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# TEST REPORT

**IEC 60945 4th Edition (2002-08)**

## **MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS**

**General requirements – Methods of testing and required results**

**Test Report Reference: F081185E1\_3<sup>rd</sup> Version**

**Equipment under Test:**

**AIS-Class-A-Transponder  
SAM3410 with Media-Converter LONGSHINE LCS-883C-TB**

**Applicant: Attingimus Nachrichtentechnik GmbH & Co. KG**

**Manufacturer: SAM Electronics GmbH**

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## 1 IDENTIFICATION

### 1.1 APPLICANT

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### 1.2 MANUFACTURER

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Country:	Germany
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### 1.3 DATES

Date of Receipt of Test Sample:	23 June 2008
Start of test:	23 June 2008
Finish of test:	03 December 2008

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## 1.4 TEST LABORATORY

The tests were carried out at:

**PHOENIX TEST-LAB GmbH**

Königswinkel 10

D-32825 Blomberg

Germany

Tel: +49 (0) 52 35 / 95 00-0

Fax: +49 (0) 52 35 / 95 00-10

accredited by Deutsche Gesellschaft für Akkreditierung mbH (DGA) in compliance with DIN EN ISO/IEC 17025 under Reg. No. DGA-PL-105/99-22

Test engineer:

Raimund BLASK



22 April 2010

Name

Date

Test report checked:

Bernd STEINER



23 April 2010

Name

Date

**PHOENIX TESTLAB GmbH**  
Königswinkel 10  
32825 Blomberg  
Tel. 0 52 35 / 95 00-0  
Fax 0 52 35 / 95 00-10

## 1.5 RESERVATION

This test report is only valid in the original form.

Any reproduction of its contents without written permission of the accredited test laboratory PHOENIX TEST-LAB GmbH is prohibited.

The test results herein refer only to the tested sample. PHOENIX TESTLAB GmbH is not responsible for any generalisations or conclusions drawn from these test results and concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page contains the PHOENIX TESTLAB Logo and the TEST REPORT REFERENCE.

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## 2 TECHNICAL DATA OF EQUIPMENT

Type:	AIS-Class-A-Transponder					
Type designation:	SAM3410 with Media-Converter LONGSHINE LCS-883C-TB					
Serial No.:	8005847.03 / 000017					
Alignment range:	156.025 to 162.025 MHz					
Switching range:	156.025 to 162.025 MHz					
Channel separation:	25 kHz					
Rated RF output power:	Nominal low power: 1.0 W / 30 dBm Nominal high power: 12.5 W / 41 dBm					
Supply Voltage*:	U <sub>nom</sub> =	24.0 V DC	U <sub>min</sub> =	19.2 V DC	U <sub>max</sub> =	28.8 V DC
Printed circuit designation:	-					
Software:	-					

Ports/Connectors:

Identification	Connector		Length
	EUT	Ancillary	
DC-power-supply	customized	-	1 m
VHF-antenna	SO-239	BNC	1 m
RS 422-Input PDP	9 pole D-Sub	9 pole D-Sub	3 m
RS 422-Input Sensor	9 pole D-Sub	9 pole D-Sub	3 m
GPS-antenna	TNC	TNC	3 m
Ethernet	RJ 45	RJ 45	3 m
Frame	-	-	-
Slot	-	-	-

### Test Report History:

Test Report Number:	Date of issue:	Report Status:
F081185E1	21 January 2010	First issue
F081185E1_2nd_Version	18 February 2010	Final radiated emission measurement results in the frequency range 1 GHz to 2 GHz were added to the Test-Report.
F081185E1_3rd_Version	20 April 2010	All Tests which were documented in the Test-Report F081185E1 were carried out with a "LONGSHINE Media Converter LCS-883C-TB 10Base-T to 10Base-2 Converter" (RJ45-LAN to BNC-LAN). This fact was added to the Test-Report (as ordered by the applicant).

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### 3 OPERATIONAL STATES AND TEST SET-UP

Description of the test setup and tests made for checking EUT performance

The monitoring checks the following ports of the EUT:

Primary Display Port as an RS-422 I/O

VHF-Link (Rx and Tx)

GPS receiver function

LAN communications port including the Media Converter

EUT: SAM3410 with Media-Converter LONGSHINE LCS-883C-TB

Monitoring PC running two instances of SAMaisTranCfg for displaying and decoding the PDP messages. SAMaisTranCfg shows the data like the AISterm program with the addition of a list of the received transponders (MKD-like) marked with the last reception time.

PC for running the program sen\_sim.exe.

MC: LONGSHINE Media Converter LCS-883C-TB 10Base-T to 10Base-2 Converter (RJ45-LAN to BNC-LAN).

Monitoring transponder DEBEG 3400

GPS antenna Micropulse 1915 AB

RF power attenuator 60 dB

All necessary interconnection cables

Expected behavior:

When applicable a GPS antenna or a GPS simulator were connected to the EUT. By watching the outputs of the SAMaisTranCfg program instances it can be verified that the EUT and the monitoring transponder receive each other with the expected data content (in this case a valid position of the EUT). This also certifies that the RS-422 Tx line of the EUT is working. An additional query for the static data of the EUT with the expected answer verifies that the reception of RS-422 data is working. For some tests an additional PC was available running the program sen\_sim.exe which provides a source of NMEA position data. These were sent to a sensor port of the EUT to additionally check the reception of data over a RS-422 port. The LAN was checked by sending ping packets to the EUT and checking that the once per second UDP packets from the EUT were present. For the test of the RJ45-LAN port this is connected directly to the monitoring PC without the media converter.

If all these tests show the expected results the performance check is passed.

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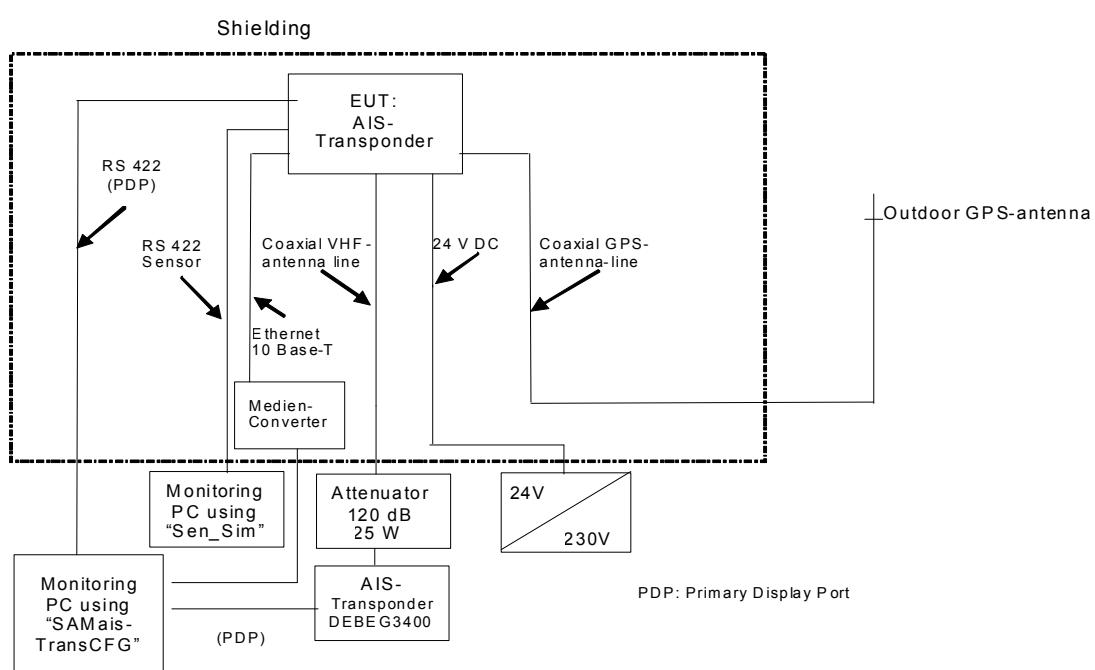
The RF-Connector of the AIS-Transponder is connected to the respective AIS test unit connector. This way all transmissions of the AIS-Transponder are monitored.

