# Bundesrepublik Deutschland
***Federal Republic of Germany***

Bundesamt für Seeschifffahrt und Hydrographie
***Federal Maritime and Hydrographic Agency***

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Conformance test report of a

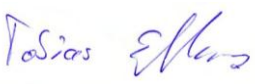
# GPS receiver module

integrated into an

# AIS SART

| | |
|---|---|
| **Equipment under test:** | **Alltek Marine Electronics Corp. AIS SART** |
| **Type:** | **PLOMO-500** |
| **Applying test standards:** | **IEC 61108-1:2003** |
| | §4.3.7/5.6.8 Dynamic range |
| | §4.3.8/5.6.9 Effects of specific interfering signals |
| **Test Report No.:** | **BSH/46121/4142396/12** |
| **Applicant:** | **Alltek Marine Electronics Corp.** |
| | **7F, NO.605, Ruei Guang Rd.** |
| | **Neihu, Taipei, Taiwan, 11492** |
| | **R.O.C.** |

**Hamburg, 16th November 2012**
**For the Federal Maritime and Hydrographic Agency**



**Tobias Ehlers**
**Test engineer**

**Jochen Ritterbusch**
**Head of Laboratory**

**nach DIN EN 17025**
**akkreditiertes Prüflaboratorium**

**Federal Maritime and Hydrographic Agency**
**Bernhard-Nocht-Str. 78**

**D-20359 Hamburg**
Germany

Deutscher Akkreditierungs Rat
DAR

**DAT-PL-086/98-02**

DATech Deutsche Akkreditierungsstelle Technik in der TGA GmbH
Signatory of the Multilateral Agreement of EA and ILAC for the mutual recognition

represented in the

# Deutschen AkkreditierungsRat

# Akkreditierung

The **TGA GmbH,** represented by the **DATech Deutsche Akkreditierungsstelle Technik in der TGA GmbH**, confirms that the Testing Laboratory

**Federal Maritime and Hydrographic Agency**
**Department Shipping**
**Laboratory for Type Approvals**
**Bernhard-Nocht-Straße 78**

**20359 Hamburg**

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out testing in the fields of

**Marine Equipment (Navigation Equipment, Radio-Communication Equipment, Life-Saving Appliances)**

according to the annexed list of standards and specifications.

The accreditation is valid until: **2013-12-22**

The annex is deemed part of this certificate and comprises **8** pages.

DAR-Registration No.: **DAT-PL-086/98-02**

Frankfurt/Main, 2008-12-23

Correctness of the english translation confirmed: Frankfurt/Main, 2008-12-23

i.V. Dipl.-Ing.(FH) R. Egner
Head of the Accreditation Body

Member in EA, ILAC, IAF

Translation for information purposes only. The German Accreditation Certificate is authoritative

See notes overleaf

# Table of contents

# 1 General

| | |
|---|---|
| Applicant: | Alltek Marine Electronics Corp.<br>7F, NO.605, Ruei Guang Rd.<br>Neihu, Taipei, Taiwan, R.O.C. |
| Equipment under test: | Alltek Marine AIS SART (Search And Rescue Transmitter) |
| Type: | PLOMO-500 |
| Manufacturer: | Same as applicant |
| Place of test: | BSH test laboratory Hamburg,<br>Room 908 roof of BSH, Room 015 GNSS Laboratory |
| Start of test: | 14th November 2012 |
| End of test: | 14th November 2012 |

## 1.1 Summary

### Test standard: IEC 61108-1 Ed. 2, 2003

| Test No. | Reference | Section | Result (passed/ not passed / not applicable / not tested) |
|---|---|---|---|
| -- | IEC 61108-1 | 4.1 Object<br>compliance with IEC 61162-1<br>compliance with IEC 60945 | not tested |
| -- | IEC 61108-1 | 4.2 GPS receiver equipment | not tested |
| -- | IEC 61108-1 | 4.3.1 General | not tested |
| -- | IEC 61108-1 | 4.3.2 Equipment output | not tested |
| -- | IEC 61108-1 | 4.3.3 Accuracy | not tested |
| -- | IEC 61108-1 | 4.3.4 Acquisition | not tested |
| -- | IEC 61108-1 | 4.3.5 Protection | not tested |
| -- | IEC 61108-1 | 4.3.6 Antenna design | not tested |
| 1-3 | IEC 61108-1 | 4.3.7 Dynamic range | **passed** |
| 4-6 | IEC 61108-1 | 4.3.8 Effects of specific interfering signals | **passed** |
| -- | IEC 61108-1 | 4.3.9 Position update | not tested |
| -- | IEC 61108-1 | 4.3.10 Differential GPS input | not tested |
| -- | IEC 61108-1 | 4.3.11 Failure warnings and status indications | not tested |
| -- | IEC 61108-1 | 4.3.12 Output of COG, SOG and UTC | not tested |
| -- | IEC 61108-1 | 4.3.13 Typical interference conditions | not tested |

## 1.2 Equipment history

| Equipment No. 1 Alltek AIS SART | | | | |
|---|---|---|---|---|
| **Type** | **PLOMO-500** | **Part No.:** | **---** | |
| **Delivery date** | **14th November 2012** | **Serial number** | **---** | |
| | | | | |
| **HW Version:** | **Delivery date** | **14th November 2012** | **Version no** | **---** |
| | **Installation date** | **14th November 2012** | | |
| **SW Version:** | **Delivery date** | **14th November 2012** | **Version no** | **---** |
| | **Installation date** | **14th November 2012** | | |
| **SW Version:** | **Delivery date** | **---** | **Version no** | **---** |
| | **Installation date** | **---** | | |
| **SW Version:** | **Delivery date** | **---** | **Version no** | **---** |
| | **Installation date** | **---** | | |
| **SW Version:** | **Delivery date** | **---** | **Version no** | **---** |
| | **Installation date** | **---** | | |

