

11 RECEIVER TESTS

The following tests shall be repeated at each of the manufacturer's stated supported frequencies in turn.

11.1 CALL SENSITIVITY

(See 6.5.3.)

11.1.1 Definition

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.

11.1.2 Method of measurement

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 (2 μ V for artificial antenna type a) or 5 μ V for artificial antenna type b)).

11.1.3 Results required

The character error rate shall be ≤ 4 %.

518kHz OK

490kHz OK

4209.5kHz OK

COMPLIANT

11.2 INTERFERENCE REJECTION AND BLOCKING IMMUNITY

11.2.1 Definition

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.

11.2.2 Method of measurement

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 7.8.

Two signals shall be applied to the EUT as specified in 7.7. 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

Test step	490 kHz receiver		518 kHz receiver		4209,5 kHz receiver	
	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

11.2.3 Results required

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

11.2.4 Results

COMPLIANT

Test step	490 kHz receiver		
	Frequency range	Level	Result
Test 1	489-489,5 kHz	+20 dB	Compliant
Test 2	490,5-491 kHz	+20 dB	Compliant
Test 3	487-489 kHz	+40 dB	Compliant
Test 4	491-493 kHz	+40 dB	Compliant
Test 5	100-487 kHz	+70 dB	Compliant
Test 6	493 kHz-30MHz	+70 dB	Compliant
Test 7	156-174 MHz	+70 dB	Compliant
Test 8	450-470 MHz	+70 dB	Compliant

Test step	518 kHz receiver		
	Frequency range	Level	Result
Test 1	517-517,5 kHz	+20 dB	Compliant
Test 2	518,5-519 kHz	+20 dB	Compliant
Test 3	515-517 kHz	+40 dB	Compliant
Test 4	519-521 kHz	+40 dB	Compliant
Test 5	100-515 kHz	+70 dB	Compliant
Test 6	521 kHz-30MHz	+70 dB	Compliant
Test 7	156-174 MHz	+70 dB	Compliant
Test 8	450-470 MHz	+70 dB	Compliant

Test step	4209,5 kHz receiver		
	Frequency range	Level	Result
Test 1	4208,5-4209 kHz	+20 dB	Compliant
Test 2	4210-4210,5 kHz	+20 dB	Compliant
Test 3	4206,5-4208,5 kHz	+40 dB	Compliant
Test 4	4210,5-4212,5 kHz	+40 dB	Compliant
Test 5	100-4206,5 kHz	+70 dB	Compliant
Test 6	4212,5 kHz-30MHz	+70 dB	Compliant
Test 7	156-174 MHz	+70 dB	Compliant
Test 8	450-470 MHz	+70 dB	Compliant

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11.3 CO-CHANNEL REJECTION

11.3.1 Definition

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.

11.3.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in item a) of 7.8.

Two signals shall be applied to the EUT as specified in 7.7. 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.

11.3.3 Results required

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

11.3.4 Results

Frequency	Compliance
518KHz	YES
490KHz	YES
4209,5KHz	YES

COMPLIANT

11.4 INTERMODULATION

11.4.1 Definition

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

11.4.2 Method of measurement

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

11.4.3 Results required

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

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11.4.4 Results

	490 kHz		Compliance
Test 1	488	486	YES
Test 2	487	484	YES
Test 3	486	482	YES
Test 4	492	494	YES
Test 5	493	496	YES
Test 6	494	498	YES

	518 kHz		Compliance
Test 1	516	514	YES
Test 2	515	512	YES
Test 3	514	510	YES
Test 4	520	522	YES
Test 5	521	524	YES
Test 6	522	526	YES

	4209.5 kHz		Compliance
Test 1	4207.5	4205.5	YES
Test 2	4206.5	4203.5	YES
Test 3	4205.5	4201.5	YES
Test 4	4211.5	4213.5	YES
Test 5	4212.5	4215.5	YES
Test 6	4213.5	4217.5	YES

COMPLIANT**11.5 OFF-FREQUENCY TRANSMITTER****11.5.1 Definition**

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.

11.5.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in item a) of 7.8.

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.

11.5.3 Results required

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

518 kHz Compliant

490 kHz Compliant

4209.5 kHz Compliant

COMPLIANT**11.6 SIMULTANEOUS OPERATION ON SEVERAL RECEIVE FREQUENCIES**

(See 6.5.1)

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11.6.1 Definition

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

11.6.2 Method of measurement

The receiver shall be connected to the artificial antenna specified in item a) of 7.8.

