TECHNICAL CONDITIONS FOR RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS, etc

(Article 7 paragraph 21, Article 14 paragraph 3, Article 40.4 paragraph 1 item 5, Article 40.4 paragraph 2 item 4, Article 40.4 paragraph 3 item 4, Article 40.4 paragraph 4 of the Ordinance Regulating Radio Equipment, and Table 1 thereof)

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The technical conditions for the radio equipment of INMARSAT ship earth stations shall be stipulated as follows based on the provisions of Article 7 paragraph 19, Article 14 paragraph 3, Article 40.4 paragraph 1 item 5, Article 40.4 paragraph 2 item 4, Article 40.4 paragraph 3 item 4, Article 40.4 paragraph 4 and Note 31 of Table 1 of the Ordinance Regulating Radio Equipment (Radio Regulatory Commission Regulations No. 18 of 1950).

Ministry of Posts and Telecommunications Announcement No. 66 of 1983 (which stipulates the technical conditions for the radio equipment of INMARSAT ship earth stations based on the provisions of the Ordinance Regulating Radio Equipment) shall be repealed.

I INMARSAT A RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS

1 General conditions

(1) Operation for transmitting a distress alarm shall be capable of being conducted at two or more places.

(2) The dedicated button for transmitting a distress alarm shall work by two or more independent operations and shall be neither an input panel complying with the conditions defined in (8) below, nor a keyboard with the standards of the International Standards Organization (ISO) (limited to the radio equipment of ship earth stations prescribed in Article 28.2 paragraph 1 of the Radio Law Enforcement Regulations (the Radio Regulatory Commission Regulations No. 14 of 1950; hereinafter referred to as “Enforcement Regulations”)).

(3) The frequency of emissions to be used and the time slot shall be automatically selected by receiving a time division multiplexing signal (hereinafter referred to as “NCS common TDM”) which is always transmitted from a coast earth station having a function for controlling a communication network through the relay of an INMARSAT artificial satellite station.

(4) When radio telegraphy based communication (except that for paging a coast earth station) is performed, the radio telegraphy shall be transmitted by means of time division multiple access (TDMA) and shall be received by means of NCS common TDM.

(5) When radio telephony based communication is performed, modulation shall be made by the sound of one channel per carrier.

(6) When radio high-speed data based communication is performed, modulation shall be made by

digitally-coded information of one channel per carrier.

(7) Mechanical noise shall be small.

(8) When the radio equipment has an input panel for figures 0 to 9, the sequence of the figures shall be based on the recommendation E.161 of the Telecommunications Standards Department of the International Telecommunications Union (hereinafter referred to as "ITU-T").

(9) The radio equipment shall have a protective means against overcurrent, overvoltage, transient fluctuations of power supply, and an incidental reverse of the polarity of power supply.

(10) The exposed metallic parts of the radio equipment shall be capable of being grounded.

(11) The power supply terminal shall not be grounded.

(12) The electrically conductive parts which conduct electricity exceeding 55 V (except electricity of high frequency) shall have a shield which complies with any of the following conditions so that the electrically conductive parts may not be easily exposed.

a The electrically conductive parts shall be of such a construction that when the shield is opened, the power supply is automatically shutdown.

b The electrically conductive parts shall be of such a construction that a tool is required to open the shield, and shall have warning cautions for high voltage indicated thereon.

(13) The radio equipment shall have a function for indicating a distress alarm being transmitted (limited to the radio equipment of ship earth stations prescribed in Article 28.2 paragraph 1 of the Enforcement Regulations).

(14) The distance in which the levels of the high frequency energy radiated from an antenna are 100 W, 25 W and 10 W per m^2 shall be indicated on the radome.

(15) Manufacturer's name, type, and manufacturing number shall be indicated on the outside of the radio equipment so that they can be clearly seen at an ordinary location where it is installed.

2 Electric conditions

(1) Transmitting device

a The transmitting device shall be capable of automatically selecting and transmitting any frequency of a 25 MHz interval from 1,636.525 MHz to 1,644.975 MHz.

b The equivalent isotropically radiated power shall be 36 dBW (with a tolerance of –2 dB to +1 dB).

c When radio telegraphy based communication is performed, the device shall comply with the following conditions.

(i) The modulation method shall be 2PSK based on differential encoding (which refers to encoding in which the phase changes by 180° when an input signal is "–").

(ii) The transmission signal for communication (except the transmission signal for paging) shall be as follows.

(a) The composition shall be as shown in Fig. 1.

(b) The preamble shall consist of a carrier regeneration code, a clock regeneration code, and a synchronizing code.

(c) The carrier regeneration code shall consist of 50 bits, and each bit shall be "0."

(d) The clock regeneration code shall consist of 29 bits, and each bit shall be "1."

(e) The synchronizing code shall be "0000 1000 0101 0011 0101 1001 1111 11."

(iii) The transmission signal for paging shall be as follows.

(a) The composition shall be as shown in Fig. 2.

(b) The preamble shall comply with the conditions stated in (b) i to iv above.

(c) The error detecting code shall be a BCH code, and the polynomial expression to produce it shall be as follows.

$$G(X) = 1 + X + X^2 + X^4 + X^5 + X^6 + X^8 + X^9 + X^{10} + X^{13} + X^{16} + X^{17} + X^{19} + X^{20} + X^{22} + X^{23} + X^{24}$$

(iv) The transmitting device shall have characteristics of a roll-off filter which makes the power level for the width of 6.3 kHz lower by 40 dB or more whenever possible than the level of a carrier in the frequency distant from a carrier frequency by 50 kHz, when a modulation signal which consists of a continuous code "1" is inputted,

(v) When paging is performed, two-wave frequencies for paging shall be selected one after the other.

(vi) Re-paging shall be capable of being performed within ten seconds after paging terminates.

d When communication is performed by means of radio telephony, the device shall comply with the following conditions.

(i) The amplitude frequency characteristics of the modulator from which a compressor has been removed shall be as shown in Fig. 3, and the group delay distortion frequency characteristics shall be as shown in Fig. 4.

(ii) The compressor shall make 0 dB an operable level at a zero relative level (which refers to a relative level in which a modulator input level which makes the maximum frequency shift 12 kHz is 0 dB; the same applies hereafter), and shall perform syllabic compression in which the input to output ratio is 2 : 1.

(iii) The hamonics distortion rate of the modulator from which a compressor has been removed shall be 4% or less. In this case, the modulation signal shall be 800 Hz, and the input level shall be from –20 dB to –5 dB at a zero relative level.

e When radio high-speed data based communication is performed, the device shall comply with the following conditions.

(i) The modulation method shall be 4PSK (hereinafter referred to as "QPSK") having the following relative phase relationship for an input signal of two orthogonal channels (hereinafter referred to as "I channel" and "Q channel").

I channel	Q channel	Relative phase
1	1	+45°
0	1	+135°
1	0	-45°
0	0	-135°

(ii) The transmission rate of a transmission signal shall be 112 k bits/s or 128 k bits/s.

(iii) The scramble shall be the one based on the recommendation V.35 of ITU-T.

(iv) The error correcting code shall be the convolutional code in which the coding rate is 1/2 and the constraint length is 36 bits, and the expression to produce it shall be as follows.

$$G(X) = 1 + X + X^2 + X^5 + X^6 + X^9 + X^{12} + X^{13} + X^{17} + X^{18} + X^{19} + X^{22} + X^{24} + X^{26} + X^{28} + X^{29} + X^{32} + X^{34} + X^{35}$$

(2) Receiving device

a The receiving device shall be capable of automatically tuning with emissions of any frequency of the 25 kHz interval from 1,535.025 MHz to 1,543.475 MHz

b When communication is performed by means of radio telegraphy, the receiving device shall comply with the following conditions.

(i) The receiving signal shall be as follows.

(a) The composition shall be as shown in Fig. 5.

(b) The synchronizing code shall be “0111 1010 1100 1101 0000.”

(c) The complementary synchronizing code shall be “1000 0101 0011 0010 1111” and shall appear once per every six frames.

(d) The error detecting code of an assigned signal shall be the BHC code, and the expression to produce it shall be as follows.

$$G(X) = 1 + X + X^6$$

(e) The transmission rate shall be 1,200 bits/s.

(ii) The selectivity characteristics up to the input of the de-modulator shall be within the range shown in Fig. 6.

c When communication is performed by means of radio telephony, the device shall comply with the following conditions.

(i) The selectivity characteristics up to the input of the de-modulator shall be within the range shown in Fig. 7.

(ii) The amplitude frequency characteristics of the demodulator from which an expander has been removed shall be as shown in Fig. 3 and the group delay distortion frequency characteristics shall be as shown in Fig. 4.

(iii) The expander shall make 0 dB an operable level at a zero relative level and shall perform syllabic compression in which the input to output ratio is 2 : 1.

(iv) The hamonics distortion rate of the demodulator from which a compressor has been removed shall be 4% or less. In this case, the demodulator input signal shall be a frequency modulation signal by a modulation signal of 800 Hz in a range of –20 dB to –5 dB at a zero relative level, and the input level shall be a demodulator standard input level.

(v) When the carrier power of a coast earth station is interrupted in accordance with the intermittence of sound and the ratio of the carrier power to the power density of the noise is 45 dB or less, the demodulator having a function for suppressing noise shall be capable of suppressing the following noise.

(a) The suppressed noise level shall be from –30 dB to –26 dB at a zero relative level in the expander input.

(b) The demodulator shall start suppression within 20 ms after the carrier is interrupted, and shall cancel the suppression within 20 ms after the carrier is regenerated.

d When radio high-speed data based communication is performed, the receiving device shall comply with the following conditions.

