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Test Report

Report Number:

F153662E2

Equipment under Test (EUT):

AIS search and rescue transmitter
SEAANGEL SA15 AIS FLARE

Applicant:

FT-TEC-Electronics GmbH

Manufacturer:

FT-TEC-Electronics GmbH

DAkkS Deutsche Akkreditierungsstelle
D-PL-17186-01-01
D-PL-17186-01-02
D-PL-17186-01-03

References

[1] **IEC 60945 (2002-08)** Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results

TEST RESULT

The requirements of the tests performed as shown in the overview (clause 4) were fulfilled by the equipment under test.
The complete test results are presented in the following.

Test engineer:	Thomas KÜHN		17.02.2016
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		17.02.2016
	Name	Signature	Date

RESERVATION

This test report is only valid in its original form.

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 concerning further samples. Any modification of the tested samples is prohibited and leads to the invalidity of this test report. Each page necessarily contains the PHOENIX TESTLAB Logo and the TEST REPORT NUMBER.

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1 Identification

1.1 Applicant

Name:	FT-TEC Electronics GmbH
Address:	Werner von Siemens-Straße 5 7343 Neutal
Country:	Austria
Name for contact purposes:	Mr. Andreas KREJCI
Phone:	+43 26 18 20 455 – 40 20
Fax:	+43 26 18 20 455 – 90 10
eMail Address:	a.krejci@ft-tec.com
Applicant represented during the test by the following person:	Mr. Klaus RUPP

1.2 Manufacturer

Name:	FT-TEC Electronics GmbH
Address:	Werner von Siemens-Straße 5 7343 Neutal
Country:	Austria
Name for contact purposes:	Mr. Andreas KREJCI
Phone:	+43 26 18 20 455 – 40 20
Fax:	+43 26 18 20 455 – 90 10
eMail Address:	a.krejci@ft-tec.com
Manufacturer represented during the test by the following person:	Mr. Klaus RUPP

1.3 Test laboratory

The tests were carried out at: **PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

accredited by DGA Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025 under Reg. No. D-PL-17186-01-02.

1.4 EUT (Equipment Under Test)

Type: *	AIS Search and Rescue Transmitter (AIS-SART)					
Type designation: *	SEAANGEL SA15 AIS FLARE					
Serial No.:	None (Prototype)					
Power amplifier difference: *	P_d = 0 dB					
Alignment range: *	161.975 to 162.025 MHz					
Switching range: *	161.975 to 162.025 MHz					
Channel separation:	50 kHz (channel bandwidth: 25 kHz)					
Rated RF output power:	1.0 W / 30 dBm					
Supply Voltage:	U_{nom}=	3.0 V DC	U_{min}=	2.5 V DC	U_{max}=	3.3 V DC
Printed circuit designation: *	5400023A01					
Software version: *	SA15V1.3					
Hardware version: *	V01					

* declared by the applicant.

Ports/Connectors

Identification	Connector		Length
	EUT	Ancillary	
-	-	-	-
-	No external lines are connectable to the EUT		-
-			-
-			-
-	-	-	-
-	-	-	-

1.5 Dates

Date of receipt of test sample:	17.11.2015
Start of test:	18.11.2015
End of test:	18.12.2015

2 Operational states and test setup

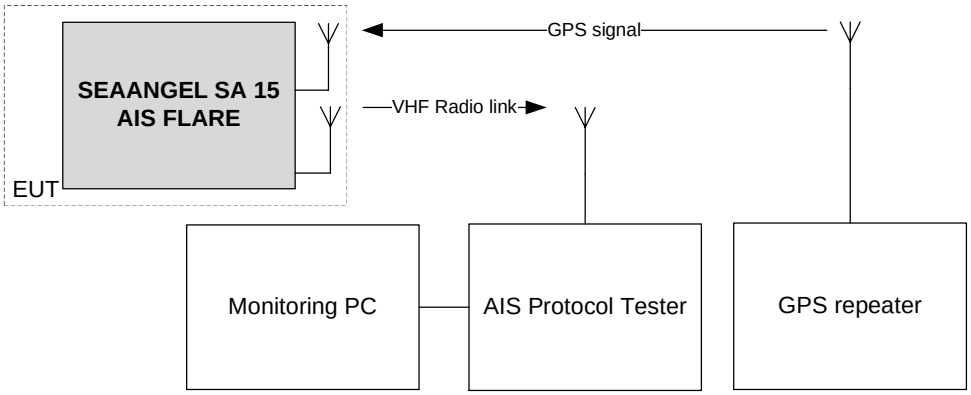
Description of the test setup and tests made for checking EUT performance:

The EUT was powered by the internal battery during all tests.

In order to reduce the testing time, the EUT was equipped with a test-firmware during the immunity tests, which transmits with a shorter interval after a start-up time of one minute after pressing the on-button. Every second an AIS message 1 was transmitted alternating on AIS 1 (161.975 MHz) and on AIS 2 (162.025 MHz). The correct function of the EUT (transmission of the correct message type on the correct channel and with the correct GPS data and message content) as required as performance test according to [1] was monitored by using the AIS protocol tester.

For the emission test the normal firmware of the EUT was used. The emission measurements were carried out after the test-button was pressed. As declared by the applicant in this mode the EUT is powered on (including the GPS receiver part, but no transmission occurs).

