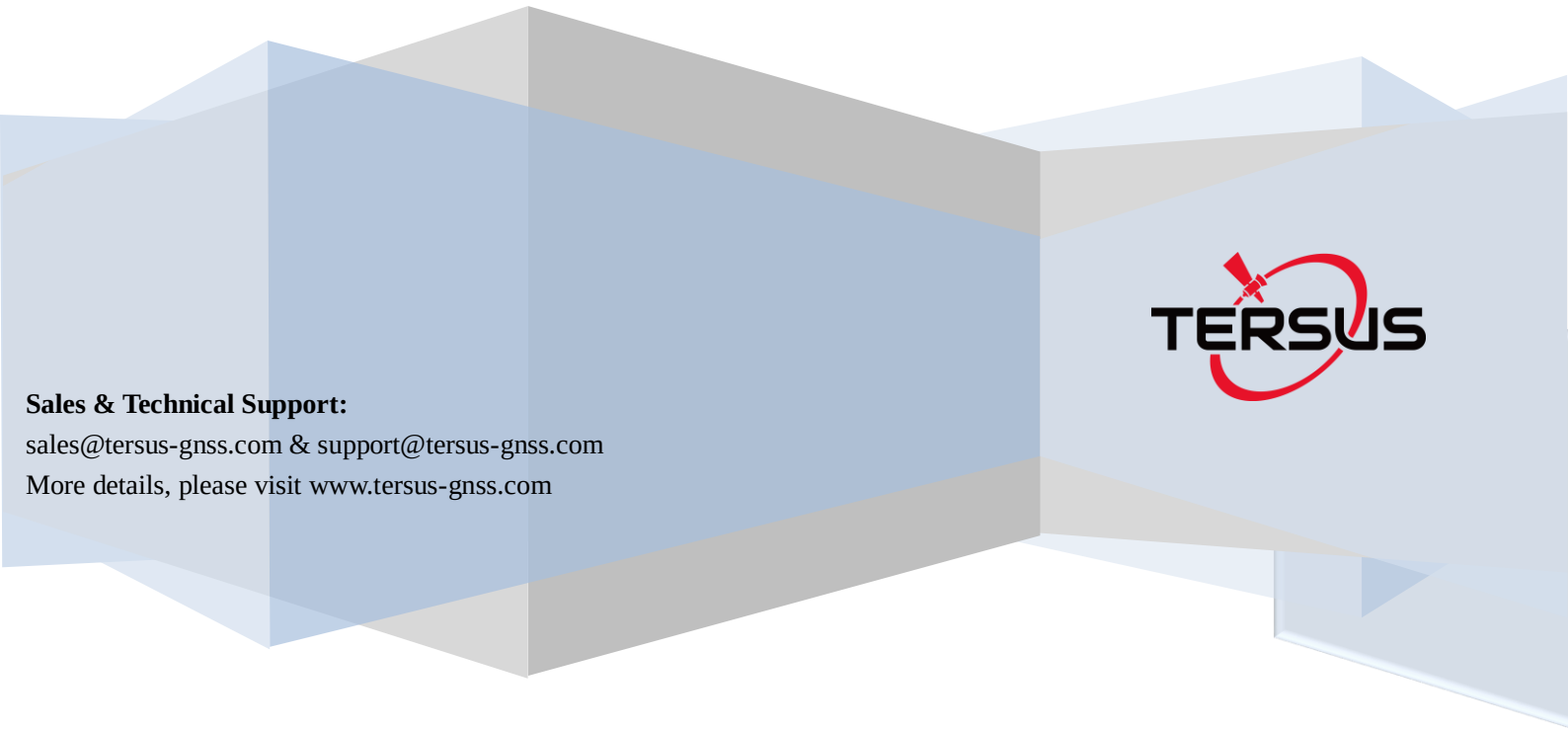
Test Report

Jun 2018

Tersus RTK Competitive Analysis



Sales & Technical Support:
sales@tersus-gnss.com & support@tersus-gnss.com
More details, please visit www.tersus-gnss.com

Contents

1 Abstract

Some tests were carried out by Tersus Inc. These tests were designed to compare the performance of our RTK engine with a number of competitor products. The objective of our testing was to quantify the RTK performance of Tersus OEM board. The paper demonstrates the usability and reliability of our products in the following test scenarios. The results show that Tersus OEM board provides available RTK positioning in real-world GNSS conditions.

Table 1 Test cases description

Index	Baseline length	Mode	Description
1	<5km	dynamic	Test data is 2018/01/02
2	25~28km	dynamic	Test data is 2018/01/08
3	<16km	dynamic	Test data is 2018/01/23
4	<1km	static and dynamic	This test is conducted is Beijing. The rover antenna is mounted on the locomotive.
5	28km	static	Test data is 2018/01/23
6	<5km	static	Partial foliage
7	15km	static	Test data is 2018/05/31

Table 2 Description of Test OEM boards

Item	Descriptions
OEM BOARDS	BX316 and other four OEM boards. A UB482/ B K708/ C NovAtel628/ D BD982
Antenna	Tersus AX3702

Note: these competitors are the same as in the document < *Tersus RTK Competitive Analysis _April 2018*>

2 Dynamic Tests results

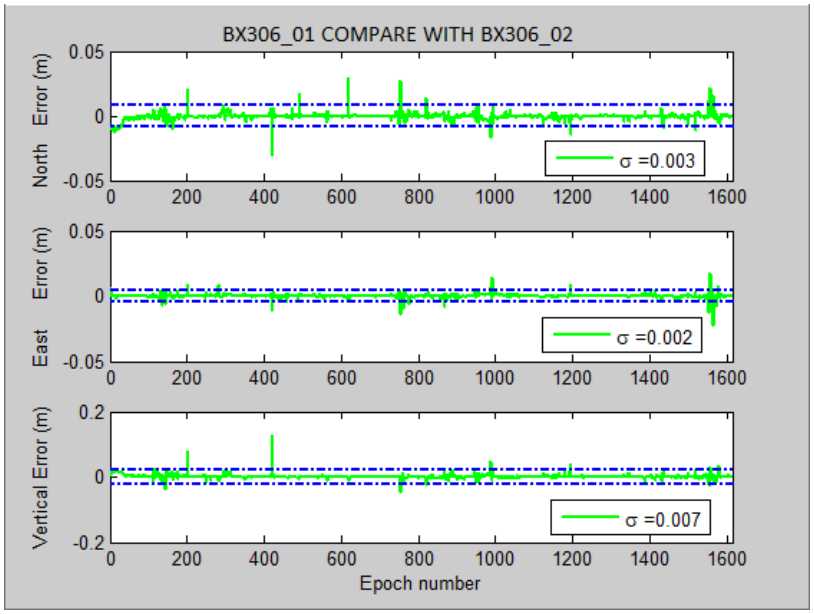
2.1 Case 1

The rover antenna was placed on the top of the car and the base antenna was placed on the building rooftop. The base OEM board is Trimble BD982. This road test was carried out for comparing the RTK performance between BX306 and competitor C. The length of baseline is shorter than **5km**.

