GEODYN Documentation
Volume 3

February 22, 2022

Contents

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 ommitted.

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 cooordinates	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       REL300 : Relativistic corrections                        ARC
RELATIVITY

GENERAL       ACCEL  : Application/adjustment of general               ARC
ACCELERATION           acceleration.
              ACCELT : Application/adjustment of general               ARC
                       acceleration in 3 dimensions.
              ACCEL9 :                                                 ARC

GEOPOTENTIAL  EARTH  : Modifies the Earth's gravitational            COMMON
                       potential/Earth's constants.
             GEODETIC: Overrides the Earth's parameters for          STAPOS
                       certain stations
              GCOEF  : Modification/estimation of the                COMMON
                       coefficients in the Geopotential model
              GCOEFS : Modification/estimation of C coeff.           COMMON
              GCOEFC : Modification/estimation of S coeff.           COMMON
              GEOPOL : Application of polar motion to the            COMMON
                       Earth's gravitational potential.
              GRVEPO : Time depended gravity time intervals.         COMMON
              GRVTIM : Estimation of time dependent gravity          COMMON
                       coefficients.
              GXPAND : Estimation of a range of geopotential         COMMON
                       coefficients.
              PLANET : Third body gravitational potential.           COMMON
              TOLS   : Maximum degree of geopotential for            COMMON
                       variational equations.

INTEGRATION   REFSYS : Specification of coordinate system              ARC
INFORMATION            for integration.
              EPOCH  : Specification of times for integration          ARC
              SLAVE  : Sets of satellites/times for                    ARC
                       integration
              STEP   : Changes integration order and stepsize          ARC

INTER -       TRKBDY : Defines tracking body                         COMMON
PLANETARY     PLANET : Third body gravitational potential            COMMON
             EXTRAGEO: Planetary shape parameters for planetary      STAPOS
                       stations.

NORMAL        NORMPT : Computation and output of normal points         ARC
POINTS        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,        ARC
                       preprocessing correction output and
                       measurement partials output
              PARFIL : Output partial derivative files                 ARC
              PLATIM : Station coordinate printout at                  ARC
                       requested times. (Plate tectonics
                       option , see PLATE)
              PRINTVU: Controls output of GIIS and GIIE on             ARC
                       UNIT06.
```

	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	EDIT	Editing multiplier/initial RMS.	ARC
CONTROL	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	SATPAR	Spacecraft related parameters	ARC
RELATED PARAMETERS	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	STAPOS	STAPOS SUBGROUP	COMMON
INFORMATION	STATION COORDINATE CARD	Coordinates for stations	STAPOS
ADJUSTMENT	CORREL	Correlation between station cooordinates	STAPOS
CONTROL	FIXED	Specify fixed stations	STAPOS
	ADJUSTED	Adjusted stations/ Sigma for stations	STAPOS
ADJUSTMENT	CONSTADJ/		STAPOS
CONTROL	CONSTEND	Constrained stations control	STAPOS
	INSTRMNT	Parameters for tracking instrument	STAPOS
	GEODETIC	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 Legengre 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 ADELAY

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ADELAY          19601101                1.0         1.00D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT         DESCRIPTION                             DEFAULT VALUE & UNITS

1-6     A6      ADELAY: Introduces parameters that describe
                and/or estimate  the Antenna Transponder Delay
                of a S/C or a laser bias in the case of a multi-beam altimeter

15-17   I3      Antenna number
                If on columns 16-17 the ID is a number  51-59 then this ID
                represents a laser ID and the Antenna Transopnder Delay
                will be treated a laser bias to be added to the measurement bias.

18-24   I7      Satellite ID

25-44   D20.8   A priori value of the Antenna Transponder Delay

45-59   D15.3   Sigma of the Antenna Transponder Delay

NOTE: The ADELAY card content  will be paired with the OFFSET card featuring
      the same antenna number.
EXAMPLE:
OFFSET 91       11606401                     1.430712      -5.320D-06   1.419411
OFFSET 91       21606401                     1.287648      -0.4826000   .1359708
OFFSET 91       31606401                    -1.305229      -0.6616698   2.009962
OFFSET 91       41606401                     1.417400      -0.6858000   .2482772
ADELAY          11606401           580.4808        1.00D-20
ADELAY          21606401           575.3643        1.00D-20
ADELAY          31606401           569.9368        1.00D-20
ADELAY          41606401           576.6929        1.00D-20


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 computed
                  or estimated.
```

2.3.2 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      = 0  Dynamic portion of altimetry                 0
                measurement partials wrt gravity
                coefficients will be considerd.

                = 1  Dynamic portion of altimetry
                measurement partials wrt gravity
                coefficients will not be considered.

8       I1      = 0  Geometric portion of altimetry               0
                measurement partials wrt gravity
                coefficients will be considered.

                = 1  Geometric portion of altimetry
                measurement partials wrt gravity
                coefficients will not be considered.

9       I1      = 0  GEODYN IIE will not replace a geoid          0
                supplied from the data tape unless gravity
                coefficients are being adjusted.

                = 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.

                = 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]

COLUMNS FORMAT          DESCRIPTION                           DEFAULT VALUE & UNITS

10      I1      = 0  GEODYN IIE will not replace geometric        0
                earth tides from the data tape unless H2
                Love number is being adjusted. [NOTE 5]

                = 1  GEODYN IIE will replace geometric
                earth tides from the data tape even if
                H2 Love number is not being adjusted. [NOTE 5]

11      I1      = 0  GEODYN IIE will not replace geometric        0
                ocean tides from the data tape. [NOTE 5]

                = 1  GEODYN IIE will replace geometric
```

		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)

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	1. ΔT_{SE} will be read from input tape 2. There are no dynamical direct effects	1. GEODYN will compute ΔT_{SE} using the Merit Standards for H2, L2, K1, and $\delta\Delta T$ 2. There are no dynamical direct effects
ETIDES H2 L2	WITH Sigma	1. GEODYN will compute ΔT_{SE} 2. Partials for H2 and L2 will be generated	1. GEODYN will compute ΔT_{SE} 2. Partials for H2 and L2 will be generated

Col 11 FLAGS:

GEODYN INPUT CARDS		**0**	**1**
OTIDES	NO Sigma	1. ΔT_{OC} will be read from input tape 2. ΔV will be computed from the ocean tide model	1. ΔT_{OC} comes from the OTIDE cards 2. ΔT_{OC} comes from the OTIDE cards
OTIDES	WITH Sigma	1. ΔT_{OC} will be read from input tape 2. Dynamic partials will be generated for ocean tides 3. NO geometric partials will be generated	1. ΔT_{OC} comes from the OTIDE cards 2. Dynamic partials will be generated 3. $\delta\Delta T_{\mathrm{OC}}$ will be read from the input tape

ΔT_{SE} Correction for the solid Earth tides
ΔT_{OC} Correction for the ocean tides

2.3.3 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		

2.3.4 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 interation.

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
```

2.3.5 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     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 column1: 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
                        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).

15-17   I3              Measurement Type which the correction will be       0
                        applied to. (This is only necessary when using
                        the ANTPHC option for DORIS station antennae
                        phase map correction, MTYPE=40)


                        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-.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
```

2.3.6 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.)


A sample of two PCV tables on unit 22:
```

```
SATID=7801041
  91   0.00   1.00   1   0.00 360.00
-.1000D-02-.2600D-02-.1200D-02-.9000D-030.5000D-030.1400D-020.2000D-020.2000D-02
0.1700D-020.5000D-03-.1000D-03-.6000D-03-.7000D-03-.6000D-03-.3000D-030.2000D-03
0.9000D-030.1800D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-020.2900D-02
0.2900D-020.2900D-020.2900D-020.2900D-02
STANO=14200501
  17   0.00   5.00   1   0.00 360.00
0.0000E+00-.9937E-03-.2876E-02-.5380E-02-.7822E-02-.1083E-01-.1299E-01-.1450E-01
-.1550E-01-.1549E-01-.1489E-01-.1354E-01-.1161E-01-.9500E-02-.6603E-02-.2883E-02
0.1401E-02
```

2.3.7 APLOAD

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

COLUMNS FORMAT          DESCRIPTION                           DEFAULT VALUE & UNITS

1 -6      A6      APLOAD - Requests The use of a binary
                  input file to be read from IIS unit 24.
                  The file contains loading displacement
                  time series for certain sites.
                  GEODYN stations having site numbers that
                  occur on the file will receive loading
                  corrections. The input file is called
                  the atmospheric pressure loading file,
                  but the displacements can come from any
                  source of loading.


IF CARD OMITTED: Atmospheric Pressure Loading will not be applied.

                General Description of GEODYN's Atmospheric Loading File
               ----------------------------------------------------------

The atmospheric loading file is a binary file that can be input to GEODYN IIS
on unit 24. The file supplies a time series of surface displacements for GEODYN
sites. Note that GEODYN makes a distinction between sites and stations.
A station has precise coordinates and is a single point on the surface of the
Earth. A site is a general area that may contain several stations. It would be
expected that at any given epoch, surface displacements would not vary within
a site. Sites may contain various stations for different tracking types (SLR,
GPS, DORIS, etc.).  Each station can be assigned a 4 digit site number ID.
Multiple stations may share the same ID and as a result, multiple stations may
share the same time series of surface displacements from the atmospheric loading
file.

The site displacements may be forced by atmospheric pressure loading,
hydrological loading, and/or non tidal ocean loading. It is up to the user which
effects to consider when constructing the surface displacement file. It should
be noted that loading from ocean tides is usually computed within GEODYN using
OLOAD cards.

It should be noted that the mass redistribution associated with the site
displacements given in the atmospheric loading file will also be reflected in
the Earth's time variable gravity field. Some of that time variable gravity
effect will be represented in the degree 1 coefficients. In other words, the
site displacements are correlated with the time series of variations between
the Earth's center of mass and center of figure (the origin of the station
coordinates). GEODYN allows the user to model the variation between the center
of mass and the center of figure of the Earth so that satellite and station
positions can be put in a common frame (see GCMMOD and COMCOF options). So,
it is possible to overcorrect for (or "double count") a loading effect.
The user should take care to ensure that Atmospheric Loading File is compatible
with any time series of center of mass variations that GEODYN may be using in
the same run.
```

Creating a Binary GEODYN Atmospheric Loading File

The format for the Binary GEODYN Atmospheric Loading File is given below in the next section. The user can create a Binary GEODYN Atmospheric Loading File by using a utility program that can be downloaded from https://earth.gsfc.nasa.gov/sites/default/files/geo/load_220124.f.

Here is some in line documentation from that program:

```
C  THIS PROGRAM ASSEMBLES LOADING DISPLACEMENTS INTO A GEODYN "ATMOSPHERE"
C  LOADING FILE (WHICH MAY CONTAIN LOADING COMPONENTS COMING FROM SOURCES
C  OTHER THAN THE ATMOSPHERE). LOADING DISPLACEMENTS MAY BE ASSEMBLED FROM
C  VARIOUS SOURCES THAT ARE  AVAILABLE AT THE WEBSITE:
C  https://massloading.gsfc.nasa.gov
C  THAT WEBSITE WAS CREATED BY LEONID PETROV AND CONTAINS THE FOLLOWING
C  LOADING MODELS:
C            ATMOSPHERE        GEOS-FPIT
C            ATMOSPHERE        MERRA2
C            HYDROLOGY         GEOS-FPIT
C            HYDROLOGY         MERRA2
C            NON-TIDAL OCEAN   MPIOM06
C            TIDAL OCEAN       GOT-48
C            TIDAL OCEAN       GOT-410.C
C            TIDAL OCEAN       FES-2012
C            TIDAL OCEAN       FES-2014B
C            TIDAL OCEAN       EQUIL01
C            TIDAL OCEAN       EQUIL02
C
C
C   THIS PROGRAM WILL ASSEMBLE ATMOSPHERE, HYDROLOGY AND NON-TIDAL OCEAN
C   COMPONENTS UPON USER REQUEST. TIDAL OCEAN LOADING IS NOT USED HERE
C   BECAUSE GEODYN ALREADY MODELS TIDAL OCEAN LOADING.
C
C   NOTE THAT FOR EACH OF LEONID'S LOADING FILES, THERE ARE TWO OPTIONS
C   FOR THE COORDINATE SYSTEM ORIGIN: (1) CENTER OF MASS OR (2)  "DEGREE
C   1 TERMS ONLY". THIS PROGRAM DEFAULTS TO CENTER OF MASS. THE USER CAN
C   SWITCH TO "DEGREE 1 TERMS ONLY" BY INSERTING A "DEG1" CARD IN THE
C   OPTIONS FILE.
```

Format of GEODYN's Atmospheric Loading File

The atmospheric loading file is not as concise as it could be. There are a couple of places where more information must be entered that is needed by GEODYN.

The binary atmospheric pressure loading file has two general header records. After the two general header records, there are a series of records for each site that has surface displacement information.

General Header Record # 1 (All words in the record are INTEGER*8)

```
    WORD 1           = 1 (to signify header # 1)
    WORD 2           = NSITE (Number of sites for which the file has a time
```

```
                        series of displacements)
    WORD 3 - NSITE+2 = NUMBER OF STATIONS BELONGING TO EACH SITE
    WORD NSITE+3     = MJDS1 (Epoch of first loading displacement. Epoch given
                        in elapsed seconds since JD 2430000.5)
    WORD NSITE+4     = MJDS2 (Epoch of last loading displacement. Epoch given
                        in elapsed seconds since JD 2430000.5)
    WORD NSITE+5     = INTRVL (interval in seconds between displacements)


    Note that the information in WORDS 3 -NSITE+2 is not used. The user can set
all of these words to 1


    General Header Record # 2 (All words in the record are INTEGER*8)
-------------------------------------------------------------------

    WORD 1           = 2 (to signify header # 2)
    WORD 2           = NSITE (Number of sites for which the file has a
                        time series of displacements)
    WORD 3 - NSITE+2 = SITE # (4 digit site number for each site with
                        displacements)

    Displacement Records for Each Site (There are NSITE groups of these records)
-------------------------------------------------------------------------------

-   Site Header Record for Site (All words in the record are INTEGER*8)

    WORD 1              = 3 (to signify this is a site header record).
    WORD 2              = NSR (number of sites on this record.
                           The only value for NSR that makes sense is 1
    WORD 3 - WORD 2+NSR = 4 DIGIT SITE NUMBERS(S) that will have the
                          displacements that follow on the next records
    WORD 3+NSR          = NEP (number of displacement records to follow)


-   Site Displacement Records (There are NEP of these record)
    (All words in these records are INTEGER*8)

    WORD 1  = 4 (to signify this is a site displacement record)
    WORD 2  = East displacement in nanometers
    WORD 3  = North displacement in nanometers
    WORD 4  = Vertical displacement in nanometers
```

2.3.8 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

                  =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 preceed
                     and follow the observation time. For
                     observations that fall before the first
                     and after the last set perform linear
                     extrapolation

13      I1        SWITCH to perform interpolation on C21
                  and S21 coefficients                           0
                   = 0 do not perform interpolation
                   = 1 perform interpolation on C21 and S21

15      I1        Starting degree of the application of          2
                  the atmospheric coefficients
                   = 0 or blank   starts at degree 2       [3]
                   = 1 to 9       starts at degree 1 to 9  [3]

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 time  period where the
               following coefficients apply and
          (b)  a stream of DEGxORD 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 90x90 expansions for this option
           given at 3 hour intervals.

NOTE [3] : Since version 2106

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

2.3.9 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

                = 71 - Jacchia 1971 Model
                = 87 - French Drag  Model [1]
                = 86 - MSIS Empirical Drag Model  [2]

11-12   I2      = 0 or 1  For Mars runs, the Culp-Stewart 1983     1
                          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

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.
```

2.3.10 BINAST

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
BINAST                                  200.             1.00    400.0    0.10
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6      BINAST - Introduces a second planetary body
                          to be integrated

25-44   D20.8    Value of GM

45-59   D15.3    Sigma for GM

60-72   D13.1    Value of semi-major axis
73-80    D8.2    Sigma for semi-major axis
```

2.3.11 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 cgmassXXXXXXX, where XXXXXXX is the satellite ID number.
The data structure of cgmassXXXXXXX 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.
```

2.3.12 COMCOF

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

COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6      COMCOF - Defines and/or requests adjustments
                of  body-centered  coordinates for center
                mass- center of figure OFFSET of an orbited
                celestial body.

