OPERATIONAL PROCEDURES FOR POWERING UP, POWERING DOWN, AND CONFIGURING THE QUALIFICATION MODEL OF THE FLTSATCOM SATELLITE

by

H. Lawson, Jr.

September 1990

Thesis Advisor: Dan C. Boger

Approved for public release; distribution is unlimited
Best Available Copy
The engineering qualification model of the FLTSATCOM satellite was donated to the Naval Postgraduate School (NPS) on 01 August 1990 by the Navy Space Systems Division and TRW Space and Technology Group. The satellite is housed in Halligan Hall at NPS and is to be used for instructional laboratories and research. With the acquisition of this spacecraft, a course was established on spacecraft testing with the intent of using the qualification model as a lab device. The course requirement calls for the ability to power up, power down, and configure the satellite within a reasonable time frame. The objective of this thesis is to produce a single source implementation guide which will fully document the step-by-step procedures for powering up, powering down, and configuring the qualification model of the FLTSATCOM satellite in its current modified configuration.
Operational Procedures for Powering Up, Powering Down,
and Configuring the Qualification Model
of the FLTSATCOM Satellite

by

H. Lawson, Jr.
Major. United States Marine Corps
B.S., U.S. Naval Academy, 1975

Submitted in partial fulfillment of the
requirements of degree of

MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY
(SPACE SYSTEMS OPERATIONS)

from the

NAVAL POSTGRADUATE SCHOOL
September 1990

Author: H. Lawson, Jr.

Approved by: Dan C. Boger, Thesis Advisor
Rudolf Panholzer, Second Reader
Rudolf Panholzer, Chairman
Space Systems Academic Group
ABSTRACT

The engineering qualification model of the FLTSATCOM satellite was donated to the Naval Postgraduate School (NPS) on 01 August 1990 by the Navy Space Systems Division and TRW Space and Technology Group. The satellite is housed in Halligan Hall at NPS and is to be used for instructional laboratories and research. With the acquisition of this spacecraft, a course was established on spacecraft testing with the intent of using the qualification model as a lab device. The course requirement calls for the ability to power up, power down, and configure the satellite within a reasonable time frame. The objective of this thesis is to produce a single source implementation guide which will fully document the step-by-step procedures for powering up, powering down, and configuring the qualification model of the FLTSATCOM satellite in its current modified configuration.
TABLE OF CONTENTS

I. INTRODUCTION................................................ 1
   A. BACKGROUND............................................ 1
   B. OBJECTIVES............................................ 4
   C. SCOPE AND LIMITATIONS.................................. 4
   D. LITERATURE REVIEW...................................... 5
   E. ORGANIZATION OF STUDY................................. 6

II. SYSTEM COMPONENTS............................................. 8
   A. LIST OF SYSTEM COMPONENTS................................ 8
   B. AEROSPACE GROUND EQUIPMENT............................ 20
   C. EAGE OVERVIEW.......................................... 20

1. Power Subset................................................. 21
   a. Power Console........................................... 21
      (1) Power Control Unit.................................... 21
      (2) Power Monitor Unit.................................... 22
      (3) Digital Voltmeter (DVM)............................... 22
      (4) Utility Power Supply.................................. 22
      (5) Load Array Power Supply............................... 23
      (6) Charge Array Power Supplies......................... 23
      (7) Intercom............................................. 23
      (8) Console Primary Power Control....................... 23

2. Telemetry, Tracking, and Command (TT&C) Subset............. 23
   a. Functional Details........................................ 23
      (1) Uplink................................................. 23
      (2) Downlink.............................................. 24

3. Attitude and Velocity Control Subsystem Subset............. 24

4. Ordnance/Test Point Monitor Subset.......................... 25
   a. Test Point Monitor....................................... 25
5. Automatic Data Processing Equipment (ADPE) .... 25
   a. ADPE Hardware ..................................... 26
   b. ADPE Software .................................... 26

III. SYSTEM INITIALIZATION AND CONTROL ............. 35
   A. INITIAL CONDITIONS FOR COMPONENTS ............... 35
   B. COLD-START PROCEDURES ............................. 41
      1. Disk Drive ....................................... 42
      2. Series I ......................................... 42
      3. Card Reader ...................................... 42
      4. IBM 1800 ......................................... 43
      5. TT&C 2 ........................................... 44
   C. POWERING UP THE SATELLITE (AUTOMATIC
      PROCEDURE - AP) .................................... 45
   D. ATTITUDE AND VELOCITY CONTROL SUBSYSTEM
      (AUTOMATIC PROCEDURE - AVCS AP) ................. 64
   E. POWERING DOWN THE SATELLITE (AUTOMATIC
      PROCEDURE - AP) .................................... 81
   F. SHUT-DOWN OF CONSOLES AND SATELLITE ............. 100
   G. COMPUTER AREA SHUT-DOWN ........................... 101

IV. TELEMETRY FUNCTIONS ................................. 103
   A. GENERAL DISCUSSION ................................. 103
   B. USER INPUTS ........................................ 106
   C. PAGE OUTPUT MESSAGES .............................. 111

V. COMMAND FUNCTIONS ..................................... 112
   A. GENERAL DISCUSSION ................................. 112
   B. USER INPUTS/COMMAND REQUESTS ...................... 113
   C. COMMAND DISPLAY FORMAT ............................ 117
   D. OUTPUT MESSAGES .................................... 120
VI. AUTOMATIC PROCEDURES FUNCTION (AP) ........................................ 124
   A. GENERAL DISCUSSION ................................................................... 124
   B. USER INPUTS ............................................................................... 124
   C. OUTPUT MESSAGES ..................................................................... 126

VII. UTILITY FUNCTIONS ..................................................................... 127
   A. GENERAL DISCUSSION ................................................................... 127
   B. USER INPUTS ............................................................................... 127
   C. OUTPUT MESSAGE ....................................................................... 129

VIII. CONCLUSIONS AND RECOMMENDATIONS .................................... 130
   A. CONCLUSIONS ........................................................................... 130
   B. RECOMMENDATIONS .................................................................... 131

APPENDIX A AUTOMATIC PROCEDURE (AP) LIBRARY ......................... 132
APPENDIX B AUTOMATIC PROCEDURE FORMAT DESCRIPTION ............. 134
APPENDIX C AP TERM GLOSSARY LIBRARY ....................................... 136
APPENDIX D LIST OF AUTOMATIC PROCEDURES ................................. 137
APPENDIX E GLOSSARY OF PERSONNEL ABBREVIATIONS USED IN APs. 138
APPENDIX F GLOSSARY OF GENERAL ABBREVIATIONS AND ACRONYMS . 139
APPENDIX G CAUTIONS AND EMERGENCY PROCEDURES ..................... 150
APPENDIX H INSTALLING A NEW DISK IN SERIES I DRIVE ................. 152
LIST OF REFERENCES ......................................................................... 154
INITIAL DISTRIBUTION LIST ......................................................... 155
LIST OF FIGURES

1. Communication Links................................................. 2
2. FLTSATCOM and System Test EAGE (Electrical Aerospace Ground Equipment).......................... 10
3. Series I System............................................................ 11
4. IBM 1800 System.......................................................... 12
5. IBM 1442 Card Reader.................................................. 13
6. TT&C Console............................................................. 14
7. Command Console....................................................... 15
8. Power Console............................................................ 16
9. AVCS Consoles............................................................ 17
10. Ordnance/Test Point Monitor Console....................... 18
11. Close-up of Ordnance/Test Point Monitor...................... 19
12. IBM 180C Core Allocation........................................... 28
13. General Print and Monitor Display Format.................. 105
14. Sample Display Format................................................ 107
LIST OF TABLES

1. FLTSATCOM TECHNICAL FEATURES.......................... 3

2. AP PROCESSOR OUTPUT MESSAGES.......................... 126
I. INTRODUCTION

A. BACKGROUND

The Fleet Satellite Communications System is a US Navy sponsored satellite system which provides world-wide, high priority military communication. Each FLTSATCOM (pronounced Fleet Sat Comm) satellite provides 23 communications channels in the UHF frequency range which are shared by the US Navy, US Air Force, Department of Defense and the National Command Authorities. The satellite system provides complete earth coverage except for the polar regions and allows communication between naval aircraft, ships, submarines, ground stations, the Strategic Air Command, and the presidential command network (Figure 1). The technical features of the system are presented in Table 1.

The engineering qualification model of the FLTSATCOM satellite has been donated to the Naval Postgraduate School (NPS) by the Navy Space Systems Division and TRW Space and Technology Group. The satellite is housed in Halligan Hall at NPS and is to be used for instructional laboratories and research. With the acquisition of this spacecraft, a course of study is being established on spacecraft testing with the intent of using the qualification model as a lab device. The course requirement calls for the ability to power up and configure the model within a reasonable time frame.
COMMUNICATION LINKS

Figure 1
[from Ref. 1:p. 1.2]
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch Vehicle</td>
<td>Atlas-Centaur</td>
</tr>
<tr>
<td>Power</td>
<td>~ 1685 Watts, Equinox, after 5 years</td>
</tr>
<tr>
<td>Frequency Band</td>
<td>244 to 400 MHz</td>
</tr>
<tr>
<td>Antenna</td>
<td>Transmit - deployable parabloid</td>
</tr>
<tr>
<td></td>
<td>Receive - deployable helix</td>
</tr>
<tr>
<td>Transponder</td>
<td>Channelized limiting repeaters</td>
</tr>
<tr>
<td></td>
<td>On-board signal processing</td>
</tr>
<tr>
<td></td>
<td>High power multichannel, UHF transmitter</td>
</tr>
<tr>
<td>Attitude Control</td>
<td>Body-fixed momentum wheel</td>
</tr>
<tr>
<td></td>
<td>0.25 degree pointing accuracy</td>
</tr>
<tr>
<td></td>
<td>Electrical and mechanical redundancy</td>
</tr>
</tbody>
</table>
B. OBJECTIVES

The qualification model delivered to NPS, for the sake of security, has had all of the classified systems removed, as well as those systems that cannot be supported by school facilities. The objective of this thesis is to produce a single source implementation guide for the spacecraft in its current modified configuration which will fully document the step-by-step procedures for powering up and configuring the satellite.

C. SCOPE AND LIMITATIONS

The FLTSATCOM satellite program is an extensive one with an abundance of technical, procedural, and testing information on each of the satellites in the current operational constellation. The scope of this thesis has been narrowed to the point of covering only those systems, subsystems, and documents necessary to provide a broad-based understanding for powering up, initializing, and powering down the model delivered to NPS. Those knowledgeable of the FLTSATCOM system may notice that certain systems and subsystems have not been discussed. Those systems have been determined not to be pertinent to the procedures for power up/down and initialization, and thus intentionally have not been addressed.
D. LITERATURE REVIEW

This section provides a list of documents not cited in the list of references which are pertinent to the maintenance and functioning of the FLTSATCOM satellite and its support equipment. Brief descriptions of the contents of each document are provided.

- **Attitude and Velocity Control Subsystem (AVCS) Patchboard Book** -- provides diagrams and procedures for producing the patchboards used on the AVCS console to provide the electronic interface between the spacecraft and the computers.

- **Automatic Data Processing Equipment (ADPE) and Telemetry, Tracking, and Command (TT&C) Subset Validation Test Procedure** -- establishes turn-on procedures leading to a baseline configuration for testing and provides a sequence for validating that each console is functioning within prescribed limits.

- **Battery Trickle Charge Validation Test Procedure** -- establishes turn-on procedures for the trickle charger leading to a baseline configuration for testing and provides a sequence for validating that the trickle charger is functioning within prescribed limits.

- **Controls (AVCS) Subset Validation Test Procedure** -- establishes turn-on procedures leading to a baseline configuration for testing and provides a sequence for validating that each console is functioning within prescribed limits.

- **Data-Control System Inc. Book** -- contains procedures for formatting and copying the disk used by the computers to run the spacecraft.

- **Flight I CRT Page Displays** -- a laminated card which provides a breakdown by subsystems of each CRT page that can be displayed under that subsystem. It shows by line which information is contained on the page in question.

- **FLTSATCOM Operators Manual** -- this book is labeled "Joe Husli" for the individual who compiled it. It contained procedures for duplicating the cards used to "cold start" the spacecraft and a compilation of
other information on the ADPE including the procedures for installing a new disk into the disk drive.

○ **FLTSATCOM Spacecraft Handling Procedures** -- describes the mechanical steps for handling the spacecraft to include installation for testing, mating, demating, and transporting the spacecraft and subassemblies, and steps for antenna handling, stowing, cleaning, and deploying.

○ **Ordnance Test Point Monitor Subset Validation Test Procedure** -- establishes turn-on procedures leading to a baseline configuration for testing and provides a sequence for validating that the console is functioning within prescribed limits.

○ **Power Subset Validation** -- establishes turn-on procedures leading to a baseline configuration for testing and provides a sequence for validating that each console is functioning within prescribed limits.

○ **Telemetry Identification Number/Cal File/Function Numbers** -- provides a translation of the numerical codes found in the telemetry streams read from the command console CRTs.

**E. ORGANIZATION OF STUDY**

Chapter II lists functional descriptions and diagrams of all of the components involved in carrying out the power up/down procedures and initializing the satellite. Chapter III covers initial conditions for start-up and step-by-step cold start procedures. Chapter III then covers the automatic procedures for initiating an Attitude Velocity Control Subsystem (AVCS) function and power down procedures. Chapters IV through VII cover functions related to the automatic data processing equipment (ADPE) including the hardware and software which provide the interface between the satellite and personnel engaged in testing or operating the satellite.
The appendices provide information directed primarily toward understanding the automatic procedure (AP) function which provides the automated process for powering up, powering down, and configuring the satellite. Prior to initiating any start-up procedures, the system components should be thoroughly reviewed for familiarity and all portions of this documents should be read and understood.
II. SYSTEM COMPONENTS

This chapter will be used to provide an overview of the FLTSATCOM satellite with its systems and subsystems which are involved in the power up/down process. Section A provides a list of all primary components of the satellite system. Section B provides a description of the Aerospace Ground Equipment (AGE) while Section C describes the Electrical Aerospace Ground Equipment (EAGE), the primary component of the AGE.

A. LIST OF SYSTEM COMPONENTS

- FLTSATCOM qualification model satellite with System Test Electrical Aerospace Ground Equipment (Figure 2)
  Computer Room Equipment
  - Series I Systems (Figure 3)
    - Series I Computer
    - Disk Drive with CRT and Keyboard
  - IBM 1800 System (Figure 4)
    - IBM 1800 Computer
    - CDC 80450 Band Printer
    - CRT and Keyboard
    - IBM 1816 Typewriter
  - IBM 1442 Card Reader with card file (Figure 5)
  - TT&C Console (Figure 6)
  - Command Consoles - 3 CRTs (Figure 7)
    - Status Display Console (Downlink TT&C)
    - Control Display Console (Uplink TT&C)
    - Automatic Procedure (AP) Display Console with keyboard (Message/Status of Commands)
- Power Console (Figure 8)
- Attitude and Velocity Control Subsystem Consoles (Figure 9)
- Ordnance/Test Point Monitor Console (Figures 10 and 11)
Figure 2. FLTSATCOM and System Test EAGE  
(Electrical Aerospace Ground Equipment)
Figure 3. Series I System
Figure 4. IBM 1800 System
Figure 5. IBM 1442 Card Reader
Figure 6. TT&C Console
[from Ref. 1]
Figure 7. Command Console
Figure 8. Power Console
[from Ref. 1:p. 10-5]
Figure 9. AVCS Consoles
[from Ref: 1:p. 10-49]

17
Figure 10. Ordnance/Test Point Monitor Console
[from Ref. 1:p. 10-55]
Figure 11. Close-up of Ordnance Test/Point Monitor
(from Ref. 1:p. 10-56)
B. AEROSPACE GROUND EQUIPMENT

Aerospace Ground Equipment (AGE) comprises Electrical Aerospace Ground Equipment (EAGE) and Mechanical Aerospace Ground Equipment (MAGE).

EAGE supports spacecraft systems tests throughout factory-to-launch operations. This support is provided during integration of payload and spacecraft modules, integrated system testing, environmental testing, subsystem performance testing, testing at the satellite assembly building, and testing on-stand prior to launch. During the entire test cycle, the EAGE provides spacecraft performance evaluation, performance trend reporting, permanent test records and an indication of accumulated test time. Section C will describe the functions of the EAGE as discussed in Reference 1.

MAGE comprises all of the equipment necessary to support the tasks of assembly, transportation, servicing and checkout of the spacecraft at the contractor's plant, subcontractor's plant, test sites, and launch site. The MAGE is not directly involved in power up/down of the satellite and will not be further discussed.

C. EAGE OVERVIEW

This equipment comprises the major components of concern for the purpose of this thesis:

- Power Subset -- provides primary electric power and monitors power subsystem operations.
- Telemetry, Tracking, and Command (TT&C) Subset -- communicates with the spacecraft to transmit command
and ranging data and to receive telemetry and returning range data.

- Controls Subset -- provides simulation/stimulus and monitoring for performance and evaluation of the Attitude and Velocity Control Subsystem (AVCS).

- Ordnance/Test Point Monitor Subset -- provides controls and indicators for testing of the ordnance firing circuits and for monitoring selected hardline test points.

- Automatic Data Processing Equipment (ADPE) -- provides, in conjunction with the TT&C subset, real-time spacecraft telemetry data processing and provides automatic single or multiple command verification.

1. Power Subset

The power subset supplies, controls, and monitors all power applied to the aerospace vehicle equipment (AVE) during test operations. The power subset consists solely of the power console.

a. Power Console

The power console is a two-bay rack as shown in Figure 8. The main assemblies of the power console are:

- power control unit
- power monitor unit
- digital voltmeter (DVM)
- utility power supply
- load array power supply
- charge array power supply
- intercom
- console primary power control

(1) Power Control Unit

This is the master control unit by which all spacecraft power switching is controlled. Quick-look meters display primary bus voltage/current, and simulated charge
array input voltages. The two major modes which can be initiated from the power control drawer are:

- **External power mode** - this mode of operation is used to perform power profile tests, under voltage tests, etc. The power subset maintains control and regulation of the primary bus by providing remote sensing at the spacecraft primary bus.

- **Load array simulate mode** - this mode of operation simulates the normal mode of operation of the spacecraft in orbital flight. The power subset provides a degraded source of spacecraft primary bus power by local sensing of the load array power supply output voltage.

(2) **Power Monitor Unit**

Quick-look meters are provided for voltage and current measurements of each of the three batteries (NPS system has only one battery).

(3) **Digital Voltmeter (DVM)**

The DVM is a five-digit integrating DC voltmeter with a resolution of 1mV. All precise data readings are made with the DVM. By panel switching on the power control and power monitor units, the DVM can monitor the following functions:

- battery A,B,C voltage
- primary bus voltage
- charge array A,B,C power supply voltage.

(4) **Utility Power Supply**

Provides 28 volts of DC control power to operate switch lights and power relays in the power control unit.
(5) **Load Array Power Supply**
Provides spacecraft main bus power in the external and load array simulate modes of operation.

(6) **Charge Array Power Supplies**
Provides charge power for the spacecraft battery assemblies.

(7) **Intercom**
Provides a communication link between test conductor and equipment operators during test operations.

(8) **Console Primary Power Control**
Master control unit for rack power. Distributes 208 volts AC, three-phase power to the load array power supply and 115 volts AC to the rack utility strips. Contains an AC line voltmeter, circuit breaker, and an elapsed time meter.

2. **Telemetry, Tracking, and Command (TT&C) Subset**
The function of this equipment is to provide two-way communication with the spacecraft, to generate command and range data, and to receive and analyze spacecraft telemetry response to commands and range return data. The TT&C subset consists of a three-bay T&C digital console (Figure 6).

a. **Functional Details**

(1) **Uplink**
The TT&C subset outputs a radio frequency signal which is modulated with FSK/PCM/NRZ format digital
information derived from the digital (TT&C) console. The uplink has the following modes of operation:

- Manual or computer (only computer mode available)
- Clear or encrypted (only clear mode is functional).

In the computer mode, commands are originated in the ADPE and shifted into the command buffer as 8-bit words. The command buffer converts the parallel data from the ADPE to a serial data stream of 63 bits. In the clear mode of operation, the 63-bit data stream derived from the ADPE is passed around the encrypter to the binary/ternary portion of the command buffer. The command buffer will process the clear 63-bit command information and output only the 20-bit command word.

