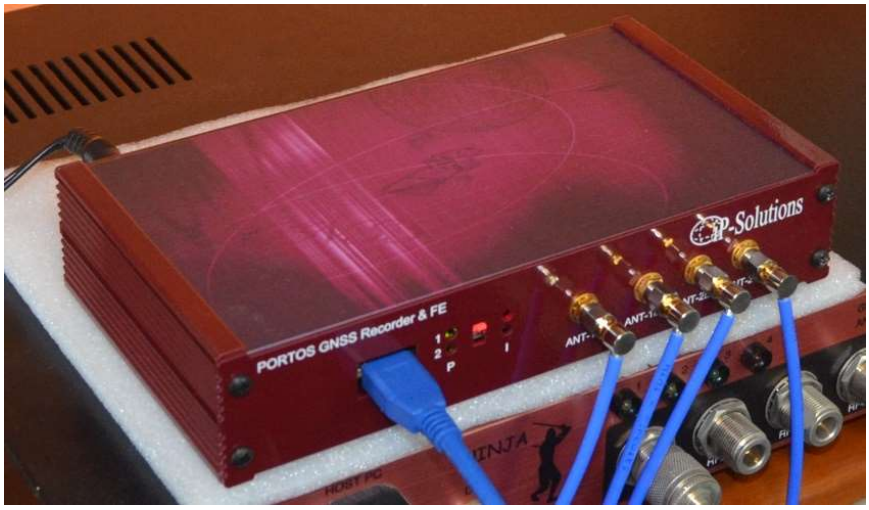
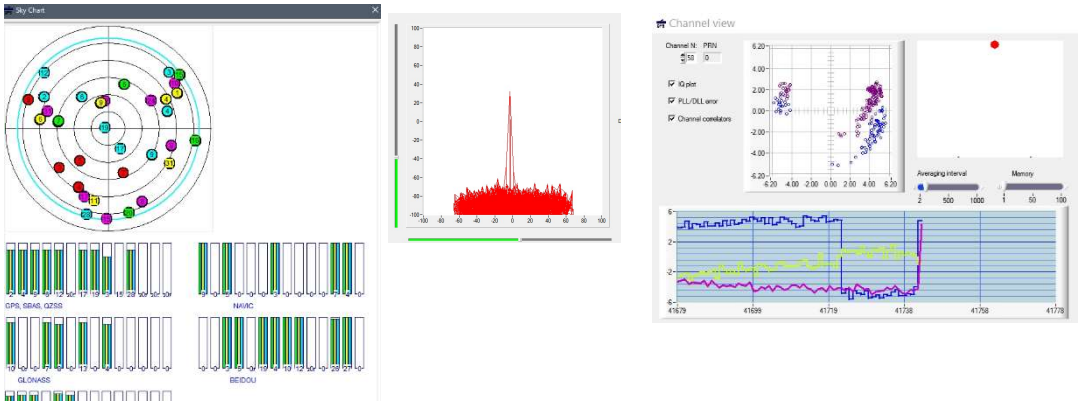
GNSS SDR Receiver

Datasheet Version: *_v24_02_RFE*



The ARAMIS receiver with PORTOS A4-R4-U3 front end.

Since 2007, IP-Solutions has been committed to the research, development, and refinement of GNSS solutions. Our particular expertise in ionospheric scintillation monitoring has driven us to present novel approaches to SDR GNSS receiver, a testament to which are our numerous publications and articles, including two books on GNSS published with Cambridge University Press and one book with Springer. Our receiver solutions represent the result of seven years of collaboration with the Japan Aerospace Exploration Agency (JAXA), offering high signal quality and industry-leading accuracy at reasonable prices. Custom algorithms can be implemented through C++ API.



The ARAMIS screenshots.

The ARAMIS software features (including optional)

1. Supported signals: multi-frequency GPS, Galileo, GLONASS, BeiDou, NavIC , QZSS, SBAS.

2. High quality code and carrier phase observables (carrier sigma, CCD).

3. Data rate up to 50 Hz

Contact: ***info@ip-solutions.jp*** **www.ip-solutions.jp**
Level 9, Ariake Frontier Building Tower B, 3-7-26 Ariake, Koto-ku, Tokyo 135-0063 Japan *Tel: +81-3-5530-8667*

3. Baseband algorithms are similar to conventional "hardware" receivers.

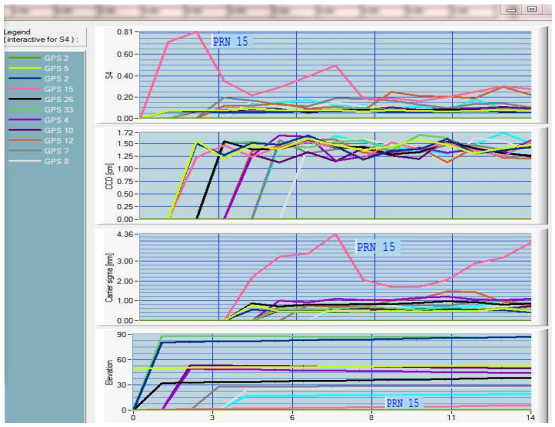
4. Coherent and adaptive tracking algorithms.

