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COMMAND CAPABILITY AND LIMITATIONS DOCUMENT ~~(S)~~

Prepared by

Approved by

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REPORT CHANGE RECORD FOR Spacecraft 4424/MABEL I
Command Capabilities and Limitations Document

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REVISION RECORD

Revision	Document:	Date
--	Basic document	71 Mar 1
Change Pages	Changed sequence of RTC and PE events to reflect engineering changes; added two new requirements to commanding limitations.	71 Oct 29
Change Pages	Changed sequence of events of some RTC's related to payload read-in off and added new commanding constraint related to tape recorder operation.	72 Sep 5
Change Page	New commanding limitation added; prevents sending of TLM-ON command while tape recorder is reading out (p 5-6A).	72 Nov 21

Note: Changes incorporated into the current revision are indicated by change bars affixed to the right margin of affected pages.

FOREWORD

This document has been prepared in accordance with the requirements of DD 1423 (sequence no. 029) of contract [redacted] 25X1

This document describes the command capabilities and limitations that control the read-in/readout operations of Spacecraft 4424.

Operational options and constraints that must be observed are included.

Table of Contents

Table of Contents
(Cont'd)

List of Illustrations

Section 1

INTRODUCTION

This document describes the operational capabilities of Spacecraft 4424 and of the MABELI payload and establishes guidelines for the collection and recovery of data. Special features, constraints, and limitations of the spacecraft and payload system are provided to establish on-orbit operational criteria for the spacecraft.

Section 2

GENERAL SYSTEM DESCRIPTION

The Spacecraft 4424/MABELI Surveillance System is capable of performing a directed search and a limited general search against Soviet antiballistic missile (ABM) and research radars located in the approximate latitude band from [redacted] The signals of interest have exotic intra- and interpulse modulations and are at selected frequencies from 151 MHz to 2.5 GHZ. The effective radiated power (ERP) is estimated to be from 118 to 152 dBm. Since the target emitters have beamwidths that range from narrow to wide, as well as different azimuth and elevation pointing directions, the MABELI system provides coverage from horizon to horizon. 25X1

Following are the primary objectives of the mission:

a. Measure polarization and power of the main beam of selected pulsed and CW radars

b. Obtain signal signatures that determine the possible presence of cooperative operation between any two emitters on the same or different frequencies

c. Detect signals from frequency-agile emitters

d. Detect signals at commandable discrete or scanned frequency ranges within the 1.5- to 2.5-GHz band.

A concept drawing of the Spacecraft 4424/MABELI system is shown in figure 2-1, and a simplified block diagram is shown in figure 2-2.

The total system needed to support mission requirements comprises the MABELI payload system, a payload antenna system (consisting of five wide-beamwidth antennas designed to operate into each of four dual-channel receivers), and ancillary power, command, and telemetry subsystems.

