

ASTEC/ACAPE Program Descriptions





P. O. Box 1250, 150 Sparkman Drive Huntsville, Alabama 35807 205 / 837–4000

F11-68-122 July 15, 1968

TO:

Distribution

SUBJECT:

ASTEC/ACAPE Program Descriptions Document

MSFC No. III-4-463-1, IBM No. 67-F11-0010

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H. M. Harriman, Manager

Program Documentation

HMH/RQR/jt



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The attached subject document is a new release.

It cancels and replaces the following listed documents identified by title and number.

 Detailed Description Document for ASTEC Preflight Program, AS 206/501 and Subsequent

MSFC No. III-4-452-6 IBM No. 66-243-0016

 General Description Document for ASTEC Preflight Program, AS 206/501 and Subsequent

MSFC No. III-4-447-8 IBM No. 66-243-0015

- 3. General Description Document for ASTEC Flight Program, AS 208/504

 MSFC No. III-4-447-7 IBM No. 66-205-0019
- General Description Document for ACAPE, AS 208/504
 MSFC No. III-4-448-5 IBM No. 66-205-0018
- 5. LVDC/PTC Trace Program, Generalized Descriptions and Flow Charts
 IBM No. 65-205-0002 H

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ASTEC/ACAPE Program Descriptions

15 July 1968 Change 3

CLASSIFICATION AND CONTENT APPROVAL _

DATA MANAGER APPROVAL

PROGRAM OFFICE APPROVAL

Space Systems Center, Huntsville, Alabama

CHANGE HISTORY

	NO.	DATE	DESCRIPTION
	-	15 Sept 1967	Original Release
	1	15 Dec 1967	Incorporate Telemetry Test Routine per ECR ACUF-606.
			Incorporate changes in the LVDC Preflight Programs per ECR ACUG-609.
	2	15 May 1968	Incorporate textual error corrections in the ASTEC/ACAPE Program descriptions
			Incorporate Issue Spacecraft Control Discrete routine
			Incorporate PTC A Register switch options
			Update Appendix D
			Incorporate Appendix E
-	3	15 July 1968	Incorporate changes in the ASTEC/ACAPE Program descriptions due to LVDC Preflight Program changes
-			Update Appendix A
-			Update Appendix F
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ASTEC/ACAPE Program Descriptions

Change 3 Incorporation Instructions

The attached pages constitute Change 3 to the document; they are to be added to, or are to rereplace pages in, this specification. Changes to a page are noted by vertical bars in the margin next to the change.

The following table gives pages of this change to be removed together with the corresponding pages to be inserted.

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FRONTA	L MATTER
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Change History Page	Change History Page
List of Effective Pages	Incorporation Instructions
vi	vi
AS	TEC
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2-91 thru 2-98	2-91 thru 2-98
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A-121 thru A-146	A-121 thru A-146

NOTE

These instructions provide both a quick reference to document changes, and a means of checking receipt of all amendments. Please retain this page at the back of the document.

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SECTION 1

INTRODUCTION

1.1 ASTEC PREFLIGHT INTRODUCTION

The purpose of the ASTEC Preflight Program is to provide a means of verifying the proper operation of the LVDC Preflight Program and to provide the preflight programmer with a useful debug tool. The program, under operator control, simulates LVDC inputs, monitors LVDA outputs and documents the operation of the LVDC Preflight Program.

1.2 ASTEC FLIGHT PROGRAM INTRODUCTION

The purpose of the ASTEC Flight Program is to serve as a debug aid to the flight program. This is accomplished by simulating preflight and flight conditions, monitoring LVDC Flight Programs and documenting preselected parameters.

1.3 ASTEC CONFIGURATION

Refer to Figure 1-1 for a functional diagram of the ASTEC configuration.

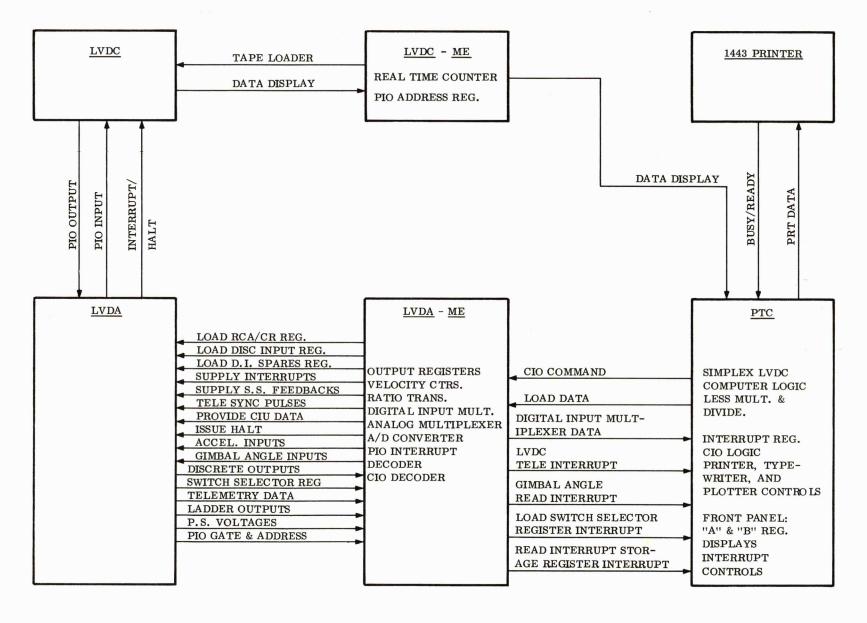


Figure 1-1. ASTEC Functional Diagram

SECTION 2

ASTEC PREFLIGHT PROGRAM

2.1 GENERAL DESCRIPTION

The ASTEC Preflight Program routines are divided into two categories; PTC Internal Routines and PTC Monitor Routines.

The PTC Internal Routines are all routines that will operate independently of the LVDA/LVDC (flight hardware). The purpose of these routines is to provide support functions to the Monitor Routines; such as, initializing registers and program constants, loading program tables, and documenting all results.

The PTC Monitor Routines are all routines that require the operation of the LVDA/LVDC (flight hardware). The purpose of these routines is to provide the capability of performing the necessary tests to insure that the LVDC Preflight Program is operating properly. These Monitor Routines shall perform the following functions:

- 1. Provide the required simulated inputs to the LVDA/LVDC:
 - a. The RCA-110A/Command Receiver Data.
 - b. Interrupt Signals.
 - c. Discrete Inputs.
 - d. Discrete Input Spares.
 - e. Switch Selector Feedback Signals.
 - f. RCA-110A Sync Pulse (a Discrete Input).
 - g. T and G Telemetry Sync Pulses.
 - h. HALT Signal.
 - i. Accelerometer Inputs.
 - j. Computer Interface Unit Data.
 - k. Gimbal Angle Inputs (Force Load the COD Serializer or Simulate resolvers by using Ratio Transformers).

ASTEC

- Accept the LVDC's telemetered outputs.
- 3. Obtain data from the LVDA's Discrete Output Register, Switch Selector Register, Ladders, and Data Output Multiplexer.
- 4. Make value judgements on all applicable LVDC/LVDA outputs.
- 5. Format and document the LVDC/LVDA outputs with all errors flagged for easy operator recognition. The documented information will consist of the following:
 - a. The name of the commanded routine.
 - b. The status of the LVDA's output registers before the commanded routine is entered and after the commanded routine is completed.
 - c. The simulated input data supplied the LVDA/DC.
 - d. The output data received from the LVDA/DC.
 - e. The correct output data expected from the LVDA/DC.

The operator will be provided the following program control capabilities to allow flexibility in the application of these routines.

- 1. Command a single routine with the "A" Register switches located on the PTC front panel.
- 2. Command any sequence of routines to be run automatically, by loading a sequence table with the "A" Register switches.
- 3. Load the simulated input data for any monitor routine. The "B" Register switches located on the PTC front panel will be used for the input data.
- 4. Command a recycle with the manual interrupt button. This interrupt may be used any time the operator wants to force the LVDC and/or PTC to their initialize routines without being required to drop all power and start from a power up condition.

The application of the PTC-ASTEC Preflight Routines determines how the operator shall utilize the control capabilities. Before the operator commands a routine or sequence of routines to be run, he must supply the simulated input data from the "B" Register switches. The operator must load all simulated input data before commanding the routine or routines.

The control capabilities furnished the operator will consist of the following:

- 1. Run a single routine with operator supplied simulated input data.
- 2. Run any sequence of routines with operator supplied simulated input data.

During the LVDC preflight checkout the PTC shall simulate the RCA-110A by sequentially commanding the LVDC into various routines. This simulation will consist of the following:

- 1. Loading the LVDA's RCA register.
- 2. Issuing the Sync signal to the LVDA's Discrete Input register.
- 3. Verifying that the commanded routine was entered.
- 4. Receiving the pertinent data that is telemetered from the commanded routine.
- 5. Processing telemetered error messages as the highest priority in the event the LVDC recognizes an error condition.

In addition, the following PIO's issued by the LVDC are decoded by the LVDA-ME and generate interrupts to the PTC:

- 1. Group 1 or 3 LVDC Telemetry.
- 2. Load the Switch Selector Register.
- 3. Selecting the Fine or Coarse Gimbal Angles.
- 4. Addressing the CIU in special cases.

2.2 SYSTEM POWER UP

The following procedure will be performed when power is initially applied to the ASTEC system:

- 1. Insure that the Preflight, Flight, and Orbital Programs are properly loaded in the LVDC memory.
- 2. Insure that the ASTEC Preflight Program is properly loaded in the PTC memory.

ASTEC

- 3. Set all PTC Interrupt Inhibits before allowing the program to operate. This is done, by manually depressing the Inhibit Control push button (the lamp will then light), to insure that an interrupt does not occur because of the interrupt being set.
- 4. Since it will be desirable that the interrupt be under program control, the operator will then reset the Inhibit Control push button previously set (the lamp will extinguish).
- 5. Place the PTC into Data Display Mode. The first program instruction will be to issue Halt to force the LVDA/DC to its power up location. This is done to insure that the PTC has complete control of the LVDC Power Up Routine. The HALT will be released when Monitor Power Up is commanded.
- 6. Place the LVDC-ME into Data Display Mode (the LVDC will not begin cycling since Halt has been applied).

2.3 PTC INTERNAL ROUTINES

2.3.1 PTC Sector Dump (Figure 2-1)

2.3.1.1 Purpose

Allow an operator the capability to verify that all 256 locations within a given sector contain the correct instructions and/or data.

2.3.1.2 Description

This routine shall be entered only from the PTC Mode Sort. It shall perform the following sequence of operations:

- 1. Issue the Sector Dump status code to the front panel Mode lights.
- 2. Read the Module, Sector start, and Sector end from the "B" register that the operator loaded indicating the sector or sectors to be dumped.
- 3. Print the Module and Sector Heading.
- 4. Load and Print an index and 8 sequential data locations.
- 5. Determine if the specified sector is completely dumped (printed), if it is not, return to step 4.
- 6. Determine if the operator specified another sector to be dumped, if he had return to step 3. When all specified sectors are dumped return to Mode Sort.

2.3.1.3 Operating Procedure

1. Using Register A, place switches 1-6 to PTC Sector Dump Mode Command 45.

S 1 2 3 4 5 6

A REG

X 1 0 0 1 0 1

MODE 45

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-8 up for Control Word Bits to be set:

S 1 2 3 4 5 6 7 8

B REG

MSSSSEEEE

CONTROL WORD

ASTEC

- 4. Operate sign switch of Register A up and down.
- 5. Review Output

NOTE: CONTROL WORD

- (M) Module of the sector(s) to be dumped
- (S) Starting Sector
- (E) Ending Sector

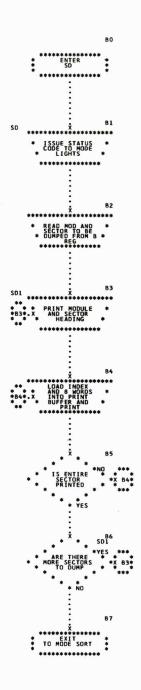


Figure 2-1. PTC Sector Dump

2.3.2 PTC Load-Run Sequence (Figure 2-2)

2.3.2.1 Purpose

Provide an operator the manual control capability to command any sequence of routines to be run automatically, by loading a sequence table with the "A" Register switches.

2.3.2.2 Description

This routine shall be entered only from the PTC Mode Sort Routine when under front panel control.

This routine shall perform the following sequence of operations:

- 1. Issue the Load-Run Sequence status code to the front panel Mode lights.
- 2. Print the messages; Load-Run Sequence and proper heading.
- 3. Allow the operator to load the first or next sequential commanded routine and the number of times that routine will be called.
- 4. Load the sequence table with the information supplied by the operator.
- 5. Document the information on the printer.
- 6. If the operator indicates that the desired sequence has been loaded, exit to Mode Sort. Otherwise return to step 3.

2.3.2.3 Operating Procedure

If data is required for any of the Routines to be run automatically, perform steps 1-7 until all data is loaded.

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command ##:

X M MM M M M O O O O O O O 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-25 up for bits to be set as required.

ASTEC

- 4. Operate sign switch of Register A up and down. If this Routine for which data is being loaded required more data, repeat steps 3-4.
- 5. Using Register A, place switch 13 OFF.
- 6. Operate sign switch of Register A up and down.
- 7. Repeat steps 1-6 for every Monitor Routine that requires data.
- 8. Using Register A, place switches 1-6 to Load Run Sequence Mode Command 26:

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 0

MODE 26

- 9. Operate sign switch of Register A up and down.
- 10. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command (##) of sequential routine to run automatically and in switches 7-12 insert the number of times that routine is to run in succession:

S 1 2 3 4 5 6 7 8 9 0 1 2 A REG

XMMMMMNNNNNN

MODE and COUNT

- 11. Using Register A, operate sign switch up and down.
- 12. Repeat steps 10-11 if continued loading sequence is desired.
- 13. Using Register A, place switch 13 OFF.
- 14. Operate sign switch of Register A up and down.

NOTE:

- (#) Octal value of routine data is to be loaded
- (M) Mode bits of desired routine
- (N) Number of times routine is to be repeated, minimum 1, maximum 64(10)

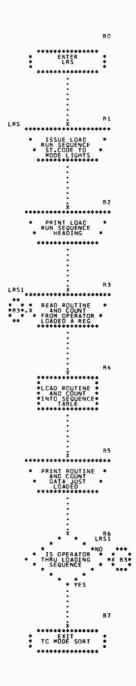


Figure 2-2. PTC Load-Run Sequence

2.3.3 PTC Initialize

2.3.3.1 Purpose

To reinitialize certain constants in the PTC ASTEC Preflight Program.

2.3.3.2 Description

This routine reinitializes special program constants used by the ASTEC Preflight Program. It is used as both a commanded routine and a subroutine.

2.3.3.3 Operating Procedure

1. Using Register A, switches 1-3, insert Mode Command 33 for PTC Initialize Routine.

S 1 2 3 4 5 6

A REG

X 0 1 1 0 1 1

SWITCHES ON

2. Operate sign switch of Register A up and down.

2.3.4 Read LVDA Power Supplies (Figure 2-3)

2.3.4.1 Purpose

Read and print the LVDA power supply voltages obtained through telemetry.

2.3.4.2 Description

This routine is both commanded as a PTC program and used as a subroutine. It is used as a subroutine to provide a record of the LVDA voltages in the Monitor Power Up Routine.

2.3.4.3 Operating Procedure

1. Using Register A, place switches 1-6 to Read Power Supplies Mode Command 34:

S 1 2 3 4 5 6

A REG

X 0 1 1 1 0 0

MODE 34

- 2. Operate sign Switch of Register A up and down.
- 3. Review Output Data.

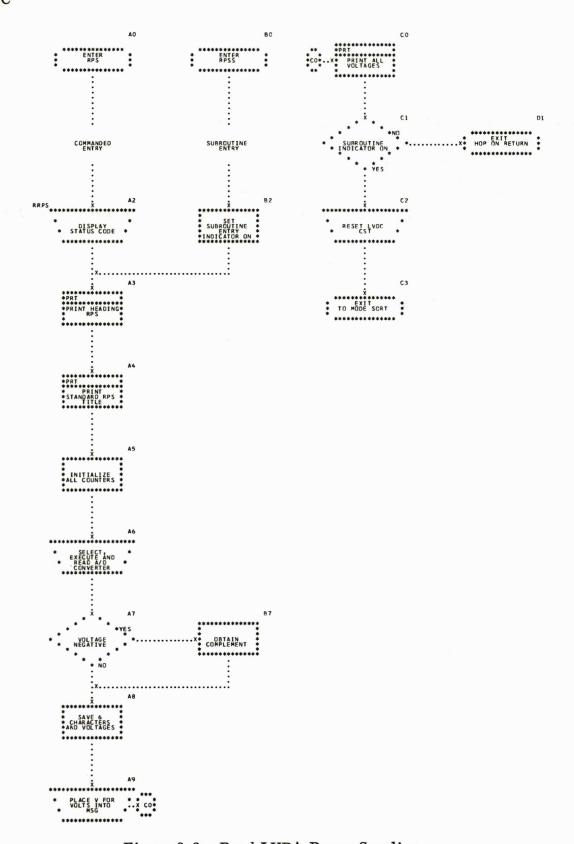


Figure 2-3. Read LVDA Power Supplies

2.3.5 PTC Power Up and Initialize (Figure 2-4)

2.3.5.1 Purpose

Perform the necessary one-time-only initialization after power has been applied to the PTC.

2.3.5.2 Description

This routine shall be automatically entered when the operator releases the Machine Reset. It shall perform the following sequence of operations:

- 1. Issue LVDC Halt to force the LVDC to its initial power up condition.
- 2. Initialize Input and Output registers, program constants, and indicators.
- 3. Select proper R. F. signal for COD simulation.
- 4. Initialize program constants for the Print operations.
- 5. Set up velocity counters for initial simulation.
- 6. Initialize special constants.
- 7. Indicate Power Up with a print message.
- 8. Exit to the Recycle and Initialize Routine.



Figure 2-4. PTC Power Up and Initialize

2.3.6 PTC Recycle and Initialize (Figure 2-5)

2.3.6.1 Purpose

Initialize certain PTC registers and program constants prior to executing any Internal or Monitor routines.

2.3.6.2 Description

This routine shall be entered only from the Power Up Initialize Routine or as a result of the manual controlled Interrupt 16. This interrupt is to be used in a situation where the operator desired to re-initialize registers and constants or as an exit from a program loop. This routine shall perform the following sequence of operations during Power Up.

- 1. Issue the Recycle status code to the PTC front panel Mode light.
- 2. Reset all PTC interrupts.
- 3. Inhibit all PTC interrupts except telemetry interrupt.
- 4. Reset the PTC Main Interrupt.
- 5. Initialize all program constants.
- 6. Initialize telemetry interrupt HOP constant.
- 7. Determine if the LVDC is in its Mode Sort Routine or at its power up location.
 - a. If it is in Mode Sort exit to the PTC Mode Sort Routine.
 - b. If it is not, issue the simulated RCA Interrupt, which forces the LVDC to its Forced Begin Routine. Exit to the Monitor Forced Begin Routine.

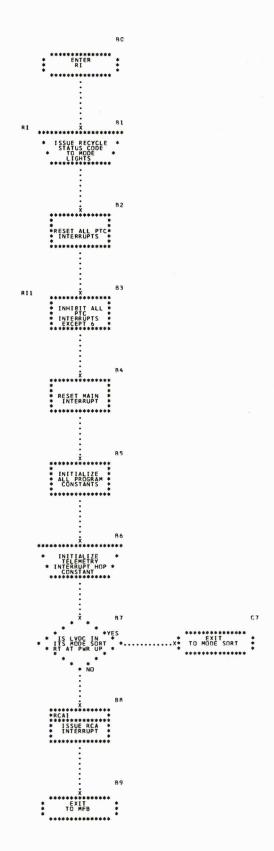


Figure 2-5. PTC Recycle and Initialize

2.3.7 PTC Mode Sort (Figure 2-6)

2.3.7.1 Purpose

Accept an input word from the operator and interpret it as a mode command indicating the desired routine to be executed.

2.3.7.2 Description

This routine shall be entered directly from the PTC Recycle and Initialize Routine, also, all routines that may be commanded from this routine. This routine shall perform the following sequence of operations:

- 1. Issue the Mode Sort status code to the PTC front panel Mode lights.
- 2. Eject Printer page if desired.
- 3. Print message "In PTC Mode Sort".
- 4. Obtain the next routine to be commanded, from the Sequence Table if it had previously been loaded by the operator. Bypass Steps 5 and 6 if the table is used.
- 5. This routine will be in a programmed loop, until the operator supplies the next commanded routine with the "A" Register switches located on the PTC front panel and will exit the loop only upon the operator's control.
- 6. Exit to the Load Data Sequence Routine if commanded by the PTC operator.
- 7. Interpret the "A" Register or table contents to obtain the correct entrance location of the commanded routine.
- 8. If an Internal Routine is commanded, exit directly to that routine.
- 9. Check to see if LVDC is in Mode Sort before commanding next routine to be executed.
- 10. If a monitor routine is commanded, obtain from a table the correct simulated fourteen (14) bit RCA-110A Mode Command word.
- 11. Supply the Mode Command word to the LVDA.
- 12. Record the present values of the Output registers in the LVDA. This will be documented later in the Monitor Routine.
- 13. Exit to the Commanded Monitor routine.

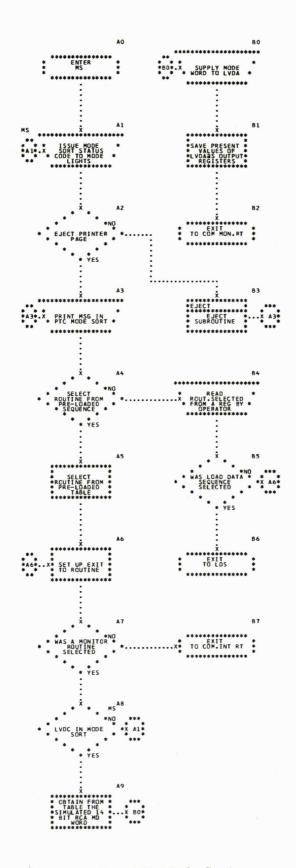


Figure 2-6. PTC Mode Sort

2.3.8 PTC Load Data Sequence (Figure 2-7)

2.3.8.1 Purpose

Allow an operator manual capability to supply the simulated RCA-110A data words that are required inputs for certain preflight routines.

2.3.8.2 Description

This routine shall be entered from the PTC Mode Sort Routine when under operator control. The following sequence of operations shall be performed:

- 1. Issue the Load Data Sequence status code to the PTC front panel Mode lights.
- 2. Print the messages; Load Data Sequence and the Heading.
- 3. Obtain the routine, from the "A" register, whose data block is to be loaded.
- 4. Determine if the operator may be permitted to load data. Certain routines do not require input data, consequently data blocks will not be provided. Also an operator must not be allowed to load more data than what the associated block will hold. If this is the case, print an appropriate message and return to Mode Sort.
- 5. If the data can be loaded, obtain it from the "B" Register and load it into the next available block location.
- 6. Document the data and the location in the PTC where it was loaded on the printer.
- 7. If the operator indicated that the desired block has been completely loaded, return to PTC Mode Sort, otherwise return to step 4 to obtain the next data.

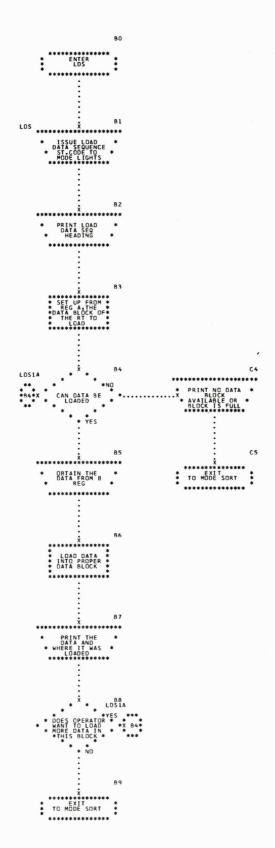


Figure 2-7. PTC Load Data Sequence

2.3.9 PTC Interrupt 16 (Figure 2-8)

2.3.9.1 Purpose

Used to reinitialize registers and program constants or as an exit from a program loop.

2.3.9.2 Description

This routine is entered as a result of the operator depressing the PTC Manual Interrupt 16 push-button on the PTC Display Panel. It performs the following sequence of operation:

- 1. Displays the Recycle status code to the front panel Mode lights.
- 2. Prints contents of the accumulator.
- 3. Converts and prints the HOP constant of the location it was entered from.
- 4. Prints all stored data and the values of all the registers.

Exit is on the HOP return or to the Recycle and Initialize Routine.

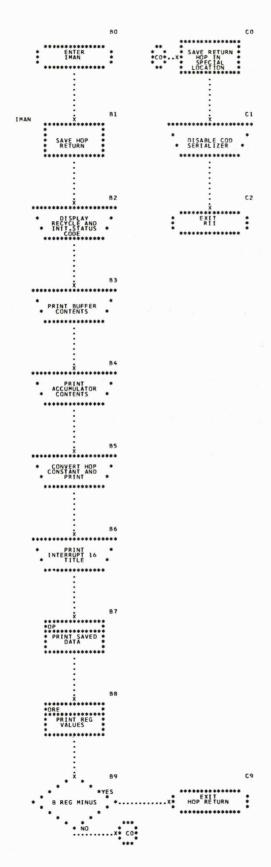


Figure 2-8. PTC Interrupt 16

2.3.10 Read Sequence Table (Figure 2-9)

2.3.10.1 Purpose

Increments through a sequence table of routines to determine what routine is to be run.

2.3.10.2 Description

This routine can be used to increment through an operator controlled sequence table or through a prestored sequence table as a function of the Automatic Sequence Routine. It supplies the status code of the next commanded routine to the Mode Sort Routine from the appropriate sequence table. Exit is to the Mode Sort Routine.

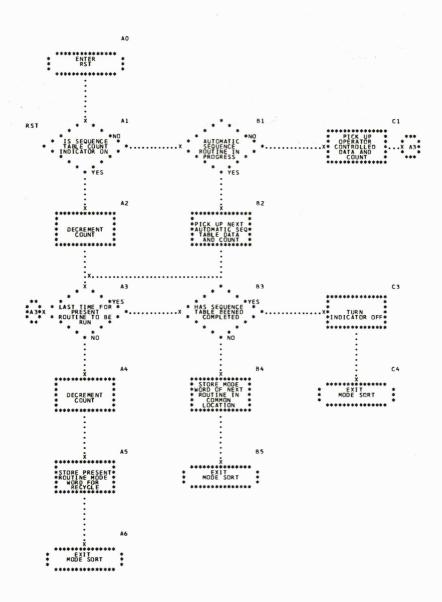


Figure 2-9. Read Sequence Table

2.4 PTC MONITOR ROUTINES

2.4.1 Monitor Power Up (Figure 2-10)

2.4.1.1 Purpose

Provide the operator with a record of the LVDA/DC duplex power supply voltages and a record of the COD error word.

2.4.1.2 Description

This routine shall be entered from PTC Mode Sort when the operator desired the LVDC Programs to operate or at anytime he wants to restart the LVDA/DC at its power up condition. This routine shall perform the following sequence of operations:

- 1. Issue Halt to the LVDA/DC, thus assuring that the LVDA/DC is at its power up condition and the LVDC is not operating any instructions.
- 2. Issue the Monitor Power Up status code to the front panel Mode lights.
- 3. Print the message; Monitor Power Up.
- 4. Read, verify and print the LVDA/DC Duplex power supplies, indicating any voltages that are not within their specified tolerances.
- 5. Test the G&C Steering Flag. If set, execute Steps 8, 9, 6, 12, and 13 in specified order.
- 6. Reset Halt to allow the LVDA/DC to begin operating.
- 7. Set LVDC CST.
- 8. Inhibit all Interrupts except Interrupt 6.
- 9. Obtain output registers initial values.
- 10. Issue four T and G Syncs to clear DOM.
- 11. Reset LVDC CST.
- 12. Read the PIO Address in the LVDA/ME until the COD error word is received. If the COD error word is not received after a small delay exit to Step 1. If error word is received, document the word on the printer.
- 13. Exit to the Monitor Forced Begin Routine.

2.4.1.3 Operating Procedure

1. Using Register A switches 1-6 insert mode command 27

- 2. Operate sign of Register A up and down to initiate program.
- 3. Review output data.

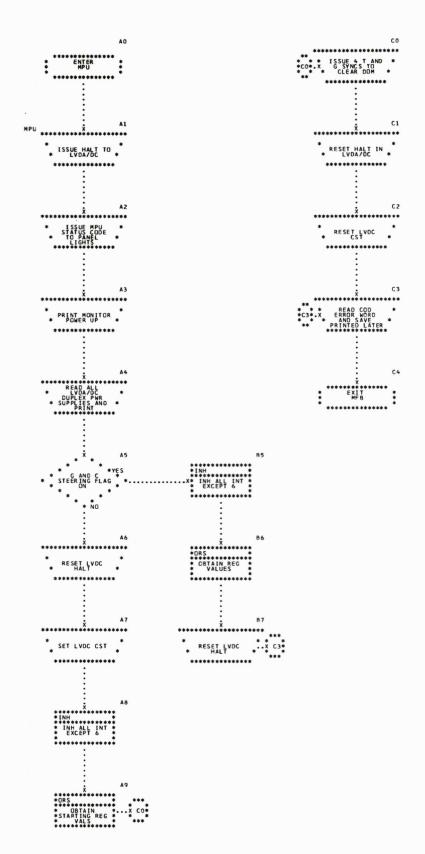


Figure 2-10. Monitor Power Up

2.4.2 Monitor Forced Begin (Figure 2-11)

2.4.2.1 Purpose

Monitor the Forced Begin Routine for proper Operation.

2.4.2.2 Description

This routine shall be entered only from Monitor Power Up or any routine that issues the RCA interrupt to the LVDA/LVDC. This routine shall perform the following sequence of operations.

- 1. Execute Eject Subroutine to eject printer page and print page numbers in Automatic Sequence.
- 2. Set Output Registers to zero.
- 3. Issue the Monitor Forced Begin status code to the front panel Mode light.
- 4. Print Monitor Forced Begin title.
- 5. Delay until the LVDC routine is in a loop waiting for the sync input discrete.
- 6. Print all data in the output storage block.
- 7. Read and print output register starting and ending values.
- 8. Set up accelerometer simulation using the Accelerometer Rate Generate Subroutine.
- 9. Remove the Gimbal Angle Serializer control.
- 10. Turn Sync on and then off allowing the LVDC to continue into its Mode Sort Routine.
- 11. Exit to PTC Mode Sort.

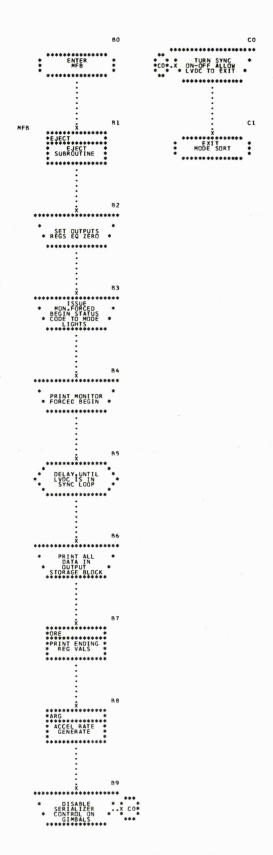


Figure 2-11. Monitor Forced Begin

2.4.3 Monitor Accelerometer Pulse Count (Figure 2-12)

2.4.3.1 Purpose

To monitor the Pulse Count Routine in the LVDC Preflight Program for proper operation.

2.4.3.2 Description

This routine will provide simulated accelerometer inputs and the required RCA data words as specified by the Preflight Routine. The RCA data word will specify the accelerometer's to be investigated and the required count accumulations. Using the simulated inputs rates and counts, the delta time's and delta count's received from the LVDC will be documented. The routine has one option that will decrease the accelerometer rate factor by 30.

This routine should be run under each of the following conditions, which can be combined:

- 1. Specify starting and stopping the first, second, and then the third accelerometer on crossover.
- 2. Specify (DR, VT, CR), (DR, CR, VT), (VT, CR, DR), (VT, DR, CR), (CR, DR, VT), and (CR, VT, DR) as the sequence of investigation.
- 3. Specify a large delta count to be accumulated with a large positive accelerometer rate.
- 4. Specify a nominal delta count to be accumulated with a nominal negative accelerometer rate.
- 5. Specify a nominal delta count to be accumulated with a small positive accelerometer rate.

The documented output will include:

- 1. Simulated accelerometer input rates.
- 2. RCA input data words.
- 3. Calculated count value, flagged if in error.
- 4. Telemetry.

2.4.3.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 02 (8):

S 1 2 3 4 5 6 7 8 9 0 1 2 3 A REG

X 0 0 0 0 1 0 0 0 0 0 0 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-13 up for bits to be set:

- 4. Operate sign switch of Register A up and down.
- 5. Using Register B, place switches S-13 up for bits to be set:

- 6. Operate sign switch of Register A up and down.
- 7. Using Register B, place switches S-13 up for bits to be set:

- 8. Operate sign switch of Register A up and down.
- 9. Using Register A, place switch 13 OFF.
- 10. Operate sign switch of Register A up and down.
- 11. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 75 (8):

S 1 2 3 4 5 6 7 8 9 0 1 2 3 A REG

X 1 1 1 1 0 1 0 0 0 0 0 1 SWITCHES ON

- 12. Operate sign switch of Register A up and down.
- 13. Using Register B, place switches S-25 up for bits to be set; DR RATE

1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 S 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

- 14. Operate sign switch of Register A up and down.
- 15. Using Register B, place switches S-25 up for bits to be set; VT RATE

- 16. Operate sign switch of Register A up and down.
- 17. Using Register B, place switches S-25 up for bits to be set; CR RATE

S 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

- 18. Operate sign switch of Register A up and down.
- 19. Using Register A, place switch 13 OFF.
- 20. Operate sign switch of Register A up and down.

If the LVDC is already in its Mode Sort Routine, steps 21-22 may be omitted.

21. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

22. Operate sign switch of Register A up and down.

If the special slow accelerometer rate option is to be used, steps 23-24 may be omitted.

23. Using Register A, place switches 1-6 to Monitor Pulse Count Mode Command 02:

S 1 2 3 4 5 6

A REG

0 0 0 0 0 1 0

MODE 02

24. Operate sign switch of Register A up and down.

Omit steps 25-26.

25. Using Register A, place switches 1-6 to Monitor Pulse Count Mode Command 75 (8):

S 1 2 3 4 5 6

A REG

0 1 1 1 1 0 1

MODE 75

- 26. Operate sign switch of Register A up and down.
- 27. Review Output Data.

NOTE: CONTROL WORDS

- (W) is used to specify which accelerometer will be started and stopped on crossovers.
- (A) is used to specify which is the first accelerometer to be investigated.
- (B) is used to specify which is the second accelerometer to be investigated.
- (C) is used to specify which is the third accelerometer to be investigated.
- (L) is used to specify the delta count to be accumulated. (Low order of a 24-bit word.)
- (H) is the high order bits of the delta count word.

NOTE: SIMULATION WORDS

(+) is the sign of the rate word, 0 is positive and 1 is negative.

- (X) is the value that is decremented by 1 every machine cycle when it reaches zero it will generate 1 DR accelerometer pulse and repeat itself.
- (Y) same as (X) for the VT accelerometer.
- (Z) same as (X) for the CR accelerometer.
- (x) same as (X) except it is the high order bits used with X to permit a very slow rate. Used only with the special slow rate option where the decrement occurs every 30 machine instructions.
- (y) same as (x) for the VT accelerometer.
- (z) same as (x) for the CR accelerometer.

DR = Downrange

VT = Vertical

CR = Crossrange

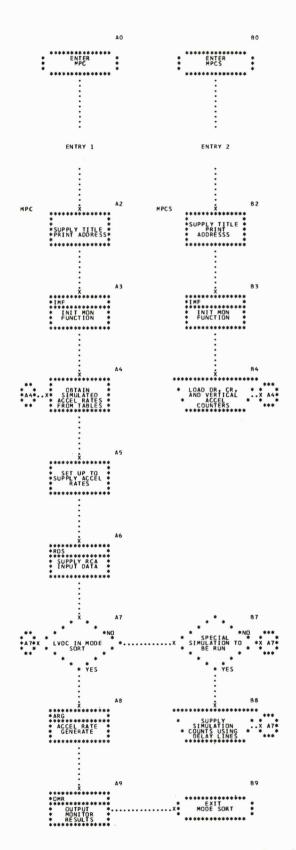


Figure 2-12. Monitor Accelerometer Pulse Count

2.4.4 Monitor Accelerometer Monitor (Figure 2-13)

2.4.4.1 Purpose

To monitor the telemetered accelerometer monitor word from the LVDC Preflight Accelerometer Monitor Routine.

2.4.4.2 Description

This routine monitors the LVDC Accelerometer Monitor Routine by monitoring the telemeter accelerometer word that is sent out on every pass through Preflight Mode Sort.

Output consists of:

- 1. All saved data
- 2. Status codes
- 3. RCA input data
- 4. Register status

Return to Mode Sort.

2.4.4.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

A 1 2 3 4 5 6 A REG

X 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Monitor Accelerometer Monitor Mode Command 46.

S 1 2 3 4 5 6 A REG

X 1 0 0 1 1 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

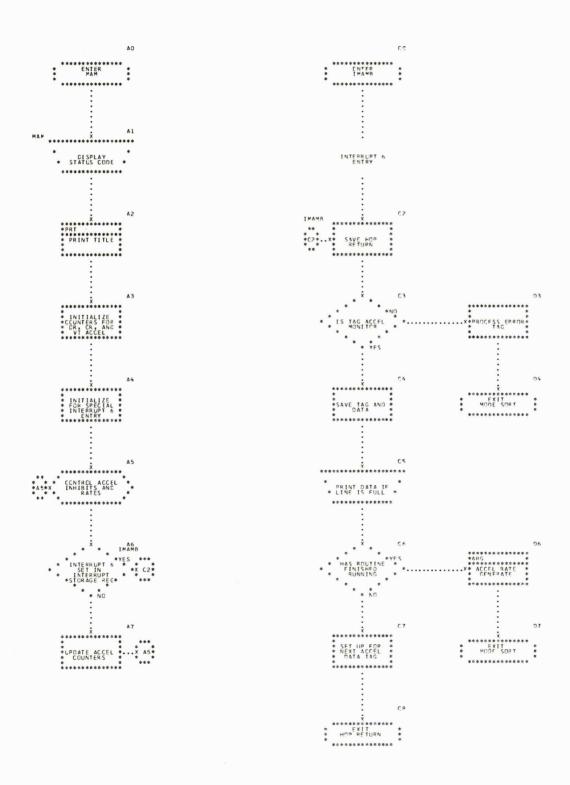


Figure 2-13. Monitor Accelerometer Monitor

2.4.5 Monitor Gimbal Angle Monitor (Figure 2-14)

2.4.5.1 Purpose

Monitor the LVDC Gimbal Angle Monitor Preflight Routine for proper operation.

2.4.5.2 Description

This routine will allow the Gimbal Angle Read Interrupt Routine to provide, under operator control, ratio transformer or cross over detector (COD) counter inputs. The ratio transformer inputs will supply simulated resolver inputs to the COD's. The direct serialized COD counter inputs will provide a means to check the calculations of the Resolver Sine Routine, which is a subroutine called by the Gimbal Angle Monitor Routine. A means to force COD values outside the tolerance range to check the error path in the Gimbal Angle Monitor Routine will be provided.

The required RCA data word will be supplied to indicate fine, coarse or backup gimbal angle reads, with or without corrections, as specified by the LVDC Preflight Routine. The three input specifications, Ratio Transformer, COD and RCA data words will be supplied through Load Data Sequence prior to entering this monitor routine or from a prestored table.

The documented output will include:

- 1. Ratio Transformer and COD simulated input values.
- 2. RCA input data word.
- 3. Telemetry.

This routine should be run using the COD Counter inputs with all gimbal angles specified in the uncorrected condition, and also run with the operator controlled sim. input for all gimbal angles in the corrected condition.

2.4.5.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 03 (8):

 $\begin{smallmatrix}&&&1&1&1&1\\S&1&2&3&4&5&6&7&8&9&0&1&2&3\end{smallmatrix}$

A REG

X 0 0 0 0 1 1 0 0 0 0 0 0 1

SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-13 up for bits to be set:

1 1 1 1 S 1 2 3 4 5 6 7 8 9 0 1 2 3 O U C C C F F F B B B O O O B REG

CONTROL WORD

- 4. Operate sign switch of Register A up and down.
- 5. Using Register A, place switch 13 OFF.
- 6. Operate sign switch of Register A up and down.

If the COD input mode is used, steps 7-18 are to be omitted.

7. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 74 (8):

A REG

SWITCHES ON

- 8. Operate sign switch of Register A up and down.
- 9. Using Register B, place switches 15-25 up for bits to be set as simulated COD counter:

1 1 1 1 1 2 2 2 2 2 2 2 5 6 7 8 9 0 1 2 3 4 5 X X X X X X X X X X X

B REG

SIM DATA WORD

- 10. Operate sign switch of Register A up and down.
- 11. Steps 7 10 must be repeated eight more times to load sim. value for C2, C3, F1, F2, F3, and B(1, 2, 3), regardless of what was loaded for the control word.
- 12. Using Register A, place switch 13 OFF.
- 13. Operate sign switch of Register A up and down.

If the LVDC is already in its Mode Sort Routine, steps 14-15 may be omitted.

14. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 15. Operate sim. switch of Register A up and down.
- 16. Using Register A, place switches 1-6 to Monitor Gimbal Angle Mode Command 03 (8):

S 1 2 3 4 5 6

A REG

0 0 0 0 0 1 1

MODE 03

- 17. Operate sign switch of Register A up and down.
- 18. Bypass steps 19-22.

If the LVDC is already in its Mode Sort Routine, steps 19-20 may be omitted.

19. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 20. Operate sign switch of Register A up and down.
- 21. Using Register A, place switches 1-6 to Monitor Gimbal Angle COD Mode Command 74 (8):

S 1 2 3 4 5 6

A REG

0 1 1 1 1 0 0

MODE 74

22. Operate sign switch of Register A up and down.

23. Review Output Data.

NOTE: CONTROL WORD

- (U) If a 1, it is for uncorrected output.
- (C) Coarse 1, 2, or 3 Gimbal Angle request.
- (F) Fine 1, 2, or 3 Gimbal Angle request.
- (B) Backup 1, 2, or 3 Gimbal Angle request.

NOTE: SIM WORD

(X) is bits to represent desired COD word, which will be automatically duplexed.

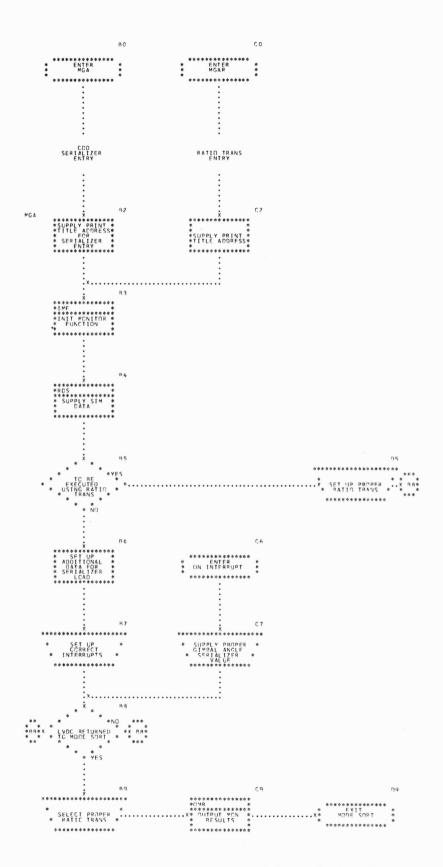


Figure 2-14. Monitor Gimbal Angle Monitor

2.4.6 Monitor Discrete Input (Figure 2-15)

2.4.6.1 Purpose

To monitor the LVDC Discrete Input Routine for proper operation.

2.4.6.2 Description

This routine will allow, under operator control, the capability of setting the Discrete Inputs, Discrete Input Spares, and Interrupts for the LVDC Routine.

This routine will reset all Discrete Inputs, Discrete Input Spares, and Interrupts as the conditions for the first pass through the LVDC Routine, then use the operator conditions for the second pass, which should be all possible Discrete Inputs, Discrete Input Spares, and Interrupts set.

The documented output will include:

- 1. Simulated discrete input data.
- 2. All telemetered data.

2.4.6.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 compliment Mode Command 73 (8):

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-23 up for DIN bits to be set:

4. Operate sign switch of Register A up and down.

5. Using Register B, place switches S-7 up for DIS bits to be set:

S 1 2 3 4 5 6 7

B REG

8 7 6 5 4 3 2 1

DIS

- 6. Operate sign switch of Register A up and down.
- 7. Using Register B, place switches S-11 up for IR bits to be set:

1 1 S 1 2 3 4 5 6 7 8 9 0 1 B REG 1 X X 0 X 8 7 6 5 4 X 2 1 IR

- 8. Operate sign switch of Register A up and down.
- 9. Using Register A, place switch 13 OFF.
- 10. Operate sign switch of Register A up and down.
- 11. Using Register A, place switches 1-6 to Monitor Discrete Input Mode Command 04:

S 1 2 3 4 5 6

A REG

X 0 0 0 1 0 0

MODE 04

- 12. Operate sign switch of Register A up and down.
- 13. Review Output Data

NOTE: (X) The operator does not have control of the bits indicated with an X for DIN or IR.

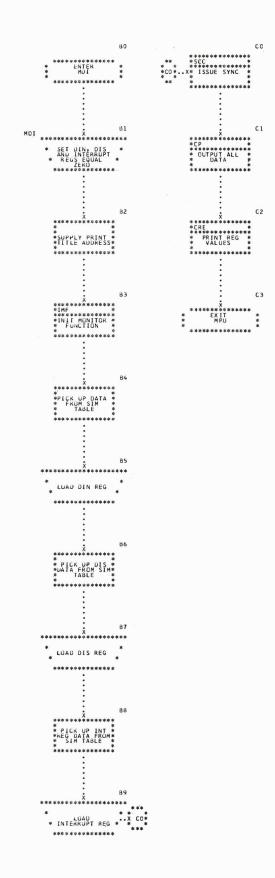


Figure 2-15. Monitor Discrete Input

2.4.7 Monitor Discrete Output (Figure 2-16)

2.4.7.1 Purpose

To monitor the LVDC Discrete Output Preflight Routine for proper operation.

2.4.7.2 Description

This routine will supply the required RCA data word. The data word will indicate the discretes to set or reset as specified by the Preflight Routines.

This routine shall be used twice, once with all discretes commanded on and once with all discretes commanded off, in that sequence.

The documented output will include:

- 1. Input data word.
- 2. Discrete output register contents.
- 3. Telemetry.

2.4.7.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 05 (8):

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switch S-13 up for bits to be set:

4. Operate sign switch of Register A up and down.

- 5. Using Register A, place switch 13 OFF.
- 6. Operate sign switch of Register A up and down.

If the LVDC is already in its Mode Sort Routine, steps 7-8 may be omitted.

7. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 8. Operate sign switch of Register A up and down.
- 9. Using Register A, place switches 1-6 to Monitor Discrete Output Mode Command 05 (8):

S 1 2 3 4 5 6

A REG

0 0 0 0 1 0 1

MODE 05

- 10. Operate sign switch of Register A up and down.
- 11. Review Output Data.

NOTE: CONTROL WORD

- (X) = Must be zero, operator does not have control of DO1.
- (R) = Bit used to control set or reset of the associated discrete bits on. A 1 is the set condition.

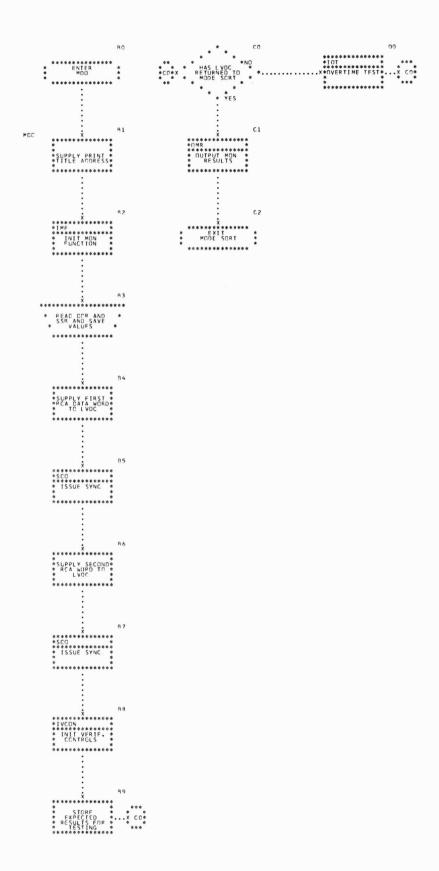


Figure 2-16. Monitor Discrete Output

2.4.8 Monitor DOM Test (Figure 2-17)

2.4.8.1 Purpose

Monitor the LVDC DOM Test Routine for proper operation.

2.4.8.2 Description

This routine will read and check the expected sequence of PIO's from the DOM. All DOM output will be recorded and documented. There is no input required.

The documented output will include:

- 1. DOM data.
- 2. RCA input data.
- 3. Telemetry.

2.4.8.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Mode Command 07 for Monitor Data Output Multiplexer Test

S 1 2 3 4 5 6 A REG

X 0 0 0 1 1 1 SWITCHES ON

- 4. Operate sign switch of A Register up and down.
- 5. Review Output Results.

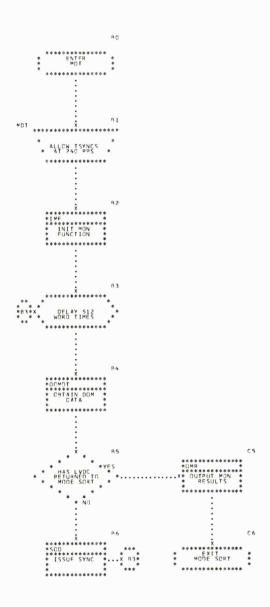


Figure 2-17. Monitor DOM Test

2.4.9 Monitor Ladder Error Test (Figure 2-18)

2.4.9.1 Purpose

Monitor the LVDC Preflight Ladder Error Test Routine for proper operation.