Test setup:



3 Additional information

The EUT is intended to be sold with two different antennas, which could be screwed on the housing. With the different antenna length it was necessary to adapt the length of the antenna counterweight. The following length of the antenna counterweight was used:

Antenna type designation	Lenght of the antenna counterweight
IN2011	12 cm
2J0936	33 cm

All measurements were carried out with these antenna / antenna counterweight combinations.

4 Overview

4.1 Radiated emissions

Radiated emission – Enclosure port				
Frequency range	Limit	Basic standard	Remark	Status
150kHz – 300kHz 300kHz – 30MHz	80 – 52 dBµV/m in 3m 52 – 34 dBµV/m in 3m	IEC 60945 Chapter 9.3	H-field	Passed
30MHz – 156MHz 156MHz– 165MHz 165MHz– 1GHz	54 dBµV/m in 3m 24 dBµV/m in 3m 54 dBµV/m in 3m	IEC 60945 Chapter 9.3	E-field	Passed
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 dBµV 60 – 50 dBµV 50 dBµV	IEC 60945 Chapter 9.2	EUT is battery supplied	Not applicable
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			

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 criterion	Status
Electromagnetic fields	80 – 2700 MHz 10 V/m; AM; 80 %; 400 Hz	IEC 60945 Chapter 10.4	---	A	Passed
Electrostatic discharge (ESD)	up to ±6 kV charging voltage for contact discharge	IEC 60945 Chapter 10.9	---	B	Passed
Electrostatic discharge (ESD)	up to ±8 kV charging voltage for air discharge	IEC 60945 Chapter 10.9	---	B	Passed

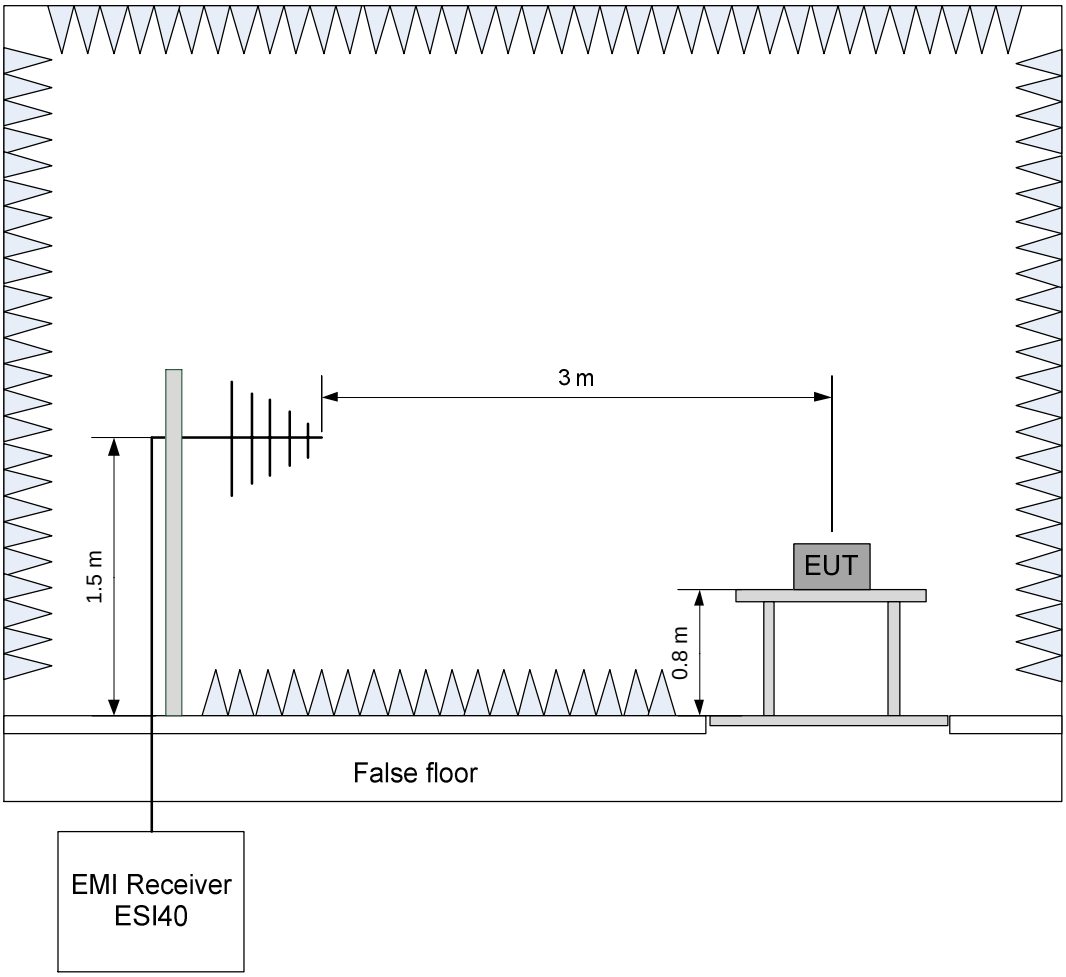
Immunity – Power supply ports, DC and AC					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criterion	Status
Conducted high frequency interference	10 V; AM; 80%; 400 Hz 10 kHz – 80 MHz	IEC 60945 Chapter 10.3	EUT is battery supplied	A	Not applicable
Conducted high 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	IEC 60945 Chapter 10.3	EUT is battery supplied	A	Not applicable
Power supply failure	3 interruptions of 60s	IEC 60945 Chapter 10.8	EUT is battery supplied	C	Not applicable
Power supply variations	U_N + 20 % for 1.5 s	IEC 60945 Chapter 10.7	EUT is battery supplied	B	Not applicable
	U_N – 20 % for 1.5 s			B	Not applicable
Fast transients (Burst)	±1 kV (peak) 5/50 ns (Tr/Th) 5 kHz repetition frequency	IEC 60945 Chapter 10.5	EUT is battery supplied	B	Not applicable
Transients (Surge)	1.2 / 50 µs up to ±0.5 kV line/line up to ±1.0 kV line/earth	IEC 60945 Chapter 10.6	EUT is battery supplied	B	Not applicable

