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 NovAtel Convert.

GNSS Signals Supported

NovAtel Convert 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 NovAtel Convert is updated accordingly. Table 1 identifies the signals that are supported by NovAtel Convert 2.6.5 for each RINEX version.

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
		1176.45	Y	Y	Y	Y	Y

Table 1: GNSS Signals Supported by NovAtel Convert 2.6.5 for Conversion to RINEX.

Required NovAtel Logs for Conversion

RINEX files includes GNSS measurement data, satellite navigation data, ionospheric information, and timing information. They also include some information specific to the GNSS receiver that was used to collect the data.

The following information is needed to get a complete set of RINEX data:

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

```
GPSEPHEM
IONUTC
```

GLONASS navigation data logs*

```
GLOEPHEMERIS
GLOCLOCK
```

Galileo navigation data logs*

```
GALINAVEPHEMERIS
GALCLOCK
GALIONO
```

BeiDou navigation data logs*

```
BDSEPHEMERIS
BDSCLOCK
BDSIONO
```

QZSS navigation data logs*

```
QZSSEPHEMERIS
QZSSIONUTC
```

NavIC navigation data logs*

```
NAVICEPHEMERIS
NAVICSYSCLOCK
NAVICIONO
```

SBAS navigation data logs*

```
SBAS9
```

Note: An A (for ASCII) or B (for binary) must be appended to the log name in the LOG command for the data to be converted with NovAtel Convert.