2.4.9.2 Description

This routine supplies the necessary RCA mode word to the LVDC Preflight Ladder Error Test Routine. It also records and documents all ladder output values, including those in error.

2.4.9.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 10 for Monitor Ladder Error Test.

S 1 2 3 4 5 6

A REG

X 0 0 1 0 0 0

SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

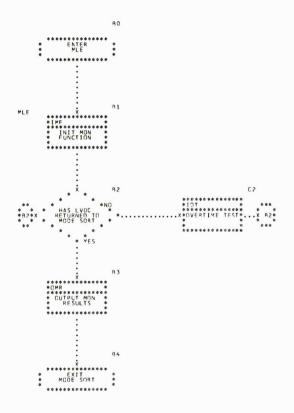


Figure 2-18. Monitor Ladder Error Test

2.4.10 Monitor Exercise Attitude Command Test 1 (Figure 2-19)

2.4.10.1 Purpose

To monitor Mode 1 of the LVDC Preflight Exercise Attitude Command Test for proper operation.

2.4.10.2 Description

Test 1 allows the proper operation of Mode 1 of the Preflight Exercise Attitude Command Test. This mode allows automatic execution of the ladder profiles. The Ladder Profiles must be monitored by means of an external recorder.

2.4.10.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1

SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 13 for Monitor Exercise Attitude Command Test 1.

S 1 2 3 4 5 6

A REG

X 0 0 1 0 1 1

SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

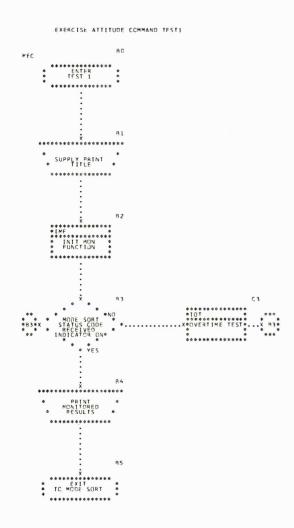


Figure 2-19. Monitor Exercise Attitude Command Test 1

2.4.11 Monitor Exercise Attitude Command Test 2 (Figure 2-20)

2.4.11.1 Purpose

To monitor Mode 2 of the LVDC Preflight Exercise Attitude Command Test for proper operation.

2.4.11.2 Description

Test 2 allows the proper operation of Mode 2 of the Preflight Exercise Attitude Command Test. This mode provides for operator controlled simultaneous ladder profiles. The Ladder Profiles must be monitored by means of an external recorder.

2.4.11.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Monitor Exercise Attitude Command Test 2 Mode Command 17.

S 1 2 3 4 5 6 A REG

X 0 0 1 1 1 1 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. At this point, the operator has two options that he may exercise.
 - a. Drive ladders 1 step (pulse) at a time by operating switch 15 of Register A up and down.
 - b. Change directions by operating switch 16 of Register A up and down.

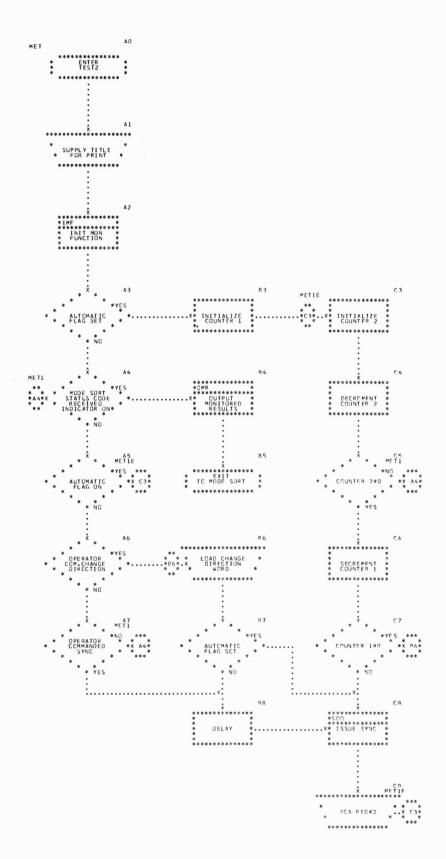


Figure 2-20. Monitor Exercise Attitude Command Test 2

2.4.12 Monitor Computer Interface Unit Read (Figure 2-21)

2.4.12.1 Purpose

To verify the proper operation of the LVDC Preflight CIU Routine.

2.4.12.2 Description

This routine will supply the required RCA input data word necessary to run the LVDC Preflight CIU Routine. This data word will indicate the CIU Address as specified by the LVDC Preflight Routine. Upon request, the PTC Program will issue the necessary CIU Interrupt to allow the LVDC to read a simulated data input word.

A special interrupt PIO 042 card must be supplied on interrupt line 11 in the Adapt IO.

The documented output will include:

- 1. Telemetry.
- 2. Status Code.
- 3. Register contents.

2.4.12.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switch 13 ON. Insert Mode Command 14 into switches 1-6 for Monitor CIU Read.

1 1 1 1 S 1 2 3 4 5 6 7 8 9 0 1 2 3

A REG

X 0 0 1 1 0 0 0 0 0 0 0 0 1

SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Using Register B, place bits 1-12 up for CIU Address data.

 $\begin{smallmatrix}&&&1&1&1&1\\S&1&2&3&4&5&6&7&8&9&0&1&2&3\end{smallmatrix}$

B REG

O A A A A A A A A A A A O

ADDRESS BITS

- 6. Operate sign switch of Register A up and down.
- 7. Using Register A, place switch 13 OFF.
- 8. Operate sign switch of Register A up and down.
- 9. Review Output Data.

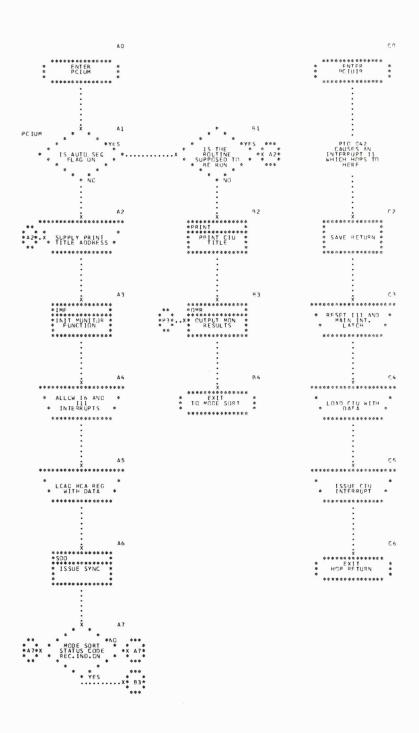


Figure 2-21. Monitor CIU Read

2.4.13 Monitor Switch Selector (Figure 2-22)

2.4.13.1 Purpose

Monitor the LVDC Preflight Switch Selector Routine for proper operation.

2.4.13.2 Description

This routine performs the necessary feedback operation necessary to monitor the Preflight Switch Selector Routine. It supplies the two RCA input words necessary for correct monitoring. A record of the Switch Selector Register and Feedback Register and associated time of each is kept and recorded. Return is to Mode Sort.

Documented output consists of:

- 1. Input data to LVDC.
- 2. Conditions of switch selector and feedback registers, and the time of each.

2.4.13.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 15 for Monitor Switch Selector.

1 1 1 1 S 1 2 3 4 5 6 7 8 9 0 1 2 3

A REG

X 0 0 1 1 0 1 0 0 0 0 0 0 1

SWITCHES ON

4. Operate sign switch of Register A up and down.

5. Using Register B, place switches S-13 up for desired 1st Control Word.

 $\begin{smallmatrix}&&&1&1&1&1\\S&1&2&3&4&5&6&7&8&9&0&1&2&3\end{smallmatrix}$

B REG

OSSSSAAAAAAAA

SWITCHES

- 6. Operate sign switch of Register A up and down.
- 7. Using Register B, place switches S-13 up for desired 2nd Control Word.

 $\begin{smallmatrix}&&&1&1&1&1\\S&1&2&3&4&5&6&7&8&9&0&1&2&3\end{smallmatrix}$

B REG

O X Y C Z O O O O O O O O

SWITCHES

- 8. Operate sign switch of Register A up and down.
- 9. Place switch 13 of Register A OFF.
- 10. Operate sign switch of Register A up and down.
- 11. Review Output Data.

CONTROL WORDS

- (S) Stage Bits
- (A) Address Bits
- X = 1 CIU Present
- Y = 1 SS Relay Present
- C = 1 Select Channel A
- Z = 1 Read Desired
- X = 0 CIU Not Present
- Y = 0 SS Relay Not Present
- C = 0 Select Channel B
- Z = 0 Read Not Desired

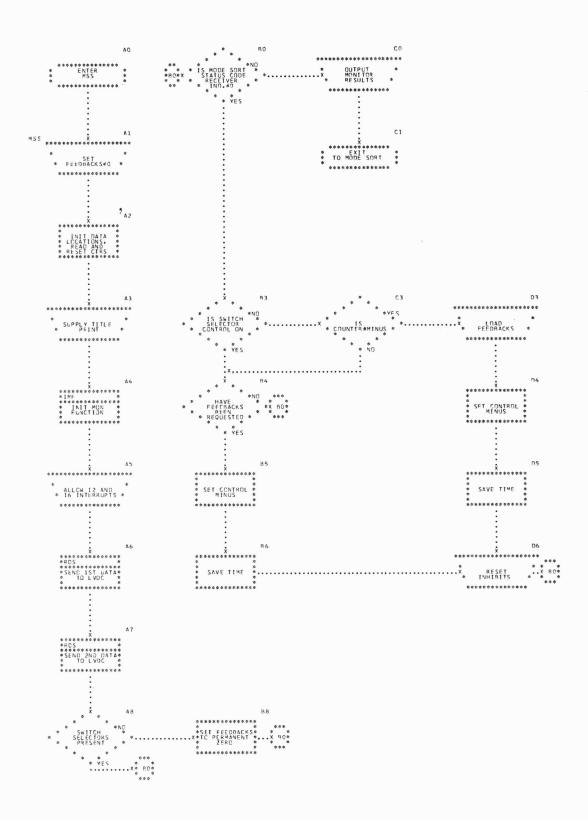


Figure 2-22. Monitor Switch Selector

2.4.14 Monitor Minor Loop, Switch Selector, and Real Time Counter Test (Figure 2-23)

2.4.14.1 Purpose

Monitor the Minor Loop, Switch Selector, and Real Time Counter Test for proper operation.

2.4.14.2 Description

This routine will be looking for error messages telemetered from the LVDC routine to indicate a failure condition.

The documented output is:

- 1. Status Code.
- 2. Telemetered error messages.

2.4.14.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Monitor Minor Loop, Switch Selector, and Real Time Counter Mode Command 24:

S 1 2 3 4 5 6 A REG

X 0 1 0 1 0 0 MODE 24

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

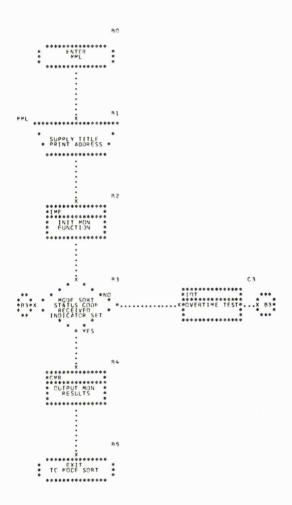


Figure 2-23. Monitor ML, SS, and RT Counter Test

2.4.15 Monitor Sector Sum Check (Figure 2-24)

2.4.15.1 Purpose

To monitor the LVDC Sector Sum Check Preflight Routine for proper operation.

2.4.15.2 Description

This routine will supply the required RCA data word. This word will indicate the sector or sectors to be sum checked in the format required by the LVDC Preflight Routine. The failure branch in the LVDC Routine may be entered by commanding a sector that cannot be sum checked.

The documented output will include:

- 1. The input RCA data word.
- 2. Status Code.
- 3. Telemetry.
- 4. Register status.

2.4.15.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 16 (8):

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-13 up for bits to be set:

B REG

OEEESSSSMMMOO

CONTROL WORD

- 4. Operate sign switch of Register A up and down.
- 5. Using Register A, place switch 13 OFF.

6. Operate sign switch of Register A up and down.

If the LVDC is already in its Mode Sort Routine, steps 7-8 may be omitted.

7. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 8. Operate sign switch of Register A up and down.
- 9. Using Register A, place switches 1-6 to Monitor Sector Sum Check Command 16 (8):

S 1 2 3 4 5 6

A REG

0 0 0 1 1 1 0

MODE 16

- 10. Operate sign switch of Register A up and down.
- 11. Review Output Data.

NOTE: CONTROL WORD

E = Ending Sector to be sum checked

S = Starting Sector to be sum checked

M = Module where the sector/sectors are located

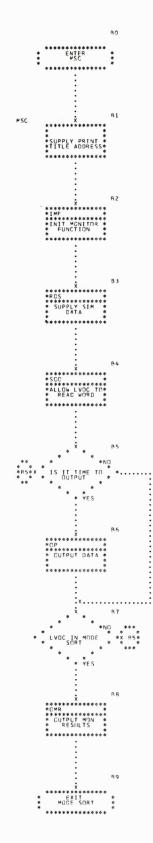


Figure 2-24. Monitor Sector Sum Check

2.4.16 Monitor LVDC Sector Dump (Figure 2-25)

2.4.16.1 Purpose

To monitor the LVDC Sector Dump Routine for proper operation.

2.4.16.2 Description

This routine will supply the required simulated RCA data word from an operator loaded table. This word will indicate the sector or sectors to be dumped in the format required by the LVDC Sector Dump Routine. The telemetered tag associated with the data being dumped will not appear in the printed output, but the proper sequential counting of this tag will be verified.

The documented output will include:

- 1. The RCA input data word.
- 2. Status Code.
- 3. The sector data being dumped.

2.4.16.3 Operating Procedure

1. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 20 (8):

- 2. Operate sign switch of Register A up and down.
- 3. Using Register B, place switches S-13 up for bits to be set:

$$\begin{smallmatrix}&&&1&1&1&1\\S&1&2&3&4&5&6&7&8&9&0&1&2&3\end{smallmatrix}$$

B REG

OEEESSSSMMMOO

CONTROL WORD

- 4. Operate sign switch of Register A up and down.
- 5. Using Register A, place switch 13 OFF.

6. Operate sign switch of Register A up and down.

If the LVDC is already in its Mode Sort Routine, steps 7-8 may be omitted.

7. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 8. Operate sign switch of Register A up and down.
- 9. Using Register A, place switches 1-6 to Monitor Sector Dump Mode Command 20 (8):

S 1 2 3 4 5 6

A REG

0 0 1 0 0 0 0

MODE 20

- 10. Operate sign switch of Register A up and down.
- 11. Review Output Data.

NOTE: CONTROL WORD

E = Ending Sector to be dumped

S = Starting Sector to be dumped

M = Module where the sector/sectors are located

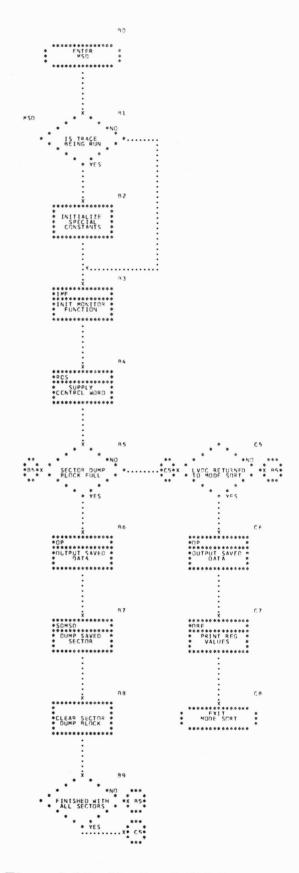


Figure 2-25. Monitor LVDC Sector Dump

2.4.17 Monitor Verify and Prepare to Load Error Test (Figure 2-26)

2.4.17.1 Purpose

To check out the error branches of the LVDC Preflight Verify and Prepare to Load Routine.

2.4.17.2 Description

This routine verifies the proper operation of the error branches of the LVDC Preflight Verify and Prepare to Load Rountine. This is accomplished by supplying the following errors: first, second, third and fourth character counter bits failures, inconsistent selection of the V-bit, and temporary table storage overflow. All telemetered error data are recorded and documented.

2.4.17.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 56 for Monitor Verify and Prepare to Load Error Test.

S 1 2 3 4 5 6 A REG

X 1 0 1 1 1 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

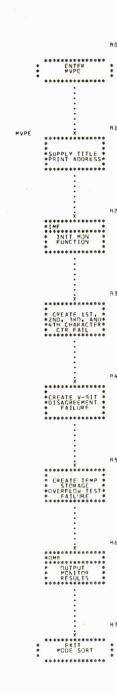


Figure 2-26. Monitor Verify and Prepare to Load Error Test

2.4.18 Monitor Mode/Data Error Tests (Figure 2-27)

2.4.18.1 Purpose

Monitor the LVDC's Mode Sort Routine and Read Input Subroutine for proper operation during controlled error conditions.

2.4.18.2 Description

This routine will supply an incorrect Mode command word to the LVDA's RCA register. This will enable the M/D sign bit error branch in the LVDC Mode Sort routine to be checked.

The LVDC will then be commanded into the Discrete Output Routine and an incorrect RCA input data word will be supplied. This will provide a check on the M/D sign bit error branch in the LVDC Read Input Subroutine.

The documented output will include:

- 1. Status Code.
- 2. Scheduled Error Messages.
- 3. RCA input data.

2.4.18.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

2. Operate sign switch of Register A up and down.

3. Using Register A. place switches 1-6 to Monitor Discrete Output Mode Command 72:

S 1 2 3 4 5 6 A REG

X 1 1 1 0 1 0 MODE 72

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

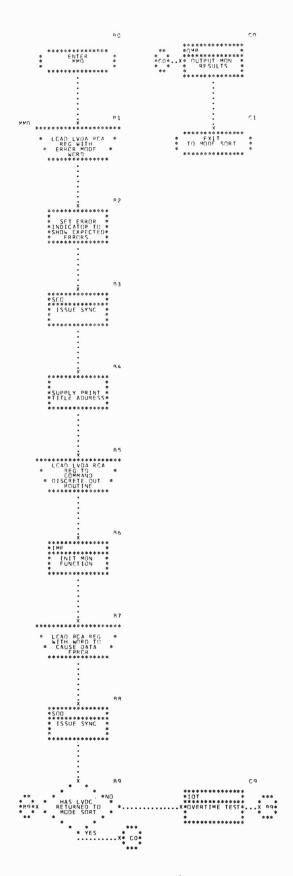


Figure 2-27. Monitor Mode/Data Error Tests

2.4.19 Monitor G and C Steering Test (Figure 2-28)

2.4.19.1 Purpose

To verify the proper operation of the LVDC Preflight G and C Steering Test Routine.

2.4.19.2 Description

This routine records and documents the DOM Data loaded by the Minor Loop segment of the LVDC Flight Program. The LVDC Flight Program must be loaded in order to run this routine.

The documented output will include:

- 1. Status Code.
- 2. RCA input data.
- 3. Obtained DOM data.

2.4.19.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, insert into switches 1-6 Mode Command 06 for Monitor of G and C Steering Test.

S 1 2 3 4 5 6 A REG

X 0 0 0 1 1 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data

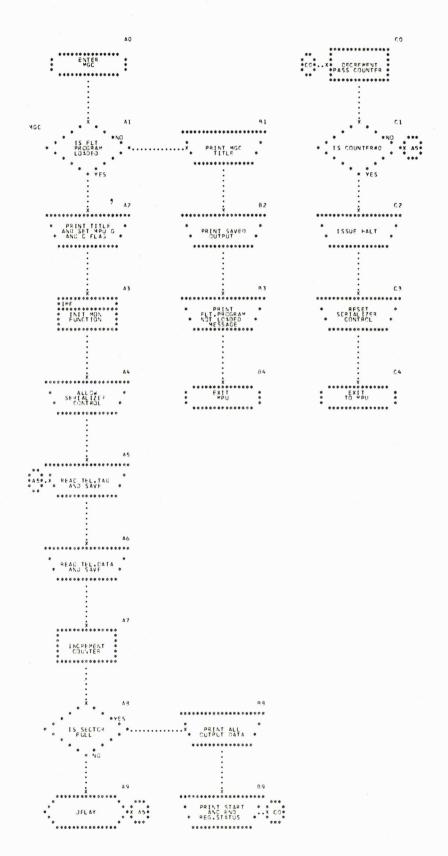


Figure 2-28. Monitor G and C Steering Test

2.4.20 Monitor Prepare to Launch (Figure 2-29)

2.4.20.1 Purpose

To verify the proper operation of the LVDC Preflight Prepare to Launch Program.

2.4.20.2 Description

This routine supplies to the LVDC Preflight Prepare to Launch Routine the necessary inputs to execute its various modes of operation. It monitors the Prepare to Launch Program by snapping ten PIO tags and their associated data. The data from these tags is documented on the printer. These tags are: real time; Fine Gimbals 1, 2, and 3; Downrange, Crossrange, and Vertical accelerometers; and Backup Gimbals 1, 2, and 3. Random samples of Amp 3 data are also saved and printed.

By operator request, the following options may be exercised:

- 1. Snapping of the special alternating telemetry PIO's instead of Fine Gimbals 1 and 2.
- 2. Special Prepare to Launch flight constants may be loaded or verified.
- 3. The variable firing azimuth capability may be exercised on a variable azimuth flight program.
- 4. Issuance of GRRA and GRR and verification to see if the flight program was entered upon GRR.

Flight Program Verification Program should be commanded before commanding this routine. On a variable azimuth flight program, GMT and TLP must be loaded within 60 seconds of entry into Prepare to Launch. This can be accomplished by using the Variable Azimuth Capability. There is no operator input necessary for the Variable Azimuth Capability.

2.4.20.3 Operating Procedure

If LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

X010111 SWITCHES ON

X 0 1 0 1 1 1 SWITCHES ON

2. Operate sign switch of Register A up and down.

The operator must decide at this point what Prepare to Launch Mode he desire to run.

If the operator does not desire to exercise the load and verify capability steps 3-10 may be omitted.

3. Using Register A, turn switch 13 on. Insert into switches 1-6 desired Mode Command for Monitor Prepare to Launch.

1 1 1 1 1 S 1 2 3 4 5 6 7 8 9 0 1 2 3 A REG

X M M M M M M O O O O O O O 1 SWITCHES ON

M = Mode

- 4. Operate sign switch of Register A up and down.
- 5. Using Register B, place switches S-25 up for bits to be set in control word.

1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 S 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 S S S M M M D X X X X X W W W W W W W W L V X X X

- 6. Operate sign switch of Register A up and down.
- 7. Using Register B, place switches S-25 up for bits to be set in data word.
- 8. Operate sign switch of Register A up and down.
- 9. Repeat steps 5-8 for all load and verify data.
- 10. Place switch 13 of Register A OFF. Operate sign switch of Register A up and down.
- 11. Using Register A, insert into switches 1-6 desired Prepare to Launch Mode Command.
- 12. Operate sign switch of Register A up and down.

At this point the operator has several options that he may exercise. Some are necessary for proper operation and verification of the Preflight Prepare to Launch Program.

These options are:

1. If the Load and Verfiy capability is desired and the control word and data have been loaded using steps 3-10, turn switch 11 of Register A ON and then OFF.

The operator must review the data on the printer and if a load is desired he must turn switch 11 of Register A ON and OFF once more.

This option can not be exercised after GRRA.

- 2. If the special alternating telemetry PIO tag test is desired turn switch 10 of Register A ON. To discontinue the test turn switch 10 OFF.
- 3. To check out the variable firing azimuth capability turn switch 9 of Register A ON and then OFF.

Review print out and when Prepare to Launch data begins Printing again, turn switch 9 of Register A ON and OFF once more.

The azimuth data supplied is all predefined, and the variable azimuth capability may be exercised a maximum of 3 times all before GRRA. This option must be exercised before 60 seconds expire after entrance into Prepare to Launch when using a variable azimuth flight program, in the flight mode.

4. The operator can issue GRRA and GRR whenever he desires.

To issue GRRA, turn switch 12 of Register A ON and then OFF.

To issue GRR, repeat 4.

All saved Amp 3 data will be printed when GRRA or GRR is issued. The first few pieces of Amp 3 data may be destroyed when GMT and TLP are loaded.

13. Review output data

S = SECTOR

M = MODULE

D = SIMPLEX/DUPLEX

W = ADDRESS

L = LAST WORD

V = LOAD/VERIFY

X = NOT USED (0)

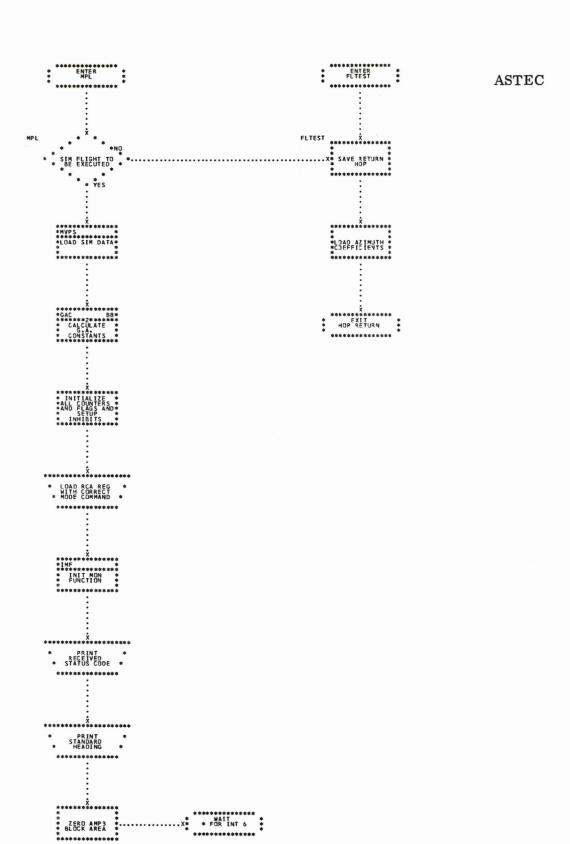


Figure 2-29. (Sheet 1 of 4) Monitor Prepare to Launch

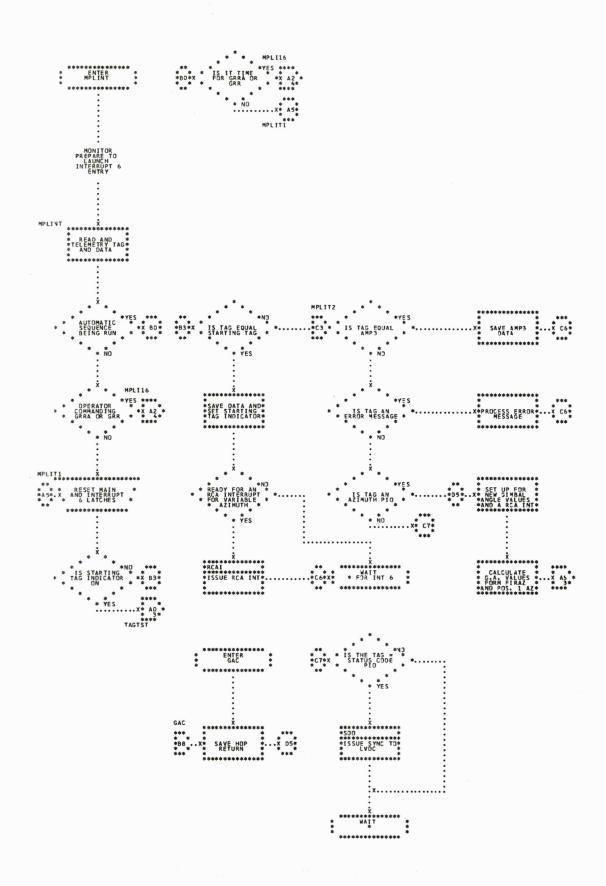


Figure 2-29. (Sheet 2 of 4) Monitor Prepare to Launch

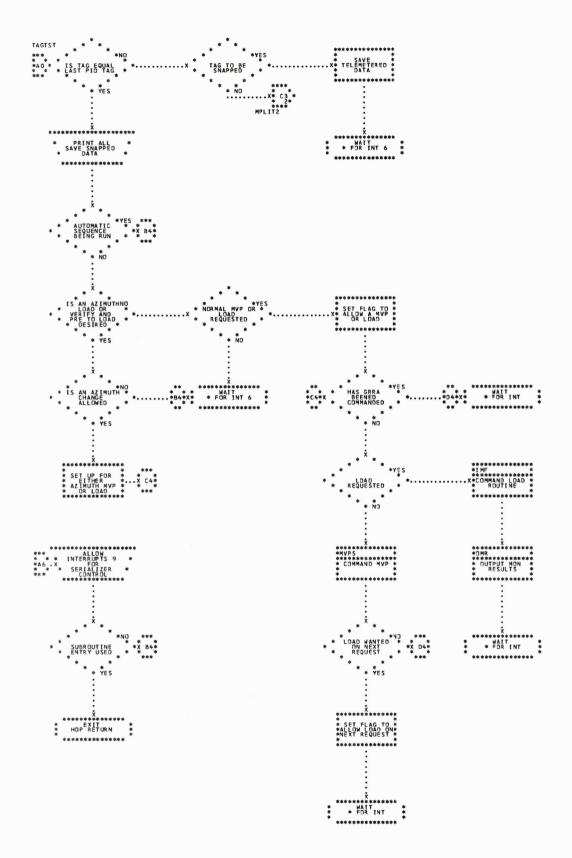


Figure 2-29. (Sheet 3 of 4) Monitor Prepare to Launch

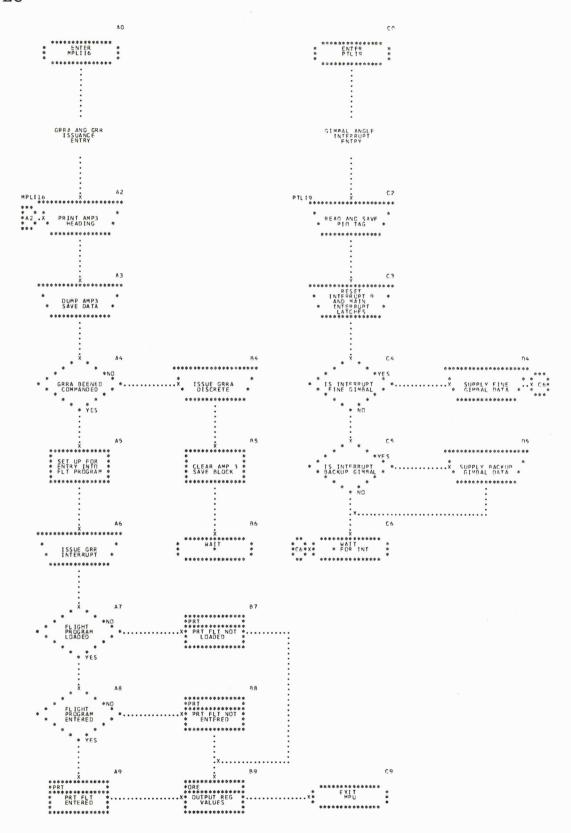


Figure 2-29. (Sheet 4 of 4) Monitor Prepare to Launch

2.4.21 Monitor Flight Loaded Verification (Figure 2-30)

2.4.21.1 Purpose

To verify that the LVDC Flight Program is loaded.

2.4.21.2 Description

This routine verifies that the LVDC Flight Program is loaded. This is accomplished by use of the LVDC Preflight Verify and Prepare to Load Routine.

2.4.21.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG
0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 50 for Monitor Flight Loaded Verification.

S 1 2 3 4 5 6 A REG X 1 0 1 0 0 0 SWITCHES ON

4. Operate sign switch of Register A up and down.

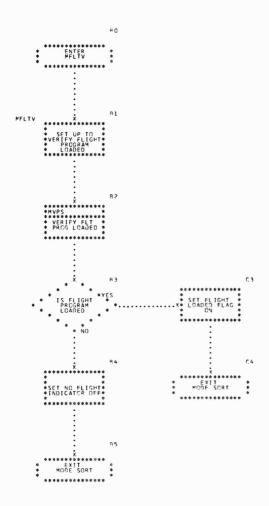


Figure 2-30. Monitor Flight Loaded Verification

2.4.22 Monitor Memory Error (Figure 2-31)

2.4.22.1 Purpose

To verify the proper operation of the LVDC Preflight Memory Error Routine.

2.4.22.2 Description

This routine allows the operator to run the Preflight Memory Error Routine. If the Memory Error Routine detects an error, an error message is sent to the PTC via Interrupt 6. Control is given to the Error Monitor Routine. Return is to the Monitor Memory Routine until Mode Sort status code is received. Documented output will include:

- 1. Status Code.
- 2. Telemetered error data.

2.4.22.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 22 for Monitor Memory Error Routine.

S 1 2 3 4 5 6 A REG X 0 1 0 0 1 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

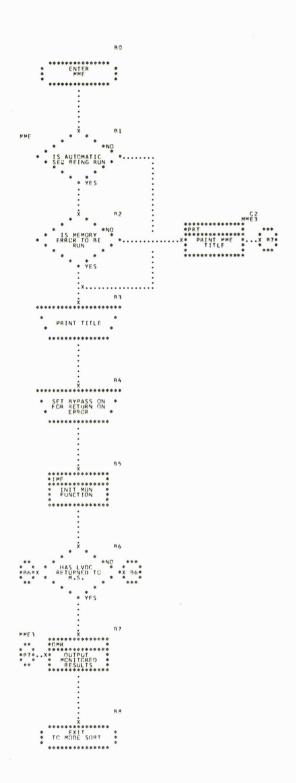


Figure 2-31. Monitor Memory Error

2.4.23 Monitor Special Loader (Figure 2-32)

2.4.23.1 Purpose

Monitor the LVDC Preflight Special Loader Routine for proper operation.

2.4.23.2 Description

This routine allows the LVDC to enter the Special Loader Mode Sort from the LVDC Preflight Power Up Routine. This routine shall perform the following sequence of operations:

- 1. Issue Halt to the LVDC.
- 2. Load RCA register with mode command for Special Loader.
- 3. Allow LVDC to read Mode Word by issuing Sync.
- 4. Reset Halt issued to LVDC.
- 5. Turn sync off.
- 6. Test for return to Special Loader Mode Sort. When the LVDC returns to the Special Loader Mode Sort, the PTC returns to the PTC Mode Sort Routine.

2.4.23.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Mode Command 52 for Monitor Special Loader.

S 1 2 3 4 5 6 A REG
X 1 0 1 1 1 0 SWITCHES ON

ASTEC

4. Operate sign switch of Register A up and down.

PTC returns to the Mode Sort Routine. Command Monitor Sector Dump and Monitor Verify and Prepare to Load if desired.

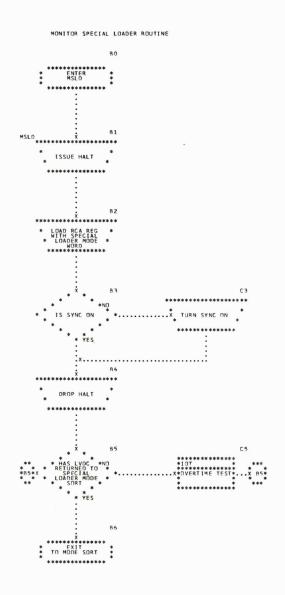


Figure 2-32. Monitor Special Loader

2.4.24 Monitor Command Receiver Test (Figure 2-33)

2.4.24.1 Purpose

To verify that the Command Receiver Test linkage is correct between the Preflight Program and the Orbital Program.

2.4.24.2 Description

This routine monitors the LVDC Preflight Command Receiver Test for proper operation. This is accomplished by testing for the correct status code via telemetry. The operator is given one minute delay to manually verify the Orbit Program is entered. Halt is then issued and Monitor Power Up is executed. LVDC Orbital Program must be loaded.

The documented output will include:

- 1. Status Code.
- 2. Register conditions.

2.4.24.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A switches 1-6, insert Mode Command 35 for Monitor Command Receiver Test.

S 1 2 3 4 5 6 A REG
X 0 1 1 1 0 1 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data

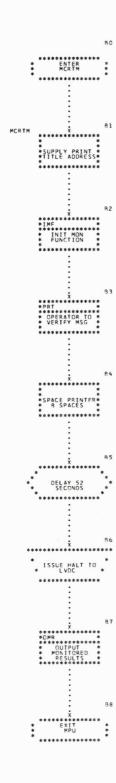


Figure 2-33. Monitor Command Receiver Test

2.4.25 Monitor Repeatable Flight Sim Linkage Test (Figure 2-34)

2.4.25.1 Purpose

To check the linkage between the LVDC Preflight Program and Flight Program on proper command.

2.4.25.2 Description

This routine allows the LVDC Preflight Program to enter LVDC Flight Program from LVDC Preflight Mode Sort. Sufficient time is allowed for Flight to be entered and a message will be printed stating if the flight program was entered or not.

The documented output consists of:

- 1. Status Code.
- 2. Telemetered data.
- 3. Register conditions.

2.4.25.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place siwtches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Repeatable Flight Sim Linkage Test Mode Command 31 (8):

S 1 2 3 4 5 6 REG A 0 0 1 1 0 0 1 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

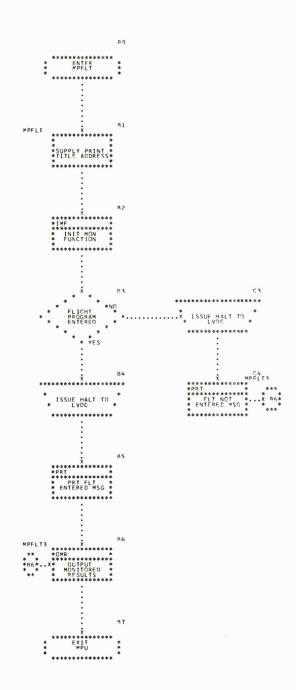


Figure 2-34. Monitor Repeatable Flight Sim Linkage Test

2.4.26 Special Loader Mode Sort Monitor (Figure 2-35)

2.4.26.1 Purpose

To allow entry to the LVDC Preflight Special Loader from the LVDC Preflight Mode Sort.

2.4.26.2 Description

This routine is commanded to allow the LVDC Preflight Special Loader to be entered from the LVDC Preflight Mode Sort. Once the Special Loader has been entered, routines common to the LVDC Special Loader can be commanded. The documented output will include:

- 1. Status Code
- 2. Register Conditions

2.4.26.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Special Loader Mode Sort Monitor Mode Command 00:

S 1 2 3 4 5 6 A REG

0 0 0 0 0 0 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data.

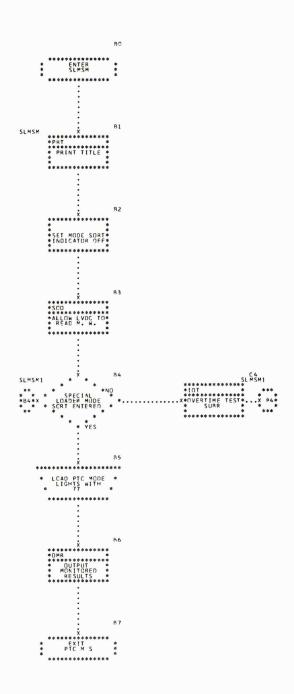


Figure 2-35. Special Loader Mode Sort Monitor

2.4.27 Monitor Verify and Prepare to Load (Figure 2-36)

2.4.27.1 Purpose

Monitor the LVDC Preflight Verify and Prepare to Load Routine for proper operation and also allow an operator to Load or Verify any data location within the LVDC memory unit.

2.4.27.2 Description

This routine will supply the required simulated RCA data words from a pre-loaded or operator loaded table. These words will indicate the memory location to be verified or the memory location and data to be loaded, in the format required by the LVDC Preflight Verify and Prepare to Load Routine.

A separate error test entry shall be provided to check the following error branches:

- 1. The telemetry load error status code.
- 2. The four character count errors.
- 3. The V-Bit error.
- 4. The LV Data Block Full error.

The documented outputs will include:

- 1. The RCA input data words.
- 2. The Standard outputs.
- 3. The Verify control word and data or the Load control word and data to be loaded by the LVDC Load routine.

The Load or Verify control word and the Load data will be verified to be correct by computing the expected values from the RCA input data words. Any errors will be indicated in the output.

2.4.27.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG

0 0 1 0 1 1 1 SWITCHES ON

ASTEC

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switch 13 ON. Insert into switches 1-6 Mode Command 21 for Monitor Verify and Prepare to Load.

1 1 1 1 1 S 1 2 3 4 5 6 7 8 9 0 1 2 3 A REG
X 0 1 0 0 0 1 0 0 0 0 0 1 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Using Register B, place switches S-25 up for bits to be set in control word.

- 6. Operate sign switch of Register A up and down.
- 7. Using Register B, place switches S-25 up for bits to be set in data word.
- 8. Operate sign switch of Register A up and down.
- 9. Repeat steps 5-8 for all Load and Verify Data.
- 10. Place switch 13 of Register A OFF.
- 11. Operate sign switch of Register A up and down.
- 12. Review Output Data.

CONTROL WORD:

- (S) Sector Bits
- (M) Module Bits
- (D) Simplex/Duplex Bit
- (X) Not Used
- (W) Address Bits
- (L) Last bit, set equal 1 for last data word to be loaded or verified.
- (V) Verify bit, set equal 1 for verify, zero (0) for load.

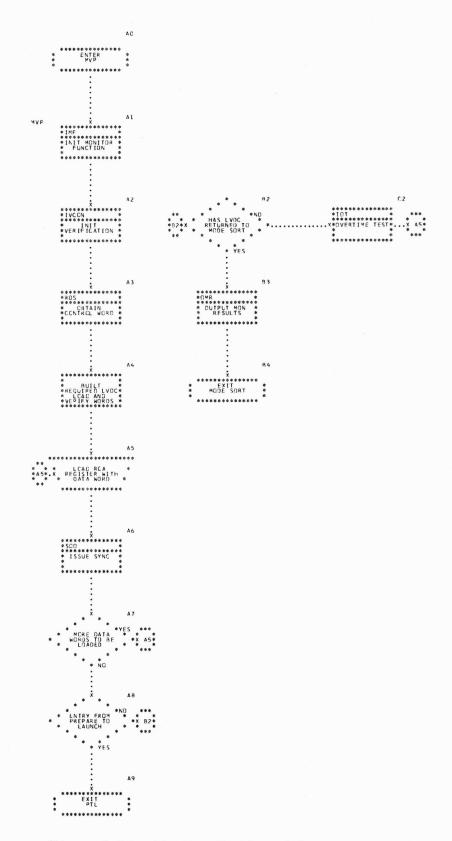


Figure 2-36. Monitor Verify and Prepare to Load

2.4.28 Monitor Load (Figure 2-37)

2.4.28.1 Purpose

Monitor the LVDC Preflight Load Routine for proper operation.

2.4.28.2 Description

This routine will allow the LVDC to load the location with the data previously specified by the Prepare to Load Routine. The error branch may be tested by commanding this routine without having previously commanded the Prepare to Load Routine.

2.4.28.3 Operating Procedure

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8):

S 1 2 3 4 5 6 A REG 0 0 1 0 1 1 1 SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switches 1-6 to Monitor Load Error Mode Command 54 (8):

S 1 2 3 4 5 6 REG A 0 1 0 1 1 0 0 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Review Output Data

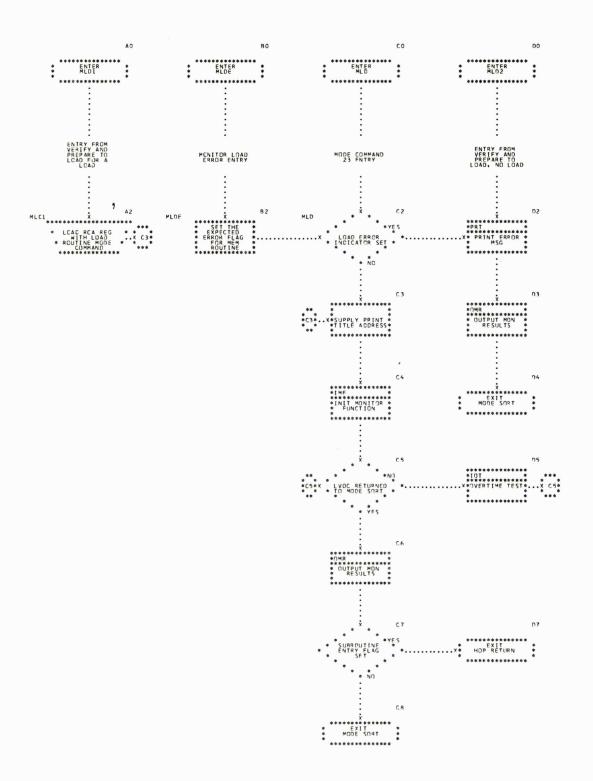


Figure 2-37. Monitor Load

2.4.29 Monitor Telemetry Test Routine (Figure 2-37A)

2.4.29.1 Purpose

To monitor the LVDC Telemetry Test Routine for proper operation.

2.4.29.2 Description

This routine allows execution of the LVDC Telemetry Test Routine by executing the following events:

- 1. Command the LVDC Telemetry Test Routine.
- 2. Supply the necessary Input word.
- 3. Obtain the LVDC Telemetry Test Routine data and associated tags.
- 4. Issue the simulated RCA Interrupt for termination upon request.
- 5. Output the monitored output.

2.4.29.3 Operating Procedures

If the LVDC is already in its Mode Sort Routine, steps 1-2 may be omitted.

1. Using Register A, place switches 1-6 to Monitor Power Up Mode Command 27 (8).

S 1 2 3 4 5 6

A REG

0 0 1 0 1 1 1

SWITCHES ON

- 2. Operate sign switch of Register A up and down.
- 3. Using Register A, place switch 13. Insert into switches 1-6 Mode Command 32 for Monitor Telemetry Test Routine.

0 0 1 1 0 1 0 0 0 0 0 0 1 SWITCHES ON

- 4. Operate sign switch of Register A up and down.
- 5. Using Register B, place into switches 1-7, the desired input word. Select only one input rate bit.

S 1 2 3 4 5 6 7

B REG

0 M A B C D E F

SWITCHES ON

M = 1, selects Standard Mode A = 1,Rate B = 1,11 \mathbf{B} 11 C = 1, 11 C D = 1,11 D E = 1,11 \mathbf{E} F = 1, 11 F

NOTE: Rate F must be previously loaded by load and verify.

- 6. Operate sign switch of Register A up and down.
- 7. Place switch B of Register A off.
- 8. Operate sign switch of Register A up and down, twice.
- 9. Terminate routine by turning sign switch of Register Bon.

NOTE: Sign switch of Register B read after print cycle.

10. Review Output Data.

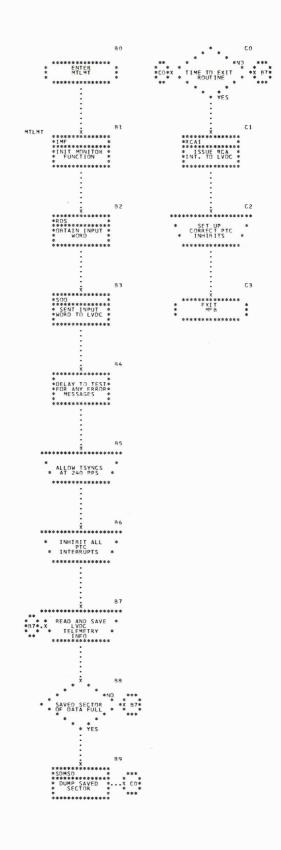


Figure 2-37A. Monitor Telemetry Test Routine

2.5 PTC MONITOR CONTROLLED INTERRUPTS

2.5.1 PTC Interrupt 6 (Figure 2-38)

2.5.1.1 Purpose

Allow the PTC to receive desired outputs from the LVDC to be documented on the printer.

2.5.1.2 Description

This routine shall be entered any time the LVDC issues a PIO of a group 1 or 3 address (LVDC Telemetry). The inhibit for this interrupt will always be reset when the LVDC is in Mode Sort to allow processing of unscheduled errors. This routine shall perform the following sequence of operations:

- 1. Save the return location and accumulator content when the interrupt occurred.
- 2. Reset the interrupt latch to allow another interrupt be recognized while in this routine.
- 3. Read the Discrete Output Register and save the value of DO2 for controlling SYNCS to the LVDC.
- 4. Read the telemetry tag and data.
- 5. Decode the tag to identify the type of data.
- 6. If the tag is not a status code, exit to step 12. If it is a status code, save the tag and data in Output Storage Block.
- 7. If the tag is the Mode Sort Status Code, set the Mode Sort Status Code Received Indicator on, issue SYNC to the LVDC and skip to step 14.
- 8. If the tag is not Mode Sort, set the Mode Sort Status Code Received Indicator off.
- 9. If the status code is EMR, set the Error Monitor Status Code Received Indicator on, issue SYNC to the LVDC and exit to Monitor Error Monitor Subroutine.
- 10. If the status code is on overtime, skip to step 14.
- 11. If the status code is not one of the already tested status codes, test to see if it is the expected status code. If it is, set the Expected Status Code Received Indicator on and skip to step 14; if not, issue RCA Interrupt to LVDC and exit to MFB.

- 12. Determine if it is an expected special purpose telemetry PIO, and take appropriate action.
- 13. If the tag was not special purpose, save the tag and date for later documentation purposes.
- 14. Exit to the appropriate Interrupt Decode and Exit Subroutine entry point.

