DSCS-III ATTITUDE CONTROL SYSTEM

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ABSTRACT

The DSCS-III (Defense Satellite Communications System) Spacecraft was designed and built for the Air Force Space Division by General Electric Space Division in Valley Forge, PA. Development of this satellite started in 1978 and was culminated in the recent (May 81) completion of testing of the first flight unit.

The attitude control system for this synchronous orbit spacecraft is a three-axis zero momentum, general microprocessor controlled concept that not only provides attitude and velocity control during the normal seven year orbital life, but also provides provisions to operate and maintain control during special circumstances such as failed battery eclipses, lunar eclipses, and nuclear events.

In addition, the attitude control system electronics and embedded software system provides the capability to drive the single axis solar array, two axis gimbal dish antenna, and translates ground commands into beam pattern reconfiguration driver signals for the phase shifters and variable power dividers of the payload multiple beam antennas.

The control system equipment compliment consists of a redundant passive radiation balance earth sensor, solar array yoke mounted analog sun sensors, and a yaw rate gyro as the sensing elements, the aforementioned general purpose microprocessor (Attitude Control Electronics containing 8K of PROM memory and 1K of RAM in which is implemented the control logic and algorithms, four skewed reaction wheels for normal orbital control torquing/momentum storage and 16 one-pound hydrazine thrusters for initial acquisition and orbit adjust maneuvers and wheel unloading.

The basic requirements to which this system was designed are to (i) acquire an earth pointing reference from arbitrary initial attitudes and rates of 1.1°/sec per axis, maintain control during initial inclination error removal (maximum of 2. 5 degrees) to within 1, 1

and 2 degrees for the roll, pitch, and yaw axes respectively for all times of year and orbit positions, (ii) maintain pitch, roll, and yaw errors to less than 0.08, 0.08, and 0.8 degrees during normal orbital operations (iii) maintain orientation of the solar array to within 1° of the sunline, (iv) establish and control station latitude and longitude to within + 0.1°, (v) provide the capability to recover from the effects of a nuclear event via autonomous detection and corrective action, (vi) provide the capability to reorient/reconfigure the payloac gimballed dish antenna and multiple beam antennas and (vii) provide the capability to modify up to 1K of the PROM stored software using a ground commanded mode.

This DSCS-III ACS as designed and tested meets all of its requirements with a system weighting only 83. 3 pounds and using approximately 64 watts of power.