(2) Downlink

The TT&C subset input is a radio frequency signal which carries telemetry information, biphase modulated on a 1.024 MHz subcarrier.

3. Attitude and Velocity Control Subsystem Subset

The purpose of the AVCS subset is to provide stimulus (radiation signals) to the earth and sun sensors, to simulate earth and sun sensor output signals to the attitude and velocity control subsystem and to monitor, measure, and record thruster status, simulator signals, and hardline signals. The AVCS subset consists of a three-bay test rack, spinning sun and earth sensor stimulus equipment, and orbital earth sensor stimulus equipment as illustrated in Figure 9.
4. Ordnance/Test Point Monitor Subset

This subset, in conjunction with the ordnance load simulator unit, energizes, controls, and monitors all spacecraft ordnance during test operations. In addition, the subset provides the capability of monitoring the frequency shift key (FSK) function during launch operations. The ordnance/test point monitor subset consists of a console which comprises a test point monitor and an FSK line driver. The console is a single-bay rack illustrated in Figure 10.

a. Test Point Monitor (Figure 11)

This unit provides indicator lights, test points, and controls the following:

- Controls - subcarrier inhibits A and B (modulation indexing)
- Test Points
  - NRZ-1 Data
  - FSK Input A,B
  - FSK Monitor A,B
  - Structure Ground

5. Automatic Data Processing Equipment (ADPE)

The function of the ADPE is to provide an automated method of transmitting and monitoring commands and of collecting, converting, and displaying telemetered test data. The ADPE consists of general purpose computers, input, output, storage, and display devices and interfacing equipment between the computers and the spacecraft TT&C subsystem via the EAGE subset.
a. ADPE Hardware

ADPE hardware consists of the following components which interact as indicated in the computer center section of Figure 2:

- Series I computer with a disk drive, CRT and keyboard.
- IBM 1800 computer with a 16-bit word length, 2-microsecond access time, a 65K core memory, a single- and double-word addressing, three index registers, and 12 priority interrupt levels.
- Peripheral Input/Output (I/O) Equipment which includes one 1442-7 card reader/punch, one CDC 80450 band printer, a CRT and keyboard, and one IBM 1816-1 typewriter/keyboard.

b. ADPE Software

ADPE software consists of the following modules for which computer core is allocated as illustrated in Figure 12:

- MPX, meaning "Multi-Programming Executive", is an IBM executive program that provides generalized real-time background batch services.
- Cal File, meaning "Calibration File", is a compilation of engineering parameters and calibration curves for translating data into engineering units. The Cal File is loaded into the operational disk.
- COSATMACS, meaning "Communication Spacecraft Assembly Test Monitor and Control," is a program to provide software support to the FLTSATCOM integration and test operations. The support is derived largely as a result of the following basic capabilities of the COSATMACS program [Ref. 3]:
  - Upon detection of a change in a function value, performs additional screening and conversions as specified by the test conductor via the calibration file.
  - Conditionally, or upon request, displays on the CRT and/or line printer telemetry parameters in engineering units.
- Provides a method of reducing the likelihood of data loss during periods of rapid fluctuations of telemetry parameters.

- Formats and transmits, upon request, spacecraft commands.

- Inhibits the transfer of subsequent commands during the time of processing by the computer and transmission time (100ms) by the command buffer.

- Generates odd parity on the command data prior to transfer to the command buffer.

- Automatically selects the spacecraft decoder address for the input command and merges it into the formatted bit string.

- Responds to command request originating from the following sources:
  * The CRT keyboard
  * The card reader (upon request from the CRT)
  * The disk (upon request from the CRT)
  * The Automatic Procedure software
  * A manual command entry device can be connected directly to the command buffer but does not interface with the computers.
Figure 12. IBM 1800 Core Allocation
[from Ref. 1:p. 10-33]
- Recognizes the CRT as the highest priority manual input source.

- Transmits a series of commands from the disk or punches cards in response to a single request from the test conductor.

- Displays and logs all command activity.

- Provides a method of modifying the vehicle code count by command.

- Insures that commands are not transmitted more rapidly than mainframe rate; i.e., one command each 2.048 seconds at 250 bps, or 0.512 seconds at 1K bps.

- Handles command inhibition and enable (see Chapter IV, Command Functions).

- Prints the sign of the value in front of the value only when the value is negative.

- Maintains mainline COMMON which is the method of providing mainline-to-subroutine communications.

- Does the bookkeeping for real-time storage of data for off-line correlation.

- Provides interfaces for and control of the Automatic Procedure software.

- Controls and updates the Command consoles in real-time (three IBM 2260 display CRTs - see Figure 6).

Test activities associated with each telemetry data stream are supported by the command consoles. Each CRT can display 12 lines of output containing 80 characters each. The test conductor interfaces with the software by means of the manual input function via the command consoles. The functions of each of the three display stations of the command consoles are defined below:
- Status Display Station (Downlink TT&C): Data for this CRT indicates the status of the telemetry data stream consisting of as many as 88 separate functions. Each function is represented by an 8-character legend in a particular location assigned to the function. The legend is split into 4-character fields, which are independently changeable. This display is used to continuously monitor the on/off and select status of the desired functions. Display criteria are applied to the running buffer data and are not affected by telemetry inhibits. The display criterion is designed to output one message if the desired portion of the telemetry word is greater than or equal to an indicated value, and the alternate message if it is less than that value. The word masks, display criteria and legends are all defined during calibration file generation (the current calibration file is already loaded into the computer). The top line of the display is reserved for a header identical to the header that appears on the printed output. The status CRT is also used to represent page displays, as requested by manual input.

- Control Display Station (Uplink TT&C): The control CRT displays input directives entered from the attached keyboard, error messages pertaining to invalid input format and ten lines devoted to a requested page display (super page). The displayed page data is obtained from the running buffer and reflects any changes in value that occur while the page is being displayed.

- AP Display Station (Message/Status of Commands): The AP CRT is used to display lines of output determined by the automatic procedures data file contained on the AP disk. Displayed output may consist of AP steps for a procedure being executed, but in general, will indicate only test failures. This display option is predetermined during creation of the AP disk file. All remark lines in the procedure are displayed. The output consists of 11 lines scrolled sequentially from top to bottom.
**COSATMACS Operational Modes** - Various COSATMACS control options are available to the computer operator by means of the IBM 1800 computer console data switches. The data switches are continuously monitored by the COSATMACS program, which then takes the appropriate action as dictated by the switch assignment shown below. In some cases, the switches produce the same response that is available through the manual entry keyboard. Data switch functions are as follows [Ref. 3: pp. 6-7]:

**Data Switch 0**

Initialize time from the time code translator. This switch should be restored to the down position after each use.

**Data Switch 1**

This switch indicates the reading of card inputs for stream 1 applications. Card reading begins only after the switch is restored to the down position.

**Data Switch 3**

Suppress printer output for stream 1. Printing resumes when the switch is turned off.

**Data Switch 4**

This switch provides the same option for stream 2 as switch 3 does for stream 1.

**Data Switch 5**

Initiates the Cal File disk polling sequence and the processing of telemetry data for stream 1. This switch performs the same function as the "start" input on the stream manual entry CRT.

**Data Switch 6**

This switch provides the same option for stream 2 as switch 5 does for stream 1.

**Data Switch 7**

Closes out any active data files on the correlation disk and the history tape for stream 1, and terminates testing for that stream. This switch performs the same function as "EOT" input on the stream 1 manual entry CRT.
Data Switch 8

This switch provides the same option for streams 2 as switch 7 does for stream 1.

Data Switch 9

Causes a printer dump of stream 1 mainframe raw telemetry data. The printout continues until the switch is turned off.

Data Switch 10

This switch provides the same option for stream 2 as switch 9 does for stream 1.

Data Switch 11

Inhibits stream 1 telemetry data output to the correlation disk data file. Data storage resumes after the switch is turned off.

Data Switch 12

This switch provides the same option for stream 2 as switch 11 does for stream 1.

Data Switch 13

Causes a page ejection to occur on the band printer. Subsequent printing begins at the top of the next page. This switch should be returned to the down position right after the page ejection occurs.

Data Switch 14

 Indicates split-stream mode of operation. Since this switch is tested initially to determine which Cal File dictionary to bring in from the disk, this switch setting may not be changed once the program has become operational.

Data Switch 15

There is no function assigned to this switch.

- COSATMACS CRT Control Functions - CRT input requests are entered via the keyboard attached to the manual input (control) CRT. All stress related inputs are applied to that stream associated with the particular CRT used. A manual input request is made up of a number of prescribed fields, each separated by commas or blanks. The number of commas or blanks between
fields is not fixed, but there must be at least one field separator between each field.

- Manual Input Procedure [Ref. 3:pp. 9]. The following steps are necessary to enter a manual input request from the control CRT keyboard:

1. Hold down the SHIFT key ad press the ENTER key. This action causes the following message to be displayed on line 1: TYPE MANUAL ENTRY

2. Hold down the SHIFT key and press the START key, then type in the request (i.e., PD,AC01). This entry will be echoed back on line 2.

3. Check the input message for format errors. If it is correct, send the message to the computer by holding down the SHIFT key and pressing the ENTER key.

If the computer program detects an error in the input request, a diagnostic message will be displayed on line 1 specifying the corrective action to be taken. Usually this indicates a message format error, in which case the operator may correct the error and re-enter the request.

- CRT Program Control Entries [Ref. 3:p. 8-9]. The following program control functions may be initiated via manual input request:

START

When the program is initiated and ready for operation, the following message is displayed on line 1 of the control CRT.

TYPE 'START' TO BEGIN PROCESSING

Entering 'START' from the keyboard at this point performs the same function as does turning on data switch 5 or 6.
STOP

The operator may suspend telemetry processing for either stream by entering 'STOP'.

EOT

This entry performs the same function as does turning on data switch 7 or 8.

CARD

This entry performs the same function as does turning on data switch 1 or 2.

HEADER

This entry provides the capability to change print headers during a test. The new header is punched in columns 1-60 on the header card, which is then entered into the card reader. The manual input 'HEADER' causes the header card to be read, thereby updating the header buffer for the appropriate stream.

MARK

This entry allows the test conductor to annotate the computer printout with desired comments at any time during a test. The comments are entered one line at a time immediately following the 'MARK' field (i.e., MARK BEGIN ENVIRONMENTAL TEST). A maximum of 60 characters may be entered per line.

STATUS

This entry restores the status CRT back to the Status display mode, removing any previous telemetry page information that may have been displayed.
III. SYSTEM INITIALIZATION AND CONTROL

A. INITIAL CONDITIONS FOR COMPONENTS

Prior to initiating cold-start procedures, the power distribution unit (PDU) must be on and the system components listed must be in the initial conditions given below:

POWER CONSOLE

1. Primary power control panel
   - circuit breakers - "on"
   - power on switch - "on"

2. Utility PS
   - line on - "on" (up position)

3. Load array power supply - "on"

4. Charge array power supplies for A, B, & C - "on"

5. Digital voltmeters model 5900
   - power - "on"
   - select - "DCV"
   - select - "Auto"
   - data out, program control ratio, and filter buttons - "out"
   - ext/rate dial - "set to any position"

6. Power monitor panel
   - battery voltage A, B, C, on - "25-35" volts
   - k1 relay status A, B, C, and D on - "charge"
   - battery A, B, and C enable - "off"
   - select - "dmv"
   - main bus voltage - "on"
   - power - "on"

7. Power control panel
   - meter range select A, B, and C voltage - "30-40" volts
   - main bus voltage - "25-45"
   - battery A, B, and C bus enable - "off"
power - "on"
battery A, B, and C charge enable switches - "off"
battery A, B, and C tap enable - "off"
charge array PS A,B,&C and load array PS
ckt breakers - "off"
dvm select - "main b-w volt"
ganged current limit - "on"
charge array A,B,C current limit control - "6"
main bus current limit control - "6"
ganged current limit control - "6"
voltage control - "turn dial fully counterclockwise"
external/solar array sim. - "set to somar sim."
main bus enable - "on"
panel power - "on"

8. Intercommunication - non-operational

ORDNANCE/TEST POINT MONITOR SUBSET

1. Primary power control panel
   circuit breakers - "on" (up)
   power switch - "on"

2. Test point monitor panel
   power switch - "on"
   FSK transmit - FSK "A"

3. Ordnance monitor panel
   power switch - "on"

4. Intercommunication - not operational

AVCS CONSOLE

1. Primary control panel
   circuit breaker - "on" (up)
   power - "on"

2. Newport model 6130 panel
   power - "off"

3. Selector panel - not operational

4. Spinning sun/earth stimulus control
   power - "on" (to provide power for orbital sun detector functions - other switches not operational)
5. Orbital sun detector control
   power - "on"

6. Orbital earth stimulus control
   power - "off"

7. Waveteks - not operational

8. 6253A power supply
   power - "on" (line on in up position)

9. Multiprogrammer
   power - "on"

10. Patch panel
    install patchboard E3 for A side operations

11. Simulator control

   voltage select switch on - "1"
   press power switch to "on"
   press operate/test switch to "operate"
   press radiance presence switch to "off"
   press earth presence switch to "off"
   press A/B select switch to A
   press data ready switch "on"
   press all four enable/disable switches to disable
   set pitch and roll error selectors to 0000
   set pitch A/pitch B switch to "pitch A"
   press spinning earth coarse/fine switch to "coarse"
   press spinning earth coarse 1/coarse 2 switch to "coarse 1"
   press yaw A/yaw B switch to "yaw B"
   press spinning sun detector coarse/fine switch to "fine"
   press spinning sun detector coarse 1/coarse 2 switch to "coarse 1"
Under spinning earth
   press A to "off"
   press B to "on"
   set pulse width to "1"
Under spinning sun detector
   press normal/external switch to "normal"
   press A/B switch to "A"
   press positive/negative switch to "negative"
   press delay 1/delay 2 switch to "delay 2"
12. Thruster firing monitor
   power - "on"

13. Radiance Simulator
   power - "on"

**TT&C CONSOLE**

1. Primary Power Control Panels
   - circuit breaker - "on"
   - power on switch - "on"
   (execute for right and left consoles - COMSEC primary
    power control panel not used)

2. Telemetry buffer
   - power - "on"
   - command count location set to "100"

3. Command Buffer
   - charge/user address/command parity set to "122505251"
   - transmit switch - "off"
   - set to "bypass"
   - set to "remote"
   - power - "on"

4. G15025
   - command channel model index select on "1"
   - PRN range channel on "0"
   - power - "on"

5. G15018
   - LPWTP-93 connectors in BB ASSY inputs 1,0,S,CLK
   - green LPTP 50 connector from BBA out to 1 milliohm - 25
     input on right side of the middle console at
     position B

6. Wavetek - not operational

7. G15006
   - power - "on"
8. G15007

lo rate PCM channel on "1"
PRN range channel on "0"
hi rate PCM channel on ')'
power - "on"

9. Switching Panel

NRZ selected
1 kbps selected

10. G15025

on all three model 4703s under Bit adj. - place all red
switches in up position, selected W on first two model
4703s from the left, selected M on far right 4703
power - "on"

11. G15013

two LWPT-93 connectors in Data/Clr Buffer area under PCM
simulator run connector from "NRZ D to SWP"
connection to "data out" connection

12. D12700 - not used

13. G15016

power - "on"

14. G15004 - not used

15. G15003 - not used

16. G15022

power - "on"

17. G22101

main frame and subframe green light - "on" (if not, press
the synch reset switch)

18. Select and Monitor

dial set to "000005"
left three switches - "up"
right three switches - "down"
19. Common Word Value (12 switches)

switches 1, 3, 5, and 7 - "up"
all other switches - "down"

20. Special Word Value (12 switches)

switches 2, 4, 6, and 8 - "up"
all other switches - "down"

21. Special Word Location Switches (6 switches)

right three switches - "up"
left three switches - "down"
dial set to "000034"

22. Bottom Right of Middle Console

noise switch - "down"

jitter
	down - "on"

int - "up"

bit synch bypass - "down"

bit rate dial on "3"

format synch card inserted (handle should be up with

card in)

power switch - "on" (up)

COMMAND CONSOLES

1. Power - "on" (switches on back of consoles in up position)

IBM 1800 COMPUTER

1. All switches down except for the "WRITE STOR PROT BITS"

2. Display address register on "SAR"

3. Data register on "Q"

4. Mode SW on "RUN"

SERIES I COMPUTER

1. On/off switch on "on"

2. IPL source switch on "primary"

3. Mode switch on "auto IPL"

4. Master switch on back panel - "on"
5. Display/line section switches all in down position (must remove upper front panel to observe switches)

6. Disk drive on lower front panel – not used

SERIES I DISK DRIVE

1. CRT on normal mode
2. CRT power – "on" (set on "1")
3. Start/stop switch on disk drive – "on"
4. Blower switch – "on" (white toggle switch located inside door on rear panel)

IBM 1816 TYPEWRITER

1. Insure paper loaded
2. power – "on"

CDC BAND PRINTER

1. Power switch – "on" (switch located inside of bottom panel on the front of the printer)
2. Ready and line on lights should be "on" when power is "on"

CARD READER

1. Procedures for turn on given as part of cold start procedure in section B.1 of this chapter

B. COLD-START PROCEDURES

Prior to cold start procedures, the 1800 card reader and band printer should be allowed to warm up for a minimum of 45 minutes. If EAGE equipment has been powered down for more than two days, allow 24 hours for the system to stabilize after turn-on. The COSATMACS operational program resides on the COSATMACS system disk. This disk must be mounted and ready before program start-up can begin (see Appendix H). Once this is done, the following procedure is followed to
cold-start the system and run an automatic procedure (AP) [Ref. 3]:

1. **Disk Drive**
   a). Bring the drive on line by pushing the "Start/Stop" button.
   b). Wait until the light stops flashing (steady light indicates the disk is up to speed), then go to the Series I.

2. **Series I**
   a). Turn the system power on by pushing the on/off button on the upper right, then push the following buttons in the sequence shown:
      1). Stop
      2). Reset
      3). Load
   b). Verify the "check" light is not "on" (if the check light is "on", repeat step 2a), then go to step c.
   c). Verify that the program has loaded by checking under **active** on the disk drive CRT that you have the following:

<table>
<thead>
<tr>
<th>Dataset name</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>cosat</td>
</tr>
<tr>
<td>1</td>
<td>cal-up</td>
</tr>
</tbody>
</table>

3. **Card Reader**
   a). With the card reader off, gather the cold-start listing cards from the card file to feed through the card reader.
b). Place the cold-start set-up card followed by the cold start card, two header cards, and one blank card face down with the "9" edge against the rear of the card reader input hopper (place the supplied weight on top of the cards to hold them firmly in place - the metal tension strips on the weight should face the front of the hopper).

c.) Press the "start" button. One card will feed through.

d). Verify the green "ready" light is on (If "ready" light is not illuminated, repeat steps a through d).

e.) Push "start" button and go to the 1800.

4. IBM 1800

a). Set all console toggle switches off (down) except for the "WRITE STOR PROT BITS" switch.

b). Place the computer in a reset condition by pressing the "stop" button and then the "reset" button.

c). Clear memory by pressing the "clear store" button and, while holding this button down, pressing the "start" button. After about one second, release both buttons.

d). Repeat steps two and three once more.

e). Push the "stop" button.

f). Push the "reset" button.

g). Press the "program load" button on the 1800 console; after the card reader reads the cards, go to the 1816 typewriter (if the check light on the 1800 is illuminated, repeat steps a through g).
h). Answer the request for month, day, year, hour, and minutes at the typewriter as show.. in the sample format below:

```
mo 09
day 27
yr 90
hr 11
min 00
```

When the information is entered, the typewriter will type out "Cold Start Complete", go to the 1300. The typewriter will also indicate that the rest of the cards should be fed into the reader - this entry should be ignored.

i). Once printing is done on the typewriter, press "Console Interrupt" on the 1800.

j). Insure all data switches except the "WRITE STOR PROT BITS are off (down) on the 1800 and press "start" (the "ready" and "run" lights illuminate at this point). The command consoles should all come up at this point. The control CIT will say "TYPE-START-TO BEGIN PROCESSING" (console CRTs may be cleared at any time by typing in "END OF TEST").

k). The following message will be typed out on the typewriter: "COSATMACS Realtime Environment Operational". At this point, the COSATMACS Program is operational.

