THE VIKING LANDER TELEMETRY SUBSYSTEM

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Abstract The Viking Program will place two orbiting spacecraft around Mars in the summer of 1976. Each spacecraft will contain a Mars soft lander. The Telemetry Subsystem is that group of electronics on the Viking Lander which interfaces all sources of operational and science data, stores and conditions that data, and provides it to the communications subsystem in appropriate form for RF transmission.

The subsystem hardware elements are the Data Acquisition and Processor Unit (DAPU), a 196, 608 bit (NDRO) Data Storage Memory (DSM), a 40 million bit tape recorder, and a family of pressure transducers.

Several program elements added spice to the subsystem design. The requirement to sterilize the hardware and the decision to use heat as the sterilization agent produced some difficulties in the selection of materials for the tape recorder, mainly for tape, capstan and lubricants. In addition, two material creep problems were encountered, one in the DAPU case material and one in a pressure transducer. Surprisingly, the heat sterilization of 250 DF for 200 hours (Qualification levels) did not cause as many problems as anticipated.

The requirement to design for four rather different mission phases added some interesting features. During cruise, the subsystem provides very low rate engineering status data to the Orbiter for time multiplexing into its Telemetry System. (The Lander is supported entirely by the Orbiter for command, telemetry and electric power during the long cruise to Mars). The DAPU contains the multiplexer and A/D conversion electronics. The Orbiter provides the data shift clock. During Orbiter/Lander preseparation checkout, a higher rate data interface (2 KBPS) is provided to the Orbiter for direct transmission to earth. Many data modes are provided to allow a thorough checkout of the Lander prior to separating it from the Orbiter.

After separation and thru landing, three hardwired data formats are provided, one for each major entry phase, aeroshell, parachute and terminal rocket engine firing. During the aeroshell phase, real time data is delayed 60 seconds in the DSM and interleaved with real time data in order to insure data retrival in the event of an ionization blackout. The Lander is telemetering data to the Orbiter continuously during entry. Data is not delayed and

interleaved during the parachute and terminal engine phases but data formats are changed to better represent the changing vehicle configuration. As a backup to the Lander/Orbiter UHF link, all entry data is placed on the tape recorder for possible transmission after landing by either the UHF relay link to the Orbiter or the Lander S-Band link to the earth. After landing, the data system will support a 90-day mission with 190 operating modes interrelating the many data sources and sinks.

The keystone of the Telemetry Subsystem design philosophy is operational flexibility, in the form of the many operating modes, contrasted to standardization of interfaces. This simplified the systems design, reduced the interaction of subsystems, and provided a degree of immunity to changing program requirements. Many aspects of the subsystem design can be touched only briefly such as grounding, piece part selection, systems test philosophy, noise levels, A/D conversion process, redundancy approach, packaging approach and present state of the hardware.