China Classification Society

Guidelines for Survey of Automatic Identification System (AIS)

2003

Guidelines for Survey of Automatic Identification System (AIS)

Contents

Chapter 1 General

1.1 General requirements

1.1.1 The Guidelines stipulate the property standards of automatic identification system (AIS), the requirements of marine product inspection, installation survey and survey in service, and relevant test methods.

1.1.2 Through satisfying the following functionalities, AIS will effectively promote the safety of navigation, marine environment protection and Vessel Traffic Service.

(1) Ship-to-ship operation mode for preventing collisions;

(2) Coastal states can obtain the information related to ships and the cargoes carried through AIS;

(3) Type of ship-to-ship operation as tools of Vessel Traffic Service (VTS).

1.1.3 The Guidelines is applicable to Class A[①] AIS equipment onboard the international and non-international ships.

1.2 Normative References

1.2.1 The following referenced documents are indispensable for the application of the Guidelines:

(1) Annex 3 of Resolution MSC.74(69); Recommendation on Performance Standards for AIS;

(2) Chapter V Safety of Navigation of the International Convention for the Safety of life at Sea adopted by MSC 73 Conference;

(3) IMO Resolution A.917 (22) Guidelines for the Onboard Operational Use of Shipborne Automatic Identification System;

(4) IEC 61993-2 Marine Navigation and Radiocommunication Equipment and Systems – Automatic Identification System – Part 2: Operation and Performance Requirements, Methods of Testing and Required test Results.

(5) ITU-R Recommendation M. 1371-1, Technical Characteristics for a Universal Shipborne Automatic Identification System Using Time Division Multiple Access in the VHF Marine Mobile Band.

1.2.2 When the Guidelines are to be carried out, the relevant provisions and requirements of international conventions, the authorities flag states and port stats.

1.3 Abbreviations

1.3.1 The following abbreviations are applicable the Guidelines:

(1) AIS – Universal shipborne automatic identification system;

(2) BER – Bit error rate;

(3) BIIT – Built-in integrity tests;

(4) COG – Course over ground;

(5) ECDIS – Electronic chart display and information system;

(6) EPFS – Electronic position-fixing system;

(7) ETA – Estimated time of arrival;

(8) EUT – Equipment under test;

---

① Performance requirements and relevant testing requirements of Class B AIS are being discussed throughout the world.

(9) GBS – GNSS Satellite fault detection: GNDSS;
(10) GGA – Global positioning system fix data;
(11) GNSS – Global navigation satellite systems;
(12) HDG – heading;
(13) HDTWPL – heading, true, waypoint location;
(14) HSC – High speed craft;
(15) IHO – International hydrographic office;
(16) LR – Long range
(17) MAC – Medium access control;
(18) MKD – Minimum keyboard and display;
(19) MMSI – Maritime mobile service identity;
(20) msg (Message);
(21) NUC – Not under command;
(22) OSD – Owner ship data;
(23) PER – Packet error rate;
(24) PI – Presentation interface;
(25) RAIN – Receiver autonomous integrity monitoring;
(26) RMC – Recommended minimum specific GDSS data;
(27) Rx – Receive / receiver;
(28) SOG – Speed over ground;
(29) Tx – Transmit / transmitter;
(30) UTC – Universal time coordination;
(31) VBW – Dual ground / water speed;
(32) VDL – VHF data link;
(33) VDM – Serial output message containing VDLK information;
(34) VSWR – Voltage standing wave ration;
(35) VTG – Course over ground and ground speed.

1.4 **Provision Requirements**[①]

1.4.1 All ships of 300 gross tonnage and upwards engaged on international voyages and cargo ships of 500 gross tonnage and upwards not engaged on international voyaged=s and passenger ships irrespective of size shall be fitted with an automatic identification system (AIS), as follows:

(1) ships constructed on or after 1 July 2002;
(2) ships engaged on international voyages constructed before 1 July 2002:
  ① in the case of passenger ships, not later than 1 July 2003;
  ② in case of tankers, not later than the first survey for safety equipment on or after 1 July 2003;
  ③ in case of ships, other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004;

[①] Modified in accordance with IMO Diplomatic Conference on Maritime Security held in December 2002.

④ in case of ships, other than passenger ships and tankers, of 300 gross tonnage and upwards, but less than 50,000gross tonnage, not later than the first survey[①] for safety equipment on or after 1 July 2004 or before 31 December 2004, whichever is earlier; and

(3) ships not engaged on international voyages constructed before 1 July 2002, not later than 1 July 2008;

(4) the Administration may exempt ships from the application of the requirements of this paragraph when such ships will be taken permanently out of service within two years after the implementation date specified in subparagraphs (2) and (3).In case of the international agreements, rules and standards providing for the protection of navigational information, ships fitted with AIS shall always keep the AIS operating.

[①] The first survey foe safety equipment means the first annual survey or first renewal survey, whichever is the earlier after 1 July 2004. In addition, the ships under construction involve initial survey.

Chapter 2 Performance Requirements

2.1 Composition[①]

.

2.1.1 The AIS shall comprise:

(1) a communication processor, capable of operating over a range of maritime frequencies with an appropriate channel selecting and switching method, in support of both short(VHF) and long (beyond VHF) range applications. For long range applications the AIS shall provide a two-way interface which complies with IEC 61162;

(2) at least one transmitter, two TDMA receivers and one dedicated DSC receiver tuned to channel 70;

(3) a means of processing data from an electronic position-fixing system which provides a resolution of one ten thousandth of a minute of arc and uses the WGS 84 datum. An interface (IEC 61162) shall be provided to input the position used for navigation;

(4) a means to automatically input data from other sensors meeting the provisions as specified in paragraph 2.5.2 (2); a means, external to the AIS, to comply with this requirement shall be tested to the applicable requirements of IEC 60945;

(5) a means to input and retrieve data manually. The possibility of manual input and retrieval as described in 2.11 shall be demonstrated based on the manufacturer's documentation;

(6) a means of error checking the transmitted and received data (see Chapter 3); and

(7) built in test equipment as specified in 2.10.1.

2.1.2 The AIS shall be capable of:

(1) providing information automatically and continuously to a competent authority and other ships, without involvement of ships personnel;

(2) receiving and processing information from other sources, including that from a competent authority and from other ships;

(3) responding to high priority and safety related calls with a minimum of delay;

(4) providing positional and manoeuvring information at a data rate adequate to facilitate accurate tracking by authority and other ships.(see 2.5.2).

2.1.3 The AIS shall work as following modes:

(1) "automatic and continuous" mode: used in the whole area. The type shall be controlled by the Administration and shall be convertible to the following modes;

(2) "indication" mode: used in the area controlled by the Administration in charge of traffic monitoring. The interval and/or time slot of data emitting shall be set by means of long range in the charge of the Administration; and

(3) "polling" or control mode: data transmitting is to respond to the polling of the ship or the Administration.

2.2 Internal GNSS Receiver

[①] For Block Diagram of AIS, see Appendix A

2.2.1 UTC source

Since UTC is required for synchronization purposes, an internal GDSS receiver shall be used to determine the UTC.

2.2.2 Source for AIS position reporting

(1) When the external position is unavailable, the internal GNSS receiver may be used as a source [①] for AIS position reporting. When the internal GNSS receiver is performing as a source for position reporting, the following requirements shall be satisfied:

① An appropriate BITT indication shall be output to PI (see 2.10.1).

② Position data shall be displayed in MKD.

③ The internal GNSS receiver shall at least be differentially modified in accordance with msg 17.

(2) When used as a source for AIS position reporting, the internal position shall comply with the following requirements of IEC 61108 standards: positioning accuracy, COG/SOG, capture, recapture, receiver sensitivity, RF dynamic range, noise immunity, position change, malfunction alarm, status display and integrity mark.

2.3 User Interface

To enable a user to access, select and display the information on a separate system, the AIS shall be provided with an inter face conforming to an appropriate international marine interface standard. All interfacing shall be made via the system interface as described in 3.6 (called presentation inter face). Where a suitable IEC 61162 interface standard is available, it shall be used. If no suitable IEC 61162 interface standard is available, an alternative appropriate interface may be used.

2.4 Identification

For the purpose of ship and message identification, the appropriate Maritime Mobile Service Identity (MMSI) number shall be used.

2.5 Information

2.5.1 Information provided by the AIS

The information provided by the AIS shall include:

(1) Static

[①] Resolution MSC. 74 (69) Annex 3 requires the AIS to have a means of processing data from an electronic position fixing system that provides a resolution of one ten thousandth of a minute of arc and uses the WGS 84 datum.

Considering:

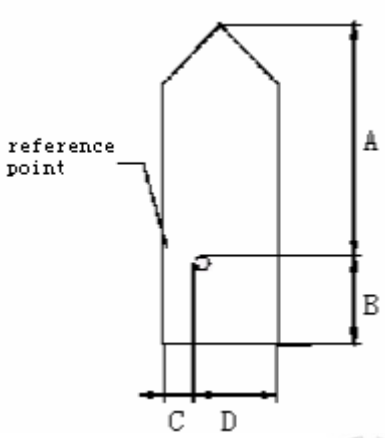
- SOLAS Ch.5 does not requires a ship to carry an EPFS fulfilling this specification,

- Resolution MSC. 74 (69) Annex 3 does not specify details of position sensor,

- Resolution A. 815 (19) requires an accuracy of position information better than 10 m in confined waters,

It is recommended that the manufacturers use a DGNSS receiver as the internal source for the AIS position.

① MMSI
② IMO number (where available)
③ Call sign and name
④ Length and beam
⑤ Type of ship
⑥ Location of the in use position-fixing antenna on the ship (aft of bow and port or starboard of centreline)



	Bit number	Bit field	Length（m）
A	9	From 0 to 8	From 0 to 511
B	9	From 9 to 17	From 0 to 511
C	6	From 18 to 23	From 0 to 63， 63=63m or more
D	6	From 24 to 29	From 0 to 63， 63=63m or more

Figure 2.5.1 (1) Reference point of reporting ship's position

(2) Dynamic
① Ship's position referenced to WGS 84 datum with accuracy indication and integrity status
② Time in UTC[①]
③ Course over ground (COG)
④ Speed over ground (SOG)
⑤ Heading
⑥ Navigation status (e.g. machine propelling navigation, at anchor, not under command (NUC), moored, draught prohibited, ground, for fishing, sailing, manual input)
⑦ Rate of turn (where available)

(3) Voyage related
① Ship's draught
② Hazardous cargo (type; as required by a competent authority)
③ Destination and estimated time of arrival (ETA) (at masters discretion)

(4) Short safety-related messages
① Short safety-related messages

2.5.2 Information update rates
(1) The different information types are valid for a different time period and thus need a different

[①] Date to be established by receiving equipment.

update rate.

① Static information: Every 6 min, when data has been amended, and on requested.

② Dynamic information: Dependent on speed and course alteration according to table 1.

③ Voyage-related information: Every 6 min, when data has been amended, and on request.

④ As requested.

Table 2.5.2 – Information update rates for autonomous mode

Type of Ship	Reporting interval
Ship at anchor or moored and not moving faster than 3 knots	3 min
Ship at anchor or moored and moving faster than 3 knots	10 s
Ship with a speed of between 0–14 knots	10 s
Ship with a speed of between 0–14 knots and changing course	3 1/3 s
Ship with a speed of between 14-23 knots	6 s
Ship with a speed of between 14-23 knots and changing course	2 s
Ship with a speed of greater than 23 knots	2 s
Ship with a speed of greater than 23 knots and changing course	2 s

Note: The reporting rate shall increase to once per 2 s when the AIS station determines that it is the semaphore.

(2) If the autonomous mode requires a higher rate than the assigned mode[①], the AIS shall use the autonomous mode.

2.5.3 Ship reporting capacity

The system shall be able to handle a minimum of 2,000 reports per minute, to provide for all operational scenarios envisioned and is capable of handling up to 4,500 reports per minute on two channels.

2.6 Security

(1) A security mechanism shall be provided to detect disabling of the AIS and to prevent unauthorized alteration of input or transmitted data. To protect the unauthorized dissemination of data, the IMO guidelines (Guidelines for Ship Reporting Systems) shall be followed[①].

(2) Means shall be provided to automatically record all periods when the AIS installation is non-functioning. It shall not be possible for the user to alter any information recorded by this device.

(3) The last 10 times when the equipment was non-functioning for more than 15 min shall be recorded, in UTC time and duration, in a non-volatile memory. Means shall be provided to recover this data.

[①] See ITU-R M.1371-1/A2-3.3.6, 3.3.6.1 and 4.3.2.

[①] See Resolution MSC.43 (64).

2.7 Permissible initialization period

The AIS installation shall be operational within 2 min of switching on[②].

2.8 Power supply

The AIS and associated sensors shall be powered from the ship's main source of electrical energy.

2.9 Technical characteristics

The technical characteristics of the AIS such as variable transmitter output power, operating frequencies (dedicated internationally and selected regionally), modulation, and antenna system shall comply with the appropriate ITU-R Recommendations. The partial characteristics are listed in the following table:

Mark	Name of characteristics	Minimum value	Maximum value
PH.RFR	Regional frequencies	156.025 MHz	162.025
PH.CHS	Channel spacing	1.5 kHz	25 kHz
PH.AIS1	AIS1 (CH87B)	161.975 MHz	161.975 MHz
PH.AIS2	AIS2 (CH88B)	161.025 MHz	161.025 MHz
PH.BR	Bits rate	9600 bps	9600bps
PH.TS	Timing sequence	24 bits	24 bits
PH.TST	Stability time of transmitter Transmitter power within 20% at last value Stable frequencies within ±1.0 kHz at last value	≤1.0 ms	≤1.0 ms
PH.TXP	Transmitter output power	2 W	12.5 W

2.10 Alarms and indications, fall-back arrangements

The AIS shall be equipped with BIIT. These tests shall run continuously or at appropriate intervals simultaneously with the standard functions of the equipment.

2.10.1 Built-in test equipment

(1) If any failure or malfunction is detected that will significantly reduce integrity or stop operation of the AIS, an alarm is initiated. In this case:
   ① the alarm shall be displayed on the minimum display
   ② the alarm relay shall be set "active"
   ③ an appropriate alarm message shall be output via the Presentation Interface upon occurrence and repeated every 30 s.

(2) If a change of a relevant system status as described below is detected, an indication is given to the user. In this case:

[②] Note: Sensors used with the AIS shall meet the requirements of their individual product standards (for example-IEC 61108-1 for GPS which permits 30 min to operation when there is no valid almanac data available, or IEC 61108-2 for GLONASS).

① the indication shall be accessible on the minimum display

② an appropriate alarm message shall be output via the Presentation Interface.

2.10.2 Alarm messages

An ALR-sentence is used to indicate a failure or malfunction that will significantly reduce integrity or stop operation of the AIS.

(1) Using the ALR formatter

① Alarm messages shall be IEC 61162-1 compliant "$AIALR"-sentences on the presentation interface output port. The parameters of this sentence formatter

(a) Time of alarm condition change (UTC),

(b) Unique alarm number (identifier) at alarm source,

(c) Alarm condition,

(d) Alarm's acknowledge state,

(e) Alarm's description text.

shall be set according to table 2.10.2 (1)

② The "alarm condition" field shall be set to "A" when the alarm condition threshold is exceeded, and "V" when the alarm condition returns to level that does not exceed the threshold. A continuing healthy status "V" shall not be sent out at less than one minute intervals.

③ The acknowledge state flag shall be set after acknowledgement of an alarm internally by means of minimum display and keyboard or externally by a corresponding ACK sentence.

④ The local alarm identifiers (alarm ID) given in the table below are defined for the use with formatters ALR, ACK, and as text identifiers in sentences to link associated messages. ALR-sentences with "alarm numbers" greater than 099 cannot be followed by TXT-sentences containing additional information by using the TXT-sentence's "text identifiers". The "text identifier" is limited to the range of 01 to 99.

(2) Monitoring of functions and integrity

In case a failure is detected in one or more of the following functions or data, an alarm shall be triggered and the system shall react as given in table 2.10.2 (1).

Table 2.10.2(1) – Integrity alarm conditions signaled using ALR sentence formatter

Alarm's description text	Alarm condition threshold exceeded	Alarm condition not exceeded	Alarm ID or text identifier	Reaction of the system to the alarm condition threshold exceeded
AIS: Tx malfunction	A	V	001	Stop transmission
AIS: Antenna VSWR exceeds limit	A	V	002	Continue operation
AIS: Rx channel 1 malfunction	A	V	003	Stop transmission on affected channel
AIS: Rx channel 2 malfunction	A	V	004	Stop transmission on affected channel
AIS: Rx channel 70 malfunction	A	V	005	Stop transmission on affected channel
AIS: general failure	A	V	006	Stop transmission

AIS: MKD connection lost	A	V	008	Continue operation with "DTE" set to "1"[1]
AIS: external EPFS lost	A	V	025	Continue operation (refer to table 2.10.3 (4))
AIS: no sensor position in use	A	V	026	Continue operation (refer to table 2.10.3 (4) priority 6)
AIS: no valid SOG information	A	V	029	Continue operation using default data
AIS: no valid COG information	A	V	030	Continue operation using default data
AIS: Heading lost/invalid	A	V	032	Continue operation using default data[2]
AIS: no valid ROT information	A	V	035	Continue operation using default data[2]
[1] If applicable [2] When so configured				

(3) Relay alarm output

① A NC (normally closed) earth free relay contact shall be provided as an independent and simple method for triggering an external alarm.

② The alarm relay shall be "active" in case of power "off"

③ The alarm relay shall be deactivated upon acknowledgement of an alarm either internally by means of minimum display and keyboard or externally by a corresponding ACK sentence.

2.10.3 Status messages

If any significant change in system operation occurs, but overall system operation is not affected, an indication is initiated. A TXT-sentence is used to indicate when such a significant change in system operation occurs.

(1) Using the TXT formatter

① Status messages shall be IEC 61162-1 compliant "$AITXT"-sentences on the presentation interface output port. Status messages do not activate the alarm relay and do not require an acknowledgement.

② The parameters of this sentence formatter

(a) Text identifier, and

(b) Text message

Shall be set according to table 2.10.3 (1)

(2) Channel Management parameters changed, TXT-sentence

The TXT-sentence, Text identifier 036, shall be followed by the appropriate ACA sentence(s) to report the affected AIS conditions.

(3) Monitoring sensor data statue

Indications shall be given and the system shall react as given in table 2.10.3 (1)

Table 2.10.3(1) – Sensor status indications signaled using TXT sentence formatter

Text message	Text identifier	Reaction of the system
AIS：UTC clock lost	007	Continue operation using indirect or semaphore synchronization
AIS：external DGNSS in use	021	Continue operation

AIS：internal GNSS in use (beacon)	022	Continue operation
AIS：internal DGNSS in use（message 17）	023	Continue operation
AIS：internal DGNSS in use	024	Continue operation
AIS：internal GNSS in use	025	Continue operation
AIS：external SOG/COG in use	027	Continue operation
AIS：internal SOG/COG in use	028	Continue operation
AIS：Heading valid	031	Continue operation
AIS：Rate of Turn indicator in use	033	Continue operation
AIS：Other ROT source in use	034	Continue operation
AIS：Channel management parameters changed	036	Continue operation

(4) Position Sensor fallback conditions

Priorities and affected position report data shall be as follows in table 2.10.3(4).

