

DNV type approval testing report IEC 61097-6 Physical Test

Model: NAVTEX Receiver

Type: NX-900

Report No : <u>K08-17-220</u>

Date of Issue: 2023/5/08



Tested by: Kimiko Tanaka

Witnessed by: Steinar Kristensen

FURUNO ELECTRIC CO., LTD. 9-52 Ashihara-cho, Nishinomiya, 662-8580, Japan Phone: +81 (0)798 63-1152 Fax: +81 (0)798 65-1142 www.furuno.co.jp



Doc. No.: K08-17-220 Rev. no.: 1 Date of Revision: 08 May 2023 Page: 2 / 26

Contents

MAIN N	AODULE	
1.	Equipment under Test (EUT)	3
2.	Product documentation	3
3.	Test Date and test place	3
4.	Observations and comments	
5.	Applicable standards	3
6.	List of attendee	
7.	Test results module (Summary)	4
8.	Test results module	5
9.	Used test equipment module	24
9.1.	Pictures of test set-up	24



Main module 1. Equipment under Test (EUT)

The following was tested

Component	Туре	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 - 2023/04/19Test 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 61097-6Ed. 2 (2005) +A1(2011) +A2(2019)IEC 61162-1Ed.5 (2016)IEC 61162-450Ed.2 (2018)IEC 62923-1/-2Ed.1 (2018)IEC 62288Ed.3 (2021)



6. List of attendee

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

7. Test results module (Summary)

	IEC 6	1097-6 Ed.2		
	NAXT	EX 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.

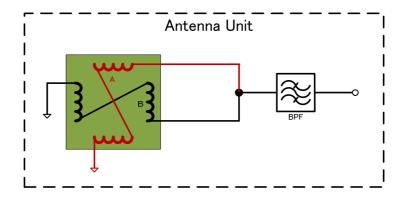
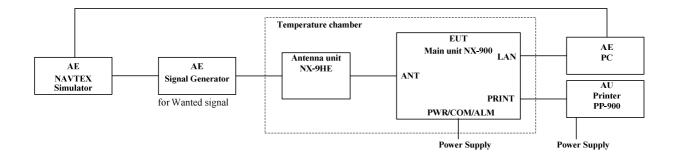


Figure 1: Anntenna unit with antenna section A and B



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 $-107 \text{ dBm} (2\mu \text{V} \text{ for artificial antenna type a})$ or $5\mu \text{V}$ 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 $\leq 4 \%$.

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.

490kHz EFFOR Rate: 0.0% 2CZC AA00 2CZ 490 518 4209.5 KHZ ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234	
ZCZC AA00 490 518 4209.5 490 490 518 4209.5 KHZ KHZ ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 567890?:, -()'=/+ 567890?:, -()'=/+ 567890?:, -()'=/+	09.5kHz Error Rate: 0.0%
567890?: ()'=/+ ABCDEFGHIJ KLMNOPQRST UVWXYZ1234 ABC	CDEFGHIJ KLMNOPQRST UVWXYZ1234 67890?:., -()'=/+ CDEFGHIJ KLMNOPQRST UVWXYZ1234 67890?:., -()'=/+ CDEFGHIJ KLMNOPQRST UVWXYZ1234 67890?:., -()'=/+

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



[Results] A-ANT

	Test conditions		Sen	sitivity level [dBm@CEI	8%]					
	Temperature	Voltage	490 kHz	518 kHz	4209.5 kHz	Satisfactory				
Normal	Tnom (+15 to +35 °C)	Vnom (24.0 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass				
Extreme	Tnom	Vmin (10.8 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass				
Extreme	(+15 to +35 °C)	Vmax (31.2 V)	-107 dBm@0%	-107 dBm@0%	-107 dBm@0%	Pass				
	Tmin	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass				
Voluntary	(-25 °C)	Vmax (31.2 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass				
Testing	Tmax	Vmin (10.8 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass				
	(+55 °C)	Vmax (31.2 V)	-107dBm@0%	-107dBm@0%	-107dBm@0%	Pass				
Limits	Limits		≤ -107 dBm @ ≤ 4%	CER						
Measuremer	Aeasurement uncertainty		±0.3dB							

B-ANT

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



[Test repeated 25 times]

A-ANT

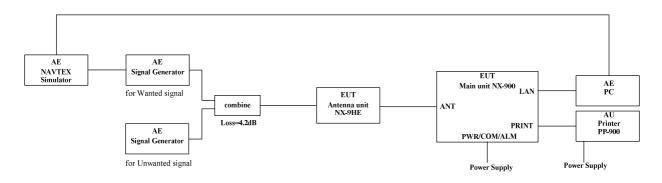
Test				W	ante	d Sig	nal I	Leve	l: -1()7 dB	m Cha	aracter	Error	Rate	(%) @	D Tno	m (+	15 to -	+35 °C	C) &V	nom (24.0V)			
receiver													(Count												Result
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
490 kHz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Pass
518 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				W	ante	d Sig	nal I	Leve	1: -10)7 dB	m Cha	aracter	Error	Rate	(%) @	9 Tno	m (+	15 to -	+35 °C	C) &V	nom (24.0V)			
receiver														Count												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 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.

