RECOMMENDATION ITU-R M.825-3*, **

CHARACTERISTICS OF A TRANSPONDER SYSTEM USING DIGITAL SELECTIVE CALLING TECHNIQUES FOR USE WITH VESSEL TRAFFIC SERVICES AND SHIP-TO-SHIP IDENTIFICATION

(1992-1995-1997-1998)

Scope

Several administrations have requirements for a radio transponder system for the purpose of obtaining information on ships entering and sailing within vessel traffic service (VTS) areas. In addition, there is a need for a system to provide ship-to-ship identification.

This Recommendation contains the characteristics of a system which uses digital selective-calling (DSC) techniques, suitable for both applications. The Recommendation is based upon Recommendation ITU-R M.493 and introduces a new message "category" for messages related to VTSs and ship-to-ship identification. It also describes the format, composition and contents of such messages.

This Recommendation for a transponder system is not intended to meet the requirements for a universal automatic identification system (AIS).

The ITU Radiocommunication Assembly,

considering

a) that the use of a transponder system expedites the passing of data between a VTS centre and ships in its service area;

b) that several administrations have developed different systems;

c) that a transponder system should, as far as practicable, make use of existing equipment on board ships;

d) that it is desirable that one transponder system for VTS purposes should fulfil the requirements of all administrations desiring to use it;

e) that the digital selective-calling system having the technical and operational characteristics in accordance with Recommendations ITU-R M.493 and ITU-R M.541 has been recommended for use in the maritime mobile service;

f) that AIS, in accordance with Recommendation ITU-R M.1371, uses this method for AIS channel management;

g) that some administrations make extensive use of transponders for tracking ships in high-traffic waterways and where radar may be unavailable, and for ship-to-ship identification, also outside VTS operating areas;

h) that some administrations are requiring more types of data messages and more data capacity than can be afforded by DSC transmissions on VHF channel 70, but that they wish to use DSC as a common gateway to facilitate the use and implementation of automatic identification systems;

j) that administrations planning to use transponders for tracking ships in high-traffic waterways with VTS systems utilizing DSC require up to four ship's position reports per second,

recommends

1 that, where there is a need for a transponder system using digital selective calling techniques in conjunction with a VTS, the system should be designed in accordance with the characteristics given in Annex 1;

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* This Recommendation should be brought to the attention of the International Maritime Organization (IMO) and the International Association of Lighthouse Authorities (IALA).

** Radiocommunication Study Group 5 made editorial amendments to this Recommendation in November 2011, in accordance with Resolution ITU-R 1.

2 that, in areas where VHF channel 70 is used for public correspondence calling, channel 70 should not be used for vessel traffic services and ship-to-ship identification unless experience indicates that sufficient spare capacity is available, in accordance with Recommendation ITU-R M.822;

3 that Annex 1 may be used as a gateway to identify the transponder system and to assign its operating channel frequencies;

4 that the transponder should be interfaced with the ship's systems as required to perform the intended operation;

5 that VHF transponders should be capable of operating on frequency channels in accordance with Annex 4 of Recommendation ITU-R M.1084;

6 that, where there is a need when using DSC techniques for a higher update rate than can be achieved by using the characteristics given in Annex 1, then the system should be designed to include the additional characteristics given in Annex 2.

ANNEX 1

Technical characteristics of a transponder system for use on maritime VHF channels for vessel traffic service purposes and ship-to-ship identification

1 General

1.1 The transponder system is a synchronous system using the transmission techniques detailed in the sections of Recommendation ITU-R M.493 describing the implementation of DSC in the maritime VHF environment.

1.2 In addition to the definitions for the symbols No. 00 to No. 127 as defined in Recommendation ITU-R M.493, the symbols No. 00 to No. 99 can also be used to represent alphanumeric data, as specified in Table 1.

TABLE 1

Symbols used to denote alphanumeric data

Symbol No.	Character	Symbol No.	Character	Symbol No.	Character
00	0	16	F	32	V
01	1	17	G	33	W
02	2	18	H	34	X
03	3	19	I	35	Y
04	4	20	J	36	Z
05	5	21	K	37	.
06	6	22	L	38	,
07	7	23	M	39	–
08	8	24	N	40	/
09	9	25	O	41	Space
10	Not used	26	P		
11	A	27	Q		
12	B	28	R		
13	C	29	S		
14	D	30	T		
15	E	31	U		

1.3 The equipment should automatically code and transmit a response to all calls received which contain the symbol No. 117 (acknowledge RQ) as the "end of sequence" character. The automatic response to calls addressed to a "VTS area" should be transmitted after a random delay distributed over the range of 0 to 20 s providing the signalling channel is clear of other traffic.

2 Technical format of a transmission sequence

2.1 The technical format of a transmission sequence is identical to that described in Recommendation ITU-R M.493. The construction of the transmission format is given in Table 2.

