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# Test Report

Report Number:

**F153662E1**

Equipment under Test (EUT):

**AIS search and rescue transmitter  
SEAANGEL SA15 AIS FLARE**

Applicant:

**FT-TEC-Electronics GmbH**

Manufacturer:

**FT-TEC-Electronics GmbH**

## References

[1] **IEC 61097-14: 2010**: Global maritime distress and safety systems (GMDSS) – Part 14: AIS Search and Rescue Transmitter (AIS-SART) – Operational and performance 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		16.02.2016
	Name	Signature	Date
Authorized reviewer:	Bernd STEINER		16.02.2016
	Name	Signature	Date

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## 1 Identification

### 1.1 Applicant

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Applicant represented during the test by the following person:	Mr. Klaus RUPP

### 1.2 Manufacturer

Name:	FT-TEC Electronics GmbH
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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: *	$P_d = 0 \text{ dB}$					
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:	$U_{\text{nom}} =$	3.0 V DC	$U_{\text{min}} =$	2.5 V DC	$U_{\text{max}} =$	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:	24.11.2015

## 2 Operational states

All tests were carried out at the two frequencies AIS1 (161.975 MHz) and AIS2 (162.025 MHz).

During the tests under extreme conditions the EUT was supplied by an external power supply within the applicants declared supply voltage ratings (refer clause 1.4 of this test report).

The EUT could be connected to a laptop computer with a test-software, which allows adjusting of the EUTs operation mode.

Conducted measurements were carried out with a temporary antenna connector installed instead of the antenna.

The following operation modes were adjustable during the tests

Test case	Operation mode
Frequency error	Transmit without modulation
Conducted power	Transmit standard test signal number 3 (defined in clause 5.6.3 [1])
Radiated power	Transmit standard test signal number 3 (defined in clause 5.6.3 [1])
Modulation spectrum slotted transmission	Transmit standard test signal number 3 (defined in clause 5.6.3 [1])
Transmitter test sequence and modulation accuracy	Transmit standard test signal number 1 and 2 (defined in clause 5.6.1 [1] and 5.6.2 [1])
Transmitter output power versus time function	Transmit standard test signal number 1 (defined in clause 5.6.1 [1])
Spurious emissions from the transmitter	Transmit standard test signal number 3 (defined in clause 5.6.3 [1])

### 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

The measurement of the radiated power was carried out with these antenna / antenna counterweight combinations.

### 4 Test overview

Subclause	Test parameter	Remark	Test result	Refer page
<b>7 [1] Physical radio tests</b>				
7.2 [1]	Frequency error	Applicable	Passed	8
7.3 [1]	Conducted power	Applicable	Passed	9
7.4 [1]	Radiated power	Applicable	Passed	10
7.5 [1]	Modulation spectrum slotted transmission	Applicable	Passed	12 et seq.
7.6 [1]	Transmitter test sequence and modulation accuracy	Applicable	Passed	14 et seq.
7.7 [1]	Transmitter output power versus time function	Applicable	Passed	17 et seq.
7.8 [1]	Spurious emissions from the transmitter	Applicable	Passed	21

## 5 Physical radio tests

### 5.1 Frequency error

Subclause 7.2 [1]

Ambient temperature	22 °C	Relative humidity	30 %
---------------------	-------	-------------------	------

Operation mode: Continuous transmission on 161.975 MHz without modulation, measured conducted at the temporary antenna port.

Test conditions		Frequency	Frequency error
Temperature	Voltage		
$T_{\text{nom}}$ (+20°C)	$U_{\text{nom}}$ (3.0 V DC)	161.974856 MHz	-144 Hz
$T_{\text{min}}$ (-20°C)	$U_{\text{min}}$ (2.5 V DC)	161.974904 MHz	-96 Hz
	$U_{\text{max}}$ (3.3 V DC)	161.974904 MHz	-96 Hz
$T_{\text{max}}$ (+55 °C)	$U_{\text{min}}$ (2.5 V DC)	161.974824 MHz	-176 Hz
	$U_{\text{max}}$ (3.3 V DC)	161.974824 MHz	-176 Hz
Maximum frequency error		-176 Hz	
Measurement uncertainty		$\pm 10$ Hz	

Operation mode: Continuous transmission on 162.025 MHz without modulation measured conducted at the temporary antenna port.