(i) The demodulation method shall be QPSK having the following relative phase relationship.

I channel	Q channel	Relative phase
1	1	+45°
0	1	+135°
1	0	-45°
0	0	-135º

(ii) The transmission rate of a receiving signal shall be 112 k bits/s or 128 k bits/s.

(iii) The de-scramble shall be the one based on the recommendation V. 35 of ITU-T.

(iv) The error correcting code shall successively decode the receiving signal in the convolutional code in which the coding rate is 1/2 and the constraint length is 36 bits, and the polynomial expression to produce it shall be as follows.

$$G(X) = 1 + X + X^2 + X^5 + X^6 + X^9 + X^{12} + X^{13} + X^{17} + X^{18} + X^{19} + X^{22} + X^{24} + X^{26} + X^{28} + X^{29} + X^{32} + X^{34} + X^{35}$$

(v) The selectivity characteristics up to the demodulator input shall comply with the following conditions.

(a) The removal ratio of all the interfering signals in a range from 1,535.0 MHz to 1,543.5 MHz excluding ±75 kHz centered around a desires signal shall be 40 dB or more.

(b) The deterioration of the performance due to the existence of two-wave adjacent signals distant upward and downward from each other by 75 kHz centered around a desired signal shall be 1 dB or less with a bit error rate of 0.001%. In this case, the adjacent signals shall be the FM wave of the maximum frequency shift 12 kHz modulated by a test signal of 1 kHz or 800 Hz which is higher than the desired signal by 3 dB.

(3) Antenna, etc.

a The axial ratio shall be 2 dB or less in the maximum directive direction.

b The antenna shall automatically track an INMARSAT artificial satellite station in a usual shake of the ship, a navigation of the ship, and the position change of an INMARSAT artificial satellite station.

c The radome shall have as little deterioration of characteristics due to the moisture, salt, and so forth which stick to it as possible.

d When there are two or more on-board devices (which refer to devices installed outside a cabin out of a plurality of radio equipment of an INMARSAT ship earth station; the same applies hereafter) on a communication system, the devices shall be as follows.

(i) Each of the on-board devices shall be capable of being switched automatically and manually.

(ii) The automatic switching of the on-board devices shall be capable of being done within 1 μs after the shield of emissions is detected and a first complementary synchronizing code is detected.

(4) Electro-magnetic interference

The electric noise level which is transmitted to the outside via a power supply circuit shall not exceed the value shown in Fig. 8

II INMARSAT C RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS

1 General conditions

(1) The radio equipment shall comply with the conditions defined in (1), (2), (3), (7) to (13), and (15) of I.1. above.

(2) The radio equipment shall be capable of printing a message received.

(3) The radio equipment shall have a function for avoiding overheat (including a function for interrupting communication for a specific period of time except distress communication after transmission of a message has finished).

(4) The radio equipment shall have a function for indicating the following.

a Synchronization state of NCS common TDM

b Response from a coast earth station to a distress alarm

c Whether there is any emission radiation

(5) The distance in which the levels of the high frequency energy radiated from an antenna are 100 W, 25 W and 10 W per m^2 shall be indicated on the radome.

(6) The position of a ship and the time when the position of a ship has been determined shall be capable of being inputted automatically or manually (limited to the radio equipment of a ship earth station prescribed in Article 28.2 paragraph 1 of the Enforcement Regulations).

2 Electric conditions

(1) Transmitting device

a The transmitting device shall be capable of automatically selecting and transmitting any frequency of a 5 kHz interval from 1,626.5 MHz to 1,646.5 MHz.

b The transmission frequency shall be generated using the carrier frequency of a channel in time division multiplexing transmitted from a coast earth station as its basis. In this case, when the transmission frequency cannot maintain the tolerance prescribed in Table 1 of Article 5 of the Ordinance Regulating Radio Equipment, the transmitting device shall not be capable of transmitting any frequency except for distress communication.

c The equivalent isotropically radiated power shall be equal to or higher than 5 dB (with 1 W regarded as 0 dB) at the elevation angle of –15° when the zenith is 90°. However, the equivalent isotropically radiated power shall not exceed 16 dB (with 1 W regarded as 0 dB) in any direction.

d The power radiated into the 1 kHz band shall not exceed the following values.

Transmission rate	Detuning frequency (which refers to the frequency of the difference from the carrier frequency; the same applies hereafter)	Ratio of the power radiated into 1 kHz band to the unmodulated frequency
600 bits/s	±4.2 kHz	-25.6 dB
	±48.6 kHz	-48 dB
1,200 bits/s	±4.2 kHz	-23.5 dB
	±48.6 kHz	-45 dB

e The number of packets which can be transmitted once (which refers to a unit in which data is

divided in a specified length, and information required for transmission and reception is added to each of the divided data; the same applies hereafter) shall be 255 or smaller.

f The transmission rate shall be capable of being switched to 600 bits/s or 1,200 bits/s by a signal in time division multiplexing transmitted from a coast earth station.

g The transmission signal for communication shall be as follows.

(i) The error correcting code shall be the convolutional code in which the coding rate is 1/2 and the constraint length is 7 bits (which refers to a convolutional code which converts seven signal bits toer an ror detecting code of two bits per signal bit; the same applies hereunder), and the polynomial expression to produce it shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(ii) The stability of the transmission rate shall be 1/1,000,000 or less for ten seconds

h The transmission signal for communication (except the transmission signal for paging) shall be as follows in addition to the provisions prescribed in g. above.

(i) The composition shall be as shown in Fig. 10.

(ii) The synchronizing code shall be such that the following string of codes are repeated twice.

0000 0111 1110 1010
1100 1101 1101 1010
0100 1110 0010 1111
0010 1000 1100 0010

(iii) In the case of (ii) above, the synchronizing code shall be transmitted without performing error detecting coding

i The transmission signal for pagings hall be as follows in addition to the provisions prescribed in g. above.

(i) The composition shall be as shown in Fig. 10.

(ii) The synchronizing code shall be such that a string of codes prescribed h-(ii) above are transmitted once.

(iii) In the case of (ii) above, the synchronizing code shall be transmitted without performing error detecting coding

(2) Receiving device

a The receiving device shall be capable of automatically tuning with any frequency of a 5 kHz interval from 1,530 MHz to 1,545 MHz.

b The receiving device shall tune with NCS common TDM except when it is in a communication state.

c The receiving signal shall be as follows.

(i) The error correcting code shall be the convolutional code in which the coding rate is 1/2 and the constraint length is 7 bits, and the polynomial expression to produce it shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(ii) The transmission rate shall be 1,200 bits/s.

(iii) The synchronizing code shall be the one prescribed in (1) h (ii).

d The selectivity characteristics up to the demodulator input shall be as shown in Fig. 6.

e When the length of the transmission packet is 128 bites, the packet error rate shall be 0.08 or

less, and when it is 48 bites, the packet error rate shall be 0.027 or less.

(i) When the radio waves from (a) to (e) below are added with an initial clock frequency of ±0.06 Hz being offset

(a) Emissions of a frequency in a range from 1.530 MHz to 1,545 MHz

(b) Emissions of the power flux density of –146.5 dB/m^2 (with 1 W regarded as 0 dB) which has not suffered from any fading

(c) Emissions whose initial frequency offset is ±850 Hz and whose frequency variation is –50 Hz to +50 Hz for three seconds.

(d) Emissions of phase noise as shown in Fig. 12

(e) Emissions of multi-pass fading in which the ratio of a direct wave to a reflection wave is 7 dB

(ii) When an interfering wave having a +5 dB relative level is added to the unmodulated carrier level distant from the carrier by ±5 kHz

(iii) When an interfering wave in the frequency band from 1,626.5 MHz to 1,646.5 MHz of the power flux density of –15 dBW/m^2 is added

(3) Antenna

The axial ratio shall be 6 dB or less in a range of elevation angle 5° to 90°, and in a range of azimuth angle 0° to 360°.

(4) Electro-magnetic interference

The electro-magnetic interference shall comply with the conditions defined in I. 2. (4) above.

III INMARSAT B RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS

1 General conditions

(1) The radio equipment shall comply with the conditions defined in I.1. (except (4), (5), (10) and (11)).

(2) When radio telegraphy based communication (except the communication for paging a coast earth station and for transmitting data exceeding 300 bits/s) is performed, the radio equipment shall transmit the communication in time division multiple access and receive it in time division multiplexing.

(3) When radio telegraphy based communication (limited to the communication for transmitting data exceeding 300 bits/s) and radio telephony based communication are performed, the radio equipment shall perform modulation by digitally coded information in a channel per carrier.

2 Electric conditions

(1) Transmitting device

a The transmitting device shall be capable of automatically selecting and transmitting any frequency of a 10 kHz interval from 1,626.5 MHz to 1,646.5 MHz.

b The equivalent isotropically radiated power shall be 25 dBW, 29 dBW, or 33 dBW, and shall be capable of being automatically selected. In this case, the tolerance shall be –2 dB to +1 dB.

c When radio telegraphy based communication (except the communication for paging a coast earth station and for transmitting data exceeding 300 bits/s) is performed, the transmitting device shall comply with the following conditions.

(i) The modulation method shall be offset 4PSK with a limited bandwidth (which refer to the 4PSK that delays the input signal of the Q channel by a half symbol as compared with the input signal of the I channel; hereinafter referred to as "O-QPSK") having the following relative phase relationship for the input signals in two orthogonal channels (which refer to "I channel" and "Q channel" hereafter).

I channel	Q channel	Relative phase
1	1	+45°
0	1	+135°
1	0	-45°
0	0	-135°

(ii) The transmitting signal shall be as follows.