5. TT&C 2

a.) Insure the selector switch on the TT&C 2 switching panel is set to "NRZ".
b). Proceed to the automatic procedure (AP) for satellite power up.

C. POWERING UP THE SATELLITE (AUTOMATIC PROCEDURE - AP)

Before start-up, take the spacecraft of battery trickle charge by turning the battery enable A power switch "off", then the primary power "off" on the battery trickle charger. Then disconnect cable 101-J7 (one of the small cables) from point "J-7" on the satellite -X side and replace it at the "J-7" point with cable #W76 (one of the large black cables).

1. On the command console keyboard, enter the command:
   
   AP, XQ, SC0001

   This initiates the automatic procedure for the A side power up sequence (the command normally must be entered three times before the system accepts it). The satellite is a dual bus system with the individual buses referred to as sides A and B. SC0003 initiates the B side.

2. Once in the AP sequence, the system will automatically go through the procedures for powering up. Provide information as requested or bypass with the command:
   
   AP GO

3. When an AP hold comes up, enter "AP GO" which will bypass the hold and continue the sequence (AP holds are system delays which come up on the monitor as "DL000"). Other delays show up as "DLxxx". The x's represent delay time in seconds. These delays represent the time it takes to complete a system...
process. The sequence continues automatically after these delays.

4. If a system failure occurs, enter "AP GO" to bypass the failure. The satellite will indicate a system failure when it is directed by an AP to carry out a function which it cannot accomplish or runs a system test and determines the system tested is outside of prescribed limits. Systems failures will occur on the AP as a result of certain tests that will fail because the systems being tested are no longer on the satellite or are now not operational. These failures will be bypassed with the AP GO command.

5. Once into an AP sequence, any commands entered are of the format:

   CX xx xxxx (see Appendix B)

Commands should only be entered when the system is in a hold (delay). Sending commands when the system is running a procedure may cause damage.

6. See attached AP sequence (SC0001) from AP Library Volume I for power up procedure (AP command "SC0001") [Ref. 4].

7. Sequence will end with "AP SC0001 COMPLETE".

8. Once "AP SC0001" is complete, power is available to initiate any of the other satellite systems using AP commands from Appendix D.

9. When directed in line 0003 of the SC0001 procedure to adjust main bus voltage to 36 volts, proceed as in step a
below. When directed by line 0005 to enable batteries, proceed as outlined in step b below.

**POWER CONSOLE**

a. Using the voltage control dial (which should be fully counterclockwise), bring the voltage up by slowly moving the dial clockwise until the digital voltmeter measures approximately 36 volts. Then return to the control console and enter AP GO.

b. To enable batteries, hold the "filter conditioning" switch on the power panel in the up position while you press the "A Bus Enable" to "on" followed by pressing the "A Tap Enable" button to "on". Once this is done, go to the control console and enter AP GO to continue the SC0001 AP sequence. The SC0001 sequence follows:
RE S/C POWER ON & INITIALIZATION - [ENTER] - "AP,XQ,SC0001" to initiate AP sequence
RE (SC0001)
RE STC CMD CA,00,XX WHERE XX= - [ENTER] - "CA,00,07" - the s/c ID for A side (to select B
RE S/C ID FOR S/C BEING TESTED.
RE - [ENTER] - "AP,GO" side use "CA,00,10" - if B side elected must switch from
RE FSK A to FSK B on Ordnance/Test
RE point monitor console)
RE 'K' BOX PERMUTER KEY TO BE USED - [ENTER] - "CA,07,A" - s/c routing (for B side use
RE FOR S/C UNDER TEST
RE - [ENTER] - "AP,GO"
RE STC DIRECT PCO TO ADJUST MAIN BUS
RE TO 36.0 ± 2.0 VOLTS see procedure to adjust main bus voltage in section C.9.a of this
RE IF BATTERY SIMULATOR IS USED VERIFY chapter under Power Console
RE 'POWER SWITCH' ON SIMULATOR
RE IS OFF.
RE [ENTER] - "AP,GO"
RE STC DIRECT PCO TO ENABLE BATTERIES - to enable batteries, see section C.9.b in this
RE A,B AND C chapter under Power Console. When battery enab
RE VERIFY ENCRYPTED CMD MODE & HARDLINE led, voltage on digital meter on power console
RE DATA SELECTED should read 285 volts.
RE - [ENTER] - "AP,GO" Hardline is only mode available. Verify TT&CC
RE console set to "bypass" on panel labeled
RE command buffer.
RE HOLD CHK-CMD IS NORMAL AT STEP 8 & 10 - will get a hold command here, may have to
RE BUT SHOULD PASS AFTER 3RD AP GO 8 OR 10 give the command "AP,GO,8" or "AP,GO,10"
RE three times to bypass, if hold at line 0008, use "AP,GO,8". If at line 0010, use
RE "AP,GO,10".
RE SEL PCME CONV B
RE SEL 1K BIT & PCME 'B' UNITS
RE VERIFY TLM SYNC AT 1K BIT 'B' UNITS,
RE [ENTER] - "AP,GO"
RE 'Frame Synch Lost", check green synch lights on
RE "PD,TCO4" and verify on line 306 that bit
RE 1800 and start over.
RE to verify telemetry sync at 1k bit - [ENT", - rate is 1k bit.
RE [ENTER] - "AP,GO"
RE [ENTER] - "AP,GO"
0014 CX, 16, 0501
SEC A OFF
0015 CX, 16, 0440
SEC A ON
0016 CX, 16, 0611
MAIN BUS CURRENT MONITOR SEL (0-25)
RE VERIFY RANGE CLEARANCE OBTAINED, IF
RE NECESSARY, TO TURN ON D/L, BEFORE
RE AP, GO. IF S/C IS TO BE TURNED ON
RE WITHOUT D/L ON AP, GO TO STEP 21,
RE BYPASS VF FAIL AT STEP 30 AND USE
RE NRZ H/L FOR TLM SYNC.
0017 CX, 16, 0204
AUTO DWNLINK ENABLE
0018 CX, 16, 0410
COHERENT MODE
0019 CX, 16, 0553
PRN INHIBIT ON
0020 CX, 16, 0055
DWNLINK ON
0021 CX, 16, 0041
KIR23A BYPASS ENABLE OFF
0022 CX, 16, 0205
KIR23A BYPASS EXECUTE OFF
0023 CX, 16, 0661
KIR23B BYPASS ENABLE OFF
0024 CX, 16, 0557
KIR23B BYPASS EXECUTE OFF
0025 DL, 035 WArt TLM UPDATE
0026 VF, B, E, 247, 377, 000
ALL ORD SAFE
0027 VF, B, E, 162, 154, 000
R/Y 1 LB CAT BED HTRS OFF, RCVR ANT DEP ORD SAFE
0028 VF, B, E, 065, 120, 120
KIR-23A BYPASS OFF
0029 VF, B, E, 079, 100, 100
- [ENTER] - "AP, GO", will go to failure at line 0028
- [ENTER] - "AP, GO" to bypass failure
will go to line 0032.
XMTR SWITCH 'A'

0030 V3, B, E, 246, 316, 116
XMTR SEL 'A' PRN INHIB ON, COHO, DNLK ENABLE TC01

0031 V3, B, E, 306, 376, 376
PCME SEL 'A' SIDE

0032 V3, B, E, 079, 240, 240
KIR-23B BYPASS OFF

TC04

0033 CX, 16, 0603
SEC B OFF

0034 CX, 16, 0644
E1A PRIME LOADS CONV A

0035 CX, 16, 0746
E1A RED LOADS CONV A

0036 CX, 16, 1004
E1A TLM PROC A ON

0037 CX, 16, 0646
E1A TLM PROC B ON

0038 CX, 16, 0212
PRIME AC SOURCE CONN

0039 CX, 16, 0355
RED AC SOURCE DISCONN

0040 CX, 16, 0257
CH A SELECT AC PRIME

0041 CX, 16, 0607
CH B SELECT AC PRIME

0042 CX, 16, 1002
CH C SELECT AC PRIME

0043 CX, 16, 0053
CH D SELECT AC PRIME

0044 CX, 16, 0145
BATT 3 TRANS RESET

0045 CX, 16, 0522
BATT 1 RED AC SOURCE

0046 CX, 16, 0353
BATT 2 RED AC SOURCE

0047 CX, 16, 0104

- [ENTER] - "AP, GO" to bypass failure
will go to failure at line 0062
BATT 3 RED AC SOURCE

0048  CX,16,0605
       CH A TRK CHG

0049  CX,16,0415
       CH B TRK CHG

0050  CX,16,0211
       CH C TRK CHG

0051  CX,16,1000
       CH D TRK CHG

0052  DL,035  WAIT TLM UPDATE

0053  VF,B,E,195,252,000
       VERIFY CH A,B,C,D TRK CHG

0054  VF,B,E,115,252,000
       VERIFY CH A,B,C,D MANUAL MODE

0055  VF,B,E,078,252,252
       VERIFY CH A,B,C,D RECOND DISABLE

0056  VF,B,E,055,252,252
       VERIFY CH A,B,C,D CHG STATUS

0057  CX,16,0361
       CH A AUTO MODE 1

0058  CX,16,0511
       CH B AUTO MODE 1

0059  CX,16,0704
       CH C AUTO MODE 1

0060  CX,16,0155
       CH D AUTO MODE 1

0061  DL,035  WAIT TLM UPDATE

0062  VF,A,E,353,377,114,127
       MAIN BUS VOLTS 36 --2.0

0063  VF,A,E,004,377,116,149
       MAIN BUS VOLTAGE EXP 36 --2 VOLTS

0064  VF,B,E,195,125,100
       VERIFY A&G CONNECT, PRIME AC

0065  VF,B,E,078,252,252
       VERIFY RECONDITION ENABLE IN DISABLE

0066  VF,B,E,245,125,001
       VERIFY B&D CONNECT, AC SOURCE

- [ENTER] - "AP,CO" to bypass failure will go to failure at line 0074
<table>
<thead>
<tr>
<th>Step</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0067</td>
<td>VF,B,E,161,377,272</td>
<td>VERIFY AUTOMODE 1, PRIME AC ON</td>
</tr>
<tr>
<td>0068</td>
<td>VF,B,E,055,252,252</td>
<td>VERIFY CHARGE STATUS</td>
</tr>
<tr>
<td>0069</td>
<td>VF,B,E,115,256,256</td>
<td>VERIFY AUTOMODE &amp; PRIM. AC SOURCE</td>
</tr>
<tr>
<td>0070</td>
<td>VF,B,E,162,003,001</td>
<td>VERIFY SEC 'A' ON, 'B' OFF</td>
</tr>
<tr>
<td>0071</td>
<td>VF,B,E,117,140,140</td>
<td>VERIFY PRIME &amp; REDUN LOADS TO SEC 'A'</td>
</tr>
<tr>
<td>0072</td>
<td>VF,A,E,069,377,000,024</td>
<td>VERIFY SEC 'B' +15V @ 0</td>
</tr>
<tr>
<td>0073</td>
<td>VF,A,E,068,377,148,158</td>
<td>VERIFY SEC 'A' +15V @ 15V</td>
</tr>
<tr>
<td>0074</td>
<td>VF,A,E,260,377,027,255</td>
<td>PROP TANK A PRESS ABOVE 45 PSIA</td>
</tr>
<tr>
<td>0075</td>
<td>VF,A,E,261,377,027,255</td>
<td>PROP TANK B PRESS ABOVE 45 PSIA</td>
</tr>
<tr>
<td></td>
<td>- to bypass failure [ENTER] - &quot;AP,GO&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- will get failures at line 0075, 0076, and 0103</td>
<td>[ENTER] - &quot;AP,GO&quot; to bypass each failure</td>
</tr>
<tr>
<td></td>
<td>- at line 0103, will give option to go to line 0270</td>
<td>[ENTER] - &quot;AP,GO&quot;, 270 at that point</td>
</tr>
<tr>
<td></td>
<td>- system will go to 271 and give an &quot;AP SC0001 complete&quot;</td>
<td>go to line 0271</td>
</tr>
<tr>
<td>0076</td>
<td>VF,B,E,196,376,376</td>
<td>ISO VALVES ALL OPEN</td>
</tr>
<tr>
<td>0077</td>
<td>CX,16,1003</td>
<td>CH A VOLTAGE SELECT 4</td>
</tr>
<tr>
<td>0078</td>
<td>CX,16,0640</td>
<td>CH A VOLTAGE SELECT 1</td>
</tr>
<tr>
<td>0079</td>
<td>CX,16,0701</td>
<td>CH A VOLTAGE SELECT 2</td>
</tr>
<tr>
<td>0080</td>
<td>CX,16,0223</td>
<td>CH B VOLTAGE SELECT 4</td>
</tr>
<tr>
<td>0081</td>
<td>CX,16,0060</td>
<td>CH B VOLTAGE SELECT 1</td>
</tr>
<tr>
<td>0082</td>
<td>CX,16,0121</td>
<td>CH B VOLTAGE SELECT 2</td>
</tr>
<tr>
<td>0083</td>
<td>CX,16,0246</td>
<td>CH C VOLTAGE SELECT 4</td>
</tr>
</tbody>
</table>
0084  CX,16,0400
       CH C VOLTAGE SELECT 1
0085  CX,16,0350
       CH C VOLTAGE SELECT 2
0086  CX,16,0610
       CH D VOLTAGE SELECT 4
0087  CX,16,0445
       CH D VOLTAGE SELECT 1
0088  CX,16,0506
       CH D VOLTAGE SELECT 2
0089  CX,16,0657
       BATT 1 PRIME SENSORS
0090  CX,16,0210
       BATT 2 PRIME SENSORS
0091  CX,16,0240
       BATT 3 PRIME SENSORS
0092  DL,035    WAIT TLM UPDATE
0093  VF,B,E,055,125,000
       VERIFY VOLT SEL #2 ALL OUT
0094  VF,B,E,115,100,100
       VERIFY CH A VOLT SEL #3 IN
0095  VF,B,E,078,025,025
       VERIFY CH B,C,D VOLT SEL #3 IN
0096  VF,B,E,245,252,000
       VERIFY VOLT SEL #1 ALL OUT
0097  RE       EPDS INITIALIZATION COMPLETE,TT&C
       INITIALIZATION IN PROGRESS
0098  CX,16,0706
       SEL XMTR 'A' & RF SWITCH TO 'A'
0099  CX,16,0063
       PSA-1 CMD PROC A TO CCV-1
0100  CX,16,0160
       PSA-1 CMD PROC B TO CCV-1
0101  CX,16,0315
       PSA-2 CMD PROC A TO CCV-2
0102  CX,16,0413
       PSA-2 CMD PROC B TO CCV-2
0103  RE          TT&G INITIALIZATION COMPLETE
       RE          IF AVCS INITIALIZATION NOT REQUIRED
       RE          AP GO STEP 270 OTHERWISE AP GO
       DL 000
       RE          AVCS INITIALIZATION IN PROGRESS
0104  CX,16,0404
       PSE-A ON
0105  CX,16,0720
       A CMD PROC ON
0106  CX,16,0417
       SPIN UP POWER A 'OFF'
0107  CX,16,0456
       SPIN UP POWER B 'OFF'
0108  CX,13,0005
       CDE-A ON
0109  CX,16,0601
       PSE-A EXECUTE
0110  CX,13,0025
       TPE-A ON
0111  CX,16,0601
       PSE-A EXECUTE
0112  CX,13,0053
       ACE-A OFF
0113  CX,16,0601
       PSE-A EXECUTE
0114  CX,13,0143
       ACE-B OFF
0115  CX,16,0601
       PSE-A EXECUTE
0116  CX,13,0031
       ADE-1A OFF
0117  CX,16,0601
       PSE-A EXECUTE
0118  CX,13,0121
       ADE-1B OFF
0119  CX,16,0601
0138  CX,13,0101
         ESA-B OFF
0139  CX,16,0601
         PSE-A EXECUTE
0140  CX,13,0055
         SESA-A OFF
0141  CX,16,0601
         PSE-A EXECUTE
0142  CX,13,0145
         SESA-B OFF
0143  CX,16,0601
         PSE-A EXECUTE
0144  CX,13,0037
0145  CX,16,0601
         TCE-A OFF
         PSE-A EXECUTE
0146  CX,13,0127
         TCE-B OFF
0147  CX,16,0601
         PSE-A EXECUTE
0148  CX,13,0077
         VDE-A 28V OFF
0149  CX,16,0601
         PSE-A EXECUTE
0150  CX,13,0075
         VDE-A 5V OFF
0151  CX,16,0601
         PSE-A EXECUTE
0152  CX,13,0167
         VDE-A 28VDC OFF
0153  CX,16,0601
         PSE-A EXECUTE
0154  CX,13,0165
         VDE-B 5V OFF
0155  CX,16,0601
         PSE-A EXECUTE
0156  CX,13,0013
       WGE-A OFF
0157  CX,16,0601
       PSE-A EXECUTE
0158  CX,13,0103
       WGE-B OFF
0159  CX,16,0601
       PSE-A EXECUTE
0160  CX,13,0033
       WDE-A OFF
0161  CX,16,0601
       PSE-A EXECUTE
0162  CX,13,0123
       WDE-B OFF
0163  CX,16,0601
       PSE-A EXECUTE
0164  CX,13,0057
       PCE-A OFF
0165  CX,16,0601
       PSE-A EXECUTE
0166  CX,13,0147
       PCE-B OFF
0167  CX,16,0601
       PSE-A EXECUTE
0168  CX,13,0105
       CDE-A OFF
0169  CX,16,0601
       PSE-A EXECUTE
0170  CX,13,0125
       TPE-A OFF
0171  CX,16,0601
       PSE-A EXECUTE
0172  DL,035  WAIT TLM UPDATE
0173  VF,B,E,419,062,040
       CDE-A ON, VDE-A(+5V), APE-A, 'OFF'
0174  VF,B,E,420,062,020
       TPE-A ON, SES-A, VDE 28V A 'OFF'
<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0175 | VF,B,E,421,360,000  
      | ESA-A,EPE-A,WCE-A,ACE-A 'OFF' |
| 0176 | VF,B,E,422,360,000  
      | WDE-A,CSE-A,TCF-A,PCE-A 'OFF' |
| 0177 | VF,B,E,169,360,000  
      | SPIN UP POWER +5V & BATT BUS 'OFF' |
| 0178 | CX,13,0015  
      | CDE-A OFF |
| 0179 | CX,16,0601  
      | PSE-A EXECUTE |
| 0180 | CX,13,0035  
      | TPE-A OFF |
| 0181 | CX,16,0601  
      | PSE-A EXECUTE |
| 0182 | CX,16,0441  
      | PSE-A OFF |
| 0183 | CX,16,1016  
      | A&B CMD PROC OFF |
| 0184 | DL,035  
      | WAIT TLM UPDATE |
| 0185 | VF,B,E,162,227,000  
      | PSE-A&B OFF |
| 0186 | VF,B,E,169,014,000  
      | PSE-A&B CMD PROC OFF |
| 0187 | CX,16,0502  
      | PSE-B ON |
| 0188 | CX,16,0757  
      | PSE-B CMD PROC ON |
| 0189 | CX,16,0417  
      | SPIN UP POWER 'A' OFF |
| 0190 | CX,16,0456  
      | SPIN UP POWER 'B' OFF |
| 0191 | CX,24,0115  
      | CDE-B ON |
| 0192 | CX,16,0222  
      | PSE-B EXECUTE |
| 0193 | CX,24,035 |
0212  CX,16,0222
       PSE-B EXECUTE
0213  CX,24,0107
       CSE-B OFF
0214  CX,16,0222
       PSE-B EXECUTE
0215  CX,24,0051
       EPE-A OFF
0216  CX,16,0222
       PSE-B EXECUTE
0217  CX,24,0141
       EPE-B OFF
0218  CX,16,0222
       PSE-B EXECUTE
0219  CX,24,0011
       ESA-A OFF
0220  CX,16,0222
       PSE-B EXECUTE
0221  CX,24,0101
       ESA-B OFF
0222  CX,16,0222
       PSE-B EXECUTE
0223  CX,24,0055
       SESA-A OFF
0224  CX,16,0222
       PSE-B EXECUTE
0225  CX,24,0145
       SESA-B OFF
0226  CX,16,0222
       PSE-B EXECUTE
0227  CX,24,0037
       TCE-A OFF
0228  CX,16,0222
       PSE-B EXECUTE
0229  CX,24,0127
       TCE-B OFF
<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0230</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0231</td>
<td>CX, 24, 0077</td>
<td>VDE-A 28V OFF</td>
<td></td>
</tr>
<tr>
<td>0232</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0233</td>
<td>CX, 24, 0075</td>
<td>VDE-A 5V OFF</td>
<td></td>
</tr>
<tr>
<td>0234</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0235</td>
<td>CX, 24, 0167</td>
<td>VDE-B 28V OFF</td>
<td></td>
</tr>
<tr>
<td>0236</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0237</td>
<td>CX, 24, 0165</td>
<td>VDE-B 5V OFF</td>
<td></td>
</tr>
<tr>
<td>0238</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0239</td>
<td>CX, 24, 0013</td>
<td>WCE-A OFF</td>
<td></td>
</tr>
<tr>
<td>0240</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0241</td>
<td>CX, 24, 0103</td>
<td>WCE-B OFF</td>
<td></td>
</tr>
<tr>
<td>0242</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0243</td>
<td>CX, 24, 0033</td>
<td>WDE-A OFF</td>
<td></td>
</tr>
<tr>
<td>0244</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0245</td>
<td>CX, 24, 0123</td>
<td>WDE-B OFF</td>
<td></td>
</tr>
<tr>
<td>0246</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0247</td>
<td>CX, 24, 0057</td>
<td>PCE-A OFF</td>
<td></td>
</tr>
<tr>
<td>0248</td>
<td>CX, 16, 0222</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PSE-B EXECUTE

