

RECOMMENDATION ITU-R M.689-2*

**INTERNATIONAL MARITIME VHF RADIOTELEPHONE SYSTEM WITH
AUTOMATIC FACILITIES BASED ON DSC SIGNALLING FORMAT****

(Question ITU-R 93/8)

(1990-1992-1994)

The ITU Radiocommunication Assembly,

considering

- a) that an automated maritime VHF radiotelephone system would expedite the handling of traffic and increase the efficient use of the radio channels;
- b) that international standardization is of great importance in the maritime mobile service;
- c) that the existing public correspondence channels listed in Appendix 18 to the Radio Regulations (RR) are in widespread use by ships and coast stations in the maritime mobile service;
- d) that no other VHF channels are available for the exclusive use of the maritime mobile service;
- e) that Articles 60 and 65 of the RR do not permit coast stations to emit signals on idle VHF radiotelephone working channels;
- f) that the digital selective-calling (DSC) system described in Recommendations ITU-R M.493 and ITU-R M.541 can be used for signalling over the radio path for an automatic system using a common VHF DSC channel;
- g) that the existing RR Appendix 18 channels can be used in such an automatic system without impairing their use for manual operations from ships or coast stations,

recommends

1. that the operational procedures described in Annex 1 be observed when operating an international radiotelephone system with automatic facilities based on the DSC signalling format, and using the public correspondence channels listed in RR Appendix 18;
2. that the same RR Appendix 18 channel can be used for both automatic and manual operation by the same coast station depending on the requirements of the ship stations;
3. that the technical characteristics of the ship and coast station equipment should be in accordance with Annex 2.

* This Recommendation should be brought to the attention of the Telecommunication Standardization Sector.

** Coast stations may also use other procedures with automatic facilities based on DSC signalling format directly on VHF radiotelephone working channels.

Operational procedures

1. Introduction

These procedures are initiated by using DSC on the VHF calling channel and based on the technical characteristics and operational procedures detailed in Recommendations ITU-R M.493 and ITU-R M.541. Connection to the PSTN is effected using any appropriate VHF public correspondence working channel listed in RR Appendix 18 without in any way impairing their use for manual operation.

Appendix 1 illustrates the timing of the call set-up, calling and acknowledgement sequences described by these procedures in the ship-to-shore direction and in the shore-to-ship direction.

2. Operational procedures in the ship-to-shore direction

2.1 *Ship station initiates call*

2.1.1 The user aboard the ship (hereafter referred to as the user) composes the calling sequence (see Note 1) on his DSC equipment as follows:

- selects the format specifier 123 (automatic/semi-automatic service);
- enters address (identification) of required VHF coast station;
- selects the category routine (100);
- (the ship station self-identification is entered automatically);
- selects first telecommand 101 (duplex F3E/G3E) or 100 (simplex F3E/G3E) or 106 (data) (see Note 2) and second telecommand as appropriate;
- inserts subscriber number required (e.g. telephone number);
- selects “end of sequence” signal “RQ”.

Note 1 – It is assumed that commercial equipment will be produced which simplifies the composition of the calling sequence. In practice the user should only need to key the VHF coast station address and the required subscriber number, all other information being inserted automatically.

Note 2 – Duplex mode of operation should be used for data communications.

2.1.2 The user selects the VHF DSC calling channel (channel 70 of RR Appendix 18) and initiates transmission of the sequence on the calling channel. In order to reduce the probability of call collisions, the DSC equipment should automatically inhibit transmission of this sequence until the calling channel is clear of any signal.

2.1.3 If the ship station does not receive an error-free acknowledgement from the called coast station (see § 2.2) within 5 s, the calling sequence should be automatically repeated. If an error-free acknowledgement is still not received within a further 5 s, then any further repetitions should be effected by manually initiating a new calling sequence. Such further repetitions to the same coast station should not, however, be initiated until at least 15 min have elapsed.

2.2 *Coast station acknowledgement*

2.2.1 The coast station should, within 3 s of receipt of the calling sequence, initiate the transmission of an acknowledgement sequence on the DSC calling channel. The coast station equipment should also automatically inhibit transmission of the acknowledgement until the calling channel is clear.

