Democratic Socialist Republic of Sri Lanka

Civil Aviation Authority of Sri Lanka

Implementing Standards

(Issued under Sec. 120, Civil Aviation Act No. 14 of 2010)

Title: Conformance to Annex-10-Aeronautical Telecommunications Vol. III (Part II) (Voice Communication Systems)

Reference No: IS-10-(iii)-11 **S.N**: 040 **Date**: 25th January 2017

Pursuant to Sec 120 of the Civil Aviation Act No.14 of 2010, Director General of Civil Aviation shall have the power to issue, whenever he considers it necessary or appropriate to do so, such Implementing Standards for the purpose of giving effect to any provision of the Civil Aviation Act, any regulations or Rules made thereunder including the Articles of the Convention on International Civil Aviation specified in the Schedule to the CA Act.

Accordingly, I, the undersigned being the Director General of Civil Aviation do hereby issue the Implementing Standards as mentioned in the Attachment hereto (Ref: Attachment No. IS-10-(iii)-11-Att.), for the purpose of giving effect to the aforementioned Act and standards and procedures described under article 37 of the convention, which are specified in the attachment,

This Implementing Standard shall come into force with immediate effect and shall come in to force with immediate effect and remain in force unless revoked.

Attention is also drawn to sec. 103 of the Act, which states inter alia that failure to comply with Implementing Standard is an offence.

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Enclosure: Attachment No. IS-10-(iii)-11-Att

.Implementing Standards
SN-040: Voice Communication Systems

1. GENERAL

1.1 Introduction

A. Requirements contained in this document are based on the amendment 90 of ICAO Annex 10 –Volume III Part II "Voice Communication Systems".

B. The requirements contained in this document are applicable to Aeronautical Telecommunication Service Providers and Service providers of Aeronautical Aids for Communication Navigation and Surveillance (CNS) in Sri Lanka.

C. This document supersedes the Implementing Standard 040 revision 00 issued by the Director General of Civil Aviation and IS 040 revision 00 which shall be treated as null and void.

D. It may be amended from time to time and the amended text will be reflected with a vertical line on the right side of the text

1. CHAPTER 01 - DEFINITIONS

Material on secondary power supply and guidance material concerning reliability and availability for communication systems is contained in implementing standard 034 Paragraph 2.9

Facility availability. The ratio of actual operating time to specified operating time.

Facility failure. Any unanticipated occurrence which gives rise to an operationally significant period during which a facility does not provide service within the specified tolerances.

Facility reliability. The probability that the ground installation operates within the specified tolerances.

This definition refers to the probability that the facility will operate for a specified period of time.

Mean time between failures (MTBF). The actual operating time of a facility divided by the total number of failures of the facility during that period of time.

The operating time is in general chosen so as to include at least five, and preferably more, facility failures in order to give a reasonable measure of confidence in the figure derived.

Signal reliability. The probability that a signal-in-space of specified characteristics is available to the aircraft.

This definition refers to the probability that the signal is present for a specified period of time.

2. CHAPTER 02 - AERONAUTICAL MOBILE SERVICE

2.1 AIR-GROUND VHF COMMUNICATION SYSTEM CHARACTERISTICS

In the following text the channel spacing for 8.33 kHz channel assignments is defined as 25 kHz divided by 3 which is 8.3333 ... kHz.

2.1.1 The characteristics of the air-ground VHF communication system used in the International Aeronautical Mobile Service shall be in conformity with the following specifications:

2.1.1.1 Radiotelephone emissions shall be double sideband (DSB) amplitude modulated (AM) carriers. The designation of emission is A3E, as specified in the ITU Radio Regulations.

2.1.1.2 Spurious emissions shall be kept at the lowest value which the state of technique and the nature of the service permit.

Appendix S3 to the ITU Radio Regulations specifies the levels of spurious emissions to which transmitters must conform.

2.1.1.3 The radio frequencies used shall be selected from the radio frequencies in the band 117.975 – 137 MHz The separation between assignable frequencies (channel spacing) and frequency tolerances applicable to elements of the system shall be as specified in Volume V.

2.1.1.4 The design polarization of emissions shall be vertical.

2.2 SYSTEM CHARACTERISTICS OF THE GROUND INSTALLATION

2.2.1 Transmitting function

2.2.1.1 *Frequency stability* – The radio frequency of operation shall not vary more than plus or minus 0.005 per cent from the assigned frequency. Where 25 kHz channel spacing is introduced in accordance with the aeronautical frequency spectrum utilization, the radio frequency of operation shall not vary more than plus or minus 0.002 per cent from the assigned frequency. Where 8.33 kHz channel spacing is introduced in accordance with Volume V, the radio frequency of operation shall not vary more than plus or minus 0.0001 per cent from the assigned frequency.

The above frequency stability requirements will not be sufficient for offset carrier systems using 25 kHz channel spacing or higher.

2.2.1.1.1 Offset carrier systems in 8.33 kHz, 25 kHz, 50 kHz and 100 kHz channel spaced environments. The stability of individual carriers of an offset carrier system shall be such as to prevent first-order heterodyne frequencies of less than 4 kHz and, additionally, the maximum frequency excursion of the outer carrier frequencies from the assigned carrier frequency shall not exceed 8 kHz. Offset carrier systems for 8.33 kHz channel spacing shall be limited to two-carrier systems using a carrier offset of plus and minus 2.5 kHz.

2.2.1.2 Power

On a high percentage of occasions, the effective radiated power should be such as to provide a field strength of at least 75 microvolts per metre (minus 109 dB/m^2) within the defined operational coverage of the facility, on the basis of free-space propagation.

2.2.1.3 *Modulation* – A peak modulation factor of at least 0.85 shall be achievable.

2.2.1.4 Means should be provided to maintain the average modulation factor at the highest practicable value without over modulation.

2.2.2 Receiving function

2.2.2.1 *Frequency stability* – Where 8.33 kHz channel spacing is introduced in accordance with Volume V, the radio frequency of operation shall not vary more than plus or minus 0.0001 per cent from the assigned frequency.

2.2.2.2 *Sensitivity* – After due allowance has been made for feeder loss and antenna polar diagram variation, the sensitivity of the receiving function shall be such as to provide on a high percentage of occasions an audio output signal with a wanted/unwanted ratio of 15 dB, with a 50 per cent amplitude modulated (A3E) radio signal having a field strength of 20 microvolts per metre (minus 120 dBW/m^2) or more.

