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PRODUCT UPDATE

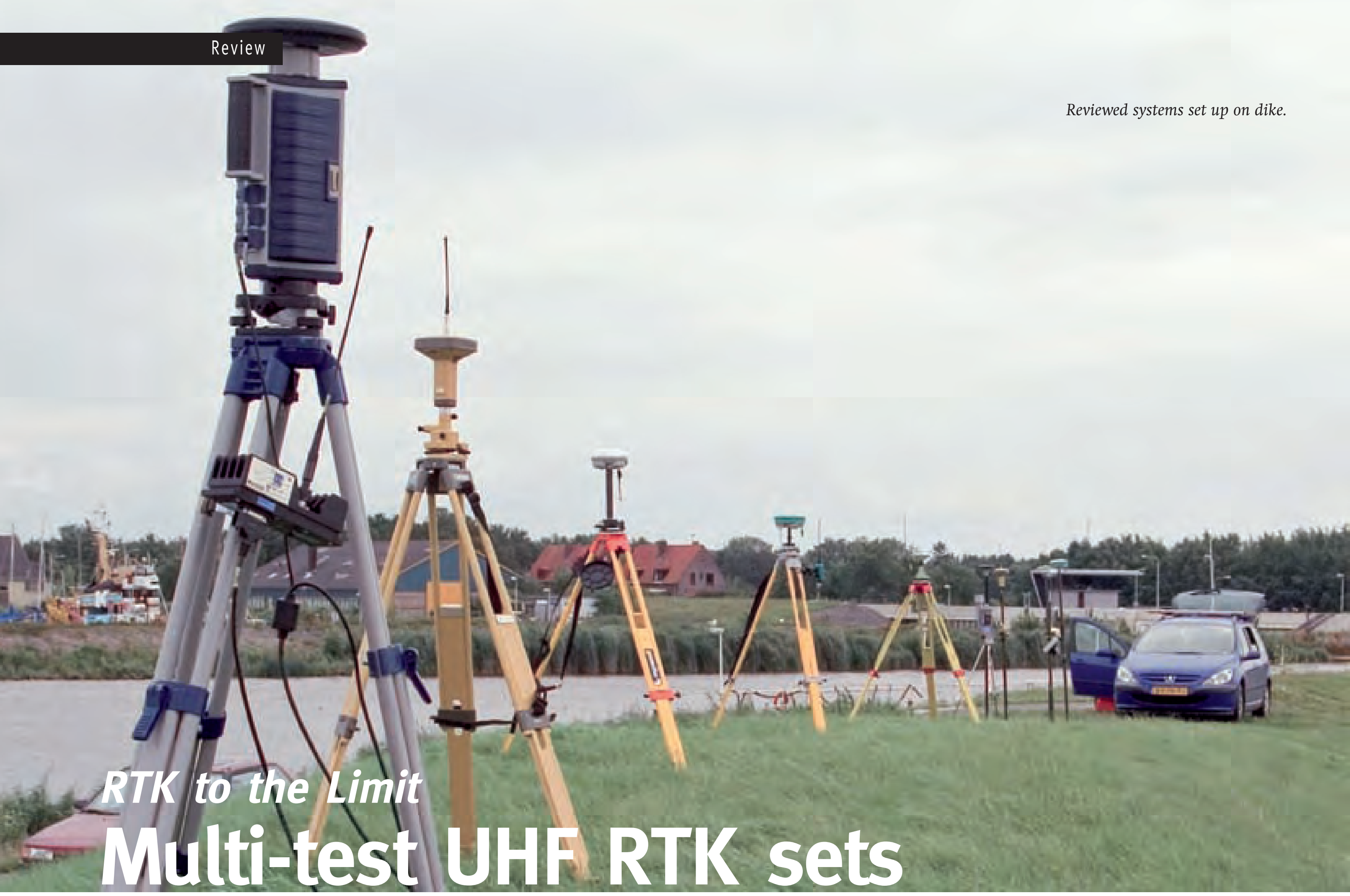
Release Date : 9 Nov 2007

GSR2700 ISX Review by GEOInformatics Magazine

SOKKIA's GSR2700 ISX receiver was well received, amongst its common competitors in an RTK test performed by GEOInformatics Magazine. The results were revealed in GEOInformatics Magazine's September 2007 issue (volume 10). Each receiver was evaluated for user friendliness and was objectively tested in several categories including RTK range, RTK initialization, RTK precision, system weight and volume, and power endurance.

All claims within the unbiased results listed in the GEOInformatics article paralleled our internal SOKKIA GSR2700 ISX Competitive Analysis, proving that the GSR2700 ISX is a highly competitive receiver if not industry's leading RTK system in terms of pure performance.