TABLE 2

Format of a transmission sequence

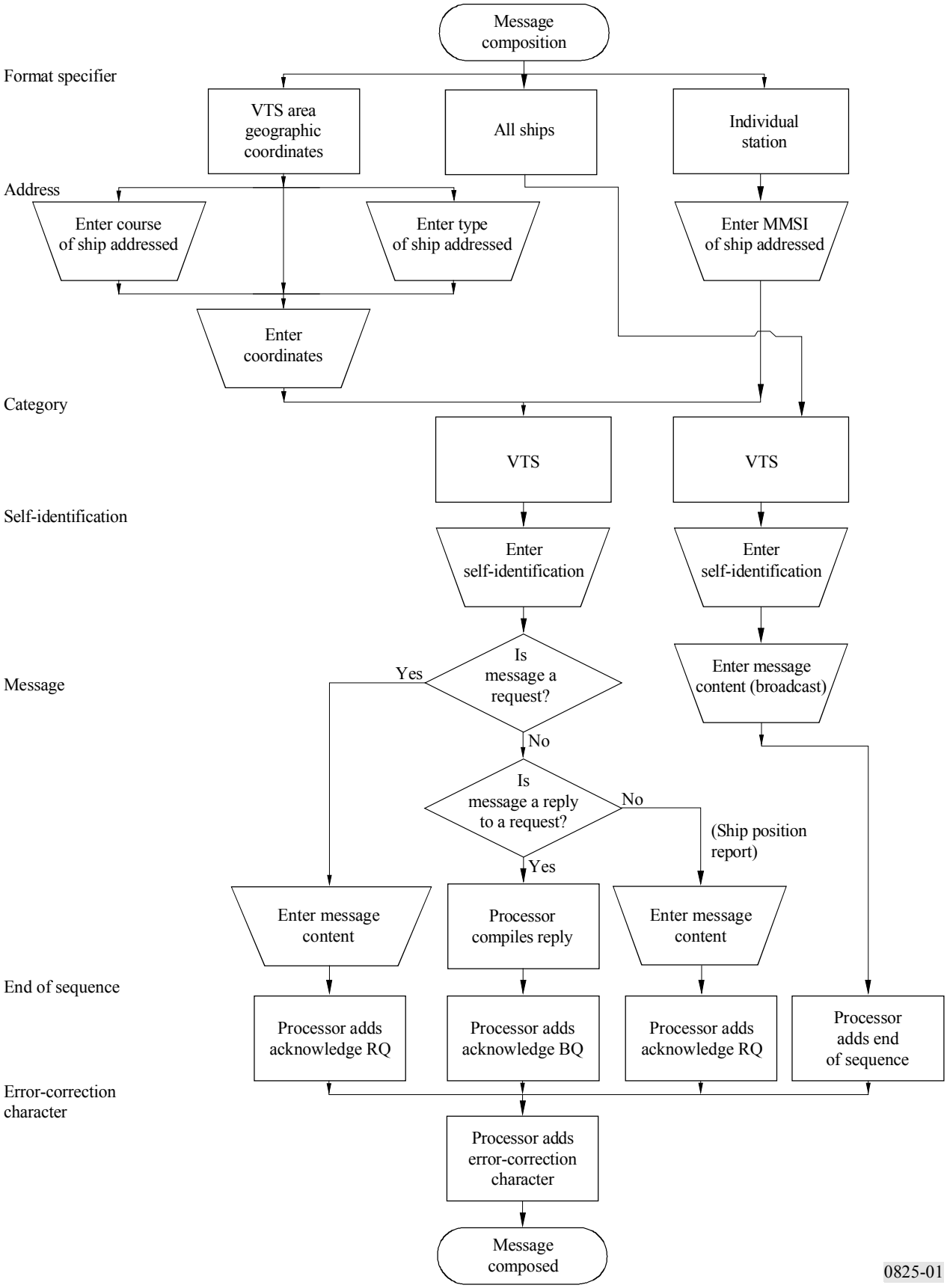
Dot pattern
DX
RX7
DX
RX6
DX
RX5
DX
RX4
DX
RX3
DX
RX2
A
RX1
A
RX0
B_1
A
B_n
A
C
B_1
D_1
B_n
D_n
C
E_1
D_1
E_n
D_n
F
E_1
G
E_n
F
F
F
G

RX/DX :	phasing sequence
A:	format specifier
B_1-B_n:	address
C:	category
D_1-D_n:	self-identification
E_1-E_n:	message
F:	end of sequence
G:	error-check character

2.2 A flow-chart illustrating the message composition is shown in Fig. 1.

FIGURE 1

Message composition flow chart



3 Dot pattern and phasing sequence

3.1 The dot pattern and phasing sequence used are formatted as described in Recommendation ITU-R M.493 for operation in the maritime VHF service.

4 Format specifier

4.1 The format specifier signals are transmitted per definition in Recommendation ITU-R M.493. The new format specifier (symbol No. 103) is utilized for all VTS DSC operations. The format specifiers relevant to VTS DSC operations are:

4.1.1 symbol No. 103 for a selective call to a group of ships in a specified VTS area;

4.1.2 symbol No. 120 for a selective call to a particular individual station;

4.1.3 symbol No. 116 for an "all ships" call to be used only for broadcast messages.

5 Addresses

5.1 For a selective call directed to an individual station, the maritime mobile service identity (MMSI) of the station is inserted in the address field following the methodology as described in Recommendation ITU-R M.493.

5.2 For a selective call directed to ships in a specified VTS area, a numerical geographic coordinated address consisting of 22 digits (i.e., 11 characters) is constructed. When all ships in the area are addressed, the coordinates shall follow immediately after the symbol No. 103. However, two characters indicating the course of the ships addressed or one character indicating that ships of a certain type are being addressed may optionally be inserted between the format symbol and the coordinates.

5.2.1 Ships on a certain course

When it is required to address a ship in the defined area which is steering a particular course, the two characters (four digits) to be inserted between the format symbol and the coordinates shall be constructed as follows:

– the first digit shall be the digit "4" to indicate that a course follows;

– the second, third and fourth digits shall indicate the designated true course in degrees (from 000 to 359). All leading zeros must be used to "fill" the field;

– for example, when addressing ships on a course of 040° true, the two characters inserted between the format specifier and the geographical address would be "40" and "40". If the course was 205° true, the two characters would be "42" and "05";

– shipborne equipment should be considered "addressed" when the ship's heading differs by 2° or less from the course given in the DSC call.

5.2.2 Ships of a certain type

When it is required to address all ships of a certain type in the defined area, the single character (two digits) to be inserted between the format symbol and the geographic coordinates shall be the appropriate symbol derived from Table 3. The first digit shall be either "5", "6", "7", "8" or "9" as defined in the table.

TABLE 3

Symbols to indicate the type of ship and for the address of calls to groups of ships in VTS areas

Symbols to be used by ships to report their type and in the address of calls directed to a group of ships in a VTS area	
Symbol No.	Special craft
50	Pilot boats
51	Search and rescue vessels
52	Tugs
53	Port tenders
54	Vessels with anti-pollution facilities or equipment
55	Law enforcement vessels
56	*spare – for assignment to local vessels*
57	*spare – for assignment to local vessels*
58	Medical transports (as defined in 1949 Geneva Conventions and additional Protocols)
59	Ships according to Resolution 18 (Mob-83)

Other ships	
First digit	Second digit
6 – Passenger ship(s)	0 – All ships of this type
7 – Cargo ship(s)	1 – Carrying DG, HS or MP IMO hazard or pollutant category A
8 – Tanker(s)	2 – Carrying DG, HS or MP IMO hazard or pollutant category B
9 – Other types of ships	3 – Carrying DG, HS or MP IMO hazard or pollutant category C
	4 – Carrying DG, HS or MP IMO hazard or pollutant category D
	5 – Not under command
	6 – Restricted by her ability to manoeuvre
	7 – Constrained by her draught
	8 – *Spare*
	9 – No additional information

DG: dangerous goods
HS: harmful substances
MP: marine pollutants

NOTE 1 – The symbol should be constructed by selecting the appropriate first and second digits. For example, a message addressed to "all tankers" would use symbol No. 80 while an identification report from a passenger ship containing no additional information would use symbol No. 69.

