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THESIS

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

by

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September 1990

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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.

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Operational Procedures for Powering Up, Powering Down, and Configuring the Qualification Model of the FLTSATCOM Satellite

by

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

Submitted in partial fulfillment of the requirements of degree of

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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.

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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.

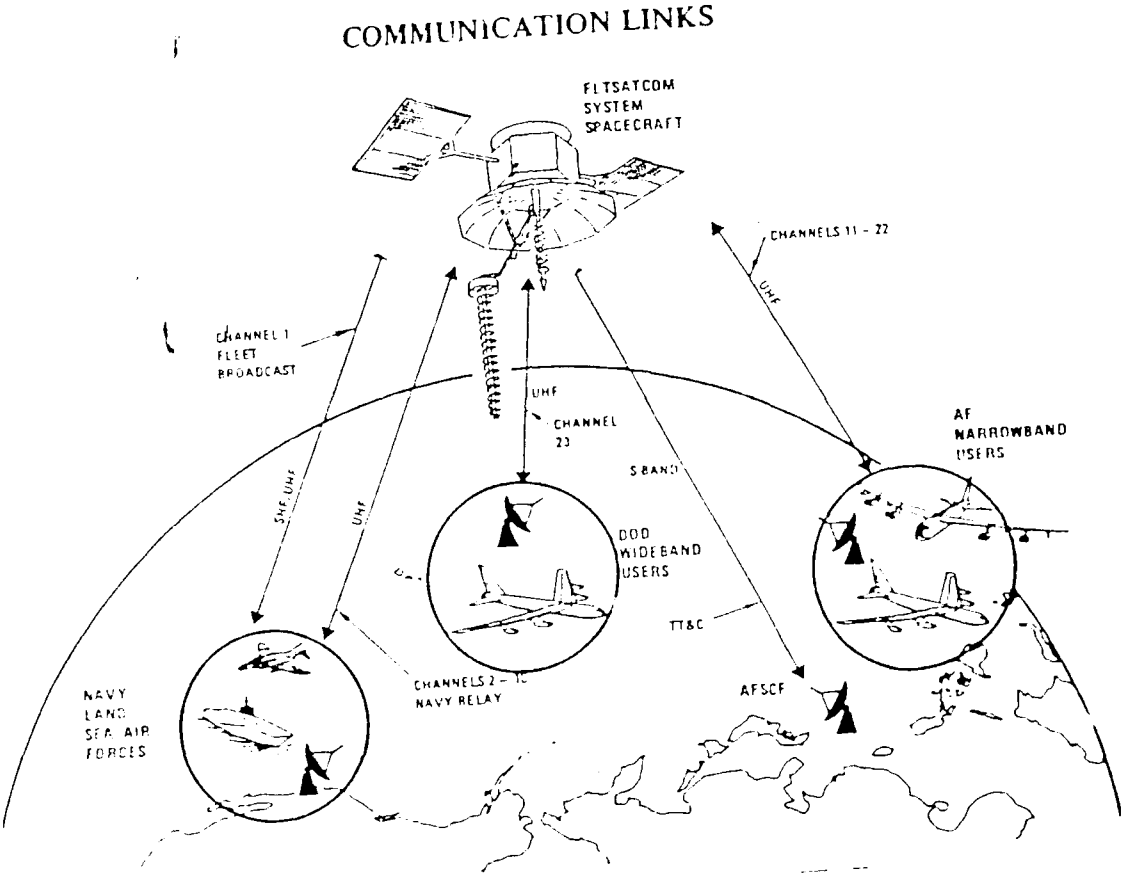


Figure 1
[from Ref. 1:p. 1.2]

TABLE 1
FLTSATCOM TECHNICAL FEATURES
[from Ref. 2:p. 4]

Launch Vehicle	Atlas-Centaur
Power	~ 1685 Watts, Equinox, after 5 years
Frequency Band	244 to 400 MHz
Antenna	Transmit - deployable paraboloid Receive - deployable helix
Transponder	Channelized limiting repeaters On-board signal processing High power multichannel, UHF transmitter
Attitude Control	Body-fixed momentum wheel 0.25 degree pointing accuracy Electrical and mechanical redundancy

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 prescribes 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.

- o 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.

- o 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 prescribes limits.

- o 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.

- o 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 e 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

- o FLTSATCOM qualification model satellite with System Test Electrical Aerospace Ground Equipment (Figure 2)

<u>Computer Room Equipment</u>

- o Series I Systems (Figure 3)
  - Series I Computer
  - Disk Drive with CRT and Keyboard
- o IBM 1800 System (Figure 4)
  - IBM 1800 Computer
  - CDC 80450 Band Printer
  - CRT and Keyboard
  - IBM 1816 Typewriter
- o IBM 1442 Card Reader with card file (Figure 5)
- o TT&C Console (Figure 6)
- o 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)

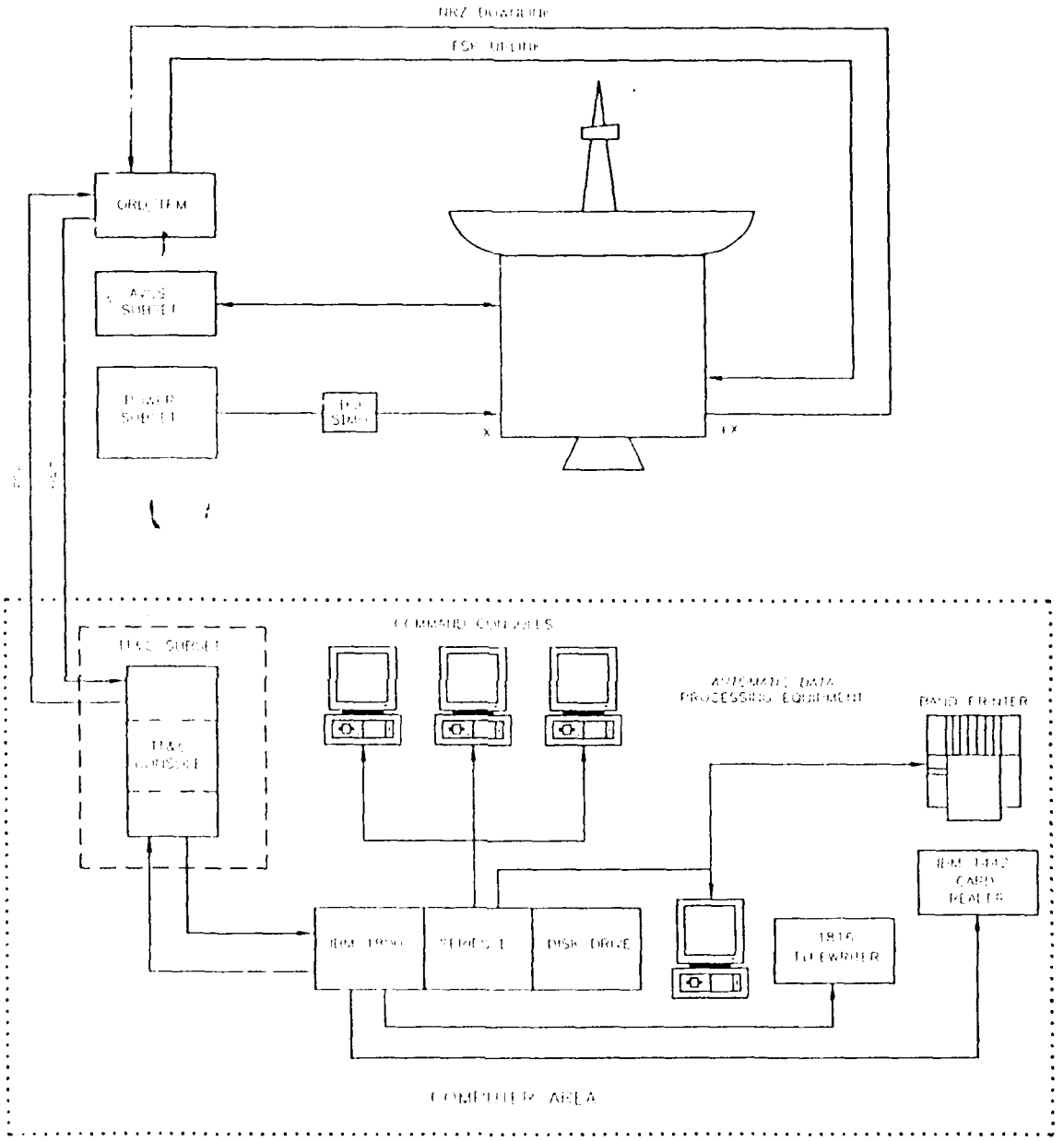
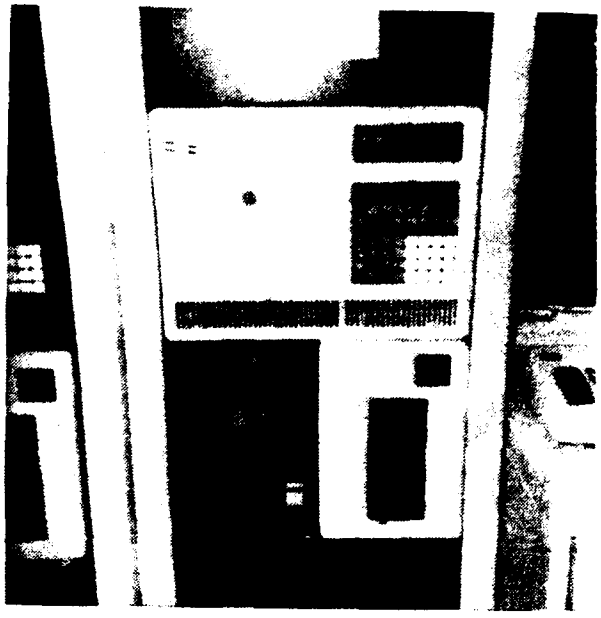


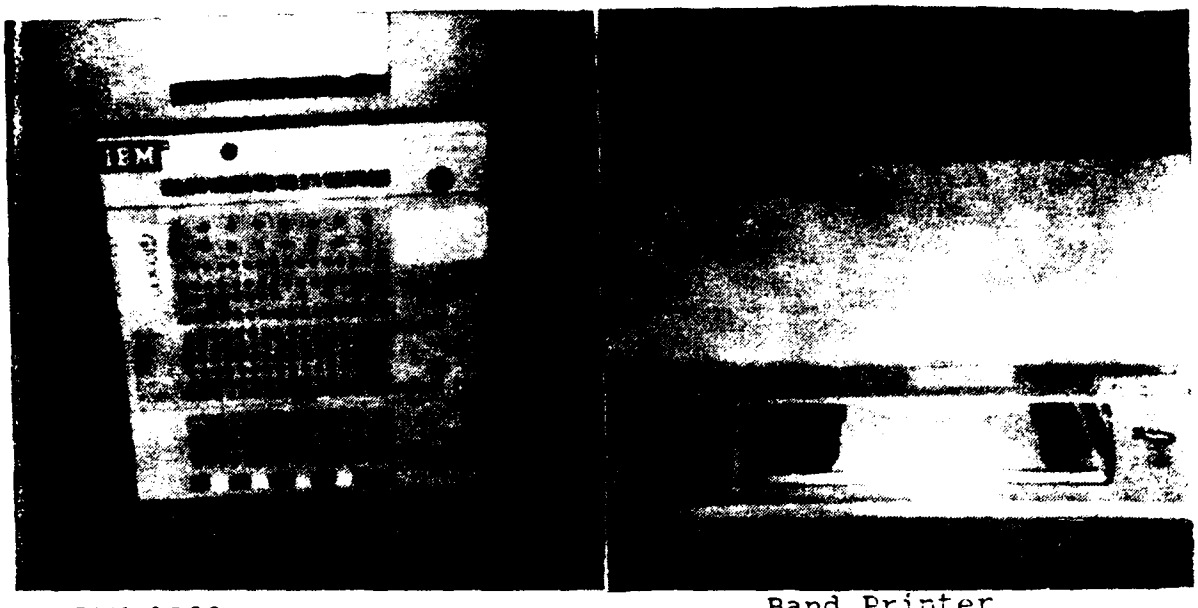
Figure 2. FLTSATCOM and System Test EAGE (Electrical Aerospace Ground Equipment)