0249 CX, 24, 0147
  PCE-B OFF

0250 CX, 16, 0222
  PSE-B EXECUTE

0251 CX, 24, 0015
  CDE-A OFF

0252 CX, 16, 0222
  PSE-B EXECUTE

0253 CX, 24, 0035
  TPE-A OFF

0254 CX, 16, 0222
  PSE-B EXECUTE

0255 DL, 035 WAIT TLM UPDATE

0256 VF, B, E, 419, 077, 010
  CDE-B ON, CDE-A, VDE-A&8B(5V), APE-A&8B OFF

0257 VF, B, E, 420, 077, 004
  TPE-B ON, TPE-A, SESA-A&8B, VDE-A&8B(28V) OFF

0258 VF, B, E, 421, 377, 000

0259 VF, B, E, 422, 377, 000
  WDE-A&8B, CSE-A&8B, TCE-A&8B, PCE-A&8B OFF

0260 VF, B, E, 169, 360, 000
  SPIN UP POWER +5V & BATT BUS OFF

0261 CX, 24, 0105
  CDE-B OFF

0262 CX, 16, 0222
  PSE-B EXECUTE

0263 CX, 24, 0125
  TPE-B OFF

0264 CX, 16, 0222
  PSE-B EXECUTE

0265 CX, 16, 0543
  PSE-B OFF

0266 CX, 16, 1016

0267 DL, 035 WAIT TLM UPDATE
0268  VF, B, E, 162, 220, 000
       PSE-A&B OFF
0269  VF, B, E, 169, 014, 000
       PSE-A&B CMD PROC OFF
       RE   AVCS TURNED OFF COMPLETED
       RE   AVCS 'A' AND 'B' UNITS OFF
0270  PP, ALL
0271  RE   AP SCO001 COMPLETE
       END OF STEP - the s/c electrical power distribution and telemetry
               systems are now powered up and prepared to accept commands
               - proceed to part D for example of running an AVCS AP
D. ATTITUDE AND VELOCITY CONTROL SUBSYSTEM (AUTOMATIC PROCEDURE - AVCS AP)

The FLTSATCOM qualification model satellite was not delivered with any of the system testing software; therefore, the satellite can be placed into any of the AVCS AP modes shown in Appendix D, but no testing can be performed using current software. To initiate an AVCS AP mode, the system must first be placed into one of the six baseline modes (AC1001 to AC1006) or be an AP which provides its own baseline as is the case with AC1030 which puts the satellite into the normal A side flight operation mode [Ref. 5]. The baseline APs place the satellite into the proper posture to execute the other AVCS APs.

Once the system has been powered up via SCO001, the AC1030 operational mode may be initiated using the command:

"AP,XQ,AC1030"

and terminated with the program:

"AP,XQ,AC2121" (A side turn off)
or terminated with the program:

"AP,XQ,SCO002"

The AC2121 program is used if planning to initiate another AVCS AP mode after turning off the AC1030 AP. The SCO002 program may be used if the intent is to turn off the AVCS system in conjunction with the shut down of the satellite system. All AVCS modes must be turned off prior to initiating any other AVCS or other mode.
The sequence of commands for AC1030 and AC2121 follow [Ref. 5] (only the pages pertinent for the sake of this example are included for AC1030):
AVCS A-SIDE MODE SEQUENCE (AC1030)

TO ENTER ANY ORBITAL MODE CONFIGURATION, XO AP.GO,XXX WHERE XXX=STEP NUMBER.

THE STEP NUMBERS FOR EACH MODE WILL APPEAR MOMENTARILY, SO TAKE NOTES IF NECESSARY. EACH CRT DISPLAY WILL REMAIN FOR 30 SECONDS ONLY. AT THE END OF EACH MODE CONFIGURATION, INSTRUCTIONS FOR SUBSEQUENT MODES WILL BE PRESENTED.

- ENTER - "AP,XQ,AC1030"
- will go to delay of DL,000
- ENTER - "XQ,AP,GO,174" - 174 will initiate normal flight mode in the satellite system will go to a failure at line 0190

Intermediate steps in the sequence have been left out (steps 0002-0166). To view these, see AP Library and Computer Disk Command Sequences, Volume II [Ref. 5]
0167  DL 035  TLM DELAY-B
0168  VF,B,E,421,377,360
       ESA-A,EPE-A,WCE-A,ACE-A ON,ESA-B,EPE-B,WCE-B,ACE-B OFF
0169  VF,B,E,422,377,360
       WDE-A,CSE-A,PCE-A TCE-A ON,WDE-B,CSE-B,TCE-B,PCE-B OFF
0170  DL 090  WHEEL RUNNING
0171  VF,A,E,391,377,111,145
       WHEEL SPEED NORMAL
RE
RE  A SIDE EARTH/SUN POINT MODE 4A WITH
RE  REACTION WHEEL ON ESTABLISHED AND
RE  CONFIRMED.
RE
RE  TO PROCEED TO NORMAL MODE 4B,
RE  XQ AP,GO.
RE
RE  FOR ANY OTHER MODE, XQ AP,GO,XXX.
0173  DL 000
0174  CX,16,0543
       PSE-B OFF
CX,16,0404
       PSE-A ON
CX,16,1116
       PSE COMMAND PROCESSORS OFF
CX,16,0720
       PSE-A COMMAND PROCESSOR ON
CX,16,0621
       COMMAND PROCESSOR CONVERTER A ON
CX,16,0243
       TANK A ISO VALVE OPEN
CX,16,0345
       TANK B ISO VALVE OPEN
CX,16,0141
       TANK CROSSCONNECT VALVE OPEN
CX,16,0447
       0.1 LB BANK A ISO VALVE OPEN
CX,16,0551
0.1 LB BANK B ISO VALVE OPEN
CX,16,0653
1.0 LB BANK A ISO VALVE OPEN
CX,16,0756
1.0 LB BANK B ISO VALVE OPEN
CX,16,0417
SPINUP POWER-A OFF
CX,16,0456
SPINUP POWER-B OFF
CX,13,0143
ACE-B OFF
CX,16,0601
PSE-A EXECUTE
CX,13,0053
ACE-A OFF
CX,16,0601
PSE-A EXECUTE
CX,13,0121
ADE-1B OFF
CX,16,0601
PSE-A EXECUTE
CX,13,0161
ADE-2B OFF
CX,16,0601
PSE-A EXECUTE
CX,13,0021
ADE-1A ON
CX,16,0601
PSE-A EXECUTE
CX,13,0061
ADE-2A ON
CX,16,0601
PSE-A EXECUTE
CX,13,0073
APE-A OFF
CX,16,0601
PSE-A EXECUTE
CX, 13, 0163
APE-B OFF
CX, 16, 0601
PSE-A EXECUTE

0176
CX, 13, 0107
CSE-B OFF
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0007
CSE-A ON
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0141
EPE-B OFF
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0041
EPE-A ON
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0101
ESA-B OFF
CX, 16, 0601
PSE-A EXECUTE

0177
CX, 13, 0001
ESA-A ON
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0055
SESA-A OFF
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0145
SESA-B OFF
CX, 16, 0601
PSE-A EXECUTE
CX, 13, 0127
TCE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0027
TCE-A ON
CX.16.0601
PSE-A EXECUTE
CX.13.0125
TPE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0025
TPE-A ON
CX.16.0601
PSE-A EXECUTE
CX.13.0167
VDE-B (28) OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0165
VDE-B (5) OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0065
VDE-A (5) ON
CX.16.0601
PSE-A EXECUTE
CX.13.0067
VDE-A (28) ON
CX.16.0601
PSE-A EXECUTE
CX.13.0103
WCE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0003
WCE-A ON
CX.16.0601
PSE-A EXECUTE
CX.13.0033
WDE-A OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0123
WDE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0147
PCE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0047
PCE-A ON
CX.16.0601
PSE-A EXECUTE
CX.13.0105
CDE-B OFF
CX.16.0601
PSE-A EXECUTE
CX.13.0005
CDE-A ON
CX.16.0601
PSE-A EXECUTE
CX.01.0000
ADE MODE, ALL OFF, +90, PLUS
CX.16.0744
ADE-A EXECUTE
CX.02.1400
VDE MODE, +R/YA, -R/YA ENABLED
CX.16.0703
VDE-A EXECUTE

0181
CX.02.0002
VDE MODE, B VALVES DISABLE
CX.16.0703
VDE-A EXECUTE
CX.02,1001
  VDE MODE, Z VALVES,PULSE,KEY,PREC DISABLED, R/YA OR ROLL PULSE
CX.16,0703
  VDE-A EXECUTE
CX.02,0003
  VDE MODE, PREC. DELAY=0
CX.16,0703
  VDE-A EXECUTE
CX.14,0004
  CSE MODE, NORMAL, A NORTH
CX.16,0642
  CSE-A EXECUTE
CX.14,0005
  CSE MODE, P/RY FINE,AUTO ACQ DISABLED,R OUT DISABLED, EARTH PITCH
CX.16,0642
  CSE-A EXECUTE
CX.14,1242
  CSE MODE, UNL INHIB,EP NORM,FUL P DZN,WHL NORM,P/RY OUT DISABLED,
  R/Y OUT ENABLED
CX.16,0642
  CSE-A EXECUTE
CX.14,0003
  CSE MODE,YAW BIAS=PLUS 0.
CX.16,0642
  CSE-A EXECUTE
0182  RE NORMAL MODE 48 COMMANDS COMPLETE.
0183  DL 035  TLM DELAY=0
0184  VF,B,E,021,001,000
        FSV0 ON
0185  VF,B,E,042,377,000
        THRUSTERS, ALL P&R OFF
0186  VF,B,E,043,017,000
        THRUSTERS, ALL R/Y OFF
0187  VF,B,E,044,377,000
        THRUSTERS, ALL B OFF
0188  VF,B,E,162,220,020
PSE-A ON,PSE-B OFF
VF.B.E,169,374,000
PSE-A CMD PRCSR ON,SPINUP PWR,PSE-B CMD PRCSR OFF
VF.B.E,196,376,376
ALL ISO VALVES OPEN
0191 VF.B.E,397,003,003
ADF-1AE2A ON
VF.B.E,398,003,000
ADF-1BE2B OFF
VF.B.E,402,377,000
ADE MODE, ALL STEP,SLEW,CAFE OFF,90,PLUS
VF.B.E,410,301,001
CSE MODE, A NORTH, UNL. INHIB.
VF.B.E,411,177,060
CSE MODE,EP NRM,WHL NRM,R/Y OUT ENABL.
AUTO ACGY OR OUTS DISABLED
VF.B.E,412,360,200
CSE MODE,FUL PDZN,PEARTh,YGP, FINE
VF.B.E,414,003,003
CSE/VDE MODE,NORMAL,R/YA OR ROLL PULSE
VF.B.E,415,007,000
VDE MODE,PREV,KEY,PULSE,DISABLED
VF.B.E,416,377,000
VALVES, ALL W B E D
VF.B.E,417,017,014
VALVES, +R/YA,-R/YA ENABL.
VF.L.E,418,377,000
VALVES, ALL Z S B L
VF.B.E,419,077,360
CDE-A,VDE-A(5) ON,CDE-B,VDE-B(5),APE-AGB OFF
VF.B.E,420,077,022
TPE-A,VDE-A(28) ON,SESA-AGB,TPE-B,VDE-A(28) OFF
VF.B.F,421,377,340
EPF-A,ESA-A,WCE-A ON,EPF-B,ESA-B,CPS-A,SPCE-B OFF
VF.B.F,422,377,160
CFE-A,PCF-A,TEC-A ON,CFE-B,PCF-B,TEC-B,WDE-AGB OFF
VF.B.F,423,003,000
-- will come to failure at this line -- [ENTER] -- "AP,GO"
VF.B.F,424,003,000
-- will go to a failure at line 0197
VF.B.F,425,003,000
-- [ENTER] -- "AP,GO" at this failure
VF.B.F,426,003,000
-- will go to a failure at 0200
VF.B.F,427,003,000
-- [ENTER] -- "AP,GO" at this failure
VF.B.F,428,003,000
-- will go to line 0206
VF.B.F,429,003,000
RE
- gives option here to spin-up the reaction wheel
- to do so [ENTER] - "CX,14,1642" - this sends the command to spin up the reaction wheel
- then [ENTER] - "CX,16,0642" - this is the command directing execution of the spin-up command
- will go to line 0207
0213  CX,01,0300
ADE MODE, SADA 162 STEP ON.

0214  CX,16,0744
ADE-A EXECUTE

0215  DL 035 TLM DELAY-10

0216  VF,B,E,402,377,300
SADA 162 STEP ON, ALL SLEW&CAKE OFF,90,PLUS.

RE  A-SIDE NORMAL MODE 48 ESTABLISHED
RE  AND CONFIRMED.
RE  FOR ANY OTHER MODE, XO AP,GO,XXX.
RE  TO EXIT PROGRAM, XO AP,GO.
RE  TO TURN AVCS OFF (AFTER PROGRAM
RE  EXIT), XO AP,AC2121

0217  DL,000

0218  RE  AC1030 COMPLETE
RE  END OF STEP

- [ENTER] - "XO,AP,AC2121" - to turn off the AVCS or may proceed to AP,SC0002 and turn off AVCS in conjunction with turn off of the satellite
- go to AC2121 sequence for example of that procedure. This one must be executed if any other mode will be selected.
BEGIN AP AC2121. AVCS 'A' SIDE OFF
THRU PSE-A.
AP GO TO TURN OFF 'A' SIDE AVCS.

- [ENTER] - "XQ,AP,AC2121" to begin procedure.
- [ENTER] - "AP,GO"
- can observe system turn off on page AC11, [ENTER] - "PD,AC11"
- system will go through to end of procedure at line 0084.

0001  DL,000
0002  CX,16.0404 -
       PSE-A ON
0003  CX,16.0720 -
       A CMD PROC ON
0004  CX,16.0417 -
       SPIN UP POWER A 'OFF'
0005  CX,16.0456 -
       SPIN UP POWER B 'OFF'
0006  CX,13.0005 -
       CDF-A ON
0007  CX,16.0601 -
       PSE-A EXECUTE
0008  CX,13.0025 -
       TPE-A ON
0009  CX,16.0601 -
       PSE-A EXECUTE
0010  CX,13.0053 -
       ACE-A OFF
0011  CX,16.0601 -
       PSE-A EXECUTE
0012  CX,13.0143 -
       ACE-B OFF
0013  CX,16.0601 -
       PSE-A EXECUTE
0014  CX,13.0031 -
       ADF-IA OFF
0015  CX,16.0601 -
       PSE-A EXECUTE
0016  CX,13.0171 -
       ADF-IB OFF
0017  CX,16.0601 -
       PSE-A EXECUTE
0018  CX,13.0071 -
PSE-A EXECUTE
0056  CX, 13, 0103
       WCE-B OFF
0057  CX, 16, 0601
       PSE-A EXECUTE
0058  CX, 13, 0033
       WDE-A OFF
0059  CX, 16, 0601
       PSE-A EXECUTE
0060  CX, 13, 0123
       WDE-B OFF
0061  CX, 16, 0601
       PSE-A EXECUTE
0062  CX, 13, 0057
       PCE-A OFF
0063  CX, 16, 0601
       PSE-A EXECUTE
0064  CX, 13, 0147
       PCE-B OFF
0065  CX, 16, 0601
       PSE-A EXECUTE
0066  CX, 13, 0105
       CDE-B OFF
0067  CX, 16, 0601
       PSE-A EXECUTE
0068  CX, 13, 0125
       TPE-B OFF
0069  CX, 16, 0601
       PSE-A EXECUTE
0070  DL, 035  WAIT TLM UPDATE
0071 ✓  VF, B, F, 419, 077, 040
       CDE-A ON, VDE-A(+5V), VDE-B(+5V), CDE-B, APE-A, ADE-B, OFF
0072  VF, B, F, 420, 077, 020
       TPE-A ON, TPE-B, SESA-A&C, VDE 28V A&C, OFF
0073  VF, B, F, 421, 377, 000
0074  VF, B, F, 422, 377, 000
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0075</td>
<td>VF, B, F, 169, 360, 000</td>
</tr>
<tr>
<td></td>
<td>SPIN UP POWER + V &amp; BATT BUS 'OFF'</td>
</tr>
<tr>
<td>0076</td>
<td>CX, 13, 0015</td>
</tr>
<tr>
<td></td>
<td>CUE-A OFF</td>
</tr>
<tr>
<td>0077</td>
<td>CX, 16, 0601</td>
</tr>
<tr>
<td></td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0078</td>
<td>CX, 13, 0035</td>
</tr>
<tr>
<td></td>
<td>TPE-A OFF</td>
</tr>
<tr>
<td>0079</td>
<td>CX, 16, 0601</td>
</tr>
<tr>
<td></td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0080</td>
<td>CX, 16, 0441</td>
</tr>
<tr>
<td></td>
<td>PSE-A OFF</td>
</tr>
<tr>
<td>0081</td>
<td>CX, 16, 1016</td>
</tr>
<tr>
<td></td>
<td>A &amp; B CMD PROC OFF</td>
</tr>
<tr>
<td>0082</td>
<td>DL, 035 WAIT TLM UPDATE</td>
</tr>
<tr>
<td>0083</td>
<td>VF, B, F, 162, 220, 000</td>
</tr>
<tr>
<td></td>
<td>PSE-A &amp; B OFF</td>
</tr>
<tr>
<td>0084</td>
<td>VF, B, E, 169, 014, 000</td>
</tr>
<tr>
<td></td>
<td>PSF-A &amp; B CMD PROC OFF</td>
</tr>
</tbody>
</table>

To power down the satellite, proceed to the next section on satellite power down.
E. POWERING DOWN THE SATELLITE (AUTOMATIC PROCEDURE - AP)

1. On the command console keyboard, enter the command:

   AP XQ SCO002

This initiates the power down sequence (the command normally must be sent three times before the system accepts it).

2. Proceed as in steps 2 through 5 of the POWER UP procedure.

3. See attached AP sequence (SCO002) from AP Library Volume I for power down sequence. B side is powered down using the same AP [Ref. 4].

