



Technical Standards for Aeronautical Mobile Service

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NATIONAL TELECOMMUNICATIONS REGULATORY COMMISSION

SAINT LUCIA

TABLE OF CONTENTS

| | |
|--|------------|
| 1.0 INTRODUCTION..... | 1 |
| 2.0 SCOPE | 1 |
| 3.0 RESOURCES | 2 |
| 4.0 DEFINITION OF TERMS | 2 |
| 5.0 ROLE OF THE COMMISSION | 8 |
| 6.0 ACCEPTIBILITY OF EQUIPMENT | 8 |
| 7.0 REGULATION OF THE AERONAUTICAL MOBILE SERVICE | 9 |
| 8.0 UTILIZATION OF FREQUENCIES BELOW 30 MHZ | 9 |
| 8.1 FREQUENCY ALLOTMENT PLAN FOR THE AERONAUTICAL MOBILE (OR) SERVICE | 9 |
| 8.2 AERONAUTICAL MOBILE (R) SERVICE | 11 |
| 9.0 UTILIZATION OF FREQUENCIES ABOVE 30 MHZ | 15 |
| 9.1 THE AMS(R) VHF FREQUENCY ALLOTMENT PLAN | 15 |
| 9.2 CLASS OF EMISSION AND MODULATION CHARACTERISTICS | 15 |
| 9.3 TECHNICAL REQUIREMENTS FOR TRANSMITTER..... | 15 |
| 9.4 TECHNICAL REQUIREMENTS OF RECEIVER..... | 19 |
| ANNEX A PART I..... | i |
| ANNEX A PART II | iv |
| ANNEX B..... | vi |
| ANNEX C | vii |
| OPERATIONAL CHARACTERISITICS OF AMS | vii |
| TRANSMITTER CONTROL REQUIREMENTS | vii |
| SPECIAL RULES RELATING TO THE USE OF FREQUENCIES | viii |

1.0 INTRODUCTION

- 1.0.1 As a holistic approach to the radio spectrum management process, the National Telecommunications Regulatory Commission has developed radio communications standards to assist in ensuring that the various radio services operate compatibly in the same environment without unacceptable levels of radio frequency interference.
- 1.0.2 The aeronautical mobile service is part of the frequency band allocations that provide radio communications within the aeronautical sector. The aeronautical mobile service covers the radio communications for commercial and general aviation, air traffic control and other uses.
- 1.0.3 The National Telecommunications Regulatory Commission was created under the Telecommunications Act 2000 to oversee the telecommunications sector in Saint Lucia. It is therefore responsible for ensuring adherence to the legislation by service providers and other telecommunications users, including aeronautical mobile radio operators. In its functions the Commission has the mandate to establish national technical standards, and in keeping with this mandate the Commission has compiled this document, which attempts to provide a guideline for the technical standards applicable to aeronautical mobile radio communications in Saint Lucia.

2.0 SCOPE

- 2.0.1 This document sets out the technical standards for radio transmitters and receivers at both ground-based and aircraft aeronautical stations operating in the Aeronautical Mobile Services (AMS) in Saint Lucia. These standards are industry standards applicable to equipment which are intended for use in Saint Lucia.
- 2.0.2 The technical standards include acceptability of equipment, frequency band assignments, frequency separation, emission classes, modulation, transmitter power output, bandwidth limitations and specific characteristics of AMS receivers. Stipulations of the general control parameters for ground-based stations and general guidance rules for the use of frequency within AMS are also included.
- 2.0.3 In the event of any inconsistencies between this document and the Act or Regulations, the provisions of the Act or applicable Regulations shall take precedence.

3.0 RESOURCES

3.0.1 Material from the following sources was used to compile this document:

- The Telecommunications Act 2000;
- The Telecommunications (Terminal Equipment and Public Networks) Regulations, 2002;
- The National Telecommunications Regulatory Commission Procedures Manual;
- The International Telecommunications Union, Radio Regulations (Appendix 26 and 27; Article 43; RESOLUTION 413);
- Aeronautical Telecommunications of ICAO (Annex 10, Vol. I);
- The Code of Federal Regulations (Title 47, Part 87); and
- “Radio Spectrum Management” David Withers.

4.0 DEFINITION OF TERMS

Act: The Telecommunications Act [No. 27 of 2000] in the jurisdiction of Saint Lucia.

ACARS: An acronym for Aeronautical Communications Addressing and Report System. ACARS is a digital data link system for transmission of small messages between aircraft and ground stations via radio or satellite.

AES: An abbreviation for Aircraft Earth Station.

Aerodrome: Any area of land, water (including the frozen surface thereof) or other supporting surface used, designed, prepared, equipped or set apart for use, either in whole or in part, for the arrival, departure, movement or servicing of aircraft. This includes any buildings, installations and equipment situated thereon or associated therewith.

Aerodrome Control Service: Air traffic control service for aerodrome traffic.

Aeronautical advisory station (unicom):

An aeronautical station used for advisory and civil defence communications primarily with private aircraft stations.

Aeronautical enroute station: An aeronautical station which communicates with aircraft stations in flight status or with other aeronautical enroute stations.

Aeronautical fixed service: A radio communication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air transport. A station in this service is an aeronautical fixed station.

Aeronautical Mobile Off-Route (OR) Service: An aeronautical mobile service intended for communications, including those relating to flight coordination, primarily outside national or international civil air routes.

Aeronautical Mobile Route (R) Service: An aeronautical mobile service reserved for communications relating to safety and regularity of flight, primarily along national or international civil air routes.

Aeronautical Mobile-Satellite Off-Route (OR) Service: An aeronautical mobile satellite service intended for communications, including those relating to flight coordination, primarily outside national and international civil air routes.

Aircraft Station: A mobile station in the aeronautical mobile service, other than a survival craft station, located on board an aircraft.

AF: An abbreviation for Audio Frequency.

Applicant: A person applying for a licence or a frequency authorisation under the Act.

Application: An application for a licence or frequency authorisation, including a modification or renewal of a licence or frequency authorisation under the Act.

ARNS: An abbreviation for Aeronautical Radio Navigation Service.