**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 RANGEB ONTIME 1
LOG GPSEPHEMB ONCHANGED
LOG IONUTCB ONCHANGED
LOG GLOEPHEMERISB ONCHANGED
LOG GLOCLOCKB ONCHANGED
LOG GALINAVEPHEMERISB ONCHANGED
LOG GALCLOCKB ONCHANGED
LOG GALIONOB ONCHANGED
LOG BDSEPHEMERISB ONCHANGED
LOG BDSCLOCKB ONCHANGED
LOG BDSIONOB ONCHANGED
LOG QZSSEPHEMERISB ONCHANGED
LOG QZSSIONUTCB ONCHANGED
LOG NAVICEPHEMERISB ONCHANGED
LOG NAVICSYSCLOCKB ONCHANGED
LOG NAVICIONOB ONCHANGED
LOG SBAS9B ONCHANGED
```

Convert to RINEX with NovAtel Convert

Once the NovAtel logs have been recorded to a log file, the file can be converted to RINEX using NovAtel Convert. For details on how to install NovAtel Convert, refer to Appendix A.

Here are the steps required to convert to RINEX using NovAtel Convert:

1. Open NovAtel Convert
2. To choose the input file(s), any of these options can be used:
   a. Drag the log file(s) into the white area below 'Input File'\
   b. Click 'Open' and choose the log file(s)
   c. Click the white area below 'Input File' and choose the log file(s) from File Explorer
3. Click on the drop-down box in the center of the window that says 'ASCII', and then select the desired RINEX version that the log file will be converted to:

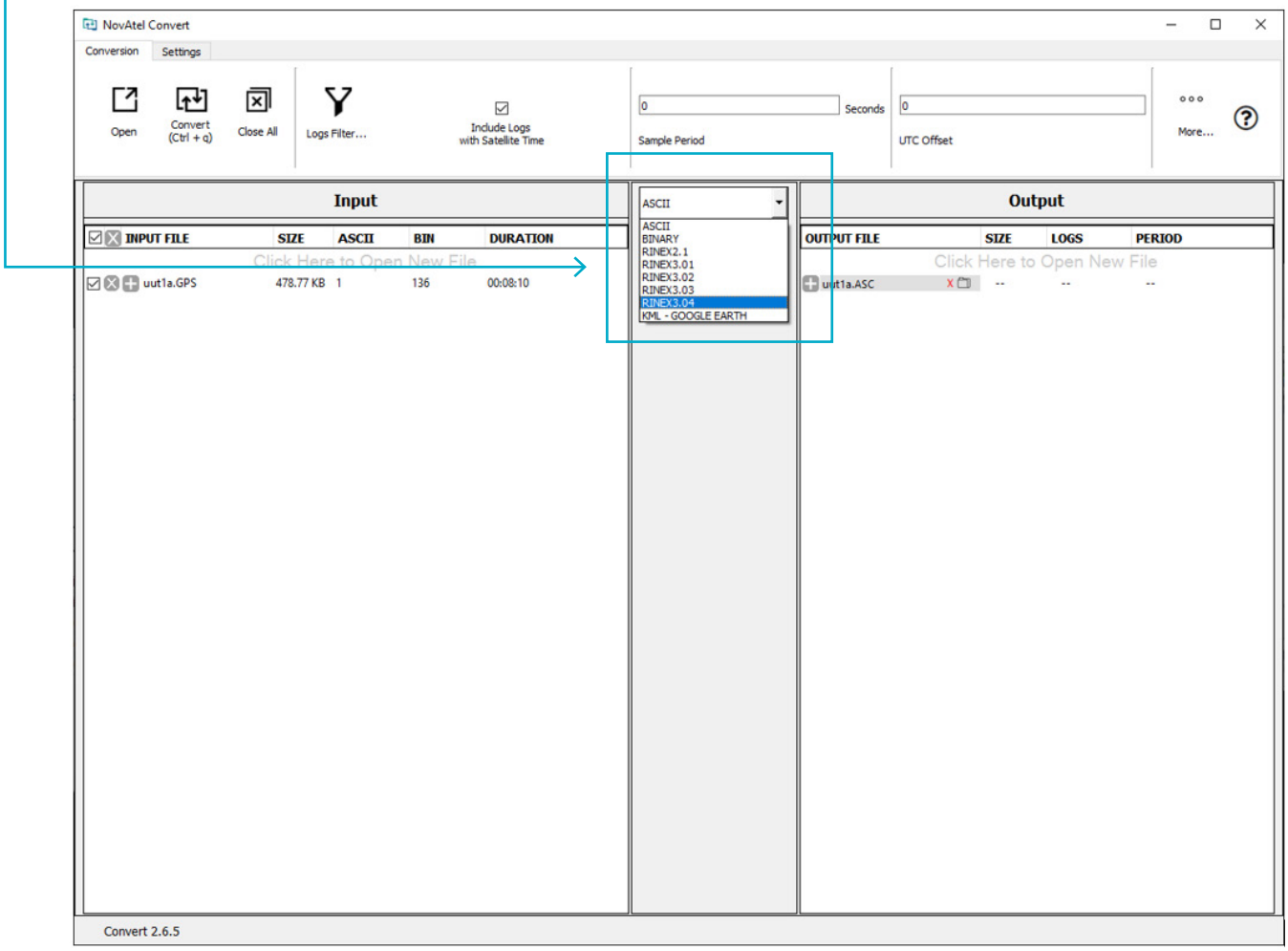


Figure 1: Selecting the desired output file data format in NovAtel Convert.

4. A user can optionally set several of the fields in the RINEX .yyO file header. To do this, before converting the file:
   a. Click on the + sign beside the output filename to expand additional options.
   b. Click on the + sign beside Files.