4. Sequence will end with "AP SCO002 COMPLETE". The SCO002 sequence follows:
SPACECRAFT POWER OFF
RE STC CMD CA,00,XX WHERE XX=
RE S/C ID FOR S/C BEING TESTED.
0001
RE DL,000
RE STC CMD CA,YY,A WHERE YY=
RE 'K' BOX PERMUTER KEY TO USE
RE FOR S/C UNDER TEST
0002
RE DL,000
RE IF 'A' SIDE AVCS IS ON AP GO TO TURN
RE OFF. IF 'B' SIDE AVCS IS ON AP GO
RE TO STEP 88 TO TURN OFF. IF ALL AVCS
RE UNITS ARE OFF AP GO TO STEP 172 TO
RE CONFIGURE S/C FOR SHUTDOWN.
0003
RE DL,000
0004
RE CX,16,0404
RE PSE-A ON
0005
RE CX,16,0720
RE A CMD PROC ON
0006
RE CX,16,0417
RE SPIN UP POWER A 'OFF'
0007
RE CX,16,0456
RE SPIN UP POWER B 'OFF'
0008
RE CX,13,0005
RE CDE-A ON
0009
RE CX,16,0601
RE PSE-A EXECUTE
0010
RE CX,13,0025
RE TPE-A ON
0011
RE CX,16,0601
RE PSE-A EXECUTE
0012
RE CX,13,0053
RE ACE-A OFF
0013
RE CX,16,0601
RE PSE-A EXECUTE
0014
RE CX,13,0143
RE ACE-B OFF

(SC0002) To initiate this procedure - [ENTER]-
"AP,XQ,SC0002"
- [ENTER] - "CA,00,07"
- [ENTER] - "AP,GO"
This section may be
bypassed with AP,GO
if the s/c address &
routing are the same
as they were for the
turn on AP.

- [ENTER] - "CA,07,A"
- [ENTER] - "AP,GO"

- since turned AVCS off with AC2121, will
  [ENTER] - "AP,GO,172"
  system will go to failure at line 0204
  (go to line 0204)
0015  CX,16,0601
       PSE-A EXECUTE
0016  CX,13,0031
       ADE-1A OFF
0017  CX,16,0601
       PSE-A EXECUTE
0018  CX,13,0121
       ADE-1B OFF
0019  CX,16,0601
       PSE-A EXECUTE
0020  CX,13,0071
       ADE-2A OFF
0021  CX,16,0601
       PSE-A EXECUTE
0022  CX,13,0161
       ADE-2A OFF
0023  CX,16,0601
       PSE-A EXECUTE
0024  CX,13,0073
       APE-A OFF
0025  CX,16,0601
       PSE-A EXECUTE
0026  CX,13,0163
       APE-B OFF
0027  CX,16,0601
       PSE-A EXECUTE
0028  CX,13,0017
       CSE-A OFF
0029  CX,16,0601
       PSE-A EXECUTE
0030  CX,13,0107
       CSE-B OFF
0031  CX,16,0601
       PSE-A EXECUTE
0032  CX,13,0051
       EPE-A OFF
0033  CX,16,0601
<table>
<thead>
<tr>
<th>Line</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0034</td>
<td>CX,13,0141</td>
<td>EPE-B OFF</td>
</tr>
<tr>
<td>0035</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0036</td>
<td>CX,13,0011</td>
<td>ESA-A OFF</td>
</tr>
<tr>
<td>0037</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0038</td>
<td>CX,13,0101</td>
<td>ESA-B OFF</td>
</tr>
<tr>
<td>0039</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0040</td>
<td>CX,13,0055</td>
<td>SES-A EXECUTE</td>
</tr>
<tr>
<td>0041</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0042</td>
<td>CX,13,0145</td>
<td>SES-B OFF</td>
</tr>
<tr>
<td>0043</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0044</td>
<td>CX,13,0037</td>
<td>TCE-A OFF</td>
</tr>
<tr>
<td>0045</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0046</td>
<td>CX,13,0127</td>
<td>TCE-B OFF</td>
</tr>
<tr>
<td>0047</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0048</td>
<td>CX,13,0077</td>
<td>VDE-A 28V OFF</td>
</tr>
<tr>
<td>0049</td>
<td>CX,16,0601</td>
<td>PSE-A EXECUTE</td>
</tr>
<tr>
<td>0050</td>
<td>CX,13,0075</td>
<td>VDE-A 5V OFF</td>
</tr>
<tr>
<td>0051</td>
<td>CX,16,0601</td>
<td></td>
</tr>
</tbody>
</table>
0070  CX,13,0125
       TPE-B OFF
0071  CX,16,0601
       PSE-A EXECUTE
0072  DL,035  WAIT TLM UPDATE
0073  VF,B,E,419,077,040
       CDE-A ON,VDE-A(+5V),VDE-B(+5V),CDE-B,APE-A,ACE-B,'OFF'
0074  VF,B,E,420,077,020
       TPE-A ON,TPE-B,SESA-A&B,VDE 28V A&B 'OFF'
0075  VF,B,E,421,377,000
0076  VF,B,E,422,377,000
0077  VF,B,E,169,360,000
       SPIN UP POWER +5V & BATT BUS 'OFF'
0078  CX,13,0015
       CDE-A OFF
0079  CX,16,0601
       PSE-A EXECUTE
0080  CX,13,0035
       TPE-A OFF
0081  CX,16,0601
       PSE-A EXECUTE
0082  CX,16,0641
       PSE-A OFF
0083  CX,16,1016
       A&B CMD PROC OFF
0084  DL,035  WAIT TLM UPDATE
0085  VF,B,E,162,220,000
       PSE-A&B OFF
0086  VF,B,E,169,014,000
       PSE-A&B CMD PROC OFF
RE   'A' SIDE AVCS IF OFF AP GO TO TURN
RE   'B' SIDE OFF. IF 'B' SIDE ALREADY
RE   OFF AP GO TO STEP 172.
0087  DL,000
<table>
<thead>
<tr>
<th>Line</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0088</td>
<td>CX, 16, 0502</td>
<td>PSE-B ON</td>
</tr>
<tr>
<td>0089</td>
<td>CX, 16, 0757</td>
<td>PSE-B CMD PROC ON</td>
</tr>
<tr>
<td>0090</td>
<td>CX, 16, 0417</td>
<td>SPIN UP POWER 'A' OFF</td>
</tr>
<tr>
<td>0091</td>
<td>CX, 16, 0456</td>
<td>SPIN UP POWER 'B' OFF</td>
</tr>
<tr>
<td>0092</td>
<td>CX, 24, 0115</td>
<td>CDE-B ON</td>
</tr>
<tr>
<td>0093</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0094</td>
<td>CX, 24, 0135</td>
<td>TPE-B ON</td>
</tr>
<tr>
<td>0095</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0096</td>
<td>CX, 24, 0053</td>
<td>ACE-A OFF</td>
</tr>
<tr>
<td>0097</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0098</td>
<td>CX, 24, 0143</td>
<td>ACE-B OFF</td>
</tr>
<tr>
<td>0099</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0100</td>
<td>CX, 24, 0031</td>
<td>ADE-1A OFF</td>
</tr>
<tr>
<td>0101</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0102</td>
<td>CX, 24, 0121</td>
<td>ADE-1B OFF</td>
</tr>
<tr>
<td>0103</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0104</td>
<td>CX, 24, 0071</td>
<td>ADE-2A OFF</td>
</tr>
<tr>
<td>0105</td>
<td>CX, 16, 0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0106</td>
<td>CX, 24, 0161</td>
<td></td>
</tr>
</tbody>
</table>
ADE-2B OFF
0107 CX,16,0222 PSE-B EXECUTE
0108 CX,24,0073 APE-A OFF
0109 CX,16,0222 PSE-B EXECUTE
0110 CX,24,0163 APE-B OFF
0111 CX,16,0222 PSE-B EXECUTE
0112 CX,24,0017 CSE-A OFF
0113 CX,16,0222 PSE-B EXECUTE
0114 CX,24,0107 CSE-B OFF
0115 CX,16,0222 PSE-B EXECUTE
0116 CX,24,0051 EPE-A OFF
0117 CX,16,0222 PSE-B EXECUTE
0118 CX,24,0141 EPE-B OFF
0119 CX,16,0222 PSE-B EXECUTE
0120 CX,24,0011 ESA-A OFF
0121 CX,16,0222 PSE-B EXECUTE
0122 CX,24,0101 ESA-B OFF
0123 CX,16,0222 PSE-B EXECUTE
0124 CX,24,0055
<table>
<thead>
<tr>
<th>Time</th>
<th>Command</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>0125</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0126</td>
<td>CX,24,0145</td>
<td>SESA-B OFF</td>
</tr>
<tr>
<td>0127</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0128</td>
<td>CX,24,0037</td>
<td>TCE-A OFF</td>
</tr>
<tr>
<td>0129</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0130</td>
<td>CX,24,0127</td>
<td>TCE-B OFF</td>
</tr>
<tr>
<td>0131</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0132</td>
<td>CX,24,0077</td>
<td>VDE-A 28V OFF</td>
</tr>
<tr>
<td>0133</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0134</td>
<td>CX,24,0075</td>
<td>VDE-A 5V OFF</td>
</tr>
<tr>
<td>0135</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0136</td>
<td>CX,24,0167</td>
<td>VDE-B 28V OFF</td>
</tr>
<tr>
<td>0137</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0138</td>
<td>CX,24,0165</td>
<td>VDE-B 5V OFF</td>
</tr>
<tr>
<td>0139</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0140</td>
<td>CX,24,0013</td>
<td>WCE-A OFF</td>
</tr>
<tr>
<td>0141</td>
<td>CX,16,0222</td>
<td>PSE-B EXECUTE</td>
</tr>
<tr>
<td>0142</td>
<td>CX,24,0103</td>
<td>WCE-B OFF</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>0162</td>
<td>CX,24,0105</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDE-B OFF</td>
<td></td>
</tr>
<tr>
<td>0163</td>
<td>CX,16,0222</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0164</td>
<td>CX,24,0125</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TPE-B OFF</td>
<td></td>
</tr>
<tr>
<td>0165</td>
<td>CX,16,0222</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE-B EXECUTE</td>
<td></td>
</tr>
<tr>
<td>0166</td>
<td>CX,16,0543</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE-B OFF</td>
<td></td>
</tr>
<tr>
<td>0167</td>
<td>CX,16,1016</td>
<td></td>
</tr>
<tr>
<td>0168</td>
<td>DL,035</td>
<td></td>
</tr>
<tr>
<td></td>
<td>WAIT TLM UPDATE</td>
<td></td>
</tr>
<tr>
<td>0169</td>
<td>VF,B,E,162,220,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE-A&amp;G OFF</td>
<td></td>
</tr>
<tr>
<td>0170</td>
<td>VF,B,E,169,014,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PSE-A&amp;G CMD PROC OFF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RE  AVCS TURN OFF COMPLETED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RE  STC AP,GO TO CONFIG EPDS FOR SHUT-DOWN</td>
<td></td>
</tr>
<tr>
<td>0171</td>
<td>DL,000</td>
<td></td>
</tr>
<tr>
<td>0172</td>
<td>CX,16,0501</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEC A OFF</td>
<td></td>
</tr>
<tr>
<td>0173</td>
<td>CX,16,0440</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEC A ON</td>
<td></td>
</tr>
<tr>
<td>0174</td>
<td>CX,16,0603</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEC B OFF</td>
<td></td>
</tr>
<tr>
<td>0175</td>
<td>CX,16,0644</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E1A PRIME LOADS CONV A</td>
<td></td>
</tr>
<tr>
<td>0176</td>
<td>CX,16,0746</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E1A RED LOADS CONV A</td>
<td></td>
</tr>
<tr>
<td>0177</td>
<td>CX,16,1004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E1A TLM PROC A ON</td>
<td></td>
</tr>
<tr>
<td>0178</td>
<td>CX,16,0646</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E1A TLM PROC B ON</td>
<td></td>
</tr>
<tr>
<td>0179</td>
<td>CX,16,0212</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRIME AC SOURCE CONN</td>
<td></td>
</tr>
</tbody>
</table>
0180  CX,16,0355  RED AC SOURCE DESCONN
0181  CX,16,0257  CH A SELECT AC PRIME
0182  CX,16,0607  CH B SELECT AC PRIME
0183  CX,16,1002  CH C SELECT AC PRIME
0184  CX,16,0053  CH C SELECT AC PRIME
0185  CX,16,0145  BATT 3 TRANS RESET
0186  CX,16,0522  BATT 1 RED AC SOURCE
0187  CX,16,0353  BATT 2 RED AC SOURCE
0188  CX,16,0104  BATT 3 RED AC SOURCE
0189  CX,16,0605  CH A TRK CHG
0190  CX,16,0415  CH B TRK CHG
0191  CX,16,0211  CH C TRK CHG
0192  CX,16,1000  CH D TRK CHG
0193  DL,035  WAIT TLM UPDATE
0194  VF,B,E,195,252,000  VERIFY CH A,B,C,D TRK CHG
0195  VF,B,E,195,125,100  VERIFY CH A,C CONNECT, PRIME AC
0196  VF,B,E,115,252,000  VERIFY CH A,B,C,D MANUAL MODE
0197  VF,B,E,078,252,252  VERIFY CH A,B,C,D RECOND DISABLE
0198  VF,B,E,055,252,252
VERIFY CH A,B,C,D CHG STATUS

0199  AX,16,0361
CH A AUTO MODE 1

0200  AX,16,0511
CH B AUTO MODE 1

0201  AX,16,0704
CH C AUTO MODE 1

0202  AX,16,0155
CH D AUTO MODE 1

0203  DL,035  WAIT TLM UPDATE

0204  VF,A,E,353,377,114,127
MAIN BUS VOLTS 36 +/-2.0

0205  VF,A,E,004,377,116,149
MAIN BUS VOLT EXP 36 +/-2.0 VOLTS

0206  VF,B,E,195,125,100
VERIFY A&C CONNECT,PRIME AC
EP02

0207  VF,B,E,078,252,252
VERIFY RECONDITION ENABLE IN DISABLE
EP02

0208  VF,B,E,245,125,001
VERIFY B&D CONNECT
EP02

0209  VF,B,E,161,377,272
VERIFY AUTOMODE 1,PRIME AC ON
EP04

0210  VF,B,E,055,252,252
VERIFY CHARGE STATUS
EP03

0211  VF,B,E,115,256,256
VERIFY AUTOMODE
EP04

0212  VF,B,E,162,003,001
VERIFY SEC 'A' ON, 'B' OFF
EP06

0213  VF,B,E,117,140,140
VERIFY PRIME & REDUN LOADS TO SEC 'A'
EP06

0214  VF,A,E,069,377,000,024
VERIFY SEC 'B' +15V @ 0
EP06

0215  VF,A,E,068,377,148,158
VERIFY SEC 'A' +15V @ 15V
EP06

0216  AX,16,1003
CH A VOLTAGE SELECT 4

0217  AX,16,0640

- [ENTER] - "AP,GO" to bypass failure at this point
will go to failure at line 0245
CH A VOLTAGE SELECT 1
0218 CX, 16, 0701
CH A VOLTAGE SELECT 2
0219 CX, 16, 0223
CH B VOLTAGE SELECT 4
0220 CX, 16, 0060
CH B VOLTAGE SELECT 1
0221 CX, 16, 0121
CH B VOLTAGE SELECT 2
0222 CX, 16, 0246
CH C VOLTAGE SELECT 4
0223 CX, 16, 0400
CH C VOLTAGE SELECT 1
0224 CX, 16, 0350
CH C VOLTAGE SELECT 2
0225 CX, 16, 0610
CH D VOLTAGE SELECT 4
0226 CX, 16, 0445
CH D VOLTAGE SELECT 1
0227 CX, 16, 0506
CH D VOLTAGE SELECT 2
0228 DL, 035 WAIT TLM UPDATE
0229 VF, B, E, 055, 125, 000
VERIFY VOLT SEL #2 ALL OUT
0230 VF, B, E, 115, 100, 100
VERIFY CH A VOLT SEL #3 IN
0231 VF, B, E, 078, 025, 025
VERIFY CH B, C, D VOLT SEL #3 IN
0232 VF, B, E, 245, 252, 000
VERIFY VOLT SEL #1 ALL OUT
0233 RE EPOS INITIALIZATION COMPLETE, TT&C
RE INITIALIZATION IN PROGRESS
0234 CX, 16, 0706
SEL XMTR 'A' & RF SWITCH TO 'A'
0235 CX, 16, 0261
SEL PCME CONV 'A'
0255  CX,16,0317
       BATT B DISCOnN
0256  CX,16,0113
       BATT C DISCOnN
0257  CX,16,0702
       BATT D DISCOnN
0258  CX,16,0457
       STOP REDOND DIS
0259  CX,16,0520
       DISABLE AUTO REDOND
0260  CX,16,0755
       BATT 1 TEMP OVERRIDE
0261  CX,16,1006
       BATT 2 TEMP OVERRIDE
0262  CX,16,0342
       BATT 3 TEMP OVERRIDE
0263  DL,035  WAIT TLM UPDATE
0264  VF,B,E,195,005,005
       CH A&C BATTERY DISCONNECT
0265  VF,B,E,245,120,120
       CH B&D BATTERY DISCONNECT
0266  VF,B,E,078,252,000
       CH A,B,C,D REDOND ENABLE
0267  VF,B,E,170,003,003
       REDOND DISCHG LOAD A&B DISCON
0268  VF,B,E,292,340,340
       BATTERY 1,2,3 OVERTEMP OVERRIDE
0269  CX,16,0341
       UHF ANT DAMPER HTRS OFF PRIME
0270  CX,16,0545
       UHF ANT DAMPER HTRS OFF RED
0271  CX,16,0316
       BATT HEATERS OFF PRIME/RED
0272  CX,16,0710
       SSA HTRS OFF PRIME/RED
0273  CX,16,0200

- [ENTER] - "AP,GO" - will get failures as lines 0268, 300, 302, 303, 306 and 307. [ENTER] - "AP,GO" at each failure to bypass them.
- will go to system hold at line 0308 after entering AP,GO at line 0307.
Go to line 0308.
DOWNLINK HTRS OFF PRIME/RED
0274  CX,16,0153
       OXCDO, TANK HTRS OFF PRIME/RED
0275  CX,16,0504
       XMTR CONV HTRS DISABLE
0276  CX,16,0712
       BANK A R/Y CAT BED HTRS OFF
0277  CX,16,0615
       BANK B R/Y CAT BED HTRS OFF
0278  CX,16,0460
       BANK A 1 LB CAT BED HTRS OFF
0279  CX,16,0421
       BANK B 1 LB CAT BED HTRS OFF
0280  CX,16,0142
       ALL VALVE LINE HTRS OFF
0281  CX,16,0140
       AKM ORD SAFE
0282  CX,16,0412
       ARRAY ORD SAFE
0283  CX,16,0454
       UHF ANT ORD SAFE
0284  CX,16,0047
       RCVR ANT HELIX ORD SAFE
0285  CX,16,0151
       RCVR ANT BOOM ORD SAFE
0286  CX,16,0141
       TANK CROSSCONN OPEN
0287  CX,16,0243
       TANK A ISO VALVE OPEN
0288  CX,16,0345
       TANK B ISO VALVE OPEN
0289  CX,16,0447
       1 LB ISO VALVE BANK A OPEN
0290  CX,16,0551
       1 LB ISO VALVE BANK B OPEN
0291  CX,16,0653
       1 LB ISO VALVE BANK A OPEN
0292  CX, 16, 0756
       1 LB ISO VALVE BANK B OPEN
       RE     SWITCH TO OR VERIFY TLM SYNC ON NRZ
       RE     H/L DATA.
0293  DL, 000
0294  CX, 16, 0245
       S-BAND AUTO DOWNLINK DISABLE
0295  CX, 16, 0116
       DOWNLINK OFF
0296  DL, 035
       RE     WAIT TLM UPDATE
0297  VF, B, E, 116, 366, 000
       D/L, BATT, SSA & .1 LB VALVE HTR OFF
0298  VF, B, E, 117, 226, 000
       R/Y & PITCH CAT BED MTRS A&B OFF
0299  VF, B, E, 162, 154, 000
       R/Y 1 LB CAT BED MTRS OFF, RCVR ANT DEP ORD SAFE
       RE     F3 ONLY FAIL IS ACCEPTABLE
       RE     IN FOLLOWING STEP
0300  VF, B, E, 196, 376, 376
       ISO VALVE ALL OPEN
0301  VF, B, E, 247, 377, 000
       ALL ORD SAFE
0302  VF, A, E, 260, 377, 027, 255
       PROPELLANT TANK A PRESSURE ABOVE 45 PSIA
0303  VF, A, E, 261, 377, 027, 255
       PROPELLANT TANK B PRESSURE ABOVE 45 PSIA
0304  VF, A, E, 184, 377, 000, 010
       XMTR A POWER OUT - NONE
0305  VF, A, E, 186, 377, 000, 010
       XMTR B POWER OUT - NONE
0306  RE    avic "A" AND "B" UNITS OFF
       RE     STC CMD CF, 1 TO FILL "A" K BOX TO '1'
       RE     STC CA 00 XX, CA YY B
       RE     WHERE XX= S/C ID AND YY= 'K' BOX
       RE     PERMUTER KEY FOR S/C UNDER TEST.
0307 DL,000
CX,16,0557
KIR238 BYPASS EXECUTE OFF
CX,16,0661
KIR238 BYPASS ENABLE OFF
RE STC CMD CF,1 TO FILL 'B' K BOX TO '1'
DL,000
0308 DL,035 WAIT TLM UPDATE - [ENTER] - "AP,00" to pass line 0308
VF,B,E,079,240,240
VERIFY B DECRYPTION NORMAL
RE DISABLE S/C BATTERIES, TURN MAIN BUS VOLTAGE TO ZERO, TURN MAIN BUS ENABLE OFF, START S/C BATTERY CHARGE PROCEDURE
RE LX-145-01 IF REQUIRED, OR PLACE BATTERY SIMULATOR BATTERIES ON CHARGE.
0309 RE AP SCO0002 COMPLETE
END OF STEP
- to disable batteries and turn off the main bus voltage, see steps F.2-F.4 of the next section under Power Console.
- to start s/c battery charge procedures, see steps F.1-F.2 in the next section under Satellite Shutdown.
- all s/c systems are now turned off
- proceed to next section for shut-down procedures for Consoles and Computers.
F. SHUT-DOWN OF CONSOLES AND SATELLITE

POWER CONSOLE

1. Under the primary power control section, place the power switch into the "off" position and the circuit breaker "off".

