

## B.4 §5.6.9 Effects of specific interfering signals

### Reference position

Made by FREIE UND HANSESTADT HAMBURG  
 Vermessungsamt –VA311-

Description of point	geocentrically co-ordinates (WGS84)	geodetical geographical co-ordinates (WGS84)	Gauß-Krüger (Bessel)
North	x(m) 3740601.680	N 53° 32' 49".49049	x(m) 5935502.790
	y(m) 657439.492	E 9° 58' 6".10408	y(m) 564257.804
	z(m) 5107029.673	Height over Ellipsoid 95.900 m	Altitude above sea level 55.969 m
South	x(m) 3740618.106	N 53° 32' 48".81889	x(m) 5935482.027
	y(m) 657442.338	E 9° 58' 6".10189	y(m) 564258.046
	z(m) 5107017.296	Height over Ellipsoid 95.849 m	Altitude above sea level 55.917

Accuracy of survey = ± 5 cm

#### B.4.1 §5.6.9.1 L-Band interference

In a normal operating mode, using an appropriate signal source, the EUT shall be subjected to radiation of  $3 \text{ W/m}^2$  at a frequency of 1636.5 MHz for 10 min. The signal shall be removed and a performance check shall be carried out.

#### **Conditions of tests performed**

Frequency:	1636.5 MHz
Radiation:	$3 \text{ W/m}^2$
Duration of test:	10 min

#### **Test results**

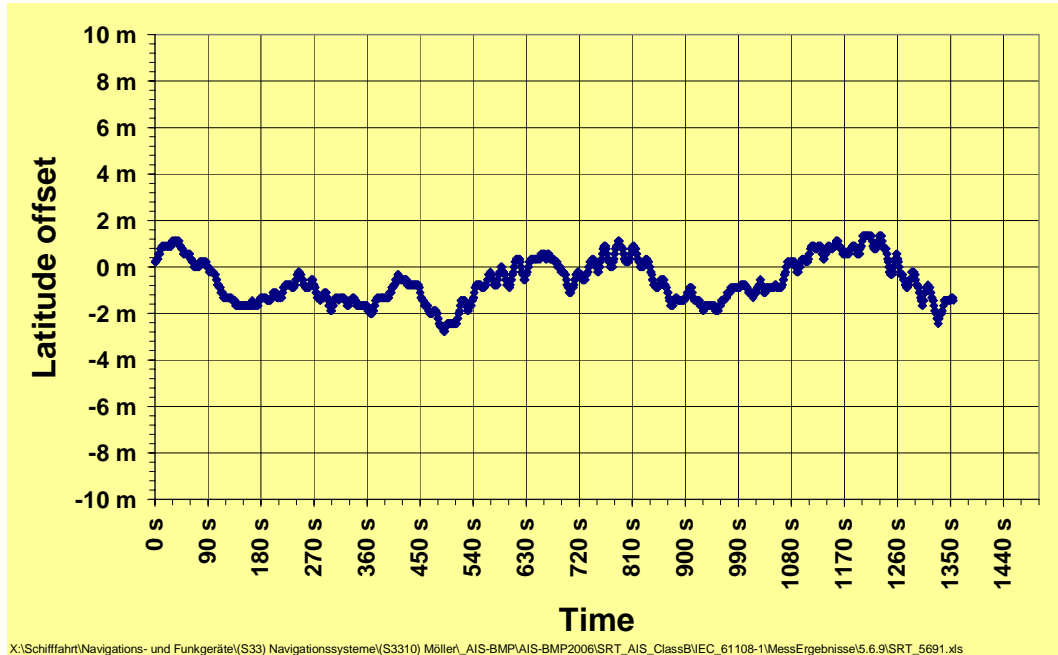
After removing the signal, the performance of the EUT was checked and found operating properly.

Position accuracy: 7.68m (2 sigma)

**Test result: Passed**

For details of validation of recorded data see the following pages.

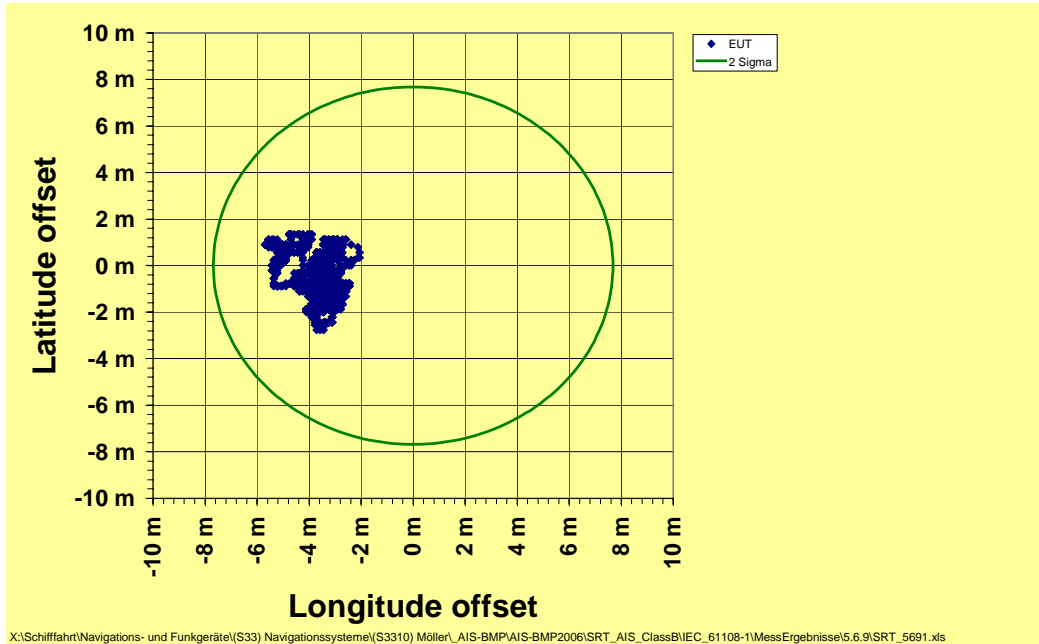
Latitude offset vs. time



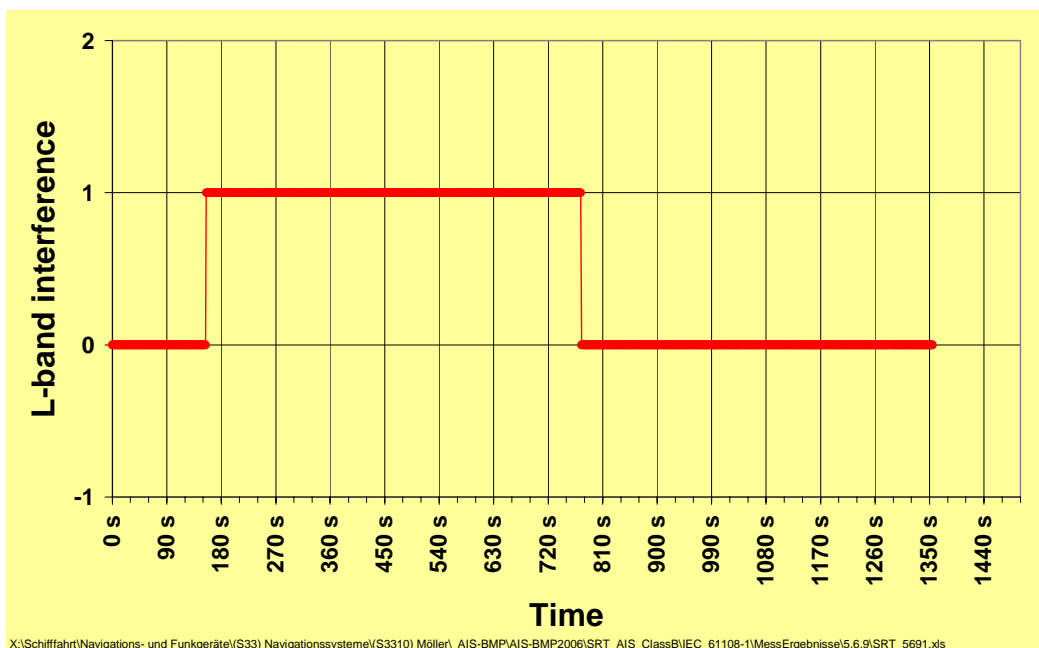
Longitude offset vs. time



### Position



### L-Band interference vs. time



#### B.4.2 §5.6.9.2 S- Band interference

In a normal operating mode, using an appropriate signal source, the EUT shall be subjected to radiation consisting of a burst of 10 pulses, each 1.0 to 1.5  $\mu$ s long on a duty cycle of 1600:1 at a frequency in the range of 2.9 to 3.1 GHz at a power density of approximately 7.5 kW/ m<sup>2</sup>. This condition shall be maintained for 10 min with the bursts of pulses repeated every 3 s.

The signal shall be removed and a performance check shall be carried out.

#### Conditions of tests performed

Frequency range:	2.9 to 3.1 GHz
Radiation:	7.5 kW/m <sup>2</sup>
Duration of test:	10 min

#### Test results

After removing the signal, the performance of the EUT was checked and found operating properly.

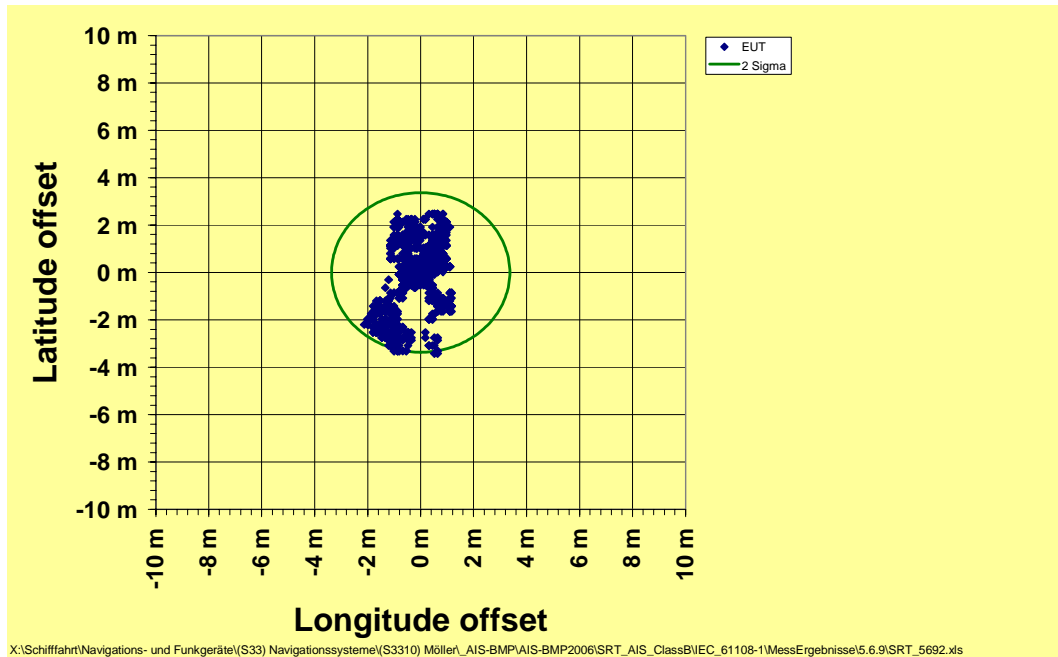
Position accuracy: 3.37m (2 sigma)

#### Test result: Passed

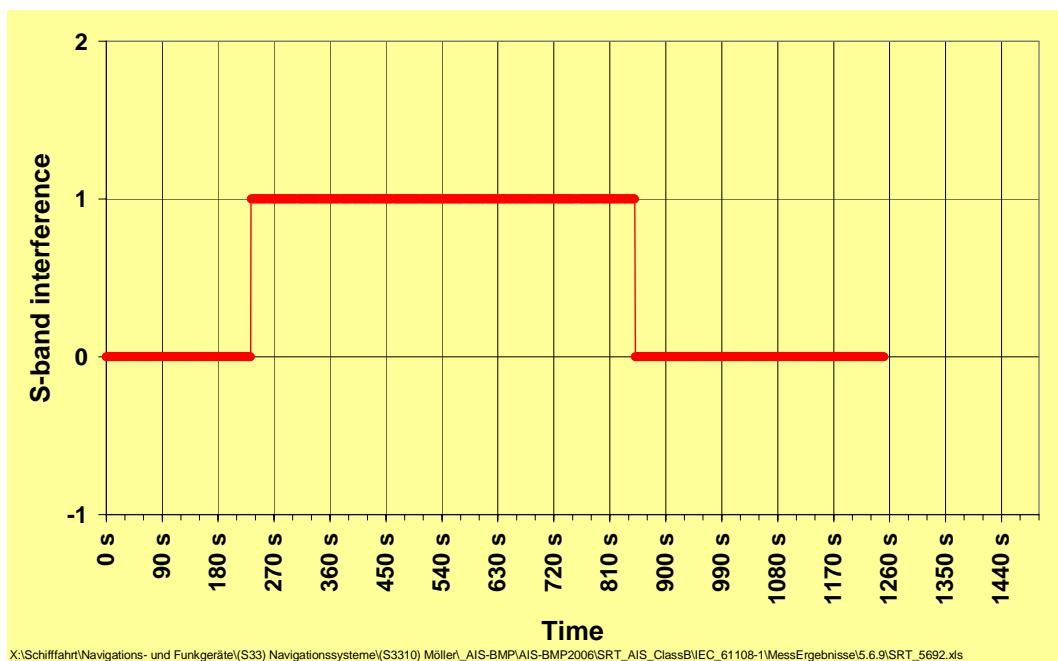
For details of validation of recorded data see the following pages.



### Position



### Interference vs. time



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## B.5 §5.6.10 Position update

### B.5.1 § 5.6.10.1 Slow speed update rate

The EUT shall be placed upon a platform, moving in approximately a straight line, at a speed of 5 knots  $\pm$ 1 knots. The position output of the EUT shall be checked at intervals of 10 s, over a period of 10 min. The output position shall be observed to be updated on each occasion.

This test may be carried out by a simulator.

The minimum resolution of position, i.e. latitude and longitude shall be checked by observation during 5.6.10.1.

Record the IEC 61162 output of the EUT during this test and confirm that received positions at the end of each interval are in compliance with the real or simulated reference position.

