# Globaltop GMS-G6 GPS/Glonass Module Tests With Kobo/XCSoar
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These notes relate to the use of a Kobo ebook reader modified to run XCSoar. They are my best shot at the time of writing. I cannot guarantee they are correct or represent ideal solutions but will correct and update them as and when I can. Please inform me of any errors or better solutions you may find. The index for other Kobo/XCSoar notes can be found at:

http://www.50k-or-bust.com/Kobo XCSoar/Kobo XCSoar.htm

## The Globaltop GMS-G6" GPS/Glonass Module - (* See Footnote)

For the purposes of adapting a Kobo Mini or Touch* to run XCSoar this module is more or less interchangeable with Globaltop PA6C or PA6H GPS only modules. The main advantage of the GMS-G6 is that it can receive the 24 Glonass satellites as well as the 32 GPS satellites which helps when the "visibility" of GPS satellites is poor. Some of the reasoning for this is outlined in an article found at:

http://www.50k-or-bust.com/Kobo XCSoar/GPS And Glonass Article 01.pdf

The GMS-G6 can also receive and utilise SBAS data where it is available to improve the accuracy of the fix. When SBAS data is being used by the GMS-G6 the "Fix Quality" changes from SPS to DGPS which is communicated to XCSoar in the NMEA $GPGGA sentence.

## GPS Only Modules

Some of these tests are also relevant to GPS only modules such as the Globaltop PA6C and PA6H.

## GMS-G6 With Bluefly TTL Vario Module

The GMS-G6 worked properly with a Bluefly TTL V8 but when used with a Bluefly TTL V10 the status page in XCSoar sometimes reported that it had gone into 2D mode. It emerged that the Bluefly module was clipping the NMEA data sentences at 79 characters. When the GMS-G6 went into DGPS mode the $GPGGA sentence was using the full 80 visible characters of the NMEA sentence and the checksum was being clipped. This was reported to Bluefly who supplied a firmware upgrade to fix the problem.

## Circuits Used In Tests

The modules were either connected to a Kobo in the usual way or to a PC

using a FTDI USB to TTL adapter cable. In both arrangements a 0.1 uF ceramic capacitor was connected across the supply and a 330R resistor was connected in series with the data TX pin. The RX connection was not used. On the Kobo the backup supply was also connected using an 8K2 resistor. For some tests the FTDI cable was connected to supply a GMS-G6 and a PA6C module simultaneously with a switch to select the data from the TX pin of either to the PC. This enabled easy comparison of the two types of module. For one test the module was connected to a Kobo Mini by a long lead so it could be "remote" from the Kobo. The module was then placed in the top pocket of a rucksack and the Kobo in a low back pocket keeping them separated by a distance of approximately 250 mm.

Indoor Tests

For these tests the module or Kobo was placed on a block approximately 100mm above the interior ledge of a south facing window which has hills obscuring to an elevation of about 20 degrees and a scattering of tall trees to an elevation of about 45 degrees. These obstructions may be the reason for the poor DGPS performance described below as the geostationary EGNOS satellites transmitting SBAS have a low elevation at this location.

Outdoor Tests

The unit under test was taken on walks of similar routes of about an hour up a hill which at one point has an almost clear horizon. The top of the module was in a rucksack oriented at an angle of about 45 degrees away from the person carrying the rucksack. The weather was different from day to day on the walks but no walks were made in conditions of precipitation.

Software Used In Tests

NMEA.exe was used to view the output of the module connected to the FTDI lead directly or to "play" recorded NMEA files from the PC or the Kobo.

Limitations Of The Tests

These tests are somewhat subjective but they are the best I can do without RF laboratory facilities. By walking up and down my local hill I cannot reproduce the high rates of climb or descent which appear to be the first victims of poor reception.

General Observations

The strength and quality of received GPS and Glonass signals varies continuously. This and the reporting of signal to noise ratios rather than

signal strengths in NMEA sentences makes assessment of performance quite difficult and somewhat subjective. In some conditions reception of GPS satellites appeared better than Glonass and vice verse. What is written below are my best guesses from observations over a period of about two months.

1) S/N ratios of received signals were usually between about 5 and 10 dB worse with modules mounted on the front of a Kobo than when distanced from it by about 150mm or more. There did not seem to be any difference between the Kobo Mini or the Touch*.

2) Degradation of the received signals appeared to be related to the amount of activity in the Kobo.

3) A module on the window ledge connected to the PC could receive SBAS signals sufficient to be able to work in DGPS mode for about 1/3 of the time.

4) A module mounted on a Kobo on the window ledge would not go into DGPS mode at all.

5) A module mounted on a Kobo outdoors on a hilltop with an almost clear horizon would go into DGPS mode most of the time, but would be in DGPS mode for only a small proportion of a walk up and down the hill.

6) A module in the rucksack mounted "remote" from the Kobo would go into DGPS mode some time after leaving the house and remain in DGPS mode for the rest of the walk. Received S/N ratios were significantly better than with Kobo mounted modules.

