



CIVIL AVIATION REGULATIONS
AIR NAVIGATION SERVICES

Part 8

AERONAUTICAL TELECOMMUNICATIONS

Governing
**VOICE COMMUNICATION
SYSTEMS**

CIVIL AVIATION AUTHORITY OF THE PHILIPPINES
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Republic of the Philippines

CIVIL AVIATION REGULATIONS AIR NAVIGATION SERVICES (CAR-ANS)


Part 8 AERONAUTICAL TELECOMMUNICATIONS

Governing VOICE COMMUNICATION SYSTEMS

04 JULY 2018

EFFECTIVITY

Part 8 of the Civil Aviation Regulations-Air Navigation Services is issued under the authority of Republic Act No. 9497 and shall take effect upon approval by the Board of Directors of the Civil Aviation Authority of the Philippines.



CAPTAIN JIM C. SYDIONGCO
Director General
Civil Aviation Authority of the Philippines

05 JUL 2018

DATE

FOREWORD

This is a CAAP safety programme document. It contains specifications of uniform application (standards) prescribed and determined to be necessary for the safety of air navigation in the airspace of the Republic of the Philippines.

The standards contained herein are referenced in the Philippine Civil Aviation Regulation - Air Navigation Service (CAR-ANS) Part 10, which sets out the regulatory requirements on the Operation and Maintenance of Communications, Navigation, Surveillance, Airfield Lighting and Power Systems Services.

This manual may be amended from time to time, and the Director General, CAAP will provide such amendment service.

Copies of this manual are available at the:

Aerodrome and Air Navigation Safety Oversight Office
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Comments about the content of this CAR-ANS are welcome from members of the aviation industry or the public. Any comments or requests for clarification should be directed to the above mentioned address.

RECORDS OF AMENDMENT AND CORRIGENDA

Amendments			
<i>Number</i>	<i>Date applicable</i>	<i>Subject(s)</i>	<i>Entered by</i>
1	14 July 2015	Incorporated additional Annex 10 Volume III Part 2 SARPs. Added a section on definitions and included definitions for facility availability; facility failure; facility reliability; mean time between failures; and, signal reliability; amended provisions regarding aeronautical mobile service; SELCAL system; aeronautical speech circuits; and emergency locator transmitter (ELT) for search and rescue; included figures regarding aeronautical mobile service; and included an appendix to CAR-ANS 8.5 regarding emergency locator transmitter coding.	LT GEN William K Hotchkiss III AFP (Ret)
2	17 May 2018	Incorporated Amendment 90 to ICAO Annex 10 Vol III Part II regarding the introduction of new section on satellite voice communications (SATVOICE).	Capt. Jim C. Sydiongco
3	11 May 2022	Incorporated Amendment 91 to Annex 10 Volume III Part 2 to CAR-ANS Part 8 regarding Selective Calling System (SELCAL)	Capt. Jim C. Sydiongco

Corrigenda			
<i>Number</i>	<i>Date applicable</i>	<i>Subject(s)</i>	<i>Entered by</i>

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	APP 8.1-8	Amendment No. 1	14 July 2015
	ATT 8A-1	Amendment No. 1	14 July 2015
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INTRODUCTION

The Civil Aviation Authority of the Philippines (CAAP) is responsible under Republic Act No. 9497 or known as the Civil Aviation Authority Act of 2008, to formulate and establish rules and regulations governing the civil aviation in the Philippines. The CAAP exercises regulatory oversight by developing and promulgating appropriate, clear and enforceable aviation safety standards.

This CAR-ANS for Voice Communications Systems is one mechanism that CAAP uses to meet the responsibilities of Republic Act No. 9497 to ensure safety regulation of air navigation services. This CAR-ANS prescribes the detailed technical requirements (standards for Voice communication systems) that have been determined to be necessary for promoting and supporting aviation safety in general and communications applications in particular.

ICAO Annex 10 Standards and Recommended Practices (SARPs) are contained in this part of CAR-ANS. The standards set out herein are applicable to all voice communication facilities used in support of international air navigation.

This CAR-ANS is referenced in CAR-ANS Part 10, Regulatory Requirements on the Operation and Maintenance of Communications, Navigation, Surveillance, Airfield Lighting and Power Systems Services. Users of this document should refer to the applicable provision of CAR-ANS to ascertain the requirements of, and the obligations imposed by, the civil aviation legislation in regard to air navigation service.

The responsibility of matters within CAR-ANS Part 8, Governing Voice Communication Systems, is with the Aerodrome and Air Navigation Services Safety Oversight Office, CAAP.

Note 1. In accordance with the ICAO guidance on the use of the text of the annexes in national regulations, CAR-ANS Part 8 reproduces SARPS for Aeronautical Telecommunications – Voice Communication Systems that are of regulatory nature together with signal-in-space specifications essential for intended system operation.

Note 2. Throughout this CAR-ANS, the original Annex 10 numbering is maintained for traceability purposes, i.e. CAR-ANS Part 8 requirement 8.2.2.3 corresponds to a standard in paragraph 2.2.3 in Chapter 2 of Annex 10, Volume III Part 2. The affixed “8” indicates CAR-ANS Part 8.

1**GENERAL**

1.1

The CAAP document hierarchy consists of:

- a) The Civil Aeronautics Act (Republic Act No. 776 as amended) and the Act Creating the Civil Aviation Authority of the Philippines (Republic Act No. 9497).
- b) Relevant Civil Aviation Regulations – Air Navigation Service (CAR- ANS) - establish the regulatory framework rules (regulations) within which all service providers must operate.
- c) Advisory Circulars (ACs) - intended to explain elements of the regulatory framework to participants in the aviation industry. Additionally an AC may provide guidance to illustrate a means, but not necessarily the only means, of complying with the requirements of standards. AC may explain certain regulatory requirements by providing interpretive and explanatory materials. As an AC provides only explanatory material, it is expected that service providers will document relevant information in their own operational manuals to put into effect information drawn from an AC.

1.2

This CAR-ANS Governing Standards on Voice Communication Systems, hereafter referred to as the CAR-ANS Part 8 is made pursuant to CAR-ANS Part 10 which sets out the regulatory regime for air navigation facility service providers supporting international and national air transport operations. By complying with the prescribed standards, facility service providers demonstrate that they have discharged their safety obligations to the regulatory authority and to their clients who, ultimately, are the travelling public.

