DNV type approval testing report

IEC 61097-6 Physical Test

Model: NAVTEX Receiver

Type: NX-900

Report No : K08-17-220

Date of Issue: 2023/5/08

☑ Witnessed ☐ Reviewed

with results as reflected by this report

Date: 08.05.2023
Sign: STEKR

Tested by: Kimiko Tanaka **Witnessed by: Steinar Kristensen**

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Contents

Main module

1. Equipment under Test (EUT)

The following was tested

Component	Type	Serial number	SW-Version	Equipment Category
NAVTEX RECEIVER (MAIN UNIT)	NX-900	1001-6400-0007	0850202-01.XX	Protected
ANTENNA UNIT	NX-9HE	000005		Exposed
PRINTER	PP-900	000007		Protected
JUNCTION BOX	IF-900	000007		Protected
AC/DC POWER SUPPLY UNIT	PR-241	103358		Protected

2. Product documentation

For production of this report the following product documentation was used:

Name	Description	Date
Operator's manual	OME57150-Z5	2023/04/13
Installation manual	Included in Operator's manual (OME57150)	---

3. Test Date and test place

Test date : 2023/04/18 – 2023/04/19
Test place : FEC (9-52 Ashihara-cho, Nishinomiya, Japan)

4. Observations and comments

None

5. Applicable standards

IMO Resolution A.694(17)
IMO Resolution A.525(13)
IMO Resolution MSC.148(77)
IMO Resolution MSC.191(79)
IMO Resolution MSC.302(87)
IMO Resolution MSC.430(98)
IMO Resolution MSC.508(105)
IMO Resolution MSC.36(63)-(1994 HSC Code) 14,
IMO Resolution MSC.97(73)-(2000 HSC Code) 14,

ITU-R M.540-2
ITU-R M.625-4

IEC 61097-6 Ed. 2 (2005) +A1(2011) +A2(2019)
IEC 61162-1 Ed.5 (2016)
IEC 61162-450 Ed.2 (2018)
IEC 62923-1/-2 Ed.1 (2018)
IEC 62288 Ed.3 (2021)

6. List of attendee

Company	Name	Signature
DNV	Kristensen, Steinar	STEKR
FEC	Kimiko Tanaka	KT

7. Test results module (Summary)

IEC 61097-6 Ed.2				
NAXTEX receiver				
Clause	GENERAL REQUIREMENTS	Performed verification (Yes/No/N.A)	Performed by	Remark
9.1	Call sensitivity	Yes	FEC K.Tanaka	
9.2	Interference rejection and blocking immunity	Yes		
9.3	Co-channel rejection	Yes		
9.4	Intermodulation	Yes		
9.5	Off-frequency transmitter	Yes		
9.6	Simultaneous operation on several receive frequencies	Yes		
9.7	Protection of input circuits	Yes		
12.1	Spurious emissions	Yes		

8. Test results module

8.1.2. Physical Tests (ref.IEC 61097-6 Clause 9, and 12)

8.1.2.2. Receiver tests (ref. IEC 61097-6 Clause 9)

About sensitivity measurement:

The antenna unit contains an antenna section and a bar coil, which receives radio waves.

The bar coil is where the 50Ω pseudo-antenna is connected.

The bar coils are placed in two directions to enable reception from anywhere in 360°.

One is called A and the other is called B. These are connected in an electrical circuit.

In a sensitivity measurement, both A and B are measured.

About other measurement items:

For the other tests the measurements were performed only using antenna section A. As A and B are connected in an electrical circuit and pass through the same filter, resulting in the same interference characteristics.

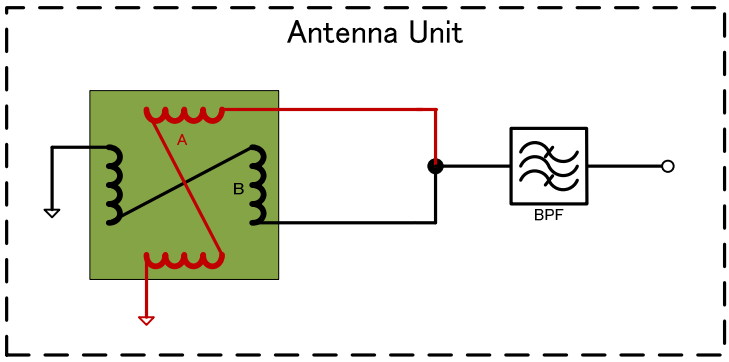
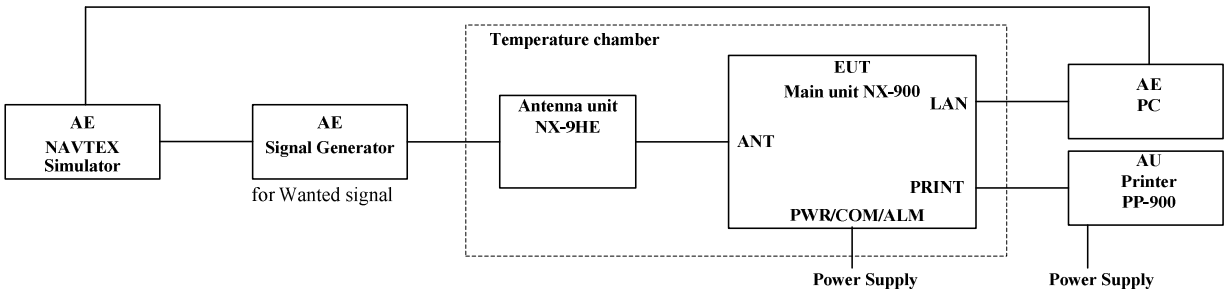


Figure 1: Anntenna unit with antenna section A and B

8.1.2.2.1. Call sensitivity (ref. IEC 61097-6 9.1)



[Test procedures]

The call sensitivity of the receiver is a defined level of the radio-frequency signal at which the receiver gives a character error ratio better than a defined value.

An STS repeated 25 times shall be connected to the EUT by an appropriate artificial antenna as specified in 5.8 at a level of –107 dBm (2µV for artificial antenna type a) or 5µV for artificial antenna type b)).

According to 5.8 Artigicial antennas of IEC61097-6 Ed2.0, terminate the bar-coil parts of the antenna unit with 50Ω and measure.

[Required results]

The character error rate shall be ≤ 4 %.

The results were verified by inspection of stated character error rate on printout of each message, ref photos below.

Additional tests beyond the requirements of the standard were carried out under extreme power supply and temperature conditions to verify call sensitivity performance also under these conditions. The EUT including the antenna was placed in a climatic chamber during the low temperature and heat tests, while the optional printer was located outside of the chamber and used to verify correct reception of NAVTEX messages.

Each test was performed once under witnessing by DNV. Repeated tests were carried out and results recorded by Furuno, and reviewed by DNV.

