Report On

EMC Testing of the
Thrane and Thrane
Sailor 6390 Navtex Receiver

COMMERCIAL-IN-CONFIDENCE

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Thrane and Thrane
Sailor 6390 Navtex Receiver

Document 75923004 Report 03 Issue 2

November 2013

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DATED 08 November 2013

This report has been revised to Issue 2 to correct test equipment data.

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Product Service

CONTENTS

Product Service

SECTION 1

REPORT SUMMARY

EMC Testing of the
Thrane and Thrane
Sailor 6390 Navtex Receiver

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Thrane & Thrane, Sailor 6390 Navtex Receiver to the requirements of IEC 60945.

Objective	To perform Electromagnetic Compatibility (EMC) Qualification Approval Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Thrane and Thrane
Model Number(s)	Sailor 6390 Navtex Receiver
Serial Number(s)	75923004-TSR0001 (with IP address 192.168.0.111) 75923004-TSR0010 (with IP address 192.168.0.112)
Number of Samples Tested	Two
Test Specification/Issue/Date	IEC 60945: 2002 + Corrigendum 1: 2008
Declared Product Equipment Category	Protected
Order Number Date	P2620 31 May 2013
Incoming Release Date	Declaration of Build State 06 June 2013
Start of Test	01 July 2013
Finish of Test	23 August 2013
Name of Engineer(s)	C McKean A R Hubbard A Guy P Joynson J Tuckwell
Related Document(s)	CISPR 16-1-2: 2006 CISPR 16-1-4: 2007 IEC 61000-4-2: 2001 IEC 61000-4-3: 2006 IEC 61000-4-4: 2004 IEC 61000-4-6: 2006 IEC 61000-4-11: 2004

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results in accordance with IEC 60945, is shown below.

Configuration 1 - As supplied						
Section	Spec Clause	Test Description	Mode	Mod State	Result	Base Standard
	Table 5, 9.2	Conducted Emissions (AC Power Port)			N/A	CISPR 16-1-2
2.1	Table 5, 9.2	Conducted Emissions (DC Power Port)	Powered (receive)	0	Pass	CISPR 16-1-2
2.2	Table 5, 9.3	Enclosure Port Magnetic Emissions - Field Strength	Powered (receive)	0	Pass	CISPR 16-1-2
2.3	Table 5, 9.3	Radiated Emissions (Enclosure Port)	Powered (receive)	0	Pass	CISPR 16-1-4
	Table 6, 10.3	Immunity to Radio Frequency Common Mode (AC Power Port)			N/A	IEC 61000-4-6
2.4	Table 6, 10.3	Immunity to Radio Frequency Common Mode (DC Power Port)	Powered (receive)	0	Pass	IEC 61000-4-6
2.5	Table 6, 10.3	Immunity to Radio Frequency Common Mode (Signal, Control and Telecommunications Port)	Powered (receive)	0	See Note 1 in section 2.5.7	IEC 61000-4-6
2.6	Table 6, 10.4	Immunity to Radio Frequency Electromagnetic Field (Enclosure Port)	Powered (receive)	0	Pass	IEC 61000-4-3
	Table 6, 10.5	Immunity to Fast Transient Bursts Common Mode (AC Power Port)			N/A	IEC 61000-4-4
2.7	Table 6, 10.5	Immunity to Fast Transient Bursts Common Mode (Signal, Control and Telecommunications Port)	Powered (receive)	0	Pass	IEC 61000-4-4
	Table 6, 10.6	Immunity to Surges (AC Power Port)			N/A	IEC 61000-4-5
	Table 6, 10.7	Immunity to Power Supply Short Term Variation (AC Power Ports)			N/A	IEC 61000-4-11
	Table 6, 10.8	Immunity to Interruptions (AC Power Port)			N/A	IEC 61000-4-11
2.8	Table 6, 10.8	Immunity to Interruptions (DC Power Port)	Powered (receive)	0	Pass	IEC 61000-4-11
2.9	Table 6, 10.9	Immunity to Electrostatic Discharge (Enclosure Port)	Powered (receive)	0	Pass	IEC 61000-4-2
2.10	11.2	Compass Safe Distance (Enclosure Port)	Powered (receive)	0	Pass	IEC 60945

N/A – Not Applicable

Product Service

1.3 DECLARATION OF BUILD STATUS

Manufacturer	Thrane and Thrane A/S
Country of origin	Denmark
Technical Description	Navtex Receiver
Model No	TT-6390A
Part No	406390A
Serial No	S/N: 192.168.0.111 S/N: 192.168.0.112
Drawing Number	97-137247-P01 (P: preliminary)
Build Status	Prototype build
Software Issue	0.95
Hardware Issue	Rev. B
FCC ID	ROJ6390
IC ID	N/A
Highest Operating Frequency	300MHz (DSP clock)

Signature	Jesper Holst *Held on File at TÜV SÜD PS*
Date	06 June 2013
D of B S Serial No	1

Note: This document has been prepared to enable manufacturers with no mechanism for producing their own Declaration of Build Status, to declare the build state of the equipment submitted for test.

1.4 DECLARATION OF SPURIOUS FREQUENCIES

Manufacturer	Thrane and Thrane A/S
Country of origin	Denmark
Technical Description	Navtex Receiver
Model No	TT-6390A
Part No	406390A
Serial No	XXX
Spurious frequencies	The following frequencies are stated to be low order receiver spurious of the Navtex Receiver, which therefore does not fall within the scope of EN60945 as per clause 10.2:
	1/3 x 490 kHz = 163.333 kHz (500 kHz receiver)
	1/2 x 490 kHz = 245.000 kHz (500 kHz receiver)
	1/3 x 518 kHz = 172.666 kHz (500 kHz receiver)
	1/2 x 518 kHz = 259.000 kHz (500 kHz receiver)
	F_{IF} = 450 kHz (4 MHz receiver)
	F_{IM} = 3309.5 kHz (4 MHz receiver)

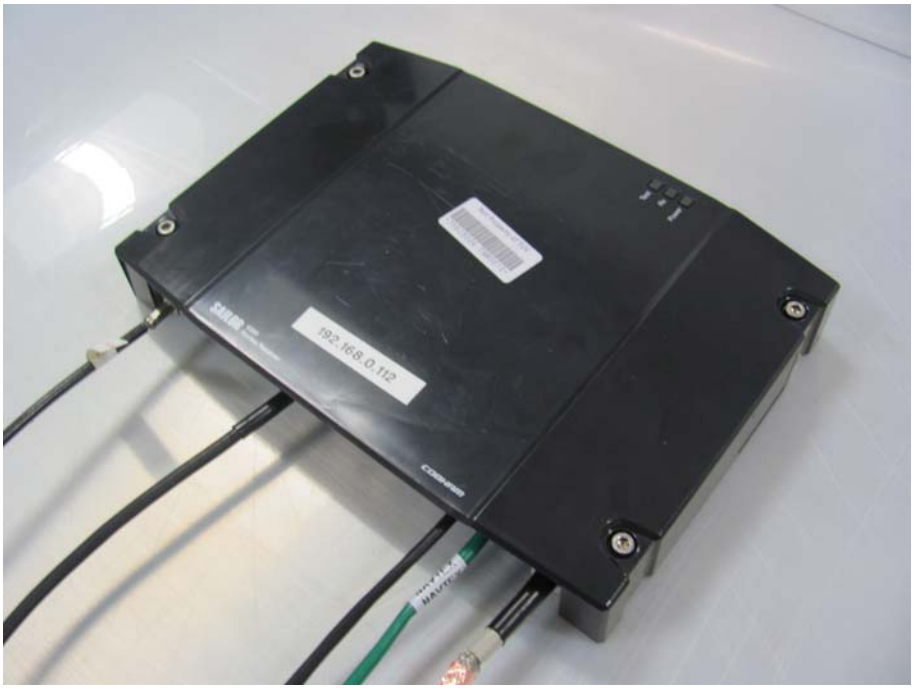
Signature	Erik Andersen
Date	2013-08-07

Product Service

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

The Equipment Under Test (EUT) was a Thrane and Thrane, Sailor 6390 Navtex Receiver as shown in the photograph below. A full technical description can be found in the manufacturer's documentation.