2.2.2.3 *Effective acceptance bandwidth* – When tuned to a channel having a width of 25 kHz, 50 kHz or 100 kHz, the receiving system shall provide an adequate and intelligible audio output when the signal specified at 2.2.2.2 has a carrier frequency within plus or minus 0.005 per cent of the assigned frequency. When tuned to a channel having a width of 8.33 kHz, the receiving system shall provide an adequate and intelligible audio output when the signal specified at 2.2.2.2 has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency.

The effective acceptance bandwidth includes Doppler shift.

2.2.2.4 *Adjacent channel rejection.* The receiving system shall ensure an effective rejection of 60 dB or more at the next assignable channel.

The next assignable frequency will normally be plus or minus 50 kHz. Where this channel spacing will not suffice, the next assignable frequency will be plus or minus 25 kHz, or plus or minus 8.33 kHz, implemented in accordance with the provisions of Volume V. It is recognized that in certain areas of the world receivers designed for 25 kHz, 50 kHz or 100 kHz channel spacing may continue to be used.

2.3 SYSTEM CHARACTERISTICS OF THE AIRBORNE INSTALLATION

2.3.1 Transmitting function

2.3.1.1 *Frequency stability* – The radio frequency of operation shall not vary more than plus or minus 0.005 per cent from the assigned frequency. Where 25 kHz channel spacing is introduced, the radio frequency of operation shall not vary more than plus or minus 0.003 per cent from the assigned frequency. Where 8.33 kHz channel spacing is introduced, the radio frequency of operation shall not vary more than plus or minus 0.0005 per cent from the assigned frequency.

2.3.1.2 *Power* – On a high percentage of occasions, the effective radiated power shall be such as to provide a field strength of at least 20 microvolts per metre (minus 120 dB/m^2) on the basis of free space propagation, at ranges and altitudes appropriate to the operational conditions pertaining to the areas over which the aircraft is operated.

2.3.1.3 *Adjacent channel power* – The amount of power from a 8.33 kHz airborne transmitter under all operating conditions when measured over a 7 kHz channel bandwidth centred on the first 8.33 kHz adjacent channel shall not exceed -45 dB below the transmitter carrier power. The above adjacent channel power shall take into account the typical voice spectrum.

The voice spectrum is assumed to be a constant level between 300 and 800 Hz and attenuated by 10 dB per octave above 800 Hz.

2.3.1.4 *Modulation* – A peak modulation factor of at least 0.85 shall be achievable.

2.3.1.5 Means should be provided to maintain the average modulation factor at the highest practicable value without over modulation.

2.3.2 Receiving function

2.3.2.1 *Frequency stability* – Where 8.33 kHz channel spacing is introduced in accordance with Volume V, the radio frequency of operation shall not vary more than plus or minus 0.0005 per cent from the assigned frequency.

2.3.2.2 Sensitivity

2.3.2.2.1 After due allowance has been made for aircraft feeder mismatch, attenuation loss and antenna polar diagram variation, the sensitivity of the receiving function should be such as to provide on a high percentage of occasions an audio output signal with a wanted/unwanted ratio of 15 dB, with a 50 per cent amplitude modulated (A3E) radio signal having a field strength of 75 microvolts per metre (minus 109 dBW/m^2).For planning extended range VHF facilities, an airborne receiving function sensitivity of 30 microvolts per metre may be assumed.

2.3.2.3 Effective acceptance bandwidth for 100 kHz, 50 kHz and 25 kHz channel spacing receiving installations. When tuned to a channel designated according to the aeronautical frequency spectrum utilization as having a width of 25 kHz, 50 kHz or 100 kHz, the receiving function shall ensure an effective acceptance bandwidth as follows:

a. in areas where offset carrier systems are employed, the receiving function shall provide an adequate audio output when the signal specified at 2.3.2.2 has a carrier frequency within 8 kHz of the assigned frequency;

b. in areas where offset carrier systems are not employed, the receiving function shall provide an adequate audio output when the signal specified at 2.3.2.2 has a carrier frequency of plus or minus 0.005 per cent of the assigned frequency.

2.3.2.4 Effective acceptance bandwidth for 8.33 kHz channel spacing receiving installations. When tuned to a channel designated in Volume V, as having a width of 8.33 kHz, the receiving function shall ensure an effective acceptance bandwidth as follows:

a. in areas where offset carrier systems are employed, the receiving function shall provide an adequate audio output when the signal specified in 2.3.2.2 has a carrier frequency of plus or minus 2.5 kHz of the assigned frequency; and

b. in areas where offset carrier systems are not employed, the receiving function shall provide an adequate audio output when the signal specified in 2.3.2.2 has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency.

The effective acceptance bandwidth includes Doppler shift.

When using offset carrier systems (ref. 2.3.2.3 and 2.3.2.4), receiver performance may become degraded when receiving two or more similar strength offset carrier signals. Caution is therefore advised with the implementation of offset carrier systems.

2.3.2.5 *Adjacent channel rejection* – The receiving function shall ensure an effective adjacent channel rejection as follows:

a. *8.33 kHz channels:* 60 dB or more at plus or minus 8.33 kHz with respect to the assigned frequency, and 40 dB or more at plus or minus 6.5 kHz;

The receiver local oscillator phase noise should be sufficiently low to avoid any degradation of the receiver capability to reject off carrier signals. A phase noise level better than minus

99 dBs/Hz 8.33 kHz away from the carrier is necessary to comply with 45 dB adjacent channel rejection under all operating conditions.

b. 25 kHz channel spacing environment: 50 dB or more at plus or minus 25 kHz with respect to the assigned frequency and 40 dB or more at plus or minus 17 kHz;

c. 50 kHz channel spacing environment: 50 dB or more at plus or minus 50 kHz with respect to the assigned frequency and 40 dB or more at plus or minus 35 kHz;

d. 100 kHz channel spacing environment: 50 dB or more at plus or minus 100 kHz with respect to the assigned frequency.

2.3.2.6 Whenever practicable, the receiving system should ensure an effective adjacent channel rejection characteristic of 60 dB or more at plus or minus 25 kHz, 50 kHz and100 kHz from the assigned frequency for receiving systems intended to operate in channel spacing environments of 25 kHz, 50 kHz and 100 kHz, respectively. Frequency planning is normally based on an assumption of 60 dB effective adjacent channel rejection at plus or minus 25 kHz, 50 kHz or 100 kHz from the assigned frequency as appropriate to the channel spacing environment.