Figure 2: Examples of printout of NAVTEX messages during physical tests in this report

[Results]

A-ANT

Test conditions			Sensitivity level [dBm@CER%]			Satisfactory
	Temperature	Voltage	490 kHz	518 kHz	4209.5 kHz	
Normal	Tnom (+15 to +35 °C)	Vnom (24.0 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
Extreme	Tnom (+15 to +35 °C)	Vmin (10.8 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
		Vmax (31.2 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
Voluntary Testing	Tmin (-25 °C)	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
		Vmax (31.2 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
	Tmax (+55 °C)	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
		Vmax (31.2 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
Limits			≤ -107 dBm @ < 4% CER			
Measurement uncertainty			±0.3dB			

B-ANT

Test conditions			Sensitivity level [dBm@CER%]			Satisfactory
	Temperature	Voltage	490 kHz	518 kHz	4209.5 kHz	
Normal	Tnom (+15 to +35 °C)	Vnom (24.0 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
Extreme	Tnom (+15 to +35 °C)	Vmin (10.8 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
		Vmax (31.2 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass
Voluntary Testing	Tmin (-25 °C)	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
		Vmax (31.2 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
	Tmax (+55 °C)	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
		Vmax (31.2 V)	- 107dBm@0%	-107dBm@0%	-107dBm@0%	Pass
Limits			≤ -107 dBm @ < 4% CER			
Measurement uncertainty			±0.3dB			

[Test repeated 25 times]

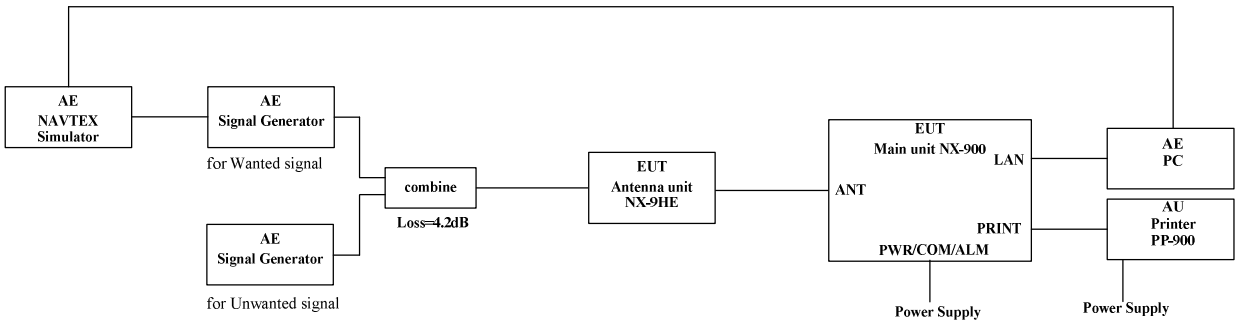
A-ANT

Test receiver	Wanted Signal Level: -107 dBm Character Error Rate (%) @ Tnom (+15 to +35 °C) &Vnom (24.0V)																									Result
	Count																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
490 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass
518 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass
4209.5 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass

B-ANT

Test receiver	Wanted Signal Level: -107 dBm Character Error Rate (%) @ Tnom (+15 to +35 °C) &Vnom (24.0V)																									Result
	Count																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
490 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass
518 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass
4209.5 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass

8.1.2.2.3. Interference rejection and blocking immunity (ref. IEC 61097-6 9.2)



[Test procedures]

Interference rejection and blocking immunity is the receiver's ability to discriminate between the wanted and unwanted signals on frequencies outside of the receiver's pass band.

NOTE If an active antenna is supplied with the receiver or otherwise required for the receiver to operate, the active antenna shall operate in such a manner that the requirements specified in this sub clause are met.

The receiver shall be connected to the artificial antenna specified in item a) of 5.8.
Two signals shall be applied to the EUT as specified in 5.7. The wanted signal shall be an STS +6 dB relative to the STS level, repeated 25 times.
The unwanted signal shall be un-modulated. The levels shall be as defined in Table 3 below.
Suitable means shall be used to examine responses to interference.

Table 3 – Unwanted signal levels

	490 kHz receiver		518 kHz receiver		4209.5 kHz receiver	
Test step	Frequency range	Level	Frequency range	Level	Frequency range	Level
Test 1	489-489.5 kHz	+20 dB	517-517.5 kHz	+20 dB	4208.5-4209 kHz	+20 dB
Test 2	490.5-491 kHz	+20 dB	518.5-519 kHz	+20 dB	4210-4210.5 kHz	+20 dB
Test 3	487-489 kHz	+40 dB	515-517 kHz	+40 dB	4206.5-4208.5 kHz	+40 dB
Test 4	491-493 kHz	+40 dB	519-521 kHz	+40 dB	4210.5-4212.5 kHz	+40 dB
Test 5	100-487 kHz	+70 dB	100-515 kHz	+70 dB	100-4206.5 kHz	+70 dB
Test 6	493 kHz-30 MHz	+70 dB	521 kHz-30 MHz	+70 dB	4212.5 kHz-30 MHz	+70 dB
Test 7	156-174 MHz	+70 dB	156-174 MHz	+70 dB	156-174 MHz	+70 dB
Test 8	450-470 MHz	+70 dB	450-470 MHz	+70 dB	450-470 MHz	+70 dB

[Required results]

The unwanted signal shall not induce a character error rate > 4 % in any of the received messages.

The results were verified by inspection of stated character error rate on printout of each message.

Each test was performed once under witnessing by DNV. Repeated tests were carried out and results recorded by Furuno, and reviewed by DNV.

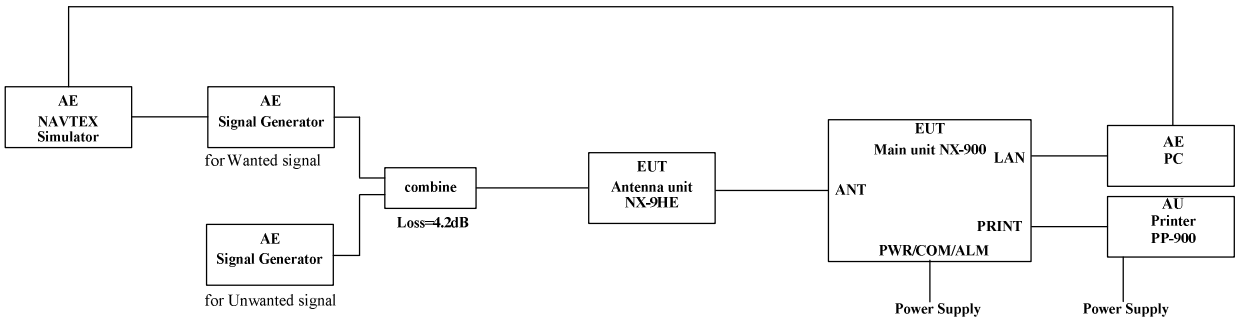
[Results]

Test conditions		Interference rejection and blocking immunity				Result
Temperature	Frequency band [kHz]	Frequency range	Tested Frequency	Character Error Rate (%) @Vnom (24.0V)	Level [dB]	
Tnom (+15 to +35 °C)	490	Test 1 489-489.5 kHz	489.5kHz	0	+20	Pass
		Test 2 490.5-491 kHz	490.5kHz	0	+20	Pass
		Test 3 487-489 kHz	489.0Hz	0	+40	Pass
		Test 4 491-493 kHz	491.0kHz	0	+40	Pass
		Test 5 100-487 kHz	100.0kHz	0	+70	Pass
			487.0kHz	0		Pass
		Test 6 493 kHz-30 MHz	493.0kHz	0	+70	Pass
			30MHz	0		Pass
		Test 7 156-174 MHz	156MHz	0	+70	Pass
			174MHz	0		Pass
		Test 8 450-470 MHz	450MHz	0	+70	Pass
			470MHz	0		Pass
	518	Test 1 517-517.5 kHz	517.5kHz	0	+20	Pass
		Test 2 518.5-519 kHz	518.5kHz	0	+20	Pass
		Test 3 515-517 kHz	515.0kHz	0	+40	Pass
		Test 4 519-521 kHz	519.0kHz	0	+40	Pass
		Test 5 100-515 kHz	100.0kHz	0	+70	Pass
			515.0kHz	0		Pass
		Test 6 521 kHz-30 MHz	521.0kHz	0	+70	Pass
			30MHz	0		Pass
		Test 7 156-174 MHz	156MHz	0	+70	Pass
			174MHz	0		Pass
		Test 8 450-470 MHz	450MHz	0	+70	Pass
			470MHz	0		Pass
	4209.5	Test 1 4208.5-4209 kHz	4209.0kHz	0	+20	Pass
		Test 2 4210-4210.5 kHz	4210.0kHz	0	+20	Pass
		Test 3 4206.5-4208.5 kHz	4208.5kHz	0	+40	Pass
		Test 4 4210.5-4212.5 kHz	4210.5kHz	0	+40	Pass
		Test 5 100-4206.5 kHz	100.0kHz	0	+70	Pass
			4206.5kHz	0		Pass
		Test 6 4212.5 kHz-30 MHz	4212.5kHz	0	+70	Pass
			30MHz	0		Pass
		Test 7 156-174 MHz	156MHz	0	+70	Pass
			174MHz	0		Pass
		Test 8 450-470 MHz	450MHz	0	+70	Pass
			470MHz	0		Pass
Wanted signal level: -101 dBm, Unwanted signal is unmodulated. Measurement uncertainty: ±0.3 dB						