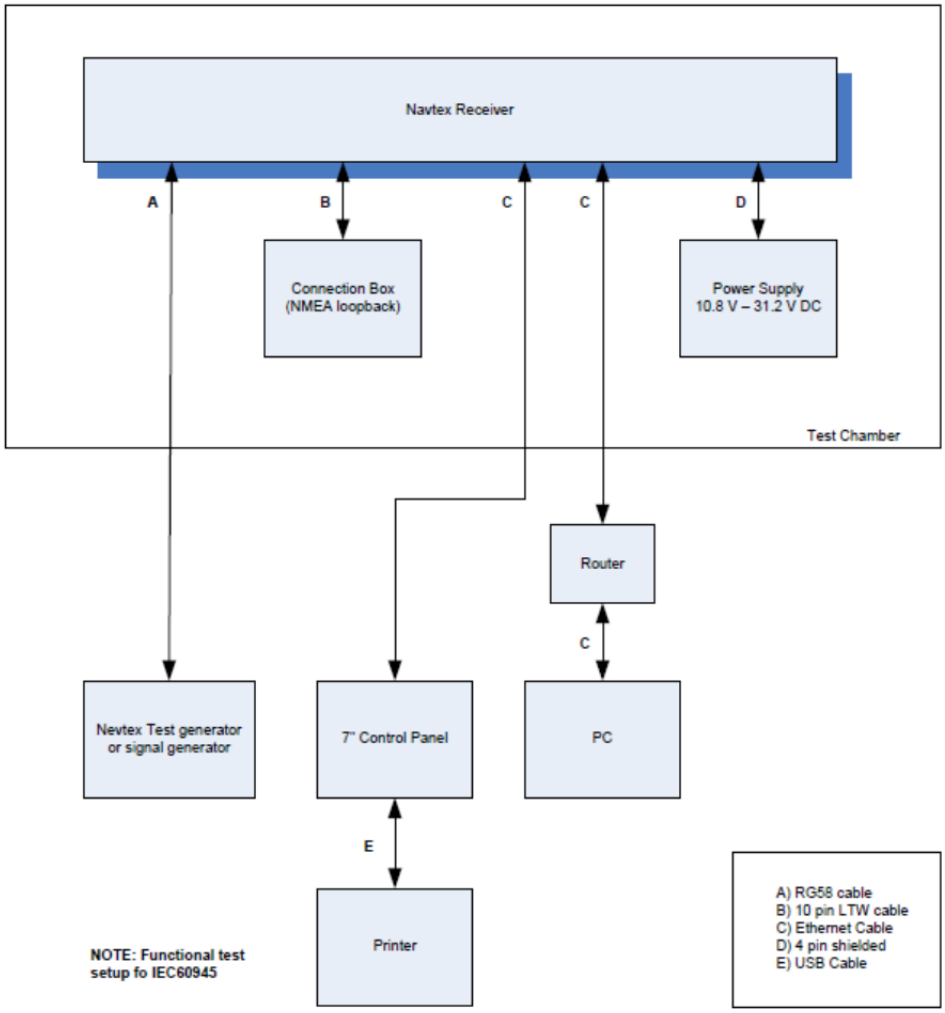


Sailor 6390 Navtex Receiver

Product Service

1.5.2 Test Configuration

Configuration 1



The EUT was configured with a BER loopback test and was performed simulataneously on 518kHz and 4209.5kHz, excercising both physical receivers within the EUT. A BER rate of 1000 bits was updated every 10 seconds, the BER figure would include any errors found within the 10 second window. A loopback check of the NMEA connection box was also activated during testing.

The BER and NMEA loopback were supplied using customer supplied software.

1.5.3 EUT Cable / Port Identification

Port	Max Cable Length specified	Usage	Type	Screened
DC Power	>1m	Supply Lead	4 core	Yes
Receive	>3m	Antenna	Co-axial	Yes
NMEA	>3m	Data	10 core	Yes
Signal	>3m	Network	Cat 5	Yes
Signal	>3m	Network	Cat 5	Yes

1.5.4 Modes of Operation

Modes of operation of each EUT during testing were as follows:

Mode 1 - Powered (receiver 1 - 518kHz)
Mode 2 - Powered (receiver 2 - 4.209MHz)
Mode 3 - Powered (receiver 1 & 2)

Information on the specific test modes utilised are detailed in the test procedure for each individual test.

1.5.5 Monitoring of Performance

Putty software was used to monitor the EUT via a laptop.

1.5.6 Performance Criteria

There shall be no increase of the character error rate (CER) above the value of 4 % shall be used as criterion for the identification of narrow band responses.

1.6 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure or test laboratory as appropriate.

The EUT was powered from a 12V DC supply.

1.7 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.8 MODIFICATION RECORD

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Product Service

SECTION 2

TEST DETAILS

EMC Testing of the
Thrane and Thrane
Sailor 6390 Navtex Receiver

2.1 CONDUCTED EMISSIONS (DC POWER PORT)

2.1.1 Specification Reference

IEC 60945: Table 5

2.1.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.1.3 Date of Test and Modification State

05 July 2013 - Modification State 0

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1-2.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.1.6 Environmental Conditions

	05 July 2013
Ambient Temperature	20°C
Relative Humidity	42%
Atmospheric Pressure	1025mbar

Product Service

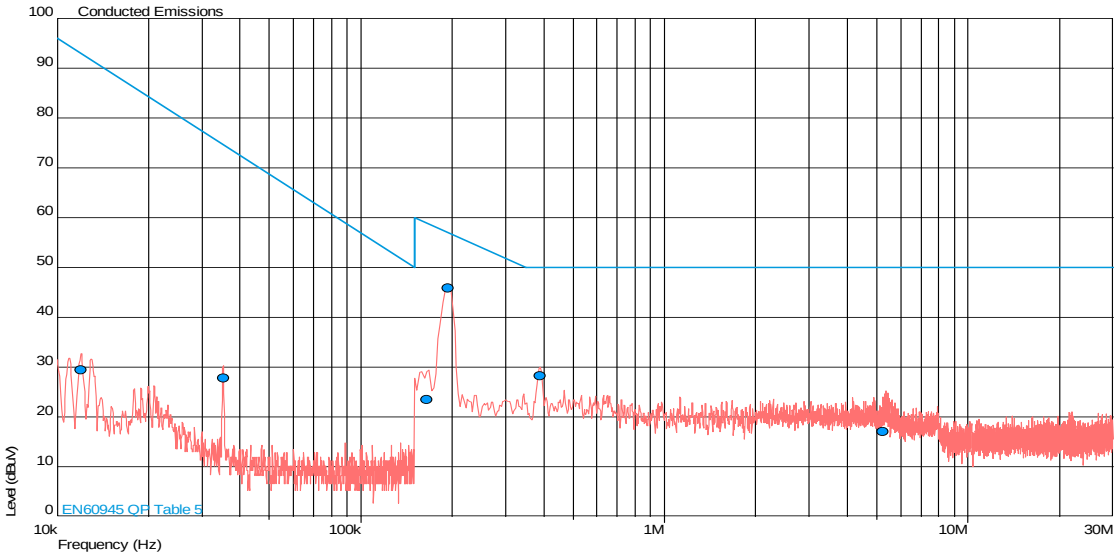
2.1.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Conducted Emissions (DC Power Port).

The test results are shown below.

