

GEODYN Documentation
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Volume 3

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1 INTRODUCTION

Specific problems to be solved by the GEODYN II program are defined by input cards. These cards fall into two categories: The Global Set and the Arc Set. The Global Set contains information which is common to all of the arcs being processed. Each Arc Set contains information defining its arc. Therefore one or more Arc Sets could be present in the GEODYN-II input.

The Global Set consists of four groups in the following order: The first group is the mandatory Run Description on three cards with no defined format. The second group is the set of Option cards which may be used to define and/or estimate conditions which are common to all the arcs being processed. The third group is the optional Station Coordinate Subgroup which may be used to alter GEODYN II's set of tracking stations. The last group in the Global Set is the mandatory Global Set Termination card.

The Arc Set also has four groups in this order: The first group is the mandatory Arc Description on three (or more) title cards well as mandatory cards to describe the reference coordinate system and time and spacecraft parameters in this arc. The second group is the set of Arc Option cards which may be specified to make use of GEODYN II's individual arc capabilities. The third group is the Data Selection/Deletion Subgroup which may be used to edit input observations. The Data Selection/Deletion Subgroup should not be present in orbit generation runs. In data reduction runs, the use of DATA and SELECT cards is mandatory (see individual card for explanation). The last group in the Arc Set is the mandatory Arc Set Termination card.

2 INPUT CARDS OVERVIEW

The Global Set begins with a mandatory subset of three cards on which the user may record any descriptive information concerning the job.

The Option cards which follow, are presented in the document in alphabetic order but not necessarily used in this order unless otherwise specified in the individual case. Information which applies to all arcs could be included in one of the following categories of input cards:

1. A forcing function description and/or condition input card such as:
 - cards which define the gravitational model
 - request application and/or modifications of the Earth or planet gravitational potential,
 - request application and/or modifications of the Earth tide model.
 - request estimation of the gravitational coefficients.
2. Observation modeling descriptive cards such as:
 - cards which require application of various models
 - modify and/or estimate parameters which describe the observation equation (polar motion, solid Earth tides, ocean tides and tectonic plate motion.)
3. Cards specifying models which describe tracking measurement corrections such as:
 - antenna or reflector offsets from the spacecraft center of gravity
 - choice of tropospheric refraction model
4. Cards which affect observation modeling.
5. Input cards controlling the format and the quantity of the listings and the printout.

The Global Set continues with the STAPOS subgroup. Input cards in this subgroup set conditions for solution, constraints and correlations pertaining to stations with available data. The STAPOS subgroup also includes cards containing station positions, geodetic information and planetary parameters for extra terrestrial stations. If the STAPOS subgroup is present it must be terminated with an ENDSTA card.

The Global Set of input cards ends with the mandatory card ENDGLB which also specifies the maximum number of Global parameter estimation iterations and the number of TITLE cards in each arc.

The Arc Set begins with a number of TITLE cards which are mandatory for each run on which the user may include any information pertaining the arc. Information to be included on the rest of the mandatory card subgroup is the coordinate system of integration, number of arc iterations, spacecraft information, start and end time of orbit integration and introduction of the components of orbital elements.

The next subgroup of the Arc Set is a group of Option cards which affects:

1. The solution itself with information such as:
 - editing multiplier
 - integration order/step size
 - apriori variance/covariance matrix for the satellite elements.
2. The observation equation with information such as:
 - measurement bias and
 - station timing bias
3. The force model with information such as application and/or adjustment of:
 - general acceleration
 - drag coefficient
 - solar radiation pressure

4. The output with information such as:

- output of E or V-matrices
- output required on specified units
- residual file output
- normal point generation control

The next subgroup in the Arc Option cards is called the Data Selection subgroup and it is introduced by the DATA card. This card must be present with any arc requiring data reduction. The cards which follow DATA are very important to the user as an editing tool. One can specify Data Selection and Deletion time intervals, input of meteorological data, application of constant bias observation correction, request data preprocessing and specification of weighting and editing sigmas.

The Data Selection subgroup ends with an ENDARC card which also denotes end of the arc. In case more than one arc are required, the user should start with a new set of Arc TITLE cards.

A detailed description for each card in the Global and Arc Sets is given in the following section. That includes format and function description, default values and units and description of the consequences in case any of these cards is omitted.

Finally the card ENDALL denotes the end of all arcs and the end of input cards.

2.1 A GUIDE TO GEODYN II INPUT CARDS

SUBJECT	CARD	DESCRIPTION	TYPE
ADJUSTMENT CONTROL	CORREL	: Correlation between station coordinates	STAPOS
	FIXED	: Specify fixed stations	STAPOS
	ADJUSTED	: Adjusted stations/ Sigma for stations	STAPOS
	CONSTADJ/		STAPOS
	CONSTEND	: Constrained stations control	STAPOS
	NORMPV	: Normal point orbit adjustment control and a-priori variance input.	ARC
	VARCOV	: A-priori var/covar matrix for the satellite elements.	ARC
	SIGMA	: Observation correction editing sigma	DATA
ALBEDO	ALBEDO	: Application of Earth radiation pressure	ARC
ALTIMETRY	ALTIM	: Altimetry related input.	COMMON
	SSCOEF	: Spherical harmonics coefficients for static sea surface topography model.	COMMON
	SSTOPO	: Max degree and order for static sea surface topography model.	COMMON
	OLOAD	: Ocean loading using the expanded tide model.	COMMON
ANTENNA / INSTRUMENT	DELAY	: Transponder delay	COMMON
	OFFSET	: Antenna offset/laser reflector offset	COMMON
	INSTRMNT	: Parameters for tracking instrument	STAPOS
ATMOSPHERIC EFFECT	DRAG	: Drag application / estimation of drag coefficient.	ARC
	ATMDEN	: Atmospheric density model.	COMMON
	FLUX	: Modify flux values.	COMMON
	REFRAC	: Tropospheric model.	COMMON
	THRDRG	: Thermal Drag model (Lageos)	ARC
BIASES	EBIAS	: Pass by pass measurement biases	ARC
	MBIAS	: Measurement biases - Station timing biases.	ARC
	PBIAS	: Pass by pass measurement or timing biases.	ARC
	OBSCOR	: Constant bias applied as observation correction.	ARC
CONSTANTS	VLIGHT	: Speed of light	COMMON
COMPUTER SELECTION	CYBG2E	: GEODYN IIE on CYBER (default).	COMMON
	IBMG2E	: GEODYN IIE on IBM.	COMMON
SUBJECT	CARD	DESCRIPTION	TYPE
DATA SELECTION	SELECT	: Data times/satellite/station/mtypes	DATA
	DELETE	: Data times/satellite/station/mtypes	DATA

	METDAT	: Override met.data information	DATA
	OBSCOR	: Constant bias observation correction	DATA
	PREPRO	: Data preprocessing.	DATA
	SIGMA	: Observation weighting and editing sigma.	DATA
GENERAL RELATIVITY	REL300	: Relativistic corrections	ARC
GENERAL ACCELERATION	ACCEL	: Application/adjustment of general acceleration.	ARC
	ACCELT	: Application/adjustment of general acceleration in 3 dimensions.	ARC
	ACCEL9	:	ARC
GEOPOTENTIAL	EARTH	: Modifies the Earth's gravitational potential/Earth's constants.	COMMON
	GEODETTIC	: Overrides the Earth's parameters for certain stations	STAPOS
	GCOEF	: Modification/estimation of the coefficients in the Geopotential model	COMMON
	GCOEFS	: Modification/estimation of C coeff.	COMMON
	GCOEFC	: Modification/estimation of S coeff.	COMMON
	GEOPOL	: Application of polar motion to the Earth's gravitational potential.	COMMON
	GRVEPO	: Time depended gravity time intervals.	COMMON
	GRVTIM	: Estimation of time dependent gravity coefficients.	COMMON
	GXPAND	: Estimation of a range of geopotential coefficients.	COMMON
	PLANET	: Third body gravitational potential.	COMMON
	TOLS	: Maximum degree of geopotential for variational equations.	COMMON
INTEGRATION INFORMATION	REFSYS	: Specification of coordinate system for integration.	ARC
	EPOCH	: Specification of times for integration	ARC
	SLAVE	: Sets of satellites/times for integration	ARC
	STEP	: Changes integration order and stepsize	ARC
INTER - PLANETARY	TRKBDY	: Defines tracking body	COMMON
	PLANET	: Third body gravitational potential	COMMON
	EXTRAGEO	: Planetary shape parameters for planetary stations.	STAPOS
NORMAL POINTS	NORMPT	: Computation and output of normal points	ARC
	NORMPV	: Normal point orbit adjustment control	ARC
SUBJECT	CARD	DESCRIPTION	TYPE
-----	-----	-----	-----
OUTPUT	NOLIST	: Interrupts GIIS input listings	ARC
CONTROL	LIST	: Negates effect of NOLIST	ARC
	OBSVU	: Controls residual printout for all arcs, preprocessing correction output and measurement partials output	ARC

	PARFIL	: Output partial derivative files	ARC
	PLATIM	: Station coordinate printout at requested times. (Plate tectonics option , see PLATE)	ARC
	PRINTVU	: Controls output of GIIS and GIIE on UNIT06.	ARC
	PUNCH	: Requests punched output	
	TERMVU	: Output on UNIT09 (80 characters/line)	ARC
	EMATRX	: Output E matrix/V matrix	ARC
	ORBFIL	: Output trajectory file on specific units	ARC
	ORBTVU	: Trajectory output on UNIT06	ARC
	RESIDU	: Residual file output on UNIT19	ARC
	NORMPT	: Computation and output of normal points	ARC
PLATE	PLATE	: Tectonic plate motion.	COMMON
TECTONICS	PLATIM	: Reference date for station coordinates for tectonic plate motion.	COMMON
POLAR MOTION	POLE	: Modifies polar motion and A1-UT1 values.	COMMON
	POLDYN	: Dynamic polar motion.	COMMON
	POLKF	: Figure axis for dynamic polar motion.	COMMON
	POLEUT	: Modification/adjustment of true pole coordinates and A1-UT1 time differences	COMMON
STATISTICAL CONTROL	EDIT	: Editing multiplier/initial RMS.	ARC
	SIGMA	: Observation correction editing sigma	DATA
SIMULATIONS	SIMDAT	: SIMULATED DATA SUBGROUP	ARC
SOFTWARE OPTIMIZATION	VECOPT	: Vector optimization, core allocation control.	COMMON
SOLAR RADIATION	SOLRAD	: Application/adjustment of solar radiation pressure.	ARC
SPACECRAFT RELATED PARAMETERS	SATPAR	: Spacecraft related parameters	ARC
	SLAVE	: Sets of satellites/times for integration	ARC
	ELEMS1	: Initial state vector (first 3 components).	ARC
	ELEMS2	: Initial state vector (last 3 components).	ARC
	VARCOV	: A-priori variance-covariance for satellite elements	ARC
SUBJECT	CARD	DESCRIPTION	TYPE

SPEED OF LIGHT	VLIGHT	: Speed of light	COMMON
STATIONS INFORMATION ADJUSTMENT CONTROL	STAPOS	: STAPOS SUBGROUP	COMMON
	STATION	COORDINATE CARD: Coordinates for stations	STAPOS
	CORREL	: Correlation between station coordinates	STAPOS
	FIXED	: Specify fixed stations	STAPOS

ADJUSTMENT CONTROL	ADJUSTED: Adjusted stations/ Sigma for stations	STAPOS
	CONSTADJ/	STAPOS
	CONSTEND: Constrained stations control	STAPOS
	INSTRMNT: Parameters for tracking instrument	STAPOS
	GEODETTIC: Overrides the Earth's parameters for certain stations	STAPOS
TIDE MODELING	ETIDEN : Colombo Earth tide model using normalized Legendre polynomials.	COMMON
	ETIDES : Colombo Earth tide model using unnormalized Legendre polynomials.	COMMON
	H2LOVE : Modification/adjustment of solid Earth tide coefficient of the 2nd kind.	COMMON
	L2LOVE : Modification/adjustment of solid Earth tide coefficient of the 3rd kind.	COMMON
	TIDES : Modifies Earth tide perturbations.	COMMON
	OLOAD : Applies ocean loading using the expanded poletide model.	COMMON
	OTIDEN : Ocean tides using the Colombo model with normalized Legendre polynomials.	COMMON
	OTIDES : Ocean tides using the Colombo model with unnormalized Legendre polynomials.	COMMON
VARIANCE/ COVARIANCE	ADJUSTED: Adjusted stations/ Sigma for stations	STAPOS
	NORMPV : Normal point orbit adjustment control and a-priori variance input.	ARC
	VARCOV : A-priori var/covar matrix for the satellite elements.	ARC
	SIGMA : Observation correction editing sigma	DATA

2.2 GLOBAL SET MANDATORY CARDS

2.2.1 TITLE

```
-----1-----2-----3-----4-----5-----6-----7-----8
USER SPECIFIED JOB DESCRIPTION - CARD 1
USER SPECIFIED JOB DESCRIPTION - CARD 2
USER SPECIFIED JOB DESCRIPTION - CARD 3
-----0-----0-----0-----0-----0-----0-----0-----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-80	10A8	User may specify on these three cards, information description of the job. These cards may also remain blank, but must always be present.	

IF CARDS OMITTED: Run will abnormally terminate.

2.3 GLOBAL SET OPTION CARDS

2.3.1 ALTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALTIM  1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTIM - Controls various options connected with the altimetry measurement type.	
7	I1	<p>= 0 Dynamic portion of altimetry measurement partials wrt gravity coefficients will be considered.</p> <p>= 1 Dynamic portion of altimetry measurement partials wrt gravity coefficients will not be considered.</p>	0
8	I1	<p>= 0 Geometric portion of altimetry measurement partials wrt gravity coefficients will be considered.</p> <p>= 1 Geometric portion of altimetry measurement partials wrt gravity coefficients will not be considered.</p>	0
9	I1	<p>= 0 GEODYN IIE will not replace a geoid supplied from the data tape unless gravity coefficients are being adjusted.</p> <p>= 1 GEODYN IIE will replace a geoid supplied from the data tape (with the geoid implied by the gravity coefficients) even if gravity coefficients are not being adjusted.</p> <p>= 2 GEODYN will use an external grid to compute the mean sea surface. This computation will replace the Geodyn computed geoid and sea surface height. The external grid file is input on unit 29 of Geodyn IIE. [NOTE 4]</p>	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	<p>= 0 GEODYN IIE will not replace geometric earth tides from the data tape unless H2 Love number is being adjusted. [NOTE 5]</p> <p>= 1 GEODYN IIE will replace geometric earth tides from the data tape even if H2 Love number is not being adjusted. [NOTE 5]</p>	0
11	I1	<p>= 0 GEODYN IIE will not replace geometric ocean tides from the data tape. [NOTE 5]</p> <p>= 1 GEODYN IIE will replace geometric</p>	0

ocean tides from the data tape. [NOTE 5]

= 2 GEODYN IIE will compute the geometric ocean tides using the GOT99.2 Ray model. [NOTE 3]

12 I1 = 0 GEODYN IIE will not replace sea surface topography from the data tape. [NOTE 5] 0

= 1 GEODYN IIE will replace sea surface topography from the data tape. [NOTE 5] 0

13 I1 Index to the altimetric observation modeling

= 0 Use the S/C normal height for modeling the observation. 0

= 1 Use the provided external attitude information to model the altimetric observation 0

=2 External attitude information is provided at observation times on the data records. (Ocean parameter records - words 6-9) 0

14 I1 Total number of points for a dynamic crossover stream after best time estimation cols 18-19

15 I1 Number of inner iterations after which the number on column 14 replaces the number on columns 18-19 and the number on columns 20-21 replace the number on columns 18-19

18-19 I2 Number of observations retained below each side of a crossover (used in dynamic crossover processing - mtype 101)

20-21 I2 Degree of the polynomial used for dynamic crossover fitting.

22-23 I2 Second choice for degree of the polynomial for dynamic crossover fitting.

25-44 D20.8 A priori value for crossover radial separator. (0.01)

45-59 D15.3 Crossover partial editing level (cm) 10000

60-72 D13.1 Crossover distance editing level (cm) 0

73-80 D8.2 Maximum number of sltimeter bounce iterations

NOTE [1]: It is possible to turn off either the dynamic portion of the Altimetry partials wrt to gravity coefficients or the geometric portion but not both.

NOTE [2]: If geoid, earth tide, or ocean tide models are not supplied from the Altimetry data, GEODYN IIE will automatically calculate the models not supplied.

NOTE [3]: For the geometric ocean tide model correction using the GOT99.2 Ray tide model the analyst needs to include the following grid file in the directory where Geodyn IIE is executed:

Hp:
 /geod4/geodyn/SUPPORT/dat_raytide/got99_grid.dat
 Cray:
 /u2/z8sgp/geodyn/support/dat_raytide/got99_grid.dat

NOTE [4]: To run this option the external grid file must be ftp'd from unitree to the directory where Geodyn IIE is executed onto unit 29:

Cray file:
 /u2/z8sgp/zms01/mssdata/mssh95.one16th.deg.craybin.Z
 Hp file:
 /u2/z8sgp/zms01/mssdata/mssh95.one16th.deg.hpbin.Z

NOTE [5]: For a better understanding of the functions invoked by the indices on columns 10 and 11 see the table below:

Col 10 FLAGS:

GEODYN INPUT CARDS		0	1
ETIDES H2 L2	NO Sigma	<ol style="list-style-type: none"> ΔT_{SE} will be read from input tape There are no dynamical direct effects 	<ol style="list-style-type: none"> GEODYN will compute ΔT_{SE} using the Merit Standards for H2, L2, K1, and $\delta\Delta T$ There are no dynamical direct effects
ETIDES H2 L2	WITH Sigma	<ol style="list-style-type: none"> GEODYN will compute ΔT_{SE} Partials for H2 and L2 will be generated 	<ol style="list-style-type: none"> GEODYN will compute ΔT_{SE} Partials for H2 and L2 will be generated

Col 11 FLAGS:

GEODYN INPUT CARDS		0	1
OTIDES	NO Sigma	<ol style="list-style-type: none"> ΔT_{OC} will be read from input tape ΔV will be computed from the ocean tide model 	<ol style="list-style-type: none"> ΔT_{OC} comes from the OTIDE cards ΔT_{OC} comes from the OTIDE cards
OTIDES	WITH Sigma	<ol style="list-style-type: none"> ΔT_{OC} will be read from input tape Dynamic partials will be generated for ocean tides NO geometric partials will be generated 	<ol style="list-style-type: none"> ΔT_{OC} comes from the OTIDE cards Dynamic partials will be generated $\delta\Delta T_{OC}$ will be read from the input tape

ΔT_{SE} Correction for the solid Earth tides

ΔT_{OC} Correction for the ocean tides

2.3.2 ALTIM2

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALTIM2 100
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTIM2 - Controls various options connected with the altimetry measurement type.(CONTINUED)	
7-10	I4	Defines perturbation value used to estimate numerical partials observations wrt satellite coordinates.	100 meters
12	I1		
13	I1		
14	I1		
15	I1		
16	I1		
18-19	I2		
20-21	I2		
22-23	I2		
25-44	D20.8		
45-59	D15.3		
60-72	D13.1		
73-80	D8.2		

2.3.3 ALTOUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALTOUT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests creation and output of the altimetry geolocation file on unit 18.	
8	I1	=0 No output. =1 Output the geolocation file at the first inner iteration of the first global iteration. =2 Output the geolocation file at the last inner iteration of the first global iteration. NOTES [2], [3]	
9	I1	=0 No output. =1 Output the PDOUT file at the first inner iteration of the first global iteration. =2 Output the PDOUT file at the last inner iteration of the first global iteration.	
25-44	D20.8	Mission reference date	YYMMDDHHMMSS
45-59	D15.3	Mission reference fraction of seconds	0.SSSSSSSS

NOTE [1]: The ALTOUT option applies only to altimetry or crossover data.

NOTE [2]: If dynamic crossover data type is being processed (mtype 101) and an ALTOUT 2 card is present, a geolocation file will be output at the last inner iteration.

NOTE [3]: If Laser Altimeter modeling using external attitude is invoked and an ALTOUT 2 card is present, a geolocation file will be output at the last inner iteration.

IF CARD OMITTED: No Geolocation file will be output

2.3.4 ANTPHC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ANTPHC
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	<p>ANTPHC - Requests the input of tables with phase center variations (PCV) for GPS transmitter, ground station and user satellite receivers. The PCV corrections are input on unit 22. When this option is invoked columns 9-10 of the INSTRMNT card (STATION POSITION SUBGROUP) is used to identify the type of antenna used at each station. For satellite antennae the antenna number is obtained from columns 11-12 of the OFFSET card. As many as 99 PCV tables can be input simultaneously on unit 22. The table of corrections for each antenna must begin with a line that has 8 characters starting in column 1: ANTNO=NN where NN is an integer from 1 through 99. After that there must be a header record. The format of header record is '(I4,2F7.2,I4,2F7.2)'. These six numbers are</p> <p>I4: the number of zenith angles in the table F7.2: the first zenith angle F7.2: step of zenith angle I4: the number of azimuth angles F7.2: the first azimuth angle F7.2: step of azimuth angle</p> <p>The header record must be followed by the data record. The number of data must match the header record (the number of zenith angles times the number of azimuth angles). Each line contains 8 corrections (8D10.4).</p>	
15-17	I3	Measurement Type which the correction will be applied to. (This is only necessary when using the ANTPHC option for DORIS station antennae phase map correction, MTYPE=40)	0

The data should be stored in the order of azimuth vs zenith. For example, if there are NAZM azimuth angles and NZEN zenith angles for a table. The first NAZM numbers are for the first zenith angle. The (NAZM+1) to 2*NAZM numbers are for the second zenith angle, etc. A sample table with ANTNO 28 is given below.

Note when ANTPHC is present and an antenna number specified in either OFFSET card or INSTRMNT card cannot be found from the external table file, PCV corrections will no be applied for that satellite or station.

See also INSTRMNT and OFFSET card

A sample PCV table:

ANTNO=28

```
  91  0.00  1.00  1  0.00 360.00
-.6100D-02-.5200D-02-.3300D-02-.1000D-020.1400D-020.3500D-020.4700D-020.4900D-02
0.4100D-020.2800D-020.8000D-03-.1000D-02-.2100D-02-.2100D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02-.1400D-02
-.1400D-02-.1400D-02-.1400D-02
```

2.3.5 ANTPH2

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ANTPH2
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	ANTPH2 - Requests application of GPS antenna phase correction by an external PCV file on unit 22. Multiple PCV tables can be input simultaneously on unit 22. Each table of corrections must start with a line beginning with either STANO or SATID, followed by the station number or satellite ID. (See Note 1)	
-----	----	---	--

Next, there needs to be a header record. The format of header record is '(I4,2F7.2,I4,2F7.2)'.
 These six numbers are

- I4: the number of zenith angles in the table
- F7.2: the first zenith angle
- F7.2: step of zenith angle
- I4: the number of azimuth angles
- F7.2: the first azimuth angle
- F7.2: step of azimuth angle

The header record must be followed by the data record. The number of data must match the header record (the number of zenith angles times the number of azimuth angles). Each line contains 8 corrections (8D10.4).

The data should be stored in the order of azimuth vs zenith. For example, if there are NAZM azimuth angles and NZEN zenith angles for a table. The first NAZM numbers are for the first zenith angle. The (NAZM+1) to 2*NAZM numbers are for the second zenith angle, etc. A sample table is given below.

Unit 22 should be structured with the SATID tables before the STANO tables, followed by the ANTNO tables. With this structure, both ANTPHC and ANTPH2 options can be used with one external file.

NOTES:

Note 1

If there is more than one antenna for a station, than the STANO header will need an antenna number included following the station number. Include this antenna number on the INSTRMNT card. (If there is only one antenna, there is no need for an antenna number following the station number or on the INSTRMNT card.)

2.3.6 ATGRAV

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ATGRAV
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ATGRAV - Requests application of atmospheric effect on the gravity field. The presence of this card requests input data on Unit 18 in GEODYN IIS. [1] The data are times and coefficients describing the atmospheric models.	
7-8	I2	Maximum degree of expansion. [2]	50
9-10	I2	Maximum order of expansion. [2]	50
11-12	I2	Indicator for linear interpolation =0 Do not perform linear interpolation for the atmospheric coefficients. Apply the given values if time of observation falls six hours before or after the time where the coefficients were computed. =1 Perform linear interpolation. Use the pair of atmospheric coefficient sets that precede and follow the observation time. For observations that fall before the first and after the last set perform linear extrapolation	0
13	I1	SWITCH to perform interpolation on C21 and S21 coefficients = 0 do not perform interpolation = 1 perform interpolation on C21 and S21	0
25-44	D20.8	YYMMDDHHMMSS.SS Start time of application	epoch start time
45-59	D15.3	YYMDDHHMMSS.SS End time of application	epoch stop time

NOTE [1]: GEODYN IIS unit 18 is a binary file which contains in each record.

- (a) The time in the middle of the 12 hour period where the following coefficients apply and
- (b) a stream of 50x50 coefficients in the following sequence

```

C00
C10
C11
S11

```

C20
C21
S21
C22
S22
C30
C31
S31
C32
S32
C33
S33

NOTE [2] : The expansion should be less than or equal to the gravity field expansion. If not, only the coefficients of degree and order less than the maximum degree and order of the gravity field will contribute. GEODYN will accept up to 50x50 expansions for this option given at 12 hour intervals.

IF CARD OMITTED: Atmospheric effect will not contribute to the gravity coefficients.

2.3.7 ATMDEN

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ATMDEN  71
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	ATMDEN - Specifies the static density model that will be used for atmospheric density calculations.	
9-10	I2	Model selection number. = 71 - Jacchia 1971 Model = 87 - French Drag Model [1] = 86 - MSIS Empirical Drag Model [2]	71
11-12	I2	= 0 or 1 For Mars runs, the Culp-Stewart 1983 atmospheric density model is used = 2 For Mars runs, the Stewart 1987 atmospheric density model is used = 3 For Mars runs, the Mars Global Reference atmospheric density model is used (Marsgram) = 4 For Mars runs, the revised Stewart atmospheric density model (by Lemoine) will be used = 5 For Mars runs, DTM-MARS is used = 0 or 1 For Venus runs, the JPL atmospheric density model is used = 2 For Venus runs, the Hedin atmospheric density model is used	1
15-16	I2	Controls choice of 3 hourly or daily Kp values and whether the solar flux average is for the end or midpoint of the 81 day averaging interval for atmospheric density model 87. Column 15 Controls whether the 81 day average solar flux value is calculated with the moving average at the end point or midpoint of the averaging interval. = 0 End point of interval = 1 Midpoint of interval	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

Column 16		Controls whether 3 hourly or daily values of Kp are used. = 0 3 hourly Kp values used [NOTE 1] = 1 Daily Kp values used	
-----------	--	---	--

25-44 D20.8 Controls the maximum height in Venus runs with JPL
Model and Hedin Model. Range is 1.0km - 1000000.0km

45-59 D15.3 If the DTM-MARS model is selected, this 0.
value gives the dust opacity (infrared wavelength)

NOTE [1]: Requires that 3 hourly Kp values be available in the BIH
Tables file on UNIT02.

NOTE [2]: Works with both 3-hourly Kp values and 24-hour Kp values.

IF CARD OMITTED: The Jacchia 1971 density model will be used for
atmospheric density calculations.

2.3.8 CGMASS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CGMASS                                     .02                               -.16                               -5.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	CGMASS - Defines new mass ratio and body-centered coordinates of center of gravity with respect to center of figure.	
7-14	I8	Ratio of current spacecraft mass to value on SATPAR card in units of 1.0E-7.(DEFAULT=10000000 for a ratio of 1)	10000000
15	I1	=0 No external CGMASS coordinates will be read. =1 Read external ascii CGMASS coordinates for this satellite. =2 Read external binary CGMASS coordinates for this satellites. [NOTE 2]	0
18-24	I7	Satellite ID (required)	0
25-44	D20.8	Start Date and Time in YYMMDDHHMMSS. [NOTE 1]	0.
45-59	D15.3	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (X coordinate in meters).	0. M
60-72	D13.1	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (Y coordinate in meters).	0. M
73-80	D8.3	Body centered fixed coordinate of the center of gravity with respect to the center of the figure (Z coordinate in meters).	0. M

NOTE 1: The time provided on the CGMASS option must be equal to or less than the beginning of the satellite arc. This will ensure that the CGMASS is applied throughout the entire arc. If there are multiple CGMASS cards the CGMASS will be applied until the next CGMASS card starts.

NOTE 2: The time dependent external CGMASS coordinates file should be named as cgmassXXXXXXXX, where XXXXXXXX is the satellite ID number. The data structure of cgmassXXXXXXXX is as following:
Header record: (4 real numbers)

Satellite ID
Start time in UTC YYMMDDHHMMSS.SS format
Stop time in UTC YYMMDDHHMMSS.SS format
Time step in seconds
Data record:
Time tag
X coordinate
Y coordinate
Z coordinate

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second

IF CARD OMITTED: The ratio of current spacecraft mass to the value on the
SATPAR card is 1.

2.3.9 DELAY

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELAY
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	DELAY - Defines transponder delay curve.		
7-14	I8	Station number. (This field required if Satellite ID is missing. This field is ignored if Satellite ID is present.)	0	
15-17	I3	Antenna number (optional if frequency is specified)	0	
18-24	I7	Satellite ID (required)	0	
25-44	D20.8	Frequency in megahertz (No frequency implies all frequencies)	0.	MH
45-59	D15.3	Transponder delay.	0.	S
60-72	D13.1	Transponder delay rate as a function of rho dot in seconds per meter per second.	0.	S/(M/S)
73-80	D8.3	Transponder delay variation as a function of rho dot squared in seconds per (meter per seconds) squared.	0.	S/(M/S)**2

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz;

IF CARD OMITTED: No antenna transponder delay will be applied.

2.3.10 EARTH

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EARTH 0          20 20          3.986004359D+14 6378144.11    298.255
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	EARTH - Modifies the earth's gravitational potential and/or introduces new earth constants.	
7	I1	Gravity model initialization indicator. = 0 Gravitational coefficients are initialized from gravity model file. They may be changed by GCOEF, GCOEFC or GCOEFS cards. > 0 Gravitational coefficients are set to zero except those which appear on GCOEF, GCOEFC, or GCOEFS cards which follow this card.	0
8	I1	Gravity model print control switch. = 0 Print two portions of model: 1. lowest degree & order; and 2. highest degree & order. = 1 Print entire gravity model. : : N/A = 2 Print only model checksum. :	0
9	I1	Indicator of the contents of the remainder of this card: = 0 Columns 25-72 contain the values for GM, ae, 1/fe. = 1 Columns 25-72 contain the sigmas for GM, ae, 1/fe.	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	Maximum degree of coefficient to be used in the gravitational model. Minimum =3. Default depends on gravity model file on unit 12.(See NOTES)	3
18-20	I3	Maximum order of coefficient to be used in the gravitational model. minimum =2. Default depends on gravity model file on unit 12.	2

25-44	D20.8	Universal gravitational constant times the mass of the Earth (GMe) or sigma value if column 9 =1	3.9860064D14	M**3/S**2
45-59	D15.3	Semi-major axis of the Earth (Ae) or sigma value if column 9 =1	6378138.0	M
60-72	D13.1	Inverse of the Earth's flattening (1/fe) or sigma value if column 9 =1	298.255	

NOTES:

- [1] The default values for degree and order of the gravity field and the Earth constants are overridden by the values from the gravity model file on unit 12.
- [2] EARTH and PLANET are actually the same keyword card except that EARTH automatically supplies the planet number (0300) and does not have planetary position adjustment capability.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second

IF CARD OMITTED: The complete geopotential field contained in the default gravity model file on UNIT 12 will be used.

2.3.11 EPHEM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EPHEM          200
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EPHEM - Tells GEODYN which ephemeris is being input on unit #1. This card is required to select the DE118 ephemeris and is optional for the DE96 and DE200 ephemerides.	
15-17	I3	Ephemeris indicator as follows: = 96 - DE96 ephemeris using mean equator and equinox of 1950 and Woolard's nutations series. =118 - DE118 ephemeris using mean equator and equinox of 1950 coordinates and Wahr's nutations series. =200 - DE200 ephemeris using mean equator and equinox of 2000 coordinates and Wahr series nutations. The selection of the DE200 ephemeris also causes different precession and Greenwich Mean Sidereal Time(GMST) calculations.	200

NOTE: GEODYN is unable to distinguish between the DE118 and DE200 ephemerides without this option card, but it is able to distinguish between the DE96 and the later DE118 and DE200 ephemerides. Thus this card is REQUIRED only when the DE118 ephemeris is selected. For the DE96 and DE200 ephemeris the program will determine which ephemeris is actually supplied on unit #1

IF CARD OMITTED: DE200 ephemeris is assumed input on UNIT 1. If a DE96 ephemeris is input on UNIT 1 and this option card is not present, GEODYN will reject the DE96 ephemeris and function properly.

2.3.12 ETIDEN

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ETIDEN          +1101 010 -0.033                0.0                10.                10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ETIDEN - Requests application and/or adjustment of earth tides using the Colombo tide model and normalized Legendre polynomials. M and K symmetry is included.	
9	I1	Indicates form of input coefficients. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients [NOTE 1]	0
15-17	I3	Sign (+1 or -1) of the Demos Number [NOTE 2]	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0
23	I1	Indicates form of tidal amplitude coefficient [$V_f(t) / \bar{V}_f$] [NOTE 3] 0 = only main line, fixed coefficient 1 = main line and sidebands, variable coefficient 2 = only main line, variable coefficient	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
24	I1	Disturbing Body (B). [NOTE 2] 0 = Moon and Sun 1 = Moon 2 = Sun	0
25-44	D20.8	"A" coefficient. [NOTE 1]	0. M
45-59	D15.3	"B" coefficient. [NOTE 1]	0. M

60-72	D13.1	Sigma "A".	0.	M
73-80	D8.2	Sigma "B".	0.	M

NOTES:

[1] The "A" and "B" coefficients are related to amplitude and phase by the following formulas:

$$A = K2 \text{ Love Number} * \cos(\text{phase})$$

$$B = -K2 \text{ Love Number} * \sin(\text{phase})$$

[2] The "Demos Number" is given by:

$$\text{Demos Number} = \text{IDSIGN} * (\text{MKH} * 1000 + (\text{J} + 10) * 10 + \text{B})$$

NOTES: (cont)

[3] There are 4 recognized main tidal lines and 16 associated sidebands. Their Demos numbers are:

	SMKH	JB	(See last page for S M K J B definitions)			
Main Line 1:	1120	01				
Side Bands:	-1112	01,	1100	01,	1110	01, -1111 -21,
	1101	21,	1111	21,	1121	21
Main Line 2:	1120	02				
Side Bands:	1101	22				
Main Line 3:	1220	01				
Side Bands:	1201	21,	1210	01,	1211	21, 1200 01,
	-1212	01,	-1211	-21,	1221	21
Main Line 4:	1220	02				
Side Bands:	1201	22				

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The expanded earth tide model is not used. See TIDES card for tide model that will be used.

2.3.13 ETIDES

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ETIDES          +1101 010 -0.033                0.0                10.                10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ETIDES - Requests application and/or adjustment of earth tides. There are two Earth Tide models available in GEODYN. First implemented was the Colombo tide model and unnormalized Legendre polynomials. M and K symmetry is NOT included. The presence of a RAYTID option before the ETIDES cards invokes the IERS convention Earth Tides. Immediately following there is a description of the Colombo model. At the end of this page there will be a description of the IERS model.	Colombo Model
9	I1	Indicates form of input coefficients. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients [NOTE 1]	0
15-17	I3	Sign (+1 or -1) of the Demos Number [NOTE 2] This sign multiplies the quantity $-\left((2-H) * \omega + (2 - 2H + J) * M + K * \Omega\right)$	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0
23	I1	Indicates form of tidal amplitude coefficient [$V(t) / V_{bar}$] [NOTE 3] f f 0 = only main line, fixed coefficient 1 = main line and sidebands, variable coefficient 2 = only main line, variable coefficient	0
24	I1	Disturbing Body (B). [NOTE 2] 0 = Moon and Sun	0

1 = Moon
2 = Sun

25-44	D20.8	"A" coefficient. [NOTE 1]	0.	M
45-59	D15.3	"B" coefficient. [NOTE 1]	0.	M
60-72	D13.1	Sigma "A".	0.	M
73-80	D8.2	Sigma "B".	0.	M

NOTES:

[1] The "A" and "B" coefficients are related to amplitude and phase by the following formulas:

$$A = K2 \text{ Love Number} * \cos(\text{phase})$$

$$B = -K2 \text{ Love Number} * \sin(\text{phase})$$

[2] The "Demos Number" is given by:

$$\text{Demos Number} = \text{IDSIGN} * (\text{MKH} * 1000 + (\text{J} + 10) * 10 + \text{B})$$

[3] There are 4 recognized main tidal lines and 16 associated sidebands. Their Demos numbers are:

SMKH JB (See last page for S M K H J B definitions)

Main Line 1:	1120	01				
Side Bands:	-1112	01,	1100	01,	1110	01, -1111 -21,
	1101	21,	1111	21,	1121	21
Main Line 2:	1120	02				
Side Bands:	1101	22				
Main Line 3:	1220	01				
Side Bands:	1201	21,	1210	01,	1211	21, 1200 01,
	-1212	01,	-1211	-21,	1221	21
Main Line 4:	1220	02				
Side Bands:	1201	22				

IERS EARTH TIDE MODEL

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ETIDES
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0
COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

- 1-6 A6 ETIDES - Requests application and/or adjustment of IERS convention earth tides .
- 9 I1 Forcing degree in tide operating potential (2 or 3). The order is the first integer in the Doodson number given in columns 18-24.

10 I1 Inteder number [0,...,3] gives phase increment after $x\{\pi/2\}$. Useful when all tides use cosine factors with positive amplitudes.

15-17 I3 Integer Flag:
 =0 no sidelines
 =1 turn n sidelines with input tidal constituent.
 =2 turn n sidelines with input tidal group.

18-24 I7 Doodson Number (six positive integers)

25-44 D20.8 "A" coefficient. 0. M

45-59 D15.3 "B" coefficient. 0. M

60-72 D13.1 Sigma "A". 0. M

73-80 D8.2 Sigma "B". 0. M

Suggested setup for Earth Tides

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The expanded earth tide model is not used. See TIDES card for tide model that will be used.

2.3.14 FANTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FANTIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTIM - Used for time dependent PHANTOM parameters (option FANTOM)	
7	I1	Index specifying the nature of the introduced global parameters: = 1 Geometric model global parameters = 2 Force model global parameters	
25-44	D20.8	Epoch time for a time dependent model [NOTE 1]	YYMMDDHHMMSS.
45-59	D15.3	Start time for a time dependent option. The end times are specified on the FANTOM cards.	YYMMDDHHMMSS.
60-72	D13.1	Space for real information applicable to all the parameters in the group.	
73-80	D8.2	Space for real information applicable to all the parameters in the group	

NOTES:

[1] This time will be considered to be a reference time with respect to which linear rates or periodic terms are evaluated.

[2] Only one FANTIM card per FANTOM parameter group is allowed.

IF CARD OMITTED: And times are included on the FANTOM cards, the run will abnormally terminate.

2.3.15 FANTOM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FANTOM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTOM - Introduces the application and/or estimation of a group of global parameters [NOTE 3]	
7	I1	Index specifying the nature of the introduced global parameters: = 1 Geometric model global parameters = 2 Force model global parameters	
8	I1	Index specifying a specific direction for the parameter appearing on cols 25-44 [NOTE 1] = 0 All the parameters in the group are treated the same way (same partial formulation) = 1 = 2 To be specified by the user = 3	
9	I1	Index specifying the nature of the contents on cols 60-72 and 73-80 = 0 These real fields are not used for the group of parametrs introduced. (Space will not be allocated for them in GEODYN). = 1 These real fields are used as they are described below = 2 These real fields may be used to include any type of real information (but time)	
18-24	I7	Satellite ID	
25-44	D20.8	Parameter value	
45-59	D15.3	Parameter sigma	
60-72	D13.1	End time for application for this parameter. (if the index on col 9 is 1) [NOTE 2]	YYMMDDHHMMSS.
73-80	D8.2	Available space for extra real information.	

NOTES:

- [1] Specify up to three (3) dimensions. Although this option is not required in order to solve for parameters in a 3-D space or solve for parameters of different significance (C and S coefficients for example) it is helpful for EMATS and other types of labeling. Also parameters with the same index will be grouped together, facilitating that way the formation of partials.

- [2] Requires the presence of the FANTIM option.

- [3] This option provides the necessary allocation and links for parameterization. In order to use this option, the user must contact a GEODYN programmer for further additions of modeling and partials code.

IF CARD OMITTED: No extra model or parameters will be included in the GEODYN calculations

2.3.16 FLUX

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FLUX   1  0
FLUX   1              1372.5398
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUES & UNIT
1-6	A6	FLUX - Adds and/or modifies FLUX (Solar and Magnetic) values in built-in tables.	
7	I1	Table printout control for flux, polar motion, A.1-UTC, and A.1-UT1 data = 0 Table values for 36 days will be printed. = 1 All Table values used for this run will be printed.	0
8	I1	Flux Kp indicator. = 0 FLUX Kp values will be obtained from columns 73-80 of this card. = 1 FLUX Kp values will be calculated from Ap values.[NOTE 1]	0
9	I1	Flux card indicator = 0 FLUX card used to modify flux values in built-in tables = 1 FLUX card specifies solar flux at 1 AU, in the real field 25-44 [NOTE 2]	0
25-44	D20.8	Date of FLUX values (in form YYMMDD). (Col. 9 = 0) Solar flux at 1AU (Col. 9 = 1)	0. 1372.5398 10 W/M**2

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	Value of SOLAR FLUX (F10.7 at 1 A.U). If blank, value in table will not be altered. [NOTE 3]	0. 10 W/M**2
60-72	D13.1	Uses input value for average solar flux, if left blank, average will not be altered.	0. 10 W/M**2

73-80 D8.2 Value of magnetic flux Kp. If column 8 contains a 1 this input value is

$$K_p = \log \left[\left(\sum_{i=1,8} e^{K_{pi}} \right) / 8 \right]$$

where Kpi are the three-hourly values of Kp.

NOTES:

When dates that are beyond the end of the flux tables are requested the average value of the last month is used. This is true for both solar and magnetic flux. Solar and magnetic flux override requests are applied to the day specified in columns 25-44 only.

[1] Kp values will be obtained by cubic interpolation of the following table

Kp	Ap	Kp	Ap	Kp	Ap	Kp	Ap
0.	0	2.3333	9	4.6666	39	7.0000	132
0.3333	2	2.6666	12	5.0000	48	7.3333	154
0.6666	3	3.0000	15	5.3333	56	7.6666	179
1.0000	4	3.3333	18	5.6666	67	8.0000	207
1.3333	5	3.6666	22	6.0000	80	8.3333	236
1.6666	6	4.0000	27	6.3333	94	8.6666	300

REFERENCE: "Geomagnetic Indices," by Gordon Rostoker, Reviews of Geophysics and Space Physics, Vol. 10, No. 4, November 1972.

[2] This card can be used with or without the first flux card (i.e. col 9 = 0) If column 9 does not equal one, field one WILL NOT represent the solar flux at 1 AU. When col 9=1 this card CAN ONLY be used to specify the solar flux at 1 AU. A second card must be used to specify additional options.

The solar flux at 1 AU is divided by the speed of light to compute the solar radiation pressure on the satellite. Therefore, when specifying this value, one must insure that the speed of light is consistent.

[3] The solar flux values input to GEODYN are the 1 A.U. values. GEODYN will scale the solar flux values to the actual earth-sun distance. The values printed out by GEODYN IIS are the scaled values.

[4] Both FLUX Cards are accepted in the same run.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 UNITS: DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds
 UNITS: H =Hertz ; MH =Mega-Hertz; W =Watts

IF FIRST CARD OMITTED: Values from tables file on UNIT 2 will be used.
 IF SECOND CARD OMITTED: Default value of solar flux at 1 AU will be used.

2.3.17 FREEZE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FREEZE
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FREEZE: Allows the user to control observation editing and arc parameter contribution during various iteration	
7-8	I2	Arc iteration after which the editing of observations will freeze.	999
9-10	I2	Global iteration for which the option on columns 7-8 will apply	1
11-12	I2	Arc iteration before which the arc parameters will not contribute to the normal matrix. This option is useful for dynamic crossover processing where a number of inner iterations is needed for the best crossover location estimate	0

IF CARD OMITTED: There will not be any editing freeze nor normal matrix changes.

NOTE: A blank FREEZE card will not cause editing freeze nor normal matrix changes.

2.3.18 G2BOUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
G2BOUT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUES & UNIT
---------	--------	-------------	-----------------------

1-6	A6	<p>G2BOUT - Requests the output of a GEODYN II observation file on unit 20. This option is useful for GPS runs, in combination with the ELCUTOFF and the SATCUT input options. In these cases, GEODYN will output only observations which are not edited by the ELCUTOF and the SATCUT specifications.</p>	
-----	----	--	--

Another useful application is the combination G2BOUT and the TRPOUT option.

IF OMITTED:

2.3.19 GCMMOD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCMMOD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GCMMOD - Requests application of the periodic Earth center of mass correction model. The model is used to modify the position of tracking stations. Multiple periodic terms may be used. [NOTE 1]	
8	I2	Option Indicator	0
		For Option Indicator = 1	
25-44	D20.8	Reference Year	0.
45-59	D20.8	Period	0. yr
		For Option Indicator = 2	
25-44	D20.8	Amplitude of X component of correction	0. mm
45-59	D20.8	Phase of X component of correction	0. deg
		For Option Indicator = 3	
25-44	D20.8	Amplitude of Y component of correction	0. mm
45-59	D20.8	Phase of Y component of correction	0. deg
		For Option Indicator = 4	
25-44	D20.8	Amplitude of Z component of correction	0. mm
45-59	D20.8	Phase of Z component of correction	0. deg

NOTES:

- Multiple periodic terms may be used to model the center of mass. The group of 4 GCMMOD cards must be included for each term. All terms must use the same reference year.

Each component of the model is calculated as follows:

$$\text{signal} = \text{amplitude} * \cos((\text{time} - \text{reference year}) * (2\pi / \text{period}) - \text{Phase})$$

IF CARD OMITTED: Earth center of mass model will not be applied

EXAMPLE: The example below gives a annual periodic term

	1	2	3	4	5	6	7	8
GCMMOD 1			1950.0		1.0			
GCMMOD 2			2.7		41.0			
GCMMOD 3			2.8		321.0			
GCMMOD 4			5.5		27.0			

2.3.20 GCOEF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCOEF 2          2  1                                1.0000000D-09 1.00D-09
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	GCOEF - Modifies and/or requests the estimation of coefficients in the geopotential model.	
7	I1	Normalization indicator. = 0 values unnormalized C,S [See NOTES] = 1 values normalized C,S = 2 values ignored C,S	0
15-17	I3	Degree of C and S coefficients (N index). [NOTE 1]	0
18-20	I3	Order of C and S coefficients (M index). [NOTE 1]	0
25-44	D20.8	A priori (or starting) value of C coefficient. [NOTE 2]	0.
45-59	D15.3	A priori (or starting) value of S coefficient. [NOTE 2]	0.
60-72	D13.1	Standard deviation or fractional uncertainty of C coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation. If the value is greater than 1.0D-5 (or (SQRT(1.0D-5) for J2) it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.
73-80	D8.2	Standard deviation or fractional uncertainty of S coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation If the value is greater than 1.0D-5 it is used as the fractional uncertainty, and the standard deviation is computed as the	0.

fractional uncertainty times the nominal value
of the coefficient. [NOTE 1]

NOTES:

- [1] The denormalization subprogram in GEODYN underflows at degree 49 and order 48.

The geopotential coefficient denormalization equation used is:

$$C_n^m = \bar{C}_n^m \times D_n^m$$
$$S_n^m = \bar{S}_n^m \times D_n^m$$

where

$$D_n^m = \sqrt{(4n+2) \frac{(n-m)!}{(n+m)!}} \text{ for } m > 0$$
$$D_n^m = \sqrt{2n+1} \text{ for } m = 0$$

and

C_n^m, S_n^m are un-normalized coefficients.
 \bar{C}_n^m, \bar{S}_n^m are normalized coefficients.

- [2] If the degree and/or order on the GCOEF card is greater than the DEFAULT values [in the gravity file on unit 12], then the highest degree and/or order that is specified on the GCOEF card must be input on the EARTH card.
- [3] If it is desired that the starting values of geopotential coefficients be different than the a priori values for those coefficients then the GCOEF card should be used as follows:
- o GCOEF cards requesting the desired coefficient adjustments should be included in the setup deck. The a priori values will be indicated on these cards.
 - o For each coefficient pair for which the starting value is to be different than the a priori value, an additional GCOEF card should be in the setup deck. This GCOEF card will indicate the starting value and come later in the deck than the corresponding GCOEF card requesting adjustment.
- [4] Nominal values of geopotential coefficients are

$$J_n^m = \frac{10^{-5} D_m^n}{n^2}$$

IF CARD OMITTED: The geopotential used will be from the gravity model input on UNIT 12 of GEODYN-IIS unless modified by EARTH, GCOEFC, or GCOEFS cards.

2.3.21 GCOEFC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCOEFC1      002000      -.48416600D-03      .000000001
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUES & UNIT
1-6	A6	GCOEFC - Modifies and/or requests the estimation of C coefficients in the geopotential model.	
7	I1	Normalization indicator.[NOTE 1] = 0 values unnormalized = 1 values normalized = 2 values ignored	0
15-17	I3	Degree of C coefficient (n index).	0.
18-20	I3	Order of C coefficient (m index).	0.
25-44	D20.8	A priori (or starting) value of C coefficient.	0.
60-72	D13.1	Standard deviation or fractional uncertainty of C coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation. If the value is greater than 1.0D-5 (or (SQRT(1.0D-5) for J2) it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.

NOTES:

[1] See GCOEF card for discussion of denormalization and nominal values.

IF CARD OMITTED: The geopotential used will be from the gravity model input on UNIT 12 of GEODYN-IIS unless modified by EARTH, GCOEF, or GCOEFS cards.

2.3.22 GCOEFS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCOEFS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GCOEFS - Modifies and/or requests the estimation of S coefficients in the geopotential model.	
7	I1	Normalization indicator. [NOTE 1] = 0 values unnormalized = 1 values normalized = 2 values ignored	0
15-17	I3	Degree of S coefficient (n index).	0
18-20	I3	Order of S coefficient (m index).	0
25-44	D20.8	A priori (or starting) value of S coefficient.	0.
60-72	D13.1	Standard deviation or fractional uncertainty of S coefficient. Coefficient will not be adjusted if this field is zero. If the value is less than or equal to 1.0D-5, it is used as the standard deviation If the value is greater than 1.0D-5 it is used as the fractional uncertainty, and the standard deviation is computed as the fractional uncertainty times the nominal value of the coefficient. [NOTE 1]	0.

NOTES:

[1] See GCOEF card for discussion of denormalization and nominal values

IF CARD OMITTED: The geopotential used will be from the gravity model input on UNIT 12 of GEODYN-IIS unless modified by EARTH, GCOEF, or GCOEFC cards.

2.3.23 GCOFCT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCOFCT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
COLUMNS  FORMAT          DESCRIPTION                                DEFAULT VALUE & UNITS

```

```

1-6      A6      GCOFCT - Requests application or
           adjustment of the C gravity
           coefficient for the time period
           defined below.

25-44    D20.8    Begin time of time period gravity

45-59    D15.3    End time of time period gravity

```

NOTE [1]: Time period gravity is introduced by groups of input cards where one group contains information about one discrete period of time. Therefore one needs as many groups as the number of discrete times where gravity coefficients are being replaced or adjusted. These groups follow the stream of the original gravity field coefficients and they have the following structure:

GCOFCT or GCOFST including beginning and end of time period, GCOEFC or GCOEFS respectively (as many as desired) with information about replacing value or adjustment and, GTPEND denoting the end of information for this time period.