(a) The composition shall be as shown in Fig. 13.

(b) The preamble shall consist of a carrier regeneration code and a clock regeneration code.

(c) The carrier regeneration code shall be such that both the I channel and the Q channel consist of 152 bits, and each bit is "0," and no scramble nor error correcting coding shall be performed for any bit.

(d) The clock regeneration code shall be such that both the I channel and the Q channel consist of 72 bits, each bit is "0" in the I channel, each bit is a repetition of "1" and "0" one after the other in the Q channel, and no scramble nor error correcting coding shall be performed for any bit.

(e) The frame synchronizing code shall be such that both the I channel and the Q channel consist of 40 bits, and shall be "0000 01110 0111 1011 1111 0001 0110 1011 0010 0010," and no scramble nor error-correcting-coding shall be performed for any bit.

(iii) The scramble shall take an exclusive logical sum with a pseudo random number system of system 2^{15}-1 (which refers to a "PN system").

(iv) The error correcting code shall be the convolutional code in which the rate is 1/2 and the constraint length is 7 bits, and the polynomial expression to produce it shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

d When radio telegraphy based communication (limited to the communication for transmitting data exceeding 300 bits/s) is performed, the transmitting device shall comply with the following conditions.

(i) The transmitting device shall comply with the conditions defined in c. (1), (3) and (4) above.

(ii) The transmitting signal shall be as follows.

(a) The composition shall be as shown in Fig. 14.

(b) The transmitting signal shall comply with the conditions defined in c. (ii) (b) to (e) above.

e When radio telephony based communication is performed, the transmitting device shall comply with the following conditions.

(i) The transmitting device shall comply with c. (i), (iii) and (iv) above.

(ii) The transmitting signal shall be as follows.

(a) The composition shall be as shown in Fig. 15.

(b) The transmitting signal shall comply with the conditions defined in c. (ii) (b) to (d) above.

(c) The frame synchronizing code shall be such that both the I channel and the Q channel consist of 24 bits, and shall be "1111 1010 1111 0011 0010 0000," and the burst mode synchronizing code shall be such that both the I channel and the Q channel consist of 40 bits, and shall be 0000 0111 0111 1011 1111 0001 0110 1011 0010 0010," and no scramble nor error correcting coding shall be performed for any code.

(iii) The error correcting code shall be the punctured convolutional code in which the coding rate is 3/4 and the constraint length is 7 bits (which refers to the coding which flexibly changes the coding rate by systematically thinning out appropriate lengthy bits of the convolutional code; the same applies hereafter), and the polynomial expression to produce the convolutional code in which the coding rate is 1/2 shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(iv) The voice coding shall be the maximum-likelihood quantization adaptation prediction coding method of 16,000 bits/s (which refers to the coding type which quantizes a predictive residual signal at an appropriate level so that the lengthiness of the voice may be removed by means of the linear prediction processing and the distortion of the original signal and the regenerated signal may be minimal; hereinafter referred to as an "APC-MLQ method").

f The paging and responding signals shall comply with the following conditions.

(i) The paging and responding signals shall comply with the conditions defined in c. (i), (iii) and (iv) above.

(ii) The signal shall be as follows.

(a) The composition shall be as shown in Fig. 16.

(b) The transmitting device shall comply with the conditions defined in c. (ii) (b) and (e) above.

g Whenever paging is performed, a paging frequency designated from a coast earth station shall be selected.

h The transmitting device shall not be capable of re-paging at least for 16 seconds after a paging sequence has finished.

(2) Receiving device

a. The receiving device shall be capable of automatically tuning with any frequency of a 10 kHz interval from 1,525 MHz to 1,545 MHz.

b The receiving device shall tune with NCS common TDM except when it is in a communication state.

c When radio telegraphy based communication (when data is transmitted, limited to the communication for transmitting data of 300 bits/s) is performed, the receiving device shall comply with the following conditions.

(i) The receiving signal shall be as follows.

(a) The modulation method shall be 2PSK.

(b) The transmission rate shall be 6,000 bits/s.

(c) The composition shall be as shown in Fig. 17.

(d) The frame synchronizing code shall be “0100 1000 0101 0111 0110 0011 1110 0110” and no scramble nor error correcting coding shall be performed for any code.

(ii) The error correcting decode shall conduct Viterbi decoding of a receiving signal in the convolutional code in which the coding rate is 1/2 and the constraint length is 7 bits, and the polynomial expression to produce it shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(iii) The scramble shall take an exclusive logical sum with a PN system of system 2^{15}-1 (which refers to a “PN system”).

(iv) The differential demodulator shall be positioned at a backward stage of the de-scramble.

(v) The selectivity characteristics up to the demodulator input shall comply with the following conditions.

(a) The removal ratio of all the interfering signals in a range from 1,535.0 MHz to 1,543.5 MHz excluding ±75 kHz centered around desires signals shall be 40 dB or more.

(b) The deterioration of performance due to the existence of two-wave adjacent signals distant upward and downward from each other by 75 kHz centered around desired signals shall be within 0.5 dB in terms of the ratio of the carrier power to the noise power density. In this case, the two adjacent signals shall be similar to the desired signals (which shall be band-limited 2PSK modulated by random data of 6,000 bits/s), and shall be higher than the desired signals by 2 dB.

d When radio telegraphy (limited to the radio telegraphy which transmits data exceeding 300 bits/s) based communication is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in (1) c. (i) above.

(ii) The receiving signal shall be as follows.

(a) The receiving signal shall comply with the conditions defined in (1) d. (ii) (a) and (b) above.

(b) The transmission rate shall be 24,000 bits/s.

(iii) The receiving device shall comply with the conditions defined in c. (iii) above.

(iv) The selectivity characteristics up to the demodulator input shall comply with the following conditions.

(a) The removal ratio of all the interfering signals in a range from 1,525 MHz to 1,559 MHz excluding ±50 kHz or lower centered around desired signals shall be 40 dB or more.

(b) The deterioration of performance due to the existence of two-wave adjacent signals distant upward and downward from each other by 20 kHz centered around desired signals shall be within 0.8 dB in terms of the ratio of the carrier power to the noise power density. In this case, the two adjacent signals shall be similar to the desired signals (which shall be band-limited O-QPSK modulated by random data of 24,000 bits/s), and shall be higher than the desired signals by 6 dB.

e When radio telephony based communication is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in d. (i), (iii) and (iv) above.

(ii) The receiving signal shall be as follows.

(a) The receiving signal shall comply with the conditions defined in (1) e. (ii) (a) and (b) above.

(b) The transmission rate shall be 24,000 bits/s.

(iii) The error correcting code shall conduct Viterbi decoding of a receiving signal in the punctured convolutional code in which the coding rate is 3/4 and the constraint length is 7 bits, and the polynomial expression to produce the convolutional code in which the coding rate is 1/2 shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(iv) The sound decoding shall be APC-MLQ.

(3) Antenna, etc.

a The axial ratio shall be 2 dB or less in the maximum directive direction.

b The antenna shall automatically track an INMARSAT artificial satellite station in a usual shake of the ship, a navigation of the ship, and the position change of an INMARSAT artificial satellite station.

c The radome shall have as little deterioration of characteristics due to the moisture, salt, and so forth which stick to it as possible.

d The antenna shall have a means for periodically detecting the position information of the antenna which consists of an elevation angle and azimuth angle of a tracking satellite at the accuracy of ±5°.

(4) Electro-magnetic interference

The electro-magnetic interference shall comply with the conditions defined in I. 2. (4) above.

IV INMARSAT M RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS

1 General conditions

(1) The radio equipment shall comply with the conditions defined in I. 1. (2) (3), (9) and (13) to (15).

(2) When radio telegraphy based communication (except the communication for paging and responding) is performed, and when radio telephony based communication is performed, the radio equipment shall perform modulation by digitally coded information in a channel per carrier.

2 Electric conditions

(1) Transmitting device

a The transmitting device shall be capable of automatically selecting and transmitting any frequency of a 5 kHz interval in the frequency range defined in (i) and (ii) below depending on the kind of radio equipment.

(i) Radio equipment of a standard tuning range type

From 1,626.5 MHz to 1,646.5 MHz

(ii) Radio equipment of a limited tuning range type

From 1,631.5 MHz to 1,646.5 MHz

b The equivalent isotropically radiated power shall be 21 dBW or 27 dBW, and shall be capable of being selected automatically. In this case, the tolerance shall be –3 dB to +2 dB.

c When radio telegraphy based communication (except the communication for paging and

responding) is performed, the transmitting device shall comply with the following conditions.

(i) The modulation method shall be O-QPSK with a limited band.

(ii) The transmitting signal shall be as follow.

(a) The composition shall be as shown in Fig. 18.

(b) The preamble shall consist of a carrier regeneration code and a clock regeneration code.

(c) The carrier regeneration code is such that both the I channel and the Q channel consist of 48 bits, each bit shall be "0", and no scramble nor error correcting coding shall be performed for any bit.

(d) The clock regeneration code shall be such that both the I channel and the Q channel consist of 12 bits in the first sub-frame, being "0111 1000 1001," and consist of 12 bits in the second and third sub-frames, being "1000 0111 0111 0110," and no scramble nor error correcting coding hall be conducted.

(e) The sub-frame synchronizing code shall be such that both the I channel and the Q channel consist of 12 bits in the first sub-frame, being "0111 1000 1001," and consist of 12 bits in the second, third and fourth sub-frames, being "1000 0111 0110," and no scramble nor error correcting coding shall be conducted.

(iii) The scramble shall take an exclusive logical sum with a PN system of system 2^{15}-1 (which refers to a "PN system").