Table 2.10.3(4) – Position sensor fallback conditions

Priorities	Affected data in msg 1、2、3 ⇒ / Position sensor status		Position accuracy flag	Time stamp	RAIM-flag	Position Longitude/ Latitude
1	External DGNSS in use（corrected）[1]		1	UTC-s	1/0*	Lat / Lon (external)
2	Internal DGNSS in use（corrected；msg17）[2]		1	UTC-s	1/0*	Lat / Lon (internal)
3	Internal DGNSS in use（corrected beacon）[3]		1	UTC-s	1/0*	Lat / Lon (internal)
4	External EPFS in use（uncorrected）[1]		0	UTC-s	1/0*	Lat / Lon (external)
5	Internal DGNSS in use（uncorrected）[2]		0	UTC-s	1/0*	Lat / Lon (internal)
6	No sensor position in use[1]	Manual pos. input	0	61	0	Lat / Lon (manual)
		Dead reckoning pos		62		Lat / Lon (dead-reck.)
		No position		63		Not available=181/91

[1] applicable in all configurations (minimum requirement).

[2] applicable only if internal GNSS receiver is used for position backup (see 2.1.2.2).

[3] applicable only if (optionally) an internal beacon receiver is provided.

* if RAIN available "1"; if not, default "0".

① The AIS shall automatically select the position source with the highest priority available. If data availability changes, the AIS shall automatically switch to the position source with the highest priority available after 5s when switching downwards or 30s when switching upwards.

② During this period, the latest valid position shall be used for reporting. On changeover from one status to another a new msg 5 shall be transmitted immediately when the reference point for the reported position has changed and an "ALR" sentence as described above shall be output to the presentation interface.

(5) SOG/COG sensor fallback conditions

SOG/COG information from internal GNSS receiver shall be used, if this internal GNSS

receiver is in use as a position source. This is to avoid transmission of information referenced of different point on the ship.

(6) ROT sensor fallback conditions

① The AIS shall automatically select the ROT source with the highest priority available as given in table 2.10.3(6).

② ROT data shall not be derived from COG information.

Table 2.10.3(6)—ROT sensor fallback condition

Priorities	**Affected data in msg 1、2、3 ⇒** **ROT sensor status**	**Content of ROT field**
1	Rate of Turn Indicator status（TI）[1]	0…+126=turning right at up to 708 degrees per minute or higher； 0…-126= turning left at up to 708 degrees per minute or higher。 Value between 0 and 708 degrees / min shall be coded by $ROT_{AIS}=4.733\ (ROT)^{1/2}$ degrees / min Where ROT is the Rate of Turn as input by the external Rate of Turn Indicator（TI）。 Values of 709 degrees per minute and above shall be cut to 708 degrees per minute.。
2	Other ROT source in use[2]	+127=turning right at more than 5°/30s（~~No TI ava~~ilable） -127=turning Left at more than 5°/30s（No TI available）
3	No valid ROT information available	-128（80 hex）indicates no turn information（default）
[1] rate of turn indicator according to IMO A.526（13）；determined by talker ID [2] i.e. based on HDG information		

2.11 Display, input and output

The AIS shall provide means to display ship and shore based AIS data and manually input data as follows:

2.11.1 Minimum keyboard and display（MKD）

MKD shall provide display and manual input device to allow the following functions：

（1）Display of at least three lines of data. Each line shall display at least bearing, range, and name of ship. Horizontal scrolling of bearing and range is not allowed. The title of display data shall be visible.
（2）Manual input of voyage and safety related messages, control of AIS and data selection.
（3）MKD is the basic part of the AIS，and can be under remote control.

2.11.2 Alarm and status information

(1) The following alarms and status information shall be indicated and the information contents displayed on request:：

① alarms and indications as a result of the Built In Integrity Test (BIIT see 2.10.1)

② received safety related messages

③ received long range interrogations

④ manual confirmation of LR interrogation if in manual mode.

(2) A means to acknowledge alarms and indications as above shall be provided.

(3) Means shall be provided to disable the acknowledgement of information as above e.g. in the case where an external alarm is provided.

2.11.3 The AIS with external display device shall comply with IMO relevant performance standards.

2.12 DSC compatibility

The AIS shall be capable of performing limited AIS-related DSC operations conforming to the provisions of Recommendation ITU-R.1371-1, Annex .3.

2.12.1 If own ship AIS “type of ship” and “cargo type” of message 5 is other than 50-99, then the type of ship response to a DSC Poll shall be 99.

2.12.2 The AIS shall respond only to a DSC poll to an individual ship (MMSI) or geographical area (with or without course or type of ship qualifiers).

2.13 Long range application

2.13.1 General requirements

(1) Class A shipborne mobile equipment shall provide a two-way interface for equipment which provides for long range communications. This interface shall comply with IEC 61162.

(2) Long range communications shall be only throng the Presentation Interface using the IEC 61162 interface dedicated to this purpose as described in 3.6.4.

(3) The long range AIS data shall be displayed on the AIS display as described in 2.11.

2.13.2 Interrogations and responses

Long range information shall only be transmitted in response to an interrogation from a long range base station.

(1) Manual and automatic response

The AIS transponder shall be capable of being set by the user to respond automatically or manually to long range interrogations. In case of automatic reply to long range interrogations, the display shall indicate that the system was long rang interrogated until the operator has replied to the interrogation or cancelled the reply on the manual input device as described in 2.11.

(2) Data format and content

The long range messages have taken into account the requirements of IMO Resolution A.851 (20). Where such information is available to the AIS system this shall be used.

The long range data types available for transmission shall be derived from the AIS system as described in table 2.13.2 (2).

Table 2.13.2 (2) – LR data types

ID	Data types format	Remarks
A	Ship name/call sign/MMSI/IMO number	MMSI number shall be used as a lag identifier
B	Date and time in UTC	Time stamp of message composition shall be given in UTC only. Day of month, hours and minutes
C	Position	WGS84，latitude/longitude degrees and minutes
D		Not available
E	Course	Course over ground（COG）：in degree
F	Speed	Speed over ground（SOG）in knots：1/10 knots
G, H		Not available
I	Destination / ETA	At master's discretion; ETA time format see B
J, K, L, M, N		Not available
O	Draught	Actual maximum draught in 1/10 of metres
Q, R, S, T		Not available
U	Length / beam / type	Length and beam in metres Type see ITU M.1371-1 A2/3.3.8.2.3 table 17，tonnage not available
V		Not available
W	Number of persons on board	
X, Y		Not available
Z		Not used

(3) Addressing AIS units

① LR interrogations shall be either by user ID (ship's MMSI) or by geographical area "all ships" call designating the North-Eastern corner and the South-Western corner of the Mercator projection rectangle, which describes the called area.

② The first LR data transfer shall take place by LR interrogation initiated by a geographical area "All ships" call. Succeeding LR data transfers shall take place by LR

interrogation based on user (MMSI).

③ To avoid replies on succeeding geographical area “All ships” calls from the same base station, the AIS shall store the MMSI of the LR base station for 24 hours.

Chapter 3 Technical Requirements

3.1 General requirements

3.1.1 The description of this Chapter adopts open system interconnection model (OSI) referred to ITU-R M1371-1, and covers layers 1 to 4 (Physical Layer, Link Layer, Network Layer, Transport Layer) of the model. Figure 3.1.1 illustrates the layers model of an AIS station (Physical Layer to Transport Layer) and the layers of the applications (Session Layer to Application Layer).

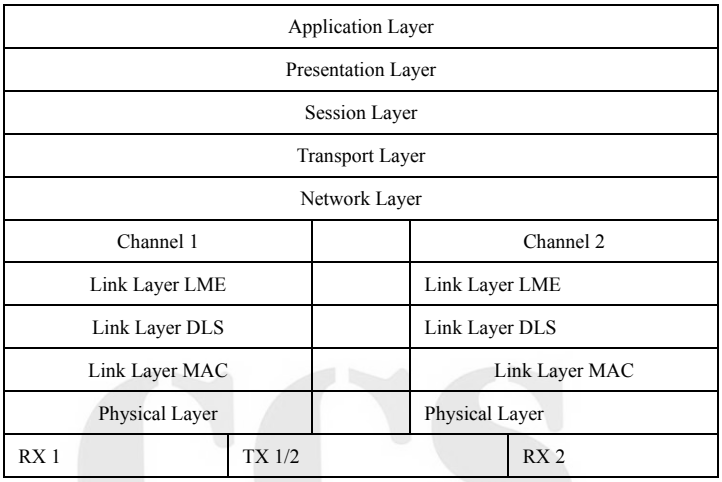


Figure 3.1.1 OSI layer model

3.2 Physical layer (M.1371-1/A2-2)

3.2.1 The Physical layer is responsible for the transfer of a bit-stream from an originator out, on to the data link. The Physical Layer shall be designed in accordance with Recommendation ITU-R.M.1371, Annex 2, Chapter 2.

3.2.2 The technical characteristics as specified in table 3.2.2 shall apply to the TDMA receivers.

Table 3.2.2 – Required receiver characteristics

Receiver parameters	25kHz channel	12.5kHzchannel
Sensitivity	20%PER for -107 dBm	20%PER for - 98 dBm
Co-channel rejection	-10 - 0 dB	-18 - 0 dB
Adjacent channel selectivity	70 dB	50 dB
Spurious response rejection	70 dB	N/A
Intermodulation response rejection and blocking	20%PER dB	N/A

3.3 Link layer (M.1371-1/A2-3)

The Link layer specifies how data shall be packaged in order to apply error detection and correction toe the data transfer. The Link layer is divided into three sublayers.

3.3.1 Link sub-layer 1：Medium Access Control (MAC) (M.1371-1/A2-3.1)

The MAC sublayer provides a method for granting access to the data transfer medium, i.e. the VHF data link. The method used shall be a Time Division Multiple Access (TDMA) scheme using a common time reference. The Medium Access Control sub-layer shall be designed in accordance with Recommendation ITU-R.M.1371, Annex 2，Chapter 3.1.

3.3.2 Link sub-layer 2：Data Link Service (DLS) (M.1371-1/A2-3.2)

The DLS sub-layer provides methods for：

(1) data link activation and release;

(2) data transfer; or

(3) error detection and control

The Data Link Service sub-layer shall be designed in accordance with Recommendation ITU-R.M.1371，Annex 2，Chapter 3.2.

3.3.3 Link sub-layer 3：Link management entity（LME）（M.1371-1/A2-3.3）

(1) The LME controls the operation of the DLS, MAC and the physical layer.

(2) The Link Management Entity sub-layer shall be designed in accordance with Recommendation ITU-R.M.1371, Annex 2，Chapter 3.3.

(3) The sub-layer 33 includes definition of VDL-messages（M.1371-1/A2-3.3.8 table 13). Table 3.3.3(3) shows how the messages defined in M.1371-1/A2-3.2 shall be used by a Class A shipborne mobile AIS device. For further details refer to the appropriate section of M.1371-1.

Table 3.3.3 (3) – Use of VDL messages

Msg. No.	Name of message	M.1371Ref.	R/P	O	T	Remarks
0	Undefined	None	Yes	Yes	No	Reserved for future use
1	Position report (scheduled)	A2-3.3.8.2.1	Yes	Yes	Yes	
2	Position report (Assigned)	A2-3.3.8.2.1	Yes	Yes	Yes	
3	Position report (When interrogated)	A2-3.3.8.2.1	Yes	Yes	Yes	
4	Based station report	A2-3.3.8.2.2	Yes	Yes	No	
5	Static and voyage related data	A2-3.3.8.2.3	Yes	Yes	Yes	
6	Addressed binary message	A2-3.3.8.2.4	Yes	Yes(1)	Yes	(1) Only if addressed to own station
7	Binary acknowledged	A2-3.3.8.2.5	Yes	INF (2)	Yes	(2) An ABKPI message shall be sent to the PI in any case
8	Binary broadcast message	A2-3.3.8.2.6	Yes	Yes	Yes	

9	Standard SAR aircraft position report	A2-3.3.8.2.7	Yes	Yes	No	
10	UTC and data inquiry	A2-3.3.8.2.8	Yes	INF	Yes	
11	UTC/data response	A2-3.3.8.2.2	Yes	INF	Yes	
12	Addressed safety related message	A2-3.3.8.2.9	Yes	Yes(3)	Yes	(3) Only if addressed to own station
13	Safety related acknowledge	A2-3.3.8.2.5	Yes	INF (4)	Yes	(4) An ABK PI message shall be sent to the PI in any case
14	Safety related broadcast message	A2-3.3.8.2.10	Yes	Yes	Yes	
15	Interrogation	A2-3.3.8.2.11	Yes	INF	Yes	Class A shipborne mobile station may be interrogate for msg 3,4,5,9,18,19,20,21,22. Slot offset shall be set to 0*
16	Assigned mode command	A2-3.3.8.2.12	Yes	INF	Yes	
17	DGNSS	A2-3.3.8.2.13	Yes(5)	INF (6)	No	(5) Only if internal GNSS receiver is capable of processing DGNSS corrections or PI contains an DGNSS output port. (6) on other ports of the PI: INF
18	Standard class B equipment position report	A2-3.3.8.2.14	Yes	Yes	No	
19	Extended class B equipment position report	A2-3.3.8.2.15	Yes	Yes	No	
20	Data link management message	A2-3.3.8.2.16	Yes	INF	No	
21	Aids-to navigation report	A2-3.3.8.2.17	Yes	Yes	No	
22	Channel management message	A2-3.3.8.2.18	Yes	INF	No	
23-63	Undefined	None	Yes	Yes	No	Reserved for future use

Legend：

R/P：Receive and process internally, e.g. prepare for output via PI, act upon the received information, and use the received information internally.

O ： Output message content via PI using PI VDM messages

T ： Transmission by own station: “YES” = either allowed or required; “No” = shall not be transmitted

INF：VDL message will be output via PI using a PI VDM message for information only. This function may be suppressed by configuration setting.

* See IALA technical clarifications to recommendation ITU - R M.1371-1.

(4) For messages 6,8,12,14, own RATDMA transmissions shall not exceed a total of 20 slots in a frame with a maximum of 5 slots per message. If either case is exceeded, the AIS will generate an ABK warning sentence.

3.4 Network layer（M.1371-1/A2-4）

3.4.1 The network layer shall be used for：

(1) establishing and maintaining channel conditions;

(2) management of priority assignments of messages;

(3) distribution of transmission packets between channels;

(4) data link congestion resolution.

The network Layer shall be designed in accordance with Recommendation ITU-R.M.1371，Annex 2，Chapter 4

3.4.2 Management of regional operating settings (M.1371-1/A2-4.1)

(1) All stored regional operating settings shall be time / data-tagged and they should be tagged with information by what input means this regional operating setting was received (TDMA msg 20，DSC tele-command, Manual input via MKD, ACA sentence input via Presentation Interface).

(2) The AIS shall constantly check the following 2 conditions:

① if the nearest boundary of the regional operating area of any stored regional operating setting is more than 500 miles away from the current position of own station;

② if any stored regional operating setting was older than five weeks.Any stored regional setting which fulfils any one of these conditions shall be erased from the memory.

(3) The regional operating settings shall be handled as a whole, i.e. a change requested for any parameter of the regional operating settings shall be interpreted as a new regional operating setting.

(4) When the user requests to manually input a regional operating setting via the Minimum Keyboard and Display (MKD), the regional operating settings in use, which may be the default operating settings, shall be presented to the user on the MKD. The user shall then be allowed to edit these settings partly or in full. The AIS shall ensure, that a regional operating area is always input and that it conforms to the rules for regional operating areas laid out in M.1371-1 A2/4.1. After completion of input of an acceptable regional operating settings set, the AIS shall require the user to confirm a second time that the input data shall be stored and possibly used instantaneously.

(5) The AIS shall not accept, i.e. ignore, any new regional operating setting which includes a regional operating setting area, which does not conform to the rules for regional operating areas laid out in M.1371-1 A2/4.1.

(6) The AIS shall not accept a new regional operating setting, which was input to it via the Presentation Interface, if the regional operating area of this new regional operating setting partly or totally overlaps or matches the regional operating area of any of the stored regional

operating settings, which were received from a base station either by msg 22or by DSC telecommand within the last two hours.

(7) A message 22 address to own station or a DSC telecommand addressed to own station shall be accepted only if the AIS is in a region defined by one of the stored regional operating settings. In this case the setting of regional operating settings shall be composed by combining the received parameters with the operating area in use.

(8) If the regional operating area of the new, accepted regional operating setting overlaps in part or in total or matches the regional operating areas of one or more older regional operating settings, this or these older regional operating settings shall be erased from the memory. The regional operating area of the new, accepted regional operating setting may be neighbouring tightly and may thus have the same boundaries as older regional operating settings. This shall not lead to the erasure of the older regional operating settings.

(9) Subsequently the AIS shall store a new, accepted regional operating setting in one free memory location of the eight memories for regional operating settings. If there is no free memory location, the oldest regional operating setting shall be replaced by the new, accepted one.

(10) No means other then defined herein shall be allowed to clear any of the stored regional operating settings. In particular, it shall not be possible to solely clear any or all of the stored regional operating settings by a manual input via the MKD or by an input via the Presentation Interface without inputting a new regional operating setting.

3.5 Transport layer (M.1371-1/A2-5)

3.5.1 The transport layer shall be responsible for::

(1) converting data into transmission packets of correct size；

(2) sequencing of data packets；

(3) interfacing protocol to upper layers.

The Transport Layer shall be designed in accordance with Recommendation ITU-R.M.1371, Annex 2, Chapter 5.

3.6 Presentation interface (PI) (M.1371-1/A2-5)

The interface between the transport layer and higher layers shall be performed by the Presentation Interface.

3.6.1 General requirements (M.1371-1/A2-5.4)

Data, which is to be transmitted by the AIS device, shall be input via the Presentation Interface. Data, which is received by the AIS device, shall be output through the Presentation Interface. The formats

and protocol used for this data stream shall be defined by the referenced IEC61162 series. If no appropriate IEC61162 format and protocol exist, other protocols may be used.

(1) Long range applications (M.1371-1/A4)

Class A shipborne mobile equipment shall provide a two-way interface for equipment which provides for long range communications. The interface shall comply with the IEC61162 series.