For example, calls addressed to all pilot boats in a geographical area would insert the character "50" between the format specifier and geographical address. Calls addressed to all tanker type ships constrained by draught would use the character "87".

5.2.3 The numerical geographic coordinate address

The numerical geographic coordinate address shall be constructed as follows:

– the designated geographical area will be a rectangle in Mercator projection;

– the upper left hand (i.e., North-West) corner of the rectangle is the reference point for the area;

5.2.3.1 the first digit indicates the azimuth sector in which the reference point is located, as follows:

– quadrant NE is indicated by the digit "0";

– quadrant NW is indicated by the digit "1";

– quadrant SE is indicated by the digit "2";

– quadrant SW is indicated by the digit "3";

5.2.3.2 the second to the seventh digits indicate the latitude of the reference point in tens and units of degrees and tens, units, tenths and hundredths of minutes;

5.2.3.3 the eighth to the fourteenth digits indicate the longitude of the reference point in hundreds, tens and units of degrees and tens, units, tenths and hundredths of minutes;

5.2.3.4 the fifteenth to the eighteenth digits indicate the vertical (i.e. North to South) side of the rectangle in tens, units, tenths and hundredths of minutes;

5.2.3.5 the nineteenth to the twenty second digits indicate the horizontal (i.e. West to East) side of the rectangle in tens, units, tenths and hundredths of minutes;

5.2.4 for example, the characters necessary to compose the geographical address defining an area with a reference point of 27° 40.30′ N and 082° 57.80′ W, a vertical side of 06.00′ and a horizontal side of 17.0′ would be:

"12" "74" "03" "00" "82" "57" "80" "06" "00" "17" "00".

6 Category

6.1 The category "information" indicates a safety call related to VTS operation. Symbol No. 103 is used to indicate this purpose. This category definition is an addition to Recommendation ITU-R M.493.

7 Self-identification

7.1 The MMSI assigned to the calling station, coded as indicated in Recommendation ITU-R M.493, is used for self-identification.

8 Messages

8.1 The message included in a transmission sequence will comprise one or more, up to a maximum of 4, of the symbols given in Table 4. Certain symbols from Table 4 are followed by an appropriate symbol or symbols, from No. 00 to No. 99, constructed as follows:

8.1.1 symbol No. 100 should be followed by twelve or thirteen symbols as follows:

8.1.1.1 the first digit indicates the azimuth sector in which the position is located, as follows:

– quadrant NE is indicated by the digit "0";

– quadrant NW is indicated by the digit "1";

– quadrant SE is indicated by the digit "2";

– quadrant SW is indicated by the digit "3";

TABLE 4

Symbols for message contents of VTS DSC calls

Symbol No.	Message
100	My position is .... at time.... (followed by twelve or thirteen symbols)
101	Switch to VHC channel .... for subsequent VTS DSC communications (followed by one symbol)
102	Report your position now and at intervals of ... minutes (followed by one symbol)
103	Report your position
104	VTS expansion messages (see Table 5)
105	Ship is leaving berth or anchorage or entering the VTS
106	Report next port of call
107	Ship is berthing, anchoring or leaving the VTS
108	Report length of ship
109	Report course of ship
110	Message acknowledged
111	Report ship's name/identification
112	Acknowledge message
113	Report your destination information (followed by one symbol)
114	My destination information is .... (followed by two to thirteen symbols)
115	Ship's name/identification is .... (followed by several symbols)
116	Report speed of ship
117	*Not to be used*
118	Report draught of ship
119	Course of ship is .... degrees (followed by two symbols)
120	Speed of ship is .... knots (followed by two symbols)
121	Next port of call is .... followed by two symbols
122	*Not to be used*
123	Draught of ship is .... metres and decimetres (followed by two symbols)
124	Length of ship is .... metres (followed by two symbols)
125	*Not to be used*
126	No information
127	*Not to be used*

8.1.1.2 the second to the ninth digits indicate the latitude of the ship in tens and units of degrees and tens, units, tenths, hundredths, thousandths and ten thousandths of minutes;

8.1.1.3 the tenth to the eighteenth digits indicate the longitude of the ship in hundreds, tens and units of degrees and tens, units, tenths, hundredths, thousandths and ten thousandths of minutes;

8.1.1.4 the nineteenth to the twenty fourth digits indicate the time at which the position was determined in hours, minutes and seconds (UTC), using the 24 h notation;

8.1.1.5 the optional twenty fifth and twenty sixth digits indicate the type of ship and certain additional information derived from Table 3;

8.1.2 symbol No. 101 should be followed by one symbol indicating the VHF channel number on which all subsequent VTS DSC communications will take place. For example, to instruct a station to use VHF channel 66 for all future VTS communication, the character "66" would follow symbol No. 101;

8.1.3 symbol No. 102 should be followed by one symbol indicating the number of minutes between reports by the ship. The symbol No. 00 when transmitted as the number of minutes between reports is used to indicate that no further position reports should be sent at pre-set intervals of time. Automatic reporting of position shall cease if either the message symbol No. 102 followed by symbol No. 00 is received or five consecutive automatic reports of position were not acknowledged by the originator of the request;

8.1.4 symbol No. 113 should be followed by a single data symbol indicating the type of destination information to return to the VTS centre. If the data symbol is a "00", then the current destination information should be reported. If the data symbol is a "01", then the next destination waypoint information should be reported to the calling station;