2.2.2 If the coast station can comply immediately with the call request, then it should immediately:

- radiate an “engaged channel” signal on the coast station transmit frequency of the appropriate working channel;
- transmit the acknowledgement sequence which should contain the same information as in the call request with the following exceptions:
 - the address will be that of the ship;
 - the self-identification will be that of the coast station;
 - the working channel number will be included;
 - the “end of sequence” signal will be “BQ”.

2.2.3 If the coast station cannot comply immediately with the call request due to the appropriate working channel(s) being busy, then the acknowledgement sequence should be as in § 2.2.2 except that the first telecommand will be 104 (unable to comply) and the second telecommand will be 103 (queue) if the optional ring-back procedure is applied, else 102 (busy) and three symbols No. 126 should be included in the channel information field.

2.2.4 If the coast station cannot comply for other reasons, the acknowledgement sequence should be as in § 2.2.3, except that the second telecommand signal should be one of symbol numbers 100-109 as appropriate.

2.2.5 The ship station, on receipt of an error-free acknowledgement in accordance with § 2.2.2 (ability to comply), should, within 5 s of receipt, change to the working channel indicated in the acknowledgement and transmit, on that working channel, a carrier for a minimum period of 2 s. Fully automated ship station equipment should, within that transmission, transmit a DSC call which is identical to the initial call (see § 2.1.1) except that the “end of sequence” signal should be 127 (see Note 1).

Note 1 – In some regional applications, ships do not transmit DSC signals on the working channels. Equipment on ships sailing beyond these regional applications and participating in the automated service, should be able to comply with the requirements for the fully automated service.

2.2.6 If the ship station receives an error-free acknowledgement in accordance with § 2.2.3 indicating “unable to comply – queue” then, if the user still requires the call connection, the ship station should continue to monitor the DSC calling channel for any calls from the coast station.

2.2.7 The ship station, on receipt of an acknowledgement indicating “unable to comply” in accordance with § 2.2.4 (or, if the coast station does not operate the “ring-back” procedure (§ 2.3.2), in accordance with § 2.2.3), should, if an automatic connection is still required, initiate an appropriate new call in accordance with § 2.1.

2.2.8 If the coast station transmitted an acknowledgement indicating “unable to comply” in accordance with § 2.2.4 (or, if the coast station does not operate the “ring-back” procedure (§ 2.3.2), in accordance with § 2.2.3), then it should take no further action with respect to the call request.

2.3 Procedures subsequent to the exchange of initial DSC calls

2.3.1 *Mandatory procedure*

2.3.1.1 If the coast station transmitted an acknowledgement indicating “able to comply” (§ 2.2.2) then, if a DSC call (§ 2.2.5) containing the same self-identification as that of the calling ship is detected on the coast station receive frequency of the working channel, the coast station should immediately start to dial the required subscriber number (see Note 1, § 2.3.1.2).

2.3.1.2 If a further call identical to the original calling sequence is received from the ship station within 16 s of receipt of the original calling sequence (see § 2.1.1) then the coast station should repeat the acknowledgement (§ 2.2.2). If a DSC call in accordance with § 2.3.1.1 (Note 1) is not detected within this 16 s period then the coast station should remove the “engaged channel” signal.

Note 1 – Some coast stations detect only the presence of a carrier at this stage. In areas of high-traffic density, carrier detection may not ensure that the calling ship has transferred to the working channel and should be avoided where practicable.

2.3.2 *Optional “ring-back” procedure*

The following additional sequence will tend to reduce repetitive ship calling and provide a better service to the ship:

2.3.2.1 If the coast station transmitted an “unable to comply – queue” acknowledgement (see § 2.2.3) then the ship’s identification and required subscriber number should be stored until an appropriate working channel becomes available. This information should be retained for a period of 15 min.

2.3.2.2 If an appropriate working channel becomes available within the 15 min period, the coast station should immediately radiate an “engaged channel” signal on the coast station transmit frequency of that working channel and initiate a DSC call on the DSC calling channel to the ship station with the same format as the acknowledgement (see § 2.2.2) except that the “end of sequence” should be “RQ”. If no appropriate working channel becomes available within this 15 min period then the information should be cleared and no further action taken by the coast station.