1.3

To assist facility operators or potential service providers, some general advice about specifications, procedures and other information of an educational or advisory nature may be issued from time to time by CAAP in the form of Memorandum Circulars.

2**APPLICABILITY**

2.1

This CAR-ANS specifies the requirements for voice communication systems to be complied with by service providers.

2.2

Subject to published conditions of use, air navigation facilities shall be kept continuously available for flight operations during published hours of operation, irrespective of weather conditions. Published conditions of use refers to aeronautical data promulgated by Philippines AIP or NOTAM or information broadcast by Air Traffic Control Units.

2.3

Standards are identified by the word 'shall' and recommendations by the word 'should'. Where a specification is expressed in the form of recommendation it does not mean that the specification can be ignored. Rather, the facility operator is encouraged to comply with it or, if the latter is not feasible, to adopt an alternate

means to achieve a similar outcome. Any such decision and the alternative means adopted are to be formally recorded and the record maintained while the chosen means of conformance exists.

2.4 Procedure must be in place to ensure that the changes to these documents stemming from the originating authority are available and the CAR-ANS is updated accordingly.

2.5 Under particularly unusual circumstances, the application of a standard or procedure may not be possible or necessary. Such a standard or procedure will be phrased as “if practicable”, “where physically practicable”, “where determined necessary” or similar words. Whilst such phrases may imply compliance is not mandatory, facility operators are required to provide justification for non-compliance. The final decision as to the applicability of the standard to a particular aerodrome facility or procedure rests with CAAP.

3 PERIODIC CHECKS

3.1 In accordance with the provision of this CAR-ANS, guidance material concerning reliability and availability of radio communications and navigation aids is available for facility operational requirements and periodic check.

4 AMENDMENT PROCEDURES AND NOTIFICATION OF DIFFERENCES TO ICAO

4.1 The system specifications in this CAR-ANS have to be changed from time to time to meet identified safety needs, technological changes and amendments of ICAO SARPS. AANSOO is responsible for maintaining the currency of CAR-ANS.

4.2 It is recognized that there may be difficulties and limitations in applying new standards to existing systems and facilities. Where there is a difference between a standard prescribed in Annex 10 or other Annexes to the Chicago Convention and one prescribed in this CAR-ANS, the CAR-ANS standard shall prevail. Should such a difference with ICAO SARPS be identified, it is the AANSOO responsibility to initiate notification of difference as per established procedure.

4.3 Differences from ICAO SARPS in Annex 10 shall be published in AIP Philippines and Supplements to the relevant Volumes of ICAO Annex 10.

4.4 In the event of any perceived disparity of meaning between CAR-ANS and ICAO Annexes, primacy of intent is to be with the CAR-ANS.

4.5 Service providers must document internal actions (rules) in their own operational manuals, to ensure the compliance with, and maintenance of, relevant standards.

4.6 This CAR-ANS is issued and amended under the authority of the

Director General, CAAP.

5**OTHER THAN SARPs PART OF CAR-ANS**a) *Appendices*

Appendices contain materials grouped separately for convenience and forming part of the standards or practices.

b) *Definitions*

Definitions do not have independent status but each one is an essential part of each standard or practice in which the term is used, since a change in the meaning of the term would affect the specifications.

c) *Tables and Figures*

Tables and Figures add to or illustrate a standard or practice, form part of the associated standard or practice and have the same status.

d) *Notes*

Notes are included in the text, where appropriate, to give factual information or references bearing on the standards or practices in question, but do not constitute part of the standards or practices.

e) *Attachments*

Attachments comprise material supplementary to the standards or practices, or are included as a guide to their application, but do not constitute part of the standards or practices.

6**RELATED DOCUMENTS**

6.1

This CAR-ANS should be read in conjunction with:

a) ICAO Annex10 SARPs, Volume III – Aeronautical Telecommunications

Part I – Digital Data Communication Systems

Part II – Voice Communication Systems

b) ICAO Annex 10 SARPs, Volume v – Aeronautical Telecommunications – Aeronautical Radio Frequency Spectrum Utilization.

8.1 DEFINITIONS

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.

Note — 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.

Note — 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.

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

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8.2 AERONAUTICAL MOBILE SERVICE

8.2.1 AIR-GROUND VHF COMMUNICATION SYSTEM CHARACTERISTICS

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

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

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

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

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

8.2.1.1.3 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 CAR-ANS Part 13.

Note. – The band 117.975 – 132 MHz was allocated to the Aeronautical Mobile (R) Service in the ITU Radio Regulations (1947). By subsequent revisions at ITU World Administrative Radio Conference the bands 132 – 136 MHz and 136 – 137MHz were added under conditions which differ for ITU Regions, or for specified countries or combinations of countries (see RRs S5.203,S5.203A and S5.203B for additional allocations in the band 136 -137 MHz, and S5.201 for the band 132 – 136 MHz).

8.2.1.1.4 The design polarization of emissions shall be vertical.

8.2.2 SYSTEM CHARACTERISTICS OF THE GROUND INSTALLATION

8.2.2.1 Transmitting function

8.2.2.1.1 *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 CAR-ANS Part 13, 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 CAR-ANS Part 13, the radio frequency of operation shall not vary more than plus or minus 0.0001 per cent from the assigned frequency.

Note, - The above frequency stability requirements will not be

sufficient for offset carrier systems using 25 kHz channel spacing or higher.

- 8.2.2.1.1.1 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.

Note - Examples of the required stability of the individual carriers of offset carrier systems may be found at the Attachment to CAR-ANS Part 8: Guidance Material for Communication Systems.

- 8.2.2.1.2 POWER

On a high percentage of occasions, the effective radiated power shall be such as to provide a field strength of at least 75 microvolts per metre (minus 109 dBW/m²) within the defined operational coverage of the facility, on the basis of free-space propagation.

- 8.2.2.1.3 *Modulation.* A peak modulation factor of at least 0.85 shall be achievable.

- 8.2.2.1.4 Means shall be provided to maintain the average modulation factor at the highest practicable value without overmodulation.

