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Brief 71-10171

NASA TECH BRIEF

Ames Research Center

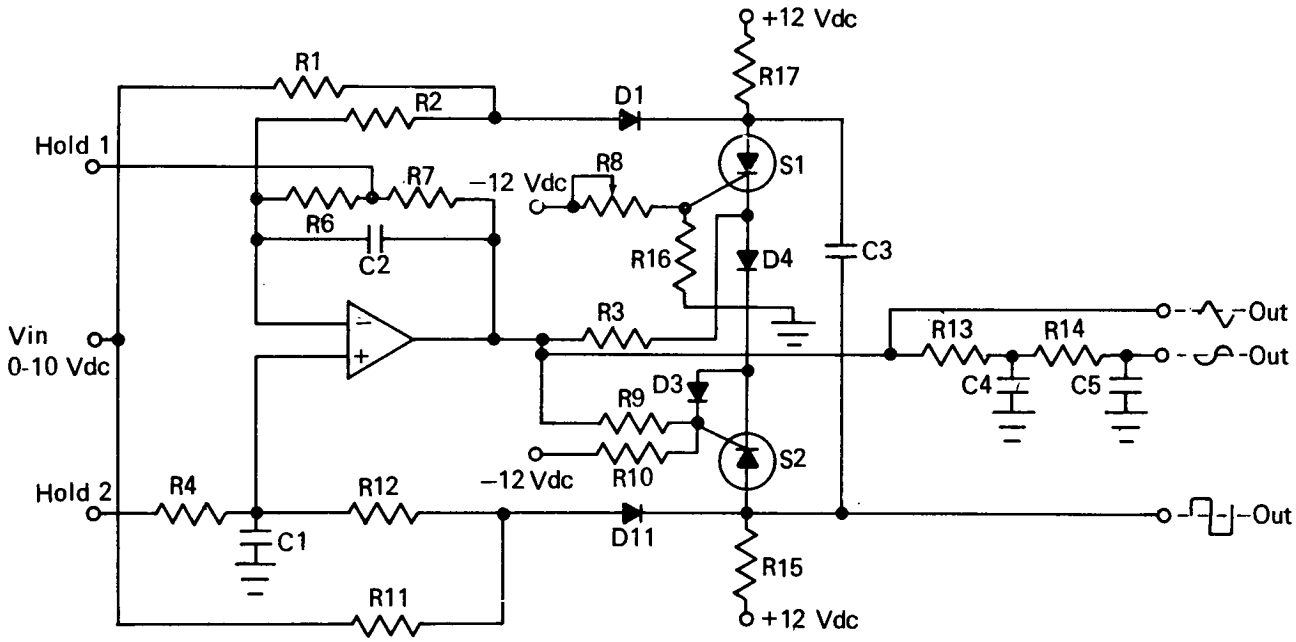
Voltage-Controlled Oscillator

The problem:

Design a stable voltage-controlled oscillator for generating triangular waveforms.

The solution:

The input voltage is integrated by the inverting input of an operational amplifier wired as a differential integrator. After reaching a predetermined value, the voltage across the integrating capacitor turns on a silicon controlled rectifier (S1) which activates the noninverting input of the amplifier. This circuit operation reverses the charge on the integrating capacitor until a positive voltage, which will turn on S2, is reached. Integration and switching from S1 to S2 causes a triangular waveform to be generated with an amplitude peak established by the trigger-point level of S1 and S2 and a frequency determined by the input voltage value.



How it's done:

The oscillator portion of the circuit shown in the figure consists of an integrated circuit, a high-performance operational amplifier wired as a differential integrator, and two silicon controlled rectifiers (SI and S2) operating in a bipolar limit trigger and bistable flip-flop configuration. A symmetrical triangular waveform is generated when the inverting and noninverting inputs are equal.

The trigger level of the limit switch S1 is set by the gate voltage so that the switch conducts when

(continued overleaf)

the integrator output exceeds −10 V. When the integrator output voltage applied to the base of S1 is more negative than the gate voltage by 0.4 to 0.6 V, S1 will trigger and latch-in by the action of D4. C3 unlatches S1, and the cycle continues. The operation of S2 is similar, except that it triggers when the amplifier output exceeds a value of +10 V, or when the gate voltage exceeds the grounded base voltage of S2 by 0.4 to 0.6 V.

Since the anode waveforms of S1 and S2 are square waves, the oscillator can supply square waves with a frequency proportional to the input voltage, at an amplitude level between the 12 V of the power supply and the 1.0 V saturation of the switch. The triangular waveform of the oscillator output can be modified by two cascaded RC networks to provide a sinusoidal output with a frequency-dependent amplitude. The frequency range of the oscillator can be varied by the input voltage from less than 0.1 Hz to the operational limits of the switches; i.e., 10 to 20 kHz. The frequency adjustment range is 4 to 1 for a 0 to 10 V input, and is limited solely by the voltage of the switch-clamp circuits at the integrator input terminals. The nominal input impedance of the oscillator circuit is approximately 66 kΩ. Resistors R4, R6, and R7 may be grounded to effect a "hold" on the circuit's operation, for such purposes as synchronization of the waveform with other oscillators.

Note:

Requests for further information may be directed to:

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Reference: B71-10171

Patent status:

No patent action is contemplated by NASA.

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