The GEOInformatics article has been attached for your reference and enjoyment. You may also log onto the magazine's website at www.geoinformatics.com to view the article details, which includes a movie showing the test setup and other details.



Reviewed systems set up on dike.

RTK to the Limit

Multi-test UHF RTK sets

RTK systems are commonly used in land surveying, hydrographic surveying and machine control. While the first is switching more and more to GSM telemetry such as NTRIP, the last two almost completely depend on UHF radio for telemetry of the correction signal. For this review we selected five UHF RTK dGPS systems commonly used in the land survey and/or machine control industries.

By Huibert-Jan Lekkerkerk

The reviewed systems are:

- Leica Geosystems GX1230GG Smartrover (Leica)
- Magellan Professional Z-Max (Magellan)
- Sokkia GSR2700 ISX (Sokkia)
- Topcon GR-3 (Topcon)
- Trimble R6 GNSS (Trimble)

All systems were tested in the configuration delivered by the Dutch or European reseller or representative, including the recommended controller and software packages. All were requested to include a UHF radio capable of transmitting and receiving correction signals on a permit-free frequency and power setting for the Netherlands.

Test Method

In contrast with other reviews I have performed, I tried to test some of the more objective specifications of the equipment. The problem with performing tests, though, is that as an editor I cannot afford a highly sophisticated laboratory. Instead I performed the tests in the field and at home using either the receivers themselves or simple tools that everyone has lying around the home or workshop.

The tests performed included a range test, re-initialization tests, weight and volume tests as well as a limited precision test and endurance test. In order to be able to compare the results, all tests had to be taken under the same circumstances (as far as possible in the field).

Besides these specialized tests I performed a more regular review as well, concentrating on user friendliness. The latter was evaluated during the field tests and no specific survey was performed. The total test time for each system depended on the maximum endurance of the rover and varied from 6.5 hours (Leica) to 14.5 hours (Magellan).

This review is divided into two parts: the table and main text describe the results of the more objective tests and comparisons, while the cadres detail the results of the practical tests, including user friendliness.

Cases, tripods and poles as delivered.

System Description

Leica GX1230 GG

The base station tested has a different set-up from the rover and uses a separate geodetic antenna, receiver and correction transmitter. As a result the base is rather bulky although not exceptionally heavy. The connection between base receiver and antennas is made using identical cables which can be prone to switching. The differential antenna arm on both rover and base can be clipped to the receiver so that it either points up or down, depending on the user requirements.

The rover receiver is very light at 1.2 kilograms although this is compensated by the weight of the controller and separate correction receiver. The rover battery is relatively small and does not last through a full survey day. Due to its different layout the base station has just enough endurance for a full survey day. For the base a separate battery pack was supplied which extends the endurance by roughly 16 hours, although this pack was not used during the tests.

The Bluetooth connection between rover and controller functioned without noticeable problems. Since both base and rover have their own controller, the receiver and controller can be exclusively mated and no switching has to take place.

Magellan Z-Max

The Z-max is the oldest system in this test; the one we tested was produced in 2003. The system is quite bulky and heavy when compared to the other systems and although the weight distribution is good, working with it for a full day becomes tiring. The base and rover receiver are identical although the UHF antenna set-up is different. In our test the base had a separate UHF radio module with its own power supply. The Magellan is also the only base in the test for which settings can be made without the use of the controller; all basic settings are accessible using the keypad and LED display on the receiver.

The UHF antenna used on the rover is mounted between the receiver and the geodetic antenna using a bayonet/screw type mounting. The receiver has two detachable units. One of the two is the long-life battery which gives an endurance of over 14 hours. The other unit of the tested system was an optional built-in GSM/GPRS unit. With the receiver/controller combination we tested, the Bluetooth connection constantly lost its connection, requiring a switch to a cable-controlled receiver.

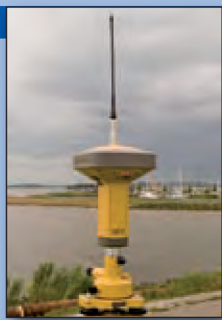
Sokkia GSR2700 ISX

This was the only receiver in the test that has non-swappable batteries although the endurance of the batteries in the receiver is long enough for a single survey day. Due to the large capacity batteries the receiver is relatively heavy at 1.8 kilograms, making it slightly harder to steady.

Due to the fact that at the time of the review Sokkia did not have two identical systems available, the base tested had a separate radio transmitter that was connected to the receiver using a serial cable. The rover was equipped with an internal UHF radio that uses a very small receiving antenna on the underside of the receiver. Although this set-up makes the receiver very compact without any shielding of the GPS horizon, it is a less optimal configuration for receiving UHF correction signals.