8.1.5 symbol No. 114 is followed by two to thirteen symbols, depending upon the destination waypoint information available to report. Desired destination information consists of the destination reported (current or next), the coordinates of the destination, the estimated time of arrival and a numeric designator indicating the position in the transited route. The first symbol following the command is the destination type. This value repeats the "00" or "01" sent in the request for information (refer to § 8.1.4). Latitude and longitude destination position data immediately follow the command symbol. The transmitted data consist of nine symbols formatted as described in § 8.1.1.1 to 8.1.1.3. If no position data are available, then no other data are considered available and the single No. "126" symbol is transmitted in response to the information inquiry with no other data. The route position indicator follows and is a single symbol, from No. 00 to No. 99. A No. "126" symbol should be transmitted if no data are available for this field. The estimated time of arrival completes the data and consists of two symbols indicating the elapsed time in hours and minutes necessary to reach the destination considering the current situation. Maximum reportable time is 99 h, 59 min. If this datum is not available, two No. 126 symbols are transmitted as the time data;

8.1.6 symbol No. 115 should be followed by symbols from Table 1 which spell the name/identification of the ship. The field shall not exceed twenty total symbols. For example, to transmit the name "sea escape" to the VTS centre, the characters following symbol No. 115 would be:

"29" "15" "11" "41" "15" "29" "13" "11" "26" "15"

8.1.7 symbol No. 119 should be followed by two symbols indicating the true course of the ship. "0" digits should be added before the course when necessary to complete the two symbols. For example, to report a course of 275° true, the two characters "02" and "75" would follow symbol No. 119;

8.1.8 symbol No. 120 should be followed by two symbols (four digits) indicating the speed in knots. The speed is reported in hundreds, tens, units and tenths of units with any position where no data is available filled with a zero. For example, to report a speed of 12.2 knots, the characters "01" and "22" would follow symbol No. 120;

8.1.9 symbol No. 121 should be followed by symbols from Table 1 which spell out the name or the next port of call of the ship. The field shall not exceed twenty total symbols;

8.1.10 symbol No. 123 should be followed by two symbols indicating the actual draught of the ship in metres and decimetres. The first symbol indicating hundreds and tens of metres, the second symbol units of metres and decimetres. For example, to report a ship's draught of 6.4 m, the two characters "00" and "64" would follow symbol No. 123;

8.1.11 symbol No. 124 should be followed by two symbols indicating the length of the ship in metres. Where necessary, "0" digits should be added before the length of the ship to complete the two symbols. For example, to report a ship's length of 264 m, the characters "02" and "64" would follow symbol No. 124 in the transmission sequence;

8.1.12 in all instances where, in response to a request for information, there is no information available the appropriate message symbol should be followed by the single symbol No. 126 (no information).

9 VTS expansion messages

9.1 The VTS expansion messages in Table 5 are used to supplement the messages found in Table 4. Within the message sequence, symbol No. 104 is followed by a symbol from Table 5 to specify the VTS expansion message to follow. These expansion messages can be combined in series by repeating symbol No. 104 and a symbol from Table 5. These messages can also be used, where appropriate, for information requests. When these messages are used as requests, the message symbols do not follow.

TABLE 5

Symbols for VTS expansion messages

Symbol No.	Message
00	Frequency channel..(followed by 2 symbols)
01	Transmitter power level (followed by 1 symbol)
02	Differential corrections (followed by differential message of variable length)
03	Activate alternate system (followed by 2 symbols)
04	Identification of alternative system(s) (followed by 2 symbols)
05	Ships heading (followed by 2 symbols)
06	Navigation antenna placement (followed by 4 symbols)
07	Ship's beam (followed by 2 symbols)
08	Data text message (followed by up to 128 symbols per packet)
09	Primary regional channel..(followed by 3 symbols)
10	Secondary regional channel..(followed by 3 symbols)
11	Guard channel for region..(followed by 3 symbols)
12	North-eastern corner of region (followed by 6 symbols)
13	South-western corner of region (followed by 6 symbols)
14	Degrees of lat/lon (followed by 2 symbols)
15-99	Spares for future assignment

For example, when the request for information sequence from a shore station is:

"104" "01" "104" "05" "104" "07"

the corresponding reporting sequence from the ships transponder would be:

"104" "01" "25" "104" "05" "17" "99" "104" "07" "02" "05".

This would indicate:

– ship's transponder transmitter power = 25 W

– ship's heading = 179.9°

– ship's beam = 20.5 m.

NOTE 1 – Because of the extended length and the special nature of the expansion messages to follow expansion symbol Nos. 02 and 08, these symbols and their messages should not be combined in a sequence with any other expansion messages. Also, since expansion symbol No. 04 serves as a transponder identifier for alternate reporting systems, it should not be combined with other expansion messages.

9.2 Expansion symbol No. 00 should be followed by two symbols (4-digits) which specify the VHF working channel as defined by Recommendation ITU-R M.1084, Annex 3. This expanded channel definition facilitates simplex use of duplex channels and 12.5 kHz channels, subject to provisions of Appendix S18 of the Radio Regulations.

9.3 Expansion symbol No. 01 should be followed by one symbol (2-digits) which indicates the RF transmitter power level used by the ship's transponder in units of whole Watts. This symbol would have a legal range of 00-25 W, 01 meaning 1 Watt or less.

9.4 Expansion symbol No. 02 should be followed by a message from Recommendation ITU-R M.823 (formatted for serial interface) which provides differential correction factors for global navigation satellite systems (GNSS). This message provides GNSS differential corrections where maritime radio beacons are not available or do not meet VTS operational requirements. This message should not be combined with other messages in a transmission sequence.

9.5 Expansion symbol No. 03 should be followed by two symbols to command a transponder to switch to an alternative system.

9.6 Expansion symbol No. 04 should be followed by two symbols to indicate the type of transponder service which is available as an alternative system. Where more than one alternative system is available, this sequence should be transmitted for each system. When expansion symbol No. 04 is used by shore stations as an information request, the two identifier symbols do not follow in the request. Expansion messages which utilize expansion symbol No. 04 should not be combined with other expansion messages, since all transponders will not necessarily be capable of operating with alternative systems.

9.7 Expansion symbol No. 05 should be followed by two symbols (4-digits) which indicate the ship's heading to tenths of a degree. The first symbol indicates the hundreds and tens digits of ship's heading, and the second symbol indicates the units and tenths digits of ship's heading. The range for ship's heading would thus be 000.0° to 359.9°.