   c. Click on the + sign beside Obs File.
   d. Click on the + sign beside Header Info.
   e. Enter additional information in the fields listed.

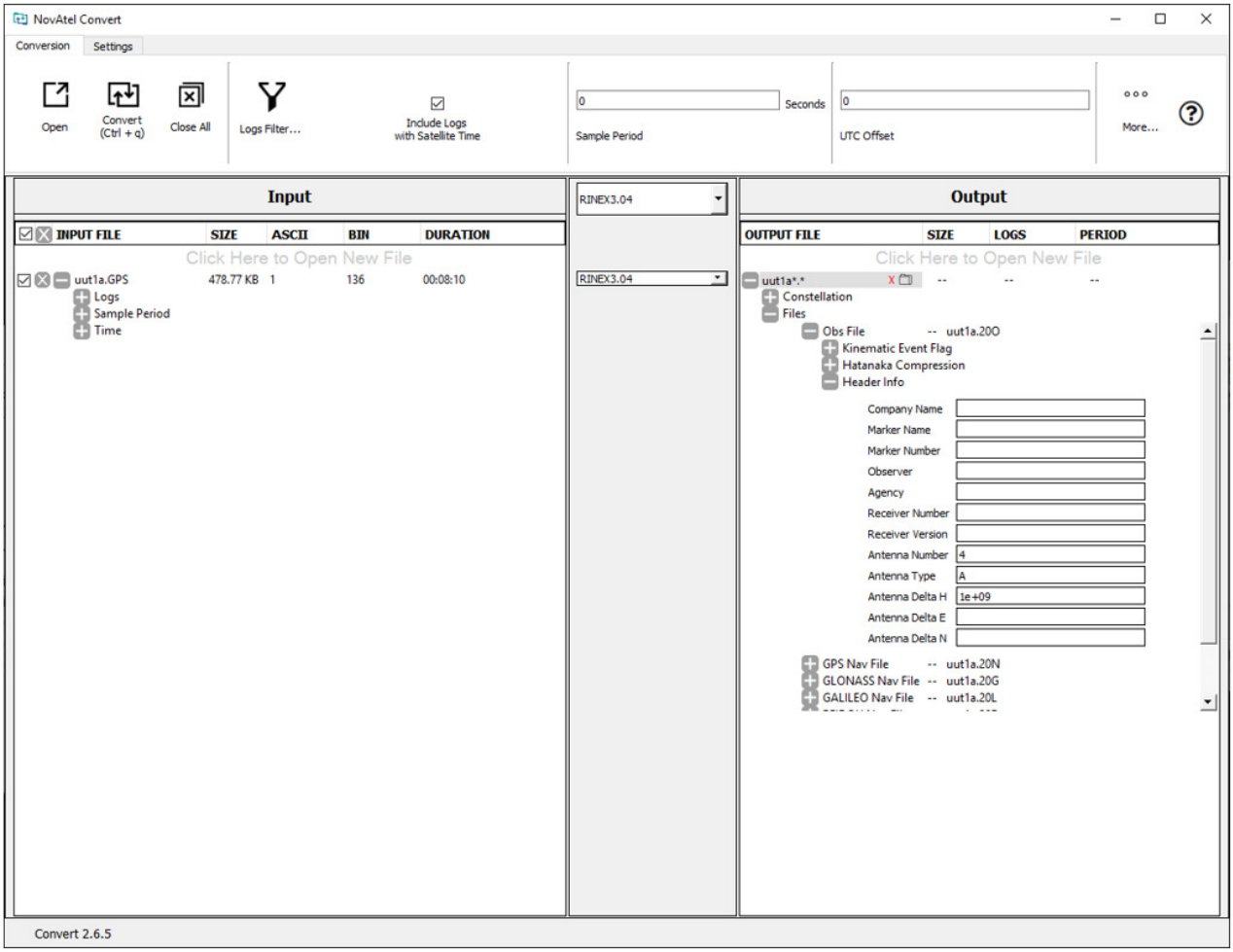


Figure 2: Entering additional information in the Header Info fields.

5. Click Convert. The resulting RINEX output files will be in the same folder location as the original NovAtel log file.

RINEX Output Files

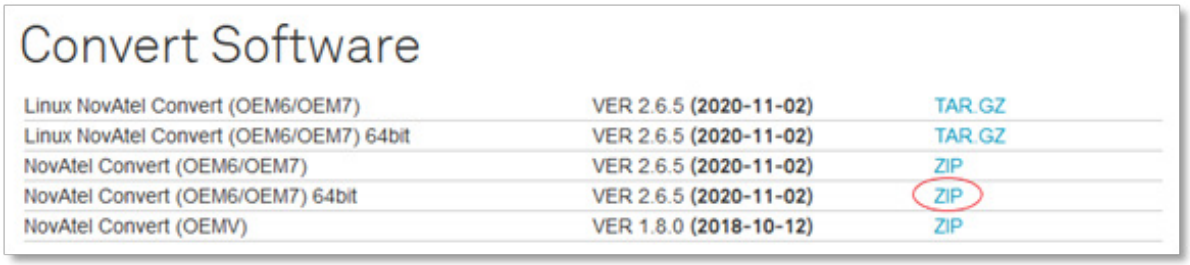
The following RINEX files are created by the conversion of NovAtel log files to RINEX format. '**yy**' is the two-digit year of the file (for instance for 2021 the **yy** is **21**).

- **.yyO** – GNSS observations. This includes:
  - Version
  - Position
  - Constellations
  - Signals
  - GLONASS phase shifts
  - GLONASS code/phase biases