#### Conditions of tests performed

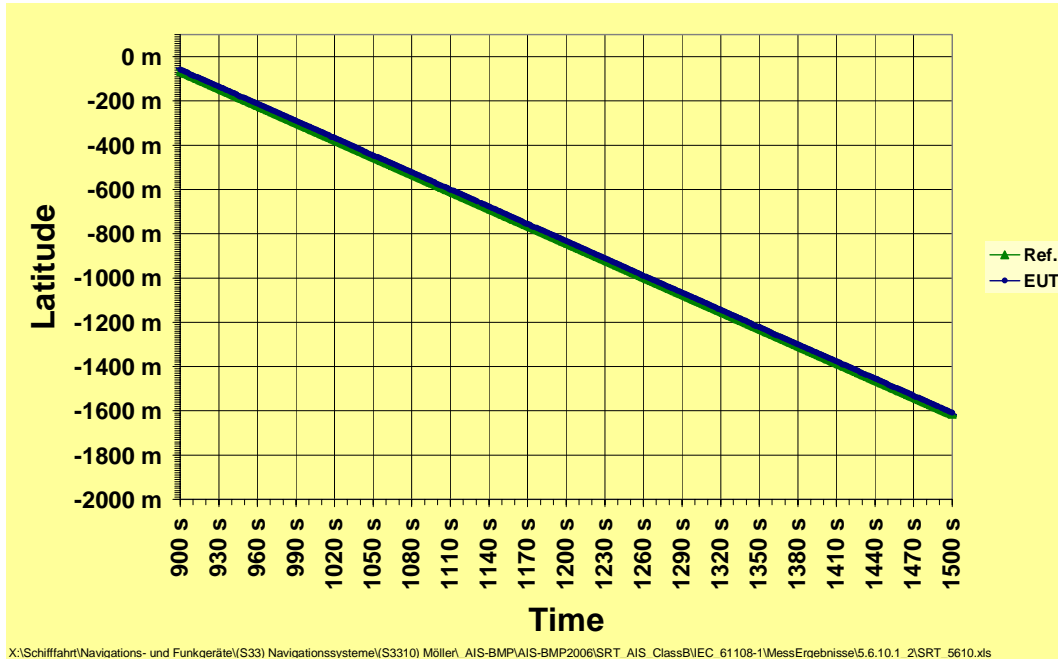
Tests performed by using a simulator

**Test result: Passed**

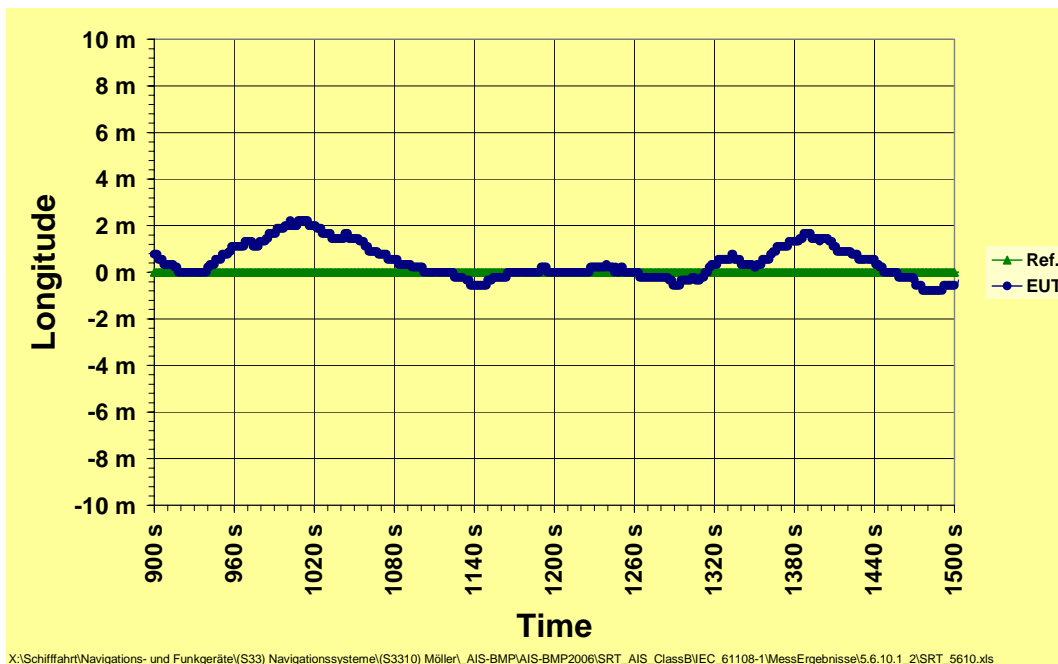
For details of validation of recorded data see the following pages.



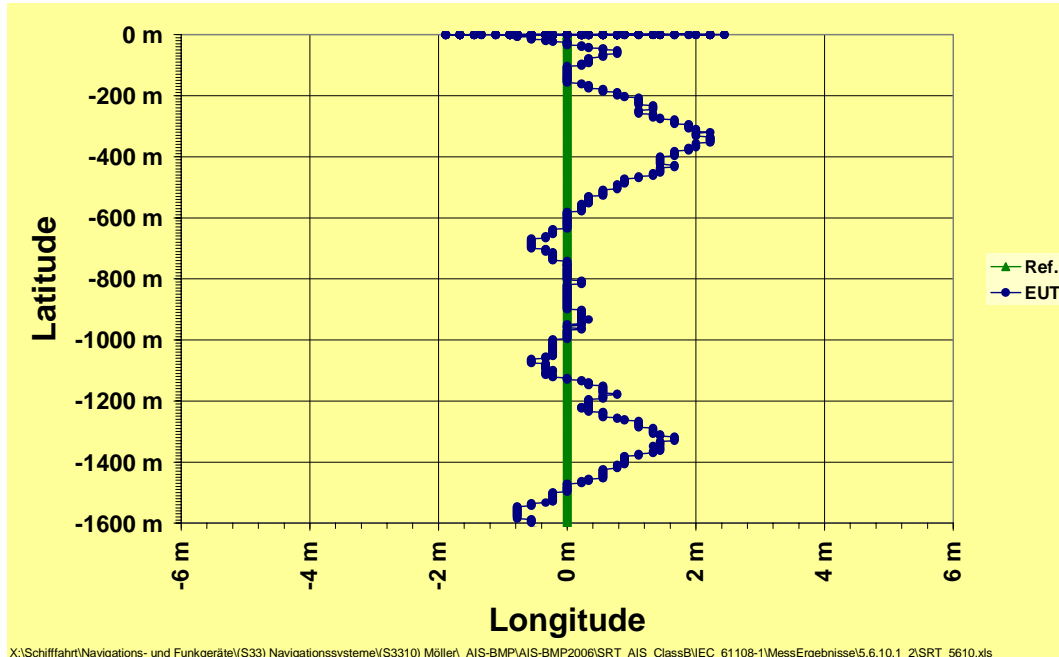
Latitude vs. time



Longitude vs. time

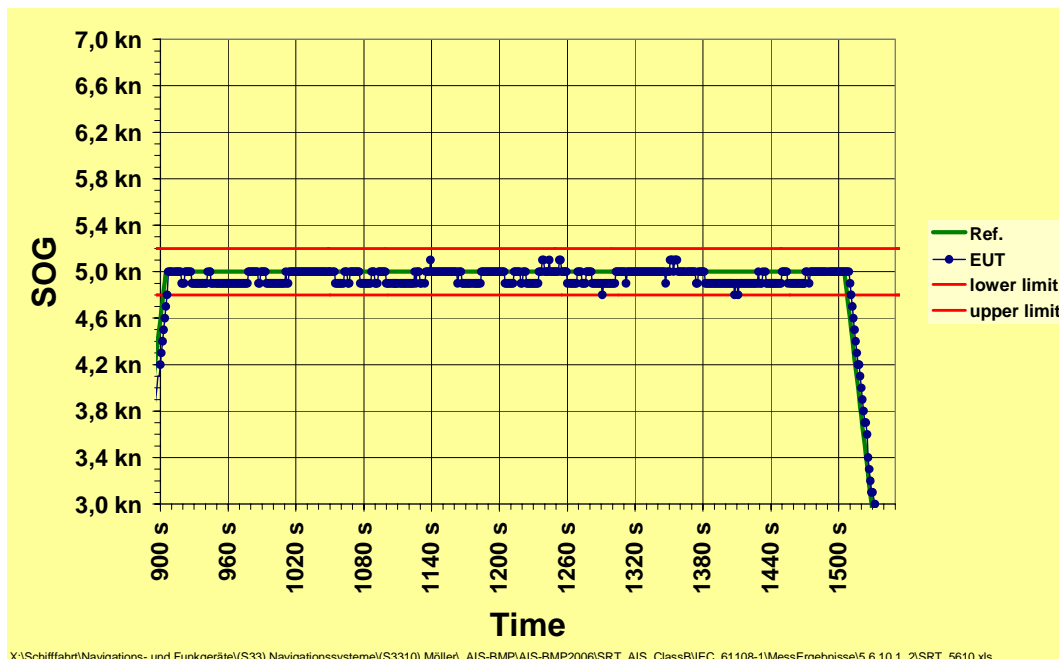


Position



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Speed over ground (SOG)



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### B.5.2 § 5.6.10.2 High speed update rate

The EUT shall be placed upon a platform, moving in approximately a straight line, at a speed of 50 knots  $\pm 5$  knots. The position output of the EUT shall be checked at intervals of 10 s, over a period of 10 min. The output position shall be observed to be updated on each occasion.

This test may be carried out by a simulator with a speed of 70 knots at intervals of 0.5 s.

The minimum resolution of position, i.e. latitude and longitude shall be checked by observation during 5.6.10.2.

Record the IEC 61162 output of the EUT during this test and confirm that received positions at the end of each interval are in compliance with the real or simulated reference position.

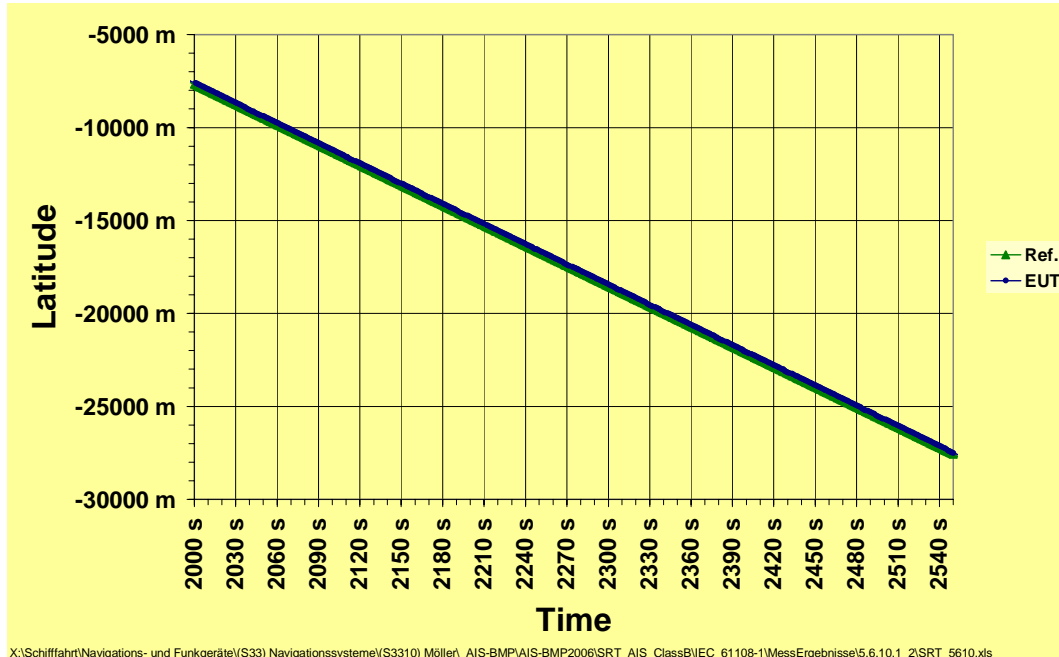
#### Conditions of tests performed

Tests performed by using a simulator

**Test result: Passed**

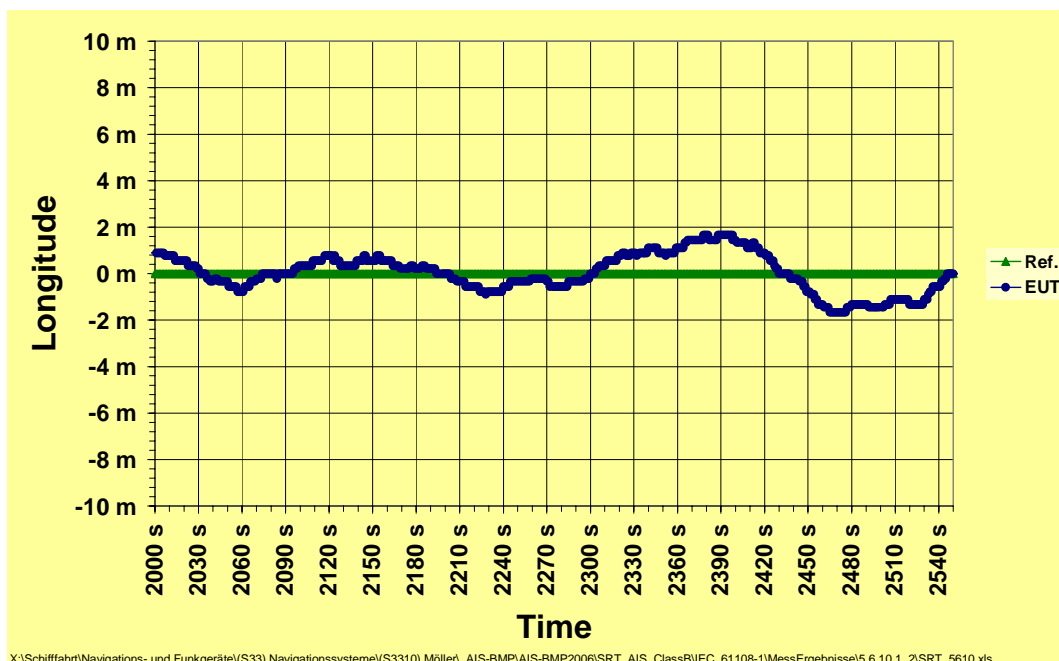
For details of validation of recorded data see the following pages.