As shown in Table 3, Figure 1 and Figure 2, BX306 and Competitor C produced similar accuracy.

Table 3 Position Accuracy Statistics

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306_01	98.8	0.2	0.3	0.7
BX306_02	98.8			
Competitor C_01	99.4	0.4	0.3	1.1
Competitor C_02	98.7			



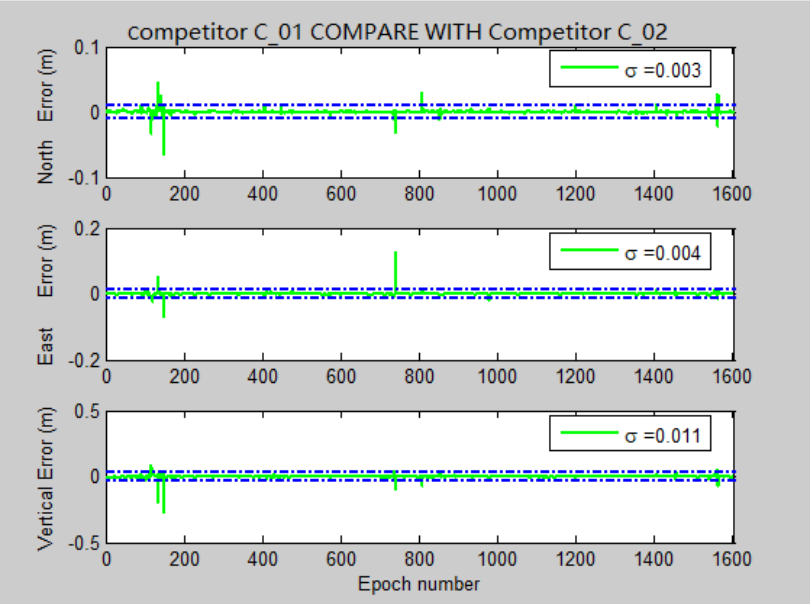


Figure 1 Position Error Time Sequence Diagrams

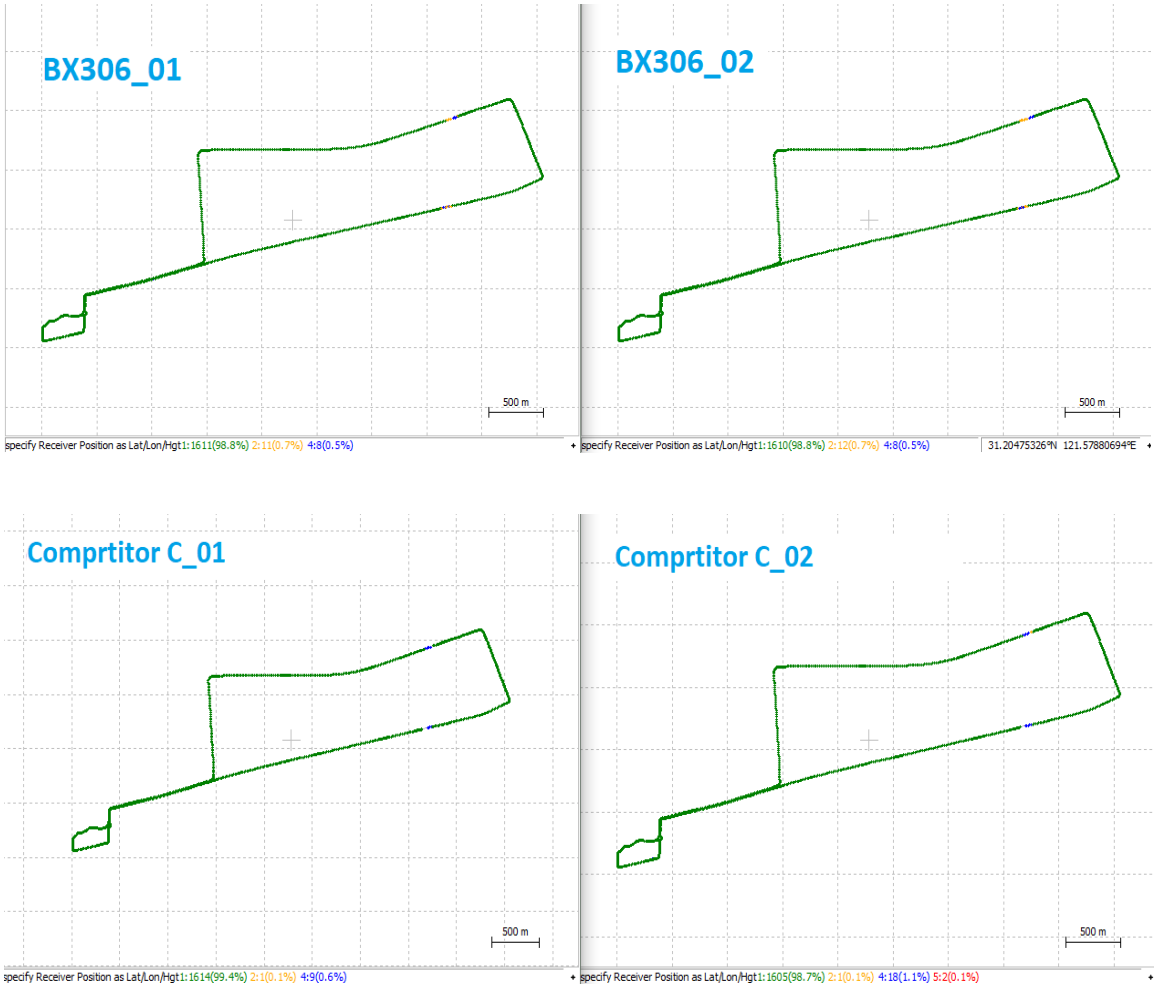


Figure 2 Trajectories of Each OEM boards

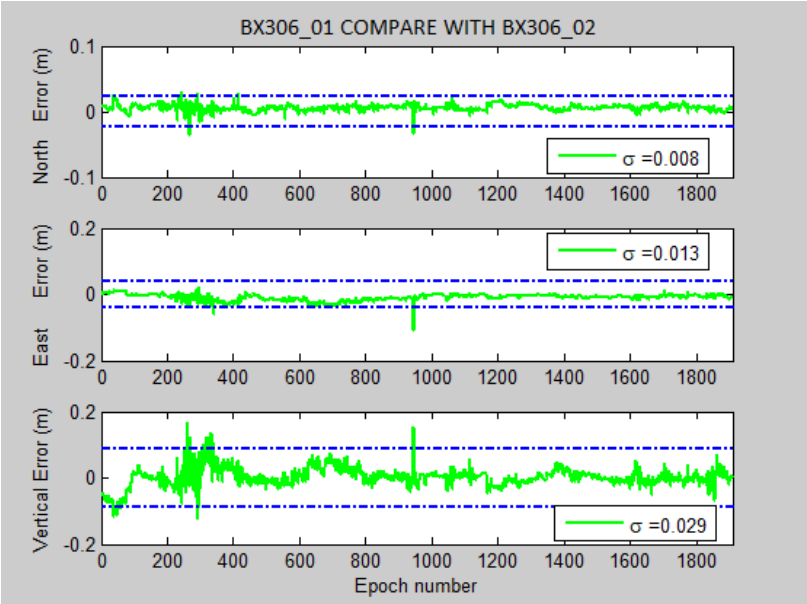
2.2 Case 2

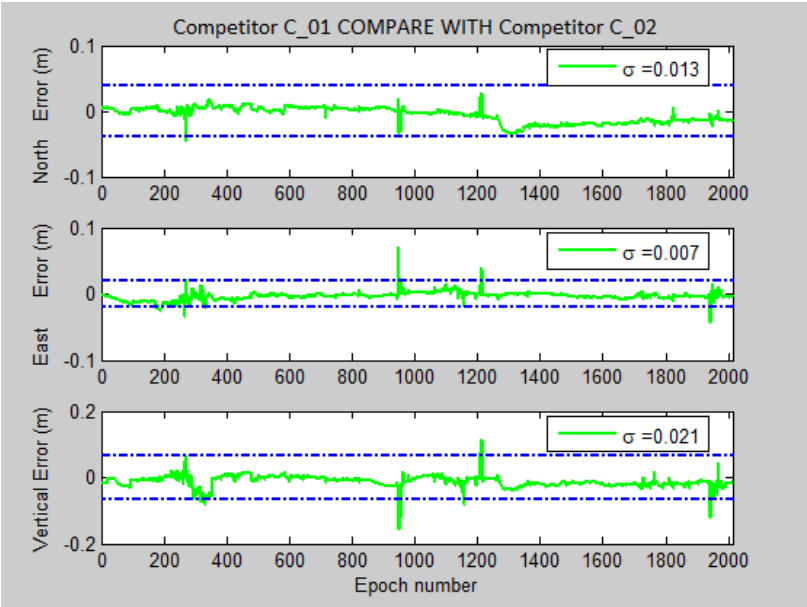
The antenna of the base station is located at a farm site 28 km from the test site and the OEM board of base is BX306. RTCM v3.2 (MT1006, MT1074, MT1084 and