ETSI EN 300 338-1 V1.4.2 (2017-11)

Technical characteristics and methods of measurement for equipment for generation, transmission and reception of Digital Selective Calling (DSC) in the maritime MF, MF/HF and/or VHF mobile service; Part 1: Common requirements

Reference
REN/ERM-TG26-594

Keywords
DSC, GMDSS, maritime, radio

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org/standards-search

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx

If you find errors in the present document, please send your comment to one of the following services:
https://portal.etsi.org/People/CommiteeSupportStaff.aspx

Contents

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (https://ipr.etsi.org/).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document is part 1 of a multi-part deliverable covering Digital Selective Calling (DSC), as identified below:

Part 1: "Common requirements";

Part 2: "Class A/B DSC";

Part 3: "Class D DSC";

Part 4: "Class E DSC";

Part 5: "Handheld VHF Class H DSC";

Part 6: "Class M DSC";

Part 7: "Interfacing DSC radio equipment to Bridge Alert Management systems (BAM)";

Part 8: "Enabling DSC radio equipment with remote control capabilities".

The present document covers the common requirements for all classes of DSC equipment. Operator interfaces and operating system details are class specific and will be found in the appropriate part.

National transposition dates	
Date of latest announcement of this EN (doa):	28 February 2018
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 August 2018
Date of withdrawal of any conflicting National Standard (dow):	31 August 2019

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document states the minimum requirements for equipment to be used for generation, transmission and reception of Digital Selective Calling (DSC) for use on board ships.

DSC is intended to be used in the Medium Frequency (MF), High Frequency (HF) and Very High Frequency (VHF) bands of the Maritime Mobile Service (MMS), for distress, urgency and safety communication and general communications.

The present document is a multipart deliverable that covers the requirements to be fulfilled by:

- DSC equipment integrated with a transmitter and/or a receiver;
- DSC equipment not integrated with a transmitter and/or a receiver.

These requirements include the relevant provisions of the ITU Radio Regulations [i.17] and Recommendations ITU-R M.493-14 [2], M.541-10 [3], M.689-3 [4] and M.1082-1 [5], the International Convention for the Safety Of Life At Sea (SOLAS) [i.16], and the relevant resolutions of the International Maritime Organization (IMO).

Equipment for generation, transmission and reception of DSC designed according to the following equipment classes:

- Class A: includes all the facilities defined in annex 1 of Recommendation ITU-R M.493-14 [2] and complies with the IMO Global Maritime Distress and Safety System (GMDSS) carriage requirements for MF/HF installations and/or VHF installations.
- Class B: provides minimum facilities for equipment on ships not required to use class A equipment and complies with the minimum IMO GMDSS carriage requirements for MF and/or VHF installations. This equipment should provide for:
  - alerting, acknowledgement and relay facilities for distress purposes;
  - calling and acknowledgement for general communication purposes; and
  - calling in connection with semi-automatic/automatic services, as defined in Recommendation ITU-R M.493-14 [2], annex 2, clause 3.
- Class D: provides minimum facilities for VHF DSC distress, urgency and safety as well as routine calling and reception as recommended by IMO MSC/Circ.803 [i.2] for non-SOLAS vessels participating in the GMDSS.
- Class E: provides minimum facilities for MF and/or HF DSC distress, urgency and safety as well as routine calling and reception as recommended by IMO MSC/Circ.803 [i.2] for non-SOLAS vessels participating in the GMDSS.
- Class H: provides minimum facilities for handheld VHF DSC distress, urgency and safety as well as routine calling and reception as recommended by IMO MSC/Circ.803 [i.2] for non-SOLAS vessels participating in the GMDSS.
- Class M: provides minimum facilities for VHF Man Overboard devices as defined in Recommendation ITU-R M.493-14 [2].

NOTE 1: Class A and Class B equipment may support the optional semi-automatic/automatic service in accordance with Recommendations ITU-R M.689-3 [4], M.1082-1 [5] and M.493-14 [2], tables 4.10.1 and 4.10.2 and are encouraged to do so.

NOTE 2: Class D and Class E equipment may also support the optional semi-automatic/automatic service.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] Recommendation ITU-T E.161: "Arrangement of digits, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

[2] Recommendation ITU-R M.493-14 (2015): "Digital selective-calling system for use in the maritime mobile service".

[3] Recommendation ITU-R M.541-10 (2015): "Operational procedures for the use of digital selective-calling equipment in the maritime mobile service".

[4] Recommendation ITU-R M.689-3 (2012): "International maritime VHF radiotelephone system with automatic facilities based on DSC signalling format".

[5] Recommendation ITU-R M.1082-1 (1997): "International maritime MF/HF radiotelephone system with automatic facilities based on digital selective calling signalling format".

[6] Recommendation ITU-T V.11 (1996): "Electrical characteristics for balanced double-current interchange circuits operating at data signalling rates up to 10 Mbit/s".

[7] IEC 61162-1:2016: "Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners".

[8] IEC 61162-2 Ed. 1.0:1998: "Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 2: Single talker and multiple listeners, high-speed transmission".

[9] IEC 61162-3 Ed. 1.2:2008+AMD1:2010+AMD2:2014: "Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 3: Serial data instrument network".

[10] IEC 61162-450 Ed. 1.1:2011+AMD1:2016: "Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 450: Multiple talkers and multiple listeners - Ethernet interconnection".

[11] Recommendation ITU-R M.1080 (1994): "Digital selective calling system enhancement for multiple equipment installations".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IEC 60529 Ed. 2.1:2001: "Degrees of protection provided by enclosures (IP Code)".

[i.2] IMO Circular MSC/Circ.803: "Participation of non-SOLAS ships in the Global Maritime Distress and Safety System (GMDSS)".

[i.3] Report Recommendation ITU-R M.501: "Digital selective-calling system for future operational requirements of the maritime mobile service".

[i.4] Void.

[i.5] Recommendation ITU-R M.821-1 (1997): "Optional expansion of the digital selective-calling system for use in the maritime mobile service".

[i.6] ETSI EN 301 925: "Radiotelephone transmitters and receivers for the maritime mobile service operating in VHF bands; Technical characteristics and methods of measurement".

[i.7] ETSI EN 301 033: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Technical characteristics and methods of measurement for shipborne watchkeeping receivers for reception of Digital Selective Calling (DSC) in the maritime MF, MF/HF and VHF bands".

[i.8] ETSI EN 301 025: "VHF radiotelephone equipment for general communications and associated equipment for Class "D" Digital Selective Calling (DSC); Harmonised Standard covering the essential requirements of articles 3.2 and 3.3(g) of Directive 2014/53/EU".

[i.9] ETSI EN 300 373-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Maritime mobile transmitters and receivers for use in the MF and HF bands; Part 1: Technical characteristics and methods of measurement".

[i.10] ETSI EN 303 402: "Maritime mobile transmitters and receivers for use in the MF and HF bands; Harmonised Standard covering the essential requirements of articles 3.2 and 3.3(g) of Directive 2014/53/EU".

[i.11] ETSI EN 302 885: "Portable Very High Frequency (VHF) radiotelephone equipment for the maritime mobile service operating in the VHF bands with integrated handheld class H DSC; Harmonised Standard covering the essential requirements of articles 3.2 and 3.3(g) of Directive 2014/53/EU".

[i.12] ISO 3791: "Office machines and data processing equipment - Keyboard layouts for numeric applications".

[i.13] MSC 302(87): "Adoption of performance standards for bridge alert management".

[i.14] IEC 61924-2 Ed. 1: "Maritime navigation and radiocommunication equipment and systems - integrated navigation systems - Part 2: Modular structure for INS - operational and performance requirements, methods of testing and required test results" (including IEC 61924-2 Corrigendum 1 November 2013).

[i.15] ETSI EN 303 132: "Maritime low power VHF personal locating beacons employing Digital Selective Calling (DSC); Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[i.16] "International Convention for the Safety of Life at Sea", 1974.

[i.17] ITU Radio Regulations (2016).

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

B-state: condition when transmitting the higher of the two Digital Selective Calling (DSC) frequencies

critical error: set of information characters obtained from one or more received DSC messages is considered to have critical errors if the automated procedure needs information characters from that set in order to proceed or perform any task, but the required information characters are in error

EXAMPLE: An acknowledgement cannot be composed to an individual DSC message that has errors in the sender's MMSI.

distress alert: single DSC sentence containing the distress format character and the distress information

distress alert attempt: complete set of distress alerts used during the transmission stage

NOTE: Usually an attempt consists of 5 distress alerts sent without a break.

distress class call: special set of DSC messages that contain the distress information and whose frequency of subsequent communication is taken implicitly from the frequency on which the DSC message is sent

NOTE: They include the distress alert, distress relay, distress alert acknowledgement, and distress relay acknowledgement.

distress information: string of DSC characters making up the five pieces of information describing a distress event

NOTE 1: They consist of (in order) the Maritime Mobile Service Identity (MMSI) number of the vessel in distress, the nature of distress, the position of the vessel in distress, the time of that position, and the preferred means of subsequent communication.

NOTE 2: It is only found in distress category calls.

distress relay: means of sending a "distress alert" from a vessel, which itself is not in distress, for a vessel that is in distress but unable to send its own distress or to relay distress information that has not otherwise been acknowledged as received

general class call: all the DSC messages that do not contain the distress information and in those cases where there are subsequent communications, the frequencies and/or channels of these communications are given explicitly in the message

NOTE: The set also includes all the special calls that do not involve subsequent communications such as the test call and position and polling request.

multi frequency alert attempts: use of consecutive transmissions on between three and six frequencies, including both the MF and HF 8 MHz band DSC distress and safety frequencies

standby: state of the operational unit when it is not in one of the procedures but is still able to receive DSC calls

valid MMSI: maritime mobile service identity formed of a series of nine digits, consisting of three digits of the Maritime Identification Digits (MID) and six more digits

NOTE 1: These identities are included in the address and self-identification parts of the call sequence and are transmitted as five characters $C_5C_4C_3C_2C_1$, comprising the ten digits of:

(X_1, X_2) (X_3, X_4) (X_5, X_6) (X_7, X_8) and (X_9, X_{10})

respectively, whereas digit X_{10} is always the figure 0 unless the equipment is also designed in accordance with Recommendation ITU-R M.1080 [11].