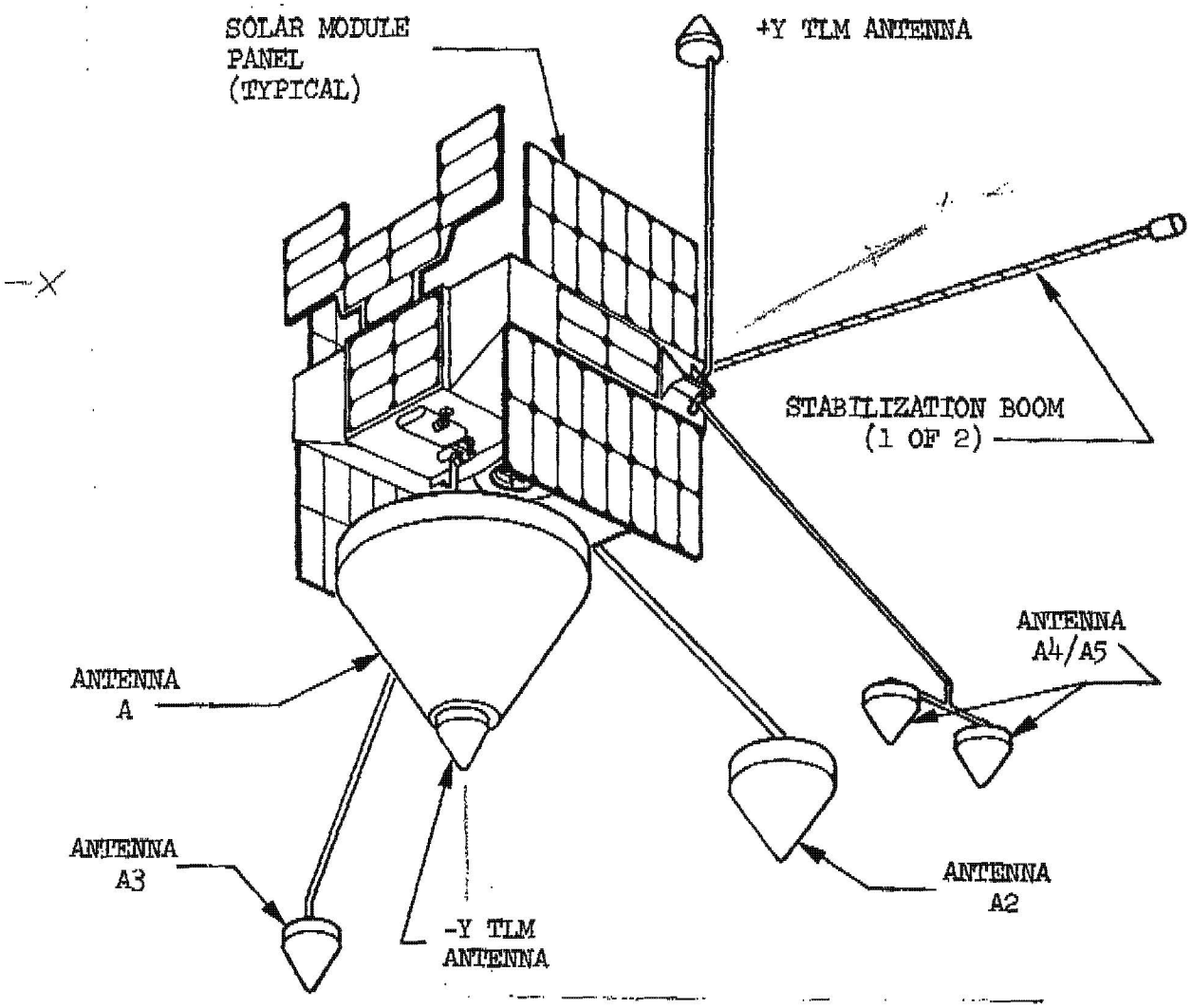

Figure 2-1 Spacecraft 4424/MABELI Intercept System Concept

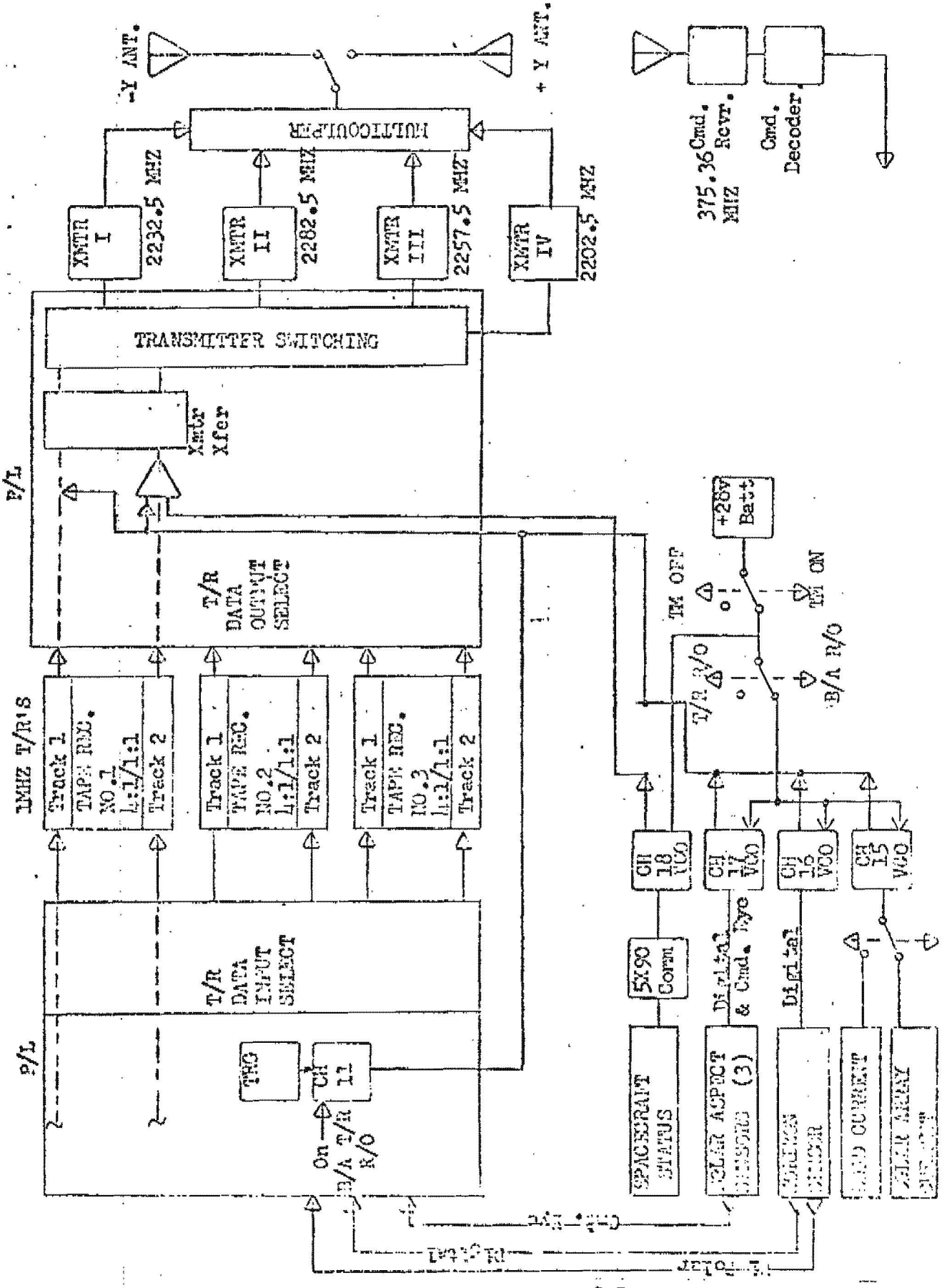

Figure 2-2 System Simplified Block Diagram

Hemispherical coverage of the target areas by the payload antenna is not feasible because of practical considerations of antenna weight, volume, and signal patterns. Because of these limitations, an attitude control system (ACS) will be used to orient the payload antenna system (the theta coverage of which is 0 to 90 degrees) to accomplish the mission requirement of horizon-to-horizon coverage from [redacted] latitude. An inertia control system (ICS) is also provided to reduce coning of the payload antenna axes to less than three degrees. Since the ICS elements and other deployables affect the products of inertia as a function of spin rate, a spin make-up system (SMUS) which can both increase and decrease the spin rate has been installed on the spacecraft. 25X1

Operational aspects, constraints, and limitation of the ACS, ICS, SMUS, and other subsystems are discussed in section 5.

SECTION 3

REAL TIME CONTROL AND DATA RECOVERY

3.1 INTRODUCTION

This section describes the commands and functions associated with data recovery. Spacecraft 4424/MABELI Systems Requirement Document, BIF003W/2-042249-70, provides a detailed description of all spacecraft commands, and Spacecraft 4424/MABELI Intercept System Technical Description, BIF003W/2-020212-70, Series E, delineates payload mode selection commanding.

3.2 TAPE RECORDER OPERATION