Test conditions		Frequency	Frequency error
Temperature	Voltage		
$T_{\text{nom}}$ (+20°C)	$U_{\text{nom}}$ (3.0 V DC)	162.024860 MHz	-140 Hz
$T_{\text{min}}$ (-20°C)	$U_{\text{min}}$ (2.5 V DC)	162.024892 MHz	-108 Hz
	$U_{\text{max}}$ (3.3 V DC)	162.024892 MHz	-108 Hz
$T_{\text{max}}$ (+55 °C)	$U_{\text{min}}$ (2.5 V DC)	162.024824 MHz	-176 Hz
	$U_{\text{max}}$ (3.3 V DC)	162.024824 MHz	-176 Hz
Maximum frequency error		-176 Hz	
Measurement uncertainty		$\pm 10$ Hz	

Limits: Subclause 7.2.3 [1]

The frequency error shall not exceed  $\pm 0.5$  kHz under normal and  $\pm 1$  kHz under extreme conditions.

Test equipment used (refer clause 6)

9, 10, 13, 16, 17

## 5.2 Conducted power

Subclause 7.3 [1]

Ambient temperature	22 °C	Relative humidity	30 %
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Antenna gain (refer 5.3 of this test report),  $P_d = 0$  dB.

Radiated power level (refer 5.3 of this test report).

Operation mode: Continuous transmission on 161.975 MHz  
measured conducted at the temporary antenna port.

Test conditions		Carrier Power (conducted)	
$T_{nom}$ (+20°C)	$U_{nom}$ (3.0 V DC)	$P_{20} =$	31.2 dBm
$T_{min}$ (-20°C)	$U_{min}$ (2.5 V DC)	$P_{-20} =$	31.9 dBm
	$U_{max}$ (3.3 V DC)		32.0 dBm
$T_{max}$ (+55°C)	$U_{min}$ (2.5 V DC)	$P_{+55} =$	30.9 dBm
	$U_{max}$ (3.3 V DC)		31.0 dBm
Minimum Carrier Power		30.9 dB	
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

Operation mode: Continuous transmission on 162.025 MHz  
measured conducted at the temporary antenna port.

Test conditions		Carrier Power (conducted)	
$T_{nom}$ (+20°C)	$U_{nom}$ (3.0 V DC)	$P_{20} =$	31.2 dBm
$T_{min}$ (-20°C)	$U_{min}$ (2.5 V DC)	$P_{-20} =$	31.9 dBm
	$U_{max}$ (3.3 V DC)		32.0 dBm
$T_{max}$ (+55°C)	$U_{min}$ (2.5 V DC)	$P_{+55} =$	30.9 dBm
	$U_{max}$ (3.3 V DC)		31.0 dBm
Minimum Carrier Power		30.9 dB	
Measurement uncertainty		+ 0.66 dB / - 0.72 dB	

Limits: Subclause 7.3.3 [1]

The conducted power, corrected for the antenna gain shall be at least the values given in Table 6.

Table 6 – Conducted power – Required results

Power	dBm
$P_{-20} + G + P_d$	27
$P_{+55} + G + P_d$	27

NOTE This power equates to the radiated power at extreme temperatures

Test equipment used (refer clause 6)

10, 13 - 17

## 5.3 Radiated power

Subclause 7.4 [1]

### 5.3.1 Radiated power with IN2011

Ambient temperature	22 °C	Relative humidity	70 %
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Length of the antenna counterweight: 12 cm

Operation mode: Transmit on 161.975 MHz, in use with internal battery already used for 92 hours.

Test conditions		Measured Power $P_R$ (radiated)	Measured Power $P_{20}$ (conducted)	Calculated Antenna-Gain $G = P_R - P_{20}$	Minimum Power (radiated)*
$T_{\text{nom}}$ (+20°C)	Angle = 0°	31.2 dBm	31.2 dBm	-0.0 dBi	30.9 dBm
	Angle = 90°	31.2 dBm		-0.0 dBi	30.9 dBm
	Angle = 180°	31.1 dBm		-0.1 dBi	30.8 dBm
	Angle = 270°	31.0 dBm		-0.2 dBi	30.7 dBm
Measurement uncertainty		+2.2 dB / -3.6 dB			

\*Calculated by using the Results of ( $P_{-20}$ ) and ( $P_{55}$ ) from Subclause 7.3

Operation mode: Transmit on 162.025 MHz, in use with internal battery already used for 92 hours.

Test conditions		Measured Power $P_R$ (radiated)	Measured Power $P_{20}$ (conducted)	Calculated Antenna-Gain $G = P_R - P_{20}$	Minimum Power (radiated)*
$T_{\text{nom}}$ (+20°C)	Angle = 0°	31.2 dBm	31.2 dBm	-0.0 dBi	30.9 dBm
	Angle = 90°	31.2 dBm		-0.0 dBi	30.9 dBm
	Angle = 180°	31.0 dBm		-0.2 dBi	30.7 dBm
	Angle = 270°	31.0 dBm		-0.2 dBi	30.7 dBm
Measurement uncertainty		+2.2 dB / -3.6 dB			

\*Calculated by using the Results of ( $P_{-20}$ ) and ( $P_{55}$ ) from Subclause 7.3

Limits: Subclause 7.4.3 [1]

The radiated power shall be at least 27 dBm (500 mW).

