APPENDIX: RINEX VERSION 2.11 FORMAT DEFINITIONS AND EXAMPLES

TABLE A1
GNSS OBSERVATION DATA FILE - HEADER SECTION DESCRIPTION

| | HEADER LABEL (Columns 61-80) | DESCRIPTION | FORMAT |
|---|---|---|---|
| | RINEX VERSION / TYPE | - Format version (2.11)<br>- File type ('O' for Observation Data)<br>- Satellite System: blank or 'G': GPS<br>'R': GLONASS<br>'S': Geostationary signal payload<br>'E': Galileo<br>'M': Mixed | F9.2,11X,<br>A1,19X,<br>A1,19X |
| | PGM / RUN BY / DATE | - Name of program creating current file<br>- Name of agency creating current file<br>- Date of file creation | A20,<br>A20,<br>A20 |
| * | COMMENT | Comment line(s) | A60 |
| | MARKER NAME | Name of antenna marker | A60 |
| * | MARKER NUMBER | Number of antenna marker | A20 |
| | OBSERVER / AGENCY | Name of observer / agency | A20,A40 |
| | REC # / TYPE / VERS | Receiver number, type, and version<br>(Version: e.g. Internal Software Version) | 3A20 |
| | ANT # / TYPE | Antenna number and type | 2A20 |
| | APPROX POSITION XYZ | Approximate marker position (WGS84) | 3F14.4 |
| | ANTENNA: DELTA H/E/N | - Antenna height: Height of bottom surface of antenna above marker<br>- Eccentricities of antenna center relative to marker to the east and north (all units in meters) | 3F14.4 |
| * | WAVELENGTH FACT L1/2 | - Default wavelength factors for L1 and L2 (GPS only)<br>1: Full cycle ambiguities<br>2: Half cycle ambiguities (squaring)<br>0 (in L2): Single frequency instrument<br>- zero or blank<br><br>The wavelength factor record is optional for GPS and obsolete for other systems. Wavelength factors default to 1. If the record exists it must precede any satellite-specific records (see below). | 2I6,<br><br>I6 |
| * | WAVELENGTH FACT L1/2 | - Wavelength factors for L1 and L2 (GPS)<br>1: Full cycle ambiguities<br>2: Half cycle ambiguities (squaring)<br>0 (in L2): Single frequency instrument<br>- Number of satellites to follow in list for which these factors are valid.<br>- List of PRNs (satellite numbers with system identifier)<br><br>These optional satellite specific lines may follow, if they identify a state different from the default values.<br><br>Repeat record if necessary. | 2I6,<br><br>I6,<br><br>7(3X,A1,I2) |
| | # / TYPES OF OBSERV | - Number of different observation types stored in the file<br>- Observation types<br>- Observation code<br>- Frequency code<br>If more than 9 observation types: | I6,<br><br>9(4X,A1,<br>A1) |

| | | |
|---|---|---|
| | Use continuation line(s) (including the header label in cols. 61-80!) | 6X,9(4X,2A1) |
| | The following observation types are defined in RINEX Version 2.11:<br><br>Observation code (use uppercase only):<br>C: Pseudorange GPS: C/A, L2C<br>Glonass: C/A<br>Galileo: All<br>P: Pseudorange GPS and Glonass: P code<br>L: Carrier phase<br>D: Doppler frequency<br>S: Raw signal strengths or SNR values as given by the receiver for the respective phase observations<br><br>Frequency code<br>GPS Glonass Galileo SBAS<br>1: L1 G1 E2-L1-E1 L1<br>2: L2 G2 -- --<br>5: L5 -- E5a L5<br>6: -- -- E6 --<br>7: -- -- E5b --<br>8: -- -- E5a+b --<br><br>Observations collected under Antispoofing are converted to "L2" or "P2" and flagged with bit 2 of loss of lock indicator (see Table A2).<br><br>Units : Phase : full cycles<br>Pseudorange : meters<br>Doppler : Hz<br>SNR etc : receiver-dependent<br><br>The sequence of the types in this record has to correspond to the sequence of the observations in the observation records | |
| * INTERVAL | Observation interval in seconds | F10.3 * |
| TIME OF FIRST OBS | - Time of first observation record (4-digit-year, month,day,hour,min,sec)<br>- Time system: GPS (=GPS time system)<br>GLO (=UTC time system)<br>GAL (=Galileo System Time)<br>Compulsory in mixed GPS/GLONASS files<br>Defaults: GPS for pure GPS files<br>GLO for pure GLONASS files<br>GAL for pure Galileo files | 5I6,F13.7,<br>5X,A3 |
| * TIME OF LAST OBS | - Time of last observation record (4-digit-year, month,day,hour,min,sec)<br>- Time system: Same value as in TIME OF FIRST OBS record | 5I6,F13.7, *<br>5X,A3 |
| * RCV CLOCK OFFS APPL | Epoch, code, and phase are corrected by applying the realtime-derived receiver clock offset: 1=yes, 0=no; default: 0=no<br>Record required if clock offsets are reported in the EPOCH/SAT records | I6 * |
| * LEAP SECONDS | Number of leap seconds since 6-Jan-1980<br>Recommended for mixed files | I6 * |
| * # OF SATELLITES | Number of satellites, for which observations are stored in the file | I6 * |
| * PRN / # OF OBS | PRN (sat.number), number of observations for each observation type indicated in the "# / TYPES OF OBSERV" - record.<br><br>If more than 9 observation types:<br>Use continuation line(s) including the header label in cols. 61-80! | 3X,A1,I2,9I6 *<br>6X,9I6 |

| | | | |
|---|---|---|---|
| | This record is (these records are) repeated for each satellite present in the data file | | |
| END OF HEADER | Last record in the header section. | | 60X |

