**SCINTEX**

**SCIN**tintillation and **T**EC **EX**change Format

Version 0.31

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# Revision History

|  |  |
| --- | --- |
| 01 Apr 2014  (v0.0) | - Creation of the document |
| 14 Apr 2014  (v0.1) | - Adding ROTI observable.  - Added comments of Dr. Tsugawa concerning:  - Naming of files  - Multi-constellation Examples  - Missing INTERVAL format on APPENDIX |
| 22 Apr 2014  (v0.2) | - Suggestions of ISTG included.  - IRNSS included (Surendra Sunda) |
| 23 Mar 2015  (v0.3) | - Change on the header description  - Inclusion of non-frequency dependent observables in the APPENDIX.  - Inclusion of Slant Tropospheric delay per satellite as non-frequency dependent observable (HTR, WTR, TTR) |
| 12 Jun 2015 | - Integricom review:  - Editorial Changes  - Removing the optionality of specifying the Phase Ionospheric DCB combination in the SYS / DCB COMB |

# REFERENCES

1. Werner Gurtner and Lou Estey “RINEX/ The RInex Independent Exchange Format, version 3.01”

# INTRODUCTION

The SCINTEX Format originates from the necessity to harmonize the format used by different vendor for future scintillation and total electron content (TEC) files.

The format is extensively based on the RINEX v3.01 format, see [1], trying to keep as much features as possible to allow the *compatibility* and easy adoption of it. The reason behind is that RINEX coped before with the problems of sharing large amounts of data between different multichannel systems and it is the standard for exchange of GNSS data.

# GENERAL FORMAT DESCRIPTION

The SCINTEX version 0.0 format consists of a single ASCII file containing all necessary information:

1. Observation data File

The file consists of a header section and a data section. The header section contains global information for the entire file and is placed at the beginning of the file. The header section contains header labels in columns 61-80 for each line contained in the header section. These labels are mandatory and must appear exactly as given in these descriptions and examples.

The format has been developed to mimic the RINEX v3 in order to maintain as much compatibility as possible. In computer systems allowing variable record lengths the observation records may be kept as short as possible. Trailing blanks can be removed from the records. There is no maximum record length limitation for the observation records.

The actual format descriptions as well as examples are given in the Tables at the end of the paper.

# THE EXCHANGE OF SCINTEX FILES

The following naming convention is recommended:

**ssssdddf.yyT**

| | | | |

| | | | +-- T: Scintillation and TEC files

| | | |

| | | +---- yy: two-digit year

| | +------ f: file sequence number/character within day.

| | daily file: f = **0** (zero)

| | hourly files:

| | **a** = 1st hour: 00h-01h; **b** = 2nd hour: 01h-02h;

| | . . . **x** = 24th hour: 23h-24h

| +--------- ddd: day of the year of first record

+------------- ssss: 4-charcter station name designator

For 15-minutes high-rate data (mostly TEC) the following name convention could be used:

**ssssdddhmm.yyT**

| | || | |

| | || | +-- T: Scintillation and TEC files

| | || +---- yy: two-digit year

| | |+----- mm: starting minute within the hour (**00**,**15**,**30**,**45**)

| | +------ h: character for the n-th hour in the day.

| |

| | **a** = 1st hour: 00h-01h; **b** = 2nd hour: 01h-02h;

| | . . . **x** = 24th hour: 23h-24h

| +--------- ddd: day of the year of first record

+------------- ssss: 4-charcter station name designator

# SCINTEX VERSION FEATURES

The data for the scintillation parameters will follow the RINEX v3.01 channel allocation, but tailored to the needs of the ionospheric community.