(iv) The error correcting code shall be the punctured convolutional code in which the coding rate is 3/4 and the constraint length is 7 bits, and the polynomial expression to produce the convolutional code in which the coding rate is 1/2 shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

d When radio telephony based communication is performed, the transmitting device shall comply with the following conditions.

(i) The transmitting device shall comply with the conditions defined in c. (i), (iii) and (iv) above.

(ii) The transmitting signal shall be as follows.

(a) The composition shall be as shown in Fig. 19.

(b) The transmitting signal shall comply with the conditions defined in c. (ii) (b) to (e) above.

(iii) The voice coding shall be IMBE of 6,400 bits/s (which refers to the IMBE voice coding method specified by corporation that the International Mobile Satellite Organization supervises; the same applies hereafter).

e The paging and responding signals shall comply with the following conditions.

(i) The modulation method shall be 2PSK.

(ii) The signals shall be as follows.

(a) The composition shall be as shown in Fig. 20.

(b) The preamble shall consist of a carrier regeneration code and a frame synchronizing code.

(c) The carrier regeneration code shall be such that both the I channel and the Q channel consist of 10 bits, and any bit shall be "0," and no scramble nor error correcting coding shall be conducted for any bit.

(d) The frame synchronizing code shall be "1010 1110 1000 1000 1111 0100," and no

scramble nor error correcting coding shall be conducted for any bit.

(iii) The error correcting code shall be the convolutional code in which the coding rate is 1/2 and the constraint length is 7 bits, and the polynomial expression to produce it shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

f Whenever paging is performed, a paging frequency designated from a coast earth station shall be selected.

g The transmitting device shall not be capable of re-paging at least for 16 seconds after a paging sequence has finished.

(2) Receiving device

a The receiving device shall be capable of automatically tuning with any frequency of a 5 kHz interval in the frequency range of (i) or (ii) below depending on the kind of radio equipment.

(i) Radio equipment of a standard tuning range type
From 1,525 MHz to 1,545 MHz

(ii) Radio equipment of a limited tuning range type
From 1,530 MHz to 1,545 MHz

b The receiving device shall tune with NCS common TDM except when it is in a communication state.

c When radio telegraphy based communication (except the communication for paging and responding) is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in (1) c. (i) above.

(ii) The receiving signal shall be as follows.

(a) The receiving signal shall comply with the conditions defined in (1) c. (ii) (a) to (e) above.

(b) The transmission rate shall be 8,000 bits/s.

(iii) The error correcting decode shall be added to only a sub-band field, and shall conduct Viterbi decoding of a receiving signal in the convolutional code in which the coding rate is 3/4 and the constraint length is 7 bits, and the polynomial expression to produce the convolutional code in which the coding rate is 1/2 shall be as follows.

$G_1(X) = 1 + X^2 + X^3 + X^5 + X^6$

$G_2(X) = 1 + X + X^2 + X^3 + X^6$

(iv) The de-scramble shall take an exclusive logical sum with a PN system of system 2^{15}-1 (which refers to a “PN system”).

(v) The selectivity characteristics up to the demodulator input shall comply with the following conditions.

(a) The removal ratio of all the interfering signals in a range from 1,525 MHz to 1,559 MHz excluding ±25 kHz centered around desired signals shall be 30 dB or more.

(b) The deterioration of performance due to the existence of two-wave adjacent signals distant upward and downward from each other by 10 kHz centered around desired signals shall be within 0.1 dB in terms of the ratio of the carrier power to the noise power density. However, the two adjacent signals shall be similar to the desired signals (which shall be band-limited O-QPSK modulated by random data of 8,000 bits/s), and shall be higher than the desired signals by 6 dB.

d When radio telephony based communication is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in c. (i), (iii), (iv) and (v) above.

(ii) The receiving signal shall be as follows.

(a) The receiving signal shall comply with the conditions defined in (1) d. (ii) (a) and (b) above.

(b) The transmission rate shall be 8,000 bits/s.

(iii) The voice coding shall be IMBE.

(3) Antenna, etc.

a The axial ratio shall be 2 dB or less in the maximum directive direction.

b The antenna shall automatically track an INMARSAT artificial satellite station in a usual shake of the ship, a navigation of the ship, and the position change of an INMARSAT artificial satellite station.

c The radome shall have as little deterioration of characteristics due to the moisture, salt, and so forth which stick to it as possible.

d The antenna shall have a means for periodically detecting the position information of the antenna which consists of an elevation angle and azimuth angle of a tracking satellite at the accuracy of ±5°.

(4) Electro-magnetic interference

The electro-magnetic interference shall comply with the conditions defined in I. 2. (4) above.

V INMARSAT F RADIO EQUIPMENT OF INMARSAT SHIP EARTH STATIONS

1 General conditions

(1) The radio equipment shall comply with the conditions defined in I. 1. (2), (3), (9) and (13) to (15).

(2) When radio telegraph based communication (except the communication for paging and responding) is performed, and when radio telephony based communication is performed, the radio equipment shall perform modulation by digitally coded information in a channel per carrier.

2 Electric conditions

(1) Transmitting device

a The transmitting device shall be capable of automatically selecting and transmitting any frequency of a 1.25 kHz interval in a range from 1,626.5 MHz to 1,660.5 MHz.

b When radio high-speed data based communication is performed, the equivalent isotropically radiated power shall be 8 dBW, 10 dBW, 12 dBW, 14 dBW, 16 dBW, 18 dBW, 20 dBW, 22 dBW, 24 dBW, 26 dBW, 28 dBW, 30 dBW, or 32 dBW, and when any other communication is performed, the equivalent isotropically radiated power shall be 6 dBW, 8 dBW, 10 dBW, 12 dBW, 14 dBW, 16 dBW, 18 dBW, 20 dBW, 22 dBW, 24 dBW, or 26 dBW. In any case, the equivalent isotropically radiated power shall be capable of being automatically selected in accordance with the ratio of the carrier power to the noise power density when communication is started. In this case, the tolerance shall be –2 dB to +1 dB.

c When radio telegraphy based communication (except the communication for paging and

responding, and radio high-speed data based communication) is performed, the modulation method shall be band-limited O-QPSK.

d When radio telephony based communication is performed, the transmitting device shall comply with the following conditions.

(i) The modulation method shall be band-limited O-QPSK.

(ii) The voice coding shall be AMBE of 4,800 bits/s (which refer to the AMBE method specified by a corporation that the International Mobile Satellite Organization supervises; the same applies hereafter).

e The modulation method for paging and responding signals shall be 2PSK.

f When radio high-speed data based communication is performed, the modulation method shall be band-limited 16-value quadrature amplitude modulation (hereinafter referred to as "16QAM").

g Whenever paging is performed, a paging frequency designated from a coast earth station shall be selected.

h The transmitting device shall not be capable of re-paging at least for 17 seconds after a paging sequence has finished.

(2) Receiving device

a The receiving device shall be capable of automatically tuning with any frequency of a 1.25 kHz interval in a range from 1,525 MHz to 1,559 MHz

b The receiving device shall tune with NCS common TDM except when it is in a communication state.

c When radio telegraphy based communication (except the communication for paging and responding, and radio high-speed data based communication) is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in (1) d. (i) above.

(ii) The transmission rate of the receiving signal shall be 5,600 bits/s or 24,000 bits/s.

(iii) The selectivity characteristics up to the demodulator input shall be as shown in the right-hand column of the table below according to the classification in the left-hand column of the table.

Classification	Selectivity characteristics
Desired signals of band-limited O-QPSK modulated by random data of 5,600 bits/s	a The removal ratio of all the interfering signals in a range from 1,525 MHz to 1,559 MHz excluding ±25 kHz of lower centered around desired signals shall be 30 dB or more. b When two adjacent signals distant upward and downward from each other by 4.5 kHz centered around desired signals exist, the bit error rate shall be 4% or less in terms of the ratio of the carrier power of 40.6 dB to the noise power density. In this case, the two adjacent signals shall be similar to the desired signals, and shall be higher than the desired signals by 6 dB.
Desired signals of band-limited O-QPSK modulated by random data of 24,000 bits/s	a The removal ratio of all the interfering signals in a range from 1,525 MHz to 1,559 MHz excluding ±50

	kHz or lower centered around desired signals shall be 40 dB or more. b The deterioration of performance due to the existence of two-wave adjacent signals distant upward and downward from each other by 20 kHz centered around desired signals shall be within 0.8 dB in terms of the ratio of the carrier power to the noise power density. In this case, the two adjacent signals shall be similar to the desired signals, and shall be higher than the desired signals by 6 dB.

d When radio telephony based communication is performed, the receiving device shall comply with the following conditions.

(i) The receiving device shall comply with the conditions defined in c. (i) to (iii) above.

(ii) The voice coding shall be AMBE.

e When radio high-speed data based communication is performed, the receiving device shall comply with the following conditions.

(i) The modulation method shall be band-limited 16QAM.

(ii) The transmission rate of the receiving signal shall be 134.4 k bits/s.

(iii) The selectivity characteristics up to the demodulator input shall comply with the following conditions.

(a) The removal ratio of all the interfering signals in a range from 1,400 MHz to 1,626.5 MHz excluding ±100 kHz centered around desires signals shall be 30 dB or more.

(b) When two adjacent signals distant upward and downward from each other by 39.5 kHz centered around desired signals exist, the bit error rate shall be 0.0001% or less in terms of the ratio of the carrier power of 53.4 dB to the noise power density. In this case, the two adjacent signals shall be similar to the desired signals (which shall be band-limited 16 QAM modulated by random data of 134.4 k bits/s), and shall be higher than the desired signals by 6 dB.