Latitude vs. time



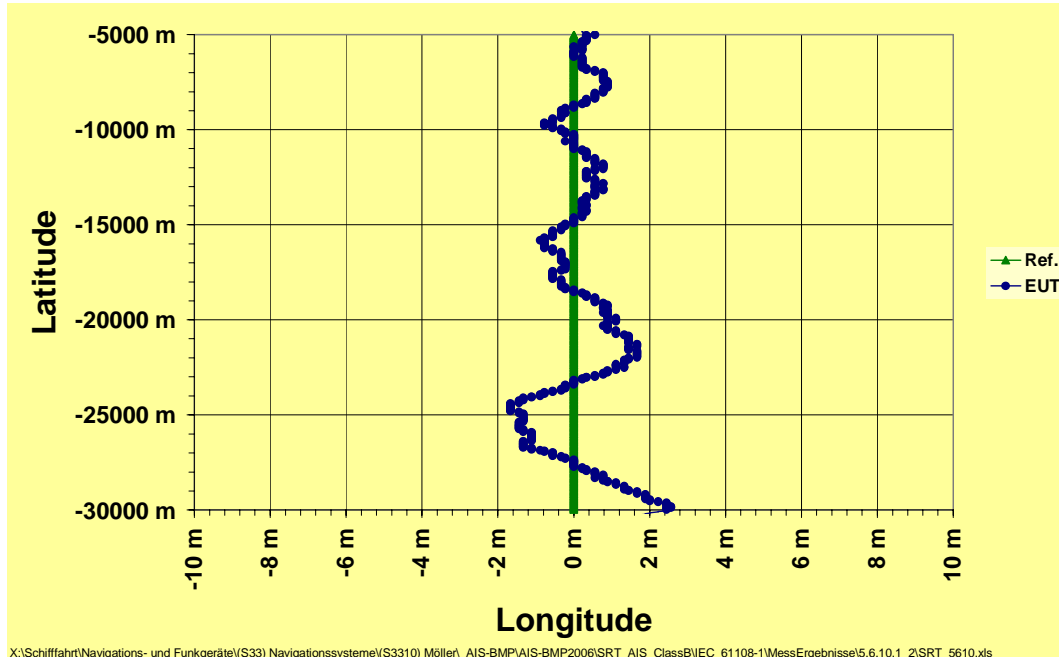
X:\Schifffahrt\Navigations- und Funkgeräte\333) Navigationssysteme\33310) Möller, AIS-BMP\AIS-BMP2006\SRT AIS ClassB\IEC 61108-1\MessErgebnisse\5.6.10.1 2\SRT\_5610.xls

Longitude vs. time



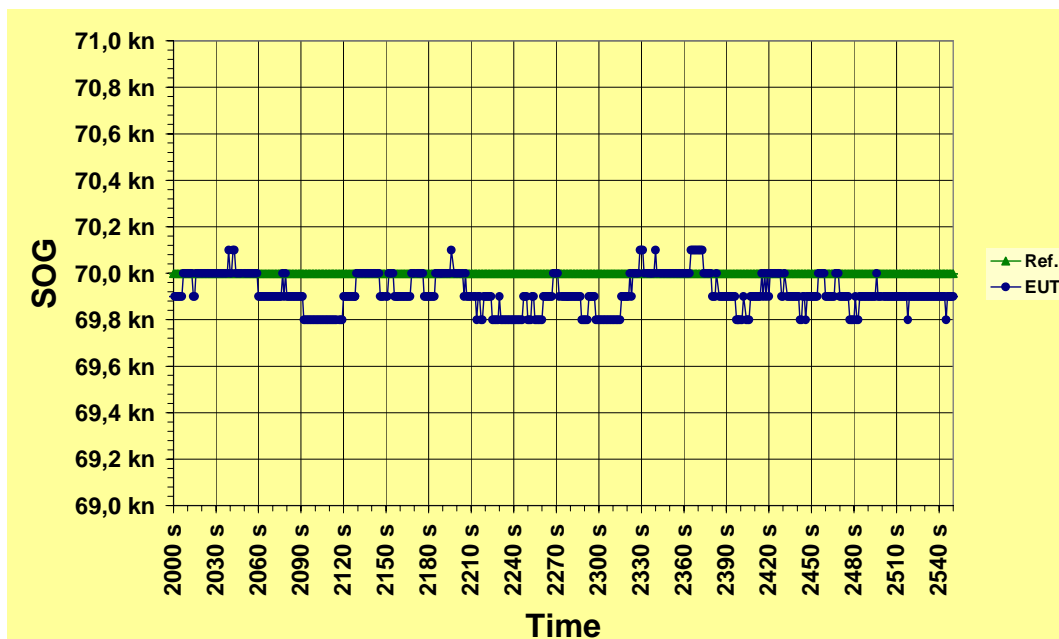
X:\Schifffahrt\Navigations- und Funkgeräte\333) Navigationssysteme\33310) Möller, AIS-BMP\AIS-BMP2006\SRT AIS ClassB\IEC 61108-1\MessErgebnisse\5.6.10.1 2\SRT\_5610.xls

Position



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Speed over ground (SOG), 70 knots



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## B.6 §5.6.12 Failure warnings and status indication

### B.6.1 Simulation scenarios for test of RAIM functionality

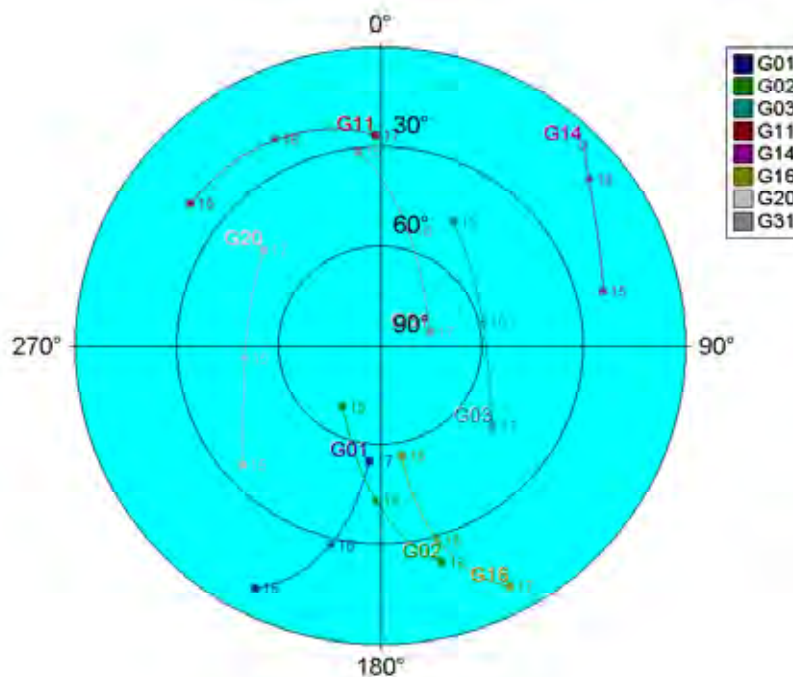
#### **Reference position WTD 81 Greding**

Made by GPS-Simulator

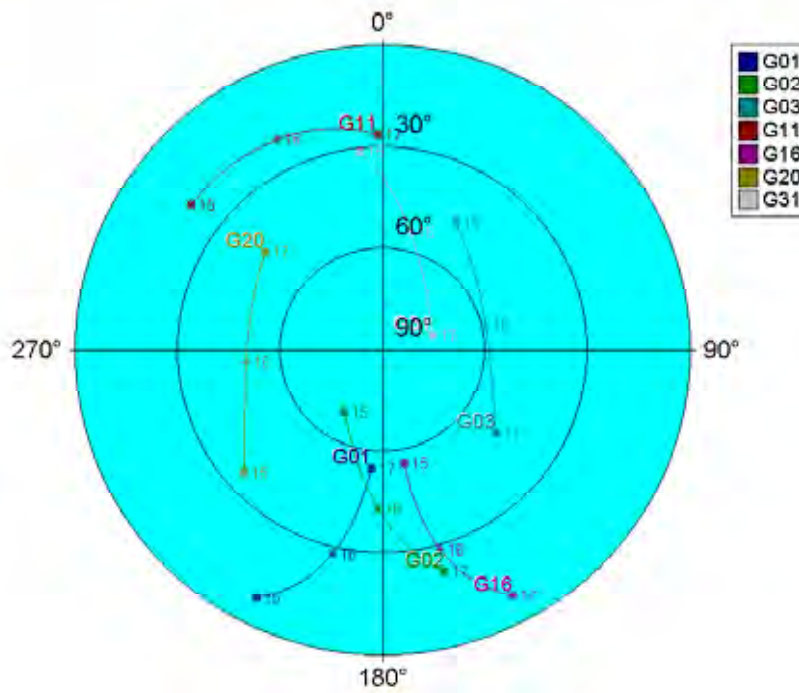
	geocentrically co-ordinates (WGS84)
Latitude	0.000000000000 ° N
Longitude	0.000000000000 ° E

Accuracy of survey = ± 0 cm

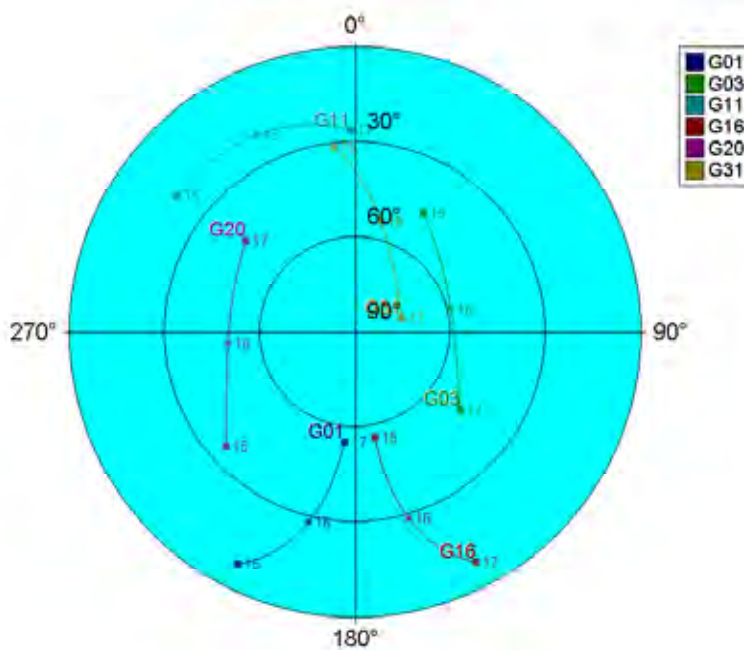
Simulated constellation with 8 satellites



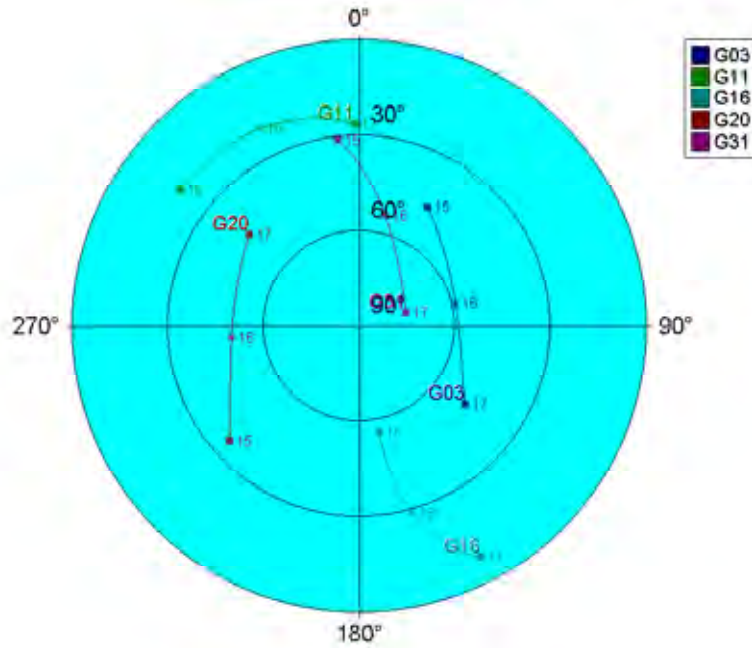
Simulated constellation with 7 satellites



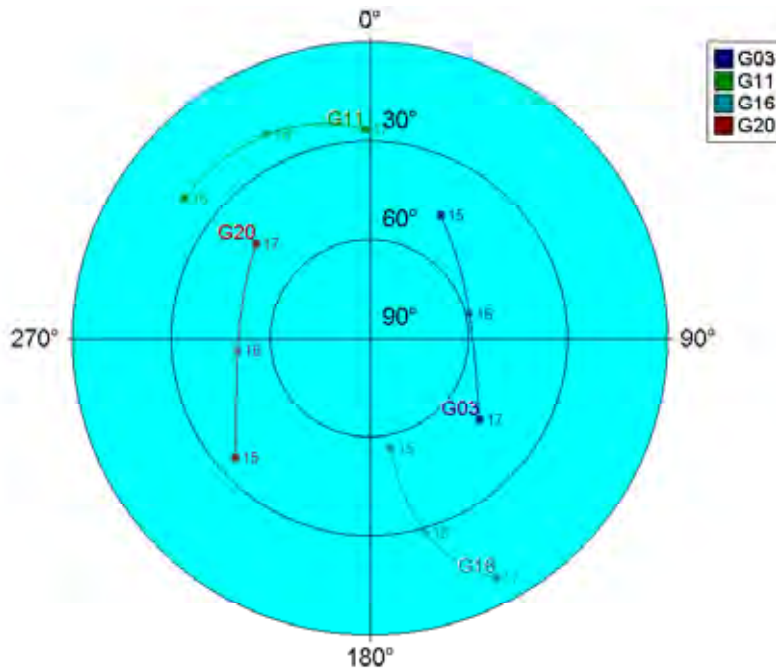
Simulated constellation with 6 satellites



Simulated constellation with 5 satellites



Simulated constellation with 4 satellites





Satellites and ramps

Scenario: W224\_1500\_8\_TO\_4\_SAT\_RAMP\_SHORT.SCEN;3

Start time: 13.12.2003, 15:00:00 Pseudorange - Ramp: 500 m  
 4 min. Ramp up, 1 min. Hold, 4 min. Ramp down  
 Sat.-Ids: 1, 2, 3, 11, 14, 16, 20, 31

4 Satellites	01:19:00							
	01:16:00	Ramp end	20					
	01:12:00	Ramp down						
	01:11:00	Ramp hold						
	01:07:00	Ramp up						
	01:06:00	Sat. Off	31					
5 Satellites	01:03:00	Ramp end	31					
	00:59:00	Ramp down						
	00:58:00	Ramp hold						
	00:54:00	Ramp up						
	00:53:00	Sat. Off	1					
6 Satellites	00:50:00	Ramp end	1					
	00:46:00	Ramp down						
	00:45:00	Ramp hold						
	00:41:00	Ramp up						
	00:40:00	Sat. Off	2					
7 Satellites	00:37:00	Ramp end	2					
	00:33:00	Ramp down						
	00:32:00	Ramp hold						
	00:28:00	Ramp up						
	00:27:00	Sat. Off	14					
8 Satellites	00:24:00	Ramp end	14					
	00:20:00	Ramp down						
	00:19:00	Ramp hold						
	00:15:00	Ramp up						
	00:00:00	Sat. Off	13	22	25	27	28	

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**B.6.2 § 5.6.12.2 Test of integrity monitoring using RAIM**

This test applies to 4.3.11.2.