Configuration 1 - Mode 1

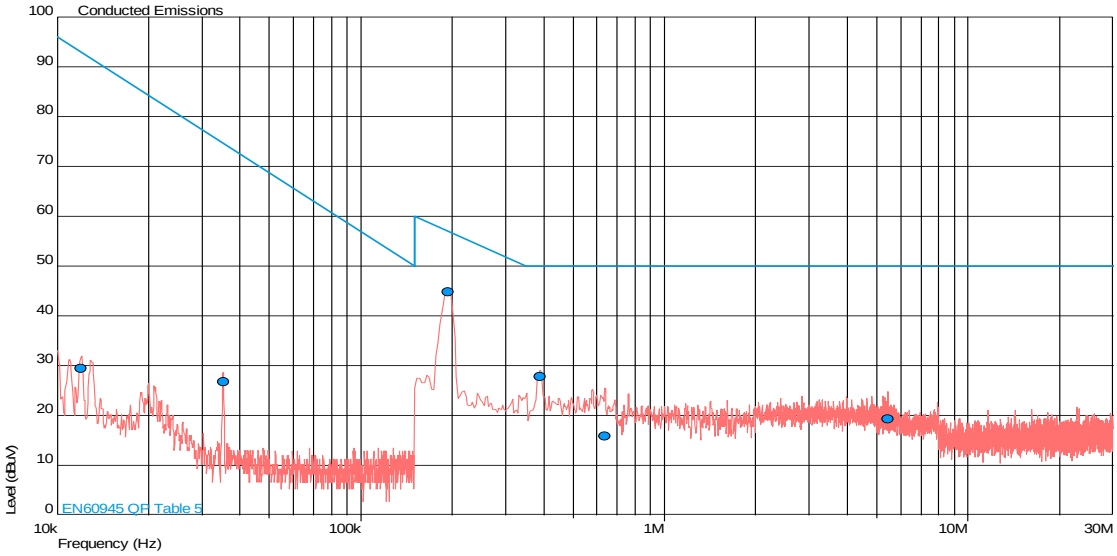
Positive Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.012	29.5	92.9	-63.4
0.035	27.9	74.6	-46.7
0.165	23.5	58.9	-35.4
0.194	45.8	57.0	-11.1
0.388	28.3	50.0	-21.7
5.255	17.0	50.0	-33.0

Product Service

Negative Line Results



Frequency (MHz)	QP Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)
0.012	29.5	92.9	-63.5
0.035	26.8	74.6	-47.8
0.194	44.8	56.9	-12.1
0.388	27.8	50.0	-22.2
0.635	15.9	50.0	-34.1
5.450	19.4	50.0	-30.6

2.2 ENCLOSURE PORT MAGNETIC EMISSIONS - FIELD STRENGTH

2.2.1 Specification Reference

IEC 60945: Table 5

2.2.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.2.3 Date of Test and Modification State

01 July 2013 - Modification State 0

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1-2.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
Configuration 1 - Mode 2

2.2.6 Environmental Conditions

	01 July 2013
Ambient Temperature	22.3°C
Relative Humidity	44%
Atmospheric Pressure	1015mbar

Product Service

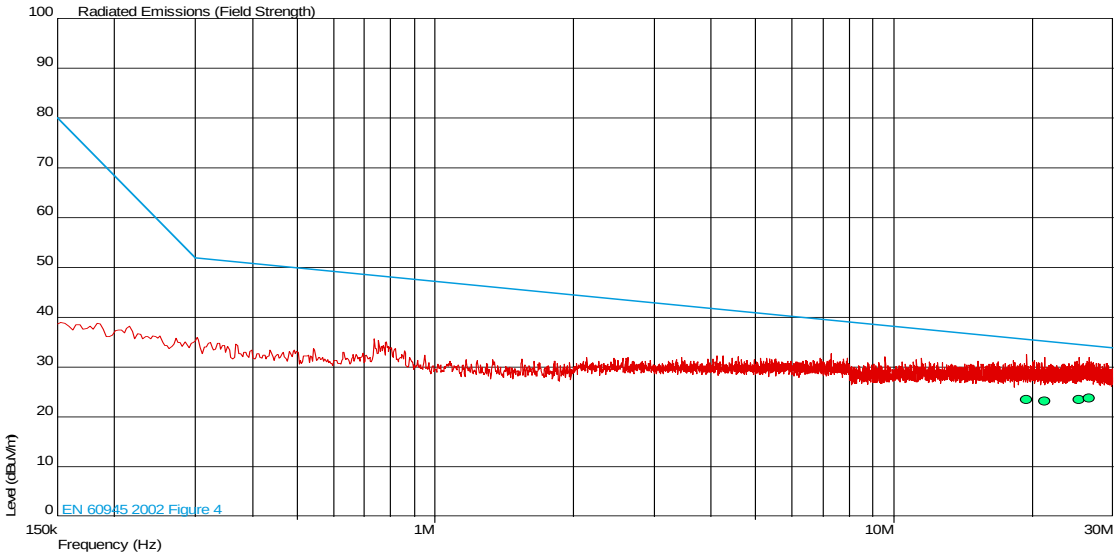
2.2.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Enclosure Port Magnetic Emissions - Field Strength.

The test results are shown below.

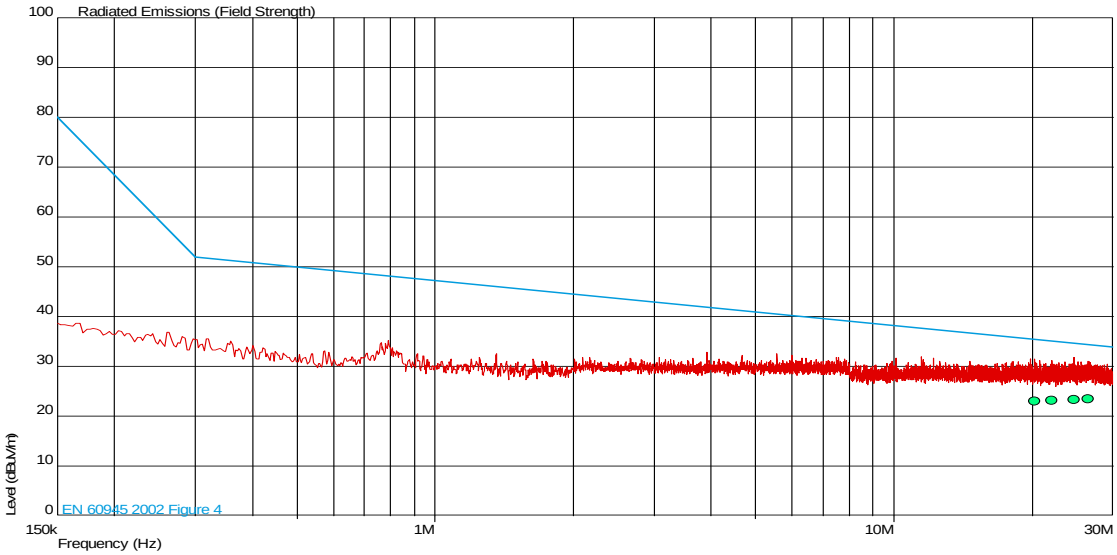
Configuration 1 - Mode 1

Mode 1



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
19.452	23.5	35.7	-12.2	64	1.50	Face On
21.265	23.2	35.3	-12.1	222	1.50	Face On
25.341	23.5	34.7	-11.2	0	1.50	Edge On
26.627	23.8	34.5	-10.7	233	1.50	Face On

Mode 2



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
20.278	23.1	35.5	-12.5	100	1.50	Face On
22.111	23.2	35.2	-12.0	147	1.50	Face On
24.689	23.4	34.8	-11.4	188	1.50	Edge On
26.457	23.6	34.5	-10.9	52	1.50	Edge On

2.3 RADIATED EMISSIONS (ENCLOSURE PORT)

2.3.1 Specification Reference

IEC 60945: Table 5

2.3.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.3.3 Date of Test and Modification State

01 July 2013 - Modification State 0

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of CISPR 16-1-4.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
Configuration 1 - Mode 2

