



# Synchronization Test with the Trimble DSM232

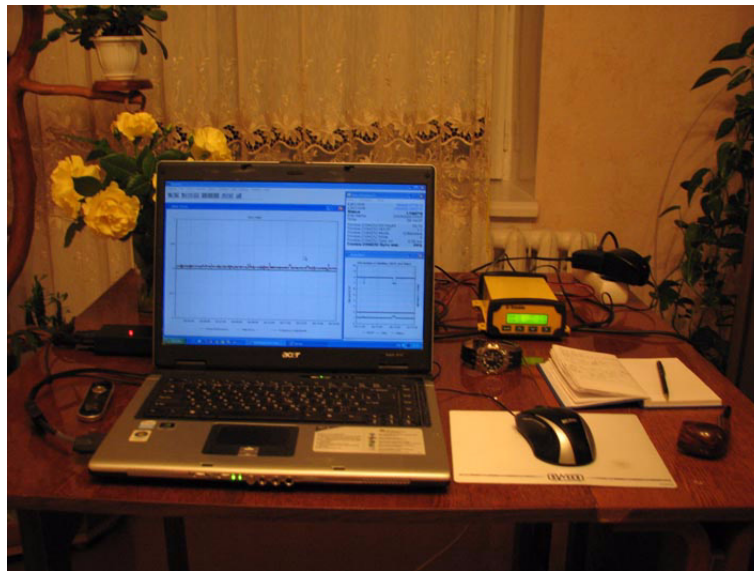
By Ivan Izaak

Recently I have made few tests to determine a behavior of the Veritime algorithm and GPS.dll and how they effect on synchronization between GPS and computer clocks with 1PPS box and with ZDA string from a GPS receiver.

## Equipment used:

1. GPS Receiver Trimble DSM232, working in differential mode.
2. Laptop ACER Aspire 5613ZWLMi.
  - Processor Intel® Pentium® dual core T2080 (1.73GHz, 533 MHz FSB, 1Mb L2 cache).
  - Graphics card NVIDIA® Geforce™ Go7300 TurboCache™.
  - Memory 1Gb DDR2
  - PCMCIA Card Quatech QSP-100 Four Port RS232 Serial Adapter.
3. 1PPS Box (black one).
4. OS Windows® XP Professional with SP2.

*FIGURE 1. Test stand*



The tests were done in Sverdlovo village near Odessa, Ukraine. The GPS antenna was installed a top the roof (5m above the ground) providing good visibility of the satellites.

The first test was made on June 4, 2009 with GPS.dll version 9.0.8.2.

The Trimble DSM232 was set to output the following messages: GSA, RMC, GGA, GGK, GST, GLL, GNS, GRS, GSV, VTG and ZDA. If the baud rate is set to 9600 and the GPS.dll is set to record Raw messages and Device specific messages, the quantity of information leads to a complete mess of the data coming to GPS.dll. In this case one should increase a speed of the data flow to at least 19200.

At a minimum, you should select VTG, GGA and ZDA data sentences; in this case, the speed of 9600 is quite enough.

If the baud rate is slow (9600) and too much data is coming into the computer, it leads to a quick loss of synchronization (within a minute), the Sync Error increases to 1000ms, the Sync Source changes from PPS to COM and then to Computer. So in this situation, synchronization fails in a minute despite your use of the 1PPS Box or ZDA sentences.

I've run SURVEY and logged the data over a few hours with the baud rate at 9600 and only GGA, VTG and ZDA sentences coming from GPS and also with the baud rate at 19200 with all the sentences coming from GPS. The results are as follows.

## WHEN SYNCHRONIZING TO THE 1PPS BOX

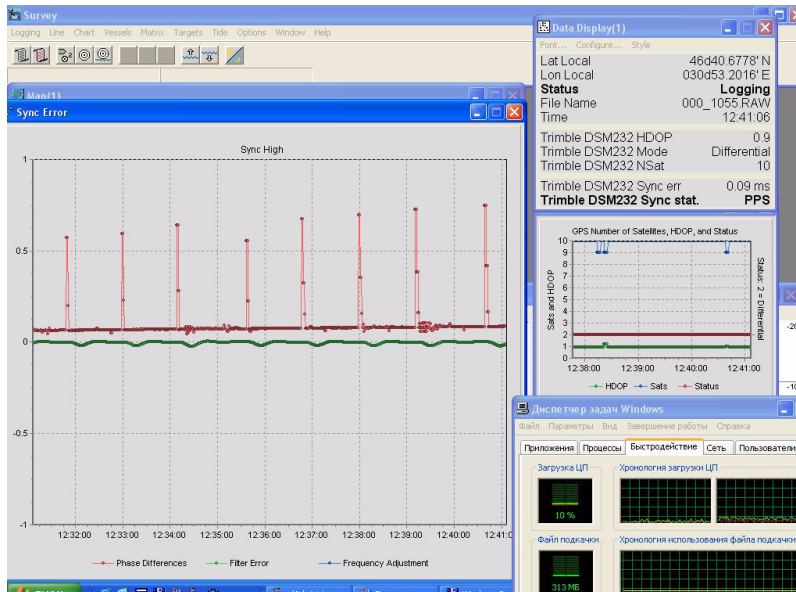
- During the first 2 hours, the synchronization error (red line on the graph) is about 0.05 ms, but the frequency adjustment increases continuously up to 100 ms (blue line on the graph).