2.3.2.7 In the case of receivers complying with 2.3.2.3 or 2.3.2.4 used in areas where offset carrier systems are in force, the characteristics of the receiver should be such that:

a. the audio frequency response precludes harmful levels of audio heterodynes resulting from the reception of two or more offset carrier frequencies;

b. the receiver muting circuits, if provided, operate satisfactorily in the presence of audio heterodynes resulting from the reception of two or more offset carrier frequencies.

2.3.2.8 VDL—Interference Immunity Performance

2.3.2.8.1 For equipment intended to be used in independent operations of services applying DSB-AM and VDL technology on board the same aircraft, the receiving function shall provide an adequate and intelligible audio output with a desired signal field strength of not more than 150 microvolts per metre (minus 102 dBW/m^2) and with an undesired VDL signal field strength of at least 50 dB above the desired field strength on any assignable channel 100 kHz or more away from the assigned channel of the desired signal.

This level of VDL interference immunity performance provides a receiver performance consistent with the influence of the VDL RF spectrum mask as specified in Volume III, Part I, 6.3.4 with an effective transmitter/receiver isolation of 68 dB. Better transmitter and receiver performance could result in less isolation required.

2.3.2.8.2 After 1 January 2002, the receiving function of all new installations intended to be used in independent operations of services applying DSB-AM and VDL technology on board the same aircraft shall meet the provisions of 2.3.2.8.1.

2.3.2.8.3 After 1 January 2005, the receiving function of all installations intended to be used in independent operations of services applying DSB-AM and VDL technology on board the same aircraft shall meet the provisions of 2.3.2.8.1, subject to the conditions of 2.3.2.8.4.

2.3.2.8.4 Requirements for mandatory compliance of the provisions of 2.3.2.8.3 shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales.

2.3.2.8.4.1 The agreement indicated in 2.3.2.8.4 shall provide at least two years' notice of mandatory compliance of airborne systems.

2.3.3 Interference Immunity Performance

2.3.3.1 After 1 January 1998, the VHF communications receiving system shall provide satisfactory performance in the presence of two signal, third-order intermodulation products caused by VHF FM broadcast signals having levels at the receiver input of minus 5 dBm.

2.3.3.2 After 1 January 1998, the VHF communications receiving system shall not be desensitized in the presence of VHF FM broadcast signals having levels at the receiver input of minus 5 dBm.

2.3.3.3 After 1 January 1995, all new installations of airborne VHF communications receiving systems shall meet the provisions of 2.3.3.1 and 2.3.3.2.

2.3.3.4 Airborne VHF communications receiving systems meeting the immunity performance Standards of 2.3.3.1 and 2.3.3.2 should be placed into operation at the earliest possible date.

2.4 SINGLE SIDEBAND (SSB) HF COMMUNICATION SYSTEM CHARACTERISTICS FOR USE IN THE AERONAUTICAL MOBILE SERVICE

2.4.1 The characteristics of the air-ground HF SSB system, where used in the Aeronautical Mobile Service, shall be in conformity with the following specifications.

2.4.1.1 Frequency Range

2.4.1.1.1 HF SSB installations shall be capable of operation at any SSB carrier (reference) frequency available to the Aeronautical Mobile (R) Service in the band 2.8 MHz to 22 MHz and necessary to meet the approved assignment plan for the region(s) in which the system is intended to operate, and in compliance with the relevant provisions of the Radio Regulations.

2.4.1.1.2 The equipment shall be capable of operating on integral multiples of 1 kHz.

2.4.1.2 Sideband Selection

2.4.1.2.1 The sideband transmitted shall be that on the higher frequency side of its carrier (reference) frequency.

2.4.1.3 Carrier (Reference) Frequency

2.4.1.3.1 Channel utilization shall be in conformity with the table of carrier (reference) frequencies at 27/16 and the Allotment Plan at 27/186 to 27/207 inclusive (or frequencies established on the basis of 27/21, as may be appropriate) of Appendix S27.

2.4.1.4 Classes of Emission and Carrier Suppression

2.4.1.4.1 The system shall utilize the suppressed carrier class of emission J3E (also J7B and J9B as applicable). When SELCAL is employed as specified in Chapter 3 of Part II, the installation shall utilize class H2B emission.

2.4.1.4.2 By 1 February 1982, aeronautical stations and aircraft stations shall have introduced the appropriate classes of emission prescribed in 2.4.1.4.1. Affective this date the use of class A3E emission shall be discontinued except as provided in 2.4.1.4.4.

2.4.1.4.3 Until 1 February 1982 aeronautical stations and aircraft stations equipped for single sideband operations shall also be equipped to transmit class H3E emission where required to be compatible with reception by double sideband equipment. Effective this date the use of class H3E emission shall be discontinued except as provided in 2.4.1.4.4.

2.4.1.4.4 For stations directly involved in coordinated search and rescue operations using the frequencies 3 023 kHz and 5 680 kHz, the class of emission J3E should be used; however, since maritime mobile and land mobile services may be involved, A3E and H3E classes of emission may be used.

2.4.1.4.5 After 1 April 1981 no new DSB equipment shall be installed.

2.4.1.4.6 Aircraft station transmitters shall be capable of at least 26 dB carrier suppression with respect to peak envelope power (P_p) for classes of emission J3E, J7B or J9B. ∗ All figures are located at the end of this chapter.

2.4.1.4.7 Aeronautical station transmitters shall be capable of 40 dB carrier suppression with respect to peak envelope power (P_p) for classes of emission J3E, J7B or J9B.

2.4.1.5 Audio Frequency Bandwidth

2.4.1.5.1 For radiotelephone emissions the audio frequencies shall be limited to between 300 and 2 700 Hz and the occupied bandwidth of other authorized emissions shall not exceed the upper limit of J3E emissions. In specifying these limits, however, no restriction in their extension shall be implied in so far as emissions other than J3E are concerned, provided that the limits of unwanted emissions are met (see 2.4.1.7).For aircraft and aeronautical station transmitter types first installed before 1 February 1983 the audio frequencies will be limited to 3 000 Hz.

2.4.1.5.2 For other authorized classes of emission the modulation frequencies shall be such that the required spectrum limits of 2.4.1.7 will be met.

2.4.1.6 Frequency Tolerance

2.4.1.6.1 The basic frequency stability of the transmitting function for classes of emission J3E, J7B or J9B shall be such that the difference between the actual carrier of the transmission and the carrier (reference) frequency shall not exceed:

- 20 Hz for airborne installations;
- 10 Hz for ground installations.