The tape recorder read-in/readout ratio is either 4:1 or 1:1 as selected by command. In the 4:1 mode, the approximate read-in time is 22 minutes, and the approximate readout time is 5.5 minutes. In the 1:1 mode, both the read-in and readout times are 5.5 minutes, approximately. The tape recorder is automatically stopped at read-in or readout end-of-tape; however, RTC-280, RTC-20, and base module timer event one (BMT-1) will also terminate tape recorder readout.

3.3 TAPE RECORDER SELECT COMMAND SEQUENCES

The spacecraft logic system provides that any of the three tape recorders may be initiated in the read-in mode by any of the four primary events (PE's) in either the 4:1 or 1:1 speed ratio. RTC-110 through RTC-116, RTC-120 through RTC-126, and RTC-130 through RTC-136 control tape recorders 1, 2, and 3 read-in selection, respectively. This selection also conditions the data switching for readouts. Readout of tape recorders 1, 2, and 3 is initiated via RTC-31, -32, and -33, respectively.

3.4 PE-3/CE-3 AND PE-4/CE-4 READ-IN CONTROL LIMITATIONS

These commands may not be used for read-in on/off control at the same time that the ACS is to be operated since they share common relays.

3.5 TAPE RECORDER SELECTION LIMITATION

When any one of the recorders is selected for a split (or "stacked") read-in, the read-in speed ratio must be the same for the entire read-in duration.

3.6 PROGRAMMED COMMANDS

For the MABELI mission, the system timer capability provides time delays for four independently programmed primary events (PE's) and four companion events (CE's). The total amount of time delay possible is 9.1 hours. Hence, up to 6 revs (at 90 minutes per rev) can be tasked at one time. For example, four 12-minute read-ins can be programmed within a 6-rev time interval. Command timing resolution is 16 seconds for the PE's and 8 seconds for the CE's. Zero load for the PE's is 2 seconds and for the CE's, 8 seconds.

