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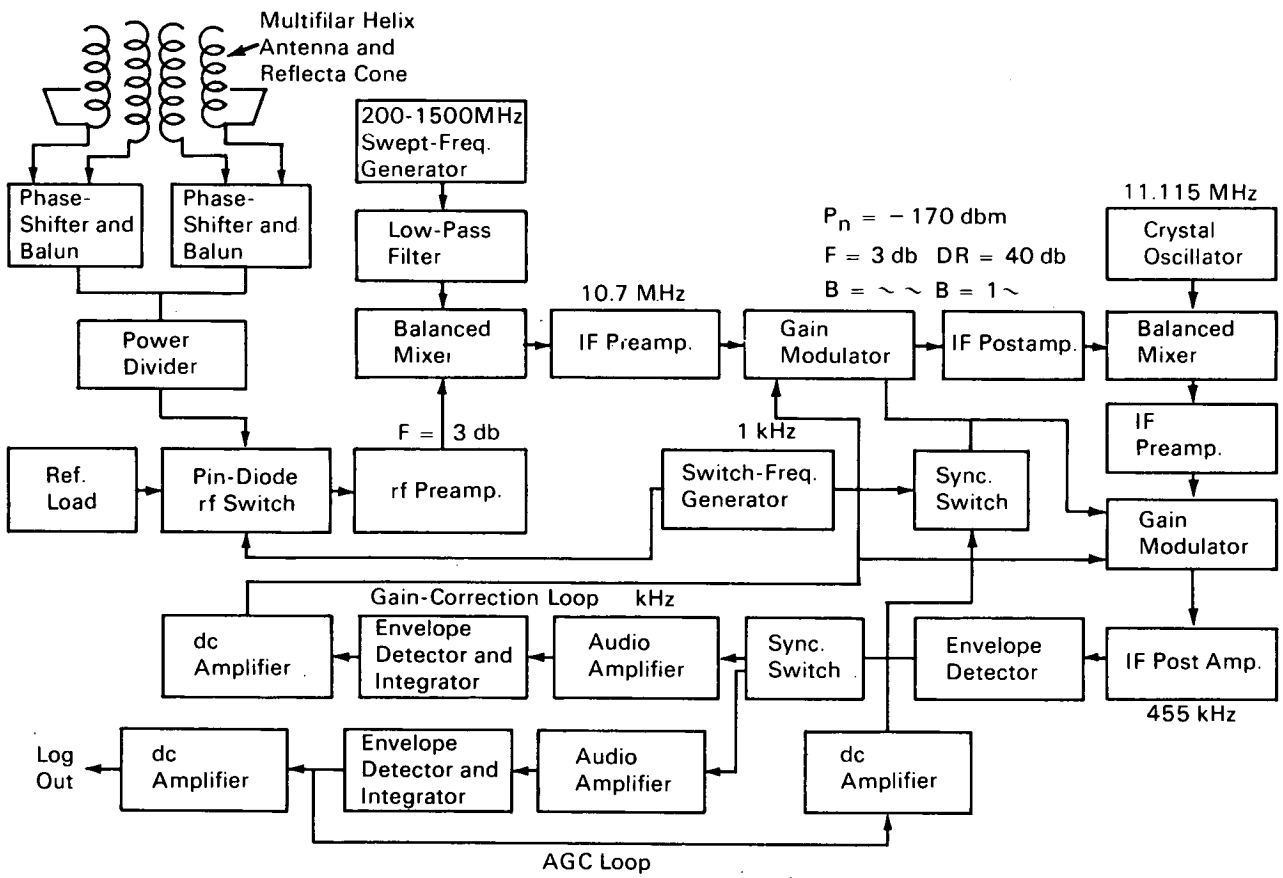
NASA TECH BRIEF

Swept-Frequency UHF Radiometer for Deep Probes of Earth: A Concept



Block Diagram of Logarithmic Self-Calibrating Receiver

A novel instrument conceived for use on the moon or the planets should be readily adaptable to terrestrial uses. This swept-frequency UHF (200 to 1500 MHz) radiometer (see fig.) could determine layering and structure as deep as 100 feet below Earth's surface; determine physical properties of the subsurface, with determination of variation in dielectric constant of the surface and subsurface layers as a function of depth; identify different types of material (including ore bodies and oil) at depths of at least 100 feet by passive-emissivity measurements in the UHF region, and locate subsurface deposits of moisture. It could also accurately locate deep faults and hazards, and thus isolate areas having poor bearing strength.

(continued overleaf)

The instrument must operate in conjunction with an infrared radiometer used to measure the kinetic surface temperature. The UHF radiometer would yield subsurface temperature profiles which, when used in conjunction with these measurements, would provide accurate emissivity profiles down to 100 feet. Because the data would be continuous from between 25 and 100 feet, detection of small anomalies in this depth range should be possible.

Regions of anomalous emissivity and thermal properties could be isolated easily, so that subsurface materials and geologic deposits could be identified three-dimensionally. Identification of deep materials would be aided by previously obtained signatures from known materials at known depths in known terrain.

The instrument's main advantage would be ability to measure radiation signatures of deep layers and deposits, which could require operation at lower frequencies (250 to 1000 MHz). Deployment aboard a satellite would be feasible for location of snow-ice and ice-water interfaces in the arctic.

The radiometer would incorporate a log-periodic array of V-antennas designed to operate in the 250-to-1000-MHz band of the UHF spectrum with constant-gain, constant-beamwidth, frequency-independent antenna patterns. The radiometric receiver would contain a swept-frequency local oscillator providing a continuous sweep between 250 and 1000 MHz and yielding depth profiles from between 25 and 100 feet in moisture-free regions. The wide-band properties of the antenna should enable operation of the radiometer over a wide rf bandwidth ($\Delta f \approx 100$ MHz) with good temperature resolution for reasonably short integration times.

Notes:

1. This instrument is in the conceptual stage only; at the time of this publication no model or prototype exists.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center, Code BM7
   Houston, Texas 77058
   Reference: TSP70-10617

Patent status:

No patent action is contemplated by NASA.

Source: Werner Koppl of
Martin Marietta Corp.
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