	490 kHz rec	eiver	518 kHz rece	iver	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			

Table 3 – Unwanted signal levels

[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]

$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Test condi	tions	Inter	ference rejecti	on and blocking immunity			
$ Thom (+15 to +35 %C) = 518 \\ +490 \\ 518 \\ +420 \\ +490 \\ +400 \\$	Temperature	band	Frequency range				Result	
$ Thom (+15 to +35 °C) = 518 = 518 \\ 420 + 518 $				489.5kHz	0	+20	Pass	
$ Thom (+15 to +35 °C) = 518 \\ 420 = 1 \\ 100 + 487 - 489 + Hz = 489.0 + Hz = 0 \\ 100 + 487 + Hz = 491.0 + Hz = 0 \\ 100 - 487 + Hz = 493.0 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 30 + Hz = 0 \\ 100 - 487 + Hz = 0 \\ 100 - 410 + Hz = 0 \\ 100 - 515 + Hz = 518.0 + Hz = 0 \\ 100 - 515 + Hz = 518.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 519.0 + Hz = 0 \\ 100 - 515 + Hz = 1 \\ 100 - 420 - 470 + Hz = 0 \\ 100 - 420 - 470 + Hz = 0 \\ 100 - 420 - 420 \\ 100 - 420 - 420 \\ 100 - 420 - 420 \\ 100 - 420 - 420 \\ 100 - 420 - 420 \\ 100 - 420 - 5 + Hz = 420 \\ 100 - 420 - 5 + Hz = 0 \\ 100 - $				490.5kHz	0	+20	Pass	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$				489.0Hz	0	+40	Pass	
$Tnom \\ +15 to +35 °C) = 100 - 470 \\ \hline 100 - 487 kHz - 487.0kHz 0 \\ \hline 493.kHz - 30 MHz - 0 \\ \hline 156.174 MHz - 174 MHz 0 \\ \hline 156.174 MHz - 174 MHz 0 \\ \hline 156.174 MHz - 0 \\ \hline 156.175 Hz - 175 KHz 0 \\ \hline 1515 - 519 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 518.5 KHz 0 \\ \hline 100 - 515 kHz - 519.0 KHz 0 \\ \hline 100 - 515 kHz - 519.0 KHz 0 \\ \hline 100 - 515 kHz - 0 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 100 - 156 hHz - 0 \\ \hline 100 - 420 \\ \hline 10 - 40 \\$		400			0	+40	Pass	
$ Thom \\ +15 to +35 °C) $ Then the set of t		490				+70	Pass	
193 Hz 30 Hz 0 + 70 + 70 + 70 + 70 + 70 + 70 + 70 +							Pass	
$ Thom \\ +15 to +35 °C) $ $ 518 = 518 = 518 + 5$						+70	Pass	
$ Thom \\ +15 to +35 °C) $ $ 518 = \begin{cases} 156-174 \text{ MHz} & 174 \text{ MHz} & 0 & 470 & 470 & 450 + 470 & 450 + 470 \text{ MHz} & 0 & 470 & 450 + 470 \text{ MHz} & 0 & 470 & 450 + 470 \text{ MHz} & 0 & 420 & 450 + 470 & 450 + 470 & 450 + 270 & 517.51 \text{ Hz} & 517.51 \text{ Hz} & 517.5 \text{ Hz} & 0 & 420 & 420 & 518.5510 \text{ Hz} & 0 & 420 & 440 & 515.517 \text{ KHz} & 518.5510 \text{ KHz} & 0 & 440 & 515.517 \text{ KHz} & 519.0 \text{ KHz} & 0 & 440 & 519.521 \text{ KHz} & 519.0 \text{ KHz} & 0 & 440 & 519.521 \text{ KHz} & 519.0 \text{ KHz} & 0 & 440 & 519.515 \text{ KHz} & 0 & 440 & 519.515 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 515.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 30 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 30 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 30 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 30 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 519.