

Preparing GPS/GNSS Receivers and Hardware for the April 6, 2019 GPS Week Number Rollover (WNRO)

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At 23:59:42 UTC on 4/6/2019 (Midnight GPS time, which differs by 18 [leap-seconds](#) from UTC), the 10-bit GPS Week Number broadcast by the constellation reset to zero for the second time since the beginning of GPS on 1/6/1980. [The official presentation on the issue from gps.gov details the issue](#), and the [U.S. Department of Homeland Security has issued a bulletin regarding the use of GPS for timing purposes](#). The journal Nature has published an article detailing the impacts of the rollover on the global scientific community, [GPS glitch threatens thousands of scientific instruments](#), which cites UNAVCO. The purpose of this UNAVCO Knowledge Base article is to educate operators of high-precision GPS receivers about any necessary action. There is also information below regarding some seismological and cellular devices.

As the [gps.gov](#) presentation states, the best course of action for all owners of GPS receivers and any other hardware that uses GPS for timing or geolocation is to "Trust but Verify" by directly contacting the manufacturer of any such hardware for advice. In addition to the high-precision receivers detailed in this article, devices such as seismometers, dataloggers, cellular modems, internet routers, etc. may also require firmware updates or hardware replacement in order to properly handle the rollover.

Now that the rollover has passed, new details have been to appropriate sections below. Not all of the systems used by the UNAVCO community performed as expected during the rollover. In most cases, systems that were expected to fail had no problems (older Trimble and Topcon hardware), while others that were expected to handle the rollover properly did not, specifically Javad receivers with older firmware in certain configurations. The overall effect on UNAVCO's operations was minimal, and was likely not perceived by the vast majority of our users. Some stations were preemptively removed from data flow and archiving for two days while their performance was assessed, but then returned to normal operations.

There were [many reports of WNRO-induced outages](#) in systems across the globe, including [New York City's Wireless Communications Network](#), [Honeywell Avionics that grounded some Boeing 787 and 777 jets](#), [Australian weather balloons](#), and [NOAA weather buoys](#). But as in the case of Y2K, the WRNO had a minimal effect, as told in "[The Tech Disaster That Didn't Happen](#)".

It's quite possible that the effects of the rollover were not immediately noticed on 4/7/2019, but may take effect at random times in the future if improper methods are used in firmware to adjust the GPS date. The primary symptom of a device that doesn't handle the rollover correctly would be that any data logged or streamed would be time stamped by 19.7 or 39.4 years in the past, i.e. rather than 4/7/2019 you would see 1/6/1980 or 8/22/1999. Simulator testing conducted by UNAVCO and many others has shown that satellite tracking, position solutions and other functions would continue, so the devices would not fail, but any system that relies on the time stamps produced by those devices might. And while any incorrectly time-stamped data files MIGHT be recoverable using translation software for post-processing, this has not yet been confirmed. The best courses of action are to ensure that firmware is updated for every device that requires it and has available updates, or to replace any hardware that cannot be updated. Also ensure that any software systems that use real-time streams from suspect hardware are capable of handling bad date stamps. **CRITICAL SYSTEMS SHOULD BE ACTIVELY MONITORED DURING AND AFTER THE ROLLOVER TO ENSURE CONTINUED OPERATION.**

Here is a [1-minute video from UNAVCO's simulator tests](#) demonstrating the improper behavior of a Topcon GB-1000 GNSS receiver with an older firmware version during the rollover. Note that the receiver is displaying UTC, which differs from GPS time by 18-seconds. Topcon has released new firmware for this receiver to correctly handle the rollover; see below for more details.

Below is a list of resources made available by the primary high-precision GPS hardware manufacturers detailing their concerns. This is by no means complete as there are many others that may be affected. If in doubt, go directly to your manufacturers' web pages and/or contact support by phone or email for detailed advice. Every manufacturer is advising that you ensure that every device has the most up-to-date firmware available installed.