(2) Composition

The Presentation Interface of the AIS shall comprise the data ports listed in table 3.6.1 (2). (Annex B, "AIS Interface Overview")

Table 3.6.1 (2) – PI Access

General function	Mechanism
Automatic input of sensor data (Sensor data input from shipborne equipment	3 IEC 61162-2 input ports，also configurable as IEC61162-1 input ports
High speed input / output ports (operator controlled commands and data input; AIS VHF Data Link (VDL) data; and AIS equipment status)	2 IEC 61162-2 paired input and output ports
Long range communications	1 IEC 61162-2 paired input and output ports
BIIT alarm output	1 isolated normally-closed (NC) contact circuit

3.6.2 Automatic input of sensor data

(1) Required ports

A minimum of three input ports shall be provided. Each port shall meet the requirements of IEC61162-2 and be capable of being reconfigured to IEC61162-1.

(2) Interface connector

The manufacture shall specify the connector for these ports.

(3) Format of sensor data

① The sensor data shall be provided using the formats described in IEC61162-1. AS a minimum, the required IEC61162-1 IEC 61162-1 sentences listed in table 3.6.2 (3) (Preferred IEC61162-1 sentences) shall be received and processed by an AIS unit, Details for these sentences are contained in IEC 61162-1.

Table 3.6.2 (3) – Preferred IEC 61162 – 1sensor sentences

Data	IEC61162-1Sentence formatters	
	Required	Optional
Preference datum	DTM	
Position system: Time of position Latitude / longitude	GNS GLL	GGA, RMC

Position accuracy		
Speed over ground（SOG）	VBW	VTG,OSD,RMC
Course over ground（COG）	RMC	VTG, OSD
Heading	HDT	OSD
RAIM indicator	GBS	
Rate of turn（ROT）	ROT	

② If a DTM sentence is received，then the AIS shall be the DTM sensor sentence to automatically confirm that the position sensor provides position information in the WGS 84 datum.

③ The reception of periodic GBS sentences, containing values for the parameters "expected error in latitude" and "expected error in longitude" shall be used to indicate with the RAIM-Flag that the position sensor is operating with a RAIM process in use.

④ Each of the items listed in table 3.6.2 (3) may be produced by various connected sensor equipment. The external sensor equipment is neither assigned to specific AIS input ports nor are the specified input sentences at each of the input ports.

3.6.3 High speed input / output ports

(1) Required ports

① A minimum of two input / output ports shall be provided. A primary input / output port for connection of onboard control equipment, ECDIS, radar, etc., and a pilot / auxiliary input / output port for connection of ship's pilot equipment, service equipment, etc. Each port hall meet the requirements of IEC61162-2.

② Both input ports shall be frequently equivalent and shall be capable of receiving the data formats defined in table 3.6.3 (1) ② (AIS high-speed input data and formats).

③ Both output ports shall be functionally equivalent and shall be capable of simultaneously transmitting the data formats defined in table 3.6.3 (1) ③ (AIS high-speed output data and formats).

(2) Interface connector

The manufacturer shall specify the connector for these ports.

(3) Input data and formats

The AIS shall as a minimum be able to receive and process the input data shown in table 3.6.3 (1) ③. The details of these sentences are contained in IEC61162-1. Manufacturer's proprietary data may also be entered using high-speed ports.

Table 3.6.3(1) ②-AIS high-speed input data and formats

Data	IEC 61162-1sentences
Normal access – parameter entry	
Voyage information Vessel type and cargo category Navigational status Draught, max. actual static Destination ETA date and time Regional application flags	VSD – voyage static data
Station information Vessel name Call sign Antenna location Length and beam	SSD – station static data
Initiate VHF data-link broadcasts	
Safety messages	ABM – addressed binary message BBM – broadcast binary message
Binary messages	ABM – addressed binary message BBM – broadcast binary message
Interrogation message	AIR-AIS interrogation information
AIS equipment – parameter entry	
AIS VHF channel selection AIS VHF power setting AIS VHF channel bandwidth Transmit / receive mode control	ACA-AIS channel assignment message ACA-AIS channel assignment message ACA-AIS channel assignment message ACA-AIS channel assignment message
MMSI IMO NUMBER Other AIS equipment controls	MKD or proprietary sentences (limited access) MKD or proprietary sentences (limited access) MKD or proprietary sentences (limited access)
BIIT input	
Alarm / indication acknowledgement	ACK – acknowledgement message
LR acknowledgement	
Manual LR acknowledgement	LRF – long range function

(4) Output data and formats

① The AIS shall as a minimum be able to generate and send the output data shown in table 3.6.3 (1) ③.

② The VDO sentence (containing message 1,2 or 3) shall be output on both high-speed output ports, at nominal 1-second interval, use A and B to indicate that the data was transmitted on the VDL channel A or B, null indicating not transmitted on the VDL.

③ The VDL sentence shall be sent simultaneously on both high-speed output ports for every VDO message received. Some VDL messages are informative according to table 3.3.3 (3). During operation, the operator may disable delivery of these informative messages, Manufacturer's proprietary data may also be sent using these high-speed ports.

Table 3.6.3 (1) ③ - AIS high-speed output data formats

Data	IEC61162-1 sentences
Prepared by AIS unit	
Notification that a session initiated by messages ABM, BBM, AIR is terminated	ABK – acknowledgement Message (M.1371-1/A2-5.4.1 and M.1371-1/A2-3.3.8.2.5)
AIS own – ship broadcast data (all transmissions available)	VDO-VDL own-vessel message
AIS equipment status (built-in-integrity-test results)	ALR/TXT – (see 6.10.2)
Channel management data	ACA-AIS channel assignment message (using query mechanism)
Received on VDL by AIS unit	
All VDL messages received Broadcast or Addressed to own station	VDM-VDL message
Received on LR communication system	
LR interrogation message received	LRI and LRF

3.6.4 Long range communications

(1) Required ports

① A minimum of one input / output port shall be provided and shall meet the requirements of IEC61162-2. It shall be connected to long-range communications equipment (e.g., satellite communications).

② The input port shall be capable receiving the data formats defined in table 3.6.4 (1) ② (AIS long range communications input data and formats).

③ The output port shall be capable of transmitting the data formats defined in table 3.6.4 (1) ③（AIS long range communications output data and formats）.

(2) Interface connector

The manufacturer shall specify the connector for these ports.

(3) Input data and formats

① Long range interrogation of an AIS unit is accomplished through the use of two IEC 61162-1sentences - LRI and LRF. This pair of interrogation sentences provides the information needed by the AIS unit to determine if it must construct and provide the

reply sentences - LR1, LR2 and LR3. The LRI – sentence contains the information needed to determine if the reply needs to be constructed. The LRF-sentence identifies the information that is being requested.

② The information, that can be requested by the LRF-sentence, is shown in table 3.6.4 (1) ② (AIS long range communications input data and formats). These information items are the same as those defined in IMO Resolution A.851 (20). The letters shown in parentheses are from IMO Resolution A.851 (20) and are used in the LRF – sentence. Details of these sentences are contained in IEC 61162-1.

Table 3.6.4 (1) ② - AIS LR Communications Input Data and Formats

Data	IEC61162-1 sentences
LR interrogation Type of request Geographic area request AIS unit request	LRI – LR interrogation
LR function identification Request for: Ship's name, call sign, and IMO number (A) Date and time of message composition (B) Position © Course over ground (E) Speed over ground (F) Destination and ETA (I) Draught (O) Ship / cargo (P) Ship's length, breadth, and type (U) Number of persons on board (W)	LRF – LR function identification

(4) Output data and formats

① The long range reply from the AIS unit is accomplished through the use of four IEC61162-1 sentence formatters - LRF, LR1, LR2 and LR3. The AIS unit shall reply with these sentences, in the following order; LRF, LR1, LR2 and LR3 when responding to an interrogation even if all the information items in the sentence are null.

② The LRF-sentence provides the "Function Reply Status" for the requested information. The following is a list of "Function Reply Status" characters with the status that represent:

(a) 2 = Information available and provided in the following LR1, LR2 and LR3

(b) 3 = Information not available from AIS unit

(c) 4 = Information is available but not provided (i.e. restricted access determined by ship's master)

③ The LR1-sentence identifies the destination for the reply and contains the information items requested by the "A" function identification character in the LRF sentence.

④ The LR2-sentence contains the information items requested by the "B, C, E and F" function identification characters in the LRF-sentence.

⑤ The LR3-sentence contains the information items requested by the "I, O, P, U and W" function identification characters in the LRF-sentence.

⑥ The individual information items shall be "null" if any of the following conditions exist:

(a) The information item was not requested in the LRF-sentence;

(b) The information item was requested but is not available; or

(c) The information item was requested but is not being provided.

⑦ The output data shown in table 3.6.4 (1) ③ shall be provided when specifically requested by function identification characters contained in the preceding LRF-sentence portion of the interrogation. Details of these sentences are contained in 2.13 and in IEC 61162.

Table 3.6.4 (1) ③－ LR output data formats

Data	IEC 61162 Sentences
Function reply status	LRF－LR function
MMSI of responder MMSI of requestor Ship's name Ship's call sign IMO number	LR1－LR response, line 1
MMSI of responder Date and time of message composition Position Course over ground Speed over ground	LR2－LR response, line 2
MMSI of responder Destination and ETA Draught Ship / cargo Ship's length, breadth, and type Number of persons on board	LR3－LR response, line 3

3.6.5 BIIT alarm output

(1) The AIS shall provide a relay output (NC contact) indicating the state of the built-in integrity test (BIIT) alarm function as specified in 2.10.1.

(2) The terminals shall be isolated from circuits and grounds in the AIS.

(3) The manufacturer's documentation shall specify the current and voltage capability of the alarm relay contacts.

Chapter 4 Type Approval and Marine Product Survey

4.1 General requirements

4.1.1 The AIS products shall be subjected to the type approval to meet the requirements of this Chapter；

4.1.2 The AIS products with certificates shall be subjected to the inspection be fore leaving the manufacturer in accordance with the relevant requirements of marine product survey.

4.1.3 Those not mentioned in this Chapter shall comply with IEC61993-2, IEC60945, the Society's Rules for Marine Product Survey and the Guidelines on Type Tests of Electrical and Electronic Equipment for Ships and Offshore Installations.

4.2 Definitions

4.2.1 Performance tests：overall tests to confirm the equipment in compliance with all requirements of the performance stipulated for its standards.

4.2.2 Performance check（partial performance tests）：partial tests to confirm the equipment in compliance with main requirements of the performance stipulated for its standards.

4.2.3 Functional tests（functional check）：a check to conform the equipment in compliance with the operating function stipulated for its standards.

4.2.4 Performance standard：during and after the EUT test, the operating performance shall be compared to the normal performance, in order to determine whether EUT function is reduced or erased. The function is divided into standard A, standard B and standard C.

4.3 Drawings and technical documents to be submitted for approval

4.3.1 The following drawings and technical documents in triplicate shall be submitted to the Society for approval:

(1) product's technical conditions (including the technical documents required in 6.7 of the Guidelines);

(2) configuration and structure of the products (containing face plate, back plate interface arrangements);

(3) system principle;

(4) test program;

(5) where the products are subjected to special verification or appraisal, the relevant reports and certificates shall be attached.

4.3.2 The following drawings and technical documents shall be submitted to the Society for information:

(1) Product's introduction manual.

4.3.3 Additional drawings and documents are required as considered necessary by the Society.

4.4 Type tests

4.4.1 The AIS test system includes at least 5 analogue aims, equipment under test AIS (EUT), sensors (or model sensor input) and indication unit; for block diagram of test system, see Annex C.

4.4.2 Type tests shall be carried out in accordance with the test program approved by the Society.

(1) Type tests shall have the overall examination of the products, the items of which shall include:

① configuration check
② performance tests

③ environment tests

④ malfunctioning tests of power supply

⑤ isolation resistor tests

⑥ voltage resistant tests (only to power device)

⑦ safe distance tests of magnetic compass

⑧ electromagnetic compatibility tests

(2) Tests shall be carried out on the same sample items. Where there is other arrangement, it shall be subjected to the agreement of the Society.

(3) The process of each item test shall be carried out in accordance with the stipulation of the Guidelines on Type Tests of Electrical and Electronic Equipment for Ships and Offshore Installations by the Society.

4.4.3 The test results from the concrete test methods and requirements of performance tests shall

comply with the provisions of Chapter 6 of the Guidelines. The performance test items shall include:

(1) operational tests

(2) physical tests

(3) link layer tests

(4) network layer tests

(5) transport layer tests

(6) presentation interface (PI) tests

(7) DSC functional tests

(8) Long range functional tests

4.4.4 The concrete test methods of environment tests shall be carried out in accordance with the provisions of the Guidelines on Type Tests of Electrical and Electronic Equipment for Ships and Offshore Installations by the Society. The test items shall include:

(1) energy wave tests

(2) vibration tests

(3) high temperature tests

(4) low temperature tests

(5) damp heat tests

(6) water spraying tests (only to the exposed equipment)

Since EUT is composed at least of one transmitter, two TDMA receivers and one special channel 70 DSC receivers. When the environment test is being carried out, the performance check and functional test shall be carried out separately to its composition, where functional tests shall only be carried out to energy wave tests, vibration test, water spraying test; when high temperature and low temperature tests are carried out, performance check and functional test shall be carried out in combination with different conditions of power supply (the supply of normal power and extreme power).

4.4.5 When high and low temperature tests are carried out to EUT transmitter, the following performance check shall be carried out. The test results of the concrete test methods and requirements shall comply with the provisions of Chapter 6 of the Guidelines.

(1) frequency error (see 6.3.1 (1))

(2) carrier power (see 6.3.1 (2))

(3) channel transfer (see 6.2.7)

(4) transmitting and initiating time (see 6.3.1 (5))

(5) transmitting and releasing time (see 6.3.1 (6))

4.4.6 When high temperature, low temperature, damp heat tests are carried out to EUT receivers (TDMA and DSC receivers), the following performance check shall be carried out.. The test result of concrete test methods and requirements shall comply with the provisions of Chapter 6 of the Guidelines.

(1) 25kHz and 12.5kHz sensibility (see 6.3.3 (1), 6.3.3 (2), 6.3.4 (1)

(2) channel transmitting time (see 6.2.7)

4.4.7 The functional tests required the environment shall be carried out in accordance with the provisions of 6.2.12 (1) of the Guidelines.

4.4.8 To avoid the repetitious tests, all the environment test items may, subject to the consent of the manufacturers, be carried out in combination with the test items required in 6.3.

4.4.9 EUT electromagnetic compatibility tests can be divided into electromagnetic emission measurements and noise immunity tests. The concrete test methods shall be carried out in accordance with provisions of the Guidelines on Type Tests of Electrical and Electronic Equipment for Ships and Offshore Installations by the Society. The test items shall include:

(1) electromagnetic harassment measurements

① conduction harassment measurements

② outer shell port radiation harassment measurements

(2) noise immunity tests

① noise immunity tests of static discharge

② noise immunity tests of radio frequency electromagnetic field

③ noise immunity tests of fast electric transient pulse train

④ noise immunity tests of surge
⑤ noise immunity tests of low frequency transduction
⑥ noise immunity tests of inductive transduction harassment of radio frequency electromagnetic field.

4.4.10 In order to prove EUT to satisfy the performance standard required for the noise immunity tests, EUT shall be set up in automatic mode. Where the AIS1 and AIS2 channels are used under standard test environment, and the communication is carried out at intervals of 2s. The performance standard of the content and intervals of the messages formed during and after the tests shall not be lower than that required.

4.4.11 After tests, reports shall be prepared in accordance with the original records and actual conditions. The tester to test unit or authorized by the manufacturer shall sign his name and the date on the test reports. The surveyor shall also sign his name and the date on the reports of witnessed items. The reports signed shall be submitted to the Society in duplicate.

4.5 Confirmation of approval

4.5.1 The Society shall examine the reports relevant to the work and tests mentioned above, and after confirming that the products comply with the type approval conditions, grant them type approval.

4.6 Survey after approval

4.6.1 After type approval, delivery inspection shall be carried out to each set of products. After satisfactory inspection, the satisfactory inspection mark by the Society and other relevant mark(s) shall be made on the products, and the certificates shall be issued.

4.6.2 According to quality control conditions of the manufacturer and actual operation conditions of the products, the delivery inspection for items shall, to the consent of the Society, at least include:

(1) visual inspection

(2) performance inspection
The inspection shall be carried out for frequency errors, carrier power, channel transfer tests as required in 4.4.5, and for 25kHz and 12.5kHz sensibility and channel transfer time as specified in 4.4.6.

(3) functional tests
To be carried out in accordance with the 6.2.1 (1).

4.6.3 Additional inspection items may be required as considered necessary by the Society.

Chapter 5 Installation Survey and Survey in Service

5.1 General requirements

5.1.1 Installation survey shall be carried out in accordance with this Chapter when AIS equipment is installed on the ship.

5.1.2 Survey in service shall be carried out to the ship equipped with AIS in accordance with this Chapter.

5.2 Inspection for plans and documents

5.2.1 For new buildings, the following plans and documents in triplicate shall be submitted to the Plan Approval Center of the Society for approval, and after approval one copy for file of the Society, one copy for the site surveyor, and one for returning to the submitting unit; for existing ships the following plans and documents in duplicate shall be submitted to the site surveyor for check, and after check one copy for file of the Society, and the other for returning to the submitting unit.

(1) AIS configuration shall include:

① AIS equipment installation position

② The positions of AIS antenna for receiving and transmission and the internal and external GNSS antenna, the position distance of GNSS antenna relevant to stem and stern and to both port and starboard sides of the ship shall be clearly displayed on the plans.

(2) AIS system diagram shall at least include:

① Each composition part of AIS equipment and functional block diagram of the external connected equipment.

② Connection line and its type and specification of the interface.

③ Power supply lines of main and emergency power sources.

5.3 AIS installation

5.3.1 The MKD of AIS shall be installed in the navigation bridge, at the position where the officer (person) on watch usually operates and observes easily. For control units (such as radar and electronic sea chart etc.) with external connection display in the navigation bridge, AIS equipment may be installed at other position easily to be operated and maintained in the navigation bridge, or the position adjacent to the navigation bridge (such as in the sea chart room or radio room).

5.3.2 The AIS equipment shall be power supplied by the navigational distribution switchboard from the main or emergency power sources, and shall satisfy the requirements of 2.4.8, Chapter 2, PART FOUR of the Rules and Regulations for the Construction and Classification of Sea-Going Steel Ships by the Society. It may also be power supplied separately by the navigational distribution switchboard and emergency switchboard for existing ships.

5.3.3 The AIS power source and data cabling shall generally be of flame-retardant bundled type, at least of flame-retardant type. Data cables are to have reliable electromagnetic shielding and to satisfy the requirements of the manufacturer. The influence of electromagnetic compatibility shall be considered in cable arrangement.

5.3.4 When in cabling, the signal cables are to be as short as practicable to minimize attenuation of the signal level. All outdoor installed connectors on the coaxial cables shall be fitted with preventive isolation to protect against water penetration.