2.3.2.3 If an acknowledgement of the above call is not received from the ship station (see § 2.3.2.4) within 5 s then the coast station should repeat the call. If there is no acknowledgement to this second call then the ship’s call details should be cleared and the “engaged channel” signal removed.

2.3.2.4 The ship station, on receipt of such a calling sequence (§ 2.3.2.2) should, if the call connection is still required, automatically initiate an acknowledgement within 2 s on the calling channel (the acknowledgement being transmitted only when the channel is clear). This acknowledgement should be identical to the received calling sequence except that the address should be that of the coast station, the self-identification should be that of the ship station and the “end of sequence” should be “BQ”.

2.3.2.5 The ship station should then continue to listen to the calling channel for a further 5 s, then change to the working channel and transmit a carrier and DSC call as described in § 2.2.5. If a further calling sequence is received within this 5 s period, the acknowledgement should be repeated.

2.3.2.6 The coast station, after receipt of an acknowledgement from the ship station, should, when a DSC call in accordance with § 2.3.1.1 (see Note 1, § 2.3.1.2) is detected on this working channel, immediately start to dial the subscriber number.

2.3.2.7 If, after a period of 15 min a ship has not received a call as indicated in § 2.3.2.2 then, if the call connection is still required, a new call should be manually initiated in accordance with § 2.1.1.

2.4 *Call connection*

2.4.1 Once the coast station begins dialling the subscriber number it should connect the line circuit to the radio path. Timing of the call for billing purposes should commence after the subscriber answers, i.e. “off-hook” condition detected. The call connection is now retained and the user should commence communication as soon as the subscriber answers.

For a ship working on a duplex basis (see Note 1) the carrier must be transmitted for the total duration of the call.

For a ship not working on a duplex basis the carrier must be activated at least once every 45 s. Such activation, when it does not occur naturally (due to the ship transmitting) should preferably be automatic. If automatic activation is not provided then means could be provided to timely alert the user that carrier activation is necessary.

Note 1 – Ships capable of working duplex but using a semi-duplex operation should use the telecommand signal 100.

2.4.2 If the called subscriber does not answer within a period of 1 min from completion of dialling, then the call should be considered as not started and the coast station should clear the circuit in accordance with § 2.5.5. The user, on hearing the ringing tones stop or hearing anything other than “ringing” tones (e.g. engaged, number unobtainable, etc.) should refrain from any further transmissions on the working channel. If a further call is required, the user should initiate a new call on the DSC calling channel. The ship’s equipment should prevent the transmission of a new call on the DSC calling channel until at least 5 s have elapsed after clearance to prevent malfunction of the coast station “call completion due to ship station clearance” procedure (see § 2.4.4.1, 2.4.4.2 and 2.5.5).

2.4.3 If a further call is attempted from the same ship within the “time-out period” (semi-duplex operation, see § 2.4.4.2), the coast station may use the information derived from the call to disconnect the previously allocated working channel.

2.4.4 If, during any period of the call, the coast station equipment detects the absence of the ship's carrier, the following procedures apply:

2.4.4.1 If the first telecommand indicated duplex operation and the coast station equipment detects the absence of the ship's carrier for a period greater than 5 s, then the call should be considered to be complete.

2.4.4.2 If the first telecommand indicated simplex operation and the coast station equipment detects the absence of the ship's carrier for a period greater than 45 s, then the call should be considered to be complete.

2.4.5 If during any period of the call, a fully automated ship station equipment detects the absence of the coast station's carrier for a period greater than 5 s, the call should be considered to be complete.

2.5 *Call completion (Note 1, § 2.2.5 applies to § 2.5.1 to 2.5.4)*

2.5.1 When the ship station wishes to terminate the call connection to the PSTN, it transmits an "end of call" DSC call on the working channel and removes the carrier. The format of this call should be the same as that described in § 2.1.1 except that the first telecommand should be 105 (end of call) and the second telecommand should be 126.

2.5.2 On receipt of that call (see Note 1), if it contains the same self-identification as that of the calling ship, the landline is disconnected, the call timing is stopped, the coast station transmits a DSC acknowledgement on the working channel within 1 s of receipt and removes its carrier from the working channel. The format of that acknowledgement should be the same as that described in § 2.5.1 except that the "end of sequence" signal should be BQ and:

- the chargeable duration of the call should be inserted in the "frequency/channel" field by coding the three characters as hours, minutes, seconds, e.g. a chargeable duration of 6 min and 50 s would be coded as 00 06 50;
- if the chargeable duration of the call is not available then the "frequency/channel" field should contain three symbols 126.