ACTION IS KNOWN TO BE REQUIRED FOR THE FOLLOWING DEVICES:

1. [Trimble NetRS receivers must be updated to Firmware version 1.3-2](#). This version can be applied to all NetRS receivers regardless of warranty date.
 1. **POST-ROLLOVER UPDATE:** All NetRS receivers regardless of firmware version handled the WNRO properly, and UNAVCO has performed post-WNRO cold restart tests to confirm proper operation. There is no guaranty, however, that the older firmware will not malfunction at some point in the future, so all receivers should still be updated to 1.3-2 whenever possible.
2. [Topcon GB-1000 receivers must be updated to Firmware version 3.5p5](#), which is a new release from Topcon. UNAVCO tested this version with a simulator and found that while the receiver board does handle the rollover properly the LCD display on the front panel will display an incorrect date 19.7 years in the past. This can safely be ignored, and is due to the fact that the display board uses a separate firmware file that has not yet been updated. Data recorded after the rollover by receivers with older firmware will NOT be usable per results of UNAVCO's simulator tests.
 1. **POST-ROLLOVER UPDATE:** GB-1000 receivers running firmware version 3.4p2 also continued to function properly after the WNRO. As in the case of the NetRS receivers, there is no guarantee that proper function will continue indefinitely, so updates to 3.5p5 are highly recommended.
3. [Topcon Net-G3A receivers require updates to 4.7p6 or 4.7p10 depending on data formats used](#).
4. [Legacy Trimble receivers 5700 Model 1, 5800 Model 1, and R8 Model 1 require updates to firmware version 2.32](#), which may require the procurement of warranty codes from Trimble support.
 1. **POST-ROLLOVER UPDATE:** All of the legacy receivers named above handled the WNRO properly on firmware version 2.30. As stated above, receivers should be updated to 2.32 regardless of current function. [A Trimble 4000SSI at UNAVCO HQ also continues to function properly post-WNRO. Only the original Trimble 4000sx did not.](#)
5. Legacy Ashtech micro-Z and Z-12 receivers have not had firmware updates available for many years. Simulator tests at JPL show that while these receivers should continue to operate through the rollover, data STREAMS produced by the receivers will be incorrectly time-stamped but can be made usable by using the proper "-week" flag when translating with teqc. (e.g. for any data recorded during the week beginning on April 7 use "-week 2048"). No testing could be done on logged data files from these receivers, so while it is likely that

they can be used in the same way it has not been confirmed.

1. **POST-ROLLOVER UPDATE:** Logged data files from micro-Z and Z-12 receivers in the field are being properly handled as expected by inserting the proper "-week" flag when translating with tecq. See [this thread in the tecq user forum regarding this issue](#), including the proper handling of .nav files.
6. Some Leica Geosystems receivers may require action. See below for details.

Here are direct links, details and summaries regarding major hardware manufacturers' products:

1. **Ashtech.**

1. As mentioned above the oldest generation of Ashtech receivers will require special translation steps to use any data acquired after the rollover. The best option is to replace them with newer hardware if possible.
2. Newer Ashtech receivers such as the ProMark 500, made after the Ashtech brand was acquired by Magellan and later Trimble (now known as the "Spectra" brand), [are described in this Trimble service bulletin](#). [Here is an additional page regarding these products with links to firmware downloads](#). **IN SOME CASES ACTION MAY BE REQUIRED.**

2. **Javad.**

1. Senior Firmware Architect at Javad has advised that all of their systems (with one exception noted below) have been tested and will function properly during the rollover, so no action is needed. Contact Javad support through normal channels with any specific questions.
2. Operators of Javad Sigma receivers should note the following: It does not appear that firmware update will be required, but should be done if practical. These receivers should be monitored closely during and after the rollover: "We have tested versions of firmware 3.3.4 and 3.4.0 by simulator, unfortunately these firmwares demonstrated the problem with week rollover, receiver excluded GPS satellites from position computation from the beginning of week and until new ephemeris with new week number were collected (30-60 seconds). Modern versions of firmware (we tested 3.7.4 and 3.7.6beta) passed this test correctly."
3. **POST-ROLLOVER UPDATE:** Many Javad receivers running older firmware experienced problems either when logging or streaming BINEX, or when tracking Galileo satellites. The best fix is to update all Javad receivers to the [latest firmware versions available on their website](#). When this is not possible, disabling BINEX logging/streaming in favor of .jps or RTCM formats, and/or disabling Galileo tracking will restore proper operations. [Javad also updated their translation software JPS2RIN](#) to fix improper generation of nav files following the WNRO; all users generating RINEX3 using this utility must update to the new version.