**§ 5.6.12.2.1 Testing of "safe" and "caution" status**

Not applicable for AIS

**§ 5.6.12.2.2 Testing of "unsafe" status**

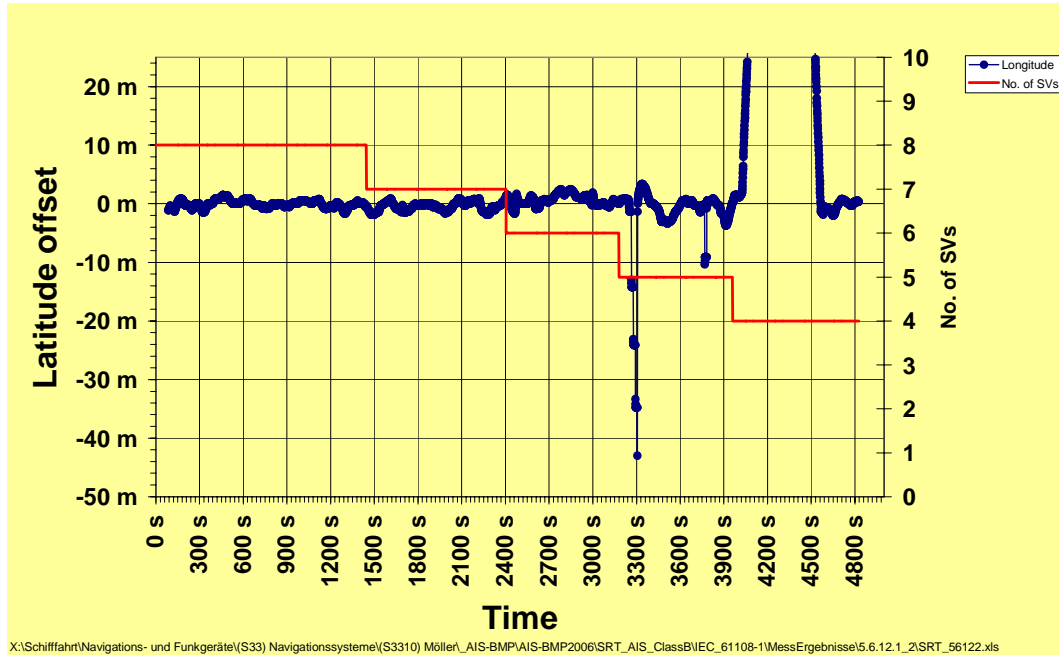
This test was performed by using the a.m. simulator.

Number of satellites was reduce from 8 down to 4, with one satellite transmitting faulty positioning data.

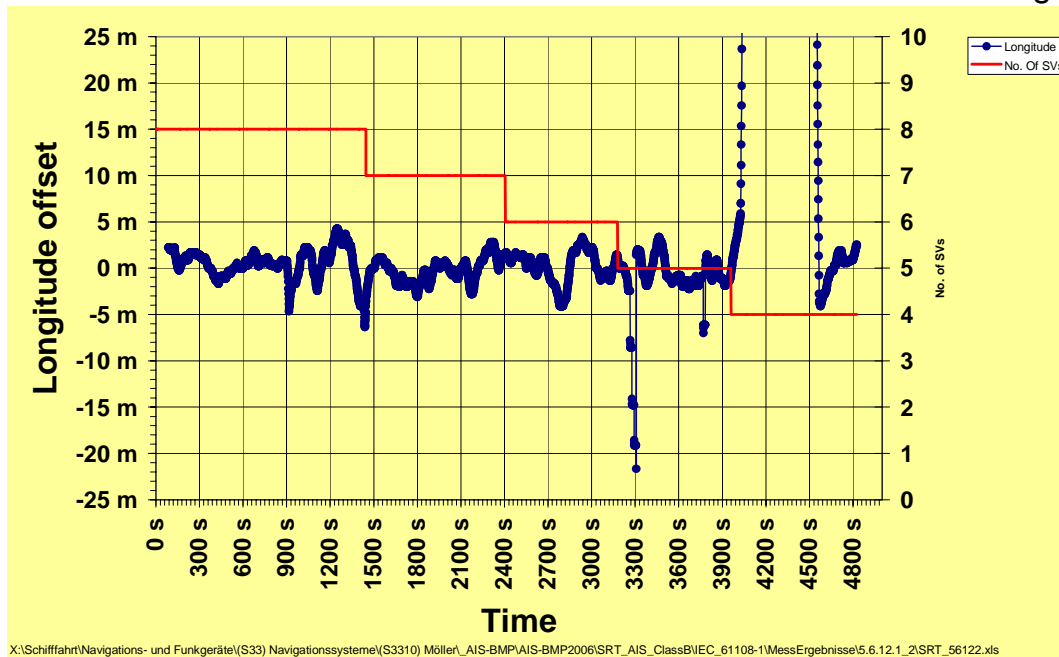
Position calculation, overall RAIM behaviour and use of PA-flag found OK.

For details see the following pages.

Position calculation with reduced no.of SVs and one "bad" SV – Latitude



Position calculation with reduced no.of SVs and one "bad" SV - Longitude



## B.7 § 5.6.13 Accuracy of COG and SOG

The EUT shall be set up on an appropriate mobile unit or simulator and all outputs indicating course over ground shall be monitored.

At a constant forward direction, the forward speed shall be within 0 knots to 1 knot. Ten seconds after being in the range, measurements shall be made for a duration of 2 min. This cycle shall be repeated for all speed ranges of the table below.

**Table – Accuracy of COG**

Speed range (knots)	Tested value	Accuracy of COG output to user
0 to ≤1 knot	( ~0.5 kn )	Unreliable or nor available
>1 to ≤17 knots	( ~14.3 kn )	± 3 °
> 17 knots	( ~25 kn )	± 1 °

### **Required results**

The test results shall be observed the display and the approved interface.

For SOG tests, no reading of the speed indicator shall differ from the constant speed being applied at the time by more than 2 % of that speed or 0.2 knots, whichever is the greater.

For COG tests, the difference between the reference direction and measured course over ground of in each test cycle shall not exceed the limits in the table.

### **Conditions of tests performed**

Tests performed by using a car-mounted reference D/GPS system (+/-0,2Knots) in combination with the EUT.

### **Test result: Passed**

For details of validation of recorded data see the following pages.

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## **Validity of COG and SOG information**

### **Method of testing**

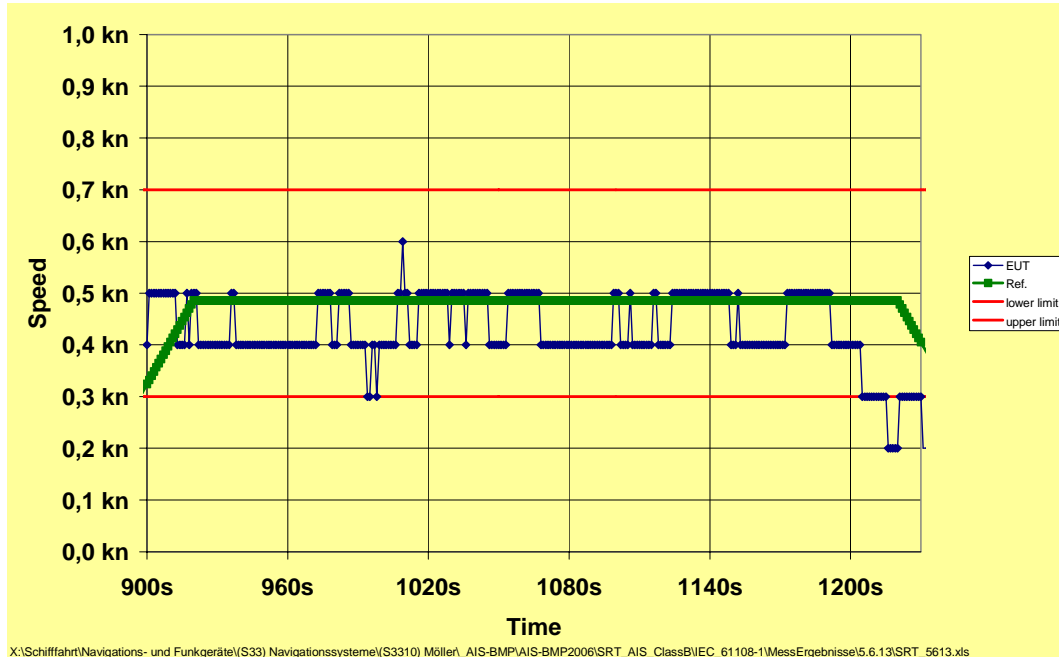
Check digital interface with IEC 61162. With the EUT normally operating, preclude invalid position by reducing the number of received satellites. Investigate the content of the resultant AIS VDO Messages.

### **Required result**

Observe that the COG and SOG information contained in AIS VDO message of IEC 61162 is replaced by "default values".

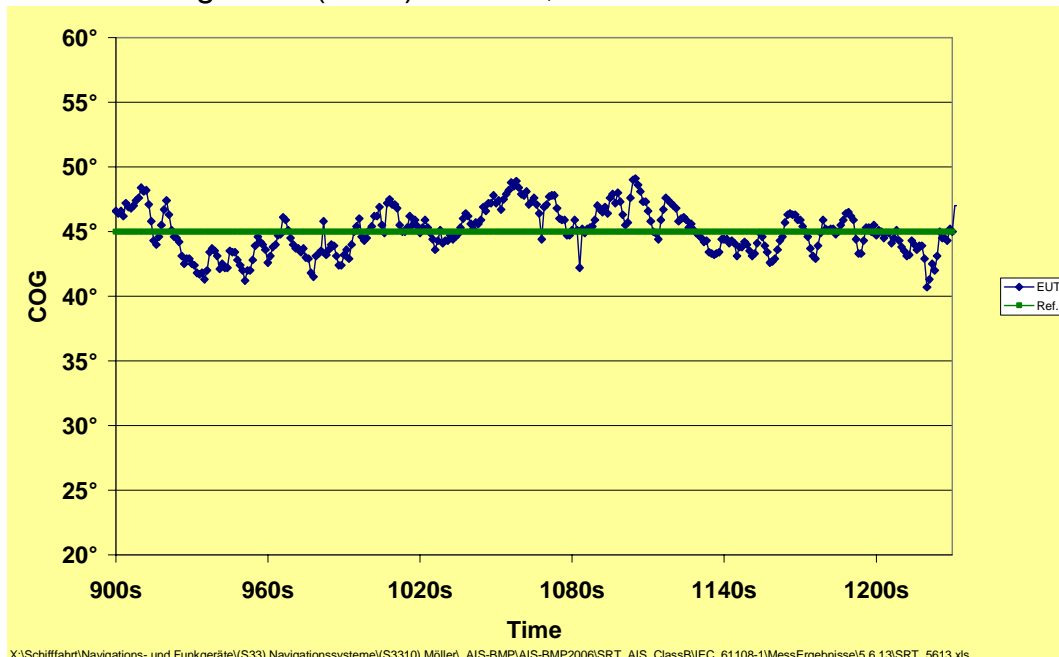
**Test result: Passed**

Speed over ground (SOG) vs. time, 0.5 Knots



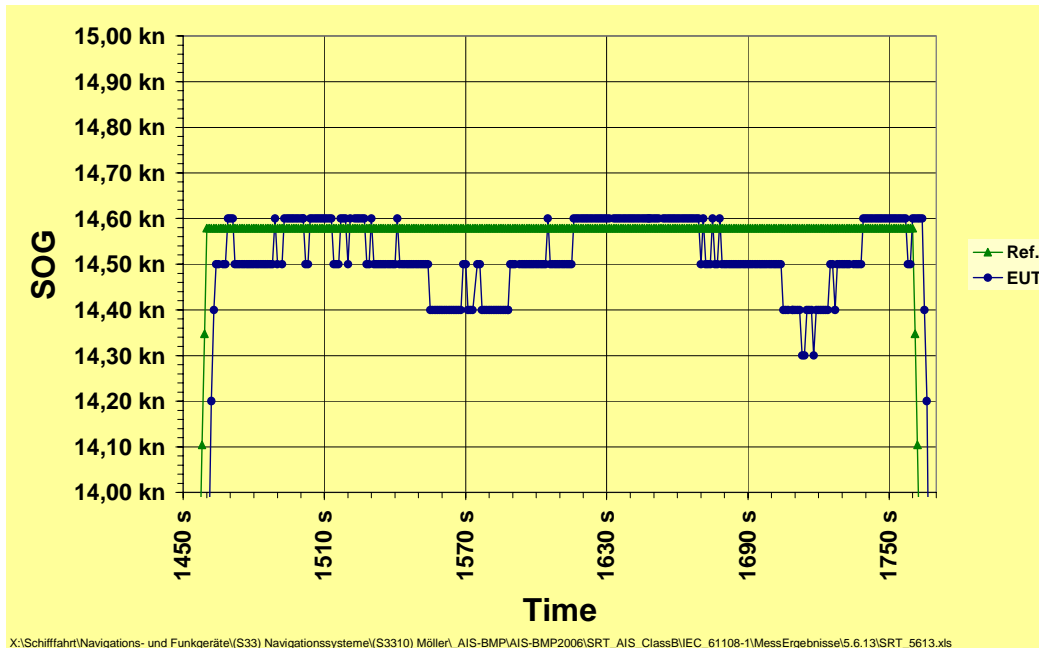
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Course over ground (COG) vs. time, 0.5Knots

