Revision 1 changes are highlighted in Turquoise

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| **U.S. Radiocommunications Sector**  **Fact Sheet** | |
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| **Document Title:** WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW RECOMMENDATION ITU-R M.[24.45-24.65\_GHz\_ARNS] - Characteristics of and protection criteria for the aeronautical radionavigation service in the frequency band 24.45-24.65 GHz | |
| **Author(s)/Contributors(s):**  Don Nellis  Federal Aviation Administration  800 Independence Ave., S.W.  Washington, DC 20591  Mohammed Rahman  Federal Aviation Administration  800 Independence Ave., S.W.  Washington, DC 20591  Michael Neale  ACES Corporation for the FAA | Phone: (202) 267-9779  e-mail: Donald.Nellis@faa.gov  Phone: (202) 267-6573  e-mail: Mohammed.Rahman@faa.gov  Phone: (858) 705-8978  e-mail: michael.neale@ACES-INC.COM |
| **Purpose/Objective:** The purpose of this contribution is to develop a new recommendation for unmanned aircraft systems (UAS) Detect and Avoid (DAA) radar systems in the 24.45-24.65 GHz band. | |
| **Abstract:** This contribution will begin the process of developing a new recommendation containing characteristics of and protection criteria for UAS DAA systems that operate in the 24.45-24.65 GHz Aeronautical Radionavigation Service allocation. | |

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| **Radiocommunication Study Groups** |  |
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| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW   RECOMMENDATION ITU-R M.[24.45-24.65\_GHz\_DAA\_RADAR][[1]](#footnote-1)\* | |
| **Characteristics of and protection criteria for radars operating in the  aeronautical radionavigation service in the frequency  band 24.45-24.65 GHz** | |

(202X)

**Introduction**

This proposed new Recommendation is intended to provide characteristics and protection criteria for aeronautical radionavigation systems, including unmanned aircraft (UA) Detect and Avoid (DAA) radar system operating in the radionavigation service in the frequency band 24.45-24.65 GHz in Regions 2 and 3. These technical and operational characteristics are to be used as a guideline in analyzing compatibility between radars operating in the aeronautical radionavigation service and systems in other services within this band.

**Proposal**

To provide the necessary characteristics for sharing studies with other systems in this band.

**Attachment**

ATTACHMENT

WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEW   
RECOMMENDATION ITU-R M.[ 24.45-24.65\_GHz\_ARNS]

Characteristics of and protection criteria for radars operating in the   
aeronautical radionavigation service in the frequency   
band 24.45-24.65 GHz

(202X)

Scope

This Recommendation specifies the characteristics and protection criteria of radars operating in the aeronautical radionavigation service (ARNS) in the frequency band 24.45-24.65 GHz. The technical and operational characteristics should be used in analysing compatibility between radars operating in the aeronautical radionavigation service and systems in other services.

Keywords

24.45-24.65 GHz, radar, characteristics, protection.

Abbreviations/Glossary

ARNS Aeronautical radionavigation service

DAA Detect and Avoid

e.i.r.p Effective Isotropically Radiated Power

GBSS Ground Based Surveillance System

PSD Power Spectral Density

UA Unmanned aircraft

UAS Unmanned aircraft system

The ITU Radiocommunication Assembly,

considering

*a)* that antenna, signal propagation, target detection, and wide necessary bandwidth of radar required to achieve their functions are optimum in certain frequency bands;

*b)* that the technical characteristics of radars operating in the aeronautical radionavigation service (ARNS) are determined by the mission of the system and vary widely even within a frequency band,

recognizing

*a)* that the frequency band 24.45-24.65 GHz is allocated on a primary basis to the radionavigation (including aeronautical radionavigation), fixed, mobile, and inter-satellite services in ITU‑R Region 2;

*b)* that the frequency band 24.45-24.65 GHz is allocated on a primary basis to the radionavigation (including aeronautical radionavigation), inter-satellite, fixed, and mobile services in ITU-R Region 3;

