

# **GPS/GNSS Receiver**

## **GPS Week Number Rollover**

### **Technical Information**

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**Revision History**

Version#	Revised description	Date
0	Initial release	2018.05.31

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## **1 Purpose**

This document describes the behavior of date and time output from FURUNO GPS/GNSS receivers when GPS week number rollover occurs.

The size of time information (week number) transmitted by the GPS satellites is 10 BIT. The output range of week number is from 0 to 1023. The week number returns to 0 after 1024 weeks as GPS specifications. It is called "GPS week number rollover". All GPS/GNSS receivers including FURUNO have logic to convert from GPS week number which is transmitted from the GPS satellites to current date and time.

This document explains about the details of conversion to current date and time based on a consideration of GPS week number rollover, and about the range of date and time which GPS/GNSS receiver can output correct date and time.

This document is the supporting document of the hardware specifications and protocol specifications for FURUNO GPS/GNSS receivers to provide in-depth understanding of GPS week number rollover. Please note that this document does not describe changes of specifications for FURUNO GPS/GNSS receivers.

## 2 Conversion from GPS Week Number to Current Date and Time

The GPS satellites started to operate from 1980/1/6. This date is set to the week 0, and the week number is continuously counted. For example, the GPS satellites broadcast “921” as GPS week number on 2017/4/19. However this “921” is generated based on the specifications which reset to “0(zero)” on the GPS week 1024. In fact, there is a time difference of 1945 (=1024+921) weeks between 1980/1/6 and 2017/4/19.

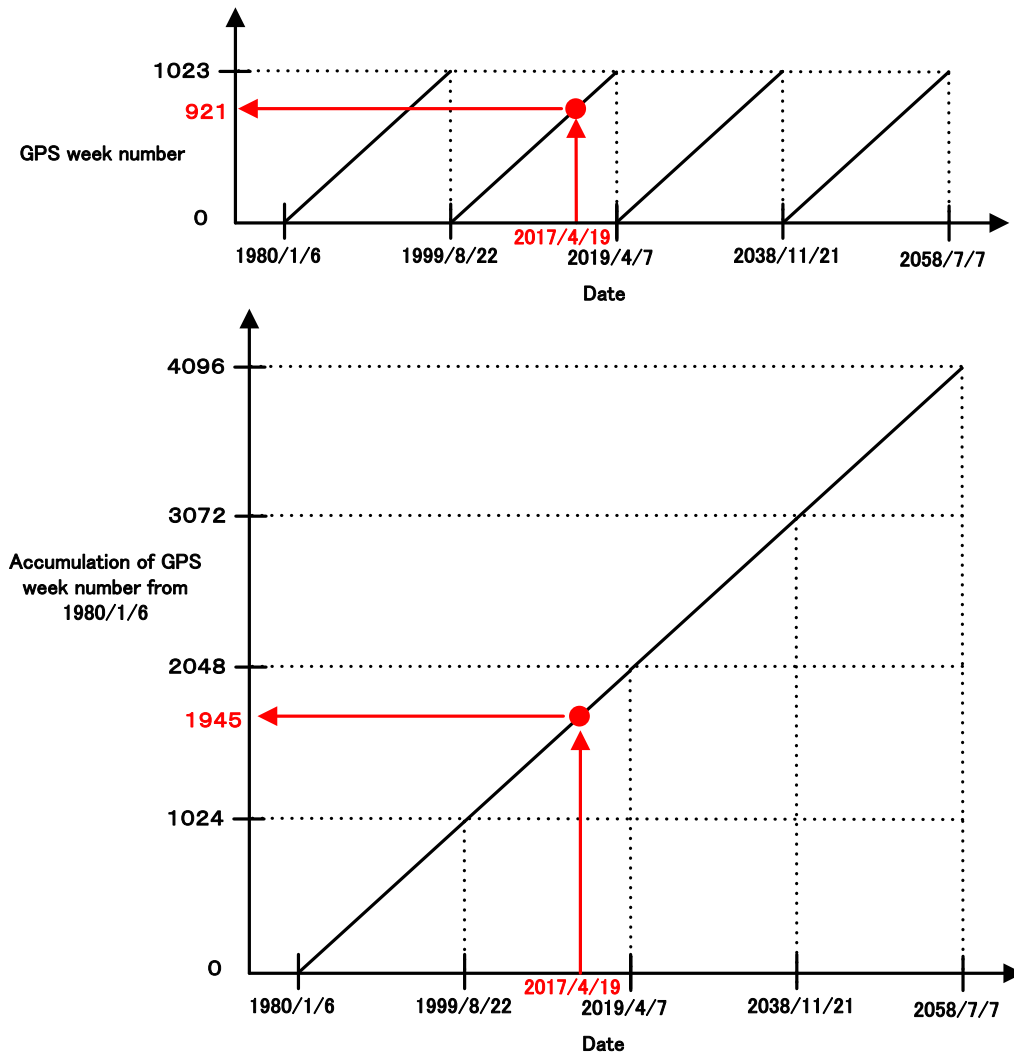
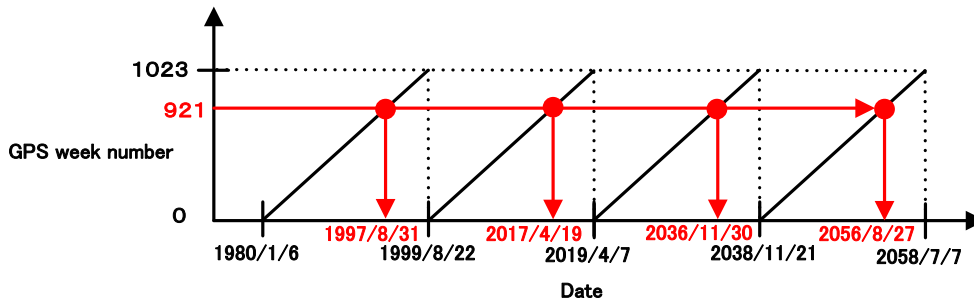