FIGURE 2. Synch graph after 10 minutes of the SURVEY run.



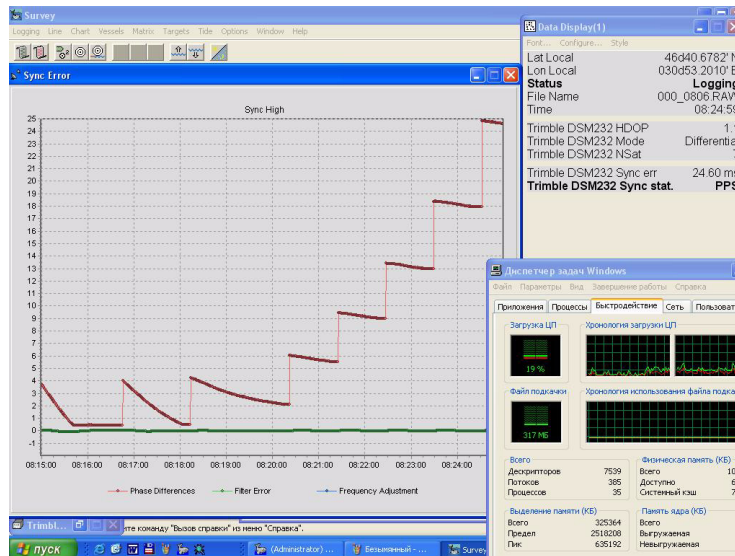
- The Sync Error graph shows spikes up to 0.8ms after 2 hours and the amplitude of the spikes is increasing with time.

**FIGURE 3. Sync Error graph after 2 hours logging**



Sync Error reaches 20ms value in 4-6 hours while error curve continues to rise:

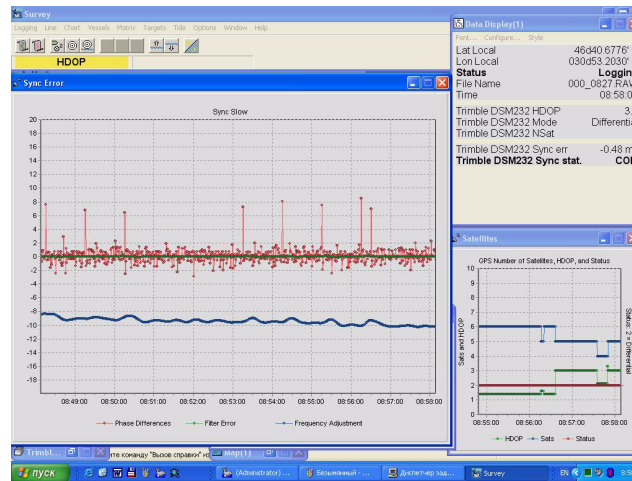
**FIGURE 4. Synch Error after 6 hours of logging**



## ***WHEN SYNCHRONIZING TO ZDA SENTENCE***

With ZDA syncing there is no such extreme rise of the sync error with time, but the overall error deviates up to 2-4ms.

**FIGURE 5.** *Synch to ZDA. 30 minutes logging.*



Our programmers have put a lot of effort into the synchronization algorithm during June and July. Our test and results were as follows:

**The test:**

- Used the latest Veritime.dll and GPS.dll,
- The 1PPS Box is used,
- All the possible sentences been output from Trimble at the speed of 19200 kB per second
- All sentences in the driver setup of the GPS.dll are checked.

**The Results:**

- Synch Error remains stable around 0 ms with no more amplitude jumps and the Frequency Adjustment graph does not rise continuously; it is stable at 25ms.