- 8.2.2.2 Receiving function

- 8.2.2.2.1 *Frequency stability.* Where 8.33 kHz channel spacing is introduced in accordance with CAR-ANS Part 13, the radio frequency of operation shall not vary more than plus or minus 0.0001 per cent from the assigned frequency.

- 8.2.2.2.2 *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/m²) or more.

- 8.2.2.2.3 *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 8.2.2.2.2 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 8.2.2.2.2 has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency. Further information on the effective acceptance bandwidth is contained in the Attachment to

CAR-ANS Part 8: Guidance Material for Communication Systems.

Note. – The effective acceptance bandwidth includes Doppler shift.

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

Note. – 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 CAR-ANS Part 13. 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.

8.2.3 **SYSTEM CHARACTERISTICS OF THE AIRBORNE INSTALLATION**

8.2.3.1 Transmitting function

8.2.3.1.1 *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.

8.2.3.1.2 *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 dBW/m²) 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.

8.2.3.1.3 *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.

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

8.2.3.1.5 Means shall be provided to maintain the average modulation factor at the highest practicable value without overmodulation.

8.2.3.2 Receiving function

8.2.3.2.1 *Frequency stability.* Where 8.33 kHz channel spacing is introduced in accordance with CAR-ANS Part 13, the radio

frequency of operation shall not vary more than plus or minus 0.0005 per cent from the assigned frequency.

8.2.3.2.2 SENSITIVITY

8.2.3.2.2.1 After due allowance has been made for aircraft feeder mismatch, attenuation loss and antenna polar diagram variation, the sensitivity of the receiving function 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 75 microvolts per metre (minus 109 dBW/m²).

Note. – For planning extended range VHF facilities, an airborne receiving function sensitivity of 30 microvolts per metre may be assumed.

8.2.3.2.3 *Effective acceptance bandwidth for 100 kHz, 50 kHz and 25 kHz channel spacing receiving installations.* When tuned to a channel designated in CAR-ANS Part 13 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 8.2.3.2.2 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 8.2.3.2.2 has a carrier frequency of plus or minus 0.005 per cent of the assigned frequency.

8.2.3.2.4 *Effective acceptance bandwidth for 8.33 kHz channel spacing receiving installations.* When tuned to a channel designated in CAR-ANS Part 13, 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 8.2.3.2.2 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 8.2.3.2.2 has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency. Further information on the effective acceptance bandwidth is contained in Attachment A to CAR-ANS Part 13.

Note 1 — The effective acceptance bandwidth includes Doppler shift.

Note 2 — When using offset carrier systems (ref. 8.2.3.2.3 and 8.2.3.2.4), 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.

8.2.3.2.5 *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;

Note - 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 dBc/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.

8.2.3.2.6 Whenever practicable, the receiving system shall ensure an effective adjacent channel rejection characteristic of 60 dB or more at plus or minus 25 kHz, 50 kHz and 100 kHz from the assigned frequency for receiving systems intended to operate in channel spacing environments of 25 kHz, 50 kHz and 100 kHz, respectively.

Note. – 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.

8.2.3.2.7 In the case of receivers complying with 8.2.3.2.3 or 8.2.3.2.4 used in areas where offset carrier systems are in force, the characteristics of the receiver shall 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.

8.2.3.2.8 VDL — INTERFERENCE IMMUNITY PERFORMANCE

8.2.3.2.8.1 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/m²) 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.

Note. – This level of VDL interference immunity performance provides a receiver performance consistent with the influence of the VDL RF spectrum mask as specified in CAR-ANS Part 7, 7.6.3.4 with an effective transmitter/receiver isolation of 68 dB. Better transmitter and receiver performance could result in less isolation required.

8.2.3.2.8.2 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 8.2.3.2.8.1.

8.2.3.2.8.3 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 8.2.3.2.8.1, subject to the conditions of 8.2.3.2.8.4.

8.2.3.2.8.4 Requirements for mandatory compliance of the provisions of 8.2.3.2.8.3 shall be made on the basis of regional air navigation agreements which specify the airspace of operation and the implementation timescales.

8.2.3.2.8.4.1 The agreement indicated in 8.2.3.2.8.4 shall provide at least two years' notice of mandatory compliance of airborne systems.

8.2.3.3 Interference immunity performance

8.2.3.3.1 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.

8.2.3.3.2 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.

Note. – Guidance material on immunity criteria to be used for the performance quoted in 8.2.3.3.1 and 8.2.3.3.2 is contained in the Attachment to Part 8, 1.3.

8.2.3.3.3 All new installations of airborne VHF communications receiving systems shall meet the provisions of 8.2.3.3.1 and 8.2.3.3.2.

8.2.3.3.4 Airborne VHF communications receiving systems meeting the immunity performance Standards of 8.2.3.3.1 and 8.2.3.3.2 shall be placed into operation at the earliest possible date.

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

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

following specifications.

8.2.4.1.1 FREQUENCY RANGE

- 8.2.4.1.1.1 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.

Note 1. – See Introduction to CAR-ANS Part 13, 13.3, and Figures 8.2-1 and 8.2-2 at the end of this chapter.

Note 2. – The ITU World Administrative Radio Conference, Aeronautical Mobile (R) Service, Geneva, 1978, established a new Allotment Plan (Appendix 27, Aer to the Radio Regulations) based on single sideband replacing the earlier double sideband Allotment Plan. The World Radio communication Conference 1995 redesignated it as Appendix S.27. Minor editorial changes were made at the World Radiocommunication Conference 1997.

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

8.2.4.1.3 SIDEBAND SELECTION

- 8.2.4.1.3.1 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.

Note. –It is intended that only the carrier (reference) frequency be promulgated in Regional Plans and Aeronautical Publications.

8.2.4.1.4 CLASSES OF EMISSION AND CARRIER SUPPRESSION

- 8.2.4.1.4.1 The system shall utilize the suppressed carrier class of emission J3E (also J7B and J9B as applicable). When SELCAL is employed as specified in 8.3 of CAR-ANS Part 8, the installation shall utilize class H2B emission.

- 8.2.4.1.4.2 Aeronautical stations and aircraft stations shall have introduced the appropriate class(es) of emission prescribed in 8.2.4.1.4.1. The use of class A3E emission shall be discontinued except as provided in 8.2.4.1.4.4 below.

- 8.2.4.1.4.3 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. The use of class H3E emission shall be discontinued except as provided in 8.2.4.1.4.4.