Figure 2.1 Example of broadcasted GPS week number and accumulation of GPS week number

In case that GPS/GNSS receiver operates from 1980/1/6 to 1999/8/21, GPS/GNSS receiver can convert current date and time from the GPS week number. On 1999/8/21 and after, GPS/GNSS receiver needs to calculate current date and time with consideration for adding unit of 1024 weeks. FURUNO GPS/GNSS receivers internally implement the logic to add week number which is unit of 1024 weeks so that GPS/GNSS receiver can convert current date and time properly when the GPS week number is received from the GPS satellites.

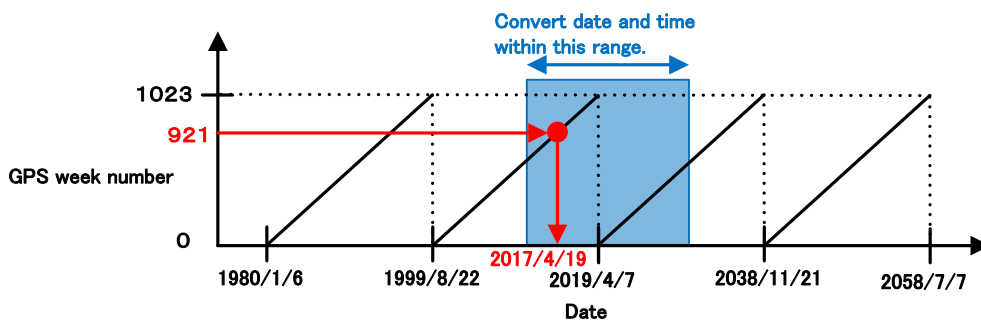
### 3 Logic to Add Week Number which is Unit of 1024 Weeks

As described chapter 2, GPS/GNSS receiver cannot convert correct date and time by simply acquisition of the week number since the GPS week number rollover occurs every 1024 weeks. For example, when GPS/GNSS receiver receives the GPS week number 921, GPS/GNSS receiver cannot correctly judge that it is 1997/8/31, 2017/4/19, 2036/11/30, or after.



**Figure 3.1 Example of pattern which is able to convert current time and date by reception of GPS week number from GPS satellite**

FURUNO GPS/GNSS receivers prospectively set to convert from the received GPS week number to the specified date and time as a solution for above issue, i.e. the blue marker range in the following figure is prospectively set. For example, recently launched FURUNO GPS/GNSS receivers prospectively set the range in blue marker in the following figure. If the blue marker range is prospectively set, GPS/GNSS receiver converts from GPS week number to current date and time in the blue marker range by adding a unit of 1024 weeks with GPS week number.



