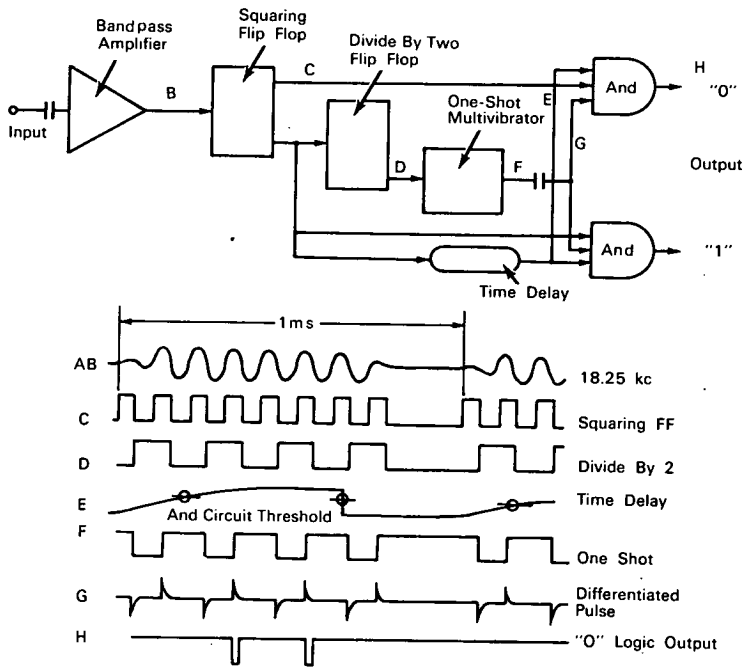
November 1965

Brief 65-10349

NASA TECH BRIEF

Frequency Discriminator with Binary Output Eliminates Tuned Circuits



The problem: To design a frequency discriminator with a binary output using components that permit the use of microminiaturized packaging techniques. Present output producing devices employ tuned circuits that are too bulky for microminiature packaging.

The solution: A bandpass amplifier and standard logic elements that convert two input frequencies into two discrete logic pulses. Output is restricted to a defined time increment to eliminate the possibility of circuit response to either noise or transients.

How it's done: The input frequency spectrum is fed to the bandpass amplifier that combines negative feedback with a parallel T-network rather than tuned circuits. Amplifier output, which will be either of two selected frequencies, is fed to a squaring flip-flop that converts the sinusoidal input to a square waveform. The complementary outputs from the squaring flip-flop are sent to both *AND* elements. The self-terminating time delay is actuated by the squaring flip-flop output and controls *AND* element output by establishing an operating threshold level. Output from a divide by two flip-flop is at one half the input signal frequency and actuates a one-shot multivibrator whose output is differentiated and serves as the third input to the *AND* elements.

(continued overleaf)

The time delay serves to inhibit logic outputs until all transients resulting from input signal start have subsided and also uses its self-terminating characteristic to suppress transients that might be generated at signal fadeout. The one-shot multivibrator is triggered in coincidence with the squaring flip-flop output, but generates an output whose time duration is independent of the input frequency to be discriminated. The duration of this waveform, and the relative position of the resultant differentiated output pulse, is selected to occur simultaneously at one of the *AND* elements with change of state of the squaring flip-flop. This timing is such that one selected input frequency will cause the required coincidence to occur at one *AND* element and the other selected input frequency will cause coincidence at the second *AND* element. The figure illustrates the waveforms resulting in a zero logic output at waveform H from an input frequency A. A system input of frequency B would, in a similar manner, result in a one logic output at the other *AND* element.

Notes:

1. This circuit has been satisfactorily operated over a temperature range from $-55°$ to $+100°C$.
2. This invention was developed as a frequency-shift keying demodulator in a satellite instrument unit command decoder.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B65-10349

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: E. DeVelde of IBM Corporation
under contract to
Marshall Space Flight Center
(M-FS-376)