

# Test Report

No.: E62607 Edition 1, 2<sup>nd</sup> version

Designation of equipment under test:

**Nauticast-B AIS-300**

EMC Test Laboratory  
accredited by  
DATech e.V.  
in compliance with DIN EN ISO/IEC 17025  
under the  
Reg. No. DAT-P-105/99-21

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Testing body:	PHOENIX TESTLAB Königswinkel 10 D-32825 Blomberg Germany
Client:	ACR Electronics Europe GmbH Handelskai 388 / Top 632 A-1020 Vienna, Austria
Order number:	62607
Type of test:	Testing of the electromagnetic disturbances characteristics Testing of the electromagnetic immunity characteristics
Tested on the basis of:	EN 60945 (October 2003) Maritime navigation and radiocommunication equipment and systems General requirements Methods of testing and required test results (IEC 60945:2002)  With additional performance criterias of  ETSI EN 301 489-1 V1.6.1 (2005-09) Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC)standard for radio equipment and services; Part 1: Common technical requirements
<hr/>	
Disturbance emission:	Chapter 9.2: Conducted emissions Chapter 9.3: Radiated emissions from enclosure port
<hr/>	
Immunity interference:	Chapter 10.3: Conducted high-frequency interference Chapter 10.4: Electromagnetic fields Chapter 10.5: Conducted fast transients (burst) Chapter 10.7: Power supply variations Chapter 10.8: Power supply failure Chapter 10.9: Electrostatic discharge Chapter 5.2.3: Confusing of the DC-poles

Equipment under test, EUT: AIS Class-B CS Transponder

Type identification: Nauticast-B AIS-300

Serial-No.: none

Manufacturer: ACR Electronics Inc.  
5757 Ravenswood Road  
Fort Lauderdale  
FL 33312-6645  
USA

Date the EUT was received: 15. January 2007

Annex: Photos of the test set-ups and the test subject

Client represented during the test by the following person(s): Mr. Andreas Lesch

Place of test: PHOENIX TESTLAB GmbH, Blomberg

Date of test: 15. January 2007 to 22. January 2007

Test result: The requirements made in the test documents were fulfilled by the equipment under test.  
The complete test results are presented in the following.

Blomberg, 02. February 2007



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Test Engineer: Bernd STEINER



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approved by authorized Engineer

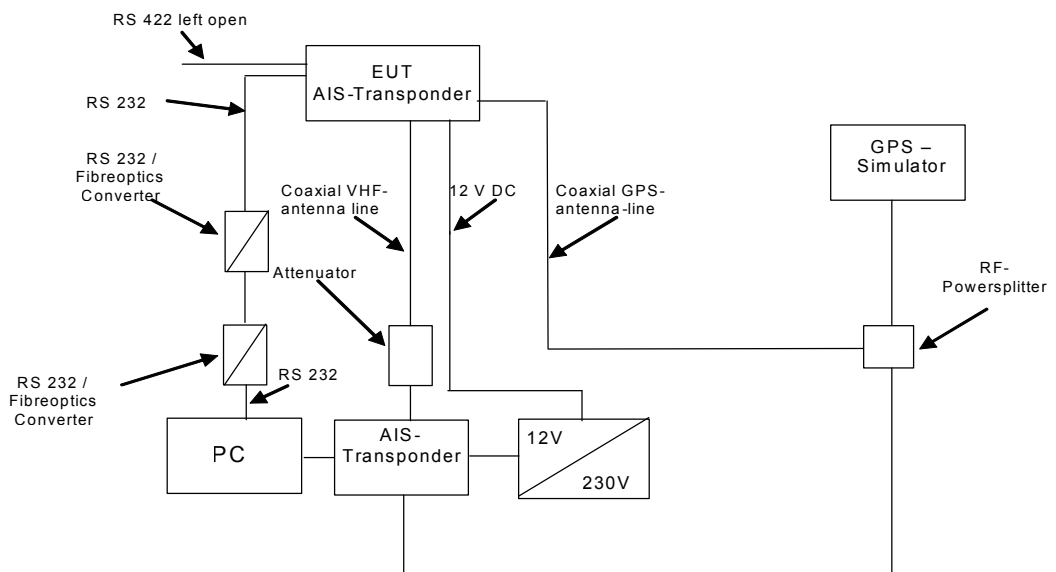
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# 1 Operational states and test set-up

The following states were defined as the operating conditions:

Two AIS transponders were supplied by 12V DC. The VHF ports were connected coaxial via a 100 dB rf-attenuator with each other. Both transponders were operating in normal operation mode with data exchange every 2 seconds. An external PC was connected to the RS232 serial port of the equipment under test. The RS 422 line was left open.

Test set-up:



Definition of the functions to be monitored and corresponding tolerance limits:

The receive- and transmit-data of each transponder and GPS Status were monitored via the RS 232 Serial port with the help of the software LINK2AISB V112 at an external PC and printed in a log file to check the numbers and the context of data during the whole test-time. Furthermore the status LED on the transponder were monitored manually by the test engineer

During and after the continuous phenomena tests

- At no time the status of the transponder shall change into warning or fail
- The GPS receiver shall receive all visible satellites.
- The data exchange between the 2 transponder shall work without error

During the transient phenomena tests

- At no time the status of the transponder shall change into fail
- The communication between the PC and the transponder shall work as intended

After the transient phenomena tests

- At no time the status of the transponder shall change into warning or fail
- The GPS receiver shall receive all visible satellites.
- The data exchange between the 2 transponder shall work without error

## 2 List of test modules and results

### 2.1 Disturbance emission

Radiated emission – Enclosure port				
Frequency range	Limit	Basic standard	Remark	Status
150 kHz – 300 kHz 300 kHz – 30 MHz	80 – 52 dB $\mu$ V/m in 3 m 52 – 34 dB $\mu$ V/m in 3 m	EN 60945 Chapter 9.3	H-field	fulfilled
30 MHz – 156 MHz 156 MHz – 165 MHz 165 MHz – 1 GHz	54 dB $\mu$ V/m in 3 m 24 dB $\mu$ V/m in 3 m QP 54 dB $\mu$ V/m in 3 m	EN 60945 Chapter 9.3	E-field	fulfilled
Remark: For frequencies from 150 kHz to 30 MHz measurements shall be made of the magnetic H-field. The receiver bandwidth in the frequency ranges 150 kHz to 30 MHz and 156 MHz to 165 MHz shall be 9 kHz, and in the frequency ranges 30 MHz to 156 MHz and 165 MHz to 2 GHz shall be 120 kHz.				

Conducted emission – Power supply ports				
Frequency range	Limit	Basic standard	Remark	Status
10 kHz – 150 kHz 150 kHz – 350 kHz 350 kHz – 30 MHz	96 – 50 dB $\mu$ V 60 – 50 dB $\mu$ V 50 dB $\mu$ V	EN 60945 Chapter 9.2	-	fulfilled
Remark: The measuring bandwidth in the frequency range 10 kHz to 150 kHz shall be 200 Hz, and in the frequency range 150 kHz to 30 MHz shall be 9 kHz				

## 2.2 EMC Immunity

Immunity – Enclosure port					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criteria	Status
Electromagnetic fields	80 – 1000 MHz 10 V/m; AM; 80 %; 400 Hz	EN 60945 Chapter 10.4	---	A	fulfilled
Electromagnetic fields	1000 - 2000 MHz 10 V/m; AM; 80 %; 400 Hz	EN 60945 Chapter 10.4	---	A	fulfilled
Electrostatic discharge (ESD)	up to $\pm 6$ kV charging voltage for contact discharge	EN 60945 Chapter 10.9	---	B	fulfilled
Electrostatic discharge (ESD)	up to $\pm 8$ kV charging voltage for air discharge	EN 60945 Chapter 10.9	---	B	fulfilled

Immunity – Power supply ports, DC and AC					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criteria	Status
Conducted high frequency interference	3 V; AM; 80 %; 400 Hz 150 kHz – 80 MHz	EN 60945 Chapter 10.3	---	A	fulfilled
Conducted high frequency interference	10 V; AM; 80 %; 400 Hz 2 / 3 / 4 MHz, 6.2 / 8.2 / 12.6 MHz, 16.5 / 18.8 / 22 / 25 MHz	EN 60945 Chapter 10.3	---	A	fulfilled
Power supply failure	3 interruptions of 60 s	EN 60945 Chapter 10.8	---	C	fulfilled
Power supply variations	$U_N + 20\%$ for 1.5 s	EN 60945 Chapter 10.7	---	B	fulfilled
	$U_N - 20\%$ for 1.5 s			B	fulfilled
Fast transients (Burst)	$\pm 2$ kV (peak) 5/50 ns (Tr/Th) 5 kHz repetition frequency	EN 60945 Chapter 10.5	---	B	fulfilled
Transients (Surge)	1,2 / 50 $\mu$ s up to $\pm 0.5$ kV line/line up to $\pm 1.0$ kV line/earth	EN 60945 Chapter 10.6	---	B	Not applicable *
Confusing the DC Poles	Confusing the DC-poles for 5 minutes	EN 60945 Chapter 5.2.3	---	B	fulfilled

\* Because of DC Powersupply

Immunity – Data, control and communications connections					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criteria	Status
Conducted high frequency interference	3 V; AM; 80 %; 400 Hz 10 kHz – 80 MHz	EN 60945 Chapter 10.3	---	A	fulfilled*
Conducted high frequency interference	10 V; AM; 80%; 400 Hz 2 / 3 / 4 MHz, 6.2 / 8.2 / 12.6 MHz, 16.5 / 18.8 / 22 / 25 MHz	EN 60945 Chapter 10.3	---	A	fulfilled*
Fast transients (Burst)	±1 kV (peak) 5/50 ns (Tr/Th) 5 kHz repetition frequency	EN 60945 Chapter 10.5	---	B	fulfilled*

Test were only performed on the RS422 line as representative Signal line for that connector. The signal lines are specified shorter that 3 m as declared by the applicant

## 2.3 Performance Criterias

### Definition of evaluation criterion according to EN 60945 chapter 10.1:

- A: the EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer;
- B: the EUT shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed, as defined in the relevant equipment standard and in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is however, allowed, but no change of actual operating state or stored data is allowed.
- C: temporary degradation or loss of function or performance is allowed during the test, provided the function is self-recoverable, or can be restored at the end of the test by the operation of the controls, as defined in the relevant equipment standard and in the technical specification published by the manufacturer.



**Definition of evaluation criterion according to ETSI EN 301 489-1 V1.6.1 chapter 6.1:**

Performance criteria for continuous phenomena applied to transmitters and receivers

If no further details are given in the relevant part of EN 301 489 series dealing with the particular type of radio equipment, the following general performance criteria for continuous phenomena shall apply. During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

**Definition of evaluation criterion according to ETSI EN 301 489-1 V1.6.1 chapter 6.2:**

Performance criteria for transient phenomena applied to transmitters and receivers

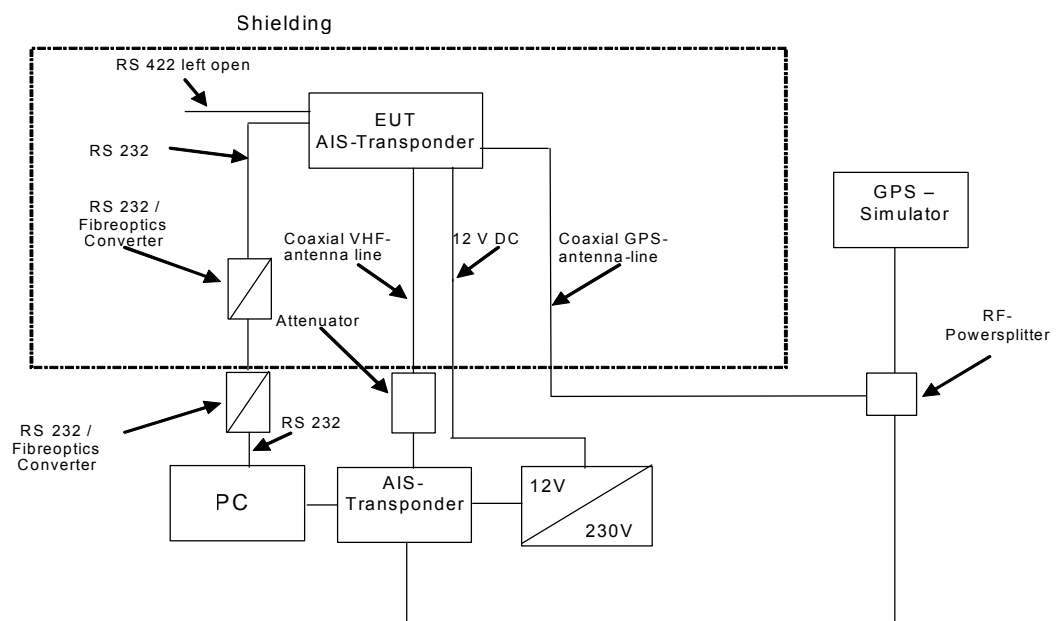
If no further details are given in the relevant part of EN 301 489 series dealing with the particular type of radio equipment, the following general performance criteria for transient phenomena shall apply. After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance. During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.