The receiver was the only one to have two Bluetooth connections, enabling the user to connect to both an external GSM/GPRS unit and the controller. The base was also equipped with an optional built-in GSM/GPRS unit.

Topcon GR-3



The GR-3 is the top model of the Topcon range, which shows in a number of clever details. The batteries, for example, can be hot swapped while the receiver is running. The battery charger, together with two batteries, can be used as an additional power pack for the receiver. Finally, standard AA alkaline penlight batteries can be used in a battery casing that holds four penlights.

The receiver and base are identical and can be swapped without a problem. The receiver feels very robust and heavy, which it is at 1.9 kilograms. Due to the weight, steadying it can become tiring after a full survey day. On the other hand, the receiver is built so sturdily that Topcon guaranties it can withstand a fall of two meters.

The GR-3 was the only receiver with reception for all current GNSS systems including Galileo. Although theoretically an advantage, there is currently only one Galileo (test) satellite, and few satellites transmitting signals other than the regular L1 and L2. When this changes in the years to come, the GR-3 will be ready and will not require a hardware update.

Trimble R6 GNSS

The R6 GNSS receiver we tested from Trimble is not very different from their top-of-the-range model, the R8 GNSS. The main difference lies with the reception of the L2C and L5 GPS frequencies. Since there are few satellites broadcasting these signals at the moment, the disadvantage in everyday use is small.

Apart from the frequencies, the model is similar to the R8 and is very compact. The base and rover are identical, making it easy to swap them. The UHF antenna is located on the underside of the receiver; it therefore does not shield the GPS horizon. The downside of this location is that the UHF reception is degraded, which is especially noticeable at longer distances.

The receiver is relatively light at 1.3 kilograms. The downside is that the battery used is very small and has the shortest endurance of the systems in this test. The base will therefore usually be equipped with an optional power pack (not tested).

The supplied controller, the TSC2, is relatively heavy but feels very robust. The touch screen is very bright and easily readable. It has three card slots and can, as with the Topcon controller, directly connect to a USB memory stick.

RTK GPS systems are high-volume products.

Weight Tests

In the world of land surveys, where GPS is considered size does matter, not so much in machine control or for the base station but mostly for the rover. Land surveyors have to carry the equipment around for hours on end and hold it as steady at the end of the day as they did at the beginning.

Of course it is not just the total rover weight that is important, but its distribution around the pole as well. The less weight on top of the pole the better, since this makes steadying the pole easier. A light controller also helps, while the weight of the pole has only a limited effect on overall weight distribution. As well, the receiver/controller combination has to be well balanced.

Finally, the smaller and lighter the overall set, the easier it is to install in remote locations.

I weighed the various system components using a kitchen scale accurate to within 10 grams and, for those components such as the tripod and the filled cases that were too heavy for the kitchen scale, a body weight scale with a resolution of 500 grams.

The weights given are the weights with a single set of receiver batteries as supplied by the manufacturer. Since some manufacturers use smaller batteries than others, this will affect the weight of the receiver, but also the maximum endurance.

Rover Weight

The average pole weight was 4.2 kilograms. The Leica receiver was, at 1.2 kilograms, the lightest in this test (although the Magellan with the separate antenna/receiver set-up had the least weight on top of the pole). However, due to its rather large controller, radio and bracket, the total pole weight of the Leica exceeded that of the overall lightest rover in our test (Trimble, 3.6 kilograms) by 300 grams.

The heaviest receiver in this test was the Magellan with a total pole weight of 5.7 kilograms. On the plus side, the Magellan can also be used as a backpack receiver, reducing the pole weight by an estimated 1.5 kilograms. Moreover, most weight in the Magellan is halfway down the pole, making it relatively easy to steady the pole.

In general the heavier rovers ran longer on one set of batteries, a full survey day or more, than the lighter models in this test. The

best weight/endurance results were achieved with the Topcon and the Sokkia which both had a total on-pole weight under 4 kilograms, and which lasted over 10 hours on a single set of batteries.

Base Weight

Most brochures only state the rover weight, giving the impression that the base and overall weights and sizes are not important. The complete system has to be transported to the site, however, with the last few hundred meters usually by hand. We therefore also measured the weight and size of the other components.

The total weight of the base was calculated from the measurements, based upon the use of a standard tripod weighing 7 kilograms. Again the Trimble came out lightest at only 9.5 kilograms and the Magellan and Leica the heaviest at 11.5 kilograms. The weight of the Magellan does not include the mandatory 13.5 kilogram battery needed to supply power to the separate UHF radio transmitter.

