



HEXAGON



APN-097

Receiver Independent Exchange Format (RINEX)

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Introduction

Receiver Independent Exchange Format (RINEX) is an ASCII data format for GNSS measurement data. The main benefit to RINEX is that it is a common format that can be used for GNSS data from any equipment manufacturer. It can be used in many post-processing programs, such as Waypoint Inertial Explorer or GrafNav, or in analysis tools.

The main drawback to RINEX is that the size of RINEX data files is much larger than the equivalent data in binary format. It also typically requires a conversion from the original data file to RINEX. This application note describes the Hexagon | NovAtel logs required for RINEX and how to convert NovAtel logs files to RINEX files using the [NovAtel Application Suite](#) (NAS).

GNSS Signals Supported

NAS can be used to convert Novatel log files into RINEX files with RINEX versions 2.1, 3.01, 3.02, 3.03, and 3.04. The RINEX standard is revised from time to time and NAS is updated accordingly. [Table 1](#) identifies the signals that are supported by NAS for each RINEX version.

Table 1: GNSS signals supported by NAS for conversion to RINEX

System	Signal	Frequency (MHz)	RINEX Version				
			2.1	3.01	3.02	3.03	3.04
GPS	L1 C/A	1575.42	Y	Y	Y	Y	Y
	L1 C	1575.42	Y	Y	Y	Y	Y
	L2 C	1227.6		Y	Y	Y	Y
	L2 P	1227.6		Y	Y	Y	Y
	L5	1176.45		Y	Y	Y	Y
GLONASS	L1 C/A	1598.0625-1605.375	Y	Y	Y	Y	Y
	L2 C	1242.9375-1248.625		Y	Y	Y	Y
	L2 P	1242.9375-1248.625	Y	Y	Y	Y	Y
	L3 OC	1202.025			Y	Y	Y
Galileo	E1	1575.42		Y	Y	Y	Y
	E5a	1176.45		Y	Y	Y	Y
	E5b	1207.14		Y	Y	Y	Y
	E5 AltBOC	1191.795		Y	Y	Y	Y
	E6	1278.75		Y	Y	Y	Y
BeiDou	B1I	1561.098			Y	Y	Y
	B2I	1207.14			Y	Y	Y
	B3I	1268.52			Y	Y	Y
	B1C	1575.42			Y	Y	Y
	B2a	1176.45			Y	Y	Y
	B2b	1207.14			Y	Y	Y
QZSS	L1 C/A	1575.42			Y	Y	Y
	L1 C	1575.42			Y	Y	Y
	L2C	1227.6			Y	Y	Y
	L5	1176.45			Y	Y	Y



	L6	1278.75			Y	Y	Y
NavIC	L5	1176.45			Y	Y	Y
SBAS	L1	1575.42	Y	Y	Y	Y	Y
	L5	1176.45	Y	Y	Y	Y	Y

RINEX Output Files

The following RINEX files are created by the conversion of NovAtel log files to RINEX format. 'yy' is the two-digit year of the file (for instance for 2023 the yy is 23).

- **.yyO** – GNSS observations. This includes:
 - Version
 - Position
 - Constellations
 - Signals
 - GLONASS phase shifts
 - GLONASS code/phase biases
 - Leap seconds
 - Satellite measurement data:
 - PRN
 - Pseudorange
 - Carrier phase / Accumulated Doppler Range (ADR)
 - Doppler
 - Signal strength / Carrier to Noise ratio (C/No)
 - Loss of lock indicator (LLI)
- **.yyF** – BeiDou navigation data, time correction, and ionospheric correction
- **.yyG** – GLONASS navigation data and time correction
- **.yyH** – SBAS navigation data, time correction, and ionospheric correction
- **.yyI** – NavIC navigation data, time correction, and ionospheric correction
- **.yyL** – Galileo navigation data, time correction, and ionospheric correction
- **.yyN** – GPS navigation data, time correction, and ionospheric correction
- **.yyQ** – QZSS navigation data, time correction, and ionospheric correction



Required NovAtel Logs for Conversion

The following information is needed to get a complete set of RINEX data with a NovAtel receiver. Users are recommended to capture all of these logs from the receiver in binary format during data collection.