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 470 & 521 \text{ KHz} & 50 \text{ MHz} & 0 & 4200 & 521 \text{ KHz} & 510.0 \text{ KHz} & 0 & 4200 & 521 \text{ KHz} & 520 \text{ KHz} & 200.0 \text{ KHz} & 0 & 420 & 520 \text{ KHz} & 4200.0 \text{ KHz} & 0 & 420 & 520 \text{ KHz} & 4200.0 \text{ KHz} & 0 & 440 & 520 \text{ KHz} & 520 \text{ KHz} & 520 \text{ KHz} & 520 \text{ KHz} & 0 & 440 & 520 \text{ KHz} & 0 & 440 & 520 \text{ KHz} & 520 $							Pass	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$						+70	Pass	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $							Pass	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						+70	Pass	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			Test 1				Pass Pass	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			Test 2				Pass	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				J10.JKHZ	0	+20	газз	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			515-517 kHz	515.0kHz	0	+40	Pass	
$4209.5 \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Tnom	510			0	+40	Pass	
$4209.5 \begin{array}{ c c c c c c c c c c c c c c c c c c c$	-	518				170	Pass	
$4209.5 \begin{array}{ c c c c c c c c c c c c c c c c c c c$,	-		100-515 kHz		0	+70	Pass
$4209.5 \begin{array}{ c c c c c c c c c c c c c c c c c c c$			Test 6	521.0kHz	0	170	Pass	
$4209.5 \begin{array}{ c c c c c c c c c c c } \hline 156-174 \text{MHz} & 174 \text{MHz} & 0 & +70 & \\ \hline Test 8 & 450 \text{MHz} & 0 & +70 & \\ \hline Test 8 & 450 \text{MHz} & 0 & +70 & \\ \hline 450-470 \text{MHz} & 470 \text{MHz} & 0 & +20 & \\ \hline 4208.5-4209 \text{kHz} & 4209.0 \text{kHz} & 0 & +20 & \\ \hline Test 2 & 4210-4210.5 \text{kHz} & 4210.0 \text{kHz} & 0 & +20 & \\ \hline Test 3 & 4206.5-4208.5 \text{kHz} & 4208.5 \text{kHz} & 0 & +40 & \\ \hline Test 4 & 4210.5-4212.5 \text{kHz} & 4210.5 \text{kHz} & 0 & +40 & \\ \hline Test 4 & 4210.5-4212.5 \text{kHz} & 4210.5 \text{kHz} & 0 & +40 & \\ \hline Test 5 & 100.0 \text{kHz} & 0 & +70 & \\ \hline 100-4206.5 \text{kHz} & 4206.5 \text{kHz} & 0 & +70 & \\ \hline Test 6 & 4212.5 \text{kHz} & 0 & +70 & \\ \hline Test 7 & 156 \text{MHz} & 0 & +70 & \\ \hline Test 8 & 450 \text{MHz} & 0 & & \\ \hline \end{array}$			521 kHz-30 MHz	30MHz	0	+70	Pass	
Image: Problem state in the image:						+70	Pass	
450-470 MHz 470 MHz 0 470 Test 1 4208.5-4209 kHz 4209.0kHz 0 +20 Test 2 4210-4210.5 kHz 4200.0kHz 0 +20 Test 3 4206.5-4208.5 kHz 4210.0kHz 0 +20 Test 3 4206.5-4208.5 kHz 4208.5kHz 0 +40 Test 4 4210.5-4212.5 kHz 4210.5kHz 0 +40 Test 5 100-4206.5 kHz 100.0kHz 0 +70 Test 6 4212.5 kHz-30 MHz 30MHz 0 +70 Test 7 156-174 MHz 174MHz 0 +70			156-174 MHz	174MHz		70	Pass	
430-470 MHz 470MHz 0 +20 Test 1 4208.5-4209 kHz 4209.0kHz 0 +20 Test 2 4210.0kHz 0 +20 4209.5 Test 3 4210.0kHz 0 +20 Test 3 4206.5-4208.5 kHz 4208.5kHz 0 +40 Test 3 4206.5-4208.5 kHz 4210.5kHz 0 +40 Test 4 4210.5kHz 0 +40 - Test 5 100.0kHz 0 +70 - 100-4206.5 kHz 4206.5kHz 0 +70 - Test 6 4212.5kHz 0 +70 - Test 7 156MHz 0 +70 - Test 7 156MHz 0 +70 - Test 8 450MHz 0 +70 -				450MHz	0	170	Pass	
$4209.5 + \frac{4208.5 + 4209 \text{ kHz}}{1 \text{ cst } 2} + \frac{4209.0 \text{ kHz}}{2 \text{ (4210-4210.5 \text{ kHz})}} + \frac{4209.0 \text{ kHz}}{2 \text{ (4210-4210.5 \text{ kHz})}} + \frac{4210.0 \text{ kHz}}{2 \text{ (4210-4210.5 \text{ kHz})}} + \frac{4210.0 \text{ kHz}}{2 \text{ (4210-5-4208.5 \text{ kHz})}} + \frac{4208.5 \text{ kHz}}{2 \text{ (4210.5 \text{ kHz})}} + \frac{4200.5 \text{ kHz}}{2 \text{ (4210.5 \text{ kHz})}} + \frac{4200.5 \text{ kHz}}{2 \text{ (4210.5 \text{ kHz})}} + \frac{4210.5 \text{ kHz}}{2 \text{ (4210.5 \text{ kHz})}} + \frac{4200.5 \text{ kHz}}{2 \text{ (4212.5 \text{ kHz})}} + \frac{4200.5 \text{ kHz}}{2 \text{ (4210.5 \text{ kHz})}} + \frac{4200.5 \text{ kHz}}{2 (4210.5 \text{ kH$			450-470 MHz	470MHz	0	+70	Pass	