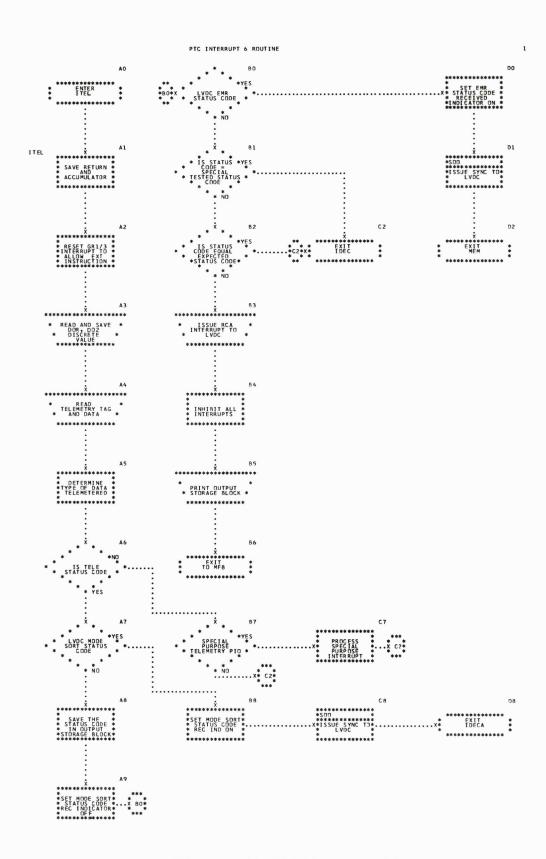


Figure 2-38. PTC Interrupt 6 Routine

2.5.2 Monitor Error Monitor (Figure 2-39)

2.5.2.1 Purpose

Control the processing of errors and associated messages received from the LVDC:

2.5.2.2 Description

This routine shall be entered only from the Telemetry Interrupt Routine when the EMR Status Code is received. If an unscheduled error occurs in the LVDC the PTC operator will be permitted the option of continuing with the program or of exiting to recycle. This routine shall perform the following sequence of operations:

- 1. Save the accumulator that the Telemetry Interrupt Routine saved.
- 2. Save the return location that the Telemetry Interrupt Routine saved.
- 3. Read and save present discrete input and RCA registers.
- 4. Reset the Main Interrupt Latch to receive, error message.
- 5. Set DIN equal zero, and RCA Reg non zero.
- 6. Delay until all error messages are received and saved.
- 7. Test to see if the operator should have control because of an unscheduled error. If the indicator is on, by-pass the operator control because the error was scheduled by controlled inputs to the LVDC. Skip to step 10.
- 8. If the indicator is off, print telemetry error message and error data.
- 9. Issue CST to the PTC. This permits the operator to analyze the printed output and determine the cause of error. The operator then decides either to force recycle by generating Interrupt 16 (front panel button) and removing the CST or continue by removing the CST.
- 10. Continuing turns sync on and then off allowing the LVDC to exit from its Error Message Routine.
- 11. Restore the old discrete input and RCA registers.
- 12. Restore the saved accumulator.
- 13. Return on the saved return.

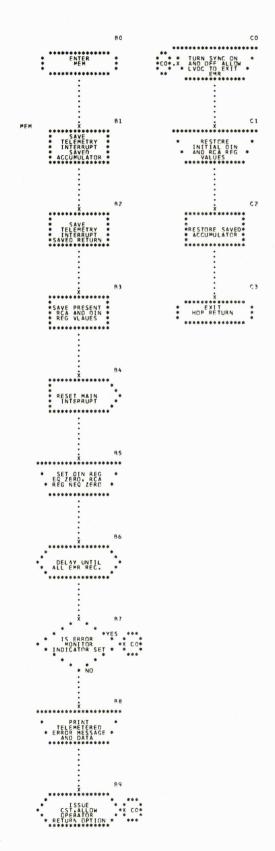


Figure 2-39. Monitor Error Monitor

2.5.3 Interrupt Decode and Exit (Figure 2-40)

2.5.3.1 Purpose

Used with LVDC Telemetry Interrupt 6 Routine to control issuing SYNC to the LVDC Preflight Program and to process multiple interrupts.

2.5.3.2 Description

This routine is entered from the PTC Interrupt 6 Routine. A test on the read value of Discrete Output Register DO2 Discrete is made. If the discrete is set, SYNC is issued to the LVDC. The PTC Interrupt Storage Register is also checked for multiple interrupts and if the interrupts are allowed, steps are taken to process them. The interrupts checked are:

- 1. Read Resolver
- 2. Manuel Interrupt 16
- 3. Switch Selector
- 4. Interrupt 6

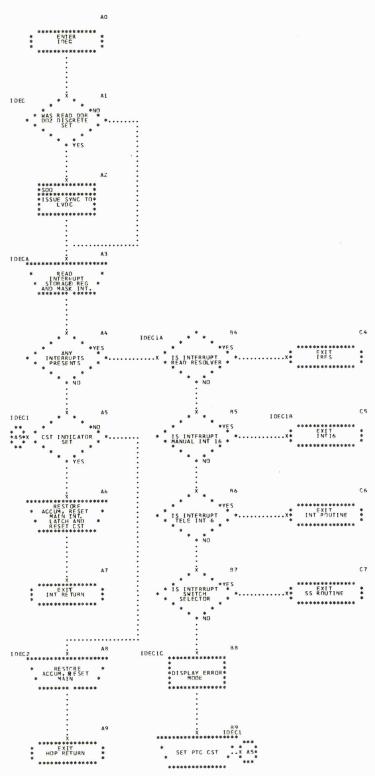


Figure 2-40. Interrupt Decode and Exit

2.5.4 Fine and Coarse Gimbal Angle Interrupts (Figure 2-41)

2.5.4.1 Purpose

Indicate to the PTC that the present gimbal angle is being read into the LVDC from the LVDA and a new gimbal angle may now be supplied.

2.5.4.2 Description

This routine shall be entered any time the LVDC issues a PIO of a Group 5 address, fine or coarse gimbal angles, with the condition that the Inhibit for this interrupt is not set. This routine shall perform the following sequence of operations:

- 1. Reset this interrupt latch to allow another interrupt be recognized while in this routine.
- 2. Reset the Main interrupt Latch.
- 3. Exit to Monitor Gimbal Angle Monitor Routine.

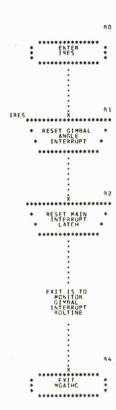


Figure 2-41. Fine and Coarse Gimbal Angle Interrupts

2.5.5 Switch Selector Register Interrupt (Figure 2-42)

2.5.5.1 Purpose

Indicate to the PTC that the Switch Selector Register is being loaded and that the Feedback lines should be supplied.

2.5.5.2 Description

This routine shall be entered any time the LVDC issues a PIO of group 2 address, Switch Selector Register, with the condition that the inhibit for this interrupt is not set. This routine shall perform the following sequence of operations:

- 1. Save the return location and the accumulator contents when the interrupt occurred.
- 2. Read and Save the Switch Selector Register contents.
- 3. Reset this interrupt latch to allow another interrupt be recognized while in this routine.
- 4. Determine if this is an error test. If it is supply an error value to the Feedback lines equal to the proper value obtained from a table.
- 5. Determine if other interrupts were received while in this routine. If there were, process and then return.
- 6. Restore the saved accumulator.
- 7. Reset the Main Interrupt Latch.
- 8. Exit on the saved return location.

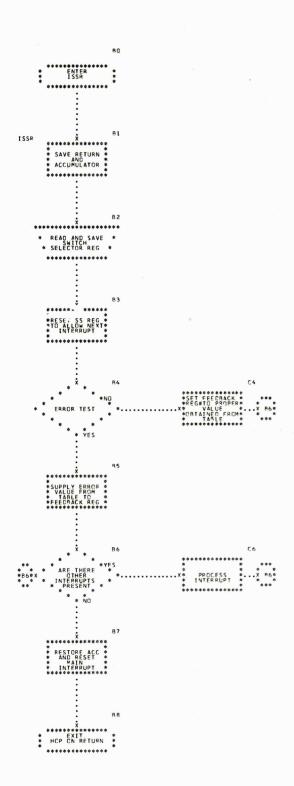


Figure 2-42. Switch Selector Register Interrupt

2.6 PTC SUBROUTINES

2.6.1 A Register P-Sync (Figure 2-43)

2.6.1.1 Purpose

To read and save A and B register data specified by the operator.

2.6.1.2 Description.

This subroutine is used whenever the operator must specify data to be used in monitoring the LVDC Preflight Program. This subroutine is called by the following routines:

- 1. PTC Mode Sort Routine whenever a mode command is desired.
- 2. Load Run Sequence Routine whenever a table of commanded routines is desired.
- 3. Load Data Sequence Routine whenever data is required for a monitor or list of monitors to be run.

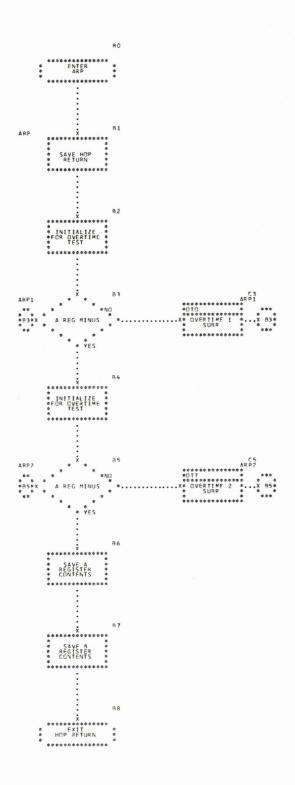


Figure 2-43. A Register P-Sync

2.6.2 <u>CST Issue</u> (Figure 2-44)

2.6.2.1 Purpose

To issue a CST to the LVDC Program if required.

2.6.2.2 Description

This subroutine issues a CST to the LVDC if the following conditions are present:

- 1. If the Monitor Power Up Indicator is set.
- 2. If the mode register bits indicate Mode Sort.
- 3. If the PIO address bits indicate Discrete Input Read.

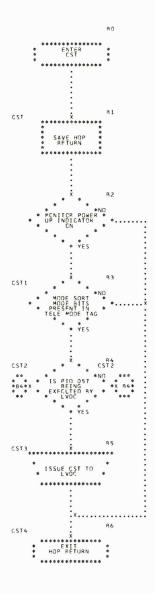


Figure 2-44. CST Issue

2.6.3 Eject (Figure 2-45)

2.6.3.1 Purpose

To initialize Printer Controls and to eject a page.

2.6.3.2 Description

This subroutine is entered in the PTC Mode Sort Routine if the correct bit is set in the PTC A Register. It is primarily used when running the Automatic Sequence Routine to print page numbers for each individual routine.

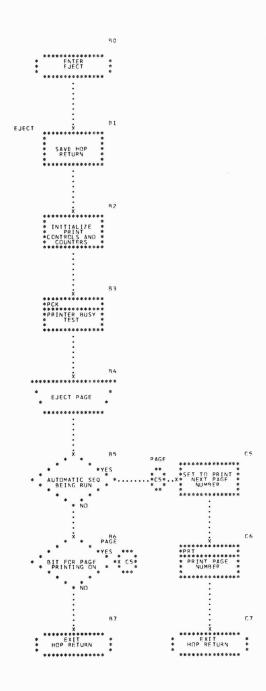


Figure 2-45. Eject

2.6.4 Inhibit All Interrupts Except 6 (Figure 2-46)

2.6.4.1 Purpose

To inhibit all PTC Interrupts except Telemetry Interrupt 6.

2.6.4.2 Description

This subroutine is used whenever only Telemetry Interrupt 6 is desired. All other possible interrupts are inhibited.



Figure 2-46. Inhibit All Interrupts Except 6

2.6.5 Accelerometer Rate Generate (Figure 2-47)

2.6.5.1 Purpose

To set up accelerometer simulation on all three axes.

2.6.5.2 Description

This subroutine is used by the Monitor Forced Begin Routine to set up simulated accelerometer counts on all three axes.

A count of 196 PPS is generated on the Vertical Accelerometer.

A count of 1 pulse every 2/3 second is generated on the Downrange and Crossrange Accelerometer.



Figure 2-47. Accelerometer Rate Generate

2.6.6 Execute Modified Instructions (Figure 2-48)

2.6.6.1 Purpose

To execute one or two program-built instructions and operate upon one data word.

2.6.6.2 Description

If program-built instructions are to be executed, the instructions must be in the accumulator upon entrance to the subroutine. The first instruction to be executed must be in syllable one and the second instruction must be in syllable zero.

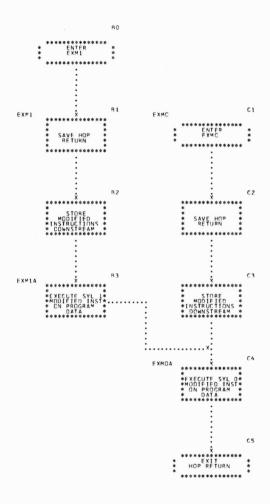


Figure 2-48. Execute Modified Instructions

2.6.7 Indicator Overtime Test (Figure 2-49)

2.6.7.1 Purpose

To test an indicator condition for a specified period of time.

2.6.7.2 Description

The Indicator Overtime Test checks an indicator for a specified period of time, looping on the test until the indicator is turned on or until the time is exceeded. If the time is exceeded, a message is printed indicating the error to the operator. Halt is then issued to the LVDC, and all accumulated output is printed. Exit is to Monitor Power Up Routine.

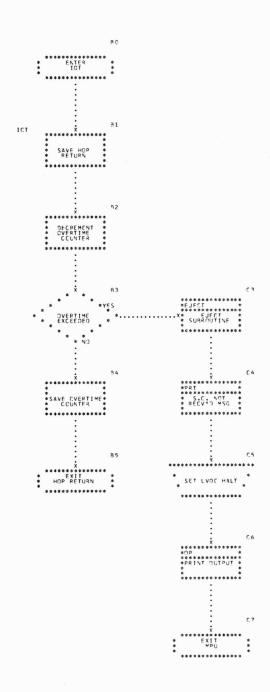


Figure 2-49. Indicator Overtime Test

2.6.8 Initial Interrupt 6 Location for Monitor Power Up (Figure 2-50)

2.6.8.1 Purpose

To set up a special interrupt 6 test for Monitor Power Up.

2.6.8.2 Description

This routine is used as the Telemetry Interrupt 6 Routine while executing Monitor Power Up. It checks for the Monitor Power Up or Abort Test Status Code. If neither of the status codes are received, an error message is printed and Monitor Power Up is re-executed. If either of the Status Codes are received, certain Output Registers are zeroed.

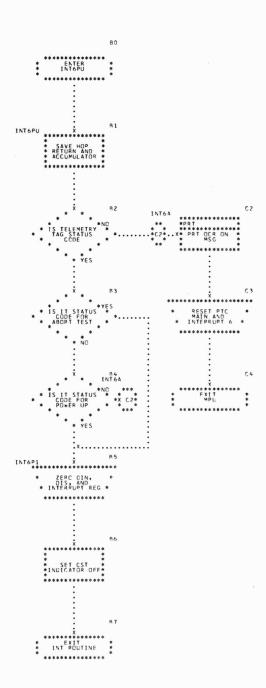


Figure 2-50. Initial Interrupt 6 Location for Monitor Power Up

2.6.9 Initialize Monitor Function (Figure 2-51)

2.6.9.1 Description

The Initialize Monitor Function shall consist of the following sequence of operations:

- 1. Display the proper PTC status code to the front panel Mode lights.
- 2. Supply the expected Status Code to the Telemetry Interrupt Routine.
- 3. Print the Monitor Routine Title and the Output Heading.
- 4. Verify that the LVDC is in Mode Sort, that it can enter the commanded routine.
- 5. Allow the LVDC to read the simulated RCA commanded Mode word by turning Sync on. Turn off to continue.
- 6. If the PTC Trace Routine has been called, set LVDC CST and exit to the Trace Routine.
- 7. If Trace is not being executed, then check for the expected Status Code and if not received print the appropriate error message.
- 8. If the expected Status Code is received exit is to the calling routine.

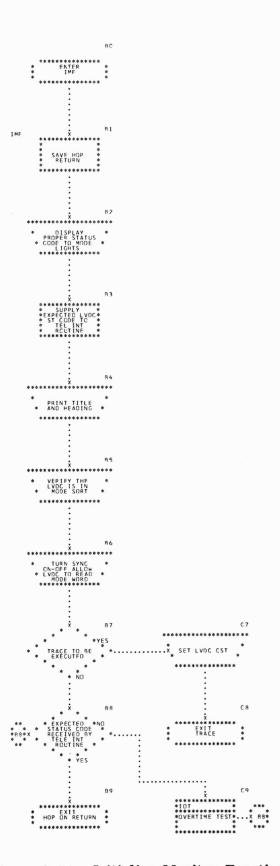


Figure 2-51. Initialize Monitor Function

2.6.10 Initialize Verification Control (Figure 2-52)

2.6.10.1 Purpose

To set up program counters and constants to be used to verify data received from the LVDC Program.

2.6.10.2 Description

This subroutine is entered to initialize counters and constants whenever data is to be received from the LVDC for verification.

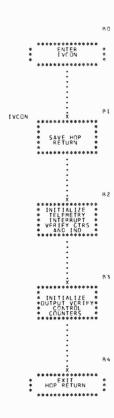


Figure 2-52. Initialize Verification Control

2.6.11 Issue RCA Interrupt (Figure 2-53)

2.6.11.1 Purpose

To issue an RCA Interrupt to the LVDC Program.

2.6.11.2 Description

This subroutine is entered whenever an RCA Interrupt is to be issued to the LVDC Preflight Program. This interrupt forces the Preflight Program to its Forced Begin Routine.

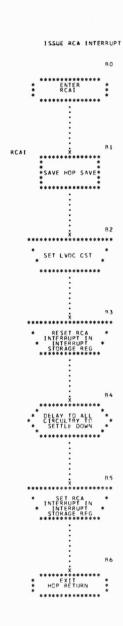


Figure 2-53. Issue RCA Interrupt

2.6.12 Obtain DOM Data (Figure 2-54)

2.6.12.1 Purpose

Obtain and print DOM data.

2.6.12.2 Description

This subroutine saves and prints all DOM data. This is accomplished by issuing G-Syncs to the LVDA to step the DOM. The data is then saved and printed.

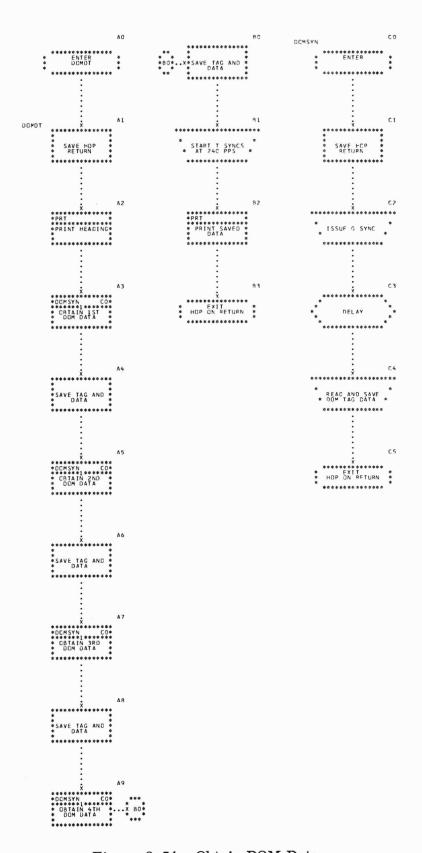


Figure 2-54. Obtain DOM Data

2.6.13 Octal to BCD Octal Conversion (Figure 2-55)

2.6.13.1 Purpose

To convert octal values to BCD octal values suitable for printing.

2.6.13.2 Description

This subroutine converts octal values to BCD octal values suitable for printing by the PTC Program. The word to be converted is stored in some specific location and the accumulator must contain the number of octal numbers to be converted.

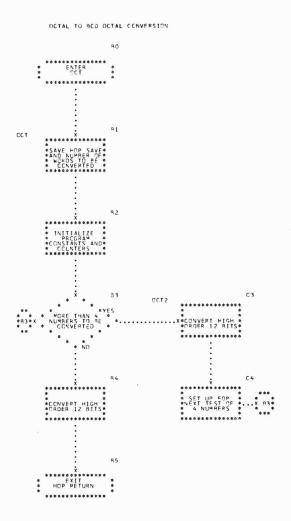


Figure 2-55. Octal to BCD Octal Conversion

2.6.14 Output Monitor Results (Figure 2-56)

2.6.14.1 Purpose

To determine and output the results of a monitor routine.

2.6.14.2 Description

This subroutine performs the following operations:

- 1. Performs all necessary calculations.
- 2. Obtains and formats all output not telemetered.
- 3. Prints all output data. The output data for each routine will contain the following standard output, Status Code, Error information, RCA Input Mode Word. Additional output will depend on the individual monitor routines.
- 4. Records and prints the Data Adapter Register status prior to entering a monitor routine and upon completion of the monitor routine.
- 5. Exits to the calling routine.

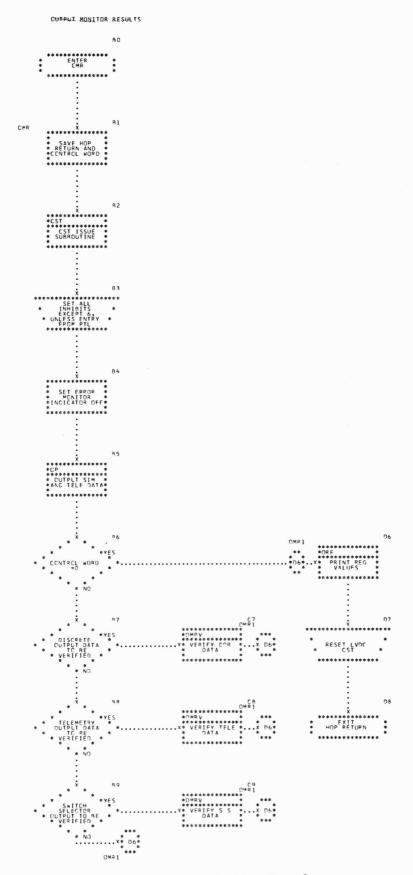


Figure 2-56. Output Monitor Results

2.6.15 Output Monitored Results Verified (Figure 2-57)

2.6.15.1 Purpose

To verify the LVDC output data with the expected data.

2.6.15.2 Description

This subroutine compares the obtained LVDC output data against a stored table of expected results data. If correct verification is not made, an error heading and the disagreement data are printed. If correct verification is made a message will be printed saying 'OUTPUT RESULTS WERE VERIFIED''.

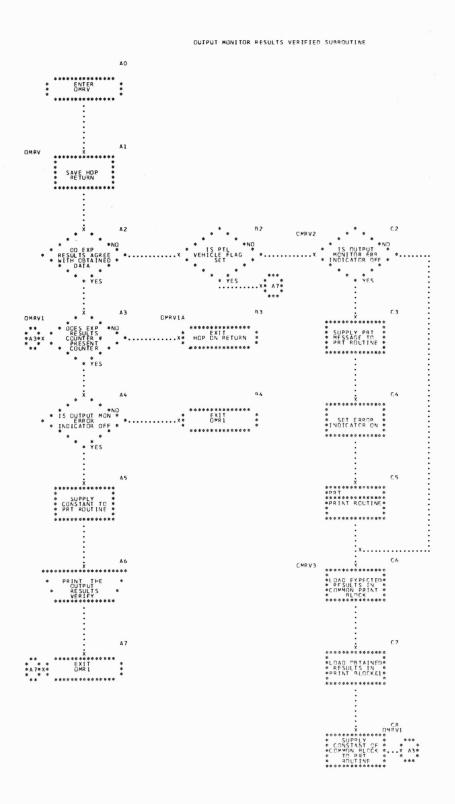


Figure 2-57. Output Monitored Results Verified

2.6.16 PTC ASTEC Output (Figure 2-58)

2.6.16.1 Purpose

To output all pertinent information that was saved while executing any monitor program.

2.6.16.2 Description

This routine prints all pertinent information formatted by the Output Storage Subroutine while executing any monitor program. This information includes the simulated input data supplied and the output data received.

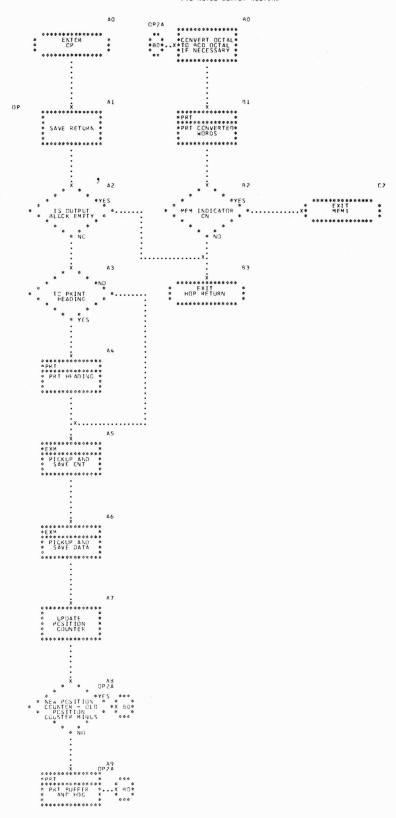


Figure 2-58. PTC ASTEC Output

2.6.17 Output Register Save and Print (Figure 2-59)

2.6.17.1 Purpose

To save the LVDC and LVDA/ME Output Registers at the start and end of any monitor routine.

2.6.17.2 Description

This subroutine is entered as the beginning of any monitor routine to save the starting conditions of the LVDA and LVDA-ME Output Register. It is also entered at the end of the same monitor routine to save the ending condition of the output registers. Exit is to the Output Register Print Subroutine where the output values are printed.

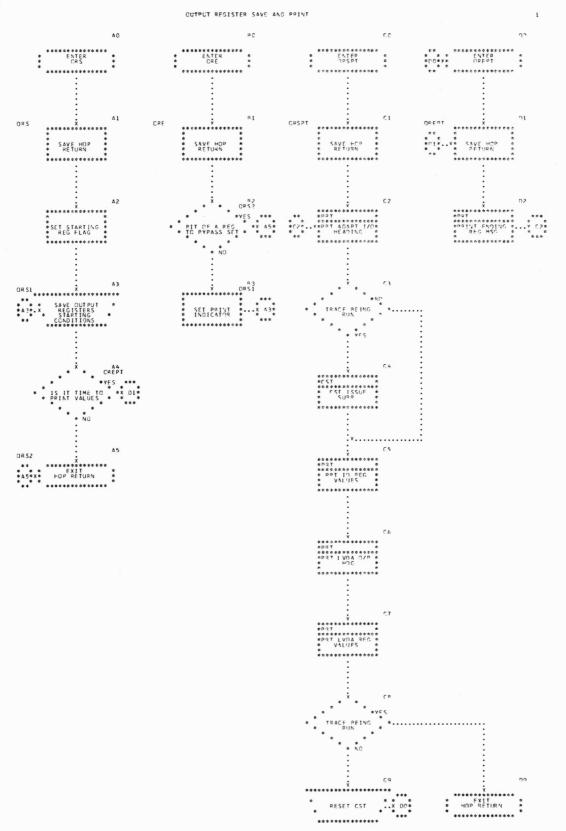


Figure 2-59. Output Register Save and Print

2.6.18 Output Storage (Figure 2-60)

2.6.18.1 Purpose

To format and save all pertinent information to be documented by the Output Subroutine.

2.6.18.2 Description

This subroutine is used by the LVDC Telemetry Interrupt 6 Routine to save all pertinent data received from the LVDC Preflight Program for later documentation. It is also used to save the data supplied to the LVDC for later documentation. The save data is later printed by the Output Subroutine.

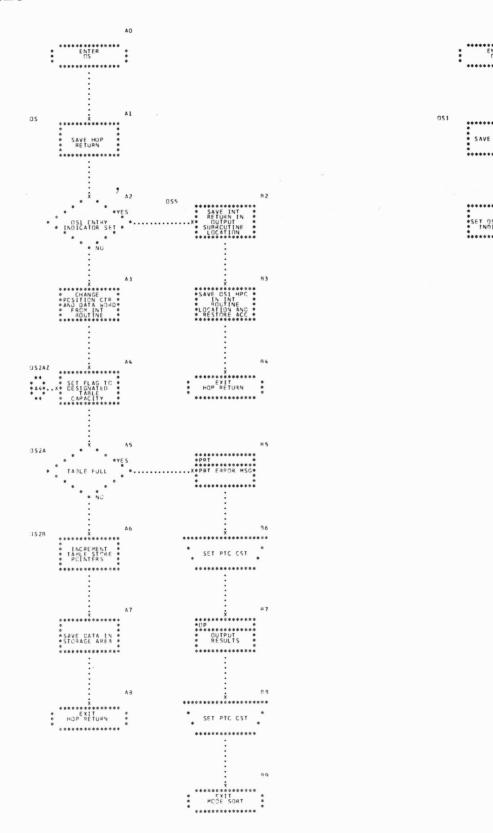


Figure 2-60. Output Storage

2.6.19 Output Verification Storage (Figure 2-61)

2.6.19.1 Purpose

To save all data that is to be verified against the data received from the LVDC Program.

2.6.19.2 Description

This subroutine stores all data that is to be verified as a result of executing some monitor program.

Once the monitored program has completed execution, the verified results will be printed by the PTC Print Subroutine.

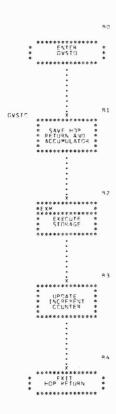


Figure 2-61. Output Verification Storage

2.6.20 PTC Print (Figure 2-62)

2.6.20.1 Purpose

To print the print command and to control carriage commands.

2.6.20.2 Description

The subroutine is entered with the control word in the accumulator. The number of words to be printed in Syllable one and the starting address of the first word in Syllable zero.

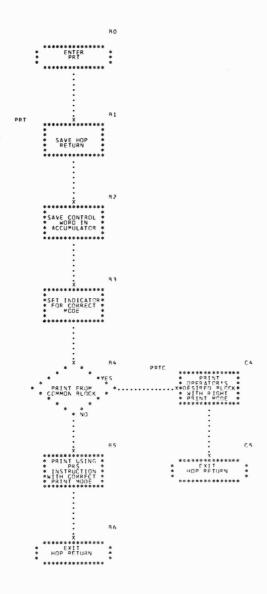


Figure 2-62. PTC Print

2.6.21 RCA Data Simulation (Figure 2-63)

2.6.21.1 Purpose

To simulate input data to the RCA Input Register.

2.6.21.2 Description

This subroutine supplies RCA simulated input data to the RCA register. This input data is obtained from a pre-loaded table. It then stores the data in the output for documentation purposes and exits.



Figure 2-63. RCA Data Simulation

2.6.22 PTC ASTEC Sync On/Off (Figure 2-64)

2.6.22.1 Purpose

Allows proper control of communication between the LVDC and PTC.

2.6.22.2 Description

This subroutine is entered when the SYNC Discrete must be issued to the LVDC Preflight Program. The SYNC Discrete is issued when ever a Mode Command is issued, and after each piece of telemetry output received from the LVDC with a few exceptions. Once the SYNC Discrete is set, it can only be reset by the setting of the LIRO Discrete by the LVDC Program. If the communication between the PTC and LVDC is not correct, an error message will be printed.

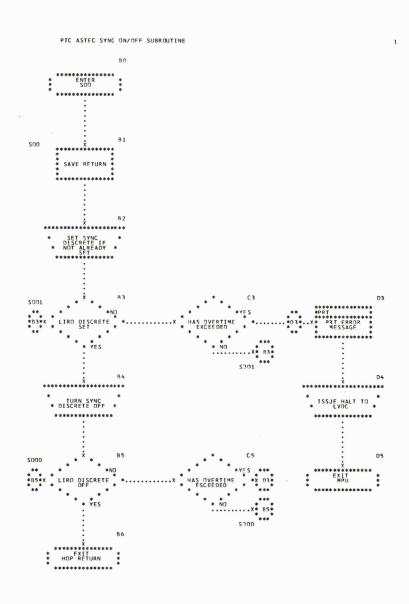


Figure 2-64. PTC ASTEC Sync On/Off

2.7 PTC UTILITY ROUTINES

2.7.1 Trace Routine Initialize

2.7.1.1 Purpose

To command the LVDC Preflight Routines to a selected routine.

2.7.1.2 Description

This routine commands the LVDC Preflight Routines to an operator selected routine and exits to the Trace Routine.

2.7.1.3 Operating Procedure

1. Using Register A switches 1-6, insert Mode 27 (8):

- 2. Operate Sign switch of Register A up and down.
- 3. Using Register A Switches 1-6 insert Mode 25:

- 4. Operate Sign switch of Register A up and down.
- 5. Using Register A switches 1-6 insert Mode of Routine desired to be traced:

- 6. Operate sign switch of Register A up and down.
- 7. Set all Register A and Register B switches off.

- 8. Perform Trace Operating Procedure for commanded routine.
- 9. To exit Trace Routine, operate Machine Reset switch on PTC.
- 10. To operate next trace, repeat steps 1-8.

NOTE: (M) Desired Mode Bits

2.7.2 PTC ASTEC Trace (Figure 2-65)

2.7.2.1 Purpose

The PTC ASTEC Trace Routine will allow the operator to trace any Preflight Routine that is commanded from the Preflight Mode Sort Table.

2.7.2.2 Description

This routine will be used as a supplement to the PTC ASTEC Monitor Routines. It will provide the following operator options:

- 1. Select type of printed output.
- 2. Allow real time operation for a predetermined number of machine cycles.
- 3. Execute a CIO instruction to supply data to the LVDA via the LVDA/ME.
- 4. Select setting the LVDC CST at the execution of each PIO instruction and obtain printed output if desired.
- 5. Select setting the LVDC CST at the execution of a unique PIO instruction and obtain printed output if desired. This option runs in real time until the unique PIO is executed.
- 6. Select setting the LVDC CST at each instruction, inhibiting printed output until a unique PIO instruction has been executed.
- 7. Select running from PIO to PIO without resetting operator controlled CST.

The operator must be familiar with the LVDC Preflight Program to make the following logical decisions:

- 1. Determine when an Input/Output CIO instruction must be executed to command the LVDC into its different program paths.
- 2. Determine if the routine to be traced must be executed in real time.

2.7.2.3 Operating Procedure

1. Using Register A, place the proper switches 14-19 and 22 on for desired option(s):

1 1 1 1 1 1 2 4 5 6 7 8 9 2 A REG

A B C D E F G OPTION

- 2. If option G is selected, trace is performed from PIO to PIO without setting operator controlled CST.
- 3. If option F or E is on, use Register B and place switches 17-25 to the unique PIO address to be compared:

1 1 1 2 2 2 2 2 2 2 7 8 9 0 1 2 3 4 5 B REG

A A A A A A A A A A A A A 9 8 7 6 5 4 3 2 1 PIO ADDRESS

- 4. If option D is on, use Register B and place switches S-25 to the desired number of instructions to be operated in the LVDC in real time (Binary counter that decrements by 1 every 2 machine cycles).
- 5. If the next PIO to be issued by the LVDC routine being traced is a request for data, perform steps 5-8; if not, skip to step 9.
- 6. Using Register A, place sign switch on and proper switches 4-12 on for the CIO address to be executed:

S 1 2 3 4 5 6 7 8 9 0 1 2 AREG

- 7. If the CIO to be executed requires data, load Register B with that data.
- 8. Depress CST ON/OFF push button on ACME.
- 9. Place sign switch of Register A OFF.

- 10. Depress CST ON/OFF push button on ACME.
- 11. Return to step 1 if trace is not complete when CST ON/OFF push button indicates CST is present.
- 12. EXIT Routine.

NOTE:

- (A) If bit is a 1 (one), printed output is not desired.
- (B) If bit is a 1 (one), printed LVDA and LVDA/ME output register status is not desired.
- (C) If bit is a 1 (one), printed DOM data is not desired.
- (D) If bit is a 1 (one), there is to be real time operation for (X) number of machine cycles.
- (E) If bit is a 1 (one), there is to be continuous CST operation until unique PIO is issued.
- (F) If bit is a 1 (one), there is to be real time operation until a unique PIO is issued.

The order of priority is A, B, C, and F, E, D.

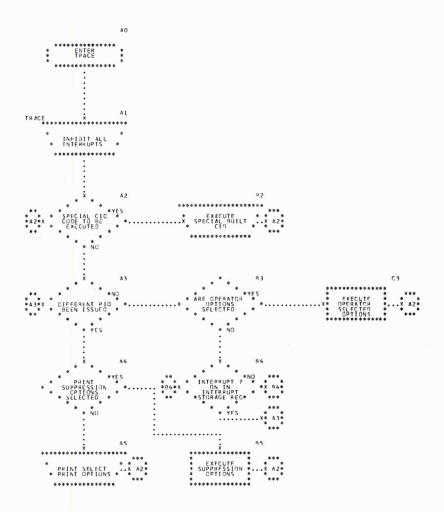


Figure 2-65. PTC ASTEC Trace

2.7.3 Automatic Sequence (Figure 2-66)

2.7.3.1 Purpose

An automatic sequence function is incorporated to provide a controlled test to verify that the Preflight Program is operating properly within the capability of the ASTEC system and the PTC ASTEC Preflight Program.

2.7.3.2 Description

The Automatic Sequence is designed to provide the following features:

- 1. Easily selected by an operator commanding an Initialize Routine.
- 2. Easily terminated by an operator commanding Machine Reset or automatically at the successful completion of the Automatic Sequence.
- 3. Once initialized, the only manual operation required, under normal conditions, is the turning on or off of a ladder output recording device, and manually verifying on the ACME Memory Load and Display Panel that the Orbit Program was entered.
- 4. An operator will be notified of program detected errors by CST being issued to the LVDC and the PTC. To continue the operator must drop CST from the ACME front panel.
- 5. The operator will be notified when to turn on or off the ladder output recording device, and when to manually verify the Orbit Program was entered with a printed message and a sufficient delay for the operation to be executed.
- 6. The simulated LVDA input data will be predefined and stored in tables to provide predictable results for each routine commanded.
- 7. Adapted to allow easy changing of the sequence of routines and/or the simulated LVDA input data by loading a trailer tape.

2.7.3.3 Operating Procedure

- 1. Clear entire LVDC and PTC memory.
- 2. The Automatic Sequence Program can only be run under two modes of operation. The operator must select either a or b.
 - a. Load the latest Preflight, Orbital, and Flight tapes. The printed output should agree with this output document.

- b. Load only the latest Preflight tape. The printed output should agree on all pages except pages 22, 27, 37, 49, 71, 74, 86, and 101.
- 3. Load PTC with latest ASTEC Preflight Program.
- 4. Set up a ladder output recording device: Hooked up, Power on, but not moving paper. Recommended speed is 2-5 mm/sec.
- 5. Place all A and B Register switches off.
- 6. Place PTC into Data Display.
- 7. Place ACME into Data Display.
- 8. Place A Register switches 6, 14, and 22 on.
- 9. Place A Register switches 15 and 16 on, if desired. (Switch 15 is for CIU Monitor special PIO 042 card in Adapt I/O Int. 11 is required. Switch 16 is for Memory Error Monitor.)
- 10. Place A Register sign switch up and down.
- 11. Operator should respond to ladder recorder on/off print messages if ladder profiles are desired.

Appendix A contains the documented output that should be verified against the printed output obtained from the Automatic Sequence Program.

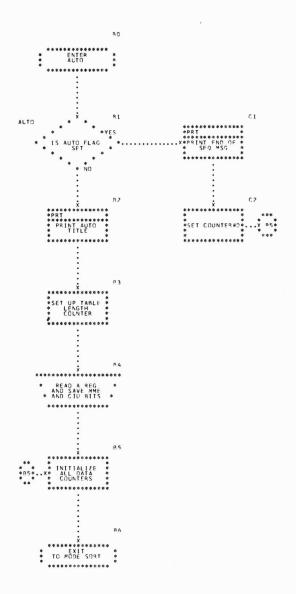


Figure 2-66. Automatic Sequence

SECTION 3

ASTEC FLIGHT PROGRAM

3.1 GENERAL DESCRIPTION

To perform the LVDC Flight Program on the ASTEC configuration, the ASTEC Flight Program must perform the following functions:

- 1. Simulate the RCA-110 computer's prelaunch function. This involves the use of the LVDA/ME's Output Registers through which the data adapter's RCA and Interrupt Storage Registers can be addressed for the purpose of commanding the LVDC to execute, in the case of the RCA Register, a prelaunch routine or the Flight Program.
- 2. Simulate inertial platform inputs to the Flight Program. This involves the use of the LVDA/ME's velocity counters and output registers (COD Serializer) through which the data adapter's duplex velocity and COD counter registers can be addressed for the purpose of supplying velocity and gimbal angle inputs to the LVDC's Flight Program.
- 3. Simulate vehicle inputs to the Flight Program. This involves the use of the LVDA/ME's Output Registers through which the data adapter's Discrete Input and Interrupt Storage Registers can be addressed for the purpose of supplying discrete inputs and interrupts (low level sense, etc.) to the LVDC's Flight Program.
- 4. Serve as an output medium by recording and documenting, as printed outputs, specified Flight Program parameters. This involves the use of the LVDA/ME by which telemetry data and switch selector data sent to the LVDA by the Flight Program can be addressed and identified.
- 5. Accept operator inputs which specify conditions under which the Flight Program will be exercised. This involves the use of the "A" and "B" Registers located on the PTC front panel from which the operator may insert, according to a definite format values which determine input/output options, issuance of discretes and interrupts, PTC and LVDC programs to be exercised and the particular flight mode to be executed by the Flight Program. The 1443 Printer will be used to indicate, through printed messages, when the operator can perform the previously mentioned functions.

The ASTEC Flight Program has three major divisions, the Preflight Monitors, the Flight Test Routines, and the Utilities Subroutines. Refer to Figure 3-1 for an overall flowchart of the program.

The Preflight Monitors control the LVDC Preflight Routines:

- 1. Monitor Power Up
- 2. Monitor Force Begin
- 3. Monitor Sum Check
- 4. Monitor Sector Dump
- 5. Monitor Prepare to Launch

The Flight Test Program Consists of the following sections:

- 1. The Initialization Section, in addition to initializing program variables and program switches, selects the options to be run as defined in the ASTEC Flight Initialize.
- 2. The Main Loop Section will be interrupted by LVDC Computer Telemetry, Fine Gimbal Angle Requests, Minor Loop Interrupts, Switch Selector Register Load, a special interrupt to process Data Adapter Single Step (DST), a special interrupt to process computer interface unit data (CIU) and the PTC manual interrupt. The Main Loop will perform the following functions:
 - a. Update time.
 - b. Compute earth's rate effect on platform gimbals and accelerometer.
 - c. Process CIU requests.
 - d. Process vehicle inputs to the Flight Program.
- 3. The Output Processing Section prints in real time, the quantities selected. These quantities consist of telemetry, Switch Selectors and special command receiver (C.R.) data which are selected in the initialize section.

Available to the user are certain routine selections under which the ASTEC Flight Program will run with certain output options to record the data generated and transmitted. The option is specified at the beginning of the run. They are listed below.

- a. Sim Flight Option 35 will document selected telemetered quantities or capture switch selector data in orbit as well as boost.
- b. Sim Flight Option 36 outputs the same telemetry quantities as Option 35 during the boost phase. Upon reaching orbit, the output format is all telemetry PIO tags.
- c. Sim Flight Option 37 outputs all telemetry PIO tags. This option must be selected before the Snap Option or the DST option can be executed.
- d. Sim Flight Option 40 documents DCS telemetry or normal telemetry and is capable of providing command receiver data and computer interface unit data to the LVDC upon request.
- e. Mode 35 (Preflight DCS) provides Command Receiver data to the LVDC upon operator request. Only DCS telemetry will be documented.

The Utilities Subroutines are used by the Preflight Monitors and the Main Loop.

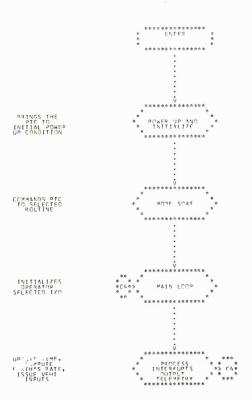


Figure 3-1. Overall Flow

3.2 SYSTEM POWER UP (Figure 3-2)

The PTC is brought to its initial power up condition at which point initialization of I/O controls is performed and the LVDC forced to its power up position.

3.2.1 LVDA/ME Set Up Procedure

- 1. If the DST is to be utilized, special interrupt card PIO 023 must be inserted into the I12 position of the LVDA/ME.
- 2. If a CIU processing routine is to be executed, insert special interrupt card PIO 042 into the Ill position of the LVDA/ME.
- 3. If a Command Receiver Routine (option 40) is to be executed, insert special interrupt card PIO 016 into the I14 position of the LVDA/ME.

3.2.2 LVDC/ME Set Up Procedure

- 1. Run an LVDC clear program to insure good parity in all memory locations.
- 2. Load the LVDC with the Flight Program, Orbital and Preflight Routines.
- 3. If the Preflight Routines are <u>not</u> in the LVDC, load the Flight Sim indicator word (SIMIND) location 2, 17, 024 with the proper bits defining the mode to be run.

3.2.3 PTC Set Up Procedure

- 1. Run a PTC clear program to insure good parity to all memory locations.
- 2. Load the PTC with the ASTEC Flight Program.
- 3. Set the Error Hold Pushbutton on. The pushbutton is located on the Processor Display Panel.
- 4. Turn Inhibit CTRL on, then off. The pushbutton is located on the Processor Display Panel.
- 5. Make the Printer ready.
- 6. Turn PROG REG A switches S-25, off.

- 7. Turn PROG REG B switches S-25 off.
- 8. Set the PTC in Data Display (DD) mode. Pushbutton located on the Tape Reader and Mode Control Panel.

The following messages will print:

PON

PLACE PIO CARDS IN THE LVDA/ME FOR,

- 1. CIU, PIO 042 IN I11
- 2. DST, PIO 023 IN I12
- 3. DCS, PIO 016 IN I14

IN PTC MODE SORT

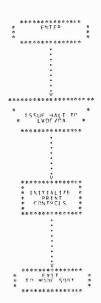


Figure 3-2. Power Up Sequence

3.3 SIM FLIGHT OPERATING PROCEDURE

This outline presents the step by step procedure for selecting the Sim Flight Mode which the LVDC Flight Programs are to run, and the type of input/output data needed. Figure 3-3 provides a convenient diagram of the PTC switch assignments.

- 1. The status code, 00 will be displayed in the PTC mode lights after the message 'In PTC Mode Sort' is printed.
 - a. Turn on the switches in the A-Register for the type of run to be made.
 - b. Turn on the switches in the B-Register for the type of input/output desired.
 - c. If it is desired to repeat a run using the same values that were entered in either of these registers on a previous run, they do not have to be specified again. However, if one switch position is to be changed with the exception of Switches 11 and 12 in the A-Register, the rest of switches in that register must be reset.
 - d. Activate the A-Register Sign Switch and the data in the registers will be processed.
 - e. A status code 77 will be displayed and program execution will pause until all the A and B switches are cleared. A-Register Switches 11 and 12 are exempted from this restriction because they may be used at any time during the run.
 - f. The heading for the A and B Registers will be printed to provide documentation of the type of run and the I/O selected. This printout will be bypassed if A-Register Switch 22 is on.
 - g. At this point, a status code of 01 will be displayed. Now load the Sim indicator in the B-Register switches. As before, if a run is to be repeated, the switches may be left in the off position.
 - h. Activate the A-Register Sign Switch and the data in the registers will be processed.
 - i. A status code 77 will be displayed and program execution will pause until all the A and B switches are cleared. A-Register Switches 11 and 12 are exempted from this restriction because they may be used at any time during the run.

- j. If the SNAP Routine has been selected, execution will pause to allow SNAP data to be entered. A status code of 02 will be displayed in the PTC Mode lights.
- k. After the above information has been processed, program execution will begin if there have not been any input errors.

2. Operator Input Errors

The following error conditions are checked by the ASTEC Program.

a. Invalid Sim Indicator

If the Sim indicator is zero or if the SIGN bit is set the message 'Invalid Sim Indicator, Reload' will be printed. Additionally, a status code of 70 will be displayed in the mode lights. The operator may reload the Sim indicator by putting the proper switches on in the B-Register and activating the A-Register Sign Switch.

b. Specify Pad

If a non-repeatable run is requested, it is necessary to specify the launch pad to obtain the correct latitude. Failure to do so will cause the message 'Specify Pad'' to be printed. A status code of 71 will be displayed in the mode lights. The operator may now specify the pad by turning on the proper B-Register switch and activating the A-Register Sign Switch.

c. Specify Discretes or Interrupts

If a non-repeatable run is requested, it is necessary to specify whether discretes or interrupts are to be issued to the LVDC Flight Program. Failure to specify either one will cause the message "Specify Discrete or Int." to be printed. A status code of 72 will be displayed in the mode lights. The operator may now specify the proper input by turning on Switches 15 or 16 in the B-Register and activating the A-Register Sign Switch.

3. Manual Selection of Routines and I/O during Program Execution. With this ASTEC Program, it is possible to manually make some program requests while a run is in process. These are described below.

a. Option Switching During Program Execution

When Options 35 or 37 have been selected, it is possible to switch from one option to the other while the run is in process. In the case of Option 35, it is also possible to change the Output Options. Also the DST Option can be selected or deleted while Option 37 is in process. The procedures for initiating this operation are given below.

- 1) To change Option 35 output, turn on switch 5 of the A-Register (indicates Option 35) and turn on one of the switches (Sign through 4) of the B-Register for the output option requested. Activate the A-Register Sign Switch and the new output option will be selected. The Sign Switch should remain on for about 1 second to allow the PTC program time to read it.
- 2) To change from Option 35 to Option 37, turn on Switch 7 of the A-Register (indicates Option 37) and activate the A-Register Sign Switch.
- 3) To change from Option 37 to Option 35, repeat Step 1).
- 4) To select the DST option, turn on Switch 7 and Switch 21 of the A-Register. Activate the A-Register Sign Switch.
- 5) To delete the DST Option, repeat procedure 5), but allow Switch 21 of the A-Register to remain off.