## Main observables

The main observable will be on the form of the observation code **tna** consists of three parts:

- **t** : observation type: **W** = S4,

**Y** = Sigma phase index,

**S** = Signal strength,

**V** = S4 correction,

**T** = Lock Time,

**M** = Code Carrier Divergence (in meters \* 10),

**N** = Sigma Code Carrier Divergence (in meters \* 10)***,***

**R** = Standard deviation of Rate change of TEC (ROTI)

***A*** *= Ambiguity of the phase observable*

- **n** : band / frequency:

- **a** : attribute:

## Ionosphere delay observables

In addition to the **TEC** observable (see Non-frequency dependent data below) the SCINTEX contains the ionospheric delay as in the RINEX v3. The ionospheric phase delay observable is expressed in full cycles of the respective satellite system-dependent wavelength as observable. Additionally the Satellite and Receiver Code Biases can be included (for instance, the Raw Ionospheric delay could be recovered).

It is recommended to use this observable for high accuracy and high frequency ionosphere data. If the receiver’s raw ionospheric data is used, then the **TEC** observable (see Non-frequency dependent data below) should be used instead.

-  **t** : observation type: **I** = Ionosphere phase delay

**J** = Satellite Delay Code Biases

**K** = Receiver Delay Code Biases

-  **n** : band / frequency: 1, 2,...,8

-  **a** : attribute: blank

The Satellite and Receiver Delay Code biases are included for high precision applications. It is allowed high sampling of the Satellite and Receiver Delay Code biases that are provided by a model. Since the Code biases are dependent on 2 frequencies this has to be indicated in the header under the **SYS / DCBS COMB**

The ionosphere delay observable has to be included into the list of observables of the respective satellite system. It is recommended one ionosphere delay observable per satellite.

d\_ion(f j) = d\_ion(fi ) ⋅ (f i/fj )^2 (accounting for 1st order effects only)

d\_ion(fi): Given ionospheric phase correction for frequency fi

If Delay Code biases are included they should be treated as follows:

d\_ion\_raw(fi)=d\_ion(fi)+dcb\_sat(fi)+dcb\_rec(fi) ;

with,

dcb\_xxx(fj)=dcb\_xxx(fi) ⋅ (f i/fj )^2

Thus, the relation with the 2 fi and fj observables are derived from (see dual frequency observations **SYS / DCBS COMB**):

dcb\_sat(fi)= (TR\_sat(fi) – TR\_sat(fj))/(1-(fi/fj)^2)

dcb\_rec(fi)= (TR\_rec(fi) – TR\_rec(fj))/(1-(fi/fj)^2)

where TR\_xxx(fi) are the group delays on frequency fi

It could also imply that:

d\_ion(fi)=d\_ion(fi,fj)\*1/((fi/fj)^2-1);

where d\_ion(fi,fj) := P(fj)-P(fi)

In general, RINEX v3 should be used to exchange GNSS observables. However, SCINTEX allows including the RINEX observables (P and L as observable type) when high rate Ionospheric data is delivered. It is recommended that when these observables are included they should be checked and filtered, and if possible cycle slips should be removed.

Examples:

* W1C: C/A channel S4 derived index
* W5Q: Pilot channel S4 derived index
* Y1P: P channel Sigma Phase derived index

## Non-frequency dependent data

Most scintillation receivers could provide the slant TEC (sTEC) as an important output. This TEC is expected to be less accurate than post-process one, but it can give information about the ionosphere directly from the receiver output.

**TEC** = Slant Total Electron Content (sTEC) from the receiver (could be either Raw or Calibrated; should be specified in the header) **in TEC Units \* 1e3**

*( 1 TEC Unit = 1TECU = 1016 e- m-2)*

d\_ion(fi) = 40.3/fi^2 \* TEC \*1e16 \*1e-3 (in meters of signal in fi)

