CLOUD ABSORPTION RADIOMETER

BY

M. G. Strange (674)

The Cloud Absorption Radiometer (CAR) was developed with Director's Discretionary Funding in 1983-84 for Dr. Michael King, Code 615, and has been flown successfully many times aboard the University of Washington's C-131 cloud physics airplane under a National Science Foundation grant. Its purpose is to measure spectrally how light is scattered by clouds and to determine the "single scattering albedo", important to meteorology and climate studies, with unprecedented accuracy. This measurement is based on ratios of downwelling to upwelling radiation within clouds, and so is not strongly dependent upon absolute radiometric calibration of the instrument.

The CAR has a 5-inch aperture and 1 degree IFOV, and spatially scans in a plane orthogonal to the flight vector from the zenith to nadir at 1.7 revolutions per second. Incoming light is measured in 13 spectral bands, using silicon, germanium, and indium-antimonide detectors. Data from each channel is digitally recorded in flight with 10-bit (0.1%) resolution.

The instrument incorporates several novel features. Since it is flown through clouds, moisture may occasionally collect on the scan mirror, producing an error. To test for water on the mirror, a thin beam of light reflected from the edge of the mirror is monitored by a photodiode. Any fogging of the mirror

scatters the light beam, reducing the specular component detected by the photodiode and flagging any stretches of faulty data. Another feature ensures that a zero-radiance input always produces a zero-volt output without the complication of a fast radiation chopper. It works by serving the output to zero during each backscan while the detectors are all completely darkened by means of a shutter. Data taken during the active portion of the scan is then measured with respect to this zero reference level. A third feature compensates instantaneous scan angle for up to ± 5 degrees of aircraft roll by using a vertical gyro to correct the scanner's time-base.

Papers published to date on the CAR are as follows:

1. King, M. D., P. V. Hobbs, and L. F. Radke, 1987: Determination of Uncertainty Parameters of Clouds from Airborne Measurements of Scattered Radiation Within Clouds, Proc. Bejing Intl. Rad Symp., Bejing, PRC.

2. King, M. D., M. G. Strange, P. Leone, and L. R. Blain, 1986: Multiwave Scanning Radiometer for Airborne Measurements of Scattered Radiation Within Clouds, J. Atmos. and Oceanic Tech., 3, 513-522.

3. King, M. D., 1981: A Method for Determining the Single Scattering Albedo of Clouds Through Observation of the Internal Scattered Radiation Field, J. Atmos. Sci., 38, 2031-2044.

4. Radke, L. F., M. D. King, and P. V. Hobbs, 1986: Preliminary Measurements of the Cloud Single Scattering Albedo and Interstitial Aerosol from an Aircraft, Proc. Ninth Intl. Cloud Phys. Conf., Tallinn, Estoria, USSR.