### 3 Test sequence and test results electromagnetic disturbances characteristics

#### 3.1 Radiated radio disturbance according to EN 60945 chapter 9.3 (magnetic. field)

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.



Test: The interfering field strength is measured in two stages. In the first non-standard stage, preliminary measurements are made in a fully anechoic chamber. Here the equipment under test is measured from various sides in normal fitted position. This procedure makes it possible to ascertain without the effect of external interference sources and without adjusting the antenna in height whether the test object is emitting interference at certain frequencies. In the second stage, the frequencies determined in the preliminary measurements are measured in compliance with the standard on a standard open area test site with a quasi-peak detector.

Measuring devices:

Preliminary measurement

AH-controller HD100 (PM-No. 480181)  
AH-antenna mast (PM-No. 480187/480188)  
AH-turntable (PM-No. 480186)  
fully anechoic chamber (PM-No. 480190)  
receiver ESI (PM-Nr. 480355)  
DC filter 4\*60A (PM-No. 480209)  
EMI softwarepackage ES-K1 (PM-No. 480111)

Final measurement

FF-controller HD 100 (PM-No. 480139)  
FF-turntable (PM-No. 480087)  
open area test site (PM-No. 480085)  
relays switch unit RSU (PM-No. 480077)  
receiver ESCS 30 (PM-No. 480270)  
Antenna R+S Loop antenna HFH2-Z2 (PM-Nr. 480059)

Measuring records: The measuring records are presented on the following pages.

Test result: The requirements of the test documents were fulfilled.

Title: Preliminary emission measurement  
according EN60945  
EUT: Nauticast-B AIS-300  
Manufacturer: ACR  
Operating Condition: transmit mode  
Test site: fully anechoic chamber M20; PHOENIX TEST LAB GmbH  
Operator: B. Steiner  
Test Specification:  
Comment:

**Scantable for the preliminary measurement: EN60945 ESI**

Unit: dB $\mu$ V/m                      Curve 1                      Curve 2  
Detector / Mode                      MaxPeak / ClearWrite                      Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	150.0 kHz				
Stop frequency	30.0 MHz				
Increment	6.0 kHz				
IF-bandwidth	9 kHz				
Measurement time	20.0 ms				
Demodulation	FM				
Autorange	On				
Preamplifier	20 dB				
RF-attenuation	0 dB				
min. RF-attenuation	0 dB				
IF-attenuation					
Ref.-Level	-30.0 dBm				
Receiver	ESI7				
Signal path	None				
Scan-mode	Lin				
Input	2DC				
Tracking-gen.					
Probe transducer	_HFH2-Z2 (dB $\mu$ V/m) 98				
System transducer	None				
add. transducer 1	RF3 9kHz- 30MHz				
add. transducer 2	None				
add. transducer 3	None				

**Scantable for the subsequent measurement: EN60945 ESI\_fin**

Unit: dB $\mu$ V/m

Curve 1

Curve 2

Detector / Mode

MaxPeak / ClearWrite

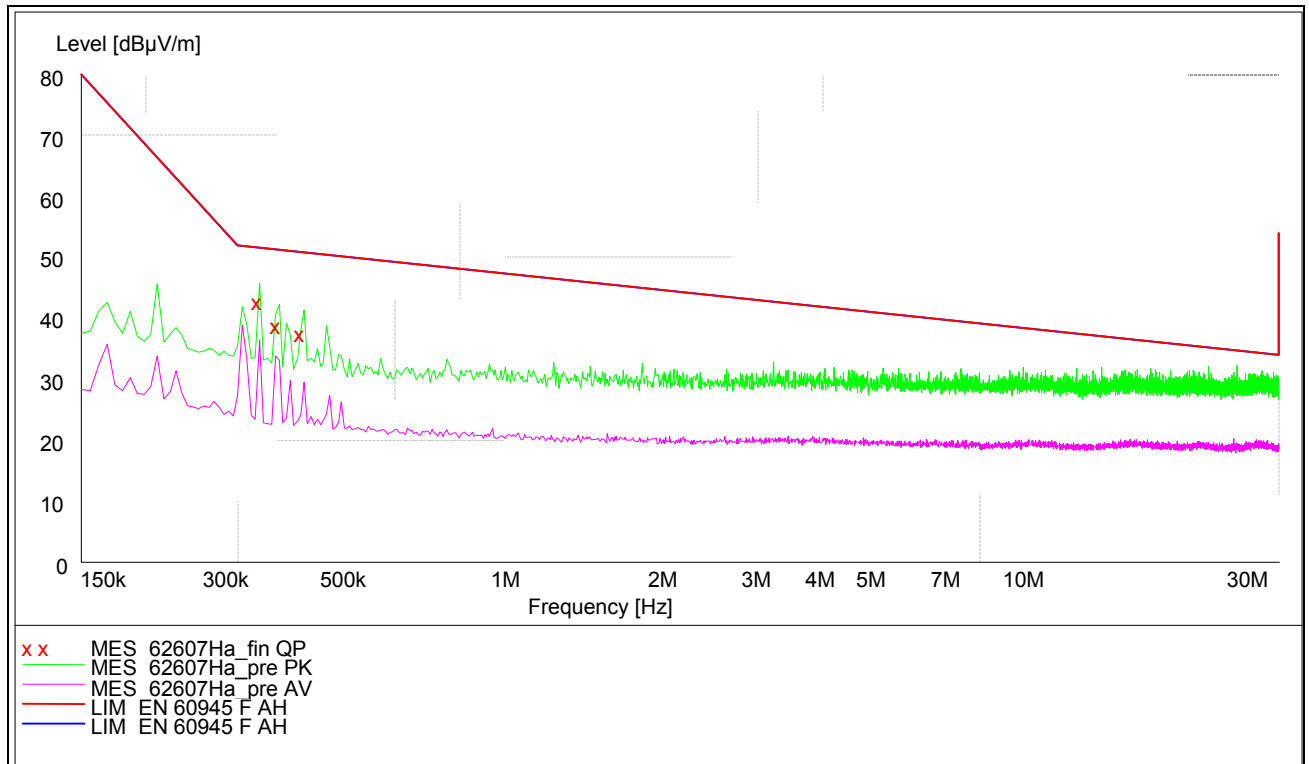
Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	150.0 kHz				
Stop frequency	30.0 MHz				
Increment	600.0 Hz				
IF-bandwidth	9 kHz				
Measurement time	10.0 ms				
Demodulation	FM				
Autorange	On				
Preamplifier	20 dB				
RF-attenuation	0 dB				
min. RF-attenuation	0 dB				
IF-attenuation					
Ref.-Level	-30.0 dBm				
Receiver	ESI7				
Signal path	None				
Scan-mode	Lin				
Input	2DC				
Tracking-gen.					
Probe transducer	_HFH2-Z2 (dB $\mu$ V/m) 98				
System transducer	None				
add. transducer 1	RF3 9kHz- 30MHz				
add. transducer 2	None				
add. transducer 3	None				

The measurement time with the quasi-peak measuring detector is 1 second.

The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with the EUT in various positions.

The top measured curve represents the peak measurement. The measured points marked with x are frequency points for which later measurements with a quasi-peak detector were carried out. These values are indicated in the following table. The bottom measured curve represents average values, which are only required for control purposes.



Data record name: 62607Ha

of 18.01.07

**Result measured with the quasipeak detector:**  
(These values are marked in the above diagram by x)

Frequency MHz	Level dBµV/m	Transducer dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Loop
0.330000	43.40	20.1	51.6	8.3	150.00	135.00	0.0
0.360000	39.40	20.1	51.3	11.9	150.00	232.00	0.0
0.402000	38.10	20.1	50.9	12.7	150.00	135.00	0.0

Data record name: 62607Ha\_fin QP

of 18.01.07

In this case it was necessary to carry out subsequent measurements because at some frequency points a value was above the Qualify limit curve during the preliminary measurements. The results from the standard subsequent measurements on the open area test site are presented in the following.

Title: Final emission measurement on open area testsite according to EN 60945  
 EUT: Nauticast-B AIS-300  
 Manufacturer: ACR  
 Operating Condition: transmit mode  
 Test site: openarea testsite M6; PHOENIX TEST LAB GmbH  
 Operator: B. Steiner  
 Test Specification:  
 Comment:

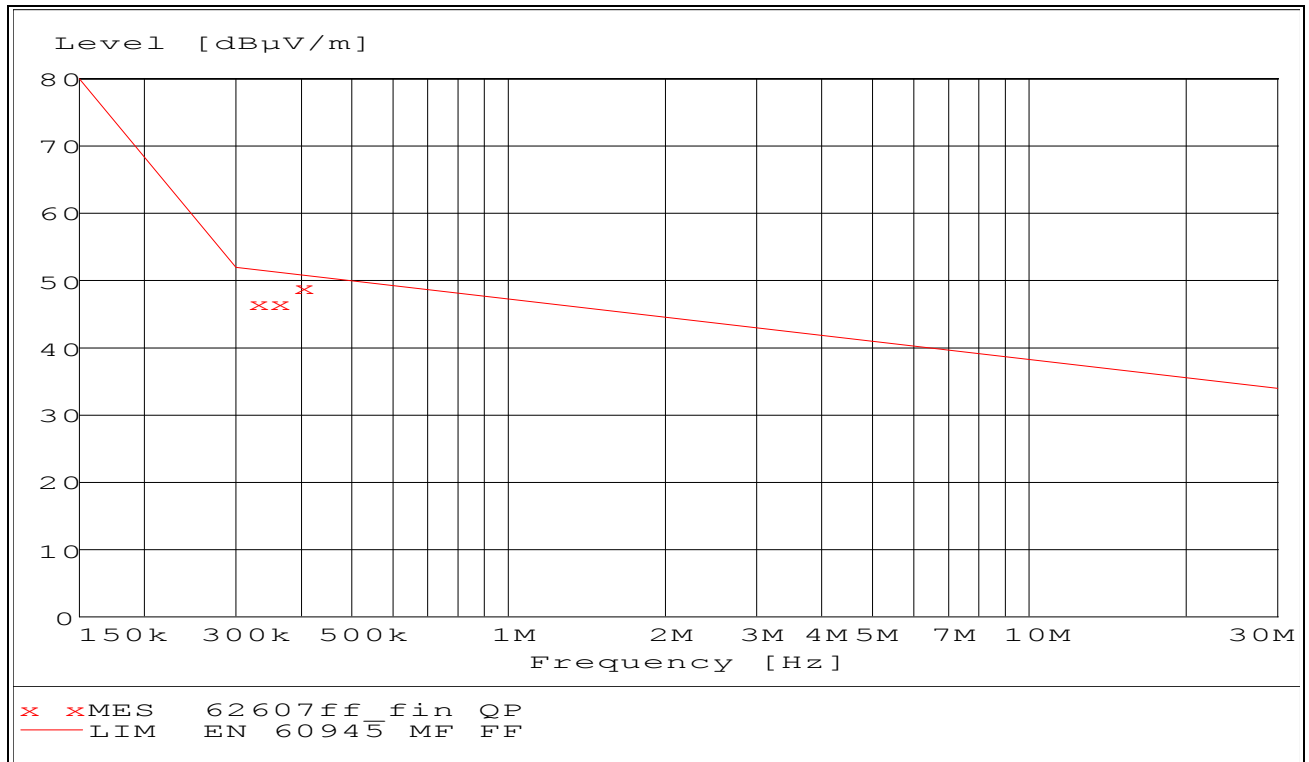
**Scantable for the subsequent measurement: H-Field M6\_fin**

Unit: dB $\mu$ V/m                      Curve 1                      Curve 2  
 Detector / Mode                      MaxPeak / ClearWrite                      Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	150.0 kHz				
Stop frequency	30.0 MHz				
Increment	900.0 Hz				
IF-bandwidth	9 kHz				
Measurement time	100.0 ms				
Demodulation	Off				
Autorange	On				
Preamplifier	Off				
RF-attenuation	0 dB				
min. RF-attenuation	0 dB				
IF-attenuation	LowNoise				
Ref.-Level					
Receiver	ESCS				
Signal path	ANT_AH MF ESCS				
Scan-mode	Lin				
Input					
Tracking-gen.	Off				
Probe transducer	_HFH2-Z2 (dB $\mu$ V/m)				
System transducer	AH CP1 Ant				
add. transducer 1	None				
add. transducer 2	None				
add. transducer 3	None				

The measurement time with the quasi-peak measuring detector is 1 second.

The measured points and the limit line in the following diagram refer to the standard measurement of the emitted interference in compliance with the above mentioned standard. The measured points marked with x are the measured results of the standard subsequent measurement on the open area test site.



Data record name: 62607ff

of 18.01.07

The results of the standard subsequent measurement on the open area test site are indicated in the table below. The limits as well as the measured results (levels) refer to the above mentioned standard while taking account of the specified requirements for a 3 m measuring distance.

