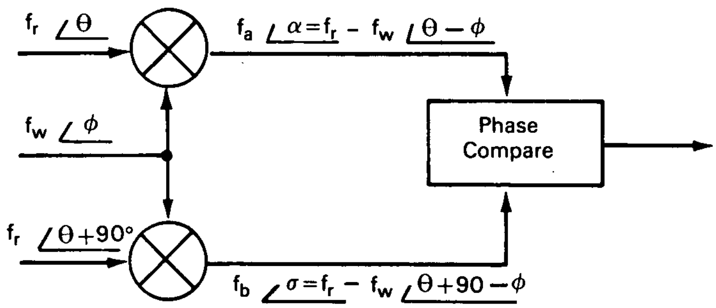
# NASA TECH BRIEF



## Electronic Frequency Discriminator




In a conventional frequency discriminator, the unknown frequency is compared against a circuit tuned to the desired center frequency. In such a discriminator, the accuracy of the discrimination is the stability of the discriminator itself. Replacement of the conventional discriminator with a digital frequency comparator, using a very stable reference frequency, would eliminate stability problems in the discriminator and allow discrimination to an accuracy of that of the reference frequency.

The figure shows the method of frequency comparison accomplished by use of a digital frequency comparator.

The unknown frequency $f_w$ is mixed with the reference $f_r$ at 0 degrees to form $f_a$, and with $f_r$ at 90 degrees to form $f_b$ in two different mixers. The outputs, $f_a$ and $f_b$ of the two mixers, are the same frequency but are shifted in phase by 90 degrees. The phase compare circuit looks at the phase of $f_b$ when $\alpha = \Theta - \phi = 0$ degrees. In this case, where $f_w < f_r$, the frequency $f_b$ will lead $f_a$ by 90 degrees which will cause the output of the phase compare circuit to go to a "1" level.

Implementation of a digital frequency comparator with such an operation, requires a difference mixer capable of mixing two signals so that the difference frequency varies from 0 to 1.2 MHz.

Using a shift register element as a mixer with one signal on the shift input and the other signal on the steering line, the maximum difference frequency is 1/2 of the clock frequency, or, in this case, 1.6 MHz if the reference frequency of 3.2 MHz is used as the clock. The shift register element transfers whatever logic condition exists on steering line to the output whenever the clock makes a negative transition.

The phase compare circuit is simply a shift register element with the $f_a$ frequency on the clock and the $f_b$ frequency on the steering. The negative transition of $f_a$ during the "0" level of $f_b$ would cause a "0" level to be transferred to the output. If $f_b$ were at a "1" level during the negative transition of $f_a$, a "1" would be transferred to the output. The shift register might not generate the actual difference frequency at all difference frequencies occurring in the range of the frequency discriminator. However, as the difference frequency becomes small compared with the clock frequency, the actual difference frequency will be produced.

The fact that the actual difference frequency is not produced does not affect the effectiveness of the frequency comparator as both mixers will still produce the same frequency.

(continued overleaf)

**Note:**

Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Huntsville, Alabama 35812
Reference: B67-10151

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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