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NASA TECH BRIEF

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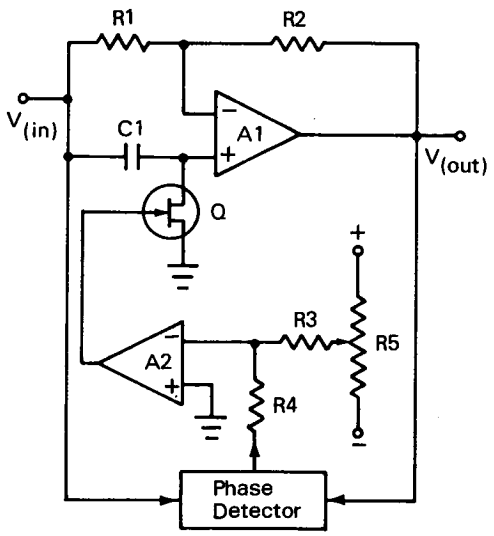
Constant-Amplitude, Frequency-Independent Phase Shifter

An electronic phase-shifting circuit using operational amplifiers provides an output with a constant phase shift amplitude, with respect to a sinusoidal input, over a wide range of frequencies. In conventional electronic phase-shifting circuits, the output amplitude and phase angle generally vary with frequency, limiting circuit operation to a narrow band of frequencies. In addition, the majority of these circuits can provide only a fixed phase-shift for a given frequency.



The new circuit includes a field effect transistor (FET), Q, operational amplifiers, A1 and A2, and a phase detector. The phase difference between the input and output is converted into a voltage which drives the electronic components of the circuit in such a way as to maintain the desired phase shift; i.e., the circuit is constantly in a balanced or null condition at a selected input-output phase relationship.

When the gate voltage of Q is properly varied, the phase shift imposed on a signal is held constant as the frequency varies, and the amplitude of the phase shifted signal also remains constant. The output of the phase detector supplies the appropriate gate voltage, which is a function of the relative phase difference between the signals, V_{in} and V_{out}, applied to its input terminals. Potentiometer R5 provides a reference voltage which is equal to the output of the phase detector for a selected phase difference. This voltage is fed to the input node of amplifier A2. Since the output of the phase detector is also fed to this node, any difference between the potential at the potentiometer wiper arm and the output of the phase detector is amplified by A2. The amplified signal is applied to the base of Q such that the phase of the output sinusoid is shifted and a null at the input node of A2 is restored. In practice, the loop gain of the circuit is maintained large enough so that virtually any deviation from the selected phase difference provides a strong corrective signal at the gate of Q. Thus, the phase difference between input and output signals is held constant even though the signal frequency may vary.

Notes:

1. The circuit can provide phase shifts of only 0 to π rad (0 to 180°); however, two circuits can be cascaded to provide phase shifts of 0 to 2 π rad (0 to 360°), and the output at a selected phase shift will be of constant amplitude at any frequency.

(continued overleaf)

2. Requests for further information may be directed to:

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Reference: TSP71-10230

Patent status:

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