**Result measured with the quasipeak detector:**

(These values are marked in the above diagram by x)

Frequency MHz	Level dBµV/m	Transducer dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Loop
0.330000	46.60	20.1	51.6	5.0	150.0	114.00	0.0
0.360000	46.80	20.1	51.3	4.5	150.0	90.00	0.0
0.402000	48.90	20.1	50.9	2.0	150.0	7.00	90.0

Data record name: 62607ff\_fin QP

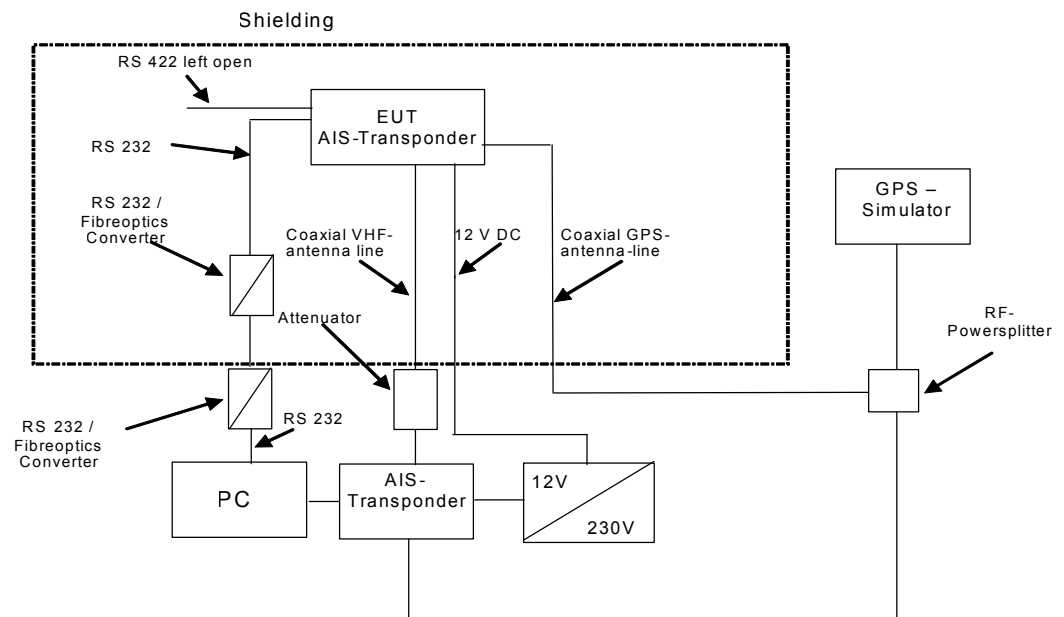
of 18.01.07



### 3.2 Radiated radio disturbance according to EN 60945 chapter 9.3 (E-field)

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.



Test: The interfering field strength is measured in two stages. In the first non-standard stage, preliminary measurements are made in a fully anechoic chamber. Here the equipment under test is measured from various sides in normal fitted position. This procedure makes it possible to ascertain without the effect of external interference sources and without adjusting the antenna in height whether the test object is emitting interference at certain frequencies. In the second stage, the frequencies determined in the preliminary measurements are measured in compliance with the standard on a standard open area test site with a quasi-peak detector.

Measuring devices:     AH-controller HD100 (PM-No. 480181)  
                          AH-antenna mast (PM-No. 480187/480188)  
                          AH-turtable (PM-No. 480186)  
                          Fully anechoic chamber (PM-No. 480190)  
                          Receiver ESI (PM-Nr. 480355)  
                          EMI softwarepackage ES-K1 (PM-No. 480111)  
                          Antenna Chase CBL 6112 (PM-No. 480185)  
                          DC filter 4\*60A (PM-No. 480209)

Measuring records:     The measuring records are presented on the following pages.

Test result:            The requirements of the test documents were fulfilled.



**Scantable for the subsequent measurement: EN60945 ESI\_fin**

Unit: dB $\mu$ V/m

Curve 1

Curve 2

Detector / Mode

MaxPeak / ClearWrite

Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	30.0 MHz	156.0 MHz	165.0 MHz	1.0 GHz	
Stop frequency	156.0 MHz	165.0 MHz	1.0 GHz	2.0 GHz	
Increment	8.0 kHz	600.0 Hz	8.0 kHz	8.0 kHz	
IF-bandwidth	120 kHz	9 kHz	120 kHz	120 kHz	
Measurement time	10.0 ms	10.0 ms	10.0 ms	10.0 ms	
Demodulation	FM	FM	FM	FM	
Autorange	On	On	On	On	
Preamplifier	20 dB	20 dB	20 dB	20 dB	
RF-attenuation	0 dB	0 dB	0 dB	0 dB	
min. RF-attenuation	0 dB	0 dB	0 dB	0 dB	
IF-attenuation					
Ref.-Level	-30.0 dBm	-30.0 dBm	-30.0 dBm	-30.0 dBm	
Receiver	ESI7	ESI7	ESI7	ESI7	
Signal path	RF1 CP1	RF1 CP1	RF1 CP1	RF1 CP1	
Scan-mode	Lin	Lin	Lin	Lin	
Input	1	1	1	1	
Tracking-gen.					
Probe transducer	_CBL6112B	_CBL6112B	_CBL6112B	_CBL6112B	
System transducer	RF1 CP1	RF1 CP1	RF1 CP1	RF1 CP1	
add. transducer 1	None	None	None	None	
add. transducer 2	None	None	None	None	
add. transducer 3	None	None	None	None	

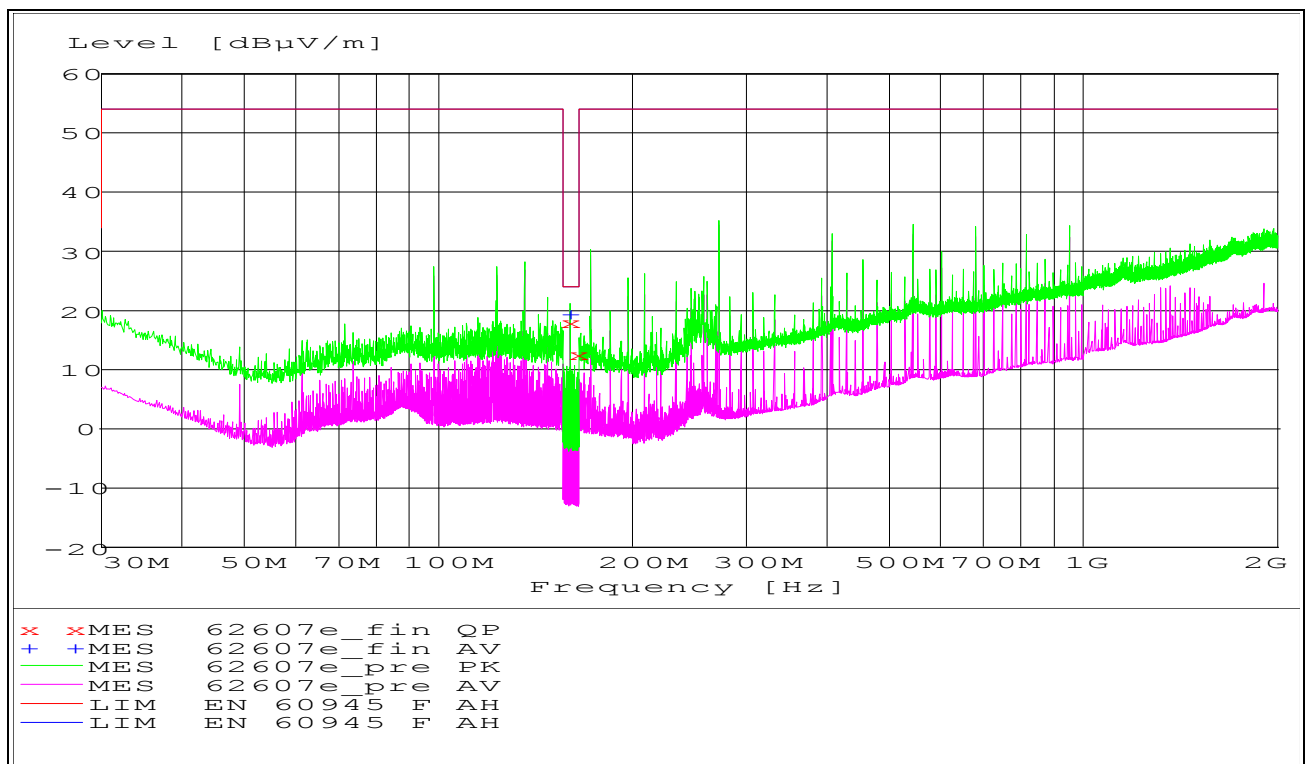
The measurement time with the quasi-peak measuring detector is 1 second.

The limit line and measurement curve shown in the diagram below refer to the preliminary measurements. Here, it must be noted that because of the reduced measuring distance and because of the floor absorbers, the measured values do not comply with the values of the above mentioned standard; they only serve as orientation in determining which frequencies must be measured on the open area test site.

The limit line is achieved with the applied standard by converting to a 3 m measurement distance (+10 dB) and the correction for the free space in which in the "worst case" the reflected floor wave is missing entirely (-6 dB). Therefore 4 dB is added to the limit line of the standard concerned.

The curves in the diagram only represent the maximum measured value for each frequency point of all preliminary measurements, which were carried out with the EUT in various positions.

The top measured curve represents the peak measurement. The measured points marked with x are frequency points for which later measurements with a quasi-peak detector were carried out. These values are indicated in the following table. The bottom measured curve represents average values, which are only required for control purposes.



Data record name: 62607e of 18.01.07

**Result measured with the quasipeak detector:**

(These values are marked in the above diagram by x)

Frequency MHz	Level dB $\mu$ V/m	Transducer dB	Limit dB $\mu$ V/m	Margin dB	Height cm	Azimuth deg	Polarisation
159.743400	18.00	9.7	24.0	6.0	150.0	135.00	HORIZONTAL
165.000000	12.60	9.5	24.0	11.4	150.0	115.00	HORIZONTAL

Data record name: 62607e\_fin QP of 18.01.07

**Result measured with the average detector:**

(These values are marked in the above diagram by +)

Frequency MHz	Level dB $\mu$ V/m	Transducer dB	Limit dB $\mu$ V/m	Margin dB	Height cm	Azimuth deg	Polarisation
159.744000	19.50	9.7	24.0	4.5	150.0	75.00	HORIZONTAL

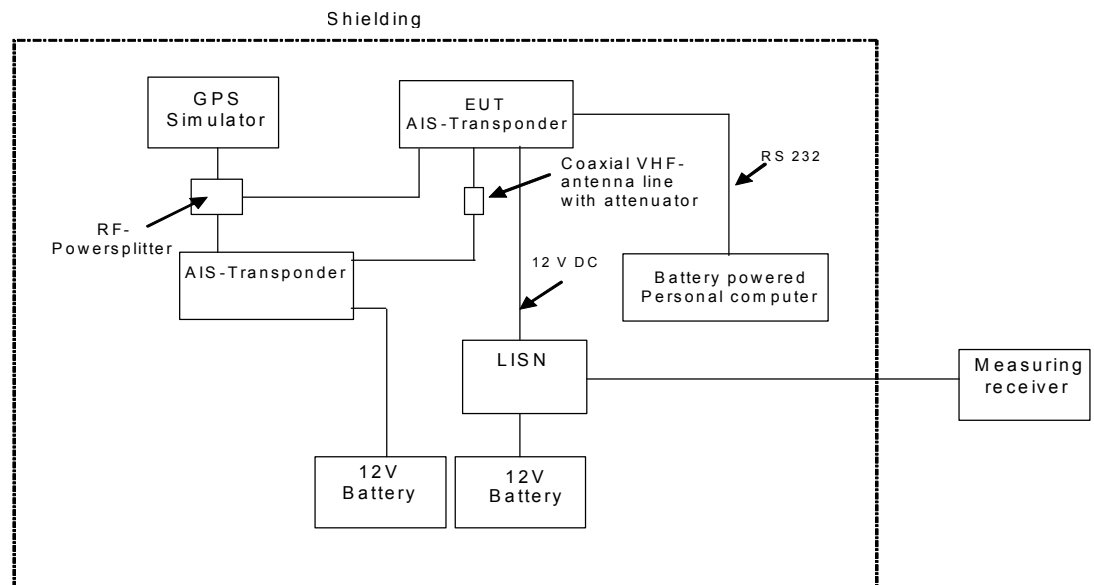
Data record name: 62607e\_fin AV of 18.01.07

Note: The measured frequency level at 159.744 MHz is caused by the fundamental frequency of the system.

In this case it was not necessary to carry out subsequent measurements because during the preliminary measurement each detected level is at least 20dB below the limit.

### 3.3 Conducted radio disturbances according to EN 60945 chapter 9.2

- Test set-up:
- Table set-up
  - The drawing below schematically shows the test set-up.
  - Photos of the test set-up can also be referred to in the annex.