ATC: An abbreviation for air traffic control.

Authorized bandwidth: The maximum permissible bandwidth of a transmission.

Band: A range of frequencies.

Bandwidth: The width of a frequency band (outside of which the mean power of the transmitted signal is attenuated at least 26 dB below the mean power if the transmitted signal is within the band).

Beacon: A station transmitting communications for the purposes of observation, propagation and reception or other related experimental activities.

Broadcasting: The transmission intended for reception by the general public, either direct or relayed.

Commission: The National Telecommunications Regulatory Commission, established under section 8 of the Act.

Control Zone: An area designated as such by Civil Aviation Authorities, and where this is not so designated, it means a distance of no more than 25 nautical miles from the air traffic control tower.

DSB: Double Side Band Modulation.

DME: An abbreviation for Distance Measuring Equipment. It is a transponder-based radio navigation technology that measures distance by timing the propagation delay of VHF or UHF radio signals.

ECTEL: Eastern Caribbean Telecommunications Authority.

Emergency communications: Communications that take place during situations where there is danger to lives and/or property.

E.R.P. : An abbreviation for Effective Radiated Power. The product of the power supplied to the antenna and its *gain relative to a half-wave dipole* in a given direction.

FM: Abbreviation for frequency modulation. It is form of modulation that conveys information over a carrier wave by varying its frequency.

Frequency Allocation Plan: A Plan which shows the frequencies to be used in particular areas without specifying the stations to which the frequencies are to be assigned.

Frequency Authorisation: Means an authorisation granted by the Minister under section 36 to use radio frequencies in connection with the operation of a network or the provision of services under an individual licence or class licence or otherwise.

Ground station: Aeronautical station equipment on ground for use with an external antenna and intended for use at a fixed location.

Harmful interference: Any radiation or induction which endangers the functioning of radio navigation service or of a safety service or obstructs or repeatedly interrupts a radio service operating in accordance with the approved Table of Frequency Allocation and with the Telecommunications (Spectrum Management) Regulations, 2002.

HF : An abbreviation for High Frequency. Refers to the band of frequencies that range from 3 MHz to 30 MHz.

ICAO: The International Civil Aviation Organization is an agency of the United Nations, that codifies the principles and techniques of international air navigation

and fosters the planning and development of international air transport to ensure safe and orderly functioning.

ILS: An abbreviation for Instrument Landing System. It is an instrument approach system which provides precise guidance to an aircraft approaching a runway and in the case of one type of Category III approach; it also provides guidance along the runway surface.

Licence: Means an individual or a class licence.

Limiter: Is a circuit that allows signals below a set value to pass unaffected, as in a Class A amplifier, and clips off the peaks of higher signals that exceed this set value, as in a Class C amplifier.

Minister: Minister responsible for Telecommunications.

MF: An abbreviation for Medium Frequency. Refers to the band of frequencies that range from 300 kHz to 3000 kHz.

MLS: An abbreviation for Microwave Landing System is an all-weather, precision landing system originally intended to replace or supplement the Instrument Landing System (ILS).

MWARA: Major World Air Route Areas.

NDB: An abbreviation for *Non-Directional Beacon*. It is a radio broadcast station in a known location, used as an aviation or marine navigational aid.

Out-of-band emission: Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Passband: Is the portion of spectrum, between limiting frequencies that is transmitted with minimum relative loss or maximum relative gain by a filtering device.

PEP: An abbreviation for Peak Envelope Power. The average power supplied to the antenna transmission line by a transmitter during one RF cycle at the crest of the modulation envelope taken under normal operating conditions.

Plan: Frequency Allocation Plan.

ppm: An abbreviation for parts per million.

RADAR: Radio Detection and Ranging is a system that uses radio waves to identify the location, direction, and/or speed of both moving and fixed objects such as aircraft, ships, motor vehicles and weather formations.

Regional and Domestic Air Route: are all those using the Aeronautical Mobile (R) Service not covered by the definition of a Major World Air Route.

Regulations: Refers to the Regulations that have been made under the Telecommunications Act, No 27 of 2000 in the jurisdiction of Saint Lucia.

RDARA: An abbreviation for *Regional and Domestic Air Route Area*. RDARA is an area embracing a certain number of the air routes.

RMS: An abbreviation for Root Mean Square.

SHF: An abbreviation for Super High Frequency. Refers to the band of frequencies that range from 3 GHz to 30 GHz.

SINAD: is the abbreviation for signal-plus-noise-plus-distortion to noise-plus-distortion ratio. This is calculated as one of:

1. The ratio of (a) total received power, *i.e.*, the received signal-plus-noise-plus-distortion power to (b) the received noise-plus-distortion power.
2. The ratio of (a) the recovered audio power, *i.e.*, the original modulating audio signal plus noise plus distortion powers from a modulated radio frequency carrier to (b) the residual audio power, *i.e.*, noise-plus-distortion powers remaining after the original modulating audio signal is removed.

The SINAD is usually expressed in dB.

Spurious Emission: Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

SSB: Single Side Band Modulation is a refinement of the technique of amplitude modulation designed to be more efficient in its use of electrical power and bandwidth.

Telecommunications: Any form of transmission, emission or reception of signs, texts, images and sounds or other intelligence of any nature by wire, radio, optical or other electromagnetic means.

Telemetry: A one-way transmission of measurements at a distance from the measuring instrument.

TFTS: An abbreviation for Terrestrial Flight Telecommunications System.

Transmitter: Any apparatus that converts electrical energy received from a source into radio frequency energy capable of being emitted.

UHF: An abbreviation for *Ultra High Frequency*. Refers to the band of frequencies that range from 300 MHz to 3000 MHz.

Unicom: Universal Integrated Communication is a ground to air radio communication facility operated by private agency to provide private advisory station service at uncontrolled aerodromes and airports with no Air Traffic Control air to ground communication facility.

Unwanted emissions: Spurious emissions and out-of-band emissions as defined in this section.

VHF: An abbreviation for *Very High Frequency*. Refers to the band of frequencies that range from 30 MHz to 300 MHz.

VOLMET Allotment Area: is an area encompassing all points where an HF broadcast facility might be required to operate on a family of frequencies common to the area.