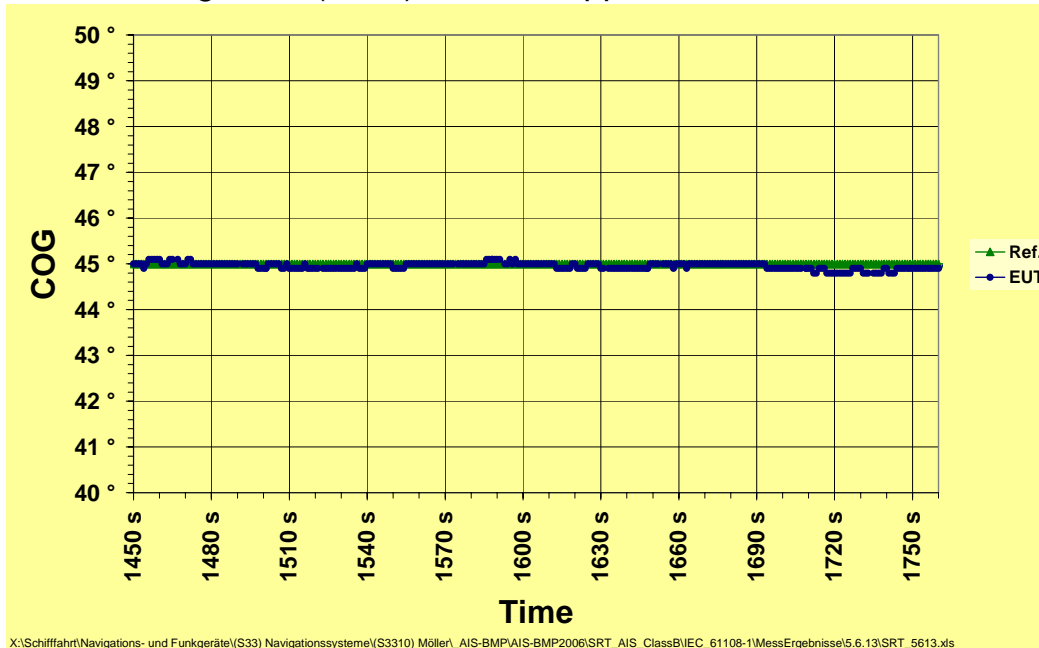


X:\Schifffahrt\Navigations- und Funkgeräte(S33) Navigationssysteme(S3310) Möller\_AIS-BMP\AIS-BMP2006\SRT\_AIS\_ClassB\IEC\_61108-1\MessErgebnisse\5.6.13\SRT\_5613.xls

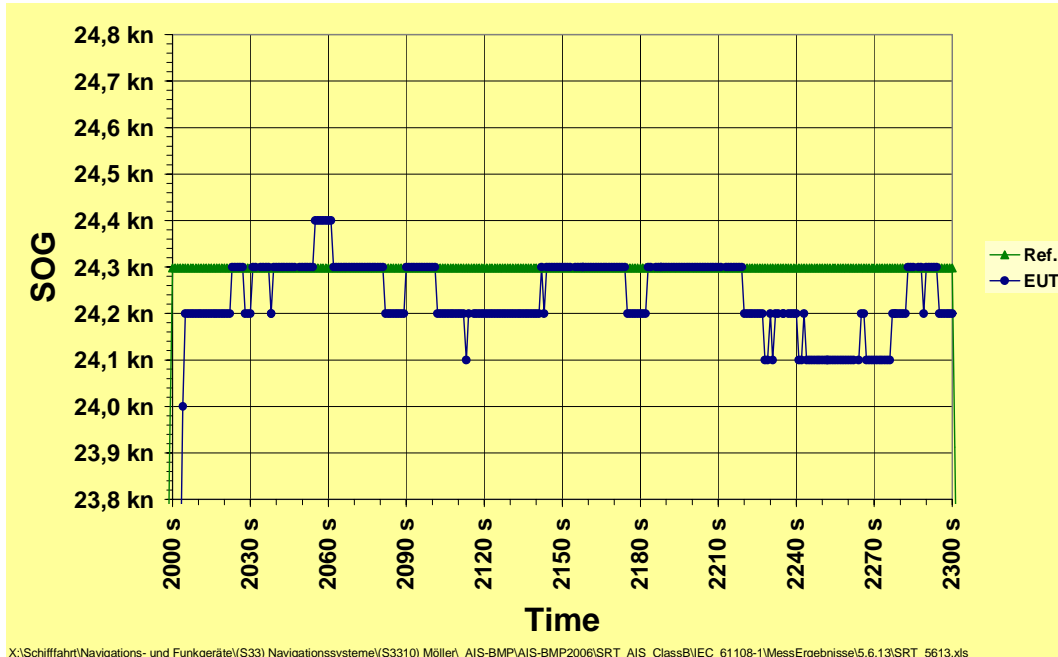
Speed over ground (SOG) vs. time, approx. 14.3Knots



Course over ground (COG) vs. time, approx. 14.3Knots

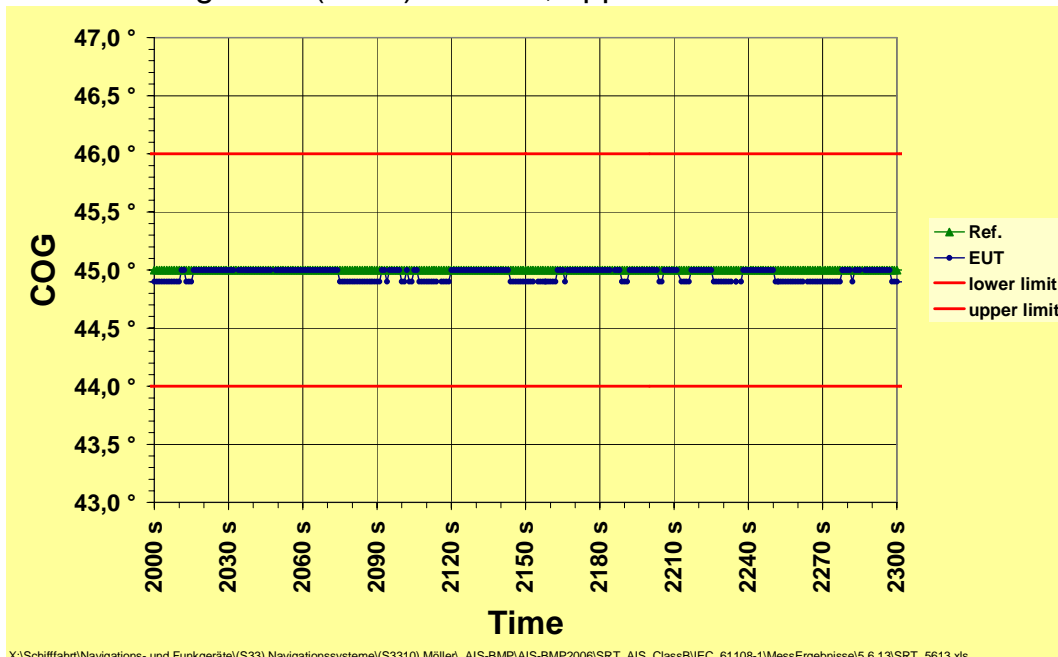


Speed over ground (SOG) vs. time, approx. 25Knots



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Course over ground (COG) vs. time, approx. 25Knots



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## B.8 § 5.7.2 Testing interference

### B.8.1 § 5.7.2.4.1 Interference conditions

Interference conditions, including broadband noise centred at 1575.42 MHz, continuous wave interference (CWI), and pulsed interference shall be simulated. For the pulsed interference tests, a pulse-modulated carrier (CW) with peak carrier level of  $-20$  dBm and duty factor of 10 % shall be used. The interference values are shown in the three tables below.

<b>Broadband interference values</b>		
Noise bandwidth (MHz)	Requested total RMS power (dBm)	Applied interference
1	-110.5	-107.5 dBm at 2 MHz

<b>Pulsed interference values</b>		
Frequency (MHz)	Pulse width (ms)	Applied interference
1575.42	1	1 ms at 1575.42 MHz

<b>Continuous wave interference (CWI) values</b>		
Frequency (MHz)	Requested power (dBm)	Applied interference
1575.42	-120.5	-120 dBm at 1575.42 MHz
1626.0	+8.0	-80 dBm at 1596.0 MHz

### § 5.7.2.4.2 Test procedures

- a) The equipment under test is subjected to one of the interference sources.
- b) The simulator scenario shall be engaged and the satellite signals turned on.
- c) The equipment under test shall be powered and initialised.
- d) While the EUT is providing position solutions, the interference shall be applied to the equipment under test, and the level of the interference shall be adjusted to the required value.
- e) When steady-state accuracy is reached, record a minimum of 100 position and HDOP value as reported by the EUT at a rate of one sample every 2 min.
- f) Repeat this cycle for any remaining interference source.

### § 5.7.2.4.3 Required results

#### Pass/fail determination

If the EUT reports a position with a normalised error greater than 10 m or fails to report a position in more than 5 % of the samples, a test failure is declared.

Conditions of tests performed

Tests performed by using a simulator.

#### Broadband noise (–107.5 dBm at 2 MHz band width)

12:11:00	Test start
12:13:00	Interference start
12:23:00	Interference stop
12:25:00	Test end

**Pulsed interference (-20 dBm at 1575.42 MHz with 1 ms pulse width)**

12:29	Test start
12:31:00	Interference start
12:41:00	Interference stop
12:45	Test end

**Continuous wave interference (-120.5 dBm at 1575.42 MHz)**

12:45	Test start
12:46:00	Interference start
12:56:00	Interference stop
12:58	Test end

**Continuous wave interference (-80 dBm at 1596 MHz)**

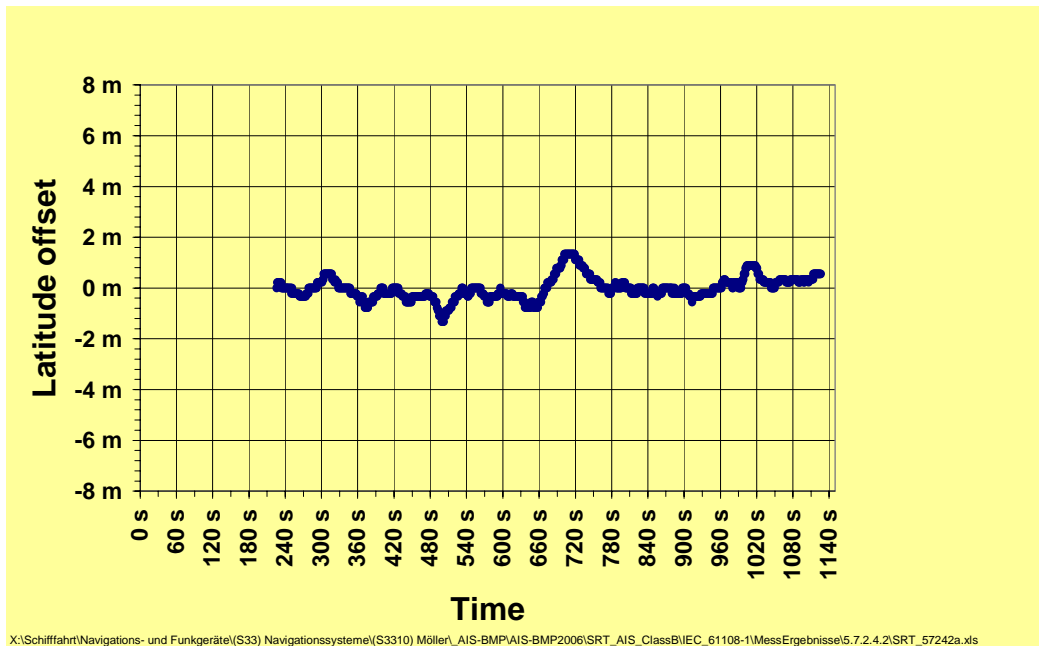
12:59	Test start
13:00:00	Interference start
13:10:00	Interference stop
13:13	Test end

**Test result: Passed**

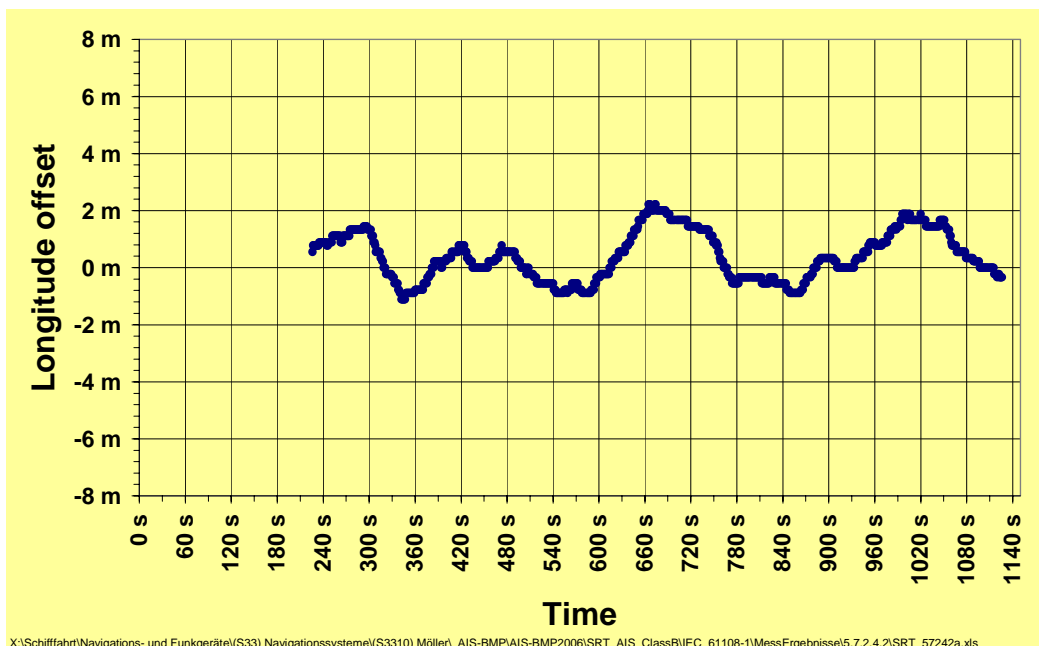
For details of validation of recorded data see the following pages.