## 1.3 Test environment

**Documentation of equipment tests and dates of tests.**
**Test environment is completely equipped as described in Annex A.**

| | |
|---|---|
| **Room** | **BSH room 908 roof of BSH,<br>BSH room 015 GNSS laboratory** |
| **Test engineer** | **T. Ehlers (S3301)** |
| **Location** | **Hamburg** |

| Equipment no | Start of test | End of test | Test engineer |
|---|---|---|---|
| **1** | **14th November 2012** | **14th November 2012** | **T. Ehlers (S3301)** |
| **---** | | | |

## 1.4 Legend

**Result marking** (in the "result" column)[2]:

| | |
|---|---|
| Passed | Item was OK, test successful<br>No colour marking |
| Not passed | Test of a required item was not successful, change required |
| N/T | Not tested |
| N/A | Not applicable |

**Specific remarks** (in the "remark" column, marked "bold italic"):

| | |
|---|---|
| REC | recommendation (in terms of IEC17025 "opinion"); an improvement or change is recommended |
| Note | Note or comment (in terms of IEC17025 "interpretation");rationale for specific results or interpretation of requirements as appropriate |

## 1.5 General observations

**General observations** unrelated to any paragraphs of applied test standards.

[2] Test items maybe colour marked in draft versions of the report as follows:

| | |
|---|---|
| Passed | no colour marking |
| Not passed | yellow |
| N/T | blue |
| N/A | no colour marking |
| REC | green |

# 2 Functional Tests

## 2.1 IEC 61108-1

| No. of test | IEC 61108-1 | Requirement/Condition | Remark | Result |
|---|---|---|---|---|
| **1** | **4.3.7** | **Dynamic range**<br>(M.112/A3.7) The GPS receiver equipment shall be capable of acquiring satellite signals with input signals having carrier levels in the range of –130 dBm to –120 dBm as measured at the output of a 3 dBi linear polarized receiving antenna. Once the satellite signals have been acquired the equipment shall continue to operate satisfactorily with satellite signals having carrier levels down to –133 dBm as measured at the output of a 3 dBi linear polarized receiving antenna. | See test results under test no. 3 and 4. | **Passed** |
| **2** | **4.3.8** | **Effects of specific interfering signals**<br>The GPS receiver equipment shall meet the following requirements:<br>a) In a normal operating mode, i.e. switched on and with antenna attached, it is subject to radiation of 3W/m² at a frequency of 1636.5MHz for 10min. When the unwanted signal is removed and the GPS receiver antenna is exposed to the normal GPS satellite signals, the GPS receiver equipment shall calculate valid position fixes within 5min without further operator intervention.<br>b) In a normal operating mode, i.e. switched on and with antenna attached, it is subject to radiation consisting of a burst of 10pulses, each 1.0µs to 1.5µs long on a duty cycle of 1600:1 at a frequency lying between 2.9GHz and 3.1GHz at power density of about 7.5kW/m². The condition shall be maintained for 10min with the bursts of pulses repeated every 3s. When the unwanted signal is removed and the GPS receiver antenna is exposed to the normal GPS satellite signals, the receiver shall calculate valid position fixes within 5min without further operator intervention. Advice shall be given in the manual for adequate installation of the antenna unit, to minimise interference with other radio equipment such as marine radars, Inmarsat SES´s, etc. | See test results under test no. 5 and 6.<br><br>**Note**<br>(Condition B)<br><br>This condition is approximately equivalent to exposing the antenna to radiation from a 60kW 'S' band marine radar operating at a nominal 1,2µs pulse width at 600 pulses/s using a 4m slot antenna rotating at 20r/min with the GPS antenna placed in the plane of the bore site of the radar antenna at a distance of 10m from the centre of rotation. | **Passed**<br><br>**Passed** |

| No. of test | IEC 61108-1 | Requirement/Condition | Remark | Result |
|---|---|---|---|---|
| | **5.6.8 (4.3.7)** | **Sensitivity and dynamic range** | | |
| **3** | **5.6.8.1** | **Acquisition**<br>This is tested by using a simulator.<br>Method:<br>Transmit the simulator signal over a suitable antenna.<br>Adjust the signal power by use of a calibrated test receiver to –125 dBm ± 5 dBm.<br>Replace the antenna of the calibrated test receiver by the receiving unit of the EUT.<br>A performance check shall be carried out.<br>Required result:<br>The EUT shall meet the requirements of this check, with this signal range. | EUT tracked GPS L1 signal at –130dBm<br><br>This test was performed by using a simulator | **Passed** |
| **4** | **5.6.8.2** | **Tracking**<br>The received satellite signals shall be monitored by a suitable test receiver. These signals shall be attenuated down to -133 dBm. Under these conditions the performance requirements of a performance check shall be met.<br>This is tested by using a simulator.<br>Method:<br>Transmit the simulator signal over a suitable antenna. Adjust the signal power by use of a calibrated test receiver to –125 dBm ± 5 dBm.<br>Replace the antenna of the calibrated test receiver by the receiving unit of the EUT.<br>After the start of transmission and tracking with the nominal transmission level condition, gradually reduce transmission level down to –133 dBm.<br>Required result:<br>The EUT shall continue tracking at least one satellite. | EUT tracked GPS L1 signal at –133dBm and a position is calculated properly<br><br>This test was performed by using a simulator | **Passed** |

| No. of test | IEC 61108-1 | Requirement/Condition | Remark | Result |
|---|---|---|---|---|
| | **5.6.9 (4.3.8)** | **Effects of specific interfering signals** | | |
| **5** | **5.6.9.1 (4.3.8 a)** | **L-Band Interference**<br>In a normal operating mode, using an appropriate signal source, the EUT shall be subjected to radiation of 3W/m² at a frequency of 1636.5MHz for 10min.<br>The signal shall be removed and a successful performance check shall be carried out within 5min. | For test results see Annex B of this report<br><br>**Note**<br>EUT is a marine AIS SART with integrated GPS module.<br>GPS position resolution is one ten-thousandth of an arc minute | **Passed** |
| **6** | **5.6.9.2 (4.3.8 b)** | **S-Band Interference**<br>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 1.0µs to 1.5µs long on a duty cycle of 1600:1 at a frequency in the range of 2.9GHz to 3.1GHz at power density of approximately 7.5kW/m². This condition shall be maintained for 10min with the bursts of pulses repeated every 3s.<br><br>NOTE The peak power density is 7.5kW/m² to be measured at the EUT, this is approximately 4.7W/m² average power at a fixed transmitting antenna.<br>The signal shall be removed and a successful performance check shall be carried out within 5min. | | **Passed** |