5. Output NMEA, RINEX, Google Earth .

6. RAIM

Extensions (some optional)

1. Ionospheric scintillation monitor (ISM) extension to the ARAMIS™



ISM extension to ARAMIS™ receiver (former JAXA COSMODE) allows to turn GNSS real-time software receiver into highly customized ionospheric scintillation monitor.

It allows high level of customization and implementation of user algorithms, including tight coupling with INS.

According to JAXA report, it overperformed other commercial scintillation monitors during flight tests due to tight coupling with JAXA's INS.

2. Instant positioning BGPS™ option

NAV API BGPS module allows for cold start less than 1 sec TTFF with predicted ephemeris.

3. INS coupling templates

NAV API INS module and API templates allows a user to implement GNSS INS coupling across all levels (loose, tight, ultra-tight),

4. Reflectometry module

Eagle-2 is used by Weather News Corporation for reflectometry research. The access to C++ code of the correspondent module is provided through NAV API.

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5. L1S option

The NAV processor L1S module allows an access to experimental JAXA QZSS L1S emergency messages.

API for ARAMIS™

The user will be provided with two comprehensive C++ APIs designed to grant full access and modification capabilities to the receiver's baseband and navigation processors. These APIs are:

1. Baseband Processor API (Baseband API)
2. Navigation Processor API (NAV API)

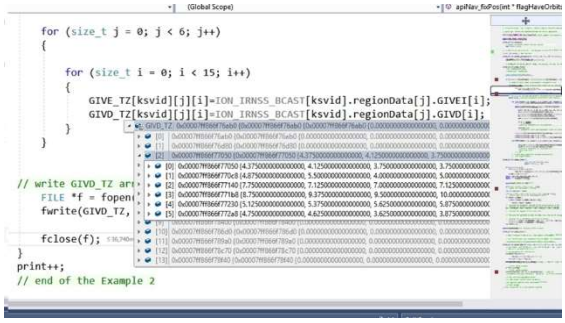
API Features

- Both APIs are delivered as fully operational MS Visual C++ projects, compatible with MS Visual Studio 2017, 2019, and later versions. These projects come with a suite of ready-to-use examples for each module to facilitate a smooth integration process.
- Comprehensive tutorials will accompany the software and hardware components, ensuring users are well-informed about every aspect of the system. These tutorials will cover the functionalities and implementation details exhaustively.
- An illustrative use case of the API at a university in India is documented in reference [3], providing practical insights into application scenarios. Additionally, our latest book [4] offers further related material and resources.

Navigation Processor API (NAV API)

The NAV API provides users with unrestricted access to all raw data generated by the baseband processor, enabling deep insights and customization. It allows a user to get access to ARAMIS™ receiver navigation processor. The user can then modify existing algorithms or implement his or her own algorithms.

Users can access and modify the source code of various navigation processor modules, including:
- Positioning (navigation) module.
- Scintillation monitoring module.
- Attitude determination module.
- INS integration module.



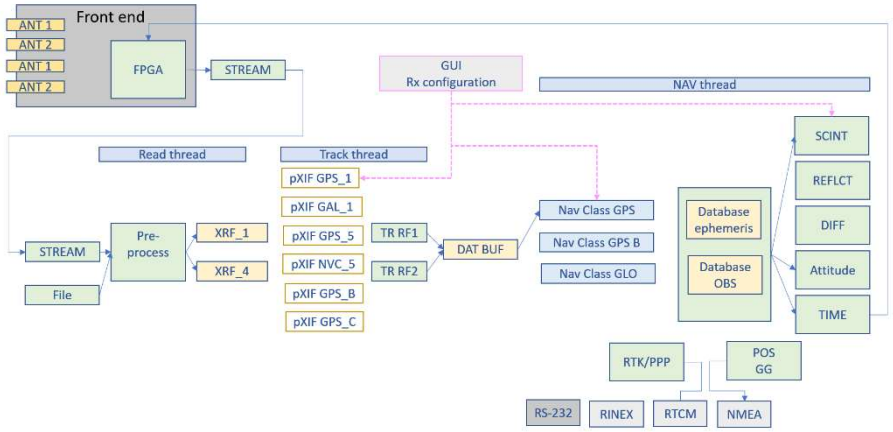
- PPP and RTK module using integration with RTKLib with complete source code available to the user.