9.8 Expansion symbol No. 06 should be followed by four symbols (8-digits) which indicate the offset distance of the reported position and the position of the centre of the ship's bow. The first two symbols (4-digits) indicate the offset from the centreline of the vessel. The first digit is either a 0 (indicating that the navigation antenna is on the port side of the ship's centreline) or a 1 (indicating that the navigation antenna is on the starboard side of the ship's centreline). The next three digits indicate the magnitude of the offset in units of metres and tenths of a metres. The range of the first two symbols (4-digits) of offset would then be port/starboard 00.0 to 99.9 m. The last two symbols (4-digits) indicate the offset distance of the ship's navigation antenna aft of the ship's bow.

9.9 Expansion symbol No. 07 should be followed by two symbols (4-digits) which indicate the ship's beam in units of metres and tenths of metres. Leading zeros should be used in indicating this value. The range for ship's beam would then be 000.0 to 999.9 m.

9.10 Expansion symbol No. 08 should be followed by standard ASCI text data of up to 128 characters per packet. Data messages over 128 characters should be packetized into packets of 128 characters or less.

9.11 Expansion symbol No. 09 should be followed by 3 symbols, which define the primary regional channel. Digits 1 to 4 define the channel number, as defined by Recommendation ITU-R M.1084, Annex 3. Digit 5 specifies the channel bandwidth, where 0 = 25 kHz wideband channel, and 1 = 12.5 kHz narrow-band channel. Digit 6 indicates the RF interference environment, where 0 = normal environment, and 1 = high RF interference environment.

9.12 Expansion symbol No. 10 should be followed by 3 symbols, which define the secondary regional channel. Digits 1 to 4 define the channel number, as defined by Recommendation ITU-R M.1084, Annex 3. Digit 5 specifies the channel bandwidth, where 0 = 25 kHz wideband channel, and 1 = 12.5 kHz narrow-band channel. Digit 6 indicates the RF interference environment, where 0 = normal environment, and 1 = high RF interference environment.

9.13 Expansion symbol No. 11 should be followed by 3 symbols, which define a receive only regional channel. Digits 1 to 4 define the channel number, as defined by Recommendation ITU-R M.1084, Annex 3. Digit 5 specifies the channel bandwidth, where 0 = 25 kHz wideband channel, and 1 = 12.5 kHz narrow-band channel. Digit 6 indicates the RF interference environment, where 0 = normal environment, and 1 = high RF interference environment.

9.14 Expansion symbol No. 12 should be followed by 6 symbols, which define the north-eastern corner of the Mercator projection rectangle for the region. The first digit indicates the azimuth sector in which the position is located, as follows:

– quadrant NE is indicated by the digit "0";

– quadrant NW is indicated by the digit "1";

– quadrant SE is indicated by the digit "2";

– quadrant SW is indicated by the digit "3".

The second to the fifth digit indicate the latitude in tens and units of degrees and tens, units and tenths of minutes.

The sixth to the twelfth digits indicate the longitude in hundreds, tens and units of degrees and tens, units and tenths of minutes.

9.15 Expansion symbol No. 13 should be followed by 6 symbols, which define the south-western corner of the Mercator projection rectangle for the region. The first digit indicates the azimuth sector in which the position is located, as follows:

– quadrant NE is indicated by the digit "0";

– quadrant NW is indicated by the digit "1";

– quadrant SE is indicated by the digit "2";

– quadrant SW is indicated by the digit "3".

The second to the fifth digit indicate the latitude in tens and units of degrees and tens, units and tenths of minutes.

The sixth to the twelfth digits indicate the longitude in hundreds, tens and units of degrees and tens, units and tenths of minutes.

9.16 Expansion symbol No. 14 should be followed by 2 symbols, which define the number of degrees of latitude and longitude, respectively, in whole degrees to be used in conjunction with geographic area calls. The first symbol shall represent the number of degrees of latitude from 00 through 99, and the second symbol shall represent the number of degrees of longitude from 00 through 99.

10 End of sequence

10.1 The end of sequence signal is transmitted three times in the DX and once in the RX position as described in Recommendation ITU-R M.493. For VTS operation, the following two symbols from Recommendation ITU-R M.493 are used:

– symbol No. 117 is used for transmission sequences requiring an automatic response (acknowledge RQ);

– symbol No. 122 is used to answer a transmission sequence requiring an automatic response (acknowledgement BQ);

– symbol No. 127 is used to broadcast a message that requires no response.

11 Error-check character

11.1 The error-check character is the final character transmitted and serves to check the entire sequence for the presence of errors which went undetected by the ten-unit error detecting code and time diversity employed. The checksum is calculated and included in the transmission sequence as specified in Recommendation ITU-R M.493.

ANNEX 2

Additional technical characteristics of a DSC transponder used in a high-speed AIS within a VTS

1 General

1.1 The purpose of this Annex is to provide a high-speed automated identification reporting system which can be implemented within a transponder system, using DSC techniques, as a second mode of operation.

This mode of operation is used within a VTS utilizing a vessel traffic centre (VTC) as a controlling base station.

This mode of operation does not utilize VHF channel 70 but uses channels designated locally for this purpose as directed by the VTC.

1.2 The features of this Annex are:

– full compliance with Annex 1 of this Recommendation including 1 200 Bd operation in accordance with Recommendation ITU-R M.493;

– provision of a means of transmitting ports data and weather maps to ships;

– provision of a means of transmitting data messages ship-to-ship, shore-to-ship, and ship-to-shore;

– provision of four ship's position reports per second.

2 Technical format

The format of the message is similar to a Recommendation ITU-R M.493 DSC message in that a DSC symbol is a 10 bit word with the 7 bits of data and 3 bits of parity at a data rate of 1 200 Bd. The message also uses a dot pattern and a modified phasing sequence to determine the start of a valid call. The checksum algorithm is also used. However, the forward error correction (repeat of data) has been deleted, and the command structure has been altered to improve reporting efficiency.

A typical message is as follows:

|dot pattern|, |matching sequence|, |command|, |supporting data|, |checksum|

Dot pattern : 2 symbols with an alternating pattern of 1's and 0's. This is used to achieve correct bit phasing for the receiver's modem.

Matching sequence : 4 symbols with a value of 125 (DX character from Recommendation ITU-R M.493, Table 1). The matching sequence is used to determine the start of the message.

