# TDS - POD INPUT FILES FOR SENTINELS ONLINE

## SENTINELSPOD

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# 1. INTRODUCTION

## 1.1. PURPOSE

This document describes the test data set prepared for the Sentinels Online website with the purpose of allowing users to perform Precise Orbit Determination (POD) for Sentinel-1A, -1B, 2-A, 2B, -3A and -3B. In order to validate their models, precise POD orbits are also provided for all satellites, so that users can compare their solution against a reference solution.

It has been prepared in the frame of the project for the Provision of the Precise Orbit Determination Service for the Sentinels missions.

## 1.2. SCOPE

This document is a deliverable by GMV in the frame of the Provision of the Precise Orbit Determination Service for the Sentinels missions.

## 1.3. DEFINITIONS AND ACRONYMS

Definition of terms and acronyms used throughout this document are present in [AD.1]

## 1.4. APPLICABLE AND REFERENCE DOCUMENTS

### 1.4.1. APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.X]:

**Table 1-1: Applicable Documents**

| Ref. | Title | Code | Version | Date |
|---|---|---|---|---|
| [AD.1] | Sentinels POD Service File Format Specification | GMES-GSEG-EOPG-FS-10-0075 | 1.22 | 18/01/2018 |

### 1.4.2. REFERENCE DOCUMENTS

The following documents, although not part of this document, extend or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.X]:

**Table 1-2: Reference Documents**

| Ref. | Title | Code | Version | Date |
|---|---|---|---|---|
| [RD.1] | Sentinel-1 Properties For GPS POD | GMV-GMESPOD-TN-0025 | 1.2 | 07/05/2018 |
| [RD.2] | Sentinel-2 Properties For GPS POD | GMV-GMESPOD-TN-0026 | 1.2 | 07/05/2018 |
| [RD.3] | Sentinel-3 Properties For GPS POD | GMV-GMESPOD-TN-0027 | 1.4 | 07/05/2018 |

# 2. DESCRIPTION OF TDS

The test data set (TDS) described in this document is composed of the following elements:

- Sentinel-1, 2, 3 daily GNSS RINEX Observation files based on a polynomial fit to GPS timescale (S-3) and aligned to GPS time scale (S-1 and S-2)
- Sentinel-1, 2, 3 Quaternions files
- Sentinel-1, 2, 3 Mass History files
- Sentinel-1, 2, 3 Manoeuvres files
- Sentinel-1, 2, 3 ANTEX files
- Sentinel-1, 2, 3 POD Precise Orbits
- Technical Note: "Sentinel-1 Properties For GPS POD"
- Technical Note: "Sentinel-2 Properties For GPS POD"
- Technical Note: "Sentinel-3 Properties For GPS POD"

The time period for which data is provided is **from 2018/08/01 until 2018/08/31**, which corresponds to 1 full month.

## 2.1. RINEX OBSERVATION FILES

**Location** of files: https://scihub.copernicus.eu/gnss/#/home

**List** of files:

```
S1A_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
S1B_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
S2A_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
S2B_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
S3A_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
S3B_OPER_AUX_GNSSRD_POD__{DATE_CREA}_V{DATE_START}_{DATE_END}.DBL
```

**Format** of files: Rinex v3.0

**Comments**: {DATE_CREA} is the creation date of the file in format `YYYYMMDDTHHMMSS`
{DATE_ START} is the start coverage date of the file in format `YYYYMMDDTHHMMSS`
{DATE_ END} is the end coverage date of the file in format `YYYYMMDDTHHMMSS`

Daily RINEX observation files for each of the satellites are available at the Sentinels GNSS RINEX Hub website. Instructions on how to download these files are as follow:

1. Access the Sentinels GNSS RINEX Hub.
2. Login (top-right corner) with guest credentials (user:gnssguest, password:gnssguest)
3. Filter (top-left corner) the search by date, mission and satellite.
4. Perform search by clicking on the magnifier.
5. Click on the download URL of the desired files.

The Observation RINEX construct an artificial timescale for S-3 by fitting a 4$^{th}$ order polynomial to the differences between IMT and GPST, and then subtracting it to IMT so that the first orders effects are removed. This allows to obtain a timescale which is very close to GPS time (to a few microseconds) while retaining the intrinsic clock stability reflected by the oscillator. This is not the case for S-1 and S-2, which align the time to GPST owe to the lower performance of their internal oscillator.

