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Maritime navigation and radiocommunication equipment and systems – Automatic identification system (AIS) – Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results

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CONTENTS

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEM (AIS) –

Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results

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International Standard IEC 62320-1 has been prepared by IEC Technical Committee 80: Maritime navigation and radiocommunication equipment and systems.

This consolidated version of IEC 62320-1 consists of the first edition (2007) [documents 80/460/FDIS and 80/468/RVD] and its amendment 1 (2008) [documents 80/522/CDV and 80/543/RVC].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 1.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62320 series, under the general title: *Maritime navigation and radio-communication equipment and systems – Automatic Identification System (AIS)* can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Chapter V of the International Convention for the Safety of Life at Sea 1974 (SOLAS) requires mandatory carriage of Automatic Identification System (AIS) equipment on all vessels constructed on or after 01 July 2002. Carriage for other types and sizes of SOLAS Convention vessels was required to be completed not later than 31 December 2004.

SOLAS Chapter V, Regulation 19, clause 2.4.5 states that AIS shall:

1 provide automatically to appropriate equipped shore stations, other ships and aircraft information, including ship's identity, type, position, course, speed, navigational status and other safety-related information;

2 receive automatically such information from similarly fitted ships;

3 monitor and track ships; and

4 exchange data with shore-based facilities.

In addition, the IMO performance standards for AIS state that:

– The AIS should improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:

  1 in a ship-to-ship mode for collision avoidance;

  2 as a means for littoral States to obtain information about a ship and its cargo; and

  3 as a VTS tool, i.e. ship-to-shore (traffic management).

– The AIS should be capable of providing to ships and to competent authorities, information from the ship, automatically and with the required accuracy and frequency, to facilitate accurate tracking. Transmission of the data should be with the minimum involvement of ship's personnel and with a high level of availability.

The provision of Shore Based AIS will be necessary to attain the full benefit of the SOLAS Convention requirements.

This part of IEC 62320 provides the minimum operational and performance requirements, methods of test and the required test results for AIS Base Stations. The testing is divided into three sections, the transceiver tests, the logical tests and the Presentation Interface tests. These are captured in Clauses 8, 9 and 10 respectively. The method used for testing is that the EUT should meet all the tests requirements of Clause 8 before proceeding to Clause 9. Likewise, the unit should meet all of the test requirements before proceeding to Clause 10. Clause 10 has also been prioritised so that the tests are progressive

Clauses 5 to 7 provide functional requirement information and Clause 8 provides the general test environment for the EUT.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – AUTOMATIC IDENTIFICATION SYSTEM (AIS) –

Part 1: AIS Base Stations – Minimum operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 62320 specifies the minimum operational and performance requirements, methods of testing and required test results for AIS Base Stations, compatible with the performance standards adopted by IMO Res. MSC.74 (69), Annex 3, Universal AIS. It incorporates the technical characteristics of non-shipborne, fixed station AIS equipment, included in recommendation ITU-R M.1371 and IALA Recommendation A-124. Where applicable, it also takes into account the ITU Radio Regulations. This standard takes into account other associated IEC international standards and existing national standards, as applicable.

This standard is applicable for AIS Base Stations. It does not include specifications for the display of AIS data on shore.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61108-1, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 1: Global positioning system (GPS) – Receiver equipment – Performance standards, methods of testing and required test results*

IEC 61162-1, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

ITU-R M.1084-4, *Interim solutions for improved efficiency in the use of the band 156-174* MHz *by stations in the maritime mobile service*

ITU-R M.1371, *Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile band*

ITU-T O.153, *Basic parameters for the measurement of error performance at bit rates below the primary rate*

IALA Recommendation A-124 *on Automatic Identification System (AIS). Shore Station and networking aspects relating to the AIS Service*

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

RTCM SC104 – *RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service*

3 Symbols and abbreviations

AIS	Automatic Identification System
BER	Bit Error Rate
BIIT	Built-In Integrity Tests
BT	Bandwidth Time product
CPU	Central Processing Unit
DGNSS	Differential Global Navigation Satellite System
EPFS	Electronic position fixing system
EUT	Equipment under test
FATDMA	Fixed Access Time Division Multiple Access
GNSS	Global Navigation Satellite System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Office
IMO	International Maritime Organization
ITU	International Telecommunications Union
kn	Knots
MAC	Medium Access Control
MKD	Minimum Keyboard and Display
MMSI	Maritime Mobile Service Identity
NM	Nautical Mile
NRZI	Non-Return to Zero Inverted
PER	Packet Error Rate
P_c	Carrier Power
PI	Presentation Interface
PPS	Pulse Per Second
PSS	Physical Shore Station
RAIM	Receiver Autonomous Integrity Monitoring
RATDMA	Random Access Time Division Multiple Access
Rx	Receive
TDMA	Time Division Multiple Access
Tx	Transmit
UTC	Universal Time Co-ordinated
VDL	VHF Data Link
VSWR	Voltage Standing Wave Ratio
VTS	Vessel Traffic Services

NOTE Abbreviations related to IEC 61162-1 are not included in the above list. For their meaning refer to that standard and Annex A.

4 Functional layout of an AIS Base Station

4.1 General

The Base Station may be designed for dependent only operation or independent operation. Both are under some control of the Physical Shore Station (PSS) as defined in the IALA Recommendation A-124.

– A dependent Base Station accesses the VHF data link (VDL) using only the combination of linked TSA+VDM sentences (see Table 1), as provided by the PSS.

– An independent Base Station accesses the VDL using either the combination of linked TSA+VDM sentences as provided by the PSS or by using internal control. When operated as an independent Base Station the unit may be delegated certain autonomous functionality under the supervisory control of the PSS.

The PSS, or external controlling entity, is responsible for Base Station configuration, transmission scheduling, and processing of received information. Presentation Interface (PI) text sentences are used to configure the Base Station, schedule message transmissions, and output information.

When TSA and VDM sentences are used, the PSS is responsible for ensuring the integrity of the VDL.

The tests in this standard are for all Base Stations. Additional tests for independent Base Stations are indicated by a note located at the beginning of each appropriate test section.

4.2 Functional block diagram of an AIS Base Station

Figure 1 shows the principal components of the AIS Base Station.

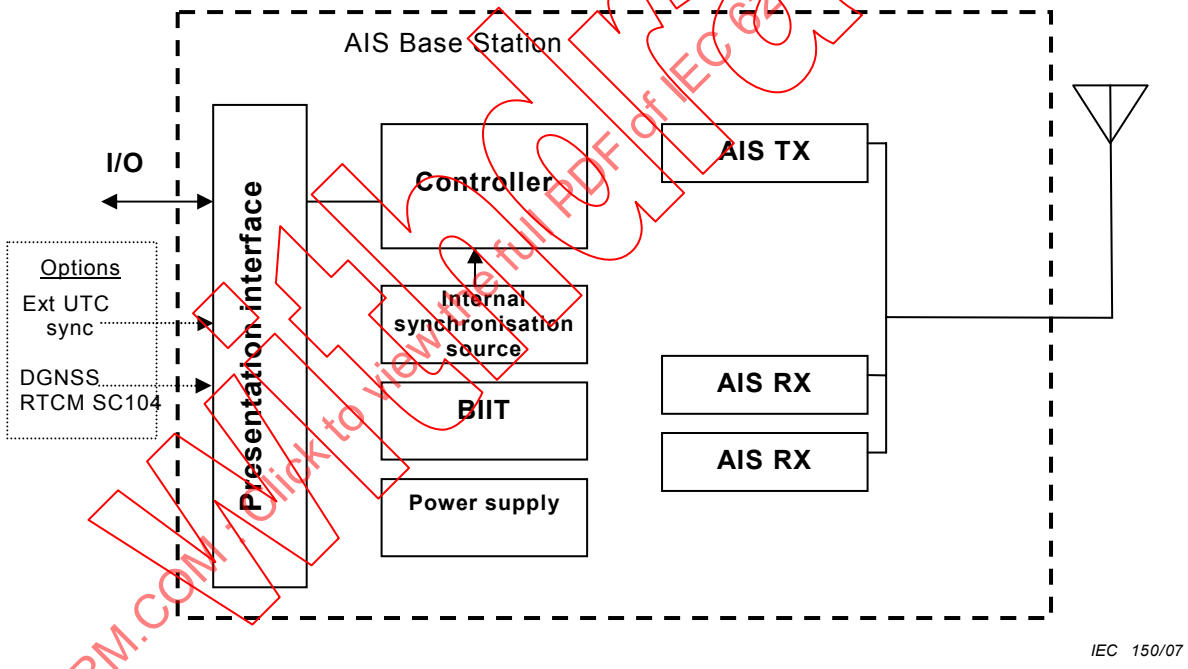

Figure 1 – Functional block diagram of an AIS Base Station

As a minimum, the following functional elements are required for the AIS Base Station:

- two multi-channel receivers;
- one multi-channel TDMA transmitter;

  NOTE Since the minimum configuration of the AIS Base Station has only one transmitter, the AIS Base Station cannot transmit on both AIS Channels (AIS A and AIS B) simultaneously.

- a controlling unit;
- an internal synchronisation source, which may also be used as a position sensor for independent Base Stations. If used as a position source, the internal GNSS receiver shall meet the appropriate requirements of IEC 61108-1;
- a Built-In-Integrity-Test unit (BIIT), which shall provide alarms;

- a power supply;
- a Presentation Interface (PI), which allows the AIS Base Station to exchange sentences with the PSS;
- optional features, for example: DGNSS (RTCM SC104); external synchronisation; DSC functionality.

4.3 General VDL requirements

The AIS Base Station interacts with the VDL by receiving and transmitting VDL messages.

4.3.1 Sources of VDL messages for transmission

In order to transmit VDL messages, the Base Station may derive the messages to be transmitted from three sources:

a) generate and transmit VDL messages autonomously as per the configuration received via sentences;

b) generate and transmit VDL messages automatically based on data input received via the PI, using different sentences from that of the VDM;

c) transmit predefined VDL messages input via the PI. The VDM sentence shall be used to input the content of the VDL messages via the PI to the AIS Base Station. The VDL message shall then be transmitted by the Base Station on the VDL.

When operating the Base Station independently, these three VDL message sources shall be supported in parallel.

When operating the Base Station dependently, only VDM messages received via the PI shall be transmitted as noted in item c) above.

4.3.2 Use of access schemes

4.3.2.1 Dependent operation

When operating as a dependent Base Station the FATDMA access scheme shall be used. The Base Station shall use the slot(s) provided by the combination of linked TSA+VDM sentences. The TSA sentence provides the channel and start slot information. The actual number of slots used is based on the number of bits conveyed by the VDM sentence(s).

Dependent operation shall not use the RATDMA access scheme

4.3.2.2 Independent operation

The default access scheme for a Base Station shall be FATDMA.

The AIS Base Station may also use RATDMA access schemes if implemented. The AIS Base Station may use the FATDMA and RATDMA access schemes concurrently. The use of pre-reserved FATDMA slots shall take priority over RATDMA access.

When using the FATDMA access scheme, the absolute slot numbers for transmission shall be determined by one of the following methods:

- the PI combination of linked TSA+VDM sentences shall provide the absolute slot number in which the AIS Base Station transmits;
- the AIS Base Station shall autonomously select an appropriate pre-reserved FATDMA slot as determined by its configuration.

Both methods shall be available and operate concurrently.

4.4 Functional diagram for operation of a Base Station

Figure 2 shows the principal components of an AIS Base Station. The diagram identifies the elements of the AIS Base Station and the PI with the PSS.

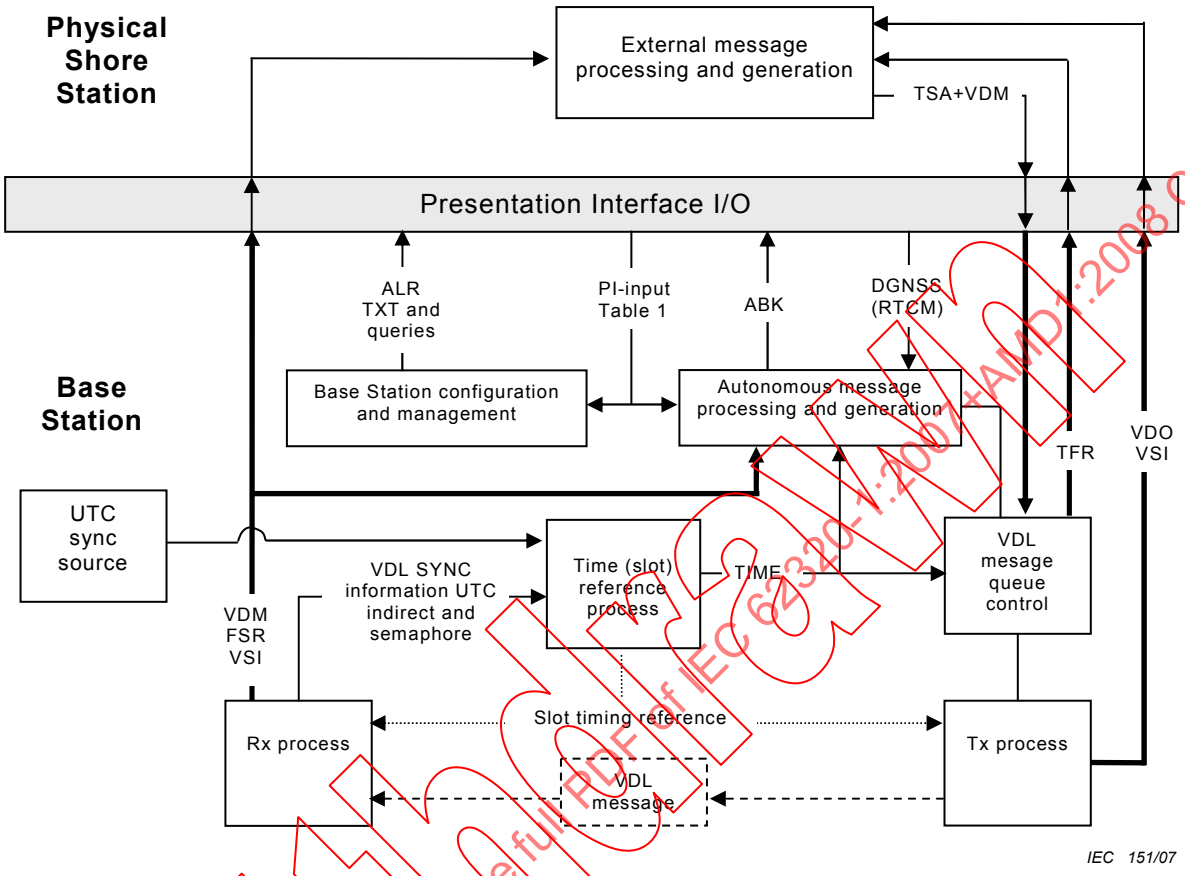

Figure 2 – Functional block diagram dependent and independent operation

The PI of an AIS Base Station consists of at least one input/output port. A specific choice for the physical input/output port is not specified. The purpose of the PI is to:

- exchange VDL messages with the PSS;
- configure the Base Station;
- enable real time control of the Base Station;
- provide an output for BIIT alarms and status.

The information exchange of the PI is supported by a combination of IEC 61162-1 sentences and Base Station sentences (see Annex A).

4.5 Base Station input/output sentence formatters

The following table lists sentence formatters used with a Base Station. It includes existing sentence formatters (grey rows) and sentence formatters developed for use with Base Stations (white rows). Clause A.1 contains the details for each of the sentence formats developed for AIS Base Stations.

A sentence linking method is described in Annex A.2. Use of this method improves the integrity of data relationships between sentences, and improves the reliability and clarity of communications with the Base Station.

Table 1 presents presents both input and output sentence formatters for dependent and independent operation. For Base Stations that support both independent and dependent operation, both sets of sentences are applicable. For Base Stations that only support dependent operation, the sentences for dependent operation are applicable and all other sentences are ignored.

Table 1 – Base Station input/output sentence formatters

Sentence formatter	Input independent	Input dependent	Output independent	Output dependent	Description
ABK			X		Addressed and binary broadcast acknowledgement
ABM	X				Addressed binary and safety related message
ACA	X		Q		AIS regional channel assignment message
ACM	X				Preparation and initiation of an AIS Base Station addressed channel message (VDL Message 22)
ACK	X	X			Acknowledge alarm
ADS			X	X	AIS Device Status (output interval configured by BCE and upon status change)
AGA	X		Q		Preparation and initiation of an AIS Base Station broadcast of a group assignment message (Message 23)
ALR			X	X	Set alarm state
AIR	X				AIS interrogation request (VDL Message 15)
ASN	X				Preparation and initiation of an AIS Base Station broadcast of assignment VDL Message 16
BBM	X				Broadcast binary message
BCE	X	X	Q	Q	General Base Station configuration extended
BCF	X	X	Q	Q	General Base Station configuration
CAB	X	X	Q	Q	Control AIS Base Station
CBM					Not supported by this IEC standard
DLM	X		Q		Data Link Management slot allocations for Base Station (VDL Message 20 – FATDMA reservations)
ECB	X		Q		Configure broadcast rates for Base Station messages with epoch planning support
FSR			X	X	Frame summary of AIS reception, defined by SPO. The manufacturer shall declare the parameters that are supported
SID	X	X			Installation of a station's identification
SPO	X	X	Q	Q	Select AIS device's reception processing and output

TFR			**X**	**X**	Transmit feed-back report – Base Station report on status of requested transmission. Automatic status response of TSA+VDM
TSA	**X**	**X**			Transmit Slot Assignment – used to identify AIS time slot used to transmit the content of a VDM sentence. TSA shall preceed the VDM sentence
TSP	**X**				Transmit Slot Prohibit
TSR			**X**		Transmit Slot Prohibit status Report. Automatic status response of TSP
VDM	**X**	**X**	**X**	**X**	VHF Data-link message
VDO			**X**	**X**	VHF Data-link Own-vessel message
VER			**Q**	**Q**	Version information about equipment. Provided in response to ABQ
VSI			**X**	**X**	VDL Signal Information, defined by SPO. The manufacturer shall declare the parameters that are supported and the corresponding accuracy. The VSI shall follow its associated VDM/VDO
NOTE 1 "X" indicates input to, or output from, the AIS Base Station. "Q" indicates that the sentence may be externally requested using the IEC 61162-1 "$xxABQ,xxx" query sentence (see Annex A) method(s) in order for the identified sentence to be output. NOTE 2 Sentence formatters shown in shaded rows are described in IEC 61162-1.					

The AIS Base Station shall output, autonomously and periodically, the ADS sentence on the PI indicating the Base Station status. This shall be output once per minute or when there is a change in the status.

5 Functional definition of the radio interface of the AIS Base Station

The physical layer of the AIS Base Station shall be designed in accordance with the following minimum requirements.

5.1 General requirements of the physical layer

The following general requirements apply to all receivers and transmitter:

- a Base Station shall use simplex channels or duplex channels in either full-duplex or half-duplex mode;
- a Base Station shall be capable of 25 kHz and, optionally, 12,5 kHz emission/reception in accordance with ITU-R M.1084-4, Annex 3 (as referenced by Recommendation ITU-R M.1371);
- a Base Station shall be capable of transmitting using at least two different power settings, as provided for by ITU-R M.1371 and IALA technical clarifications to ITU-R M.1371. The Base Station shall have the capability to set its power level as stipulated by an input command.

5.2 Required parameter settings for the physical layer of the AIS Base Station

Table 2, Table 3 and Table 4 are derived from Recommendation ITU-R M.1371 and give the parameters required for an AIS Base Station.

NOTE For the meaning of the symbols and additional information refer to the appropriate clause of Recommendation ITU-R M.1371.

The constants of the physical layer of the AIS Base Station shall comply with the values given in Table 3 and Table 4.

Table 2 – Required parameter settings for an AIS Base Station

Symbol	Parameter name	Low setting	High setting
PH.RFR	Regional frequencies	156,025 MHz	162,025 MHz
PH.CHS	Channel spacing	12,5 kHz Optional	25 kHz
PH.AIS1	AIS 1 (default channel 1)	161,975 MHz	161,975 MHz
PH.AIS2	AIS 2 (default channel 2)	162,025 MHz	162,025 MHz
PH.CHB	Channel bandwidth	12,5 kHz Narrow Optional	25 kHz Wide
PH.BR	Bit rate	9 600 bps	9 600 bps
PH.TS	Training sequence Always start with a zero (0101010…)	24 bits	24 bits
PH.TST	Transmitter settling time (Transmit power within 20 % of final value, frequency stable to within ± 1,0 kHz of final value)	≤ 1,0 ms	≤ 1,0 ms

Table 3 – Required settings of physical layer constants

Symbol	Parameter name	Value
PH.DE	Data encoding	NRZI
PH.FEC	Forward error correction	Not used
PH.IL	Interleaving	Not used
PH.BS	Bit scrambling	Not used
PH.MOD	Modulation	Bandwidth adapted; GMSK (see Table 4)

Table 4 – Bandwidth related parameters of the physical layer of the AIS Base Station

Symbol	Parameter name	PH.CHB/narrow	PH.CHB/wide
PH.TXBT	Transmit BT-product	0,3	0,4
PH.RXBT	Receive BT-product	0,3	0,5
PH.MI	Modulation index	0,25	0,50

5.3 Minimum requirements for the TDMA transmitter of the AIS Base Station

The minimum technical characteristics as specified in Table 5 shall apply to the TDMA transmitters.