  - Leap seconds
  - Satellite measurement data:
    - PRN
    - Pseudorange
    - ADR
    - C/No
    - Lock time
- **.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

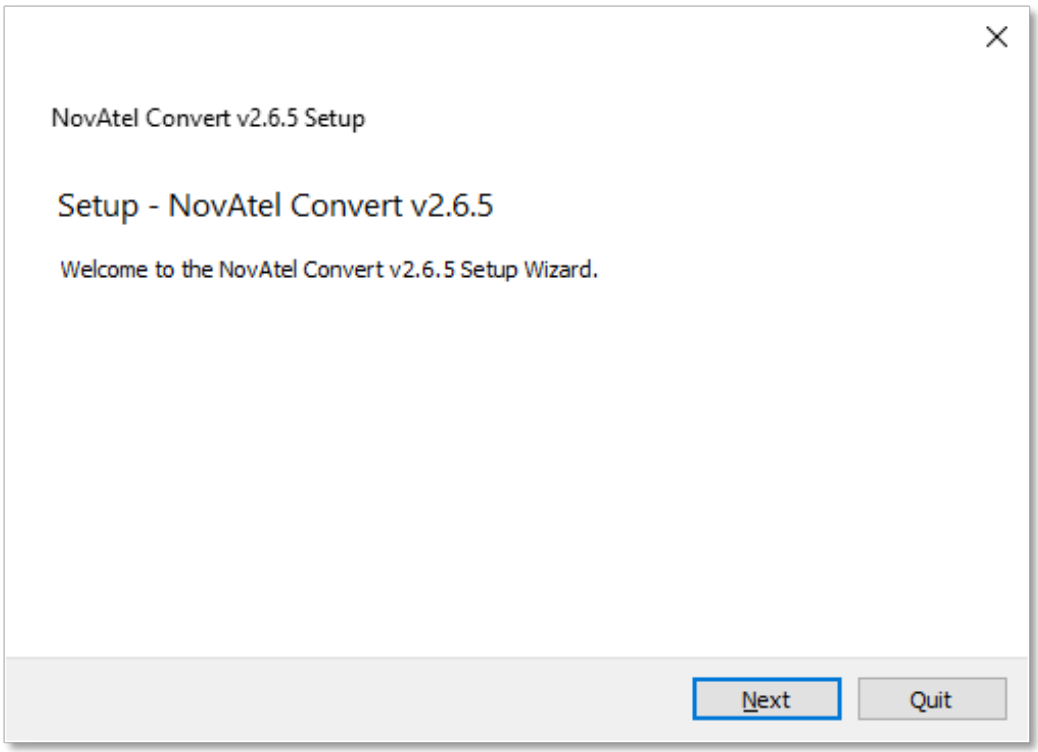
Appendix A: NovAtel Convert Installation

Here are the steps to install NovAtel Convert:

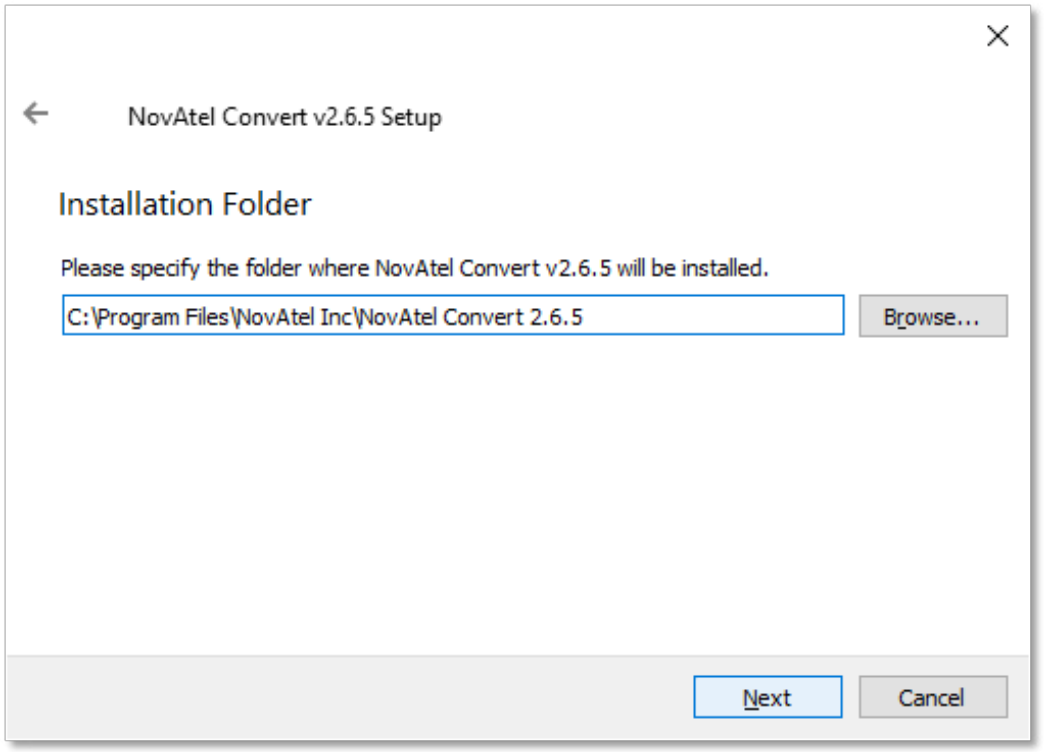
1. Download NovAtel Convert.
2. In most cases the 64 bit version is the best choice. Click on 'ZIP' to download.



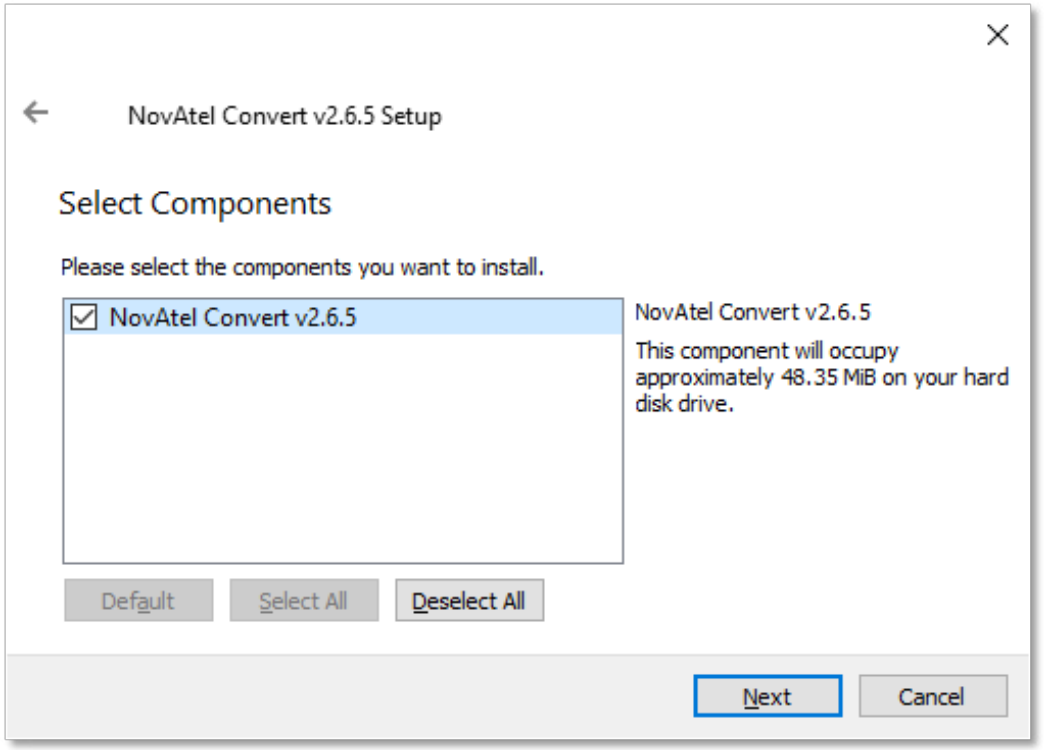
3. Unzip the downloaded file.
4. Double-click on the unzipped directory, then NovAtel-Convert-64bit, then double-click **NovAtelConvert_Setup.exe.** Depending on the IT settings, it may be necessary to right-click on **NovAtelConvert_Setup.exe** and then choose '**Run As Administrator**' and '**Yes**'.