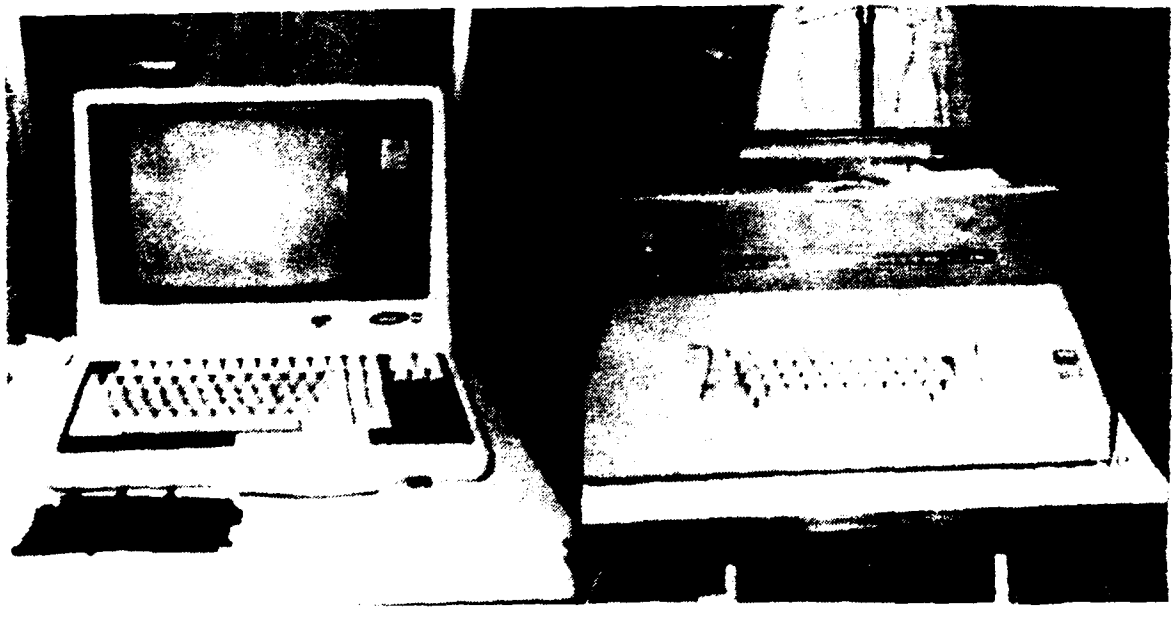
Series I

Series I Disk Drive

Figure 3. Series I Syster



IBM 1800 Band Printer



CRT/Keyboard 1816 Typewriter

Figure 4. IBM 1800 System

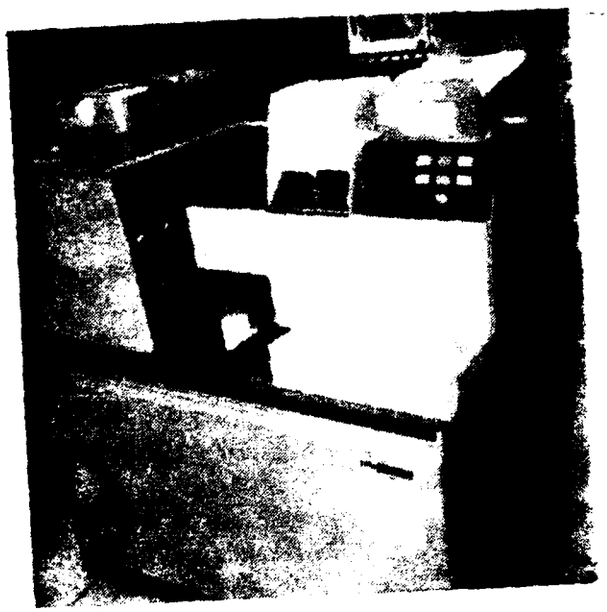


Figure 5. IBM 1442 Card Reader

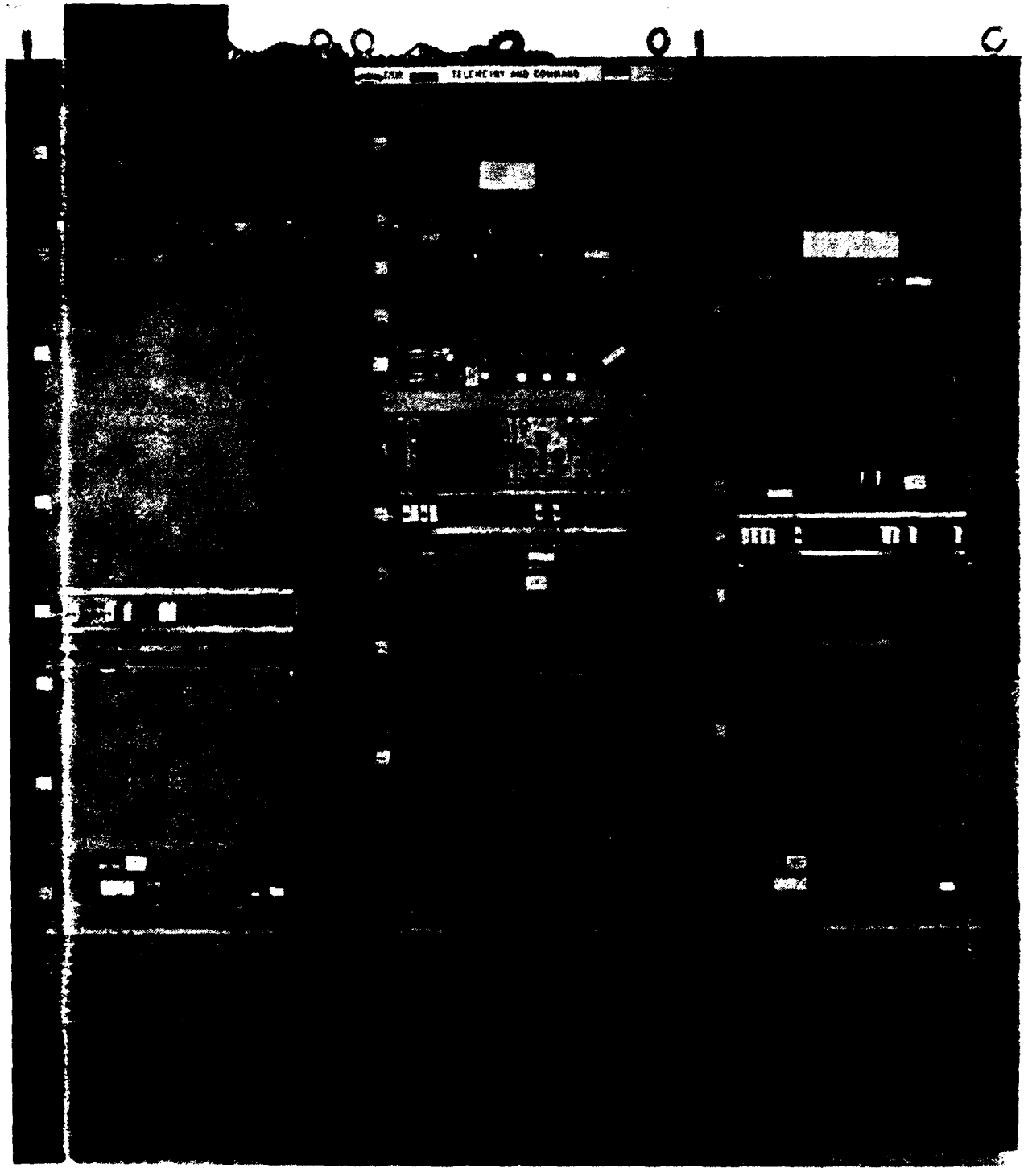


Figure 6. TT&C Console
[from Ref. 1]

Figure 7. Command Console

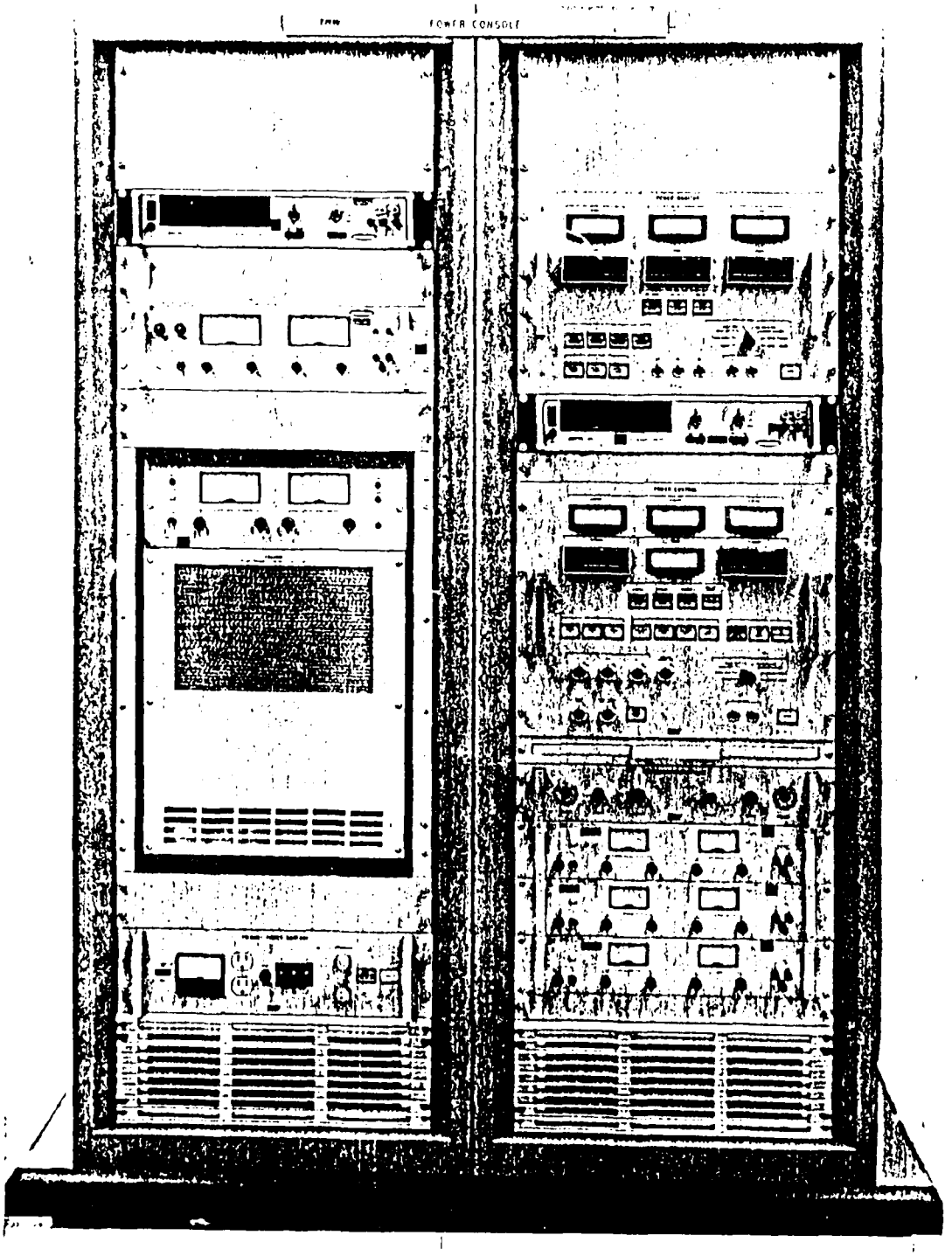


Figure 8. Power Console
[from Ref. 1:p. 10-5]