Measuring devices:      Shielded chamber (PM-No. 480088)  
                                  ESAI test receiver + display (PM-No. 480025, PM-No. 480026)  
                                  EMI ES-K1 software package (PM No. 480111)  
                                  LISN NSLK8128 (PM-No. 480058)  
                                  GPS Simulator STR 4500 (PM-No. 480463)

Measuring records:      The measuring records are presented on the following pages.

Test results:              The requirements of the test documents were fulfilled.

Title: Conducted Spurious Emission Measurement  
according EN 60945  
EUT: Nauticast-B AIS-300  
Manufacturer: ACR  
Operating Condition: transmit mode  
Test site: shielded chamber M4; PHOENIX TEST LAB GmbH  
Operator: B. Steiner  
Test Specification:  
Comment:

**Scantable for the preliminary measurement: EN60945V**

Unit: dB $\mu$ V                                  Curve 1                                  Curve 2  
Detector / Mode                              MaxPeak / ClearWrite                      Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	9.0 kHz	150.0 kHz			
Stop frequency	150.0 kHz	30.0 MHz			
Increment	150.0 Hz	6.0 kHz			
IF-bandwidth	200 Hz	9 kHz			
Measurement time	50.0 ms	50.0 ms			
Demodulation	AM	AM			
Autorange	On	On			
Preamplifier	Off	Off			
RF-attenuation	20 dB	0 dB			
min. RF-attenuation	20 dB	20 dB			
IF-attenuation					
Ref.-Level	-30.0 dBm	-50.0 dBm			
Receiver	ESAI	ESAI			
Signal path	Tisch	Tisch			
Scan-mode	Lin	Lin			
Input	1DC	1DC			
Tracking-gen.	Off	Off			
Probe transducer	_NSLK	_NSLK			
System transducer	SK Tisch 01/02	SK Tisch 01/02			
add. transducer 1	None	None			
add. transducer 2	None	None			
add. transducer 3	None	None			



**Scantable for the subsequent measurement: EN60945V\_fin**

Unit: dB $\mu$ V

Curve 1

Curve 2

Detector / Mode

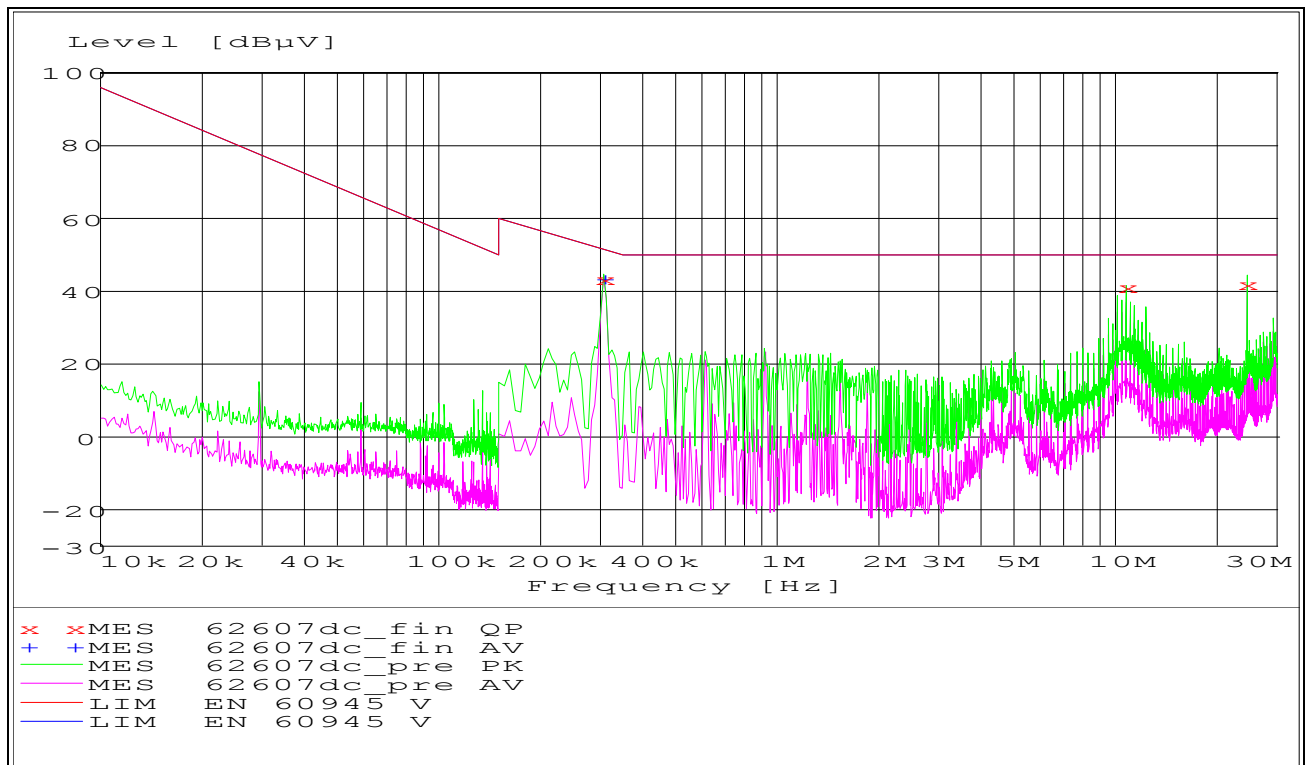
MaxPeak / ClearWrite

Average / ClearWrite

Subrange	1	2	3	4	5
Start frequency	9.0 kHz	150.0 kHz			
Stop frequency	150.0 kHz	30.0 MHz			
Increment	20.0 Hz	900.0 Hz			
IF-bandwidth	200 Hz	9 kHz			
Measurement time	100.0 ms	100.0 ms			
Demodulation	AM	AM			
Autorange	On	On			
Preamplifier	Off	Off			
RF-attenuation	20 dB	20 dB			
min. RF-attenuation	20 dB	20 dB			
IF-attenuation					
Ref.-Level	-50.0 dBm	-50.0 dBm			
Receiver	ESAI	ESAI			
Signal path	Tisch	Tisch			
Scan-mode	Lin	Lin			
Input	1DC	1DC			
Tracking-gen.	Off	Off			
Probe transducer	_NSLK	_NSLK			
System transducer	SK Tisch 01/02	SK Tisch 01/02			
add. transducer 1	None	None			
add. transducer 2	None	None			
add. transducer 3	None	None			

The measurement time with the quasi-peak measuring detector is 5 seconds.

The curves in the diagram only represent for each frequency point the maximum measured value of all preliminary measurements which were made for each power supply line. The top measured curve represents the peak measurement and the bottom measured curve the average measurement. The quasi-peak measured points are marked by x and the average measured points by +.



Data record name: 62607dc

of 18.01.2007

**Result measured with the quasipeak detector:**  
(These values are marked in the above diagram by x)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.307500	44.00	0.7	51.5	7.6	+	----
10.752000	41.70	1.4	50.0	8.3	+	----
24.576000	42.10	2.8	50.0	7.9	-	----

Data record name: 62607dc\_fin QP

of 18.01.2007

**Result measured with the average detector:**  
(These values are marked in the above diagram by +)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.306600	43.80	0.7	51.6	7.8	+	----

Data record name: 62607dc\_fin AV

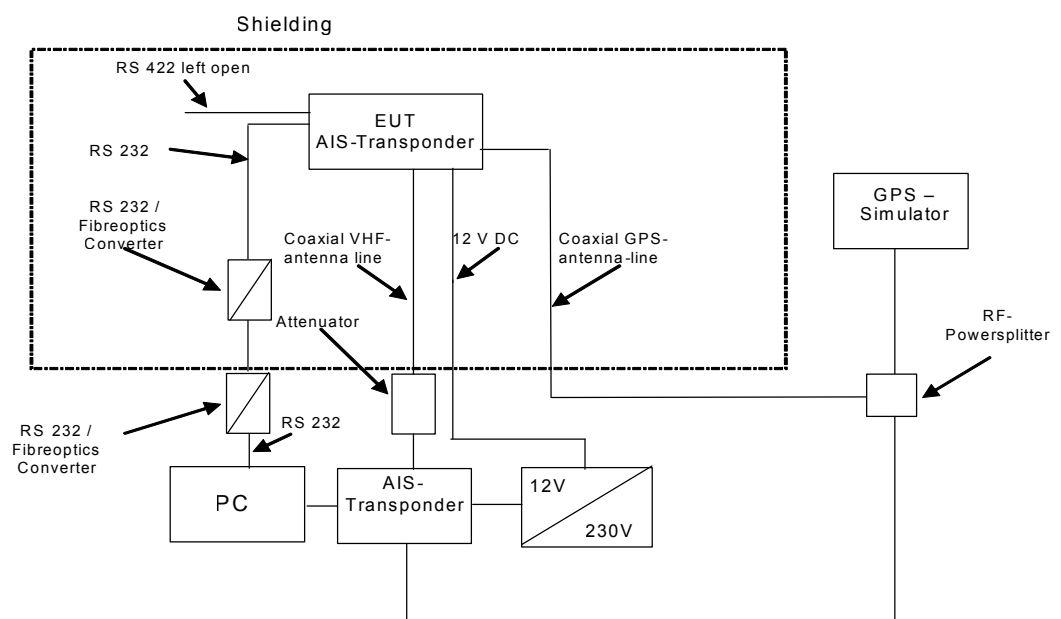
of 18.01.2007

## 4 Test sequence and test results electromagnetic immunity characteristics

### 4.1 Immunity test for high frequency electromagnetic fields according to EN 60945 chapter 10.4

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.
- The transmitting antenna is set at 1.5m above the floor.



Monitoring of EUT:

The output signals were checked by the monitoring system outside the anechoic chamber.

Measuring devices:

- AH-controller HD100 (PM-No. 480326)
- AH-turntable (PM-No. 480315)
- AH-antenna mast (PM-No. 480187, 480188)
- Fully anechoic chamber M20 (PM-No. 480303)
- Power amplifier AR AR 60S1G3 (PM-No. 480418)
- Power amplifier AR AR 150W1000 (PM-No. 480419)
- Signal generator SML03 (PM-No. 480421)
- Power meter NRVD (PM-No. 480177)
- Insertion unit URV5-Z2 (PM-No. 480441, 480442)
- Relays switch unit RSU (PM-No. 480175)
- Relays switch unit RSU (PM-No. 480182)
- Relay interface ICS 4874 (PM No. 480066)
- Fieldsensor Display Radisense (PM-No.: 480461)
- Fieldprobe Radisense (PM-No.: 480460)
- EMS softwarepackage EMS-K1 (PM-No. 480222)
- Horn antenna BBHA 9120E (PM-No. 480335)
- Log.per.antenna HL 046 (PM-No. 480429)
- DC filter 4\*60A (PM-No. 480209)
- GPS Simulator STR 4500 (PM-No. 480463)

Measuring records:

The tests in the table below were carried out.