Records marked with * are optional

TABLE A2

GNSS OBSERVATION DATA FILE - DATA RECORD DESCRIPTION

| OBS. RECORD | DESCRIPTION | FORMAT |
|---|---|---|
| EPOCH/SAT or EVENT FLAG | - Epoch :<br>- year (2 digits, padded with 0 if necessary)<br>- month,day,hour,min,<br>- sec | 1X,I2.2,<br>4(1X,I2),<br>F11.7, |
| | - Epoch flag 0: OK<br>1: power failure between previous and current epoch<br>>1: Event flag | 2X,I1, |
| | - Number of satellites in current epoch | I3, |
| | - List of PRNs (sat.numbers with system identifier, see 5.1) in current epoch | 12(A1,I2), |
| | - receiver clock offset (seconds, optional) | F12.9 |
| | If more than 12 satellites: Use continuation line(s) | 32X,<br>12(A1,I2) |
| | If epoch flag 2-5: | |
| | - Event flag:<br>2: start moving antenna<br>3: new site occupation (end of kinem. data) (at least MARKER NAME record follows)<br>4: header information follows<br>5: external event (epoch is significant, same time frame as observation time tags) | [2X,I1,] |
| | - "Number of satellites" contains number of special records to follow.<br>Maximum number of records: 999 | [I3] |
| | - For events without significant epoch the epoch fields can be left blank | |
| | If epoch flag = 6:<br>6: cycle slip records follow to optionally report detected and repaired cycle slips (same format as OBSERVATIONS records; slip instead of observation; LLI and signal strength blank or zero) | |
| OBSERVATIONS | - Observation<br>- LLI<br>- Signal strength<br>rep. within record for each obs.type (same seq as given in header) | m(F14.3,<br>I1,<br>I1) |
| | If more than 5 observation types (=80 char): continue observations in next record. | |
| | This record is (these records are) repeated for each satellite given in EPOCH/SAT - record. | |
| | Observations:<br>Phase : Units in whole cycles of carrier<br>Code : Units in meters<br>Missing observations are written as 0.0 or blanks. | |
| | Phase values overflowing the fixed format F14.3 have to be clipped into the valid interval (e.g. add or subtract 10**9), set LLI indicator. | |

| | | | |
|---|---|---|---|
| | Loss of lock indicator (LLI). Range: 0-7<br>0 or blank: OK or not known<br>Bit 0 set : Lost lock between previous and current observation: cycle slip possible<br>Bit 1 set : Opposite wavelength factor to the one defined for the satellite by a previous WAVELENGTH FACT L1/2 line or opposite to the default. Valid for the current epoch only.<br>Bit 2 set : Observation under Antispoofing (may suffer from increased noise)<br><br>Bits 0 and 1 for phase only.<br><br>Signal strength projected into interval 1-9:<br>1: minimum possible signal strength<br>5: threshold for good S/N ratio<br>9: maximum possible signal strength<br>0 or blank: not known, don't care | | |

TABLE A3

GPS NAVIGATION MESSAGE FILE - HEADER SECTION DESCRIPTION

| | HEADER LABEL (Columns 61-80) | DESCRIPTION | FORMAT | |
|---|---|---|---|---|
| | RINEX VERSION / TYPE | - Format version (2.10)<br>- File type ('N' for Navigation data) | F9.2,11X,<br>A1,19X | |
| | PGM / RUN BY / DATE | - Name of program creating current file<br>- Name of agency creating current file<br>- Date of file creation | A20,<br>A20,<br>A20 | |
| * | COMMENT | Comment line(s) | A60 | * |
| * | ION ALPHA | Ionosphere parameters A0-A3 of almanac (page 18 of subframe 4) | 2X,4D12.4 | * |
| * | ION BETA | Ionosphere parameters B0-B3 of almanac | 2X,4D12.4 | * |
| * | DELTA-UTC: A0,A1,T,W | Almanac parameters to compute time in UTC (page 18 of subframe 4)<br>A0,A1: terms of polynomial<br>T : reference time for UTC data<br>W : UTC reference week number. Continuous number, not mod(1024)! | 3X,2D19.12,<br>2I9<br>*) | * |
| * | LEAP SECONDS | Delta time due to leap seconds | I6 | * |
| | END OF HEADER | Last record in the header section. | 60X | |

Records marked with * are optional

TABLE A4

GPS NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION

| OBS. RECORD | DESCRIPTION | FORMAT |
|---|---|---|
| PRN / EPOCH / SV CLK | - Satellite PRN number | I2, |
| | - Epoch: Toc - Time of Clock | |
| | year (2 digits, padded with 0 if necessary) | 1X,I2.2, |
| | month | 1X,I2, |
| | day | 1X,I2, |
| | hour | 1X,I2, |
| | minute | 1X,I2, |
| | second | F5.1, |
| | - SV clock bias (seconds) | 3D19.12 |
| | - SV clock drift (sec/sec) | |
| | - SV clock drift rate (sec/sec2) | *) |