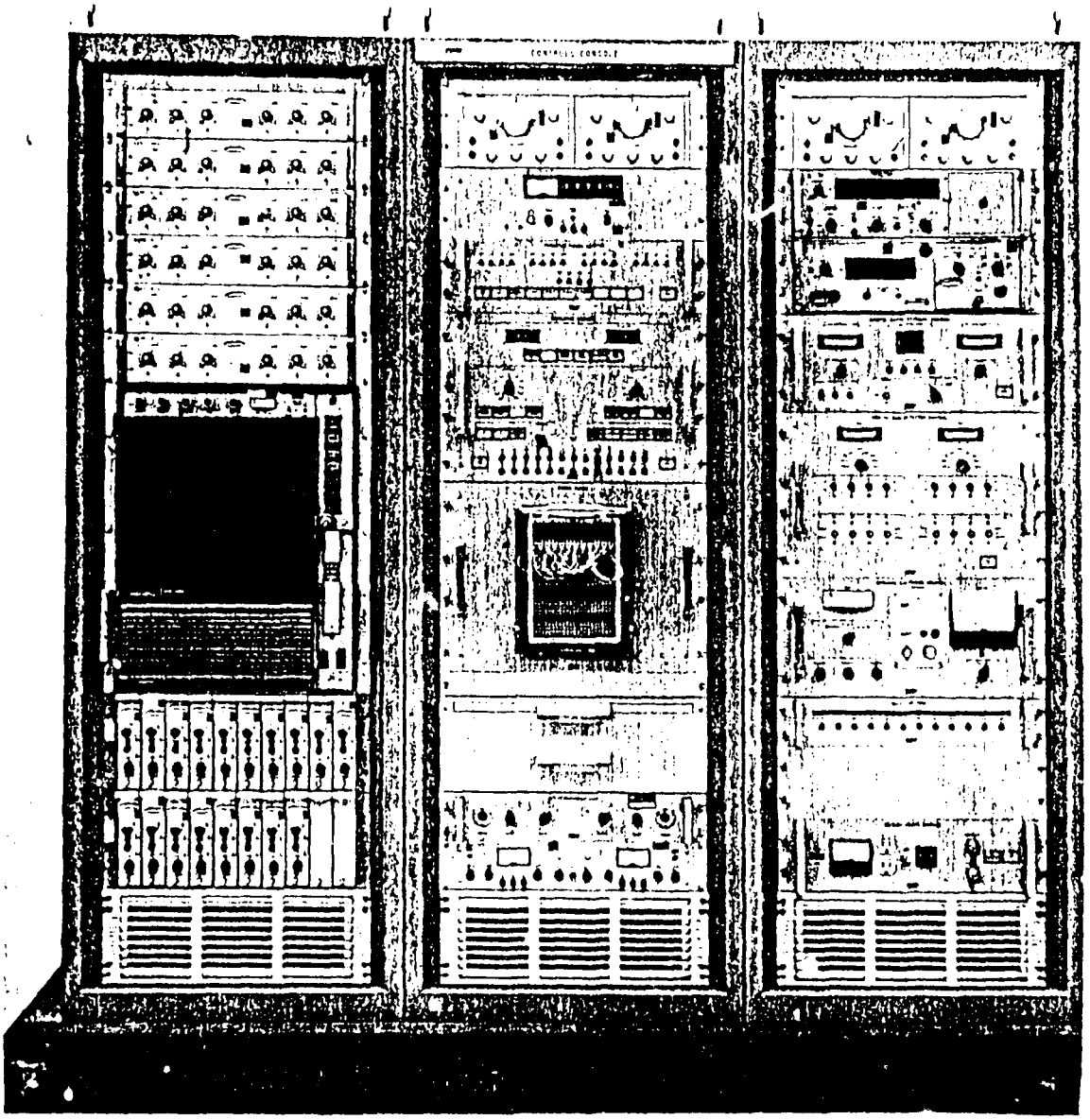


Figure 9. AVCS Consoles
[from Ref: 1:p. 10-49]

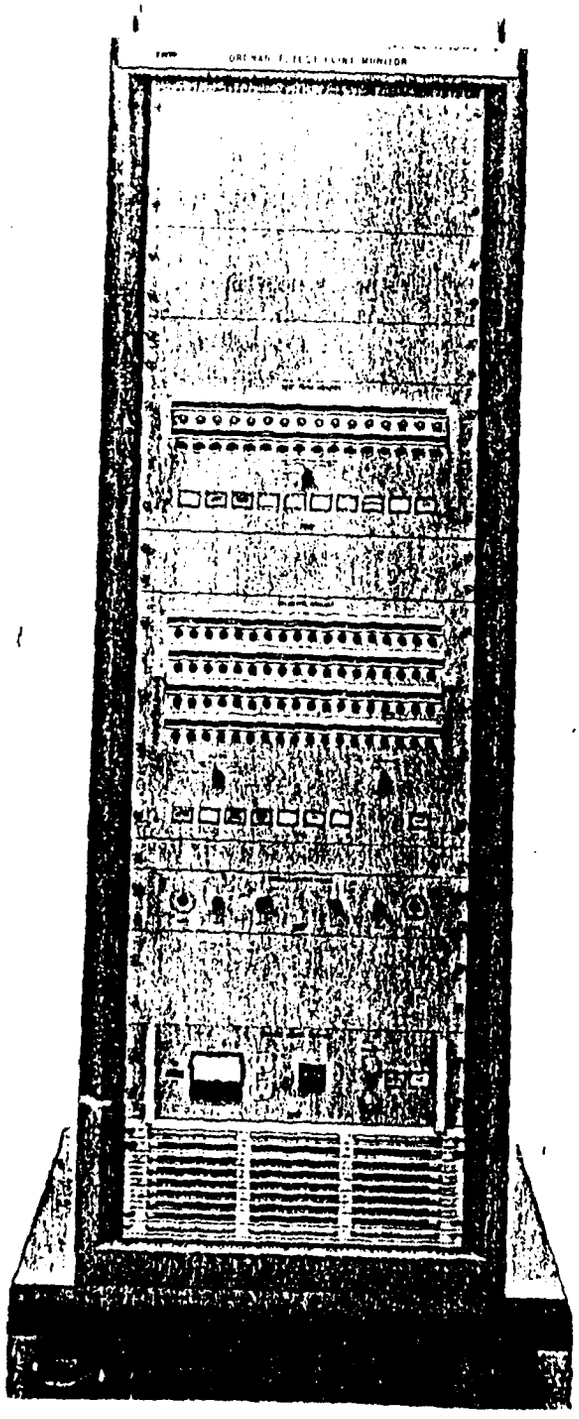


Figure 10. Ordnance/Test Point Monitor Console
[from Ref. 1:p. 10-55]

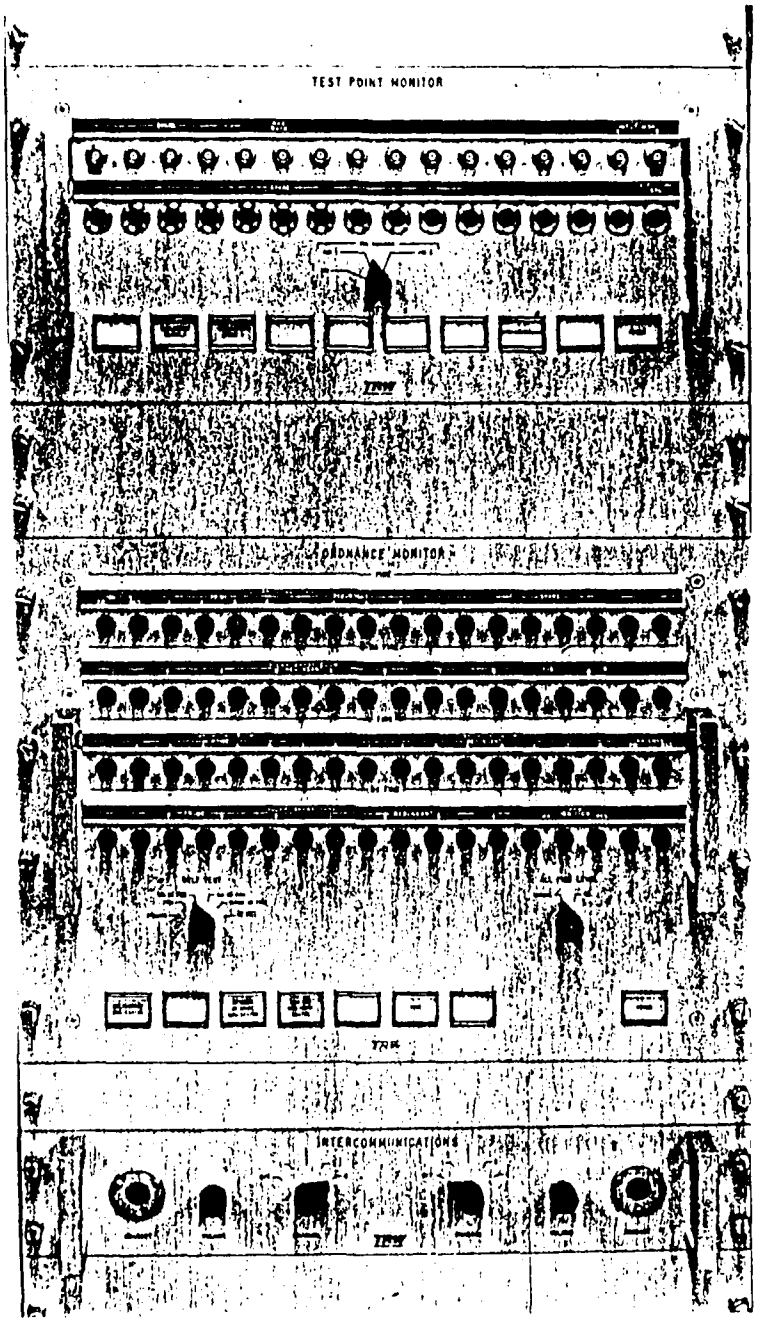


Figure 11. Close-up of Ordnance Test/Point Monitor [from Ref. 1:p. 10-56]

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.

