VOL. 3

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COMPUTER SCIENCES CORPORATION

# PRELIMINARY DRAFT

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MULTISATELLITE ATTITUDE DETERMINATION/

OPTICAL ASPECT BIAS DETERMINATION (MSAD/OABIAS)

SYSTEM DESCRIPTION AND OPERATING GUIDE

VOLUME 3

OPERATING GUIDE

Prepared for

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PRELIMINARY DRAFT

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## PREFACE

This volume is the third of four which make up the Multisatellite Attitude Determination/Optical Aspect Bias Determination (MSAD/OABIAS) System Description and Operating Guide. The volumes are

- Volume 1 - Introduction and Analysis
- Volume 2 - System Description
- Volume 3 - Operating Guide
- Volume 4 - Program Listing and Sample Execution

This volume contains a complete description of all MSAD/OABIAS NAMELIST control parameters, a description and a sample of all printed output unique to OABIAS and of each IBM 2250 graphics display, an explanation of and user response for all error messages generated by the MSAD/OABIAS System, and a listing of the job control language (JCL) required to operate the system.

Volume 1 contains an introductory exposition of the MSAD/OABIAS System and describes the analytic basis for the OABIAS Subsystem. This includes a detailed discussion of the recursive estimator algorithm, each of the 12 state vector elements, and the 8 observation models used.

Volume 2 describes the system flow and the components of the MSAD/OABIAS System. The table language descriptions provide detailed information relating the operational displays on the IBM 2250 display device to specific COMMON areas and subroutines within the MSAD/OABIAS System.

Volume 4 contains the program listing with supplementary output and line-printer plots of all IBM 2250 displays occurring during a sample execution of the program. This volume preserves, in source form, the MSAD/OABIAS System as it is presented in this document.

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## ABSTRACT

This document describes the Multisatellite Attitude Determination/Optical Aspect Bias Determination (MSAD/OABIAS) System, designed to determine spin axis orientation and biases in the alignment or performance of optical or infrared horizon sensors and Sun sensors used for spacecraft attitude determination. MSAD/OABIAS uses any combination of eight observation models to process data from a single onboard horizon sensor and Sun sensor to determine simultaneously the two components of the attitude of the spacecraft, the initial phase of the Sun sensor, the spin rate, seven sensor biases, and the orbital in-track error associated with the spacecraft ephemeris information supplied to the system. In addition, the MSAD/OABIAS system provides a data simulator for system and performance testing, an independent deterministic attitude system for preprocessing and independent testing of biases determined, and a multipurpose data prediction and comparison system.

MSAD/OABIAS has extensive capabilities for an interactive graphics mode and makes use of the Graphics Executive Support System (GESS), formerly known as the Multisatellite Attitude Determination System (MSAD), services. MSAD/OABIAS is a multisatellite system capable of supporting, in its present form, Small Scientific Satellite ($S^3$), Interplanetary Monitoring Platform (IMP), Atmosphere Explorer (AE), and Synchronous Meteorological Satellite (SMS) missions or any similar missions using optical or infrared horizon scanners and providing attitude data that can be read by the MSAD/OABIAS System.

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# SECTION 7 - OPERATING GUIDE

## 7.1 INTRODUCTION

The purpose of Section 7 is to provide the user with the information required to operate the MSAD/OABIAS System in both graphic and nongraphic modes. The reader is assumed to be familiar with the material in Sections 1, 2, and 3, but not necessarily familiar with Sections 4, 5, and 6.

## 7.2 RESOURCES

The MSAD/OABIAS System was designed to run on the IBM System 360 Model 95. If all system options are exercised and the suggested overlay structure is used, approximately 450K bytes of core storage are required.

A 2314 disk pack is required for the GESS nonresident tables and for the program load module. A 2250 or 2260 display device is required for operation in a graphic mode. The OABIAS data set will normally reside on disk or tape; in a simulation mode a scratch disk or scratch tape can be used. The Atmosphere Explorer (AE) data set, if used, must reside on disk or tape. Control parameters are normally read from cards and output routed to a lineprinter, but job control language (JCL) modifications can alter this at the option of the user. The remaining data sets (attitude tape, CalComp plot tape, and ephemeris files) are optional and may reside on any stroage device (e.g., tape, disk, or data cell).

## 7.3 CARD INPUT; NAMELIST PARAMETERS

All of the following card input is normally read from FORTRAN unit 5, with the exception of NAMELIST CONTRL and the optional GESS control cards, which are read from FORTRAN unit 97. However, in a nongraphic mode the user may specify the FORTRAN unit number for NAMELIST BIASNL using the parameter REDUNT. The first NAMELIST BIASNL in each set must appear on unit 5.

Card input should be ordered as follows for a job in a nongraphic mode:

FORTRAN unit 97:

1. NAMELIST CONTRL
2. GESS array allocation sizes (optional; read only if IRDART = 1 in NAMELIST CONTROL; normally omitted)
3. GESS display status flags (optional; read only if IRDXST = 1 in NAMELIST CONTRL; normally omitted)

FORTRAN unit 5:

1. NAMELIST MAIN
2. NAMELIST LIST (optional; read only if sumulation is specified (ISIM = 1) in NAMELIST MAIN)
3. NAMELIST OPMAN1
4. NAMELIST BIASNL
5. Additional sets of NAMELIST parameters for NAMELIST BIASNL; read only if REDUNT (1) $\neq$ 0 in the previous NAMELIST BIASNL
6. NAMELIST MAIN
7. NAMELIST LIST
8. NAMELIST OPMAN1
9. NAMELIST BIASNL
10. Additional NAMELIST sets, ordered the same as items 6-9, above

For the graphic mode, the same set of card input may be used, except that all card input following item 4 will be ignored.

Note that NAMELIST parameters are not reset to their default values after processing the first set. Thus, in a nongraphic mode, additional sets of

NAMELIST parameters need specify only those parameters which are to be changed from the previous set. A description of each NAMELIST follows. Each NAMELIST has been divided into logical subsets for purposes of description.

### 7.3.1 NAMELIST CONTRL

NAMELIST CONTRL is read by the GESS Executive and is read only once in a job.

Parameters in NAMELIST CONTRL are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| IFTABL | I*4 | 96 | FORTRAN unit number for GESS non-resident tables |
| IFTUBE | I*4 | 23 | FORTRAN unit number for graphics device |
| IFTPRT | I*4 | 6 | FORTRAN unit number for GESS printout |
| IRDART[1] | I*4 | 0 | Array allocation sizes reading option:<br>= 0, do not read array allocation sizes<br>= 1, read array allocation sizes |
| IRDXST[2] | I*4 | 0 | Display status flags reading option:<br>= 0, do not read display status flags<br>= 1, read display status flags |
| GSATID | R*8 | '*' | Character string for satellite identification |
| GRUNID | R*8 | '*' | Character string for run identification |
| IDIREC<br>IRDTPD<br>NUMSUB<br>NUMCNC<br>NUMSCA<br>KOFFEE<br>IRYEAR<br>IRMON<br>IRDAY | | | Not applicable to MSAD/OABIAS |

[1]See Section 7.3.2.

[2]See Section 7.3.3.

7.3.2 GESS Array Allocation Sizes

GESS array allocation sizes may be read from cards to change the default array allocation sizes in a nongraphic mode. See Reference 13, page 4-25 for a description. This input is needed only if IRDART = 1 in NAMELIST CONTRL. These array allocation sizes are normally omitted.

7.3.3 GESS Display Status Flags

GESS display status flags may be read from cards to change the display status flags in a nongraphic mode. See Reference 13, page 4-25 for a description. This input is needed only if IRDXST = 1 in NAMELIST CNTRL. These display status flags are normally omitted.

7.3.4 NAMELIST MAIN

NAMELIST MAIN is read by OADRIV, the main control module of MSAD/ OABIAS.

The parameter for subsystem selection is as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| ISIM | I*4 | 1 | Subsystem selection indicator:<br>= 1, simulate data<br>= 2, read data from OABIAS data set<br>= 3, display data already in core<br>= 4, copy AE data set to OABIAS data set<br>=-5, terminate |

The following parameters apply only for simulation (ISIM = 1):

| Name | Type | Default | Description |
| --- | --- | --- | --- |
| NFRAME | I*4 | 200 | Number of frames to simulate |
| IREWND | I*4 | 1 | Rewind indicator for simulated data set:<br>= 0, do not rewind before writing simulated data<br>= 1, rewind before writing simulated data |
| OMEGA1(2) | R*4 | 100.,0.0 | Spin rate coefficients (degrees per second, degrees per second$^2$) |
| TOMEGA(6) | R*4 | 6*0.0 | Reference time for spin rate (universal time (UT): year, month, day, hours, minutes, seconds). The spin rate at time t is computed as: OMEGA1(1) + (t - TOMEGA) * OMEGA1(2) |
| IDISK | I*4 | 50 | FORTRAN unit number for simulated OABIAS data set |

The following parameters apply only to copying the AE data to the OABIAS data set (ISIM = 4):

| Name | Type | Default | Description |
|---|---|---|---|
| IBLK1 | I*4 | 1 | First block on AE data set to be copied |
| IBLK2 | I*4 | 99999 | Last block on AE data set to be copied |
| IAEUN | I*4 | 49 | FORTRAN unit number of the AE data set |
| ICSKIP | I*4 | 1 | Record skipping indicator. Copy every ith wheel horizon sensor frame on the AE data set, where i = ICSKIP |
| AESENS(4) | R*4 | | Sensor mounting angles for AE (degrees) |
| (1) | | 104.0 | Wheel horizon sensor 1 |
| (2) | | 118.0 | Wheel horizon sensor 2 |
| (3) | | 110.0 | Body horizon sensor 1 or 2 |
| (4) | | 110.0 | Not used |
| IBSKIP | I*4 | 1 | Record skipping indicator for body horizon sensor data. Copy every ith body horizon sensor frame on the AE data set, where i = IBSKIP |
| BHSREF | R*4 | 90.0 | Azimuth of AE body horizon sensor with respect to Sun sensor (degrees) |
| ISUNSP | I*4 | 0 | Inertial spin period indicator:<br>= 0, use spin periods reported with data<br>= 1, use Sun times to generate inertial spin periods |
| OLDRPM | R*4 | 0.0 | Initial inertial spin period value reported for first frames until valid inertial period available from Sun times. Valid only if ISUNSP = 1 |
| IBOLOF | I*4 | 0 | OABIAS AE data set indicator:<br>= 0, do not write OABIAS AE data set<br>= 1, write OABIAS AE data set on FORTRAN unit number specified by IBOLOU |
| IBOLOU | I*4 | 49 | FORTRAN unit number for OABIAS AE data set |

The following parameters apply to reading the OABIAS data set (ISIM = 2):

| Name | Type | Default | Description |
|---|---|---|---|
| IREC1 | I*4 | 1 | Record number of first record to read |
| IREC2 | I*4 | 99999 | Record number of last record to read |
| IADD | I*4 | 0 | Option for combining newly read data with data already in core:<br>= 0, replace old data<br>= 1, add new data to old data (concatenate)<br>= 2, compress old data, deleting frames which are flagged; then add new data to old data |
| ISKIP | I*4 | 1 | Record skipping indicator. Select every ith record, where i = ISKIP |
| IPLOT | I*4 | 0 | Rotation angle plot indicator:<br>= 0, plot Earth-in and Earth-out on same plot<br>= 1, plot Earth-in and Earth-out on separate plots only; used to avoid exceeding 2250 buffer size |
| IEFMFG | I*4 | 0 | Ephemeris vector indicator:<br>= 0, do not preserve ephemeris vectors with data<br>= 1, preserve ephemeris vectors with data ('input data records' master number must be 200 or less; data sent to Optical Aspect Attitude Determination System (OASYS) must start with frame number 1) |
| IHEADR | I*4 | 3 | Selection indicator for header records and/or data records:<br>= 1, save data records only<br>= 2, save header records only<br>= 3, save both header records and data records |

| Name | Type | Default | Description |
|---|---|---|---|
| ICBSEL(4) | I*4 | | Array specifying central body selection based on central body flag on OABIAS data set:<br>= 0, do not select this central body (skip records with this central body)<br>= 1, select this central body |
| (1) | | 1 | Earth |
| (2) | | 1 | Moon |
| (3) | | 0 | Sun |
| (4) | | 1 | Unidentified |
| ICNSEL(8) | I*4 | 8*1 | Array specifying selection of configuration flag:<br>ICNSEL(i) = 0, do not select configuration flag i (skip records with this configuration)<br>= 1, select configuration flag i (the sensor configurations are described in Section 7.4) |
| IDISK | I*4 | 50 | FORTRAN unit number for OABIAS data set |
| IXXIXX | I*4 | 0 | Periodic reading indicator<br>= 0, read all data<br>= 1, read data periodically<br>PERIOD, BNDWTH, and TREF6 apply only if IXXIXX = 1. If IXXIXX = 1, then only data in the intervals T = TREF6 + N*PERIOD to TREF6 + N*PERIOD + BNDWTH are read. N is any integer, positive or negative |
| PERIOD | R*4 | 0.0 | Period for periodic reading (see above) |
| BNDWTH | R*4 | 0.0 | Interval width for periodic reading (see above) |
| TREF6(6) | R*4 | 0.0 | Reference time for periodic reading (year, month, day, hour, minute, second) (see above) |

The following parameters apply only to selecting a block of data for processing by OASYS (ISIM = 3):

| Name | Type | Default | Description |
|---|---|---|---|
| NFRAM1 | I*4 | 1 | First frame number of block of data to pass to OASYS |
| NFRAM2 | I*4 | 200 | Last frame number of block of data to pass to OASYS |
| IEPHEM | I*4 | 1 | Option for using ephemeris data from OABIAS data set:<br>= 0, do not use ephemeris data from OABIAS data set<br>= 1, use ephemeris data from OABIAS data set (data set must have been read with IEFMFG = 1) |
| ITERM | I*4 | 1 | Option for using terminator flags on OABIAS data set:<br>= 0, do not use terminator flags<br>= 1, use terminator flags (reject all triggerings identified as terminators) |
| ICB | I*4 | 1 | Not used |
| TADJ | R*4 | 0.0 | Time adjustment (seconds). Added to all times to be passed to OASYS |
| INOISE | I*4 | 3 | Option for adding noise to data to be passed to OASYS:<br>= 1, process data twice, once without noise and once with noise (applies in nongraphic mode only)<br>= 2, process data once, with noise<br>= 3, process data once, without noise<br>NOTE: If INOISE = 3, then the remaining parameters in this section do not apply |
| STDV(6) | R*4 | 6*0.0 | Standard deviation of Gaussian noise to be applied to data |
| (1) | | | Telemetry frame time (seconds) (not used) |
| (2) | | | Sun time (seconds) |
| (3) | | | Time in (seconds) |

| Name | Type | Default | Description |
|---|---|---|---|
| STDV(4)<br>(5)<br>(6) | R*4 | 6*0.0 | Time out (seconds)<br>Spin rate (degrees per second)<br>Sun angle (degrees) |
| BIAS(6) | R*4 | 6*0.0 | Biases to be added to data (same order and units as for STDV) |
| PROB(6) | R*4 | 6*0.0 | Probability of telemetry error (bit change); same order as for STDV |
| IRAND | I*4 | 123456789 | Initial number for random number generator (any odd integer) |
| BGAM | R*4 | 0.0 | Bias to be added to each sensor mounting angle (degrees) |
| SQUANT | R*4 | 0.0 | Sun angle quantization (degrees):<br>= 0.0, no effect<br>≠ 0.0, each Sun angle is quantized as follows:<br>$\beta = (\beta/SQUANT) * SQUANT + SQUANT/2.0$<br>where $\beta$ is the Sun angle, and the quantity in parentheses is truncated to an integer |
| ABETA1 | R*4 | 0.0 | Sun angle coefficient for linear fit (degrees) (see note below) |
| ABETA2 | R*4 | 0.0 | Rate of change of Sun angle (degrees per hour) (see note below) |
| TBETA(6) | R*4 | 6*0.0 | Reference time for Sun angle fit (UT: year, month, day, hours, minutes, seconds) |

NOTE: If ABETA1 = 0.0, and ABETA2 = 0.0, then the Sun angle from the OABIAS data set is used, and the Sun angle fit parameters (ABETA1, ABETA2, TBETA) are ignored.

If ABETA1 ≠ 0.0, or ABETA2 ≠ 0.0, then the Sun angle computed as follows

| Name | Type | Default | Description |
|---|---|---|---|
| TBETA(6) (Cont'd) | R*4 | 6*0.0 | replaces the Sun angle from the OABIAS data set: $\beta(t)$ = ABETA1 + ABETA2* (t - TBETA) where $\beta(t)$ = the Sun angle at time t. If TBETA is earlier than September 1, 1957 (e.g., if TBETA = 6*0.0), then the initial time from the block of data is used in place of TBETA in the above expression. |
| OMEG1 | R*4 | 0.0 | Spin rate coefficient for linear fit (degrees per second) (see note below) |
| OMEG2 | R*4 | 0.0 | Rate of change of spin rate (degrees per second$^2$) (see note below) |
| TOMEG(6) | R*4 | 6*0.0 | Reference time for spin rate (UT: year, month, day, hours, minutes, seconds) |

NOTE: If OMEG1 = 0.0 and OMEG2 = 0.0, the spin rates from the OABIAS data set are used. If OMEG1 $\neq$ 0.0 or OMEG2 $\neq$ 0.0, then the spin rate computed as follows replaces the spin rate from the OABIAS data set:
$\omega(t)$ = OMEG1 + OMEG2* (t - TOMEG)
where $\omega(t)$ = spin rate at time t
If TOMEG is earlier than September 1, 1957, then the initial time from the block of data is used in place of TOMEG.

The following parameters apply only to the data prediction subsystem, PLOTOC. Parameters whose description begins with an asterisk (*) have three components which refer to plot 1, 2, and 3, respectively.

| Name | Type | Default | Description |
|---|---|---|---|
| ISTATE(3) | I*4 | 1,2,0 | *State selection indicator for plot of predicted and observed rotation angles and scan widths:<br>= 0, no plot<br>= 1, use specified values of ALF, DEL (see note below) and biases<br>= 2, use specified values for BETA, PHI (see note below) and biases<br>= 3, use OABIAS final state for attitude and biases<br>= 4, use OASYS block average results for attitude and the input biases used in OASYS<br>>4, repeat old plot<br>NOTE: When returning to the options for data prediction display from within PLOTOC, the subroutine automatically returns 11, 22, 33, or 44 to the "Use State" (=ISTATE) for each plot to indicate whether the previous plot was 1, 2, 3, or 4, respectively. The only user options are to redisplay the arrays previously displayed in that plot or to generate a new plot or to generate no plot. |
| ALF(3) | R*4 | 0.0 | *Right ascension (geocentric inertial (G.I.)) (degrees) |
| DEL(3) | R*4 | 0.0 | *Declination (G.I.) (degrees) |
| BETA(3) | R*4 | 0.0 | *Sun angle (degrees) between Sun vector and spin axis at block start time |
| PHI(3) | R*4 | 0.0 | *Phase of attitude on Sun cone (degrees) at block start time; defined as the dihedral angle from the plane defined |

| Name | Type | Default | Description |
|---|---|---|---|
| PHI(3) (Cont'd) | R*4 | 0.0 | by the Sun vector and the Z-axis (G.I.) to the plane defined by the Sun vector and the spin axis |
| BSIGMA(3) | R*4 | 0.0 | *Bias to be added to sensor mounting angle (degrees) |
| BRHO(3) | R*4 | 0.0 | *Bias to be added to the angular radius of the central body (degrees) |
| BA1(3) | R*4 | 0.0 | *Bias to be added to observed in-triggering (degrees) |
| BA2(3) | R*4 | 0.0 | *Bias to be added to observed out-triggering (degrees) |
| BTIME(3) | R*4 | 0.0 | *Time adjustment to be added to telemetry times (seconds) |

NOTE: For all values of ISTATE, the program fills in the values appropriately for ALF, DEL, BETA, PHI, BSIGMA, BRHO, BA1, BA2, and BTIME, and these values can be examined the next time this display appears. For example, if ISTATE = 1, then the attitude specified by ALF and DEL is converted to the coordinate system for BETA and PHI, and BETA and PHI are set. If ISTATE = 2, then BETA and PHI are converted to ALF and DEL. If ISTATE = 3, then the OABIAS final state is used to set ALF and DEL, and this attitude is converted to set BETA and PHI. The biases (BSIGMA, BRHO, BA1, BA2, and BTIME) are set to the corresponding bias values from the OABIAS final state.

| Name | Type | Default | Description |
|---|---|---|---|
| ICENT(3) | I*4 | 1 | *Central body indicator:<br>= 1, Earth is central body<br>= 2, Moon is central body |
| RADE(3) | R*4 | 6378.16 | *Effective radius of Earth (kilometers) |
| RADM(3) | R*4 | 1738. | *Effective radius of Moon (kilometers) |
| DANGE(3) | R*4 | 89.7 | *Dark angle of Earth (degrees) |
| DANGM(3) | R*4 | 89.7 | *Dark angle of Moon (degrees) |
| IOBLAT(3) | I*4 | 1 | *Oblateness indicator:<br>= 0, use spherical Earth with radius RADE + HT<br>= 1, use oblate Earth |
| HT(3) | R*4 | 0.0 | *Height of atmosphere above Earth surface (kilometers) |
| IPSKIP(3) | I*4 | 1 | *Frame skipping indicator. Generate two frames of predicted data for every (i + 2)th frame, where i = IPSKIP (used to reduce execution time) |
| IWIDTH | I*4 | 0 | Scan width indicator:<br>= 0, plot both rotation angles and scan widths<br>= 1, plot scan width only |
| ITIME | I*4 | 0 | Parameter for selecting equal time increment plotting (applies to all plots):<br>= 0, plot at the frame times<br>= 1, plot at NPTS equal frame points between TSTART and TEND (see note below)<br>NOTE: NPTS, TSTART, and TEND apply only if ITIME = 1 |
| NPTS | I*4 | 200 | Number of points for equal time increment plotting; must be 200 or less. If NPTS = 0, the number of frames of observed data is used |

| Name | Type | Default | Description |
|---|---|---|---|
| TSTART(6) | R*4 | 0.0 | Start time for data prediction (UT: year, month, day, hours, minutes, seconds). If TSTART is earlier than September 1, 1957, then the start time of the observed data is used |
| TEND(6) | R*4 | 0.0 | Final time for data prediction (UT: year, month, day, hours, minutes, seconds). If TEND is earlier than September 1, 1957, then the end time of the observed data is used |
| IORBC(3) | I*4 | 1 | Orbital motion correction indicator:<br>= 0, do not correct for orbital motion within a spin period. Compute prediction based on spacecraft position at the in-triggering time<br>= 1, correct for orbital motion during a spin period. Compute prediction for in-triggering based on spacecraft position at the in-triggering time and prediction for out-triggering based on spacecraft position at the out-triggering time<br>NOTE: Execution time for predictions is approximately doubled if IORBC = 1 |
| ISAME | I*4 | 1 | Duplicate parameters indicator:<br>= 0, use specified parameters for each plot<br>= 1, use plot 1 parameters (ICENT on only) for plot 2 and plot 3 |
| IDATA | I*4 | 1 | New data plot parameter:<br>= 0, use old data plot<br>= 1, generate new data plot |
| IVSTAT(3) | I*4 | 1,2,0 | *IVSTAT(i) retains the value of ISTATE(i) used to generate the current plot i |
| ISAVTM | I*4 | 0 | ISAVTM retains the value of ITIME used to generate the current plots |

| Name | Type | Default | Description |
|---|---|---|---|
| OMEGAP | R*4 | 0 | Spin rate used to generate time for predicted data for flagged frames. Automatically set to spin rate calculated by OABIAS (degrees per second) |
| NRDF | I*4 | 1 | Number of revolutions per frame of data; (used to generate time for predicted data for flagged frames) |

7.3.5 NAMELIST LIST

NAMELIST LIST is read by subroutine ODAPIN and contains parameters specifying the simulation conditions.

Spacecraft attitude parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| ALPHA | R*4 | 0.0 | Right ascension (G.I.) of the spin axis (degrees). Valid range: $0 \leq$ ALPHA $<$ 360. This parameter does not apply if IATAPE = 0 |
| DELTA | R*4 | 0.0 | Declination (G.I.) of the spin axis (degrees). Valid range: $-90 \leq$ DELTA $\leq$ 90. This parameter does not apply if IATAPE = 0 |
| IATAPE | I*4 | 0 | Attitude tape indicator:<br>= 0, get attitude from attitude tape<br>= 1, use fixed ALPHA and DELTA read from cards |

Simulation time parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| T0(6) | R*4 | 6*0.0 | Starting time for data simulation (UT: year, month, day, hours, minutes, seconds). If T0 is not specified and IATAPE = 0, then the starting time is taken as the start time of the attitude tape. If IATAPE = 1, T0 must be specified |
| TF(6) | R*4 | 6*0.0 | Not used; should not be specified |
| DELTAT | R*4 | 60.0 | Time interval at which simulated data will be generated (seconds). Valid range: DELTAT > 0 . This parameter does not apply if IATAPE = 0 and INTERP = 0 |
| INTERP | I*4 | 0 | Interpolation indicator for attitude tape:<br>= 0, use the time spacing on the attitude tape, without interpolation (i.e., start at the first time on the attitude tape greater than or equal to T0 and use each suceeding time). Note that the time spacing on the attitude tape need not be uniform<br>= 1, use linear interpolation with the attitude tape to obtain the attitude at the desired times, using the specified value of DELTAT. INTERP does not apply if IATAPE = 1 |

Simulation orbital elements (in the arrays dimensioned (2), subscript = 1 applies to spacecraft orbit around Earth or Moon, subscript = 2 applies to orbit of Moon around Earth) are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| A(2) | R*4 | 2*0.0 | Semimajor axis (kilometers) |
| E(2) | R*4 | 2*0.0 | Eccentricity (unitless) |
| EYE(2) | R*4 | 2*0.0 | Inclination (degrees) |
| EMO(2) | R*4 | 2*0.0 | Mean anomaly at epoch time (degrees) |
| WO(2) | R*4 | 2*0.0 | Argument of perigee (degrees) |
| RANODE(2) | R*4 | 2*0.0 | Right ascension of ascending node (degrees) |
| ORBITE(6) | R*4 | 6*0.0 | Epoch time of orbital elements for spacecraft (UT: year, month, day, hours, minutes, seconds) |
| ORBITM(6) | R*4 | 6*0.0 | Epoch time of orbital elements for Moon (UT: year, month, day, hours, minutes, seconds) |
| ISUN | I*4 | 1 | Sun ephemeris indicator:<br>= 1, use SUN1 to obtain Sun position (equinox of date) (see Reference 6)<br>= 2, use SUNRD to obtain Sun position (uses a direct-access data set on FORTRAN unit 14; either equinox of date or equinox of 1950.0 depending on data set accessed) (see Appendix B)<br>= 3, use RJPLT to obtain Sun position (accesses a Jet Propulsion Laboratory (JPL) ephemeris data set on FORTRAN unit NRJPLT; equinox of date) (see Reference 5) |
| ISPC | I*4 | 2 | Spacecraft ephemeris indicator:<br>= 1, use ORBGEN to generate spacecraft orbit, using orbital elements for an orbit around the Earth (see module description of ORBGEN) |

| Name | Type | Default | Description |
|---|---|---|---|
| ISPC | I*4 | 2 | = 2, use DTAPRE to obtain spacecraft position (accesses a standard Definitive Orbit Determination System (DODS) EPHEM data set on FORTRAN unit NORB1; must be Earth-centered ephemeris) (see Reference 3)<br>= 3, use GETHDR/GETVCT to obtain spacecraft position (accesses a Goddard Trajectory Determination System (GTDS) ephemeris file, either direct-access or sequential, depending on the value of LEVEL (see below); the ephemeris may be either Earth-centered or Moon-centered; the header record of the data set specifies the origin for the coordinates) (see Reference 4)<br>= 4, use ORBGEN to generate spacecraft orbit, using orbital elements for an orbit around the Moon (see module description of ORBGEN)<br>= 5, use DTAPRE to obtain spacecraft position (accesses a standard DODS EPHEM data set on FORTRAN unit NORB1; must be Moon-centered ephemeris) (see Reference 3) |
| IMOON | I*4 | 0 | Moon ephemeris indicator:<br>= 0, do not obtain Moon position. This option must not be chosen if ICB > 2, or if a Moon-centered ephemeris file is used for GETHDR/GETVCT, or if ORBGEN is used for a spacecraft orbit around the Moon (ISPC = 4), or if DTAPRE is used with a Moon-centered EPHEM tape (ISPC = 5)<br>= 1, use ORBGEN to generate orbit of Moon using orbital elements for an orbit around the Earth (see module description of ORBGEN) |

| Name | Type | Default | Description |
|---|---|---|---|
| IMOON | I*4 | 0 | = 2, use SUNRD to obtain Moon position (accesses a direct-access data set on FORTRAN unit 14; either equinox of date or equinox of 1950.0, depending on data set accessed) (see Appendix B)<br>= 3, use RJPLT to obtain Moon position (accesses a JPL ephemeris data set on FORTRAN unit NRJPLT; equinox of date) (see Reference 5)<br>NOTE: The orbital elements and epoch time for the spacecraft must be specified if ISPC = 1 or 4. Orbital elements and epoch time for the Moon must be specified if IMOON = 1. |
| NRJPLT | I*4 | 28 | FORTRAN unit number for JPL ephemeris data set, read by RJPLT |
| NORB1 | I*4 | 30 | FORTRAN unit number for DODS EPHEM data set, read by DTAPRE |
| NGTDS | I*4 | 29 | FORTRAN unit number for GTDS ORBIT file, read by GETHDR/GETVCT (only if a sequential file is used, LEVEL = 0; see below) |
| LEVEL | I*4 | 0 | Level number for GETHDR/GETVCT:<br>= 0, use sequential orbit file, FORTRAN unit number NGTDS<br>> 0, level number on direct-access orbit file, FORTRAN unit number 31 |

Parameters which control simulation printout are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| IPRINT | I*4 | 0 | Print indicator:<br>= 0, print every output line (i.e., do not suppress printing)<br>= 1, suppress printout of an output line if the data condition flag for this line is the same as the data flag for the previous line (i.e., print an output line only for those times at which the data flag changes). The output line for the first time in the prediction interval is always printed, regardless of the value of the data flag. The output line for the final time is also printed, unless this problem terminates abnormally |
| IREPOR | I*4 | 0 | Report generation indicator:<br>= 0, generate final report summary<br>= 1, do not generate final report |

Simulation control parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| SIGMA | R*4 | 90.0 | Initial value for the sensor mounting angle between the spin axis and the optical axis of the horizon telescope (degrees). Valid range: 0 ≤ SIGMA ≤ 180. The sensor mounting angle is incremented by the value STEP after each frame or after each spin period if no sensor triggering occurs |
| STEP | R*4 | 0.703125 | Step size for panoramic scanner (degrees). If STEP = 0.0, the sensor mounting angle will remain constant at the value SIGMA |
| BIASRE | R*4 | 0.0 | Bias to be added to angular radius of Earth (degrees) |
| BIASRM | R*4 | 0.0 | Bias to be added to angular radius of Moon (degrees) |
| IOBLAT | I*4 | 1 | Model for Earth radius<br>= 0, use spherical Earth, of radius = RADE+HT<br>= 1, use oblate Earth, with atmosphere height HT above surface |
| RADE | R*4 | 6378.16 | Earth radius (kilometers); used only if IOBLAT = 0 |
| HT | R*4 | 0.0 | Height of atmosphere layer above surface (kilometers) |
| ICB | I*4 | 3 | Central body indicator:<br>= 1-2, consider Earth only as central body<br>= 3-6, consider both Earth and Moon as central bodies. Note that there is no option provided to consider the Moon as the only central body; however, if data for the Earth as central body are not desired, the dark angle of the Earth, DANGE, may be set to 360.0 degrees, causing the Earth to be ignored |

| Name | Type | Default | Description |
|---|---|---|---|
| OBLAT1 | R*4 | 0.0033528 | Earth oblateness parameter (see note below) |
| OBLAT2 | R*4 | 0.0 | Earth oblateness parameter for asymmetric Earth (see note below)<br>NOTE: The Earth radius is computed using the formula<br>R = 6378.16 (1.0 - OBLAT1 * $\sin^2 \phi$ + OBLAT2 * $\sin \phi$) + HT<br>where R = effective Earth radius in kilometers<br>$\phi$ = geocentric latitude |
| EPS | R*4 | 0.0 | Angular field of view of sensor (degrees). Valid range: $0 \le$ EPS $\le 180$. This parameter is used to determine if the sensor field covers the entire view of the central body or if part of the sensor field hits the central body |
| THETAC | R*4 | 45 | Sensor cutoff angle (degrees). The sensor is disabled when the dihedral angle from the plane defined by the spin axis and the Sun vector to the plane defined by the spin axis and the optical axis of the horizon telescope is less than THETAC or greater than 360 - THETAC. Valid range: $0 \le$ THETAC $\le 180$ |
| DANGE | R*4 | 90.0 | Dark angle of the Earth, in degrees measured between the vector to the terminator and the negative of the Sun vector |
| DANGM | R*4 | 90.0 | Dark angle of the Moon (degrees). (Note that the dark angle is approximately 90 degrees - $h_S$, where $h_S$ = half the angle subtended by the Sun = 0.27 degree. However, the dark angle may depend on the extent of the central body's atmosphere and the sensitivity of the sensor. For an infrared sensor, both DANGE and DANGM should be set to -90) |

| Name | Type | Default | Description |
|---|---|---|---|
| DELPHI | R*4 | 0.5 | Angular increment (degrees) used when searching for pairs of terminator crossings. If there are two terminator crossings for which the spacecraft rotation angles are closer then DELPHI, these crossings may be overlooked. Valid range: DELPHI > 0. Values of DELPHI less than 0.40 should not be used, unless the routine TERMIN is modified to allow more than 1000 steps in the terminator search. Larger values of DELPHI may be used to reduce execution time |
| PHITOL | R*4 | 0.01 | Maximum allowable error in the phase angle of a terminator crossing. The half-interval search is terminated when the interval becomes smaller than PHITOL. Valid range: PHITOL > 0. Values of PHITOL less than 0.001 should not be used, due to the limited precision of REAL *4 arithmetic (degrees) |
| ISKIP | I*4 | 0 | Data condition skipping indicator:<br>= 0, simulate one frame of data for each time point; do not skip time points<br>= 1, skip any time point if the data condition flag for this time point is blank (i.e., do not store the data for this time point in the simulated data arrays). Continue incrementing the time until a frame is obtained for which the data condition flag is not blank. (This option must be used in conjunction with a value for IFLAG. See below) |

| Name | Description |
|---|---|
| IFLAG | Flag indicator:<br>= 1, normal flag function<br>= 2, set flag to blanks if no sensor triggering occurs for this frame; otherwise, use normal flag function<br>= 3, set flag to blanks if no sunlit horizon triggerings occurred; otherwise, use normal flag function<br>= 4, set flag to blanks if a triggering was caused by a terminator crossing or if no triggerings occurred; otherwise, use normal flag function<br>= 5, use normal flag function if at least one triggering occurred at a terminator; otherwise, set flag to blanks |

Simulation uncertainty parameters are used mainly for simulation summary printout to indicate the expected quality of an attitude solution based on a given frame of data given the following uncertainties. If all uncertainties equal 0.0, no attitude uncertainty is computed. Simulation uncertainty parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| ERRBET | R*4 | 0.0 | Uncertainty in Sun angle (degrees) |
| ERRGAM | R*4 | 0.0 | Uncertainty in sensor mounting angle (degrees) |
| ERRA | R*4 | 0.0 | Uncertainty in rotation angle of spacecraft from Sun crossing to horizon crossing (degrees) |
| ERRAD | R*4 | 0.0 | Uncertainty in angular radius of the central body (degrees) |
| ERRTIM | R*4 | 0.0 | Uncertainty in absolute time of horizon crossings, or uncertainty in ephemeris information (seconds) |
| IDEBUG | I*4 | 0 | Debug indicator for uncertainty printout:<br>= 0, no debug printout<br>> 0, generate debug printout on FORTRAN data set reference number IDEBUG |

Parameters controlling corrections for orbital motion in data simulation are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| TOL | R*4 | 0.0001 | Desired tolerance for sensor triggering time (seconds). If no iteration is desired, a large value may be used (e.g., 1.0E+50,) so that convergence will always occur on the first iteration |
| MAXIT | I*4 | 10 | Maximum allowed number of iterations |

7.3.6 NAMELIST OPMAN1

NAMELIST OPMAN1 is read by subroutine OPINIT and contains parameters specifying the processing options for OASYS.

Orbital elements (in arrays dimensioned (2), subscript = 1 applies to spacecraft orbit around Earth or Moon, subscript = 2 applies to orbit of Moon around Earth) are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| A(2) | R*4 | 2*0. | Semimajor axis (kilometers) |
| E(2) | R*4 | 2*0. | Eccentricity (unitless) |
| EYE(2) | R*4 | 2*0. | Inclination (degrees) |
| EMO(2) | R*4 | 2*0. | Mean anomaly (degrees) |
| WO(2) | R*4 | 2*0. | Argument of perigee (degrees) |
| RANODE(2) | R*4 | 2*0. | Right ascension of ascending node (degrees) |
| ISUN | I*4 | 1 | Sun ephemeris indicator:<br>= 1, use SUN1 to obtain Sun position (equinox of date) (see Reference 6)<br>= 2, use SUNRD to obtain Sun position (uses a direct-access data set on FORTRAN unit 14; either equinox of date or equinox of 1950.0, depending on data set accessed) (see Appendix B)<br>= 3, use RJPLT to obtain Sun position (accesses a JPL ephemeris data set on FORTRAN unit NRJPLT; equinox of date) (see Reference 5) |
| ISPC | I*4 | 2 | Spacecraft ephemeris indicator:<br>= 1, use ORBGEN to generate spacecraft orbit, using orbital elements for an orbit around the Earth (see module description of ORBGEN) |

| Name | Type | Default | Description |
|---|---|---|---|
| ISPC (Cont'd) | I*4 | 2 | = 2, use DTAPRE to obtain spacecraft position (accesses a standard DODS EPHEM data set on FORTRAN unit NORB1; must be Earth-centered ephemeris) (see Reference 3)<br>= 3, use GETHDR/GETVCT to obtain spacecraft position (accesses a GTDS ephemeris file, either direct access or sequential, depending on the value of LEVEL (see below); the ephemeris may be either Earth-centered or Moon-centered; the header record of the data set specifies the origin for the coordinates) (see Reference 4)<br>= 4, use ORBGEN to generate spacecraft orbit, using orbital elements for an orbit around the Moon (see module description of ORBGEN)<br>= 5, use DTAPRE to obtain spacecraft position (accesses a standard DODS EPHEM data set on FORTRAN unit NORB1; must be Moon-centered ephemeris) (see Reference 3) |
| IMOON | I*4 | 0 | Moon ephemeris indicator:<br>= 0, do not obtain Moon position. This option must not be chosen if CBFLAG > 2, or if a Moon-centered ephemeris file is used for GETHDR/GETVCT, or if ORBGEN is used for a spacecraft orbit around the Moon (ISPC = 4), or if DTAPRE is used with a Moon-centered EPHEM tape (ISPC = 5)<br>= 1, use ORBGEN to generate orbit of Moon using orbital elements for an orbit around the Earth |

| Name | Type | Default | Description |
|---|---|---|---|
| IMOON (Cont'd) | I*4 | 0 | = 2, use SUNRD to obtain Moon position (accesses a direct access data set on FORTRAN unit 14; either equinox of date or equinox of 1950.0, depending on data set accessed) (see Appendix B)<br>= 3, use RJPLT to obtain Moon position (accesses a JPL ephemeris data set on FORTRAN unit NRJPLT; equinox of date) (see Reference 5)<br>NOTE: The orbital elements and epoch time for the spacecraft must be specified if ISPC = 1 or 4. Orbital elements and epoch time for the Moon must be specified if IMOON = 1. |
| NRJPLT | I*4 | 28 | FORTRAN unit number for JPL ephemeris data set, read by RJPLT |
| NORB1 | I*4 | 30 | FORTRAN unit number for DODS EPHEM data set, read by DTAPRE |
| NGTDS | I*4 | 29 | FORTRAN unit number for GTDS ORBIT file, read by GETHDR/GETVCT (only if a sequential file is used, LEVEL = 0; see below) |
| LEVEL | I*4 | 0 | Level number for GETHDR/GETVCT:<br>= 0, use sequential orbit file, FORTRAN unit number NGTDS<br>> 0, level number on direct-access orbit file, FORTRAN unit number 31 |
| TORBIT(6) | R*4 | 6*0. | Epoch time of orbital elements for spacecraft (year, month, day, hour, minutes, seconds) |
| TMOON(6) | R*4 | 6*0. | Epoch time of orbital elements for Moon (year, month, day, hour, minutes, seconds) |

Uncertainty parameters for OASYS data weighting are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| ERRBET | R*4 | 0.0 | Uncertainty in Sun angle (degrees) |
| ERRGAM | R*4 | 0.0 | Uncertainty in sensor mounting angle (degrees) |
| ERRA | R*4 | 0.0 | Uncertainty in rotation angle of spacecraft from Sun crossing to horizon crossing (degrees) |
| ERRAD | R*4 | 0.0 | Uncertainty in angular radius of the central body (degrees) |
| ERRTIM | R*4 | 0.0 | Uncertainty in absolute time of horizon crossing, or uncertainty in ephemeris information (seconds) |
| IDEBUG | I*4 | 0 | Debug indicator for subroutines UNCERT, UNCDBL, and UNCDH:<br>= 0, no debug printout<br>> 0, generate debug printout on FORTRAN data set reference number IDEBUG |

NOTE: If it is desired to utilize the data weighting and uncertainty options of the system, the following parameters must be specified:

- The NAMELIST parameter IAPIOR must be 4 or 8. The NAMELIST parameters APRA and APDEC must be specified. (See OPMAN1 Control.)
- One or more of the uncertainty parameters (ERRBET, ERRGAM, ERRA, ERRAD, and ERRTIM) must have a nonzero value.

Bias parameters for OASYS are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| IOBLAT | I*4 | 1 | Earth radius model indicator:<br>= 0, use spherical Earth model, with radius = (RADE + HT)<br>= 1, use oblate Earth model, with atmosphere layer at height HT above Earth surface (the value of RADE is ignored) |
| HT | R*4 | 0.0 | Height of atmosphere layer above Earth surface (kilometers) |
| ABIAS1 | R*4 | 0.0 | Bias added to the central body in-triggering (degrees) |
| ABIAS2 | R*4 | 0.0 | Bias added to central body out-triggering (degrees) |
| BIASRE | R*4 | 0.0 | Bias added to angular radius of Earth (degrees) |
| BIASRM | R*4 | 0.0 | Bias added to angular radius of Moon (degrees) |
| RADE | R*4 | 6378.16 | Effective optical aspect radius of Earth (kilometers) |
| RADM | R*4 | 1738.0 | Effective optical aspect radius of Moon (kilometers) |
| DANGE | R*4 | 89.7 | Dark angle of Earth (degrees) |
| DANGM | R*4 | 89.7 | Dark angle of Moon (degrees) |
| BGAMMA | R*4 | 0.0 | Bias on sensor mounting angle (degrees) |
| OBLAT1 | R*4 | 0.0033528 | Earth oblateness parameter (see note below) |
| OBLAT2 | R*4 | 0.0 | Earth oblateness parameter for asymmetric Earth (see note below) |

NOTE: The effective Earth radius, R, in kilometers, is computed as

$$R = 6378.16\ (1.0 - OBLAT1 * \sin^2 \phi + OBLAT2 * \sin \phi) + HT$$

where $\phi$ = geocentric latitude

OASYS printout control parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| IPLOT | I*4 | 5 | Lineprinter plot level:<br>= 0, no lineprinter plots<br>≥ 1, plots of alpha versus frame number and delta versus frame number (including rejected points)<br>≥ 2, plots of alpha versus frame number and delta versus frame number (omitting rejected points)<br>≥ 3, plots of arc length uncertainty versus frame number<br>≥ 4, plots of nadir angle versus frame number<br>≥ 5, plots of dihedral angle versus frame number |
| DEBUG | I*4 | 8 | Printout level indicator:<br>= 0, no printout<br>≥ 1, print error messages<br>≥ 2, print averages<br>≥ 3, print input parameters<br>≥ 4, print single frame results<br>≥ 5, print pointer frames<br>≥ 6, print input telemetry frames<br>≥ 7, print Sun vectors<br>≥ 8, print ephemeris vectors |

OASYS control parameters are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| IAPIOR | I*4 | 0 | A priori attitude indicator:<br>= 0, no a priori attitude available<br>= 4, use a priori attitude only if deterministic logic fails<br>= 8, use a priori attitude first to resolve all ambiguities |
| APRA | R*4 | 0.0 | A priori right ascension (G.I.) (degrees) |
| APDEC | R*4 | 0.0 | A priori declination (G.I.) (degrees) |
| EPSILN | R*4 | 50.0 | Sensor cutoff angle (degrees) |
| EPS | R*4 | 1.4 | Angular field of view of sensor (degrees) |
| ATTOL | R*4 | 360.0 | Error limit on a priori attitude (degrees) |
| TRMCHK | I*4 | 0 | Terminator rejection flag:<br>= 0, no restriction<br>= 4, reject data if terminator is visible |
| ITMAX | I*4 | 10 | Maximum number of iterations allowed to resolve ambiguities in SPINAV (see Reference 8) |
| SPNSIG | R*4 | 3. | Rejection tolerance. An attitude is rejected if its deviation from the block average is greater than SPNSIG*STDV, where STDV is the computed standard deviation |
| SPNTOL | R*4 | 20. | Rejection tolerance. An attitude is rejected if its deviation from the block average is greater than SPNTOL (degrees) |
| SRLOW | R*4 | 0. | Lower bound on spin rate (degrees per second) |
| SRHIGH | R*4 | 1.E6 | Upper bound on spin rate (degrees per second) |
| SUNLOW | R*4 | 0. | Lower bound on Sun angle (degrees) |
| SUNHI | R*4 | 180. | Upper bound on Sun angle (degrees) |

| Name | Type | Default | Description |
|---|---|---|---|
| CBFLAG | I*4 | 2 | Central body indicator:<br>= 1-2, consider Earth only as central body<br>= 3-6, consider both Earth and Moon as central bodies<br>= 7-10, consider Moon only as central body |
| DELPHI | R*4 | 0.5 | Terminator search increment, used by predictor. A pair of terminator crossings may be overlooked if their angular separation is less than DELPHI (degrees) |
| PHITOL | R*4 | 0.01 | Terminator angle tolerance. Used to terminate half-interval search in predictor (degrees) |
| DIHTOL | R*4 | 10. | Maximum expected error in degrees in dihedral angle computed from double horizon scan midtime. Used to resolve ambiguities in double horizon width method |
| IDISK | I*4 | 0 | OABIAS data archive control parameter:<br>≤ 0, do not write archive data set<br>> 0, write archive data set on FORTRAN unit number IDISK: See Section 7.4 for a description of this data set |
| BDYCHK | I*4 | 0 | Double horizon crossing flag:<br>= 0, use double horizon methods only if central body is fully sunlit<br>= 1, use double horizon methods only if a scan at the a priori attitude does not cross the terminator<br>= 2, use double horizon methods regardless of lighting conditions on central body |
| MIN | I*4 | 1 | Single horizon-in flag:<br>= 0, do not process with single horizon-in method<br>= 1, process with single horizon-in method |

| Name | Type | Default | Description |
|---|---|---|---|
| MOUT | I*4 | 1 | Single horizon-out flag:<br>= 0, do not process with single horizon-out method<br>= 1, process with single horizon-out method |
| MDBL | I*4 | 1 | Double horizon width flag:<br>= 0, do not process with double horizon width method<br>= 1, process with double horizon width method |
| MDIH | I*4 | 1 | Double horizon dihedral flag:<br>= 0, do not process with double horizon dihedral method<br>= 1, process with double horizon dihedral method |
| SUNSIG | R*4 | 3. | Rejection tolerance. A Sun angle is rejected if it differs from its smoothed value by more than SUNSIG*STDV, where STDV = the computed standard deviation |
| SUNTOL | R*4 | 20. | Rejection tolerance. A Sun angle is rejected if it differs from its smoothed value by more than SUNTOL (degrees) |
| ISNPRO | I*4 | 0 | Sun angle processing indicator:<br>= 0, normal Sun angle processing (linear fit)<br>= 1, do not smooth Sun angles |
| SUNIN | R*4 | 0.0 | Sun angle input:<br>= 0.0, no effect<br>≠ 0.0, use the value SUNIN for every Sun angle; ignore the Sun angles in the telemetry, and ignore the value of ISNPRO (degrees) |

NOTE: The following parameters in NAMELIST OPMAN1 are not applicable for MSAD/OABIAS; see Reference 8 for a discussion of these parameters:

| | | | |
|---|---|---|---|
| SENANG | STIME1 | SRSIG | WTNAD |
| APPER | FTIME0 | SRTOL | WTDIH |
| MIDTIM | FTIME1 | ISRPRO | WTNAD2 |
| TWIDTH | IGCORE | WTSUN | WTDIH2 |
| STIME0 | | | |

### 7.3.7 NAMELIST BIASNL

NAMELIST BIASNL is read by subroutine INITIL and contains parameters specifying processing options for the OABIAS Subsystem.