**DEC** = difference of sTEC from last epoch (t – INTERVAL) **in TEC Units \* 1e3**

**ELE** = Elevation of the satellite in view **in degrees \* 1e6**

**AZI** = Azimuth of satellite in view **in degrees \* 1e6**

**HTR** = Slant Hydrostatic tropospheric delay **in mm**

**WTR** = Slant Non-Hydrostatic tropospheric delay **in mm**

**TTR** = Slant Total tropospheric delay **in mm**

*The values are scaled to fully represent the accuracy if necessary.*

## Band and channel description

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| System | Freq. Band | Frequency | Channel or Code | Channel ID |
| **GPS** | L1 | 1575.42 | C/A | 1C |
| L1C(M) | 1S |
| L1C(L) | 1L |
| L1C(M+L) | 1X |
| P | 1P |
| Z-Tracking and similar (AS on) | 1W |
| Y | 1Y |
| M | 1M |
| codeless | 1N |
| L2 | 1227.60 | C/A | 2C |
| L1(C/A)+(P2-P1) (semi-codeless) | 2D |
| L2C (M) | 2S |
| L2C (L) | 2L |
| L2C (M+L) | 2X |
| P | 2P |
| Z-Tracking and similar (AS on) | 2W |
| Y | 2Y |
| M | 2M |
| codeless | 2N |
| L5 | 1176.45 | I | 5I |
| Q | 5Q |
| I+Q | 5X |
| **GLONASS** | G1 | 1602+k\*9/16 k=-7...+12 | C/A (GLONASS M) | 1C |
| P | 1P |
| G2 | 1246+k\*7/16 | C/A (GLONASS M) | 2C |
| P | 2P |
| G3 | 1202.025 | I | 3I |
| Q | 3Q |
| I+Q | 3X |
| **Galileo** | E1 | 1575.42 | A PRS | 1A |
| B I/NAV OS/CS/SoL | 1B |
| C no data | 1C |
| B+C | 1X |
| A+B+C | 1Z |
| E5a | 1176.45 | I F/NAV OS | 5I |
| Q no data | 5Q |
| I+Q | 5X |
| E5b | 1207.140 | I F/NAV OS | 7I |
| Q no data | 7Q |
| I+Q | 7X |
| E5  (E5a + E5b) | 1191.795 | I | 8I |
| Q | 8Q |
| I+Q | 8X |
| E6 | 1278.75 | A PRS | 6A |
| B C/NAV CS | 6B |
| C no data | 6C |
| B+C | 6X |
| A+B+C | 6Z |
| **SBAS** | L1 | 1575.42 | C/A | 1C |
| L5 | 1176.45 | I | 5I |
| Q | 5Q |
| I+Q | 5X |
| **BDS** | B1 | 1561.098 | I | 1I |
| Q | 1Q |
| I+Q | 1X |
| B2 | 1207.14 | I | 7I |
| Q | 7Q |
| I+Q | 7X |
| B3 | 1268.52 | I | 6I |
| Q | 6Q |
| I+Q | 6X |
| **QZSS** | L1 | 1575.45 | C/A | 1C |
| L1C (D) | 1S |
| L1C (P) | 1L |
| L1C (D+P) | 1X |
| L1-SAIF | 1Z |
| L2 | 1227.60 | L2C (M) | 2S |
| L2C (L) | 2L |
| L2C (M+L) | 2X |
| L5 | 1176.45 | I | 5I |
| Q | 5Q |
| I+Q | 5X |
| LEX(6) | 1278.75 | S | 6S |
| L | 6L |
| S+L | 6X |
| **IRNSS** | L5 | 1176.45 | Unknown | 5 |
|  | S | 2492.028 | Unknown | 9 |

**Unknown tracking mode**: In case of unknown tracking mode or channel the attribute **a** can be left blank. However, a mixture of blank and non-blank attributes within the same observation type of the same frequency band and of the same satellite system has to be avoided.

## Satellite system-dependent list of observables

The order of the observations stored per epoch and satellite in the observation records is given by a list of observation codes in a header record. As the types of the observations actually generated by a receiver may heavily depend on the satellite system SCINTEX uses the same solution as in RINEX v3. It specifies a system-dependent observation code list (header record type **SYS / # / OBS TYPES**) with all recorded observation types stored in the file.

## Signal strengths

The raw signal strengths optionally stored as **Sna** observations in the data records should be stored in dbHz if possible. The new SIGNAL STRENGTH UNIT header record can be used to indicate the units of these observations. (This is the preferred option)

## Observation data records

As the types of the observations and their order within a data record depend on the satellite system, the new format should make it easier for programs as well as human beings to read the data records. Each observation record begins with the satellite number snn, the epoch record starts with special character >. This eases synchronization of parsers to the next epoch record in case of a corrupted data file or corrupted streamed observation data. There is no record length limitation.