Immunity – Data, control and communications connections					
Environmental phenomena	Test specification and units	Basic standard	Remark	Performance criterion	Status
Conducted high frequency interference	10 V; AM; 80%; 400 Hz 10 kHz – 80 MHz	IEC 60945 Chapter 10.3	No connections. available	A	Not applicable
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	IEC 60945 Chapter 10.3	No connections. available	A	Not applicable
Fast transients (Burst)	±1 kV (peak) 5/50 ns (Tr/Th) 5 kHz repetition frequency	IEC 60945 Chapter 10.5	No connections. available	B	Not applicable

5 Test sequence and test results electromagnetic disturbances characteristics

5.1 Radiated radio disturbance according to IEC 60945 chapter 9.3 (Electric E field)

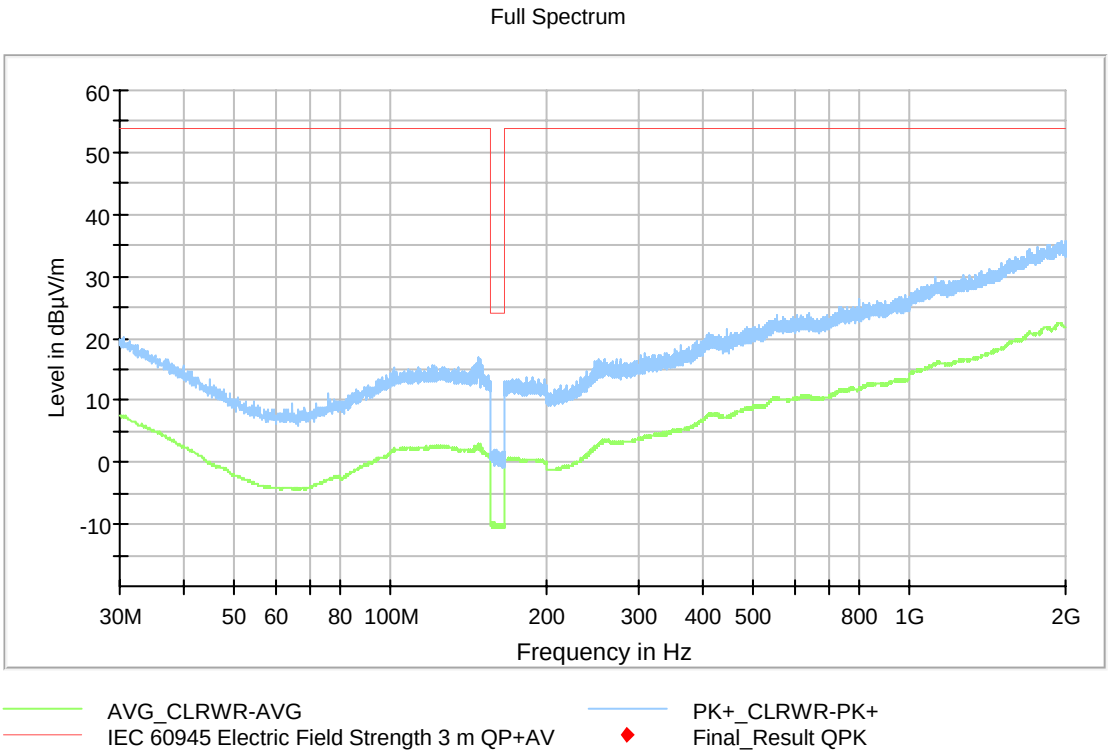
Test setup: - Table setup
- The drawing below schematically shows the test setup.
- Photos of the test setup can also be referred to in the annex.



Test procedure: The radiated 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.

5.1.1 Radiated radio disturbance (E-field) of AIS FLARE with IN2011

Test Description:	Radiated emission measurement
EUT:	AIS FLARE with IN2011 and 12 cm counterweight
Manufacturer:	FT-TEC
Operating Conditions:	Receive, CPU active
Test Site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator Name:	Th. KÜHN
Comment:	



