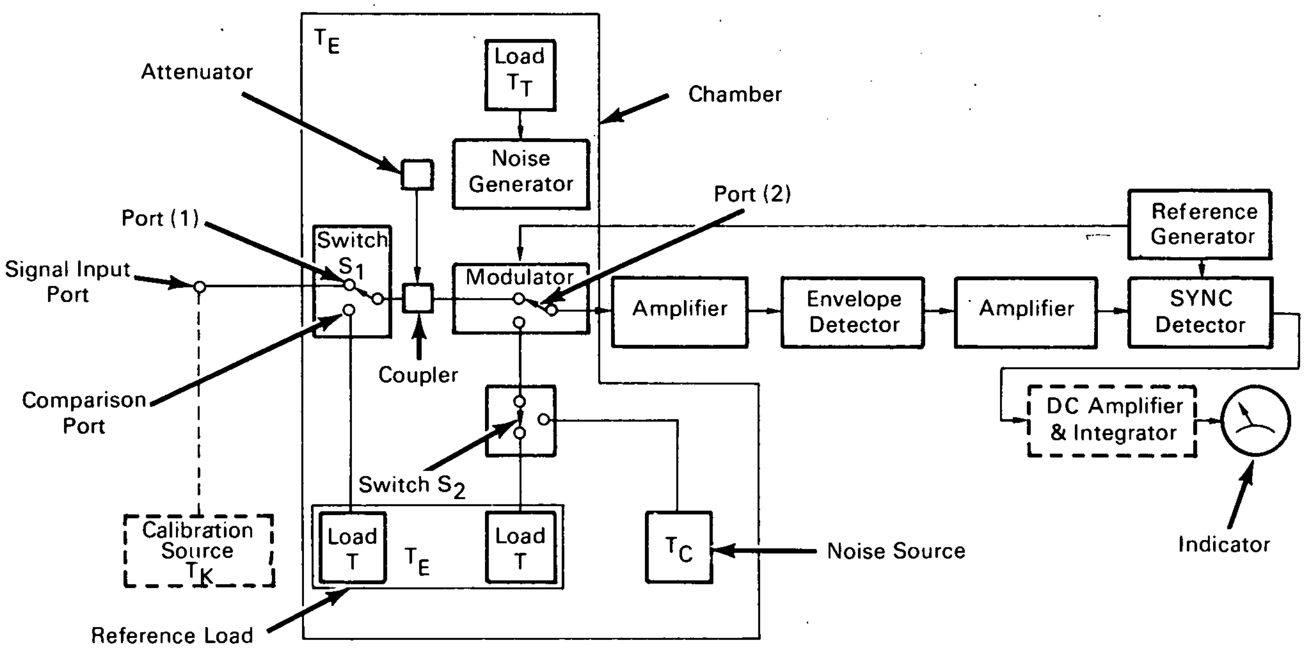
NASA TECH BRIEF

Radiometric Absolute Noise-Temperature Measurement System Features Improved Accuracy and Calibration Ease



The problem:

Standard radiometric methods for measuring the absolute temperature of microwave and millimeter noise sources require precise knowledge of rf attenuation effects on instrument calibration. The measurement of weak signals from low-noise-temperature sources requires a resistive load immersed in liquid helium acting as a comparison noise source. These methods require complex calibration procedures to ensure accurate measurements.

The solution:

A new radiometric receiver system measures noise temperatures in degrees Kelvin and does not require cryogenic noise sources for routine operation. This system eliminates radiometer calibration errors associated with rf attenuation measurements. Output indicator zero position represents zero degrees Kelvin and the scale reads directly in degrees Kelvin. A calibrated noise source is required only for laboratory adjustment and calibration.

How it's done:

All rf components of the system (represented in the block diagram) are contained within an environmental chamber at a temperature slightly higher than the highest anticipated ambient operating condition. Connecting the comparison port of switch S_1 to a

(continued overleaf)

reference load establishes the indicator-scale zero position. Introducing an external, calibrated noise source to the signal input port, then through port (1) to port (2), causes a negative indicator deflection proportional to the noise-temperature difference between the chamber and the calibration source. The relationship between the deflection in scale units and the noise-temperature differential provides a scale calibration in degrees Kelvin. Receiver calibration is completed by activating the noise generator and adjusting the attenuator to provide a positive indicator deflection equivalent to the known absolute temperature, T_K. Switch S_2 and noise source T_C provide an independent measure of the noise level injected by the noise generator, attenuator, and coupler combination.

The novelty of the system lies in (1) introducing switch S_1 and the reference load to provide a zero-position reading; (2) using a noise generator to provide an absolute calibration in degrees Kelvin; (3) using a noise source to monitor the radiometer; and (4) maintaining all critical rf components at a common, near-ambient temperature. These features combine to provide a highly accurate radiometer useful for studying microwave emissions from the earth's surface and atmosphere; measuring atmospheric effects, plasma noise temperatures, and antenna-system noise temperatures; and in high-altitude radiometry of clear-air turbulence phenomena.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:
NASA-TR-R-271 (N67-35599), Absolute Temperature Measurement at Microwave Frequencies

Patent status:

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Electronics Research Center
(ERC-90066)