| | | |
|---|---|---|
| BROADCAST ORBIT - 1 | - IODE Issue of Data, Ephemeris | 3X,4D19.12 |
| | - Crs (meters) | |
| | - Delta n (radians/sec) | |
| | - M0 (radians) | |
| BROADCAST ORBIT - 2 | - Cuc (radians) | 3X,4D19.12 |
| | - e Eccentricity | |
| | - Cus (radians) | |
| | - sqrt(A) (sqrt(m)) | |
| BROADCAST ORBIT - 3 | - Toe Time of Ephemeris | 3X,4D19.12 |
| | (sec of GPS week) | |
| | - Cic (radians) | |
| | - OMEGA (radians) | |
| | - CIS (radians) | |
| BROADCAST ORBIT - 4 | - i0 (radians) | 3X,4D19.12 |
| | - Crc (meters) | |
| | - omega (radians) | |
| | - OMEGA DOT (radians/sec) | |
| BROADCAST ORBIT - 5 | - IDOT (radians/sec) | 3X,4D19.12 |
| | - Codes on L2 channel | |
| | - GPS Week # (to go with TOE) | |
| | Continuous number, not mod(1024)! | |
| | - L2 P data flag | |
| BROADCAST ORBIT - 6 | - SV accuracy (meters) | 3X,4D19.12 |
| | - SV health (bits 17-22 w 3 sf 1) | |
| | - TGD (seconds) | |
| | - IODC Issue of Data, Clock | |
| BROADCAST ORBIT - 7 | - Transmission time of message **) | 3X,4D19.12 |
| | (sec of GPS week, derived e.g. | |
| | from Z-count in Hand Over Word (HOW) | |
| | - Fit interval (hours) | |
| | (see ICD-GPS-200, 20.3.4.4) | |
| | Zero if not known | |
| | - spare | |
| | - spare | |

**) Adjust the Transmission time of message by -604800 to refer to the reported week, if necessary.

*) In order to account for the various compilers, E,e,D, and d are allowed letters between the fraction and exponent of all floating point numbers in the navigation message files.
Zero-padded two-digit exponents are required, however.

TABLE A5

METEOROLOGICAL DATA FILE - HEADER SECTION DESCRIPTION

| HEADER LABEL (Columns 61-80) | DESCRIPTION | FORMAT |
|---|---|---|
| RINEX VERSION / TYPE | - Format version (2.11) | F9.2,11X, |
| | - File type ('M' for Meteorological Data) | A1,39X |
| PGM / RUN BY / DATE | - Name of program creating current file | A20, |
| | - Name of agency creating current file | A20, |
| | - Date of file creation | A20 |
| *COMMENT | Comment line(s) | A60 * |
| MARKER NAME | Station Name | A60 |
| | (preferably identical to MARKER NAME in | |
| | the associated Observation File) | |
| *MARKER NUMBER | Station Number | A20 * |
| | (preferably identical to MARKER NUMBER in | |
| | the associated Observation File) | |
| # / TYPES OF OBSERV | - Number of different observation types | I6, |

| | | |
|---|---|---|
| | stored in the file | |
| | - Observation types | 9(4X,A2) |
| | | |
| | The following meteorological observation types are defined in RINEX Version 2: | |
| | | |
| | PR : Pressure (mbar) | |
| | TD : Dry temperature (deg Celsius) | |
| | HR : Relative humidity (percent) | |
| | ZW : Wet zenith path delay (mm) (for WVR data) | |
| | ZD : Dry component of zenith path delay (mm) | |
| | ZT : Total zenith path delay (mm) | |
| | WD : Wind azimuth (deg) from where the wind blows | |
| | WS : Wind speed (m/s) | |
| | RI : "Rain increment" (1/10 mm): Rain accumulation since last measurement | |
| | HI : Hail indicator: 1 = Hail detected since last measurement | |
| | | |
| | The sequence of the types in this record must correspond to the sequence of the measurements in the data records | |
| | | |
| | If more than 9 observation types are being used, use continuation lines including header label in cols. 61-80! | 6X,9(4X,A2) |
| SENSOR MOD/TYPE/ACC | Description of the met sensor<br>- Model (manufacturer)<br>- Type<br>- Accuracy (same units as obs values)<br>- Observation type<br>Record is repeated for each observation type found in # / TYPES OF OBSERV record | A20,<br>A20,6X,<br>F7.1,4X,<br>A2,1X |
| SENSOR POS XYZ/H | Approximate position of the met sensor<br>- Geocentric coordinates X,Y,Z (ITRF<br>- Ellipsoidal height H or WGS-84)<br>- Observation type<br>Set X,Y,Z to zero if not known.<br>Make sure H refers to ITRF or WGS-84!<br>Record required for barometer, recommended for other sensors. | 3F14.4,<br>1F14.4,<br>1X,A2,1X |
| END OF HEADER | Last record in the header section. | 60X |

Records marked with * are optional

TABLE A6

METEOROLOGICAL DATA FILE - DATA RECORD DESCRIPTION

| OBS. RECORD | DESCRIPTION | FORMAT |
|---|---|---|
| EPOCH / MET | - Epoch in GPS time (not local time!)<br>year (2 digits, padded with 0 if necessary)<br>month,day,hour,min,sec | 1X,I2.2,<br>5( 1X,I2), |
| | The 2-digit years in RINEX Version 1 and 2.xx files are understood to represent<br>80-99: 1980-1999 and 00-79: 2000-2079 | |
| | - Met data in the same sequence as given in the header | mF7.1 |
| | More than 8 met data types: Use continuation lines | 4X,10F7.1,3X |