[Test repeated 25 times]

Test conditions		Interference rejection and blocking immunity																												
Frequency band [kHz]	Frequency range(Hz)	Tested Frequency	Character Error Rate (%) @Vnom (24.0V) & Tnom(+15 to +35 °C)																										Level [dB]	Result
			Count																											
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
490	Test 1 489-489.5 k	489.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 2 490.5-491 k	490.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 3 487-489 k	489.0Hz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 4 491-493 k	491.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 5 100-487 k	100.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		487.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 6 493 kHz-30 M	493.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		30MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 7 156-174 M	156MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		174MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 8 450-470 M	450MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		470MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
518	Test 1 517-517.5 k	517.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 2 518.5-519 k	518.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 3 515-517 k	515.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 4 519-521 k	519.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 5 100-515 k	100.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		515.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 6 521 kHz-30 M	521.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		30MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 7 156-174 M	156MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		174MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 8 450-470 M	450MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		470MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
4209.5	Test 1 4208.5-4209 k	4209.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 2 4210-4210.5 k	4210.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+20	Pass
	Test 3 4206.5-4208.5 k	4208.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 4 4210.5-4212.5 k	4210.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+40	Pass
	Test 5 100-4206.5	100.0kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		4206.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 6 4212.5 k-30M	4212.5kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		30MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 7 156-174 M	156MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		174MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
	Test 8 450-470 M	450MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
		470MHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
Wanted signal level: -101 dBm, Unwanted signal is unmodulated. Measurement uncertainty: ±0.3 dB																														

8.1.2.2.3. Co-channel rejection (ref. IEC 61097-6 9.3)



[Test procedures]

The co-channel rejection is the receiver's ability to receive a wanted signal in the presence of an unwanted signal, with both signals being at the nominal frequency of the wanted channel.

The receiver shall be connected to the artificial antenna specified in item a) of 5.8.

Two signals shall be applied to the EUT as specified in 5.7. The wanted signal shall be an STS +6 dB relative to the STS level, repeated 25 times. The unwanted signal shall be unmodulated at a level of –6 dB relative to the wanted signal, at the nominal EUT frequency.

[Required results]

The unwanted signal shall not induce a character error rate of > 4 % in any of the received messages.

The results were verified by inspection of stated character error rate on printout of each message.

Each test was performed once under witnessing by DNV. Repeated tests were carried out and results recorded by Furuno, and reviewed by DNV.

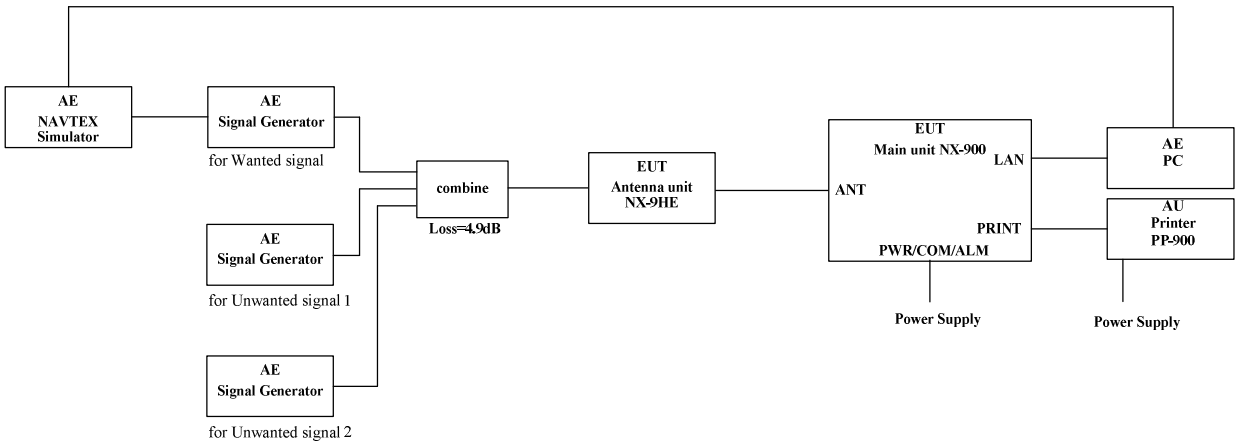
[Results]

Test conditions			Co-channel rejection			Result
	Temperature	Voltage	Frequency [kHz]	Character error rate [%]	Level	
Normal	Tnom (+15 to+35 °C)	Vnom (24.0 V)	490	0	-6dB	Pass
			518	0		Pass
			4209.5	0		Pass
Wanted signal level: -101 dBm Unwanted signal is unmodulated, signal level: -107 dBm						
Measurement uncertainty: ±0.3dB						

[Test repeated 25 times]

Frequency [kHz]	Character error rate[%] @Vnom (24.0V) & Tnom(+15 to +35 °C) count																									Level	Result
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
490	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6dB	Pass
518	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
4209.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		Pass
Wanted signal level: -101 dBm Unwanted signal is unmodulated, signal level: -107 dBm																											
Measurement uncertainty: ±0.3dB																											

8.1.2.2.6. Intermodulation (ref. IEC 61097-6 9.4)



[Test procedures]

Intermodulation is a process whereby signals are produced from two or more signals simultaneously present in a non-linear circuit.

NOTE If an active antenna is supplied with the receiver or otherwise required for the receiver to operate, the active antenna shall operate in such a manner that the requirements specified in this sub clause are met.

The receiver shall be connected to the artificial antenna specified in item a) of 5.8.
Three signals shall be applied to the EUT as specified in 5.7. The wanted signal shall be an STS +6 dB relative to the STS level. The two unwanted signals shall be unmodulated at equal levels of +50 dB relative to the wanted signal, outside of a guard band specified around the receive frequency.
The intermodulation frequency pairs shall include those defined in Table 4.