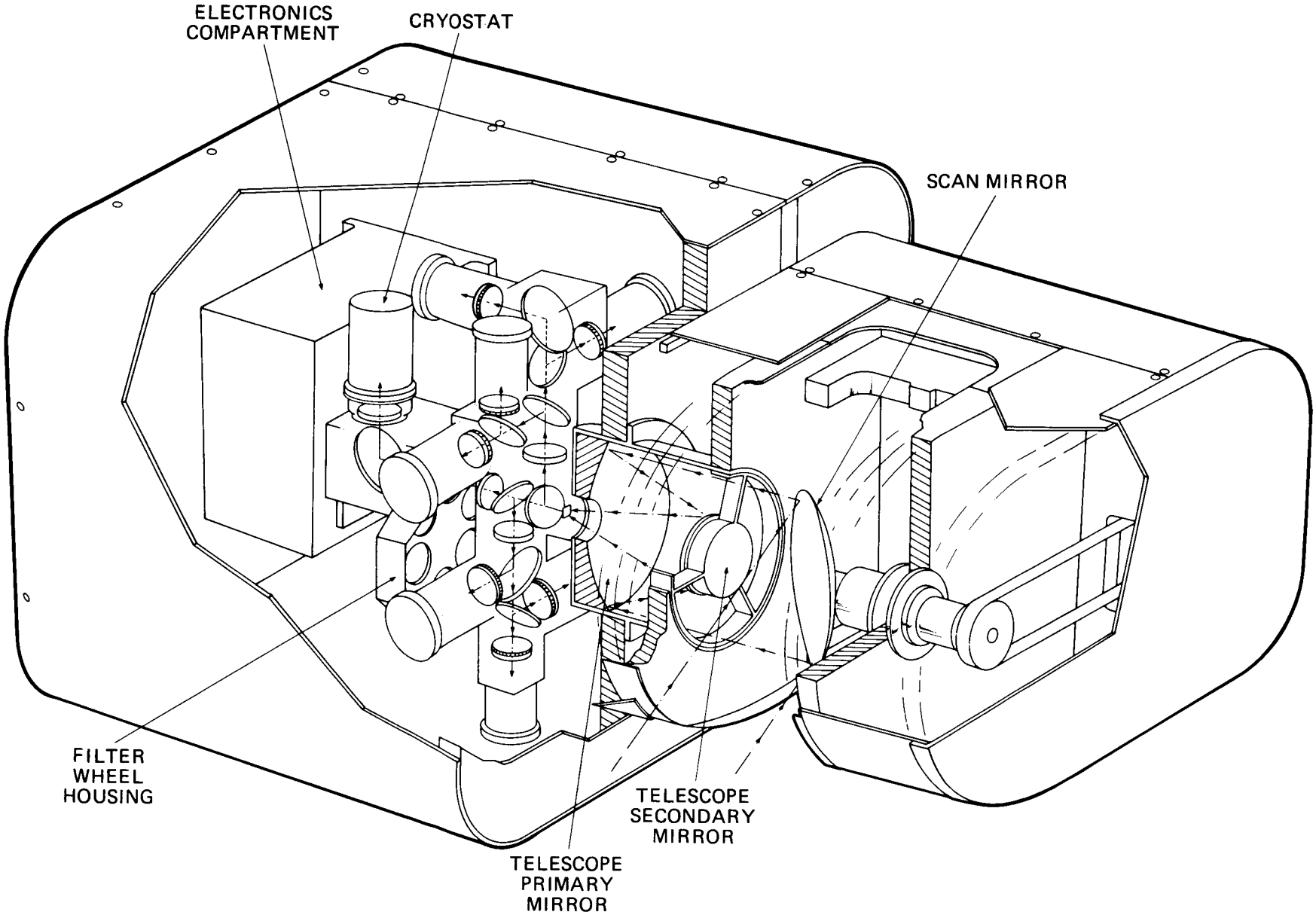

Figure 1. Cutaway drawing of the internal optics of the CAR

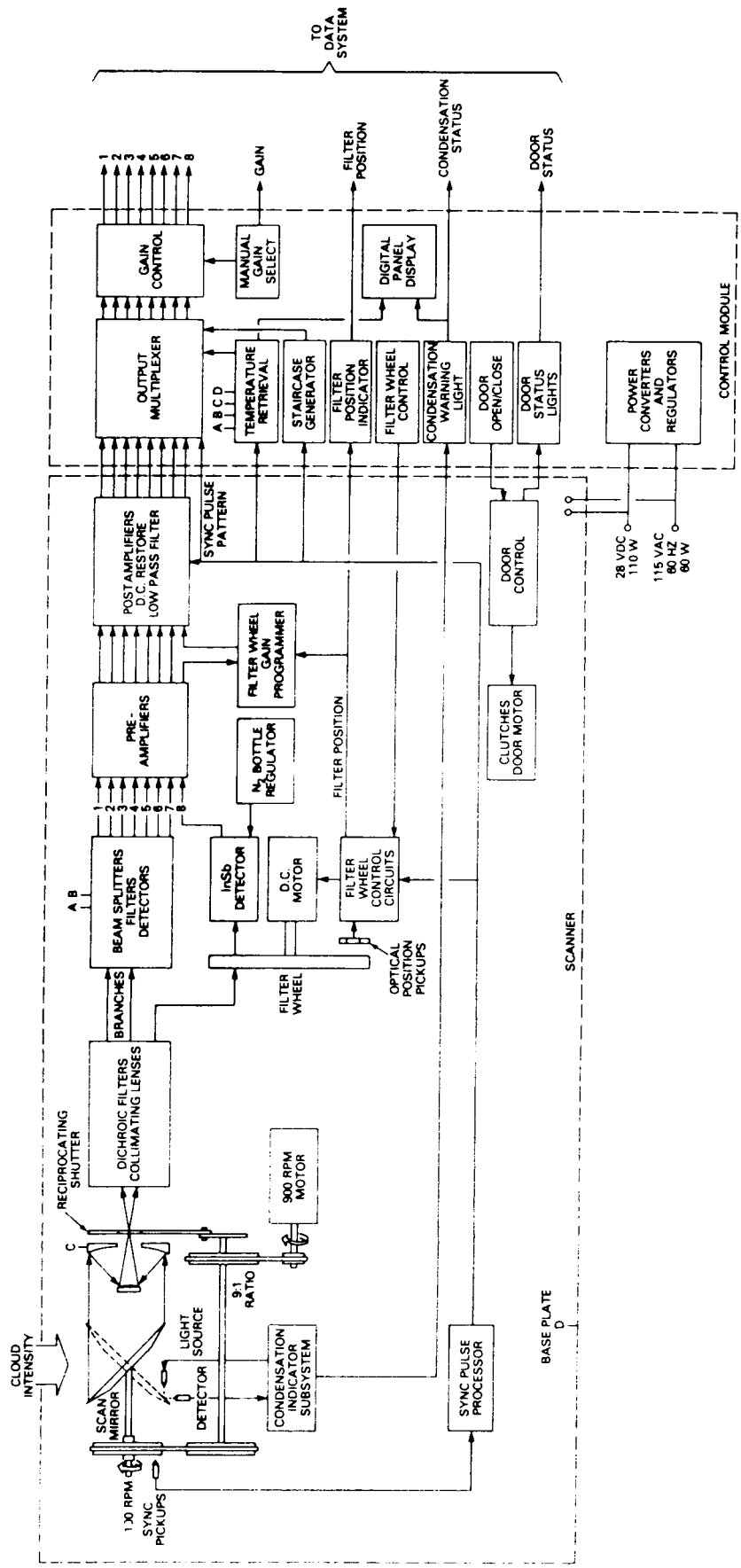

Figure 2. Block Diagram of the electronics of the CAR