NASA TECH BRIEF

Marshall Space Flight Center

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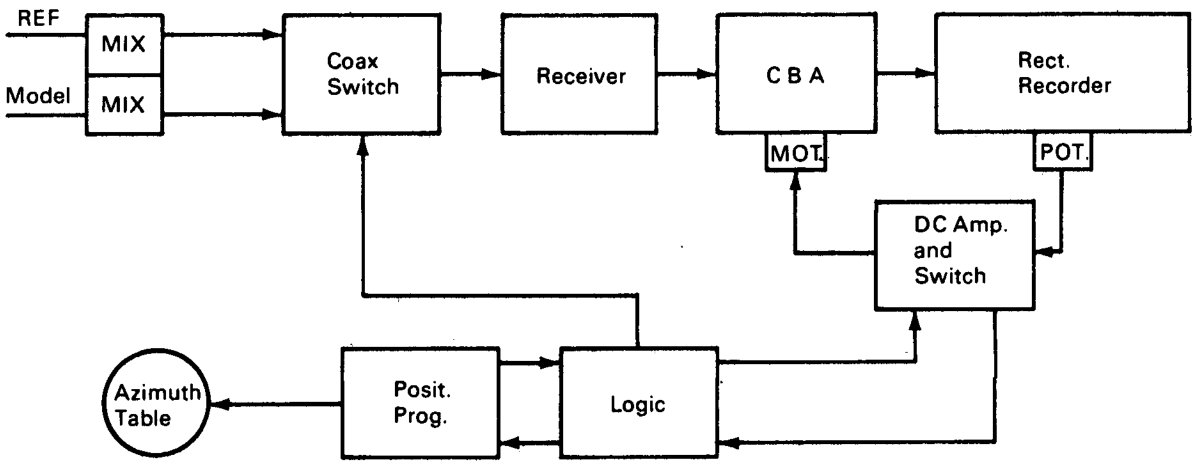
Automatic Reference Level Control for an Antenna Pattern Recording System

The problem:

To reduce recorder drift during antenna radiation distribution determinations. Antenna radiation distribution is determined by the recorded contours of the four major polarizations: right-hand circular, left-hand circular, vertical and horizontal. Usually, eight hours of continuous recording are required, with the inherent possibility of cumulative error occurring. Experience has shown that recorder drift error can be as great as two decibels on one contour alone. Considerable time is lost in attempting to stabilize the recording system to rerun the data, and the drift of the individual contours is not corrected.



The solution:

An automatic gain control system that keeps the recorder reference level within 0.2 decibels during operation.

How it's done:

The data output of the antenna pattern recorder is on binary paper tape with indications from zero to −40 decibels. An encoder potentiometer mechanically coupled to the rectangular recording pen digitizes the data. To run a contour, find the maximum signal level, and adjust the system gain for a zero-decibel level on the rectangular recorder. The sampled-data automatic level control adjusts the system gain during the contour run to keep the reference level within 0.2 decibels.

Since the reference level is seen only twice in a series of four contours, a reference antenna is added. It is impossible to monitor continuously because the reference antenna level displaces the contour data; however, by positioning the reference antenna on the elevation axis, each azimuth cut ($\Theta = 0°$) can be monitored during the elevation incrementation cycle without loss of contour data.

In order to include all of the analog system in the control loop, a sample is extracted through a potentiometer mechanically coupled to the rectangular recorder pen. One turn equals 40 db.

During initial setup, the potentiometer output is

(continued overleaf)

differentially balanced to the gain control potentiometer of a Crystal Bolometer Amplifier (CBA), which then stores the level for as long as required. Thereafter, any difference is amplified and used to drive a motor coupled to the CBA gain control potentiometer. This form of compensation is used because it is the quickest and easiest to implement, and it allows the automatic level control (ALC) to be switched off during or between contours.

A null width, within which no compensation takes place, exists. If this width is less than the peak-to-peak pen jitter, the excursion through the null may be too quick to allow for shutdown. Increasing the null width by decreasing the voltage across the potentiometers (thus decreasing the sensitivity) overcomes this problem.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
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Patent status:

No patent action is contemplated by NASA.

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