For the following list of observation types for the six satellite systems G,S,E,R,B,J

G 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

S 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

E 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

R 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

B 7 W1I Y1I S1I T1I TEC AZI ELE SYS / # / OBS TYPES

J 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

I 7 W5 Y5 S5 T5 TEC AZI ELE SYS / # / OBS TYPES

the epoch and observation records look as follows *(not real data example)*:

> 2011 08 28 21 06 0.0000000 0 09

G09 0.141 0.036 50.000 211.000 3.500 9200000.000 75000000.000

G25 0.121 0.056 43.900 211.000 6.100 55100000.000 45000000.000

S20 0.061 0.066 45.900 321.000 4.000 25200000.000 55000000.000

E19 0.100 0.076 48.000 211.000 11.200 5300000.000 25000000.000

E20 0.541 0.086 43.400 211.000 8.600 245400000.000 35100000.000

R03 0.141 0.022 42.300 213.000 12.700 135700000.000 25900000.000

B01 0.341 0.036 42.700 213.000 12.200 145500000.000 26700000.000

J01 0.141 0.016 41.300 211.000 22.800 45200000.000 10100000.000

I01 0.141 0.016 41.320 211.000 25.800 5200000.000 11100000.000

## Dual frequency observations

In case that the SCINTEX is used to exchange high accuracy TEC information, the **SYS / DCBS COMB** gives valuable and necessary information to know which combination has been used to get the ionosphere phase delay.

The record allows knowing which observables have been used to compute the ionospheric phase delay. It also records which satellites are using that combination.

Examples:

G I 1C2P 1P2P 09 G01 G02 G03 G04 G05 G06 G07 G08 G09

The observable I1 for satellites from G01 to G09 has been computed using:

Code: P1C and P2P

Phase: L1P and L2P

E I 1C5Q 1C5Q

All Galileo satellites uses the same observations for code and phase as follows:

Code: P1C and P5Q

Phase: L1C and L5Q

## Order of the header records, order of data records

As the record descriptors in columns 61-80 are mandatory, the programs reading a RINEX Version 3 header are able to decode the header records with formats according to the record descriptor, provided the records have been first read into an internal buffer.

We therefore propose to allow free ordering of the header records, with the following exceptions:

- The **SCINT VERSION / TYPE** record must be the first record in a file

- The **SYS / # / OBS TYPES** record(s) should precede any **SYS / DCBS COMB**.

- The **# OF SATELLITES** record (if present) should be immediately followed by the corresponding number of **PRN / # OF OBS** records. (These records may be handy for documentary purposes, and it is up to the user to include them).

- The **END OF HEADER** of course is the last header in the record

**Data records**: We explicitly exclude multiple epoch data records with identical time tags (exception: Event records). Epochs have to appear ordered in time.