Table 5 – Minimum required TDMA transmitter characteristics

Transmitter parameters	25 kHz channels	12,5 kHz channels
Carrier power error	± 1,5 dB	± 1,5 dB
Carrier frequency error	± 500 Hz	± 500 Hz
Spectrum mask for slotted transmissions	–25 dBc at ± 10 kHz –70 dBc at ± 25 kHz	0 dBc at ± 2,5 kHz –60 dBc at ± 12,5 kHz
Transmitter test sequence and modulation accuracy	'0' bit start for test signals 1 and 2 1 760 Hz + 352 Hz/ –176 Hz for test signal 1 2 400 Hz ± 240 Hz for test signal 2	'0' bit start for test signals 1 and 2 535 Hz + 108 Hz/ –54 Hz for test signal 1 1 200 Hz ± 120 Hz for test signal 2
Transmitter output power versus time	Power within mask shown in Figure 11 and timings given in Table 12	Not applicable
Intermodulation attenuation	≥ 40 dB	Not applicable

5.4 Minimum requirements for the TDMA receivers of the AIS Base Station

The minimum technical characteristics as specified in Table 6 shall apply to the TDMA receivers.

Table 6 – Minimum TDMA receiver characteristics

Receiver parameters	25 kHz channels	12,5 kHz channels
Sensitivity	20 % PER at –107 dBm	20 % PER at –98 dBm
Co-channel rejection	20 % PER at –10 dB	20 % PER at –18 dB
Adjacent channel selectivity	20 % PER at 70 dB	20 % PER at 50 dB
Spurious response rejection	20 % PER at 70 dB	Not applicable
Intermodulation response rejection	20 % PER at 74 dB	Not applicable
Blocking	20 % PER at 86 dB	Not applicable

5.5 Shutdown procedure for an AIS Base Station

An automatic transmitter hardware shutdown procedure and indication shall be provided in case a transmitter continues its transmission at the end of its transmission period. This feature shall be independent of the Base Station software control. The AIS Base Station shall shut down the TDMA transmitter in less than 2 s.

6 Requirements for AIS Base Station

6.1 General

This clause describes the requirements for a Base Station operating as a dependent or independent station.

The Base Station may be operated as an independent station that contains all of the functionality or as a dependent station that relies on external functionality. It is the responsibility of the competent authority to ensure proper operation.

When operated as a dependent Base Station, the unit operates under full control of the PSS.

When operated as an independent Base Station, the unit may be delegated certain autonomous functionality under the supervisory control of the PSS.

6.2 Dependent Base Station requirements

This clause describes the functional requirements of an AIS Base Station operating as a dependent unit with regard to internal processing of AIS VDL messages and Presentation Interface sentences.

6.2.1 General rules

When operating as a dependent Base Station, the unit shall comply with the following general rules:

- each dependent AIS Base Station shall, as a default, be identified by its own individual MMSI on the VDL interface and the unique identifier on the PI interface. The AIS Base Station MMSI and unique identifier shall be configurable by means of a SID sentence via the PI;
- the dependent AIS Base Station shall be capable of transmitting messages with a different MMSI provided by the PSS by means of a standard VDM input sentence;
- the dependent AIS Base Station shall be able to receive all VDL messages;
- every received VDL message shall be passed to the PI as a VDM sentence without further data content processing;
- every received PI VDM sentence shall be transmitted on the VDL channel and beginning in the slot indicated by the linked TSA sentence without further data content processing;
- every message transmitted on the VDL shall be passed to the PI as a VDO sentence linked with a VSI sentence;
- messages to be transmitted on the VDL are passed using the sentence linking method (see Annex A);
- the dependent AIS Base Station does not transmit Message 4 without PSS control;
- all transmissions are done via TSA+VDM PI input sentences;
- the dependent AIS Base Station shall not be semaphore qualified and shall not operate autonomously;
- when the UTC sync source is unavailable, the AIS Base Station shall use UTC indirect or shall be synchronised to another Base Station;
- upon request via the sentence VER, the dependent AIS Base Station shall provide its hardware and software version information.

6.2.2 General processing diagram

The AIS Base Station shall internally process data in accordance with Figure 3.

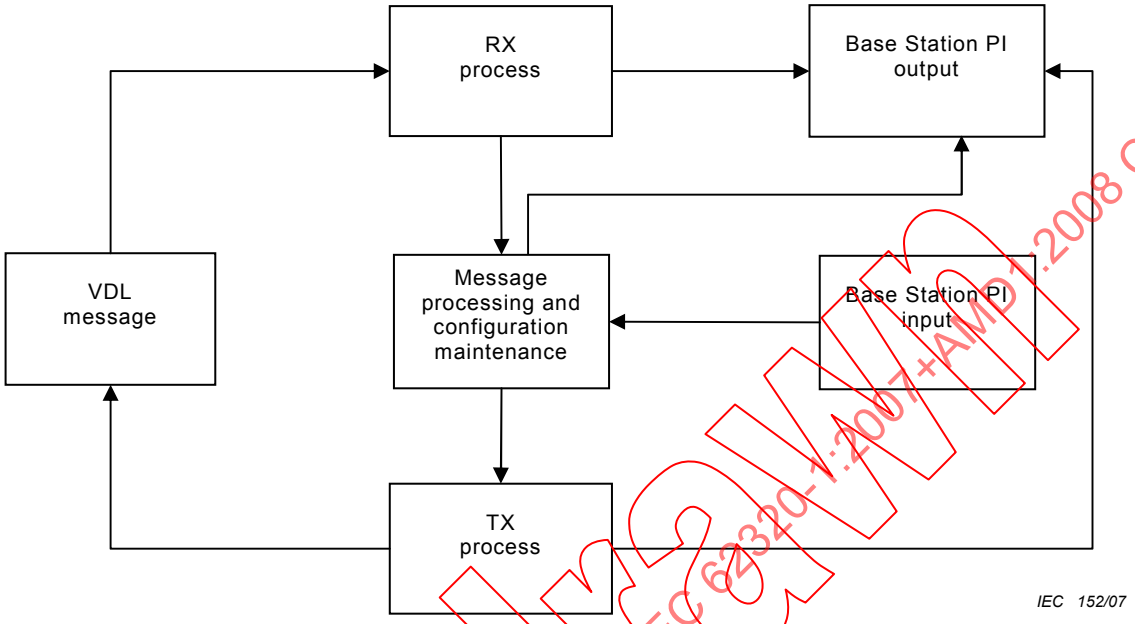

Figure 3 – General processing diagram

6.2.3 AIS Base Station response to PI input

The AIS Base Station shall respond to input sentences from the PI in accordance with Table 1, "output dependent" when operating as a dependent Base Station.

6.2.4 AIS Base Station response to VDL input

The AIS Base Station shall respond to input messages from the VDL in accordance with Table 7.

Table 7 – Base Station response to input messages from the VDL

VDL input	Resulting PI output	Resulting VDL output	Resulting VDL reporting rate
Any message (regardless of MMSI)	VDM, VSI	Nil	Nil
All messages in a frame (regardless of MMSI)	FSR	Nil	Nil

6.3 Independent Base Station requirements

This clause describes the functional requirements of an AIS Base Station operating as an independent unit with regard to internal processing of AIS VDL messages and Presentation Interface sentences.

NOTE Requirements for Base Stations operating as an independent unit are in addition to the requirements for Base Stations operating as a dependent unit.

6.3.1 General rules

When operating as an independent Base Station, the unit shall comply with the following general rules:

- with regard to the access schemes to the VDL, refer to 6.3.4 AIS Base Station interaction on the VDL;
- the independent AIS Base Station shall, as a default, use a surveyed position. When using a surveyed position, the “position accuracy” flag in VDL Message 4 shall be set upon configuration, and the “RAIM” flag shall be set to 0;
- when the UTC sync source is unavailable, the independent AIS Base Station shall use UTC indirect or the semaphore rules as defined by ITU-R M.1371;
- the independent AIS Base Station shall revert to semaphore behaviour upon detection of semaphore condition on the VDL;
- all VDL messages shall be as short as possible.

NOTE In order to behave as a semaphore, the independent AIS Base Station must be transmitting Message 4. The required increase of the reporting rate is autonomous. This behaviour is not influenced by FATDMA or RATDMA.

6.3.2 General processing diagram

The AIS Base Station shall internally process data in accordance with Figure 4.

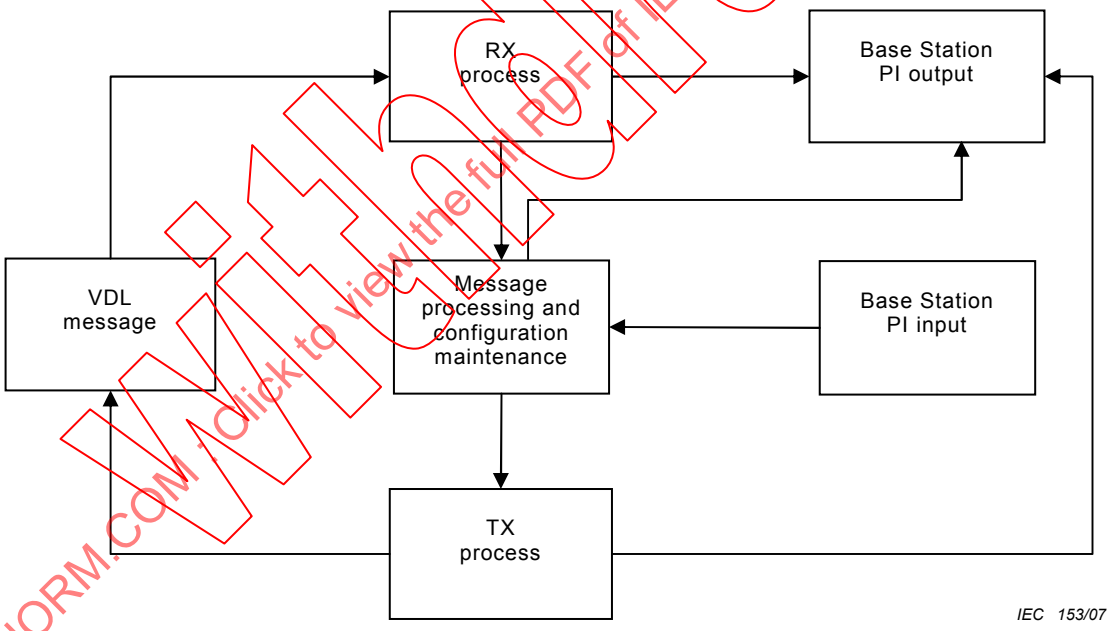

Figure 4 – General processing diagram

6.3.3 AIS Base Station response to PI input

The AIS Base Station shall respond to input sentences from the PI in accordance with Table 1 , “output independent” when operating as an independent Base Station.

6.3.3.1 Requirements for configuration of FATDMA access scheme (Link Management Message)

Use of FATDMA is reserved for Base Stations operating as either dependent or independent.

6.3.3.1.1 Slot reuse

A Base Station's transmission slots are protected by reservation of slots (Message 4 and 20) and the 120 nautical mile rule. Slots allocated or reserved by other Base Stations should not be used for RATDMA unless the other Base Station is located over 120 nautical miles from the Base Station.

6.3.3.1.2 Configuration of Data Link Management Messages

The Data Link Management Message (Message 20) is a continuously scheduled and transmitted message. The Data Link Management Message applies only to the frequency channel on which it is transmitted.

The Data Link Management Message shall be used by Base Station(s) to pre-announce the fixed allocation schedule (FATDMA) for one or more Base Station(s) and it shall be repeated as often as required.

The AIS Base Station shall use the ECB sentence to schedule the autonomously and continuously transmission of Data Link Management Messages, which refresh the FATDMA reservations.

6.3.4 AIS Base Station interaction on the VDL

The interaction of the AIS Base Station on the VDL is presented in Table 8.

Table 8 – Base Station response to input messages from the VDL

VDL input	Resulting PI output	Resulting VDL output	Resulting VDL reporting rate
Any message (regardless of MMSI)	VDM, VSI**	Nil	Nil
Message 6 own MMSI	VDM, VSI**, VDO	Message 7	Once
Message 7 own MMSI	VDM, VSI**, ABK	Nil	Nil
Message 10 own MMSI	VDM, VSI**, VDO	Message 4	Once
Message 12 own MMSI	VDM, VSI**, VDO	Message 13	Once
Message 13 own MMSI	VDM, VSI**, ABK	Nil	Nil
Message 15 own MMSI	VDM, VSI**, VDO	Message 4, 17, 20, 22, or 23	Once*
Semaphore qualified	VDO, VSI**	Message 4	3 1/3 s
Not semaphore qualified	VDO, VSI**	Message 4	10 s

* If the AIS Base Station is set up for autonomous transmission of these messages, then the reply is on the next scheduled transmission. If the Base Station is not set up for autonomous transmission of Message 4, then the Base Station should respond within 4 s. If the Base Station is not set up for transmission of these messages, then there should be no response.

** If VSI enabled.

6.3.4.1 Transmission of DGNSS corrections

There are two possible ways to accept DGNSS corrections for transmission:

- as a result of a VDM sentence via the PI. All required information for transmission is included in the VDM sentence;
- via the dedicated optional DGNSS input port.

This standard provides tests for the VDM DGNSS corrections only.

6.3.4.2 Autonomous Base Station report Message 4

The independent Base Station shall periodically generate the Base Station report (Message 4) with a reporting interval of 10 s according to its given configuration. The Base Station shall operate in this state until it detects that it is required to operate as semaphore. The Base Station shall then increase its update rate of Message 4 to MAC SyncBaseRate (one report per 3 1/3 s). Three minutes after the requirement for the Base Station to be semaphore has ceased it shall revert to the 10 s reporting interval.

6.3.4.3 Autonomous Tx of data link management messages

The DLM PI sentence shall be used to set up the link for use by the Base Station.

6.3.4.4 Requirements for acknowledgement/retries configuration

The number of retries for addressed messages as described in ITU-R M.1371 shall be input by configuration sentence BCF/BCE.

6.3.4.5 Requirements for assigned mode commands

Assignment commands shall be transmitted by a Base Station when operating as a controlling entity. The Base Station shall be able to assign a specified transmission schedule to a mobile station.

The reporting rate assigned by a Base Station shall be, as a minimum, 20 reports per 10 min and, as a maximum, 1 report per second.

The Base Station shall be capable of assigning two mobile stations simultaneously.

6.3.4.6 Autonomous response to interrogation

When a Base Station receives a Message 15 from a mobile station, it shall automatically provide a single response with the message number indicated by the Message 15 (see Table 8).

6.3.4.7 Requirements for the preset of the repeat-indicator

The independent Base Station shall preset the repeat indicator for own transmissions of all VDL messages to a value between 0 and 3[1] in accordance with Recommendation ITU-R M.1371. If no configuration was received, the AIS Base Station shall use the default value of zero.

6.3.4.8 AIS Base Station response to VDM input

The Base Station shall transmit, on the VDL, VDM sentences received on the PI.

FATDMA shall be used as the access scheme for transmission. RATDMA may also be configured for use.

A transmission initiated by a VDM input shall not replace a scheduled message.

Messages 4, 11 and 20 shall not be transmitted.

Messages 15 and 16 shall not be transmitted if a slot offset is provided unless the slot offset is recalculated by the base station. Messages that have a Comm.state shall have the Synch.state bits of the Comm.state set to the current status of the station. The remaining Comm.state bits shall be set to zero to prevent false slot allocations.

The repeat indicator shall be set to greater than zero before transmitting.

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[1] By pre-set of the repeat indicator by non zero, the Base Station is disqualified from becoming an indirect sync source.

After receiving a VDM sentence, the Base Station responds with the appropriate TFR sentence.

The following rules shall be used for VDL transmission (as shown in Figure 5):

- the VDL message shall be transmitted in available FATDMA slots;

NOTE Available FATDMA slots are local 'L' slots without planned ECB transmissions.

- if FATDMA slots are not available within 4 s and RATDMA is available, then RATDMA shall be used;
- if RATDMA is not available, and if there is an available FATDMA slot within 6 min, it shall be used;
- if FATDMA and RATDMA are not available, there shall be no transmission and the VDM is discarded.

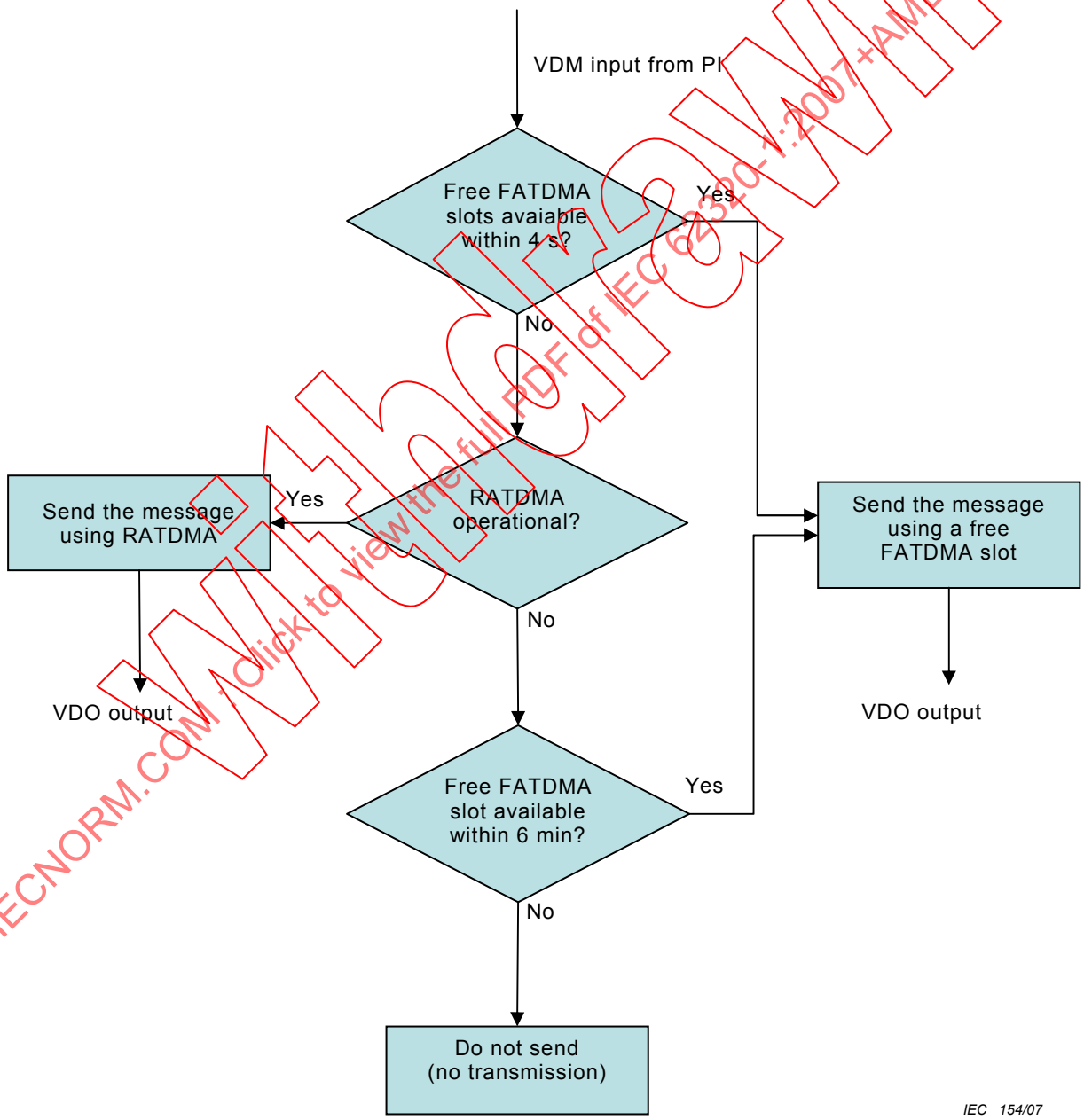

Figure 5 – Flow diagram for AIS Base Station response to VDM input

6.3.4.9 Requirements for management of mobile AIS stations by AIS Base Station

The following operational settings for mobile AIS stations shall be controlled by an AIS Base Station:

a) regional area designation;
b) regional working frequencies assignment;
c) power level;
d) bandwidth;
e) Tx/Rx mode;
f) transitional zone size;
g) reporting rate;
h) slot use (reservation).

