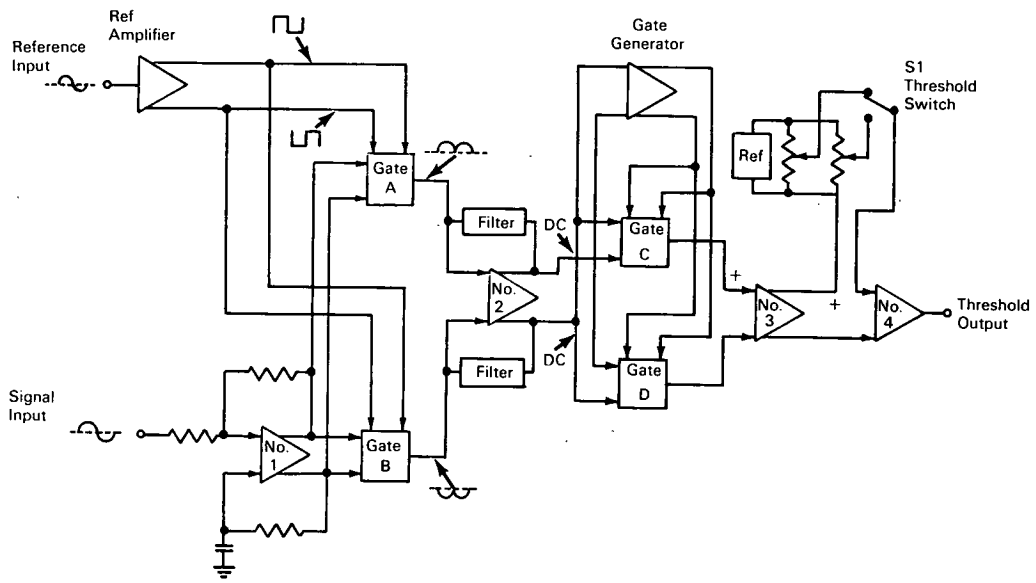
NASA TECH BRIEF

Stable AC Phase and Amplitude Comparator



The problem:

To design a comparator circuit that will detect excessive vehicle maneuvering or vibration. Since the allowable vehicle vibration or maneuvering changes in accordance with the particular phase of the mission, multiple preselected thresholds are required. The monitoring elements are the rate gyros. They generate an ac output amplitude proportional to the rate of change of position. The phase of the output (0 or 180 degrees) is determined by the direction of the change of position. Therefore, vibration of the vehicle will generate a phase-modulated gyro output, and the frequency of the modulation will be the frequency of vibration. Control signal processing of rate integrating gyros for missile and satellite applications require very low drifts over an extreme temperature range.

The solution:

A stable ac phase and amplitude comparator with phase demodulation, low-pass filter, and multiple threshold-setting capability designed specifically for low drifts over a wide range of temperatures (−55° to +125°C). Differential operation of the comparator, from input through threshold detection, prevents drifts with respect to ground from affecting the threshold adjustments.

How it's done:

The comparator is designed to provide an output if the ac input exceeds a predetermined amplitude within a specified frequency range of phase modulation. The differential output of amplifier No. 1 provides two ac inputs to transmission gates A and B. The reference amplifier outputs are used as gate-enable signals for gates A and B. Operation of the

(continued overleaf)

gates on the outputs of amplifier No. 1 provides two phase-sensitive, full-wave inputs, 180 degrees out of phase, to amplifier No. 2. This amplifier filters the phase-demodulated signals, providing a differential output. The amplitude and polarity of this output will be determined by the amplitude and phase of the input as long as the phase-modulation frequency is within the bandpass of the amplifier filters. As the modulation frequency increases, the amplifier output will decrease according to the frequency attenuation characteristics of the filters. The gate generator is a saturable switch that enables the differential outputs of transmission gates C and D to be always the same polarity regardless of the polarity of the inputs from amplifier No. 2. Amplifier No. 3 is a buffer amplifier used to provide adequate isolation so that a reference voltage can be floated on one side of the differential output. The inputs to amplifier No. 4 have an offset voltage determined by the potentiometer setting from zero to the maximum voltage of the reference source. As the comparator input amplitude increases, the offset voltage decreases, until the offset voltage is exceeded, changing the output polarity of amplifier No. 4.

The threshold levels may be changed by switching S1 or by adding other amplifiers and potentiometers, connected like amplifier No. 4, for each reference voltage setting desired. A relay driver at the output of amplifier No. 4 may be used to provide isolation of the load from the comparator.

Notes:

1. Suggested applications for this comparator are advanced control-signal processor, a rate switch control-signal processor, and a rate switch.
2. Inquiries concerning this development may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10459

Patent status:

No patent action is contemplated by NASA.

Source: H. P. Bruce
of the Martin Company,
under contract to
Marshall Space Flight Center
(MFS-13086)