Recommended to be logged with the trigger ONCE

Version log

VERSION

Position log

BESTPOS (Alternatives: PSRPOS or MARKPOS)

Recommended to be logged with the trigger ONTIME and the desired period (in seconds)

Measurement logs

RANGE (Alternatives: RANGECMP, RANGECMP2 or RANGECMP4)

Recommended to be logged with the trigger ONCHANGED

GPS navigation data logs

GPSEPH
IONUTC

GLONASS navigation data logs¹

GLOEPHEMERIS
GLOCK

Galileo navigation data logs¹

GALINAVEPHEMERIS
GALCLOCK
GALIONO

BeiDou navigation data logs¹

BDSEPHMERIS
BDSCLOCK
BDSIONO

QZSS navigation data logs¹

QZSEPHMERIS
QZSSIONUTC

NavIC navigation data logs¹

NAVICEPHEMERIS
NAVICSYSLOCK
NAVICIONO

SBAS navigation data logs¹

SBAS9

¹ The navigation data logs for constellations other than GPS (GLONASS, Galileo, BeiDou, QZSS, NavIC, and SBAS) should be included in the log list if the receiver is tracking those constellations.



NovAtel Logs Example

Below is an example set of logs for a complete set of RINEX files if the receiver is tracking all constellations:

```
LOG VERSIONB ONCE
LOG BESTPOSB ONCE
LOG RANGE ONTIME 1
LOG GPSEPHMEMB ONCHANGED
LOG IONUTC ONCHANGED
LOG GLOEPHEMERISB ONCHANGED
LOG GLOCLOCKB ONCHANGED
LOG GALINAVEPHEMERISB ONCHANGED
LOG GLOCLOCKB ONCHANGED
LOG GALIONOB ONCHANGED
LOG BDSEPHMEMB ONCHANGED
LOG BDSCLOCKB ONCHANGED
LOG BDSIONOB ONCHANGED
LOG QZSEPHMEMB ONCHANGED
LOG QZSSIONUTC ONCHANGED
LOG NAVICEPHEMERISB ONCHANGED
LOG NAVICSYSLOCKB ONCHANGED
LOG NAVICIONOB ONCHANGED
LOG SBAS9B ONCHANGED
```

Convert to RINEX with NovAtel Application Suite

Once the NovAtel logs have been recorded to a log file, the file can be converted to RINEX using NAS. For details on how to install NAS, refer to [Appendix A](#).

Here are the steps required to convert to RINEX using NAS:

1. Open NAS (the version must be 1.11.1 or later).
2. Click **Convert**.

My Applications

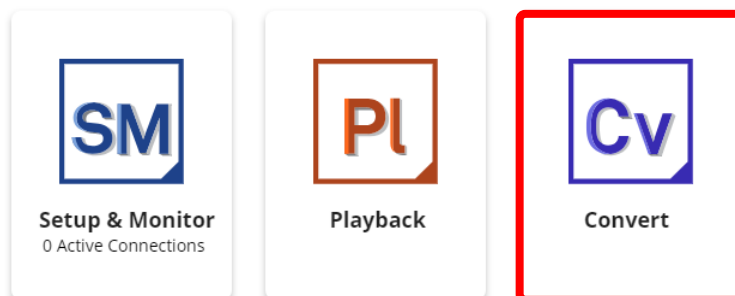


Figure 1: NAS Convert selection



3. Leave the radio button unchanged as **OEM**. To choose the input file(s), any of these options can be used:
 - a. Drag the log file(s) into the box **Drag and drop files here**.
 - b. Click **Browse your files** and choose the log file(s) from File Explorer.
 - c. At this time (NAS 1.12.0), GIII data cannot be converted to RINEX.

Which receiver type are your log files from?

OEM

GIII

Drag and drop files here
or
[Browse your files](#)

Figure 2: NAS Convert file selection

4. Click **Next**.
5. Choose the applicable RINEX version. More than one can be selected. Change the destination if applicable.

File ready to convert | Name: UUT3_1.GPS | Size: 1.54 MB

Output Settings

1. Messages > 2. Format

Time Interval (Optional)
Start 05 Dec 2022 23:52:12 UTC | End 05 Dec 2022 23:53:21 UTC (Duration 00:01:09)

Format

ASCII	<input type="checkbox"/>	Binary	<input type="checkbox"/>
KML - Google Earth	<input type="checkbox"/>	RINEX v2.1	<input type="checkbox"/>
RINEX v3.01	<input type="checkbox"/>	RINEX v3.02	<input type="checkbox"/>
RINEX v3.03	<input type="checkbox"/>	RINEX v3.04	<input checked="" type="checkbox"/>

Sample Rate
Example: 100 (Hz)
This will apply a single rate to all output files.