5.3.5 The connection lines of the AIS system shall be reliably fixed. Cabling shall satisfy the relevant requirements of PART FOUR of the Rules and Regulations for the Construction and Classification of Sea-Going Steel Ships by the Society. Coaxial cables shall have sufficient bending radius, and the minimum bending radius shall be of 5 times the cable's external diameter. Coaxial cables are to generally be laid separately and at least 10 cm away from the power supply cables.

5.3.6 Where the AIS collects information from other equipment (such as GNSS, gyrocompass, ROT indicator etc.), it shall generally collect from the output interface of the equipment. When necessary, additional output interface of the equipment may be installed. Anyhow, the connection to the AIS shall not affect normal operating performance of the equipment. The external sensors connected to the AIS are to be such that they are the installations, equipment and systems used for normal navigation of the ship.

5.3.7 Where the AIS is installed on the existing ship, in addition that the cables laid shall be fixed as specified, it is not to affect the original structures of the ship. The tightness of original decks or bulkheads shall be maintained when cables pass through.

5.3.8 The AIS antenna shall as far as possible be installed in accordance with the following requirements. Where it is impracticable, it may appropriately be relaxed subject to the consent of the Society.

(1) The AIS VHF antenna shall have omnidirectional vertical polarization providing 3 to 5 dB gain.

(2) The objective for the AIS VHF antenna is to see the horizon freely through 360°. The antenna shall not be installed close to any large vertical obstruction. It shall be placed in an elevated position with a minimum of 2 m in horizontal direction from constructions made of conductive materials.

(3) The AIS VHF antenna shall be installed safely away from interfering high-power energy sources like radar and other transmitting radio antennas, preferably at least 3 m away from and out of the transmitting beam.

(4) The AIS VHF antenna shall be mounted directly above or below the ship's primary VHF radiophone antenna, with no horizontal separation and with a minimum of 2 m vertical separation. If it is located on the same level as other antennas, the distance apart shall be at least 10 m.

(5) The GNSS antenna must be installed where it has a clear view of the sky. The objective is to see the horizon freely through 360° with a vertical observation of 5° to 90° degrees above the horizon. Small diameter obstructions, such as masts and booms, do not seriously degrade signal reception, but such objects must not eclipse more than a few degrees of any given bearing. The antenna shall be far from S wave radar. INMARSAT system as high power transmitter shall transmit beams with 3 m.

5.3.9 DGNSS system shall be installed in accordance with the requirements of IEC61108-4, Ed 1, Annex D.

5.3.10 The BIIT requires that an alarm output (outlay) be connected to an audible alarm device. Alternatively, the BIIT alarm system may use the alarm messages output on the PI, provided its alarm system is AIS compatible.

5.3.11 Where applicable, a plug connected to this port shall be installed on the bridge near the pilot's operating position so that a pilot can connect a Personal Pilot Unit (PPU).

5.3.12 The AIS initialized data list (static information specified in 2.5.2 (1)) shall be submitted to the site surveyor for confirmation. After confirmed, the list shall be kept onboard the ship.

5.4 Installation survey

5.4.1 The certificate of the AIS equipment and fitness symbols shall be checked.

5.4.2 A visual inspection shall be carried out to the equipment to ensure no damage of its shell and interface. The protective shape of the shell is to be appropriate to the installation site.

5.4.3 A visual inspection shall be carried out to the connection lines and power source device of the equipment to ensure reliability of the cable connection and no danger of using electricity. The equipment is so arranged that it is easy to operate and is appropriate to repair and maintain. The inspection shall be carried out that the AIS equipment is connected well to the ground in accordance with those specified in the plans. The arrangement of lining shall be in compliance with the AIS system.

5.4.4 The inspection of the installation conditions of AIS antenna and internal and external GNSS antenna shall be carried out to ensure the installation position compliance with that indicated in the plans. The antenna installation shall be fixed and reliable.

5.4.5 Where the system is ensured to be connected correctly, the power can be switched on and the following measurements can be carried out:

(1) to inspect whether the operation of the external equipment connected to the AIS such as GDSS and gyrocompass is in normal conditions;

(2) to give self-measurement with the self-measurement function inside the AIS equipment to confirm the normal result;

(3) when confirming the external sensor with efficient input signal, the AIS equipment shall operate within 2 min and shall transmit the information of the own ship in accordance with the specified reporting rate;

(4) to confirm GNSS and gyrocompass applicable to the data the equipment displays, and conforming with the data collected inside the AIS . The accuracy of the data shall comply with the performance standard of the AIS;

(5) in accordance with the provided AIS initialized list, confirm the relevant the static and / or voyage information of the ship correctly input, attention shall be paid that whether the data is correct of input MMSI, GNSS installation position;

(6) under normal conditions of the AIS, initiate the relevant equipment of the maneuvering console. Suggest initiating MHF and radar etc. to confirm the AIS under normal operation conditions while transmitting in MHF;

(7) after a period of time's intercepting and information collecting, the AIS shall carry out normal transmissions. The targets displayed in display unit of the AIS shall be observed, so compared the radar echo. Both observe objectives shall be in compliance, and the accurate position of the objectives, if necessary, shall be settled by means of other communication. Where the target has a little bit greater error, the cause of which shall further be explored;

(8) to simulate a man-made fault such as GNSS looses its position information. The AIS can send out audible alarm at maneuvering console through the alarming unit connected to the outside. The alarming information displayed in the displaying unit shall comply with the actual malfunctioning;

(9) as far as practicable, long range communication function of the AIS equipment shall be carried out.

5.5 Survey in service

The following surveys shall be carried out to the AIS equipment in combination with annual survey and periodical / renewal surveys of the safety equipment.

5.5.1 Annual survey

(1) Visual inspection shall be carried out to the connection lines and power source device of the equipment to confirm reliability of the cable connection and no danger of using electricity.

(2) The AIS and GNSS antenna connected to it are not excessively rusted, with no sheath peeled off. Confirm the water-tightness is well kept at the junctions of antenna and cables. The tightness of the bulkheads shall be maintained when cables pass through.

(3) Switching on test shall be carried out to the AIS equipment. When the external equipment is under normal operation conditions, the AIS shall be in good operation condition within 2 min, and confirm the results of self-inspection is normal.

(4) To inspect that the internal static information of the own ship and voyage related information inside the AIS is capable of being displayed correctly, and in compliance with the actual conditions.

(5) To confirm the target information that the AIS displays by means of VHF or other communication methods, or to compare the target echo of the radar.

(6) To confirm that the information of the own ship is transmitted in accordance with the reporting rate the AIS specifies.

(7) To simulate an AIS malfunctioning to confirm whether the related alarm information given by MKD is in compliance.

(8) To inspect the last 10 mal-operation records by the own AIS to confirm the operation conditions of the equipment.

5.5.2 Renewal survey / periodical survey

In addition to the annual surveys mentioned above, the following shall be carried out:

(1) To confirm GNSS displayed and gyrocompass data comply with those of external equipment, and confirm the GNSS and gyrocompass under normal operation conditions.

(2) To inspect the AIS emergency power source to confirm the capacity and performance satisfy the requirements.

(3) Where possible, recommending to contact AIS base station to transmitting inquiry messages to the own ship to confirm the correct responses given by the AIS of the station.

Chapter 6 Methods of Testing and Required Test Results

6.1 Test conditions

6.1.1 Normal and extreme test conditions

(1) Normal test conditions

① Temperature and humidity shall be within following range:
Temperature：+15℃ to +35℃
Humidity：20% to 75%.

② Power supply
The normal power supply for the tests shall be in accordance with IEC60945 CI.5.2.1.

(2) Extreme test conditions

Extreme test conditions are as specified in IEC60945. Where required, test under extreme test conditions shall be a combination of dry heat and supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.
During type testing the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

6.1.2 AIS standard test environment

(1) The EUT is an environment using test equipment to simulate and to log VDL-messages. Standard environment consists of at least 5 simulated targets. The signal input level at the RF input port of the EUT for any simulated target shall be at least -100dBm. Own ship sensor inputs to EUT will be simulated by the test system or other means. Operation is checked on channels in the maritime mobile band.

(2) Channels in use shall be selected by manual input or channel assignment messages（see Chapter 3）before starting tests.

6.1.3 Testing signal[①]

⑴ Standard test signal 1
A DSC call with an individual station address and with command sets 103 (report your position) and 111 (report ship name) unless otherwise stated.

[①] Note: Transmitters may have limitations concerning their maximum conditions transmit time and / or their transmission duty cycle. It is intended that such limitations are respected during testing.

(2) Standard test signal 2

For TDMA Type 1: A test signal consisting of an infinite series of 010101.

(3) Standard test signal 3

For TDMA Type 2: A test signal consisting of an infinite series of 00110011

6.1.4 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50Ω (see 6.1.7). This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously. The levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of dBm. The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

6.1.5 Encoder for receiver measurements

Whenever needed and in order to facilitate measurements on the receiver, an encoder for the data system shall accompany the EUT, together with details of the normal modulation process. The encoder is used to modulate a signal generator for use as a test signal source.

Complete details of all codes and code format(s) used shall be given.

6.1.6 Waiver for receivers

If the manufacturer declares the both TDMA receivers are identical, the test shall be limited to one receiver and test for the second receiver shall be waived. The test report shall mention this.

6.1.7 Impedance

In this standard the term "50Ω" is used for a 50Ω non-receive impedance.

6.1.8 Artificial antenna (dummy load)[①]

Tests shall be carried out using an artificial antenna which shall be a non-reactive and non-radiating load of 50Ω connected to the antenna connector.

6.1.9 Facilities for access

All tests shall be performed using the standard ports of the EUT. Where access facilities are required to enable any specific test, they are to be provided by the manufacturer.

6.1.10 Modes of operation of the transmitter

For the purpose of the measurements according to this standard, there shall be a facility to operate the transmitter unmodulated.

Alternatively, the method of obtaining an unmodulated carrier or special types of modulation patterns

[①] Note: Some of the methods of measurement described in this standard for the transmitters, allow for two or more different test set-ups in order to perform those measurements. The corresponding figures illustrate therefore one particular test set up, and are given as examples. In many of those figures, power attenuators (providing a non-reactive non-radiating load of 50Ω to the antenna connector) have been shown. These attenuators are not "artificial antennas" as defined in 6.1.8. The method of measurement used shall be stated in the test report.

may also be decided by agreement between the manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test. For instance in the case of direct Frequency Shift Keying (FSK), a means to transmit continuously a sequence containing only “zero” and a sequence containing only “one” is preferable.

6.1.11 Measurement uncertainties

(1) Maximum values of absolute measurement uncertainties shall be as follows：

① RF frequency ±1×10^{7}

② RF power ±0.75dB

③ Adjacent channel power ±5 dB

④ Conducted spurious emission of transmitter ±4dB

⑤ Conducted spurious emission of receiver ±3 dB

⑥ Two-signal measurement ±4dB

⑦ Three-signal measurement ±3dB

⑧ Radiate emission of transmitter ±6dB

⑨ Radiate emission of receiver ±6 dB

⑩ Transmitter attack time ±20%

⑪ Transmitter release time ±20%

⑫ Transmitter transient frequency (frequency difference) ±250Hz/.

(2) For the test methods according to this standard, these uncertainty figures are valid to a confidence level of 95 %.

(3) The interpretation of the results recorded in a test report for the measurements described in this standard shall be as follows:

① the measured value related to the corresponding limit shall be used to decide whether the equipment meets the requirements of this standard;

② the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;

③ the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in this clause (absolute measurement uncertainties).

6.2 Operational test

6.2.1 Operational modes / capability

(1) autonomous mode

① transmit position reports

Method of measurement:

Set up a standard test environment. Record the VDL communication and check for messages of the EUT.

Required results：

Confirm that the EUT transmits continuously and that the transmitted data complies with sensor inputs.

② Receiving position reports

Method of measurement:

Set up a standard test environment.

a) Switch on test targets, then start operation of the EUT.

b) Start operation of the EUT, then switch on test targets.

Required results:

Confirm that EUT receives continuously under conditions a) and b) and outputs the received messages via the PI.

(2) Assigned mode

Method of measurement:

Set up a standard test environment and operate EUT in autonomous mode. Transmit an assigned mode command msg 16 to the EUT:

a) Slot offset and increment. b) Designated reporting rate.

Record transmitted messages.

Required results:

Confirm that the EUT transmits position reports msg 2 according to defined parameters and reverts to SOTDMA msg 1 with standard reporting rate after 4 to 8 min.

(3) Polled mode

① Transmit an interrrogation

Method of measurement：

Set up a standard test environment and operate EUT in autonomous mode. Initiate the transmission of an interrogation message（msg 15）by the EUT addressing 1 or 2 destinations according to message table requesting the following responses:

a) msg 3、msg 5 from mobile stations;

b) msg 4、msg 20、msg 22 from base stations.

Record transmitted messages.

Required results:

Check that EUT transmits the interrogation message（msg 15）as appropriate.

② Interrogation response

Method of measurement:

Set-up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (msg 15; EUT as destination) to the VDL according to message table for responses with msg 3, msg 5 and slot offset set to defined value. Record transmitted messages and frame structure.

Required results:

Check that the EUT transmits the appropriate interrogation response message as requested after defined slot offset. Confirm that the EUT transmits the response on the same channel as where interrogation was received.

(4) Addressed operation

① Transmit an addressed message

Method of measurement:

Set up a standard test environment and operate EUT in autonomous mode. Initiate the transmission of an addressed binary message（msg 6；EUT as source）according to message table by the EUT. Record the transmitted messages.

Required results:

Check that the EUT transmits the msg 6 as appropriate. Repeat test with the addressed safety related message (msg12).

② Receive addressed message

Method of measurement:

Set up a standard test environment and operate EUT in autonomous mode.

a) Apply an addressed binary message（msg 6; EUT as destination）to the VDL.

b) Apply an addressed binary message（msg 6; other station as destination）to the VDL.

Record transmitted messages and frame structure.

Required results:

Check that EUT transmits the appropriate acknowledgement message. Confirm that:

a) EUT outputs the received message via the presentation interface;

b) EUT does not output the received message via the presentation interface.

6.2.2 Multiple slot messages

(1) 5 slot messages

Method of measurement

Apply a BBM sentence (see Annex) to the PI of EUT with a max. of 121 data bytes of binary data in order to initiate transmission of a binary message（msg 8）.

Required methods

Check that the message is transmitted in up to 5 slots accordingly.

(2) Longer messages

Method of measurement

Apply a BBM sentence to the PI of the EUT with an information content not fitting in 5 slots (i.e. more than 121data bytes).

Required results

Check that the message is not transmitted. Check that a negative acknowledgement is given on the presentation interface.

6.2.3 Information content

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

Apply all static, dynamic and voyage related data to the EUT.

Record all messages on VDL and check the content of position report msg 1 and static data report msg 5.

Required results

Confirm that data transmitted by the EUT complies with manual and sensor inputs.

6.2.4 Reporting rates

(1) Speed and course change

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

a） start with own speed of 10 knots; record all messages on VDL for 10min and evaluate reporting rate for position report of EUT by calculating average slot offset over test period.

b）Increased speed and change course（ROT＞10°/min，derived from heading）in accordance

with 2.5.2 and ITU-R M.1371-1 A2/4.3.

c) Reduce speed and rotation rate to values below those given in table 2.5.2.

d) Make speed and / or heading sensor unavailable.

For b）, c）, d）record all messages on VDL and check slot offset between two consecutive transmissions.

Required results

a) Reporting rate shall comply with table 1（10s±10%）.

b) Confirm that the new reporting rate has been established.

c) Confirm that the reporting rate is reduced after 4min（speed reduction）20s (ROT reduction).

d) Check that with unavailable sensors the reporting rate reverts to default values (10s if no sensor connected).

(2) Change of navigational status

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Change navigational status by applying voyage data message to the presentation interface of the EUT.

a) set NavStatus to “at anchor” and speed < 3 knots；

b) set NavStatus to “at anchor” and speed > 3 knots；

c) set NavStatus to other values.

Record all messages on VDL and evaluate reporting rate of position report of EUT.

Required results

d) Reporting rate shall be 3min.

e) Reporting rate shall be 10s.

f) Reporting rate shall be adjusted according to speed and course.

(3) Assigned reporting rates

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Transmit an assigned mode command msg 16 to the EUT:

a) initial slot offset and increment;

b) designated reporting rate.

Change course, speed and NavStatus. Record transmitted messages.

Required results

Confirm that the EUT transmits position reports msg 2 according to the parameters defined by msg 16; the reporting rate shall not be affected by course, speed or Nav Status. The EUT shall revert to msg 2 or 3 in autonomous mode with standard reporting rate after 4 to 8min.

(4) Static data reporting rates

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

a) Record the transmitted messages and check for static and voyage related data (msg5).

b) Change static and / or voyage related station data. Record the transmitted messages and check for static and voyage related data.

Required results

a) Confirm that the EUT transmits msg 5 with a reporting rate of 6 min.

b) Confirm that the EUT transmits msg 5 within 1 min reverting to a reporting rate of 6min.

6.2.5 Security

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Switch the EUT off for more than 15min and on again at least ten times. Recover and readout recorded data.

Required results

Confirm that the EUT records and displays times and events correctly.

6.2.6 Initialization period

Method of measurement

Set up a standard test environment with all sensors available.

a) Switch on EUT operating in autonomous mode.

b) Switch off EUT for approx. 0.5 s. Record transmitted messages.

Required results

Confirm that the EUT starts transmissions within 2 min after switch on.

6.2.7 Channel selection

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Switch the EUT to different channels randomly selected from the maritime mobile band using both 25kHz and 12.5kHz channel

spacing（incl. 12.5kHzemission on a 25kHzchannel）：

a) manually;

b) by transmission of channel management message (msg 22) broadcast and addressed to EUT;

c) by application of ACA sentence to the presentation interface;

d) by transmission of DSC telecommand to EUT.

Record the VDL messages
Required results
Confirm that the EUT switches to channel / band width and duplex / simplex channels accordingly.
Confirm that the EUT delivers a TXT-sentence with ID 036, followed by the ACA-sentences needed to inform of changes in the AIS use of regional operating settings.

6.2.8 Transceiver protection
Method of measurement
Set up a standard test environment and operate EUT in autonomous mode.
Open circuit and short circuit VHF-antenna terminals of the EUT for at least 60s each.
Required results
The EUT shall be operative again within 2 min after refitting the antenna without damage to the transceiver.

6.2.9 Alarms and indicators, fall-back arrangements

(1) Loss of power supply
Method of measurement
Disconnect power supplies of the EUT.
Required result
Verify that the relay output is “active” when the power is “off”.

(2) Monitoring of functions and integrity

① Tx malfunction
Method of measurement
Disable the transmitter by disconnecting the antenna.
Required result
Verify that an alarm sentence ALR with alarm ID001 is sent and the relay output signals the failure state.
Verify that relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.