| TABLE A7 |
| GPS OBSERVATION DATA FILE - EXAMPLE |

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

     2.10           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
BLANK OR G = GPS,  R = GLONASS,  E = GALILEO,  M = MIXED    COMMENT
XXRINEXO V9.9       AIUB                24-MAR-01 14:43     PGM / RUN BY / DATE
EXAMPLE OF A MIXED RINEX FILE (NO FEATURES OF V 2.11)       COMMENT
A 9080                                                      MARKER NAME
9080.1.34                                                   MARKER NUMBER
BILL SMITH          ABC INSTITUTE                           OBSERVER / AGENCY
X1234A123           XX                  ZZZ                 REC # / TYPE / VERS
234                 YY                                      ANT # / TYPE
  4375274.       587466.      4589095.                      APPROX POSITION XYZ
        .9030          .0000          .0000                 ANTENNA: DELTA H/E/N
     1     1                                                WAVELENGTH FACT L1/2
     1     2     6   G14   G15   G16   G17   G18   G19      WAVELENGTH FACT L1/2
     0                                                      RCV CLOCK OFFS APPL
     5    P1    L1    L2    P2    L5                        # / TYPES OF OBSERV
    18.000                                                  INTERVAL
  2005     3    24    13    10   36.0000000                 TIME OF FIRST OBS
                                                            END OF HEADER
 05  3 24 13 10 36.0000000  0  4G12G09G06E11                        -.123456789
  23629347.915            .300 8         -.353    23629364.158
  20891534.648           -.120 9         -.358    20891541.292
  20607600.189           -.430 9          .394    20607605.848
                          .324 8                                  .178 7
 05  3 24 13 10 50.0000000  4  4
     1     2     2   G 9   G12                                   WAVELENGTH FACT L1/2
  *** WAVELENGTH FACTOR CHANGED FOR 2 SATELLITES ***            COMMENT
      NOW 8 SATELLITES HAVE WL FACT 1 AND 2!                    COMMENT
                                                                COMMENT
 05  3 24 13 10 54.0000000  0  6G12G09G06R21R22E11                -.123456789
  23619095.450      -53875.632 8    -41981.375    23619112.008
  20886075.667      -28688.027 9    -22354.535    20886082.101
  20611072.689       18247.789 9     14219.770    20611078.410
  21345678.576       12345.567 5
  22123456.789       23456.789 5
                     65432.123 5                           48861.586 7
 05  3 24 13 11  0.0000000  2  1
           *** FROM NOW ON KINEMATIC DATA! ***                  COMMENT
 05  3 24 13 11 48.0000000  0  4G16G12G09G06                        -.123456789
  21110991.756       16119.980 7     12560.510    21110998.441
  23588424.398     -215050.557 6   -167571.734    23588439.570
  20869878.790     -113803.187 8    -88677.926    20869884.938
  20621643.727       73797.462 7     57505.177    20621649.276
                             3  4
A 9080                                                      MARKER NAME
9080.1.34                                                   MARKER NUMBER
         .9030         .0000         .0000                  ANTENNA: DELTA H/E/N
          --> THIS IS THE START OF A NEW SITE <--           COMMENT
 05  3 24 13 12  6.0000000  0  4G16G12G06G09                        -.123456987
  21112589.384       24515.877 6     19102.763 3  21112596.187
  23578228.338     -268624.234 7   -209317.284 4  23578244.398
  20625218.088       92581.207 7     72141.846 4  20625223.795
  20864539.693     -141858.836 8   -110539.435 5  20864545.943
 05  3 24 13 13  1.2345678  5  0
                            4  1
        (AN EVENT FLAG WITH SIGNIFICANT EPOCH)              COMMENT
 05  3 24 13 14 12.0000000  0  4G16G12G09G06                        -.123456012
  21124965.133       89551.30216     69779.62654  21124972.2754
  23507272.372     -212616.150 7   -165674.789 5  23507288.421
  20828010.354     -333820.093 6   -260119.395 5  20828017.129
  20650944.902      227775.130 7    177487.651 4  20650950.363
                             4  1
          *** ANTISPOOFING ON G 16 AND LOST LOCK             COMMENT
 05  3 24 13 14 12.0000000  6  2G16G09
                 123456789.0      -9876543.5
                         0.0            -0.5
                             4  2
          ---> CYCLE SLIPS THAT HAVE BEEN APPLIED TO        COMMENT
               THE OBSERVATIONS                             COMMENT
 05  3 24 13 14 48.0000000  0  4G16G12G09G06                        -.123456234
  21128884.159      110143.144 7     85825.18545  21128890.7764
  23487131.045     -318463.297 7   -248152.72824  23487146.149
```

```
  20817844.743     -387242.571 6   -301747.22925  20817851.322
  20658519.895      267583.67817    208507.26234  20658525.869
                          4  3
         ***   SATELLITE G 9   THIS EPOCH ON WLFACT 1 (L2)  COMMENT
         *** G 6 LOST LOCK AND THIS EPOCH ON WLFACT 2 (L2)  COMMENT
               (OPPOSITE TO PREVIOUS SETTINGS)             COMMENT

