xylem

Sounding Better!
April 2026

Qinertia Processing in HYPACK

by Amanda Whaling and Jocelyn Kane

Introduction

HYPACK users who are familiar with the GUI version of Qinertia from SBG Systems know it as a powerful post-processing software for generating processed trajectory data to improve survey position and elevation. Less widely known is that Qinertia is available as a command line interface (CLI), which processes your data through scripted commands. To eliminate the time spent learning and writing command line syntax, HYPACK leveraged the Qinertia CLI to create a streamlined tool that works directly within the HYPACK software suite. The tool launches from the HYPACK Shell, lets you choose raw data files from your HYPACK project folder, and automatically writes output and configuration files. It produces post-processed position and elevation data as an SBET (Smoothed Best Estimate of Trajectory), typically achieving centimeter-level accuracy. The SBET can be applied directly to HYPACK survey data in SBMAX64 or MBMAX64, facilitating efficient and accurate batch processing across multiple missions.

Who can benefit from the Qinertia Interface?

The Qinertia Interface is designed for HYPACK users who need accurate post-processed positioning and trajectory data without spending excessive time on manual project configuration. This tool is particularly beneficial for users handling multiple missions or multi-day campaigns, as it enables efficient batch processing through a consistent and repeatable setup by using an automatically generated JSON configuration file. The configuration file stores your lever arm offsets, geodesy settings, and processing selections, making it easy to reload these parameters in the Qinertia Interface.

Using the same core algorithms available from the GUI/CLI, the Qinertia Interface can import raw data from SBG *.sbg files, third-party logger formats such as HYPACK's Input Echo *.bin files, and proprietary formats like Trimble Applanix *.000, extending its benefits to a broad range of users and equipment manufacturers.

The Qinertia Interface offers processing modes ranging from GNSS only PPK (Post Processed Kinematic) to fully automated tightly coupled GNSS + INS (Inertial Navigation System) solutions, giving users the flexibility to meet a variety of project requirements. It also generates a detailed processing report that summarizes the selected processing mode, reference stations, and solution quality and accuracy. This feature ensures reliable, efficient, and accurate results across multiple survey days and campaigns with the Qinertia Interface.