EXAMPLE:

```

GCOFCT                800801000000.00800801060000.00
GCOEFC1              2  0    -.500000000000000D-03          1.0
GCOEFC1              3  1    0.300000000000000D-05          1.0
GCOEFC1              4  1    -.600000000000000D-06          1.0
GTPEND
GCOFCT                800801070000.00800801090000.00
GCOEFC1              2  0    -.500000000000000D-03          0.0
GCOEFC1              3  1    0.300000000000000D-05          0.0
GCOEFC1              4  1    -.600000000000000D-06          1.0
GTPEND
GCOFST                800801000000.00800801060000.00
GCOEFS1              3  1    0.250000000000000D-06          0.0
GCOEFS1              4  1    -.550000000000000D-06          1.0

```

IF CARD OMITTED: Time period gravity will not be applied.

2.3.24 GCOFST

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GCOFST
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GCOFST - Requests application or adjustment of the S gravity coefficient for the time period defined below.	
25-44	D20.8	Begin time of time period gravity	
45-59	D15.3	End time of time period gravity	

NOTE [1]: See note on GCOFCT card.

IF CARD OMITTED: Time period gravity will not be applied.

2.3.25 GDYNEP

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GDYNEP
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GDYNEP - specifies a new Geodyn Internal Reference Time for this run.	
25-44	D20.8	New Geodyn Internal Reference Time in "YMMDD". [NOTE 1]	410101 (JD = 2430000.5)

NOTE [1]: If YY = [51-99] the year is 19YY
 If YY = [00-50] the year is 20YY

IF CARD OMITTED: Geodyn will use its default reference time

2.3.26 GEOPOL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GEOPOL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	<p>GEOPOL - The GEOPOL option changes the Z axis used by GEODYN for computing latitude and longitude when evaluating spherical harmonic functions for gravity. By default (without the GEOPOL card) the Z axis used by GEODYN for these computations is the Earth's rotation pole. However, when the GEOPOL option is selected, the Z axis used by GEODYN for these computations is the mean pole implied by polar motion series input on unit 2.</p> <p>Note that in either case (GEOPOL selected or not), the Z axis used by GEODYN for gravity computations will not be the same as the Earth's figure axis. This can only be compensated by the use degree 2 order 1 terms in the gravity field which vary according to polar motion. The POLDYN and POLKF option cards can be used to model can be used to model these degree 2 order 1 terms.</p> <p style="text-align: right;">Most users select the GEOPOL option</p> <p>if the the GEOPOL option is selected, then it is especially important to make use of the POLDYN and POLKF cards. That is because the Z axis implied by the GEOPOL option is further away from the figure axis than the default Z axis. Also note that when the GEOPOL and POLDYN options are used, the user should place background degree 2 order 1 terms in the gravity field (see POLDYN card).</p>	
7	I1	<p>If GEOPOL is used with the POLKF card, Kf is normally +1/3. So if the GEOPOL card is present, the program only allows positive Kf, unless a "1" is input in col 7 of the GEOPOL card. If = 1, can have Kf < 0. If not = 1, can only have Kf > 0.</p>	0.

IF CARD OMITTED: See above first paragraph.

2.3.27 GLBARC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GLBARC
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GLBARC - Requests user selected arc parameter partials to be summed into the E-MATRIX at the end of the arc section. This allows the specified arc parameters to be treated as the first global parameters in the E-MATRIX. At present only the drag parameters can be selected.[1]	
7	I1	Selects drag parameters = 0 - drag parameters will be selected = 1 - turns off this option for the drag parameters	0
8-15		Additional parameters to be added in the future.	

NOTE [1]: This option only applies to E-MATRIX runs. The parameter is given a new E-MATRIX number. See Volume 5 for a description of the new E-MATRIX labels. labels.

IF CARD OMITTED: This option will not be enabled
For interplanetary runs this option will be enabled.

2.3.28 GPSMOD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GPSMOD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GPSMOD - A blank GPSMOD card should be included in all GPS runs.	
7	I1	Index to allow final arc adjustment during an EMAT/GPS run. The index must be >0 to allow the arc inversion. The default (0) means that the job will terminate right after the E-MATRIX was formed and saved.	0
8	I1	<p>=1 This is a gps run (measurement type 85 or 87) but the biases are provided on the setup as a combination of measurement type 41 and 43 for input MTYPE=85 or a combination of measurement type 41 for input MTYPE=87. Instead of providing an MBIAS for the 4-legged measurement type, we provide a bias for each leg (station-satellite or satellite-satellite). The one way biases describe horizon-to-horizon biases therefore they may apply to more than one configuration.</p> <p>=0 Input MTYPE is the same as MBIAS type for GPS observations</p>	0

2.3.29 GPSSHD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GPSSHD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	<p>GPSSHD - This option will instruct GEODYN to produce yaw polynomial input for GPS runs if this is not available. The computation are being done in GEODYN according to the Journal of Geodesy Paper by Bar-Sever.</p> <p>The GPSSHD option will turn any GPS data reduction run into an ORBGEN run automatically, regardless of what other cards are present.</p> <p>Yaw polynomials will be computed and output on unit 48 of GEODYN IIE, in the form of YAWPOL group cards. These YAWPOL group cards may be then included in the global part of the setup for data reduction with the appropriate yaw modeling. NOTE [1]</p>	
25-44	D20.5	12 hrs + endarc time	YYMMDDHHMMSS
45-59	D15.3	Cutoff angle that helps save some computation NOTE [2]	deg 20

NOTE [1]: The end of the GPSSHD group is denoted by the presence of the SHDEND card. In between the GPSSHD and the SHDEND option cards we enter the required YAWRAT cards with yaw rate and yaw rate rate information.

NOTE [2]: GPS satellites are not completely shadowed, unless the beta angle of the orbit plane is about 15o (in absolute value) or less. In a GPSSHD run, GEODYN will compute the beta angle for each GPS satellite at EPOCH. If the absolute of the beta angle is greater than the cutoff (20o or the input on columns 45-59), for a particular GPS satellite at epoch, then that satellite will be excluded from all further consideration in the GPSSHD run.

IF CARD OMITTED:

2.3.30 GRIDS

2.3.30.1 GRIDS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GRIDS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GRIDS - Introduces the use of grid elevation input files in IIE. These grid data files may be mean sea surface heights or land elevations from a given surface or origin. The names and the data for these grid files are provided on the following option cards. The GRIDS option ends with the ENDGRD option card. No more than 6 different grids are allowed as input. The grid files should be binary files consisting of variable length records. Each record contains REAL*4 numbers representing the specified height, for all the grid points of the same latitude in an eastward direction. The first record begins at the highest latitude, so the first point in the file is located at the NW corner of the grid.	

IF CARD OMITTED:

yet GFILE cards are present, the IIS run will abnormally terminate

2.3.30.2 GFILE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GFILE   5760 82-80   0360 225.00                225.00
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GFILE - Supplies the name and input data for the grid file.	
7	I1	Index for grid data origin: =0 Elevations are given from the reference ellipsoid. =1 Elevations are given from the mean sea surface =2 Radii are given from the center of the planet	0
8	I1	Indicator of the data location on the grid file: = 0 The data are located on the grid intersection = 1 The data are located at the center of the grid.	
9-12	I4	Number of data points in one record	no default
15-17	I3	Grid size	(arcsec) No default
25-44	D20.8	Maximum latitude of the grid	(deg) 90
45-59	D15.3	Minimum latitude of thr grid	(deg) -90
60-72	D13.1	Maximum longitude of the grid counting from 0-360 degrees.	(deg) 360
22-24	D8.3	Minimum longitude of the grid	

IF CARD OMITTED:

This model will not be used to compute the observations.

UNITS: M =Meters ; S =Seconds ; deg =Degrees

2.3.30.3 ENDGRD

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDGRD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDGRD - Denotes the end of the grid file sub-group.	

IF CARD OMITTED:

And GRIDS cards are present, the IIS run will abnormally terminate

2.3.31 GRVEPO

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GRVEPO                                890101000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GRVEPO - Sets the epoch time for the time dependent gravity option. See option GRVTIM for more details.	
25-44	D20.8	Epoch time in YYMMDDHHMMSS. for the time dependent gravity model. Linear rates and periodic terms in the time dependent gravity model will be calculated from this time.	0.

NOTES: See option GRVTIM for the time dependent gravity formulation.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 MAS=Milliarc seconds

IF CARD OMITTED: Epoch time for time dependent gravity will be zero.

2.3.32 GRVTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GRVTIM1                                -2.5D-11
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS																				
1-6	A6	GRVTIM - Requests application and/or adjustment of time dependent gravity coefficients. The geopotential coefficients may be given a linear rate and/or up to nine periodic terms. The epoch time for this option is set with the GRVEPO option.																					
7	I1	C or S geopotential coefficient designator. =1 C coefficient indicator. =2 S coefficient indicator.																					
8	I1	Defines the content of the fields in columns 25-80 as follows: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Columns</th> <th>Columns</th> <th>Columns</th> <th>Columns</th> </tr> <tr> <th>25 - 44</th> <th>45 - 59</th> <th>60 - 72</th> <th>73 - 80</th> </tr> </thead> <tbody> <tr> <td>=1 Linear Rate</td> <td>Rate sigma</td> <td></td> <td></td> </tr> <tr> <td>=2</td> <td>A</td> <td>B</td> <td>Period</td> </tr> <tr> <td>=3</td> <td>A sigma</td> <td>B sigma</td> <td></td> </tr> </tbody> </table>	Columns	Columns	Columns	Columns	25 - 44	45 - 59	60 - 72	73 - 80	=1 Linear Rate	Rate sigma			=2	A	B	Period	=3	A sigma	B sigma		[NOTE 2]
Columns	Columns	Columns	Columns																				
25 - 44	45 - 59	60 - 72	73 - 80																				
=1 Linear Rate	Rate sigma																						
=2	A	B	Period																				
=3	A sigma	B sigma																					
15-17	I3	Degree of C and S coefficients (n index)	0																				
18-20	I3	Order of C and S coefficients (m index)	0																				
21-22	I2	# of period for this coefficient (a number between 1-9)	1																				
25-44	D20.8	This field contains geopotential linear rate or rate sigma information as defined by the values selected in columns 7 & 8. col 8=1 Cdot or Sdot (linear rate).	per year																				

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	This field contains geopotential rate sigma, amplitude (A), or amplitude (A) sigma information as defined by the values selected in columns 7 & 8. col 8=1 Standard deviation for Cdot or Sdot. A non zero sigma indicates that this parameter will be adjusted. col 8=2 Amplitude (A) of cosine term. col 8=3 Standard deviation for amplitude	

(A). A non zero sigma indicates that this parameter will be adjusted.

60-72 D13.1 This field contains geopotential amplitude (B), or amplitude (B) sigma information as defined by the values selected in columns 7 & 8.

col 8=2 Amplitude (B) of sine term.
col 8=3 Standard deviation for amplitude (B). A non zero sigma indicates that this parameter will be adjusted.

73-80 D8.3 This field contains the period for the periodic option. The frequency will be computed as $\text{frequency} = 2\pi / \text{period}$. years

NOTE 1: See next page for the time dependent gravity formulation. The cards specifying the apriori periodic terms MUST precede the cards which carry the accompanying sigma information, as in the following example. In the following example the coefficient C21 has two periodic terms.

GRVTIM12	2	0	0.0	0.0	1.0
GRVTIM13	2	0	1.0D-07	1.D-07	
GRVTIM12	2	1 1	0.0	0.0	1.0
GRVTIM13	2	1 1	1.0D-07	1.D-07	
GRVTIM12	2	1 2	0.0	0.0	1.0
GRVTIM13	2	1 2	1.0D-07	1.D-07	
GRVTIM12	2	2	0.0	0.0	1.0
GRVTIM13	2	2	1.0D-07	1.D-07	
GRVTIM22	2	2	0.0	0.0	1.0
GRVTIM23	2	2	1.0D-07	1.D-07	

NOTE 2: Coefficient rates should be normalized in case of application of time dependent gravity.

IF CARD OMITTED: Time dependent gravity will not be applied.

The formulation for the time dependent gravity implementation follows:

None

2.3.33 GTPEND

-----1-----2-----3-----4-----5-----6-----7-----8
GTPEND
-----0-----0-----0-----0-----0-----0-----0-----0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GTPEND - Requests end of application of time period gravity	

IF CARD OMITTED: Abnormal termination will occur.

2.3.34 GXPAND

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GXPAND      02 36 01                                     1.0D-06  1.0D-06
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GXPAND - Requests estimation of a range of geopotential coefficients.	
11-14	I4	Starting degree for geopotential estimation.	2
15-17	I3	Ending degree for geopotential estimation. (Default = degree of geopotential specified on EARTH card.)	0
18-20	I3	Starting order for geopotential estimation.	0
21-24	I4	Ending order for geopotential estimation. (Default = degree of geopotential being generated.)	0
60-72	D13.1	Standard deviation of C coefficient. [NOTE 1]	0.
73-80	D8.2	Standard deviation of S coefficient. [NOTE 1]	0.

NOTES:

The a priori values of the coefficients will be obtained from the current geopotential model including all modifications to the model prior to this card.

[1] See GCOEF card for explanation of the standard deviation for the C and S coefficients.

IF CARD OMITTED: Geopotential coefficients will not be requested unless requested by GCOEF, GCOEFC, or GCOEFS cards.

2.3.35 H2LOVE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
H2LOVE                                     .600
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	H2LOVE - Requests that solid earth tide coefficients of the second kind be modified and/or adjusted.	
7	I1	If > 0, print solid tide correction to station height. [NOTE 1]	
25-44	D20.8	A priori value of love number of the second kind to account for radial displacement, H2.	.600
45-59	D15.3	A priori sigma of H2. If greater than 0, requests adjustment of H2.	0.

NOTE [1]: Solid tide induced changes in station height are in
unit 98.

IF CARD OMITTED: Default value (H2 = 0.600) will be used.

2.3.36 I64G2E

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
I64G2E
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	I64G2E - Specifies options for the interface and data file output by GEODYN IIS on unit 11 and 41 for a 64 bit integer machine.	
8	I1	Specifies whether binary or formatted interface and data files will be created by IIS. =0 Binary interface and data files will be created with the following attributes: Information in the interface file will be treated as follows: Double precision - left as 64 bit IBM words to be converted on the CYBER Integers - converted from 32 bit IBM words to 64 bit CYBER integer words Logicals - converted from 32 bit IBM words to 64 bit CYBER logical words Alpha-numeric - converted from EBCDIC to ASCII =1 formatted interface and data file will be created.	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Specifies 80 column or 132 column formatted interface and data files. =0 132 column formatted interface and data files will be created. =8 80 column formatted interface and data files will be created.	0
11-17	17	Core memory requested for IIS in MW.	2.4 MW

IF CARD OMITTED: Binary Interface and data files will be created for a 64 bit integer machine. See I32G2E option for outputting an interface and data file for a 32 bit integer machine.

2.3.37 IAU200

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
IAU200
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	IAU200 - If this card is present GEODYN will use the new IAU-2000 standards for precession and nutation. New precession modules will be called in GEODYN IIE and the Chebyshev polynomial coefficients to produce the nutations DPSI and DEPS will be read from a special planetary ephemeris. The presence of the IAU200 option requires that presence of the new planetary ephemeris on input unit 1 of GEODYN IIS. and vice versa. If only one of the above conditions does not exist, GEODYN will terminate abnormally.	

IF CARD OMITTED: GEODYN will apply the old precession and nutation standards.

2.3.38 INVERT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
INVERT 1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	INVERT - Controls various matrix inversion routine options.	
7	I1	= 0 Subroutine DSINV will be used to invert normal matrices. = 1 Subroutine SYMINV will be used to invert normal matrices.	0
8	I1	= 0 Inverted normal matrices will not be printed out. = 1 Inverted normal matrices will be printed out.	0
9	I1	= 0 Subroutine DSINV or SYMINV will be used to invert NORMAL POINT pass by pass normal matrices with a priori information as supplied from NORMPV card. = 1 A generalized inverse scheme will be used to invert NORMAL POINT pass by pass normal matrices. A priori information supplied from the NORMPV card will be ignored.	0

2.3.39 L2LOVE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
L2LOVE                                     .075
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	L2LOVE - Requests that solid earth tide coefficients of the third kind be modified and/or adjusted.	
7	I1	If > 0, print solid tide correction to station height. [NOTE 1]	
25-44	D20.8	A priori value of love number of the third kind to account for horizontal shearing. (L2)	.075
45-69	D15.3	A priori sigma of L2 .If greater than zero, requests adjustment of L2 .	0.

NOTE [1]: Solid tide induced changes in station height printed on unit 98.

IF CARD OMITTED: Default value (L2 = 0.075) will be used

2.3.40 LINK

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
LINK
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LINK - This option links two GEODYN parameters together. During the formation of the normal matrix, the partials of the second parameter will be folded into the partials of the first parameter. The computed correction will adjust both parameters.	
8-12	I5	ID number of the first adjusted parameter [NOTE1]	
13-17	I5	ID number of the second adjusted parameter [NOTE1]	

NOTE 1: The adjusted parameter ID number can be found in the IIS parameter summary.

IF CARD OMITTED: No parameter linking will occur.

2.3.41 LIST

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
LIST
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-4	A4	LIST - If NOLIST option has been exercised earlier in Global Set options, then LIST option will negate effects of NOLIST and cause GEODYN-IIS to resume listing of input from this point forward.	

IF CARD OMITTED: Listings of input will terminate with 'NOLIST' or 'ENDALL' whichever is encountered first.

2.3.42 LOCALG

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
LOCALG
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	LOCALG - Requests appliation and possibly estimation of gravity anomalies. Gravity anomalies [1] are regional (local) departures from the gravity field implied by the input set of spherical harmonics. The location of the gravity anomaly is specified on a second card [2].	
-----	----	---	--

7-14	I8	Gravity Anomaly number. This is a unique number specified by the user to identify the gravity anomaly parameter. No two gravity anomaly parameters may use the same gravity anomaly number. Information about the area of the gravity anomaly parameter is input on a grid [3]. The gravity anomaly number helps link up information from the grid to the gravity anomaly parameter.	
------	----	--	--

18-24	I7	Grid Number [3]. Information about the gravity anomaly area is given on an external grid. The grid number identifies the grid which is being used. All gravity anomaly parameters in the same run must use the same grid.kk	
-------	----	---	--

25-44	D20.8	A priori value of the gravity anomaly at the center of the master block. [2]	mgals
-------	-------	--	-------

73-80	D8.3	Standard deviation of gravity anomaly. A value > 0 results in estimation of gravity anomalies.	
-------	------	--	--

Note [1] The parameters are free air anomalies on the surface of a sphere with radius $(a*b)^{1/3}$ where a is the semi major axis and b is the semi minor axis of the central body.

Note [2] A card which is blank in COLs 1-6 must follow each LOCALG card. This second card contains information in COLs 7-66 about the location of the gravity anomaly.

Note [3] When LOCALG parameters are present, IIS searches for a data set called SUBBLK. SUBBLK contains points which are assigned to the LOCALG parameters. The points represent subdivision areas of the LOCALG parameters and are used to numerically integrate the equations which upward continue the gravity anomaly to the satellite location.

SUBBLK is a formatted data set as follows:

7-14 I8 Gravity Anomaly number. This is a unique number for LOCALG parameters. At least one (preferably more than one) grid point will match each LOCALG parameter's gravity anomaly number.

18-24 I7 Grid Number. This is a number which uniquely identified the grid (all points on the grid have the same grid number).

25-49 D25.16 Geocentric latitude of grid point (degrees)

50-74 D25.16 Longitude of grid point (degrees)

75-99 D25.16 Area on unit sphere represented by the grid point

IF CARD OMITTED: Gravity anomalies will not be applied.

SECOND CARD

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
 -----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Contains information about master block and its subdivisions.	
7-21	D15.2	Latitude of the center of the master block.	deg
22-36	D15.2	East longitude at the center of the master block.	deg
37-51	D15.2	Size of the master block in the direction of latitude.	deg
52-66	D15.2	Size of the master block in the direction of longitude.	deg

IF CARD OMITTED: And LOCALG was requested the program will terminate abnormally.

2.3.43 LRARC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
LRARC 17 5 5 5
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests input of laser retro-reflector range corrections on UNIT 8 [NOTE 1] (Currently, only applies to TOPEX)	
7-8	I2	Number of incidence angles for which information is available on UNIT 8	17
9-10	I2	Maximum Order of Fourier Coefficients for X-coordinates	5
11-12	I2	Maximum Order of Fourier Coefficients for Y-coordinates	5
13-14	I2	Number of Station Detector Types in Range Correction Tables	14
23-24	I2	=1 This is the SARAL satellite and an LRA correction will be applied.'	

NOTE 1: This corrects the observation from the reflecting corner cube back to a fixed point on the spacecraft. It is also station dependent and is tied to the laser tracking station detector type specified on the INSTRMNT card. This must be used in conjunction with the OFFSET and CGMASS cards to get the complete range correction from the corner cube to the spacecraft CG.

Currently, this option can only be used for the TOPEX satellite.

IF CARD OMITTED: No lra range corrections will be read or used.

2.3.44 NETCON

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NETCON                                     1.331                               0.896                               4.789
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NETCON - Introduces values for the right hand side equations and sigmas for network rotation and/or translation constraints	
7	I1	= 1 The values represent station network translation constraints = 2 The values represent station network rotation constraints = 3 The values represent quasar network rotation constraints	
8	I1	= 1 The values represent RHS values = 2 The values represent sigmas	
25-44	D20.8	RHS x compopnent value OR sigma	
45-59	D15.3	RHS y compopnent value OR sigma	
60-72	D13.1	RHS z compopnent value OR sigma	

NOTE [1] :

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz;

IF CARD OMITTED: No network translations or rotations will be invoked

2.3.45 NOLIST

```
-----1-----2-----3-----4-----5-----6-----7-----8
NOLIST
-----0-----0-----0-----0-----0-----0-----0-----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NOLIST - Will cause GEODYN-IIS listings of input to be interrupted from point of NOLIST until next LIST option encountered.	

IF CARD OMITTED: Listings will terminate with 'ENDALL'.

2.3.46 NONSNS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NONSNS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NONSNS - Shuts off the "No Shirt No Service" (NSNS) protection in a GPS data reduction run. Unless this card is present, NSNS protection is provided in a GPS data reduction run. When NSNS protection is in force, every block of GPS data that is not covered by an ambiguity bias (simple measurement bias) is edited.	

IF CARD OMITTED: NSNS protection is provided.

2.3.47 NORMPT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NORMPTO                120
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests the computation and output onto unit 20 in GEODYN-IIE of metric data normal points on the last inner iteration of each data reduction arc during the last global iteration.	
7	I1	Indicates whether or not a normal point report should be printed on unit 15 by GEODYN-IIE. 0 - Print a normal point report on unit 15. 1 - Do not print a normal point report.	0
8	I1	Maximum number of local iterations to perform in editing each pass of data prior to formation of normal points.	5
9-10	I2	Maximum number of physical buffers to be used in outputting normal points to unit 20.	2
11-14	I4	Controls the maximum number of observations that will be used in one data block (minimum no. = 11 , maximum = 9999, default value = 40 when EMATRX option is used)	1000
15-17	I3	Number of integration steps over which interpolation may be simultaneously performed. Must be greater than or equal to integration order minus one.	Integration order minus one.
18-20	I3	Maximum number of physical buffers per input observation block. This number must be greater than or equal to the value used by the Tracking Data Formatter.	10

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
21-24	I4	Normal point bin size in seconds. If a positive integer is not entered in this field, normal points will not be generated.	None
25-44	D20.8	Normal point pass editing multiplier. (See Arc EDIT option for default)	Residual edit multiplier.
45-59	D15.3	Normal point pass editing initial RMS. (See Arc EDIT option for default)	Editing RMS from previous Inner Iter.

73-80 D8.2 Normal point pass editing iteration
convergence criterion. (See Arc EDIT)

Inner Iteration
RMS convergence.

NOTES:

[1] When in normal point generation mode, large numbers of parameters should not be estimated. This option also overrides columns 11-17 of the VECOPT card. Observation data to be input for normal point generation should be processed through the Tracking Data Formatter with the normal point option exercised in TDF.

Values in columns 11-14 and 15-17 of this card override values in these same columns on VECOPT option.

See also Arc Set option card NORMPV.

IF CARD OMITTED: Normal points will not be generated.

2.3.48 NUTATE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NUTATE
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NUTATE - Requests the application of nutation corrections that refer to the IAU-2000 model and/or used to modify and/or request adjustment of corrections to nutation components DPSI (nutation in longitude) and EPST (nutation in true obliquity).	
7	I1	= 0 No parameter adjustment only nutation corrections since J2000 are applied. [NOTE 1] = 1 Parameter adjustment requested with no nutation corrections applied. = 2 Parameter adjustment requested and nutation corrections since J2000 are applied.	0
25-44	D20.8	Date in form YYMMDD.FFF of DPSI and EPST correction values[1] to which this card applies. This date is for the midpoint of the interval specified in columns 25-44 of card two.	No default.
45-59	D15.3	DPSI (nutation in longitude) correction.	See col. 8. (SA)
60-72	D13.1	EPST (nutation in true obliquity) correction.	See col. 8. (SA)

[NOTE 1] Use the NUTATE card with the new EOP IAU 2000 tables to apply nutation corrections since year 2000.

SECOND CARD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
                                         5.0           0.01           0.1           0.1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-23	23X	Blanks must be present.	
24	I1	=1 the units for the below averaging interval is hours =0 the units for the below averaging interval is days	0

25-44 D20.8 Averaging period[1] in the above units for No default.
DPSI and EPST values. The date in columns
25-44 of the first card is for the midpoint
of this interval

45-59 D15.3 A priori standard deviation in DPSI. 0.0 (SA)

60-72 D13.1 A priori standard deviation in EPST. 0.0 (SA)

IF CARD OMITTED: The nutation correction will not be applied.

2.3.49 OBSVU

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OBSVU 3          0010
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	OBSVU - Controls residual printout for all arcs.	
7	I1	Residual printout controlled as follows: =0 or blank - Indicates that residuals are requested on the first inner iteration of the first global iteration and the last inner iteration of the last global iteration for all arcs. This is the same as =3 below. =1 Indicates that residuals are requested on the first inner iteration of the first global interaction for all arcs. =2 Indicates that residuals are requested on the last inner iteration of the last global iteration for all arcs. =3 Indicates that residuals are requested on the first inner iteration of the first global iteration and the last inner iteration of the last global iteration for all arcs. =4 Indicates residuals are requested on all iterations for all arcs. =5 Indicates no residuals are requested for any arc.	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
8	I1	= 1 Indicates preprocessing corrections are to be written on unit 16 for the iterations indicated by column 7 and for the modulo selected in columns 21-24.	0

Residuals must be printed on the first iteration if the option is invoked.
[see NOTE 1 below]

21-24 I4 Modulo number for printing of residuals, preprocessing corrections, and partials. Default is to print all residuals. A value N input here requests printing of every Nth residual. 1

NOTE [1]: The numbering system that is used on the preprocessing printout on UNIT16 is related to the Header Record and partition number as described in Volume 5 Section 2 under Observation Corrections Record.
[eg. if the UNIT16 printout was for a range measurement and the number printed was 13 it would mean Header #1 partition #3 which would pertain to a dry tropospheric refraction correction for station #1. G means that the program computes and applies the correction. Absence of a "G" means the correction was provided by the data record.]

IF CARD OMITTED: Residuals are requested on the first inner iteration of the first global iteration and the last inner iteration of the last global iteration for all arcs. No preprocessing nor measurement partial files are created and all residuals in the given iteration are output.

2.3.50 OFFADJ

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OFFADJ
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OFFADJ - Provides for the adjustment of tracking point offset coordinates on a satellite. This card must be used in conjunction with a OFFSET card. The OFFSET card describes the tracking point coordinate parameters. Columns 7-44 of the OFFADJcard must match columns 7-44 of the OFFSET card which corresponds to the tracking point coordinates for which the adjustment is desired.	
45-59	D15.3	Standard Deviation of X coordinate	(meter)
60-72	D13.1	Standard Deviation of Y coordinate	(meter)
73-80	D8.2	Standard Deviation of Z coordinate	(meter)

IF CARD OMITTED:

2.3.51 OFFSET

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OFFSET          7806401 0.                    1.331          0.896          4.789
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-6	A6	OFFSET - Inputs body-centered coordinates for antenna offset or laser reflector offset.	
7	I1	= 1 Indicates link 1 of offset. A second link (OFFSET2) must follow. = 2 Indicates link 2 of offset. [NOTE 1], [NOTE 2] = 3 Indicates link 3 of offset. [NOTE 1], [NOTE 2] = 7 Antenna orientation vector in the x direction = 8 Antenna orientation vector in the y direction = 9 Antenna orientation vector in the z direction [NOTE 6], [NOTE 7]	0
8	I1	= 9 Indicates external attitude model used for link # 1 rotations and link # 2 and # 3 movable antenna rotations. Must have external attitude file available. If this option is selected an antenna # in column 17 must be present, only antenna #'s 1-4 are valid. This option overrides the coordinate system specified in column 15. Not applicable for OFFSET2 or OFFSET3 card. OFFSET1 card value is used for OFFSET2 and OFFSET3. [NOTE 2]	0
9	I1	= 1 Indicates use of new metric data format prepro word antenna identification scheme. If this option is selected an antenna # in column 17 must be present, only antenna #'s 1-4 are valid. Not applicable for OFFSET2 or OFFSET3 card. OFFSET1 card value is used for OFFSET2 and OFFSET3. [NOTE 3]	0
10	I1	= 1 Indicates use of OFFSET3 card. = 0 No OFFSET3 shall be used.	0

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

11-12 I2 Antenna type number used for phase map corrections

14-15 I2 Body fixed coordinate system used to calculate offset. [NOTE 4]

- 0 - Position and velocity vectors
- 1 - Position and sun vectors
- 2 - TOPEX/Poseidon
- 3 - SPOT-2
- 4 - GPS
- 5 - ERS-1
- 6 - Mars observer Mapping Phase
- 7 - Mars observer Cruise Phase
- 8 - TDRSS
- 9 - Magnetically stabilized S/C
- 10 - GFO
- 11 - TRMM
- 12 - EUVE
- 13 - ICESAT
- 14 - ENVISAT
- 15 - CRYOSAT-2
- 16 - Leading GRAIL satellite
- 17 - Trailing GRAIL satellite
- 18 - HY2A
- 19 - SARAL

Not applicable for OFFSET2 or OFFSET3 card.
 OFFSET1 card value is used for OFFSET2.

16-17 I2 Antenna number (optional if frequency is specified). Mandatory if external attitude or new metric data antenna identification scheme is selected. This antenna number must match the appropriate external attitude file antenna number and/or the metric data antenna number.

Not applicable for OFFSET2 or OFFSET3 card.
 OFFSET1 card value is used for OFFSET2 and OFFSET3.

OR

50+ Laser Id if Laser Altimeter data are being processed. If the laser Altimeter Id is 1 then the user should put 51 on columns 16-17. This convention distinguishes from the antenna number and the antenna identification scheme in the GEODYN code.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	I7	Satellite ID (required). Not applicable for OFFSET2 card. OFFSET1 card value is used for OFFSET2.	0
25-44	D20.8	Frequency in mega-hertz. Used to	0. MH

discriminate between antennae when more than one antenna is on a satellite. (Frequency = 0. implies that offset applies to all antenna.) Not applicable for OFFSET2 or OFFSET3 card. OFFSET1 card value is used for OFFSET2. (optional if antenna number and new prepro ID scheme selected).

If the index in column 7 is equal to 7 then this field contains the first component of the orientation unit vector in the x direction

If the index in column 7 is equal to 8 then this field contains the first component of the orientation unit vector in the y direction

If the index in column 7 is equal to 9 then this field contains the first component of the orientation unit vector in the z direction

45-59 D15.3 Body centered fixed offset link 1 or link 2 or link 3 antenna from center of figure; x-axis. 0. M

If the index in column 7 is equal to 7 then this field contains the second component of the orientation unit vector in the x direction

If the index in column 7 is equal to 8 then this field contains the second component of the orientation unit vector in the y direction

If the index in column 7 is equal to 9 then this field contains the second component of the orientation unit vector in the z direction

60-72 D13.1 Body centered fixed offset link 1 or link 2 or link 3 antenna from center of figure; y-axis. 0. M

If the index in column 7 is equal to 7 then this field contains the third component of the orientation unit vector in the x direction

If the index in column 7 is equal to 8 then this field contains the third component of the orientation unit vector in the y direction

If the index in column 7 is equal to 9 then this field contains the third component of the orientation unit vector in the z direction

73-80 D8.3 Body centered fixed offset link 1 or 0. M

link 2 or link 3 antenna from center of
figure; z-axis.
OR Antenna Cutoff angle if the index on col. 7
is "9"

NOTE [1] : OFFSET1 and OFFSET2 cards are a pair. OFFSET1 card must be
followed by OFFSET2 card. If present, OFFSET3 must follow
OFFSET2.

NOTE [2] : See Volume 5 for a description of the external attitude file.
Multiple link offset may only be used with Mars observer
(Col 15 = 6) and external attitude. Using multiple links implies
link # 1 is Spacecraft Body Fixed (SBF) Frame, and link # 2 is a
movable link. Link 1 and CGMASS vector are in the same SBF frame
Link # 2 gets rotation from external attitude or internal attitude
model. If q1 of quaternions equals -9999999 for any point in the
block, then the internal model (selected in col. 15) will be used
for the offset vector rotations. If no SBF to J2000 quaternions
are found for the antenna number requested then the internal model
(selected in col. 15) will be used for the offset vector rotations.
If no movable antenna quaternions are present in the external
attitude file only the 1st link will be applied with the SBF to
J2000 quaternion information.

NOTE [3] : See the antenna identification word in the metric data format
description.

NOTE [4] : The two vectors listed for each group are the initial vectors used
to describe the satellite body fixed coordinate system.
(options 0 and 1 only)

Position and velocity vectors - The X-axis is given by the velocity
vector, the X-axis crossed with the position vector gives the
Y-axis, and the X-axis crossed with the Y-axis gives the Z-axis.

Position and sun vectors - The Z-axis is given by the negative of
the position vector, the Z-axis crossed with the sun vector gives
the Y-axis, and the Y-axis crossed with the Z-axis gives the X-axis.

NOTE [5] : See CGMASS for reference between center of figure/center of gravity.

NOTE [6] : The default values for the antenna orientation vectors
for GPS satellites

x = (1,0,0)

y = (0,1,0)

z = (0,0,1)

for user satellites

x = (1,0,0)

y = (0,-1,0)

z = (0,0,-1)

NOTE [7] : If the index in column 7 is 7, 8 or 9
then the user needs to fill the satellite ID (cols 18-24)
and the first 3 real fields with the antenna orientation
in all 3 directions.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz;

IF CARD OMITTED: No antenna offset will be applied.

2.3.52 OLOAD

The OLOAD option may be used for two different parameter estimation options in GEODYN.

1. Application and Estimation of Ocean Loading
1. Application and Estimation of Center of Mass (COM) corrections and Earth Orientation and UT1 (EOP/UT1) corrections caused by high frequency tides.

The description below refers to Ocean Loading application and estimation. (For Tidal driven COM corrections and EOP/UT1 corrections please scroll down)

We attach here a reference by Richard Ray on Background to GEODYN Modeling of Diurnal/Semi

```

-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
OLOAD  3  7051      273555  -.00378                +.00378                10.                10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	OLOAD - Requests application and/or adjustment of ocean loading using the formulation described in NOTES [4, 5 and 6]. Also see NOTE [1]		
7	I1	Print Options (See NOTE [3] below)		
8	I1	Direction specification. 1 - East, 2 - North, 3 - Vertical	3	
11-14	I4	Site Number (See NOTE [8] below)		
18-24	I7	Doodson number. (see NOTE [7] below)	0	
25-44	D20.8	"A" coefficient.	0.0	M
45-59	D15.3	"B" coefficient.	0.0	M
60-72	D13.1	Sigma "A".	0.0	
73-80	D8.2	Sigma "B".	0.0	

NOTES:

- [1] In the second half of 2017, R Ray and D Rowlands scrubbed most aspects of tide modeling in GEODYN (solid Earth tide displacements for stations were not re-examined, although dynamic Earth tides, ETIDES were). The re-examination resulted in some code changes that were implemented in version 1802.0. Using the same OLOAD setup decks as in previous versions will result in slightly different ocean loading displacements due to a cleanup of sideband computations. Xp and Yp computations have changed quite a bit (see note [10]). One should not attempt to model Xp and Yp with OLOADS prior to version 1802.0. Furthermore, some input changes are recommended on this web page.

- [2] NOTES [3 & 4] pertains to ocean loading corrections only.
 NOTES [5-8] pertain to ocean loading, center of mass variations
 and Earth orientation. NOTES [9-11] pertain to center of mass
 and Earth orientation
- [3] Ocean loading station lat, lon, height changes printed on unit 96.
- [4] GEODYN uses the following formula to compute the change
 in a component (East, North or Vertical) of position due
 due to the loading of the ith tide (a tide is specified
 by a Doodson number):
- $$\text{delta}(i,t)=A(i) * \cos(\text{arg}(i,t)) + B(i) * \sin(\text{arg}(i,t))$$
- The argument, $\text{arg}(i,t)$, is mainly (see notes [5i and 6]) a
 linear combination of certain astronomical angles at time, t.
 The factors factors of the linear combination are dictated by
 the input Doodson number.
- [5] In order to be consistent with the tidal community,
 for certain Doodson numbers, $\text{arg}(i,t)$ is offset by
 an amount given in the table that follows just below
 NOTE that for the dynamic Earth and ocean tides (ETIDES
 and OTIDES) the angle by which the Doodson number is offset
 is defaulted to zero for all tides. It is up to the user
 specify a multiple of $\text{PI}/2$ to offset the dynamic tides.

Doodson	OFFFSET	TIDE
165555	PI/TWO	! K1
145555	-PI/TWO	! O1
163555	-PI/TWO	! P1
135655	-PI/TWO	! Q1
055565	PI	! Node tide
117655	-PI/TWO	! alpha1
125755	-PI/TWO	! 2Q1
127555	-PI/TWO	! sigma1
137455	-PI/TWO	! rho1
147555	PI/TWO	! tau1
153655	PI/TWO	! beta1
155455	PI/TWO	! M1 couplet line
155655	PI/TWO	! M1
157455	PI/TWO	! chi1
162556	-PI/TWO	! pi1
164554	PI/TWO	! S1 gravitational
164555	PI	! S1 met line, not gravitational
164556	PI/TWO	! S1 gravitational
166554	PI/TWO	! psi1
167555	PI/TWO	! phi1
173655	PI/TWO	! theta1
175455	PI/TWO	! J1
183555	PI/TWO	! S01
185555	PI/TWO	! 001
195455	PI/TWO	! upsilon1
253755	PI	! Gamma2
254556	PI	! alpha2
263655	PI	! lambda2
265455	PI	! L2

```
274554  PI      ! R2
355555  PI      ! M3
```

[6] Starting with version 1802.0, alterations due to sidebands are automatically computed for every OLOAD input (whether for actual ocean loading or for tidally driven center of mass or EOP changes). Prior to version 1802.0, sideband computation was performed according to what was being done with the same Doodson number in the dynamic tides. There were multiple problems with this approach, Sideband modeling slightly modify $\arg(i,t)$ (described above) and also scale the A and B coefficients. NOTE that sideband computations are also possible for the parameters associated with OTIDES and ETIDES cards, but for these the user must request these sideband computations, The OLOAD parameters use sideband option #1 as described on the OTIDES card.