Furthermore transmissions addressing the AIS-Transponder are initiated on the test unit.

The reaction of the AIS-Transponder is examined.

A terminal program running on a separate PC acts as a counterpart for the presentation interface of the AIS-Transponder. A connection is made between the presentation port and a serial port of the PC via a RS422-RS232 converter. The NMEA sentences transmitted on the presentation interface are recorded. Sending a VSD-sentence sent to the transponder triggers the emission of a message type 5 on the RF-Channels. This again is monitored by the AIS test unit.

Test set-up:



## 4 LIST OF TEST MODULES AND RESULTS

### 4.1 DISTURBANCE EMISSION

Radiated emission – Enclosure port				
Frequency range	Limit	Basic standard	Remark	Status
150kHz – 300kHz 300kHz – 30MHz	80 – 52 dB $\mu$ V/m in 3m 52 – 34 dB $\mu$ V/m in 3m	IEC 60945 Chapter 9.3	H-field	fulfilled
30MHz – 156MHz 156MHz – 165MHz 165MHz – 1GHz	54 dB $\mu$ V/m in 3m 24 dB $\mu$ V/m in 3m 54 dB $\mu$ V/m in 3m	IEC 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 1 GHz shall be 120 kHz.				

Conducted emission – Power supply ports				
Frequency range	Limit	Basic standard	Remark	Status
10kHz – 150kHz 150kHz – 350kHz 350kHz – 30MHz	96 – 50 dB $\mu$ V 60 – 50 dB $\mu$ V 50 dB $\mu$ V	IEC 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				

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

## 4.2 EMC IMMUNITY

Definition of evaluation criterion according to IEC 60945 chapter 10.1:

- A: No apparent impairment of function within the tolerance limits.
- B: Partial impairment of function, however self-regulating through e.g. automatic restart. Function must be restored within the tolerance limits after the test; a safe state must be guaranteed at all times.
- C: Partial impairment of function, however non self-regulating, e.g. manual start-up is necessary (Reset, Program start); a safe state must be guaranteed at all times.

Immunity – Enclosure port					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criteria	Status
Electromagnetic fields	80 – 2700 MHz 10 V/m; AM; 80 %; 1 kHz	IEC 60945 Chapter 10.4	---	A	fulfilled
Electrostatic discharge (ESD)	up to $\pm 6$ kV charging voltage for contact discharge	IEC 60945 Chapter 10.9	---	B	fulfilled
Electrostatic discharge (ESD)	up to $\pm 8$ kV charging voltage for air discharge	IEC 60945 Chapter 10.9	---	B	fulfilled

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Immunity – Power supply ports, DC and AC					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criteria	Status
Conducted high frequency interference	10 V; AM; 80%; 1 kHz 10 kHz – 80 MHz	IEC 60945 Chapter 10.3	---	A	fulfilled
Conducted high frequency interference	10 V; AM; 80%; 1 kHz 2 / 3 / 4 MHz, 6.2 / 8.2 / 12.6 MHz, 16.5 / 18.8 / 22 / 25 MHz	IEC 60945 Chapter 10.3	---	A	fulfilled
Power supply failure	3 interruptions of 60s	IEC 60945 Chapter 10.8	---	C	fulfilled
Power supply variations	$U_N + 20\%$ for 1.5 s	IEC 60945 Chapter 10.7	---	B	fulfilled
	$U_N - 20\%$ for 1.5 s			B	fulfilled
Fast transients (Burst)	$\pm 2\text{ kV}$ (peak) 5/50 ns (Tr/Th) 5 kHz repetition frequency	IEC 60945 Chapter 10.5	---	B	fulfilled
Transients (Surge)	1.2 / 50 $\mu\text{s}$ up to $\pm 0.5\text{ kV}$ line/line up to $\pm 1.0\text{ kV}$ line/earth	IEC 60945 Chapter 10.6	EUT is DC-powered	B	Not applicable

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

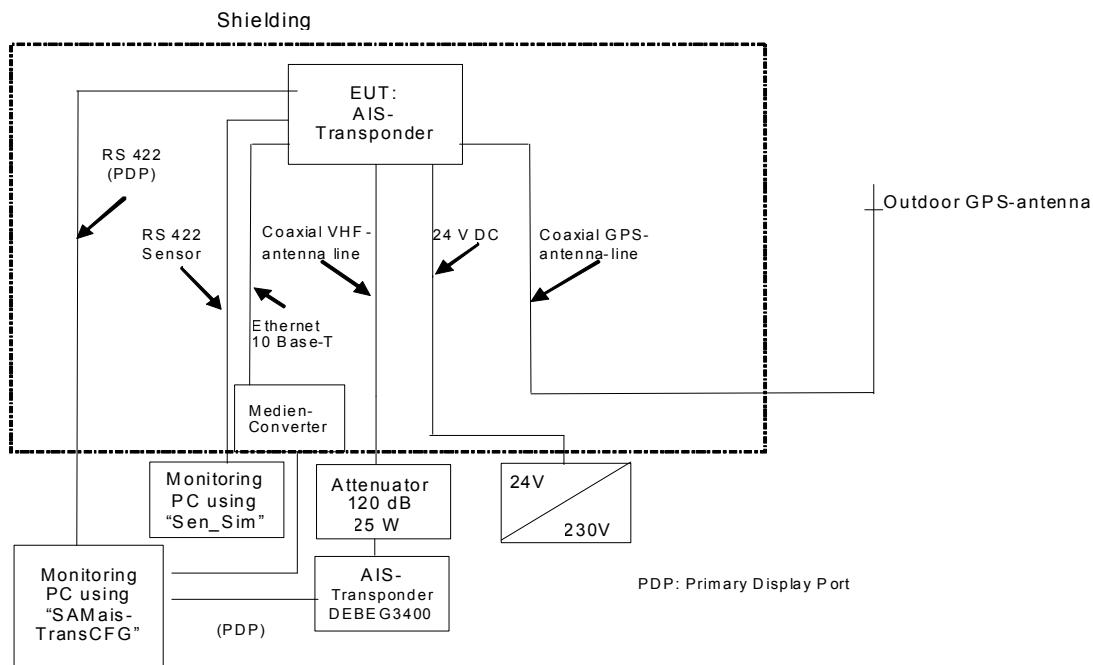
## 5 TEST SEQUENCE AND TEST RESULTS

### ELECTROMAGNETIC DISTURBANCES CHARACTERISTICS

#### 5.1 RADIATED RADIO DISTURBANCE ACCORDING TO IEC 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.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measuring devices: 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)  
EMI softwarepackage ES-K1 (PM-No. 480111)  
Antenna Chase CBL 6112 (PM-No. 480185)  
DC filter 4\*60A (PM-No. 480209)  
Filter (X11) 0-4MHz; 100R; 2\*symm. Typ C110-E1 (PM-No. 480213)