(3) Antenna, etc.

a The axial ratio shall be 2 dB or less in the maximum directive direction.

b The antenna shall automatically track an INMARSAT artificial satellite station in a usual shake of the ship, a navigation of the ship, and the position change of an INMARSAT artificial satellite station.

c The radome shall have as little deterioration of characteristics due to the moisture, salt, and so forth which stick to it as possible.

d The antenna, etc. shall have a means for periodically detecting the position information of the antenna which consists of an elevation angle and azimuth angle of a tracking satellite at the accuracy of ±5°.

(4) Electro-magnetic interference

The electro-magnetic interference shall comply with the conditions defined in I. 2. (4) above.

VI INMARSAT ENHANCED GROUP CALLING RECEIVER

1 General conditions

(1) The receiver shall comply with the conditions defined in I. 1. (6) to (11) and (13) above.

(2) The receiver shall be capable of memorizing and selecting 20 NCS common TDM numbers.

(3) The receiver shall have a function for indicating the following.

a Synchronization state of NCS common TDM

b Reception of a message

2 Electric conditions

(1) Receiving device

The receiving device shall comply with the conditions defined in II. 2. (2) a. to c. and e. above.

(2) Antenna

a The polarized waves of received emissions shall be right-hand polarized waves.

b The axial ratio shall comply with the conditions defined in II. 2. (3). However, this does not apply to the antenna for automatically tracking an INMARSAT artificial satellite station.

(3) Electro-magnetic interference

The electro-magnetic interference shall comply with the conditions defined in I. 2. (4) above.

3 Conditions for receiving and printing

(1) The receiver shall be capable of selecting whether it can receive a message or not depending on the kind of the message. However, the receiver shall always receive distress communications, emergency communications, and safety communications.

(2) The receiver shall have a storage capacity of 32,768 bites for storing messages.

(3) The identification signal of a message which has been received without any mistake (hereinafter referred to as “ID”) shall be stored.

(4) The number of ID to be stored shall be 225 or more, and when the number of ID to be stored exceeds the storage capacity, the most up-to-date ID shall be preferentially stored.

(5) ID shall be stored for 60 hours after a message is received and shall be deleted by 72 hours after the message is received.

(6) The receiver shall have a function for not printing the message with the same ID as the one which has been stored, even when the said message is received.

(7) The receiver shall indicate or print the date and time (which shall be the coordinated universal time) when a message is received for a message received.

(8) The receiver shall print an underline “–“ for characters received which have an error.

(9) The receiver shall not indicate or print a word over a plurality of lines.

(10) The receiver shall be capable of printing 40 letters or more per line.

(11) The receiver shall have an audible alarm function which indicates that the paper is coming close to its end.

VII RADIO EQUIPMENT OF RADIO STATIONS WHICH ARE ESTABLISHED ON A STRUCTURE OPERATED IN A SEA AREA AND WHICH PERFORM RADIO COMMUNICATION BY MEANS OF A RELAY THROUGH AN INMARSAT ARTIFICIAL

SATELLITE STATION

The provisions concerning INMARSAT A, C, B, and M radio equipment of INMARSAT ship earth stations prescribed in Article 7 paragraph 19, Article 14 paragraph 3, Article 40.4, Note 33 of Table 1 of the Ordinance Regulating Radio Equipment as well as in this Announcement shall be mutatis mutandis applied. However, this does not apply to the following provisions.

1 The provisions of Article 40.4 paragraph 1 item 1 of the Ordinance Regulating Radio Equipment

2 The provisions of I. 1. (1) and (6) to (13), 2. (3) b., (3) d. and (4) (including the case where these provisions are applied based on the provisions of II, III, or IV)

3 The provisions of II. 1. (2) to (5)

4 The provisions of III. 2. (3) b. to d.

5 The provisions of IV. 2. (3) b. to d.

Supplementary Provisions (November 5, 1996
Ministry of Posts and Telecommunications Announcement No. 572)

1 This Announcement shall come into force as of the day of promulgation.

2 Notwithstanding the provisions after amendment, the technical conditions for INMARSAT A, C, B, and M radio equipment of INMARSAT ship earth stations which was installed in ships before November 22, 1996 can continue to conform to the prior regulations as long as the radio equipment remains installed in the said ships.

Fig. 1 Composition of a transmitting signal (except a transmitting signal for paging) for transmission based on the radio telegraphy of INMARSAT A radio equipment of INMARSAT ship earth stations

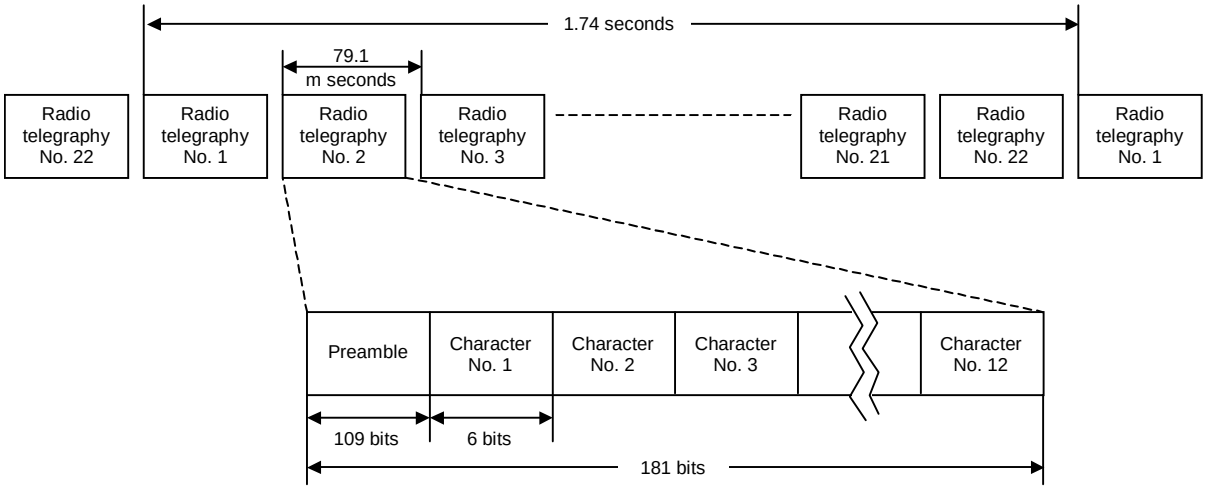


Fig. 2 Composition of a transmitting signal for paging based on the radio telegraphy of INMARSAT A radio equipment of INMARSAT ship earth stations

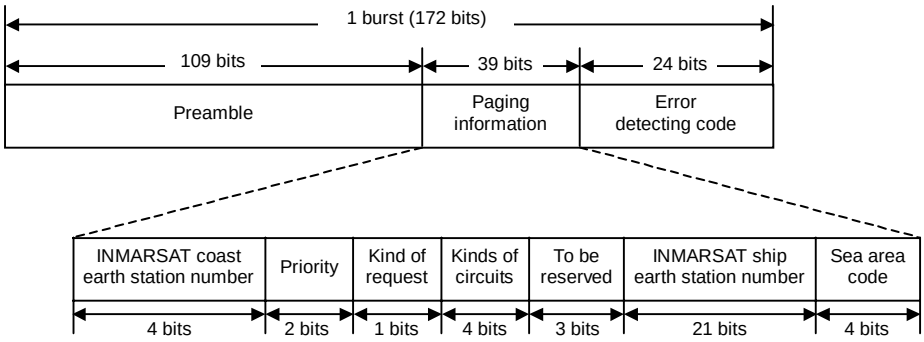


Fig. 3 Amplitude frequency characteristics of a modulator and demodulator of INMARSAT A radio equipment of INMARSAT ship earth stations

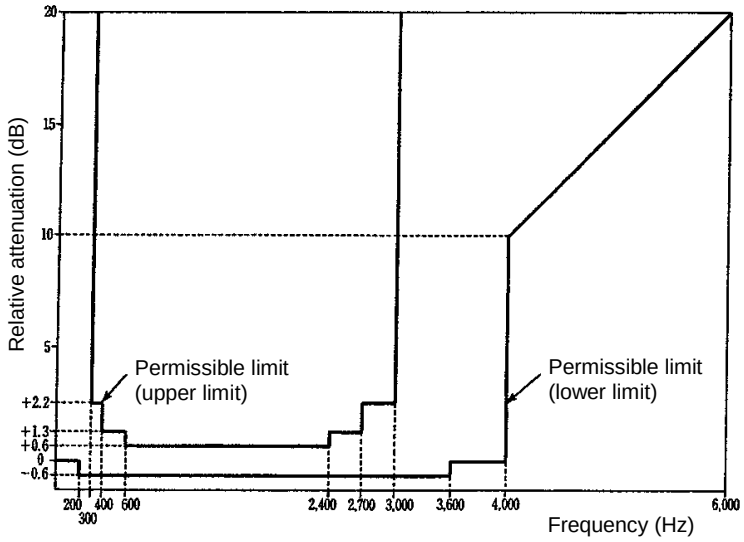


Fig. 4 Group delay distortion frequency characteristics of a modulator and demodulator of INMARSAT A radio equipment of INMARSAT ship earth stations