# Annex A - Test equipment

## A.1 Test equipment summary

| *Model / Program* | *Serial No. / Version No.* | *Calibrated / Function test* | *Used for* |
|---|---|---|---|
| Reference position<br>roof of BSH building | | Lat: 53 32.8136481666'<br>Lon:9 58. 1016981666' | S-Band interference |
| GNSS Simulation Unit | SPIRENT Communications<br><br>Hardware:Typ: GSS8000, S/N: 8628/9<br><br>Software:<br>SimGEN Ver. 3.01 | Calibration date 2012/10/22<br><br>Function tests performed successfully according documented test procedures before performance of tests | All GPS testing, unless stated otherwise |
| Trimble Net R9<br>GNSS reference receiver | 5112K74564 | Function tests performed successfully | Reference and differential data source for GLONASS and GPS |
| MiniCircuits RF- Amplifier | ZHL-5W-2G-S+ | Function tests performed successfully | L-Band interference |
| Radar-Device<br>Furuno FR 2135S | FR-2105 Series | Function tests performed successfully | S-Band interference |
| Signal Generator<br>R&S SMJ100 | S/N: 100858 | Calibration date: 2010/10/07 | Interference tests IEC 61108-1 Ed.2, §5.6.9.1 |
| Agilent spectral analizer<br>E4440A | S/N: MY44022884 | Calibration date: 2011/03/08 | Calibration of GPS measurement inside RF-chamber |
| Narda Broadband Field Meter | B-1059/NBM550 | Calibration date: 2012/05/24 | Induced Power of L/S-Band |
| Horn Antenna<br>Schwarzbeck BBHA 9120A | BBHA 9120A 535 | Calibration date: 2009/11/26 | Calibration of GPS measurement inside RF-chamber |

# Reference position

**Made by FREIE UND HANSESTADT HAMBURG**
**Vermessungsamt –VA311-**

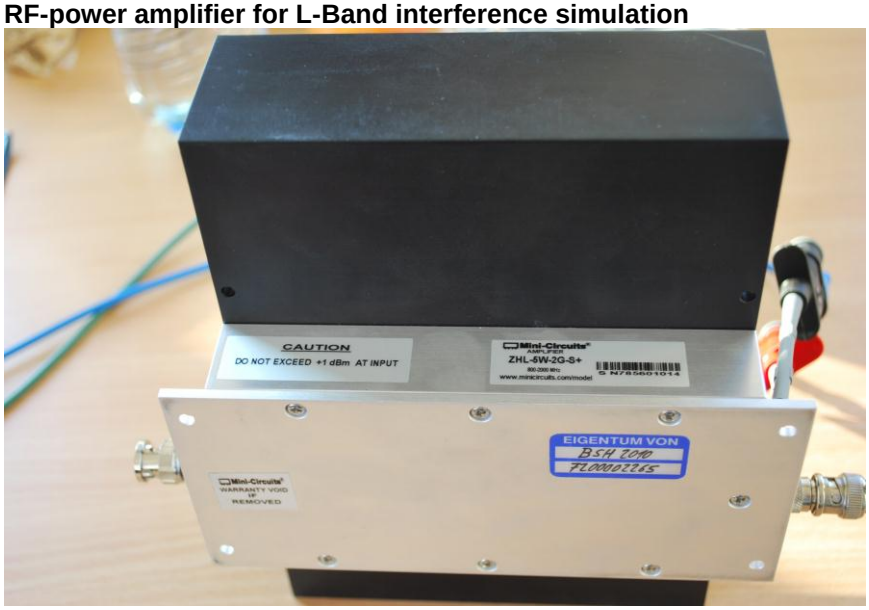
| Description of point | geocentrically co-ordinates (WGS84) | | geodetical geographical co-ordinates (WGS84) | | Gauß-Krüger (Bessel) | |
|---|---|---|---|---|---|---|
| North | x(m) | 3740601.680 | N | 53°32’ 49’’.49049 | x(m) | 5935502.790 |
| | y(m) | 657439.492 | E | 9°58’ 6’’.10408 | y(m) | 3564257.804 |
| | 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) | 3564258.046 |
| | z(m) | 5107017.296 | Height over Ellipsoid | 95.849 m | Altitude above sea level | 55.917 |