- 8.2.4.1.4.4 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 shall be used; however, since maritime

mobile and land mobile services may be involved, A3E and H3E classes of emission may be used.

- 8.2.4.1.4.5 After 1 April 1981 no new DSB equipment shall be installed.
- 8.2.4.1.4.6 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.
- 8.2.4.1.4.7 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.

8.2.4.1.5 AUDIO FREQUENCY BANDWIDTH

- 8.2.4.1.5.1 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 8.2.4.1.7).

Note — For aircraft and aeronautical station transmitter types first installed before 1 February 1983 the audio frequencies will be limited to 3 000 Hz.

- 8.2.4.1.5.2 For other authorized classes of emission the modulation frequencies shall be such that the required spectrum limits of 8.2.4.1.7 will be met.

8.2.4.1.6 FREQUENCY TOLERANCE

- 8.2.4.1.6.1 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.

- 8.2.4.1.6.2 The basic frequency stability of the receiving function shall be such that, with the transmitting function stabilities specified in 8.2.4.1.6.1, 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.

8.2.4.1.7 SPECTRUM LIMITS

- 8.2.4.1.7.1 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:

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

8.2.4.1.7.2 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;
- a) aircraft station transmitters: 43 dB;
- b) aeronautical station transmitters: for transmitter power up to and including 50 W:

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

For transmitter power more than 50 W: 60 dB.

Note — See Figures 8.2-1 and 8.2-2 at the end of CAR-ANS 8.2.

8.2.4.1.8 POWER

8.2.4.1.8.1 *Aeronautical station installations.* Except as permitted by the relevant provisions of Appendix S27 to the ITU Radio Regulations, the peak envelope power (P_p) 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.

8.2.4.1.8.2 *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 shall 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 (ITU Radio Regulations), 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:

<i>Class of emission</i>	<i>Stations</i>	<i>Max. peak envelope power</i>
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.

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

8.2.5 **SATELLITE VOICE COMMUNICATION (SATVOICE) SYSTEM CHARACTERISTICS**

Note.— Guidance material for the implementation of the aeronautical mobile satellite service is contained in the Manual on the 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).

8.2.5.1 *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 8.2-1; and
- c) aircraft SATVOICE number, which is the aircraft address expressed as an 8-digit octal number.

8.2.5.2 For ground-to-air calls, the SATVOICE 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.

8.2.5.3 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 unique 6-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 8.2-1.

Table 8.2-1. 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, when appropriate.
2 / HGH / Q12 Operational high (second highest) Safety of flight	Flight safety. Typically assigned to calls between aircraft and ANSPs.
3 / LOW / Q10 Operational low (third highest) Safety of flight	Regularity of flight, meteorological, administrative. Typically assigned to calls between aircraft operators and their aircraft.
4 / PUB / Q9 Non-operational (lowest) Non safety	Public correspondence.

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FIGURES FOR CAR-ANS 8.2

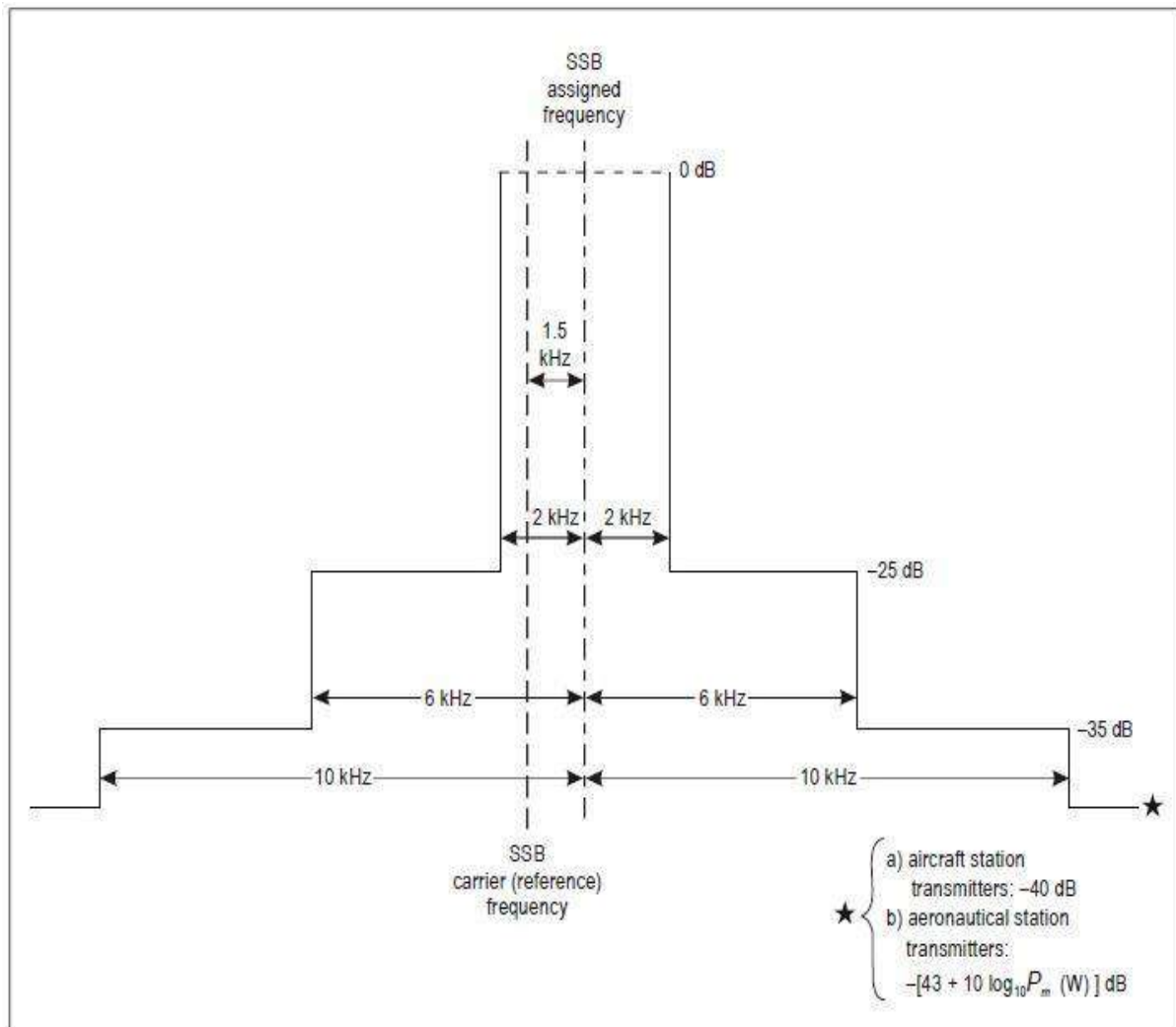


Figure 8.2-1. Required spectrum limits (in terms of mean power) for aircraft station transmitter types and for aeronautical station transmitters first installed before 1 February 1983