2.3.6 Environmental Conditions

	01 July 2013
Ambient Temperature	22.3°C
Relative Humidity	44%
Atmospheric Pressure	1015mbar

Product Service

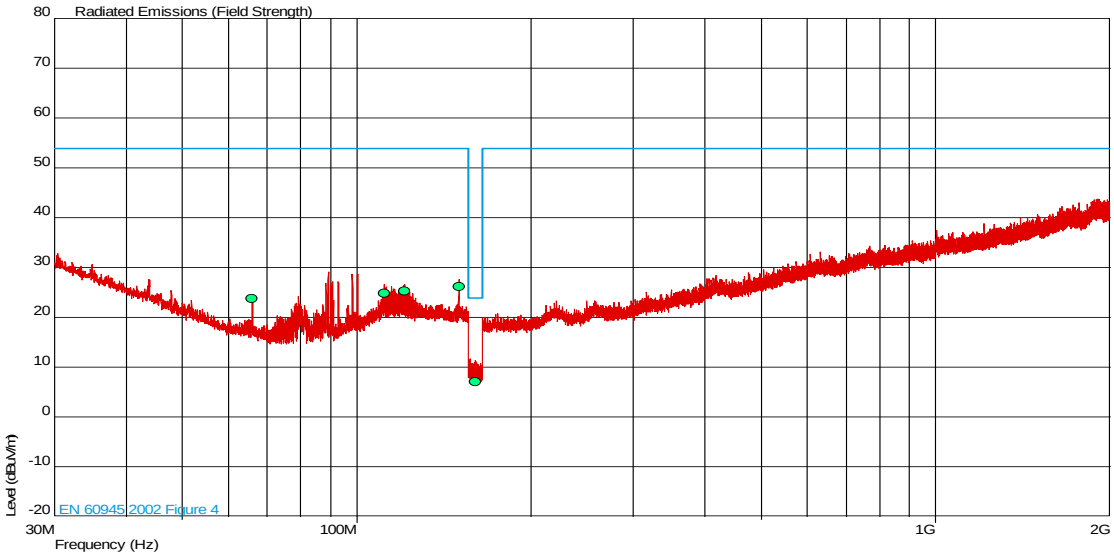
2.3.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Radiated Emissions (Enclosure Port).

The test results are shown below.

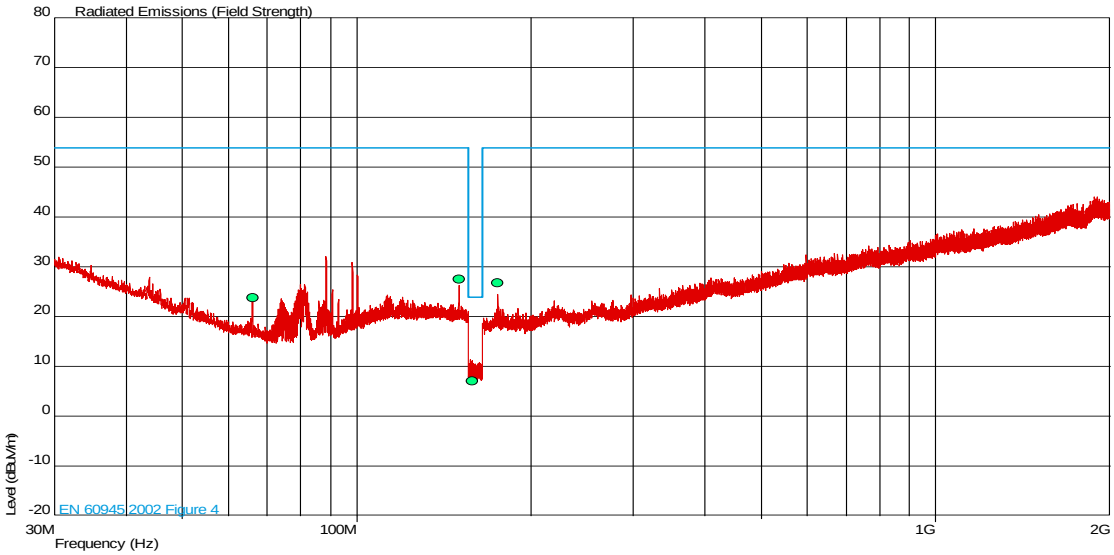
Configuration 1 - Mode 1

Mode 1



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
65.998	23.9	54.0	-30.1	354	1.00	Vertical
111.650	24.9	54.0	-29.1	329	1.00	Vertical
120.798	25.4	54.0	-28.6	261	1.00	Vertical
149.998	26.1	54.0	-27.9	0	1.00	Vertical
160.066	7.1	24.0	-16.9	152	1.00	Horizontal

Mode 2



Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
66.004	23.8	54.0	-30.2	360	1.15	Vertical
150.001	27.5	54.0	-26.5	24	1.00	Vertical
158.092	7.1	24.0	-16.9	159	2.07	Horizontal
175.008	26.8	54.0	-27.2	19	1.75	Horizontal

2.4 IMMUNITY TO RADIO FREQUENCY COMMON MODE (DC POWER PORT)

2.4.1 Specification Reference

IEC 60945: Table 6

2.4.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0001 (with IP address 192.168.0.111)

2.4.3 Date of Test and Modification State

12 July 2013 - Modification State

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-6.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.4.6 Environmental Conditions

	12 July 2013
Ambient Temperature	20.9°C
Relative Humidity	37%
Atmospheric Pressure	1019mbar

Product Service

2.4.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Radio Frequency Common Mode (DC Power Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

Port Under Test	Test Level (Vrms)	Freq. Range	Modulation/Freq Depth	Step Size	Dwell Time	Coupling Method	Interference Return Path	Result
DC Mains	3 + MU	150kHz to 80MHz	AM, 400Hz, 80%	1%	3 s	M2 CDN	M3 on support	Pass
DC Mains	10 + MU	Spot frequencies	AM, 400Hz, 80%	N/A	30 s	M2 CDN	M3 on support	Pass
Spot frequencies		2M, 3M, 4M, 6.2M, 8.2M, 12.6M, 16.5M, 18.8M, 22M & 25MHz						

2.5 IMMUNITY TO RADIO FREQUENCY COMMON MODE (SIGNAL, CONTROL AND TELECOMMUNICATIONS PORT)

2.5.1 Specification Reference

IEC 60945: Table 6

2.5.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0001 (with IP address 192.168.0.111)

2.5.3 Date of Test and Modification State

13 July 2013 - Modification State

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-6.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.5.6 Environmental Conditions

	13 July 2013
Ambient Temperature	20.5°C
Relative Humidity	37%
Atmospheric Pressure	1019mbar

Product Service

2.5.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Radio Frequency Common Mode (Signal, Control and Telecommunications Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

Port Under Test	Test Level (Vrms)	Freq. Range	Modulation/Freq Depth	Step Size	Dwell Time	Coupling Method	Interference Return Path	Result
Receive	3 + MU	150kHz to 80MHz	AM, 400Hz, 80%	1%	3 s	M2 CDN	M2 on power	see note 1 below
Receive	10 + MU	Spot frequencies	AM, 400Hz, 80%	N/A	30 s	M2 CDN	M2 on power	Pass
NMEA	3 + MU	150kHz to 80MHz	AM, 400Hz, 80%	1%	3 s	M2 CDN	M2 on power	Pass
NMEA	10 + MU	Spot frequencies	AM, 400Hz, 80%	N/A	30 s	M2 CDN	M2 on power	Pass
Signal	3 + MU	150kHz to 80MHz	AM, 400Hz, 80%	1%	3 s	M2 CDN	M2 on power	Pass
Signal	10 + MU	Spot frequencies	AM, 400Hz, 80%	N/A	30 s	M2 CDN	M2 on power	Pass
Spot frequencies		2M, 3M, 4M, 6.2M, 8.2M, 12.6M, 16.5M, 18.8M, 22M & 25MHz						

Note 1:

Following an initial suspected failure in the EUT's receive mode and within the frequency range of 150kHz to 80MHz, an investigation was carried out. It was observed that harmonics of the intentional test signal being injected onto the EUT were within the EUT's receiver band.

The power level of the harmonics from the injected interference signal were measured to be greater than the wanted signal level from the EUT's ancillary equipment at the EUT's antenna port.

It has been concluded that the harmonics of the test signal were causing the susceptibility due to the power level of the test signals harmonics being greater than the EUT receiver sensitivity within the receivers test exclusion band.

The nature of this harmonic interference can be considered a receiver spurious response according to clause 10.2 of IEC 60945 and therefore excluded from the immunity test.