Overall Weight and Size

The total weight and size of the cases was calculated as well. Have you ever wondered why GPS representatives drives such big cars? It is not so much the result of the profits they make, but more the immense size of the systems. Excluding the tripod, pole and loose accessories, the storage volume of the cases for a single system varied between 45 litres (Trimble) and 92 litres (Magellan). The total volume of all the cases for the systems tested was 354 litres which, together with the poles and tripods, is enough to fill the back of a medium-sized European station wagon with the back seats folded down.

The weight of a single case was always less than the Dutch legal limit for workmen, 25 kilograms, with the two Leica and Sokkia cases the lightest at 8 kilograms apiece and the single Topcon case the heaviest at 15 kilograms. Of course the total volume and weight

Antenna layout on the roof of the car for the range test.

Performing the initialization test with a piece of tinfoil.

of the cases depends on the type of case and the options selected by the client. All representatives, however, claimed that the cases and options supplied were those usually selected by their clients.

Range Test Set-up

For this test we wanted to see what the maximum achievable range was for the systems. This is especially important when using the system over larger survey areas. All manufacturers were requested to supply a system set to a legal frequency and power setting. I meant 439 MHz and 500 mW but did not communicate this explicitly at an early stage. As a result some systems were set at other power settings, with the Leica for example being set to 1 W. At the time I thought this was illegal but Leica corrected me, referring me to the website of the Dutch Telecom agency. The difference in power settings, however, meant that comparing the results would be hard. We did proceed with the range tests, though.
In order to test the ranges under comparable circumstances a specific set-up was needed. Therefore all five bases were erected five meters apart in a row at a straight angle to the range, a road on an unobstructed dike. During this test both the Sokkia and the Magellan were at a slight disadvantage since their base antennas had to be mounted on the legs of the tripod, resulting in a slightly lower antenna height which can, potentially, reduce the maximum range.
The five rovers were then mounted one meter apart on the roof of my car in such a way that almost all antennas (both GPS and telemetry) had a free field of view. The exception was the UHF antenna of the Magellan which, due to its construction, had to be mounted slightly lower than the others to prevent it from shielding other GPS antennas, giving the system a slight disadvantage (see photo).
The systems were than set to continuous position logging with the exception of the Sokkia, which did not have this option in the supplied software. The Sokkia was therefore read manually. With the systems thus set, the car was driven along the dike at speeds never exceeding 10 m/s. At the end of the dike, the car was turned around and the test was repeated in the other direction.

Range Results

The results varied greatly and proved hard to compare. On average the range varied from slightly over 2 kilometers to over 7 kilometers. Some systems, however, had trouble maintaining lock during this test, without any obvious reason at the time.
One of the problems with a test like this is

User Interface

Leica GX1230 GG

The software on the Leica controller has quite a few options. A first-time user can easily get lost in all the menus and settings. The advantage of all these options, of course, is that the system can be specifically geared towards a specific application. The controller is also the only one that can be fully and easily controlled using the keyboard. The rover was supplied with the new colour touch screen that is very easy to read, even in bright sunlight. I personally felt that the touch screen did not respond as well to the pen as the greyscale screen on the base controller. Logging data is relatively simple once the unit has been set up. Data can be logged to a CompactFlash card slot in the receiver. Exporting data is simple once the export format has been defined using the office software. No standard export formats are provided with the controller, although the office software holds a number of formal templates that can be used as is or modified.

Leica also provides a controller simulator, making it possible to change settings and to export towards specific formats without having to have the physical controller in the office. The operation of the simulator is identical to the controller and can even be configured to display in either greyscale or colour.

Magellan Z-Max

The Z-max is the only receiver in this test that does not have Glonass support. Furthermore, due to the fact that I seem to have had SBAS switched on during the tests, the Magellan structurally received two to three fewer satellites than the other systems. This is a result of two channels being dedicated to receiving SBAS corrections, which means fewer channels available for satellite tracking. The result is that it was harder for the receiver to get an RTK fix in the re-initialization tests.

The software used with the Allegro controller was the commercially available Fast Survey package. This package is very easy to understand and use and has all the features one needs in the field. Data export is mainly towards standard ASCII text files, which can be read by most processing software. If needed, export to shape and dxf formats is also available. Due to the limitations on the controller, data export has to be performed using ActiveSync over a serial cable, which can be a problem since fewer and fewer computers are equipped with a serial port. A serial to USB converter or the optional USB dock can be a solution, but some converters will work better than others.

Sokkia GSR2700 ISX

Configuring the Sokkia system is relatively easy. The base requires no settings at all: simply switch it on and it will start measuring and transmitting results. All settings can be done in the controller from the rover location, where the base position as transmitted from the base can be overridden.

