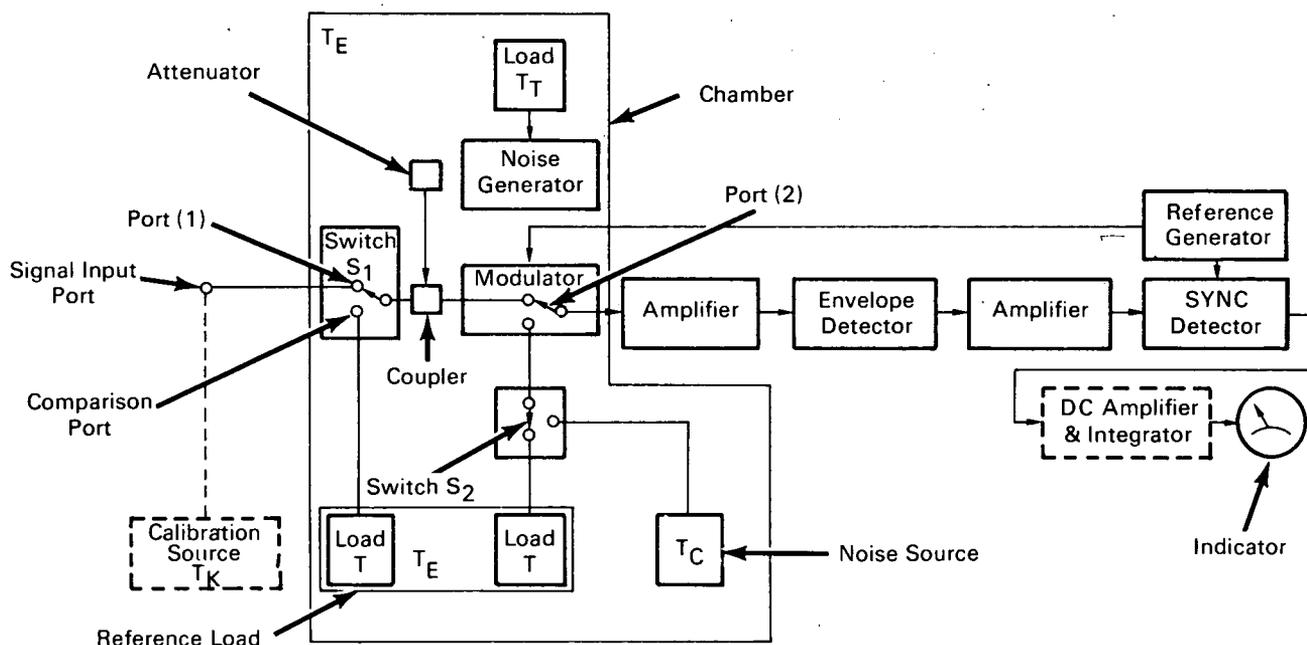


# NASA TECH BRIEF



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Division, NASA, Code UT, Washington, D.C. 20546.

## 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 Micro-  
wave Frequencies

**Patent status:**

This invention is owned by NASA, and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

Source: G. Haroules, W. Brown of  
Electronics Research Center  
and H. Ewen of  
Ewen Knight Corp.  
under contract to  
Electronics Research Center  
(ERC-90066)