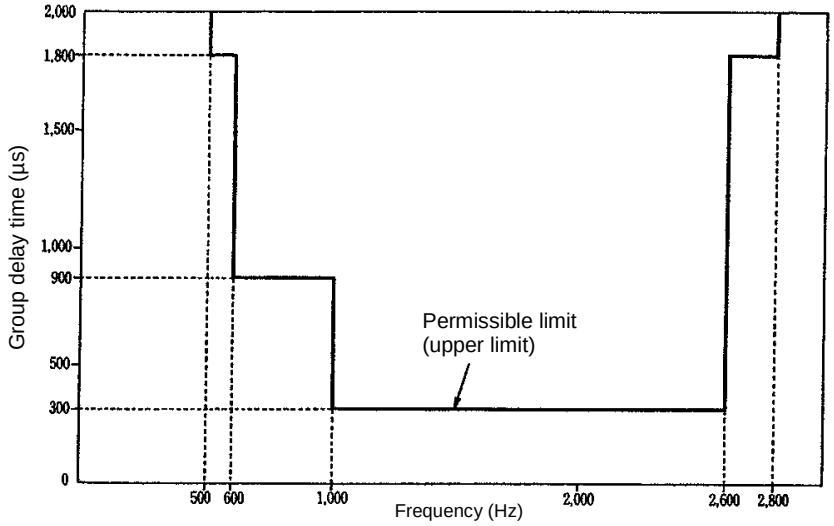


Fig. 5 Composition of a receiving signal for communication based on the radio telegraphy of INMARSAT A radio equipment of INMARSAT ship earth stations

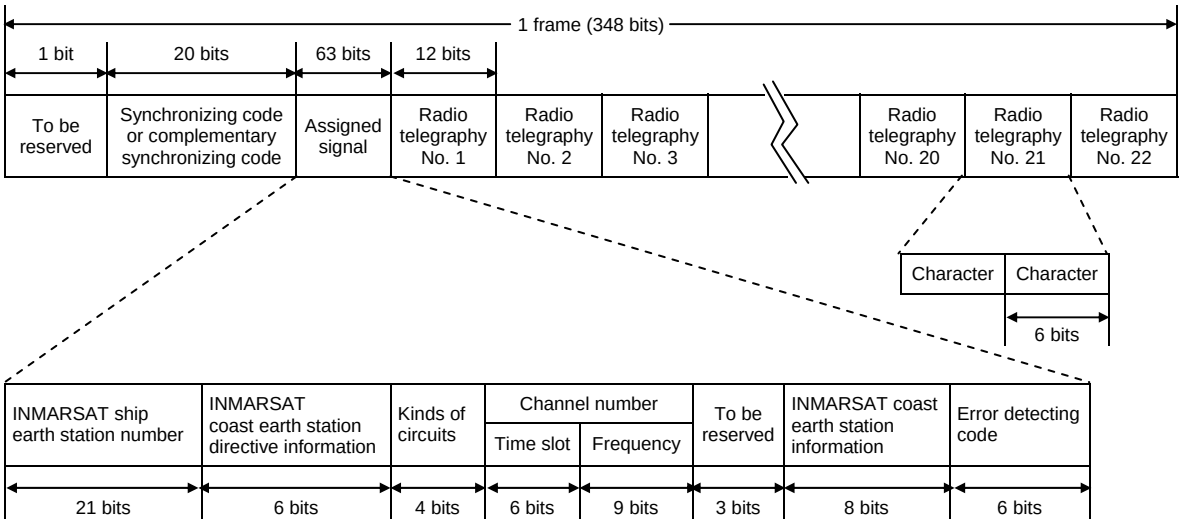


Fig. 6 Reception selectivity characteristics in INMARSAT A radio equipment and INMARSAT C radio equipment of INMARSAT ship earth stations and in the radio telegraphy of an INMARSAT enhanced group calling receiver

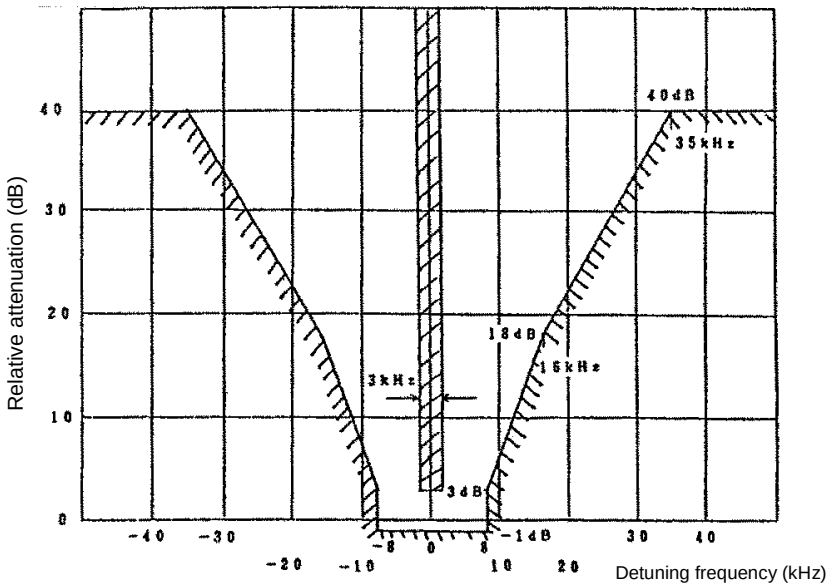


Fig. 7 Reception selectivity characteristics in INMARSAT A radio equipment of INMARSAT ship earth stations

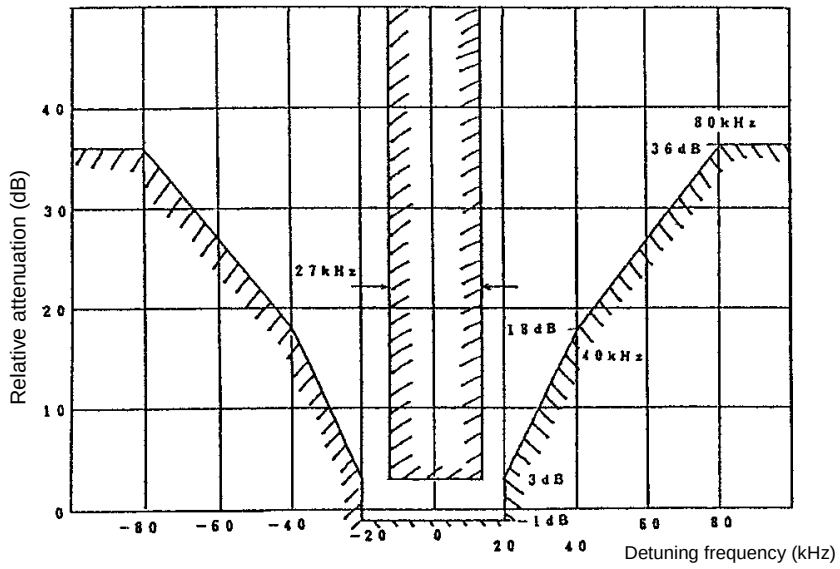


Fig. 8 Electro-magnetic interference of INMARSAT A radio equipment, INMARSAT C radio equipment, INMARSAT B radio equipment, INMARSAT M radio equipment, INMARSAT F radio equipment of INMARSAT ship earth stations and an INMARSAT enhanced group calling receiver

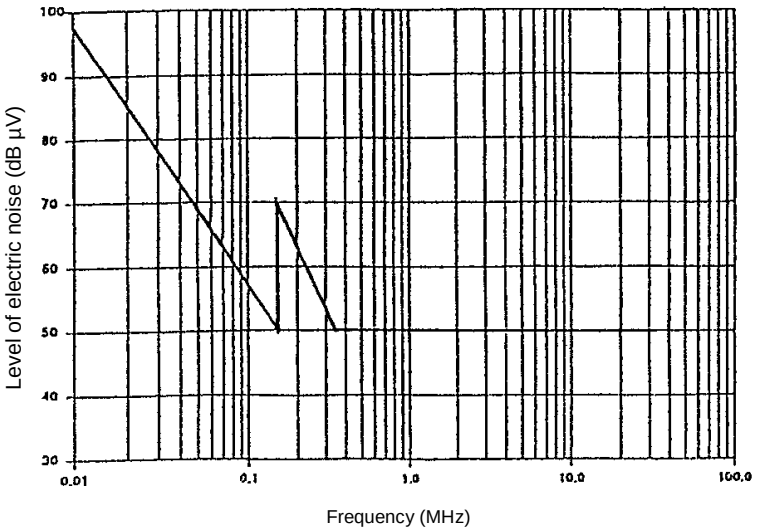


Fig. 9 Deleted

Fig. 10 Composition of a transmitting signal (except a signal for paging) for communication of INMARSAT C radio equipment of INMARSAT ship earth stations