4. Manual Operations with Sim Flight Option 40

Option 40 is designed especially to check out the orbital LVDC programs. It is convenient to have the capability to provide input data to these programs any time during program execution. Therefore, the following procedures are available.

a. CIU Operating Procedure

Switch 14 and 15 of the A-Register provide CIU data as follows:

Switches 14 and 15 - 0 No CIU Data

14 - 1 Variable Data

15 - 1 Constant Data

Activate the A-Register Sign Switch to initiate the data input. A-Register Bits 1 - 6 must be all zero.

b. Command Receiver Operating Procedure

The Command Receiver may be exercised under 3 modes: the Automatic Mode, the Automatic Modified Mode and the Manual Mode.

The Automatic Mode will issue command receiver data to the LVDC Program from PTC Memory. To operate, place in A-Register Switches 1 - 6 the six bit octal number which selects the mode command, activate the A-Register Sign Switch and the data will be issued to the LVDC.

The Automatic Modified Mode will issue command receiver data to the LVDC program from PTC memory, but the data will be modified to produce certain errors as indicated by the B-Register input shown below:

S-12	Input words to fail
13-15	Number of failures
16	Sequence bit error
17	Complement error
18-25	Spares

Up to 13 input words will fail, 'X' number of times each, in the manner specified. Count the mode command as the first word. To operate, place in the A-Register Switches 1-6 the six bit number which selects the mode command. Activate the A-Register Sign Switch and the data will be issued to the LVDC.

The Manual Mode will issue command receiver data to the LVDC Program from the B-Register switches. Place in the B-Register Switches S-23 the 6 bit data words. B-Register Switches 24 and 25 indicate the number of data words to be issued. A detailed description of the command receiver data format is given in Appendix B.

5. Manual Operations with Mode 35

Mode 35 is designed to check out the Digital Command System (DCS) for updating flight parameters while the LVDC Preflight Routines are in execution.

The Command Receiver operating procedures described above also apply for this option.

FIRING

AZIMUTH

ALIGN-

MENT

FOR

CUTOFF

FOR

CUTOFF

FOR

PAD 34

FOR

PAD 37B

A SWITCH REG 10 SIGN 1 2 3 4 5 6 7 8 9 11 12 MON. MON. MON. PTC SIM FLT SIM FLT SIM FLT SIM FLT HAND LOAD OCTAL INST. MODE SECTOR SUM SECTOR OPTION POWER OPTION OPTION OPTION PATCH TO SECTOR 35 DEC DUMP CHECK DUMP UPDUMP 35 36 37 40 OPT ROUTINE SELECTOR 13 14 15 16 17 18 19 20 21 22 23 24 25 CIU OPT ABORT TO COMPUTE LVDC PATCH AS-200 CIU OPT ABORT TO COMMAND BYPASS LOAD ORBIT SNAP DST HEADING PUNCH VARIABLE CONSTANT ORBIT ORBIT REC orOPT. 1 OPT OPT. 2 ROUTINE OPT AS-500 DATA DATA WORD B SWITCH REG 12 2 3 4 5 11 SIGN 1 6 7 8 9 10 SPACE-H₂O METH DIN 10 OR H₂O METH SELECT SELECT SELECT SELECT SELECT SELECT SELECT CRAFT DĨN 11 OR OUTPUT OUTPUT OUTPUT OUTPUT OUTPUT SWT SEL SWT SEL CONTROL DIN SPARE DIN SPARE OPT SIGN OPT 1 OPT 2 OPT 3 OPT 4 OPT 1 OPT 2 DIN 9 INPUT/OUTPUT SELECTOR 13 17 18 19 21 22 23 24 25 14 15 16 20 VARIABLE FIN 1 INTERRUPT DISCRETES LATITUDE LATITUDE LATITUDE LATITUDE

FOR

PAD 39A

FOR

PAD 39B

3.4 SIM FLIGHT OPTIONS

These routines will operate the LVDC Flight Program in the Sim Flight Mode. They are selected by turning on the following switches of the A-Register.

- 1. Switch 5 selects Sim Flight Option 35. (See Figure 3-4). This option outputs certain telemetry quantities which will be described later. This option must be run to capture Switch Selector data in orbit as well as boost.
- 2. Switch 6 selects Sim Flight Option 36. This option outputs the same telemetry quantities as Option 35 during the boost phase. Upon reaching orbit, the output format is all telemetry PIO tags.
- 3. Switch 7 selects Sim Flight Option 37. This option outputs all telemetry PIO tags.
- 4. Switch 8 selects Sim Flight Option 40. This option will output either Digital Command System (DCS) telemetry or Normal Telemetry Executive Telemetry and it is capable of providing Command Receiver (CR) data and Computer Interface Unit (CIU) data to the LVDC upon request. When this option is run the platform must be powered down.
- 4A. Switch 9 selects Mode 35 (Preflight DCS). This option provides Command Receiver data to the LVDC upon request and receives Digital Command System (DCS) telemetry outputs in return.
- 5. Switch 11 turned on will provide decimal output when running Sim Flight Option 35 or Option 36 during the boost phase. However, because of the conversion time required, every other computation cycle will be missed. If every computation cycle is desired, it is possible to switch to octal printout while the run is in process.
- 6. Switch 12 is used in conjunction with the sector dump options. If this switch is turned on, the dumps will be made in an instruction format. It is possible to switch back and forth from instruction format to octal format at any time during a dump.
- 7. Switch 13 selects the proper input conditions for running an AS-200 or an AS-500 LVDC Flight Program. This switch should be placed in the OFF position when running with 200 programs. The ON position is used for 500 programs.
- 8. Switch 14 turned on allows one of the Computer Interface Options (the CIU option) to operate. When this option is selected, the PTC will simulate the transfer of 10 bits of variable data from the CIU to the LVDA. The operation of this option is described as follows:

Whenever the LVDC program issues a load CIU address PIO, (PIO 042) the normal execution flow of the PTC routines will be interrupted (this is the reason for the special PIO 042 interrupt card requirement) and the CIU data will be loaded. When Sim Flight Options 35, 36, or 37 are running, this data transfer will be almost immediate. However, Option 40 provides a time delay. This delay starts at 83 milliseconds and is decremented to 0 milliseconds in steps of 1 millisecond for each PIO 042 received.

- 9. Switch 15 turned on also simulates CIU operation. However, in this case, a constant data value is transferred to the LVDA instead of variable data as in the first option.
- 10. Switch 16 turned on selects one of the Abort to Orbit Options. It will issue the proper DCS Mode Command and interrupts to cause the LVDC Flight Program to enter the abort routines. In the case of an AS-200 flight program, the abort commands will be issued 5 seconds after the outboard engine cutoff. For the AS-500 case, the abort commands will be issued 5 seconds after S-IC engine cutoff.
- 11. Switch 17 turned on selects the other abort option. It is similar to the first option except for the time delay in issuing the commands. In the AS-200 case, the abort command is issued 100 seconds after S-IB outboard engine cutoff, and 100 seconds after S-IC engine cutoff for AS-500 programs. Both of the abort options require that the run be non-repeatable.
- 12. Switch 18 has been reserved for the planned Compute Orbit Option. This option will be capable of computing the orbit characteristics, such as apogee, perigee, etc., from telemetered data quantities. This option is not available at the time of this writing.
- 13. Switch 19 is used together with Sim Flight Option 40. When turned on, DCS telemetry only will be output when a run is in process. If switch 19 is turned off, DCS and telemetry executive telemetry will be output on the printer. This switch selection must be made prior to the start of a particular run.
- 14. Switch 20 is used with Sim Flight Option 37 only. This switch turned on specifies that the SNAP option is to be run. Prior to the start of a run, execution will pause to allow up to 10 SNAP start and stop times to be read into PTC memory. The format is as follows:

A switches

SNAP start time scaled B16

B switches

SNAP stop time corresponding to the above start time, scaled B16

Activating the A-Register Sign Switch, will allow these values to be read into the PTC memory. Repeat for up to 10 start/stop times. If a zero stop time is specified, continuous printing will begin at the specified start time.

15. Switch 21 is used with Sim Flight Option 37 (See Figure 3-5). This switch turned on specifies that the DST option is to be run with Option 37. DST (Data Adapter Single Step) will stop the execution of the flight program to allow time for the accumulated telemetry which has been stored in PTC memory to be printed. When this storage buffer has been printed, the DST will be released and operation will continue until the buffer is filled again. When DST is used, operating time is increased by about a 5 or 6 to 1 ratio. If DST is not selected (Switch 21 left off), telemetry will not be stored when the storage buffer is filled. After the buffer has been printed, further telemetry will be stored until the buffer is filled again. Therefore, segments of telemetry output will be stored and printed each time storage space is available. The storage buffer will store 1024 telemetry quantities.

3.4.1 MANUAL UTILITY SELECTION

The PTC A Register Switches may be used to select the following manual utility options.

- 1. Switch 10 turned on selects the Handload Patch Option, which allows the operator to put patches into special PTC core locations through use of PTC A and B Register switches.
- 2. Switch 23 turned on selects the LVDC Load Option, which loads patches into LVDC core from the PTC.
- 3. Switch 24 turned on selects the Patch Punch Options. This option punches the handload patches, which have been manually loaded into PTC core, onto paper or mylar tape.

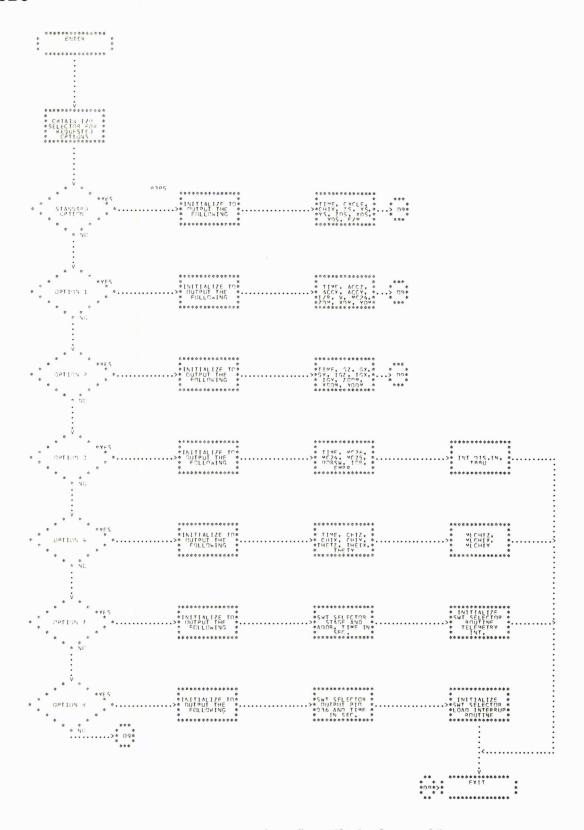


Figure 3-4. Initialize Sim Flight Option 35

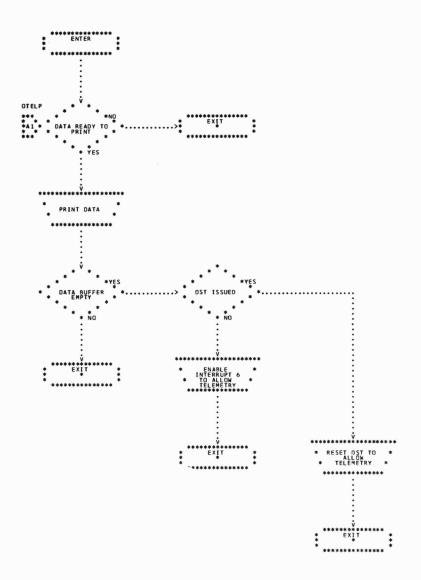


Figure 3-5. Option 37 Print Routine

3.5 INPUT/OUTPUT SELECTION

The PTC B switches are used to select the following input/output options.

- 1. Switches (sign) through 4 are used to select the different telemetry quantities to be printed when running Sim Flight Option 35. Trailer tapes will be provided to accommodate the different telemetry quantities output by both the AS-200 and AS-500 Flight Program. The normal telemetry output is given below. The description of the trailer tapes is given in Appendix C.
 - a. The Sign Switch turned on will output the following:

PIO	QUANTITY
0000	TASEC
0575	CCCNT
0011	CHIY
0034	ZS
0044	XS
0050	YS
0110	ZDS
0114	XDS
0120	YDS
1144	F/M

b. Switch 1

PIO	QUANTITY
0000	TASEC
0004	ACCZ
0010	ACCX
0014	ACCY
0054	I/R
0124	V
0415	MC24
1020	ZDM
1024	XDM
1030	YDM

c. Switch 2

PIO	QUANTITY
0000 0060 0064 0070 1074 1100	TASEC GZ GX GY IGZ IGX
1104 1130 1134 1140	IGY ZDDM XDDM YDDM

d. Switch 3

PIO	QUANTITY
0000	TASEC
0401	MC26
0415	MC24
0421	MC25
0425	DORSW
0431	ICR
0435	EMRR
0441	INT
0465	DIS. IN.
0475	TBBU

e. Switch 4

PIO	QUANTITY
0000	TASEC
0001	CHIZ
0005	CHIX
0011	CHIY
0015	\mathtt{THETZ}
0021	THETX
0025	\mathtt{THETY}
0501	MLCHIZ
0505	MLCHIX
0511	MLCHIY

3.5 INPUT/OUTPUT SELECTION

The PTC B switches are used to select the following input/output options.

- 1. Switches (sign) through 4 are used to select the different telemetry quantities to be printed when running Sim Flight Option 35. Trailer tapes will be provided to accommodate the different telemetry quantities output by both the AS-200 and AS-500 Flight Program. The normal telemetry output is given below. The description of the trailer tapes is given in Appendix C.
 - a. The Sign Switch turned on will output the following:

PIO	QUANTITY
0000	TASEC
0575	CCCNT
0011	CHIY
0034	ZS
0044	XS
0050	YS
0110	ZDS
0114	XDS
0120	YDS
1144	F/M

b. Switch 1

PIO	QUANTITY
0000	TASEC
0004	ACCZ
0010	ACCX
0014	ACCY
0054	I/R
0124	V
0415	MC24
1020	ZDM
1024	XDM
1030	YDM

c. Switch 2

PIO	QUANTITY
0000	TASEC
0060	GZ
0064	GX
0070	GY
1070	IGZ
1100	IGX
1104	IGY
1130	ZDDM
1134	XDDM
1140	YDDM

d. Switch 3

PIO	QUANTITY
0000 0401 0415 0421 0425	TASEC MC26 MC24 MC25 DORSW ICR
0435 0441 0465 0475	EMRR INT DIS. IN. TBBU

e. Switch 4

PIO	QUANTITY
	m + GT G
0000	TASEC
0001	CHIZ
0005	CHIX
0011	CHIY
0015	THETZ
0021	THETX
0501	THETY
0505	MLCHIX
0511	MLCHIY

- 2. Switch 7 turned on will provide the following switch selector output.
 - a. Switch Selector Stage and Address
 - b. Time Base
 - c. Time of Switch Selector, output referenced from the respective Time Base

To obtain accurate times for the switch selector output, a hand load is required in the LVDC program time base change routine. This hand load is a PIO 561 which will cause the time base change to be telemetered near the time it actually took place. A location is reserved for this hand load in the LVDC program.

- d. Time of switch selector output referenced from Guidance Reference Release.
- 3. Switch 8 turned on will provide the following switch selector output.
 - a. Contents of the LVDA switch selector register which is loaded by an LVDC PIO 036 command.
 - b. Time Base
 - c. Time of switch selector output referenced from the respective time base.

To obtain accurate times for the switch selector output, a hand load is required in the LVDC program time base change routine. This hand load is a PIO 561 which will cause the time base change to be telemetered near the time it actually took place. A location is reserved for this hand load in the LVDC Program.

- d. Time of switch selector output from Guidance Reference Release.
- 4. Switch 13 turned on indicates that the flight program utilizes a variable firing azimuth. The flight program will require additional input which has not been defined at the time of this writing. Some PTC program modification will have to be made to supply this information. This will probably be done at a later date.

5. Switch 14 will select the proper vehicle FIN 1 alignment which is required by the flight program.

Switch
$$14 = 0$$
 Supplies 90° = 1 Supplies 100°

6. Switches 15 and 16 provide the capability to the operator to select either interrupts or discretes as input to the flight program. These inputs provide the necessary information for the flight program to initiate the following time base changes:

AS-200	AS-500
LIFT OFF	LIFT OFF
LOW LEVEL SENSE	LOW LEVEL SENSE
OUTBOARD ENGINE CUT OFF	S-IC CUT OFF
S-IV-B CUT OFF	S-II CUT OFF S-IV-B CUT OFF

Switch 15 turned on provides interrupts and Switch 16 turned on provides discretes. Both switches turned on provide both these inputs. It should be pointed out that in the AS-200 flights, the S-IB stage does not include discretes as a necessary input to indicate nominal LLS or OBECO. The PTC program at the time of this writing provides discretes for inboard engine out (IBEO) and outboard engine out (OBEO) at the nominal time for LLS and OBECO. Detailed information is provided in Appendix D, if it is desired to prevent the issuance of these discretes or to change them. Additionally Appendix D supplies the nominal time values which the interrupts or discretes are issued.

7. Switches 17 through 20 indicate to the PTC program the latitude of the launch pad for which the flight program is initialized. This is a necessary requirement to allow the PTC program to provide the correct platform inputs. The values for latitude provided are given below:

SWITCH	PAD	LATITUDE (deg.)
17	34	28.521963
18	37B	28.531856
19	39A	28.647480
20	39 B	28.627307

NOTE: The inputs described in Paragraphs 4 and 5 are required only when the flight program is run in the non-repeatable Sim Flight Mode.

3.6 ROUTINES

3.6.1 Mode Sort (Figure 3-6)

3.6.1.1 Purpose

To accept an input word from the operator and interpret it as a Mode Command indicating the desired routine to be executed.

3.6.1.2 Description

The Mode Sort Routine reads the PTC A and B Registers to determine the Monitor Routine or the simulation mode to be executed. The Monitor Routine causes a status code to be issued to the LVDC preflight routines indicating the Preflight Routine to be monitored. When one of the simulation modes is to be executed, an exit is to the initialize routine for that mode.

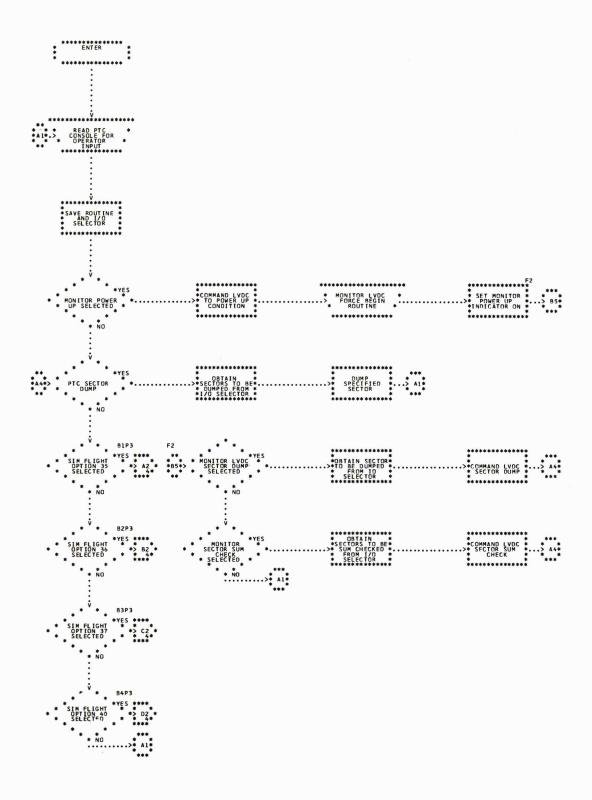


Figure 3-6. Mode Sort

3.6.2 Flight Test Initialize (Figure 3-7)

3.6.2.1 Purpose

Select and initialize the various Flight Test Input/Output Options.

3.6.2.2 Description

This routine is entered from PTC Mode Sort to one of four entries depending on the simulation flight option selected, thus providing linkage between Mode Sort and the flight test routines.

Each entrance will save the PTC program status light value and initialize indicators, flags and HOP constants for that particular option.

It calls the subroutines which provide the operator with documented messages as well as subroutines which accept input data from the PTC Switches and load data into the LVDC Flight Program. It also calls subroutines which initialize routines in the Main Loop of the Flight Test Program.

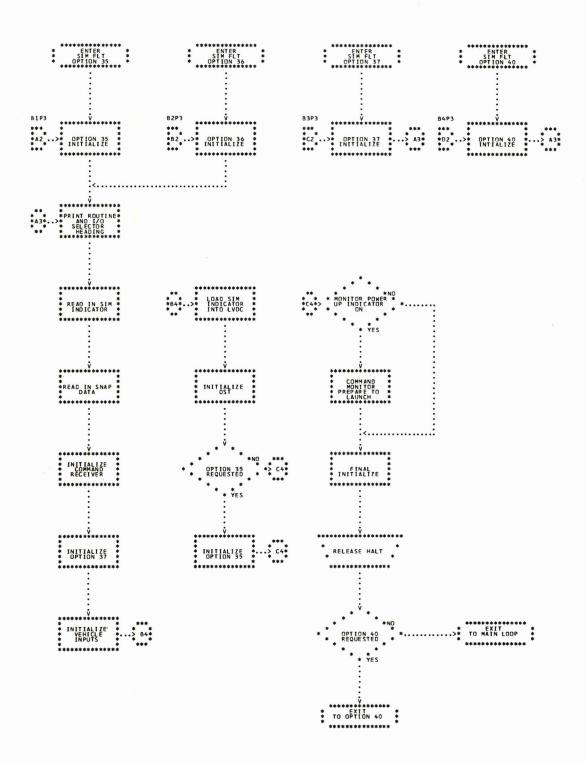


Figure 3-7. Flight Test Initialize

3.6.3 Main Loop (Figure 3-8)

3.6.3.1 Purpose

To perform calculations and issue vehicle inputs.

3.6.3.2 Description

This routine will perform earth rate calculations for the platform inputs, update time and issue vehicle inputs when GRRI (Guidance Reference Release Interrupt) is issued.

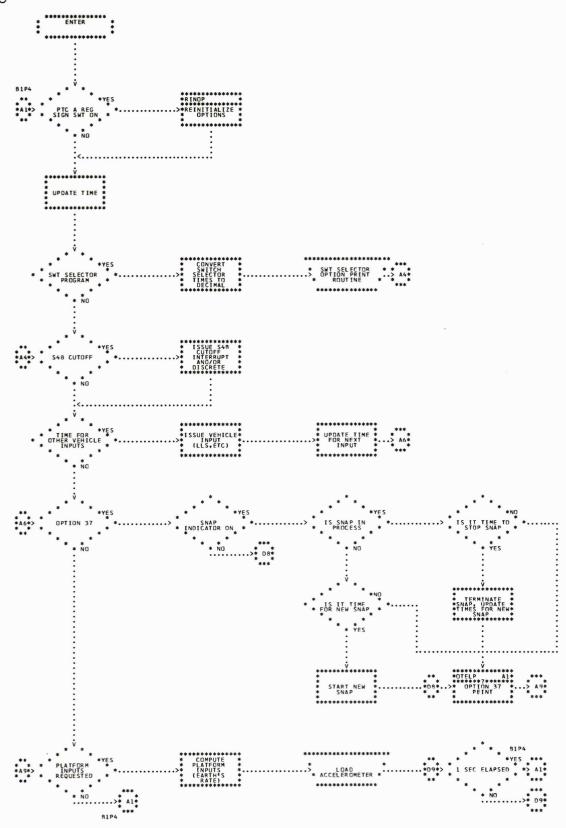


Figure 3-8. Main Loop

3.6.4 Interrupt Processing (Figure 3-9)

3.6.4.1 Description

The Interrupt Processing Routines consist of LVDC Telemetry, Fine Gimbal Angle Requests, Minor Loop, Switch Selector Register Load, DST, CIU, and PTC Manual Interrupt.

Switch Selector Interrupt Routine No. 1 is used to set flags when certain switch selector addresses are received.

Switch Selector Interrupt Routine No. 2 is used to capture switch selector data for the Switch Selector Routine (Sim Flight Option 35, I/O Option 8). In addition S4BCO flag will be set by this routine.

Minor Loop Interrupt Routine loads the COD shift register with gimbal angles computed by the Earth Rate Routine.

Fine Gimbal Angle Read Interrupt Routine determines which PIO (Pitch or Roll) caused the interrupt and loads gimbal angle value into the COD shift register. If neither one caused the interrupt, the one value for any is loaded into the COD shift register.

CIU Interrupt Rouţine causes the PTC to simulate the transfer of ten bits of variable data or a constant data value from the CIU to the LVDA.

PTC Manual Interrupt Routine will issue DST to the flight program. The purpose of the DST is to provide time to change telemetry tapes.

The LVDC Computer Telemetry Interrupt Routine reads and stores the telemetered data word and buffer register word for the output routine.

The DST Interrupt Routine will issue DST to the LVDA. If the DST is used, all computer telemetry will be printed.

The Command Receiver Interrupt Routines will issue Command Receiver inputs to the Flight Program.

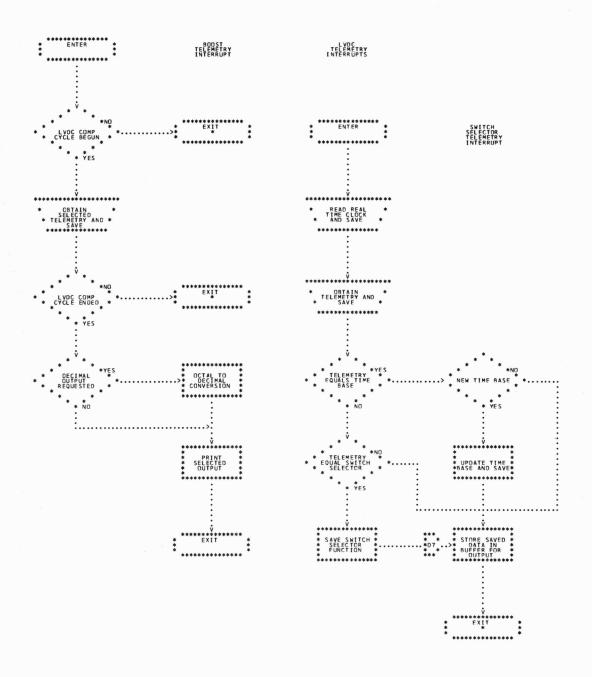


Figure 3-9. (Sheet 1 of 7) Interrupt Routines

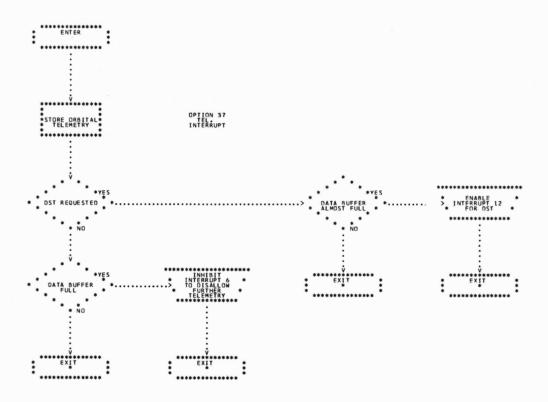


Figure 3-9. (Sheet 2 of 7) Interrupt Routines

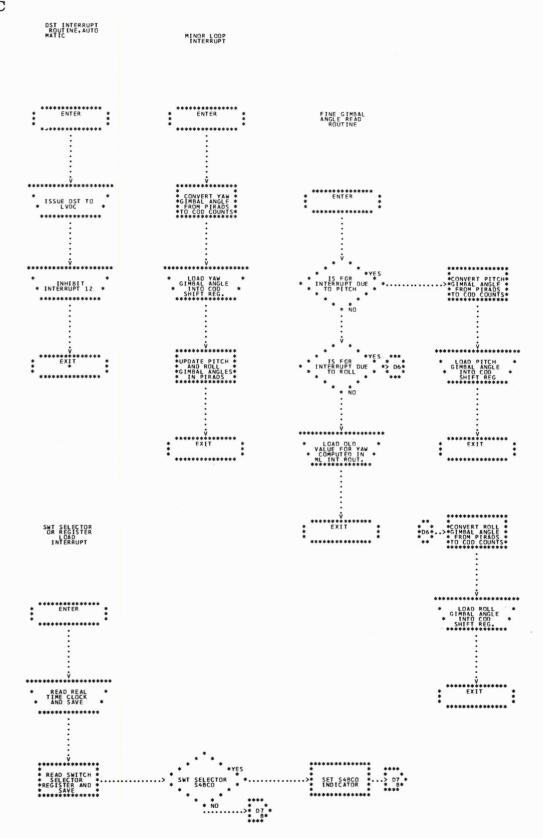
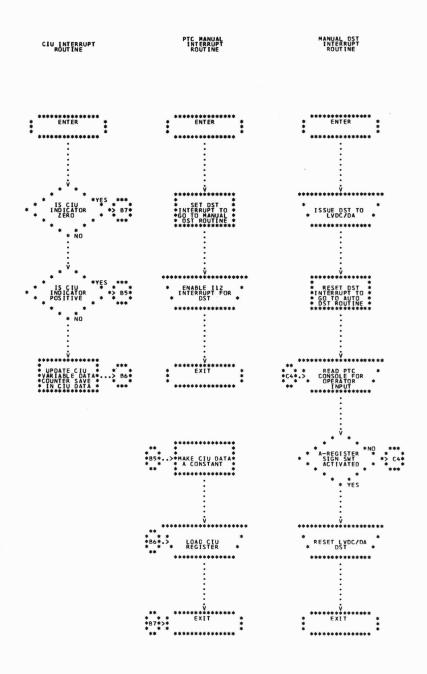


Figure 3-9. (Sheet 3 of 7) Interrupt Routines



Figures 3-9. (Sheet 4 of 7) Interrupt Routines

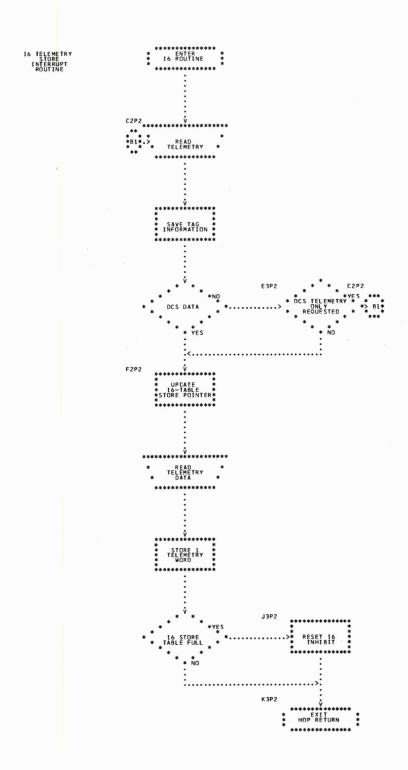


Figure 3-9. (Sheet 5 of 7) Interrupt Routines

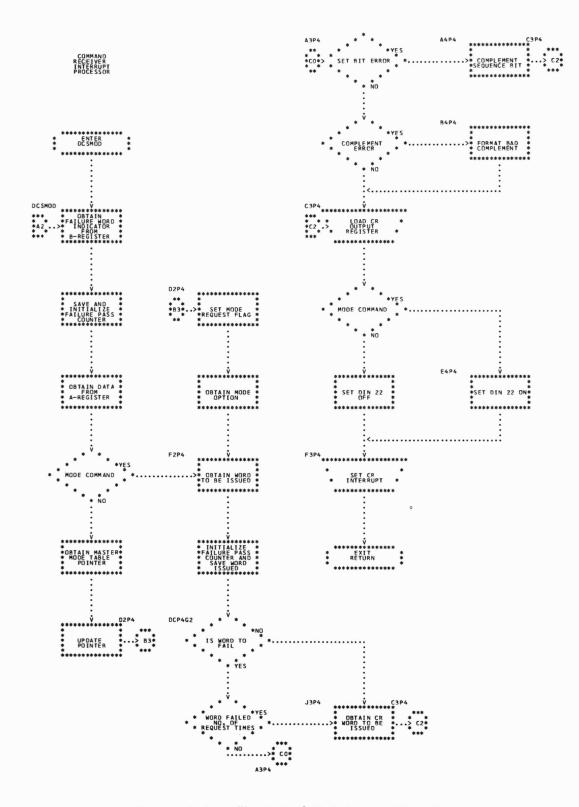


Figure 3-9. (Sheet 6 of 7) Interrupt Routines

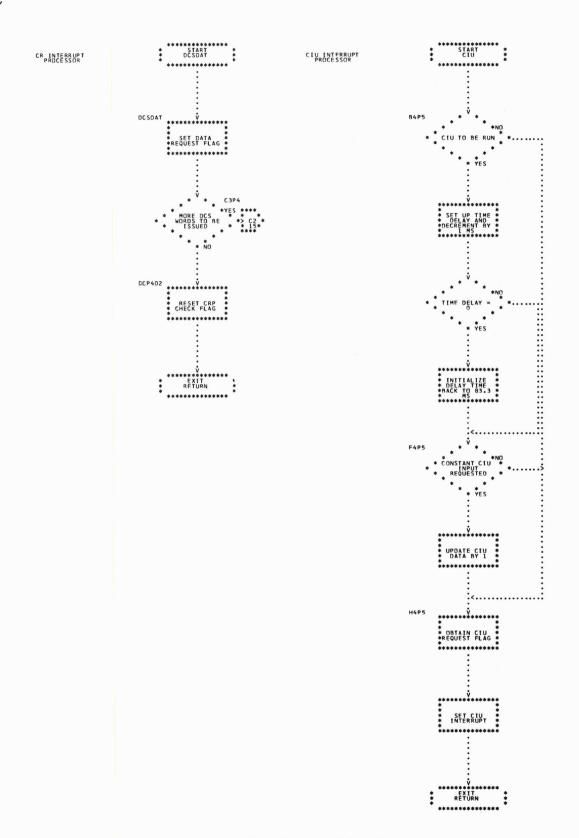


Figure 3-9. (Sheet 7 of 7) Interrupt Routines

3.6.5 Monitor Power Up

3.6.5.1 Purpose

Operates the LVDC Preflight Programs into Mode Sort.

3.6.5.2 Description

This routine shall be entered from PTC Mode Sort when the operator desires the LVDC programs to operate or anytime the LVDC/DA is restarted at its power condition. This routine shall perform the following sequence of operations:

- 1. Issue Halt to the LVDC/DA, thus assuring that the LVDC/DA is at its power up condition and the LVDC is not operating any instructions.
- 2. Issue the Monitor Power Up status code to the front panel mode lights.
- 3. Print the message: MPU
- 4. Set monitor power up indicator on and exit to Monitor Force Begin.

3.6.5.3 Operating Procedure

This routine is automatically executed if Switch 1 of the A-Register is not turned on. If for some reason the preflight routines have not been loaded into LVDC memory, Switch 1 should be turned on to bypass the execution of MPU.

3.6.6 Monitor Force Begin

3.6.6.1 Purpose

To monitor the Force Begin Routine for proper operation.

3.6.6.2 Description

This routine is automatically entered from Monitor Power Up and by any routine that issues the RCA interrupt to the LVDC/DA. This routine performs the following sequence of operations:

- 1. Issues the Monitor Force Begin status code to the front panel mode light.
- 2. Prints Monitor Force Begin message.
- 3. Prints output heading and releases Halt.

- 4. Delays until the LVDC routine is in a loop waiting for the sync input discrete.
- 5. Prints all telemetry data in the output storage block.
- 6. Resets certain LVDA registers.
- 7. Resets telemetry interrupt inhibit if it was set when the RCA interrupt was issued.
- 8. Turn sync on and then off allowing the LVDC to continue into its Mode Sort Routine.
- 9. Exits to PTC Mode Sort.

3.6.7 Monitor Sum Check

3.6.7.1 Purpose

Monitor the LVDC Sector Sum Check Routine for proper operation.

3.6.7.2 Description

This routine will supply the required simulated RCA data word from a pre-loaded or operator loaded table. This word will indicate the sector or sectors to be sum checked in the format required by the LVDC prelaunch routine.

The documented output will include:

- 1. The input RCA data word.
- 2. Status Code
- 3. Telemetry Data

3.6.7.3 Operating Procedure

This routine will operate the LVDC Sector Sum Check Routine. It will be selected when Switch 3 of the A-Register is turned on. MPU must be executed in order for this routine to operate. The modules and sectors to be sum checked are entered into the B-Register switches as follows:

Switches	1-4	Ending sector to be sum checked
	5- 8	Starting sector to be sum checked

9-11 Module Selection

3.6.8 Monitor Sector Dump

3.6.8.1 Purpose

Monitor the LVDC Sector Dump

3.6.8.2 Description

This routine will supply the required simulated RCA data word from a pre-loaded or operator loaded table. This word will indicate the sector or sectors to be dumped in the format required by the LVDC Sector Dump prelaunch routine.

The documented output will include:

- 1. The RCA input data word.
- 2. Status Code
- 3. The sector data being dumped in an instruction format or octal format.

3.6.8.3 Operating Procedure

This routine will be selected when Switch 2 of the A-Register is turned on. MPU must be executed in order for this routine to operate. The modules and sectors to be dumped are entered into the B-Register switches as follows:

Switches	1-4	Ending sector to be dumped
	5-8	Starting sector to be dumped
	9-11	Module Selection

3.6.9 Monitor Prepare to Launch

3.6.9.1 Purpose

Commands the Preflight Routines through Prepare to Launch.

3.6.9.2 Description

This routine is entered from the Flight Test Initialize Subroutine. It will load the RCA register with the prepare to launch mode word, issue Guidance Reference Release Alert and Guidance Reference Release.

3.6.10 Print Heading

3.6.10.1 Purpose

To print a heading which describes the contents of the PTC A and B Registers.

3.6.10.2 Description

This subroutine is used by Flight Test Initialize. It is an optional subroutine and will print the title for each optional subroutine available in the ASTEC Flight Program. This subroutine, also, provides the operator with a documented status of the options selected.

3.6.11 Print Sim Indicator

3.6.11.1 Purpose

To print a heading which describes the contents of the Sim Flight Indicator Word.

3.6.11.2 Description

This subroutine is used by Flight Test Initialize. It is an optional subroutine which prints the title for the Sim Indicator Word loaded into the LVDC Flight Program. This subroutine will also print the status of the Sim Indicator Word.

3.6.12 Load Sim Indicator

3.6.12.1 Purpose

To load the Sim Indicator word, Firing Azimuth and Fin 1 Alignment into LVDC Memory, using the LVDC Prelaunch Load and Verify Routines.

3.6.12.2 Description

This subroutine is used by Flight Test Initialize. The Sim Indicator word is loaded with the Huntsville or Cape Kennedy conditions depending upon the option selected by the operator. The Sim Indicator is commanded from the PTC B-Register Switches.

This subroutine formats the Sim Indicator Word as required for LVDC input data, calculates the firing azimuth and fin alignment in Pirads and formats them as input data words to the LVDC. The Verify and Prepare to Load Status Code is issued to the LVDC and the RCA Register is loaded with the data formatted above. It then commands the LVDC to its Load Program and to Mode Sort.

3.6.13 Reinitialize Options

3.6.13.1 Purpose

To reinitialize the telemetry output options upon command by the operator or automatically.

3.6.13.2 Description

This routine is entered from Time Update upon command by the operator or automatically upon entering orbit when Sim Flight Option 36 is selected.

The following sequence of operations is performed:

- 1. Inhibit switch selector and telemetry interrupts.
- 2. Determine what Sim Flight Option is selected and the output desired.
- 3. Reset status light for the Sim Flight Option selected.
- 4. Reinitialize various HOP locations.
- 5. Reset inhibits and exit to time update entrance 1.

3.6.14 Issue Water Methanol Discretes

3.6.14.1 Purpose

To issue the Water Methanol Discretes to the LVDC Flight Program, upon command by the operator.

3.6.14.2 Description

This routine is entered from time update upon command by the operator. It issues the Water Methanol Discretes by loading the Discrete Input Register or the Discrete Input Spare Register and exits to time update.

3.6.14.3 Operating Procedure

When Option 35, 36, or 37 has been selected, it is possible to issue Water Methanol Discretes in boost and orbit. When Option 40 is selected, this routine will not be executed. Another restriction is that this routine cannot be commanded simultaneously with the Output Option Switching Program. The Output Option Switching Program will always have precedence. The procedures for initiating this operation are given below.

- 1. To command Water Methanol Discretes on, turn on Switch 10 of the B Register (indicating DIN 10 for AS-200 or DIN Spare 1 for AS-500) and/or turn on Switch 11 of the B Register (indicating DIN 11 for AS-200 or DIN Spare 2 for AS-500). Activate the A Register Sign Switch and the discretes or discrete spares will be issued to the Flight Program.
- 2. To command Water Methanol Discretes off, turn off Switch 10 and/or Switch 11 of the B Register. Activate the A Register Sign Switch.

3.6.14A Issue Spacecraft Control Discrete

3.6.14A.1 Purpose

To issue the Spacecraft Control Discrete to the LVDC Flight Program upon operator command.

3.6.14A.2 Description

This routine is entered from the Time Update Routine upon operator command. It issues the Spacecraft Control Discrete by loading the Discrete Input Register, and returns to the Time Update Routine.

3.6.14A.3 Operating Procedure

This routine can only be commanded, when Simulated Flight Option 35, 36 or 37 is in execution. It cannot be commanded simultaneously with the Output Option Switching Program, which will always have precedence. The procedures for initiating this operation are given below.

- 1. To command Spacecraft Discrete on, turn on Switch 9 of the B Register and activate the A Register Sign Switch.
- 2. To command Spacecraft Discrete off, turn switch 9 to the off position and activate A Register Sign Switch.

NOTE

The Water Methanol Discretes and the Spacecraft Control Discrete must be commanded simultaneously.

3.6.15 Time Update

3.6.15.1 Purpose

Update time in the ASTEC Flight Program and Check for time to issue inputs to the LVDA/DC.

3.6.15.2 Description

The Time Update Routine has two entrances. Entrance 1 forces time update to exit to a predefined location. Entrance 2 forces time update to exit to the calling program. The Entrance 1 Routine determines if the Sim Flight Option and the output option will be changed, updates real time and determines if switch selector options are selected, checks S4BCO flag and times to issue inputs, and exits to a predefined location. The Entrance 2 Routine follows the same flow except no check is made for reinitializing Sim Flight options and the exit is to the calling program.

3.6.16 Compute Earth's Rate

3.6.16.1 Purpose

To Simulate the Effect of the Earth Rate on the Platform Gimbal Angles and Accelerometers.

3.6.16.2 Description

The Compute Earth Rate Routine is entered once per second from Time Update. This routine calculates gimbal angles and accelerometer as inputs the LVDC. These changing quantities are computed from a given latitude, Fin 1 Alignment and Azimuth by the following equations

(1)
$$\ddot{X} = -g_0 \cos \lambda (\cos A_z \sin \lambda (1-\cos \omega t) + \sin A_z \sin \omega t)$$

(2)
$$\dot{Y} = g_0 \left(\sin^2 \lambda + \cos^2 \lambda \cos \omega t \right)$$

(3)
$$\ddot{Z} = -g_0 \cos \lambda \left(-\sin A_2 \sin \lambda \left(1-\cos \omega t.\right) + \cos A_Z \sin \omega t\right)$$

(4)
$$\dot{\theta}_{XE} = \omega \cos (F_1 + \theta_{YE})$$

(5)
$$\dot{\theta}_{YE} = \omega \sin \lambda + \omega \cos \lambda$$
 $\frac{\sin \theta_{XE} \sin (F_1 + \theta_{YE})}{\cos \theta_{XE}}$

(6)
$$\dot{\theta}_{ZE} = -\omega \cos \lambda \frac{\sin (F_1 + \theta_{YE})}{\cos \theta_{XE}}$$

The value computed from equations 4, 5, and 6, are divided by the number of minor loops per second, thus obtaining the average change of the gimbal angles each minor loop.

The accelerometer values computed from equations 1, 2, and 3 are converted to counts and incremented by the remainder from the previous calculation. This is to obtain a more accurate accelerometer value. After all calculations, the accelerometer value for each axis is loaded in counts and the direction of the Accelerometer Subtractive Counters is set. The routine then exits to time update.

3.6.17 Snap

3.6.17.1 Purpose

To obtain all telemetry quantities at time intervals specified by the operator for program verification.

3.6.17.2 Description

This routine is entered every computation cycle from Time Update. The Snap option is requested prior to program execution, at which time, ten or less time intervals may be specified. Each time interval must be at least one second in length.

Once Snap is in process, all telemetered quantities are obtained during each time interval specified and printed in the orbital print format.

The routine compares the beginning time interval with the ending time, when these times are equivalent only selected telemetry quantities will be obtain until another snap time is determined.

3.6.18 PTC Print

3.6.18.1 Purpose

To execute the print command and Control Carriage Commands.

3.6.18.2 Description

This subroutine is used by any calling routine. The accumulator must contain the number of words to be printed in syllable 1 and the starting address of the data to be printed in syllable 0 upon entering this subroutine.

It sets up the proper print mode, issues print and carriage commands the requested number of times.

3.6.19 DST

3.6.19.1 Purpose

To obtain telemetry quantities for program verification.

3.6.19.2 Description

DST (Data Adapter Single Step) will stop the execution of the flight program to allow time for the accumulated telemetry which has been stored in PTC Memory to be printed. When this storage buffer has been printed, the DST will be released and operation will continue until the buffer is filled again. Therefore, segments of the telemetry output will be stored and printed each time storage space is available. The storage buffer will store 1024 telemetry quantities. When DST is used, operating time is increased by about 5 or 6 to 1 ratio.

3.6.20 Issue Vehicle Cutoff Interrupts and Discretes

3.6.20.1 Purpose

To set the proper bits in the Interrupt and Discrete Registers at the requested time.

3.6.20.2 Description

Entrance to these routines are from time update. These routines are usually entered prior to the time to issue the interrupt and discrete. Both discrete and interrupt will be issued at the same time. The following sequence of operations is performed:

- 1. Increment current time by the required amount of time for the interrupt and discrete to be issued.
- 2. Go to time update until time to issue the interrupt and discrete.
- 3. Load interrupt register with proper bit position.

- 4. Load discrete register with proper bit position.
- 5. Initialize time for next interrupt and discrete, and reset HOP constants.
- 6. Exit to set return HOP constant.

3.6.21 Issue DCS Abort to Orbit Command

3.6.21.1 Purpose

To Issue the Abort Command to the LVDC Flight Program at a prespecified time.

3.6.21.2 Description

This routine is entered from the Time Update Routine at a prespecified time after AS-500 SIC Cutoff.

The following sequence of operations will be executed:

- 1. Increment current time by the prespecified abort time and initialize for the abort to orbit mode command.
- 2. Issue S-II Cutoff interrupt and discrete.
- 3. Go to time update until the prespecified time is up.
- 4. Read Din Register and issue the DCS Mode Command discrete.
- 5. Load Command Receiver Output Register with the Mode Command to initiate time base 4.
- 6. Read Interrupt Register and issue CR Interrupt.
- 7. Clear Interrupt Register and return to time update.

3.6.22 Octal to Decimal Conversion

3.6.22.1 Purpose

To Convert Octal Data to Decimal for Output.

3.6.22.2 Description

The Octal to Decimal Conversion Routine has two entries. The first entry is from any routine in the ASTEC Flight Program. This entry will cause the Octal to Decimal

Conversion Routine to convert only one data word and the routine will return to the calling routine with the converted data in the print buffer.

The second entry is from the 'Sim Flight' Option 35 or 36 Telemetry Interrupt Routine. This entry will cause the Octal to Decimal Routine to convert 10 data words from octal to decimal. Some of the telemetry data words are not to be converted. These words will be loaded into the print buffer in the octal print format.

For those data words which are to be converted the Octal to Decimal Conversion Routines will convert the nine octal digits of the data word to seven decimal digits. The converted data along with the sign of the data word and the exponential scale factor will be loaded into the print buffer. Three BCD characters are used to print the data. The first character contains the sign and the first three decimal digits. The second character contains the last four decimal digits and the third character contains the exponential scale factor. After the desired number of words are converted and loaded into the print buffer, the Octal to Decimal Routine will return to the calling routine.

3.6.22.3 Operating Procedure

When Options 35 or 36 have been selected, it is possible to obtain the output in decimal format by turning on Switch 11 of the A-Register. The normal octal format may be obtained by turning the switch off. This operation can be executed any time during the process of a run if Option 35 is selected. Decimal output can be obtained only during the powered phases of a flight if Option 36 is selected.

3.6.23 PTC Sector Dump

3.6.23.1 Purpose

Allow an operator the capability to verify that all 256 locations within a given sector contain the correct instruction and/or data.

3.6.23.2 Description

This subroutine shall be entered only from PTC Mode Sort. It displays the PTC Status Code on the front panel mode lights, and obtains the sector or sectors to be dumped from the PTC B-Register.

The documented output may be in octal or instruction format.

3.6.23.3 Operating Procedure

This routine will be selected when Switch 4 of the A-Register is turned on. The modules and sectors to be dumped are entered into the B-Register switches as follows:

Switches	S - 0	Module 0
	S-1	Module 1
	1-4	Starting sector to be dumped
	5 - 8	Ending sector to be dumped

3.6.24 Instruction Sector Dump

3.6.24.1 Purpose

To translate the octal sector dump format into instruction format.

3.6.24.2 Description

This routine is an optional routine used by the PTC Sector Dump. It decodes each syllable of a sector into an instruction format and documents the output one syllable at a time.

3.6.24.3 Operating Procedure

When the Sector Dump option has been selected, it is possible to obtain the dump in an instruction format by turning on Switch 12 of the A-Register. The normal octal dump may be obtained by turning the switch off. The format change will not take effect until the sector which is in the process of being dumped is completed. For example, sectors 1 and 2 of some module are to be dumped. If switch 12 is turned on when sector 1 is in process; the instruction format will not appear until sector 2.