Unknown Data
☒ Separate file ☐ Interleave
This will separate the unknown bytes into a single separate file for each chosen output format.

Destination
☐ Source file folder ☒ Select folder
G:\RinexConversion

Prefix/Suffix (Optional)
Example: my-gps
This will be added to the output file name(s)
☒ Prefix ☐ Suffix

Help Start over Previous Convert

Figure 3: NAS Convert RINEX version



6. If desired, it is possible to optionally set several of the fields in the RINEX .yyO file header. To do this, before converting the file:
 - a. Click on the **gear icon** beside the RINEX version.
 - b. Update the fields as applicable.
 - c. Click **Apply**.

The 'Format Settings' dialog box is shown with the 'RINEX' tab selected. It contains several input fields for header information: Company name, Comments, Marker name, Marker number, Observer, Agency, Receiver name, Receiver version, Antenna number, and Antenna type. There are also checkboxes for 'Force kinematic data flag' and 'Use Hatanaka compression', and a 'UTC Offset' field set to 0 (s). At the bottom right, there are 'Cancel' and 'Apply' buttons.

Figure 4: NAS Convert RINEX header information

7. Click **Convert** (same image as step 5).
8. After conversion, the results will be displayed. Non-RINEX logs will be listed as not converted.

The 'Conversion Results' screen shows a summary of the conversion process. It includes a 'Time interval' section with a timeline showing the start and end times of the conversion. Below this, the 'Formats' section lists the messages that were converted and the bytes that could not be converted. The 'Summary' tab is selected, and there are 'Help' and 'Done' buttons at the bottom.

Figure 5: NAS Convert results summary

9. To see more information on the converted logs, click on the **Details** tab.

Conversion Results [Open Output Folder](#)

Summary **Details**

Conversion details View **All files** Per file

Messages(30)	Source Count	Converted Count	Conversion Status
> ALMANAC	1	0	✗ Not converted
> BDSALMANAC	31	0	✗ Not converted
> BDSCLK	1	1	✓
> BDSEPHMERIS	16	16	✓
> BESTPOS	59	59	✓
> BESTSATS	6	0	✗ Not converted
> CHANCONFIGLIST	1	0	✗ Not converted
> CLOCKSTEERING	140	0	✗ Not converted
> GALALMANAC	28	0	✗ Not converted
> GALCLK	2	2	✓
> GALNAVEPHMERIS	19	19	✓
> GALINAVEPHMERIS	12	12	✓
> GLOALMANAC	1	0	✗ Not converted

[Help](#) **Done**

Figure 6: NAS Convert results details

10. To see the output result, click on **Open Output Folder** at the top of the screen.
11. Click **Done** to finish.



Appendix A: NovAtel Application Suite Installation

Follow the steps to install NAS:

1. Download [NAS](#). Click on **ZIP** beside the appropriate version.

Software Downloads

NovAtel Application Suite

Ubuntu 20.04 + (64-bit)	VER 1.11.1 (2022-12-13)	ZIP
Windows 10/11 (64-bit)	VER 1.11.1 (2022-12-13)	ZIP

Figure 7: NAS download

2. Unzip the downloaded file.
3. In the unzipped directory, double-click **NovAtelApplicationSuite_Setup_1-11-1.exe** (version name may be slightly different). Depending on the IT settings, it may be necessary to right-click on **NovAtelApplicationSuite_Setup_1-11-1.exe** and then choose **Run As Administrator** and **Yes**.
 - a. For later versions, the filename will be slightly different.
4. For the installation questions:
 - a. Select **Yes, continue**.