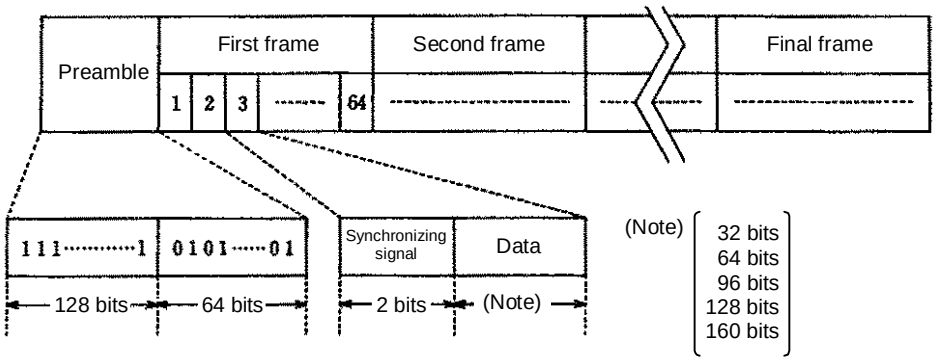
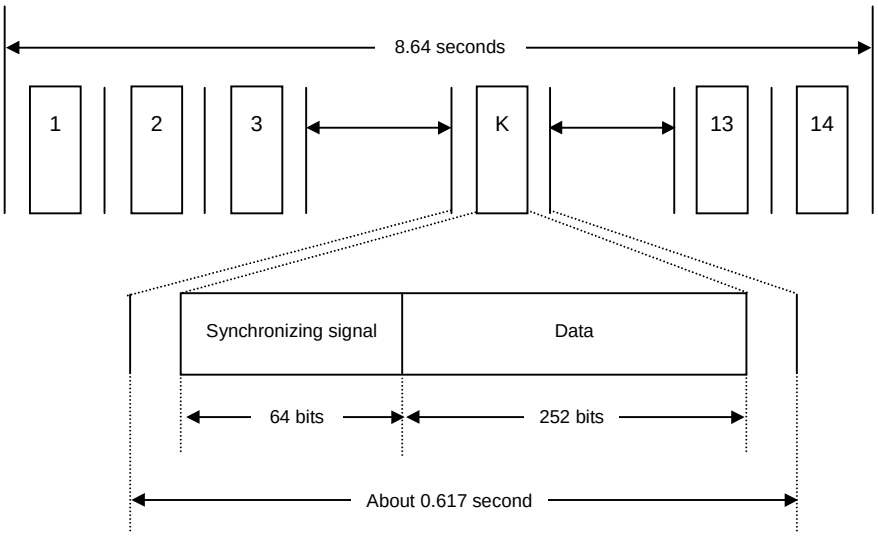

Preamble
First frame
Second frame
Final frame
1
2
3
64
1 1 1 ····· 1
0 1 0 1 ····· 0 1
Synchronizing signal
Data
128 bits
64 bits
2 bits
(Note)
(Note)
32 bits
64 bits
96 bits
128 bits
160 bits

Fig. 11 Composition of a transmitting signal for paging INMARSAT C radio equipment of INMARSAT ship earth stations

(1) When the transmission rate is 600 bits/s



(2) When the transmission rate is 600 bits/s

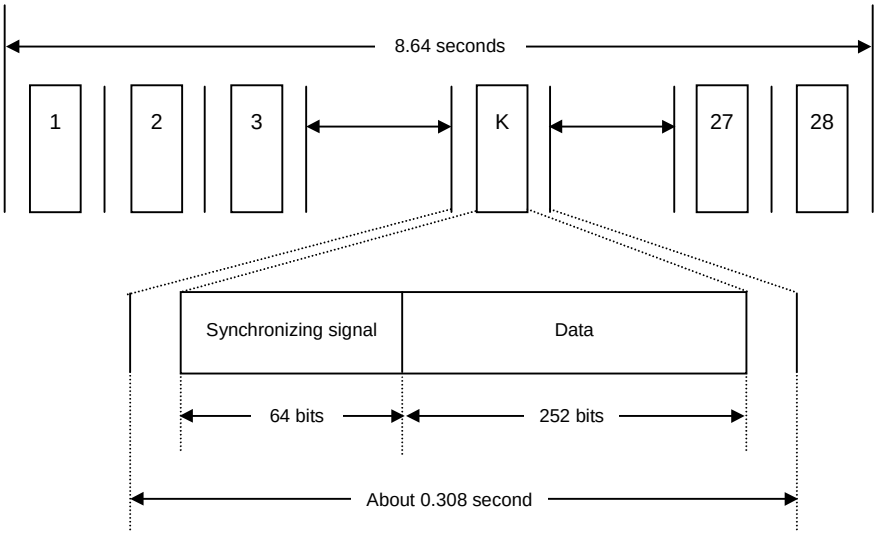


Fig. 12 Phase noise

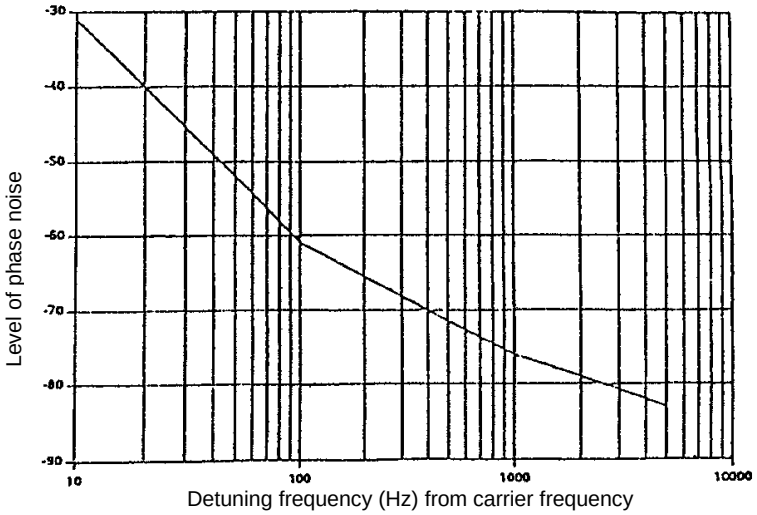
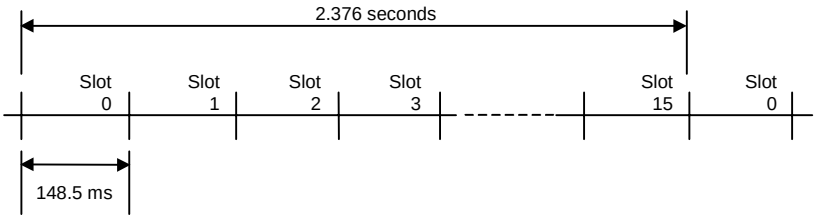
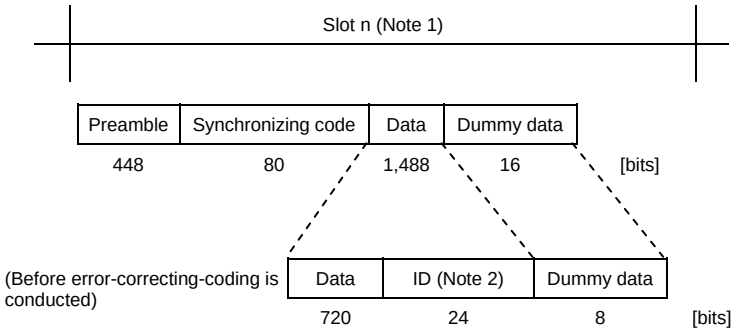


Fig. 13 Composition of a transmitting signal for communication (limited to the communication whose transmission rate is 300 bits/s when data transmission is performed) based on the radio telegraphy of INMARSAT C radio equipment of INMARSAT ship earth stations

(1) Composition of transmission time slot

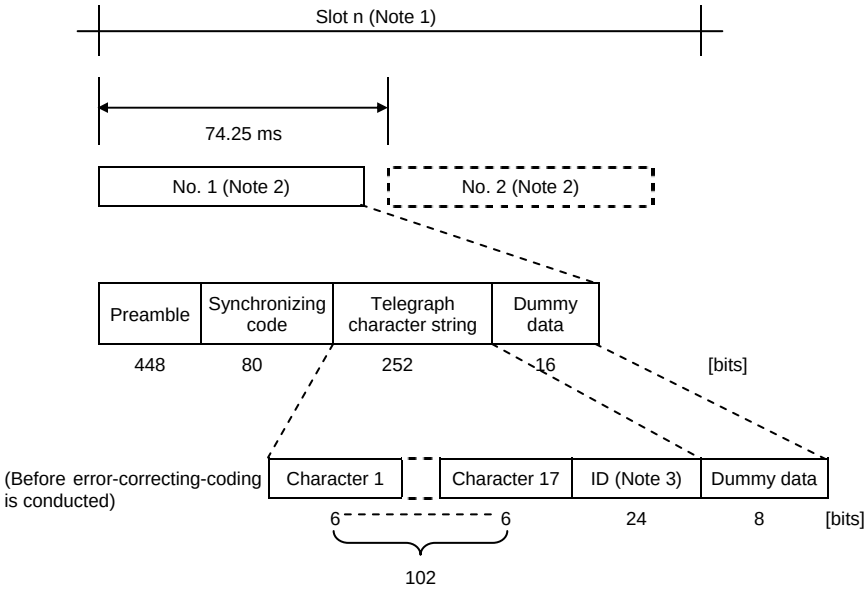


(2) Composition a transmitting signal when data transmission based communication is performed



Note 1. n shall be the slot number that a coast earth station designates.
2. ID shall be the INMARSAT B ship earth station number that the International Maritime Satellite Organization designates.

(3) Composition of a transmitting signal when radio telegraphy based communication except for data transmission is performed



Note 1. n shall be the slot number that a coast earth station designates.
2. A signal shall be transmitted at the timing of either No. 1 or No. 2 based on the specification of a coast earth station.
3. ID shall be the INMARSAT B ship earth station number that the International Maritime Satellite Organization designates.