Parameters defining the initial state are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| XO(1) | R*8 | 0.0 | Initial estimate of right ascension (G.I.) (degrees) |
| XO(2) | R*8 | 0.0 | Initial estimate of declination (G.I.) (degrees) |
| XO(3) | R*8 | 0.0 | Initial estimate of phase (degrees)<br>= 0.0, program will compute the initial phase |
| XO(4) | R*8 | 0.0 | Initial estimate of bias in horizon scanner mounting angle from spin axis (degrees) |
| XO(5) | R*8 | 0.0 | Initial estimate of horizon scanner azimuth relative to the Sun sensor on central body in-triggering (degrees) |
| XO(6) | R*8 | 0.0 | Initial estimate of horizon scanner azimuth relative to the Sun sensor on central body out-triggering (degrees) |
| XO(7) | R*8 | 0.0 | Initial estimate of bias on the angular radius of the central body (degrees) |
| XO(8) | R*8 | 0.0 | Initial estimate of bias in Sun angle (degrees) |
| XO(9) | R*8 | 0.0 | Initial estimate of spin rate (revolutions per minute):<br>= 0.0, compute initial estimate using average of spin rates in INDATA |
| XO(10) | R*8 | 0.0 | Initial estimate of Sun sensor plane tilt (degrees) |
| XO(11) | R*8 | 0.0 | Initial estimate of horizon sensor plane tilt (degrees) |
| XO(12) | R*8 | 0.0 | Initial estimate of orbit time adjustment (seconds) |

| Name | Type | Default | Description |
|---|---|---|---|
| PO(12) | R*8 | 12*0.0 | Estimate of the error in the initial state (units same as XO) |
| ATTOPT | I*4 | 2 | Initial attitude options:<br>= 1, use OASYS block average results for both attitude and uncertainties; ignore XO(1), XO(2), PO(1), PO(2)<br>= 2, use XO(1) and XO(2) for initial attitude; use PO(1) and PO(2) for initial uncertainties<br>= 3, use state vector and uncertainties from previous OABIAS run; ignore XO and PO entirely<br>= 4, use state vector from previous OABIAS run, and input values of PO; ignore XO entirely<br>= 5, use OASYS block average results for attitude, and input values for PO; ignore XO(1) and XO(2) |

Parameters specifying OABIAS models are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| MODEL(10) | L*4 | 10*F | Observation model selector. If true, the selected model is processed |
| (1) | | | Sun angle |
| (2) | | | Sun time |
| (3) | | | Nadir vector projection |
| (4) | | | Horizon time |
| (5) | | | Single horizon dihedral angle |
| (6) | | | Double horizon scan width |
| (7) | | | Small target nadir angle |
| (8) | | | Scan midtime dihedral angle |
| (9) | | | Unused |
| (10) | | | Unused |
| RESMOD(10) | L*4 | 10*F | Residual calculation selector. If true, the residual for that model is computed. RESMOD(i) is defined in the same way as MODEL(i) |

Parameters defining processing options are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| REJOPT | I*4 | 0 | Data rejection option:<br>= 0, process all data<br>= 1, reject an observation if it was rejected by the corresponding model in OASYS |
| IUPDAT | I*4 | 0 | State vector updating sequence:<br>= 0, update after every model processing<br>= N, update at every Nth frame |
| NUMITR | I*4 | 0 | Iteration controller:<br>= 0, no iteration<br>= N, allow up to N iterations on each state update |
| CONVRG | R*8 | 11*1.D-5 | Array of convergence criteria for iteration loop. If $\Delta \hat{X}$ < CONVRG, the iteration loop is completed (units the same as XO) |
| REDUNT(10) | I*4 | 5,9*0 | In a nongraphic mode, if REDUNT(1) $\neq$ 0, another set of parameters for NAMELIST BIASNL will be read from the FORTRAN unit number specified by REDUNT(1). If REDUNT(1) = 0, OABIAS will return after completing the processing requested in this NAMELIST. In a graphics mode, REDUNT has no effect. REDUNT(2) through REDUNT(10) are not applicable in MSAD/OABIAS |
| INTOUT | I*4 | 0 | Results printout frequency controller:<br>= 0, print after each model processing<br>= N, print after each Nth frame |
| IOBLAT | I*4 | 0 | Oblateness model indicator:<br>= 0, use spherical Earth model<br>= 1, use oblate Earth model |
| ITER | I*4 | 1 | Maximum number of iterations for linearity fix:<br>= 1, do not use linearity fix<br>= N, maximum of N iterations |

| Name | Type | Default | Description |
|---|---|---|---|
| ISPINR | I*4 | 0 | Spin rate processing option:<br>= 0, use block average spin rate for processing every frame<br>= 1, use spin rate from each telemetry frame for processing that frame<br>ISPINR does not apply if PO(9) $\neq$ 0.0 |

Parameters controlling OABIAS printout are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| ERUNIT | I*4 | 19 | Unit number for printout of error messages and diagnostic output |
| IDUMPL | I*4 | 0 | Diagnostic output level controller:<br>= 0, print only summary of errors<br>= 4, print error messages and summary |
| IPLOT(12) | I*4 | 12*3 | Plotting option for printer plots of state vector and state uncertainties:<br>= 0, do not plot state or uncertainty<br>= 1, plot state only<br>= 2, plot uncertainty only<br>= 3, plot both state and uncertainty<br><br>There is one indicator for each state component as listed for XO. Note that if PO(I) = 0.0 for any state component, plots will not be generated for that state component, regardless of the value of IPLOT |
| IDIAGN(32) | I*4 | 32*0 | Diagnostic printout flag for each subroutine:<br>= 0, print nothing<br>≥ 1, print header and trailer<br>≥ 2, input variables<br>≥ 4, output variables<br>≥ 6, internal variables before and after they are passed via an internal subroutine call<br>≥ 8, other internal variables |
| (1) | | | AMATRX |
| (2) | | | APARTS |
| (3) | | | BIASER |
| (4) | | | DIAFUN |
| (5) | | | DIAMOD |
| (6) | | | FRAPRO |
| (7) | | | INITIL |
| (8) | | | LCOMP |
| (9) | | | LNFUN |
| (10) | | | LNMOD |
| (11) | | | LPARTS |

| Name | Type | Default | Description |
|---|---|---|---|
| (12) | | | LRFUN |
| (13) | | | LRMOD |
| (14) | | | OABIAS |
| (15) | | | PRINT |
| (16) | | | PSIPHA |
| (17) | | | RECURS |
| (18) | | | ROTATE |
| (19) | | | SANFUN |
| (20) | | | SANMOD |
| (21) | | | STMFUN |
| (22) | | | STMMOD |
| (23) | | | DHFUN |
| (24) | | | DHMOD |
| (25) | | | SCBFUN |
| (26) | | | SCBMOD |
| (27)-(32) | | | Unused |
| IPRINT | I*4 | 20 | FORTRAN unit number for results printout. Results are printed on units IPRINT, IPRINT + 1, IPRINT + 2, IPRINT + 3, IPRINT + 4, and IPRINT + 5 |
| ILEVEL | I*4 | 4 | Results printout level controller:<br>= 0, print nothing<br>= 2, print time, state vector, $\alpha$, $\delta$, frame number, observation type<br>= 4, print above plus covariance matrix<br>= 6, print above plus gain matrix<br>= 8, print above plus matrix of partials, weights, residuals<br>= 10, print above plus observation and calculated observation<br>= 12, print above plus inertial vectors |

Parameters defining observation weights are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| SANGRN | R*4 | 1.E-4 | Sun angle granularity (degrees) |
| STMGRN | R*4 | 1.E-4 | Sun time granularity (seconds) |
| OAGRAN | R*4 | 1.E-4 | Timing granularity of the optical aspect (OA) telescope (seconds) |
| RHOGRN | R*4 | 1.0 | Granularity in central body angular radius for model 7 (degrees) |

Parameters defining OABIAS calculation tolerances are as follows:

| Name | Type | Default | Description |
|---|---|---|---|
| TOLDEN | R*4 | 1.E-4 | Minimum value allowed for $S_1R_2 - S_2R_1$ in LCOMP subroutine |
| TOLDET | R*4 | 1.E-4 | Determinant singularity tolerance in LPARTS subroutine |
| DELTAT | R*4 | 10.0 | Time increment used for computing spacecraft velocity by numerical differentiation (seconds) |
| ROTLIM | R*4 | 20.0 | Declination tolerance for coordinate transformation (degrees). A rotation is performed if the absolute value of the initial declination is $<$ ROTLIM or $>$90 - ROTLIM |
| LINTOL(12) | R*8 | 12*1.D-5 | Tolerances for linearity fix (units the same as for XO) |
| GAMDEG | R*8 | -- | Not used |
| IDISK | I*4 | -- | Not used |

### 7.3.8 Description of a Sample NAMELIST

This subsection describes a sample set of input cards. The input NAMELIST parameters together with the default values are designed to first simulate a spacecraft with an infrared (IR) sensor in an elliptic orbit. The simulated data span covers 6 minutes about 1 hour after perigee. The simulated data is first processed by OASYS and then by OABIAS. This sample problem provides the printout and graphs which are described in Sections 7.12 and 7.14.

The sample NAMELISTs together with the default values are given in Section 7.3.8.1. A description of the effects of each NAMELIST is given separately in the following subsections.

#### 7.3.8.1 Sample NAMELIST

| Card Input | | Default Values Assumed |
|---|---|---|
| Column 2 | | |
| &CONTRL | | IFTABL = 96 |
| | | IFTUBE = 23 |
| | | IFTPRT = 6 |
| | | IRDART = 0 |
| | | IRDXST = 0 |
| | | GSATID = '*' |
| | | GRUNID = '*' |
| &END | | |
| &MAIN | | |
| | | ISIM = 1 |
| | NFRAME = 25 | |
| | | IREWND = 1 |
| | | OMEGA1 = 100., 0. |
| | | IREC1 = 1 |
| | | IREC2 = 99999 |



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| | Card Input | Default Values Assumed |
|---|---|---|
| | | IADD = 0 |
| | | ISKIP = 1 |
| | | IHEADR = 3 |
| | | ICBSEL = 1, 1, 0, 1 |
| | | ICNSEL = 8*1 |
| | IDISK = 51 | |
| | | NFRAM1 = 1 |
| | NFRAM2 = 25 | |
| | IEPHEM = 0 | |
| | ITERM = 0 | |
| | ICB = 0 | |
| | | TADJ = 0.0 |
| | INOISE = 2 | |
| | STDV = 4 * 0.005, 2 * 0.0 | |
| | | BIAS = 6 * 0.0 |
| | | PROB = 6 * 0.0 |
| | | IRAND = 123456789 |
| | | BGAM = 0.0 |
| | SQUANT = 0.5 | |
| | | ABETA1 = 0.0 |
| | | ABETA2 = 0.0 |
| | | OMEG1 = 0.0 |
| | | OMEG2 = 0.0 |
| &END | | |
| &LIST | ALPHA = 351. | |
| | DELTA = -20. | |
| | IATAPE = 1 | |

| Card Input | Default Values Assumed |
|---|---|
| T0 = 1974., 1., 4., 23., 4., 0. | |
| DELTAT = 15. | |
| A = 24548., 0. | |
| E = 0.73264, 0. | |
| EYE = 28.3, 0. | |
| | EMO = 0. , 0. |
| WO = 180. , 0. | |
| RANODE = 260. , 0. | |
| ORBITE = 1974., 1., 4., 22., 51., 26. | |
| | ISUN = 1 |
| ISPC = 1 | |
| | IMOON = 0 |
| | IPRINT = 0 |
| | IREPOR = 0 |
| ISKIP = 1 | |
| IFLAG = 2 | |
| SIGMA = 86. | |
| STEP = 0.0 | |
| | BIASRE = 0.0 |
| | RADE = 6378.16 |
| IOBLAT = 0 | |
| | HT = 0.0 |
| ICB = 1 | |
| | EPS = 0.0 |
| THETAC = 0.0 | |
| DANGE = -90. | |

| Card Input | Default Values Assumed |
|---|---|
| | DELPHI = 0.5 |
| | PHITOL = 0.01 |
| ERRBET = 0.25 | |
| ERRGAM = 0.1 | |
| ERRA = 0.1 | |
| ERRAD = 0.5 | |
| ERRTIM = 30. | |
| | IDEBUG = 0 |
| | TOL = 0.0001 |
| | MAXIT = 10 |
| &END | |
| &OPMAN1 | |
| | ISUN = 1 |
| ISPC = 1 | |
| | IMOON = 0 |
| TORBIT = 1974., 1., 22., 51., 26. | |
| A = 24548., 0. | |
| E = 0.73264, 0. | |
| EYE = 28.3, 0. | |
| | EMO = 0.0, 0. |
| WO = 180., 0. | |
| RANODE = 260., 0. | |
| ERRBET = 0.25 | |
| ERRGAM = 0.1 | |
| ERRA = 0.1 | |
| ERRAD = 0.5 | |
| ERRTIM = 30. | |

| Card Input | Default Values Assumed |
|---|---|
| | IDEBUG = 0 |
| IOBLAT = 0 | |
| | HT = 0.0 |
| | ABIAS1 = 0.0 |
| | ABIAS2 = 0.0 |
| | BIASRE = 0.0 |
| | RADE = 6378.16 |
| DANGE = -90.0 | |
| | BGAMMA = 0.0 |
| | IPLOT = 5 |
| | DEBUG = 8 |
| IAPIOR = 8 | |
| APRA = 350. | |
| APDEC = -19. | |
| EPSILN = 0.0 | |
| | EPS = 1.4 |
| | ATTOL = 360. |
| | TRMCHK = 0 |
| | ITMAX = 10 |
| | SPNSIG = 3. |
| | SPNTOL = 20. |
| | SRLOW = 0. |
| | SRHIGH = 1.E6 |
| | SUNLOW = 0. |
| | SUNHI = 180. |
| CBFLAG = 1 | |
| | DELPHI = 0.5 |
| | PHITOL = 0.01 |

| Card Input | Default Values Assumed |
| --- | --- |
| | DIHTOL = 10. |
| | IDISK = 0 |
| | MIN = 1 |
| | MOUT = 1 |
| | MDBL = 1 |
| | MDIH = 1 |
| | SUNSIG = 3. |
| | SUNTOL = 20. |
| ISNPRO = 1 | |
| | SUNIN = 0.0 |
| &END | |
| &BIASNL | |
| | XO = 12 * 0.0 |
| PO = 3 * 100. ,<br>9 * 10. , | |
| ATTOPT = 5 | |
| MODEL = 6 * T, F,<br>T, 2 * F | |
| RESMOD = 6 * T<br>F, T<br>2 * F | |
| REJOPT = 1 | |
| | IUPDAT = 0 |
| | NUMITR = 0 |
| REDUNT(1) = 0 | |
| | INTOUT = 0 |
| | IOBLAT = 0 |
| | ITER = 1 |
| ERUNIT = 12 | |
| IDUMPL = 4 | |



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| Card Input | Default Values Assumed |
|---|---|
| | IPLOT = 12 * 3 |
| | IDIAGN = 32 * 0 |
| IPRINT = 6 | |
| ILEVEL = 12 | |
| SANGRN = 30. | |
| STMGRN = 0.1 | |
| OAGRAN = 0.5 | |
| | TOLDEN = 1.E-4 |
| | TOLDET = 1.E-4 |
| | ROTLIM = 20. |

&END

7.3.8.2 NAMELIST CONTRL

The GESS nonresident tables will be read on FORTRAN unit number 96, and the graphic device specified on FORTRAN unit number 23 will be used (default: IFTABL = 96; default: IFTUBE = 23). GESS output will be printed on FORTRAN unit number 6 (default: IFTPRT = 6).

7.3.8.3 NAMELIST MAIN

Twenty-five frames of data (NFRAME = 25) will be simulated (default: ISIM = 1) using the constant spin rate of 100 degrees per second (default: OMEGA1 = 100., 0.). The data will be written on a device specified by FORTRAN unit number 51 (IDISK = 51). The device will be rewound prior to being written on (default: IREWND = 1).

The ephemeris data, terminator flags, and central body flags on the OABIAS data set will not be used in the OASYS and OABIAS runs (IEPHEM = 0, ITERM = 0, ICB = 0). These options will let OASYS obtain the ephemeris data and identify the central body and terminator crossings. The data will be processed once with noise (INOISE = 2) generated by the standard deviations specified by STDV(6). No biases will be added to the simulated data (default: BIAS = 6 * 0.0; default: BGAM = 0.0; default: TADJ = 0.0) , but the Sun angles will be quantized (SQUANT = 0.5).

7.3.8.4 NAMELIST LIST

This NAMELIST contains parameters specifying the simulation conditions. The data will be simulated every 15 seconds (DELTAT = 15.), starting at 2304 hours, January 4, 1974 (T0 = 1974., 1., 4., 23., 4., 0.), based on the attitude (ALPHA = 351., DELTA = 20.) read from cards (IATAPE = 1).

The Earth is the only central body considered here (ICB = 1), and the Moon position is not required (default: IMOON = 0). The spacecraft orbit will be generated by subroutine ORBGEN (ISPC = 1) using the orbit parameters A, E, EYE, EMO, WO, RANODE, and ORBITE. The Sun position will be obtained by subroutine SUN1 (default: ISUN = 1).

It is assumed that the horizon sensor has a mounting angle of 86.0 degrees (SIGMA = 86.0) and an angular field of view of 0.0 degree and that there is no cutoff angle (THETAC = 0.0). Because the sensor mounting angle is constant, STEP must be set to zero (STEP = 0.0). No bias on the angular radius of Earth is considered (default: BIASRE = 0.0). Note that all biases except BIASRE are in NAMELIST MAIN. This is because the bias on the angular radius, unlike the other biases, cannot be simply added to unbiased data.

A spherical Earth model is used (IOBLAT = 0). In this example an IR sensor is assumed so that the terminator has no influence. In order to ensure both horizon in- and out-triggerings, the dark angle of Earth must be set to -90.0 degrees (DANGE = -90). The IR sensor is assumed to trigger at the surface of Earth; i.e., the effective height of atmosphere layer is zero (default: HT = 0.0).

The expected quality of the attitude solutions obtained by OASYS will be printed out in terms of the uncertainty in the attitude caused by uncertainties in Sun angle, sensor mounting angle, rotation angle, angular radius of Earth, and absolute time of horizon crossing (ERRBET = 0.25, ERRGAM = 0.1, ERRA = 0.1, ERRAD = 0.5, ERRTIM = 30.).

7.3.8.5 NAMELIST OPMAN1

This NAMELIST contains parameters specifying the processing options for the OASYS Subsystem.

The spacecraft orbit and the Sun position will be obtained in the same way as in the simulation (default: ISUN = 1, ISPC = 1; default: IMOON = 0). The orbit parameters, A, E, EYE, EMU, WU, RANODE, and TORBIT, should be the same as those in NAMELIST LIST. Note that the epoch time here is denoted by TORBIT while ORBITE is used in LIST.

The computation of the uncertainty in the determined attitude will be based on the uncertainty in the Sun angle, sensor mounting angle, rotation angle, angular radius of the Earth, and absolute time of the horizon crossing (ERRBET = 0.25, ERRGAM = 0.1, ERRA = 0.1, ERRAD = 0.5, ERRTIM = 30.).

As in the simulation, the spherical Earth model with zero effective atmosphere layer and a dark angle of -90.0 degrees will be used (IOBLAT = 0; default: HT = 0.0; DANGE = -90.). No bias adjustment will be made in determining the attitude (default: ABIAS2 = 0.0; default: BIASRE = 0.0, default: BGAMMA = 0.0).

As in the simulation, only the Earth will be considered as a central body (CBFLAG = 1). The Sun angles will not be smoothed (ISNPRO = 1). Note that the Sun angles in this example problem are quantized as described in LIST.

All four attitude determination methods, the single horizon-in and horizon-out, double horizon width, and double horizon dihedral method, will be processed to determine the attitude (default: MIN = 1; default: MOUT = 1; default: MDBL = 1; default: MDIH = 1). The a priori attitude is used first to resolve all ambiguities (APRA = 350., APDEC = 19., IAPIOR = 8). All solutions will be included prior to the block averaging (default: ATTOL = 360.). An attitude will be rejected if it deviates from the block average by more than 20 degrees or by more than 3 times the computed standard deviation (default: SPNTOL = 20.; default: SPNSIG = 3.). The attitudes, uncertainties, nadir angles, and dihedral angles obtained from the four attitude methods will be plotted by the line-printer (IPLOT = 5).

7.3.8.6 NAMELIST BIASNL

This NAMELIST contains parameters specifying processing options for the OABIAS Subsystem. In this sample problem, the user is assumed to have no a priori estimate of the attitude and biases. The best choice, then, is ATTOPT = 5, which allows OABIAS to use the block average attitude from OASYS as the initial estimate. Zero bias will be used as the initial estimate (default: XO = 12 * 0.0). The initial estimate of the uncertainties will be given by PO. All 12 elements of the state vector will be corrected. Note that PO(J) = 0.0 restricts Jth component of the state vector to its initial value.

All models but the small target nadir angle model will be processed, and the residuals for each model will be computed (MODEL = 6 * T, F, T, 2 * F, RESMOD = 6 * T, F, T, 2 * F). Generally, updating the state vector after processing each observation (default: IUPDAT = 0) with no iteration (default: NUMITR = 0) gives the best results. Since the spherical Earth model is used in simulation, the use of that model is appropriate (default: IOBLAT = 0). Usually, the attitude estimated by OASYS is sufficiently close to the true state, unless unexpectedly large biases are present. The linearity fix, then, is not necessary (default: ITER = 1). The data rejected in each model by the block averaging in OASYS will be rejected in processing of the corresponding model (REJOPT = 1) in OABIAS.

The printout will include the state vector, uncertainties, partial derivatives vector, gain vectors, observation and weight, and the statistics of the residuals (ILEVEL = 12) on FORTRAN units numbered 6, 7, 8, 9, 10, 11, respectively (IPRINT = 6). Both the state vector and uncertainties will be plotted (default: IPLOT = 12 * 3) on FORTRAN unit number 6 (IPRINT = 6). Note that the residuals for a model will be plotted on FORTRAN unit number 6 (IPRINT = 6) if the corresponding array element of RESMOD is true. A line of printout will occur for every observation, and a point will be plotted at every frame (default: INTOUT = 0). The error messages and error summary table will be printed (IDUMPL = 4) on FORTRAN unit number 12 (ERUNIT = 12). No diagnostic printout will be generated (default: IDIAGN = 32 * 0).

The granularities required for each model are shown below:

| Model | Granularity Required |
|---|---|
| Sun angle model | SANGRN |
| Sun time model | STMGRN |
| Nadir vector projection model | OAGRAN |
| Horizon time model | OAGRAN |
| Single horizon dihedral angle model | STMGRN, OAGRAN |
| Double horizon scan width model | OAGRAN |
| Small target nadir angle model | RHOGRN |
| Scan midtime dihedral angle model | STMGRN, OAGRAN |

Since all models but the small target nadir angle model will be processed, all granularities but RHOGRN are required (SANGRN = 30., STMGRN = 0.1, OAGRAN = 0.5).

When any two vectors of the horizon vector, $\hat{L}_H$ ; spin axis vector, $\hat{S}$ ; and spacecraft position vector, $\hat{R}$ , are either nearly parallel or nearly antiparallel, a singularity in computing the partial derivatives of $\hat{L}_H$ is encountered. Whenever the estimate and geometry result in a matrix whose determinant is less than TOLDET, the processing of that observation is terminated (default: TOLDET = 1. E-4). TOLDET is required for the horizon time model, single horizon dihedral angle model, and double horizon scan with model.

The G.I. coordinate system will be rotated if the absolute value of the initial estimate of the declination of the spin axis is less than 20 degrees or between 70 and 90 degrees (default: ROTLIM = 20.).

The NAMELIST parameters that have no effect in this sample problem are CONVRG, RHOGRN, DELTAT, and LINTOL. If an iteration on each state update is needed (NUMITR $\neq$ 0), CONVRG is required. If the linearity fix is attempted (ITER > 1), LINTOL is required. If the correction of the in-track time error is required and the central body is the moon, DELTAT must be specified.

## 7.4 OABIAS DATA SET

The OABIAS data set is written by the Radio Astronomy Explorer-B (RAE-B) Attitude Determination System or written by the OASYS Subsystem running under the SSS-A, SMS-A, or IMP-J Attitude Determination Systems. In a simulation mode, the simulator within MSAD/OABIAS also writes a data set in this format. For the AE spacecraft, the subroutine AECOPY copies the AE data set into this format.

The data set consists of one or more blocks of data, with each block preceded by a pair of header records. Each block of data consists of one or more frames; each frame consists of two records, an in-triggering followed by an out-triggering.

The data set is a FORTRAN A-format data set (i.e., all parameters are read and written in an A format); it resides on FORTRAN unit IDISK, where IDISK is a parameter in NAMELIST MAIN (default value = 50).

The two 50-byte header records which precede each block of data are as follows:

Record 1:

| Name | Description | Type |
|---|---|---|
| IHFLAG | Header flag = -999 | I*2 |
| TREF | Current time of job running (local time) (year, month, day, hours, minutes, seconds) | R*8 |
| TFIRST | Time of first sample (UT: seconds from 0 hours, September 1, 1957) | R*8 |
| THE[1] (1) | Upper SAS zenith reference angle from +Z (degrees) | R*4 |
| (2) | Lower SAS zenith reference angle from +Z (degrees) | R*4 |
| (3) | PAS1 null zenith reference angle from +Z (degrees) | R*4 |
| (4) | PAS2 null zenith reference angle from +Z (degrees) | R*4 |
| PAD (1) | Padding (ignored) | R*8 |
| (2) | Padding (ignored) | R*8 |

Record 2:

| Name | Description | Type |
|---|---|---|
| NSAMP | Number of samples = number of data records following this header | I*2 |
| PHI[1] (1) | Upper SAS azimuth reference angle from +X (degrees) | R*4 |
| (2) | Lower SAS azimuth reference angle from +X (degrees) | R*4 |
| (3) | PAS1 null azimuth reference angle from +X (degrees) | R*4 |
| (4) | PAS2 null azimuth reference angle from +X (degrees) | R*4 |

[1] Applies to RAE-B spacecraft only.

| Name | Description | Type |
|---|---|---|
| PHI[1] (5) | PAS1 Sun azimuth reference angle from +X (degrees) | R*4 |
| (6) | PAS2 Sun azimuth reference angle from +X (degrees) | R*4 |
| RHOEB | Bias on Earth angular radius (degrees) | R*4 |
| RHOMB | Bias on Moon angular radius (degrees) | R*4 |
| PAD (1) | Padding (ignored) | R*8 |
| (2) | Padding (ignored) | R*8 |

The 50-byte data records (always occurring in pairs) which constitute each frame on a block of data are as follows:

| Name | Description | Type |
|---|---|---|
| INVERT[1] | Inversion flag:<br>= 0, normal<br>= 1, inverted | I*2 |
| TTRIG | Time of horizon triggering (UT: seconds from 0 hours, September 1, 1957) | R*8 |
| BETA | Sun angle (degrees) (0-180) | R*4 |
| GAM | Sensor mounting angle (degrees) (0-180) | R*4 |
| RPM | Spin rate (revolutions per minute) | R*4 |
| A | Dihedral angle from Sun to horizon (degrees) (0-360) | R*4 |
| PASPHI[1] | Phase angle used in computing A (degrees) (0-360) | R*4 |
| RMINUS (3) | Unit vector from spacecraft to center of central body, inertial coordinates | R*4 |
| RMAG | Distance from spacecraft to center of central body (kilometers) | R*4 |
| KCNFLG | Configuration flag (see note below) | I*2 |

[1] Applies to RAE-B spacecraft only.

| Name | Description | Type |
|---|---|---|
| CBPAS | Central body indicator:<br>= E, Earth<br>= M, Moon<br>= S, Sun (central body vector ignored)<br>= U, unknown (central body vector ignored) | L*1 |
| HORTER | Horizon terminator indicator:<br>= H, horizon<br>= T, terminator<br>= U, unknown | L*1 |

NOTE: For the RAE-B spacecraft, the configuration flag is defined as follows:

| KCNFLG | Sun Angle | Sun Sensor Used for Sun Triggering | Horizon Sensor Used |
|---|---|---|---|
| = 1 | <90 | SAS | PAS1 |
| = 2 | <90 | SAS | PAS2 |
| = 3 | <90 | PAS1 | PAS1 |
| = 4 | <90 | PAS2 | PAS2 |
| = 5 | >90 | SAS | PAS1 |
| = 6 | >90 | SAS | PAS2 |
| = 7 | >90 | PAS1 | PAS1 |
| = 8 | >90 | PAS2 | PAS2 |

For the AE spacecraft, the configuration flag is defined as follows:

= 1, wheel horizon sensor 1, gimbal Sun sensor
= 2, wheel horizon sensor 2, gimbal Sun sensor
= 3, body horizon sensor 1 or 2, digital Sun sensor

For all other spacecraft, the configuration flag is fixed at 1.

## 7.5 AE DATA SET

The AE input data set is written by the AE-C Attitude Determination System. This data set can be accessed only through the use of subroutine RDBUFF from the AE libraries. See Reference 14 for a description of this data set. The AE input data set is read from FORTRAN unit number IAEUN, a parameter in NAMELIST MAIN.

Not all of the data brought in to subroutine AECOPY is used in OABIAS processing. Since some of the data which is not used is of interest in modeling the performance of the bolometer for the AE wheel mounted sensors, the option exits to write wheel horizon sensor data on FORTRAN unit number IBOLOU. IBOLOU is a parameter in NAMELIST MAIN. The AE bolometer data set consists of one or more frames of data with each frame in the following format:

| Name | Description | Type |
|---|---|---|
| WHSTIM | Wheel horizon sensor triggering time for each frame (UT: seconds from 0 hour, September 1, 1957) | R*8 |
| EW1 | Earth width times for wheel horizon sensor 1 (seconds) | R*4 |
| EW2 | Earth width times for wheel horizon sensor 2 (seconds) | R*4 |
| SI | Split-to-index pulse times (seconds) | R*4 |
| WHSSP | Wheel spin period for each frame (seconds) | R*4 |
| WHSFLG | Wheel horizon sensor flag:<br>= 0, (EBCDIC) good frame<br>≠ 0, bad frame | L*1 |

## 7.6 JPL LUNAR AND SOLAR EPHEMERIS FILE

The JPL ephemeris file contains lunar and solar ephemeris information accessed by subroutine RJPLT. The file is required if the parameter ISUN = 3 or IMOON = 3 in NAMELIST LIST or OPMAN1. (See Sections 7.3.5 and 7.3.6.) The FORTRAN unit number is specified by the parameter NRJPLT in NAMELIST LIST or OPMAN1 (default value = 28).

See Reference 5 for a description of this data set.

## 7.7 SUNRD LUNAR AND SOLAR EPHEMERIS FILE

The SUNRD ephemeris file contains lunar and solar ephemeris data accessed by subroutine SUNRD. The file is required if the parameter ISUN = 2 or

IMOON = 2 in NAMELIST LIST or OPMAN1. (See Sections 7.3.5 and 7.3.6.) The FORTRAN unit number for the file is 14.

See Appendix B in Volume 1 for a description of this data set.

## 7.8 GTDS SPACECRAFT EPHEMERIS FILE

The GTDS ephemeris file contains spacecraft ephemeris data accessed by subroutine GETHDR/GETVCT. The file is required if the parameter ISPC = 3 in NAMELIST LIST or OPMAN1. (See Sections 7.3.5 and 7.3.6.) If the parameter LEVEL = 0, then the FORTRAN unit number is specified by the parameter NGTDS (default value = 29); if LEVEL $\neq$ 0, the FORTRAN unit number is 31.

See Reference 4 for a description of this data set.

## 7.9 DODS SPACECRAFT EPHEMERIS FILE

The DODS ephemeris file contains spacecraft ephemeris data accessed by DTAPRE (an entry point of RO1TAP). The file is required if ISPC = 2 or 5 in NAMELIST LIST or OPMAN1. (See Sections 7.3.5 and 7.3.6.) The FORTRAN unit number is specified by the parameter NORB1 (default value = 30).

See Reference 3 for a description of this data set.

## 7.10 SPACECRAFT ATTITUDE TAPE

The spacecraft attitude tape is a standard Multisatellite Attitude Prediction (MSAP) attitude data set which is used by the simulator to simulate a spacecraft with a slowly varying attitude. This data set is required if the parameter IATAPE = 0 in NAMELIST LIST. The FORTRAN unit number for the attitude tape is 12.

See Reference 20 for a description of this data set.

## 7.11 GESS NONRESIDENT TABLES

The GESS nonresident tables reside on a partitioned data set and contain the display tables which describe each GESS display in the system. The tables are accessed one at a time by the GESS Executive as required. The FORTRAN unit number is specified by parameter IFTABL in NAMELIST CONTRL (default value = 96).

See Reference 13 for a description of this data set.

## 7.12 PRINTED OUTPUT

Printed output is generated by the GESS Executive, the OADRIV control module, the Optical Aspect Determination Prediction (ODAP) Subsystem, the OASYS Subsystem, and the OABIAS Subsystem.

Printed output may be generated on FORTRAN unit numbers 6, 9, 10, 94, and 95, plus the unit numbers specified by the parameters IFTPRT (in NAMELIST CONTRL), ERUNIT (in NAMELIST BIASNL), and IPRINT through IPRINT + 5 (in NAMELIST BIASNL). Thus if IFTPRT = ERUNIT = IPRINT = 6, then units 6, 7, 8, 9, 10, 11, 94, and 95 may be used. The following data definition (DD) card is required for each unit:

```
//FT xx F001 DD SYSOUT = A, DCB = (RECFM = VBA,
//         LRECL = 137, BLKSIZE = 7265, BUFNO = 1)
```

The block size for each data set should be chosen to optimize input/output (I/O) time and core requirements based on the amount of printout expected for each unit. A DUMMY DD card should be provided for any unit number from which printout is not desired.

### 7.12.1 <u>Printed Output From the GESS Executive</u>

Printed output from the GESS Executive consists of a listing of the parameters in NAMELIST CONTRL (see Figure 7-1) on FORTRAN unit IFTPRT. The

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```
                         NAMELIST/CONTRL/

IFTABL = 96          FORTRAN UNIT NUMBER FOR DISPLAY TABLES

IFTUBE = 23          FORTRAN UNIT NUMBER FOR THE GRAPHICS DEVICE

IFTPRT =  6          FORTRAN UNIT NUMBER FOR THE PRINTER

IRDART =  0          EQ 1, READ IN MASTER NUMBERS
                     NE 1, DO NOT READ IN MASTER NUMBERS

IRDXST =  0          EQ 1, READ IN DISPLAY STATUS FLAGS
                     NE 1, DO NOT READ IN DISPLAY STATUS FLAGS

IDIREC =  0          EQ 0, DO NOT READ IN DIRECTORY ARRAYS
                     NE 0, READ IN DIRECTORY ARRAYS

IRDTPD =  0          EQ 0, DO NOT READ NAMELIST/TPDSET/
                     NE 0, READ NAMELIST/TPDSET/

NUMSUB =  3          NUMBER OF MAJOR SUBSYSTEMS

NUMCNC =  0          NUMBER OF CONVERSION AND CORRECTION ROUTINES

NUMSCA =  0          NUMBER OF SPECIAL CAPABILITY ROUTINES

KOFFEE =  0          EQ 0, TERMINATE AFTER FINE ATTITUDE
                     EQ 1, RECYCLE TO TELEMETRY PROCESSING

GSATID = ********    SATELLITE IDENTIFICATION

GRUNID = ********    RUN IDENTIFICATION

IRMON  =  9          MONTH OF REFERENCE DATE

IRDAY  =  1          DAY OF REFERENCE DATE

IRYEAR = 1957        YEAR OF REFERENCE DATE
```

Figure 7-1. NAMELIST CONTRL



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only other printout from GESS consists of printed copies of character displays; see Section 7.14 for examples of these displays.

In addition, the GESS Executive will generate a core dump on the data set SYSPRINT if the MSAD/OABIAS System abends in a graphics mode and the GESS Executive is able to intercept the abend. A DUMMY DD card can be provided for this data set to minimize the time required to recover from an abend in the graphic mode.

### 7.12.2 Printed Output From OADRIV

The only printed output from OADRIV consists of a listing of the parameters in NAMELIST MAIN on FORTRAN unit 6 (see Figure 7-2). In a nongraphic mode, this printout is generated following the reading of each new set of NAMELIST parameters for NAMELIST MAIN; in a graphic mode this printout is generated following each display at which the operator could have changed any parameters in NAMELIST MAIN.

### 7.12.3 Printed Output From the ODAP Subsystem

Printed output from ODAP includes all printout described in Reference 20.

### 7.12.4 Printed Output From the OASYS Subsystem

Printed output from OASYS includes all printout described in Reference 8, with the exception of the printout from GCONES.

### 7.12.5 Printed Output From the OABIAS Subsystem

The printed output of OABIAS results consists of tables and plots of the state vector, other quantities relevant to the recursive estimator, and the statistics. The printout is controlled by the NAMELIST parameters, ILEVEL, IPRINT, IDUMPL, ERUNIT, INTOUT, and IPLOT(12). The printout generated by OABIAS in the sample problem (Section 7.3.8) is shown in Figures 7-3 through 7-18.

```
                                        MSAD/OABIAS  --  VERSION SMS-8,10-10-74
&MAIN
ISIM=           1,NFRAME=        25,OMEGA1=  100.00000   , 0.0         ,TOMEGA= 0.0          , 0.0          , 0.0          ,
 0.0            , 0.0           , 0.0         ,PROB= 0.0      , 0.0           , 0.0           , 0.0
 0.0            , 0.0           ,STDV= 0.0    , 0.49999985E-03, 0.49999985E-03, 0.49999985E-03, 0.0          ,
 0.99999964E-01,BIAS= 0.0                      , 0.0           , 0.0           , 0.0           , 0.0          ,
          2,IRAND=  123456789,IREC1=          1,IREC2=        99999,IADD=           0,ISKIP=          1,NFRAM1=      ,INOISE=
       130,ICBSEL=           1,           1,           0,           1,ICNSEL=      1,          1,           1,            1,NFRAM2=
         1,           1,           1,           1,IHEADR=        3,IDISK=       51,IREWND=           1,IEPHEM=          1,
         0,ICB=            1,TADJ= 0.0         ,BGAM=  1.0000000     ,SQUANT= 0.0        ,IBLK1=           1,IBLK2=    0,ITERM=
IAEUN=          50,ICSKIP=          1,AESENS=  104.39200   ,  118.31699    ,  109.94800   ,  109.94800   ,ABETA1= 0.0     99999,
ABETA2= 0.0              ,TBETA= 0.0          , 0.0          , 0.0          , 0.0          , 0.0          , 0.0          ,
IBSKIP=          1,BHSREF= 0.0          ,CMEG1= 0.0         ,OMEG2= 0.0        ,TOMEG= 0.0        , 0.0          ,
 0.0            , 0.0           , 0.0         , 0.0          ,ISUNSP=          0,OLDRPM= 0.0     ,IXXIXX=        0,
PERIOD= 0.0                     ,BNDWTH= 0.0          ,TREF6= 0.0          , 0.0           , 0.0          , 0.0          ,
 0.0            , 0.0           ,ISTATE=          1,          2,          0,ALF=  79.925735  ,  80.018539  , 0.0          ,DEL=
-21.657455      , -21.591095    , 0.0         ,BATA=  48.894196    ,  48.875458    , 0.0          ,PHI1=  215.36304    ,
 215.46251      , 0.0           ,BSIGMA= -1.0113297   , 0.0          , 0.0          ,BRHO=-0.35249997E-01, 0.0          ,
 0.0            ,BA1= 0.0       , 0.0          , 0.0          ,BA2= 0.0          , 0.0          , 0.0          ,BTIME=
 0.0            , 0.0           , 0.0          ,ICENT=          1,          1,          1,RADE=  6378.1563    ,  6378.1563    ,
 6378.1563      ,RADM=  1738.0000   ,  1738.0000   ,  1738.0000   ,DANGE= -90.000000   , -90.000000   , -90.000000   ,DANGM=
 89.699997      ,  89.699997    ,  89.699997   ,IOBLAT=          1,          1,          1,HT=  37.599991    ,  37.599991    ,
 37.599991      ,IPSKIP=          1,          1,IWIDTH=          0,ITIME=          0,STARTT= 0.0          ,
 0.0            , 0.0           , 0.0          , 0.0          , 0.0          ,ENDT= 0.0          , 0.0          ,
 0.0            , 0.0           , 0.0          , 0.0          ,NPTS=          0,IORBC=          1,          1,ISAME=
          1,IDATA=          1,SVSTAT=         11,         22,          0,ISAVTM=         0,OMEGAF=-0.17305563E 20,NRPF=    1,
IPLOT=          1,IEFMFG=          0,IBOLOF=          0,IBOLOU=      49
&END
```

Figure 7-2. NAMELIST MAIN

7.12.5.1 Input to OABIAS Table

The input to OABIAS is printed on FORTRAN unit number IPRINT. At the beginning of each pass through OABIAS, all necessary parameters in BIASNL are printed. This printout can be eliminated by setting ILEVEL to zero. Figure 7-3 shows the input to OABIAS table generated by the sample problem.

7.12.5.2 OABIAS Attitude Summary--Heading Definition

The definition of the column headings of subsequent tables is printed on FORTRAN unit number IPRINT when ILEVEL is greater than 0 . Figure 7-4 shows an example of this table.

7.12.5.3 Attitude and State Vector Table

The attitude and state vector table includes the attitude and biases estimated at each frame and the final estimate of the uncertainties. This table is printed on FORTRAN unit number IPRINT when ILEVEL is greater than or equal to 2. The first and last pages of this table generated in the sample problem are shown in Figure 7-5. Note that the right ascension and declination of the spin axis are printed rather than the state vector components, $S_1$ and $S_2$ .

7.12.5.4 Uncertainty Table

The uncertainty table includes the square root of each diagonal element of the covariance matrix, P (uncertainty), estimated at each frame. This table is printed on FORTRAN unit number IPRINT + 4 when ILEVEL is greater than or equal to 4. Figure 7-6 shows the uncertainty table generated in the sample problem. Note that the uncertainty in the right ascension and declination are printed rather than those in the state vector components, $S_1$ and $S_2$.

7.12.5.5 Partial Derivative Table

The partial derivative table includes the partial derivatives, G , of the observation with respect to each element of the state vector evaluated at each frame.

