

APN 073:

RTK ASSIST

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RTK ASSIST

RTK ASSIST Overview

NovAtel's RTK ASSIST™ empowers RTK users to seamlessly operate with centimeter level accuracy during RTK correction signal outages caused by radio connectivity issues or wireless or cellular signal disruptions. RTK users can continue their operation without largely being impacted by signal outages, leading to increased productivity. The RTK ASSIST feature is supported through NovAtel's satellite based correction services and thus does not require any local infrastructure. RTK ASSIST is currently available for OEM6 and OEM7 product lines, for eligible hardware and firmware models.

How It Works

RTK ASSIST works by using the precise GNSS correction data delivered by the geostationary (GEO) satellites¹ to maintain centimeter level accuracy in the absence of RTK corrections. These corrections are received through L-Band tracking and subsequently used by the position engine to maintain centimeter level accuracy.

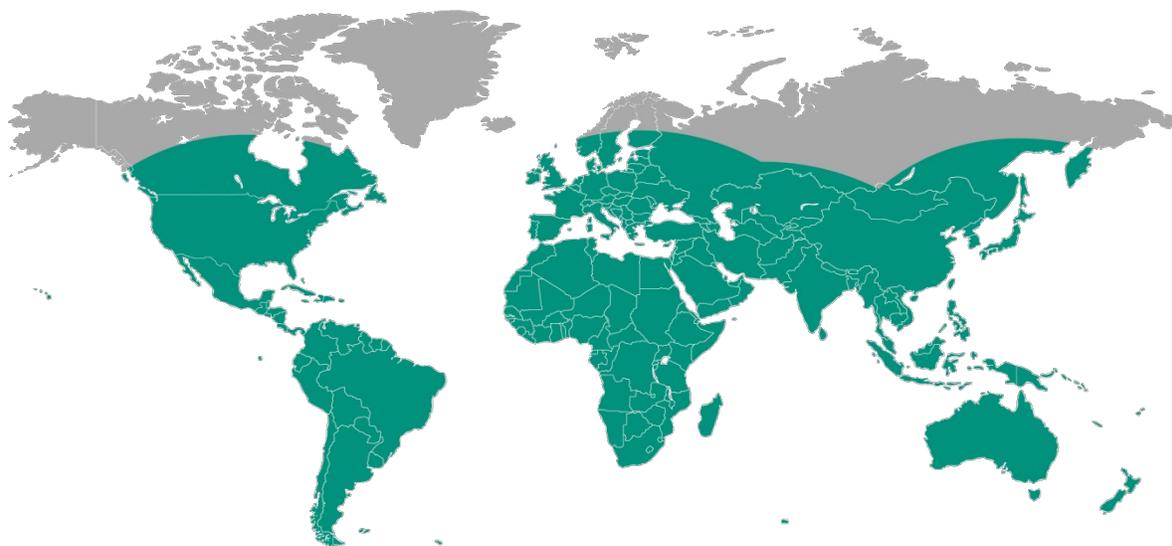


Figure 1: Global Coverage Map for Correction Delivery

RTK ASSIST operates seamlessly in the background for up to twenty minutes from the onset of an RTK outage. After that, the position type will transition to the next most accurate available. Datum

¹ GNSS correction service is provided by TerraStar.

differences or biases are automatically compensated for when transitioning between position types. The algorithm is designed to facilitate smooth transitions during RTK outages. However, as with any carrier phase based positioning, there is a possibility that a position jump may occur due to an incorrect ambiguity fix. The positioning solution will transition back to using RTK corrections once connection has been re-established with the correction source.

As the RTK ASSIST technology uses the precise correction data delivered via geostationary satellites, any obstructions (i.e., buildings, grain tanks, tree lines) can potentially degrade or block the satellite signals. Depending on the L-Band signal blockage duration, the position error will increase over time. If L-Band signals are lost for more than 2 minutes, RTK-level accuracies cannot be maintained and RTK ASSIST will disengage. The resulting position type will be determined by the accuracy level of the solution at the time RTK ASSIST becomes inactive.

The RTK ASSIST functionality will engage as long as there is L-Band tracking and the GNSS receiver has had at least one RTK fix prior to the outage.

Users can expect centimeter level accuracy during the RTK outage when using RTK ASSIST. However, the accuracy will degrade as the outage duration increases but will stabilize (approximately 4 cm RMS). If the RTK outage occurs in the first 30 minutes of operation, further degradation (approximately 20 cm RMS) may be observed.