**Broadband noise (-107.5 dBm at 2 MHz band width)**

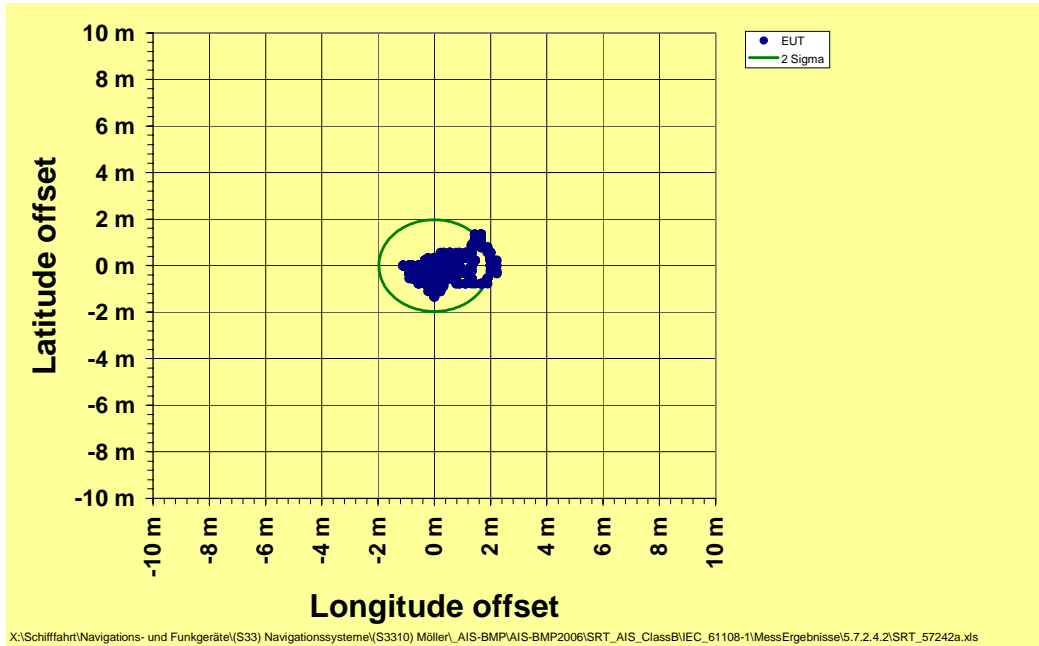
Latitude offset vs. time



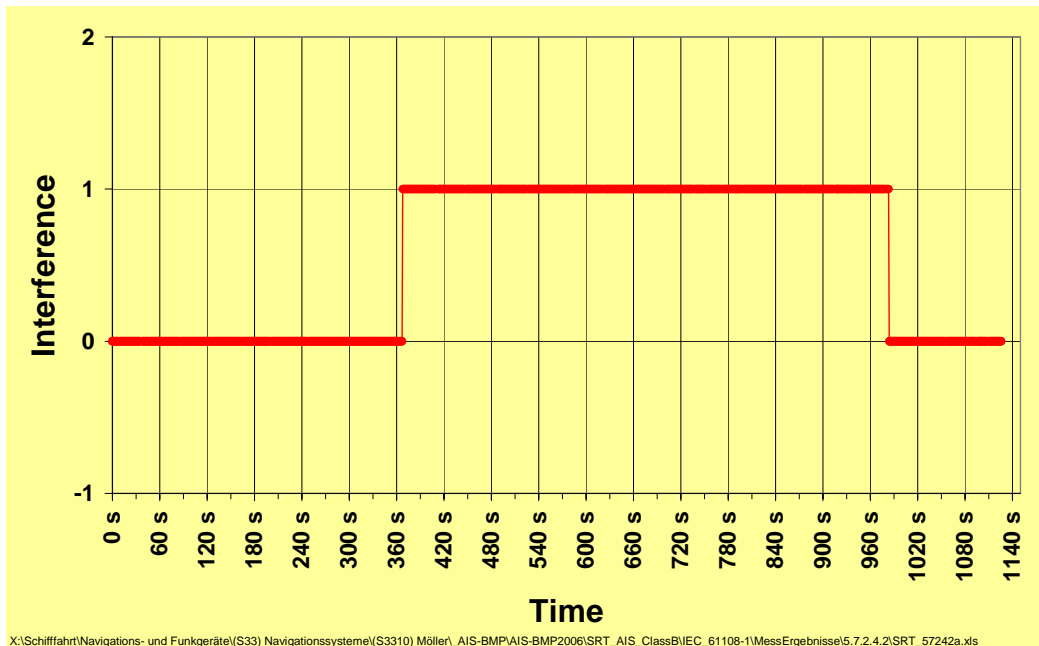
Longitude offset vs. time



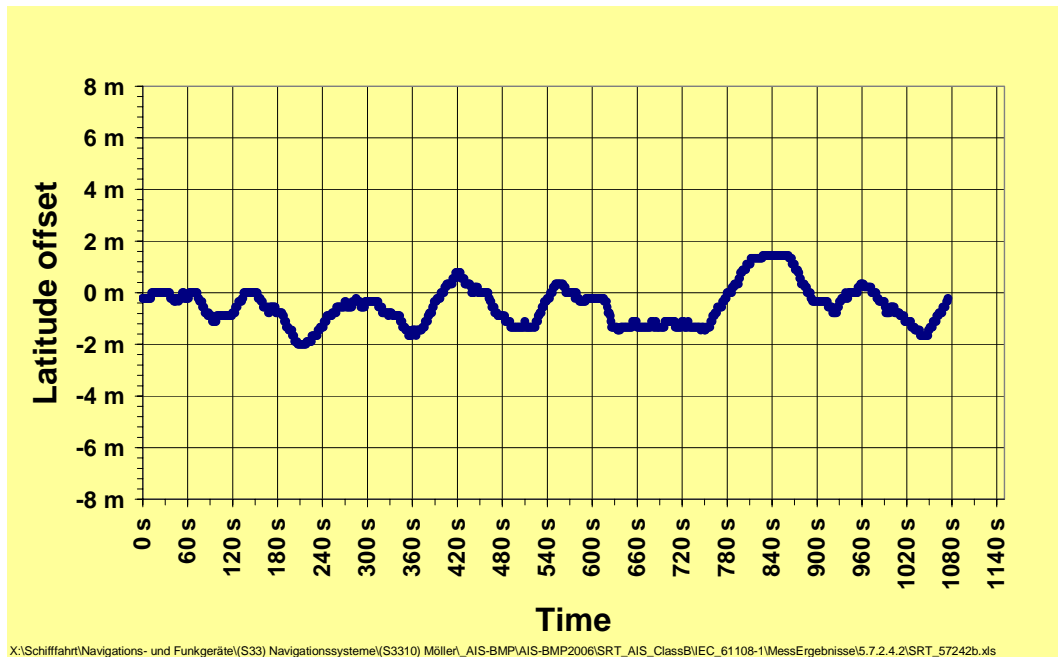
Position offset



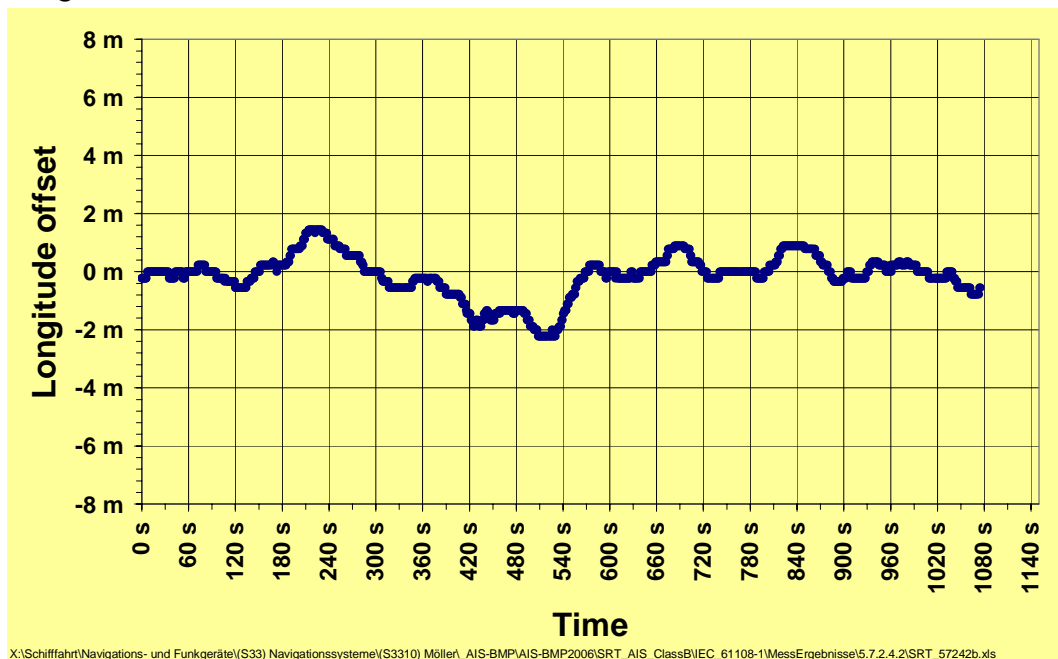
RF interference vs. time



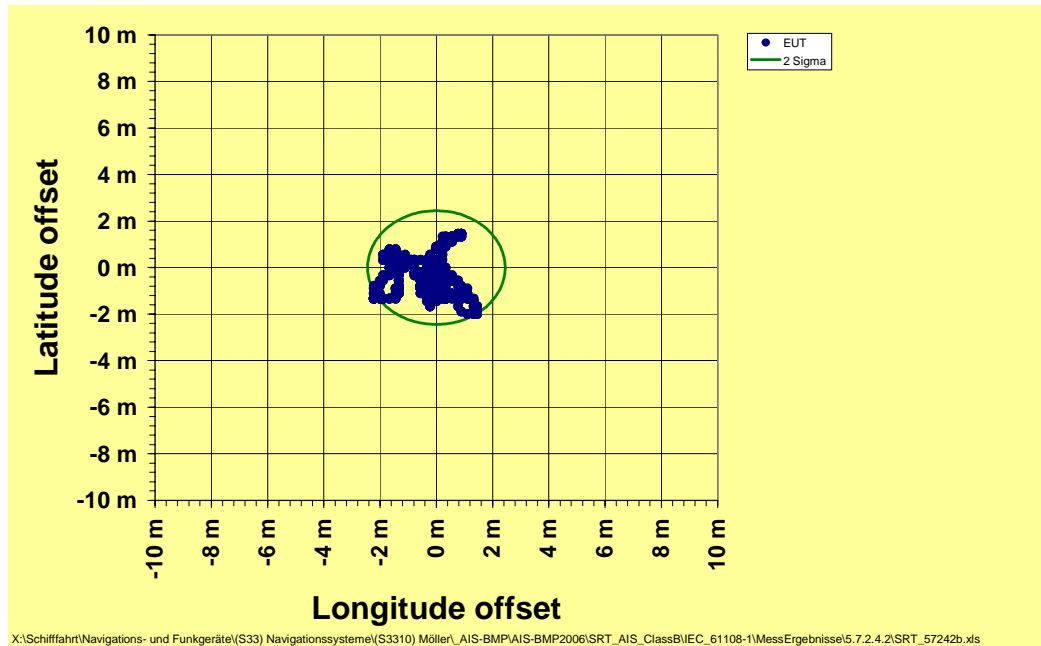
**Pulsed interference (-20 dBm at 1575.42 MHz with 1 ms pulse width)**  
Latitude offset vs. time