NOTE 2: This is defined in the ITU Radio Regulations [i.17], Article 19.

Y-state: condition when transmitting the lower of the two DSC frequencies

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
BAM	Bridge Alert Management
CH	Channel
DC	Direct Current
DSC	Digital Selective Calling
DX	First transmission of sequence
ECC	Error Check Character
EUT	Equipment Under Test
FM	Frequency Modulation
FSI	Frequency Set Information
GGA	GPS fix data
GLL	Geographical position Lat/Long
GMDSS	Global Maritime Distress and Safety System
GNS	GNSS fix data
HF	High Frequency
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
ISO	International Standardization Organization
ITU	International Telecommunications Union
ITU-R	ITU - Radiocommunications sector
ITU-T	ITU - Telecommunications sector
MF	Medium Frequency
MID	Maritime Identification Digits
MMS	Maritime Mobile Service
MMSI	Maritime Mobile Service Identity
MSC	Maritime Safety Committee (IMO)
PM	Phase Modulation
RF	Radio Frequency
RMC	Recommended Minimum transit data
Rx	Receive
S/N	Signal to Noise
SOLAS	Safety Of Life At Sea
SSB	Single Side Band
STS	Standard Test Signal
Tx	Transmit
UTC	Universal Time Co-ordinated
VHF	Very High Frequency

4 General requirements

4.1 General

The equipment shall comprise the necessary facilities for coding and transmission of DSC and for decoding and conversion of the information content of received DSC to visual form in plain language.

A naming convention is used that is based upon how the messages are handled in software or by the automated procedures. This approach organizes the DSC messages into two major sets; DSC messages that contain the distress information (distress DSC messages), and those that do not (non distress DSC messages).

Within the non distress DSC messages the operator generally has the option to specify the addressing mode or destination (format), the priority (category), the type of subsequent communication or activity (telecommand), and the frequency or channel (frequency message) parameters. Certain DSC messages require a fixed set of these parameter combinations and these DSC messages have been given the names test, position request, group, individual routine, medical transports, and neutral craft. The remaining DSC messages are denoted as "general" when necessary.

The language of the present document is necessarily detailed to clearly describe the internal operation of the equipment. The designer and/or manufacturer shall be aware that simple language or graphics shall be used in the user interface. This language shall be readily understood by the mariner required to carry this class of equipment. For instance, the interface shall use terms such as "OK" or "Cancel" instead of "terminate procedure", and "all ships" instead of "format 116", and "radio telephone" instead of "telecommand J3E", and use labels such as "Calling station 567555454" instead of "Sending non distress automated procedure".

The design and function of DSC equipment shall comply with the provisions of Recommendations ITU-R M.493-14 [2] and M.541-10 [3].

The equipment may be either:

- an independent unit for connection to an associated radiotelephone designed for maritime radio communication; or
- mechanically and electrically integrated in such radio equipment.

However in both cases the DSC equipment shall be capable of remotely switching the associated frequency (MF/HF) or channel (VHF) in the radio equipment.

4.2 Frequencies

For integrated equipment, the RF equipment shall be capable of operation on one or more of the following frequencies for distress, urgency and safety purposes:

- 2 187,5 kHz (MF);
- 4 207,5 kHz, 6 312 kHz, 8 414,5 kHz, 12 577 kHz and 16 804,5 kHz (HF);
- VHF channel 70 (156,525 MHz).

Such integrated equipment shall also be capable of operation on one or more of the following frequencies for routine call purposes:

- 2 177,0 kHz simplex (ship to ship MF);
- 2 177,0 kHz Rx / 2 189,5 kHz Tx (ship to coast station MF);
- within the band 4 MHz to 27,5 MHz (HF) as defined in Recommendation ITU-R M.541-10 [3], annex 5;
- VHF channel 70 (156,525 MHz).

Additionally the equipment may be capable of operation on frequencies from the following bands as permitted by the ITU Radio Regulations [i.17]:

- 415 kHz to 526,5 kHz;
- 1 606,5 kHz to 4 000 kHz;
- 4 MHz to 27,5 MHz;
- 156 MHz to 174 MHz.

4.3 Classes of emission

Integrated equipment used for MF/HF transmission and/or reception shall provide for the following classes of emission:

F1B Frequency Modulation (FM) with digital information, without a sub-carrier for automatic reception; or

J2B Single SideBand (SSB) with digital information, with the use of a modulating sub-carrier, with the carrier suppressed to at least 40 dB below peak envelope power.

Integrated equipment used for VHF transmission and/or reception shall provide for the following class of emission:

G2B Phase Modulation (PM) with digital information, with a sub-carrier for automatic reception.

4.4 Accessibility

All parts of the equipment which are subject to inspection and maintenance adjustments shall be easily accessible. Components shall be easily identifiable either by markings within the equipment, or with the aid of technical description.

4.5 Calibration

The equipment shall be so constructed that its main modules can easily be replaced and put into operation without elaborate calibration or re-adjustment.

4.6 Controls and indicators

4.6.1 General

The number of operational controls, their design and manner of functioning, location, arrangement and size should provide for simple, quick and efficient operation. The controls should be arranged in a manner which minimizes the risk of inadvertent activation.

Where a digital input panel with the digits "0" to "9" is provided, the digits shall be arranged to conform with Recommendation ITU-T E.161 [1]. However, where an alphanumeric keyboard layout is provided, the digits "0" to "9" may, alternatively, be arranged to conform with ISO 3791 [i.12].

All operational controls shall be easy to be identified from the position at which the operator operates the equipment.

Controls which are not necessary for normal operation of the equipment shall not be readily accessible to the operator.

4.6.2 Markings

All controls, instruments, indicators and terminals shall be clearly marked. Details of the power supply from which the equipment is intended to operate shall be clearly indicated. The type designation of the equipment shall be marked on the equipment so as to be clearly visible.

4.7 Distress alert activation

A distress alert should be activated only by means of a dedicated distress button that has no other function other than activating distress alerts. This button should not be any key of a digital input panel or a keyboard provided on the equipment. This button shall only operate if an own MMSI (clause 4.8) is installed.

The distress button should be clearly identified and be protected against inadvertent operation with a lid or cover that shall automatically re-close subsequent to any operation of the distress button.

This button shall be red in colour and marked "DISTRESS". Where a non-transparent protective lid or cover is used, it shall also be red and marked "DISTRESS".

It shall not be necessary for the user to remove seals or to break the lid or cover in order to operate the distress button.

The distress alert initiation should require at least two independent actions.

At all times it shall take a maximum of 5 seconds for lifting or opening the lid or cover and continually pressing the dedicated distress button for a minimum of 3 seconds before a distress alert is transmitted.

No other button or control on the equipment shall cause a distress alert to be transmitted, however it is composed.

The equipment shall indicate the status of the distress alert transmission.

The use of the dedicated distress button shall automatically have priority over any other operation of the equipment.

The button shall not be used for activating any other function or accessing any menu.

4.8 Own MMSI

The EUT shall have facilities for entering and storing its own 9-digit MMSI with the 10^{th} digit set automatically to 0 in its use in any DSC message unless the equipment is designed to use the 10th digit in accordance with Recommendation ITU-R M.1080 [11]. The factory default for the MMSI shall be some indicator to the equipment that it is invalid.

Once an own-MMSI is programmed, this number shall not be able to be edited by means of any of the user controls. Intervention by the manufacturer or authorized representative shall be required.

No DSC message shall be able to be sent or received without a correctly programmed own-MMSI since all DSC messages contain this number:

- If there is no correctly programmed own-MMSI entered, on switch on the EUT shall display information to the user that there is no MMSI entered, DSC is disabled, the distress button will not work, or equivalent. The EUT shall also sound a warning alarm and display the reason for the alarm and the means to silence it. This aural alarm may self terminate.

4.9 Group MMSI

The equipment shall provide at least 20 user programmable group MMSIs to enable the equipment to recognize DSC messages addressed to either the ship's MMSI or the Group MMSIs.

4.10 Own position

To enable updating of position:

1) the EUT shall have facilities for manually entering the ship's position;

2) if position data is being updated automatically, an alarm shall sound if no updating is received after a period of 10 minutes that can only be silenced manually or by the reception of new position data, a displayed reminder or error message that the automatic position updating is "offline" shall remain until the position is updated;

3) if the ship's position is older than 4 hours, an alarm shall sound that can only be silenced manually or by the reception or entry of new position data, a displayed reminder shall remain until the position is updated;

4) if the ship's position is older than 23,5 hours, the position values shall be erased, an alarm shall sound that can only be silenced manually or by the reception or entry of new position data, a displayed reminder shall remain until the position is updated.

Distress alerts shall use the expansion message unless manual input is used and no enhanced position information is available. See Recommendation ITU-R M.821-1 [i.5], clause 3.1: "*The expansion message field with enhanced position resolution may be appended to any standard DSC transmission sequences which include position information, provided the data is available*".

4.11 Light sources

If the equipment is provided with light sources for indication, illumination, etc., the equipment shall be provided with a control by which the light from such sources can be reduced either continuously or in steps to the point of extinction.

If extinguished - light shall be automatically restored to the lowest visible level if the equipment is engaged or any control is operated. Following this shall be possible to override manually.