② Antenna VSWR
Method of measurement

Prevent the EUT from radiating with full power by mismatching the antenna for a VSWR of 3:1. During the mismatch the output power is not required to be the rated output power.

Required result

Verify that the EUT continues operating. Verify that an alarm sentence ALR with alarm ID002 is sent and the relay output signals the failure state.

Verify that relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.

③ Rx malfunction

Manufacturer shall provide documentation describing how the AIS detects Rx malfunction and that an ALR sentence with alarm ID as appropriate is sent.

④ Loss of UTC

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Disconnect the GNSS antenna (UTC clock lost).

Required result

Verify that the system continues to operate but changes to indirect synchronization and that a TXT-sentence with ID 007 is sent and the relay output is not activated.

⑤ Remote MKD disconnection, when so configured

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

a) Disconnect the connection to the remote MKD.

b) Provide an alarm acknowledgement, ACK sentence with ID 008, to the PI.

Required results

a) Verify that an alarm sentence, alarm ID 008, is sent and relay output signals the failure. Verify that the AIS continues operation, with the DTE value “1” in msg 5.

b) Verify that the relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.

(3) Monitoring of sensor data

① Priority of position sensors

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

Verify the manufacturer’s documentation to ascertain the configuration implemented on the EUT for position sensors. Apply position sensor data in a way that the EUT operates

in the states defined below:

a) external DGNSS in use (corrected);

b) internal DGNSS in use (corrected; msg 17) if implemented;

c) internal DGNSS in use (corrected beacon) if implemented;

d) external EPFS in use (uncorrected);

e) internal GNSS in use (uncorrected) if implemented;

f) no sensor position in use.

Check the ALR sentence and the position accuracy flag in the VDL msg 1.
Required result
Verify that the use of position source, position accuracy flag, RAIM flag and position information complies with table 2.10.3 (4).
Verify that when the status is changed, an ，ALR（025，026，029，030）, or TXT（021，022，023，024，025，027，028）sentence is sent according to table 2.10.2 (1) or table 2.10.3 (1) respectively.
Verify that the status is changed after 5s when switching downwards and 30s when switching upwards.

(4) Heading sensor
Method of measurement
Set up standard test environment and operate EUT in autonomous mode.

a) Disconnect the inputs for HDG and ROT or set their data to invalid.

b) Reconnect the inputs for HDG and ROT.

c) Disconnect the input for ROT.

d) Reconnect the ROT input.

Required result

a) Check that an alarm sentence ALR with alarm ID 032 for invalid HDG and an alarm sentence ID 035 for invalid ROT are sent to the PI and the “default” data is sent in VDL msg 1, 2, 3.

b) Check that an alarm sentence ALR with alarm ID 031 for valid HDG and ID 033 for

valid ROT is sent to the PI. Verify that, in the alarm sentences, the alarm condition flag is set to "V" and that the relay output is not activated.

c) Check that a TXT-sentence with ID 034 for "other ROT source in use" is sent to the PI and that the contents of the message's ROT field is the correct "direction of turn" (table 2.10.3 (6) ROT sensor fallback conditions, Priority 2).

(5) Speed sensor

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensor.

a) apply valid external DGNSS position and external speed data;

b) disconnect external DGNSS position, disconnect the inputs for SOG, COG or set their data to invalid.[①]

Required result

a) Check that an alarm sentence ALR with alarm ID 027 is sent to the PI and external data for SOG/COG is sent in VDL msg 1, 2, 3. Verify that the system continues to operate and that the relay output is not activated.

b) Check that an alarm sentence ALR with alarm ID 027 is sent to the PI and internal operate and that the relay output is not activated.

6.2.10 Display and control

(1) Data input / output facilities

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode.

a) Check size of minimum display

b) Record received messages and check contents of minimum display.

c) Input static and voyage related data via the minimum display

Required result

a) The minimum display shall contain at least three lines of data, with no horizontal scrolling of the range and bearing data display.

b) Confirm that all messages including binary and safety related and long range messages received can be displayed and that means to select messages and data fields to be

[①] Note： Test b) is applicable only if the internal GNSS is used as position source.

displayed are available.

c) Confirm that all necessary data can be input.

(2) Initiate message transmission

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Initiate the transmission of non scheduled messages and interrogations as provided by the EUT.

Required results

Confirm that at least the transmission of safety related addressed and broadcast messages （msg 12 and msg 14）can be initiated by means of the minimum display. Confirm that transmission of msgs 4，16，17，18，19，20，21，22 is not possible[①].

(3) System control

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Performance system control / configuration commands as specified. Check indication of system status / alarms.

Required results

At least initiation of channel switching shall be possible with the minimum display. Output power may not be switched manually. Confirm that the configuration level and other functions, not intended for use by the operator, are protected by password or adequate means.

6.3 Physical Tests

6.3.1 TDMA transmitter

(1) Frequency error

Definition：The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation of the transmitter and its required frequency.

Method of measurement

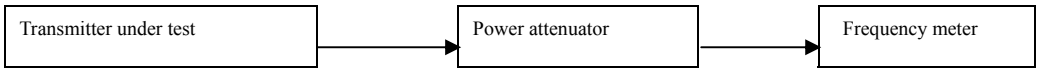


Figure 6.3.1(1) Measurement arrangement

The equipment shall be connected as illustrated. The carrier frequency shall be made under normal test conditions and extreme test conditions. Test shall be performed on 4 channels: 156.025 MHz, 157.4125 MHz, 160.6375 MHz, 162.025 MHz.

Required results

The frequency error shall not exceed ± 0.5kHz under normal and ± 1kHz under extreme test conditions.

[①] Note: Use of msgs 4，16，17，18，19，20，21，22 is restricted to base stations or class B AIS

(2) Carrier power

Definition：The transmitter carrier power (conducted) is the mean power delivered to a normal 50 Ohm load during a radio frequency cycle. The rated output power is the carrier power (conducted)) defined as nominal High and Low.

The power is measured during a pulse (slot)[①].

Method of measurement

The measurement shall be carried out under normal and extreme test conditions on both high and low power settings.

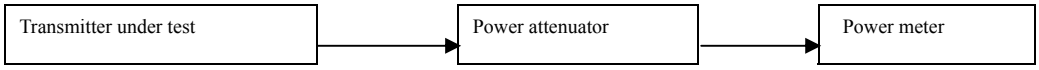


Figure 6.3.1(2) Measurement arrangement

Required results

The carrier power (conducted) shall be within ±1.5dB of the rated carrier power (conducted).

The carrier power (conducted) under extreme test conditions shall be within +2.0dB and -3.0 dB of the rated output power.

(3) Modulation spectrum 25kHz channel mode

Method of measurement

This test is produced to insure that the modulation sidebands produced by the specified test patterns, fall within the allowable masks.

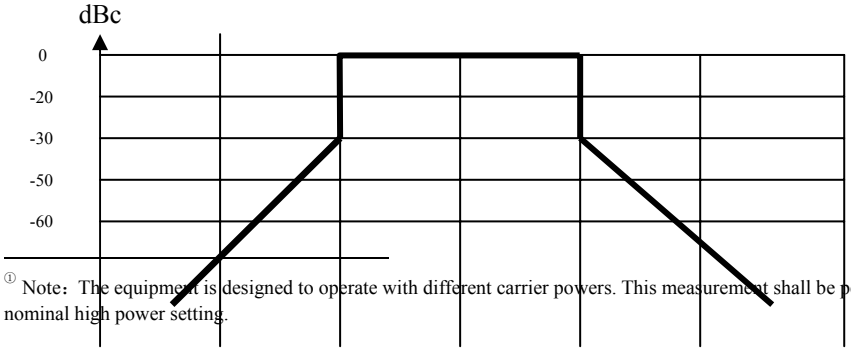
Two methods of measurements are accepted.

a) The test shall be performed using the modulation and transmitter keying of the EUT.

b) Alternatively, to perform this test the manufacturer shall provide access to the modulator and the transmitter key. An external test signal shall be applied to the EUT.

The test shall be carried out using standard modulation, for both DSC and TDMA modes, using successively standard test signals 1、2 and 3 (see 6.1.4).

Using standard modulation, for both DSC and TDMA modes, the emission mask for 25KHz channel modes is:



[①] Note：The equipment is designed to operate with different carrier powers. This measurement shall be performed at the nominal low and nominal high power setting.

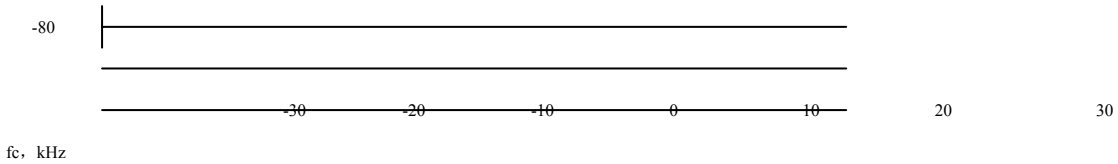


Figure 6.3.1(3) modulation spectrum 25KHz

——At ±10 KHz removed from the carrier, the modulation sidebands is below －25dBc,

——At ±25 KHz removed from the carrier, the modulation sidebands is below －70dBc, without any need to be below 0.25μW.

In the region between ±10 KHz and ±25 KHz removed from the carrier, the modulation sidebands is below a line specified between these two points.

Required result

The modulation spectrum shall be within the mask specified in figure 6.3.1(3).

(4) Modulation spectrum 12.5Khzchannel mode

Method of measurement：see 6.3.1(3)

The test shall be carried out using standard modulation in TDMA mode, using successively standard test signals 2 and 3 (see 6.1.3).

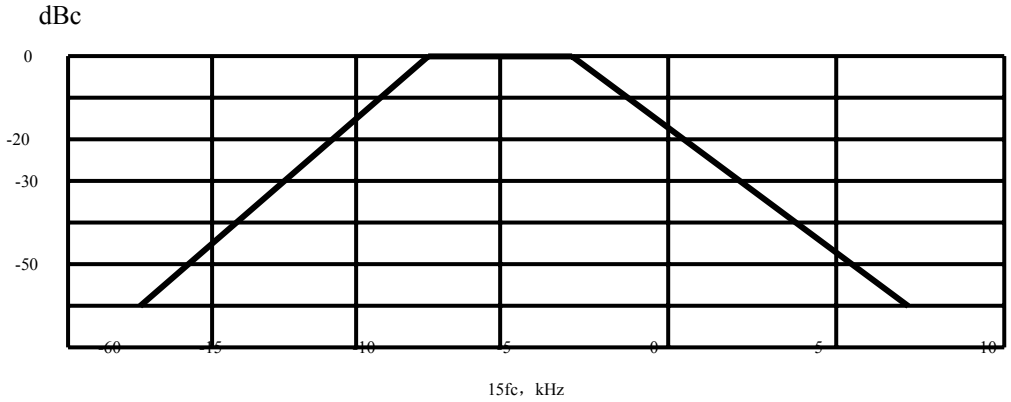
The emission mask for 12.5KHz channel mode is：

at ±12.5 KHz removed from the carrier, the modulation sidebands is below －60dbc;

in the region between ±2.5KHz and ±12.5 KHz removed from the carrier, the modulation sidebands is below a line starting at 0 dBc/±2.5KHz and ending at －60dBc/±2.5KHz without any need to be below 0.25μW.

Required result

The modulation spectrum shall be within the mask specified in figure 6.3.1(4).



本图重新画过 **Figure 6.3.1(4) Modulation spectrum 12.5KHz**

(5) Transmitter attack time

Definition：The transmitter attack time（t_a）is the time which elapses between the initiation of the“transmitter on”（T_o）and:

a) the moment when the transmitter output power has reached a level 1 dB below or 1,5 dB above the steady state power (P_c) and maintains level within +1.5 dB / -1 dB from P_C thereafter as seen on the measuring equipment or in the plot of power as a function of time; or

b) the moment after which the frequency of the carrier always remains within ±1Khzofits steady state frequency ($F_{c)}$.

The choice of b)，above, is made in order to make the method of measurement easier to perform and to have good repeatability. Under these conditions, the frequency of the carrier shall be within the required frequency tolerance a few ms after the end of the attack time.

Method of measurement

The measurement is carried out with an unmodulated carrier.

The measurement procedure shall be as follows:

a) The transmitter is connected to a RF detector and to a test discriminator via matched test load. The attenuation of the test load shall be chosen in such a way that the input of the test discriminator is protected against overload and the limiter amplifier of the test discriminator operates correctly in the limiting range as soon as the transmitter carrier power (before attenuation) exceeds 1 mW as shown in Figure 6.3.1(5).

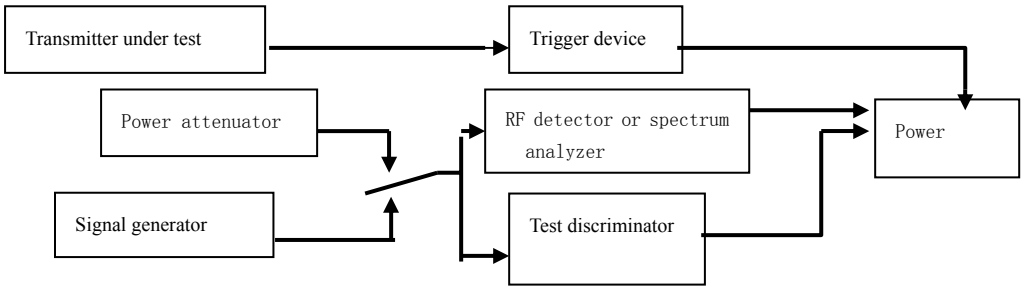


Figure 6.3.1(5) Test arrangement for transient behaviour of transmitter power and frequency, including transmitter attack and release time

The test discriminator may consist of a mixer and a local oscillator (providing the auxiliary frequency).

——the test discriminator shall be sensitive enough to measure input signals down to P_c-30 dB.

——the test discriminator shall be fast enough to display the frequency deviations (approximately 100KHz/100ms).

——the test discriminator output shall be d.c. coupled.

b) The traces of the oscilloscope shall be calibrated in power and frequency and in time, using the signal generator;

c) The transmitter attack time may (preferably) be measured by direct reading on the oscilloscope while the transmitter is unmoldulated.

Required result

The transmitter attack time shall not exceed 1ms，and the transient power level shall not exceed +1.5dB of its final value at any time. The carrier frequency shall not exceed ±1kHz of its required value after 1 ms.

(6) Transmitter release time

Definition: The transmitter release time（t_r）is the time which elapses between the initiation of the “transmitter off”function and the moment when the transmitter output power has reduced to a level 50 dB below the steady state power ($P_{c)}$.

Method of measurement: see figure 6.3.1(5)

The measurement is carried out with an unmodulated carrier.

The measurement procedure shall be as follows:

a) The transmitter is connected to a RF detector and to a test discriminator via a matched power attenuator. Its attenuation shall be chosen in such a way that the input of the test discriminator is protected against overload and that the limiter amplifier of the test discriminator operates correctly in the limiting range as long as the transmitter carrier power (before attenuation) exceeds 1 mW. A dual trace storage oscilloscope (or a transient recorder) records the amplitude transient from the detector on a logarithmic scale and the frequency transient from the discriminator. A trigger device may be required to ensure that the start of the sweep of the oscilloscope time base occurs the instant at which the “transmitter off”function is initiated. If the transmitter possesses an automatic powering down facility (e.g. in the case of fixed length message transmission),

it may replace the trigger device for starting the sweep of the oscilloscope.

b) The traces of the oscilloscope shall be calibrated in power and frequency and in time by replacing the transmitter and test load by the signal generator.

c) The transmitter release time shall be measured by direct reading on the oscilloscope while the transmitter is preferably unmodulated.

Required result

The transmitter release time shall not exceed 1ms.

6.3.2. DSC transmissions

(1) Frequency error of the DSC signal

Definition：The frequency error for the B（2100Hz）and Y（1300Hz）state is the difference between the measured frequency from the demodulator and the nominal values.

Method of measurement

The transmitter shall be connected to the artificial antenna as specified in 6.1.10 and a suitable FM demodulator. The transmitter shall be set to channel 70.

The equipment shall be set to transmit a continuous B or Y state.

To measure the modulated output for both the continuous B and Y state.

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

Required results

The B and Y state frequencies for both normal and extreme test conditions shall be within ±1%.

(2) Modulation rate

Definition: The modulation rate is defined as the bit stream speed measured in bit /s.

Method of measurement

The equipment shall be set to transmit continuous dot pattern. The RF output terminal of the equipment shall be connected to a linear FM demodulator followed by a suitable FSK demodulator.

Required results

The baud rate shall be 1200bits/s±30ppm.

6.3.3 TDMA receivers

(1) Sensitivity - 25KHz operation

Definition: The maximum usable sensitivity (data or messages, conducted) is the minimum level of signal at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

Method of measurement

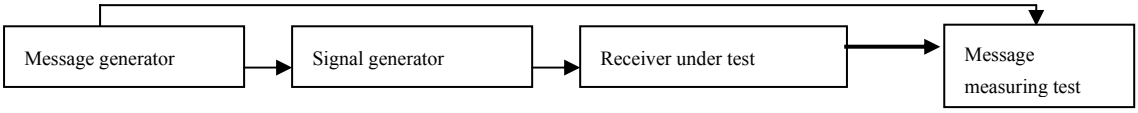


Figure 6.3.3(1)

Two types of packets shall be used: one which has a data field with a bit pattern consisting of altering ones and zeroes (10101010…), one, which has a bit pattern with alternating double ones and double zeroes（110011001100…）. The test shall alternate between the two types during the test process.[①]

Table 6.3.3(1)

Parameter	Bits
Preamble	24
Start flag	8
Data	168
CRC	16
End flag	8
Total	224

A minimum of 1,000 packets shall be transmitted during the test. The PER shall be derived by dividing the received packets with the number of transmitted packets. The test shall be performed with the frequencies 156.025MHz and 162.025MHz.

Required results

The sensitivity shall be -107dBm under normal test conditions, and -101 dBm under extreme test conditions, when operating on a 25KHz channel with a PER of 20%.

(2) Sensitivity -12.5KHz operation

Definition: The maximum usable sensitivity (data or messages, conducted) is the minimum level of signal (dBm) at the receive input, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

Method of measurement

Use of method of 6.3.3(1). The test shall be performed with the frequencies 157.4125MHz and 160.6375MHz.

Required result

The sensitivity shall be -98 dBm under normal test conditions, and -92 dBm under extreme test conditions, when operating on a 12.5KHz channel with a PER 20%.

(3) Error behaviour at high input levels

[①] Note： A broadcast binary message structure is allowed to be used for this test. In this case, the data field is reduced by 40 bits, which will be occupied by the message id for broadcast binary message and the unique identifier for the transmitting station (MMSI). The application identifier shall be selected so that it corresponds with the selected bit pattern.