# APPENDIX: SCINTEX FORMAT DEFINITIONS AND EXAMPLES

+----------------------------------------------------------------------------+

| TABLE A1 |

| GNSS OBSERVATION DATA FILE - HEADER SECTION DESCRIPTION |

+--------------------+------------------------------------------+------------+

| HEADER LABEL | DESCRIPTION | FORMAT |

| (Columns61-80) | | |

+--------------------+------------------------------------------+------------+

|SCINT VERSION / TYPE| - Format version : 0.31 | F9.2,11X, |

| | - File type: SCINTILLATION/TEC DATA | A23,1X |

| | - Satellite System: G: GPS | A1,1X, |

| | R: GLONASS | A14 |

| | E: Galileo | |

| | S: SBAS payload | |

| | C: BeiDou | |

| | J: QZSS | |

| | I: IRNSS | |

| | M: Mixed | |

| | The Description of the Satellite System | |

| | is optional, only the A1 is mandatory | |

+--------------------+------------------------------------------+------------+

|PGM/ RUN BY /DATE | - Name of program creating current file | A20, |

| | - Name of agency creating current file | A20, |

| | - Date and time of file creation | |

| | Format: yyyymmdd hhmmss zone | A20 |

| | zone: 3-4 char. Code for time zone. | |

| | UTC recommended | |

| | examples: | |

| | CET Central European Time | |

| | IST Indian Standard Time | |

| | JST Japan Standard Time | |

| | PDT Pacific Daylight Time | |

| | ‘blank’ if not known | |

+--------------------+------------------------------------------+------------+

|COMMENT | Comment line(s) | A60 |\*

+--------------------+------------------------------------------+------------+

|MARKER NAME | Name of antenna marker | A60 |

+--------------------+------------------------------------------+------------+

|OBSERVER/AGENCY | Name of the observer / agency | A20,A40 |

+--------------------+------------------------------------------+------------+

|REC # / TYPE / VERS | Receiver number, type, and version | 3A20 |

+--------------------+------------------------------------------+------------+

|ANT # / TYPE / VERS | Antenna number, type, and version | 3A20 |

+--------------------+------------------------------------------+------------+

|APPROX POSITION XYZ | Geocentric approximate marker position | 3F14.4 |

| | (Units: Meters, System: ITRS recommended)| |

+--------------------+------------------------------------------+------------+

|POSITION LON LAT ALT| Ellipsoidal approximate marker position | 2F14.8, |

| | (Units, degrees and meters, System: | F14.4 |

| | WGS84 recommended) | |

+--------------------+------------------------------------------+------------+

|SYS/ # / OBS TYPES | - Satellite system code (G/R/E/S/C/J/M) | A1 |

| | - Number of different observation types | 2X,I3 |

| | for the specified satellite system | |

| | - Observation descriptors: | 13(1X,A3) |

| | +Non-frequency dependent: | |

| |o TEC, DEC, AZI, ELE, HTR, WTR, TTR | |

| | +Frequency dependent: | |

| |o Type | |

| |o Band | |

| |o Attribute | |

| | Use continuation line(s) for more than 13| 6X |

| | observation descriptors. | 13(1X,A3) |

| | In mixed files: Repeat for each satellite| |

| | system. | |

| |The following observation descriptors | |

| | are defined in SCINTEX Version 0.xx: | |

| | **Type:** | |

| |W = S4 | |

| |Y = Sigma phase index | |

| |S = Raw signal strength | |

| |V = S4 correction | |

| |T = Lock Time | |

| |M = Code Carrier Divergence | |

| |N = Sigma Code Carrier Divergence | |

| |I = Ionosphere phase delay | |

| |J = Satellite Code biases | |

| |K = Receiver Code biases | |

| | **Band:** | |

| |1= L1 (GPS, QZSS, SBAS) | |

| | G1 (GLO) | |

| | E2-L1-E1 (GAL) | |

| | B1 (BDS) | |

| |2= L2 (GPS, QZSS) | |

| | G2 (GLO) | |

| |5= L5 (GPS, QZSS, SBAS, IRNSS) | |

| | E5a (GAL) | |

| |6= E6 (GAL) | |

| | LEX (QZSS) | |

| | B3 (BDS) | |

| |7= E5b (GAL) | |

| | B2 (BDS) | |

| |8= E5a+b (GAL) | |

| |9= S (IRNSS) | |

| | **Attribute:** | |

| |P = P code-based (GPS,GLO) | |

| |C = C code-based (SBAS,GPS,GLO, QZSS) | |