3.6.25 Handload Patch Option

3.6.25.1 Purpose

To accept handload patches from the PTC A and B Registers switches and document the patches on the 1443 printer. The patches are maintained in memory for later loading into the LVDC or for punching on mylar tape.

3.6.25.2 Description

The subroutine may be entered only from PTC Mode Sort. It will accept the inputs from the PTC A and B Registers switches and form a handload patch, which is stored

into reserved core locations. A maximum of 46 patches is allowed.

3.6.25.3 Operating Procedure

This subroutine will be selected when Switch 10 of the A Register is turned on. After entering into the subroutine, the control words are entered into the A Register switches as follows:

Switches	H, Zo
1-4	Sector ($S_1 S_2 S_3 S_4$) to be loaded
5-7	Module $(M_1 M_2 M_3)$ to be loaded
8	On position for duplex Off position for simplex
9-16	Address (${\bf W_8}$ ${\bf W_7}$ ${\bf W_6}$ ${\bf W_5}$ ${\bf W_4}$ ${\bf W_3}$ ${\bf W_2}$ ${\bf W_1}$) to be loaded
17	On position indicates last patch entered Off position indicates more patches are to be entered

The data words, which may be octal data or instruction data, are entered into the B Register switches (S-25). If the data words are instruction data, both instruction syllables must be entered. Upon activating the A Register Sign Switch, the control word and data word will be read into PTC Core.

If the handload patches exceed the allowable maximum (46 patches), the last patch indicator bit will automatically be set in the control word and the patches printed. Should the operator discover errors in the data word, the steps shown below are required to correct it. If the errors were made in the control word, the option must be commanded again and all the handload patches re-entered.

- 1. Turn A Register Switch 10 on and activate A Register Sign Switch.
- 2. Re-enter the same control word that is associated with the load data word, and enter the correct data word. Activate A Register Sign Switch.
- 3. After the last correction has been made, the last handload patch from the previous commands must be re-entered with Switch 17 of the control word on.

In order to command the PTC back to Mode Sort, turn all A and B Register switches off and activate the A Register Sign Switch. See Appendix B for switch assignments.

3.6.26 LVDC Load Patch Option

3.6.26.1 Purpose

To load handloads patches into LVDC Core.

3.6.26.2 Description

This subroutine is entered from PTC Mode Sort. A control word and a data word are called from special PTC core locations and formatted to form four data words. These four words load one LVDC core location when the load and verify command is issued.

3.6.26.3 Operating Procedure

Load the LVDC Preflight Program into LVDC Core. Turn A Register Switch 23 on and activate the A Register Sign Switch. The load is performed and the PTC returns to Mode Sort.

3.6.27 Patch Punch Option

3.6.27.1 Purpose

To punch paper tapes from handload patches.

3.6.27.2 Description

This subroutine is entered from PTC Mode Sort. It obtains a control word and a data word from PTC Core, formats the two words to form nine data words, sets word and syllable parity, and issues the punch command.

3.6.27.3 Operating Procedure

Turn PTC A Register Switch 24 on and activate the A Register Sign Switch.

3.7 UTILITIES SUBROUTINES

3.7.1 Monitor Error Monitor

Controls the processing of errors and Associated Messages received from the LVDC.

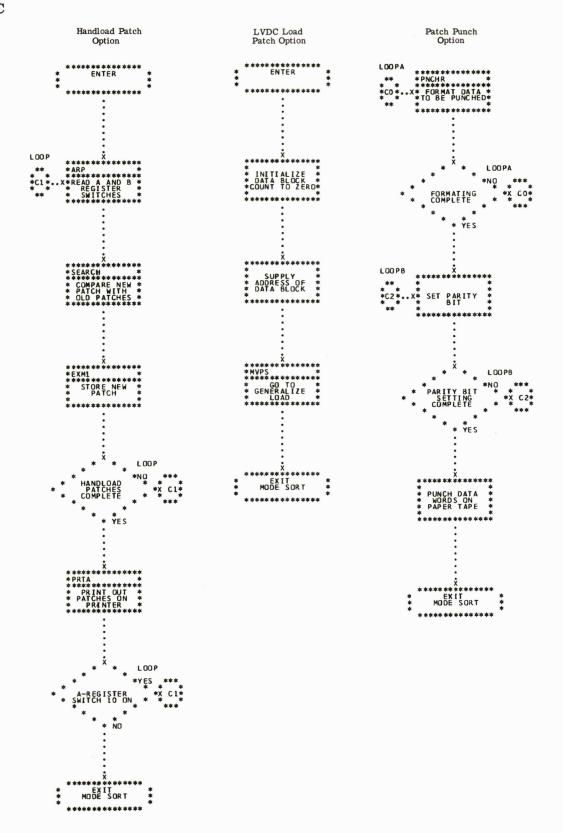


Figure 3-10. Manual Utility Options

3.7.2 Internal Recycle and Initialize

Initializes certain PTC registers and program constants prior to executing any internal or monitor routines.

3.7.3 Internal Power Up Initialize

Performs the necessary one-time-only program initialization after power has been applied to the PTC-ASTEC.

3.7.4 Overtime Subroutine

Tests an indicator for a specified period of time, looping on the test until the indicator is turned on.

3.7.5 A-Register P-Sync Subroutine

Allows the operator to load the A and B Registers and Control Program Continuation at the proper time.

3.7.6 PTC ASTEC Initialize Monitor Function

Command the LVDC to a particular routine and verify.

3.7.7 PTC ASTEC Indicator Overtime Test

Detects if the preflight routines are running in a loop by not performing certain functions.

3.7.8 PTC ASTEC Sync On/Off

Allows the proper control of communications from the PTC to the LVDC.

3.7.9 Read RCA Data Simulation

Obtains from the operator loaded tables, the required input data and simulation data.

3.7.10 PTC ASTEC Output

Outputs all pertinent information that has been formatted and saved. This includes the simulated input data supplied and output data received.

3.7.11 Output Storage

Formats and saves all pertinent information to be documented by the Output Routine.

3.7.12 Issue RCA Interrupt

Issues the simulated RCA interrupt to the LVDC that forces the Preflight Program to the Force Begin Routine.

3.7.13 Initialize Vehicle Inputs

Initializes the proper vehicle input routines as indicated by data read in from the PTC B-Register.

3.7.14 Sine/Cosine

Computes the sine and cosine values of the argument contained in the Accumulator (Pirads, scaled zero). Exits with the sine value in the accumulator and the cosine value in cosval.

SECTION 1

INTRODUCTION

1.1 ACAPE PREFLIGHT TRACE PROGRAM INTRODUCTION

The purpose of the ACAPE Preflight Trace Program is to provide the programmer with a diagnostic aid for debugging ACAPE Programs. It has the capability of tracing programs running on the LVDC alone, the PTC alone, or both in simultaneous operation tion. A memory dump feature is provided to allow dumps of any or all sectors of the PTC.

1.2 ACAPE FLIGHT PROGRAM INTRODUCTION

The primary function of the ACAPE Flight Program is to serve as a debug aid to the flight programmer. This is accomplished by providing program simulation of variable vehicle and data adapter inputs and outputs, and to record that data for subsequent simulation and analysis.

In order to exercise flight program logic, the functions of the data adapter must be duplicated. Simulation of the internal registers of the data adapter, is accomplished by storing in the PTC the data sent from the LVDC upon a PIO request. Other external inputs to the LVDC are prestored in time tables and are issued to the LVDC at predetermined times. A sequence of interrupts is also issued on a timed basis in order to more closely approximate actual flight conditions.

1.3 ACAPE CONFIGURATION

The ACAPE configuration consists of a LVDC, an ACME (Aerospace Computer Manual Exerciser), a PTC with a 1443 bar printer, a typewriter, and a plotter.

SECTION 2

ACAPE PREFLIGHT TRACE PROGRAM

2.1 GENERAL DESCRIPTION

The LVDC-PTC Trace Program has the capability of performing four separate functions. These functions will be referred to as modes of operation. (Modes A, B, C, and D.)

Mode A is an instruction by instruction trace of any program run in the LVDC. The output will consist of Module, Sector and Operation Code Data plus Accumulator, Input/Output Register (I/O Reg), Switch Selector Counter (SS CTR), Minor Loop Counter (ML CTR), Real Time Counter (RT CTR) and Transfer Register (TRS).

Mode B is a trace of the PTC program only. The output will consist of Module, Sector and Operation Code Data plus Accumulator and TRS.

Mode C will be a simultaneous trace of the primary program run in the LVDC and a control program run in the PTC. The printed output will consist of Module, Sector and Operation Code Data plus Accumulator, TRS and I/O Reg. for the LVDC routine, and Module, Sector and Operation Code Data plus Accumulator and TRS for the program being traced in the PTC.

Mode D is a PTC Memory Dump in octal format of any or all sectors of the PTC. The printed output will be one sector per page.

There are certain peculiarities inherent in the PTC trace program which can result in printed output which may appear incorrect unless the operator has a previous knowledge of these limitations. Although in most cases they have little or no effect on the program operation, it is necessary to make the operator aware of them.

When tracing the LVDC or the dual trace of the LVDC and PTC no HOP instructions should be printed. The reason for this is that a HOP instruction cannot be interrupted. Therefore, when the trace program tries to single step the LVDC and a HOP instruction is the next instruction to be executed in the LVDC the HOP will inhibit the single step issued from the trace program to the LVDC for one extra instruction cycle. This will allow the LVDC to execute a second instruction. Therefore, when the trace program picks up the information from the history delay lines, it takes the last instruction that the LVDC executed. In this case the instruction will always be the instruction which followed the HOP. The programmer can determine when a HOP has occurred by checking the sequence numbers which will skip a step in this situation or by noticing a change in Instruction Module or Instruction Sector.

ACAPE

Another peculiarity is encountered when the LVDC is executing a MPY or DIV, and an interrupt occurs in the LVDC. During a normal instruction cycle for a MPY or DIV several other instructions can be executed simultaneously. When tracing the LVDC with the trace program only the MPY or DIV is allowed to be executed. Therefore, if an interrupt to the LVDC occurs before the next instructions are allowed to be executed some instructions will not be executed in the proper sequence. The reason for this is that the LVDC cannot be stopped by an interrupt during a MPY or DIV.

When running the trace program the LVDC is in single step (CST) and the MPY or DIV instruction alone will be executed and printed out by the trace program. When the trace program is completed with the MPY or DIV instruction it will single step the LVDC and obtain the next instruction from the history delay lines of the LVDC. The trace program normally operates on this instruction and after it is printed, proceeds to the next instruction. However, if during the MPY, DIV, or any of the next instructions an interrupt to the LVDC occurs, this interrupt forces the LVDC to start at a new location. This is done by the interrupt — it will remove the CST, then the LVDC will perform the HOP to the interrupt routine and the HOP save, then replace the CST. Now the LVDC is at a new location waiting for the trace program.

At this time the trace program will start tracing the instructions from the new location which the LVDC was forced to by the interrupt. The trace program traces the LVDC through the interrupt routine and HOP's back to the main program. At this time the trace program will start tracing at the location where the LVDC was interrupted. Now those instructions following a MPY or DIV instruction will be executed. This interrupt is indicated to the programmer by an I printed to the right of the sequence number of the first instruction printed after the interrupt, and from then on until the main interrupt is reset by the interrupt routine.

2.2 ROUTINES

2.2.1 LVDC Trace Routine (Figure 2-1)

2.2.1.1 Purpose

This routine exercises, monitors, and analyzes routines being run in the LVDC.

2.2.1.2 Description

This routine utilizes the PTC to perform the three basic functions listed below, even though the full capabilities of the ACAPE configuration are not utilized.

- 1. Automatically service all PIO outputs from the LVDC.
- 2. Automatically service all PIO input real time requests.
- 3. Provide a complete instruction by instruction trace of the program being operated by the LVDC.

The PTC performs the trace in the following manner:

- 1. Checks to see if the LVDC is at a PIO. If so, this is indicated by an interrupt to the PTC from the LVDC when a PIO instruction is executed by the LVDC.
- 2. If the LVDC is at the PIO, the PTC will obtain the data from the history delay lines.
- 3. Determines if the PIO is an input request or output transmission.
- 4. If it is an input PIO, loads printer buffer with PIO XXX wait, issues a print command and waits for the operator to service the PIO. Otherwise, goes to Step 6.
- 5. When the PIO has been serviced, the operator will manually execute a PIO repeat. Which will drop the CST and force the LVDC to re-execute the PIO. The LVDC will then be replaced in CST.
- 6. Obtains data from history delay lines and prints.
- 7. Issues a CST GO and a CST STOP to the LVDC in consecutive instructions. This will allow the LVDC to execute one instruction. When the CST STOP is recognized by the LVDC, interrupt 7 is issued to the PTC.

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- 8. Interrupt 7 will give control to the trace program and the trace will obtain data from history delay lines and determine if the instruction which the LVDC has just executed was a PIO.
- 9. If it is a PIO, goes to Step 3.
- 10. If not a PIO, loads the printer buffer with proper data for the instruction, issues a print command, and goes to Step 7.

The printed output will consist of instruction module, (IM), Instruction Sector (IS), Syllable (S), Location (Loc), Data Module (DM), Data Sector (DS), A9 bit (9), Operation Code (OPC), Address (ADR), Accumulator (AI3), Transfer Register (TRS), Input Output Reg. I (I/O), Minor Loop Counter (ML Ctr.), Switch Selector Counter (SS Ctr.), Real Time Counter (RT Ctr.), Sequence Number (Seq. #).

2.2.1.3 Operating Procedure

- 1. Set Bit 1 of the PTC Prog Reg A switches.
- 2. Load the program to be traced into the LVDC.
- 3. Load the LVDC/PTC Trace Program into the PTC.
- 4. Set up the test equipment as follows:
 - a. LVDC/ME Set Up
 - 1) Set LVDC/ME in Memory Load
 - 2) Clear I/O Regs No. 1 and 2
 - 3) Set LVDC/ME in operational program (OP) mode. Pushbutton located on the LVDC/ME Interface Exerciser Panel.
 - 4) Release Manual Halt
 - 5) Set Manual Bit 25 of the Data Switches off.
 - 6) Set the LVDC/ME in the Data Display (DD) mode. Pushbutton located on the LVDC/ME Tape Reader and Mode Control Panel.

7) The LVDC is stopped at first PIO.

NOTE: If operator desires to start tracing at a certain PIO the operator must set bit 5 of the PTC program Reg A switches and set the PIO Repeat pushbutton on in the LVDC/ME until the desired PIO is displayed in the Address Register.

b. PTC Set Up

- 1) Set PTC in Memory Load.
- 2) Set PTC in Data Display (DD) mode. Pushbutton located on the Tape Reader and Mode Control panel.
- 3) Depress PTC Machine Reset.
- 4) Turn Inhibit Control on then off. Pushbutton located on the Processor Display panel.
- 5) Place bit 25 of A switches on.
- 6) Make Printer Ready.
- 7) Depress manual Int. 16.

NOTE: A and B switches are now free for program usage.

- 8) Turn bit 25 of A switches off.
- 5. Print format will be as follows:

IM IS S LOC DM DS 9 OPC ADR AI3 TRS I/O ML CTR SS CTR RT CTR SEQ NO IM IS I A DM C SS C C S DS A O C D A CAI CT CAR ML RT N NO NE YND AO AE PO A D OCN OR OCE IO 0 WE 0 EI 0 \mathbf{E} U SD SC LSD TD TC E D TD NCS N A NMG NO U IL U AM U Q M TU TT L T R AU ATBREARTT TN N LE N U TE OP N TE \mathbf{B} RL RO A R E L OIA E EFR E S E 1 T CC T T E E UE UR B U S E RTT NOU N F \mathbf{E} HT \mathbf{E} E N R S NI LCS C C \mathbf{E} S TRC T E T/ R \mathbf{R} R C 0 T T ET S R SO R E ST Ι Ι Ι $\mathbf{L}\mathbf{I}$ 0 0 0 OAO OR O N N N FSN F E F Т G

- NOTE: 1. An I printed to the right of the seq. number indicates that the Main Int. Latch is set.
 - 2. When the LVDC executes a HOP inst. the PTC cannot interrupt a HOP so the sequence number will be increased by two counts.
 - 3. When the LVDC executes a MPY or DIV some instructions may be executed out of seq. if an interrupt occurs during the MPY or DIV.
 - 4. If no I7 is printed recheck the initial set up.

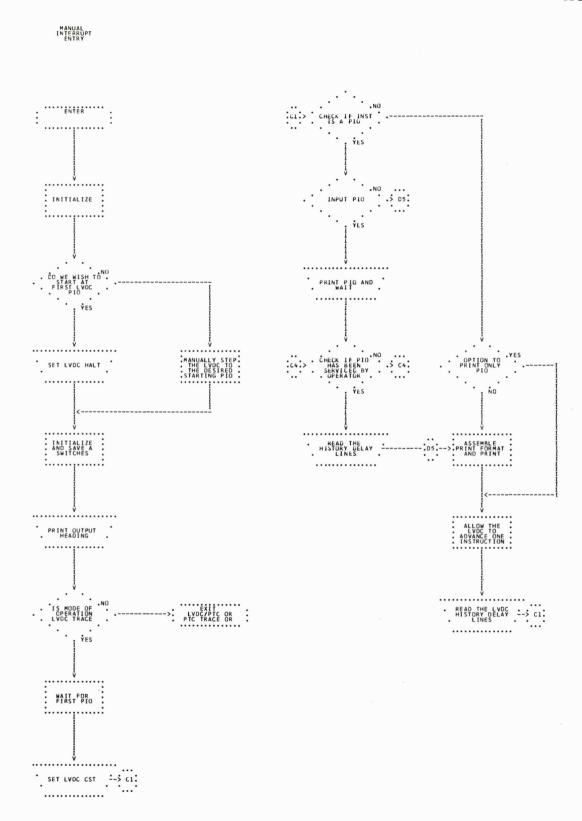


Figure 2-1. LVDC Trace Routine

2.2.2 PTC Trace Routine (Figure 2-2)

2.2.2.1 Purpose

This routine has the capability of tracing the PTC routines instruction by instruction.

2.2.2.2 Description

To operate this made the PTC is first placed in memory load. The LVDC-PTC trace program and the PTC routines are loaded into the PTC. Once various registers and switches on the PTC have been initialized the operator can now enter the selected mode. If the operator desires to start trace operations at a certain location, he can enter the starting location in the switches on the PTC front panel along with the selected mode of operation.

With the proper mode (Mode B in this case) selected, the operator can begin the trace by releasing the PTC from memory load and by depressing interrupt 16.

The PTC performs the trace itself in the following manner:

- 1. Obtains the next instruction of the PTC routine in the PTC. This instruction is located by interrogating the HOP constant which the trace program will keep up-dating.
- 2. Interrogates the instruction and loads the printer buffer with the data format.
- 3. Checks if the operator has selected a starting location. If no starting location has been selected, goes to Step 5. Otherwise, proceeds to Step 4.
- 4. If a starting location has been selected, checks to see if this is the selected location. If it is not the selected location, goes to Step 7. If it is the starting location, proceeds to Step 5.
- 5. Issues a print command.
- 6. Checks if this instruction is performed by the trace program or executed by the PTC. If performed by the trace program, goes to Step 8. Otherwise proceeds to Step 7.
- 7. Steps the PTC one instruction by not resetting interrupt 16 and resetting the main interrupt, then HOP's to the instruction that is to be executed. One instruction will be performed and control will be returned to the trace program by an interrupt 16 and goes to Step 1.

8. Trace program performs the instruction and goes to Step 1.

The printed output will consist of Instruction Module (IM), Instruction Section (IS), Syllable (S), Location (Loc), Data Module (DM), Data Sector (DS), A9 bit (9), Operation Code (OPC), Address (ADR), Accumulator (AI3), Memory Location specified in the operand (TRS).

2.2.2.3 Operating Procedures

- 1. Set Bit 2 of PTC Prog Reg A switches ON.
- 2. Load the program to be traced into the PTC.
 - NOTE: The PTC Trace occupies sectors 15, 16, and 17 of modules 1 also it will use manual Int. 16. There is one other small program in module 0, sector 0, location 1 through 5, which will cause the PTC to Loop on bit 25 of the A switches. This small program is for operator control of the PTC and is not absolutely necessary for Trace Operations, but if it is used a HOP to the start of the program to be traced should follow this small program.
- 3. Load the LVDC/PTC Trace Program into the PTC.
- 4. Set up the test equipment as follows:

PTC Set Up

- a. Place the PTC in Data Display (DD) mode. Pushbutton located on the Tape Reader and Mode Control.
- b. Set PTC Machine Reset
- c. Turn Inhibit Control on then off. Pushbutton located on the Processor Display panel.
- d. If the operator desires to start the printing at a certain location then enter into the B switches the HPC for the starting location.
- e. Turn bit 25 of A switches on
- f. Make Printer Ready

g. Depress manual Int. 16

NOTE: A and B switches are now free for program usage.

- h. Turn bit 25 of A switches off
- 5. Print format will be as follows:

```
TRS I/O IM IS S LOC DM DS 9 OPC ADR
IM IS S LOC DM DS 9 OPC ADR AI3
                                               NOT USED
               DS A O C D A CAI CML /
     S I A DM
NO NE Y N D AO
               E D T D NCS NMC
SD SC L S D TD
               TC
TU TT L T R AU
               AT B R E A R T T TOA
RL RO A R E
                         E EFR ERT
                OIA
           \mathbf{L}
UE UR B U S
                RTT
                         S NOU NYI
     LCS
                    \mathbf{E}
                            TRC T O
C
   C
                            STSN
Т
   \mathbf{T}
     E T
Ι
   Ι
       Ι
                            LI
0
   0
       0
                            OAO O
                            FSN F
   N
       N
N
```

6. No printout indicates setup error.

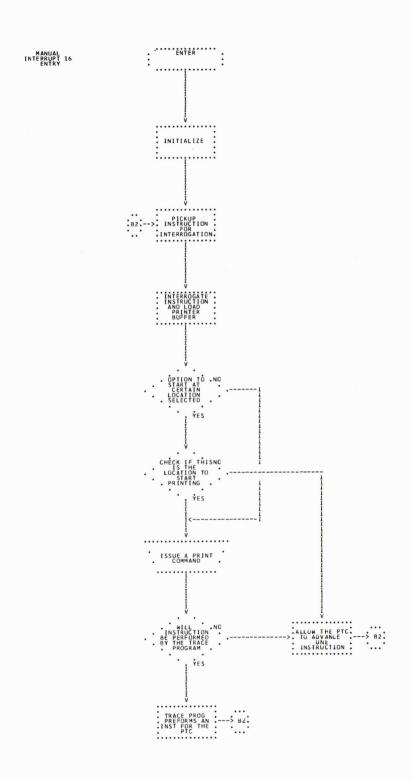


Figure 2-2. PTC Trace Routine

2.2.3 PTC/LVDC Trace Routine (Figure 2-3)

2.2.3.1 Purpose

The purpose of this routine is to trace ACAPE programs utilizing both the PTC and LVDC.

2.2.3.2 Description

The PTC performs the trace in the following manner:

- 1. Checks to see if the LVDC is at a PIO. If so, this is indicated by an interrupt to the PTC from the LVDC when a PIO instruction is executed by the LVDC.
- 2. When the LVDC is at the PIO, obtains the data from the history delay lines.
- 3. Determines if PIO is input or output.
- 4. Loads part of printer buffer with the proper data for the PIO instruction print out.
- 5. Obtains the next instruction of the control program in the PTC. This instruction is located by interrogating the HOP constant which the trace program will keep updating.
- 6. Loads the rest of the printer buffer with the PTC instruction and prints.
- 7. Steps the PTC one instruction by not resetting interrupt 7 and by resetting the main interrupt, then HOP's to the instruction that is to be executed. One instruction of the control program will be performed by the PTC and then control will be returned to the trace program by interrupt 7 again taking effect.
- 8. If the input PIO has not been taken care of, returns to Step 4. Otherwise proceeds to Step 9.
- 9. Issues a CST GO and CST STOP to the LVDC in consecutive instructions. This will allow the LVDC to execute one instruction. When the CST STOP is recognized by the LVDC interrupt 7 is issued to the PTC.
- 10. Interrupt 7 will give control to the trace program and the trace will obtain data from history delay lines and determine if the instruction which the LVDC has just executed was a PIO.

- 11. If it is a PIO, goes to Step 3.
- 12. If not a PIO, loads the printer buffer with proper data for the instruction and goes to Step 5.

The printed output will consist of Instruction Module, Instruction Sector, Syllable, Location, Data Module, Data Sector, A9 bit, Operation Code, Address, Accumulator, Transfer Register, and Input Output Register for the LVDC. The same output format will be used by the PTC with the exception of the input output register.

2.2.3.3 Operating Procedure

- 1. Set sign bit ON in PTC Prog Reg A switches.
- 2. Load the LVDC program to be traced into the LVDC.
- 3. Load the PTC/LVDC Trace Program into the PTC.
- 4. Load the PTC Program (Control Prog) into the PTC.
- 5. Set up test equipment as follows:
 - a. LVDC/ME Set Up Procedure
 - 1) Set LVDC/ME in Memory Load.
 - 2) Clear I/O Reg. No. 1 and 2.
 - 3) Set LVDC/ME in operational program (OP) mode. Pushbutton located on the LVDC/ME Interface Exerciser Panel.
 - 4) Release manual Halt.
 - 5) Set Manual Bit 25 of Data Switches off.
 - 6) Set LVDC/ME in the Data Display (DD) mode. Pushbutton located on the LVDC/ME Tape Reader and Mode Control Panel.
 - 7) The LVDC is stopped at first PIO.
 - b. PTC Set Up
 - 1) Set PTC in Memory Load.
 - 2) Set PTC in Data Display (DD) mode. Pushbutton located on the Tape Reader and Mode Control Panel.

- 3) Depress PTC Machine Reset.
- 4) Turn Inhibit Control on then off. Pushbutton located on the Processor Display panel.
- 5) Place bit 25 of A switches on.
- 6) Make Printer Ready.
- 7) Depress manual Int. 16.

NOTE: A and B switches are now free for program usage.

- 8) Turn bit 25 of A switches off.
- 5. Print format will be as follows:

	$\underline{ ext{LVDC}}$										
IM	IS	S	LOC	DM	DS	9	LOC	ADR	AI3	TRS	I/O
IM NO SD TU RL UE C	IS NE SC TT RO UR C T	S Y L A B L	I A N D S D T R R E U S C S T	DM AO TD AU L E	DS AE TC AT O R	A 9 B I T	O C P O E D R E A T	D A A D T D A R E S S	CAI OCN NCS T T EFR NOU TRC S T	C T O R N A T N E S N F T E S R	CAR OCE NMG TE E 1 NI T/ SO
I O	I O		I O						LI OAO	O R	0
N	N		N						FSN	F E	F
									\mathbf{T}	G	

р	П	Г	1	7
T	J	L	•	J

IM	IS	S	LOC	DM	DS	9	OPC	ADR	AI3	TRS
IM	IS	\mathbf{S}	I A	DM	DS	Α	ОС	D A	CAI	СТ
NO	NE	Y	N D	AO	AE	9	РО	A D	OCN	O R
SD	SC	\mathbf{L}	S D	TD	TC		E D	TD	NCS	N A
TU	TT	\mathbf{L}	TR	AU	AT	В	R E	AR	TT	TN
RL	RO	Α	R E	${f L}$	O	I	Α	\mathbf{E}	\mathbf{EFR}	E S
UE	$\mathbf{U}\mathbf{R}$	В	US	\mathbf{E}	\mathbf{R}	T	\mathbf{T}	S	NOU	NF
C	C	$_{\scriptscriptstyle L}$	C S				\mathbf{E}	S	TRC	тЕ
T	\mathbf{T}	\mathbf{E}	T						ST	S R
I	I		I						\mathbf{LI}	
O	O		O						OAO	O R
N	N		N						FSN	F E
									${f T}$	G

NOTE: When the LVDC executes a MPY or DIV some instructions may be executed out of sequence if an interrupt occurs during the MPY or DIV.

6. If no I7 is printed recheck the initial set up.

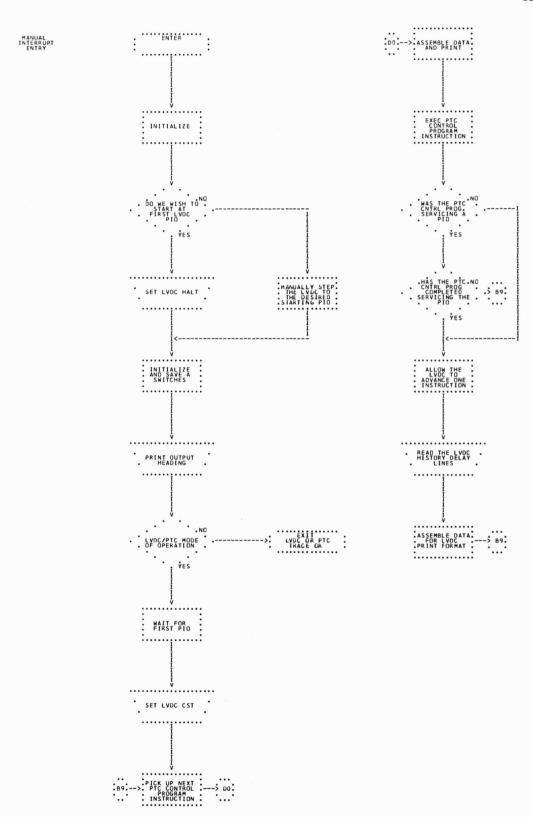


Figure 2-3. PTC/LVDC Trace Routine

2.2.4 PTC Dump Routine (Figure 2-4)

2.2.4.1 Purpose

The PTC Dump Routine provides the capability of dumping any or all sectors of the PTC.

2.2.4.2 Description

The PTC performs the dump itself in the following manner:

- 1. Picks up the starting sector from the switches on the PTC front panel.
- 2. Prints the sector out in an octal format.
- 3. Checks the stopping sector to see if all sectors have been dumped.
- 4. If all sectors are not printed, sets up for next sector and goes to Step 2. Otherwise, hangs up in a loop.

The output will consist of one sector per printer page in octal format.

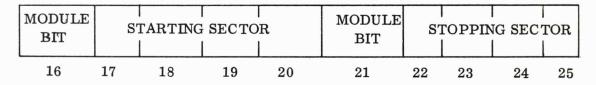
2.2.4.3 Operating Procedure

- 1. Set Bit 3 of PTC Prog A Reg switches ON.
- 2. Load the PTC/LVDC Trace Program into the PTC.

NOTE: The Trace Program Loads into module 1, sectors 15, 16, 17

3. Select the sector or sectors to be dumped with PTC Prog B Reg switches.

Prog Reg B switch set up.



To print one sector make stopping sector equal starting sector

4. Set bit 25 of A switches ON.

- 5. Set PTC in Data Display (DD) mode. Pushbutton located on the Tape Reader and Mode Control Panel.
- 6. Depress PTC Machine Reset.
- 7. Turn Inhibit Control on then off. Pushbutton located on the Processor Display Panel.
- 8. Make Printer Ready.
- 9. Depress Manual Int. 16.
- 10. Turn bit 25 of A Switches off.
- 11. The printout will be 1 sector per page. The left hand column will indicate what module, sector and locations are to be dumped as follows:

LOCATIONS * *MODULE AND

*** **SECTOR

000000000

** **

NOT USED* *NOT USED

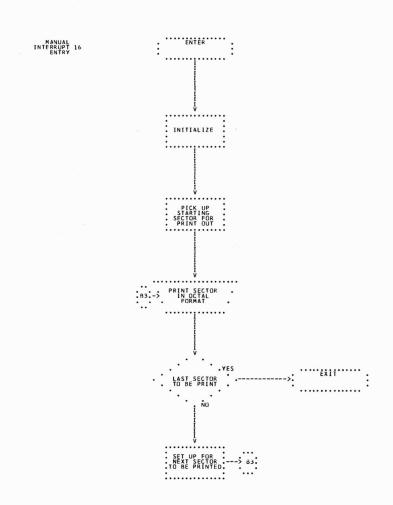


Figure 2-4. PTC Dump Routine

SECTION 3

ACAPE FLIGHT PROGRAM

3.1 GENERAL DESCRIPTIONS

The ACAPE Flight Program has three major divisions allowing program simplicity, real time efficiency and simplified interrupt processing. These three sections are: a) initialization, b) main loop and c) interrupt processing.

The first division, initialization, is divided into two subsections, general initialization and stage initialization. The General Initialize Routine prepares the program for first stage operation and liftoff by zeroing program counters, such as the total time counter, and setting the required program switches. The function of the Stage Initialize Routine is to initialize for each consecutive stage those conditions and counters required for that stage. The definition of the options desired by the user for a particular stage is also a function of this routine.

The second division, the main loop, will be interrupted by PIO, Minor Loop, Switch Selector, and manual push button interrupts. The functions of the main loop are to record real time, to check for a snap shot option, to check for a predetermined time to terminate the flight, and to issue simulated vehicle discretes and interrupts to the LVDC when required.

The final division is interrupt processing due to a PIO, Minor Loop, or Switch Selector Interrupt. All requests for input information and the issuance of all output data must be done by the LVDC with its PIO instruction. Upon issuance of a PIO, an interrupt will be generated to the PTC and a CST will be issued to the LVDC. While the LVDC is in single step mode, the interrupt generated to the PTC will be processed. This processing will establish which group the PIO pertains to, i.e., input or output. By means of the PIO address, unique for each PIO, the PTC will transfer control to the appropriate program which will either supply or store the respective I/O information, and then enter the appropriate output routine specified by the user in the State Initialize Routine to print the data. A return to the Main Loop or the End of Stage Routine will be initiated depending on present stage conditions. This division will also process and issue the Minor Loop and Switch Selector interrupts to the LVDC if not inhibited.

These three divisions give the ACAPE program simplicity, real time efficiency and simplified interrupt processing by simulating the LVDA and the LVDA-ME functions during actual flight.

For test purposes, valid or erroneous data may be generated by the PTC and sent to the LVDC. The flight test may be canceled manually or automatically. Restart

capabilities are provided to restart from the stop location or from the beginning of first stage.

Variable output formats are provided. Any of four types, or none, may be selected on a stage to stage basis. The variable format may be altered by inserting the PIO addresses desired. Snapshot capability allows output suppression for a particular time interval.

At the end of each stage of flight, the user will automatically receive a sequential output of all switch selectors set, all discretes issued either by the PTC acting as the vehicle/LVDA system or by the LVDC, and all interrupts issued by the PTC. These outputs will be referenced to both total and stage times.

Due to PTC PIO interrupt processing which causes a stop and go condition, the program is not executed in a real time domain.

3.2 SYSTEM POWER UP

3.2.1 Description

The Power Up section will initialize the PTC, set the Switch Selectors and Minor Loop Counters to a large value, and force the LVDC to Power Up by issuing a halt. Before entering Mode Sort, the Message "Entering Power-Up" will be printed.

3.2.2 LVDC/ME Set Up Procedure

- 1. Run an LVDC clear program to insure good parity in all memory locations.
- 2. Load the LVDC with the Flight Program and Pre-Flight Routines.
- 3. In Module 0, Sector 0, Syllable 0, Location 000 and 001, load the following:

Location 000 - HOP 001

Location 001 - The HOP Constant for Flight Initialize.

- 4. Set the LVDC MANUAL MLC INH and MANUAL SSC INH on. Pushbuttons located on the LVDC/ME Interface Exerciser Panel.
- 5. Press the LVDC/ME COMPTR DISPLAY and COMMAND DISPLAY RESET buttons. Pushbuttons located on the LVDC/ME Memory Load and Data Display Panel, Memory Loader Section.
- 6. a. Set the LVDC/ME in Operational Program (OP) Mode. Pushbutton located on the LVDC/ME Interface Exerciser Panel.
 - b. Set the LVDC/ME in the Data Display (DD) Mode. Pushbutton located on the LVDC/ME Tape Reader and Mode Control Panel.

3.2.3 PTC Set Up Procedure

- 1. Run a PTC clear program to insure good parity in all memory locations.
- 2. Load the PTC with the ACAPE Flight Program.
- 3. Set the Error Hold Pushbutton on. Pushbutton located on the Processor Display Panel.
- 4. Turn Inhibit CTRL on then off. Pushbutton located on the Processor Display Panel.

- 5. Make the Printer Ready.
- 6. Turn PROG REG A sign switch on, 1-22 off.

Turn PROG REG B S-25 switches off.

7. Set the PTC in Data Display (DD) Mode. Pushbutton located on the Tape Reader and Mode Control.

The following message will print: ENTERING POWER UP

3.2.4 Restart Procedure

- 1. Press Machine Reset to restart the Flight.
- 2. Press Interrupt 16 to reselect the options.

Interrupt 16 will also dump the End Condition Data.

The End Condition Data consists of a table containing all Switch Selector, Discrete Inputs, Discrete Outputs, Interrupts Issued, and the time of issuance.

3.3 SPECIFY FLIGHT (Figure 3-1)

3.3.1 Mode Sort

The Mode Sort Routine requires operator action to first select the Flight or Sim Flight Mode and to designate which vehicle, 200 or 500.

If the Flight Mode (F/M) is selected, the Mode Sort Routine will initialize, dependent upon Vehicle designation, the force, mass, mass flow rate, indicators and constants used by the F/M Routine to calculate Stage 1 acceleration, and will transfer to the General Initialize Routine.

However, the selection of Sim Flight will direct the Mode Sort Routine to skip F/M Initialize and transfer to General Initialize.

The failure to select either Flight or Sim Flight, will cause an error message to be printed and the ACAPE Program will return to Mode Sort.

3.3.2 General Initialize

The General Initialize Routine resets program counters and constants required for first stage and is necessary for sequential runs. Registers and indicators used by the program are also reset. The routine indicates to the user that the ACAPE Flight Program is entering Flight Mode by sending the Mode Code for Flight to the PTC console and printing "Entering ACAPE Flight 500" for AS-500 or "Entering ACAPE Flight 200" for AS-200.

3.3.3 Operating Procedure

The ACAPE Program will print the following message:

SPECIFY STATUS CODE

After this message has been printed the operator will select either Flight or Sim Flight Mode for AS-200 or AS-500 by setting the program A Register Switches 1-3 in the following manner:

Switch 1 ON for Flight Switch 2 ON for Sim Flight Switch 3 ON for AS-200 or Off for AS-500

The operator must then turn the A Register Sign Switch OFF and then ON. The ACAPE Program will print the contents of the A Register and the following message:

ENTERING ACAPE (Flight or Sim Flight) (200 or 500)

If the wrong code is entered "UNDEFINED REQUEST" will be printed and the status code must be reselected.



Figure 3-1. Specify Flight

3.4 <u>INITIALIZE</u> (Figure 3-2)

3.4.1 Stage Initialize

The Stage Initialize division resets counters and constants required from stage to stage, updates table addresses used by the End of Stage Routine, and indicates the beginning of each stage by printing "ENTERING STAGE (stage number)".

3.4.2 Specify Options

This division provides the program with a choice of ten options. Some options check the failure and backup routines contained in the Flight Program by issuing failures which are selected by the operator. These options are Liftoff, CIU, Gimbal Angle Failures, Vehicle Inputs, Fail Switch Selectors, Discrete Inputs and Timed Interrupts. The remaining options are designed to enable the operator more freedom in the type of run and the length of time he wishes to run. These options are Cancel Time, Stage Bypass, and Mode Code 25.

The program will print: SPECIFY OPTIONS

After this message has been printed, the operator may select one or more of the following options, or bypass the selection completely. The Prog. Reg. A switches 1-10 are used to select the option desired. In order to select an option, the operator must turn the assigned switch on.

Switch 1 = Liftoff Option

Switch 2 = Cancel Time

Switch 3 = Fail Switch Selectors

Switch 4 = Fail Gimbal Angles

Switch 5 = Discrete Inputs

Switch 6 = Stage Bypass

Switch 7 = Vehicle Input Option

Switch 8 = Mode Code 25 Option

Switch 9 = Timed Interrupt Option

Switch 10 = CIU Data Option

The contents of the Prog. Reg. A are read and printed by turning the Prog. Reg. A Sign Switch off and then back on.

3.4.3 Liftoff Options

The Liftoff Options check the backup modes concerned with liftoff. The operator may select one of the following failures:

- 1. Liftoff discrete set and no acceleration
- 2. No Liftoff discrete set and normal acceleration
- 3. No Liftoff discrete set and no acceleration

If the operator selects a failure of no acceleration, the ACAPE Program will give an acceleration equal to the earth's rate. On the other hand, if the operator selects none of the above failures, the ACAPE Program will issue the liftoff discrete and normal acceleration readings.

If selected, the program will print:

SPECIFY LIFTOFF OPTION

After the message is printed, the operator must:

- 1. Specify a liftoff pattern in Prog. Reg. A.
 - a. No liftoff and normal acceleration is specified by loading Switch 1 in the on position.
 - b. Liftoff and no acceleration is specified by loading Switch 2 in the on position.
 - c. No liftoff and no acceleration is specified by loading Switch 3 in the on position.
 - Normal liftoff and normal acceleration is specified by load Prog. Reg. A. Switches 1-22 in the off position.
- 2. Turn Prog. Reg. A sign switch off.
- 3. Turn Prog. Reg. A sign switch on.

3.4.4 Cancel Time

The Cancel Time Option allows the operator to terminate the run at a specified time during the flight. Upon cancellation the end of stage table will be printed.

If selected, the next print message will be:

SPECIFY CANCEL TIME IN REG. A

After the message is printed, the operator will,

- 1. Load Prog. Reg. A Switches 1-22 with time to cancel in seconds, scaled 17.
- 2. Turn Prog. Reg. A sign switch off.
- 3. Turn Prog. Reg. A sign switch on.

3.4.5 Fail Switch Selectors

The Flight Program's Switch Selector Routines contain two tests, the Hung Stage Test and the Verify Feedback, which the ACAPE's Fail Switch Selector Option is designed to check.

Before the Initial Stage and address Operation for a Switch Selector Command, the Flight Program must assure that a "hung stage" will not cause a failure. A hung stage occurs when the stage select network in a switch selector fails to reset after a read reset operation. A Hung Stage causes a possible failure only when the switch selector, which failed, is different from the switch selector used in the next command. Therefore, it is possible to eliminate the Hung Stage Test if the stage selected is the same as the previous stage select. The Hung Stage condition is detected by looking at the switch selector feedback (PIO 077). When the Hung Stage is detected, a reset operation of the switch selector is executed. The next operation removes the reset and issues the stage and address. The hung stage test is performed a maximum of one time per switch selector function.

After the stage and address are sent to the switch selector, but before the read operation, the switch selector feedback (PIO 077) is checked. If the commanded address was interpreted properly by the switch selector, the feedback is a ones complement of the address issued. In this case, the next operation on the switch selector is a read operation. However, when the feedback does not equal the complement of the address issued, a program reset operation is issued. Before removing the reset, a channel processing is accomplished. The next switch selector operation removes the reset and issues the stage and ones complement of the command address. The feedback is also verified a maximum of one time per switch selector function.

The Fail Switch Selector Options will fail the Hung Stage and verify feedback tests according to the following sequence, starting with the first switch selector.

FLIGHT PROGRAM TEST

1. Hung Stage Test Feedback

- 2. Hung Stage Test Feedback
- 3. Hung Stage Test Feedback
- 4. Hung Stage Test Feedback

ACAPE PROGRAM INPUT

No Hung Stage
Feedback Bad
Hung Stage
Feedback Bad
Hung Stage
Feedback Good
No Hung Stage
Feedback Good

If selected, the next print message will be:

TO FAIL SS, PUT REG A BIT 1 ON

After the message is printed, the operator will:

- 1. Turn Prog. Reg. A switch 1 on.
- 2. Turn Prog. Reg. A sign switch off.
- 3. Turn Prog. Reg. A. Sign Switch on.

3.4.6 Gimbal Angle Failures

The Flight Program processes the Gimbal Angle reading during the Minor Loop Routine. This routine has three tests which a Gimbal reading must pass before the reading will be accepted. These tests are crossover, disagreement bit and unreasonableness. In order to check these Minor Loop Tests, the Fail Gimbal Angle Option will allow the

operator to fail the X, Y or Z gimbal angle reading by selecting the time to fail and one of the following types of failures; crossover, disagreement, and unreasonable

1. Crossover Failure

This failure will fail the gimbal reading by issuing one of the following readings:

A Counter greater than B Counter B Counter greater than A Counter

The crossover error will occur once in the first overflow or underflow of the gimbal selected.

2. Disagreement Failure

Disagreement Failure allows the operator to fail fine readings by selecting either temporary or permanent disagreement failures. The temporary failure will be issued once per computation cycle and the permanent failure will be issued every minor loop. Four types of permanent or temporary failures are available:

- a. Set disagreement bit only
- b. Bad A Counter
- c. Bad B Counter
- d. Bad A and B Counter

If the operator selects either the second, third, or fourth type of failure, he must specify whether to fail the gimbal readings by having the B Counter greater than the A Counter or the A Counter greater than the B Counter. The disagreement failures are generated for fine gimbal angle readings only.

3. Unreasonable Failure

This failure allows the operator to fail fine and backup reading by selecting either temporary or permanent fine readings and temporary or permanent backup readings. If the operator selects temporary fine failure, the selection of a backup failure will not be necessary because the Flight Program will not request a backup gimbal reading. However, if a permanent fine failure is selected, the operator must specify a backup failure. A temporary fine failure will cause bad readings to be issued for only one or two consecutive minor loops, a temporary backup failure

will cause bad readings to be issued for three to five consecutive minor loops, and both permanent fine and backup failures will cause bad readings to be issued permanently for the selected gimbal.

The fine and backup failures will fail the gimbal readings by feeding the Flight Program a zero value or a calculated value upon PIO request. The calculated value will be one degree more or one degree less than the calculated reading.

If selected, the next print message will be:

SPECIFY Z.G.A. FAIL TIME IN REG A DATA IN REG B

The operator may select to fail the Z axis by specifying one of three failures: cross-over, unreasonable, and disagreement.

The following outline is the procedure for selecting unreasonable or disagreement failures:

- 1. Load Program Register A Switches 1-22 with time to fail the gimbal angle in seconds, scaled 17.
- 2. Load Program Register B Switches Sign -5 with desired failure pattern.
- 3. For unreasonable failures the Sign Switch is loaded in the off position and in the on position for disagreement failures.

3.4.6.1 Unreasonable Failure Selected

If unreasonable failures are selected, the operator must select the types of gimbal readings desired by loading switch 1-5 accordingly.

1. Select Fine Failures

For temporary fine failures, Switch 1 is loaded in the off position; for permanent failures, Switch 1 is loaded in the on position. If temporary fine failures have been selected, it will not be necessary to select the type of backup failure desired.

2. Select Backup Failures

For temporary backup failures, Switch 2 is loaded in the off position; for permanent backup failures, Switch 1 is loaded in the on position.

3. Select Type of Failure

The two types of failures are a zero failure and a calculated failure.

For a zero failure, Switch 3 is loaded in the off position and in the on position for a calculated failure. If a calculated failure is desired, the operator must select a plus or minus failure by loading Switch 4 in the off position for a plus failure and in the on position for a minus failure.

- 4. Turn Prog. Reg. A Sign Switch off.
- 5. Turn Prog. Reg. A Sign Switch on.

3.4.6.2 Disagreement Failure Selected

If disagreement failures are selected, the next step is to select the type of disagreement failures desired.

1. Select temporary or permanent failures.

For temporary failures, Switch 1 is loaded in the off position and in the on position for permanent failures.

2. Select Type of Failures.

Three types of failures are available for failing the gimbal readings.

a. Disagreement bit set

Switch 2 loaded in the on position will specify to set the Disagreement Bit only.

b. Bad A Counter

Switch 3 loaded in the on position will specify to issue a bad \boldsymbol{A} Counter value.

c. Bad B Counter

Switch 4 loaded in the on position will specify to issue a bad B Counter value.

If a Bad A Counter or Bad B Counter failure is selected, the operator must specify how the value is to be bad. By loading Switch 5 in the on position, the counter will be bad by having the B Counter greater than A

Counter and in the off position, the counter will be bad by having the A Counter greater than B Counter

- 3. Turn Prog. Reg. A Sign Switch Off.
- 4. Turn Prog. Reg. B Sign Switch Off.

3.4.6.3 Crossover Failures

- 1. Load Prog. Reg. A.
 - a. Specify Crossover Failure
 Crossover failure is specified by loading Switch 1 in the on position.
 - b. Select Type of Failure

Two types of failures are available.

- A Counter Greater than B Counter.
 This failure is specified by loading Switch 2 in the on position.
- 2) B Counter Greater than A Counter.This failure is specified by loading Switch 2 in the off position.
- 2. Turn Prog Reg B switches off
- 3. Turn Prog Reg A sign switch off
- 4. Turn Prog Reg A sign switch on

After the operator has selected the failures for the Z gimbal angle the ACAPE Program will Print,

SPECIFY X.G.A. FAIL TIME IN REG A DATA IN REG B

at which time the operator will select the failure pattern for the X gimbal angle using the same procedure used to select the Z gimbal angle failures. After the selection is complete the program will print.

SPECIFY Y.G.A. FAIL TIME IN REG A DATA IN REG B and the failure selection will be made for the Y gimbal angle.

3.4.7 Discrete Inputs

The ACAPE Program issues discretes to the LVDC on a timed basis. The discrete input option allows the operator to vary the discretes issued by manually loading a discrete table. The operator loads the table by specifying the discrete and time it is to be issued. The maximum number of discrete times that may be selected is 24. This option may only be selected when the Liftoff Option specified liftoff.

If selected, the next print message will be:

SPECIFY DISCRETE I/P TIME IN REG A DATA IN REG B

After this message is printed the operator may specify time to issue discretes to the Flight Program. Discrete inputs can only be selected when the Liftoff option specified normal Liftoff. 24 discrete times may be selected by the following procedure:

- 1. Load Prog Reg A switches 1-22 with time to issue discretes in seconds, scaled 17.
- 2. Load Prog Reg B switches S-25 with discrete data.
- 3. Turn Prog Reg A sign switch off.
- 4. Turn Prog Reg A sign switch on.