MT1124) messages were transmitted through the network to the test boards. The rover antenna was placed on the top of the car. The length of baseline is form 22 km to 28 km. The RTK performance of BX306 and two competitor OEM boards was compared in this test.

Table 4 shows the statistical results of three types OEM boards. Figure 3 and Figure 4 show the details of RTK results.

Table 4 Position Accuracy Statistics

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306_01	97.9	1.3	0.8	2.9
BX306_02	95.2			
Competitor C_01	100	0.7	1.3	2.1
Competitor C_02	100			
Competitor D_01	98.1	1.5	1.0	0.8
Competitor D _02	99.2			





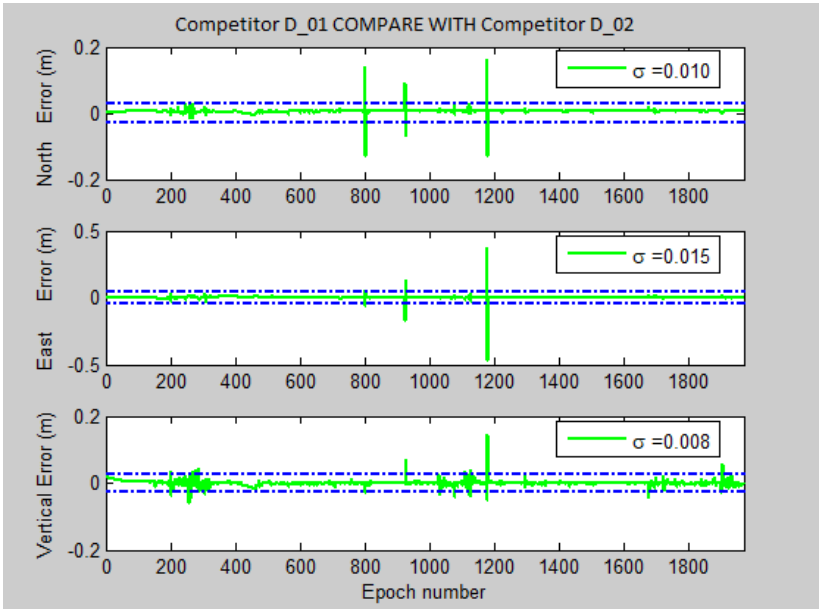
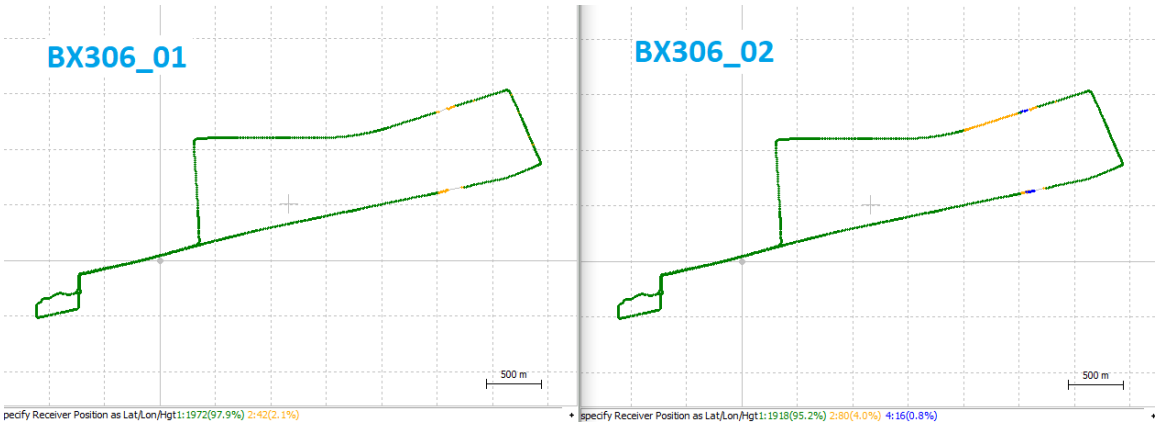