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

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

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

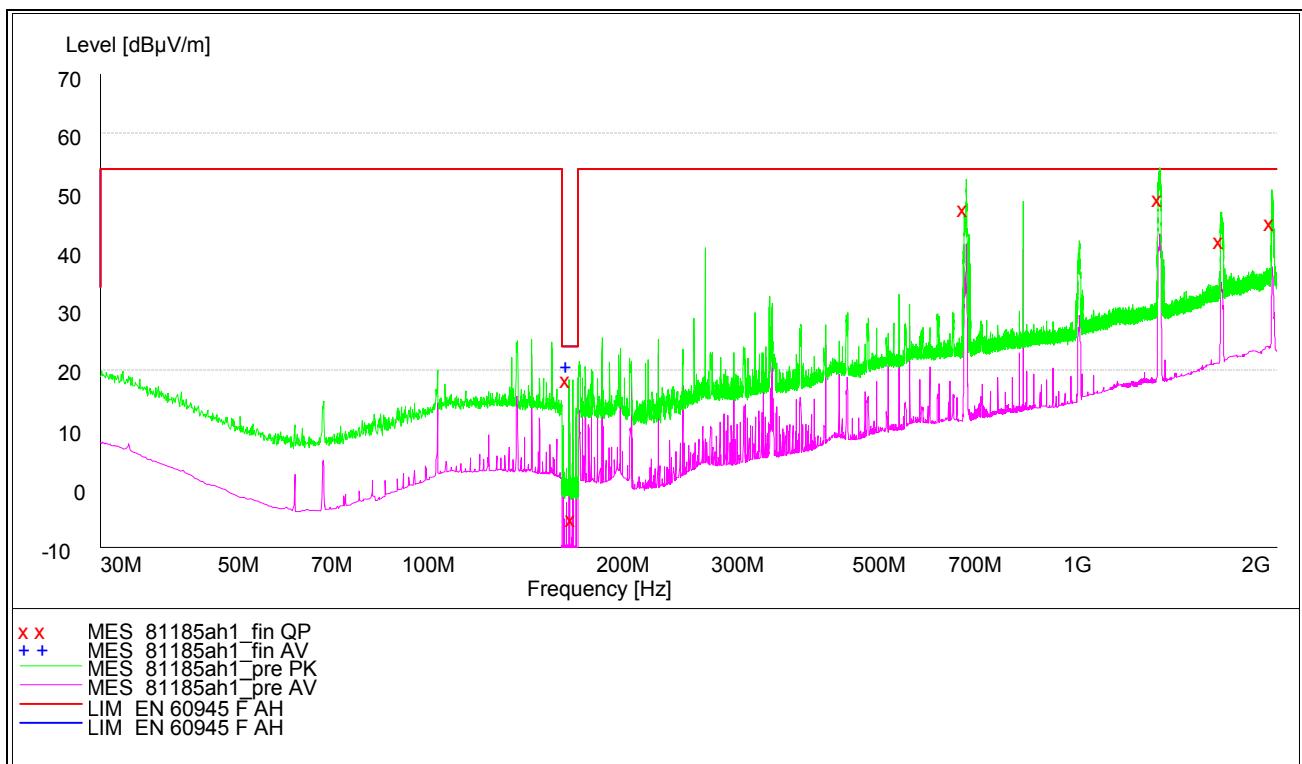
Title: Spurious emission measurement  
 according EN60945  
 EUT: AIS-Transponder with Ethernet-Converter  
 Manufacturer: SAM / Attingimus  
 Operating Condition: Normal operation mode  
 Test site: fully anechoic chamber M20; PHOENIX TEST LAB GmbH  
 Operator: R. Blask  
 Test Specification: With external position sensor and GPS antenna

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 3m measurement distance (+10 dB) and the correction for the free space in which in the "worst case" the reflected floor wave is missing entirely (-6dB). Therefore 4dB 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: 81185ah1

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

**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
160.0080	19.00	9.7	24.0	5.0	150.0	327.00	HORIZONTAL
162.1416	-4.50	9.6	24.0	28.5	150.0	56.00	HORIZONTAL
660.5040	47.90	19.7	54.0	6.1	150.0	91.00	VERTICAL
1318.872	49.70	24.6	54.0	4.3	150.0	102.00	VERTICAL
1319.848	49.70	24.6	54.0	4.3	150.0	71.00	VERTICAL
1642.016	42.20	26.8	54.0	11.8	150.0	67.00	VERTICAL
1970.144	45.40	28.5	54.0	8.6	150.0	99.00	VERTICAL

Data record name: 81185ah1\_fin QP

**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
160.007400	21.00	9.7	24.0	3.0	150.0	315.00	HORIZONTAL

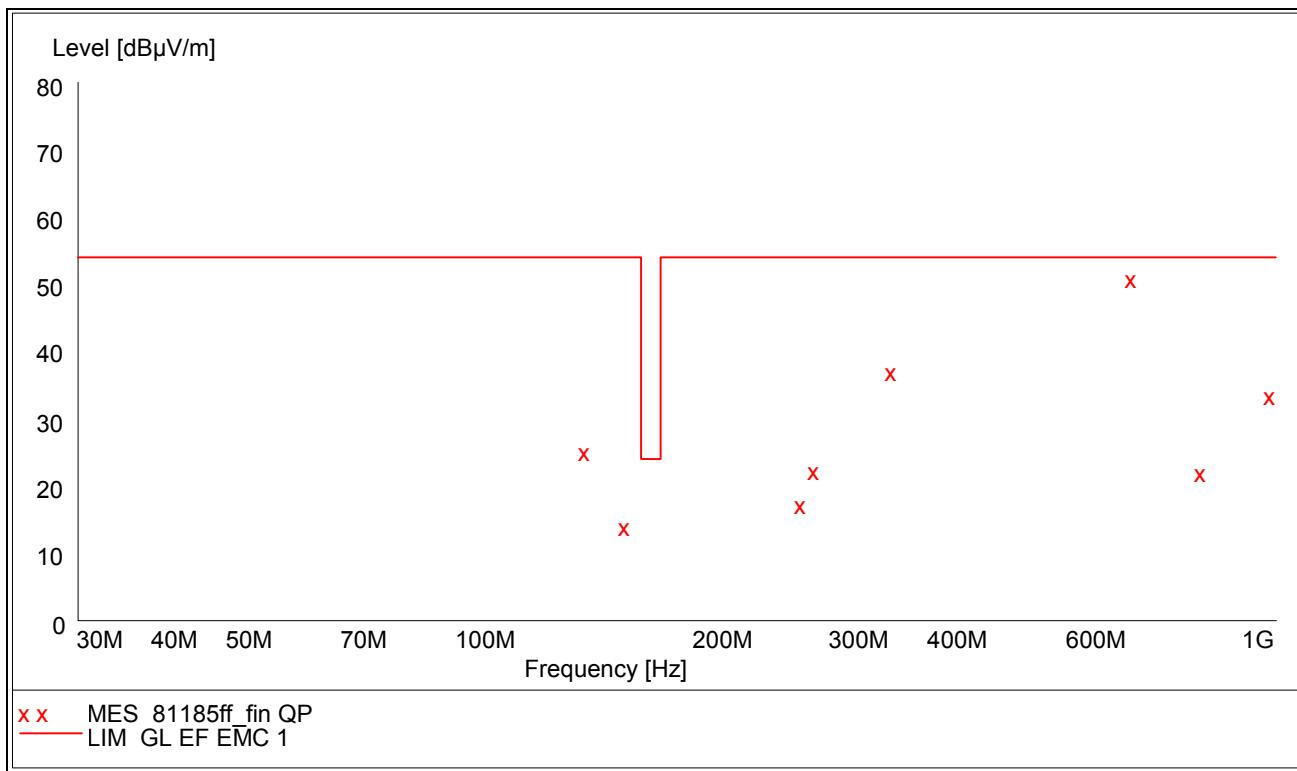
Data record name: 81185ah1\_fin AV

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.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Title: Spurious emission measurement according to EN60945  
 EUT: AIS-Transponder with Ethernet-Converter  
 Manufacturer: SAM / Attingimus  
 Operating Condition: Normal operation mode  
 Test site: PHOENIX TESTLAB Blomberg; open area test site M6  
 Operator: R. Blask  
 Test Specification: With external position sensor and GPS antenna

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: 81185ff

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 10m measuring distance.