For additional entries repeat steps 1, 2, 3, and 4. To select the next option, turn Prog Reg A Switches 1-22 off and repeat steps 3 and 4.

3.4.8 Stage Bypass

The Stage Bypass Option has no effect on the Flight Program. The purpose of this option is to bypass the end of stage print-out. However, the ACAPE Program will continue to store switch selector, discrete inputs, discrete outputs and interrupts issued during the stage until the 'end of stage' table is full or until the 'end of flight' at which time the program will print the contents of the table.

If selected, the next print message will be:

SPECIFY STAGE 2 INIT OPTION IN REG A

After the message has been printed:

- 1. TURN PROGREG A SWITCH 1 ON
- 2. TURN PROG REG A SIGN SWITCH OFF
- 3. TURN PROG REG A SIGN SWITCH ON

3.4.9 Vehicle Inputs

This option allows the operator to specify what type of input will be issued to the Flight Program. The purpose of this option is to force the Flight Program through its backup modes or to enable the issuance of early vehicle interrupts.

If selected, the next print message will be:

SPECIFY VEHICLE INPUTS

After the message has been printed, the operator may specify one of four types of vehicle inputs. The selection of these inputs are made by loading PROG REG A in the following manner:

- 1. Select Type of Inputs
 - a. Switches 1-22 off specifies normal inputs.
 - b. Switch 1 on specifies interrupts.
 - c. Switch 2 on specifies discretes.
 - d. Switch 3 on specifies no inputs.
- 2. Turn Prog Reg A sign switch off.
- 3. Turn Prog Reg A sign switch on.

3.4.10 Mode Code 25 Option

This option is provided to dump the End of Stage data and issued switch selector data at selected functions of the Flight Program as specified by the Mode Code Word. A maximum of twenty-six mode code words can be specified.

If selected, the next print message will be:

SPECIFY MODE CODE 25

After the message is printed, load the Prog. Reg. A and B switches by the following procedure.

- 1. Turn Prog. Reg. A Switch 1 on.
- 2. Load Prog. Reg. B switches sign 25 with Mode Code Bits.

- 3. Turn Prog. Reg. A sign switch off.
- 4. Turn Prog. Reg. A sign switch on.
- 5. Repeat previous steps or activate A Reg. sign switch off and then back on with the A and B Reg. switches off to select next option.

3.4.11 Timed Interrupt Option

The ACAPE Program issues interrupts to the LVDC on a timed basis. The Timed Interrupt Option allows the operator to vary the interrupts issued to the LVDC by manually loading an interrupt table. The operator loads the table by specifying the interrupt and the time it is to be issued. The maximum number of interrupt times which may be selected is 12.

If selected, the next print message will be:

SPECIFY INTERRUPTS TIME IN REG A DATA IN REG B

After the message is printed, load Prog. Reg. A and B switches by the following procedure:

- 1. Load time to issue interrupts in seconds, scaled 17, in Prog. Reg. A Switches 1-22.
- 2. Load Interrupt data in Prog. Reg. B Switches S-12.
- 3. Turn Prog. Reg. A sign switch off.
- 4. Turn Prog. Reg. A Sign Switch on.
- 5. Repeat 1, 2, 3, and 4 for additional entries or set Prog. Reg. A switches 1-22 off and repeat 3 and 4 to select next option.

3.4.12 CIU Data Option

The CIU Portion of the Orbital Routines in the Flight Program only stores data whose value disagrees with a standard value by more than a specified amount. The CIU Data Option in the ACAPE Program provides a means of checking the CIU Routines. The operator may select one of the following types of input data:

1. A Constant

The values will stay constant thus causing no failure.

2. A Count.

The values will vary above the tolerance which will cause the CIU Routine to flag the data as an error.

If selected, the next print message will be:

CIU DATA OPTION

After message is printed, load Prog. Reg. A by the following procedure.

- 1. Specify type of input data:
 - a. A count is generated if Switch 1 is loaded in the off position.
 - b. A constant is generated if Switch 1 is loaded in the on position.
- 2. Turn Prog. Reg. A Sign Switch off.
- 3. Turn Prog. Reg A. Sign Switch on.

3.4.13 Output Options

The ACAPE Program provides four output formats:

- 1. Telemetry
- 2. PIO
- 3. Variable
- 4. Fixed

At the beginning of each stage the user may specify one of the four output formats he desires for that stage. The final output at the end of each stage for all four output options is a sequential listing of all switch selectors, discrete inputs, discrete outputs and interrupts issued or set during a stage. This output is based on total time from liftoff. However, if the user fails to specify any of the above formats, no output will be produced during the stage.

The program will print:

SPECIFY OUTPUT OPTION

1. Switch 1 on specifies telemetry output.

This option is a telemetry dump of all group 1 and 3 PIO's. The PIO address, and the associated data are printed sequentially across the page, paragraphed by computation cycle.

If selected, the program will print:

SPECIFY START TIME IN REG A STOP TIME IN REG B FOR SNAP

After the message is printed, select the start and stop times by the following procedure or by-pass by turning Prog. Reg. A sign switch off and then on. Ten different start and stop times may be selected.

- a. Load Prog. Reg. A switches 1-22 in seconds, scaled 17 for start time.
- b. Load. Prog. Reg. B. Switches 1-25 in seconds scaled 16 for stop time. When a start time is specified, a zero stop time will provide continuous printing.
- c. Turn A Reg. Sign Switch Off.
- d. Turn A Reg. Sign Switch On.
- e. Repeat step a. for next Start-Stop Time or activate Reg. A sign switch off and the on to continue.
- 2. Switch 2 on specifies all PIO output.

This optional output is an entire PIO Dump. All PIO's Group 1, 2, 3, 4 and 5, are printed. The Print Format is the same as the print format for the telemetry output option. However, it is paragraphed by the ACAPE Print Routine which allows only 56 lines to be printed per paragraph or by the end of the computation. An optional snapshot feature is provided for the telemetry and PIO output options, which will suppress the output except for the time interval specified by the user at the start of the particular stage.

If selected, the printout and operating procedures are identical to the telemetry output option.

3. Switch 3 on specifies a variable output.

This option is a variable dump of seven particular Group 1 and 3 PIO's specified by the user. The PIO address is printed in octal and the associated data is printed in octal or converted to decimal.

If selected, program will print:

SPECIFY VARIABLE CHANGE CODE IN REG. A

After the message is printed:

a. Load Table positions to be changed in Prog. Reg. A Switches 1-7.

To enter 7 variables turn switches 1-7 on. If less than 7 variables are to be changed; turn the switch on which corresponds to the table position of the variable; for example, to change the second variable, turn switch 2 on.

- b. Turn Prog. Reg. A Sign Switch off.
- c. Turn Prog. Reg. A Sign Switch on.

The program will then print:

SPECIFY VARIABLE TAG IN REG B

After this message is printed, follow this procedure:

- a. Load Prog. Reg. B.
 - 1) Load PIO Tag.

Switches S-11 are used to specify the PIO tag desired.

2) Load Scale Factor.

Switch 12-17 are used to specify the scale factor.

3) Scale factor +, - or 0.

For a + scale factor, switch 18 is loaded in the on position and in the off position for a - or 0 scale factor.

4) Select Octal or Decimal Output.

For octal output switch 24 is loaded in the on position and in the off position for decimal output.

- b. Turn Prog. Reg. A Sign Switch Off.
- c. Turn Prog. Reg. A. Sign Switch On.
- d. Repeat step (a).

After all variable tags have been loaded, the program will begin printing.

4. Switch 4 ON specifies the fixed output.

This option is a fixed dump of seven specific Group 1 and 3 PIO's which the user cannot change. The format is the same as the variable output option. The output is in decimal.

- 5. No output is specified when the switches are loaded a zero.
- 6. After selecting one of the preceding options turn Prog. Regs. A and B off.

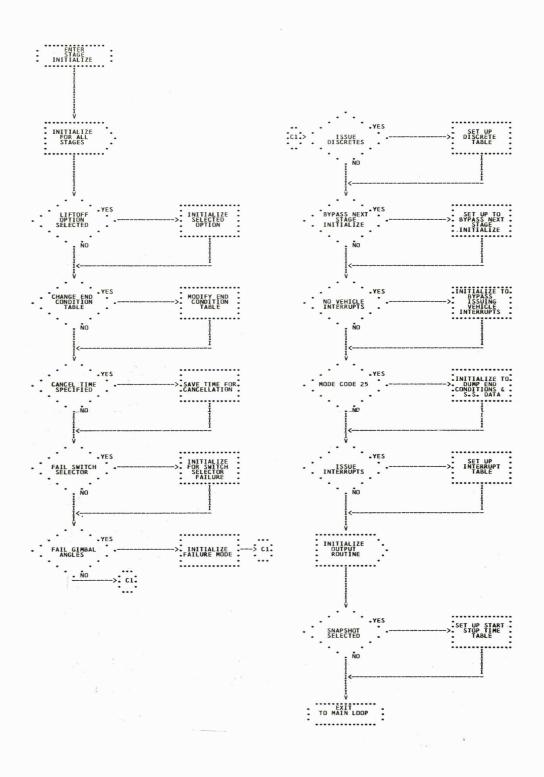


Figure 3-2. Initialize

3.5 MAIN LOOP PROCESSING (Figure 3-3)

The Main Loop will be interrupted by PIO, Minor Loop, Switch Selector, and manual push button interrupts. The only entry to the main loop is time up. The purpose of the Main Loop is to:

- 1. Read and Update Real Time
- 2. Issue Discretes and Interrupts
- 3. Execute Cancellation and Snapshot Options

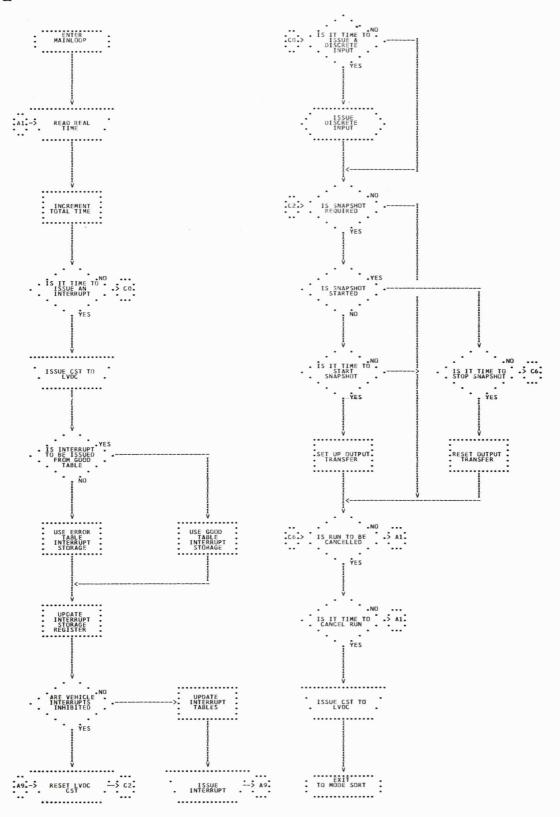


Figure 3-3. Main Loop

3.6 INTERRUPT PROCESSOR (Figure 3-4)

3.6.1 PIO Interrupt Processor

Upon entry from a hardware interrupt signal, the PIO Interrupt Processor Routine will read the PTC interrupt register and check if the course of the interrupt was the manual push button, or a PIO. If the interrupt is manual, the switch selector data is printed, and the program returns to Stage Initialize.

If the interrupt is due to the issue of an LVDC PIO, the PIO address is decoded into its respective group. For telemetry (Group 1 and 3) the associated data is stored and a transfer to the output routine is initiated. If the PIO is a group 2, 4, or 5, a HOP instruction is built from the PIO address bits and executed to the appropriate PIO processing routine. Upon return, a check is made for End Of Stage and a reset and return to the Main Loop is initiated if the End Of Stage has not occurred, otherwise, a transfer to the End Of Stage Routine is executed.

The PIO Interrupt Processor has three general types of routines depending upon the type of interrupt.

The Input PIO's are those which require an input from the LVDA to the LVDC. They simulate the registers and routines which issue the requested input data to the LVDC, and supply gimbal angle and accelerometer readings.

The Output PIO's are those which send data from the LVDC to the LVDA. They simulate the registers and counters in the LVDA which receive this output information.

When an undefined PIO is requested, the interrupt processor will transfer to the Undefined Requested Routine. This routine will print "Undefined Requested" and return the ACAPE Program to Mode Sort. The Undefined Requested routine was designed to prevent the PIO Interrupt Processor from building an incorrect HOP instruction.

3.6.2 Minor Loop and Switch Selector Interrupt Processing

The minor loop and switch selector interrupt processing routine issues INTC to the LVDC if the interrupt is uninhibited. This interrupt routine has two basic routines which will process the Minor Loop and Switch Selector Interrupts; Interrupt Reset Routine and I1 and I2 Interrupt.

The Interrupt Reset Routine will process the interrupt, if it is an II or I2 interrupt. If the interrupt is not an II or I2 interrupt, the routine will reset the interrupt condition and return to the Main Loop.

The I1 and I2 Interrupt Routine Processes the Minor Loop and Switch Selector interrupts and issues them to the LVDC.

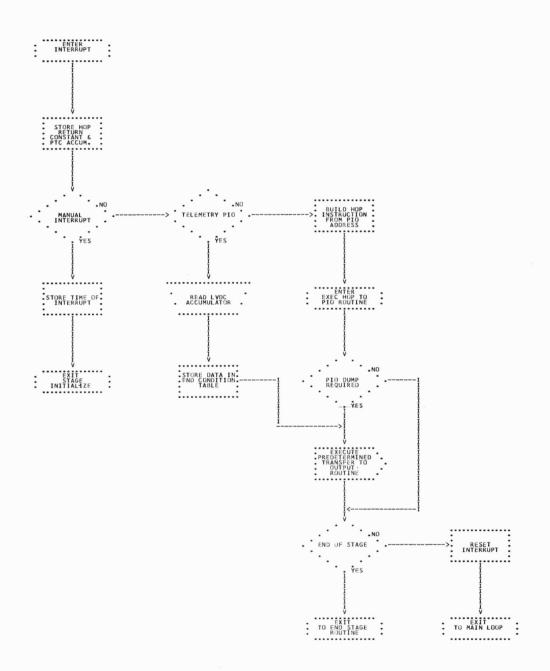


Figure 3-4. Interrupt Processor

3.7 ROUTINES

3.7.1 Read Discrete Input Register (Figure 3-5)

The function of this routine is to issue a simulated time dependent input register to the LVDC.

Entry is from the PIO Interrupt Processor Routine.

- 1. Read the real time counter and update time.
- 2. Check the accumulated time against the stored time of the next discrete to be issued.
 - a. If it is not time to issue a discrete, the present stored discrete output register is issued to the LVDC.
 - b. If it is time to issue a discrete, (1) update the simulated discrete input register by the indicated discrete from the discrete table;
 (2) update the discrete table from the next discrete to be issued;
 (3) The time of issuance of the discrete is/stored for end of stage output. (4) The stored discrete and time blocks are update for the next store operation. (5) Supply the simulated DIN register to LVDC.
- 3. A transfer to PIO output routine if specified, otherwise, a return to the interrupt processor to check for end of stage is then executed.

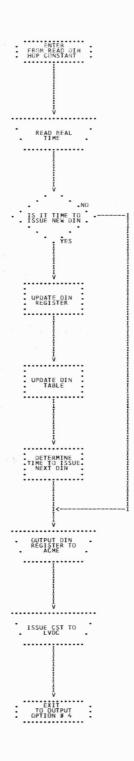


Figure 3-5. Read Discrete Input Register

3.7.2 Accelerometer (Figure 3-6)

The Accelerometer Routine will provide a complete verification of the Accelerometer Processing Routine in the Flight Program.

The ACAPE Program, assuming that only one set of accelerometers will be read per computation cycle, will upon recognition of the first accelerometer read, PIO 107, be forced into the ACAPE accelerometer processing routine. First, the ACAPE Program will calculate the nominal expected accelerometers by resolution of (F/M) through the CHI's. Then the program will monitor the sign switch of the B-register. If the switch is not on, the accelerometer values just calculated will be sent upon PIO request to the Flight Program. However, if the sign switch is on, the program will load the contents of the B-register into memory. The contents of the B-switches will be printed for later program verification. When the sign switch is set to the off state, the proper initialization will be executed and the program will force the requested error conditions.

The accelerometer routine has the capability of failing the accelerometers on one, two, or all three axis at any one time. If one of these axis is not specified, the calculated accelerometer values for that axis will be sent to the Flight Program upon PIO request.

The operator may select either temporary or permanent failures. If temporary failures are selected, the maximum number of failures the operator may select is 15. The operator may reselect the type of failures on an axis by resetting the B-switches. However, if temporary failures were selected, the program will not monitor the B-register until all the failures have been completed. If more than one axis has been selected to fail, the program will not monitor the B Register until the temporary failures have been completed for each axis. If permanent failures were selected, the Program will monitor the B-Register for each PIO requested, but will not accept the B-Register contents until a PIO 107 is issued.

This routine provides four general types of failures:

- 1. Freeze A-Counter
- 2. Freeze B-Counter
- 3. Increment A-Counter
- 4. Increment B-Counter

If the program chooses to freeze A or B, then the program will load the previous counter value issued to the Flight Program. In order to increment A and B, the programmer may specify the values by which he wishes each counter to be incremented.

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The following outline presents a step by step procedure for selecting the failures and type of failures for the X, Y, and Z accelerometers.

1. Load B-Register.

a. Select axis to be failed.

Switches 1, 2, and 3 of the B-Register are used to specify fail X, Y, and Z axis respectively. The routine has the capability of failing one, two, or all three axis at a time.

b. Select temporary or permanent failures.

For temporary failures, Switch 4 is loaded in the off position and in the on position for permanent failures.

If temporary failures are requested, the programmer must load the number of times the accelerometer is to fail in Switches 15-18. The maximum number of failures, is 15 and the minimum, 1.

c. Select type of failure.

Four types of failures are available for failing the axis. They are as follows:

1) Freeze A-Counter

Switch 5 on specifies freeze A-Counter. The routine will load the A-Counter value issued the previous computation cycles.

2) Freeze B-Counter

Switch 6 on specifies freeze B-Counter. The routine will load the B-Counter value issued the previous computation cycle.

3) Increment A-Counter

Switch 7 on indicates that the operator has selected to increment the A-Counter. The value by which the operator wants the counter incremented must be specified by placing the values 0-7 in switches 9-11.

The available values for increments are:

Value in SWT 9-11	Bias Number	Contents Load into the A-Counter					
0	B1	Previous Counter Value +1					
1	B2	Previous Counter Value -1					
2	В3	1.5 Times Present Counter Value					
3	B4	0.5 Times Present Counter Value					
4	В5	Previous Counter +10					
5	В6	Previous Counter - 10					
6	В7	Present Counter Value + 1					
7	В8	Present Counter Value - 1					

4) Increment B-Counter

Switch 8 turned on indicates increment the B-Counter. The bias numbers needed to increment the B-Counter are the same as those for the A-Counter. The selection of the bias must be loaded in Switches 12-14.

2. Turn Sign Switch on in B-Reg.

When the routine recognizes the Sign Switch, it will stop the Output Routine and print the contents of the B-Register.

3. Turn Sign Switch Off.

When the Sign Switch is turned off, the program will force the requested error conditions.

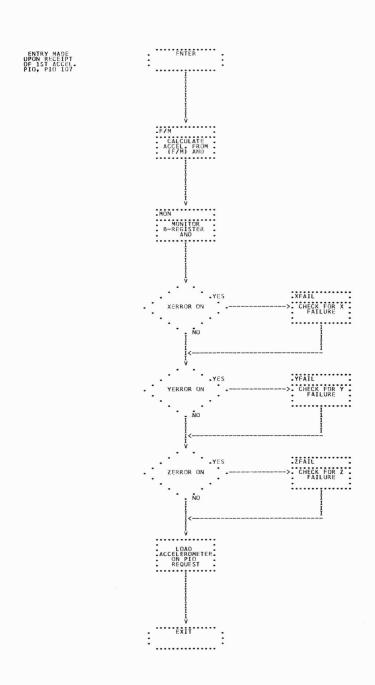


Figure 3-6. (Sheet 1 of 3) Accelerometer

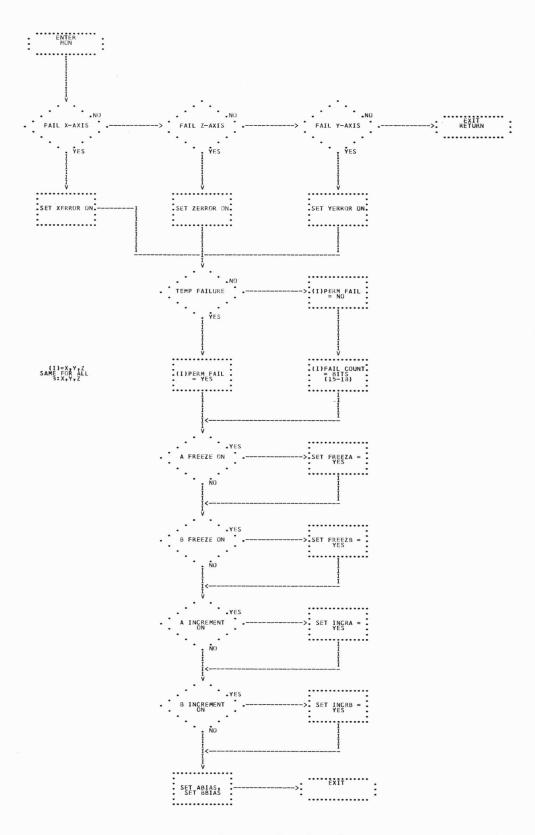


Figure 3-6. (Sheet 2 of 3) Accelerometer

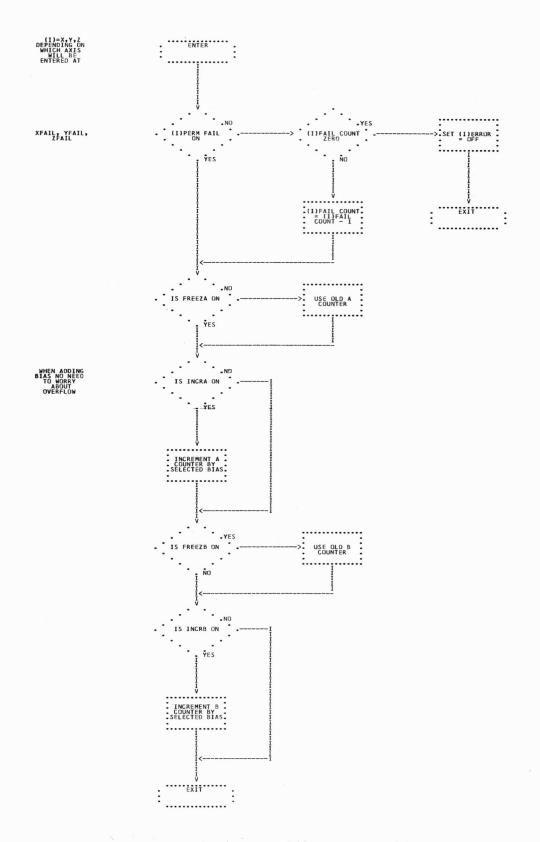


Figure 3-6. (Sheet 3 of 3) Accelerometer

3.7.3 PIO Switch Selector Set (Figure 3-7)

The following is a general description of the logic contained in the "Group 2 PIO Switch Selector Set" flowchart. Entry is from the Interrupt Processor Routine and exit is to the PIO Output Routine if specified or to the End of Stage Test.

1. No Error Conditions.

- a. Read the PIO address register in the ACME and store as tag.
- b. Read the PIO data register in the ACME and store.
- c. Check the reset bit in the data for a hung stage or bad beedback condition.
- d. Check for a complement of stage and address command.
- e. With counter value equal to 1, store tag and data for end of stage output.
- f. With counter value equal to 2, store time of set read command for end of stage output.
- g. With counter value equal to 3, i.e., upon detection of reset read command, recycle counter for steps e, f, g.
- h. Transfer to PIO output routine if specified or end of stage test.

2. Error Conditions.

- a. Steps (a) and (b) of Part 1.
- b. Check the reset bit in the data for a hung stage or feedback condition.
- c. With counter value equal to 1, store tag and data for end of stage output.
- d. Set 'A' flag (+) indicative of a RESET Bit being present and check the stage and address bits for a zero configuration.
- e. Test the 'A' flag (+), indicative of the reset bit being reset, check the stage and address bits for a zero configuration, the reset bit equal to zero and set the 'B' flag (+) to indicate the operation of an error condition.

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- f. Check for a complement of stage and address command which indicates a bad feedback condition.
- g. Reset the 'B' flag to zero to indicate termination of bad feedback condition.
- h. Steps f, g and h of Part 1.

3.7.3.1 Switch Selector Read

The Switch Selector Read Routine processes the commanded switch selector and stores the stage and switch selector address.

3.7.3.2 Switch Selector Feedback

The Switch Selector Feedback Routine will return a zero or ones complement feedback to the LVDC upon receipt of a switch selector read feedback PIO request. If the switch selector fail pattern is set it will issue invalid data.

3.7.3.3 Switch Selector Failure

The Switch Selector Failure Routine will return a bad feedback to the LVDC depending on the binary failure pattern. If the bit is one, the data in the feedback register will be modified. The failure pattern will be shifted until zero. When zero, all feedbacks will be valid. The Binary Failure Pattern is 0011110.

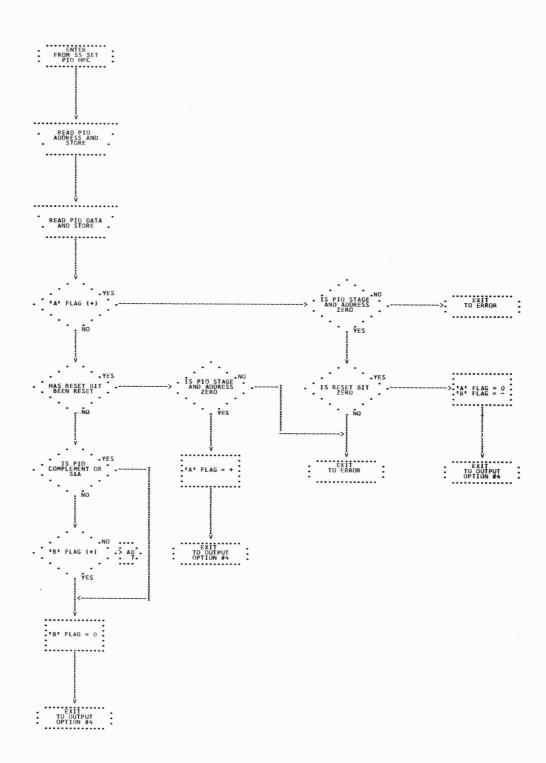


Figure 3-7. (Sheet 1 of 2) PIO Switch Selector Set

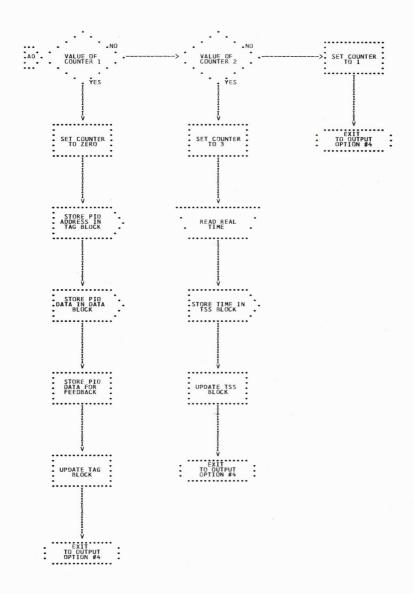


Figure 3-7. (Sheet 2 of 2) PIO Switch Selector Set

3.7.4 Gimbal Angle (Figure 3-8)

The function of this routine is to supply a fine, course, or backup, COD Counter reading for the X, Y, or Z gimbal angles to the LVDC upon PIO request.

The following is a general description of the logic contained in the "Group 5 PIO Read Gimbal Angle" flowchart. Entry is from the PIO Interrupt Processor Routine and exit is to the PIO Output routine if specified or to the end of stage test.

- 1. Determine which Gimbal Angle is requested.
- 2. Determine the resolution (fine or backup) requested.
- 3. Check for start of a new flight computation cycle, if not indicated, output the appropriate present COD Counter to the LVDC.
- 4. If a new flight cycles is indicated, reset the new comp cycle flag.
- 5. Check the Gimbal Angle flag, and store the appropriate commanded steering angle.
- 6. Check which resolution is requested and store the appropriate scale factor.
- 7. Convert the stored steering angle to a COD Counter reading by use of the stored scale factor.
- 8. Form the duplex COD Counter reading.
- 9. Store the simulated duplex COD Counter for the appropriate Gimbal Angle according to type (fine or backup).
- 10. Output the simulated COD Counter to the ACME.
- 11. Go the the PIO output routine if specified, otherwise, go to the end of stage test in the Interrupt Processor.

3.7.4.1 Fine Gimbal Readings Requested

If a fine gimbal reading is requested, the Routine will calculate a new COD Counter X, Y, or Z gimbal angle value for each computer cycle change and send it to the LVDC. If the operator has requested a failure, the value of the COD Counter X, Y, or Z gimbal angle issued will depend on the type of failure requested. If the computer cycle has not changed, a fine X, Y, or Z fudge factor will be added to the previously

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calculated COD Counter and the result sent to the LVDC.

3.7.4.2 Course Gimbal Readings Requested

If course gimbal readings are requested by the Flight Program, the routine will set the disagreement bit for the requested gimbal angle reading.

3.7.4.3 Backup Gimbal Reading Requested

If backup gimbal readings are requested, the Gimbal Angle Routine will calculate the new backup COD Counter values for the X, Y, and Z gimbal angle readings for each computer cycle change and send it to the LVDC. If the operator has selected to fail either the X, Y, or Z backup gimbal readings, the value issued to the LVDC for the specified gimbal will depend on the type of failure requested. If the computer cycle has not changed a backup X, Y, or Z fudge factor will be added to the calculated COD Counter and the result sent to the LVDC.

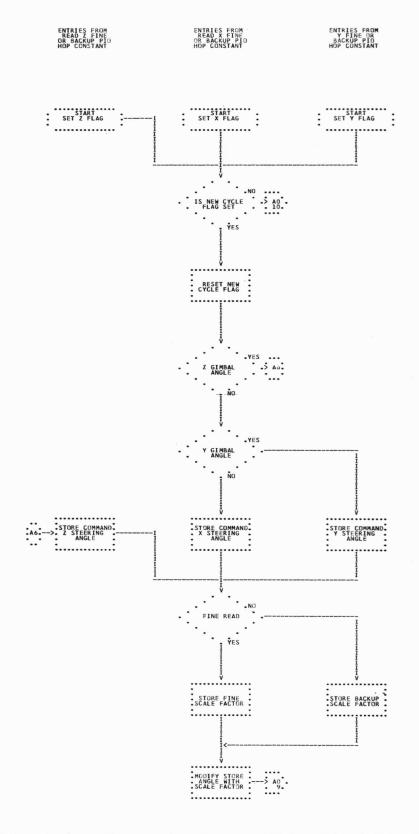


Figure 3-8. (Sheet 1 of 3) Group 5 PIO Read Gimbal Angle

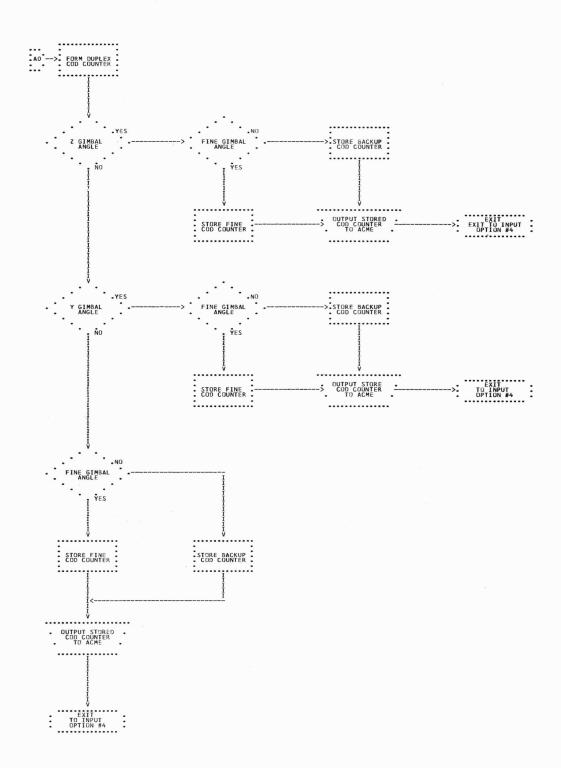


Figure 3-8. (Sheet 2 of 3) Group 5 PIO Read Gimbal Angle

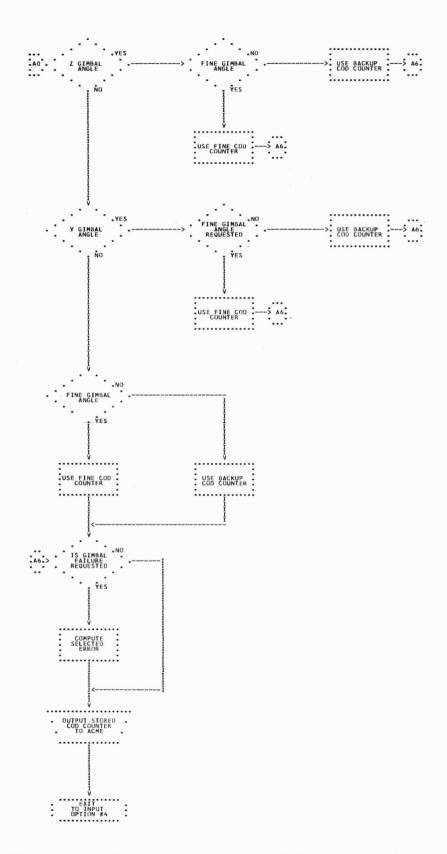


Figure 3-8. (Sheet 3 of 3) Group 5 PIO Read Gimbal Angle

3.7.5 Telemetry or PIO Output (Figure 3-9)

The function of this routine is to list sequentially and print in octal, six PIO addresses and the corresponding data per line. The output will be Group 1 and 3 (telemetry) PIO's or all PIO's depending on the users specifications. A new heading is printed every cycle change. A PIO Pointer Routine is available which will flag PIO's 075, 570, 441, 465, and either a PIO requested by the programmer or PIO 137 for both the telemetry and all PIO's output.

The following is a description of the generalized flowchart of the Telemetry or PIO Output Routine. Entry is from the Interrupt Processor after checking the end condition table if telemetry is specified, or after processing the Group 2, 4, or 5 PIO's if all "PIO's are being outputed". Return is to the Interrupt Processor to check for the end of stage.

Upon entry, a check is made for a cycle change. If there was one, a print is executed. A skip to a new page is initiated and a new heading printed. The PIO address is converted to octal BCD and placed in the print buffer with the associated data. If the buffer is full, a print is initiated; otherwise, a return to the Interrupt Processor is executed to check for end of stage.

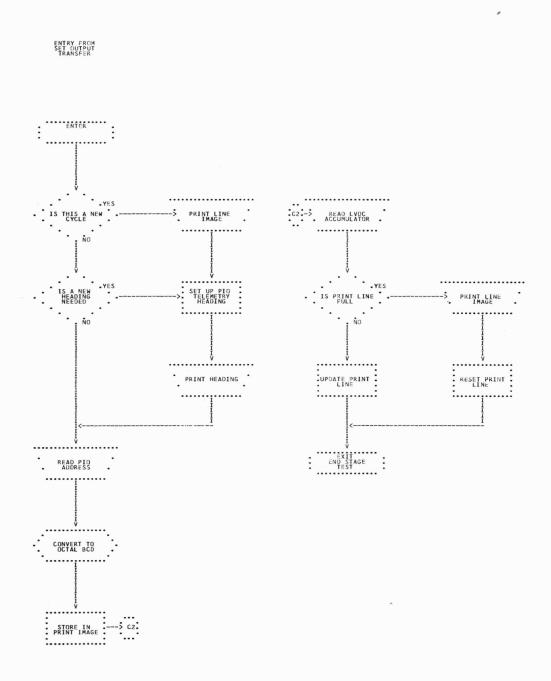


Figure 3-9. Telemetry or PIO Output

3.7.6 Variable or Fixed Output (Figure 3-10)

The function of this routine is to store the data for seven specific group 1 or 3 telemetry PIO's whenever addressed into a table. A cycle change or a repeat of a PIO within the same cycle will result in the contents of the table being converted to decimal and then printed with the present cycle counter. A heading is printed at the start of each page.

The following is a description of the generalized flowcharts of the Variable or Fixed Output Routine:

Entry is from the Interrupt Processor after the end condition table has been checked. The normal sequence is to print a new heading if required, to obtain the PIO address, scan the fixed or variable table for that address and if found store the associated octal data obtained in the table if unfulled and return to the Interrupt Processor to test for End of Stage.

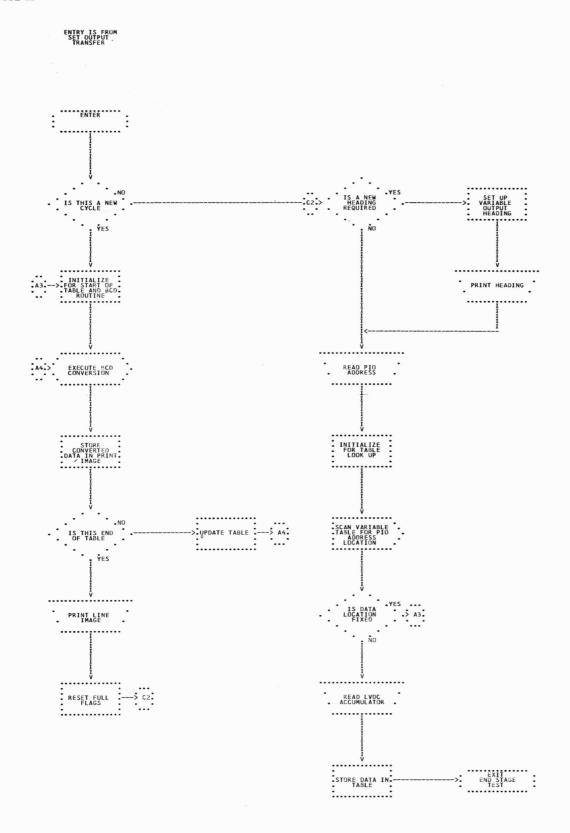


Figure 3-10. Variable or Fixed Output

3.7.7 End of Stage (Figure 3-11)

The function of this routine is to store all switch selectors, interrupts, discrete inputs and discrete outputs, in a table, and at the end of a stage or when a manual interrupt 16 is received, print the contents of the table. The output is a list of all switch selectors, interrupts, and discretes issued or set in a sequential time reference from liftoff. The routine will also print the total time and stage time elapsed from liftoff.

Entry is from the Interrupt Processor if the End of Stage flag has been set.

Exit is to Stage Initialize or to Mode Sort.

Upon entry a message is printed indicating the end of the stage. The total time and stage time elapsed from liftoff are printed. A heading is printed for the final listing of switch selectors, discretes and interrupts issued during the stage. The appropriate I/O data is then listed sequentially according to time of occurrence. If this is the last stage, a return to Mode Sort is executed, otherwise return is to Stage Initialize to prepare for the next stage.

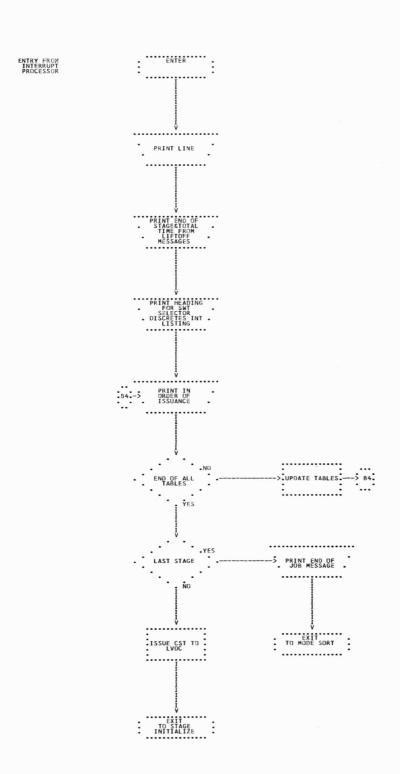


Figure 3-11. End of Stage

3.7.8 Pointer

This routine allows the operator to flag a PIO tag in either the Telemetry or PIO Output Options. The routine will monitor A-Reg. Sign Switch. If the Sign Switch is on, the routine will read the A-Reg. and compare the contents of the A-Reg. with the PIO tag being processed. If they are the same, the routine will print a flag, \$, beside the tag. If the Sign Switch is not on, the routine will flag PIO 37 instead.

PROG. REG. A SWITCHES

SIGN												
SWITCH	1	2	3	4	5	6	7	8	9	10	11	12
	1st digit or MODE TAG		2nd digit		3rd digit			4th digit				

Procedure:

- 1. Turn Program Reg. A Sign Switch off.
- 2. Load PIO Tag in switches 1-12 of the A-Reg.
 - a. Mode tag or high order digit in switches 1-3, possible values 0-7.
 - b. 2nd high order digit in switches 4-6 possible values 0-7.
 - c. 3rd digit in switches 7-9, possible values 0-7.
 - d. Last digit in switches 10-12 possible values 0-7.
- 3. Turn Sign Switch on.

In order to change tag, repeat the above procedure.

3.7.9 Read Real Time

The function of this routine is to supply the present real time counter value to the LVDC.

3.7.10 Discrete Input Spares Read

This routine will specify zeros to the LVDC when a PIO 053 (Read Discrete Input Spares) is commanded.

3.7.11 CIU Register Load

The function of this routine is to supply the assembled CIU data to the output routine.

3.7.12 Internal Control Register Set

The function of this routine is to set the bits in the simulated internal control register as specified in the LVDC PIO data.

3.7.13 Internal Control Register Reset

The function of this routine is identical to the above routine with the exception of resetting those bits in the simulated internal control register specified by the PIO data register in the ACME.

3.7.14 CIU Output

The function of this routine is to assemble CIU data for the LVDC. The data will be either a count or a constant.

3.7.15 Interrupt Storage Register

The function of this routine is to supply a simulated LVDC interrupt storage register, representing all interrupts issued by the PTC, to the LVDC.

3.7.16 Error Monitor Register

The function of this routine is to supply a simulated error monitor register to the LVDC.

3.7.17 Interrupt Inhibit Register Set

The function of this routine is to set the simulated Interrupt Inhibit Register with the data specified by the PIO data register in the ACME and to compare the data with the simulated interrupt storage register to determine which interrupts can be issued.

3.7.18 Interrupt Register Reset (Limiting)

The function of this routine is to set the simulated limiting register with the data specified by the PIO data register in the ACME and to compare the data with the simulated interrupt storage register to determine which interrupts are to be reset.

3.7.19 Ladder No. 1, No. 2, and No. 3 Set

The function of these routines is to set the simulated ladder output registers with the data specified by the PIO data register in the ACME.

3.7.20 Switch Selector Interrupt Counter Set

The function of this routine is to load the Switch Selector Counter into the ACME.

3.7.21 Mode Register

The function of this routine is to set the simulated mode register with the data specified by the PIO data register in the ACME.

3.7.22 Discrete Output Register Set and Reset

The function of the routines is to set or reset these bits in the simulated discrete output register specified by the PIO data register in the ACME.

3.8 SUBROUTINES

3.8.1 BCD Conversion Routine for Integers and Fractions.

The function of this routine is to convert octal integers and fractions to a decimal print format. The following routines are from octal to BCD. A BCD word contains 4 BCD digits.

1. BCD Add Subroutine.

This routine will add two BCD words decimally.

2. BCD Carry Routine.

This routine will check for a high order carry and set a flag for adding the carry to the low order BCD digit of the next BCD word.

3. BCD Mode Zero Conversion.

This routine will test a BCD word for zeroes and replace the octal zeroes for the printed output.

3.8.2 Octal to BCD

The function of this routine is to convert the time that each switch selector, interrupt and discrete is issued or set, from octal to BCD for printout during the end of stage routine.

3.8.3 Octal-BCD Conversion

The function of this routine is to convert octal binary data to a decimal print format.

3.8.4 Print and Console Read

This routine will go to the ACAPE Print Routine to print the contents of the buffer. It will then read the PTC console A and B registers, check the A register for a valid response from the operator. If a valid response is not received, the routine will print "waiting for response to proceed, put sign bit off". When a correct response is received, the desired A and B registers are read and the data operated on according to the stored instruction. The routine will then print "waiting for response to proceed put sign bit on".

3.8.5 Printer Busy Test

This routine will test if the printer is busy before loading the buffer or issuing a print command.

3.8.6 ACAPE Print

This routine will print the contents of the buffer and execute the print carriage control commands. It must also maintain line counter for output routines to print heading. Maximum number of lines is 56.

3.8.7 Time Base Test

The purpose of this routine is to check which time base the Flight Program is in, load the print buffer with the correct time base and transfer to the End of Stage Output Dump Routine.

3.8.8 End of Stage Data Store

The function of this routine is to store sequentially all switch selectors, interrupts, discrete inputs, and discrete outputs issued or set during a stage, for listing at the end of the stage.

3.8.9 Zero Out Table

The function of this routine is to clear the output table in order to restore data areas in table and print area.

3.8.10 Table Search

The function of this routine is to search a table for the corresponding location of the data given. The address of the table entry is available to the user upon return. If a particular flag is set, this routine will store data into the adjacent table location.

3.8.11 Sine/Cosine Calculation

The function of this routine is to calculate the sine and cosine of CHI Z and CHI Y for the accelerometer routine.

3.8.12 Multiply Instruction

The function of this routine is to execute a multipy instruction.

3.8.13 Change Data Sectors

The function of this routine is to change the data sector in a HOP constant to the desired data sector according to the HOP save constant.

3.8.14 Load In and Read Out

The function of this routine is to store and execute one or two instructions.

APPENDIX A

OUTPUT

OF

ASTEC PREFLIGHT
AUTOMATIC SEQUENCE ROUTINE

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE 0001

S.C.

40

MPU

COD ERROR WORD

XXXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

MFB

OUTPUT

PAGE 0002

S.C. 26

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the 'ENDING REG STATUS' heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR SECTOR DUMP ROUTINE

Module $\underline{\hspace{1cm}0\hspace{1cm}}$ (M)

Starting Sector 0 (S_S)

Ending Sector $\underline{}$ (S_E)

Input Word S 1 2 3 4 5 6 7 8 9 10 11 12

 $\underline{0} \quad \underline{1} \quad \underline{1} \quad \underline{1} \quad \underline{1} \quad \underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{0}$

OUTPUT

PAGE 0003

S.C. 20 MSD

RCAM 440000000 or 536000000

RCAD <u>360000000</u>

Verify that the output contains dumps of the specified sectors. The following sectors should be dumped.

Sector 0 through Sector 17

MONITOR SECTOR DUMP ROUTINE

Module $\underline{1}$ (M)

Starting Sector 0 (S_S)

Ending Sector $\underline{}$ (S_E)

Input Word S 1 2 3 4 5 6 7 8 9 10 11 12

OUTPUT

PAGE 0004

S.C. 20 MSD

RCAM 440000000 or 536000000

RCAD 360100000

Verify that the output contains dumps of the specified sectors. The following sectors should be dumped.

Sector 0 through Sector 17.

