NASA TECH BRIEF

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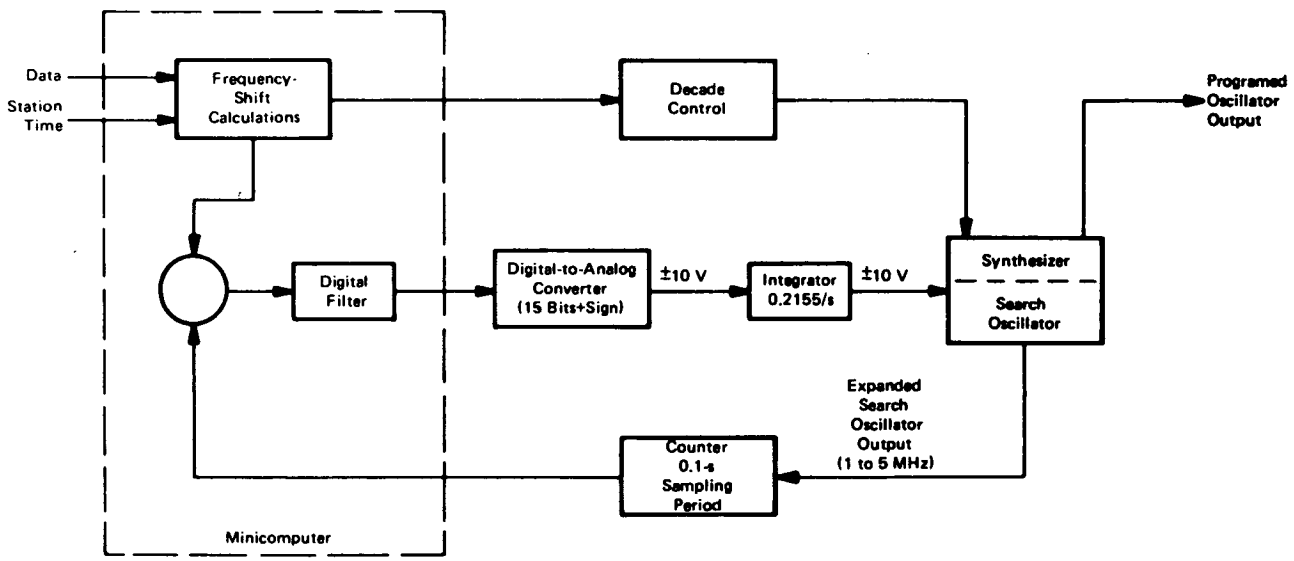
Minicomputer-Controlled Frequency Generator

A minicomputer has been used to build an extremely-accurate and low phase-noise frequency generator that varies an oscillator frequency as a predetermined function of time. The system has several potential commercial applications; and it can be quickly added to existing product lines, since it is constructed almost entirely from readily available equipment. It could be used: (a) to automatically vary transmission frequencies in accordance with seasonal and diurnal changes in ionospheric conditions, (b) as an automatic tuner for heterodyne receivers, or (c) as a control element for phase-locked telemetry receivers.

The programed oscillator is diagramed in the illustration: a modified commercial frequency synthesizer and a minicomputer are connected in a central-loop configuration. At the beginning of a day's operation, time and control constants are input to the computer, which is programed to calculate the desired frequency variations with time. The frequency synthesizer has a specially-selected, low phase-noise search oscillator with a 200-Hz range, symmetrical about the center frequency. The synthesizer is modified to provide an expanded (multiplied and frequency-translated) function of the search oscillator frequency on a separate output. (Thus, in one system, the 200-Hz oscillator range corresponds to a 12.8-kHz range at an S-band frequency of 2388 MHz.)



Programed Oscillator Block Diagram

(continued overleaf)

The minicomputer sets the frequency range on the search oscillator through a decade with control logic, and frequencies are varied within the selected 200-Hz range by controlling the search oscillator in a sampled-data feedback loop. A 32-bit counter continuously samples the expanded output of the oscillator, recycling to zero when the full count is reached. Every one-tenth second, the sample is dumped into a buffer register and fed to the computer. The computer forms error numbers by comparison with the calculated desired phase. The error numbers are digitally filtered and passed to a digital-to-analog converter and then to an integrator. The voltage-controlled search oscillator (±10-volt control range corresponding to the 200-Hz oscillator range) is then adjusted to the desired frequency.

This system requires only a single rack of equipment and may be operated in a phase-tracking mode as well as frequency tracking. One system now in operation has the following characteristics:

	Oscillator	S-Band Output
Output range	200 Hz	12.8 kHz
Phase control (least increment)	0.018°	1.15°
Frequency change rate (maximum)	21.55 Hz/s	1379 Hz/s
Jitter	0.02°	1.28°
Drift	0.03°/min	1.92°/min

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP74-10163

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,764,933). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
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