VOLMET Reception Area: is an area within which aircraft should be able to receive broadcasts from one or more stations in the associated VOLMET Allotment Area.

VOR: An abbreviation for *VHF Omni-directional Radio Range*. It is a type of radio navigation equipment for aircrafts.

5.0 ROLE OF THE COMMISSION

5.0.1 The National Telecommunications Regulatory Commission (NTRC) was established under the Telecommunications Act 2000 to regulate the telecommunications sector in Saint Lucia. Based on the functions of the Commission as outlined in section 12 of the Act, and relevant to the aeronautical mobile service, the Commission is required to:

- (i) be responsible for technical regulations and the setting of technical standards of telecommunications and ensure compatibility with international standards;
- (ii) plan, supervise and manage the use of the radio frequency spectrum in conjunction with ECTEL, including the assignment and registration of radio frequencies to be used by all stations operating in St. Lucia or on any ship, aircraft or other floating or airborne contrivance or spacecraft registered in Saint Lucia;
- (iii) Receive and review applications for licences and advise the Minister accordingly.

5.0.2 The Commission is therefore keen that persons comply with the telecommunications legislation. The Act does not apply to programme content and scheduling, and so the Commission has no jurisdiction in respect of the information conveyed via telecommunications networks and operations. In sum, the Commission's responsibility is to ensure that the legal and technical requirements for the establishment of telecommunications networks and the provision of telecommunications services are satisfied.

6.0 ACCEPTIBILITY OF EQUIPMENT

6.0.1 The telecommunications equipment intended for use in the aeronautical mobile service must be granted Type Approval certification by the Commission and must meet the requisite technical standards established for operation in Saint Lucia.

7.0 REGULATION OF THE AERONAUTICAL MOBILE SERVICE

7.0.1 Two types of aeronautical mobile service are defined in this document:

- Aeronautical mobile (R) service: An aeronautical mobile service reserved for communications relating to safety and regularity of flight primarily along national or international civil air routes.
- Aeronautical mobile (OR) service: An aeronautical mobile service intended for communications, including those relating to flight coordination, primarily outside national or international civil air routes.

7.0.2 These two categories of the aeronautical mobile service are governed by distinct procedures, in particular the aeronautical mobile (R) service, in which frequency assignments in the bands that are used globally for communication with civil airliners and air traffic control (ATC), are managed by the International Civil Aviation Organization (ICAO).

8.0 UTILIZATION OF FREQUENCIES BELOW 30 MHz

8.1 FREQUENCY ALLOTMENT PLAN FOR THE AERONAUTICAL MOBILE (OR) SERVICE

8.1.1 CHANNELLING ARRANGEMENTS

8.1.1.1 The channelling arrangements for the carrier frequencies which are used by aeronautical stations in the AMS (OR) are in the frequency bands between 3 025 kHz to 18 030 kHz. With the exception of the carrier (reference) frequencies 3 023 kHz and 5 680 kHz one or more frequencies may be assigned to any aeronautical station and/or aircraft station, in accordance with the Frequency Allotment Plan, as contained in Annex B.

8.1.2 Emission Bandwidth

8.1.2.1 Bandwidth of up to 2.8 kHz, situated wholly within frequency channel concerned. For the aeronautical radiotelephone stations the upper sideband shall be employed, and the assigned frequency shall be 1 400 Hz higher than the carrier (reference) frequency.

8.1.3 Classes of Emission

8.1.3.1 The following are the classes of emission permitted:

(i) Radio telephony

- The aeronautical radiotelephone stations shall use only single-sideband emissions (J3E). The upper sideband shall be employed, and the assigned frequency shall be 1400 Hz higher than the carrier (reference) frequency.

(ii) Telegraphy (including automatic data transmission)

- A1A, A1B, F1B;
- (A,H)2(A,B);
- (R,J)2(A,B,D);
- J(7,9)(B,D,X).

In the AMS (OR) the use of other emission is permissible but subjected to certain compliances stipulated by appendix 26 of Radio Regulations of the ITU-R.

8.1.4 TRANSMITTER POWER OUTPUT

8.1.4.1 In table 8.1.4 shows the general power limits (power supplied to an antenna) that shall be applied:

| Emission Class | Power Limit Values (peak envelope power supplied to the antenna) | |
|----------------|--|----------------------|
| | AERONAUTICAL STATION/ dBW | AIRCRAFT STATION/dBW |
| J3E | 36 | 23 |
| A1A, A1B | 30 | 17 |
| F1B | 30 | 17 |
| A2A, A2B | 32 | 19 |
| H2A, H2B | 33 | 20 |
| (RJ)2(A,B,D) | 36 | 23 |
| J(7,9)(B,D,X) | 36 | 23 |

Table 8.1.4: Peak power for AMS (OR) emissions class

8.2 AERONAUTICAL MOBILE (R) SERVICE

8.2.1 CHANNELLING ARRANGEMENTS

8.2.1.1 The channelling arrangements for the carrier frequencies which are used by aeronautical stations in the AMS (R) are in the frequency bands between 2 850 kHz to 22 000 kHz. One or more frequencies may be assigned to any aeronautical station and/or aircraft station, in accordance with the Frequency Allotment Plan, as contained in **Annex A Part II**. The Plan is presented as an allotment plan in numerical order of frequencies.

8.2.2 METHOD OF OPERATION

8.2.2.1 Annex 10 of the ICAO specifies that in AMS(R), radiotelephone communications should utilize single, simplex channels in the frequency bands 2 850 kHz to 22 000 kHz.

8.2.3 TECHNICAL CHARACTERISTICS USED IN THE PLAN

8.2.3.1 The Plan is based on the following technical characteristics:

- (i). The frequency separation between carrier (reference) frequencies shall be 3 kHz. The carrier (reference) frequency of the channels in the Plan shall be an integral multiple of 1 kHz.
- (ii). For radiotelephone emissions the audio frequencies are limited to between 300 Hz and 2 700 Hz and the occupied bandwidth of other authorized emissions do not exceed the upper limit of J3E emissions. In specifying these limits, however, no restriction in their extension is implied in so far as emissions other than J3E are concerned, provided that the limits of unwanted emissions are met.
- (iii). The emissions used for telephony are J3E (on any plan frequency) and A3E, H3E (on frequencies 3 023 kHz and 5 680¹ kHz). Classes of emission used for telegraphy including automatic data transmission are A1A; A1B; F1B; H2B and any SSB (suppressed carrier) class of emission (e.g., J2B, J2D, J7B, J7D, J9B, J9D).