Table 4 - Intermodulation frequency pairs

	490 kHz		518 kHz		4209.5 kHz	
Test 1	488	486	516	514	4207.5	4205.5
Test 2	487	484	515	512	4206.5	4203.5
Test 3	486	482	514	510	4205.5	4201.5
Test 4	492	494	520	522	4211.5	4213.5
Test 5	493	496	521	524	4212.5	4215.5
Test 6	494	498	522	526	4213.5	4217.5

[Required results]

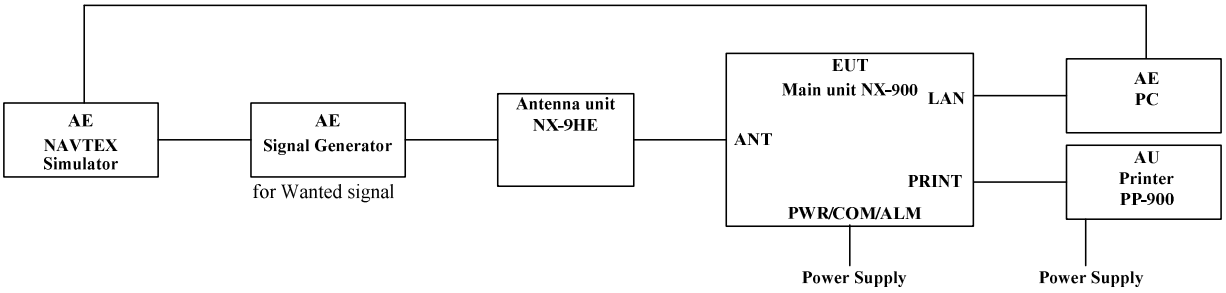
Intermodulation shall not induce a character error rate of > 4 %.

The results were verified by inspection of stated character error rate on printout of each message.

[Results]

Test conditions		Intermodulation			Result
Temperature	Frequency band [kHz]	Frequency pairs	Character Error Rate (%) at Vnom (24.0 V)	Level [dB]	
Tnom (+15 to +35 °C)	490	Test 1 488+486 kHz	0	+50dB	Pass
		Test 2 487+484 kHz	0		Pass
		Test 3 486-482 kHz	0		Pass
		Test 4 492+494 kHz	0		Pass
		Test 5 493+496 kHz	0		Pass
		Test 6 494+498 kHz	0		Pass
	518	Test 1 516+514 kHz	0		Pass
		Test 2 515+512 kHz	0		Pass
		Test 3 514+510 kHz	0		Pass
		Test 4 520+522 kHz	0		Pass
		Test 5 521+524 kHz	0		Pass
		Test 6 522-526 kHz	0		Pass
	4209.5	Test 1 4207.5+4205.5 kHz	0		Pass
		Test 2 4206.5+4203.5 kHz	0		Pass
		Test 3 4205.5+4201.5 kHz	0		Pass
		Test 4 4211.5+4213.5 kHz	0		Pass
		Test 5 4212.5+4215.5 kHz	0		Pass
		Test 6 4213.5+4217.5 kHz	0		Pass
Wanted signal level: -101 dBm Unwanted signal is unmodulated, signal level: -51 dBm.					
Measurement uncertainty: ±0.3 dB					

8.1.2.2.4. Off-frequency transmitter (ref. IEC 61097-6 9.5)



[Test procedures]

The off-frequency transmitter test is a check that the receiver performance is not compromised if the transmitter is operating off frequency by up to 25 Hz.

The receiver shall be connected to the artificial antenna specified in item a) of 5.8.

The STS at a level +6 dB relative to the STS level, shall be applied to the EUT for more than 3 min with the objective of obtaining sufficient confidence that the equipment is working correctly.

The test shall be repeated with a shift of the selected receive frequency so that the total mark and space frequency error is 25 Hz.

[Required results]

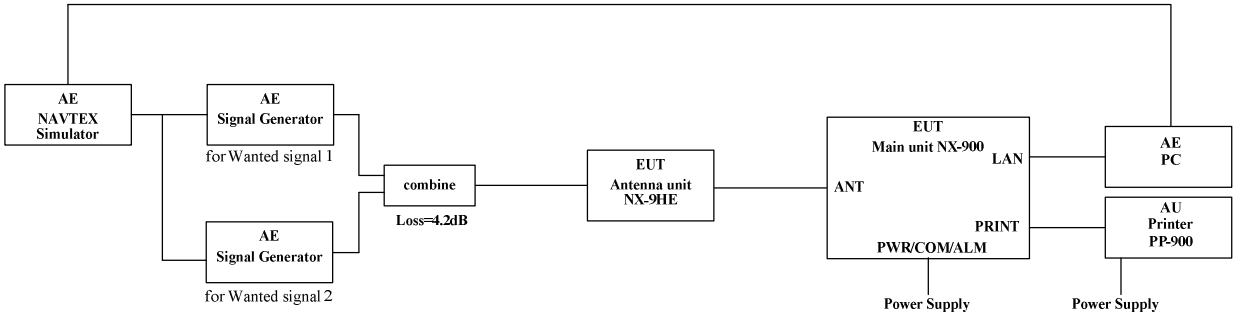
The test signal shall not produce in the EUT a character error rate of > 4 % for each test.

The results were verified by inspection of stated character error rate on printout of each message.

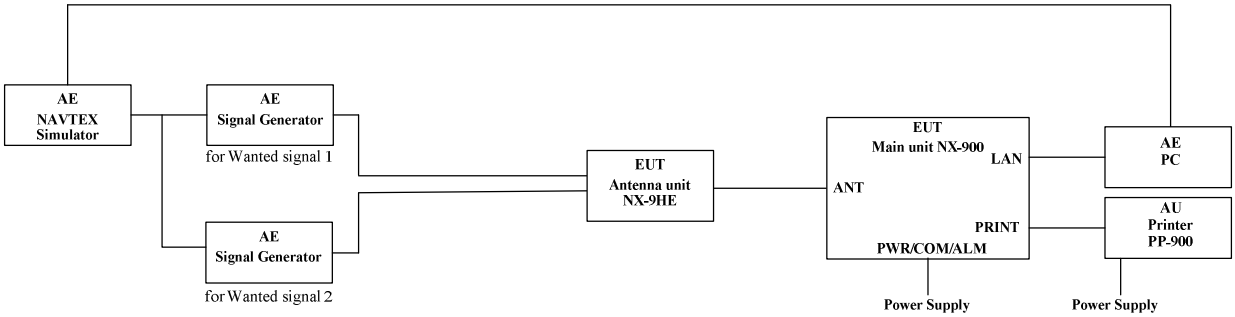
[Results]

Test conditions			Off-frequency transmitter				Result
	Temperature	Voltage	Frequency [kHz]	Frequency offset [Hz]	Character error rate [%]	Limit CER [%]	
Normal	Tnom (+15 to+35 °C)	Vnom (24.0 V)	490	+25/ -25	0/0	< 4 @25Hz offset	Pass
			518	+25/ -25	0/0		Pass
			4209.5	+25 / -25	0/0		Pass
Wanted signal level: -101 dBm							
Measurement uncertainty frequency offset: ±0.43 @4300kHz							

8.1.2.2.4. Simultaneous operation on several receive frequencies (ref. IEC 61097-6 9.6)



Test set-up with combination of 490kHz and 518kHz signals



Test set-up with combination of 490kHz or 518kHz and 4209.5kHz signals

[Test procedures]

This test is a check that the receiver performance is not compromised if one of the other receivers is simultaneously receiving.

The receiver shall be connected to the artificial antenna specified in item a) of 5.8.

As in 9.1 with two STSs set to two operating frequencies which the manufacturer has declared supported by the EUT, applied simultaneously to the EUT.

Apply one wanted STS at a level +6 dB relative to the STS level and the other at a level of +50 dB relative to the STS level, each at one of the EUT's specified operating frequencies. The test shall be repeated for several combinations of receiver frequencies and power levels.

[Required results]

The display/print-out of the STS transmitted on each frequency shall have a character error rate of ≤ 4 %.