6.3.5 Autonomous channel management

The ACA sentence shall be used to set up the channel management information for the AIS Base Station which shall result in transmission of Message 22.

The "in use" data field of the ACA sentence defines the status of the region (0 = not in use, 1 = in use). The manufacturer shall declare the number of regions supported.

If optional DSC functionality is included, the ACA sentence may be used for DSC channel management.

6.4 BIIT conditions

The AIS Base Station shall monitor the following BIIT conditions and shall generate the appropriate ALR sentences on the PI. The ALR sentence shall be output at least once per minute. The alarm conditions are noted in Table 9 and the resulting alarm status is sent via PI sentence ADS. If an alarm is active (acknowledged or not), the ADS alarm status field is set to A; if no alarm is active the field is set to V.

Table 9 – BIIT alarm conditions monitored by an AIS Base Station

Alarms 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 A malfunction	A	V	003	Stop transmission on affected channel
AIS: Rx channel B malfunction	A	V	004	Stop transmission on affected channel
AIS: General failure	A	V	006	Stop transmission
AIS: Clock lost	A	V	007	Independent – follow synchronisation rules including semaphore. Dependent – follow synchronisation rules. Stop transmission when there is no synchronisation source.
AIS: No sensor position in use	A	V	026	Continue operation
AIS: Frame synchronisation failure	A	V	037	Stop transmission
AIS: DGNSS input failed [a]	A	V	038	Continue operation

[a] Optional.

A Alarm.

V Valid.

6.5 Further requirements for optional features

This subclause describes features that are optional for both dependent and independent operation of AIS Base Stations. If an option is selected, then the AIS Base Station shall comply with the requirements of the option selected, and this option shall be tested.

NOTE Tests for optional features are not included within this standard except for narrow band option.

6.5.1 Narrow band option

When the narrow band option (12,5 kHz) is implemented, the AIS Base Station shall comply with the additional requirements associated with 12,5 kHz as indicated in 5.1.

When the optional 12,5 kHz operating mode is implemented, the AIS Base Station shall be capable of changing bandwidth during normal operation.

6.5.2 External synchronisation source option

The AIS Base Station may use an external synchronisation source via a dedicated input port. If used, the external synchronisation source shall have accuracy better than 52 µs.

The UTC synchronisation source in use shall be configurable by the sentence BCE.

The dedicated input port for external UTC synchronisation may consist of

- pulse per second (PPS) detailed setting subject to configuration;
- UTC date and time.

6.5.3 DGNSS dedicated port option

The AIS Base Station may be configured to transmit DGNSS corrections (Message 17) that are input via a dedicated RTCM SC104 format DGNSS port.

Base Stations shall convert the RTCM SC104 format to VDL format before transmission.

This option shall only be available for the independent operation and care should be taken to minimise the impact on the VDL.

7 Functional definition of the presentation interface of the AIS Base Station

The presentation interface (PI) provides a method of communication with the Base Station, including a method for linking PI sentences together.

7.1 Physical requirements for the presentation interface

An interface shall be provided to handle the data bandwidth requirements of the PI.

7.2 Presentation interface data exchange

Regardless of the physical interface used, the AIS Base Station shall exchange data using the sentences defined in IEC 61162-1 and Annex A. A method for linking sentences is provided in Annex A.2.

7.2.1 Base Station presentation interface output

Table 1 includes the list of IEC 61162-1 output sentences.

All transmitted VDL messages shall be output by VDO sentences. The UTC hour, UTC minute (frame), and slot number of the slot or the first slot of a multi-slot message in which each VDL message was transmitted shall be provided by linking a VDO to a VSI sentence.

Each output sentence is identified by the talker identifier (first two characters of an IEC 61162-1 sentence) as configured by the BCF sentence.

7.2.2 Base Station presentation interface input

Regardless of the physical interface implemented, the AIS Base Station shall accept data input conforming to IEC 61162-1. Table 1 lists the mandatory sentences for each type of Base Station.

8 Tests of AIS Base Stations – Method of measurement and required results

NOTE Physical test parameters and testing subject to national requirements may override parameters stated below. These parameters are stated as a guideline only.

8.1 Test conditions

8.1.1 Normal test conditions

8.1.1.1 Temperature and humidity

Temperature and humidity shall be within the following range:

Temperature	+15 °C to + 35 °C
Humidity	20 % to 75 %

8.1.1.2 Power supply

The normal power supply for the tests shall be as specified by the manufacturer.

8.1.2 Extreme test conditions

The extreme temperature conditions are –15 °C and +55 °C. Where required, tests under extreme test conditions shall be a combination of

- dry heat and upper limit of 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.

8.1.3 Standard test environment

The EUT is tested in 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 –100 dBm. Own position sensor inputs to the EUT will be simulated by the test system or other means.

Channels in use shall be selected by manual input before starting the tests.

8.1.4 Test signals

8.1.4.1 Standard test signal number 1

For TDMA Type 1: A test signal consisting of a 26 ms packet (1 slot) of 010101.

8.1.4.2 Standard test signal number 2

For TDMA Type 2: A test signal consisting of a 26 ms packet (1 slot) of 00001111.

8.1.4.3 Standard test signal number 3

This test signal consists of 200 packets grouped into clusters of 4 as described in Figure 6. Each cluster consists of 2 consecutive transmissions of packets. NRZI shall be applied to every packet. After sending packet 1 and 2, the initial state of the NRZI process shall be inverted and then packet 1 and 2 repeated.

Between every transmitted packet there shall be at least 2 free slots. The RF carrier shall be switched off between packets to simulate slotted behaviour.

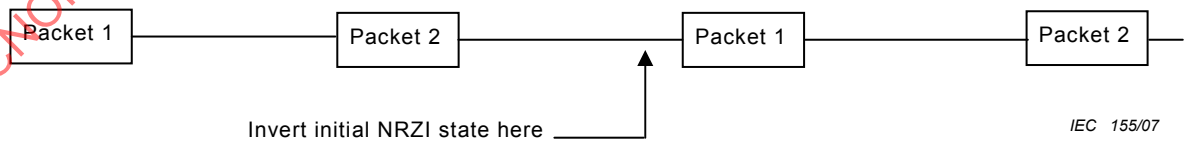

Figure 6 – Format for repeating four-packet cluster

Table 10 – Content of first two packets

Packet	Parameter	Bits	Contents	Comment
1	Training	24	0101....0101	
	Start flag	8	01111110	
	Data	168	Pseudo random	As per Table 11
	CRC	16	Calculated	
	End flag	8	01111110	
2	Training	24	1010....1010	
	Start flag	8	01111110	
	Data	168	Pseudo random	As per Table 11
	CRC	16	Calculated	
	End flag	8	01111110	

Table 11 – Fixed PRS data derived from ITU-T O.153

Address	Contents (HEX)							
0-7	0x04	0xF6	0xD5	0x8E	0xFB	0x01	0x4C	0xC7
	0000.0100	1111.0110	1101.0101	1000.1110	1111.1011	0000.0001	0100.1100	1100.0111
8-15	0x76	0x1E	0xBC	0x5B	0xE5	0x92	0xA6	0x2F
	0111.0110	0001.1110	1011.1100	0101.1011	1110.0101	1001.0010	1010.0110	0010.1111
16-20	0x53	0xF9	0xD6	0xE7	0xE0	21 Bytes = 168 bits (+ 4 stuffed bits) , CRC = 0x3B85		
	0101.0011	1111.1001	1101.0110	1110.0111	1110.0000			

8.1.5 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 50 Ω.

The impedance 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.

8.1.6 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.

8.1.7 Waiver for receivers

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

8.1.8 Impedance

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

8.1.9 Artificial antenna (dummy load)

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

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 one particular test set-up, and are provided as examples. In many of the figures, power attenuators (providing a non-reactive, non-radiating load of 50 Ω to the antenna connector) have been shown. These attenuators are not "artificial antennas". The method of measurement used shall be stated in the test report.

8.1.10 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, these shall be provided by the manufacturer.

8.1.11 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 may also be decided by agreement between the manufacturer and the test laboratory. The method used shall be described in the test report and may involve suitable temporary internal modifications of the equipment under test.

NOTE For example, in the case of direct Frequency Shift Keying (FSK), a means to continuously transmit a sequence containing only "zeros" and a sequence containing only "ones" is preferable.

8.1.12 Measurement uncertainties

Maximum values of absolute measurement uncertainties are given in Table 12.

Table 12 – Maximum values of absolute measurement uncertainties

RF frequency	± 1 x 10^{-7}
RF power	± 0,75 dB
Adjacent channel power	± 5 dB
Conducted spurious emission of transmitter	± 4 dB
Conducted spurious emission of receiver	± 3 dB
Two-signal measurement	± 4 dB
Three-signal measurement	± 3 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Transmitter attack time	± 20 %
Transmitter release time	± 20 %

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

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

- the measured value related to the corresponding limit shall be used to decide whether equipment meets the requirements of this standard;
- the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;
- 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).

9 Physical radio tests

Unless otherwise stated, all physical radio tests shall be performed for 25 kHz channel spacing.

NOTE 12,5 kHz operation is optional.

9.1 Transceiver protection test

9.1.1 Purpose

This test demonstrates that the transceiver is properly protected against malfunction due to faults in the antenna system. This shall be the first test applied to the EUT.

9.1.2 Method of measurement

While the transmitter is transmitting at the highest output power, the antenna port shall first be short-circuited and then open-circuited, in each case for a period of 5 min.

The EUT shall transmit 225 single slot messages evenly spread across the 5 min period during the short-circuit condition and the open-circuit condition.

NOTE A method for transmitting these messages should be provided by the manufacturer.

9.1.3 Required results

The proof that the transceiver is protected against malfunctions at the antenna terminal is substantiated by the ability to pass the remainder of the tests in this clause.

9.2 TDMA transmitter

Unless otherwise stated, all transmitter tests shall be performed at the highest power setting.

9.2.1 Frequency error at 25 kHz operation

9.2.1.1 Purpose

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

9.2.1.2 Method of measurement

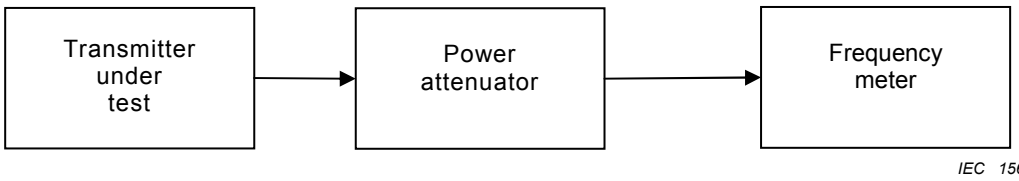

Figure 7 – Measurement arrangement

a) The equipment shall be connected as illustrated in Figure 7.

b) The carrier frequency shall be measured in the absence of modulation.

c) The measurement shall be made under normal test conditions and extreme test conditions.

d) The test shall be performed at 156,025 MHz and 162,025 MHz.

9.2.1.3 Required results

The frequency error shall not exceed ±0,5 kHz, under normal test conditions and ±1 kHz under extreme test conditions.

9.2.2 Frequency error at optional 12,5 kHz operation

9.2.2.1 Purpose

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

9.2.2.2 Method of measurement

Use the method of 9.2.1 while substituting the frequencies in step d) with 157,4125 MHz and 160,6375 MHz.

9.2.2.3 Required results

The frequency error shall not exceed ±0,5 kHz, under normal test conditions and ±1 kHz under extreme test conditions.

9.2.3 Carrier power

9.2.3.1 Purpose

The transmitter carrier power conducted (P_c) is the mean power delivered to a nominal 50 Ω load during a radio frequency cycle. The rated nominal high power setting shall be 12,5 W and the rated nominal low power setting shall be 2 W. If there is a requirement for different nominal power settings, the carrier power accuracy shall be tested at all settings.

9.2.3.2 Method of measurement

a) The equipment shall be connected as illustrated in Figure 8.

b) The carrier power shall be measured in the absence of modulation.

c) The measurement shall be made under normal test conditions and extreme test conditions.

d) The test shall be performed at 156,025 MHz and 162,025 MHz.

e) The carrier power accuracy shall be tested at all settings.

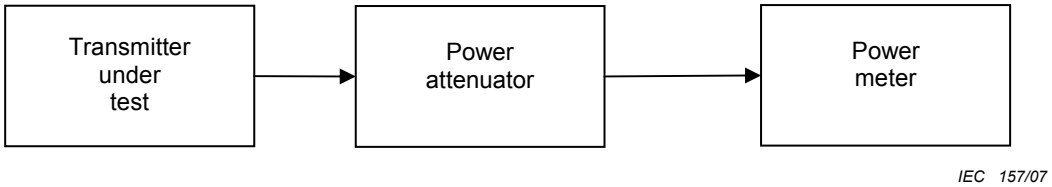

Figure 8 – Measurement arrangement

9.2.3.3 Required results

P_c shall be within ±1,5 dB of the rated carrier power conducted.

P_c under extreme test conditions shall be within ±3 dB of the rated carrier power conducted.

9.2.4 Modulation spectrum slotted transmission for 25 kHz channel

9.2.4.1 Purpose

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

9.2.4.2 Method of measurement

a) The EUT shall be connected to a spectrum analyser.

b) The test shall be carried out using slotted transmission of test signal number 1.

c) A minimum resolution bandwidth of 300 Hz and video bandwidth of 3 kHz and positive peak detection (max hold) shall be used for this measurement.

d) A sufficient number of sweeps and transmission packets shall be measured to ensure that the emission profile is developed.

e) Repeat steps a) through d) using test signal number 2.

f) Tests shall be performed at 156,025 MHz and 162,025 MHz.

9.2.4.3 Required results

The modulation spectrum shall be within the mask detailed in Figure 9.

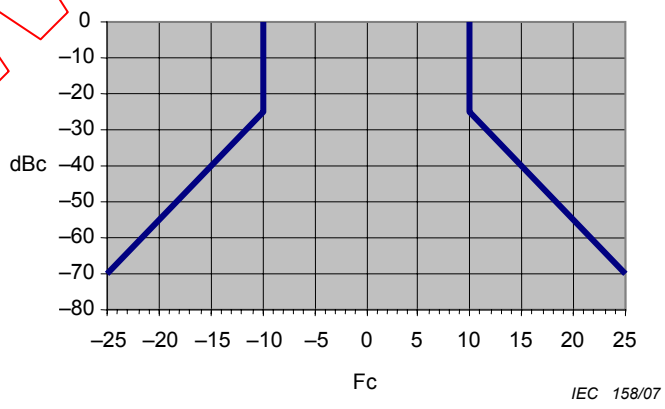

Figure 9 – Modulation spectrum for slotted transmission 25 kHz

The emission mask for 25 kHz channel mode is:

– at ±10 kHz removed from the carrier, the modulation sidebands are below –25 dBc;

– at ±25 kHz removed from the carrier, the modulation sidebands are below –70 dBc, with no need to be below –36 dBm;

– in the region between ±10 kHz and ±25 kHz removed from the carrier, the modulation sidebands shall be below a line specified between these two points.

9.2.5 Modulation spectrum slotted transmission at optional 12,5 kHz channel

9.2.5.1 Purpose

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

9.2.5.2 Method of measurement

a) The EUT shall be connected to a spectrum analyser.

b) The test shall be carried out using slotted transmission of test signal number 1.

c) A minimum resolution bandwidth of 300 Hz and video bandwidth of 3 kHz and positive peak detection (max hold) shall be used for this measurement.

d) A sufficient number of sweeps and transmission packets shall be measured to ensure that the emission profile is developed.

e) Repeat steps a) through d) using test signal number 2.

f) Tests shall be performed at 157,4125 MHz and 160,6375 MHz.

9.2.5.3 Required results

The modulation spectrum shall be within the mask detailed in Figure 10.

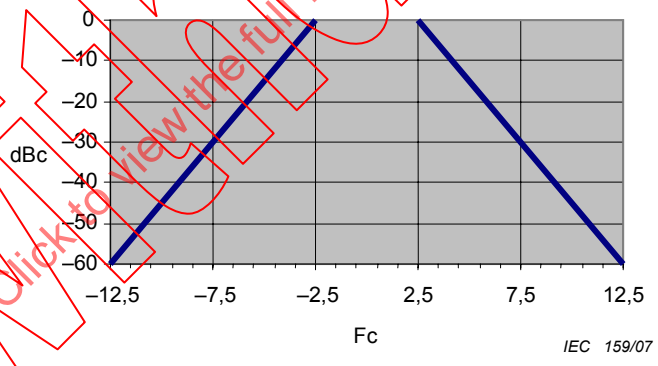

Figure 10 – Modulation spectrum for slotted transmission at optional 12,5 kHz

The emission mask for 12,5 kHz channel mode is:

– at ±12,5 kHz removed from the carrier, the modulation sidebands are below –60 dBc;

– in the region between ±2,5 kHz and ±12,5 kHz removed from the carrier, the modulation sidebands are below a line starting at 0 dBc/±2,5 dBc and ending at –60 dBc/±12,5 kHz with no need to be below –36 dBm.

9.2.6 Transmitter test sequence and modulation accuracy verification for 25 kHz operation

9.2.6.1 Purpose

The test is to verify that the training sequence is a 0101 pattern of 24 bits and starts with a 0. The peak frequency deviation is derived from the baseband signal to verify modulation accuracy.

9.2.6.2 Method of measurement

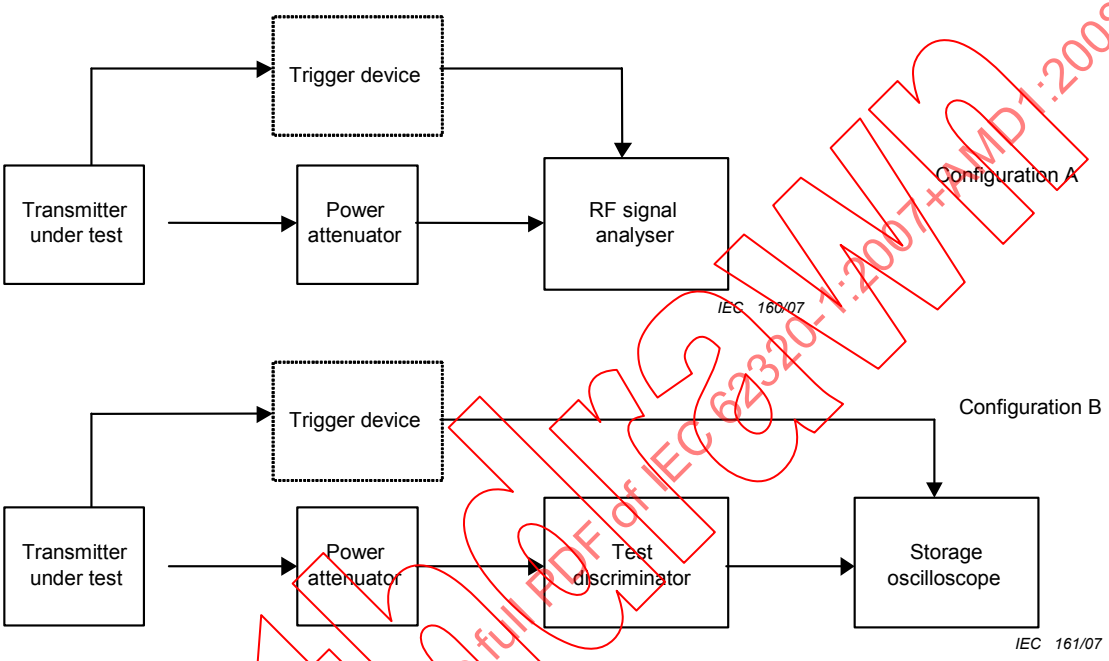

Figure 11 – Measurement arrangement for modulation accuracy

The measurement procedure shall be as follows:

a) the equipment shall be connected in either configuration A or configuration B as shown in Figure 11;

b) the trigger device is optional if the equipment is capable of synchronising to the transmitted bursts;

c) the transmitter shall be tuned to 156,025 MHz;

d) the transmitter shall be modulated with a continuous test signal number 1;

e) the deviation from the carrier frequency shall be measured as a function of time;

f) repeat steps a) through e) with test signal number 2;

g) measurement shall be repeated at 162,025 MHz.

9.2.6.3 Required results

For test signal number 1: the training sequence shall start with a '0' bit and, the peak frequency deviation shall be 1 760 Hz + 352 Hz/ – 176 Hz.

For test signal number 2: The peak frequency deviation shall be 2 400 Hz ± 240 Hz.

9.2.7 Transmitter test sequence and modulation accuracy verification for 12,5 kHz operation

9.2.7.1 Purpose

The test is to verify that the training sequence is a 0101 pattern of 24 bits and starts with a 0. The peak frequency deviation is derived from the baseband signal to verify modulation accuracy.