8.2.4 CLASSES OF EMISSION

8.2.4.1 In the AMS (R) the use of emissions such as those listed below is permissible subject to compliance with the special provisions applicable to each case and

¹ The carrier frequencies 3 023 kHz and 5 680 kHz are intended for common use on a world -wide basis.

provided that such use does not cause harmful interference to other users of the channel concerned.

Radio telephony- Amplitude Modulation:

- double sideband A3E ²
- single sideband, full carrier H3E ²

- single sideband, suppressed carrier J3E

**Telegraphy (including automatic data transmission):
Amplitude modulation**

- telegraphy without the use of a modulating audio frequency (by on-off keying) A1A, A1B ³

- telegraphy by the on-off keying of an amplitude modulating audio frequency or audio frequencies or by the on-off keying of the modulated emission and including selective calling, single sideband full carrier. H2B

- multi-channel voice frequency telegraphy, single sideband, suppressed carrier J7B

- other transmissions such as automatic data transmission, single sideband, suppressed carrier JXX

Frequency Modulation:

- Telegraphy by frequency shift keying without the use of a modulating audio frequency, one of two frequencies being emitted at any instant. F1B³

8.2.5 TRANSMITTER POWER OUTPUT

8.2.5.1 The peak envelope power supplied to the antenna transmission line must not exceed the maximum values indicated in the table below; the corresponding peak effective radiated power being assumed to be equal to two-thirds of these values. It is recognized that the power employed by aircraft transmitters may, in practice, exceed the limits specified in the table 8.2.5. However, the use of such increased power (which normally should not exceed 600 W PEP) shall not cause harmful interference to stations using frequencies in accordance with the technical principles on which the allocation Plan is based.

| Class of emission | Stations | Maximum peak envelope power |
|-------------------|----------|-----------------------------|
|-------------------|----------|-----------------------------|

² A3E and H3E to be used on 3 023 kHz and 5 680 kHz.

³ A1A, A1B and F1B are permitted provided they do not cause harmful interference to classes of emission H2B, J3E, J7B and JXX.

| | | |
|---|--|-----------------|
| H2B, J3E, J7B, JXX A3E*, H3E* (100% modulation) | Aeronautical stations Aircraft stations | 6 kW 400 W |
| Other emissions such as A1A, A1B, 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.

Table 8.2.5: Maximum peak power for stations

8.2.6 TECHNICAL PROVISIONS RELATING TO THE USE OF SINGLE-SIDEBAND EMISSIONS

Definitions carrier modes:

| Carrier mode | Level N (dB) of the carrier with respect to peak envelope power |
|--------------------------------------|---|
| Full carrier (for example H2B) | $0 \geq N \geq -6$ |
| Suppressed carrier (for example J3E) | Aircraft stations $N < -26$ |
| | Aeronautical stations $N < -40$ |

Table 8.2.6

8.2.6.1 TOLERANCE FOR LEVELS OF EMISSION OUTSIDE THE NECESSARY BAND-WIDTH

In a single-sideband transmission, the mean power of any emission supplied to the antenna transmission line of an aeronautical or aircraft station on any discrete frequency shall be less than the mean power (PY) of the transmitter in accordance with Table 8.2.6.1A.

For aircraft station transmitter types first installed before 1 February 1983:

| Frequency separation Δ from the assigned frequency (kHz) | Minimum attenuation below mean power (PY) (dB) |
|---|--|
| $2 \leq \Delta < 6$ | 25 |
| $6 \leq \Delta < 10$ | 35 |
| $10 \leq \Delta$ | Aircraft stations: 40 Aeronautical stations: $43 + 10 \log_{10} (PY) (W)$ |

Table 8.2.6.1 A

NOTE – All transmitters first placed in operation after 1 February 1983 shall comply with the specifications contained in table 8.2.6.1B.

In a single-sideband transmission, the peak envelope power (PEP) of any emission supplied to the antenna transmission line of an aeronautical or aircraft station on any discrete frequency shall be less than the peak envelope power of the transmitter in accordance with the Table 8.2.6.1 B.

For aircraft station transmitters first installed after 1 February 1983 and for aeronautical station transmitters in use after 1 February 1983:

| Frequency separation Δ from the assigned frequency (kHz) | Minimum attenuation below peak envelope power (PX) (dB) |
|---|---|
| $1.5 \leq \Delta < 4.5$ | 30 |
| $4.5 \leq \Delta < 7.5$ | 38 |
| $7.5 \leq \Delta$ | Aircraft stations: 43 Aeronautical stations: * |

Table 8.2.6.1 B

8.2.6.2 OTHER TECHNICAL PROVISIONS

Assigned frequencies

For single-sideband emissions, except the class of emission H2B, the assigned frequency shall be at a value 1 400 Hz above the carrier (reference) frequency.

For aeronautical stations equipped with selective calling systems, the class of emission shall be H2B and the emission designator shall be 2K80H2B.

For classes of emission A1A, A1B and F1B the assigned frequency are chosen in accordance with a given formula ⁴.

The assigned frequency of a station employing double sideband emissions (A3E) shall be at the carrier (reference) frequency.

⁴ For transmitter power up to and including 50 W: $43 + 10 \log_{10} (PX)$ (W). For transmitter powers more than 50 W, the attenuation shall be at least 60 dB.