Accuracy of survey = 0.02 m - last survey dated 2009-05-04

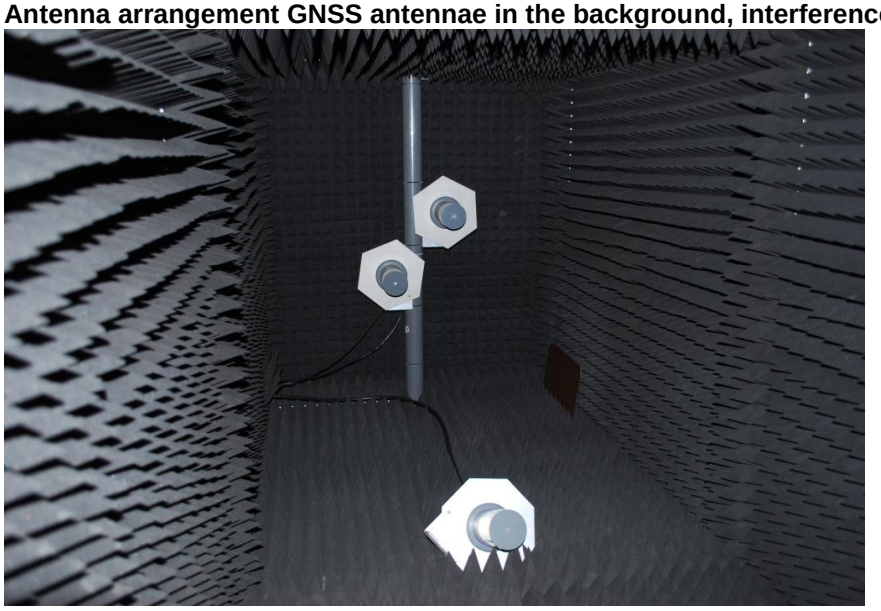
# A.2 Documentation of test equipment

## A.2.1 L-Band interference signal amplifier

**RF-power amplifier for L-Band interference simulation**




**Antenna arrangement GNSS antennae in the background, interference antenna in front**



## A.2.2 Radar device

### Specification of RADAR used for S-Band Test


**Manufacturer:** **Furuno Electric Co., LTD.**
**Model:** **FR-2105 Series**
**Specifications:**

**Antenna radiator:**
**Type:** **Slotted waveguide array**
**Bandwidth:** **S-Band**
**Radiator Type:** **SN7AF**
**Length:** **12 ft**
**Beamwidth (H):** **1.9**
**Beamwidth (V)** **20**
**Sidelobes ±10 :** **-28 dB**
**Polarization:** **Horizontal**
**RF Transceiver:**
**Frequency:** **X-Band, 3050 MHz ± 30 MHz**
**Output power:** **FR-2135S/SW: 35 KW**

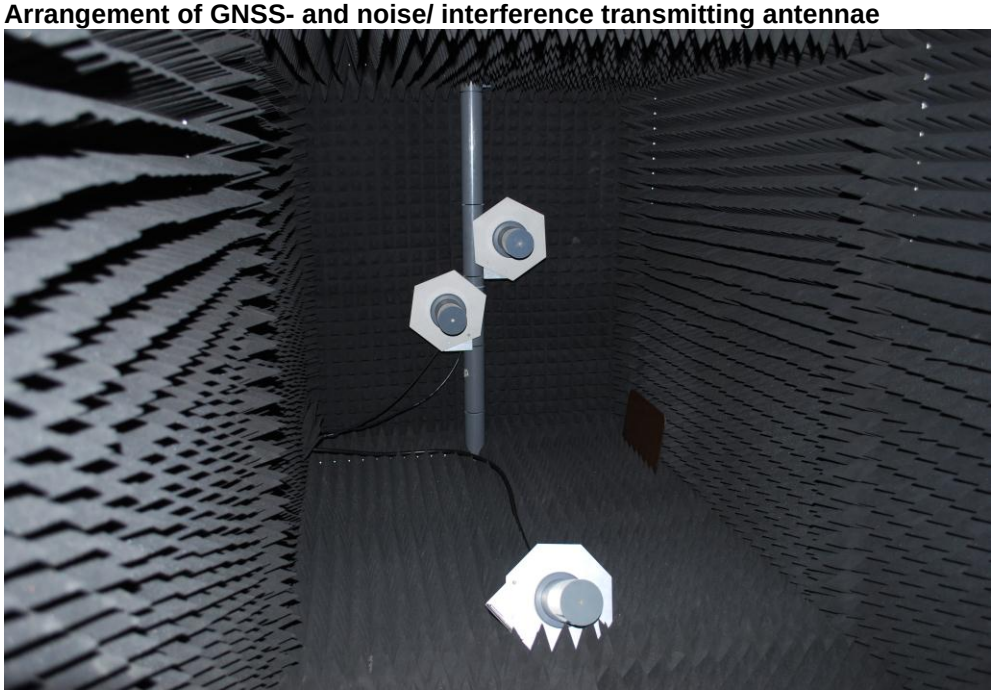
**Pulse lengths and PRR**

| Range scales | P/L (µs) | PRR (Hz) |
|---|---|---|
| 0.125 / 0.25 | 0.07 | 3000 |
| 0.5 | 0.07 / 0.15 | 3000 |
| 0.75 / 1.5 | 2 from 0.07 / 0.15 / 0.3 | 3000 / 1500 |
| 3 | 2 from 0.15 / 0.3 / 0.5 / 0.7 | 3000 / 1500 |
| 6 | 2 from 0.3 / 0.5 / 0.7 / 1.2 | 1500 / 1500 |
| 12 / 24 | 2 from 0.5 / 0.7 / 1.2 | 1000 / 600 |
| 48 / 96 | 1.2 | 600 |

## A.2.3 GNSS Simulation

**GNSS Simulation at BSH**

**Arrangement of GNSS- and noise/ interference transmitting antennae**



**GPS test box, exterior view**

**GPS test box, interior view**

## A.2.4 Calibration protocol of RF- Chamber

**Calibration protocol**

| | |
|---|---|
| **Date** | 14th November 2012 |
| **Test eng.** | Ehlers |
| **Place of test** | BSH, Room 015 |

**Equipment**

R&S SMJ100A Signalgenerator
Helixantenna H1116R6
Schwarzbeck BBHA 9120 Hornantenna
GPS- transmitting antenna 2G1216P - Antcom Corp.
Agilent spectral analyser E4440A
Spirent GSS8000

| | | | |
|---|---|---|---|
| Pdef. | -130 | dBm | ICD GPS200 defines -130dBm as minimum received power at 3dBi antenna |
| | | | IEC61108-1:2003 defines -125dBm for typ. interference testing up to -120dBm |
| G trans. Ant. | 4,5 | dBi | Gain of GPS- transmitting antenna |
| Prec. | **-125,32** | dBm | Needed received power @ Schwarzbeck BBHA9120 |
| Grec.ant. | 9 | dBi | Gain of calibrated Schwarzbeck BBHA 9120 @ 1575MHz |
| Adapt. Factor | 5 | dB | Adaption factor of Schwarzbeck BBHA9120 vs. 3dB antenna incl. Cable loss |
| | | | |
| **Attenuation** | **-15,9** | **dB** | attenuation needed for adjusted power level |