- o Controls Subset -- provides simulation/stimulus and monitoring for performance and evaluation of the Attitude and Velocity Control Subsystem (AVCS).
- o Ordnance/Test Point Monitor Subset -- provides controls and indicators for testing of the ordnance firing circuits and for monitoring selected hardline test points.
- o 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:

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

- o 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.
- o 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:

- o battery A,B,C voltage
- o primary bus voltage
- o 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:

- o Manual or computer (only computer mode available)
- o 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:

- o Controls - subcarrier inhibits A and B (modulation indexing)
- o 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.

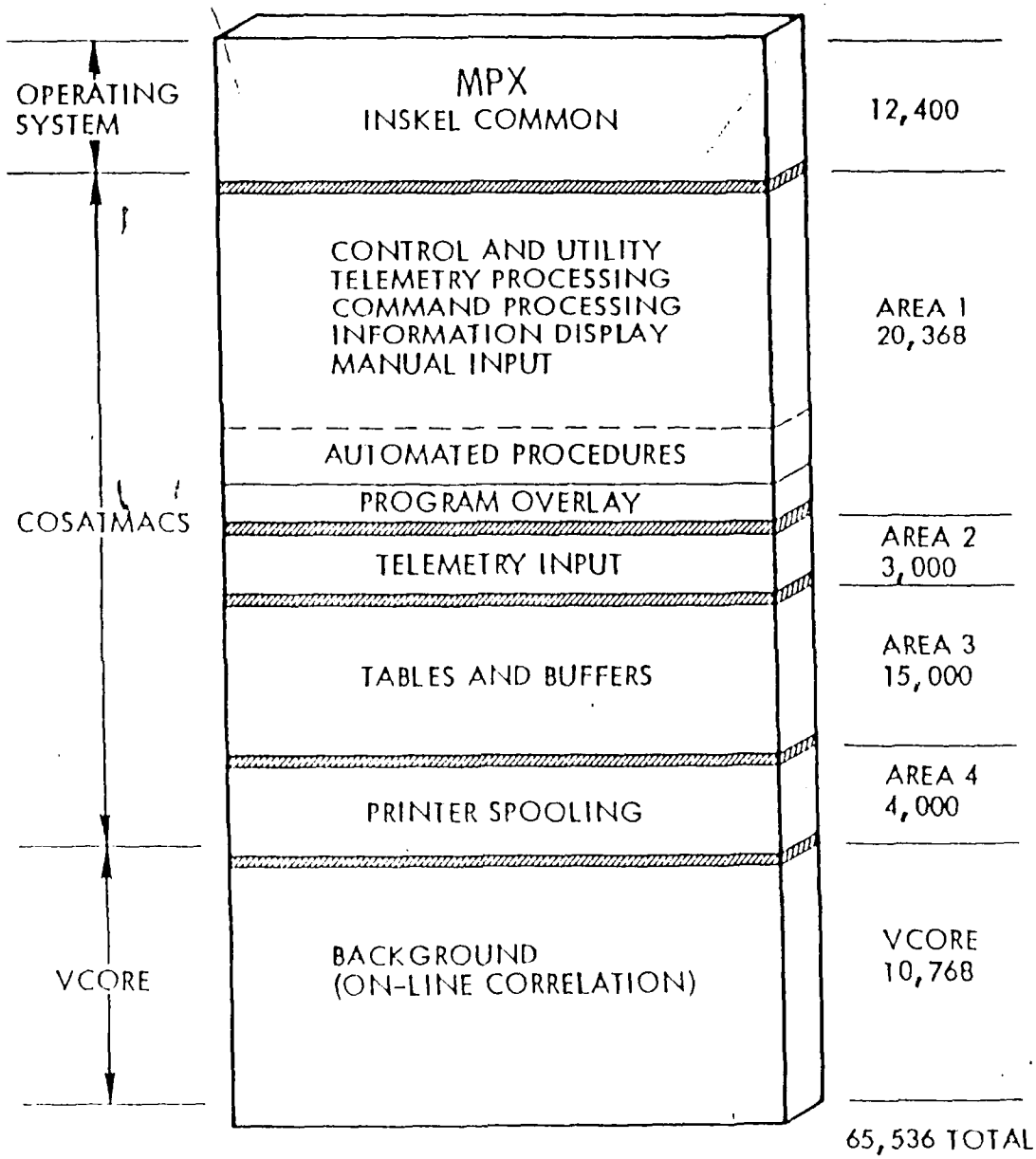


Figure 12. IBM 1800 Core Allocation
[from Ref. 1:p. 10-33]

- 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 bus 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:

	Dataset name	Volume
0	cosat	qual
1	cal-up	qual

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 shown 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 CRT 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 COSATMAC 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 G0.

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.  side use "CA,00,10 - if B side elected must switch from
0001    DL,000                          - [ENTER] - "AP,GO"          FSK A to FSK B on Ordnance/Test
        RE      STC CMD CA,YY,A WHERE YY=                            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                                    "CA,10,B")
0002    DL,000                          - [ENTER] - "AP,GO"
0003    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.
0004    DL,000                          - [ENTER] - "AP,GO"
0005    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 en-
        RE      VERIFY ENCRYPTED CMD MODE & HARDLINE abled, voltage on digital meter on power console
        RE      DATA SELECTED ---------------------> should read 285 volts.
0006    DL,000          - [ENTER] - "AP,GO"          Hardline is only mode available.  Verify TT&C
0007    CX,16,0157                                   console set to "bypass" on panel labeled
          PCME ON                                    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"
0008    CX,16,0322                                     three times to bypass, if hold at line 0008,
          SEL PCME CONV B                              use "AP,GO,8". If at line 0010, use
0009    CX,30,0040                                     "AP,GO,10".
          SEL 1K BIT & PCME 'B' UNITS                - if systems goes down and screen says "Frame
        RE      VERIFY TLM SYNC AT 1K BIT 'B' UNITS,   Synch Lost", check green synch lights on
0010    DL,000 ------------------------------------   TT&C under section G22201. If off, hit the
0011    CX,16,0261                                     "reset" button; if system telemetry does not
          SEL PCME CONV 'A'                            come back up, check to see if telemetry has
0012    CX,30,0077                                     has inverted by moving the red switch (on
          SEL 1K BIT AND PCME 'A' UNITS                the middle model 4703 under bit adj) to the
        RE      VERIFY TLM SYNC AT 1K BIT PRIME UNITS  position opposite the one it is in.  If this
0013    DL,000                                         does not bring system up, must re-boot th
                                                       1800 and start over.
                                                     - to verify telemetry sync at 1k bit - [ENTER] -
                                                       "PD,TC04" and verify on line 306 that bit
                                                       rate is 1k bit.
                                                       [ENTER] - "AP,GO"
                                                       [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.
        DL,000                                        - [ENTER] - "AP,GO", will go to failure at line 0028
0017    CX,16,0204
          AUTO DWNLINK ENABLE
0018    CX,16,0410
          COHERENT MODE
0019    CX,16,0553
          PRN INHIBIT ON
0020    CX,16,0055
          DOWNLINK 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   WAIT TLM UPDATE
0026    VF,8,E,247,377,000
          ALL ORD SAFE
0027    VF,8,E,162,154,000
          R/Y 1 LB CAT BED HTRS OFF, RCVR ANT DEP ORD SAFE
0028    VF,8,E,065,120,120                            - [ENTER] - "AP,GO" to bypass failure
          KIR-23A BYPASS OFF                            will go to line 0032.
0029    VF,8,E,079,100,100
```

```
          XMTR SWITCH 'A'
0030      VF,B,E,246,316,116
          XMTR SEL 'A' PRN INHIB ON ,COHO,DNLK ENABLE  TC01
0031      VF,B,E,306,376,376
          PCME SEL 'A' SIDE                                TC04
0032      VF,B,E,079,240,240                    - [ENTER] - "AP,GO" to bypass failure
          KIR-238 BYPASS OFF                      will go to failure at line 0062
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
```

```
          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          - [ENTER] - "AP,GO" to bypass failure
          MAIN BUS VOLTS 36 +-2.0           will go to failure at line 0074
0063      VF,A,E,004,377,116,149
          MAIN BUS VOLTAGE EXP 36 +-2 VOLTS
0064      VF,B,E,195,125,100
            VERIFY A&C CONNECT,PRIME AC                    EP02
0065      VF,B,E,078,252,252
            VERIFY RECONDITION ENABLE IN DISABLE           EP02
0066      VF,B,E,245,125,001
            VERIFY B&D CONNECT,AC SOURCE                   EP02
```

```
0067    VF,B,E,161,377,272
          VERIFY AUTOMODE 1,PRIME AC ON                    EP04
0068    VF,B,E,055,252,252
          VERIFY CHARGE STATUS                             EP03
0069    VF,B,E,115,256,256
          VERIFY AUTOMODE & PRIM. AC SOURCE                EP04
0070    VF,B,E,162,003,001
          VERIFY SEC 'A' ON, 'B' OFF                       EP06
0071    VF,B,E,117,140,140
          VERIFY PRIME & REDUN LOADS TO SEC 'A'            EP06
0072    VF,A,E,069,377,000,024
          VERIFY SEC 'B' +15V @ 0                          EP06
0073    VF,A,E,068,377,148,158
          VERIFY SEC 'A' +15V @ 15V                        EP06
0074    VF,A,E,260,377,027,255                  - to bypass failure [ENTER] - "AP,GO"
          PROP TANK A PRESS ABOVE 45 PSIA       - will get failures at line 0075, 0076, and 0103
0075    VF,A,E,261,377,027,255                    [ENTER] - "AP,GO" to bypass each failure
          PROP TANK B PRESS ABOVE 45 PSIA       - at line 0103, will give option to go to line 0270
        RE       F3 ONLY  FAIL IS ACCEPTABLE      [ENTER] - "AP,GO",270 at that point
        RE        IN FOLLOWING STEP             - system will go to 271 and give an "AP SC0001 complete"
0076    VF,B,E,196,376,376                      - go to line 0271
          ISO VALVES ALL OPEN
0077    CX,16,1003
          CH A VOLTAGE SELECT 4
0078    CX,16,0640
          CH A VOLTAGE SELECT 1
0079    CX,16,0701
          CH A VOLTAGE SELECT 2
0080    CX,16,0223
          CH B VOLTAGE SELECT 4
0081    CX,16,0060
          CH B VOLTAGE SELECT 1
0082    CX,16,0121
          CH B VOLTAGE SELECT 2
0083    CX,16,0246
          CH C VOLTAGE SELECT 4
```

```
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
        RE        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&C 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
```