9.0 UTILIZATION OF FREQUENCIES ABOVE 30 MHZ

9.1 THE AMS(R) VHF FREQUENCY ALLOCATION PLAN

9.1.1 The frequency band 117.975 to 137 MHz is allocated for the AMS(R). The ICAO has established a frequency allocation plan for this band and has incorporated it into its basic instrument, the *Convention on International Civil Aviation*. The plan is based on the use of AM telephony with DSB modulation. Originally the channel bandwidth was 100 KHz. As receivers of improved selectivity have been taken into use, the plan has been modified; in particular the channel bandwidth has been reduced by stages to allow more channels to be provided. Currently allowances are made for a channel bandwidth of 8.33 kHz, although 25 kHz channel bandwidth is readily thought to be the default used in Saint Lucia. The 8.33 kHz channels are suited for short distance links, typically for ATC of aircraft en route but within range of VHF aeronautical stations and for the approach phase, landing and takeoff at airports.

9.2 EMISSION CLASSES AND MODULATION CHARACTERISTICS

9.2.1 The equipment uses Double Side Band (DSB) Amplitude Modulation (AM) full carrier, (6K80A3EJN for 25 kHz, 5K00A3EJN for 8.33 kHz), for speech and 13k0A2D for data. The equipment must be designed to operate satisfactorily with a channel separation of 8.33 kHz or 25 kHz.

9.3 TECHNICAL REQUIREMENTS FOR TRANSMITTER

9.3.1 FREQUENCY ERROR

9.3.1 Frequency error is the difference between the measured carrier frequency and its nominal value. Frequency error shall be within the requirements of the table 9.3.1.

| Frequency Error | Temperature Range 0 ° C to 40 ° C |
|-----------------------------|--------------------------------------|
| 8.33 kHz fixed Base | ± 1 ppm |
| 8.33 kHz Mobile/portable | ± 1 ppm |
| 8.33 kHz Hand held | ± 1 ppm |
| 25 kHz Fixed Base | ± 1 ppm |
| 25 kHz Mobile/portable | < < ± 1 ppm |
| 25 kHz hand held | < < ± 1 ppm |
| 2-/3- carrier offset system | ± 5 ppm |
| 4-carrier offset system | ± 3.8 ppm |
| 5-carrier offset system | ± 0.3 ppm |

Table 9.3.1: Accepted Frequency Error Limits

9.3.2 CARRIER POWER

Definitions

The carrier power is the mean power delivered to the coaxial termination during transmission in the absence of modulation. The technical requirements of the present document shall be met for all power output levels at which the transmitter is intended to operate into 50 Ω.

Tolerances

The carrier power measured under normal operations with the output power adjusted to maximum, shall not vary by more than ±1.5 dB from the rated maximum output power.

Extreme test conditions

The carrier power measured under extreme test conditions with the output adjusted to maximum rated power, shall not vary by more than +1.5 dB and -3 dB from the rated maximum output power.

9.3.3 AMPLITUDE MODULATION CHARACTERISTIC

Modulation depth (speech)

Definitions

Amplitude modulation depth:

The amplitude modulation depth is the fractional ratio, expressed as a percentage, of the difference and the sum of the numerical values of the largest and smallest amplitudes encountered in one cycle of the modulating waveform.

Limits

The amplitude modulation depth shall be at least 85 % under normal temperature conditions and at least 80 % for extreme temperature measurements.

9.3.4 MODULATION DEPTH (DATA MODE)

Limits

The amplitude modulation depth shall be 85 % under normal temperature conditions for an input signal of 0 dBm at the data input.

9.3.5 AMPLITUDE MODULATION DISTORTION

Definition

The amplitude modulation distortion is the ratio of the total rms voltage of all the harmonics of the modulated waveform to the total rms voltage.

Limits

The amplitude modulation distortion shall be less than 10 %.

9.3.6 AUDIO FREQUENCY RESPONSE

Definition

The audio frequency response expresses the ability of the transmitter to operate without excessive degradation of its frequency response as a function of the modulation frequency.

Limits 8.33 kHz channel spacing

The ratio of the maximum and minimum modulation depth as measured over the AF modulating frequency range of 350 Hz to 2.5 kHz shall be less than +2 dB and -4 dB (referred to 1 kHz). At 3.2 kHz the ratio shall be at least -25 dB referred to 1 kHz.

Limits 25 kHz channel spacing

The ratio of the maximum and minimum modulation depth as measured over the AF modulating frequency range of 300 Hz to 3.4 kHz shall be less than +2 dB and -4 dB (referred to 1 kHz). The necessary AF test range for mobile, portable and handheld equipment can be reduced to 350 Hz to 2.5 kHz. At 5 kHz the ratio shall be at least -25 dB referred to 1 kHz. For data operation, the ratio of the maximum and minimum modulation depth as measured over the AF modulating frequency range of 1.2 kHz to 2.4 kHz shall be less than ± 3 dB.

9.3.7 ADJACENT CHANNEL POWER

Definition

The adjacent channel power is that part of the total power output of a transmitter under defined conditions of modulation, which falls within a specified passband centered on the nominal frequency of either of the adjacent channels. This power is the sum of the mean power produced by the transmitter.

Limits

The adjacent channel power shall not exceed the following values below the carrier power of the transmitter:

- 8.33 kHz Channel spacing: 50 dB;
- 25 kHz Channel spacing: 60 dB.

9.3.8 CONDUCTED SPURIOUS EMISSIONS

Definition

Conducted spurious emissions are RF emissions appearing at the RF output port on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Conducted spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out of band emissions.

| Frequency Range | Test Limits Tx Standby | Test Limits Tx active mode | Reference Bandwidth |
|---------------------|---------------------------|---|---------------------|
| 9 kHz to 150 kHz | -57 dBm | -46 dBm | B= 1 kHz |
| > 150 kHz to 30 MHz | -57 dBm | -46 dBm | B= 9 kHz to 10 kHz |
| > 30 MHz to 1 GHz | -57 dBm | -36 dBm for harmonics, -46 dBm for non-harmonic spurious | B= 10 kHz |
| > 1 GHz to 4 GHz | -47 dBm | -30 dBm for harmonics -40 dBm for non-harmonic spurious | B= 10 kHz |

Table 9.3.8: Limits of conducted spurious emissions

9.4 TECHNICAL REQUIREMENTS OF RECEIVERS

9.4.1 RECEIVER SENSITIVITY.

Definition

The sensitivity of the receiver is the level of the signal at the nominal frequency of the receiver which, when applied to the receiver input produces:

- (i). in all cases, an audio frequency output power not less than 50 % of the rated output power; and
- (ii). a SINAD ratio of 12 dB.