As in 11.1 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.

11.6.3 Results required

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

11.6.4 Results**11.7 PROTECTION OF INPUT CIRCUITS****11.7.1 Method of measurement**

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.

A performance check shall be carried out after the test signal is removed.

11.7.2 Results required

The EUT shall continue to operate normally.

11.7.3 Results

Test 518 kHz receiver: OK

Test 490 kHz receiver: OK

Test 4209.5 kHz receiver: OK

COMPLIANT

12 PRINTER TESTS

NOT APPLICABLE

12.1 BASIC REQUIREMENTS

(See 6.7.1.1 and 6.7.1.5.)

12.1.1 Method of measurement

The manufacturer shall declare the paper requirement and printing capacity of the EUT. An STS shall be applied to the EUT.

12.1.2 Results required

The declarations in Annex D shall be consistent with a minimum paper and printing capacity of 200 000 characters.

The EUT print-out shall have at least 32 easily legible characters per line. The acoustic noise shall be ≤ 60 dBA at a distance of 1 m from any part of the equipment.

12.2 PAPER ROLL END ALARM AND STORAGE INHIBITION

(See 6.7.1.5)

12.2.1 Method of measurement

The printer shall be set up so that while the STS is received the paper-end alarm is activated.

An STS +6 dB relative to the STS level, with its message content repeated 25 times, shall be applied to the EUT. A new paper roll is then inserted into the printer. One further identical STS shall be applied to the EUT.

12.2.2 Results required

The paper-end alarm shall be activated when the paper is running out.

The EUT shall neither print out the initial (for example 25 times long) test message nor store the associated message identifications.

After insertion of the new roll of paper, the EUT shall print out the (one) extra test message.

12.3 AUTOMATIC LINE FEED INDICATION AND PAPER FEED

(See 6.7.1.2)

12.3.1 Method of measurement

The manufacturer shall declare the number of characters per line for the EUT. The STS shall be applied to the EUT with a message containing more characters than the declared characters per line.

12.3.2 Results required

Any division of a word by an automatic line feed shall be indicated in the print-out. There shall be two line feeds at the end of the message.

12.4 MUTILATED CHARACTER INDICATION

(See 6.7.1.4)

12.4.1 Method of measurement

ITU-R Recommendation M.625 Annex I, 4.6.5 defines the conditions under which a character is defined as mutilated. A test signal shall be applied to the EUT containing randomly mutilated characters in the message.

12.4.2 Results required

The print-out shall contain an asterisk for each mutilated character.

12.5 TESTS OF TECHNICAL CHARACTERISTICS (ITU-R RECOMMENDATION M.540)

12.5.1 B1/B2 characters selection

(See 6.3.1) These tests are in 10.1 and 10.2.

12.5.2 Printer activation/error-free preamble B1-B4

(See 6.3.3)

12.5.2.1 Method of measurement

The EUT shall be programmed to select specific B1 and B2 characters.

An STS shall be input to the EUT with the B1, B2, B3 and B4 message identification characters mutilated in turn.

12.5.2.2 Results required

The EUT shall neither store the message identifications nor print out the messages.

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12.5.3 Non-repetitive printing of a message

(See 6.3.4)

This test is covered by 13.3.

12.5.4 Message with B3B4 = 00

(See 6.3.5)

12.5.4.1 Method of measurement

The EUT shall be programmed to select a specific *B1* character.

An STS +6 dB relative to the STS level, with *B3B4* = 00 and with the selected *B1* and then with a *B1* not selected, shall be applied to the EUT.

12.5.4.2 Results required

The EUT shall always print the test message.

13 MEMORY TESTS

These tests require that the manufacturer provides a method of deleting all stored messages via a method unavailable to the end user. The manufacturer shall also provide a 'standard test file' STF which shall be used to pre-load and 100 % fill the non-volatile message memory, and a method of loading this file into memory.

The message storage capacity shall be declared by the manufacturer.

The EUT must be configured to display/print the stations and message types used in the test.

13.1 INTERNAL STORAGE, MESSAGE TAGGING AND ERASURE OF OLDEST MESSAGE IDENTIFICATIONS

(See 6.8.1.3)

This test is not required for EUTs with integral printers and can be conducted using any combination of the declared receive frequencies as the source of test messages.