```
***   INPUT TO OABIAS FOR BLOCK  1  PASS NO.  1   ***                                   PAGE 1
           (VERSION 4.1 --- OCT 1973)
                            (1)           (2)

                            INITIAL STATE ESTIMATES
XO(1)    =  0.35114477540D 03   DEGREES(RIGHT ASCENSION)
XO(2)    = -0.19975980470D 02   DEGREES(DECLINATION)
XO(3)    =  0.0                 PHASE WILL BE COMPUTED BY THE PROGRAM
XO(4)    =  0.0                 DEGREES(HORIZON SENSOR MOUNTING ANGLE)
XO(5)    =  0.0                 DEGREES(HORIZON SENSOR AZIMUTH EARTH-IN)
XO(6)    =  0.0                 DEGREES(HORIZON SENSOR AZIMUTH EARTH-OUT)
XO(7)    =  0.0                 DEGREES(BIAS ON ANGULAR RADIUS OF THE EARTH)
XO(8)    =  0.0                 DEGREES(BIAS IN SUN ANGLE)
XO(9)    =  0.0                 THE AVERAGE SPIN RATE WILL BE COMPUTED BY THE PROGRAM
XO(10)   =  0.0                 DEGREES(SUN SENSOR SLIT PLANE TILT ANGLE)
XO(11)   =  0.0                 DEGREES(BIAS IN EPSILON)
XO(12)   =  0.0                 SECONDS(IN-TRACK TIME ADJUSTMENT)

                                ESTIMATES OF UNCERTAINTY IN INITIAL STATE ESTIMATE
PO(1)    =  0.10000000000D 03   DEGREES(ERROR IN XO(1))
PO(2)    =  0.10000000000D 03   DEGREES(ERROR IN XO(2))
PO(3)    =  0.10000000000D 03   DEGREES(ERROR IN XO(3))
PO(4)    =  0.10000000000D 02   DEGREES(ERROR IN XO(4))
PO(5)    =  0.10000000000D 02   DEGREES(ERROR IN XO(5))
PO(6)    =  0.10000000000D 02   DEGREES(ERROR IN XO(6))
PO(7)    =  0.10000000000D 02   DEGREES(ERROR IN XO(7))
PO(8)    =  0.10000000000D 02   DEGREES(ERROR IN XO(8))
PO(9)    =  0.10000000000D 02   RPM(ERROR IN XO(9))
PO(10)   =  0.10000000000D 02   DEGREES(ERROR IN XO(10))
PO(11)   =  0.10000000000D 02   DEGREES(ERROR IN XO(11))
PO(12)   =  0.10000000000D 02   SECONDS(ERROR IN XO(12))

                            PROCESSING OPTIONS
ATTOPT   =  5                   BLOCK AVERAGE ATTITUDE AND PO WILL BE USED
REJCPT   =  1                   HORIZON CROSSINGS WILL BE REJECTED BY REJ
IUPDAT   =  0                   THE STATE VECTOR WILL BE UPDATED AFTER EACH MODEL HAS BEEN PROCESSED
NUMITR   =  0                   THERE WILL BE NO ITERATION

ROTLIM   =  20.00               ROTATION LIMIT. IF ABS(DELTA) LT ROTLIM OR GT (90-ROTLIM), ROTATE COORDINATES
ITER     =  1                   THERE WILL BE NO LINEARITY FIX
```

1 DATA BLOCK NUMBER TO BE PROCESSED
2 NUMBER OF OABIAS RUNS ON THIS BLOCK

Figure 7-3. Input to OABIAS Table (1 of 3)

```
***    INPUT TO OABIAS FOR BLOCK  1 PASS NO.  1    ***
          (VERSION 4.1 --- OCT 1973)

                 PROCESSING OPTIONS (CONTINUED)

SANGRN     =  0.300000E 02      SUN ANGLE GRANULARITY
STMGRN     =  0.100000E 00      SUN TIME GRANULARITY
CAGRAN     =  0.500000E 00      CA TIME GRANULARITY
RHOGRN     =  0.200000E 01      WEIGHTING FACTOR FOR SMALL TARGET MODEL

DELTAT     =  0.100000D 02      TIME INCREMENT FOR COMPUTING VELOCITY(SEC)

TOLDEN     =  0.100000E-03      MINIMUM ALLOWED VALUE FOR THE DENOMINATOR,*S1R2-S2R1* IN *LCOMP*
TOLDET     =  0.100000E-03      DETEMINANT SINGULARITY TOLERANCE FOR *LPARTS*

IOBLAT     =  0                 USE SPHERICAL EARTH MODEL


MODEL(1)   =     T              PROCESS SUN ANGLE
MODEL(2)   =     T              PROCESS SUN SIGHTING TIME
MODEL(3)   =     T              PROCESS NADIR PROJECTION
MODEL(4)   =     T              PROCESS HORIZON CROSSING TIME
MODEL(5)   =     T              PROCESS DIHEDRAL ANGLE
MODEL(6)   =     T              PROCESS EARTH-WIDTH
MODEL(7)   =     F              PROCESS SMALL TARGET
MODEL(8)   =     T              PROCESS MID-TIME DIHEDRAL ANGLE MODEL
MODEL(9)   =     F
MODEL(10)  =     F


RESMOD(1)  =     T              COMPUTE SUN ANGLE RESIDUAL
RESMOD(2)  =     T              COMPUTE SUN SIGHTING TIME RESIDUAL
RESMOD(3)  =     T              COMPUTE NADIR PROJECTION RESIDUAL
RESMOD(4)  =     T              COMPUTE HORIZON CROSSING TIME RESIDUAL
RESMOD(5)  =     T              COMPUTE DIHEDRAL ANGLE RESIDUAL
RESMOD(6)  =     T              COMPUTE EARTH WIDTH RESIDUAL
RESMOD(7)  =     F              COMPUTE SMALL TARGET RESIDUAL
RESMOD(8)  =     T              COMPUTE DIHEDRAL ANGLE (MID-TIME) RESIDUAL
RESMOD(9)  =     F
RESMOD(10) =     F
```

Figure 7-3. Input to OABIAS Table (2 of 3)

```
***    INPUT TO OABIAS FOR BLOCK  1 PASS NO.  1    ***
              (VERSION 4.1 --- OCT 1973)

REDUNT                             ARRAY OF UNIT NUMBERS FOR READING ADDITIONAL NAMELIST
                                   EACH ELEMENT CORRESPONDS TO THE BLOCK OF DATA.
                                   IF =0, DO NOT READ AN ADDITIONAL BLOCK
                                   IF =N, READ AN ADDITIONAL NAMELIST ON UNIT N
REDUNT( 1)=  0  REDUNT( 2)=  0  REDUNT( 3)=  0  REDUNT( 4)=  0  REDUNT( 5)=  0
REDUNT( 6)=  0  REDUNT( 7)=  0  REDUNT( 8)=  0  REDUNT( 9)=  0  REDUNT(10)=  0

INTOUT     =   0                   RESULTS WILL BE PRINTED AFTER EACH MODEL HAS BEEN PROCESSED
IPRINT     =   6                   UNIT NUMBER FOR RESULTS PRINTOUT
ILEVEL     =  12                   RESULTS PRINTOUT LEVEL CONTROLER
IDISK      =   0                   UNIT NUMBER FOR ARCHIVING DATA. IN THIS CASE, NO DATA WILL BE ARCHIVED
ERUNIT     =   4                   UNIT NUMBER FOR PRINTING ERROR MESSAGES
IDUMPL     =   4                   ERROR MESSAGES WILL BE PRINTED

                                   ***  DIAGNOSTIC OUTPUT LEVEL SPECIFIERS  ***
IDIAGN( 1)= 0 (AMATRX),   IDIAGN( 2)= 0 (APAPTS),   IDIAGN( 3)= 0 (BIASER),   IDIAGN( 4)= 0 (DIAFUN)
IDIAGN( 5)= 0 (DIAMOD),   IDIAGN( 6)= 0 (FRAFRC),   IDIAGN( 7)= 0 (INITIL),   IDIAGN( 8)= 0 ( LCOMP)
IDIAGN( 9)= 0 ( LNFUN),   IDIAGN(10)= 0 ( LNMOD),   IDIAGN(11)= 0 (LPARTS),   IDIAGN(12)= 0 ( LRFUN)
IDIAGN(13)= 0 ( LRMOD),   IDIAGN(14)= 0 (OABIAS),   IDIAGN(15)= 0 ( PRINT),   IDIAGN(16)= 0 (PSIPHA),
IDIAGN(17)= 0 (RECURS),   IDIAGN(18)= 0 (ROTATE),   IDIAGN(19)= 0 (SANFUN),   IDIAGN(20)= 0 (SANMOD)
IDIAGN(21)= 0 (STMFUN),   IDIAGN(22)= 0 (STMMOD),   IDIAGN(23)= 0 (CHFUN ),   IDIAGN(24)= 0 (DFMOD ),
IDIAGN(25)= 0 (SCBFUN),   IDIAGN(26)= 0 (SCBMOD),   IDIAGN(27)= 0 (      ),   IDIAGN(28)= 0 (      ),
IDIAGN(29)= 0 (      ),   IDIAGN(30)= 0 (      ),   IDIAGN(31)= 0 (      ),   IDIAGN(32)= 0 (      ),

IPLOT                              ARRAY OF PLOT OPTION
                                   EACH ELEMENT CORRESPONDS TO STATE VECTOR ELEMENT
                                   IF =0, DO NOT PLOT STATE VECTOR OR UNCERTAINTIES
                                   IF =1, PLOT THE STATE VECTOR ONLY
                                   IF =2, PLOT UNCERTAINTIES ONLY
                                   IF =3, PLOT BOTH STATE VECTOR AND UNCERTAINTIES
IPLOT( 1) =  3
IPLOT( 2) =  3
IPLOT( 3) =  3
IPLOT( 4) =  3
IPLOT( 5) =  3
IPLOT( 6) =  3
IPLOT( 7) =  3
IPLOT( 8) =  3
IPLOT( 9) =  3
IPLOT(10) =  3
IPLOT(11) =  3
IPLOT(12) =  3
```

Figure 7-3.  Input to OABIAS Table (3 of 3)



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```
                         O A B I A S   A T T I T U D E   S U M M A R Y

HEADING DEFINITION

           ALPHA     RIGHT ASCENSION OF THE SPIN AXIS
           DELTA     DECLINATION OF THE SPIN AXIS
           PSIO      INITIAL PHASE OF THE SUN SENSOR        (IN SPIN INERTIAL SYSTEM)
           DELTAG    BIAS ON THE OPTICAL TELESCOPE MOUNTING ANGLE
           PHIIH     AZIMUTH OF THE OPTICAL TELESCOPE       (RELATIVE TO THE SUN SENSOR ON EARTH-IN)
           PHIOH     AZIMUTH OF THE OPTICAL TELESCOPE       (RELATIVE TO THE SUN SENSOR ON EARTH-OUT)
           DELRHO    BIAS ON THE ANGULAR RADIUS OF THE EARTH
           THEAO     SUN BIAS ANGLE
           OMEGA     SPIN RATE
           EPSS      SUN SENSOR SLIT PLANE TILT
           EPSH      PAS SENSOR TILT
           DELTIM    IN-TRACK TIME ADJUSTMENT
           K         RECURSIVE ESTIMATOR GAIN MATRIX ELEMENT
           G         PARTIAL OF OBSERVATION WITH RESPECT TO THE STATE VARIABLE
           Y         OBSERVATION
           YC        CALCULATED OBSERVATION
           Z         OBSERVATION RESIDUAL                   (Y-YC)
           W         OBSERVATION WEIGHT
           TYPE

                     =1.   SUN ANGLE MODEL
                     =2.   SUN TIME MODEL
                     =3.   NADIR VECTOR PROJECTION MODEL
                     =4.   HORIZON TIME MODEL
                     =5.   SINGLE HORIZON DIHEDRAL ANGLE MODEL
                     =6.   DOUBLE HORIZON SCAN WIDTH MODEL
                     =7.   SMALL TARGET NADIR ANGLE MODEL
                     =8.   SCAN MID-TIME DIHEDRAL ANGLE MODEL
                     =11.  AT END OF FRAME
                     =12.  AT END OF EACH ITERATION
                     =13.  AT COMPLETION OF ITERATION
                     =14.  AT END OF BLOCK
```

Figure 7-4. OABIAS Attitude Summary--Heading Definition



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OABIAS SUMMARY OUTPUT FOR 74/ 1/ 4 (1)
ATTITUDE AND STATE VECTOR TABLE
BLOCK 1 PASS NO. 1

| TIME HH/MM/SS (2) | FRAME NUM (3) | TYP | ALPHA DEG | DELTA DEG | PSIO DEG | DELTAG DEG | PHIIH DEG | PHIOH DEG | DELRHO DEG | THEAD DEG | OMEGA RPM (4) | EPSS DEG | EPSH DEG | DELTAM SEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | 351.145 | -19.980 | 52.043 | 0.0 | 0.0 | 0.0 | 0.0 | -0.000 | 16.667 | 0.0 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 2 | 351.145 | -19.980 | 52.043 | 0.0 | 0.0 | 0.0 | 0.0 | -0.000 | 16.667 | 0.000 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 3 | 350.997 | -19.514 | 52.007 | 0.006 | 0.0 | 0.006 | -0.009 | -0.004 | 16.668 | 0.004 | -0.000 | 0.0 |
| 23/ 4/ 3 | 1 | 4 | 350.904 | -19.226 | 51.984 | 0.010 | 0.0 | 0.011 | -0.014 | -0.007 | 16.669 | 0.006 | -0.001 | 0.0 |
| 23/ 4/ 3 | 1 | 5 | 350.877 | -19.144 | 51.977 | 0.011 | 0.0 | 0.012 | -0.016 | -0.008 | 16.669 | 0.007 | -0.001 | 0.0 |
| 23/ 4/ 3 | 1 | 6 | 350.913 | -19.306 | 51.924 | 0.001 | 0.0 | 0.024 | -0.002 | -0.013 | 16.669 | 0.014 | -0.002 | 0.0 |
| 23/ 4/18 | 2 | 1 | 350.920 | -19.299 | 51.923 | 0.001 | 0.0 | 0.024 | -0.002 | -0.013 | 16.669 | 0.014 | -0.002 | 0.0 |
| 23/ 4/18 | 2 | 2 | 350.919 | -19.291 | 51.719 | -0.001 | 0.0 | 0.023 | 0.001 | -0.012 | 16.669 | 0.014 | -0.002 | 0.0 |
| 23/ 4/18 | 2 | 3 | 350.929 | -19.319 | 51.728 | -0.000 | 0.0 | 0.021 | -0.000 | -0.011 | 16.669 | 0.013 | -0.001 | 0.0 |
| 23/ 4/18 | 2 | 4 | 350.951 | -19.381 | 51.747 | 0.001 | 0.0 | 0.017 | -0.002 | -0.009 | 16.669 | 0.011 | -0.001 | 0.0 |
| 23/ 4/18 | 2 | 5 | 350.968 | -19.427 | 51.728 | 0.001 | 0.0 | 0.013 | -0.003 | -0.007 | 16.669 | 0.009 | -0.001 | 0.0 |
| 23/ 4/18 | 2 | 6 | 351.001 | +19.610 | 51.614 | -0.014 | 0.0 | 0.039 | 0.019 | -0.020 | 16.669 | 0.024 | -0.003 | 0.0 |
| 23/ 4/18 | 2 | 8 | 351.000 | -19.639 | 51.587 | -0.018 | 0.0 | 0.050 | 0.015 | -0.026 | 16.669 | 0.030 | -0.010 | 0.0 |
| 23/ 4/32 | 3 | 1 | 351.004 | -19.635 | 51.588 | -0.018 | 0.0 | 0.050 | 0.015 | -0.026 | 16.669 | 0.031 | -0.010 | 0.0 |
| 23/ 4/32 | 3 | 2 | 351.009 | -19.630 | 50.085 | -0.027 | 0.0 | 0.032 | 0.030 | -0.022 | 16.673 | 0.029 | -0.008 | 0.0 |
| 23/ 4/32 | 3 | 3 | 351.008 | -19.630 | 50.084 | -0.027 | 0.000 | 0.032 | 0.030 | -0.022 | 16.673 | 0.029 | -0.008 | 0.0 |
| 23/ 4/32 | 3 | 3 | 351.032 | -19.694 | 50.100 | -0.025 | 0.000 | 0.025 | 0.026 | -0.019 | 16.673 | 0.025 | -0.008 | 0.0 |
| 23/ 4/32 | 3 | 4 | 351.032 | -19.694 | 50.096 | -0.025 | 0.002 | 0.025 | 0.027 | -0.019 | 16.673 | 0.026 | -0.008 | 0.0 |
| 23/ 4/32 | 3 | 4 | 351.093 | -19.865 | 50.125 | -0.019 | 0.003 | 0.009 | 0.016 | -0.012 | 16.672 | 0.017 | -0.007 | 0.0 |
| 23/ 4/32 | 3 | 5 | 351.097 | -19.863 | 50.123 | -0.016 | -0.003 | 0.008 | 0.012 | -0.009 | 16.672 | 0.014 | -0.006 | 0.0 |
| 23/ 4/32 | 3 | 5 | 351.157 | -20.023 | 50.027 | -0.009 | -0.004 | -0.009 | 0.001 | -0.000 | 16.672 | 0.004 | -0.006 | -0.0 |
| 23/ 4/32 | 3 | 6 | 351.181 | -20.156 | 49.957 | -0.016 | -0.011 | 0.015 | 0.016 | -0.010 | 16.672 | 0.014 | -0.005 | 0.0 |
| 23/ 4/46 | 4 | 1 | 351.182 | -20.155 | 49.957 | -0.018 | -0.011 | 0.015 | 0.016 | -0.010 | 16.672 | 0.014 | -0.005 | 0.0 |
| 23/ 4/46 | 4 | 2 | 351.112 | -20.106 | 52.621 | -0.027 | 0.029 | 0.051 | 0.029 | -0.049 | 16.666 | 0.042 | -0.011 | 0.0 |
| 23/ 4/46 | 4 | 3 | 351.110 | -20.101 | 52.621 | -0.027 | 0.029 | 0.052 | 0.029 | -0.049 | 16.666 | 0.042 | -0.011 | 0.0 |
| 23/ 4/46 | 4 | 4 | 351.106 | -20.088 | 52.621 | -0.028 | 0.029 | 0.053 | 0.030 | -0.050 | 16.666 | 0.043 | -0.011 | 0.0 |
| 23/ 4/46 | 4 | 5 | 351.080 | -20.017 | 52.670 | -0.032 | 0.030 | 0.062 | 0.038 | -0.054 | 16.666 | 0.048 | -0.012 | 0.0 |
| 23/ 4/46 | 4 | 6 | 351.077 | -19.998 | 52.681 | -0.031 | 0.031 | 0.058 | 0.036 | -0.052 | 16.666 | 0.046 | -0.012 | 0.0 |
| 23/ 5/ 1 | 5 | 1 | 351.079 | -19.995 | 52.681 | -0.031 | 0.031 | 0.058 | 0.036 | -0.052 | 16.666 | 0.046 | -0.012 | 0.0 |
| 23/ 5/ 1 | 5 | 2 | 351.083 | -20.004 | 52.456 | -0.031 | 0.028 | 0.054 | 0.035 | -0.051 | 16.666 | 0.044 | -0.011 | 0.0 |
| 23/ 5/ 1 | 5 | 3 | 351.088 | -20.003 | 52.463 | -0.028 | 0.022 | 0.054 | 0.031 | -0.047 | 16.666 | 0.040 | -0.011 | 0.0 |
| 23/ 5/ 1 | 5 | 3 | 351.081 | -19.984 | 52.465 | -0.030 | 0.022 | 0.056 | 0.034 | -0.048 | 16.666 | 0.041 | -0.011 | 0.0 |
| 23/ 5/ 1 | 5 | 4 | 351.095 | -19.983 | 52.486 | -0.022 | 0.003 | 0.057 | 0.023 | -0.038 | 16.666 | 0.031 | -0.010 | 0.0 |
| 23/ 5/ 1 | 5 | 4 | 351.075 | -19.926 | 52.492 | -0.026 | 0.002 | 0.064 | 0.030 | -0.040 | 16.667 | 0.034 | -0.011 | 0.0 |
| 23/ 5/ 1 | 5 | 5 | 351.090 | -19.927 | 52.478 | -0.018 | -0.018 | 0.064 | 0.018 | -0.030 | 16.667 | 0.023 | -0.010 | 0.0 |
| 23/ 5/ 1 | 5 | 5 | 351.074 | -19.886 | 52.508 | -0.021 | -0.017 | 0.069 | 0.024 | -0.032 | 16.667 | 0.026 | -0.010 | 0.0 |
| 23/ 5/ 1 | 5 | 6 | 351.057 | -19.778 | 52.570 | -0.015 | -0.008 | 0.042 | 0.016 | -0.021 | 16.667 | 0.016 | -0.010 | 0.0 |
| 23/ 5/ 1 | 5 | 8 | 351.057 | -19.771 | 52.573 | -0.014 | -0.007 | 0.040 | 0.018 | -0.020 | 16.667 | 0.015 | -0.008 | 0.0 |
| 23/ 5/15 | 6 | 1 | 351.057 | -19.771 | 52.573 | -0.014 | -0.007 | 0.040 | 0.018 | -0.020 | 16.667 | 0.015 | -0.008 | 0.0 |
| 23/ 5/15 | 6 | 2 | 351.048 | -19.764 | 52.803 | -0.016 | -0.001 | 0.044 | 0.020 | -0.026 | 16.666 | 0.019 | -0.009 | 0.0 |
| 23/ 5/15 | 6 | 3 | 351.047 | -19.761 | 52.804 | -0.016 | -0.001 | 0.044 | 0.021 | -0.026 | 16.666 | 0.019 | -0.009 | 0.0 |
| 23/ 5/15 | 6 | 4 | 351.043 | -19.750 | 52.806 | -0.017 | -0.001 | 0.046 | 0.023 | -0.026 | 16.666 | 0.020 | -0.009 | 0.0 |
| 23/ 5/15 | 6 | 5 | 351.036 | -19.731 | 52.821 | -0.018 | -0.001 | 0.048 | 0.026 | -0.028 | 16.666 | 0.021 | -0.009 | 0.0 |
| 23/ 5/15 | 6 | 6 | 351.047 | -19.810 | 52.774 | -0.022 | -0.009 | 0.069 | 0.030 | -0.037 | 16.666 | 0.029 | -0.008 | 0.0 |
| 23/ 5/29 | 7 | 1 | 351.048 | -19.809 | 52.775 | -0.022 | -0.008 | 0.069 | 0.031 | -0.037 | 16.666 | 0.029 | -0.008 | 0.0 |
| 23/ 5/29 | 7 | 2 | 351.060 | -19.828 | 52.451 | -0.020 | -0.015 | 0.062 | 0.026 | -0.032 | 16.667 | 0.024 | -0.007 | 0.0 |
| 23/ 5/29 | 7 | 3 | 351.062 | -19.834 | 52.449 | -0.019 | -0.015 | 0.062 | 0.025 | -0.032 | 16.667 | 0.024 | -0.007 | 0.0 |
| 23/ 5/29 | 7 | 4 | 351.068 | -19.852 | 52.444 | -0.017 | -0.015 | 0.060 | 0.022 | -0.031 | 16.667 | 0.023 | -0.007 | 0.0 |
| 23/ 5/29 | 7 | 5 | 351.080 | -19.885 | 52.418 | -0.014 | -0.014 | 0.055 | 0.016 | -0.029 | 16.667 | 0.020 | -0.006 | 0.0 |
| 23/ 5/29 | 7 | 6 | 351.091 | -19.974 | 52.367 | -0.018 | -0.022 | 0.079 | 0.019 | -0.041 | 16.667 | 0.030 | -0.005 | 0.0 |
| 23/ 5/29 | 7 | 8 | 351.091 | -19.979 | 52.364 | -0.018 | -0.022 | 0.081 | 0.017 | -0.042 | 16.667 | 0.031 | -0.007 | 0.0 |
| 23/ 5/48 | 8 | 1 | 351.091 | -19.978 | 52.364 | -0.018 | -0.022 | 0.082 | 0.017 | -0.042 | 16.667 | 0.031 | -0.007 | 0.0 |

1 DATE OF THE FIRST FRAME OF DATA IN YEAR/MONTH/DAY (GMT). IF THE FIRST FRAME HAS BEEN FLAGGED THIS DATE WILL BE 5/ 9/ 1

2 TIME OF THE SUN SIGHTING IN HOUR/MINUTE/SECOND

3 FRAME NUMBER.

4 REFER TO HEADING DEFINITION (FIGURE 7-4)

Figure 7-5. Attitude and State Vector Table From OABIAS (1 of 2)



PRELIMINARY DRAFT

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 9/16 | 22 | 2 | 351.085 | -20.058 | 52.312 | 0.001 | -0.020 | 0.074 | -0.014 | -0.072 | 16.667 | 0.026 | -0.002 | 0.0 |
| 23/ 9/16 | 22 | 3 | 351.085 | -20.058 | 52.312 | 0.001 | -0.020 | 0.074 | -0.014 | -0.072 | 16.667 | 0.027 | -0.002 | 0.0 |
| 23/ 9/16 | 22 | 3 | 351.085 | -20.058 | 52.312 | 0.001 | -0.020 | 0.074 | -0.013 | -0.072 | 16.667 | 0.027 | -0.002 | 0.0 |
| 23/ 9/16 | 22 | 4 | 351.084 | -20.059 | 52.312 | 0.001 | -0.020 | 0.073 | -0.014 | -0.073 | 16.667 | 0.027 | -0.001 | 0.0 |
| 23/ 9/16 | 22 | 4 | 351.084 | -20.055 | 52.314 | 0.000 | -0.020 | 0.074 | -0.012 | -0.072 | 16.667 | 0.027 | -0.001 | 0.0 |
| 23/ 9/16 | 22 | 5 | 351.083 | -20.056 | 52.314 | -0.000 | -0.019 | 0.073 | -0.012 | -0.074 | 16.667 | 0.027 | -0.001 | 0.0 |
| 23/ 9/16 | 22 | 5 | 351.081 | -20.051 | 52.318 | -0.001 | -0.019 | 0.074 | -0.011 | -0.073 | 16.667 | 0.027 | -0.001 | 0.0 |
| 23/ 9/16 | 22 | 6 | 351.081 | -20.045 | 52.321 | -0.002 | -0.018 | 0.072 | -0.009 | -0.072 | 16.667 | 0.027 | -0.002 | 0.0 |
| 23/ 9/16 | 22 | 8 | 351.081 | -20.046 | 52.321 | -0.003 | -0.019 | 0.073 | -0.010 | -0.072 | 16.667 | 0.027 | -0.003 | 0.0 |
| 23/ 9/31 | 23 | 1 | 351.081 | -20.046 | 52.321 | -0.003 | -0.019 | 0.073 | -0.010 | -0.072 | 16.667 | 0.027 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 2 | 351.090 | -20.060 | 52.248 | 0.002 | -0.023 | 0.073 | -0.017 | -0.068 | 16.667 | 0.025 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 3 | 351.090 | -20.060 | 52.248 | 0.002 | -0.023 | 0.073 | -0.017 | -0.069 | 16.667 | 0.025 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 3 | 351.091 | -20.066 | 52.245 | 0.003 | -0.023 | 0.073 | -0.019 | -0.069 | 16.667 | 0.025 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 4 | 351.090 | -20.068 | 52.244 | 0.003 | -0.021 | 0.072 | -0.019 | -0.071 | 16.667 | 0.025 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 4 | 351.095 | -20.117 | 52.218 | 0.012 | -0.018 | 0.065 | -0.036 | -0.075 | 16.667 | 0.026 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 5 | 351.102 | -20.113 | 52.218 | 0.013 | -0.020 | 0.070 | -0.036 | -0.071 | 16.667 | 0.025 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 5 | 351.116 | -20.176 | 52.174 | 0.025 | -0.016 | 0.067 | -0.058 | -0.076 | 16.667 | 0.026 | -0.004 | 0.0 |
| 23/ 9/31 | 23 | 6 | 351.115 | -20.234 | 52.142 | 0.034 | -0.026 | 0.082 | -0.069 | -0.091 | 16.667 | 0.028 | 0.004 | 0.0 |
| 23/ 9/31 | 23 | 8 | 351.119 | -20.229 | 52.143 | 0.043 | -0.022 | 0.075 | -0.062 | -0.086 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 1 | 351.119 | -20.229 | 52.143 | 0.043 | -0.022 | 0.075 | -0.062 | -0.086 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 2 | 351.120 | -20.230 | 52.138 | 0.043 | -0.022 | 0.075 | -0.062 | -0.086 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 3 | 351.120 | -20.229 | 52.139 | 0.043 | -0.023 | 0.075 | -0.062 | -0.086 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 3 | 351.121 | -20.233 | 52.136 | 0.044 | -0.022 | 0.075 | -0.064 | -0.086 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 4 | 351.124 | -20.228 | 52.139 | 0.044 | -0.025 | 0.076 | -0.063 | -0.082 | 16.667 | 0.026 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 4 | 351.131 | -20.267 | 52.118 | 0.052 | -0.022 | 0.074 | -0.076 | -0.085 | 16.667 | 0.027 | 0.020 | 0.0 |
| 23/ 9/45 | 24 | 5 | 351.135 | -20.263 | 52.118 | 0.052 | -0.025 | 0.075 | -0.076 | -0.081 | 16.667 | 0.025 | 0.019 | 0.0 |
| 23/ 9/45 | 24 | 5 | 351.143 | -20.300 | 52.093 | 0.060 | -0.022 | 0.073 | -0.089 | -0.084 | 16.667 | 0.026 | 0.019 | 0.0 |
| 23/ 9/45 | 24 | 6 | 351.142 | -20.324 | 52.080 | 0.064 | -0.027 | 0.079 | -0.094 | -0.090 | 16.667 | 0.027 | 0.022 | 0.0 |
| 23/ 9/45 | 24 | 8 | 351.145 | -20.321 | 52.080 | 0.070 | -0.024 | 0.074 | -0.089 | -0.087 | 16.667 | 0.026 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 1 | 351.145 | -20.321 | 52.080 | 0.070 | -0.024 | 0.074 | -0.089 | -0.087 | 16.667 | 0.026 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 2 | 351.137 | -20.310 | 52.132 | 0.066 | -0.021 | 0.074 | -0.084 | -0.091 | 16.667 | 0.027 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 3 | 351.137 | -20.310 | 52.132 | 0.066 | -0.021 | 0.074 | -0.084 | -0.091 | 16.667 | 0.027 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 3 | 351.138 | -20.311 | 52.132 | 0.066 | -0.021 | 0.074 | -0.084 | -0.091 | 16.667 | 0.027 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 4 | 351.139 | -20.309 | 52.133 | 0.066 | -0.022 | 0.074 | -0.084 | -0.089 | 16.667 | 0.027 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 4 | 351.142 | -20.323 | 52.125 | 0.069 | -0.021 | 0.073 | -0.089 | -0.090 | 16.667 | 0.027 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 5 | 351.140 | -20.325 | 52.125 | 0.069 | -0.017 | 0.073 | -0.089 | -0.093 | 16.667 | 0.028 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 5 | 351.140 | -20.326 | 52.124 | 0.069 | -0.019 | 0.073 | -0.090 | -0.093 | 16.667 | 0.028 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 6 | 351.140 | -20.331 | 52.122 | 0.070 | -0.020 | 0.074 | -0.091 | -0.094 | 16.667 | 0.028 | 0.035 | 0.0 |
| 23/10/ 0 | 25 | 8 | 351.140 | -20.331 | 52.122 | 0.070 | -0.021 | 0.075 | -0.091 | -0.094 | 16.667 | 0.028 | 0.034 | 0.0 |
| 23/10/ 0 | 25 | 14 | 351.140 | -20.331 | 52.122 | 0.070 | -0.021 | 0.075 | -0.091 | -0.094 | 16.667 | 0.028 | 0.034 | 0.0 |
| FINAL ESTIMATE OF UNCERTAINTY | | | 8.469 | 13.342 | 10.699 | 0.968 | 7.084 | 7.505 | 7.192 | 6.170 | 0.003 | 9.109 | 9.025 | 9.984 |

1 FINAL RESULTS FROM OABIAS

2 THE UNITS ARE THE SAME AS THE CORRESPONDING STATE VECTOR.

Figure 7-5. Attitude and State Vector Table From OABIAS (2 of 2)

OABIAS SUMMARY OUTPUT FOR 74/ 1/ 4
UNCERTAINTY TABLE
BLOCK 1 PASS NO. 1

1

| TIME HH/MM/SS | FRA NUM | TYPE | P ALPHA | P DELTA | P PSIO | P DGAM | P PHI1H | P PHIOH | P DELRHO | P THEAO | P OMEGA | P EPSS | P EPSH | P DELTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | 0.34D 02 | 0.97D 02 | 0.10D 03 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 |
| 23/ 4/ 3 | 1 | 2 | 0.34D 02 | 0.97D 02 | 0.10D 03 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.34D 00 | 0.10D 02 | 0.10D 02 | 0.10D 02 |
| 23/ 4/ 3 | 1 | 3 | 0.26D 02 | 0.72D 02 | 0.10D 03 | 0.10D 02 | 0.10D 02 | 0.10D 02 | 0.99D 01 | 0.99D 01 | 0.31D 00 | 0.10D 02 | 0.10D 02 | 0.10D 02 |
| 23/ 4/ 3 | 1 | 4 | 0.20D 02 | 0.51D 02 | 0.10D 03 | 0.10D 02 | 0.10D 02 | 0.99D 01 | 0.99D 01 | 0.99D 01 | 0.28D 00 | 0.10D 02 | 0.10D 02 | 0.10D 02 |
| 23/ 4/ 3 | 1 | 5 | 0.17D 02 | 0.44D 02 | 0.10D 03 | 0.99D 01 | 0.10D 02 | 0.99D 01 | 0.99D 01 | 0.99D 01 | 0.28D 00 | 0.10D 02 | 0.10D 02 | 0.10D 02 |
| 23/ 4/ 3 | 1 | 6 | 0.16D 02 | 0.38D 02 | 0.10D 03 | 0.99D 01 | 0.10D 02 | 0.98D 01 | 0.97D 01 | 0.99D 01 | 0.28D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 1 | 0.15D 02 | 0.38D 02 | 0.10D 03 | 0.99D 01 | 0.10D 02 | 0.98D 01 | 0.97D 01 | 0.99D 01 | 0.28D 00 | 0.95D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 2 | 0.15D 02 | 0.38D 02 | 0.63D 02 | 0.98D 01 | 0.10D 02 | 0.98D 01 | 0.97D 01 | 0.99D 01 | 0.15D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 3 | 0.15D 02 | 0.37D 02 | 0.63D 02 | 0.98D 01 | 0.10D 02 | 0.98D 01 | 0.97D 01 | 0.99D 01 | 0.15D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 4 | 0.14D 02 | 0.35D 02 | 0.62D 02 | 0.98D 01 | 0.10D 02 | 0.97D 01 | 0.97D 01 | 0.99D 01 | 0.15D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 5 | 0.14D 02 | 0.34D 02 | 0.62D 02 | 0.98D 01 | 0.10D 02 | 0.97D 01 | 0.97D 01 | 0.99D 01 | 0.15D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 6 | 0.14D 02 | 0.33D 02 | 0.62D 02 | 0.98D 01 | 0.10D 02 | 0.96D 01 | 0.96D 01 | 0.99D 01 | 0.15D 00 | 0.99D 01 | 0.10D 02 | 0.10D 02 |
| 23/ 4/16 | 2 | 8 | 0.14D 02 | 0.32D 02 | 0.62D 02 | 0.96D 01 | 0.10D 02 | 0.95D 01 | 0.96D 01 | 0.98D 01 | 0.15D 00 | 0.98D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 1 | 0.13D 02 | 0.32D 02 | 0.62D 02 | 0.98D 01 | 0.10D 02 | 0.95D 01 | 0.96D 01 | 0.98D 01 | 0.15D 00 | 0.98D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 2 | 0.13D 02 | 0.32D 02 | 0.43D 02 | 0.98D 01 | 0.10D 02 | 0.94D 01 | 0.95D 01 | 0.98D 01 | 0.86D-01 | 0.98D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 3 | 0.13D 02 | 0.32D 02 | 0.43D 02 | 0.96D 01 | 0.99D 01 | 0.94D 01 | 0.95D 0. | 0.98D 01 | 0.88D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 3 | 0.13D 02 | 0.32D 02 | 0.43D 02 | 0.96D 01 | 0.99D 01 | 0.94D 01 | 0.95D 01 | 0.98D 01 | 0.85D-01 | 0.98D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 4 | 0.13D 02 | 0.32D 02 | 0.42D 02 | 0.97D 01 | 0.98D 01 | 0.94D 01 | 0.94D 01 | 0.98D 01 | 0.84D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 4 | 0.13D 02 | 0.32D 02 | 0.42D 02 | 0.97D 01 | 0.98D 01 | 0.94D 01 | 0.94D 01 | 0.97D 01 | 0.83D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 5 | 0.13D 02 | 0.32D 02 | 0.42D 02 | 0.97D 01 | 0.97D 01 | 0.94D 01 | 0.94D 01 | 0.97D 01 | 0.83D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 5 | 0.13D 02 | 0.31D 02 | 0.42D 02 | 0.97D 01 | 0.97D 01 | 0.94D 01 | 0.93D 01 | 0.97D 01 | 0.82D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/32 | 3 | 6 | 0.13D 02 | 0.31D 02 | 0.42D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.82D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 1 | 0.12D 02 | 0.30D 02 | 0.42D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.82D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 2 | 0.12D 02 | 0.30D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.56D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 3 | 0.12D 02 | 0.30D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.56D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 4 | 0.12D 02 | 0.30D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.55D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 5 | 0.12D 02 | 0.29D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.93D 01 | 0.93D 01 | 0.97D 01 | 0.55D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 4/46 | 4 | 6 | 0.12D 02 | 0.29D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.92D 01 | 0.93D 01 | 0.97D 01 | 0.55D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 1 | 0.12D 02 | 0.29D 02 | 0.33D 02 | 0.97D 01 | 0.96D 01 | 0.92D 01 | 0.93D 01 | 0.97D 01 | 0.55D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 2 | 0.12D 02 | 0.29D 02 | 0.28D 02 | 0.97D 01 | 0.96D 01 | 0.92D 01 | 0.93D 01 | 0.97D 01 | 0.40D-01 | 0.97D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 3 | 0.12D 02 | 0.29D 02 | 0.28D 02 | 0.97D 01 | 0.96D 01 | 0.92D 01 | 0.93D 01 | 0.97D 01 | 0.40D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 3 | 0.12D 02 | 0.29D 02 | 0.28D 02 | 0.97D 01 | 0.96D 01 | 0.92D 01 | 0.92D 01 | 0.97D 01 | 0.40D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 4 | 0.12D 02 | 0.29D 02 | 0.28D 02 | 0.96D 01 | 0.95D 01 | 0.92D 01 | 0.92D 01 | 0.96D 01 | 0.40D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 4 | 0.12D 02 | 0.28D 02 | 0.28D 02 | 0.96D 01 | 0.95D 01 | 0.92D 01 | 0.92D 01 | 0.96D 01 | 0.39D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 5 | 0.12D 02 | 0.28D 02 | 0.28D 02 | 0.96D 01 | 0.94D 01 | 0.92D 01 | 0.92D 01 | 0.96D 01 | 0.39D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 5 | 0.11D 02 | 0.28D 02 | 0.28D 02 | 0.96D 01 | 0.94D 01 | 0.92D 01 | 0.91D 01 | 0.96D 01 | 0.39D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 6 | 0.11D 02 | 0.27D 02 | 0.28D 02 | 0.96D 01 | 0.94D 01 | 0.91D 01 | 0.91D 01 | 0.96D 01 | 0.39D-01 | 0.96D 01 | 0.99D 01 | 0.10D 02 |
| 23/ 5/ 1 | 5 | 8 | 0.11D 02 | 0.27D 02 | 0.28D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.39D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 1 | 0.11D 02 | 0.27D 02 | 0.28D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.39D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 2 | 0.11D 02 | 0.27D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.30D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 3 | 0.11D 02 | 0.27D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.30D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 4 | 0.11D 02 | 0.27D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.30D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 5 | 0.11D 02 | 0.26D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.90D 01 | 0.91D 01 | 0.95D 01 | 0.30D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/15 | 6 | 6 | 0.11D 02 | 0.26D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.91D 01 | 0.95D 01 | 0.30D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 1 | 0.11D 02 | 0.26D 02 | 0.25D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.91D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 2 | 0.11D 02 | 0.26D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.91D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 3 | 0.11D 02 | 0.26D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.90D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 4 | 0.11D 02 | 0.26D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.90D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 5 | 0.11D 02 | 0.26D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.89D 01 | 0.90D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 6 | 0.11D 02 | 0.25D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.88D 01 | 0.90D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |
| 23/ 5/29 | 7 | 8 | 0.11D 02 | 0.25D 02 | 0.23D 02 | 0.96D 01 | 0.94D 01 | 0.87D 01 | 0.90D 01 | 0.95D 01 | 0.24D-01 | 0.95D 01 | 0.98D 01 | 0.10D 02 |

1 FOR SUBSCRIPTS, SEE THE HEADING DEFINITION. THE UNITS ARE THE SAME AS THE CORRESPONDING ELEMENTS IN THE STATE VECTOR TABLE.

Figure 7-6. Uncertainty Table From OABIAS

This table is printed on FORTRAN unit number (IPRINT +2) when ILEVEL is greater than or equal to 6. Figure 7-7 shows the partial derivative table generated in the sample problem.

7.12.5.6 Recursive Estimator Gain Table

The recursive estimator gain table includes the elements of the gain vector, K, for each element of the state vector estimated at each frame. This table is printed on FORTRAN unit number (IPRINT +1) when ILEVEL is greater than or equal to 8. Figure 7-8 shows the recursive estimator gain table generated in the sample problem.

7.12.5.7 Attitude, Observable, and Vector Table

The attitude, observable, and vector table consists of the attitude, the residual, the inverse of the weight, the observation, the computed observation, and the three components of the Sun and position vector at each frame. This table is printed on FORTRAN unit number (IPRINT +3) when ILEVEL is greater than or equal to 10. Figure 7-9 shows the attitude, observation, and vector table generated in the sample problem.

7.12.5.8 Residual Table

The residual table includes the mean residual and the standard deviation of the residuals computed at each frame. This table is printed on FORTRAN unit number (IPRINT +5) when ILEVEL is greater than or equal to 12. The first and last page of the residual table generated in the sample problem are shown in Figure 7-10.

7.12.5.9 Error Messages

The error messages are printed on FORTRAN unit number ERUNIT when IDUMPL is greater than or equal to 4. Some of the messages generated in the sample problem are shown in Figure 7-11. See Section 7.16.4 for a detailed description of the error messages.

OABIAS SUMMA... UTPUT FOR 74/ 1/ 4
PARTIAL DERIVATIVE TABLE
BLOCK 1 PASS NO. 1

| TIME HH/MM/SS | FRA NUM | TYPE | G X(1)* | G X(2)* | G PSIO* | G DGAM* | G PHIIH* | G PHIOH* | G DELRHO* | G THEAO* | G OMEGA* | G EPSS* | G EPSH* | G DELTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | -.76D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 2 | -.12D 01 | -.40D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.52D 02 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 3 | 0.79D-01 | -.27D 00 | 0.57D 00 | 0.51D 00 | 0.0 | 0.57D 00 | -.78D 00 | 0.0 | 0.36D 02 | 0.0 | -.40D-01 | 0.91D-03 |
| 23/ 4/ 3 | 1 | 4 | -.17D 00 | 0.47D 00 | -.10D 01 | -.90D 00 | 0.0 | -.10D 01 | 0.13D 01 | 0.0 | -.63D 02 | 0.0 | 0.70D-01 | -.85D-03 |
| 23/ 4/ 3 | 1 | 5 | 0.66D 00 | 0.55D 00 | 0.0 | -.52D 00 | 0.0 | -.57D 00 | 0.78D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.49D-03 |
| 23/ 4/ 3 | 1 | 6 | 0.12D 01 | 0.33D 00 | 0.0 | -.11D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.50D 00 | 0.0 | 0.11D-05 | 0.25D-03 |
| 23/ 4/18 | 2 | 1 | -.75D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.14D-03 | 0.0 | 0.0 |
| 23/ 4/18 | 2 | 2 | -.11D 01 | -.42D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.65D 02 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 4/18 | 2 | 3 | 0.62D-01 | -.28D 00 | 0.57D 00 | 0.53D 00 | 0.0 | 0.57D 00 | -.77D 00 | 0.0 | 0.44D 02 | 0.0 | -.40D-01 | 0.90D-03 |
| 23/ 4/18 | 2 | 4 | -.95D-01 | 0.49D 00 | -.10D 01 | -.94D 00 | 0.0 | -.10D 01 | 0.14D 01 | 0.0 | -.78D 02 | 0.0 | 0.70D-01 | -.84D-03 |
| 23/ 4/18 | 2 | 5 | 0.70D 00 | 0.55D 00 | 0.0 | -.54D 00 | 0.0 | -.57D 00 | 0.75D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.48D-03 |
| 23/ 4/18 | 2 | 6 | 0.12D 01 | 0.33D 00 | 0.0 | -.11D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.50D 00 | 0.0 | 0.12D-05 | 0.27D-03 |
| 23/ 4/18 | 2 | 8 | -.42D 00 | 0.25D 00 | 0.0 | 0.35D 00 | 0.0 | -.57D 00 | 0.0 | 0.0 | -.17D 01 | -.32D 00 | 0.39D 00 | -.40D-03 |
| 23/ 4/32 | 3 | 1 | -.75D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.30D-03 | 0.0 | 0.0 |
| 23/ 4/32 | 3 | 2 | -.12D 01 | -.40D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.77D 02 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 4/32 | 3 | 3 | -.13D 01 | -.40D-01 | -.56D 00 | 0.53D 00 | -.56D 00 | 0.0 | -.77D 00 | 0.0 | -.51D 02 | 0.0 | 0.39D-01 | -.32D-03 |
| 23/ 4/32 | 3 | 3 | 0.56D-01 | -.26D 00 | 0.57D 00 | 0.53D 00 | 0.0 | 0.57D 00 | -.77D 00 | 0.0 | 0.53D 02 | 0.0 | -.40D-01 | 0.89D-03 |
| 23/ 4/32 | 3 | 4 | -.23D 01 | -.71D-01 | -.10D 01 | 0.94D 00 | -.10D 01 | 0.0 | -.14D 01 | 0.0 | -.91D 02 | 0.0 | 0.70D-01 | -.13D-02 |
| 23/ 4/32 | 3 | 4 | -.34D-01 | 0.50D 00 | -.10D 01 | -.94D 00 | 0.0 | -.10D 01 | 0.14D 01 | 0.0 | -.92D 02 | 0.0 | 0.70D-01 | -.82D-03 |
| 23/ 4/32 | 3 | 5 | -.55D 00 | 0.23D 00 | 0.0 | 0.54D 00 | -.57D 00 | 0.0 | -.75D 00 | 0.0 | -.14D 01 | -.32D 00 | 0.40D-01 | -.76D-03 |
| 23/ 4/32 | 3 | 5 | 0.74D 00 | 0.55D 00 | 0.0 | -.54D 00 | 0.0 | -.57D 00 | 0.75D 00 | 0.0 | -.15D 01 | -.32D 00 | 0.40D-01 | -.47D-03 |
| 23/ 4/32 | 3 | 6 | 0.13D 01 | 0.32D 00 | 0.0 | -.11D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.45D 00 | 0.0 | 0.67D-05 | 0.29D-03 |
| 23/ 4/46 | 4 | 1 | -.76D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.14D-03 | 0.0 | 0.0 |
| 23/ 4/46 | 4 | 2 | -.12D 01 | -.42D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.90D 02 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 4/46 | 4 | 3 | -.21D-01 | -.28D 00 | 0.55D 00 | 0.53D 00 | 0.0 | 0.55D 00 | -.76D 00 | 0.0 | 0.59D 02 | 0.0 | -.39D-01 | 0.84D-03 |
| 23/ 4/46 | 4 | 4 | 0.32D-01 | 0.50D 00 | -.10D 01 | -.95D 00 | 0.0 | -.10D 01 | 0.14D 01 | 0.0 | -.11D 03 | 0.0 | 0.70D-01 | -.79D-03 |
| 23/ 4/46 | 4 | 5 | 0.79D 00 | 0.55D 00 | 0.0 | -.55D 00 | 0.0 | -.57D 00 | 0.75D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.46D-03 |
| 23/ 4/46 | 4 | 6 | 0.14D 01 | 0.32D 00 | 0.0 | -.11D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.48D 00 | 0.0 | 0.16D-04 | 0.31D-03 |
| 23/ 5/ 1 | 5 | 1 | -.76D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.45D-03 | 0.0 | 0.0 |
| 23/ 5/ 1 | 5 | 2 | -.12D 01 | -.40D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 03 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 5/ 1 | 5 | 3 | -.13D 01 | -.27D-01 | -.53D 00 | 0.53D 00 | -.53D 00 | 0.0 | -.76D 00 | 0.0 | -.64D 02 | 0.0 | 0.37D-01 | -.32D-03 |
| 23/ 5/ 1 | 5 | 3 | -.79D-01 | -.28D 00 | 0.53D 00 | 0.53D 00 | 0.0 | 0.53D 00 | -.76D 00 | 0.0 | 0.64D 02 | 0.0 | -.37D-01 | 0.81D-03 |
| 23/ 5/ 1 | 5 | 4 | -.24D 01 | -.44D-01 | -.10D 01 | 0.98D 00 | -.10D 01 | 0.0 | -.14D 01 | 0.0 | -.12D 03 | 0.0 | 0.70D-01 | -.13D-02 |
| 23/ 5/ 1 | 5 | 4 | 0.11D 00 | 0.52D 00 | -.10D 01 | -.98D 00 | 0.0 | -.10D 01 | 0.14D 01 | 0.0 | -.12D 03 | 0.0 | 0.70D-01 | -.78D-03 |
| 23/ 5/ 1 | 5 | 5 | -.62D 00 | 0.24D 00 | 0.0 | 0.57D 00 | -.57D 00 | 0.0 | -.81D 00 | 0.0 | -.14D 01 | -.32D 00 | 0.40D-01 | -.77D-03 |
| 23/ 5/ 1 | 5 | 5 | 0.83D 00 | 0.57D 00 | 0.0 | -.57D 00 | 0.0 | -.57D 00 | 0.81D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.45D-03 |
| 23/ 5/ 1 | 5 | 6 | 0.15D 01 | 0.33D 00 | 0.0 | -.11D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.47D 00 | 0.0 | 0.14D-04 | 0.32D-03 |
| 23/ 5/ 1 | 5 | 8 | -.44D 00 | 0.28D 00 | 0.0 | 0.37D 00 | 0.0 | -.57D 00 | 0.0 | 0.0 | -.17D 01 | -.32D 00 | 0.41D 00 | -.40D-03 |
| 23/ 5/15 | 6 | 1 | -.75D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.15D-03 | 0.0 | 0.0 |
| 23/ 5/15 | 6 | 2 | -.12D 01 | -.41D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.12D 03 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 5/15 | 6 | 3 | -.11D 00 | -.28D 00 | 0.52D 00 | 0.54D 00 | 0.0 | 0.52D 00 | -.75D 00 | 0.0 | 0.71D 02 | 0.0 | -.37D-01 | 0.79D-03 |
| 23/ 5/15 | 6 | 4 | 0.20D 00 | 0.54D 00 | -.10D 01 | -.10D 01 | 0.0 | -.10D 01 | 0.14D 01 | 0.0 | -.13D 03 | 0.0 | 0.70D-01 | -.76D-03 |
| 23/ 5/15 | 6 | 5 | 0.88D 00 | 0.58D 00 | 0.0 | -.59D 00 | 0.0 | -.57D 00 | 0.82D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.44D-03 |
| 23/ 5/15 | 6 | 6 | 0.15D 01 | 0.33D 00 | 0.0 | -.12D 01 | 0.0 | 0.0 | 0.16D 01 | 0.0 | -.46D 00 | 0.0 | 0.13D-04 | 0.33D-03 |
| 23/ 5/29 | 7 | 1 | -.76D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.29D-03 | 0.0 | 0.0 |
| 23/ 5/29 | 7 | 2 | -.12D 01 | -.40D 00 | -.87D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.13D 03 | 0.49D 00 | 0.0 | 0.0 |
| 23/ 5/29 | 7 | 3 | -.14D 00 | -.29D 00 | 0.52D 00 | 0.54D 00 | 0.0 | 0.52D 00 | -.75D 00 | 0.0 | 0.77D 02 | 0.0 | -.36D-01 | 0.77D-03 |
| 23/ 5/29 | 7 | 4 | 0.28D 00 | 0.55D 00 | -.10D 01 | -.11D 01 | 0.0 | -.10D 01 | 0.15D 01 | 0.0 | -.15D 03 | 0.0 | 0.70D-01 | -.74D-03 |
| 23/ 5/29 | 7 | 5 | 0.93D 00 | 0.58D 00 | 0.0 | -.60D 00 | 0.0 | -.57D 00 | 0.83D 00 | 0.0 | -.19D 01 | -.32D 00 | 0.40D-01 | -.43D-03 |
| 23/ 5/29 | 7 | 6 | 0.16D 01 | 0.33D 00 | 0.0 | -.12D 01 | 0.0 | 0.0 | 0.17D 01 | 0.0 | -.45D 00 | 0.0 | 0.95D-05 | 0.36D-03 |
| 23/ 5/29 | 7 | 8 | -.45D 00 | 0.30D 00 | 0.0 | 0.37D 00 | 0.0 | -.57D 00 | 0.0 | 0.0 | -.17D 01 | -.32D 00 | 0.41D 00 | -.39D-03 |
| 23/ 5/46 | 8 | 1 | -.76D 00 | 0.11D 01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.10D 01 | 0.0 | -.30D-03 | 0.0 | 0.0 |