Note 1 – Some coast stations do not recognize this "end of call" DSC call or transmit the above acknowledgement but rely solely on the procedures described in § 2.5.5.

2.5.3 If the coast station receives a second "end of call" DSC from the ship station within 4 s then it should repeat the procedure given in § 2.5.2.

2.5.4 If the ship station does not receive an "end of call acknowledgement" within 2 s then it should automatically repeat the "end of call", then after a further 2 s or after receipt of an "end of call acknowledgement" (whichever occurs first) it should consider the call to be complete and remove the carrier from the working channel.

2.5.5 If the coast station does not receive the "end of call" as described in § 2.5.1, then the call will be considered to be complete when the "on-hook" condition is detected from the PSTN or if no reply within 1 min or loss of ship's carrier for more than 5 s (duplex) or 45 s (simplex) is detected (see § 2.4.2 to 2.4.4.2). When this indication is registered at the coast station, the following action should take place:

- call timing is stopped;
- the line is cleared and disconnected from the radio circuit;
- the coast station transmits an "end of call" DSC call whose format is the same as that of the acknowledgement described in § 2.5.2 except that the "end of sequence" signal should be 127;
- the coast station's carrier is removed from the working channel.

The radio channel is now free to handle other traffic.

2.5.6 If the ship station detects the absence of the coast station's carrier for a period greater than 5 s, then it should cease to transmit on the working channel. If further calls are required by the ship then a new call should be initiated on the DSC calling channel.

3. Operational procedures in the shore-to-ship direction

3.1 *Coast station initiates call*

3.1.1 The equipment of a VHF coast station should provide the capability to distinguish the ship's identity, in accordance with Recommendation ITU-R M.585, when transmitted from the PSTN.

3.1.2 When receiving a call request from the PSTN and if there is a working channel available, the coast station equipment should radiate an engaged channel signal on the coast station transmit frequency of that working channel.

3.1.3 If the coast station cannot comply immediately with the call request because no working channel is available, then it should transmit a busy signal to the calling subscriber.

3.1.4 If there is a working channel available and a ship's identity is detected in accordance with § 3.1.1, the coast station should transmit a calling sequence on the DSC calling channel in accordance with the following conditions:

- the format specifier will be 123 (automatic/semi-automatic service),
- the address will be that of the ship,
- the category will be 100 (routine),
- the self-identification will be that of the coast station,
- the first telecommand will be 101 (duplex F3E/G3E) or 100 (simplex F3E/G3E) or 106 (data) (see Note 1) and second telecommand as appropriate,
- the working channel number will be included,
- the PSTN subscriber number may follow if known,
- the “end of sequence” signal will be RQ.

Note 1 – Duplex mode of operation should be used for data communications.

3.1.5 If the coast station has not received an error-free acknowledgement from the called ship station (see § 3.2) within 5 s, the calling sequence should be repeated automatically. If an error-free acknowledgement of the repeated call is not received within the following 5 s, the call is regarded as not started. The engaged channel signal is then removed and a busy signal is transmitted to the calling subscriber for 5 s, after which the line is cleared.

3.2 *Ship station acknowledgement*

3.2.1 On receipt of an error-free calling sequence in accordance with § 3.1.4, the ship station should, within 3 s of receiving it, automatically initiate the transmission of an acknowledgement sequence on the DSC calling channel.

3.2.2 If the ship station can comply immediately with the call request, the acknowledgement sequence should contain the same information as in the call request (§ 3.1.4), with the following exceptions:

- the address will be that of the coast station,
- the self-identification will be that of the ship,
- the first and second telecommands will be as appropriate,
- the “end of sequence” signal will be BQ.

3.2.3 If the ship station cannot comply immediately with the call request, the acknowledgement sequence should be as in § 3.2.2, except that the first telecommand should be 104 (unable to comply) and the second telecommand should be as appropriate to indicate the reason for being unable to comply or symbol No. 126.