```
          PSE-A EXECUTE
0120      CX,13,0071
          ADE-2A OFF
0121      CX,16,0601
          PSE-A EXECUTE
0122      CX,13,0161
          ADE-2A OFF
0123      CX,16,0601
          PSE-A EXECUTE
0124      CX,13,0073
          APE-A OFF
0125      CX,16,0601
          PSE-A EXECUTE
0126      CX,13,0163
          APE-B OFF
0127      CX,16,0601
          PSE-A EXECUTE
0128      CX,13,0017
          CSE-A OFF
0129      CX,16,0601
          PSE-A EXECUTE
0130      CX,13,0107
          CSE-B OFF
0131      CX,16,0601
          PSE-A EXECUTE
0132      CX,13,0051
          EPE-A OFF
0133      CX,16,0601
          PSE-A EXECUTE
0134      CX,13,0141
          EPE-B OFF
0135      CX,16,0601
          PSE-A EXECUTE
0136      CX,13,0011
          ESA-A OFF
0137      CX,16,0601
          PSE-A EXECUTE
```

```
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
          WCE-A OFF
0157    CX,16,0601
          PSE-A EXECUTE
0158    CX,13,0103
          WCE-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-B OFF
0169    CX,16,0601
          PSE-A EXECUTE
0170    CX,13,0125
          TPE-B 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,SESA-A,VDE 28V A 'OFF'
```

```
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,TCE-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,162,220,000
            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,24,0235
```

```
                0175    VF,8,E,421,360,000
0194                      ESA-A,EPE-A,WCE-A,ACE-A 'OFF'
                0176    VF,8,E,422,360,000
0195                      WDE-A,CSE-A,TCE-A,PCE-A 'OFF'
                0177    VF,8,E,169,360,000
0196                      SPIN UP POWER +5V & BATT BUS 'OFF'
                0178    CX,13,0015
0197                      CDE-A OFF
                0179    CX,16,0601
0198                      PSE-A EXECUTE
                0180    CX,13,0035
0199                      TPE-A OFF
                0181    CX,16,0601
0200                      PSE-A EXECUTE
                0182    CX,16,0441
0201                      PSE-A OFF
                0183    CX,16,1016
0202                      A&B CMD PROC OFF
                0184    DL,035   WAIT TLM UPDATE
0203            0185    VF,8,E,162,220,000
                          PSE-A&B OFF
0204            0186    VF,8,E,169,014,000
                          PSE-A&B CMD PROC OFF
0205            0187    CX,16,0502
                          PSE-B ON
0206            0188    CX,16,0757
                          PSE-B CMD PROC ON
0207            0189    CX,16,0417
                          SPIN UP POWER 'A' OFF
0208            0190    CX,16,0456
                          SPIN UP POWER 'B' OFF
0209            0191    CX,24,0115
                          CDE-B ON
0210            0192    CX,16,0222
                          PSE-B EXECUTE
0211            0193    CX,24,0135
```

```
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
```

```
0230      CX,16,0222
            PSE-B EXECUTE
0231      CX,24,0077
            VDE-A 28V OFF
0232      CX,16,0222
            PSE-B EXECUTE
0233      CX,24,0075
            VDE-A 5V OFF
0234      CX,16,0222
            PSE-B EXECUTE
0235      CX,24,0167
            VDE-B 28V OFF
0236      CX,16,0222
            PSE-B EXECUTE
0237      CX,24,0165
            VDE-B 5V OFF
0238      CX,16,0222
            PSE-B EXECUTE
0239      CX,24,0013
            WCE-A OFF
0240      CX,16,0222
            PSE-B EXECUTE
0241      CX,24,0103
            WCE-B OFF
0242      CX,16,0222
            PSE-B EXECUTE
0243      CX,24,0033
            WDE-A OFF
0244      CX,16,0222
            PSE-B EXECUTE
0245      CX,24,0123
            WDE-B OFF
0246      CX,16,0222
            PSE-B EXECUTE
0247      CX,24,0057
            PCE-A OFF
0248      CX,16,0222
```

```
          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&B(5V),APE-A&B OFF
0257      VF,B,E,420,077,004
          TPE-B ON,TPE-A,SESA-A&B,VDE-A&B(28V) OFF
0258      VF,B,E,421,377,000
          ESA-A&B,EPE-A&B,ACE-A&B,WCE-A&B OFF
0259      VF,B,E,422,377,000
          WDE-A&B,CSE-A&B,TCE-A&B,PCE-A&B 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 SC0001 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 show 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 SC0001, 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,SC0002"

The AC2121 program is used if planning to initiate another AVCS AP mode after turning off the AC1030 AP. The SC0002 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):

```
        RE      AVCS A-SIDE MODE SEQUENCE (AC1030)
        RE
        RE      TO ENTER ANY ORBITAL MODE CONFIGURA-  - [ENTER] - "AP,XQ, AC1030"
        RE      TION, XQ AP,GO,XXX WHERE XXX=STEP     - will go to delay of DL,000
        RE      NUMBER.                               - [ENTER] - "XQ,AP,GO,174" - 174 will initiate normal
        RE      THE STEP NUMBERS FOR EACH MODE WILL     flight mode in the satellite
        RE      APPEAR MOMENTARILY, SO TAKE NOTES
        RE      IF NECESSARY. EACH CRT DISPLAY WILL   - system will go to a failure at line 0190
        RE      REMAIN FOR 30 SECONDS ONLY. AT THE
        RE      END OF EACH MODE CONFIGURATION,     - intermediate steps in the sequence have been left out
        RE      INSTRUCTIONS FOR SUBSEQUENT MODES       (steps 0002-0166). To view these, see AP Library and
        RE      WILL BE PRESENTED.                      Computer Disk Command Sequences, Volume II [Ref. 5]
        DL,030  STRT DELAY 1
        RE      STEP NUMBERS FOR MODES ARE-
        RE         LAUNCH MODE 1A=001
        RE      COAST MODE 2A=24
        RE      DESPIN MODE 2B=55
        RE      AQUISITION MODE 3A=90
        RE      EARTH SEARCH MODE 3B=131
        RE      EARTH/SUN POINT MODE 4A=131
        RE    - NORMAL MODE 4B=174 -
        RE      TO EXIT AT ANY POINT,XQ AP GO 218
        DL,030  STRT DELAY 2
        RE      AT APPROPRIATE POINTS, OPTIONS WILL
        RE      BE PRESENTED ON THE CRT TO ACTIVATE
        RE      DEVICES SUCH AS RWA OR SADA. FOLLOW
        RE      DISPLAYED INSTRUCTIONS ACCORDING TO
        RE      TEST REQUIREMENTS. FOLLOWING AN EXIT
        RE      WITH AP AC2121 WILL TURN OFF THE
        RE      AVCS. XQ CRT ENTRIES ONLY DURING
        RE      HOLD (DL,000) CONDITIONS.
        RE
        RE
        DL,000
0001    CX,16,0543
          PSE-B OFF
        CX,16,0404
```

```
0167    DL 035   TLM DELAY-8
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
0172    RE          A SIDE EARTH/SUN POINT MODE 4A WITH
        RE          REACTION WHEEL ON ESTABLISHED AND
        RE         CONFIRMED.
        RE
        RE         TO PROCEED TO NORMAL MODE 48,
        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,16,1016
          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
0175    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
0178    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
0179    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
0180      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&Y 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&Y 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-9
0184    VF,8,E,021,001,000
           FSVD ON
0185    VF,8,E,042,377,000
          THRUSTERS, ALL P&R OFF
0186    VF,8,E,043,017,000
          THRUSTERS, ALL R/Y OFF
0187    VF,8,E,044,377,000
          THRUSTERS, ALL Z OFF
0188    VF,8,E,162,220,020
```

```
          PSE-A ON,PSE-B OFF
0189      VF,B,E,169,374,004
          PSE-A CMD PRCSR ON,SPINUP PWR,PSE-B CMD PRCSR OFF
0190      VF,B,E,196,376,376                          - will come to failure at this line - [ENTER] -
          ALL ISO VALVES OPEN                           "AP,GO"
0191      VF,B,E,397,003,003                          - will go to a failure at line 0197
          ADE-1A&2A ON
0192      VF,B,E,398,003,000
          ADE-1B&2B OFF
0193      VF,B,E,402,377,000
          ADE MODE, ALL STEP,SLEW,CAGE OFF,90,PLUS
0194      VF,B,E,410,301,001
          CSE MODE, A NORTH, UNL. INHIB.
0195      VF,B,E,411,177,060
          CSE MODE,EP NORM,WHL NORM,R/Y OUT ENABLE,
          AUTO ACQ&P&Y&R OUTS DISABLED
0196      VF,B,E,412,360,200
          CSE MODE,FUL PDZN,PEARTH,Y&P FINE
0197      VF,B,E,414,003,003                          - [ENTER] - "AP,GO" at this failure
          CSE/VDE MODE-NORMAL,R/YA OR ROLL PULSE      - will go to a failure at 0200
0198      VF,B,E,415,007,000
          VDE MODE,PREC,KEY,PULSE,DISABLED
0199      VF,B,E,416,377,000
          VALVES,ALL P&R DISABLED
0200      VF,B,E,417,017,014                          - [ENTER] - "AP,GO" at this failure
          VALVES, +R/YA,-R/YA ENABLED                 - will go to line 0206
0201      VF,B,E,418,377,000
          VALVES,ALL Z DISABLED
0202      VF,B,E,419,077,060
          CDE-A,VDE-A(5) ON,CDE-B,VDE-B(5),APE-A&B OFF
0203      VF,B,E,420,077,022
          TPE-A,VDE-A(28)ON,SESA-A&B,TPE-B,VDE-B(28)OFF
0204      VF,B,E,421,377,340
          EPE-A,ESA-A,WCE-A ON,EPE-B,ESA-B,ACE-A&B,WCE-B OFF
0205      VF,B,E,422,377,160
          CSE-A,PCE-A,TCE-A ON,CSE-B,PCE-B,TCE-B,WDE-A&B OFF
0206      RE
```

```
        RE      A-SIDE MODE 48 (INACTIVE) ESTA-
        RE      BLISHED. RWA & SADA ARE OFF. ADE
        RE      COMMAND REGISTER IS LOADED AND SADA
        RE      WILL STEP IF ADE EXECUTE IS ISSUED.
        RE
        RE      THE FOLLOWING OPTIONS WILL RESULT IN
        RE      RWA RUN-UP. IF SELECTED. THE CRT
        RE      DISPLAY WILL LAST 60 SECONDS, SO
        RE      TAKE NOTES IF NECESSARY.
        DL.030  STRT DELAY 1
        RE      1) PROVIDE A STIMULUS EARTH VIA THE
        RE      EARTH SENSOR.
        RE      2) XQ CMDS CX,14,1642 AND CX,16,0642
        RE      FOR EARTH PRES OVERRIDE.
        RE      3) ENABLE A-NORTH PITCH AND ROLL AND
        RE      A-SOUTH PITCH AND ROLL ON RADIANCE
        RE      SIMULATOR.
        RE
        RE      AFTER EXECUTING SELECTED OPTION,
        RE      XQ.AP,GO TO RUN UP WHEEL.
        DL.060  TEXT DELAY 1
        RE
        RE      TO ACTIVATE SADA AND NOT RUN UP THE
        RE      WHEEL,XQ AP,GO 213
0207    DL.000
0208    CX.13.0023
          WDE-A ON
        CX.16.0601
          PSE-A EXECUTE
0209    DL.035   WHEEL RUNNING UP
0210    VF,8,F,422,377,360
          WDE-A,PCE-A,CSE-A,TCE-A ON,WDE-B,PCE-B,CSE-B,TCE-B OFF
0211    RE
        RE      RWA ON. TO ACTIVATE SADA STEP,
        RE      XQ.AP,GO.
        RE
0212    DL.000
```