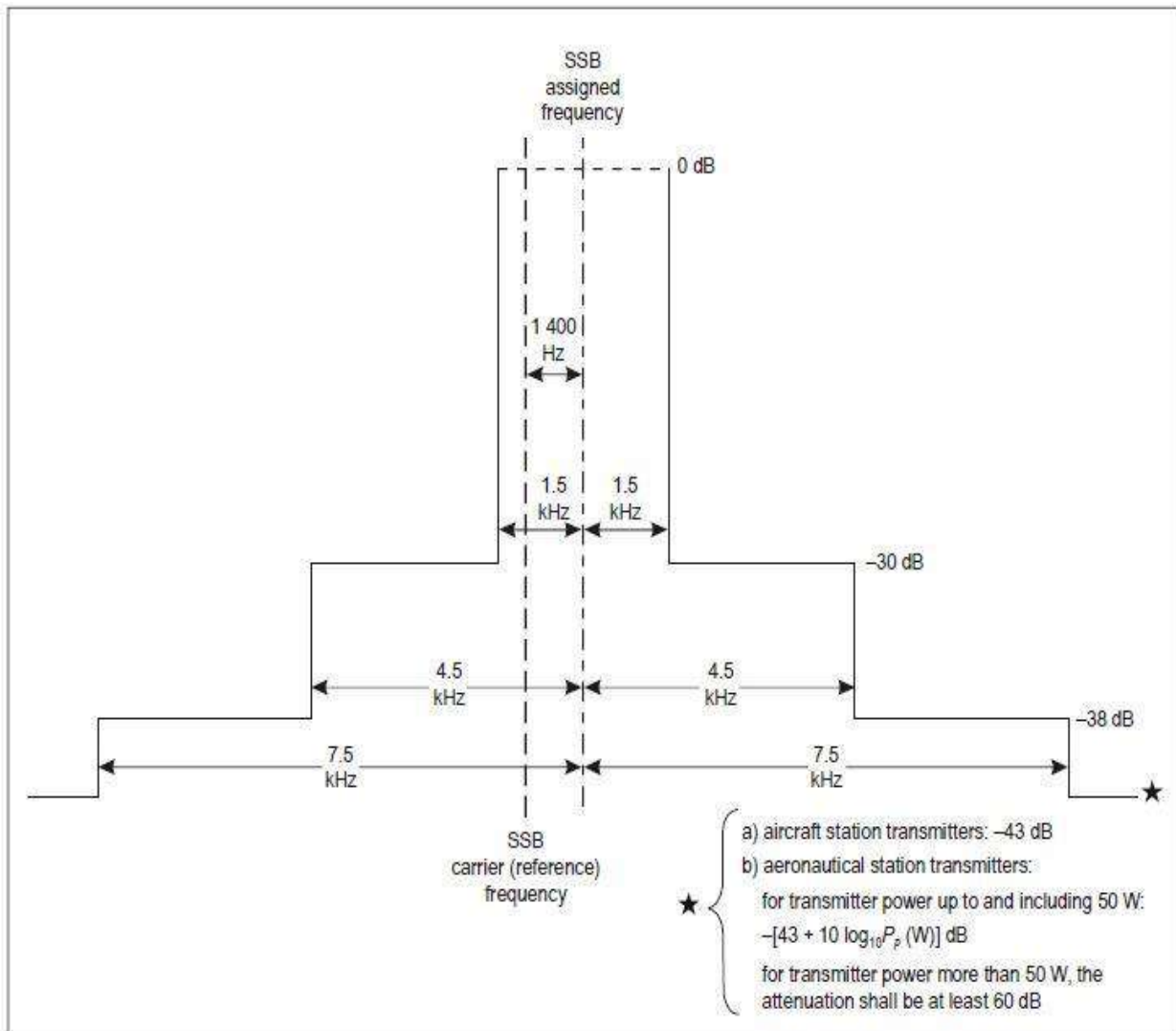


Figure 8.2-2. Required spectrum limits (in terms of peak power) for aircraft station transmitters first installed after 1 February 1983 and aeronautical station transmitters in use after 1 February 1983

8.3 SELCAL SYSTEM

8.3.1

Until 2 November 2022, where a SELCAL system is installed, the following system characteristics shall be applied:

- a) *Transmitted code.* Each transmitted code shall be made up of two consecutive tone pulses, with each pulse containing two simultaneously transmitted tones. The pulses shall 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 shall be held to plus or minus 0.15 per cent tolerance to ensure proper operation of the airborne decoder.
- c) *Distortion.* The over-all audio distortion present on the transmitted RF signal shall not exceed 15 per cent.
- d) *Per cent modulation.* The RF signal transmitted by the ground radio station shall contain, within 3 dB, equal amounts of the two modulating tones. The combination of tones shall 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 shall be made up of various combinations of the tones listed in the following table and designated by colour and letter as indicated:

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

Note 1 — It should be noted that the tones are spaced by $\text{Log}^{-1} 0.045$ to avoid the possibility of harmonic combinations.

Note 2 — 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.

Note 3 — Guidance material on the use of SELCAL systems is contained in the Attachment 8A, Guidance Material for Communication Systems.

Note 4 — The tones Red P, Red Q, Red R, and Red S are applicable, in accordance with 8.3.2.

8.3.2 Until 2 November 2022, 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 8.3.1. SELCAL codes using the tones Red P, Red Q, Red R, and Red S may be assigned.