3.2.4 If the coast station receives an acknowledgement in accordance with § 3.2.2 then it should transmit a ringing signal to the calling subscriber.

3.2.5 If the coast station receives an acknowledgement in accordance with § 3.2.3 then it should remove the engaged channel signal and transmit a busy signal to the calling subscriber for 5 s and then release the line.

3.3 Procedures subsequent to the exchange of initial DSC calls

3.3.1 If the ship station transmitted an acknowledgement in accordance with § 3.2.2 then it should continue to listen to the calling channel for a further 5 s, and when the ship subscriber indicates that he is able to accept the call (e.g. by lifting the handset) it should change to the working channel and transmit a carrier as described in § 2.2.5. A DSC call, if contained within that transmission, should be in accordance with § 3.2.2. If a further calling sequence in accordance with § 3.1.4 is received within this 5 s period, the acknowledgement should be repeated. If the ship subscriber does not accept the call within 1 min then the call should be considered as not started and the procedures described in § 2.4.2 to 2.5.5 applied.

3.3.2 If the coast station does not receive a transmission on the working channel within 1 min, the call is regarded as not started, the carrier is removed from the working channel, and a busy signal is transmitted to the calling subscriber for 5 s, after which the PSTN subscriber is disconnected from the coast station.

3.4 Call connection

The coast station, on receipt of a transmission on the working channel in accordance with § 3.3.1, should stop transmitting the ringing signal to the calling subscriber and begin timing the call.

3.5 Call completion

The procedures for completion of the call should be as described in § 2.5, except that indication of chargeable duration of the call in the “end of call” sequence to the ship may be omitted.

APPENDIX 1*

Timing diagram of call set-up sequences when the ship station initiates the call

		Time (s)		
		12		
		<i>Coast station able to comply</i>		<i>Coast station unable to comply (busy)</i>
Time (s)	Ship	Coast station	Ship	Coast station
0	Initiate call (§ 2.1.2)		Initiate call (§ 2.1.2)	
1	.....	Receive call and radiate engaged channel signal (§ 2.2.2)		Receive call
2				
3				
4	.....	Initiate acknowledgement (able) (§ 2.2.2)		Initiate acknowledgement (unable) (§ 2.2.3 and 2.2.4) Store ship ID and telephone number (§ 2.3.2.1) if “ring back” procedure
5	Receive acknowledgement (§ 2.2.5) {or initiate 2nd call (§ 2.1.3)}		Receive acknowledgement and continue monitoring DSC channel (§ 2.2.4) {or initiate 2nd call (§ 2.1.3)}	

* This timing diagram is only applicable to fully automated ship station equipment that operate with coast stations employing DSC signalling on the working channels.

Coast station able to comply

Coast station unable to comply (busy)

Time (s)	Ship	Coast station	Ship	Coast station
6	.....	{Receive 2nd call (and radiate engaged channel signal if 1st call not received – § 2.2.2)}		{Receive 2nd call}
7				
8				
9	.....	{Initiate acknowledgement due to 2nd call (§ 2.3.1.2 and § 2.2.2)}		{Initiate acknowledgement due to 2nd call (§ 2.3.1.2, § 2.2.2.3 and § 2.2.2.4)}
10	Transmit carrier and DSC call on working channel (§ 2.2.5) {or receive “2nd” acknowledgement}		{Receive “2nd” acknowledgement and continue monitoring DSC channel (§ 2.2.6)}	
11	.....	Recognize DSC call then dial (§ 2.3.1.1)		
12				
13				
14				
15	{If not already done so, transmit carrier and DSC call on working channel (§ 2.2.5)}			
16	.....	{If not already done so, recognize DSC call then dial (§ 2.3.1.1)}		
17	.....	{If no DSC call recognized, remove engaged channel signal and delete calling record (§ 2.3.1.2)}		
	=			
	=			
<= 15 min	.....			If working channel available then radiate engaged channel signal on working channel and transmit DSC “ring-back” call (§ 2.3.2.2)
5	.....		Receive “ring-back” call	
6				
7	.....		Transmit “ring-back” acknowledgement (§ 2.3.2.4)	

Coast station able to comply

Coast station unable to comply (busy)