Fig. 14 Composition of a transmitting signal for communication (limited to the communication for data transmission exceeding 300 bits/s) based on the radio telegraphy of INMARSAT B radio equipment of INMARSAT ship earth stations

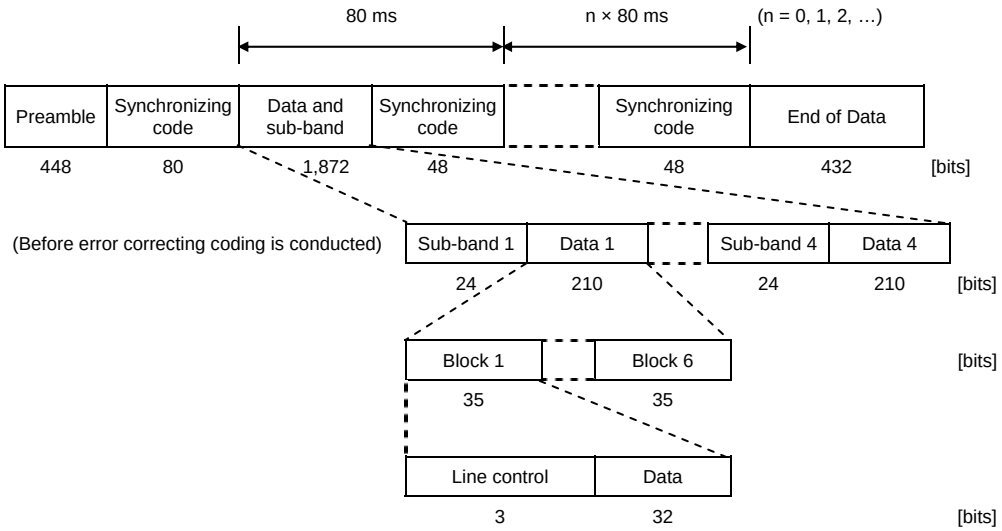


Fig. 15 Composition of a transmitting signal for communication based on the radio telegraphy of INMARSAT B radio equipment of INMARSAT ship earth stations

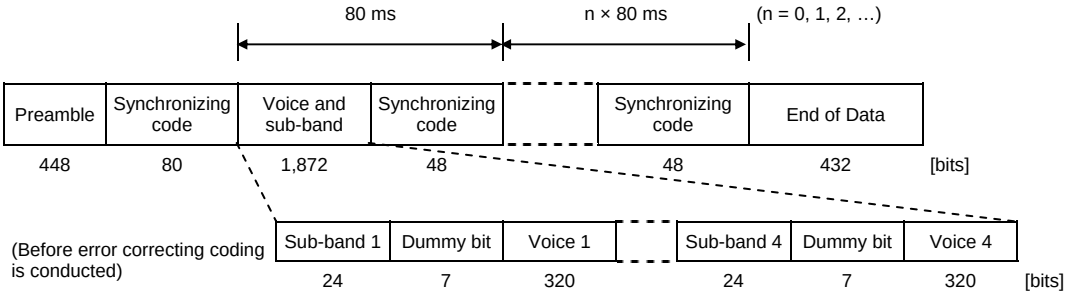


Fig. 16 Composition of a paging and responding signal based on INMARSAT B radio equipment of INMARSAT ship earth stations

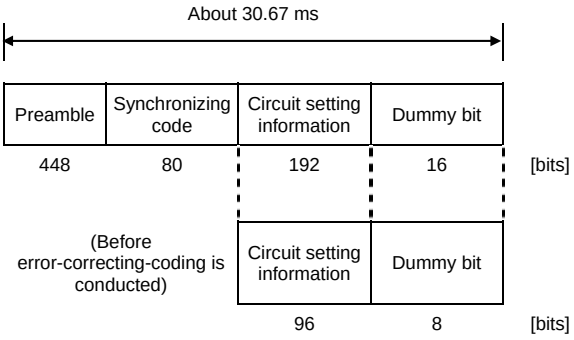
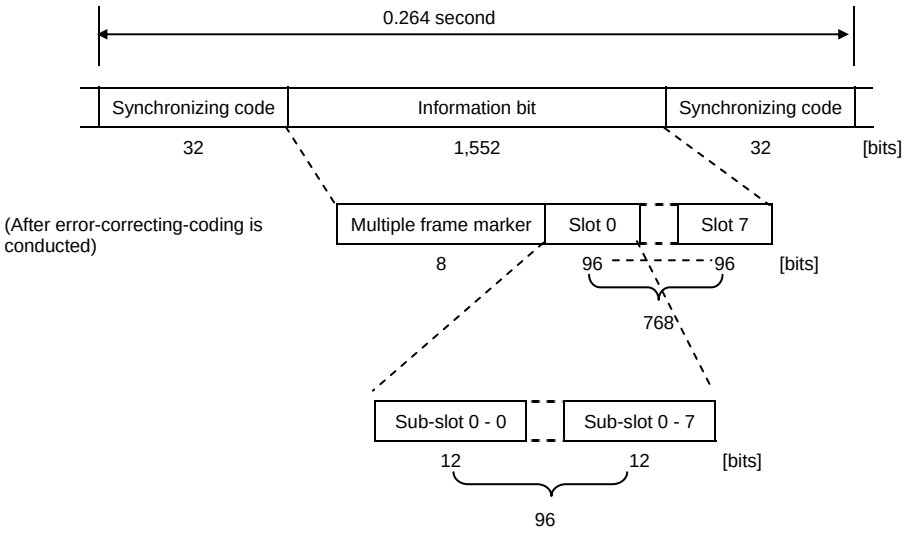
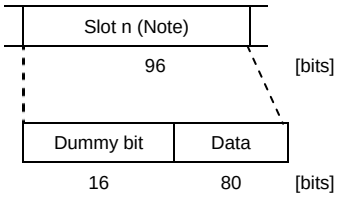


Fig. 17 Composition of a receiving signal for communication (limited to the communication whose transmission rate is 300 bits/s when data transmission is performed) based on the radio telegraphy of INMARSAT B radio equipment of INMARSAT ship earth stations

(1) Composition of receiving time slot

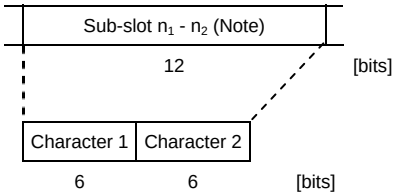


(2) Composition of a receiving signal when data transmission based communication is performed



Note: n shall be the slot number that a coast earth station designates.

(3) Composition of a receiving signal when radio telegraphy based communication except for data transmission is performed



Note: n_1 and n_2 shall be the slot number and sub-slot number that a coast earth station designates respectively.

Fig. 18 Composition of a transmitting signal for communication based on the radio telegraphy of INMARSAT M radio equipment of INMARSAT ship earth stations

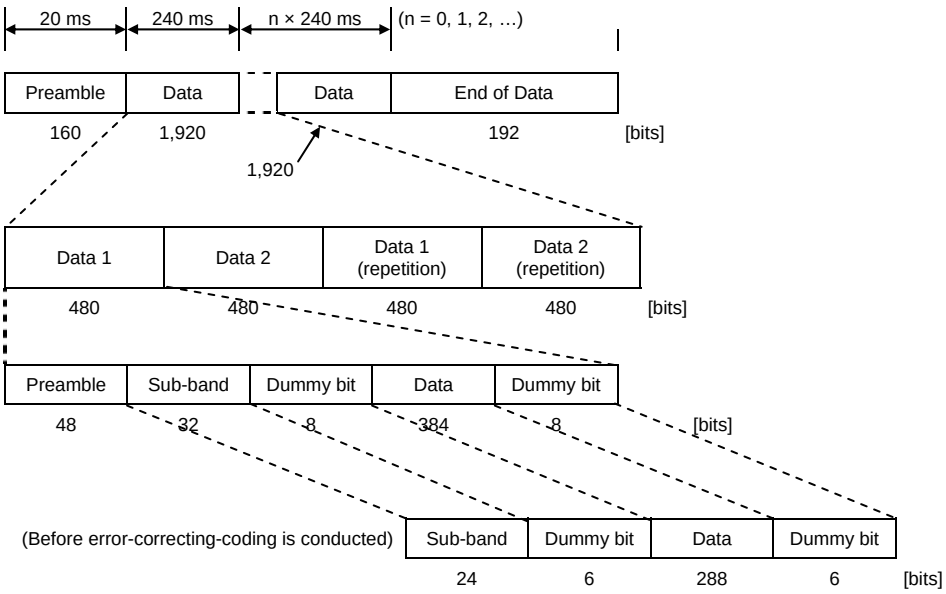
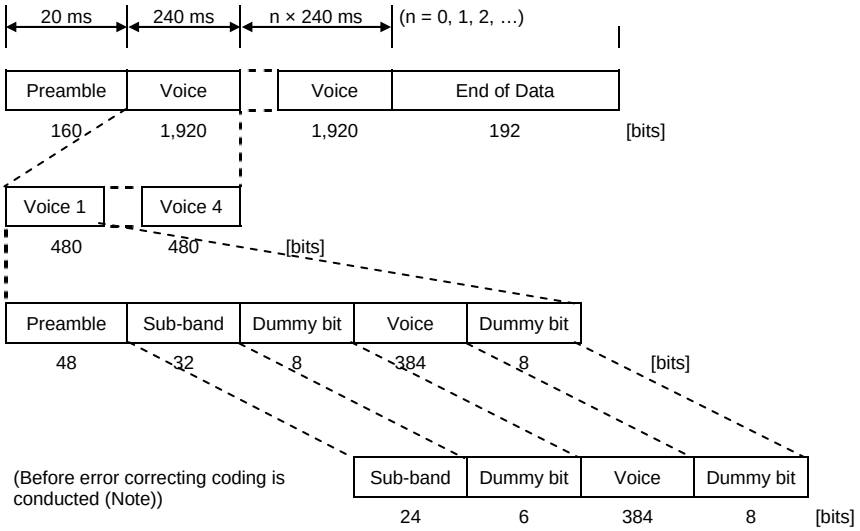


Fig. 19 Composition of a transmitting signal for communication based on the radio telephony of INMARSAT M radio equipment of INMARSAT ship earth stations



Note: Error correcting coding shall be implemented only for a sub-band and a dummy bit which follows it.

Fig. 20 Composition of a paging and responding signal based on INMARSAT M radio equipment of INMARSAT ship earth stations