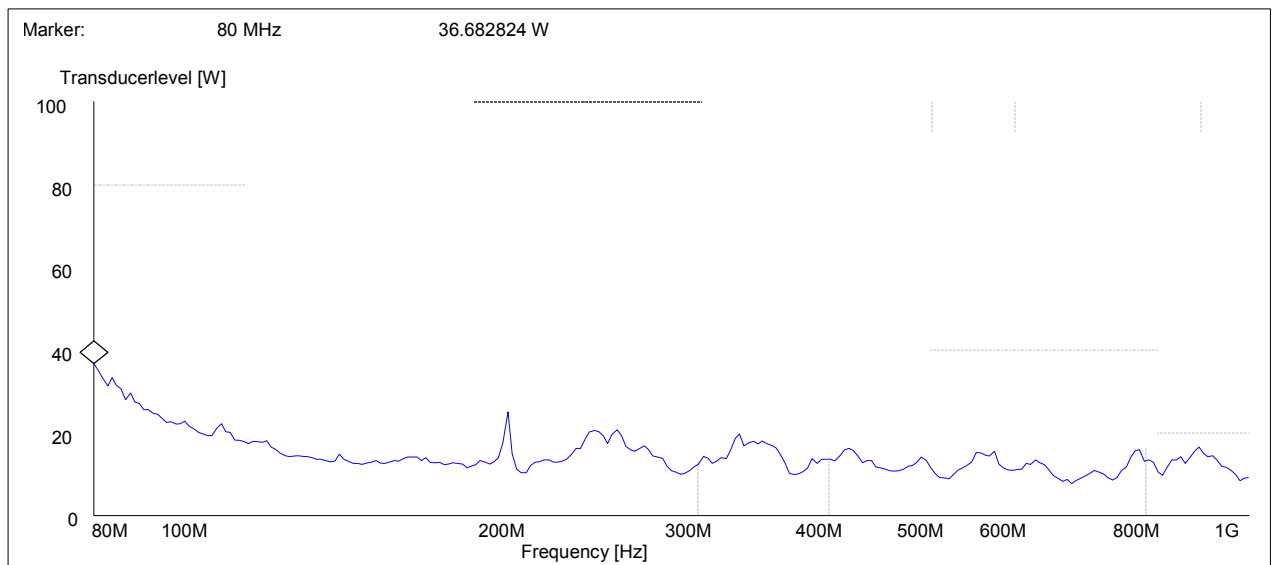
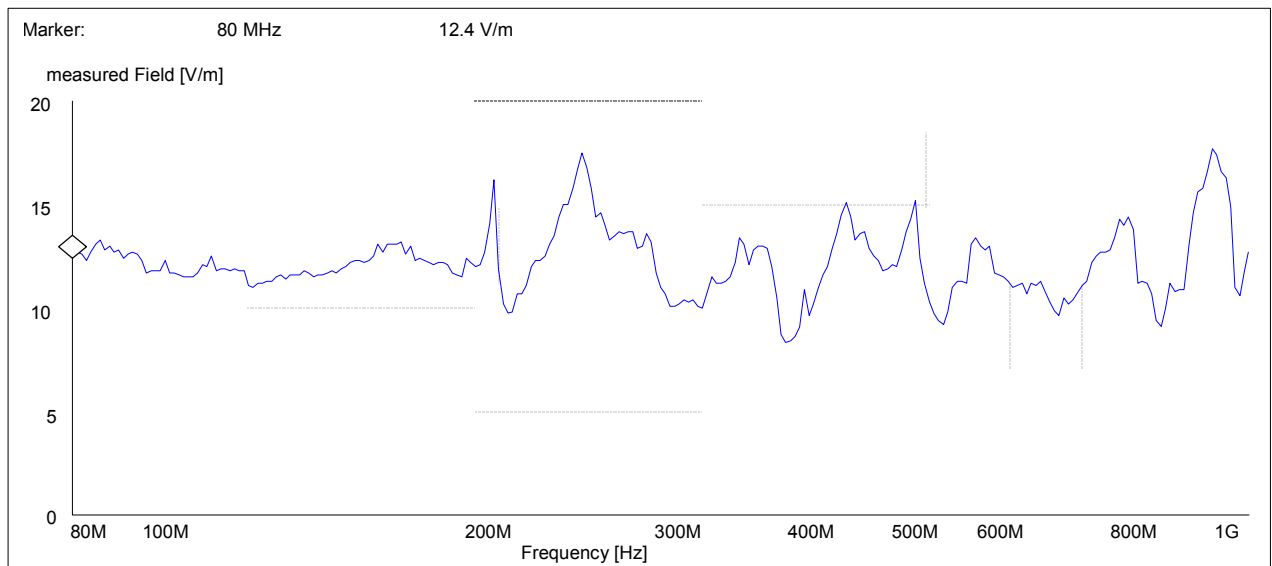
Date of test:		15.01.2007 + 18.01.2007		
Ambient conditions:		35 % Frel, 19°C		
Test level:		80-2000 MHz, 10 V/m, AM, 400 Hz, 80 %		
Increment:		log 1 %		
Dwell time:		≥3 s		
Distance antenna/ test object	Polarisation	Radiation direction	EUT reaction	Result
3 m	vertical	0 °	No reaction detected	A
3 m	vertical	90 °	No reaction detected	A
3 m	vertical	180 °	No reaction detected	A
3 m	vertical	270 °	No reaction detected	A
3 m	horizontal	0 °	No reaction detected	A
3 m	horizontal	90 °	No reaction detected	A
3 m	horizontal	180 °	No reaction detected	A
3 m	horizontal	270 °	No reaction detected	A

Test results:                    The requirements of the test documents were fulfilled.

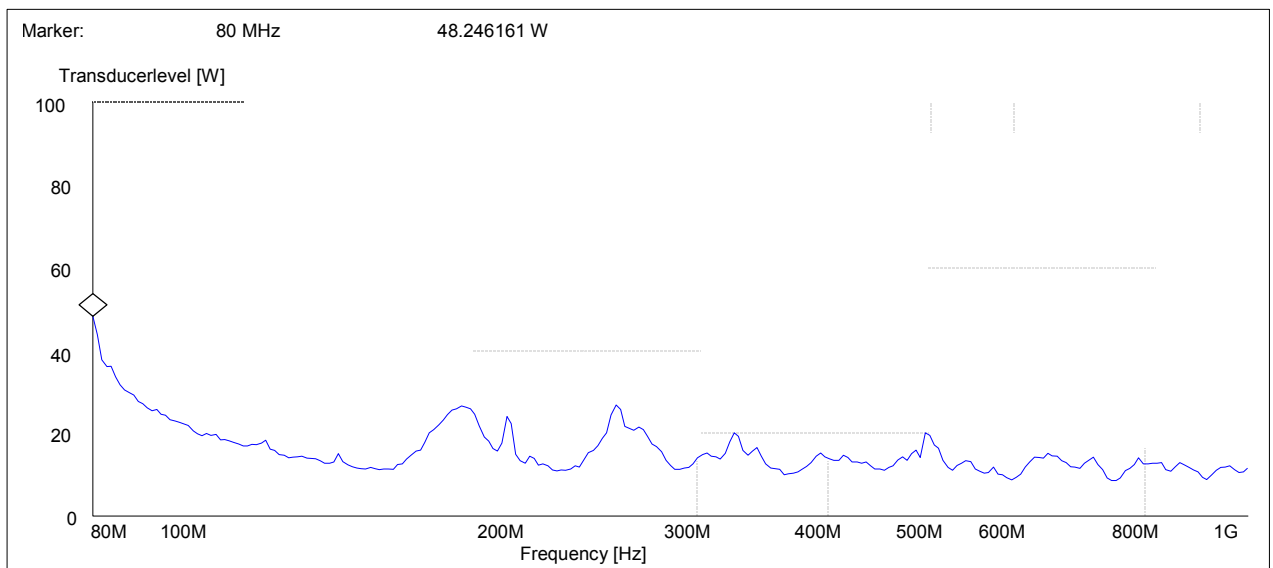
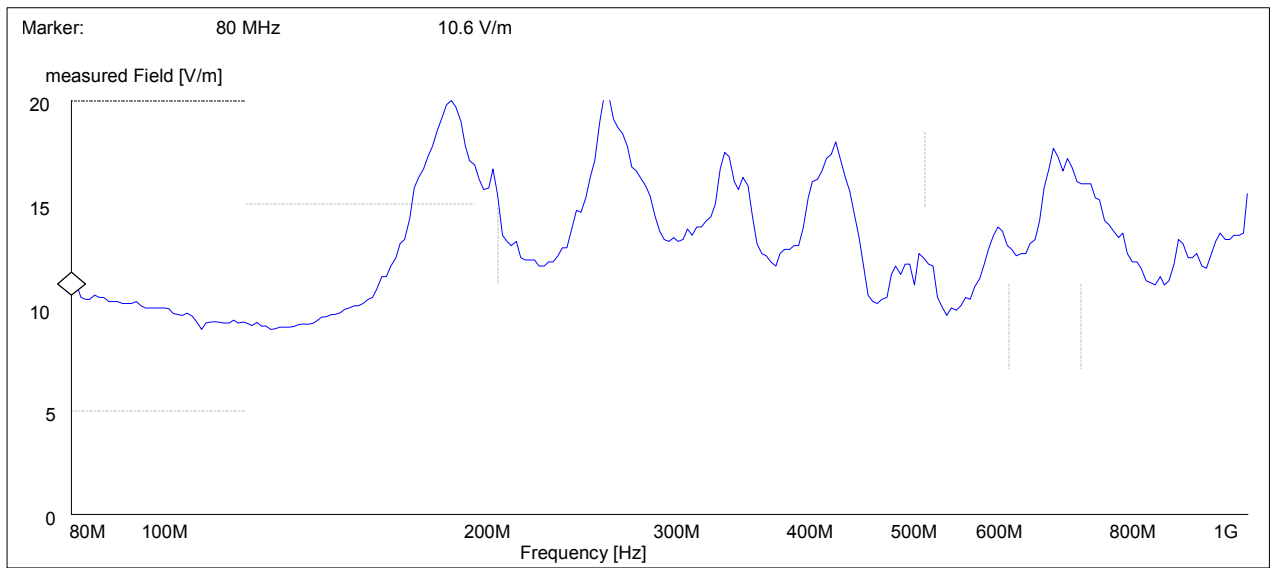
The curves in the following graphs are representative of the entire frequency range:

- The 'Transducerlevel' curve represents the power transmitted by the antenna. This power profile must be taken as the basis of any subsequent test.
- The 'measured Field' curve shows the measured field strength corresponding with polarisation of the transmitting antenna. This curve only serves to prove that a field was produced. Refer to the Annex for a photo of the position of the field probe in relation to the equipment under test.

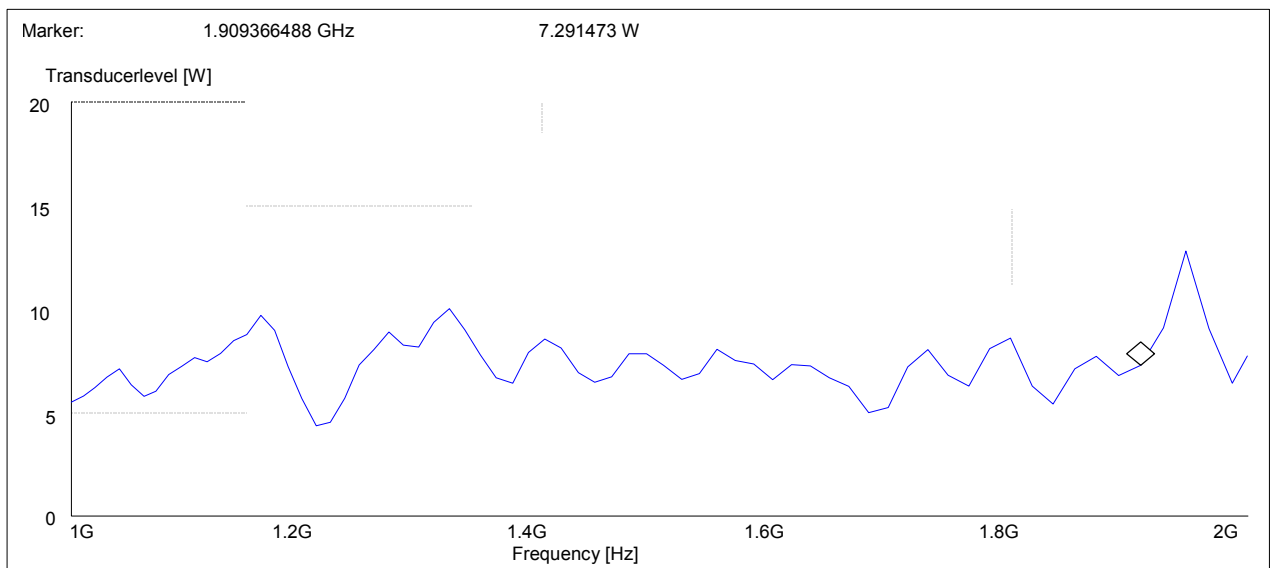
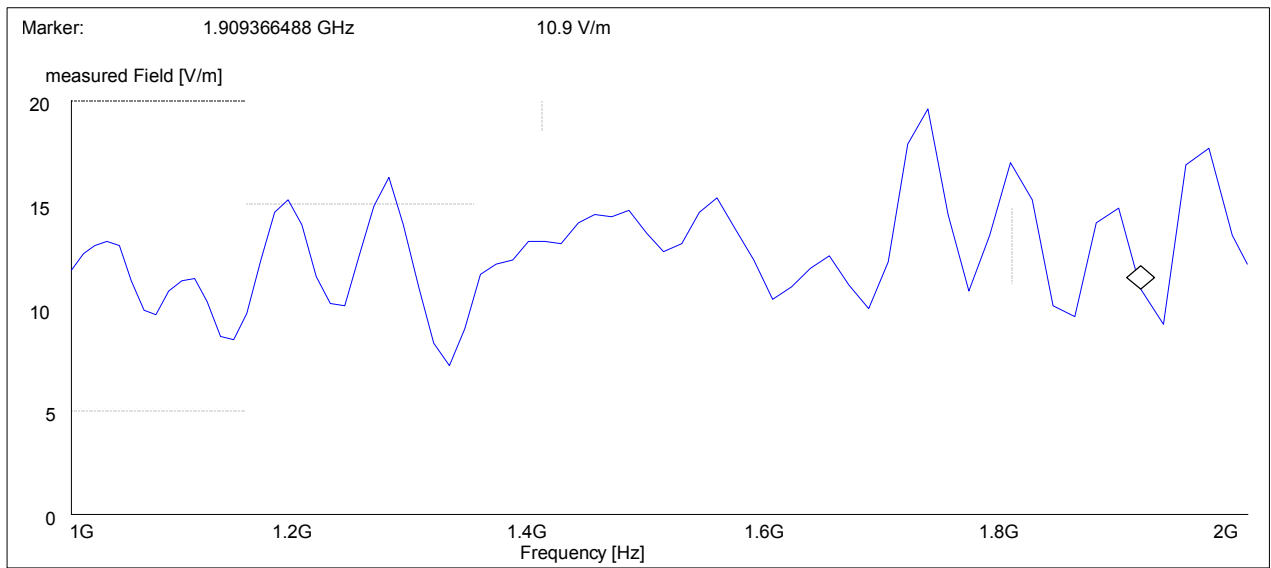
62607LH0: 80 MHz to 1000 MHz, horizontal polarisation