$4209.5 \begin{array}{ c c c c c c c c } \hline 4210.4210.5 \text{ kHz} & 4210.0 \text{ kHz} & 0 & 420 \\ \hline \text{Test 3} \\ 4206.5 - 4208.5 \text{ kHz} & 4208.5 \text{ kHz} & 0 & +40 \\ \hline \text{Test 4} & 4210.5 \text{ kHz} & 0 & +40 \\ \hline \text{Test 5} & 100.0 \text{ kHz} & 0 & +70 \\ \hline \text{Test 5} & 100.0 \text{ kHz} & 0 & +70 \\ \hline \text{Test 6} & 4212.5 \text{ kHz} & 0 & +70 \\ \hline \text{Test 6} & 4212.5 \text{ kHz} & 0 & +70 \\ \hline \text{Test 7} & 156 \text{ MHz} & 0 & +70 \\ \hline \text{Test 7} & 156 \text{ MHz} & 0 & +70 \\ \hline \text{Test 8} & 450 \text{ MHz} & 0 & -70 \\ \hline \end{array}$				4209.0kHz	0	+20	Pass	
$4209.5 \begin{array}{ c c c c c c c } \hline Test 3 \\ \hline 4206.5 \cdot 4208.5 \text{ kHz} \\ \hline 4206.5 \cdot 4208.5 \text{ kHz} \\ \hline Test 4 \\ \hline 4210.5 \cdot 4212.5 \text{ kHz} \\ \hline 4210.5 \cdot 4212.5 \text{ kHz} \\ \hline 100 \cdot 4206.5 \text{ kHz} \\ \hline 100 \cdot 4212.5 \text{ kHz} \\ \hline 0 \\ \hline Test 6 \\ \hline 4212.5 \text{ kHz} \cdot 30 \text{ MHz} \\ \hline 0 \\ \hline Test 7 \\ \hline 156.174 \text{ MHz} \\ \hline 174 \text{ MHz} \\ \hline 0 \\ \hline \hline Test 8 \\ \hline 450 \text{ MHz} \\ \hline 0 \\ \hline \end{array} \begin{array}{ c c c c c c c c c c c c c c c c c c c$				4210.0kHz	0	+20	Pass	
$4209.5 \begin{array}{ c c c c c c c c c } \hline 4210.5 \text{ kHz} & 4210.5 \text{ kHz} & 0 & 440 & \hline \\ \hline 4210.5 - 4212.5 \text{ kHz} & 100.0 \text{ kHz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 4206.5 \text{ kHz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 4206.5 \text{ kHz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 300 \text{ Hz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 300 \text{ Hz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 300 \text{ Hz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 176 \text{ MHz} & 0 & & +70 & \hline \\ \hline 100 - 4206.5 \text{ kHz} & 174 \text{ MHz} & 0 & & +70 & \hline \\ \hline \hline 100 - 4206.5 \text{ kHz} & 174 \text{ MHz} & 0 & & +70 & \hline \\ \hline \hline 100 - 4206.5 \text{ kHz} & 174 \text{ MHz} & 0 & & & +70 & \hline \\ \hline \hline 100 - 4206.5 \text{ kHz} & 450 \text{ MHz} & 0 & & & & \\ \hline \hline 100 - 4206.5 \text{ kHz} & 450 \text{ MHz} & 0 & & & & & \\ \hline \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & & & & & \\ \hline 100 - 4206.5 \text{ kHz} & 0 & & & & & & & & & & & & & & & & & $				4208.5kHz	0	+40	Pass	
4209.5 Test 5 100.0kHz 0 +70 100-4206.5 kHz 4206.5kHz 0 +70 Test 6 4212.5kHz 0 +70 4212.5 kHz-30 MHz 30MHz 0 +70 Test 7 156MHz 0 +70 156-174 MHz 174MHz 0 +70 Test 8 450MHz 0 100				4210.5kHz	0	+40	Pass	
Test 6 4212.5kHz 0 4212.5 kHz-30 MHz 30MHz 0 Test 7 156MHz 0 156-174 MHz 174MHz 0 Test 8 450MHz 0		4209.5		100.0kHz	0	. 70	Pass	
Test 6 4212.5kHz 0 +70 4212.5 kHz-30 MHz 30MHz 0 +70 Test 7 156MHz 0 +70 156-174 MHz 174MHz 0 +70					0	+/0	Pass	
4212.5 kHz-30 MHz 30MHz 0 Test 7 156MHz 0 156-174 MHz 174MHz 0 Test 8 450MHz 0			Test 6	4212.5kHz	0	170	Pass	
Test 7 156MHz 0 +70 156-174 MHz 174MHz 0 +70 Test 8 450MHz 0 -			4212.5 kHz-30 MHz	30MHz	0	+/0	Pass	
156-174 MHz 174 MHz 0 +/0 Test 8 450 MHz 0 -			Test 7		0	. 70	Pass	
Test 8 450MHz 0		156-174 MHz		0	+/0	Pass		
			Test 8	450MHz	0		Pass	
+/0						+70	Pass	