9.2.7.2 Method of measurement

Follow the measurement method in 9.2.6.

9.2.7.3 Required results

For test signal number 1: The training sequence shall start with a '0' bit and the peak frequency deviation shall be 535 Hz + 108 Hz/ – 54 Hz.

For test signal number 2: The peak frequency deviation shall be 1 200 Hz ± 120 Hz.

9.2.8 Transmitter output power versus time function

9.2.8.1 Definition

Transmitter output power versus time function is a combination of the transmitter delay, attack time, release time and transmission duration as defined in Table 13 where:

a) transmitter delay time ($T_A - T_0$) is the time between the start of the slot and the moment when the transmit power exceeds –50 dB of the steady-state power (P_{ss});

b) transmitter attack time ($T_{B2} - T_A$) is the time between the transmit power exceeding –50 dBc and the moment when the transmit power maintains a level within +1,5 dB –1 dB from P_{ss};

c) transmitter release time ($T_F - T_E$) is the time between the end flag being transmitted and the moment when the transmitter output power has reduced to a level 50 dB below P_{ss} and remains below this level thereafter;

d) transmission duration ($T_F - T_A$) is the time from when power exceeds –50 dBc to when the power returns to and stays below –50 dBc.

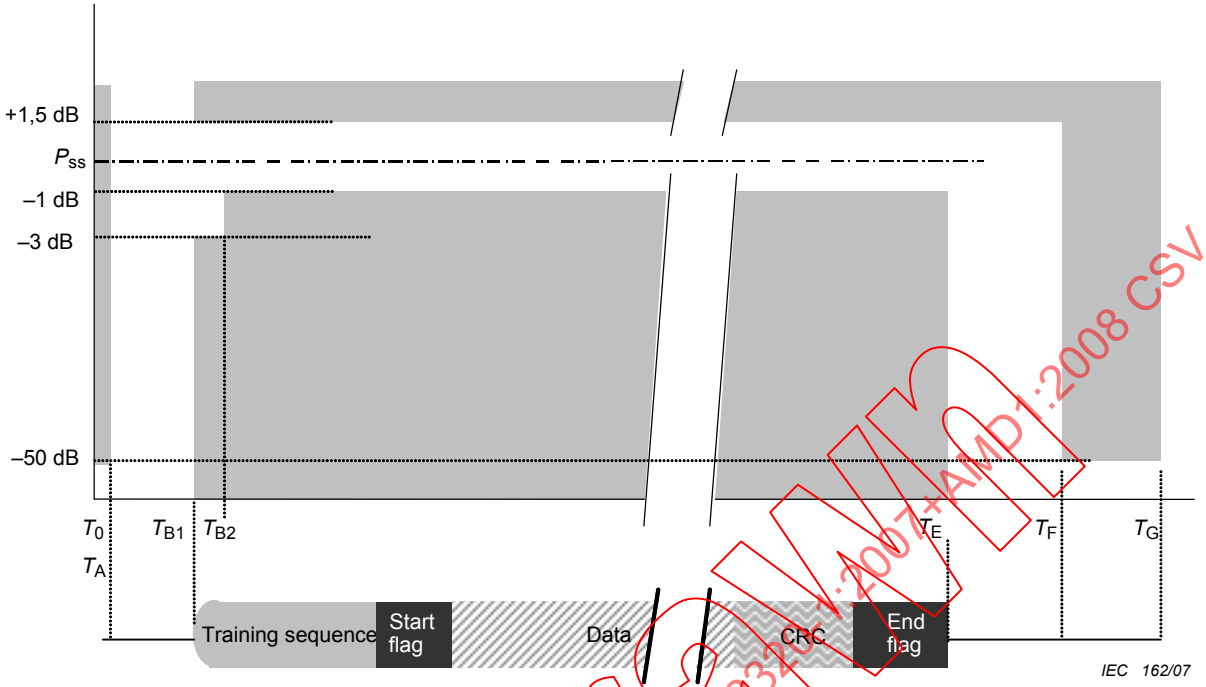

Figure 12 – Power versus time mask

Table 13 – Definition of timings for Figure 12

Reference		Bits	Time	Definition
T_0		0	0 ms	Start of transmission slot. Power shall NOT exceed –50 dB of P_{ss} before T_0
T_A		0-6	0-0,624 ms	Power exceeds –50 dB of P_{ss}
T_B	T_{B1}	6	0,624 ms	Power shall be within +1,5 or –3 dB of P_{ss}
	T_{B2}	8	0,8324 ms	Power shall be within +1,5 or –1 dB of P_{ss}
T_E (includes 1 stuffing bit)		231	24,024 ms	Power shall remain within +1,5 or –1 dB of P_{ss} during the period T_{B2} to T_E
T_F (includes 1 stuffing bit)		239	26,146 ms	Power shall be –50 dB of P_{ss} and stay below this
T_G		256	26,624 ms	Start of next transmission time period

There shall be no modulation of the RF after the termination of transmission (T_E) until the power has reached zero and next slot begins (T_G).

9.2.8.2 Method of measurement

a) The measurement shall be carried out by transmitting test signal number 2 (note that this test signal generates one additional stuffing bit within its CRC portion).

b) The EUT shall be connected to a spectrum analyser. A resolution bandwidth of 1 MHz, video bandwidth of 1 MHz and a sample detector shall be used for this measurement. The analyser shall be in zero-span mode for this measurement.

c) For the purposes of this test, the EUT shall be equipped with a test signal (SYNC) indicating the start of each time period that it intends to transmit into. This will be used as a trigger source for the spectrum analyser. The SYNC signal shall be aligned to the nominal start time (T_0) of the transmission time period.

d) Tests shall be performed on the lowest operating frequency on which the EUT can transmit according the manufacturers specification and AIS2 (162,025 MHz).

9.2.8.3 Required result

The transmitter power shall remain within the mask shown in Figure 12 and associated timings given in Table 13.

9.2.9 Intermodulation attenuation

9.2.9.1 Purpose

The intermodulation attenuation is a measure of the capability of a transmitter to inhibit the generation of signals caused by the presence of the carrier and an interfering signal entering the transmitter via its antenna.

9.2.9.2 Method of measurement

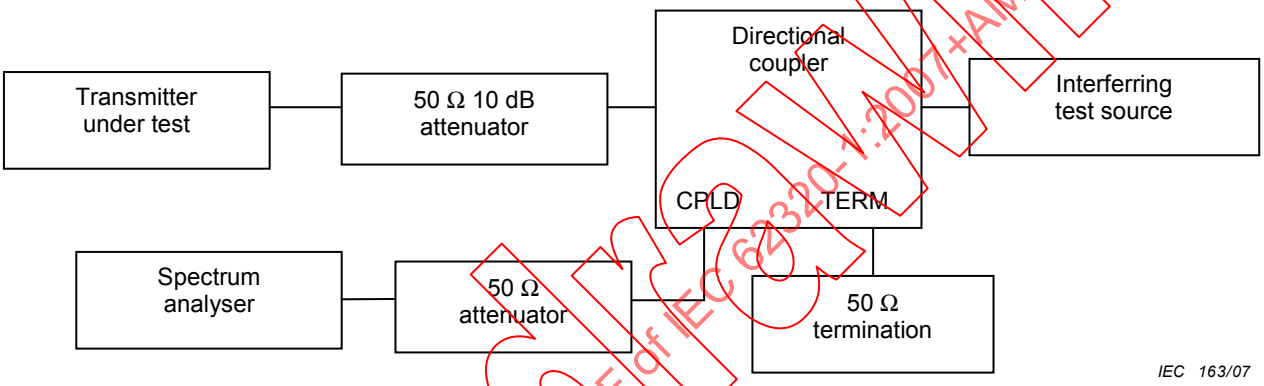

Figure 13 – Measurement arrangement

The measurement arrangement shown in Figure 13 shall be used.

a) The transmitter shall be connected to a 50 Ω 10 dB power attenuator and via a (directional) coupler to a spectrum analyser. An additional attenuator may be required between the directional coupler and the spectrum analyser to avoid overloading.

b) In order to reduce the influence of mismatch errors, it is important that the 10 dB power attenuator is coupled to the transmitter under test with the shortest possible connection.

c) The interfering test signal source shall be either a transmitter providing the same power output as the transmitter under test and be of a similar type, or a signal generator and a linear power amplifier capable of delivering the same output power as the transmitter under test.

d) The (directional) coupler shall have an insertion loss of less than 1 dB. If a directional coupler is used, it shall have a directivity of at least 20 dB.

e) The transmitter under test and the test signal source shall be physically separated so that the measurement is not influenced by direct radiation.

f) The transmitter under test shall be unmodulated and the spectrum analyser adjusted to a span of 500 kHz. The transmitter under test shall be set to continuous transmission mode.

g) The interfering test signal source shall be unmodulated and its frequency shall be within 50 kHz to 100 kHz above the frequency of the transmitter under test. The frequency shall be chosen in such a way that the intermodulation components to be measured do not coincide with other spurious components.

h) The power output of the interfering test signal source shall be adjusted to the carrier power level of the transmitter under test.

i) The ratio of the largest third order intermodulation component with respect to the carrier shall be measured on the spectrum analyser and recorded.

j) This measurement shall be repeated with the interfering test signal source at a frequency within 50 kHz to 100 kHz below the frequency of the transmitter under test.

k) The intermodulation attenuation of the equipment under test shall be expressed as the lower of the two values recorded in above.

9.2.9.3 Required results

The intermodulation ratio shall be not less than 40 dB.

9.3 TDMA receivers

9.3.1 Sensitivity for 25 kHz operation

9.3.1.1 Purpose

The maximum usable sensitivity (data or messages, conducted) is the minimum signal level at the receiver input, produced by a carrier at the specified frequency of the receiver, modulated with the specified test signal, which will, without interference, produce a data signal with a specified packet error rate (PER) after demodulation. If there is a requirement for sensitivity requirements below –107 dBm, the EUT shall be tested at this stated sensitivity level.

9.3.1.2 Method of measurement

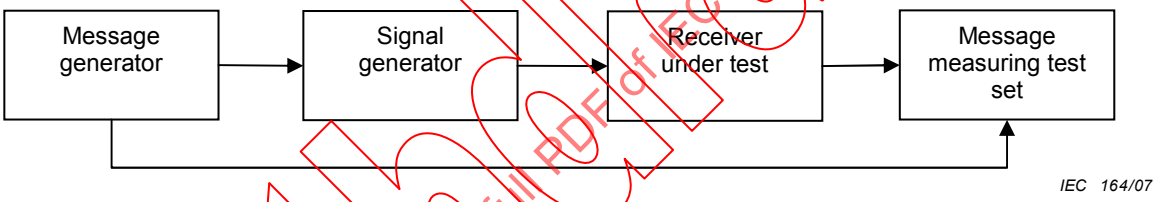

Figure 14 – Measurement arrangement

a) The equipment shall be connected as illustrated in Figure 14.

b) The signal generator shall be set to –107 dBm or declared sensitivity level.

c) Use test signal number 3.

d) The test shall be performed at 156,025 MHz and 162,025 MHz.

e) A minimum of 200 packets shall be transmitted during the test.

f) Repeat the test under extreme conditions with the signal generator level set to –101 dBm.

9.3.1.3 Required results

A minimum PER of 20 % is required.

9.3.2 Sensitivity for optional 12,5 kHz operation

9.3.2.1 Purpose

The maximum usable sensitivity (data or messages, conducted) is the minimum signal level at the receiver input, produced by a carrier at the specified frequency of the receiver, modulated with the normal test signal, which will, without interference, produce a data signal with a specified packet error rate (PER) after demodulation. If there is a requirement for sensitivity requirements below –98 dBm, the EUT shall be tested at this stated sensitivity level.

9.3.2.2 Method of measurement

Use the method detailed in 9.3.1 with the following settings:

a) Signal generator level shall be –98 dBm for normal conditions and shall be –92 dBm for extreme conditions.

b) The test shall be performed at 157,4125 MHz and 160,6375 MHz.

9.3.2.3 Required result

A minimum PER of 20 % is required.

9.3.3 Error behaviour at high input levels for 25 kHz operation

9.3.3.1 Purpose

The error behaviour (performance) at high input levels is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is 100 dB above the maximum usable sensitivity.

9.3.3.2 Method of measurement

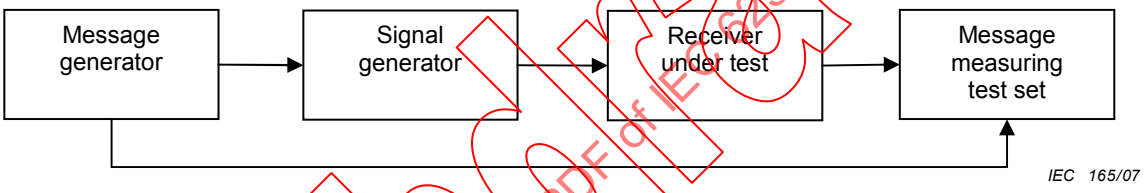

Figure 15 – Measurement arrangement

The measurement procedure shall be as follows:

a) an input signal set to 161,975 MHz, modulated with test signal number 3 shall be applied to the receiver;

b) the level of the input signal shall be adjusted to –77 dBm;

c) 200 packets shall be transmitted and the PER shall be calculated;

d) the measurement shall be repeated with the input signal at –7 dBm.

9.3.3.3 Required results

The PER shall not exceed 1 % in either case.

9.3.4 Co-channel rejection for 25 kHz operation

9.3.4.1 Purpose

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 specified frequency of the receiver.

9.3.4.2 Method of measurement

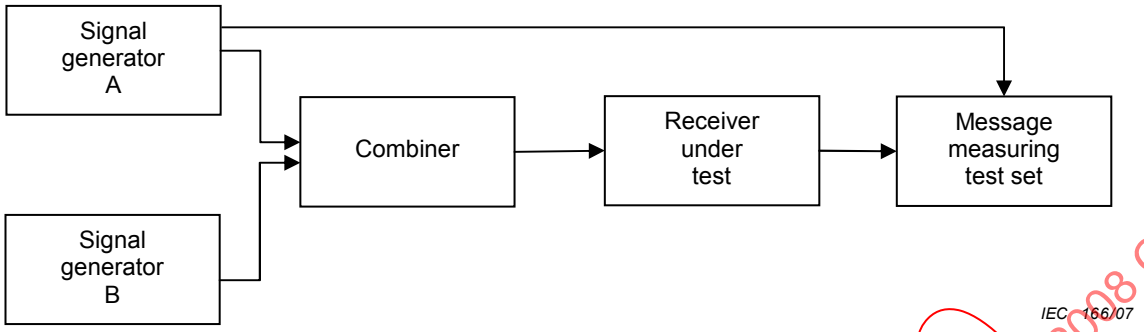

Figure 16 – Measurement arrangement

The measurement procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall be at the specified frequency of the receiver and shall be modulated to generate test signal number 3;

c) the unwanted signal, provided by generator B, shall also be at the specified frequency of the receiver. Generator B shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz;

d) the level of the wanted signal from generator A shall be adjusted to –104 dBm;

e) the level of the unwanted signal from generator B shall be adjusted to –114 dBm;

f) the message measuring test set shall be monitored and the packet error rate observed over 200 transmissions;

g) the test shall be carried out at a specified frequency of 156,025 MHz and 162,025 MHz.

9.3.4.3 Required result

The PER shall not exceed 20 %.

9.3.5 Co-channel rejection for optional 12,5 kHz operation

9.3.5.1 Purpose

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 specified frequency of the receiver.

9.3.5.2 Method of measurement

Use the method of 9.3.4 with the wanted signal generator level set to –95 dBm and the unwanted signal generator level to –113 dBm. The unwanted signal generator shall be modulated with a 400 Hz sine wave giving a deviation of ±1,5 kHz.

9.3.5.3 Required result

The PER shall not exceed 20 %.

9.3.6 Adjacent channel selectivity for 25 kHz operation

9.3.6.1 Purpose

The adjacent channel selectivity 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 signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

9.3.6.2 Method of measurement

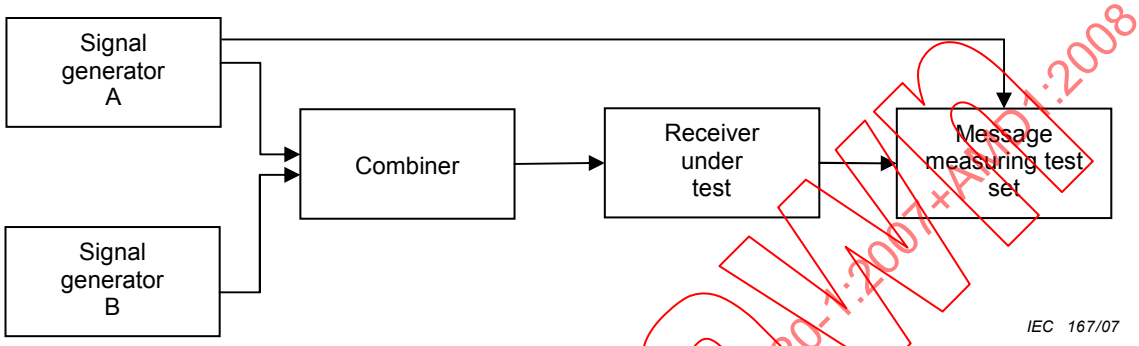

Figure 17 – Measurement arrangement

The measurement procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall initially be at 156,025 MHz and be modulated to generate test signal number 3;

c) the unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at a frequency 25 kHz above that of the wanted signal;

d) the level of the wanted signal from generator A shall be adjusted to a level of –104 dBm;

e) the level of the unwanted signal from generator B shall be adjusted to –34 dBm;

f) the message measuring test set shall be monitored and the PER observed over 200 transmissions;

g) repeat the above measurement with the unwanted signal 25 kHz below the wanted signal;

h) repeat the whole of test steps a) to g) at 162,025 MHz.

9.3.6.3 Required results

The PER shall not exceed 20 %.

9.3.7 Adjacent channel selectivity for optional 12,5 kHz operation

9.3.7.1 Purpose

The adjacent channel selectivity 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 signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

9.3.7.2 Method of measurement

Use the method in 9.3.6 but substitute –95 dBm for the level of the wanted signal generator and –45 dBm for the level of the unwanted signal generator. Also, the modulation deviation of the unwanted signal generator shall be set to ±1,5 kHz.

9.3.7.3 Required results

The PER shall not exceed 20 %.

9.3.8 Spurious response rejection for 25 kHz operation

9.3.8.1 Purpose

The spurious response 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 at any other frequency, at which a response is obtained.

9.3.8.2 Manufacturers' declarations

The manufacturer shall declare the following in order to calculate the "limited frequency range" over which the initial part of the test will be performed:

a) list of intermediate frequencies (IF_1, IF_2,...IF_N) in Hz;

b) switching range of the receiver[2] (sr);

c) frequency of the local oscillator[3] at 162,025 MHz (AIS2) and at the lowest TDMA channel (f_{LOH}, f_{LOL}).

9.3.8.3 Introduction to the method of measurement

The initial evaluation of the EUT shall be performed over the limited frequency range and shall then be performed at the frequencies identified from this test and at "specific frequencies of interest" (as defined below).

To determine the frequencies at which spurious responses can occur, the following calculations shall be made.

9.3.8.4 Calculation of the limited frequency range

The limits of the limited frequency range (LFR_{HI} LFR_{LO}) are determined from the following calculations:

$$LFR_{HI} = f_{LOH} + (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$
$$LFR_{LO} = f_{LOL} - (IF_1 + IF_2 + \ldots + IF_N + sr/2)$$

Calculation of specific frequencies of interest (SFI) outside the limited frequency range:

These are determined by the following calculations:

$$SFI_1 = (K * f_{LOH}) + IF_1$$
$$SFI_2 = (K * f_{LOL}) - IF_1$$

where K is an integer from 2 to 4.

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2 Switching range corresponds to the frequency range over which the receiver can be tuned.

3 This may be a VCO, crystal, sampling clock, BFO, numerically controlled oscillator depending on the design of the equipment.

9.3.8.5 Method of measurement over the limited frequency range

Two methods are available for the measurements over the limited frequency range, one based on SINAD measurements and the other based on PER measurements. Either method may be used, but in each case shall be followed by the method of measurement at identified frequencies.