HYPACK
xylem

Revision A

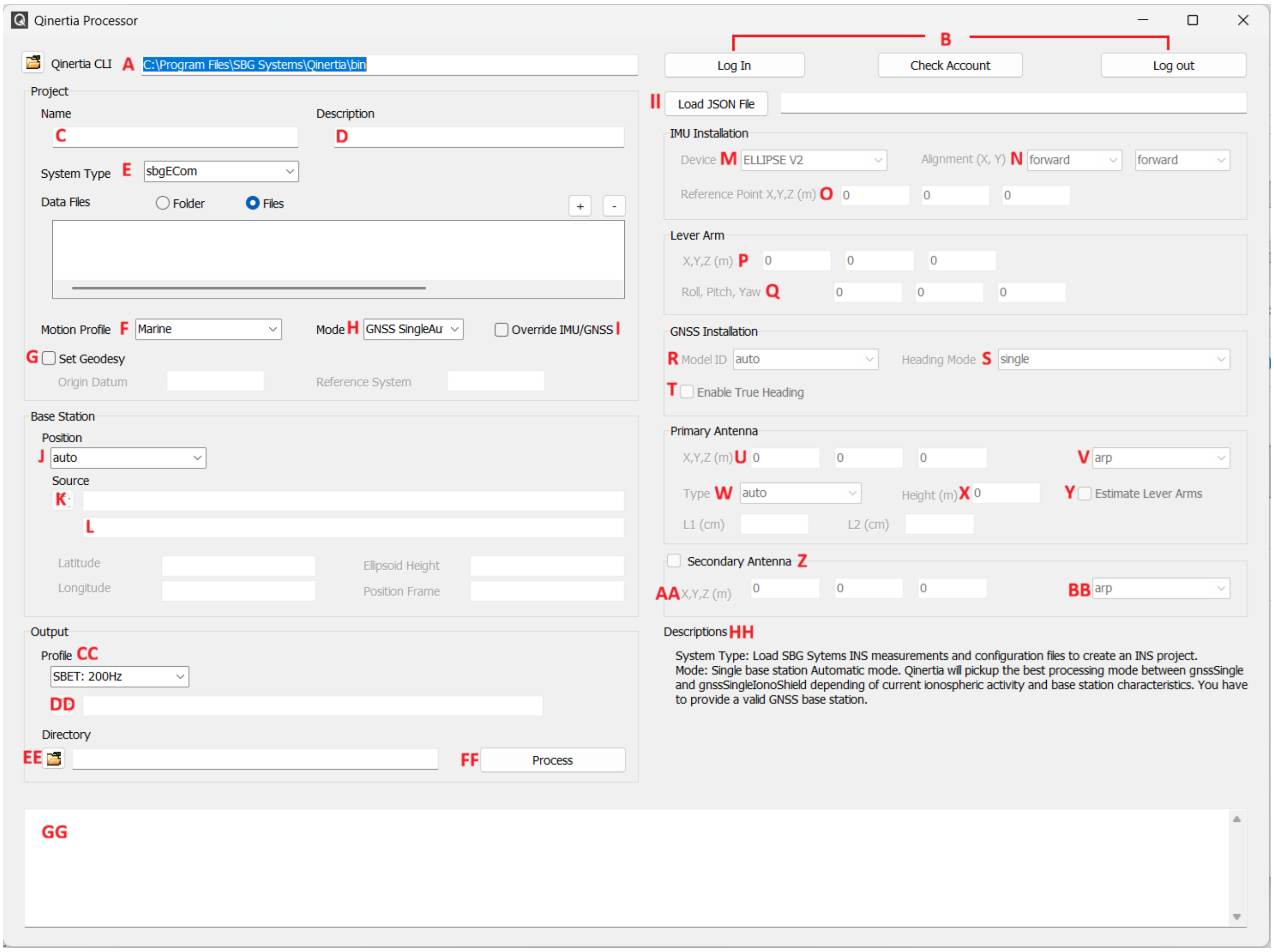
Getting started with the Qinertia Interface

Before you begin

License and access:

A Qinertia license is required to use the Qinertia Interface, which facilitates user login so you can authenticate your account quickly. Licenses are available to purchase from the HYPACK sales team (sales@hypack.com) with flexible durations, including subscriptions and perpetual options. Once provided, new customers activate their license by creating a MySBG account, following the procedure laid out at https://support.sbg-systems.com/sc/qd/4.3/getting-started/activating-your-license. Existing customers whose licenses are about to expire can renew theirs and continue using their current account.

Figure 1. Screenshot of Qinertia Interface



Revision A, April 2026

Instructions

1) Log in

Launch the Qinertia Interface tool from the HYPACK Shell by navigating to Processing in the main menu. When the Qinertia Interface window opens, the **Qinertia CLI** field (A) auto populates with the default install location. If you installed or moved QinertiaCLI, click the **folder** icon, browse to the correct path, and click **OK**. The path updates and the Processor can find the CLI. Use the **Login and Check Account** controls (B) to log into your MySBG account or check who is signed in. If you skip this, the Processor will prompt you at processing time.

2) Set up your project

In the **Project** section, begin by entering a **Project Name** (C) and an optional **Description** (D). Select the **System Type** (E) from the dropdown menu, which lists the supported GNSS and INS manufacturers. If you are unsure which option applies to your data, the description for the selected system type is shown in the **Descriptions** panel (HH) in the lower-right corner of the interface.

Next, add your input data using the **Data Files** section (E). You can add individual files or entire folders of raw data that match the **System Type** you specified. Then use the plus icon to add files or the minus icon to remove them. The input data should contain GNSS receiver observations and, when applicable, inertial sensor data. Qinertia provides native support for several GNSS manufacturers, including Septentrio, NovAtel, u-blox (F9P L1/L2 receivers), and Trimble (RT27), and fully supports standard RINEX and RTCM formats. GNSS + INS processing is available only for INS systems that are natively supported by Qinertia, such as SBG Systems INS, Septentrio INS, NovAtel SPAN, and Trimble Applanix POS INS (*.000 file format only).