2.4.1.6.2 The basic frequency stability of the receiving function shall be such that, with the transmitting function stabilities specified in 2.4.1.6.1, the overall frequency difference between ground and airborne functions achieved in service and including Doppler shift, does not exceed 45 Hz. However, a greater frequency difference shall be permitted in the case of supersonic aircraft.

2.4.1.7 Spectrum Limits

2.4.1.7.1 For aircraft station transmitter types and for aeronautical station transmitters first installed before 1 February 1983 and using single sideband classes of emission H2B, H3E, J3E, J7B or J9B the mean power of any emission on any discrete frequency shall be less than the mean power (P_m) of the transmitter in accordance with the following:

- on any frequency removed by 2 kHz or more up to 6 kHz from the assigned frequency: at least 25 dB;
- on any frequency removed by 6 kHz or more up to 10 kHz from the assigned frequency: at least 35 dB;
- on any frequency removed from the assigned frequency by 10 kHz or more:
  a. aircraft station transmitters: 40 dB;
  b. aeronautical station transmitters:

$$[43 + 10 \log_{10} P_m\ (W)]\ dB$$

2.4.1.7.2 For aircraft station transmitters first installed after 1 February 1983 and for aeronautical station transmitters in use as of 1 February 1983 and using single sideband classes of emission H2B, H3E, J3E, J7B or J9B, the peak envelope power (P_p) of any emission on any discrete frequency shall be less than the peak envelope power (P_p) of the transmitter in accordance with the following:

- on any frequency removed by 1.5 kHz or more up to 4.5 kHz from the assigned frequency: at least 30 dB;
- on any frequency removed by 4.5 kHz or more up to 7.5 kHz from the assigned frequency: at least 38 dB;

- on any frequency removed from the assigned frequency by 7.5 kHz or more:
  a. aircraft station transmitters: 43 dB;
  b. aeronautical station transmitters: for transmitter power up to and including 50 W:

$$[43 + 10 \log_{10} P_p\ (W)]\ dB$$

For transmitter power more than 50 W: 60 dB

See Figures 2-1 and 2-2.

2.4.1.8 Power

2.4.1.8.1 *Aeronautical station installation* – Except as permitted by the relevant provisions of Appendix S27 to the ITU Radio Regulations, the peak envelope power (*Pp*) supplied to the antenna transmission line for H2B, H3E, J3E, J7B or J9B classes of emissions shall not exceed a maximum value of 6 kW.

2.4.1.8.2 *Aircraft station installations* – The peak envelope power supplied to the antenna transmission line for H2B, H3E, J3E, J7B or J9B classes of emission shall not exceed 400 W except as provided for in Appendix S27 of the ITU Radio Regulations as follows:

S27/68 It is recognized that the power employed by aircraft transmitters may, in practice, exceed the limits specified in No. 27/60. However, the use of such increased power (which normally should not exceed 600 $W\ P_p$) shall not cause harmful interference to stations using frequencies in accordance with the technical principles on which the Allotment Plan is based.

S27/60 Unless otherwise specified in Part II of this Appendix, the peak envelope powers supplied to the antenna transmission line shall not exceed the maximum values indicated in the table below; the corresponding peak effective radiated powers being assumed to be equal to two-thirds of these values:

Class of emission Stations

Class of emission	*Stations*	*Max. peak envelope power (P_p)*
H2B, J3E, J7B, J9B, A3E*, H3E* (100% modulation)	Aeronautical stations Aircraft stations	6 kW 400 W
Other emission such as A1A, F1B	Aeronautical stations Aircraft stations	1.5 kW 100 W

* A3E and H3E to be used only on 3 023 kHz and 5 680 kHz.

2.4.1.9 *Method of operation.* Single channel simplex shall be employed.

2.5 SATELLITE VOICE COMMUNICATION (SATVOICE) SYSTEM CHARACTERISTICS

Note: Guidance material for the implementation of the aeronautical mobile satellite service is contained in the Manual of aeronautical Mobile satellite (Route) Service (Doc. 9925). Additional guidance for SATVOICE systems is contained in the Satellite Voice Operations Manual (Doc. 10038), and the Performance – based Communication and Surveillance (PBCS) Manual (Doc. 9869)

2.5.1 For ground – to- air calls, the SATVOICE system shall be capable of contacting the aircraft and enabling the ground party/system to provide, as a minimum, the following,

a. secure calling

b. priority level as defined in Table 2-1, and

c. aircraft SATVOICE number, which is the aircraft address expressed as an 8-digit octal number.

2.5.2 For ground-to- air calls, the SATVOICE the system shall be capable of locating the aircraft in the appropriate airspace regardless of the satellite and ground earth station (GES) to which the aircraft is logged on.

2.5.3 For air-to- ground calls, the SATVOICE system shall be capable of:

a. contacting the aeronautical station via an assigned SATVOICE number, which is a unique6-digit number or public switched telephone network (PSTN) number, and

b. allowing the flight crew and/or aircraft system to specify the priority level for the call as defined in Table 2-1.

Table 2-1. Priority levels for SATVOICE calls (air-to-ground/ ground –to- air)

Priority level	Application category
1/EMG/Q15 Emergency (highest) Safety of Flight	Distress and urgency For use by Flight crew
2/HGH/Q12 Operational high (second highest)	Flight Safety Typically assigned to calls between aircraft and ANSP
3/ Low/Q10 Operational low (third highest)	Regularity of flight, meteorological, administrative. Typically assigned to calls between aircraft and operators and their aircraft
4/PUB/Q9 Non-operational (lowest) Non safety	Public correspondence