62607LH0: 80 MHz to 1000 MHz, horizontal polarisation

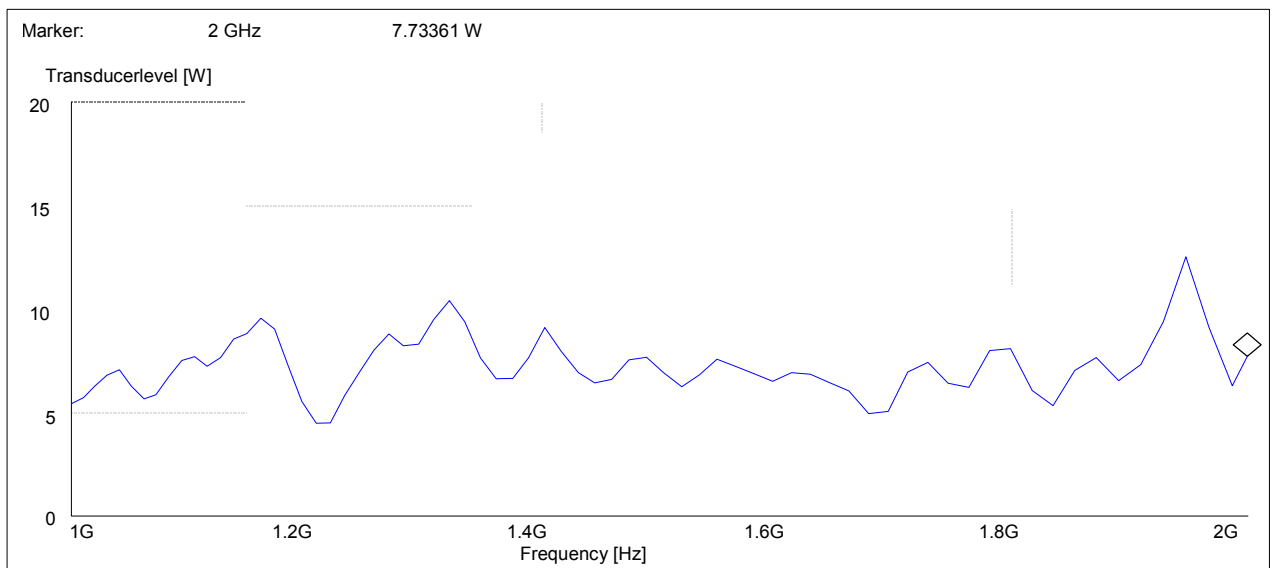
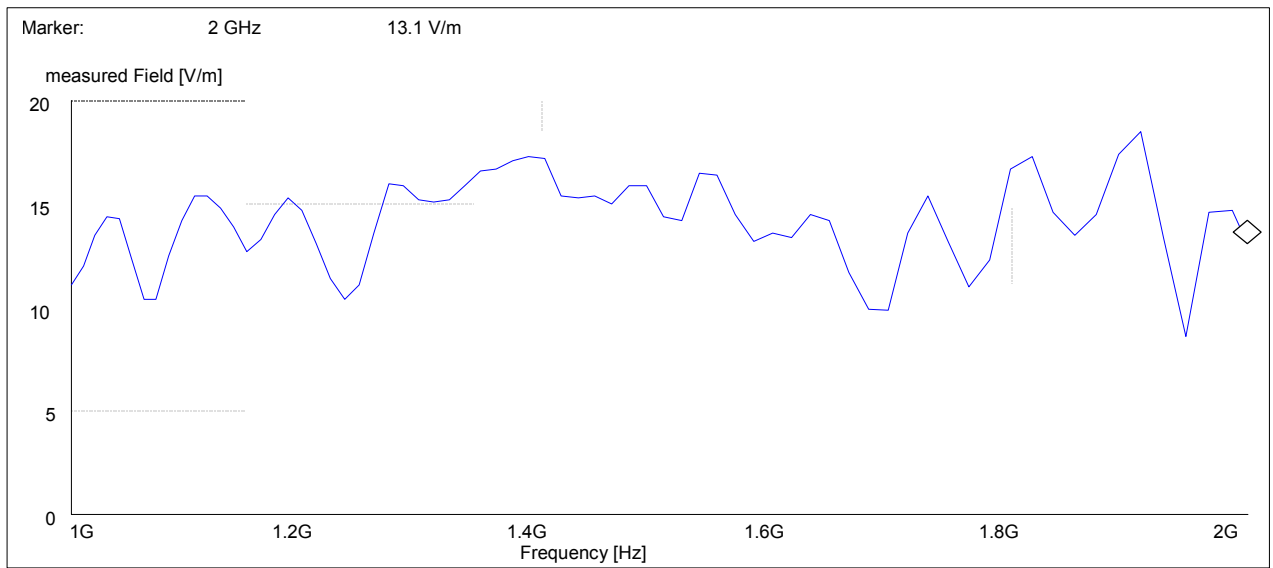


62607LV0: 80 MHz to 1000 MHz, vertical polarisation



62607HH0: 1 GHz to 2 GHz, horizontal polarisation



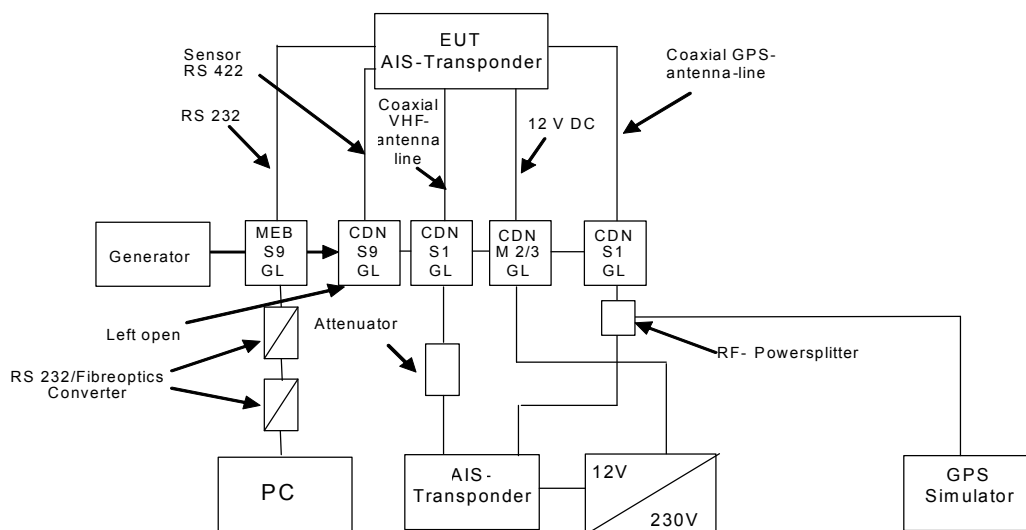


62607HV0: 1 GHz to 2 GHz, vertical polarisation

## 4.2 Immunity test for conducted voltages, induced by RF-fields according to EN 60945 chapter 10.3

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.
- The EUT is placed 10 cm above the ground plane.



Measurement devices: Power amplifier AR 75A400 (PM No. 480459)  
 Signal generator SMY (PM No. 580010)  
 Millivoltmeter URV5 (PM No. 480015)  
 Power probe URV5-Z2 (PM No. 480019, PM No. 480020)  
 Terminating impedance RNB (PM No. 480007, PM No. 480008)  
 Attenuator 6dB (PM-No. 410061)  
 EMS software package EMS-K1 (PM No. 480112)  
 Shielded room (PM No. 480088)  
 DC filter (PM-No. 480099)  
 EMV CDN S1GL A (PM-No. 410172)  
 EMV CDN S1GL C (PM-No. 410173)  
 Lüthi CDN 801-S9A (PM-No. 410040)  
 EMV CDN S9B (PM-No.: 410199)  
 EMV CDN M2/3 A (PM-No. 410038)

Measuring records:

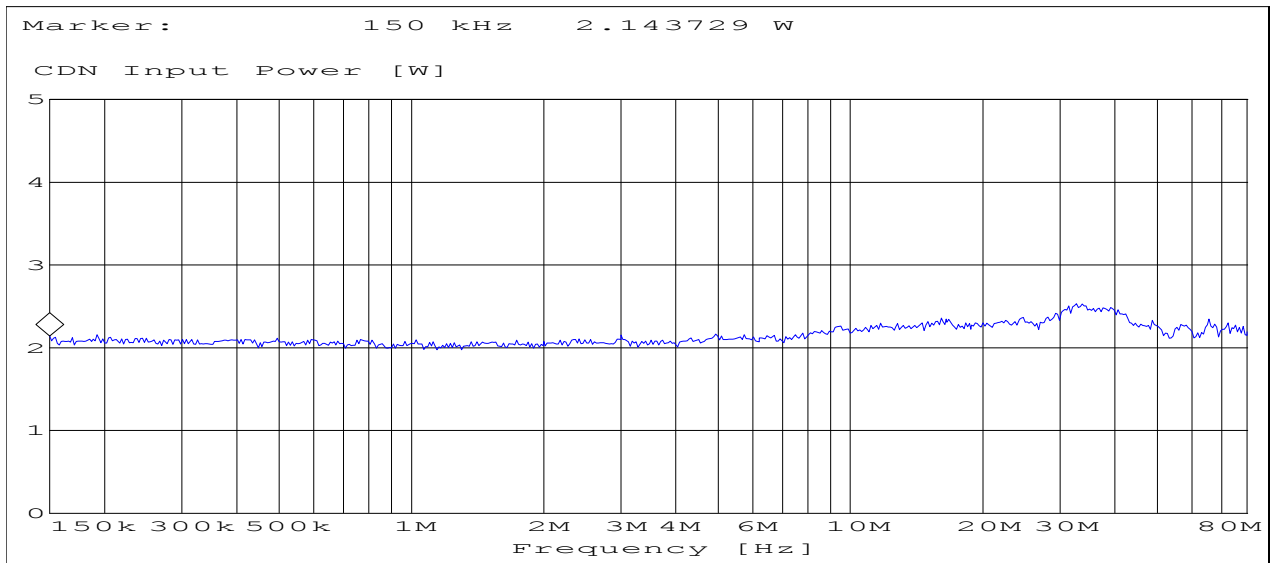
The tests in the table below were carried out.

Date of test:	19. January 2007		
Ambient conditions:	35 % F <sub>rel</sub> , 19 °C		
Test level 1:	150 kHz – 80 MHz, 10 V, AM, 80 %, 400 Hz		
Increment:	log 1 %		
Test level 2:	2 MHz, 3 MHz, 4 MHz, 6.2 MHz, 8.2 MHz, 12.6 MHz, 16.5 MHz, 18.8 MHz, 22 MHz, 25 MHz, 10V, AM, 80%, 400 Hz		
Dwell time:	≥3s		
Coupling network	Coupling to	EUT reaction	Result
CDN M2/3	12 V DC	No reaction detected	A
CDN S9 GL	RS 422 line	No reaction detected	A
CDN S1C GL	GPS-antenna	No reaction detected	A
CDN S1A GL	VHF-antenna	No reaction detected	A

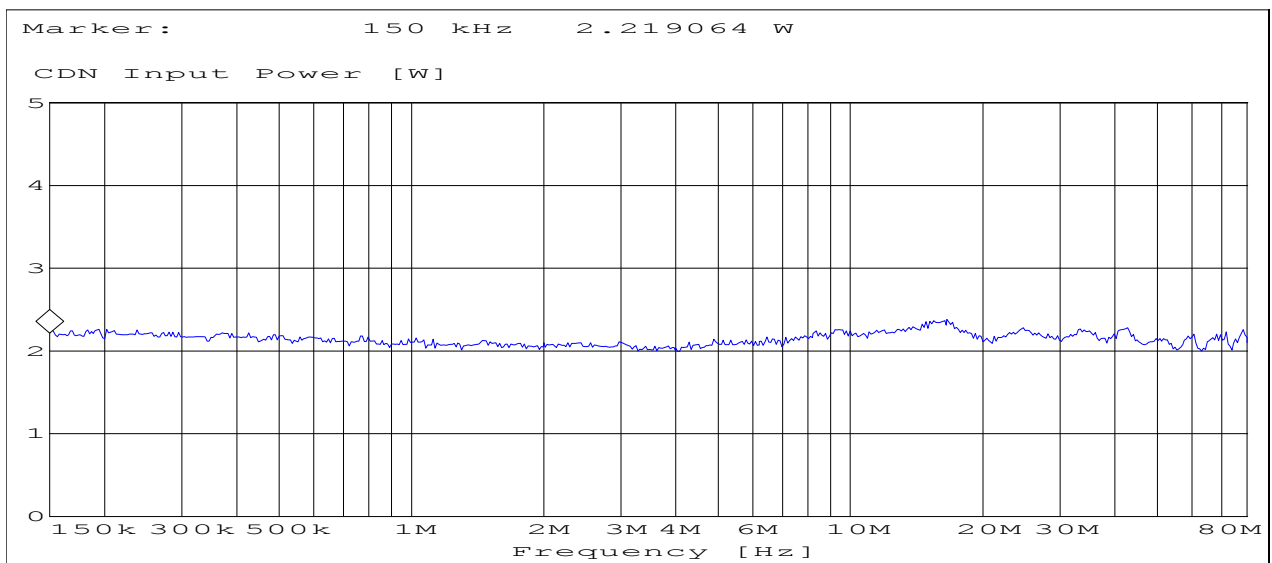
Test result: The requirements for the test documents were fulfilled.