However, warning and alarm indicators which are illuminated in the warning/alarm condition and indicators required for switching the equipment on or off, or resetting the equipment, or initiating a distress alert shall be clearly visible in all appropriate conditions of ambient illumination.

4.12 Operation

The equipment shall be so designed that misuse of the controls cannot cause damage to the equipment or injury to personnel.

For integrated equipment means shall be provided to interrupt the transmissions and to reset the equipment manually.

4.13 Routine testing

For DSC equipment integrated with a radio transceiver, routine testing can use DSC Test calls and acknowledgements. For non-integrated DSC equipment manufacturers shall declare the process employed and how any error codes, etc. displayed should be interpreted.

4.14 Safety precautions

4.14.1 Excessive current and voltage

Provision shall be made for protecting the equipment from the effects of excessive current or voltage and from excessive rise of temperature in any part of the equipment due to failure of the cooling system, if any.

4.14.2 Protection

Provision shall be made for protecting the equipment from damage if the power supply is subject to transient voltage changes and from damage due to the accidental reversal of the polarity of the power supply.

No connection of, or failure within, any external circuits shall disable the DSC equipment.

4.14.3 Earthing

Means shall be provided for earthing exposed metallic parts of the equipment.

4.14.4 Access

All parts and wiring in which direct or alternating voltages, or both, (other than RF voltages) combine to give a peak voltage greater than 50 V shall be protected against accidental access and shall be isolated automatically from all sources of electrical energy if the protective covers are removed.

Alternatively, the equipment shall be so constructed that access to such voltages can only be gained after having used a tool for this purpose (e.g. a spanner or screwdriver). In this case, warning labels shall be prominently displayed both within the equipment and on protective covers.

4.15 Memory

The information in programmable memory devices shall be protected from interruptions in the power supply of at least 10 hours duration.

Non volatile memory shall be used for the following:

- Own MMSI.
- Configuration data inherent to the DSC process.
- All DSC call logs.
- The fact the equipment is turned on.

Furthermore if the equipment was interrupted during an active sending distress automated procedure, the user shall be presented with the options to resume or cancel this procedure after power has been restored.

4.16 Compass safe distance

The compass safe distance to standard, and steering, magnetic compasses shall be stated on the equipment or in the manual.

4.17 Instructions

Adequately detailed operating instructions shall be provided with the equipment.

4.18 Warming-up period

4.18.1 Time

The equipment shall be operational and shall meet the requirements of the present document within one minute after switching on, except as provided in clause 4.18.2.

4.18.2 Heaters

If the equipment includes parts which require to be heated in order to operate correctly, e.g. crystal ovens, then any warming-up period required shall be clearly documented in the operating instructions of the equipment, after which time the requirements of the present document shall be met.

Such warming-up periods shall not exceed 30 minutes.

4.18.3 Heating circuits

Where clause 4.18.2 is applicable, the power supplies to the heating circuits shall be arranged so that they can remain operative when other supplies to the equipment, or within the equipment, are switched off. If a special switch for these circuits is provided on the equipment, the function of the switch shall be clearly indicated and the operating instructions shall state that the circuit should normally be left connected to the supply voltage. A visual indication that power is connected to such circuits shall be provided on the front panel.

4.19 Selection of signal characteristics

Equipment constructed for DSC to be used on frequencies both in the MF/HF range and in the maritime VHF band shall automatically select the signal characteristics relevant to the frequency range concerned (see Recommendation ITU-R M.493-14 [2], annex 1, clauses 1.2 and 1.3).

4.20 Automatic/semi-automatic service

Equipment designed for use in an automatic/semi-automatic VHF radiotelephone service using DSC shall comply with the provisions of Recommendation ITU-R M.689-3 [4].

Equipment designed for use in an automatic/semi-automatic MF/HF radiotelephone service using DSC shall comply with the provisions of Recommendation ITU-R M.1082-1 [5].

4.21 RF power used for DSC signalling

Integrated equipment constructed for DSC to be used on frequencies both in the MF/HF range and in the maritime VHF band shall automatically select the maximum RF power relevant to the frequency range concerned. Otherwise, the DSC controller shall automatically set the RF power parameters of the FSI sentence to maximum.

5 Test conditions

5.1 Test conditions, power sources, and ambient temperatures

5.1.1 Normal and extreme test conditions

Conformance tests shall be made under normal test conditions and also, where stated, under extreme test conditions (see clauses 5.2 and 5.3 applied simultaneously).

5.1.2 Test power source

During conformance testing, the equipment shall be supplied from a test power source capable of producing normal and extreme test voltages as specified in clauses 5.2.2 and 5.3.2.

The internal impedance of the test power source shall be low enough for its effect on the test results to be negligible. For the purpose of testing, the power source voltage shall be measured at the input terminals of the equipment.

During testing, the power source voltages shall be maintained within a tolerance of ±3 % relative to the voltage level at the beginning of each test.

5.2 Normal test conditions

5.2.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be a combination of temperature and humidity within the following ranges:

- temperature: +15 °C to +35 °C;
- relative humidity: 20 % to 75 %.

Where the relative humidity is less than 20 %, it shall be stated in the test report.

5.2.2 Normal power sources

5.2.2.1 Battery power source

Where the equipment is designed to operate from a battery, the normal test voltage shall be the nominal voltage of the battery (12 V, 24 V, etc.).

5.2.2.2 Other power sources

For operation from other power sources the normal test voltage shall be that declared by the manufacturer.

5.3 Extreme test conditions

5.3.0 General

Unless otherwise stated the extreme test conditions means that the EUT shall be tested at the upper temperature and at the upper limit of the supply voltage applied simultaneously, and at the lower temperature and the lower limit of the supply voltage applied simultaneously.

5.3.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with clause 5.3.3, at a lower temperature of -15 °C and an upper temperature of +55 °C.

5.3.2 Extreme values of test power sources

5.3.2.1 Battery power source

Where the equipment is designed to operate from a battery, the extreme test voltages shall be 1,3 and 0,9 times the nominal voltage of the battery (12 V, 24 V, etc.).

5.3.2.2 Other power sources

For operation from other sources the extreme test voltages shall be those declared by the manufacturer.

5.3.3 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature stabilizing periods.

Before conducting tests at the upper temperature, the equipment shall be placed in the test chamber and left until thermal equilibrium is reached. The equipment shall then be switched on in the high power transmit condition for at least 30 minutes. The equipment shall meet the requirements of the present document after this period.

For tests at the lower temperature, the equipment shall be left in the test chamber until thermal equilibrium is reached and shall then be switched to the standby or receive position for one minute, after which the equipment shall meet the requirements of the present document.

5.4 Standard test signals

5.4.1 References to standard test signals

Standard test signals consist of a series of identical call sequences, each of which contains a known number of information symbols (format specifier, address, category, identification etc. of Recommendation ITU-R M.493-14 [2], clause 1.5).

Standard test signals should be of sufficient length for the measurements to be performed or it should be possible to repeat them without interruption to make the measurements.

5.4.2 Standard test signal no. 1

Standard test signal no. 1 for MF/HF DSC decoder shall be a signal at the nominal receiver frequency with a frequency shift of ±85 Hz and capable of being modulated with a modulation rate of 100 bit/s with various types of digital selective calls generated by the calibrated apparatus. When testing non-integrated equipment, the standard test signal no. 1 shall have a nominal frequency of 1 700 Hz.

5.4.3 Standard test signal no. 2

Standard test signal no. 2 for MF/HF DSC decoder operating with binary signals shall have logic levels complying with Recommendation ITU-T V.11 [6] and shall be modulated with a modulation rate of 100 bit/s with various types of digital selective calls generated by the calibrated apparatus.

5.4.4 Standard test signal no. 3

Standard test signal no. 3 for VHF DSC decoder shall be a phase-modulated signal at VHF channel 70 with modulation index = 2. The modulating signal shall have a nominal frequency of 1 700 Hz and a frequency shift of ±400 Hz. For non-integrated equipment, the standard test signal no. 3 shall be the modulating signal only.

5.4.5 Standard test signal no. 4

Standard test signal no. 4 for VHF DSC decoder operating with binary signals shall have logic levels complying with Recommendation ITU-T V.11 [6] and be modulated with a modulation rate of 1 200 bit/s with various types of digital selective calls generated by the calibrated apparatus.

5.5 Determination of the symbol error rate in the output of the receiving part

The information content of the decoded call sequence to which forward error correction, interleaving technique and check-sum information is applied, shall be divided into blocks, each of which corresponding to one information symbol in the applied test signal (see clause 5.4.1). The total number of incorrect information symbols relative to the total number of information symbols shall be registered.

5.6 Test Impedances

The impedances as indicated in table 1 shall be used.

Table 1: Connection Ports Impedances

Port	Application	Impedance (see note)
Analogue port	DSC analogue signals, load/source	600 Ω non-reactive
Digital port	DSC digital signals, load/source	100 Ω non-reactive
NOTE: This impedance shall be substantially constant over the frequency range of measurement.		

6 RF test or baseband test of DSC equipment

6.1 RF test of integrated DSC equipment

6.1.1 SOLAS VHF class A/B

RF tests are performed according to ETSI EN 301 925 [i.6] and ETSI EN 301 033 [i.7].

6.1.2 Non-SOLAS VHF class D

RF tests are performed according to ETSI EN 301 025 [i.8].

6.1.3 SOLAS MF/HF class A/B

RF tests are performed according to ETSI EN 300 373-1 [i.9] and ETSI EN 301 033 [i.7].

6.1.4 Non-SOLAS MF/HF class E

RF tests are performed according to ETSI EN 303 402 [i.10].

6.1.5 Non-SOLAS VHF class H

RF tests are performed according to ETSI EN 302 885 [i.11].

6.1.6 MoB class M

RF tests are performed according to ETSI EN 303 132 [i.15].