[7] Any number specified in columns 18-23 specified as a Doodson number having a leading digit greater than 6 will be interpreted as a retrograde tide having the same Doodson number but with 6 less in the leading digit. For example, 855555 is a retrograde M2 tide (255555).

[8] In addition to describing parameters that model station displacements due to ocean loading, the OLOAD card can also describe parameters for the Earth's center of mass variations and also variations in Earth orientation parameters (Xp, Yp and UT1). Site number 1 is reserved for (indicates that the card pertains to) center of mass variations. Site number 2 is reserved for (indicates that the card pertains to) Earth orientation. For use of the OLOAD card for center of mass or Earth orientation, scroll down

```
UNITS:  KM =Kilometers; M  =Meters      ; S  =Seconds      ; Kg =Kilograms
        DEG=Degrees      ; RAD=Radians   ; AS =Arc seconds; MAS=Milli-arc seconds
```

IF CARD OMITTED: Ocean loading will not be used.

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OLOAD  1      2      875555      -1.3832215D-10  2.5079538D-11
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & U
1-6	A6	OLOAD - Requests application and/or adjustment of Center of Mass OR Earth Orientation (EOP) and UT1 corrections driven by High Frequency Tides (See NOTE [1] and NOTE[9])	
8	I1	Type of parameter	

For column 14=1
 1=X direction
 2=Y direction
 3=Z direction

For column 14=2
 1=Xp and Yp (Polar Motion)
 3=UT1

14	I1	Index defining the Group of Parameters	
		1 - Center of Mass correction (See NOTE [10])	
		2 - EOP/UT1 correction (See NOTE [11])	
18-24	I7	Doodson number. (See NOTES 5 and 6 above)	0
			COM/EOP/UT1
25-44	D20.8	"A" coefficient.	0.0 M /RAD/ S
			COM/EOP/UT1
45-59	D15.3	"B" coefficient.	0.0 M /RAD/ S
60-72	D13.1	Sigma "A".	0.0
73-80	D8.2	Sigma "B".	0.0

[9] Suggested OLOLAD setups for center of mass and EOP are provide on this webpage. The corrections that result from these setups are also provided for a 10 day period in 1994. These corrections have been compared to corrections provided by other researchers.

[10] The sense of the center of mass correction is that after it is added to coordinates given in the terrestrial reference frame of the stations, the coordinates are in a center of of the Earth s mass frame consistent with satellite orbits. GEODYN uses the following formula to compute the center of mass correction in a component (X, Y or Z) of position due to of the ith tide (a tide is specified by a Doodson number):

$$\text{delta}(i,t)=A(i) * \cos(\text{arg}(i,t)) + B(i) * \sin(\text{arg}(i,t))$$

The argument, arg(i,t), is mainly (see notes [5] and [6]) a linear combination of certain astronomical angles at time, t. The factors factors of the linear combination are dictated by the input Doodson number.

[11] The sense of EOP corrections is that when they are added to a smooth time series of EOP the resulting EOP series is closer to observed values.

UT1

The UT1 correction due to the ith tide (a tide is specified by a Doodson number) is computed according to the following formula:

$$\text{delta}(i,t)=A(i) * \cos(\text{arg}(i,t)) + B(i) * \sin(\text{arg}(i,t))$$

The argument, $\arg(i,t)$, is mainly (see notes [5i and 6]) a linear combination of certain astronomical angles at time, t . The factors factors of the linear combination are dictated by the input Doodson number.

Xp and Yp

Xp and Yp corrections are linked together. Richard Ray has prepared a PDF to give more background on this. The PDF can be download from this webpage.

The correction due to the i th tide for Xp and Yp is linked by a common pair of A and B coefficients.

$$\begin{aligned}\text{deltaXp}(i,t) &= A(i) * \cos(\arg(i,t)) - B(i) * \sin(\arg(i,t)) \\ \text{deltaYp}(i,t) &= -B(i) * \cos(\arg(i,t)) - A(i) * \sin(\arg(i,t))\end{aligned}$$

The argument, $\arg(i,t)$, is mainly (see notes [5i and 6]) a linear combination of certain astronomical angles at time, t . The factors factors of the linear combination are dictated by the input Doodson number. This approach requires the use of both prograde and retrograde tides. See NOTE [7].

EXAMPLE SETUPS AND CORRECTIONS FOR EOP AND COM

EOP

EXAMPLE SETUP FOR EOP OLOAD CARDS

(These coefficients are based on the ocean tide "Model C" from the paper by Chao, Ray, Gipson, Egbert, & Ma (JGR, 1996), with minor constituents inferred from a Munk-Cartwright Fourier series expansion of the tidal admittances. The tidal model is the same one that was adopted for the IERS-2010 Conventions, although the coefficients themselves are slightly different owing to various translations done by the IERS.)

These corrections are consistent with the suggested EOP input

When comparing our EOP coefficients to those tabulated by the IERS, there are some important differences. The main one is a different convention for the tidal arguments. In addition, the IERS explicitly tabulates all nodal sidelines. This must NOT be done for GEODYN, because GEODYN internally computes all needed lunar nodal modulations (as well as perigee modulations for M1 and L2). Thus, a GEODYN set of EOP coefficients will always be smaller than the corresponding table of IERS coefficients, at least when the same tidal constituents are being included. Please see the reference by Richard Ray on:
Background to GEODYN Modeling of Diurnal/Semidiurnal Tidal Polar Motion

COM

EXAMPLE SETUP FOR COM OLOAD CARDS

(These coefficients are based on the GOT4.10c ocean tide model, which is a small revision to the GOT4.10 model described by Ray (JGR-Oceans,

118, 4570, 2013), with the revision being a more rigorous accounting for tidal geocenter motion during the model development, as described by Desai & Ray (GRL, 41, 2454, 2014).)

These corrections are consistent with the suggested COM input - X component

These corrections are consistent with the suggested COM input - Y component

These corrections are consistent with the suggested COM input - Z component

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Tidal driven EOP/UTI or COM corrections will not be applied

2.3.53 OTCOEF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OTCOEF
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Provides the apriori values for the S coefficients needed for the ocean tide model evaluation. This card applies to the ocean tide model that employs Proudman functions.	
7-8	I2	Tidal constituent identification number = 0 M2 = 1 K2 = 2 S2 = 3 N2 = 4 K1 = 5 O1 = 6 P1 = 7 Q1	
25-44	D20.8	A priori value for C coefficient.	0.
45-59	D15.3	A priori value for S coefficient.	0.
60-72	D13.1	Standard deviation for C coefficient. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation for S coefficient. No adjustment if this field is zero.	0.

NOTE [1]: A stream of OTCOEF cards should follow the OTMOD card (See OTMOD Vol. 3).

IF CARD OMITTED: and OTMOD has been requested the run will terminate abnormally.

2.3.54 OTIDEN

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OTIDEN+1  2 2 +1220 011  -.0224744          +.0192629          10.          10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OTIDEN - Requests application and/or adjustment of ocean tides using the Colombo tide model and normalized Legendre polynomials. M and K symmetry is taken into account.	
7-8	I2	Indicates sign (+ or -) term in harmonic expansion.	+1
9	I1	Indicates form of input coefficients. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients. [NOTE 1]	0
11-12	I2	Degree of expansion.	0
13-14	I2	Order of expansion.	0
15-17	I3	Sign (+1 or -1) of the Demos Number. [NOTE 2]	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
23	I1	Indicates form of tidal amplitude coefficient [$V(t) / V_{bar}$] [NOTE 3] f f 0 = only main line, fixed coefficient 1 = main line and sidebands, variable coefficient 2 = only main line, variable coefficient	0
24	I1	Disturbing Body (B). [NOTE 2] 0 = Moon and Sun	0

1 = Moon
2 = Sun

25-44	D20.8	"A" coefficient. [NOTE 1] (Amplitude)	0.	M
45-59	D15.3	"B" coefficient. [NOTE 1] (Phase)	0.	M
60-72	D13.1	Sigma "A". (Amplitude)	0.	M
73-80	D8.2	Sigma "B". (Phase)	0.	M

NOTES :

[1] The "A" and "B" coefficients are related to amplitude and phase by the following formulas:

$$A = \text{amplitude} * \cos(\text{phase})$$

$$B = \text{amplitude} * \sin(\text{phase})$$

NOTES (cont):

[2] The "Demos Number" is represented in the Parameter Label (Word #2) as follows:

```
*****
*   SIGN OF   *                               *   SIGN OF   *
*   HARMONIC *           MKH*1000+(J+10)*10+B *   DEMOS     *
*   EXPANSION *                               *   NUMBER     *
*****
```

[3] There are 30 recognized main tidal lines.
Their Demos numbers are:

SMKH	JB	SMKH	JB	(See page 1 for S M K J B definitions)
-1020	02	-1020	11	
1001	-11	1120	11	
-1001	11	1101	11	
-1020	01	-1101	-11	
1120	01	1101	-11	
1120	02	-1101	11	
1101	01	-1120	01	
-1101	01	1220	21	
1101	02	1220	11	
-1101	02	1220	-11	
1101	00	1201	01	
1220	01	-1201	01	
1220	02	1201	02	
1001	-12	-1201	02	

-1001 12

1201 00

Of these 30 main lines there are 18 distinct frequencies. The side bands associated with these 18 main line frequencies are:

Main Line 1: Ssa -1020 02
Side Bands: 1001 -22

Main Line 2: Mm 1001 -11, -1001 11
Side Bands: -1021 11, -1011 11, 1011 -11, 1021 -11,
-1020 -11, -1010 -11, 1002 11, 1012 11

Main Line 3: Mf -1020 01
Side Bands: -1021 21, -1011 21, 1001 -21, 1011 -21,
1021 -21, -1010 01, -1000 01, 1012 01

Main Line 4: O1 1120 01
Side Bands: -1112 01, 1100 01, 1110 01, -1111 -21,
1101 21, 1111 21, 1121 21

Main Line 5: P1 1120 02
Side Bands: 1101 22

Main Line 6: K1 1101 01, -1101 01, 1101 02, -1101 02, 1101 00
Side Bands: -1121 01, -1111 01, 1111 01, 1121 01

Main Line 7: M2 1220 01
Side Bands: 1201 21, 1210 01, 1211 21, 1200 01, -1212 01,
-1211 -21, 1221 21

Main Line 8: S2 1220 02
Side Bands: 1201 22

Main Line 9: Sa 1001 -12, -1001 12
Side Bands: -1020 -12

Main Line 10: Mtm -1020 11
Side Bands: 1001 -31, -1010 11, 1002 -11

Main Line 11: Q1 1120 11
Side Bands: 1100 11, 1110 11, 1101 31

Main Line 12: M1 1101 11, -1101 -11
Side Bands: 1110 -11, 1120 -11, -1111 -11, 1111 11, 1121 11

Main Line 13: J1 1101 -11, -1101 11
Side Bands: -1111 11, 1111 -11, 1121 -11, -1120 -11, -1110 -11

Main Line 14: O01 -1120 01
Side Bands: 1101 -21, 1111 -21, -1110 01, 1102 01, 1112 01

Main Line 15: 2N2 1220 21
Side Bands: 1210 21

Main Line 16: N2 1220 11

Side Bands: 1210 11

Main Line 17: L2 1220 -11

Side Bands: 1210 -11, -1211 -11, 1201 11, 1211 11, 1221 11

Main Line 18: K2 1201 01, -1201 01, 1201 02, -1201 02, 1201 00

Side Bands: -1211 01, 1211 01, 1221 01

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The expanded ocean tide model is not used. See TIDES card for
 tide model that will be used.

2.3.55 OTIDES

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OTIDES+1  2 2 +1220 011 -.0224744          +.0192629          10.          10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	OTIDES - Requests application and/or adjustment of ocean tides. There are two Ocean Tide models available in GEODYN. First implemented was the Colombo tide model and unnormalized Legendre polynomials. M and K symmetry is NOT included. The presence of a RAYTID option before the OTIDES cards invokes the Doodson Ocean Tides. Immediately following there is a description of the Colombo model. At the end of this page there will be a description of the Doodson model.	Colombo Model
7-8	I2	Indicates sign (+ or -) term in harmonic expansion, for prograde or retrograde	+1
9	I1	Indicates form of input coefficients. 0 = A and B coefficients. [NOTE 1]	0
10	I1	Indicates form of input sigmas. 0 = A and B coefficients. [NOTE 1]	0
11-12	I2	Degree of expansion.	0
13-14	I2	Order of expansion.	0
15-17	I3	Sign (+1 or -1) of the Demos Number. [NOTE 2] This sign multiplies the quantity $-\left(\left(2-H\right) * \omega + \left(2-2H+J\right) * M + K * \Omega\right)$	+1
18-20	I3	MKH expansion arguments of the Demos number. [NOTE 2] M = 0,1,2 K = 0,1,2 H = 0,1,2	0
21-22	I2	"J" expansion argument of Demos number. -9. LE. J .LE. 9 [NOTE 2]	0
23	I1	Indicates form of tidal amplitude coefficient [V (t) / V bar] [NOTE 3] f f 0 = only main line, fixed coefficient	0

1 = main line and sidebands, variable coefficient
 2 = only main line, variable coefficient

24	I1	Disturbing Body (B). [NOTE 2]	0	
		0 = Moon and Sun		
		1 = Moon		
		2 = Sun		
25-44	D20.8	"A" coefficient. [NOTE 1]	0.	M
45-59	D15.3	"B" coefficient. [NOTE 1]	0.	M
60-72	D13.1	Sigma "A".	0.	M
73-80	D8.2	Sigma "B".	0.	M

NOTES:

[1] The "A" and "B" coefficients are related to amplitude and phase by the following formulas:

$$A = \text{amplitude} * \cos(\text{phase})$$

$$B = -\text{amplitude} * \sin(\text{phase})$$

[2] The "Demos Number" is represented in the Parameter Label (Word #2) as follows:

```
*****
*   SIGN OF   *                               *   SIGN OF   *
*   HARMONIC *           MKH*1000+(J+10)*10+B *   DEMOS     *
*   EXPANSION *                               *   NUMBER     *
*****
```

[3] There are 30 recognized main tidal lines. Their Demos numbers are:

SMKH	JB	SMKH	JB	(See page 1 for S M K H J B definitions)
-1020	02	-1020	11	
1001	-11	1120	11	
-1001	11	1101	11	
-1020	01	-1101	-11	
1120	01	1101	-11	
1120	02	-1101	11	
1101	01	-1120	01	
-1101	01	1220	21	
1101	02	1220	11	
-1101	02	1220	-11	
1101	00	1201	01	
1220	01	-1201	01	
1220	02	1201	02	
1001	-12	-1201	02	
-1001	12	1201	00	

Of these 30 main lines there are 18 distinct frequencies. The side bands associated with these 18 main line frequencies are:

Main Line 1: Ssa	-1020	02						
Side Bands:	1001	-22						
Main Line 2: Mm	1001	-11,	-1001	11				
Side Bands:	-1021	11,	-1011	11,	1011	-11,	1021	-11,
	-1020	-11,	-1010	-11,	1002	11,	1012	11
Main Line 3: Mf	-1020	01						
Side Bands:	-1021	21,	-1011	21,	1001	-21,	1011	-21,
	1021	-21,	-1010	01,	-1000	01,	1012	01
Main Line 4: O1	1120	01						
Side Bands:	-1112	01,	1100	01,	1110	01,	-1111	-21,
	1101	21,	1111	21,	1121	21		
Main Line 5: P1	1120	02						
Side Bands:	1101	22						
Main Line 6: K1	1101	01,	-1101	01,	1101	02,	-1101	02,
Side Bands:	-1121	01,	-1111	01,	1111	01,	1121	01
								1101 00
Main Line 7: M2	1220	01						
Side Bands:	1201	21,	1210	01,	1211	21,	1200	01,
	-1211	-21,	1221	21				-1212 01,
Main Line 8: S2	1220	02						
Side Bands:	1201	22						
Main Line 9: Sa	1001	-12,	-1001	12				
Side Bands:	-1020	-12						
Main Line 10: Mtm	-1020	11						
Side Bands:	1001	-31,	-1010	11,	1002	-11		
Main Line 11: Q1	1120	11						
Side Bands:	1100	11,	1110	11,	1101	31		
Main Line 12: M1	1101	11,	-1101	-11				
Side Bands:	1110	-11,	1120	-11,	-1111	-11,	1111	11,
								1121 11
Main Line 13: J1	1101	-11,	-1101	11				
Side Bands:	-1111	11,	1111	-11,	1121	-11,	-1120	-11,
								-1110 -11
Main Line 14: O01	-1120	01						
Side Bands:	1101	-21,	1111	-21,	-1110	01,	1102	01,
								1112 01
Main Line 15: 2N2	1220	21						
Side Bands:	1210	21						
Main Line 16: N2	1220	11						
Side Bands:	1210	11						
Main Line 17: L2	1220	-11						
Side Bands:	1210	-11,	-1211	-11,	1201	11,	1211	11,
								1221 11

Main Line 18: K2 1201 01, -1201 01, 1201 02, -1201 02, 1201 00
Side Bands: -1211 01, 1211 01, 1221 01

[4]

This document contains the complete list of GEODYN OTIDE cards. If a Doodson number does not appear on the printed tables, then GEODYN cannot model the tide associated with that Doodson number.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: The ocean tide model is not used.

OCEAN TIDE MODELING

Ocean tide modeling in GEODYN is accomplished using the OTIDES option. The following explanation will assist the user in invoking specific tides and describes in more detail the implementation of the "tidal families" within GEODYN. The ocean tidal constituents are divided into two categories: Those major tides which (a) do and those which (b) do not have significant sideband constituents. The sidebands are long period modulations within a narrow band of the main tide lines. For the 18 tide lines identified by GEODYN as having significant sidebands, under the assumption that the admittances can be treated as identical for near-by frequencies, GEODYN used linear admittances to provide for the sideband tides within these so-called "tidal families" if requested. When column 23 is set to 1 on the OTIDES card, every degree and order element specified for the mainline tide causes inclusion of the same harmonic for all of the corresponding sideband tide lines in both the surface height and force modeling calculations. However, if the tide line is not recognized by GEODYN as having significant sideband contributions, a 1 in column 23 will be ignored. Since the linear admittances are computed using the ratio of the Doodson coefficients of the sidebands with respect to the mainline, the Doodson coefficients shown in the following tables indicate the relative importance of the sideband terms within the total tidal family.

The following tables describe the ocean tidal constituents available within GEODYN. Tables 1, 1.1, 1.2, and 1.3 present tidal constituents which have no internal tables containing sideband terms. Therefore, even if the option flag in column 23 is set to 1, no sideband modeling will be invoked. Table 2. lists the most important tides commonly used in orbit modeling which fall within this category. Tables 3, 3.1, 3.2 and 3.3 present the 18 tidal families which can be invoked using the "family option" (column 23 set equal to 1 on the OTIDES card). Shown within these tables is the mainline tide, the default sidebands which are included, and the terms in the angular arguments defining the tide which modulate the mainline angular argument.

1. TIDES TREATED AS MAINLINE CONSTITUENTS:

NOTE: THESE TIDES HAVE NO PRE-DEFINED SIDEBAND CONSTITUENTS

1.1. LONG PERIOD BAND

DOODSONS NUMBER	EARTH PERIOD (D=DAY , H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT
058.5525	121.7532D	0.000007	1001-32
058.5545	121.7493D	0.004262	1020 12
059.5535	91.3127D	0.000173	1020 22
05X.5525	73.0505D	0.000006	1020 32
095.1455	6.8956D	-0.000003	1011 41
095.1555	6.8886D	0.000044	1001-41
095.1655	6.8817D	-0.000003	1011-41
095.3555	6.8594D	0.004014	1020 21
095.3655	6.8525D	0.001663	1010 21
095.3755	6.8456D	0.000156	1000 21
095.3855	6.8387D	-0.000003	1012-21
0X5.2555	5.4922D	0.000456	1020 31
0X5.2655	5.4877D	0.000189	1010 31
0X5.2755	5.4833D	0.000018	1000 31
0E5.1555	4.5794D	0.000047	1020 41
0E5.1655	4.5763D	0.000020	1010 41
0E5.1755	4.5732D	0.000002	1000 41

1.2 DIURNAL BAND

DOODSONS NUMBER	EARTH PERIOD (D=DAY , H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT
105.9455	1.2751D	0.000022	1110 41
105.9555	1.2749D	0.000114	1120 41
115.8355	1.2190D	-0.000006	1100 31
115.8455	1.2187D	0.000207	1110 31
115.8555	1.2185D	0.001099	1120 31
125.7355	1.1673D	-0.000056	1100 21
125.7455	1.1671D	0.001823	1110 21
125.7555	1.1669D	0.009669	1120 21
125.9555	1.1661D	-0.000016	1101 41
125.9655	1.1659D	-0.000003	1111 41
155.4355	1.0357D	0.000060	1100-11
155.4455	1.0355D	-0.001965	1110-11
155.4555	1.0354D	-0.010427	1120-11
155.6355	1.0350D	-0.000005	-1121-11
155.6455	1.0349D	0.000864	-1111-11
155.6555	1.0347D	-0.029805	1101 11
155.6655	1.0346D	-0.005907	1111 11
155.6755	1.0344D	0.000127	1121 11
160.5585	1.0111D	0.000014	1120 32
161.5575	1.0083D	0.000418	1120 22
162.5565	1.0055D	0.010266	1120 12
162.5585	1.0055D	-0.000003	1101 32
164.5545	1.0000D	-0.001467	1120-12
164.5565	2 4.0000H	-0.004214	1101 12
166.5545	2 3.8693H	-0.004214	1101-12
166.5565	2 3.8693H	0.000063	-1120-12
167.5535	2 3.8045H	-0.000106	1101-22

2Q1

π_1

S_1

ψ_1

167.5555	2	3.8045H	-0.007544	-1120	02	ϕ_1
167.5556	2	3.8045H	-0.000002	-1110	02	
168.5525	2	3.7400H	-0.000003	1101	-32	
168.5545	2	3.7400H	-0.000442	1120	12	
169.5535	2	3.6759H	-0.000018	-1120	22	
175.2555	2	3.1122H	0.000001	1120	-31	
175.4355	2	3.1050H	-0.000005	-1121	11	
175.4455	2	3.1017H	0.000864	-1111	11	
175.4555	2	3.0985H	-0.029805	1101	-11	J_1
175.4655	2	3.0952H	-0.005907	1111	-11	
175.4755	2	3.0919H	0.000127	1121	-11	
175.6555	2	3.0847H	0.000449	1120	-11	
175.6655	2	3.0815H	0.000288	-1110	-11	
175.6755	2	3.0782H	0.000060	1102	11	
175.6855	2	3.0749H	0.000004	1112	11	
195.2455	2	1.5931H	0.000006	-1111	31	
195.2555	2	1.5903H	-0.000198	1101	-31	
195.2655	2	1.5874H	-0.000039	1111	-31	
195.4555	2	1.5782H	-0.003125	-1120	11	
195.4655	2	1.5754H	-0.002000	-1110	11	
195.4755	2	1.5725H	-0.000420	1102	-11	
195.4855	2	1.5697H	-0.000028	1112	-11	
1X5.1555	2	0.9077H	-0.000016	1101	-41	
1X5.1655	2	0.9050H	-0.000003	1111	-41	
1X5.3555	2	0.8964H	-0.000417	-1120	21	
1X5.3655	2	0.8937H	-0.000267	-1110	21	
1X5.3755	2	0.8910H	-0.000056	1102	-21	
1X5.3855	2	0.8884H	-0.000004	1112	-21	
1E5.2555	2	0.2563H	-0.000047	-1120	31	
1E5.2655	2	0.2538H	-0.000030	-1110	31	
1E5.2755	2	0.2513H	-0.000006	1102	-31	
1F5.1555	19.6543H		-00.0000005	-1120	41	
1F5.1655	19.6519H		-00.0000003	-1110	41	

1.3 SEMI-DIURNAL BAND

DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT			
215.	9455	13.	4306H	- 0.000010	1210 41	
215.	9555	13.	4295H	0.000275	1220 41	
225.	8355	13.	1644H	0.000001	1200 31	
225.	8455	13.	1633H	- 0.000099	1210 31	
225.	8555	13.	1622H	0.002647	1220 31	
235.	7555	12.	9054H	0.023293	1220 21	$2N_2$
270.	5585	12.	0495H	0.000035	1220 32	
271.	5575	12.	0329H	0.001006	1220 22	
274.	5545	11.	9836H	- 0.003535	1220-12	R_2
274.	5565	11.	9836H	0.000914	1201 12	
276.	5545	11.	9509H	0.000914	1201-12	
276.	5565	11.	9509H	- 0.000007	- 1220-12	
277.	5535	11.	9346H	0.000023	1201-22	
277.	5555	11.	9346H	0.000783	- 1220 02	
278.	5545	11.	9184H	0.000046	- 1220 12	
279.	5535	11.	9022H	0.000002	- 1220 22	
285.	2555	11.	7581H	0.000003	1220-31	
285.	4455	11.	7554H	- 0.000121	- 1211 11	

285.	4555	11.	7545H	0.006465	1201-11	η_2
285.	4655	11.	7537H	0.002816	1211-11	
285.	4755	11.	7528H	0.000305	1221-11	
285.	6555	11.	7510H	- 0.000047	- 1220-11	
285.	6655	11.	7501H	- 0.000040	- 1210-11	
285.	6755	11.	7493H	- 0.000013	1202 11	
285.	6855	11.	7484H	- 0.000002	1212 11	
295.	3455	11.	5501H	- 0.000010	- 1211 21	
295.	3555	11.	5492H	0.000532	1201-21	
295.	3655	11.	5484H	0.000232	1211-21	
295.	3755	11.	5476H	0.000025	1221-21	
295.	5555	11.	5458H	0.001686	- 1220 01	
295.	5655	11.	5450H	0.001460	- 1210 01	
295.	5755	11.	5442H	0.000474	1202 01	
295.	5855	11.	5433H	0.000068	1212 01	
295.	5955	11.	5425H	0.000004	1222 01	
2X5.	2555	11.	3510H	0.000043	1201-31	
2X5.	2655	11.	3502H	0.000019	1211-31	
2X5.	2755	11.	3494H	0.000002	1221-31	
2X5.	4555	11.	3477H	0.000324	-1220 11	
2X5.	4655	11.	3469H	0.000281	-1210 11	
2X5.	4755	11.	3461H	0.000091	1202-11	
2X5.	4855	11.	3453H	0.000013	1212-11	
2E5.	1555	11.	1595H	0.000003	1201-41	
2E5.	1655	11.	1587H	0.000001	1211-41	
2E5.	3555	11.	1562H	0.000043	-1220 21	
2E5.	3655	11.	1555H	0.000037	-1210 21	
2E5.	3755	11.	1547H	0.000012	1202-21	
2E5.	3855	11.	1540H	0.000002	1212-21	
2F5.	2555	10.	9712H	0.000005	-1220 31	
2F5.	2655	10.	9704H	0.000004	-1210 31	
2F5.	2755	10.	9697H	0.000001	1202-31	

2. IMPORTANT TIDES TREATED AS MAINLINE CONSTITUENTS:

NOTE: THESE TIDES HAVE NO PRE-DEFINED SIDEBAND CONSTITUENTS

TIDE	DOODSONS NUMBER	EARTH PERIOD (Y=YEAR, H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA
18.6 YR LUN	055.5655	18.8712Y	-0.065520	1011 01	0	0	1	0
9.4 YR LUN	055.5755	9.4356Y	0.000640	1021 01	0	0	2	0
T2 SOLAR	272.5565	12.0164H	0.024729	1220 12	2	3	2	2

3. TIDES WHICH CAN BE MODELED AS FAMILIES:

NOTE: THESE TIDES HAVE PRE-DEFINED SIDEBAND CONSTITUENTS

3.1 LONG PERIOD BAND

	DOODSONS NUMBER	SA EARTH PERIOD (D=DAY, Y=YEAR)	FAMILY DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA
MAINLINE	056.5545	1.0139Y	0.011733	1001-12	0	1	0	0
SIDEBAND	056.5565	1.0138Y	-0.000609	-1020-12	2	1	2	0

		SSA	FAMILY			SUN			
					OMEG	MEAN	NODE	THETA	
MAINLINE	057.5555	182.6211D	0.072687	-1020 02	2	2	2	0	
SIDEBAND	057.5535	182.6298D	0.000295	1001-22	0	2	0	0	

		MM	FAMILY			MOON			
					OMEG	MEAN	NODE	THETA	
MAINLINE	065.4555	27.5546D	0.082984	1001-11	0	1	0	0	
SIDEBAND	065.4355	27.7797D	0.000053	-1021 11	0	1	2	0	
SIDEBAND	065.4455	27.6667D	-0.005390	-1011 11	0	1	1	0	
SIDEBAND	065.4655	27.4433D	-0.005390	1011-11	0	1	-1	0	
SIDEBAND	065.4755	27.3330D	0.000053	1021-11	0	1	-2	0	
SIDEBAND	065.6555	27.0925D	-0.004329	-1020-11	2	1	2	0	
SIDEBAND	065.6655	26.9850D	-0.001793	-1010-11	2	1	1	0	
SIDEBAND	065.6755	26.8783D	-0.000168	1002 11	2	1	0	0	
SIDEBAND	065.6855	26.7724D	0.000004	1012 11	2	1	-1	0	

		MF	FAMILY			MOON			
					OMEG	MEAN	NODE	THETA	
MAINLINE	075.5555	13.6608D	0.156567	-1020 01	2	2	2	0	
SIDEBAND	075.3355	13.8333D	0.000004	-1021 21	0	2	2	0	
SIDEBAND	075.3455	13.8053D	-0.000443	-1011 21	0	2	1	0	
SIDEBAND	075.3555	13.7773D	0.006827	1001-21	0	2	0	0	
SIDEBAND	075.3655	13.7494D	-0.000443	1011-21	0	2	-1	0	
SIDEBAND	075.3755	13.7217D	0.000004	1021-21	0	2	-2	0	
SIDEBAND	075.5655	13.6334D	0.064864	-1010 01	2	2	1	0	
SIDEBAND	075.5755	13.6061D	0.006086	-1000 01	2	2	0	0	
SIDEBAND	075.5855	13.5789D	-0.000131	1012 01	2	2	-1	0	

		MTM	FAMILY			MOON			
					OMEG	MEAN	NODE	THETA	
MAINLINE	085.4555	9.1329D	0.030112	-1020 11	2	3	2	0	
SIDEBAND	085.2555	9.1849D	0.000551	1001-31	0	3	0	0	
SIDEBAND	085.4655	9.1207D	0.012475	-1010 11	2	3	1	0	
SIDEBAND	085.4755	9.1085D	0.001171	1002-11	2	3	0	0	

3.2 DIURNAL BAND

		Q1	FAMILY			MOON			
	DOODSONS NUMBER	EARTH PERIOD (D=DAY, H=HOURL)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA	
MAINLINE	135.6555	1.1195D	0.072536	1120 11	-2	-3	-2	1	
SIDEBAND	135.6355	1.1199D	-0.000420	1100 11	-2	-3	0	1	
SIDEBAND	135.6455	1.1197D	0.013673	1110 11	-2	-3	-1	1	
SIDEBAND	135.8555	1.1187D	-0.000198	1101 31	0	-3	0	1	

		01	FAMILY			MOON			
					OMEG	MEAN	NODE	THETA	
MAINLINE	145.5555	1.0758D	0.377150	1120 01	-2	-2	-2	1	

SIDEBAND	145.5255	1.0763D	0.000021	-1112 01	-2	-2	1	1
SIDEBAND	145.5355	1.0761D	-0.002186	1100 01	-2	-2	0	1
SIDEBAND	145.5455	1.0760D	0.071090	1110 01	-2	-2	-1	1
SIDEBAND	145.7455	1.0753D	0.000071	-1111-21	0	-2	1	1
SIDEBAND	145.7555	1.0751D	-0.002452	1101 21	0	-2	0	1
SIDEBAND	145.7655	1.0749D	-0.000486	1111 21	0	-2	-1	1
SIDEBAND	145.7755	1.0748D	0.000010	1121 21	0	-2	-2	1

M1 FAMILY

MOON

					OMEG	MEAN	NODE	THETA
MAINLINE	155.6555	1.0347D	-0.029805	1101 11	0	-1	0	1
SIDEBAND	155.4455	1.0355D	-0.001965	1110-11	-2	-1	-1	1
SIDEBAND	155.4555	1.0354D	-0.010427	1120-11	-2	-1	-2	1
SIDEBAND	155.6455	1.0349D	0.000864	-1111-11	0	-1	1	1
SIDEBAND	155.6655	1.0346D	-0.005907	1111 11	0	-1	-1	1
SIDEBAND	155.6755	1.0344D	0.000127	1121 11	0	-1	-2	1

P1 FAMILY

SUN

					OMEG	MEAN	NODE	THETA
MAINLINE	163.5555	1.0027D	0.175093	1120 02	-2	-2	-2	1
SIDEBAND	163.5575	1.0027D	-0.000106	1101 22	0	-2	0	1

K1 FAMILY

SUN/MOON

					OMEG	MEAN	NODE	THETA
MAINLINE	165.5555	23.9345H	-0.530078	1101 01	0	0	0	1
SIDEBAND	165.5355	23.9415H	-0.000066	-1121 01	0	0	2	1
SIDEBAND	165.5455	23.9380H	0.010506	-1111 01	0	0	1	1
SIDEBAND	165.5655	23.9310H	-0.071809	1111 01	0	0	-1	1
SIDEBAND	165.5755	23.9274H	0.001541	1121 01	0	0	-2	1

J1 FAMILY

MOON

					OMEG	MEAN	NODE	THETA
MAINLINE	175.4555	23.0985H	-0.029805	1101-11	0	1	0	1
SIDEBAND	175.4455	23.1017H	0.000864	-1111 11	0	1	1	1
SIDEBAND	175.4655	23.0952H	-0.005907	1111-11	0	1	-1	1
SIDEBAND	175.4755	23.0919H	0.000127	1121-11	0	1	-2	1
SIDEBAND	175.6555	23.0847H	0.000449	-1120-11	2	1	2	1
SIDEBAND	175.6655	23.0815H	0.000288	-1110-11	2	1	1	1

001 FAMILY

MOON

					OMEG	MEAN	NODE	THETA
MAINLINE	185.5555	22.3061H	-0.016249	-1120 01	2	2	2	1
SIDEBAND	185.3555	22.3189H	-0.002452	1101-21	0	2	0	1
SIDEBAND	185.3655	22.3159H	-0.000486	1111-21	0	2	-1	1
SIDEBAND	185.5655	22.3030H	-0.010401	-1110 01	2	2	1	1
SIDEBAND	185.5755	22.3000H	-0.002186	1102 01	2	2	0	1
SIDEBAND	185.5855	22.2969H	-0.000144	1112 01	2	2	-1	1

3.3 SEMI-DIURNAL BAND

2N2 FAMILY

MOON

	DOODSONS NUMBER	EARTH PERIOD (H=HOUR)	DOODSONS COEFFIC.	GEODYN +MKH JB ARGUMENT	OMEG	MEAN	NODE	THETA
MAINLINE	235.7555	12.9054H	0.023293	1220 21	-2	-4	-2	2
SIDEBAND	235.7455	12.9064H	-0.000869	1210 21	-2	-4	-1	2
		N2 FAMILY					MOON	
MAINLINE	245.6555	12.6583H	0.174731	1220 11	-2	-3	-2	2
SIDEBAND	245.6455	12.6593H	-0.006518	1210 11	-2	-3	-1	2
		M2 FAMILY					MOON	
MAINLINE	255.5555	12.4206H	0.908507	1220 01	-2	-2	-2	2
SIDEBAND	255.5255	12.4234H	-0.000003	-1212 01	-2	-2	1	2
SIDEBAND	255.5355	12.4225H	0.000474	1200 01	-2	-2	0	2
SIDEBAND	255.5455	12.4215H	-0.033892	1210 01	-2	-2	-1	2
SIDEBAND	255.7455	12.4176H	-0.000010	-1211-21	0	-2	1	2
SIDEBAND	255.7555	12.4166H	0.000532	1201 21	0	-2	0	2
SIDEBAND	255.7655	12.4157H	0.000232	1211 21	0	-2	-1	2
SIDEBAND	255.7755	12.4147H	0.000025	1221 21	0	-2	-2	2
		L2 FAMILY					MOON	
MAINLINE	265.4555	12.1916H	-0.025118	1220-11	-2	-1	-2	2
SIDEBAND	265.4455	12.1925H	0.000937	1210-11	-2	-1	-1	2
SIDEBAND	265.6455	12.1887H	-0.000121	-1211-11	0	-1	1	2
SIDEBAND	265.6555	12.1878H	0.006465	1201 11	0	-1	0	2
SIDEBAND	265.6655	12.1869H	0.002816	1211 11	0	-1	-1	2
SIDEBAND	265.6755	12.1860H	0.000305	1221 11	0	-1	-2	2
		S2 FAMILY					SUN	
MAINLINE	273.5555	12.0000H	0.421776	1220 02	-2	-2	-2	2
SIDEBAND	273.5575	12.0000H	0.000023	1201 22	0	-2	0	2
		K2 FAMILY					SUN/MOON	
MAINLINE	275.5555	11.9672H	0.114980	1201 01	0	0	0	2
SIDEBAND	275.5455	11.9681H	-0.001475	-1211 01	0	0	1	2
SIDEBAND	275.5655	11.9664H	0.034235	1211 01	0	0	-1	2
SIDEBAND	275.5755	11.9655H	0.003713	1221 01	0	0	-2	2

DOODSON OCEAN TIDE MODEL

```

-----1-----2-----3-----4-----5-----6-----7-----8
OTIDES
-----0-----0-----0-----0-----0-----0-----0-----0-----0
COLUMNS FORMAT      DESCRIPTION                                DEFAULT VALUE & UNITS

```

1-6 A6 OTIDES - Requests application and/or

7-8	I2	Indicates sign term of the expansion: +1 = prograde tide -1 = retrograde tide		
9	I1	Forcing degree in tide operating potential (2 or 3). The order is the first integer in the Doodson number given in columns 18-24.		
10	I1	Integer number [0,...,3] gives phase increment after $x\{\pi/2\}$. Useful when all tides use cosine factors with positive amplitudes.		
11-12	I2	Response degree of A,B coefficients.		
13-14	I2	Response order of A,B coefficients.		
15	I1	Parameter type index =0 Ocean tide coefficient =1 Atmospheric Tide coefficient		
16-17	I2	Integer Flag: =0 no sidelines =1 turn n sidelines with input tidal constituent. =2 turn n sidelines with input tidal group.		
18-24	I7	Doodson Number (six positive integers)		
25-44	D20.8	"A" coefficient.	0.	M
45-59	D15.3	"B" coefficient.	0.	M
60-72	D13.1	Sigma "A".	0.	M
73-80	D8.2	Sigma "B".	0.	M

2.3.56 OTMOD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OTMOD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Introduces the application/estimation of ocean tide model which employs Proudman functions evaluated at several points located on a uniform grid on the globe. The tidal height at a given location is evaluated by interpolation and it represents the tidal effect measured from the mean sea surface.	

NOTE [1]: This card must be followed by a number of OTCOEF cards which represent the total number of Proudman functions.

IF CARD OMITTED: The above described tide model will not be applied.

2.3.57 PARFIL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PARFIL      7375                                         20000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	Requests output of measurement partial derivative file(s) on last inner iteration of each data reduction arc during first global iteration.	
-----	----	---	--

7	I1	Indicates whether each arc should open a new logical unit for output or continue writing to the same unit as the previous arc.	0
---	----	--	---

- 0 - Concatenate all arcs providing header information between each arc.
- 1 - CLOSE currently open output file at end of each arc and increment output unit number for start of each new arc.
- 2 - ENDFILE currently open output file at end of each arc. (applies only to IBM type operating environment for GEODYN-IIE)

11-12	I2	Indicates logical unit number (NU1) of first segment of file. Maximum segment size is specified in columns 73-80. NOTE: 90 .LE. NU1 .LE. 99	90
-------	----	--	----

If segment size is exceeded, the currently open logical unit will be CLOSED, the unit number will be incremented by one and output will continue.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

11-12 cont.		If column 7 contains a one, then the currently open logical unit will be CLOSED at the end of each arc, the unit number will be incremented by one and output will continue for the next arc.	
-------------	--	---	--

If column 7 contains a two, then the currently open logical unit will be ENDFILED at the end of each arc, the unit number will remain the same, and output will continue for the next arc.

13-14	I2	Maximum unit number (NU2) that will be opened	Same as cols.
-------	----	---	---------------

for output of this partial derivative file. 11-12
NOTE: NU1 .LE. NU2 .LE. 99

25-44	D20.8	Partial derivative file number to uniquely identify the file.	E-Matrix Number or 0. if no EMAT
73-80	F8.1	Number of blocks (of 512 64-bit words) of disk space requested for each segment of the measurement partial derivative file.	20000.

A good estimate for the total disk space required for the entire measurement partial derivative file may be obtained by multiplying the number of weighted observations by the number of adjusted parameters and dividing by 512.

If outputting to tape, specification of a very large number here will prevent incrementing of unit number unless specified by column 7.

IF CARD OMITTED: No measurement partial derivative file will be generated.

2.3.58 PLANET

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PLANET      300 20 20                3.986004359D+14 6378144.11    298.255
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLANET - Modifies the 3rd body gravitational potential and/or introduces new constants.	
7	I1	Gravity model initialization indicator. = 0 Gravitational coefficients are initialized from gravity model file. They may be changed by GCOEF, GCOEFC or GCOEFS cards. > 0 Gravitational coefficients are set to zero except those which appear on GCOEF, GCOEFC, or GCOEFS cards which follow this card.	0
8	I1	Gravity model print control switch. = 0 Print two portions of model: 1. lowest degree & order; and 2. highest degree & order. = 1 Print entire gravity model. : : N/A = 2 Print only model checksum. :	0
9	I1	Indicator of the contents of the remainder of this card: = 0 Columns 25-80 contain the values for GMb, Ab, 1/fp, 1/fe. = 1 Columns 25-80 contain the (see NOTE[3]) sigmas for GMb, Ab, 1/fp, 1/fe.	0
10	I1	> 0 Indicates that this body should be excluded from force model calculations	
11-14	I4	Indicates body for which gravity perturbation is to be modified.	no default

Body numbers are as follows:

```

0100 Mercury
0200 Venus
0300 Earth
0301 Earth's Moon
0400 Mars

```

0500 Jupiter
 0600 Saturn
 0700 Uranus
 0800 Neptune
 0900 Pluto
 9999 Sun

15-17	I3	Maximum degree of coefficient to be used in the gravitational model. Minimum =3. Default depends on gravity model file on unit 12.(See NOTE[1] and NOTE[2]).	3
18-20	I3	Maximum order of coefficient to be used in the gravitational model. Minimum =2. Default depends on gravity model file on unit 12. (See NOTE[2]).	2
		The presence of degree and order in the two integer fields above automatically defines this planet as the center of integration	
21-22	I2	Precession model indicator for Mars orbiters. =0 The old precession model is used =1 The new precession nutation model is used	old model
23	I1	Index to planetary constant option =0 1989 planetary constants for Venus =1 1991 planetary constants for Venus =2 2000 planetary constants for Venus =4 2000 IAU constants for Mars =5 The Mars orientation model Konopliv-Yoder will be used =6 2011 Margot Model for Mercury =7 IAU2000 for Mercury	1989 Planetary constants for Venus 1991 Mars IAU const. 2011 Margot Model
24	I1	Index to lunar orientation parameter option =0 values from the report /IAU/IAG/COSPAR =1 values from the 403 Planetary Ephemeris	COSPAR report
25-44	D20.8	Universal gravitational constant times the mass of the Body (GMb), or sigma value if column 9 =1,	See table below for third body perturb. (M**3/S**2)
45-59	D15.3	Semi-major axis of the Body (Ab), or sigma value if column 9 =1,	See table below for third body perturb. (M)
60-72	D13.1	Inverse of the Body's polar flattening (1/fp), or sigma value if column 9 =1,	See table below for third body perturb.
73-80	D8.3	Inverse of the Body's equatorial flattening	0.

(1/fe) or sigma value if column 9 =1.

TABLE OF DEFAULT BODY CONSTANTS

Body	GMb	Ab	fp	fe
Mercury	2.203208000D+14			
Venus	3.248602000D+14	6.168810000D+06	0.0	0.0
Earth's Moon	4.902778000D+12	1.738090000D+06	0.378000000D-03	0.0
Mars	4.282845000D+13	3.380422000D+06	0.105000000D-01	0.0
Jupiter	1.267077000D+17	7.137155400D+07	0.667000000D-01	0.0
Saturn	3.792653500D+16	6.041128000D+07	0.105000000D	00 0.0
Uranus	5.780158500D+15			
Neptune	6.871307800D+15			
Pluto				
Sun	1.327125000D+20	6.960000000D+08	0.500000000D-04	0.0

NOTE [1]:

The default values for degree and order of the gravity field and the Body constants are overridden by the values from the gravity model file on unit 12.

EARTH and PLANET are actually the same keyword card except that EARTH automatically supplies the planet number (0300).

NOTE [2]:

All interplanetary runs need PLANET cards for Saturn and Jupiter for the relativity modelling.

NOTE [3]:

Only one set of (GMb,Ab,1/fp,1/fe) parameters can be adjusted. This set of parameters must be for the central body.

UNITS: M =Meters ; S =Seconds

IF CARD OMITTED:

The complete gravitational field contained in the default gravity model file on unit 12 will be used for the central body and the sun and moon will be used as third body perturbers. If the central body is other than Earth, then Earth will replace that body as a third body perturbation.