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

TABLE A8

GPS NAVIGATION MESSAGE FILE - EXAMPLE

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

     2.10           N: GPS NAV DATA                         RINEX VERSION / TYPE
XXRINEXN V2.10      AIUB                 3-SEP-99 15:22     PGM / RUN BY / DATE
EXAMPLE OF VERSION 2.10 FORMAT                              COMMENT
     .1676D-07   .2235D-07  -.1192D-06  -.1192D-06          ION ALPHA
     .1208D+06   .1310D+06  -.1310D+06  -.1966D+06          ION BETA
     .133179128170D-06  .107469588780D-12   552960     1025 DELTA-UTC: A0,A1,T,W
    13                                                      LEAP SECONDS
                                                            END OF HEADER
 6 99  9  2 17 51 44.0 -.839701388031D-03 -.165982783074D-10  .000000000000D+00
     .910000000000D+02  .934062500000D+02  .116040547840D-08  .162092304801D+00
     .484101474285D-05  .626740418375D-02  .652112066746D-05  .515365489006D+04
     .409904000000D+06 -.242143869400D-07  .329237003460D+00 -.596046447754D-07
     .111541663136D+01  .326593750000D+03  .206958726335D+01 -.638312302555D-08
     .307155651409D-09  .000000000000D+00  .102500000000D+04  .000000000000D+00
     .000000000000D+00  .000000000000D+00  .000000000000D+00  .910000000000D+02
     .406800000000D+06  .000000000000D+00
13 99  9  2 19  0  0.0  .490025617182D-03  .204636307899D-11  .000000000000D+00
     .133000000000D+03 -.963125000000D+02  .146970407622D-08  .292961152146D+01
    -.498816370964D-05  .200239347760D-02  .928156077862D-05  .515328476143D+04
     .414000000000D+06 -.279396772385D-07  .243031939942D+01 -.558793544769D-07
     .110192796930D+01  .271187500000D+03 -.232757915425D+01 -.619632953057D-08
    -.785747015231D-11  .000000000000D+00  .102500000000D+04  .000000000000D+00
     .000000000000D+00  .000000000000D+00  .000000000000D+00  .389000000000D+03
     .410400000000D+06  .000000000000D+00

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

TABLE A9

METEOROLOGICAL DATA FILE - EXAMPLE

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

     2.10           METEOROLOGICAL DATA                     RINEX VERSION / TYPE
XXRINEXM V9.9       AIUB                 3-APR-96 00:10     PGM / RUN BY / DATE
EXAMPLE OF A MET DATA FILE (NO FEATURES OF V 2.11)          COMMENT
A 9080                                                      MARKER NAME
     3    PR    TD    HR                                   # / TYPES OF OBSERV
PAROSCIENTIFIC      740-16B                    0.2    PR SENSOR MOD/TYPE/ACC
HAENNI                                         0.1    TD SENSOR MOD/TYPE/ACC
ROTRONIC            I-240W                     5.0    HR SENSOR MOD/TYPE/ACC
        0.0           0.0           0.0       1234.5678 PR SENSOR POS XYZ/H
                                                            END OF HEADER
 96  4  1  0  0 15  987.1   10.6   89.5
 96  4  1  0  0 30  987.2   10.9   90.0
 96  4  1  0  0 45  987.1   11.6   89.0

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

TABLE A10

GLONASS NAVIGATION MESSAGE FILE - HEADER SECTION DESCRIPTION

| HEADER LABEL (Columns 61-80) | DESCRIPTION | FORMAT |
|---|---|---|

| | | |
|---|---|---|
|RINEX VERSION / TYPE| - Format version (2.10)<br>- File type ('G' = GLONASS nav mess data)| F9.2,11X,<br>A1,39X |
|PGM / RUN BY / DATE | - Name of program creating current file<br>- Name of agency creating current file<br>- Date of file creation (dd-mmm-yy hh:mm)| A20,<br>A20,<br>A20 |
|*COMMENT | Comment line(s) | A60 |*
|*CORR TO SYSTEM TIME | - Time of reference for system time corr (year, month, day)<br>- Correction to system time scale (sec) to correct GLONASS system time to UTC(SU) (-TauC)| |*<br>3I6,<br>3X,D19.12<br>*) |
|*LEAP SECONDS | Number of leap seconds since 6-Jan-1980 | I6 |*
|END OF HEADER | Last record in the header section. | 60X |

Records marked with * are optional

TABLE A11

GLONASS NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION

| OBS. RECORD | DESCRIPTION | FORMAT |
|---|---|---|
|PRN / EPOCH / SV CLK| - Satellite number:<br>Slot number in sat. constellation<br>- Epoch of ephemerides (UTC)<br>- year (2 digits, padded with 0, if necessary)<br>- month,day,hour,minute,<br>- second<br>- SV clock bias (sec) (-TauN)<br>- SV relative frequency bias (+GammaN)<br>- message frame time (tk)<br>(0 .le. tk .lt. 86400 sec of day UTC)<br><br>The 2-digit years in RINEX 1 and 2.xx files are understood to represent 80-99: 1980-1999 and 00-79: 2000-2079| I2,<br><br><br>1X,I2.2,<br>4(1X,I2),<br>F5.1,<br>D19.12,<br>D19.12,<br>D19.12<br><br>*)<br> |
| BROADCAST ORBIT - 1| - Satellite position X (km)<br>- velocity X dot (km/sec)<br>- X acceleration (km/sec2)<br>- health (0=OK) (Bn)| 3X,4D19.12 |
| BROADCAST ORBIT - 2| - Satellite position Y (km)<br>- velocity Y dot (km/sec)<br>- Y acceleration (km/sec2)<br>- frequency number (-7 ... +13)| 3X,4D19.12 |
| BROADCAST ORBIT - 3| - Satellite position Z (km)<br>- velocity Z dot (km/sec)<br>- Z acceleration (km/sec2)<br>- Age of oper. information (days) (E)| 3X,4D19.12 |

*) In order to account for the various compilers, E,e,D, and d are allowed letters between the fraction and exponent of all floating point numbers in the navigation message files.
Zero-padded two-digit exponents are required, however.