MONITOR SECTOR SUM CHECK ROUTINE

	Module		0				(M)							
	Starting Sector	_	0				(S _S)							
	Ending Sector	_	17				(S _E)							
	Input Word	S	1	2	3	4	5	6	7	8	9	10	11	12
		0	s_{E}	$s_{\rm E}$	$s_{\rm E}$	$s_{\rm E}$	s_s	s_s	s_s	s_s	M	M	M	0
		0	1	1	1	1	0	0	0	0	0	0	0	0
OUTP	UT											,		PAGE <u>0005</u>
	S.C. 16	MSC	C											
	RCAM 43400	000	00 01	542	0000	00								
	RCAD 36000	000	00									٠		
ERRO	R MSGE E	MI	R DA	TA		TA	.G		TEL	DAT	ΓA			
						37	4	19						
						37	0							

340

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	
		314	<u> </u>
		310	
		304	
		300	
		274	-
		270	
		264	
		260	·
		254).
		250	
		244	
		240	
	£ 27	234	
		230	-
		224	
		220	
	,	214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR SUM CHECK ROUTINE

	Module				1		_	(M)							
	Starting S	Sector			0		_	(S _S)							
	Ending Se	ector		***************************************	17	-	_	(S _E)							
	Input Wo	rd	S	1	2	3	4	5	6	7	8	9	10	11	12
			0	\mathbf{s}_{E}	$\mathbf{s}_{\mathbf{E}}$	\mathbf{s}_{E}	\mathbf{s}_{E}	$s_{\rm S}$	$\mathbf{s}_{\mathbf{S}}$	$s_{\rm S}$	$s_{\rm S}$	M	M	M	0
			0	1	1	1	1	0	0	0	0	0	0	1	0
OUTP	UT														PAGE <u>0006</u>
	S.C.	16		ľ	MSC										
	RCAM	43400	0000	00 or	542	0000	00								
	RCAD	36010	0000	00											
ERRO	R MSGE	E	EMI	R DA	та		TA	G		TEL	DAT	ГΑ			
							37	4							
							37	0							
				,			36	4			-				
							36	0							
							35	4		-					
							35	0							
							34	4							
							34	0							

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	
		314	
		310	
		304	
		300	
		274	
		270	
		264	
		260	
		254	
		250	
		244	
		240	*
		234	
		230	
		224	
		220	
	•.	214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR ACCELEROMETER PULSE COUNT

Number Spe	ecified _	1							
Sequence	Sequence \underline{X} , \underline{Y} , \underline{Z} , $(X = 00, Y = 10, Z = 01)$								
Count Requ	unt Requested 65,535 (Decimal)								
X - Rate		+1P/32 Ma	achine Cycles Appro	x. 400 P	PS				
Y - Rate		+1P/64 Ma	achine Cycles Appro	x. 200 P	PS				
Z - Rate		+1P/128 M	Iachine Cycles Appr	ox. 100 I	PPS				
Syl. Used		0 <u>√</u> , 1_	***************************************						
OUTPUT						PAGE <u>0007</u>			
SC		02	MPC(S)	STATUS	SCODE				
RCA	AM	404000000	or 572000000	Mode Co	ommand				
DR	V	00000100							
VT	V	000000200							
CR	v	00000400							
RCA	AD	102200000		Data Wo	ord 1				
RCA	AD	377760000		Data Wo	ord 2				
RCA	AD	000160000		Data Wo	ord 3				
240		005252500	005252656	ACC1	TIME				
234		000377776	000400010	ACC1	SYL 1				
230		000377776	000400010	ACC1	SYL 0				
224		Approx.	005223256	ACC2	TIME				
220		Approx.	000176722	ACC2	SYL 1				
214		Approx.	000176722	ACC2	SYL 0				
210		Approx.	005223362	ACC3	TIME				
204		Approx.	000077354	ACC3	SYL 1				
202		Approx.	000077354	ACC3	SYL 0				

MONITOR ACCELEROMETER PULSE COUNT

Number Specified	2
Sequence	\underline{X} , \underline{Z} , \underline{Y} , $(X = 00, Y = 10, Z = 01)$
Count Requested	900 (Decimal)
X - Rate	+1P/512 Machine Cycles Approx. 25 PPS
Y - Rate	+1P/1216 Machine Cycles Approx. 10 PPS
Z - Rate	+1P/2432 Machine Cycles Approx. 5 PPS
Syl. Used	0, 1

OUTPUT PAGE 0008

SC	02	MPC (S)	STATUS	CODE
RCAM	404000000	or 572000000	Mode Co	ommand
DR V	000002000			
VT V	000004600	<u>)</u>		
CR V	000011400	<u>)</u>		
RCAD	211100000	<u>)</u>	Data Wo	ord 1
RCAD	034100000	<u>)</u>	Data Wo	ord 2
RCAD	000000000	<u>)</u>	Data Wo	ord 3
240	Approx.	005450252	ACC1	TIME
234	Approx.	000007030	ACC1	SYL 1
230	Approx.	000007030	ACC1	SYL 0
224	005442000	005455700	ACC2	TIME
220	000003410	000003422	ACC2	SYL 1
214	000003410	000003422	ACC2	SYL 0
210	Approx.	005427664	ACC3	TIME
204	Approx.	000020510	ACC3	SYL 1
202	Approx.	000020510	ACC3	SYL 0

MONITOR ACCELEROMETER PULSE COUNT

Number Specified 3Sequence Z, X, Y, (X = 00, Y = 10, Z = 01)Count Requested 9 (Decimal) X - Rate Approx. +1P/SEC Y - Rate Approx. +1P/20 SEC Z - Rate Approx. +1P/5 SECSyl. Used $0 \checkmark$, 1____

OUTPUT PAGE 0009

SC	02	MPC(S)	STATUS	SCODE
RCAM	404000000 o	r 572000000	Mode C	ommand
DR V	000001450			
VT V	000040000			
CR V	000007710			
RCAD	304400000		Data Wo	ord 1
RCAD	000220000		Data Wo	ord 2
RCAD	000000000		Data Wo	ord 3
240	Approx.	007315276	ACC1	TIME
234	Approx.	000000140	ACC1	SYL 1
230	Approx.	000000140	ACC1	SYL 0
224	Approx.	007324676	ACC2	TIME
220	Approx.	000000740	ACC2	SYL 1
214	Approx.	000000740	ACC2	SYL 0
210	005702436	007400360	ACC3	TIME
204	000000022	000000030	ACC3	SYL 1
202	000000022	000000030	ACC3	SYL 0

MONITOR CIMBAL ANGLE MONITOR SERIALIZER

Sequence Selected (Identify by Checks) CG1. CG2, CG3, FG1, FG2, FG3, BG1, BG2, BG3 Desired Gimbal Angles CG1 000000000 CG2 000000006 CG3 000000070 FG1 000000700 FG2 000007000 FG3 000007676 BG1 000005252 BG2 000005252BG3 000005252 YES _____ NO ____ CORRECTIONS? **OUTPUTS PAGE 0010** S.C. 03 MGA **RCAM** 406000000 **RCAD** 377600000 CG1 00000000 CG2 00000006 CG3 00000070 FG1 00000700 FG2 000007000 FG3 000007676 BG1 000005252

BG2

BG3

000005252

000005252

350	NU
344	NU
340	NU
334	NU
330	NU
324	NU
320	NU
314	NU
310	NU
304	NU
300	NU
274	NU
270	NU
264	NU
260	NU
254	NU
250	NU
244	NU
240	$\underline{000000000}$
234	$\underline{000300006}$
230	$\underline{003400070}$
224	$\underline{034000700}$
220	340007000
214	373707676
210	$\underline{252505252}$
204	252505252
202	$\underline{252505252}$

 $\underline{\underline{\text{NOTE}}}$: A NU in an output location indicates that that output is not used by the options selected.

MONITOR GIMBAL ANGLE MONITOR SERIALIZER

Sequence Selected (Identify by Checks)

CG1, CG2, CG3, FG1, FG2, FG3, BG1, BG2, BG3

Desired Gimbal Angles

CG1 <u>000000000</u> CG2 <u>000000006</u> CG3 <u>000000070</u>

FG1 <u>000000700</u> FG2 <u>000007000</u> FG3 <u>000007676</u>

BG1 <u>000005252</u> BG2 <u>000005252</u> BG3 <u>000005250</u>

CORRECTIONS? YES _____ NO ____

OUTPUTS PAGE 0011

S.C. 03 MGA

RCAM 406000000

RCAD 177600000

CG1 000000000

CG2 000000006

CG3 000000070

FG1 000000700

FG2 000007000

FG3 000007676

BG1 000005252

BG2 000005252

BG3 000005252

350	00000000
344	000003642
340	000003642
334	000300006
330	000003650
324	000003650
320	003400070
314	000003732
310	$\underline{000003732}$
304	034000700
300	000000700
274	000000700
270	340007000
264	000007000
260	<u>000007000</u>
254	373707676
250	000007676
244	000007676
240	252505252
234	$\underline{000005252}$
230	000005252
224	252505252
220	$\underline{000005252}$
214	000005252
210	$\underline{252505252}$
204	000005252
202	000005252

MONITOR GIMBAL ANGLE MONITOR (RATIO TRANS)

Desir	ed Gimba	l Angles				
GC1		<u></u>	GC2		GC3	✓
FG1			FG2		FG3	✓
BG1			BG2		BG3	✓
OUTF	PUT					PAGE 0012
	S.C.	03 MGAR				
	RCAM	570000000		SYL. 1 and 0 m	ay vary by:	41
	RCAD	377600000				
	240	367107562		CG1 ± 8 counts	F - 2	
	234	371007620		CG2 ± 8 counts		
	230	121202424		CG3 ± 8 counts		
	224	022200444		FG1 ± 4 counts		
	220	016000340		FG2 ± 4 counts		
	214	351607234		$FG3 \pm 4$ counts		
	210	361407430		BG1 ± 4 counts		
	204	365007520		BG2 ± 4 counts		
	202	242405050		$BG3 \pm 4$ counts		

MONITOR GIMBAL ANGLE MONITOR (RATIO TRANS)

Desir	ed Gimba	l Angles	3			
GC1		<u> </u>		GC2	GC3	
FG1		,		FG2	FG3	
BG1		/		BG2	BG3	
OUT	PUT	,				PAGE 0013
	S.C.	03	MGAR			
	RCAM	570000	0000		SYL. 1 and 0 may vary by	:
	RCAD	311000	0000			
	240	NU				
	234	NU	*			
	230	NU				
	224	NU				
	220	NU				
	214	NU				
	210	367107	7562		CG1 ± 8 counts	
	204	022200	0444		FG1 ± 4 counts	with the second

 $BG1 \pm 4$ counts

202

361607430

77777740

Desired DIS Format			 776000000	_		
Desired IR Format			 107300000	_		
OUTPU	JTS					PAGE 0014
	S.C.	04	MDI			

ь. С.	OT MIDI		
RCAM	410000000 or 566000000		
210	000000006		
204	001777X76		
202	000020000		
DIN	77777740	DIN	DESIRED
DIS	776000000	DIS	DESIRED
IR	107300000	IR	DESIRED
210	77777746	DIN	READ
204	77777X76	DIS	READ
202	107320000	IR	READ

Desired DIN Format

Also examine DIS, DIN & IR under "ENDING REG STATUS", adapt I/O output to verify that the inputs are as desired.

Because the LVDC and PTC are not properly synchronized, a 'STATUS CODE NOT RECEIVED" message may be printed. This causes Monitor Power Up to be run and thus page numbers will not correspond to this document.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S.C.

40

MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0015

S.C.

26

MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

	Desired	DOR For	mat	777600	000		-		
	DOR Set			DOR R	eset		-		
	Desired	S.S. For	mat	774000	000		-		
	Issue SS	PIO?		YES	<u>/</u> , 1	NO	-		
OUTP	UTS							PAGE	0016
	S.C.	05 MD	O					. 1	
	RCAM	41200000	0						
	RCAD	37774000	0						
	RCAD	37600000	0						
Verify headin		and SSR	outputs printed	l under the	"ENDING	G REG	STATUS,	LVDA ()/P"
	DOR sho	ould be <u>77</u>	7600000						
	SSR sho	ould be <u>77</u>	4000000						

Desired DOR Format	777600000
DOR Set,	DOR Reset
Desired S.S. Format	000000000
Issue SS PIO?	YES, NO

OUTPUTS PAGE 0017

S.C. 05 MDO

RCAM 412000000

RCAD 000000000

RCAD <u>000000000</u>

Verify the DOR and SSR outputs printed under the "ENDING REG STATUS, LVDA $\mathrm{O/P}$ headings.

DOR should be 777600000

	Desired	DOR F	'ormat		000000000					
	DOR Set	~	,		DOR Reset					
	Desired	S.S. F	'ormat		000000000					
	Issue SS PIO?				YES	NO_				
OUTPU	JTS								PAGE (0018
	S.C.	05	MDO							
	RCAM	41200	0000							
	RCAD	37770	0000							
	RCAD	00000	0000							
Verify heading		and SS	R outputs print	ed ur	nder the "ENI	DING 1	REG S	STATUS,	LVDA ()/P''
	DOR sho	ould be	000000000							

	Desired	l DOR	Format		000000	0000			
	DOR Se	t	 ,		DOR R	Reset			
	Desired	s.s.	Format		000000	0000			
	Issue SS PIO?			YES_	<u></u>				
OUT	PUTS						**************************************	PAGE	0019
	S.C.	05	MDO						. 1
	RCAM	4120	00000						
	RCAD	0000	40000						
	RCAD	0000	00000				X .		

Verify the DOR and SSR outputs printed under the "ENDING REG STATUS, LVDA $\mbox{O/P}\mbox{"}$ headings.

DOR should be 000000000

	Desired DOR Format			000000000			
	DOR Set			DOR Reset			
				00000000			
				YES, NO			
OUTP	UTS				PAGE <u>0020</u>		
	s.c.	05	MDO				
	RCAM	412000	0000				
	RCAD	377700	0000				
	RCAD	000000	0000				

Verify the DOR and SSR outputs printed under the "ENDING REG STATUS, LVDA O/P" headings.

DOR should be 000000000

MONITOR VERIFY AND PREPARE TO LOAD

Module $\underline{2}$ (M)

Sector 17 (S)

Address 024 (A)

S/D 0 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

V Bit 1 V = 1 = Verify

PTC INPUT CONTROL WORD

Data expected or loaded 400000000

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT PAGE 0021

S.C.	21	MVP
RCAM	44200	0000
RCAD	<u>75000</u>	2460
RCAD	40000	0000
RCAD	NU	
244	NU	
240	NU	
234	NU	
230	NU	
224	NU	
220	NU	·
214	NU	
210	NU	
204	75070	02436
202	40000	00000

If a load is being performed also expect a

S.C. 23 MLD

MONITOR G AND C STEERING

This routine shall obtain the DOM data which is loaded by the Minor Loop segment of the Flight Program.

Lack of synchronization control between stepping and reading of the DOM data causes a few of the quantities to be missing from the output.

OUTPUT PAGE 0022

S.C. 06 MGC

RCAM 414000000 or 562000000

ERROR MSGE EMR DATA TAG TEL DATA

Unpredictable telemetry tags and data can be expected from the Flight Program.

QUANTITIES TO BE IDENTIFIED

I. D	TAG WORD	DATA WORD
• Fine G.A. 1	06A230000	00000C000
• Fine G.A. 2	06B630000	00000C000
• Fine G.A. 3	06B530000	00000C000
COD ERR Word	06A660000	XXXXXXXX
DIS	06A510000	001777X76
ICR	06A220000	C00000000
DIN	06A550000	000000006
EMR	06A210000	000000000

NOTE:

A = 0 or 4

B = 1 or 5

C = 2, 4, or 6

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT PAGE NU

S.C. 40 MPU

COD ERROR WORD XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT PAGE 0023

S.C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR DOM ROUTINE

${ t JT}$				PAGE <u>0024</u>
S.C.	07	MDT		
DOM DATA	TAG #	TAG DATA	DATA #	DATA
ICR SET	1	GHA220000	1	020040002
DIN	2	GHA550000	2	000000006
DIS	3	GHA510000	3	001777X76
SSFB	4	GHA750000	4	774007776
ICR SET	1	GHA220000	1	020040002
EMR	2	GHA210000	2	XXXXXXXX
CIU READ	3	GHA650000	3	000377776
RCA	4	GHA410000	4	XXXXX7776
ICR SET	1	GHA220000	1	020040002
X ACC.	2	GHB050000	2	XXXXXXXX
Y ACC.	3	GHB250000	3	XXXXXXXX
Z ACC.	4	GHB150000	4	XXXXXXXX
ICR SET	1	GHA220000	1	020040002
SSR	2	GHA360000	2	000000000
DOR	3	GHA120000	3	000000000
SS/DO	4	GHA520000	4	000000000
TEL OUTPUT	1	GHC000000	1	070707070
ICR SET	2	GHA220000	2	020040002
READ TIME	3	GHB010000	3	7777XXXXX
DIN	4	GHA550000	4	000000006
ICR SET	1	GHA220000	1	020040002
FG1 & LAD 1	2	GHA230000	2	XXXXDEXXX
FG2 & LAD 2	3	GHB630000	3	XXXXDFXXX
FG3 & LAD 3	4	GHB530000	4	XXXXBF0000
	DOM DATA ICR SET DIN DIS SSFB ICR SET EMR CIU READ RCA ICR SET X ACC. Y ACC. Z ACC. ICR SET SSR DOR SS/DO TEL OUTPUT ICR SET READ TIME DIN ICR SET FG1 & LAD 1 FG2 & LAD 2	S. C. 07 DOM DATA TAG # ICR SET 1 DIN 2 DIS 3 SSFB 4 ICR SET 1 EMR 2 CIU READ 3 RCA 4 ICR SET 1 X ACC. 2 Y ACC. 3 Z ACC. 4 ICR SET 1 SSR 2 DOR 3 SS/DO 4 TEL OUTPUT 1 ICR SET 2 READ TIME 3 DIN 4 ICR SET 1 FG1 & LAD 1 FG2 & LAD 2 3	S. C. 07 MDT DOM DATA TAG # TAG DATA ICR SET 1 GHA220000 DIN 2 GHA550000 DIS 3 GHA510000 SSFB 4 GHA750000 ICR SET 1 GHA220000 EMR 2 GHA210000 CIU READ 3 GHA650000 RCA 4 GHA410000 ICR SET 1 GHA220000 X ACC. 2 GHB050000 Y ACC. 3 GHB250000 Z ACC. 4 GHB150000 ICR SET 1 GHA220000 SSR 2 GHA360000 DOR 3 GHA120000 SS/DO 4 GHA520000 TEL OUTPUT 1 GHC000000 ICR SET 2 GHA220000 TEL OUTPUT 1 GHC000000 ICR SET 2 GHA220000 READ TIME 3 GHB010000 DIN 4 GHA550000 ICR SET 1 GHA220000 FG1 & LAD 1 2 GHA230000 FG2 & LAD 2 GHA230000 FG2 & LAD 2	S.C. 07 MDT DOM DATA TAG # TAG DATA DATA # ICR SET 1 GHA220000 1 DIN 2 GHA550000 2 DIS 3 GHA510000 3 SSFB 4 GHA750000 4 ICR SET 1 GHA220000 1 EMR 2 GHA210000 2 CIU READ 3 GHA210000 3 RCA 4 GHA410000 4 ICR SET 1 GHA220000 1 X ACC. 2 GHB050000 2 Y ACC. 3 GHB050000 2 Y ACC. 3 GHB050000 3 Z ACC. 4 GHB150000 4 ICR SET 1 GHA220000 1 SSR 2 GHA360000 2 DOR 3 GHA120000 1 SSP/DO 4 GHA520000 4 TEL OUTPUT 1 GHC000000 1 ICR SET 2 GHA220000 1 ICR SET 2 GHA220000 1 ICR SET 3 GHA220000 2 READ TIME 3 GHB010000 3 DIN 4 GHA550000 4 ICR SET 1 GHA220000 1 ICR SET 1 GHA220000 1 ICR SET 1 GHA220000 1 ICR SET 2 GHA220000 2 READ TIME 3 GHB010000 3 DIN 4 GHA550000 4 ICR SET 1 GHA220000 1 FG1 & LAD 1 2 GHA230000 2 FG2 & LAD 2 3 GHB630000 3

IGNORE	1	XXXXXXXXX	1	XXXXXXXXX
IGNORE	2	XXXXXXXX	2	XXXXXXXX
IGNORE	3	XXXXXXXXX	3	XXXXXXXX
IGNORE	4	XXXXXXXXX	4	XXXXXXXXX

RCAM

416000000 or 560000000

200

070707070

NOTE:

A = 0 or 4

B = 1 or 5

C = 2 or 6

D = 0, 2, 4, or 6

E = 2 or 3

F = 4 or 5

X = Not Predictable

G = 0, 1, 2, or 3

H = 1 - 7

MONITOR LADDER ERROR ROUTINE

The purpose of this routine is to fully exercise the ladder error detection circuitry. No output other than the status code should be expected unless a hardware failure occurs.

OUTPUT

PAGE 0025

S.C. 10 MLE

RCAM 420000000 or 556000000

Pages A-34 through A-49 have been deleted.

The following data will be loaded regardless of the type of flight program used.

MONITOR VERIFY AND PREPARE TO LOAD

PAGE 0026

Module _____ (M)

Sector 17 (S)

Address 255 (A)

S/D 0 S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

Data expected or loaded 002100000 (BYPASS)

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector 16 (S)

Address 370 (A)

S/D 1 S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0

Data expected or loaded 146314632

MONITOR VERIFY AND PREPARE TO LOAD

Module 2 (M)

Sector 17 (S)

Address 024 (A)

S/D 1 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

 $V \ Bit \qquad \qquad 0 \qquad \qquad V = 1 = Verify$

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 A A A A A A A A L V 0 0 0

Data expected or loaded 000000000

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTP	UT									PA	AGE.	NU	_
	S.C.	21	MV	P									
	RCAM	4420	00000	0									
	RCAD	740	02550	0									
	RCAD	002	10000	0									
	RCAD	702	03700	0									
	RCAD	1463	31463	2									
	RCAD	752	00244	.0									
	RCAD	000	00000	0									
	RCAD	NU											
	RCAD	NU	,										
	RCAD	NU											
	RCAD	NU											
	244	NU											
	240	NU											
	234	NU											
	230	NU											
	224	740	72552	6									
	220	002	10000	00									
	214	702	73702	6									
	210	146	31463	32									
	204	752	70242	6									_
	202	000	00000	00									

If a load is being performed also expect a

S. C. 23 MLD

Module

2 (M)

Sector

____17 (S)

Address

026 (A)

S/D

1 S/D = 1 = Duplex

L Bit

1

L = 1 = Last Value

V Bit

___1

V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S M M M S/D 0 0 0 0 0 A A A A A A A L V 0 0 0

 $\underline{1} \quad \underline{1} \quad \underline{1} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{1} \quad \underline{0} \quad \underline{0} \quad \underline{0}$

Data expected or loaded XXXXXXXX

Data being picked up is the Sim Flight Indicator

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT PAGE <u>002</u>7

S.C.	21 MVP
RCAM	442000000
RCAD	750002660
RCAD	400000000
RCAD	NU
244	NU
240	NU
234	NU
230	NU
224	NU
220	NU
214	NU
210	NU
204	750702636
202	XXXXXXXX

If a load is being performed also expect a

S. C. 23 MLD

MONITOR PREPARE TO LAUNCH

This routine will monitor the Prepare to Launch Preflight Routine regardless whether the Flight Program is loaded or not.

OUTPUT

PAGE NU

MPL S.C. 110000000 or 300000000

Verify that Time, the 3 accelerometers, the 3 fine gimbal angles, and 3 backup gimbal angles are telemetered, and that the AMP3 telemetered quantities are received.

A few telemetry quantities from the Flight Program may be printed.

Pages A-55 through A-57 have been deleted.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S.C. 40 MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0028

S.C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "END-ING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR EXERCISE ATTITUDE COMMAND

MODE 1

- 1) Drive Pitch Output to +3° in 17 incremental steps of 0.18° each with a time delay of 187.5 ms between steps
- · 2) Delay 3 seconds
- 3) Drive Pitch to zero in same manner
- 4) Delay 3 seconds
- 5) Drive Pitch Ladder to -3° in same manner
- 6) Delay 3 seconds
- 7) Drive Pitch Ladder to zero in same manner
- 8) Exercise Yaw in the same manner as Pitch
- 9) Exercise Roll in the same manner as Pitch except drive to $\pm 5^{\circ}$ in each direction with 28 incremental steps of 0.18° each with a decay of 107 ms between steps.

OUTPUTS	PAGE	0029-0030
RCAM	426000000 or 550000000	
S.C. 13	MEC	
46		
13		
46		
13		
46		
13		
46		

OUTPUTS PAGE 0029-0030

RCAM 13 MEC 46 13 46

13 00

Module 0 (M)

Sector 6 (S)

Address 141 (A)

S/D 0 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Data expected or loaded 000007076 (ECCONT)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

PAGE 0031	OUTPUT
merandomental de la companya del companya de la companya del companya de la compa	

~		0.4	BATTT
-	С.	21	MVP

RCAM 442000000

RCAD 300014140

RCAD 000007076

RCAD NU

244 NU

240 NU

234 NU

230 NU

224 NU

220 NU

214 NU

210 NU

204 300714126

 $202 \qquad 000007076$

If a load is being performed also expect a

S. C. 23 MLD

MONITOR EXERCISE ATTITUDE COMMAND

MODE 2

Ladder	Converter	A	C = 0 is (A)	(C)
Pitch	Increments	.42°	.06°/Bit	(P)
Pitch	Sign	+		(SP)
Roll	Increments	.06°	.06°/Bit	(R)
Roll	Sign			(SR)
Yaw	Increment	.18°	.06°/Bit	(Y)
Yaw	Sign	-		(AY)

Input Word Loaded

S, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

OUTPUTS PAGE 0032

SC MET

17 RCAM 436000000 or 540000000

46

00

Module 0 (M)

Sector 6 (S)

Address 141 (A)

S/D 0 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

Data expected or loaded 400030502(ECCONT)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT	PAGE	0033
		0000

	S.C.	21 MVP
	RCAM	442000000
	RCAD	300014140
	RCAD	400030502
	RCAD	NU
3.	244	NU
	240	NU
	234	NU
	230	NU
	224	NU
	220	NU
	214	NU
	210	NU
	204	300714126
	202	400030502

If a load is being performed also expect a

S.C. 23 MLD

MONITOR EXERCISE ATTITUDE COMMAND

MODE 2

Ladder	Converter	B	C = 0 is (A)	(C)
Pitch	Increments	.06°	.06°/Bit	(P)
Pitch	Sign			(SP)
Roll	Increments	36°	.06°/Bit	(R)
Roll	Sign	+		(SR)
Yaw	Increment	.24°	.06°/Bit	(Y)
Yaw	Sign	+		(AY)

Input Word Loaded

S, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

C 0 0 0 0 0 0 0 0 0 0 0 0 R R R SY SR SP 0 Y Y P P P 0

1 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 1 0

OUTPUTS PAGE 0034-0035

SC MET

17 RCAM 436000000 or 540000000

46

00

MONITOR CIU READ

This routine verifies that the Preflight CIU Routine is functioning properly.

OUTPUT PAGE 0036

S. C. 14 MCU

RCAM 430000000

202 736777776

MONITOR REPEATABLE FLIGHT SIM LINKAGE TEST

This routine will, upon receiving the Status Code 31, exit to Monitor Power Up.

OUTPUT

PAGE 0037

S. C. 31 RFLT

RCAM 462000000

Unpredicted telemetry data may also be printed.

A message will be printed telling if the Flight Program was entered successfuly or not.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S. C. 40 MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0038

S. C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "END-ING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR SWITCH SELECTOR ROUTINE

Number of Stages

2

Address Bits

252

SS Relay Present

Yes ____, No __X__ Yes = 1

Read Desired

Yes ____, No _X_ Yes = 1

Select Channel

A X , B A = 1

S 1 2 3 4 5 6 7 8 9 10 11 12 13

First Wd 0 S S S S S A A A A A A A A

 $0 \quad 0 \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad 0 \quad 0$

Y = 1 SS Relay Present

Z = 1 Read Desired

C = 1 Select Channel A

S = Stage Bits

A = Address Bits

OUTPU	T					
	S. C.	15	MSS			
	RCAM	4320	00000 or 54400	0000		
	RCAD	3052	40000			
	RCAD	0400	00000			
			FBRD	00000000		
			SSR	142520000		
			SSFB	00000000		
			FBRD	00000000		
S.S. Pr	esent (Yes	3)			S.S. Pre	sent (No)
SSR	00000000	0			SSR	000000000
SSFB		-			SSFB	000000000
FBRD		_			END	
SSR		_				
Issu	e Read ?					
			Yes		No	
SSR	40000000	0			SSR	200000000
SSFB	00000000	0				
SSR	00000000	0				
			SSFB	000000000		
			SSR	200000000		
			SSFB	00000000		
			SSR	00000000		
			SSFB	00000000		

^{*}The time reading are useful only for forming times.

MONITOR SWITCH SELECTOR ROUTINE

Number of Stages ____1__

Address Bits 125

SS Relay Present Yes X, No Yes = 1

Read Desired Yes_____, No_X Yes = 1

Select Channel A _____, B X A = 1

S 1 2 3 4 5 6 7 8 9 10 11 12 13

First Wd O S S S S S A A A A A A A A

 $\underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{0} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1} \quad \underline{0} \quad \underline{1}$

Second Wd 0 0 Y C Z 0 0 0 0 0 0 0 0

 $0 \quad 0 \quad \underline{1} \quad \underline{0} \quad \underline{0} \quad 0 \quad 0$

Y = 1 SS Relay Present

Z = 1 Read Desired

C = 1 Select Channel A

S = Stage Bits

A = Address Bits

	S. C.	15	MSS
--	-------	----	-----

RCAM 432000000 or 544000000

RCAD <u>042520000</u>

RCAD 100000000

FBRD 000000000

SSR <u>021250000</u>

SSFB 002520000

FBRD 002520000

S. S. Present (Yes) S. S. Present (No)

SSR 000000000 SSR 000000000

SSFB <u>002520000</u> SSFB 000000000

FBRD <u>002520000</u> END

SSR 021250000

Issue Read ?

Yes

SSR 400000000 SSR 200000000

SSFB 000000000

SSR 000000000

 SSFB
 000000000

 SSR
 200000000

 SSFB
 000000000

 SSR
 000000000

 SSFB
 0000000000

*The time reading are useful only for forming times.

MONITOR SWITCH SELECTOR ROUTINE

Number of Stages 2

Address Bits ___000____

SS Relay Present Yes X, No Yes = 1

Read Desired Yes X, No Yes = 1

Select Channel A X, B A = 1

S 1 2 3 4 5 6 7 8 9 10 11 12 13

First Wd 0 S S S S S A A A A A A A A

 $\underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0}$

Second Wd 0 0 Y C Z 0 0 0 0 0 0 0 0 0

 $0 \quad 0 \quad \underline{1} \quad \underline{1} \quad \underline{1} \quad 0 \quad 0$

Y = 1 SS Relay Present

Z = 1 Read Desired

C = 1 Select Channel A

S = Stage Bits

A = Address Bits

OUTPUT

OUTPUT	r					
	S.C.	15	MSS			
	RCAM	43200	00000 or 544000	0000		
	RCAD	03000	00000			
	RCAD	16000	00000			
			FBRD	000000000		
			SSR	014000000		
			SSFB	003770000		
			FBRD	003770000		
S.S. Pr	esent (Yes)			S.S. Pres	sent (No)
SSR	000000000	0			SSR	000000000
SSFB	003770000	<u>0</u>			SSFB	000000000
FBRD	003770000	<u>0</u>			END	
SSR	014000000	<u>0</u>				
Issue	Read ?					
			Yes		No	
SSR	40000000	0			SSR	200000000
SSFB	000000000	0				
SSR	00000000	0				
			SSFB	000000000		
			SSR	200000000		
			SSFB	000000000		
			SSR	000000000		
			SSFB	000000000		

^{*}The time reading are useful only for forming times.

Module _____ (M)

Sector _____17 (S)

Address <u>225</u> (A)

S/D _ _ 0 S/D = 1 = Duplex

L Bit $\underline{}$ L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \$

Data expected or loaded <u>000000002</u>

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT	PAGE 0042

S.C.	21 MVP
RCAM	442000000
RCAD	740022540
RCAD	000000002
RCAD	NU
244	NU
240	NU
234	NU
230	NU
224	NU
220	NU
214	NU
210	NU
204	740722526
202	00000002

If a load is being performed also expect a

S. C. 23 MLD

MONITOR SECTOR SUM CHECK ROUTINE

	Module		_	0)	-		(M))											
	Starting Se	cto	r_	0)	_		(S _S)											
	Ending Sec	tor	_	17				(S _E	2)											
			<i>a</i>		0			_	•	_	0	•	10		•					
	Input Word																			
			0	$\mathbf{s}_{\mathbf{E}}$	$^{\mathrm{S}}\mathrm{_{E}}$	$^{\rm S}$ E	$^{\mathrm{S}}\mathrm{_{E}}$	s_{s}	$^{\mathrm{S}}$ S	s_s	s_s	M	M	M	0					
			0	1	1	1	1	0	0	0	0	0	0	0	0					
OUTPU	UT																PA	GE	004	<u>13</u>
	S.C	16	;	M	SC															
	RCAM	43	40	000	00 o	r 54	2000	0000												
	RCAD	36	00	000	00															
ERROI	R MSGE			EM	R D	ATA		TA	G		7	ΓEΙ	L D	ΑTA	Λ					
								37	4		-									
								37	0		-									
								36	4		-									
								36	0		-									
								35	4		-									
								35	0		-									
								34	4		_									
								34	0		_									

		710 2454	m A C	MET DAMA
ERROR	MSGE	EMR DATA	TAG	TEL DATA
			334	
			330	
			324	
			320	
			314	
			310	
			304	
			300	
			274	
			270	
			264	,
			260	
			254	
			250	
			244	
			240	
			234	
			230	
			224	
			220	-
			214	
			210	-
			204	
			202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR SUM CHECK ROUTINE

	Module	_]	<u> </u>			(M)								
	Starting Sec	ctor)			(S _S)								
	Ending Sector17						(S _E)								
	Input Word	S	1	2	3	4	5	6	7	8	9	10	11	12	
		0	$\mathbf{s}_{\mathbf{E}}$	$\mathbf{s}_{_{\mathbf{E}}}$	$\mathbf{s}_{\mathbf{E}}$	$\mathbf{s}_{\mathbf{E}}$	s_s	s_s	s_s	s_s	M	M	M	0	
		0	1	1	1	1	<u>0</u>	0	<u>0</u>	0	0	0	1	0	
OUTP	UT														PAGE <u>0044</u>
	S. C.	16	M	sc											
	RCAM	4340	0000	00 o	r 54	2000	000								
	RCAD	360	1												
ERRO	R MSGE		EM	R D	АТА		TAC	Ť		TE	LI	ATA	A		
							374								
							370								
							364								
							360								
							354								
							350								
							344			-					
							340								

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	
		314	
		310	
		304	
		300	
		274	
		270	***************************************
		264	
		260	***************************************
		254	
		250	-
		244	
		240	***************************************
		234	
		230	
		224	
		220	
		214	
		210	-
		204	***************************************
		202	

Sum Check Values are subject to change.

Values must be otained from other sources.

(M)

(S)

(A)

Module

0

Sector

6

Address

141

S/D

0_____

S/D = 1 = Duplex

L Bit

0

L = 1 = Last Value

V Bit

1

V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0 0

Data expected or loaded 400030502 (Eccont)

Module _____ (M)

Sector 17 (S)

Address <u>225</u> (A)

S/D O S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit 1 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \$

Data expected or loaded 000000002 (MPLC1)

Module _____ (M)

Sector _____17____(S)

Address _____170 ____ (A)

S/D O S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

V Bit V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 A A A A A A A A L V 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \$

Data expected or loaded 777763376 (EMCON)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT			PAGE <u>0045</u>
S. C.	21 MVP		
RCAM	442000000		
RCAD	300014120		
RCAD	400030502		
RCAD	740022520		
RCAD	000000002		
RCAD	740017060		
RCAD	777763376		
RCAD	NU		
244	NU		
240	NU		
234	NU		
230	NU		
224	300714136		¥
220	400030502		
214	740722536		
210	000000002		
204	740717036		
202	777763376		

If a load is being performed also expect a

S. C. 23 MLD

MONITOR MEMORY ERROR

This routine checks for proper operation of the Preflight Memory Error Routine. All telemetered error data is printed.

OUTPUT

PAGE <u>0046</u>

S.C.

22

MME

RCAM

444000000

MONITOR LOAD

This routine shall be an error test when not commanded automatically by a successful Prepare to Load.

OUTP	UT .				PAGE <u>0047</u>
	S. C.	23	MLD		
	S. C.	47			
	RCAM		53000000		
	ERR MSGE		231000000		- 4
	EMR DATA		000000000		
	S. C.	00			

VERIFY AND PREPARE TO LOAD ERROR TEST

The purpose of this test is to insure that the Verify and Prepare to Load routine will reject any input data word with an incorrect character counter. This program also verifys that the program mode cannot switch during a load or verify operation and that the program will recognize an attempt to exceed the available table length.

OUTPUT				PAGE <u>0048</u>
		MVPE		
		RCAM	534000000	
S. C.	ERR MSGE		EMR DATA	
21				
47	211000000		xxxxxxxx	
00				
21				
47	212000000		xxxxxxxx	
00				
21				
47	213000000		XXXXXXXX	
00				
56				
47	214000000		XXXXXXXX	
00				
56				
47	215000000		XXXXXXXX	
00		a.		
21				
47	216000000		XXXXXXXX	

00

MONITOR COMMAND RECEIVER TEST

This routine will, upon receiving the Status Code 35, exit to Monitor Power Up.

OUTPUT

PAGE 0049

S. C.

35 MCRT

RCAM

472000000

A message will be printed: "ALLOWING 1 MIN. DELAY FOR OPERATOR TO MANUALLY VERIFY ORBIT PROGRAM ENTERED".

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S. C.

40

MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

MFB

OUTPUT

PAGE 0050

S. C.

26

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR MINOR LOOP, SWITCH SELECTOR & REAL TIME COUNTER TEST

This routine tests the real time to insure that it increments properly by 1 every 3 instruction cycles. The minor loop and switch selector counters are checked over a 1.28 sec. interval to insure that all of the counter logic functions properly.

OUTPUT

PAGE 0051

S. C. 24 MML

RCAM 526000000 or 450000000

MONITOR AMP 3

The purpose of this routine is to run AMP 3 with simulated accelerometer inputs. This program will cycle for approximately 3.5 min.

OUTPUTS			PAGE <u>0052</u>
S. C.	21	MAM - SIMULATED LEVEL PLATFO	ORM
RCAM	442000000		
RCAD	740022540		
RCAD	000000000		
204	740722526		Teriffe part
202	000000000		
S. C.	23	MLD	
S. C.	00		

Observe following AMP 3 output for proper operation.

INITIAL DATA WORD	377	377	376	or	377	377	376
1st CHANGE	377	377	A72		377	01 X	376
2nd CHANGE	377	40X	A72		377	01X	A72
3rd CHANGE	377	40X	5XX		377	40X	A72
4th CHANGE	000	40X	5XX		00X	40X	5XX

A = 3 or 7

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector _____17___(S)

Address 225 (A)

S/D 0 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \$

Data expected or loaded

000000000 (MPLC1)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPU	J T				PAGE <u>0053</u>
	S. C.	21 MVP			
	RCAM	442000000			
	RCAD	740022540			
	RCAD	000000000			
	RCAD	NU			
	RCAD	NU			
	RCAD	NU			
	RCAD	NU			· · · · · · · · · · · · · · · · · · ·
	RCAD	NU			
	RCAD	NU			
	RCAD	NU			
	RCAD	NU			
	244	NU			
	240	NU			
	234	NU			
	230	NU			
	224	NU			
	220	NU			
	214	NU			
	210	NU			
	204	740722526			
	202	000000000			

If a load is being performed also expect a

S. C. 23 MLD

MODE DATA ERROR TEST

The purpose of this routine is to insure that the Mode Sort Routine will reject data type inputs and that the Read Input Data Subroutine will reject mode type input data properly.

OUTP	UT				PAGE 005	4
		MMD				
		RCAM	56400000	0		
	s. c.	ERR MSGE		EMR DATA		
	47	001000000		xxxxxxxx		~ v
	00				*	
	05					
	47	451000000		xxxxxxxx		

00

MONITOR SECTOR SUM CHECK ROUTINE

0 (M)

Module

	Starting Sector				0		(S _S)								
	Ending Se	ector			17		(S _E)								
	Input Wor	d	S	1	2	3	4	5	6	7	8	9	10	11	12
			0	s_E	s_E	s_E	s_E	s_s	s_s	s_s	s_s	M	M	M	0
			0	1	1	1	1	0	0	0	0	0	0	0	0
OUTP	UT														PAGE 0055
	s. c.	16	M	ISC											
	RCAM	434	000	000	or	542	2000	000							
	RCAD	360	000	000											
ERROI	R MSGE			EM	R D	ATA			7	ГAG			TE	EL DA	ATA
									3	374					
									3	370					-
									3	364			-	-	
									3	860			**********		
									3	354					
									3	350					no continuo de sustante de la continua del continua del continua de la continua d
									3	844			-		<u> </u>
									3	340			, y		

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	-
		320	
		314	
		310	
		304	
		300	
		274	
		270	
		264	· ·
		260	
		254	-
		250	
		244	
		240	-
		234	
		230	
	$\epsilon_{-q'}$	224	
		220	
		214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR SUM CHECK ROUTINE

Module ____1 (M)

	Starting Sector Ending Sector			0		(S _S)									
					17		(S _E)								
	Input Wor	rd	S	1	2	3	4	5	6	7	8	9	10	11	12
			0	s_E	s_E	s_E	s_E	s_{s}	s_s	s_s	s_s	M	M	M	0
			0	1	1	1	1	0	0	0	0	0	0	1	0
OUTP	UT														PAGE 0056
	s. c.	16	N	ISC											
	RCAM	434	000	000	or	5420	0000	00							
	RCAD	360	100	000											
ERRO	R MSGE			Е	MR	DAI	ΓA			T	AG			TI	EL DATA
										37	74			-	*
		,4,								37	70				
										36	34				
										36	30			-	-
										35	54			Participation (CA)	
										35	50				
										34		į			
										34					
										0.1				-	

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	
		314	
		310	APPENDING CONTRACTOR OF THE PROPERTY OF THE PR
		304	
		300	
		274	
		270	
		264	
		260	***************************************
		254	
		250	
		244	
		240	
		234	
		230	
		224	-
		220	
		214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR ACCELEROMETER PULSE COUNT

Number Specified	1								
Sequence	X, Y, Z, (X = 00, Y = 10, Z = 01)								
Count Requested	65.535 (Decimal)								
X - Rate	-1P/32 Machine Cycl	es Approx400	PPS						
Y - Rate	-1P/64 Machine Cycles Approx200 PPS								
Z - Rate	-1P/128 Machine Cycles Approx100 PPS								
Syl. Used	0 <u>X</u> , 1								
OUTPUT		,		PAGE 0057					
SC	02 MPC (S)		STATUS C	ODE					
RCAM	404000000 or 572000	0000	Mode Com	mand					
DR V	400000100								
VT V	400000200								
CR V	400000400								
RCAD	102200000		Data Word	1					
RCAD	377760000		Data Word	2					
RCAD	000160000		Data Word	3 ,					
240	005252500 -005252	2656	ACC1	TIME					
234	777400002 -77737		ACC1	SYL 1					
230	777400002 77737		ACC1	SYL 0					
224	Approx. 005238	THE PARTY OF THE P	ACC2	TIME					
220	Approx. 777600	0500	ACC2	SYL 1					
214	Approx. 777600	0500	ACC2	SYL 0					
210	Approx. 00523	5332	ACC3	TIME					
204	Approx. 777700	0236	ACC3	SYL 1					
202	Approx. 777700)236	ACC3	SYL 0					

MONITOR ACCELEROMETER PULSE COUNT

Number Specified									
Sequence	<u>Y, Z, X,</u> (X	X = 00, Y = 10, Z =	01)						
Count Requested	900 (E	Pecimal)							
X - Rate	-1/P512 Ma	achine Cycles Appr	ox25 PPS						
Y - Rate	-1P/1216 M	achine Cycles Appr	ox10 PPS						
Z - Rate	-1 P/2432 Ma	achine Cycles Appr	ox5 PPS						
Syl. Used	0, 1	0, 1X							
OUTPUT				PAGE 0058					
SC	02	MPC (S)	STATUS	CODE					
RCAM	404000000 c	or 572000000	Mode Con	nmand					
DR V	400002000								
VT V	400004600								
CR V	400011400								
RCAD	211100000		Data Wor	d 1					
RCAD	034100000		Data Wor	d 2					
RCAD	000000000		Data Wor	d 3					
240	Approx.	005450252	ACC1	TIME					
234	Approx.	777770750	ACC1	SYL 1					
230	Approx.	777770750	ACC1	SYL 0					
224	005442000	005455700	ACC2	TIME					
220	777774370	777774356	ACC2	SYL 1					
214	777774370	777774356	ACC2	SYL 0					
210	Approx.	005427664	ACC3	TIME					
204	Approx.	777757270	ACC3	SYL 1					
202	Approx.	777757270	ACC3	SYL 0					

MONITOR ACCELEROMETER PULSE COUNT

Number Specified	3
Sequence	\underline{Z} , \underline{X} , \underline{Y} , (X = 00, Y = 10, Z = 01)
Count Requested	9 (Decimal)
X - Rate	Approx1P/SEC
Y - Rate	Approx1P/20 SEC
Z - Rate	Approx1P/5 SEC
Syl. Used	0 <u>X</u> , <u>1</u>

OUTPU	UT			. }		PAGE 0059
	SC	02	MPC (S)		STATUS CO	ODE
	RCAM	404000000	or 572000000		Mode Comm	nand
	DR V	400001450				
	VT V	400040000				
	CR V	400007710				
	RCAD	304400000			Data Word	1
	RCAD	000220000			Data Word	2
	RCAD	00000000			Data Word 3	
	240	Approx.	007315300		ACC1	TIME
	234	Approx.	77777640	•	ACC1	SYL 1
	230	Approx.	777777640		ACC1	SYL 0
	224	Approx.	007324676		ACC2	TIME
	220	Approx.	777777040		ACC2	SYL 1
	214	Approx.	777777040		ACC2	SYL 0
	210	005702436	007400360		ACC3	TIME
	204	77777756	77777750		ACC3	SYL 1
	202	77777756	77777750		ACC3	SYL 0

MONITOR GIMBAL ANGLE MONITOR SERIALIZER

Seque	nce Selecte	ed (Identify	by Checks)				
CG1,	CG2,	CG3,	FG1,	FG2,	FG3,	BG1,	BG2,	BG3
<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>~</u>
Desir	ed Gimbal	Angles						
CG1_	000000	000	CG2	00000	0006	CG	3000	000007
FG1_	000000	007	FG2	00000	7000	FG	3000	007676
BG1_	000005	252	BG2	00000	5252	BG	3000	005252
	CORRE	ECTIONS?		YES		NO	<u> </u>	
OUTF	PUTS						P.	AGE <u>0060</u>
	s. c.	03	MGA					
	RCAM	4060000	00					
	RCAD	3776000	00					
	CG1	0000000	00					
	CG2	0000000	06			٠		
	CG3	0000000	70					
	FG1	0000007	00					
	FG2	0000070	00					
	FG3	0000076	76					

BG1

BG2 BG3 000005252

000005252

000005252

350	NU	************	
344	NU		
340	NU		
334	NU		
330	NU		
324	NU		
320	NU		
314	NU		
310	NU		
304	NU		
300	NU		
274	NU		
270	NU		
264	NU		
260	NU		
254	NU		
250	NU		
244	NU		
240	000	000	000
234	000	300	006
230	003	400	070
224	034	000	700
220	340	007	000
214	373	707	676
210	252	505	252
204	252	505	252
202	252	505	252

MONITOR GIMBAL ANGLE MONITOR SERIALIZER

Seque	nce Selecte	d (Identify	by Checks)				
CG1,	CG2,	CG3,	FG1,	FG2,	FG3,	BG1,	BG2,	BG3
<u>~</u> ,	<u>~</u> ,	<u>~</u> ,	<u>√</u> ,	<u>√</u> ,	✓,	<u>~</u> ,	<u>√</u> ,	<u> </u>
Desir	ed Gimbal .	Angles				*		
CG1 _	000000	000	CG2	00000	0006	CG3	000	000070
FG1_	000000	700	FG2	00000	7000	FG3	000	007676
BG1 _	000005	252	BG2	00000	5252	BG3	000	005252
	CORRE	ECTIONS?		YES_	<u> </u>	NO		
OUTP	UTS					· · · · · · · · · · · · · · · · · · ·	P	AGE 0061
	S. C.	03	MGA					
	RCAM	40600000	00					
	RCAD	17760000	00					
	CG1	00000000	00					
	CG2	00000000	<u>)6</u>			•		
	CG3	00000007	70					
	FG1	00000070	00					
	FG2	00000700	00					
	FG3	00000767	76					
	BG1	00000525	52					
	BG2	00000525	52					
	BG3	00000525	52					

350	000	000	000
344	000	003	642
340	000	003	642
334	000	300	006
330	000	003	650
324	000	003	650
320	003	400	070
314	000	003	732
310	000	003	732
304	034	000	700
300	000	000	700
274	000	000	700
270	340	007	000
264	000	007	000
260	000	007	000
254	373	707	676
250	000	007	676
244	000	007	676
240	252	505	252
234	000	005	252
230	000	005	252
224	252	505	252
220	000	005	252
214	000	005	252
210	252	505	252
204	000	005	252
202	000	005	252

MONITOR GIMBAL ANGLE MONITOR (RATIO TRANS)

Desir	ed Gimbal A	Angles				
GC1			GC2	✓	GC3	
FG1	✓	-	FG2	✓	FG3	✓
BG1_	<u> </u>		BG2		BG3	<u> </u>
OUTI	PUT					PAGE 0062
	S. C.	03	MGAR			*
	RCAM	5700000	00	SYL. 1 and 0	may vary by:	
	RCAD	3776000	00			
	240	3671075	62	CG1 ±8 count	ts	
	234	3710076	20	CG2 ±8 count	cs	
	230	1212024	24	CG3 ±8 count	s	
	224	0222004	44	FG1 ±4 count	s	
	220	0160003	40	FG2 ±4 count	s	
	214	3516072	34	FG3 ±4 count	s	
	210	3614074	30	BG1 ±4 count	s	
	204	3650075	20	BG2 ±4 count	s	
	202	2424050	50	BG3 ±4 count	s	

MONITOR GIMBAL ANGLE MONITOR (RATIO TRANS)

Desir	ed Gimbal A	Angles		
GC1	✓	GC2 _	GC3	
FG1	✓	FG2 _	FG3	
BG1		BG2 _	BG3	
OUTI	PUT	,	· ·	PAGE 0063
	s. c.	03 MGAR		*
	RCAM	570000000	SYL. 1 and 0 may vary by:	
	RCAD	311000000		
	240	NU		
	234	NU		
	230	NU		
	224	NU		
	220	NU		
	214	NU		
	210	367107562	CG1 ±8 counts	
	204	022200444	FG1 ±4 counts	
	202	361607430	BG1 +4 counts	

Desire	ed DIN Form	at	7777	77740		
Desire	ed DIS Form	at	7760	00000		
Desire	ed IR Form	at	1073	00000		
OUTP	UTS					PAGE 0064
	S. C.	04	MDI			
	RCAM	410000000	or 5660000	00		
	210	000000006				
	204	001777X76	3			
	202	000020000				
	DIN	77777740	_	DIN	DESIRED	
	DIS	776000000		DIS	DESIRED	
	IR	107300000		IR	DESIRED	
	210	77777746	_	DIN	READ	
	204	77777 X 76	3	DIS	READ	
	202	107320000		IR	READ	

Also examine DIS, DIN & IR under "ENDING REG STATUS", adapt I/O output to verify that the inputs are as desired.

Because the LVDC and PTC are not properly synchronized, a "STATUS CODE NOT RECEIVED" message may be printed. This causes Monitor Power Up to be run and thus page numbers will not correspond to this document.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S.C.