The measurement procedure shall be as follows:

a) an input signal with a frequency equal to the nominal frequency of the receiver, having normal test modulation（see 6.1.3(2) and 6.1.3(3)), in accordance with the instructions of the manufacturer and agreed by the testing laboratory, shall be applied to the receiver input terminals;

b) the level of the input signal shall be adjusted to a level which is – 77 dBm for the degradation measurements;

c) the normal test signal shall then be transmitted 1,000 times whilst observing in each case whether or not a message is successfully received;

d) the number of messages not successfully received shall be recorded;

e) the measurement shall be repeated with the input signal of the receiver at a level of－7dBm for the degradation measurements.

Required results

The number of messages not correctly received (lost or corrupted) at - 7dBm shall not differ by more than 1 % from that recorded at - 77 dBm.

(4) Co-channel rejection - 25KHz operation

Definition: The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

Method of measurement

The measurement procedure shall be as follows:

a) Two signal generators, A and B shall be connected to the receiver via a combining network. The wanted signal provided by signal generator A shall be at the nominal frequency of the receiver and shall have normal test modulation（see 6.1.3 and method of measurement in 6.3.3(1)）. The unwanted signal provided by B shall be modulated with a 400Hz signal with a deviation of 12 % of the channel separation. Both input signals shall be at the nominal frequency of the receiver.

b) Initially, signal generator B shall be switched off（maintaining the output impedance）. The level of the wanted signal from generator A shall be adjusted to a level which is 6 dB above the level of the limit of the maximum usable sensitivity as specified in 6.3.3 (1).

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of less than 10 % is obtained.

d) The normal test signal（see 6.1.3(1) and method of measurement in 6.3.3(1)）shall then be

transmitted repeatedly while observing in each case whether or not a message is successfully received.

The level of the unwanted signal shall be reduced by 2dB for each occasion that a message is not successfully received.

The procedure shall be continued until three consecutive messages are successfully received. The level of the input signal shall then be noted.

e) The level of the signal shall be increased by 1 dB and the new value noted. The normal test signal (see 6.1.3 (1) and method of measurement in 6.3.3 (1)) shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

No level of the unwanted signal level shall be noted unless preceded by a change in level.

The average of the values noted in steps b) and c)（which provides the level corresponding to the successful message ratio of 80%）shall be noted.

f) For each frequency of the unwanted signal, the co-channel rejection ratio shall be expressed as the ratio, in dB, of the average level noted in step c) to the level of the wanted signal, at the receiver input. This ratio shall be recorded.

g) The measurement shall be repeated for displacements of the unwanted signal of ±12% of the channel separation.

h) The co-channel rejection of the equipment under test shall be expressed in dB, calculated in step d).

i) Repeat this test using test signal 2（as defined in 6.1.3(2) and method of measurement in 6.3.3(1)）in place of signal generator B.

Required result

The value of the co-channel rejection ratio shall be between -10dB~0dB. Any positive value is also acceptable.

(5) Co-channel rejection - 12.5KHz operation

For definition and method of measurement, see 6.3.3(4)

Required result

The value of the co-channel rejection ratio shall be between -18dB~0dB. Any positive value is also acceptable.

(6) Adjacent channel selectivity - 25KHz operation

Definition: The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

Method of measurement

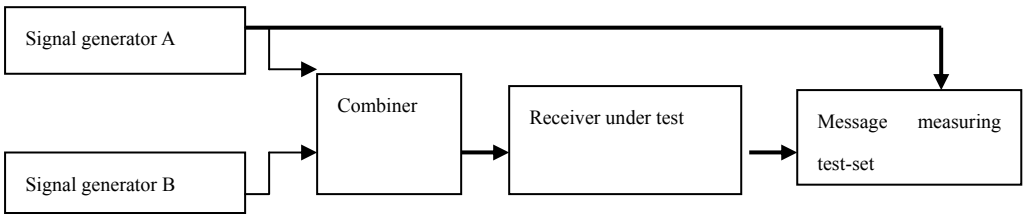


Figure 6.3.3(6) Measurement arrangement with messages

The measurement procedure shall be as follows:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network.
The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated by the normal test signal (see 6.1.3).
The unwanted signal. provided by signal generator B, shall be a modulated signal and shall be at the frequency of the channel immediately above that of the wanted signal.

b) Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance). The level of the wanted signal from generator A shall be adjusted to the level which is 6 dB above the level of the limit of the maximum usable sensitivity at the receiver input terminals.

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of 10% is obtained.

d) The normal signal (see 6.1.3) shall be transmitted repeatedly whilst observing in each case whether or not a message is successfully received.

e) The level of the unwanted signal shall be reduced in steps of 2 dB for each occasion that a message not successfully received. The procedure shall be continued until three consecutive message are successfully received. The level of the input signal shall then be noted.

f) The level of the unwanted signal shall be increased by 1 dB and the new value noted.
The normal test signal（see 6.1.3）shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.
If a message is successfully received, the level of the unwanted signal shall not be changed until three consecutive messages have been successfully received. In this case, the unwanted signal shall be increased by 1 dB and the new value noted.

g) The average of the values noted in steps e) and f) (which provides the level corresponding to the successful message ratio of 80 %) shall be noted.

h) For each adjacent channel, the selectivity shall be expressed as the ratio, in dB, of the level of the unwanted signal to the level of wanted signal, at the receiver input. This ratio shall be recorded.

i) The measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal.

j) The adjacent channel selectivity of the equipment under test shall be expressed as the lower of the two values measured in the upper and lower channels nearest to the receiving channel.

k) The measurement shall be repeated under extreme test conditions (extreme temperature and extreme voltages applied simultaneously), using the level of the wanted signal, as specified in 6.3.3 (1), increased by 6 dB.

Required results

The adjacent channel selectivity shall be no less than the values given in table 6.3.3 (6):

Table 6.3.3 (6) Adjacent channel selectivity 25kHz

Channel separation	25kHz
Normal test conditions	70.0dB
Extreme test conditions	60.0dB

(7) Adjacent channel selectivity - 12.5KHzoperation

Definition: see 6.3.3(6)

Method of measurement: see 6.3.3(6)

Required results

The adjacent channel selectivity shall be no less than the values given in 6.3.3(7):

Table 6.3.3(7) Adjacent channel selectivity 12.5kHz

Channel separation	12.5kHz
Normal test conditions	50.0dB
Extreme test conditions	50.0dB

(8) Spurious response rejection

Definition: The spurious response rejection is a message of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

Method of measurement

To determine the frequencies at which spurious responses can occur the following calculations

shall be made:

a) calculation of the limited frequency range:
The limited frequency range is defined as the frequency of the oscillator signal（f_{LO}）applied to the first mixer of the receiver plus or minus the sums of the intermediate frequencies（f_{I1}，…f_{In}）and half the switching range (sr) of the receiver (156 ~163 MHz); hence, the frequency f_I of the limited frequency range is:

$$f_{LO}-\Sigma^{j=n}_{j=1}f_{Ij}- sr/2 \leq f_I \leq f_{LO}+\Sigma^{j=n}_{j=1}f_{Ij}+ sr/2$$

b) calculation of frequencies outside the limited frequency range:
A calculation of the frequencies at which spurious responses can occur outside the range determined in a) is made for the remainder of the frequency rang of interest.
The frequencies outside the limited frequency range are equal to the harmonics of the frequency of the local oscillator signal（f_{LO}）applied to the first mixer of the receiver plus or minus the first intermediate frequency (f_{I1}) of the receiver; hence, the frequencies of these spurious responses are:

$$n f_{LO} \pm f_{I1}$$

where: n is an integer greater than or equal to 2.

The measurement of the first image response of the receiver shall initially be made to verify the calculation of spurious response frequencies.
For the calculations a）and b）above， the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal（f_{LO}）applied to the 1st mixer of the receiver, the intermediate frequencies（$f_{I1,}$ f_{I2} etc.），and the switching range（sr）of the receiver.
Method of search over limited frequency range

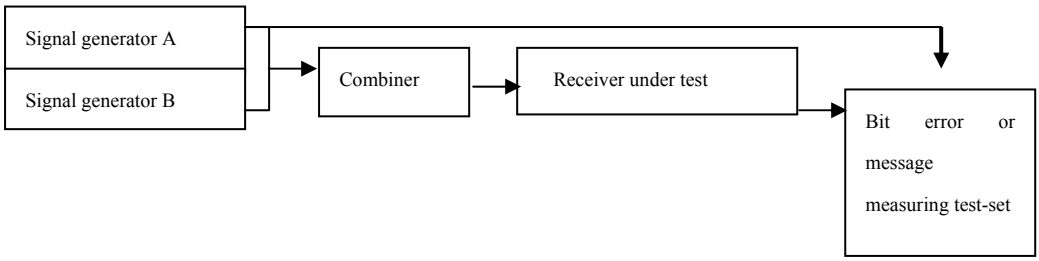


Figure 6.3.3(8) Measurement arrangement

The measurement procedure shall be as follows:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network. The wanted signal, provided by signal generator A, shall be at the normal frequency of the receiver and shall have the normal test signal or modulation（see 6.1.4）.

The unwanted signal, provided by signal generator B, shall be modulated with a 400Hz signal with a deviation of ±3KHz.

b) Initially, signal generator B shall be turned off（maintaining the output impedance）.The level of the wanted signal from generator A shall be adjusted to the level which is 3 dB above the level of the limit of the maximum usable sensitivity.
In the case where a continuous bit stream is used, the bit error ratio of the receiver after demodulation shall be noted.

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted to -27dBm at the receiver input terminals. The frequency of the unwanted signal generator shall be varied in increments of 5KHz over the limited frequency range and over the frequencies in accordance with the calculations outside of this frequency range.

d) The frequency of any spurious response detected (e.g. by an increase in the previously noted bit error ratio) during the research shall be recorded.

e) In the case where operation using a continuous bit stream is not possible, spurious responses shall be identified by a degradation of the successful message ratio.

Method of measurement with messages
The measurement shall be performed as follows, using the measurement arrangement of figure 6.3.3(8):

a) Two signal generators, A and B, shall be connected to the receiver via a combining network. The wanted signal, provided by signal generator A, shall be at the normal frequency of the receiver and shall have the normal test signal or modulation (see 6.1.3).
The unwanted signal, provided by signal generator B, shall be modulated with a frequency of 400Hz and with a deviation of ±3KHz. And shall be at the frequency of that spurious response being considered.

b) Initially, signal generator B shall be turned off（maintaining the output impedance）. The level of the wanted signal from generator A shall be adjusted to the level which is 3 dB above the level of the limit of the maximum usable sensitivity.

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of less than 10 % is obtained.

d) The normal test signal shall then be transmitted repeatedly whilst observing in each case whether or not a message is successfully received.
The level of the unwanted signal shall be reduced by 2 dB for each occasion that a message is not successfully received.
The procedure shall be continued until three consecutive messages are successfully

received. The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted. The normal test signal shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.
If a message is successfully received, the level of the unwanted signal shall not be changed until three consecutive messages have been successfully received. In this case the unwanted signal shall be increased by 1 dB and the new value noted.
The average of the values of the unwanted signal in steps d) and e) shall be noted.

f) For each frequency, the spurious response rejection shall be expressed as the ratio, in dB, of the level of the unwanted signal to the level of the wanted signal, at the receiver input. This ratio shall be recorded.

g) The measurement shall be repeated at all spurious response frequencies.

h) The spurious response rejection of the equipment under test shall be expressed as the lowest value recorded in step f.

Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection shall not be less than 70.0 dB.

(9) Intermodulation response rejection and blocking

Definition: The intermodulation response rejection is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

Method of measurement

Four signal generators shall be connected to the AIS transponder under test (see 6.3.3 (9)) The wanted signals, represented by signal generator A, shall be set up in accordance with the packet error rate measurement (see 6.3.3(3)) to the TDMA AIS test. The wanted signal levels at the RF input of the AIS transponder shall be set to -101 dBm.

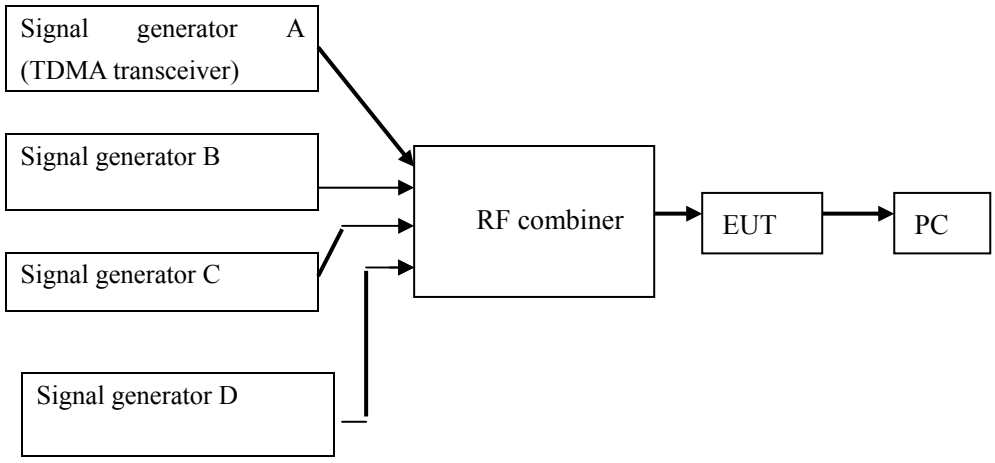


Figure 6.3.3(9)

The unwanted signal from signal generator B shall be modulated by 400Hz with deviation of ±3KHz and adjusted to a frequency 500kHz above or below the frequency of the AIS 1 channel. The unwanted signal from signal generator C shall be unmodulated and adjusted to a frequency 1,000 kHz above or below the frequency of the AIS . The unwanted signal levels from signal generators B and C at the RF input of the AIS transponder shall be set to –27 dBm.

The unwanted signal from signal generator D shall be unmodulagted and adjusted to a frequency 5,725kHz above or below the frequency of the AIS channel. The unwanted signal level from signal generator D at the RF input of the AIS transponder shall be set to -15dBm.

Required results

The packet error rate, with the outputs of signal generators B, C, D switched on, shall be 20 % or less.

⑽ Transmit to receive switching time

Definition: The transmit to receive switching time describes the capability of the TDMA receiver to receive in the slot immediately following the transmission slot.

Method of measurement

Configure the measurement in accordance with figure 6.3.3(8)，but add a 30 dB power attenuator. Set the TDMA transmitter in the unit under test to transmit at the default power setting (nominal 12.5W) in the slot immediately preceding the slot used for performing the receiver sensitivity measurement..

Required results

The sensitivity shall be –107 dBm with a PER of at most 20 % under normal test conditions.

6.3.4 DSC receiver

⑴ Maximum sensitivity

Definition: The maximum sensitivity of the receiver is the minimum level of the signal dBm at the nominal frequency of the receiver which when applied to the receiver input with a test modulation will produce a bit error rate of 10^{-2} .

Method of measurement

The test equipment shall be set to transmit continuous DSC dot pattern as the test modulation of the RF signal generator connected to the EUT. The EUT shall provide a logic level test output from its internal DSC demodulator to measure bit error rate.

Required result

The maximum usable sensitivity shall not be less sensitive than -107 dBm under normal test conditions, and -101 dBm under extreme test conditions. The test shall be repeated at the nominal carrier frequency (156.525MHz) ±1.5kHz.

⑵ Error behaviour at high input levels

Definition: The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the bit error rate in the output of

the receiver does not exceed a specified value.

Method of measurement

A test signal, in accordance with standard test signal number 1, shall be applied to the receiver input. The level of the test signal shall be -7 dBm.

Required result

The BER shall not exceed 10^{-2}

(3) Co-channel rejection

Definition：see 6.3.3(4)

Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be -104dBm. The unwanted signal shall be frequency modulated by 400Hz with a deviation of ±3kHz. The input level of the unwanted signal shall be -112dBm.

Both input signals shall be at the nominal frequency of the receiver under test and the measurement shall be repeated for displacements of the unwanted signal of up to ±3kHz.

Required result

The value of the co-channel rejection ratio, at the signal displacements given in the method of measurement, shall be between -10.0 dB and 0 dB. The BER shall not exceed 10^{-2} .

(4) Adjacent channel selectivity

Definition: see 6.3.3(6)

Method of measurement

The unwanted signal shall be standard test signal number 1. The level of the wanted signal shall be -104dBm. The unwanted signal shall be frequency modulated by 400Hz with deviation of ±3KHz. The input level of the unwanted signal shall be -34 dBm. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channels. The measurement shall be repeated with the unwanted signal tuned to the centre frequency of the lower adjacent channel.

Required result

The adjacent channel selectivity for different channel separations shall not be less than the values given in table 6.3.4(4).

Table 6.3.4(4) Adjacent channel selectivity DSC

Normal test conditions	70.0dB
Extreme test conditions	60.0dB

The BER shall not exceed 10^{-2}.

(5) Spurious response rejection

Definition: The spurious response characterizes the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be -104dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied between 100Hz and 2GHz. The level of the unwanted signal shall be -24dBm.

Required result

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection shall not be less than 70 dB. The BER shall not exceed 10^{-2}.

(6) Inter-modulation response rejection

Definition: The inter-modulation response characterizes the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency..

Method of measurement

The wanted signal represented by signal generator A shall be at the nominal frequency of the receiver and shall be standard test signal number 1. The level of the wanted signal shall be -104dBm.

The unwanted signal from signal generator B shall be unmodulated and adjusted to a frequency50Hz above the nominal frequency of the receiver. The second unwanted signal from signal generator C shall be modulated by 400Hz with a deviation of ±3kHz and adjusted to a frequency 100kHzabove the nominal frequency of the receiver. The input level of each unwanted signal shall be -39dBm. The test shall be repeated with the frequency of the unwanted signals below the nominal frequency of the receiver.

Required result

The inter-modulation response rejection ratio shall not be less than 65.0 dB. The BER shall not exceed 10^{-2}.

(7) Blocking or desensitization

Definition: The blocking immunity characterizes the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

Method of measurement

The wanted signal shall be standard test signal number 2. The level of the wanted signal shall be -104dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied between -10MHz and -1MHz and also between +1MHz and +10MHz relative to the nominal frequency of the wanted signal. The level of the unwanted signal shall be -20dBm.

Required result

The blocking ratio for any frequency within the specified ranges shall not be less than 84 dB, except at frequencies on which spurious response are found. The BER shall not exceed 10^{-2}。

6.3.5 Conducted spurious emissions conveyed to the antenna

(1) Spurious emissions from the receiver

Definition: Conducted spurious emissions to the antenna are any RF emissions generated in the receiver and conveyed to the antenna terminal.

Method of measurement

Conducted spurious emissions shall be measured as the power level of any detected component to the antenna terminals of the receiver. The receiver antenna terminals are conducted to a spectrum analyzer or selective voltmeter having an input impedance of 50Ω and the receiver is switched on. If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 150 kHz and 2 GHz.

Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed -57dBm（2nW）in the frequency range 150kHz to 1GHz and -47dBm（20nW）in the frequency range 1GHz to 2GHz.