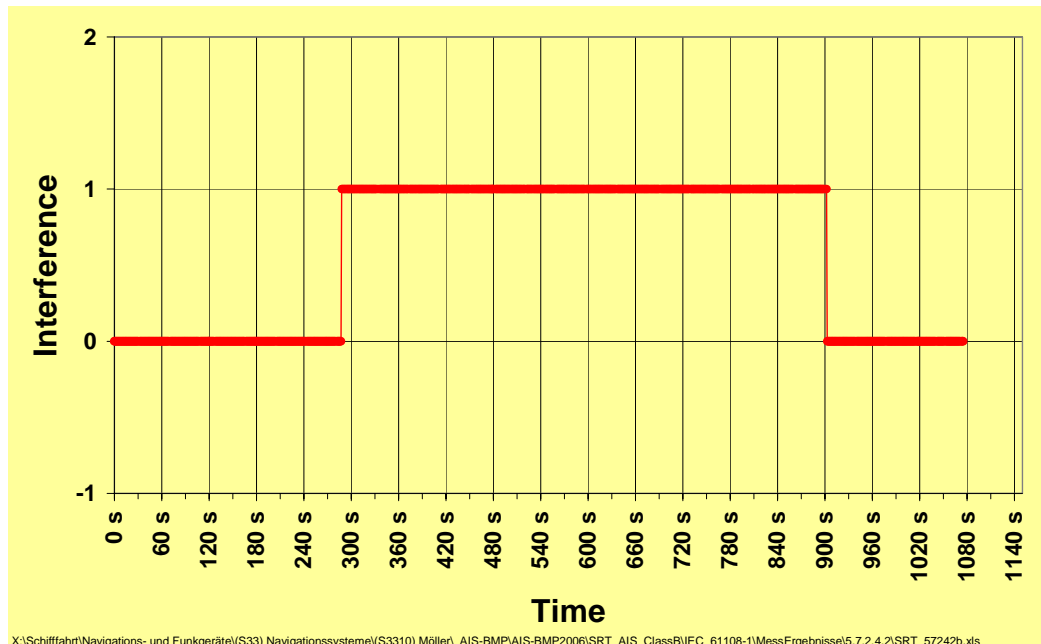
Longitude offset vs. time



### Position offset

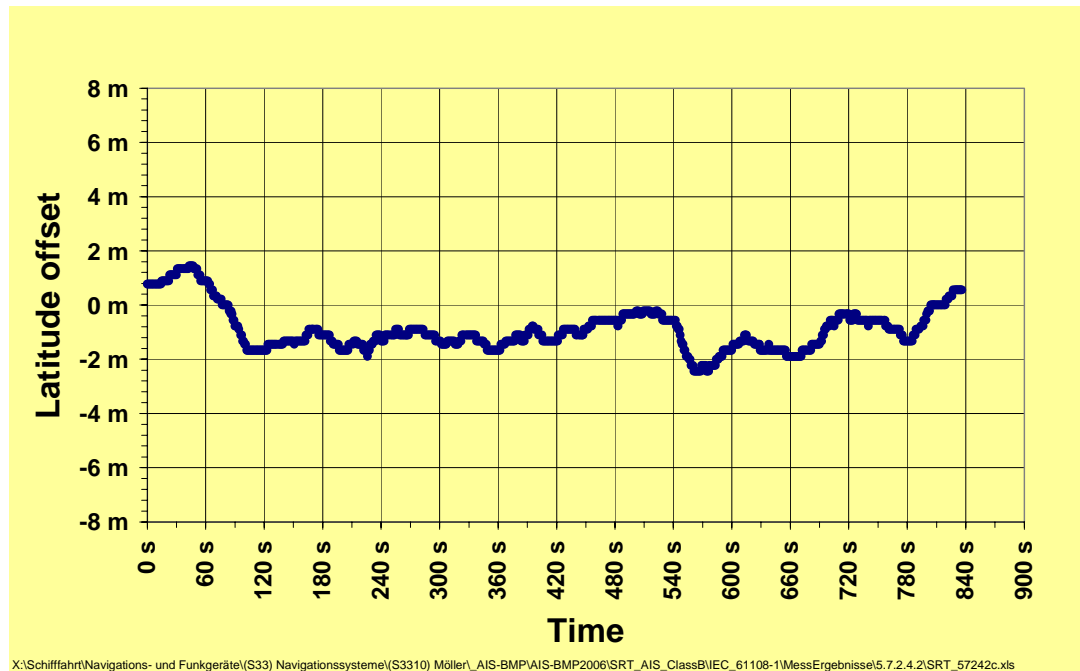


### RF interference vs. time



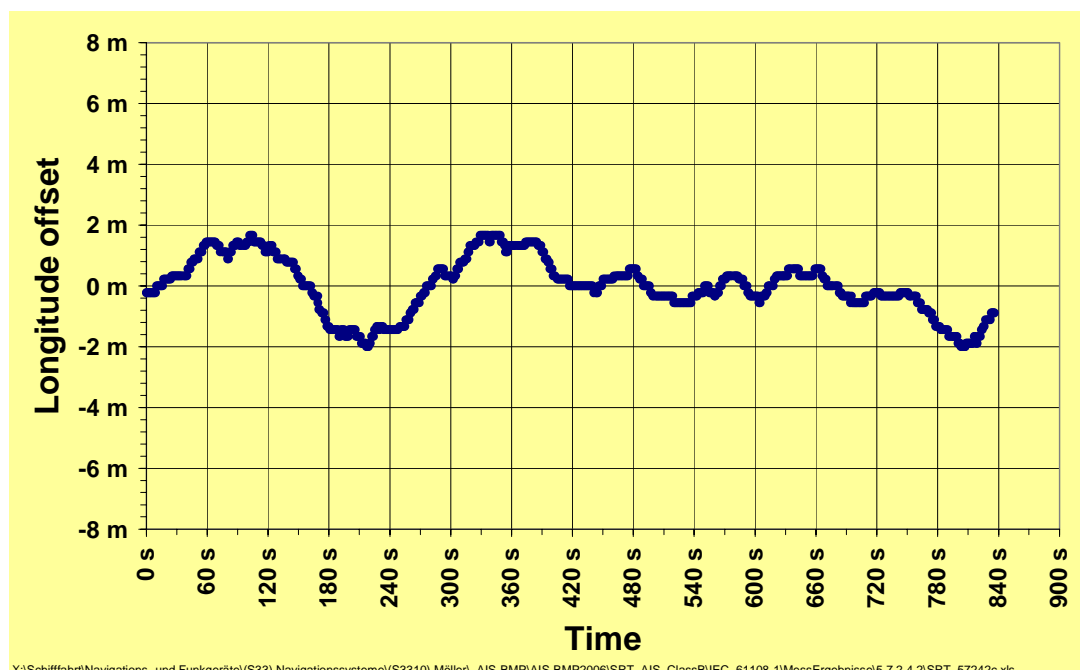
### Continuous wave interference (-120.5 dBm at 1575.42 MHz)

Latitude offset vs. time



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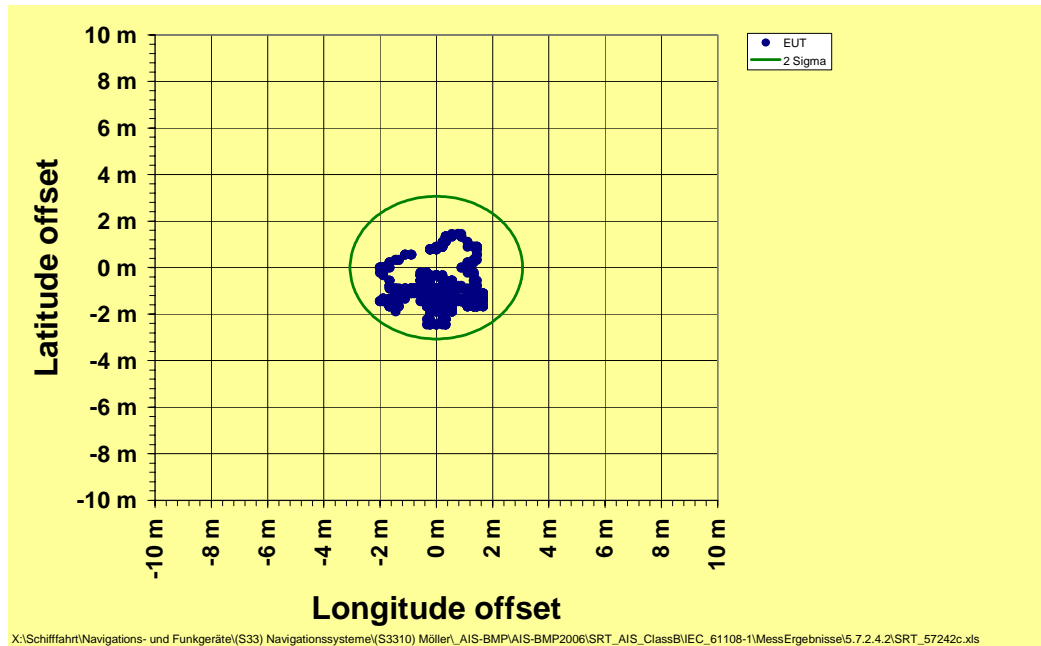
Longitude offset vs. time



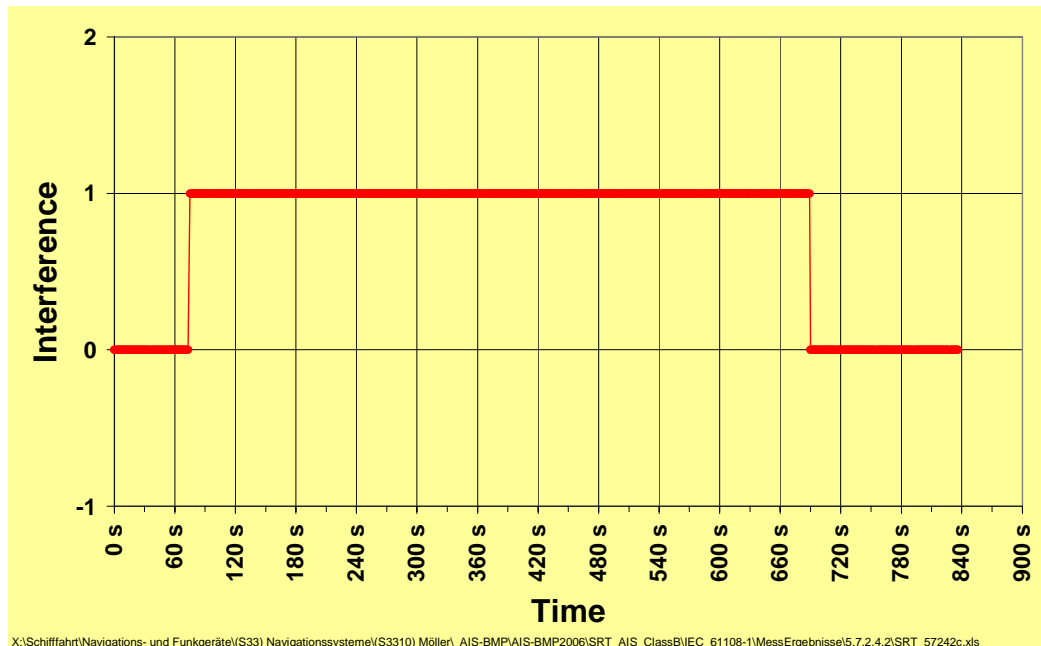
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### Position offset

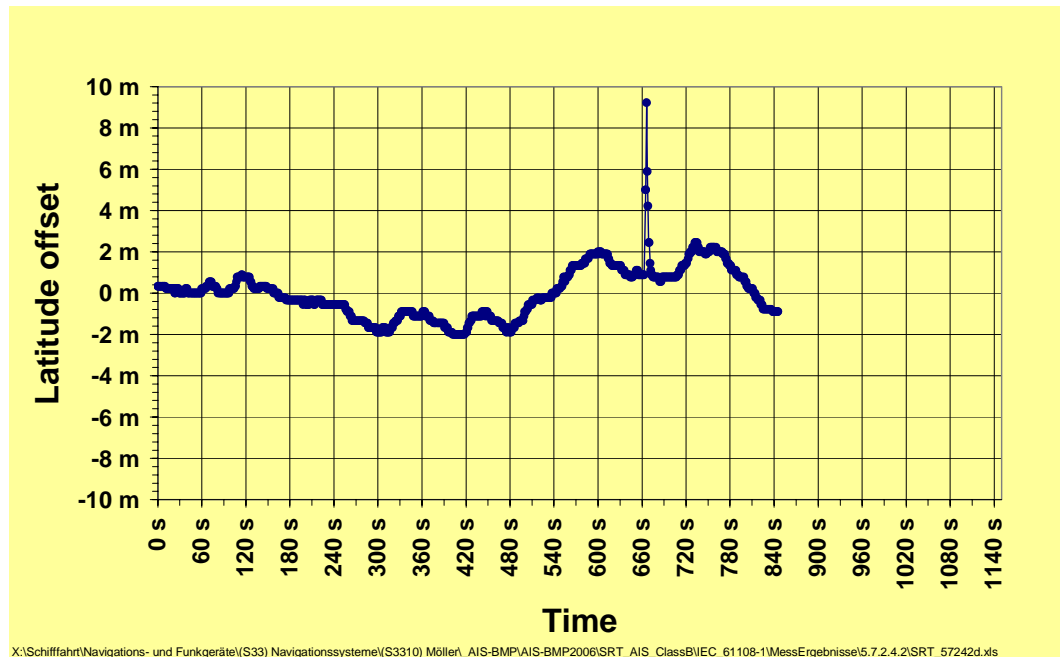


### RF interference vs. time



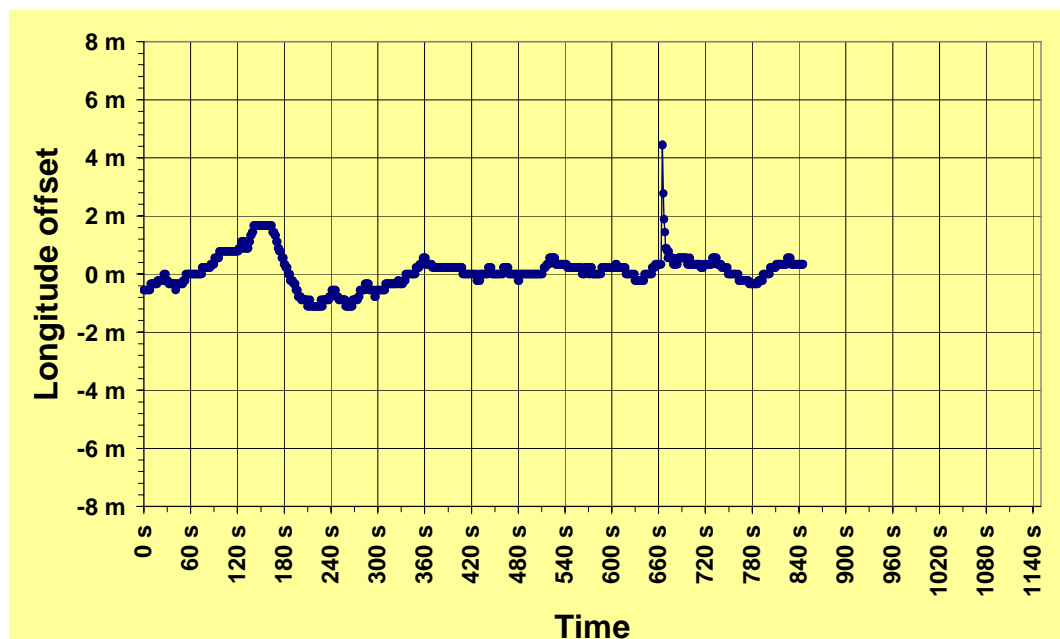
### Continuous wave interference (-80 dBm at 1596 MHz)

Latitude offset vs. time



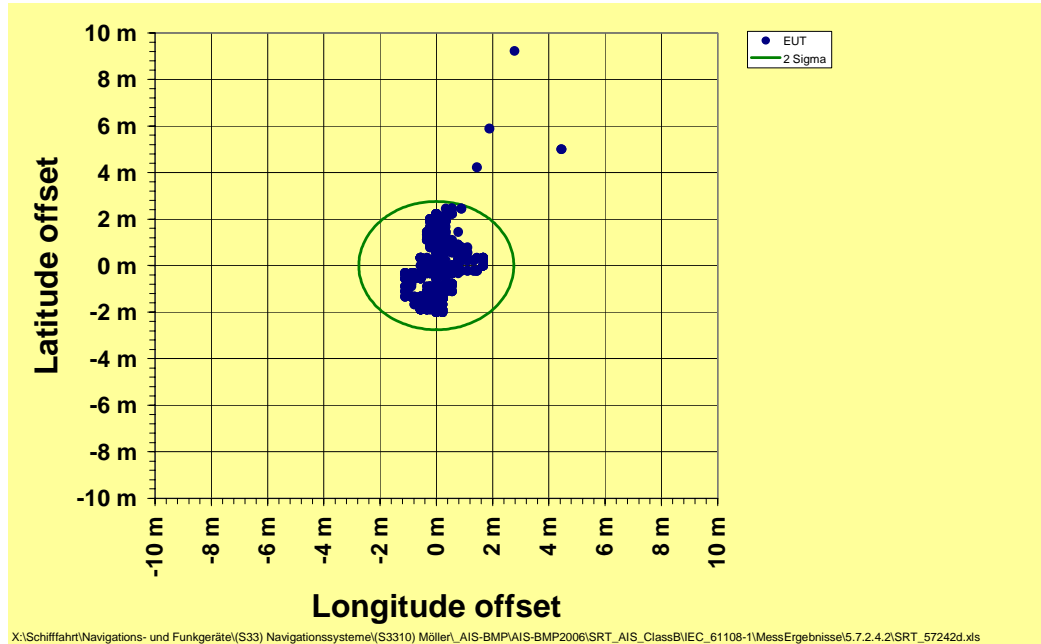
X:\Schifffahrt\Navigations- und Funkgeräte(S33) Navigationssysteme(S3310) Möller\_AIS-BMP\AIS-BMP2006\SR\_T\_AIS\_ClassB\IEC\_61108-1\MessErgebnisse\5.7.2.4.2\SR\_T\_57242d.xls

