

# ***System 500***

***RTK Integrity Monitoring  
Reliability >99.9%***

***How Does it Work.....?***

*March, 2001*



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Over the last 12 years we have seen great advances in GPS Technology and how it is applied in the world of Surveying and Engineering. GPS Systems have become, lighter, faster and easier to use. They have proved themselves without a doubt that they are extremely productive and versatile.

In the early days of GPS, highly trained specialists were required to operate the equipment. Today many users expect a black box that gives the right answer, the first time, all the time.

Leica's System 500 offers "RTK Integrity Monitoring" to meet today's expectations. This Technical Bulletin is intended to give you an overview as to how the "RTK Integrity Monitoring" works.

## **RTK Integrity Monitoring, Continued**

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### *A Little Background*

By having a reference station setup on a known point, broadcasting its satellite observation data via a data link to a roving unit, it is possible to derive a real-time centimeter position of the roving unit in relation to the reference station.

This is accomplished by using the most efficient RTK algorithms to search for the correct ambiguities. As there are many whole wavelengths between the satellites and the rover there are always many, many possible sets of ambiguity solutions. Rigorous statistical tests are performed to determine the "most probably correct" solution.

However, if a system chooses the wrong set of ambiguities - even after statistical testing - the wrong coordinates would be computed and displayed to the end user. This means that every point surveyed would be incorrect.

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### *Question ?*

How can you be even more certain that the correct set of ambiguities has been found?

The answer.....

### **RTK Integrity Monitoring**



## RTK Integrity Monitoring, Continued

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### RTK Integrity Monitoring

#### How it Works...

Lets have a look at how the RTK Integrity Monitoring works:

- As soon as the rover has acquired 4 satellites on L1 a precise differential code position is available.
- Once there are 5 satellites available on L1 and L2, the system begins the ambiguity search and computes the most likely set of ambiguities using one set of GPS observations.
- The rover then REPEATS the whole ambiguity search routine again using a different set of GPS observations. This leads to a second set of ambiguities.
- The ambiguities computed from this second search routine are then compared with the ambiguities computed from the first ambiguity search. If the two sets of ambiguities are identical, then the ambiguities are considered to be correct and an RTK position to cm accuracy is computed on the rover.
- It is only at this stage that the Sensor will beep, a graphical icon changes to represent a high precision position and the Coordinate Quality indicator reflects cm accuracy.

Differential Code



Ambiguity Set 1 Resolved



Ambiguity Set 2 Resolved



Fixed Solution



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### Continuous Checking

Now that the system has fixed the ambiguities twice the system is now ready to measure positions to centimeter accuracy. To ensure that the highest possible reliability of the computed positions the ambiguity search routine is continually repeated in the background.

The ambiguities computed from these repeated search routines are compared with the current solution. If they agree all is fine. If they disagree, the system beeps, changes the solution type to differential code and starts the whole ambiguity search routine again from the beginning.

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## **RTK Integrity Monitoring, Continued**

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### *The Result*

System 500 will resolve ambiguities on the fly twice, perform a statistical analysis, compute the coordinates of the rover in relation to the reference and maintain reliability in excess of 99.9%. And with the latest v3 firmware, it is possible to do all this in less than 10 SECONDS.

Additionally once the system has fixed the integers the solution is continuously checked by re-computing the ambiguities.

This entire process ensures the user, that the right solution is being recorded at all times. If the system does not resolve ambiguities as quickly as you would expect there is a reason - it simply does not want to give the wrong answer.

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### *Think on!*

Leica System 500 offers the fastest and most reliable RTK performance available today.

The question that must be asked is what would you prefer? An RTK system that may occasionally resolve ambiguities a few seconds faster, but in this time has only resolved ambiguities once and then does not continue to check this solution? Or would you prefer an RTK system that resolved ambiguities a few seconds later, but in this time has resolved ambiguities twice and then continues to repeatedly check this solution? There is only one answer.

Do you know of other RTK Systems that can offer "RTK Integrity Monitoring"?

**"Never Compromise the Reliability"**

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