Limits

The maximum sensitivity shall not exceed -101 dBm under normal test conditions and -95 dBm under extended or extreme test conditions as applicable.

9.4.2 EFFECTIVE ACCEPTANCE BANDWIDTH

Definition

The effective acceptance bandwidth is the frequency range over which an applied signal shall not be rejected by the receiver. In 25 kHz spaced channels this bandwidth allows the reception of offset carriers.

Limits

The SINAD ratio shall be > 12 dB. The test signal frequency shall be at least ± 8.5 kHz for 25 kHz receivers and ± 2.8 kHz for 8.33 kHz receivers from the nominal carrier frequency.

NOTE: For receivers intended for use with 3, 4 and 5 offset channels a 6 dB point of ± 11 kHz is recommended.

9.4.3 SPURIOUS RESPONSE REJECTION

The spurious response rejection is a measure of the capability of the receiver to discriminate between the wanted modulated signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained.

Limit

At any frequency separated from the nominal frequency of the receiver by more than two channels, the spurious response rejection ratio shall be not less than 70 dB.

9.4.4 CONDUCTED SPURIOUS EMISSIONS

Conducted spurious emissions from the receiver are signals at any frequency, emitted from the antenna port. The level of spurious radiation shall be measured by their power level at the antenna connector.

Limits

The power of any conducted spurious emission shall not exceed the values given in table 9.4.4.

| Frequency Range | Test Limits Rx | Test Limits Rx | Reference Bandwidth |
|---------------------|----------------|---|-----------------------|
| 9 kHz to 150 kHz | -57 dBm | -46 dBm | B= 1 kHz |
| > 150 kHz to 30 MHz | -57 dBm | -46 dBm | B= 9 kHz to 10 kHz |
| > 30 MHz to 1 GHz | -57 dBm * | -36 dBm for harmonics, -46 dBm for non-harmonic spurious | B= 100 kHz to 120 kHz |
| > 1 GHz to 4 GHz | -47 dBm | -30 dBm for harmonics -40 dBm for non-harmonic spurious | B= 1 MHz |

* Spurious limit -81 dBm, with a reference bandwidth of 10 kHz, for ground base station equipment in the band 118 MHz to 136.975 MHz.

Table 9.4.4: conducted Spurious Emissions for Receivers

9.4.5 Cross modulation rejection

Definition

Cross modulation is the transposition of the AM component from a strong unwanted signal to the wanted signal. Cross modulation rejection is the level difference between an unwanted signal and the maximum sensitivity level at the point where the audio component due to cross modulation tone reduces the SINAD ratio of the wanted signal to 20 dB.

Limits

The cross modulation rejection ratio shall be at least 80 dB for base station equipment and 70 dB for mobile portable and handheld equipment.

9.4.6 Receiver dynamic range

Definition

The receiver dynamic range expresses the capability of the receiver to limit the resulting audio output as a function of varying input signal levels.

Limit

The RF automatic gain control shall process an input level change of 100 dB with respect to the limit of the maximum sensitivity level to less than 6 dB resulting audio output power changes.

ANNEX A PART I

The following is an extract from *ECTEL Table of Frequency Allocations* listing the frequency bands allocated to the aeronautical mobile service. Footnotes pertaining to these allocations have not been included in the table. Primary allocation status is indicated in capital letters, secondary allocation status is indicated in normal characters, and permitted allocation is indicated in capital letters between oblique strokes.

LF and MF Radio Communications

| Frequency Band (kHz) | Services | Details |
|----------------------|--|---|
| 190-200 | AERONAUTICAL RADIONAVIGATION | |
| 200-285 | AERONAUTICAL RADIONAVIGATION Aeronautical Mobile | |
| 285-300 | AERONAUTICAL RADIONAVIGATION | Radiobeacons |
| 325-335 | AERONAUTICAL RADIONAVIGATION | Radiobeacons |
| 335-405 | AERONAUTICAL RADIONAVIGATION Aeronautical Mobile | |
| 415-495 | MARITIME MOBILE Aeronautical Radio navigation | Non-directional beacons not using voice transmission. |
| 510-525 | MARITIME RADIONAVIGATION Aeronautical Radio navigation | |
| 1705-1800 | FIXED MOBILE RADIOLOCATION AERONAUTICAL RADIONAVIGATION | |

Table of Frequency Allotment for AMS in LF and MF bands

HF Radio Communications

The table below shows the frequency allocation in the bands 2850 kHz to 23 350 kHz. All emissions are transmitted in the single-sideband suppressed carrier mode. The frequency assignments are normally for communications between aircrafts and ground stations.

| Frequency Band (kHz) | Services | Details |
|----------------------|-----------------------------|----------------------|
| 2850 - 3025 | AERONAUTICAL MOBILE (R) | |
| 3025 - 3155 | AERONAUTICAL MOBILE (OR) | |
| 3400- 3500 | AERONAUTICAL MOBILE (OR) | |
| 4650- 4700 | AERONAUTICAL MOBILE (R) | |
| 4700 - 4750 | AERONAUTICAL MOBILE (OR) | |
| 5450- 5730 | AERONAUTICAL MOBILE (R) | Transoceanic Flights |
| 6525-6685 | AERONAUTICAL MOBILE (R) | |
| 6685 - 6765 | AERONAUTICAL MOBILE (OR) | |
| 8815-8965 | AERONAUTICAL MOBILE (R) | |
| 8965 - 9040 | AERONAUTICAL MOBILE (OR) | |
| 10 005 - 10 100 | AERONAUTICAL MOBILE (R) | |
| 11 275 - 11 400 | AERONAUTICAL MOBILE (R) | |
| 13 200 - 13 260 | AERONAUTICAL MOBILE (OR) | |
| 13 260 - 13 360 | AERONAUTICAL MOBILE (R) | |
| 15 010 - 15 100 | AERONAUTICAL MOBILE (OR) | |
| 17 900- 17 970 | AERONAUTICAL MOBILE (R) | |
| 17 970 - 18 030 | AERONAUTICAL MOBILE (OR) | |
| 21 924- 22 000 | AERONAUTICAL MOBILE (R) | |