2.3.59 PLATE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PLATE
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	PLATE - Requests application of tectonic plate motion. A new tectonic plate can be added or values for the default model can be overridden.	
7-8	I2	Plate number.	0
		--2 Plate values from model NUVEL1 used.	
		--1 Plate values from default model AM0-2 used.	
		= 0 Plate values from default model AM1-2 used.	
		=1-14 Plate values in default model will be replaced by values from columns 25-71 of this card.	
		>11 New plate number and values from columns 25-72 will be added to the model for this run.	
25-44	D20.8	Angular velocity of plate in degrees per million years.	0. DEG/MEGA-YRS
45-59	D15.3	Latitude of axis of rotation of plate in degrees north.	0. DEG
60-72	D13.1	Longitude of axis of rotation of plate in degrees east.	0. DEG

NOTES:

[1] The user should assign plate numbers on the station coordinate cards. (STAPOS subgroup) The plate numbers on the station coordinate correspond to the following plates.

Plate number	Plate
1	Africa
2	Antarctica
3	Arabia
4	Caribbean

5	Cocos
6	Eurasia
7	Australia
8	Nazca
9	North America
10	Pacific
11	South America
12	India
13	Juan de Fuca
14	Philippine

[2] See option card PLATIM to request station position printouts on selected dates.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: PLATE motion will not be applied.

2.3.60 PLATIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PLATIM800101          810101.          820101.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	PLATIM - Sets the reference date for the station coordinates for plate motion and requests printing of station coordinates at specified dates. This option may only be used in conjunction with the PLATE option.	
-----	----	---	--

7 - 8	I2	YY	Year, month and day of reference date for station coordinates.	80
9 -10	I2	MM		01
11-12	I2	DD		01

25-44	D20.8	First date for printing station positions. (YYMMDD.)	0.
-------	-------	--	----

45-59	D15.3	Next date for printing station positions. (YYMMDD.)	0.
-------	-------	---	----

60-72	D13.1	Next date for printing station positions. (YYMMDD.)	0.
-------	-------	---	----

73-80	D8.2	Next date for printing station positions. (YYMMDD.)	0.
-------	------	---	----

NOTES:

Any number of PLATIM cards may be included in your deck, but only one reference date may be used. If more than one reference date is found the last one will be used.

See option card PLATE to request application of the tectonic plate model. Inclusion of a PLATIM card without a PLATE card will NOT invoke the plate model.

IF CARD OMITTED: If PLATE motion is applied, the reference date will be 800101 and no additional station coordinate printouts will be made.

2.3.61 PLMOON

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PLMOON      401                      720000.0000000                      10000.00
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
COLUMNS  FORMAT          DESCRIPTION                                DEFAULT VALUE & UNITS

```

1-6 A6 PLMOON - Requests application and or adjustment of planetary moon GM. This option can be selected for up to 5 moons. The moons must be orbiting the central body of the run. This option is not to be used for the following central bodies: Earth, Earth's moon, and the Sun. Since, the moons selected by this option are not contained in the JPL planetary ephemeris, the user must supply a Keplerian ephemeris for each of the moons. The format and file names for the ephemeris are described below.

12-14 I3 Indicates the moon for which this perturbation should be applied. NO DEFAULTS

Body numbers are in the following format: COM
 C - is central body of this run:

- 1 = Mercury
- 2 = Venus
- 4 = Mars
- 5 = Jupiter
- 6 = Saturn
- 7 = Uranus
- 8 = Neptune
- 9 = Pluto

M - number of this moon (up to 5 moons can be specified)

Example: Mars moon numbers could be:

- Phobos - 401
- Deimos - 402

25-44 D20.8 Universal gravitational constant times the mass of the moon M**3/s**2

Default values exist for the following bodies:

- Phobos - 401 - 720000.0 M**3/s**2
- Deimos - 402 - 120000.0 M**3/s**2

60-72 D13.1 Sigma value for above moon GM

MOON EPHEMERIS INFORMATION:

For each moon specified in a run, an ephemeris must be supplied to the GEODYN IIE portion of the program. The file names used in the IIE setup have the following construction:

MOON EPHEMERIS FILE NAME = MON###

where ### is the particular moon number specified on the PLMOON card.

Thus, for a typical Mars run with 2 PLMOON cards (one for PHOBOS - 401 and one for DEIMOS - 402) a moon ephemeris needs to be supplied for each moon. An example of the file names follows:

MON401 - IIE ephemeris file for Mars moon #1 (PHOBOS)
MON402 - IIE ephemeris file for Mars moon #2 (DEIMOS)

The moon ephemeris file has the following format:

HEADER RECORD -> F10.2 -> constant bias to be applied to mean anomaly values.
DATA RECORDS -> 1X, I6, I5, F10.6, F16.3, F15.11, F16.9, 3F17.9
WORD #1 -> I6 -> YYMMDD
WORD #2 -> I5 -> OHHMM
WORD #3 -> F10.6 -> SECONDS INCLUDING FRACTION
WORD #4 -> F16.3 -> SEMI-MAJOR AXIS (meters)
WORD #5 -> F15.11-> ECCENTRICITY
WORD #6 -> F16.9 -> INCLINATION (degrees)
WORD #7 -> F17.9 -> LONGITUDE OF THE ASCENDING NODE (degrees)
WORD #8 -> F17.9 -> ARGUMENT OF PERIGEE (degrees)
WORD #9 -> F17.9 -> MEAN ANOMALY (degrees)

IF CARD OMITTED: Planetary moon perturbations will not be applied.

2.3.62 PLNEPH

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLNEPH - Allows for correction to the ephemeris planet state vector by adjusting the orbital elements at an osculating epoch	
7-8	I2	Indicator of type of orbital elements 1 Keplerian [NOTE 2] 2 Brouwer-Clemence Set III	2
9-12	I4	Body identifier 0100 = Mercury 0200 = Venus 0300 = Earth 0301 = Earth's Moon 0400 = Mars 0500 = Jupiter 0600 = Saturn 0700 = Uranus 0800 = Neptune 0900 = Pluto 9999 = Sun 0001 <---- 0002 0003 0004 0005 for possible celestial bodies 0006 in the supplementary ephemeris 0007 0008 0009 0010 <----	none
13-14	I2	Element Indicator For each type of elements the following table indicates a number from 1 to 6	none
21-24	I4	Year of the osculating epoch:YYYY [NOTE 3]	the beginning time of the run
25-44	D20.8	MMDDHHMMSS.SS of the osculating epoch. [NOTE 3]	the beginning time of the run

45-59	D15.3	Element correction (for type and component in cols. 7-8 and 13-14) for the osculating epoch	0.0
60-72	D13.1	Sigma for the value in cols. 45-59	0.0
73-80	D8.2		

Note [1]: In order to adjust a particular element a non-zero sigma should be given for that element. Body ID is required on ALL PLNEPH cards.

Note [2]: Adjustment of Keplerian elements is not implemented at the present.

Note [3]: The user may specify a correction EPOCH later than the end of the arc but not earlier than the start time of the arc.

2.3.63 POLDYN

POLDYN : There have been additions to the POLDYN capability starting with version 1802. A POLDYN card used with a version earlier than 1802 works as before. However, the explanations have changed.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
POLDYN      880901      0.              0.              3.              3.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	<p>POLDYN - Used to set options and define parameters associated with two force model effects and one surface deformation effect. The two force model effects are:</p> <p>(1) variations in the C21 and S21 gravitational coefficients due to variations in the Earth's figure axis and (2) the ocean pole tide, The surface deformation effect is the solid Earth pole tide.</p>	
-----	----	---	--

These three effects all depend on the crust-fixed path of the Earth's spin axis and the figure axis of the Earth.

The instantaneous location of the spin axis is obtained from the polar motion series input on unit 2. The figure axis however has a complex motion of which ONLY the secular part is of interest in the computation of the ocean pole tide and solid Earth pole tide effects. The secular component of the path of the instantaneous spin axis is the same as the secular component of the path of the figure axis. These are now modeled as a line (linear path). The history is sketched in the next paragraph.

Note that in the past, the IERS provided a series of a "filtered" version of their C01 EOP series, and that was used to approximate the trajectory of the figure axis. After lengthy investigations and a dedicated workshop in July 2017, the IERS has adopted a conventional linear model to describe the secular trajectory of the figure axis. There are two IERS Conventions chapters that involve the new secular pole and products that use it: Ch. 6 (solid and ocean pole tides) and Ch. 7 where the secular pole is actually defined, and the site displacements due to various sources are computed. The final (online) versions of these two re-writes can be obtained by the public from:

Ch. 6 URL: http://iers-conventions.obspm.fr/2010/2010_update/chapter6/icc6.pdf

Ch. 7 URL: http://iers-conventions.obspm.fr/2010/2010_update/chapter7/icc7.pdf

It is very important to understand that for the computation of the rotational deformation (whether solid Earth or ocean pole tide), the relative coordinates {m1,m2} of the location of the instantaneous spin axis with respect to the location of the secular figure axis, MUST be obtained from the adopted linear model for the secular path of the figure axis and NOT from a filtered version of C01 as it was done in the past. This will ensure that products derived by different entities on the basis of space geodetic data from ANY technique, i.e. SLR, VLBI, GNSS or DORIS, will all be consistent. The old IERS "mean pole" is now called the "secular pole" and it is derived from a simple linear fit of the C01 series over the period 1900 to 2015. Under the new convention, the term "mean" is NOT allowed, since there is nothing that is the "mean" of anything in this realization. The functional form of the model is:

$$X_s(t) = X_s(t_0) + X_{s_dot} * (t - t_0) ; \text{ and}$$

$$Y_s(t) = Y_s(t_0) + Y_{s_dot} * (t - t_0)$$

where "t" is time in years of 365.25 days and $t_0 = 2000.0$ is the reference epoch for the new IERS secular pole model. The model adopted by the IERS can be realized as follows:

$$\begin{aligned} X_s(t_0) &= 55.00 \text{ [mas]} \\ X_{s_dot} &= 1.677 \text{ [mas/y]} \end{aligned}$$

and:

$$\begin{aligned} Y_s(t_0) &= 320.50 \text{ [mas]} \\ Y_{s_dot} &= 3.460 \text{ [mas/y]} \end{aligned}$$

Column 14 of the POLDYN card is devoted to defining the model used to approximate the figure axis. In addition to that, column 14 dictates how the C21 and S21 gravitational coefficients will be computed.

7	I1	If > 0, apply the ocean pole tide	0
8	I1	Only for versions 1802 and later This column allows the degree of the ocean pole tide model to be extended past 99 (see cols 9-10).	0
9-10	I2	The degree of the ocean pole tide model. The maximal degree is 60 for versions prior to 1802. For versions 1802 and later 360 is the max degree	0

Describe the model used for the secular pole path (its use strongly recommended that the model described below in columns 15-80 be used)

Also define how the C21 and S21 gravitational coefficients will be computed. It is HIGHLY recommended that the NOTES (further below) be read before selecting an option on this column. The terminology used here is ONLY explained in the NOTES. Also note that options 0, 1, 2 and 3 be avoided. They are here only to explain previous conventions and GEODYN setup decks that may have used these.

0 = A linear model is used for the secular path of polar motion. The linear model can be defined in columns 15-80. Only the "second path" contribution to C21 and S21 is computed. The second path contribution is made using GEODYN's original formulation for the second path. This option can be used with or without the presence of a GEOPOL card.

1 = The IERS2010 model is used for the secular path of polar motion. This model is cubic for times from 1976 to 2010, and linear after 2010. Only the "second path" contribution to C21 and S21 is computed. The second path contribution is made using GEODYN's original formulation for the second path. This option can be used with or without the presence of a GEOPOL card.

2 = The IERS2010 model is used for the secular path of polar motion. This model is cubic for times from 1976 to 2010, and linear after 2010. Both the "first path" and "second path" contribution to C21 and S21 are computed. The second path contribution is made using IERS2010 equation 6.22. This option should only be used when a GEOPOL card is also present.

3 = The IERS2010 model is used for the secular path of polar motion. This model is cubic for times from 1976 to 2010, and linear after 2010. Only the "second path" path contribution to C21 and S21 is computed. The second path contribution is made using IERS2010 equation 6.22. This option should only be used when a GEOPOL card is also present.

4 = Available only in versions 1802 and later. A linear model is used to describe the secular motion of the figure axis. The linear

model is defined in columns 15-80.
 Both the "first path" and "second path"
 contribution to C21 and S21 are computed.
 The second path contribution is made using
 IERS2010 equation 6.22. This option should
 only be used when a GEOPOL card is also present.

5 = Available only in versions 1802 and later.
 A linear model is used to describe the
 secular motion of the figure axis. The linear
 model is defined in columns 15-80.
 Only the "second path" path contribution
 to C21 and S21 is computed.
 The second path contribution is made using
 IERS2010 equation 6.22. This option should
 only be used when a GEOPOL card is also present.

15-20	I6	Reference epoch "t0"for the linear model of the secular pole in YYYYDD format.	Epoch time on EPOCH card
25-44	D20.8	Xs(t0) value corresponding to the secular pole coordinate at the epoch t0 specified in columns 15-20 (intercept of the linear model for Xs)	0. MAS
45-59	D15.3	Ys(t0) value corresponding to the secular pole coordinate at the epoch t0 specified in columns 15-20 (intercept of the linear model for Ys)	0. MAS
60-72	D12.8	Xs_dot drift rate for the secular pole model specified in columns 25-44 (slope of the the linear model for Xs)	0. MAS/Yr.
73-80	D8.3	Ys_dot drift rate for the secular pole model specified in columns 45-59.	0. MAS/Yr.

Notes:

Background Geophysics

The ellipsoidal shape of the Earth is caused by Earth rotation.
 As the rotation axis of the Earth wanders (polar motion), the figure
 axis of the Earth's ellipsoid changes location too. The wandering of
 the Earth's figure axis can not quite keep up with the rotation axis.
 All three effects covered by the POLDYN card are connected with this
 lagging of the figure axis. To compute where the figure axis is, it is
 necessary to have a model for the secular path of the Earth's rotation
 axis. That is because the instantaneous figure axis is about 2/3 of the
 distance from the actual rotation axis to the secular path of the
 the rotation axis (closer to the secular path pole). Note that the
 secular path of the rotation axis is the same as the secular path
 of the figure axis. So, for the three effects connected with the
 POLDYN card, the secular pole path model is compared to the location

of the actual pole (given by the polar motion series input on unit 2).

Models for the Secular Path of the Pole

GEODYN allows two secular path models: a linear model for the secular path and the IERS2010 model which is cubic for times from 1976 to 2010, and linear after 2010. Once the model for the secular path is set, then the ocean pole tide and the solid Earth tide deformation models are also set (other than the fact that the user must specify the degree to which the ocean pole tide will be modeled).

C21 and S21

The remainder of this note is devoted to an explanation of the third effect connected with the POLDYN card, the computation of the C21 and S21 gravitational coefficients. At this point it is worthwhile remembering that C21 and S21 values mainly reflect the separation between two axes: the instantaneous figure axis and the Earth fixed Z axis used to compute the gravity field (there are also some small deformation effects).

Connection Between C21, S21 and GEOPOL

The previous paragraph sets up the connection between the POLDYN card and the GEOPOL card. Most modern GEODYN setup decks include a GEOPOL card. If a GEOPOL card is not present, then the Z axis of the gravity field is the same as the Earth's rotation axis. In this case, the Z axis of the gravity field is not truly Earth fixed. In this case, however, the Z axis of the gravity field is not separated very much from the figure axis. If a GEOPOL card is present, then the Z axis of the gravity field is truly Earth fixed. It is the same Z axis as is used by stations. The separation between the gravity Z axis and the rotation axis is large. The figure axis is near the spin axis, so the separation is very roughly the size of polar motion.

Some of the options given on Col 14 of the POLDYN card are sensible only if a GEOPOL card is present in the deck. Each option on col 14 spells out whether GEOPOL is required or not.

Path 1 and Path 2 to the Figure Axis (from the Z axis of the gravity field)

It is clear that the choice of a model for the secular path of the rotation axis along with the choice of using a GEOPOL card are needed for determining the separation of the figure axis from the Z axis of the gravity field. It is important to keep in mind that the figure axis is about 2/3 of the distance from the actual rotation pole to the secular path pole. Also, C21 and S21 are very roughly (ignoring some deformation effects) given by:

$$\begin{aligned}C21 &= \text{SQRT}(3)*X*C20 - X*C22 + Y*S22 \\S21 &= -\text{SQRT}(3)*Y*C20 - Y*C22 - X*S22\end{aligned}$$

Where the gravitational coefficients are normalized and X and Y are angles in radians. X proceeds west (like X polar motion) from the Z axis of the gravity field to the figure axis and Y proceeds south (like Y polar motion) from the the Z axis of the gravity field.

Note that one can break the computation of C21 and S21 into multiple sub-paths that connect from the Z axis of the gravity field to the figure axis. Each path would have its own X and Y angle. It is only necessary that the sub-paths form a connected complete path.

There are two cases depending on the GEOPOL card (or the lack of one):

Case 1 (the most likely) GEOPOL option has been selected:

The path from the Z axis of the gravity field to the figure axis is broken into two paths:

Path (1): Gravity Z axis to secular path pole

then

Path (2): secular path pole to instantaneous figure axis

If the the contribution from the first path is computed analytically, it would be given by:

$$\begin{aligned}C21_part1 &= \text{SQRT}(3)*xp_sec*C20 - xp_sec*C22 + yp_sec*S22 \\S21_part1 &= -\text{SQRT}(3)*yp_sec*C20 - yp_sec*C22 - xp_sec*S22\end{aligned}$$

Depending on the setting in Col 14, this part1 contribution may be computed by GEODYN. If it is not computed by GEODYN, then it must be modeled and/or estimated using GCOEF and GRVTIM cards.

The contribution from the second path can be modeled using one of two methods depending on how Col 14 is set:

Method (1) for second path contribution is GEODYN's original formulation:

$$\begin{aligned}C21_part2 &= \text{SQRT}(3)*C20*Kf*(xp - xp_sec) \\S21_part2 &= -\text{SQRT}(3)*C20*Kf*(yp - yp_sec)\end{aligned}$$

where Kf is defined on the POLKF card and should be about 1/3 , The polar motion values are in radians.

Note that when GEODYN's original formulation for the contribution from the second path is chosen, the contribution from the first path is NOT computed. In this case the user MUST model and/or estimate C21_part1 and S21_part1 with a

combination of GCOEF and GRVTIM cards.

Method (2) for second path contribution is according to IERS2010 equation 6.22:

```
C21_part2 = -1.333E-9*(m1 + 0.0115*m2)
C21_part2 = -1.333E-9*(m2 - 0.0115*m1)
m1 = xp-xp_sec
m2 = -(yp-yp_sec)
```

Here the polar motion values are in seconds of arc.

Note that when the IERS2010 formulation for C21 and S21 is selected, C21_part1 and S21_part1 may be computed by GEODYN depending on Col 14.

The two ways of computing the second path contribution are roughly equivalent except that the IERS2010 approach uses Love numbers and takes into account deformation. The factor of 1.333E-9 has approximately the same factors built into it as GEODYN's original approach (plus a conversion from seconds of arc to radians).

Remember that both approaches for the second path contribution depend on the fact that the second path starts at the secular path pole and heads in the direction of the instantaneous rotation axis.

This is why the factor 1/3 is built into the second path contribution. If the full path went through the actual pole, the second path would start at the actual pole and head towards the secular path pole. The absolute value of the 1/3 factor would change to 2/3 and either the sign of the factor would flip or equivalently m1 would be xp_sec-xp and m2 would change to -(yp_sec-yp). Also the computation for the first path would depend on actual polar motion, not the secular path values. It probably makes more sense to use the secular path because the more delicate second path computation (which involves deformation) is smaller when one starts at the secular path, At any rate, this is way the IER2010 conventions have it.

Case 2 GEOPOL option has NOT been selected
(this is given only to interpret old setups):

Nowadays, this would be a rare case. If no GEOPOL card is present, then there is no first path (the overall path would start close to the figure axis) and no need for the C21_part1 and S21_part1 computations mentioned in Case 1 (GEOPOL).

As far as C21_part2 and S21_part2 go, the IERS210 formulation:

```

C21_part2 = -1.333E-9*(m1 + 0.0115*m2)
C21_part2 = -1.333E-9*(m2 - 0.0115*m1)
m1 = xp-xp_sec
m2 = -(yp-yp_sec)

```

can not be used without some modification. It has a factor of 1/3 built into it somewhere. This would need to be changed to -2/3 because the path from the gravity Z axis starts at the actual rotation pole. The modified version of this is NOT available in GEODYN.

The only sensible selection for C21 and S21 computation when there is no GEOPOL card is GEODYN's original formulation:

```

C21_part2 = SQRT(3)*C20*Kf*(xp - xp_sec)
S21_part2 = -SQRT(3)*C20*Kf*(yp - yp_sec)

```

where Kf is defined on the POLKF card and should be about -2/3 ,

Using GCOEF and GRVTIM cards When Col 14 Excludes the Part 1 Contribution

When GEODYN computes the part 1 contribution to C21 and S21 the following equation is used:

```

C21_part1 = SQRT(3)*xp_sec*C20 - xp_sec*C22 + yp_sec*S22
S21_part1 = -SQRT(3)*yp_sec*C20 - yp_sec*C22 - xp_sec*S22

```

To have GCOEF and GRVTIM cards mimic this the user will need to evaluate the above equations at the epoch of the GRVTIM cards to get the values used on the GCOEF cards for the C21 and S21 coefficients. The rates used on the GRVTIM cards will come from differentiating the secular path model for the pole and then evaluating:

```

C21_part1_dot = SQRT(3)*xp_sec_dot*C20 - xp_sec_dot*C22 + yp_sec_dot*S22
S21_part1_dot = -SQRT(3)*yp_sec_dot*C20 - yp_sec_dot*C22 - xp_sec_dot*S22

```

IF CARD OMITTED: Dynamic polar motion will not be applied.

2.3.64 POLE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
POLE  0                780903.                176.                421.                17.0842
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-5	A5	POLE - Modifies polar motion and/or A.1-UT1 values obtained from the BIH tables file on unit 2.		
7	I1	Indicator of whether X of the pole, Y of the pole or A.1-UT1 (or any combination of the 3) are to be replaced by the values on this card. Col 7 Values to be replaced = 0 Xp Yp A.1-Ut1 = 1 Xp = 2 Yp = 3 Xp Yp = 4 A.1-Ut1 = 5 Xp A.1-Ut1 = 6 Yp A.1-Ut1		
25-44	D20.8	Date of pole/A.1-UT1 value. (YYMMDD.HH) This must correspond exactly with the BIH date that is being overridden.	0.	
45-59	D15.3	Value of X of the pole.	0.	MAS
60-72	D13.1	Value of Y of the pole.	0.	MAS
73-80	D8.2	Value of A.1-UT1.	0.	S

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Values from tables file on UNIT 2 will be used.

2.3.65 POLEUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
POLEUT23          860104.          22.72530          0.1890          0.1639
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-6	A6	POLEUT - Used to modify and/or request adjustment of true pole coordinates and A.1-UT1 time differences. If the user choses option 4 on col.7, then modification and/or adjustment of EOP rates is introduced as well.	
7	I1	= 0 No parameter adjustment. > 0 Parameter adjustment requested. < 2 Third card not present in this group. = 2 Pole adjustment constrained along the great circle passing through the pole and defined by the longitude specified in columns 25-44 of the third card in this group = 3 Adjusted parameter a priori correlations provided on the third card in this group. = 4 Adjust EOP rates [NOTE 2]	0
8	I1	= 0 Pole and A.1-UT1 values are obtained from POLEUT card. = 1 Pole values are obtained from tables; A.1-UT1 obtained from POLEUT card. = 2 Pole values obtained from POLEUT card; A.1-UT1 obtained from tables. = 3 Pole and A.1-UT1 values obtained from tables.	0
25-44	D20.8	Date in form YYMMDD.FFF of pole and A.1-UT1 values[1] to which this card applies. This date is for the midpoint of the interval specified in columns 25-44 of card two.	No default.
45-59	D15.3	A.1-UT1 value [1].	See col. 8. (S)
60-72	D13.1	X of pole [1].	See col. 8. (SA)
73-80	D8.2	Y of pole [1].	See col. 8. (SA)

SECOND CARD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
                    5.0          0.01          0.1          0.1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-23	23X	Blanks must be present.		
24	I1	=1 the units for the below averaging interval is hours =0 the units for the below averaging interval is days	0	
25-44	D20.8	Averaging period[1] in the above units for pole and A.1-UT1 values. The date in columns 25-44 of the first card is for the midpoint of this interval	No default.	
45-59	D15.3	A priori standard deviation in A.1-UT1.	0.0	(S)
60-72	D13.1	A priori standard deviation in X of pole.	0.0	(SA)
73-80	D8.2	A priori standard deviation in Y of pole.	0.0	(SA)

THIRD CARD

1	2	3	4	5	6	7	8
		280.0		0.0		0.0	0.0
0	0	0	0	0	0	0	0

1-24	24X	Blanks must be present.		
25-44	D20.8	Longitude of great circle constraint for X and Y of pole.	See col. 7.	(DEG)
45-59	D15.3	A priori cross correlation between A.1-UT1 and X of pole.	0.0	Unitless
60-72	D13.1	A priori cross correlation between A.1-UT1 and Y of pole.	0.0	Unitless
73-80	D8.2	A priori cross correlation between X of pole and Y of pole.	0.0	Unitless

FOURTH CARD

1	2	3	4	5	6	7	8
				0.0		0.0	0.0
0	0	0	0	0	0	0	0

1-24	24X	Blanks must be present.		
45-59	D15.3	A priori standard deviation for X-pole rate		
60-72	D13.1	A priori standard deviation for Y-pole rate		
73-80	D8.2	A priori standard deviation for A.1-UT1 rate		

IF CARD OMITTED: DEFAULT VALUES GIVEN ABOVE ARE USED.

NOTE: [1] Values provided in columns 45-80 of first card are differenced with interpolated table values for specified date (cols. 25-44) and differences are applied as a discrete offset over entire averaging interval (second card cols. 25-44).

NOTE: [2] Normally (GEODYN default) the EOP at a given time t are computed in GEODYN from the table values using biquadratic interpolation. When option 4 on col. 7 is chosen then EOP rates are requested and the model changes. In this case to compute the EOP at a given time t , we use the linear model

$$P_t = P_T + \dot{P}_t (t-T)$$

where P_t is the value of the earth orientation parameter from the tables at time t and \dot{P}_t is the rate computed at t using the tables values $P_{(t-1)}$ and $P_{(t+1)}$

This model should be used with the 1-day pole tables.

UNITS: DEG-DEGREES; S-SECONDS; SA-SECONDS OF ARC

IF CARD OMITTED: DEFAULT VALUES GIVEN ABOVE ARE USED.

2.3.66 POLKF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
POLKF                                     -.66667
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	POLKF requests application and or adjustment of the Kf factor described in the POLDYN documentation (see Note(1)).	
25-44	D20.8	Kf factor. [NOTE 1,2]	-2./3.
45-59	D15.3	Standard deviation for Kf.	0.

NOTE [1]: This option is tightly connected to the GEOPOL and POLDYN options. The documentaion for the GEOPOL option should be read first, then the documentation for the POLDYN card should be read.

NOTE [2]: If a GEOPOL card is present, Kf must be > 0. If Kf < 0 is desired, use GEOPOL1. See GEOPOL card documentation.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 MAS=Milliarc seconds

IF CARD OMITTED: The default value of -2./3. will be used for the figure axis scale factor. Dynamic polar motion will not be applied unless the POLDYN option is selected.

2.3.67 POLTID

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
POLTID
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	<p>POLTID - Request application of pole tide on station positions. THIS REQUIRES THE DEFINITION OF A MODEL FOR THE MEAN PATH OF POLAR MOTION. This model must be specified on the POLDYN card. Unfortunately, versions prior to 1802 will proceed to compute an invalid POLTID correction without a POLDYN card.</p>	

IF CARD OMITTED: The pole tide correction will not be applied.

2.3.68 PRNTVU

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PRNTVU  222
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PRNTVU - Requests suppression of output of selected GEODYN-IIS and GEODYN-IIE printout items to unit 6.	
7-8	I2	Specifies either the number of lines per page to be output on unit 6. 6 - 61 lines per page. 8 - 81 lines per page. >20 - specific number of lines per page.	61
9-17	9I1	For columns 9-17 the following applies: Blank or zero - Default will apply 1 - .False. - GEODYN-IIS output suppressed. 2 - .True. - Requests GEODYN-IIS output.	
9	I1	Simple list of GEODYN-IIS setup.	2 - .TRUE.
10	I1	Interpretive list of GEODYN-IIS setup.	1 - .FALSE.
11	I1	Observation block selection report.	1 - .FALSE.
12	I1	Gravity model coefficients.	2 - .TRUE.
13	I1	Global parameter values and sigmas.	2 - .TRUE.
14	I1	Arc parameter values and sigmas.	2 - .TRUE.
15	I1	Sea surface topography.	1 - .FALSE.
16	I1	Ocean Tide Model.	2 - .TRUE.
17	I1	Reserved for GEODYN-IIS.	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
18-24	7I1	For columns 18-24 the following applies: Blank or zero - Default will apply 1 - .False. - GEODYN-IIE output suppressed. 2 - .True. - Requests GEODYN-IIE output.	
18	I1	Simple list of GEODYN-IIS setup.	2 - .TRUE.

19	I1	Values of estimated E-biases.	1 - .FALSE.
20	I1	E-matrix labels in Summary Page.	1 - .FALSE.
21	I1	Adjusted station baselines.	1 - .FALSE.
22	I1	Correlations for adjusted parameters.	2 - .TRUE.
23	I1	Shadow crossing.	1 - .FALSE.
24	I1	Reserved for GEODYN-IIE.	

IF CARD OMITTED: Defaults apply.

2.3.69 PUNCH

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PUNCH
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PUNCH - Requests punched output on unit 7 for complete setup deck or for adjusted parameters only.	
8	I1	Punched output control. = 0 Requests that complete setup deck be punched with all estimated parameters replaced by the adjusted values. = 1 Requests that only updated parameters be punched.	0
9	I1	Iteration control for punched output = 0 Requests that punching occur on last inner of each global iteration = 1 Requests that punching occur on all iterations	0

IF CARD OMITTED: No punched output will be generated.

2.3.70 RAYTID

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
RAYTID
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	RAYTID - Request application of the IERS convention Earth Tides and the Doodson Ocean Tide model	
-----	----	--	--

IF CARD OMITTED: The default tide models will be applied. See ETIDES and OTIDES options.

2.3.71 REFRAC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
REFRAC 1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-6	A6	REFRAC - Specifies the tropospheric model to be used for tropospheric corrections to the observations.	
8	I1	Model selection number = 0 Hopfield Model = 1 Marini Murray Model [NOTE 1] = 2 VLBI/GPS = 3 GPS Model using Niell mapping functions = 4 Marini Murray for laser data Model 03 for nonlaser data = 5 Mendez (Porto) model for laser data = 6 GPT is used to calculate pressure and temperature; Hopfield model is used to calculate the apriori hydrostatic zenith delay; GMF is the mapping function. = 7 Option 7 is the same as option 6 except that Saastamoinen model is used to calculate the apriori hydrostatic zenith delay. = 8 VMF1 [NOTE 3]	0
		[NOTE 2]	
9	I1	Correction Component Applied For all models 0-4 This correction pertains to the wet and dry correction carried on the 3rd and 4th word of the observation corrections record. These corrections will be added to the sum of observation corrections which later on in GEODYN will be subtracted from the residual. = 0 Wet and Dry = 1 Wet Only = 2 Dry Only	0
		(!NOTE!) For the time being (GEODYN version 0812) ONLY the index=0 is true to the description. As soon as the problem will be fixed, this comment will be removed.	
		*(For Mendez Model only)** =0 Use Mapping Function dependent on latitude, height and temperature =1 Use Mapping Function with no dependence on meteorological data	
10	I1	Scale Factor Adjustment For all models 0-7 = 0 K*(Wet + Dry)	0

```

          = 1 K*Wet Only

11      I1      Wet Component Mapping Function (Model 2 only)      0
          = 0 Chao
          = 1 CFA2.2

12      I1      Dry Component Mapping Function (Model 2 only)      0
          = 0 Chao
          = 1 CFA2.2

13      I1      SWITCH FOR PRINT OF TROP EBIAS AND ZENITH
          PATH DELAYS                                          0
          = 0 No print out
          = 1 Print zpds and trop EBIAS (UNIT 400)

15-17   I3      Measurement type

```

NOTES:

[1] The Marini Murray model is only available for laser range data. If the Marini Murray model is selected (column 8 =1) and data other than laser range is present, the Hopfield model will be used for all non laser range data and the Marini Murray model will be used for the laser range data.

[2] MODELS	NON-LASER	LASER
0	HOPFIELD	HOPFIELD
1	HOPFIELD	MARINI-MURRAY
2	VLBI/GPS	VLBI/GPS
3	GPS/NEIL	GPS/NEIL
4	GPS/NEIL	MARINI-MURRAY
5	HOPFIELD	MENDEZ
6	GMF/HOPFIELD	GMF/HOPFIELD
7	GMF/SAASTAMOINEN	GMF/SAASTAMOINEN
8	VMF1	VMF1

[3] VMF compressed data files may be found on xyz2 in the following directory:

/users/geodyn/SUPPORT/dat_FILES/dat_VMF/VMF_GRID_FILES

IF CARD OMITTED: Hopfield model will be used for non laser range data.

(!NOTE!) The default below is not accurate as of GEODYN 0812. When the default for laser data is fixed, we will remove this comment.

Marini Murray model will be used for laser range data.

2.3.72 REL300

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
REL300
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	REL300 - Requests that relativistic corrections be applied for earth orbiting satellites. This includes general relativistic light time corrections to the measurement model, general relativistic point mass accelerations, and the Lense-Thirring effect, and the relativistic coriolis force.	

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 MAS=Milliarc seconds

IF CARD OMITTED: Relativistic corrections will not be applied.

2.3.73 SATCUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SATCUT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SATCUT - Gives the user the ability to set an elevation cut off angle for satellite to satellite links in measurements. The cut off angle for satellite to satellite links is reckoned from the horizon of the lower satellite. The default value is 0	

2.3.74 SCBODY

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SCBODY
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SCBODY - Allows the user to overwrite values and request adjustment of physical parameters of a celestial body featured in the EPHEM2 global option. (Supplementary Planetary Ephemeris)	
7	I1	Gravity model initialization indicator. = 0 Gravitational coefficients are initialized from the gravity model file. The option to modify the coefficients using GCOEF, GCOEFC, and GCOEFS cards is not yet applicable. > 0 (See PLANET card) Not Available yet.	
8-10	I3	Celestial body sequence in the supplementary planetary sequence.	
11-17	I7	Celestial body ID.	
18-20	I3	Max degree of coefficient to be used in the gravitational model.	
21-23	I2	Max degree of coefficient to be used in the gravitational model.	
24	I1	Indicator of the contents of the real fields (col 25-80). = 0 Columns 25-80 contains the values of GM, A, 1/fp, 1/fe = 1 Columns 25-80 contains the sigmas of GM, A, 1/fp, 1/fe	
25-44	D20.8	Universal gravitational constant times the mass of the body (GM) or sigma value if column 7 = 1	
45-59	D15.3	Semi-major axis of the body (A) or sigma value if column 7 = 1	
60-72	D20.8	Inverse of the body's polar flattening (1/fp) or sigma value if column 7 = 1	
73-80	D20.8	Inverse of the body's equatorial flattening (1/fp) or sigma value if column 7 = 1	

IF CARD OMITTED: Values of planetary physical parameters
from the supplementary planetary ephemeris
will be used.

2.3.75 SHDEND

```
-----1-----2-----3-----4-----5-----6-----7-----8
SHDEND
-----0-----0-----0-----0-----0-----0-----0-----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SHDEND - Denotes the end of the GPSSHD group	

IF CARD OMITTED: Abnormal termination

2.3.76 SSCOEF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSCOEF2          2  1                                     1.0000000D-091.00D-09
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSCOEF - Modifies and/or requests the estimation of spherical harmonic coefficients in static sea surface topography model.	
7	I1	Normalization indicator [NOTE 1] = 1 values normalized C,S = 3 values unnormalized C,S [See NOTES]	1
15-17	I3	Degree of C and S coefficients (N index).	0
18-20	I3	Order of C and S coefficients (M index).	0
25-44	D20.8	A priori (or starting) value of C coefficient. [NOTE 2]	0.
45-59	D15.3	A priori (or starting) value of S coefficient. [NOTE 2]	0.
60-72	D13.1	Standard deviation of C coefficient. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation of S coefficient. No adjustment if this field is zero.	0.

NOTES:

- [1] The denormalization subprogram in GEODYN underflows at degree 49 and order 48.

The geopotential coefficient denormalization equation used is:

$$C_n^m = \bar{C}_n^m \times D_n^m$$

$$S_n^m = \bar{S}_n^m \times D_n^m$$

where

$$D_n^m = \sqrt{(4n+2) \frac{(n-m)!}{(n+m)!}} \text{ for } m > 0$$

$$D_n^m = \sqrt{2n+1} \text{ for } m = 0$$

and

C_n^m , S_n^m are un-normalized coefficients.

\bar{C}_n^m , \bar{S}_n^m are normalized coefficients.

The denormalization subprogram in GEODYN underflows at degree 49 order 48.

- [2] If the degree and order on the SSCOEf card must be less than or equal to the maximum degree and order as input on the SSTOP0 card.
- [3] If it is desired that the starting values of coefficients be different than the a priori values for those coefficients then the SSCOEf card should be used as follows:
 - o SSCOEf cards requesting the desired coefficient adjustments should be included in the setup deck. The a priori values will be indicated on these cards.
 - o For each coefficient pair for which the starting value is to be different than the a priori value, an additional SSCOEf card should be in the setup deck. This SSCOEf card will indicate the starting value and come later in the deck than the corresponding SSCOEf card requesting adjustment.

IF CARD OMITTED: Static Sea Surface Topography model will be null.

2.3.77 SSTCOF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTCOF
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTCOF - Provides the apriori values for the coefficients needed for sea surface topography height evaluation.	
25-44	D20.8	A priori value for coefficient.	
60-72	D13.1	Standard deviation for coefficient. No adjustment if this field is zero.	0.

NOTE [1]: A stream of SSTCOF cards should follow the SSTMOD card
(See SSTMOD Vol. 3).

IF CARD OMITTED: And SSTMOD has been requested the run will terminate abnormally.

2.3.78 SSTMOD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTMOD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	SSTMOD - Introduces the application/ estimation of a sea surface topography model which employs a number of functions evaluated at several points located on a uniform grid on the globe. The sea surface topography height at a given location is evaluated by interpolation and represents the height from the geoid to the mean sea surface. The user may input the grid file either in IIS or in IIE. For large grid files IIE input is recommended.		
7-8	I2	= 0 Function file input from IIE [2] = 1 Function file input from IIS [3]	0	27,28 21
9-10	I2	Input file number for the Proudman function SST coefficients. Recommended units are 45-49		
11-12	I2	Number of real variables on one record of the above input file. Each record should include all the coefficients that describe one function in the following order: constant term periodic terms -		
13-14	I2	Internal geodyn number that describes the function model 1 = constant term only 8 = periodic terms for one frequency 9 = periodic terms for two frequencies 10 = periodic terms for three frequencies		
15-17	I3	Index for printing a coefficient report on unit 6 of the GEODYN IIS output =0 No report will be printed =1 A coefficient report will be printed		
25-44	D20.8	Period for model 8 (sec)		
45-59	D15.3	Period for model 9 (sec)		
60-72	F13.1	Period for model 10 (sec)		

73-80 F8.1 Editing factor for boundary locations
editing. This must be a real number between
0.D0 and 1.D0.

NOTE [1]: This card must be followed by a number of SSTCOF cards which
represent the total number of functions evaluated per grid
point.

NOTE [2]: Files input from IIE:
Two files (units 27 and 28) must be brought into the directory
where GEODYN will execute. These files which are specific to the
machine on which they are used, represent the direct access
function file (27) and the matching grid file (28). See Vol. 5
Sect. 2.10 for a description of the files

NOTE [3]: File input from IIS: unit 21
See Vol. 5, Section 2.10 for description of the file.

IF CARD OMITTED: The above described Sea surface topography model will
not be applied.

2.3.79 SSTOPO

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTOPO
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTOPO - Defines the altimetric sea surface topography model maximum degree and order and the epoch time for the time dependent terms.	
8	I1	Sea surface topography model print control switch. = 1 Print entire model. = 2 Print only model checksum.	2
15-17	I3	Maximum degree of coefficient to be used in the spherical harmonic expansion of the sea surface topography model.	3
18-20	I3	Maximum order of coefficient to be used in the spherical harmonic expansion of the sea surface topography model.	2
25-44	D20.3	Epoch time in YYMMDDHHMMSS.SS for the time dependent sea surface topography linear rate and periodic terms.	

IF CARD OMITTED: Sea surface topography computations will not be performed.

2.3.80 SSTPRD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTPRD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTPRD - Modifies and/or requests the estimation of the periodic sine and cosine coefficients for the C or S spherical harmonic coefficients in sea surface topography model. Defines the periodic frequency.	
7	I1	Normalization indicator = 1 values normalized C,S = 3 values unnormalized C,S	1
8	I1	Coefficient type = 1 Coefficient of Cosine (C) = 2 Coefficient of Sine (S)	0
9	I1	Frequency/Period indicator (frequency=2*pi/period) = 1 Annual (365.2524 days) = 2 Semi-annual (182.6262 days) = 3 Seasonal (91.3131 days) = 4 Monthly (30.4377 days) = 5 To be defined in columns 10-14	1
10-12	I3	Integer number of days in period	0
13-14	I2	Fractional number of days in period	0
15-17	I3	Degree of C or S coefficients	0
18-20	I3	Order of C and S coefficients	0
25-44	D20.8	A priori value of the cosine coefficient (a)	0.
45-59	D15.3	A priori value of the sine coefficient (b)	0.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTPRD
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
60-72	D13.1	Standard deviation of the cosine coefficient. No adjustment if this fields is zero.	0.
73-80	D8.2	Standard deviation of the sine coefficient (b).	0.

No adjustment if this field is zero.

NOTE: Card must be used in conjunction with SSTOP0 card.
Card cannot be used in conjunction with SSCOEF card.

IF CARD OMITTED: Periodic terms not included in sea surface
topography computations.

2.3.81 SSTTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SSTTIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SSTTIM - Modifies and/or requests the estimation of the mean and secular spherical harmonic coefficients in sea surface topography model.	
7	I1	Normalization indicator = 1 values normalized C,S = 3 values unnormalized C,S	1
8	I1	Coefficient type = 1 Coefficient of Cosine (C) = 2 Coefficient of Sine (S)	0
15-17	I3	Degree of C or S coefficients	0
18-20	I3	Order of C and S coefficients.	0
25-44	D20.8	A priori (or starting) value of the mean Cbar or Sbar coefficient.	0.
45-59	D15.3	A priori (or starting) value of the Cdot or Sdot linear rate coefficients.	0.
60-72	D13.1	Standard deviation of the mean Cbar or Sbar coefficient. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation of the secular Cdot or Sdot coefficient. No adjustment if this field is zero.	0.

NOTE: Card must be used in conjunction with SSTOP0 card.
Card cannot be used in conjunction with SSCOEF card.

IF CARD OMITTED: Cbar, Sbar, Cdot, Sdot terms not included in sea surface topography computations.

2.3.82 STIERS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STIERS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STIERS - Request application of the IERS (DEHANT) model for solid earth tides	

IF CARD OMITTED: The default default simple model will be applied.

2.3.83 TERMVU

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TERMVU  222
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TERMVU - Requests output of selected IIE printout items to unit 9 where the linesize is 80 characters. For columns 9-18 the following applies: Blank or zero - default will apply 1 - .False. - means no output 2 - .True. - requests output	
9	I1	Requests output of GEODYN-IIS setup.	1 - .FALSE.
10	I1	Iteration control . = 1 Requests items selected by columns 11-15 be output on each iteration. = 2 Requests items selected by columns 11-15 be output on last inner iteration of each global iteration.	2 - .TRUE.
11	I1	Requests output of observation residuals.	1 - .FALSE.
12	I1	Requests output of station residual summary.	1 - .FALSE.
13	I1	Requests output of observation type residual summary.	2 - .TRUE.
14	I1	Requests output of E-BIAS adjustment.	1 - .FALSE.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15	I1	Requests output of arc parameter adjustments.	2 - .TRUE.
16	I1	Requests output of summary page.	2 - .TRUE.
17	I1	Requests output of global parameter adjustments.	2 - .TRUE.

18 I1 Requests output of arc global update. 2 - .TRUE.

IF CARD OMITTED: Default values will be used to control output to UNIT 9.

2.3.84 TIDES

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TIDES 20             .29
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-5 A5 TIDES - Modifies Earth tide perturbation and requests application of pole tide. The default model for standard tides is the one that applies K2 amplitude, K2 phase and K3 amplitude. An extended model may also be used in GEODYN. The description follows the default model K2 ampl/K2 phase/K3 phase

7-8 I2 Indicates which tidal coefficient to be modified. 0

VALUE	COEFFICIENT
20	K2 amplitude
21	K2 phase
30	K3 amplitude

A value of 0 sets all coefficients (K2 amplitude, K2 phase and K3 amplitude) to zero. [1]

9-10 I2 A value of 1 means that the pole tide is applied to correct the station positions. (stations only) 0

25-44 D20.8 Value of tidal parameter being modified. Defaults:

COEFFICIENT	VALUE	
K2 amplitude	0.29	0.29 [2]
K2 phase	2.5 degrees	2.5 [2] DEG
K3 amplitude	0.0	0.

45-59 D15.3 Standard deviation of tidal coefficient. If non-zero value is specified, tidal parameter will be adjusted. 0.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TIDES   2 0      2 00.30190      -0.00000      1.0      1.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

1-5 A5 TIDES - Description of the extended model

7-8 I2 Must be zero to assume the extended model.

11-12 I2 Forcing degree

13-14	I2	Forcing order	
21-22	I2	Receiving degree	
23-24	I2	Receiving order	
25-44	D20.8	"A" coefficient.	0.
45-59	D15.3	"B" coefficient.	0.
60-72	D13.1	Sigma "A". [NOTE 3]	0.
73-80	D8.2	Sigma "B". [NOTE 3]	0.

