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NASA TECH BRIEF

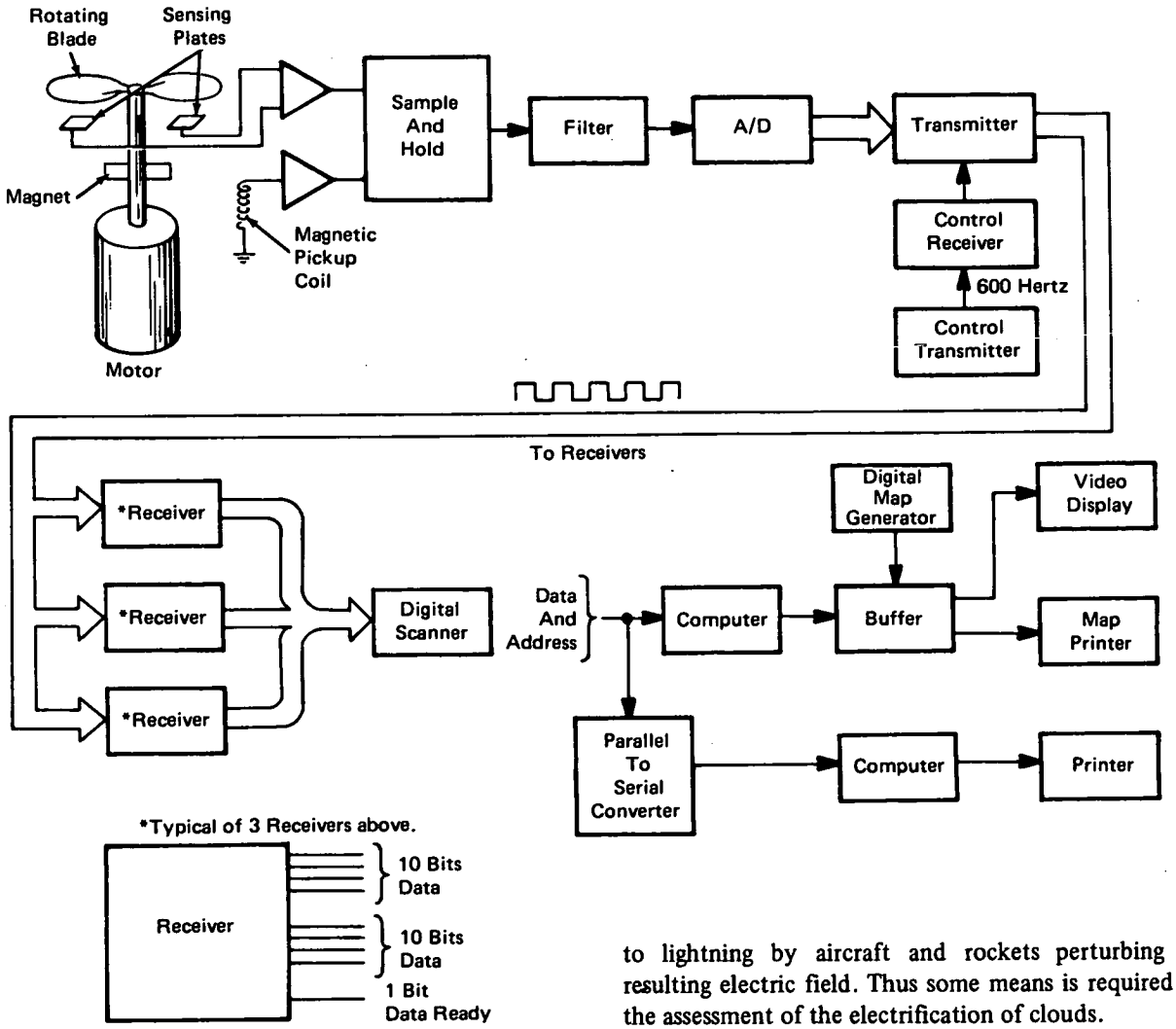
John F. Kennedy Space Center

Measuring the Electric Field of a Cloud

The problem:

Lightning is a common threat in most locations of the earth. The obvious indications of lightning hazard are the development of towering clouds and the observation of lightning and sferics activity (static on AM radio).

There are cloud formations which will generate lightning, but have much more subtle indications of the hazard. Electrical charges do develop in clouds which do not appear threatening; in addition, charge levels which do not develop natural lightning can be induced



to lightning by aircraft and rockets perturbing the resulting electric field. Thus some means is required for the assessment of the electrification of clouds.

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The solution:

Charged clouds develop electric fields which extend to the earth. The resulting fields measured at the earth are complexly dependent on charge configuration, number of clouds or cells, distance from the sensing station, and other factors that are not fully understood.

In order to assess the lightning hazard of charged clouds, it is necessary to measure the associated electric fields. A network of electric field measuring stations which transmit electric field data to a central data processing area has been developed at Kennedy Space Center.

How it's done:

The sensor shown in the figure has two electric field sensor plates located beneath a rotating blade. As the blade rotates, the plates are alternately unshielded and shielded from the electric field. When they are unshielded, the plates sense the electric field and generate an alternating current proportional to the electric field. Two signals are generated by the instrument and fed into a sample and hold circuit. One is an amplified ac signal from the unshielded capacitor plates. The other, a synchronizing pulse from a magnetic pickup, is generated every time a magnet attached to the blade shaft passes the pickup.

The sample and hold circuit samples the peak of each half-cycle of the ac signal from the capacitors and produces a pulsed dc signal. The signal is filtered and digitized to a 10-bit parallel word by an analog-to-digital converter.

A transmitter at the sensing station transmits the parallel digitized signal upon instruction from the command center. At the command center, a number of receivers (one for each 20 stations) receive the cloud data, add ten bits of address information, and feed the signal to a digital scanner.

The digital scanner selects the data and sends it to a computer where it is processed and displayed or printed. The electric field data are presented on a map as isoelectric field lines which form closed paths around centers of high electric fields resulting from charged clouds. This display aids a meteorologist in assessing the hazard of lightning.

Note:

Requests for further information may be addressed to:

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Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning exclusive or nonexclusive license for its commercial development should be addressed to:

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