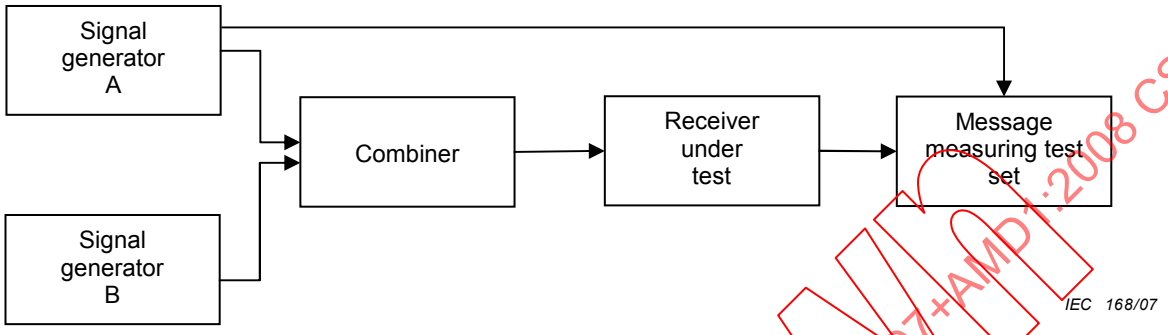


Figure 18 – PER/BER or SINAD measuring equipment

9.3.8.6 Method of search over the "limited frequency range" using SINAD measurement

a) Two generators A and B shall be connected to the receiver via a combining network.

b) The wanted signal, provided by generator A, shall be at 162,025 MHz and shall be modulated with a 1 kHz sine wave at ±2,4 kHz deviation.

c) The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz.

d) Initially, generator B (unwanted) shall be switched off (maintaining the output impedance).

e) The signal level from generator A (wanted) shall be adjusted to –101 dBm at the receiver.

f) The SINAD value shall be noted (and shall be greater than 14 dB).

g) Signal generator B shall be switched on and adjusted to –27 dBm at the receiver.

h) The frequency of the unwanted signal shall be varied in steps of 5 kHz over the Limited Frequency Range (from LFR_{LO} to LFR_{HI}).

i) The frequency of any spurious response detected (by an decrease in SINAD of 3 dB or more) during the search shall be recorded for use in the next measurement.

j) Repeat the test using the lowest frequency.

9.3.8.7 Method of search over the limited frequency range using PER or BER measurement

a) Two generators A and B, shall be connected to the receiver via a combining network.

b) The wanted signal, provided by generator A, shall be at 162,025 MHz and shall be modulated to generate test signal number 3.

c) The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz.

d) Initially, generator B (unwanted) shall be switched off (maintaining the output impedance).

e) The signal level from generator A (wanted) shall be adjusted to –101 dBm at the receiver.

f) The PER or BER shall be noted.

g) Signal generator B shall be switched on and adjusted to –27 dBm at the receiver.

h) The frequency of the unwanted signal shall be varied in steps of 5 kHz over the limited frequency range (from LFR_{LO} to LFR_{HI}).

i) The frequency of any spurious response detected (by an increase in either PER or BER) during the search shall be recorded for use in the next measurements. In the case where operation using a continuous packet stream is not possible a similar method may be used.

j) Repeat the test using the lowest frequency.

9.3.8.8 Method of measurement (at identified frequencies)

a) Two generators A and B, shall be connected to the receiver via a combining network.

b) The wanted signal, provided by generator A, shall be at the high and low channels used for the calculation of SFI_1 and SFI_2 and shall be modulated to generate test signal number 3.

c) The unwanted signal, provided by generator B, shall be frequency modulated with a 400 Hz sine wave giving a deviation of ±3 kHz. Generator B shall be at the frequency of that spurious response being considered.

d) Initially, generator B (unwanted) shall be switched off (maintaining the output impedance).

e) The signal level from generator A (wanted) shall be adjusted –101 dBm at the receiver.

f) Generator B shall be switched on, and the level of the unwanted signal set to –31 dBm.

g) For each frequency noted during the tests over the limited frequency range and the Specific Frequencies of Interest (SFI_1 and SFI_2), transmit 200 packets to the EUT and note the PER.

9.3.8.9 Required results

At any frequency separated from the specified frequency of the receiver by two channels or more, the PER shall not exceed 20 %.

9.3.9 Spurious response rejection for optional 12,5 kHz operation

9.3.9.1 Purpose

The spurious response 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 at any other frequency, at which a response is obtained.

9.3.9.2 Manufacturer's declaration

Use the manufacturer's declaration stated in 9.3.8.

9.3.9.3 Method of measurement

Use the method of measurement detailed in 9.3.8 with the receiver frequency set to 157,4125 MHz.

NOTE The step size of the frequency of the unwanted signal in 9.3.8.6 h) and 9.3.8.7 h) should be reduced to 2,5 kHz.

9.3.9.4 Required results

At any frequency separated from the specified frequency of the receiver by two channels or more, the PER shall not exceed 20 %.

9.3.10 Intermodulation response rejection for 25 kHz operation

9.3.10.1 Purpose

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 close-spaced unwanted signals with a specific frequency relationship to the wanted signal frequency.

9.3.10.2 Method of test

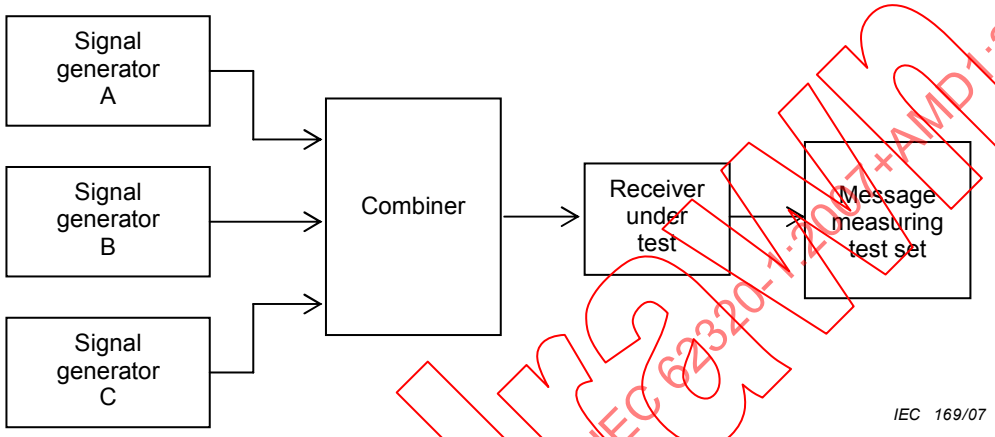


Figure 19 – Measurement arrangement for inter-modulation

The measurement procedure shall be as follows:

a) three signal generators shall be connected to the receiver via a combining network;

b) the wanted signal, provided by signal generator A, shall be at the specified frequency of the receiver and shall be modulated to generate test signal number 3;

c) the unwanted signal from generator B shall be unmodulated;

d) the unwanted signal from generator C shall be frequency modulated with a 400 Hz sine wave at a deviation of ±3 kHz:

e) the signal level from generator A (wanted) shall be set for –101 dBm at the receiver input;

f) the signal level from generators B and C shall be set for –27 dBm at the receiver input;

g) the frequencies of generators A, B, and C shall be set as per test number 1 of Table 14;

h) the message measuring test set shall be monitored and the PER observed over 200 transmissions;

i) repeat the measurement with frequencies set as per test number 2 of Table 14.

Table 14 – Frequencies for inter-modulation tests

Test number	Generator A Wanted AIS signal	Generator B Unmodulated (± 500 kHz)	Generator C Modulated (±1 000 kHz)
1	162,025 MHz	161,525 MHz	161,025 MHz
2	156,025 MHz	156,525 MHz	157,025 MHz

9.3.10.3 Required results

The PER shall not exceed 20 %.

9.3.11 Blocking or desensitisation for 25 kHz operation

9.3.11.1 Purpose

Blocking 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 input signal at any frequency other than those of the spurious responses or the adjacent channels.

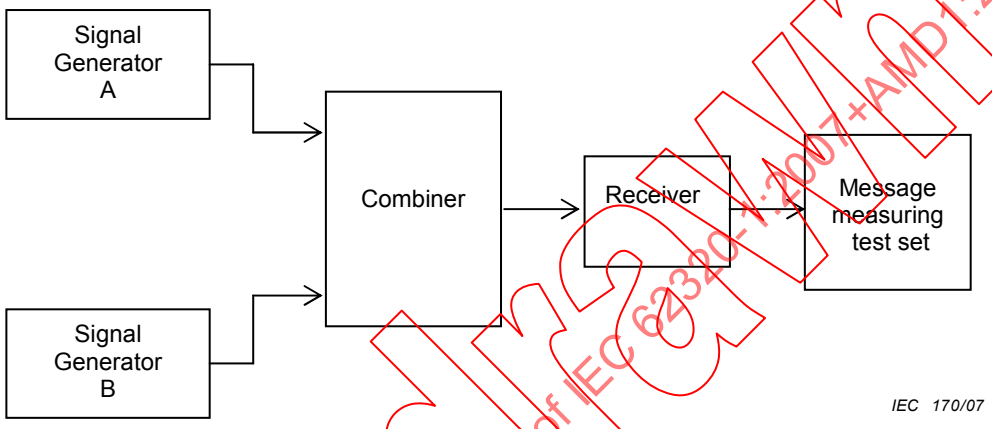


Figure 20 – Measurement arrangement for blocking or de-sensitisation

9.3.11.2 Method of measurement

The measurement procedure shall be as follows:

a) two generators A and B, shall be connected to the receiver via a combining network as shown in Figure 20;

b) the wanted signal, provided by signal generator A, shall be initially at 156,025 MHz and be modulated to generate test signal number 3;

c) the unwanted signal from generator B shall be unmodulated and tuned to 161,75 MHz. 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 –101 dBm at the receiver input;

d) generator B shall then be switched on, and the level of the unwanted signal set to –15 dBm;

e) 200 packets shall be transmitted and the PER recorded;

f) repeat the test steps a) to e) with the wanted signal generator tuned to 162,025 MHz and the unwanted signal generator tuned to 156,3 MHz.

9.3.11.3 Required results

The PER shall not exceed 20 %.

9.4 Conducted spurious emissions at the antenna

9.4.1 Spurious emissions from the receiver

9.4.1.1 Purpose

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

9.4.1.2 Method of measurement

Conducted spurious emissions shall be measured as the power level of any frequency component to the antenna terminals of the receiver. The receiver antenna terminals are connected to a spectrum analyser or selective voltmeter having an input impedance of 50 Ω and the receiver is switched on.

The measurement shall extend over the frequency range 9 kHz to 2 GHz.

9.4.1.3 Required results

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm in the frequency range 9 kHz to 1 GHz and –47 dBm in the frequency range 1 GHz to 2 GHz.

9.4.2 Spurious emissions from the transmitter

9.4.2.1 Purpose

Spurious emissions are emissions at frequencies other than those of the carrier and sidebands associated with normal modulation.

9.4.2.2 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 9 kHz to 2 GHz, excluding the channel on which the transmitter is operating and its adjacent channels.

9.4.2.3 Required results

The power of any spurious emission at any frequency shall not exceed –36 dBm in the frequency range 9 kHz to 1 GHz and –30 dBm in the frequency range 1 GHz to 2 GHz.

10 Functional tests for Base Station

This clause identifies the functional tests for the Base Station. Validation of the presentation interface is integrated in the following tests. The tests are for all Base Stations. Some of the tests are not required if the Base Station is to be tested as a dependent unit only. These tests and results are indicated at the start of the test by a note.

10.1 Pre-set-up

NOTE The sentences provided in the pre-set-up condition and throughout this test clause contain data fields as examples only.

For all tests the pre-set-up conditions are:

a) query the EUT to obtain the current unique identifier and MMSI. Provide a SID sentence to set the unique identifier and MMSI to a known value;

$xxABQ,VER*hh<CR><LF>

$xxABQ,BCF*hh<CR><LF>

$xxSID,xxxxxxxxxxxxxxx,AA0000003770007,xxxxxxxxx,003770007*hh<CR><LF>

b) the EUT will be given a BCF sentence to set the following: position source to surveyed, LAT/LON position to a known location, position accuracy to high, channels to 2087 and 2088, transmitter power to high, messages retries to three, repeat indicator to three, and talker ID to ABM;

$xxBCF,003770007,0,2959.9990,N,8359.9990,W,1,2087,2088,2087,2088,0,0,3,3,AB*hh<CR><LF>

c) the EUT will be given a BCE sentence to set RATDMA to zero (disabled);

$xxBCE,AA003770007,0,1,60*hh<CR><LF>

d) the EUT will be given a series of ECB sentences to disable all autonomous transmissions;

$xxECB,AA003770007,4,0,-1,,,0,-1,,*hh<CR><LF>

$xxECB,AA003770007,17,0,-1,,,0,-1,,*hh<CR><LF>

$xxECB,AA003770007,20,0,-1,,,0,-1,,*hh<CR><LF>

$xxECB,AA003770007,22,0,-1,,,0,-1,,*hh<CR><LF>

$xxECB,AA003770007,23,0,-1,,,0,-1,,*hh<CR><LF>

e) the EUT will be given a SPO sentence to ensure all optional VDL information is disabled;

$xxSPO,AA003770007,N,0,0,0,0,0,0,0,0,0,0,0,0,*hh<CR><LF>

f) the EUT will be given a series of 20 DLM sentences to clear any FATDMA reservations;

$xxDLM,0,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,0,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,1,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,1,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,2,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,2,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,3,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,3,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,4,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,4,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,5,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,5,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,6,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,6,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,7,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,7,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,8,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,8,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,9,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,9,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

g) the standard test environment shall include 5 AIS mobile targets running on the default AIS channels 2087 and 2088 or appropriate test channels;

h) normal mode for the EUT is EUT with power on, UTC available, both transmitters enabled and AIS channels set to 2087 and 2088 or appropriate test channels;

i) record all messages on the VDL and record all messages on the PI.

10.2 Normal operation

10.2.1 Base Station configuration and services

10.2.1.1 Base Station configuration

10.2.1.1.1 Purpose

The purpose of this test is to verify that the Base Station can be configured with an MMSI and unique identifier. This test verifies the EUT's correct response to these two SID data fields.

10.2.1.1.2 Method of measurement

a) Apply the following SID sentence using an incorrect unique identifier:

$xxSID, AA0000003770009,AA0000003770001,003770007,*hh<CR><LF>

Query the EUT for the VER sentence:

$xxABQ,VER*hh<CR><LF>

b) Apply the following SID sentence using the correct unique identifier:

$xxSID, AA0000003770007,AA0000003770009,003770005,*hh<CR><LF>

Query the EUT for the VER sentence:

$xxABQ,VER*hh<CR><LF>

c) Apply the following BCE sentence using the correct unique identifier and enabling comment blocks:

$xxBCE,AA0000003770009,1,,1*hh<CR><LF>

Apply the following ECB sentence with an incorrect unique identifier and DLM sentence:

\s:ControlPC1,d:AA0000003770007,c:1149654649*hh\$xxECB,AA0000003770009,4,0,4,750,,0,379,750,*hh<CR><LF>

\s:ControlPC1,d:AA0000003770007,c:1149654649*hh\$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

10.2.1.1.3 Required results

a) Confirm the content of the VER sentence and that the correct MMSI and unique identifier has been retained

b) Confirm the content of the VER sentence and that the new MMSI and unique identifier has been configured

c) Confirm that the ECB and DLM sentences were ignored,

10.2.1.2 Base Station report information content and reporting rate

10.2.1.2.1 Purpose

This test verifies the basic functionality of a Base Station. This test will verify the "pre-set-up condition" used in subsequent testing.

10.2.1.2.2 Method of measurement

a) Set up standard test environment and apply the BCF, BCE, ECB, SPO and DLM sentences to the EUT as defined in the pre-set-up conditions.

b) Apply a TSA sentence and a VDM sentence with encapsulated Message 4 to the EUT:

$xxTSA,AA003770007,9,A,HHMM,1050,2*hh<CR><LF>

!xxVDM,1,1,9,A,40C4qnh00041?G1RMfL0tJi004P4,0*hh<CR><LF>

c) Apply the following BBM sentence to the EUT:

!xxBBM,1,1,0,0,14,D5CDP=5CC175,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

d) Apply the following DLM sentence to the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

e) Apply the following ECB sentence to the EUT:

$xxECB,AA003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

f) Apply the following SPO sentence to the EUT:

$xxSPO,AA003770007,A,1,1,1,,1,,,1,1,1,1*hh<CR><LF>

10.2.1.2.3 Required results

a) Confirm that the BCF, BCE, ECB, SPO and DLM sentences were received correctly by the EUT using the query sentence. Confirm that the EUT is receiving position reports on both A and B channels from 5 test targets and verify that the VDM has the correct data for the 5 test targets. Confirm that the EUT is not transmitting.

b) Confirm that the appropriate TFR sentence is output on the PI. Confirm that the EUT is transmitting Message 4 in the assigned slot and channel. Confirm that the Message 4 contains the same data as defined by the VDM sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

c) Confirm that the EUT did not transmit Message 14 and issued an ABK type 2.

NOTE The following results are required for a Base Station operated as an independent unit.

d) Confirm that the DLM sentences were received correctly by the EUT using the query sentence for DLM.

e) Confirm that the ECB sentences were received correctly by the EUT using the query sentence for ECB. Confirm that the EUT is transmitting Message 4 and Message 20 in the assigned slots, interval, and channels as defined in the ECB sentences. Confirm that the content of Message 20 is as defined by the DLM. Confirm that the EUT is transmitting Message 4 with an interval of 10 s, alternating transmission channels A and B. Confirm that the content of Message 4 is as defined by the BCF. Confirm that in the content of Message 4 the UTC/date is provided correctly. Confirm that the communications state for Message 4 is implemented correctly. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

f) Confirm that the VSI sentence contains the associated information about each VDM or VDO sentence. Confirm that the FSR sentence contains the associated information about the conditions for the previous frame.

10.2.1.3 Retention of Base Station report Information content and reporting rate

10.2.1.3.1 Purpose

This test will verify that a Base Station retains all of its configuration settings upon restart. There are two methods of restart, a physical restart of the Base Station and a restart using the CAB sentence. This test will verify that the Base Station retains its last configuration after these restarts. The test will also verify that the Base Station sets its configuration to "undefined" after reset.

10.2.1.3.2 Method of measurement

Set up standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Remove power from the EUT for 2 s and then re-apply power to the EUT.

b) Apply the following CAB sentence to the EUT:

$xxCAB,,,1,*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

c) Apply the following DLM sentences to the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

d) Apply the following ECB sentences to the EUT:

$xxECB,AA003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

e) Remove power from the EUT for 2 s and then re-apply power to the EUT.

f) Apply the following CAB sentence to restart the EUT:

$xxCAB,,,1,*hh<CR><LF>

g) Apply the following CAB sentence to reset the EUT:

$xxCAB,,,,1*hh<CR><LF>

10.2.1.3.3 Required results

a) Confirm that BCF, DLM and ECB sentences were retained correctly, as defined by the pre-set-up conditions, by the EUT using query for these sentences. Confirm that the EUT is receiving position reports on both A and B channels from 5 test targets. These results shall occur within 2 min.

b) Confirm that the BCF sentence was retained correctly by the EUT using the query sentence for the BCF sentence. Confirm that the EUT is receiving position reports on both A and B channels from 5 test targets. These results shall occur within 2 min.

NOTE The following tests are required for a Base Station operated as an independent unit.

c) Confirm that the DLM sentences were received correctly by the EUT using the query sentence for DLM.

d) Confirm that the ECB sentences were received correctly by the EUT using the query sentence for ECB.

e) Confirm that BCF and ECB sentences were retained correctly by the EUT using query for these sentences. Confirm that the EUT is receiving position reports on both A and B channels from 5 test targets. Confirm that the EUT is transmitting Message 4 and Message 20 in the assigned slots, interval, and channels as defined in the ECB sentences. Confirm that the content of Message 20 s is as defined by the DLM. Confirm that the content of Message 4 is as defined by the BCF. Confirm that in the content of Message 4 the UTC/date is provided correctly. Confirm that the communications state for Message 4 is

handled properly. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

These results shall occur within 2 min.

f) Confirm that BCF and ECB sentences were retained correctly by the EUT using query for these sentences. Confirm that the EUT is receiving position reports on both A and B channels from 5 test targets. Confirm that the EUT is transmitting Message 4 and Message 20 in the assigned slots, interval, and channels as defined in the ECB sentences. Confirm that the content of Message 20 s is as defined by the DLM. Confirm that the content of Message 4 is as defined by the BCF. Confirm that in the content of Message 4 the UTC/date is provided correctly. Confirm that the communications state for Message 4 is handled properly. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

These results shall occur within 2 min.

g) Verify all configuration information is undefined with the exception of receive only on AIS1 and AIS2.

10.2.1.4 Configuration and operating parameters

10.2.1.4.1 Purpose

This test will verify that the Base Station configuration can be modified. In addition, it will verify the non-default settings. The operation of the TSA+VDM transmission is verified when operating independently.