NOTE [1]: It is sufficient to turn on the pole tide in one card (even if more TIDES option cards are included in the setup).

NOTE [2]: These default values apply only to earth tracking stations. In case of other planetary stations the default values are zero.

NOTE [3]: Convention for adjusting standard tides:

1. If there is no sigma on any TIDES card, there will be no adjustment of the standard tides.
2. If there is a sigma in one of the TIDES cards, GEODYN applies that sigma to the parameter, and all the other parameters will be assigned a sigma= 1.D-20

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Default values given above are used, and pole tide will not be applied.

2.3.85 TOLS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOLS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOLS - Requests changes in integration tolerances.	
11-14	I3	Maximum degree of geopotential used in computing the variational equations.	12 Except = maximum degree of geopotential whenever E-matrix requested.

IF CARD OMITTED: Defaults apply.

2.3.86 TRPOUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TRPOUT      300
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	TRPOUT - Requests estimation of tropospheric biases. The estimated tropospheric biases will be added to the original observation, and the sum of the observation corrections.	
-----	----	---	--

The new osbserveration and sum of observations corrections will then be output on unit 20 on a GEODYN II binary data file. This option works only with the presence of the global option G2BOUT.

IF CARD OMITTED:

2.3.87 VLIGHT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
VLIGHT                                     299792500.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	VLIGHT - Modifies and/or requests adjustment of speed of light.		
25-44	D20.8	Current best value of speed of light.[NOTE 1] If = 0, value will default to a priori speed of light.	299792458.	M/S
45-59	D15.3	A priori value of speed of light. [NOTE 1]	299792458.	M/S
60-72	D13.6	Standard deviation of speed of light. If greater than zero speed light will be adjusted.	0.	M/S

NOTES:

[1] Speed of light values will be checked for reasonableness and will be ignored if different from default value by more than 1 part per million.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD IS OMITTED: Default value will be used.

2.3.88 VECOPT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
VECOPT  5  40 10                                7000000.0                                20000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	VECOPT - Vector optimization and core allocation control option.	
7	I1	Controls vector optimization for the chaining of partials and the formation of the normal matrix. =0 Optimizes over the number of observations >0 Optimizes over the number of estimated parameters. >1 Forms normal matrix by partitions.[3]	0 if no EMATRX card, 2 if EMATRX card in setup.
9-10	I2	Indicates number of scratch units available for storage of partials when normal matrix is formed by partitions. Limit of 20. First scratch unit will be 51. Subsequent scratch units will increment by one up to 70.	1
11-14	I4	Controls the maximum number of observations that will be used in one data block (minimum no. = 11 , maximum = 9999) [1,2].	1000 if no EMATRX card, 40 if EMATRX card in setup.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
15-17	I3	Number of integration steps over which interpolation may be simultaneously performed. Must be greater than or equal to integration order minus one. Increasing this number allows more observations per block [2]. This is of particular advantage when MBIAS, PBIAS or EBIAS options are invoked along with local pass editing (see EDIT card column 7).	Integration order minus one [2].

This options consumes considerably more memory and is therefore disadvantageous to large E-Matrix generation runs.

25-44	D20.8	Maximum amount of memory available for 2E job. For CRAY runs this would be the same amount of memory requested on your QSUB card. For Cyber runs 5100000 64 bit words is suggested.	7000000	64 bit words
73-80	F8.1	Number of blocks (of 512 64-bit words) of disk space requested for each normal matrix partitioned formation scratch file.	20000.	

A good estimate for the total disk space required for all of these scratch files may be obtained by multiplying the number of weighted observations plus twice the number of E-biases by the number of adjusted parameters and dividing by 512.

NOTES:

- [1] The Tracking Data Formatter program outputs a maximum of 9999 obs. per block. GEODYN-IIS may reduce the number of observations in a block but not increase it. By reducing the number of observations in a block, memory requirements are decreased. This may be required when a large number of parameters are estimated.
- [2] Values in columns 11-14 and 15-17 are automatically provided by NORMPT option.
- [3] Partitioning is automatically requested for E-matrix runs regardless of the value indicated in column 7.

IF CARD OMITTED: Default optimizations will be used.

2.3.89 XEPHEM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
XEPHEM 2   500                920324000000.                920325000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	XEPHEM - Indicates that an external ephemeris will be provided for use in the measurement model routines for determining the orbits. Note [1]	
7-8	I2	Number of satellite ephemerides provided on external ephemeris. The ID's for the satellites are included in the header record of the ephemeris file.	1
11-14	I4	Size of internal buffers used to hold the satellite ephemeris information. Note [2]	300
15-16	I2	Unit number for the file that contains the external ephemeris. This unit is read only in IIE. IIS does not verify that the file exists, nor does it verify that the file actually contains the number of satellites or time periods specified. IIE will terminate if the information is incorrect.	66
25-44	D20.8	Start time for the external ephemeris in the form: YYMMDDHHMMSS. Start time must be at least three time steps prior to the first observation point for the 10 point hermitian interpolation. NOTE [3]	
45-59	D15.3	End time for the external ephemeris in the form: YYMMDDHHMMSS. End time must be at least five time steps after the last observation for the 10 point hermitian interpolation. NOTE [3]	

Note [1]: The external ephemeris file contains a cartesian trajectory for some or all of the satellites in the run. All satellites in the run are still specified after the REFSYS card with each satellite requiring a SATPAR, an EPOCH and two ELEMS cards. A 10th order hermitian interpolator is used to interpolate the satellite trajectory to the epochs required for measurement modeling.

Note [2]: In most cases the coordinate system used for the trajectories on the external ephemeris file is the True of Date coordinate system associated with the central body with the origin at the center of mass of the central body. However starting with version 1507.12, the XEPHEM option can be used to input and replace the trajectory of the central body when the INTGCB capability is being used. When the XEPHEM option is being used in conjunction with the INTCB option, the trajectory coordinate system is in the

True of Reference coordinate system (usually J2000 Earth Equator and Equinox) with the origin at the center of mass of the sun.

Note [3]: When using the XEPHEM option the user should remember that although GEODYN is using the input ephemeris for measurement modeling, the trajectory and associated force model partials are still being computed and folded into the normal equations, To avoid a degraded least square solution, all force model parameters associated with a satellite on the external ephemeris should be tightly constrained.

Note [4]: IIE uses a double buffering scheme where each buffer is $(6 * \text{No. of satellites} * \text{Buffer size})$ 64 bit words. In general, the larger the buffer the more efficient the run.

Note [5]: To determine the start time for the external ephemeris note that the integrator evaluates the first point 5 integration steps before the listed epoch time. The external ephemeris start time must be at least 3 time steps prior to this point. So, if the integration step size is T_{step} , and the interval on the external ephemeris is T_{extint} , then the external ephemeris start time must be less than $T_{\text{start}} - 5 * T_{\text{step}} - 3 * T_{\text{extint}}$.
To determine the stop time for the external ephemeris note that the integrator may go 2 integration steps beyond the epoch stop time. The external ephemeris stop time must be at least 5 time steps after this point. So, if the integration step size is T_{step} , and the interval on the external ephemeris is T_{extint} , then the external ephemeris stop time must be greater than $T_{\text{stop}} + 2 * T_{\text{step}} + 5 * T_{\text{extint}}$.

IF CARD OMITTED: Satellite ephemeris is obtained from integration of orbit.

EXTERNAL EPHEMERIS

The external ephemeris file is a binary file consisting of a header record and any number of data records. The total number of data records is optional, but it must be sufficient to at least cover the data times in the GEODYN run (+3 steps before the first data point and 5 steps after the last data point for the 10 point hermitian interpolation). Following is a description of the header and data records.

HEADER RECORD. (Record Length, RECL = $6 * \text{nsat} + 1$)

Word(s)

1	- Number of satellite ephemerides in this file (nsat)
2	- Start time of ephemeris data in UTC yymmddhhmmss.
3	- Time interval between ephemeris points. (Step size)
4 -> nsat+3	- Satellite ID's of the satellites in this file in the order that the satellite ephemeris data is provided in the data records. (i.e. the first satellite ID must belong to the first set of six satellite elements in the data record)
nsat+4 -> RECL	- Set to zero. Not currently used.

DATA RECORDS. (Record Length, RECL = $6 + \text{nsat} + 1$)

The time between data records must correspond exactly to the time interval specified in word 3 of the header record. The satellite elements provided in each data record must be in the same order as the satellite ID's specified in the header record. The satellite elements provided must be true of data cartesian elements.

Word(s)	
1	- Time in seconds from start time specified in the header record. For the first data record this must be zero seconds.
2 -> 7	- Six satellite elements for satellite number 1
.	.
.	.
$6*(nsat-1)+2$ -> $6*nsat+1$	- Six satellite elements for satellite number nsat

2.3.90 YAWPOL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
YAWPOL 2   500                920324000000.                920325000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
		Introduces a group of option cards with Yaw polynomial information. This group may be used for GPS satellites in order to control the Yaw that GEODYN will compute. The end of the YAWPOL group is defined by the global card YPLEND.	
1-6	A6	YAWPOL - Following the blank YAWPOL card, the Yaw polynomial information cards, have the following format:	
1-7	I7	Satellite ID. NOTE [1]	
10-22	F13.1	ET start time.	SEC. from 2430000.5
24-36	F13.1	ET stop time.	SEC. from 2430000.5
39-49	F11.6	a0 of the quadratic polynomial	degrees
52-62	F11.6	a1 of the quadratic polynomial	degrees
65-76	F11.6	a2 of the quadratic polynomial	degrees
79	A1	It is important that column 79 be filled with the letters S, P or N. These are just comments but it helps GEODYN IIS realize that the card is a YAW polynomial card. NOTE [2]	
80	A1	1 - first half of maneuver 2 - second half of maneuver N - noon	

Note [1]: All polynomials should be grouped by satellite ID and time order.

Note [2]: Input to columns 79-80 are interpreted as follows:
 S1 = first half of shadow maneuver
 S2 = second half of shadow maneuver
 P1 = first post shadow maneuver (not always present)
 P2 = second post shadow maneuver (usually present)
 NN = Noon maneuver (only present for very low beta angles)

IF CARD OMITTED:

2.3.91 YAWRAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
YAWRAT 2   500                920324000000.          920325000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	YAWRAT - Provide the maximum yaw rates, and yaw rate rates for each satellite in the GPSSHD group	
8-24	I7	Satellite ID.	
25-34	D20.5	Yaw rate value	deg/sec
24-36	F13.1	Yaw rate rate value	deg/sec ²

IF CARD OMITTED:

2.3.92 YPLEND

```

-----1-----2-----3-----4-----5-----6-----7-----8
YAWPOL 2   500           920324000000.       920325000000.
-----0-----0-----0-----0-----0-----0-----0-----0-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	YPLEND - Denotes the end of the YAWPOL group.	

IF CARD OMITTED: Abnormal termination.

2.3.93 POSITION CARD GROUP

2.3.93.1 STATION COORDINATE SUBGROUP

2.3.93.1.1 STAPOS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STAPOS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STAPOS - Introduces station position sub-group cards. The station position sub-group contains also optional station linear velocity information.	
7	I1	<p>Coordinate system for adjustment of stations and indicator that all stations are to be adjusted except those explicitly excluded using the FIXED subgroup card.</p> <p>= 0 Indicates no adjustment, or adjustment of individual stations will be indicated explicitly by use of ADJUSTED cards.</p> <p>> 0 Indicates that all stations for which tracking data exists will be adjusted unless explicitly overridden by use of a FIXED card. (Columns 25-72 must be a non zero)</p> <p>Coordinate system for adjustment:</p> <p>= 1 Geodetic - Phi, Lambda, Height</p> <p>= 2 Cartesian - X, Y, Z</p> <p>= 3 Cylindrical - S.A.D, Lambda, Z</p> <p>= 4 Spherical - Phi, Lambda, R</p>	0
8	I1	<p>Station geodetic file indicator. (Default is for geodetics file to be read prior to reading station coordinates following this STAPOS card)</p> <p>= 0 Indicates stations will be read from the station geodetic file on unit 16.</p> <p>> 0 Indicates that no stations from the station geodetics file are to be used.</p>	0
9	I1	> 0 Value in columns 73-80 overrides ELCUTOFF in Station Geodetics File and sets new default until overridden with ELCUTOFF following this card.	
11-14	I4	Maximum number of configurations which data is available in this run. [NOTE 1]	50
25-44	D20.8	Sigma for first station component	0.

		as indicated by value in column 7. (must be a non zero if col 7>0)	
45-59	D15.3	Sigma for second station component as indicated by value in column 7. (must be a non zero if col 7>0)	0.
60-72	D13.1	Sigma for third station component as indicated by value in column 7. (must be a non zero if col 7>0)	0.
73-80	D8.2	Elevation cutoff override of Station Geodetics File (see column 9).	

NOTES:

[1] A configuration in GEODYN II is defined as a unique combination of station-satellite-measurement type.

The valid STAPOS subgroup cards are listed below

ADJUSTED - Turns on station adjustment
CORREL - Station correlations
CONSTADJ - Start of constrained stations
CONSTEND - End of constrained stations
FIXED - Turns off station adjustment
GEODETTIC - Defines station geodetic information
EXTRAGEO - Specifies planetary shape parameters
ELCUTOFF - Sets station elevation cutoff angle
INSTRMNT - Sets station antenna and operating frequency information
STATION COORDINATE CARDS - Station positions
STAVEL - Station velocities
TIMVEL - Reference time for station velocities
SIGVEL - Sigmas for adjusted station velocities
STATL2 - Station earth tide L2
STATH2 - Station earth tide H2
ENDSTA - End of STAPOS subgroup

The format of all cards in the subgroup is as follows:

A8,2I1,I2,I8,3D15.6,I5,10

There are two categories of stations:

1. Those adjusted (i.e., those which follow an ADJUSTED card).
2. Those not adjusted (i.e., those which follow a FIXED card).
Within the set of stations which are adjusted there are those which are constrained to move together. A set of stations constrained to move as a set can be defined as that set which is adjusted and which follows a CONSTADJ card and precedes either a CONSTEND card or a FIXED card or an ENDGLB card or the next CONSTADJ card.

The conditions stated on an ADJUSTED card or a FIXED card are imposed until another ADJUSTED or FIXED card is encountered or an ENDSTA card is encountered.

The conditions stated on a CORREL card apply only to adjusted stations and are imposed until another CORREL card is encountered. (Default correlations are zero).

The conditions stated on an ELCUTOFF card are imposed until another ELCUTOFF card is encountered. (Default - ELCUTOFF is zero degrees.)

The conditions stated on an INSTRMNT card are imposed until another INSTRMNT card is encountered.

The conditions stated on a GEODETIC card or an EXTRAGEO card are imposed until another GEODETIC or EXTRAGEO card is encountered.

Station Location cards follow the appropriate cards of other types necessary to specify the conditions that are to apply to those station locations.

Station Location cards without values in the location data fields imply that the location data is to be obtained from the Station Geodetics file but that the other conditions indicated by the preceding STAPOS Subgroup cards apply.

The STAPOS card can indicate the adjustment of all tracking stations not explicitly excluded by the FIXED card. This includes stations obtained from the Station Geodetics file if this file has not been specifically excluded. If the adjustment of all stations has been requested using the STAPOS card, then the ADJUSTED card may still be used to specify the conditions of adjustment of particular subgroups of station coordinates. Unless specified otherwise (using GEODETIC or EXTRAGEO) all stations are considered to be located on the earth (see Keyword Option Card EARTH).

Station velocity cards (STAVEL) should follow immediately the station location cards.

It is required that the station velocity group has the following sequence:

STATION POSITION CARD
STAVEL
TIMVEL
SIGVEL

If no velocity cards are present, GEODYN will apply zero velocities to the stations, therefore extra velocity parameters will appear in the GEODYN parameter summary printout.

Considering the station position and station velocity combinations, GEODYN will handle:

- a. Fixed positions/ fixed velocities
- b. Adjusted positions/ fixed velocities
- c. Fixed positions/ adjusted velocities
- d. Adjusted positions/ adjusted velocities

No correlations are provided for station velocities.

Extra attention should be given at a setup with constraint stations. The station velocity cards in this case should follow immediately the master station and not the constrained station (station with data).

Cards like ADJUSTED and FIXED do not affect station velocities. Only the presence of SIGVEL controls the adjustment of station velocities.

The STATL2 (or STATH2) cards should follow the station velocity group cards or if there are no velocity cards this card must follow the station coordinate cards, for example:

```
STATION POSITION CARD
(STAVEL)
(TIMVEL)
(SIGVEL)
STATL2
STATH2
```

STATL2 and STATH2 cards are independent of each other. The user can apply or solve for L2 or H2 or both per station. If the STATL2 (or STATH2) card is not present for an individual station the solid earth tide corrections for this station will either use the value from the L2LOVE card (or H2LOVE) if they are present or the default GEODYN value if they are not present.

2.3.93.1.2 ADJUSTED

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ADJUSTED2          10.          10.          10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-8	A8	ADJUSTED - Requests adjustment of all stations following this card up to a FIXED or ENDSTA card.		
9	I1	Coordinate system for adjustment of station.	0	
		= 0 or 1 Phi,Lambda,Height		
		= 2 X,Y,Z		
		= 3 S.A.D.,Lambda,Z		
		= 4 Phi,Lambda,R		
21-35	D15.6	Sigma Phi or Sigma X or Sigma S.A.D.	0.	S or M
36-50	D15.6	Sigma Lambda or Sigma Y	0.	S or M
51-65	D15.6	Sigma Height or Sigma Z or Sigma R	0.	M

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Stations will not be adjusted unless adjustment of all stations requested by inclusion of non-zero sigmas on STAPOS card.

2.3.93.1.3 CONSTADJ

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CONSTADJ
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	Adjusted stations which follow this card are constrained together.	
		CONSTADJ is negated by CONSTEND, FIXED, next CONSTADJ or ENDSTA.	
		An ADJUSTED card must precede the CONSTADJ card.	

IF CARD OMITTED: Stations will not be constrained.

2.3.93.1.4 CONSTEND

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CONSTEND
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	CONSTEND - Turns of constrained stations. Negates CONSTADJ card.	

IF CARD OMITTED: If a previous CONSTADJ card exists, then all stations after CONSTADJ will be constrained. If no CONSTADJ card exists, this card is ignored.

2.3.93.1.5 CORREL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CORREL          .831          .917          .983
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	CORREL - Provides for correlations between station coordinate components. Uses the same coordinate system as specified on STAPOS or last ADJUSTED card.	
21-35	D15.6	Correlation between components 1 and 2.	0.
36-50	D15.6	Correlation between components 1 and 3.	0.
51-65	D15.6	Correlation between components 2 and 3.	0.

IF CARD OMITTED: No correlations between the station components exist.

2.3.93.1.6 ELCUTOFF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ELCUTOFF                10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-8	A8	ELCUTOFF - Specifies elevation angle below which data will automatically be edited.		
21-35	D15.6	Elevation cutoff angle.	0.	DEG

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Elevation cutoff of zero degrees is used.

2.3.93.1.7 EXTRAGEO

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EXTRAGEO          0300      6378145.0  298.255
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-8	A8	EXTRAGEO - Specifies planetary shape parameters for stations which follow.		
17-20	I4	Planetary body number:	0	
		Mercury	0100	
		Venus	0200	
		Earth	0300	
		Earth's Moon	0301	
		Mars	0400	
		Jupiter	0500	
		Saturn	0600	
		Uranus	0700	
		Neptune	0800	
		Pluto	0900	
		Sun	9999	
21-35	D15.6	Semi-major axis for planet.	6378138.	M
36-50	D15.6	Inverse of polar flattening of the planet.	298.255	
51-65	D15.6	Inverse of equatorial flattening of the planet.	0.	

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Default values for earth apply.

2.3.93.1.8 FIXED

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FIXED
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	<p>FIXED - Used to indicate that for the stations that follow this card there will be no adjustment. This card is used to negate adjustment requests by either the STAPOS or ADJUSTED cards.</p> <p>To negate the FIXED card another ADJUSTED card may be used.</p>	

IF CARD IS OMITTED: No negation of adjustment will occur.

2.3.93.1.9 GEODETIC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GEODETIC          6378145.0          298.255
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-8	A8	GEODETIC - Specifies Earth ellipsoid parameters for stations which follow.		
21-35	D15.6	Earth semi-major axis in meters. [NOTE 1]	0.	M
36-50	D15.6	Inverse of the flattening (1/f) of the earth. [NOTE 1]	0.	

NOTES:

[1] Defaults will be obtained in the following order:

- Default values built into GEODYN IIS
- Values obtained from Gravity Model File
- Values obtained from EARTH card
- Values from GEODETIC card

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Default values from gravity file on UNIT 12 or from an earth option card will apply.

2.3.93.1.10 INSTRMNT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
INSTRMNT 3           1.0           0.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-8 A8 INSTRMNT - Specifies tracking instrument parameters.

9-10 I2 Antena number (If ANTPHC option has been invoked) 0
 GEODYN will use the antenna number which have been provided on unit 22.

 otherwise

Antenna mount type. (If ANTPHC option has NOT been invoked) 3

- =1 X-Y East-West
- =2 X-Y North- South
- =3 Azimuth-Elevation
- =4 Hour Angle-Declination
- =5 Richmond VLBI Antenna Mount
- =6 Displacement applied to station height
- =7 Station height read from unit 23 [NOTE 2]
- =8 Pressure changes read from unit 23 [NOTE 3]

13-16 I4 Laser Tracking Station Detector Type 1

MCP Stations:

- =1 Wuhan
- =2 Wettzell
Tokyo
- =3 MOBLAS-5 (Yarragadee)
HOLLAS (Haleakala, HI)
TLRS-4
- =4 MOBLAS-4 (Monument Peak, CA)
MOBLAS-8 (Quincy, CA)
TLRS-3
MLRS (FT. Davis, TX)
- =5 MOBLAS-7 (Greenbelt, MD)
- =6 TLRS-1
- =7 TLRS-2
- =8 Bar Giyyora
- =9 Orroral
MTLRS-2

PMT Stations:

- =10 Herstmonceux
- =11 Zimmerwald
Borowiec, Poland
- =12 Grasse
- =13 Shanghai

San Fernando, Spain
 =14 MTLRS-1
 =15 Helwan
 =16 Beijing
 =17 Chang Chun
 Katsively, Ukraine
 Riga, Latvia
 =18 Postsdam
 Dunaovcy, Ukraine
 Maidanak, Uzbekistan
 Evpatoria, Ukraine
 Komsomolsk, Russia
 Balkash, Russia
 Simeiz, Ukraine
 =19 Santiago, Cuba
 Metsahovi, Finland

SPAD Stations:

=20 Herstmonceux
 Graz
 Simosato
 MTLRS-1
 FTLRS

Matera Station:

=21 Matera

21-35	D15.6	Antenna axis displacement in meters.	0.	M
36-50	D15.6	Nominal received wavelength in microns. (0. indicates nominal wavelength will be used from observation file as supplied by the Tracking Data Formatter Program.)	0.	M*1.0D-6
51-65	D15.6	Turn around factor (TRF). (TRF=Wavelength trans./wavelength rec.)	1.	

NOTES:

[1] Inclusion of an INSTRMNT card which is blank except for columns 1-8 negates any previous INSTRMNT card and reverts back to the station complement defaults.

[2] A "7" in column 10 requests reading the station height offsets from unit 23. The following quantities are read:

Col			
1-6	IYMD	I6	- year, month, day (YYMMDD)
7-10	IHM	I4	- hour, minute (HHMM)
11-20	SEC	F10.1	- seconds
21-22			- not used
23-30	NSTA	I8	- station number
36-59	AOFF	D24.16	- height offset

If the file connected to unit 23 is not present or is empty, no station height offsets are applied. Otherwise, the station height offset is chosen as the value on the record whose time is less than or equal to the current time. A time before the start of the table takes the value of the first offset for that station; a time after the end of the table takes the last value in the table.

- [3] A "8" in column 10 requests reading the station pressure values from unit 23. The following quantities are read:

Col			
1-6	IYMD	I6	- year, month, day (YYMMDD)
7-10	IHM	I4	- hour, minute (HHMM)
11-20	SEC	F10.1	- seconds
21-22			- not used
23-30	NSTA	I8	- station number
36-59	pmean	D24.16	- pressure offset (mbar)
60-83	scale		- pressure scale factor

The reading of unit 23 and the assignment of values is done as for option 7. (See NOTE [2] above)

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD IS OMITTED: No instrument correction will be applied.

2.3.93.1.11 STATH2

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STATH2
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STATH2 - Requests application or estimation of solid earth tide coefficient of the second kind for this station only	
13-20	I8	Station number	
21-35	D15.6	A priori value of the coefficient	value from H2LOVE
36-50	D15.6	Sigma of the coefficient. If this field is zero the coefficient will not be estimated.	

NOTE: A STATH2 card must follow the station velocity card group, or if there are no velocity cards this card must follow the station coordinate card, if solid earth tide of the second kind correction, other than the one specified on the H2LOVE card is to be applied.

IF CARD OMITTED: Earth tide for the preceeding station will be applied using the coefficient from the H2LOVE card. If H2LOVE card is not present GEODYN will use the default value.

2.3.93.1.12 STATL2

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STATL2
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	STATL2 - Requests application or estimation of solid earth tide coefficient of the third kind for this station only	
13-20	I8	Station number	
21-35	D15.6	A priori value of the coefficient	value from L2LOVE
36-50	D15.6	Sigma of the coefficient. If this field is zero the coefficient will not be estimated.	

NOTE: A STATL2 card must follow the station velocity card group, or if there are no velocity cards this card must follow the station coordinate card, if solid earth tide of the third kind correction, other than the one specified on the L2LOVE card is to be applied.

IF CARD OMITTED: Earth tide for the preceeding station will be applied using the coefficient from the L2LOVE card. If L2LOVE card is not present GEODYN will use the default value.

2.3.93.1.13 STATION COORDINATE CARDS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STALAS      000070631130719.3758    -4831370.1542    3994089.0480
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	Station name.	no default
9	I1	Coordinate system indicator:	0
		= 0 GEODYN will determine if input is geodetic or cartesian.	
		= 1 Geodetic - Phi,Lambda,Height	
		= 2 Cartesian - X,Y,Z	
		= 3 Cylindrical - S.A.D,Lambda,Z	
		= 4 Spherical - Phi,Lambda,R	N / A
10	I1	Net Constraints Index	
		=0 : No participation	
		=1 : The station participates in net translation	
		=2 : The station participates in net rotation	
		=3 : The station participates in both	
11-12	I2	< 99 is Plate number. = 99 apply thermal deformation for antenna	0
13-20	I8	Station number.	0
21-35	D15.6	First coordinate: (+ or -)DDMMSS.SSS (+ or -)XXXXXXXX.XXX meters	0.
36-50	D15.6	Second coordinate: DDDMMSS.SSS (+ or -)XXXXXXXX.XXX meters	0.
51-65	D15.6	Third coordinate: (+ or -) XXXXXXXX.XXX meters	0.
67-70	I4	Site number only for stations involved in ocean loading (same as in columns 13-20)	0
71-80	A10	Available for comments.	

IF CARD OMITTED: Stations coordinates will be obtained from geodetic file on UNIT 16.

2.3.93.1.14 STAVEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STAVEL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	STAVEL: Introduces station velocities in a 3-D Cartesian coordinate system.		
13-20	I8	Station number		
21-35	D15.6	First component of velocity	0	M/S
36-50	D15.6	Second component of velocity	0	M/S
51-65	D15.6	Third component of velocity	0	M/S

NOTE : A STAVEL card must follow the equivalent station coordinate card if velocities other than zero are to be applied.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz; YR=Years

IF CARD OMITTED: Station velocities for the preceding stations are assumed to be zero.

2.3.93.1.15 TIMVEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TIMVEL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TIMVEL: Introduces a reference time for the station velocities.	
13-20	I8	Station number	
21-35	D15.6	Reference time in YYYYMMDD.	EPOCH START TIME

NOTE : A TIMVEL card corresponding to a certain station should follow its station coordinate and STAVEL card.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz;

IF CARD OMITTED: And station velocities have been already introduced by the STAVEL card, EPOCH start time is considered to be reference time.

2.3.93.1.16 SIGVEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIGVEL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS	
1-6	A6	SIGVEL: Requests adjustment of the velocities for the preceeding station.		
13-20	I8	Station number		
21-35	D15.6	Sigma for the first velocity component	0	M/S
36-50	D15.6	Sigma for the second velocity component	0	M/S
51-65	D15.6	Sigma for the third velocity component	0	M/S

NOTE : A SIGVEL card must follow the equivalent STAVEL and TIMVEL card if velocity adjustment for the preceeding station is requested.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second
H =Hertz ; MH =Mega-Hertz; YR=years

IF CARD OMITTED: Velocities will be applied on the preceeding station but no velocity adjustment will take place.

2.3.93.1.17 ENDSTA

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDSTA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION
1-8	A8	ENDSTA - Ends STAPOS Subgroup. This card is required if a STAPOS card is present.

IF CARD OMITTED: Run will terminate if a STAPOS card is present and no
ENDSTA card is included

2.3.93.2 QUASAR COORDINATE SUBGROUP

2.3.93.2.1 QUAPOS

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
QUAPOS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	QUAPOS - Introduces quasar position sub-group cards.	

IF CARD OMITTED: VLBI data processing will abnormally terminate.

2.3.93.2.2 QUASAR COORDINATE CARD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
0016+731    4000                01945.786329    732730.01803                0.015  0.020
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-8	A8	Quasar name	
9-16	I8	Quasar ID	
20	I1	Net Constraints Index	=0 : No participation =1 : The quasar participates in net rotation
25-44	D20.8	Quasar right ascension	HHMMSS.SSSSSS
45-59	D15.3	Quasar declination	+/- DDMSS.SSSS
60-72	D13.1	Quasar right ascension sigma	seconds
73-80	D8.2	Quasar declination sigma	arc seconds

IF CARD OMITTED: VLBI data processing will abnormally terminate

2.3.93.2.3 ENDQUA

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDQUA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDQUA - Denotes the end of Quasar coordinate subgroup	

IF CARD OMITTED: VLBI data processing will abnormally terminate.

2.3.94 GLOBAL SET TERMINATOR

2.3.94.1 ENDGLB

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDGLB
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	ENDGLB - Indicates the end of the global set option cards. This card is MANDATORY in all runs.		
7-8	I2	Convergence criteria for the global iterations in percent. [NOTE 1]	02	%
9	I1	Minimum number of global iterations.	1	
10	I1	Maximum number of global iterations	1	

NOTES:

[1] Global convergence is defined as follows:

$ABS(RMS P - RMS C) / RMS C * 100$.LE. Convergence Criteria

Where:

RMS P = RMS previous global iteration
 RMS C = RMS current global iteration
 .LE. = Less than or equal

On the first global iteration the value for the previous RMS is defaulted to 1000.

IF CARD OMITTED: Run will abnormally terminate.

2.4 ARC SET MANDATORY CARDS

2.4.1 ARC SET MANDATORY OVERVIEW

The ARC mandatory section includes three lines for the user to provide appropriate comments about the ARC, a REFSYS line to establish the inertial coordinate system that will be used for satellite orbit integration, a SATPAR line to define the satellite ID and cross sectional area and mass, an EPOCH line to define the epoch time for the satellite elements, and an ELEMS1 and ELEMS2 line to define the satellite elements.

The first eight lines of the ARC Set for each arc must be in the specific order shown below:

```
Arc title 1
Arc title 2
Arc title 3
REFSYS
SATPAR      --
EPOCH      | These four lines are repeated for
ELEMS1     | each satellite in the arc
ELEMS2     --
```

If more than one satellite is used in an arc than the last four lines are repeated (SATPAR, EPOCH, ELEMS1 ELEMS2) for each satellite.

2.4.2 TITLE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
USER SPECIFIED JOB DESCRIPTION - CARD 1
USER SPECIFIED JOB DESCRIPTION - CARD 2
USER SPECIFIED JOB DESCRIPTION - CARD 3
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-80	10A8	User may specify on these three cards, information description of the arc. These cards may also remain blank, but must always be present.	

IF CARDS OMITTED: Run will abnormally terminate.

2.4.3 REFSYS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
REFSYS 2          830901000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	REFSYS - Specifies the coordinate system of integration and the number of arc iterations.	
7-8	I2	Maximum number of arc iterations during the first global iteration.	1
9	I1	Minimum number of arc iterations during the first global iteration.	1
10	I1	Maximum number of arc iterations during global iterations after the first.	1
11	I1	Coordinate reference system 0 True of reference date and time 1 Mean of J2000 [1]	0
21-26	I6	Year,month,day of reference date (YYMMDD).	0
27-30	I4	Hour,minute of reference time (HHMM).	0
31-40	D10.8	Seconds of reference time (SS.SSSSSSS).	0.

NOTE:

[1] The DE200 Ephemeris is needed when the J2000 reference system is selected. No reference date is needed in cols. 21-40 if J2000 is selected.

IF CARD OMITTED: Run will abnormally terminate.

2.4.4 SATPAR

1	2	3	4	5	6	7	8
SATPAR	76039010.28274			411.000			
0	0	0	0	0	0	0	0
COLUMNS	FORMAT	DESCRIPTION				DEFAULT VALUE & UNITS	
1-6	A6	SATPAR - Specifies spacecraft identification number (Satellite ID), cross sectional area and mass. Also specifies maximum degree of gravitational coefficients to be considered significant for this spacecraft.					
7	I1	0 - Obtain average S/C cross sectional area and S/C mass from columns 25-59 of this card. 1 - Obtain same from S/C parameters file.				0	
8	I1	0 - No tables of S/C cross section or solar radiation to be obtained from S/C parameter file. 1 - Only drag cross section tables used from S/C parameter file. :N/A 2 - Only solar radiation tables used from S/C parameters file. 3 - Both drag cross section and solar radiation tables used from S/C parameters file.				0	
9	I1	Twelve parameter state combination identifier. If this index is present there must be one more SATPAR card in the unit 5 setup to form the pair. For the first satellite the index must be 1 and for the second 2. For the satellites forming a pair with these indices on col. 9, the following ELEMS1 and ELEMS2 cards contain 6 (six) each of the twelve state vector combination parameters. The first SATPAR with the index 1 is followed by ELEMS cards featuring the mid-point parameters, and the second SATPAR is followed by ELEMS cards featuring baseline parameters (Ref. NOTE [2]). Any following VARCOV cards for these two satellites feature the sigmas of the 12 state combination parameters.					
10-11	I2	Spacecraft attitude control algorithm 0 - Cannonball(no attitude control) 2 - TOPEX/Poseidon 3 - SPOT-2 4 - GPS				0	

- 5 - ERS-1
- 6 - Mars Observer Mapping Phase
- 7 - Mars Observer Cruise Phase
- 8 - TDRSS
- 9 - Magnetically stabilized S/C
- 10 - GFO
- 11 - TRMM
- 12 - EUVE
- 13 - ICESAT
- 14 - ENVISAT
- 15 - CRYOSAT-2
- 16 - Leading GRAIL satellite
- 17 - Trailing GRAIL satellite
- 18 - HY2A
- 19 - SARAL

12	I1	Requests external attitude for this satellite:	0	
		0 - No external attitude		
		9 - External attitude (See Volume 5 for a description of the external attitude file)		
13	I1	Local gravity application switch:	0	
		0 - Consider gravity anomaly, surface: density and geoid height local gravity terms to be significant for this spacecraft.		N/A
		1 - Consider local gravity terms to be insignificant for this spacecraft.		
14	I1	Requests external thermal acceleration for this satellite:	0	
		0 - No external thermal acceleration		
		1 - External thermal acceleration (See Volume 5 for a description of the external acceleration file)		
15-17	I3	Maximum degree of gravitational coefficients to be considered significant for this S/C.		Max. of Model
18-24	I7	Satellite ID (satellite ID is required).	0	
25-44	D20.8	S/C cross sectional area.		See col. 7 M**2
45-59	D15.3	S/C mass.		See col. 7 Kg

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTES:
 [1] If more than one satellite is used in an arc than the four lines SATPAR, EPOCH, ELEMS1 ELEMS2 - are repeated for each satellite.

SATPAR --
 EPOCH | These four lines are repeated for
 ELEMS1 | each satellite in the arc

ELEMS2

--

- [2] A full description for the baseline representation of the initial epoch state parameters may be found in the following reference:
"Short-arc analysis of intersatellite tracking data in a gravity mapping mission", D.D.Rowlands, R.D.Ray, D.S.Chinn, F.G.Lemoine, Journal of Geodesy (2002)76:307-316

IF CARD OMITTED: Run will abnormally terminate

2.4.5 EPOCH

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EPOCH          830901          830901          830903
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EPOCH - Specifies epoch time for satellite elements ,optional start time for orbit integration,and mandatory stop time for the run. The stop time is used by GEODYN to determine ephemeris and flux data requirements.	
21-26	I6	Year, month and day of epoch (YYMMDD).	0
27-30	I4	Hours and minutes of epoch (HHMM).	0
31-40	D10.8	Seconds of epoch (SS.SSSSSSS).	0.
41-46	I6	YYMMDD of start. : Default is epoch time.	cols. 21-26
47-50	I4	HHMM of start. : If specified as other	cols. 27-30
51-60	D10.8	Seconds of start.: than epoch, orbit will : be integrated to this : time and epoch reset : to this time before any : measurement processing.	cols. 31-40
61-66	I6	YYMMDD of stop. : A STOP TIME IS	0
67-70	I4	HHMM of stop. : MANDATORY	0
71-80	D10.8	Seconds of stop. : FOR ALL ARCS	0.

NOTE: All times specified on the ORBTUVU and the ORBFIL card must fall between the start time and the stop time specified on the EPOCH card.

2.4.6 SLAVE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SLAVE                                     7603901
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	SLAVE - Used in place of EPOCH card to indicate that this satellite belongs to a set of satellites.	
24-30	I7	Satellite ID of Master Satellite for this set. The Master Satellite must exist and the SATPAR,EPOCH,ELEMS1,AND ELEMS2 cards for the Master Satellite must have been defined prior to any SATPAR,SLAVE,ELEMS1, and ELEMS2 cards for a set. See discussion of slave satellites below.	

2.4.7 ELEMS1

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ELEMS1          8986390.0780          8283790.5802          -1502498.2249
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ELEMS1 - Introduces the first three components of the orbital elements for the S/C.	
7	I1	Form of elements 0 - Either Cartesian or Keplerian 1 - Cartesian 2 - Keplerian 3 - Non-singular Keplerian 5 - Cartesian non-elliptic 6 - Keplerian non-elliptic	0
8	I1	Coordinate system of input elements NOTE(2)	0
11-14	I4	Central body for input elements. 0100 - Mercury 0200 - Venus 0300 - Earth 0301 - Earth's moon 0400 - Mars 0500 - Jupiter 0600 - Saturn 0700 - Uranus 0800 - Neptune 0900 - Pluto 9999 - Sun	300

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
21-40	D20.14	Element 1 see Table on next page	0 M
41-60	D20.14	Element 2 see Table on next page	0 M or none
61-80	D20.14	Element 3 see Table on next page	0 M, DEG or none

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE: [1] GEODYN II expects the elements to be referred to the IAU system regardless of which planet the S/C is orbiting about.

NOTE: [2] The coordinate system of input elements should be the same system as specified on column 11 of the REFSYS option.

2.4.8 ELEMS2

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ELEMS2          849.44502691749          -1854.4317908133          -5301.4527479779
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ELEMS2 - Introduces the second three components of the orbital elements for the S/C.	
21-40	D20.14	Element 4 see Table below	0 M/S, DEG or none
41-60	D20.14	Element 5 see Table below	0 M/S, DEG or none
61-80	D20.14	Element 6 see Table below	0 M/S or DEG

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

ELEMENTS DEFINITION

	INERTIAL CARTESIAN ELEMENTS	OSCULATING KEPLERIAN ELEMENTS	NON SINGULAR KEPLERIAN ELEMENTS
' Element 1 '	x (meters)	A (meters)	A (meters)
' Element 2 '	y (meters)	E	E*cos(w+OMEGA)
' Element 3 '	z (meters)	I (degrees)	E*sin(w+OMEGA)
' Element 4 '	x (meters/sec)	OMEGA (degrees)	sin(I/2)*sin(OMEGA)
' Element 5 '	y (meters/sec)	w (degrees)	sin(I/2)*cos(OMEGA)
' Element 6 '	z (meters/sec)	M (degrees)	M+w+OMEGA (degrees)

NOTE: [1] GEODYN II expects the elements to be referred to the IAU system regardless of which planet the S/C is orbiting about.

2.5 ARC SET OPTION CARDS

2.5.1 ACCELERATION SUBGROUP

2.5.1.1 ACCEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCEL 30          7603901          1.80D-12
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCEL - Requests application and/or adjustment of general acceleration.	
7	I1	Acceleration type 1 - Radial (R) 2 - Crosstrack (R x V) 3 - Alongtrack (V) 4 - In - plane (X axis) 5 - GPS X BIAS (along GPS X-axis) 6 - GPS Y BIAS (along GPS Y-axis) 7 - GPS Z BIAS (along GPS Z-axis)	0
8	I1	Indicates order of acceleration coefficients 0 - Ga . 1 - Ga .. 2 - Ga	0
18-24	I7	Satellite ID (required).	0
25-44	D20.8	A priori value of acceleration coefficients.	0. M/S**2 or M/S**3 or M/S**4

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
45-59	D15.3	This field must be left blank unless the time dependent acceleration option is wanted. To select time dependent acceleration the end time of the period for which this acceleration coefficient applies is input in the form YYMMDDHHMMSS.SS in this field. See NOTE[1] for more details.	0.
60-72	D13.1	A priori sigma of acceleration coefficient.	0. M/S**2 or M/S**3 or M/S**4

NOTE [1]:

Time periods may be specified only for the highest order coefficients used (i.e. if Ga and Ga dot are used, only Ga dot can have time intervals). When using time periods the number of ACCEL cards required is equal to the number of time periods plus the order (order = the number in column 8 +1). The Ga, Ga dot, and/or Ga double dot without a time interval are used for times beyond the end of the

the last interval specified on the ACCEL cards. See following example.

EXAMPLE: ACCEL cards for time dependent general accelerations
(highest order - Ga ;three time intervals; 4 cards required)

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCEL 30          7603901                1.80D-12
ACCEL 30          7603901                1.82D-12 840901000000.
ACCEL 30          7603901                1.84D-12 840902000000.
ACCEL 30          7603901                1.86D-12 840903000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

WARNINGS: If duplicate time periods are specified the run will terminate
in IIS with a warning message.
The first time period that exceeds the end time of the run
(see EPOCH card) will be accepted. All other end times exceeding
the end time of the run will be ignored.

IF CARD OMITTED: General accelerations are not applied

2.5.1.2 ACCLRM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCLRM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	ACCLRM - Introduces the accelerometer data group. Options included in this group are ACCBIA and DYNSEL The option ACCEND denotes the end of the accelerometer data group.	
-----	----	---	--

25-44	D20.8	Time tolerance for matching external acceleration file times with interation times. This optio is used with the dynamic acceleration mode (DYNSEL)	S
-------	-------	--	---

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: and other accelerometer related options are on IIS will terminate abnormally

2.5.1.3 AXES

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
AXES      9      9
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	<p>AXES: allows the user to manipulate the way input values from the accelerometer are used in GEODYN. The program ingests X, Y & Z accelerometer components both in geometric and dynamic modes.</p> <p>columns 7-9 are used to denote which axes will be used in GEODYN for dynamic accelerometry.</p> <p>columns 10-12 are used to allow the change of the sign of accelerometry components in the dynamic mode.</p> <p>columns 13-15 are used to allow the change of the sign of accelerometry components in the geometric mode.</p>	
7	I1	<p>=0 The X component of accelerometry will replace the geodyn computed</p> <p>=9 The X component of accelerometry will not replace the geodyn computed</p>	0
8	I1	<p>=0 same as above for Y component</p> <p>=9</p>	0
9	I1	<p>=0 same as above for Z component</p> <p>=9</p>	0
10-12	3I1	<p>=9 changes the sign implied by the GFZ document for X,Y or Z axis for dynamic accelerometry</p> <p>=0 does not change the sign</p>	0
13-15	3I1	<p>=9 changes the sign implied by the GFZ document for X, Y or Z axis for geometric accelerometry</p> <p>=0 does not change the sign</p>	0

NOTE:

A 9 in column 9 of the AXES card will delete Z axis for dynamic accelerometry.

A 9 in column 14 would cause the Y axis to have the opposite sign from the sign implied by the GFZ document for geometric accelerometry.

IF CARD OMITTED: The axes will have the signs implied by GFZ document.

2.5.1.4 ACCBIA(UP TO 0407.00)

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCBIA121          2000039          000807000000.00000808000000.00  -7.21444D-06  1.0D-25
                                     5635.00
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBIA: Requests application and/or adjustment of accelerometer data biases	
7	I1	Type of Bias 1 - Absolute Bias 2 - Scale Bias 3 - Timing Bias	
8	I1	Component of Bias 1 - Total acceleration 2 - X component 3 - Y component 4 - Z component	
9	I1	Order of Bias 1 - Constant 2 - Linear 3 - Quadratic 4 - Periodic (sinwt) 5 - Periodic (coswt)	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for the accelerometer bias	YYMMDDHHMMSS.SS
45-59	D15.3	End time for the accelerometer bias	YYMMDDHHMMSS.SS
60-72	D13.1	A priori value of accelerometer bias	0.
73-80	D8.2	A priori sigma of accelerometer bias	1.D-25

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	6X	BLANKS must be present	
25-44	D20.8	Period for the two periodic terms in the model associated with the time interval specified on the previous card.	S

NOTE [1] The times on the ACCBIA cards should be input in advanced time order for each satellite. If the time order is not observed, GEODYN IIS will terminate abnormally.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If the ACCBIA card is omitted, no biases will be applied to the accelerometer data. If the ACCBIA card is present, but the second BLANK card is missing the program will terminate abnormally.

2.5.1.5 ACCBIA(0407.01 AND BEYOND)

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCBIA121      2012001      30702      0.00 30702 30000.00
ACCBIA2              -.11276023375774D-05      0.5655D+04              0.10D+02
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBIA: Requests application and/or adjustment of accelerometer data biases	
7	I1	Type of Bias 1 - Absolute Bias 2 - Scale Bias 3 - Timing Bias	
8	I1	Component of Bias 1 - Total acceleration 2 - X component 3 - Y component 4 - Z component	
9	I1	Order of Bias 1 - Constant 2 - Linear 3 - Quadratic 4 - Periodic (sinwt) 5 - Periodic (coswt)	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for the accelerometer bias	YYMMDDHHMMSS.SS
45-59	D15.3	End time for the accelerometer bias	YYMMDDHHMMSS.SS

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCBIA2	
25-44	D20.1	A priori value of accelerometer bias	0.
45-59	D15.3	Period for the two periodic terms in the model associated with the time interval specified on the previous card.	S
73-80	D8.2	A priori sigma of accelerometer bias	1.D-25

NOTE [1] The times on the ACCBIA cards should be input in advanced time order for each satellite. If the time order is not observed, GEODYN IIS will terminate abnormally.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If the ACCBIA card is omitted, no biases will be applied to the accelerometer data. If the ACCBIA card is present, but the second BLANK card is missing the program will terminate abnormally.

2.5.1.6 DYNSEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DYNSEL          2000039          000807000037.00000808000000.00
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DYNSEL - Defines the times for which GEODYN will use external accelerations to drive the satellite. During these any accelerometer biases or attitude parameters become force model parameters.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Begin time for using external accelerometer data	YYMMDDHHMMSS.SS
45-59	D15.3	End time for using external accelerometer data.	YYMMDDHHMMSS.SS

IF CARD OMITTED: The satellite will be integrated as usual and there will be no external acceleration contribution.

2.5.1.7 SURFRC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SURFRC11111111  2000039
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Defines the surface forces to use when in dynamic acceleration period. (NOTE) For all the indices below: 0 = This force will not be used in dynamic acceleration periods 1 = This force will be used in dynamic acceleration periods	
7	I1	Index for General Acceleration	
8	I1	Index for Drag	
9	I1	Index for Solar Radiation	
10	I1	Index for Albedo	
11	I1	Index for Topex Thermal Radiation.	
12	I1	Index for Topex Louver Forces	
13	I1	Lageos Thermal Drag	
18-24	I7	Satellite ID	

NOTE: THE SURFRC cards should always be the last in the group before the ENDACC option

IF CARD OMITTED: No surface forces will be used for dynamic acceleration

2.5.1.8 ENDACC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDACC
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDACC - Denotes the end of the accelerometer data sub-group	

2.5.2 ACCELT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCELT3          7603901                1.80D-12
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACCELT - Requests application and/or adjustment of general accelerations in three dimensions. This is a special option that may be used to simulate thrusting by applying accelerations in the alongtrack, crosstrack and radial directions at the same time. SPECIAL CARE is required in using this option because the input must be in a very specific order. (See the sample setup)	
7	I1	Acceleration type 1 - Radial 2 - Crosstrack 3 - Alongtrack	0
18-24	I7	Satellite ID (required).	0
25-44	D20.8	A priori value of acceleration.	0. M/S**2
45-59	D15.3	End time of the period for which this acceleration coefficient applies in the form YYMMDDHHMMSS.SS	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
60-72	D13.1	A priori sigma of acceleration coefficient.	0. M/S**2 or M/S**3 or M/S**4

NOTES:

- [1] This option is not user friendly. The input cards must be in the order shown in the example on the next page. All of the cards pertaining to the alongtrack acceleration come first, followed by the cards pertaining to the crosstrack acceleration, followed by the cards pertaining to the radial accelerations. The times on the alongtrack cards are the only times that are used, however, times are required on the crosstrack and radial cards. The times must be in ascending order and all times specified must be within the run times specified on the EPOCH card or GEODYN IIS will throw them out.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: General accelerations are not applied.

Sample ACCELT Setup

Following is a set of ACCELT cards used to apply two thrusting type of accelerations (thrusting in the sense that the accelerations are zero prior to and after the acceleration interval).

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCELT3          7603901          0.0
ACCELT3          7603901          0.0          911007020000.00
ACCELT3          7603901          1.000E-06911007020200.00
ACCELT3          7603901          0.0          911007040000.00
ACCELT3          7603901          1.000E-06911007040200.00
ACCELT3          7603901          0.0          911007060000.00

ACCELT2          7603901          0.0          911017020000.00
ACCELT2          7603901          1.000E-06911017020200.00
ACCELT2          7603901          0.0          911017040000.00
ACCELT2          7603901          1.000E-06911017040200.00
ACCELT2          7603901          0.0          911017060000.00

ACCELT1          7603901          0.0          911027020000.00
ACCELT1          7603901          1.000E-06911027020200.00
ACCELT1          7603901          0.0          911027040000.00
ACCELT1          7603901          1.000E-06911027040200.00
ACCELT1          7603901          0.0          911027060000.00
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

```

Notice that the first card does not have a time period specified and that the times for the crosstrack (2) and radial (1) cards have been increased by 10 days. This will require that the end time specified on the EPOCH card be 20 days later.