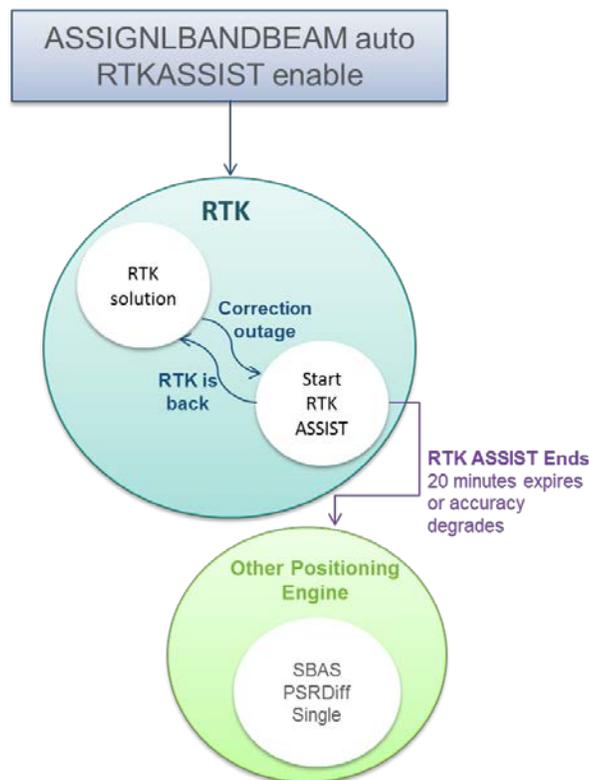


Figure 2: Summary of how RTK ASSIST works

Figure 2 shows the basic flow structure that RTK ASSIST will follow. If an outage occurs while in RTK mode, RTK ASSIST will engage. At this point, if RTK returns before the 20 minute time period, RTK will resume as normal. However, if RTK corrections do not return, the next most accurate position type will be used (SBAS, PSRDiff etc.) until corrections are re-established.

Operating Modes

RTK ASSIST operates in two different modes: Coast and Full Assist.

Coast:

Coast is available as soon as the RTK ASSIST corrections are received from the L-Band satellite. In this position mode, error growth during the RTK outage is slightly greater when compared to Full Assist mode. When in this mode, RTK will not resume following a full GNSS signal outage until after RTK corrections are restored.

Full Assist:

Full assist provides the lowest position error growth during RTK correction outages and makes it possible for RTK to resume even if there are complete GNSS signal outages during the RTK ASSIST period. This mode requires a convergence period of approximately 30 minutes from navigation start.

Requirements for using RTK ASSIST

The RTK ASSIST functionality requires the receiver to be enabled for both RTK positioning and L-Band tracking. These requirements can be checked against the model of the receiver and determine that options for L-Band and RTK are both enabled.

Based on the OEM6 model structure, firmware Option 4 must be RTK (i.e. "R"), the firmware Option 2 must be "2" or higher, and the firmware Option 3 should be "L" or "J". For example:

- OEM628-D**2L**-R0G-TT0
- OEM638-D**2J**-RPR-TTN
- SM6L-D**2L**-RPG-0T0

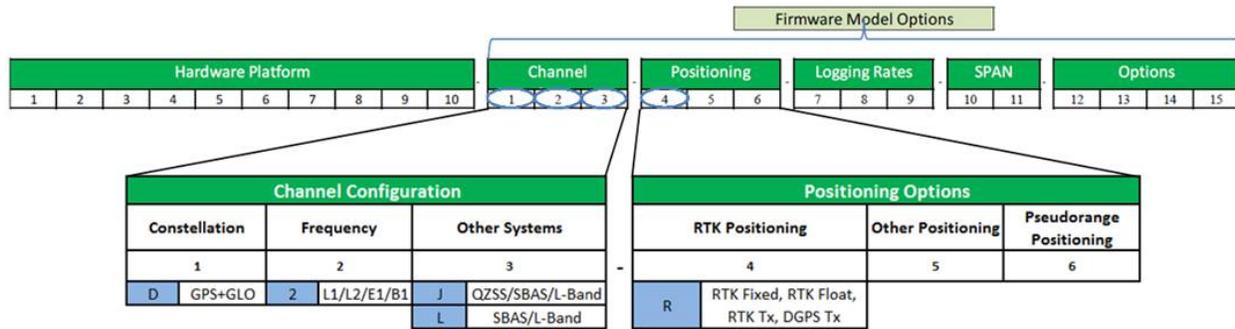


Figure 3: OEM6 Model Structure & Firmware Model Options for RTK ASSIST

The “L” or “J” option enables L-Band tracking, and the “R” option allows the receiver to use RTK ASSIST service. However, the user must configure the receiver to track the L-Band signal (see **Enable L-Band Tracking**) and a RTK ASSIST subscription must be purchased and activated before the receiver will start using the corrections and providing RTK ASSIST functionality.