NOTE This equates to a nominal radiated output power of 1 W with a -3 dB tolerance to allow for antenna gain characteristics and temperature variations.

Test equipment used (refer clause 6)

1 – 7

### 5.3.2 Radiated power with 2J0936

Ambient temperature	22 °C	Relative humidity	70 %
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Length of the antenna counterweight: 33 cm

Operation mode: Transmit on 161.975 MHz, in use with internal battery already used for 92 hours.

Test conditions		Measured Power $P_R$ (radiated)	Measured Power $P_{20}$ (conducted)	Calculated Antenna-Gain $G = P_R - P_{20}$	Minimum Power (radiated)*
$T_{\text{nom}}$ (+20°C)	Angle = 0°	29.4 dBm	31.2 dBm	-1.8 dBi	29.1 dBm
	Angle = 90°	29.3 dBm		-1.9 dBi	29.0 dBm
	Angle = 180°	29.3 dBm		-1.9 dBi	29.0 dBm
	Angle = 270°	29.4 dBm		-1.8 dBi	29.1 dBm
Measurement uncertainty		+2.2 dB / -3.6 dB			

\*Calculated by using the Results of ( $P_{-20}$ ) and ( $P_{55}$ ) from Subclause 7.3

Operation mode: Transmit on 162.025 MHz, in use with internal battery already used for 92 hours.

Test conditions		Measured Power $P_R$ (radiated)	Measured Power $P_{20}$ (conducted)	Calculated Antenna-Gain $G = P_R - P_{20}$	Minimum Power (radiated)*
$T_{\text{nom}}$ (+20°C)	Angle = 0°	29.3 dBm	31.2 dBm	-1.9 dBi	29.1 dBm
	Angle = 90°	29.3 dBm		-1.9 dBi	29.0 dBm
	Angle = 180°	29.3 dBm		-1.9 dBi	29.0 dBm
	Angle = 270°	29.4 dBm		-1.8 dBi	29.1 dBm
Measurement uncertainty		+2.2 dB / -3.6 dB			

\*Calculated by using the Results of ( $P_{-20}$ ) and ( $P_{55}$ ) from Subclause 7.3

Limits: Subclause 7.4.3 [1]

The radiated power shall be at least 27 dBm (500 mW).

NOTE This equates to a nominal radiated output power of 1 W with a -3 dB tolerance to allow for antenna gain characteristics and temperature variations.

Test equipment used (refer clause 6)

1 – 7

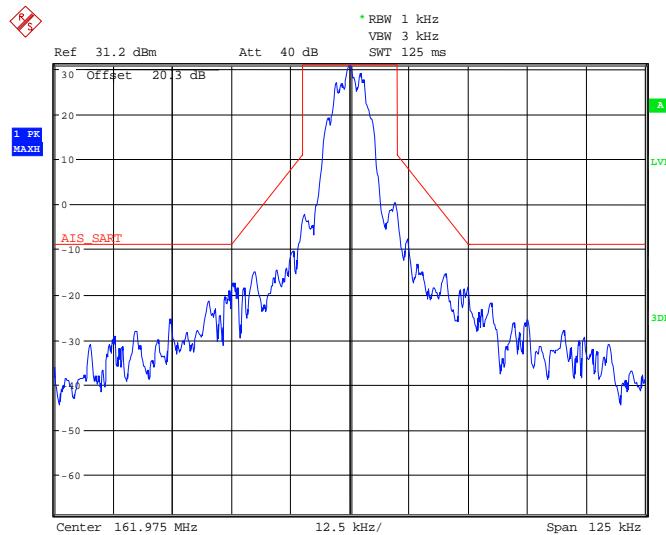
## 5.4 Modulation spectrum slotted transmission

Subclause 7.5 [1]