**Calibration of RF-GPS- Chamber - L-Band Interference §5.6.9.1**

| | |
|---|---|
| Date | 14th November 2012 |
| Engineer | Ehlers |

Equipment

R&S SMJ100A signal generator
MiniCirquits ZHL-5W-2G-S RF-Amplifier
Helix antenna H1116R6
Narda fieldmeter

| | | |
|---|---|---|
| Powerlever SMJ | -5.9 | dBm |
| | | |
| Measured field strength EUT | 3.12 | W/m² |

# Annex B - Test diagrams

## B.1 § 5.6.9 Effects of specific interfering signals

### B.1.1 § 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 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 – Simulated GPS signal

| | |
|---|---|
| Frequency: | 1636.5 MHz |
| Radiation: | 3.12 W/m$^2$ |
| Duration of test: | 10 min |

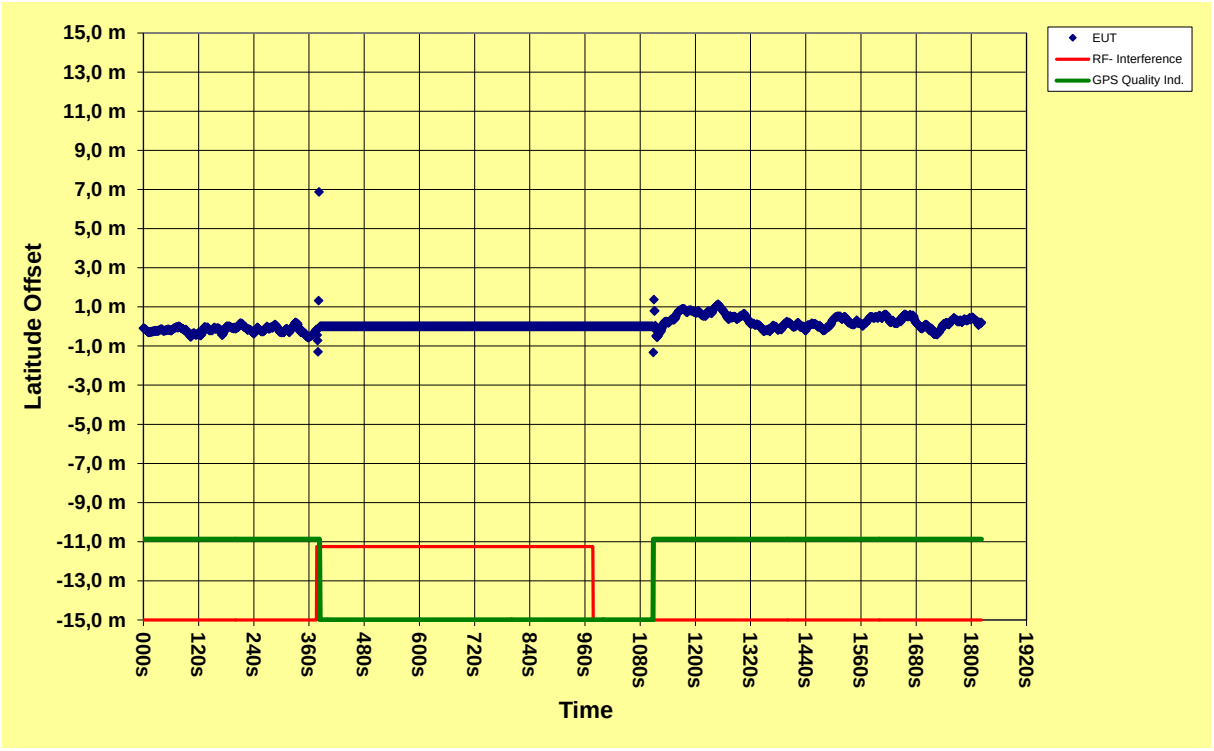
**Test results**

After removing the signal, the performance of the EUT was checked and found operating properly. Resolution of GPS position output is confirmed to be one ten-thousandth of an arc minute.