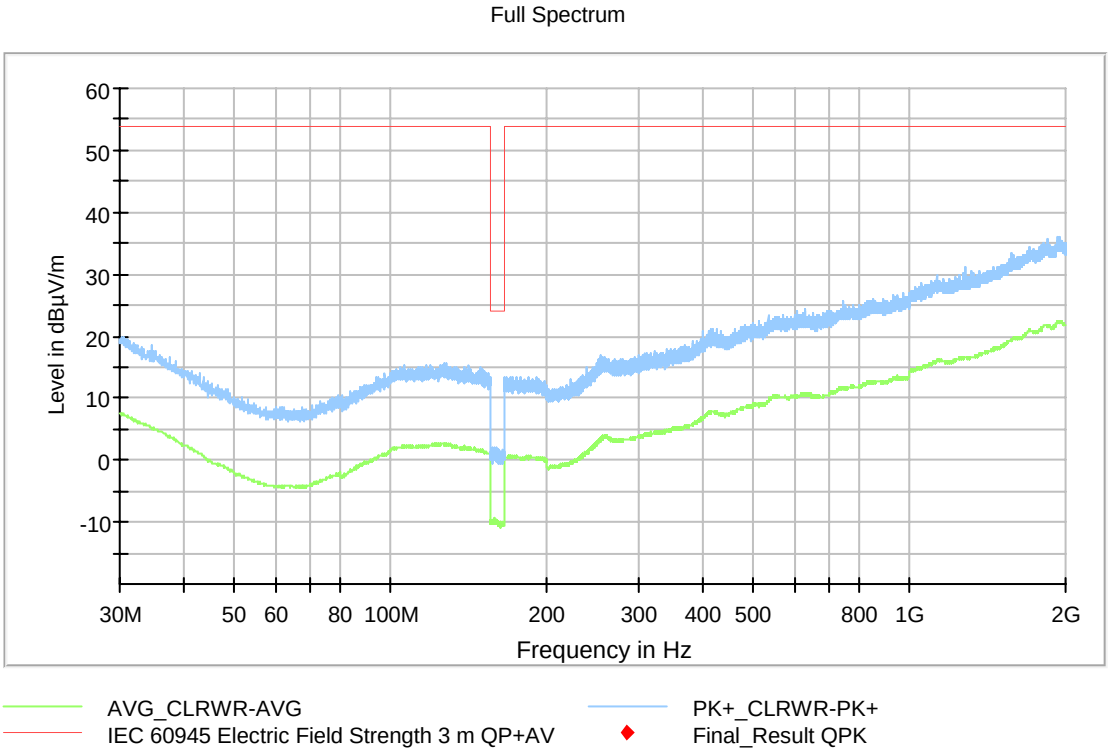
In this case it was not necessary to carry out subsequent measurements because at no frequency was a value above the noise floor of the measuring system during the preliminary measurements.

Equipment used: Fully anechoic chamber (PM-No. 480190)
Controller Maturo MCU (PM-No. 480181)
Antenna mast (PM-No. 480187/480188)
Turntable (PM-No. 480186)
Receiver ESI 40 (PM-Nr. 480355)
EMI softwarepackage ES-K1 (PM-No. 480111)
Antenna Chase CBL 6112 (PM-No. 480185)

Test result: Passed.

5.1.2 Radiated radio disturbance (E-field) of AIS FLARE with 2J0936

Test Description:	Radiated emission measurement
EUT:	AIS FLARE with 2J0936 and 33 cm counterweight
Manufacturer:	FT-TEC
Operating Conditions:	Receive, CPU active
Test Site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator Name:	Th. KÜHN
Comment:	



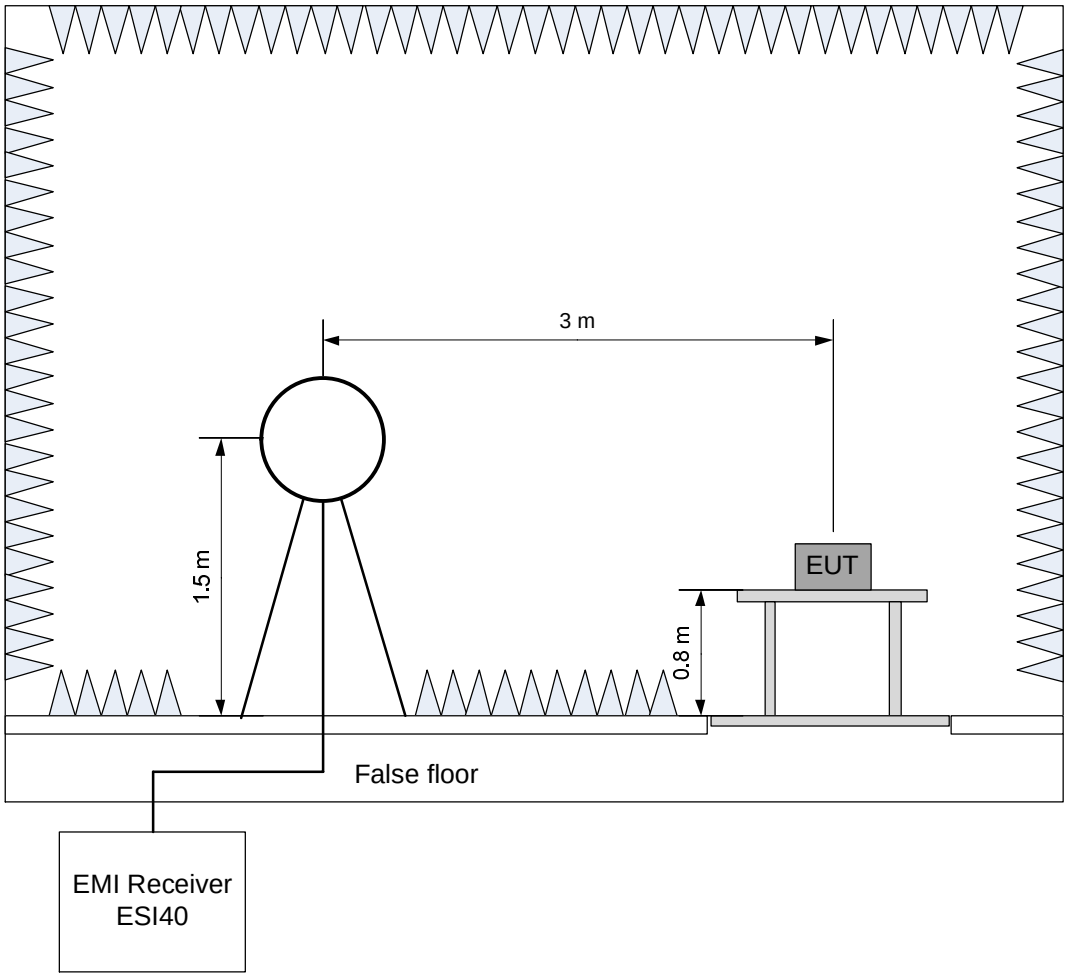
In this case it was not necessary to carry out subsequent measurements because at no frequency was a value above the noise floor of the measuring system during the preliminary measurements.