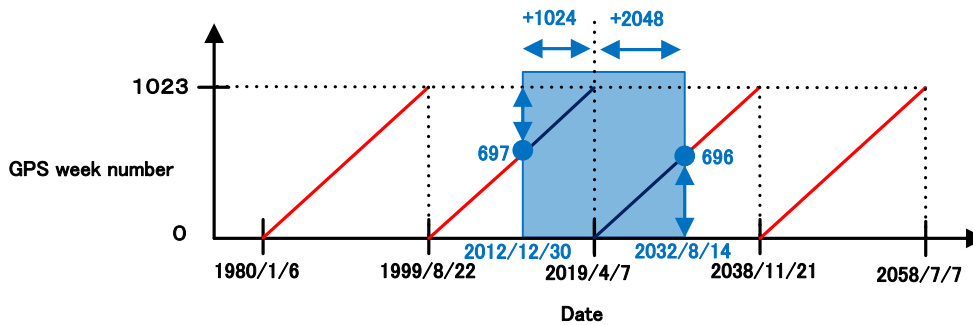
**Figure 3.2 Range of conversion from GPS week number**

In the above figure, the blue marker range has 1024 weeks. Please note that the starting time of the range does not match up with 0 week of GPS week number. The starting time of the blue marker range is set shortly before the launching date of FURUNO GPS/GNSS receivers. The end time of the range is 1024 weeks from the starting time, i.e. FURUNO GPS/GNSS receivers have this range so that GPS/GNSS receivers can convert correct current date and time for 1024 weeks (19.6 years approx.).

The details of the blue marker range (i.e. period of conversion to current date and time) are explained in the next chapter.

## 4 Period of Conversion to Current Date and Time

FURUNO GNSS timing receiver GT-8777 is used as an example of explanation for the details of period of conversion to current date and time in the blue marker range. The starting time in the blue marker range for GT-8777 is 2012/12/30 and the end time is 2032/8/14. This means that GT-8777 can absolutely output correct date and time from 00:00:00 on 2012/12/30 to 23:59:59 on 2032/8/14.



**Figure 4.1 GT-8777 setting range**

As above figure, the timing of GPS week number rollover (2019/4/7) is included in the blue marker range. FURUNO GPS/GNSS receivers can convert current date and time properly even if the timing of GPS week number rollover is included. The following calculation is executed automatically.

- In case that the obtained GPS week number is within the range of 697 (2012/12/30) to 1023(2019/4/6), GPS/GNSS receiver converts current date and time after adding moreover +1024 week.
- In case that the obtained GPS week number is within the range of 0 (2019/4/7) to 696 (2032/8/14), GPS/GNSS receiver converts current date and time after adding moreover +2048 week.

In other words, GPS/GNSS receiver converts from GPS week number to current date and time within the blue marker range of the above figure. GPS/GNSS receiver can continue to output correct date and time even if the timing of GPS week number rollover (2019/4/7) passed over.

Conversely, if the range is exceeded, i.e. GPS/GNSS receiver operates date and time in the range of the red slant lines, GPS/GNSS receiver has the possibility not to output correct date and time (There may be error with a unit of 1024 weeks.) when GPS/GNSS receiver operates after power OFF and power ON in the case of no backup power supply or no preset command.

FURUNO advises the end time of blue marker range as the internal rollover date and time, i.e. it is the upper limit of the date and time, which is able to output correct current date and time. The internal rollover date for above figure is 2032/8/15.

The internal rollover date and time for FURUNO GPS/GNSS receivers are specified in the next chapter.

## 5 FURUNO GPS/GNSS Receiver GPS Week Number Rollover Date

The following table shows the date and week number of occurrence of internal rollover, and output date after the internal rollover.

Some GPS/GNSS receivers can adjust the timing of occurrence of internal rollover by entering the command. The method of adjustment is described in the next chapter. The GPS/GNSS receivers which are not described in the next chapter have the possibility not to output correct date and time after the occurrence of internal rollover.

Model	Occurrence of internal rollover		Output date after internal rollover
	YYYY/MM/DD	Week#	YYYY/MM/DD
GN-72	2010/12/12	1614	1991/04/28
GN-74/ GT-74	2013/08/11	1753	1993/12/26
GN-77/GF-7712/GF-7715	2017/09/17	1967	1998/02/01
GN-77C1	2018/08/19	2015	1999/01/03
GT-77/GT-7731	2018/09/16	2019	1999/01/31
GN-78/GN-79	2019/03/17	2045	1999/08/01
GN-8093/GN-8096 GN-8097/GS-8094	2021/06/20	2163	2001/11/04
GN-80/GH-80/GH-8299	2022/01/02	2191	2002/05/19
GT-80/GO-80/GT-8031 GT-8036/GT-8037 GF-8043/GF-8048	2022/09/18	2228	2003/02/02
GH-81/GH-82	2024/03/24	2307	2004/08/08
GF-8044/GF-8045/GF-8046 GF-180	2025/02/02	2352	2005/06/19
GN-84/ GV-84H/ GH-84	2026/08/23	2433	2007/01/07
GT-84	2027/08/22	2485	2008/01/06
GF-8051/GF-8052	2028/04/23	2520	2008/09/07
GF-8055/GF-7712A/GF-7715A	2030/02/17	2615	2010/07/04
GN-85F/ GV-85/ GH-85 GT-85/ GT-8536/GF-8557	2030/08/25	2642	2011/01/09
GN-86F/GN-87F/GN-8615/GN-8715 GV-86/GV-87/GV-8615/GV-8715 GT-86/GT-87/GT-8736/GT-8777 GF-8701/GF-8702/ GF-8703 GF-8704/GF-8705 GF-8648/GF-8612/GF-8613	2032/08/15	2745	2012/12/30
GN-8620/GN-8720 GV-8620/GV-8720	2034/08/20	2850	2015/01/04

