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NASA TECH BRIEF

John F. Kennedy Space Center

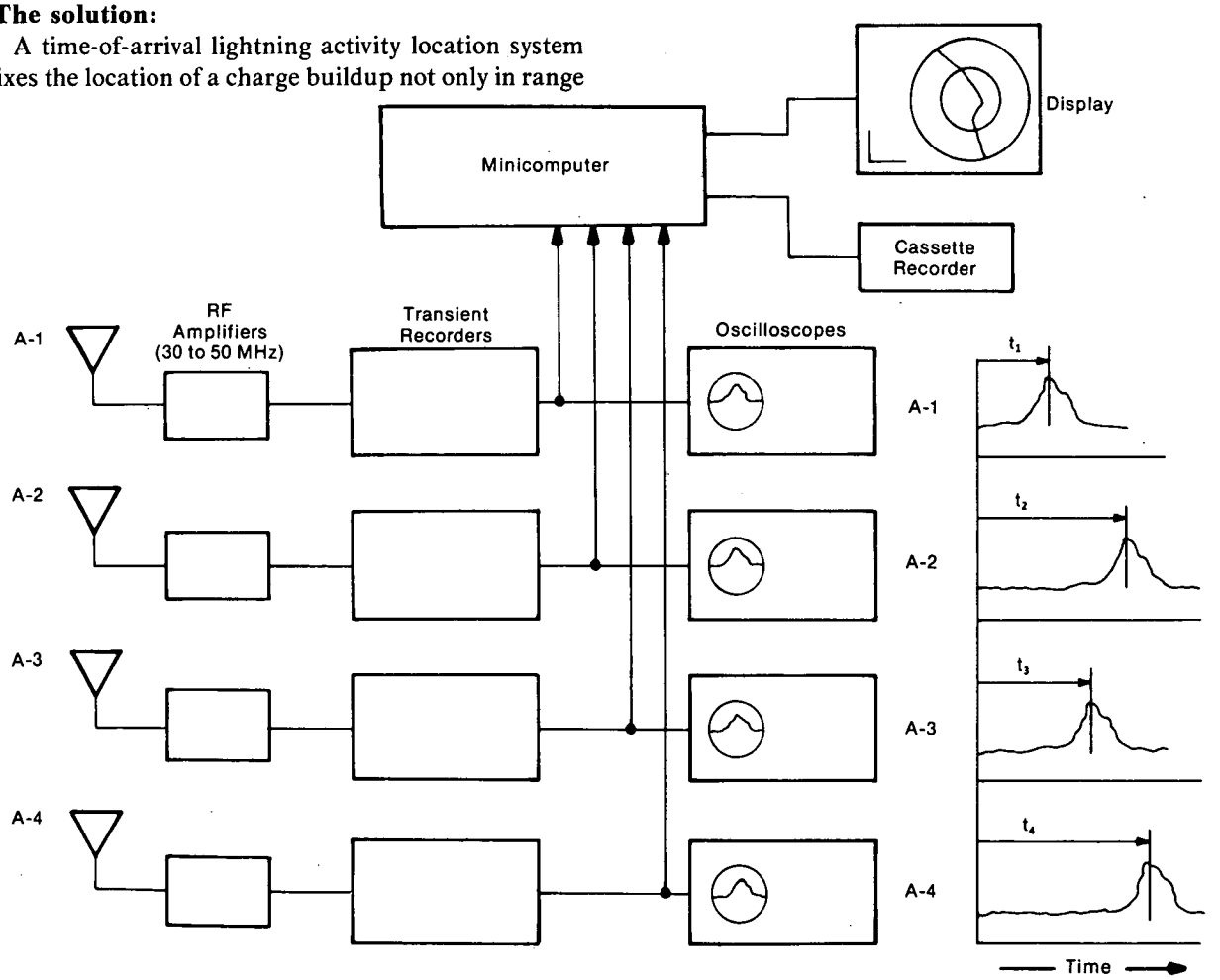
Time-of-Arrival Lightning Activity Location System

The problem:

Charge buildup in clouds that occurs prior to a thunderstorm could result in lightning being triggered by the launch of a missile.

The solution:

A time-of-arrival lightning activity location system fixes the location of a charge buildup not only in range and azimuth but also in elevation. The information is available in near-real-time so that a warning of charge buildup can be implemented.



Lightning Activity Location System Implementation

(continued overleaf)

How it's done:

The system is based on the precise detection (at four carefully-placed detection stations) of the time-of-arrival of radio-frequency signals emitted by electrical discharges in the sky that take place during thunderstorms and thunderstorm buildup. From the time of arrival, the system computes the azimuth, the elevation, and the range of an electrical discharge.

The system consists of four high-speed analog-to-digital (A/D) converting transient recorders that continually sample and digitize the incoming waveforms. A minicomputer controls the system, processes the data, formats the data for recording on a cassette recorder, and produces a plot of the range, azimuth, and elevation of the detected electrical discharge on a computer display terminal, seconds after the event.

Signals arriving at the four broadly-tuned, vertically-polarized, onmidirectional antennas (shown as A-1, A-2, A-3, and A-4) are filtered (30 to 50 MHz), then are amplified and envelope detected by log-IF amplifiers, and then are fed to four transient recorders. The transient recorders use digital techniques to record defined segments of an analog signal.

A signal that exceeds a prescribed level at station A-2 triggers all four transient recorders. Once triggered, the wave-shape data of 1,024 samples, taken at intervals of 0.01 microsecond prior to and after the trigger, are available to the computer. Data prior to the trigger are available since the input signals are continuously sampled and stored and being replaced by new data.

After applying threshold and wave-shape criteria, the computer determines the maximum amplitude of each wave shape and then uses a correlation routine to calculate the time differences in arrival relative to station A-2. The time intervals are used by the computer to solve for azimuth, elevation, and range which are then displayed on the terminal. In addition to the display, the data are also continuously recorded on a cassette recorder which can record more than 4 days of data unattended.

Note:

Requests for further information may be directed to:

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Reference: TSP75-10297

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

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