2.6 IMMUNITY TO RADIO FREQUENCY ELECTROMAGNETIC FIELD (ENCLOSURE PORT)

2.6.1 Specification Reference

IEC 60945: Table 6

2.6.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.6.3 Date of Test and Modification State

02 July 2013 - Modification State 0

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-3.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.6.6 Environmental Conditions

	02 July 2013
Ambient Temperature	24°C
Relative Humidity	46%
Atmospheric Pressure	1018mbar

Product Service

2.6.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Radio Frequency Electromagnetic Field (Enclosure Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

Amplitude Modulation	Frequency	400Hz	
	Depth	80%	
Stepped Frequency Increments		1% with respect to last momentary frequency	
Dwell Time		3 Seconds	
Frequency Range (MHz)		80 – 1000	
Field Strength (V/m)		10 + MU	
Dwell Time		9 Seconds	
Frequency Range (MHz)		1400 – 2000	
Field Strength (V/m)		10 + MU	
		Result	
Orientation of EUT		Vertical Polarisation	Horizontal Polarisation
Front (inc cables)		Pass	Pass
Right Side		Pass	Pass
Rear		Pass	Pass
Left Side		Pass	Pass

2.7 IMMUNITY TO FAST TRANSIENT BURSTS COMMON MODE (SIGNAL, CONTROL AND TELECOMMUNICATIONS PORT)

2.7.1 Specification Reference

IEC 60945: Table 6

2.7.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.7.3 Date of Test and Modification State

10 July 2013 - Modification State 0

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-4.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.7.6 Environmental Conditions

	10 July 2013
Ambient Temperature	21°C
Relative Humidity	44%
Atmospheric Pressure	1019mbar

Product Service

2.7.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Fast Transient Bursts Common Mode (Signal, Control and Telecommunications Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

Cables Under Test	Test Level (±kV)	Repetition Rate (kHz)	Test Duration (minutes)	Coupling Method	Result
Receive	0.5 & 1.0	5	3 each polarity	Capacitive Clamp	Pass
NMEA	0.5 & 1.0	5	3 each polarity	Capacitive Clamp	Pass
Signal	0.5 & 1.0	5	3 each polarity	Capacitive Clamp	Pass

2.8 IMMUNITY TO INTERRUPTIONS (DC POWER PORT)

2.8.1 Specification Reference

IEC 60945: Table 6

2.8.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.8.3 Date of Test and Modification State

10 July 2013 - Modification State 0

2.8.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-11.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.8.6 Environmental Conditions

	10 July 2013
Ambient Temperature	21°C
Relative Humidity	44%
Atmospheric Pressure	1018mbar

2.8.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Interruptions (DC Power Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

Operating Voltage - Vnom VDC	Duration seconds	Result
12	60	Pass

2.9 IMMUNITY TO ELECTROSTATIC DISCHARGE (ENCLOSURE PORT)

2.9.1 Specification Reference

IEC 60945: Table 6

2.9.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0010 (with IP address 192.168.0.112)

2.9.3 Date of Test and Modification State

10 July 2013 - Modification State 0

2.9.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 61000-4-2.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.9.6 Environmental Conditions

	10 July 2013
Ambient Temperature	21°C
Relative Humidity	44%
Atmospheric Pressure	1018mbar

Product Service

2.9.7 Test Results

For the period of test the EUT continued to operate as intended and therefore met the requirements of IEC 60945 for Immunity to Electrostatic Discharge (Enclosure Port).

The applied test levels are shown below.

Configuration 1 - Mode 1

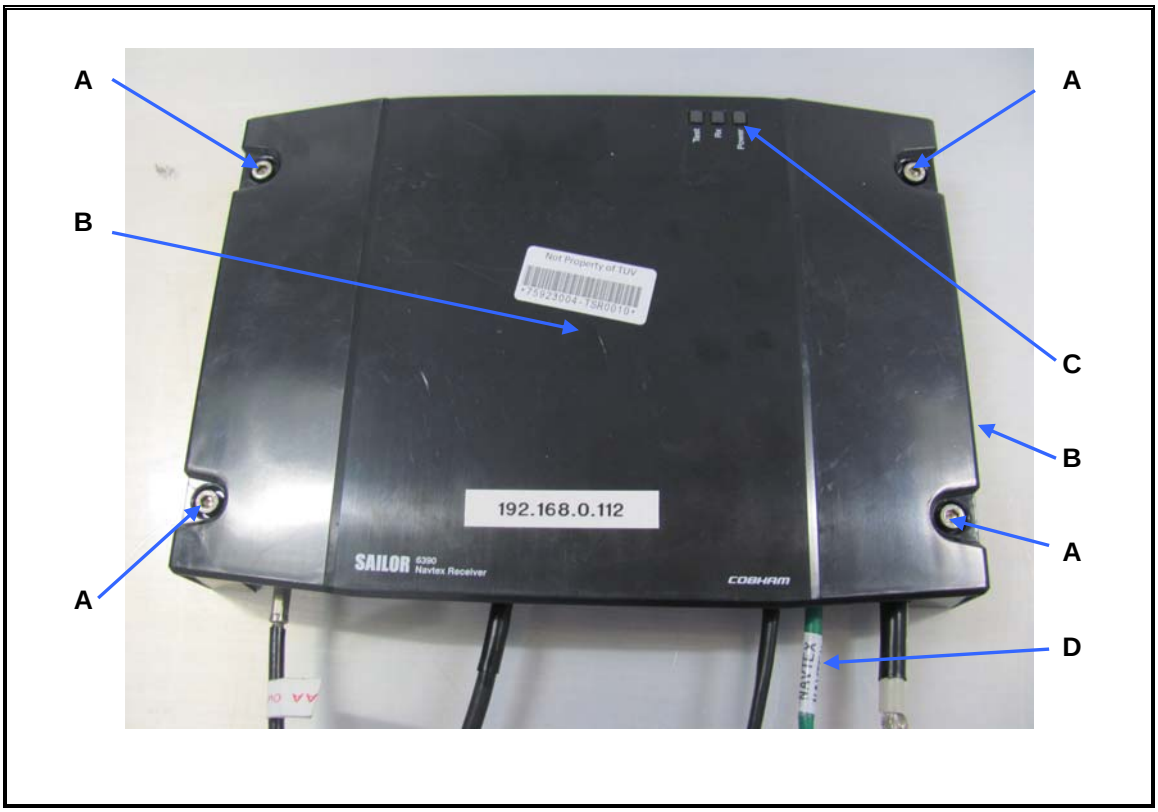
		Contact Discharges (kV)								Air Discharge (kV)							
		2		4		6		8		2		4		8		15	
Test Points		+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-
Horizontal Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vertical Coupling Plane		✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
A	Screws x 4	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B	Case	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
C	LEDs x 3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
D	Cables x 5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	✓*	✓*	✓*	✓*	✓*	✓*	N/A	N/A
E	Main Body	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F	RX connection	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
G	Connection box Screws x 4	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
H	Connection box Case	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Key to Results