FIGURES FOR CHAPTER 2

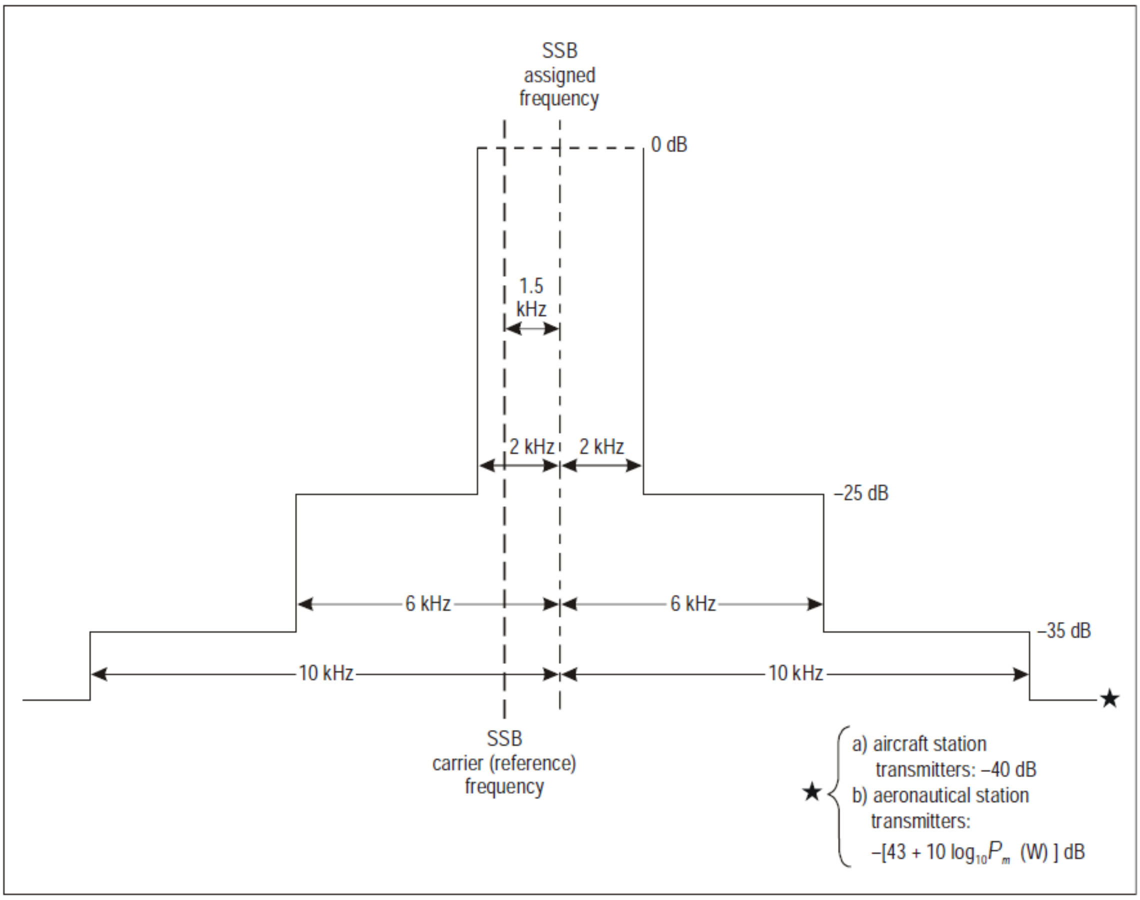

Figure2-1. Required spectrum limits (in terms of mean power) for aircraft station transmitter types and for aeronautical station transmitters first installed before 1 February 1983

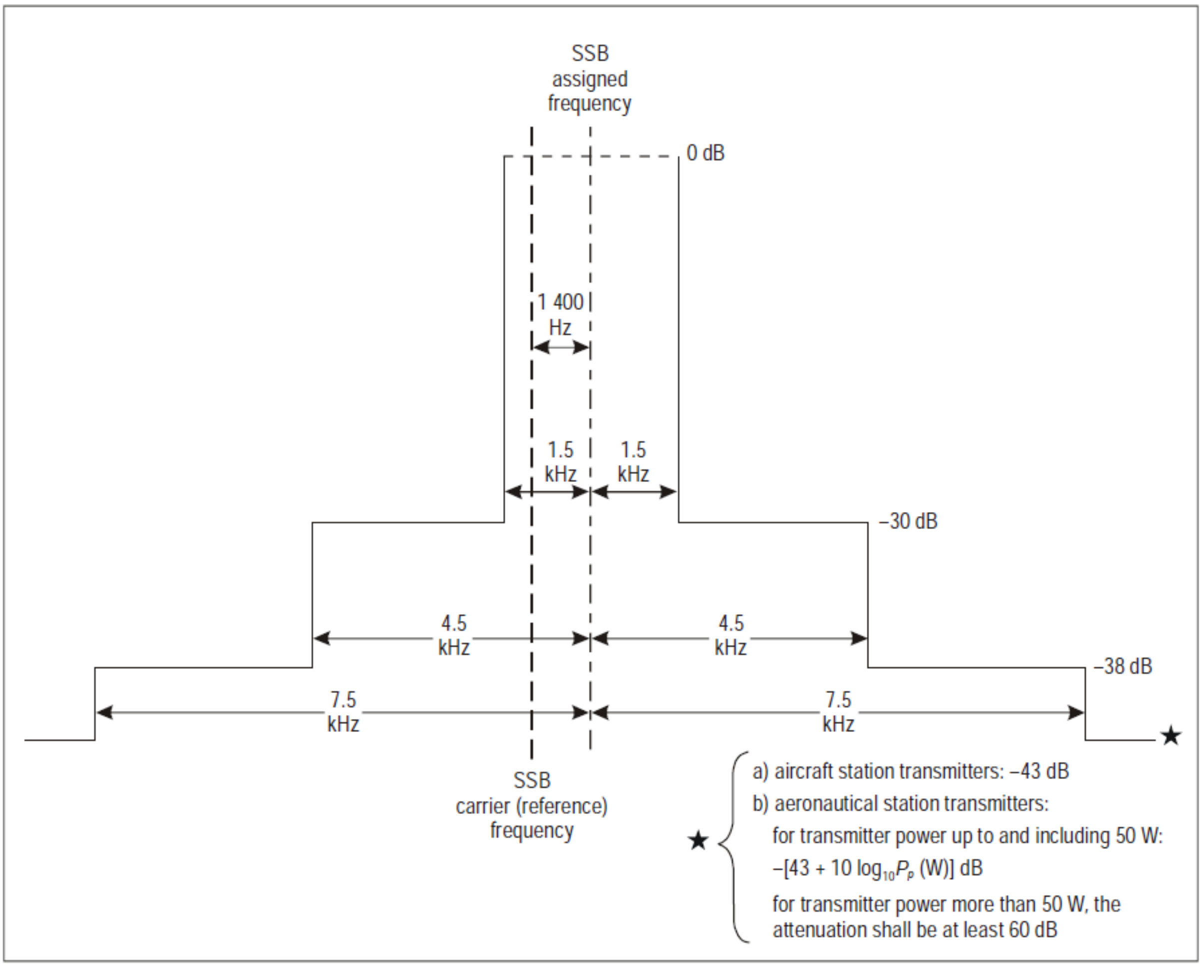

Figure 2-2. Required spectrum limits (in terms of peak power) for aircraft station transmitters first installed after 1 February 1983 and aeronautical station transmitters in use after 1 February 1983