25-44   D20.8   x coordinate of the com-cof offset

45-59   D15.3   y coordinate of the com-cof offset

60-72   D13.1   z coordinate of the com-cof offset

73-80   D8.3    Sigma for the com-cof coordinates
```

2.3.13 CYBG2E

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CYBG2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6     CYBG2E - Specifies that the interface
               file output by GEODYN IIS on unit 11
               will be for a IIE run on a CYBER 200
               series computer.

               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


IF CARD OMITTED: Interface file will be created for the Cyber computer. See
                 IBMG2E option for outputting IBM interface file.
```

2.3.14 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.

2.3.15 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 initalization indicator.               0

               = 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.

8       I1     Gravity model print control switch.                  0

               = 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.     :

9       I1     Indicator of the contents of the                     0
               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.


COLUMNS FORMAT         DESCRIPTION                            DEFAULT VALUE & UNITS

15-17   I3     Maximum degree of coefficient to be                  3
               used in the gravitational model.
               Minimum =3.  Default depends on gravity
               model file on unit 12.(See NOTES)

18-20   I3     Maximum order of coefficient to be                   2
               used in the gravitational model.
               minimum =2.  Default depends on
               gravity model file on unit 12.

25-44   D20.8  Universal gravitational constant          3.9860064D14 M**3/S**2
```

```
                times the mass of the Earth (GMe)
                or sigma value if column 9 =1

45-59   D15.3   Semi-major axis of the Earth (Ae) or        6378138.0        M
                sigma value if column 9 =1

60-72   D13.1   Inverse of the Earth's flattening             298.255
                (1/fe) or sigma value if column 9 =1
```

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.

2.3.16 ELEVWT

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

```
COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6     ELEVWT - Requests application of elevation
                        dependent down weighting

11-12   I2     Option Indicator [NOTE 1]                            0

               If == 99, this card is used as a header card
               If.NE.99, this card is used as a data card

13-14   I2     Elevation angle                                      0      Deg

               If Option Indicator = 99
                   Maximum elevation angle at which the
                   observation weight will be decreased

               If Option Indicator NE 99
                   Elevation angle which to apply down weighting
                   scale factor

15-17   I3     Measurement Type (required on every card)            0

25-44   D20.8  IF Option Indicator NE 99                            0.
                   Down-weighting scale factor
```

```
NOTES:
       Note 1   A set of elevation dependent down-weighting may
       be given for each measurement type. Each set of down-weighting
       scale factors must begin with a header card. Following the
       header card, the down-weighting scale factors must be given in
       descending order at one degree intervals down to zero.

IF CARD OMITTED:  Elevation dependent weighting will not be applied.

EXAMPLE: Elevation dependent downweighting for Measurement Type = 40
         for elevation angles up to 15 degrees:
```

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ELEVWT    9915040
ELEVWT      15 40        0.99500
ELEVWT      14 40        0.99000
ELEVWT      13 40        0.98500
ELEVWT      12 40        0.98000
ELEVWT      11 40        0.97500
ELEVWT      10 40        0.97000
ELEVWT      09 40        0.96500
ELEVWT      08 40        0.96000
ELEVWT      07 40        0.95500
ELEVWT      06 40        0.95000
```

```
ELEVWT       05 40        0.94500
ELEVWT       04 40        0.94000
ELEVWT       03 40        0.93500
ELEVWT       02 40        0.93000
ELEVWT       01 40        0.92500
ELEVWT       00 40        0.92000
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```

2.3.17 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:                    200

                = 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.

 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.
```

2.3.18 EPHEM2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EPHEM2        30
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6     EPHEM2 - Introduces a supplementary
               planetary ephemeris for use in GEODYN
               to determine celestial body positions.
               The supplemenatry planetary ephemeris
               might include data from one or more
               celestial bodies.
               Anyone of the bodies can be used as
               the center of integration or just for
               force modeling purposes. [1]

8       I1     Sequence of the celestial body that
               will be used as center of integration.
               If this field is zero none of the
               celestial bodies in the supplementary
               ephemeris will be the center of integration.

15-17   I3     Number of celestial bodies in the
               supplementary planetary ephemeris.


Note [1] : Use the global option SCBODY for the additional celestial
           bodies, physical parameter estimation and gravity field
           specification.


IF CARD OMITTED: GEODYN will not use a supplementary ephemeris.
```

2.3.19 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

                 0  =  A and B coefficients. [NOTE 1]

10      I1      Indicates form of input sigmas.                   0

                 0  =  A and B coefficients [NOTE 1]

15-17   I3      Sign (+1 or -1) of the Demos Number [NOTE 2]     +1

18-20   I3      MKH expansion arguments of the                    0
                Demos number. [NOTE 2]

                      M = 0,1,2
                      K = 0,1,2
                      H = 0,1,2

21-22   I2      "J" expansion argument of Demos number.           0
                  -9. LE. J .LE. 9 [NOTE 2]

23      I1      Indicates form of tidal amplitude                 0
                coefficent  [ 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

COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

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 =  K2 Love Number * cos(phase)
            B = -K2 Love Number * sin(phase)


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

              Demos Number = IDSIGN*(MKH*1000+(J+10)*10+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 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.
```

2.3.20 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         Colombo Model
            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 invoques 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 descrption of the IERS
            model.

9       I1      Indicates form of input coefficients.              0

                 0  =  A and B coefficients. [NOTE 1]

10      I1      Indicates form of input sigmas.                    0

                 0  =  A and B coefficients [NOTE 1]

15-17   I3      Sign (+1 or -1) of the Demos Number [NOTE 2]      +1

                This sign multiplies the quantity
                -((2 -H) * ω + (2 - 2H + J) * M + K * Omega

18-20   I3      MKH expansion arguments of the                     0
                Demos number. [NOTE 2]
                      M = 0,1,2
                      K = 0,1,2
                      H = 0,1,2

21-22   I2      "J" expansion argument of Demos number.            0
                  -9. LE. J .LE. 9 [NOTE 2]

23      I1      Indicates form of tidal amplitude
                coefficient [ V (t) / V bar ]  [NOTE 3]            0
                               f       f

                 0 = only main line, fixed coefficient
                 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 =  K2 Love Number * cos(phase)
            B = -K2 Love Number * sin(phase)


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

              Demos Number = IDSIGN*(MKH*1000+(J+10)*10+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
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.
```

2.3.21 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.

2.3.22 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.  YYMMDDHHMMSS.
                    (if the index on col 9 is 1)
                    [NOTE 2]

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 parameterizaton. 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

2.3.23 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         0
                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.

8       I1      Flux Kp indicator.                             0

                =  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]

9       I1      Flux card indicator                            0

                =  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]

25-44   D20.8   Date of FLUX values (in form                   0.
                YYMMDD).  (Col. 9 = 0)
                                                                          -22
                Solar flux at 1AU (Col. 9 = 1)              1372.5398  10   W/M**2


COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS
                                                                           -22
45-59   D15.3   Value of SOLAR FLUX (F10.7 at 1 A.U).          0.        10  W/M**2
                If blank, value in table will not be
                altered. [NOTE 3]
                                                                           -22
60-72   D13.1   Uses input value for average solar             0.        10  W/M**2
                flux, if left blank, average will
                not be altered.

73-80   D8.2    Value of magnetic flux Kp. If
```

```
column 8 contains a 1 this input
value is
_                Kpi
Kp= log[ (sum (e    )  for i=1,8) / 8]

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.

2.3.24 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 usefulfor dynamic crossover processing where a number of inner iterations is needed for the best crossover location extimate	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.

2.3.25 G2COFC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
G2COFC          1  0      0.144337567303D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                             DEFAULT VALUE & UNITS

1-6      A6     G2COFC -  C coefficients of the second asteroid in a binary
                          asteroid situation.

25-44   D20.8   Value of the C coefficient

60-72   D13.1   Sigma of the C coefficient


Example of G2COFC (and G2COFS cards:
G2COFC        001000
G2COFC        001001
G2COFC        002000           -.14369265D-01                .001
G2COFC        002001                                         .001
G2COFC        002002            .47033751D-02                .001
G2COFS        001001
G2COFS        002001                                         .001
G2COFS        002002                                         .001
```

2.3.26 G2COFS

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
G2COFS          1  1      0.144337567303D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6     G2COFS -  S coefficients of the second asteroid in a binary
                         asteroid situation.

25-44  D20.8   Value of the S coefficient

60-72  D13.1   Sigma of the S coefficient


Example of G2COFC (and G2COFS cards:
G2COFC        001000
G2COFC        001001
G2COFC        002000          -.14369265D-01                .001
G2COFC        002001                                        .001
G2COFC        002002           .47033751D-02                .001
G2COFS        001001
G2COFS        002001                                        .001
G2COFS        002002                                        .001
```

2.3.27 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     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.

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

2.3.28 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     Refrence 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:

1) 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:

```
    signal = amplitude * cos( (time - reference year)*(2pi/period)- 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
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
```

2.3.29 GCOEF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GCOEF 2         2  1                                        1.0000000D-091.00D-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

               =  0  values unnormalized C,S [See NOTES]

               =  1  values normalized C,S

               =  2  values ignored C,S

15-17   I3     Degree of C and S coefficients                     0
               (N index). [NOTE 1]

18-20   I3     Order of C and S coefficients                      0
               (M index). [NOTE 1]

25-44   D20.8  A priori (or starting) value of C                  0.
               coefficient. [NOTE 2]

45-59   D15.3  A priori (or starting) value of S                  0.
               coefficient. [NOTE 2]

60-72   D13.1  Standard deviation or fractional                   0.
               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]

73-80   D8.2   Standard deviation or fractional uncertainty       0.
               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]

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.

2.3.30 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.

2.3.31 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.

2.3.32 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    -.50000000000000D-03               1.0
GCOEFC1         3  1    0.30000000000000D-05               1.0
GCOEFC1         4  1    -.60000000000000D-06               1.0
GTPEND
GCOFCT                       800801070000.00800801090000.00
GCOEFC1         2  0    -.50000000000000D-03               0.0
GCOEFC1         3  1    0.30000000000000D-05               0.0
GCOEFC1         4  1    -.60000000000000D-06               1.0
GTPEND
GCOFST                       800801000000.00800801060000.00
GCOEFS1         3  1    0.25000000000000D-06               0.0
GCOEFS1         4  1    -.55000000000000D-06               1.0

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

2.3.33 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.
```

2.3.34 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       410101 (JD = 2430000.5)
                       Time in "YYMMDD".  [NOTE 1]


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
```

2.3.35 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     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.

               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.
                                                      Most users select the GEOPOL option
               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).


7       I1     If GEOPOL is used with the POLKF card,            0.
               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.



IF CARD OMITTED: See above first paragraph.
```

2.3.36 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 paramters in
               the E-MATRIX.  At present only the drag
               parameters can be selected.[1]

 7      I1     Selects drag parameters                              0

                = 0 - drag parameters will be selected

                = 1 - turns off this option for the drag parameters

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.
```

2.3.37 GMSUN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
GMSUN                   2.11060885327268D-07        1.D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                                 DEFAULT VALUE & UNITS

1-6      A6      GMSUN  - Introduces GM of the SUN as a parameter

25-44   D20.8    GM of the sun value

45-59   D15.3    Sigma for GM
```

2.3.38 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       0
                         an EMAT/GPS run. The index must be >0 to allow
                the arc inversion. The default (0) means thet
                the job will terminate right after the E-MATRIX
                was formed and saved.

  8      I1       =1     This is a gps run  (measurement type 85 or 87)   0
            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.
                  =0     Input MTYPE is the same as MBIAS type for GPS
            observations
```

2.3.39 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     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.

               The GPSSHD option will turn any GPS data
               reduction run into an ORBGEN run automa-
               tically, regardless of what other cards
               are present.

               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]

25-44   D20.5  12 hrs + endarc time                             YYMMDDHHMMSS

45-59   D15.3  Cutoff angle that helps save some computation    deg 20
               NOTE [2]

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.
```

2.3.40 GRIDS

2.3.40.1 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
```

2.3.40.2 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         0
                  ellipsoid.
               =1 Elevations are given from the mean sea
                  surface
               =2 Radii are given from the center of
                  the planet
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  Minimum longitude of the grid
               counting from 0-360 degrees.                   (deg)   0

73-80   D8.1   Maximum longitude of the grid                  (deg) 360


IF CARD OMITTED: This model will not be used to compute the observations.


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

2.3.40.3 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
```

2.3.41 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            0.
               dependent gravity model. Linear rates and
               periodic terms in the time dependent gravity
               model will be calculated from this time.


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.
```

2.3.42 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:

                  Columns       Columns     Columns   Columns
                  25 - 44       45 - 59     60 - 72   73 - 80

               =1 Linear Rate  Rate sigma                          [NOTE 2]
               =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                     1
                 (a number between 1-9)

25-44   D20.8  This field contains geopotential linear rate      per year
               or rate sigma information as defined by the
           values selected in columns 7 & 8.
               col 8=1    Cdot or Sdot (linear rate).


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              years
               computed as frequency=2*pi/period.
```

```
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:

```
1#1
+ Cdot(n,m)*(t-t0) + 2#2*(t-t0))
       + 3#3*(t-t0))


4#4
+ Sdot(n,m)*(t-t0) + 5#5*(t-t0))
       + 6#6
*(t-t0))


7#7
- Normalized geopotential C and S coefficients.
```

Cdot , Sdot - Linear rates for the geopotential coefficients.

t0 - Start time for application of time dependent gravity.
(See GRVEPO option for setting the start time.)

t - Current time. Time at which time dependent gravity

will be computed.

Aci ,Asi - Amplitude of the cosine term for the C or S coefficient

for application of a periodic gravity effect.

Bic ,Bsi - Amplitude of the sine term for the C or Scoefficient

for application of a periodic gravity effect.

Omegai(n,m) - Frequency for the periodic gravity effect for the
(n,m) coefficients. (Where Frequency=2*pi/period)

8#8

2.3.43 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.
```

2.3.44 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.

2.3.45 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 h
unit 98.

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

2.3.46 I32G2E

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
I32G2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS

1-6     A6     I32G2E - Specifies options for the
               interface and data file output by
               GEODYN IIS on unit 11 and 41 for a
               32 bit integer machine.

  8     I1     Specifies whether binary or formatted              0
               interface and data files will be created
               by IIS.

               =0  Binary interface and data files
                   will by created with the following
                   attributes:

               Information in the interface file
               will be treated as follows:

                Floating point - 64-bit IBM word.        64-bit IBM word.

                Integers       - IBM 32-bit word.        null 32-bit IBM word
                                                         and 32-bit IBM word.

                Logicals       - IBM 32-bit word.        null 32-bit IBM word
                                                         and 32-bit IBM word.

                Alpha-numeric  - EBCDIC characters.      EBCDIC characters.

               =1  formatted interface and data
                   file wil be created.

 10     I1     Specifies 80 column or 132 column                 0
               formatted interface and data files.

               =0  132 column formatted interface
                   and data files will be created.

               =8  80 column formatted interface
                   and data files wil be created.


COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS

 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.
```

2.3.47 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              0
               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.


COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

 10     I1     Specifies 80 column or 132 column formatted        0
               interface and data files.

               =0  132 column formatted interface and
                   and data files will be created.

               =8  80 column formatted interface and
                   data files will be created.

 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.

2.3.48 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 polymomial 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 aplly the old precession and nutation standards.

2.3.49 INTGCB

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


COLUMNS FORMAT         DESCRIPTION                               DEFAULT VALUE & UNITS

1-6     A6      INTGCB- In interplanetary mode
                this option allows the dual orbit
                determination of a satellite orbiting
                a planetary body along with the
                planetary body.

7       I1      If I=1, the orientation of the planetary
                (orbited) body will be computed from a force
                model starting from the initial conditions
                supplied on the PLANOR cards.


IF CARD OMITTED: The orbit of the central planetary body can not
        be refined. In this case The trajectory of the central
        (orbited) planetary body must be supplied on either the
        standard planetary ephemeris or on the supplemental
        ephemeris. Also, without this card the orientation of the
        central body can not be modeled dynamically


NOTES:

1. When this option is used the REFSYS card must request the Earth
Equator and Equinox J2000 coordinate system for the reference.

2. When this option is used the elements of the planetary body must be
supplied before (first) the elements of the artificial satellites.
The elements of the planetary body are heliocentric J2000. The elements
of the artificial satellites are planet centered J2000.

3. Just below is an example of the PLANET card section of the global setup
when the INTGCB option is invoked. It is for a case when the orbit of
Mercury is being estimated along with an artificial satellite. Note that
the standard Mercury planet card has a VERY small GM value.  Also note
that the last PLANET card is the one being used for Mercury and that this
card should also appear in the Gravity file (Unit 12).

INTGCB
PLANET   10100          2.20317821893582D-13       2440000.0 10000000.000
PLANET    0200          3.24858598826460D+14       6051900.0 10000000.000
PLANET    0300           .39860044150000D+15 .637813630D+07 .2982564D+03
PLANET    0301           .49028004760000D+130.173800000D+070.4608295D+04
PLANET    0400          4.28283697739390D+13       3397000.0       154.409
PLANET    0500          1.26712767857796D+17      71492000.0        15.414
PLANET    0600          3.79406260611373D+16      60268000.0        10.208
PLANET    0700          5.79454900707187D+15      25559000.0        43.616
PLANET    0800          6.83653406387926D+15      24764000.0        58.543
PLANET    0900          9.81600887707005D+11       1151000.0 10000000.000
PLANET    9999          1.32712440017987D+20     696000000.0 10000000.000
```

```
PLANET 1     1020020    2.20317821893582D+13      2440000.0 10000000.000
```

4. Starting with version 1507.12, the numerically integrated ephemeris of the central planetary body that is produced when the INTGCB card is present can be replaced with the XEPHEM option. This allows for the use of dynamic orientation while still using an input trajectory for the orbited central planetary body. When this is done, the gravitational torques computed for the dynamic orientation will use the positions from the external ephemeris.