Sokkia has the only talking receiver. Although other manufacturers have a talking controller, none has a receiver that can quite clearly (and in different languages!) tell you that you just lost RTK. It is somewhat of a gadget, but it enables operation without having to look at the controller all the time.

The Allegro controller ran Sokkia's own software. The software performs all basic tasks, but has no options for auto logging or extensive attribute information. For this reason no points are displayed in the precision test results.

An advantage of the software is that it stores its information in a relational database. This makes adjustment of the results possible on the controller without having to use any office software. Just change the base coordinates, and all points measured from that base will shift with it.

Topcon GR-3

As with most manufacturers, Topcon uses a single software package for all its land survey instruments. The package has a very simple layout and surveying is relatively easy. I personally find inputting values into the software a bit of a nuisance since only an onscreen keyboard is available with the supplied controller (FC200). The layout of this onscreen keyboard is not QWERTY, which takes some getting used to.

Communication between controller and base/rover is usually done using Bluetooth. With this particular setup the controller lost the Bluetooth connection every now and then, even with the controller close to the rover. Exchanging data with the office computer can be via data card, USB connection or with a USB memory stick. However the USB port only takes very slim memory sticks such as the one supplied by Topcon Europe. The ports are very well shielded from dust and moisture by rubber flaps that open and close without a problem.

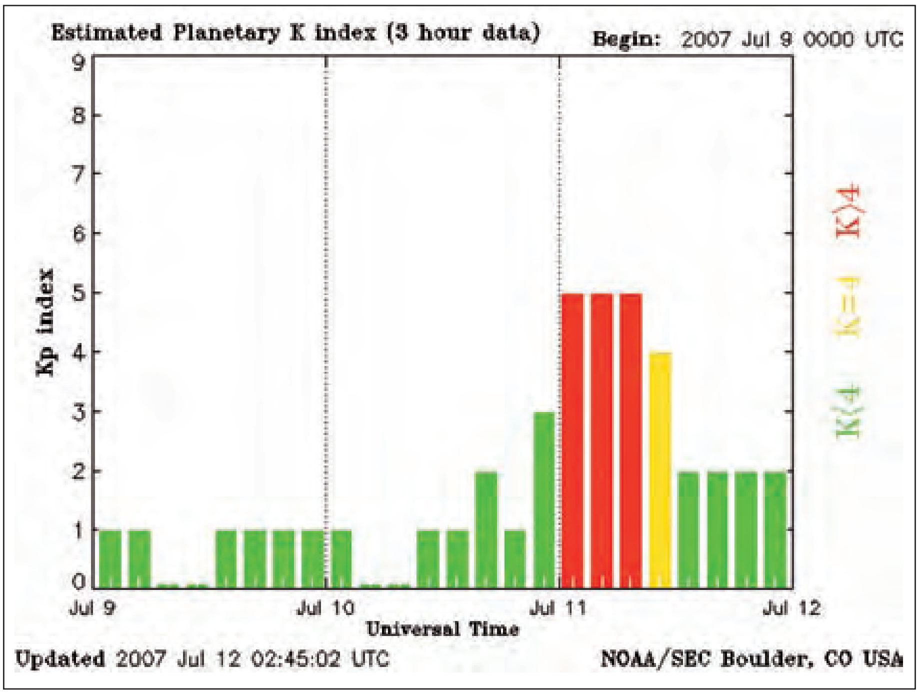
After a full day of testing and one day in storage the battery of the controller was empty and had to be replaced. It seems the controller uses power even when shut off.

Trimble R6 GNSS

Whenever the radio signal was lost during the tests, a computer-generated female voice provided you with information. Similar to the Sokkia, this is something of a gadget, but it makes it easier to detect problems with multiple systems running or when temporarily performing other duties.

The Trimble and Leica receivers were the only receivers that give only global status information on the receiver itself, requiring the controller to be connected to the system for more exact information. Both also display the information from the base in the controller display of the rover.

Exporting both the position information and the quality information in a simple ASCII file proved impossible with the installed export formats. Additional formats can be easily downloaded from the Trimble website, however, giving a broad range of export possibilities.



Ionospheric conditions (Kp index) during range test (source: www.sec.noaa.gov)

that there are five transmitters operating at similar frequencies, albeit not exactly the same. Frequencies close to each other can cause crosstalk, making it harder for the receiver to maintain lock.

Further, since the frequency used is line of sight, every obstruction between the base and rover will deteriorate the range. This can be partially solved by elevating the base antenna. The range selected was, however, free of obstacles for 7.5 kilometers, apart from the occasional passing car.