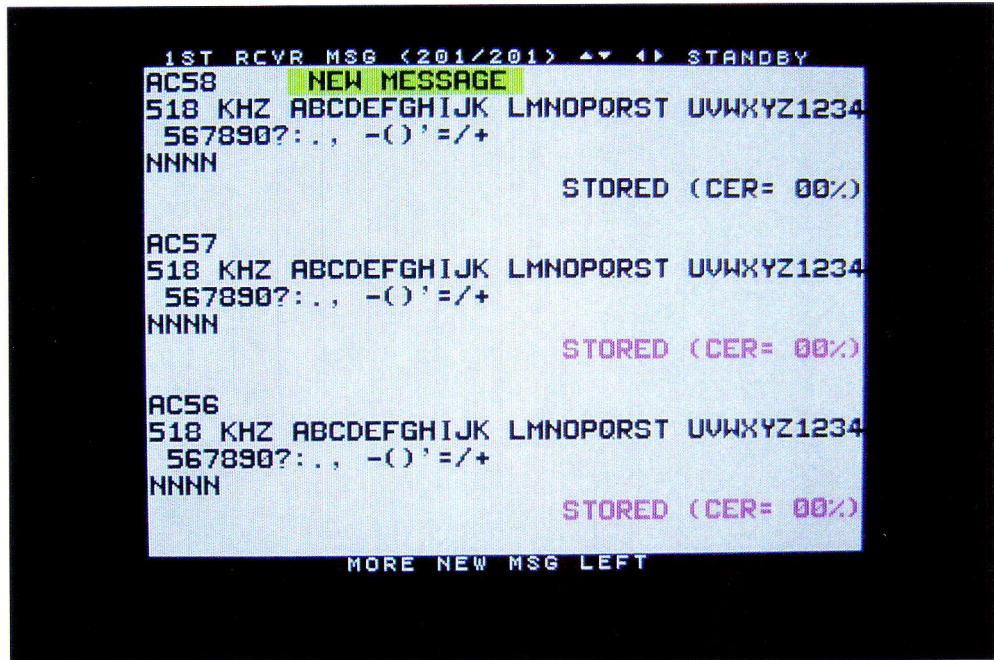
13.1.1 Method of measurement

- a) The STF shall be used to pre-load and 100 % fill the non-volatile message memory. The size of this file shall be defined by the manufacturer and the last message shall be MSGn.
- b) The 5 oldest messages shall then be tagged for permanent retention.
- c) A test script consisting of 10 unique identifiable messages each 500 characters long shall be sent to the EUT.
- d) The tagged messages shall then be untagged and a new test script of ten unique messages (MSG 211-220) shall then be sent to the EUT.

13.1.2 Results required

- a) The following results are required: a check of the EUT shall indicate that all messages of the STF have been stored;

NAVTEX messages stored
MSG1
MSG2
MSGn



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b) the EUT shall be checked to ensure it has correctly tagged the messages;

NAVTEX messages stored
MSG1 TAG
MSG2 TAG
MSG3 TAG
MSG4 TAG
MSG5 TAG
MSG6
MSGn

```

1ST RCVR MSG <2/201>  ▲▼  ◀▶  STANDBY
AA30  PROTECTED
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

AA29  PROTECTED
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

AC58  NEW MESSAGE
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

MORE NEW MSG LEFT
  
```

```

1ST RCVR MSG <6/201>  ▲▼  ◀▶  STANDBY
AA34
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

AA33  PROTECTED
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

AA32  PROTECTED
518 KHZ ABCDEFGHIJK LMNOPQRST U VWXYZ1234
567890?:., -()'=/+
NNNN
                                STORED (CER= 00%)

MORE NEW MSG LEFT
  