A combiner was applied for the test signals at 490kHz and 518kHz. The connections were directly into the antenna unit when the tests were performed with the 4209.5kHz signal, as they are received by different antenna modules (ref pictures below)

The results were verified by inspection of stated character error rate on printout of each message.

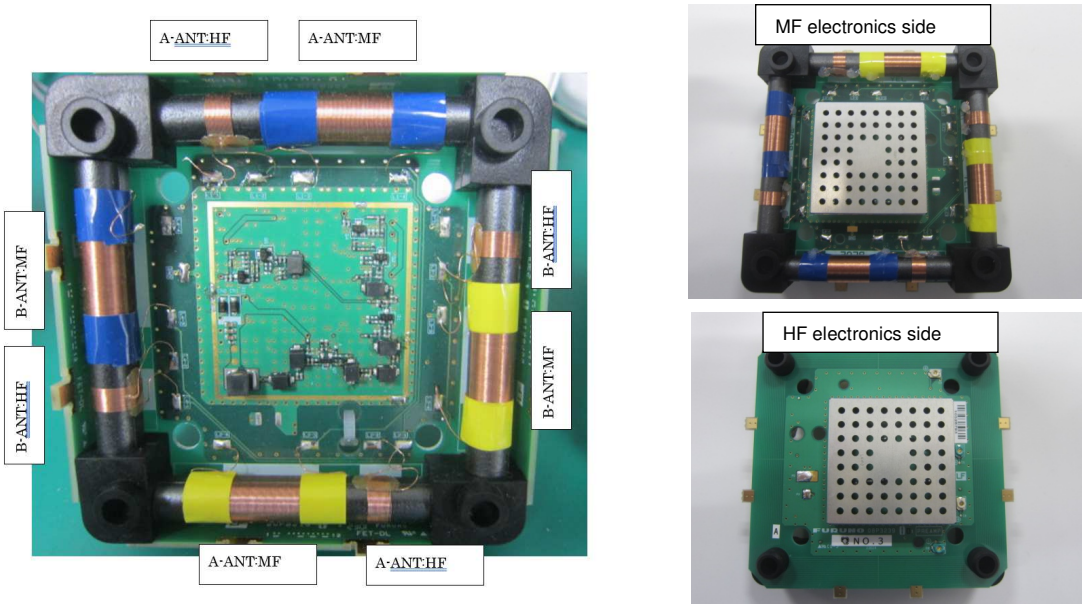
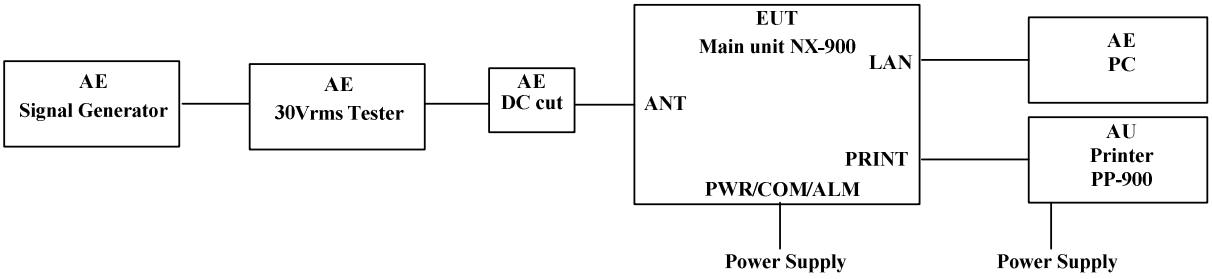


Figure 3: Antenna unit for medium and high-frequncy bands

[Results]

Test conditions	Simultaneous operation on several receive frequencies				
Temperature	Test script	Frequency [kHz]	Character error rate [%] Vnom (24.0 V)	Limit CER [%]	Result
Tnom (+15 to +35 °C)	Signal 1 (A)	518	0	< 4%	Pass
	Signal 2 (A)	490	0		Pass
	Signal 1 (B)	518	0		Pass
	Signal 2 (B)	4209.5	0		Pass
	Signal 1 (C)	490	0		Pass
	Signal 2 (C)	518	0		Pass
	Signal 1 (D)	490	0		Pass
	Signal 2 (D)	4209.5	0		Pass
	Signal 1 (E)	4209.5	0		Pass
	Signal 2 (E)	518	0		Pass
	Signal 1 (F)	4209.5	0		Pass
	Signal 2 (F)	490	0		Pass
Wanted signal 1 level: -101 dBm Wanted signal 2 level: -57 dBm					
Measurement uncertainty: ±0.3 dB					

8.1.2.2.2. Protection of input circuits (ref. IEC 61097-6 9.7)



[Test procedures]

An unmodulated signal at an e.m.f. level of 30 V r.m.s. shall be applied to the antenna input of the EUT, as specified in 5.7, for a period of 15 min on any frequency between 100 kHz to 28 MHz.
Adjust the Signal Generator output level to 30 V r.m.s. when the load is open.
After applying for 15 min, confirm that there is no decrease in call sensitivity.

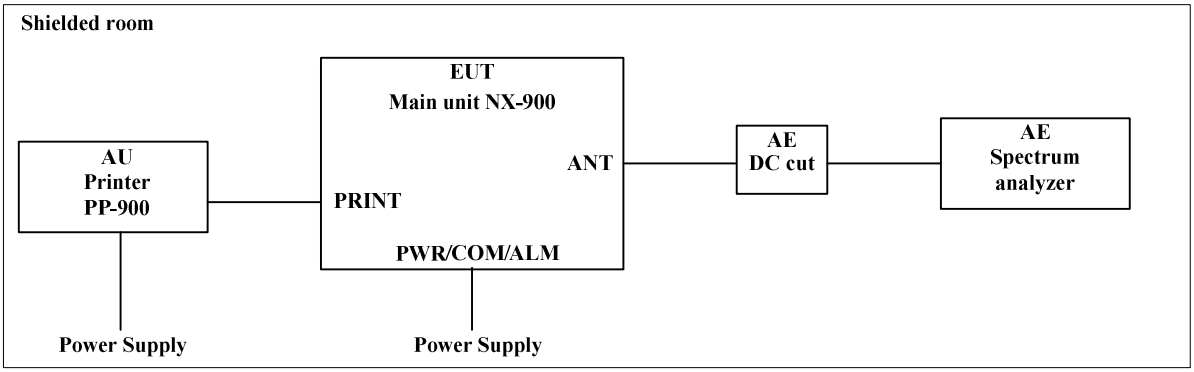
[Required results]

The EUT shall continue to operate normally.
Verified that the sensitivity was unchanged after applying the 30V r.m.s. signal for 15min.

[Results]

Test conditions			Protection of input circuits			Result
	Temperature	Voltage	Test Frequency [kHz]	Sensitivity level [dBm@CER%]		
				518 kHz	4209.5 kHz	
Normal	Tnom (+15 to+35 °C)	Vnom (24.0 V)	4350*)	-107dBm@0%	-107dBm@0%	Pass
Sensitivity level limits: ≤ -107 dBm @ < 4% CER Sensitivity level before test: -107dBm@0.0% at 518 kHz, -107dBm@0.0% at 4209.5 kHz						
*) Test frequency chosen to correspond with output of Furuno FS-xx75 series MF/HF radios.						

8.1.2.3.2. Spurious emissions (ref. IEC 61097-6 12.1)



[Test procedures]

Spurious emissions are any radio-frequency emissions generated in the EUT and radiated by conduction from the antenna.