Since the results varied and had some unexplained gaps in them where receivers lost lock, I investigated the measuring conditions when manufacturers reported that the ranges measured were not representative. When I checked the ionospheric conditions during the range test on the morning of July 11, I found that they were truly bad, which probably was the reason some receivers were losing lock. Due to this the actual results of the range test are not shown here since they are not representative of the range under more normal conditions. One thing I did notice, though, is that having the antenna on top of the GPS antenna certainly provides an advantage.

Reacquisition Test Set-up

The reacquisition of the RTK fixed solution after passing under a tree or bridge is important since every second spent waiting seems to be one too many in the field. The actual reacquisition time depends on various factors among which are the numbers of satellites in view, their constellation, and the distance between base and rover. In order to test the reacquisition time as reliably as possible, all rovers were set within 1.5 meters of each other, with all the bases in the same configuration as for the range test. The average distance between bases and rovers was in the order of 25 meters.

With this set-up, each receiver GPS antenna was in turn shielded using tinfoil. As soon as the rover reported a loss of RTK and the number of satellites in view remained at a steady low value, the foil was removed. The time between removing the foil and the moment the rover reported an RTK fix was taken as the initialization time. The test was performed three times per rover within a short time span (minutes).

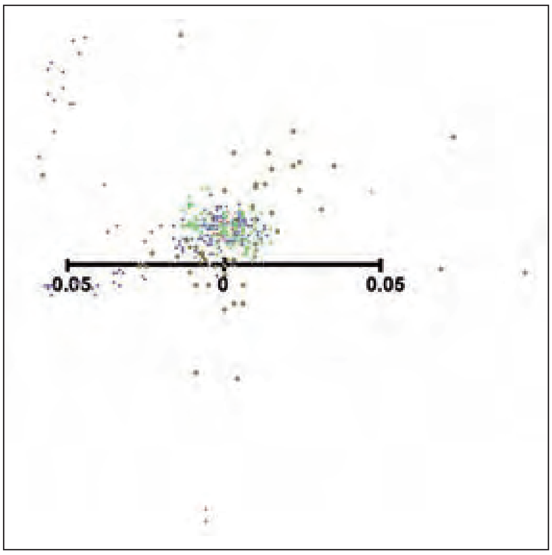
Reacquisition Results

Almost all systems re-initialized within, on average, 15 seconds, with the Sokkia slightly faster at 10 seconds. Only the results for the Magellan were higher, but not comparable due to an incorrect setting in the receiver. It seems that I had the SBAS option turned on during the tests, which reduces the number of available channels for GPS measurements by two. Considering that this reduces the number of satellites available for the solution, initialization times increased. I estimate that, on this short baseline, the results would otherwise have been comparable.

One can, however, question the effect of these differences in survey practice; all the systems initialized before the average surveyor would have reached the next survey point and steadied the pole.

Endurance Test Set-up

The field endurance of an RTK UHF system is mainly defined by the endurance of the base and therefore by the batteries used in the



Results of the precision test (Green = Leica; Red = Magellan; Blue = Topcon; Yellow = Trimble)

base. Although all manufacturers can supply additional power packs, in this test only the single set of internal batteries delivered with the system was used. The endurance test was run parallel to the other tests, with the times of switching on and off being noted. Using the auto logging function, the time of shutdown was determined to within the closest half hour.

Battery results always depend on the conditions under which they are used: the colder it is, the less performance one gets. During these tests the ambient temperature was between 18°C and 22°C.

All batteries were charged using the supplied battery chargers until the indicator showed the battery was 'in the green' or no longer charging. The systems were then run until they switched themselves off, a condition that is not optimal for the system and should be avoided in everyday practice.

Endurance Results

Surprisingly, in their brochures almost all manufacturers are pessimistic when they state the endurance of the system. On average the systems ran 1.5 hours longer than stated, the exception being the Topcon, which ran 2.5 hours less than stated in the brochure.

The first base to stop function was the Trimble; it ran for 5.5 hours – not nearly enough for a full survey day. The longest to run was the Magellan with a base endurance of around 14.5 hours: more than enough for even a 12-hour survey day. The endurance of the Magellan is largely the result of the separate battery used for the UHF radio and the large 8.8 Ah internal batteries.

Almost all rovers ran longer than their corresponding base systems. The exception was the Leica, where the base ran 1 hour longer than the rover. This is the result of a different set-up for the base system, with the base having larger batteries.

Almost all controllers had a battery that lasted longer than the rover they were coupled to. The Topcon controller only lasted throughout the first survey day. It seems however that the controller does not completely switch off and uses power even in 'off' mode. The battery on the Magellan controller came close to running out, but considering the uptime of the Magellan rover this was no surprise.