Command : 1 symbol indicating the type of data to follow.

Supporting data : if required by the particular acknowledgement.

Checksum : 1 symbol used to validate the integrity of the data. The checksum is computed as in Recommendation ITU-R M.493, i.e. the modulo-2 sums of all information symbols, not including the dot pattern or the matching sequence.

In order to address a transponder, both a group number and a sequence number are required. These are assigned when a transponder is switched to operation in accordance with this Annex.

The commands used are listed in Tables 6 to 8.

TABLE 6

VTC command list

Symbol No.	Command
100	Position request from list of transponder units
102	Text data for a transponder from VTC
104	System information update
106	Text data for a transponder from a transponder
108	Resume Annex 1 operation
109	Ports data
110	Weather data
120	Update of transponder information
122	VTC command acknowledgement to a transponder
124	Differential corrections (Recommendation ITU-R M.823)

TABLE 7

Transponder command list

Symbol No.	Command
101	Position data response
103	Text data for VTC
105	Text data for a transponder
107	Updated transponder information
111	Broadcast of vessel position
115	Broadcast of text message from vessel
117	Broadcast of static vessel information
121	Acknowledgement of symbol No. 115
123	Transponder command acknowledgement to VTC

TABLE 8

Transponder request list

Symbol No.	Request
01	Request to send text data to VTC
02	Request to sent text data to another transponder
03	Request for all transponder information update
04	Request to update transponder information

3 VTC command list

3.1 Symbol No. 100 is used to request the position data from a list of transponder units that are identified by group number and sequence number. The VTC transmits this command message and waits for the responses from the transponders. The format of the request is as follows:

|command|, |count|, |group|, |sequence|, |sequence|, ... |sequence|

command: the symbol No. 100

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the transponders which need to respond

sequence: a symbol defining the sequence number of the transponders which need to respond.

The sequence numbers are strung together, up to 120 sequences, to define a list of transponders from a selected group which shall respond with their position information.

3.2 Symbol No. 102 is used to identify a text data message to an individual transponder. This command expects an acknowledgement from the transponder which shall include the block number. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |total blocks|, |block|, |text data|

command: the symbol No. 102

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the address

sequence : a symbol defining the sequence number of the address

total blocks : a symbol defining the total number of data blocks in the complete text data sequence

block : a symbol defining the current block number of the text data transfer

text data : up to 120 symbols which contain the text data.

3.3 Symbol No. 104 is used to update a transponder with new system information. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |new channel|, |new group|, |new sequence|, |power|

command : the symbol No. 104

count : a symbol which indicates the number of symbols to follow

group : a symbol defining the group number of the address

sequence : a symbol defining the sequence number of the address

new channel : 2 symbols defining the new working channel number

new group : a symbol defining the new group number for the transponder

new sequence : a symbol defining the new sequence number for the transponder

power : a symbol defining the transmitter power the transponder shall use for all subsequent responses.

3.4 Symbol No. 108 is used to logout a transponder from operation in accordance with this Annex and resume Annex 1 operation on VHF channel 70. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|

command : the symbol No. 108

count : a symbol which indicates the number of symbols to follow

group : a symbol defining the group number of the address

sequence : a symbol defining the sequence number of the address.

3.5 Symbol No. 109 is used to broadcast the special data stream which represents the ports data (data containing tide levels, current speed and direction, wave heights, wind speed and direction, etc.). This command message is intended for all transponders and contains no address information. The format of the command message is as follows:

|command|, |count|, |data|

command : the symbol No. 109

count : a symbol which indicates the number of symbols to follow

data : variable length of symbols that contain the data defined by the ports data service.

3.6 Symbol No. 110 is used to broadcast the special data stream which represents the weather service data. This command message is intended for all transponders and contains no address information. The format of the command message is as follows:

|command|, |count|, |data|

command : the symbol No. 110

count : a symbol which indicates the number of symbols to follow

data : variable length of symbols that contain the data defined by the weather service provider**.**

3.7 Symbol No. 120 is used to broadcast the static transponder information. This command message is intended for all transponders and contains no address information. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |DSC ID|, |vessel's name|, |vessel type|, |length|, |draught|, |antenna position|

command: the symbol No. 120

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the transponder which this information pertains to. This symbol is set to 126 for transponders that are not operating in accordance with this Annex

sequence: a symbol defining the sequence number of the transponder which this information pertains to

DSC ID: the DSC identification (MMSI) of the transponder

vessel's name: 20 symbols containing the vessel's name in accordance with Annex 1

vessel type: a symbol defining the vessel type in accordance with Annex 1

length: 2 symbols defining the vessel's length, has a range of 0000-9999 m

draught: 2 symbols defining the vessel's draught, has a range of 000.0-999.9 m

antenna position: 4 four symbols (8-digits) which indicate the offset distance of the reported position and the position of the centre of the ship's bow. The first two symbols (4-digits) indicate the offset from the centreline of the vessel. The first digit is either a 0 (indicating that the navigation antenna is on the port side of the ship's centreline) or a 1 (indicating that the navigation antenna is on the starboard side of the ship's centreline). The next three digits indicate the magnitude of the offset in units of metres and tenths of a metre. The range of the first two symbols (4-digits) of offset would then be port/starboard 00.0 to 99.9 m. The last two symbols (4-digits) indicate the offset distance of the ship's navigation antenna aft of the ship's bow.

3.8 Symbol No. 122 is used to acknowledge a transponder's request which is embedded in its position response. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |request|, |supporting data|

command: the symbol No. 122

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the address

sequence: a symbol defining the sequence number of the address

request: a symbol which is the request that the transponder used

supporting data: if required by the particular acknowledgement

3.9 Symbol No. 124 is used to broadcast differential correction data. This command string is intended for all ships and contains no address information. The format of the command message is as follows:

|command|, |count|, |data corrections|

command: the symbol No. 124

count: a symbol which indicates the number of symbols to follow

data corrections: a variable number of symbols that contains the GNSS differential corrections data. The content of this data is in accordance with Recommendation ITU-R M.823, formatted for serial interface.