STEPS 2 THROUGH 6 ARE CARRIED OUT WHEN DIRECTED TO DO SO BY LINE 0308 IN THE SC0002 AUTOMATIC PROCEDURE

2. Turn the Main Bus Enable to the "off" position.
3. Then turn the Line On "off".
4. Press the A TAP ENABLE switch to "off".
5. Press the A BUS ENABLE switch to "off".
6. Using the voltage control dial, turn the voltage to "zero" by turning the dial fully counterclockwise (dial located under the charge array current limit).

SATELLITE

1. When directed to "Start Spacecraft Battery Charge Procedure" by line 0308 of the SC0002 power down AP, put the satellite on trickle charge by unscrewing the cable #W-76 (large black cable) from point J-7 on the -X side of the satellite and plugging cable 101-J7 (the small cable) into the J-7 point.

2. Then put the POWER switch into the "on" position, then the POWER ENABLE switch into the "ON" position on the battery trickle charger.
AVCS CONSOLE

1. Turn off any stimulus (earth sensor, sun sensor, hardline, etc.) that is on.
2. Under the primary power control section of each cabinet, place the power switch into the "off" position and the circuit breaker "off".

COMMAND CONSOLES

1. Place the power switch on the back of each of the three consoles into the "off" position (down).
2. Go to the procedures for shut-down of the computer room.

G. COMPUTER AREA SHUT-DOWN

IBM 1800

1. Switch data ENTRY SWITCH 7 to the "UP" position, then back to the "DOWN" position (this clears all CRTs/it can also be done by typing in "END OF TEST" on the control console).
2. After the printer stops, push and hold down the "CLEAR STOR" button while hitting the "START" button.
3. Push the "STOP" button.
4. Push the "RESET" button.
5. Go to the disk drive.
DISK DRIVE

1. Push the "START/STOP" button.

2. Go to the card reader and remove the card deck weight and push the "NPRO" button to remove the cards from the reader. Then push "STOP".

3. Go to the TT&C 2 and turn the primary power switches and the circuit breakers "off" on each console.

4. All other systems not previously turned off should be turned off at this time by turning off the primary power sources.

5. This completes the shut-down procedures.
IV. TELEMETRY FUNCTIONS

A. GENERAL DISCUSSION

The basic telemetry functions as described in Reference 3, the COSATMACS User's Manual, will be discussed in this chapter. The "START" function as discussed in Chapter II, under "CRT Program Control Entries", initiates the telemetry (TLM) data processing activity. Telemetry processing consists basically of decommutating, change-checking, storing, screening, and calibrating for output raw telemetry data. The COSATMACS program produces outputs of significant data to the various CRT displays and provides hard-copy line printer outputs of all status CRT outputs as well as selected items from the control CRT. The printed page is divided into two 60-character halves, with data for stream 1 appearing on the left half-page and data for stream 2 appearing on the right half-page. The general print and monitor display format for a print-on-change function is shown in Figure 13:

where

\[
\begin{align*}
fn & = \text{Three-digit function number ranging from 000 to 422.} \\
b & = \text{Blank} \\
function\ description & = \text{Brief description of the measured function.} \\
value & = \text{Calibrated value of the function in decimal engineering units.}
\end{align*}
\]
$u =$ Engineering units associated with the function.

$\text{comment} =$ Brief comment indicating the relationship of the function to a particular range of values, as specified in the calibration file.

$\text{bd} =$ Two-character band designator indicating a delta change (D) within a specified band (i.e., DG), or a transition of the function value from one band to another (i.e., GI). The three possible categories of operating bands are: in limits (I), guard band (G), and out of limits (O).

$\ast =$ Asterisk appears only if the previous data value(s) for this function has been lost (not printed) because the to-be-processed buffer holding the data for output has overflowed. No more than four values of a function can be held in this buffer awaiting output.

$\text{mm}, \text{ss} =$ Time tag indicating the time in minutes and seconds at which the corresponding data was valid.

An example of a typical analog and bilevel printer output is shown below:

(analog function)

165 CH.12R RECV.SIG.STR. -55.915 DBM NO LIMIT DG 26 25

(bilevel function)

101 CH.16A AF PROC. FSK ON BIT 5=1 31 24
Figure 13. General Print and Monitor Display Format
[from Ref. 3:p. 10]
B. USER INPUTS

The CRT user inputs described below are concerned with telemetry processing or with the representation of telemetry-related information (i.e., page displays, inhibits status display, etc.). The procedures for entering these inputs are as described in Chapter II under "Manual Input Procedures" section of COSATMACS CRT Control Functions [Ref. 3:pp. 11-15].

1. Telemetry Inhibit

\[\text{TI}, s, fff \quad (i.e., \ TI,1,245)\]

This function inhibits the processing of function \( fff \) on stream \( s \).

2. Telemetry Enable

\[\text{TI}, s, fff \quad (i.e., \ TI,1,245)\]

This entry enables the processing of function \( fff \) on stream \( s \).

3. Inhibit Status

\[I\]

This entry results in a display on the control CRT of the telemetry inhibit status for every TLM function. An "I" is situated at each position in a matrix representation corresponding to an inhibited function. A sample display format is shown in Figure 14.
<table>
<thead>
<tr>
<th>UNITS</th>
<th>TENS</th>
<th>TWENTIES</th>
<th>THIRTY</th>
<th>FORTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-64</td>
<td>:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>65-128</td>
<td>:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>129-192</td>
<td>:...:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>193-256</td>
<td>:...:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>257-320</td>
<td>:...:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>321-384</td>
<td>:...:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
<tr>
<td>385-448</td>
<td>:...:...:</td>
<td>:...:...:</td>
<td>:...:..:</td>
<td>:...:..:</td>
</tr>
</tbody>
</table>

Figure 14. Sample Display Format
[from Ref. 3:p. 12]
4. Display TLM Function

\[ D, s, fff \] (i.e., D,1,245)

This entry results in a display on line 2 of the control CRT of both a binary and decimal representation of function fff in data stream s. The function is continuously monitored and the displayed data is maintained current until this display request is disabled using the disable TLM command given below. A sample display line is shown below:

STREAM 1 FUNCTION NUMBER 245 BINARY = 000000000110101
DECIMAL = 000053

5. Disable TLM Display

DE

This entry causes the binary/decimal display of any prior TLM data to be discontinued.

6. Inhibit Page

PI,aann

This entry inhibits processing of telemetry page aann. Functions appearing on this page will no longer be output in the monitor mode, but will still be available for special displays.

7. Enable Page

PE,aann

This entry enables processing of a telemetry page aann, releasing any previous inhibit. Functions appearing on this page will be restored to monitor output eligibility as determined by the data-screening criteria.
8. Display Status Page

PD,aann,S

This entry produces a normal display of page aann on
the status CRT. The display is updated from the running
buffer each time that page is read in during the Cal File
polling cycle. A page inhibit does not affect the page
display function.

9. Kill Status Page

PK,S

This entry clears any prior page display from the
status CRT and returns the CRT to the display status mode.

10. Display Super Page

PD,aann

This entry produces a super page display of page aann
on the control CRT. This page is read into a buffer dedicated
to the super page display and, therefore, can be updated from
the running buffer at telemetry processing rates rather than
at the Cal File polling frequency. A page inhibit does not
affect the super page display function.

11. Kill Super Page

PK

This entry terminates any super page updates on the
control CRT. The display remains frozen until it is changed
by a subsequent request.

109
12. Print Page

PP,aann

This entry causes page aann to be output on both the 1443 band printer and the control CRT. Updates will occur on the displayed page as in the case for a display super page request, but no updates will be made to the printed page.

13. Print Subsystem

PS,aa

This entry results in a printout of all pages contained within the subsystem aa. There is no accompanying CRT display.

14. Print All

PP,ALL

This entry results in a printout of all Cal File pages defined for the associated stream. There is no accompanying CRT display.

15. Print Super Page

PP

If a super page is already displayed on the control CRT, this entry will result in the immediate printing of that page, without the usual Cal File polling delay.

16. Print Status Page

Ps

This entry causes the status page for stream s, as defined in the Cal File, to be output to the 1443 band printer.
C. PAGE OUTPUT MESSAGES

The page request processor outputs the following messages via the CRT and/or the band printer:

1. Page Message Format Error

   This message is displayed on the first line of the control CRT if an error is detected in a page input directive.

2. Page aann Not Defined

   This message is displayed on the first line of the control CRT if a page input directive (display or print page) references a page ID that does not exist on the Cal File.

3. Page Inhibit aann

   This message is output on the printer in response to an inhibit page request.

4. Page Enable aann

   This message is output on the printer in response to an enable page request.

5. Telemetry Page Display Requests Delay Until PP All Complete

   This message is displayed on the first line of the control CRT following a PP,ALL or a print subsystem request.

6. -PP All-Function In Progress, Wait For Completion Then Request Again

   This message is displayed on the first line of the control CRT if a PP,ALL or a print subsystem request is made while a PP,ALL or a subsystem print is taking place.
V. COMMAND FUNCTIONS

A. GENERAL DISCUSSION

This chapter covers command functions as described in section four of the Communication Assembly Test Monitor and Control System (COSATMACS) [Ref. 3]. The command (CMD) processing subsystem provides the test conductor with an automated method of transmitting commands, either individually or in groups, and monitoring the command information status. It also provides a log of commands transmitted, as well as alert and error information for operation observation.

The command processor accepts requests from the control CRT keyboard, the card reader, the disk, and the AP software. The CRT is the universal input source mainly because it is equipped to generate an interrupt to alert the system of a desire to input data, and secondly it is directly accessible to the test conductor. A request to read cards must come from the CRT. Once the reader is activated, it is essentially equivalent to the CRT in request capability. The disk may be activated by either the card reader or the CRT; it is the least versatile of the sources.

Since each CMD acknowledgement requires a mainframe function, sequential CMDs cannot be transmitted more rapidly than at the mainframe rate. When software begins transferring a CMD to the buffer, subsequent commands from any source are
inhibited until the appropriate authenticate function or CMD echo has been interrogated.

Actual command output is a matter of a transmission to the command buffer (hardware) via the computer's digital output register. The output subroutine alerts the telemetry processor that a command has been output. The telemetry processor then answers the alert after the next frame interrupt has been received and the vehicle code count (VCC) updated. The process is repeated for subsequent commands.

B. USER INPUTS/COMMAND REQUESTS

The general form of input for command processing is shown below [Ref. 3:pp. 17-20]. The individual input formats are described in the following subparagraphs. Note that although a comma is used as the field separator, one or more blanks may be used.

\[
\begin{align*}
\text{CQ} & \quad \text{RA} \quad \text{CMDV} \quad \text{KT} \quad \text{I} \\
\text{CQ} & = \text{Program Control Characters (alphabetic characters)} \\
\text{RA} & = \text{Routing Address (1 or 2 octal digits)} \\
\text{CMDV} & = \text{Command Value (up to 4 octal digits \(< 1777\))} \\
\text{KT} & = \text{Optional Repeat Control (1 or 2 decimal digits)} \\
\text{I} & = \text{Optional Print Inhibit}
\end{align*}
\]

1. Spacecraft/Assembly Address
   
   \[
   \begin{align*}
   \text{CA,00,id} \\
   \text{CA,xx,A}
   \end{align*}
   \]
The first form of the entry, identified by the zero value in the second field, provides the spacecraft identification, id, for use in routing commands. The second form provides the hardware assembly address, \( xx \), for use in routing commands and specifies the authenticate function to be used. The authenticate function options are either A or B.

2. Specify Card Sequence

\( CC \)

This entry specifies that a sequence of command requests is to be read from the card reader. The reader is activated upon receipt of this request.

3. Specify Disk Sequence

\( CD,nn \)
\( CD,GO \)
\( CD,GO,xx \)

Disk sequence assigns each command a sequence number (01-99). The first form of the CD entry sends prestored disk resident sequence \( nn \) of commands as fast as telemetry rate will allow. Should a CD sequence be interrupted for any reason, the second form of the entry restarts where it left off. The third form of the entry restarts an interrupted sequence at command number \( xx \).

4. Enable

\( CE,HP \)
\( CE,ra,xxx \)
The first form of this input enables command input from the IBM 1800 computer. The second form reenables a previously inhibited command of routing address ra and command value xxxx.

5. **Fill VCC**

   \[ \text{CF,ccccccc} \]

   This entry sets the vehicle command count to the value ccccccc (up to 7 octal digits). A fill to zero is automatically issued by the program whenever the VCC reaches the maximum value.

6. **Halt Cards**

   \[ \text{CH} \]

   This entry halts the sending of a sequence of commands from the card reader.

7. **Inhibit**

   \[ \text{CI,HP} \]

   \[ \text{CI,ra,xxxx} \]

   The first form inhibits commands from the computer, while the second form inhibits the command of routing address ra and command value xxxx.

8. **Stop Sequence**

   \[ \text{CK} \]

   This entry stops a repeat or disk command sequence.

9. **Print Commands**

   \[ \text{CL} \]
This entry causes the list of inhibited commands to be printed.

10. Repeat Sequence
   CR,ra,xxxx
   CR,ra,xxxx,ss
   CR,ra,xxxx,ss,I

   This entry causes the command of routing address ra and command value xxxx to be send repeatedly, until stopped by a CK entry. The first form sends the command as fast as telemetry rate allows. The second form sends the command once each ss seconds. The third form sends it once each ss seconds, but prints it only the first time.

11. Flip Simulator
   CS

   This entry flips the status of the command authentication simulator between on and off.

12. Send Command
   CX,ra,xxxx
   CX,ra,xxxx,nn
   CX,ra,xxxx,nn,I

   This entry causes the command of routing address ra and command value xxxx to be transmitted. The first sends the command only once, while the second form its it nn times. The third form sends it nn times, but only prints the first and last occurrence of it.
13. Zero Fixed Bits
CZ
This entry sets the fixed data bits in the command output buffer to zero.

14. Restore Fixed Bits
CY
This entry restores the fixed bits zeroed by the CZ request to their original values.

15. Routing Control
C U, (SR or XR)
This entry specifies the routing address to be used in command output as primary (XR) or secondary (SR).

C. COMMAND DISPLAY FORMAT

Command displays on the CRT and band printer occur after the command has been transmitted and the authenticate, along with the VCC, has been received. If the authenticate shows rejection or the VCC exceeds the maximum, the appropriate indication is inserted into the display message, sequences for that stream are halted, and the message is output, regardless of the print option selected. The command display format is described below [Ref. 3:pp. 21-23].

```
tt Cq s ra cmdv nn i rr st a=ccccccc ee ra cmdv sc P cs mm ss
```

- **tt** = command request source
- **Cq s ra cmdv nn i** = command request
- **rr** = authenticate error field
st = stream indicator (1 or 2)
a = KIT-23 assembly (A or B) - KIT-23 no longer on satellite
ccccccc = VCC count
ee = echo error field
ra cmdv sc P = command echo
cs = command simulator active indicator (if active, CS)
mm ss = time in minutes and seconds

1. Command Request Source

This field describes the source of the request. The possible values are:

AP - automatic procedure
KB - keyboard
CC - card command sequence
HP - computer ACTE link
RP - repeat command sequence
CD - disk sequence
CR - card via MINT
IN - internal (automatic command input)

2. Command Request

This group of fields defines the transmitted command.

Cq - command request type
s - secondary routing address indicator. Value = S if a CU,SR request is in effect, otherwise field is blank.
ra - routing address in octal
cmdv - command value in octal
nn - optional: number of times to repeat if CX request, or number of seconds between command if CR request

i - option to print first and last command only in a repeat command request (I)

3. Authenticate Error

This field indicates the type of authenticate error, if any.

*J - command reject
*V - VCC count error
*M - maximum VCC count exceeded
bb - command authenticated

4. Vehicle Command Count (VCC)

A count of command request accepted by the spacecraft is updated after each accepted command. If the system is in command bypass mode, the VCC field will say "CLR TXT". If the request command is found to be inhibited, all fields to the right of the = sign are replaced by the message "CMD INHIBITED".

5. Echo Error Field

This field indicates the occurrence of an echo error.

*E - echo error
NE - non-echo error
bb - good echo
6. Command Echo Field

An echo of the transmitted command is returned in the telemetry stream. This echo is used to assure that the spacecraft received the command correctly. The echo fields are defined under command request. The other fields are as follows:

sc - spacecraft ID in octal
p - command parity bit

D. OUTPUT MESSAGES

Each input stream is screened by the processor to ensure that 1) the control character is among those defined for use; 2) the data fields do not exceed the maximum size; 3) the octal value contains no digits greater than 7; 4) the operation request is possible at the present time; and 5) the request command is not on the prohibited list. If any of the above errors exist, the corresponding message is output on the control CRT. The operator may then reenter the corrected statement. The error messages are described in the following subparagraphs [Ref. 3:pp. 24-25].

1. Invalid Command

If a command request contains an invalid request type, the following message is output to the control CRT:

"Illegal Control Character"
2. Non-octal Value

If a digit greater than 7 appears in a command field in which only octal values are allowed, the following message is output to the control CRT:

"Non Octal Number in REQ"

3. Command Error

The message presented below is output to the control CRT if one of the following conditions occurs: 1) a CR or CX request has less than 3 fields; 2) the command value or routing address field of a CR or CX request is too large; or 3) a CF request is issued when the system is CLR TXT mode.

"Invalid Command Value Or Format Error"

4. Missing VCC

After the transition from clear to encrypted mode, if a CX or CR request is not preceded by a CF (fill VCC) request, the following message is output to the control CRT:

"Need Fill Command"

5. Invalid Sequence Number

If a CD,xx request is input with a sequence number less than 01 or greater than 99, the following message is output to the control CRT:

"Invalid SEQ. NO. --"
6. Undefined Sequence Number

If a CD,xx request is input with a sequence number which is not defined in the disk dictionary, the following message is output to the control CRT:

"SEQ. Not In Dictionary"

7. Card Reader Busy

If a CC request is input while the card reader is engaged in another activity, the following message is output to the control CRT:

"Card Reader In Use"

8. Authenticate Message

When a command is transmitted, the authenticate function is sampled after two mainframe delays. This method is used to avoid sampling of the authenticate function during transitional or intermediate phases of command operations where the authenticate function has proven to be unpredictable. The authenticate function is monitored for the following conditions [Ref. 3:pp. 25-26]:

- The "not busy" bit is expected to always be on.
- The VCC associated with the function not being used for commanding, is expected to be at a constant value.
- The VCC associated with the function being used for commanding is expected to change by a count of one only.