The user can also get access to broadcast NAVDATA. For example, to access grid data in SBAS or NavIC signal, and modify positioning algorisms to use these data [3].

The ARAMIS™ even allows the user to compare API positioning results with algorithms used by the receiver.

Baseband Processor API (Baseband API)

The Baseband API offers access to the baseband processor's data, including the I/Q outputs from accumulators. It allows for the modification of tracking loops, acquisition parameters, and discriminators, among others.
The user has the flexibility to employ a variable number of correlators for I/Q outputs, extending beyond the standard early, late, and prompt correlators to include options for 5, 7, and 32 correlators. This feature is particularly beneficial for conducting research in areas like multipath effects, reflectometry, and other related fields.



The block-scheme of the receiver.

Hardware

The ARAMIS™ receiver can be supplied with various front ends. Some examples of the IP-Solution's off-the-shelf hardware are as follows.

*1) **Eagle**. TCXO clock, up to 2 RF and 2 antennas.*
*2) **ATOS**. OCXO clock, 2 RF, single antenna.*
*3) **PORTOS A1-R4-U2**. USB-2, OCXO clock, 4 RF and 1 antenna.*
*4) **PORTOS A4-R4-U3.** USB-3, OCXO clock, 4 RF and 4 antennas.*

IP-Solutions can also provide highly customized hardware based on specific user requirements. Single RF channel can work with all signals on one central frequency. For example, PORTOS A1-R4-U2 is capable of working with dual frequency GPS, Galileo, NavIC, QZSS, SBAS plus single frequency GLONASS or BeiDou at the same time.

GNSS signal recorder PORTOS A1-R4-L-U2 (supports four frequencies

The hardware channels can be configured to any frequency within the hardware specification and provide corresponding digitized IF streams (depicted on the block scheme as XRF_). The software can assign a digitized IF channel to correspondent GNSS (depicted as pointers pXIF_). In that way using a front end with two RF inputs and two RF channels, for example, the receiver can process GPS and NavIC signals from the same antenna using a splitter or process two GPS (or NavIC) signals from two antennas for reflectometry, indoor positioning or attitude determination.

The front end RF channel hardware specification must be specified with order. It will define to which frequency the front end's channel can be set to.

Off-the-shelf front end model	*RF inputs (Ax-)*	*Frequency band*	*RF cards (Rx-)*	*Interface*	*Comments*
Eagle A1-L1-R1-U2	*1*	*L1*	*1*	*USB-2*	
Eagle-2 A2-L1-R2-U2	*2*	*L1*	*2*	*USB-2*	
Atos A1-R4-Q14-U2	*1*	*L*	*2*	*USB-2*	
Portos A4-R4-LS-U2	*4*	*L,S*	*4*	*USB-2*	
Portos A1-R4-LX-U2	*1*	*L*	*4*	*USB-2*	
Portos A4-R4-LX-U3	*4*	*L*	*4*	*USB-3*	

Simulator off-the-shelf hardware models

ARAMIS version	
-Ac	*Academic version*
-Pro	*professional version*
-D	*Differential.*
-RFE	*Supports 4 antenna , attitude determination, PPP, RTK, ISM*

Simulator control software versions

Selected published references:

[1] Petrovski II, Ivan G., Tsujii, T., (2012) Digital Satellite Navigation and Geophysics, Cambridge University Press, New York.
[2] Tsujii, Fujiwara, Suganuma, Tomita, Petrovski, Development of INS-Aided GPS Tracking Loop and Flight Test Evaluation, SICE Journal of Control, Measurement, and System Integration, 2011
[3] Desai M.V., Shah S.N.(2022), Implementation and Analysis of Grid-Based Ionospheric Correction Technique and Positioning Errors of NavIC + GPS ARAMIS SDR Receiver, , IETE Technical Review, DOI: 10.1080/02564602.2022.2152880.
https://doi.org/10.1080/02564602.2022.2152880
[4] Petrovski (2024) Ionosphere with GNSS SDR. Springer, pp.350

Support and Warranty

Our dedication to our clients extends beyond delivering products. We provide extensive post-sales support and a comprehensive warranty on our ARAMIS receiver and front end / recorder products. We also provide our customers with customized updates.

Revision history

This section documents the changes made to the IP-Solutions Simulator product datasheet.

Version	*Release Date*	*Description of Changes*
_v24_01	*2024 / 01*	*Revision history section*
_v24_02_RFE	*2024 / 02*	*Enhanced specification and adjusted values for tailored product features Ref. IU202300580501*

Note: Each version of the datasheet supersedes previous versions unless otherwise stated. For RFE (Request for Enhancement / Explanation) specific versions please refer to the version number appended with 'RFE', which indicates custom or additional features not included in the standard product.