3.7 TRANSMITTER AND TAPE RECORDER TRANSFER

Data inputs from any one of the three dual-track tape recorders to any two of the four transmitters are interchanged when RTC-293 is sent, and returned to the normal configuration when RTC-291 is sent. Transfer of the two payload outputs to one of the recorders occurs when RTC-292 is sent and returned to normal via RTC-291. If a tape recorder is read in while transferred, it must be read out transferred.

3.8 UHF-ON DURATION

When any of the four UHF transmitters is turned on, BMT time delay no. 1 (BMT-1) is initiated, and clocks out at 668 ± 4 seconds. The primary function of BMT-1 is to turn off the transmitters and to terminate the acquisition should, for some reason, the tracking station be unable to transmit real time commands.

3.9 S-BAND DATA LINK ANTENNA

The S-band data link antenna system is similar to that used on most other recent spacecraft. Real time switching of the antenna once per pass is necessary to maintain the required signal strengths at the tracking station

throughout the pass. A data loss in the order of 10 msec (maximum) can be expected during antenna switching.

3.10 UHF TRANSMITTER SELECTION

Since the tape recorders must be read out serially, one transmitter is required for each of the two tracks of the selected recorder. Selection of any two of the four UHF transmitters is accomplished by RTC-190 through RTC-196, and turn-on of the two selected transmitters is via RTC-10 through RTC-14.

Section 4

PAYLOAD OPERATIONAL CONTROL

Details of the payload features are presented in the Spacecraft 4424/MABELI Intercept System Technical Description, BIF003W/2-020212-70, Series E. This section deals only with a delineation of the actual operational control of the payload.

4.1 PAYLOAD MODE PROGRAMMING

Sixteen real time commands are used for programming payload operating modes (including data selection and tape recorder selection logic). In addition, command address (CA) commands -5, -6, or -7 together with 10 function bits are used to provide 3072 discrete commands for payload usage. (See section 4 of BIF003W/2-020212, Series E, for a detailed listing of these assignments.)

4.2 PAYLOAD READ-IN ON

The start of payload read-in is controlled by primary events (PE-1, -2, -3, and -4) from the timer with an accuracy of +0, -1 second plus ±0.02 percent of the programmed delay. PE delays can be programmed in 16-second increments to occur from a minimum of 2 seconds to a maximum of 32,756 seconds. The time delays must be reprogrammed for each read-in. Following RTC-10, CA-1, -2, -3, and -4 load the CE delays. Prior to RTC-100, CA-1, -2, -3, and -4 load the PE delays.

PE-3 and -4 are used for payload-on commands only following RTC-175. After RTC-176, PE-3 and -4 are used for ACS operations. Thus, if the ACS is to be used, PE-3 and -4 cannot be used for payload read-in programming. There is a 4-second delay between the initiation of any PE and the actual turn-on of the payload to allow the recorder to come up to full speed.

4.3 PAYLOAD READ-IN OFF

Each PE in the timer has an associated companion event (CE) that is initiated with the occurrence of its respective PE. CE-1, -2, -3, and -4 can be orbit programmed in 8-second increments from 8 to 2040 seconds. The CE will occur within ±4 seconds of the programmed time.

CE logic is of the nondestruct type; therefore, the delay is required to be reprogrammed only when there is a change in the time delay. CA-1, -2, -3, and -4 load the PE delays following RTC-100. After RTC-10, CA-1, -2, -3, and -4 load the CE delay.

CE-3 and -4 are used for payload-off commands only following RTC-175. After RTC-176, CE-3 and -4 are used for ACS operations. Thus, if the ACS is to be used, CE-3 and -4 cannot be used for payload turn-off.

Within the limits of the tape recorder capacity, the read-in durations are controlled by CE-1, -2, -3, and -4. On occasion, several CE's may be operating simultaneously. Whichever CE is effective first will terminate the read-in.

4.4 PAYLOAD-ON TIME PRIOR TO TARGET

If sun sensor data is not present during any portion of the read-in, horizon sensor data must be collected at least nine degrees before or after the location where the spin axis is nadir pointing; therefore, payload read-ins that fall totally within this 18-degree band must start at least 150 seconds before the spin axis is nadir pointing or must continue until at least 150 seconds after. (See figure 4-1).

4.5 READ-IN OPTIONS AVAILABLE

Available read-in options are listed below. The payload read-in mode can only be programmed at the real time TIM-on acquisition. Split read-ins can be separated in time to approximately six orbits.