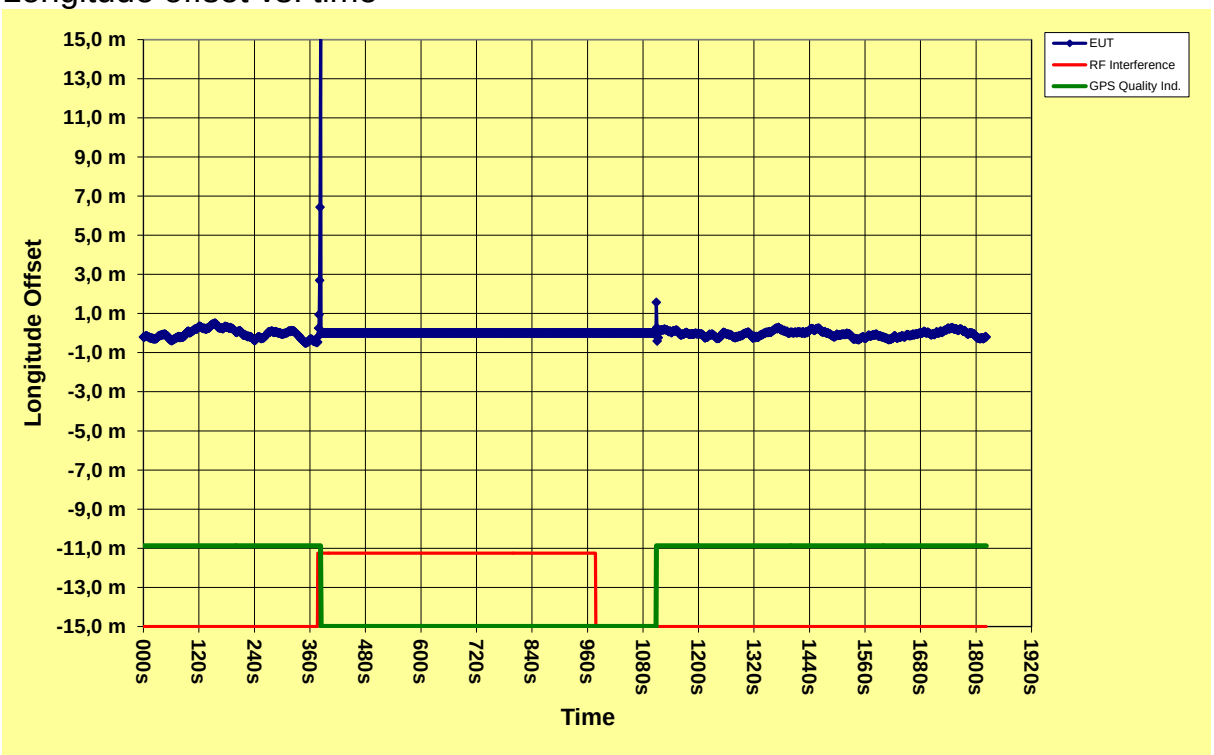
**Test result: Passed**

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

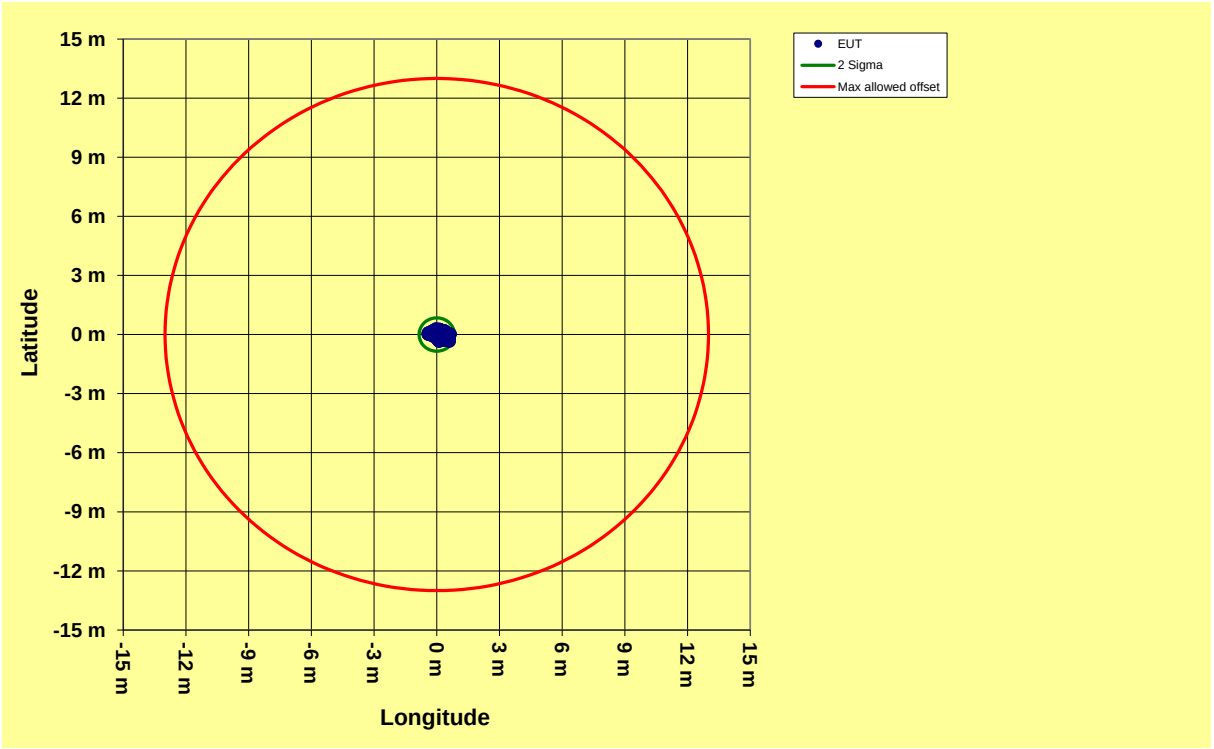
## Latitude offset vs. time




## Longitude offset vs. time



Position offset after interference had been switched off



## B.1.2 §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 µs 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/ $m^2$. 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 - Real GPS signal

| | |
|---|---|
| Frequency range: | 3.05 GHz |
| Radiation: | 7.5kW/$m^2$ |
| Duration of test: | 10 min |