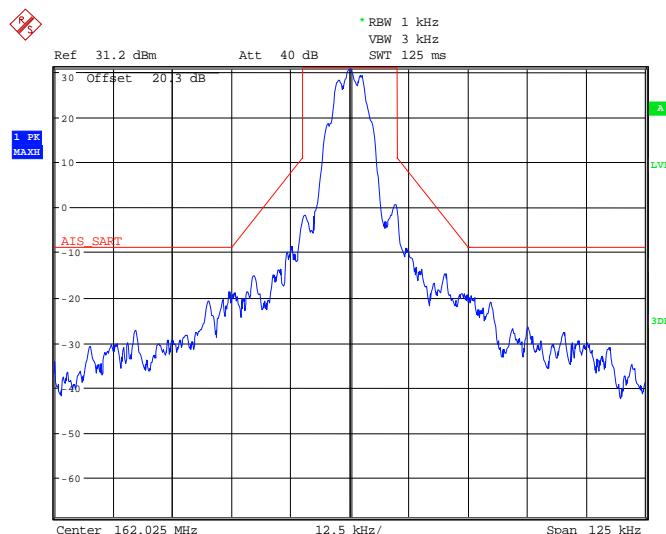
Ambient temperature	22 °C	Relative humidity	30 %
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Measured conducted at the temporary antenna port.

153662\_1.wmf: Transmission spectrum, transmit on 161.975 MHz:



152663\_2.wmf: Transmission spectrum, transmit on 162.025 MHz:



Limits: Subclause 7.5.3 [1]

The spectrum for slotted transmission shall be within the emission mask as follows:

In the region between the carrier and  $\pm 10$  kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc.

At  $\pm 10$  kHz removed from the carrier, the modulation and transient sideband shall be below - 20 dBc.

At  $\pm 25$  kHz to  $\pm 62.5$  kHz removed from the carrier, the modulation and transient sideband shall be below the lower value of -40 dBc.

In the region  $\pm 10$  kHz and  $\pm 25$  kHz removed from the carrier, the modulation and transients sidebands shall be below a line specified between these two points.

Test equipment used (refer clause 6)

9, 13

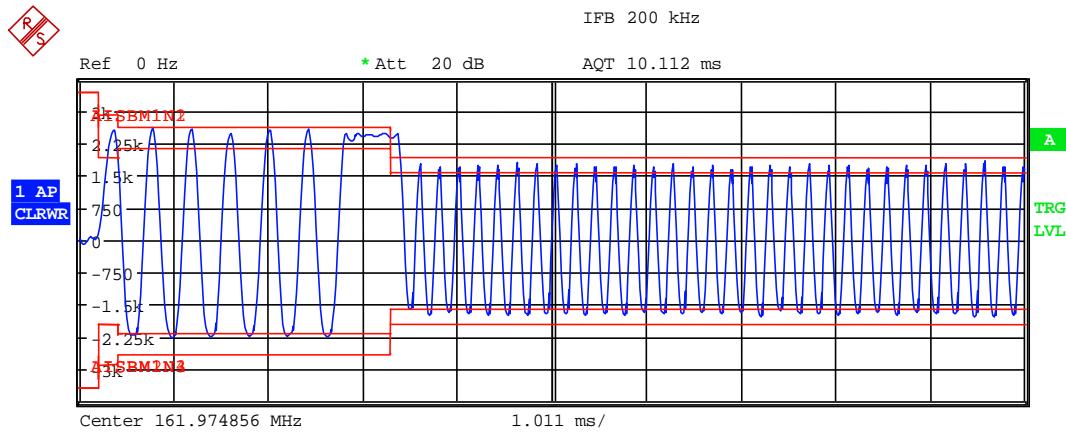
## 5.5 Transmitter test sequence and modulation accuracy

Subclause 7.6 [1]

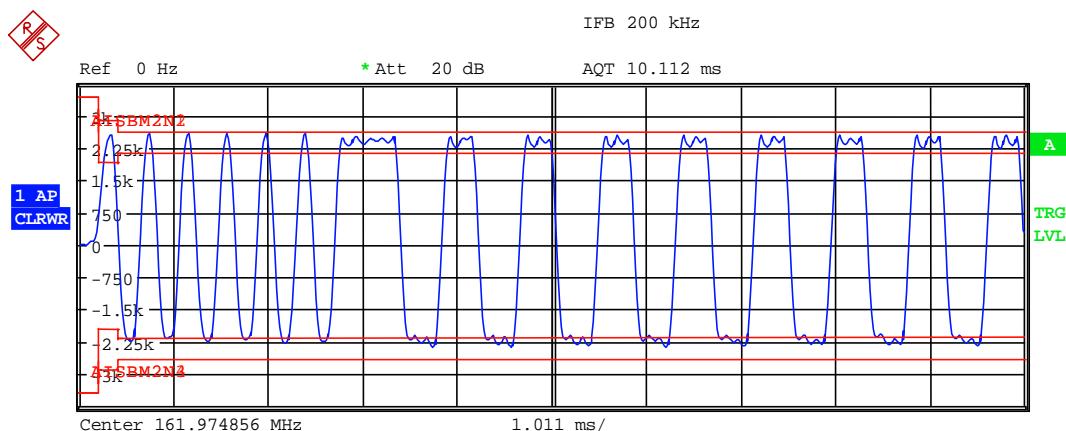
Ambient temperature	22 °C	Relative humidity	30 %
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Measured conducted at the temporary antenna port.