3) Define processing parameters

Still in the **Project** Section, select a **Motion Profile** (F) from the dropdown menu that matches your platform. The profile informs Qinertia of your system's expected motion, helping the navigation algorithms interpret GNSS and INS data. For example, the **Automotive** profile assumes typical vehicle motion, including smooth accelerations, turns, and stop-and-go behavior. Other common profiles include **Marine**, **Marine Harsh**, and **UAV**, reflecting the characteristic motion of those platforms and GNSS environment.

Next, use the **Set Geodesy** option (G) to explicitly define the coordinate reference information for the project. When enabled, you can enter EPSG codes for both the Origin Datum and the coordinate Reference System. These codes correspond to definitions maintained by the EPSG authority (https://epsg.org/home.html). If this option is left unchecked, Qinertia uses an automatic selection process to choose appropriate datums and reference systems based on the imported data.

Now we have come to one of the most important selections: the **Processing Mode** (H). Qinertia offers two main categories: GNSS-only and GNSS + INS. GNSS-only modes rely solely on observations from the roving GNSS antenna, while GNSS + INS modes combine these observations with inertial measurements to maintain accuracy during outages or degraded signals.

Revision A, April 2026

GNSS-only Modes

- **GNSS PPPGNSS Single**
- **GNSS SingleIonoShield**
- **GNSS VBS**
- **GNSS Auto**
- **GNSS SingleAuto**

GNSS + INS Modes

- **INS PPP**
- **INS Loosely**
- **INS Single**
- **INS SingleIonoShield**
- **INS VBS**
- **INS Auto**
- **INS SingleAuto**

Before you choose a mode, it's important to understand the concepts behind each processing option and why it matters. First, consider PPP versus PPK. Precise Point Positioning (**PPP**) does not rely on a local base station; instead, it uses global GNSS corrections to compute an accurate position. This is ideal for remote areas where no base station is available, though it typically requires longer convergence times. Post-Processed Kinematic (**PPK**), on the other hand, uses corrections from a network of stations, typically from the CORS network (Continuously Operating Reference Stations), or a single base station (which may be user-supplied or from the CORS network) to achieve high accuracy over short baselines. Any mode that enables the **Base Station** section performs PPK processing using the selected reference station(s). If possible, PPK is usually the preferred choice because it delivers centimeter-level accuracy quickly.

Next, you may see references to **VBS** (Virtual Base Station) among the mode options. This approach creates a "virtual" reference by combining data from multiple base stations. It is particularly beneficial for long baselines or areas with dense CORS coverage, as it optimizes corrections across the entire trajectory rather than relying on a single reference station. By contrast, modes labeled **Single** use only one user-supplied or CORS station to compute the PPK solution.

Another key concept is **coupling**, which describes how GNSS and INS data are integrated. In the loosely coupled approach, represented only by the **INS Loosely** option, GNSS positions are computed independently and then fed into the INS filter. This works, but it is less robust when GNSS signals degrade. All other GNSS + INS modes—including **INS PPP**, **INS Single**, **INS SingleIonoShield**, **INS VBS**, **INS Auto**, and **INS SingleAuto**—are tightly coupled, meaning GNSS and inertial measurements are fused within a single filter. Even partial GNSS observations help constrain the INS, reducing drift and improving accuracy. When selecting from GNSS + INS modes, tightly coupled modes generally provide better performance, especially in challenging GNSS conditions.

You'll also notice some modes mention **IonoShield**. This is an additional algorithm that mitigates ionospheric errors, which can distort GNSS signals in certain regions or conditions. Applying IonoShield improves accuracy when ionospheric activity is high.