1 FOR SUBSCRIPTS SEE THE HEADING DEFINITION. THE UNITS ARE (UNIT OF OBSERVATION)/(UNIT OF CORRESPONDING ELEMENT OF THE STATE VECTOR, XI)

2 THESE CORRESPOND TO $\dot{x}_1$ AND $x_2$ RATHER THAN ... AND ...

Figure 7-7. Partial Derivative Table From OABIAS

OABIAS SUMMARY OUTPUT FOR 74/ 1/ 4 [1]
RECURSIVE ESTIMATOR GAIN TABLE
BLOCK 1 PASS NO. 1

| TIME HH/MM/SS | FRA NUM | TYPE | K X(1) [2] | K X(2) [2] | K FSIO | K DGAM | K PHIIH | K PHIOH | K DELRHO | K THEAO | K OMEGA | K EPSS | K EPSH | K DELJIM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | -.13D 00 | 0.83D 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -.91D-02 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 2 | -.25D-03 | -.18D-03 | -.88D-03 | 0.0 | 0.0 | 0.0 | 0.0 | -.18D-05 | -.19D-01 | 0.49D-05 | 0.0 | 0.0 |
| 23/ 4/ 3 | 1 | 3 | -.39D 00 | -.30D 00 | -.66D-01 | 0.11D-01 | 0.0 | 0.12D-01 | -.16D-01 | -.73D-02 | 0.12D-01 | 0.69D-02 | -.82D-03 | 0.61D-01 |
| 23/ 4/ 3 | 1 | 4 | 0.28D 00 | 0.21D 00 | 0.47D-01 | -.77D-02 | 0.0 | -.85D-02 | 0.11D-01 | 0.54D-02 | -.88D-02 | -.50D-02 | 0.59D-03 | -.48D-02 |
| 23/ 4/ 3 | 1 | 5 | 0.31D 00 | 0.24D 00 | 0.54D-01 | -.93D-02 | 0.0 | -.97D-02 | 0.13D-01 | 0.72D-02 | -.50D-02 | -.57D-02 | 0.67D-03 | -.83D-02 |
| 23/ 4/ 3 | 1 | 6 | 0.25D 00 | 0.14D 00 | -.18D 00 | -.33D-01 | 0.0 | 0.42D-01 | 0.48D-01 | -.18D-01 | -.29D-02 | 0.24D-01 | -.29D-02 | 0.19D 00 |
| 23/ 4/16 | 2 | 1 | -.15D 00 | 0.35D 00 | -.53D-01 | 0.75D-03 | 0.0 | 0.11D-01 | -.12D-02 | -.11D-01 | 0.19D-02 | 0.62D-02 | -.75D-03 | 0.41D-01 |
| 23/ 4/16 | 2 | 2 | 0.54D-01 | 0.21D-01 | 0.30D 01 | 0.25D-01 | 0.0 | 0.25D-01 | -.37D-01 | -.12D-01 | -.55D-01 | -.25D-02 | -.18D-02 | 0.82D-01 |
| 23/ 4/16 | 2 | 3 | -.62D-01 | -.51D-01 | -.41D-01 | -.22D-02 | 0.0 | 0.88D-02 | 0.37D-02 | -.47D-02 | 0.24D-02 | 0.51D-02 | -.61D-03 | 0.79D-01 |
| 23/ 4/16 | 2 | 4 | 0.86D-01 | 0.71D-01 | 0.55D-01 | 0.30D-02 | 0.0 | -.12D-01 | -.51D-02 | 0.63D-02 | -.33D-02 | -.69D-02 | 0.83D-03 | -.31D-01 |
| 23/ 4/16 | 2 | 5 | 0.13D 00 | 0.11D 00 | -.11D 00 | 0.32D-02 | 0.0 | -.20D-01 | -.55D-02 | 0.10D-01 | -.14D-02 | -.10D-01 | 0.14D-02 | -.54D-01 |
| 23/ 4/16 | 2 | 6 | 0.13D 00 | 0.64D-01 | -.18D 00 | -.25D-01 | 0.0 | 0.41D-01 | 0.35D-01 | -.20D-01 | 0.78D-04 | 0.24D-01 | -.29D-02 | 0.18D 00 |
| 23/ 4/16 | 2 | 8 | -.26D-01 | -.43D-02 | 0.14D 00 | 0.22D-01 | 0.0 | -.58D-01 | 0.23D-01 | 0.29D-01 | -.11D-02 | -.34D-01 | 0.41D-01 | -.12D 00 |
| 23/ 4/32 | 3 | 1 | -.11D 00 | 0.22D 00 | 0.20D-01 | -.42D-02 | 0.0 | 0.18D-01 | 0.11D-02 | -.12D-01 | 0.35D-03 | 0.97D-02 | -.47D-02 | 0.61D-01 |
| 23/ 4/32 | 3 | 2 | 0.24D-02 | -.57D-02 | 0.22D 01 | 0.13D-01 | 0.0 | 0.26D-01 | -.21D-01 | -.58D-02 | -.34D-01 | 0.23D-02 | -.36D-02 | 0.87D-01 |
| 23/ 4/32 | 3 | 3 | -.16D-02 | 0.13D-01 | 0.53D-01 | 0.10D-01 | -.21D-01 | -.36D-03 | -.15D-01 | 0.11D-01 | -.99D-03 | -.12D-01 | 0.94D-03 | -.35D-01 |
| 23/ 4/32 | 3 | 3 | -.34D-01 | -.29D-01 | -.17D-01 | -.28D-02 | -.19D-03 | 0.81D-02 | 0.47D-02 | -.38D-02 | 0.11D-02 | 0.45D-02 | -.47D-03 | 0.76D-01 |
| 23/ 4/32 | 3 | 4 | -.29D-02 | 0.20D-01 | 0.81D-01 | 0.15D-01 | -.32D-01 | -.42D-03 | -.24D-01 | 0.17D-01 | -.15D-02 | -.19D-01 | 0.14D-02 | -.14D 00 |
| 23/ 4/32 | 3 | 4 | 0.54D-01 | 0.45D-01 | 0.20D-01 | 0.44D-02 | 0.96D-03 | -.11D-01 | -.72D-02 | 0.50D-02 | -.17D-02 | -.59D-02 | 0.67D-03 | -.27D-01 |
| 23/ 4/32 | 3 | 5 | -.14D-02 | 0.36D-01 | -.20D-01 | 0.24D-01 | -.53D-01 | -.29D-02 | -.37D-01 | 0.28D-01 | -.14D-03 | -.31D-01 | 0.26D-02 | -.23D 00 |
| 23/ 4/32 | 3 | 5 | 0.66D-01 | 0.74D-01 | -.11D 00 | 0.82D-02 | -.20D-02 | -.20D-01 | -.13D-01 | 0.10D-01 | -.43D-03 | -.12D-01 | 0.15D-02 | -.63D-02 |
| 23/ 4/32 | 3 | 6 | 0.69D-01 | 0.45D-01 | -.11D 00 | -.13D-01 | -.10D-01 | 0.36D-01 | 0.23D-01 | -.16D-01 | -.23D-03 | 0.15D-01 | 0.50D-03 | 0.13D 00 |
| 23/ 4/46 | 4 | 1 | -.87D-01 | 0.16D 00 | 0.23D-01 | -.10D-01 | 0.88D-02 | 0.15D-01 | 0.12D-01 | -.14D-01 | 0.42D-03 | 0.13D-01 | -.40D-02 | 0.88D-01 |
| 23/ 4/46 | 4 | 2 | -.16D-01 | -.39D-01 | 0.15D 01 | -.52D-02 | 0.23D-01 | 0.21D-01 | 0.73D-02 | -.23D-01 | -.22D-01 | 0.16D-01 | -.36D-02 | 0.15D 00 |
| 23/ 4/46 | 4 | 3 | -.26D-01 | -.22D-01 | -.17D-02 | -.35D-02 | -.28D-03 | 0.65D-02 | 0.57D-02 | -.30D-02 | 0.65D-03 | 0.35D-02 | -.36D-03 | 0.69D-01 |
| 23/ 4/46 | 4 | 4 | 0.42D-01 | 0.36D-01 | 0.30D-02 | 0.56D-02 | 0.45D-03 | -.10D-01 | -.91D-02 | 0.48D-02 | -.10D-02 | -.56D-02 | 0.58D-03 | -.25D-01 |
| 23/ 4/46 | 4 | 5 | 0.69D-01 | 0.59D-01 | -.10D 00 | 0.94D-02 | -.96D-03 | -.18D-01 | -.15D-01 | 0.83D-02 | -.16D-03 | -.10D-01 | 0.12D-02 | -.54D-01 |
| 23/ 4/46 | 4 | 6 | 0.72D-01 | 0.32D-01 | -.94D-01 | -.12D-01 | -.87D-02 | 0.36D-01 | 0.18D-01 | -.16D-01 | -.30D-04 | 0.16D-01 | 0.25D-03 | 0.14D 00 |
| 23/ 5/ 1 | 5 | 1 | -.68D-01 | 0.13D 00 | 0.33D-01 | -.84D-02 | 0.71D-02 | 0.15D-01 | 0.96D-02 | -.12D-01 | 0.10D-03 | 0.12D-01 | -.33D-02 | 0.61D-01 |
| 23/ 5/ 1 | 5 | 2 | -.20D-01 | -.24D-01 | 0.11D 01 | -.29D-02 | 0.13D-01 | 0.19D-01 | 0.43D-02 | -.85D-02 | -.15D-01 | 0.12D-01 | -.27D-02 | 0.12D 00 |
| 23/ 5/ 1 | 5 | 3 | 0.34D-03 | 0.11D-01 | 0.18D-01 | 0.66D-02 | -.16D-01 | 0.25D-03 | -.94D-02 | 0.91D-02 | -.38D-03 | -.91D-02 | 0.77D-03 | -.16D-01 |
| 23/ 5/ 1 | 5 | 3 | -.22D-01 | -.18D-01 | 0.56D-02 | -.36D-02 | -.34D-03 | 0.54D-02 | 0.61D-02 | -.23D-02 | 0.41D-03 | 0.26D-02 | -.29D-03 | 0.64D-01 |
| 23/ 5/ 1 | 5 | 4 | 0.15D-02 | 0.19D-01 | 0.29D-01 | 0.11D-01 | -.27D-01 | 0.81D-03 | -.16D-01 | 0.15D-01 | -.64D-03 | -.15D-01 | 0.13D-02 | -.11D 00 |
| 23/ 5/ 1 | 5 | 4 | 0.35D-01 | 0.30D-01 | -.83D-02 | 0.55D-02 | 0.12D-02 | -.95D-02 | -.96D-02 | 0.38D-02 | -.68D-03 | -.46D-02 | 0.47D-03 | -.20D-01 |
| 23/ 5/ 1 | 5 | 5 | 0.43D-02 | 0.32D-01 | -.33D-01 | 0.19D-01 | -.45D-01 | -.33D-03 | -.26D-01 | 0.25D-01 | 0.14D-04 | -.25D-01 | 0.23D-02 | -.19D 00 |
| 23/ 5/ 1 | 5 | 5 | 0.58D-01 | 0.51D-01 | -.93D-01 | 0.96D-02 | -.72D-03 | -.17D-01 | -.17D-01 | 0.80D-02 | -.77D-04 | -.92D-02 | 0.10D-02 | -.47D-01 |
| 23/ 5/ 1 | 5 | 6 | 0.64D-01 | 0.29D-01 | -.82D-01 | -.82D-02 | -.13D-01 | 0.36D-01 | 0.10D-01 | -.15D-01 | -.63D-04 | 0.13D-01 | 0.34D-03 | 0.12D 00 |
| 23/ 5/ 1 | 5 | 8 | -.48D-01 | -.73D-02 | 0.58D-01 | 0.16D-01 | 0.55D-02 | -.48D-01 | 0.30D-01 | 0.23D-01 | -.25D-04 | -.24D-01 | 0.39D-01 | -.59D-01 |
| 23/ 5/15 | 6 | 1 | -.53D-01 | 0.10D 00 | 0.23D-01 | -.89D-02 | 0.93D-02 | 0.16D-01 | 0.88D-02 | -.15D-01 | 0.11D-03 | 0.14D-01 | -.44D-02 | 0.91D-01 |
| 23/ 5/15 | 6 | 2 | -.15D-01 | -.35D-01 | 0.87D 00 | -.62D-02 | 0.22D-01 | 0.16D-01 | 0.10D-01 | -.22D-01 | -.11D-01 | 0.16D-01 | -.25D-02 | 0.14D 00 |
| 23/ 5/15 | 6 | 3 | -.18D-01 | -.15D-01 | 0.80D-02 | -.32D-02 | -.57D-03 | 0.48D-02 | 0.61D-02 | -.20D-02 | 0.28D-03 | 0.23D-02 | -.17D-03 | 0.61D-01 |
| 23/ 5/15 | 6 | 4 | 0.31D-01 | 0.26D-01 | -.14D-01 | 0.56D-02 | 0.99D-03 | -.84D-02 | -.11D-01 | 0.35D-02 | -.45D-03 | -.41D-02 | 0.30D-03 | -.17D-01 |
| 23/ 5/15 | 6 | 5 | 0.52D-01 | 0.45D-01 | -.85D-01 | 0.95D-02 | 0.99D-06 | -.15D-01 | -.18D-01 | 0.71D-02 | -.32D-04 | -.78D-02 | 0.67D-03 | -.39D-01 |
| 23/ 5/15 | 6 | 6 | 0.57D-01 | 0.24D-01 | -.76D-01 | -.65D-02 | -.12D-01 | 0.34D-01 | 0.79D-02 | -.15D-01 | -.63D-05 | 0.13D-01 | 0.21D-02 | 0.12D 00 |
| 23/ 5/29 | 7 | 1 | -.46D-01 | 0.88D-01 | 0.25D-01 | -.82D-02 | 0.83D-02 | 0.15D-01 | 0.84D-02 | -.13D-01 | 0.39D-04 | 0.13D-01 | -.38D-02 | 0.82D-01 |
| 23/ 5/29 | 7 | 2 | -.21D-01 | -.27D-01 | 0.71D 00 | -.60D-02 | 0.14D-01 | 0.15D-01 | 0.10D-01 | -.11D-01 | -.80D-02 | 0.12D-01 | -.20D-02 | 0.10D 00 |
| 23/ 5/29 | 7 | 3 | -.16D-01 | -.13D-01 | 0.92D-02 | -.32D-02 | -.56D-03 | 0.44D-02 | 0.62D-02 | -.17D-02 | 0.21D-03 | 0.21D-02 | -.15D-03 | 0.58D-01 |
| 23/ 5/29 | 7 | 4 | 0.29D-01 | 0.24D-01 | -.17D-01 | 0.59D-02 | 0.99D-03 | -.76D-02 | -.11D-01 | 0.29D-02 | -.37D-03 | -.36D-02 | 0.27D-03 | -.14D-01 |
| 23/ 5/29 | 7 | 5 | 0.46D-01 | 0.41D-01 | -.80D-01 | 0.10D-01 | 0.59D-03 | -.13D-01 | -.19D-01 | 0.68D-02 | -.14D-04 | -.68D-02 | 0.57D-03 | -.31D-01 |
| 23/ 5/29 | 7 | 6 | 0.54D-01 | 0.20D-01 | -.72D-01 | -.48D-02 | -.10D-01 | 0.34D-01 | 0.46D-02 | -.17D-01 | 0.12D-04 | 0.13D-01 | 0.20D-02 | 0.12D 00 |
| 23/ 5/29 | 7 | 8 | -.41D-01 | -.49D-02 | 0.49D-01 | 0.15D-01 | 0.43D-02 | -.41D-01 | 0.28D-01 | 0.22D-01 | -.23D-04 | -.21D-01 | 0.38D-01 | -.41D-01 |
| 23/ 5/48 | 8 | 1 | -.40D-01 | 0.76D-01 | 0.25D-01 | -.85D-02 | 0.69D-02 | 0.14D-01 | 0.80D-02 | -.12D-01 | 0.20D-04 | 0.12D-01 | -.43D-02 | 0.76D-01 |

1 FOR SUBSCRIPTS SEE THE HEADING DEFINITION. UNITS ARE (UNIT OF THE CORRESPONDING ELEMENT OF THE STATE VECTOR)/(UNIT OF THE OBSERVATION).

2 THESE CORRESPOND TO $\hat{x}_1$ AND $x_2$ RATHER THAN a AND b

Figure 7-8. Recursive Estimator Gain Table From OABIAS

CABIAS SUMMARY OUTPUT FOR 74/ 1/ 4
ATTITUDE, OBSERVABLE, AND VECTOR TABLE
BLOCK 1 PASS NO. 1

| TIME HH/MM/SS | FRA NUM | TYPE | ALPHA DEG (1) | DELTA DEG | Z | [illegible] | Y | YC | SUN VECTOR (2) | | | SATELLITE POSITION VECTOR (3) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | 351.145 | -19.989 | -.690D-07 | 0.340D-01 | 0.110D 01 | 0.110D 01 | 0.246 | -0.889 | -0.386 | -0.830 (4)<br>-0.831 (5) | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/ 3 | 1 | 2 | 351.145 | -19.980 | -.130D-05 | 0.300D-01 | 0.0 | -.240D-10 | 0.246 | -0.889 | -0.386 | -0.830<br>-0.831 | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/ 3 | 1 | 3 | 350.957 | -19.514 | 0.280D-02 | 0.760D 00 | 0.0 | -.490D-02 | 0.246 | -0.889 | -0.386 | -0.830<br>-0.831 | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/ 3 | 1 | 4 | 350.904 | -19.226 | -.200D-02 | 0.760D 00 | 0.0 | 0.350D-02 | 0.246 | -0.889 | -0.386 | -0.830<br>-0.831 | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/ 3 | 1 | 5 | 350.877 | -19.144 | -.140D-02 | 0.260D 00 | 0.340D 01 | 0.340D 01 | 0.246 | -0.889 | -0.386 | -0.830<br>-0.831 | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/ 3 | 1 | 6 | 350.913 | -19.306 | 0.280D-02 | 0.250D 00 | 0.890D 00 | 0.880D 00 | 0.246 | -0.889 | -0.386 | -0.830<br>-0.831 | 0.835<br>0.834 | -0.518<br>-0.519 |
| 23/ 4/18 | 2 | 1 | 350.920 | -19.299 | 0.140D-03 | 0.340D-01 | 0.110D 01 | 0.110D 01 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 2 | 350.919 | -19.291 | -.100D-03 | 0.300D-01 | 0.0 | 0.180D-03 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 3 | 350.929 | -19.319 | -.190D-02 | 0.760D 00 | 0.0 | 0.340D-02 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 4 | 350.981 | -19.381 | 0.270D-02 | 0.760D 00 | 0.0 | -.470D-02 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 5 | 350.968 | -19.427 | 0.250D-02 | 0.260D 00 | 0.340D 01 | 0.340D 01 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 6 | 351.001 | -19.610 | 0.830D-02 | 0.250D 00 | 0.880D 00 | 0.870D 00 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.848 | 0.826<br>0.825 | -0.526<br>-0.527 |
| 23/ 4/18 | 2 | 8 | 351.000 | -19.639 | -.310D-02 | 0.260D 00 | 0.290D 01 | 0.290D 01 | 0.246 | -0.889 | -0.386 | -0.847<br>-0.847 | 0.826<br>0.826 | -0.526<br>-0.527 |
| 23/ 4/32 | 3 | 1 | 351.004 | -19.635 | 0.170D-03 | 0.340D-01 | 0.110D 01 | 0.110D 01 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 2 | 351.009 | -19.630 | -.160D-02 | 0.300D-01 | 0.0 | 0.280D-02 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 3 | 351.008 | -19.630 | -.140D-03 | 0.760D 00 | 0.0 | 0.240D-03 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 3 | 351.032 | -19.694 | -.830D-02 | 0.760D 00 | 0.0 | 0.140D-01 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 4 | 351.032 | -19.694 | -.320D-03 | 0.760D 00 | 0.0 | 0.560D-03 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 4 | 351.053 | -19.865 | 0.120D-01 | 0.760D 00 | 0.0 | -.220D-01 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 5 | 351.057 | -19.863 | 0.180D-02 | 0.260D 00 | 0.250D 01 | 0.250D 01 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 5 | 351.157 | -20.023 | 0.130D-01 | 0.260D 00 | 0.340D 01 | 0.340D 01 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/32 | 3 | 6 | 351.161 | -20.156 | 0.950D-02 | 0.250D 00 | 0.870D 00 | 0.860D 00 | 0.246 | -0.889 | -0.386 | -0.863<br>-0.864 | 0.817<br>0.817 | -0.534<br>-0.535 |
| 23/ 4/46 | 4 | 1 | 351.162 | -20.165 | 0.610D-04 | 0.340D-01 | 0.110D 01 | 0.110D 01 | 0.246 | -0.889 | -0.386 | -0.880<br>-0.860 | 0.808<br>0.808 | -0.542<br>-0.542 |
| 23/ 4/46 | 4 | 2 | 351.112 | -20.106 | 0.610D-02 | 0.300D-01 | 0.0 | -.110D-01 | 0.246 | -0.889 | -0.386 | -0.880<br>-0.880 | 0.808<br>0.808 | -0.542<br>-0.542 |
| 23/ 4/46 | 4 | 3 | 351.110 | -20.101 | 0.760D-03 | 0.760D 00 | 0.0 | -.130D-02 | 0.246 | -0.889 | -0.386 | -0.880<br>-0.880 | 0.808<br>0.808 | -0.542<br>-0.542 |
| 23/ 4/46 | 4 | 4 | 351.106 | -20.088 | -.120D-02 | 0.760D 00 | 0.0 | 0.210D-02 | 0.246 | -0.889 | -0.386 | -0.880 | 0.808 | -0.542 |

1 FOR DEFINITION, SEE THE HEADING DEFINITION FIGURE 7-4
2 THREE COMPONENTS OF THE UNIT SUN VECTOR IN G.I. COORDINATES
3 THREE COMPONENTS OF THE VECTOR FROM THE CENTRAL BODY TO THE SPACECRAFT IN G.I. COORDINATES IN UNITS OF EARTH RADII
4 SATELLITE UNIT POSITION VECTOR (G.I.) ON CENTRAL BODY IN TRIGGERING
5 SATELLITE UNIT POSITION VECTOR (G.I.) ON CENTRAL BODY OUT TRIGGERING

Figure 7-9. Attitude, Observable, and Vector Table From OABIAS




PRELIMINARY DRAFT

OABIAS 5 / OUTPUT FOR 74/ 1/ 4
RESIDUAL TABLE
BLOCK 1 PASS NO. 1

| TIME HH/MM/SS | FRA NUM | TYPE | MODEL | ① SUM OF SQUARES | SUM OF RESIDUALS | MEAN RESIDUALS | ② STANDARD DEVIATION | NO. OF RESIDUALS COMPUTED |
|---|---|---|---|---|---|---|---|---|
| 23/ 4/ 3 | 1 | 1 | | 0.48021D-14 | -.69297D-07 | -.69297D-07 | 0.0 | 1 |
| 23/ 4/ 3 | 1 | 2 | | 0.16197D-11 | -.12727D-05 | -.12727D-05 | 0.0 | 1 |
| 23/ 4/ 3 | 1 | 3 | | 0.78931D-05 | 0.28095D-02 | 0.28095D-02 | 0.0 | 1 |
| 23/ 4/ 3 | 1 | 4 | | 0.39746D-05 | -.19937D-02 | -.19937D-02 | 0.0 | 1 |
| 23/ 4/ 3 | 1 | 5 | | 0.18591D-05 | -.13635D-02 | -.13635D-02 | 0.0 | 1 |
| 23/ 4/ 3 | 1 | 6 | | 0.80571D-05 | 0.28455D-02 | 0.28455D-02 | 0.0 | 1 |
| 23/ 4/18 | 2 | 1 | | 0.19616D-07 | 0.13999D-03 | 0.69994D-04 | 0.99065D-04 | 2 |
| 23/ 4/18 | 2 | 2 | | 0.10746D-07 | -.10493D-03 | -.52463D-04 | 0.72394D-04 | 2 |
| 23/ 4/18 | 2 | 3 | | 0.11692D-04 | 0.86050D-03 | 0.43025D-03 | 0.33647D-02 | 2 |
| 23/ 4/18 | 2 | 4 | | 0.11069D-04 | 0.66978D-03 | 0.33489D-03 | 0.32931D-02 | 2 |
| 23/ 4/18 | 2 | 5 | | 0.81230D-05 | 0.11393D-02 | 0.56965D-03 | 0.27339D-02 | 2 |
| 23/ 4/18 | 2 | 6 | | 0.72595D-04 | 0.10871D-01 | 0.54356D-02 | 0.36629D-02 | 2 |
| 23/ 4/18 | 2 | 8 | | 0.93878D-05 | -.30640D-02 | -.30640D-02 | 0.0 | 1 |
| 23/ 4/32 | 3 | 1 | | 0.49492D-07 | 0.31285D-03 | 0.10428D-03 | 0.91849D-04 | 3 |
| 23/ 4/32 | 3 | 2 | | 0.26728D-05 | -.17365D-02 | -.57883D-03 | 0.91314D-03 | 3 |
| 23/ 4/32 | 3 | 3 | | 0.11710D-04 | 0.72428D-03 | 0.24143D-03 | 0.24016D-02 | 3 |
| 23/ 4/32 | 3 | 3 | | 0.80363D-04 | -.75614D-02 | -.18904D-02 | 0.46925D-02 | 4 |
| 23/ 4/32 | 3 | 4 | | 0.11174D-04 | 0.34633D-03 | 0.11544D-03 | 0.23594D-02 | 3 |
| 23/ 4/32 | 3 | 4 | | 0.16546D-03 | 0.12768D-01 | 0.31919D-02 | 0.64474D-02 | 4 |
| 23/ 4/32 | 3 | 5 | | 0.11195D-04 | 0.28921D-02 | 0.96403D-03 | 0.20503D-02 | 3 |
| 23/ 4/32 | 3 | 5 | | 0.19092D-03 | 0.16298D-01 | 0.40746D-02 | 0.64424D-02 | 4 |
| 23/ 4/32 | 3 | 6 | | 0.16247D-03 | 0.20356D-01 | 0.67853D-02 | 0.34651D-02 | 3 |
| 23/ 4/46 | 4 | 1 | | 0.53207D-07 | 0.37375D-03 | 0.93437D-04 | 0.78069D-04 | 4 |
| 23/ 4/46 | 4 | 2 | | 0.40475D-04 | 0.44122D-02 | 0.11031D-02 | 0.34454D-02 | 4 |
| 23/ 4/46 | 4 | 3 | | 0.80945D-04 | -.67986D-02 | -.13597D-02 | 0.42338D-02 | 5 |
| 23/ 4/46 | 4 | 4 | | 0.16695D-03 | 0.11547D-01 | 0.23093D-02 | 0.59221D-02 | 5 |
| 23/ 4/46 | 4 | 5 | | 0.24911D-03 | 0.86701D-02 | 0.17340D-02 | 0.76498D-02 | 5 |
| 23/ 4/46 | 4 | 6 | | 0.16537D-03 | 0.18654D-01 | 0.46634D-02 | 0.51113D-02 | 4 |
| 23/ 5/ 1 | 5 | 1 | | 0.98612D-07 | 0.58684D-03 | 0.11737D-03 | 0.66222D-04 | 5 |
| 23/ 5/ 1 | 5 | 2 | | 0.41217D-04 | 0.35536D-02 | 0.71073D-03 | 0.31101D-02 | 5 |
| 23/ 5/ 1 | 5 | 3 | | 0.94874D-04 | -.30665D-02 | -.51108D-03 | 0.43159D-02 | 6 |
| 23/ 5/ 1 | 5 | 3 | | 0.11912D-03 | 0.83782D-03 | 0.11969D-03 | 0.42621D-02 | 7 |
| 23/ 5/ 1 | 5 | 4 | | 0.20641D-03 | 0.17828D-01 | 0.29714D-02 | 0.55396D-02 | 6 |
| 23/ 5/ 1 | 5 | 4 | | 0.25138D-03 | 0.11123D-01 | 0.15890D-02 | 0.62410D-02 | 7 |
| 23/ 5/ 1 | 5 | 5 | | 0.29686D-03 | 0.15580D-01 | 0.25967D-02 | 0.71611D-02 | 6 |
| 23/ 5/ 1 | 5 | 5 | | 0.32511D-03 | 0.10266D-01 | 0.14665D-02 | 0.71866D-02 | 7 |
| 23/ 5/ 1 | 5 | 6 | | 0.29524D-03 | 0.72573D-02 | 0.14515D-02 | 0.84367D-02 | 5 |
| 23/ 5/ 1 | 5 | 8 | | 0.10242D-04 | -.21396D-02 | -.10698D-02 | 0.28202D-02 | 2 |
| 23/ 5/15 | 6 | 1 | | 0.10352D-06 | 0.65699D-03 | 0.10950D-03 | 0.79451D-04 | 6 |
| 23/ 5/15 | 6 | 2 | | 0.43019D-04 | 0.48960D-02 | 0.81601D-03 | 0.27937D-02 | 6 |
| 23/ 5/15 | 6 | 3 | | 0.11077D-03 | 0.16426D-02 | 0.20533D-03 | 0.39718D-02 | 8 |
| 23/ 5/18 | 6 | 4 | | 0.23334D-03 | 0.97201D-02 | 0.12150D-02 | 0.56741D-02 | 8 |
| 23/ 5/18 | 6 | 5 | | 0.33296D-03 | 0.74644D-02 | 0.93305D-03 | 0.68242D-02 | 8 |
| 23/ 5/15 | 6 | 6 | | 0.38466D-03 | 0.16706D-01 | 0.27847D-02 | 0.82224D-02 | 6 |
| 23/ 5/29 | 7 | 1 | | 0.11550D-06 | 0.76640D-03 | 0.10949D-03 | 0.72565D-04 | 7 |
| 23/ 5/29 | 7 | 2 | | 0.49470D-04 | 0.23561D-02 | 0.33659D-03 | 0.28483D-02 | 7 |
| 23/ 5/29 | 7 | 3 | | 0.11306D-03 | 0.12796D-03 | 0.14217D-04 | 0.37593D-02 | 9 |
| 23/ 5/29 | 7 | 4 | | 0.26061D-03 | 0.12417D-01 | 0.13796D-02 | 0.55168D-02 | 9 |
| 23/ 5/29 | 7 | 5 | | 0.36175D-03 | 0.12831D-01 | 0.14256D-02 | 0.65523D-02 | 9 |
| 23/ 5/29 | 7 | 6 | | 0.50920D-03 | 0.27872D-01 | 0.39817D-02 | 0.81468D-02 | 7 |
| 23/ 5/29 | 7 | 8 | | 0.11125D-04 | -.30790D-02 | -.10263D-02 | 0.19956D-02 | 3 |

1 SUM OF SQUARES OF THE RESIDUAL OF EACH MODEL.

2 THE UNITS ARE.

| TYPE | UNIT | TYPE | UNIT |
|---|---|---|---|
| 1 | RADIAN | 5 | SECOND |
| 2 | SECOND | 6 | SECOND |
| 3 | SECOND | 7 | RADIAN |
| 4 | SECOND | 8 | SECOND |

Figure 7-10. Residual Table From OABIAS (1 of 2)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 23/ 9/16 | 22 | 1 | | 0.237460D-06 | 0.204970D-02 | 0.931690D-04 | 0.470540D-04 | 22 |
| 23/ 9/16 | 22 | 2 | | 0.249710D-03 | 0.597460D-02 | 0.271570D-03 | 0.343710D-02 | 22 |
| 23/ 9/16 | 22 | 3 | | 0.276170D-03 | -.410120D-02 | -.110840D-03 | 0.276750D-02 | 37 |
| 23/ 9/16 | 22 | 3 | | 0.276310D-03 | -.373550D-02 | -.983020D-04 | 0.273090D-02 | 38 |
| 23/ 9/16 | 22 | 4 | | 0.105480D-02 | 0.263250D-01 | 0.711490D-03 | 0.536480D-02 | 37 |
| 23/ 9/16 | 22 | 4 | | 0.105550D-02 | 0.252890D-01 | 0.665510D-03 | 0.529540D-02 | 38 |
| 23/ 9/16 | 22 | 5 | | 0.184840D-02 | 0.233690D-01 | 0.631580D-03 | 0.713690D-02 | 37 |
| 23/ 9/16 | 22 | 5 | | 0.185010D-02 | 0.220770D-01 | 0.580960D-03 | 0.704670D-02 | 38 |
| 23/ 9/16 | 22 | 6 | | 0.116570D-02 | 0.273040D-01 | 0.124110D-02 | 0.740600D-02 | 22 |
| 23/ 9/16 | 22 | 8 | | 0.144700D-03 | -.220060D-02 | -.157190D-03 | 0.333230D-02 | 14 |
| 23/ 9/31 | 23 | 1 | | 0.257960D-06 | 0.219290D-02 | 0.953450D-04 | 0.471420D-04 | 23 |
| 23/ 9/31 | 23 | 2 | | 0.265560D-03 | 0.199430D-02 | 0.607100D-04 | 0.347320D-02 | 23 |
| 23/ 9/31 | 23 | 3 | | 0.276560D-03 | -.425830D-02 | -.109190D-03 | 0.269560D-02 | 39 |
| 23/ 9/31 | 23 | 3 | | 0.294200D-03 | -.845590D-02 | -.211400D-03 | 0.273820D-02 | 40 |
| 23/ 9/31 | 23 | 4 | | 0.105830D-02 | 0.237590D-01 | 0.609200D-03 | 0.524100D-02 | 39 |
| 23/ 9/31 | 23 | 4 | | 0.120100D-02 | 0.357070D-01 | 0.892600D-03 | 0.547520D-02 | 40 |
| 23/ 9/31 | 23 | 5 | | 0.185940D-02 | 0.251230D-01 | 0.644150D-03 | 0.696460D-02 | 39 |
| 23/ 9/31 | 23 | 5 | | 0.211580D-02 | 0.411360D-01 | 0.102840D-^2 | 0.729150D-02 | 40 |
| 23/ 9/31 | 23 | 6 | | 0.130880D-02 | 0.383970D-01 | 0.166940D-02 | 0.752170D-02 | 23 |
| 23/ 9/31 | 23 | 8 | | 0.236790D-03 | 0.739590D-02 | 0.493060D-03 | 0.408090D-02 | 15 |
| 23/ 9/45 | 24 | 1 | | 0.281190D-06 | 0.234530D-02 | 0.977200D-04 | 0.475510D-04 | 24 |
| 23/ 9/45 | 24 | 2 | | 0.265620D-03 | 0.174670D-02 | 0.727800D-04 | 0.335750D-02 | 24 |
| 23/ 9/45 | 24 | 3 | | 0.295430D-03 | -.734690D-02 | -.179190D-03 | 0.271160D-02 | 41 |
| 23/ 9/45 | 24 | 3 | | 0.306320D-03 | -.106470D-01 | -.253500D-03 | 0.272130D-02 | 42 |
| 23/ 9/45 | 24 | 4 | | 0.121260D-02 | 0.391050D-01 | 0.953790D-03 | 0.542050D-02 | 41 |
| 23/ 9/45 | 24 | 4 | | 0.130740D-02 | 0.488420D-01 | 0.116290D-02 | 0.552280D-02 | 42 |
| 23/ 9/45 | 24 | 5 | | 0.212960D-02 | 0.448460D-01 | 0.109380D-02 | 0.721200D-02 | 41 |
| 23/ 9/45 | 24 | 5 | | 0.222520D-02 | 0.546270D-01 | 0.130060D-02 | 0.724850D-02 | 42 |
| 23/ 9/45 | 24 | 6 | | 0.133050D-02 | 0.430540D-01 | 0.179390D-02 | 0.738160D-02 | 24 |
| 23/ 9/45 | 24 | 8 | | 0.282780D-03 | 0.141770D-01 | 0.886070D-03 | 0.424430D-02 | 16 |
| 23/10/ 0 | 25 | 1 | | 0.303790D-06 | 0.249560D-02 | 0.998250D-04 | 0.477260D-04 | 25 |
| 23/10/ 0 | 25 | 2 | | 0.275700D-03 | 0.492220D-02 | 0.196890D-03 | 0.338340D-02 | 25 |
| 23/10/ 0 | 25 | 3 | | 0.306820D-03 | -.100930D-01 | -.234720D-03 | 0.269150D-02 | 43 |
| 23/10/ 0 | 25 | 3 | | 0.308150D-03 | -.113280D-01 | -.257460D-03 | 0.266430D-02 | 44 |
| 23/10/ 0 | 25 | 4 | | 0.131050D-02 | 0.505990D-01 | 0.117670D-02 | 0.545740D-02 | 43 |
| 23/10/ 0 | 25 | 4 | | 0.132510D-02 | 0.544200D-01 | 0.123680D-02 | 0.540630D-02 | 44 |
| 23/10/ 0 | 25 | 5 | | 0.222840D-02 | 0.528400D-01 | 0.122880D-02 | 0.717720D-02 | 43 |
| 23/10/ 0 | 25 | 5 | (1) | 0.222850D-02 | 0.530420D-01 | 0.120550D-02 | 0.709490D-02 | 44 |
| 23/10/ 0 | 25 | 6 | | 0.133140D-02 | 0.440370D-01 | 0.176150D-02 | 0.722800D-02 | 25 |
| 23/10/ 0 | 25 | 8 | | 0.283310D-03 | 0.134490D-01 | 0.791090D-03 | 0.412620D-02 | 17 |
| 23/10/ 0 | 25 | 14 | SANMOD | 0.303790D-06 | 0.249560D-02 | 0.998250D-04 | 0.477260D-04 | 25 |
| 23/10/ 0 | 25 | 14 | STMMOD | 0.275700D-03 | 0.492220D-02 | 0.196890D-03 | 0.338340D-02 | 25 |
| 23/10/ 0 | 25 | 14 | LRMOD | 0.308150D-03 | -.113280D-01 | -.257460D-03 | 0.266430D-02 | 44 |
| 23/10/ 0 | 25 | 14 | LNMOD | 0.132510D-02 | 0.544200D-01 | 0.123680D-02 | 0.540630D-02 | 44 |
| 23/10/ 0 | 25 | 14 | DIAMOD | 0.222850D-02 | 0.530420D-01 | 0.120550D-02 | 0.709490D-02 | 44 |
| 23/10/ 0 | 25 | 14 | DHMOD | 0.133140D-02 | 0.440370D-01 | 0.176150D-02 | 0.722800D-02 | 25 |
| 23/10/ 0 | 25 | 14 | SMDMOD | 0.283310D-03 | 0.134490D-01 | 0.791090D-03 | 0.412620D-02 | 17 |

1 THESE SYMBOLS ARE ABBREVIATIONS FOR THE MODELS AS FOLLOWS

| | | | |
|---|---|---|---|
| SANMOD | SUN ANGLE MODEL | DIAMOD | SINGLE HORIZON DIHEDRAL ANGLE MODEL |
| STMMOD | SUN TIME MODEL | DHMOD | DOUBLE HORIZON SCAN WIDTH MODEL |
| LHMOD | NADIR VECTOR PROJECTION MODEL | SCBMOD | SMALL TARGET NADIR ANGLE MODEL |
| LNMOD | HORIZON TIME MODEL | SMDMOD | SCAN MID TIME DIHEDRAL ANGLE MODEL |

Figure 7-10. Residual Table From OABIAS (2 of 2)

PRELIMINARY DRAFT

```
***** ERROR IN FRAME   4 FROM LNMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   4 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   4 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   6 FROM LRMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   6 FROM LNMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   6 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   6 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   7 FROM LRMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   7 FROM LNMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME   7 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  11 FROM LRMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  11 FROM LNMOD  -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  11 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  11 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  16 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  18 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
***** ERROR IN FRAME  21 FROM DIAMCD -  DATA REJECT - REJOPT = 1, REJ = 0
```

Figure 7-11. Error Messages From OABIAS

7.12.5.10 Error Summary Count Table

The error summary count table contains the number of errors that occurred in each subroutine during the pass. This table is printed on FORTRAN unit number ERUNIT. If IDUMPL is set to zero, only this table is printed and the error messages shown in Figure 7-11 are not printed. Figure 7-12 shows the error summary count table generated in the sample problem. See Section 7.16.4 for a description of the error messages corresponding to the locations in the error summary count table.

7.12.5.11 State Vector Plot

Each element of the state vector is plotted on FORTRAN unit number IPRINT if IPLOT for the corresponding element is 1 or 3 . As examples, Figures 7-13 and 7-14 show the plots of the right ascension and declination of the spin axis generated in the sample problem.

7.12.5.12 Uncertainty Plot

The square root of each diagonal element of the covariance matrix (uncertainty) is plotted on FORTRAN unit number IPRINT if IPLOT for the corresponding element is 2 or 3 . As examples, the uncertainty plots for the right ascension and declination of the spin axis generated in the sample problem are shown in Figures 7-15 and 7-16, respectively.

7.12.5.13 Residual Plot

The residual for each model is plotted on FORTRAN unit number IPRINT if RESMOD for the corresponding model is .TRUE..