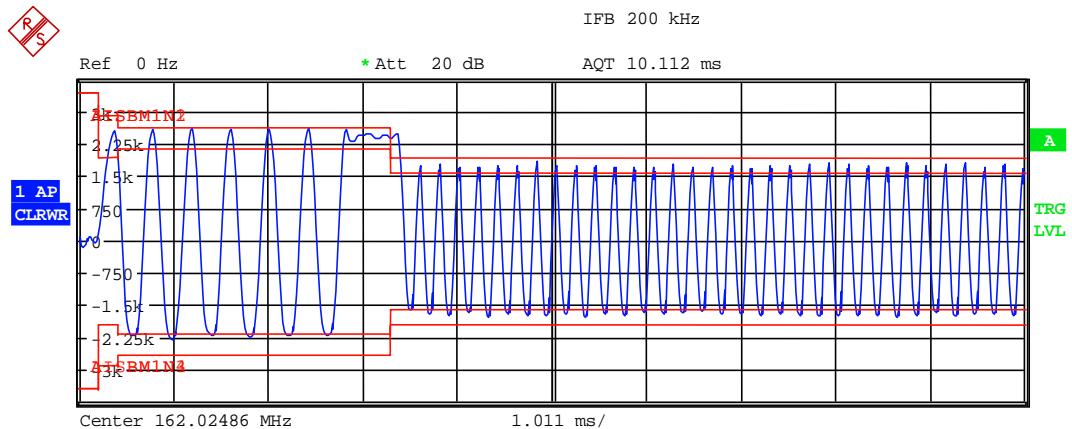
153662\_3.wmf: Modulation accuracy, transmit on 161.975 MHz with test signal 1; U = 3.0 V DC; T = 20 °C:



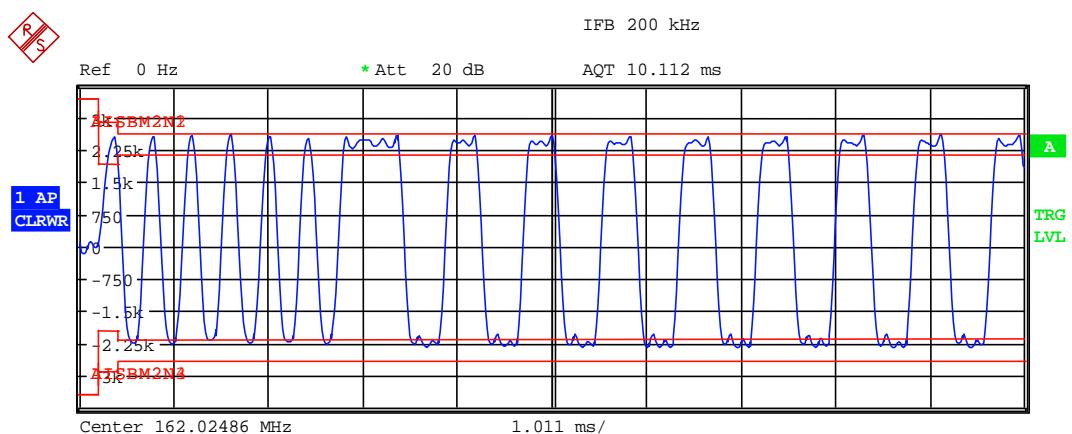
153662\_4.wmf: Modulation accuracy, transmit on 161.975 MHz with test signal 2; U = 3.0 V DC; T = 20 °C:



153662\_5.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 1; U = 3.0 V DC; T = 20 °C:



153662\_6.wmf: Modulation accuracy, transmit on 162.025 MHz with test signal 2; U = 3.0 V DC; T = 20 °C:



Additional Information:

This test was carried out under normal and extreme conditions. All measurement results were within the limits listed below. In order to reduce the scale of this test report, only the results, which were observed under normal test conditions (because of the tighter limits) are documented. The plots of the measurement results under extreme conditions are listed in annex B of this test report.

Limits: Subclause 7.6.3 [1]

In each case, verify that the training sequence begins with "0".

Peak frequency deviation at various points within the data frame shall comply with table 7. These limits apply to both the positive and negative modulation peaks. Bit 0 is defined as the first bit of the training sequence.