Figure 3 Position Error Time Sequence Diagrams



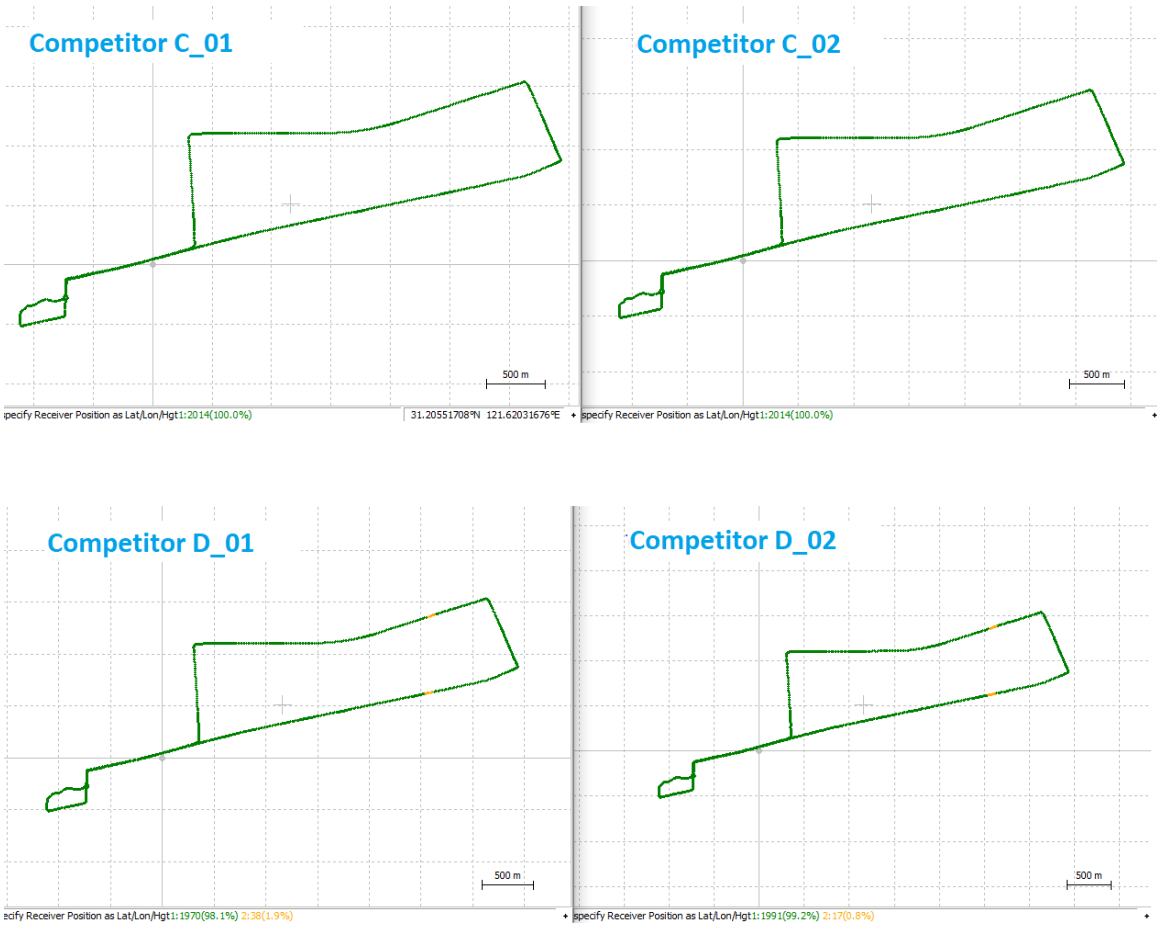


Figure 4 Trajectories of Each OEM boards

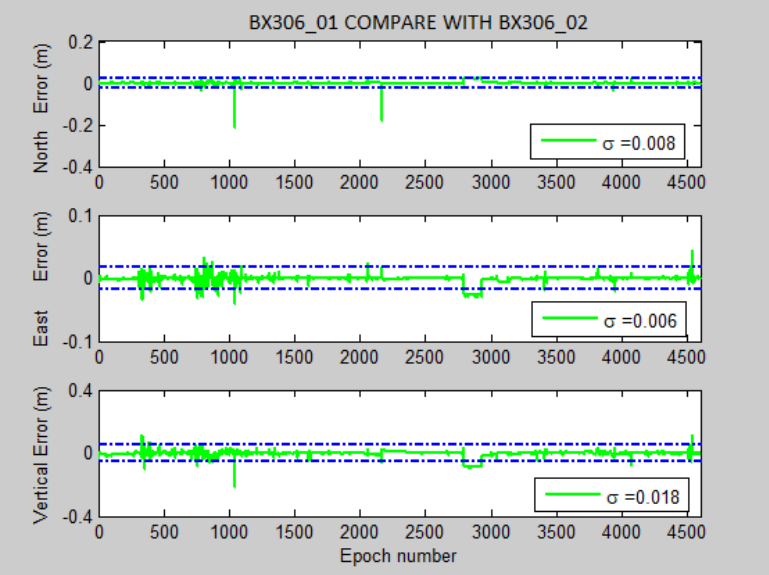
2.3 Case 3

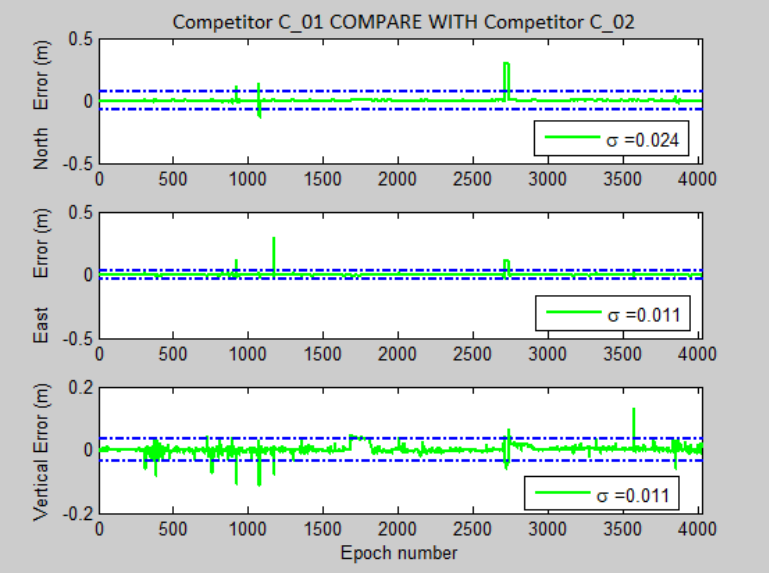
The test was designed to compare the RTK performance between BX OEM board and two competitors. Because one competitor OEM board was working incorrectly during the test, so the number of fixed RTK solutions of competitor C was less than others.

The Base OEM board is BX316 and the base antenna was place on the building rooftop. RTCM v3.2 (MT1006, MT1074, MT1084 and MT1124) messages were transmitted through the network to the test boards. The length of baseline is from 1km to about 16km. Table 5 shows the statistical results of three types OEM boards. Figure 5 is the position error time sequence diagrams. With the help of RTKPLOT tool, Figure 6 shows the trajectories of each OEM boards.