The remaining options are the **Auto modes**, which simplify decision-making by letting Qinertia select the best processing strategy for your data and environment. **SingleAuto** mirrors the behavior of the corresponding **Single** modes for GNSS or GNSS + INS, but automatically determines whether to apply **IonoShield** corrections. For new users or those unfamiliar with Qinertia, the fully automatic modes (**GNSS Auto** and **INS Auto**) provide an easy starting point. These modes analyze mission data and reference station availability to select the most suitable augmentation strategy. When using **GNSS Auto** or **INS Auto**, the **Base Station** section remains active, allowing you to supply a base station. Qinertia will also evaluate nearby CORS stations and may select a single CORS station (Single mode) or a virtual base station (VBS mode) if it provides more accurate results.

Revision A, April 2026

xylem Let's Solve Water

The final processing parameter is a checkbox that tells the Processor to use your inputs if installation information is missing or needs correction. Check **Override IMU/GNSS** (I) to enable inputs on the right side. This step may not be necessary for all equipment—for example, Apogee, Quanta, and Equinox setups do not require new offsets if they were correctly configured during real-time collection. Step 5 (Configure installation and offsets) provides additional guidance for entering the installation information if you enable this option.

4) Choose your corrections

If you selected a **PPK-capable Processing Mode** (H), the **Base Station** section becomes available, allowing you to define which reference station(s) Qinertia will use. The **Position** (J) dropdown controls how the base station coordinates are determined, and this choice directly affects what must be entered in the **Source** fields.

You start by selecting a **Position** (J) option:

- **Published**: Uses coordinates published by the CORS provider or read directly from the base station file header. Manual coordinate entry is disabled, but you must still specify the correction source in the **Source** fields.

- **Manual:** Allows you to explicitly enter base station coordinates. **Latitude** and **Longitude** are entered in decimal degrees, and **Ellipsoid Height** is entered in meters.

- **PPP**: Qinertia computes a static Precise Point Positioning solution internally to determine the base station position. When selected, the correction source is handled automatically, and the **Source** fields are disabled.

- **Auto**: Allows Qinertia to compare published coordinates against a static PPP solution and select the most reliable position if a discrepancy is detected. Like PPP, this option disables manual source input.

Next, Qinertia needs correction data. This is where the **Source** fields come in. If you chose **Published** or **Manual**, you must specify sources. There are two options for your source inputs:

- **File upload** (K): Base station observation files (RINEX or raw formats from Septentrio, u-blox, NovAtel, Trimble). Use the folder icon to select file(s).

- **CORS stations** (L): CORS stations, listed by station ID and separated by commas. CORS station IDs can be identified using the Base Station Manager in the Qinertia GUI or via NGS's CORS Map Explorer (NGS Map).

The number of source inputs you need depends on the **Processing Mode** (H) selection from earlier:

- **Single** modes: Exactly one reference station.

- **VBS** modes: At least three stations are required, and all listed stations are used to form the virtual base; if the network geometry is unsuitable, processing will fail.

- **GNSS Auto** or **INS Auto**: Source input is optional. When no CORS stations or base station file are specified, Qinertia automatically evaluates nearby CORS stations and selects the optimal Single or VBS solution. Any supplied base station file is included in the evaluation.

Lastly, you have a few options for combining source inputs based on your **Position** (J) selection:

- If you selected **Manual**, you can only include one manually entered base station and add CORS stations for VBS or Auto modes.

- If **Published** is selected, you may add multiple CORS stations or base station files. For base station files, the RINEX files are expected to already include accurate coordinate information.

5) Configure installation and offsets

For the IMU installation settings, begin by selecting the correct **Device** (M) from the dropdown menu, then specify the **X and Y Alignment (X,Y)** (N). The Z direction is automatically computed to complete a right-handed coordinate frame. If required, enter the lever arm offsets for the measured vector from the IMU to the **Reference Point (X,Y,Z)** (O).

The IMU Reference Point defines both where all lever arms are measured from and where the INS solution is computed. SBG Systems INS products define multiple reference points to simplify installation and hardware replacement during maintenance. All SBG Systems INS units include multiple reference points except for ELLIPSE and OEM products. Most third-party IMUs do not define reference points. In all cases, the reference point frame is the vehicle frame, and its offsets are directly added to all entered lever arms.