**Result measured with the quasipeak detector:**

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

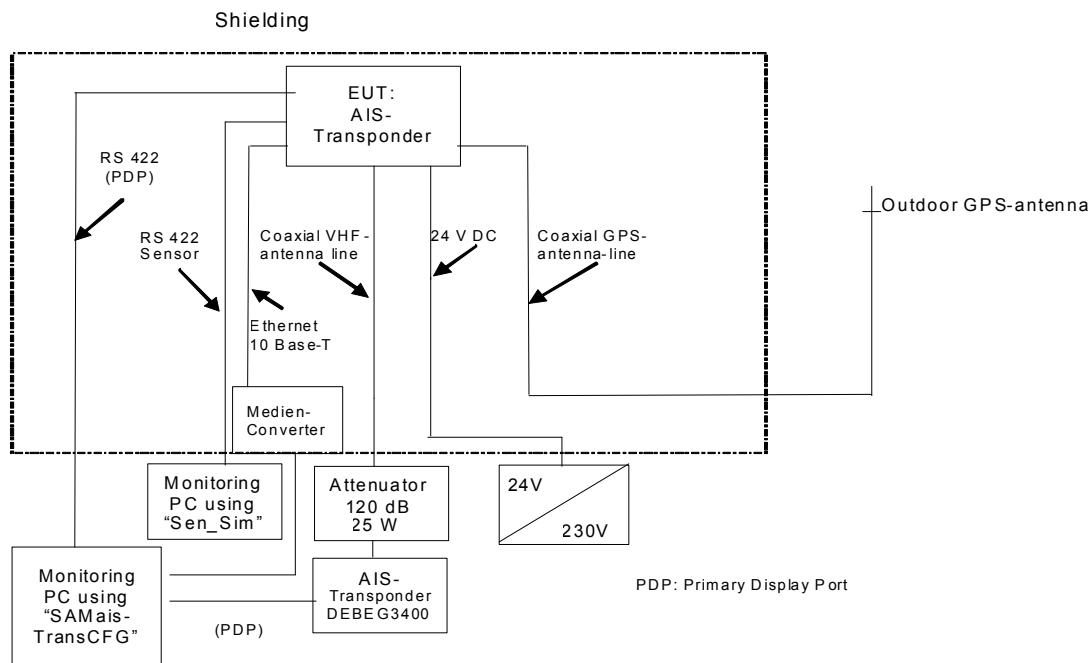
Frequency MHz	Level dB $\mu$ V/m	Transducer dB	Limit dB $\mu$ V/m	Margin dB	Height cm	Azimuth deg	Polarisation
133.150000	25.70	12.3	54.0	28.3	100.0	278.00	VERTICAL
150.240000	14.30	11.4	54.0	39.7	101.0	0.00	VERTICAL
250.030000	17.40	13.7	54.0	36.6	102.0	272.00	HORIZONTAL
260.040000	22.90	14.8	54.0	31.1	102.0	250.00	HORIZONTAL
327.040000	37.30	15.6	54.0	16.7	103.0	315.00	HORIZONTAL
660.504000	51.30	21.7	54.0	2.7	124.0	45.00	HORIZONTAL
810.120000	22.30	23.1	54.0	31.7	118.0	45.00	HORIZONTAL
990.900000	33.90	24.6	54.0	20.1	105.0	39.00	VERTICAL

Data record name: 81185ff\_fin QP

## 5.2 RADIATED RADIO DISTURBANCE ACCORDING TO IEC 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.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measuring devices: 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)  
EMI softwarepackage ES-K1 (PM-No. 480111)  
FF-controller HD 100 (PM-No. 480139)  
FF-antenna mast (PM-No. 480086)  
FF-turntable (PM-No. 480087)  
open area test site (PM-No. 480085)  
relays switch unit RSU (PM-No. 480077)  
receiver ESAI + Display (PM-Nr. 480025, PM-Nr. 480026)  
Antenna R+S Loop antenna HFH2-Z2 (PM-Nr. 480059)  
DC filter 4\*60A (PM-No. 480209)  
filter (X11) 0-4MHz; 100R; 2\*symm. Type C110-E1 (PM-No. 480213)

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

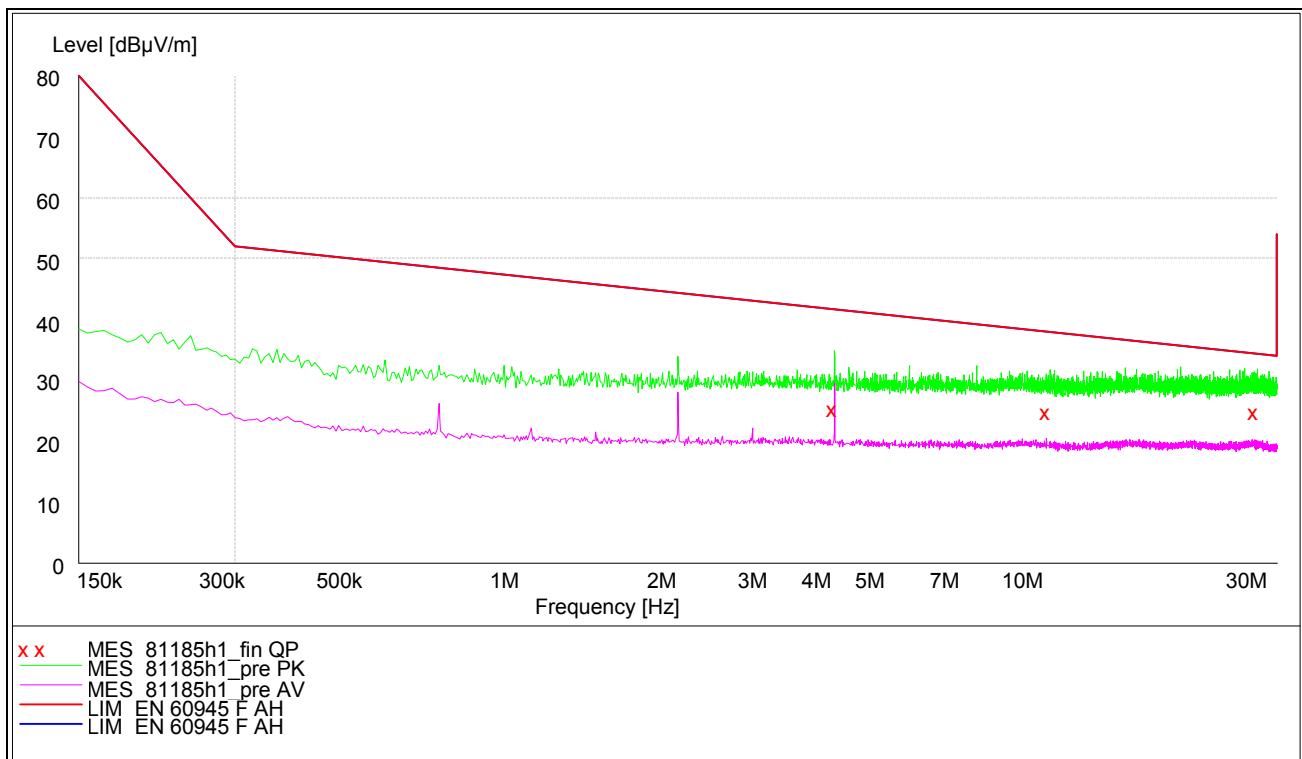
Test result: The requirements of the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Title: Spurious emission measurement according to EN60945  
 EUT: AIS-Transponder with Ethernet-Converter  
 Manufacturer: SAM / Attingimus  
 Operating Condition: Normal operation mode  
 Test site: fully anechoic chamber M20; PHOENIX TEST LAB GmbH  
 Operator: R. Blask  
 Test Specification: With external position sensor and GPS antenna

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: 81185h1

### 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	Loop
4.248000	25.80	19.9	41.6	15.9	150.0.0	91.00	0.0
11.004000	25.20	19.8	37.9	12.7	0.0	155.00	0.0
27.582000	25.20	20.4	34.3	9.1	0.0	165.00	0.0