Table 5 Position Accuracy Statistics

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306_01	97.0	0.6	0.8	1.8
BX306_02	96.6			
Competitor C_01	98.3	1.1	2.4	1.1
Competitor C_02	99.4			
Competitor D_01	98.3	0.9	0.8	1.1
Competitor D _02	97.8			





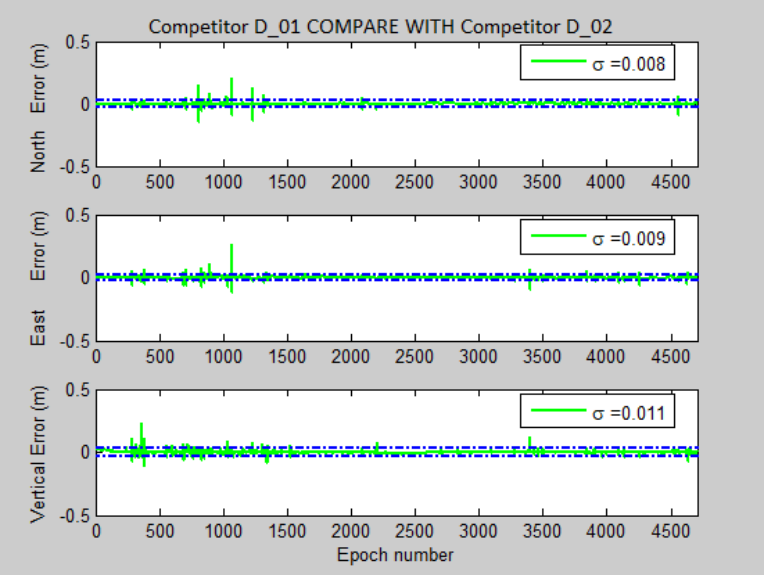
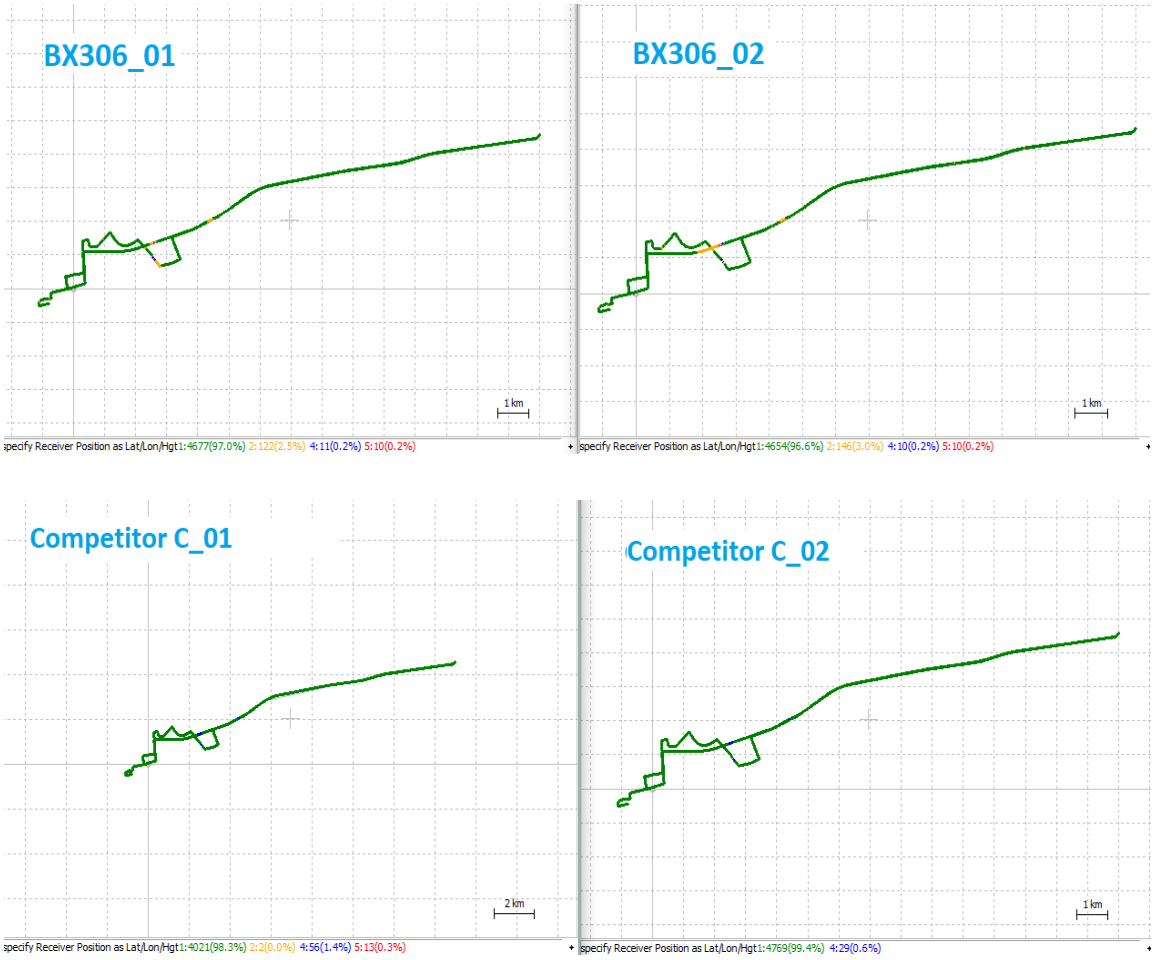


Figure 5 Position Error Time Sequence Diagrams



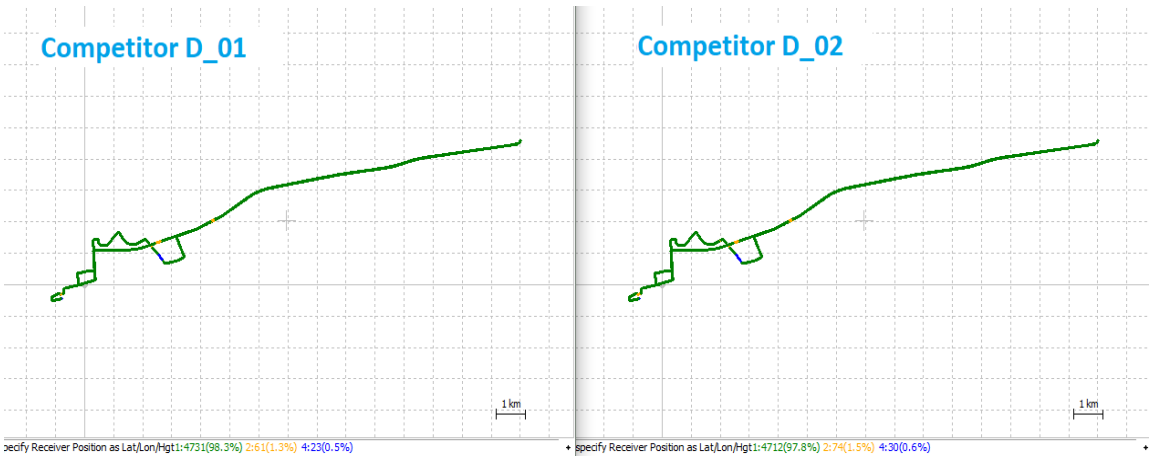


Figure 6 Trajectories of Each OEM boards

2.4 Case 4

The test environment, is close to the high voltage cable, as shown in Figure 7. There are many equipment at the engine head which caused the “locktime” of both BX board and Competitor C board reset frequently. Figure 8 and Figure 9 show the results of BX316 and Competitor C.