```

COMPLIANT

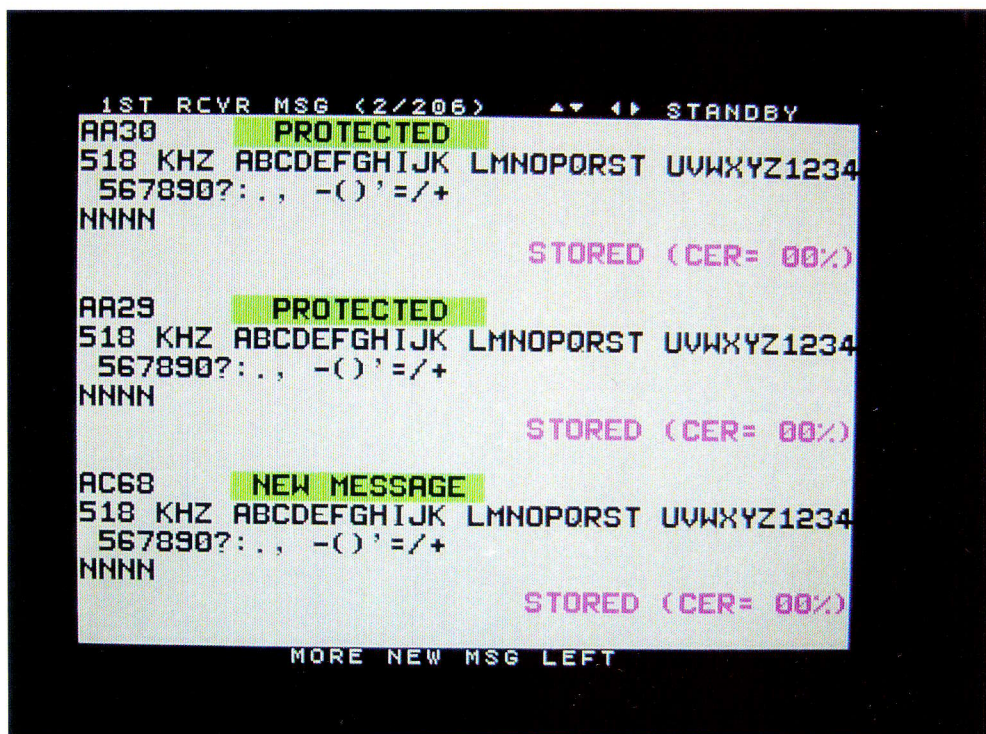
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c) a check of the EUT shall indicate that all messages of the test script have been stored, that the first (oldest) 5 tagged messages are still stored and that the next 10 oldest messages of the STF are no longer stored;

NAVTEX messages stored
MSG1 TAG
MSG2 TAG
MSG3 TAG
MSG4 TAG
MSG5 TAG

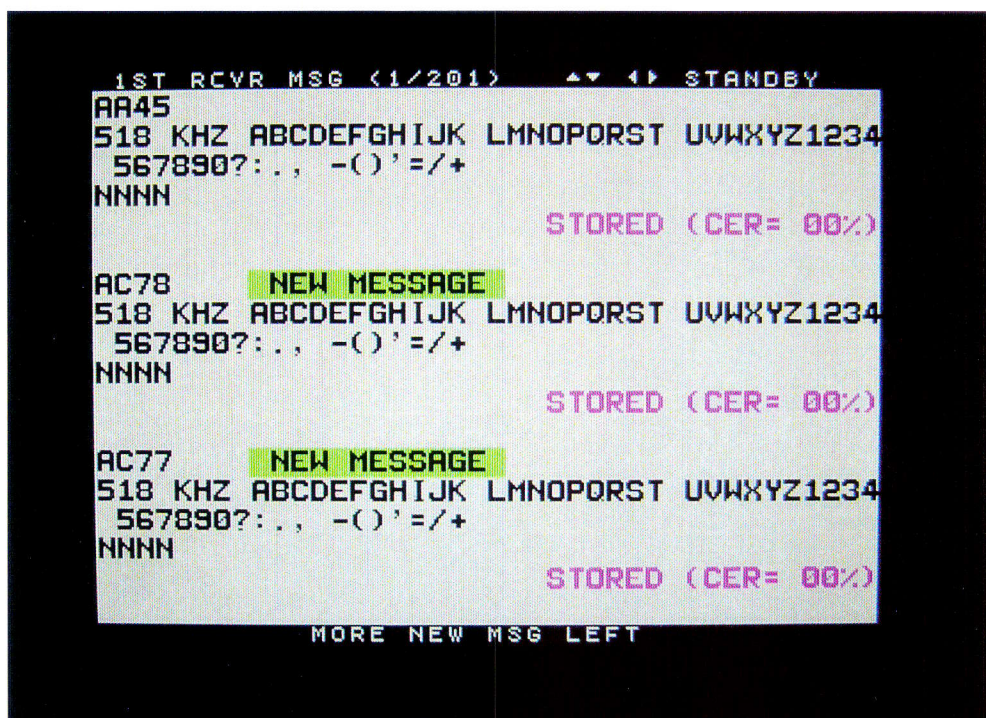
MSG16
MSGn
MSGn+1
MSGn+10



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d) a check of the EUT shall indicate that the 10 oldest messages have been replaced by the 10 new messages.