Table 7 – Peak frequency deviation versus time

Measurement period from centre of centre of each bit	Test signal 1		Test signal 2	
	Normal	Extreme	Normal	Extreme
Bit 0 to bit 1	<3400 Hz			
Bit 2 to bit 3	2400 Hz $\pm$ 480 Hz			
Bit 4 to bit 31	2400 Hz $\pm$ 240 Hz	2400 Hz $\pm$ 480 Hz	2400 Hz $\pm$ 240 Hz	2400 Hz $\pm$ 480 Hz
Bit 32 to bit 199	1740 Hz $\pm$ 175 Hz	1740 Hz $\pm$ 350 Hz	2400 Hz $\pm$ 240 Hz	2400 Hz $\pm$ 480 Hz

Test equipment used (refer clause 6)

9, 10, 13, 16, 17

## 5.6 Transmitter output power characteristics

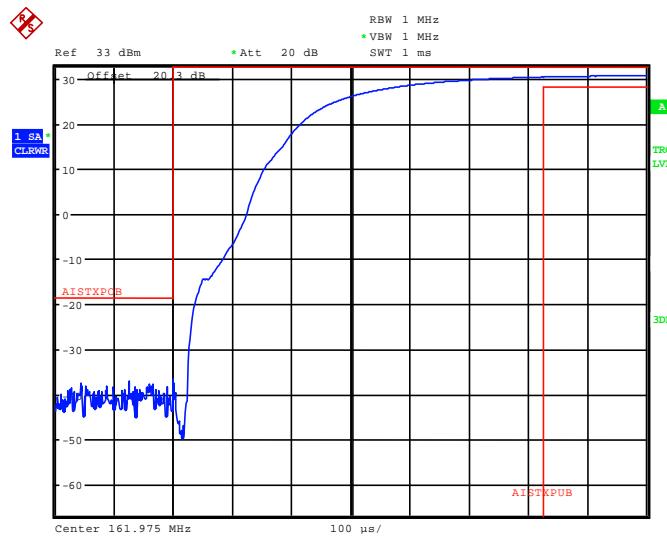
Subclause 7.7 [1]

Ambient temperature	22 °C	Relative humidity	30 %
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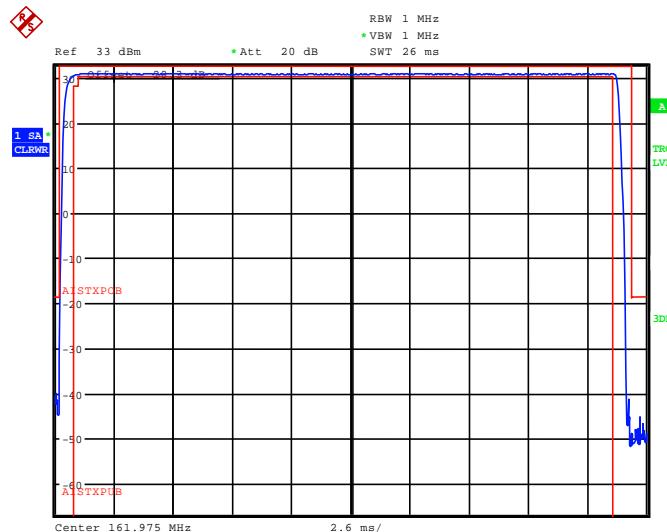
Operation mode: Transmit in AIS-mode (test signal number 1).

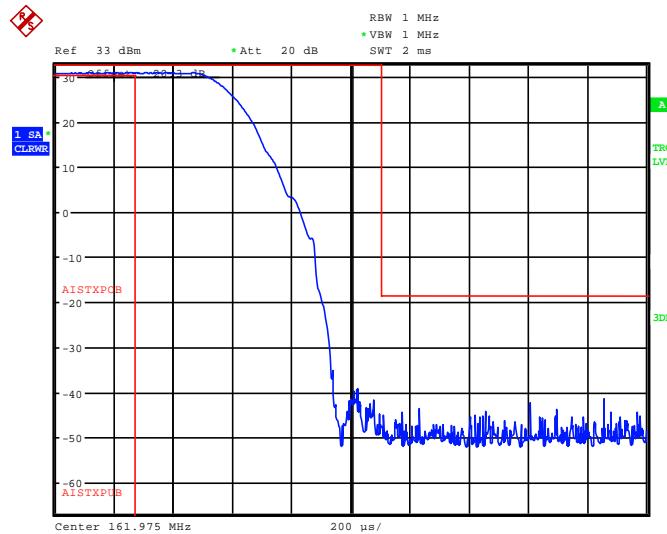
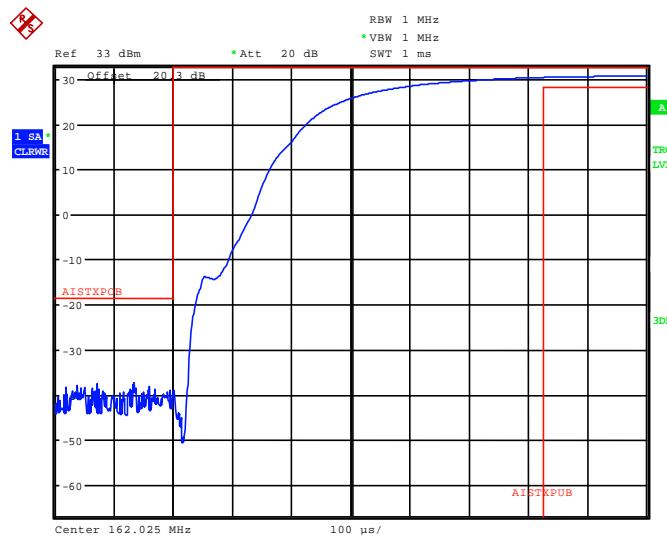
Method of measurement: Conducted at the temporary antenna port.