3. CHAPTER 03 - SELCAL SYSTEM

3.1 Where a SELCAL system is installed, the following system characteristics should be applied:

a. Transmitted code – Each transmitted code should be made up of two consecutive tone pulses, with each pulse containing two simultaneously transmitted tones. The pulses should be of 1.0 plus or minus 0.25 seconds duration, separated by an interval of 0.2 plus or minus 0.1 second.

b. Stability – The frequency of transmitted tones should be held to plus or minus 0.15 per cent tolerance to ensure proper operation of the airborne decoder.

c. Distortion – The overall audio distortion present on the transmitted RF signal should not exceed 15 per cent.

d. Per cent modulation – The RF signal transmitted by the ground radio station should contain, within 3 dB, equal amounts of the two modulating tones. The combination of tones should result in a modulation envelope having a nominal modulation percentage as high as possible and in no case less than 60 per cent.

e. Transmitted tones – Tone codes should be made up of various combinations of the tones listed in the following table and designated by colour and letter as indicated:

Designation	*Frequency (Hz)*
Red A	*312.6*
Red B	*346.7*
Red C	*384.6*
Red D	*426.6*
Red E	*473.2*
Red F	*524.8*
Red G	*582.1*
Red H	*645.7*
Red J	*716.1*
Red K	*794.3*
Red L	*881.0*
Red M	*977.2*
Red P	*1 083.9*
Red Q	*1 202.3*
Red R	*1 333.5*
Red S	*1 479.1*

It should be noted that the tones are spaced by Log–1 0.045 to avoid the possibility of harmonic combinations.

In accordance with the application principles developed by the Sixth Session of the Communications Division, the only codes at present used internationally are selected from the red group.

The tones Red P, Red Q, Red R, and Red S are applicable after 1 September 1985, in accordance with 3.2.

3.2 As from 1 September 1985, aeronautical stations which are required to communicate with SELCAL-equipped aircraft shall have SELCAL encoders in accordance with the red group in the table of tone frequencies of 3.1. After 1 September 1985, SELCAL codes using the tones Red P, Red Q, Red R, and Red S may be assigned.

4. CHAPTER 04 - AERONAUTICAL SPEECH CIRCUITS

4.1 TECHNICAL PROVISIONS RELATING TO INTERNATIONAL AERONAUTICAL SPEECH CIRCUIT SWITCHING AND SIGNALLING FOR GROUND-GROUND APPLICATIONS

4.1.1 The use of circuit switching and signaling to provide speech circuits to interconnect ATS units not interconnected by dedicated circuits shall be by agreement between the Administrations concerned.

4.1.2 The application of aeronautical speech circuit switching and signaling shall be made on the basis of regional air navigation agreements.

4.1.3 ATC communication requirements defined in Implementing Standard 025 Section 6.2 should be met by implementation of one or more of the following basic three call types:

a. instantaneous access;
b. direct access; and
c. indirect access.

4.1.4 In addition to the ability to make basic telephone calls, the following functions should be provided in order to meet the requirements set out in IS 025

a. means of indicating the calling/called party identity;
b. means of initiating urgent/priority calls; and
c. conference capabilities.

4.1.5 The characteristics of the circuits used in aeronautical speech circuit switching and signaling should conform to appropriate ISO/IEC international standards and ITU-T recommendations.

4.1.6 Digital signaling systems should be used wherever their use can be justified in terms of any of the following:

a. improved quality of service;
b. improved user facilities; or
c. reduced costs where quality of service is maintained.

4.1.7 The characteristics of supervisory tones to be used (such as ringing, busy, number unobtainable) should conform to appropriate ITU-T recommendations.

4.1.8 To take advantage of the benefits of interconnecting regional and national aeronautical speech networks, the international aeronautical telephone network numbering scheme should be used

5. CHAPTER 05 - EMERGENCY LOCATOR TRANSMITTER (ELT) FOR SEARCH AND RESCUE

5.1 GENERAL

5.1.1 Emergency locator transmitters shall operate either on both 406 MHz and 121.5 MHz or on 121.5 MHz

ELTs operating on 121.5 MHz will be required to meet the improved technical characteristics contained in 5.2.1.8.

5.1.2 All installations of emergency locator transmitters operating on 406 MHz shall meet the provisions of 5.3.

5.1.3 All installations of emergency locator transmitters operating on 121.5 MHz shall meet the provisions of 5.2.

5.1.4 Emergency locator transmitters shall operate on 406 MHz and 121.5 MHz simultaneously.

5.1.5 All emergency locator transmitters installed on or after 1 January 2002 shall operate simultaneously on 406 MHz and 121.5 MHz

5.1.6 The technical characteristics for the 406 MHz component of an integrated ELT shall be in accordance with 5.3.

5.1.7 The technical characteristics for the 121.5 MHz component of an integrated ELT shall be in accordance with 5.2.

5.1.8 States shall make arrangements for a 406 MHz ELT register. Register information regarding the ELT shall be immediately available to search and rescue authorities. States shall ensure that the register is updated whenever necessary.

5.1.9 ELT register information shall include the following:

a. transmitter identification (expressed in the form of an alphanumerical code of 15 hexadecimal characters);

b. transmitter manufacturer, model and, when available, manufacturer’s serial number;

c. COSPAS-SARSAT* type approval number;

d. name, address (postal and e-mail) and emergency telephone number of the owner and operator;

e. name, address (postal and e-mail) and telephone number of other emergency contacts (two, if possible) to whom the owner or the operator is known;

f. aircraft manufacturer and type; and

g. colour of the aircraft.

* COSPAS = Space system for search of vessels in distress;

SARSAT = Search and rescue satellite-aided tracking.

5.2 SPECIFICATION FOR THE 121.5 MHz COMPONENT OF EMERGENCY LOCATOR TRANSMITTER (ELT) FOR SEARCH AND RESCUE

Information on technical characteristics and operational performance of 121.5 MHz ELTs is contained in RTCA Document DO-183 and European Organization for Civil Aviation Equipment (EUROCAE) Document ED.62.