2.3.50 IBMG2E

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
IBMG2E
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6     IBMG2E - Specifies that the interface
               file output by GEODYN IIS on unit 11
               will be for a GEODYN-IIE run on an IBM
               compatible computer.

               Information in the interface file
               will be treated as follows:

                Floating point - 64-bit IBM word.       64-bit IBM word.

                Integers       - IBM 32-bit word.       null 32-bit IBM word
                                                        and 32-bit IBM word.

                Logicals       - IBM 32-bit word.       null 32-bit IBM word
                                                        and 32-bit IBM word.

                Alpha-numeric  - EBCDIC characters.     EBCDIC characters.


 IF CARD OMITTED: Interface file will be created for the Cyber computer.
```

2.3.51 INTCOM

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
INTCOM                                  890601.   890701.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                              DEFAULT VALUE & UNITS

1-6     A6          INTCOM: Turns on the intercomparison
                    capability. This option allows the user
                    to perform certain specific orbit
                    generation runs. In these runs some
                    assumptions are made, or certain
                    perturbations only are turned on in
                    order to study the output orbit and/or
                    compare it with orbits generated by
                    similar software packages.
                    The output orbit is writen on unit59 at
                    a rate depending on the users request on
                    the ORBTVU card and expressed in inertial
                    True-of-Date Cartesian elements. [NOTE 2]
                    The assumptions and/or supressions for
                    each individual case are described under
                    Case Indicator on columns 9-10.


9-10     I2         Case Indicator: Integer number which indicates
                    a specific case. See NOTE 1 for description of
                    the individual cases.

25-44   D20.8       Start time for 3-hourly kp values storage      Epoch start
                    in the form YYMMDD. (Applies on Case 15)          time

45-59   D15.8       Stop time for 3-hourly kp values storage in    Epoch stop
                    the form YYMMDD. (Applies on Case 15)             time


NOTE [1]: 1  Two body orbit generation (point masses) - Output mean of reference
             system - Supressed precession and nutation - No other forces
             applied. (CASE1A of the TOPEX intercomparison)

          2  Two body - Output True-of-Date - Only precession and nutation
             applied. - No other forces applied.(CASE1B of the TOPEX
             intercomparison)

          3  Two body - Output Pseudo body-fixed - Fixed true pole - Tests
             Greenwich hour angle and UT1 - Modify POLE cards accordingly.
             (CASE1C of the TOPEX intercomparison)

          4  Two body - Output body fixed - UT1=UTC - Tests polar motion -
             corrections will be applied to UT1-UTC - Modify POLE cards
             accordingly. (CASE1D of the TOPEX intercoimparison).

          5  Two body - Output full body-fixed - Tests polar motion and UT1
             combined. (CASE1E of the TOPEX intercomparison).

          6  Case 2 - application of J2 (CASE2 of the TOPEX intercomparison).
```

7 Case 2 + Point mass effects for other celestial bodies - Modify PLANET cards accordingly. (CASE3A of the TOPEX intercomparison).

8 Case 7 + Indirect effect of the Earth's J2. (CASE3B of the TOPEX intercomparison).

9 Case 6 + Polar motion and UT1 (CASE4 of the TOPEX intercomparison).

10 Case 6 + Complete gravity model GEM-T1. Tests Gravity Model. (CASE5 of the TOPEX intercomparison).

11 Case 6 + Empirical along track accelerations - Include necessary ACCEL cards. (CASE6 of the TOPEX intercomparison).

12 Case 6 + Solar radiation - Use SOLRAD card. (CASE7 of the TOPEX intercomparison).

13 Case 10 + Simple solid Earth tide model - Use correct input on the TIDES cards (CASE8 of the TOPEX intercomparison).

14 Case 10 + Complete Earth and Ocean tides. (CASE9 of the TOPEX intercomparison).

15 Case 6 + Drag application using DTM atmospheric model - Constant fluxes are used - FLUX and ATMDEN cards are necessary. Three hourly Kp values are used - Include the right BIH tables on UNIT02. (CASE10 of the TOPEX intercomparison).

16 All perturbations in Cases 2-15 applied. (CASE11 of the TOPEX intercomparison).

17 Case 6 + Earth radiation - Use ALBEDO card AND SOLRAD card. (CASE12 of the TOPEX intercomparison).

18 Case 6 + General relativity - Use REL300 card. (CASE13 of the TOPEX intercomparison).

NOTE [2]: OUTPUT FORMAT

A. HEADER RECORD

ITEM	FORMAT	DESCRIPTION
1-132	A1	Description of the run. Contents of the second COMMON TITLE card.

B. EPHEMERIS RECORDS (Two records for each point)

First record

ITEM	FORMAT	DESCRIPTION
1	D22.16	Julian Date (integral part) (UTC)
2	D22.16	Fractional Julian Date (UTC)
3	D22.16	Greenwich Hour Angle

4-6	3D22.16	Satellite X Y Z elements (meters)

Second record

1-3	3D22.16	Satellite Xdot Ydot Zdot elements (meters/sec)
4	D22.16	Satellite geodetic latitude (instantaneous z axis) (degrees).
5	D22.16	Satellite East longitude (degrees).
6	D22.16	Satellite height above the reference ellipsoid (meters).

NOTE [3]: Sample UNIT05 setups for the orbit generation options exist in ZCDEP.TOPEX.UNIT05.DATA. The GLOBAL TITLE cards describe the individual cases.

IF CARD IS OMITTED: No Intercomparison will take place.

2.3.52 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                 0
               to invert normal matrices.

               = 1  Subroutine SYMINV will be used
               to invert normal matrices.


8       I1     = 0  Inverted normal matrices will not be          0
               printed out.

               = 1  Inverted normal matrices will be
               printed out.


9       I1     = 0  Subroutine DSINV or SYMINV will be used       0
                    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.

10      I1     = 1  The SRIF (square root information filter) (NOTE 1)
                    option is invoked
               = 0  Default Inversion

NOTE 1:   SRIF: A reliable and effective method for computing numerically
          accurate estimates in problems where high precision is required.
          Square root formulations increase numerical computation accuracy
          by guaranteeing positive-definiteness of the associated covariances
          and by decreasing the condition numbers of the normal matrices.
```

2.3.53 IONCOR

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

COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6      IONCOR - Requests the application of the
                ionospheric correction based on the ionospheric
                model IR-95.  [Ref. 1]

 7      I1      Indicates the type of coefficients to be used in
                the model. [NOTE 1]                                  0
                = 0 CCIR coefficients
                = 1 URSI coefficients

 8      I1      Indicates the type of interpolation to be used
                for electron density profiles.                       0
                = 0 linear interpolation
                = 1 logarithmic interpolation (not tested yet)

NOTE [1]: CCIR - model recommended by the International Radio Consultative
                 Committee (1967) (Ref. 1 p. 52).
          URSI - Model proposed by the International Union of Radio Science
                 (1989) (Ref. 1 p. 52).
          Both sets of coefficient files must be included in the
          directory of the IIS execution. Files are located on geodesy2
          in  /users/geodyn/SUPPORT/dat_ion95.
          There are 24 files, 12 files of each type, one for each month of
          the year.  The filenames are in the following format:  ccir*.asc
          and ursi*.asc where * is equal to the month plus ten.

NOTE [2]: Frequencies used in the computation of the correction are
          obtained in one of two ways:

          Option 1 - Frequencies provided. Nominal center or average
                     (over forward and return) frequencies per link
                     are included on columns 25-44 on the OFFSET input
                     cards. In this case an OFFSET card must be
                     included for each satellite in the run. Also
                     frequencies must be input on all the OFFSET cards
                     or option 2 will be invoked.
          Option 2 - Frequencies computed in GEODYN, invoked only when
                     one or more OFFSET cards do not provide frequencies,
                     or OFFSET cards are not included in the setup.

NOTE [3]: The earth orientation and flux tables used with the IONCOR
          option are special tables which include ionospheric indices.
          The analyst must use these tables with GEODYN IIS. However at this
          point TDF has not been modified to interpret the new tables format.
          With TDF runs the analyst should use the default GEODYN tables.

 [Ref. 1] Dieter Bilitza, "International Reference Ionosphere 1990.",
      Nov. 1990. NSSDC/WDC-A-R&S 90-92.
```

2.3.54 J2SUN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
J2SUN                   2.11060885327268D-07       1.D-02
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6      J2SUN  - Introduces J2 of the SUN as a parameter

25-44   D20.8    J2 of the sun value

45-59   D15.3    Sigma for J2
```

2.3.55 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

2.3.56 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.
```

2.3.57 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.
```

2.3.58 LNSTHR

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

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	LNSTHR - is used to modify the model for the relativistic Lense-Thirring effect and/or solve for related parameters. 1. The Lense-Thirring model introduce a paramter which multiplies the acceleration due to the Lense-Thirring effect in the form (1 +). 2. A parameter related to a force described as Yukawa-type force. The acceleration due to this force is given by $$\vec{A} = \alpha \frac{GM(1+KR)}{R^3} e^{-KR} \vec{R}$$ where: α - is the parameter G - the gravitational constant M - the mass of the earth K - $1/\lambda$; λ is the range of the force $\vec{R}$ - is the position vector of the satellite	
7	I1	1 - data for mu (μ) 2 - data for alpha (α)	
18-24	I7	Satellite Id.	
25-44	D20.8	Parameter value	0.D0
45-59	D15.3	Parameter sigma	0.D0
73-80	D8.2	If col7 = 2 this specifies the range of the force	

IF CARD OMITTED: The above models will not apply to the force model.

2.3.59 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                 mgals
               the center of the master block. [2]

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*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              deg
                    block.

22-36   D15.2       East longitude at the center of the               deg
                    master block.

37-51   D15.2       Size of the master block in the direction         deg
                    of latitude.

52-66   D15.2       Size of the master block in the direction         deg
                    of longitude.

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

2.3.60 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               17
                  information is available on UNIT 8

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.
```

2.3.61 MLTDEM

```
----+----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.
```

2.3.62 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 wil be invoked
```

2.3.63 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'.
```

2.3.64 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.
```

2.3.65 NORMPT

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
NORMPT0             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 multipler.
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.

2.3.66 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           0
                    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.

25-44   D20.8  Date in form YYMMDD.FFF of DPSI and EPST        No default.
               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.

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
               =0 the units for the below averaging interval is days

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.

2.3.67 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                      0
               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.


COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS


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

2.3.68 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 conjuntion 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)

2.3.69 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.                     0
                   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]

 8      I1     = 9 Indicates external attitude model               0
                   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]

 9      I1     = 1 Indicates use of new metric data format         0
                   prepro word antenna idenfication 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]
10      I1     = 1 Indicates use of OFFSET3 card.                  0
                 = 0 No OFFSET3 shall be used.


COLUMNS FORMAT        DESCRIPTION                         DEFAULT VALUE & UNITS

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

```
14-15    I2     Body fixed coordinate system                     0
                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
                 20 - SENTINEL

                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).                         0
                Not applicable for OFFSET2 card.
                OFFSET1 card value is used for OFFSET2.

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. 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	0.	M
60-72	D13.1	Body centered fixed offset link 1 or link 2 or link 3 antenna from center of figure; y-axis. 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	0.	M
73-80	D8.3	Body centered fixed offset link 1 or link 2 or link 3 antenna from center of figure; z-axis. OR Antenna Cutoff angle if the index on col. 7	0.	M

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 rotaton 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.
```

2.3.70 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
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):

    delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(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.

[5] In order to be consistent with the tidal community,
    for certain Doodson numbers, 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 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  ! SO1
185555    PI/TWO  ! OO1
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 sone 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
NITS

COLUMNS	FORMAT	DESCRIPTION
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):

         delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(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:

         delta(i,t)=A(i) * cos(arg(i,t)) + B(i) * sin(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 ith tide for Xp and Yp is linked by a common pair of A and B coefficients.

```
deltaXp(i,t)= A(i) * cos(arg(i,t)) - B(i) * sin(arg(i,t))
deltaYp(i,t)=-B(i) * cos(arg(i,t)) - A(i) * sin(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. 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
```

2.3.71 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.             0.
               No adjustment if this field is zero.

73-80   D8.2   Standard deviation for S coefficient.             0.
               No adjustment if this field is zero.

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.
```

2.3.72 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          +1
                expansion.

9        I1     Indicates form of input coefficients.              0

                 0  =  A and B coefficients. [NOTE 1]

10       I1     Indicates form of input sigmas.                    0

                 0  =  A and B coefficients. [NOTE 1]

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                     0
                Demos number. [NOTE 2]

                      M = 0,1,2
                      K = 0,1,2
                      H = 0,1,2

21-22    I2     "J"  expansion argument of Demos number.           0
                -9. LE. J .LE. 9  [NOTE 2]


COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

23       I1     Indicates form of tidal amplitude                  0
                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

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
               (Amplitude)

45-59   D15.3  "B" coefficient. [NOTE 1]                       0.   M
               (Phase)

60-72   D13.1  Sigma "A".                                      0.   M
               (Amplitude)

73-80   D8.2   Sigma "B".                                      0.   M
               (Phase)
```

NOTES:

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

```
A =  amplitude * cos(phase)
B =  amplitude * sin(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
                                           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: OO1 -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 theat will be used.
```

2.3.73 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         Colombo Model
            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 invoques the
            Doodson Ocean Tides. Immediately
            following there is a description of the
            Colombo model. At the end of this page
            there will be a descrption of the Doodson
            model.


7-8     I2      Indicates sign (+ or -) term in harmonic          +1
                expansion, for prograde or retrograde
9       I1      Indicates form of input coefficients.              0

                 0  =  A and B coefficients. [NOTE 1]

10      I1      Indicates form of input sigmas.                    0

                 0  =  A and B coefficients. [NOTE 1]

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
                This sign multiplies the quantity
                -((2 -H) * ω + (2 - 2H + J) * M + K * Omega )

18-20   I3      MKH expansion arguments of the                     0
                Demos number. [NOTE 2]

                      M = 0,1,2
                      K = 0,1,2
                      H = 0,1,2

21-22   I2      "J"  expansion argument of Demos number.           0
                -9. LE. J .LE. 9  [NOTE 2]

23      I1      Indicates form of tidal amplitude                  0
                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

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 =  amplitude * cos(phase)
B = -amplitude * sin(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
-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

(See page 1 for S M K H J B definitions)

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: OO1 -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 ceofficients 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	2Q1
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	π_1
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	S_1
166.5545	2	3.8693H	-0.004214	1101-12	ψ_1
166.5565	2	3.8693H	0.000063	-1120-12	
167.5535	2	3.8045H	-0.000106	1101-22	

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	-00.000003	-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	$2N2$
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

	SA FAMILY				SUN			
	DOODSONS NUMBER	EARTH PERIOD (D=DAY,Y=YEAR)	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=HOUR)	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

		O1 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
		OO1	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		
					OMEG	MEAN	NODE	THETA
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		
					OMEG	MEAN	NODE	THETA
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	
					OMEG	MEAN	NODE	THETA
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		
					OMEG	MEAN	NODE	THETA
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		
					OMEG	MEAN	NODE	THETA
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
COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & UNITS

1-6      A6      OTIDES - Requests application and/or
```

adjustment of Doodson ocean tides .   Colombo Ocean Tides

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	Paramater 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

2.3.74 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.
```

2.3.75 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 - 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)	0
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 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.	90

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 for output of this partial derivative file.	Same as cols. 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. 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 outputing to tape, specification of a very large number here will prevent incrementing of unit number unless specified by column 7.	20000.

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

2.3.76 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 initalization indicator.              0

                = 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.

8       I1      Gravity model print control switch.                 0

                = 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.     :

9       I1      Indicator of the contents of the                    0
                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.

10      I1      > 0     Indicates that this body should be
                        excluded from force model calculations

11-14   I4              Indicates body for which gravity       no default
                        perturbation is to be modified.

                        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               3
                used in the gravitational model.
                Minimum =3.  Default depends on gravity
                model file on unit 12.(See NOTE[1] and
                NOTE[2]).

18-20   I3      Maximum order of coefficient to be                2
                used in the gravitational model.
                Minimum =2.  Default depends on
                gravity model file on unit 12.
                (See NOTE[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            old model
                =1 The new precession nutation model
                 is used

23      I1      Index to planetary constant option          1989 Planetary
                =0 1989 planetary constants for Venus       constants for Venus
                =1 1991 planetary constants for Venus
                =2 2000 planetary constants for Venus
            =4 2000 IAU constants for Mars              1991 Mars IAU const.
            =5 The Mars orientation model
           Konopliv-Yoder will be used
                =6 2011 Margot Model for Mercury            2011 Margot Model
                =7 IAU2000 for Mercury

24      I1      Index to lunar orientation parameter        COSPAR report
                option
                =0 values from the report /IAU/IAG/COSPAR
                =1 values drom the 403 Planetary Ephemeris

25-44   D20.8   Universal gravitational constant            See table below for
                times the mass of the Body (GMb),           third body perturb.
                or sigma value if column 9 =1,                 (M**3/S**2)

45-59   D15.3   Semi-major axis of the Body (Ab),           See table below for
                or sigma value if column 9 =1,              third body perturb.
                                                                   (M)

60-72   D13.1   Inverse of the Body's polar                 See table below for
                flattening (1/fp),                          third body perturb.
                or sigma value if column 9 =1,

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 pertubation.

2.3.77 PLANOR

```
*** NOTE ***

The documentation below is for the latest version of GEODYN (version 1501 and later).
Earlier versions have a different setup for applying the PLANOR option.

