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TECHNICAL REPORT : Datum / Symmetricom TS2100 tests with Heol N024 GPS receiver

Abstract

In January 2015, the TymServe 2100 server started failing in the time displayed, and there was 1 second offset.
At May 3rd, the TS2100 showed another bug, by displaying an incorrect date : September 17, 1995 (exactly 1024 weeks difference).
Symmetricom (Microsemi) published a note about this bug, explaining that no fix was available.
Heol Design was contacted by some companies who owned the TS2100, to see if the replacement of the Trimble ACE III GPS receiver mounted on the TS2100 motherboard by the N024 (ACE III clone) could solve this date&time problem. Heol engineers then worked on a solution, and developed a specific firmware to replace the existing Trimble ACE III with the new N024 inside the TS2100, and found a fix for the date and time bugs.
As well as correcting these bugs, the N024 enables higher performance :
-cold start 39s
-hot start 2s
-sensitivity -160dBm, enabling start-up in urban canyons and inside buildings
-pps accuracy 100ns
-almanac/ephemeris stored in Flash memory
-lower power consumption
-T-RAIM algorithm for high integrity of timing signals
-Possibility to extend to Glonass, Beidou and Galileo GNSS constellations

Many tests have been processed on this enhanced TS2100, for the current time, and also simulations for the future (July, 1st 2015 for leap second insertion, week number rollover, etc…). This technical note describes some of the tests which have been processed with the TS2100+N024 system.

Systems & equipment used for testing

1 Datum TS2100
1 Symmetricom TS2100 with Rubidium Oscillator
1 Heol Design T107 Rubidium NTP server / GPS clock
1 General Electric SR750 management relay (IRIG input)
1 PC with various NTP and monitoring softwares

Test of TS2100 with ACE III

The false date & time information results from 2 bugs : 1 in the TS2100 (bad management of GPS epochs), and 1 in the Trimble ACE III GPS receiver (TSIP frame problem occurring in 2015, as announced by Trimble on the ACE III manual) :

3.5.1 Effect of GPS Week Number Roll-over (WNRO)

The ACE III GPS module has been designed to handle WNRO, and there are no problems with either dates or first fix after WNRO through the year 2015.

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As you can see on the screen copy, current displayed date is 1995.

Replacement of ACE III by N024-TS-V2

Drop-in replacement of the ACE III GPS board is very easy.
After unplugging AC cord, the cover screws must be removed.
Then the SMB antenna connector of the ACE III board must be pulled-off, and the 4 screws removed, and the board unplugged.
The N024 board is plugged at the same emplacement. Care must be taken to plug correctly the 8 pin 2mm connector.

Mounting on TS2100-RUB
Mounting on standard TS2100

Current time measurements

After powering the TS2100 unit, the Tracking LED goes ON after about 1 minute.
UTC Time displayed is correct (LCD screen and RS232 terminal).

Through NTP, we can compare different time sources:
- Heol T107 Rubidium server (IP 192.168.1.20)
- Tymserve 2100 (192.168.1.14)
- Public server pool.ntp.org (to check both UTC times are correct)

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The Heol Time Service software connects to these 3 NTP sources, and displays their offset. As you can see, offset between Heol T107 and Tymserve is very low (it displays 0ms, but Windows Timebase accuracy is around the millisecond). Public server pool.ntp.org has more offset, as it is not on the LAN.
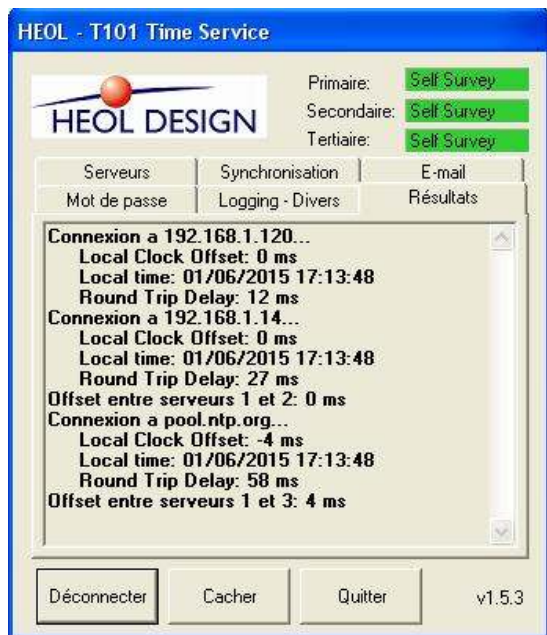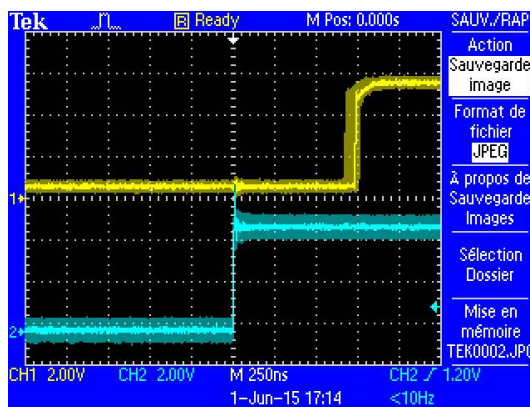

PPS output

The Heol T107 Rubidium has been as a very accurate GPS time reference, to compare both pps outputs :
- In blue the T107 pps output
- In yellow the Tymserve pps output
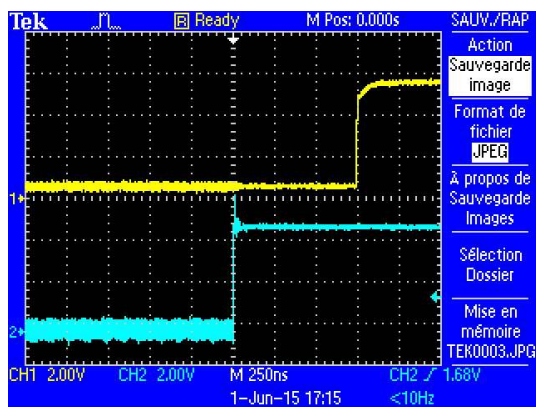
Single shot trigger   Multi shots trigger (1 hour running)

IRIG output

The SR750 form General Electric has been used to test the output of the TS2100 IRIG signal (amplitude modulated). It has been compared to UTC time as correct.

Simulation of future leap seconds and rollovers

The TS2100 with N024 has passed the simulation of the future leap second (which will occur at June 30, 2015).

Same simulation for 2020 (next GPS epoch passed)

And same for the year 2035.

This TrimbleMon screen copy shows Week Number and Time Of Week simulated at the year 2035.