- 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

- [ENTER] - "PD,AC01" then [ENTER]- "AP,GO" to run up the reaction wheel. PD,AC01 will bring up page 01 and allow the viewing of the current and voltage as wheel spins up.
- "PD,AC08" will allow viewing of the SADA
- "PD,AC14" should be viewed at regular intervals to check temperature at line 378 and insure it does not go above 128°F.
- system will go to a delay at line 0212

- [ENTER] - "AP,GO"
- will go to procedure complete at line 0217

```
0213    CX,01,0300
          ADE MODE, SADA 1&2 STEP ON.
        CX,16,0744
          ADE-A EXECUTE
0214    DL 035   TLM DELAY-10
0215    VF,B,E,402,377,300
          SADA 1&2 STEP ON, ALL SLEW&CAGE OFF,90,PLUS.
0216    RE
        RE          A-SIDE NORMAL MODE 48 ESTABLISHED
        RE          AND CONFIRMED.
        RE
        RE          FOR ANY OTHER MODE, XQ AP,GO,XXX.
        RE
        RE          TO EXIT PROGRAM, XQ AP,GO.
        RE
        RE          TO TURN AVCS OFF (AFTER PROGRAM
        RE          EXIT), XQ AP,AC2121
0217    DL,000
0218    RE          AC1030 COMPLETE
        END OF STEP
```

- [ENTER] - "XQ,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.

- [ENTER] - "XQ,AP,AC2121" to begin procedure.

```
        RE      BEGIN AP AC2121. AVCS 'A' SIDE OFF
        RE      THRU PSE-A.
        RE      AP GO TO TURN OFF 'A' SIDE AVCS.
0001    UL.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
          CDE-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
          ADE-1A OFF
0015    CX,16,0601
          PSE-A EXECUTE
0016    CX,13,0121
          ADE-1B OFF
0017    CX,16,0601
          PSE-A EXECUTE
0018    CX,13,0071
```

- [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.

```
          ADE-2A OFF
0019      CX,16,0601
          PSE-A EXECUTE
0020      CX,13,0161
          ADE-2A OFF
0021      CX,16,0601
          PSE-A EXECUTE
0022      CX,13,0073
          APE-A OFF
0023      CX,16,0601
          PSE-A EXECUTE
0024      CX,13,0163
          APE-B OFF
0025      CX,16,0601
          PSE-A EXECUTE
0026      CX,13,0017
          CSE-A OFF
0027      CX,16,0601
          PSE-A EXECUTE
0028      CX,13,0107
          CSE-B OFF
0029      CX,16,0601
          PSE-A EXECUTE
0030      CX,13,0051
          EPE-A OFF
0031      CX,16,0601
          PSE-A EXECUTE
0032      CX,13,0141
          EPE-B OFF
0033      CX,16,0601
          PSE-A EXECUTE
0034      CX,13,0011
          ESA-A OFF
0035      CX,16,0601
          PSE-A EXECUTE
0036      CX,13,0101
          ESA-B OFF
```

```
0037      CX,16,0601
            PSE-A EXECUTE
0038      CX,13,0055
            SESA-A OFF
0039      CX,16,0601
            PSE-A EXECUTE
0040      CX,13,0145
            SESA-B OFF
0041      CX,16,0601
            PSE-A EXECUTE
0042      CX,13,0037
            TCE-A OFF
0043      CX,16,0601
            PSE-A EXECUTE
0044      CX,13,0127
            TCE-B OFF
0045      CX,16,0601
            PSE-A EXECUTE
0046      CX,13,0077
            VDE-A 28V OFF
0047      CX,16,0601
            PSE-A EXECUTE
0048      CX,13,0075
            VDE-A 5V OFF
0049      CX,16,0601
            PSE-A EXECUTE
0050      CX,13,0167
            VDE-A 28VDC OFF
0051      CX,16,0601
            PSE-A EXECUTE
0052      CX,13,0165
            VDE-B 5V OFF
0053      CX,16,0601
            PSE-A EXECUTE
0054      CX,13,0013
            WCE-A OFF
0055      CX,16,0601
```

```
          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,E,419,077,040
          CDE-A ON,VDE-A(+5V),VDE-B(+5V),CDE-B,APE-A,ADE-B, 'OFF'
0072      VF,B,E,420,077,020
          TPE-A ON,TPE-B,SESA-A&B,VDE 28V A&B 'OFF'
0073      VF,B,E,421,377,000
          ESA-A&B,EPE-A&B,WCE-A&B,ACE-A&B 'OFF'
0074      VF,B,E,422,377,000
```

```
          WDE-A&B,CSE-A&B,TCE-A&B,PCE-A&B 'OFF'
0075      VF,B,E,169,360,000
          SPIN UP POWER +5V & BATT BUS 'OFF'
0076      CX,13,0015
          CDE-A OFF
0077      CX,16,0601
          PSE-A EXECUTE
0078      CX,13,0035
          TPE-A OFF
0079      CX,16,0601
          PSE-A EXECUTE
0080      CX,16,0441
          PSE-A OFF
0081      CX,16,1016
          A&B CMD PROC OFF
0082      DL,035   WAIT TLM UPDATE
0083      VF,B,E,162,220,000
          PSE-A&B OFF
0084      VF,B,E,169,014,000
          PSE-A&B CMD PROC OFF
          END OF STEP
```