Technical characteristics of emergency locator transmitters operating on 121.5 MHz are contained in ITU-R Recommendation M.690-1. The ITU designation for an ELT is Emergency Position — Indicating Radio Beacon (EPIRB).

5.2.1 Technical characteristics

5.2.1.1 Emergency locator transmitters (ELT) shall operate on 121.5 MHz. The frequency tolerance shall not exceed plus or minus 0.005 per cent.

5.2.1.2 The emission from an ELT under normal conditions and attitudes of the antenna shall be vertically polarized and essentially omnidirectional in the horizontal plane.

5.2.1.3 Over a period of 48 hours of continuous operation, at an operating temperature of minus 20°C, the peak effective radiated power (PERP) shall at no time be less than 50 mW

5.2.1.4 The type of emission shall be A3X. Any other type of modulation that meets the requirements of 5.2.1.5, 5.2.1.6 and 5.2.1.7 may be used provided that it will not prejudice precise location of the beacon by homing equipment.

Some ELTs are equipped with an optional voice capability (A3E) in addition to the A3X emission.

5.2.1.5 The carrier shall be amplitude modulated at a modulation factor of at least 0.85.

5.2.1.6 The modulation applied to the carrier shall have a minimum duty cycle of 33 per cent.

5.2.1.7 The emission shall have a distinctive audio characteristic achieved by amplitude modulating the carrier with an audio frequency sweeping downward over a range of not less than 700 Hz within the range 1 600 Hz to 300 Hz and with a sweep repetition rate of between 2 Hz and 4 Hz.

5.2.1.8 The emission shall include a clearly defined carrier frequency distinct from the modulation sideband components; in particular, at least 30 per cent of the power shall be contained at all times within plus or minus 30 Hz of the carrier frequency on 121.5 MHz.

5.3 SPECIFICATION FOR THE 406 MHz COMPONENT OF EMERGENCY LOCATOR TRANSMITTER (ELT) FOR SEARCH AND RESCUE

5.3.1 Technical characteristics

Transmission characteristics for 406 MHz emergency locator transmitters are contained in ITU-R M.633.

Information on technical characteristics and operational performance of 406 MHz ELTs is contained in RTCA Document DO-204 and European Organization for Civil Aviation Equipment (EUROCAE) Document ED-62.

5.3.1.1 Emergency locator transmitters shall operate on one of the frequency channels assigned for use in the frequency band 406.0 to 406.1 MHz

The COSPAS-SARSAT 406 MHz channel assignment plan is contained in COSPAS-SARSAT Document C/S T.012.

5.3.1.2 The period between transmissions shall be 50 seconds plus or minus 5 per cent.

5.3.1.3 Over a period of 24 hours of continuous operation at an operating temperature of –20°C, the transmitter power output shall be within the limits of 5 W plus or minus 2 db.

5.3.1.4 The 406 MHz ELT shall be capable of transmitting a digital message.

5.3.2 Transmitter identification coding

5.3.2.1 Emergency locator transmitters operating on 406 MHz shall be assigned a unique coding for identification of the transmitter or aircraft on which it is carried.

5.3.2.2 The emergency locator transmitter shall be coded in accordance with either the aviation user protocol or one of the serialized user protocols described in the Appendix to this chapter, and shall be registered with the appropriate authority.

APPENDIX TO CHAPTER 5. EMERGENCY LOCATOR TRANSMITTER CODING
(see Chapter 5, 5.3.2)

A detailed description of beacon coding is contained in Specification for COSPAS-SARSAT 406 MHz Distress Beacons (C/S T.001). The following technical specifications are specific to emergency locator transmitters used in aviation.

1. GENERAL

1.1 The emergency locator transmitter (ELT) operating on 406 MHz shall have the capacity to transmit a programmed digital message which contains information related to the ELT and/or the aircraft on which it is carried.

1.2 The ELT shall be uniquely coded in accordance with 1.3 and be registered with the appropriate authority.

1.3 The ELT digital message shall contain either the transmitter serial number or one of the following information elements:

a. aircraft operating agency designator and a serial number;

b. 24-bit aircraft address;

c. aircraft nationality and registration marks.

1.4 All ELTs shall be designed for operation with the COSPAS-SARSAT* system and be type approved.

Note:- Transmission characteristics of the ELT signal can be confirmed by making use of the COSPAS-SARSAT Type Approval Standard (C/S T.007).

2. ELT CODING

2.1 The ELT digital message shall contain information relating to the message format, coding protocol, country code, identification data and location data, as appropriate.

2.2 For ELTs with no navigation data provided, the short message format C/S T.001 shall be used, making use of bits 1 through 112. For ELTs with navigation data, if provided, the long message format shall be used, making use of bits 1 through 144.

3. PROTECTED DATA FIELD

3.1 The protected data field consisting of bits 25 through 85 shall be protected by an error correcting code and shall be the portion of the message which shall be unique in every distress ELT.

3.2 A message format flag indicated by bit 25 shall be set to “0” to indicate the short message format or set to “1” to indicate the long format for ELTs capable of providing location data.

COSPAS = Space system for search of vessels in distress;

SARSAT = Search and rescue satellite-aided tracking.

3.3 A protocol flag shall be indicated by bit 26 and shall be set to “1” for user and user location protocols, and “0” for location protocols.A country code, which indicates the State where additional data are available on the aircraft on which the ELT is carried, shall be contained in bits 27 through 36 which designate a three-digit decimal country code number expressed in binary notation.

Country codes are based on the International Telecommunication Union (ITU) country codes shown in Table 4 of Part I, Volume I of the ITU List of Call Signs and Numerical Identities.

3.4 Bits 37 through 39 (user and user location protocols) or bits 37 through 40 (location protocols) shall designate one of the protocols where values “001” and “011” or “0011”, “0100”, “0101”, and “1000” are used for aviation as shown in the examples contained in this appendix.

3.5 The ELT digital message shall contain either the transmitter serial number or an identification of the aircraft or operator as shown below.

3.6 In the serial user and serial user location protocol (designated by bit 26=1 and bits 37 through 39 being “011”), the serial identification data shall be encoded in binary notation with the least significant bit on the right. Bits 40 through 42 shall indicate type of ELT serial identification data encoded where:

- “000” indicates ELT serial number (binary notation) is encoded in bits 44 through 63;
- “001” indicates aircraft operator (3 letter encoded using modified Baudot code shown in Table 5-1) and a serial number (binary notation) are encoded in bits 44 through 61 and 62 through 73, respectively;
- “011” indicates the 24-bit aircraft address is encoded in bits 44 through 67 and each additional ELT number (binary notation) on the same aircraft is encoded in bits 68 through 73.