The EUT shall be connected to the artificial antenna specified in 5.8 and the r.m.s. value of any component of the spurious emissions shall be measured. The measurements shall cover the frequency range from 9 kHz to 2 GHz.

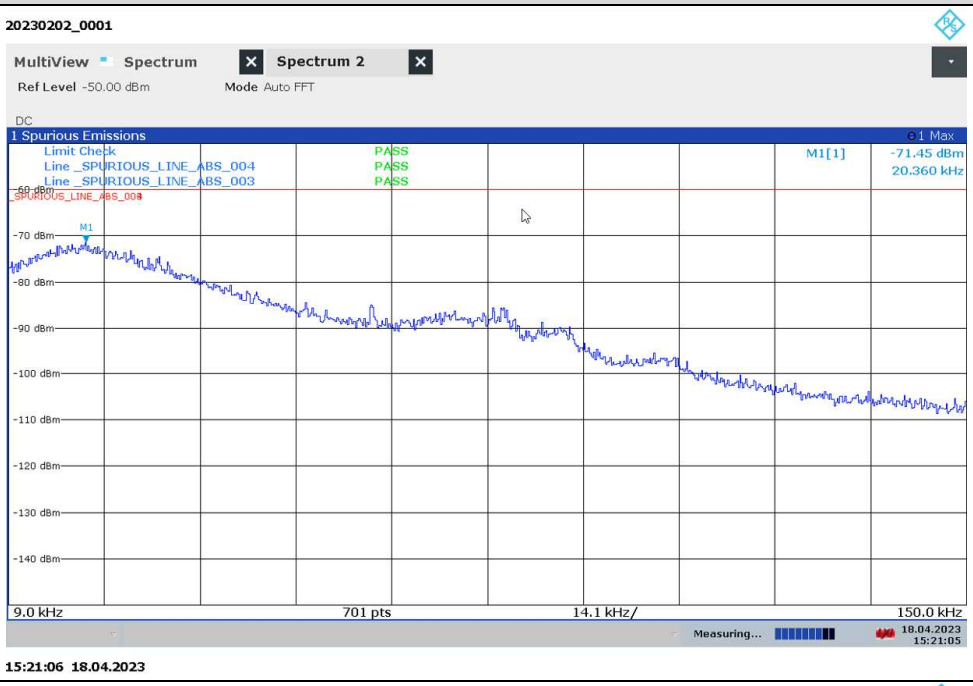
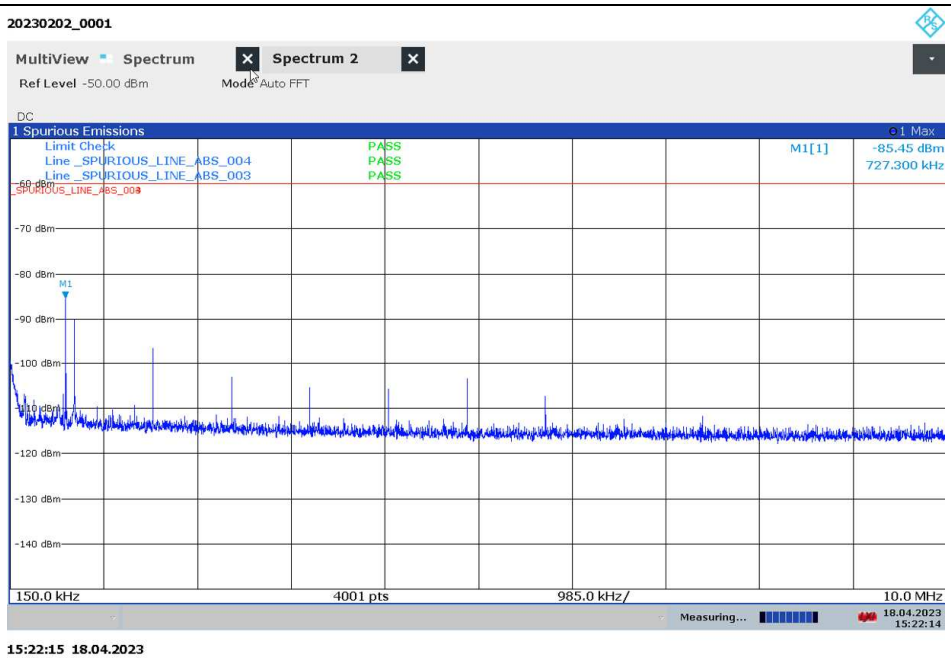
[Required results]

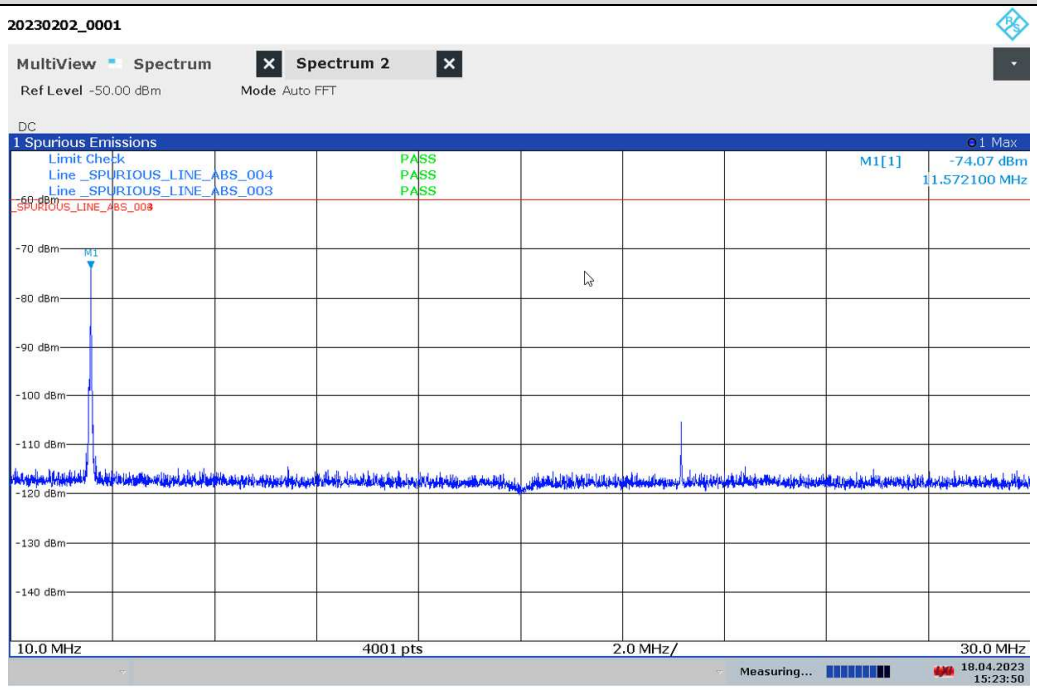
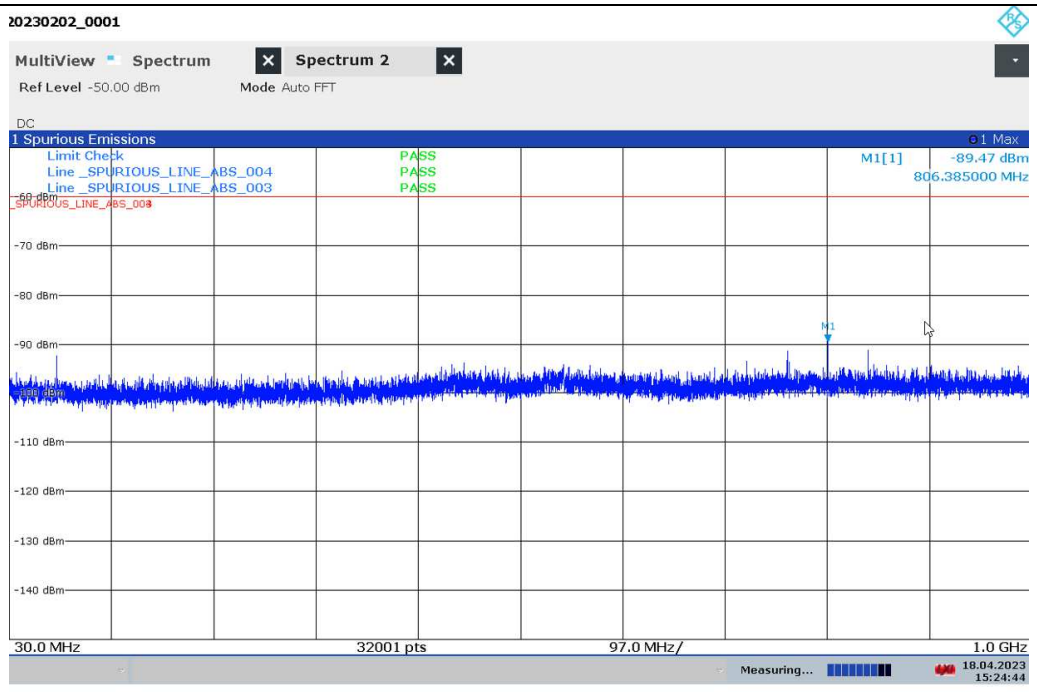
The power of any discrete component shall be $\leq 1 \times 10^{-9}$ W.