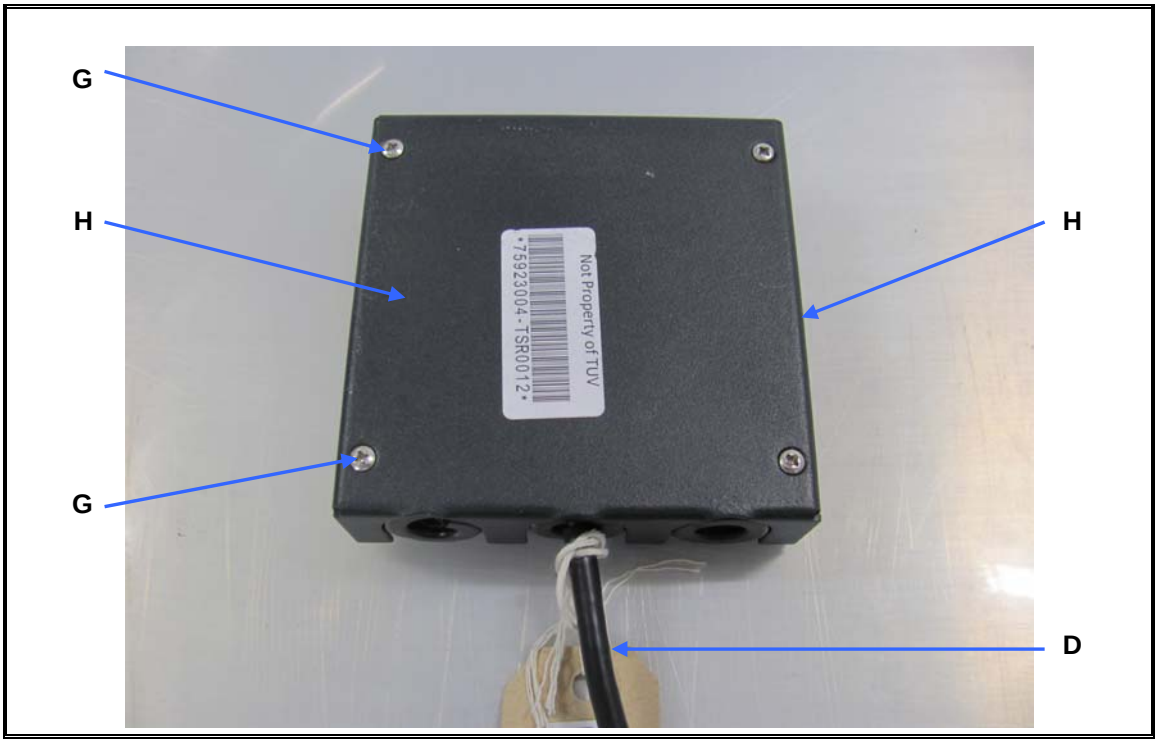
✓ The EUT's performance was not impaired at this test point when the ESD pulse was applied.
✓* No discharge occurred at this test point when the ESD pulse was applied.
N/A Test not applicable as defined in the specification.

Product Service

ESD TEST POINTS



Product Service



2.10 COMPASS SAFE DISTANCE (ENCLOSURE PORT)

2.10.1 Specification Reference

IEC 60945: Clause 11.2

2.10.2 Equipment Under Test

Sailor 6390 Navtex Receiver, TUV Ref: 75923004-TSR0001 (with IP address 192.168.0.111)

2.10.3 Date of Test and Modification State

01 August 2013 - Modification State

2.10.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.10.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of IEC 60945.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1

2.10.6 Environmental Conditions

	01 August 2013
Ambient Temperature	26.7°C
Relative Humidity	54.8%
Atmospheric Pressure	1007mbar

Product Service

2.10.7 Test Results

For the period of test the EUT met the requirements of IEC 60945 for Compass Safe Distance (Enclosure Port).

The test results are shown below.

Configuration 1 - Mode 1

Standard Compass safe distance (mm)	200
Emergency Compass safe distance (mm)	200

Horizontal maximum flux density, Magnetic North (H)	H	15.8
Standard compass deviation limit (degrees)	5.4/H = A	A = 0.3
Emergency compass deviation limit (degrees)	18/H = B	B = 1.1

Orientation of the EUT	Un-powered State		Normalised		Powered Up	
	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection	Distance From Compass Centre (mm) at A° deflection	Distance From Compass Centre (mm) at B° deflection
Front	170	170	170	170	170	170
Top	170	170	180	170	170	170
Left Hand Side	170	170	170	170	170	170
Right Hand Side	170	170	170	170	170	170
Underside	170	170	170	170	170	170
Rear	170	170	170	170	170	170

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 EMC - Conducted Emissions					
Transient Limiter	Hewlett Packard	11947A	15	12	11-Dec-2013
LISN	Rohde & Schwarz	ESH2-Z5	17	12	31-Jul-2013
Screened Room (1)	Rainford	Rainford	1541	-	TU
Test Receiver	Rohde & Schwarz	ESIB26	2085	12	24-Jan-2014
Section 2.2 EMC - Magnetic Emissions					
Antenna (Active Loop, 9kHz-30MHz)	Rohde & Schwarz	HFH2-Z2	333	24	30-Oct-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
Section 2.3 EMC - Radiated Emissions					
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Jan-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Section 2.4 & 2.5 EMC - Conducted Immunity					
Absorbing Clamp	Rohde & Schwarz	MDS21	1	-	TU
Coupling Network	MEB Messelektronik	M2-801-CDN (150kHz to 80MHz)	204	12	15-Oct-2013
Coupling/Decoupling Network	MEB Messelektronik	M3-801-6	208	12	21-Nov-2013
Termination	MEB Messelektronik	TRA150	209	-	TU
CDN Jig	MEB Messelektronik	M2-801	213	12	21-Nov-2013
8dB Attenuator (2 x 4dB)	Schaffner	INA 2070-1	221	12	25-Jul-2013
RF Generator + Attenuator	Schaffner	NSG2070-400	222	12	4-Jan-2014
Coupling Clamp	MEB Messelektronik	KEMZ-801	228	-	TU
Calibration Fixture (x2)	MEB Messelektronik	KEMZ-801	229	-	TU
Load (50ohm, 30W)	JFW	50T-054	348	12	1-Oct-2013
Load (50ohm, 30W)	Weinschel	50T-054	350	12	20-Jun-2014
Attenuator (10dB)	Weinschel	45-10-43	509	12	9-Oct-2013
Attenuator 6dB	Advance	10023-6/MF	1539	12	22-Oct-2013

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.6 EMC - Radiated Immunity					
Load (50ohm, 30W)	Weinschel	50T-054	275	-	TU
Antenna (Bilog)	Schaffner	CBL6143	316	-	TU
Power Meter	Rohde & Schwarz	NRVD	747	-	TU
Screened Room (1)	Rainford	Rainford	1541	-	TU
Laser Powered Electric Field Sensor	Dare Development	RadiSense VI - CTR1001A	2149	12	2-Aug-2013
Directional Coupler	Amp Research	DC6180	2763	-	TU
Amplifier (250W, 80MHz - 1GHz)	Amp Research	250W1000A	3029	-	TU
Signal Generator, 9kHz to 6GHz	Rohde & Schwarz	SMB 100A	3500	12	10-Jun-2014
Microwave Amplifier 1GHz - 2.5GHz; 500W; CW	Thorn	PTC6440	3736	-	TU
Power Sensor; 100kHz - 6GHz/500pW - 20mW	Rohde & Schwarz	NRV-Z4	3815	-	TU
Section 2.7 EMC - Fast Transient Bursts					
Immunity Test Set	Schaffner	BEST EMC V2.7	295	12	11-Oct-2013
Capacitive Coupling Clamp	Omiran	EFTC 105	298	-	TU
Section 2.8 EMC - Voltage Dips, Interruptions and Variations					
Immunity Test Set	Schaffner	BEST EMC V2.7	295	12	11-Oct-2013
Section 2.9 EMC - Electrostatic Discharges					
ESD Simulator	Schaffner	NSG 435+SL 171-504	552	12	22-Aug-2013
Digital Multimeter	Iso-tech	IDM-101	2895	12	17-Apr-2014
Section 2.10 EMC - Compass Safe Distance					
Magnetometer	Bartington	MAG01	671	36	14-Nov-2014
Compass Verification Unit	TUV SUD Product Service	CVU	3579	-	TU
Marine Binacle Compass with Repeater Display	Cassens & Plath	Compass: Type 11	3834	-	TU

TU – Traceability Unscheduled

Product Service

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.2dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Conducted Emissions, ISN	150kHz to 30MHz Amplitude	2.1dB
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
Discontinuous Interference	150kHz to 30MHz Amplitude	3.0dB*
Interference Power	30MHz to 300MHz Amplitude	3.0dB*
Radiated E-Field Susceptibility	10MHz to 6GHz Test Amplitude	2.0dB†
Conducted Susceptibility RF	50kHz to 1000MHz Amplitude EM Clamp Method of Test CDN Method of Test BCI Clamp Method of Test Direct Injection Method of Test	 3.1dB• 1.2dB• 1.1dB• 1.2dB•
Conducted Susceptibility LF	DC to 150kHz	1.0%†
Power Frequency Magnetic Field	50Hz/60Hz Amplitude	0.45%
Magnetic Emissions	9kHz to 30MHz Amplitude	3.4dB*
Magnetic Field/Flux iaw EN 50366	10Hz to 400kHz	2.64%
Harmonics and Flicker	The test was applied using proprietary equipment that meets the requirements of EN 61000-3-2 and EN 61000-3-3	—
Mains Voltage Variations and Interrupts	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11	—
Fast Transient Burst	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4	—
Electrostatic Discharge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2	—
Surge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-5	—
Vehicle Transients	The test was applied using proprietary equipment that meets the requirements of ISO 7637-1 and 2	—
Compass Safe Distance	Azimuth Accuracy	0.10°

Worst case error for both Time and Frequency measurement 12 parts in 10^6.