8.3.1 As of 3 November 2022, where a SELCAL system is installed, the following system characteristics shall be applied:

a) Transmitted code. Each transmitted code shall be made up of two consecutive tone pulses, with each pulse containing two simultaneously transmitted tones. The pulses shall 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) Frequency stability. The frequency of transmitted tones shall 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 shall not exceed 15 per cent.

d) Level stability. The RF signal transmitted by the ground radio station shall contain, within 3 dB, equal amounts of the two modulating tones

8.3.1.1 As of 3 November 2022, modulation envelope. The combination of tones shall result in a modulation envelope having a nominal modulation percentage as high as possible and not less than 60 per cent.

8.3.2 As of 3 November 2022, the transmitted codes shall be made up of various combinations of the tones listed in Tables 8.3-1. They are designated by colour and letter or number as indicated:

Table 8.3-1. SELCAL tones designated by colour and letter or number (*applicable as of 3 November 2022*)

<i>Designation</i>	<i>Frequency (Hz)</i>
<i>Red A</i>	312.6
<i>Red B</i>	346.7
<i>Red C</i>	384.6
<i>Red D</i>	426.6
<i>Red E</i>	473.2
<i>Red F</i>	524.8
<i>Red G</i>	582.1
<i>Red H</i>	645.7
<i>Red J</i>	716.1
<i>Red K</i>	794.3
<i>Red L</i>	881.0
<i>Red M</i>	977.2
<i>Red P</i>	1083.9
<i>Red Q</i>	1202.3
<i>Red R</i>	1333.5
<i>Red S</i>	1479.1
<i>Red T</i>	329.2
<i>Red U</i>	365.2
<i>Red V</i>	405.0
<i>Red W</i>	449.3
<i>Red X</i>	498.3
<i>Red Y</i>	552.7
<i>Red Z</i>	613.1
<i>Red 1</i>	680.0
<i>Red 2</i>	754.2
<i>Red 3</i>	836.6
<i>Red 4</i>	927.9
<i>Red 5</i>	1 029.2
<i>Red 6</i>	1 141.6
<i>Red 7</i>	1 266.2
<i>Red 8</i>	1 404.4
<i>Red 9</i>	1 557.8

Note 1.— The frequencies of the tones are spaced by $\text{Log}^{-1} 0.0225$ to avoid the possibility of harmonic combinations.

Note 2.— 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.

Note 3.— Guidance material on the use of SELCAL systems is contained in the Attachment 8A, Guidance Material for Communication Systems.

8.3.3

As of 3 November 2022, aeronautical stations which are required to communicate with SELCAL-equipped aircraft shall have SELCAL encoders that support all tones in accordance with Table 8.3-1.

8.3.4

As of 3 November 2022, SELCAL codes using the tones Red T through Red 9 as given in Table 8.3-1 shall only be assigned to SELCAL-equipped aircraft with the capability of receiving these tones.

8.4 AERONAUTICAL SPEECH CIRCUITS

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

Note.— Guidance material on the implementation of aeronautical speech circuit switching and signalling for ground-ground applications is contained in the Manual on Air Traffic Services (ATS) Ground-Ground Voice Switching and Signalling (Doc 9804). The material includes explanation of terms, performance parameters, guidance on basic call types and additional functions, references to appropriate ISO/IEC international standards and ITU-T recommendations, guidance on the use of signalling systems, details of the recommended numbering scheme and guidance on migration to future schemes.

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

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

8.4.1.3 The ATC communication requirements defined in CAR-ANS Part 11, 11.6.2 shall 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.

8.4.1.4 In addition to the ability to make basic telephone calls, the following functions shall be provided in order to meet the requirements set out in CAR-ANS Part 11:

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

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

8.4.1.6 Digital signalling systems shall 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.

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

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

8.5 EMERGENCY LOCATOR TRANSMITTER (ELT) FOR SEARCH AND RESCUE**8.5.1 GENERAL**

8.5.1.1 Until 1 January 2005, emergency locator transmitters shall operate either on both 406 MHz and 121.5 MHz or on 121.5 MHz.

Note — ELTs operating on 121.5 MHz will be required to meet the improved technical characteristics contained in 8.5.2.1.8.

8.5.1.2 All installations of emergency locator transmitters operating on 406 MHz shall meet the provisions of 8.5.3.

8.5.1.3 All installations of emergency locator transmitters operating on 121.5 MHz shall meet the provisions of 8.5.2.

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

8.5.1.5 All emergency locator transmitters shall operate simultaneously on 406 MHz and 121.5 MHz.

8.5.1.6 The technical characteristics for the 406 MHz component of an integrated ELT shall be in accordance with 8.5.3.

8.5.1.7 The technical characteristics for the 121.5 MHz component of an integrated ELT shall be in accordance with 8.5.2.

8.5.1.8 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.

8.5.1.9 ELT register information shall include the following:

- a) transmitter identification (expressed in the form of an alphanumeric 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.

Note 1 — Various coding protocols are available to ICAO Member States. Depending on the protocol adopted, States may, at their

discretion, include one of the following as supplementary identification information to be registered:

- a) aircraft operating agency designator and operator's serial number; or
- b) 24-bit aircraft address; or
- c) aircraft nationality and registration marks.

The aircraft operating agency designator is allocated to the operator by ICAO through the CAAP, and the operator's serial number is allocated by the operator from the block 0001 to 4096.

Note 2.— At their discretion, depending on arrangements in place, States may include other relevant information to be registered such as the last date of register, battery expiry date and place of ELT in the aircraft (e.g. "primary ELT" or "life-raft No. 1").

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

Note 1 — 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.

Note 2 — 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).

- 8.5.2.1 Technical characteristics
 - 8.5.2.1.1 Emergency locator transmitters (ELT) shall operate on 121.5 MHz. The frequency tolerance shall not exceed plus or minus 0.005 per cent.
 - 8.5.2.1.2 The emission from an ELT under normal conditions and attitudes of the antenna shall be vertically polarized and essentially omnidirectional in the horizontal plane.
 - 8.5.2.1.3 Over a period of 48 hours of continuous operation, at an operating temperature of minus 20 degrees Celsius, the peak effective radiated power (PERP) shall at no time be less than 50 mW.
 - 8.5.2.1.4 The type of emission shall be A3X. Any other type of modulation that meets the requirements of 8.5.2.1.5, 8.5.2.1.6, and 8.5.2.1.7 may be used provided that it will not prejudice precise location of the beacon by homing equipment.
 - 8.5.2.1.5 The carrier shall be amplitude modulated at a modulation factor of at least 0.85.
 - 8.5.2.1.6 The modulation applied to the carrier shall have a minimum duty cycle of 33 per cent.