4 Transponder command list

4.1 Symbol No. 101 is used for transponder's position responses. This is the only message in this Annex that contains no count field. Also, since there is no group identifier, the response is assumed to be from the group that was requested. The format of the response message is as follows:

|command|, |sequence|, |request/status|, |lat/lon|, |cog|, |heading|, |sog|

command: the symbol No. 101

sequence: a symbol which indicates which transponder in the group is reporting

request/status: a symbol which is bit mapped for indicating the status of the transponder and allows the transponder to make request of the VTC. The format of the symbol is as follows:

The most significant digits d6-d3 are used by the transponder to make the request and have a range of 0-16. Digit d2 is used to indicate current power setting with 0 indicating high power, and 1 indicating low power. The least significant digits d1 and d0 are used to indicate position quality with 0 indicating "no position", 1 indicating "uncorrected position" and 3 indicating "corrected position"

lat/lon: 9 symbols used to report the latitude and longitude position of a vessel measured to one ten thousandth of a minute. The coding of the symbols is as given in Annex 1 for position coding

cog: 2 symbols used to report the course over ground of a vessel measured to one tenth of a degree

heading: 2 symbols used to report the heading of a vessel measured to one tenth of a degree

sog: 2 symbols used to report the speed over ground of a vessel measured to one tenth of knot.

4.2 Symbol No. 103 is used to identify a text message from a transponder to the VTC. This command expects an acknowledgement from the VTC which includes the block number. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |total blocks|, |block|, |text data|

command: the symbol No. 103

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the transponder's address

sequence: a symbol defining the sequence number of the transponder's address

total blocks: a symbol defining the total number of data blocks in the complete text data message

block: a symbol defining the current block number of the text data transfer

text data: up to 120 symbols which contain the text data.

4.3 Symbol No. 105 is used to identify a text message from a transponder to a transponder. This command message expects an acknowledgement which includes the block number. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |dest group|, |dest sequence|, |total blocks|, |block|, |text data|

command: the symbol No. 105

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the transponder's address

sequence: a symbol defining the sequence number of the transponder's address

dest group: a symbol defining the group number of the destination transponder's address

dest sequence: a symbol defining the sequence number of the destination transponder's address

total blocks: a symbol defining the total number of data blocks in the complete text data message

block: a symbol defining the current block number of the text data transfer

text data: up to 120 symbols which contain the text data.

4.4 Symbol No. 107 is used to update the VTC with current information about the vessel. The format of the command message is as follows:

|command|, |count|, |group|, |sequence|, |vessel's name|, |next port|, |ship ident|, |draught|, |length|, |beam|, |antenna position|

command: the symbol No. 107

count: a symbol which indicates the number of symbols to follow

group: a symbol defining the group number of the transponder 's address

sequence: a symbol defining the sequence number of the transponder's address

vessel's name: 20 symbols containing the vessel's name as defined in accordance with Annex 1

next port: 20 symbols defining the next port of call as defined in accordance with Annex 1

ship ident: 10 symbols defining the alternative ship identification as defined in accordance with Recommendation ITU-R M.821

draught: 2 symbols defining the vessel's draught; has a range of 000.0-999.9 m

length: 2 symbols defining the vessel's length; has a range of 0000-9999 m

beam: 2 symbols defining the vessel's beam; has a range of 000.0-999.9 m

antenna position: 4 symbols (8-digits) which indicate the offset distance of the reported position and the position of the centre of the ship's bow. The first two symbols (4-digits) indicate the offset from the centreline of the vessel. The first digit is either a 0 (indicating that the navigation antenna is on the port side of the ship's centreline) or a 1 (indicating that the navigation antenna is on the starboard side of the ship's centreline). The next three digits indicate the magnitude of the offset in units of metres and tenths of a metres. The range of the first two symbols (4-digits) of offset would then be port/starboard 00.0 to 99.9 m. The last two symbols (4-digits) indicate the offset distance of the ship's navigation antenna aft of the ship's bow.

4.5 Symbol No. 111 is used for broadcast transmission of ship's position reports. This symbol and its message are like symbol/message No. 101, except that the ship's MMSI is used instead of a sequence number, and the message is time-stamped at the end. This message is transmitted on the average of every 12 s with a random peak variation of ±2.4 s in increments of 0.3 s. The format of the message using symbol No. 111 is as follows:

|command|, |DSC ID|, |request/status|, |lat/lon|, |cog|, |heading|, |sog|, |UTC|, |checksum|

command: the symbol No. 111

DSC ID: 5 symbols (10 numeric digits) indicating the DSC identification (MMSI) of the transponder.

request/status: a symbol, which is bit mapped for indicating the status of the transponder. The format of the symbol is as described in § 4.1.

lat/lon: 9 symbols used to report the latitude and longitude of a vessel measured to one ten thousandth of a minute. The coding of the symbols is as described in Annex 1 for position coding.

cog: 2 symbols used to report the course over ground of a vessel measured to one tenth of a degree.

heading: 2 symbols used to report the heading of a vessel measured to one tenth of a degree.

sog: 2 symbols used to report the speed over ground of a vessel measured to one tenth of a knot.

UTC: 3 symbols that indicate the UTC time of the vessel's reported position. The coding of the symbols is as described in Annex 1 for UTC coding.

4.6 Symbol No. 115 is used for broadcast transmission of a text message from a ship to a ship. This command message expects an acknowledgment (symbol/message No. 121). The format of the message using symbol No. 115 is as follows:

|command|, |DSC ID|, |request/status|, |lat/lon|, |cog|, |heading|, |sog|, |UTC|, |count|, |data|

command: the symbol No. 115

DSC ID: 5 symbols (10 numeric digits) indicating the DSC identification (MMSI) of the transponder.

request/status: a symbol, which is bit mapped for indicating the status of the transponder. The format of the symbol is as described in § 4.1.

lat/lon: 9 symbols used to report the latitude and longitude of a vessel measured to one ten thousandth of a minute. The coding of the symbols is as described in Annex 1 for position coding.

cog: 2 symbols used to report the course over ground of a vessel measured to one tenth of a degree.

heading: 2 symbols used to report the heading of a vessel measured to one tenth of a degree.

sog: 2 symbols used to report the speed over ground of a vessel measured to one tenth of a knot.

UTC: 3 symbols that indicate the UTC time of the vessel's reported position. The coding of the symbols is as described in Annex 1 for UTC coding.

count: 1 symbol that indicates the number of data characters that will follow.

data: a variable length field that contains the text message.