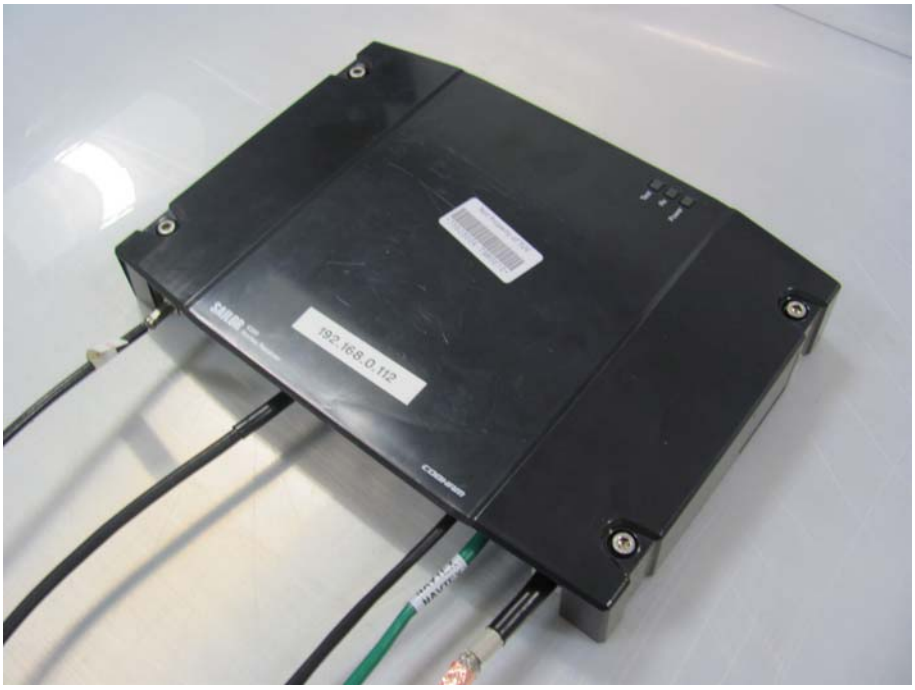
* In accordance with CISPR 16-4-2
† In accordance with UKAS Lab 34
• In accordance with EN 61000-4-6: 2009

Product Service

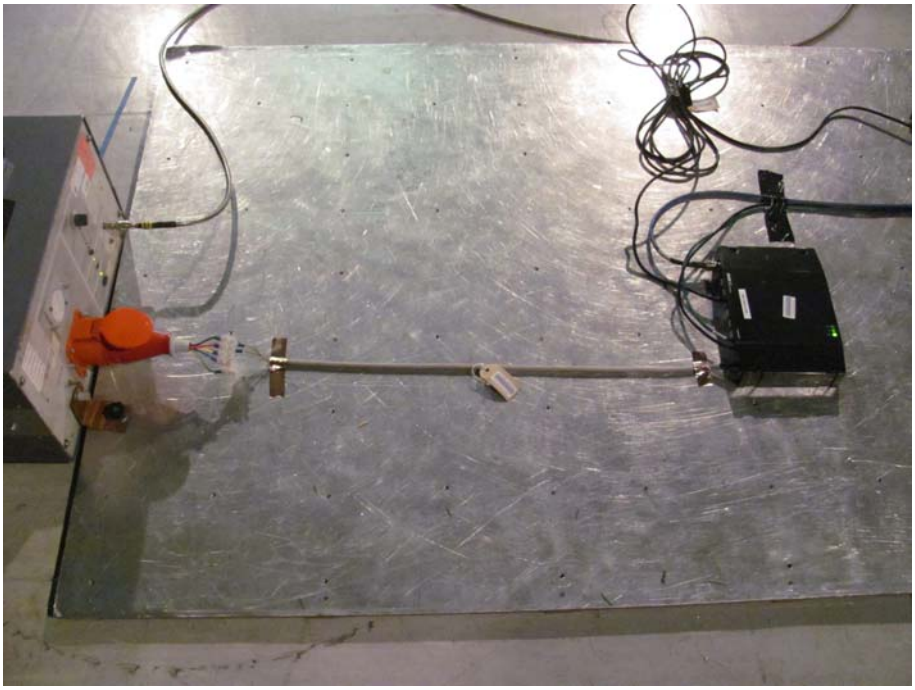
SECTION 4

PHOTOGRAPHS

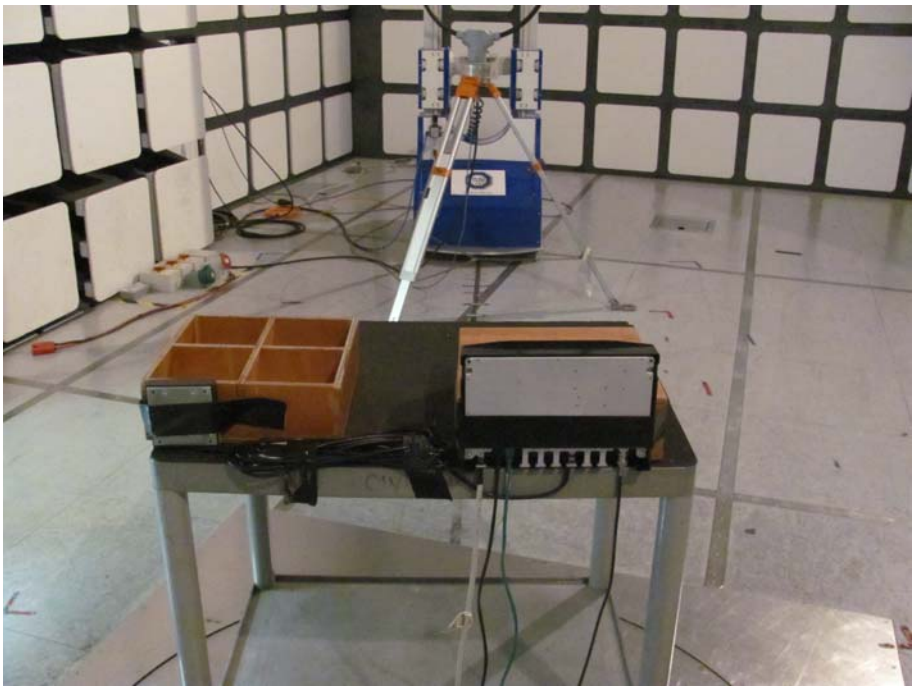
4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