**FIGURE 6.** *Synch to 1PPS. 10 minutes logging.*

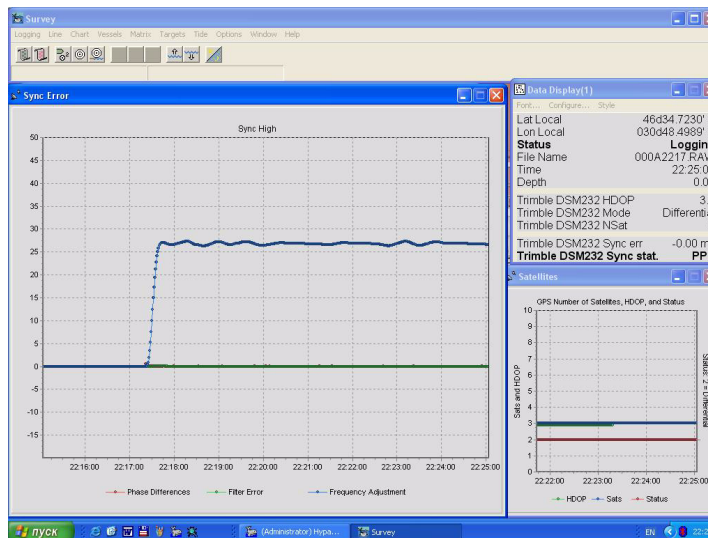
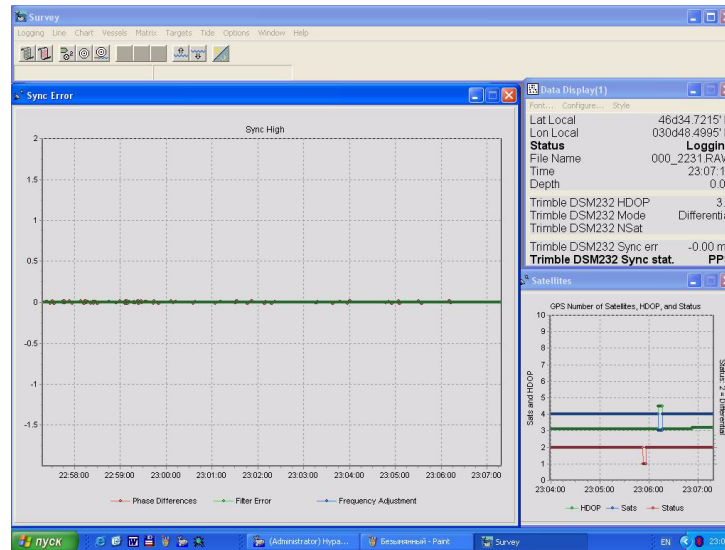
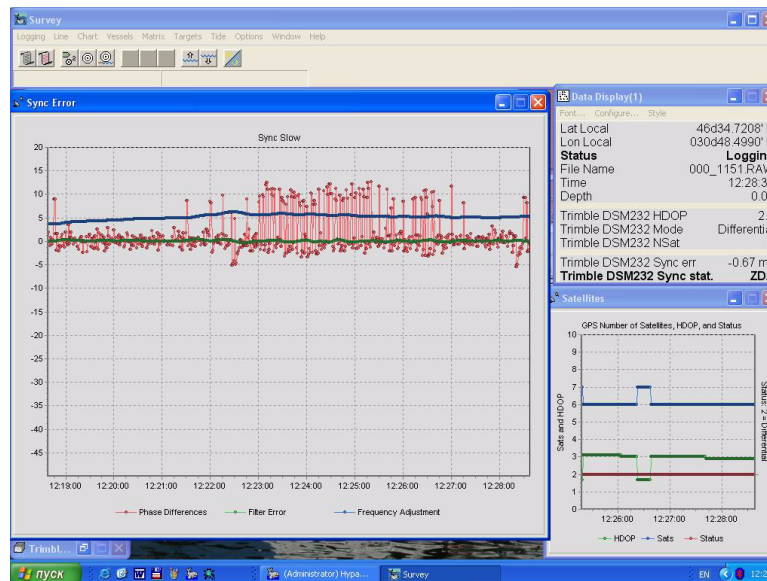


FIGURE 7. Sync to 1PPS after 6.5 hours logging.



- Previously, if the Sync Source changed from PPS to ZDA, the program gave a Sync Source as 'COM' and it was confusing as to whether this meant ZDA or Computer time. Now if the Sync Status is 'ZDA' it means that the synch source is the ZDA message from the GPS (so no more COM!).
- When syncing to the ZDA message, the sync error deviation is much higher but it is still stable:.

FIGURE 8. Sync to ZDA.



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## ***IN CONCLUSION***

- **The newest GPS.dll and Veritime.dll are included in the HYPACK® 2009a release and also in HYPACK® 2009 SP1.** They will not work in versions earlier than Hypack® 2009.
- **For good synchronization**, note the following:
  - if your GPS unit transmits too much information, increase the speed to 19200 or more.
  - If you transmit only GGA, VTG and ZDA, then 9600 is all right.
- **Always keep an eye on the Status information.** If you are synching to the 1PPS, the GPS Sync Status should always be PPS.