10.2.1.4.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions. Switch the working channels for the 5 test targets to appropriate channels as defined in the new BCF sentence.

a) Apply the following BCF sentences to the EUT with an incorrect MMSI:

$xxBCF,003770008,1,,,,,0,2085,2086,2085,2086,1,1,0,0,AB*hh<CR><LF>

b) Apply the following BCF and BCE sentences to the EUT:

$xxBCF,003770007,1,,,,,0,2085,2086,2085,2086,1,1,0,0,AB*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

c) Apply a TSA sentence and a VDM sentence with encapsulated Message 4 to the EUT:

$xxTSA,AA0000003770007,9,A,HHMMSS,1050,2*hh<CR><LF>

!xxVDM,1,1,9,A,40C4qnh00041?G1RMfL0tJi004P4,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

d) Apply the following DLM sentence to the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

e) Apply the following ECB sentences to the EUT to start autonomous transmissions:

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

f) Modify the DLM reservations:

$xxDLM,0,A,L,104,1,7,250,L,100,1,7,0,,,,,,,,,*hh<CR><LF>

$xxDLM,0,B,L,229,1,7,250,L,106,1,7,0,,,,,,,,,*hh<CR><LF>

g) Apply the following ECB sentences to modify the transmission slots:

$xxECB,AA0000003770007,4,0,104,750,,0,479,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,100,0,,0,106,0,,*hh<CR><LF>

h) Apply the following DLM sentence to the EUT:

$xxDLM,0,A,C,,,,,C,,,,,,,,,,,,,*hh<CR><LF>

$xxDLM,0,B,C,,,,,C,,,,,,,,,,,,,*hh<CR><LF>

i) Apply the following ECB sentence to the EUT:

$xxECB,AA0000003770007,20,0,-1,,,0,-1,,*hh<CR><LF>

j) Apply the following CAB sentence to the EUT:

$xxCAB,0,1,,*hh<CR><LF>

k) Apply a TSA sentence and a VDM sentence with encapsulated Message 4 to the EUT on the disabled channel:

$xxTSA,AA0000003770007,9,A,HHMMSS,1050,2*hh<CR><LF>

!xxVDM,1,1,9,A,40C4qnh00041?G1RMfL0tJi004P4,0*hh<CR><LF>

l) Apply the following ECB sentence to the EUT:

$xxECB,AA0000003770007,4,0,-1,,,0,-1,,*hh<CR><LF>

m) Apply the following BBM and VDM sentences to the EUT:

$xxCAB,1,1,,*hh<CR><LF>

!xxBBM,1,1,0,0,14,D5CDP=5CC175,0*hh<CR><LF>

!xxVDM,2,1,7,A,502=aEP000000000000ph9u0ThuC:222222222016@jI071C0vSchH88,0*hh<CR><LF>

!xxVDM,2,2,7,A,888888888888888,2*hh CR><LF>

10.2.1.4.3 Required results

a) Confirm that the BCF sentence was ignored by the EUT using the query sentence for the BCF sentence.

b) Confirm that BCF and BCE sentences were processed correctly by the EUT using query sentences.

c) Confirm that the appropriate TFR sentence is output on the PI. Confirm that the EUT transmits the Message 4 in the assigned slot and channel. Confirm that the content of Message 4 is as defined by the VDM sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

NOTE The following results are required for a Base Station operated as an independent unit.

d) Confirm that the DLM sentences were received correctly by the EUT using the query sentence for DLM.

e) Confirm that the ECB sentences were received correctly by the EUT using the query sentence for ECB. Confirm that the EUT is transmitting Message 4 and Message 20 in the assigned slots, interval and channel as defined in the ECB sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the content of Message 4 is as defined by the BCF sentence. Confirm that the content of Message 20 is as defined by the DLM sentence. Confirm that the EUT is receiving position reports on both channels A and B from the 5 AIS targets.

f) Confirm that the DLM sentences were received correctly using the query sentence for DLM.

g) Confirm that the ECB sentences were received correctly using the query sentence for ECB. Confirm that the EUT is transmitting Message 4 and Message 20 in the assigned slots, interval and channel as defined in the ECB sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

h) Confirm that the DLM sentences were received correctly using the query sentence for DLM. Check that the first two entries are deleted and the third entry is retained.

i) Confirm that the ECB sentences were received correctly using the query sentence for ECB. Confirm that the Base Station stops transmitting Message 20. Confirm that the EUT is only transmitting Message 4 in the assigned slots as defined in the ECB message.

j) Confirm that CAB sentence was received correctly by the EUT using the query sentence for CAB sentence. Confirm that the EUT is receiving position reports on both A and B channels from other AIS. Confirm that the EUT is transmitting Message 4 in the assigned slots, interval and transmitting on channel B only at a reporting rate of 20 s.

k) Confirm that the appropriate TFR sentence with status 9 is output on the PI. Confirm that the EUT is NOT transmitting Message 4 in channel A.

l) Confirm that the ECB sentences were received correctly by the EUT using the query sentence for ECB. Confirm that the Base Station stops transmitting Message 4.

m) Confirm that the EUT transmitted Message 14 and issued an ABK type 3. Confirm that the EUT transmitted Message 5.

10.2.1.5 FATDMA configuration

10.2.1.5.1 Purpose

This test will verify the ability of the Base Station to configure all twenty FATDMA data set definitions (ten per channel).

10.2.1.5.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following BCE sentence to enable the use of RATDMA:

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

b) Apply the following 20 DLM sentences to the EUT:

$xxDLM,0,A,L,0004,1,7,0250,L,0000,1,7,0000,L,0010,1,7,0450,L,0070,2,7,0075*hh<CR><LF>

$xxDLM,0,B,L,0129,1,7,0250,L,0006,1,7,0000,L,0012,1,7,0450,L,0050,2,7,0075*hh<CR><LF>

$xxDLM,1,A,L,0100,1,7,0000,L,0101,2,6,0000,L,0103,3,5,0000,L,0106,5,4,0000*hh<CR><LF>

$xxDLM,1,B,L,0300,1,7,0000,L,0301,2,6,0000,L,0303,3,5,0000,L,0306,5,4,0000*hh<CR><LF>

$xxDLM,2,A,L,0400,1,7,0000,L,0401,2,6,0000,L,0403,3,5,0000,L,0406,5,4,0000*hh<CR><LF>

$xxDLM,2,B,L,0600,1,7,0000,L,0601,2,6,0000,L,0603,3,5,0000,L,0606,5,4,0000*hh<CR><LF>

$xxDLM,3,A,L,0700,1,7,0000,L,0701,2,6,0000,L,0703,3,5,0000,L,0706,5,4,0000*hh<CR><LF>

$xxDLM,3,B,L,0900,1,7,0000,L,0901,2,6,0000,L,0903,3,5,0000,L,0906,5,4,0000*hh<CR><LF>

$xxDLM,4,A,L,1100,1,7,0000,L,1101,2,6,0000,L,1103,3,5,0000,L,1106,5,4,0000*hh<CR><LF>

$xxDLM,4,B,L,1200,1,7,0000,L,1201,2,7,0000,L,1203,3,7,0000,L,1206,5,7,0000*hh<CR><LF>

$xxDLM,5,A,L,1300,1,7,0000,L,1301,2,6,0000,L,1303,3,5,0000,L,1306,5,4,0000*hh<CR><LF>

$xxDLM,5,B,L,1500,1,7,0000,L,1501,2,7,0000,L,1503,3,7,0000,L,1506,5,7,0000*hh<CR><LF>

$xxDLM,6,A,L,1600,1,7,0000,L,1601,2,7,0000,L,1603,3,7,0000,L,1606,5,7,0000*hh<CR><LF>

$xxDLM,6,B,L,1800,1,7,0000,L,1801,2,7,0000,L,1803,3,7,0000,L,1806,5,7,0000*hh<CR><LF>

$xxDLM,7,A,L,1900,1,7,0000,L,1901,2,7,0000,L,1903,3,7,0000,L,1906,5,7,0000*hh<CR><LF>

$xxDLM,7,B,L,2100,1,7,0000,L,2101,2,7,0000,L,2103,3,7,0000,L,2106,5,7,0000*hh<CR><LF>

$xxDLM,8,A,L,2150,1,7,0000,L,2151,2,7,0000,L,2153,3,7,0000,L,2156,5,7,0000*hh<CR><LF>

$xxDLM,8,B,L,2200,1,7,0000,L,2201,2,7,0000,L,2203,3,7,0000,L,2206,5,7,0000*hh<CR><LF>

$xxDLM,9,A,L,1700,1,7,0000,L,1701,2,7,0000,L,1703,3,7,0000,L,1706,5,7,0000*hh<CR><LF>

$xxDLM,9,B,L,1750,1,7,0000,L,1751,2,7,0000,L,1753,3,7,0000,L,1756,5,7,0000*hh<CR><LF>

c) Apply the following ECB sentences to the EUT:

$xxECB,AA0000003770008,4,0,104,750,,0,479,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,10,450,,0,12,450,*hh<CR><LF>

d) Apply the following DLM sentences to remove the FATDMA allocations:

$xxDLM,0,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,0,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,1,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,1,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,2,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,2,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,3,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,3,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,4,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,4,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,5,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,5,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,6,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,6,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,7,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,7,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,8,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,8,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,9,A,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

$xxDLM,9,B,C,,,,,C,,,,,C,,,,,C,,,,*hh<CR><LF>

e) Apply the following DLM sentences to the EUT:

$xxDLM,0,A,L,0004,1,7,0250,L,0010,1,7,0450,R,0005,5,7,0030,R,0015,5,7,0030*hh<CR><LF>

$xxDLM,1,A,R,0020,4,7,0030,R,0025,5,7,0030,R,0030,4,7,0030,R,0011,2,7,0030*hh<CR><LF>

f) Apply the following BBM sentences to the EUT:

!xxBBM,1,1,0,0,14,D5CDPC165DIP=5CC1750,0*hh<CR><LF>

10.2.1.5.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the BCE sentences were received correctly by the EUT using the query sentence for the BCE sentence.

b) Confirm that DLM sentences were received correctly by the EUT using the query sentence for the DLM sentence.

c) Confirm that the ECB sentences were received correctly by the EUT using the query sentence for the ECB sentence. Confirm that the appropriate VDO sentence is output on the PI when a Message 20 is transmitted. Confirm that the EUT is transmitting Message 20(s) over the VDL in the specified slots and specified channels with the specified configuration parameters from the DLM and the ECB sentence. Confirm that all the Message 20 s required by the full set of DLM sentences are transmitted over the VDL within 2 frames in the assigned slots as defined in the ECB sentence.

d) Confirm the DLM sentences were received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the EUT is no longer transmitting any Message 20 over the VDL. Confirm that the EUT continues to transmit Message 4 over the VDL.

e) Confirm that DLM sentences were received correctly by the EUT using the query sentence for DLM sentence.

f) Confirm that the Message 14 is transmitted over the VDL within 4 s using RATMDA in available slots and not using the remotely allocated slots.

10.2.1.6 Channel management

10.2.1.6.1 Purpose

This test will verify that the Base Station will transmit an addressed Message 22.

10.2.1.6.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following ACA sentence to the EUT:

$xxACA,0,3500.00,N,08000.00,W,3400.00,N,08100.00,W,5,2087,0,2088,0,0,0,,,*hh<CR><LF>

b) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

c) Apply the following DLM sentence to reserve slots for Message 22 transmissions:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,1,7,75,L,1,1,7,0*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,1,7,75,L,7,1,7,0*hh<CR><LF>

d) Apply the following ECB sentence to start Message 22 transmissions by the EUT:

$xxECB,AA0000003770007,22,0,1,0,,0,7,0,*hh<CR><LF>

e) Apply the following ACM sentence to the EUT:

$xxACM, (MMSI of mobile 1),(MMSI of mobile 2),2087,0,2088,0,0,0,2,3*hh<CR><LF>

f) Cycle power on the EUT.

10.2.1.6.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the ACA sentence was received correctly by the EUT using the query sentence for the ACA sentence.

b) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

c) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence.

d) Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence. Confirm that the EUT is transmitting Message 22 over the VDL in the specified slots and specified channels. Confirm the content of the Message 22 is as defined by the ACA message. Confirm that the EUT continues to transmit Messages 4 and 20 as defined. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

e) Confirm that the EUT transmits the data of the ACM to the specified mobiles within the 4 s. Confirm the content of the Message 22 is as defined by the ACM sentence and that the MMSI has the correct number of bits in Message 22.

f) Confirm that the EUT´s channel management settings are retained and that the Message 22 starts transmitting again within 2 min.

10.2.1.7 VDM to VDL processing

10.2.1.7.1 Purpose

This test will verify that the Base Station can receive multiple types of VDM inputs and transmit the encapsulated message as required by the message type.

10.2.1.7.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply a VDM sentence to the EUT.

b) Enable RATDMA and apply a VDM sentence to the EUT:

$xxBCE,AA0000003770007,1,,*hh<CF><LF>

c) Apply the following DLM+ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,,0,6,0,,*hh<CR><LF>

d) Apply VDM sentences with encapsulated Message 1 to 23 to the EUT.

e) Apply the following VDM sentence with inappropriate comm.state and repeat indicator to the EUT:

!ABVDM,1,1,,A,15M3NSwP00J6TN>?a0e3Ngv000Sq,0*hh<CR><LF>

f) Disable RATDMA and clear available FATDMA slots. Apply a VDM sentence to the EUT:

$xxBCE,AA0000003770007,0,,*hh<CF><LF>

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,C,,,,,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,C,,,,,,,,,*hh<CR><LF>

g) Apply a DLM sentence with available slots at the end of the epoch. Apply a VDM sentence to the EUT. Then apply 5 VDM sentences:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,1,7,0,,,,,*hh<CR><LF>

10.2.1.7.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the EUT generates an appropriate TFR sentence and does NOT transmit the VDM.

b) Confirm that the BCE sentence was received correctly by the EUT using the query for the BCE sentence. Confirm that the EUT generates an appropriate TFR sentence and transmits the Message within 4 s.

c) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

d) Confirm that the EUT generates an appropriate TFR sentence and transmits each allowable Message, allowing up to 4 s between transmissions in available FATDMA or RATDMA slots. Confirm that the information in each transmitted Message is complete and correct. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that VDL Message 4, 11 and 20 VDM sentences are not transmitted. Confirm that VDL messages 15 and 16 are only transmitted when no slot offset is provided.

e) Confirm that the EUT generates an appropriate TFR sentence and transmits the message after correcting Comm.state and that the repeat indicator is not zero.

f) Confirm the EUT generates an appropriate TFR sentence and does NOT transmit the VDM.

g) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the EUT transmits the 5 VDM messages one in each frame.

10.2.1.8 TSA and associated VDM processing

10.2.1.8.1 Purpose

This test will verify that the Base Station can receive a TSA and the associated VDM for all message types and transmit the encapsulated message as required by the message type in the assigned slot.

10.2.1.8.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Apply TSA+VDM sentence pair with encapsulated Message 1 to 23 to the EUT.

b) Apply the following TSA+VDM sentence pair with inappropriate Comm.state and repeat indicator to the EUT:

$xxTSA,AA0000003770007,9,A,HHMM,2100,2*hh<CR><LF>

!xxVDM,1,1,9,A,15M3NSwP00J6TN>?a0e3Ngv000Sq,0*hh<CR><LF>

c) Apply five TSA and five VDM sentences with encapsulated Message 1 to the EUT assigning the transmission of the five Messages 1s in consecutive slots on the same channel.

$xxTSA,AA0000003770007,0,A,HHMM,1001,2*hh<CR><LF>

!ABVDM,1,1,0,A,15M3NSwP00J6TN0?a0iT<Ov>0D01,0

$xxTSA,AA0000003770007,1,A,HHMM,1002,2*hh<CR><LF>

!ABVDM,1,1,1,A,15M3NSwP00J6TN0?a0iT<Ov>0D01,0

$xxTSA,AA0000003770007,2,A,HHMM,1003,2*hh<CR><LF>

!ABVDM,1,1,2,A,15M3NSwP00J6TN0?a0iT<Ov>0D01,0

$xxTSA,AA0000003770007,3,A,HHMM,1004,2*hh<CR><LF>

!ABVDM,1,1,3,A,15M3NSwP00J6TN0?a0iT<Ov>0D01,0

$xxTSA,AA0000003770007,4,A,HHMM,1005,2*hh<CR><LF>

!ABVDM,1,1,4,A,15M3NSwP00J6TN0?a0iT<Ov>0D01,0

d) Apply the TSA+VDM sentence pair with an encapsulated message ID that is undefined, with the correct message structure to the EUT.

$xxTSA,AA0000003770007,5,A,HHMM,1005,2*hh<CR><LF>

!ABVDM,1,1,5,A,W5M3NSwP00J6TN0?a0iT<Ov>0D01,0

e) Apply a TSA sentence and a VDM sentence with encapsulated Message 8, using five slots.

$xxTSA,AA0000003770007,6,B,HHMM,1005,2*hh<CR><LF>

!xxVDM,3,1,6,B,8h3OHqh0J00@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048,0*hh<CR><LF>

!xxVDM,3,2,6,B,<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048,0*<CR><LF>

!xxVDM,3,3,6,B,<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT0,0*hh<CR><LF>

Apply a TSA sentence and a VDM sentence with encapsulated Message 14 at least 266 ms (10 slot duration) before the scheduled Message 8 using one slot and using the same start slot number on the same channel.

$xxTSA,AA0000003770007,7,B,HHMM,1005,2*hh<CR><LF>

!xxVDM,1,1,7,B,>h3OHqi@E=@,2*hh<CR><LF>

f) Apply a TSA sentence and a VDM sentence with encapsulated Message 14 using one slot with a UTC time that is invalid to the EUT (e.g.25h61min).

$xxTSA,AA0000003770007,8,B,2561,1005,2*hh<CR><LF>

!xxVDM,1,1,8,B,>h3OHqi@E=@,2*hh<CR><LF>

g) Apply a TSA sentence and a VDM sentence with encapsulated Message 14 using an invalid slot number to the EUT.

$xxTSA,AA0000003770007,9,B,HHMM,2250,2*hh<CR><LF>

!xxVDM,1,1,9,B,>h3OHqi@E=@,2*hh<CR><LF>

h) Apply a TSA sentence and a VDM sentence with encapsulated Message 14 using six slots to the EUT.

$xxTSA,AA0000003770007,6,B,HHMM,1005,2*hh<CR><LF>

!xxVDM,3,1,6,B,>h3OHqh048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048,0*hh<CR><LF>

!xxVDM,3,2,6,B,<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048,0*hh<CR><LF>

!xxVDM,3,3,6,B,<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048<@DHLPT048,0*hh<CR><LF>

i) Apply the number of TSA+VDM pairs needed to exceed available memory.

j) Apply a VDM.

!xxVDM,1,1,7,B,>h3OHqi@E=@,2*hh<CR><LF>

k) Apply TSA and VDM sentences with encapsulated Message 14 to the EUT assigning the transmission of the Messages 14 with the scheduled time before the current time. Apply the same TSA with the priority set to 0.

$xxTSA,AA0000003770007,0,A,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,0,B,>h3OHqi@E=@,2*hh<CR><LF>

$xxTSA,AA0000003770007,0,A,HHMM,1001,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

l) Apply a TSP to prohibit the use of slots.

$xxTSP,AA0000003770007,99,A,HHMMSS,0,1000,5,,,,*hh<CR><LF>

Apply a TSA+VDM that uses the prohibited slots reserved by the TSP.

$xxTSA,AA0000003770007,7,A,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,>h3OHqi@E=@,2*hh<CR><LF>

Apply a TSA+VDM Message 8 pair in the subsequent frame for the same slots.

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

m) Apply a TSA+VDM in the same slot, different frame from j).

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,>h3OHqi@E=@,2*hh<CR><LF>

n) Apply an ECB to begin the autonomous transmission of Message 4.

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

Apply a TSA/Message 8 VDM pair with low priority in conflict with the autonomous Message 4 transmission defined in the ECB.

$xxTSA,AA0000003770007,7,B,HHMM,1129,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

o) Apply a TSA/Message 8 VDM pair with high priority in conflict with the autonomous Message 4 transmission defined in the ECB.

$xxTSA,AA0000003770007,7,B,HHMM,1879,1*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

p) Apply a TSP to reserve slots in conflict with the Message 4 schedule.