Equipment used: Fully anechoic chamber (PM-No. 480190)
Controller Maturo MCU (PM-No. 480181)
Antenna mast (PM-No. 480187/480188)
Turntable (PM-No. 480186)
Receiver ESI 40 (PM-Nr. 480355)
EMI softwarepackage ES-K1 (PM-No. 480111)
Antenna Chase CBL 6112 (PM-No. 480185)

Test result: Passed.

5.2 Radiated radio disturbance according to IEC 60945 chapter 9.3 (Magnetic H field)

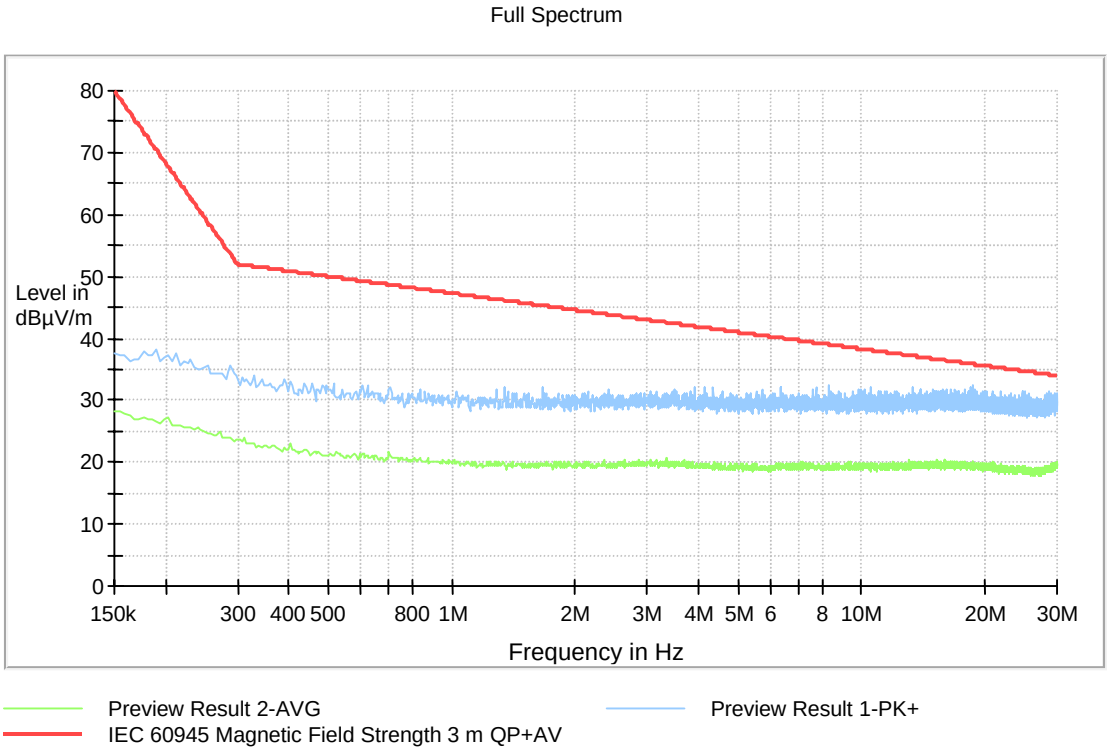
Test setup: - Table setup
- The drawing below schematically shows the test setup.
- Photos of the test setup can also be referred to in the annex.



Test procedure: The radiated 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.

5.2.1 Radiated radio disturbance (H-field) of AIS FLARE with IN2011

Test Description:	Radiated emission measurement
EUT:	AIS FLARE with IN2011 and 12 cm counterweight
Manufacturer:	FT-TEC
Operating Conditions:	Receive, CPU active
Test Site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator Name:	Th. KÜHN
Comment:	