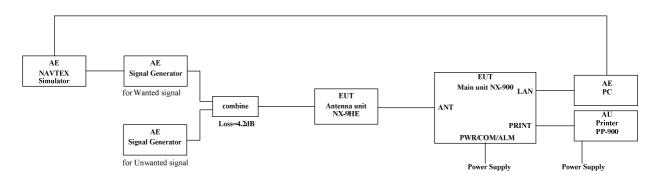


[Test repeated 25 times]

-	conditions		-1			Int	erfe	ren	ice	rej	ect	ion	and	d bl	ocl	kins	g ir	nm	uni	ty									
			C	har								@Vı					-			·	5 t	<u>د 0</u>	.35	°C)				
Frequ			C.	llai	acti		2110	IK	ale			w ۷۱					ſα	11	lom	(+1	51	U T	.55	C)				
ency	Frequency	Tested												C	oui	nt												Level	D L
band	range(Hz)	Frequency										1	1		1	1	1	1	1	1	1	0	0	2	•	_	2	[dB]	Result
[kHz]			1	2	3	4	5	6	7	8	9	$\begin{vmatrix} 1 \\ 0 \end{vmatrix}$	1	1 2	1 3	1	1 5	1 6	17	1 8	1 9	2 0	2	2 2	2 3	2 4	2 5		
												U	1	2	5	-	5	0	'	0		0	1	2	5	7	5		
	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
490	Test 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
	100-487 k	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	493.0kHz	0	0	0	0	0	0	0	-	0	0	0	-	0	-	0	0	0	0	0	0	0	0	0	0	0	+70	Pass
	493 kHz-30 M	30MHz	0	0	0	0	0	0	0	0	0	-	0		0	-	0	-	0	0	0	0	0	0			0		Pass
	Test 7	156MHz	0	0	0	0	0	0				-	0	-			0	v	0	0		0	_	0	÷		0		Pass
	156-174 M	174MHz	0	0	0	0	0	0	-	÷	-	÷	0	~	-	~	-	v	0	0	-	0	0	v	÷	-	0		Pass
	Test 8	450MHz	0	0	0	0	0	0		-		•	0	-	0	-		~	0	0		0	0	-	-		0	+70	Pass
	450-470 M	470MHz	0	0	0	0	0	0		0	0	0	0			0				0		0	0	0	0	0	0		Pass
	Test 1 517-517.5 k Test 2	517.5kHz	0	0	0	0	0	0		0	0	0	0				0			0		0		0	0	0	0	+20	Pass
	518.5-519 k Test 3	518.5kHz	0	0	0		0	0					0		0		_			0					-	0		-	Pass
	515-517 k Test 4	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
	519-521 k	519.0kHz	0	0	0	0	0	0	-				0		-				-	0			-	Ű		-	_		Pass
518	Test 5	100.0kHz	0	0	0	0	0	0		÷	~	÷	0		÷	~	~	÷	÷	0	-	0	0	÷	÷	÷	0	+70	Pass
	100-515 k	515.0kHz	0	0	0	0	0	0		÷	-	÷	0	-	0	-	~	v	0	0		0	0	0	÷	-	0	.70	Pass
	Test 6 521 kHz-30 M	521.0kHz 30MHz	0	0	0	0	0	0		_			0				-	-	-	0		0	÷	-	_	_			Pass Pass
	Test 7	156MHz	0	0	0	0	0	0		_			0	-		~		-	0	0		0	0	0			-		Pass
	156-174 M	174MHz	0	0	0	0	0	0				•	0					~		0		0	0	÷	_		_		Pass
	Test 8	450MHz	0	0	0	0	0	0	-	0		-	0	_		-		~	0	0	0	0	0	· ·	-	-	0	+70	Pass
	450-470 M	470MHz	0	0	0	0	0	0		_			0					~	0	0		0			_			170	Pass
	Test 1 4208.5-4209 k	4209.0kHz	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
4209.5	Test 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
	100-4206.5	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	+70	Pass
	Test 6	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
	4212.5 k-30M	30MHz	0	0	0	0	0	0	-	0	0	0	0	-	0	0	0	0	0	0	-	0	-	0	_	0		+70	Pass
	Test 7	156MHz	0	0	0	0	0	0		_		0	0	-		0	0	0	0	0		0	_	0		0		+70	Pass
	156-174 M	174MHz	0	0	-	0	0	0	-	~	-		0	~	_	~	~	v	0	0	-	0	-	÷	_	0			Pass
	Test 8	450MHz	0	0	0	~	-	0		0	-	-	0	-	-	0	-	~		0	_		-	÷	-	0	-	+/0	Pass
	450-470 M	470MHz	0	0	~	÷		0		-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	770	Pass
	Wanted signal level: -101 dBm, Unwanted signal is unmodulated.																												
Measur	ement uncertain	ty: ±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]