The curves in the following graphs are representative of the entire frequency range:

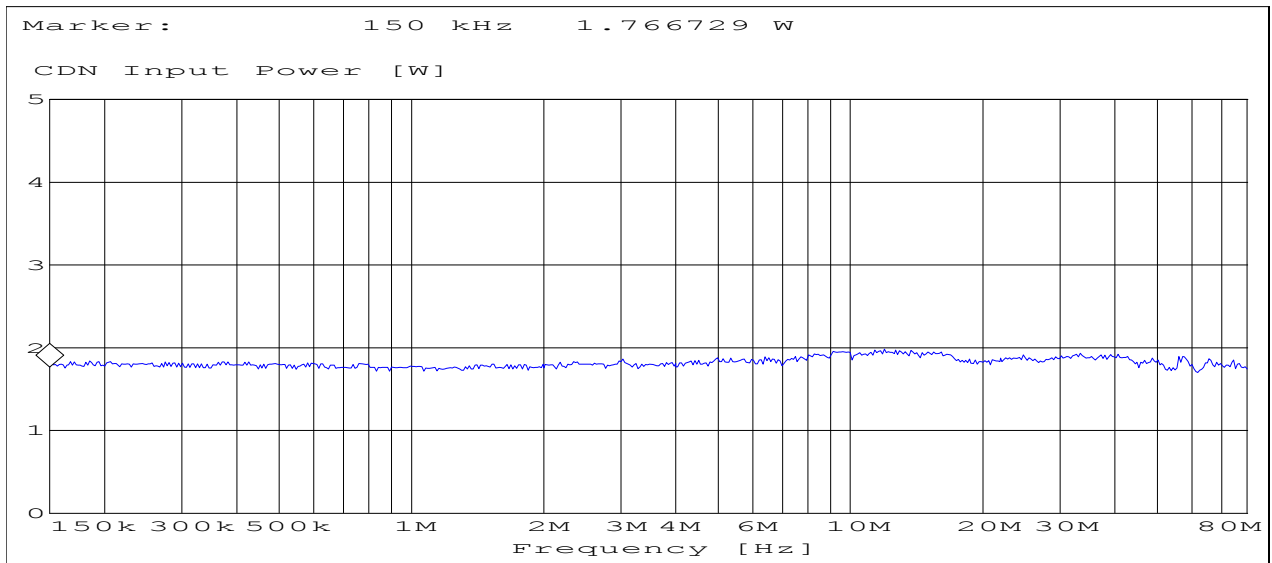
- The 'CDN INPUT POWER' curve represents the power transmitted to the CDN.
- This power profile must be taken as the basis of any subsequent test.



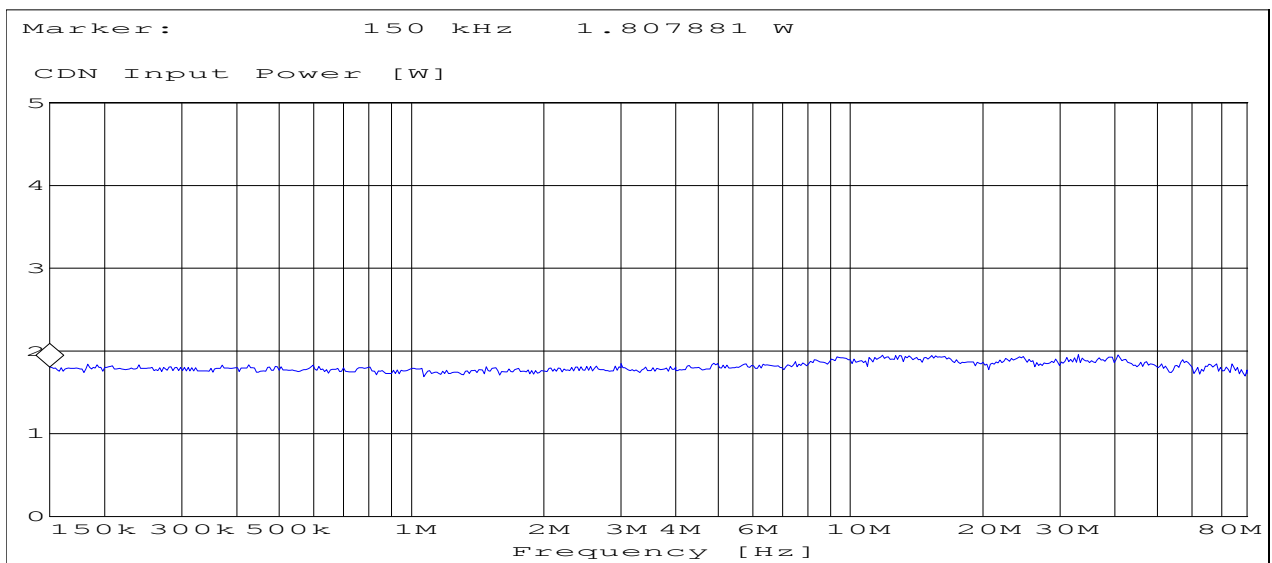
62607DC: 150 kHz to 80 MHz, coupling to 12 V DC-line



62607 VHF: 150 kHz to 80 MHz, coupling to VHF-line



62607GPS: 150 kHz to 80 MHz, coupling to GPS antenna-line

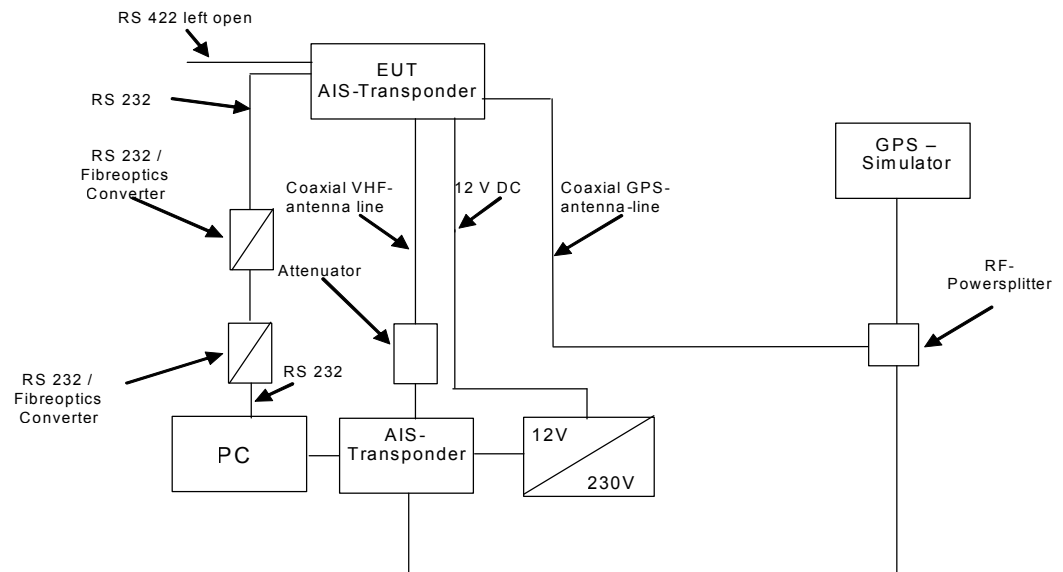


62607RS422: 150 kHz to 80 MHz, coupling to RS 422 line

### 4.3 Immunity test for discharge of static electricity according to EN 60945 chapter 10.9

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.



Test plan:

The equipment under test is triggered with 10 positive and negative impulses each per discharge location and test voltage.

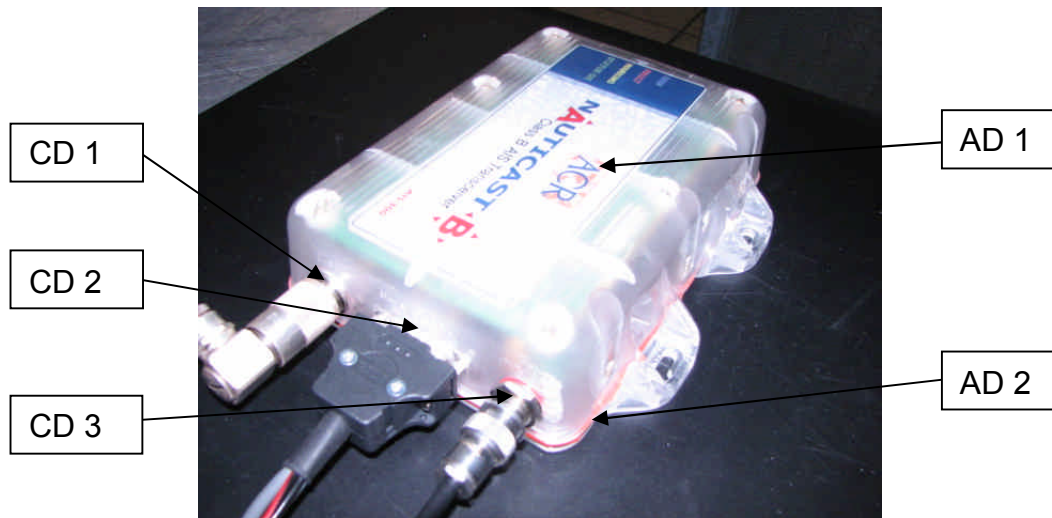
Contact discharge (CD) is carried out on the conductive parts of the equipment under test and on the coupling plates for the indirect discharge.

Air discharge (AD) is carried out on isolating parts of the equipment under test.

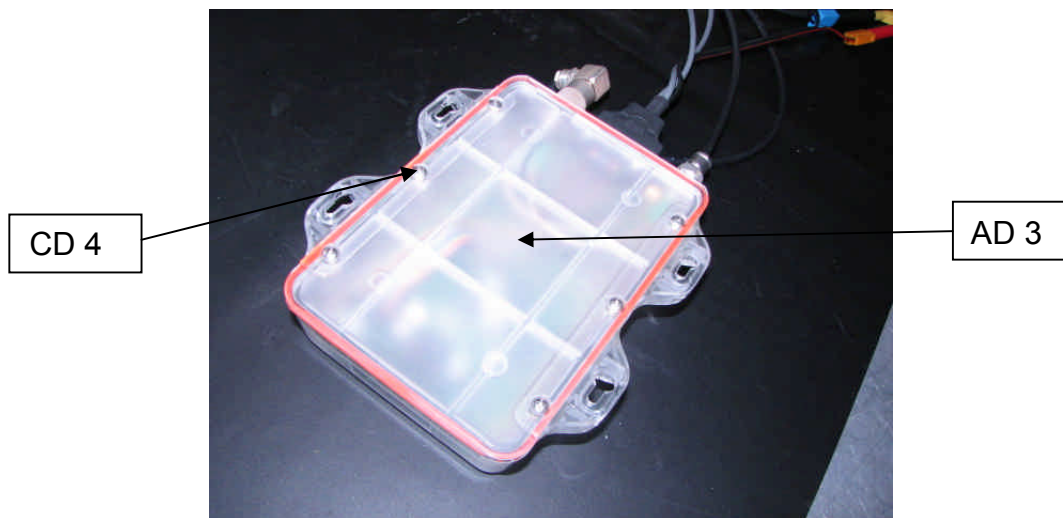
The discharge locations can be seen on the following figure.

Indirect discharge (ID) is carried out on the vertical (VCP) and horizontal (HCP) coupling plate.

Test set-up: Front view



Test set-up: Rear view



- |                        |                              |
|------------------------|------------------------------|
| AD 1: Enclosure top    | CD 1: VHF Connector          |
| AD 2: Sealing          | CD 2: 15 pol D-Sub Connector |
| AD 3: Enclosure bottom | CD 3: GPS Connector          |
|                        | CD 4: Screws                 |

Measuring devices: Schaffner ESD simulator NSG 435 (PM No. 480027)  
Testing table Numerik PTi (PM No. 480049)

Measuring records:

The tests in the table below were carried out.