| |D = semi-codeless (GPS) | |

| |Y = Y code-based (GPS) | |

| |M = M code-based (GPS) | |

| |N = codeless (GPS) | |

| |A = A channel (GAL) | |

| |B = B channel (GAL) | |

| |C = C channel (GAL) | |

| |I = I channel (GPS,GAL, QZSS, BDS) | |

| |Q = Q channel (GPS,GAL, QZSS, BDS) | |

| |S = M channel (L2C GPS, QZSS) | |

| |L = L channel (L2C GPS, QZSS) | |

| |S = D channel (GPS, QZSS) | |

| |L = P channel (GPS, QZSS) | |

| |X = B+C channels (GAL) | |

| |X = I+Q channels (GPS,GAL, QZSS, BDS) | |

| |X = M+L channels (GPS, QZSS) | |

| |X = D+P channels (QZSS) | |

| |W = Z-tracking (GPS) | |

| |Z = A+B+C channels (GAL) | |

| |blank : for types I and X (all) or unknown| |

| |tracking mode | |

| |All characters in uppercase only! | |

| | | |

| |Units: | |

| |S4 and S4 correction: dimensionless | |

| |Sigma phase index: radians | |

| |Lock Time: seconds | |

| |CCD and Sigma CCD: meters \* 1e1 | |

| |SNR: receiver-dependent| |

| |Ionosphere: full cycles | |

| |DCB satellite/receiver: full cycles | |

| |TEC and DEC: TEC Units \* 1e3 | |

| |AZI and ELE: degrees \* 1e6 | |

| |0 <= AZI\*1e-6 < 360 | |

| |0 <= ELE\*1e-6 <= 90 | |

| | | |

| | The sequence of the observations in the | |

| | observation records has to correspond to | |

| | the sequence of the types in this record | |

| | of the respective satellite system. | |

+--------------------+------------------------------------------+------------+

|SIGNAL STRENGHT UNIT| Unit of the carrier to noise ratio | A20,40X |\*

| | observables Snn (if present) | |

| | DBHZ: s/N given in dbHz | |

+--------------------+------------------------------------------+------------+

|INTERVAL | Observation interval in seconds | F10.3 |

+--------------------+------------------------------------------+------------+

|SYS / DCBS COMB | Channels used to perform the ionospheric | |\*

| | combination. | |

| | - Satellite system (G/R/E/S/C/J) | A1,1X |

| | - Ionosphere phase delay (I) | A1,1X |

| | - 1st frequency observation | I1A1, |

| | - Code Band (1,2..8) | |

| | - Code Attribute (P,A..X, blank) | |

| | - 2nd frequency observation | I1A1, |

| | - Code Band | |

| | - Code Attribute | |

| | Phase observations must be specified even| |

| | if not used, they can also be different | 1X, |

| | - 1st frequency observation | I1A1, |

| | - Phase Band (1,2..8) | |

| | - Phase Attribute (P,A..X, blank) | |

| | - 2nd frequency observation | I1A1,) |

| | - Phase Band | |

| | - Phase Attribute | |

| | - Number of satellites involved 0 | 1X,I2.2, |

| | or blank: All | |

| | - List of satellites | 11(1X,A3) |

| | Use continuation line(s) for more than 11| 16X, |

| | satellites | 11(1X,A3) |

| | Repeat record for each Ionosphere phase | |

| | delay | |

+--------------------+------------------------------------------+------------+

|# OF SATELLITES | Number of satellites, for which | I6 |\*

| | observations are stored in the file | |

+--------------------+------------------------------------------+------------+

|PRN / # OF OBS | Satellite numbers, number of observations| 3X |\*

| | for each observation type indicated | A1,I2.2 |

| | in the SYS/ # / OBS TYPES record | 9I6 |

| | | |

| | If more than 9 observations types: | 6X,9I6 |

| | Use continuation line(s) | |

| | In order to avoid format overflows, 99999| |

| | indicates >= 99999 observations. | |

| | This record is (these records are) | |

| | repeated for each satellite present in | |

| | the data file. | |

+--------------------+------------------------------------------+------------+

|TIME OF FIRST OBS | - Time of first observation record | 5I6,F13.7, |

| | (4-digit- year, month, day, hour, min | |

| | sec) | |

| | Time system: | |

| | - GPS (=GPS time system) | 5X,A3 |

| | - GLO (=UTC time system) | |

| | - GAL (=Galileo System Time) | |

| | - QZS (= QZSS time system) | |

| | - BDT (=BDS Time system) | |

| | Compulsory in mixed GNSS files Defaults: | |

