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# TECHNICAL REPORT

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## KONGSBERG SEATEX AS

ENVIRONMENTAL TESTING OF AIS 200/SIMRAD AI  
80 MOBILE STATION AND SIMRAD AI 80 MINIMUM  
DISPLAY KEYBOARD (MKD)

REPORT No. 2004-3406

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DET NORSKE VERITAS



# TECHNICAL REPORT

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**Summary:**  
The AIS 200/SIMRAD AI 80 Mobile station and SIMRAD AI 80 Minimum Display Keyboard (MKD) manufactured by Kongsberg Seatex AS, has been environmentally tested in order to verify compliance with requirements stated in the EU "Council Directive 96/98/EC on Marine Equipment"

The testing has been carried out according to selected and relevant parts of the following standards:

- IEC 60945 (2002, Fourth edition): Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results
- LR Type Approval System. Test Specification Number 1, 2002

The EUT passed all tests.

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Report title: Environmental testing of AIS 200/SIMRAD AI 80 Mobile station and SIMRAD AI 80 Minimum Display Keyboard (MKD)	
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## 1 SCOPE OF WORK

The AIS 200/SIMRAD AI 80 Mobile station and SIMRAD AI 80 Minimum Display Keyboard (MKD) manufactured by Kongsberg Seatex AS, has been environmentally tested in order to verify compliance with requirements stated in the EU "Council Directive 96/98/EC on Marine Equipment"

The testing has been carried out according to selected and relevant parts of the following standards:

- IEC 60945 (2002, Fourth edition): *Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results*
- LR Type Approval System. Test Specification Number 1, 2002

For each test, reference is made to the relevant section or paragraph in the standard.

Only one specimen of the product has been tested. The test results thus apply solely for this specimen.

## 2 TEST LABORATORY

The tests were carried out in the Environmental Test Laboratory at Det Norske Veritas, Høvik, Norway.

### Laboratory accreditation:

NORSK AKKREDITERING, No. TEST 034

P6 – Electromagnetic Compatibility

P17 – Environmental Testing

P20 – Safety Testing

According to NS-EN ISO/IEC 17025. Valid through 22.04.2008.

Ambient conditions in the laboratory:

Parameter	Required (IEC 60068-1)	Actual
Temperature	15 – 35 °C	20 – 28
Humidity	25 – 75 % RH	25 – 51
Barometric pressure	860 – 1060 mbar	993 - 1035

For details about the test facilities and instruments used, see Chapter 9.



### 3 TEST PERIOD

The tests were carried out during the time period 2004-08-17 to 2004-09-17.

### 4 ATTENDING REPRESENTATIVE

The following client representative was partly present during the testing and took part in the performance testing:

- Martin Stensby

### 5 EQUIPMENT UNDER TEST

#### 5.1 Equipment submitted for tests

A test system assembly comprising at least one of each unit subject to qualification testing was submitted for test.

Unit No.	Description	Model	S/N	Category	Part ID
EUT 1	AIS Class A mobile unit	AIS200/ SIMRAD AI 80	4008	Protected	A101-11_1
EUT 2	Minimum keyboard and display	AI 80 MKD	5003	Protected	A101-12_1

The above will from now on be referred to as EUT (Equipment Under Test).

#### 5.2 Modifications

In order to pass the test the EUT 1 was modified as follows:

Unit no	Test	Modification
EUT 1	Vibration	A new and stiffer base/bottom plate with drawing reference 04008_P011RevC was mounted onto the AIS mobile unit



### 5.3 Test configuration

The following Auxiliary equipment (AE) was used in order to operate and function test the system:

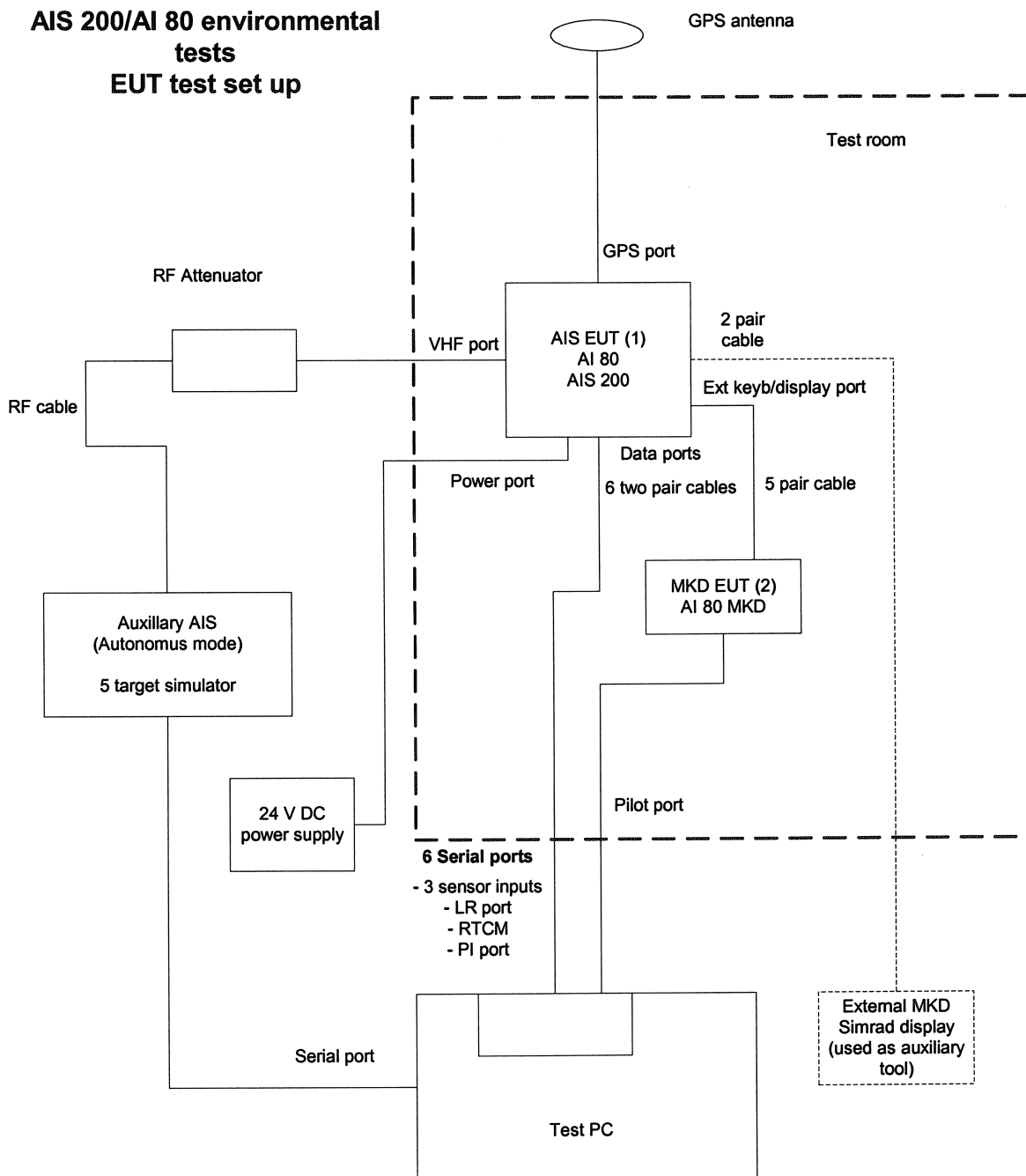
AE	Description	Make	Type	Ser. no.
1	Autonomous AIS	Kongsberg Seatex	AIS 5 target simulator	C 08
2	External Minimum Keyboard/Display	Simrad	Simrad AIS MKD; A101-07	AA55
3	Personal Computer with multiple serial ports interface	Cinet	Test PC	NA

All items of the test system were interconnected by screened cable corresponding to the manufacturer specification for a normal installation.