(2) Spurious emissions from the transmitter

Definition: Conducted spurious 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. Spurious emissions include harmonic emissions, parasitic missions, inter-modulation products and frequency conversion products, but exclude out-of band emissions.

Method of measurement

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna. The measurement shall be made over a frequency range from 150 kHz to 2GHz, exceeding the channel on which the transmitter is operating and its adjacent channels.

Required results

The power of any spurious emissions on any discrete frequency shall not exceed -36dBm（0.25μW）in the frequency rang 150kHz to 1GHz and -30dBm（1μW）in the frequency range 1GHz to 2GHz.

6.4 Specific tests of link layer

6.4.1 TDMA synchronization

(1) Synchronization test using UTC

Method of measurement

Set up standard test environment; chose test conditions in a way that the EUT operates in following synchronization modes:

a) UTC direct

b) UTC indirect（internal GNSS receiver disabled; at least one other station UTC direct synchronized）

c) base direct（internal GNSS receiver disabled; base station with UTC direct synchronization within range）

Check CommState Parameter SyncState in position report and reporting rate.
Required result
Transmitted communication state shall fit the synchronization mode.

(2) Synchronization test without UTC, semaphore
Method of measurement
Set up standard test environment without available. Let EUT operate as a sync source (semaphore) for other stations. Check CommState Parameter SyncState in position report and reporting rate
Required results
Transmitted communication state shall fit the synchronization mode
The EUT shall increase reporting rate to 2 s when acting as a semaphore.

(3) Synchronization test without UTC
Method of measurement
Set up standard test environment; chose test conditions in a way that EUT operates in following sync modes:

a) base indirect (internal GNSS disabled; no station with UTC direct synchronization or base station within range)

b) mobile indirect (internal GNSS disabled; other station with UTC direct synchronization or base station without range)

c) enable internal GNSS in synchronization modes other than UTC direct

Check CommState Parameter SyncState in position report and reporting rate.
Required results

a) Transmitted communication state shall fit the synchronization mode

b) Transmitted communication state shall fit the synchronization mode

c) Synchronization mode shall revert to UTC direct

6.4.2 Time division (frame format)
Method of measurement
Set the EUT to max reporting rare of 2 s by applying a speed of >23 kn and a ROT of > 20^{o}/s. Record VDL messages and check for used slots. Check parameter slot number in CommState of position report. Check slot length (transmission time).
Required results

Slot number used and slot number indicated in CommState shall match. Slot number shall not exceed 2249. Slot length shall not exceed 26,67 ms.

6.4.3 Synchronization jitter

Definition: Synchronization jitter (transmission timing error) is the time between nominal slot start as determined by the UTC synchronization source and the initiation of the "transmitter on " function（T_0 see figure 3.2.2.10 in Rec. ITU-R M.1371-1）.

Method of measurement

Set up standard test environment. Set the EUT to 25 kHz bandwidth, max reporting rate of 2 s and using

a) UTC direct synchronization

b) UTC indirect synchronization by disconnecting the GNSS antenna of the EUT.

Record VDL messages and measure the time between the nominal beginning of the slot interval and the initiation of the "transmitter on" function. Alternative methods, e.g. by evaluating the test flag and calculating back to T_o are allowed.

Repeat the test for 12.5kHz bandwidth.

Required results

Synchronization jitter shall not exceed

a) $\pm 104\ \mu s$ using UTC direct synchronization

b) $\pm 312\ \mu s$ using UTC indirect synchronization

6.4.4 Data encoding (bit stuffing)

Method of measurement

Set up standard test environment.

a) apply a binary broadcast message (msg 8) to the VDL containing the HEX-values "7E 3B 3C 3E 7E" in the data portion and check presentation interface output of EUT.

b) apply a BBM message to the EUT initiating the transmission of msg 8 containing the HEX-values as above in the data portion and check the VDL.

Required results

Confirm that

a) transmitted VDL message conforms to data input on the presentation interface

b) data output on the presentation interface conforms to the transmitted data

6.4.5 Frame check sequence

Method of measurement

Apply a simulated position report message with wrong CRC bit sequence to the VDL.

Required results

Confirm that this message is not forwarded to the PI by the EUT.

6.4.6 Slot allocation (channel access protocols)

(1) Network entry

Method of measurement

Set up standard test environment; switch on EUT. Record transmitted scheduled position reports for the first 3 frames after initialization period. Check CommState for channel access mode.

Required results

EUT shall start autonomous transmissions of msg 3 (position report) with ITDMA CommState with KeepFlag set true for first frame and msg 1 with SOTDMA CommState for consecutive frames.

(2) Autonomous scheduled transmissions（SOTDMA）

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Record transmitted scheduled position reports msg 1 and check frame structure. Check CommState of transmitted messages for channel access mode and parameters slot timeout, slot number and slot offset.

Required results

Check that nominal reporting rate is achieved ±20% (allocating slots in selection interval SI). Confirm that the EUT allocates new slots NTS within SI after 3 to 8 min. Check that slot offset indicated in CommState matches slots used for transmission.

(3) Safety related / binary message transmission （RATDMA）

Method of measurement

Set up standard test environment and operate EUT in autonomous mode.

a) Apply a 1 slot binary broadcast message (msg 8) to the PI of the EUT. Record transmitted messages.

b) Apply combinations of binary broadcast message (msg 8), addressed binary message (msg 14), broadcast safety related message (msg6) and addressed safety related message (msg 12) to the PI of the EUT. Record transmitted messages and output of the PI of the EUT.

Required results

a) Confirm that EUT transmits this msg 8 within max. 4 s. Retry with 90 % channel load.

b) Confirm that maximum 20 slots can be used per frame for unannounced messages using RATDMA access scheme and that messages using the twenty first slot and above are rejected. Confirm that message ABK is sent with acknowledge type 2 (message could not be broadcast) when the message is rejected.

(4) Assigned operation

① Assigned mode using reporting rates

Method of measurement

Operate standard test environment and EUT in autonomous mode. Transmit an assigned mode command message msg 16 to the EUT with:

a) The number of reports per 10 min which is not a multiple of 20.

b) The number of reports per 10 min which is higher than 600.

Required results

a) Confirm that the EUT transmits position reports message msg 2 at a report rate that corresponds to the next highest multiple of 20.

b) Confirm that the EUT transmits position reports message msg 2 at a report rate of one report per second.

② Receiving test

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit an assigned mode command (msg16) to the EUT with:

a) slot offset and increment

b) designated reporting rate

Record transmitted messages.

Required results

Confirm that EUT transmits position report msg 2 according to defined parameters and reverts to SOTDMA msg 1 with standard reporting rate after 4 – 8 min（IYU-R M.1371-1 A2 / 3.3.8.2.12）.

③ Assignment selectivity

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Check frame structure. Transmit an assigned mode command (msg16) to another AIS with a slot offset and increment pointing to a slot used by the EUT. Record transmitted messages.

Required results

Confirm that EUT does not allocate slots on a msg 16 addressed to other stations.

④ Slot assignment to FATDMA reserved slots

A test to check the combined operation of a msg 16 assignment to slots reserved by msg 20.

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a data link management message (msg 20) to the EUT with slot offset and increment. Transmit an assigned mode command (msg16) to the EUT and command it to use one or more of those FATDMA allocated slots. Record transmitted messages.

Required results

Confirm that the EUT uses the slots commanded by msg 16 for own transmissions.

(5) Fixed allocated transmissions（FATDMA）

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a data link management message (msg 20) to the EUT with slot offset and increment. Record transmitted messages.

Required results

Confirm that EUT does not use slots allocated by msg 20 for own transmissions until timeout of 4-8min.

6.4.7 Message formats

(1) Received messages

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply messages according to table 7 to the VDL. Record messages output by the PI of EUT.

Required results

Confirm that EUT outputs corresponding message with correct field contents and format via the PI or responds as appropriate.

(2) Transmitted messages

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Initiate the transmitted messages relevant for a mobile station according to table 7 by the EUT record transmitted messages.

Required results

Confirm that EUT transmits messages with correct field contents and format or responses as appropriate. Confirm that messages 4, 9, 16, 17, 18, 19, 21, 22 are not being transmitted by the EUT.

6.5 Specific tests of net work layer

6.5.1 Dual channel operation

(1) Alternate transmissions

Method of measurement

Set up standard test environment and operate EUT in autonomous mode on default channels AIS 1, AIS 2. Record transmitted scheduled position reports on both channels. Check CommState for slot allocation.

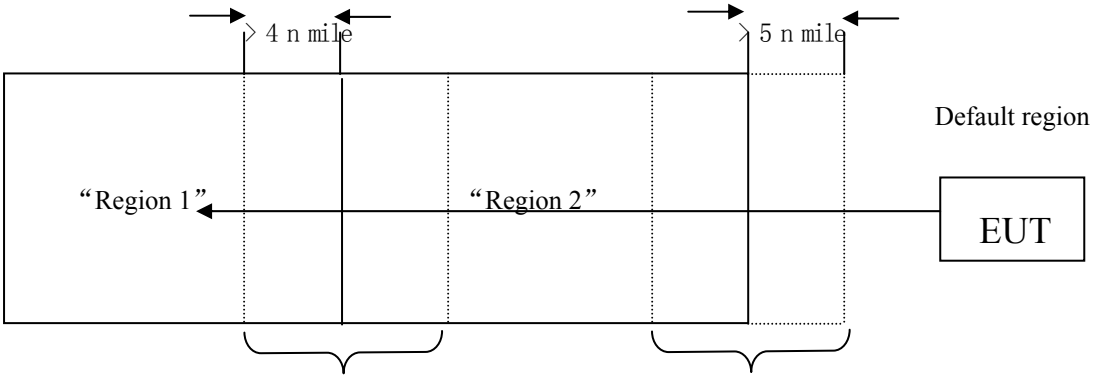
Required results

Confirm that EUT allocates slots in both channels alternating. Repeat check for data link access period.

6.5.2 Regional area designation by VDL message

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply channel management messages (msg 22) to the VDL defining two adjacent regional areas 1 and 2 with different channel assignments for both regions and a transitional zone extending 4 nm either side of the regional boundary. At least one channel shall be 12.5 kHz channel. Let the EUT approach region 1 from outside region 2 more than 5nm away from region boundary transmitting on default channels. Record transmitted messages on all 6 channels.（see figure 6.5.2）



本图重新画过

Figure 6.5.2

Regional area scenario

	Primary channel	Secondary channel
“Region 1”	CHA1	CHB1
“Region 2”	CHA2	CHB2
Default region	AIS1	AIS2

Required results

Check that the EUT transmits and receives on the primary channels assigned for each region alternating channels and doubling reporting rate when passing through the transitional zones. EUT shall revert to default autonomous operation on the regional channels after leaving the transitional zones.

For channel changes, see the table below:

	Area	Channels in use
1	Default region	AIS1，AIS2
2	First transitional zone	AIS1，CHA2
3	Region 2	CHA2，CHB2
4	Second transitional zone	CHA2，CHA1
5	Region 1	CHA1，CHB1

6.5.3 Regional area designation by serial message

Repeat test 6. 5. 2 using ACA serial message for channel assignment.

6.5.4 Power setting

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit channel management message (msg 22) defining output power high / low. Repeat test using ACA and manual input.

Required result

Check that EUT sets output power as defined.

6.5.5 Message priority handling

Method of measurement

Set up standard test environment and operate test equipment with 90 % channel load. Set the EUT to max reporting rate of 2 s by applying a speed of >23 knots and a ROT > 20° /s. Record VDL messages and check for used slots. Initiate the transmission of two 5 slot messages (msg 12 and msg 8) by the EUT. Record transmitted messages on both channels.

Required results

Check that EUT transmits the messages in correct order according to their priority (ITU－R M.1371-1 A/3.3.8.1 table).

6.5.6 Slot reuse (link congestion)

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Transmit a data link management message (msg 20) to the EUT with slot offset and increment to allocate slots for a base station. Assure that at test receiver location the signal level received from EUT exceeds the signal level received from test transmitter. Record transmitted messages and check frame structure. Set up additional test targets to simulate a VDL load of > 90 % until slot reuse by EUT is observed.

Required results

Check that the nominal reporting rate for position report msg 1 is achieved ± 10 % (allocating slots in selection interval SI) under link congestion conditions. Confirm that the slot occupied by the most distant station (within selection interval) is used by the slot reuse algorithm. Check that a station is not subject to slot reuse more than once a frame. Check that slots allocated by a local base station are not subject to slot reuse.

6.5.7 Management of received regional operating settings

(1) Test for replacement or erasure of dated or remote regional operating settings

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Send a valid regional operating setting to the EUT by msg 22 with the regional operating area including the own position of the EUT. Consecutively send a total of seven valid regional operating settings to EUT, using both msg 22 and DSC telecommands, with regional operating areas not overlapping to the first and to each other. Perform the following in the order shown:

a) Send a ninth msg 22 to the EUT with valid regional operating areas not overlapping with the previous eight regional operating areas.

b) Step 1: Set down position of EUT into any of the regional operating areas defined by the second to the ninth telecommands sent to the EUT previously.
Step 2: Send a tenth telecmmand to the EUT, with a regional operating area which partly overlaps the regional operating area to which the EUT was set by Step 1 but which does not include the own position of the EUT.

c) Step 1: Move own position of EUT to a distance of more than 500 miles from all regions defined by previous commands.

Step 2: Consecutively set own position of EUT to within all regions defined by the previous telecommands.

Required results

After the initialization, the EUT should operate according to the regional operating settings defined by the first msg 22 sent.

a) The EUT shall return to the default operating settings.

b) Step 1：Check that the EUT changes its operating settings to those of that region which includes own position of the EUT.

Step 2：Check that the EUT reverts to the default settings

（Note: Since the regional operating settings to which the EUT was set in Step 1 shall be erased due to Step 2, and since there is no other regional setting due to their non-overlapping definition, the EUT shall return to default.）

c) Step 1: Check that the EUT operates with the default settings.

Step 2: Check that the EUT operates with the default settings

(2) Test of correct input via presentation interface or MKD

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order:

a) Send msg 22 or a DSC telecommand with valid regional operating settings to the EUT with a regional operating area, which contains the current position of own station.

b) Input a different, valid regional operating setting via the MKD.

c) Send a different regional operating setting with a regional operating area which partly overlaps the regional operating area input via the MKD to the EUT via the presentation interface in the previous step, and which contains the present position of own station.

d) Input the default operating settings via the MKD for the regional operating area, which was received by the previous command via the presentation interface.

e) Send msg 22 or a DSC telecommand with a different regional operating setting to the EUT with a regional operating area, which contains current position of own station.

f) Within two hours, after e), send a different regional operating setting to the EUT via presentation interface with a valid regional operating area overlapping the regional operating area sent to the EUT by msg 22 or a DSC telecommand.

Required results

a) Confirm that the EUT uses the regional operating settings commanded by msg 22 or DSC telecommand.

b) Step 1: Confirm that the regional operating settings of the previous msg 22 or DSC telecommand are displayed to the user on the MKD for editing.
Step 2: Check, that the EUT allows the user to edit the displayed regional operating setting. Check, that the EUT does not accept incomplete or invalid regional operating settings. Check, that the EUT accepts a complete and valid regional operating setting.
Step 3: Check, that the EUT prompt the user to confirm the intended change of regional operating settings, Check, that the EUT allows the user to return to the editing menu or to abort the change of the regional operating settings.
Step 4: Check, that the EUT uses the regional operating settings input via the MKD.

c) Check, that the EUT uses the regional operating settings received via the presentation interface.

d) Check, that the EUT accepts the default operating settings.

e) Check, that the EUT does not use the regional operating settings commanded to it by msg 22 or DSC telecommand.

f) Check, that the EUT does not use the regional operating setting commanded to it via the presentation interface.

(3) Test of addressed telecommand

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order:

a) Send msg 22 or a DSC telecommand with valid regional operating settings, that are different from the default operating settings, to the EUT with a regional operating area, which contains the current position of own station.

b) Send an addressed msg 22 or an addressed DSC telecommand to the EUT with different regional operating settings than the previous command.

c) Move the EUT out of the regional operating area defined by the previous addressed telecommand into an area without regional operating settings.

Required results

a) Check, that the EUT uses the regional operating settings commanded to it in a).
b) Check, that the EUT uses the regional operating settings commanded to it in b).

c) Check, that the EUT reverts to default.

(4) Test for invalid regional operating areas (three regional operating areas with same corner)

Method of measurement

Set up a standard test environment and operate EUT in autonomous mode. Perform the following tests in the following order after completion of all other tests related to change of regional operating settings:

a) Send different valid regional operating settings with adjacent regional operating areas, their corners within eight miles of each other, to the EUT by msg 22 or DSC telecommand, presentation interface input and manual input via MDK. The current own position of the EUT shall be within the regional operating area of the third regional operating setting.

b) Move current own position of the EUT consecutively to the regional operating areas of the first two valid regional operating settings.

Required results

a) Check, that the EUT uses the operating settings that were in use prior to receiving the third regional operating setting.

b) Check, that the EUT consecutively uses the regional operating settings of the first two received regional operating areas.

(5) Self-certification of other conditions

The fulfillment of all other conditions of 3.4.2 shall be self-certified by the manufacturer.

6.5.8 Continuation of autonomous mode reporting rate

Method of measurement

When in the presence of an assigned mode command and in a transition zone, check that the EUT continues to report at the autonomous mode-reporting-rate.

Required result

Ensure that the autonomous reporting rate is maintained.

6.6 Specific tests of transport layer

6.6.1 Addressed messages

(1) Transmission

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Set up a test target for scheduled transmissions on channel AIS 1 only. Initiate the transmission of an addressed binary message (msg 6) by the EUT (test target as destination). Record transmitted messages on both channels.

Required results

Check that the EUT transmits msg 6 on channel AIS 1. Repeat test for AIS2.

(2) Acknowledgement (receipt)

Method of measurement

Operate standard test environment and the EUT in autonomous mode. Apply up to 4 addressed binary messages (msg 6; EUT as destination) to the VDL on Channel AIS 1. Record transmitted messages on both channels. Repeat with AIS 2.

Required result

Confirm that EUT transmits a binary acknowledge message (msg 7) with the appropriate sequence numbers within 4 s on the channel where the msg 6 was received. Confirm that EUT transmit the result with an appropriate message to PI.

(3) Transmission retry

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Initiate the transmission of up to 4 addressed binary messages by the EUT which will not be acknowledged (i.e. destination not available). Record transmitted messages.

Required results

Confirm that retires the transmission up to 3 times (configurable) for each addressed binary message. Confirm that the time between transmissions is 4 to 8 s. Confirm that EUT transmit the overall result with an appropriate message to PI.

(4) Acknowledgment of addressed safety related messages

Repeat test with addressed safety related message.

6.6.2 Interrogation responses

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (msg 15; EUT as destination) to the VDL according to table 7 for responses with msg 5 and slot offset set to defined value on channel AIS 1. Record transmitted messages on both channels.