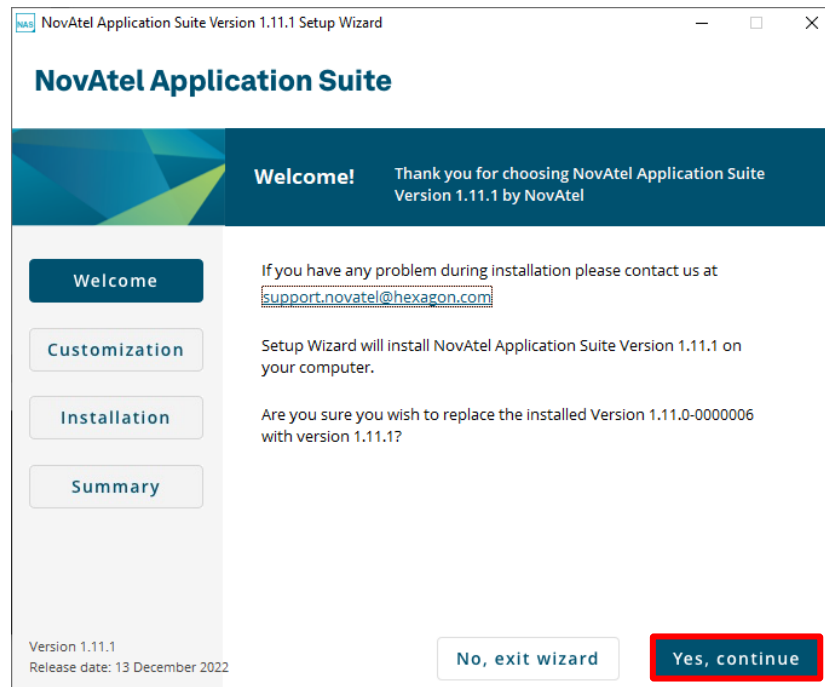


Figure 8: NAS welcome page



- b. Select **Install**. The default settings are recommended.

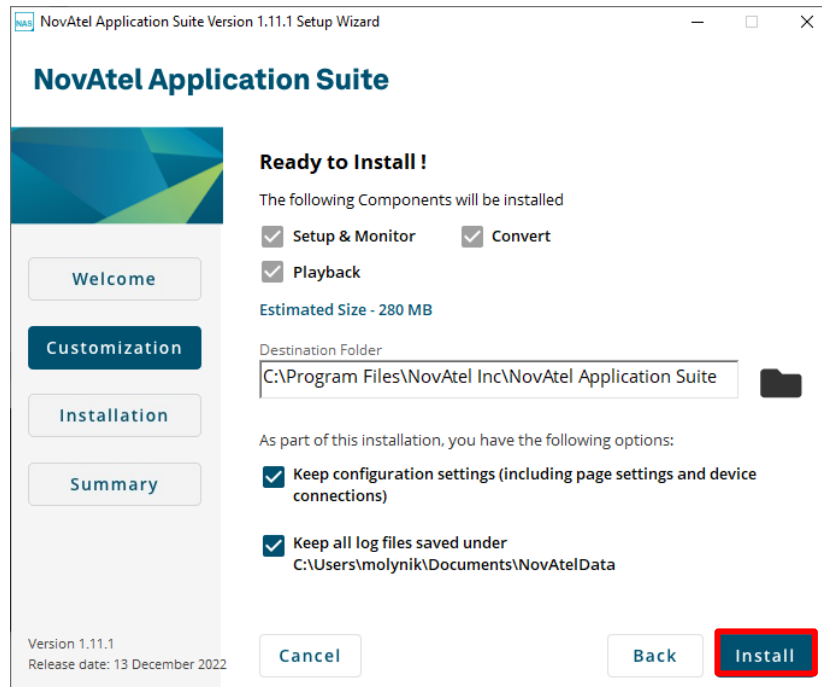


Figure 9: NAS customization

- c. NAS will now be installed. This may take a few minutes.

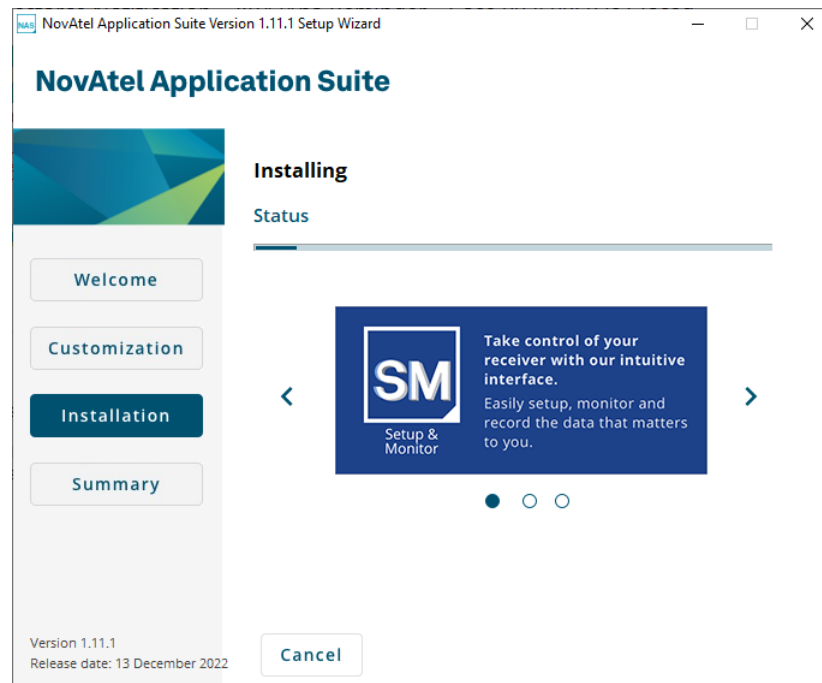


Figure 10: NAS installation



- d. At this point the installation is complete. Check the boxes if desired and select **Finish**.