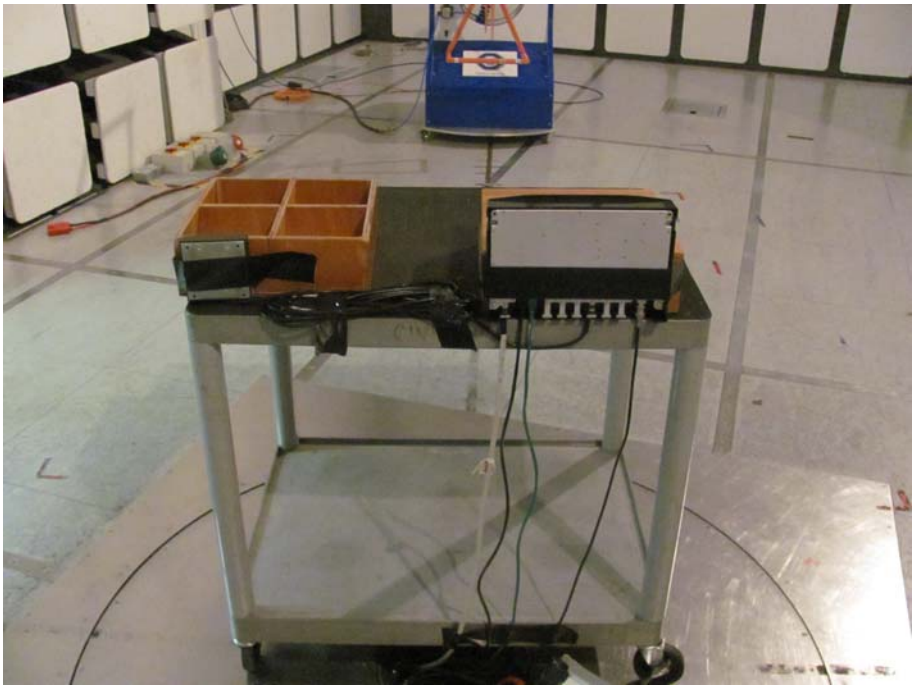
Thrane and Thrane, Sailor 6390 Navtex Receiver



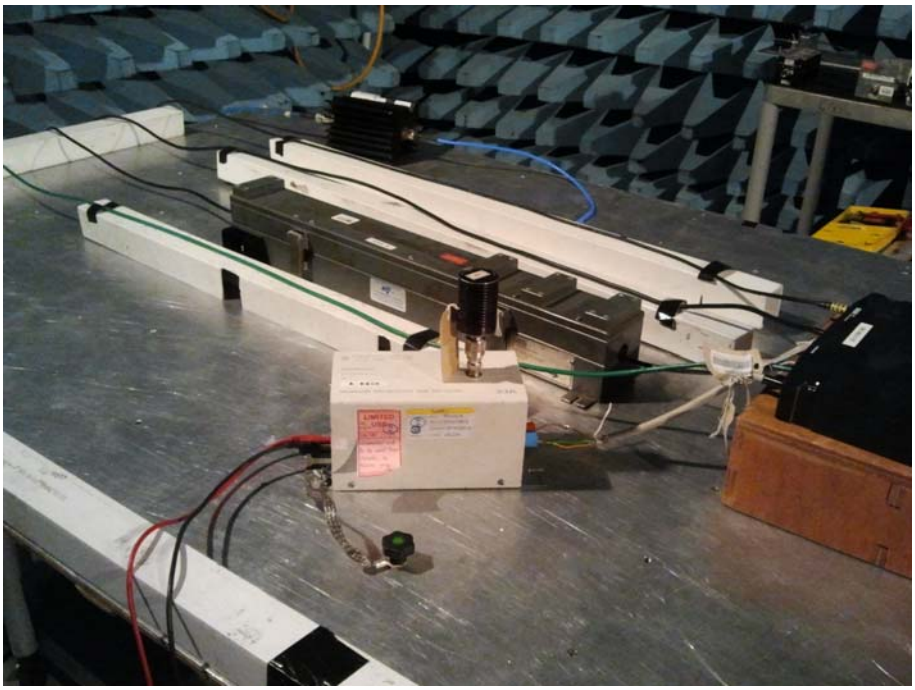
Conducted Emissions (DC Power Port)



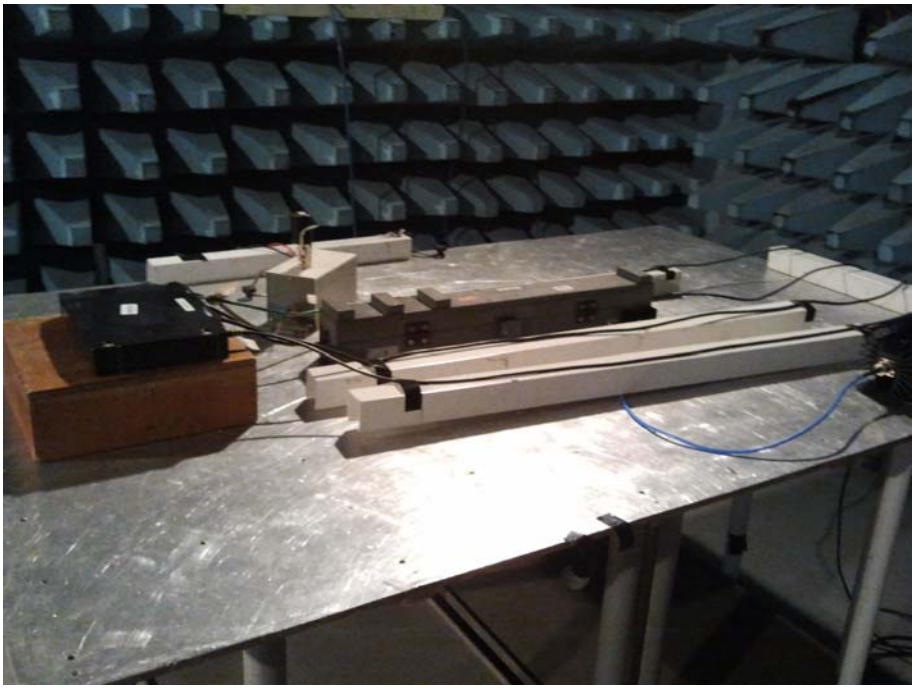
Enclosure Port Magnetic Emissions - Field Strength



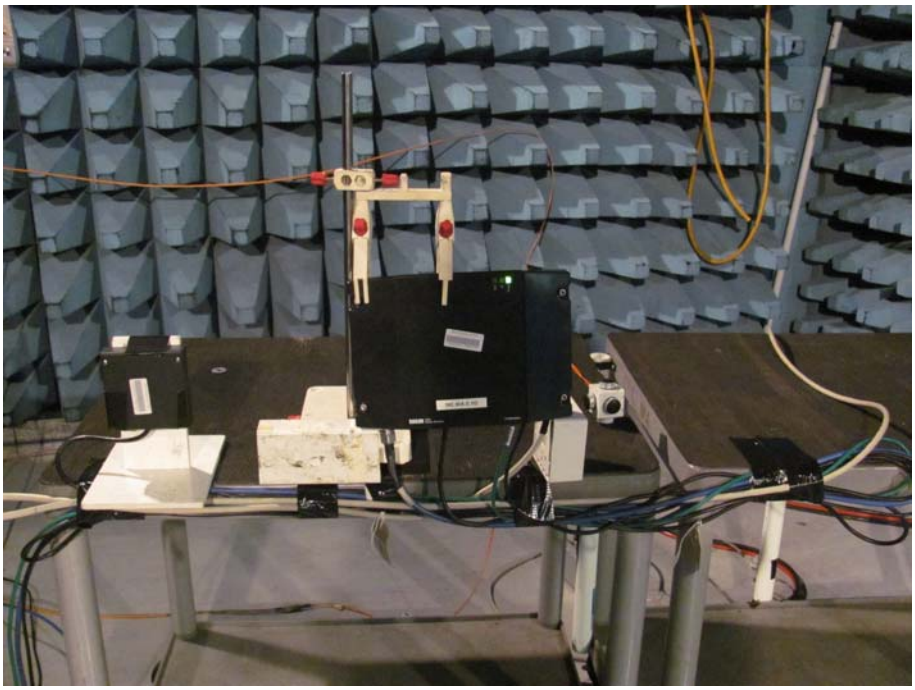
Radiated Emissions (Enclosure Port)



Immunity to Radio Frequency Common Mode (DC Power Port)



Immunity to Radio Frequency Common Mode (Signal, Control and Telecommunications Port)



Immunity to Radio Frequency Electromagnetic Field (Enclosure Port)

Immunity to Fast Transient Bursts Common Mode (Signal, Control and Telecommunications Port)

Immunity to Interruptions (DC Power Port)

Compass Safe Distance (Enclosure Port)

Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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