming of component values may be necessary.

Calibration will also depend on the supply voltage which should be regulated. I have used a 12 V mains powered regulated supply, but if a 9 V battery is used I would recommend the use of a series regulator with low standby current, such as the µA105.

Figure 2 is a modified version of Figure 1 and it gives a very good performance. It is useful when the input signal needs to be conditioned, such as low level sine waves, to produce a square wave input to the monostable portion of the circuit.

Basically, IC1a and IC1d are wired as a flip-flop which changes its output state with a snap action when the inputs to these gates alternately go low. There are a number of different ways of driving such a flip-flop, but in this case I chose to use a pair of transistors connected as a differential amplifier.

This has the advantage that it can be dc coupled to low frequency, ground referenced signals and it also gives a modest amount of signal amplification. However, this arrangement does need a dual power supply. The input sensitivity is better than 200 mV p-p, depending on the gain of the transistors and the supply voltage. ▶