

VISIBLE INFRARED SPIN-SCAN RADIOMETER

James E. Phenix

The visible infrared spin-scan radiometer (VISSR) may be considered as a camera system capable of simultaneously providing both visible and infrared earth and cloud-cover pictures every 20 minutes from the geostationary synchronous meteorological satellite (SMS). With a 0.9-kilometer resolution in the visible spectrum and a 9-kilometer resolution in the IR spectrum, the VISSR/SMS system will, for the first time, enable investigators to study atmospheric dynamics through 24-hour continuous observation of cloud altitudes, patterns, motion, and temperature distributions.

A cross section of the 62-kilogram VISSR scanner, which has a length of 1.5 meter and diameter of 0.45 meter, is shown in Figure 1. The scanner may be conveniently divided into six basic elements as follows:

- A 2.9-meter focal length, 0.41-meter diameter optical system consisting of three solid beryllium mirrors with focus adjustment capability in both IR and visible channels
- A primary and redundant torque motor/encoder servo-scan drive system which, in 18.2 minutes, steps the dynamically balanced 18-kilogram scan mirror assembly a total of 1820 times to a precision of 1 arc second. It is through the combined spacecraft spin and mirror stepping that the raster scan composite earth picture is developed
- Eight photomultiplier tubes, each of which views, through separate fiber optics strands, a 0.9-kilometer square scene
- A primary and redundant HgCdTe detector combination which is passively cooled to 95 K and is capable of providing radiance temperature measurements between 180 K and 315 K to a sensitivity of approximately 0.5 K
- Two IR and eight visible channel preamplifiers
- A beryllium housing for lightweight thermal and structural stability

Not shown is a 6-kilogram, 20-watt electronics module which contains circuitry for interfacing the scanner electronics with the spacecraft, provides the logic circuitry for scan drive and focus operations, and conditions the scanner signal channels.

As of November 2, 1972, Santa Barbara Research Center, the VISSR prime contractor, has successfully assembled, tested, and delivered an engineering model VISSR. In addition, SBRC is currently subjecting the first in a series of three flight models to environmental tests at Hughes Aircraft Company, El Segundo, California. These tests are expected to be completed by November 15. Some of the significant measured performance parameters are in Figure 2.

In summary, it is appropriate to mention that the 0.9 kilometer resolution solid beryllium optics, the 81 K passive radiation cooler, the beryllium structure, and the precision scan drive system are, as a result of the VISSR program, now state-of-the-art achievements. As an integrated operational system, VISSR will be the most sophisticated radiometer in NASA's history.

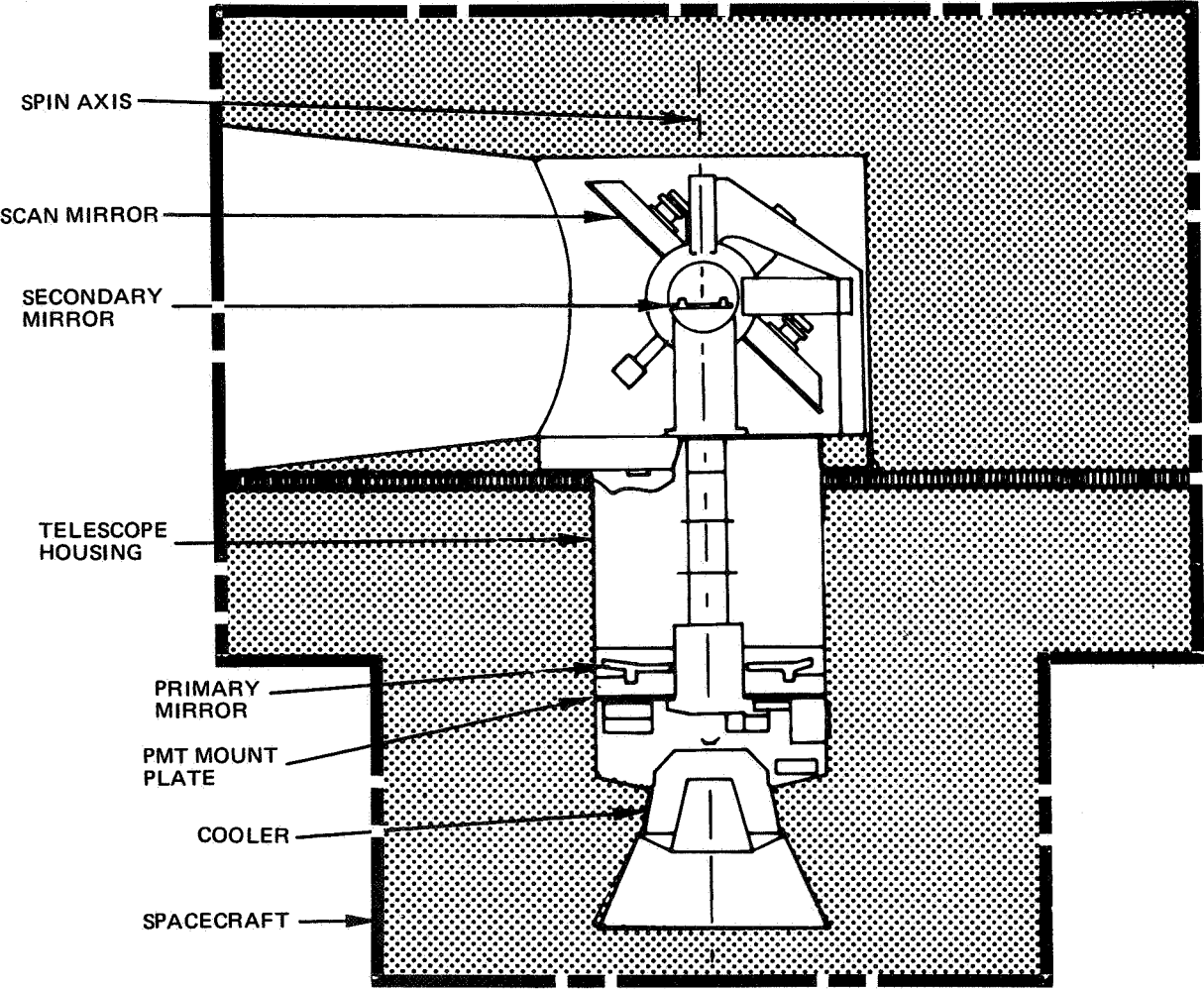


Figure 1. VISSR/SMS.

- **VISIBLE CHANNELS (0.55 TO 0.75 MICRONS)**
 - S/N = 37 AT 50 PERCENT ALBEDO
 - MTF = 0.40 AT ½ NM
- **IR CHANNEL (10.5 TO 12.5 MICRONS)**
 - S/N = 565 AT 315 K
 - NEDT = 0.15 AT 300 K
 - 0.60 AT 200 K
 - MTF = 60 AT 5 NM
- **PASSIVE RADIATION COOLER TEMPERATURE 81 K**
- **STRUCTURAL INTEGRITY QUALIFIED TO PROTOTYPE LEVELS**
- **SCAN DRIVE QUALIFIED**

Figure 2. Verified VISSR performance characteristics.