Required results

Check that EUT transmits the appropriate interrogation response message as requested on channel AIS 1. repeat test for AIS 2.

6.6.3 Other non periodic messages

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Initiate the transmission of 5 binary broadcast messages (msg 8) by the EUT. Record transmitted messages on both channels.

Required result

Check that EUT transmits the msg 8 messages on channels A and B alternating.

6.7 Specific presentation interface tests

6.7.1 General requirements

The EU (Equipment Under Test) including all necessary test equipment shall be set up and checked that it is operational before testing commences. The manufacturer shall provide sufficient technical documentation of the EUT and its interface in particular. The following tests shall be carried out under "normal" environmental conditions as defined in IEC60945. Where appropriate, tests against different clauses of this and other chapters may be carried out simultaneously.

6.7.2 Check of the manufacturer's documentation

(1) The following checks for formal consistency and compliance shall be made for all ports.

① approved sentences against IEC61162

② proprietary sentences against IEC61162

③ usage of fields as required for different functions including provided default values or settings

④ transmission intervals against IEC61162

⑤ configuration of hardware and software if this is relevant to the interface performance and port selection.

(2) The following checks for compliance with IEC61162

① output drive capability

② load on the line of inputs

③ electrical isolation of input circuits

6.7.3 Electrical test

Method of measurement

Input / output ports configured as IEC6112－1 or IEC6112－2 shall be tested according to the relevant standard with regard to minimum and maximum voltage and current at the input terminals.

Required results

The interfaces shall fulfill the requirements of the relevant standards.

6.7.4 Test of input sensor interface performance

Method of measurement

Connect all inputs and outputs of the EUT as specified by the manufacturer and simulate VDL-messages using test system. Operate inputs with simulated sensor data that are both the relevant data and additional data with formatters not provided for the relevant input. Each sensor input shall be

loaded with 70 % to 80 % of the interface's capacity. Record the VDL and output from the EUT's high speed port.

Required results

Verify that the output on the VDL and the presentation interface agree with simulated input and all output data is transmitted without loss or additional delay.

6.7.5 Test of sensor input

Method of measurement

Set up standard test environment and operate inputs with simulated sensor data. Record VDL output.

(1) Simulate sensor information for position, speed, heading, ROT

(2) simulate invalid and unavailable data

Required results

(1) Verify that the recorded VDL message contents agree with the simulated sensor information.

(2) Verify that affected data is set to default values.

6.7.6 Test of high speed output

Method of measurement

Set up standard test environment and simulate VDL-position report using test system. Record output from the EUT high speed port（see table 3.6.3(1) ③）

Required results

Verify that the recorded message contents agree with the simulated VDL contents (VDM) and own transmitted data (VDO) and in accordance with the sentence specifications of IEC61162－1.

6.7.7 High speed output interface performance

Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Increase the VDL load to > 90 %. Record transmitted messages and check PI output of EUT on port for "external display" and "auxiliary display".

Required results

Confirm that EUT outputs all received messages to the PI. Repeat test for port "auxiliary display"

6.7.8 Test of high speed input

Method of measurement

Set up standard test environment. Apply simulated input data, in accordance with the sentence specifications of IEC61162－1 and 7.6.3.3 table 10, to the EUT and record VDL output.

Required results

Verify that the VDL message contents agree with simulated input data.

6.8 DSC functional tests

6.8.1 General requirements

（1） For the tests in this clause, set the EUT into autonomous mode using channels AIS 1 and AIS 2 with a reporting interval of 2 s.

（2）Check with a sequence of valid calls consisting of a test signal number 1, a geographic call from ITU－R M.493, a test signal number 1, an individual call from ITU－R M.493 and a test signal number 1 that the EUT correctly receives and processes the three tests calls its correct AIS operation is not affected by the interleaved calls.

（3） Check that the EUT does not respond to invalid calls – incorrect MMSI position outside addressed geographic area, different course, or ship's type.

（4） Send to the EUT a standard test signal number 1 but with symbol numbers 104 and 03 followed by values 01 and 120 (Activate alternate system with group number 1 and sequence number 120). Check that the EUT does not respond.

6.8.2 Regional area designation

Send to the EUT a standard test signal number 1 but with symbol numbers appropriate to the geographical regions and channels specified in the test. Note the transition boundary is 5 nm in this test.

6.8.3 Scheduling

（1） Check that the time sequence of the TDMA messages is not changed when the EUT transmits a DSC signal.

（2） Send a valid geographical level call to the EUT. Check that the response is transmitted after a random delay distributed over the range of 0 to 20 s and subject to the restrictions of ITU－R M.1371-1 A3/2.2.

（3） Send a valid geographical call to the EUT followed by a signal consisting of test signal number 1 with a signal level of – 107 dBm at the receiver input of 25 s duration. Check that the response is not transmitted.

6.8.4 Polling

（1） Check that the EUT is capable of receiving, processing and automatically transmitting a response to the following calls from ITU－R M.825: 101 (command to duplex-channel), 102, 103, 108, 109, 111, 112 and 116. The sequence of calls consisting of test signals number 1 and Valid geographic calls shall demonstrate the capability of the EUT to operate on single frequency channels as well as on two frequency channels.

（2） Verify through this test, that ships maritime mobile service identify (MMSI), ship name, ship length and type of ship is programmed into the EUT.

（3） Send a standard test signal number 1 with additional symbols number 109 and 116 and check that the reply messages 100, 119 and 120 are programmed automatically.

（4） Check that when information is not available to respond to a command the transmitted

response is followed by the symbol 126.

（5） Send a standard test signal number 1 with additional symbol 101 followed by channel number 87. Repeat the test with channel number 88 and with symbol 104 and 00 followed by channel number 2087 and 2088. Check in all cases that the response is made on channel 70.

（6） Send a DSI sentence to CH 4 and CH 5 (see annex D) with an individual station address and with command sets 103 9REPORT YOUR POSITION) AND 111 (REPORT SHIP NAME). Check that the EUT does not transmit a DSC message.

（7） Set the RF output power of the EUT high / low using the appropriate DSC command. Check that the output power is set accordingly.

6.9 **Long range functional tests**

6.9.1 Long range interrogation

（1）Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply a LR addressed interrogation message to the LR-interface port of EUT; record LR output port and AIS high-speed output port. Set EUT to

① automatic response

② manual response via MKD

③ manual response via PI

（2）Required results

Check that EUT displays LR interrogation messages and sends to PI. Check that EUT outputs a LR position report message

① automatically (and indicates action on display)

② after manual confirmation via MKD

③ after manual confirmation via PI

6.9.2 LR“all ships”interrogation

（1）Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Apply a LR “all ships” interrogation message to the LR-interface port of EUT defining a geographical

area which contains own ships position; record LR output port. Set EUT to

① automatic response

② manual response.

Repeat check with own ship outside specified area

（2）Required results

Check that EUT outputs a LR position report message

① automatically (and indicates action on display)

② after manual confirmation.

No response shall be output on the repeat check.

6.9.3 Consecutive LR “all ships” interrogation

（1）Method of measurement

Set up standard test environment and operate EUT in autonomous mode. Set EUT to autonomous mode. Apply 5 LR “all ships” interrogation messages to the LR-interface port of EUT defining a geographical area which contains own ships position; record LR output port. Set the control flag in the LRI message to

① 0（reply on first interrogation only）

② 1（reply on all applicable interrogations）

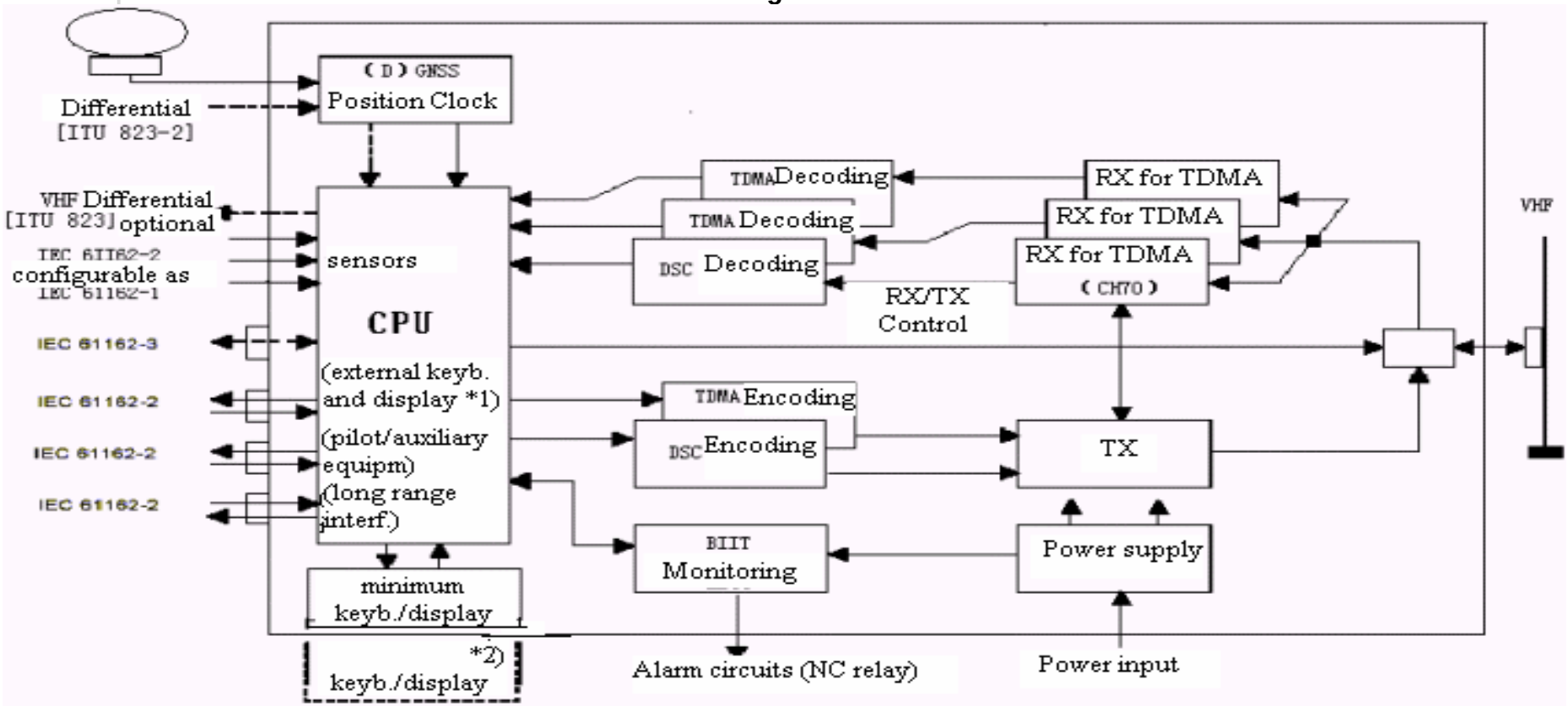
（2）Required results

Check that EUT outputs a LR position report message

① on the first interrogation only

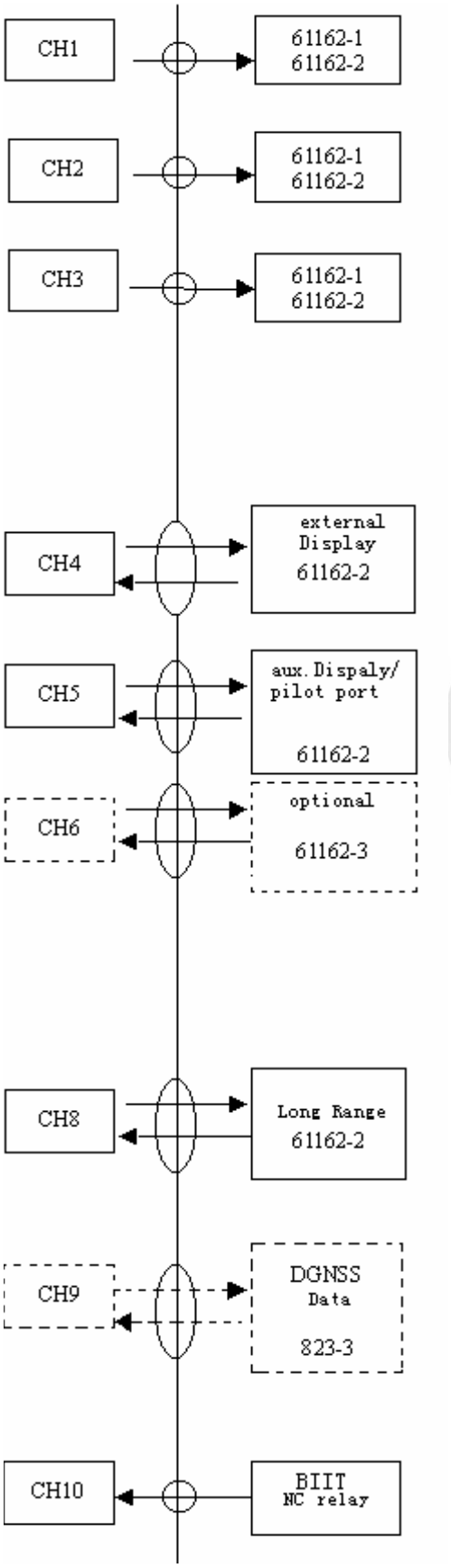
② on all interrogations.

Annex A
(informative)
Block diagram of AIS



*1) The external keyboard/display may be e.g. a radar, ECDIS or dedicated devices.
*2) The internal keyboard/display may optionally be remote.

Annex B AIS Interface Overview



Sensor inputs		
Minimum required input sentences		
Position	GNS、GLL	int/ext*
SOG	VBW	int/ext*
COG	RMC	int/ext*
Heading	HDT	ext
Rot. rate	ROT	ext
RAIM	GBR	ext

*For priorities, see 2.10.3 (4)

Input / output of AIS data

Input

Manual data input:
Voyage data VSD
Static data SSD
VDL—messages:
ABM
BBM
AIR Inquiry
Other:
ACA channel access
ACK alarm ack.

Output

VDL—messsages:
VDM
(Data block of VDM representing binary data contents of VDL messages)
Other:
VDO own ship data
ALR alarm status
ABK VDL ack.
TXT sensor status
ACA channel access
LRI, LRF LR inter-rogstion

Long range port

Input

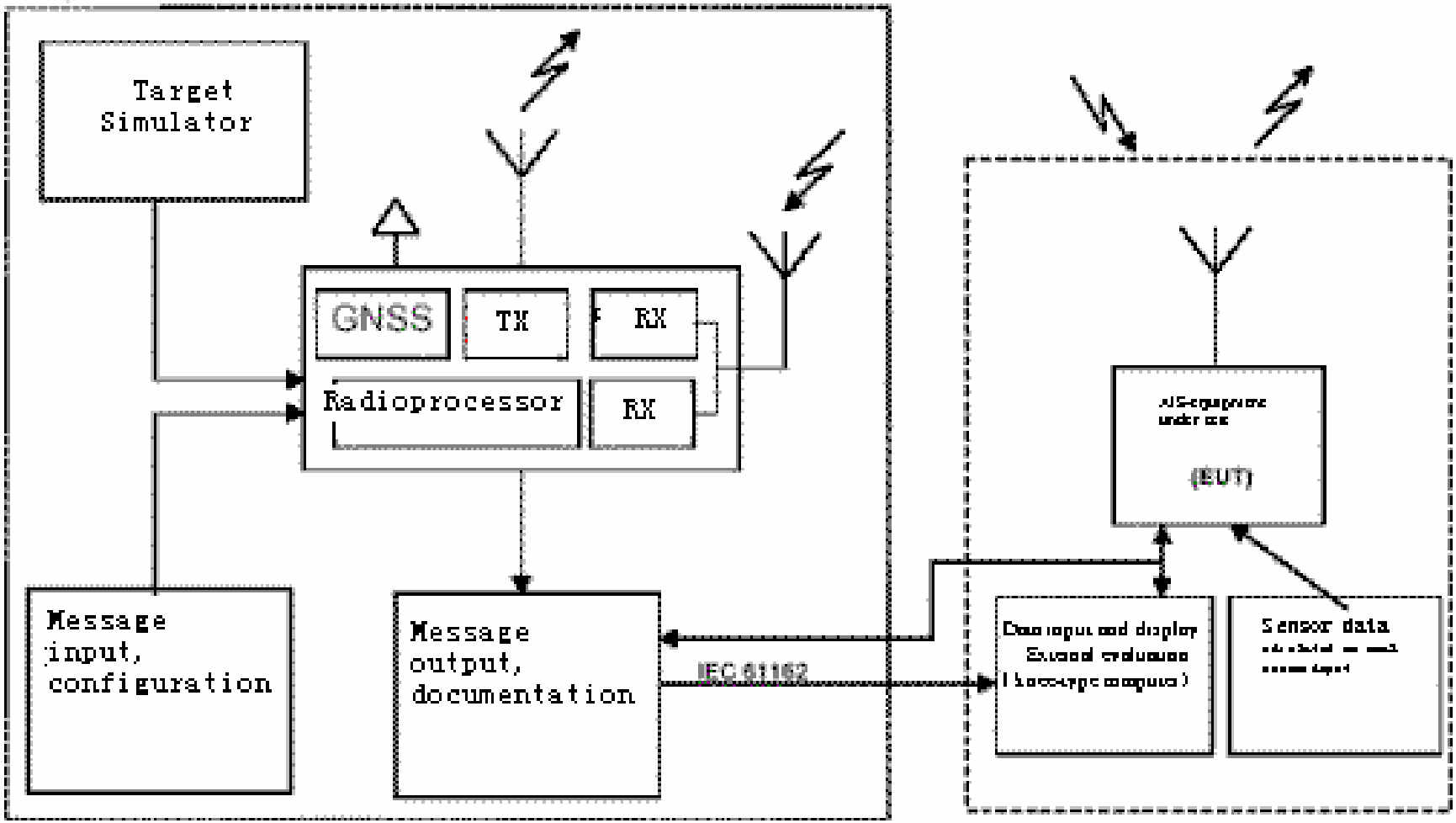
Output LRF, LR1, 2, 3

DGNSS data port (alternative)

Correction data information

BIIT output port

Annex C Block diagram of AIS test system



Annex D IEC 61162-1 sentences due to AIS

ABK – Addressed and binary broadcast acknowledgement
ABM – Addressed binary and safety related message
ACA – AIS regional channel assignment message
ACS – Channel management information source
AIR – AIS interrogation request
BBM – Broadcast binary message
LRI – Long range interrogation
LRF – Long range function
LR 1 – long range reply with destination for function request “A”
LR 2 – Long range reply for function request “B, C, E and F”
LR 3 – Long range reply for function request “I, O, P, U and W”
SSD – ship static data
VDM – VHF data-link message
VDO – VHF data-link own-vessel message
VSD – Voyage static data.