153662\_7.wmf: Transmitter versus time function, transmit on 161.975 MHz:

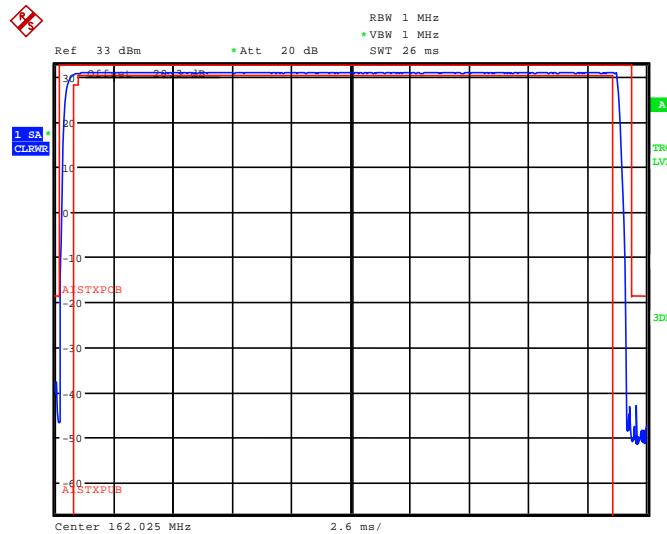


153662\_8.wmf: Transmitter versus time function, transmit on 161.975 MHz:

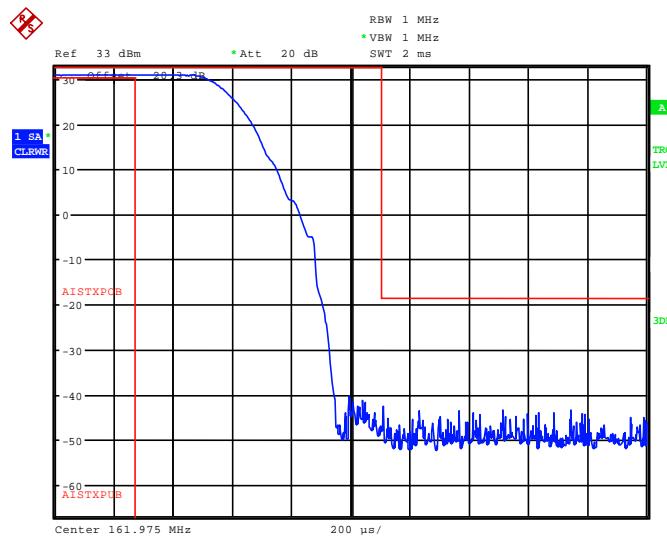


153662\_9.wmf: Transmitter versus time function, transmit on 161.975 MHz:

153662\_10.wmf: Transmitter versus time function, transmit on 162.025 MHz:


153662\_011.wmf: Transmitter versus time function, transmit on 162.025 MHz:



153662\_012.wmf: Transmitter versus time function, transmit on 162.025 MHz:



Limits: Subclause 7.7.3 [1]

The transmitter power shall remain within the mask shown in figure 6 and associated timings given in Table 8.