$xxTSP,AA0000003770007,1,A,HHMMSS,0,750,5,,,,*hh<CR><LF>

10.2.1.8.3 Required results

a) Confirm that the appropriate TFR sentences are output on the PI. Confirm that the EUT is transmitting Messages 1 to 23 as required over the VDL in the assigned slots and that the information is complete and correct. Confirm that the appropriate VDO sentences are output on the PI when a message is transmitted.

b) Confirm that the appropriate TFR sentence is output on the PI. Confirm that the EUT transmits the message with no data content processing. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

c) Confirm that the appropriate TFR sentences are output on the PI. Confirm that the EUT transmits the five Messages 1s in the assigned consecutive slots on the same channel and that the information is complete and correct. Confirm that the appropriate VDO sentences are output on the PI when a message is transmitted.

d) Confirm that the appropriate TFR sentence is output on the PI. Confirm that the EUT transmits the message with no data content processing. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

e) Confirm that the EUT generates a TFR sentence with status 0 for Message 8 on the PI. Confirm that the EUT generates a TFR sentence with status 1 for Message 14 on the PI. Confirm that the EUT transmits only Message 14. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

f) Confirm that the EUT generates a TFR sentence with status 10 for Message 14 on the PI. Confirm that the EUT does not transmit Message 14.

g) Confirm that the EUT generates a TFR sentence with status 10 for Message 14 on the PI. Confirm that the EUT does not transmit Message 14.

h) Confirm that the EUT generates a TFR sentence with status 10 for Message 14 on the PI. Confirm that the EUT does not transmit Message 14.

i) Confirm that the EUT generates a TFR sentence with status 3. If it is not possible to exceed the available memory the test is deemed to be passed.

j) Confirm that the EUT generates a TFR with status 10 and does not transmit Message 14.

k) Confirm that the EUT generates a TFR sentence with status 2. Confirm that the EUT generates a TFR with the status 4 and that Message 14 is not transmitted.

NOTE The following results are required for a Base Station operated as an independent unit.

l) Confirm that the EUT generates a TSR sentence with status 0. Confirm that the EUT generates a TFR sentence with status 7. Confirm that the EUT generates a TFR sentence with status 0. Confirm the EUT transmits Message 8.

m) Confirm that the EUT generates a TFR sentence with status 0. Confirm that the EUT transmits Message 14.

n) Confirm that the ECB PI sentence was received correctly by the EUT using the PI query for the ECB PI sentence. Confirm that the EUT generates a TFR sentence with status 5. Confirm that the EUT does NOT transmit Message 8.

o) Confirm that the EUT generates a TFR sentence with status 1. Confirm that the EUT transmits Message 8.

p) Confirm that the EUT generates a TSR sentence with status 1.

10.2.1.9 DGNSS VDM Message 17

10.2.1.9.1 Purpose

This test will verify that the Base Station is capable of handling a VDM with an encapsulated Message 17.

10.2.1.9.2 Method of measurement

NOTE The following tests are required for a Base Station operated as an independent unit.

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Apply the following DLM sentence to the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,750,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,85,2,7,750,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

b) Apply the following ECB sentence to the EUT:

$xxECB,AA0000003770007,17,0,10,750,2,0,85,750,2*hh<CR><LF>

c) Apply VDM sentences with encapsulated Message 17 for a period of 1 min.

d) Discontinue the VDM sentences with encapsulated Message 17.

e) Apply the following ECB sentence to the EUT to disable the scheduling for Message 17:

$xxECB,AA0000003770007,17,0,-1,,,0,-1,,*hh<CR><LF>

f) Apply VDM sentences with encapsulated Message 17 for a period of 1 min.

10.2.1.9.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm the ECB was received correctly by the EUT using the query sentence for the ECB sentence.

b) Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

c) Confirm that the EUT is transmitting Message 17 over the VDL in the specified slots, intervals and channels as defined by the ECB. Confirm the content of Message 17 is the most current and as defined by the VDM. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

d) Verify that the EUT continues transmitting Message 17 over the VDL for 1 min. then stops transmission.

e) Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

f) Verify that the EUT does not transmit Message 17 over the VDL unless slots are available in accordance with the rules for VDM transmissions.

10.2.1.10 Assigned mode and group assignment

10.2.1.10.1 Purpose

This test will verify that the Base Station can establish hard and soft slot assignments using a Message 16 and is able to do a group assignment using a Message 23.

10.2.1.10.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following AGA for Message 23 content, followed by DLM and ECB sentences to establish autonomous transmission of Messages 4, 20 and 23 by the EUT:

$xxAGA,AA0000003770007,0,0,NElat,NElong,SWlat,SWlong,0,0,1*hh<CR><LF>

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,L,45,1,7,0*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

$xxECB,AA0000003770007,23,0,45,0,,,,,,*hh<CR><LF>

b) Input the following ASN sentence to the EUT:

$xxDLM,0,A,L,4,1,7,750,L,0,1,7,0,L,10,1,7,150,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,85,1,7,150,,,,,*hh<CR><LF>

$xxASN,000006042,,10,5,125557007,600,,0,1*hh<CR><LF>

c) Input a BCE to enable RATDMA and then input the BBM sentence (Message 8) to the EUT:

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

!xxBBM,1,1,0,1,8,7E3B3C3E7E,0*hh<CR><LF>

10.2.1.10.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence. Confirm that Messages 4, 20 and 23 are transmitted on the defined slots. Confirm the content of Message 23 is as defined in the AGA sentence.

b) Confirm that the EUT is transmitting Message 16, within 4 s in an available FATDMA slot, over the appropriate channel on the VDL. Confirm the content of Message 16 is as defined by the ASN. Confirm that the slot used for the transmission and the slot offset information agrees with the “hard assignment” parameters supplied with the ASN sentence. Confirm that the reporting interval information for the transmission agrees with the “soft assignment” parameters supplied with the ASN sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted.

c) Confirm that the EUT is transmitting Message 8 within 4 s not using an assigned FATDMA slot.

10.2.1.11 Receive messages

10.2.1.11.1 Purpose

This test will verify that the Base Station is capable of receiving all VDL message types and outputting a VDM to the PI. The contents of binary Message 8 will verify the bit stuffing capability and the correct CRC check of the received messages is also verified.

10.2.1.11.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Input the following messages to the VDL:

Message 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24

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

10.2.1.11.3 Required results

a) Check that the EUT outputs each message to the PI with the message content complete and correct.

b) Verify that the message is not output on the PI.

10.2.2 Addressed and broadcast messaging

10.2.2.1 Normal operations

10.2.2.1.1 Purpose

This test will verify that the Base Station is capable of transmitting both broadcast (Messages 8, 14) and addressed (Messages 6, 12) safety related and binary messages.

10.2.2.1.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Input the following BBM sentence to the EUT:

!xxBBM,1,1,0,1,8,7E3B3C3E7E,0

b) Input the following ABM sentence to the EUT:

!xxABM,1,1,2,000001005,1,6,06P0test,0

c) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,5,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,5,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

d) Input the following BBM sentences to the EUT:

!xxBBM,1,1,0,1,8,7E3B3C3E7E,0*hh<CR><LF>

!xxBBM,1,1,0,0,14,D5CDP=5CC175,0*hh<CR><LF>

e) Input the following ABM sentence to the EUT:

!xxABM,1,1,2,000001005,1,6,06P0test,0*hh<CR><LF>

!xxABM,1,1,0,000006042,0,12,D5CDP=5CC175,0*hh<CR><LF>

The addressed station shall provide the appropriate response, Messages 7 and13.

f) Input the following BBM sentences to the EUT:

!xxBBM,4,1,6,2,8,06P045678901234567890123456789012345678 9,0*hh<CR><LF>

!xxBBM,4,2,6,2,8,012345678901234567890123456789012345678 9,0*hh<CR><LF>

!xxBBM,4,3,6,2,8,012345678901234567890123456789012345678 9,0*hh<CR><LF>

!xxBBM,4,4,6,2,8,0123456789012345678901234567890123456789 01,4*hh<CR><LF>

!xxBBM,4,1,7,2,14,012345678901234567890123456789012345678 9,0*hh<CR><LF>

!xxBBM,4,2,7,2,14,012345678901234567890123456789012345678 9,0*hh<CR><LF>

!xxBBM,4,3,7,2,14,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxBBM,4,4,7,2,14,01234567890123456789012345678901234567890,0*hh<CR><LF>

g) Input the following ABM sentences to the EUT:

!xxABM,4,1,5,432674839,2,6,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,2,5,432674839,2,6,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,3,5,432674839,2,6,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,4,5,432674839,2,6,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,1,6,432674839,2,12,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,2,6,432674839,2,12,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,3,6,432674839,2,12,01234567890123456789012345678901234567890,0*hh<CR><LF>

!xxABM,4,4,6,432674839,2,12,01234567890123456789012345678901234567890,0*hh<CR><LF>

h) Input the following BBM sentence to the EUT:

!xxBBM,5,1,1,2,14,wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww,0*hh<CR><LF>

!xxBBM,5,2,1,2,14,wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww,0*hh<CR><LF>

!xxBBM,5,3,1,2,14,wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww,0*hh<CR><LF>

!xxBBM,5,4,1,2,14,wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww,0*hh<CR><LF>

!xxBBM,5,5,1,2,14,ww,0*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

i) Establish 80 % channel load. Initiate the transmission of two 5 slot messages (Message 8 followed by Message 12) by the EUT. (5*5 slot blocks within 4 s to create 4 sets of candidate slots within 4 s)

10.2.2.1.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the EUT does NOT transmit and generates an ABK type 2.

b) Confirm that the EUT does NOT transmit and generates an ABK type 2.

c) Confirm that the DLM sentence was received correctly by the EUT using PI query for DLM. Confirm that the ECB sentence was received correctly by the EUT using PI query for ECB.

d) Confirm that the EUT is transmitting Messages 8 and 14 once each over the VDL with the specified configuration parameters from the associated BBM sentences within 4 s using available FATDMA slots. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the ABK sentence with ABK type 3 is output on the PI of the EUT when Messages 8 and 14 are transmitted.

e) Confirm that the EUT is transmitting Messages 6 and 12 once each over the VDL with the specified configuration parameters from the associated ABM sentences within 4 s using

available FATDMA slots. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the EUT has received the Binary Acknowledgement Message 7 and Safety Related Acknowledgement Message 13 from the addressed station by reviewing the PI VDM sentences. Confirm that the ABK sentence with ABK type 0 is output on the PI of the EUT when acknowledge to Messages 6 and 12 are received.

f) Confirm that the EUT is transmitting Messages 8 and 14 once each over the VDL with the specified configuration parameters from the associated BBM sentences within 4 s using available FATDMA slots. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the ABK Sentence with ABK type 3 is output on the PI of the EUT when Messages 8 and 14 are transmitted.

g) Confirm that the EUT is transmitting Messages 6 and 12 once each over the VDL with the specified configuration parameters from the associated ABM sentences within 4 s using available FATDMA slots. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the EUT has received the Binary Acknowledgement Message 7 and Safety Related Acknowledgement Message 13 from the addressed station by reviewing the PI VDM sentences. Confirm that the ABK sentence with ABK type 0 is output on the PI of the EUT when acknowledge to Messages 6 and 12 are received.

h) Confirm that the EUT did not broadcast Message 14. Confirm that the EUT response with an ABK sentence with ABK type '2'.

i) Check that the EUT transmits in correct order according to their priority (Messages 12 before 8). Check that the EUT transmits in free slots within 4 s according to the RATDMA algorithm.

10.2.2.2 Unacknowledged messaging

10.2.2.2.1 Purpose

This test will verify that the Base Station will retry the transmission of an addressed message as defined by the retry field in the BCF sentence.

10.2.2.2.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

b) Input the following ABM sentence to the EUT to an MMSI other than the 5 test targets in the standard test environment:

!xxABM,1,1,0,000006042,0,12,D5CDP=5CC175,0*hh<CR><LF>

c) Input the following BCF sentence to the EUT:

$xxBCF,003660007,0,2959.9990,N,8359.9990,W,1,2087,2088,2087,2088,0,0,1,3,AB*hh<CR><LF>

Input the following ABM sentence to the EUT to an MMSI other than the 5 test targets in the standard test environment:

!xxABM,1,1,0,000006042,0,12,D5CDP=5CC175,0*hh<CR><LF>

10.2.2.2.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the DLM sentence was received correctly by the EUT using PI query for DLM. Confirm that the ECB sentence was received correctly by the EUT using PI query for ECB.

b) Confirm that the EUT is transmitting Message 12 over the VDL with the specified configuration parameters from the associated ABM sentence within 4 s using the available FATDMA slot. Confirm that the EUT re-transmits Message 12, within 4 s to 8 s after the previous transmission using the available FATDMA slot, in accordance with the EUT "number of retries" configuration from the BCF sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the ABK sentence with ABK type 1 is output on the PI of the EUT after the last transmission of Message 12.

c) Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF. Confirm that the EUT is transmitting Message 12 over the VDL with the specified configuration parameters from the associated ABM sentence within 4 s using the available FATDMA slot. Confirm that the EUT re-transmits Message 12, within 4 s to 8 s using the available FATDMA slot, in accordance with the EUT "number of retries" configuration from the BCF sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the ABK type 1 is output on the PI of the EUT after the last transmission of Message 12.

10.2.3 Interrogations and interrogation response

10.2.3.1 Interrogation transmission

10.2.3.1.1 Purpose

This test will verify that the Base Station can transmit an interrogation, Message 15.

10.2.3.1.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

b) Input an AIR sentence, with a slot offset, to the EUT; Interrogate for Messages 3, 4, 5, 9, 17, 18, 19, 20, 21, 22, 24

10.2.3.1.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the DLM sentence was received correctly by the EUT using PI query for DLM. Confirm that the ECB sentence was received correctly by the EUT using PI query for ECB.

b) Confirm that the EUT is transmitting Message 15 over the VDL with the specified configuration parameters from the associated AIR sentence within 4 s using an available FATDMA slot. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Confirm that the EUT outputs an ABK with ABK type 3 to the PI after Message 15 has been transmitted.

10.2.3.2 Interrogation response

10.2.3.2.1 Purpose

This test will verify the ability of the Base Station to respond to an interrogation request.

10.2.3.2.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Apply a Message 15 onto the VDL, addressing the EUT requesting Messages 4, 17, 20, 22.

NOTE The following tests are required for a Base Station operated as an independent unit.

b) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

c) Apply a Message 15 onto the VDL, addressing the EUT requesting Messages 4, 17, 20, 22.

Apply a Message 15 onto the VDL, addressing the EUT requesting Message 1.

d) Apply the following ECB sentences to the EUT:

$xxECB,AA0000003770007,4,0,-1,,0,-1,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,-1,,0,-1,*hh<CR><LF>

Apply a Message 15 onto the VDL, addressing the EUT requesting Messages 4 and 20.

10.2.3.2.3 Required results

a) Confirm the EUT does not respond.

NOTE The following results are required for a Base Station operated as an independent unit.

b) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

c) Check that the EUT transmits the appropriate Message 4, and 20 as determined by the ECB sentence. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Check that the EUT does not transmit Messages 17 and 22. Check that the EUT does not transmit Message 1.

d) Check that the EUT transmits the appropriate Message 4 within 4 s. Confirm that the appropriate VDO sentence is output on the PI when a message is transmitted. Check that the EUT does not transmit Message 20.

10.2.4 Addressed operation

10.2.4.1 Receive addressed message

10.2.4.1.1 Purpose

This test will verify that the Base Station will respond to addressed messages with the appropriate message type. This test will also verify that the Base Station does not respond to messages that are not addressed to the EUT.

10.2.4.1.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Apply a Message 6 onto the VDL, addressed to the EUT.

b) Apply a Message 12 onto the VDL, not addressed to the EUT.

c) Apply a Message 10 onto the VDL, addressed to the EUT.

NOTE The following tests are required for a Base Station operated as an independent unit.

d) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

e) Apply a Message 6 onto the VDL, addressing the EUT.

f) Apply a Message 12 onto the VDL, not addressing the EUT.

g) Apply a Message 10 onto the VDL, addressing the EUT.

10.2.4.1.3 Required results

a) Confirm the EUT does not transmit.

b) Confirm the EUT does not transmit.

c) Confirm the EUT does not transmit.

NOTE The following results are required for a Base Station operated as an independent unit.

d) Confirm that the DLM sentence was received correctly by the EUT using PI query for DLM. Confirm that the ECB sentence was received correctly by the EUT using PI query for ECB.

e) Check that the EUT transmits Message 7 as a response. Check for the VDM and VDO sentences output using the PI.

f) Check that the EUT does not transmit Message 13 as a response. Check for the VDM sentence output using the PI.

g) Check that the EUT transmits a Message 4 as a response. Check for the VDM and VDO sentence output using the PI.

10.2.5 Slot phase and frame synchronisation – Base Station operation

10.2.5.1 UTC direct

10.2.5.1.1 Purpose

This test will verify that the Base Station will operate as required with UTC direct synchronisation mode. This test will also verify synchronisation jitter.

10.2.5.1.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Disable the UTC source for the Base Station. Insert multiple Message 1(s) on the VDL with Comm. State 0, indicating UTC direct.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

b) Apply the following BCE sentence to disable ADS reporting:

$xxBCE,AA0000003770007,,,0,*hh<CF><LF>

c) Apply the following BCE sentence to enable ADS reporting:

$xxBCE,AA0000003770007,,,60,*hh<CF><LF>

d) Restore the UTC source to the Base Station.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

e) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CF><LF>

f) Disable the UTC source for the Base Station. Insert multiple Message 1(s) on the VDL with Comm. State 0, indicating UTC direct.

g) Restore the UTC source to the Base Station.

10.2.5.1.3 Required results

a) Confirm that the EUT is transmitting Message 8 in the assigned slot and channel. Verify synchronisation jitter does not exceed ± 156 µs as required for UTC indirect. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

b) Confirm that ADS reporting is disabled.

c) Confirm that ADS reporting is enabled, with a reporting rate of 60 s.

d) Confirm that the EUT is transmitting Message 8 in the assigned slot and channel. Verify synchronisation jitter does not exceed ± 52 µs as required for UTC direct. Confirm that the ADS indicates the correct Sync. State and alarm status.

NOTE The following results are required for a Base Station operated as an independent unit.

e) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

f) Verify that the Base Station maintains the same reporting rate for Message 4 but changes the Comm. State to 1. Verify synchronisation jitter does not exceed ± 156 µs as required for UTC indirect. Confirm that the slot length is 26,67 ms. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

g) Verify that the Comm. State of the Message 4(s) is 0, indicating UTC direct. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

10.2.5.2 UTC indirect to a Base Station:

10.2.5.2.1 Purpose

This test will verify that the Base Station will operate as required with UTC indirect synchronisation mode. This test will also verify synchronisation jitter.

10.2.5.2.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Disable the UTC source for the Base Station.

Insert Message 1(s) on the VDL with Comm. State 0, indicating UTC direct.

Insert Message 4(s) on the VDL with Comm. State 0, indicating UTC direct with a position distance of 120NM at the slot following the EUT Message 4 transmission.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

b) Restore the UTC source to the Base Station.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

c) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

d) Disable the UTC source for the Base Station.

Insert Message 1(s) on the VDL with Comm. State 0, indicating UTC direct.

Insert Message 4(s) on the VDL with Comm. State 0, indicating UTC direct with a position distance of 120 NM at the slot following the EUT Message 4 transmission.

e) Restore the UTC source to the Base Station.

10.2.5.2.3 Required results

a) Confirm that the EUT is transmiting Message 8 in the assigned slot and channel. Verify synchronisation jitter does not exceed ± 156 µs as required for UTC indirect taking into account propagation delay. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

b) Confirm that the EUT is transmiting Message 8 in the assigned slot and channel. Verify synchronisation jitter does not exceed ± 52 µs as required for UTC direct. Confirm that the ADS indicates the correct Sync. State and alarm status.

NOTE The following results are required for a Base Station operated as an independent unit.

c) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

d) Verify that the Base Station maintains the same reporting rate for Message 4 but changes the Comm. State to 1 using the Base Station as UTC indirect sync source. Verify synchronisation jitter does not exceed ± 156 µs as required for UTC indirect. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

e) Verify that the Comm. State of the Message 4(s) is 0, indicating UTC direct. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

10.2.5.3 Synchronised to Base Station:

10.2.5.3.1 Purpose

This test will verify that the Base Station will operate as required with indirect synchronisation to Base Station. This test will also verify synchronisation jitter.

10.2.5.3.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Disable the UTC source for the Base Station. Insert Message 4(s), with a lower MMSI than the EUT, with Comm. State 3, indicating semaphore operation.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

b) Restore the UTC source to the Base Station.

Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT:

$xxTSA,AA0000003770007,7,B,HHMM,1001,2*hh<CR><LF>

!xxVDM,1,1,7,B,8h3OHqh0J7ps?3qv,0*hh<CR><LF>

NOTE The following tests are required for a Base Station operated as an independent unit.

c) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

d) Disable the UTC source for the Base Station. Insert Message 4(s), with a lower MMSI than the EUT, with Comm. State 3, indicating semaphore operation.

e) Restore the UTC source to the Base Station.