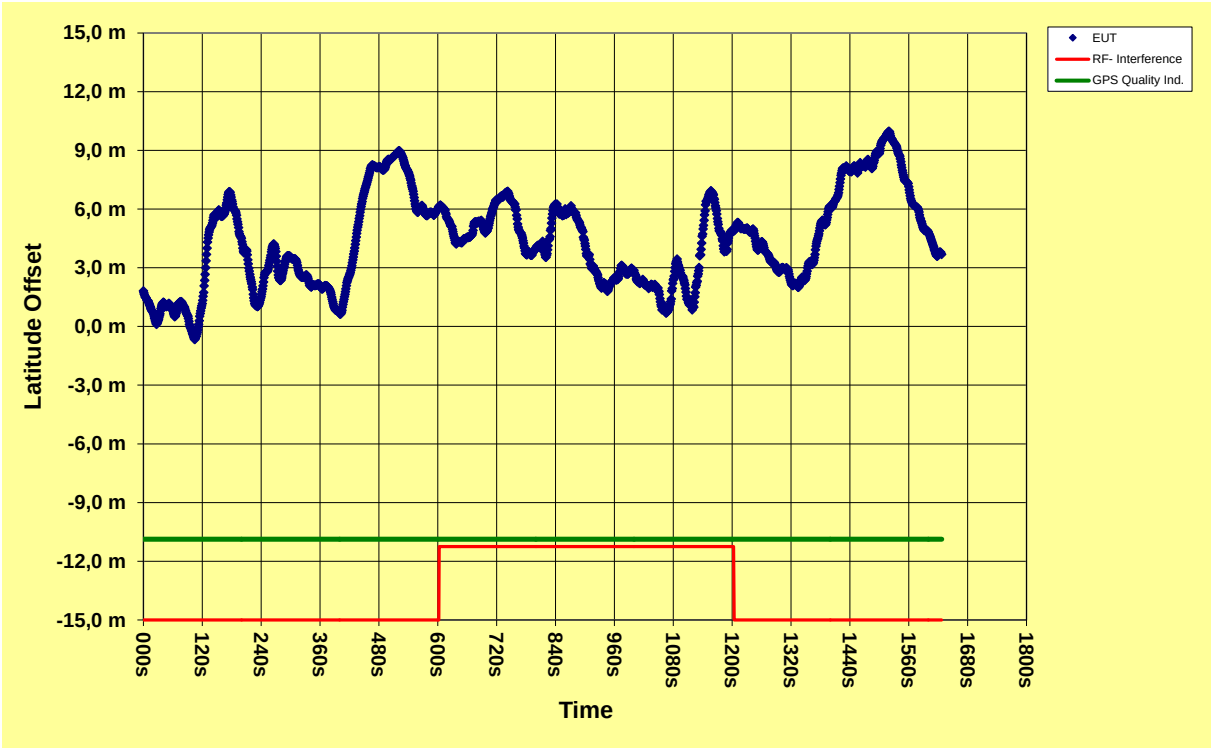
## Test results

After removing the signal, the performance of the EUT was checked and found operating properly. Resolution of GPS position output is confirmed to be one ten-thousandth of an arc minute.