6) In all cases reception of GPS satellites on the GMS-G6 appeared better than on the PA6C.

<u>Conclusions</u>

When used with XCSoar for paragliding and hang-gliding the Kobo appears to significantly interfere with GPS and Glonass reception when the receiving module is mounted on the Kobo. However this has a noticeable effect on the operation of XCSoar only in conditions of poor satellite "visibility". In such conditions the availability of Glonass satellites in addition to GPS satellites in the GMS-G6 almost certainly improves reliability of fix, especially altitude, over the PA6C or the PA6H. Reception sensitivity of both GPS and Glonass satellites can be improved considerably by mounting the receiving module remotely (more than 150mm) from the Kobo.

<u>Other Observations</u>

1) A close fitting “cap” of black Sugru mouldable rubber was made which could be fitted or removed from any of the modules used. This cap was thicker than the covering used when mounting modules on Kobos but appeared to have no effect on reception of either GPS or Glonass signals.

2) Some tests were made with the receiving modules on small ground planes which sometimes appeared to improve sensitivity a little. However the problem of apparent noise from the Kobo negated their benefits when mounted on or close to a Kobo.

3) The GMS-G6 usually locked on to GPS satellites faster than Glonass satellites although on two occasions it acquired a fix entirely on Glonass. In all cases it achieved a fix significantly faster than the PA6C.

4) As suggested by their specifications these modules appear to need a relatively strong signal to lock onto a satellite but once locked they can track a satellite with a much weaker signal. This can make assessment of reception quality by the “number of satellites used” or similar very confusing.

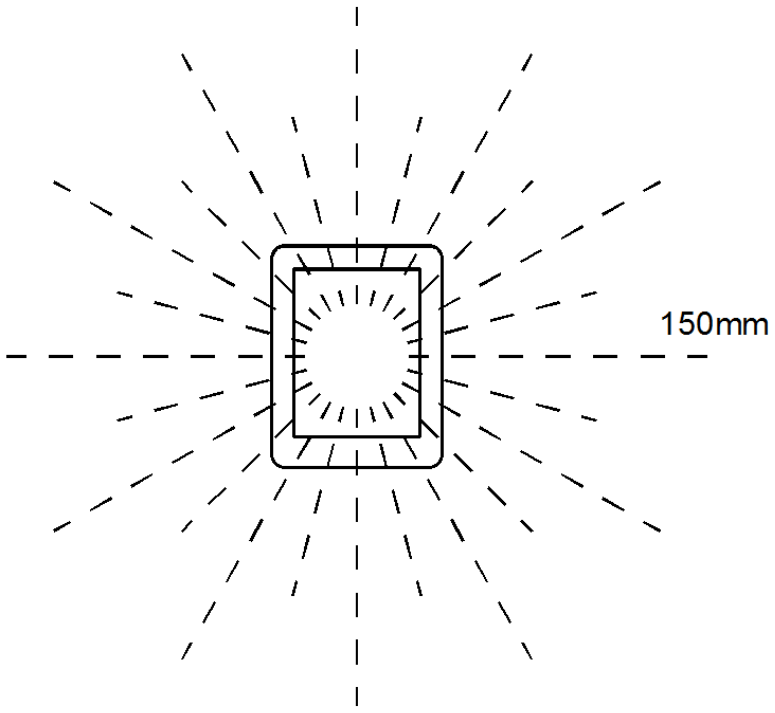
(3) and (4) are good reasons to switch on a GPS or GPS/Glonass system for some time before launching.

Other Implications

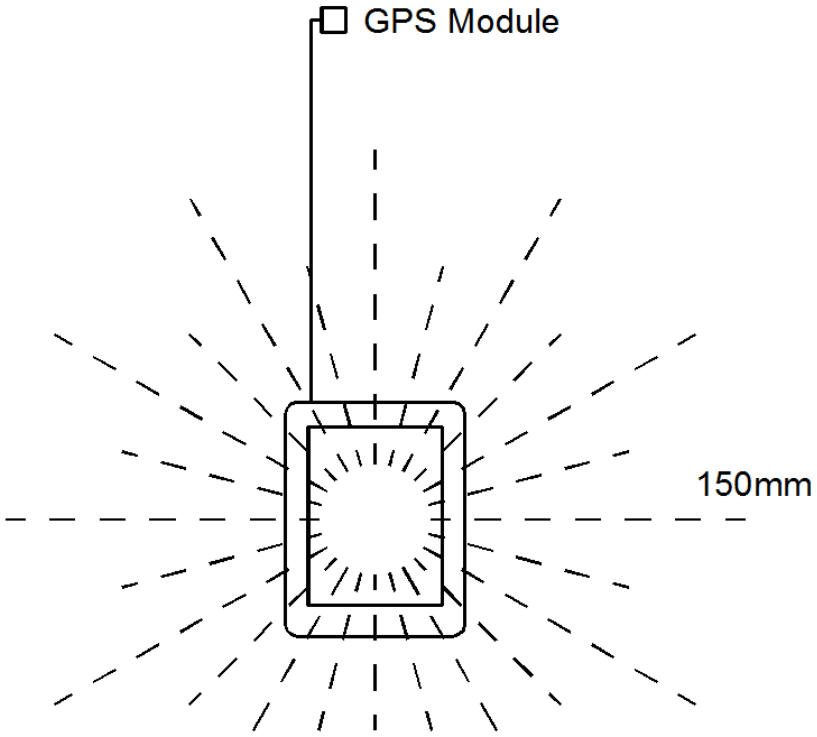
Kobo based instruments are often used alongside other instruments on flight decks and it seems likely that EM noise from Kobos could affect other GPS based instruments. It may be possible to fit screening to Kobos to reduce EM emissions. More investigation would be beneficial.