If using GEODYN version 1410, see PLANOR_1410.

If using GEODYN version 1404 or earlier, see PLANOR_1312_AND_EARLIER.

************

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

1-6     A6     PLANOR - Introduces modification and/or
               estimation of planetary orientation parameters.

               The planetary orientation parameters are used
               to describe the orientation of the central body
               at any epoch. The orientation of the body is
               given by three angles: the right ascension (RA)
               and declination (DEC) of the pole (with respect
               to the J2000 Earth equator and equinox coordinate
               system) and the W angle between the prime meridian
               of the body and the body's inertial IAU vector
               (the RA and DEC of the pole determine the inertial
               location of the IAU vector).

               For the sun, the moon and the 9 major planets,
               GEODYN has default models for orientation. The
               PLANOR option allows the user to build a user
               defined planetary orientation model to repalce a
               default model or to define the orientation of a
               body not included on the DEXXX ephemeris. In
               versions prior to 1501 the user defined model is
               analytical with linear terms in RA and DEC. For W
               a quadratic model with an arbitrary number of
               periodic terms is possible.

               Starting with version 1501 many upgrades have been
               made to the PLANOR capability. There are two types
               of models avaiable, analytical and dynamic. In
               analytical mode the RA and DEC now have periodic
               terms in addition to the linear terms. The
               analytical model may have an aribitrary number of
               periods. For each period there will be an Acos and
               Bsin parameter for each of the three angles, RA,
               DEC and W. The linear and quadratic terms must be
               referenced to a base epoch and this is the J2000
               epoch (12 HR Jan 1, 2000, ET).


               Also starting with the 1501 version the user may
               request a dynamic orientation model. The dynamic
```

orientation model is used when there is a "1" in column 7 of the INTGCB card. So, the dynamic orientation model is available only when the orbit of the central body is being numerically integrated. In dynamic mode there are 12 parameters. These are the three angles (RA, DEC and W) at the initial epoch of the arc, the derivatives wrt time of the three angles at the initial epoch of the arc and 6 moments of inertia of the central body with respect to the body fixed cartesian axes. In this mode the orientation of the axes is numerically integrated from the initial state at the initial arc epoch. The step size of the integration is the same as that chosen for the central body orbit numerical integration.

Just below is a list of all of the parameters available (some apply only to analytical mode or only to dynamic mode, for the units see NOTE 2):

α = right ascension
(analytical and dynamic mode)

dα/dt = right ascension rate
(analytical and dynamic mode)

δ = declination
(analytical and dynamic mode)

dδ/dt = declination rate
(analytical and dynamic mode)

W = prime meridian
(analytical and dynamic mode)

dW/dt = prime meridian rate
(analytical and dynamic mode)

d2W/dt2 = prime meridian acceleration
(analytical mode only)

Ai = Coefficient to cosωti term for Right Ascension.
(analytical mode only, 1501 version and later)

Bi = Coefficient to sinωti term for Right Ascension.
(analytical mode only, 1501 version and later)

Ci = Coefficient to cosωti term for Declination.
(analytical mode only, 1501 version and later)

Di = Coefficient to sinωti term for Declination.
(analytical mode only, 1501 version and later)

Ei = Coefficient to cosωti term for Rotation.
(analytical mode only)

Fi = Coefficient to sinωti term for Rotation.

(analytical mode only)

i = 1, # of periodic terms

Ixx = Moment of inertia about X axis
(dynamic mode only)

Iyy = Moment of inertia about Y axis
(dynamic mode only)

Izz = Moment of inertia about Z axis
(dynamic mode only)

Ixy = XY axis moment
(dynamic mode only)

Iyz = YZ axis moment
(dynamic mode only)

Ixz = XZ axis moment
(dynamic mode only)

7-8 I2 Index that allows estimation and modification of selected parameters.

ANALYTICAL MODEL:

=10 right ascension

=20 right ascension rate

=30 declination

=40 declination rate

=50 prime meridian

=60 prime meridian rate

=70 prime meridian acceleration

=11 Coefficient to cosωti term for Right Ascension

=12 Coefficient to sinωti term for Right Ascension

=21 Coefficient to cosωti term for Declination

=22 Coefficient to sinωti term for Declination

=31 Coefficient to cosωti term for Rotation

=32 Coefficient to sinωti term for Rotation

PLANOR11 up to PLANOR32 as a group of 6 cards, may be repeated as many times as the number of periodic terms. More than one parameter may be selected and modified. When only one parameter is selected (ex PLANOR10), then a value for this parameter may be specified on cols. 60-72 and a sigma may be specified on cols. 73-80. In this case all the other planetary orientation parameters (13 total) will be fixed using a sigma = 1.D-20.

DYNAMIC MODEL:

=10 right ascension

=20 right ascension rate

=30 declination

=40 declination rate

=50 prime meridian

=60 prime meridian rate

=01 Moment of inertia about X axis

=02 Moment of inertia about Y axis

=03 Moment of inertia about Z axis

=04 XY axis moment

=05 YZ axis moment

=06 XZ axis moment

For a theoretical description of the dynamic model, see volume 1 of the documentation, Section 8.16 - Orientation Initial Conditions - Variational Equations

17	I1	Index for the planetary body used in a binary asteroid case. =0 Default applies to one body =1 First body (orbited body) =2 Second body	
25-44	D20.8	Period in earth seconds must be included on every PLANOR11, PLANOR21 and PLANOR31 card	
60-72	D13.1	Value of parameter specified by index on col. 7-8.	GEODYN defaults

α = degrees

dα/dt = degrees/Julian centuries of 36525 days

δ = degrees

dδ/dt = degrees/Julian centuries of 36525 days

W = degrees

dW/dt = degrees/day

d2W/dt2 = degrees/day2

Ai = degrees

Bi = degrees

Ci = degrees

Di = degrees

Ei = degrees

Di = degrees

Ixx = kg*m2

Iyy = kg*m2

Izz = kg*m2

Ixy = kg*m2

Iyz = kg*m2

Ixz = kg*m2

73-80 D8.2 Sigma of parameter specified by index on col. 7. [NOTE 1]

NOTE[1]: When planetary orientation parameters are adjusted, the GEODYN output summary expresses them in the frame and units of adjustment. This is degrees of epoch J2000 and degrees/seconds for the rates.

NOTE[2]:
Units of PLANOR parameters in GEODYN
The PLANOR parameters are input to GEODYN via the PLANOR cards.
On the cards the units for the parameters are:

Right ascension α	= degrees
Right ascension rate dα/dt	= degrees/Julian century of 36525 days
Declination δ	= degrees
Declination rate dδ/dt	= degrees/Julian century of 36525 days
Prime meridian angle W	= degrees
Prime meridian angle dW/dt	= degrees/day
Prime meridian angle d2W/dt2	= degrees/day**2

```
Ai Coefficient to costi term for RA    = degrees
Bi Coefficient to sinti term for RA    = degrees
Ci Coefficient to costi term for DEC   = degrees
Di Coefficient to sinti term for DEC   = degrees
Ei Coefficient to costi term for ROT   = degrees
Fi Coefficient to sinti term for ROT   = degrees
```

These values are in IIS (PLN subroutines) converted as follows and loaded into PARMV(IPVAL(IXXTRO...)) and PARMVO(IPVALO(IXXTRO..))

```
Right ascension α         ‘            = radians
Right ascension rate dα/dt             = radians/second
Declination δ                          = radians
Declination rate dδ/dt                 = radians/second
Prime meridian angle W                 = radians
Prime meridian angle dW/dt             = radians/second
Prime meridian angle d2W/dt2           = radians/second**2
Ai Coefficient to costi term           = radians
Bi Coefficient to sinti term           = radians
Ci Coefficient to costi term           = radians
Di Coefficient to sinti term           = radians
Ei Coefficient to costi term           = radians
Fi Coefficient to sinti term           = radians
```

The values in PARMV(IPVAL(IXXTRO...)) and PARMVO(IPVALO(IXXTRO..))
are not used in the formations of the partials as in all instances the PLANOR parials are computed numerically and load into PMPA.
The numerical partials are computed in degrees.
For printing purposes (unit 6 in subroutine ESTIMG.f)
the parameter values are converted to:

```
Right ascension                        = degrees
Right ascension rate                   = degrees/Julian century of 36525 days
Declination                            = degrees
Declination rate                       = degrees/Julian century of 36525 days
Prime meridian angle                   = degrees
Prime meridian angle rate              = degrees/day
Prime meridian angle acceleration      = degrees/day**2
Ai Coefficient to costi term           = degrees
Bi Coefficient to sinti term           = degrees
Ci Coefficient to costi term           = degrees
Di Coefficient to sinti term           = degrees
Ai Coefficient to costi term           = degrees
Fi Coefficient to sinti term           = degrees
```

For output to the EMAT file the values are
converted to the units of the partials

```
Right ascension                        = degrees
Right ascension rate                   = degrees/sec
Declination                            = degrees
Declination rate                       = degrees/sec
Prime meridian angle                   = degrees
Prime meridian angle rate              = degrees/sec
Prime meridian angle acceleration      = degrees/sec**2
Ai Coefficient to costi term           = degrees
Bi Coefficient to sinti term           = degrees
Ci Coefficient to costi term           = degrees
```

```
Di Coefficient to sinti term           = degrees
Ei Coefficient to costi term           = degrees
Fi Coefficient to sinti term           = degrees


EXAMPLE SETUP FOR BINARY ASTEROIDS
PLANOR1        1                                                0.0000  .1D-40
PLANOR2        1                                                        .1D-40
PLANOR3        1                                               90.0000  .1D-40
PLANOR4        1                                                        .1D-40
PLANOR5        1                                              0.0       .1D-40
PLANOR6        1                                              360.0     .1D-40
PLANOR7        1                                                        .1D-40
PLANOR11       1        18973.4002                                      .1D-40
PLANOR12       1                                                        .1D-40
PLANOR21       1        18973.4002                                      .1D-40
PLANOR22       1                                                        .1D-40
PLANOR31       1        18973.4002                                      .1D-40
PLANOR32       1                                                        .1D-40
PLANOR1        2                                               0.0      .1D-40
PLANOR2        2                                                        .1D-40
PLANOR3        2                                               90.0000  .1D-40
PLANOR4        2                                                        .1D-40
PLANOR5        2                                                0.0     .1D-40
PLANOR6        2                                              360.0     .1D-40
PLANOR7        2                                                        .1D-40
PLANOR11       2        18973.4002                                      .1D-40
PLANOR12       2                                                        .1D-40
PLANOR21       2        18973.4002                                      .1D-40
PLANOR22       2                                                        .1D-40
PLANOR31       2        18973.4002                                      .1D-40
PLANOR32       2                                                        .1D-40
PLANOR 1       2                                          1.460096E+15 1.0D-40
PLANOR 2       2                                          1.517356E+15 1.0D-40
PLANOR 3       2                                          1.640224E+15 1.0D-40PLANOR 4
2                                            6.630338E+10 1.0D-40
PLANOR 5       2                                          2.955852E+10 1.0D-40
PLANOR 6       2                                         -2.040129E+11 1.0D-40
```

2.3.78 PLNOR2

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLNOR2                                       0.01D0         0.01D0       0.01D0  0.01D0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT		DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	PLNOR2	Modification and/or estimation of planetary orientation parameters: All the parameters below are evaluated and input at J2000. (Continues from PLANOR)	
7-8	I2			
9	I1			
10	I1			
11-12	I2			
13-14	I2			
15-17	I3			
18-20	I3			
21-22	I2			
23	I1			
24	I1			
25-44	D20.8	DXGEO1	Used as an observation perturbation in the creation of numerical observation partial derivative. (RA and DEC)	0.01D0
45-59	D15.3	DXGEO2	Used as an observation perturbation in the creation of numerical observation partial derivative. (RA and DEC)	0.01D0
60-72	D13.1	DXFRC1	Used as an acceleration perturbation in the creation of explicit numerical acceleration partial derivative. (Rotation Prime Meridian)	0.01D0
73-80	D8.2	DXFRC2	Used as an acceleration perturbation in the creation of explicit numerical acceleration partial derivative. (Rotation Prime Meridian)	0.01D0

NOTES:

[1] There must be a PLANOR card in the setup deck.

[2] This card must be used in conjuction with columns 7-10 of the ALTIM2 card.

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

IF CARD OMITTED: If PLANOR adjustment has been invoked, default values will be used.

2.3.79 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             0.  DEG/MEGA-YRS
               per million years.

45-59   D15.3  Latitude of axis of rotation of                  0.  DEG
               plate in degrees north.

60-72   D13.1  Longitude of axis of rotation of                 0.  DEG
               plate in degrees east.
```

NOTES:

[1] The user should assign plate numbers on the station cooordinate 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.

2.3.80 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 refer-               80
9 -10   I2     MM    ence date for station coord-               01
11-12   I2     DD    inates.                                    01


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

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

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

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

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.
```

2.3.81 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      NO DEFAULTS
               should be applied.

               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   M**3/s**2
              of the moon

              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    -> 0HHMM
     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.

2.3.82 PLNEPH

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PLNEPH
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
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             2

                1 Keplerian [NOTE 2]
                2 Brouwer-Clemence Set III

9-12    I4      Body identifier                                   none

                 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   <----


COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS

13-14   I2       Element Indicator                                none

                 For each type of elements the following table
                 indicates a number from 1 to 6

21-24   I4              Year of the osculating epoch:YYYY        the beginning
                        [NOTE 3]                                  time of the run

25-44   D20.8           MMDDHHMMSS.SS of the osculating epoch.   the beginning
                        [NOTE 3]                                  time of the run

45-59   D15.3           Element correction (for type and             0.0
                        component in cols. 7-8 and 13-14)
                        for the osculating epoch
```

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.

2.3.83 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      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:
                (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.

                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:

```
Xs(t) = Xs(t0) + Xs_dot * (t -t0) ; and

Ys(t) = Ys(t0) + Ys_dot * (t -t0)
```

where "t" is time in years of 365.25 days and t0 = 2000.0 is the reference epoch for the new IERS secular pole model. The model adopted by the IERS can be realized as follows:

```
Xs(t0) =   55.00 [mas]
Xs_dot =   1.677 [mas/y]
```

and:

```
Ys(t0) =  320.50 [mas]
Ys_dot =   3.460 [mas/y]
```

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

```
14      I1      Describe the model used for the secular           0
                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 YYMMDD 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:

```
C21 =  SQRT(3)*X*C20 - X*C22 + Y*S22
S21 = -SQRT(3)*Y*C20 - Y*C22 - X*S22
```

```
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:


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

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:

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 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.

2.3.84 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)         0.
                This must correspond exactly with the BIH
                date that is being overridden.