6.2 Baseband test of non integrated DSC equipment

6.2.1 VHF Encoder

6.2.1.1 Frequency error

6.2.1.1.1 Definition

The frequency error is the difference between the measured frequency and its nominal value.

6.2.1.1.2 Method of measurements

The measurement shall be carried out under normal test conditions and under extreme test conditions.

A non-reactive load of 600 Ω shall be connected to the output terminal of the equipment. The frequencies corresponding to the B-state and the Y-state (Recommendation ITU-R M.493-14 [2]) shall be measured on the output terminal. The encoder shall be set to generate continuous B or Y signal.

6.2.1.1.3 Limits

The measured frequency following after the warming up period (see clause 4.18) shall at any time for the B state be within ±10 Hz relative to 1 700 Hz + 400 Hz and for the Y state be within ±10 Hz relative to 1 700 Hz to 400 Hz.

6.2.1.2 Output voltage

6.2.1.2.1 Definition

The output voltage is the audio voltage measured across a non-reactive load of 600 Ω. For binary output, this voltage is the level of the "1" and the "0".

6.2.1.2.2 Method of measurement

A non-reactive load of 600 Ω shall be connected to the output terminal of the equipment.

The equipment shall be set to transmit continuous dot pattern, and the rms output voltage during the dot pattern shall be measured.

6.2.1.2.3 Limits

Analogue voltage

The output voltage shall be adjustable by at least ±10 dB from 0,775 V (rms).

The output level of the two tones shall not vary by more than 0,5 dB during the transmission of an information block or control signal and each tone shall be within 0,5 dB relative to the other.

Binary voltage

The levels of the output voltage shall conform to Recommendation ITU-T V.11 [6].

6.2.1.3 Bit stream speed

6.2.1.3.1 Definition

The bit stream speed is the number of bit/s.

6.2.1.3.2 Method of measurement

The equipment shall be set to transmit a continuous dot pattern.

The output terminal of the equipment shall be connected to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

The frequency of the dot pattern shall be measured.

6.2.1.3.3 Limits

The frequency shall be 600 Hz ± 30 ppm corresponding to a bit stream speed of 1 200 baud.

6.2.1.4 Unwanted spectral components of the output signal

6.2.1.4.1 Definition

Unwanted spectral components are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Unwanted spectral components include harmonic spectral components and intermodulation products.

6.2.1.4.2 Method of measurement

The output terminals of the equipment shall be connected to a non-reactive load of 600 Ω.

The equipment shall be set to transmit a continuous dot pattern.

The unwanted spectral components in the output signal shall be determined.

6.2.1.4.3 Limits

The unwanted spectral components shall fulfill the requirement in figure 1, 0 dB refers to the registered mean power output level.

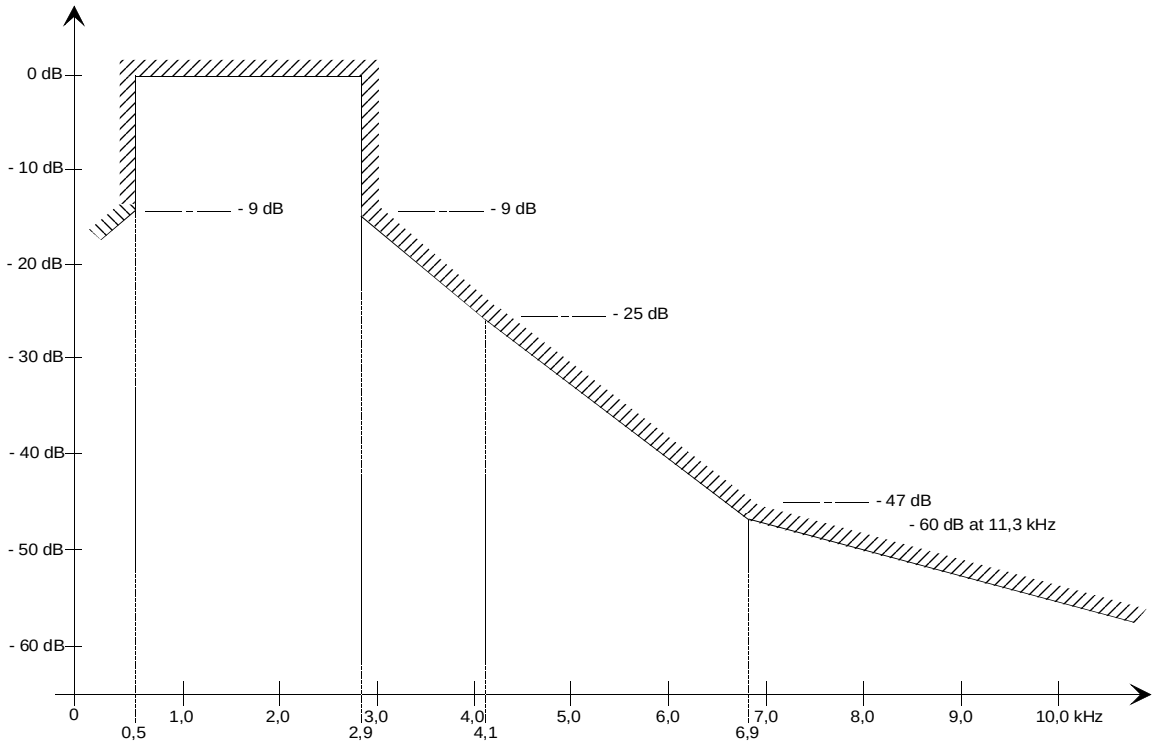

Figure 1: Unwanted spectral components (VHF DSC encoder)

6.2.1.5 Residual frequency modulation

6.2.1.5.1 Definition

The residual frequency modulation level is the ratio in dB between the noise power during the emission of a continuous B or Y signal and the output power while emitting continuous dot pattern.

6.2.1.5.2 Method of measurement

The output terminal of the equipment shall be terminated with a non-reactive load of 600 Ω and fed to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low-pass filter with a cut-off frequency of 3 kHz and a slope of 12 dB/octave.

The rms output levels shall be measured during emission of the B or Y signals and during the emission of a continuous dot pattern.

The ratio of the two rms output levels from the demodulator shall be determined.

DC voltages shall be suppressed by an AC coupling device so that they do not influence the results of the measurements.

6.2.1.5.3 Limits

The residual analogue frequency modulation ratio shall not be greater than -36 dB.

6.2.2 VHF DSC decoder

6.2.2.1 Dynamic range

6.2.2.1.1 Definition

The dynamic range of the equipment is the range from the minimum to the maximum audio frequency signal level at which a message shall be decoded without errors.

For a binary input the dynamic range is the differential input voltage necessary to assume correctly the intended binary state.

6.2.2.1.2 Method of measurement

Analogue voltage

Standard test signal no. 1 which shall be varied by ±10 dB relative to 0,775 V rms shall be applied to the input terminal of the equipment.

If the equipment is provided with a pre-set control for adjustment to different analogue-frequency input levels, this shall be set to correspond to the input level for which the equipment is designed.

The centre frequency of the test signal shall during the test periodically be changed to a value ±20 Hz relative to its nominal value.

Binary voltage

Standard test signal no. 2 which shall be varied over the entire common-mode voltage range of +7 V to -7 V with a differential input voltage of ≥ 2,0 V shall be applied to the input terminals of the equipment.

The symbol error rate in the decoder output shall be determined as described in clause 5.5.

The measurements shall be carried out under normal test conditions and under extreme test conditions.

6.2.2.1.3 Limits

Within the stated voltage range the DSC messages shall be decoded without errors.

6.2.2.2 Noise immunity

6.2.2.2.1 Definition

The noise immunity of the decoder is the S/N relative to the nominal input voltage at which the decoder gives a symbol error rate $\leq 10^{-2}$.

6.2.2.2.2 Method of test

A noise generator at 600 Ω, 0 dBm, adjustable at least ±20 dB and a bandwidth of 300 Hz to 3 000 Hz and a calibrated apparatus for generation and transmission of DSC messages, shall be connected through a suitable network simultaneously to the decoder input terminal.

The standard test signal no. 1 (clause 5.4.2) shall be applied to the decoder as applicable. The noise level shall be increased until the symbol error rate, determined as described in clause 5.5, is $> 10^{-2}$.

6.2.2.2.3 Limits

The sensitivity shall be less than or equal to 10 dB S/N.

6.2.3 MF/HF DSC encoder

6.2.3.1 Frequency error

6.2.3.1.1 Definition

The frequency error is the difference between the measured frequency and its nominal value.

6.2.3.1.2 Method of measurement

The measurement shall be carried out under normal test conditions and under extreme test conditions.

A non-reactive load of 600 Ω shall be connected to the output terminal of the equipment. The frequencies corresponding to the B state and the Y state (Recommendation ITU-R M.493-14 [2]) shall be measured on the output terminal. The encoder shall be set to generate continuous B or Y signal.

6.2.3.1.3 Limits

The measured frequency following after the warming up period (clause 4.7) shall at any time for the B state be within ±1 Hz relative to 1 700 Hz + 85 Hz and for the Y state be within ±1 Hz relative to 1 700 Hz to 85 Hz.

6.2.3.2 Output voltage

6.2.3.2.1 Definition

The output voltage is the audio voltage measured across a non-reactive load of 600 Ω. For binary output, this voltage is the level of the "1" and the "0".

6.2.3.2.2 Method of measurement

An appropriate load of 600 Ω as specified in clause 6.2.1.1.2 shall be connected to the output terminal of the equipment.

The equipment shall be set to transmit continuous dot pattern and the rms output voltage during the dot pattern shall be measured.

6.2.3.2.3 Limits

Analogue voltage

The output voltage shall be adjustable by at least ±10 dB from 0,775 V (rms).

The output level of the two tones shall not vary by more than 0,5 dB during the transmission of an information block or control signal and each tone shall be within 0,5 dB relative to the other.