If any of these expectations are not met, a message is output on the band printer as follows:
***AUTH(A or B)*** b f pppppppp --- cccccc

where:

A or B = the authenticate function in question
b = the not busy bit (1 or 2)
f = the authenticate indicator (1 or 2)

ppppppp = previous value of the VCC (7 octal digits)
ccccccc = current value of the VCC (7 octal digits)

The above message is unconditionally printed at startup, at the end of a PP-ALL request, and at the end of testing.
VI. AUTOMATIC PROCEDURES FUNCTION (AP)

A. GENERAL DISCUSSION

An Automatic Procedure (AP) is a group of telemetry, command, and spinning sensor functions which have been identified as a procedure, tagged with an identification label, and stored on disk. During real-time operations, a procedure of many such functions may be initiated and controlled through only a few keyboard inputs. This chapter presents the user input commands and system output messages as given in section seven of the Communication Spacecraft Assembly Test Monitor and Control System [Ref. 3].

Each function, when stored on disk, is given a step number, with a maximum of 9999 steps allowed in any single AP. In addition to the functions mentioned above, two special AP functions may be included as steps. These functions are: 1) delay for a specified number of seconds, and 2) verify telemetry against limits specified in the step.

B. USER INPUTS

1. Start AP

   \text{AP,XQ,xxxxxx,[P]}

   This entry initiates the procedure sequence identified by the six alphanumeric characters represented by xxxxxx. The
input parameter P is optional. If P is included, all telemetry verification will be printed.

2. Halt AP

   AP,SP

   This entry will halt the AP currently being processed, thus placing the AP into a hold mode.

3. Resume AP

   AP,GO,[xxxx]

   This entry will resume processing of an AP which was previously halted, either by an AP,SP directive or delay request included in the procedure. xxxx is an optional input representing a step number of up to 4 decimal digits. If the step number is included in the input, procedure processing will be resumed at that step. If no step number is included, the procedure will continue from the step at which it was halted.

4. Resume AP, Single Step Mode

   AP,SS,[xxxx]

   This entry releases the AP from a hold mode in the same manner as does an AP,GO. In addition, the single step mode is enabled. This means that after execution of the indicated step, the AP again enters the hold mode, and either another AP,GO or AP,SS must be entered to continue processing.

5. Abort AP

   AP,AB

   This entry aborts the AP in progress.
C. OUTPUT MESSAGES

In response to the user input directives, the AP processor will output condition and error messages to inform the user of current AP operational status. Messages reporting AP status are output on the band printer and the AP CRT. Error messages are displayed only on the control CRT. Both groups of messages are listed in Table 2.

Table 2
AP Processor Output Messages
[Ref. 3:p. 35]

<table>
<thead>
<tr>
<th>STATUS MESSAGES</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. *Begin AP xxxxxx</td>
<td>Start of AP xxxxxx was requested</td>
</tr>
<tr>
<td>2. *AB,AP</td>
<td>An abort directive was input</td>
</tr>
<tr>
<td>3. *Go to AP STP xxxx</td>
<td>An AP,GO or AP,SS was input with step number specified</td>
</tr>
<tr>
<td>4. *AP SP TC REQ</td>
<td>A halt request was input</td>
</tr>
<tr>
<td>5. *AP GO</td>
<td>Output in response to an input of AP,GO or AP,SS without step number</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ERROR MESSAGES</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. AP Directive Format</td>
<td>Format of an AP input was incorrect</td>
</tr>
<tr>
<td>Error</td>
<td></td>
</tr>
<tr>
<td>2. Error in Step Number</td>
<td>The step number input was incorrect in length or character type</td>
</tr>
<tr>
<td>3. No AP Active, REQ</td>
<td>A control directive was entered prior to initiating an AP</td>
</tr>
<tr>
<td>Denied</td>
<td></td>
</tr>
<tr>
<td>4. AP xxxxxx Active</td>
<td>An initiate AP request was input while AP xxxxxx was still running</td>
</tr>
<tr>
<td>5. AP Not On Disk</td>
<td>An initiate AP request was made for an AP not present on the disk</td>
</tr>
</tbody>
</table>
VII. UTILITY FUNCTIONS

A. GENERAL DISCUSSION

The utility request processor is designed primarily for the use of software personnel as a program debugging tool. The application of the utility functions, therefore, is not ordinarily required during normal spacecraft testing activities. Great care should be exercised in the use of these features during spacecraft testing, since the proper functioning of COSATMACS could be severely altered by some of these requests. The information presented in this chapter can be found in section eight of the Communication Spacecraft Assembly Test Monitor and Control System [Ref. 3:pp. 37-38].

B. USER INPUTS

1. Print Core Storage

   U,Dump,H,xxxx,yyyy
   U,Dump,I,xxxx,yyyy

   This request causes a dump of the contents of computer storage from address xxxx to yyyy on the 1443 printer. The data is output either in hexadecimal (H) or integer (I) format depending on the third field of the input directive. If the last field (yyyy) is omitted, a single line of 16 values will be printed, beginning with location xxxx.
2. Display Core Storage
   U,DSP,xxxx
   This entry causes the contents of 12 consecutive core locations, starting from address xxxx, to be displayed on line 2 of the control CRT.

3. Modify Core Storage
   U,MOD,H,xxxx,vvvvl,...,vvvvn
   This entry replaced the contents of up to 10 consecutive memory locations, beginning at address xxxx, with the specified data vvvvl,...,vvvvn. Data is specified in hexadecimal form.

4. Protect Core Storage
   U,ZAP,xxxx
   This request causes memory location xxxx to become storage protected.

5. Clear Storage Protect
   U,ZAPU,xxxx

6. Read Register
   U,RWR,REG1,...,REG6
   This entry causes the contents of any digital input register(s) (DIV) to be read and displayed on the control CRT. REG is defined as a 3-digit decimal register number. Up to six registers may be specified in the directive.

7. Write Register
   U,RWW,REG,vvvv
This entry causes data to be output through a digital output register (RO). REG is defined as a 3-digit decimal register number, and vvvv is the hexadecimal data value to be input.

C. OUTPUT MESSAGE

1. Error Message

In the event that a utility function directive is entered with an incorrect format, the following error message will be displayed on the first line of the control CRT:

Keyboard Input Format Error
A. CONCLUSIONS

This thesis has attempted to look at all phases of the power-up, configuring, and power-down procedures. Every attempt has been made to provide the necessary information to carry out the above procedures and to provide comments, cautions, and other information which should be useful to operators of the system. The procedures provided will power up, configure, and power down the system provided all system components are functioning properly. There will be occasions when systems consoles will be working properly and procedures will be followed to the letter, yet system faults will occur. These faults will generally be traceable to items that can be corrected by the operator and will simply require such actions as resetting the computers, insuring that the cold-start cards are feeding properly into the card reader, then repeating the steps for the procedure in question. The more common system and procedural problems which occur and can be corrected by the operator, have been addressed at the appropriate places in this thesis.

During the preparation of this thesis, the majority of the original TRW personnel who were involved in designing the software and maintaining the hardware, were no longer with the FLTSATCOM program office. Of those individuals who were
currently with the program, each had knowledge of a specific area, but no one had detailed knowledge of all aspects of the system. For the most part, there was a working knowledge of the system with the ability to handle minor problems; but major problems required costly outside assistance from consultants.

B. RECOMMENDATIONS

As a means of minimizing major system problems, it is recommended that a minimum of two, but preferably three individuals, be trained as well as possible on all aspects of the system. All available sources as well as the trial-and-error method should be used. As these individuals' knowledge of the system grows, this thesis should be updated to include any new information and to insure that there is always an up-to-date single source document that can be referred to in order to bring the system on line and to trouble-shoot minor problems.
APPENDIX A
AUTOMATIC PROCEDURE (AP) LIBRARY

This appendix was extracted from portions of the Automatic Procedure (AP) Library and Computer Disk (CD) Command Sequences FLTSATCOM, Volume I [Ref. 4:p. 0001-0002]. The AP Library is a listing of automatic procedure routines and command sequences which have been stored on disk. The library contains sequences which can be called up by the test conductor during the performance of a test procedure to perform automatic testing on the spacecraft or payload. Because of the stable format of the test routines involved, their availability as a permanent disk listing reduces the size of other test procedures as it is only necessary to call up the AP routine or CD to accomplish the tasks contained therein.

Automatic procedure routines are grouped by subsystems, given permanent six figure alphanumeric coding and written on disk.

Subsystems included (by volume) are:

Volume I
1. Electrical power and distribution subsystem (EPDS)
2. Telemetry, tracking and command subsystem (TT&C)
3. Miscellaneous AP's (validation, electromagnetics, etc.)
4. Command Sequences (CD)

132
Volume II
1. Attitude and Velocity Control Sequences (AVCS), Qual
2. Reaction Control Subsystem, Qual

Volume III
1. Payload (Communication Subsystem), Qual

Volume IV
1. Payload (Communication Subsystem), Flight

Volume V
1. Attitude and Velocity Control Subsystem (AVCS), Flight
2. Reaction Control Subsystem, Flight

AP Sequence are assigned as follows:

AC0001 to AC9999   AVCS
EP0001 to EP9999   Electrical Power and Distribution
TC0001 to TC9999   TT&C
RC0001 to RC9999   Reaction Control Subsystem
PL0001 to PL9999   Payload (Communication Subsystem)
VL0001 to VL9999   Validation (EAGE)
SC0001 to SC9999   Spacecraft Systems
EM0001 to EM9999   Electromagnetics
CD0001 to CD9999   Command Disks

The desired automatic procedure is called up manually by the test conductor (TC) on the entry keyboard (Control Display CRT). Confirmation of the typed instruction is presented on the control display CRT. It is then implemented by simultaneously activating the "entry" and "shift" keys on the keyboard.
APPENDIX B
AUTOMATIC PROCEDURE FORMAT DESCRIPTION

This appendix can be found in The Automatic Procedure (AP) Library and Computer Disk (CD) Command Sequences FLTSATCOM, Volume I [Ref. 4:p. 001-002]. It provides a brief description of the AP format which, when combined with the glossary (Appendix C), will aid in understanding the contents of the AP library.

The AP program is written on disk. The disk is marked, controlled and read from the Series I disk drive. To address the disk, the test conductor need only type AP,XQ XXXXXX (X-X being the AP program number) and enter it on the control display keyboard for execution.

The following are examples of AP operations and their translations:

1CX,16,0543  
(1=step number, CX=cmd transmission - see Appendix C for abbreviations used in this position, 16= routing address, 0543=cmd in octal)

**,PSE-B OFF  
(no step number, **=message follows, the message)

1VF,B,E,204,252,000  
(1=step number, VF=verify, B=bi level data, E=print failures only, 204=function number, 252=octal mask defining bits to be interrogated, 000=expected bit pattern)

1VF,A,P,205,377,150,200  
(1=step number, VF=verify, A=analog data, P=unconditional print, 205=function number, 377=octal mask defining bits to be interrogated, 150=minimum decimal
level expected, 200=upper decimal level expected)

1PD,AC01 (l=step number, PD=page display, AC01=alphanumeric title of CRT page to be displayed)

PP,AC01 (No step number, PP=print page, AC01=alphanumeric title of CRT page to be printed)

1PS,AC (l=step number, PS=print subsystem, AC=alpha of CRT pages in AVCS system, all of which will be printed)

1DL,010 (l=step number, DL=delay, 010=10 seconds)

1RE,CONFIGURATION COMP. (l=step number, RE=comment card, CONFIGURATION COMP.=the comment)

END OF STEP (No step number, end of step=termination of step)
### APPENDIX C
AP TERM GLOSSARY LIBRARY
[Ref. 4:p. 002]

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Analog</td>
</tr>
<tr>
<td>ACXX</td>
<td>AVCS CRT page (XX) number</td>
</tr>
<tr>
<td>AP</td>
<td>Automatic procedure</td>
</tr>
<tr>
<td>B</td>
<td>Bi level</td>
</tr>
<tr>
<td>CX</td>
<td>Command</td>
</tr>
<tr>
<td>DLO</td>
<td>Delay time indefinite hold</td>
</tr>
<tr>
<td>DLXXX</td>
<td>Delay time (XXX) in seconds</td>
</tr>
<tr>
<td>E</td>
<td>Print failures only</td>
</tr>
<tr>
<td>EPXX</td>
<td>Electrical power CRT page (XX) number</td>
</tr>
<tr>
<td>P</td>
<td>Unconditional print</td>
</tr>
<tr>
<td>PD</td>
<td>Page display</td>
</tr>
<tr>
<td>PL</td>
<td>Communication payload CRT page (XX) number</td>
</tr>
<tr>
<td>PP</td>
<td>Print page</td>
</tr>
<tr>
<td>PS</td>
<td>Print subsystem</td>
</tr>
<tr>
<td>RA</td>
<td>Routing address</td>
</tr>
<tr>
<td>RCXX</td>
<td>Reaction control CRT page (XX) number</td>
</tr>
<tr>
<td>RE</td>
<td>Comment card</td>
</tr>
<tr>
<td>TCXX</td>
<td>TT&amp;C CRT page (XX) number</td>
</tr>
<tr>
<td>TPXX</td>
<td>Test page CRT page (XX) number</td>
</tr>
<tr>
<td>VF</td>
<td>Verify</td>
</tr>
<tr>
<td>**</td>
<td>Comment card</td>
</tr>
</tbody>
</table>
APPENDIX D
LIST OF AUTOMATIC PROCEDURES

This appendix contains a partial list of automatic procedures which can be run by the qualification model satellite in its current modified configuration. A complete list of automatic procedures can be found in the AP Library or Part I of the "Comprehensive System Test (CST) Procedure" document [Ref. 6:pp. 60-65].

Electrical Power Distribution System-APs

<table>
<thead>
<tr>
<th>AP Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC0001</td>
<td>Spacecraft Power On and Initialization</td>
</tr>
<tr>
<td>SC0002</td>
<td>Spacecraft Power Off</td>
</tr>
<tr>
<td>SC0003</td>
<td>Spacecraft Power On and Initialization</td>
</tr>
<tr>
<td>CD0001</td>
<td>Power Initialization</td>
</tr>
<tr>
<td>CD0002</td>
<td>Power Removal</td>
</tr>
<tr>
<td>CD0005</td>
<td>Power Initialization</td>
</tr>
</tbody>
</table>

Attitude and Velocity Control Subsystem-APs

<table>
<thead>
<tr>
<th>AP Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC1001</td>
<td>Baseline-Launch Mode AA</td>
</tr>
<tr>
<td>AC1002</td>
<td>Baseline-Spin Mode AA</td>
</tr>
<tr>
<td>AC1003</td>
<td>Baseline-Orbit Mode AA</td>
</tr>
<tr>
<td>AC1004</td>
<td>Baseline-Launch Mode BB</td>
</tr>
<tr>
<td>AC1005</td>
<td>Baseline-Spin Mode BB</td>
</tr>
<tr>
<td>AC1006</td>
<td>Baseline-Orbit Mode BB</td>
</tr>
<tr>
<td>AC103</td>
<td>AVCS A Side Mode Sequence</td>
</tr>
<tr>
<td>AC2122</td>
<td>AVCS A Side Off Sequence</td>
</tr>
</tbody>
</table>

137
### APPENDIX E
**GLOSSARY OF PERSONNEL ABBREVIATIONS USED IN APs**
[Ref. 6:p. 12]