Note that when this option is used, GEODYN IIE will print the thrusting acceleration vector in m/(sec**2) at integration steps where the thrusting vector has a magnitude of larger than 1.0E-7(m/sec**2)

2.5.3 ACCEL9

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCEL999          7603901                1.80D-12
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	ACCEL9 - Requests application and/or adjustment of general acceleration.	
-----	----	--	--

9	I1	Indicates direction of 9 parameter general acceleration 1 - Along Track ((R x V) x R) 2 - Cross Track (R x V) 3 - Radial (R)	0
---	----	---	---

10	I1	Indicates type of 9 parameter general acceleration parameter 1 - Cosine coefficient (A) 2 - Sine coefficient (B) 3 - Constant (C)	0
----	----	--	---

11-12	I2	Indicates if this card will be used to specify period end time for 9 parameter general acceleration option. See NOTE[2] for details. 99 - Card DOES specify 9 parameter general acceleration end time.	0
-------	----	--	---

13	I1	Thrust Index 0 - Acceleration 1 - Acceleration Thrust	
----	----	---	--

18-24	I7	Satellite ID (required).	0
-------	----	--------------------------	---

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

25-44	D20.8	A priori value of acceleration coefficients.	0. M/S**2 or M/S**3 or M/S**4
-------	-------	--	-------------------------------------

45-59	D15.3	This field must be left blank unless the time dependent acceleration option is wanted. To select time dependent acceleration the end time of the period for which this acceleration coefficient applies is input in the form YYYYMMDDHHMMSS.SS in this field.	0.
-------	-------	---	----

60-72 D13.1 A priori sigma of acceleration coefficient. 0. M/S**2
or M/S**3
or M/S**4

NOTE [1]:

When choosing the nine parameter general acceleration model, a card specifying the period endtime (99 in Cols.11-12) must precede all other cards. A priori values for the coefficients in this period must follow subsequently. One no longer has to include all nine cards for each coefficient in a period.

EXAMPLE: ACCEL cards for time dependent 9 parameter general accelerations

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACCEL9   99      7603901                                851230010000.00
ACCEL9  11      7603901                                1.1D-11                                1.0D0
ACCEL9  12      7603901                                2.2D-11                                1.0D0
ACCEL9  21      7603901                                4.4D-11
ACCEL9  22      7603901                                5.5D-11                                1.0D0
ACCEL9   99      7603901                                860101000000.00
ACCEL9  31      7603901                                7.7D-11
ACCEL9  32      7603901                                8.8D-11
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

WARNINGS: If duplicate time periods are specified the run will terminate in IIS with a warning message.
The first time period that exceeds the end time of the run (see EPOCH card) will be accepted. All other end times exceeding the end time of the run will be ignored.

IF CARD OMITTED: General accelerations are not applied

2.5.4 ACOEF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ACOEF
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ACOEF - Coefficients for Albedo or Emissivity Models.	
7-8	I2	Indicator of Albedo or Emissivity model 1 = Albedo 0 = Emissivity	
9-10	I2	Degree of coefficient	
11-12	I2	Order of coefficient	
25-44	D20.8	C - Coefficient value	0
45-59	D15.3	S - Coefficient value	0

The coefficients above should be unnormalized.

NOTE [1]: For a setup example see note on ALTIME card.

IF CARD OMITTED: And non-default Earth model has been requested, run will abnormally terminate.

2.5.5 ALBEDO

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALBEDO  2
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALBEDO - Requests application of earth or other planet radiation pressure	
7-8	I2	# of rings	2
9-10	I2	Model indicator 0 = default 1 = model provided below [Note 3]	0
11-12	I2	TUM model used if greater then zero (only applicable to GPS satellites) [Note 4]	0
25-44	D20.8	ALBEDO constant [Note 2]	
45-59	D15.3	Emissivity constant [Note 2]	

NOTE [1] : Solar radiation must be turned on when using ALBEDO.

NOTE [2] : If the albedo constant is zero, then the spherical harmonic albedo Earth model (currently zeroeth first and second degree zonal harmonics) will be used. If the emissivity constant is zero, then the spherical harmonic emissivity model (same as above) will be used.

NOTE [3] : For an example setup of this case look at the ALTIME card.

NOTE [4] : To use the TUM model, the following files must be present in the directory that IIE is executed:

```

EMITM001
EMITM002
EMITM003
EMITM004
EMITM005
EMITM006
EMITM007
EMITM008
EMITM009
EMITM010
EMITM011
EMITM012
REFLM001
REFLM002
REFLM003

```


REFLM004
REFLM005
REFLM006
REFLM007
REFLM008
REFLM009
REFLM010
REFLM011
REFLM012

These files can be found in the following directory
on the xyz2 machine:

/Users/geodyn/SUPPORT/dat_FILES/dat_TUM/Earth_Radiation_Pressure

IF CARD OMITTED: Earth radiation pressure will not be applied.

2.5.6 ALTIME

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTIME - time input card for albedo and emissivity	
7-8	I2	Albedo or Emissivity indicator 1 = Albedo 0 = Emissivity	
11-12	I2	Maximum degree of model following this card	
13-14	I2	Maximum order of model following this card	
21-22	I2	North latitude boundary for polar caps	
23-24	I2	South latitude boundary for polar caps	
25-44	D20.8	Begin solar longitude	hours in degrees of arc elapsed since local midnight
45-59	D15.3	End solar longitude	hours in degree of arc elapsed since local midnight
60-72	D13.1	Albedo or emissivity constant for north pole	
73-80	D8.2	Albedo or emissivity constant for south pole	

NOTE [1]: GEODYN II input decks have been created with Albedo and emissivity coefficients for all solar longitude intervals in the following directories.

/geod4/dmoore/alb

alb.br010	alb.br084	alb.br130	alb.br205	alb.br290
alb.br030	alb.br090	alb.br150	alb.br225	alb.br310
alb.br050	alb.br110	alb.br168	alb.br250	alb.br330
alb.br070	alb.br126	alb.br185	alb.br274	alb.br350

/geod4/dmoore/emiss

emiss.br010	emiss.br090	emiss.br168	emiss.br250	emiss.br350
emiss.br030	emiss.br110	emiss.br170	emiss.br274	
emiss.br050	emiss.br126	emiss.br185	emiss.br290	
emiss.br070	emiss.br130	emiss.br205	emiss.br310	
emiss.br084	emiss.br150	emiss.br225	emiss.br330	

NOTE [2]: Example setup:

```
ALBEDO 6 1
ALTIME 0 0 3 3           168.00           185.0
ACOEFF 0 0 0           0.6762392000000D+00
```

ACOEF	0	1	0	0.98872310000000D-02		
ACOEF	0	1	1	-0.75151300000000D+00	-.916294200D-01	
ACOEF	0	2	0	-0.50709950000000D+00		
ACOEF	0	2	1	-0.91629400000000D-01	.297368800D-01	
ACOEF	0	2	2	0.11775700000000D-00	.618260100D-02	
ACOEF	0	3	0	0.61487610000000D-01		
ACOEF	0	3	1	0.67782210000000D-01	.334011800D-02	
ACOEF	0	3	2	0.21936710000000D-02	-.613645100D-02	
ACOEF	0	3	3	-0.39664540000000D-02	.406565900D-03	
ALTIME	1	0	6	0	168.00	185.0
ACOEF	1	1	0	0.23963750000000D-03		
ACOEF	1	2	0	-0.94549286000000D-01		
ACOEF	1	3	0	0.70892866000000D-01		
ACOEF	1	4	0	-0.80324064000000D-01		
ACOEF	1	5	0	0.45253057000000D-01		
ACOEF	1	6	0	0.35431022000000D-01		

IF CARD OMITTED: And non-default Earth model has been requested,
run will abnormally terminate

2.5.7 ALTWVL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALTWVL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ALTWVL Provides the wavelenth of the altimeter laser. If altimetry data are being processed and this option is invoked, the value of the wavelength will override that provided on the data records.	microns
18-24	I7	Satelltite ID.	
25-44	D20.8	Wavelength in microns.	

IF CARD OMITTED: The wavelength provided by the data will be used.

2.5.8 CON9PA

1	2	3	4	5	6	7	8
COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS				
1-6	A6	Introducing constraints for time dependent 9 parameter general acceleration					
7	I1	Direction of 9 parameter general acceleration 1 = along track 2 = cross track 3 = radial					
8	I1	Type of 9 parameter general acceleration. 1 = cosine coefficient 2 = sine coefficient 3 = constant					
9	I1	[2] Indicator used to indicate if the normal matrix will be updated in the last inner iteration according to constraints: 0 - IIE will NOT update the normal matrix before writing EMATRIX file. 1 - IIE will update the normal matrix before writing EMATRIX file.				'0'	
18-24	I7	Satellite ID.					
25-44	D20.3	Begin time of adjacent [1] periods to be constrained.				YYMMDDHHMMSS.SS	
45-59	D15.3	End time of adjacent periods to be constrained.				YYMMDDHHMMSS.SS	
60-72	D13.1	Weight assigned to adjacent periods					
73-80	D8.3	Correlation time.				sec	

NOTE [1]: Only one CON9PA card is needed to constrain a number of adjacent periods from ACCEL9. If some periods from the ACCEL9 stream are excluded from constrained adjustments, use as many CON9PA cards as the number of sets of continuous adjacent periods.

NOTE [2]: If a value other than 0 or 1 is present in column 9 GEODYN IIS will stop and show an error message.

2.5.9 CONBIA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CONBIA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
COLUMNS  FORMAT          DESCRIPTION                                DEFAULT VALUE & UNITS

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Introducing constraints for time dependent tropospheric biases.	
7-14	I8	Station ID	
15-17	I3	Type of bias to be constrained =500 for tropospheric biases	
25-44	D20.3	Begin time of adjacent [2] periods to be constrained.	YYMMDDHHMMSS.SS
45-59	D15.3	End time of adjacent periods to be constrained.	YYMMDDHHMMSS.SS
60-72	D13.1	Weight assigned to adjacent periods.	
73-80	D8.3	Correlation time.	sec

NOTE [1]: The CONBIA option is station dependent, therefore the station ID is required.

NOTE [2]: Only one CONBIA card is needed to constrain a number of adjacent periods from MBIAS. If some periods from the MBIAS stream are excluded from constrained adjustments, use as many CONBIA cards as the number of sets of continuous adjacent periods.

2.5.10 CONDRG

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8							
CONDRG							
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----							
COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS				
1-6	A6	Introducing constraints for time dependent drag.					
9	I1	[2] Indicator used to indicate if the normal matrix will be updated in the last inner iteration according to constraints:					
		0 - IIE will NOT update the normal matrix before writing EMATRIX file.	'0'				
		1 - IIE will update the normal matrix before writing EMATRIX file.					
18-24	I7	Satellite ID.					
25-44	D20.3	Begin time of adjacent [1] periods to be constrained.	YYMMDDHHMMSS.SS				
45-59	D15.3	End time of adjacent periods to be constrained.	YYMMDDHHMMSS.SS				
60-72	D13.1	Weight assigned to adjacent periods.					
73-80	D8.3	Correlation time.	sec				

NOTE [1]: Only one CONDRG card is needed to constrain a number of adjacent periods for time dependent DRAG. If some periods from the DRAG stream are excluded from constrained adjustments, use as many CONDRG cards as the number of sets of continuous adjacent periods.

NOTE [2]: If a value other than 0 or 1 is present in column 9 GEODYN IIS will stop and show an error message.

2.5.11 CONSOL

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Introducing constraints for time dependent solar radiation.	
18-24	I7	Satellite ID.	
25-44	D20.3	Begin time of adjacent [1] periods to be constrained.	YYMMDDHHMMSS.SS
45-59	D15.3	End time of adjacent periods to be constrained.	YYMMDDHHMMSS.SS
60-72	D13.1	Weight assigned to adjacent periods.	
73-80	D8.3	Correlation time.	sec

NOTE [1]: Only one CONSOL card is needed to constrain a number of adjacent periods for time dependent SOLRAD. If some periods from the SOLRAD stream are excluded from constrained adjustments, use as many CONSOL cards as the number of sets of continuous adjacent periods.

2.5.12 CONSPL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
CONSPL  20001304          0.1          0.1          0.1          0.1
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0
COLUMNS FORMAT          DESCRIPTION          DEFAULT VALUE  UNITS

```

1-6 A6 CONSPL - Input information for VLBI spline parameters constraints.

7-14 I8 Station Number. 0

15-17 I3 Bias Type. See list of bias types after this option description. 0

25-44 D20.8 Standard deviation for degree 0

45-59 D15.3 Standard deviation for degree 1

60-72 D13.1 Standard deviation for degree 2

73-80 D8.2 Standard deviation for degree 3

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No constraints will be applied to the spline type biases.

2.5.13 DSTATE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DSTATE
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DSTATE - Requests estimation of an instantaneous state difference at a specific time. This capability is extremely useful with thrusts	
7	I1	Dstate Component 1 = x 2 = y 3 = z 4 = x 5 = y 6 = z	
8	I1	Coordinate system of input indicator =1 Inertial TOR coordinate system =2 Position and velocity are in the satellite along track, cross track and radial directions.	
18-24	I7	Satellite ID.	0
25-44	D20.8	Dstate value	0.0
45-59	D15.3	Dstate time (YYMMDDHHMMSS.SS)	
60-72	D13.1	Dstate sigma	1.D-25

NOTE 1: The DSTATE option requires that all the data from one satellite should be input together and in advanced time order. Also all the satellites must be in the same order as on the SATPAR input cards.
Not all 6 components of the DSTATE at a specific time must be present if the user does not wish to solve for them, however GEODYN will use a tight sigma for those components that are not present in the estimation process

NOTE 2: The DSTATE option is a force model option, but no forces are associated with the DSTATE parameters. The DSTATE parameters simply cause the COWELL numerical integration sums to be altered. There are two integration scenarios: INTGCB option and no INTGCB option (see INTGCB card). The user needs to be

aware of these two scenarios when using DSTATE parameters.

NOTE 2a: When no INTGCB card is present only the orbit of the artificial satellite (and not the orbited body) is being numerically integrated. In this mode, the DSTATE option requires the use of multi-rate integration. Multi-rate integration is accessed by using in columns 60-72 of the STEP card. Note that unlike most applications that require multi-rate integration, the DSTATE option does NOT require the use of the HRATEF card.

NOTE 2b: When an INTGCB card is present, both the orbit of the artificial satellite well as the orbited body are being numerically integrated. In this mode, multi-rate integration is not possible and prior to version 1507.11 DSTATE modeling was not available together with INTGCB. Starting with version 1507.11 DSTATE modeling without multi-rate integration is possible when using the INTGCB capability. In this mode, the DSTATE option requires that a 1 second step size is used. If a DSTATE epoch occurs in-between integration steps, the DSTATE event will be modeled at the nearest integration step.

2.5.14 DRAG

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DRAG    0                7654321 2.3
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DRAG - Modifies drag application and/or requests estimation of drag coefficients.	
8	I1	Indicates order of drag coefficients: 0 - Cd . 1 - Cd .. 2 - Cd	0
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Drag coefficient. (For Cd and Cd ^{..} the units are per second and per second squared)	0. none or 1/S or 1/S**2
45-59	D15.3	This field must be left blank unless the time dependent drag option is wanted. To select time dependent drag specify the end time of the period for which this acceleration coefficient applies in the form YYMMDDHHMMSS.SS in this field. See NOTE[1] for more details.	0.
60-72	D13.1	Standard deviation of drag coefficient.	none or 1/S or 1/S**2

NOTE [1]:

Time periods may be specified only for the highest order coefficients used (i.e. if Cd and Cd dot are used, only Cd dot can have time intervals).

When using time periods the number of drag cards required is equal to the number of time periods plus the order (order = the number in column 8 +1).

The first DRAG card with an end time covers the time period from epoch to the specified end time. Subsequent drag cards with end times cover the time interval from the preceding end time to the current end time. In this manner continuous time intervals are guaranteed from epoch to the last specified end time. If orbit integration continues beyond the end of the last specified drag time interval, the Cd (or Cd dot, or Cd double dot) without a time interval is used. A Cd (or Cd dot or Cd double dot) without a time interval is MANDATORY when

using this time dependent option. See example below.

EXAMPLE: Drag cards for using time dependent drag coefficients.
(highest order - Cd dot;two time intervals; 4 cards required)

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DRAG    0           7654321 2.3
DRAG    1           7654321 .00002
DRAG    1           7654321 .000021           840902000000.
DRAG    1           7654321 .000022           840903000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

WARNINGS: If duplicate time periods are specified the run will terminate in IIS with a warning message.
The first time period that exceeds the end time of the run (see EPOCH card) will be accepted. All other end times exceeding the end time of the run will be ignored.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Drag is applied with a default Cd of 2.3

2.5.15 EBIAS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EBIAS          51          1.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EBIAS - Requests adjustment of pass by pass measurement biases.	
7-14	I8	Station Number. [2]	0
15-17	I3	Bias Type. See list of bias types after this option description. [2]	0
18-24	I7	Satellite ID. [2]	0
45-59	D15.3	Start date and time for generating pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.
60-72	D13.1	End date and time for generation of pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.

NOTE [1]: If the start and end dates are left blank electronic biases will be generated for the entire data span.

NOTE [2]: The station number, satellite ID and bias type are required. Blanks and /or zeroes will not work.

NOTE [3]: If the measurement type is larger than 99 (3 digit) use EBIASM card to specify it.

GEODYN-II E-BIAS TYPES

The GEODYN-II E-bias types include all of the GEODYN-II measurement types as well as other types which are an extension of the simple measurement bias.

At present, the only E-bias types defined include simple constant measurement biases. Other future E-bias types will include linearly varying measurement biases and observation scale biases.

E-bias type numbers are assigned as follows:

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	STATION DEPENDENT
-----	-----	-----	-----
simple measurement biases	measurement type	no	or yes
measurement bias varying linearly with time	meas. type + 100	no	or yes

measurement scale bias	meas. type + 200	no	or	yes
tropospheric refraction scale bias	500	no	or	yes

2.5.16 EBIASM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EBIASM          100
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EBIASM - This card is used when the measurement type is larger than 99 (3 digit). The 3 digits in columns 15-17 will overwrite the measurement type in columns 16-17 of the PBIAS card. Requests adjustment of pass by pass measurement biases.	
15-17	I3	Measurement Type.	0

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the EBIAS card.

2.5.17 EDIT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EDIT           3.5           200.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EDIT - Specifies editing multiplier and initial RMS value.	
7	I1	Special editing switch. = 0 Normal editing performed. = 1 Perform local pass editing on 1st iteration. = 2 Perform local pass editing on all iterations.	0
25-44	D20.8	Editing multiplier. This number remains constant for all iterations in the arc.	3.5
45-59	D15.3	Editing RMS. Initial RMS value used for iteration number 1. Subsequent iterations use the RMS from the previous iteration.	200.
60-72	D13.1	Electronic bias edit level.	Value in cols. 25-44 times value in cols. 45-59.
73-80	D8.2	Arc convergence criteria.	.02

NOTES:

[1] The editing level for each iteration is determined as follows:

$$\text{Edit level} = \text{Edit multiplier} * \text{Edit RMS}$$

[2] The "ratio to sigma" for each observation is compared to this edit level and "ratio to sigmas" greater than the edit level are eliminated from the current iterations solution.

[3] The electronic bias edit level defaults to the same edit level as described above. (edit multiplier * edit RMS)

NOTES: (continued)

[4] Time periods may be specified only for the highest order coefficients

[5] Convergence on first iteration
 GEODYN II will converge on the first inner iteration if the RMS on the EDIT card is within 2% of the first iteration RMS

[6] E-bias Edit level

For E-bias editing the E-bias edit level is given by default as the edit multiplier * RMS from the EDIT card. If the "electronic bias edit level" from columns 60-72 of the EDIT card is non zero, then the value from column 60-72 is used as the edit level (Not the value in column 60-72 times anything else)

IF CARD OMITTED: The default edit level of 700 (3.5*200) is used.

2.5.18 EMATRIX

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
EMATRIX 1                123456.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	EMATRIX - Requests output of an E-matrix file on unit 71 and on option a V-matrix file on unit 80. Also automatically requests partitioned formation of normal equations.	
8	I1	> 0 indicates a V-matrix file will also be output.	0
9	I1	E-matrix print options 0 - E-matrix is not printed. 1 - E-matrix header and label information is printed. 2 - Complete E-matrix is printed.	0
15-17	I3	Number of processors to be used for an EMAT run	
25-44	D20.8	E-matrix number. This number may be any number greater than 0.	0.
45-59	D15.3	Stop date for V-matrix output in form YYYYDDHHMMSS.	0.
60-72	D13.1	Output interval in seconds for the V-matrix. If a V-matrix has been requested this number must be greater than zero in order to get a V-matrix at regular times. If the V-matrix is requested at measurement times, this number should be greater than negative one and less than or equal to zero. V-matrix partials will be output in the true of reference coordinate system.	0. S

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No E-matrix of V-matrix will be output.

SEE ALSO: VECOPT option in Global Set.

NOTE: [1] The input elements for the S/C in an interplanetary run must refer to the IAU system otherwise V-matrix values will be erroneous. See ELEMS1 and ELEMS2 cards.

2.5.19 FANTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FANTIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTIM - Used for time dependent PHANTOM parameters (option FANTOM)	
7	I1	Index specifying the nature of the introduced arc parameters: = 1 Geometric model arc parameters = 2 Force model arc parameters	
25-44	D20.8	Epoch time for a time dependent model [NOTE 1]	YYMMDDHHMMSS.
45-59	D15.3	Start time for a time dependent option. The end times are specified on the FANTOM cards.	YYMMDDHHMMSS.
60-72	D13.1	Space for real information applicable to all the parameters in the group.	
73-80	D8.2	Space for real information applicable to all the parameters in the group	

NOTES:

[1] This time will be considered to be a reference time with respect to which linear rates or periodic terms are evaluated.

[2] Only one FANTIM card per FANTOM parameter group is allowed.

IF CARD OMITTED: And times are included on the FANTOM cards, the run will abnormally terminate.

CG OFFSET PARAMETERS USING FANTIM:

This option uses FANTOM cards to model the center of gravity offset in the x, y and z components in the satellite body-fixed frame.

FANTIM

col. 7 1 - means arc geometric FANTOM parameters

col. 25-44 Epoch time for a time dependent model YYMMDDHHMMSS.

[NOTE 1]

col. 45-59 Start time for a time dependent option. The YYMMDDHHMMSS.

end times are specified on the FANTOM cards.

See ARC FANTOM OPTION FOR THE FANTOM SPECIFICATIONS

2.5.20 FANTOM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FANTOM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FANTOM - Introduces the application and/or estimation of a group of arc parameters [NOTE 3]	
7	I1	Index specifying the nature of the introduced arc parameters: = 1 Geometric model arc parameters = 2 Force model arc parameters	
8	I1	Index specifying a specific direction for the parameter appearing on cols 25-44 [NOTE 1] = 0 All the parameters in the group are treated the same way (same partial formulation) = 1 = 2 To be specified by the user = 3	
9	I1	Index specifying the nature of the contents on cols 60-72 and 73-80 = 0 These real fields are not used for the group of parametrs introduced. (Space will not be allocated for them in GEODYN). = 1 These real fields are used as they are described below = 2 These real fields may be used to include any type of real information (but time)	
18-24	I7	Satellite ID	
25-44	D20.8	Parameter value	
45-59	D15.3	Parameter sigma	
60-72	D13.1	End time for application for this parameter. (if the index on col 9 is 2) [NOTE 2]	YYMMDDHHMMSS.
73-80	D8.2	Available space for extra real information.	

NOTES:

[1] Specify up to three (3) dimensions. Although this option is not required in order to solve for parameters in a 3-D space or solve for parameters of different significance (S and S coefficients for example) it is helpful for EMATS and other types of labeling. Also parameters with the same index will be grouped together, facilitating that way the formation of partials.

[2] Requires the presence of the FANTIM option.

[3] This option provides the necessary allocation and links for parameterization. In order to use this option, the user must contact a GEODYN programmer for further additions of modeling and partials code.

IF CARD OMITTED: No extra model or parameters will be included in the GEODYN calculations

CG OFFSET PARAMETERS USING FANTIM:

This option uses FANTOM cards to model the center of gravity offset in the x, y and z components in the satellite body-fixed frame.

FANTOM

col. 7 1 - means arc geometric FANTOM parameters
col. 8 component number (x = 1, y = 2, z = 3)
col. 9 must be = 2 to specify col. 60-72 contains the sinusoidal period

col. 18-24 Satellite ID

col. 25-44 Parameter value

col. 45-59 Parameter sigma [NOTE 2]

col. 60-72 Period for the sinusoidal function in sec.

NOTES:

[1] This time will be considered to be a reference time with respect to which linear rates or periodic terms are evaluated.

[2] The parameter sigma must always be non-zero for this model. If a FANTOM parameter to be adjusted, set the sigma to a very small positive number.

It is assumed that you will have 15 FANTOM cards, one for each of the parameters in the The cgmass offset is modeled in the satellite body fixed frame as:

$$x_offset = a(1) + a(2) * \sin(twopi * t / period(2)) + a(3) * \cos(twopi * t / period(2)) + a(4) * \sin(twopi * t / period(4)) + a(5) * \cos(twopi * t / period(4))$$

$$y_offset = a(6) + a(7) * \sin(twopi * t / period(7)) + a(8) * \cos(twopi * t / period(7)) + a(9) * \sin(twopi * t / period(9)) + a(10) * \cos(twopi * t / period(9))$$

$$z_offset = a(11) + a(12) * \sin(twopi * t / period(12)) + a(13) * \cos(twopi * t / period(12)) + a(14) * \sin(twopi * t / period(14)) + a(15) * \cos(twopi * t / period(14))$$

where:

- a(i) is the value on the ith FANTOM card
- period(i) is the period on the ith FANTOM card

The periods on cards 1, 6 and 11 are not used.

An example set of FANTOM cards is:

FANTIM1		90802140000.		90802140000.
FANTOM112	8032001	0.00	1.00	E-02 0.
FANTOM112	8032001	0.00	1.00	E-02 3600.
FANTOM112	8032001	0.00	1.00	E-02 3600.
FANTOM112	8032001	0.00	1.00	E-02 7200.
FANTOM112	8032001	0.00	1.00	E-02 7200.
FANTOM122	8032001	0.00	1.00	E-02 0.
FANTOM122	8032001	0.00	1.00	E-02 3600.
FANTOM122	8032001	0.00	1.00	E-02 3600.
FANTOM122	8032001	0.00	1.00	E-02 7200.
FANTOM122	8032001	0.00	1.00	E-02 7200.
FANTOM132	8032001	0.00	1.00	E+02 0.
FANTOM132	8032001	0.00	1.00	E-02 3600.
FANTOM132	8032001	0.00	1.00	E-02 3600.
FANTOM132	8032001	0.00	1.00	E-02 7200.
FANTOM132	8032001	0.00	1.00	E-02 7200.

2.5.21 GPSBXW

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GPSBXW
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS FORMAT DESCRIPTION DEFAULT VALUE & UNITS

1-6 A6 GPSBXW - Requests application and/or adjustment of parameters associated with the GPS satellite Box-wing TUM (Technical University of Munich) model

7 I1 Parameter Type

= 1 Solarpanel scale factor φ SEE NOTE BELOW

= 2 Solarpanel rotation lag θ

= 3 Box wing X+ ($\alpha + \delta$)

= 4 Box wing X+ (e)

= 5 Box wing Z+ ($\alpha + \delta$)

= 6 Box wing Z+ (e)

= 7 Box wing Z- ($\alpha + \delta$)

= 8 Box wing Z- (e)

= 9 Y-bias

18-24 I7 Satellite ID

25-44 A priori value

45-59 Sigma

NOTE: The presence of one GPSBXW option for one GPS satellite will invoke the adjustment of ALL 9 parameters with a sigma = 1.D-30 A-priori values equal to zero will be overwritten in GEODYN by default values (per block) according to the reference:

"Adjustable box-wing model for solar radiation pressure impacting GPS satellites", by C.J. Rodriguez-Solano, U. Hugentobler, P. Steigenberger, in "Advances in Space Research, 0273-1177, 2012 COSPAR. Published by Elsevier Ltd, doi:10.1016/j.asr.2012.01.016.

GEODYN A PRIORI VALUES

SPSF0	for block:	I	1.2640000000
dthetasp	for block:	I	0.0000000000
aplusdxp	for block:	I	0.5660000000
rhoxp	for block:	I	0.4340000000
aplusdzp	for block:	I	0.3550000000
rhozp	for block:	I	0.6450000000
aplusdzm	for block:	I	0.6280000000
rhozm	for block:	I	0.3720000000
yb	for block:	I	0.0000000000
SPSF0	for block:	II	1.2350000000
dthetasp	for block:	II	0.0000000000
aplusdxp	for block:	II	0.9000000000
rhoxp	for block:	II	0.1000000000

aplusdzp	for block:	II	0.8880000000
rhozp	for block:	II	0.1120000000
aplusdzm	for block:	II	0.9170000000
rhozm	for block:	II	0.0830000000
yb	for block:	II	0.0000000000
SPSF0	for block:	IIA	1.2350000000
dthetasp	for block:	IIA	0.0000000000
aplusdxp	for block:	IIA	0.9000000000
rhoxp	for block:	IIA	0.1000000000
aplusdzp	for block:	IIA	0.8880000000
rhozp	for block:	IIA	0.1120000000
aplusdzm	for block:	IIA	0.9170000000
rhozm	for block:	IIA	0.0830000000
yb	for block:	IIA	0.0000000000
SPSF0	for block:	IIR	1.2783333333
dthetasp	for block:	IIR	0.0000000000
aplusdxp	for block:	IIR	1.0000000000
rhoxp	for block:	IIR	0.0000000000
aplusdzp	for block:	IIR	1.0000000000
rhozp	for block:	IIR	0.0000000000
aplusdzm	for block:	IIR	1.0000000000
rhozm	for block:	IIR	0.0000000000
yb	for block:	IIR	0.0000000000
SPSF0	for block:	IIR-M	1.2783333333
dthetasp	for block:	IIR-M	0.0000000000
aplusdxp	for block:	IIR-M	1.0000000000
rhoxp	for block:	IIR-M	0.0000000000
aplusdzp	for block:	IIR-M	1.0000000000
rhozp	for block:	IIR-M	0.0000000000
aplusdzm	for block:	IIR-M	1.0000000000
rhozm	for block:	IIR-M	0.0000000000
yb	for block:	IIR-M	0.0000000000
SPSF0	for block:	IIF	1.2193333333
dthetasp	for block:	IIF	0.0000000000
aplusdxp	for block:	IIF	0.8880000000
rhoxp	for block:	IIF	0.1120000000
aplusdzp	for block:	IIF	0.8880000000
rhozp	for block:	IIF	0.1120000000
aplusdzm	for block:	IIF	1.0000000000
rhozm	for block:	IIF	0.0000000000
yb	for block:	IIF	0.0000000000

2.5.22 HRATEF

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Defines forces to use for high rate integration. For all the indices below: 0 = Force not included for HR integration 1 = Force included for HR integration	
7	I1	Index for Drag	
8	I1	Index for Solar Radiation	
9	I1	Index for General Acceleration	
10	I1	Index for Topex Thermal Radiation.	
11	I1	Index for Topex Louver Forces	
12	I1	Index for Albedo	
13	I1	Lageos Thermal Drag	
14	I1	Index for Geopotential	
15	I1	Index for Earth and Ocean Tides	
16	I1	Index for Gravity Anomalies	
17	I1	Index for Central Body Gravitation	
18	I1	Index for Third Bidy Indirect Oblation	
19	I1	Index for Mars Moons Indrrect Acceleration	
20	I1	Index for General Relativity	
21	I1	Index for Yukawa Gravity	
22	I1	Index for Planetary Moon Gravity	
23	I1	Index for Yarkovsky/Schach Acceleration	
25-44	D20.8	Satellite ID	

NOTE 1: This card is not needed to implement DSTATE modeling/estimation

IF CARD OMITTED: No forces will be used for high rate integration

2.5.23 MBIAS SUBGROUP

2.5.23.1 MBIAS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MBIAS      7063 517603901 0.                850731000000.  850831000000. 10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0
COLUMNS  FORMAT          DESCRIPTION                                     DEFAULT VALUE & UNITS

```

1-6	A6	MBIAS - Requests application and/or adjustment of measurement or station timing bias.	
7-14	I8	Station Number.	0
15-17	I3	Bias Type. See list of bias types after this option description.	0
18-24	I7	Satellite ID.	0
OR FOR VLBI SPLINE TYPE PARAMETERS:			
18-20	I3	Total number of parameters in the string	
21-23	I3	Parameter number in the sequence of a string	
24	I1	Degree of spline	
25-44	D20.8	Value of the bias (a priori estimate if adjusted). Units are: Length - M, Time - S, Angles - RAD	0.
45-59	D15.3	Date and time at which the bias is to begin in form: YYMMDDHHMMSS.	0.
60-72	D13.1	Date and time at which the bias is to end in form: YYMMDDHHMMSS.	0.
73-80	D8.2	Standard deviation of the a priori bias in the same units as bias value. If this value is greater than zero bias will be adjusted.	0.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE [1]: Please also see EBIAS and PBIAS options.

NOTE [2]: If the measurement type is larger than 99 (3 digit) use MBIASM card to specify it.

IF CARD OMITTED: Measurement biases are not applied. See also EBIAS and PBIAS option.

GEODYN-II BIAS TYPES

The GEODYN-II bias types include all of the GEODYN-II measurement types as well as other types which are independent from measurement type or which are an extension of the simple measurement bias.

At present, the only bias types defined include simple constant measurement biases and simple time biases independent

of measurement type. Other future bias types will include linearly varying measurement biases, observation scale biases, tropospheric and ionospheric refraction scale biases, station clock polynomials and satellite clock polynomials.

Bias type numbers are assigned as follows:

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	or	STATION DEPENDENT	UNITS
simple measurement biases	measurement type	yes	or	yes	
measurement scale bias	meas. type + 100	yes	or	yes	
station clock bias	300	no		yes	sec
station clock linear drift	301	no		yes	sec/hour ²
station clock quadratic drift	302	no		yes	sec/hour ³
station clock cubic drift	303	no		yes	sec/hour
station clock bias (spline)	304	no		yes	sec/hour
satellite clock bias	400	yes		no	sec
satellite clock linear drift	401	yes		no	sec/hour ²
satellite clock quadratic drift	402	yes		no	sec/hour ³
satellite clock cubic drift	403	yes		no	sec/hour
tropospheric refraction scale bias	500	no		yes	[NOTE 1]
tropospheric bias zenith (spline)	501	no		yes	
tropospheric bias gradient east (spline)	502	no		yes	
tropospheric bias gradient north(spline)	503	no		yes	
ionospheric refraction scale bias	600	no		yes	
a: coefficient to TDRSS 1-way range-rate user frequency correction $\Delta f / F_{\text{ref}}$	700 [NOTE 3]	yes		no	sec

F_{ref} => Reference frequency

Δf => Difference between reference
frequency and user transmit
frequency

frequency correction can be
specified to a cubic:

$$\frac{\Delta f}{F_{\text{ref}}} = a + b(t - t_0) + c(t - t_0)^2 + d(t - t_0)^3$$

t => Observation time
 t₀ => Epoch time defined
 by the user [NOTE 2]

b: coefficient (to the linear term)	701	yes	no	
c: coefficient (to the quadratic term)	702	yes	no	1/sec
d: coefficient (to the cubic term)	703	yes	no	1/sec**2
VLBI baseline bias	800	no	or	yes
VLBI baseline bias	NOTE [4] 801	no	or	yes
simple time biases	900	yes	or	yes

NOTE [1]: In order to apply a troposphere refraction scale bias the parameter must be adjusted.

NOTE [2]: Clock polynomials (400) and TDRSS one-way correction (700) cannot be handled by GEODYN simultaneously.

NOTE [3]: Bias type is measurement type dependent. To specify the measurement type for MBIAS 700 the user should include an MBIASM card immediately following the MBIAS 700 card.

NOTE [4]: Bias type 800 represents a VLBI baseline bias. To define this we need to specify a second station ID. The option MBIAS 801 following immediately MBIAS 800 serves only for defining this station ID. NO OTHER information besides the station ID and the bias type 801 is needed on the second card.

MBIAS	7063800	0.0	850731000000.	850831000000.
MBIAS	7064801			

2.5.23.2 MBIASn

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MBIAS      7063 517603901 0.                850731000000.  850831000000.  10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-5	A5	MBIAS - Requests application and/or adjustment of measurement or station timing bias.	
6	A1	n - Used for estimation of multi-station and/or multi-satellite identification. If "n" is zero or one, then this card takes on the form of the "MBIAS" card. "n" may also take on the values two or three. When this occurs, the station and satellite information on these cards ("MBIAS2" or "MBIAS3") augments that already provided on the "MBIAS" form card.	0
7-14	I8	Station number for the "n"th station in the measurement configuration.	0
15-17	I3	Bias Type. See list of measurement types after ENDARC description (not used if "n" equals 2 or 3).	0
18-24	I7	Satellite ID for the "n"th satellite in the measurement configuration.	0
OR FOR VLBI SPLINE TYPE PARAMETERS:			
18-20	I3	Total number of parameters in the string	
21-23	I3	Parameter number in the sequence of a string	
24	I1	Degree of spline	
25-44	D20.8	Value of the bias (a priori estimate if adjusted). Units are: Length - M, Time - S, Angles - RAD	0.
45-59	D15.3	Date and time at which the bias is to begin in form: YYMMDDHHMMSS.	0.
60-72	D13.1	Date and time at which the bias is to end in form: YYMMDDHHMMSS.	0.
73-80	D8.2	Standard deviation of the a priori bias in the same units as bias value. If this value is greater than zero bias will be adjusted.	0.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE: If the time fields on cards with "n" equal to 2 or 3 are non-zero GEODYN will internally generate a complete new set of MBIAS cards having the same configuration with different times. The bias type field will be ignored on MBIAS cards with "n" equal to 2 or 3.

Please also see EBIAS and PBIAS options.

EXAMPLE FOR SAT-TO-SAT MEASUREMENTS:

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MBIAS1          0577502701 0.                780101000000.  780101000000.
MBIAS2          18570577403901              780101000000.  780101000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

BIAS DESCRIPTION	BIAS TYPE NUMBER	DEPENDENT	DEPENDENT	DEPENDENT UNITS
-----	-----	-----	-----	-----
simple measurement biases	measurement type	yes	or	yes
measurement scale bias	meas. type + 100	yes	or	yes
station clock bias	300	no		yes sec
station clock linear drift	301	no		yes sec/hour 2
station clock quadratic drift	302	no		yes sec/hour 3
station clock cubic drift	303	no		yes sec/hour
station clock bias (spline)	304	no		yes sec/hour
satellite clock bias	400	yes		no sec
satellite clock linear drift	401	yes		no sec/hour 2
satellite clock quadratic drift	402	yes		no sec/hour 3
satellite clock cubic drift	403	yes		no sec/hour
tropospheric refraction				
500 no yes [NOTE 1]				
scale bias				
tropospheric bias zenith (spline)	501	no		yes
tropospheric bias gradient east (spline)	502	no		yes
tropospheric bias gradient north(spline)	503	no		yes
ionospheric refraction	600	no		yes
scale bias				
a: coefficient to TDRSS	700 [NOTE 3]	yes		no sec
1-way range-rate user				

b: coefficient (to the linear term)	701	yes	no	
c: coefficient (to the quadratic term)	702	yes	no	1/sec
d: coefficient (to the cubic term)	703	yes	no	1/sec**2
VLBI baseline bias	800	no	or	yes
VLBI baseline bias	NOTE [4] 801	no	or	yes
simple time biases	900	yes	or	yes

[NOTE 1] In order to apply a tropospheric refraction scale bias the parameter must be adjusted.

iNOTE [2]: Clock polynomials (400) and TDRSS one-way correction (700) cannot be handled by GEODYN simultaneously.

NOTE [3]: Bias type is measurement type dependent. To specify the measurement type for MBIAS 700 the user should include an MBIASM card immediately following the MBIAS 700 card.

NOTE [4]: Bias type 800 represents a VLBI baseline bias. To define this we need to specify a second station ID. The option MBIAS 801 following immediately MBIAS 800 serves only for defining this station ID. NO OTHER information besides the station ID and the bias type 801 is needed on the second card.