TABLE A12

GLONASS NAVIGATION MESSAGE FILE - EXAMPLE

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

     2.10           GLONASS NAV DATA                         RINEX VERSION / TYPE
ASRINEXG V1.1.0 VM  AIUB               19-FEB-98 10:42     PGM / RUN BY / DATE
```

```
STATION ZIMMERWALD                                          COMMENT
  1998     2    16    0.379979610443D-06                   CORR TO SYSTEM TIME
                                                           END OF HEADER
 3 98  2 15  0 15  0.0 0.163525342941D-03 0.363797880709D-11 0.108000000000D+05
    0.106275903320D+05-0.348924636841D+00 0.931322574615D-09 0.000000000000D+00
   -0.944422070313D+04 0.288163375854D+01 0.931322574615D-09 0.210000000000D+02
    0.212257280273D+05 0.144599342346D+01-0.186264514923D-08 0.300000000000D+01
 4 98  2 15  0 15  0.0 0.179599039257D-03 0.636646291241D-11 0.122400000000D+05
    0.562136621094D+04-0.289074897766D+00-0.931322574615D-09 0.000000000000D+00
   -0.236819248047D+05 0.102263259888D+01 0.931322574615D-09 0.120000000000D+02
    0.762532910156D+04 0.339257907867D+01 0.000000000000D+00 0.300000000000D+01
11 98  2 15  0 15  0.0-0.559808686376D-04-0.272848410532D-11 0.108600000000D+05
   -0.350348437500D+04-0.255325126648D+01 0.931322574615D-09 0.000000000000D+00
    0.106803754883D+05-0.182923507690D+01 0.000000000000D+00 0.400000000000D+01
    0.228762856445D+05 0.447064399719D+00-0.186264514923D-08 0.300000000000D+01
12 98  2 15  0 15  0.0 0.199414789677D-04-0.181898940355D-11 0.108900000000D+05
    0.131731816406D+05-0.143945598602D+01 0.372529029846D-08 0.000000000000D+00
    0.171148715820D+05-0.118937969208D+01 0.931322574615D-09 0.220000000000D+02
    0.135737919922D+05 0.288976097107D+01-0.931322574615D-09 0.300000000000D+01

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

+------------------------------------------------------------------------------+
| TABLE A13 |
| GLONASS OBSERVATION FILE - EXAMPLE |
+------------------------------------------------------------------------------+

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

     2.10           OBSERVATION DATA    R (GLONASS)         RINEX VERSION / TYPE
XXRINEXO V1.1       AIUB                27-AUG-93 07:23     PGM / RUN BY / DATE
TST1                                                        MARKER NAME
VIEWEG              BRAUNSCHWEIG                            OBSERVER / AGENCY
100                 XX-RECEIVER         1.0                 REC # / TYPE / VERS
101                 XX-ANTENNA                              ANT # / TYPE
  3844808.114    715426.767   5021804.854                  APPROX POSITION XYZ
        1.2340         .0000         .0000                  ANTENNA: DELTA H/E/N
     1     1                                                WAVELENGTH FACT L1/2
     2    C1    L1                                         # / TYPES OF OBSERV
    10.000                                                  INTERVAL
  1993     8    23    14    24   40.0490000     GLO         TIME OF FIRST OBS
                                                            END OF HEADER
 93  8 23 14 24 40.0490000  0  3  2R01R21
  23986839.824       20520.565 5
  23707804.625       19937.231 5
  23834065.096       -9334.581 5
 93  8 23 14 24 50.0490000  0  3  2R01R21
  23992341.033       49856.525 5
  23713141.002       48479.290 5
  23831189.435      -24821.796 5
 93  8 23 14 25   .0490000  0  3  2R01R21
  23997824.854       79217.202 5
  23718494.110       77092.992 5
  23828329.946      -40219.918 5
 93  8 23 14 25 10.0490000  0  5  2R05R17R01R21
  24003328.910      108602.422 5
  24933965.449      -19202.780 5
  22203326.578       -2987.327 5
  23723851.686      105777.849 5
  23825485.526      -55529.205 5
 93  8 23 14 25 20.0490010  0  5  2R05R17R01R21
  24008828.023      138012.178 5
  24927995.616      -51188.500 5
  22202547.907       -7213.298 5
  23729236.758      134533.636 5
  23822662.277      -70749.590 5
 93  8 23 14 25 30.0490000  0  5  2R05R17R01R21
  24014330.779      167446.477 5
  24922041.288      -83151.666 5
  22201767.457      -11388.909 5
  23734633.024      163360.131 5
  23819848.894      -85881.102 5