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.
```

2.3.85 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
                > 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]

8       I1      = 0  Pole and A.1-UT1 values are obtained from       0
                     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.

25-44   D20.8   Date in form YYMMDD.FFF of pole and A.1-UT1     No default.
                values[1] to which this card applies. This
                date is for the midpoint of the interval
                specified in columns 25-44 of card two.

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
                 =0 the units for the below averaging interval is days

25-44    D20.8   Averaging period[1] in the above units for      No default.
                 pole and A.1-UT1 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 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     See col. 7. (DEG)
                 X and Y of pole.

45-59    D15.3   A priori cross correlation between A.1-UT1      0.0  Unitless
                 and X of pole.

60-72    D13.1   A priori cross correlation between A.1-UT1      0.0  Unitless
                 and Y of pole.

73-80    D8.2    A priori cross correlation between X of pole    0.0  Unitless
                 and Y of pole.
```

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 biquadradic interpolation. When option 4 on col. 7 s 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

$P_T = P_t + \dot{P}_{(t-T)}$ where P_t is the value of the earth orientation parameter from the tables at time t and $\dot{P}$ 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.

2.3.86 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 documention.

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.

2.3.87 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      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.


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

2.3.88 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               61
                 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.


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.

2.3.89 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

                = 0  Requests that complete setup deck be
                     punched with  all estimated para-
                     meters replaced by the adjusted values.

                = 1  Requests that only updated parameters
                     be punched.


9       I1      Iteration control for punched output                0

                = 0  Requests that punching occur on last
                     inner of each global iteration

                = 1  Requests that punching occur on all
                     iterations


IF CARD OMITTED: No punched output will be generated.
```

2.3.90 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.

2.3.91 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
                = 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]

                   [NOTE 2]

9       I1     Correction Component Applied                    0
               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
    (!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                         0
               For all models 0-7
                = 0 K*(Wet + Dry)
                = 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          HOPFILED         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
      The user must select the VMF file that covers their arc.
      The name of the VMF file features the covered dates.
      The VMF files usually cover several months and have adequate
      overlap to cover all date ranges.

      The presence of an ascci file with the name 'orography_ell.txt' IS
      REQUIRED in the directory where GEODYN IIE is executed. The file may be
      found in the same directory as above
      /users/geodyn/SUPPORT/dat_FILES/dat_VMF/VMF_GRID_FILES
      OR on this documentation main page under the name :
      VMF OROGRAPHY FILE (MEAN GRID VALUES)

      When using the VMF refraction model in GEODYN IIS will produced an
      interface file with the name 'vmf_interface_file' which will contain the
      data in the time range requested by the user.

      If any of the two files , vmf_interface_file, and  orography_ell.txt
      are not present or not created, GEODYN will terminate with a
```

comprehensive error message.

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.

2.3.92 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.
```

2.3.93 RELPPN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
RELPPN                                  1.D+00         1.D-30       1.D+00  1.D-30
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
COLUMNS FORMAT         DESCRIPTION                                DEFAULT VALUE & UNITS

1-6     A6     RELPPN - Introduces the PPN relativity model. The third-body
                        perturbation of each body (Sun, planets and asteroids)
                        is derived from the isotropic, parametrized
                        post-Newtonian  (PPN) n-body metric.
                        The acceleration of the spacecraft and the integrated
                        body due to interaction with other point masses follows
                        the formulation reported in Eq. 27 of :
                        " The Planetary and Lunar Ephemerides DE430 and DE431 "
                        by Folkner et al. 2014.
                        There are two parameters associated with this model,
                        Gamma and Beta
                        [NOTE 1]
                        Use RELPPN only for Interplanetary satellites [NOTE 2]

25-44   D20.8  Value of Gamma

45-59   D15.3  Sigma for Gamma

60-72   D13.1  Value of Beta

73-80    D8.2  Sigma for Beta


NOTE 1. The presence of both RELPPN and REL300 in a GEODYN setup sets
        RELPPN to be the used model. GEODYN will not double count the
        relativistic effect.
NOTE 2. RELPPN cannot be used for Earth orbiting satellites because of
        reference frame computation issues.
```

2.3.94 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 meas-
                        urements. The cut off angle for
                        satellite to satellite links is
                        reckoned from the horizon of the
                        lower satellite. The default value
                        is 0
```

2.3.95 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.

2.3.96 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
```

2.3.97 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 then or equal to the maximum degree and order as input on the SSTOPO 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.

2.3.98 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.               0.
               No adjustment if this field is zero.

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.
```

2.3.99 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]	0	27,28
		= 1 Function file input from IIS [3]		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.

2.3.100 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.

2.3.101 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

               = 1  values normalized C,S
               = 3  values unnormalized C,S

8       I1     Coefficient type                                     0

               = 1  Coefficient of Cosine (C)
               = 2  Coefficient of Sine   (S)

9       I1     Frequency/Period indicator                           1
               (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

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.        0.
               No adjustment if this fields is zero.

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 SSTOPO card.
       Card cannot be used in conjunction with SSCOEF card.


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

2.3.102 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 coefficent. No adjustment if this field is zero.	0.
73-80	D8.2	Standard deviation of the secular Cdot or Sdot coefficent. No adjustment if this field is zero.	0.

NOTE: Card must be used in conjunction with SSTOPO 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.

2.3.103 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.
```

2.3.104 TARGET

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

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TARGET - Introduces coordinates of a station on a planet other than the earth.	
7	I1	Type of planet centered fixed coordinates	0
		=0 - X,Y,Z (Cartesian)	0. M
		=1 - latitude,longitude,radius (Spherical)	0. degrees or M
		=2 - axis, longitude, height (Cylindrical)	0. degrees or M
18-24	I7	Target ID number.	
25-44	D20.8	X (meters), φ (latitude in degrees) or A (axis in meters)	
45-59	D15.3	Y (meters) or λ (west longitude in degrees)	
60-72	D13.1	Z (meters), r (radius in meters) or H (height in meters)	

2.3.105 TARSIG

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

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	TARSIG - Introduces sigmas for the coordinates of a planetary station (Target).	
18-24	I7	Target ID number.	
25-44	D20.8	sigma of X (meters), ϕ (latitude in degrees) or A (axis in meters)	
45-59	D15.3	sigma of Y (meters) or λ (west longitude in degrees)	
60-72	D13.1	sigma of Z (meters), r (radius in meters) or H (height in meters)	

IF CARD OMITTED: And measurement types 37, 38, 47 or 48 are being processed planetary target coordinates will not be solved for.

2.3.106 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 .                             2 - .TRUE.

                = 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.


11      I1      Requests output of observation                  1 - .FALSE.
                residuals.

12      I1      Requests output of station residual             1 - .FALSE.
                summary.

13      I1      Requests output of observation type             2 - .TRUE.
                residual summary.

14      I1      Requests output of E-BIAS adjustment.           1 - .FALSE.


COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS



15      I1      Requests output of arc parameter                2 - .TRUE.
                adjustments.

16      I1      Requests output of summary page.                2 - .TRUE.

17      I1      Requests output of global parameter             2 - .TRUE.
                adjustments.

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

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

2.3.107 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                    K2 ampl/K2 phase/
                 perturbation and requests application          K3 phase
                 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

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

                     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           0
                 applied to correct the station positions.
                 (stations only)

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                       0.
                 coefficient.  If non-zero value is
                 specified, tidal parameter will be
                 adjusted.
```

```
----+----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.

2.3.108 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 geo-potential whenever E-matrix requested.

IF CARD OMITTED: Defaults apply.

2.3.109 TRKBDY

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

```
COLUMNS FORMAT          DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6     TRKBDY - Sets the planet number
               of the tracking body, i.e. body
               on which are located the tracking
               stations.


11-14   I4              Indicates body number for the               0300
                        tracking body.

                        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


UNITS:  M  =Meters    ; S  =Seconds


IF CARD OMITTED: Then Earth (0300) is used as the tracking body.
```

2.3.110 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 osbservation 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.
```

2.3.111 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.

2.3.112 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            0 if no EMATRX card,
               the chaining of partials and the            2 if EMATRX card in
               formation of the normal matrix.               setup.

               =0 Optimizes over the number of
                  observations

               >0 Optimizes over the number of
                   estimated parameters.

               >1 Forms normal matrix by partitions.[3]


9-10    I2     Indicates number of scratch units                   1
               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.

11-14   I4     Controls the maximum number of            1000 if no EMATRX card,
               observations that will be used in           40 if EMATRX card in
               one data block (minimum no. = 11 ,            setup.
               maximum = 9999) [1,2].


COLUMNS FORMAT         DESCRIPTION                         DEFAULT VALUE & UNITS

15-17   I3     Number of integration steps over which       Integration order
               interpolation may be simultaneously            minus one [2].
               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).

               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. 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.	20000.

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.

2.3.113 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         1
                   on external ephemeris. The ID's for the
                   satellites are included in the header
                   record of the ephemeris file.

11-14   I4         Size of internal buffers used to hold the        300
                   satellite ephemeris information. Note [2]

15-16   I2         Unit number for the file that contains the       66
                   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.

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 * No. of satellites * 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 Tstep, and the interval on the external ephemeris is Textint, then the external ephemeris start time must be less than Tstart - 5*Tstep - 3*Textint.
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 Tstep, and the interval on the external ephemeris is Textint, then the external ephemeris stop time must be greater than Tstop + 2*Tstep + 5*Textint.

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*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+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
```

2.3.114 YARKOV

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

```
COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6     YARKOV - Requests the computation and
                        application of the Yarkovsky/
                        Schach effect on small spinning
                        satellites such as LAGEOS and
                        LAGEOS II


  7     I1              Index for GEODYN "TYPE" of run

                        =0  GEODYN will do an ORBGEN and
                            will produce a binary file
                           (UNIT 67) containing the
                            necessary shadowing information.
                        =1  Data reduction run where GEODYN
                            will read UNIT 67 and will
                            compute the Yarkovsky
                            accellerations

  8     I1              Index for model to be applied:

                        =0  Rapid spin case
                        =1  Slow rotating case

18-24    I7    Satellite ID

25-44   D20.8  The amplitude of the perturbative acceleration.

45-59   D15.3  Thermal relaxation time
```

2.3.115 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 colums 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)

2.3.116 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/sec2

2.3.117 YPLEND

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
YAWPOL 2   600          920324000000.       920325000000.
----+----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.

2.3.118 POSITION CARD GROUP

2.3.118.1 STATION COORDINATE SUBGROUP

2.3.118.1.1 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       Coordinate system for adjustment              0
                 of stations and indicator that
                 all stations are to be adjusted
                 except those explicitly excluded
                 using the FIXED subgroup card.

                 = 0  Indicates no adjustment, or
                      adjustment of individual stations
                      will be indicated explicitly
                      by use of ADJUSTED cards.

                 > 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)

                      Coordinate system for adjustment:
                       =  1  Geodetic     - Phi,Lambda,Height
                       =  2  Cartesian    - X,Y,Z
                       =  3  Cylindrical  - S.A.D,Lambda,Z
                       =  4  Spherical    - Phi,Lambda,R

8       I1       Station geodetic file indicator.              0
                 (Default is for geodetics file to be read
                  prior to reading station coordinates
                  following this STAPOS card)

                 = 0 Indicates stations will be read from
                     the station geodetic file on unit 16.

                 > 0 Indicates that no stations from the
                     station geodetics file are to be used.

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        50
                 data is available in this run.  [NOTE 1]

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             0.
                 as indicated by value in column 7.
                 (must be a non zero if col 7>0)

60-72   D13.1    Sigma for third station component              0.
                 as indicated by value in column 7.
                 (must be a non zero if col 7>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
    GEODETIC  -  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 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.

2.3.118.1.2 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                 0
                of station.

                =  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.
```

2.3.118.1.3 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 preceed
                  the CONSTADJ card.


IF CARD OMITTED:  Stations will not be constrained.
```

2.3.118.1.4 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.
```

2.3.118.1.5 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.

2.3.118.1.6 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 auto-
               matically 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.
```

2.3.118.1.7 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         298.255
                planet.

51-65   D15.6   Inverse of equatorial flattening              0.
                of the planet.


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.
```

2.3.118.1.8 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     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.

               To negate the FIXED card another ADJUSTED
               card may be used.


IF CARD IS OMITTED:  No negation of adjustment will occur.
```

2.3.118.1.9 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             0.
               earth. [NOTE 1]
```

```
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.
```

2.3.118.1.10 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                0
                been invoked)
                GEODYN will use the antenna number
                which have been provided on unit 22.

                        otherwise

                Antenna mount type. (If ANTPHC option              3
                has NOT been invoked)

                 =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.    M*1.0D-6
               ( 0. indicates nominal wavelength will
                 be used from observation file as
                 supplied by the Tracking Data
                 Formatter Program.)

51-65   D15.6  Turn around factor (TRF).                     1.
               (TRF=Wavelength trans./wavelength rec.)
```

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.

2.3.118.1.11 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.
```

2.3.118.1.12 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.
```

2.3.118.1.13 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.                            0
                  = 99 apply thermal deformation for antenna

13-20   I8        Station number.                                  0

21-35   D15.6     First coordinate:                                0.
                   (+ or -)DDMMSS.SSS
                   (+ or -)XXXXXXX.XXX meters

36-50   D15.6     Second coordinate:                               0.
                          DDDMMSS.SSS
                   (+ or -)XXXXXXX.XXX meters

51-65   D15.6     Third coordinate:                                0.
                   (+ or -) XXXXXXX.XXX meters

67-70   I4        Site number only for stations involved           0
                  in ocean loading (same as in columns
                  13-20)

71-80   A10       Available for comments.


IF CARD OMITTED: Stations coordinates will be obtained from geodetic
                 file on UNIT 16.
```

2.3.118.1.14 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 preceeding stations are assumed to
                  be zero.
```

2.3.118.1.15 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 YYMMDD.                    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.
```

2.3.118.1.16 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.
```

2.3.118.1.17 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
```

2.3.118.2 QUASAR COORDINATE SUBGROUP

2.3.118.2.1 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.
```

2.3.118.2.2 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                       +/- DDMMSS.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
```

2.3.118.2.3 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.
```

2.3.119 GLOBAL SET TERMINATOR

2.3.119.1 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 identi-
                    fication 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         0
                        area and S/C mass from columns
                        25-59 of this card.
                    1 - Obtain same from S/C parameters
                        file.

8       I1          0 - No tables of S/C cross section or :        0
                        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.                  :

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 fisrt 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
                     0 - Cannonball(no attitude control)
                     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
               20 - SENTINEL

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  :  N/A
                        for this spacecraft.             :
                    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   Max. of Model
                   to be considered significant for this S/C.

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. : If specified as other	cols. 21-26
47-50	I4	HHMM of start. : than epoch, orbit will : be integrated to this	cols. 27-30
51-60	D10.8	Seconds of start.: 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 ORBTVU 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
                     0 - Either Cartesian or Keplerian
                     1 - Cartesian
                     2 - Keplerian
                     3 - Non-singular Keplerian
                     5 - Cartesian non-elliptic
                     6 - Keplerian non-elliptic

8       I1         Coordinate system of input elements NOTE(2)   0


11-14   I4         Central body for input  elements.            300

                     0100 - Mercury
                     0200 - Venus
                     0300 - Earth
                     0301 - Earth's moon
                     0400 - Mars
                     0500 - Jupiter
                     0600 - Saturn
                     0700 - Uranus
                     0800 - Neptune
                     0900 - Pluto
                     9999 - Sun

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 refered 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   OSCULATING KEPLERIAN  NON SINGULAR KEPLERIAN
                 ELEMENTS             ELEMENTS               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 refered 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                            0
                      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)

8       I1          Indicates order of acceleration              0
                    coefficients

                      0 - Ga
                          .
                      1 - Ga
                          ..
                      2 - Ga

18-24   I7          Satellite ID (required).                     0

25-44   D20.8       A priori value of acceleration               0.    M/S**2
                    coefficients.                                   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     0.
                    time dependent acceleration option is
                    wanted. To select time dependent accel-
                    eration 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.