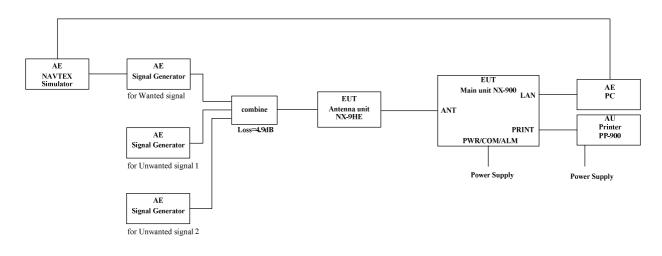
	Test conditions			Co-channel rejection						
	Temperature	Voltage	Frequency [kHz]	Character error rate [%]	Level	Result				
			490	0		Pass				
Normal	Tnom (+15 to+35 °C)	Vnom (24.0 V)	518	0	-6dB	Pass				
			4209.5	0		Pass				
Wanted signal level: -101 dBm Unwanted signal is unmodulated, signal level: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

[Test repeated 25 times]

^		(Cha	rac	ter	erro	or r	ate	[%]		@V	no	m (24.	.0V) &	Tr	non	n(+	15	to +	-35	°C)		. .	
Frequency												С	our	nt		/								/		Level	Result
[kHz]	1	2		4	5	6	7	8	9	1	1	1	1	1	1	1	1	1	1	2	2	2		2	2		
	L	2)	4	5	0		0	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5		
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		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	-6dB	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	lev	el:	-1	01 (dBı	n																					
Unwanted sign	Unwanted signal is unmodulated, signal level: -107 dBm																										
Measurement	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.

	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	

Table 4 - Intermodulation frequency pairs

[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.

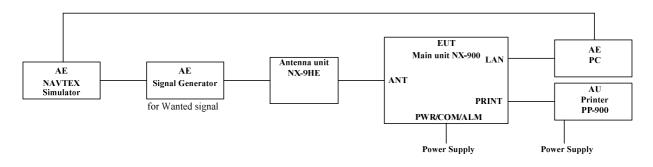


[Results]

Test condi	tions			_	
Temperature	Frequency band [kHz]	Frequency pairs	Character Error Rate (%) at Vnom (24.0 V)	Level [dB]	Result
		Test 1 488+486 kHz	0		Pass
		Test 2 487+484 kHz	0		Pass
	-	Test 3 486-482 kHz	0		Pass
	490	Test 4 492+494 kHz	0		Pass
	-	Test 5 493+496 kHz	0		Pass
	-	Test 6 494+498 kHz	0		Pass
		Test 1	0		Pass
	-	516+514 kHz Test 2 515+512 kHz	0		Pass
T	-	515+512 kHz Test 3	0		Pass
Tnom +15 to +35 °C)	518	Test 4		+50dB	Pass
	-	520+522 kHz Test 5	S20+S22 kHZ O Test 5 0 521+524 kHz 0		Pass
	-	Test 6 522-526 kHz	0		Pass
		Test 1 4207.5+4205.5 kHz	0		Pass
	-	Test 2 4206.5+4203.5 kHz	0		Pass
	-	Test 3	0		Pass
	4209.5	4205.5+4201.5 kHz Test 4	0		Pass
		4211.5+4213.5 kHz Test 5 4212.5+4215.5 kHz	0		Pass
		Test 6 4213.5+4217.5 kHz	0		Pass



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.

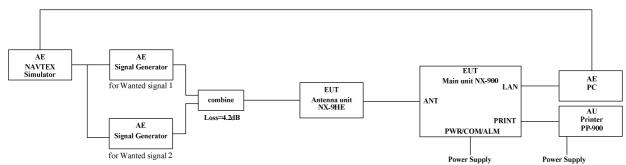
The results were verified by inspection of stated character error rate on printout of each message.