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

TABLE A14

MIXED GPS/GLONASS OBSERVATION FILE - EXAMPLE

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

     2.10           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
YYRINEXO V2.8.1 VM  AIUB                 6-FEB-00 13:59     PGM / RUN BY / DATE
TST2                                                        MARKER NAME
001-02-A                                                    MARKER NUMBER
JIM                 Y-COMPANY                               OBSERVER / AGENCY
1                   YY-RECEIVER         2.0.1               REC # / TYPE / VERS
1                   GEODETIC L1                             ANT # / TYPE
  3851178.1849   -80151.4072  5066671.1013                  APPROX POSITION XYZ
       1.2340        0.0000        0.0000                   ANTENNA: DELTA H/E/N
     1     0                                                WAVELENGTH FACT L1/2
     2    C1    L1                                          # / TYPES OF OBSERV
    10.000                                                  INTERVAL
    11                                                      LEAP SECONDS
  2000     2     6    11    53    0.0000000     GPS         TIME OF FIRST OBS
                                                            END OF HEADER
 00  2  6 11 53  0.0000000  0 14G23G07G02G05G26G09G21R20R19R12R02R11
                              R10R03
  22576523.586   -11256947.60212
  22360162.704   -16225110.75413
  24484865.974    14662682.882 2
  21950524.331   -13784707.24912
  22507304.252     9846064.848 2
  20148742.213   -20988953.712 4
  22800149.591   -16650822.70012
  19811403.273   -25116169.741 3
  23046997.513    -3264701.688 2
  22778170.622  -821857836.745 1
  22221283.991  -988088156.884 2
  19300913.475   -83282658.19013
  20309075.579  -672668843.84713
  23397403.484  -285457101.34211
 00  2  6 11 53 10.0000000  0 14G23G07G02G05G26G09G21R20R19R12R02R11
                              R10R03
  22578985.016   -11244012.910 2
  22359738.890   -16227337.841 2
  24490324.818    14691368.710 2
  21944376.706   -13817012.849 2
  22512598.731     9873887.580 2
  20147322.111   -20996416.338 4
  22798942.949   -16657163.594 2
  19812513.509   -25110234.795 3
  23053885.702    -3227854.397 2
  22770607.029  -821898566.774 1
  22222967.297  -988079145.989 2
  19297913.736   -83298710.38413
  20313087.618  -672647337.04113
  23392352.454  -285484291.40311

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

TABLE A15

GEOSTATIONARY NAVIGATION MESSAGE FILE - HEADER SECTION DESCRIPTION

| HEADER LABEL (Columns 61-80) | DESCRIPTION | FORMAT |
|---|---|---|
| RINEX VERSION / TYPE | - Format version (2.11)<br>- File type ('H' = GEO nav mess data) | F9.2,11X,<br>A1,39X |
| PGM / RUN BY / DATE | - Name of program creating current file<br>- Name of agency creating current file<br>- Date of file creation (dd-mmm-yy hh:mm) | A20,<br>A20,<br>A20 |
| * COMMENT | Comment line(s) | A60 * |
| * CORR TO SYSTEM TIME | - Time of reference for system time corr (year, month, day) | 3I6, * |
| Obsolete in | - Correction to transform the GEO system | 3X,D19.12 |

| RINEX Version 2.11 | time to UTC (W0) | *) |
|---|---|---|
| *\|D-UTC A0,A1,T,W,S,U | Corrections to transform the system time to UTC<br>A0,A1 Coefficients of 1-deg polynomial<br>A0 sec, A1 sec/sec<br>CORR(s) = A0 + A1*DELTAT<br>T Reference time for polynomial<br>(Seconds into GPS week)<br>W Reference week number<br>(GPS week, continuous number)<br>S EGNOS, WAAS, or MSAS ...<br>(left-justified)<br>Derived from MT17 service provider.<br>If not known: Use Snn with<br>nn = PRN-100 of satellite<br>broadcasting the MT12<br>U UTC Identifier (0 if unknown)<br>1=UTC(NIST), 2=UTC(USNO), 3=UTC(SU),<br>4=UTC(BIPM), 5=UTC(Europe Lab),<br>6=UTC(CRL), >6 = reserved for future<br><br>Omit record if corrections not provided.<br><br>Replaces CORR TO SYSTEM TIME ! | <br>2D19.12,<br><br><br>I7,<br><br>I5,<br><br>X,A5,X<br><br><br><br><br><br>I2,2X<br><br><br><br><br><br><br><br> | * |
| *\|LEAP SECONDS | Number of leap seconds since 6-Jan-1980 | I6 | * |
| END OF HEADER | Last record in the header section. | 60X | |

Records marked with * are optional

TABLE A16

GEOSTATIONARY NAVIGATION MESSAGE FILE - DATA RECORD DESCRIPTION

| OBS. RECORD | DESCRIPTION | FORMAT |
|---|---|---|
| PRN / EPOCH / SV CLK | - Satellite number (PRN - 100)<br>- Epoch of ephemerides (GPS) (Toe)<br>- year (2 digits, padded with 0 if necessary)<br>- month,day,hour,minute,<br>- second<br>- SV clock bias (sec) (aGf0)<br>- SV relative frequency bias (aGf1)<br>- Transmission time of message (start of the message) in GPS seconds of the week | I2,<br><br>1X,I2.2,<br>4(1X,I2),<br>F5.1,<br>D19.12,<br>D19.12,<br>D19.12 |
| BROADCAST ORBIT - 1 | - Satellite position X (km)<br>- velocity X dot (km/sec)<br>- X acceleration (km/sec2)<br>- health (0=OK) | 3X,4D19.12<br><br>*) |
| BROADCAST ORBIT - 2 | - Satellite position Y (km)<br>- velocity Y dot (km/sec)<br>- Y acceleration (km/sec2)<br>- Accuracy code (URA, meters) | 3X,4D19.12 |
| BROADCAST ORBIT - 3 | - Satellite position Z (km)<br>- velocity Z dot (km/sec)<br>- Z acceleration (km/sec2)<br>- IODN (Issue of Data Navigation, DO229, 8 first bits after Message Type if MT9) | 3X,4D19.12 |

*) In order to account for the various compilers, E,e,D, and d are allowed letters between the fraction and exponent of all floating point numbers in the navigation message files.
Zero-padded two-digit exponents are required, however.