Binary voltage

The levels of the output voltage shall conform with Recommendation ITU-T V.11 [6].

6.2.3.3 Bit stream speed

6.2.3.3.1 Definition

The bit stream speed is the number of bit/s.

6.2.3.3.2 Method of measurement

The equipment shall be set to transmit a continuous dot pattern.

The output terminal of the equipment shall be connected to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

The frequency of the dot pattern shall be measured.

6.2.3.3.3 Limits

The frequency shall be 50 Hz ± 30 ppm corresponding to a bit stream speed of 100 bit/s.

6.2.3.4 Unwanted spectral components of the output signal

6.2.3.4.1 Definition

Unwanted spectral components are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Unwanted spectral components include harmonic spectral components and intermodulation products.

6.2.3.4.2 Method of measurement

The output terminals of the equipment shall be connected to a non-reactive load of 600 Ω.

The equipment shall be set to transmit continuous dot pattern. The unwanted spectral components in the output signal shall be determined.

6.2.3.4.3 Limits

The unwanted spectral components shall fulfill the requirement in figure 2, 0 dB refers to the registered mean power output level.

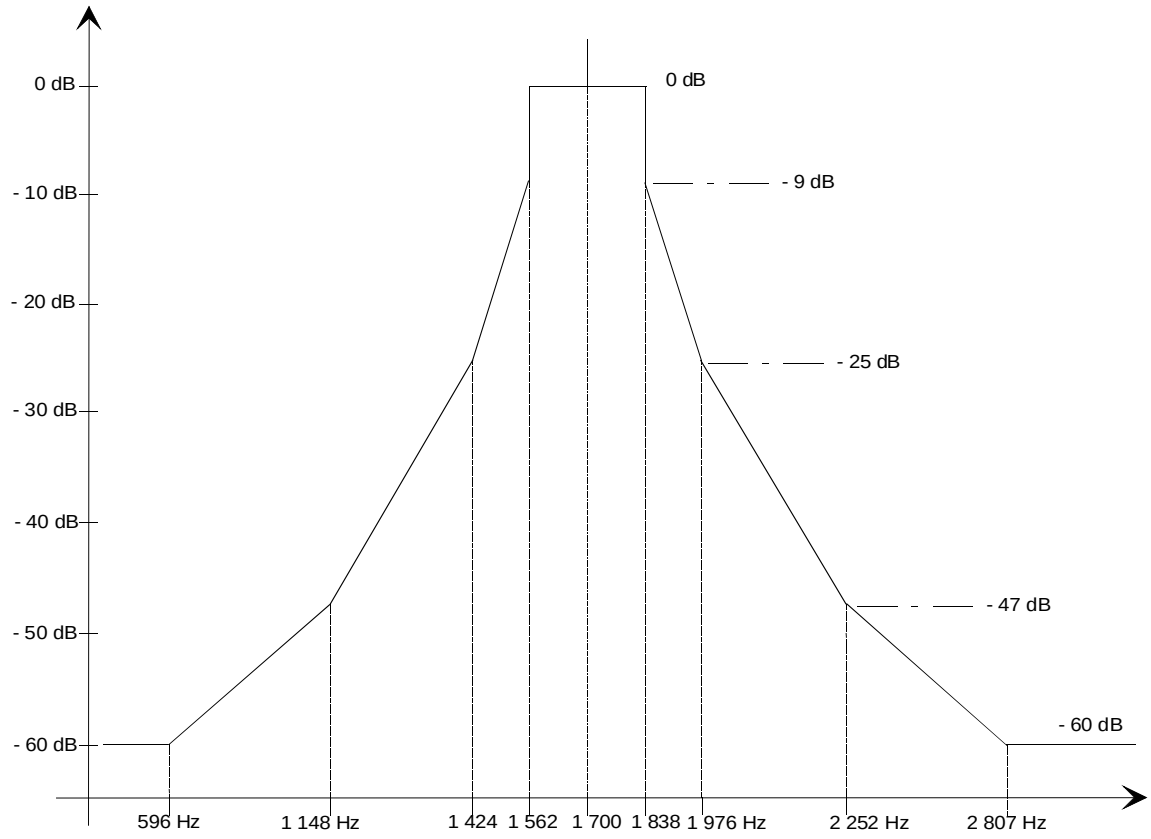

Figure 2: Unwanted spectral components (MF/HF DSC encoder)

6.2.3.5 Residual frequency modulation

6.2.3.5.1 Definition

The residual frequency modulation level is the ratio in dB between the noise power during the emission of a continuous B or Y signal and the output power while emitting continuous dot pattern.

6.2.3.5.2 Method of measurement

The output terminal of the equipment shall be terminated with a non-reactive load of 600 Ω and fed to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low-pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

The rms output level shall be measured during the emission of a continuous dot pattern and during the emission of a continuous B or Y signal.

The ratio of the two rms output levels from the demodulator shall be determined.

DC voltages shall be suppressed by an AC coupling device so that they do not influence the results of the measurements.

6.2.3.5.3 Limits

The residual frequency modulation ratio shall not be greater than -36 dB.

6.2.4 MF/HF DSC decoder

6.2.4.1 Interface for scanning

If the MF/HF DSC decoder is intended to be used with an MF/HF receiver for reception of digital selective calls with facilities for scanning six digital selective calling channels, the decoder shall fulfill the following requirements:

- The decoder shall provide a suitable signal to stop the scanning process automatically only on detection of a 100 baud dot pattern of more than 20 bits length.
- Means shall be provided at the MF/HF receiver to transmit information of the frequency or channel on which scanning has stopped using either IEC 61162-1 [7], IEC 61162-2 [8], IEC 61162-3 [9] or IEC 61162-450 [10]. The frequency or channel shall be displayed or printed in relation to the DSC message received.
- The decoder shall provide a suitable signal to restart the scanning process after receipt of a DSC message or, during the reception of a DSC message which is not addressed to the ship, as soon as it is recognized as not being addressed to the ship.
- The stop signal shall be logic "0" and the start signal shall be logic "1" with levels complying with Recommendation ITU-T V.11 [6].
- The stop and restart signals may be substituted by direct frequency setting of the scanning receiver by the DSC equipment using either IEC 61162-1 [7], IEC 61162-2 [8], IEC 61162-3 [9] or IEC 61162-450 [10].

6.2.4.2 Scanning efficiency

6.2.4.2.1 Definition

Scanning efficiency is the ability of the decoder to correctly identify DSC messages preceded by more than 20 bits of a 200 bit dot pattern ignoring all other signals and noise and generate suitable signals to control an associated scanning receiver.

6.2.4.2.2 Method of measurement

Two standard test signals no. 1 or no. 2 containing a series of DSC message sequences shall be applied alternately to the receiver at random time intervals.

One standard test signal shall be a single distress alert. The other standard test signal shall contain DSC messages with a 20 bit dot pattern.

The number of transmitted distress alerts shall be 200 and the symbol error rate shall be determined as described in clause 5.5.

6.2.4.2.3 Limits

The total number of received distress alerts shall be equal to or exceed 95 % of distress alerts transmitted and the symbol error rate shall be $\leq 10^{-2}$.

6.2.4.3 Dynamic range

6.2.4.3.1 Definition

The dynamic range of the decoder is the range from the minimum to the maximum audio frequency level at which a message shall be decoded without errors.

For a binary input the dynamic range is the differential input voltage necessary to assume correctly the intended binary state.

6.2.4.3.2 Method of measurement

Analogue voltage

Standard test signal no. 1 which shall be varied by ±10 dB relative to 0,775 V rms shall be applied to the input terminal of the equipment.

If the equipment is provided with a pre-set control for adjustment to different audio frequency input levels, this shall be set to correspond to the input level for which the equipment is designed.

The centre frequency of the test signal shall during the test periodically be changed to a value ±20 Hz relative to its nominal value.

Binary voltage

Standard test signal no. 2 which shall be varied over the entire common-mode voltage range of +7 V to -7 V with a differential input voltage of ≥ 2,0 V shall be applied to the input terminals of the equipment.

The symbol error rate in the decoder output shall be determined as described in clause 5.5.

The measurements shall be carried out under normal test conditions and under extreme test conditions.

Limits

Within the stated voltage range the DSC messages shall be decoded without errors.

6.2.4.4 Noise Immunity

6.2.4.4.1 Definition

The noise immunity of the decoder is the S/N relative to the nominal input voltage at which the decoder gives a symbol error rate 10^{-2}.

6.2.4.4.2 Method of test

A noise generator at 600 Ω, 0 dBm, adjustable at least ±20 dB and a bandwidth of 1 550 Hz to 1 850 Hz for MF/HF and a calibrated apparatus for generation and transmission of DSC messages, shall be connected through a suitable network simultaneously to the decoder input terminal.

STS-1 or STS-4 shall be applied to the decoder as applicable. The noise level shall be increased until the symbol error rate, determined as described in clause 5.5, is > 10^{-2}.

6.2.4.4.3 Limits

The sensitivity shall be less than or equal to 10 dB S/N.

7 Environmental tests

7.1 Environmental tests

7.1.1 Introduction

The equipment shall be capable of continuous operation under the conditions of various sea states, vibration, humidity and change of temperature likely to be experienced on a ship in which it is installed. The applicable tests depend on the class of DSC and the intended installation position of the equipment as declared by the manufacturer.

7.1.2 Procedure

Environmental tests shall be carried out before tests of the same equipment in respect to the other requirements of the present document are performed.

Unless otherwise stated, the equipment shall be connected to an electrical power source only during the periods for which it is specified that electrical tests shall be carried out. These shall be done with normal test voltage.