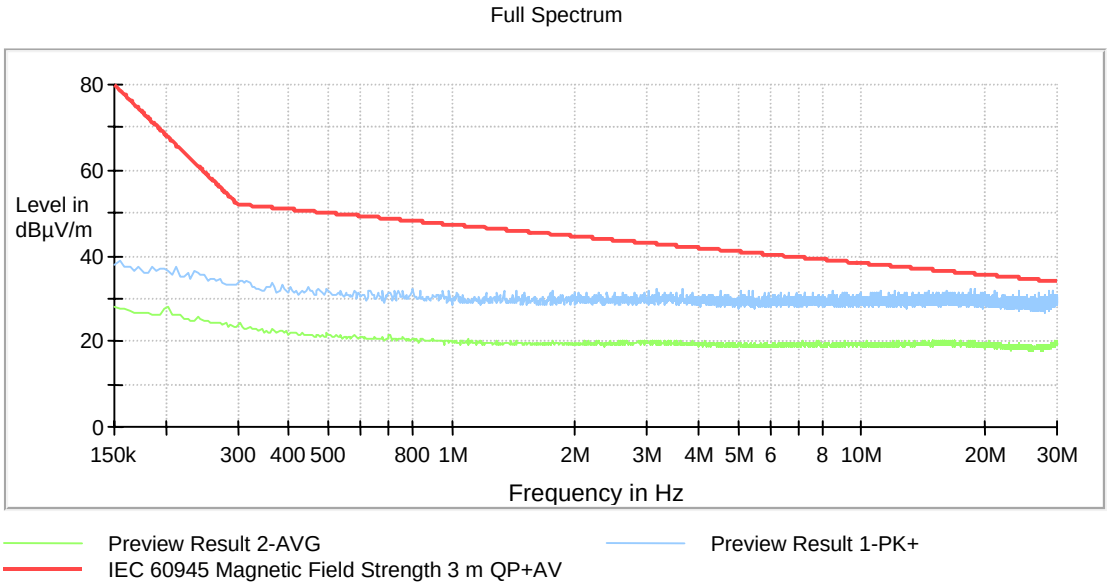
In this case it was not necessary to carry out subsequent measurements because at no frequency was a value above the noise floor of the measuring system during the preliminary measurements.

Test equipment used: Fully anechoic chamber (PM-No. 480190)
Controller Maturo MCU (PM-No. 480181)
Antenna mast (PM-No. 480187/480188)
Turntable (PM-No. 480186)
Receiver ESI 40 (PM-Nr. 480355)
EMI software package ES-K1 (PM-No. 480111)
Antenna R+S Loop antenna HFH2-Z2 (PM-Nr. 480059)

Test result: Passed.

5.2.2 Radiated radio disturbance (H-field) of AIS FLARE with 2J0936

Test Description:	Radiated emission measurement
EUT:	AIS FLARE with 2J0936 and 33 cm counterweight
Manufacturer:	FT-TEC
Operating Conditions:	Receive, CPU active
Test Site:	Phoenix TESTLAB GmbH, anechoic chamber M20
Operator Name:	Th. KÜHN
Comment:	



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

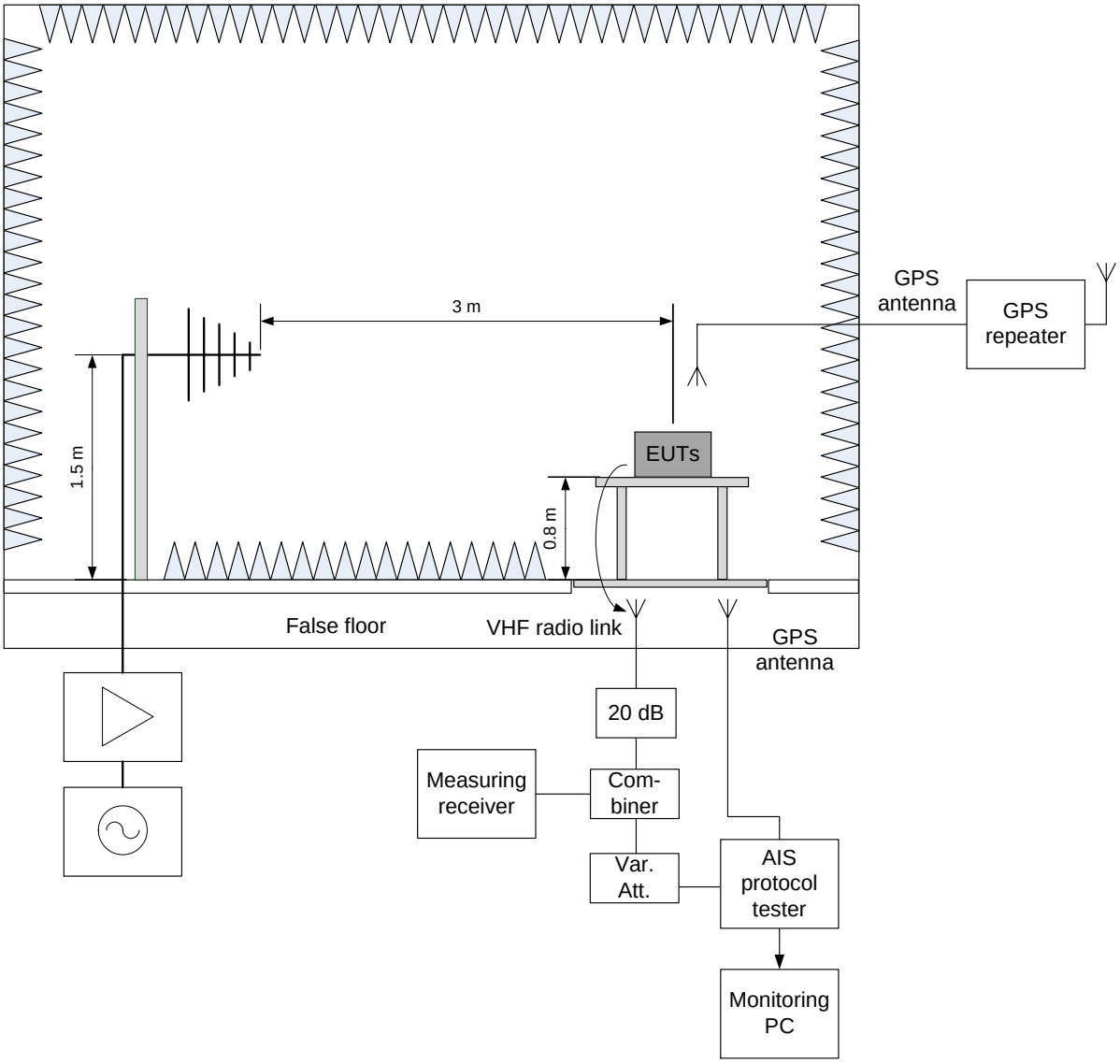
Test equipment used: Fully anechoic chamber (PM-No. 480190)
Controller Maturo MCU (PM-No. 480181)
Antenna mast (PM-No. 480187/480188)
Turntable (PM-No. 480186)
Receiver ESI 40 (PM-Nr. 480355)
EMI software package ES-K1 (PM-No. 480111)
Antenna R+S Loop antenna HFH2-Z2 (PM-Nr. 480059)