5. For the installation questions:
   a. Select 'Next':



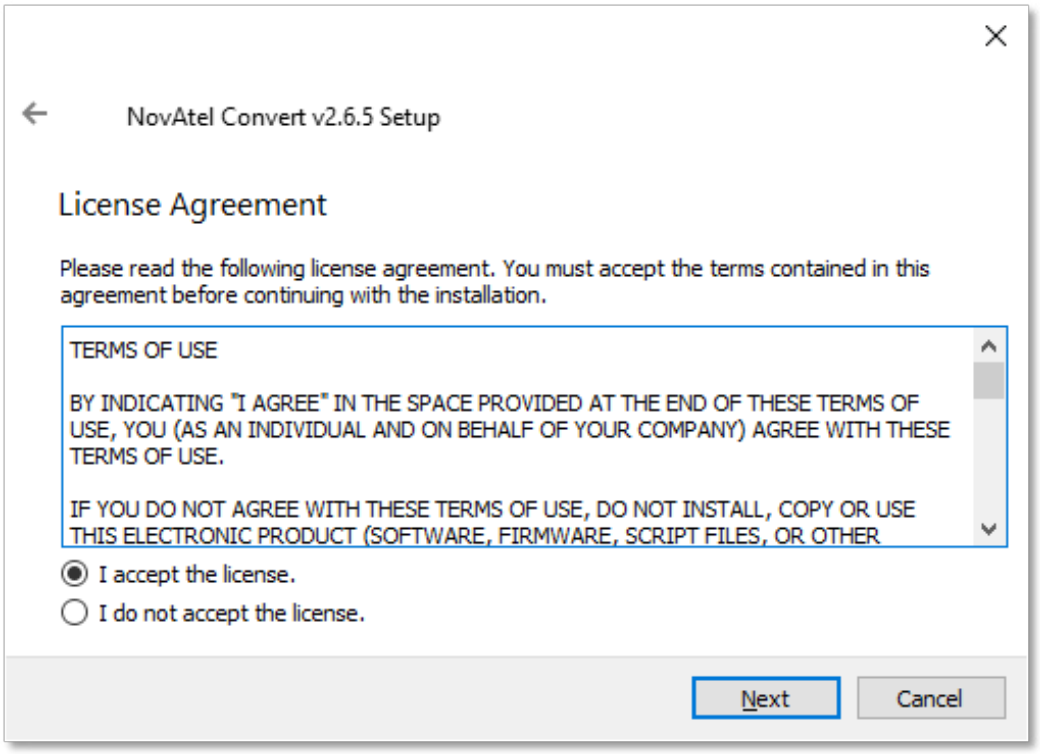
b. Select a directory and then ‘Next’:



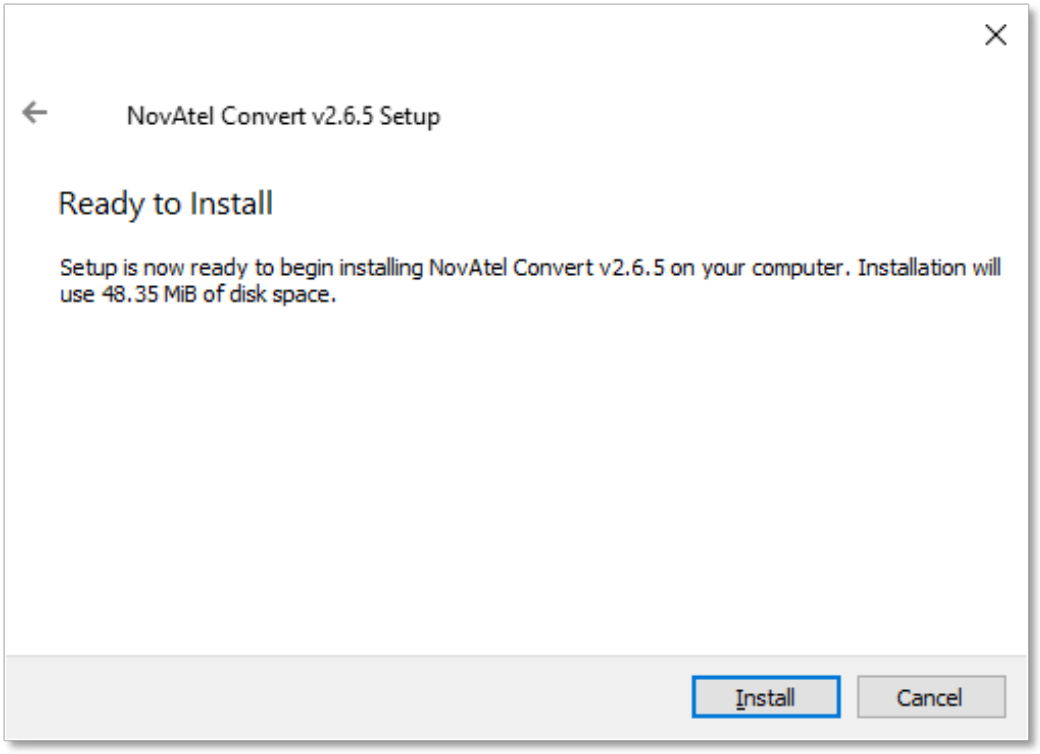
c. Select ‘Next’:



d. Read and accept the license and click ‘Next’:



e. Click ‘Install’:



Appendix B: Additional Resources

Commands and Logs

Commands (new and legacy):

- LOG

Logs (new and legacy):

- VERSION
- BESTPOS
- RANGE
- GPSEPHEM
- IONUTC
- GLOEPHEMERIS
- GLOCLOCK
- GALINAVEPHEMERIS
- GALCLOCK
- GALIONO
- BDSEPHEMERIS
- BDSCLOCK
- BDSIONO
- QZSSEPHEMERIS
- QZSSIONUTC
- NAVICEPHEMERIS
- NAVICSYSCLOCK
- NAVICIONO
- SBAS9

References

NovAtel Convert Software 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

NovAtel 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 Contact. To enable the online form and submit a ticket, first select a “Product Line” and then an associated “Product” from the list.

Before contacting Support, it is helpful to collect data from the receiver to help investigate and diagnose any performance-related issues. If the support case is RINEX related, then if possible provide Support with the raw NovAtel log files, the converted RINEX files, and a description of the issue.

The data described above can be collected using a terminal program that supports binary data logging, or NovAtel’s Connect utility can be downloaded and installed from the NovAtel website.

Documentation

All logs and commands described can be found in the Documentation Portal for OEM7.

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