7.1.3 Performance check

For the purpose of the present document, the term performance check shall be taken to mean:

1) decoding of DSC signals:

   i) for both MF/HF and VHF decoders, the input terminals shall be connected to a calibrated apparatus for generation of DSC signals. The level of the signals shall be within +7 V and -7 V with a differential voltage of ≥ 2,0 V for binary voltage and between ± 10 dB relative to 0,775 V rms for analogue signals. The decoded call sequences at the output of the decoders shall have correct technical format, including error-check character;

2) encoding of DSC signals:

   i) for both MF/HF and VHF encoders, the method of measurement and relevant limit in clause 6.2.1.2 (VHF) or clause 6.2.3.2 (MF/HF) shall apply;

   ii) for MF/HF encoder, the method of measurement in clause 6.2.3.1.2 shall apply, with the measurement performed only for continuous B or Y state. The relevant limit in clause 6.2.3.1.3 shall apply;

   iii) for VHF encoder, the method of measurement in clause 6.2.1.1.2 shall apply, with the measurement performed only for a continuous B or Y state. The relevant limit in clause 6.2.1.1.3 shall apply;

   iv) for both MF/HF and VHF encoders, standard test signal no. 1 modulated with an undesignated distress call shall be applied. The signal shall be decoded without character errors.

7.1.4 Vibration test (all classes)

7.1.4.1 Method of measurement

The EUT, complete with any shock and vibration absorbers with which it is provided, shall be clamped to the vibration table by its normal means of support and in its normal attitude. Provision may be made to reduce or nullify any adverse effect on equipment performance which could be caused by the presence of an electromagnetic field due to the vibration unit.

The equipment shall be subjected to sinusoidal vertical vibration at all frequencies between:

- 2 Hz and 13,2 Hz with an excursion of ±1 mm ± 10 % (7 m/s^2 maximum acceleration at 13,2 Hz);
- 13,2 Hz and 100 Hz with a constant maximum acceleration of 7 m/s^2.

The frequency sweep rate shall be slow enough to allow the detection of resonances in any part of the equipment.

A resonance search shall be carried out throughout the test. If any resonance of the equipment had $Q \geq 5$ measured relative to the base of the vibration table, the equipment shall be subjected to a further vibration endurance test at each resonant frequency at the vibration level specified in the test with a duration of 2 hours. If resonances occur only with $Q < 5$, the further endurance test shall be carried out at one single observed resonant frequency. If no resonance occurs, the endurance test shall be carried out at a frequency of 30 Hz.

The performance check shall be carried out at the end of each 2 hour endurance test period.

The procedure shall be repeated with vibration in each of two mutually perpendicular directions in the horizontal plane.

After conducting the vibration tests, the equipment shall be inspected for any mechanical deterioration.

7.1.4.2 Requirement

The requirement for the performance check shall be met.

There shall be no harmful deterioration of the equipment visible to the naked eye.

7.1.5 Temperature tests

7.1.5.1 Dry heat for externally mounted equipment (all classes)

7.1.5.1.1 Method of measurement

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The EUT shall then be switched on, along with any climatic control devices with which it is provided. The temperature shall then be raised to +55 °C ± 3 °C and maintained for a period of 10 to 16 hours.

The EUT shall then be subjected to the performance checks. The temperature of the chamber shall be maintained at +55 °C ± 3 °C during the performance check.

At the end of the test, the EUT shall be returned to normal environmental conditions.

7.1.5.1.2 Requirement

The requirement for the performance check shall be met.

7.1.5.2 Damp heat cycle (all classes)

7.1.5.2.1 Method of measurement

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall be raised to +40 °C ± 2 °C, and the relative humidity raised to 93 % ± 3 % over a period of three hours ±0,5 hour. These conditions shall then be maintained for a period of 10 to 16 hours.

Any climatic control devices provided in the EUT may be switched on at the end of this period. The EUT shall be switched on thirty minutes later, or after such period as agreed by the manufacturer, and shall be kept operational for at least two hours during which period the EUT shall be subjected to the performance checks. The temperature and relative humidity of the chamber shall be maintained at +40 °C ± 2 °C and 93 % ± 3 % respectively during the performance checks.

At the end of the test period and with the EUT still in the chamber, the chamber shall be brought to room temperature in not less than one hour, and the EUT shall then be returned to normal environmental conditions.

7.1.5.2.2 Requirement

The requirement for the performance check shall be met.

7.1.5.3 Low temperature cycle

7.1.5.3.1 Method of measurement for externally mounted equipment (all classes)

The equipment shall be placed in a chamber at normal room temperature. Then the temperature shall be reduced to, and maintained at, -25 °C (±3 °C for class A/B) or -15 °C (±3 °C for class D or E) for a period of at least 10 hours.

Any climatic control devices provided in the equipment may then be switched on at the conclusion of this period.

The EUT shall be switched on 30 minutes later and shall be kept operational for at least 2 hours during which period the EUT shall be subjected to a performance check.

7.1.5.3.2 Method of measurement for internally mounted equipment

The EUT shall be placed in a chamber at normal room temperature and relative humidity. The temperature shall then be reduced to -15 °C ± 3 °C, and maintained for a period of 10 to 16 hours.

Any climatic control devices provided in the EUT may be switched on at the end of this period. The EUT shall be switched on thirty minutes later, and shall be kept operational for at least two hours during which period the EUT shall be subjected to the performance checks. The temperature of the chamber shall be maintained at -15 °C ± 3 °C during the performance checks.

At the end of the test the EUT shall be returned to normal environmental conditions.

7.1.5.3.3 Requirement

The requirement for the performance check shall be met.

7.1.6 Corrosion test (class A or B)

7.1.6.1 General

If sufficient evidence is provided by the applicant that the requirements of this clause are met then this test may be omitted.

7.1.6.2 Method of measurement

The equipment shall be placed in a chamber fitted with apparatus capable of spraying in the form of fine mist, such as would be produced by a spray gun, a salt solution to the following formula:

- sodium chloride 26,50 g ± 10 %;
- magnesium chloride 2,50 g ± 10 %;
- magnesium sulphate 3,30 g ± 10 %;
- calcium chloride 1,10 g ± 10 %;
- potassium chloride 0,73 g ± 10 %;
- sodium bicarbonate 0,20 g ± 10 %;
- sodium bromide 0,28 g ± 10 %;
- distilled water to make the solution up to 1 litre.

Alternatively a 5 % sodium chloride (NaCl) solution may be used.

The salt used for the test shall be high quality sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodide and not more than 0,3 % of total impurities.

Salt solution concentration shall be 5 % (±1 %) by weight.

The solution shall be prepared by dissolving 5 parts ± 1 by weight of salt in 95 parts by weight of distilled or demineralized water.

The pH value of the solution shall be between 6,5 and 7,2 at temperature of 20 °C (±2 °C). The pH value shall be maintained within this range during conditioning; for this purpose, diluted hydrochloric acid or sodium hydroxide may be used to adjust the pH value, provided that the concentration of NaCl remains within the prescribed limits. The pH value shall be measured when preparing each new batch of solution.

The spraying apparatus shall be such that the products of corrosion cannot mix with the salt solution contained within the spray reservoir.

The equipment shall be sprayed simultaneously on all its external surfaces with the salt solution for a period of 1 hour.

This spraying shall be carried out 4 times with a storage period of 7 days at 40 °C (±2 °C) after each spraying. The relative humidity during storage shall be maintained between 90 % and 95 %.

At the end of the total period the equipment shall be examined visually.

The equipment shall then be subjected to a performance check.

7.1.6.3 Requirements

There shall be no undue deterioration or corrosion of the metal parts, finishes, material or component parts visible to the naked eye.

In the case of hermetically sealed equipment there shall be no evidence of moisture penetration.

The requirement for the performance check shall be met.

7.1.7 Rain test (externally mounted, class A or B)

7.1.7.1 General

This test corresponds to IEC 60529 [i.1] table 2, first column, numeral 6: "Equipment protected against heavy seas".

The test shall only be performed for equipment to be externally mounted.

7.1.7.2 Method of measurement

The equipment shall be placed in an appropriate measurement chamber.

Throughout the test the equipment shall be working normally.

The test shall be carried out by spraying the equipment from all practicable directions with a stream of water from a hose.

The conditions to be observed are as follows:

- internal diameter of the nozzle: 12,5 mm;
- delivery rate: 100 l / minute (±5 %);
- water pressure at the nozzle: approximately 100 kPa (1 bar);
- test duration: 30 minutes;
- distance from the nozzle to the equipment surface: approximately 3 m.

The pressure shall be adjusted to achieve the specified delivery rate. At 100 kPa the water shall rise freely for a vertical distance of approximately 8 m above the nozzle.

At the end of the test the equipment shall be subjected to a performance check and inspected.

Following inspection, the equipment shall be resealed in accordance with the manufacturer's instructions.

7.1.7.3 Requirements

The requirements for the performance check shall be met.

There shall be no evidence of ingress of water visible to the naked eye.

8 Decoding and error correction

8.1 Reception of DSC messages

The dedicated HF watch receiver shall be set at the factory to scan all six distress, urgency and safety frequencies. If this setting can be changed by the operator a minimum of three frequencies shall be scanned. These shall include at least 2 MHz and 8 MHz.