Test result: Passed.

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



Monitoring of EUTs: EUT in transmit mode: The output signals and correct timing / position were checked by using an AIS protocol tester.
EUT in standby mode: Unintentional transmissions were monitored with a spectrum analyser.
Furthermore the EUTs were monitored with the help of the optical monitoring system of the anechoic chamber manually by the test engineer.

Exclusion band: No tests were carried out in the frequency range 153.876 MHz to 170.126 MHz.

Test records: The tests in the table below were carried out.

Date of test: 25.11.2015 Ambient conditions: 31 % F_{rel}, 21 °C			Test level: 80-2700 MHz, 10 V/m, AM, 400 Hz, 80 % Increment: log 1 % Dwell time: ≥ 3 s	
AIS FLARE with IN2011 standby mode, AIS FLARE with 2J0936 in transmit mode				
Distance antenna/ test object	Polarisation	Radiation direction	EUT reaction	Result
3 m	Vertical	0 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	90 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	180 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	270 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	0 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	90 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	180 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	270 °	No noticeable reaction, no unintentional transmission.	A
AIS FLARE with IN2011 in transmit mode, AIS FLARE with 2J0936 standby mode				
Distance antenna/ test object	Polarisation	Radiation direction	EUT reaction	Result
3 m	Vertical	0 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	90 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	180 °	No noticeable reaction, no unintentional transmission.	A
3 m	Vertical	270 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	0 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	90 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	180 °	No noticeable reaction, no unintentional transmission.	A
3 m	Horizontal	270 °	No noticeable reaction, no unintentional transmission.	A

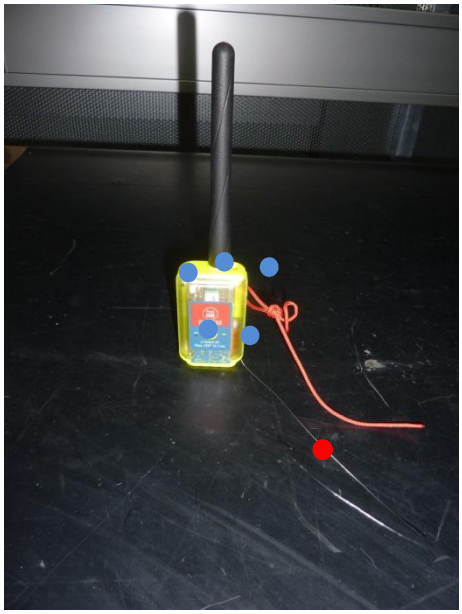
Test equipment used:	Controller Maturo MCU (PM-No. 480326) Turntable (PM-No. 480315) Antenna support (PM-No. 480187, 480325) Fully anechoic chamber (PM-No. 480303) Power amplifier AR150W1000 (PM-No. 480419) Power amplifier AR60S1G3 (PM-No. 480418) Signal generator SML03 (PM-No. 480421) Power meter NRVD (PM-No. 480176, 480177) Power probe 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) Relay switch unit (PM-N0. 480175) EMS Software-Package EMS-K1 (PM-No. 480222) Horn antenna Schwarzbeck 9120 (PM-No. 480082) Log.-Per. Antenna HL046 (PM-No. 480189) 20 dB attenuator WA8 / 18-20-34 (PM No. 481450) Variable Attenuator 0 -11 dB 8494B (PM No. 480264) Variable Attenuator 0 - 110 dB 8496B (PM No. 480265) AIS test unit MK II (PM No. 481422) Combiner Mini Circuits ZFSC-2-11 (PM No. 410171) Measuring receiver Rohde & Schwarz ESI 40 (Pm No. 480355)
Test result:	Passed.