MBIAS	7063800	0.0	850731000000.	850831000000.
MBIAS	7064801			

2.5.23.3 MBIASM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MBIASM100      100                                     10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	MBIASM - This card is used when the measurement type is larger than 99 (3 digit). The 3 digits in columns 7-10 will overwrite the measurement type in columns 16-17 of the MBIAS card. This option applies to simple measurement biases and measurement scale biases.	
7-10	I3	Measurement Type.	0
15-17	I3	Measurement Type for TDRSS one way range correction application. [NOTE 1]	0

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE [1]: If an MBIASM card follows an MBIAS 700 card, columns 15-17 are used to specify the measurement type for which a TDRSS one-way correction will apply. This correction acts like a scale to long link and a constant bias.

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the MBIAS card.

2.5.24 MLTARC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MLTARC
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	MLTARC - Requests Multi-arc data file options for arcs 2 through the number of arcs.	
7	I1	IF =0 THEN the current unit for the input 2S observation file will not be advanced. IF =1 THEN the current unit for the input 2S observation file will be advanced. [NOTE 1]	0
8	I1	IF =0 THEN the current unit for the input 2S observation file will not be rewound. IF =1 THEN the current unit for the input 2S observation file will be rewound.	0

NOTE [1] : Unit 40 will be advanced from the DD name of FT40F001 to the DD name (or file name) of ARC##, where ## is the number of the arc for which this option is being requested.

Example: If this option is requested for the second arc, then unit 40 will be attached to the DD name ARC02.

IF CARD OMITTED: The unit 40 observation file will be read sequentially for all arcs.

2.5.25 NORMPV

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NORMPV1 452361      7654321                1.0D+02                1.0D-14                1.0D-12 1.0D-12
NORMPV5              7654321                1.0D-12                1.0D-12
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	NORMPV - Normal point orbit adjustment control and a priori variance input.	
-----	----	---	--

7	I1	Specifies elements of normal point a priori diagonal variance/covariance matrix being input on this card.	1
---	----	---	---

1 - a,e,i & asc. node variances input in fields 25-44, 45-59, 60-72 and 73-80 respectively. Parameter elimination order specified in columns 9-14.

5 - arg. perigee & mean anomaly variances input in fields 25-44 and 45-59 respectively. Columns 9-14 ignored.

9-14	6I1	Order in which Kepler orbit parameters are to be eliminated when using single pass orbit adjustments to edit data before normal point binning.	452361
------	-----	--	--------

Parameter Name	Number	Variance	Units
----------------	--------	----------	-------

Semi-major Axis	1	M**2	
Eccentricity	2	()**2	
Inclination	3	DEG**2	
R. A. of Asc. Node	4	DEG**2	
Arg. of Perigee	5	DEG**2	
Mean Anomaly	6	DEG**2	

Order of elimination is determined by parameter numbers specified in columns 9-14, where order of elimination is indicated by column number minus 8.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

18-24	I7	Satellite ID.	0
-------	----	---------------	---

25-44	D20.8	Element #1 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not be adjusted during normal point editing.	0.
-------	-------	--	----

45-59	D15.3	Element #2 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not	0.
-------	-------	---	----

be adjusted during normal point editing.

60-72	D13.1	Element #3 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not be adjusted during normal point editing.	0.
73-80	D8.2	Element #4 of var/cov matrix as determined by column 7. If .LE.0 , parameter will not be adjusted during normal point editing.	0.

Example - Diagonal elements of Keplerian variance/covariance matrix.

1-6	7	9 - 14	18-24	25-44	45-59	60-72	73-80
NORMPV	1	452361	7654321	V11	V22	V33	V44
NORMPV	5		7654321	V55	V66		

NOTES: The parameters specified on this card have no effect on the actual orbit adjustment process. They are used only in single pass orbit parameter adjustments used to edit data prior to the formation of normal points on the last inner iteration of the last global iteration.

The Global Set option card NORMPT must be exercised if normal points are to be generated.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds
()=Unitless

IF CARD OMITTED: Diagonal matrix with values as follows will be used:
V11=1.0D2, V22=1.0D-14, V33=1.0D-12, V44=1.0D-12, V55=1.0D-12, V66=1.0D-12

2.5.26 VLBI SUBGROUP

2.5.26.1 OPVLBI

1	2	3	4	5	6	7	8
COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS			
1-6	A6	OPVLBI: Denotes the beginning of the VLBI options					

2.5.26.2 VLBSTR

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	VLBSTR		
8	I1	Index for option (1,8)		
11-74	A64	Body of the string		

2.5.26.3 ENDOPV

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	ENDOPV: Denotes the end of the VLBI options.		

2.5.27 ORBFIL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ORBFIL          6302610 840201080000.          840201090000. 10.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests output of trajectory file(s) on specified unit(s) on the last iteration of the run.	
7	I1	Coordinate system of output 0 - True of date (default) 1 - True of reference date 2 - Mean of year 2000	0
8	I1	Switch indicating whether trajectory file is for a single satellite or a set of satellites. 0 - Single satellite 1 - Set of satellites. This option has meaning only when used in conjunction with sets of satellites (See EPOCH and SLAVE option cards for more details). If satellite ID in columns 18-24 is a master satellite, then the trajectory for all satellites in the set will be output.	0
9-11	I3	Mandatory unit number for trajectory file. All trajectory files within an arc must have unique unit numbers. The suggested unit number starts at 130. [3]	0
12	I1	Option to convert cgmass in sbf to tor frame 0 - Center of mass (default) 1 - Center of figure	0
18-24	I7	Satellite ID. This field must contain a valid ID.	0
25-44	D20.3	Start date and time for trajectory output (YYMMDDHHMMSS.SS).	No Default
45-59	D15.3	Stop date and time for trajectory output (YYMMDDHHMMSS.SS).	No Default
60-72	D13.1	Time interval between successive trajectory outputs.	0 S

NOTES :

- [1]: In multiple satellite runs (like GPS runs), a separate ORBFIL option card is needed for each satellite. The same start and stop times on each card should be used.
- [2]: If master satellite and its slaves are output as a set (column 8=1), individual members of the set may still be output in separate files by including separate ORBFIL card(s) for the desired satellite(s).
- [3]: The user can place in column 9-11 values between 130 and 230 without over-writing any 2E output units.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No trajectory output file will be generated.

2.5.28 ORBINF

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ORBINF15                841101000000.          841108000000.    300.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ORBINF - Requests ORBINF file (station/satellite look angles) be generated for the indicated stations and time period.	
7-8	I2	Number of stations (N) to be included in the ORBINF file. The first N stations in the GEODETICS file will used first. If N is larger than the number of stations in the GEODETICS file then stations from the STAPOS subgroup will be used. The maximum number of stations (N) allowed is 15.	
18-24	I7	Satellite ID.	
25-44	D20.8	Start date and time for ORBINF output. (YYMMDDHHMMSS.SSSSS) (NOTE 1)	
45-59	D15.3	End date and time for ORBINF output. This end date MUST be less than or equal to the stop date specified on the epoch card. (YYMMDDHHMMSS.SS) (NOTE 1)	
60-72	D13.1	Interval for station/satellite look angle generation in integral seconds.	

NOTE [1]: All times specified on any arc option cards must fall between the earlier of the epoch and start time and end prior to or at the stop time specified on the epoch card.

IF CARD OMITTED: No ORBINF file will be created.

2.5.29 ORBTUVU

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ORBTUVU1          6302610650630180000.          650708000000.  3600.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests trajectory printout. Cartesian elements on unit 8 and Keplerian elements on unit 10. Use an ORFIL card for trajectory file generation. Required in orbit generation runs, optional in data reduction runs. [NOTE 4]	
7	I1	Frequency of trajectory output.	0
		<ul style="list-style-type: none"> 0 - Trajectory output viewed between times specified in columns 25-59 and at interval specified in columns 60-72. 1 - Trajectory output viewed between times specified in columns 25-59 at data points only. 2 - Trajectory output viewed between times specified in columns 25-59 at data points and at the interval specified in columns 60-72. 	
8	I1	Coordinate system of output	0
		<ul style="list-style-type: none"> 0 - True of date 1 - True of reference date 2 - Mean of year 2000 	0
9	I1	Trajectory type indicator.	0
		<ul style="list-style-type: none"> 0 - Cartesian ephemeris 1 - Keplerian ephemeris 2 - Both Cartesian and Keplerian ephemerides. 	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
10	I1	Iterations on which trajectory will be printed.	0
		<ul style="list-style-type: none"> 0 - First arc iter of first global iter 1 - Last arc iter of last global iter 2 - Both first first and last last 3 - All iterations 	
18-24	I7	Satellite ID. If not specified applies	0

to all S/C in arc.

25-44	D20.3	Start date and time for trajectory viewing (YYMMDDHHMMSS.SS). [NOTE 3]		
45-59	D15.3	Stop date and time for trajectory viewing (YYMMDDHHMMSS.SS). [NOTE 3]		
60-72	D13.1	Nominal interval between successive trajectory viewings.	0.	S

NOTE 1: Cartesian elements are printed on unit 8 and Keplerian elements are printed on unit 10.

NOTE 2: Orbit generation mode (ORBGEN mode) is implied by the lack of a DATA card or simulated data generation (SIMDAT) card.

NOTE 3: Start and stop dates are required. There are no defaults.

NOTE 4: For an orbit generation run, the users should make sure that all arc parameters have zero sigmas. Orbit generation with arc parameter estimation request are incompatible in GEODYN.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: No trajectory output will be generated

2.5.30 PANEL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PANEL   0   1   1   7521345                               1.0E0                               0.0E0                               0.0E0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	PANEL - Requests application and/or adjustment of parameters associated with a flat panel for use in nonconservative force modeling.	
9	I1	Panel motion indicator	0
		0 - Panel is fixed in satellite body-fixed coordinates	
		1 - Indicates a movable Panel with respect to the spacecraft body fixed frame (ie. the TOPEX solar array). [NOTE 1]	
10	I1	Index for the type of frequency received by the panels	
		=0 panel receives both short wave and long wave radiation (default)	
		=1 panel receives short wave radiation	
		=2 panel receives long wave radiation	
11-12	I2	Indicates panel number	1
13-14	I2	Parameter type	
		1 - Normal vector in body-fixed coordinates	
		2 - Area	0. m**2
		3 - Specular reflectivity	0.
		4 - Diffuse reflectivity	0.
		5 - Emissivity	0. K
		6 - Temperature A (cold equilibrium temperature)	
		7 - Temperature C (delta temperature between hot and cold equilibrium temperature)	0. K
		8 - Temperature decay time D (exponential decay time for panel cooling)	0. Sec.
		9 - Temperature decay time F (exponential decay time for panel heating)	0. Sec.

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

		10 - Temperature/satellite rotation X (divisor for cos(theta) term in heating equation)	0.
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Apriori parameter value as dictated in columns 13-14. (X component of normal vector if 1 is specified in columns 13-14)	
45-59	D15.3	Apriori parameter sigma as dictated in columns 13-14. (Y component of normal vector if 1 is specified in columns 13-14)	
60-72	D13.1	Z component of panel normal vector (if 1 is specified in columns 13-14)	

NOTE [1] : Movable panels must be grouped after the non-movable panels,
and in ascending order.

2.5.31 PBIAS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PBIAS      9001 517603901  1.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PBIAS - Requests adjustment of pass by pass measurement or timing biases. [Note 2]	
7-14	I8	Station Number.	0
15-17	I3	Bias Type. See list of bias types after this option description.	0
18-24	I7	Satellite ID.	0
25-44	D20.8	A priori bias value. Units: Length - M, Time - S, Angles - RAD	0.
45-59	D15.3	Start date and time for generating pass by pass biases (YYMMDDHHMMSS). See NOTE 1.	0.
60-72	D13.1	End date and time for generation of pass by pass biases. (YYMMDDHHMMSS). See NOTE 1.	0.
73-80	D8.2	Standard deviation of the a priori bias in the same units. This field must be a non-zero.	

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE [1]: If the start and end dates are left blank pass by pass biases will be generated for the entire data span.

NOTE [2]: Warning. If the PBIAS option is used with the PUNCH option, MBIAS cards are generated from the PBIAS option. This means that the original PBIAS cards must be removed from the setup if the MBIAS cards generated by the PUNCH option are used in the next run.

NOTE [3]: If the measurement type is larger than 99 (3 digit) use the PBIASM card to specify it.

BIAS DESCRIPTION	BIAS TYPE NUMBER	SATELLITE DEPENDENT	STATION DEPENDENT
simple measurement biases	measurement type	yes	or yes
measurement bias varying linearly with time	meas. type + 100	yes	or yes
measurement scale bias	meas. type + 200	yes	or yes

tropospheric refraction scale bias	500	no	yes
ionospheric refraction scale bias	600	no	yes
simple time biases	900	yes	or yes
clock frequency bias	901	yes	or yes
clock frequency drift	902	yes	or yes

2.5.32 PBIASM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PBIASM          100
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PBIASM - This card is used when the measurement type is larger than 99 (3 digit). The 3 digits in columns 15-17 will overwrite the measurement type in columns 16-17 of the PBIAS card. Requests adjustment of pass by pass measurement or timing biases.	
15-17	I3	Measurement Type.	0

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Measurement type will be read from cols 16-17 of the PBIAS card.

2.5.33 RELTMC

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	RELTMC - Requests application of the range correction due to relativistic periodic and secular space craft clock drift. [1],[2],[3],[4],[5]	
7	I1	Type of satellite 0 - Not GPS - applies secular and periodic correction 1 - GPS - applies periodic correction only	
25-44	D20.8	Satellite ID	
45-59	D15.3	Satellite ID	
60-72	D13.1	Satellite ID	
73-80	D8.2	Satellite ID	

NOTES:

- [1] If no satellite ID's are specified, card applies to all satellites in run.
- [2] The user may request application of this correction for up to four satellites on one card. (A maximum of 30 satellites for this option can be requested)
- [3] The relativistic time correction applies to the following measurement types: 39, 40, 41, 42, 55, 56.
- [4] A PREPRO card must be present in order for the correction to be applied. The contribution of this correction is summed into the total relativistic measurement correction which can be printed on unit 16.
- [5] Currently, GEODYN uses the first point in the block to compute the semi-major axis, and also utilizes the time of the block start for the synchronization time. Because of this, you may get slightly different results if you change the blocking of your run.

IF CARD OMITTED: No relativistic time correction will be applied.

2.5.34 RESIDU

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
RESIDU
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	RESIDU - Requests residual file output on unit 19 on the last inner of the last global iteration.	
7	I1	Event times/location data switch. 0 - Residual file will not contain event times or trajectory information. 1 - Requests event times and spacecraft trajectory or true pole station locations at those event times be output along with the residual information. Trajectory output is in the true of data coordinate system.	0
8		Observation data switch. 0 - Residual file will not contain observation data. 1 - Requests observation data be output along with the residual information. 2 - Requests observation data and observation correction data be output along with the residual information.	0

IF CARD OMITTED: No Residual File will be generated.

2.5.35 ROCK4

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ROCK4
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ROCK4 - Requests application of the ROCK4 or ROCK42 solar radiation model. [2]	
9-10	I1	Newer thermal model = 0 Older thermal model = 1	0
25-44	D20.8	Satellite ID	
45-59	D15.3	Satellite ID	
60-72	D13.1	Satellite ID	
73-80	D8.2	Satellite ID	

NOTES : [1] If no satellite ID's are specified, card applies to all satellites in run.

[2] The user may request application of this solar radiation model for up to four satellites on one card (A maximum of 30 satellites can be requested).

[3] The new version of the rock4 solar radiation model came from a paper given by H.F.Fliegel and T.E.Gallini at the AGU 30May91 where for BLOCK I satellites X and Z are as follows

$$\begin{aligned}
 X &= -4.55\sin(B) + .08\sin(2B + .9) - .06\cos(4B + .08) + .08 \\
 Z &= -4.54\cos(B) + .20\sin(2B - .3) - .03\sin(4B)
 \end{aligned}$$

For BLOCK II satellites, X and Z are

$$\begin{aligned}
 X &= -8.96\sin(B) + .16\sin(3B) + .10\sin(5B) - .07\sin(7B) \\
 Z &= -8.43\cos(B)
 \end{aligned}$$

For BLOCK IIR satellites, X and Z are

$$\begin{aligned}
 X &= -11\sin(B) - 0.2\sin(3B) + 0.2\sin(5B) \\
 Z &= -11.3\cos(B) + 0.1\cos(3B) + 0.2\cos(5B)
 \end{aligned}$$

[4] This card is used in conjunction with SOLRD card.

[5] The satellite ID for BLOCK I satellites must end in "1", for BLOCK II satellites in "2", and for BLOCK IIR satellites in "3".

IF CARD OMITTED: ROCK4 or ROCK42 models will not be applied.

2.5.36 SLFSHD

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SLFSHD Requests application of a self shadowing effect to non conservative models (drag, solar radiation) due to the shadowing of the S/C macromodel plates on each other.	
7	I1	=0 Use ascii shadowing file =1 Use binary shadowing file	
8	I1	Shadowing application index. =0 Do not use shadowing on this satellite =1 Use shadowing for this satellite	
9-10	I2	Force application index =11 Use shadowing for both Solar Radiation and Drag =10 Use shadowing for Solar Radiation only =01 Use shadowing for Drag only.	
18-24	I7	Satellite ID.	0

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Self shadowing will not be applied on any satellite.

THE DATA STRUCTURE FOR SHADOWING FILE

One shadowing file should be used for each satellite. Each shadowing file should have one general header record and one or two blocker header record. The block header record must be followed by data records. The shadowing file could be either ascii or binary file.

ASCII SHADOWING FILE

General Header Record: four integers

1: number of blocks

2: number of panels for this satellite

This number must match the panel cards in the IIS setup file.

3: model indicator

0 for ratio

1 for actual cross-section

4: satellite ID number

Block Header Record: one integer followed by three real numbers

1 (integer): block indicator

0 for solar radiation

1 for drag

2 (real): start time in UTC YYMMDDHHMMSS.SS format

3 (real): stop time in UTC YYMMDDHHMMSS.SS format

4 (real): time step in seconds

Data Record:

Each data record includes the time tag followed by the values for each panel.

BINARY SHADOWING FILE

The binary has exactly the same structure as the ascii shadowing file. One should be careful that the size of integers in binary file should be consistent with the GEODYN versions (i32 or i64).

Note if one wants to use binary shadowing file and has multiple satellites, one must set the 7th columns on all the SLFSHD cards to 1, otherwise GEODYN IIS will assume ascii shadowing files shall be used for all the satellites. In other words, one could only use either ascii or binary files simultaneously for all those satellites.

2.5.37 SIMULATION DATA SUBGROUP

2.5.37.1 SIMDAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMDAT 0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMDAT - Requests output of simulated data to UNIT 20 on final iteration. Actual data replaced with calculated value from final iteration. The simulated data is in the GEODYN II binary format expected by UNIT 40 of IIS.	
8	I1	Simulated data generation indicator. =0 Simulated data will be generated by replacing real data with computed data. =1 Data will be simulated for measurement types and times as specified on the SIMDAT control cards following this SIMDAT card. The SIMDAT control cards may be input as a separate file in UNIT17.	
10	I1	Indicator specifying the input file of the SIMDAT control cards. =1 SIMDAT control cards are input on UNIT17	

Please see NOTE [1] below

NOTE [1]: This Option is not yet available for all measurement types. For the time being only range and range rate, altimetry and angle measurement types can be simulated. For paired angle measurement types read the note on the SIMTYP card.

IF CARD OMITTED: No data will be simulated.

2.5.37.2 SIMDAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMDAT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
---------	--------	-------------	-----------------------

1-6	A6	SIMDAT: A blank SIMDAT card in the beginning of UNIT17 introduces the simulated data generation mode specification subgroup which may include up to 20 configurations and ends with the ENDSIM card.	
-----	----	--	--

Each individual configuration includes the following cards:

```

SIMSAT
SIMSTA
SIMTIM      This group must be repeated with
SIMTYP      each individual configuration.
ENDCON

```

NOTE: For further details see individual card descriptions in the following pages and Section 3.1.7 and see sample setup in APPENDIX Example 7.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing the run will terminate.

2.5.37.3 SIMLIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMLIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMLIM: Requests certain limitations for the simulated data generation mode	
7-14	I1	Index to orbit pattern choice:	0
		=0 all orbits as defined by the following input cards.	
		=1 only ascending orbits	N / A
		=2 only descending orbits	N / A
31-45	D15.8	The interval between "observations" The same interval will be used as counting interval in all measurement types involving distrust Doppler data.	S
46-60	D15.8	Visibility checking time interval	N / A
61-70	D10.2	Elevation cutoff angle below which no data will be generated.	DEG 0

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing the run will terminate.

2.5.37.4 SIMSAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMSAT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMSAT: Defines a set of satellites involved in the present configuration. SIMSAT and the following SIMSTA cards defines a tracking configuration in simulated data generation mode.	
7-14	I8	Satellite ID for the tracked satellite in this configuration.	
15-22	I8	Satellite ID for the relay satellite in this configuration.	
23-30	I8	Satellite ID for the third satellite in this configuration.	

NOTE: For all the satellites involved there must be an equivalent SATPAR card on UNIT 5. For any given configuration (measurement) GEODYN is limited to a maximum of three satellites and three stations.

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing the run will terminate.

2.5.37.5 SIMSTA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMSTA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMSTA: Defines a set of stations involved in the present configuration.	
7-14	I8	Receiving station number No station number is required for altimetry data generation.	
15-22	I8	Transmitting station number.	
23-30	I8	Third station number.	

NOTE: For all the stations listed on this option card there must be corresponding station coordinates in the STAPOS subgroup.

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing for measurement types where stations are involved, the run will terminate.

2.5.37.6 SIMTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMTIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMTIM: Start and end time for simulated data generation for the tracking configuration defined on the previous SIMCON card and for the types defined on the previous SIMTYP cards.	
31-45	D12.	Start date in form YYMMDDHHMMSS.	Earliest start date and time from EPOCH cards on UNIT5
46-60	D12.	Stop date in form YYMMDDHHMMSS.	Latest stop date and time from EPOCH card on UNIT5
61-70	I10	Elevation cutoff angle, overrides any values on SIMLIM cards	Value from SIMLIM card.
71-80	I10	Surface elevation for altimetry data	N / A

IF CARD OMITTED: Run will abnormally terminate.

2.5.37.7 SIMTYP

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SIMTYP
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIMTYP: Data for the measurement type described on this card will be generated for the tracking configuration defined on the preceding SIMSAT and SIMSTA cards. [NOTE 1]	
12-14	I3	Measurement type. (See Section 5.0 for discussion on measurement types.	
31-45	D15.8	Measurement noise level, for 1st measurement. [NOTE 2]	0
46-60	D15.8	Measurement noise level, for 2nd measurement. (in case of paired measurements) [NOTE 2]	0
61-70	D10.2	Observation time interval	Value from SIMLIM card. S

NOTE [1] : For simulating paired measurement types the user should only specify the first measurement in the pair i.e. 17 for the pair 17-18. GEODYN will automatically simulate both. This convention applies for all measurement types between 17 and 30.

NOTE [2] : For the noise level use the same units as the observations (M or or M/Sec for metric type, DEG RAD or MAS for angles). For each observation the noise level will be multiplied by a random number between -1 and 1.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing the run will terminate

2.5.37.8 ENDCON

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDCON
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	I6	ENDCON: End of configuration Will be followed by an ENDSIM card if this is the last configuration. Will be followed by a SIMSAT card if another configuration is requested.	

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing the run will terminate.

2.5.37.9 ENDSIM

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDSIM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDSIM: End of the simulated data input cards	

IF CARD OMITTED: If simulated data generation (not replacement) is invoked and this card is missing, the run will terminate.

2.5.38 SOLRAD

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SOLRAD 0          7654321 1.5
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SOLRAD - Requests application and/or adjustment of solar radiation pressure.	
8	I1	Indicates order of radiation pressure coefficients. 0 - Cr . 1 - Cr .. 2 - Cr	0
9	I1	=1 The UCL solar radiation bus model will be used for JASON =2 The UCL solar radiation model will be used for GFO =3 The UCL solar radiation model will be used for ENVISAT	
10	I1	=1 The UCL solar radiation panel model will be used for JASON	
11	I1	=1 The UCL re-radiation panel model will be used for JASON	
14	I1	Sunlight Ratio input =1 Sunlight Ratio input will be read from UNIT 77 and will be used instead of the ratio being calculated in SOLRAT =0 SOLRAT will calculate Sunlight Ratio See NOTE(2) for more details.	0
18-24	I7	Satellite ID.	0
25-44	D20.8	Solar radiation pressure coefficient. (Units for Cr dot and Cr double dot are per second and per second squared)	0. none or 1/S or 1/S**2
45-59	D15.3	This field must be left blank unless the time dependent solar radiation option is wanted. To select time dependent solar radiation the end time of the period for which this acceleration coefficient applies is input in the form YYMMDDHHMMSS.SS in this field. See NOTE(1) for more details.	0.
60-72	D13.1	Standard deviation of radiation pressure coefficient.	0. none or 1/S or 1/S**2

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

NOTE[1]: Time periods may be specified only for the highest order coefficients used (i.e. if Cr and Cr dot are used, only Cr dot can have time intervals). When using time periods the number of SOLRAD cards required is equal to the number of time periods plus the order (order = the number in column 8 +1). The Cr, Cr dot, and/or Cr double dot without a time interval are used for times beyond the end of the the last interval specified on the SOLRAD cards. See example on next page.

EXAMPLE: SOLRAD cards for using time dependent general accelerations
 (highest order - Cr ;three time intervals; 4 cards required)

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SOLRAD 0          7654321 1.5
SOLRAD 0          7654321 1.51          840901000000.
SOLRAD 0          7654321 1.52          840902000000.
SOLRAD 0          7654321 1.53          840903000000.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

NOTE[2]: The input file should have the following structure:

MAIN HEADER

Contains Number of Satellites
 FORMAT(I2)

SUBHEADERS

One subheader for each satellite.
 Contains Satellite ID and Number of observations (observations being when the SC is transitioning to/from the sunlight/shadow)
 FORMAT(I7,1X,I6)

TITLE HEADER for Satellite 1
 Just a title reading SATELLITE 1 DATA

DATA

Data includes times and sunlight ratios immediately before, during, and immediately after the spacecraft transitions to/from full sunlight.
 During the transitions, data should be at regular time intervals.
 Time is in UTC.
 Data is in the following structure:
 Time Ratio
 FORMAT(F14.3,1X,F6.4)

This is followed by the TITLE HEADER and DATA of remaining satellites.

EXAMPLE: The following is a portion of input for two satellites, where

there are 9245 observations for each satellite 2012001 and
satellite 2012002. A line of stars represent a jump in the input.

```
2
2012001  9245
2012002  9245
  SATELLITE 1 DATA
2245277866.791 1.0000
2245277871.791 0.7663
2245277876.791 0.3945
2245277881.791 0.1352
2245277886.791 0.0000
2245280541.886 0.0000
2245280546.886 0.3428
2245280551.889 0.6467
2245280556.889 1.0000
*****
  SATELLITE 2 DATA
2245277866.791 1.0000
2245277871.791 0.7663
2245277876.791 0.3945
2245277881.791 0.1352
2245277886.791 0.0000
2245280541.886 0.0000
```

WARNINGS: If duplicate time periods are specified the run will terminate
in IIS with a warning message.
The first time period that exceeds the end time of the run
(see EPOCH card) will be accepted. All other end times exceeding
the end time of the run will be ignored.

2.5.39 STEP

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
STEP           7654321 45.                    45.
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	STEP - Changes integrator order and step size.		
7-8	I2	Order of integration for orbit.	11	
9-10	I2	Order of integration for variational	Same as orbit	
11-12	I2	Number of output buffers to save integration information.		
14	I1	>1 For this satellite we need to write integration information out for later use.	0	
15-17	I3	Millions of words devoted to this satellite in dynamic arrays for integration information.		
18-24	I7	Satellite ID.	0	
25-44	D20.8	Step size for orbit integration.	60.	S
45-59	D15.3	Step size for variational equations.	Same as orbit	
60-72	D13.1	Small stepsize used for variable size integration step.	1.	S

NOTE 1: If the DSTATE option is in the setup, variable intergration is required. Columns 60-72 need to be filled in with appropriate step size.

NOTE 2: Multirate integration should be used for the DSTATE option (note 1) or when it is desired to numarically integrate some forces at a smaller step size than others. When dividing forces into different step sizes the HRATEF card should be used. There is no reason to use the HRATEF card if multi-rate integration is being used only for the purpose of modeling/estimating DSTATE parameters.

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

2.5.40 TATBIA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TATBIA                                0.0                                0.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TATBIA - Defines biases in the solar array pitch and spacecraft yaw for satellites other than TOPEX.	
18-24	I7	Satellite ID	
25-44	D20.8	Solar array pitch bias [NOTE 1]	0.0 deg

NOTE [1]:

The solar array pitch bias applies to the time period specified on the TATBTM card which immediately follows this card. If no TATBTM card immediately follows this card the time period will be taken from the EPOCH card. Multiple TATBIA cards may be included in a run. The time periods on corresponding TATBTM cards should not overlap. If there is no solar array pitch bias specified for a certain time period the default value applied will be zero.

2.5.41 TATBTM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TATBTM                                0.0                                0.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TATBTM - Specifies the start and stop times for the solar array pitch bias on the TATBIA card immediately before this card.	
25-44	D20.8	Start time for solar array pitch value specified on TATBIA card immediately before this card. (YYMMDDHHMMSS.SS)	none
45-59	D15.3	Stop time for solar array pitch value specified on TATBIA card immediately before this card. (YYMMDDHHMMSS.SS)	none

IF CARD OMITTED: The time period applied to the TATBIA card will be taken from the EPOCH card.

2.5.42 TELEM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TELEM
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	Requests output of TOPEX telem file on unit 97 on the last iteration of the run.	
18-24	I7	Satellite ID of the LEO in a GPS run. This input will invoke a special TELEM output on unit 97 for the LEO on the last iteration. A GPSSMOD option is also required in the same setup for this option to work. The absence of the satellite ID will cause TELEM to work normally with attitude and panel output information.	0

IF CARD OMITTED: No TOPEX telem file will be generated.

2.5.43 THRDRG

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8 THRDRG
7603901
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
COLUMNS FORMAT          DESCRIPTION                                     DEFAULT VALUE & UNITS

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRDRG - Requests thermal drag application.	
7		Card number indicator (1 or 2). The second card is used to request adjustment of the satellite spin axis.	1
8	I1	> 0 Indicates that partials are to be calculated but the thermal drag force will not be applied.	0
18-24	I7	Satellite ID (Required)	0
25-44	D20.8	Scaling parameter D (see model below)	-11.836**-12 MS**-2
45-59	D15.3	Model variable parameter ζ (see model description below)	1.2 unitless
60-72	D13.1	Colatitude of the satellite's spin axis θ If there is a 2 in column 7 (if this is the second THRDRG card), then this field is for the standard deviation of the a priori spin axis colatitude. The default standard deviation is zero.	22 DEG
73-80	D8.2	The right ascension of the satellite's spin axis λ If there is a 2 in column 7 (if this is the second THRDRG card), then this field is for the standard deviation of the a priori spin axis right ascension. The default standard deviation is zero.	313 DEG

Note [1]: The option to adjust the spin axis will not work in a run with more than one satellite or more than one arc.

Note [2]: The thermal drag acceleration is computed from the equation (for detailed description see section 8.12, Vol. 1):

$$\vec{a}_{TD} = \left[\frac{-D(\vec{r}_d \cdot \vec{S})}{\sqrt{1 + \zeta^2}} \right] \vec{S}$$

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; M/S=Meters per second

DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED : Thermal drag acceleration will not be included.

2.5.44 TIEOUT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TIEOUT                                     931224000000.00
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TIEOUT - Used to request TIEOUT information be written at end of parameter labels record of emat.	
25-44	D20.8	Output request epoch	YYMMDDHHMMSS.SS
45-59	D15.3	Reference coordinate system date of output defaulted to value in columns 26-44.	cols. 26-44 YYMMDDHHMMDD.SS

2.5.45 TOPATT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOPATT  2          9606123  960701112233.00000 960702112233.0          90.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPATT - Requests override of nominal TOPEX yaw steering algorithm.	
9	I1	Yaw steering mode indicator 1 - Sinusoidal yaw 2 - Fixed yaw 3 - Ramp Up 4 - Ramp Down 5 - Geocentric pointing	0
18-24	I7	Satellite ID (required).	0
25-44	D20.3	Start time of yaw steering event. YYMMDDHHMMSS.SS [See Note 1]	
45-59	D15.3	Stop time of yaw steering event. YYMMDDHHMMSS.SS [See Note 1]	
60-72	D13.1	Satellite fix yaw angle (mode 2)	0 (deg)

NOTE 1 : TOPATT cards must be in ascending time order.

IF CARD OMMITTED: TOPEX will follow nominal yaw steering algorithm.

2.5.46 TOPBIA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOPBIA                                0.0                                0.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPBIA - Defines biases in the solar array pitch and spacecraft yaw for the TOPEX satellite.	
25-44	D20.8	Solar array pitch bias [1]	0.0 deg
45-59	D15.3	Yaw bias	0.0 deg

NOTE [1]:

The solar array pitch bias applies to the time period specified on the TOPBTM card which immediately follows this card. If no TOPBTM card immediately follows this card the time period will be taken from the EPOCH card. multiple TOPBIA cards may be included in a run. The time periods on corresponding TOPBTM cards should not overlap. If there is no solar array pitch bias specified for a certain time period the default value applied will be zero.

2.5.47 TOPBTM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOPBTM                                0.0                                0.0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPBTM - Specifies the start and stop times for the solar array pitch bias on the TOPBIA card immediately before this card.	
25-44	D20.8	Start time for solar array pitch value specified on TOPBIA card immediately before this card. (YYMMDDHHMMSS.SS)	none
45-59	D15.3	Stop time for solar array pitch value specified on TOPBIA card immediately before this card. (YYMMDDHHMMSS.SS)	none

IF CARD OMITTED: The time period applied to the TOPBIA card will be taken from the EPOCH card.

2.5.48 TOPLOV

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOPLOV
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPLOV - Requests application of an acceleration due to thermal radiation emitted from the louvers on the TOPEX spacecraft.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Magnitude of the acceleration in the TOPEX body fixed frame. component of normal vector if 1 is specified in columns 13-14)	0 m/s**2
45-59	D15.3	X component of normal vector of the acceleration in the TOPEX body-fixed frame.	
60-72	D13.1	Y component of normal vector of the acceleration in the TOPEX body-fixed frame.	
73-80	D15.3	Z component of normal vector of the acceleration in the TOPEX body-fixed frame.	

If card omitted: no louver acceleration will be applied.

2.5.49 TOPYAW

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TOPYAW          9601123                15.0                0.1                80.00
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TOPYAW - Defines betaprime boundaries marking changes in yaw steering mode for the TOPEX satellite.	
10	I1	=1 Default for the following Beta prime values is zero =0 Default for the following Beta prime values are indicated below	
18-24	I7	Satellite ID	
25-44	D20.8	Betaprime value marking the boundary between fixed yaw at low betaprime and sinusoidal yaw	15.0 deg
45-59	D15.3	Betaprime value marking the boundary between fixed yaw and the flip maneuver	0.1 deg
60-72	D13.1	Betaprime value marking boundary between sinusoidal and fixed yaw at high betaprime if 1 is specified in column 10	80.0 deg

2.5.50 TSTLOV

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TSTLOV
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TSTLOV - Requests application of an acceleration due to thermal radiation emitted from the louvers on spacecrafts other than TOPEX.	
18-24	I7	Satellite ID (required).	0
25-44	D20.8	Magnitude of the acceleration in the spacecraft body fixed frame. component of normal vector if 1 is specified in columns 13-14)	0 m/s**2
45-59	D15.3	X component of normal vector of the acceleration in the spacecraft body-fixed frame.	
60-72	D13.1	Y component of normal vector of the acceleration in the spacecraft body-fixed frame.	
73-80	D15.3	Z component of normal vector of the acceleration in the spacecraft body-fixed frame.	

IF CARD OMITTED: no louver accceleration will be applied.

2.5.51 TUMSOL

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
TUMSOL
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TUMSOL - Introduces the application of the TUM (Tehcnical University of MUNICH) solar radiation model. (only applicable to GPS satellites)	
7	I1	= 0 The model will apply to all satellites = 1 The model will apply to the satellite on on columns 18-24	
8	I1	= 1 Return complete solar radiation acceleration = 2 Return only the solar orientation bias	1
9	I1	= 1 Return contribution of Y-bias acceleration = 2 Exclude Y-bias acceleration	2
18-24	I7	Satellite ID	

2.5.52 VARCOV

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
VARCOV  0 10      7654321                1.0D+14      1.0D+14      1.0D+14  1.0D+14
VARCOV  0 11      7654321                1.0D+14      1.0D+14
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	VARCOV - A-priori variance/covariance matrix for the satellite epoch elements.	
8	I1	Indicator of coordinate system of adjustment. 0 or 1 - Cartesian. 2 - Keplerian. 3 - Low e and i (Non-singular Keplerian).	0
9	I1	Indicates whether diagonal or upper triangular part of matrix will be input. 0 - Diagonal elements only. 1 - Upper triangular matrix.	0
11-12	I2	Card identifier (REQUIRED) (see examples next page).	0
18-24	I7	Satellite ID. (blank or zero means apply to all satellites).	0
25-44	D20.8	Element #1 of var/cov matrix as determined by column 11. [1]	0.
45-59	D15.3	Element #2 of var/cov matrix as determined by column 11. [1]	0.
60-72	D13.1	Element #3 of var/cov matrix as determined by column 11. [1]	0.
73-80	D8.2	Element #4 of var/cov matrix as determined by column 11. [1]	0.

Example 1 - Diagonal elements of variance/covariance matrix

1-6	8	9	11-12	18-24	25-44	45-59	60-72	73-80
VARCOV			10	7654321	V11	V22	V33	V44
VARCOV			11	7654321	V55	V66		

Example 2 - Upper triangular variance/covariance matrix

1-6	8	9	11-12	18-24	25-44	45-59	60-72	73-80
VARCOV			1	10	7654321	V11	V12	V13
VARCOV			1	11	7654321	V15	V16	

VARCOV	1	20	7654321	V22	V23	V24	V25
VARCOV	1	21	7654321	V26			
VARCOV	1	30	7654321	V33	V34	V35	V36
VARCOV	1	40	7654321	V44	V45	V46	
VARCOV	1	50	7654321	V55	V56		
VARCOV	1	60	7654321	V66			

Where V_{ij} represent "i"th row and the "j"th column and where the units are as defined by the tables below.

Cartesian Variance/Covariance Units

\ j		1	2	3	4	5	6
i \		-----					
1		M**2	M**2	M**2	M*M/S	M*M/S	M*M/S
2			M**2	M**2	M*M/S	M*M/S	M*M/S
3				M**2	M*M/S	M*M/S	M*M/S
4					(M/S)**2	(M/S)**2	(M/S)**2
5						(M/S)**2	(M/S)**2
6							(M/S)**2

Keplerian Variance/Covariance Units

\ j		1	2	3	4	5	6
i \		-----					
1		M**2	M	M*RAD	M*RAD	M*RAD	M*RAD
2			()**2	()*RAD	()*RAD	()*RAD	()*RAD
3				RAD**2	RAD**2	RAD**2	RAD**2
4					RAD**2	RAD**2	RAD**2
5						RAD**2	RAD**2
6							RAD**2

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds
 ()=Unitless

IF CARD OMITTED: Diagonal matrix with values of 1.0D+14 will be used

2.5.53 YAWBIA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
YAWBIA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	YAWBIAS: Requests for application of yaw bias	
18-24	I7	Satellite ID	
25-44	D20.8	Yaw bias	0.0 deg.
45-59	D15.3	Start time	EPOCH start time
60-72	D13.1	End time	EPOCH end time

IF CARD OMITTED: Yaw bias will not be applied.

2.5.54 DATA SELECTION / DELETION SUBGROUP

2.5.54.1 DATA

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DATA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-4	A4	DATA - Indicates data reduction mode utilizing an input data file on unit 41, and introduces the data selection subgroup.	

Note: GEODYN II assumes orbit generation type of run unless a DATA or SIMDAT card is present in the arc.

DATA SELECTION SUBGROUP

The DATA card must be present in any arc which requires a data file.

The DATA SELECTION SUBGROUP begins with the DATA card and ends with the ENDARC card. The ENDARC card must be the last card in the arc. The DATA SELECTION SUBGROUP consists of the following keyword cards:

ENDARC METDAT OBSCOR PREPRO SELECT/DELETE SIGMA

and must contain at least one SELECT card.

IF CARD OMITTED: Program will operate in orbit generation mode

2.5.54.2 SELECT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SELECT          517603901                      830901                      830903
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0
COLUMNS FORMAT          DESCRIPTION                      DEFAULT VALUE & UNITS

```

1-6	A6	SELECT - Requests the selection of observation data for the data reduction process. Any OBSCOR, SIGMA, METDAT, and PREPRO cards that precede the first SELECT card apply to all data except where explicitly overridden.	
7-14	I8	Station number.	0
15	I1	Station satellite configuration sequence number.	0
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types Section 5.0.	0
18-24	I7	Satellite ID.	0
25-30	I6	Measurement modulo number.	1
31-40	D10.8	Measurement Type. 3 digits or less. Will be converted to an integer. See list of measurement types Section 5.0.	0
41-46	I6	Start date in form YYYYDD. :	Earliest Start date and time from EPOCH card(s).
47-50	I4	Start time in form HHMM. :	
51-60	D10.8	Seconds of start time. :	
61-66	I6	Stop date in form YYYYDD. :	Latest Stop date and time from EPOCH card(s).
67-70	I4	Stop time in form HHMM. :	
71-80	D10.8	Seconds of stop time. :	

IF CARD OMITTED: No data will be selected.

2.5.54.3 DELETE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE          517603901                830901                830903
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DELETE - Requests the deletion of observation data for the data reduction process.	
7-14	I8	Station number. [1]	0
15	I1	Station satellite configuration sequence number. [2]	0
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0
18-24	I7	Satellite ID. [1]	0
25-30	I6	Measurement modulo number.	1
31-40	D10.8	Measurement Type. 3 digits or less. Will be converted to an integer. See list of measurement types after ENDARC description.	0
41-46	I6	Start date in form YYMMDD. :	Earliest Start
47-50	I4	Start time in form HHMM. :	date and time from
51-60	D10.8	Seconds of start time. :	EPOCH card(s).
61-66	I6	Stop date in form YYMMDD. :	Latest Stop
67-70	I4	Stop time in form HHMM. :	date and time from
71-80	D10.8	Seconds of stop time. :	EPOCH card(s).

NOTES:

[1] Unless a specific configuration sequence number is specified on col. 15, all measurements that include this station or this satellite will be deleted (or selected).

[2] The station/satellite configuration number enables the user to delete (or select) measurement types including more than one station or more than one satellite without affecting other configurations which may include the same station or the same satellite.

Here are some examples:

In the case of measurement type 51 (two-way range) where only one station and one satellite are involved, the user does not need to specify anything on col. 15 of the DELETE or the SELECT card.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE          517603901                      830901                      830903
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

will delete all measurements 51 from all stations to satellite # 7603901 between the times 830901 and 830903.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE      314 517603901                      830901                      830903
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

will delete all measurements 51 from station 314 to satellite # 7603901 between the times 830901 and 830903.

In the case of measurement type 61 (singly differenced one way ranges where we have one satellite and two stations we will need two DELETE (or SELECT) cards for precise specification of the configuration ie.

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE      3211618003201
DELETE      4212618003201
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

This means, delete all measurement types 61 from configurations where station 321 is the first station and 421 is the second station in the configuration both observing satellite # 8003201.

Another example is given here for measurement type 87 (doubly differenced one way ranges) (GPS):

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE      3211878003201                      870103121956                      870103122156
DELETE      4212878307201                      870103121956                      870103122156

DELETE      5211878003201                      870103115956                      870103120156
DELETE      4212878307201                      870103115956                      870103120156

DELETE      3211878509301                      870103100156                      870103100556
DELETE      4212878307201                      870103100156                      870103100556

DELETE      5211878509301                      870103093756                      870103094156
DELETE      4212878307201                      870103093756                      870103094156
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8

```

This setup will delete all observations of measurement type 87 with the following configurations:

1. stat 1 =321, stat 2= 421, sat 1= 8003201 and sat 2= 8307201 between times 870103 121956.000 and 870103 122156.000 (Cards 1 and 2)
2. stat 1 =521, stat 2= 421, sat 1= 8003201 and sat 2= 8307201 between times 870103 115956.000 and 870103 120156.000 (Cards 3 and 4)

3. stat 1 =321, stat 2= 421, sat 1= 8509301 and sat 2= 8307201
between times 870103 100156.000 and 870103 100556.000
(Cards 5 and 6)

4. stat 1 =521, stat 2= 421, sat 1= 8509301 and sat 2= 8307201
between times 870103 093756.000 and 870103 094156.000
(Cards 7 and 8)

An efficient way for the user to find out how many DELETE
(or SELECT) cards he/she needs for each measurement type is
to look at section 5.0 in Vol 3 of the GEODYN II documentation
(Measurement types). The measurement type description indicates
how many stations and satellites are involved.

Assuming we have three stations and three satellites involved,
the way to find out which goes on configuration number 1, 2 or 3
is to look at the unit 90 output of TDF. Satellites and stations
under the label ONE, TWO or THREE correspond to the DELETE
(or SELECT) card configuration number.

It is important for these complicated measurement types to
specify information on as many DELETE (or SELECT) cards as
the maximum number of stations or satellites involved in the
measurement type.

IF CARD OMITTED: No data that has been selected will be deleted.

2.5.54.4 METDAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
METDAT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	METDAT - Allows input of meteorological data overriding information on data.	
7-14	I8	Station number.	0
18-24	I7	Temperature in millidegrees K.	0
25-30	I6	Relative humidity in thousandths of percent.	0
31-40	D10.8	Atmospheric pressure in millibars.	0.
41-46	I6	Start date in form YYMMDD. :	Earliest Start
47-50	I4	Start time in form HHMM. :	date and time from
51-60	D10.8	Seconds of start time. :	EPOCH card(s).
61-66	I6	Stop date in form YYMMDD. :	Latest Stop
67-70	I4	Stop time in form HHMM. :	date and time from
71-80	D10.8	Seconds of stop time. :	EPOCH card(s).