## 2.2. QUATERNIONS FILES

**Location** of files: SENTINEL-1A/att SENTINEL-1B/att
SENTINEL-2A/att SENTINEL-2B/att
SENTINEL-3A/att SENTINEL-3B/att

**List** of files:

```
se1a_quaternions_{YY}{DDD}.att.gz se1b_quaternions_{YY}{DDD}.att.gz
se2a_quaternions_{YY}{DDD}.att.gz se2b_quaternions_{YY}{DDD}.att.gz
se3a_quaternions_{YY}{DDD}.att.gz se3b_quaternions_{YY}{DDD}.att.gz
```

  

**Format** of files: A23,X,3(X,F12.6),X,I2 (ref. [RD.1], [RD.2], [RD.3])

- Epoch (GPS time)
- Quaternion real component
- Quaternion component 1
- Quaternion component 2
- Quaternion component 3
- Attitude Mode

**Comments**: {YY} is the year in 2-digit format
{DDD} is the day of year in 3-digit format

## 2.3. MASS HISTORY FILE

**Location** of files:

S1: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-1-sar/pod/satellite-parameters

S2: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-2-msi/pod/satellite-parameters

S3: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-altimetry/pod/satellite-parameters

**List** of files:

```
s1a.mhf      s1b.mhf
s2a.mhf      s2b.mhf
s3a.mhf      s3b.mhf
```

**Format** of files: A23,X,F9.3,3(X,F8.5) (ref. [RD.1], [RD.2], [RD.3])

- Epoch (UTC time)
- Mass (kg)
- Centre of gravity in Satellite Reference Frame (m)

## 2.4. MANOEUVRES FILE

**Location** of files:

S1: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-1-sar/pod/satellite-parameters

S2: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-2-msi/pod/satellite-parameters

S3: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-altimetry/pod/satellite-parameters

**List** of files:

```
s1a.man      s1b.man
s2a.man      s2b.man
s3a.man      s3b.man
```

**Format** of files: A23,4X,3(D15.8),I4

- Epoch (UTC time)
- Manouvre delta-V components in RAC reference frame ($km/s^2$)
- Start of manoeuvre (1) – End of manoeuvre (0) flag

## 2.5. SENTINELS ANTEX FILE

**Location** of files:

S1: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-1-sar/pod/satellite-parameters

S2: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-2-msi/pod/satellite-parameters

S3: https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-altimetry/pod/satellite-parameters

**List** of files:

```
sen08.atx
```

**Format** of files: Antex v1.4

**Comments**: This is the file with the PCO/PCV corrections of the receivers on-board Sentinel-1, -2 and -3, computed from the phase residuals of the POD processing.

  

## 2.6. PRECISE ORBITS

**Location** of files: SENTINEL-1A/orb SENTINEL-1B/orb
SENTINEL-2A/orb SENTINEL-2B/orb
SENTINEL-3A/orb SENTINEL-3B/orb

**List** of files:

`S1ACPOD{GPSWEEK}{DAYWEEK}.sp3.gz S1BCPOD{GPSWEEK}{DAYWEEK}.sp3.gz`
`S2ACPOD{GPSWEEK}{DAYWEEK}.sp3.gz S2BCPOD{GPSWEEK}{DAYWEEK}.sp3.gz`
`S3ACPOD{GPSWEEK}{DAYWEEK}.sp3.gz S3BCPOD{GPSWEEK}{DAYWEEK}.sp3.gz`

**Format** of files: SP3-c

**Comments**: {GPSWEEK} is the GPS week
{DAYWEEK} is the week day starting from 0 on Sundays

## 2.7. TECHNICAL NOTE: "SENTINEL-1 PROPERTIES FOR GPS POD"

**Location** of files:

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/ground-segment/pod/documentation

**List** of files:

Sentinel-1 properties for GPS POD: `GMV-GMESPOD-TN-0025_v1.2_Sentinel-1 properties for GPS POD.pdf`

**Format** of files: pdf

**Comments**: This document describes the required information concerning Sentinel-1 in order to carry out GNSS based POD processing. In particular, the nominal attitude of the satellite, the GPS configuration parameters, and the format of the NAPEOS internal files for attitude and mass history file are described.

## 2.8. TECHNICAL NOTE: "SENTINEL-2 PROPERTIES FOR GPS POD"

**Location** of files:

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/ground-segment/pod/documentation

**List** of files:

Sentinel-2 Properties for GPS POD: `GMV-GMESPOD-TN-0026_v1.2_Sentinel-2 properties for GPS POD.pdf`

**Format** of files: pdf

**Comments**: This document describes the required information concerning Sentinel-2 in order to carry out GNSS based POD processing. In particular, the nominal attitude of the satellite, the GPS configuration parameters, and the format of the NAPEOS internal files for attitude and mass history file are described.

## 2.9. TECHNICAL NOTE: "SENTINEL-3 PROPERTIES FOR GPS POD"

**Location** of files:

https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-3/ground-segment/pod/documentation

**List** of files:

Sentinel-3 Properties for GPS POD: `GMV-GMESPOD-TN-0027_v1.4_Sentinel-3 properties for GPS POD.pdf`

**Format** of files: pdf

**Comments**: This document describes the required information concerning Sentinel-3 in order to carry out GNSS based POD processing. In particular, the nominal attitude of the satellite, the GPS, DORIS and SLR configuration parameters, and the format of the NAPEOS internal files for attitude and mass history file are described.

  

# 3. MEDIA

Data packages are located in the Sentinels Online website for each of the Sentinel missions:

S-1: https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-1/ground-segment/pod/products-requirements

S-2: https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/ground-segment/pod/products-requirements

S-3: https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-3/ground-segment/pod/products-requirements

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