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

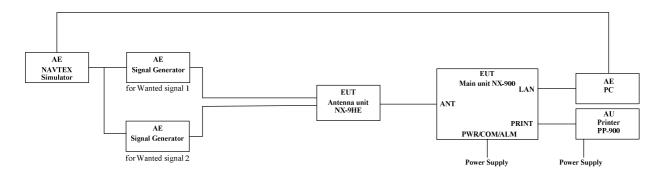
[Results]



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.

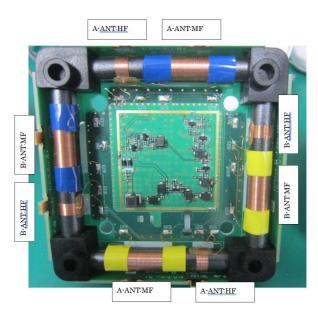


[Required results]

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.



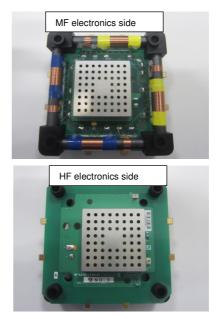


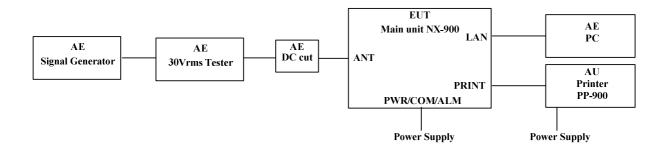
Figure 3: Antenna unit for medium and high-frequncy bands

[Results]

Test conditions	Sim	ultaneous operation of	on several receive frequencies		
		Frequency	Character error rate [%]	Limit	Result
Temperature	Test script	[kHz]	Vnom (24.0 V)	CER [%]	Result
	Signal 1 (A)	518	0		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
Tnom	Signal 2 (C)	518	0	< 4%	Pass
(+15 to +35 °C)	Signal 1 (D)	490	0	• + 70	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



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]

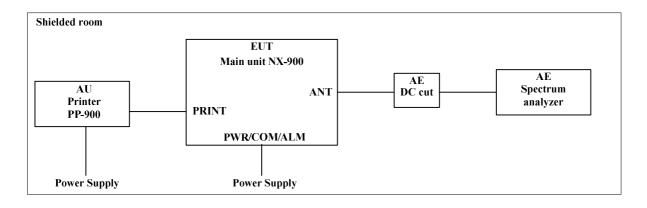
The EUT shall continue to operate normally. Verified that the sensitivity was unchanged after applying the 30V r.m.s. signal for 15min.

[Results]

	Test conditions			ts						
	Temperature	Voltage	Test Frequency	Sensitivity level [dBm@CER%]	Result				
	I		[kHz]	518 kHz	4209.5 kHz					
Normal	al 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	5	Spurious emissions														
	Temperature		Frequency band	Spurious	RBW	Spurio	ous level	Limit	Result								
	1	Voltage	1 5	frequency		[dBm]	[nW]										
			9 kHz - 150 kHz	20.36kHz	100Hz	-71.45	0.071614	((0 JD									
	Tnom	Vnom	150 kHz - 10 MHz	Hz - 10 MHz 727.3kHz 1kHz -85.45 0.00285		0.002851	< - 60 dBm (1nW)										
Normal	(+15 to			Vnom				Vnom (24.0 V)			10 MHz - 30 MHz	11.5721MHz	1kHz	-74.07	0.039174	for 9 kHz	Pass
	+35 °C)	(2 4 .0 V)	30 MHz - 1 GHz	806.385MHz	100kHz	-89.47	0.00113	- 2 GHz									
			1 GHz - 2 GHz	1.420784GHz	1MHz	-79.86	0.010328	2 0112									