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Test set-up:



Test set-up for operation and monitoring of the EUT. Coupling networks and cabling modifications were applied as required to perform the tests according to the relevant standards.



## 6 EVALUATION OF PERFORMANCE DURING THE TESTS

### 6.1 Function testing

In order to verify correct function of the EUT a test program that was logging and calculating the statistical rate of missing data was run and recorded on the test PC. The following RF and data links were monitored:

- VDL RX (RF) – VHF link
- VDL TX (RF) – VHF link
- EUT SENSOR 1 PORT (RS422)
- EUT SENSOR 2 PORT (RS422)
- EUT SENSOR 3 PORT (RS422)
- EUT PILOT PORT (RS422)
- EUT PI PORT (RS422)
- EUT LR PORT (RS422)
- EUT RTCM PORT (RS422)

In addition the GPS and the two Minimum Keyboard and Display (MKD) were checked.

### 6.2 Performance monitoring

Verification of the performance was carried out by running the test program (with data logging) from the test PC continuously during the test period.

The GPS signal was visually monitored. (Blinking LED in front of Mobile station)

### 6.3 CRITERIA OF ACCEPTANCE

In order to pass each test, the EUT shall meet the following criteria:

- Perform in compliance with the test specifications and referenced standards
- Conform with the following manufacturer requirements for maximum allowable missing data transmissions/recordings:
 

VDL RX:	PER* < 2 %
VDL TX:	PER < 2 %
EUT SENSOR 1 PORT:	BER† < 10 <sup>-5</sup>
EUT SENSOR 2 PORT:	BER < 10 <sup>-5</sup>
EUT SENSOR 3 PORT:	BER < 10 <sup>-5</sup>
EUT PILOT PORT:	BER < 10 <sup>-5</sup>
EUT PI PORT:	BER < 10 <sup>-5</sup>
EUT LR PORT:	BER < 10 <sup>-5</sup>
EUT RTCM PORT:	BER < 10 <sup>-5</sup>
- GPS receiver running
- Internal Minimum Display and Keyboard operating as intended.
- Not show signs of other malfunctions

\* PER: Packet error rate (number derived from IEC 61993-2, Ed1)

† BER: Bite error rate





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## 7 TESTS

### 7.1 Power supply

#### 7.1.1 Extreme power supply

Test: 7.1 Extreme power supply

Referenced standard: IEC 60092-101

The test was carried out at the following environmental test conditions:

Environmental condition	Verification of function	
	Normal power supply	Extreme power supply
Dry heat	Performance test	Performance check
Damp heat	Performance check	-
Low temperature	Performance test	Performance check
Normal temperature	Performance test	Performance check

Test characteristics:

Power supply	Voltage variation
DC	+30 % / -10 %

**Result:** The EUT passed the test

#### 7.1.2 Excessive conditions

Test: 7.2 Excessive conditions

Test characteristics:

##### 1) Power supply misconnection

The EUT was subject to an input from a power supply of reversed polarity for a period of five minutes. After reconnecting with the right polarity the system was tested for correct operation.

##### 2) Excessive voltage

The threshold for excessive voltage is set to approximately 49 VDC. In the test the voltage was increased from the nominal supply up to 49 VDC. Then the protection network activated and fuse was blown. After replacement of protection network the EUT was tested for proper operation

**Result:** The EUT passed the test



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## 7.2 Durability and resistance to environmental conditions

### 7.2.1 Dry heat

Test: 8.2.2, Functional test

Referenced standards: IEC 60068-2-2

Test characteristics: Test temperature: +55 °C  
Duration: 16 hours

The EUT was placed in the chamber in operating mode at normal room temperature and relative humidity. The temperature was then raised to and maintained at test temperature for 16 hours. At the end of the soak period a performance test was carried out at normal power supply condition and a performance check was carried out at extreme power condition.