Table of Frequency Allocation for aeronautical service (including navigational aids) in HF bands

VHF Radio communications

| Frequency Band (MHz) | Services | Details |
|----------------------|------------------------------|--|
| 74.8 - 75.2 | AERONAUTICAL RADIONAVIGATION | Marker beacons and used in conjunction with ILS |
| 108 - 117.975 | AERONAUTICAL RADIONAVIGATION | VOR systems. The frequencies 108.1 to 111.975 MHz are used for terminal VOR. The frequencies 112.1 to 117.9 MHz are used for en-route VOR. |

| | | |
|-----------|-------------------------|--|
| 118 -127 | AERONAUTICAL MOBILE (R) | Reserved for Radiotelephony for ATC |
| 127 - 137 | AERONAUTICAL MOBILE (R) | Reserved for radiotelephony for non-ATC communications |

Table of Frequency Allocation for aeronautical service (including navigational aids) in VHF bands

UHF and SHF Radio communications

| Frequency Band (MHz) | Services | Details |
|----------------------|------------------------------|-------------------------------|
| 328.6 - 335.4 | AERONAUTICAL RADIONAVIGATION | |
| 960 - 1215 | AERONAUTICAL RADIONAVIGATION | DME and aircraft transponders |
| 1300 - 1350 | AERONAUTICAL RADIONAVIGATION | Reserved for Primary Radar |
| 1559- 1610 | AERONAUTICAL RADIONAVIGATION | |
| 4200-4400 | AERONAUTICAL RADIONAVIGATION | |
| 5000 - 5091 | AERONAUTICAL RADIONAVIGATION | |
| 5250 - 5350 | AERONAUTICAL RADIONAVIGATION | |
| 8750- 8850 | AERONAUTICAL RADIONAVIGATION | |
| 13 250 - 13 400 | AERONAUTICAL RADIONAVIGATION | |

Table of Frequency Allocation for Aeronautical (including navigational aids) in UHF and SHF bands

Annex A Part II

Frequencies allocated

The list of carrier (reference) frequencies allocated in the bands allocated exclusively to the AMS (R), on the basis of the frequency separation provided for the Caribbean region.

| Frequency (kHz) | Authorized Area of Use | Remarks |
|-----------------|----------------------------------|------------------------------------|
| 2 887 | M CAR R 2A 2B 3A 7E 13I 14C | CC 2A2B 3A C001/2A 2B 3A |
| 3 455 | M CAR CWP R 2A 2C 7B 13H | CC 2A 2C |
| 3 494 | W WORLDWIDE | C100/II |
| 3 497 | W WORLDWIDE | C100/II |
| 4 654 | W WORLDWIDE | C100/I II |
| 4 687 | W WORLDWIDE | C100/I II III |
| 5 520 | M CAR R 2B 2C 3B 6D 7E | CC 2B 2C 3B |
| 5 529 | W WORLDWIDE | C100/I II |
| 5 544 | W WORLDWIDE | C100/II V |
| 5 550 | M CAR R 2B 2C 3B 5D 6C 6E 14G | CC 2B 2C 3B |
| 5 680 | W WORLDWIDE (R) and (OR) | See Part II, Section II, Article 3 |
| 6 577 | M CAR R 2B 2C 3B 4B 6D 13E | CC 2B 2C 3B |
| 6 637 | W WORLDWIDE | C100/I II III |
| 6 640 | W WORLDWIDE | C100/II V |
| 6 646 | W WORLDWIDE | C100/II V |
| 8 846 | M CAR R 2 3 7F 9 | CC 2 3 |
| 8 927 | W WORLDWIDE | C100/II V |
| 8 933 | W WORLDWIDE | C100/II V |
| 8 936 | W WORLDWIDE | C100/I II |
| 10 027 | W WORLDWIDE | C100/I II |
| 10 033 | W WORLDWIDE | C100/II V |
| 10 075 | W WORLDWIDE | C100/II V |
| 11 342 | W WORLDWIDE | C100/II III |
| 11 348 | W WORLDWIDE | C100/II V |

| | | | |
|--------|---|----------------|-------------------------|
| 11 354 | W | WORLDWIDE | C100/II V |
| 11 396 | M | CAR EA SEA | CC EA SEA |
| 13 297 | M | CAR EA SAM | CC CAR SAM |
| 17 907 | M | CAR EA SAM SEA | CC CAR SAM CC EA SEA |
| 17 919 | W | WORLDWIDE | C100/II IV |
| 17 925 | W | WORLDWIDE | C100/II V |
| 17 934 | W | WORLDWIDE | C100/II III |
| 17 940 | W | WORLDWIDE | C100/II III |
| 21 964 | W | WORLDWIDE | C100/II |
| 21 985 | W | WORLDWIDE | C100/II |

ITU's Frequency allocated in the AMS for the Caribbean Area

Explanation of symbols and abbreviations

Column 2

M = MWARA

R = RDARA

V = VOLMET

W = worldwide

Column 3

CC = common channel to

C001/... Restricted to daytime only, in the area indicated after the slant stroke

C100/... Worldwide Allotment Area is indicated after the symbol.

ANNEX B

The channelling arrangement for the AMS (OR) between the frequencies 3 025 kHz and 18 030 kHz as indicated in the table below.