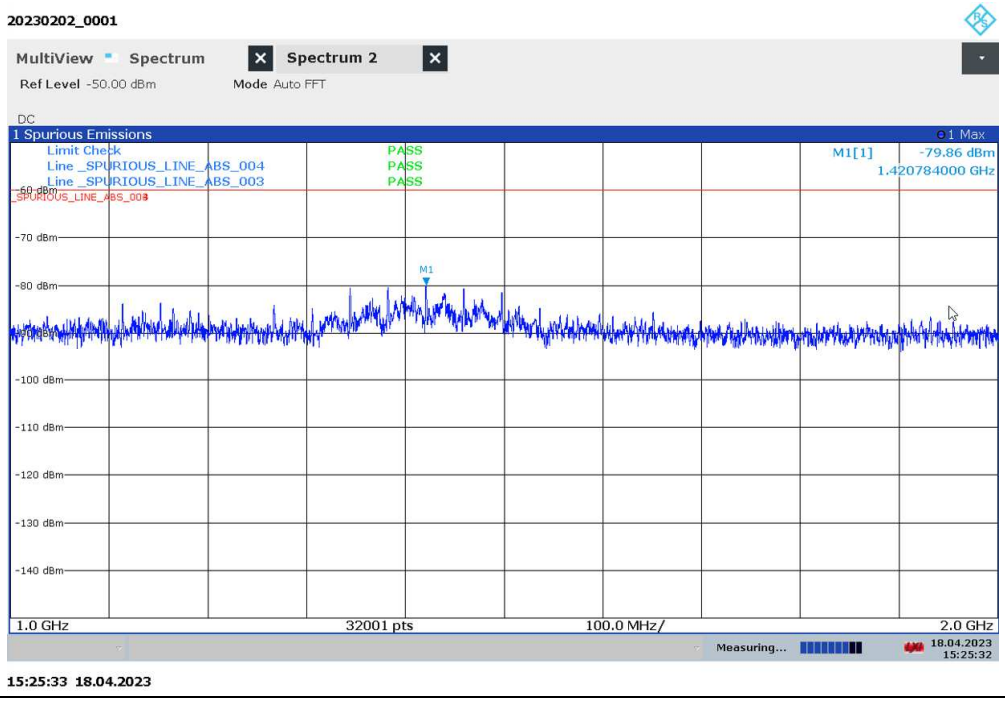
[Results]

Test conditions			Spurious emissions						Result
	Temperature	Voltage	Frequency band	Spurious frequency	RBW	Spurious level		Limit	
						[dBm]	[nW]		
Normal	Tnom (+15 to +35 °C)	Vnom (24.0 V)	9 kHz - 150 kHz	20.36kHz	100Hz	-71.45	0.071614	< - 60 dBm (1nW) for 9 kHz - 2 GHz	Pass
			150 kHz - 10 MHz	727.3kHz	1kHz	-85.45	0.002851		
			10 MHz - 30 MHz	11.5721MHz	1kHz	-74.07	0.039174		
			30 MHz - 1 GHz	806.385MHz	100kHz	-89.47	0.00113		
			1 GHz - 2 GHz	1.420784GHz	1MHz	-79.86	0.010328		

(*1): Spurious components other than the above were not observed for the test frequency range.

Frequency band	Spectrum analyzer image	Peak level
9 kHz - 150 kHz		-71.45dB @20.36kHz
150 kHz - 10 MHz		-85.45dBm @727.3kHz

Frequency band	Spectrum analyzer image	Peak level
10 MHz - 30 MHz		-74.07dBm @11.5721MHz
30 MHz – 1GHz		-89.47 dBm @ 806.385MHz

Frequency band	Spectrum analyzer image	Peak level
1 GHz - 2 GHz		-79.86 dBm @1.420784GHz