Precision 'Test'

An RTK system is bought for its accuracy of centimeters or better. Without a proper laboratory set-up it is not possible, however, to test both the precision (standard deviation) and reliability for all the systems under exactly the same conditions. Instead we only performed a quick field test to check precision. During this test we left all systems

	Leica Geosystems GX1230 GG	Magellan Z-Max	Sokkia GSX2700 ISX	Topcon GR-3	Trimble R6 GNSS
Channels (g)	72 - GPS L1, L2, L2c - Glonass L1, L2 - SBAS	24 - GPS L1, L2 - SBAS	72 - GPS L1, L2, L2c - GPS L5 - Glonass L1, L2 - SBAS	72 - GPS L1, L2, L2c - GPS L5 - Glonass L1, L2, L2c - Galileo (all) - SBAS	72 - GPS L1, L2 - Glonass L1, L2 - SBAS
Telemetry rover (g)	- 1 Bluetooth	- 1 Bluetooth - (1 UHF) [9] - (1 GSM / GPRS) [8]	- 2 Bluetooth - (1 UHF) [9] - (1 GSM / GPRS) [8]	- 1 Bluetooth - 1 UHF - (1 GSM / GPRS) [8]	- 1 Bluetooth - 1 UHF - (1 GSM / GPRS)
Input / Output rover (g)	- 1 RS232 - 1 USB / RS232	- 1 RS232 - 1 RS488 - SD card	- 1 RS232 - 1 USB / RS232 -	- 1 SD card - 1 RS232 - 1 USB	- 2 RS232
Telemetry controller (g)	- 1 Bluetooth - (1 GSM / GPRS) - (1 UHF) [9]	- 1 Bluetooth	- 1 Bluetooth - (Wifi)	- 1 Bluetooth - 1 802.1 Wifi	- 1 Bluetooth - 1 802.1 Wifi
Input / Output controller (g)	- 1 Leica docking - 1 CF card - 1 RS232 / USB	- 1 PCMCIA card - 1 CF card - 1 USB (docking) - 2 RS232	- 1 PCMCIA card - 1 CF card - 1 USB (docking) - 2 RS232	- 1 CF card - 1 SD card - 2 USB - 1 RS232	- 2 CF cards - 1 SD card - 2 USB - 1 RS232
Water / Dustproof to (g):	IP67	IP54	IP67	IP66	IPX7
Weight base (m) [3]	11.5 kg	11.5[10] kg	11 kg	11 kg	9.5 kg
Weight rover (m)	1.2 kg	3.9 kg	1.8 kg	1.9 kg	1.4 kg
Weight controller (m) [1]	2.0 kg	1.3 kg	1.3 kg	1.1 kg	1.3 kg
Total pole weight (m) [2]	3.9 kg	5.7 kg	4.0 kg	3.9 kg	3.6 kg
Total weight (m) [4]	16.5 kg	41 kg	17 kg	15 kg	12.5 kg
Total volume (m) [4]	2 x 32 ltr	2 x 46 ltr	2 x 42 ltr	1 x 69 ltr	1 x 45 ltr
Initialisation (g / m) [5]	8 s / 15 s (11 SVs)	2 s / [11]	10 s / 10 s (11 SVs)	15 s (12 SVs)	< 30 s / 15 s (12 SVs)
Endurance – base (g / m) [6]	7.5 hours	> 14 / 14.5 hours	9 / 10.5 hours	11 / 7.5 hours [7]	3.5 / 5.5 hours
Endurance – rover (g / m) [6]	5 / 6.5 hours	> 14 / 13 hours	10 / 11.5 hours	13 / 10.5 hours	5.3 / 7 hours

Test results. Notes:
M = measurement based upon system tested (see text for details)
G = as given by manufacturer
( ): Optional; see additional remarks
1: Including mounting bracket and radio receiver where applicable
2: With the pole/pole mount delivered with the system
3: Excluding optional power packs and including tripod and bracket as delivered.
4: Approximate size/weight of the filled cases delivered with the system, excluding tripod and pole
5: Maximum initialization time measured during tests/given by manufacturer
6: With a single set of standard batteries required to operate the system
7: The controller ran out after the first 6 hours
8: Model reviewed included GSM/GPRS
9: Model reviewed included UHF
10: Excluding 13.5 kilogram required base battery
11: Results were not comparable due to an incorrect setting in the receiver

running after the initialization tests.
The data was logged for roughly one hour at 30-second intervals for all systems with the exception of the Sokkia whose software did not support auto logging. The resulting position plot for each system was then shifted towards an imaginary central point using software in order to be able to compare the results visually.