**Result:** The EUT passed the test

### 7.2.2 Damp heat

Test: 8.3.1 Functional test

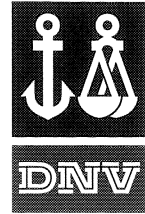
Referenced standard: IEC 60068-2-30

Test characteristics:

Parameters	Severity levels		
	Temperature	Room temp. to +40°C	+40 °C
Humidity	Room cond. to 93 % RH	93 % RH	93 % RH to room cond.
Duration	3 hrs	16 hrs	1 hour

The EUT was placed in the chamber at normal room temperature and relative humidity. The temperature was then raised to and maintained at test temperature for 16 hours. The EUT was switched on 30 min. after completion of the 16 hour period and kept operating for 2 hours while the temperature and humidity conditions of the chamber was maintained as specified. A performance check was carried out at normal power supply condition during this period.

**Result:** The EUT passed the test



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**7.2.3 Low temperature**

Test: 8.4.2.3, Functional test

Referenced standard: IEC 60068-2-48

Test characteristics: Test temperature: -15 °C, ± 3 °C  
 Duration: 16 hours

The EUT was placed in the chamber at normal room temperature and relative humidity. The temperature was then reduced to and maintained at test temperature for 16 hours. The EUT was switched on 30 min. after completion of the 16 hour period and kept operating for 2 hours while the temperature conditions was maintained as specified. During this period, a performance test was carried out at normal power supply condition and a performance check was carried out at extreme power condition.

**Result:** The EUT passed the test

The total uncertainty for this test is as follows:

- Uncertainty of the temperature: < ± 1.9 °C

The uncertainty is calculated in accordance with NAMAS document NIS 80, and is given as 2 standard deviations.

**7.2.4 Vibration**

Test: 8.7

Referenced standard: IEC 60068-2-6

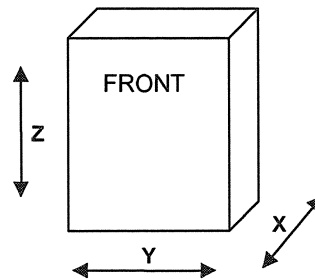
Test characteristics, resonance search:

Parameters	Severity levels	
Waveform	Sinusoidal	
Frequency range	3 – 13.2 Hz	13.2 – 100 Hz
Displacement/acceleration	±1 mm	0.7g
Sweep rate	0.5 oct. per minute	

The EUT was mounted to a 25 mm plywood plate fixed to the vibration machine.

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Vibration direction convention:

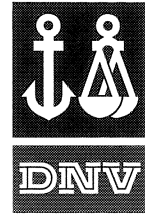


Mounting of EUT for vibration testing

A single sweep resonance search was run along each of the three perpendicular axes.

Based on the resonance search tests, a 2-hour endurance test was carried out at the frequencies and directions where amplification factors above 5 were found.

For units or directions where no amplification factor above 5 was found, the endurance test was carried out for 2 hours at one single observed frequency or at 30 Hz where no resonance occurred.



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Resonance search test:

Unit	Axes	Measure point	Resonance frequency	Amp. Factor
1	X	GPS module	No resonance	-
	Y	GPS module	No resonance	-
	Z	AIS processing Board (DSP/TX)	No resonance	-
2	X	Display window	59 Hz	6,4
	Y	On the right side of the EUT	87 Hz	6,1
	Z	On the top of the EUT	68 Hz	2,0

The EUT was subject to 2 hours testing at each resonance frequency as follows:

Unit	Axes	Frequency [Hz]	Amplitude
1	X	30	0,7 g
	Y	30	0,7 g
	Z	30	0,7 g
2	X	59	0,7 g
	Y	87	0,7 g
	Z	68	0,7 g

A performance check was carried out during the endurance test at each frequency.