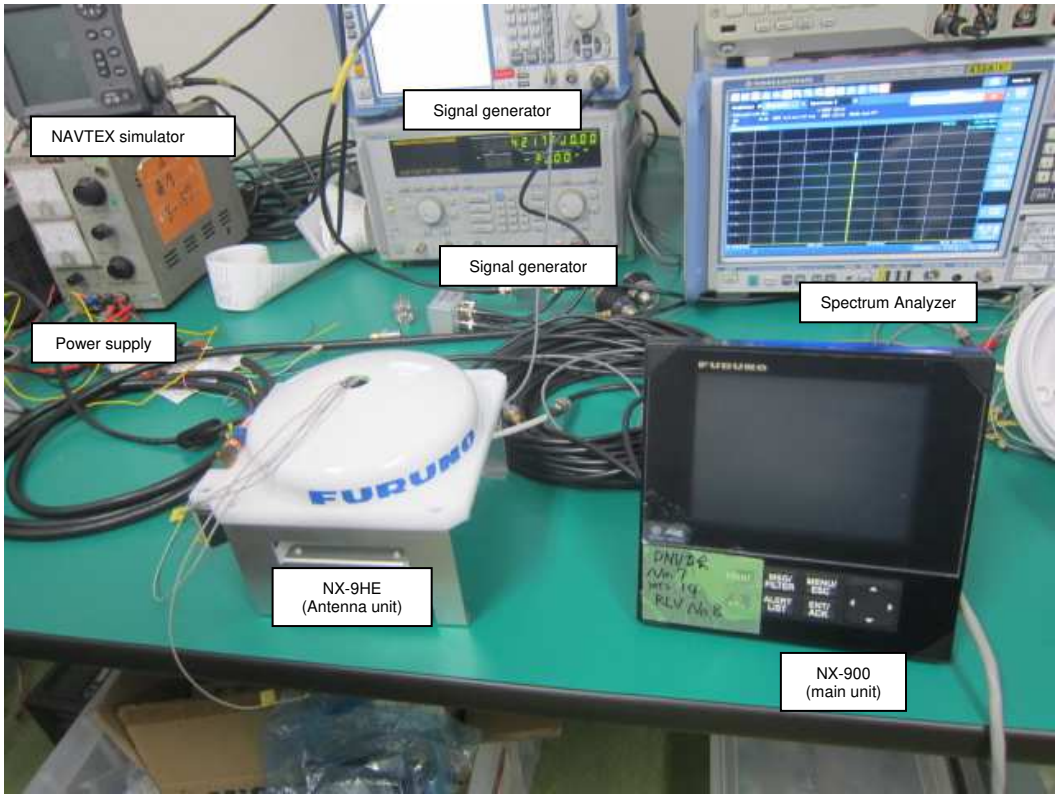
9. Used test equipment module

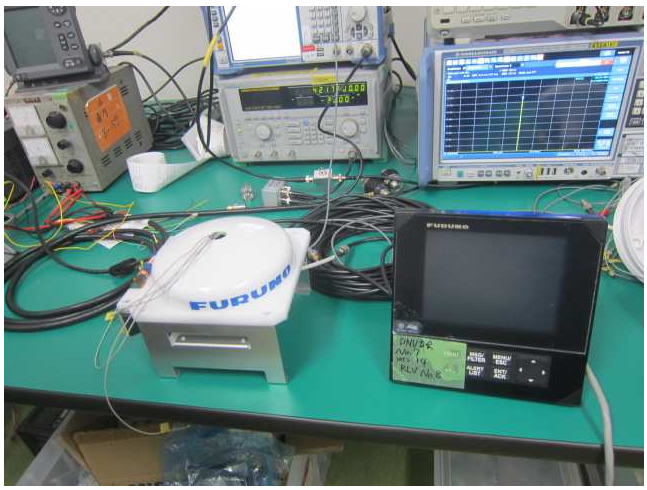
No.	Instrument/Ancillary	Type	Manufacture	Serial.No	Calibration Due date
01	Signal Generator	SMC100A	Rohde&Schwarz	104003	23/10
02	Signal Generator	SMC100A	Rohde&Schwarz	108904	23/9
03	Signal Generator	MG3642A	Anritsu	6200948867	23/7
04	Signal Generator	SMBV100A	Rohde&Schwarz	258135	23/9
05	Spectrum Analyzer	FSW26	Rohde&Schwarz	101356	23/10
06	Combiner	ZFSC-2-4+	Mini-Circuits	-	-
07	Combiner	ZFSC-3-2+	Mini-Circuits	-	-
08	Laptop PC	Dynabook	Toshiba	1936N023	-
09	NAVTEX Simulatior	NAV-SIM	FEC	-	-
10	Multimeter	21105112	Keithley	1421956	24/1
11	Oscilloscope	DPO2024B	Tektronix	C010938	23/8

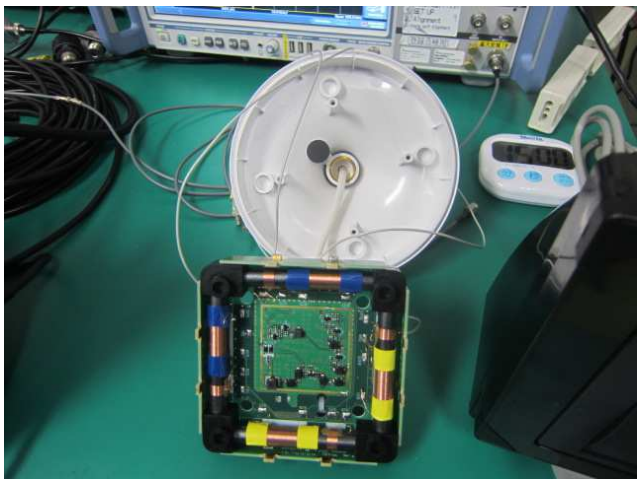
All Instrumets are calibrated in 1 year period.

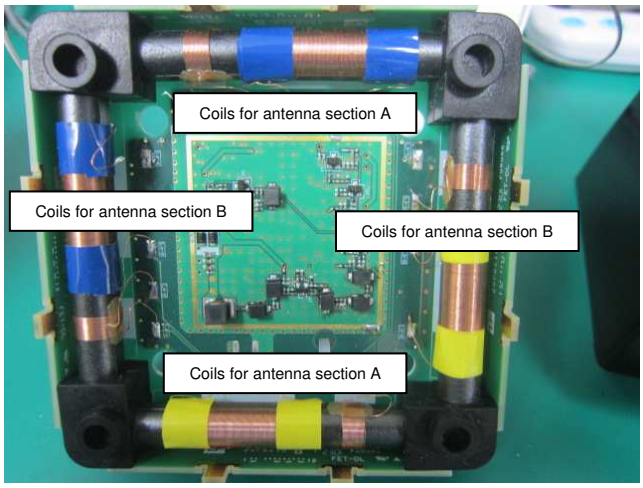
Application		Version
NAVTEX Simulator tool	for all tests	Ver. NX_JIGU-02.01
UDP Debugger	for “all command setting” of test	Ver. 23.181130

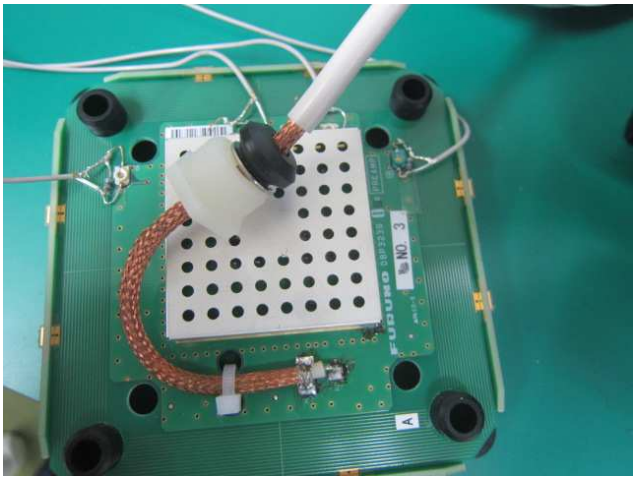
9.1. Pictures of test set-up

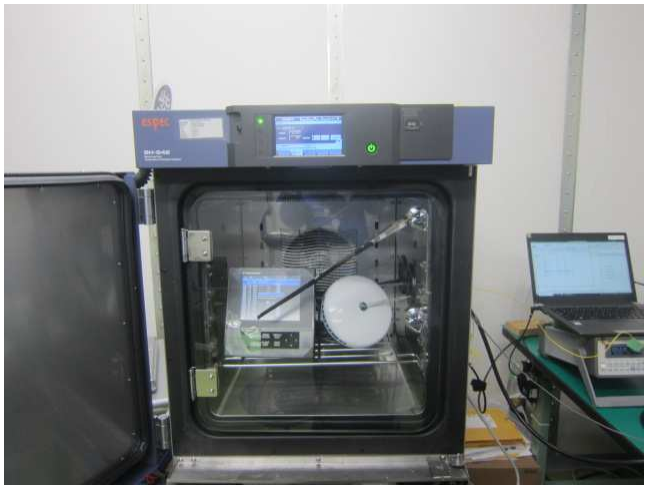







Coils for antenna section A
Coils for antenna section B
Coils for antenna section B
Coils for antenna section A






518kHz Error Rate: 0.0%
ZCZC AA00
490 518 4209.5
KHZ
ABCDEFGHIJ KLMNOPQRST UVWXYZ1234
567890?:., -()'=/+
ABCDEFGHIJ KLMNOPQRST UVWXYZ1234
567890?:., -()'=/+
ABCDEFGHIJ KLMNOPQRST UVWXYZ1234
567890?:., -()'=/+
NNNN