Figure 7 Environment of Rover Station

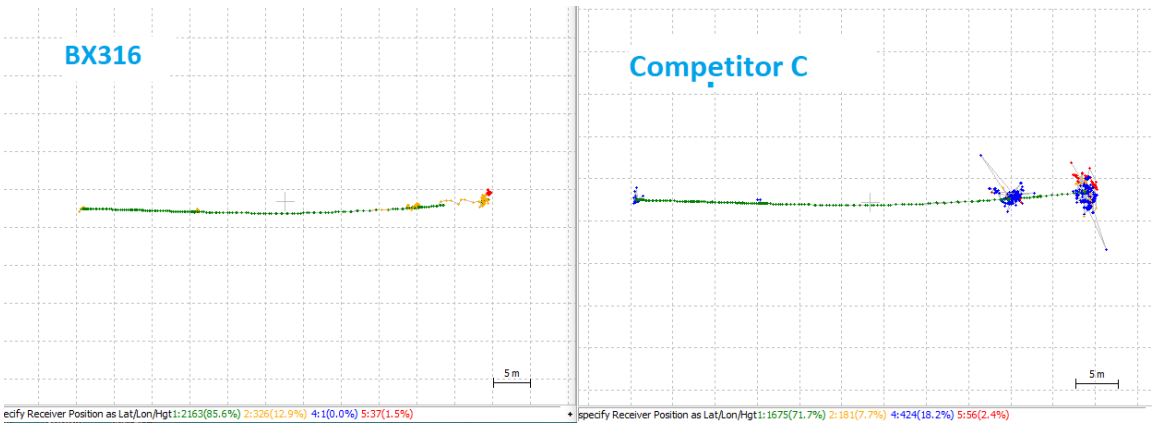


Figure 8 Trajectories of Each OEM boards (dynamic)

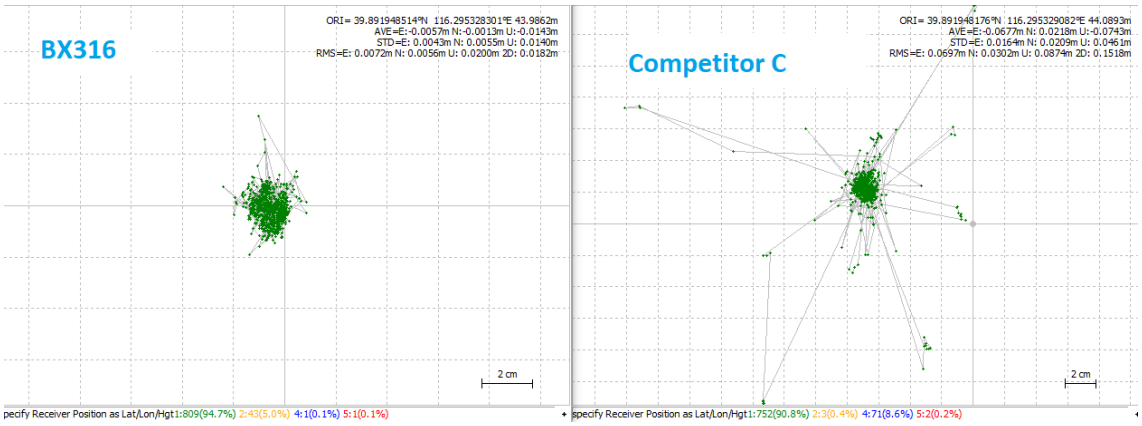


Figure 9 Trajectories of Each OEM boards (static)

3 Static Tests results

3.1 Case 1

The antenna of the base station is located at a farm site 28 km from the test site and the OEM board of base is BX306. RTCM v3.2 (MT1006, MT1074, MT1084 and MT1124) messages were transmitted through the network to the test boards. The rover antenna was placed on building rooftop with minimal multipath for ideal GNSS signal conditions.

The baseline length is 28km. BX306 and two Competitor's OEM boards were tested for about 24 hours. With the help of RTKPLOT tool, the results of each OEM boards are documented in Figure 10.

Table 6 Position Accuracy Statistics

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306_01	100.0	0.5	0.7	1.5
BX306_02	100.0	0.5	0.7	1.5
Competitor C_01	100.0	0.5	0.7	1.6
Competitor C_02	100.0	0.5	1.0	2.2
Competitor D_01	100.0	0.1	0.2	0.4
Competitor D_02	100.0	0.2	0.2	0.3