Data record name: 81185h1\_fin QP

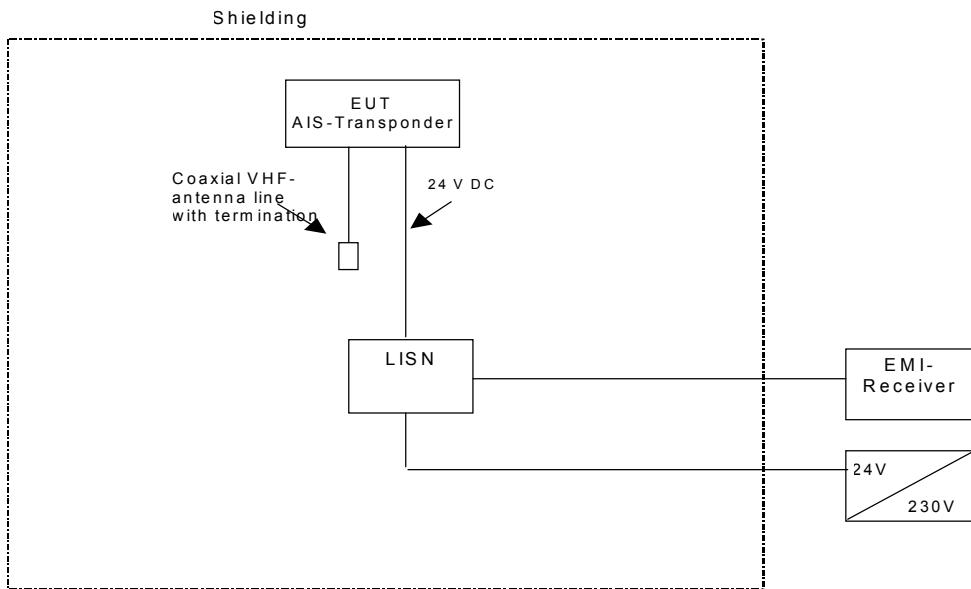
In this case it was not necessary to carry out subsequent measurements because at no frequency was a value above the noise of the system.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

### 5.3 CONDUCTED RADIO DISTURBANCES ACCORDING TO IEC 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)  
 DC filter (PM-No. 480099)

Measuring records:

The measuring records are presented on the following pages.

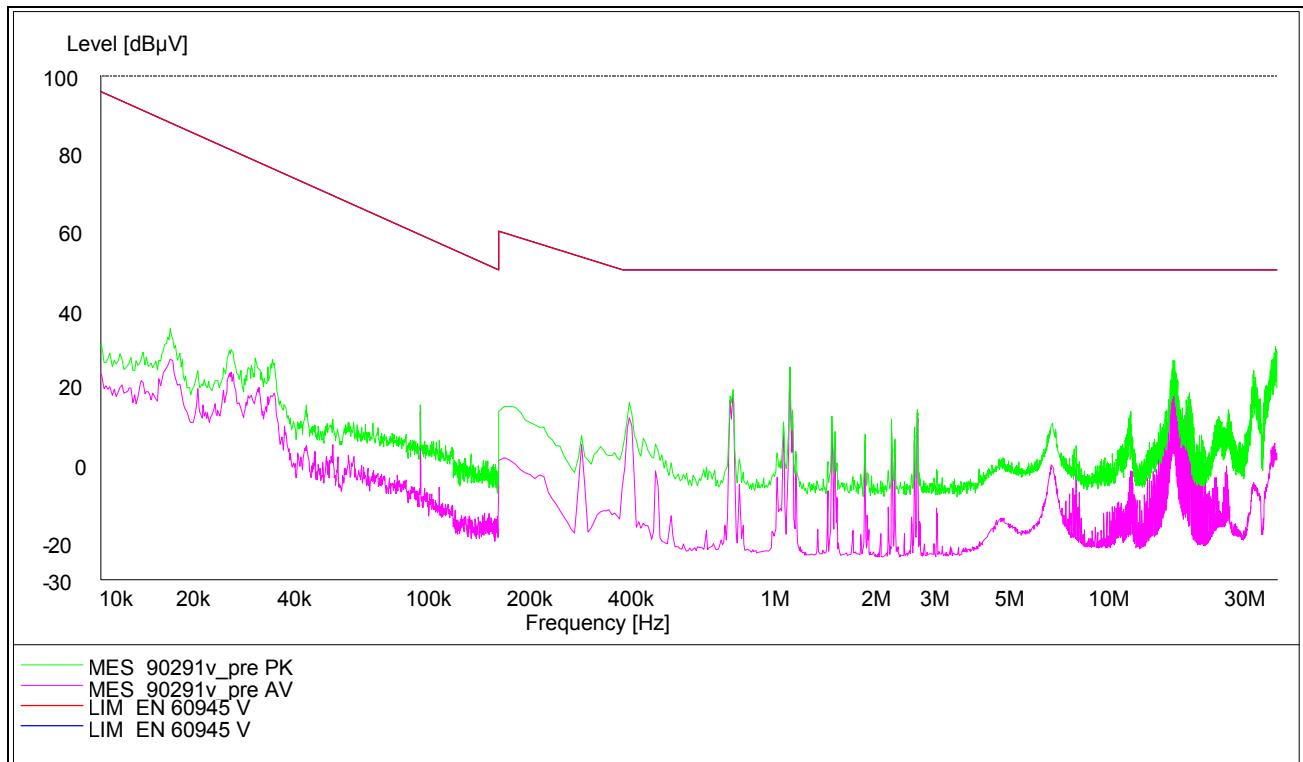
Test results:

The requirements of the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Title: Conducted Spurious Emission Measurement  
 according to EN 60945  
 EUT: AIS-Transponder with Ethernet-Converter  
 Manufacturer: SAM / Attingimus  
 Operating Condition: Normal operation mode  
 Test site: PHOENIX TEST-LAB Blomberg M4  
 Operator: R. Blask  
 Test Specification: Tested with SAM-DC-Filter

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 quasipeak measured points are marked by x and the average measured points by +.



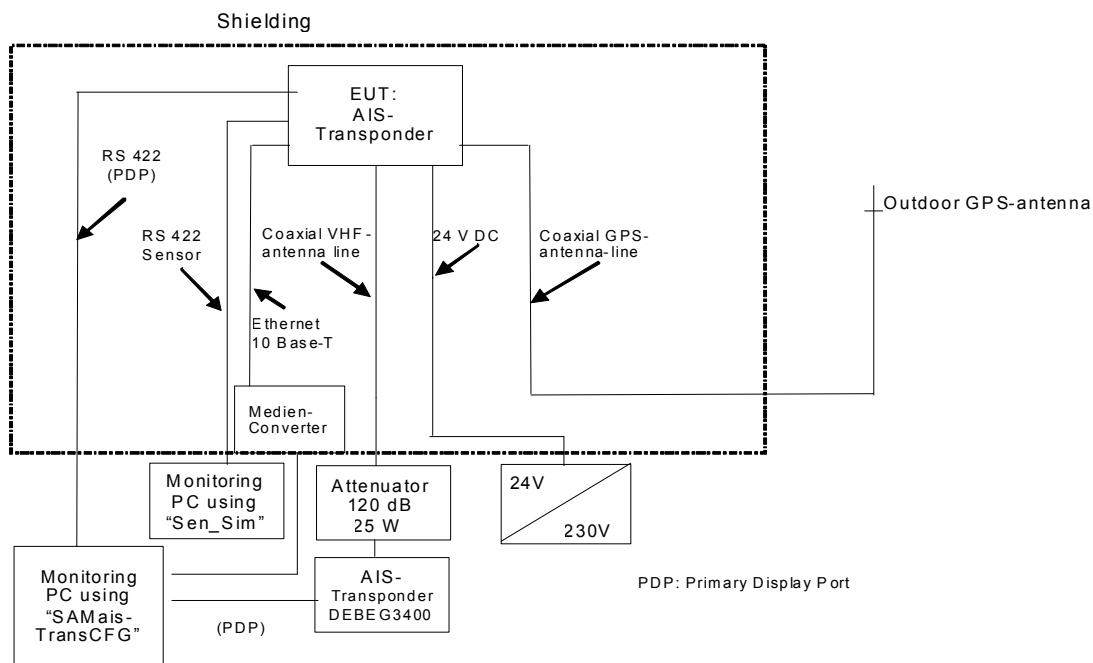
Data record name: 90291v

## 6 TEST SEQUENCE AND TEST RESULTS ELECTROMAGNETIC IMMUNITY CHARACTERISTICS

### 6.1 IMMUNITY TEST FOR HIGH FREQUENCY ELECTROMAGNETIC FIELDS ACCORDING TO IEC 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.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measuring devices:

AH-controller HD100 (PM-No. 480181)  
AH-turntable (PM-No. 480186)  
AH-antenna mast (PM-No. 480187, 480188)  
Fully anechoic chamber (PM-No. 480190)  
Power amplifier AR 1000L M20 (PM-No. 480198)  
Power amplifier AR 500W1000M5 (PM-No. 480199)  
Power amplifier AR 200T1G2 (PM-No. 480200)  
Power amplifier AR 200T2G4 (PM-No. 480201)  
Signal generator SME06 (PM-No. 480174)  
Power meter NRVD (PM-No. 480176, 480177)  
Insertion unit URV5-Z2 (PM-No. 480191, 480192)  
Terminating impedance RNB (PM-No. 480062, 480063)  
Power probe NRV-Z2 (PM-No. 480193/480194)  
Relays switch unit RSU (PM-No. 480175)  
Amplifier interface SCIU (PM-No. 480178)  
Control unit FM2000 (PM-No. 480173)  
Field sensor FP2000 (PM-No. 480195)  
Field sensor FP2080 (PM-No. 480196)  
EMS softwarepackage EMS-K1 (PM-No. 480222)  
Horn antenna EMCO 3109 (PM-No. 480082)  
Log.per.antenna AT1080 (PM-No. 480189)  
DC filter 4\*60A (PM-No. 480209)  
Filter (X11) 0-4MHz; 100R; 2\*symm. Type C110-E1  
(PM-No. 480213)

Measuring records:

The tests in the table below were carried out.

Date of test:	26. June 2008			
Ambient conditions:	55% Frel, 20°C			
Test level:	80-2700MHz, 10V/m, AM, 400 Hz, 80%			
Increment:	log 1%			
Dwell time:	≥3s			
Distance antenna/ test object	Polarisation	Radiation direction	EUT reaction	Result
3m	vertical	0 °	No reaction detected	A
3m	vertical	90 °	No reaction detected	A
3m	vertical	180 °	No reaction detected	A
3m	vertical	270 °	No reaction detected	A
3m	horizontal	0 °	No reaction detected	A
3m	horizontal	90 °	No reaction detected	A
3m	horizontal	180 °	No reaction detected	A
3m	horizontal	270 °	No reaction detected	A

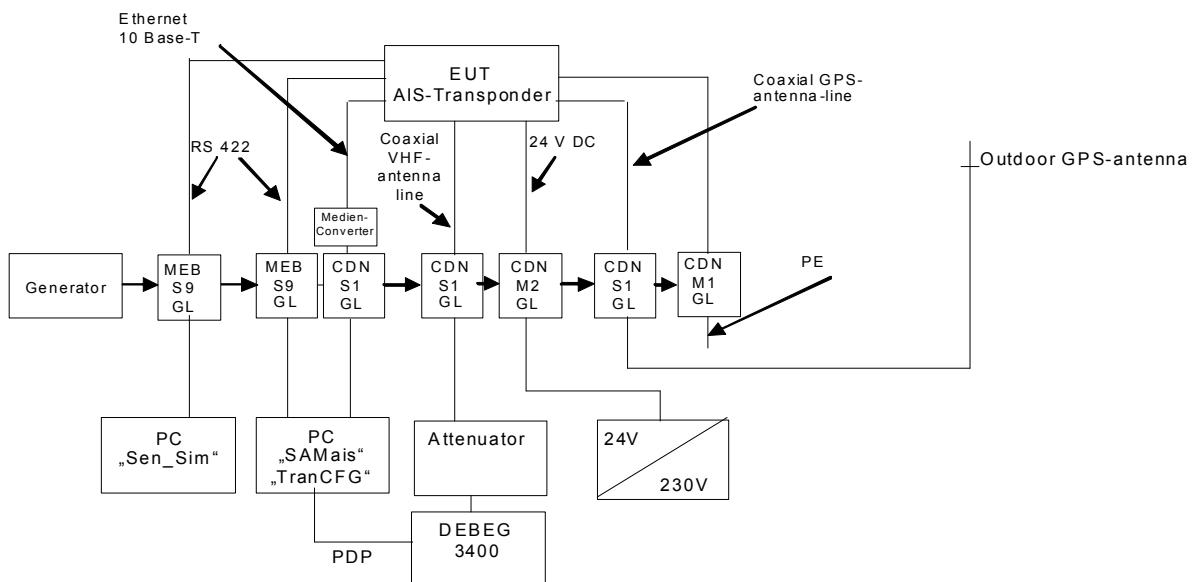
Test results:

The requirements of the test documents were fulfilled.

## 6.2 IMMUNITY TEST FOR CONDUCTED VOLTAGES, INDUCED BY RF-FIELDS ACCORDING TO IEC 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.



### Monitoring of EUT:

The output signals were checked by the monitoring system.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measurement devices:

Power amplifier AR75A400 (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)  
 Lüthi CDN S9 (PM-No. 410040)  
 MEB CDN S9 (PM-No. 410034)  
 EMV CDN M2 C (PM-No. 410174)  
 Schaffner CDN M1 B (PM-Nr. 410036)  
 EMV CDN S1 A (PM-No. 410172)  
 EMV CDN S1 B (PM-No. 410173)  
 MEB CDN S1 C (PM-No. 410033)

Measuring records:

The tests in the table below were carried out.

Date of test:	30. June 2008		
Ambient conditions:	45% F <sub>rel</sub> , 20°C		
Test level 1:	10 kHz – 80 MHz, 3V, 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 M2C	24 V DC	No reaction detected	A
CDN 801-S9A	Sensor line	No reaction detected	A
CDN 801-S9B	Presentation port	No reaction detected	A
CDN S1A	VHF-antenna	No reaction detected	A
CDN S1B	GPS-antenna	No reaction detected	A
CDN S1C	Ethernet 10-Base-T	No reaction detected	A
CDN M1B	PE	No reaction detected	A

Test result:

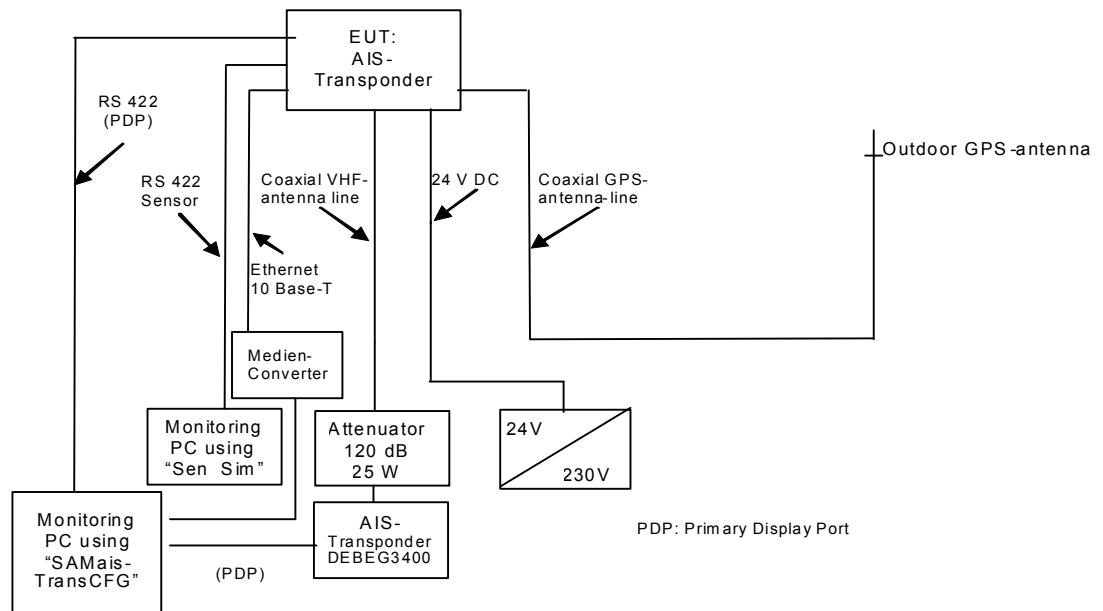
The requirements for the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