Frequency band 3 025 - 3 155 kHz: 43 + 1 channels

| | | | | | | | | | |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 3 023 ¹ | 3 026 | 3 029 | 3 032 | 3 035 | 3 038 | 3 041 | 3 044 | 3 047 | 3 050 |
| 3 053 | 3 056 | 3 059 | 3 062 | 3 065 | 3 068 | 3 071 | 3 074 | 3 077 | 3 080 |
| 3 083 | 3 086 | 3 089 | 3 092 | 3 095 | 3 098 | 3 101 | 3 104 | 3 107 | 3 110 |
| 3 113 | 3 116 | 3 119 | 3 122 | 3 125 | 3 128 | 3 131 | 3 134 | 3 137 | 3 140 |
| 3 143 | 3 146 | 3 149 | 3 152 | | | | | | |

Frequency band 4 700 - 4 750 kHz: 16 channels

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 4 700 | 4 703 | 4 706 | 4 709 | 4 712 | 4 715 | 4 718 | 4 721 | 4 724 | 4 727 |
| 4 730 | 4 733 | 4 736 | 4 739 | 4 742 | 4 745 | | | | |

Frequency band 6 685 - 6 765 kHz: 26 channels

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 6 685 | 6 688 | 6 691 | 6 694 | 6 697 | 6 700 | 6 703 | 6 706 | 6 709 | 6 712 |
| 6 715 | 6 718 | 6 721 | 6 724 | 6 727 | 6 730 | 6 733 | 6 736 | 6 739 | 6 742 |
| 6 745 | 6 748 | 6 751 | 6 754 | 6 757 | 6 760 | | | | |

Frequency band 8 965 - 9 040 kHz: 25 channels

| | | | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 8 965 | 8 968 | 8 971 | 8 974 | 8 977 | 8 980 | 8 983 | 8 986 | 8 989 | 8 992 |
| 8 995 | 8 998 | 9 001 | 9 004 | 9 007 | 9 010 | 9 013 | 9 016 | 9 019 | 9 022 |
| 9 025 | 9 028 | 9 031 | 9 034 | 9 037 | | | | | |

Frequency band 11 175 - 11 275 kHz: 33 channels

| | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 11 175 | 11 178 | 11 181 | 11 184 | 11 187 | 11 190 | 11 193 | 11 196 | 11 199 | 11 202 |
| 11 205 | 11 208 | 11 211 | 11 214 | 11 217 | 11 220 | 11 223 | 11 226 | 11 229 | 11 232 |
| 11 235 | 11 238 | 11 241 | 11 244 | 11 247 | 11 250 | 11 253 | 11 256 | 11 259 | 11 262 |
| 11 265 | 11 268 | 11 271 | | | | | | | |

Frequency band 13 200 - 13 260 kHz: 20 channels

| | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 13 200 | 13 203 | 13 206 | 13 209 | 13 212 | 13 215 | 13 218 | 13 221 | 13 224 | 13 227 |
| 13 230 | 13 233 | 13 236 | 13 239 | 13 242 | 13 245 | 13 248 | 13 251 | 13 254 | 13 257 |

Frequency band 15 010 - 15 100 kHz: 30 channels

| | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 15 010 | 15 013 | 15 016 | 15 019 | 15 022 | 15 025 | 15 028 | 15 031 | 15 034 | 15 037 |
| 15 040 | 15 043 | 15 046 | 15 049 | 15 052 | 15 055 | 15 058 | 15 061 | 15 064 | 15 067 |
| 15 070 | 15 073 | 15 076 | 15 079 | 15 082 | 15 085 | 15 088 | 15 091 | 15 094 | 15 097 |

Frequency band 17 970 - 18 030 kHz: 20 channels

| | | | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 17 970 | 17 973 | 17 976 | 17 979 | 17 982 | 17 985 | 17 988 | 17 991 | 17 994 | 17 997 |
| 18 000 | 18 003 | 18 006 | 18 009 | 18 012 | 18 015 | 18 018 | 18 021 | 18 024 | 18 027 |

Table of Channelling arrangement for AMS(OR) service

¹ For use of the carrier (reference) frequencies 3 023 kHz and 5 680 kHz, intended for worldwide communications.

ANNEX C

OPERATIONAL CHARACTERISTICS OF AMS

The AMS operational characteristics focus on the general requirements for ground station and provide an outline for the use of frequencies.

TRANSMITTER CONTROL REQUIREMENTS

- (a) Each transmitter must be installed so that it is not accessible to, or capable of being operated by persons other than those authorized by the licensee.
- (b) Each station must be provided with a control point at the location of the transmitting equipment, unless otherwise specifically authorized. A control point is the location at which the radio operator is stationed. It is the position at which the transmitter(s) can immediately be turned off.
- (c) Applicants for additional control points at aeronautical advisory (Unicom) stations must specify the location of each proposed control point.
- (d) Except for aeronautical enroute stations governed by section f within this section, the following are necessary:
 - (i) A device that indicates when the transmitter is radiating or when the transmitter control circuits have been switched on. This requirement does not apply to aircraft stations;
 - (ii) Aurally monitoring of all transmissions originating at dispatch points;
 - (iii) A way to disconnect dispatch points from the transmitter;
 - and
 - (iv) A way to turn off the transmitter.
- (e) A dispatch point is an operating position subordinate to the control point. Dispatch points may be installed without authorization from the Commission, and dispatch point operators are not required to be licensed.
- (f) In the aeronautical enroute service, the control point for an automatically controlled enroute station is the computer facility which controls the transmitter. Any computer controlled transmitter must be equipped to automatically shut down after 3 minutes of continuous transmission of an unmodulated carrier.

SPECIAL RULES RELATING TO THE USE OF FREQUENCIES

Frequencies in any band allocated to the aeronautical mobile (R) service and the aeronautical mobile-satellite (R) service are reserved for communications relating to safety and regularity of flight between any aircraft and those aeronautical stations and aeronautical earth stations primarily concerned with flight along national or international civil air routes.

Frequencies in any band allocated to the aeronautical mobile (OR) service and the aeronautical mobile-satellite (OR) service are reserved for communications between any aircraft and aeronautical stations and aeronautical earth stations other than those primarily concerned with flight along national or international civil air routes.

No public nor private communications shall be permitted in the frequency bands allocated exclusively to aeronautical mobile service or to the aeronautical mobile-satellite service.

In order to reduce interference, aircraft stations shall, within the means at their disposal, endeavour to select for calling the band with the most favourable propagational characteristics for effecting reliable communication. In the absence of more precise data, an aircraft station shall, before making a call, listen for the signals of the station with which it desires to communicate. The strength and intelligibility of such signals are useful as a guide to propagational conditions and indicate which of the bands is the preferable one for calling.