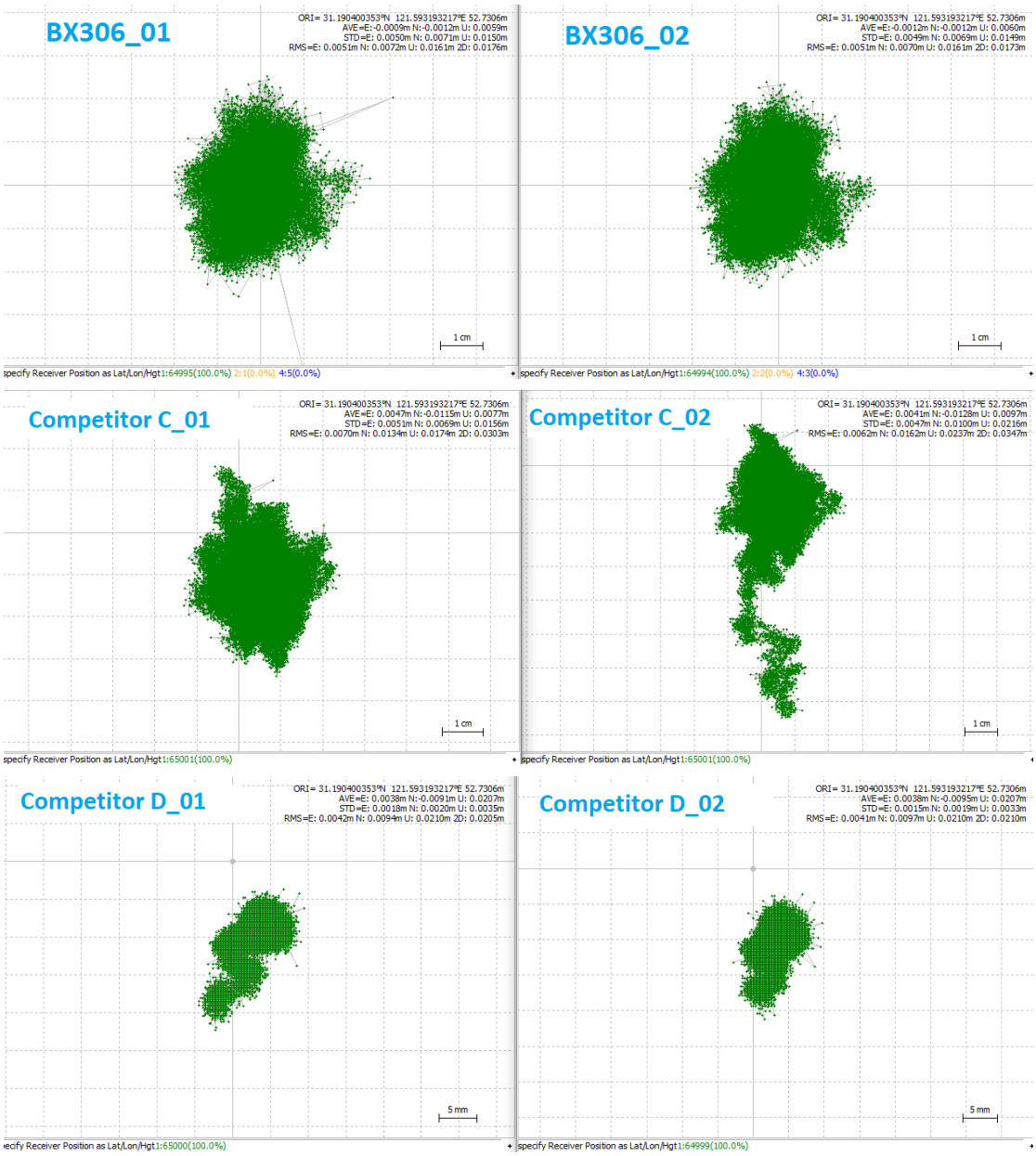


Figure 10 Trajectories of Each OEM boards

3.2 Case 2

GNSS users are rarely subject to the ideal conditions found in the open sky test. Buildings, trees and other obstructions limit the number of visible satellites and also reflect GNSS satellite signals, a phenomenon referred to as multipath propagation. These reflected signals interfere with the direct signal, degrading the GNSS measurement quality. So this test was run in a moderate foliage survey environment, as shown in Figure 11. The base OEM board is Trimble BD982 and the antenna was placed on the building rooftop.

Figure 11 Environment of Rover Station

Table 7 Position Accuracy Statistics

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306_01	98.3	0.1	0.3	0.5
BX306_02	98.3			
Competitor C_01	100	1.4	0.6	2.3
Competitor C_02	100			
Competitor D_01	95.9	0.2	0.2	0.4
Competitor D _02	99.2			

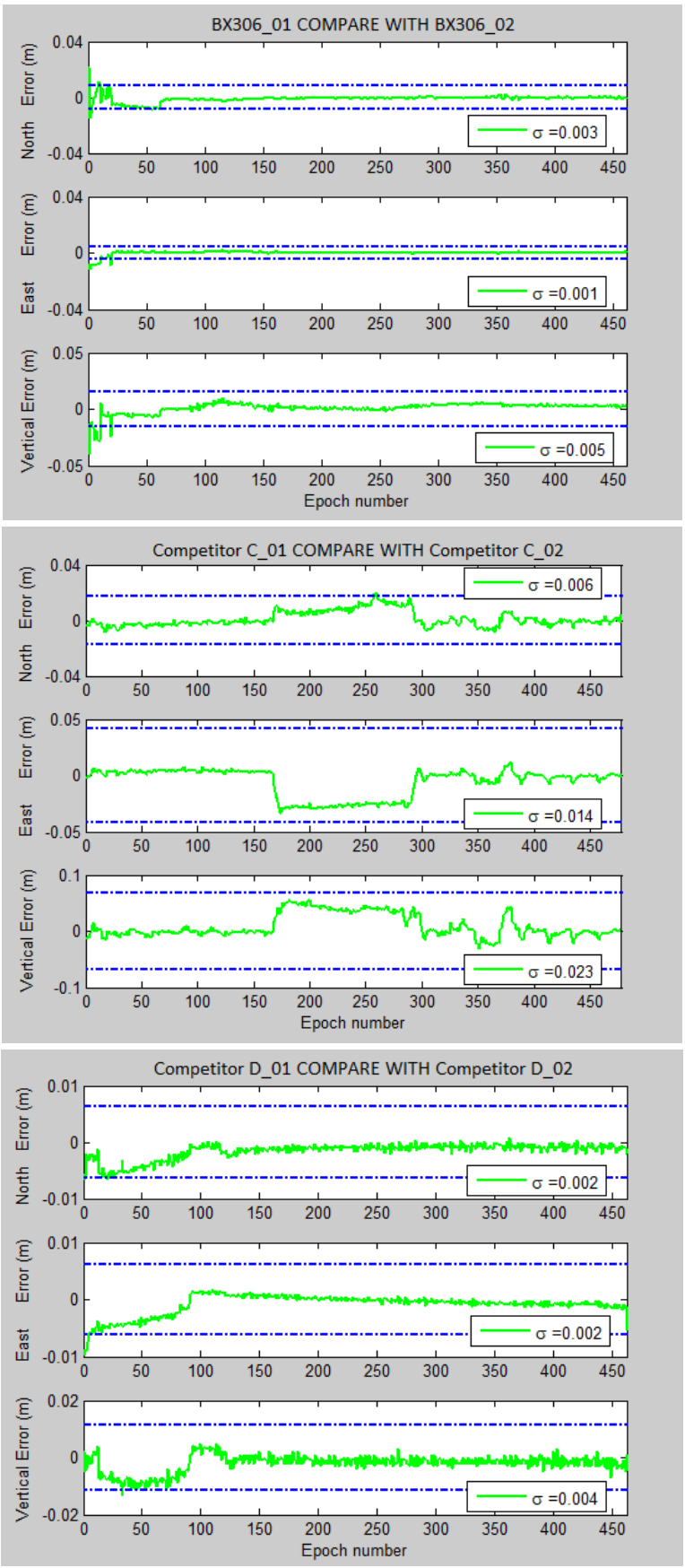


Figure 12 Position Error Time Sequence Diagrams

3.3 Case 3

A 15 km baseline was selected for the open-sky RTK test. The rover antenna was placed on the ground as shown in Figure 13. Three OEM boards from Competitors were tested along with Tersus BX306 in this case. All OEM boards use the same Tersus AX3702 GNSS antenna, for identical antenna placement. In addition, all OEM boards receive the RTCMv3 messages broadcasted by the same brand OEM boards (the test method has a detailed description in the document < *Tersus RTK Competitive Analysis _April 2018*>).