## **6 Method of Adjustment for Internal Rollover Date (Modification Method of Period to Convert Current Date and Time)**

The following GPS/GNSS receivers can be modified the period to convert current date and time by entering the command.

(1) GT-77/GT-7731/GF-7704/GF-7705/GF-7712A/GF-7715A

The receivers can update the date up to year 2040 by entering the date with ZDA command.

(2) GF-8043/GF-8044/GF-8045/GF-8046/GF-8048/GF-8051/GF-8052/GF-8055/GF-180

The receivers can update the date up to year 2040 by entering the date with ZDA command.

(3) GT-80/GT-8031/GO-80

The receivers can update the date up to year 2079 by entering the date with ZDA command.

(4) GT-85/GF-8557

The receivers can update the date up to year 2079 by entering the date with TIME command.

(5) GT-8036/GT-8037/GT-8536

The receivers can update the date up to year 2079 by entering the date with @@Gb command.

(6) GN-86F/GN-87F/GN-8615/GN-8715/GV-86/GV-87/GV-8615/GV-8715

The receivers can update the date up to year 2099 by entering the date with TIME command.

(7) GT-86/GT-87/GT-8736/GT-8777

The receivers can update the date up to year 2099 by entering the date with TIME command.

(8) GT-8777 (PFEC)

The receiver can update the date up to year 2099 by entering the date with ZDA command.

(9) GT-8736 (M12)

The receiver can update the date up to year 2099 by entering the date with @@Gb command.

(10) GF-8701/GF-8702/GF-8703/GF-8704/GF-8705

The receivers can update the date up to year 2099 by entering the date with TIME command.

(11) GF-8648

The receiver can update the date up to year 2099 by entering the date with TIME command.

(12) GF-8612/GF-8613

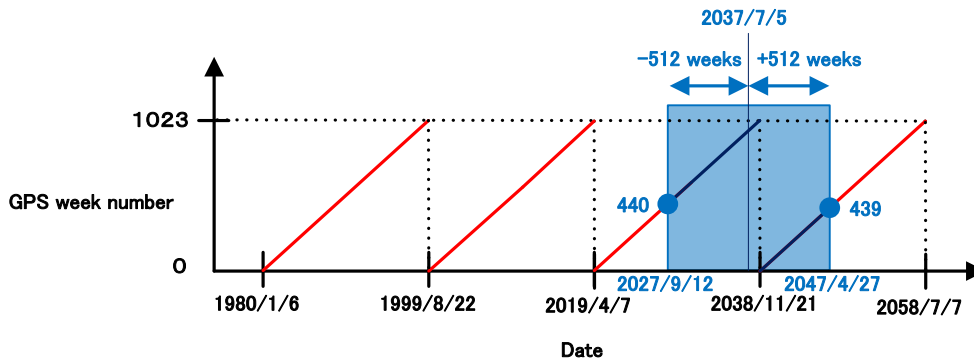
The receivers can update the date up to year 2099 by entering the date on the Network page.

(13) GN-8620/GN-8720/GV-8620/GV-8720

The receivers can update the date up to year 2099 by entering the date with TIME command.



The following figure shows an example of the entering of commands for time setting on 2037/7/5. In this case, GPS/GNSS receiver adjusts the zone which is utilized date and time conversion so that correct date and time can be output in the range +/-512 week in the center of 2037/7/5.



**Figure 6.1 Adjustment of period to convert current date and time**

FURUNO GPS/GNSS receiver output incorrect date and time due to the impact of GPS week number rollover only when GPS/GNSS receiver receives GPS satellites under the condition that GPS/GNSS receiver is powered OFF and ON without backup data of date and time. If GPS/GNSS receiver operates continuously, or GPS/GNSS receiver has backup data of date and time, FURUNO GPS/GNSS receivers can continue to output correct date and time after the occurrence of internal rollover.

End.