Table 8 – Definition of timings

Reference	Bits	Time [ms]	Definition
$T_0$	0	0	Start of transmission slot. Power shall not exceed -50 dB of $P_{SS}$ before $T_0$
$T_0 - T_A$	0 to 6	0 to 0.625	Power may exceed -50 dB of $P_{SS}$ <sup>a</sup>
$T_B$	$T_{B1}$	0.625	Power shall be within +1.5 dB or -3 dB of $P_{SS}$ <sup>a</sup>
	$T_{B2}$	0.833	Power shall be within +1.5 dB or -1 dB of $P_{SS}$ <sup>a</sup>
$T_E$ (includes 1 stuffing bit)	233	24.271	Power shall remain within +1.5 dB or -1 dB of $P_{SS}$ during the period $T_{B2}$ to $T_E$ <sup>a</sup>
$T_F$ (includes 1 stuffing bit)	241	25.104	Power shall be -50 dB of $P_{SS}$ and stay below this
$T_G$	256	26.667	Start of next transmission time period

<sup>a</sup> There shall be no modulation of the RF after the termination of transmission ( $T_E$ ) until the power has reached zero and next slot begins ( $T_G$ ).

Test equipment used (refer clause 6)

9, 13

## 5.7 Spurious emissions from the transmitter

Subclause 7.8 [1]

Ambient temperature	22 °C	Relative humidity	25 %
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Measured conducted at the temporary antenna port.

Operation mode: Transmit on 161.975 MHz.

Spurious emission level					
f [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
115.200	-45.0	100	-16.0	29.0	Passed
132.050	-49.2	100	-16.0	33.2	Passed
158.521	-41.4	100	-16.0	25.4	Passed
161.497	-32.4	100	-16.0	16.4	Passed
-	-	-	-	-	-
Measurement uncertainty		+0.66 dB / -0.72 dB			

Operation mode: Transmit on 162.025 MHz.

Spurious emissions level					
F [MHz]	Level [dBm]	Bandwidth [kHz]	Limit [dBm]	Margin [dB]	Result
115.200	-45.0	100	-16.0	29.0	Passed
131.950	-49.1	100	-16.0	33.1	Passed
158.549	-41.3	100	-16.0	25.3	Passed
161.475	-32.6	100	-16.0	16.6	Passed
-	-	-	-	-	-
Measurement uncertainty		+0.66 dB / -0.72 dB			

Limits: Subclause 7.8.3 [1]

No signal level within these bands shall exceed 25 µW or -16 dBm.

Test equipment used (refer clause 6)

9, 11 - 13

## 6 Test equipment and ancillaries used for tests

No.	Test equipment	Type	Manufacturer	Serial No.	PM-No
1	Fully anechoic chamber M20	-	Albatross Projects	B83107-E2439-T232	480303
2	Measuring receiver	ESI 40	Rohde & Schwarz	100064	480355
3	Bikon Antenna	HK 116	Rohde & Schwarz	836891/012	480122
4	Precision Dipole	HZ 12	Rohde & Schwarz	831781/02	480061
5	Signal generator	83650L	Agilent	3844A00554	480333
6	RF-cable No. 3	Sucoflex 106B	Suhner	0563/6B	480670
7	RF-cable No. 36	Sucoflex 106B	Suhner	0522/6B	480571
8	RF-cable No. 40	Sucoflex 106B	Suhner	0708/6B	481330
9	Spectrum Analyser	FSU	Rohde & Schwarz	200125	480956
10	Temperature chamber	MK 240	Binder	05-79022	480462
11	Tuneable notch filter	WTRCD5-150-165-0.05-0.61-40EEK	Wainwright Instruments	1	481810
12	High pass filter	WHJ9-167-200-2000-60EF	Wainwright Instruments	1	481811
13	Attenuator 20 dB / 10 W	WA8 / 18-20-34	Weinschel	-	481450
14	Power meter	NRVD	Rohde & Schwarz	833697/030	480589
15	Peak power sensor	NRV-Z31	Rohde & Schwarz	100027	481180
16	Power Supply	TOE8852	Toellner.	51712	480233
17	Multimeter	971A	Hewlett Packard	JP39009358	480721

## 7 Report history

Report Number	Date	Comment
F153662E1	16.02.2016	Document created
-	-	-
-	-	-

## 8 List of annexes

Annex A

Photographs

15 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\_i.JPG: SEAANGEL SA15 AIS FLARE, PCB, top view, battery removed  
153662\_j.JPG: SEAANGEL SA15 AIS FLARE, PCB, bottom view

Photographs of the test setups:

153662\_1.JPG: SEAANGEL SA15 AIS FLARE with 2J0936, test set-up fully anechoic chamber  
153662\_3.JPG: SEAANGEL SA15 AIS FLARE with 2J0936, test set-up fully anechoic chamber  
153662\_2.JPG: SEAANGEL SA15 AIS FLARE with IN2011, test set-up fully anechoic chamber  
153662\_4.JPG: SEAANGEL SA15 AIS FLARE with IN2011, test set-up fully anechoic chamber  
153662\_5.JPG: SEAANGEL SA15 AIS FLARE, test set-up temperature chamber

Annex B

Measurement results

12 pages