4.7 Symbol No. 117 is used for broadcast transmission of a ship's static and voyage-related data. This message is sent once every 6 minutes as a substitution for the symbol/message No. 111, since it also contains the data required for symbol/message No. 111. The format of the message using symbol No. 117 is as follows:

|command|, |DSC ID|, |request/status|, |lat/lon|, |cog|, |heading|, |sog|, |UTC|, |vessel name|, |next port|, |ship ident|, |draught|, |length|, |beam|, |antenna position|

command: the symbol No. 117

DSC ID: 5 symbols (10 numeric digits) indicating the DSC identification (MMSI) of the transponder.

request/status: a symbol, which is bit mapped for indicating the status of the transponder. The format of the symbol is as described in § 4.1.

lat/lon: 9 symbols used to report the latitude and longitude of a vessel measured to one ten thousandth of a minute. The coding of the symbols is as described in Annex 1 for position coding.

cog: 2 symbols used to report the course over ground of a vessel measured to one tenth of a degree.

heading: 2 symbols used to report the heading of a vessel measured to one tenth of a degree.

sog: 2 symbols used to report the speed over ground of a vessel measured to one tenth of a knot.

UTC: 3 symbols that indicate the UTC time of the vessel's reported position. The coding of the symbols is as described in Annex 1 for UTC coding.

vessel name: 20 symbols containing the vessel's name as defined in accordance with Annex 1.

next port: 20 symbols defining the next port of call as defined in accordance with Annex 1.

ship ident: 10 symbols defining the alternative ship identifications as defined in accordance with Recommendation ITU-R M.821.

draught: 2 symbols defining the vessel's draught; has a range of 000.0-999.9 m

length: 2 symbols defining the vessel's length; has a range of 0000-9999 m

beam: 2 symbols defining the vessel's beam; has a range of 000.0-999.9 m

antenna position : 4 symbols which indicate the offset distance of the reported position and the position of the centre of the ship's bow. The first two symbols indicate the offset from the centreline of the vessel. The first digit is either a 0 (indicating the navigation antenna is on the port side of the ship's centreline) or a 1 (indicating that the navigation antenna is on the starboard side of the ship's centreline). The next three digits indicate the magnitude of the offset with a range of 00.0 to 99.9 m. The last two symbols indicate the offset distance of the ship's navigation antenna aft of the ship's bow with a range of 000.0 to 999.9 m.

4.8 Symbol No. 121 is used to acknowledge the reception of a text message that used symbol No. 115. The format of the message using symbol No. 121 is as follows:

|command|, |DSC ID|, |request/status|, |lat/lon|, |cog|, |heading|, |sog|, |UTC|, |address|

command : the symbol No. 121

DSC ID : 5 symbols (10 numeric digits) indicating the DSC identification (MMSI) of the transponder.

request/status : a symbol, which is bit mapped for indicating the status of the transponder. The format of the symbol is as described in § 4.1.

lat/lon 9 symbols used to report the latitude and longitude of a vessel measured to one ten thousandth of a minute. The coding of the symbols is as described in Annex 1 for position coding.

cog : 2 symbols used to report the course over ground of a vessel measured to one tenth of a degree.

heading : 2 symbols used to report the heading of a vessel measured to one tenth of a degree.

sog : 2 symbols used to report the speed over ground of a vessel measured to one tenth of a knot.

UTC : 3 symbols that indicate the UTC time of the vessel's reported position. The coding of the symbols is as described in Annex 1 for UTC coding.

address : 5 symbols which indicates the DSC identification (MMSI) of the transponder to which the acknowledgement is addressed.

4.9 Symbol No. 123 is used to acknowledge the reception of a text message that used Symbol No. 106. The format of the message using symbol No. 123 is as follows:

|command|, |count|, |group|, |sequence|, |data|

command : the symbol No. 123

count : a symbol, indicates the number of symbols to follow

group : a symbol, indicates the group number of the transponder

sequence : a symbol, indicates the sequence number of the transponder

data : a symbol, indicates the command symbol for which the acknowledgement is for.

5 Transponder requests

The transponder request symbols are embedded in the transponder command symbol No. 101 as detailed in § 4.1.

5.1 Symbol No. 01 is used by the transponder to alert the VTC that the transponder needs to send a text message to the VTC.

5.2 Symbol No. 02 is used by the transponder to alert the VTC that the transponder needs to send text data to another transponder.

5.3 Symbol No. 03 is used by the transponder to inform the VTC that the transponder needs a vessel information update.

6 Position request and response event

The VTC issues a position request string which identifies the transponders which are to reply by group number and sequence number. The transponders respond to the request sequentially according to their position in the request string. Considering that the position response string is a fixed length of symbols and there is a fixed length of time for Tx to Rx transitions, a transponder computes its relative time to report by taking its position in the response event and multiplying it by the transponder response time.

6.1 Timing requirements

Tx/Rx transition time = 29.993 ms ± 0.4 ms.

NOTE 1 – This time includes allowances for time/distance, modem synchronization, transceiver Rx/Tx switching and all other necessary transponder operations.

DSC symbol = 8.333 ms.

Base position request = ((10 + number of transponders) × 8.333 ms) + 29.993 ms.

NOTE 2 – The value "10" takes into account the fixed length of message 100 and its dot pattern and phasing sequence, which is 10 DSC symbols.

Transponder position response = (25 × 8.333 ms) + 29.993 ms = 238.266 ms.

NOTE 3 – The value "25" takes into account the fixed length of message 101 and its dot pattern and phasing sequence, which is 25 DSC symbols.

6.2 Timing example

Time for a VTC to request position reports from 40 ships:

$$TVTC = ((10+40) \times 8.333 \text{ ms}) + 29.993 \text{ ms} = 446.64 \text{ ms}$$

Time for 40 ships to reply with position reports:

$$TSHIPS = 238.266 \times 40 = 9\,530.64 \text{ ms}$$

Total time for request and reports:

$$TTOTAL=997\ 7.28 \text{ ms}=9.97728 \text{ s}$$

Timing efficiency factor for entire system (including VTC request):

$$40 \text{ ships reports}/9.97728\text{s} = 4.009 \text{ ships reports/s}$$