For message detection and decoding:

a) the DSC message detection and decoding shall follow the flowchart given in annex A;

b) the receiver shall not require a dot pattern preceding the phasing sequence for correct bit phasing and unambiguous determination of the positions of the characters within a DSC message sequence;

c) the decoder shall use word recognition for the purposes of word synchronization. (Word synchronization is the stage at which the decoder is able to recognize that the dot pattern has completed and the 10-bit words of the message have started);

d) on MF/HF the decoder shall stop the scanning of the dedicated watch receiver only if the length of the dot pattern preamble is greater than 20;

e) upon word synchronization, the decoder shall use the 3-bit zero count to check the 7-bit information content of all received words. The 7-bit symbol shall be considered received in error if the 3-bit zero count is incorrect;

f) the decoder shall reject the message if the format symbol cannot be received in any of its four positions error free;

g) the decoder shall reject the message if the error-free format symbol does not have a value allowed by Recommendation ITU-R M.493-14 [2] unless the equipment is specifically designed to handle other values;

h) if the format symbol is either distress (112) or all ships (116), the message shall be rejected if the format symbol is not received correctly at least twice in either the DX or RX position;

i) for those words that are sent duplicated in the five-word time diversity pattern, the symbol shall be considered received in error if both of the symbols are received in error or both are received error free and are not equal;

j) the message shall be rejected if the format symbol is not distress (112) or all ships (116), and all five address symbols are not received correctly or if the address indicates that it is not for this station (it does not contain the station MMSI or group MMSI or the station is not in the specified geographic area);

k) the equipment shall compute a local ECC if a set of received information symbols can be obtained error-free;

l) if the DSC message is a distress alert, the equipment shall follow the decoding techniques for each individual message and successively attempt to correct any information characters received in error in previous messages with the corresponding correctly received characters in the latest message;

m) the decoder shall recognize the end of sequence pattern as the termination of a standard DSC message, regardless of what follows, and shall be able to decode the standard part of the message;

n) equipment that supports the Recommendation ITU-R M.821-1 [i.5] extensions shall be able to decode the standard part of the DSC message even when the extension is received in error;

o) if one of the four end of sequence symbols is not received error free at the end of the standard DSC message the message shall be rejected. However, if the end of sequence character is received correctly at the end of the enhanced extension the equipment shall not be prevented from using the latter end of sequence symbol to identify and accept the standard (and thus entire) message.

8.2 Error handling in the automated procedures

8.2.1 General

This clause describes the handling of received DSC messages that contain errors in any of the information characters except the format, address (the destination MMSI, group MMSI or area), and end of sequence characters which shall be received correctly in order for the message to be accepted.

NOTE: For the purposes of these tests "performing comparison error correction" between identical sets of information characters means that if one of a corresponding pair of information characters is in error, the information character in error is replaced by the information character that is not in error. A given information character is received in the DX and RX positions of the DSC message from which a final set of information characters is determined.

A DSC message shall initiate or be handled by an automated procedure if the format test passes, the destination address, and end of sequence information characters are able to be determined error free.

If an automated procedure is initiated by the reception of a DSC message that contains critical errors, the aural alarm shall self terminate.

When an automated procedure initiated with critical errors first receives a subsequent message without critical errors or the procedure is first able to correct the critical errors by combining received messages, the normal initiating alarm shall sound.

A received DSC message shall be considered pertinent to an automated procedure if the received information characters are identical to the set of information characters normally used to identify pertinence.

In no case shall the reception of an identical DSC message introduce more errors into the information characters (and their display) that are used to identify the procedure.

Automated procedures shall indicate all displayed information characters that are in error. Individual elements of any MMSIs and any position information that are in error shall be indicated by a special symbol (manufacturer defined) at the place of the error.

8.2.2 Distress automated procedures

A DSC message with errors in the ECC or information characters is considered a non distress DSC message by an automated procedure unless:

a) the format character is distress (112) which makes the message a distress alert; or

b) the format character is all ships and the number of information characters excluding the enhanced position extension is 23; or

c) the format character is area, group, or individual and the number of information characters excluding the enhanced position extension is 28 which makes the message a relay; and

d) if (b) is true and the telecommand 1 parameter is received in error and the end of sequence character is no acknowledgement requested, the DSC message shall be assumed to be a relay (it could be a distress alert acknowledgment) and an error in DSC message type shall be indicated.

A distress procedure handling an individually addressed distress relay shall not allow the sending of the acknowledgment if any one of the digits in the sender MMSI is in error.

Received distress automated procedures shall not allow the sending of any further distress DSC messages as long as any one of the current distress information characters remains in error. In that case the automated procedure shall only offer the operator the option of composing and sending a distress relay on behalf of someone else (the operator is then free to enter a best estimate of what the distress information shall be based upon the received distress information).

A distress automated procedure shall assume radio telephone if the communications parameter is received in error. The distress automated procedure shall indicate to the operator that it is making the assumption due to the error.

For a distress automated procedure to be considered acknowledged by a received distress DSC acknowledgment:

a) the MMSI (or unknown) of the vessel in distress shall be received error free;

b) if the acknowledgment is on MF/HF, the distress communications parameter shall also be received error free;

c) if the MMSI of the vessel in distress is unknown, all the parameters of the distress information shall also be received error free.

A distress automated procedure shall correct receive errors by performing comparison error correction in the following manner:

a) if the entire set of received information characters is identical to the previously received set of information characters, comparison error correction shall be performed on the entire set of information characters;

b) if only the set of received distress information characters is identical to the distress information determined from the reception of previous DSC messages, comparison error correction shall only be performed on the set of distress information characters;

c) if the new message has the enhanced position information characters comparison error correction shall be performed on the enhanced position information characters, and if the enhanced position information characters are absent in the current set of distress information characters, the current set shall be updated with the new set of enhanced position information characters;

d) if only the received distress event information characters are identical, comparison error correction shall only be performed on the distress event information characters.

8.2.3 Non distress automated procedures

A non distress automated procedure shall not tune to the frequencies of subsequent communication if the DSC message is addressed to a group, an area or all ships if the telecommand 1 (MF/HF only) and/or frequency information characters are received in error.

A non distress automated procedure shall not allow the acknowledgment of a non distress DSC message that has errors in either the category, sender MMSI, or telecommand 1 information characters.

A non distress automated procedure shall not be acknowledged by a non distress DSC acknowledgement that has errors in any one of the sender MMSI, telecommand 1, or frequency information characters.

9 Interfaces

9.1 DSC signals input/output: analogue signals

If the equipment is designed as an independent DSC unit for connection to the audio frequency terminals of external radio equipment, the input and output impedances shall be 600 Ω free of earth.

9.2 DSC signals input/output: digital signals

If the equipment is designed as an independent DSC unit, with binary inputs and outputs for DSC, the logic level shall comply with Recommendation ITU-T V.11 [6].

9.3 Entry of position information

Means shall be provided for manual entry of the geographical position information and of the time when this position information was valid. In addition, facilities for automatic entry and encoding of the geographical position, geographical area and time information (UTC) shall be provided.

As a minimum the equipment shall recognize the following sentences: GLL, GGA, RMC and GNS as defined in IEC 61162-1 [7].

Position and time information shall be supported via at least one of the following: IEC 61162-1 [7], IEC 61162-2 [8], IEC 61162-3 [9] or IEC 61162-450 [10].

In case position information is accepted from several position sources simultaneously it shall be possible to select the preferred position source either manually or automatically.

An automatic selection algorithm (using quality, priority, etc.) shall be described by the manufacturer, and the current selected position source shall be displayed to the operator on request.

9.4 Interfaces between DSC equipment and external circuits

9.4.1 Operational interfaces

The equipment may also be provided with additional suitable interfaces. These may include the following:

- the control of any external transmitter and receiver associated with the DSC operation;
- the control of scanning receivers;
- bridge alert management systems (see MSC 302(87) [i.13] and IEC 61924-2 [i.14]).

For independent units such interfaces, if provided, shall comply with either IEC 61162-1 [7], IEC 61162-2 [8], IEC 61162-3 [9] or IEC 61162-450 [10].

9.4.2 Printer output

The decoding part of the equipment may be provided with a printer or an output terminal for connecting an external printer. The electrical characteristics of the output shall be an industry standard printer type interface.

9.4.3 Other interfaces

The equipment may, in addition to the standardized interfaces, be provided with interfaces for the same functions, offering other electrical characteristics.

10 Multiple operator positions

10.1 Priority

If the equipment can be operated from more than one position, the control unit provided at the position from where the ship is normally navigated shall be considered as the priority controller. Individual control units shall be provided with an indicator showing whether the equipment is in operation.

10.2 Alarms

Any audible or visual alarm shall be relayed to all controllers.

10.3 Specific functionality

It shall not be possible for any controller to interrupt any DSC signalling that is in progress.

Any non-priority controller that can initiate DSC signalling shall have the full functionality as required for that class of DSC in the appropriate part of this multipart deliverable.

However, if a distress alert is initiated by any controller:

- it will take immediate priority over any current operation or call;
- no controller will be considered as the priority controller after a distress alert has been initiated;
- priority shall be re-established manually after any distress situation is completed.

11 Multiple radio installations

This is for equipment that is designed to use the 10^{th} digit of the DSC address in accordance with Recommendation ITU-R M.1080 [11].

DSC controllers that have a non-zero 10^{th} digit in the address shall have restricted DSC functionality as follows:

- all automatic acknowledgements shall be disabled if the 10^{th} digit is ignored in decoding.

12 Channel and frequency coding

12.1 Frequency information in DSC messages

For MF/HF both the Rx and Tx frequencies will be transmitted especially as there are occasions where split channel operation may be used.

If only 1 data field is received then the DSC decoder will assume that this is the ship Rx frequency of a standard channel pair as defined in either Appendix 17 or Appendix 18 of the ITU Radio Regulations [i.17] as appropriate.

For VHF operation only 1 data field is required to be transmitted. The first frequency element will contain the information. If both data fields are received in a message then the radio will ignore the second one.

Calls addressed to coast stations shall always use six 126 (no information) characters for the frequency information.

Unused frequency elements shall be filled with "no information" (126).

EXAMPLE 1 (table 2):

Transmitted and received frequency information:

- 1st frequency element is E1.
- 2nd frequency element is E2.