Next, in the **Lever Arm** section, enter the primary **X, Y, Z (m)** (P) offsets in meters, along with the rough alignment **Roll, Pitch, and Yaw** (Q) angles in degrees that describe the offset from the IMU to the vehicle's center of rotation. These parameters are used by the INS filter for motion profiles such as ground vehicles to correctly apply lateral motion constraints and are also used for marine applications to improve heave filter stability.

Continuing with the GNSS installation, the **Model ID** (R) dropdown lists supported GNSS receivers and is used to select the appropriate error model for dual-antenna heading integration during INS processing. Qinertia can automatically detect the receiver model from the input data, using the default option as a fallback if detection fails. Alternatively, you may manually select a compatible receiver model. Next, specify the **Heading Mode** (S) to indicate whether the dual-antenna lever arm is known or should be estimated. If you are performing tightly coupled INS processing, GNSS-only processing, or using dual-antenna heading, check **Enable True Heading** (T).

The **Primary Antenna** configuration begins with the **X, Y, Z (m)** (U) offsets in meters from the INS to the GNSS antenna. Use the dropdown menu for the **antenna reference point** (V) to specify whether the GNSS lever arm is referenced to the antenna reference point (arp) or the antenna phase center (apc). The **Type** (W) dropdown allows you to override antenna information stored in the input data. As with the Model ID (R), the **auto** option attempts to detect stored antenna parameters, **default** applies no offsets, and **custom** requires manual entry of L1/L2 offsets.

Complete the primary antenna setup by specifying the antenna **Height (m)** (X) and whether Qinertia should **Estimate the Lever Arms** (Y). When enabled, Qinertia will estimate lever arms during processing rather than refining the primary GNSS lever arm or dual-antenna alignment.

For dual-antenna configurations, enable **Secondary Antenna** (Z) to enter the secondary antenna **X, Y, Z (m)** (AA) offsets and select the appropriate secondary antenna reference (BB) from the dropdown menu.

Revision A, April 2026

6) Output and run

Now you're ready to get your post-processed trajectory! In the **Output** section, select how your results will be exported using the **Profile** (CC) dropdown menu. Choosing **Custom** enables the folder navigation button (DD), so you can browse to a file containing your own export profile.

Next, use the output directory button (EE) to choose where your exported files will be saved. Once processing completes successfully, Qinertia will generate your output files in an **exports** folder, along with a PDF report named reportFull_[projectName] in a **reports** folder.

When everything is set up, click the **Process** (FF) button to run the post-processing. Qinertia will execute your workflow using all the settings you've configured, and generate a JSON configuration file containing all parameters. This makes future runs much faster, because you can simply load the JSON file (II) to pre-populate the Processor fields — then adjust only what's needed or go straight to processing. Note that the Load JSON File button is located below the Login and account controls (B).

While processing is running, you can monitor progress and view any error messages in the scrollable **message window** (GG) at the bottom of the interface. Once processing completes successfully, navigate to the output directory to find your PDF report, which provides a convenient way to review results and verify accuracy. If you are satisfied with the processing parameters, you can reload the JSON configuration file generated during processing for subsequent runs, allowing the Qinertia Interface to quickly apply the same settings to multiple datasets and fully leverage its batch processing capabilities.

Use Cases

Multibeam

Generate SBET for application in MBMAX64 to offshore multibeam data.

- System Type: pos
- Motion Profile: Marine
- Mode: INS Auto (Auto selection may be chosen over INS Single or INS VBS if there are no nearby CORS stations to select from in an offshore environment)

LiDAR

Generate SBET for application in MBMAX64 to drone-acquired LiDAR data.

- System Type: sbgECom
- Motion Profile: UAV
- Mode: INS VBS (user supplied list of CORS stations)

Single Beam

Generate SBET for application in SBMAX64 to canoe-acquired single beam data.

- System Type: sbgECom
- Motion Profile: Marine Harsh (urban river setting with poor GNSS environment)
- Mode: INS Single (user-supplied local base station)

Revision A, April 2026