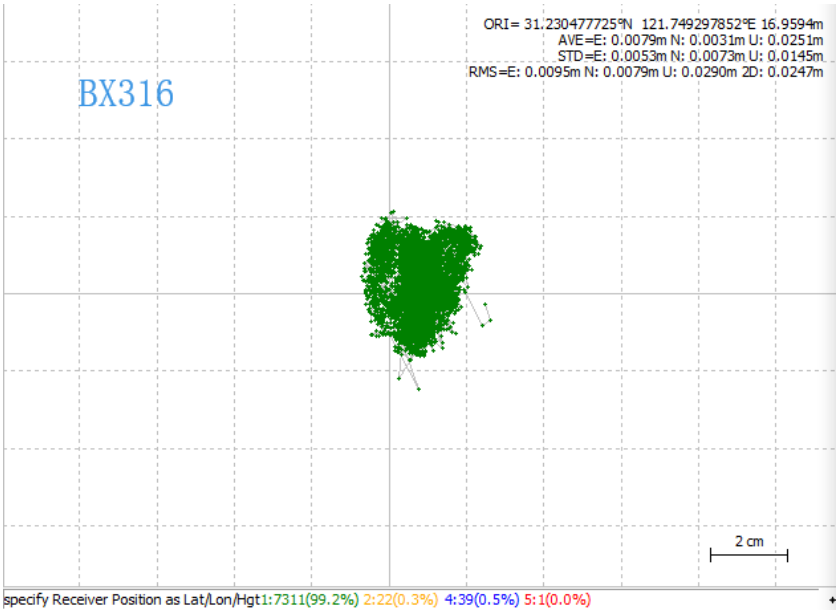
Data was collected for nearly 3 hours. Mean value of the Competitor C's RTK fixed solutions is used as the reference value to calculate the external coincidence precision of the other OEM boards (not eliminating the gross error), as shown in

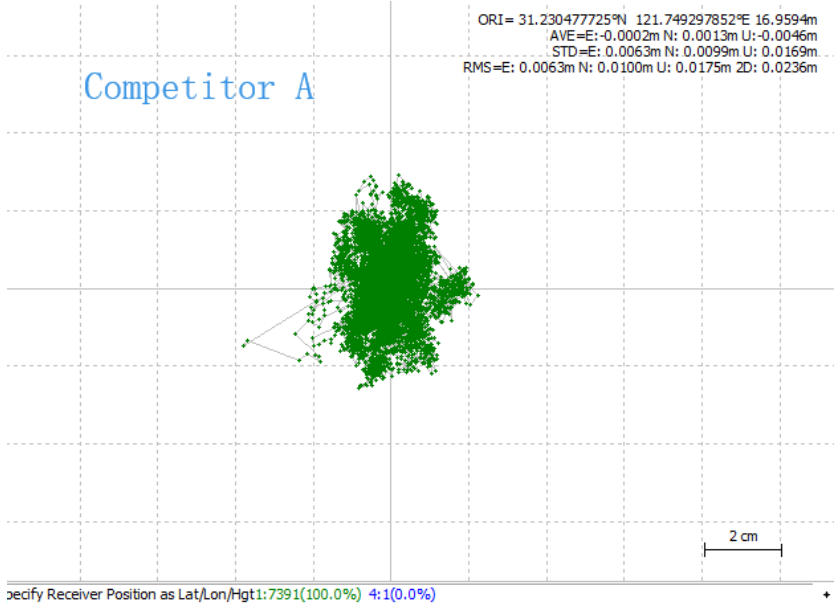
Table 8. In order to better explain the positioning accuracy of RTK, RTKPLOT tool was used to document the horizontal position error and the corresponding statistical information was given as well (Figure 14).

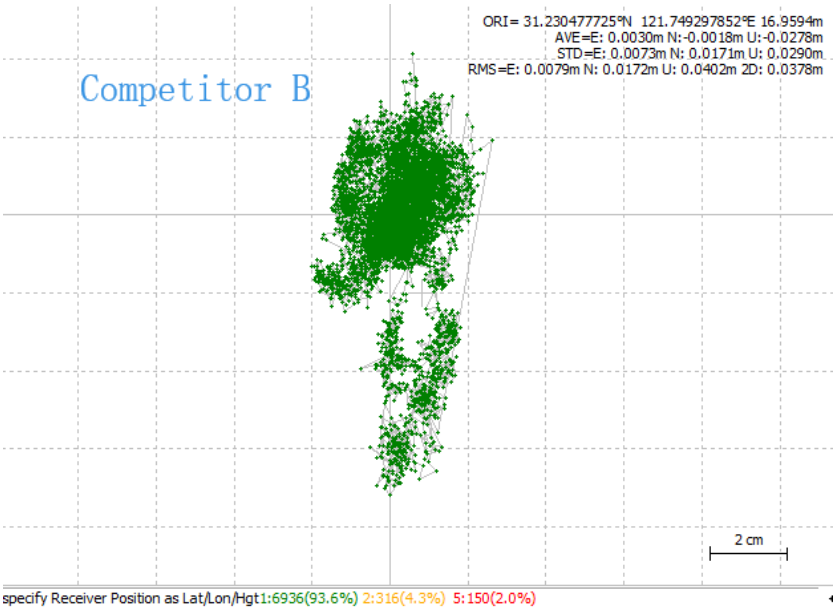
Figure 13 Environment of Rover Station

Table 8 RTK precision statistics of 15km baseline – open sky

OEM BOARDS	FIX RATE (%)	RMS (unit: cm)		
		E	N	U
BX306	99.2	0.95	0.79	2.47
Competitor A	100.0	0.63	1.00	2.36
Competitor B	93.6	0.79	1.72	3.78
Competitor C	99.8	0.56	0.83	2.01







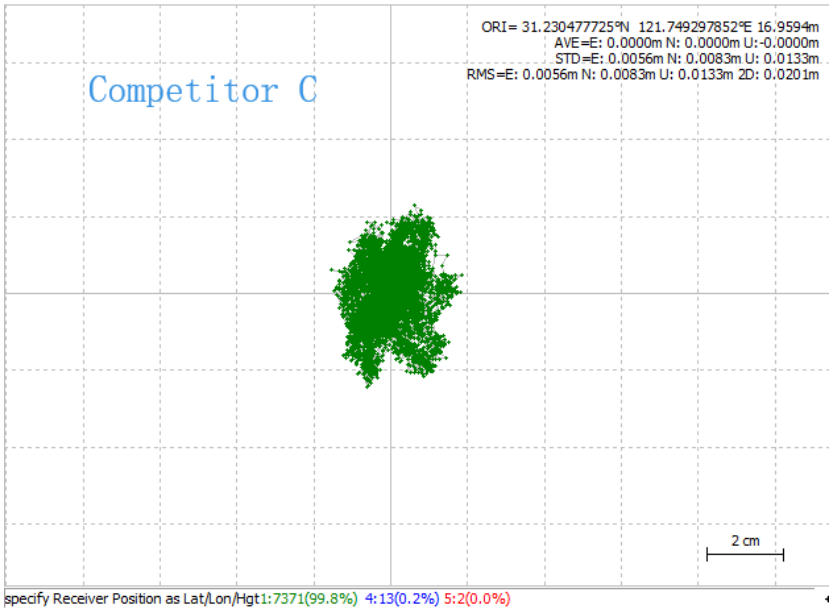


Figure 14 Trajectories of Each OEM boards