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>STC</td>
<td>Spacecraft test conductor</td>
</tr>
<tr>
<td>PLTC</td>
<td>Payload test conductor</td>
</tr>
<tr>
<td>MTC</td>
<td>Mechanical test conductor</td>
</tr>
<tr>
<td>ACE</td>
<td>Attitude control systems engineer</td>
</tr>
<tr>
<td>SRFE</td>
<td>Spacecraft radio frequency (RF) engineer</td>
</tr>
<tr>
<td>SCO</td>
<td>Spacecraft computer operator</td>
</tr>
<tr>
<td>CCO</td>
<td>Controls console operator</td>
</tr>
<tr>
<td>PCO</td>
<td>Power and ordnance consoles operator</td>
</tr>
<tr>
<td>TTO</td>
<td>TT&amp;C console operator</td>
</tr>
<tr>
<td>SET</td>
<td>Spacecraft electrical technician</td>
</tr>
<tr>
<td>RFT</td>
<td>Spacecraft RF technician</td>
</tr>
<tr>
<td>SI</td>
<td>Spacecraft quality assurance</td>
</tr>
<tr>
<td>PI</td>
<td>Payload quality assurance</td>
</tr>
<tr>
<td>SDA</td>
<td>Spacecraft data analyst</td>
</tr>
<tr>
<td>PIDA</td>
<td>Payload data analyst</td>
</tr>
<tr>
<td>THT</td>
<td>Thermal installation technician</td>
</tr>
<tr>
<td>SMT</td>
<td>Spacecraft mechanical technician</td>
</tr>
<tr>
<td>OSE</td>
<td>Operational safety engineer</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>ABSG</td>
<td>Alumina Based Spherical Granules</td>
</tr>
<tr>
<td>ACE</td>
<td>Acquisition Control Electronics</td>
</tr>
<tr>
<td>ACTE</td>
<td>Automated Communication Test Equipment</td>
</tr>
<tr>
<td>ACU</td>
<td>Auxiliary Control Unit</td>
</tr>
<tr>
<td>ADE</td>
<td>Array Drive Electronics</td>
</tr>
<tr>
<td>ADPE</td>
<td>Automatic Data Processing Equipment</td>
</tr>
<tr>
<td>AE</td>
<td>Hangar AE at Eastern Test Range</td>
</tr>
<tr>
<td>AEA</td>
<td>Auxiliary Electronics Assembly</td>
</tr>
<tr>
<td>AFETR</td>
<td>Air Force Eastern Test Range</td>
</tr>
<tr>
<td>AFSCF</td>
<td>Air Force Satellite Control Facility</td>
</tr>
<tr>
<td>AGE</td>
<td>Aerospace Ground Equipment</td>
</tr>
<tr>
<td>AI&amp;T</td>
<td>Assembly, Integration, and Test</td>
</tr>
<tr>
<td>AJ</td>
<td>Antijam</td>
</tr>
<tr>
<td>AKM</td>
<td>Apogee Kick Motor</td>
</tr>
<tr>
<td>AM</td>
<td>Amplitude Modulation</td>
</tr>
<tr>
<td>AN</td>
<td>Analog</td>
</tr>
<tr>
<td>AOES</td>
<td>Advanced Orbital Ephemeris System</td>
</tr>
<tr>
<td>AOS</td>
<td>Acquisition of Signal</td>
</tr>
<tr>
<td>APE</td>
<td>Attitude Processing Electronics</td>
</tr>
<tr>
<td>APU</td>
<td>Auxiliary Power Unit</td>
</tr>
<tr>
<td>ARIA</td>
<td>Advanced Range Instrumentation Aircraft</td>
</tr>
<tr>
<td>ASTG/SI</td>
<td>Aerospace Test Group/Satellite Integration</td>
</tr>
<tr>
<td>ATP</td>
<td>Acceptance Test Plan</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>BAUD</td>
<td>A variable unit of data transmission speed, usually equal to 1 bit/sec</td>
</tr>
<tr>
<td>BBRT</td>
<td>Bird Buffer Recorder Tape</td>
</tr>
<tr>
<td>BECO</td>
<td>Booster Engine Cutoff (Atlas)</td>
</tr>
<tr>
<td>BER</td>
<td>Bit Error Rate</td>
</tr>
<tr>
<td>BH</td>
<td>Blockhouse</td>
</tr>
<tr>
<td>BI</td>
<td>Bilevel</td>
</tr>
<tr>
<td>BOL</td>
<td>Beginning of Life</td>
</tr>
<tr>
<td>BR</td>
<td>Emergency Action Message (EAM)</td>
</tr>
<tr>
<td>BY</td>
<td>EAM Bypass</td>
</tr>
<tr>
<td>CADM</td>
<td>Configuration and Data Management</td>
</tr>
<tr>
<td>CC</td>
<td>Communication Converter</td>
</tr>
<tr>
<td>CDE</td>
<td>Count Down Electronics</td>
</tr>
<tr>
<td>CDRL</td>
<td>Contract Data Requirements List</td>
</tr>
<tr>
<td>CEA</td>
<td>Control Electronics Assembly</td>
</tr>
<tr>
<td>CL,EN</td>
<td>Clear, Enable</td>
</tr>
<tr>
<td>CMD EX</td>
<td>Command Execute</td>
</tr>
<tr>
<td>CMD REC/PROC</td>
<td>Command Receiver/Processor</td>
</tr>
<tr>
<td>CMO</td>
<td>Configuration Management Office</td>
</tr>
<tr>
<td>COHO</td>
<td>Coherent</td>
</tr>
<tr>
<td>COMM</td>
<td>Communication Subsystem</td>
</tr>
<tr>
<td>CC CONV</td>
<td>Communications Converter</td>
</tr>
<tr>
<td>COMPOOL</td>
<td>Common Pool of Information</td>
</tr>
<tr>
<td>COMSEC</td>
<td>Communications Security</td>
</tr>
<tr>
<td>C/N</td>
<td>Carrier-to-Noise Ratio</td>
</tr>
<tr>
<td>CPC</td>
<td>Computer Program Components</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>C.S</td>
<td>Command Receiver/Synthesizer</td>
</tr>
<tr>
<td>CSE</td>
<td>Command Storage Electronics</td>
</tr>
<tr>
<td>CST</td>
<td>Comprehensive Systems Test</td>
</tr>
<tr>
<td>CU</td>
<td>Command Unit</td>
</tr>
<tr>
<td>CX 36</td>
<td>Launch Complex 36</td>
</tr>
<tr>
<td>V</td>
<td>Delta Velocity (velocity change)</td>
</tr>
<tr>
<td>DA</td>
<td>Data Analysis</td>
</tr>
<tr>
<td>DGTL</td>
<td>Digital</td>
</tr>
<tr>
<td>DOD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DP</td>
<td>Data Presentation</td>
</tr>
<tr>
<td>DRM</td>
<td>Derived Rate Modulators</td>
</tr>
<tr>
<td>DTC</td>
<td>Data Transmission Center</td>
</tr>
<tr>
<td>DTM</td>
<td>Dual Thruster Module</td>
</tr>
<tr>
<td>EAGE</td>
<td>Electrical Aerospace Ground Equipment</td>
</tr>
<tr>
<td>EAM</td>
<td>Emergency Action Message</td>
</tr>
<tr>
<td>EARL</td>
<td>Excess Axial Ratio Loss</td>
</tr>
<tr>
<td>ECI</td>
<td>Electronic Communications, Inc.</td>
</tr>
<tr>
<td>EED</td>
<td>Electroexplosive Device</td>
</tr>
<tr>
<td>EIUA</td>
<td>Electrical Integration Assembly</td>
</tr>
<tr>
<td>ELV</td>
<td>Expendable Launch Vehicles</td>
</tr>
<tr>
<td>EMI</td>
<td>Electromagnetic Interference</td>
</tr>
<tr>
<td>EMP</td>
<td>Electromagnetic Pulse</td>
</tr>
<tr>
<td>EMT</td>
<td>Electromechanical Test Building</td>
</tr>
<tr>
<td>EOL</td>
<td>End of Life</td>
</tr>
<tr>
<td>EPDS</td>
<td>Electrical Power and Distribution Subsystem</td>
</tr>
<tr>
<td>EPE</td>
<td>Earth Processing Electronic</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>EQ</td>
<td>Equinox</td>
</tr>
<tr>
<td>ES</td>
<td>Earth Sensor</td>
</tr>
<tr>
<td>ESA</td>
<td>Earth Sensor Assembly</td>
</tr>
<tr>
<td>ESA-60A</td>
<td>Explosive Safe Area 60A</td>
</tr>
<tr>
<td>ETR</td>
<td>Eastern Test Range</td>
</tr>
<tr>
<td>EVD</td>
<td>Expendable Vehicles Directorate (NASA/KSC)</td>
</tr>
<tr>
<td>F1</td>
<td>S/C Flight No.1</td>
</tr>
<tr>
<td>F2</td>
<td>S/C Flight No.2</td>
</tr>
<tr>
<td>F3</td>
<td>S/C Flight No.3</td>
</tr>
<tr>
<td>F4</td>
<td>S/C Flight No.4</td>
</tr>
<tr>
<td>F5</td>
<td>S/C Flight No.5</td>
</tr>
<tr>
<td>FB</td>
<td>Fleet Broadcast</td>
</tr>
<tr>
<td>FBP</td>
<td>Fleet Broadcast Processor</td>
</tr>
<tr>
<td>FCP</td>
<td>FLTSATCOM Command Program</td>
</tr>
<tr>
<td>FDV</td>
<td>Fill and Drain Value</td>
</tr>
<tr>
<td>FG</td>
<td>Frequency Generator</td>
</tr>
<tr>
<td>FGO</td>
<td>Frequency Generator Output</td>
</tr>
<tr>
<td>FLTSATCOM</td>
<td>Fleet Satellite Communications</td>
</tr>
<tr>
<td>FM</td>
<td>Frequency Modulation</td>
</tr>
<tr>
<td>FOV</td>
<td>Field of View</td>
</tr>
<tr>
<td>FREQ GEN</td>
<td>Frequency Generator</td>
</tr>
<tr>
<td>FSA</td>
<td>Fuel Storage Area</td>
</tr>
<tr>
<td>FSC</td>
<td>FLTSATCOM</td>
</tr>
<tr>
<td>FSK</td>
<td>Frequency Shift Keying</td>
</tr>
<tr>
<td>FS</td>
<td>Frequency Select</td>
</tr>
<tr>
<td>GD/C</td>
<td>General Dynamics/Convair</td>
</tr>
</tbody>
</table>
GFE  Government Furnished Equipment
GFP  Government Furnished Property
GMT  Greenwich Mean Time
GN2  Gaseous Nitrogen
GSE  Ground Support Equipment
GSFC Goddard Space Flight Center (NASA)
GTV  Ground Transport Vehicle
GWM  Guam (AFSCF Station)
HIP  Hardware Interface Panel (Interface Working Group)
HP   High Power
Hz   Hertz (cycle per second)
IBM  International Business Machines
ICD  Interface Control Document
IF (SIGNAL) Intermediate Frequency
IFJ  In-Flight Jumper
IHA  Integrated Harness Assembly
IM   Intermodulation (Products)
IOS  Indian Ocean Station
IPT  In-Plant Transporter
I&T  Integration and Test
IRON (6392) Inter Range Operations Number
ISO  Isolation (Valve)
ISP  Specific Impulse
IWG  Interface Working Group
KSC  Kennedy Space Center
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>lbf</td>
<td>Pound Force</td>
</tr>
<tr>
<td>lbm</td>
<td>Pound Mass</td>
</tr>
<tr>
<td>LBTP L</td>
<td>Launch Base Test Plan</td>
</tr>
<tr>
<td>LC-36</td>
<td>Launch Complex 36 (at CCAFS)</td>
</tr>
<tr>
<td>LeRC</td>
<td>Lewis Research Center (NASA)</td>
</tr>
<tr>
<td>LHCP</td>
<td>Left Hand Circularly Polarized</td>
</tr>
<tr>
<td>LOWG</td>
<td>Launch Operations Working Group</td>
</tr>
<tr>
<td>LIM-2</td>
<td>Limiter-2</td>
</tr>
<tr>
<td>LO</td>
<td>Local Oscillator</td>
</tr>
<tr>
<td>LOS</td>
<td>Loss of Signal</td>
</tr>
<tr>
<td>LP</td>
<td>Low Power</td>
</tr>
<tr>
<td>LSB</td>
<td>Least Significant Bit</td>
</tr>
<tr>
<td>LV</td>
<td>Launch Vehicle</td>
</tr>
<tr>
<td>MAGE</td>
<td>Mechanical Aerospace Ground Equipment</td>
</tr>
<tr>
<td>MC/F</td>
<td>Multicoupler/Filter</td>
</tr>
<tr>
<td>MDC</td>
<td>Mission Director's Center (Hangar AE, CCAFS)</td>
</tr>
<tr>
<td>MDI</td>
<td>Mechanical Design Integration</td>
</tr>
<tr>
<td>MECO</td>
<td>Main Engine Cutoff (Centaur)</td>
</tr>
<tr>
<td>MES</td>
<td>Main Engine Start (Centaur)</td>
</tr>
<tr>
<td>MF</td>
<td>Main Frame</td>
</tr>
<tr>
<td>MLSR</td>
<td>Maximum Length Shift Register</td>
</tr>
<tr>
<td>MS</td>
<td>Millisecond</td>
</tr>
<tr>
<td>MSS</td>
<td>Mobile Service Structure</td>
</tr>
<tr>
<td>MSB</td>
<td>Most Significant Bit</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NASA/ELV</td>
<td>Expendable Launch Vehicle</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>NASA/KSC</td>
<td>Kennedy Space Center</td>
</tr>
<tr>
<td>NASA/LeRC</td>
<td>Lewis Research Center</td>
</tr>
<tr>
<td>NB</td>
<td>Narrowband</td>
</tr>
<tr>
<td>NiCd</td>
<td>Nickel-Cadmium</td>
</tr>
<tr>
<td>NONCOHO</td>
<td>Noncoherent</td>
</tr>
<tr>
<td>NRZ-L</td>
<td>Nonreturn to Zero Level</td>
</tr>
<tr>
<td>OCXO</td>
<td>Oven Controlled Crystal Oscillator</td>
</tr>
<tr>
<td>OD</td>
<td>Operations Directive</td>
</tr>
<tr>
<td>O.D.</td>
<td>Orbital Determination</td>
</tr>
<tr>
<td>OMT</td>
<td>Orthomode Transducer</td>
</tr>
<tr>
<td>OOH</td>
<td>Orbital Operations Handbook</td>
</tr>
<tr>
<td>OR</td>
<td>Operations Requirements</td>
</tr>
<tr>
<td>ORC</td>
<td>Operations Request Card</td>
</tr>
<tr>
<td>P</td>
<td>Pitch</td>
</tr>
<tr>
<td>P/L</td>
<td>Payload</td>
</tr>
<tr>
<td>PCE</td>
<td>Pitch Control Electronics</td>
</tr>
<tr>
<td>PCM</td>
<td>Pulse Code Modulation</td>
</tr>
<tr>
<td>PCME</td>
<td>Pulse Coded Modulation Electronics</td>
</tr>
<tr>
<td>PCU</td>
<td>Power Control Unit</td>
</tr>
<tr>
<td>PDA</td>
<td>Propellant Distribution Assembly</td>
</tr>
<tr>
<td>PDL-1</td>
<td>Preamplifier/Downconverter/Limiter-1</td>
</tr>
<tr>
<td>PPLS</td>
<td>Propellant and Presurrant Loading System</td>
</tr>
<tr>
<td>PRD/OR/RD</td>
<td>Program Requirements Document/Operation Requirements/Requirement Document</td>
</tr>
<tr>
<td>PRI</td>
<td>Primary</td>
</tr>
<tr>
<td>PRN</td>
<td>Psuedo-Random Noise</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>PROC</td>
<td>Processor</td>
</tr>
<tr>
<td>PROC.REC.</td>
<td>Processor Receiver</td>
</tr>
<tr>
<td>PRS</td>
<td>Processor Receiver/Synthesizer</td>
</tr>
<tr>
<td>PSA</td>
<td>Payload Switching Assembly</td>
</tr>
<tr>
<td>PSE</td>
<td>Power Switching Electronics</td>
</tr>
<tr>
<td>psia</td>
<td>Pounds Per Square Inch Absolute</td>
</tr>
<tr>
<td>psid</td>
<td>Pounds Per Square Inch Differential</td>
</tr>
<tr>
<td>PSK</td>
<td>Phase Shift Keying</td>
</tr>
<tr>
<td>PSO</td>
<td>Pad Safety Officer</td>
</tr>
<tr>
<td>PSP</td>
<td>Program Support Plan</td>
</tr>
<tr>
<td>PTT</td>
<td>Processed Telemetry Tape</td>
</tr>
<tr>
<td>PWG</td>
<td>Payload Working Group</td>
</tr>
<tr>
<td>Q.K.D.</td>
<td>Quasi Keydown</td>
</tr>
<tr>
<td>R</td>
<td>Clear</td>
</tr>
<tr>
<td>R</td>
<td>Range Rate</td>
</tr>
<tr>
<td>R</td>
<td>Roll</td>
</tr>
<tr>
<td>RCS</td>
<td>Reaction Control Subsystem</td>
</tr>
<tr>
<td>RCV</td>
<td>Receiver</td>
</tr>
<tr>
<td>RDN</td>
<td>Redundant</td>
</tr>
<tr>
<td>REDUN</td>
<td>Redundant</td>
</tr>
<tr>
<td>RHCP</td>
<td>Right Hand Circularly Polarized</td>
</tr>
<tr>
<td>RR</td>
<td>Repeater Receiver</td>
</tr>
<tr>
<td>RTS</td>
<td>Remote Vehicle Control Facility</td>
</tr>
<tr>
<td>RWA</td>
<td>Reaction Wheel Assembly</td>
</tr>
<tr>
<td>R/Y</td>
<td>Roll/Yaw</td>
</tr>
<tr>
<td>S&amp;A</td>
<td>Safe and Arm</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>SAB</td>
<td>Satellite Assembly Building</td>
</tr>
<tr>
<td>SAD</td>
<td>Solar Array Drive</td>
</tr>
<tr>
<td>SADA</td>
<td>Solar Array Drive Assembly</td>
</tr>
<tr>
<td>SADEC</td>
<td>Spin Axis Declination</td>
</tr>
<tr>
<td>SAEF-2</td>
<td>Satellite Assembly and Encapsulation Facility No.2</td>
</tr>
<tr>
<td>SD</td>
<td>Space Division</td>
</tr>
<tr>
<td>SD/YK</td>
<td>Space Division Deputy for Space Communications Systems</td>
</tr>
<tr>
<td>SAP</td>
<td>Solar Array Panel</td>
</tr>
<tr>
<td>SARA</td>
<td>Spin Axis Right Ascension</td>
</tr>
<tr>
<td>S/C</td>
<td>Spacecraft</td>
</tr>
<tr>
<td>SFC</td>
<td>Satellite Control Facility</td>
</tr>
<tr>
<td>SDU</td>
<td>Signal Distribution Unit</td>
</tr>
<tr>
<td>sec</td>
<td>Seconds</td>
</tr>
<tr>
<td>SEC</td>
<td>Space Equipment Conv.</td>
</tr>
<tr>
<td>SECO</td>
<td>Sustainer Engine Cutoff (Atlas)</td>
</tr>
<tr>
<td>SESA</td>
<td>Spinning Earth Sensor Assembly</td>
</tr>
<tr>
<td>SGLS</td>
<td>Space Ground Link System</td>
</tr>
<tr>
<td>SHF</td>
<td>Super High Frequency</td>
</tr>
<tr>
<td>SHF XMTR</td>
<td>Super High Frequency Transmitter</td>
</tr>
<tr>
<td>SLV-3D</td>
<td>Space Launch Vehicle (Atlas) for Centaur Stage</td>
</tr>
<tr>
<td>SIOP</td>
<td>Single Integrated Operating Plan</td>
</tr>
<tr>
<td>SOH</td>
<td>State of Health</td>
</tr>
<tr>
<td>SOPM</td>
<td>Standard Orbital Parameters Message</td>
</tr>
<tr>
<td>SPO</td>
<td>System Program Office</td>
</tr>
<tr>
<td>SS</td>
<td>Summer Solstice</td>
</tr>
</tbody>
</table>
SSA  Sun Sensor Assembly
SSSA Spinning Sun Sensor Assembly
SST  System Support Tape
SSTS Solid State Temperature Switch
STC  Satellite Test Center
SVE  Sun-Vehicle-Earth
TA  Technical Advisor
TATS Tactical Transmission Systems
TBD To Be Determined
TBS To Be Supplied
TC  Transmitter Converter
TCE Thruster Control Electronics
TCT Test Control Team
TD  Time Delay
TLM  Telemetry
TPE  Telemetry Processing Electronics
TPM Test Point Monitor (Console)
TRS Test Record Sheet
TRW TRW Defense and Space System Group
TT&C Telemetry, Tracking and Command
TTY Teletype
TX  Transmitter
UHF Ultra High Frequency
USAF United States Air Force
USMC United States Marine Corps
USN United States Navy
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV</td>
<td>Ultraviolet</td>
</tr>
<tr>
<td>U/V</td>
<td>Undervoltage</td>
</tr>
<tr>
<td>VCC</td>
<td>Vehicle Code Count</td>
</tr>
<tr>
<td>VCO</td>
<td>Voltage-Controlled Oscillator</td>
</tr>
<tr>
<td>VDE</td>
<td>Valve Drive Electronics</td>
</tr>
<tr>
<td>VE</td>
<td>Vehicle Ephemeris</td>
</tr>
<tr>
<td>VSWR</td>
<td>Voltage-to-Standing-Wave Radio</td>
</tr>
<tr>
<td>WB</td>
<td>Wideband</td>
</tr>
<tr>
<td>WDE</td>
<td>Wheel Drive Electronics</td>
</tr>
<tr>
<td>WS</td>
<td>Winter Solstice</td>
</tr>
<tr>
<td>XMTR</td>
<td>Transmitter</td>
</tr>
<tr>
<td>Z</td>
<td>Yaw</td>
</tr>
</tbody>
</table>
1. To power up the spacecraft using AP SC0001, the system must have been powered down using the automatic procedure SC0002 discussed under powering down the satellite in Chapter III. If shut down did not occur using SC0002, the SC0002 power down procedure must be performed prior to initiating the SC0001 automatic power up procedure.

2. If a problem occurs during the running of an AP, the program can be aborted with the command, "AP,AB" or halted with the command, "AP,SP". To resume after a halt, type in "AP,GO".

3. Commands should not be entered while an AP is running. They should be entered on y when the program is in a delay or hold mode.

4. Prior to powering up the system, insure that the voltage control dial on the power console under the charge array current limit section is fully counterclockwise (CCW). The console will not come up if this is not the case. Once the console is on, bring the voltage up slowly while watching the current. Voltage and current may be read under the battery status section of the power console: voltage is read on the digital multimeter model 5900; current at "main bus +y current" or "main bus -y current" displays. The voltage should be brought up to 36 volts. The current on each dial
should read 2.5 amperes (the total of the -y and +y readings gives the total current of the system which should not exceed 9 amperes).

5. If running an AP which involves spinning of the reaction wheel, the temperature of the system should be monitored at regular intervals to insure that overheating does not occur. If the system begins to overheat (goes above 128°F), it should be shut down immediately using the AP halt or AP abort commands given in paragraph 2 above. Temperature may be monitored by using the command, "PD,AC14" which will display page 14 where the temperature may be observed for A side on line 378 and line 377 for B side (the spacecraft is a dual bus system with buses referred to as sides A and B).

6. If an emergency occurs which requires power removal, the following sequence [Ref. 6:p. 14] should be used.

On the power console:

a. Turn battery tap and enable switches A, B, and C "off".

b. Turn the voltage control dial fully counterclockwise to remove spacecraft power.
APPENDIX H
INSTALLING A NEW DISK IN SERIES I DRIVE

This procedure is required prior to using a new operational disk. This is a one-time procedure that does not actually involve changing the disk, but rather changing the mapped drive in the Series I disk drive; therefore, once run this procedure is valid as long as the same operational disk or copies of that disk are in use. Any change to a disk of a different name (i.e., different mapped drive) requires that this procedure be run prior to the first time use of the new disk.

SERIES I DISK DRIVE
1. Install disk.
2. Push start and wait until ready light glows steady.

SERIES I
Press:
stop
reset
load

SERIES I CRT
1. Enter "alt 8".
2. At prompt, enter "change return."
3. At prompt, drive # to change, enter "0".
4. At prompt, new dataset name, enter "cosat".
5. At prompt, new volume name, enter the volume name of your disk.

6. At prompt, continue, enter "y".

7. At prompt, drive # to change, enter "1".

8. At prompt, new dataset name, enter "cal-ap" for normal operation.

9. At prompt, new volume, enter your volume name.

10. At prompt, continue, enter "y".

11. At prompt, enter "end".

12. Go to series I, press:
   a. stop
   b. reset
   c. load

13. Verify on the Series I CRT that under active you have:

<table>
<thead>
<tr>
<th>DSNAME</th>
<th>VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>COSAT</td>
</tr>
<tr>
<td></td>
<td>your volume name (i.e., Qual, Flight 8, etc.)</td>
</tr>
<tr>
<td>1</td>
<td>CAL-AP</td>
</tr>
<tr>
<td></td>
<td>your volume name</td>
</tr>
</tbody>
</table>
LIST OF REFERENCES