- 8.5.2.1.7 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.
- 8.5.2.1.8 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.
- 8.5.3 SPECIFICATION FOR THE 406 MHZ COMPONENT OF EMERGENCY LOCATOR TRANSMITTER (ELT) FOR SEARCH AND RESCUE**
- 8.5.3.1 Technical characteristics
- Note 1 — Transmission characteristics for 406 MHz emergency locator transmitters are contained in ITU-R M.633.*
- Note 2 — 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.*
- 8.5.3.1.1 Emergency locator transmitters shall operate on one of the frequency channels assigned for use in the frequency band 406.0 to 406.1 MHz.
- Note — The COSPAS-SARSAT 406 MHz channel assignment plan is contained in COSPAS-SARSAT Document C/S T.012.*
- 8.5.3.1.2 The period between transmissions shall be 50 seconds plus or minus 5 per cent.
- 8.5.3.1.3 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.
- 8.5.3.1.4 The 406 MHz ELT shall be capable of transmitting a digital message.
- 8.5.3.2 Transmitter identification coding
- 8.5.3.2.1 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.
- 8.5.3.2.2 The emergency locator transmitter shall be coded in accordance with either the aviation user protocol or one of the serialized user protocols described in Appendix 8.1 to this CAR-ANS, and shall be registered with the appropriate authority.

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APPENDIX 8.1 EMERGENCY LOCATOR TRANSMITTER CODING

(see CAR-ANS 8.5, Section 8.5.3.2)

Note.— 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 (COSPAS = Space system for search of vessels in distress; SARSAT = Search and rescue satellite-aided tracking) 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.
- 2.3 Protected data field
- 2.3.1 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.
- 2.3.2 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.

- 2.3.3 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.
- 2.3.4 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.
- Note.— 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.*
- 2.3.5 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.
- 2.3.6 The ELT digital message shall contain either the transmitter serial number or an identification of the aircraft or operator as shown below.
- 2.3.7 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 8.5-1) 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.
- Note.— States will ensure that each beacon, coded with the country code of the State, is uniquely coded and registered in a database. Unique coding of serialized coded beacons can be facilitated by including the COSPAS-SARSAT Type Approval Certificate Number which is a unique number assigned by COSPAS-SARSAT for each approved ELT model, as part of the ELT message.*
- 2.3.8 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 8.5-1 to encode seven alphanumeric characters. This data shall be right justified with the modified Baudot “space” (“100100”) being used where no character exists.

- 2.3.9 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.
- 2.3.10 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 8.5-1) using only the 5 right most bits per letter and dropping the left most bit which has a value of 1 for letters.

Table 8.5-1 Modified Baudot code

<i>Letter</i>	<i>Code MSB LSB</i>	<i>Figure</i>	<i>Code MSB LSB</i>
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 bit

LSB = least significant bit

* = hyphen

** = space

EXAMPLES OF CODING

ELT serial number

25	27	36	37	40	44	63	64	73	74	83	85			
F	1	COUNTRY	0	1	1	T	T	T	C	SERIAL NUMBER DATA (20 BITS)	SEE NOTE 1	SEE NOTE 2	A	A

Aircraft address

25	27	36	37	40	44	67	68	73	74	83	85			
F	1	COUNTRY	0	1	1	T	T	T	C	AIRCRAFT ADDRESS (24 BITS)	SEE NOTE 3	SEE NOTE 2	A	A

Aircraft operator designator and serial number

25	27	36	37	40	44	61	62	73	74	83	85			
F	1	COUNTRY	0	1	1	T	T	T	C	OPERATOR 3-LETTER DESIGNATOR	SERIAL NUMBER 1-4096	SEE NOTE 2	A	A

Aircraft registration marking

25	27	36	37	40	81	83	85				
F	1	COUNTRY	0	0	1	AIRCRAFT REGISTRATION MARKING (UP TO 7 ALPHANUMERIC CHARACTERS) (42 BITS)		0	0	A	A

T = Beacon type TTT: = 1 indicates ELT serial number is encoded;
 = 2 indicates operating agency and serial number are encoded;
 = 011 indicates 24-bit aircraft address is encoded.

C = Certificate flag bit: = 1 = to indicate that COSPAS-SARSAT Type Approval Certificate
 0 = otherwise

F = Format flag 0 = Short Message
 1 = Long Message

A = Auxiliary radio-locating device: 00 = no auxiliary radio-locating device
 01 = 121.5 Mhz
 11 = other auxiliary radio-locating device

Note 1.— 10 bits, all 0s or National use

Note 2.— COSPAS-SARSAT Type Approval Certificate number in binary notation with the least significant bit on the right, or National use

Note 3.— 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.

EXAMPLE OF CODING (USER LOCATION PROTOCOL)

25	26	←2	←37	85→				←86	10	←113	132→				←133								
		7	40→					106→	7					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				12-BIT BCH CODE
				24				1	9	1	10	1	5		4	1	5	4					
				0011				N = 0	LAT DEG	E = 0	LON DEG	M I N U T E S	S C O N T I N E R S		0	M I N U T E S	S C O N T I N E R S						
				AIRCRAFT 24 BIT ADDRESS														S = 1	0-90 (1/4 d)	W = 1	0-180 (1/4 d)	0-30 (1 m)	
0101		15		9		AIRCRAFT OPER. DESIGNATO		SERIAL No															
0100		10		14		C/STA No 1-1023		SERIAL No															

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 – 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

Note 1.— Further details on protocol coding can be found in Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001).

Note 2.— All identification and location data are to be encoded in binary notation with the least significant bit on the right.