To use the RTK ASSIST service, the channel configuration options for dual-frequency (L1 & L2) tracking must be included in the model, as well as GPS+GLONASS tracking for best performance. To allow for this, the first two firmware options must be a minimum of “D” and “2” as shown in the examples and Figure 3 above.

Channel Configuration			Positioning Options		
Constellation	Frequency	Reserved	CORRECT Positioning	Heading	Reserved
char[1]	char[2]	char[3]	char[4]	char[5]	char[6]
G	GPS Only	S Single Frequency L1/E1/B1	L Low End Positioning ¹	Z Heading	N
D	GPS +GLO	D Dual Frequency	P L + Unrestricted PPP	Y Z + Moving Baseline	
W	GPS + GAL	F All Frequencies	R P + RTK	N None	
P	GPS + BDS		N None		
T	GPS + GLO + GAL				
C	GPS + GLO + BDS				
F	GPS + GLO + GAL + BDS				

Figure 4: OEM7 Model Structure and Firmware Model Options for RTK ASSIST

On OEM7, Dual frequency is represented by the “D” or “F” in the 2nd character. The “R” model is required for RTK in the 4th character. As stated above, GPS + GLONASS tracking should be enabled for optimal performance of the system.

- OEM729-DFN-RNN-CBN

The firmware requirements for OEM6/OEM7:

OEM6: Version 6.710 (OEM060710RN0000) or later

OEM7: Version 7.200 (OM7MR0200RN0000) or later

RTK ASSIST Subscriptions

To purchase a RTK ASSIST subscription, contact your NovAtel dealer or sales office². NovAtel Customer Support can provide free 3 or 5-day trial RTK ASSIST subscriptions for test and demonstration purposes³. Users cannot subscribe to both RTK ASSIST and TerraStar subscriptions simultaneously.

The receiver's NovAtel Product Serial Number (PSN) or TerraStar Product Activation Code (PAC) is needed to obtain a subscription. Before contacting your NovAtel sales office, obtain the PSN for the receiver you wish to activate using the command "LOG VERSION".

To verify an RTK ASSIST subscription, users can use the TERRASTARINFO log as demonstrated below:

LOG TERRASTARINFO

```
< TERRASTARINFO COM1 0 87.0 FINESTEERING 1919 247530.423 02000020 a7ce 32768
```

```
"QU075:2185:6222" PAYG 00000800 0 0 0 LOCAL_AREA 51.11639 -114.03806 2
```

Bit	Mask	Description
0-8	0x000001FF	Reserved
9	0x00000200	TerraStar-C service
10	0x00000400	TerraStar-L service
11	0x00000800	TerraStar RTK ASSIST service
12-31	0xFFFFFFFF	Reserved

Table 1: Terrastarinfo bit mask description

The bit mask (0x00000800) indicates that the receiver has a TerraStar RTK ASSIST service.

² <http://www.novatel.com/where-to-buy/sales-offices/>

³ Contact support@novatel.com for more details. Maximum of 3 test subscriptions will be provided per receiver.

Verifying RTK ASSIST

Users can check the status of their RTK ASSIST solution by looking at the RTKASSISTSTATUS log⁴

LOG RTKASSISTSTATUS

```
< RTKASSISTSTATUS COM1 0 68.0 FINESTEERING 1919 166861.000 00040020 80fe 46774
    ACTIVE COAST 1085.0 21.0
```

ACTIVE: The active keyword indicates that RTK ASSIST is engaged and currently providing positioning. This field will report **INACTIVE** when not being used.

1085.0: This is the time remaining (seconds) in the RTK ASSIST mode before transitioning to the next most accurate available positioning mode. The maximum is 20 minutes (1200 seconds).

21.0: The corrections age reported in the RTKASSISTSTATUS log should typically be below 30 seconds. If the age exceeds this value, then L-Band tracking is likely being degraded. The most likely cause of degraded L-Band tracking is obstructions between the antenna and the L-Band satellite.

An alternative way to see if RTK ASSIST is active for users using the BESTPOS log is to look at Field #20 (Extended Solution Status) to see if bit four is active.

Bit	Mask	Description
0	0x01	If an RTK solution: NovAtel CORRECT solution has been verified If a PDP solution: solution is GLIDE Otherwise: Reserved
1-3	0x0E	Pseudorange Iono Correction 0 = Unknown or default Klobuchar model 1 = Klobuchar Broadcast 2 = SBAS Broadcast 3 = Multi-frequency Computed 4 = PSRDiff Correction 5 = NovAtel Blended Iono Value
4	0x10	RTK ASSIST active
5	0x20	0 - No antenna warning 1 - Antenna information is missing See to the RTKANTENNA command
6-7	0xC0	Reserved

Figure 5: BESTPOS Extended Solution Status

⁴ Users can find the relevant logs and commands in the user manual for their product.