40

MPU

COD ERROR WORD XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0065

S. C.

26

MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

Desired DOR Format	777600000	
DOR Set,	DOR Reset	
Desired S.S. Format	774000000	
Issue SS PIO?	YES, NO	
OUTPUTS		PAGE <u>0066</u>
S. C. 05	MDO	
RCAM 41200	0000	
RCAD 37774	0000	
RCAD 376000	0000	
Verify the DOR and SSR of O/P" headings.	outputs printed under the "ENDING REG STATUS,	LVDA
DOR should be 777600000	0	
SSR should be 77400000		

Desire	ed DOR Form	mat 777600000	
DOR S	Set	, DOR Reset	
Desire	ed S.S. For	mat 000000000	
Issue	SS PIO?	YES, NO	
OUTP	UTS		PAGE 0067
	S. C.	05 MDO	
	RCAM	412000000	$\sim \Lambda$
	RCAD	00000000	
	RCAD	00000000	
	the DOR an	nd SSR outputs printed under the "ENDING REG STATUS	, LVDA
DOR 8	should be 77	77600000	
SSR s	should be 00	00000000	

Desired DOR Form	nat 000000000	
DOR Set	_, DOR Reset	
Desired S.S. Form	nat 000000000	
Issue SS PIO?	YES, NO	
OUTPUTS		PAGE 0068
S. C.	05 MDO	
RCAM	412000000	
RCAD	377700000	
RCAD	00000000	
Verify the DOR and O/P" headings.	SSR outputs printed under the "ENDING REG STATUS,	LVDA
DOD should be 000	000000	

SSR should be 000000000

Desired DOR For	mat	0000	000000			
DOR Set	,	DOF	Reset			
Desired S.S. For	mat	0000	000000	 		
Issue SS PIO?	YES	<u>~</u> ,	NO	·		
OUTPUTS						PAGE 006
S. C.	05	MDO				
RCAM	412000000					- A -
RCAD	000040000					
RCAD	00000000					
Verify the DOR as O/P" headings.	nd SSR outpu	ts printe	d under the	"ENDING RE	EG STATUS,	LVDA
DOR should be 0	00000000					
SSR should be 0	00000000			*:		

Desired DOR For	mat	(00000	0000	<u> </u>		
DOR Set	_,	I	OOR I	Reset			
Desired S.S. For	mat	(00000	0000	_		
Issue SS PIO?		YES_	, _,	NO			
OUTPUTS							PAGE 0070
S. C.	05	MDO					
RCAM	41200	0000				* *	
RCAD	37770	0000					
RCAD	00000	0000					
Verify the DOR and O/P" headings.	nd SSR (outputs pr	in te d	under the ''E	CNDING RE	G STATUS,	LVDA
DOR should be 00	000000	0					

 $SSR\$ should be 000000000

MONITOR G AND C STEERING

This routine shall obtain the DOM data which is loaded by the Minor Loop segment of the Flight Program.

Lack of synchronization control between stepping and reading of the DOM data causes a few of the quantities to be missing from the output.

OUTPUT

PAGE 0071

S. C.

06

MGC

RCAM

414000000 or 562000000

ERROR MSGE

EMR DATA

TAG

TEL DATA

Unpredictable telemetry tags and data can be expected from the Flight Program.

QUANTITIES TO BE IDENTIFIED

I. D	TAG WORD	DATA WORD
X Fine G.A.	06A230000	00000C000
Y Fine G.A.	06B630000	00000C000
Z Fine G.A.	06B530000	00000C000
COD ERR Word	06A660000	XXXXXXXX
DIS	06A510000	001777X76
ICR	06A220000	C00000000
DIN	06A550000	000000006
EMR	06A210000	000000000

NOTE:

A = 0 or 4

B = 1 or 5

C = 2, 4, or 6

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S. C. 40

MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0072

S. C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

Pages A-122 through A-137 have been deleted.

The following data will be loaded regardless of the type of flight program used.

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector 17 (S)

Address 255 (A)

S/D 0 S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

Data expected or loaded 002100000 (BYPASS)

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector 16 (S)

Address 370 (A)

S/D 1 S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 A A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{1} \ 0 \ 0 \ 0 \ 0 \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ 0 \ 0 \ 0 \ 0 \ 0$

Data expected or loaded 146314632

,

MONITOR VERIFY AND PREPARE TO LOAD

Module 2 (M)

Sector 17 (S)

Address 024 (A)

S/D 1 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

V Bit 0 V = 1 = Verify

PTC INPUT CONTROL WORD

 $S \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \quad 7 \quad 8 \ 9 \ 10 \ 11 \ 12 \ 13 \ 14 \ 15 \ 16 \ 17 \ 18 \ 19 \ 20 \ 21 \ 22 \ 23 \ 24 \ 25$

S S S S M M M S/D 0 0 0 0 A A A A A A A A L V 0 0 0

Data expected or loaded 100000000

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT		PAGE <u>NU</u>
S. C	21 MVP	
RCAM	442000000	
RCAD	740025500	
RCAD	002100000	1
RCAD	702037000	
RCAD	$\underline{146314632}$	1
RCAD	752002440	
RCAD	100000000	
RCAD	NU	
244	NU	
240	NU	
234	NU	
230	NU	
224	740725526	If a load is being performed
220	002100000	also expect a
214	702737026	S. C. 23 MLD
210	146314632	1
204	752702426	
202	100000000	

MONITOR VERIFY AND PREPARE TO LOAD

Module

2 (M)

Sector

17 (S)

Address

(A)

S/D

1 S/D = 1 = Duplex

L Bit

1

L = 1 = Last Value

V Bit

1 V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 S S S S M M M S/D 0 0 00 0 A A A A A A A 0 1 1 1 1 0 1 0 $0 \ 0 \ 0 \ 0 \ 0$ 0 1 1 0

Data expected or loaded XXXXXXXXX

Data picked up is the Sim Flight Indicator

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT

PAGE <u>74</u>

S.C.	21 MVP
RCAM	442000000
RCAD	750002660
RCAD	XXXXXXXX
RCAD	NU
244	NU
240	NU
234	NU
230	NU
224	NU
220	NU
214	NU
210	NU
204	750702636
202	XXXXXXXX

If a load is being performed also expect a

S. C. 23 MLD

MONITOR PREPARE TO LAUNCH

This routine will monitor the Prepare to Launch Preflight Routine regardless whether the Flight Program is loaded or not.

OUTPUT

PAGE NU

MPL

S.C.

110000000 or 300000000

Verify that Time, the 3 accelerometers, the 3 fine gimbal angles, and 3 backup gimbal angles are telemetered, and that the AMP 3 telemetered quantities are received.

A few telemetry quantities from the Flight Program may be printed.

Pages 143 through 145 have been deleted.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S. C.

40

MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT PAGE 0075

S. C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR DOM ROUTINE

OUTPUT PAGE $\underline{0076}$

S. C. DOM DATA	07 TAG #	MDT TAG DATA	DATA #	DATA
ICR SET	1	GHA220000	1	020040002
DIN	2	GHA550000	2	000000006
DIS	3	GHA510000	3	001777X76
SSFB	4	GHA750000	4	774007776
ICR SET	1	GHA220000	1	020040002
EMR	2	GHA210000	2	XXXXXXXX
CIU READ	3	GHA650000	3	000377776
RCA	4	GHA410000	4	XXXXX7776
ICR SET	1	GHA220000	1	020040002
X ACC.	2	GHB050000	2	XXXXXXXX
Y ACC.	3	GHB250000	3	XXXXXXXX
Z ACC.	4	GHB150000	4	XXXXXXXX
ICR SET	1	GHA220000	1	020040002
SSR	2	GHA360000	2	000000000
DOR	3	GHA120000	3	000000000
SS/DO	4	GHA520000	4	000000000
TEL OUTPUT	1	GHC000000	1	070707070
ICR SET	2	GHA220000	2	020040002
READ TIME	3	GHB010000	3	7777XXXXX
DIN	4	GHA550000	4	000000006
ICR SET	1	GHA220000	1	020040002
FG1 & LAD 1	2	GHA230000	2	XXXXDEXXX
FG2 & LAD 2	3	GHB630000	3	XXXXDFXXX
FG3 & LAD 3	4	GHB530000	4	XXXXBF0000

IGNORE	1	xxxxxxxx	1	xxxxxxxx
IGNORE	2	xxxxxxxx	2	xxxxxxxx
IGNORE	3	xxxxxxxx	3	xxxxxxxx
IGNORE	4	xxxxxxxx	4	xxxxxxxx

RCAM 416000000 or 560000000

200 070707070

NOTE:

A = 0 or 4

B = 1 or 5

C = 2 or 6

D = 0,2,4, or 6

E = 2 or 3

F = 4 or 5

X = Not predictable

G = 0, 1, 2, or 3

H = 1-7

MONITOR LADDER ERROR ROUTINE

The purpose of this routine is to fully exercise the ladder error detection circuitry. No output other than the status code should be expected unless a hardware failure occurs.

OUTPUT

PAGE <u>0077</u>

S. C. 10 MLE

RCAM 420000000 or 556000000

MONITOR EXERCISE ATTITUDE COMMAND

MODE 1

- 1) Drive Pitch Output to +3° in 17 incremental steps of 0.18° each with a time delay of 187.5 ms between steps
- 2) Delay 3 seconds
- 3) Drive Pitch to zero in same manner
- 4) Delay 3 seconds
- 5) Drive Pitch Ladder to -30 in same manner
- 6) Delay 3 seconds
- 7) Drive Pitch Ladder to zero in same manner
- 8) Exercise Yaw in the same manner as Pitch
- 9) Exercise Roll in the same manner as Pitch except drive to ±5° in each direction with 28 incremental steps of 0.18° each with a decay of 107 ms between steps.

OUTPUTS PAGE 0078-0079

MONITOR VERIFY AND PREPARE TO LOAD

Module _____ (M)

Sector _____6 (S)

Address 141 (A)

S/D 0 S/D = 1 = Duplex

L Bit $\underline{1}$ $\underline{L} = 1 = Last Value$

PTC INPUT CONTROL WORD

S S S S M M M S/D 0 0 0 0 A A A A A A A A L V 0 0 0

Data expected or loaded 000007076

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUI	PUT		PAGE <u>0080</u>
	S.C.	21 MVP	
	RCAM	442000000	
	RCAD	300014140	
	RCAD	000007076	
	RCAD	NU	
	244	NU	
	240	NU	
	234	NU	
	230	NU	If a load is being performed
	224	NU	also expect a
	220	NU	S. C. 23 MLD
	214	NU	
	210	NU	
	204	300714126	
	202	000007076	

MONITOR EXERCISE ATTITUDE COMMAND

MODE 2

Ladder	Converter	A	C = 0 is (A)	(C)
Pitch	Increments	.420	.06 ⁰ /Bit	(P)
Pitch	Sign	+		(SP)
Roll	Increments	06°	$.06^{\rm O}/{ m Bit}$	(R)
Roll	Sign	-		(SR)
Yaw	Increment	180°	$.06^{\rm O}/{ m Bit}$	(Y)
Yaw	Sign			(AY)

Input Word Loaded

S, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

C 0 0 0 0 0 0 0 0 0 0 0 0 R R R SY SR SP 0 Y Y P P P 0

0

OUTPUTS PAGE 0081

SC MET

17 RCAM 436000000 or 540000000

46

00

MONITOR VERIFY AND PREPARE TO LOAD

Module

0_____0

(M)

(S)

(A)

Sector

6____

Address

141

S/D

報

0

S/D = 1 = Duplex

L Bit

____1

L = 1 = Last Value

V Bit

0____

V = 1 = Verify

PTC INPUT CONTROL WORD

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0 0

Data expected or loaded 400030502

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT			PAGE <u>0082</u>
s. c.	21 MVP		
RCAM	442000000		
RCAD	309014140		1
RCAD	400030502		
RCAD	NU	•	
RCAD	NU		
244	NU		
240	NU		
234	NU		
230	NU		
224	NU		
220	NU	If a load is being	performed
214	NU	also expect a	
210	NU	S. C. 23 ML	'D
204	300714126		
202	400030502		

MONITOR EXERCISE ATTITUDE COMMAND

MODE 2

Ladder	Converter	B	C = 0 is (A)	(C)
Pitch	Increments	.06°	.06 ⁰ /Bit	(P)
Pitch	Sign	-		(SP)
Roll	Increments	.36°	.060/Bit	(R)
Roll	Sign	+		(SR)
Yaw	Increment	.240	.060/Bit	(Y)
Yaw	Sign	+		(AY)

Input Word Loaded

S, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

 $\begin{smallmatrix} \begin{smallmatrix} \begin{smallmatrix} 1 \end{smallmatrix} & \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \end{smallmatrix} & \end{smallmatrix} & \end{smallmatrix} & \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \begin{smallmatrix} 1 \end{smallmatrix} & \end{smallmatrix} &$

0

OUTPUTS PAGE 0083-0084

SC MET

17 RCAM 436000000 or 540000000

46

00

MONITOR CIU READ

This routine verifies that the Preflight CIU Routine is functioning properly.

OUTPUT PAGE 0085

S. C.

14 MCU

RCAM

430000000

202

736777776

MONITOR REPEATABLE FLIGHT SIM LINKAGE TEST

This routine will, upon receiving the Status Code 31, exit to Monitor Power Up.

OUTPUT

PAGE 0086

S.C.

31 RFLT

RCAM

462000000

Unpredictable telemetry data may be outputed.

A message will be printed telling if the Flight Program was entered successfully or not.

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT

PAGE NU

S. C. 40 MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0087

S. C. 26 MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "END-ING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR SWITCH SELECTOR ROUTINE

	Number of Stages											2						
	Add	re	ss	Bi	ts				_	252				_				-
	SS I	Rel	ay	Pı	es:	ent	;			Yes			, N	Vо	X	_Ye	s = 1	
	Rea	d I	Des	ir	ed						Y	es_		, N	Го	X	_Ye	s = 1
Select Channel												A_	X	.,	в_		_	A = 1
		s	1	2	3	4	5	6	7	8	9	10	11	12	13			
First W	/d	0	S	S	s	s	S	Α	Α	Α	Α	A	A	Α	A			
		0	1	1	0	<u>0</u>	0	1	0	1	0	1	0	1	0			
Second	Wd	0	0	Y	C	\mathbf{z}	0	0	0	0	0	0	0	0	0			
		0	0	0	1	0	0	0	0	(0	0	0	0	0			
	Y =	1			SS	Re	elay	y F	Pre	sei	nt							
	z =	1			Re	ad	De	si	red	l								
C = 1 Select Channe								el.	A									
	S =				Sta	ıge	Bi	its										
	A =				Ad	dre	ess	в	its									

	S. C.	15	5 MSS									
	RCAM	43200	00000 or 544000	0000								
	RCAD	30524	10000									
	RCAD	04000	00000									
			FBRD	000000000								
			SSR	142520000								
			SSFB	00000000								
			FBRD	00000000								
			1 1111									
S. S. P	resent (Yes))			S.S. Pres	sent (No)						
SSR	000000000				SSR	00000000						
SSFB					SSFB	000000000						
FBRD					END)						
SSR												
Iss	sue Read ?	•										
			Yes		No							
SSR	400000000				SSR	200000000						
SSFB	000000000											
SSR	000000000											
			SSFB	000000000								
			SSR	200000000								
			SSFB	000000000								
			SSR	000000000								
			SSFB	00000000								

^{*}The time reading are useful only for forming times.

MONITOR SWITCH SELECTOR ROUTINE

	Nun	Number of Stages										1		-					
	Add	res	ss	Bit	ts						12	25_		_					
	SS I	Rel	ay	Pr	es	ent					Y	es_	X	_,	No_		Υe	es =	1
	Rea	d I	Des	ire	ed					Yes, No_X_					Υe	es =	1		
	Select Channel								A, BX_					A =	1				
		S	1	2	3	4	5	6	7	8	9	10	11	12	13				
First V	Vd	0	S	s	s	s	S	A	A	A	Α	A	Α	Α	A				
		0	0	<u>0</u>	<u>1</u>	<u>0</u>	0	0	1	0	1	<u>0</u>	1	0	1				
Second	Wd	0	0	Y	C	\mathbf{z}	0	0	0	0	0	0	0	0	0				
		0	0	1	0	0	0	0	0	C	0	0	0	0	0				
	Y =	1			SS	Re	lay	7 I	re	se	nt								
	Z =	1			Re	ad	Dε	si	rec	ı									
	C = 1 Select Chann					nn	el	A											
	S = Stage Bits																		
	A =				Ad	dre	988	B	its										

OUTP	UT						PAC
	S. C.	15	MSS				
	RCAM	4320	00000 or 54400	0000			
	RCAD	0425	20000				
	RCAD	1000	00000				
			FBRD	000000000			
			SSR	021250000			
			SSFB	002520000			
			FBRD	002520000			
S.S. F	Present (Yes)			S.S. Pre	sent (No)	
SSR	000000000				SSR	000000000	
SSFB	002520000				SSFB	000000000	
FBRD	002520000				ENI)	
SSR	021250000						
Iss	ue Read ?						
			Yes		No		
SSR	400000000				SSR	200000000	
SSFB	000000000						
SSR	000000000						
			SSFB	000000000			
			SSR	200000000			
,			SSFB	000000000			

00000000

00000000

SSFB

SSR

^{*}The time reading are useful only for forming times.

MONITOR SWITCH SELECTOR ROUTINE

	Number of Stages									2		-					
	Address Bits								000								
	SS Relay Present								Yes_X_, No Yes = 1								
Read Desired								Yes_X_, No Yes = 1								1	
	Sele	ect	Cha	nne	e1					A_	X	 ;	В		A =	1	
		S	1	2	3	4	5	6	7	8	9	10	11	12	13		
First V	Vd	0	S	S	S	S	S	Α	A	A	A	A	A	A	Α		
		0	0	0	0	1	1	<u>0</u>	0	0	0	0	0	0	0		
Second	Wd	0	0	Y	C	Z	0	0	0	0	0	0	0	0	0		
		0	0	1	1	1	0	0	0	0	0	0	0	0	0		
	Y =	1		S	S Re	elay	Pı	rese	nt								
Z = 1 Read Desire $C = 1$ Select Chann							ed										
							nel	A									
	S =			St	tage	Bit	ts										
	A =			A	ddr	ess	Bi	ts									

	S. C.	15		MSS			
	RCAM	43200	00000 or 5	4400			
	RCAD	03000	00000				
	RCAD	16000	00000				
			FBRD		000000000		
			SSR		014000000		
			SSFB		003770000		
			FBRD		003770000		
S.S. P	resent (Yes)				S.S. Pre	sent (No)
SSR	000000000					SSR	000000000
SSFB	003770000					SSFB	000000000
FBRD	003770000					EN	D
SSR	014000000						
Iss	ue Read ?						
			Yes			No	
SSR	400000000					SSR	200000000
SSFB	000000000						
SSR	000000000						
			SSFB		000000000		
			SSR		200000000		
			SSFB		000000000		
			SSR		000000000		
			SSFB		000000000		

^{*}The time reading are useful only for forming $\,$ times.

MONITOR VERIFY AND PREPARE TO LOAD

Module _____ (M)

Sector _____17 (S)

Address <u>225</u> (A)

S/D _____ 0 S/D = 1 = Duplex

L Bit 1 L = 1 = Last Value

PTC INPUT CONTROL WORD

Data expected or loaded <u>000000002</u>

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPUT		PAGE <u>0091</u>
S. C.	21 MVP	
RCAM	442000000	
RCAD	740022540	
RCAD	000000002	
RCAD		
RCAD	Military and proposed proposed and a second contract of the second c	
RCAD		
RCAD		
RCAD	THE REAL PROPERTY OF THE PROPE	
RCAD		
RCAD		
RCAD		
244		
240	Milder Control of the	
234	Secretary and the secretary an	
230	Allestes and a constitution of the description of the second of the seco	
224		If a load is being performed also expect a
220		S.C. 23 MLD
214		S. C. 25 MLD
210	Will gunnal consequently relatively desired.	
204	740722526	

202

000000002

MONITOR SECTOR SUM CHECK ROUTINE

(M)

____0

Module

Starting Sector	:	0				(S	$_{ m S})$								
Ending Sector		17			(S _E)							
Input Word	S	1	2	3	4	5	6	7	8	9	10	11	12		
	0	s_E	s_E	s_{E}	s_{E}	s_s	s_s	s_s	ss	M	M	M	0		
	0	1	1	1	1	0	0	0	0	0	0	0	0		
OUTPUT														PAGE <u>0092</u>	2
S. C. 16		MS	SC												
RCAM 434	1000	0000	or 5	5420	0000	0									
RCAD <u>360</u>	00													2	
ERROR MSGE		EMI	R DA	ΥA			Γ	AG			7	rel	DATA	Α	
							3	74			_				
							3	70			_				
*							3	64			-				
							3	60			_				
							3	54			_				
							3	50			_				
							3	44			_				
							3	40			_		-		

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	Commence Com
		330	
	•	324	-
		320	
		314	-
		310	-
		304	
		300	
		274	-
		270	
		264	
		260	
		254	
		250	
		244	
		240	
		234	
		230	
		224	
		220	
		214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR SUM CHECK ROUTINE

	Module			1			(M)												
	Starting Sector			0				(S _S)											
	Ending Sector			17				(S _E)											
	Input Wor	d	S	1	2	3	4	5	6	7	8	9	10	11	12				
			0	s_{E}	s_E	s _E	$^{\rm S}$ E	s_s	s_s	s_s	s_s	M	M	M	0				
			0	1	1	1	1	0	0	0	0	0	0	1	0				
OUTP	UT															P	AGE	E <u>00</u>	93
	S.C.	16		MS	C														
	RCAM	4340	000	000 0	or 54	1200	0000)											
	RCAD	3601	_																
ERRO	R MSGE]	EMR	DA	TA			Т	AG			Т	EL	DAT	A			
									3	874			_						
									3	370					·				
									3	864			-	-					
										860			_						
										854							¢		
										350			-				•		
										344							•		
									3	340					~~~				

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	****
		314	
		310	***************************************
		304	651/5-6-7-10-0
		300	
		274	-
		270	
		264	-
		260	
		254	
		250	
		244	
		240	-
		234	
		230	
		224	
		220	
		214	***
		210	
		204	
*		202	

Sun Check Values are subject to change.

Values must be obtained from other sources.

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector ______ (S)

Address 141 (A)

S/D _____ 0 S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit $\underline{1}$ V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 A A A A A A A A A L V 0 0 0

 $\underline{0} \ \underline{1} \ \underline{1} \ \underline{0} \ 0 \ 0 \ 0 \ 0 \ \underline{0} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ 0 \ 0 \ 0$

Data expected or loaded 400030520 (ECCONT)

MONITOR VERIFY AND PREPARE TO LOAD

Module _____ (M)

Sector _____17 (S)

Address <u>225</u> (A)

S/D O S/D = 1 = Duplex

L Bit 0 L = 1 = Last Value

V Bit $\underline{1}$ V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1}$

Data expected or loaded 000000002 (MPLC1)

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector 17 (S)

Address ______(A)

S/D O S/D = 1 = Duplex

L Bit $\underline{}$ L = l = Last Value

V Bit $\underline{1}$ V = 1 = Verify

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ 0 \ 0 \ 0 \ 0 \ \underline{0} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{1} \ \underline{1} \ \underline{0} \ 0 \ 0$

Data expected or loaded 777763376 (EMCON)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUT	PUT						PAGE <u>0094</u>
	S.C.	21	MVP				
	RCAM	442000	000				
1	RCAD	300014	120				
	RCAD	400030	502	,			
	RCAD	740022	520				
	RCAD	000000	002				
	RCAD	740017	060				
	RCAD	777763	376				
	RCAD	NU	-				
	RCAD	NU					
	RCAD	NU	and the second s				
	RCAD	NU	-ph-salada, stra				
	244	NU					
	240	NU					
	234	NU					
	230	NU					
à	224	300714	136				
	220	400030	502	If a loa	d is bein	g performed	also expect a
	214	740722	536	S.C.	23	MLD	
	210	000000	002				
	204	740717	036				
	202	777763	376				

MONITOR LOAD

This routine shall be an error test when not commanded automatically by a successful Prepare to Load.

OUTPUT PAGE 0095

S.C. 23 MLD

S.C. 47

RCAM 530000000

ERR MSGE 231000000

EMR DATA 000000000

S.C. 00

MONITOR MEMORY ERROR

This routine checks for proper operation of the Preflight Memory Error Routine. All telemetered error data is printed.

OUTPUT

PAGE 0096

S.C. 22 MME

RCAM 444000000

VERIFY AND PREPARE TO LOAD ERROR TEST

The purpose of this test is to insure that the Verify and Prepare to Load Routine will reject any input data word with an incorrect character counter. This program also verifys that the program mode cannot switch during a load or verify operation and that the program will recognize an attempt to exceed the available table length.

OUTPUT **PAGE 0097** MVPE RCAM S.C. ERR MSGE EMR DATA XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX XXXXXXXX

MONITOR MINOR LOOP, SWITCH SELECTOR & REAL TIME COUNTER TEST

This routine tests the real time to insure that it increments properly by 1 every 3 instruction cycles. The minor loop and switch selector counters are checked over a 1.28 sec. interval to insure that all of the counter logic functions properly.

OUTPUT

PAGE 0098

S.C.

24 MML

RCAM

526000000 or 450000000

MONITOR AMP 3

The purpose of this routine is to run AMP 3 with simulated accelerometer inputs. This program will cycle for approximately 3.5 min.

OUTPUTS		PAGE <u>0099</u>
s.c.	21	MAM - SIMULATED LEVEL PLATFORM MVPS
RCAM	442000000	
RCAD	740022540	
RCAD	000000000	
204	740722526	
202	000000000	
S. C.	23	MLD
S.C.	00	

Observe following AMP 3 output for proper operation.

INITIAL DATA WORD	377	377	376	or	377	377	376
1st CHANGE	377	377	A72		377	01X	376
2nd CHANGE	377	40X	A72		377	01X	A72
3rd CHANGE	377	40X	5XX		377	40X	A72
4th CHANGE	000	40X	5XX		00X	40X	5XX

A = 3 or 7

MONITOR VERIFY AND PREPARE TO LOAD

Module 0 (M)

Sector _____17____(S)

Address <u>225</u> (A)

S/D _ 0 S/D = 1 = Duplex

L Bit L = 1 = Last Value

PTC INPUT CONTROL WORD

S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

S S S S M M M S/D 0 0 0 0 0 A A A A A A A A L V 0 0 0

 $\underline{1} \ \underline{1} \ \underline{1} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{1} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0} \ \underline{0}$

Data expected or loaded 000000000 (MPLC1)

MONITOR VERIFY AND PREPARE TO LOAD, AND LOAD

OUTPU	JT					I	PAGE <u>0100</u>
	S.C.	21	MVP				
	RCAM	442000000					
	RCAD	740022540					
	RCAD	00000000					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	RCAD	NU					
	244	NU					
	240	NU					
	234	NU					
	230	NU					
	224	NU		If a load	is being	performed also	expect a
	220	NU		S.C.	23	MLD	
	214	NU					
	210	NU					
	204	740722526					
	202	000000000					

MONITOR COMMAND RECEIVER TEST

This routine will, upon receiving the Status Code 35, exit to Monitor Power Up.

OUTPUT

PAGE 0101

S.C.

35

MCRT

RCAM

472000000

A message will be printed, "ALLOWING 1 MIN DELAY FOR OPERATOR TO MANUALLY VERIFY ORBIT PROGRAM ENTERED".

MONITOR POWER UP

This routine will allow the LVDC to proceed to its Forced Begin Routine.

OUTPUT PAGE NU

S.C. 40

MPU

COD ERROR WORD

XXXXXXXX

A STATUS CODE NOT REC print message may appear if Prepare to Launch had been previously commanded.

An OCR BIT ON, REPEATING MPU TO OBTAIN COD ERROR WORD print message may also appear, but only once.

The status code 40 will be printed as part of the output from Forced Begin.

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0102

S.C.

26

MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MODE DATA ERROR TEST

The purpose of this routine is to insure that the Mode Sort Routine will reject data type inputs and that the Read Input Data Subroutine will reject mode type input data properly.

OUTPUT				PAGE <u>0103</u>
	MMD			
	RCAM	564000000		
S.C.	ERR MSGE		EMR DATA	
47	001000000		xxxxxxxx	
00				
05				
47	451000000		xxxxxxxx	
00				

MONITOR TELEMETRY TEST ROUTINE

This routine monitors the LVDC Telemetry Test Routine for proper operation.

OUTPUT PAGE <u>0104</u>

S. C. 32 MTLM

RCAM 464000000

RCAD 100000000

The above output will be part of the following Forced Begin Output.

Additional output shall consist of the data received by reading the LVDC Telemetry Buffer Register. Sampled data shall have the following format:

TAG	DATA
32600	707070706
32773	77777776
32722	525252524
32624	252525252

MONITOR FORCE BEGIN

This routine will allow the LVDC to proceed to its Mode Sort Loop.

OUTPUT

PAGE 0105

S.C.

26

MFB

Verify the SSFB, DIN, DIS, CIU, OCR, DOR, and SSR output printed under the "ENDING REG STATUS" heading are zero.

Two Status Codes of 51 may appear if the Error Monitor Register is not zero, which may be the case with initial power on and after commanding a routine that uses the Ladders. The EMR data is associated to an output tele tag of 303.

MONITOR SECTOR SUM CHECK ROUTINE

	Module	-	0	-		(1)	1)										
	Starting Se	ctor_	0	_		(S	S)										
	Ending Sec	tor _	17			(S	E)										
	Input Word	l	S	1	2	3	4	5	6	7	8	9	10	11	12		
			0	s_E	s_E	s_E	s_E	s_s	s_s	s_s	s_{S}	M	M	M	0		
			0	1	1	1	1	0	0	0	0	0	0	0	0		
OUTP	UT															PAGE 0	106
	S. C.	16		M	SC												
	RCAM	4340	000	000	or 5	4200	0000	0									
	RCAD	3600	000	000													
ERRO	R MSGE			EMF	R DA	ТА			Γ	AG			Т	EL	DAT	A	

ERROR MSGE	EMR DATA	TAG	TEL DATA
		374	
		370	Short of the same and the same
		364	
		360	
		354	
		350	
		344	
		340	

ERROR MSGE	EMR DATA	TAG	TEL DATA
	¥	334	
		330	
		324	*
		320	
		314	
		310	
		304	
		300	
		274	
		270	
		264	
		260	
		254	
		250	
		244	
		240	
		234	
		230	
		224	
		220	
		214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR SUM CHECK ROUTINE

■OUTPUT PAGE 0107

S.C. 16 MSC

RCAM 434000000 or 542000000

RCAD 360100000

ERROR MSGE	EMR DATA	TAG	TEL DATA
		334	
		330	
		324	
		320	
*		314	
		310	
		304	
		300	
		274	
		270	
		264	
		260	
		254	Professional Reprintment of the Real State of th
		250	
		244	
		240	
		234	
		230	
		224	
		220	
		214	
		210	
		204	
		202	

Sum Check Values are subject to change.

Values must be obtained from other sources.

MONITOR SECTOR DUMP ROUTINE

Module

0

(M)

Starting Sector 0

 (S_S)

Ending Sector 17

 (S_E)

Input Word

S 1 2 3 4 5 6 7 8 9 10 11 12

OUTPUT

PAGE 0108

S.C.

20

MSD

RCAM

440000000 or 536000000

RCAD

360000000

Verify that the output contains dumps of the specified sectors. The following sectors should be dumped.

Sector <u>0</u> through Sector <u>17</u>

MONITOR SECTOR DUMP ROUTINE

Module 1 (M)

Starting Sector_0 (SS)

Ending Sector $\underline{17}$ (S_E)

Input Word S 1 2 3 4 5 6 7 8 9 10 11 12

OUTPUT

S.C. 20 MSD

RCAM 440000000 or 536000000

RCAD 360100000

Verify that the output contains dumps of the specified sectors. The following sectors should be dumped.

Sector 0 through Sector 17

PAGE 0109

APPENDIX B

ASTEC FLIGHT COMMAND RECEIVER DATA FORMAT

The following tables provide a detailed description of the Command Receiver Data Format. They are used with the Manual Mode of SIM Flight Option 40.

B-1. SECTOR DUMP

	14	13	12	11	10	9
Word 1 -	MODULE MSB	MODULE	MODULE LSB		FIRST MODULE MSB	FIRST SECTOR
Word 2 -	FIRST SECTOR	FIRST SECTOR LSB	LAST SECTOR MSB	LAST SECTOR	LAST SECTOR	LAST SECTOR LSB

B-2. TELEMETRY SINGLE MEMORY ADDRESS

	14	13	12	11	10	9
Word 1 -	MODULE MSB	MODULE	MODULE LSB	ADDR MSB	ADDR	ADDR
Word 2 -	ADDR	ADDR	ADDR	ADDR	ADDR LSB	х
Word 3 -	SECTOR MSB	SECTOR	SECTOR	SECTOR LSB	х	х

B-3. GENERALIZED SWITCH SELECTOR

	14	13	12	11	10	9
Word 1 -	IU STAGE	S-IVB STAGE	x	ADDR 8	ADDR 7	ADDR 6
Word 2 -	ADDR 5	ADDR 4	ADDR 3	ADDR 2	ADDR 1	X

APPENDIX C

ASTEC FLIGHT TELEMETRY TAG TABLES

It is sometimes necessary to obtain telemetry quantities with Option 35 other than provided with the standard options. The operator must modify the buffer tags located in the PTC memory to capture these quantities. The modification may be done with hand loads or trailer tapes.

C-1. HAND LOADING NEW TELEMETRY BUFFER TAGS

Table C-1 shows the location of the buffer tags used with the standard options. It also identifies each tag. The high order 14 bits of the octal value contain the buffer tag. The low order 12 bits contain a CLA instruction and an operand. The operand indicates the address of the scale factor of the corresponding telemetry quantity.

The range of scale factors available is B-63 to B-64. The address of scale factor BO is 077₈. Therefore, to obtain the correct address for the appropriate scale factor, add the scale factor value to the address of BO.

Example 1

Scale factor = $B10 \text{ or } 12_8$

Scale factor address = BO + B10 = $077_8 + 12_8 = 111_8$

Example 2

Scale factor = B-12 or -14_8

Scale factor address = BO + b-12 = 077_8 + (-14_8) = 063_8

In addition, the buffer tags for each option must be entered in ascending numerical sequence.

C-2. NEW TELEMETRY BUFFER TAGS WITH TRAILER TAPES

To eliminate the necessity for making the above hand loads; trailer tapes will be provided to supplement the standard options. Table C-2 and C-3 describe the telemetry quantities which can be obtained using these tapes. One is for use with AS-200 flight programs, and the second is for AS-500 programs. The options are punched on the tapes in the same order that they appear in the tables. The trailer tapes were punched using a program which is available on the IBM 1800. If the operator desires to make up new trailer tapes, the input card decks for the original tapes are available. When making changes to the input decks the same rules must be followed as described in Paragraph C-1.

Table C-1. Option 35 Standard Output Quantities

Location	Octal Value	Description
		* OPTION 1 CONSTANTS
1 04 063	002040000	ACCZ TAG
1 04 064	002100000	ACCX TAG
1 04 065	002140000	ACCY TAG
1 04 066	002545136	1/R TAG
1 04 067	003251536	V TAG
1 04 070	006160000	MC24 TAG
1 04 071	012211536	ZDM TAG
1 04 072	012251536	XDM TAG
1 04 073	012311536	YDM TAG
		* OPTION 2 CONSTANTS
1 04 074	002610336	GZ TAG
1 04 075	002650336	GX TAG
1 04 076	002710336	GY TAG
1 04 077	012751536	IGZ TAG
1 04 100	013011536	IGX TAG
1 04 101	013051536	IGY TAG
1 04 102	013310536	ZDDM TAG
1 04 103	013350536	XDDM TAG
1 04 104	013410536	YDDM TAG
		* OPTION 3 CONSTANTS
1 04 105	006020000	MC26 TAG
1 04 106	006160000	MC24 TAG
1 04 107	006220000	MC25 TAG
1 04 110	006260000	DORSW TAG
1 04 111	006320000	ICR TAG
1 04 112	006360000	EMRR TAG
1 04 113	006420000	INT TAG
1 04 114	006660000	DIS. IN. TAG
1 04 115	006760000	TBBU TAG
		* OPTION 4 CONSTANTS
1 04 116	006007736	CHIZ TAG
1 04 117	006047736	CHIX TAG
1 04 120	006107736	CHIY TAG
1 04 121	006147736	THETZ TAG
1 04 122	006207736	THETX TAG
1 04 123	006247736	THETY TAG
1 04 124	007027736	MLCHIZ TAG
1 04 125	007067736	MLCHIX TAG
1 04 126	007127736	MLCHIY TAG

Table C-1. Option 35 Standard Output Quantities (Continued)

Location	Octal Value	Description
		* Sign Option Constants*
$1\ 04\ 127$	002352636	ZS TAG
1 04 130	002452636	XS TAG
1 04 131	002512636	YS TAG
1 04 132	003111536	ZDS TAG
1 04 133	003151536	XDS TAG
1 04 134	003211536	YDS TAG
1 04 135	006107736	CHIY TAG
1 04 136	013450536	F/MTAG

Table C-2. Trailer Tape 1, AS-200 $\,$

	Quantity	(SCL)	LVDC	BTG		Quantity	(SCL)	LVDC	BTG
B-Reg.	TASEC	(15)	0000	0200	B-Reg.	TASEC	(15)	0000	0200
Switch	V	(14)	0124	0324	Switch	CHIZ	(0)	0001	0600
(1)	F/M	(6)	1144	1344	(3)	CHIY	(0)	0011	0610
	DXDV	(14)	2464	2266		ACZ1	(18)	1501	1702
	DYDV	(14)	2470	2272		ACX1	(18)	1505	1706
	DZDV	(14)	2474	2276		ACY1	(18)	1511	1712
	GO	(11)	2510	2312		RLT1	(6)	1515	1716
	GOP	(11)	2524	2326		ACZ2	(18)	1521	1722
	(M/F)I	(- 2)	2150	2350		ACX2	(18)	1525	1726
1	(M/F)S	(-2)	2154	2354		ACY2	(18)	1531	1732
B-Reg.					B-Reg.				
Switch					Switch				
(2)	TASEC	(15)	0000	0200	(4)	TASEC	(15)	0000	0200
	PSI	(0)	2414	2216		T1I	(10)	0400	0202
	CHITZ	(0)	2500	2302		$\mathbf{Z4}$	(23)	0434	0236
	CHITY	(0)	2504	2306		X4	(23)	0444	0246
	N1	(0)	2514	2316		Y4	(23)	0450	0252
	N2	(-8)	2520	2322		T3I	(10)	0460	0262
	N3	(0)	2530	2332		TAUD	(10)	0544	0346
	N4	(-7)	2534	2336		TAU1	(10)	2404	2206
	CHIZP	(0)	2550	2352		TAU3	(10)	2410	2212
	CHIYP	(0)	2554	2356		DT31P	(10)	2454	2256

Table C-3. Trailer Tape 2, AS-500

	Quantity	(SCL)	LVDC	BTG		Quantity	(SCL)	LVDC	BTG
B-Reg.	TASEC	(15)	0000	0200	B-Reg.	TASEC	(15)	0000	0200
Switch	T1I	(10)	0400	0200	Switch	V	(14)	0124	0324
(1)	T3I	(10)	0464	0266	(3)	F/M	(6)	1144	1344
(1)	CHIZ	(0)	0001	0600	(0)	DZDV	(14)	2464	2266
	CHIY	(0)	0011	0610		DXDV	(14)	2470	2272
	T2I	(10)	0171	0770		DYDV	(14)	2474	2276
	TAU 1	(10)	2404	2206		DYV	(23)	2510	2312
	TAU 3	(10)	2410	2212		DXV	(24)	2524	2326
	TCI	(10)	2054	2254		(M/F)I	(-2)	2150	2350
	TAU2	(10)	2175	2774		(M/F)S	(-2)	2154	2354
B-Reg.					B-Reg.				
Switch					Switch				
(2)	TASEC	(15)	0000	0200	(4)	TASEC	(15)	0000	0200
(2)	CHIXB	(0)	1500	1302	(1)	T3I	(10)	0464	0266
	CHIZB	(0)	1504	1306		VT	(14)	0130	0330
	K3	(1)	1514	1316		THETAT	(0)	0550	0352
	K4	(- 2)	1520	1332		1/RT	(- 22)	0170	0370
	K1	(1)	1530	1332		GT	(5)	0574	0376
	K2	(-1)	1534	1336		CHIY	(0)	0011	0610
	PSI	(0)	2414	2216		T2I	(10)	0171	0770
	CHIX4	(0)	2550	2352		PSI	(0)	2414	2216
	CHIZ4	(0)	2554	2356		(M/F)S	(- 2)	2154	2354
B-Reg.									
Switch									
(1)	TASEC	(15)	0000	0200					
\ -/	GZ	(4)	0060	0260					
	GX	(4)	0064	0264					
	GY	(4)	0070	0270					
	ZDDV	(4)	0504	0306					
	XDDV	(4)	0510	0312					
	YDDV	(4)	0514	0316					
	ZDDD	(4)	0520	0322					
	XDDD	(4)	0524	0326					
	YDDD	(4)	0530	0332					

APPENDIX D

ASTEC FLIGHT INPUT DATA TABLES FOR FLIGHT PROGRAM VARIABLES

It is not possible to make the ASTEC Flight Program completely compatible with all existing and future flight programs. However, it is possible to hold the necessary changes to a minimum. The following tables provide the location and description of the input data quantities which may change from one flight to another. If it becomes necessary to change any of these values they may be hand loaded or trailer tapes may be punched.

Table D-1 will be used with AS-200 flight programs and Table D-2 with AS-500 programs.

2-AS-206

Table D-1. AS-200 Input Quantities

No.	Location Mod, Sec, Loc	Present Octal Value	Use	Description	Units	Scaling
1	1,04,242	000 000 200	S-IVB Cuff Off Discrete	DIN Bit 5	N/A	N/A
2	1,04,243	000 200 000	S-IB Outboard Engine Out Discrete	DIN Bit 14	N/A	N/A
3	1,04,244	000 400 000	S-IB Inboard Engine Out Discrete	DIN Bit 15	N/A	N/A
4	1,04,245	400 000 000	S-IB Lift Off Discrete	DIN Bit 24	N/A	N/A
5	1,04,251	000 200 000	S-IB Low Level Sense Interrupt	LVDA Interrupt Storage Register (ISR) Bit 2	N/A	N/A
6	1,04,252	001 000 000	S-IVB Cut Off Interrupt	LVDA ISR Bit 4	N/A	N/A
7	1,04,253	002 000 000	S-IB Outboard Engine Cut Off Interrupt	LVDA ISR Bit 5	N/A	N/A
81	1,04,254	000 356 060	Time to Enter Orbit After S-IVB Cut Off	Nominal Value of 15 seconds	Quarter m-sec.	B25
8 ²	1,04,255	003 063 232	Time to Enter Orbit After S-IVB Cut Off	Nominal Value of 100 seconds	Quarter m-sec.	B25
9	1,04,257 1- AS-205	000 117 272	Time to Issue Abort to Orbit Command after S-IB Cut Off (Abort Option 1)	Nominal Value of 5 seconds	Quarter m-sec.	B25
	1- AS-205					

Table D-1. AS-200 Input Quantities (Continued)

No.	Location Mod, Sec, Loc	Present Octal Value	Use	Description	Units	Scaling
10	1,04,260	003 063 232	Time to Issue Abort to Orbit Command After S-IB Cut Off (Abort Option 2)	Nominal Value of 100 seconds	Quarter m-sec.	B25
11	1,04,262	312 230 000	DCS Mode Command for Abort to Orbit	DCS Mode Command 31	N/A	N/A
12	1,04,306	000 117 272	Time Lift Off is Issued After GRR	Nominal Value of 5 seconds	Quarter m-sec.	B25
13 ¹	1,04,307	004 175 010	Time LLS Issued After Lift Off	Nominal Value of 136.9 seconds	Quarter m-sec.	B25
13 ²	1,04,307	004 150 310	Time LLS Issued After Lift Off	Nominal Value of 135.6 seconds	Quarter m-sec.	B25
141	1,04,310	000 140 646	Time OBCO Issued After LLS	Nominal Value of 6.1 seconds	Quarter m-sec.	B25
14^2	1,04,310	000 137 172	Time OBCO Issued After LLS	Nominal Value of 6.0 seconds	Quarter m-sec.	B25
15	1,04,320	022 231 656	Time for Option 36 to Enter Orb. Mode for Repeatable Run	Nominal Value of 590.3 seconds	Quarter m-sec.	B25
	1,04,323 AS-205 AS-206	001 431 516	Time to Cut Off Second S-IVB Burn After Enable Switch Selector	Nominal Value of 50 seconds	Quarter m-sec.	B25

Table D-2. AS-500 Input Quantities

No.	Location Mod, Sec, Loc	Present Octal	Use	Description	Units	Scaling
1	1,04,242	000 000 200	S-IVB Cut Off Discrete	DIN Bit 5	N/A	N/A
2	1,04,246	004 000 000	S-IC Cut Off Discrete	DIN Bit 18	N/A	N/A
3	1,04,256	000 020 000	S-IC LLS Discrete	DIN Bit 11	N/A	N/A
4	1,04,247	010 000 000	S-II Cut Off Discrete	DIN Bit 19	N/A	N/A
5	1,04,245	400 000 000	S-IC Lift Off Discrete	DIN Bit 24	N/A	N/A
6	1,04,252	001 000 000	S-IVB Cut Off Interrupt	LVDA ISR Bit 4	N/A	N/A
7	1,04,251	000 200 000	S-IC LLS Interrupt	LVDA ISR Bit 2	N/A	N/A
8	1,04,253	002 000 000	S-IC Cut Off Interrupt	LVDA ISR Bit 5	N/A	N/A
9	1,04,250	004 000 000	S-II Cut Off Interrupt	LVDA ISR Bit 6	N/A	N/A
10	1,04,255	003 063 232	Time to Enter Orbit After S-IVB Cut Off	Nominal Value of 100 seconds	Quarter m-sec.	B25
11	1,04,257	000 117 272	Time to Issue Abort to Orbit Command After S-IC Cut Off (Abort Option 1)	Nominal Value of 5 seconds	Quarter m-sec.	B25

D-5/D-6

Table D-2. AS-500 Input Quantities (Continued)

No.	Location Mod, Sec, Loc	Present Octal	Use	Description	Units	Scaling
12	1,04,260	003 063 232	Time to Issue Abort to Orbit Command After S-IC Cut Off (Abort Option 2)	Nominal Value of 100 seconds	Quarter m-sec.	B25
13	1,04,263	232 620 000	DCS Mode Command for Abort to Orbit	DCS Mode Command 23	N/A	N/A
14	1,04,311	000 415 656	Time Lift Off is Issued	Nominal Value of 17 seconds	Quarter m-sec.	B25
15	1,04,312	004 142 020	Time S-IC Cut Off is After Lift Off	Nominal Value of 135.2 seconds	Quarter m-sec.	B25
16	1,04,313	013 245 344	Time S-II Cut Off is Issued After S-IC Cut Off	Nominal Value of 367.7 seconds	Quarter m-sec.	B25
17	1,04,321	024 314 344	Time for Option 36 to Enter Orbital Mode for a Repeatable Run	Nominal Value of 658 seconds	Quarter m-sec.	B25
18	1,04,322	014 315 150	Time to Issue Lox/LH ₂ Burner Malfunction DIN After the Burner Auto- matic System ARM Switch Selector	Nominal Value of 400 seconds	Quarter m-sec.	B25

APPENDIX E

PROGRAM PATCH PUNCH OPTION FORMAT

$\underline{\mathbf{A}}$ SWITCH REG

CONTROL WORD FORMAT

SIGN	1	2	3	4	5	6	7	8	9	10	11	12
	$\lceil s_1 \rceil$	S_{2}	$\lceil s_3 \rceil$	$\lceil s_4 \rceil$	M_1	M_2	M_3	D/S	$\left[\mathbf{w_{8}}\right]$	W_7	w_6	W_5
				_ T			L					
13	14	15	16	17	18	19	20	21	22	23	24	25
$\lceil w_4 \rceil$	$\begin{bmatrix} w_3 \end{bmatrix}$	$\left[\mathbf{W}_{2}\right]$	W_1									
4	3			L								

B SWITCH REG

$\begin{array}{c} \text{INSTRUCTION DATA FORMAT} \\ \text{SYL 1} \end{array}$

SIGN	1	2	3	4	5	6	7	8	9	10	11	12	
A8	A7	A6	A5	A4	A3	A2	A1	A9	0P ₄	0P ₃	$\boxed{\tiny 0P_{2}}$	0P ₁	
						SYL 0	Ì						

13	14	15	16	17	18	19	20	21	22	23	24	25	
A8	A7	A6	A5	A4	A3	A2	A1	A 9	0P ₄	$0P_3$	$\begin{bmatrix} 0 ext{P}_2 \end{bmatrix}$	$0P_1$	

APPENDIX F

ABBREVIATIONS AND ACRONYMS

ACAPE Aerospace Computer Automatic Program Evaluation

ACME Aerospace Computer Manual Exerciser

A/D Analog to Digital

ASTEC Aerospace System Test and Evaluation Complex

BCD Binary Coded Decimal

CIU Computer Interface Unit

COD Crossover Detector

CST Computer Single Step

DCS Digital Command System

DIN LVDC Discrete In

DOM Data Output Multiplexer

DST Data Adapter Single Step

EMR Error Monitor Register

G and C Guidance and Control

GRR Guidance Reference Release

GRRA Guidance Reference Release Alert

IBCO Inboard Engine Cutoff

I/O Input/Output

LLS Low Level Sense Interrupt

LVDA Launch Vehicle Data Adapter

LSB Least Significant Bit

LVDC Launch Vehicle Digital Computer

ME Manual Exerciser

MSB Most Significant Bit

OBCO Outboard Engine Cutoff

PIO An LVDC Machine Instruction (used to process input/output data)

PTC Programmable Test Controller

TLP Time of Liftoff





Apollo/Saturn Team