### 6.3 IMMUNITY TEST FOR DISCHARGE OF STATIC ELECTRICITY ACCORDING TO IEC 60945 CHAPTER 10.9

Test set-up:

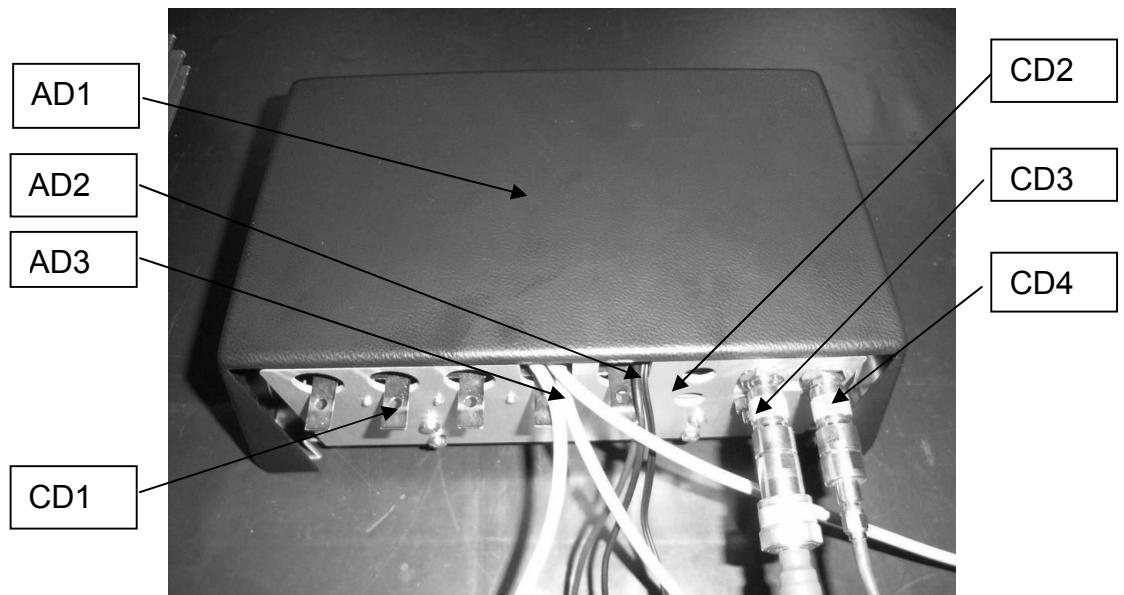
- Table set-up
- The drawing below schematically shows the test set-up.
- Photos of the test set-up can also be referred to in the annex.



TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

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.



CD 1: Enclosure  
 CD 3: Connector  
 AD 1: Enclosure  
 AD 3: Cable

CD 2: Enclosure  
 CD 4: Connector  
 AD 2: Cable

Measuring devices:

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

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measuring records:

The tests in the table below were carried out.

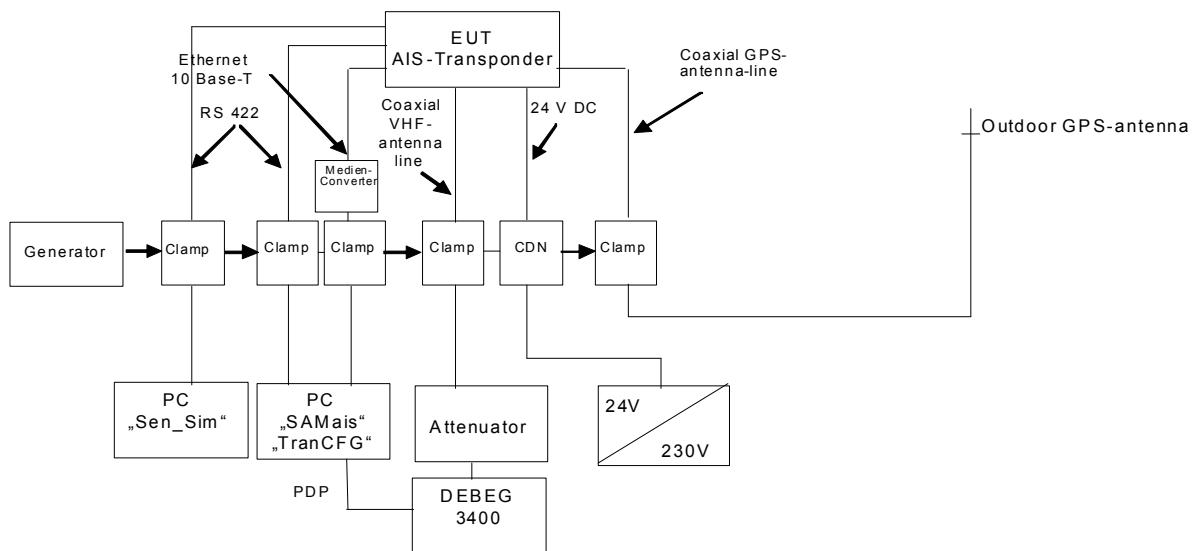
Date of test:	05. August 2008		
Ambient conditions:	50% F <sub>rel</sub> , 20°C; Air pressure conforms to the requirements of the standard		
Number of impulses:	10 per polarity, test voltage and discharge location		
Method of discharge	Discharge location	EUT reaction	Result
Indirect coupling $\pm 2\text{kV}$	HCP VCP	No reaction detected No reaction detected	B B
Indirect coupling $\pm 4\text{kV}$	HCP VCP	No reaction detected No reaction detected	B B
Indirect coupling $\pm 6\text{kV}$	HCP VCP	No reaction detected No reaction detected	B B
Direct coupling $\pm 2\text{kV}$	CD	No reaction detected	B
Direct coupling $\pm 4\text{kV}$	CD	No reaction detected	B
Direct coupling $\pm 6\text{kV}$	CD	No reaction detected	B
Air discharge $\pm 2\text{kV}$	AD	No reaction detected	B
Air discharge $\pm 4\text{kV}$	AD	No reaction detected	B
Air discharge $\pm 8\text{kV}$	AD	No reaction detected	B

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

## 6.4 IMMUNITY TEST FOR ELECTRICAL FAST TRANSIENTS (BURST) ACCORDING TO IEC 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 Transient 2000 (Burst) (PM No. 580008)  
Coupling clamp IP4A (PM No. 480030)

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

Measuring records:

The tests in the table below were carried out.