60-72   D13.1       A priori sigma of acceleration               0.    M/S**2
                                coefficient.                        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 extarnal                S
                  acceleration file times with interation
                  times. This optio is used with the dynamic
                  acceleration mode (DYNSEL)


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        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

                  columns 7-9 are used to denote which axes will be used
                  in GEODYN for dynamic accelerometry

                  columns 10-12 are used to allow the change of the sign
                  of accelerometry components in the dynamic mode

                  columns 13-15 are used to allow the change of the sign
                  of accelerometry components in the geometric mode


7       I1        =0  The X component of accelerometry                0
                      will replace the geodyn computed
                  =9  The X component of accelerometry
                      will  not replace the geodyn computed

8       I1        =0   same as above for Y component                  0
                  =9

9       I1        =0   same as above for Z component                  0
                  =9


10-12   3I1       =9 changes the sign implied by the GFZ document     0
                     for X,Y or Z axis for dynamic accelerometry
                  =0 does not change the sign


13-15   3I1       =9 changes the sign implied by the GFZ document     0
                     for X, Y or Z axis for geometric accelerometry
                  =0 does not change the sign
```

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
ACCBI2                 -.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	ACCBI2	
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
SURFRC1111111    2000039
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6      A6             During dynamic accelerometry periods, accelerations
                        from the external acceleration file are added to the
                        accelerations that GEODYN computes for a satellite.
                        Usually, the accelerations on the external acceleration
                        file come from an accelerometer on board the satellite.
                        Accelerometers measure forces that act on the surface of
                        a satellite (like solar radiation and atmospheric drag).
                        During periods of dynamic acceleration, the SURFRC card
                        allows a user to prevent the surface forces that GEODYN
                        usually computes from internal models from the being
                        added to the total satellite acceleration. This prevents
                        double counting of forces during dynamic acceleration
                        periods.

                        When there is a "1" in any of the columns from 7-13,
                        during periods of dynamic acceleration GEODYN will not
                        add the acceleration from the internal model associated
                        with that force to the total satellite acceleration.

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: During dynamic acceleration periods, all surface accelerations
                 computed from GEODYN internal models will be added to the
                 total satellite 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 date 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 YYMMDDHHMMSS.SS in this field.	0.	
60-72	D13.1	A priori sigma of acceleration	0.	M/S**2

coefficient. 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

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ALTIME
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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
ACOEF  0 0 0             0.6762392000000D+00
ACOEF  0 1 0             0.9887231000000D-02
ACOEF  0 1 1            -0.7515130000000D+00-.916294200D-01
```

```
ACOEF  0 2 0           -0.5070995000000D+00
ACOEF  0 2 1           -0.9162940000000D-01 .297368800D-01
ACOEF  0 2 2            0.1177570000000D-00 .618260100D-02
ACOEF  0 3 0            0.6148761000000D-01
ACOEF  0 3 1            0.6778221000000D-01 .334011800D-02
ACOEF  0 3 2            0.2193671000000D-02-.613645100D-02
ACOEF  0 3 3           -0.3966454000000D-02 .406565900D-03
ALTIME 1 0 6 0                       168.00          185.0
ACOEF  1 1 0            0.2396375000000D-03
ACOEF  1 2 0           -0.9454928600000D-01
ACOEF  1 3 0            0.7089286600000D-01
ACOEF  1 4 0           -0.8032406400000D-01
ACOEF  1 5 0            0.4525305700000D-01
ACOEF  1 6 0            0.3543102200000D-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 ATITUD

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

```
COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS

1-6     A6              Requests application and/or
                        adjustment of attitude angles
                        (roll, pitch, yaw).

7       I1              Index defining the attitude angle
                        1 - Roll
                        2 - Pitch
                        3 - Yaw

8       I1              Index defining the term of the
                        polynomial.
                        0 - constant term
                        1 - Coefficient of linear term
                        2 - Coefficient of quadratic term
                        3 - Coefficient of amplitude
                        4 - Coefficient of phase

10-11   I3              Indicates if this card will be used
                        to specify end time for application.

                        99 - Card DOES specify application
                             end time.
                        00 - Card provides a-priori values
                             and sigmas for parameters.

12-14   I3              If cols 10-11 are 99 then this 3 digit
                        integer represents the sequence of
                        rotations for this period of time for
                        the S/C
                        ex: 123 means first apply roll, then
                        pitch, last yaw. 312 means first apply
                        yaw, then roll, last pitch.
                        If cols 10-11 are 00 this field
                        must be filled with the laser number.
                        For the S/C this number should be 00
                        (See example).
                        =999 This attitude parameter is a force
                        model parameter. It works only  in
                        combination with the DYNSEL option.


COLUMNS FORMAT          DESCRIPTION                        DEFAULT VALUE & UNITS

15-17   I3              If cols 10-11 are 99 then this
                        3 digit number represents the
                        sequence of rotations for the
                        individual lasers and for this
                        period of time All the individual
                        lasers will have the same sequence
                        of rotation.  Also in this case a
```

```
                         combination of the numbers 1,2,3
                         should be used.

18-24   I7               Satellite ID.

25-44   D20.8            If cols 10-11 are 00 this field
                         contains the a-priori value of
                         the coefficient.
                         If cols 10-11 are 99 this field
                         must be empty.

45-59   D15.3           If cols 10-11 are 99 this field
                        contains the end time of application
                        of the parameters that follow.

                        If cols 10-11 are 00 this field
                        must be empty.  The period that
                        ends at the specified time, begins
                        at the previous end time or at
                        EPOCH time.  The end time is in
                        the form:  YYMMDDHHMMSS.SS.

60-72                   If cols 10-11 are 00 this field
                        contains the standard deviation
                        of the coefficient. If this field
                        is zero,  GEODYN will assign a
                        very small standard deviation to
                                          -30
                        the parameter 1x10    .
                        If cols 10-11 are 00 this field
                        contains the period of the S/C


The example below requests adjustment of roll, pitch and yaw (complete
five term polynomial: constant, linear, quadratic, amplitude and phase
terms) with a sigma 1.D0 for each parameter. The S/C (id=9252010) has a
laser instrument (id=001) and a solution is requested for both S/C and
laser instrument at time periods:
1. EPOCH           -  930219031600.00
2. 930219031600.00 -  930219111600.00
The sequence of rotations for the S/C is: ROLL-PITCH-YAW
The sequence of rotations for the laser is: ROLL-PITCH-YAW

ATITUDE  991231239205201                        930219031600.00
ATITUD10   000   9205201 +.0100000000000D-02                    .100000D+01
ATITUD11   000   9205201 +.0200000000000D-05                    .100000D+01
ATITUD12   000   9205201 +.0300000000000D-11                    .100000D+01
ATITUD13   000   9205201 +.0400000000000D-11                    .100000D+01
ATITUD14   000   9205201 +.0500000000000D-11                    .100000D+01
ATITUD20   000   9205201 +.0400000000000D-02                    .100000D+01
ATITUD21   000   9205201 +.0500000000000D-05                    .100000D+01
ATITUD22   000   9205201 +.0600000000000D-11                    .100000D+01
ATITUD23   000   9205201 +.0700000000000D-11                    .100000D+01
ATITUD24   000   9205201 +.0800000000000D-11                    .100000D+01
ATITUD30   000   9205201 +.0700000000000D-02                    .100000D+01
ATITUD31   000   9205201 +.0800000000000D-05                    .100000D+01
ATITUD32   000   9205201 +.0900000000000D-11                    .100000D+01
ATITUD33   000   9205201 +.1000000000000D-11                    .100000D+01
```

```
ATITUD34   000   9205201 +.1100000000000D-11                     .100000D+01
ATITUD10   001   9205201 +.1100000000000D-02                     .100000D+01
ATITUD11   001   9205201 +.1200000000000D-05                     .100000D+01
ATITUD12   001   9205201 +.1300000000000D-11                     .100000D+01
ATITUD13   001   9205201 +.1400000000000D-11                     .100000D+01
ATITUD14   001   9205201 +.1500000000000D-11                     .100000D+01
ATITUD20   001   9205201 +.1400000000000D-02                     .100000D+01
ATITUD21   001   9205201 +.1500000000000D-05                     .100000D+01
ATITUD22   001   9205201 +.1600000000000D-11                     .100000D+01
ATITUD23   001   9205201 +.1700000000000D-11                     .100000D+01
ATITUD24   001   9205201 +.1800000000000D-11                     .100000D+01
ATITUD30   001   9205201 +.1700000000000D-02                     .100000D+01
ATITUD31   001   9205201 +.1800000000000D-05                     .100000D+01
ATITUD32   001   9205201 +.1900000000000D-11                     .100000D+01
ATITUD33   001   9205201 +.2000000000000D-11                     .100000D+01
ATITUD34   001   9205201 +.2100000000000D-11                     .100000D+01
ATITUD   991233219205201                     930219111600.00
ATITUD10   000   9205201 +.0100000000000D-02                     .100000D+01
ATITUD11   000   9205201 +.0200000000000D-05                     .100000D+01
ATITUD12   000   9205201 +.0300000000000D-11                     .100000D+01
ATITUD13   000   9205201 +.0400000000000D-11                     .100000D+01
ATITUD14   000   9205201 +.0500000000000D-11                     .100000D+01
ATITUD20   000   9205201 +.0100000000000D-02                     .100000D+01
ATITUD21   000   9205201 +.0200000000000D-05                     .100000D+01
ATITUD22   000   9205201 +.0300000000000D-11                     .100000D+01
ATITUD23   000   9205201 +.0400000000000D-11                     .100000D+01
ATITUD24   000   9205201 +.0500000000000D-11                     .100000D+01
ATITUD30   000   9205201 +.0100000000000D-02                     .100000D+01
ATITUD31   000   9205201 +.0200000000000D-05                     .100000D+01
ATITUD32   000   9205201 +.0300000000000D-11                     .100000D+01
ATITUD32   000   9205201 +.0400000000000D-11                     .100000D+01
ATITUD42   000   9205201 +.0500000000000D-11                     .100000D+01
ATITUD10   001   9205201 +.0100000000000D-02                     .100000D+01
ATITUD11   001   9205201 +.0200000000000D-05                     .100000D+01
ATITUD12   001   9205201 +.0300000000000D-11                     .100000D+01
ATITUD13   001   9205201 +.0400000000000D-11                     .100000D+01
ATITUD14   001   9205201 +.0500000000000D-11                     .100000D+01
ATITUD20   001   9205201 +.0100000000000D-02                     .100000D+01
ATITUD21   001   9205201 +.0200000000000D-05                     .100000D+01
ATITUD22   001   9205201 +.0300000000000D-07                     .100000D+01
ATITUD23   001   9205201 +.0400000000000D-07                     .100000D+01
ATITUD24   001   9205201 +.0500000000000D-07                     .100000D+01
ATITUD30   001   9205201 +.0100000000000D-11                     .100000D+01
ATITUD31   001   9205201 +.0200000000000D-05                     .100000D+01
ATITUD32   001   9205201 +.0300000000000D-07                     .100000D+01
ATITUD33   001   9205201 +.0400000000000D-07                     .100000D+01
ATITUD34   001   9205201 +.0500000000000D-07                     .100000D+01
```

In the same example as above, if one wishes to solve only for Yaw constant and linear terms and for the same periods of time the input reduces to :

```
ATITUDE  991231239205201                     930219031600.00
ATITUD30   000   9205201 +.0700000000000D-02                     .100000D+01
ATITUD31   000   9205201 +.0800000000000D-05                     .100000D+01
ATITUD30   001   9205201 +.1700000000000D-02                     .100000D+01
ATITUD31   001   9205201 +.1800000000000D-05                     .100000D+01
ATITUD   991233219205201                     930219111600.00
ATITUD30   000   9205201 +.0100000000000D-02                     .100000D+01
```

```
ATITUD31   000   9205201 +.0200000000000D-05                    .100000D+01
ATITUD30   001   9205201 +.0100000000000D-11                    .100000D+01
ATITUD31   001   9205201 +.0200000000000D-05                    .100000D+01
```

In the above case GEODYN will assign zero values and sigmas =1.D-30 to all the other parameters in the model. In general, if only one parameter in the model has been assigned a sigma, GEODYN will use a full model parameterization scheme with tight sigmas for all the other parameters.

Here is an example of Attitude parameters that will be considered as force model parameters. This capability is possible only along with the DYNSEL accelerometer option.

```
ATITUD   999999992000039                   000808000000.00
ATITUD10   000   2000039 0.1010000                            1.0
ATITUD11   000   2000039 0.0000000                            1.0
ATITUD12   000   2000039 0.0000000
ATITUD13   000   2000039 0.0000000
ATITUD14   000   2000039 0.0000000
ATITUD20   000   2000039 0.0150000                            1.0
ATITUD21   000   2000039 0.0000000                            1.0
ATITUD22   000   2000039 0.0000000
ATITUD23   000   2000039 0.0000000
ATITUD24   000   2000039 0.0000000
ATITUD30   000   2000039 0.0000000
ATITUD31   000   2000039 0.0000000
ATITUD32   000   2000039 0.0000000
ATITUD33   000   2000039 0.0000000
ATITUD34   000   2k00039 0.0000000
```

IF CARD OMITTED: Attitude modeling will not be invoked in GEODYN

2.5.9 CAMERA

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

COLUMNS FORMAT        DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6          CAMERA - Requests application and/or
                    adjustment of camera distortion parameters

7       I1          Parameter Index (1-8)

                       1-5 : Focal length/Distortion parameter
                             (Adjustable)
                         6 : Center Pixel Coordinates
                             (Unadjustable)
                       7-8 : K-Matrix parameter
                             (Unadjustable)

18-24   I7          Camera ID number

                    FOR PARAMETER INDICES 1-5
25-44               Parameter value (a-priori)
45-59               Parameter sigma

                    FOR PARAMETER INDEX 6
25-44               First Center Pixel Coordinate
45-59               Second Center Pixel Coordinate

                    FOR PARAMETER INDEX 7
25-44               K-MATRIX(1)
45-59               K-MATRIX(2)
60-72               K-MATRIX(3)

                    FOR PARAMETER INDEX 8
25-44               K-MATRIX(4)
45-59               K-MATRIX(5)
60-72               K-MATRIX(6)
```

EXAMPLE: CAMERA cards to define all camera parameters:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CAMERA1          2007043          150.07328     0.0004D-03
CAMERA2          2007043        0000000D-06    0.04308D-03
CAMERA3          2007043        0000000D-06    0.04308D-03
CAMERA4          2007043        0000000D-06    0.04308D-03
CAMERA5          2007043        0000000D-06    0.04308D-03
CAMERA6          2007043            512.5D0        512.5D0
CAMERA7          2007043          71.4286D0      0.00000D0        0.0D0
CAMERA8          2007043          0.00386D0    -71.44341D0        0.0D0
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

2.5.10 CON9PA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CON9PA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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          '0'
                        matrix before writing EMATRIX
                        file.
                    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        YYMMDDHHMMSS.SS
                   to be constrained.

45-59   D15.3      End time of adjacent periods to be        YYMMDDHHMMSS.SS
                   constrained.

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.
```

2.5.11 CONBIA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONBIA
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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        YYMMDDHHMMSS.SS
                   to be constrained.

45-59   D15.3      End time of adjacent periods to be        YYMMDDHHMMSS.SS
                   constrained.

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.
```

2.5.12 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          '0'
                        matrix before writing EMATRIX
                        file.
                    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       YYMMDDHHMMSS.SS
                   to be constrained.

45-59   D15.3      End time of adjacent periods to be       YYMMDDHHMMSS.SS
                   constrained.

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.
```

2.5.13 CONSOL

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
CONSOL
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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        YYMMDDHHMMSS.SS
                   to be constrained.

45-59    D15.3     End time of adjacent periods to be        YYMMDDHHMMSS.SS
                   constrained.

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.
```

2.5.14 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       0
                   this option description.

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.
```

2.5.15 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.

2.5.16 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 - $\dot{Cd}$ 2 - $\ddot{Cd}$	0	
18-24	I7	Satellite ID (required).	0	
25-44	D20.8	Drag coefficient.(For $\dot{Cd}$ and $\ddot{Cd}$ 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 preceeding 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

2.5.17 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

2.5.18 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.
```

2.5.19 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:

Edit level = Edit multiplier * 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.

2.5.20 EMATRX

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
EMATRX  1               123456.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS

1-6     A6        EMATRX - 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          0
                       also be output.

9       I1        E-matrix print options                       0
                    0 - E-matrix is not printed.
                    1 - E-matrix header and label
                        information is printed.
                    2 - Complete E-matrix is printed.

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      0.
                  number greater than 0.

45-59   D15.3     Stop date for V-matrix output in             0.
                  form YYMMDDHHMMSS.

60-72   D13.1     Output interval in seconds for the V-matrix. 0.     S
                  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.

73-80   D8.2      Sigma used in the case of a  Reduced Normal Matrix
                  case. (NOTE 1)

NOTE 1:  GEODYN considers the adjusted parameters as a group of parameters
     where all adjust with their assigned sigma value.
     Some parameters are often tightly constrained and do not change with
     the adjustments. This scenario  may produce very large normal matrices.
     With this option any GEODYN parameter for which the sigma is less than a
     certain constant, will not be contributing in the normal matrix.