3. **Leica Geosystems** has issued the following advice. **IN SOME CASES ACTION MAY BE REQUIRED.**

1. On April 6, 2019, the transmitted GPS week number in the navigation message will rollover from 1023 to 0 (https://ics-cert.us-cert.gov/sites/default/files/documents/Memorandum_on_GPS_2019.pdf). This will be the second era rollover since GPS time was established.

In preparation for this event, Leica Geosystems reference station and monitoring teams have tested all their GR/GM/GMX series receivers by simulating the week rollover. We have determined that all receivers will continue to operate normally during and after the rollover. The week number will continue to increment. The below table summarizes the recommended and minimum receiver and measurement engine (ME) firmware versions required for continuous operation. You should guarantee that all receivers are at least operating with the minimum receiver/ME firmware before 6 April 2019.

Receiver Type	Recommended Receiver / ME Firmware
GR30/50 and GM30	RefWorx 4.30.63 / 7.402
GR10/25 and GM10	RefWorx 4.30.63 / 6.525
GRX1200+ and GRX1200+GNSS	SmartWorx 9.20 / 6.405
GRX1200 GG Pro	SmartWorx 9.20 / 3.823
GRX1200 Lite/Classic/Pro	SmartWorx 9.20 / 2.127
GMX910	./ 7.403
GMX901 plus	./ 6.406
GMX902 GG/GNSS (ME4)	./ 6.423
GMX902 GG (ME3)	./ 3.823
GMX902	./ 2.127
GMX901	./ 942

Important Note

We always recommend to upgrade receivers to the latest released RefWorx, SmartWorx and ME firmware versions to guarantee continuous operation. Older firmware versions than the minimum Receiver / ME Firmware mentioned in the table above have not been tested for the GPS Era Week Rollover.

4. **NovAtel.**

1. Detailed information about NovAtel systems are available on their [Rollover Page](#)

5. **Septentrio.**

1. Septentrio has advised that their modern receivers such as the PolaRx4 and PolaRx5 series will function properly with any firmware version, as will OEM boards such as the AsteRxM and M2 in use in Xeos Resolute receivers. See [Septentrio's informative page regarding the rollover](#), as well as [this service bulletin for details on other devices](#).

6. Topcon Positioning Systems.

1. As mentioned above **ACTION IS REQUIRED FOR MANY WIDELY USED TOPCON RECEIVERS**. All Topcon users should consult [Topcon's Rollover Information page](#), which contains all available information and links to appropriate downloads. Note that free registration may be required to access many of the linked areas.

7. Trimble. ACTION IS REQUIRED FOR SOME TRIMBLE RECEIVERS

1. Newer, networked Trimble Reference Station CORS-class receivers including the Alloy, NetR9, and NetR8 should work with all but the very oldest firmware versions. UNAVCO verified that older NetR9 FW versions functioned as expected in simulated rollover testing. **Only the NetRS, as described above, will require updating to firmware version 1.3-2. See this Trimble service bulletin for more details on specific models and Trimble Pivot Platform, GPSNet and RTKNet software.**
2. **Some older, serial port style Trimble receivers such as the 5700 Model 1, 5800 Model 1, and R8 Model 1 require updates to firmware version 2.32** as described above. **A copy of firmware version 2.32 is provided below.** Other similar models should work regardless of firmware version. **See this service bulletin for details on this class of Trimble receiver.**
3. **Trimble Spectra branded receivers, described in the Ashtech section above are described in this service bulletin.**
4. **Additional information about Trimble's receivers are available at:** <https://www.trimble.com/wnro>

Users of real-time GNSS software are advised to ensure that their systems are up-to-date. [BKG NTRIP Client \(BNC\)](#) has been updated to properly handle the rollover.

Operators of seismological and other equipment are strongly encouraged to contact their manufacturers for details regarding rollover preparedness. IRIS's PASSCAL Instrument Center has published a [bulletin regarding their seismic equipment](#). GFZ Potsdam has posted an [advisory regarding their Geophysical Instrument Pool](#). Here are bulletins from [Güralp regarding their systems](#), [Nanometrics regarding their dataloggers](#), [Kinematics regarding the Q-330 series](#), and [Sierra Wireless regarding their routers and gateways](#).

I will be continuously updating this article with new information and links of interest as I receive them, so check back periodically or contact support AT UNAVCO.org if there are specific questions that your manufacturers or web searches cannot address.

Posted by: [Freddy Blume](#) - Wed, Mar 27, 2019 at 6:17 PM. This article has been viewed 21 754 times.

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