Date of test:	03. December 2008			
Ambient conditions:	50% Frel, 20°C; the air pressure conforms to the requirements of the standard			
Test duration:	10 min per polarity, test voltage and line			
Burst frequency:	5 kHz			
Method of coupling	Coupling to	Test voltage	EUT reaction	Result
CDN	24 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 PDP	± 1 kV CM	No reaction detected	B
Coupling clamp	RS 422 Sensor	± 1 kV CM	No reaction detected	B
Coupling clamp	Ethernet 10 Base-T	± 1 kV CM	No reaction detected	B

Remark: DM: Differential mode  
CM: Common mode

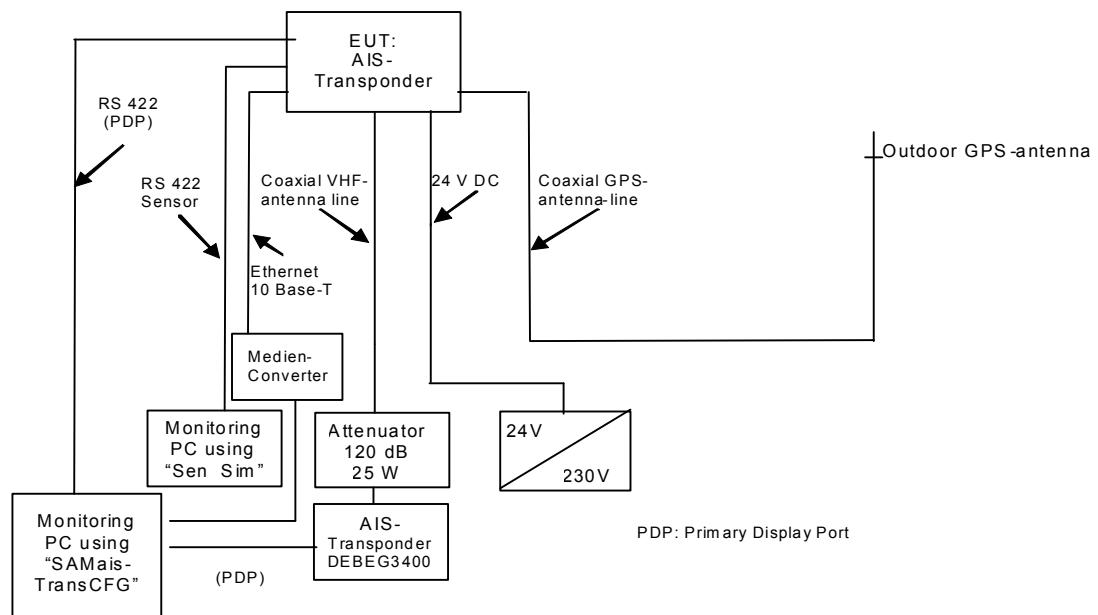
Test results: The requirements of the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

## 6.5 POWER SUPPLY FAILURE ACCORDING TO IEC 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:	03. December 2008	
Test level:	3 interruptions of 60s within a 5-minute period	
Coupling to	EUT action	Result
24V DC	Automatic restart of the system, no user reaction necessary	B

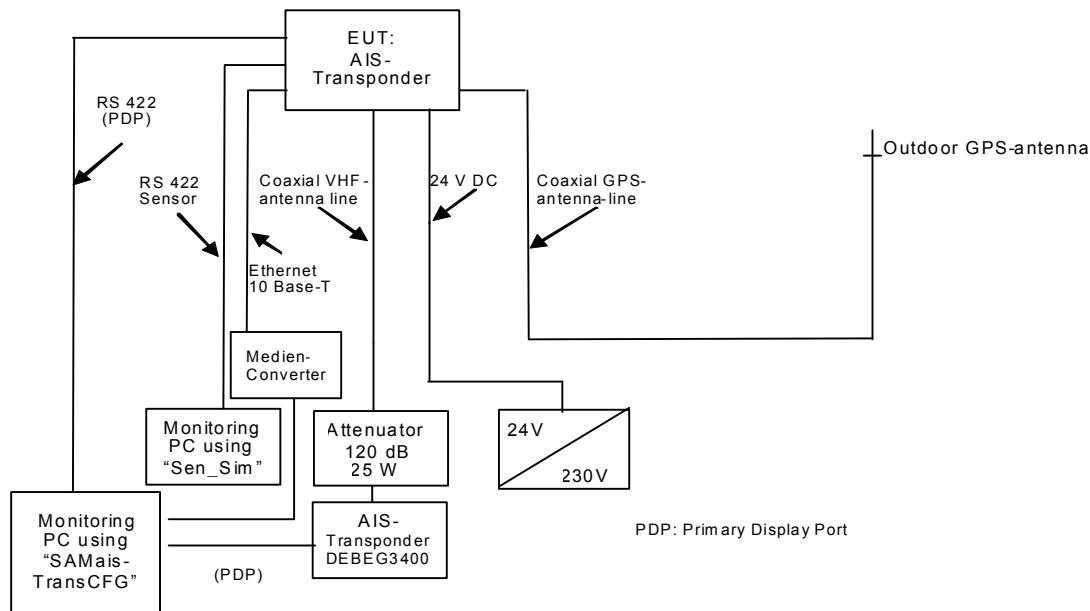
Test result: The requirements made in the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

## 6.6 POWER SUPPLY VARIATIONS ACCORDING TO IEC 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:	03. December 2008		
Test basics:	Electrical supply – rectified alternating current		
Coupling to	Test level	EUT reaction	Result
24 V DC	$U_B +20\%$ permanent	No reaction detectable	B
	$U_B -20\%$ permanent	No reaction detectable	B

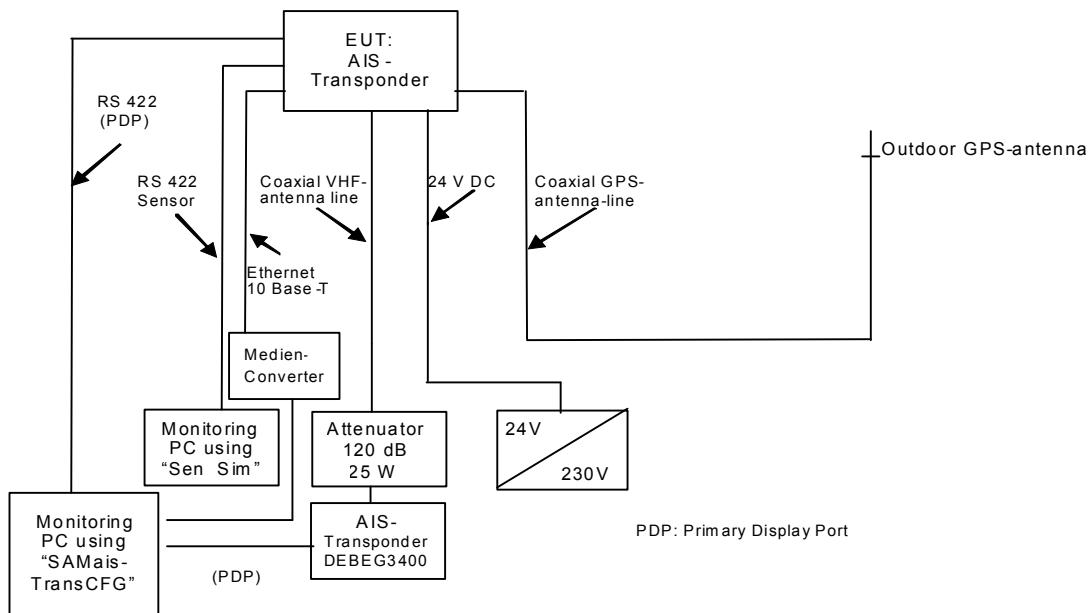
Test result: The requirements made in the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

## 6.7 EXCESSIVE CONDITIONS ACCORDING TO IEC 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:	03. December 2008	
Test level:	Confusing the DC-poles for 5 minutes	
Coupling to	EUT action after test	Result
24V DC	Automatic restart of the system, no user reaction necessary	B

Test result:

The requirements made in the test documents were fulfilled.

TEST REPORT REFERENCE: F081185E1\_3<sup>rd</sup>\_Version

## 7 ANNEX

The annex consists of 10 pages and contains pictures of the test set-ups:

Test set-up preliminary radiated emissions, E-Field	81185emi3.jpg
Test set-up preliminary radiated emissions	81185emi1.jpg
Test set-up radiated emissions, H-Field	81185emi5.jpg
Test set-up final radiated emissions, E-Field	81185emi11.jpg
Test set-up radiated immunity	81185ems3.jpg
Test set-up radiated immunity	81185ems4.jpg
Test set-up conducted emissions on DC-Power	81185emi_c6.jpg
Test set-up conducted immunity	81185ems_c3.jpg
Test set-up electrostatic discharge	81185esd5.jpg
Test set-up fast transients	81185burst1.jpg