Date of test:	22. January 2007		
Ambient conditions:	34% F <sub>rel</sub> , 19°C; Air pressure conforms to the requirements of the standard		
Number of impulses:	10 per polarity, test voltage and discharge location		
Method of discharge	Discharge location	EUT reaction	Result
Indirect coupling ±2kV	HCP 1 to 4	No reaction detected	B*
	VCP 1 to 4	No reaction detected	B*
Indirect coupling ±4kV	HCP 1 to 4	No reaction detected	B*
	VCP 1 to 4	No reaction detected	B*
Indirect coupling ±6kV	HCP 1 to 4	No reaction detected	B*
	VCP 1 to 4	No reaction detected	B*
Direct coupling ±2kV	CD 1 to 4	No reaction detected	B*
Direct coupling ±4kV	CD 1 to 4	No reaction detected	B*
Direct coupling ±6kV	CD 1 to 4	No reaction detected	B*
Air discharge ±2kV	AD 1 to 3	No reaction detected	B*
Air discharge ±4kV	AD 1 to 3	No reaction detected	B*
Air discharge ±8kV	AD 1 to 3	No reaction detected	B*

\*During the test the GPS Simulator was disconnected. Therefore no monitoring of the GPS Function was possible. All other functions performed as intended.

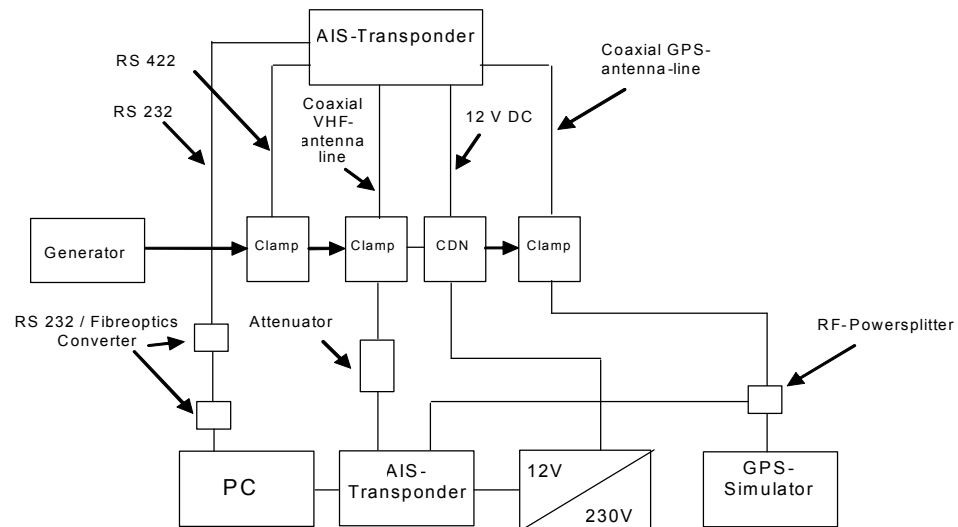
Test results:                      The requirements of the test documents were fulfilled.



#### 4.4 Immunity test for electrical fast transients (burst) according to EN 60945 chapter 10.5

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.
- The EUT is placed 10 cm above the ground plane.



Measuring devices:

- Test table Numerik PTi (PM No. 480050)
- Test system PEFT (Burst) (PM No. 480028)
- Coupling filter FP-EFT 32.1 (PM No. 480029)
- Coupling clamp IP4A (PM No. 480030)

Measuring records:

The tests in the table below were carried out.

Date of test:		19 January 2007		
Ambient conditions:		35% Frel, 20°C; the air pressure conforms to the requirements of the standard		
Test duration:		5 min per polarity, test voltage and line		
Burst frequency:		5 kHz		
Method of coupling	Coupling to	Test voltage	EUT reaction	Result
CDN	12 V DC	± 2 kV DM ± 1 kV CM	No reaction detected	B*
Coupling clamp	VHF-Antenna	± 1 kV CM	No reaction detected	B*
Coupling clamp	GPS-Antenna	± 1 kV CM	No reaction detected	B*
Coupling clamp	RS 422	± 1 kV CM	No reaction detected	B*

\*During the test the GPS Simulator was disconnected. Therefore no monitoring of the GPS Function was possible. All other functions performed as intended.

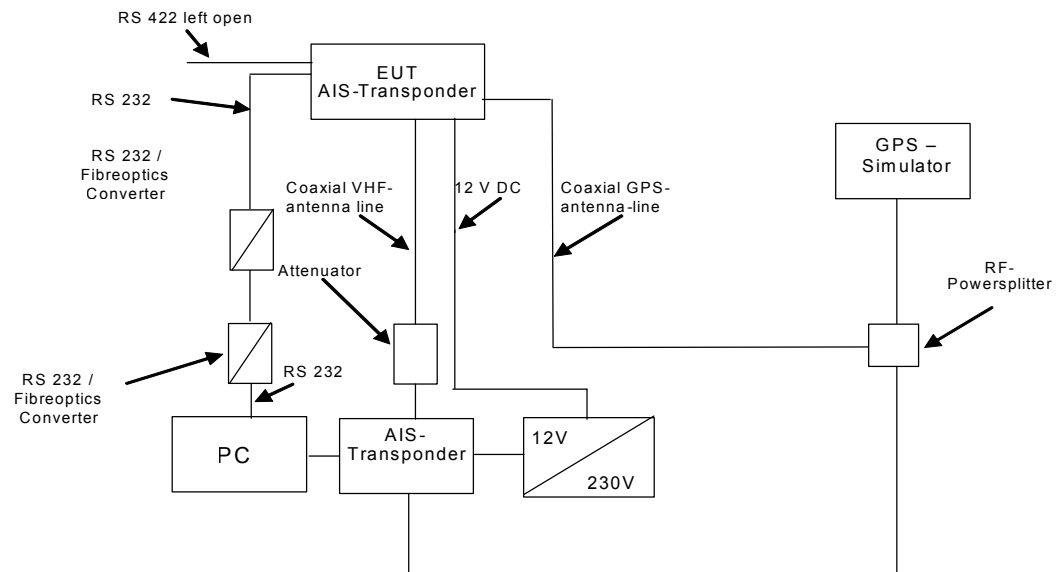
Remark:                   DM: Differential mode  
                              CM: Common mode

Test results:             The requirements of the test documents were fulfilled.

## 4.5 Power supply failure according to EN 60945 chapter 10.8

Test set-up:

- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.



Measuring devices: Power amplifier PAS 5000 (PM-No. 480357)  
 Generator SyCore (PM-No. 480356)  
 Software: Script Manager (PM-No. 480114)

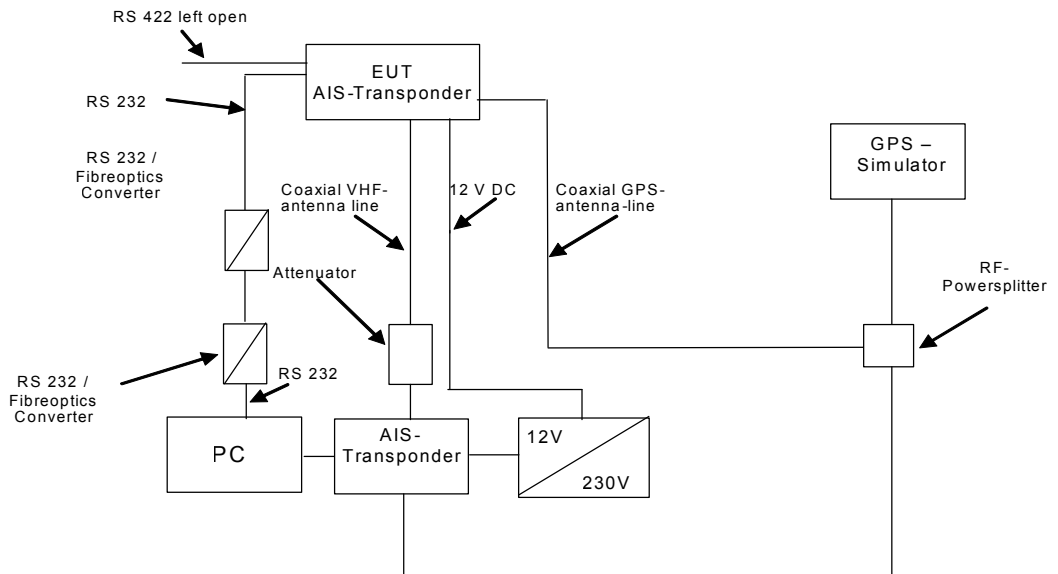
Measuring records:

Date of test:	22 January 2007	
Test level:	3 interruptions of 60 s within a 5-minute period	
Coupling to	EUT action	Result
12V DC	Automatic restart of the system, no user reaction necessary	B

Test result: The requirements made in the test documents were fulfilled.

## 4.6 Power supply variations according to EN 60945 chapter 10.7

Test set-up:                   - Table set-up  
                                     - The drawing below schematically shows the test set-up.



Measuring devices:       power amplifier PAS 5000 (PM-No. 480357)  
                                  generator SyCore (PM-No. 480356)  
                                  software: Script Manager (PM-No. 480114)

Measuring records:

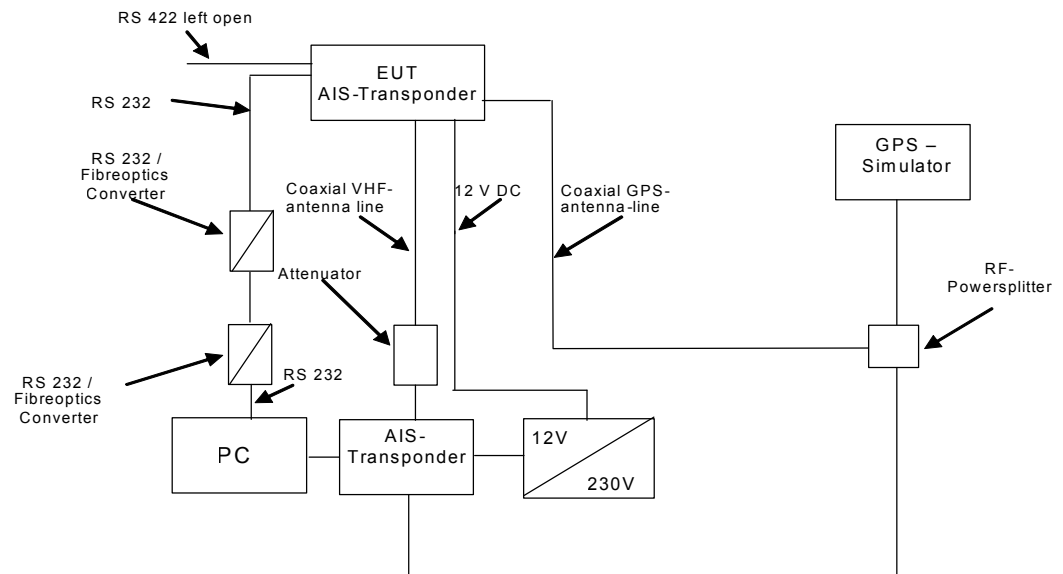
Date of test:	22 January 2007		
Test basics:	Electrical supply – rectified alternating current		
Coupling to	Test level	EUT reaction	Result
12 V DC	$U_B +20\%$ permanent	No reaction detectable	B*
	$U_B -20\%$ permanent	No reaction detectable	B*

\*During the test the GPS Simulator was disconnected. Therefore no monitoring of the GPS Function was possible. All other functions performed as intended.

Test result:                   The requirements made in the test documents were fulfilled.

## 4.7 Excessive conditions according to EN 60945 chapter 5.2.3 (confusing of the DC-poles)

Test set-up:                   - Table set-up  
                                     - The drawing below schematically shows the test set-up.



Measuring records:

Date of test:	22 January 2007	
Test level:	Confusing the DC-poles for 5 minutes	
Coupling to	EUT action after test	Result
12V DC	Automatic restart after connecting the correct DC-poles, no user action necessary.	B

Test result:                   The requirements made in the test documents were fulfilled.

## 5 Document history

Test Report No.:	Date	Comment
E62607	26. January 2007	First issue
E62607 2 <sup>nd</sup> version	02. February 2007	Performance criteria of ETSI EN 301 489-1 added, Chapter 1 modified

## 6 Annex

The annex consists of 11 pages and contains photographs of the test set-ups:

Testsetup preliminary emission measurement E-Field	emi7.JPG, emi6.JPG
Testsetup preliminary emission measurement H-Field	emi8.JPG
Testsetup final measurement H-Field	emiff2.JPG
Testsetup conducted emission measurement on DC-line	emicon1.JPG
Testsetup electromagnetic fields	ems1.JPG, ems4.JPG
Testsetup conducted high-frequency interference	emscon3.JPG
Testsetup electrostatic discharge	esd5.JPG
Testsetup fast transients	burst1.JPG
Testsetup voltage variations and interruptions	power1.JPG