As examples, the residual plots for the Sun angle model and single horizon dihedral angle model are shown in Figures 7-17 and 7-18, respectively. The mean residual and standard deviation at the end of the block are also shown in these plots.

| | ERROR SUMMARY COUNT | | | | | |
|---|---|---|---|---|---|---|
| SUBROUTINE | ER 1 | ER 2 | ER 3 | ER 4 | ER 5 | ER 6 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 14 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 0 | 6 | 0 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | 0 | 6 | 0 | 0 | 0 | 0 |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 |

Figure 7-12. Error Summary Count Table From OABIAS

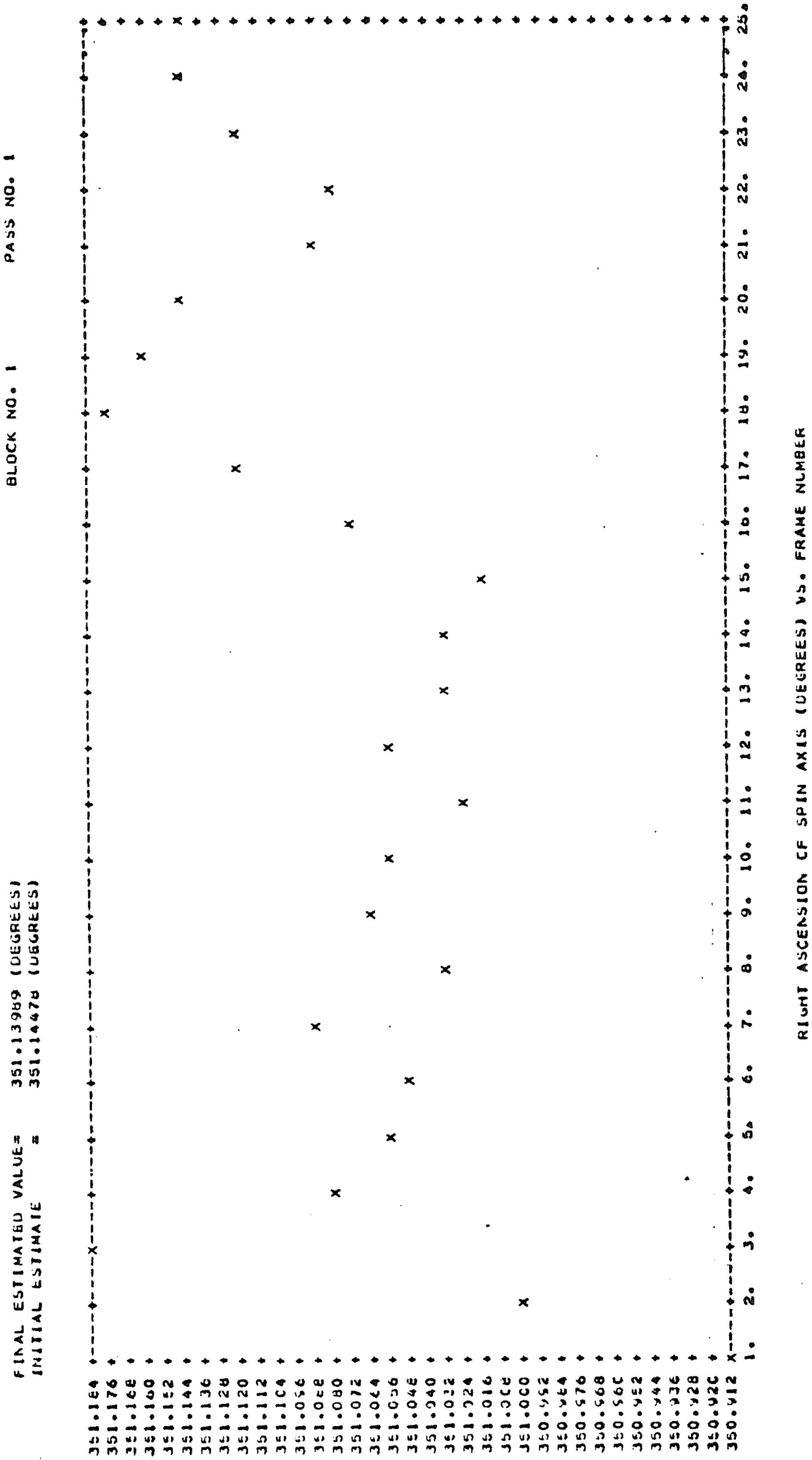


Figure 7-13. OABIAS Filter Response in Right Ascension of Spin Axis

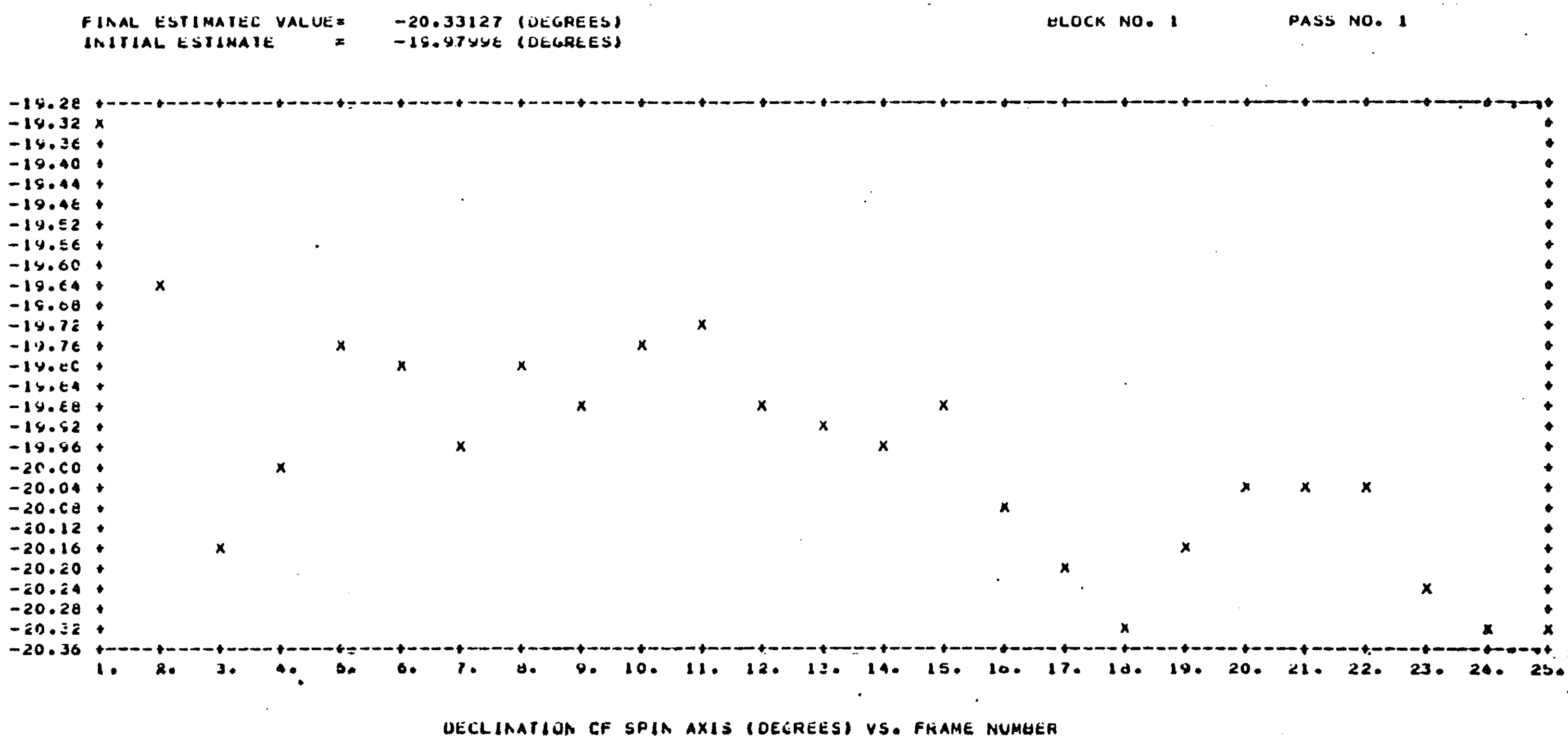


Figure 7-14. OABIAS Filter Response in Declination of Spin Axis

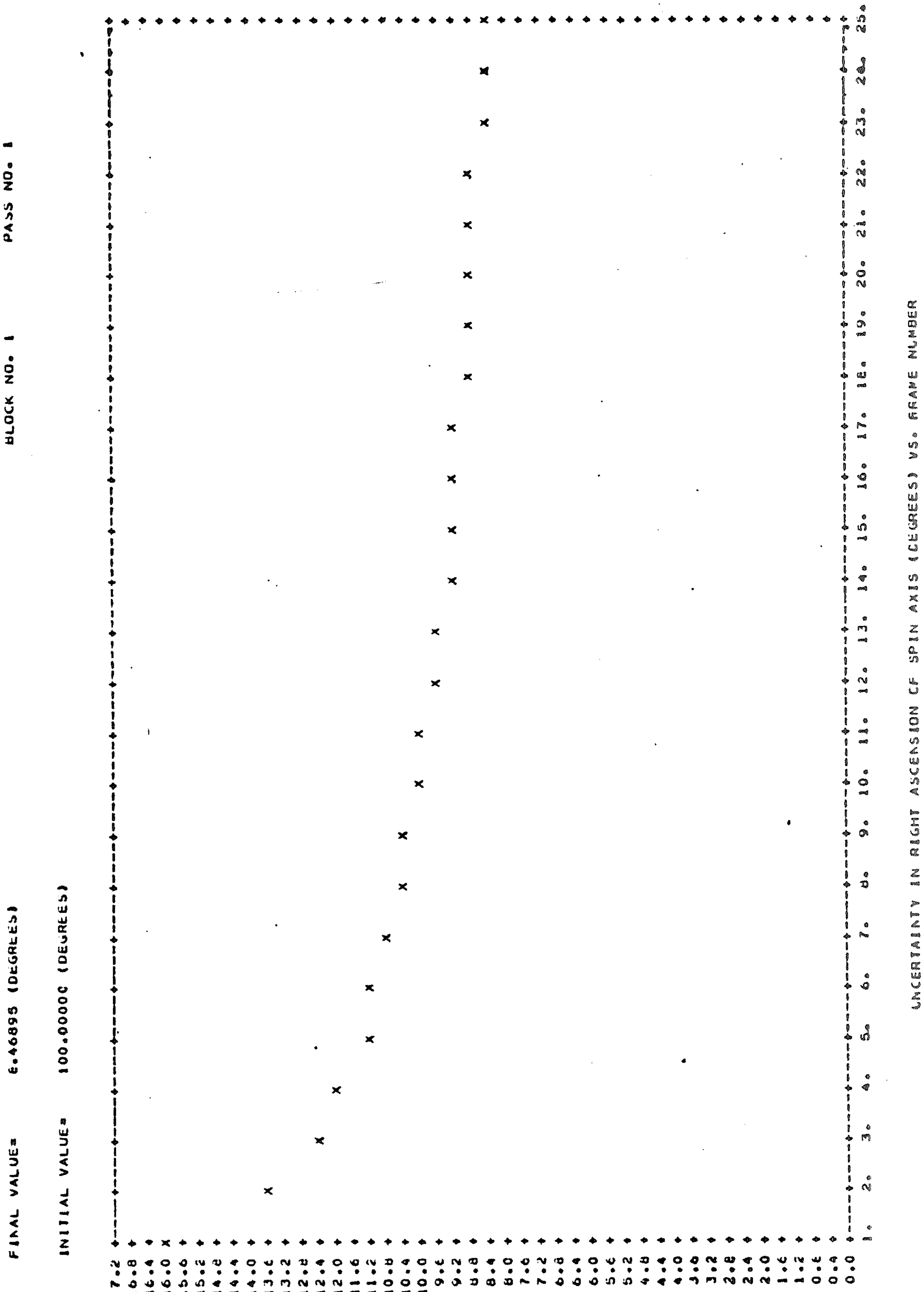


Figure 7-15. Estimated Uncertainty in Right Ascension of Spin Axis

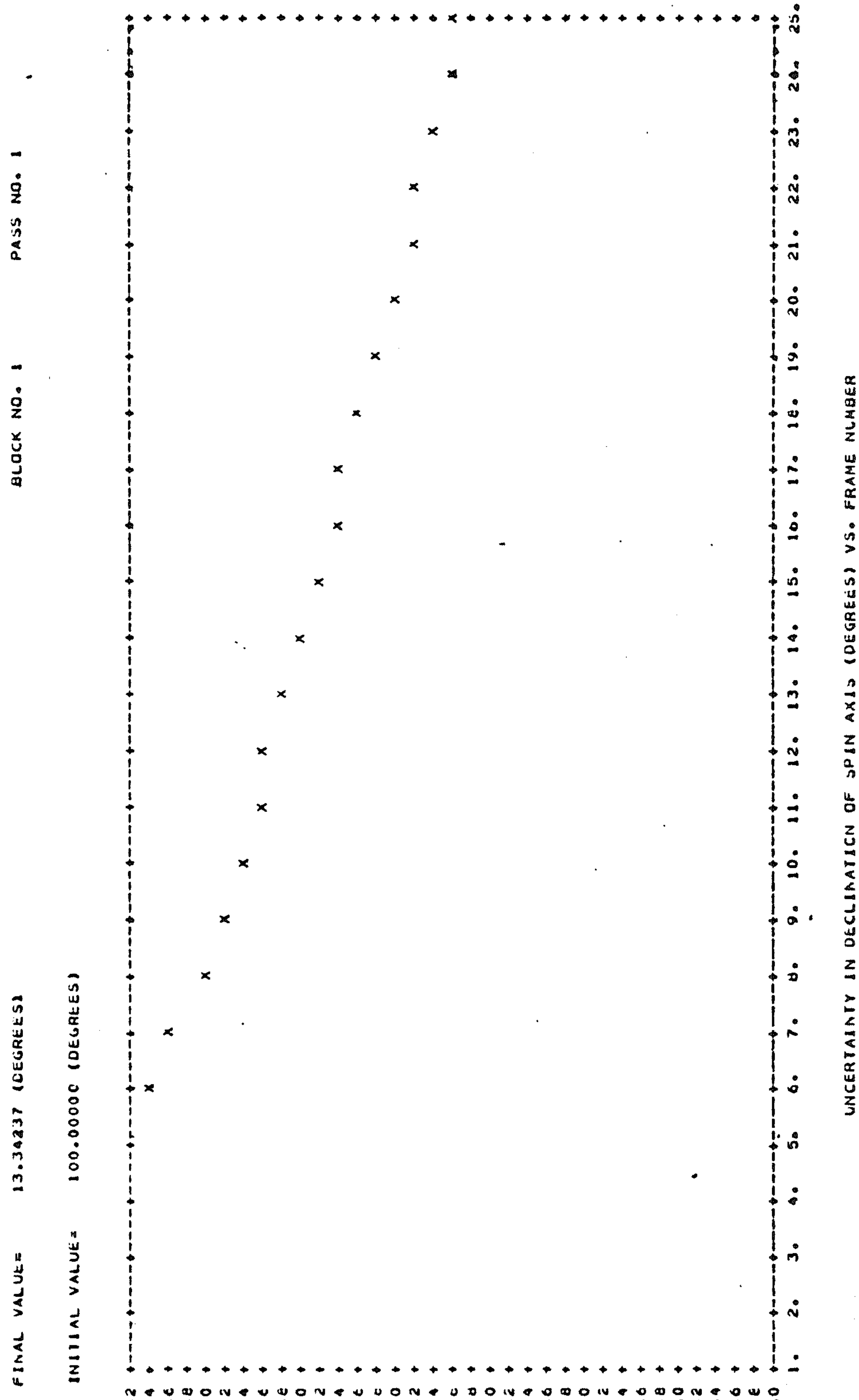


Figure 7-16. Estimated Uncertainty in Declination of Spin Axis

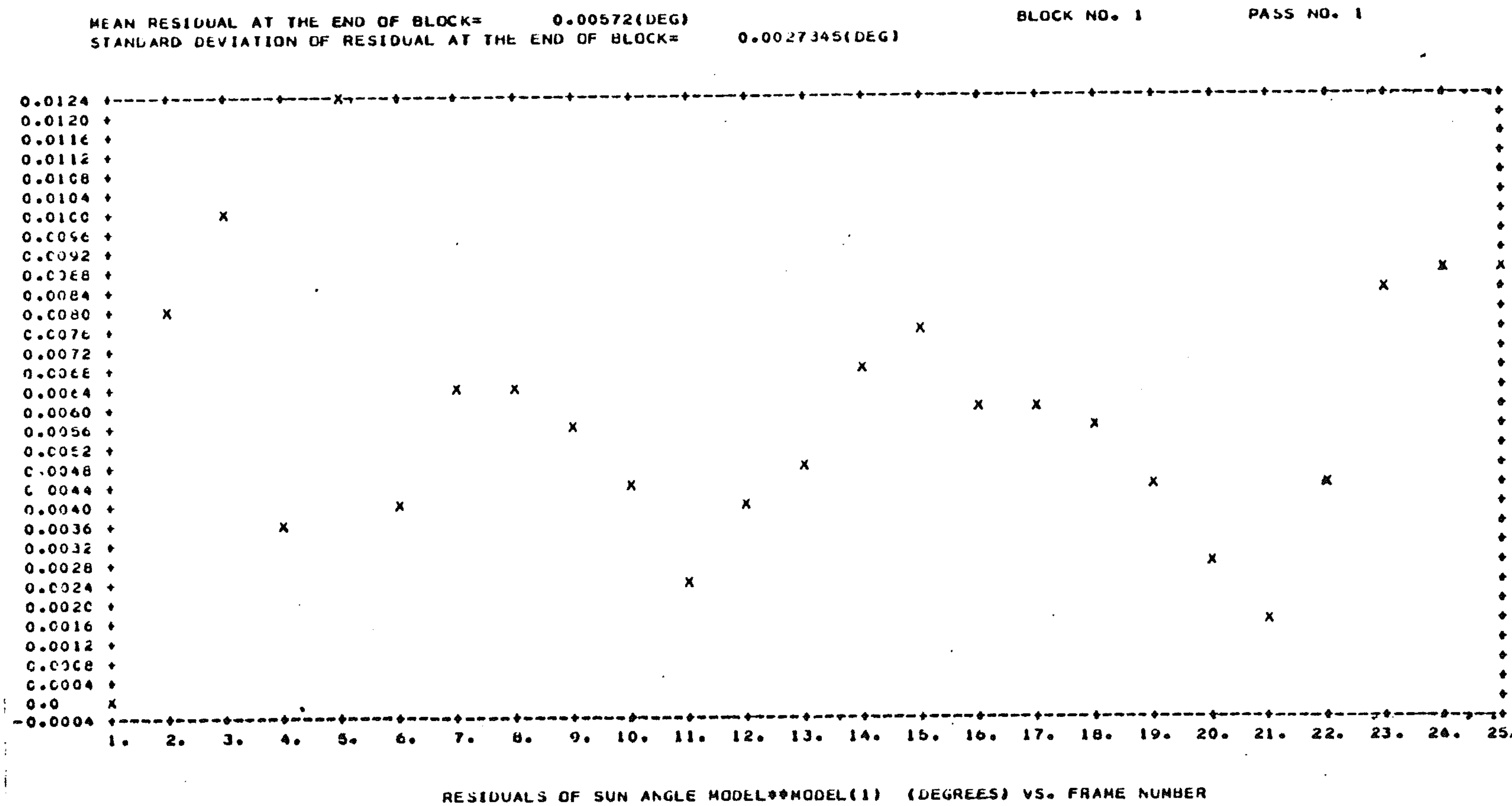


Figure 7-17. Residuals of Sun Angle Model

MEAN RESIDUAL AT END OF BLOCK= 0.00121(SEC), 0.12055(DEG)
STANDARD DEVIATION OF RESIDUAL= 0.0070949(SEC), 0.7094931(DEG)

BLOCK NO. 1 PASS NO. 1

I**CENTRAL-BODY-IN
O**CENTRAL-BODY-OUT

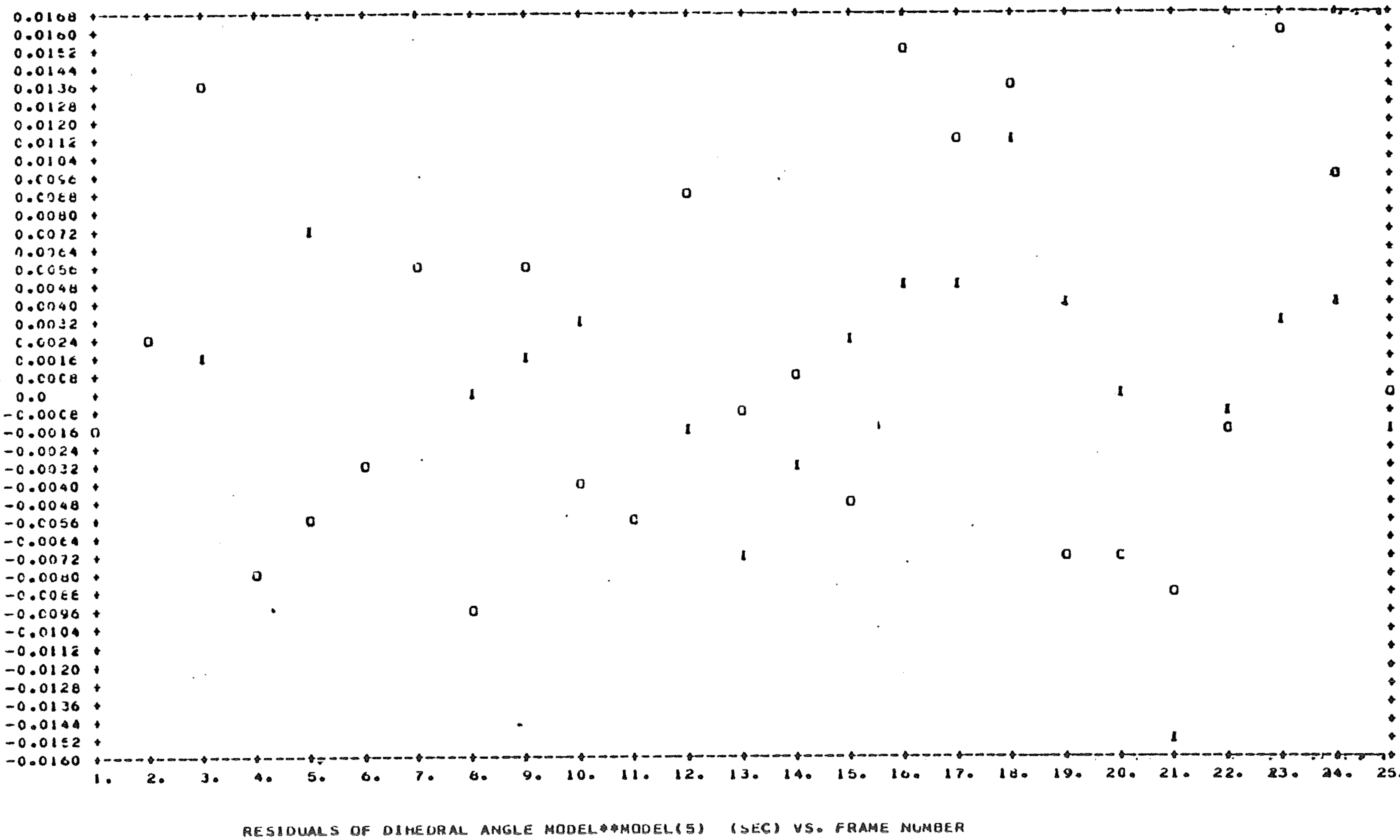


Figure 7-18. Residuals of Single Horizon Dihedral Angle Model



PRELIMINARY DRAFT

## 7.13 CALCOMP PLOT TAPE

The GESS Executive can be used to generate a CalComp plot tape of the GESS plot displays. If CalComp plots are desired, a DD card must be included for the tape. See Section 7.18 for a description of the DD card.

Following termination of the job, the tape must be taken to the CalComp plotter in the basement of Building 1 (GSFC). The user should specify plain white paper, 12 inches wide, for the plots. The number of CalComp files on the tape should be specified as 999. CalComp plotting time will be approximately 5 minutes per plot. A maximum of about 200 plots will fit on 1 reel of tape.

## 7.14 GESS DISPLAYS

This subsection describes each GESS display and provides a hard-copy example. For each control parameter display (e.g., NAMELIST display), the hard-copy example is annotated with the variable name associated with each parameter, unless the descriptor line on the display already includes the variable name. Note that certain integer control flags are displayed as alphanumeric fields rather than integers (e.g., the parameter IOBLAT is displayed as YES or NO rather than 1 and 0). In each case where this occurs, the descriptor line on the display lists all possible alphanumeric keys which are valid. The hard-copy is annotated with the corresponding parameter values in the same order.

The displays are described in the order in which they normally appear. This order should be noted so that the operator can move efficiently forward or backward to the desired display in a graphic mode.

### 7.14.1 Display Status Flags and Key Assignments

Figure 7-19 shows the display status flags and key assignments display generated from the GESS Executive. The user may alter the status of any control point from this display, as described in Reference 13. The key assignments,



PRELIMINARY DRAFT

```
************************************     G E S S     ************************************
****    AE-C   OABIAS    ***********   D I S P L A Y   ***********  74.318.19.26.24  ****
**                                                                                     **
**      XSTOPS           DISPLAY STATUS FLAGS AND KEY ASSIGNMENTS                      **
**                                                                                     **
**      XSTOPS DISPLAY                                  STOP                           **
**      ARTCOM DISPLAY                                  STOP                           **
**      MAIN CONTROL DISPLAY                            STOP                           **
**      AECOPY OPTIONS DISPLAY                          STOP                           **
**      AE DATA DISPLAY                                 SKIP                           **
**      SIMULATOR OPTIONS DISPLAY                       STOP                           **
**      NAMELIST /LIST/ DISPLAY                         STOP                           **
**      DISPLAY OF READING OPTIONS                      STOP                           **
**      HEADER RECORD DISPLAY                           STOP                           **
**      DATA RECORDS. FLAG UNPROTECTED                  STOP                           **
**      DATA RECORDS. ALL UNPROTECTED                   SKIP                           **
**      SUN ANGLE DATA                                  STOP                           **
**      SPIN RATE DATA                                  STOP                           **
**      ROTATION ANGLE DATA                             STOP                           **
**      EARTH-IN AND EARTH-OUT DATA                     STOP                           **
**      EARTH WIDTH DATA                                STOP                           **
**      SELECT DATA                                     STOP                           **
**      NAMELIST /OPMANI/ DISPLAY                       STOP                           **
**      SPACECRAFT ORBITAL ELEMENTS                     STOP                           **
**      BLOCK AVERAGE DISPLAY                           STOP                           **
**      ALPHA, INCLUDING REJECTED POINTS                STOP                           **
**      ALPHA, OMITTING REJECTED POINTS                 STOP                           **
**      DELTA, INCLUDING REJECTED POINTS                STOP                           **
**      DELTA, OMITTING REJECTED POINTS                 STOP                           **
**      ARC LENGTH UNCERTAINTY                          STOP                           **
**      NADIR PLOT                                      STOP                           **
**      DIHEDRAL PLOT                                   STOP                           **
**      NAMELIST /BIASNL/ DISPLAY                       STOP                           **
**      FINAL RESULTS FROM OABIAS                       STOP                           **
**      STATE PLOT  1                                   STOP                           **
**      STATE PLOT  2                                   STOP                           **
**      STATE PLOT  3                                   STOP                           **
**      STATE PLOT  4                                   STOP                           **
**      STATE PLOT  5                                   STOP                           **
**      STATE PLOT  6                                   STOP                           **
**      STATE PLOT  7                                   STOP                           **
**      STATE PLOT  8                                   STOP                           **
**      STATE PLOT  9                                   STOP                           **
**      STATE PLOT 10                                   STOP                           **
**      STATE PLOT 11                                   STOP                           **
**      STATE PLOT 12                                   STOP                           **
**      P DIAGONAL PLOT  1                              STOP                           **
**      P DIAGONAL PLOT  2                              STOP                           **
**      P DIAGONAL PLOT  3                              STOP                           **
**      P DIAGONAL PLOT  4                              STOP                           **
**      P DIAGONAL PLOT  5                              STOP                           **
**      P DIAGONAL PLOT  6                              STOP                           **
**      P DIAGONAL PLOT  7                              STOP                           **
**                                                                                     **
**     CPOINT=OADRI1 WHAT NOW   NEXT       CALL DISPLAY                                **
**                                                                                     **
************************************     G E S S     ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-19. Display Status Flags and Key Assignments (1 of 3)



PRELIMINARY DRAFT

PRELIMINARY DRAFT

```
*************************************     G E S S     *************************************
****    AE-C    OABIAS    ***********    D I S P L A Y    ***********    74.318.19.26.28    ****
**                                                                                          **
**      XSTOPS          DISPLAY STATUS FLAGS AND KEY ASSIGNMENTS                            **
**                                                                                          **
**      P DIAGONAL PLOT  8                        STOP                                      **
**      P DIAGONAL PLOT  9                        STOP                                      **
**      P DIAGONAL PLOT 10                        STOP                                      **
**      P DIAGONAL PLOT 11                        STOP                                      **
**      P DIAGONAL PLOT 12                        STOP                                      **
**      RESIDUAL PLOT  1                          STOP                                      **
**      RESIDUAL PLOT  2                          STOP                                      **
**      RESIDUAL PLOT  3                          STOP                                      **
**      RESIDUAL PLOT  4                          STOP                                      **
**      RESIDUAL PLOT  5                          STOP                                      **
**      RESIDUAL PLOT  6                          STOP                                      **
**      RESIDUAL PLOT  7                          STOP                                      **
**      RESIDUAL PLOT  8                          STOP                                      **
**      OPTIONS FOR DATA PREDICTION               STOP                                      **
**      ROTATION ANGLES VS. TIME                  STOP                                      **
**      ROTATION ANGLES VS. FRAME NO.             STOP                                      **
**      SCAN WIDTHS VS. TIME                      STOP                                      **
**      SCAN WIDTHS VS. FRAME NO.                 STOP                                      **
**      CORE STORAGE AND TIME DISPLAY             STOP                                      **
**                                                                                          **
**     CPOINT=OADRI1 WHAT NOW   NEXT       CALL DISPLAY                                     **
**                                                                                          **
*************************************     G E S S     *************************************
*************************************    D I S P L A Y    *************************************
```

Figure 7-19. Display Status Flags and Key Assignments (2 of 3)



PRELIMINARY DRAFT

```
****** GESS ******
**** AE-C OABIAS *********** D I S P L A Y *********** 74.318.19.26.37 ****
**     XSTOPS     DISPLAY STATUS FLAGS AND KEY ASSIGNMENTS
                 KEY     CONTROL POINT
                  0        ARTCMM
                  1        OADRI1
                  4        DATDIS
                  5        BETA
                  6        OMEGA
                  7        ROANGL
                  8        EWIDTH
                  9        OAOPTS
                 10        OPMAI1
                 11        BLKPL1
                 12        ALFPLT
                 13        DELPLT
                 14        ARCUNC
                 15        NADPLT
                 16        OABIA1
                 17        OAPLO1
                 18        STATE1
                 19        PDIAG1
                 20        RESMD1
                 22        PLOTO1
                 23        RTANGT
                 24        SCANT
                 30        XSTOPS
                 31        PRINT

**   CPOINT=OADRI1 WHAT NOW          CALL DISPLAY
****** GESS ******
****** D I S P L A Y ******
```

Figure 7-19. Display Status Flags and Key Assignments (3 of 3)





PRELIMINARY DRAFT

shown on the second page of this display, are for information only. The user may move asynchronously to this display at any time by depressing key 30.

7.14.2 Array Allocation Sizes

Figure 7-20 shows the array allocation sizes display. The user may change array allocation sizes from this display. The values of 200 for OABIAS "Data Records" may be decreased, if desired, to save core but should not be increased to more than 200. The value of 300 for "Input Data Records" may be increased to allow additional input data records for data selection purposes. Approximately 1300 input data records is the maximum that can be displayed by the 2250 display device. The value of 20 for RAE-B "Header Records" may be increased, if desired, to allow saving more than 20 header records. The user may return to this display at any time by depressing key 0. The other array sizes should not be changed by the operator.

7.14.3 Main Control Display

Figure 7-21 shows the main control display generated from OADRIV. This display contains the parameter ISIM from NAMELIST MAIN described in Section 7.3.4.

The user may return to this display at any time by depressing key 1.

7.14.4 Options for Copying AE Data Set

Figure 7-22 shows the display of options for copying the AE data set to the OABIAS data set format. This display includes parameters from NAMELIST MAIN, described in Section 7.3.4.

7.14.5 Simulator Options Display

Figure 7-23 shows the simulator options display. This display contains simulation parameters in NAMELIST MAIN, described in Section 7.3.4.

```
******************************************     G E S S        *******************************************
****   TEST    DABIAS   ************        D I S P L A Y     ***********  74.315.17.35.35  ****
**                                                                                            **
**       ARTCC 4                             MASTER NUMBERS                                   **
**                                                                                            **
**       DIRECTORY ARRAYS                                  46                                 **
**       DATA RECORDS                                     200                                 **
**       INPUT DATA RECORDS                               300                                 **
**       PLOT ARRAYS                                      803                                 **
**       HEADER RECORDS                                    20                                 **
**       WHS ARRAYS FOR AE                                220                                 **
**       UHS ARRAYS FOR AE                                 30                                 **
**       MAG ARRAYS FOR AE                                125                                 **
**       ERROR ARRAYS FOR DABIAS                           32                                 **
**       CORRELATION COEFFICIENTS                          12                                 **
**                                                                                            **
**       CPOINT=AFTCM  WHAT NOW             CALL DISPLAY          DISP   1 OF   1             **
**                                                                                            **
******************************************     G E S S        *******************************************
******************************************  D I S P L A Y     *******************************************
```

Figure 7-20.  Array Allocation Sizes

```
                                    G E S S
AE-C   OABIAS   ***********      D I S P L A Y    ***********   74.318.19.26.50
 MNOPTS                            MAIN CONTROL DISPLAY

 MSAD/OABIAS -- VERSION SMS-B,74/10/10

 ACTION (SIM,READ,PROC,AECOPY,TERM)       SIM




CPOINT=OADRI1 WHAT NOW   S          CALL DISPLAY        DISP   1 OF   1
                                    G E S S
                                 D I S P L A Y
```

Figure 7-21. Main Control Display

```
*************************************      G E S S      ************************************
****   TEST    OABIA3    ***********    D I S P L A Y    ***********   74.315.17.38.11   ****
**                                                                                          **
**        AECOPY              OPTIONS FOR COPYING AE DATA SET                               **
**                                                                                          **
**        FIRST BLOCK ON AE DATA SET                          1                             **
**        LAST BLOCK ON AE DATA SET                       99999                             **
**                                                                                          **
**        UNIT NO. FOR AE DATA SET                        49                                **
**                                                                                          **
**        COPY EVERY I-TH WHS RECORD                          1                             **
**                                                                                          **
**        SENSOR MOUNTING ANGLE - WHS1 (DEG)               134.00000                        **
**        SENSOR MOUNTING ANGLE - WHS2 (DEG)               118.00000                        **
**        SENSOR MOUNTING ANGLE - BHS1 (DEG)               110.00000                        **
**        SENSOR MOUNTING ANGLE - BHS2 (DEG)               110.00000                        **
**        COPY EVERY I-TH BHS RECORD                          1                             **
**        REFERENCE AZIMUTH FOR BHS (DEG)                    0.0                            **
**        UNIT NO. FOR OUTPUT COPY (SCRATCH)               51                               **
**        USE SUN TIMES FOR SPIN RATE (YES,NO)             NO               ISUNSD(0,1)     **
**           INITIAL SPIN RATE (DEG/SEC)                      0.0           OLDRPM          **
**                                                                                          **
**        WRITE AE DATA SET (YES,NO)                       YES              IBOLOF(1,0)     **
**        UNIT NO. FOR DATA SET                             7               IBOLOU          **
**                                                                                          **
**                                                                                          **
**        CPOINT=AECOPY WHAT NOW                 CALL DISPLAY         DISP   1 OF   1       **
**                                                                                          **
*************************************      G E S S      ************************************
*************************************    D I S P L A Y    **********************************
```

Figure 7-22. Options for Copying AE Data Set

PRELIMINARY DRAFT

```
****************************************   G E S S   ****************************************
****     AE-C   OABIAS    ************    D I S P L A Y   ************   74.318.19.27.28   ****
**                                                                                          **
**       SIMOPT                          SIMULATOR OPTIONS                                  **
**                                                                                          **
**       NUMBER OF FRAMES TO SIMULATE                   25                                  **
**       REWIND UNIT BEFORE WRITING (YES,NO)           YES                                  **
**       SPIN RATE (DEG/SEC)                              100.00000000                      **
**                                                                                          **
**       RATE OF CHANGE OF SPINRA (DEG/SEC**2)             0.0                              **
**       REF TIME FOR SPINRA (Y,M,D,H,M,S) (1)           0.0                                **
**       REF TIME FOR SPINRA (Y,M,D,H,M,S) (2)           0.0                                **
**       REF TIME FOR SPINRA (Y,M,D,H,M,S) (3)           0.0                                **
**       REF TIME FOR SPINRA (Y,M,D,H,M,S) (4)           0.0                                **
**       REF TIME FOR SPINRA (Y,N,D,H,M,S) (5)           0.0                                **
**       REF TIME FOR SPINRA (Y,M,D,H,M,S) (6)           0.0                                **
**                                                                                          **
**       UNIT NUMBER FOR SIMULATED DATA SET        51              IDISK                    **
**                                                                                          **
**      CPOINT=OASIMI WHAT NOW             CALL DISPLAY         DISP   1 OF   1             **
**                                                                                          **
****************************************   G E S S   ****************************************
****************************************  D I S P L A Y  ************************************
```

Figure 7-23. Simulator Options

PRELIMINARY DRAFT

### 7.14.6 NAMELIST LIST Display

Figure 7-24 shows the display of parameters in NAMELIST LIST. See Section 7.3.5 for a description of these parameters.

### 7.14.7 Options for Reading Data

Figure 7-25 shows the display of options for reading the OABIAS data set. This display includes parameters from NAMELIST MAIN, described in Section 7.3.4.

### 7.14.8 Header Record Displays

Figure 7-26 shows the three displays which contain data from the OABIAS header records. For a description of the data on the header records, see Section 7.4.

### 7.14.9 Data Record Display

Figure 7-27(1) shows the OABIAS data records display. The data on this display are described in Section 7.4, with the following exceptions:

| Heading | Description |
|---|---|
| REC. NO. | Record number on data set |
| FRM NO. | Frame number, the index in the internal arrays (1-200) |
| FLAG | A four-character flag: |
| First character | = I, inversion case (out-triggering occurred before in-triggering)<br>= Blank, normal case<br>= X, inversion flag invalid (not 0 or 1) |
| Second character | = 1-8, configuration flag<br>= X, configuration flag invalid (not 1-8) |
| Third character | = E, M, S, U, central body flag |
| Fourth character | = H, T, U, terminator/horizon flag |

| Heading | Description |
|---|---|
| R | Data rejection flag (set automatically by OADRIV, and may be changed by operator):<br>= '.', valid frame<br>≠ '.', flagged frame<br><br>The following character is used by OADRIV for flagging data:<br>= X, configuration flag invalid (not 1-8 or central body flag invalid (not E, M, S, or U) |

Following the data records display are six sets of plots of the data. Each set consists of a plot of data versus time followed by a plot of data versus frame number. The data plotted are the same as those tabulated in the data records display. Points may be flagged from the plots by use of the GESS FLAGPT options.

The light pen is used to touch the FLAGPT option, each point to be flagged, and the END option. The six plot displays are as follows:

1. Sun angle (degrees)
2. Spin rate (degrees per second)
3. Rotation angle, Earth-in (degrees) and Earth-out (degrees)
4. Earth-in (degrees)
5. Earth-out (degrees)
6. Earth width (degrees) = Earth-out minus Earth-in

Figure 7-27(2) shows the plot of rotation angles versus time. The other plots are similar.

### 7.14.10 Data Selection Options for OASYS

Figure 7-28 shows the display of data selection options for OASYS. These parameters are in NAMELIST MAIN described in Section 7.3.4.

# PRELIMINARY DRAFT

ORIGINAL PAGE IS
OF POOR QUALITY

```
*********************************     M S A D     *********************************
*********************************   D I S P L A Y   ***********  73.291.10.41.37  ****
**                                                                                 **
**     COAFNM        NAMELIST /LIST/  --  SIMULATION PARAMETERS    NAMELIST/LIST/  **
**                                                                                 **
**     ALPHA (DEG)                                  351.00000                      **
**     DELTA (DEG)                                  -70.0000                       **
**     DELTAT (SEC)                                    15.0000                     **
**     CANGE (DEG)                                  -90.0000                       **
**     CANGN (DEG)                                   90.0030                       **
**     BIASNE (DEG)                                   0.0                          **
**     BIASRN (DEG)                                   0.0                          **
**     OBLATENESS MODEL (YES,NO)                    NO            IOBLAT (1, 0)    **
**     HEIGHT OF ATMOSPHERE (KM)                       0.0        HT               **
**     RADIUS OF EARTH (KM)                          6378.16      RADE             **
**     DELAT1, OBLATENESS PARAMETER                  0.0033528                     **
**     DELAT2, OBLATENESS PARAMETER                  0.0                           **
**     USE ATTITUDE TAPE (YES,NO)                   NO            IATAPE (0, 1)    **
**     ICB                                          1                              **
**     IFLAG                                        2                              **
**     INTERPOLATE ON ATTITUDE TAPE (YES,NO)        NO            INTERP (1, 0)    **
**     PRINT ONLY WHEN FLAG CHANGES (YES,NO)        NO            IPRINT (1, 0)    **
**     SKIP FRAMES WITH FLAG BLANK (YES,NO)         YES           ISKIP (1, 0)     **
**                                                                                 **
**     MOUNTING ANGLE STEP SIZE (DEG)                  0.0        STEP             **
**     SENSOR MOUNTING ANGLE (DEG)                    86.0000     SIGMA            **
**     SENSOR FIELD OF VIEW (DEG)                     0.0         EPS              **
**     SENSOR CUTOFF ANGLE (DEG)                       0.0        THETAC           **
**     DELPHI, TERMINATOR INCREMENT (DEG)              0.5000                      **
**     PHITOL, TERMINATOR TOLERANCE (DEG)              0.0100                      **
**                                                                                 **
**     START TIME (Y,M,D,H,M,S)              (1)    1974.0000     T0 (1)           **
**     START TIME (Y,M,D,H,M,S)              (2)       1.0000       (2)            **
**     START TIME (Y,M,D,H,M,S)              (3)       4.0000       (3)            **
**     START TIME (Y,M,D,H,M,S)              (4)      22.0000       (4)            **
**     START TIME (Y,M,D,H,M,S)              (5)       4.0000       (5)            **
**     START TIME (Y,M,D,H,M,S)              (6)       0.0          (6)            **
**                                                                                 **
**     ERREST (DEG)                                    0.2500                      **
**     ERRGAM (DEG)                                    0.1000                      **
**     ERRA (DEG)                                      0.1000                      **
**     ERRAD (DEG)                                     0.5000                      **
**     ERRTIM (SEC)                                     30.0000                    **
**     IDEBUG, UNIT FOR UNIERT PRINTOUT               0                            **
**                                                                                 **
**     ORBITAL ELEMENTS  SPACECRAFT=1, NOCN=2                                      **
**                                                                                 **
**     A, SEMI-MAJOR AXIS (KM)               (1)      24546.00                     **
**     A, SEMI-MAJOR AXIS (KM)               (2)          0.0                      **
**     E, ECCENTRICITY                       (1)    0.7326400                      **
**     E, ECCENTRICITY                       (2)    0.0                            **
**     EYE, INCLINATION (DEG)                (1)    28.299988                      **
**     EYE, INCLINATION (DEG)                (2)    0.0                            **
**                                                                                 **
**    CPCINT=ODAPIN WHAT NOW    NEXT      CALL DISPLAY        DISP   1 OF   1      **
**                                                                                 **
*********************************     M S A D     *********************************
*********************************   D I S P L A Y   *********************************
```

Figure 7-24. NAMELIST LIST (1 of 2)



PRELIMINARY DRAFT

```
************************************   M S A D    ************************************
************************************  D I S P L A Y  ***********  73.291.10.41.38  ****
**                                                                                   **
**     CDAFNM        NAMELIST /LIST/  --  SIMULATION PARAMETERS     NAMELIST/LIST/   **
**                                                                                   **
**     EMO. MEAN ANOMALY (DEG)                (1)    0.0                             **
**     EMO. MEAN ANOMALY (DEG)                (2)    0.0                             **
**     WC. ARG OF PERIGEE (DEG)               (1)  180.000000                        **
**     WC. ARG OF PERIGEE (DEG)               (2)    0.0                             **
**     RANODE. R.A. OF ASC NODE (DEG)         (1)  260.000000                        **
**     RANODE. R.A. OF ASC NODE (DEG)         (2)    0.0                             **
**                                                                                   **
**     SUN EPHEM ROUTINE (SUN1.SUNRD.RJPLT)        SUN1          ISUN (1, 2, 3)      **
**     SPC EPHEM ROUTINE (ORBGEN.DTAPRE.           ORBGEN        ISPC (1, 2, 3, 4, 5)**
**         GETVCT.ORBGENM.DTAPREM)                                                   **
**     MOON (NONE.ORBGEN.SUNRD.RJPLT)              NONE          IMOON (0, 1, 2, 3)  **
**     NRJPLT. UNIT NO. FOR RJPLT                  28                                **
**     NCRB1. UNIT NO. FOR DTAPRE                  30                                **
**     NGTDS. UNIT NO. FOR GETVCT (LEVEL=0)        29                                **
**     LEVEL. LEVEL NO. FOR GETVCT                  0                                **
**                                                                                   **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (1)    1974.0000      ORBITE (1)           **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (2)       1.0000             (2)           **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (3)       4.0000             (3)           **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (4)      22.0000             (4)           **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (5)      51.0000             (5)           **
**     EPOCH TIME. SPCRFT (Y.M.D.H.M.S)   (6)      26.0000             (6)           **
**                                                                                   **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (1)       0.0         ORBITM (1)           **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (2)       0.0                (2)           **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (3)       0.0                (3)           **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (4)       0.0                (4)           **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (5)       0.0                (5)           **
**     EPOCH TIME. MOON (Y.M.D.H.M.S)     (6)       0.0                (6)           **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**                                                                                   **
**    CFGINT=ODAPIN WHAT NO.         CALL DISPLAY          DISP   1 OF   1           **
**                                                                                   **
************************************   M S A D    ************************************
************************************  D I S P L A Y  **********************************
```

Figure 7-24. NAMELIST LIST (2 of 2)

```
*************************************   G E S S   ***********************************
****  AE-C   OABIAS   ***********   D I S P L A Y   ***********  74.318.19.32.17  ****
**                                                                                   **
**      RDOPTS                    OPTIONS FOR READING DATA                           **
**                                                                                   **
**      FIRST RECORD NUMBER                              1                           **
**      LAST RECORD NUMBER                           99999                           **
**      ADDING OPTION (REPLACE,ADD,COMPRESS)         REPLACE                         **
**      SAVE RECORDS (DATA,HEADER,BOTH)              BOTH                            **
**      ISKIP.  READ EVERY I-TH RECORD                   1                           **
**      COMBINED ROTATION ANGLE PLOT(YES,NO)         YES             IPLOT(1,0)      **
**      PRESERVE EPHEM VECTORS PASSED                                                **
**          WITH DATA(YES,NO)                        NO              IEFMFG(1,0)     **
**                                                                                   **
**      CENTRAL BODY SELECTION --                                                    **
**                                                                                   **
**      SELECT EARTH  (YES,NO)                       YES                             **
**      SELECT MOON   (YES,NO)                       YES                             **
**      SELECT SUN    (YES,NO)                       NO                              **
**      SELECT UNIDENTIFIED (YES,NO)                 YES                             **
**                                                                                   **
**      SENSOR CONFIGURATION SELECTION --                                            **
**      SUN ANGLE / SUN TRIGGER / HORIZON                                            **
**                                                                                   **
**      1/SAS/PAS1   (KCNFLG=1)   (YES,NO)           YES                             **
**      1/SAS/PAS2   (KCNFLG=2)   (YES,NO)           YES                             **
**      1/PAS1/PAS1  (KCNFLG=3)   (YES,NO)           YES                             **
**      1/PAS2/PAS2  (KCNFLG=4)   (YES,NO)           YES                             **
**      2/SAS/PAS1   (KCNFLG=5)   (YES,NO)           YES                             **
**      2/SAS/PAS2   (KCNFLG=6)   (YES,NO)           YES                             **
**      2/PAS1/PAS1  (KCNFLG=7)   (YES,NO)           YES                             **
**      2/PAS2/PAS2  (KCNFLG=8)   (YES,NO)           YES                             **
**                                                                                   **
**      UNIT NUMBER FOR DATA SET                     51                              **
**                                                                                   **
**      READ DATA PERIODICALLY (YES,NO)              NO              IXXIXX(1,0)     **
**      PERIOD (SEC)                                       0.0       PERIOD          **
**      INTERVAL WIDTH (SEC)                             0.0         BNDWTH          **
**      REFERENCE TIME (Y,M,D,H,M,S)         (1)         0.0         TREFG(1)        **
**      REFERENCE TIME (Y,M,D,H,M,S)         (2)         0.0              (2)        **
**      REFERENCE TIME (Y,M,D,H,M,S)         (3)         0.0              (3)        **
**      REFERENCE TIME (Y,M,D,H,M,S)         (4)         0.0              (4)        **
**      REFERENCE TIME (Y,M,D,H,M,S)         (5)         0.0              (5)        **
**      REFERENCE TIME (Y,M,D,H,M,S)         (6)         0.0              (6)        **
**                                                                                   **
**                                                                                   **
**     CPOINT=OAREAD WHAT NOW            CALL DISPLAY         DISP   1 OF   1        **
**                                                                                   **
*************************************   G E S S   ***********************************
*************************************  D I S P L A Y  *******************************
```

Figure 7-25. Options for Reading Data

PRELIMINARY DRAFT



PRELIMINARY DRAFT

```
***********************************          M S A D          ***********************************
***********************************    D I S P L A Y    ***********  73.291.10.41.52  ****
**                                                                                          **
**       FAEFD1              HEADER RECORDS. DISPLAY 1 OF 3                                 **
**                                                                                          **
**               FIRST        LAST          START TIME           JOB TIME                   **
**                REC          REC         YYMMDD.HHMMSS       YYMMDD.HHMMSS                **
**                  1           25         740104.230400       730102.030405                **
**                                                                                          **
**       U9C1 END OF FILE ON DASIAS DATA SET                                                **
**         CPCINT=HEADER WHAT NO*              CALL DISPLAY          DISP   1 OF   3        **
**                                                                                          **
***********************************          M S A D          ***********************************
***********************************    D I S P L A Y    ***********************************
```

Figure 7-26. Header Record Displays (1 of 3)

PRELIMINARY DRAFT



PRELIMINARY DRAFT

```
                M S A D
            D I S P L A Y          73.291.10.41.53

FAEFD2           HEADER RECORDS. DISPLAY 2 OF 3

 FIRST   LAST   THE(1)   THE(2)   THE(3)   THE(4)   RHOER   RHOMB
  REC     REC   (DEG)    (DEG)    (DEG)    (DEG)    (DEG)   (DEG)
    1      25   90.00    90.00   -90.00    90.00     1.00    2.00






U9C1
CFCINT=HEADER WHAT NO=               CALL DISPLAY       DISP   2 OF   3
                M S A D
            D I S P L A Y
```

Figure 7-26. Header Record Displays (2 of 3)



PRELIMINARY DRAFT

PRELIMINARY DRAFT

```
                                    M S A D
                                  D I S P L A Y          73.291.10.41.53

     FAEFD3              HEADER RECORDS, DISPLAY 3 OF 3

       FIRST    LAST    PHI(1)   PHI(2)   PHI(3)   PHI(4)   PHI(5)   PHI(6)
        REC      REC    (DEG)    (DEG)    (DEG)    (DEG)    (DEG)    (DEG)
          1       25      0.0      0.0    63.00   297.00   333.00   207.00

     U9C1
       CFCINT=HEADER WHAT NJ=                 CALL DISPLAY       DISP   3 OF   3

                                    M S A D
                                  D I S P L A Y
```

Figure 7-26. Header Record Displays (3 of 3)



PRELIMINARY DRAFT