TABLE A17

MIXED GPS/GEO OBSERVATION FILE - EXAMPLE

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

     2.10           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
RinExp V.2.0.2      TESTUSER            00-02-04 09:30      PGM / RUN BY / DATE
                                                            COMMENT
The file contains L1 pseudorange and phase data of the      COMMENT
geostationary AOR-E satellite (PRN 120 = S20)               COMMENT
                                                            COMMENT
TLSE D                                                      MARKER NAME
ESTB                TESTAGENCY                              OBSERVER / AGENCY
SGL98030069         Novatel Millennium  HW3-1 SW 4.45/2.3   REC # / TYPE / VERS
                    ASH701073.1                             ANT # / TYPE
  4629365.0750   112100.1790  4371619.4160                  APPROX POSITION XYZ
        0.0000        0.0000        0.0000                  ANTENNA: DELTA H/E/N
     1     1                                                WAVELENGTH FACT L1/2
     4    C1    L1    L2    P2                              # / TYPES OF OBSERV
     1                                                      INTERVAL
  2000     1    13    14    45    0.000000      GPS         TIME OF FIRST OBS
  2000     1    13    15     0    0.000000      GPS         TIME OF LAST OBS
     0                                                      RCV CLOCK OFFS APPL
                                                            END OF HEADER
 00 01 13 14 45  0.0000000  0  8G25G17G06G05G24G29G30S20             0.000535140
  21839900.207     -236148.877 9   -184047.71049  21839901.4384
  25151926.413     -161002.900 9   -125509.72447  25151935.8274
  20531103.515      763336.059 9    594797.53149  20531105.0114
  23001624.801     -432989.642 9   -337436.50348  23001628.1684
  23610349.510     -384890.728 9   -299952.38848  23610354.3504
  23954474.398     -151982.173 9   -118480.96847  23954481.1994
  20622367.016     -332628.466 9   -259214.55249  20622367.8754
  38137559.506      335849.135 9
 00 01 13 14 45  1.0000000  0  8G25G17G06G05G24G29G30S20             0.000535144
  21839500.278     -238250.743 9   -185685.52549  21839501.4814
  25151246.148     -164576.503 9   -128294.33947  25151256.2614
  20531084.382      763235.849 9    594719.44849  20531085.8784
  23002123.430     -430369.237 9   -335394.62748  23002126.7114
  23610670.127     -383205.864 9   -298639.51048  23610674.9834
  23955051.773     -148948.417 9   -116117.00748  23955058.5034
  20622558.579     -331621.765 9   -258430.11049  20622559.4574
  38137558.783      335846.284 9
 00 01 13 14 45  2.0000000  0  8G25G17G06G05G24G29G30S20             0.000535144
  21839100.418     -240352.173 9   -187323.00449  21839101.6534
  25150565.890     -168150.148 9   -131078.97647  25150576.2144
  20531065.378      763136.116 9    594641.73549  20531066.8984
  23002622.082     -427748.683 9   -333352.63648  23002625.3444
  23610990.819     -381520.461 9   -297326.20848  23610995.8424
  23955629.062     -145914.531 9   -113752.94748  23955636.5544
  20622750.161     -330614.723 9   -257645.40149  20622751.0554
  38137558.365      335843.457 9

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

TABLE A18

GEO NAVIGATION MESSAGE FILE - EXAMPLE

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

     2.11           H: GEO NAV MSG DATA                    RINEX VERSION / TYPE
SBAS2RINEX 2.0      CNES                20-Oct-03 14:01     PGM / RUN BY / DATE
0.133179128170D-06-0.107469588780D-12 518400 1240 EGNOS  5  D-UTC A0,A1,T,W,S,U
    13                                                      LEAP SECONDS
This file contains navigation message data from a SBAS      COMMENT
(geostationary) satellite, here AOR-W (PRN 122 = # 22)      COMMENT
                                                            END OF HEADER
22 03 10 18  0  1  4.0-1.005828380585D-07 6.366462912410D-12 5.184420000000D+05
    2.482832392000D+04-3.593750000000D-04-1.375000000000D-07 0.000000000000D+00
   -3.408920872000D+04-1.480625000000D-03-5.000000000000D-08 4.000000000000D+00
   -1.650560000000D+01 8.360000000000D-04 6.250000000000D-08 2.300000000000D+01
22 03 10 18  0  5 20.0-9.872019290924D-08 5.456968210638D-12 5.186940000000D+05
    2.482822744000D+04-3.962500000000D-04-1.375000000000D-07 0.000000000000D+00
   -3.408958936000D+04-1.492500000000D-03-5.000000000000D-08 4.000000000000D+00
   -1.628960000000D+01 8.520000000000D-04 6.250000000000D-08 2.400000000000D+01
22 03 10 18  0  9 36.0-9.732320904732D-08 4.547473508865D-12 5.189510000000D+05
```

```
    2.482812152000D+04-4.325000000000D-04-1.375000000000D-07 0.000000000000D+00
   -3.408997304000D+04-1.505000000000D-03-5.000000000000D-08 4.000000000000D+00
   -1.606960000000D+01 8.800000000000D-04 6.250000000000D-08 2.500000000000D+01
22 03 10 18  0 13 52.0-9.592622518539D-08 4.547473508865D-12 5.192110000000D+05
    2.482800632000D+04-4.681250000000D-04-1.375000000000D-07 0.000000000000D+00
   -3.409035992000D+04-1.518125000000D-03-3.750000000000D-08 4.000000000000D+00
   -1.584240000000D+01 8.960000000000D-04 6.250000000000D-08 2.600000000000D+01

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