NAVTEX messages stored
MSG21
MSG22
MSG23
MSG24
MSG25
MSG26
MSGn
MSGn+1
MSGn+20



COMPLIANT

13.2 ERASURE OF MESSAGE IDENTIFICATIONS/STORAGE TIME

(See 6.8.1.3)

This test is required for EUTs that do not contain an integral printer and can be conducted using any combination of the declared receive frequencies as the source of test messages.

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13.2.1 Method of measurement

After the test of 11.1 wait 59 h and then apply to the EUT one more message with a specific message identification previously used and currently stored in the EUT. At the same time, tag another of the previously used messages for permanent retention. Wait another 2 h and apply a new previously unused message 'A'. Check the contents of non-volatile message storage. Wait another 12 h, check the contents of non-volatile message storage. Then again apply the test script of 13.1 with the message identifications previously used. Check non-volatile storage for the last time.

13.2.2 Results required

A check of the EUT shall indicate that the message applied after 59 h was not stored and did not overwrite any of the stored contents of the EUT.

A check of the EUT shall indicate that the message 'A' applied after 61 h was stored and overwrote the oldest message stored in the EUT.

A check of the EUT after 73 h shall indicate that only message 'A' and the message tagged for retention are stored in the EUT.

After applying the test script the EUT shall contain the contents of the test script, message 'A', and the message tagged for retention.

13.3 STORAGE OF MESSAGE IDENTIFICATIONS

(See 6.8.2)

This test is required for EUTs with an integral printer only and can be conducted using any combination of the declared receive frequencies as the source of test messages.

13.3.1 Method of measurement

An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of ≤ 4 %. The STS shall be repeated 35 times with unique message identification for each transmission.

After the first part of this test, wait 59 h and then apply to the EUT one more message with a specific message identification previously used and currently stored in the EUT.

Wait another 2 h and apply a new previously unused message 'A'. Check the contents of non-volatile message storage. Wait another 12 h, check the contents of non-volatile message storage. Then again apply the test script with the message identifications previously used. Check non-volatile storage for the last time

13.3.2 Results required

The print-out or display of the test messages shall be examined and the character error rate shall not exceed 4 %. The message identifications shall be stored.

A check of the EUT shall indicate that the message applied after 59 h was not stored and did not overwrite any of the stored contents of the EUT.

A check of the EUT shall indicate that the message 'A' applied after 61 h was stored in the EUT.

A check of the EUT after 73 h shall indicate that only message 'A' was stored in the EUT.

After applying the test script the EUT shall contain the contents of the test script and message A.

NOT APPLICABLE

13.4 RECEPTION OF MESSAGES WITH CHARACTER ERRORS

(See 6.3.6)

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This test is required for all EUTs and can be conducted using any combination of the declared receive frequencies as the source of test messages.

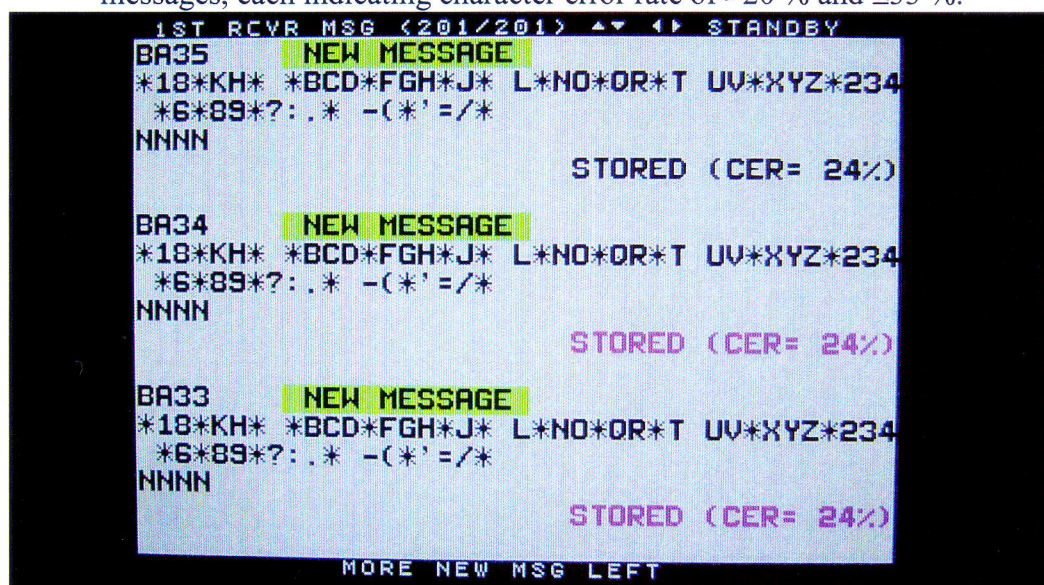
13.4.1 Method of measurement

a) An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of $>20\%$ and $\leq 33\%$. The STS shall be repeated 35 times with unique message identification for each transmission. There shall then be a check of the contents of message memory (for non-printing EUTs) or the print-out (printing NAVTEX).