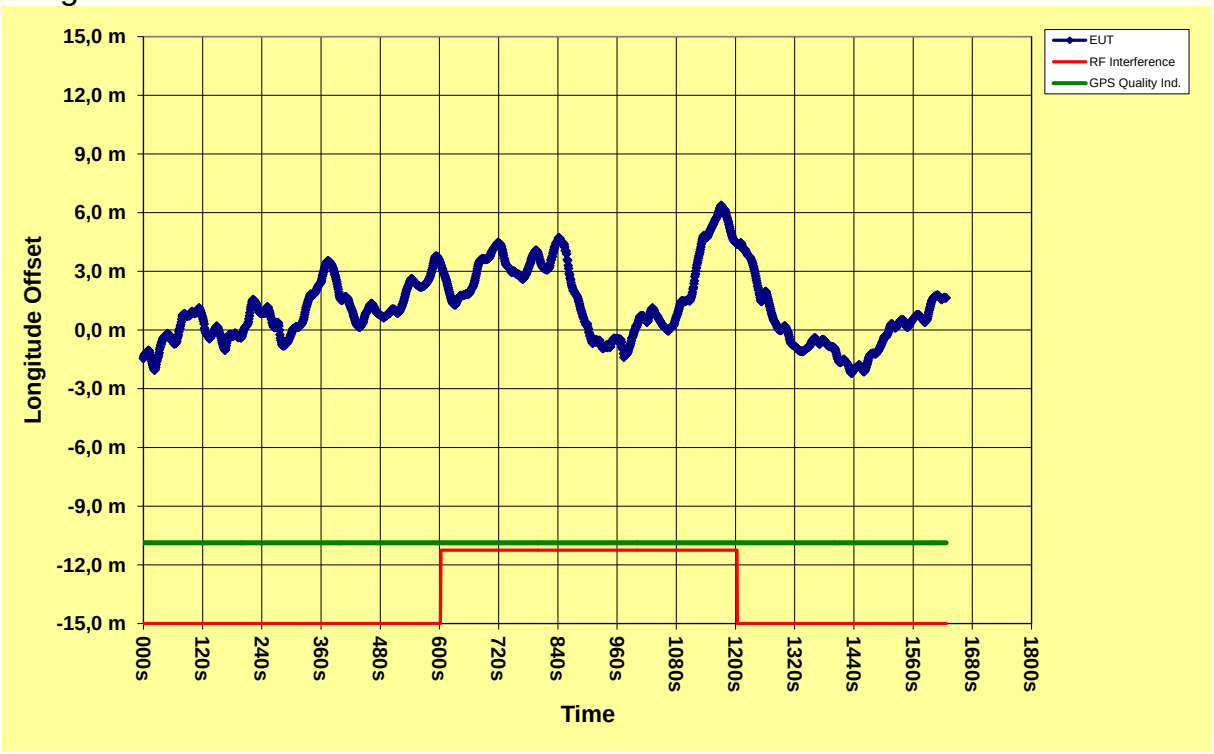
**Test result: Passed**

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

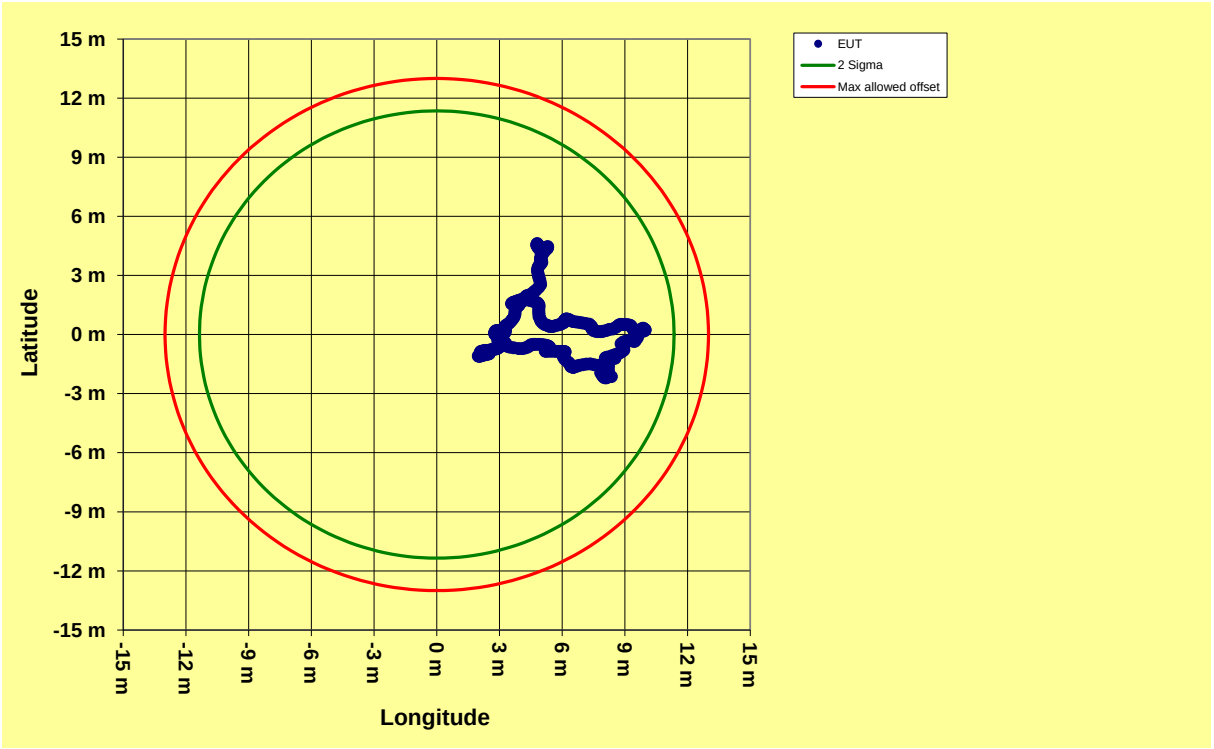
## Latitude offset vs. time




## Longitude offset vs. time



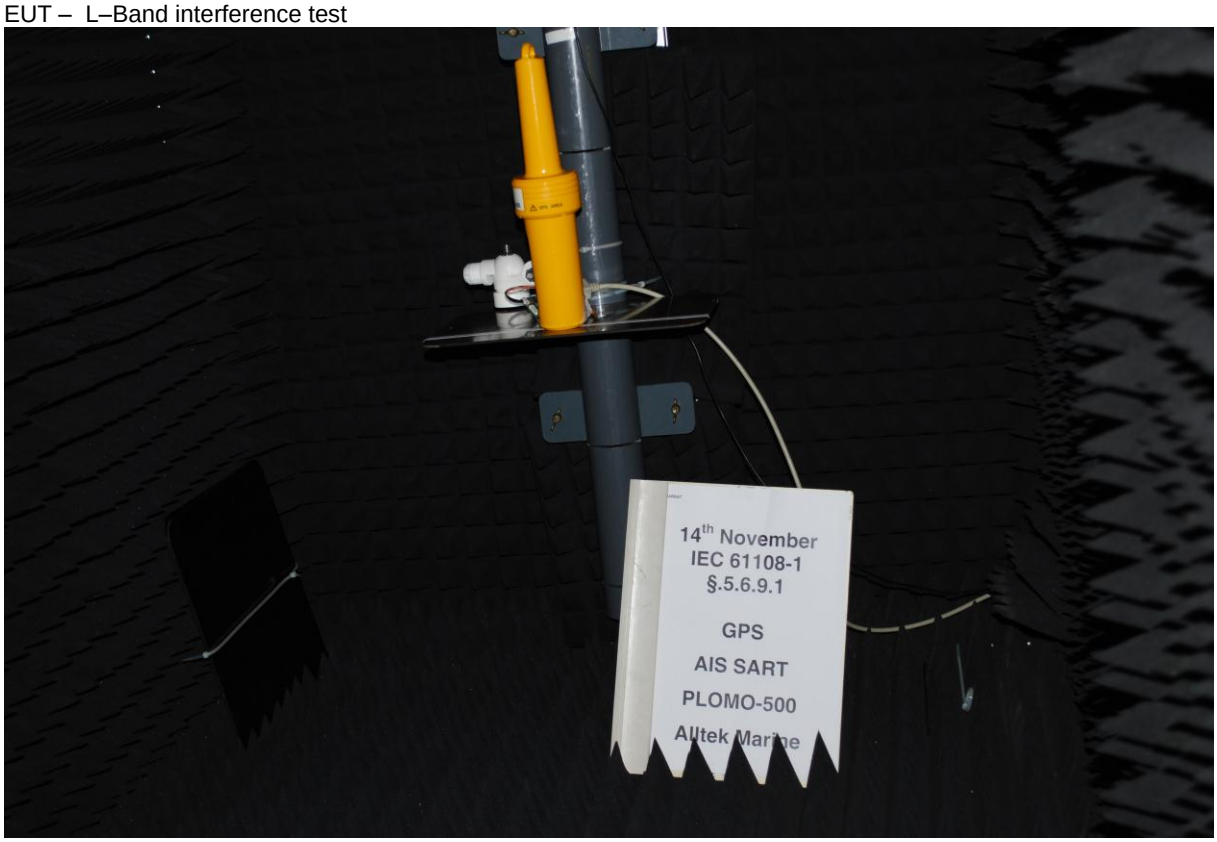
Position offset after interference had been switched off



# Annex C - Photos of equipment under test

**EUT at testside, roof of BSH Hamburg**
EUT – S–Band interference test

EUT – L–Band interference test



EUT id tag


AMEC
AIS SART
PLOMO-500
To Power Off
Press & Hold
TEST
Under Test
Over Usage
Test OK