Longitude offset vs. time

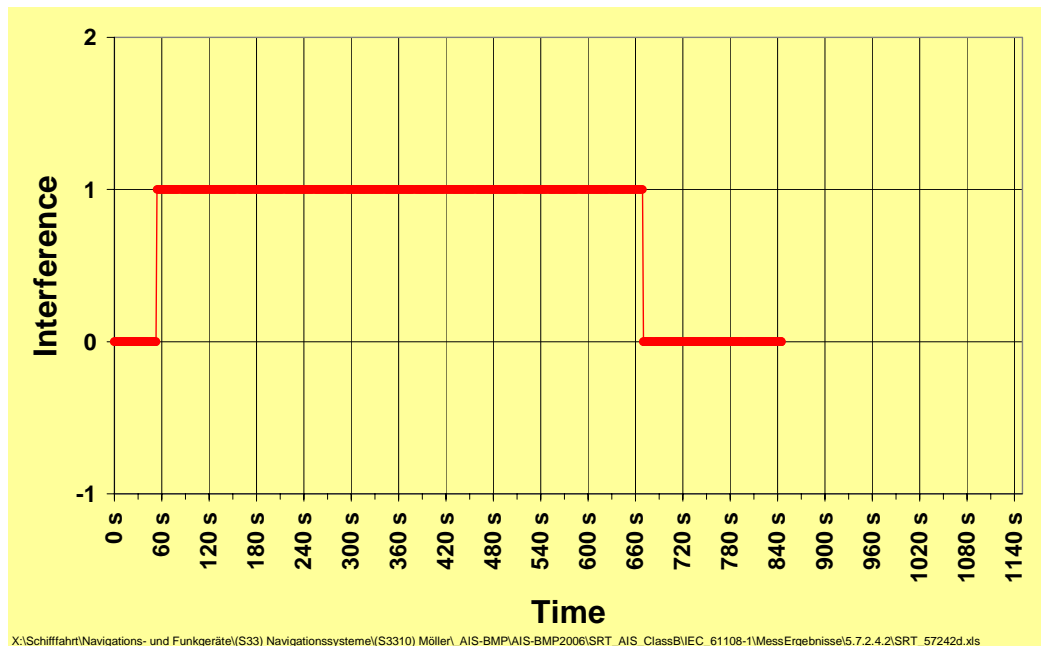


X:\Schifffahrt\Navigations- und Funkgeräte(S33) Navigationssysteme(S3310) Möller\_AIS-BMP\AIS-BMP2006\SR\_T\_AIS\_ClassB\IEC\_61108-1\MessErgebnisse\5.7.2.4.2\SR\_T\_57242d.xls

### Position offset



### RF interference vs. time



## B.8.2 §5.7.2.5 Reacquisition test

### **Method of test**

The reacquisition test is designed to simulate a temporary loss of signal, such as Passing under a bridge. To determine the re-acquisition pass/fail criteria, consider a single trial where the EUT provides a valid position fix that is within required accuracy at 30s (60s for AIS) from restoration of the satellite signals, and maintains a tracking status for at least the next 60 s. This unit is considered to have passed one trial.

#### **§ 5.7.2.5.1 Re-acquisition test procedures**

#### **§ 5.7.2.5.2 Interference conditions**

The interference condition to be tested is shown below. This is a broadband noise Value centred at 1575.42 MHz.

Noise bandwidth (MHz)	Total RMS power (dBm)
1	-110.5

#### **§ 5.7.2.6 Re-acquisition scenarios**

##### **§ 5.7.2.6.1 Test procedures**

- a) The equipment under test is subjected to the broadband interference source.
- b) The simulator scenario shall be engaged and the satellite signals turned on.
- c) The equipment under test shall be powered and initialised.
- d) The EUT shall be allowed to reach steady-state accuracy before the satellites are to be switched off.
- e) The simulator RF output shall be removed for 30 s.
- f) The simulator RF output shall be restored to the EUT.
- g) After 30 s (60s AIS) record a position and HDOP value as reported by the EUT. If after 30 s (&=s AIS), no position report has been sent from the receiver, record a trial failure and go to step i).
- h) Ensure that the receiver continues position reporting for the next 60 s.
- i) Go to Step d) and repeat as required. (note that if the simulator scenario is reset, some receivers may require purging of all previous data to enable proper operation. This is due to the persistence of time data in the receiver and the inability of the receiver's software to deal with a backward transition in time).

## § 5.7.2.6.2 Required results

### Pass/fail determination

A failure by the EUT to provide a position output after 30 s (60s AIS), reporting a position with normalised error greater than 10 m, or failing to continue position reporting for 60 s after sampling indicates a failure mode, and results in declaring a trial failure. To determine the reacquisition time pass/fail criteria, the test disposition table shall be used.

### Conditions of tests performed

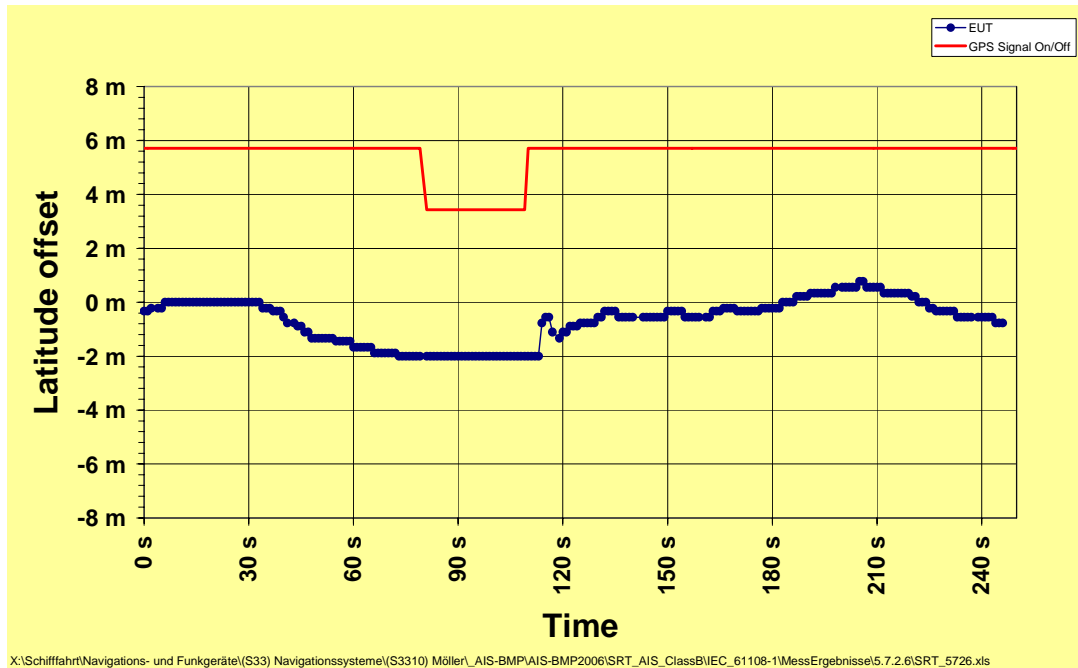
Tests performed by using a simulator.

13:13	Test start
13:15:00	Simulator RF off
13:15:30	Simulator RF on
13:17	Test end

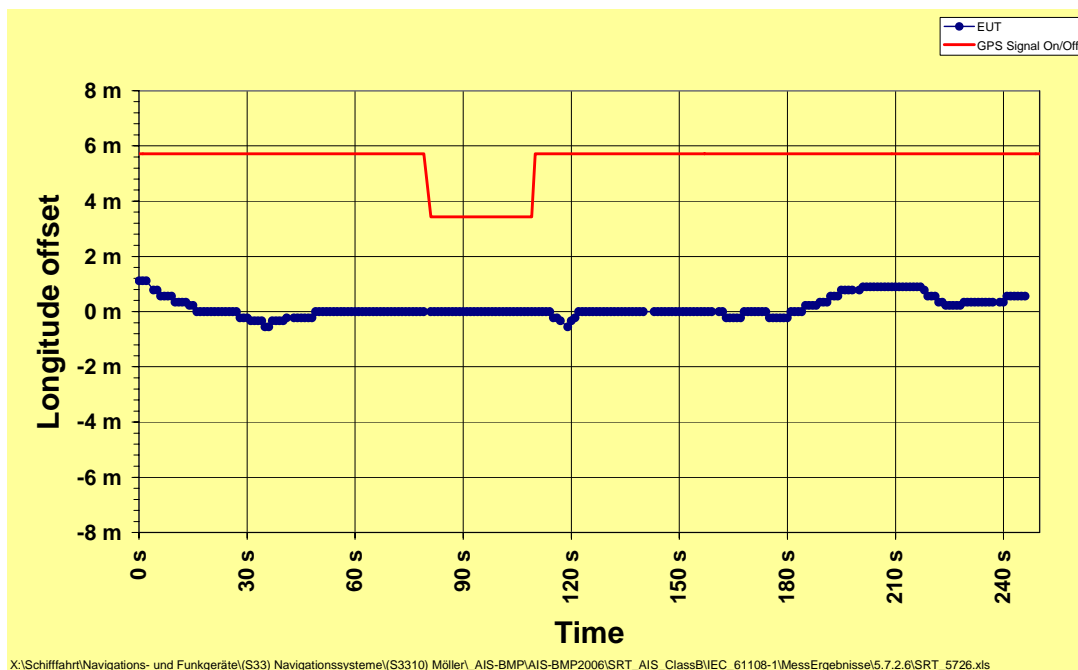
### Test result: Passed

For details of validation of recorded data see the following pages.

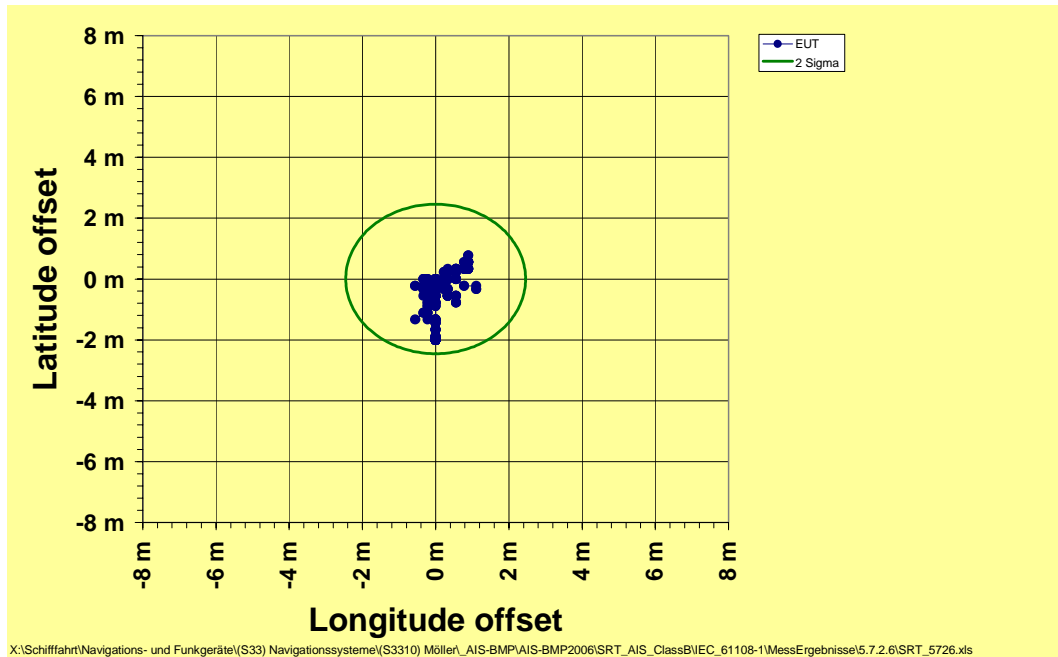
Latitude offset vs. time



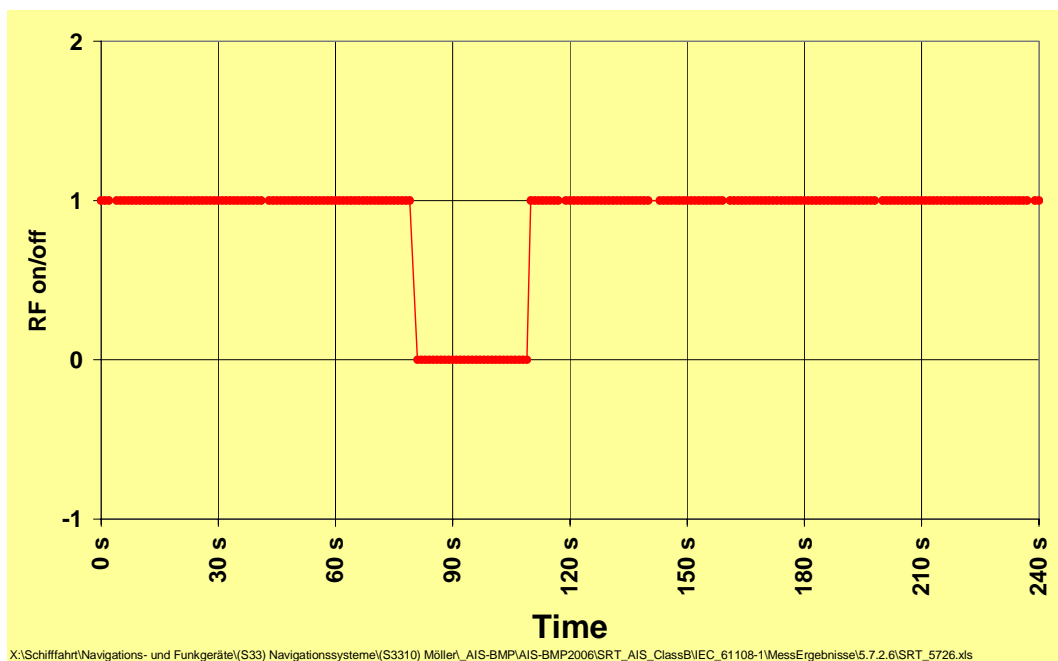
Longitude offset vs. time



Position offset



RF GPS signal vs. time





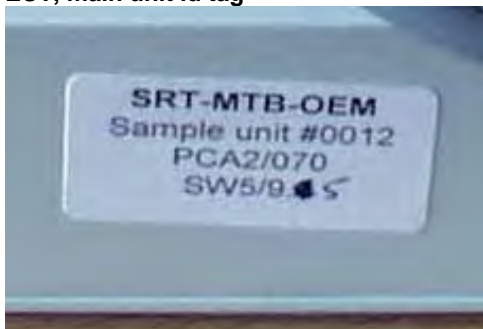


## Annex C - Photos of equipment under test

EUT at testside, BSH Hamburg



EUT, main unit id tag



EUT, rearview



L-Band interference test – GPS antenna



S-Band interference test – GPS antenna

