MSX Command and Data Handling System Summary

Background

The Midcourse Space Experiment (MSX) Program is being conducted by The Johns Hopkins University Applied Physics Laboratory (JHU/APL) for the Ballistic Missile Defense Organization Sensor and Interceptor Technology Directorate (BMDO/DTS). MSX is primarily a data-collection experiment, concentrating on target detection and tracking. It will also gather celestial and earthlimb background data and data on the understanding and control of contamination.

The MSX spacecraft will be able to collect complete data sets needed for ground data-processing demonstrations. JHU/APL has been tasked by BMDO to develop or procure the spacecraft sub-systems, integrate and test the spacecraft and instruments, and provide launch, mission operations, and data acquisition support. A 5-year mission is planned after the spacecraft is launched into an 898-km polar orbit.

Command and Data Handling System

The spacecraft’s command and data handling (C&DH) system is composed of the data handling system, command processors, power switching units, tape recorders, and KG/Tempest electronics units for data encryption and decryption. The system’s capabilities include:

- Controlling the spacecraft, using pulse commands, data commands, and a total of over 200 power switching relays. Commands transmitted from ground stations are acquired using S-Band transponders. In addition, commands may be executed from command processor memory or obtained from the tracking and attitude processors.
- Gathering, formatting, and serially outputting the 16-kbps, 1-Mbps, and 25-Mbps data streams.
- Maintaining and distributing mission elapsed time (MET) and Universal time (UT) on the spacecraft.
- Implementing autonomous spacecraft functions.
- Encrypting downlink data, decrypting uplink (command) data, and providing command authentication.
- Recording the prime science data stream at 5 Mbps or 25 Mbps. Data storage capacity is 54 Gb per recorder. Data are played back at 25 Mbps to the ground station at JHU/APL over an X-Band RF link.

The MSX C&DH system incorporates redundancy and cross-strapping. The uplink receiver, decryptor, and command processor functions are actively redundant, i.e., powered continuously for the life of the mission. Other units are selectively powered with cross-strap data paths commanded to route data appropriately. Downlink data streams are routed by selection of multiplexer switches in the KG/Tempest units.

JHU/APL has designed, fabricated, and tested the command processor, power switching units, and data handling system. The KG/Tempest electronics and tape recorders were custom built to JHU/APL specifications by outside vendors. All C&DH flight hardware has been integrated with the MSX spacecraft. After environmental tests at NASA/Goddard Space Flight Center, Greenbelt, Md., the spacecraft will be launched from Vandenberg Air Force Base, Calif.

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