OEM6: <http://www.novatel.com/assets/Documents/Manuals/om-20000129.pdf>

OEM7: <http://beta-documents.novatel.com/Content/Home.htm>

Enable L-Band Tracking

To enable L-Band tracking, the “ASSIGNLBANDBEAM” command is used. The factory default setting for “ASSIGNLBANDBEAM” is “IDLE”, which means that the receiver will not track an L-Band signal unless configured to do so.

To enable L-Band tracking, the “AUTO” setting is recommended in most cases. Specifically:

ASSIGNLBANDBEAM AUTO

The auto setting allows the GNSS receiver to automatically track the signal from the highest elevation TerraStar satellite for the best performance. To determine which TerraStar signal is the best to use in a particular location, the receiver must have a position solution available.

To verify the L-Band tracking status, the “LBANDTRACKSTAT” log can be used. For example:

```
<LBANDTRACKSTAT COM1 0 80.5 FINESTEERING 1835 140789.000 00000020 29fd 13306  
< 1  
< "98W" 1539902500 1200 974c 00c2 0 345.395 42.398 3.5073 71580.844 1363392 1168  
1085 173150784 136010 0.0038
```

This log reports the L-Band tracking status of the TerraStar signal. Some helpful fields are highlighted above and described below:

- **98W**: This is the name of the TerraStar beam or transmitting satellite being tracked.
- **00c2**: This is the “Tracking Status Word”. A tracking status of “00c2” indicates that the receiver is tracking and locked onto the TerraStar signal.
- **42.398**: This is the C/No or “Carrier to Noise Density Ratio” (in dB-Hz). The C/No is typically about 40-45 dB-Hz in ideal conditions. A low C/No can result in missed corrections and correspondingly degraded performance.
- **71580.44**: This is the “Lock Time” (in seconds). This field can be monitored to ensure that the L-Band signal is being tracked continuously without any loss of lock.

While the TerraStar signal can be tracked even without a subscription, the receiver will not decode and use the TerraStar service data until a valid subscription has been activated.

Configuration for RTK ASSIST

To enable RTK ASSIST on a receiver with a valid model and subscription, use the commands provided below.

LOG TERRSTARINFO (Indicates a valid RTK ASSIST subscription)

ASSIGNLBANDBEAM AUTO (Enables L-Band tracking)

RTKASSIST ENABLE (On by default – users can verify by logging the command)

RTKASSISTTIMEOUT SUBSCRIPTION_LIMIT (Use the maximum amount of time possible)

LOG RTKASSISTSTATUS (Users can verify that RTKASSIST is working when there is no RTK correction signal)

Logs and Commands

All logs and commands described below can be found in documentation for OEM6 and OEM7 in their respective firmware manual

OEM6: <http://www.novatel.com/assets/Documents/Manuals/om-20000129.pdf>

OEM7: <http://beta-documents.novatel.com/Content/Home.htm>

Where to go for Support

To help answer questions and/or diagnose any technical issues that may occur, the NovAtel Support website is a first resource: www.novatel.com/support/

Remaining questions or issues, including requests for test subscriptions or activation resends, can be directed to NovAtel Support by visiting www.novatel.com/support/contact/. To enable the online form and submit a ticket, first select a "Product Line" and then an associated "Product" from the list.

However, before contacting Support, it is helpful to collect data from the receiver to help investigate and diagnose any performance-related issues. In those cases, if possible, collect the following list of logs (the LOG command with the recommended trigger and data rate is included):

```
LOG VERSIONA ONCE
LOG RXSTATUSA ONCHANGED
LOG RAWEPHEMB ONCHANGED
LOG ALMANACB ONCHANGED
LOG IONUTCB ONCHANGED
LOG GLORAWEPHEMB ONCHANGED
LOG GLORAWALMB ONCHANGED
LOG GLOCLOCKB ONCHANGED
LOG RANGE B ONTIME 1
LOG BESTPOS B ONTIME 1
LOG LBANDTRACKSTAT B ONTIME 1
LOG TERRASTARINFOA ONCHANGED
LOG TERRASTARSTATUSA ONCHANGED
LOG RXCONFIGA ONCE
LOG RTKASSISTSTATUSA ONTIME 1
```

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: www.novatel.com/support/info/documents/809.