**Result:** All the EUT units passed the test

The total uncertainty for this test is as follows:

- Uncertainty in the vibration amplitude < 5 %

The uncertainty is calculated in accordance with NAMAS document NIS 80, and is given as 2 standard deviations.



### 7.3 Special purpose tests

#### 7.3.1 Compass safe distance

Test: 11.2

The distance at which the EUT will not cause an unacceptable deviation of a ship's standard and steering compasses was determined.

The EUT was tested:

- In the Magnetic conditioned in which it was received with the EUT unpowered.
- After normalizing with the EUT unpowered
- In the powered condition.

The EUT was rotated to determine the direction in which it produces the maximum deviation.

The greatest distance obtained under all these conditions is the safe distance. Distances are rounded up to the nearest 5 cm.

**Result:**

Unit No.	Model	Description	Safe Distance	
			Standard Compass	Emergency Compass
1	AI 80	AIS Class A mobile unit	35 cm	25 cm
2	AI 80 MKD	Minimum keyboard and display	30 cm	25 cm

#### 7.3.2 Acoustic noise and signals

Test: 11.1

The acoustic noise power detected shall not exceed a peak level of 60dBA at a distance of 1m from any part of the EUT.

No internal audible alarms.

**Result:** The EUT passed the test.




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### 7.3.3 Damp heat, cyclic

Test specification: LR, sec. 14

Referenced standard: IEC 60068-2-30, Test Db

Test characteristics:

Parameters	Severity levels
Temperature cycle	20 / 55 / 20 °C
Humidity	97 %
Number of cycles	2
Total duration	48 hours

The EUT was in operation during the complete first cycle and switched off during the last cycle of the test, except for a functional test.

Functional tests were carried out during the first 2 hours of the first cycle at test temperature, during the last 2 hours of the second cycle at test temperature, and after recovery.

Insulation resistance test was carried out after recovery.

**Result:** The EUT passed the test

### 7.3.4 High voltage

Test specification: LR, sec. 19

Referenced standard: IEC 60092-504

Test levels, power supply terminals, between each line and earth, LR:

Parameters	Severity levels
	Low voltage control and electronic products, DC Powered / AC powered
Amplitude	550V
Duration	>1 min.

The EUT was not powered during the test. A full Function test was carried out after the test. An Insulation resistance test was carried out after the High voltage test.

**Result:** The EUT passed the test



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### 7.3.5 Insulation resistance

Test specification: LR, sec. 7

Referenced standard: IEC 60092-504

The EUT was tested between the power input terminals and earth with a test voltage of 50V.

This test was carried out before and after the following tests:

	Low temp.	Damp heat	High voltage
Before	> 3 GΩ	> 3 GΩ	> 3 GΩ
After	1,5 GΩ	1,5 GΩ	> 3 GΩ

Acceptance limits: >10 MΩ before and >1 MΩ after the test

**Result:** The EUT passed the test

## 8 SUMMARY OF TEST RESULTS

The EUT passed all the tests.

## 9 TEST FACILITIES AND INSTRUMENTS

Instrument Description	Make	Model	Serial number
Vibrator	Instron	1508	NA
Accelerometer (Instron)	KISTLER	8702B500M3	C63013
Accelerometer	KISTLER	8732A500	C137197
Accelerometer	KISTLER	8732A500	C137199
Climatic Chamber (1)	Heraeus Vötsch	VUK 06/1000	28310
Climatic Chamber (2)	Heraeus Vötsch	VSKZ 04/90/S	44055
Helmholz Coils	DNV	LABH-96-1	NA
Single axis fluxgate magnetometer, Probe	Bartington	0.2mT	697
Insulation tester	NORMA	UNILAP ISO X	0836197FC
High voltage tester	ELABO	2GA27 90-1D	90-1D/9604024
Power supply	Delta Elektronika	SM 7020-D	014606000048
SW for Climatic Chamber	Vötsch	SIMPATI	V 2.02
Vibration Control System	Spectral Dynamics	PUMA	2400-1823

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