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.
```

2.5.21 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          YYMMDDHHMMSS.
                   [NOTE 1]

45-59   D15.3      Start time for a time dependent option. The    YYMMDDHHMMSS.
                   end times are specified on the FANTOM cards.

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 OFFEST 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

2.5.22 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.  YYMMDDHHMMSS.
                   (if the index on col 9 is 2)
                   [NOTE 2]

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 parameterizaton. 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 OFFEST 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 paramete 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
                   a(4)  * sin( twopi * t / period(4) )  + a(5)  * cos( twopi * t / period


y_offset =  a(6) + a(7)  * sin( twopi * t / period(7) )  + a(8)  * cos( twopi * t / period
                   a(9)  * sin( twopi * t / period(9) )  + a(10) * cos( twopi * t / period


z_offset =  a(11)+ a(12) * sin( twopi * t / period(12) ) + a(13) * cos( twopi * t / period
                   a(14) * sin( twopi * t / period(14) ) + a(15) * cos( twopi * t / period
```

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.
```

2.5.23 FNBURN SUBGROUP

2.5.23.1 FNBURN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FNBURN           9601101   200402082905.0000    .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS FORMAT         DESCRIPTION                              DEFAULT VALUE & UNITS

1-6     A6          FNBURN - Introduces the application and/or
                    estimation of finite burn parameters
         FNBURN is the first card in a group of cards
                    which also contains the cards THRUST,FLRATE,THRRTA,
                    THRDEC, and end ends with the card ENDBRN.
                    Each of the cards above is described separately.
                    An example of the FNBURN group is given below (NOTE 1)

18-24   I7         Satellite ID

25-44   D20.8      Date in YYMMDDHHMMSS.SSSS UT

45-59   D15.3      Parameter sigma

[NOTE 1]:
FNBURN           1606401   181015170000.3990   1.000000D-50
THRUST1                      1.0922824000D+02   5.282000D-50
THRUST2                      4.1985467000D+00   1.000000D-50
THRUST3                     -3.9539867000D-01   1.000000D-50
THRUST4                      1.5605763000D-02   1.000000D-50
THRUST5                     -2.1846148000D-04   1.000000D-50
FLRATE0                      1.4917600000D+03   1.000000D-50
FLRATE1                      5.3764724000D-02   2.301200D-55
FLRATE2                      0.0000000000D+00   1.000000D-50
FLRATE3                      0.0000000000D+00   1.000000D-50
FLRATE4                      0.0000000000D+00   1.000000D-50
THRRTA1                      8.3447575000D+01   4.332500D-55
THRRTA2                      0.0000000000D+00   1.000000D-50
THRRTA3                      0.0000000000D+00   1.000000D-50
THRRTA4                      0.0000000000D+00   1.000000D-50
THRRTA5                      0.0000000000D+00   1.000000D-50
THRDEC1                      7.5908608000D+00   4.332500D-55
THRDEC2                      0.0000000000D+00   1.000000D-50
THRDEC3                      0.0000000000D+00   1.000000D-50
THRDEC4                      0.0000000000D+00   1.000000D-50
THRDEC5                      0.0000000000D+00   1.000000D-50
ENDBRN1                      3.0000000000D+01   1.284000D-55
ENDBRN                                          1.000000E-50
ENDBRN                                          1.000000E-50
ENDBRN                                          1.000000E-50
FNBEND
FNBURN           1606401   181015170030.3990   1.000000D-50
THRUST1                      8.6930216000D+02   4.114100D+01
THRUST2                      0.0000000000D+00   1.000000D+01
THRUST3                      0.0000000000D+00   1.000000D+01
THRUST4                      0.0000000000D+00   1.000000D+01
THRUST5                      0.0000000000D+00   1.000000D+01
FLRATE0                      1.4901440000D+03   1.000000D-50
FLRATE1                      3.6994717000D-01   1.792400D-55
FLRATE2                      0.0000000000D+00   1.000000D-50
```

```
FLRATE3                      0.0000000000D+00   1.000000D-50
FLRATE4                      0.0000000000D+00   1.000000D-50
THRRTA1                      8.3501789000D+01   2.731100D-55
THRRTA2                      0.0000000000D+00   1.000000D-50
THRRTA3                      0.0000000000D+00   1.000000D-50
THRRTA4                      0.0000000000D+00   1.000000D-50
THRRTA5                      0.0000000000D+00   1.000000D-50
THRDEC1                      7.7018506000D+00   2.731100D-55
THRDEC2                      0.0000000000D+00   1.000000D-50
THRDEC3                      0.0000000000D+00   1.000000D-50
THRDEC4                      0.0000000000D+00   1.000000D-50
THRDEC5                      0.0000000000D+00   1.000000D-50
ENDBRN1                      2.2436700000D+02   7.479700D-01
ENDBRN                                          1.000000E-50
ENDBRN                                          1.000000E-50
ENDBRN                                          1.000000E-50
FNBEND
```

IF CARD OMITTED: The finite burn model will not be considered in this run. calculations

2.5.23.2 THRUST

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRUST1                                    0.5       .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                           DEFAULT VALUE & UNITS

1-6     A6          THRUST - Defines the thrust coefficients'

 7      I1                  Order of coefficient

25-44   D20.8      A-priori value (newtons/sec**order)

45-59   D15.3      Parameter sigma
```

Sample FNBURN group setup featuring THRUST

```
FNBURN          1606401   181015170000.3990   1.000000D-50
THRUST1                     1.0922824000D+02   5.282000D-50
THRUST2                     4.1985467000D+00   1.000000D-50
THRUST3                    -3.9539867000D-01   1.000000D-50
THRUST4                     1.5605763000D-02   1.000000D-50
THRUST5                    -2.1846148000D-04   1.000000D-50
FLRATE0                     1.4917600000D+03   1.000000D-50
FLRATE1                     5.3764724000D-02   2.301200D-55
FLRATE2                     0.0000000000D+00   1.000000D-50
FLRATE3                     0.0000000000D+00   1.000000D-50
FLRATE4                     0.0000000000D+00   1.000000D-50
THRRTA1                     8.3447575000D+01   4.332500D-55
THRRTA2                     0.0000000000D+00   1.000000D-50
THRRTA3                     0.0000000000D+00   1.000000D-50
THRRTA4                     0.0000000000D+00   1.000000D-50
THRRTA5                     0.0000000000D+00   1.000000D-50
THRDEC1                     7.5908608000D+00   4.332500D-55
THRDEC2                     0.0000000000D+00   1.000000D-50
THRDEC3                     0.0000000000D+00   1.000000D-50
THRDEC4                     0.0000000000D+00   1.000000D-50
THRDEC5                     0.0000000000D+00   1.000000D-50
ENDBRN1                     3.0000000000D+01   1.284000D-55
ENDBRN                                         1.000000E-50
ENDBRN                                         1.000000E-50
ENDBRN                                         1.000000E-50
FNBEND
FNBURN          1606401   181015170030.3990   1.000000D-50
THRUST1                     8.6930216000D+02   4.114100D+01
THRUST2                     0.0000000000D+00   1.000000D+01
THRUST3                     0.0000000000D+00   1.000000D+01
THRUST4                     0.0000000000D+00   1.000000D+01
THRUST5                     0.0000000000D+00   1.000000D+01
FLRATE0                     1.4901440000D+03   1.000000D-50
FLRATE1                     3.6994717000D-01   1.792400D-55
FLRATE2                     0.0000000000D+00   1.000000D-50
FLRATE3                     0.0000000000D+00   1.000000D-50
FLRATE4                     0.0000000000D+00   1.000000D-50
THRRTA1                     8.3501789000D+01   2.731100D-55
THRRTA2                     0.0000000000D+00   1.000000D-50
THRRTA3                     0.0000000000D+00   1.000000D-50
THRRTA4                     0.0000000000D+00   1.000000D-50
```

THRRTA5	0.0000000000D+00	1.000000D-50
THRDEC1	7.7018506000D+00	2.731100D-55
THRDEC2	0.0000000000D+00	1.000000D-50
THRDEC3	0.0000000000D+00	1.000000D-50
THRDEC4	0.0000000000D+00	1.000000D-50
THRDEC5	0.0000000000D+00	1.000000D-50
ENDBRN1	2.2436700000D+02	7.479700D-01
ENDBRN		1.000000E-50
ENDBRN		1.000000E-50
ENDBRN		1.000000E-50
FNBEND		

2.5.23.3 FLRATE

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
FLRATE0                                    5.6       .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS FORMAT          DESCRIPTION                         DEFAULT VALUE & UNITS

1-6     A6          FLRATE - Defines mass flow rate coefficients

 7      I1                   Type of parameter
                       =0 mass at T0 (Kg)
                       =1-4 order of coefficient

25-44   D20.8      A-priori value of derivative of the mass flow
                            (kg/sec**order)

45-59   D15.3      Parameter sigma
```

2.5.23.4 THRRTA

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRRTA1                                0.001     .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRRTA - Defines coefficients for Thrust Right Ascension	
7	I1	- Order of coefficient	
25-44	D20.8	A-priori value (degrees)	
45-59	D15.3	Parameter sigma	

2.5.23.5 THRDEC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
THRDEC1                                  0.007     .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

COLUMNS	FORMAT	DESCRIPTION	DEFAULT VALUE & UNITS
1-6	A6	THRDEC - Defines coefficients for Thrust Declination	
7	I1	- Order of coefficient	
25-44	D20.8	A-priori value (degrees)	
45-59	D15.3	Parameter sigma	

2.5.23.6 FNBEND

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

```
COLUMNS FORMAT         DESCRIPTION                          DEFAULT VALUE & UNITS

1-6     A6         FNBEND - Defines the end of the FNBURN group
```

2.5.23.7 ENDBRN

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ENDBRN1                                 0.007      .100000D+20
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0


COLUMNS FORMAT          DESCRIPTION                              DEFAULT VALUE & UNITS

1-6     A6          FNBEND - Defines burn termination parameters

 7      I1                - index to denote parameter
                      =1 DT
                      =2 DV
                      =0 Additional parameters (3) if 7=2 (DV)

25-44   D20.8      A-priori value (degrees)

45-59   D15.3      Parameter sigma
```

2.5.24 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 1
                       = 2  Solarpanel rotation lag θ
                       = 3  Box wing X+ (α + δ)
                       = 4  Box wing X+ (e)
                       = 5  Box wing Z+ (α + δ)
                       = 6  Box wing Z+ (e)
                       = 7  Box wing Z- (α + δ)
                       = 8  Box wing Z- (e)
                       = 9  Y-bias

 8      I1          Extended Parameter Type                     Since Ver 2110
                       = 0  Parameter Type is specified at Column 7
                       = 1  Watts (Column 7 is ignored)                SEE NOTE 2

18-24   I7          Satellite ID

25-44               A priori value

45-59               Sigma

NOTE 1:  The presence of one GPSBXW option for one GPS satellite will
       invoke the adjustment of ALL 10 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.

NOTE 2:  The default values for GPS transmit power are cited from:

  "GPS and GLONASS Satellite Transmit Power: Update for IGS repro3.",
  by Steigenberger, Peter & Thölert, Steffen & Montenbruck, Oliver. (2019)

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
WATT     for block:   I         50.0000000000
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
WATT     for block:  II         50.0000000000
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
WATT     for block: IIA         50.0000000000
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
WATT     for block: IIR         60.0000000000
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
WATT     for block: IIR-M      145.0000000000
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
WATT     for block: IIF        240.0000000000
SPSF0    for block: III          1.0800000000
dthetasp for block: III          0.0000000000
aplusdxp for block: III          0.9000000000
```

```
rhoxp    for block: III          0.1000000000
aplusdzp for block: III          0.9000000000
rhozp    for block: III          0.1000000000
aplusdzm for block: III          1.0000000000
rhozm    for block: III          0.0000000000
yb       for block: III          0.0000000000
WATT     for block: III        300.0000000000
```

2.5.25 HRATEF

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
HRATEF11100 0000000000           2000039.
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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
```

2.5.26 HUBER

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
HUBER                  1.5
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0

COLUMNS FORMAT         DESCRIPTION                               DEFAULT VALUE & UNITS

1-6     A6     HUBER - Requests HUBER weighting
               to the observations.

15-17   I3     Measurement Type that HUBER
               weighting will apply.
               If cols 15-17 are blank, HUBER
               weighting will apply to all
               Measurement types.

25-44   D20.8  C = a factor that multiplies the
               observation sigma to create a new
               weight. [NOTE 1]


               NOTE [1]: With Huber weighing a user can specify a number,
                         C (1.5 is a typical specification for C). If the
                         ratio of DABS(resid_i)/sig_i is larger than C,
                         then the original weight that would have been
                         applied to that observation is multiplied by
                         C*sig_i/DABS(resid_i) to obtain the new weight
                         that is actually applied.
                         The result of this is to cause what the solution
                         is minimizing to change. The solution now minimizes
                         the combination of the sum of (resid_i/sig_i)**2
                         for all small residuals plus the sum of
                         DABS(resid_i)/(C*sig_i) for all large residuals.
                         This accommodates the larger residuals without
                         bending the solution so much towards them. The norm
                         is L2 for small residuals and L1 for large residuals.

IF CARD OMITTED:  Regular GEODYN observation weighting will be applied.
```

2.5.27 MBIAS SUBGROUP

2.5.27.1 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          0
                  this option description.

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             0.
                  if adjusted). Units are:
                  Length - M, Time - S, Angles - RAD

45-59   D15.3     Date and time at which the bias is to            0.
                  begin in form: YYMMDDHHMMSS.

60-72   D13.1     Date and time at which the bias is to            0.
                  end in form: YYMMDDHHMMSS.

73-80   D8.2      Standard deviation of the a priori               0.
                  bias in the same units as bias value.
                  If this value is greater than zero bias
                  will be adjusted.


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		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
station clock quadratic drift	302	no		yes	sec/hour^2
station clock cubic drift	303	no		yes	sec/hour^3
station clock bias (spline)	304	no		yes	sec/hour
altimeter attitude timing bias	399	yes		yes	sec
satellite clock bias	400	yes		no	sec
satellite clock linear drift	401	yes		no	sec/hour
satellite clock quadratic drift	402	yes		no	sec/hour^2
satellite clock cubic drift	403	yes		no	sec/hour^3
timing bias (only if MBIAS399 in use; see NOTE 5)	499	yes		yes	sec
tropospheric refraction scale bias	500	no		yes	[NOTE 1]
tropospheric bias zenith (spline)	501	no		yes	
tropospheric bias gradient north (biases tied together in spline for VLBI or a simple interval bias for GPS)	502	no		yes	[NOTE 6]
tropospheric bias gradient east (biases tied together in spline for VLBI or a simple interval bias for GPS)	503	no		yes	[NOTE 6]
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
t_0 => 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.

NOTE [5]: A MBIAS900 card should be used for altimeter an observation timing bias. A MBIAS900 card should be used for altimeter an observation timing bias.
An exception to this is when a MBIAS399 card is being used for an altimeter attitude timing bias. I this case a MBIAS399 card and not a MBIAS900 card should be used.

```
MBIAS     7063800         0.0                          850731000000.  850831000000.
MBIAS     7064801
```

NOTE [6]: Since IIE version 2106.p02.
When tropospheric bias parameters including gradients are being estimated for a GPS station and the simple interval

approach is being used, the setup for one interval would
look like this:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
MBIAS 21612191500                             210612000000.  210612010000.  1.0
MBIAS 21612191502  1  11         0.000645     210612000000.  210612010000. 0.01
MBIAS 21612191503  1  11        -0.000097     210612000000.  210612010000. 0.01
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

2.5.27.2 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       0
                  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.

7-14    I8        Station number for the "n"th station in        0
                  the measurement configuration.

15-17   I3        Bias Type. See list of measurement types       0
                  after ENDARC description
                  (not used if "n" equals 2 or 3).

18-24   I7        Satellite ID for the "n"th satellite in        0
                  the measurement configuration.

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           0.
                  if adjusted). Units are:
                  Length - M, Time - S, Angles - RAD

45-59   D15.3     Date and time at which the bias is to          0.
                  begin in form: YYMMDDHHMMSS.

60-72   D13.1     Date and time at which the bias is to          0.
                  end in form: YYMMDDHHMMSS.

73-80   D8.2      Standard deviation of the a priori             0.
                  bias in the same units as bias value.
                  If this value is greater than zero bias
                  will be adjusted.


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	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
station clock quadratic drift	302	no		yes	sec/hour^2
station clock cubic drift	303	no		yes	sec/hour^3
station clock bias (spline)	304	no		yes	sec/hour
altimeter attitude timing bias	399	yes		yes	sec
satellite clock bias	400	yes		no	sec
satellite clock linear drift	401	yes		no	sec/hour
satellite clock quadratic drift	402	yes		no	sec/hour^2
satellite clock cubic drift	403	yes		no	sec/hour^3
timing bias (only if MBIAS399 in use; see NOTE 5)	499	yes		yes	sec
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	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              701      yes        no
      term)

c: coefficient (to the quadratic           702      yes        no    1/sec
          term)

d: coefficient (to the cubic               703      yes        no   1/sec**2
          term)

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 immediatlly
          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.