Note 3.— 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	←37			←86	107	←113			←133										
		36	40→ ←41			106→	112		132→		144→										
←————— 6 —————→						BCH-1	←————— 2 —————→				BCH-2										
————— 1 —————							————— 6 —————														
1	1	10	4	45								21	6	7	7	6	12				
1	0	CC	1000	18 bits	2								SD	Δ LATITUDE			Δ LONGITUDE			NU	12-BIT BCH CODE
				ID	7 bits LATITUDE				LONGITUDE												
				18	1	7	5	1	8	5											
				NATIONAL ID NUMBER	N = 0 S = 1	D E G R E E S	M I N U T E S	E = 0 W = 1	D E G R E E S	M I N U T E S											
						0-90 (1)	0-58 (2m)		0-180 (2m)	0-58 (2m)											
											-- = 0 + = 1	M I N U T E S	S E C O N D S	-- = 0 + = 1	M I N U T E S	S E C O N D S	0-3 0-56 (4)				

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).

Note 1.— Further details on protocol coding can be found in Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001).

Note 2.— All identification and location data are to be encoded in binary notation with the least significant bit on the right.

Note 3.— For details on BCH error correcting code see Specification for COSPAS-SARSAT 406 MHz Distress Beacon (C/S T.001)

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ATTACHMENT 8A GUIDANCE MATERIAL FOR COMMUNICATION SYSTEMS**1. VHF COMMUNICATIONS****1.1 Audio characteristics of VHF communication equipment**

1.1.1 The aeronautical radiotelephony services represent a special case of the application of radiotelephony, in that the requirement is for the transmission of messages in such a way that fidelity of wave form is of secondary importance, emphasis being upon fidelity of basic intelligence. This means that it is not necessary to transmit those parts of the wave form which are solely concerned with individuality, accent and emphasis.

1.1.2 The effective acceptance bandwidth for 8.33 kHz equipment is required to be at least plus and minus 3 462 Hz. This value considers the general case, i.e. air-to-ground transmissions and consists of 2 500 Hz audio bandwidth, 685 Hz for an aircraft transmitter instability of 5 ppm, 137 Hz for a ground receiver instability of 1 ppm and 140 Hz due to Doppler shift (Refer to 8.2.2.2.4 and 8.2.3.2.6).

1.2 Offset carrier system in 25 kHz, 50 kHz and 100 kHz spaced channels

The following are examples of offset carrier systems which meet the requirements of 8.2.2.1.1.1.

a) 2-carrier system. Carriers should be spaced at plus and minus 5 kHz. This requires a frequency stability of plus or minus 2 kHz (15.3 parts per million at 130 MHz);

b) 3-carrier system. Carriers should be spaced at zero and plus and minus 7.3 kHz. This requires a frequency stability of plus or minus 0.65 kHz (5 parts per million at 130 MHz);

The following are examples of 4- and 5-carrier systems which meet the requirements of 8.2.2.1.1.1.

c) 4-carrier system. Carriers should be spaced at plus and minus 2.5 kHz and plus and minus 7.5 kHz. This requires a frequency stability of plus or minus 0.5 kHz (3.8 parts per million at 130 MHz).

d) 5-carrier system. Carriers should be spaced at zero, plus and minus 4 kHz and plus and minus 8 kHz. A frequency stability in the order of plus or minus 40 Hz (0.3 parts per million at 130 MHz) is an achievable and practicable interpretation of the requirement in this case.

Note 1.— The carrier frequency spacings referred to above are with respect to the assigned channel frequency.

Note 2.— In aircraft receivers which employ a measurement of the received carrier-to-noise ratio to operate the mute, the audio heterodynes caused by the reception of two or more off-set carriers can be interpreted as noise and cause the audio output to be muted even when an adequate wanted signal is present. In order that the airborne receiving system can conform with the

sensitivity recommendations contained in 8.2.3.2.2, the design of the receivers may need to ensure that their sensitivity is maintained at a high level when receiving off-set carrier transmissions. The use of a carrier level override is an unsatisfactory solution to this requirement, but where it is employed, setting the override level as low as possible can ameliorate the problem.

1.3 Immunity performance of COM receiving systems in the presence of VHF FM broadcast interference

- 1.3.1 With reference to the Note of 8.2.3.3.2, the immunity performance defined there must be measured against an agreed measure of derogation of the receiving system's normal performance, and in the presence of, and under standard conditions for the input wanted signal. This is necessary to ensure that the checking of receiving station equipment on bench test can be performed to a repeatable set of conditions, and results, and to facilitate their subsequent approval. An adequate measure of immunity performance may be obtained by the use of wanted signal of minus 87 dBm into the receiving equipment and the signal modulated with a 1 kHz tone at 30 per cent modulation depth. The signal-to-noise ratio should not fall below 6 dB when the interfering signals specified at 8.2.3.3.1 and 8.2.3.3.2 are applied. The broadcast signals should be selected from frequencies in the range between 87.5 and 107.9 MHz and should be modulated with a representative broadcast type signal.

Note 1.— The signal level of minus 87 dBm assumes a combined antenna and feeder gain of 0 dB.

Note 2.— The reduction in the signal-to-noise ratio quoted above is for the purpose of standardization when checking that receiving station equipment on bench measurements meet the required immunity. In the planning of frequencies and in the assessment of protection from FM broadcast interference, a value not less than this, and in many cases higher, depending on the operational circumstances in individual cases, should be chosen as the basis of the interference assessment.

2. SELCAL SYSTEM

- 2.1 This material is intended to provide information and guidance relating to the operation of the SELCAL system. It is associated with the Recommended Practices contained in CAR-ANS Part 8, 8.3.
- a) Function. The purpose of the SELCAL system is to permit the selective calling of individual aircraft over radiotelephone channels linking the ground station with the aircraft, and is intended to operate on en-route frequencies with existing HF and VHF ground-to-air communications transmitters and receivers with a minimum of electrical and mechanical modification. The normal functioning of the ground-to-air communications link should be unaffected, except at such time as the selective calling function is being formed.
 - b) Principles of operation. Selective calling is accomplished by

the coder of the ground transmitter sending a single group of coded tone pulses to the aircraft receiver and decoder. The airborne receiver and decoder equipment is capable of receiving and interpreting, by means of an indicator, the correct code and rejecting all other codes in the presence of random noise and interference. The ground portion of the coding device (ground selective calling unit) supplies coded information to the ground- to-air transmitter. The airborne selective calling unit is the special airborne equipment which operates with existing communications receivers on the aircraft to permit decoding of the ground-to-air signals for display on the signal indicator. The type of signal indicator can be chosen to suit operational requirements of the user and may consist of a lamp, a bell, a chime or any combination of such indicating devices.

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