Time (s)	Ship	Coast station	Ship	Coast station
8				Receive "ring-back" acknowledgement
9				{Initiate 2nd "ring-back" call (§ 2.3.2.3)}
10			{Receive 2nd "ring-back" call}	
11				
12			Transmit carrier and DSC call on working channel {and transmit acknowledgement due to 2nd call} (§ 2.3.2.5)	
13				Recognize DSC call then dial (§ 2.3.2.6) {and receive "2nd" "ring-back" acknowledgement}
14				
15				
16				
17			{If not already done so, transmit carrier and DSC call on working channel due to 2nd call (§ 2.3.2.5)}	
18				{If not already done so recognize DSC call then dial (§ 2.3.2.6) or, if no DSC call and acknowledgement, remove engaged channel signals and clear call details (§ 2.3.2.3)}

Timing diagram of call set-up sequences when the coast station initiates the call

Time (s)	Coast station	Ship station
0	Transmit DSC call on calling channel (§ 3.1.4) and engaged channel signal on the reserved working channel (§ 3.1.2)	
1		Receive call on calling channel (§ 3.2.1)
4		Initiate acknowledgement able (§ 3.2.2) or unable (§ 3.2.3)

Time (s)	Coast station	Ship station
5	Receive acknowledgement on calling channel If able, transmit ringing signal to the calling subscriber (§ 3.2.4) If unable, remove the engaged channel signal and transmit a busy signal to the calling subscriber (§ 3.2.5)	
6	{Transmit 2nd call if error-free acknowledgement not received (§ 3.1.5)}	
7	.....	{Receive 2nd call (§ 3.3.1)}
10	.....	{Transmit 2nd acknowledgement (§ 3.3.1)}
11	{Receive 2nd acknowledgement (§ 3.3.1)} If error-free acknowledgement still not received, remove the engaged channel signal and transmit a busy signal to the calling subscriber (§ 3.2.5)	
≤71		Lift handset and transmit within 5 s on working channel (§ 3.3.1)
76	Receive call on working channel (§ 3.4). Connect radio path to the calling subscriber. If no call received, remove the engaged channel signal, transmit a busy signal to the calling subscriber and release the line (§ 3.3.2)	

Note 1 – Timing diagram assumes 1 s between call initiation and reception and assumes maximum timing between calls and acknowledgements.

Note 2 – Sequences in parentheses { . . . } are only applicable if repeat calls or acknowledgements are necessary.

ANNEX 2

Technical characteristics

1. Ship station

1.1 The DSC equipment should meet the VHF technical characteristics detailed in Recommendation ITU-R M.493, Annexes 1 or 2. This equipment need not necessarily provide all combinations of codes, e.g. it may be simplified DSC equipment (with no distress functions), but it must provide all the necessary formats for automatic/semi-automatic VHF DSC signalling.

1.2 The VHF transceiver should be capable of operating on all public correspondence working channels listed in RR Appendix 18 and on the DSC calling channel and be capable of automatic channel selection and carrier transmission under control of the DSC equipment.

1.3 The equipment should be capable of sensing the presence of a signal on the DSC calling channel (see RR Appendix 19).

1.4 After initiation of a DSC call, the equipment should be capable of automatic prevention of the transmission of that call, when the calling channel is occupied by calls (see RR Appendix 19).

1.5 The equipment should be capable of operating in accordance with the operational procedures described in Annex 1.

2. Coast station

2.1 The DSC equipment should meet the VHF technical characteristics detailed in Recommendation ITU-R M.493, Annex 1. The installation should be capable of receiving and transmitting all types of VHF DSC calls on the DSC calling channel.

2.2 The VHF installation should be capable of operating in full duplex mode on the coast station's designated public correspondence working channels and in simplex mode on the DSC calling channel.

2.3 After initiation of a DSC call, the equipment should be capable of automatic prevention of the transmission of that call when the calling channel is occupied by calls (see RR Appendix 19).

2.4 The coast station equipment should be capable of detecting the presence of a DSC call on a working channel and also the line subscriber's "off-hook" and "on-hook" conditions.

2.5 The coast station should be capable of radiating an "engaged channel" signal on any of its working channels which should be dissimilar from any present line signalling tones.

2.6 The equipment should be capable of operating in accordance with the operational procedures described in Annex 1.