b) An STS with the same 35 message identifications shall be applied to the EUT. The signal shall contain a character error rate of $>4\%$ and $\leq 20\%$. There shall then be a check of the contents of message memory (for non-printing EUTs) or the print-out (printing NAVTEX).

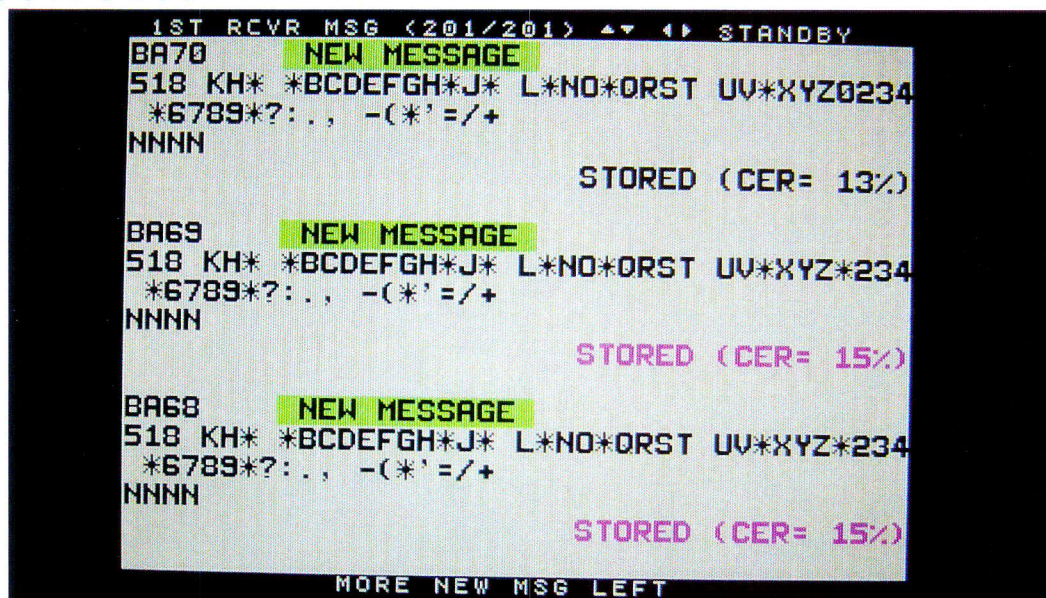
13.4.2 Results required

a) The EUT shall store (non-printing EUTs) or print (printing EUTs) the 35 messages, each indicating character error rate of $>20\%$ and $\leq 33\%$.



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b) The EUT shall store (non-printing EUTs) or print (printing EUTs) the 35 messages, each indicating character error rate of $>4\%$ and $\leq 20\%$.



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13.5 UNSATISFACTORY RECEPTION

(See 6.3.6)

This test is required for all EUTs and can be conducted using any combination of the declared receive frequencies as the source of test messages.

13.5.1 Method of measurement

An STS is applied to the EUT. The test signal shall be so composed that the message identification is correct. The signal shall contain a character error rate of >33 %. The STS shall be repeated 35 times with unique message identification for each transmission.

13.5.2 Results required

The EUT shall not store messages or message identifications. An EUT with an integral printer shall not print any of the test messages.

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13.6 POWER-OFF CHECK

(See 6.3.8)

This test is required for all EUTs that do not contain an integral printer and can be conducted using any combination of the declared receive frequencies as the source of test messages.

13.6.1 Method of measurement

The STF shall be loaded into the EUT. The power shall be removed for a period of 6 h. Power shall then be applied and the contents of the non-volatile message storage shall then be checked. The previously applied settings for transmitter coverage area (B1) and message type (B2) for each receiver and any other settings that the manufacturer has declared are non-volatile shall also be checked.

13.6.2 Results required

After a 6 h power-down cycle the EUT's non-volatile message storage shall contain the set of messages defined in the STF. All settings that the manufacturer has declared as non-volatile shall be unchanged from before the power-off cycle.

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