10.2.5.3.3 Required results

a) Confirm that the EUT is transmitting Message 8 in the assigned slot and channel. Confirm that the EUT does not transmit Message 4. Verify synchronisation jitter does not exceed ± 104 µs compared to the received Message 4(s). Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

b) Confirm that the EUT is transmitting Message 8 in the assigned slot and channel. Verify synchronisation jitter does not exceed ± 52 µs as required for UTC direct. Confirm that the ADS indicates the correct Sync. State and alarm status.

NOTE The following results are required for a Base Station operated as an independent unit.

c) Confirm that the DLM sentence was received correctly by the EUT using the query sentence for the DLM sentence. Confirm that the ECB sentence was received correctly by the EUT using the query sentence for the ECB sentence.

d) Verify that the Base Station maintains the same reporting rate for Message 4 but changes the Comm. State to 2. Verify synchronisation jitter does not exceed ± 104 µs as required for UTC indirect. Confirm that the EUT outputs ALR ID 007 using PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

e) Verify that the Comm. State of the Message 4(s) is 0, indicating UTC direct. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

10.2.5.4 As semaphore

10.2.5.4.1 Purpose

This test will verify that the Base Station will operate as semaphore. This test will also verify synchronisation jitter.

10.2.5.4.2 Method of measurement

NOTE The following tests are required for a Base Station operated as an independent unit.

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

Disable the UTC source for the Base Station. Insert Message 1(s) with Comm. State 3, indicating semaphore operation, onto the VDL.

b) Restore the UTC source to the Base Station and insert Message 1(s) with Comm. State 1 indicating UTC indirect.

c) Disable the UTC source for the Base Station. Insert Message 1(s) with Comm. State 2, indicating Base Station synchronisation, onto the VDL.

d) Restore the UTC source to the Base Station and insert Message 1(s) with Comm. State 1 indicating UTC indirect.

10.2.5.4.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Verify that the Base Station increases its Message 4, reporting rate to 3 1/3 s. Verify that the Comm. State of the Message 4(s) is 3, indicating semaphore operation. Confirm that the EUT outputs ALR ID 007 using PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

b) Verify that the Comm. State of the Message 4(s) is 0, indicating UTC direct. Verify that 3 min after the restoration of the UTC source, the Base Station decreases its reporting rate to 10 s. Confirm that the ADS indicates the correct Sync. State and alarm status.

c) Verify that the Base Station increases its Message 4, reporting rate to 3 1/3 s. Verify that the Comm. State of the Message 4(s) is 3, indicating semaphore operation. Confirm that the EUT outputs ALR ID 007 using PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

d) Verify that the Comm. State of the Message 4(s) is 0, indicating UTC direct. Verify that three minutes after the restoration of the UTC source, the Base Station decreases its reporting rate to 10 s. Confirm that the EUT outputs ALR ID 007 via PI with the appropriate status value. Confirm that the ADS indicates the correct Sync. State and alarm status.

10.2.6 Position source

10.2.6.1 Purpose

This test will verify that the Base Station will accept and correctly handle each position source setting. In addition, this test will verify that the Base Station responds correctly if a position source is lost.

10.2.6.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

NOTE The following tests are required for a Base Station operated as an independent unit.

a) Apply the following DLM and ECB sentences to establish autonomous transmission of Messages 4 and 20 by the EUT:

$xxDLM,0,A,L,4,1,7,250,L,0,1,7,0,L,10,2,7,75,,,,,*hh<CR><LF>

$xxDLM,0,B,L,129,1,7,250,L,6,1,7,0,L,20,2,7,75,,,,,*hh<CR><LF>

$xxECB,AA0000003770007,4,0,4,750,,0,379,750,*hh<CR><LF>

$xxECB,AA0000003770007,20,0,0,0,,0,6,0,,*hh<CR><LF>

b) Input the following BCF sentence to the EUT indicating surveyed position:

$xxBCF,003770007,0,2959.9990,N,8359.9990,W,1,2087,2088,2087,2088,0,0,3,3,AB*hh<CR><LF>

c) If implemented, input the following BCF sentence to the EUT indicating internal position source:

$xxBCF,003770008,1,,,,,0,2085,2086,2085,2086,1,1,0,0,AB*hh<CR><LF>

d) Remove the GPS antenna to generate a failure for the position.

e) If implemented, input the following BCF sentence to the EUT indicating external position source. Supply the EUT, using the PI, a series of GGA, RMC, or GLL sentences.

$xxBCF,003770008,2,,,,,0,2085,2086,2085,2086,1,1,0,0,AB*hh<CR><LF>

f) Discontinue the position sentences for 30 s.

g) Input the following BCF sentence to the EUT indicating survey position:

$xxBCF,003770007,0,2959.9990,N,8359.9990,W,1,2087,2088,2087,2088,0,0,3,3,AB*hh<CR><LF>

h) Repeat steps c) and d) using the following positions sources:

3 = internal EPFS in use with automatic fall back to surveyed position;

4 = internal EPFS in use with automatic fall back to external EPFS upon failure of internal EPFS.

i) Repeat steps e) and f) using the following positions sources:

5 = external EPFS in use with automatic fall back to surveyed position;

6 = external EPFS in use with automatic fall back to internal position source upon failure of external position source.

10.2.6.3 Required results

NOTE The following results are required for a Base Station operated as an independent unit.

a) Confirm that the DLM sentence was received correctly by the EUT using PI query for DLM. Confirm that the ECB sentence was received correctly by the EUT using PI query for ECB. Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF.

b) Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF. Confirm that the EUT transmits the Message 4 with a position source indicating surveyed. Confirm that the ADS indicates the current position source.

c) Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF. Confirm that the EUT transmits the Message 4 with a position source indicating internal. Confirm that the ADS indicates the current position source.

d) Confirm that Alarm Message 26 is output using the PI indicating a loss of position source. Confirm that the EUT transmits the Message 4 with no position available. Confirm that the ADS indicates the current position source.

e) Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF. Confirm that the EUT transmits the Message 4 with a position source indicating external. Confirm that the ADS indicates the current position source.

f) Confirm that Alarm Message 26 is output using the PI indicating a loss of position source. Confirm that the EUT transmits the Message 4 with no position available. Confirm that the ADS indicates the current position source.

g) Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF. Confirm that the EUT transmits Message 4 with a position source indicating surveyed. Confirm that the ADS indicates the current position source.

h) For each position source:

Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF.

Confirm that the EUT transmits Message 4 with a position source indicating internal.

Confirm that the ADS indicates the current position source.

Confirm that the EUT transmits Message 4 with required fall back position source.

Confirm that the ADS indicates the current position source.

i) For each position source:

Confirm that the BCF sentence was received correctly by the EUT using PI query for BCF.

Confirm that the EUT transmits Message 4 with a position source indicating external.

Confirm that the ADS indicates the current position source.

Confirm that the EUT transmits Message 4 with required fall back position source.

Confirm that the ADS indicates the current position source.

10.2.7 Alarm messages

10.2.7.1 Purpose

This test will verify that the Base Station will output alarm messages as required. See Table 9.

10.2.7.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

a) Disconnect the transmit antenna from the EUT. Apply a TSA+VDM sentence pair to activate a transmission.

b) Provide the EUT with an ACK with alarm value 1 using the PI.

c) Reconnect the transmit antenna to remove the alarm condition. Apply a TSA+VDM sentence pair to activate a transmission.

d) Prevent the EUT from radiating with full power by mismatching the antenna for a VSWR of 3:1. Apply a TSA+VDM sentence pair to activate a transmission.

e) Provide the EUT with an ACK with alarm value 2 using the PI.

f) Reconnect the transmit antenna to remove the alarm condition. Apply a TSA+VDM sentence pair to activate a transmission.

10.2.7.3 Required results

a) Confirm that the EUT continues to generate an ALR sentence with alarm value 1 to the PI at least once per minute.

b) Confirm that the EUT generates an ALR sentence with alarm value 1 with an acknowledged status once the ACK has been received.

c) Confirm that the EUT generates an ALR sentence with an ALR ID and Status V, V in the alarm field.

d) Confirm that the EUT continues to generate an ALR sentence with alarm value 2 to the PI once per minute.

e) Confirm that the EUT generates an ALR sentence with alarm value 2 with an acknowledged status once the ACK has been received.

f) Confirm that the EUT generates an ALR sentence with a ALR ID and Status V, V and every minute an ALR sentence with null value in the alarm field.

10.3 Intentional slot reuse (link congestion)

10.3.1 Purpose

Verify that the EUT will operate properly in a >90 % load environment.

10.3.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions. Ensure that the signal level received from the EUT exceeds the signal level received from the test transmitter at the test receiver location.

a) Set up additional test targets to simulate a VDL load of >90 % which include base stations both within and beyond 120 nautical miles and remotely allocated FATDMA slots. Wait at least 1 min.

b) Apply a TSA sentence and a VDM sentence with encapsulated Message 8 to the EUT.

NOTE The following tests are required for a Base Station operated as an independent unit.

c) Apply the following BCE to enable RATDMA:

$xxBCE,AA0000003770008,1,,*hh<CR><LF>

d) Wait at least 1 min, then transmit a 1 slot binary Message 8 using RATDMA.

10.3.3 Required results

a) Confirm that the EUT generates the required VDM sentences for all messages.

b) Confirm that the EUT transmits in the assigned slot and channel. Confirm that the EUT generates the required TFR with status 0.

NOTE The following results are required for a Base Station operated as an independent unit.

c) Confirm that the BCE sentence was received correctly. Confirm that the EUT continues to generate the required VDM sentences for all messages.

d) Confirm that the slot used by the slot reuse algorithm is a random selection within the candidate slots (4 most distant stations). Check that a station is not subject to slot reuse more than once a frame.

Check that slots allocated by a local Base Station, for own use or for use by remote base station, are not subject to slot reuse.

Check that slots reserved by a Base Station within the 120 nautical miles are not subject to slot reuse.

Check that slots reserved by a Base Station beyond the 120 nautical miles are subject to slot reuse.

10.4 Comment block encapsulation

10.4.1 Purpose

This test will verify that the Base Station can respond and generate comment blocks properly.

10.4.2 Method of measurement

Set up the standard test environment and operate the EUT as defined in the pre-set-up conditions.

Query the EUT for a VER sentence that is encapsulated with comment blocks with both the correct unique identifier, then with the wrong unique identifier. The EUT shall only respond to the Query with the correct unique identifier. In the following example, the query source has the unique identifier, ControlPC1. The Base Station is assigned the talker identifier, AB, with a unique identifier, AA0000003770007.

a) Apply the following SID to the EUT with proper unique identifier:

$xxSID,xxxxxxxxxxx,AA0000003770007,003770007,E*hh<CR><LF>

Apply the following BCE to the EUT with proper unique identifier:

$xxBCE,AA0000003770007,1,,*hh<CR><LF>

Query the EUT for the VER sentence

$xxABQ,VER*hh<CR><LF>

b) Apply the following query for VER with the correct unique identifier:

\s:ControlPC1,d:AA0000003770007,c:1149654649*hh\$xxABQ,VER*hh<CR><LF>

c) Apply the following query for VER with the wrong unique identifier:

\s:ControlPC1,d:B00000003669955,c:1149654649*hh\$xxABQ,VER*hh<CR><LF>

d) Apply the following query for VER with no comment block:

$xxABQ,VER*hh<CR><LF>

e) Apply the following SPO Sentence to the EUT with correct unique identifier:

\s:ControlPC1,d:AA0000003770007,c:1149654649*hh\$$xxSPO,AA0000003770007,E,1,1,1,,,,,,1,1,*hh<CR><LF>

10.4.3 Required results

a) Confirm the content of the VER sentence and that the correct MMSI and unique identifier have been configured.

b) Confirm that the EUT responds with the VER sentence with the following comment block added:

\s:AA0000003770007,d:ControlPC1*2C\$ABVER,1,1,AB,XYZ,AA0000003770007,XYZ 0001,Beta,0.1,0.1*hh.

c) Confirm that the EUT does not respond to the request for VER.

d) Confirm that the EUT does not respond to the request for VER.

e) Confirm that the EUT links the VSI and VDM information correctly. Format will be similar to the following:

\1G3:2346,s:AA0000003770007,c:1120959342*hh\

\2G3:2346*hh\!ABVDM,1,1,1,B,15N1u<PP1cJnFj:GV4>:MOw:0<02,0*hh

\3G3:2346*hh\$ABVSI,AA0000003770007,1,013538.05654921,1427,-101,*hh

Annex A
(normative)

Additional AIS Base Station sentences

A.1 Format definition of input/output sentences specifically defined for AIS Base Stations

A.1.1 General

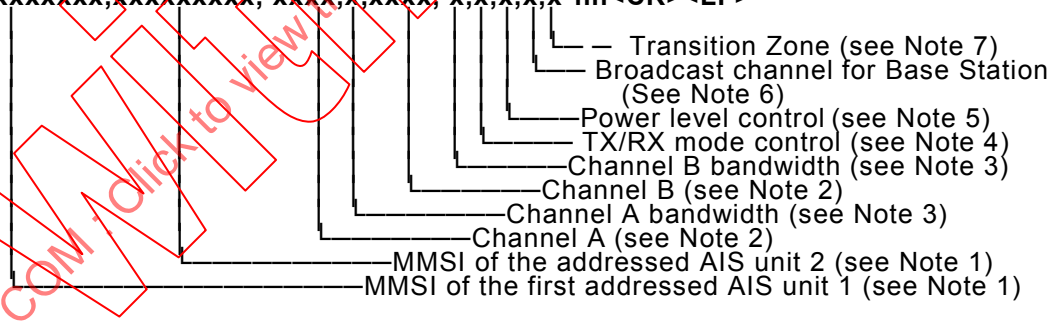
The following sentence definitions contain a number of variable length data fields. Some sentence definitions permit variable length data fields, which when totalled, could result in a sentence with a total number of characters in excess of the 79 character limit described in IEC 61162-1. Subclause 5.3 of IEC 61162-1 describes that the maximum number of characters in a sentence shall be 79 characters between the starting delimiter "$" or "!" and terminating delimiter <CR><LF>. Note that the character content of a "comment block" plus the comment block delimiters (See A.2.) are not included in the character count.

This 79-character limit should be observed when applying the following sentences. Care should be taken to either manage data field size or use multiple line grouping (See A.3.3, parameter-code "xGy:") to meet the 79 character limit requirement.

A.1.2 ACM – Preparation and initiation of an AIS Base Station addressed channel management message (ITU-R M.1371 Message 22)

This sentence is used to provide an AIS Base Station with the information it uses to transmit an addressed VDL Message 22. This contains settings that are transmitted to one or two specified AIS station(s). Upon receiving this sentence, the Base Station should prepare and make the appropriate transmission (See ITU-R M.1371 Message 22).

$--ACM,xxxxxxxxx,xxxxxxxxx, xxxx,x,xxxx, x,x,x,x,x,x*hh<CR><LF>



NOTE 1 Identifies the distant addressed AIS unit(s) intended to receive the ITU-R M.1371 Message 22. The first MMSI field (field 1) identifies the first AIS unit. The second MMSI field (field 2) identifies the second AIS unit, and may be set to null if only one AIS unit is being addressed.

NOTE 2 VHF channel number, see ITU-R M.1084, Annex 4.

NOTE 3 0 = bandwidth is specified by channel number, see ITU-R M.1084, Annex 4

1 = bandwidth is 12,5 kHz

NOTE 4 0 = transmit on channels A and B, receive on channels A and B

1 = transmit on channel A, receive on channels A and B

2 = transmit on channel B, receive on channels A and B

NOTE 5 0 = high power

1 = low power

NOTE 6 The field identifies the channel that the Base Station should use to broadcast the ITU-R M.1371 Message 22. (This field cannot be a "null" field)

0 = No broadcast channel preference

1 = broadcast on AIS channel A

2 = broadcast on AIS channel B

3 = broadcast on both AIS channel A and AIS channel B

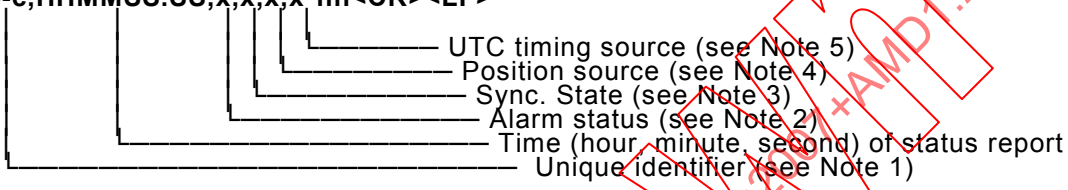
NOTE 7 Value of 1 nautical mile to a value of 8 nautical miles (with a resolution of 1 nautical mile)

A.1.3 ADS – AIS device status

This sentence is used to output, autonomously and periodically, the current AIS station status condition.

The interval for automatic output of this sentence is defined using the BCE sentence. The ADS sentence is output at the defined interval or when there is a change in status. Null data fields are not allowed. The ADS sentence is invalid if it contains a null data field.

$--ADS,c--c,HHMMSS.SS,x,x,x,x*hh<CR><LF>



NOTE 1 The unique identifier is used for system level identification of a station with a maximum of 15 alphanumeric characters. (see the SID sentence formatter)

NOTE 2 A = active V = not active

NOTE 3 0 = UTC direct

1 = UTC indirect

2 = station synchronised to a Base Station

3 = station is semaphore

4 = no VDL synchronisation reference

NOTE 4 I = internal

E = external

S = surveyed

N = none

NOTE 5 E = external

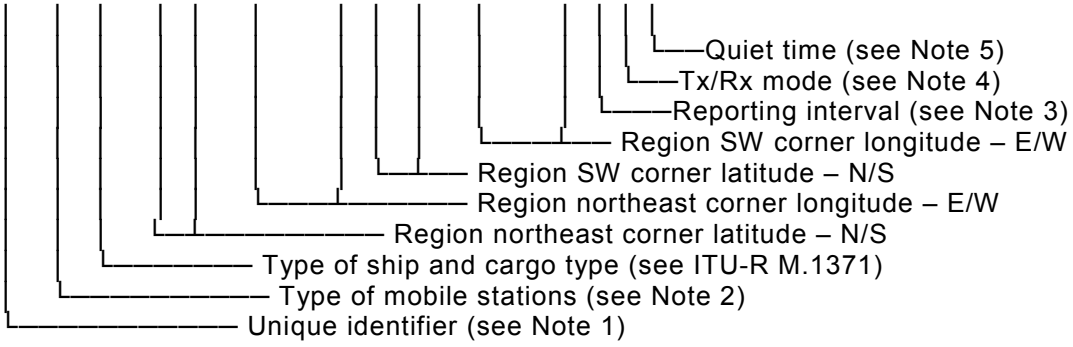
I = internal

N = none

A.1.4 AGA – Preparation and initiation of an AIS Base Station broadcast of a group assignment message (Message 23)

This sentence is used to provide an AIS Base Station with information it uses to broadcast a "group assignment Message 23". Upon receiving this sentence, the Base Station should prepare and make appropriate broadcast.

$--AGA,c--c,x.x,xxx,llll.ll,a,yyyyy.yy,a,llll.ll,a,yyyyy.yy,a,xx,x,xx*hh<CR><LF>



NOTE 1 The unique identifier is used for system level identification of a station with a maximum of 15 alphanumeric characters and identifies the Base Station to which the information in this AGA sentence is intended. (See SID sentence formatter). This data field should match the Base Station's unique identifier.

The Base Station should ignore this sentence when this data field does not match the Base Station's unique identifier.

NOTE 2 The field identifies the group of mobile stations for the group assignment.

0 = all types of mobiles, except Class A (default)

1 = reserved for future use

2 = all types of Class B mobiles

3 = SAR airborne mobiles

4 = A to N stations

5 = Class B"CS" stations

6 = Inland waterway stations

7-9 = for regional use

10-15 = for future use

NOTE 3 The field identifies the reporting interval as defined in Table 17 of IEC 62287.

0 = as defined in autonomous mode

1 = 10 min

2 = 6 min

3 = 3 min

4 = 1 min

5 = 30 s

6 = 15 s

7 = 10 s

8 = 5 s

9 = next shorter interval

10 = next longer interval

11 = 2 s

12-15 = reserved for future use

NOTE 4 0 = transmit on channels A and B, receive on channels A and B (default)

1 = transmit on channel A, receive on channels A and B

2 = transmit on channel B, receive on channels A and B

3 = reserved for future use

NOTE 5 0 = no quiet time (default)

1-15 = quiet time 1min to 15 min

A.1.5 ASN – Preparation and initiation of an AIS Base Station broadcast of assignment VDL Message 16.

This sentence is used to provide an AIS Base Station with the information it uses to broadcast an "assignment VDL Message 16". This contains settings that are broadcast to the specified AIS station(s). Upon receiving this information, the Base Station should prepare and make the appropriate broadcast (see ITU-R M.1371, Message ID 16).

$--ASN,xxxxxxxxx,x.x,x.x,x,xxxxxxxxx,x.x,x.x,x,x*hh<CR><LF>