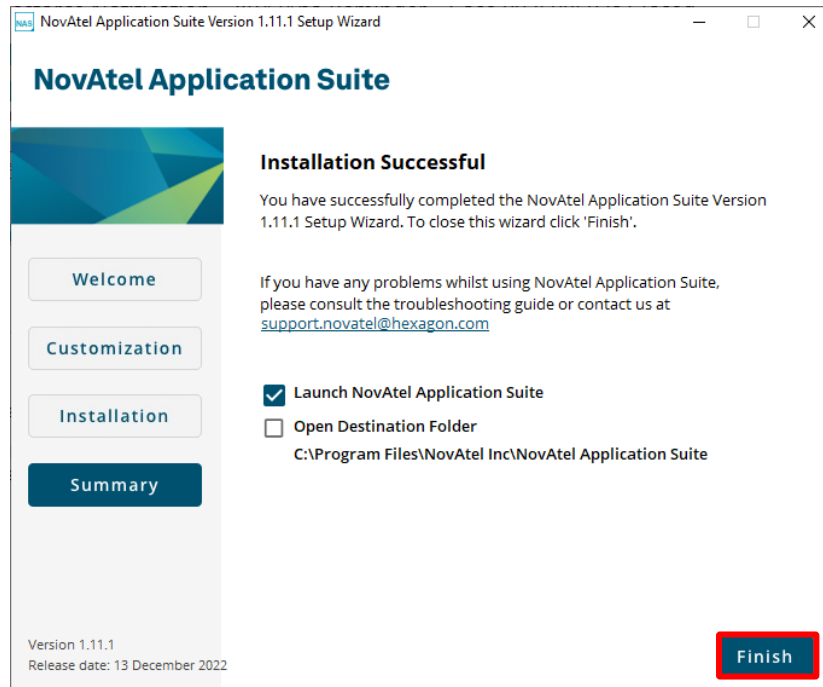


Figure 11: NAS installation complete



Appendix B: Additional Resources

Commands (new and legacy):

- [LOG](#)

Logs (new and legacy):

- [VERSION](#)
- [BESTPOS](#)
- [RANGE](#)
- [GPSEPHM](#)
- [IONUTC](#)
- [GLOEPHEMERIS](#)
- [GLOCLOCK](#)
- [GALINAVEPHEMERIS](#)
- [GALCLOCK](#)
- [GALIONO](#)
- [BDSEPHMERIS](#)
- [BDSCLOCK](#)
- [BDSIONO](#)
- [QZSSEPHMERIS](#)
- [QZSSIONUTC](#)
- [NAVICEPHEMERIS](#)
- [NAVICSYSCLOCK](#)
- [NAVICIONO](#)
- [SBAS9](#)

References

- [NovAtel Application Suite Download](#)
- [RINEX Version 3.04](#)
- [RINEX Version 3.03](#)
- [RINEX Version 3.02](#)
- [RINEX Version 3.01](#)
- [RINEX Version 2.1](#)
- [Waypoint Inertial Explorer](#)
- [Waypoint GrafNav](#)



Support

To help answer questions and/or diagnose any technical issues that may occur, the [NovAtel Support website](#) is a first resource.

Remaining questions or issues, including requests for test subscriptions or activation resends, can be directed to [NovAtel Support](#).

Before contacting Support, it is helpful to collect data from the receiver to help investigate and diagnose any performance-related issues. A list of appropriate troubleshooting logs can be found on the [OEM7 Documentation Portal](#) (the LOG command with the recommended trigger and data rate is included with each log).

The data can also be collected using [NovAtel Application Suite](#).

Documentation

For any questions on logs and commands, please visit the [OEM7 Documentation Portal](#).

Contact Hexagon | NovAtel

support.novatel@hexagon.com 1-800-NOVATEL (U.S. and Canada) or 1-403-295-4900

For more contact information, please visit novatel.com/contact-us

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