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 SC0002

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 (SC0002) 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 SC0002 COMPLETE". The SC0002 sequence follows:

```
                SPACECRAFT POWER OFF
          RE        STC CMD CA,00,XX WHERE XX=
          RE        S/C ID FOR S/C BEING TESTED.
0001      DL,000
          RE        STC CMD CA,YY,A WHERE YY=
          RE        'K' BOX PERMUTER KEY TO USED
          RE        FOR S/C UNDER TEST
0002      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      DL,000
0004      CX,16,0404
            PSE-A ON
0005      CX,16,0720
            A CMD PROC ON
0006      CX,16,0417
            SPIN UP POWER A 'OFF'
0007      CX,16,0456
            SPIN UP POWER B 'OFF'
0008      CX,13,0005
            CDE-A ON
0009      CX,16,0601
            PSE-A EXECUTE
0010      CX,13,0025
            TPE-A ON
0011      CX,16,0601
            PSE-A EXECUTE
0012      CX,13,0053
            ACE-A OFF
0013      CX,16,0601
            PSE-A EXECUTE
0014      CX,13,0143
            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
```

```
          PSE-A EXECUTE
0034    CX,13,0141
          EPE-B OFF
0035    CX,16,0601
          PSE-A EXECUTE
0036    CX,13,0011
          ESA-A OFF
0037    CX,16,0601
          PSE-A EXECUTE
0038    CX,13,0101
          ESA-B OFF
0039    CX,16,0601
          PSE-A EXECUTE
0040    CX,13,0055
          SESA-A OFF
0041    CX,16,0601
          PSE-A EXECUTE
0042    CX,13,0145
          SESA-B OFF
0043    CX,16,0601
          PSE-A EXECUTE
0044    CX,13,0037
          TCE-A OFF
0045    CX,16,0601
          PSE-A EXECUTE
0046    CX,13,0127
          TCE-B OFF
0047    CX,16,0601
          PSE-A EXECUTE
0048    CX,13,0077
          VDE-A 28V OFF
0049    CX,16,0601
          PSE-A EXECUTE
0050    CX,13,0075
          VDE-A 5V OFF
0051    CX,16,0601
```

```
          PSE-A EXECUTE
0052      CX,13,0167
          VDE-A 28VOC OFF
0053      CX,16,0601
          PSE-A EXECUTE
0054      CX,13,0165
          VDE-B 5V OFF
0055      CX,16,0601
          PSE-A EXECUTE
0056      CX,13,0013
          WCE-A OFF
0057      CX,16,0601
          PSE-A EXECUTE
0058      CX,13,0103
          WCE-B OFF
0059      CX,16,0601
          PSE-A EXECUTE
0060      CX,13,0033
          WDE-A OFF
0061      CX,16,0601
          PSE-A EXECUTE
0062      CX,13,0123
          WDE-B OFF
0063      CX,16,0601
          PSE-A EXECUTE
0064      CX,13,0057
          PCE-A OFF
0065      CX,16,0601
          PSE-A EXECUTE
0066      CX,13,0147
          PCE-B OFF
0067      CX,16,0601
          PSE-A EXECUTE
0068      CX,13,0105
          CDE-B OFF
0069      CX,16,0601
          PSE-A EXECUTE
```

```
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,ADE-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
          ESA-A&B,EPE-A&B,WCE-A&B,ACE-A&B 'OFF'
0076    VF,B,E,422,377,000
          WDE-A&B,CSE-A&B,TCE-A&B,PCE-A&B 'OFF'
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,16,0441
          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
```

```
0088      CX,16,0502
            PSE-B ON
0089      CX,16,0757
            PSE-B CMD PROC ON
0090      CX,16,0417
            SPIN UP POWER 'A' OFF
0091      CX,16,0456
            SPIN UP POWER 'B' OFF
0092      CX,24,0115
            CDE-B ON
0093      CX,16,0222
            PSE-B EXECUTE
0094      CX,24,0135
            TPE-B ON
0095      CX,16,0222
            PSE-B EXECUTE
0096      CX,24,0053
            ACE-A OFF
0097      CX,16,0222
            PSE-B EXECUTE
0098      CX,24,0143
            ACE-B OFF
0099      CX,16,0222
            PSE-B EXECUTE
0100      CX,24,0031
            ADE-1A OFF
0101      CX,16,0222
            PSE-B EXECUTE
0102      CX,24,0121
            ADE-1B OFF
0103      CX,16,0222
            PSE-B EXECUTE
0104      CX,24,0071
            ADE-2A OFF
0105      CX,16,0222
            PSE-B EXECUTE
0106      CX,24,0161
```

```
          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
```

```
          SESA-A OFF
0125      CX,16,0222
            PSE-B EXECUTE
0126      CX,24,0145
            SESA-B OFF
0127      CX,16,0222
            PSE-B EXECUTE
0128      CX,24,0037
            TCE-A OFF
0129      CX,16,0222
            PSE-B EXECUTE
0130      CX,24,0127
            TCE-B OFF
0131      CX,16,0222
            PSE-B EXECUTE
013.      CX,24,0077
            VDE-A 28V OFF
0133      CX,16,0222
            PSE-B EXECUTE
013.      CX,24,0075
            VDE-A 5V OFF
0135      CX,16,0222
            PSE-B EXECUTE
0136      CX,24,0167
            VDE-B 28V OFF
0137      CX,16,0222
            PSE-B EXECUTE
0138      CX,24,0165
            VDE-B 5V OFF
0139      CX,16,0222
            PSE-B EXECUTE
0140      CX,24,0013
            WCE-A OFF
0141      CX,16,0222
            PSE-B EXECUTE
0142      CX,24,0103
            WCE-B OFF
```

```
0143    CX,16,0222
          PSE-B EXECUTE
0144    CX,24,0033
          WDE-A OFF
0145    CX,16,0222
          PSE-B EXECUTE
0146    CX,24,0123
          WDE-B OFF
0147    CX,16,0222
          PSE-B EXECUTE
0148    CX,24,0057
          PCE-A OFF
0149    CX,16,0222
          PSE-B EXECUTE
0150    CX,24,0147
          PCE-B OFF
0151    CX,16,0222
          PSE-B EXECUTE
0152    CX,24,0015
          CDE-A OFF
0153    CX,16,0222
          PSE-B EXECUTE
0154    CX,24,0035
          TPE-A OFF
0155    CX,16,0222
          PSE-B EXECUTE
0156    DL,035   WAIT TLM UPDATE
0157    VF,B,E,419,077,010
          CDE-B ON,CDE-A,VDE-A&B(5V),APE-A&B OFF
0158    VF,B,E,420,077,004
          TPE-B ON,TPE-A,SESA-A&B,VDE-A&B(28V) OFF
0159    VF,B,E,421,377,000
          ESA-A&B,EPE-A&B,ACE-A&B,WCE-A&B OFF
0160    VF,B,E,422,377,000
          WDE-A&B,CSE-A&B,TCE-A&B,PCE-A&B OFF
0161    VF,B,E,169,360,000
```

```
          SPIN UP POWER +5V & BATT BUS OFF
0162      CX,24,0105
            CDE-B OFF
0163      CX,16,0222
            PSE-B EXECUTE
0164      CX,24,0125
            TPE-B OFF
0165      CX,16,0222
            PSE-B EXECUTE
0166      CX,16,0543
            PSE-B OFF
0167      CX,16,1016
0168      DL,035   WAIT TLM UPDATE
0169      VF,B,E,162,220,000
            PSE-A&B OFF
0170      VF,B,E,169,014,000
            PSE-A&B CMD PROC OFF
          RE        AVCS TURN OFF COMPLETED
          RE        STC AP,GO TO CONFIG EPDS FOR SHUT-
          RE        DOWN.
0171      DL,000
0172      CX,16,0501
            SEC A OFF
0173      CX,16,0440
            SEC A ON
0174      CX,16,0603
            SEC B OFF
0175      CX,16,0644
            E1A PRIME LOADS CONV A
0176      CX,16,0746
            E1A RED LOADS CONV A
0177      CX,16,1004
            E1A TLM PROC A ON
0178      CX,16,0646
            E1A TLM PROC B ON
0179      CX,16,0212
            PRIME AC SOURCE CONN
```

```
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      CX,16,0361
          CH A AUTO MODE 1
0200      CX,16,0511
          CH B AUTO MODE 1
0201      CX,16,0704
          CH C AUTO MODE 1
0202      CX,16,0155
          CH D AUTO MODE 1
0203      DL,035   WAIT TLM UPDATE
0204      VF,A,E,353,377,114,127          - [ENTER] - "AP,GO" to bypass failure at this point
          MAIN BUS VOLTS 36 +-2.0           will go to failure at line 0245
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      CX,16,1003
            CH A VOLTAGE SELECT 4
0217      CX,16,0640
```

```
          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       EPDS 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'
```

```
0236    CX,16,0157
          PCME ON
0237    CX,30,0077
          SEL 1K BIT AND PCME 'A' UNITS
0238    CX,16,0204
          AUTO DWNLINK ENABLE
0239    CX,16,0410
          COHERENT MODE
0240    CX,16,0553
          PRN INHIBIT ON
0241    CX,16,0055
          DOWNLINK ON
0242    CX,16,0041
          KIR23A BYPASS ENABLE OFF
0243    CX,16,0205
          KIR23A BYPASS EXECUTE OFF
0244    DL,035   WAIT TLM UPDATE
0245    VF,B,E,065,120,120                  - [ENTER] - "AP,GO" to bypass this failure
          KIR-23A NORM                        will go to failure at line 0267
0246    VF,B,E,079,100,100
          XMTR SWITCH 'A'
0247    VF,B,E,246,316,116
          XMTR SEL 'A' PRN INHIB ON ,COHO,DNLK ENABLE  TC01
0248    VF,B,E,306,376,376
          PCME SEL 'A' SIDE                            TC04
0249    CX,16,0063
          PSA-1 CMD PROC A TO CCV-1
0250    CX,16,0160
          PSA-1 CMD PROC B TO CCV-1
0251    CX,16,0315
          PSA-2 CMD PROC A TO CCV-2
0252    CX,16,0413
          PSA-2 CMD PROC B TO CCV-2
0253    RE       TT&C INITIALIZATION COMPLETE
        RE       EPDS FINAL SHUTDOWN IN PROGRESS
0254    CX,16,0507
          BATT A DISCONN
```

```
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 RECOND
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 RECOND ENABLE
0267    VF,B,E,170,003,003
          RECOND. 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
          OCXO,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 HTRS A&B OFF
0299    VF,B,E,162,154,000
          R/Y 1 LB CAT BED HTRS 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      AVCS '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
          KIR23B BYPASS EXECUTE OFF
        CX,16,0661
          KIR23B 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,GO" to pass line 0308
        VF,B,E,079,240,240
          VERIFY B DECRYPTER NORMAL
        RE      DISABLE S/C BATTERIES. TURN MAIN BUS     - to disable batteries and turn off the main
        RE      VOLTAGE TO ZERO. TURN MAIN BUS ENABLE      bus voltage, see steps F.2-F.4 of the next
        RE      OFF. START S/C BATTERY CHARGE PROCEDURE    section under Power Console.
        RE      LX-14S-01 IF REQUIRED, OR PLACE BATTERY  - to start s/c battery charge procedures, see
        RE      SIMULATOR BATTERIES ON CHARGE.             steps F.1-F.2 in the next section under
        RE      AP SC0002 COMPLETE                         Satellite Shutdown.
0309    END OF STEP                                      - 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

fn =	Three-digit function number ranging from 000 to 422.
b =	Blank
function description =	Brief description of the measured function.
value =	Calibrated value of the function in decimal engineering units.

u = Engineering units associated with the function.

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

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).

* = 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.

mm,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
```

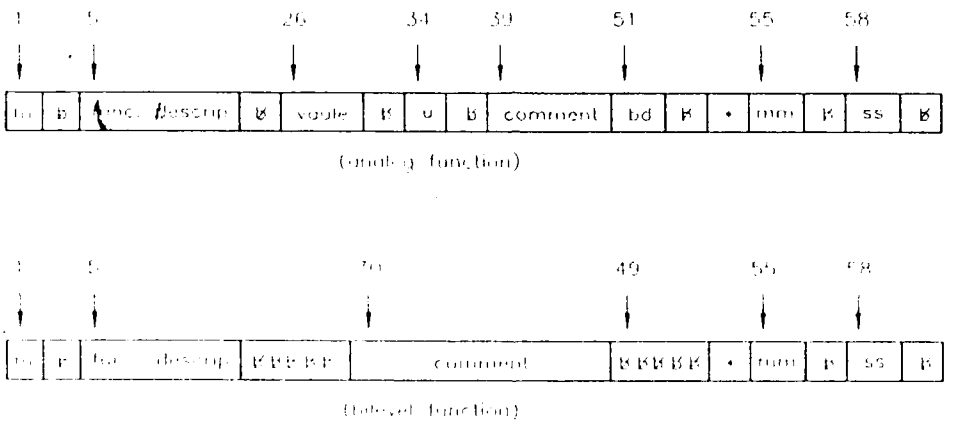


Figure 13. General Print and Monitor Display Format
[from Ref. 3:p. 10]

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

TI,s,fff (i.e., TI,1,245)

This function inhibits the processing of function fff on stream s.

2. Telemetry Enable

TI,s,fff (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.

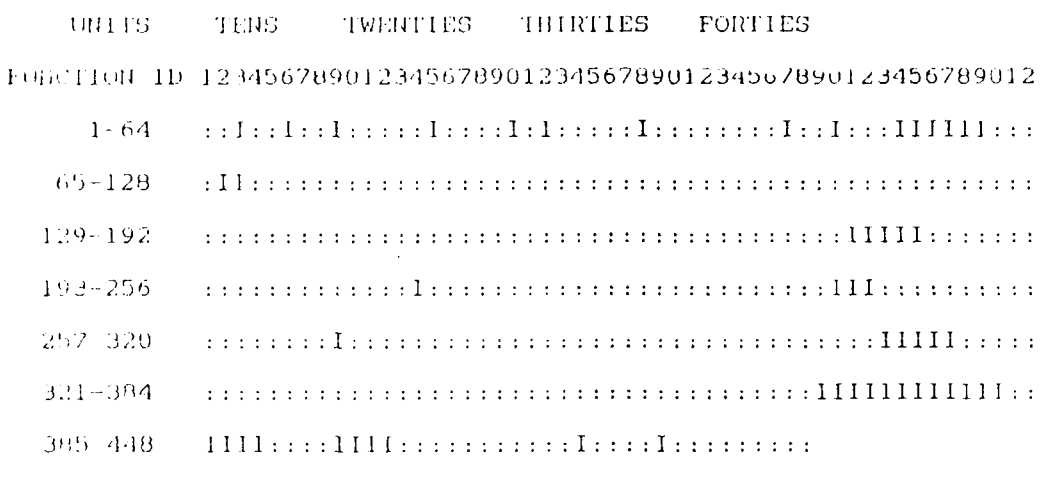


Figure 14. Sample Display Format
[from Ref. 3:p. 12]

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 = 0000000000110101 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.

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.

CQ RA CMDV KT I

CQ = Program Control Characters (alphabetic characters)

RA = Routing Address (1 or 2 octal digits)

CMDV = Command Value (up to 4 octal digits < 1777)

KT = Optional Repeat Control (1 or 2 decimal digits)

I = Optional Print Inhibit

1. Spacecraft/Assembly Address

CA,00,id

CA,xx,A

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

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

CH

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

7. Inhibit

CI,HP

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

CK

This entry stops a repeat or disk command sequence.