```
************************************ M S A D ************************************
************************************ D I S P L A Y *********** 73.291.10.41.54 ****
**                                                                               **
**      FAEDAT                    HORIZON SCANNER DATA                           **
**                                                                               **
```

| REC. NO. | FRM NO. | TIME YYMMDD.HHMMSS | BETA (DEG) | GAMMA (DEG) | SPINRA DEG/SEC | AIN (DEG) | AOUT (DEG) | FLAG IN | FLAG OUT | R |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 740104.230406 | 60.61 | 86.00 | 100.00 | 250.52 | 339.59 | 1FH | 1EH | . |
| 2 | 2 | 740104.230421 | 60.61 | 86.00 | 100.00 | 250.45 | 337.87 | 1EH | 1FH | . |
| 3 | 3 | 740104.230435 | 60.61 | 86.00 | 100.00 | 250.39 | 336.16 | 1EH | 1EH | . |
| 4 | 4 | 740104.230449 | 60.61 | 86.00 | 100.00 | 250.34 | 334.45 | 1EH | 1EH | . |
| 5 | 5 | 740104.230504 | 60.61 | 86.00 | 100.00 | 250.29 | 332.75 | 1EH | 1EH | . |
| 6 | 6 | 740104.230518 | 60.61 | 86.00 | 100.00 | 250.25 | 331.04 | 1EH | 1EH | . |
| 7 | 7 | 740104.230533 | 60.61 | 86.00 | 100.00 | 250.22 | 329.34 | 1EH | 1EH | . |
| 8 | 8 | 740104.230551 | 60.61 | 86.00 | 100.00 | 250.18 | 327.22 | 1EH | 1EH | . |
| 9 | 9 | 740104.230605 | 60.61 | 86.00 | 100.00 | 250.17 | 325.52 | 1EH | 1EH | . |
| 10 | 10 | 740104.230619 | 60.61 | 86.00 | 100.00 | 250.16 | 323.83 | 1EH | 1EH | . |
| 11 | 11 | 740104.230634 | 60.61 | 86.00 | 100.00 | 250.16 | 322.13 | 1EH | 1EH | . |
| 12 | 12 | 740104.230648 | 60.61 | 86.00 | 100.00 | 250.17 | 320.44 | 1FH | 1EH | . |
| 13 | 13 | 740104.230703 | 60.61 | 86.00 | 100.00 | 250.19 | 318.75 | 1FH | 1EH | . |
| 14 | 14 | 740104.230721 | 60.61 | 86.00 | 100.00 | 250.22 | 316.65 | 1EH | 1EH | . |
| 15 | 15 | 740104.230735 | 60.61 | 86.00 | 100.00 | 250.26 | 314.96 | 1EH | 1EH | . |
| 16 | 16 | 740104.230749 | 60.61 | 86.00 | 100.00 | 250.31 | 313.28 | 1FH | 1EH | . |
| 17 | 17 | 740104.230804 | 60.61 | 86.00 | 100.00 | 250.36 | 311.60 | 1FH | 1EH | . |
| 18 | 18 | 740104.230818 | 60.61 | 86.00 | 100.00 | 250.43 | 309.92 | 1FH | 1EH | . |
| 19 | 19 | 740104.230833 | 60.61 | 86.00 | 100.00 | 250.52 | 308.23 | 1EH | 1EH | . |
| 20 | 20 | 740104.230851 | 60.61 | 86.00 | 100.00 | 250.64 | 306.13 | 1EH | 1EH | . |
| 21 | 21 | 740104.230905 | 60.61 | 86.00 | 100.00 | 250.75 | 304.45 | 1FH | 1EH | . |
| 22 | 22 | 740104.230919 | 60.61 | 86.00 | 100.00 | 250.88 | 302.76 | 1EH | 1EH | . |
| 23 | 23 | 740104.230934 | 60.61 | 86.00 | 100.00 | 251.02 | 301.07 | 1FH | 1EH | . |
| 24 | 24 | 740104.230948 | 60.61 | 86.00 | 100.00 | 251.18 | 299.38 | 1FH | 1EH | . |
| 25 | 25 | 740104.231003 | 60.61 | 86.00 | 100.00 | 251.36 | 297.67 | 1EH | 1EH | . |

```
**   CPOINT=DATDIS WHAT NO=           CALL DISPLAY        DISP  1 OF  2         **
**                                                                               **
************************************ M S A D ************************************
************************************ D I S P L A Y *******************************
```

Figure 7-27. Data Record Displays (1 of 2)

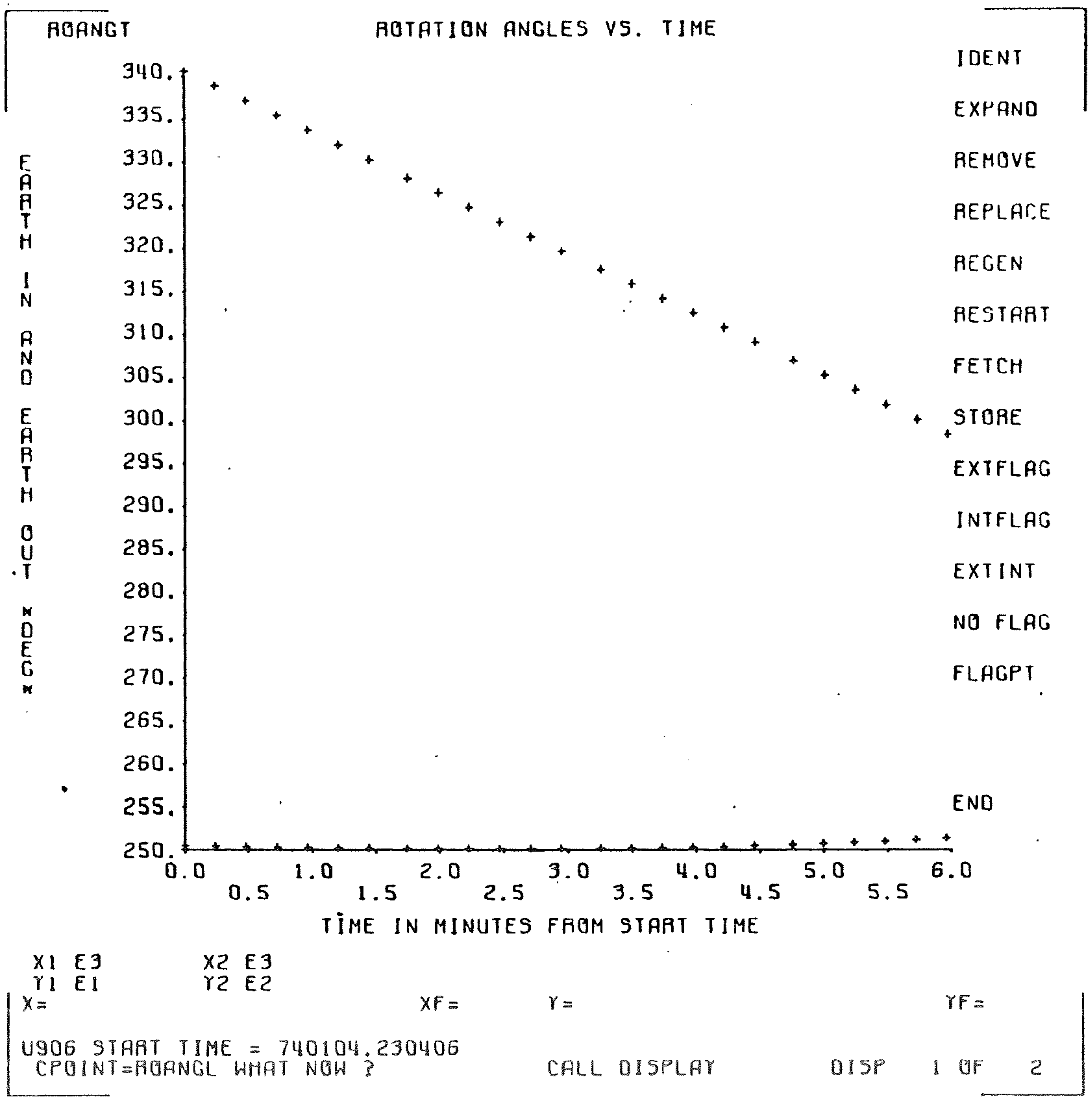


Figure 7-27. Data Record Displays (2 of 2)

```
************************************         M S A D       ************************************
************************************    D I S P L A Y    ************   73.309.10.03.45   ****
**                                                                                              **
**      DATDIS                    SELECT DATA FOR OASYS                                         **
**                                                                      NAMELIST/MAIN/          **
**       FIRST FRAME NUMBER TO PROCESS                  1               NFRAM1                  **
**       LAST FRAME NUMBER TO PROCESS                  25               NFRAM2                  **
**                                                                                              **
**       CENTRAL BODY SELECTION --                                                              **
**       SELECT EARTH (YES,NO)                        YES               ICBSEL (1) (1,0)        **
**       SELECT MOON  (YES,NO)                        YES                      (2)              **
**       SELECT SUN   (YES,NO)                        NO                       (3)              **
**       SELECT UNIDENTIFIED (YES,NO)                 YES                      (4)              **
**                                                                                              **
**       SENSOR CONFIGURATION SELECTION --                              ICNSEL (1) (1,0)        **
**       1/SAS/PAS1  (KCNFLG=1)  (YES,NO)             YES                      (2)              **
**       1/SAS/PAS2  (KCNFLG=2)  (YES,NO)             YES                      (3)              **
**       1/PAS1/PAS1 (KCNFLG=3)  (YES,NO)             YES                      (4)              **
**       1/PAS2/PAS2 (KCNFLG=4)  (YES,NO)             YES                      (5)              **
**       2/SAS/PAS1  (KCNFLG=5)  (YES,NO)             YES                      (6)              **
**       2/SAS/PAS2  (KCNFLG=6)  (YES,NO)             YES                      (7)              **
**       2/PAS1/PAS1 (KCNFLG=7)  (YES,NO)             YES                      (8)              **
**       2/PAS2/PAS2 (KCNFLG=8)  (YES,NO)             YES                                       **
**                                                                                              **
**       TIME ADJUSTMENT (SEC)                                  0.0     TADJ                    **
**       USE EPHEM DATA ON CABIAS FILE (YES,NO)      NO                 IEPHEM (1,0)            **
**       USE TERMINATOR FLAGS (YES,NO)                NO                ITERM (1,0)             **
**                                                                      INOISE (3,2,1)          **
**       APPLY NOISE (NONOISE,NOISE,BOTH)             NOISE             STDV (2)                **
**       STDV OF SUN TIME (SEC)                          0.00500             (3)                **
**       STDV OF TIMEIN (SEC)                            0.00500             (4)                **
**       STDV OF TIMOUT (SEC)                            0.00500             (5)                **
**       STDV OF SPIN RATE (DEG/SEC)                     0.0                 (6)                **
**       STDV OF SUN ANGLE (DEG)                         0.0                                    **
**                                                                                              **
**       BIAS ON SUN TIME (SEC)                            0.0          BIAS (2)                **
**       BIAS ON TIMEIN (SEC)                              0.0               (3)                **
**       BIAS ON TIMOUT (SEC)                              0.0               (4)                **
**       BIAS ON SPIN RATE (DEG/SEC)                       0.0               (5)                **
**       BIAS ON SUN ANGLE (DEG)                           0.0               (6)                **
**       INITIAL RANDOM NUMBER                       123456789          IRAND                   **
**       BIAS ON SENSOR MOUNTING ANGLE (DEG)             0.0            BGAM                    **
**       SUN ANGLE QUANTIZATION (DEG)                    0.50000        SQUANT                  **
**                                                                                              **
**       BETA1, SUN ANGLE COEFFICIENT (DEG)              0.0            ABETA1                  **
**       RATE OF CHANGE OF SUN ANGLE (DEG/HR)            0.0            ABETA2                  **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (1)           0.0            TBETA (1)               **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (2)           0.0                  (2)               **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (3)           0.0                  (3)               **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (4)           0.0                  (4)               **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (5)           0.0                  (5)               **
**       REF TIME FOR BETA1 (Y,M,D,H,M,S)  (6)           0.0                  (6)               **
**                                                                                              **
**                                                                                              **
**      CFCINT=DATDIS WHAT NOW             CALL DISPLAY          DISP    2 OF    2              **
**                                                                                              **
************************************         M S A D       ************************************
************************************    D I S P L A Y    ************************************
```

Figure 7-28. Data Selection Options for OASYS

7.14.11 NAMELIST OPMAN1 Display

Figure 7-29 (1 and 2) shows the NAMELIST OPMAN1 display. These parameters are described in Section 7.3.6. Figure 7-29(3) shows the source of the orbit to be used for processing (ephemeris tape, GTDS file, or orbit generator) and the orbital elements from either the header record of ephemeris tapes or GTDS files or the input parameters to the orbit generator.

7.14.12 OASYS Block Average Display

Figure 7-30 shows the display of block average results from OASYS. These values are stored in COMMON AVRAGE.

7.14.13 OASYS Plots of Single Frame Results

There are seven plot displays of the single frame results from OASYS. Each plot includes up to four curves, corresponding to the four different attitude computation methods in OASYS. If the GESS IDENTIFY option is used (see Reference 13), a number will appear on each curve to identify it as follows:

= 1, single horizon method, in

= 2, single horizon method, out

= 3, double horizon width method

= 4, double horizon dihedral method

The seven plots are as follows:

1. Alpha, including rejected points--This plot shows right ascension alpha, versus frame number, plotting the selected attitude from each ambiguous pair and including attitudes rejected in block averaging.

2. Alpha, omitting rejected points--This plot is the same as plot 1, but attitudes rejected in the block average are omitted.

```
************************************     M S A D     ************************************
************************************   D I S P L A Y   ***********  73.291.10.41.55  ****
**                                                                                      **
**        CANAME                         NAMELIST /OPMAN1/             NAMELIST/OPMAN1/ **
**                                                                                      **
**        AFRA, INITIAL ALPHA (DEG)                   350.00000                         **
**        APDEC, INITIAL DELTA (DEG)                  -19.00000                         **
**        EPSILN, CUTOFF ANGLE (DEG)                    0.0                             **
**        EPS, FIELD OF VIEW (DEG)                      1.40000                         **
**        ATTCL, ATTITUDE ESTIMATE TOLERANCE          360.00000                         **
**        REJECT IF TERMINATOR VISIBLE (YES,NO)       NO               TRMCHK (4, 0)    **
**        EDYCHK, DOUBLE HORIZON FLAG                 0                                 **
**        DEBUG, PRINT LEVEL                          8                                 **
**        CBFLAG, EPHEM OPTION                         1                                **
**        IAPICR, A PRIORI FLAG                       8                                 **
**                                                                                      **
**        RADE, EARTH RADIUS (KM)                     6378.16                           **
**        RADM, MOON RADIUS (KM)                      1738.00                           **
**        CANGE, DARK ANGLE, EARTH (DEG)              -90.0000                          **
**        CANGM, DARK ANGLE, MOON (DEG)                89.7000                          **
**        USE OBLATENESS MODEL (YES,NO)               NO               IOBLAT (1, 0)    **
**        HT, HEIGHT OF ATMOSPHERE (KM)                  0.0                            **
**        CELAT1, OBLATENESS PARAMETER                 0.0033528                        **
**        CELAT2, OBLATENESS PARAMETER                 0.0                              **
**                                                                                      **
**        AEIAS1, BIAS ON EARTH-IN (DEG)                0.0                             **
**        ABIAS2, BIAS ON EARTH-OUT (DEG)               0.0                             **
**        BIASRE (DEG)                                0.0                               **
**        BIASRM (DEG)                                0.0                               **
**        IDISK, UNIT NO. FOR DABIAS ARCHIVE          C                                 **
**        DIHTOL, DIHEDRAL ANGLE TOL. (DEG)           10.00000                          **
**        PROCESS SINGLE HORIZON IN (YES,NO)          YES              MIN (1, 0)       **
**        PROCESS SINGLE HORIZON OUT (YES,NO)         YES              MOUT (1, 0)      **
**        PROCESS WIDTH METHOD (YES,NO)               YES              MDBL (1, 0)      **
**        PROCESS DIHEDRAL METHOD (YES,NO)            YES              MDIH (1, 0)      **
**        IPLOT, PRINTER PLOT LEVEL INDICATOR         5                                 **
**        EGAMMA, BIAS ON MOUNTING ANGLE (DEG)          0.0                             **
**                                                                                      **
**        ERRBET (DEG)                                0.2500                            **
**        ERRGAM (DEG)                                0.1000                            **
**        ERRA (DEG)                                  0.1000                            **
**        ERRAD (DEG)                                 0.5000                            **
**        ERRTIM (SEC)                                  30.0000                         **
**        IDEBUG, UNIT FOR UNCERT PRINTOUT            0                                 **
**                                                                                      **
**        SMOOTH SUN DATA (YES,NO)                    NO               ISNPRO (0, 1)    **
**        OVERRIDE SUN ANGLE (DEG)                    0.0              SUNIN            **
**                                                                                      **
**        SPNSIG, SIGMA MULTIPLIER FOR SPINAV         3.0000                            **
**        SPNTOL, REJECTION TOL. FOR SPINAV           20.0000                           **
**                                                                                      **
**        ORBITAL ELEMENTS  SPACECRAFT=1, MOON=2                                        **
**                                                                                      **
**                                                                                      **
**     CPCINT=OPMAI1 WHAT NOW   NEXT      CALL DISPLAY        DISP   1 OF   1           **
**                                                                                      **
************************************     M S A D     ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-29. NAMELIST OPMAN1 (1 of 3)

```
************************************       M S A D       ************************************
************************************   D I S P L A Y   ***********  73.291.10.41.55  ****
**                                                                                        **
**      CANAME                       NAMELIST /OPMAN1/                NAMELIST/OPMAN1/    **
**                                                                                        **
**      A, SEMI-MAJOR AXIS (KM)                (1)     24548.00                          **
**      A, SEMI-MAJOR AXIS (KM)                (2)         0.0                           **
**      E, ECCENTRICITY                        (1)     0.7326400                         **
**      E, ECCENTRICITY                        (2)     0.0                               **
**      EYE, INCLINATION (DEG)                 (1)     28.299988                         **
**      EYE, INCLINATION (DEG)                 (2)      0.0                              **
**      EMO, MEAN ANOMALY (DEG)                (1)      0.0                              **
**      EMO, MEAN ANOMALY (DEG)                (2)      0.0                              **
**      WC, ARG OF PERIGEE (DEG)               (1)    180.000000                         **
**      WC, ARG OF PERIGEE (DEG)               (2)      0.0                              **
**      RANODE, R.A. OF ASC NODE (DEG)         (1)    260.000000                         **
**      RANODE, R.A. OF ASC NODE (DEG)         (2)      0.0                              **
**                                                                                        **
**      SUN EPHEM ROUTINE (SUN1,SUNRD,RJPLT)          SUN1            ISUN (1, 2, 3)      **
**      SPC EPHEM ROUTINE (ORBGEN,DTAPRE,             ORBGEN          ISPC (1, 2, 3, 4, 5)**
**          GETVCT,ORBGENM,DTAPREM)                                                       **
**      MOON (NONE,ORBGEN,SUNRD,RJPLT)                NONE            IMOON (0, 1, 2, 3)  **
**      NRJPLT, UNIT NO. FOR RJPLT                    28                                  **
**      NORB1, UNIT NO. FOR DTAPRE                    30                                  **
**      NGTDS, UNIT NO. FOR GETVCT (LEVEL=0)          29                                  **
**      LEVEL, LEVEL NO. FOR GETVCT                    0                                  **
**                                                                                        **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (1)   1974.0000             TORBIT (1)          **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (2)      1.0000                    (2)          **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (3)      4.0000                    (3)          **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (4)     22.0000                    (4)          **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (5)     51.0000                    (5)          **
**      EPOCH TIME, SPCRFT (Y,M,D,H,M,S)  (6)     26.0000                    (6)          **
**                                                                                        **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (1)       0.0               TMOON (1)           **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (2)       0.0                     (2)           **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (3)       0.0                     (3)           **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (4)       0.0                     (4)           **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (5)       0.0                     (5)           **
**      EPOCH TIME, MOON (Y,M,D,H,M,S)    (6)       0.0                     (6)           **
**                                                                                        **
**      DELPHI, TERMINATOR INCREMENT (DEG)          0.5000                                **
**      PHITOL, TERMINATOR TOLERANCE (DEG)          0.0100                                **
**                                                                                        **
**                                                                                        **
**                                                                                        **
**     CFGINT=OPMAI1 WHAT NO.           CALL DISPLAY          DISP   1 OF   1             **
**                                                                                        **
************************************       M S A D       ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-29. NAMELIST OPMAN1 (2 of 3)

```
*************************************       G E S S      *************************************
****    AE-C   OABIAS   ***********      D I S P L A Y   ***********  74.318.19.38.30   ****
**                                                                                        **
**      ORBIT                    SPACECRAFT ORBITAL ELEMENTS                              **
**                                                                                        **
**                                                                                        **
**      SOURCE                                                 1                          **
**                                                                                        **
**          1 = ORBGEN                                                                    **
**          2 = EPHEM TAPE                                                                **
**          3 = GTDS FILE                                                                 **
**          4 = ORBGEN (MOON CENTERED)                                                    **
**          5 = EPHEM TAPE (MOON CENTERED)                                                **
**                                                                                        **
**      ELEMENTS                                                                          **
**                                                                                        **
**        A. SEMI-MAJOR AXIS                (KM)     24548.000000                         **
**        E. ECCENTRICITY                                0.732640                         **
**        EYE. INCLINATICN                 (DEG)        28.299988                         **
**        EMO. MEAN ANOMALY                (DEG)         0.0                              **
**        WO. ARGUMENT OF PERIGEE          (DEG)       180.000000                         **
**          RATE OF CHANGE OF WO       (DEG/DAY)         0.0                              **
**        RANODE. R. A. CF ASC. NODE       (DEG)       260.000000                         **
**          RATE OF CHANGE OF RANODE (DEG/DAY)           0.0                              **
**                                                                                        **
**        EPOCH TIME             (YYMMDD.HHMMSS)   740104.225126                          **
**        PERIOD                           (MIN)      638.042552                          **
**                                                                                        **
**        REF. TIME OF G.H.A.    (YYMMDD.HHMMSS)         0.0                              **
**        GREENWICH HOUR ANGLE             (DEG)         0.0                              **
**                                                                                        **
**      DATA INTERVAL                                                                     **
**                                                                                        **
**        START TIME             (YYMMDD.HHMMSS)   740104.230404                          **
**        END   TIME             (YYMMDD.HHMMSS)   740104.231000                          **
**                                                                                        **
**      GTDS FILE ONLY                                                                    **
**                                                                                        **
**        LEVEL                                          0                                **
**        START TIME             (YYMMDD.HHMMSS)         0.0                              **
**        END   TIME             (YYMMDD.HHMMSS)         0.0                              **
**                                                                                        **
**        RETURN CODE                                    0                                **
**          0 = NORMAL RETURN                                                             **
**          1 = ORBIT LEVEL NOT IN FILE                                                   **
**          2 = ERROR IN READING HEADER                                                   **
**                                                                                        **
**      RATE OF CHANGE OF WO AND RANODE                                                   **
**      AVAILABLE FOR GTCS FILE ONLY                                                      **
**                                                                                        **
**                                                                                        **
**                                                                                        **
**                                                                                        **
**    CPOINT=ORBIT   WHAT NOW           CALL DISPLAY        DISP   1 OF   1               **
**                                                                                        **
*************************************       G E S S      *************************************
*************************************    D I S P L A Y   *************************************
```

Figure 7-29. NAMELIST OPMAN1 (3 of 3)

PRELIMINARY DRAFT

```
*********************************** M S A D ***********************************
*********************************** D I S P L A Y *********** 73.291.10.42.04 ****
**                                                                            **
**      AVGBLK                    OASYS BLOCK AVERAGES                        **
**                                                                            **
**      ALPHA (DEG) (SINGLE HORIZON IN)       (1)   351.12476                 **
**      ALPHA (DEG) (SINGLE HORIZON OUT)      (2)   351.15649                 **
**      ALPHA (DEG) (DOUBLE HORIZON WIDTH)    (3)   351.17212                 **
**      ALPHA (DEG) (MID-TIME DIHEDRAL)       (4)   351.15674                 **
**      ALPHA (DEG) (TOTAL)                   (5)   351.14478                 **
**                                                                            **
**      DELTA (DEG)                           (1)   -19.91432                 **
**      DELTA (DEG)                           (2)   -20.01831                 **
**      DELTA (DEG)                           (3)   -20.06760                 **
**      DELTA (DEG)                           (4)   -20.03612                 **
**      DELTA (DEG)                           (5)   -19.97998                 **
**                                                                            **
**      NO. OF OBS. BEFORE EDIT               (1)       25                    **
**      NO. OF OBS. BEFORE EDIT               (2)       25                    **
**      NO. OF OBS. BEFORE EDIT               (3)       25                    **
**      NO. OF OBS. BEFORE EDIT               (4)       25                    **
**      NO. OF OBS. BEFORE EDIT               (5)      100                    **
**                                                                            **
**      NO. OF OBS. AFTER EDIT                (1)       19                    **
**      NO. OF OBS. AFTER EDIT                (2)       25                    **
**      NO. OF OBS. AFTER EDIT                (3)       25                    **
**      NO. OF OBS. AFTER EDIT                (4)       17                    **
**      NO. OF OBS. AFTER EDIT                (5)       86                    **
**                                                                            **
**      TOTAL WEIGHT BEFORE EDIT              (1)         13.3760             **
**      TOTAL WEIGHT BEFORE EDIT              (2)          4.0518             **
**      TOTAL WEIGHT BEFORE EDIT              (3)          6.9982             **
**      TOTAL WEIGHT BEFORE EDIT              (4)          1.3733             **
**      TOTAL WEIGHT BEFORE EDIT              (5)         25.7992             **
**                                                                            **
**      TOTAL WEIGHT AFTER EDIT               (1)         12.5717             **
**      TOTAL WEIGHT AFTER EDIT               (2)          4.0518             **
**      TOTAL WEIGHT AFTER EDIT               (3)          6.9982             **
**      TOTAL WEIGHT AFTER EDIT               (4)          1.0062             **
**      TOTAL WEIGHT AFTER EDIT               (5)         24.6278             **
**                                                                            **
**      STD. DEV. (DEG ARC LENGTH)            (1)      0.75226                **
**      STD. DEV. (DEG ARC LENGTH)            (2)      0.60435                **
**      STD. DEV. (DEG ARC LENGTH)            (3)      0.38972                **
**      STD. DEV. (DEG ARC LENGTH)            (4)      1.15335                **
**      STD. DEV. (DEG ARC LENGTH)            (5)      0.66818                **
**                                                                            **
**      STD. DEV. OF ALPHA (DEG)              (1)      0.21260                **
**      STD. DEV. OF ALPHA (DEG)              (2)      0.17199                **
**      STD. DEV. OF ALPHA (DEG)              (3)      0.11161                **
**      STD. DEV. OF ALPHA (DEG)              (4)      0.32657                **
**      STD. DEV. OF ALPHA (DEG)              (5)      0.18930                **
**                                                                            **
**                                                                            **
**    CFCINT=BLKPL1 WHAT NO=   NEXT      CALL DISPLAY        DISP  1 OF  1    **
**                                                                            **
*********************************** M S A D ***********************************
*********************************** D I S P L A Y *****************************
```

Figure 7-30. OASYS Block Average Results (1 of 2)



PRELIMINARY DRAFT

```
******************************  M S A D   ******************************
******************************  D I S P L A Y   ***********  73.291.10.42.04  ****
**                                                                          **
**      AVGBLK                 OASYS BLOCK AVERAGES                         **
**                                                                          **
**      STD. DEV. OF DELTA (DEG)           (1)        0.72529               **
**      STD. DEV. OF DELTA (DEG)           (2)        0.58236               **
**      STD. DEV. OF DELTA (DEG)           (3)        0.37534               **
**      STD. DEV. OF DELTA (DEG)           (4)        1.11190               **
**      STD. DEV. OF DELTA (DEG)           (5)        0.64410               **
**                                                                          **
**      UNCERTAINTY (DEG ARC LENGTH)       (1)        1.20514               **
**      UNCERTAINTY (DEG ARC LENGTH)       (2)        2.38497               **
**      UNCERTAINTY (DEG ARC LENGTH)       (3)        1.81553               **
**      UNCERTAINTY (DEG ARC LENGTH)       (4)        4.02826               **
**      UNCERTAINTY (DEG ARC LENGTH)       (5)        1.68804               **
**                                                                          **
**      UNCERTAINTY IN ALPHA (DEG)         (1)        0.45580               **
**      UNCERTAINTY IN ALPHA (DEG)         (2)        0.68943               **
**      UNCERTAINTY IN ALPHA (DEG)         (3)        0.56000               **
**      UNCERTAINTY IN ALPHA (DEG)         (4)        1.08735               **
**      UNCERTAINTY IN ALPHA (DEG)         (5)        0.54965               **
**                                                                          **
**      UNCERTAINTY IN DELTA (DEG)         (1)        1.12577               **
**      UNCERTAINTY IN DELTA (DEG)         (2)        2.29634               **
**      UNCERTAINTY IN DELTA (DEG)         (3)        1.73791               **
**      UNCERTAINTY IN DELTA (DEG)         (4)        3.89984               **
**      UNCERTAINTY IN DELTA (DEG)         (5)        1.60564               **
**                                                                          **
**                                                                          **
**     CFGINT=BLKPL1 WHAT NO#            CALL DISPLAY       DISP  1 OF  1   **
**                                                                          **
******************************  M S A D   ******************************
******************************  D I S P L A Y   ******************************
```

Figure 7-30. OASYS Block Average Results (2 of 2)





PRELIMINARY DRAFT

3. Delta, including rejected points--This plot is the same as plot 1 but is for declination.

4. Delta, omitting rejected points--This plot is the same as plot 2 but is for declination.

5. Arc length uncertainty--This plot shows arc length uncertainty in attitude versus frame number. Points for which the uncertainty is undefined are omitted, but points rejected on the block average are included.

6. Nadir angle plot--This plot shows nadir angle versus frame number, including points rejected in the block average.

7. Dihedral angle plot--This plot is the same as plot 6 but is for dihedral angles.

Figure 7-31 shows an example of plot 1. The other plots are similar.

#### 7.14.14 NAMELIST BIASNL Display

Figure 7-32 shows the NAMELIST BIASNL display. These parameters are described in Section 7.3.7.

#### 7.14.15 Final Results From OABIAS

Figure 7-33 shows the display of final results from OABIAS. These parameters are stored in COMMON TABCOM.

#### 7.14.16 Table of Errors From OABIAS

Figure 7-34 shows the display of errors from the OABIAS Subsystem. The errors are described in Table 7-1, Section 7.16.4.

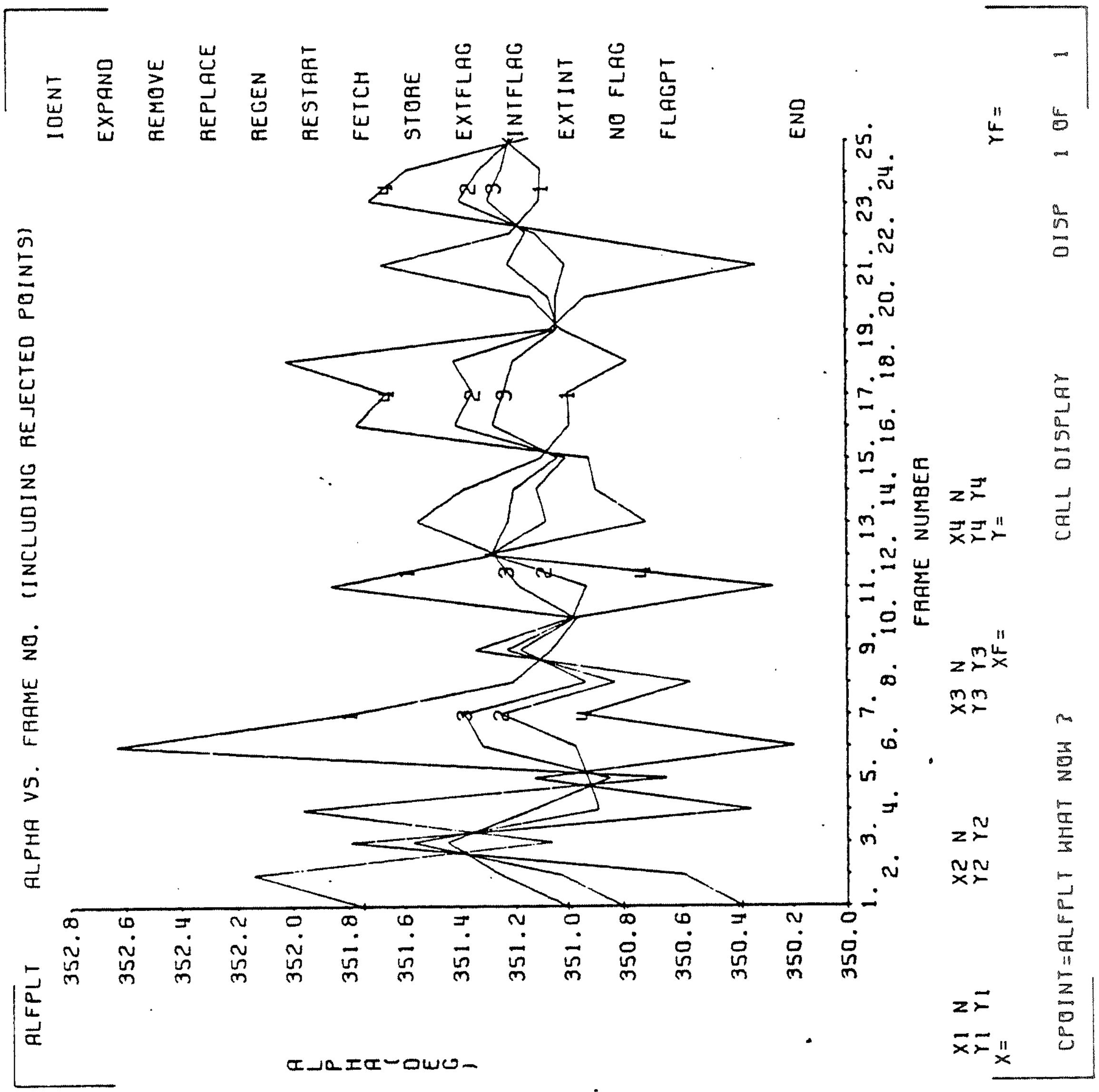


Figure 7-31. Alphas Versus Frame Number, Including Rejected Points

```
************************************      G E S S      ************************************
****     AE-C    OABIAS    ***********    D I S P L A Y    ***********    74.318.19.41.46  ****
**                                                                                           **
**          OBNAME                          NAMELIST /BIASNL/                NAMELIST /BIASNL/  **
**                                                                                           **
**          ATTOPT, INITIAL ATTITUDE OPTION                5                                  **
**          REJECT DATA FLAGGED IN OASYS (YES,NO)          YES               IOBLAT(1,0)      **
**          ITER, MAX. ITERATIONS FOR LINEARITY              1                                **
**          USE OBLATENESS MODEL (YES,NO)                  NO                                 **
**                                                                                           **
**          SUN ANGLE GRANULARITY (DEG)                       30.000000      SANGRN           **
**          SUN TIME GRANULARITY (SEC)                         0.100000      STMGRN           **
**          HORIZON TIME GRANULARITY (SEC)                     0.500000      OAGRN            **
**          RHOGRN, RHO GRANULARITY (DEG)                      2.000000                       **
**                                                                                           **
**          XO(1), ALPHA (DEG)                                 0.0                            **
**          XO(2), DELTA (DEG)                                 0.0                            **
**          XO(3), PHASE (DEG)                                 0.0                            **
**          XO(4), SENSOR MOUNTING ANGLE BIAS                  0.0                            **
**          XO(5), EARTH-IN BIAS (DEG)                         0.0                            **
**          XO(6), EARTH-OUT BIAS (DEG)                        0.0                            **
**          XO(7), BIAS ON RHO (DEG)                           0.0                            **
**          XO(8), SUN ANGLE BIAS (DEG)                        0.0                            **
**          XO(9), SPIN RATE (RPM)                             0.0                            **
**          XO(10), SUN SENSOR PLANE TILT (DEG)                0.0                            **
**          XO(11), HORIZON SENSOR PLANE TILT                  0.0                            **
**          XO(12), TIME ADJUSTMENT (SEC)                      0.0                            **
**                                                                                           **
**          PO, ERROR IN INITIAL STATE          (1)      100.00000                            **
**          PO, ERROR IN INITIAL STATE          (2)      100.00000                            **
**          PO, ERROR IN INITIAL STATE          (3)      100.00000                            **
**          PO, ERROR IN INITIAL STATE          (4)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (5)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (6)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (7)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (8)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (9)       10.00000                            **
**          PO, ERROR IN INITIAL STATE          (10)      10.00000                            **
**          PO, ERROR IN INITIAL STATE          (11)      10.00000                            **
**          PO, ERROR IN INITIAL STATE          (12)      10.00000                            **
**                                                                                           **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(1)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(2)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(3)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(4)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(5)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(6)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(7)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(8)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(9)    X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(10)   X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(11)   X                                        **
**          IPLOT, GENERATE PLOT (NO,X,P,BOTH)(12)   X                                        **
**                                                                                           **
**        CPOINT=OABIA1  WHAT NOW   NEXT      CALL DISPLAY        DISP   1 OF   1            **
**                                                                                           **
************************************      G E S S      ************************************
************************************    D I S P L A Y    ************************************
```

Figure 7-32. NAMELIST BIASNL (1 of 3)

PRELIMINARY DRAFT



```
************************************     G E S S     ************************************
****    AE-C   OABIAS   ***********    D I S P L A Y   ***********   74.318.19.42.56   ****
**                                                                                        **
**       OBNAME                          NAMELIST /BIASNL/               NAMELIST /BIASNL/ **
**                                                                                        **
**                                                                                        **
**       ROTATION LIMIT (DEG)                          20.00000          ROTLIM           **
**                                                                                        **
**       MODEL(1), USE SUN ANGLE MODEL (T,F)        T                                     **
**       MODEL(2), USE SUN TIME MODEL (T,F)         T                                     **
**       MODEL(3), USE NADIR PROJ MODEL (T,F)       T                                     **
**       MODEL(4), USE HORIZON TIME MODEL(T,F)      T                                     **
**       MODEL(5), USE DIHEDRAL ANG MODEL(T,F)      T                                     **
**       MODEL(6), USE EARTH-WIDTH MODEL (T,F)      T                                     **
**       MODEL(7), USE SMALL TARGET MODEL(T,F)      F                                     **
**       MODEL(8), MID-TIME DIHEDRAL MODEL(T,F)     T                                     **
**       MODEL(9),           (T,F)                  F                                     **
**       MODEL(10),          (T,F)                  F                                     **
**                                                                                        **
**       RESMOD, PLOT RESIDUALS (T,F)        (1)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (2)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (3)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (4)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (5)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (6)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (7)    F                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (8)    T                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (9)    F                                     **
**       RESMOD, PLOT RESIDUALS (T,F)        (10)   F                                     **
**                                                                                        **
**       IUPDAT, UPDATING FREQUENCY                   0                                   **
**       NUMITR, ITERATION LIMIT                      0                                   **
**       INTOUT, PRINTOUT FREQUENCY                   0                                   **
**       IPRINT, UNIT NO. FOR PRINTOUT              6                                     **
**       ILEVEL, PRINT LEVEL                        12                                    **
**                                                                                        **
**       ERUNIT, UNIT NO. FOR ERROR MESSAGES        6                                     **
**       IDUMPL, ERROR MESSAGE CONTROLLER           4                                     **
**       TOLDEN, MINIMUM DENOMINATOR                0.100E-03                             **
**       TOLDET, MINIMUM DETERMINANT                0.100E-03                             **
**                                                                                        **
**       DELTAT (SEC), (FOR COMPUTING VELOCITY)      10.000000                            **
**                                                                                        **
**       USE SPIN RATE FOR EACH FRAME (YES,NO)      NO                   ISPINR           **
**                                                                                        **
**       LINTOL, LINEARITY TOLERANCE         (1)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (2)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (3)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (4)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (5)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (6)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (7)    0.100D-04                             **
**       LINTOL, LINEARITY TOLERANCE         (8)    0.100D-04                             **
**                                                                                        **
**      CPOINT=OABIAI WHAT NOW   NEXT      CALL DISPLAY        DISP   1 OF   1            **
**                                                                                        **
************************************     G E S S     ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-32. NAMELIST BIASNL (2 of 3)

PRELIMINARY DRAFT

```
***********************************      G E S S      ***********************************
****    AE-C   OABIAS   ***********    D I S P L A Y    ***********   74.318.19.43.08   ****
**                                                                                       **
**       CBNAME                            NAMELIST /BIASNL/                             **
**                                                                                       **
**       LINTOL, LINEARITY TOLERANCE          (9)     0.100D-04                          **
**       LINTOL, LINEARITY TOLERANCE          (10)    0.100D-04                          **
**       LINTOL, LINEARITY TOLERANCE          (11)    0.100D-04                          **
**       LINTOL, LINEARITY TOLERANCE          (12)    0.100D-04                          **
**                                                                                       **
**       IDIAGN, PRINT LEVEL INDICATORS       (1)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (2)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (3)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (4)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (5)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (6)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (7)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (8)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (9)     0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (10)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (11)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (12)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (13)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (14)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (15)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (16)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (17)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (18)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (19)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (20)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (21)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (22)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (23)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (24)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (25)    0                                  **
**       IDIAGN, PRINT LEVEL INDICATORS       (26)    0                                  **
**                                                                                       **
**       IDISK, UNIT NO. FOR ARCHIVE                  0                                  **
**                                                                                       **
**                                                                                       **
**      CPOINT=OABIAI WHAT NOW              CALL DISPLAY          DISP   1 OF   1        **
**                                                                                       **
***********************************      G E S S      ***********************************
***********************************    D I S P L A Y    *********************************
```

Figure 7-32. NAMELIST BIASNL (3 of 3)



PRELIMINARY DRAFT

```
************************************      M S A D      ************************************
************************************   D I S P L A Y   ************  73.291.10.42.58  ****
**                                                                                       **
**        SUMMRY                    FINAL RESULTS FROM OABIAS                            **
**                                                                                       **
**        OABIAS RESULTS FOR PASS NO.                       1                            **
**                                                                                       **
**        X(1), ALPHA (DEG)                                 351.13989                    **
**        X(2), DELTA (DEG)                                 -20.33127                    **
**        X(3), PHASE (DEG)                                  52.12182                    **
**        X(4), MOUNTING ANGLE BIAS (DEG)                     0.06954                    **
**        X(5), EARTH-IN BIAS (DEG)                          -0.02052                    **
**        X(6), EARTH-OUT BIAS (DEG)                          0.07457                    **
**        X(7), BIAS ON RHO (DEG)                            -0.09114                    **
**        X(8), BIAS ON SUN ANGLE (DEG)                      -0.09427                    **
**        X(9), SPIN RATE (RPM)                              16.66673                    **
**        X(10), SUN SENSOR PLANE TILT (DEG)                  0.02787                    **
**        X(11), HORIZON SENSOR TILT (DEG)                    0.03382                    **
**        X(12), TIME ADJUSTMENT (SEC)                        0.00680                    **
**                                                                                       **
**        P, UNCERTAINTY IN FINAL STATE      (1)              8.46895                    **
**        P, UNCERTAINTY IN FINAL STATE      (2)             13.34237                    **
**        P, UNCERTAINTY IN FINAL STATE      (3)             10.69924                    **
**        P, UNCERTAINTY IN FINAL STATE      (4)              8.96790                    **
**        P, UNCERTAINTY IN FINAL STATE      (5)              7.88386                    **
**        P, UNCERTAINTY IN FINAL STATE      (6)              7.50547                    **
**        P, UNCERTAINTY IN FINAL STATE      (7)              7.19153                    **
**        P, UNCERTAINTY IN FINAL STATE      (8)              8.16953                    **
**        P, UNCERTAINTY IN FINAL STATE      (9)              0.00338                    **
**        P, UNCERTAINTY IN FINAL STATE      (10)             9.10858                    **
**        P, UNCERTAINTY IN FINAL STATE      (11)             9.02535                    **
**        P, UNCERTAINTY IN FINAL STATE      (12)             9.98426                    **
**                                                                                       **
**        STDV (DEG), SUN ANGLE MODEL(1)                      0.002734                   **
**        STDV (DEG), SUN TIME MODEL (2)                      0.338338                   **
**        STDV (DEG), NADIR PROJ MODEL (3)                    0.266431                   **
**        STDV (DEG), HORIZON TIME MODEL (4)                  0.540834                   **
**        STDV (DEG), DIHED ANG MODEL (5)                     0.709493                   **
**        STDV (DEG), EARTH-WIDTH MODEL (6)                   0.722805                   **
**        STDV (DEG), SMALL TARGET MODEL (7)                  0.0                        **
**        STDV (DEG), MID-TIME DIHED MODEL (8)                0.412820                   **
**                                                                                       **
**        MEAN RESIDUAL (DEG)    --    MODEL   (1)            0.005720                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (2)            0.019689                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (3)           -0.025746                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (4)            0.123683                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (5)            0.120549                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (6)            0.176148                   **
**        MEAN RESIDUAL (DEG)    --    MODEL   (7)            0.0                        **
**        MEAN RESIDUAL (DEG)    --    MODEL   (8)            0.079109                   **
**                                                                                       **
**        NUMBER OF RESIDUALS FOR MODEL      (1)      25                                 **
**        NUMBER OF RESIDUALS FOR MODEL      (2)      25                                 **
**                                                                                       **
**      CFCINT=CAPL01 WHAT NO#   NEXT        CALL DISPLAY          DISP   1 OF   2       **
**                                                                                       **
************************************      M S A D      ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-33. Final Results From OABIAS (1 of 2)



PRELIMINARY DRAFT

PRELIMINARY DRAFT

```
************************************      M S A D      ************************************
************************************    D I S P L A Y    ***********  73.291.10.42.58  ****
**                                                                                        **
**         SUMMARY                 FINAL RESULTS FROM OABIAS                              **
**                                                                                        **
**         NUMBER OF RESIDUALS FOR MODEL      (3)     44                                  **
**         NUMBER OF RESIDUALS FOR MODEL      (4)     44                                  **
**         NUMBER OF RESIDUALS FOR MODEL      (5)     44                                  **
**         NUMBER OF RESIDUALS FOR MODEL      (6)     25                                  **
**         NUMBER OF RESIDUALS FOR MODEL      (7)      0                                  **
**         NUMBER OF RESIDUALS FOR MODEL      (8)     17                                  **
**                                                                                        **
**                                                                                        **
**       CFCINT=OAPLOI WHAT NO=            CALL DISPLAY        DISP   1 OF   2            **
**                                                                                        **
************************************      M S A D      ************************************
************************************    D I S P L A Y    ************************************
```

Figure 7-33. Final Results From OABIAS (2 of 2)



PRELIMINARY DRAFT

```
************************************  M S A D   ************************************
************************************  D I S P L A Y   ***********  73.291.10.42.58  ****
**                                                                                  **
**        ERRCRS               ERROR SUMMARY FRCM OABIAS                            **
**                                                                                  **
```

| SUBROUTINE NAME | ERR (1) | ERR (2) | ERR (3) | ERR (4) | ERR (5) | ERR (6) |
|---|---|---|---|---|---|---|
| ANATRX | 0 | 0 | 0 | 0 | 0 | 0 |
| APARTS | 0 | 0 | 0 | 0 | 0 | 0 |
| EIASER | 0 | 0 | 0 | 0 | 0 | 0 |
| CTAFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| DIAMOD | 0 | 0 | 0 | 14 | 0 | 0 |
| FRAPRO | 0 | 0 | 0 | 0 | 0 | 0 |
| INITIL | 0 | 0 | 0 | 0 | 0 | 0 |
| LCCMP | 0 | 0 | 0 | 0 | 0 | 0 |
| LNFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| LNMOD | 0 | 6 | 0 | 0 | 0 | 0 |
| LPARTS | 0 | 0 | 0 | 0 | 0 | 0 |
| LRFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| LRMCD | 0 | 6 | 0 | 0 | 0 | 0 |
| CABIAS | 0 | 0 | 0 | 0 | 0 | 0 |
| PRINT | 0 | 0 | 0 | 0 | 0 | 0 |
| PSIPHA | 0 | 0 | 0 | 0 | 0 | 0 |
| RECURS | 0 | 0 | 0 | 0 | 0 | 0 |
| RCTATE | 0 | 0 | 0 | 0 | 0 | 0 |
| SANFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| SANMCD | 0 | 0 | 0 | 0 | 0 | 0 |
| STNFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| STNMOD | 0 | 0 | 0 | 0 | 0 | 0 |
| DHFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| CHMOD | 0 | 0 | 0 | 0 | 0 | 0 |
| SCBFUN | 0 | 0 | 0 | 0 | 0 | 0 |
| SCBMOD | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |

```
**                                                                                  **
**    CPCINT=CAPLO1 WHAT NJ#            CALL DISPLAY          DISP   2 OF   2       **
**                                                                                  **
************************************  M S A D   ************************************
************************************  D I S P L A Y   ************************************
```

Figure 7-34. Table of Errors From OABIAS

PRELIMINARY DRAFT



PRELIMINARY DRAFT

7.14.17 Table of Correlation Coefficients from OABIAS

Figure 7-35 shows the display of correlation coefficients from the OABIAS Subsystem. Each value in the table is computed as follows:

$$A_{ij} = \sqrt{\frac{P_{ij}^2}{P_{ii}\ P_{jj}}}$$

where P is the final covariance matrix. Since the matrix is symmetric, the lower diagonal portion is filled with zeroes on the display.

7.14.18 State Component Plots From OABIAS

Figure 7-36 shows one example of a state component plot. The state component right ascension is plotted versus frame number.

7.14.19 Plots of Uncertainties in State Components

Figure 7-37 shows one example of a plot of the uncertainty on the state components. The uncertainty in right ascension is plotted versus frame number.

7.14.20 Residual Plots From OABIAS

Figure 7-38 shows one example of a residual plot. The residuals from the Sun angle model are plotted versus frame number.

7.14.21 Options for Data Prediction

Figure 7-39 shows the display of options for data prediction. These parameters appear in NAMELIST MAIN and are described in Section 7.3.4.

7.14.22 Plot of Predicted and Observed Rotation Angles

Figure 7-40 is an example of the plot of predicted and observed rotation angles versus time. The X-axis is in units of minutes from the start time of the prediction. The plot shows dihedral angles from the Sun to Earth-in and the Sun

```
************************************      M S A D      ************************************
************************************   D I S P L A Y   ***********  73.317.08.41.07  ****

CORREL                     CORRELATION COEFFICIENTS
```

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 0.120 | 0.718 | 0.531 | 0.347 | 0.014 | 0.430 | 0.587 | 0.034 | 0.034 | 0.059 | 0.011 |
| 0.0 | 1.000 | 0.258 | 0.185 | 0.343 | 0.423 | 0.265 | 0.834 | 0.036 | 0.366 | 0.038 | 0.030 |
| 0.0 | 0.0 | 1.000 | 0.325 | 0.131 | 0.149 | 0.266 | 0.555 | 0.482 | 0.450 | 0.017 | 0.005 |
| 0.0 | 0.0 | 0.0 | 1.000 | 0.125 | 0.155 | 0.313 | 0.119 | 0.022 | 0.136 | 0.106 | 0.010 |
| 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.222 | 0.232 | 0.246 | 0.008 | 0.182 | 0.019 | 0.020 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.313 | 0.321 | 0.020 | 0.246 | 0.160 | 0.024 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.007 | 0.035 | 0.111 | 0.109 | 0.016 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.011 | 0.266 | 0.055 | 0.029 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.010 | 0.005 | 0.002 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.265 | 0.021 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 | 0.002 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.000 |

```
CFOINT=OAPL01 WHAT NOW            CALL DISPLAY        DISP   3 OF   3
************************************      M S A D      ************************************
************************************   D I S P L A Y   ************************************
```

Figure 7-35. Correlation Coefficients

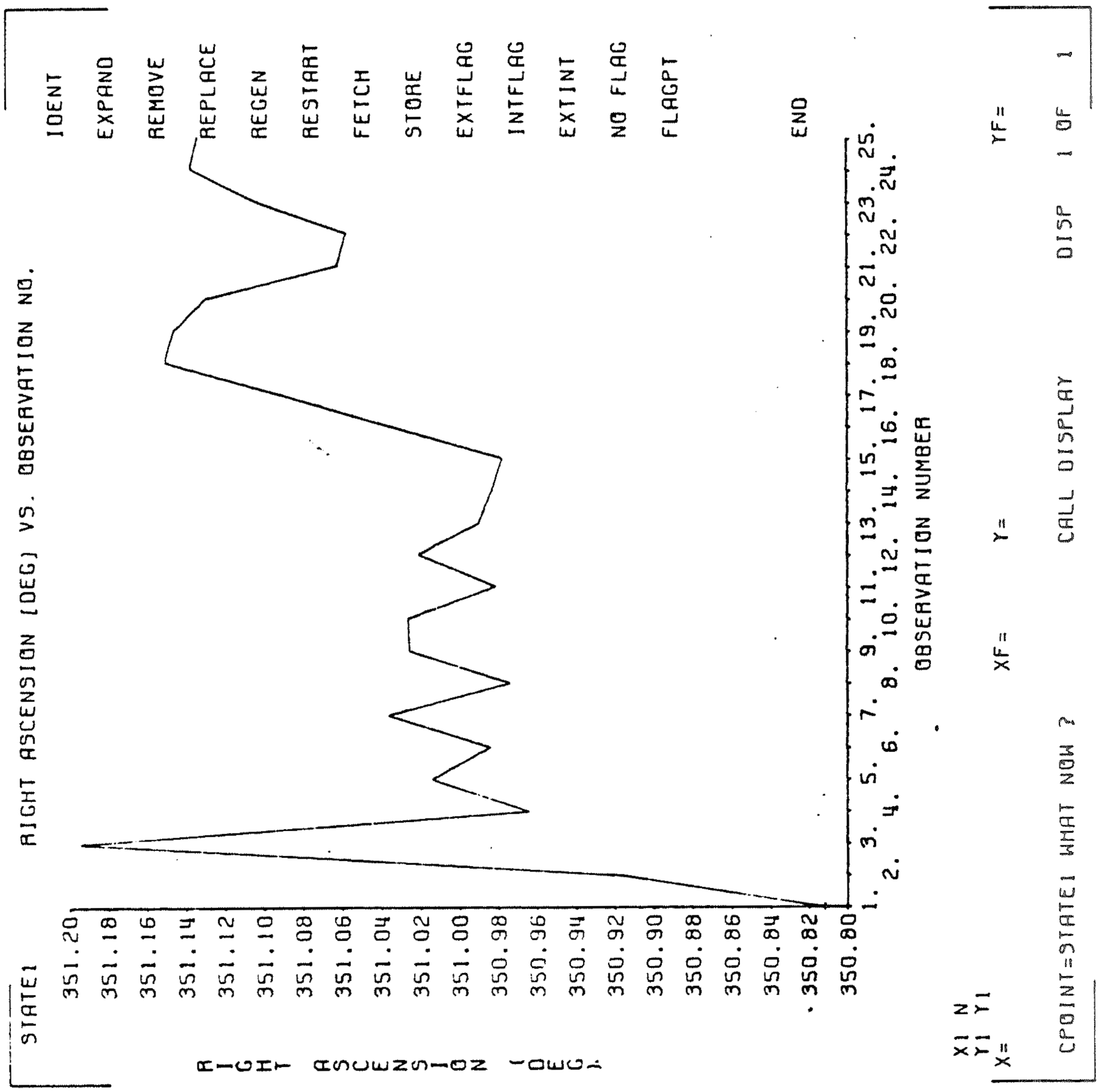


Figure 7-36. Right Ascension Versus Frame Number

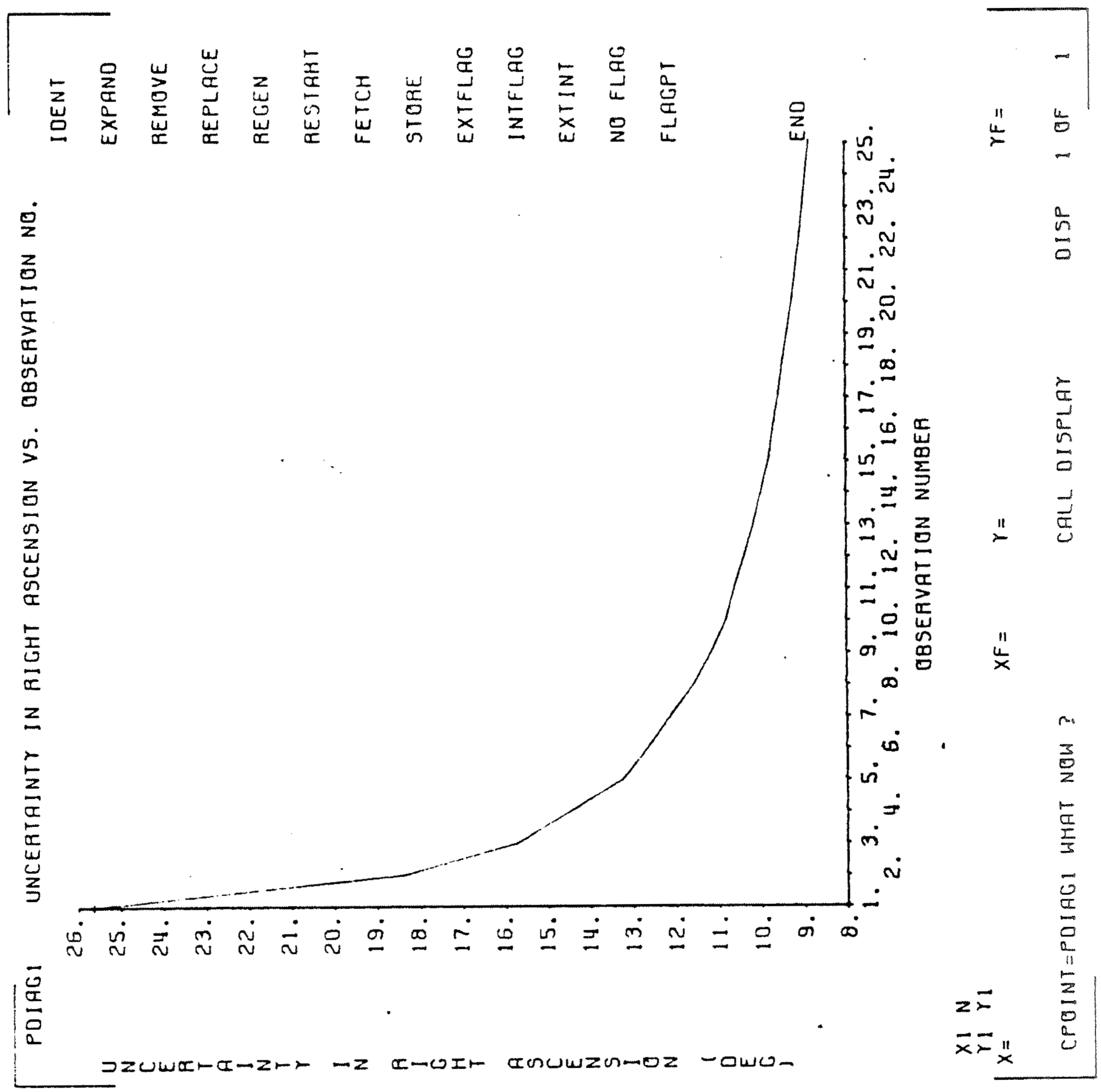


Figure 7-37. Uncertainty in Right Ascension Versus Frame Number

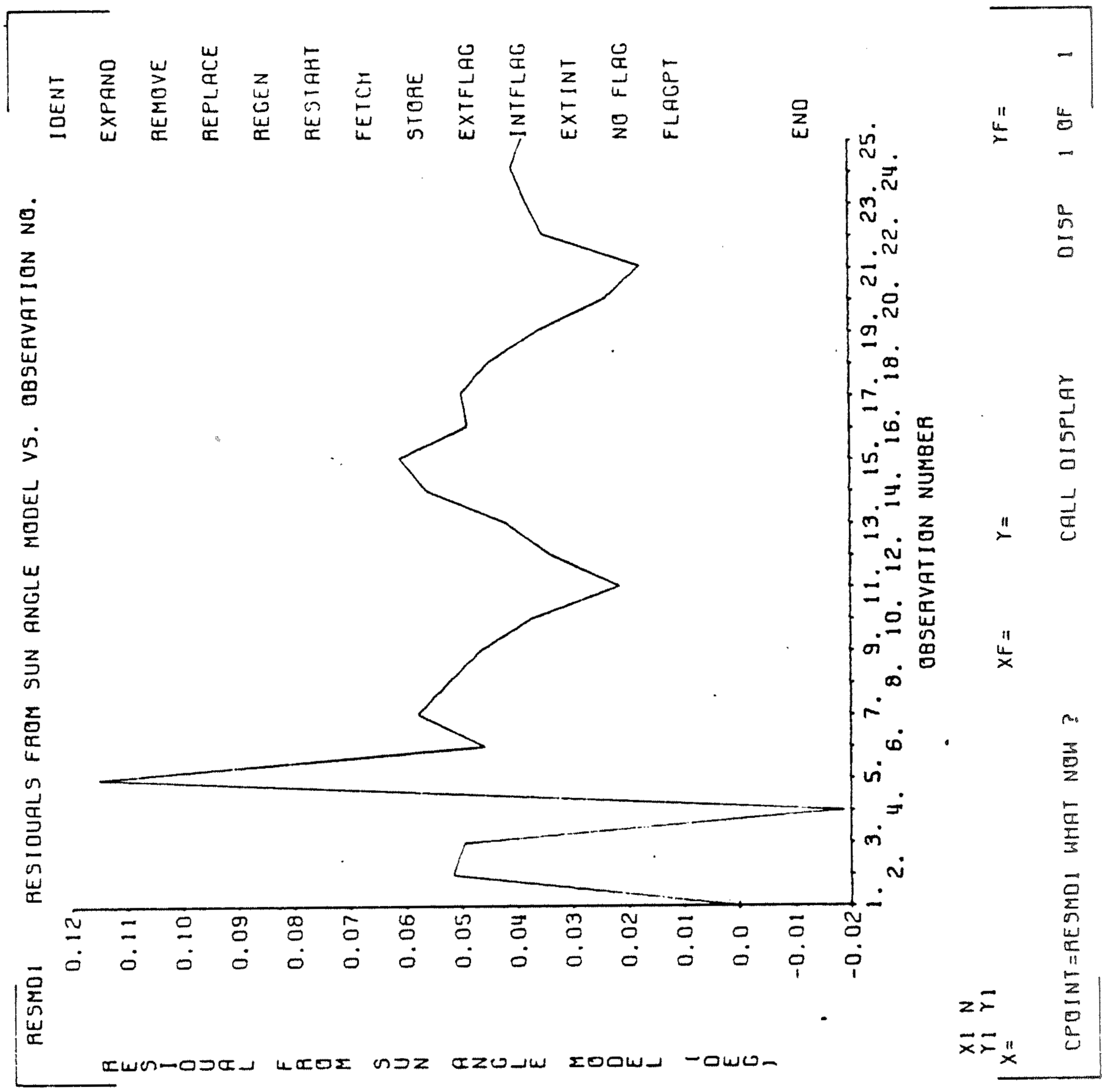


Figure 7-38. Residuals From Sun Angle Model

PRELIMINARY DRAFT

```
************************************      G E S S      ***********************************
****   AE-C    OABIAS    ***********    D I S P L A Y   ***********  74.318.19.52.00   ****
**                                                                                        **
**   PLOT01                  OPTIONS FOR DATA PREDICTION              NAMELIST /MAIN/     **
**                                                                                        **
**   PLOT NUMBER 1                                                                        **
**   USE STATE -- 0=NC PLOT   .GT.5=OLD PLOT    1                     ISTATE(1)           **
**             -- 1=OABIAS FINAL STATE                                                    **
**             -- 2=OASYS SOLN AND BIASES                                                 **
**             -- 3=ALF,DEL,BIASES                                                        **
**             -- 4=BETA,PHI,BIASES                                                       **
**   ALF, RIGHT ASCENSION (DEG)                    0.0                                    **
**   DEL, DECLINATION (DEG)                        0.0                                    **
**   BETA, INITIAL SUN ANGLE (DEG)                 0.0                                    **
**   PHI, INITIAL PHASE ON SUN CONE (DEG)          0.0                BSIGMA(1)           **
**   SENSOR MOUNTING ANGLE BIAS (DEG)              0.0                BRHO  (1)           **
**   BIAS ON RHO (DEG)                             0.0                BA1   (1)           **
**   ABIAS1 (DEG)                                  0.0                BA2   (1)           **
**   ABIAS2 (DEG)                                  0.0                BTIME (1)           **
**   TIME ADJUSTMENT (SEC)                            0.0                                 **
**        NO. OF RESIDUALS                        0                                       **
**        MEAN RESIDUAL (DEG)                     0.0                                     **
**        STANDARD DEVIATION (DEG)                0.0                                     **
**                                                                                        **
**   PLOT NUMBER 2                                                                        **
**   USE STATE                                    3                   ISTATE(2)           **
**   ALF, RIGHT ASCENSION (DEG)                   351.13062                               **
**   DEL, DECLINATION (DEG)                       -20.45374                               **
**   BETA, INITIAL SUN ANGLE (DEG)                 0.0                                    **
**   PHI, INITIAL PHASE ON SUN CONE (DEG)          0.0                BSIGMA(2)           **
**   SENSOR MOUNTING ANGLE BIAS (DEG)              0.0                BRHO  (2)           **
**   BIAS ON RHO (DEG)                            -4.14               BA1   (2)           **
**   ABIAS1 (DEG)                                  0.0                BA2   (2)           **
**   ABIAS2 (DEG)                                  0.0                BTIME (2)           **
**   TIME ADJUSTMENT (SEC)                            0.0                                 **
**        NO. OF RESIDUALS                        0                                       **
**        MEAN RESIDUAL (DEG)                     0.0                                     **
**        STANDARD DEVIATION (DEG)                0.0                                     **
**                                                                                        **
**   PLOT NUMBER 3                                                                        **
**   USE STATE                                    0                   ISTATE(3)           **
**   ALF, RIGHT ASCENSION (DEG)                    0.0                                    **
**   DEL, DECLINATION (DEG)                        0.0                                    **
**   BETA, INITIAL SUN ANGLE (DEG)                 0.0                                    **
**   PHI, INITIAL PHASE ON SUN CONE (DEG)          0.0                BSIGMA(3)           **
**   SENSOR MOUNTING ANGLE BIAS (DEG)              0.0                BRHO  (3)           **
**   BIAS ON RHO (DEG)                             0.0                BA1   (3)           **
**   ABIAS1 (DEG)                                  0.0                BA2   (3)           **
**   ABIAS2 (DEG)                                  0.0                BTIME (3)           **
**   TIME ADJUSTMENT (SEC)                            0.0                                 **
**        NO. OF RESIDUALS                        0                                       **
**        MEAN RESIDUAL (DEG)                     0.0                                     **
**        STANDARD DEVIATION (DEG)                0.0                                     **
**                                                                                        **
**   CPOINT=PLOT01  WHAT NOW    NEXT      CALL DISPLAY          DISP   1 OF   1           **
**                                                                                        **
************************************      G E S S      ***********************************
************************************   D I S P L A Y   ***********************************
```

Figure 7-39. Options for Data Prediction (1 of 3)

PRELIMINARY DRAFT

```
GESS DISPLAY
AE-C   OABIAS                                              74.318.19.52.02

PLOT01                      OPTIONS FOR DATA PREDICTION              NAMELIST /MAIN/

NEW DATA PLOT (YES,NO)                        YES                   IDATA
SCAN WIDTHS ONLY, ALL PLOTS (YES,NO)          NO                    IWIDTH
MISSING DATA SPIN RATE (DEG/SEC)                  0.0               OMEGAP
NO. OF REVOLUTIONS PER FRAME                      1                 NRDF

SCAN WIDTH RESIDUALS
NO. OF SC.W. RESIDUALS                   (1)      0
NO. OF SC.W. RESIDUALS                   (2)      0
NO. OF SC.W. RESIDUALS                   (3)      0
MEAN SC.W. RESIDUAL (DEG)                (1)     0.0
MEAN SC.W. RESIDUAL (DEG)                (2)     0.0
MEAN SC.W. RESIDUAL (DEG)                (3)     0.0
SC.W. STANDARD DEVIATION (DEG)           (1)     0.0
SC.W. STANDARD DEVIATION (DEG)           (2)     0.0
SC.W. STANDARD DEVIATION (DEG)           (3)     0.0

CENTRAL BODY (E,M)                       (1)  E                     ICENT(1,2)(1,2,3)
RADE, RADIUS OF EARTH (KM)               (1)      6378.16
RADM, RADIUS OF MOON (KM)                (1)      1738.00
CANGE, DARK ANGLE OF EARTH (DEG)         (1)    -90.00000
DANGM, DARK ANGLE OF MOON (DEG)          (1)     89.70000
USE OBLATENESS (YES,NO)                  (1)  YES                   IOBLAT(1,0)(1,2,3)
HT, HEIGHT OF ATMOSPHERE (KM)            (1)        37.60
USE ORBITAL MOTION CORRECTION (YES,NO)        YES                   IORBC(1,0) (1,2,3)
PREDICT FOR EVERY I-TH FRAME             (1)      1                 IPSKIP     (1,2,3)

USE ABOVE FOR PLOTS 2 AND 3 (YES,NO)          YES                   ISAME(1,0)

CENTRAL BODY (E,M)                       (2)  E                     ICENT(1,2) (2)
RADE, RADIUS OF EARTH (KM)               (2)      6378.16
RADM, RADIUS OF MOON (KM)                (2)      1738.00
CANGE, DARK ANGLE OF EARTH (DEG)         (2)    -90.00000
DANGM, DARK ANGLE OF MOON (DEG)          (2)     89.70000
USE OBLATENESS (YES,NO)                  (2)  YES                   IOBLAT(1,0)(2)
HT, HEIGHT OF ATMOSPHERE (KM)            (2)        37.60
USE ORBITAL MOTION CORRECTION (YES,NO)        YES                   IORBC(1,0) (2)
PREDICT FOR EVERY I-TH FRAME             (2)      1                 IPSKIP     (2)

CENTRAL BODY (E,M)                       (3)  E                     ICENT(1,2) (3)
RADE, RADIUS OF EARTH (KM)               (3)      6378.16
RADM, RADIUS OF MOON (KM)                (3)      1738.00
CANGE, DARK ANGLE OF EARTH (DEG)         (3)    -90.00000
DANGM, DARK ANGLE OF MOON (DEG)          (3)     89.70000
USE OBLATENESS (YES,NO)                  (3)  YES                   IOBLAT(1,0)(3)
HT, HEIGHT OF ATMOSPHERE (KM)            (3)        37.60
USE ORBITAL MOTION CORRECTION (YES,NO)        YES                   IORBC(1,0) (3)
PREDICT FOR EVERY I-TH FRAME             (3)      1                 IPSKIP     (3)

CPOINT=PLOT01 WHAT NOW    NEXT      CALL DISPLAY        DISP  1 OF  1
GESS DISPLAY
```

Figure 7-39. Options for Data Prediction (2 of 3)

```
****************************************      G E S S      ****************************************
****     AE-C    OABIAS    ************      D I S P L A Y    ************   74.318.19.52.04     ****
**                                                                                                   **
**        PLOT01                    OPTIONS FOR DATA PREDICTION                 NAMELIST /MAIN/      **
**                                                                                                   **
**        PREDICT WITH EQUAL TIME INCR (YES,NO)     NO                          ITIME(1,0)           **
**                                                                              TSTART(1)            **
**        START TIME (Y,M,D,H,M,S)               (1)        0.0                       (2)            **
**        START TIME (Y,M,D,H,M,S)               (2)        0.0                       (3)            **
**        START TIME (Y,M,D,H,M,S)               (3)        0.0                       (4)            **
**        START TIME (Y,M,D,H,M,S)               (4)        0.0                       (5)            **
**        START TIME (Y,M,D,H,M,S)               (5)        0.0                       (6)            **
**        START TIME (Y,M,D,H,M,S)               (6)        0.0                                      **
**                                                                                                   **
**        END TIME (Y,M,D,H,M,S)                 (1)        0.0                 TEND(1)              **
**        END TIME (Y,M,D,H,M,S)                 (2)        0.0                     (2)              **
**        END TIME (Y,M,D,H,M,S)                 (3)        0.0                     (3)              **
**        END TIME (Y,M,D,H,M,S)                 (4)        0.0                     (4)              **
**        END TIME (Y,M,D,H,M,S)                 (5)        0.0                     (5)              **
**        END TIME (Y,M,D,H,M,S)                 (6)        0.0                     (6)              **
**                                                                                                   **
**        NO. OF POINTS TO PREDICT                          0                   NPTS                 **
**                                                                                                   **
**       CPOINT=PLOT01  WHAT NOW                  CALL DISPLAY           DISP    1 OF    1           **
**                                                                                                   **
****************************************      G E S S      ****************************************
****************************************    D I S P L A Y    ****************************************
```

Figure 7-39. Options for Data Prediction (3 of 3)



PRELIMINARY DRAFT

to Earth-out. The observed rotation angles appear as points. The predicted rotation angles appear as lines. There are up to four segments for each predicted plot: first horizon, first terminator, second terminator, and second horizon. There are up to three predicted plots, corresponding to the three sets of inputs in the plot option table shown in Section 7.14.21. The three predicted plots are identified by the numbers 1, 2, and 3 when the GESS IDENTIFY is used to identify the curves. Numbers 4 and 5 in the identify option referred to observed Earth-in data and Earth-out data, respectively. The plot of predicted and observed rotation angles versus frame number is identical to the plot in Figure 7-40 except that the X-axis is frame number. The frame number plot is only available if ITIME = 0 (see Section 7.14.21).

### 7.14.23 Plot of Predicted and Observed Earth Widths

Figure 7-41 is an example of the plot of predicted and observed earth widths versus frame number. The three predicted plots and the observed plot correspond to the same data as the rotation angle plots (see Section 7.14.22). The Earth width equals the Earth-out dihedral angle minus the Earth-in dihedral angle. The plot of predicted and observed Earth width versus time is identical to the frame number plot, except that the X-axis is measured in minutes from the start time of the prediction.

### 7.14.24 Core Storage and Time Remaining Display

Figure 7-42 shows an example of the core storage and time remaining display. This display is generated whenever the operator enters the command 'CORTIM' into the WHAT NOW field of any display. The display indicates the amount of free core storage within the user's region, the extent of core fragmentation, and the computer processing unit (CPU) and I/O time remaining in the job.

PRELIMINARY DRAFT

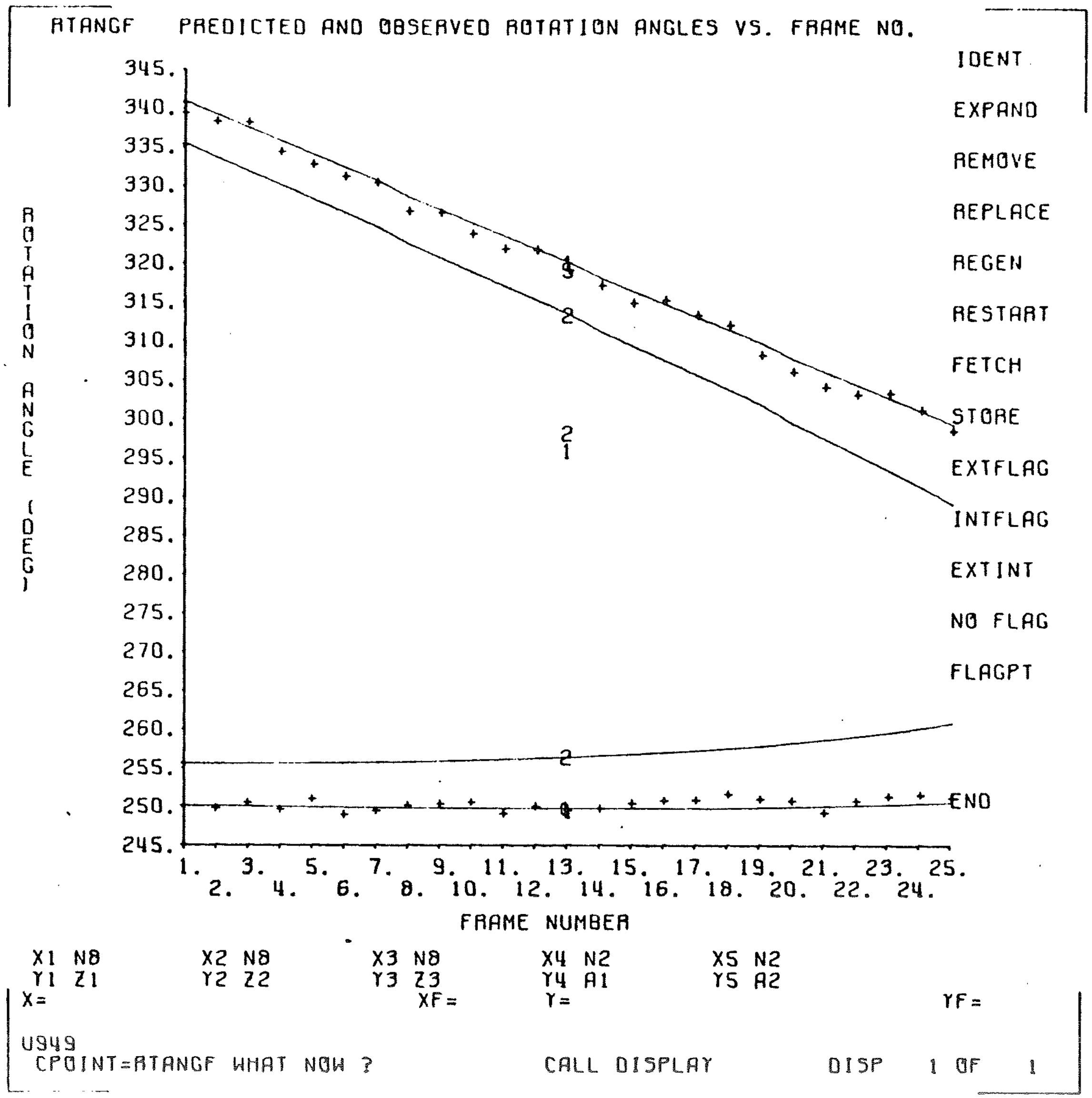


Figure 7-40. Predicted and Observed Rotation Angles Versus Time



PRELIMINARY DRAFT

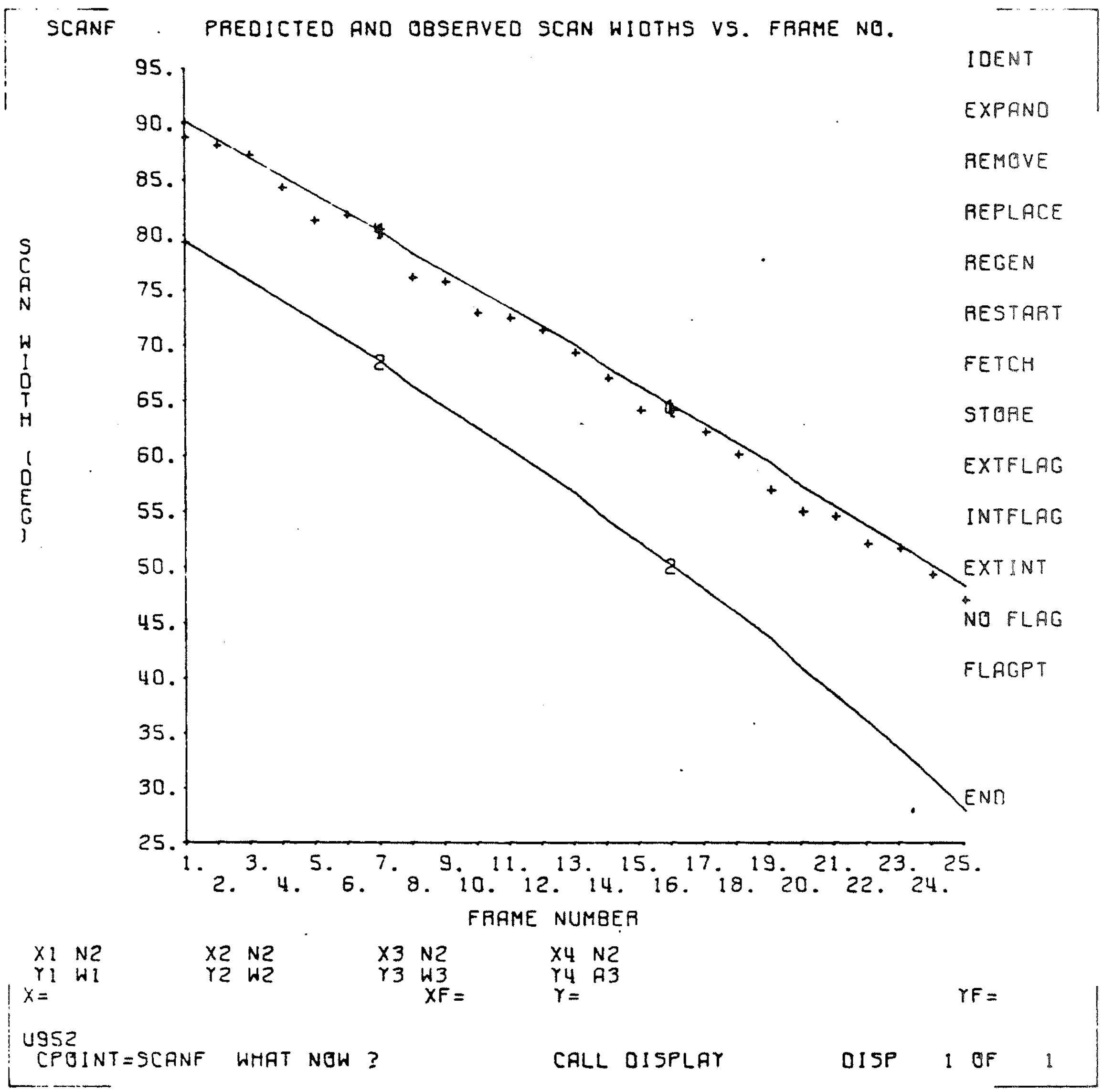


Figure 7-41. Predicted and Observed Earth Widths Versus Frame Number

```
****************************************    M S A D    ****************************************
****  ****************  ************   D I S P L A Y   ***********  73.275.21.46.25  ****
**                                                                                          **
**    CORTHI           CORE AVAILABLE AND TIME REMAINING                                    **
**                                                                                          **
**    REGION SIZE (K BYTES) ................  390                                           **
**                                                                                          **
**    TOTAL FREE BLOCKS OF CORE (K BYTES) ..   54                                           **
**                                                                                          **
**         20 LARGEST FREE BLOCKS (K BYTES)                                                 **
**                                     (1)     54                                           **
**                                     (2)      0                                           **
**                                     (3)      0                                           **
**                                     (4)      0                                           **
**                                     (5)      0                                           **
**                                     (6)      0                                           **
**                                     (7)      0                                           **
**                                     (8)      0                                           **
**                                     (9)      0                                           **
**                                    (10)      0                                           **
**                                    (11)      0                                           **
**                                    (12)      0                                           **
**                                    (13)      0                                           **
**                                    (14)      0                                           **
**                                    (15)      0                                           **
**                                    (16)      0                                           **
**                                    (17)      0                                           **
**                                    (18)      0                                           **
**                                    (19)      0                                           **
**                                    (20)      0                                           **
**                                                                                          **
**    TOTAL FREE CORE IN SJBPOOLS                                                           **
**      (IN BLOCKS OF LESS THAN 2K) (BYTES)     11864                                       **
**                                                                                          **
**    CPU TIME REMAINING (MINUTES) .........  14                                            **
**                       (SECONDS) .........  45                                            **
**                                                                                          **
**    I/O TIME REMAINING (MINUTES) .........  14                                            **
**                       (SECONDS) .........  10                                            **
**                                                                                          **
**   CPOINT=CORTHI WHAT NJB               CALL DISPLAY        DISP   1 OF   1                **
**                                                                                          **
****************************************    M S A D    ****************************************
****************************************  D I S P L A Y  **************************************
```

Figure 7-42. Core Storage and Time Remaining Display

## 7.15 CONTROL WITH INTERACTIVE GRAPHICS

This subsection describes the ways in which the operator can modify program flow in a graphic mode. The reader is assumed to have a knowledge of the general capabilities of GESS graphics systems (see Reference 13, pages 6-14 ff.).

### 7.15.1 Programmed Function Keys

The MSAD/OABIAS System uses 20 programmed function keys, in addition to keys 0, 30, and 31 which are normally provided in any MSAD system. The functions of these keys are listed below:

| Key | Function |
|---|---|
| 0 | Causes move to array allocation sizes display. Allows the operator to change array allocation sizes. Always a backward move to the beginning of the system |
| 1 | Causes move to main control display in OADRIV |
| 4 | Causes move to tabular display of input data |
| 5 | Causes move to plot of Sun angle data versus time |
| 6 | Causes move to plot of spin period data versus time |
| 7 | Causes move to plot of rotation angle data versus time. (NOTE: If IPLOT = 1 in the data reading options display, then key 7 will cause a move to the Earth-in data versus time plot. See Section 7.3.4.) |
| 8 | Causes move to plot of Earth width data versus time |
| 9 | Causes move to display of options for selecting data for OASYS |
| 10 | Causes move to NAMELIST OPMAN1 display in the OASYS Subsystem |
| 11 | Causes move to character display of block average results from OASYS |

| Key | Function |
|---|---|
| 12 | Causes move to plot of alpha (including rejected points) from OASYS |
| 13 | Causes move to plot of delta (including rejected points) from OASYS |
| 14 | Causes move to plot of arc length uncertainties from OASYS |
| 15 | Causes move to plot of nadir angles from OASYS |
| 16 | Causes move to NAMELIST BIASNL display in the OABIAS Subsystem |
| 17 | Causes move to character display of final results from OABIAS |
| 18 | Causes move to plot display of first state component in OABIAS |
| 19 | Causes move to plot display of uncertainty in first state component in OABIAS |
| 20 | Causes move to plot display of residuals from first model in OABIAS |
| 22 | Causes move to display of options for data prediction in PLOTOC Subsystem (NAMELIST MAIN) |
| 23 | Causes move to plot of predicted and observed rotation angles versus time |
| 24 | Causes move to plot of predicted and observed Earth-widths versus time |
| 30 | Causes move to GESS XSTOPS display used to control graphics displays and check key assignments |
| 31 | Causes move to GESS PRINT; prints lineprinter plot of character displays and CalComp plot of plot displays |

NOTE: Once the OABIAS Subsystem has been entered, the operator can leave this subsystem only by making a backward move (usually either key 1 or key 10). In a graphic mode, the OABIAS Subsystem is in an infinite loop, always returning to the NAMELIST BIASNL display to accept new parameters for reprocessing.

The programmed function keys are assigned for convenient use with the 2250 graphic display device. The four long rows on the key console correspond to the four major subsystems of OABIAS--OADRIV, OASYS, OABIAS, and PLOTOC. The keys are normally used as follows: if the operator desired to return to the main control display in OADRIV from any point in the system, (e.g., to read new data or terminate), key 1 is depressed. Within OADRIV the first long row is used to move rapidly back and forth to examine data tables and displays, flag data, and select data for further processing. Within the first long row, key 4 shows the tabular data display, keys 5 through 8 show plots of the input data, and key 8 shows the options for adding noise or biases to the data and selecting data for further processing. The second long row controls OASYS processing and result displays. The first key in the row shows the OASYS processing parameters. The second key is depressed to obtain the tabular results of the OASYS processing. The remainder of the keys are used to move quickly back and forth among the plots of OASYS results. The third row is the OABIAS Subsystem and is similar in structure to the second row. The first two keys are processing parameters and final results table, respectively. The next three keys show plots of OABIAS results. The fourth long row controls the PLOTOC Subsystem. The first key of the row shows the options for data prediction. The next two keys show the predicted and observed rotation angle and Earth-width plots. Finally the last two keys on the console bring up the XSTOPS display and provide the PRINT option.

See Section 2.4 for a detailed example of controlling system flow in a graphic mode.

7.15.2 Asynchronous Calls

The following control point names may be used for asynchronous calls. For an asynchronous call, the control point name is entered into the WHAT NOW field of any display; the specified control point is then invoked. Following execution of the actions specified at that control point, control returns to the display from which the asynchronous call was made.

| Control Point Name | Action |
|---|---|
| HEADER | Generate displays of OABIAS header records (three displays) |
| DATDIS | Generate tabular display of OABIAS telemetry data |
| BETA | Generate plot display of Sun angle versus time and versus frame number |
| OMEGA | Generate plot display of spin rate versus time and versus frame number |
| ROANGL | Generate plot display of rotation angles versus time and versus frame number |
| EWIDTH | Generate plot display of Earth width versus time and versus frame number |
| CORTIM | Generate core storage and time remaining display |

Control point HEADER would be invoked asynchronously only if the operator desired to look at the header record information. Control points DATDIS, BETA, OMEGA, ROANGL, and EWIDTH could be invoked asynchronously to allow the operator to examine the data or to change the rejection flags. The rejection flags from the data display are re-examined each time processing is performed in OASYS or OABIAS, and the rejection status of the data is modified appropriately.

Control point CORTIM can be invoked whenever the operator wishes to examine core fragmentation or the amount of CPU or I/O time remaining in the job.

## 7.16 ERROR MESSAGES

### 7.16.1 Messages Displayed in a Graphic Mode

Two types of error messages appear in a graphic mode: ADDMSG messages appear on a single line at the bottom of the display; MESAGE messages appear on a separate display. For messages not listed below, see Reference 13.

ADDMSG Messages are as follows:

| Message | Description |
|---|---|
| U700 REQUESTED INTERVAL COPIED. NORMAL COMPLETION OF AECOPY | The requested block(s) from the AE data set have been copied to the OABIAS data set. At least one frame was copied<br><br>User response: None |
| U701 END OF FILE ON AE DATA SET. NORMAL COMPLETION OF AECOPY | An end-of-file was encountered on the AE data set before the end of the requested interval was encountered. At least one frame was copied<br><br>User response: None |
| U702 END OF FILE ON AE DATA SET. REQUESTED INTERVAL NOT FOUND | An end-of-file was encountered on the AE data set before the beginning of the specified interval was found No records were copied<br><br>User response: Specify a valid interval, or an interval beginning with block 1 |
| U703 NO RECORDS ON AE DATA SET | An end-of-file was encountered while attempting to read the first block from the AE data set. The AE data set is empty. No records were copied<br><br>User response: Obtain a valid AE data set |
| U801 END OF FILE OR I/O ERROR. NAMELIST /BIASNL/ | An end-of-file or I/O error was encountered while reading NAMELIST BIASNL in INITIL. See description of U920, below |

| Message | Description |
|---|---|
| U901 END OF FILE ON OABIAS DATA SET | An end-of-file was encountered on the OABIAS data set before reading of the requested interval was completed<br><br>User response: None |
| U902 ARRAYS FILLED | Either the header record arrays or the data record arrays were filled before reading of the requested interval was completed<br><br>User response: None |
| U903 INVALID DATA INTERVAL SELECTED | The data interval specified by IREC1 and IREC2 in NAMELIST MAIN (for a read request) or NFRAM1 and NFRAM2 in NAMELIST MAIN (for a processing request) is invalid<br><br>For a read request:<br>IREC1 > IREC2 or<br>IREC1 ≤ 0<br><br>For specifying data to be passed to OASYS:<br>NFRAM1 < 1 or<br>NFRAM1 > NFRAM2 or<br>NFRAM2 > the number of frames of data currently in core<br>NFRAM2 - NFRAM1 >200<br><br>User response: Correct the invalid parameter, and repeat the request |
| U904 NO DATA RECORDS IN CORE | Following processing of the read request, there are still no data records in core because the user requested reading of header records only, or the specified data interval is not on the data set<br><br>User response: Read some data records into core by specifying the correct parameters |

| Message | Description |
|---|---|
| U905 ERROR RETURN xxx FROM ODAP | Subroutine ODAP returned before completing simulation of the requested block, probably because invalid parameters were input to NAMELIST LIST. See the description of error code xxx in Section 7.16.2<br><br>User response: Repeat the simulation request, and specify valid parameters in NAMELIST LIST |
| U906 START TIME = XXXXXX.XXXXXX | This message always appears on plot displays of data versus time. START TIME is the time of the first unflagged frame of data (expressed as YYMMDD.HHMMSS) and is the zero point for the X-axis coordinate<br><br>User response: None |
| U907 FIRST FRAME NO. TO BE PROCESSED MUST BE 1 IF EPHEM VECTORS SAVED | An incorrect interval for passing data to OASYS has been requested. If ephemeris vectors are to be saved with the data, the data interval passed to OASYS must be 1 to N. $1 \le N \le 200$<br><br>User response: Set NFRAM1 = 1 on "Select Data for OASYS" display or IEFMFG = 0 on "Options for Reading Data" display |
| U908 TO SAVE EPHEM VECTORS SET INPUT DATA RECORDS MASTER NO. .LE. 200 | An attempt was made to save the ephemeris vectors passed with the data with an invalid "Input Data Records" master number<br><br>User response: Set IEFMFG = 0 in "Options for Reading Data" display or return to array allocation sizes display (key 0) and set "Input Data Records" master number to 200 or less |
| U909 EPHEM VECTORS NOT PRESERVED | An attempt was made to use the ephemeris information on the OABIAS file when that information was not preserved |



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| Message | Description |
|---|---|
| | User response: Set IEPHEM = 0 on "Select Data for OASYS" display or re-read data with IEFMFG = 1. (NOTE: See restrictions on preserving ephemeris vectors in error messages U907 and U908) |
| U920 END OF FILE NAMELIST/LIST/ | An end-of-file was encountered while reading NAMELIST LIST in ODAPIN. The NAMELIST cards are probably missing or in the wrong order<br><br>User response: Supply the necessary NAMELIST parameters via the display |
| U930 END OF FILE NAMELIST/OPMAN1/ | An end-of-file was encountered while reading NAMELIST OPMAN1 in OPINIT. See description of U920, above |
| U947 ERROR RETURN xxx FROM EPHEMG | Subroutine EPHEMG returned an error code while attempting to access ephemeris data for the plot of predicted and observed rotation angles. The error codes from EPHEMG are as follows:<br>= 0, normal return<br>= 1, time before start of tape (DTAPRE)<br>= 2, time after end of tape (DTAPRE)<br>= 3, I/O error on tape (DTAPRE)<br>= 4, interpolation error (DTAPRE)<br>= 5, too many tapes (DTAPRE)<br>= 6, time before start of tape (RJPLT)<br>= 7, time after end of tape (RJPLT)<br>= 8, requested body not on file (SUNRD)<br>= 9, I/O error (SUNRD)<br>= 10, orbit level not found (GETHDR)<br>= 11, I/O error reading header (GETHDR)<br>= 12, time not on file (GETVCT)<br>= 13, I/O error reading data record (GETVCT)<br>= 14, input code is invalid (ISUN, ISPC, or IMOON, in COMMON/ORBIT1/) |



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| Message | Description |
|---|---|
| | = 15, central body flag returned by GETHDR is not 1 or 2<br>= 16, exceeded maximum iterations in solution of Kepler's equation (ORBGEN)<br><br>User response: Depress key 2 to return to the NAMELIST OPMAN1 display and correct the ephemeris option |
| U948 SPACECRAFT WITHIN CENTRAL BODY-PLOTOC | The ephemeris data places the spacecraft within the central body<br><br>User response: Correct the ephemeris options on the NAMELIST OPMAN1 display or correct the effective central body radius on the display of options for data prediction |
| U949 T0 = XXXXXX.XXXXXX STDU = X.XXX, X.XXX, X.XXX. RESD = X.XXX, X.XXX, X.XXX | This message always appears on the plot of predicted and observed rotation angles versus time. T0 is the start time of the prediction in the form YYMMDD.HHMMSS. STDV and RESD are the standard deviation and mean residual, respectively, of the predicted rotation angles minus the observed rotation angles. The three values are for plots 1, 2, and 3, respectively<br><br>User response: None |
| U950 PLOTS CALL FOR DIFFERENT INDEPENDENT VARIABLE | An attempt was made to obtain plots with different X-axis coordinates, such as plotting at data times combined with equal time increment plotting<br><br>User response: Regenerate all plots by setting ISTATE to 4 or less for each plot |
| U951 INDEPENDENT VARIABLES DISAGREE AT XXXTH ELEMENT | Two plots have different X-coordinate elements for the XXXth point<br><br>User response: Check source of X-array for probable error |

| Message | Description |
|---|---|
| U952 T0 = XXXXXX.XXXXXX STDV = X.XXX, X.XXX, X.XXX, RESD = X.XXX, X.XXX, X.XXX | This message always appears on plot of predicted and observed Earth width versus time. Same interpretation as U949 above with Earth width substituted for rotation angle<br>User response: None |
| U953 ILLEGAL USE STATE AT PLOT X HAS BEEN CORRECTED. PROCEED. | An invalid use state was requested for plot X. The use state has been changed to reflect the current contents of that plot array<br>User response: Proceed |
| MESAGE MESSAGES: | |
| END OF FILE NAMELIST/MAIN/ | An end of file was encountered while reading NAMELIST MAIN in OADRIV. The NAMELIST cards for MAIN are probably missing<br>User response: Continue. Supply the necessary parameters via the display. All other NAMELISTS in the deck will have been skipped over also |
| TERMINATION REQUESTED | The operator has requested termination of the job<br>User response: If termination is desired, continue. If termination is not desired, depress key 1 |
| HEADER RECORD AT ODD POSITION ON DATA SET | A header record was encountered on the OABIAS data set as the second record of a pair of records<br>User response: Continue. The first record in the pair will be ignored. Correct the program which operated the OABIAS data set to generate a valid data set |
| ODD NUMBER OF RECORDS ON DATA SET | An end-of-file was encountered while attempting to read the second record in a pair of records |

| Message | Description |
| --- | --- |
| | User response: Continue. Correct the program which generated the OABIAS data set to generate a valid data set |
| INVALID RECORD. NSAMP .LE. 0 | The parameter NSAMP on the OABIAS data set is ≤ 0<br><br>User response: Same as for previous message |
| DATA RECORD PRECEEDS RECORD HEADER | The first record on the OABIAS data set is not a header record<br><br>User response: Correct processing of data records is not possible unless the header record is available. Correct the program which generated the OABIAS data set to create a valid data set |
| ARRAYS NOT ALLOCATED FOR AE COPY | One or more of the arrays passed to AECOPY has not been allocated by the GESS Executive (i.e., the array allocation size is zero). Return to the array allocation sizes display via key 0 and correct the array allocation sizes. |
| OABIAS AECOPY IN PROGRESS COPYING BLOCK NO. XX | Copying of the AE data set is proceeding. The XXth block has been processed<br><br>User response: None |
| OABIAS DATA READ IN PROGRESS | Reading of the data into core is proceeding<br><br>User response: None |
| OABIAS OASYS PROCESSING IN PROGRESS | Processing of the data by OASYS is proceeding<br><br>User response: None |

| Message | Description |
|---|---|
| OABIAS<br>BIAS DETERMINATION<br>IN PROGRESS<br>XX FRAMES PROCESSED<br>XXX.XX UNCERTAINTY<br>IN ALPHA = XXX.XX DEG.<br>UNCERTAINTY IN DELTA =<br>XXX.XX DEG | OABIAS processing is proceeding. After XX frames of data have been processed, the uncertainties in right ascension and declination are as given<br>User response: None |
| OABIAS<br>DATA PREDICTION IN<br>PROGRESS PLOT NO. X | PLOTOC data prediction is proceeding. Plot number X has been generated<br>User response: None |

7.16.2 Printed Messages From the ODAP Subsystem

All error messages are written on FORTRAN unit number 6, as shown in Figure 7-43. Each error message provides the following information:

| Heading | Description |
|---|---|
| FRAME NUMBER | A number corresponding to the frame number which appears in the detailed printout. With this number, a user can determine at what time in the simulation the error occurred. If the frame number = 0, then the error occurred in the initialization phase of the program |
| ERROR CODE | A number identifying the error type |
| CENTRAL BODY | Either EARTH, MOON, or blanks. If this error occurred while processing for a particular central body, then the central body is indicated. If this column is blank, it does not apply |
| MESSAGE | A message describing the error |

The following is a list of all error messages produced by the program. Those messages with an error code less than 100 are warning messages only; an