IF CARD OMITTED: Meteorological corrections will be obtained from observation data records if present or will be defined as 293.16 degrees Kelvin, 40 percent relative humidity, and 1013.5 millibars scaled by the altitude in meters (H) of the tracking station, $P=1013.5*(1-1.1138D-4*H)$.

2.5.54.5 OBSCOR

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
OBSCOR
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	OBSCOR - Constant bias observation corrections as provided on this card are to be subtracted from the data to which this card applies.		
7-14	I8	Station number.	0	
15	I1	Station/satellite configuration.	0	
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0	
18-24	I7	Satellite ID.	0	
25-30	I6	Measurement Type. 3 digits or less. See list of measurement types after ENDARC description.	0	
31-40	D10.8	Observation correction.	0.	M, M/S or RAD
51-60	D10.8	Observation #2 correction.	0.	RAD
71-80	D10.8	Time correction.	0.	S

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds

IF CARD OMITTED: Constant bias corrections will not be subtracted.

2.5.54.6 PREPRO

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PREPRO
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PREPRO - Requests data preprocessing. Provides a means of overriding observation data preprocessing indicators which may be in error.	
7-14	I8	Station number.	
15	I1	Station/satellite configuration.	
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0
18-24	I7	Satellite ID.	
25	I1	Indicates header record PREPRO word to which the information on the this card applies. 0 - PREPRO words on all header records 9 - PREPRO words on all Master header records n - PREPRO word on Header record number "n" (n<4).	

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
26	I1	Defines default actions for columns 27-30, 41-50, and 61-70 if those columns remain blank or zero. Value Action 0 Compute and apply corrections as indicated by the PREPRO word. 1 Only apply corrections already provided by the data. 2 Ignore the data block PREPRO words and apply corrections appropriate for this type data. 3 Remove corrections provided in the data.	

	4	Remove corrections provided in the data and compute and apply corrections appropriate for this type of data.	
27-30	4I1	Switches for bits 1-4 of PREPRO word.	
41-50	10I1	Switches for bits 5-14 of PREPRO word.	
61-70	10I1	Switches for bits 15-24 of PREPRO word.	
71-80	D10.8	Measurement Type. 3 digits or less. Will be converted to an integer. See list of measurement types after ENDARC description.	0

NOTES: [1] Columns 27-30, 41-50, 61-70 have different meanings for different types of data. However, digits specified in these columns result in actions being taken by the program in the same manner as indicated for column 26.

[2] If PREPRO is intended to apply to all data a PREPRO card should precede all SELECT cards otherwise PREPRO applies only to its preceding SELECT card in the setup.

IF CARD OMITTED: The absence of a PREPRO card is an indicator that the observation data is to be used as it appears on the input data file.
With a blank PREPRO card corrections will be applied as indicated by the PREPRO word on all header records.

2.5.54.7 SIGMA

```

-----1-----2-----3-----4-----5-----6-----7-----8
SIGMA      7010 517603901      .10                      .25
-----0-----0-----0-----0-----0-----0-----0-----0

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	SIGMA - Permits specification of observation weighting and editing sigmas.	
7-14	I8	Station number.	0
15	I1	Station/satellite configuration #.	0
16-17	I2	Measurement Type. 2 digits or less. See list of measurement types after ENDARC description.	0
18-24	I7	Satellite ID.	0
25-30	I6	Measurement Type. 3 digits or less. See list of measurement types after ENDARC description.	0
31-40	D10.8	Observation standard deviation. Used in forming normal equations.	Obtained from data
41-46	I6	Flag used to indicate if value in columns 31-40 will scale the data observation sigma or replace the data observation sigma. 0=replaced obssig with value in columns 31-40 1=scale obssig by value in columns 31-40	0
51-60	D10.8	Observation editing sigma. Used for data editing only. If this field is left blank the standard deviation specified in columns 31-40 will be used for data editing.	Value in cols. 31-40

Units for sigmas are : Range - M, Range Rate - CM/S, Angles - AS

UNITS: KM =Kilometers; M =Meters ; S =Seconds ; Kg =Kilograms
 DEG=Degrees ; RAD=Radians ; AS =Arc seconds; MAS=Milli-arc seconds
 CM =Centimeters

NOTE : If SIGMA is intended to apply to all data, a SIGMA card should precede all SELECT cards, otherwise SIGMA applies only to its preceding SELECT card in the setup. An example is provided here:

```
SIGMA      40          2.0          2.0
```

SELECT			90041300000.	900414000000
SIGMA	40	0.0	0.0	
SELECT			90041400000.	900415000000
SIGMA	40	1.0	1.0	
SELECT			90041600000.	900417000000
SIGMA	40	0.0	0.0	

In the example above $\sigma = 0.0$ will be applied to all measurements between 900413 and 900414 and between 900416 and 900417, $\sigma = 1.0$ will be applied to all observations between 900414 and 900415, $\sigma = 2.0$ will be applied to all observations between 900415 and 900416. The epoch times in this example are 900413 and 900417.

IF CARD OMITTED: Sigma on data records will be used.

2.5.55 ARC SET TERMINATOR

2.5.55.1 ENDARC

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ENDARC
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDARC - End of DATA SUBGROUP and end of arc indicator. Must be last card in any DATA SUBGROUP section. Only the following option cards can exist between a DATA card and an ENDARC card: SELECT,DELETE, METDAT,OBSCOR,PREPRO and SIGMA.	

3 GENERAL INFORMATION ABOUT GEODYN-II

In the following section a general description is given concerning INPUT/OUTPUT files used by GEODYN-II. The INPUT/OUTPUT files include file names, format specifications for the scratch units and descriptions for both GEODYN-IIS and GEODYN-IIIE I/O files including space allocation requirements where needed. Furthermore, the ephemeris files (GEODYN IIS UNIT 1) and the tables file (polar motion, UT1, solar and geomagnetic flux) (GEODYN IIS UNIT 2) are provided. Brief descriptions of the default gravity field file (GEODYN IIS UNIT 12) and the default station geodetics file (GEODYN IIS UNIT 16) are also given.

Unit names on various computers

Computer	Name
-----	----
IBM	FTNNF001
CRAY	fort.N
HP	ftnNN

NN = 01,02,.....,99

N = 1,2,.....,99

3.1 GEODYN-IIS INPUT/OUTPUT FILE NAMES AND BRIEF DESCRIPTIONS

UNIT NO.	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
1	VBS	6296	6300(DE 96)	JPL Planetary Ephemeris input.
	VBS	6620	6624(DE118)	Necessary for all runs.
	VBS	6620	6624(DE200)	
2	VBS	196	7294	Polar Motion, UT1, and Solar & Geomagnetic Flux input. Necessary for all runs.
5	FB	80	*	GEODYN-IIS Input Control Data. Necessary for all runs.
6	VBA	137	#	General Printer Output.
8	FB	80		LRA correction file
11				Interface File output to GEODYN-IIE
BINARY	VBS	X	15476	Allocated default space of 90 tracks will hold
ASCII	FB	132	15048	4050 blocks of observations and minimal number of parameters. Recommended space is 30 tracks, and in case additional space is needed, add 1 track per 45 blocks of observations. Space on unit 11 is a function of the number and the type of the parameters used, the number of observations and the number of blocks of observations.
12	FB	80	*	Default Gravity File. See description at the end of this section. (Section 3.5)
15	FB	80	3120	Default Spacecraft Area and Mass Table. (DUMMY) N/A
16	FB	80	*	Default Station Geodetics File. See description at the end of this section. (Section 3.6)
17	FB	80	*	Default Simulated Data Control Data See description at the end of this section. (Section 3.7)
18	VBS	X	15476	File which contains harmonic expansion coefficients that describe the atmospheric effect on the gravity coefficients (See Vol 3 ATGRAV)

20	VBS	X	15476	Proudman functions input file (See Vol 3 OTMOD and Vol 5 Section 2.10)
21	VBS	X	15476	Sea Surface Topography functions input file (See Vol 3 SSTMOD and Vol 5 Section 2.10)
23	FB	80	8000	Input file for station height modification (See INSTRMNT card col. 10)
30	VBS	X	15476	Scratch file used for planetary ephemeris processing. Allocated space of 5 tracks will hold 1135 ephemeris records (32 days each. For additional n output records increase the number of tracks by $((n-1)/227)+1$.
40	VBS	X	15476	Input Observation Data file (from Tracking Data Formatter). Necessary for all data reduction runs.
41	BINARY	VBS	X	Selected Observation Data file output to GEODYN-IIE. Necessary for all data reduction runs.
	ASCII	FB	132	15048 One track is required for every 50-100 observations depending on measurement type. Default allocated space 60 tracks.
42	U		32000	Observation Directory scratch file. Allocated space of 200 blocks of 32000 bytes each will hold 200 observation directory records. The number of observation directory records is also the number of output logical blocks of observations. For additional space the maximum number of observations per pass/500 gives the number of output logical blocks and therefore the number of additional blocks required.

UNIT NO.	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
43	VBS	X	15476	Pass-by-pass bias scratch file. Allocated space of 10 tracks will hold 2020 pass records. For additional passes increase the number of tracks by $((n-1)/202)+1$
50	FB	80	3520	Copy of setup deck scratch file. Allocated space of 6 tracks will hold information from 1428 cards. For additional n input cards increase number of tracks by $n*80/BLKSIZE$
52	VBS	X	15476	Scratch files for ARC information. Allocated space should be less than or equal to the space required for UNIT 11.

53	VBS	X	15476	Scratch files for ARC information. Allocated space should be less than or equal to the space required for UNIT 11.
77				File containing external sunlight ratio data to be used if called for on the SOLRAD card.
88	FB	80	15040	File containing GEODYN warnings for the TOPEX Expert Systems.
89	VBS	X	15476	File containing A1-UTC time differences
90				Debugging output file (DUMMY)
91				Debugging output file (DUMMY)
** exat##	VBS	X	15476	External attitude file. ## is the number of the arc for which the external attitude applies.

* BLKSIZE FOR FB FILES IS PROVIDED BY THE SYSTEM

** THERE IS NO UNIT NO. FOR THIS FILE. FILENAME IS SPECIFIED EXPLICITLY.

BLKSIZE FOR VBA FILES IS PROVIDED BY THE SYSTEM

3.2 GEODYN-IIIE INPUT/OUTPUT FILE NAMES AND BRIEF DESCRIPTIONS

UNIT NO.	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
5	FB	80	3200	Debug print switch input (N/A)
6	VBA	137	#	General printer output
7	FB	80	3200	Updated setup ('punched') output
8	VBA	137	#	Cartesian ephemeris printer output
9	FB	80	8000	Terminal output (see TERMVU description)
10	VBS FB	X 132	15476 15048	Keplerian ephemeris printer output. VBS for unformatted and FB for formatted.
11	VBS FB	X 132	15476 15048	Interface file from IIS. VBS for unformatted (BINARY) and FB for formatted (ASCII).
12	VBS FB	15470 132	15476 15048	Observation file from IIS (DCB for binary and ascii).
13	U	18944	18944	Observation random access scratch file. Allocated space equal or larger than space of data set used on UNIT 12. For additional n observations increase the number of tracks by $((n+5)+(n+5)*4)/18944$
14	FB	80	15040	Copy of setup deck scratch file. Allocated space of 20 tracks will hold 4760 cards. For cards add 1 track per 238 cards.
15	VBA	137	#	Normal point printer report file.
16	VBA	137	#	Preprocessing corrections printer file.
17				PDOUT file.
18				Geolocation Output file.
19	VBS	X	15476	Observation/Residual output file
20	VBS	X	15476	Simulation/Normal Point Generation output file Space requited is the same as in GEODYN IIS UNIT 41.
27	VBS	X	15476	Proudman function Direct access file
30	VBS	X	15476	Recommended unit for trajectory file.
35	FB	80	*	Shadowing beginning and end times in the form of DELETE cards. Used only by simulated data option.

42-48	VBS	X	15476	GPS shadwing
51	VBS	X	15476	Work file for partial derivative storage when forming normal equations by parts. Total amount of partial derivative scratch space when forming the normal equations with partitioning will be $2*(20+NUMBER\ OF\ ADJUSTED\ PARAMETERS)*NUMBER\ OF\ WEIGHTED\ MEASUREMENTS*8/15476$ tracks.
5x 55 6x 70	VBS	X	15476	Optional work files for partial Optical Data Auxillary file derivative storage when forming normal equations by parts.
62	VBS	X	15476	Dstate Constraints
66	VBS	X	15476	External Ephemeris output. See Volume 3 - XEPHEM input card. See Volume 5 - Section 4.
67	VBS	X	15476	File used for the Yarkovksy model
71	VBS	X	15476	E-matrix output files ($x > 0$). Space required is $((NUMBER\ OF\ ADJUSTED\ PARAMETERS)**2)*4/15476$ tracks.
80	VBS	X	15476	V-matrix output files. (N/A) Space required is $((6*NUMBER\ OF\ ADJUSTED\ FORCE\ MODEL\ PARAMETERS + 12)*(LENGTH\ OF\ ARC/OUTPUT\ RATE)+5*[(3*NUMBER\ OF\ ADJUSTED\ MODEL\ PARAMETERS)+12])/15476$ tracks.
88	FB	80	15040	File containing GEODYN. warning messages for the TOPEX Expert System.
90	VBS	X	15476	Measurement Partial Derivative output. (N/A) Space required is $((50+NUMBER\ OF\ ADJUSTED\ PARAMETERS)*NUMBER\ OF\ OBSERVATIONS)+(6*NUMBER\ OF\ ADJUSTED\ PARAMETERS+1))/15476$ tracks.
96	FB	132	13200	Unit 96 writes out station position changes due to ocean loading.
97	binary ieee - 64 bit binary on Cray			Spacecraft telemetry file.
98	FB	132	13200	Unit 98 writes out station position changes due to the solid tide.
99	FB	132	13200	Unit 99 writes out station position effects where the station height has been modified

using the INSTRMNT card (col. 10).

400

Unit 400 writes out the troposphere EBIAS and the zenith path delays if the option is selected on the REFRAC card.

* BLKSIZE FOR FB FILES IS PROVIDED BY THE SYSTEM
BLKSIZE FOR VBA FILES IS PROVIDED BY THE SYSTEM

3.3 PLANETARY EPHEMERIS FILES

DATA SET NAME	EPHEMERIS	TIME SPAN COVERED
CRAY (charney)		

/u2/z8sgp/geodyn/support/ephmbin.data	DE200	
HP (geodesy2)		
--		
/geod4/geodyn/SUPPORT/ephem.data	DE200	
ephem403.data	DE403	
SUN (Canopy)		

/home/geodyn/support/ephem.data	DE200	
ephem403.data	DE403	

3.4 POLAR MOTION, UT1, SOLAR AND GEOMAGNETIC FLUX FILE

CRAY (charney)

/u2/z8sgp/geodyn/support/gdntable.data

HP (geodesy2)

--

/geod4/geodyn/SUPPORT/gdntable.data

SUN (Canopy)

/home/geodyn/support/gdntable.data

3.5 DEFAULT GRAVITY FIELD FILE (UNIT 12)

UNIT 12 in GEODYN IIS is used as input unit for gravity field setup. Gravity information on UNIT 12 will be used unless other information is input on UNIT 05. Cards which can be input on UNIT 12 are the following:

- TITLE which contains descriptive information.
- EARTH which introduces earth constants.
- GCOEF which C and S defines coefficients in the geopotential model.
- GCOEFC which defines C coefficients in the geopotential model.
- GCOEFS which defines S coefficients in the geopotential model.

The structure of this file is such that the first card is a TITLE card followed immediately by an EARTH card and then as many GCOEF or GCOEFC and GCOEFS cards as necessary to define all of the spherical harmonic coefficients. All the GCOEFC cards should be together followed by all the GCOEFS cards. Estimation information input on UNIT 12 is ignored.

See GLOBAL SET EARTH, GCOEF, GCOEFC, GCOEFS for detailed description and format. EARTH, GCOEF, GCOEFC and GCOEFS cards on UNIT 05 override information on the same cards on UNIT 12.

3.6 DEFAULT CARD IMAGE STATION GEODETICS FILE (UNIT 16)

UNIT 16 in GEODYN IIS is used as input unit for Stations position setup. Station position information included on UNIT 16 will be used unless other information referring to the same stations is included on UNIT 05. Cards to be included as input to UNIT 16 are the following:

- STAPOS which introduces the station position subgroup
- GEODETIC which defines station geodetic information
- EXTRAGEO which specifies planetary shape parameters
- ELCUTOFF which sets station elevation cutoff angle
- INSTRMNT which sets station antenna and provides operating frequency information
- STATION COORDINATE which gives the station positions
- STATION VELOCITY GROUP CARDS (STAVEL, TIMVEL only)
- STATION EARTH TIDES COEFFICIENT CARDS (STATH2 and STATL2)
- ENDSTA which denotes the end of the station position subgroup

The structure of this file is such that the first card should be a STAPOS card and the last card is a ENDSTA card. STATION COORDINATE cards, STATION VELOCITY cards and STATION EARTH TIDES COEFFICIENT cards follow the appropriate cards of other types necessary to specify the conditions that are to apply to those station locations.

Cards which contain adjustment information (ADJUSTED, CORREL, CONSTADJ, CONSTEND) are not to be included on UNIT 16.

For detailed description see the GLOBAL SET STAPOS subgroup. Input cards included on UNIT 05 will override input cards on UNIT 16.

3.7 DEFAULT SIMULATED DATA CONTROL FILE (UNIT 17)

UNIT 17 in GEODYN IIS is used as input for the simulated data capability where observations are to be created not from real data replacement with computed observations but from generation of simulated tracking data according to the users instructions. These instructions are to be supplied in UNIT 17 as a set of input cards containing information about measurement types, station/satellite configuration, times and various other limitations. The same information may be specified on UNIT 05 instead, right after the ARC OPTION SIMDAT card. Information on UNIT 05 overrides information on UNIT 17. Data created using this capability after being checked for visibility will be output on UNIT 20 in the internal GEODYN II format and therefore they can be reintroduced later into GEODYN IIS as if they were real data.

The simulated data generation capability is introduced by including a SIMDAT card in the ARC section of UNIT 05. The ARC OPTION SIMDAT card must have a 1 on column 8, otherwise simulated data will be generated by replacing real observations with the computed ones.

The input cards in UNIT 17 (or UNIT 05) must begin with a SIMDAT card. This card is NOT the same as the ARC OPTION SIMDAT card. Its presence requests simulated data generation according to the specifications that follow. The cards which can be included on UNIT 17 are the following:

```
SIMDAT
SIMLIM

SIMSAT .
SIMSTA .   These cards are called the simulated
SIMTYP .   data configuration group.
SIMTIM .
ENDCON .

ENDSIM
```

The sequence of the input cards is as given above. The SIMDAT card is mandatory. The SIMLIM card introduces certain limitations for the blocks of data to be generated.

The simulated data configuration group describes in five cards elements and scheduling information for the simulation. These cards are described individually in the next chapter. The last card in this group is the ENDCON card and denotes the end of this particular configuration.

The user may include as many simulated data configuration groups as desired. Finally the ENDSIM card denotes the end of the simulated data generation input.

A detailed description of all the cards on UNIT 17 is given in Section 2.6 right after the SIMDAT arc option card and right before the SOLRAD arc option card.

4 TRACKING DATA FORMATTER OPERATIONS

The Tracking Data Formatter program is designed to convert data in a variety of formats to blocked GEODYN-II binary format. (64-bit floating point format). Input to the program consists of BIH tables, a set of users option cards and data of various format types falling into one of the following categories:

1. PCE Data Format
2. GEOS-A/B Card Image Format N/A
3. GEOS-C Card Image Format
4. GEODYN Binary Format
5. GEODYN Binary Format extended for Altimetry

Chronologically ordered files containing any kind of the above data types can be input and they are block time merged. The output observation file (IUNT41) contains blocks of data sorted by measurement type and by tracking pass.

The Tracking Data Formatter includes input card processing and a limited amount of data preprocessing.

The input cards introduce certain limits and requirements for further data reduction, (special description follows).

During measurement processing input files of data are read and time merged. Furthermore they are converted into internal binary format and each preprocessing word is decomposed. Range data are transit time corrected (all time changed to ground received) and all data are changed to UTC time. Logical file blocks are formed which include one measurement type from one tracking pass per output block. Preprocessing words are composed according to GEODYN-II binary tracking data format and the Header Record as well as the Observation Records are formed for each block.

4.1 INPUT / OUTPUT UNITS

INPUT UNITS

UNIT #	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
2	VBS	196	7294	BIH tables (same as required for GEODYN-II runs)
5	FB	80		User option cards (see special description)
22-40				Data in the format specified in the FORMAT card. Only six of these units can be used at any one time. See FORMAT card in input option description.

OUTPUT UNITS

UNIT #	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
6	VBA	137	#	Printer output giving summary of run.
41	VBS	X	15476	Tracking data in format compatible with GEODYN-II Allocated space 600 tracks.
90	VBA	137	#	Printer output giving summary of each block of data reformatted.

SCRATCH UNITS

UNIT #	FORMAT			DESCRIPTION
	RECFM	LRECL	BLKSIZE	
20	VBS	X	15476	Scratch file for the altimeter crossover identification (could be a dummy file in non-crossover runs)
21	U		15476	Scratch file used when forming new physical blocks. Allocated space of 100 tracks will hold 100 physical blocks. Each physical block contains 236 logical records of length 10
50	FB	80		Copy of setup deck scratch file Allocated space 2 tracks.

4.2 TDF UNIT 5 INPUT CARDS

In the following pages a complete description of all the cards which could be used as input to the Tracking Data Formatter is given.

Information specified by these cards include format of input data, size limitations for logical blocks to be formed, a set of data select cards, an option card for normal point data and a set of cards used for altimetry data.

It is mandatory to use a FORMAT card unless GEODYN binary data are used. PASS and MAXOBS are optional cards. The Tracking Data Formatter input cards may include a DATA SELECTION subgroup similar in editing capabilities to the DATA SELECTION subgroup of GEODYN-IIS. This subgroup must start with a DATA card and end with an ENDDAT card. It may include cards for data selection and deletion limitations and specifications concerning normal points in case this option is desired.

Each individual input UNIT must be represented by its own DATA SELECTION subgroup. If DATA SELECTION conditions are the same for all input UNITS then the DATA SELECTION subgroup must be included after the last FORMAT card.

For altimetry data the set of ALTIM and LOCDAT cards should both be input and in the above sequence. The ENDALL card denotes the end of the Tracking Data Formatter input cards.

4.2.1 FORMAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
FORMAT          40  0
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	FORMAT	
13-14	I2	Unit number for input of data in the format denoted by the number in column 17 (must be greater than 22 and smaller than 41)	40
16	I1	Type of binary data [4] 0 - Binary data is old IBM format which has I*2's and R*4's. 1 - Binary data is new IBM format which only has I*4's and R*8's.	0
17	I1	Type of Data Format Indicator [3] 0 - Geodyn binary 1 - 90 byte ASCII Range Rate Data 2 - Merit II SLR Data 3 - GEOS-3 card image - 80 byte format 4 - Extended Geodyn binary (altimetry) 5 - PCE [2] 6 - Extended GEOS-3 card image - 120 byte format 7 - GPS metric type format 8 - VLBI binary format 9 - Merit-X SLR Data from CRD reformatter	
18	I1	Extended Geodyn altimetry binary format type 0 - Old extended format (34, 8 byte words for a I64 machine or 38, 4 byte words for a I32 machine) 1 - Super extended altimetry format (54, 8 byte words for a I64 machine or 58, 4 byte words for a I32 machine)	(default)
24	I1	Time system indicator change 7 Converts time system indicator 7 of modified SSD data to a 3 (UTC BIH). If this is omitted epoch time scale will be considered as being ET	
30	I1	1 - Indicates altimetry data on this input unit 2 - Indicates crossover data on this unit	

- NOTE [1]: One format card must be present for every type of data used in the run, unless only Geodyn binary data is used, then the unit will default to 40. The data from the different units will be time merged. One can also use this to merge two sets of the same type data by inputting each set on a different unit. No more than 6 FORMAT cards can be input.
- NOTE [2]: If PCE data is input then the FIRST record in the data stream on the logical unit specified by the pertinent FORMAT card must have a 90 in columns 2 and 3 and the satellite ID is columns 22-45 (format D24.16). All data following this card goes with that satellite. If using PCE data from more than one satellite then insert another FIRST record each time the satellite ID changes. See Volume 5 for the format of the FIRST record.
- NOTE [3]: For a detailed description of the various formats see Volume 5, Section 1.0.
- NOTE [4]: This option only applies when the TDF is run on a computer that allows I*2 and R*4 data formats.
- NOTE [5]: Column 17 on this card should be 4 for this option.

4.2.2 GDYNEP

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
GDYNEP
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	GDYNEP - specifies a new Geodyn Internal Reference Time for this run	
25-30	I6	New Geodyn Internal Reference Time in "YMMDD". NOTE	410101 (JD = 2430000.5)

NOTE: If YY = [51-99] the year is 19YY
 If YY = [00-50] the year is 20YY

IF CARD OMITTED: TDF will use its default reference time

4.2.3 PASS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
PASS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-4	A4	PASS	
31-40	D10.8	Max time difference allowed between contiguous data records before starting new logical block (sec)	900

4.2.4 MAXOBS

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
MAXOBS
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	MAXOBS	
7-14	I8	Maximum number of observations allowed in one logical block (limit=9999) (default for PCE data is 500)	1000 [1]
18-24	I7	Maximum number of output buffers per logical block.(MAXBUF) MAXBUF must be less than or equal to 100 and greater than or equal to 10	10
25-30	I6	Maximum number of scratch buffers in core must be greater than or equal to 5 and less than or equal to 500. [2]	5 200
31-40	D10.3	Bin size in seconds for normal point calculations. If this is present then a value greater than zero must be entered in columns 51-60.	
41-46	I6	Maximum internal directories that can be open simultaneously during TDF execution. Must less than 1000. [3]	500
51-60	D10.3	Minimum spacing between data points for normal point calculation runs. All data closer than minimum spacing will be discarded. If this value is present then a value greater than zero must be entered in columns 31-40. This value can be overridden for specific stations and/or measurement types if NORMPT cards are present.	

NOTE [1]: IIS imposes two restrictions on a block of observations. No block can span a time period that is longer than 10*STEPSIZE, and no single block of observations from the TDF can be subdivided into more than 100 blocks in IIS. The number of IIS subdivisions is given by: IIS subdivisions= Number of observations in a block/(10*STEPSIZE/time interval between observations). If the number of IIS subdivisions is greater than 100, the maximum number of observations per block must be reduced.

NOTE [2]: If this parameter needs to be greater than 500, please contact the GEODYN Group. The error in TDF if 500 is not enough reads: "Unit 21, attempt to read past end of record"

NOTE [3]: Often when large data sets with many configurations are processed TDF stops with a message "UNIT21 attempt to read past the end of

record" . In that case please contact someone from Geodyn
group to help you.

4.2.5 DATA

```
-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DATA
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-4	A4	DATA Introduces the data selection subgroup.	

4.2.6 SELECT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
SELECT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE	UNITS
1-6	A6	SELECT - Requests data be selected between specific times.		
25-30	I6	Minimum spacing between observations	0	sec
41-46	I6	YYMMDD - year, month, day of time to begin data selection.		
47-50	I4	HHMM - hours, minutes of time to begin data selection.		
51-60	D10.8	SEC - seconds of time to begin data selection.		
61-66	I6	YYMMDD - year, month, day of time to end data selection.		
67-70	I4	HHMM - hours, minutes of time to end data selection.		
71-80	D10.8	SEC - seconds of time to end data selection.		

NOTE: [1] For low rate altimetry data to be produced, specify the minimum spacing in seconds in columns 25-30.

NOTE: [2] One can use only one SELECT card per input unit.

4.2.7 DELETE

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
DELETE
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	DELETE - Deletes data by either type or station	
7-14	I8	Station number - all data for this station will be deleted.	
16-17	I2	Measurement type - GEODYN I - all data of this type will be deleted.	

NOTE: One can use as many DELETE cards as necessary, however any one card can indicate only one station number or a measurement type. If both fields 7-14 and 16-17 are non-zero then the card is invalid.

4.2.8 NRMPNT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
NRMPNT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	NRMPNT - is used when normal point data is being processed to designate the minimum spacing between accepted data for specific station and/or measurement type. All data closer than minimum spacing (col 51-60) will be discarded. Default value on MAXOBS card will be used if no specific NRMPNT card is in for station or type	
7-14	I8	Station number - The minimum spacing in columns 51-60 will be used for all data from this station.	
16-17	I2	Measurement type - GEODYN I - the minimum spacing in columns 51-60 will be used for all data of this type.	
51-60	D10.3	Minimum spacing between data points in seconds. All data closer than this spacing will be discarded.	

NOTE: One can use as many NRMPNT cards as necessary. If only the station field is present it refers to all data from that station. If only the measurement type field is present then it refers to all data of that type. If both fields are present then it refers to only data of that type at that station. Cards with both fields present will override cards with only station or only measurement type fields defined. For this function the order of the cards does not play any role.

4.2.9 ENDDAT

```
-----1-----2-----3-----4-----5-----6-----7-----8
ENDDAT
-----0-----0-----0-----0-----0-----0-----0-----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDDAT - Indicates end of SELECT/DELETE cards.	

4.2.10 ALTIM

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
ALTIM          10
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-5	A5	ALTIM - Denotes set of LOCDAT cards immediately follow this card.	
13-14	I2	Number of LOCDAT cards that follow must be at least 1 and less than or equal to 5. THIS MEANS THAT AT LEAST ONE LOCDAT CARD IS NEEDED WITH THE ALTIMETRY RUNS. LOCDAT cards are informational only.	

4.2.11 LOCDAT

```

-----+-----1-----+-----2-----+-----3-----+-----4-----+-----5-----+-----6-----+-----7-----+-----8
LOCDAT
-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----+-----0-----

```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LOCDAT - This card is used for information only	
9-16	A8	Alphanumeric name denoting reference ellipsoid used for altimetry data.	
17-24	A8	Alphanumeric name denoting geoid on altimetry data.	
25-32	A8	Alphanumeric name denoting mean sea surface on altimetry data.	
33-40	A8	Alphanumeric name denoting orbits placed on altimetry data.	
41-60	D20.14	Semi-major axis of ellipsoid used to represent earth (meters).	
61-80	D20.14	Inverse of ellipsoidal flattening used in surface height calculations.	
NOTE 1:		At least one LOCDAT card must be included in all altimetry runs	
NOTE 2:		LOCDAT cards follow ALTIM card	
NOTE 3:		The number of LOCDAT cards must equal the value in columns 7-14 on the ALTIM card.	

4.2.12 ENDALL

```
-----1-----2-----3-----4-----5-----6-----7-----8
ENDALL
-----0-----0-----0-----0-----0-----0-----0-----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	ENDALL - Indicates end of unit 5 input no cards may follow this card.	

5 MEASUREMENT TYPE DESCRIPTIONS

TYPE NO.	MEASUREMENT DESCRIPTION (REV's 1.5 and later)
01	INERTIAL TRUE OF DATE "X" POSITION (S1) [NOTE 1]
02	INERTIAL TRUE OF DATE "Y" POSITION (S1)
03	INERTIAL TRUE OF DATE "Z" POSITION (S1)
04	INERTIAL TRUE OF DATE "X" VELOCITY (S1)
05	INERTIAL TRUE OF DATE "Y" VELOCITY (S1)
06	INERTIAL TRUE OF DATE "Z" VELOCITY (S1)
07	OSCULATING SEMI-MAJOR AXIS (S1)
08	OSCULATING ECCENTRICITY (S1)
09	OSCULATING INCLINATION (S1)
10	OSCULATING RIGHT ASCENSION OF ASCENDING NODE (S1)
11	OSCULATING ARGUMENT OF PERIGEE (S1)
12	OSCULATING MEAN ANOMALY (S1)
13	INERTIAL RIGHT ASCENSION (S1-->T1) or Laser Illum. (T2-->S1-->T1)
14	INERTIAL DECLINATION (S1-->T1) or Laser Illum. (T2-->S1-->T1)
15	LOCAL HOUR ANGLE (S1-->T1)
16	DECLINATION (S1-->T1)
17	AZIMUTH (S1-->T1)
18	ELEVATION (S1-->T1)
19	X-ANGLE (S1-->T1)
20	Y-ANGLE (S1-->T1)
21	l DIRECTION COSINE (S1-->T1)
22	m DIRECTION COSINE (S1-->T1)
23	LANDMARK SCAN ELEMENT (S1-->T1)
24	LANDMARK SCAN LINE (S1-->T1)
25	PLANETARY EDGE SCAN ELEMENT (S1-->T1)
26	PLANETARY EDGE SCAN LINE (S1-->T1)
27	CELESTIAL LANDMARK S/C B.C.F. RIGHT ASCENSION (S1-->T1)
28	CELESTIAL LANDMARK S/C B.C.F. DECLINATION (S1-->T1)
29	PLANETARY EDGE S/C B.C.F. RIGHT ASCENSION (S1-->T1)
30	PLANETARY EDGE S/C B.C.F. DECLINATION (S1-->T1)

NOTE [1]: For information on radial PCE data see volume 5, Section 1.2.

TYPE NO.	MEASUREMENT DESCRIPTION
31	VLBI DELAY (Q1-->T1,T2)
32	VLBI DELAY RATE (Q1-->T1,T2)
33	CAMERA DATA (IMAGES)
34	LANDMARK DATA (PLANET/ASTEROID ORBITING MODE OR HELIOCENTRIC MODE)
35	
36	DELTA-DOR ((S1-->T1)-(S1-->T2)) - (Q1-->T1,T2)
37	ONE-WAY PLANET-EARTH RANGE (P1T1-->T2)
38	ONE-WAY PLANET-EARTH DOPPLER (P1T1-->T2)
39	ONE-WAY STA-SAT RANGE (T1-->S1)
40	ONE-WAY STA-SAT DOPPLER (T1-->S1)

41 ONE-WAY RANGE (S1-->T1)
 42 ONE-WAY DOPPLER (S1-->T1)
 43 ONE-WAY SAT-SAT RANGE (S2-->S1)
 44 ONE-WAY SAT-SAT DOPPLER (S2-->S1)
 45 TWO-WAY GROUND TRANSPONDER RANGE (S1-->T1-->S1)
 46 TWO-WAY GROUND TRANSPONDER DOPPLER (S1-->T1-->S1)
 47 TWO-WAY EARTH-PLANET-EARTH RANGE (T2-->P1T1-->T2)
 48 TWO-WAY EARTH-PLANET-EARTH DOPPLER (T2-->P1T1-->T2)
 49 TWO-WAY SAT-SAT RANGE (S2-->S1-->S2)
 50 TWO-WAY SAT-SAT DOPPLER (S2-->S1-->S2)

51 TWO-WAY RANGE (T1-->S1-->T1)
 52 TWO-WAY DOPPLER (T1-->S1-->T1)
 53 THREE-WAY RANGE (T2-->S1-->T1)
 54 THREE-WAY DOPPLER (T2-->S1-->T1)
 55 THREE-WAY SAT-SAT RELAY RANGE (S2-->S1-->T2)
 56 THREE-WAY SAT-SAT RELAY DOPPLER (S2-->S1-->T2)+SF*(T2-->S1-->T2)
 57 FOUR-WAY SAT-SAT RELAY RANGE (T3-->S3-->S1-->S2-->T2)
 58 FOUR-WAY SAT-SAT RELAY DOPPLER (T3-->S3-->S1-->S2-->T2)+SF*
 (T2-->S2-->T2)
 59 FOUR-WAY SAT-TARGET RELAY RANGE (T3-->S3-->T1-->S2-->T2)
 60 FOUR-WAY SAT-TARGET RELAY DOPPLER (T3-->S3-->T1-->S2-->T2)+SF*
 (T2-->S2-->T2)

TYPE
 NO.

MEASUREMENT DESCRIPTION

61 SINGLY DIFFERENCED ONE-WAY RANGES (S1-->T1)-(S1-->T2)
 62 SINGLY DIFFERENCED ONE-WAY DOPPLERS (S1-->T1)-(S1-->T2)
 63 SINGLY DIFFERENCED ONE-WAY RANGES (S1-->T1)-(S2-->T1)
 64 SINGLY DIFFERENCED ONE-WAY DOPPLERS (S1-->T1)-(S2-->T1)
 65 SINGLY DIFFERENCED ONE-WAY SAT-SAT RANGES (S2-->S1)-(S3-->S1)
 66 SINGLY DIFFERENCED ONE-WAY SAT-SAT DOPPLERS (S2-->S1)-(S3-->S1)
 67 SINGLY DIFFERENCED ONE-WAY SAT-SAT RANGES (S2-->S1)-(S2-->T1)
 68 SINGLY DIFFERENCED ONE-WAY SAT-SAT DOPPLERS (S2-->S1)-(S2-->T1)
 69 SINGLY DIFFERENCED ONE-WAY PLANETRY RANGES (P1T1-->T2)-(P1T1-->T3)
 70 SINGLY DIFFERENCED ONE-WAY PLANETRY DOPPLERS (P1T1-->T2)-(P1T1-->T3)

71 SINGLY DIFFERENCED ONE- AND TWO-WAY RANGES (S2-->S1-->T2)-
 (S2-->T2)
 72 SINGLY DIFFERENCED ONE- AND TWO-WAY DOPPLERS (S2-->S1-->T2)-
 (S2-->T2)
 73 SINGLY DIFFERENCED THREE-WAY SAT-SAT RANGES (S1-->S2-->T2)-
 (S1-->S3-->T3)
 74 SINGLY DIFFERENCED THREE-WAY SAT-SAT DOPPLERS (S1-->S2-->T2)-
 (S1-->S3-->T3)
 75 SINGLY DIFFERENCED THREE-WAY SAT-SAT RANGES (S2-->S1-->T2)-
 (S3-->S1-->T3)
 76 SINGLY DIFFERENCED THREE-WAY SAT-SAT DOPPLERS (S2-->S1-->T2)-
 (S3-->S1-->T3)
 77 SINGLY DIFFERENCED TWO- AND THREE-WAY RANGES (T2-->S1-->T1)-
 (T2-->S1-->T2)
 78 SINGLY DIFFERENCED TWO- AND THREE-WAY DOPPLERS (T2-->S1-->T1)-

79 SINGLY DIFFERENCED FOUR-WAY SAT-SAT RANGES $(T2 \rightarrow S1 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow S1 \rightarrow S3 \rightarrow T3)$
 80 SINGLY DIFFERENCED FOUR-WAY SAT-SAT DOPPLERS $(T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) + SF2S * (T2 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow S1 \rightarrow S3 \rightarrow T3) - SF3S * (T3 \rightarrow S3 \rightarrow T3)$
 81 SINGLY DIFFERENCED FOUR-WAY SAT-TARGET RANGES $(T3 \rightarrow S3 \rightarrow T1 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow T1 \rightarrow S3 \rightarrow T3)$
 82 SINGLY DIFFERENCED FOUR-WAY SAT-TARGET DOPPLERS $(T3 \rightarrow S3 \rightarrow T1 \rightarrow S2 \rightarrow T2) + SF2T * (T2 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow T1 \rightarrow S3 \rightarrow T3) - SF3T * (T3 \rightarrow S3 \rightarrow T3)$
 83 SINGLY DIFFERENCED FOUR-WAY SAT&TARGET RANGES $(T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow P1T1 \rightarrow S2 \rightarrow T2)$
 84 SINGLY DIFFERENCED FOUR-WAY SAT&TARGET DOPPLERS $(T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) + SF2S * (T2 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow P1T1 \rightarrow S2 \rightarrow T2) - SF2T * (T2 \rightarrow S2 \rightarrow T2)$

TYPE
NO.

MEASUREMENT DESCRIPTION

85 DOUBLY DIFFERENCED ONE-WAY RANGES $[(S2 \rightarrow T1) - (S3 \rightarrow T1)] - [(S2 \rightarrow S1) - (S3 \rightarrow S1)]$
 86 DOUBLY DIFFERENCED ONE-WAY DOPPLERS $[(S2 \rightarrow S1) - (S3 \rightarrow S1)] - [(S2 \rightarrow T1) - (S3 \rightarrow T1)]$
 87 DOUBLY DIFFERENCED ONE-WAY RANGES $[(S1 \rightarrow T1) - (S2 \rightarrow T1)] - [(S1 \rightarrow T2) - (S2 \rightarrow T2)]$
 88 DOUBLY DIFFERENCED ONE-WAY DOPPLERS $[(S1 \rightarrow T1) - (S2 \rightarrow T1)] - [(S1 \rightarrow T2) - (S2 \rightarrow T2)]$
 89 DOUBLY DIFFERENCED ONE- AND TWO-WAY RANGES $[(S2 \rightarrow S1 \rightarrow T2) - (S2 \rightarrow T2)] - [(S3 \rightarrow S1 \rightarrow T3) - (S3 \rightarrow T3)]$
 90 DOUBLY DIFFERENCED ONE- AND TWO-WAY DOPPLERS $[(S2 \rightarrow S1 \rightarrow T2) - (S2 \rightarrow T2)] - [(S3 \rightarrow S1 \rightarrow T3) - (S3 \rightarrow T3)]$
 91 DOUBLY DIFFERENCED ONE- AND THREE-WAY RANGES $[(P1T1 \rightarrow S2 \rightarrow T2) - (P1T1 \rightarrow T2)] - [(P1T1 \rightarrow S3 \rightarrow T3) - (P1T1 \rightarrow T3)]$
 92 DOUBLY DIFFERENCED ONE- AND THREE-WAY DOPPLERS $(P1T1 \rightarrow S2 \rightarrow T2) - (P1T1 \rightarrow T2) - [(P1T1 \rightarrow S3 \rightarrow T3) - (P1T1 \rightarrow T3)]$
 93 DOUBLY DIFFERENCED TWO- AND THREE-WAY RANGES $(S1 \rightarrow S2 \rightarrow T2) - (T1 \rightarrow S2 \rightarrow T2) - [(S1 \rightarrow S3 \rightarrow T3) - (T1 \rightarrow S3 \rightarrow T3)]$
 94 DOUBLY DIFFERENCED TWO- AND THREE-WAY DOPPLERS $(S1 \rightarrow S2 \rightarrow T2) - (T1 \rightarrow S2 \rightarrow T2) - [(S1 \rightarrow S3 \rightarrow T3) - (T1 \rightarrow S3 \rightarrow T3)]$
 95 DOUBLY DIFFERENCED FOUR-WAY RANGES $[(T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow S1 \rightarrow S3 \rightarrow T3)] - [(T3 \rightarrow S3 \rightarrow T1 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow T1 \rightarrow S3 \rightarrow T3)]$
 96 DOUBLY DIFFERENCED FOUR-WAY DOPPLERS $[(T3 \rightarrow S3 \rightarrow S1 \rightarrow S2 \rightarrow T2) + SF2S * (T2 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow S1 \rightarrow S3 \rightarrow T3) - SF3S * (T3 \rightarrow S3 \rightarrow T3)] - [(T3 \rightarrow S3 \rightarrow T1 \rightarrow S2 \rightarrow T2) + SF2T * (T2 \rightarrow S2 \rightarrow T2) - (T3 \rightarrow S3 \rightarrow T1 \rightarrow S3 \rightarrow T3) - SF3T * (T3 \rightarrow S3 \rightarrow T3)]$
 97 RESERVED
 98 RESERVED
 99 ALTIMETRY
 100 ALTIMETRY CROSSOVERS
 101 DYNAMIC CROSSOVERS
 110 ALTIMETRY CONSTRAINT - LINEAR DISTANCE OF BOUNCE POINT
 111 ALTIMETRY CONSTRAINT - RADIAL DISTANCE OF BOUNCE POINT

NOTE :

SYMBOL LEGEND

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- S_n REFERS TO THE SATELLITE WHICH IS DEFINED ON BLOCK HEADER RECORD NUMBER " n " OF THE GEODYN-II BINARY TRACKING DATA FORMAT.
- T_n REFERS TO THE TRACKING STATION WHICH IS DEFINED ON BLOCK HEADER RECORD NUMBER " n " OF THE GEODYN-II BINARY TRACKING DATA FORMAT.
- P_n REFERS TO THE PLANET ON WHICH THE TRACKING STATION T_n EXISTS. AN IMPLICIT REFERENCE TO PLANETARY BODIES IS MADE SIMPLY BY SPECIFICATION OF THE TRACKING STATION T_n . THIS IS BECAUSE EACH TRACKING STATION MUST BE REFERENCED TO A PLANETARY BODY WHEN INPUT TO GEODYN-II. THE EXPLICIT REFERENCE IN THE ABOVE MEASUREMENT DESCRIPTIONS TO PLANETARY BODY P_n IS DONE TO REMIND THE READER OF THIS FORMAT THAT THESE MEASUREMENTS ARE COMMON OR LIKELY INTER-PLANETARY MEASUREMENT TYPES. IN SOME INSTANCES, THE MEASUREMENTS ONLY MAKE SENSE WITHIN AN INTER-PLANETARY FRAMEWORK. LIKewise, IT IS POSSIBLE FOR MEASUREMENTS NOT EXPLICITLY DENOTED WITH P_n TO BE OF AN INTER-PLANETARY NATURE.
- SF_nX REFERS TO TWO-WAY DOPPLER SCALING FACTOR FOR SATELLITE n TRACKING USER A SATELLITE ($X=S$) OR REMOTE RELAY STATION ($X=T$).
- Q_n REFERS TO THE QUASAR WHICH IS DEFINED ON BLOCK HEADER RECORD NUMBER " n " OF THE GEODYN-II BINARY TRACKING DATA FORMAT.