9. Print Commands

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

CU,{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 he 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 ra 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 rrom 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 ppppppp --- ccccccc

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 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

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]

STATUS MESSAGES	EXPLANATION
1. *Begin AP xxxxxx	Start of AP xxxxxx was requested
2. *AB,AP	An abort directive was input
3. *Go to AP STP xxxx	An AP,GO or AP,SS was input with step number specified
4. *AP SP TC REQ	A halt request was input
5. *AP GO	Output in response to an input of AP,GO or AP,SS without step number
ERROR MESSAGES	EXPLANATION
1. AP Directive Format Error	Format of an AP input was incorrect
2. Error in Step Number	The step number input was incorrect in length or character type
3. No AP Active, REQ Denied	A control directive was entered prior to initiating an AP
4. AP xxxxxx Active	An initiate AP request was input while AP xxxxxx was still running
5. AP Not On Disk	An initiate AP request was made for an AP not present on the disk

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,vvvv1,...,vvvvn

This entry replaced the contents of up to 10 consecutive memory locations, beginning at address xxxx, with the specified data vvvv1,...,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

VIII. CONCLUSIONS AND RECOMMENDATIONS

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)

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 page	(1=step number, PD=page display, AC01=alphanumeric title of CRT to be displayed)
PP,AC01	(No step number, PP=print page, AC01=alphanumeric title of CRT page to be printed)
1PS,AC	(1=step number, PS=print subsystem, AC=alpha of CRT pages in AVCS system, all of which will be printed)
1DL,010	(1=step number, DL=delay, 010=10 seconds)
1RE,CONFIGURATION COMP.	(1=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]

Abbreviation	Function
A	Analog
ACXX	AVCS CRT page (XX) number
AP	Automatic procedure
B	Bi level
CX	Command
DLO	Delay time indefinite hold
DLXXX	Delay time (XXX) in seconds
E	Print failures only
EPXX	Electrical power CRT page (XX) number
P	Unconditional print
PD	Page display
PL	Communication payload CRT page (XX) number
PP	Print page
PS	Print subsystem
RA	Routing address
RCXX	Reaction control CRT page (XX) number
RE	Comment card
TCXX	TT&C CRT page (XX) numbner
TPXX	Test page CRT page (XX) number
VF	Verify
**	Comment card

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

AP Number	Title
SC0001	Spacecraft Power On and Initialization
SC0002	Spacecraft Power Off
SC0003	Spacecraft Power On and Initialization
CD0001	Power Initialization
CD0002	Power Removal
CD0005	Power Initialization

Attitude and Velocity Control Subsystem-APs

AC1001	Baseline-Launch Mode AA
AC1002	Baseline-Spin Mode AA
AC1003	Baseline-Orbit Mode AA
AC1004	Baseline-Launch Mode BB
AC1005	Baseline-Spin Mode BB
AC1006	Baseline-Orbit Mode BB
AC103	AVCS A Side Mode Sequence
AC2122	AVCS A Side Off Sequence

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

Abbreviation	Title
STC	Spacecraft test conductor
PLTC	Payload test conductor
MTC	Mechanical test conductor
ACE	Attitude control systems engineer
SRFE	Spacecraft radio frequency (RF) engineer
SCO	Spacecraft computer operator
CCO	Controls console operator
PCO	Power and ordnance consoles operator
TTO	TT&C console operator
SET	Spacecraft electrical technician
RFT	Spacecraft RF technician
SI	Spacecraft quality assurance
PI	Payload quality assurance
SDA	Spacecraft data analyst
PLDA	Payload data analyst
THT	Thermal installation technician
SMT	Spacecraft mechanical technician
OSE	Operational safety engineer

APPENDIX F
GLOSSARY OF GENERAL ABBREVIATIONS AND ACRONYMS
[Ref. 2:pp. 45-53]

ABSG	Alumina Based Spherical Granules
ACE	Acquisition Control Electronics
ACTE	Automated Communication Test Equipment
ACU	Auxiliary Control Unit
ADE	Array Drive Electronics
ADPE	Automatic Data Processing Equipment
AE	Hangar AE at Eastern Test Range
AEA	Auxiliary Electronics Assembly
AFETR	Air Force Eastern Test Range
AFSCF	Air Force Satellite Control Facility
AGE	Aerospace Ground Equipment
AI&T	Assembly, Integration, and Test
AJ	Antijam
AKM	Apogee Kick Motor
AM	Amplitude Modulation
AN	Analog
AOES	Advanced Orbital Ephemeris System
AOS	Acquisition of Signal
APE	Attitude Processing Electronics
APU	Auxiliary Power Unit
ARIA	Advanced Range Instrumentation Aircraft
ASTG/SI	Aerospace Test Group/Satellite Integration
ATP	Acceptance Test Plan

BAUD	A variable unit of data transmission speed, usually equal to 1 bit/sec
BBRT	Bird Buffer Recorder Tape
BECO	Booster Engine Cutoff (Atlas)
BER	Bit Error Rate
BH	Blockhouse
BI	Bilevel
BOL	Beginning of Life
BR	Emergency Action Message (EAM)
BY	EAM Bypass
CADM	Configuration and Data Management
CC	Communication Converter
CDE	Count Down Electronics
CDRL	Contract Data Requirements List
CEA	Control Electronics Assembly
CL,EN	Clear, Enable
CMD EX	Command Execute
CMD REC/PROC	Command Receiver/Processor
CMO	Configuration Management Office
COHO	Coherent
COMM	Communication Subsystem
CC CONV	Communications Converter
COMPOOL	Common Pool of Information
COMSEC	Communications Security
C/N	Carrier-to-Noise Ratio
CPC	Computer Program Components

C S	Command Receiver/Synthesizer
CSE	Command Storage Electronics
CST	Comprehensive Systems Test
CU	Command Unit
CX 36	Launch Complex 36
V	Delata Velocity (velocity change)
DA	Data Analysis
DGTL	Digital
DOD	Department of Defense
DP	Data Presentation
DRM	Derived Rate Modulators
DTC	Data Transmission Center
DTM	Dual Thruster Module
EAGE	Electrical Aerospace Ground Equipment
EAM	Emergency Action Message
EARL	Excess Axial Ratio Loss
ECI	Electronic Communications, Inc.
EED	Electroexplosive Device
EIUA	Electrical Integration Assembly
ELV	Expendable Launch Vehicles
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EMT	Electromechanical Test Building
EOL	End of Life
EPDS	Electrical Power and Distribution Subsystem
EPE	Earth Processing Electronic

EQ	Equinox
ES	Earth Sensor
ESA	Earth Sensor Assembly
ESA-60A	Explosive Safe Area 60A
ETR	Eastern Test Range
EVD	Expendable Vehicles Directorate (NASA/KSC)
F1	S/C Flight No.1
F2	S/C Flight No.2
F3	S/C Flight No.3
F4	S/C Flight No.4
F5	S/C Flight No.5
FB	Fleet Broadcast
FBP	Fleet Broadcast Processor
FCP	FLTSATCOM Command Program
FDV	Fill and Drain Value
FG	Frequency Generator
FGO	Frequency Generator Output
FLTSATCOM	Fleet Satellite Communications
FM	Frequency Modulation
FOV	Field of View
FREQ GEN	Frequency Generator
FSA	Fuel Storage Area
FSC	FLTSATCOM
FSK	Frequency Shift Keying
FS	Frequency Select
GD/C	General Dynamics/Convair

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

lbf	Pound Force
lbm	Pound Mass
LBTP L	Launch Base Test Plan
LC-36	Launch Complex 36 (at CCAFS)
LeRC	Lewis Research Center (NASA)
LHCP	Left Hand Circularly Polarized
LOWG	Launch Operations Working Group
LIM-2	Limiter-2
LO	Local Oscillator
LOS	Loss of Signal
LP	Low Power
LSB	Least Significant Bit
LV	Launch Vehicle
MAGE	Mechanical Aerospace Ground Equipment
MC/F	Multicoupler/Filter
MDC	Mission Director's Center (Hangar AE, CCAFS)
MDI	Mechanical Design Integration
MECO	Main Engine Cutoff (Centaur)
MES	Main Engine Start (Centaur)
MF	Main Frame
MLSR	Maximum Length Shift Register
MS	Millisecond
MSS	Mobile Service Structure
MSB	Most Significant Bit
NASA	National Aeronautics and Space Administration
NASA/ELV	Expendable Launch Vehicle

NASA/KSC	Kennedy Space Center
NASA/LeRC	Lewis Research Center
NB	Narrowband
NiCd	Nickel-Cadmium
NONCOHO	Noncoherent
NRZ-L	Nonreturn to Zero Level
OCXO	Oven Controlled Crystal Oscillator
OD	Operations Directive
O.D.	Orbital Determination
OMT	Orthomode Transducer
OOH	Orbital Operations Handbook
OR	Operations Requirements
ORC	Operations Request Card
P	Pitch
P/L	Payload
PCE	Pitch Control Electronics
PCM	Pulse Code Modulation
PCME	Pulse Coded Modulation Electronics
PCU	Power Control Unit
PDA	Propellant Distribution Assembly
PDL-1	Preamplifier/Downconverter/Limiter-1
PPLS	Propellant and Presurrant Loading System
PRD/OR/RD	Program Requirements Document/Operation Requirements/Requirement Document
PRI	Primary
PRN	Psuedo-Random Noise

PROC	Processor
PROC.REC.	Processor Receiver
PRS	Processor Receiver/Synthesizer
PSA	Payload Switching Assembly
PSE	Power Switching Electronics
psia	Pounds Per Square Inch Absolute
psid	Pounds Per Square Inch Differential
PSK	Phase Shift Keying
PSO	Pad Safety Officer
PSP	Program Support Plan
PTT	Processed Telemetry Tape
PWG	Payload Working Group
Q.K.D.	Quasi Keydown
R	Clear
R	Range Rate
R	Roll
RCS	Reaction Control Subsystem
RCV	Receiver
RDN	Redundant
REDUN	Redundant
RHCP	Right Hand Circularly Polarized
RR	Repeater Receiver
RTS	Remote Vehicle Control Facility
RWA	Reaction Wheel Assembly
R/Y	Roll/Yaw
S&A	Safe and Arm

SAB	Satellite Assembly Building
SAD	Solar Array Drive
SADA	Solar Array Drive Assembly
SADEC	Spin Axis Declination
SAEF-2	Satellite Assembly and Encapsulation Facility No.2
SD	Space Division
SD/YK	Space Division Deputy for Space Communications Systems
SAP	Solar Array Panel
SARA	Spin Axis Right Ascension
S/C	Spacecraft
SFC	Satellite Control Facility
SDU	Signal Distribution Unit
sec	Seconds
SEC	Space Equipment Conv.
SECO	Sustainer Engine Cutoff (Atlas)
SESA	Spinning Earth Sensor Assembly
SGLS	Space Ground Link System
SHF	Super High Frequency
SHF XMTR	Super High Frequency Transmitter
SLV-3D	Space Launch Vehicle (Atlas) for Centaur Stage
SIOP	Single Integrated Operating Plan
SOH	State of Health
SOPM	Standard Orbital Parameters Message
SPO	System Program Office
SS	Summer Solstice

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

UV	Ultraviolet
U/V	Undervoltage
VCC	Vehicle Code Count
VCO	Voltage-Controlled Oscillator
VDE	Valve Drive Electronics
VE	Vehicle Ephemeric
VSWR	Voltage-to-Standing-Wave Radio
WB	Wideband
WDE	Wheel Drive Electronics
WS	Winter Solstice
XMTR	Transmitter
Z	Yaw

APPENDIX G
CAUTIONS AND EMERGENCY PROCEDURES

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 only 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:

	DSNAME	VOLUME
0	COSAT	your volume name (i.e., Qual, Flight 8, etc.)
1	CAL-AP	your volume name

LIST OF REFERENCES

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2. Launch and Ascent Operations, TRW Space and Technology Group, 1987.

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6. Comprehensive System Test Procedures, Part I, TRW Systems Group, 1986.