Precision Results

Although the test as performed by us is not a true indication of the precision of the systems, it gives a good idea of the differences between the systems and the respective settings made within the software. For example, with the incorrect SBAS=ON setting the Magellan lost RTK lock at some point during the tests and therefore logged fewer points, which in turn were very close together. The Topcon on the other hand had no problem getting into RTK lock but seems to have had some multi-path problems during the test resulting in a larger position spread.
The standard deviation for all systems, when locked, was well within the 0.025-meter range and therefore within expectations for such a system. The test did, however, show that specific settings and differences in software can influence the results.

Conclusion

I tested five systems that are marketed by their respective manufacturers as comparable. During the tests we found differences between the systems, not so much in their user friendliness or the applications they could be used for, but in the hardware itself. What is clearly visible from the results, though, is that every manufacturer has to make certain choices in the design phase of the system. Some will opt for batteries with long endurance and accept a higher weight and others value versatility over a simple user interface.
As such, selection of a specific system should be based not so much on the type of application the software supports but more on factors such as price, maximum operational range, endurance and weight of the system for the specific application(s) one has in mind.

Huibert-Jan Lekkerkerk (hlekkerkerk@geoinformatics.com) is Editor-in-chief of Geoinformatics. For more information on these receivers: www.leica-geosystems.com; www.pro.MagellanGPS.com; www.sokkia.com; www.topcon.eu; www.trimble.com.

Manufacturers' Remarks on the Results

Leica GX1230 GG

The range performance of Leica might be tempered by the test set-up but not by ionospheric conditions. The antenna position, radio equipment quality and line of sight are important aspects to guarantee receiving of corrections signals. On the reacquisition and precision test results, just a fast TTFF is ignoring the reliability. The Leica precision test shows the best repeatability with small position spread. No outliers support the fact of reliability. GPS1200 realizes this by solving the ambiguities twice and independently before providing a fix.

Magellan Z-Max

The Magellan Z-Max is a truly ultra-flexible survey system that lets surveyors control their survey their own way. It permits surveyors to select only the modules they want for the most cost-effective survey solution. The Z-Max is available to survey in NTRIP, VRS, or FKP networks; GPRS or even UHF+GSM/GPRS. It switches seamlessly from post-processing to RTK, and it is suitable as either a base or rover. The detachable modules make configuration changes and system upgrades simple. And, if you're looking for a high-precision RTK solution at about half the cost of any of the systems tested in this article, take a good look at the new Magellan ProMark3 RTK with BLADE, the new Magellan GNSS engine.

Sokkia GSR2700 ISX

The Sokkia GSR2700 ISX is proofed as a user-friendly receiver with excellent environmental specs and a strong RTK performance. We would have welcomed a test of long-range RTK performance since the GSR2700 ISX excels in quick and reliable RTK solutions over long distances, which can be related to the reacquisition results. Furthermore Sokkia's controller software SDR+ is positively received where its strong feature is freedom in the field. That's why we built SDR+ based on a relational database environment. Sokkia is determined to serve surveying professionals with reliable and accurate positioning solutions such as the GSR2700 ISX, now and in the years to come.

Topcon GR-3

This field review is a good practical test. It proves that Topcon's GR-3 is a leading product and performs well when compared to others. Its unique design helped achieve the longest range at only 0.5watt radio power. Although the GR-3 is claimed to be heavier than some, it should be remembered the battery life is sufficient for a full day, so no extras are needed and it includes a built-in GSM/GPRS, which others have to add. The fact that the GR-3 is ready for Galileo means no costly hardware changes or add-ons are needed as the satellite program progresses beyond the current single satellite, making the unit future proof. As the test proves, the GR-3 is ready for all aspects of current and future use.

Trimble R6 GNSS

The Galileo satellite radio navigation system proposed by the European Union offers advantages to Global Navigation Satellite System (GNSS) users by providing additional satellites, additional signals, and compatibility with GPS. Trimble fully supports this advancement in the GNSS market.
As we have done with products that capitalize on next-generation GPS capabilities, we are committed to having Galileo-compatible products available for our customers well in advance of Galileo system availability. In the case of GPS Modernization, our compatible products were available a year ahead of the first L2C-capable satellite launch. Trimble has also developed products for the coming L5 GPS signal.
Likewise, we will offer equipment with Galileo capability well ahead of the time when production satellites are launched. In the meantime, it is our goal to offer the most productive and competitive equipment that addresses our customers' needs both now and in the future.

You can also find a movie of the test in our movies section on the website www.geoinformatics.com.