Improving Reception

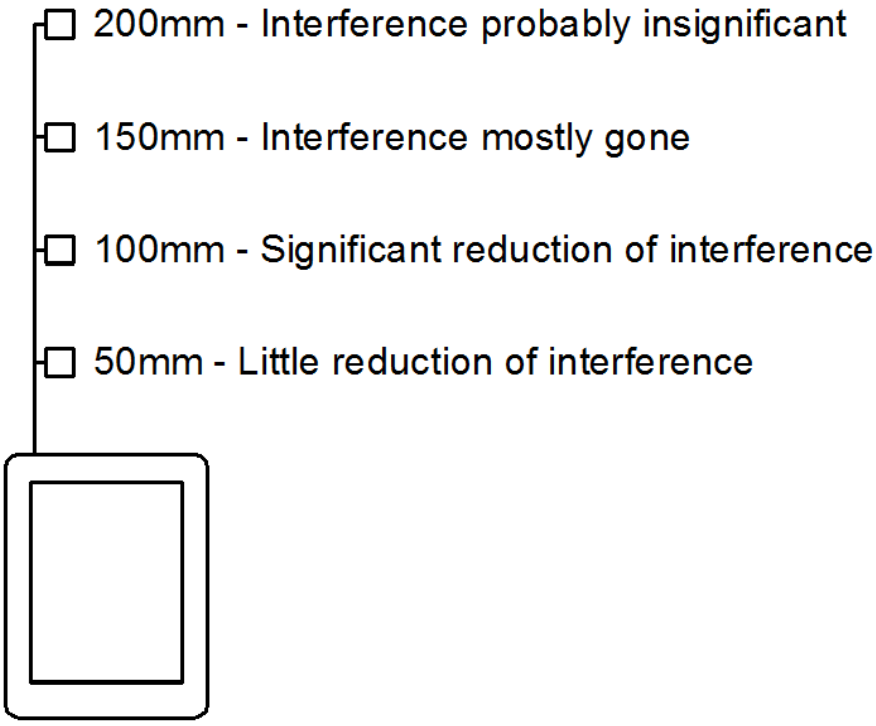
In most Kobo/XCSoar units the GPS or GPS/Glonass module is mounted on the front of the Kobo. Interference significantly affecting the module appears to extend from the Kobo to approximately 150 mm from the edge.




Reception can be improved by locating the module outside this area.




When locating the module so it is probably a good idea to fit a 0.1uF capacitor across the supply pins. Based on the above tests, the diagram below is a very rough guide to how large a benefit might be obtained from such efforts.




Robustly implementing such an arrangement on a paraglider flight deck could be difficult and it is up to the individual to decide whether such measures might be beneficial.



* Footnote - Kobo Touch and GPS/Glonass Module GMS-G9

In later tests the performance of a GMS-G6 module on a Kobo Touch was found to be worse than on the Kobo Mini. However a pilot referred me to an application note on patch antennas he thought would help.

http://www.taoglas.com/images/product_images/original_images/TAOGLAS%20-%20GPS%20Patch%20Antenna%20Integration%20Application%20Note(APN-12-8-002.B).pdf

This document mentions bandwidth limitations of small patch antennas and de-tuning effects related to the size of groundplane on which they are mounted. These effects diminish as the size of patch increases. The Globaltop GMS-G9 has a larger patch than the GMS-G6 and when fitted to the Kobo Touch produced a significant improvement in performance. The GMS-G9 module is larger than the GMS-G6 but there is plenty of room for it on the front of the Kobo Touch.

Footnote 2 - Receiver Firmware Considerations

Since writing this a number of anecdotal failures to locate occurring on Kobo/XCSoar units has led me to suspect that GlobalTop GPS and GPS/GLONASS modules may sometimes give large altitude and horizontal location errors whilst reporting a good GPS lock and that this could be some kind of firmware problem. Realising this I have searched for alternatives and have located the V.Kel VK2828U7G5LF module one of which I have on trial on a Kobo Touch. Some details are available at the following link:

http://www.50k-or-bust.com/Kobo XCSoar/Kobo XCSoar VKel Module Notes 01.pdf