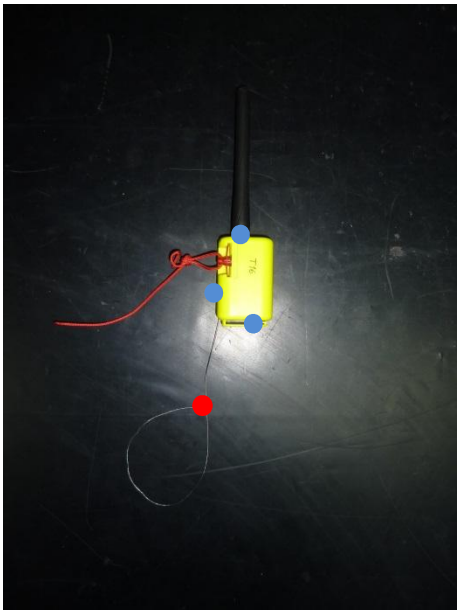
6.2 Immunity test for discharge of static electricity according to IEC 60945 chapter 10.9

Test setup: - Table setup
- Photos of the test setup 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 in transmit and standby mode.
Contact discharge (CD) was carried out up to ±6 kV.
Air discharge (AD) was carried out up to ±8 kV.
Indirect discharge (ID) was carried out on the vertical (VCP) and horizontal (HCP) coupling plate up to ±6 kV.

Points of air discharge ●:
Points of contact discharge ●:





6.2.1 Electrostatic discharge with AIS FLARE and IN2011

Test records operation mode transmit

Date of test: 18.12.2015 Ambient conditions: 38 % F_{rel}, 22 °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 discharge ±2kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±4kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±6kV	HCP VCP	No reaction detected No reaction detected	A A
Contact discharge ±2kV	CD	No reaction detected	A
Contact discharge ±4kV	CD	No reaction detected	A
Contact discharge ±6kV	CD	No reaction detected	A
Air discharge ±2kV	AD	No reaction detected	A
Air discharge ±4kV	AD	No reaction detected	A
Air discharge ±8kV	AD	No reaction detected	A

Test records operation mode standby

Date of test: 10 March 2014 Ambient conditions: 30 % F_{rel}, 22 °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 discharge ±2kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±4kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±6kV	HCP VCP	No reaction detected No reaction detected	A A
Contact discharge ±2kV	CD	No reaction detected	A
Contact discharge ±4kV	CD	No reaction detected	A
Contact discharge ±6kV	CD	No reaction detected	A
Air discharge ±2kV	AD	No reaction detected	A
Air discharge ±4kV	AD	No reaction detected	A
Air discharge ±8kV	AD	No reaction detected	A

Test equipment used: Schaffner ESD simulator NSG 435 (PM No. 480027)
Testing table Numerik PTi (PM No. 480049)
AIS test unit MK II (PM No. 481422)

6.2.2 Electrostatic discharge with AIS FLARE and 2J0936

Test records operation mode transmit

Date of test: 18.12.2015 Ambient conditions: 38 % F_{rel}, 22 °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 discharge ±2kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±4kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±6kV	HCP VCP	No reaction detected No reaction detected	A A
Contact discharge ±2kV	CD	No reaction detected	A
Contact discharge ±4kV	CD	No reaction detected	A
Contact discharge ±6kV	CD	No reaction detected	A
Air discharge ±2kV	AD	No reaction detected	A
Air discharge ±4kV	AD	No reaction detected	A
Air discharge ±8kV	AD	Transmission interrupted, restarts automatically after 1 min.	B

Test records operation mode standby

Date of test: 10 March 2014 Ambient conditions: 30 % F_{rel}, 22 °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 discharge ±2kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±4kV	HCP VCP	No reaction detected No reaction detected	A A
Indirect discharge ±6kV	HCP VCP	No reaction detected No reaction detected	A A
Contact discharge ±2kV	CD	No reaction detected	A
Contact discharge ±4kV	CD	No reaction detected	A
Contact discharge ±6kV	CD	No reaction detected	A
Air discharge ±2kV	AD	No reaction detected	A
Air discharge ±4kV	AD	No reaction detected	A
Air discharge ±8kV	AD	No reaction detected	A

Test result: Passed.

7 Report history

Report Number	Date	Comment
F153662E2	17.02.2016	Document created
-	-	-
-	-	-

8 List of annexes

Annex A Photographs 18 pages

External photographs of the test sample:
153662_a.JPG: SEAANGEL SA15 AIS FLARE with 2J0936, front view
153662_b.JPG: SEAANGEL SA15 AIS FLARE with 2J0936, front view, cover removed
153662_e.JPG: SEAANGEL SA15 AIS FLARE with 2J0936, rear view
153662_c.JPG: SEAANGEL SA15 AIS FLARE with IN2011, front view
153662_d.JPG: SEAANGEL SA15 AIS FLARE with IN2011, front view, cover removed

Internal photographs of the test sample:
153662_f.JPG: SEAANGEL SA15 AIS FLARE, internal view 1 (housing opened)
153662_g.JPG: SEAANGEL SA15 AIS FLARE, internal view 2 (PCB sandwich removed)
153662_h.JPG: SEAANGEL SA15 AIS FLARE, PCB, top view
153662_l.JPG: SEAANGEL SA15 AIS FLARE, PCB, top view, battery removed
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Photographs of the test setups:
153662_7.JPG: SEAANGEL SA15 AIS FLARE with IN2011, test set-up fully anechoic chamber
153662_6.JPG: SEAANGEL SA15 AIS FLARE with IN2011, test set-up fully anechoic chamber
153662_8.JPG: SEAANGEL SA15 AIS FLARE, test set-up electric E field measurement
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