| | GPS for pure GPS files | |

| | GLO for pure GLONASS files | |

| | GAL for pure Galileo files | |

| | QZS for pure QZSS files | |

| | BDT for pure BDS files | |

+--------------------+------------------------------------------+------------+

|TIME OF LAST OBS | - Time of first observation record | 5I6,F13.7, |\*

| | (4-digit- year, month, day, hour, min | |

| | sec) | |

| | -Time system: Same value as TIME OF | 5X,A3 |

| | FIRST OBS record | |

+--------------------+------------------------------------------+------------+

|END OF HEADER | Last record in the header section | 60X |

+--------------------+------------------------------------------+------------+

Records marked with ‘\*’ are optional

+----------------------------------------------------------------------------+

| TABLE A2 |

| GNSS OBSERVATION DATA FILE – DATA RECORD DESCRIPTION |

+---------------------------------------------------------------+------------+

| DESCRIPTION | FORMAT |

+---------------------------------------------------------------+------------+

| - Record identifier : > | A1 |

| - Epoch | |

| - year (4 digits): | 1X,I4 |

| - month, day, hour, min (two digits) | 4(1X,I2.2),|

| - sec | F11.7, |

| - Epoch flag | 2X,I1, |

| 0: OK | |

| 1: power failure between previous and current epoch | |

| >1: Special event | |

| - Number of satellites observed in current epoch | I3, |

| - (reserved) | 6X, |

| - Receiver clock offset (seconds, optional) | F15.12, |

+---------------------------------------------------------------+------------+

| Epoch flag = 0 or 1: OBSERVATION records follow | |

| - Satellite number | A1,I2.2, |

| - Observation - repeat within record for each observation | m(F14.3) |

| This record is repeated for each satellite having been | |

| observed in the current epoch. The record length is given | |

| by the number of observation types for this satellite. | |

| Observations: For definition see text. | |

| Missing observations are written as 0.0 or blanks. | |

+---------------------------------------------------------------+------------+

| --> Special events are fully compatible with RINEX v3.0 | |

| Listed the most common ones in SCINTEX | |

| - Epoch flag 2 - 5: EVENT: Special records may follow | [2X,I1] |

| - 4: header information follows | |

| | |

| - "Number of satellites" contains number of special records | [I3] |

| to follow. 0 if no special records follow. | |

| - Maximum number of records: 999 | |

| | |

| For events without significant epoch the epoch fields in | |

| the EPOCH RECORD can be left blank | |

+---------------------------------------------------------------+------------+

## Example SCINTEX file for GPS and Galileo:

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

0.31 SCINTILLATION/TEC DATA M: Mixed SCINT VERSION / TYPE

scintex\_sept\_v1 ESA 20140401 153912 CET PGM / RUN BY / DATE

scintex file containing scintillation information COMMENT

ESTE MARKER NAME

Unknown MARKER NUMBER

Unknown Unknown OBSERVER / AGENCY

9999999 Septentrio PolaRxS 0.0.0 REC # / TYPE / VERS

Unknown Unknown 0.0.0 ANT # / TYPE / VERS

5760940.0104 -1556238.7358 2276652.7023 APPROX POSITION XYZ

344.88314896 21.01074126 11567.5697 POSITION LON LAT ALT

E 18 W1C V1C Y1C S1C T1C M1C N1C W7Q V7Q Y7Q S7Q T7Q M7Q SYS / # / OBS TYPES

N7Q TEC DEC ELE AZI SYS / # / OBS TYPES

G 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

S 7 W1C Y1C S1C T1C TEC AZI ELE SYS / # / OBS TYPES

E I 1C7Q 1C7Q 02 E19 E20 SYS / DCBS COMB

60.000 INTERVAL

2011 8 28 21 06 0.0000000 GPS TIME OF FIRST OBS

2011 8 28 21 59 59.0000000 GPS TIME OF LAST OBS

10 # OF SATELLITES

END OF HEADER

> 2011 08 28 21 06 0.0000000 0 01

E19 0.041 0.036 0.000 48.900 11.000 0.000 0.000 0.037 0.038 0.000 48.500 11.000 0.019 0.019 0.000 0.000 0.000 0.000

> 2011 08 28 21 07 0.0000000 0 06

E19 0.041 0.040 0.000 48.000 71.000 -307.520 409.090 0.037 0.039 0.000 48.300 71.000 0.018 0.129 -8.000 885261.000 13000000.000 57000000.000