NOTE [5]: A MBIAS900 card should be used for altimeter an observation timing
          bias. A MBIAS900 card should be used for altimeter an observation
          timing bias.
          An exception to this is when a MBIAS399 card is being used for an
          altimeter attitude timing bias. I this case a MBIAS399 card and not a
          MBIAS900 card should be used.


MBIAS     7063800         0.0                          850731000000.  850831000000.
MBIAS     7064801
```

2.5.27.3 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           0
                  range correction application.  [NOTE 1]


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.
```

2.5.28 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       0
                   2S observation file will not be advanced.

                   IF =1 THEN the current unit for the input
                   2S observation file will be advanced.  [NOTE 1]

8       I1         IF =0 THEN the current unit for the input       0
                   2S observation file will not be rewound.

                   IF =1 THEN the current unit for the input
                   2S observation file will be rewound.


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.
```

2.5.29 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                1
                   a priori diagonal variance/covariance
                   matrix being input on this card.

                   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      452361
                   to be eliminated when using single pass
                   orbit adjustments to edit data before
                   normal point binning.

                   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        0.
                   by column 7. If .LE.0 , parameter will not
                   be adjusted during normal point editing.

45-59   D15.3      Element #2 of var/cov matrix as determined        0.
                   by column 7. If .LE.0 , parameter will not
                   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

2.5.30 VLBI SUBGROUP

2.5.30.1 OPVLBI

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

  1-6     A6        OPVLBI: Denotes the beginning of the VLBI options
```

2.5.30.2 VLBSTR

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

  1-6      A6       VLBSTR

    8      I1       Index for option (1,8)

11-74     A64       Body of the string
```

2.5.30.3 ENDOPV

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

   1-6    A6      ENDOPV: Denotes the end of the VLBI options.
```

2.5.31 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-writting 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.

2.5.32 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.

2.5.33 ORBTVU

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
ORBTVU1          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

                    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

                    0 - True of date                              0
                    1 - True of reference date
                    2 - Mean of year 2000

9       I1        Trajectory type indicator.                      0
                    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          0
                  printed.

                    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

2.5.34 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                         0.    K
                        (delta temperature between hot and
                         cold equilibrium temperature)
                    8 - Temperature decay time D              0.    Sec.
                        (exponential decay time for panel
                         cooling)
                    9 - Temperature decay time F              0.    Sec.
                        (exponential decay time for panel
                         heating)


COLUMNS FORMAT         DESCRIPTION                       DEFAULT VALUE & UNITS

                   10 - Temperature/satellite rotation X      0.
                        (divisor for cos(theta) term in
                         heating equation)
```

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.

2.5.35 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	500	no		yes

scale bias				
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

2.5.36 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.
```

2.5.37 PENUMB

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
PENUMB          7603901
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
```

```
COLUMNS FORMAT         DESCRIPTION                              DEFAULT VALUE & UNITS

1-6     A6         PENUMB  - Invoke the  R.Robertson's Penumbra model
                   for the satellite on columns 18-24

18-24   I7         Satellite ID.                                      0
```

2.5.38 RELTMC

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
RELTMC
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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
      sychronization 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.
```

2.5.39 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

                    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.

8                  Observation data switch.                    0

                     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.


IF CARD OMITTED: No Residual File will be generated.
```

2.5.40 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                0
                   Older thermal model = 1

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

               X=-4.55SIN(B)+.08SIN(2B+.9)-.06COS(4B+.08)+.08
               Z=-4.54COS(B)+.20SIN(2B-.3)-.03SIN(4B)

            For BLOCK II satellites, X and Z are

               X=-8.96SIN(B)+.16SIN(3B)+.10SIN(5B)-.07SIN(7B)
               Z=-8.43COS(B)

            For BLOCK IIR satellites, X and Z are

              X=-11SIN(B)-0.2SIN(3B)+0.2SIN(5B)
               Z=-11.3COS(B)+0.1COS(3B)+0.2COS(5B)

        [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.
```

2.5.41 SLFSHD

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
SLFSHD
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+----0
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, otherwsie 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.

2.5.42 SIMULATION DATA SUBGROUP

2.5.42.1 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.
```

2.5.42.2 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.
```

2.5.42.3 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"            S
                 The same interval will be used as
                 counting interval in all measurement
                 types involving distruct Doppler data.

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.
```

2.5.42.4 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.
```

2.5.42.5 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.
```

2.5.42.6 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.

2.5.42.7 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

2.5.42.8 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.
```

2.5.42.9 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.
```

2.5.43 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         0
                     coefficients.

                       0 - Cr
                           .
                       1 - Cr
                           ..
                       2 - Cr

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                          0
                       =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.

18-24   I7           Satellite ID.                                 0

25-44   D20.8        Solar radiation pressure coefficient.         0.     none or
                     (Units for Cr dot and Cr double dot are              1/S or
                     per second and per second squared)                   1/S**2

45-59   D15.3        This field must be left blank unless          0.
                     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.

60-72   D13.1        Standard deviation of radiation pressure      0.     none or
                     coefficient.                                         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.

2.5.44 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

2.5.45 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.

2.5.46 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.

2.5.47 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 GPSMOD 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.

2.5.48 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
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 ascencion. 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):

$$\vec{a}_{\text{TD}} = \left[\frac{-D(\vec{r}_d \cdot \vec{S})}{\sqrt{1+\zeta^2}}\right]\vec{S}$$

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.
```

2.5.49 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          cols.     YYMMDDHHMMDD.SS
               of output defaulted to value in           26-44
               columns 26-44.
```

2.5.50 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                  0

                    1 - Sinusoidal yaw
                    2 - Fixed yaw
                    3 - Ramp Up
                    4 - Ramp Down
                    5 - Geocentric pointing

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 OMITTED:    TOPEX will follow nominal yaw steering algorithm.
```

2.5.51 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.

2.5.52 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.

2.5.53 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
                   emmitted 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     0  m/s**2
                   body fixed frame. component of normal vector
                   if 1 is specified in columns 13-14)

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 ommitted:  no louver accceleration will be applied.
```

2.5.54 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        15.0  deg
                    fixed yaw at low betaprime and sinusoidal yaw

45-59   D15.3       Betaprime value marking the boundary between         0.1  deg
                    fixed yaw and the flip manuever

60-72   D13.1       Betaprime value marking boundary between            80.0  deg
                    sinusoidal and fixed yaw at high betaprime
                    if 1 is specified in column 10
```

2.5.55 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 emmitted 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 space- craft 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.

2.5.56 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      1
                   = 2 Return only the solar orientation bias

9       I1         = 1 Return contribution of Y-bias acceleration        2
                   = 2 Exclude Y-bias acceleration

18-24   I7         Satellite ID
```

2.5.57 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	V14
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 Vij 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
```

2.5.58 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.

2.5.59 DATA SELECTION / DELETION SUBGROUP

2.5.59.1 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 asumes 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
```

2.5.59.2 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                 0
                   sequence number.

16-17   I2         Measurement Type. 2 digits or less.             0
                   See list of measurement types Section 5.0.

18-24   I7         Satellite ID.                                   0

25-30   I6         Measurement modulo number.                      1

31-40   D10.8      Measurement Type. 3 digits or less.             0
                   Will be converted to an integer.
                   See list of measurement types
                   Section 5.0.

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: No data will be selected.
```

2.5.59.3 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               0
                  sequence number. [2]

16-17   I2        Measurement Type. 2 digits or less.           0
                  See list of measurement types after
                  ENDARC description.

18-24   I7        Satellite ID. [1]                             0

25-30   I6        Measurement modulo number.                    1

31-40   D10.8     Measurement Type. 3 digits or less.           0
                  Will be converted to an integer.
                  See list of measurement types after
                  ENDARC description.

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   he
      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 satelliteare 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 cofigurations:

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 (Measuremebnt 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 trhe 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.

2.5.59.4 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).

2.5.59.5 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.

2.5.59.6 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.           0
                   See list of measurement types after
                   ENDARC description.

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.            0
                  Will be converted to an integer.
                  See list of measurement types after
                  ENDARC description.
```

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 preceed all SELECT cards otherwise PREPRO applies only to its preceeding 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.

2.5.59.7 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.            0
                  See list of measurement types after
                  ENDARC description.

18-24   I7        Satellite ID.                                  0

25-30   I6        Measurement Type. 3 digits or less.            0
                  See list of measurement types after
                  ENDARC description.

31-40   D10.8     Observation standard deviation.         Obtained from data
                  Used in forming normal equations.

41-46   I6        Flag used to indicate if value in
                  columns 31-40 will scale the data              0
                  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

51-60   D10.8     Observation editing sigma. Used for     Value in cols. 31-40
                  data editing only. If this field is
                  left blank the standard deviation
                  specified in columns 31-40 will be
                  used for data editing.

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
       preceed 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.

2.5.60 ARC SET TERMINATOR

2.5.60.1 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-IIE 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)

UNIT NO.         FORMAT         DESCRIPTION
           RECFM LRECL BLKSIZE
---------+---------+---------+---------+---------+---------+---------+---------
  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                              Selected Observation Data file output to
BINARY     VBS       X  15476     GEODYN-IIE. Necessary for all data reduction
ASCII      FB      132 15048      runs.
                                  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-IIE INPUT/OUTPUT FILE NAMES AND BRIEF DESCRIPTIONS

UNIT NO.	FORMAT RECFM	LRECL	BLKSIZE	DESCRIPTION
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	X	15476	Keplerian ephemeris printer output. VBS for
	FB	132	15048	unformatted and FB for formatted.
11	VBS	X	15476	Interface file from IIS. VBS for unformatted
	FB	132	15048	(BINARY) and FB for formatted (ASCII).
12	VBS	15470	15476	Observation file from IIS (DCB for binary and
	FB	132	15048	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 troposhere 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 ajustment 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 RECFM	FORMAT LRECL	FORMAT BLKSIZE	DESCRIPTION
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 RECFM	FORMAT LRECL	FORMAT BLKSIZE	DESCRIPTION
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 RECFM	FORMAT LRECL	FORMAT BLKSIZE	DESCRIPTION
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 nmust 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              40
                format denoted by the number in column 17
                (must be greater than 22 and smaller
                than 41)

16      I1      Type of binary data  [4]                           0

                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.

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)            (default)
                1 - Super extended altimetry format
                    (54, 8 byte words for a I64 machine or
                     58, 4 byte words for a I32 machine)


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 "YYMMDD". 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              1000  [1]
               in one logical block (limit=9999)
               (default for PCE data is 500)

18-24   I7     Maximum number of output buffers per                10
               logical block.(MAXBUF)
               MAXBUF must be less than or equal to 100
               and greater than or equal to 10

25-30   I6     Maximum number of scratch buffers in core           5
               must be greater than or equal to 5 and
               less than or equal to 500.  [2]                     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
                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)
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 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)-
                                                       (T2-->S1-->T2)
 79     SINGLY DIFFERENCED FOUR-WAY SAT-SAT RANGES (T3-->S3-->S1-->S2-->T2)-
                                                   (T3-->S3-->S1-->S3-->T3)
 80     SINGLY DIFFERENCED FOUR-WAY SAT-SAT DOPPLERS(T3-->S3-->S1-->S2-->T2)
              +SF2S*(T2-->S2-->T2)-(T3-->S3-->S1-->S3-->T3)-SF3S*(T3-->S3-->T3)
 81     SINGLY DIFFERENCED FOUR-WAY SAT-TARGET RANGES(T3-->S3-->T1-->S2-->T2)-
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                                                         (T3-->S3-->T1-->S3-->T3)
 82      SINGLY DIFFERENCED FOUR-WAY SAT-TARGET DOPPLERS(T3-->S3-->T1-->S2-->T2)
               +SF2T*(T2-->S2-->T2)-(T3-->S3-->T1-->S3-->T3)-SF3T*(T3-->S3-->T3)
 83      SINGLY DIFFERENCED FOUR-WAY SAT&TARGET RANGES  (T3-->S3-->S1-->S2-->T2)-
                                                          (T3-->S3-->P1T1-->S2-->T2)
 84      SINGLY DIFFERENCED FOUR-WAY SAT&TARGET DOPPLERS (T3-->S3-->S1-->S2-->T2)
              +SF2S*(T2-->S2-->T2)-(T3-->S3-->P1T1-->S2-->T2)-SF2T*(T2-->S2-->T2)

TYPE
 NO.     MEASUREMENT DESCRIPTION
----     -----------------------------------------------------------------------

 85      DOUBLY DIFFERENCED ONE-WAY RANGES   [(S2-->T1)-(S3-->T1)]-
                                             [(S2-->S1)-(S3-->S1)]
 86      DOUBLY DIFFERENCED ONE-WAY DOPPLERS [(S2-->S1)-(S3-->S1)]-
                                             [(S2-->T1)-(S3-->T1)]
 87      DOUBLY DIFFERENCED ONE-WAY RANGES   [(S1-->T1)-(S2-->T1)]-
                                             [(S1-->T2)-(S2-->T2)]
 88      DOUBLY DIFFERENCED ONE-WAY DOPPLERS [(S1-->T1)-(S2-->T1)]-
                                             [(S1-->T2)-(S2-->T2)]
 89      DOUBLY DIFFERENCED ONE- AND TWO-WAY RANGES   [(S2-->S1-->T2)-(S2-->T2)]-
                                                      [(S3-->S1-->T3)-(S3-->T3)]
 90      DOUBLY DIFFERENCED ONE- AND TWO-WAY DOPPLERS [(S2-->S1-->T2)-(S2-->T2)]-
                                                      [(S3-->S1-->T3)-(S3-->T3)]
 91      DOUBLY DIFFERENCED ONE- AND THREE-WAY RANGES [ (P1T1-->S2-->T2)
                           -(P1T1-->T2)]-[P1T1-->S3-->T3)-(P1T1-->T3)]
 92      DOUBLY DIFFERENCED ONE- AND THREE-WAY DOPPLERS (P1T1-->S2-->T2)
                           -(P1T1-->T2)]-[P1T1-->S3-->T3)-(P1T1-->T3)]
 93      DOUBLY DIFFERENCED TWO- AND THREE-WAY RANGES   (S1-->S2-->T2)
                        -(T1-->S2-->T2)]-[(S1-->S3-->T3)-(T1-->S3-->T3)]
 94      DOUBLY DIFFERENCED TWO- AND THREE-WAY DOPPLERS  (S1-->S2-->T2)
                        -(T1-->S2-->T2)]-[(S1-->S3-->T3)-(T1-->S3-->T3)]
 95      DOUBLY DIFFERENCED FOUR-WAY RANGES   [(T3-->S3-->S1-->S2-->T2)-
                   (T3-->S3-->S1-->S3-->T3)]-[(T3-->S3-->T1-->S2-->T2)
                                              -(T3-->S3-->T1-->S3-->T3)]
 96      DOUBLY DIFFERENCED FOUR-WAY DOPPLERS [(T3-->S3-->S1-->S2-->T2)+
                          SF2S*(T2-->S2-->T2)-(T3-->S3-->S1-->S3-->S3)-
                                                   SF3S*(T3-->S3-->T3)]-
                                              [(T3-->S3-->T1-->S2-->T2)+
                          SF2T*(T2-->S2-->T2)-(T3-->S3-->T1-->S3-->S3)-
                                                   SF3T*(T3-->S3-->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
------   -----------------------------------------------------------------------

  Sn     REFERS TO THE SATELLITE WHICH IS DEFINED ON BLOCK HEADER RECORD
         NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.
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Tn REFERS TO THE TRACKING STATION WHICH IS DEFINED ON BLOCK HEADER RECORD NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.

Pn REFERS TO THE PLANET ON WHICH THE TRACKING STATION Tn EXISTS. AN IMPLICIT REFERENCE TO PLANETARY BODIES IS MADE SIMPLY BY SPECIFICATION OF THE TRACKING STATION Tn. 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 Pn 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 Pn TO BE OF AN INTER-PLANETARY NATURE.

SFnX REFERS TO TWO-WAY DOPPLER SCALING FACTOR FOR SATELLITE n TRACKING USER A SATELLITE (X=S) OR REMOTE RELAY STATION (X=T).

Qn REFERS TO THE QUASAR WHICH IS DEFINED ON BLOCK HEADER RECORD NUMBER "n" OF THE GEODYN-II BINARY TRACKING DATA FORMAT.