3.7 In the aviation user or user location protocol (designated by bit 26=1 and bits 37 through 39 being “001”), the aircraft nationality and registration marking shall be encoded in bits 40 through 81, using the modified Baudot code shown in Table 5-1 to encode seven alphanumeric characters. This data shall be right justified with the modified Baudot “space” (“100100”) being used where no character exists.

Bits 84 and 85 (user or user location protocol) or bit 112 (location protocols) shall indicate any homing transmitter that may be integrated in the ELT.

3.8 In standard and national location protocols, all identification and location data shall be encoded in binary notation with the least significant bit right justified. The aircraft operator designator (3 letter code) shall be encoded in 15 bits using a modified Baudot code (Table 5-1) using only the 5 right most bits per letter and dropping the left most bit which has a value of 1 for letters.

Table 5-1. Modified Baudot code

Letter	Code MSB LSB	Figure	Code MSB LSB
A	111000	(-)*	011000
B	110011		
C	101110		
D	110010		
E	110000	3	010000
F	110110		
G	101011		
H	100101		
I	101100		
J	111010	8	001100
K	111110		
L	101001		
M	100111		
N	100110		
O	100011	9	000011
P	101101	0	001101
Q	111101	1	011101
R	101010	4	001010
S	110100		
T	100001	5	000001
U	111100	7	011100
V	101111		
W	111001	2	011001
X	110111	/	010111
Y	110101	6	010101
Z	110001		
( )**	100100		

MSB =most significant LSB =least significant *=hyphen ** =space

EXAMPLE OF CODING (USER LOCATION PROTOCOL)

25	26	←27 36→	←37 39→	←40 83→	85→	←86 106→	←107 112→		←113				132→	←133 144→
1	1	10	3	44	2	21	1	12			13			12
1	1	CC	T	IDENTIFICATION DATA (AS IN ANY OF USER PROTOCOLS ABOVE)	A	21-BIT BCH ERROR CORRECTING CODE	E	LATITUDE			LONGITUDE			12-BIT BCH ERROR CORRECTING CODE
								1	7	4	1	8	4	
								N / S	DEG 0–90 (1 d)	MIN 0–56 (4m)	E / W	DEG 0–180 (1 d)	MIN 0–56 (4m)	

CC = Country Code;
E = Encoded position data source: 1 = Internal navigation device, 0 = External navigation device

EXAMPLE OF CODING (STANDARD LOCATION PROTOCOL)

25	26	←27 36→	←37 40→	←41					85→	←86 106→	107 112	←113					132→	←133 144→
← 61 BITS →											← 26 BITS →							
1	1	10	4	45						21	6	20						12
1	0	CC	PC	IDENTIFICATION DATA		LATITUDE		LONGITUDE			SD	Δ LATITUDE			Δ LONGITUDE			
				24		1	9	1	10			1	5	4	1	5	4	
			0011	AIRCRAFT 24 BIT ADDRESS		N = 0 S = 1	LAT DEG 0–90 (1/4 d)	E = 0 W = 1	LON DEG 0–180 (1/4 d)	21-BIT BCH CODE		= 0 + = 1	MINUTES 0–30 (1 m)	SECONDS 0–56 (4 s)	= 0 + = 1	MINUTES 0–30 (1 m)	SECONDS 0–56 (4 s)	12-BIT BCH CODE
			0101	15	9													
				AIRCRAFT OPER. DESIGNATOR	SERIAL No 1–511													
			0100	10	14													
				C/STA No 1–1023	SERIAL No 1–16383													

CC = Country Code;
PC = Protocol Code 0011 indicates 24-bit aircraft address is encoded;
0101 indicates operating agency and serial number are encoded;
0100 indicates ELT serial number is encoded.
SD = Supplementary Data bits 107 – 110 = 1101;
bit 111 = Encoded Position Data Source (1 = internal; 0 = external)
bit 112: 1 = 121.5 MHz auxiliary radio locating device;
0 = other or no auxiliary radio locating device.

10 bits, all 0s or National use.

COSPAS-SARSAT Type Approval Certificate number in binary notation with the least significant bit on the right, or National use.

Serial number, in binary notation with the least significant bit on the right, of additional ELTs carried in the same aircraft or default to 0s when only one ELT is carried.

Further details on protocol coding can be found in Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001).

All identification and location data are to be encoded in binary notation with the least significant bit on the right except for the aircraft operator designator (3 letter code).

For details on BCH error correcting code see Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001).

EXAMPLE OF CODING (NATIONAL LOCATION PROTOCOL)

25	26	←27 36→	←37 40→	←41						85→	←86 106→	107 112	←113						132→	←133 144→
61 BITS PDF-1											BCH-1	26 BITS PDF-2								BCH-2
1	1	10	4	45							21	6	7			7			6	12
1	0	CC	1000	18 bits ID	27 bits LATITUDE			LONGITUDE			21-BIT BCH CODE	SD	Δ LATITUDE			Δ LONGITUDE			NU	12-BIT BCH CODE
				18	1	7	5	1	8	5			1	2	4	1	2	4		
				NATIONAL ID NUMBER	N = 0 S = 1	DEGREES 0–90 (1 d)	MINUTES 0–58 (2 m)	E = 0 W = 1	DEGREES 0–180 (1 d)	MINUTES 0–58 (2 m)			− = 0 + = 1	MINUTES 0–3 (1 m)	SECONDS 0–56 (4 s)	− = 0 + = 1	MINUTES 0–3 (1 m)	SECONDS 0–56 (4 s)		

CC = Country Code;
ID = Identification Data = 8-bit identification data consisting of a serial number assigned by the appropriate national authority
SD = Supplementary Data = bits 107 – 109 = 110;
bit 110 = Additional Data Flag describing the use of bits 113 to 132:
1 = Delta position; 0 = National assignment;
bit 111 = Encoded Position Data Source: 1 = internal, 0 = external;
bit 112: 1 = 121.5 MHz auxiliary radio locating device;
0 = other or no device
NU = National use = 6 bits reserved for national use (additional beacon type identification or other uses).

Further details on protocol coding can be found in Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001).

All identification and location data are to be encoded in binary notation with the least significant bit on the right.

For details on BCH error correcting code see Specification for COSPAS-SARSAT 406 MHZ Distress Beacon (C/S T.001).

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