Table 2

E1 C3		E1 C2		E1 C1		E1 C0		E2 C3		E2 C2		E2 C1		E2 C0		Note
9	0	0	0	2	0	N/A		126		126		126		N/A		A
9	0	1	0	0	2	N/A		126		126		126		N/A		B
9	0	2	0	8	2	N/A		126		126		126		N/A		C
0	4	3	6	1	4	N/A		0	4	0	6	9	4	N/A		D
1	3	1	6	5	4	N/A		1	2	3	1	8	4	N/A		E
2	2	7	1	2	4	N/A		2	2	0	1	6	4	N/A		F
1	3	1	6	5	4	N/A		126		126		126		N/A		G
4	0	X	X	X	X	X	X	0	Y	Y	Y	Y	Y	Y	Y	H
4	1	X	X	X	X	X	X	126		126		126		126		I
4	2	X	X	X	X	X	X	2	Y	Y	Y	Y	Y	Y	Y	J

NOTE: For transmitted and received frequency information:

A	VHF CH:20	157,000 MHz Tx / 161,600 MHz Rx.
B	VHF CH:1002	156,100 MHz simplex.
C	VHF CH:2082	161,725 MHz simplex.
D	HF Channel 402	4 069,4 kHz Tx / 4 361,4 kHz Rx.
E	HF Channel 1230	12 318,4 kHz Tx / 13 165,4 kHz Rx.
F	HF Channel 2206	22 016,4 kHz Tx / 22 712,4 kHz Rx.
G	HF Broadcast call on	13 165,4 kHz Simplex.
H	HF Frequency	0X XXX,XX kHz Tx / 0Y YYY,YY kHz Rx.
I	HF Broadcast call on	1X XXX,XX kHz Tx.
J	HF Frequency	2X XXX,XX kHz Tx / 2Y YYY,YY kHz Rx.

EXAMPLE 2 (table 3):

Decoding frequency information.

Table 3

E1 C3		E1 C2		E1 C1		E1 C0		E2 C3		E2 C2		E2 C1		E2 C0		Note
9	0	0	0	2	0	N/A		Ignore						N/A		K
9	0	1	0	0	2	N/A		Ignore						N/A		L
9	0	2	0	8	2	N/A		Ignore						N/A		M
3	0	0	4	0	2	N/A		3	0	0	4	0	2	N/A		N
3	0	1	2	3	0	N/A		126		126		126		N/A		O
3	0	2	2	0	6	N/A		3	0	2	2	0	6	N/A		P
4	0	X	X	X	X	X	X	0	Y	Y	Y	Y	Y	Y	Y	Q
4	1	X	X	X	X	X	X	1	Y	Y	Y	Y	Y	Y	Y	R
4	2	X	X	X	X	X	X	2	Y	Y	Y	Y	Y	Y	Y	S

NOTE: For decoding frequency information:

K	VHF CH:20	157,000 MHz Tx / 161,600 MHz Rx.
L	VHF CH:1002	156,100 MHz simplex.
M	VHF CH:2082	161,725 MHz simplex.
N	HF Channel 402	4 069,4 kHz Tx / 4 361,4 kHz Rx (for reverse compatibility purposes).
O	HF Channel 1230	12 318,4 kHz Tx / 13 165,4 kHz Rx (for reverse compatibility purposes).
P	HF Channel 2206	22 016,4 kHz Tx / 22 712,4 kHz Rx (for reverse compatibility purposes).
Q	HF Frequency	0X XXX,XX kHz Tx / 0Y YYY,YY kHz Rx.
R	HF Frequency	1X XXX,XX kHz Tx / 1Y YYY,YY kHz Rx.
S	HF Frequency	2X XXX,XX kHz Tx / 2Y YYY,YY kHz Rx.

13 Call set-up procedures

For the specific case of individual calls to a ship station there is almost always uncertainty about whether the called party is within RF range. The following call set-up procedure will give a more efficient use of the RF channel as well as more confidence in call completion.

On selecting an individual call (routine) to non coast station MMSI the DSC controller will:

i) send a polling call to the called party MMSI;

ii) as soon as the calling party receives an acknowledgement to the polling call then the calling party will automatically send the individual call request;

iii) on MF/HF the polling call may be repeated once if no acknowledgement has been received during the specified waiting time (see note);

iv) if the calling party does not receive an acknowledgement to the polling call during the specified waiting time, the equipment shall indicate that called party may not be in range and that an unconfirmed call can be attempted. If the operator responds "ok" then the individual call is placed;

v) the waiting times are:

- VHF: 5 seconds;
- MF/HF: 25 seconds.

Polling calls should be automatically acknowledged by ships stations.

For the called party the call set-up procedure is as follows:

i) on receipt of a polling call it should be acknowledged as quickly as the RF channel permits. No alarm is activated on the reception of a polling call;

ii) receipt of an individual call should cause an appropriate alarm and a display of the calling party MMSI and the proposed working channel;

iii) if the proposed working channel is not programmed or not available in the equipment the called party shall automatically send an unable to comply acknowledgement (incompatible working channel);

iv) otherwise when the operator responds "ok" to accept the individual call, the called party terminal will then send an able to comply acknowledgement and then switch to the proposed working channel;

NOTE: The probability of a single DSC transmission on MF/HF being received error-free by a particular receiving station will, in general, be lower than at VHF (typically 60 % on HF; 95 % on MF (day); 100 % on VHF as given in Report ITU-R M.501 [i.3]).

Annex A (normative): DSC Message Detection and Decoding

Figure A.1 shows a schematic of the various tests and error checks that shall be performed before the message is accepted. The "bit detector" is the output of the DSC modem and provides the source of the 0 and 1 bitstream computed from the received signal. A DSC "word" consists of 10 bits, a 7-bit "symbol" and a 3-bit "number of zeros in the symbol" or "zero-count" value.

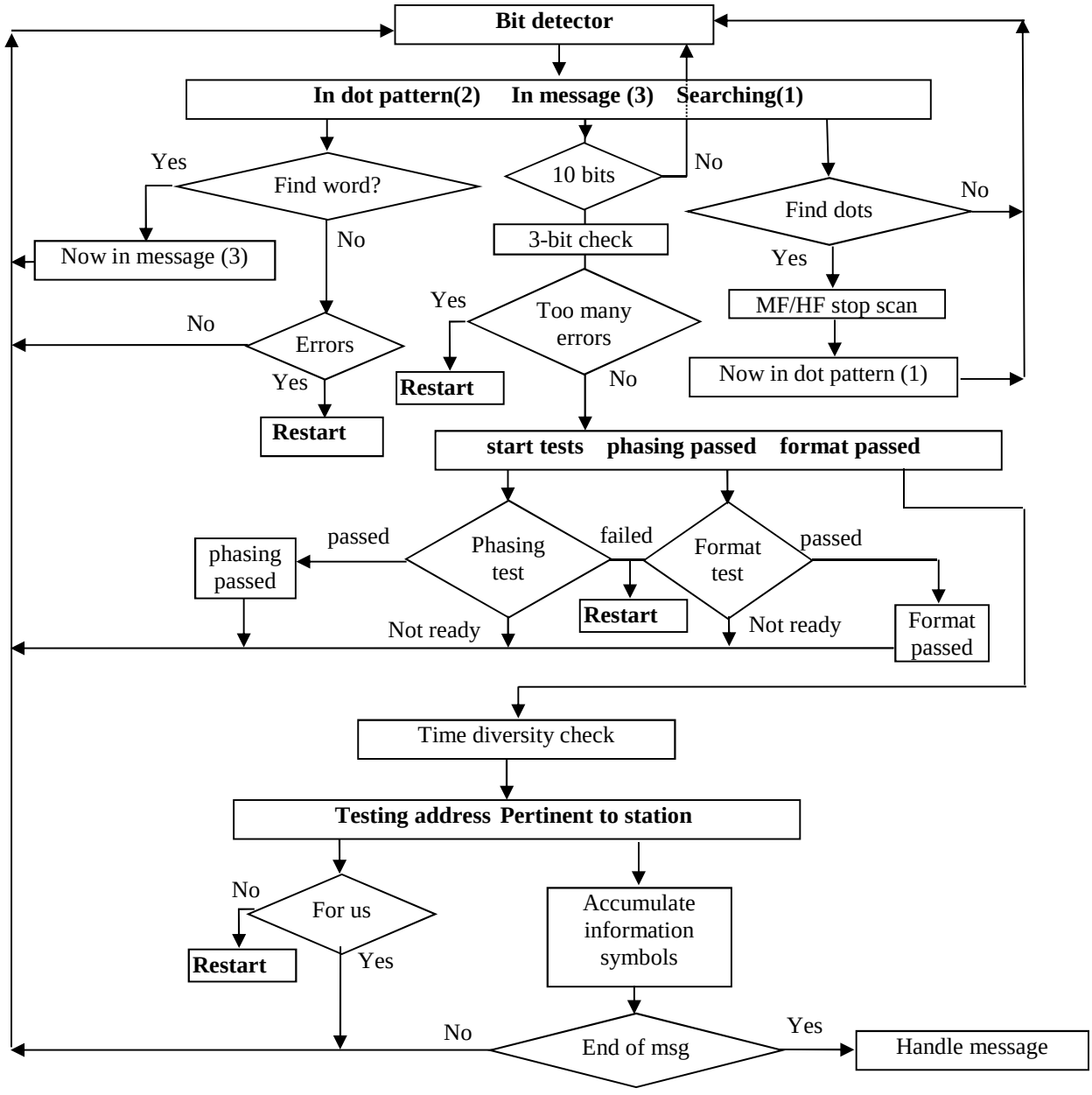

Figure A.1: Tests and error checks

History

Document history		
Edition 1	November 1995	Publication as ETSI ETS 300 338
V1.2.1	April 1999	Publication as ETSI EN 300 338
V1.3.1	February 2010	Publication
V1.4.1	February 2017	Publication
V1.4.2	November 2017	Publication