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



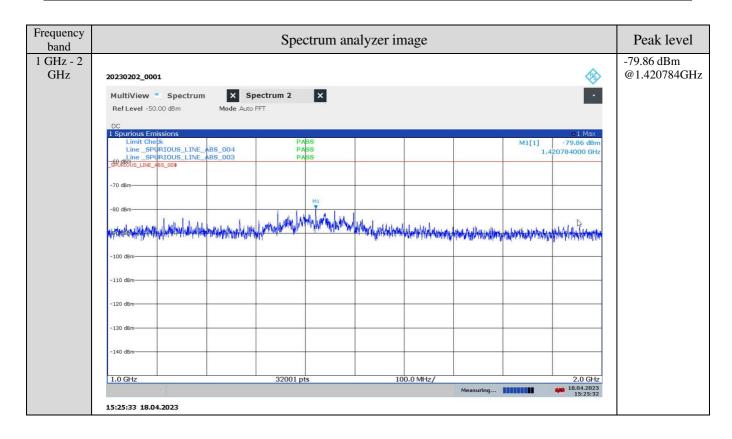
Frequency band	Spectrum analyzer image	Peak level
9 kHz - 150 kHz	20230202_0001 MultiView Spectrum 2 X Ref Level -50.00 dBm Mode Auto FFT DC	-71.45dB @20.36kHz
	1 Spurious Emissions 01 Max Limit Chelk PASS M1[1] -71.45 dBm Line_SPURIOUS_LINE_ABS_004 PASS 20.360 kHz -public_Une_ABS_003 PASS 20.360 kHz	
	-70 dbm M1 C C C C C C C C C C C C C C C C C C	
	-100 dBm	
	-130 dBm	
	9.0 kHz 701 pts 14.1 kHz/ 150.0 kHz	
150 kHz - 10 MHz	20230202_0001	-85.45dBm @727.3kHz
	I Spurious Emissions 01 Max Limit Chelk PASS M1[1] -85.45 dBm Line_SPURIOUS_LINE_ABS_003 PASS 727.300 kHz SPURIOUS_LINE_ABS_003 PASS 727.300 kHz	
	-80 dem	
	-130 dBm	
	150.0 kHz 4001 pts 985.0 kHz/ 10.0 MHz Measuring ↓ 18.04.2023 15:22:15 18.04.2023	



Frequency band	Spectrum analyzer image	Peak level
10 MHz - 30 MHz	20230202_0001 MultiView Spectrum Spectrum 2 X Ref Level -50.00 dBm Mode Auto FFT DC	-74.07dBm @11.5721MHz
	1 Spurious Emissions 01 Max Limit Chelk PASS Line_SPURIOUS_LINE_ABS_004 PASS Line_SPURIOUS_LINE_ABS_003 PASS SPURIOUS_LINE_ABS_003 PASS -70 dBm 11.572100 MHz	
	-90 dBm	
	-120 dBm	
	10.0 MHz 4001 pts 2.0 MHz/ 30.0 MHz Measuring 11.0.0 MHz 18.04.2023 15:23:50 18.04.2023	
30 MHz – 1GHz	20230202_0001 Image: Constraint of Constraints of C	-89.47 dBm @ 806.385MHz
	I Spurious Emissions O1 Max Limit Chelk PASS Line_SPURIOUS_LINE_ABS_004 PASS Line_SPURIOUS_LINE_ABS_003 PASS StriftOvs_Line_Ass_004 PASS -70 dbm -70 dbm	
	-80 dBm	
	-120 dBm	
	30.0 MHz 32001 pts 97.0 MHz/ 1.0 GHz Measuring 10 GHz 15:24:45 18.04.2023	



Doc. No.: K08-17-220 Rev. no.: 1 Date of Revision: 08 May 2023 Page: 23 / 26





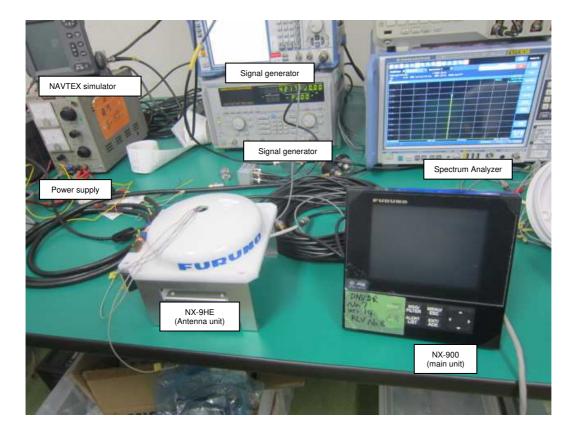
9. Used test equipment module

No.	Instrument/Ancillary	Туре	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





Doc. No.: K08-17-220 Rev. no.: 1 Date of Revision: 08 May 2023 Page: 25 / 26

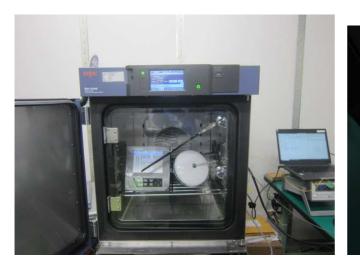


FURUNO ELECTRIC CO., LTD.



Doc. No.: K08-17-220 Rev. no.: 1 Date of Revision: 08 May 2023 Page: 26 / 26





518kHz ZCZC AA00 490 518 420		Rate:	0.0%
KHZ	KLMNOPQRST	UVWXY.	Z1234
567890?:			
567890?:	KLMNOPQRST	UVWXY	21234
NNNN			