```
************************* ERROR MESSAGES FOR PROBLEM NO.     1  ***************************
FRAME    ERROR  CENTRAL   -----------------------------------------MESSAGE---------------------------------------
NUMBER   CODE   BODY

   1      200              EOF ON ATTITUDE TAPE WHILE READING HEADER RECORD

**************************** EXECUTION OF THIS PROBLEM TERMINATED DUE TO SEVERE ERROR
```

Figure 7-43. Error Message From ODAP

appropriate fixup is taken, and execution of the problem continues. Those messages with an error code greater than or equal to 100 result in termination of the simulation, with the additional message:

EXECUTION OF THIS PROBLEM TERMINATED DUE TO SEVERE ERROR

Control then returns to OADRIV, and message U905 is displayed. (See Section 7.16.1, above.)

| Error Code | Message | Meaning |
|---|---|---|
| 1 | CONES DO NOT INTERSECT--ODAP1 | The CONES routine indicates that the sensor scan does not intersect the central body, although a previous computation indicated that the scan should intersect the central body. This error may occasionally result due to truncation error with REAL*4 arithmetic<br><br>User response: None |
| 2 | DIHEDRAL ANGLE UNDEFINED--ODAP1 | The spin axis is parallel to the sun vector or the sensor mounting angle is zero or 180 degrees, so rotation angles cannot be computed<br><br>User response: None |
| 3 | MAX ITERATIONS IN TERMIN--DELPHI TOO SMALL | The terminator search exceeded 1000 steps. This error cannot occur if the default value of DELPHI is used<br><br>User response: Increase DELPHI |
| 4 | POINT DOES NOT LIE ON CENTRAL BODY--TERMIN | In the search for a terminator crossing, a point in the scan failed to lie on the central body, although a previous computation indicated that all points in this segment of the scan should lie on the central |

| Error Code | Message | Meaning |
| --- | --- | --- |
| | | body. This error will occur occasionally due to the inaccuracy of REAL*4 arithmetic<br>User response: None |
| 5 | MAX ITERATIONS IN SEARCH--PHITOL TOO SMALL | The half-interval search for a terminator crossing exceeded 30 steps. This cannot occur if the default value of PHITOL is used<br>User response: Increase PHITOL |
| 6 | POINT DOES NOT LIE ON CENTRAL BODY--SEARCH | See Error Code 4 |
| 7 | ORDER OF CROSSINGS UNDEFINED | The vector to the horizon crossing point is parallel to the nadir vector or the spin axis; the order of the horizon crosssings cannot be determined<br>User response: None |
| 21 | INVALID INPUT TO SUBROUTINE xxxxxx | xxxxxx will be the name of one of the uncertainty routines, UNCERT, UNCDBL, or UNCDH. No solution was obtained for attitude, using the unbiased simulated data. This will occasionally result due to truncation error with REAL*4 arithmetic<br>User response: None |
| 23 | INVALID INPUT TO SUBROUTINE xxxxxx | xxxxxx will be the name of one of the uncertainty routines UNCERT or UNCDBL. The spacecraft position obtained from EPHEMG is within the central body<br>User response: Correct the orbit information being used by EPHEMG. |


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| Error Code | Message | Meaning |
|---|---|---|
| 31-46 | INVALID INPUT TO SUBROUTINE xxxxxx | xxxxxx will be the name of one of the uncertainty routines, UNCERT, UNCDBL, or UNCDH. An error return was encountered from EPHEMG, with error code 1-16, respectively. See description of EPHEMG |
| 70 | EOF ON ATTITUDE TAPE--NORMAL TERMINATION | An end-of-file was encountered while attempting to read a data record on the attitude tape<br>User response: None |
| 80 | EXCEEDED MAX ITERATIONS IN ODAP | The maximum number of iterations specified by the user to be used in the iterative process to correct for orbital motion has been exceeded<br>User response: None |
| 101-116 | ERROR IN EPHEM ROUTINE | Error return 1-16 respectively from subroutine EPHEMG. See description of EPHEMG |
| 130 | STOP TIME COMES BEFORE START TIME | The specified value of TF is earlier than the specified value of T0. (NAMELIST LIST)<br>User response: Do not specify TF |
| 150 | SPACECRAFT IS WITHIN EARTH | The spacecraft coordinates place it within the Earth<br>User response: Correct the orbital elements or orbit tape |
| 160 | SPACECRAFT IS WITHIN MOON | See Error Code 150 |
| 200 | EOF ON ATTITUDE TAPE WHILE READING HEADER RECORD | An end-of-file occurs within the header record, or there is an illegal, missing, or DUMMY DD card for the attitude tape<br>User response: Check the attitude tape DD card |



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| Error Code | Message | Meaning |
|---|---|---|
| 210 | ATTITUDE TAPE DOES NOT COVER ANY OF THE DESIRED TIME INTERVAL | The range covered by the attitude tape, as indicated on the header record, does not include any of the requested time interval, as defined by TO and TF (NAMELIST LIST); or the attitude tape has fewer than two data records; or the header record does not correctly indicate the start and stop times of the data records<br><br>User response: Check the printout of the header record to see if the tape covered the requested interval |
| 220 | TIME REVERSAL--BACKSPACING IS NOT PROVIDED FOR ATTITUDE TAPE | Interpolation has been specified (INTERP = 1, NAMELIST LIST), and the requested time is earlier than the time interval covered by the two records which have been saved. This error should not occur<br><br>User response: Correct the program so that the error does not occur |

The following unnumbered message is provided:

| Message | Meaning |
|---|---|
| END OF FILE ON UNIT 5--NAMELIST/LIST/NOT FOUND | An end-of-file was encountered on FORTRAN data set reference number 5, while attempting to read NAMELIST LIST for the first problem. This message is always accompanied by the graphics message U920 described in Section 7.16.1<br><br>User response: Supply the NAMELIST parameters via the display device, if this is a graphics run |

### 7.16.3 Printed Messages From the OASYS Subsystem

All error messages from the OASYS Subsystem are written on FORTRAN unit number 6. The following messages are provided:

| Message | Description |
|---|---|
| A PRIORI ATTITUDE WAS USED TO RESOLVE AMBIGUITIES IN SPINAV | The a priori attitude provided was used to resolve ambiguities, either because the deterministic logic failed or because IAPIOR = 8 (NAMELIST OPMAN1)<br><br>User response: Warning message only. The correctness of the results may depend on the accuracy of the a priori attitude |
| NO A PRIORI ATTITUDE AVAILABLE--AMBIGUITIES CANNOT BE RESOLVED IN SPINAV | The search technique for resolving ambiguities failed to yield any set of selections which contained more than one useful attitude<br><br>User response: Increase the block size and/or the time range of the block. Increase values of SPNSIG and SPNTOL. Try using IAPIOR = 4 and providing an a priori attitude (NAMELIST OPMAN1) |
| SPINAV DIVERGED--NO AVERAGES AVAILABLE | In the process of iterating to improve the selections for ambiguous pairs of attitudes, every attitude in the block was rejected as spurious<br><br>User response: Increase rejection tolerances SPINSIG and SPNTOL. Try using IAPIOR = 8. Increase the block size and/or the time range of the block (NAMELIST OPMAN1) |

| Message | Description |
|---|---|
| SPINAV FAILED TO CONVERGE--RESULTS ARE GIVEN FOR LAST ITERATION | The process for selecting the correct attitude from ambiguous pairs failed to converge within ITMAX iterations. The selections which are given for the last iteration are not necessarily consistent with the average obtained using those selections<br><br>User response: Increase ITMAX. Try using IAPIOR = 8 and specifying an initial attitude estimate. Increase the block size and/or the time range of the block (NAMELIST OPMAN1) |
| FITTING OF SUN DATA FAILED DUE TO ZERO DETERMINANT IN BLOCK xx | In attempting to perform a linear fit to the Sun angles as a function of time, a zero determinant was obtained<br><br>User response: Set ISNPRO=1 (NAMELIST OPMAN1). Check Sun angles and Sun times for extreme erroneous values, and flag these frames |
| FAULTY POINTER INFORMATION IN SUNPRO | The pointer information in COMMON/POINT/ is invalid. This error should not occur<br><br>User response: Correct the program so that the error does not occur |

### 7.16.4 Printed Error Messages From OABIAS

Error messages from the OABIAS Subsystem are written by subroutine BIASER on the FORTRAN unit number specified by ERUNIT. All messages start with the frame number and the name of the subroutine in which the error occurred. This information is followed by the error message.



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In many cases, the same error message may be printed by several subroutines. Therefore the error messages are given below in the order in which they appear in the OABIAS error summary table. (See Section 7.14.16 for an example). Table 7-1 provides the correlation between the error summary table and the error message descriptions.

The subroutine BIASER prints the appropriate error message based on the variable IERR which it receives via the calling sequence. IERR is a four-digit number. The first two digits indicate which subroutine has encountered an error. The next two digits are the index for the error which was encountered within the subroutine, i.e., the first, second, or third. The numbers which identify the subroutines are given in Table 7-1. The indices utilized by each subroutine are indicated in Table 7-1 by a reference to an error message number. A blank space indicates no error message for that index. The values of IERR which can cause an error message to be written are listed in the message descriptions.

In some cases, the message contains parameters which may be useful in determining the exact cause of the error. For example,

***** ERROR IN FRAME 32 FROM DIAMOND - DATA REJECT - REJOPT = 1, REJ = 8

where REJOPT is the data rejection option in NAMELIST BIASNL, and REJ is the data rejection flag for frame 32 in COMMON/REJCOM/. This message was caused by IERR = 0511. In the error messages given below, the characters 'XXXX' will be used to indicate the printing of a variable in that place in the message.


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Table 7-1. OABIAS Error-Message Error-Table Correlation Matrix

| Number | Subroutine Name | Error 1 | Error 2 | Error 3 | Error 4 | Error 5 | Error 6 |
|---|---|---|---|---|---|---|---|
| 1 | AMATRX | | | | | | |
| 2 | APARTS | | | | | | |
| 3 | BIASER | | | | | | |
| 4 | DIAFUN | 2 | 3 | 4 | 5 | 6 | 7 |
| 5 | DIAMOD | 8 | 9 | 10 | 11 | 12 | 13 |
| 6 | FRAPRO | | | | | | |
| 7 | INITIL | | | | | | |
| 8 | LCOMP | 14 | 15 | | 16 | 17 | |
| 9 | LNFUN | | | | | | |
| 10 | LNMOD | 8 | 11 | 12 | 13 | | |
| 11 | LPARTS | 18 | 19 | | | | |
| 12 | LRFUN | 16 | 17 | | | | |
| 13 | LRMOD | 8 | 11 | 12 | | | |
| 14 | OABIAS | | | | | | |
| 15 | PRINTB | | | | | | |
| 16 | PSIPHA | | | | | | |
| 17 | RECURI | | | | | | |
| 18 | ROTATE | | | | | | |
| 19 | SANFUN | 20 | | | | | |
| 20 | SANMOD | 9 | 10 | 12 | | | |
| 21 | STMFUN | | | | | | |
| 22 | STMMOD | 9 | 10 | 12 | | | |
| 23 | DMFUN | 21 | | | | | |
| 24 | DHMOD | 8 | 11 | 12 | 13 | | |
| 25 | SCBFUN | 16 | | 22 | 17 | | |
| 26 | SCBMOD | 8 | 11 | 12 | | | |



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The OABIAS error messages fall into two classes: warnings and information. The warning error messages are associated with computational failures. The program action is to bypass the observation which caused the error. If any user response is required, it is indicated after the description of the error message. The information messages record data rejection. If an observation has been flagged, it is not processed. No user response is required.

Warning error messages are as follows:

| Message Number | IERR | Message | Description |
|---|---|---|---|
| 2 | 0401 | DOT PRODUCT OF SUN VECTOR AND SPIN VECTOR IS 1 or -1 | The Sun vector and spin axis vector are parallel or antiparallel (the computed Sun angle is zero or 180 degrees) |
| 3 | 0402 | SENSOR MOUNTING ANGLE = 0.0 | Computed sensor mounting angle is zero |
| 4 | 0403 | ARGUMENT OF SQRT, DELR, IS NEGATIVE | Argument of square root is negative in computing the variable DELR in subroutine DIAFUN |
| 5 | 0404 | ARGUMENT OF SQRT, DELP, IS NEGATIVE | Argument of square root is negative in computing the variable DELP in subroutine DIAFUN |
| 6 | 0405 | TOP**2/BOT** = -1,<br>TOP**2 = XXXX<br>BOT**2 = XXXX | A denominator in computing the single horizon dihedral angle model function is zero |
| 7 | 0406 | ARGUMENT OF ARCSIN, (TE, TH) .GT. 1.0 | The argument of arcsine of quantities in computing the single horizon dihedral angle model function is greater than 1.0 |

| Message Number | IERR | Message | Description |
|---|---|---|---|
| 8 | 0501<br>1001<br>1301<br>2401<br>2601 | EARTH SIGHTING TIME IS NEGATIVE. EINOUT = 1<br>(0 = EARTH-OUT)<br>(1 = EARTH-IN)<br>INITIM = XXXX<br>EARTH-IN TIME = XXXX<br>EARTH-OUT ITME = XXXX | The observation is not processed because the central body sighting time is negative (data rejection flag). EINOUT indicates the type of triggering. INITIM is the block reference time in from September 1, 1957 |
| 9 | 0502<br>2001<br>2201 | SUNSIGHTING TIME IS NEGATIVE, SUNTIM = XXXX | The observation is not processed because the sun sighting time is negative (data rejection flag) |
| 10 | 0503<br>2002<br>2202 | SUNANG (NOBS) = XXXX IS LT 0 OR GT PI | Sun angle observation is either negative or greater than $\pi$. Error in the telemetry |
| 11 | 0504<br>1002<br>1302<br>2402<br>2602 | DATA REJECT -<br>REJOPT = XXXX<br>REJ = XXXX | Data is rejected because it was rejected by the corresponding model in OASYS |
| 12 | 0505<br>1003<br>1303<br>2003<br>2203<br>2403<br>2603 | BAD ESTIMATE, FIX-UP BY NORMALIZATION<br>S1 = XXXX, S2 = XXXX | The sum of $S_1^2$ and $S_2^2$ exceeds unity. $S_1$ and $S_2$ are adjusted so that $S_1^2 + S_2^2 < 1$<br>User response: If this occurs frequently, use smaller PO |
| 13 | 0506 | L VECTOR NOT OBTAINED IN LCOMP | The current estimate of the attitude and biases yields a scan which misses the central body. The model calling subroutine LCOMP is not processed |

| Message Number | IERR | Message | Description |
|---|---|---|---|
| 14 | 0801 | D = XXXX, XXXX, XXXX LT TOLDEN = XXXX | Denominator (D) in computing the horizon vector, $L_H$, is less than a specified tolerance (TOLDEN in NAMELIST BIASNL) |
| 15 | 0802 | ARGUMENT OF SQRT = XXXX NEGATIVE IN QUADRATIC EQUATION | A complex solution for the horizon vector, $\hat{L}_H$, was obtained. This implies that the current estimate of the attitude and biases does not yield a scan of the central body |
| 16 | 0804<br>1201<br>2501 | POSITION VECTOR IS ZERO | The position vector is zero. Error in the telemetry |
| 17 | 0805<br>1202<br>2504 | ERROR IN EPHEMV | Observation is not processed because error occurs in subroutine EPHEMV |
| 18 | 1101 | THE DETERMINANT XXXX LT THE SINGULARITY TOLERANCE = XXXX | The matrix to be inverted in computing the partial derivatives of the horizon vector, $\hat{L}_H$, is singular<br><br>User response: If this occurs frequently, decrease the tolerance. This error is inevitable if the nadir angle is close to 180 degrees or the central body is extremely small. If this is the case, use the nadir vector projection model and/or scan mid-time dihedral angle model only |



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| Message Number | IERR | Message | Description |
|---|---|---|---|
| 19 | 1102 | ERROR IN MINVM | Observation is not processed because error occurs in subroutine MINVM |
| 20 | 1901 | CHI GE 1,<br>CHI = XXXX<br>COS(X(10)) = XXXX | The cosine of the computed Sun angle exceeds 1.0 |
| 21 | 2301 | BOT = 0.0 | The denominator BOT in subroutine DHFUN is zero |
| 22 | 2503 | ABS (RCHI) .GT. 1.0 | Cosine of the computed mounting angle is greater than 1.0 |

## 7.17 JOB CONTROL LANGUAGE

Figure 7-44 shows the JCL required to load the required source modules from tape to disk, perform GESS table generation, compile the source modules, perform linkage editing with overlay, and execute the MSAD/OABIAS System. The source library on file 1 of the tape contains OADRIV and its associated modules and routines for the ODAP and OASYS Subsystems which were modified for use with MSAD/OABIAS. File 2 contains the modules in the OABIAS Subsystem. All other required routines come from the non-executable load module libraries referenced in the link step.

Note that in the link step subroutine RJPLT, which reads the JPL Lunar and Solar Ephemeris File, has been replaced by a dummy routine in order to save about 12K bytes of core storage. Thus the option to read the JPL Ephemeris File will not be available; subroutine SUNRD can be used to obtain lunar and solar ephemeris. If the user requires subroutine RJPLT then the cards with sequence numbers 810 and 820 must be deleted.

```
//ZBJRWOAB JOB (GHB001852C,T,G00529,005008),FFF      OABIAS   COMPILE
//*MAIN  LINES=100
//*
//* RFLOAD SOURCE CODE FROM TAPE TO DISK
//*
//PDSUR1 EXFC PGM=PDSUR,REGION=080K
 RELOAD F=T1,T=D2,L
 RELOAD F=T2,T=D1
//T1 DD DISP=(,PASS),LABEL=(1,BLP),UNIT=2400,DSN=TAPE01,VOL=SER=36715,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=7280,DEN=3)
//T2 DD DISP=(,PASS),LABEL=(2,BLP),VOL=REF=*.T1,DCB=*.T1,DSN=*.T1
//D1    DD DISP=(NEW,PASS),SPACE=(CYL,(5,1,5)),UNIT=2314,DSN=&&B,
//    DCB=*.T1
//D2    DD DISP=(NEW,PASS),SPACE=(CYL,(5,1,5)),UNIT=2314,DSN=&&A,
//    DCB=*.T2
//SYSPRINT DD SYSOUT=A
//*
//* ASSEMBLE MSAD TABLES.
//*
//ASMG    EXEC  ASMG,PARM='NOX,LINECNT=76',REGION=300K
//SYSLIB DD
//    DD
//               DD DISP=SHR,DSN=ATTIT.GESSMAC.ASM
//SYSLIN    DD UNIT=(DISK,4),SPACE=(CYL,(5,1))
//SYSPRINT  DD  UNIT=(DISK,4)
//SYSUT2 DD UNIT=(DISK,4)
//SYSUT3 DD UNIT=(DISK,4)
//SYSIN DD DISP=(OLD,PASS),DSN=&&A(TABLES)
//*
//* EXECUTE MSAD TABLE GENERATION PROGRAM.
//*
//TAB  EXEC  LINKGO,PARM='NCAL,LIST,MAP',COND=(16,LT),REGION.GO=150K
//SYSLIB        DD DISP=SHR,DSN=ATTIT.GESS.LOAD
//SYSLIN DD DISP=(OLD,PASS)
//OBJECT DD *
 INCLUDE SYSLIB(TABGEN)
  ENTRY TABGEN
//GO.DISPLAYS DD DSN=&&NONRES,UNIT=DISK,DISP=(NEW,PASS),
// SPACE=(CYL,(2,2,9)),DCB=(RECFM=UT,BLKSIZE=5000)
//GO.X DD DSN=&&LODMOD,DISP=(OLD,DELETE)
//*
//* CONVERT &&A TO SEQUENTIAL
//*
//SEQ1   EXEC   SEQL,DSN='&&A'
AFCOPY
BLKPLT
BLOCKDAT
DISKS
OADRIV
OAMAIN
OAPLOT
ODAP
ODAPIN
ODAP2
OPINIT
OPMAIN
PLOTOC
SETFLG
TAPHED
TCON20
TCON40
//*
//* COMPILE &&A
//*
//COMPL1    EXEC FORTRANH,PARM='OPT=2,MAP,XREF',REGION=300K
//SYSLIN    DD UNIT=(DISK,4),SPACE=(CYL,(5,1))
//SYSPRINT DD UNIT=(DISK,4)
//SYSIN DD DSN=&&SOURCE,DISP=(OLD,DELETE)
//*
//* CONVERT &&B TO SEQUENTIAL
//*
//SEQ2   EXEC   SEQL,DSN='&&B'
AMATRX
APARIS
BIASER
BLOCKDAT
DHFUN
DHMOD
DIAFUN
DIAMOD
EPHEMG
EPHEMV
FRAPRO
GETHDR
```

Figure 7-44. JCL to Compile, Link, and Execute MSAD/OABIAS (1 of 4)

```
HEMITR
INITIL
LCOMP
LNFUN
LNMOD
LPARTS
LRFUN
LRMOD
MINVM
OABIAS
ORBGEN
PRINTB
PRINTP
PSIPHA
RECUR1
ROTATE
SANFUN
SANMOD
SCBFUN
SCBMOD
STMFUN
STMMOD
VECROT
//*
//* COMPILE &&B
//*
//COMPL2    EXEC FORTRANH,PARM='OPT=2,MAP,XREF',REGION=300K
//SYSLIN    DD UNIT=(DISK,4),SPACE=(CYL,(5,1))
//SYSPRINT DD UNIT=(DISK,4)
//SYSIN DD DSN=&&SOURCE,DISP=(OLD,DELETE)
//*
//*  LINK EDIT WITH OVERLAY.
//*
//LINK   EXEC  LINK,COND=(16,LT),NBLK=250,PARM=(LET,LIST,MAP,OVLY)
//SYSLIB          DD DISP=SHR,DSN=ATTIT.GESS.LOAD
//                DD DISP=SHR,DSN=ATTIT.ADDA.DASYS4.LIB.OBJ
//                DD DISP=SHR,DSN=ATTIT.OPRLIB.OBJ
//                DD DISP=SHR,DSN=ATTIT.RAEB.LOAD
// DD DSN=SYS1.FORTLIB,DISP=SHR
// DD DSN=SYS2.GSFCLIB,DISP=SHR
// DD DSN=SYS1.SSPAK,DISP=SHR
//SYSLMOD DD DSN=&&LODMOD(OABIAS)
//SYSUT1 DD UNIT=(DISK,3)
//SYSLIN DD *
 INCLUDE AFLIB(IHCFRRM)
 CHANGE IHCFRRM(FORTERRM)
 INCLUDE SYSLIB(IHCFRRM)
 REPLACE NONRES1,NONRES2
 INCLUDE RES
 INCLUDE SYSLIB(MSADMAIN)
 INCLUDE SYSLIB(MSADBLOK)
 INCLUDE SYSLIB(PLOTS)
 INCLUDE SYSLIB(GCOMM)
 INCLUDE SYSLIB(BLOCKD1)
 CHANGE BYPASS(RJPLT)
 INCLUDE SYSLIB(BYPASS)
 CHANGE BYPASS(GCONVC)
 INCLUDE SYSLIB(BYPASS)
 INCLUDE AFLIB(ZBPAB4)
 ENTRY MSADMAIN
 OVERLAY A
   INSERT INIT,RDXSTP,RDRTCM,MSFORM,FMTCOM
 OVERLAY A
   INSERT OADRIV,OPMAIN
 OVERLAY B
   INSERT AFCOPY,WRTOUT,WRTBUF
   INSERT BITS4,BITS8,GAUSS,NOISE4,NOISE8,RANDU,TCON20,TCON40
 OVERLAY B
   INSERT ODAP,ATDATA,FLAG,ICHAR,ODAPIN,ODAP2,OMEGA,REPORT
 OVERLAY B
   INSERT OAMAIN,DOUBLE,DHCOM,DBLCOM,EXTRA,OUTINF
 OVERLAY F
   INSERT DISKS,OPDETS,TERCHK,DBLCRS
 OVERLAY E
   INSERT CHOOSE,ERROR1,OPINIT,SPINAV,SPNAV1,SUNPRO
 OVERLAY E
   INSERT BLKPLT,OAGRAF,CURTIM
 OVERLAY B
   INSERT OABIAS,PRINTB,BIASER,DISPLY,VECROT
   INSERT EPHROT,RESIDU,FILPAR,ERRCOM,VCOMON
 OVERLAY C
   INSERT INITIL,PSIPHA,ROTATE,OAPLOT,PRINTP
 OVERLAY C
   INSERT AMATRX,APARTS,DIAFUN,DIAMOD,FRAPRO,LNFUN
```

Figure 7-44. JCL to Compile, Link, and Execute MSAD/OABIAS (2 of 4)


PRELIMINARY DRAFT

```
   INSERT LPARTS,LRFUN,LRMOD,RECUR1
   INSERT AB,EPHEMV
 OVERLAY MSAD(REGION)
   INSERT GEXEC,GTSIZE,PTSIZE,READTAB,SCOPE,DISPTITL,LIGHTS,INCORE
   INSERT INCORX,FTABNO,REMTIM
   INSERT CPTERM,DATERM,RETRIEVE,CPEXEC,CPINIT,DAEXEC,DAINIT,CP1BY1
   INSERT VALCONP
   INSERT VALDATA,DACONV,DISPCOLS,DISPDATA,DISPPARM
   INSERT PLTEXEC,PLTCOM,GENGOP,VPTERM
   INSERT EXPAND,GETPUT,IDENTIFY,SCOPLT
   INSERT PROCTAB,RASCAL,MSCALE,AXLINE,AXTIT,LABAX,OPTION,VARTIT
   INSERT VPVECTOR,DISPLIN
 OVERLAY MSAD
   INSERT DHMOD,SCBMOD,SANMOD,STMMOD,STMFUN,LCOMP,MINVM
   INSERT DHFUN,SCBFUN,SANFUN,LNMOD
 OVERLAY MSAD
   INSERT GRAPH,SCALE,SETFLG
 OVERLAY MSAD
   INSERT ATTDET
   INSERT HLIGHT,LIGHT,ODAPER,ODAP1,OPSIM
   INSERT ORDER,SEARCH,SPHERE,SUNVIS
   INSERT TERMIN,UNCERT,VPHASE
   INSERT DBLU,DHCOMP,UNCDH,UNCDBL
//RES DD DSN=&&OBJMOD,DISP=(OLD,DELETE)
//AFLIB         DD DISP=SHR,DSN=ATTIT.AODA.LOAD
//*
//* UNLOAD SOURCE CODE, LOAD MODULE, AND TABLES FROM DISK TO TAPE
//*
//PDSUR2 EXEC PGM=PDSUR,REGION=80K,COND=(8,LT)
 UNLOAD F=D1,T=T1,L
 UNLOAD F=D2,T=T2,L
 UNLOAD F=D3,T=T3,L
 UNLOAD F=D4,T=T4
//D1 DD DISP=(OLD,DELETE),DSN=&&A
//D2 DD DISP=(OLD,DELETE),DSN=&&B
//D3 DD DISP=(OLD,PASS),DSN=&&LODMOD
//D4 DD DISP=(OLD,PASS),DSN=&&NONRES
//T1 DD DISP=(,PASS),LABEL=(1,BLP),UNIT=2400,DSN=TAPE02,VOL=SER=31330,
// DCB=(RECFM=FB,LRECL=80,BLKSIZE=7280,DEN=3)
//T2 DD DISP=(,PASS),LABEL=(2,BLP),VOL=REF=*.T1,DCB=*.T1,DSN=*.T1
//T3 DD DISP=(,PASS),LABEL=(3,BLP),VOL=REF=*.T1,DCB=*.T1,DSN=*.T1
//T4 DD DISP=(,PASS),LABEL=(4,BLP),VOL=REF=*.T1,DCB=*.T1,DSN=*.T1
//SYSPRINT DD SYSOUT=A
//
//
//*
//* EXECUTE OABIAS
//*
//OABIAS EXEC PGM=KEEPUP,PARM='EXMON50 ',REGION=450K,COND=EVEN
//STEPLIB DD DSN=SYS1.LINKLIB,DISP=SHR,DCB=BUFNO=1
// DD DSN=SYS2.GTS,DISP=SHR,DCB=BUFNO=1
//    DD DISP=SHR,DSN=&&LODMOD
//              DD DISP=SHR,DSN=ATTIT.OPRLIB.LOAD
//    DD DISP=SHR,DSN=ATTIT.AODA.LOAD
//GPAKDD DD UNIT=2250
//TJSSP DD DSN=GTS.JCLO,DISP=SHR
//FILE DD UNIT=2314,DISP=SHR,VOL=REF=SYS1.LINKLIB
//SYSUT1 DD UNIT=2314,SPACE=(TRK,(10,5))
//SYSUT2 DD UNIT=2314,SPACE=(TRK,(10,5))
//TJSCA DD DSN=GTS.LOGREC,DISP=SHR
//IEFRDR DD DSN=GTS.JCLO,DISP=SHR
//IEFPDSI DD DSN=SYS1.PROCLIB,DISP=SHR
//IEFDATA DD UNIT=SYSIN,SPACE=(TRK,(1,1)),
// DCB=(RECFM=F,LRECL=80,BLKSIZE=80,BUFNO=2,BUFL=80)
//SYSOUT DD SYSOUT=A
//SYSPRINT DD DUMMY  MSAD DUMPS
//FT05F001  DD  DISP=SHR,DSN=GKSMS.DATALIB.DATA(OPMAN),LABEL=(,,,IN)
//*
//* SYSOUT DATA SETS.  ASSUMING IPRINT=ERUNIT=6.
//*
//* PRINTOUT FROM MSAD, OADRIV, ODAP, OASYS, AND OABIAS.
//FT06F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=7265,BUFNO=1),
// SPACE=(CYL,(6,2)),UNIT=(DISK,4)
//* PRINTOUT FROM OABIAS.   (IPRINT+1).
//FT07F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))
//* PRINTOUT FROM OABIAS.   (IPRINT+2).
//FT08F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))
//* PRINTOUT FROM ODAP (EARTH AS CENTRAL BODY), AND OABIAS (IPRINT+3).
//FT09F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))
//* PRINTOUT FROM ODAP (MOON  AS CENTRAL BODY), AND OABIAS (IPRINT+4).
//FT10F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),
```

Figure 7-44. JCL to Compile, Link, and Execute MSAD/OABIAS (3 of 4)

```
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))
//* PRINTOUT FROM OABIAS.   (IPRINT+5).
//FT11F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))
//FT13F001     DD DISP=SHR,DSN=ATTIT.SSS1.MSAP.ERROR.DATA
//FT16F001  DD  DISP=SHR,DSN=ATTIT.SMSB.OABIAS.DATA
//FT23F001 DD UNIT=AFF=GPAKDD
//FT28F001 DD DUMMY      JPL LUNAR AND SOLAR EPHEMERIS FILE (NRJPLT).
//FT29F001 DD DUMMY  GTDS SEQUENTIAL SPC. EPHEMERIS FILE (NGTDS).
//FT30F001 DD DUMMY      DODS SPACECRAFT EPHEMERIS FILE (NORB1).
//FT31F001 DD DUMMY  GTDS DIRECT ACCESS SPC. EPHEMERIS FILE
//FT50F001 DD DUMMY              OABIAS DATA SET.
//*
//* SCRATCH DATA SET FOR SIMULATED OABIAS DATA.
//*
//FT51F001 DD UNIT=(DISK,4),SPACE=(CYL,(2,2)),
//   DCB=(RECFM=FB,LRECL=50,BLKSIZE=2000,BUFNO=1)
//GO.FT90F001 DD DSN=&&NONRES,DISP=(OLD,PASS)     MSAD TABLES (IFTABL).
//FT91F001 DD UNIT=2250        GRAPHICS DEVICE  (IFTUBE).
//FT94F001 DD DUMMY      UDAP REPORT PRINTOUT (EARTH AS CENTRAL BODY).
//FT95F001 DD DUMMY      ODAP REPORT PRINTOUT (MOON  AS CENTRAL BODY).
//GO.SYSUDUMP DD SYSOUT=A,SPACE=(CYL,(0,2)),UNIT=(DISK,4)
//*
//* CALCOMP PLOT TAPE.
//*
//PLOTAPE      DD  UNIT=2400-7,DCB=DEN=1,LABEL=(,BLP),DISP=(NEW,KEEP),
//  DSN=D.PLOT,VOL=SER=35033
```

Figure 7-44. JCL to Compile, Link, and Execute MSAD/OABIAS (4 of 4)

The following notes, which apply to the GO-step DD cards, describe alternatives available to the user. In all of the examples it is assumed that the FORTRAN unit numbers are as shown in the sample NAMELIST (default values for all unit numbers except IPRINT = 6 (BIASNL), ERUNIT = 6 (BIASNL), and IDISK = 51 (MAIN). See Section 7.3.8.)

- The SYSPRINT data set may be directed to a printer if the user desires to obtain an MSAD SNAP dump if the system abends when operating in a graphic mode

  The following DD cards are required

```
//SYSPRINT DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=7265,BUFNO=1),   00001740
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                     00001745
```

  The user should note that if these cards are provided, it may take several minutes of real time for the dump to be generated, during which time the program will not respond to the operator. If the program abends in a nongraphic mode, if the GESS Executive is unable to intercept the abend in a graphic mode, or if the operator does not attempt to recover or is unable to recover from the abend in a graphic mode, then a dump is always provided on the SYSUDUMP data set.

- If a spacecraft attitude tape is to be used to simulate data for a time-varying attitude then the following DD cards are required:

```
//FT12F001 DD UNIT=2400,DISP=(OLD,KEEP),DSN=ZB2MSATT,LABEL=(,BLP),        00001880
//   DCB=(RECFM=VBS,LRECL=50,BLKSIZE=3004,DEN=3,BUFNO=1),VOL=SER=XXXXX   00001885
```

  where XXXXX is replaced by the library number of the attitude tape.

- If it is desired to obtain solar and lunar ephemeris data in equinox of 1950.0 rather than equinox of date, using the SUNRD routine, then the following DD card is required:

```
//FT14FC01 DD UNIT=DISK,DISP=SHR,VOL=SER=DODS01,DSN=GTDS.SLP1950.JAN71  00001900
```

- If a 2260 graphics device is to be used, then the following DD card is required:

```
//FT23FC01 DD UNIT=2260                                                00001905
```

- If the run is to be made in a nongraphics mode, then the DD card with sequence number 1905 must be removed.

- If it is desired to obtain lunar and solar ephemeris data from a JPL Ephemeris File, then the following DD card is required:

```
//FT28F001 DD UNIT=2400,DISP=(OLD,KEEP),DSN=ZB2MSJPL,LABEL=(,BLP),       00001910
//   DCB=(RECFM=VBS,LRECL=8276,BLKSIZE=8280,DEN=3,BUFNO=1),VOL=SER=XXXXX 00001915
```

where XXXXX is the library number of the JPL Ephemeris tape. (Note that the link step must be changed to include subroutine RJPLT if the user desires to access the JPL tape. See the notes on the link step above.)

- If it is desired to obtain spacecraft ephemeris data from a GTDS sequential file then the following DD cards are required:

```
//FT29F001 DD UNIT=2400,DISP=(OLD,KEEP),DSN=ZB2MSGTD,LABEL=(,BLP),       00001920
//   DCB=(RECFM=VBS,LRECL=1096,BLKSIZE=1100,DEN=3,BUFNO=1),VOL=SER=XXXXX 00001925
```

where XXXXX is the library number of the GTDS ephemeris tape.

- If it is desired to obtain the spacecraft ephemeris from a DODS EPHEM tape, then the following DD cards are required:

```
//FT30F001 DD UNIT=2400,DISP=(OLD,KEEP),DSN=ZB2MSDOD,LABEL=(,BLP),        00001930
//  DCB=(RECFM=VBS,LRECL=2804,BLKSIZE=2808,DEN=3,BUFNO=1),VOL=SER=XXXXX 00001935
```

where XXXXX is the library number of the DODS EPHEM tape.

- If it is desired to obtain the spacecraft ephemeris from a GTDS direct-access file, then the following DD cards are required:

```
//FT31F001 DD UNIT=DISK,DISP=SHR,VOL=SER=XXXXXX,DSN=YYYYYY                00001940
```

where XXXXXX is the name of the disk pack on which the GTDS file resides, and YYYYYY is the data set name.

- If it is desired to read an AE data set, then the following DD card is required:

```
//FT49F001 DD UNIT=DISK,DISP=SHR,VOL=SER=XXXXXX,DSN=YYYYYY                00001950
```

where XXXXXX is the name of the disk pack on which the AE data set resides, and YYYYYY is the data set name.

- If it is desired to process real data from an OABIAS data set then the following DD card is required:

```
//FT50F001 DD UNIT=DISK,DISP=SHR,VOL=SER=XXXXXX,DSN=YYYYYY,DCB=BUFNO=1  00001960
```

where XXXXXX is the name of the disk pack on which the OABIAS data set resides, and YYYYYY is the data set name.

NOTE: To read this data set, the parameter IDISK (NAMELIST MAIN) must be restored to its default value of 50. In order to avoid operator confusion, the convention has been established that unit 51 is used for a scratch OABIAS data set for simulating data or copying AE data; unit 50 is used for a real OABIAS data set, which should not be written over by the MSAD/OABIAS System.



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- If printed output of the summary reports from the simulator are desired, then the following DD cards are required:

```
//FT94FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),  00002040
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                   00002045
```

```
//FT95FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),  00002050
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                   00002055
```

(These units are normally dummied to save core storage).

- If it is not desired to generate CalComp plots of plot displays, then the DD cards with sequence numbers 2090 and 2100 must be deleted.

Figure 7-45 shows the JCL required to execute the MSAD/OABIAS System assuming that the executable load module resides on ATTIT.OPRLIB.LOAD and the GESS nonresident tables reside on ATTIT.AODA.OABIAS.NRT.DATA. The notes given above for the GO-step DD cards apply equally to this example. ample.

```
//ZB2MS004 JOB (GH7001857A,T,C00431,004010),FFF,MSGLEVEL=(2,0)           00000010
//*                                                                       00001360
//*  EXECUTE MSAD/OABIAS FROM A LOAD MODULE AND MSAD TABLES ON G1SYS4.    00001370
//*                                                                       00001380
//GO EXEC PGM=OABIAS,REGION=40CK                                          00001385
//STEPLIB DD UNIT=DISK,DISP=SHR,VOL=SER=G1SYS4,                           00001386
//  DSN=G1.ZBMEP.OABIAS.LOADMOD                                           00001387
//GO.FT05F001 DD *           NAMELIST INPUT.                              00001390
 &MAIN ISIM=1,OMEGA1=100.,NFRAME=25,NFRAM2=25,
 IDISK=51,
 INCISE=2,STDV=4*0.005, SQUANT=0.5,
 IEPHEM=0,ITERM=0,ICB=0, &END
 &LIST IATAPE=1,ICB=1,ICBLAT=C,
 ISUN=1,ISPC=1,IMOON=0,
 ALPHA=351.,DELTA=-20.,
 ORBITE=1974.,1.,4.,22.,51.,26.,
 A=24548.,E=0.73264,EYE=28.3,EMO=0.,WO=180.,RANODE=260.,
 IFLAG=2,ISKIP=1,THETAC=0.,
 DANGE=-90.,STEP=0.,SIGMA=86.,
 ERRBET=0.25,ERRGAM=0.1,ERRA=C.1,ERRAD=0.5,ERRTIM=30.,
 TO=1974.,1.,4.,23.,04.,DELTAT=15., &END
 &CPMAN1 CBFLAG=1,EPSILN=C.,DEBUG=8,ISNPRO=1,ICBLAT=0,
 DANGE=-90.,
 ISUN=1,ISPC=1,IMOON=0,
 TORBIT=1974.,1.,4.,22.,51.,26.,
 A=24548.,E=0.73264,EYE=28.3,EMO=0.,WO=180.,RANODE=260.,
 ERRBET=0.25,ERRGAM=0.1,ERRA=C.1,ERRAD=0.5,ERRTIM=30.,
 IAPICR=8,APRA=350.,APDEC=-19., &END
 &BIASNL ATTOPT=5,REJOPT=1,RESMOD=6*T,F,T,MODEL=6*T,F,T,
 IPRINT=6,ERUNIT=6,IDUMPL=4,ILEVEL=12,IPLOT=12*3,REDUNT=10*0,
 OAGRAN=.5,STMGRN=.1,SANGRN=30.,RHOGRN=2.,
 XC=12*0., PO=3*100.,9*10., &END
//*                                                                       00001650
//* SYSOUT DATA SETS.  ASSUMING IPRINT=ERUNIT=6.                          00001660
//*                                                                       00001670
//* PRINTOUT FROM MSAD, OADRIV, ODAP, CASYS, AND OABIAS.                  00001680
//GO.FT06F001 DD DCB=(RECFM=VBA,LRECL=137,BLKSIZE=7265,BUFNO=1),          00001690
// SPACE=(CYL,(2,2)),UNIT=(DISK,4),SYSOUT=A                               00001700
//* PRINTOUT FROM OABIAS.  (IPRINT+1).                                    00001710
//FT07F001 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),    00001720
//   UNIT=(DISK,4),SPACE=(CYL,(0,2))                                      00001730
//SYSPRINT DD DUMMY     MSAD SNAP DUMP DATA SET.                          00001740
//* PRINTOUT FROM OABIAS.  (IPRINT+2).                                    00001750
```

Figure 7-45.  JCL to Execute MSAD/OABIAS (1 of 2)

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```
//FT08FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),   00001760
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                     00001770
//* PRINTOUT FROM ODAP (EARTH AS CENTRAL BODY), AND OABIAS (IPRINT+3).   00001780
//FT09FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),   00001790
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                     00001800
//* PRINTOUT FROM ODAP (MOON  AS CENTRAL BODY), AND OABIAS (IPRINT+4).   00001810
//FT10FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),   00001820
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                     00001830
//* PRINTOUT FROM OABIAS.  (IPRINT+5).                                    00001840
//FT11FC01 DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=137,BLKSIZE=1374,BUFNO=1),   00001850
//    UNIT=(DISK,4),SPACE=(CYL,(0,2))                                     00001860
//*                                                                       00001870
//FT12F001 DD DUMMY     SPACECRAFT ATTITUDE TAPE.                         00001880
//* SUNRD LUNAR AND SOLAR EPHEMERIS FILE.                                 00001890
//FT14FC01 DD UNIT=DISK,DISP=SHR,VOL=SER=DODS01,DSN=GTDS.SLPTCD.JAN71    00001900
//FT23FC01 DD UNIT=2250       GRAPHICS DEVICE  (IFTUBE).                  00001905
//FT28FC01 DD DUMMY     JPL LUNAR AND SOLAR EPHEMERIS FILE (NRJPLT).      00001910
//FT29FC01 DD DUMMY  GTDS SEQUENTIAL SPC. EPHEMERIS FILE (NGTDS).         00001920
//FT30FC01 DD DUMMY     DODS SPACECRAFT EPHEMERIS FILE (NCRB1).           00001930
//FT31FC01 DD DUMMY  GTDS DIRECT ACCESS SPC. EPHEMERIS FILE               00001940
//FT49FC01 DD DUMMY          AE DATA SET.                                 00001950
//FT50FC01 DD DUMMY          OABIAS DATA SET.                             00001960
//*                                                                       00001970
//* SCRATCH DATA SET FOR SIMULATED OABIAS DATA.                           00001980
//*                                                                       00001990
//FT51F001 DD UNIT=(DISK,4),SPACE=(CYL,(2,2)),                            00002000
//  DCB=(RECFM=FB,LRECL=50,BLKSIZE=2000,BUFNO=1)                          00002010
//FT94FC01 DD DUMMY     ODAP REPORT PRINTOUT (EARTH AS CENTRAL BODY).     00002040
//FT95FC01 DD DUMMY     ODAP REPORT PRINTOUT (MOON  AS CENTRAL BODY).     00002050
//FT96FC01 DD UNIT=DISK,DISP=SHR,VOL=SER=G1SYS4,                          00002056
//  DSN=G1.ZBMEP.OABIAS.TABLES                                            00002057
//FT97FC01 DD *    MSAD NAMELIST                                          00002058
 &CONTRL  &END
//*                                                                       00002060
//* CALCOMP PLOT TAPE.                                                    00002070
//*                                                                       00002080
//GO.PLOTAPE DD UNIT=7TRACK,DCB=DEN=1,LABEL=(,BLP),DSN=ZB2MSPLT,          00002090
//      DISP=(OLD,KEEP),VOL=SER=31636H                                    00002100
//GO.SYSUDUMP DD SYSOUT=A,SPACE=(CYL,(0,2)),UNIT=(DISK,4)                 00002110
```

Figure 7-45. JCL to Execute MSAD/OABIAS (2 of 2)



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