E11 0.045 0.036 0.000 48.800 17.000 1.520 0.730 0.033 0.035 0.000 49.200 17.000 0.016 0.040 0.000 0.000 60000000.000 291000000.000

E08 0.040 0.039 0.000 48.200 26.000 -0.020 0.330 0.035 0.038 0.000 48.500 26.000 0.006 0.024 0.000 0.000 0.000 0.000

G09 0.141 0.036 50.000 211.000 3.500 9200000.000 75000000.000

G25 0.121 0.056 43.900 211.000 6.100 55100000.000 45000000.000

S20 0.061 0.066 45.900 321.000 4.000 25200000.000 55000000.000

## Example SCINTEX file for GPS from real GSV4004B data:

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

0.31 SCINTILLATION/TEC DATA M: Mixed SCINT VERSION / TYPE

ScintexConvertor ESA 20150617 103000 PGM / RUN BY / DATE

scintex file containing scintillation information COMMENT

This is an example for Novatel Data COMMENT

COMMENT

kevo MARKER NAME

1234567 MARKER NUMBER

ESA ESA OBSERVER / AGENCY

N/A Novatel GSV4004B 0.0.0 REC # / TYPE / VERS

Unknown Unknown 0.0.0 ANT # / TYPE / VERS

6378177.0000 0.0000 0.0000 APPROX POSITION XYZ

0.00000000 0.00000000 40.0000 POSITION LON LAT ALT

G 18 TEC DEC ELE AZI W1C W2D Y1C Y2D S1C S2D V1C V2D T1C SYS / # / OBS TYPES

T2D M1C M2D N1C N2D SYS / # / OBS TYPES

S 11 TEC DEC ELE AZI W1C Y1C S1C V1C T1C M1C N1C SYS / # / OBS TYPES

60.000 INTERVAL

2013 04 26 03 00 0.0000000 GPS TIME OF FIRST OBS

END OF HEADER

> 2013 04 26 03 00 0.0000000 0 10

G18 0.000 0.000 8810000.000 76850000.000 0.152 0.312 39.750 8.550 0.103 16931.340 0.540 -12.182 0.037

G01 -3895.328 111.014 52670000.000 264310000.000 0.030 0.040 52.280 34.350 0.024 2287.942 2274.060 -2.594 0.051

G28 6708.581 -213.756 23280000.000 293770000.000 0.098 0.093 45.040 19.690 0.056 5145.522 256.060 -7.217 0.103

G17 0.000 -97865359.375 14840000.000 328410000.000 0.250 0.094 41.560 25.040 0.084 848.740 1.560 -5.127 0.070

G32 -2074.697 -59.006 31290000.000 227610000.000 0.056 0.062 47.030 25.810 0.045 1354.420 1047.080 -1.452 0.066

G11 -3025.820 -397.196 57390000.000 225060000.000 0.033 0.081 53.480 32.400 0.021 6288.128 6277.060 -10.743 0.009

G19 -2424.454 113.963 21080000.000 191300000.000 0.091 0.153 44.080 23.060 0.063 13463.520 97.060 -16.216 0.040

G24 11133.545 276.009 25100000.000 26930000.000 0.077 0.221 45.240 22.450 0.055 2061.316 2047.060 -2.588 0.018

G22 -3040.419 -93.106 37030000.000 90400000.000 0.055 0.039 50.540 27.570 0.030 8470.572 8455.080 -8.715 0.111

G14 457.862 -91.526 48910000.000 116910000.000 0.047 0.043 52.050 30.010 0.025 4687.518 4290.580 -11.156 0.016