*c)* that the inter-satellite service operating in the frequency band 24.45-24.65 GHz shall not claim protection from harmful interference from airport surfacedetection equipment stations of the radionavigation service,

recommends

**1** that the technical and operational characteristics of the radars operating in the ARNS described in the Annex should be considered representative of those operating in the frequency band 24.45-24.65 GHz and used in studies of compatibility with systems in other services;

**2** that the criterion of interfering signal power to radar receiver noise power level (*I*/*N)* of [‑6 dB/‑10 dB], should be used as the required protection level for the aeronautical radionavigation radars, and that this represents the aggregate protection level if multiple interferers are present.

Annex  
  
Technical and operational characteristics of radars operating in the  
aeronautical radionavigation service in the  
frequency band 24.45-24.65 GHz

# 1 Introduction

ARNS system operates worldwide on a primary basis in the frequency band 24.45-24.65 GHz. This Annex presents the technical and operational characteristics of representative ARNS radars operating in this frequency band.

ARNS systems are installed in unmanned aircraft (UA) or on the ground to detect non-ccoperative aircraft as a component of an UA Detect and Avoid (DAA) system. The RTCA (formally known as Radio Technical Commission for Aeronautics) has developed a minimum operational performance standard for the airborne equipment “*DO-366 – Air-to-Air Radar for Traffic Surveillance*” and for the ground equipment “*DO-381 – Ground Based Surveillance System (GBSS) for Traffic Surveillance*”. These radars are used for collision avoidance on-board UA and are a vital part of the integration of unmanned aircraft system (UAS) in non-segregated airspace.

# 2 Characteristics of aeronautical radionavigation Detect and Avoid radar

The safe flight operation of UA necessitates advanced techniques to detect and track nearby aircraft, terrain, and obstacles to navigation. UA must avoid these objects in the same manner as manned aircraft. The remote pilot will need to be aware of the environment within which the aircraft is operating, be able to identify the potential threats to the continued safe operation of the aircraft, and take the appropriate action. The DAA radar is part of an unmanned aircraft collision avoidance system whose primary function is to provide the capability to detect, track and report non-cooperative air traffic information to the remote pilot in order to maintain adequate separation from intruders. The system utilizes a “Pilot-in-the-Loop” approach in which the ground-based UA pilot will have final authority regarding UAS manoeuvers to avoid other aircraft (manned or unmanned). The technical parameters are provided in Table 1.

TABLE 1

Technical parameters of Detect and Avoid radar

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Units | Radar 1 | Radar 2 |
| Platform |  | Aircraft | Ground |
| Platform height | km | Up to 20 | 0 |
| Radar type |  | Air-to-air radar for UA DAA system | Ground surveillance radar for UA DAA system |
| Ground speed | km/h | [TBD] | 0 |
| Frequency tuning range | GHz | 24.45-24.65 | 24.45-24.65 |
| Emission type |  | [TBD] | [TBD] |
| Pulse width | μs | [TBD] | [TBD] |
| Pulse rise and fall times | ns | [TBD] | [TBD] |
| RF emission bandwidth at  -3 dB  -20 dB  -40 dB | MHz | [TBD]  [TBD]  [TBD] | [TBD]  [TBD]  [TBD] |
| Pulse repetition frequency | pps | [TBD] | [TBD] |
| Average transmitter power | W | [TBD] | [TBD] |
| Receiver IF bandwidth  -3 dB  -20 dB  -60 dB | MHz | [TBD]  [TBD]  [TBD] | [TBD]  [TBD]  [TBD] |
| Sensitivity | dBm | [TBD] | [TBD] |
| Receiver noise figure | dB | [TBD] | [TBD] |
| Calculated Rx noise power | dBW | [TBD] | [TBD] |
| Antenna type |  | [TBD] | [TBD] |
| Antenna placement |  | [TBD] | [TBD] |
| Antenna gain | dBi | [TBD] | [TBD] |
| First antenna side lobe | dBi | [TBD] | [TBD] |
| Horizontal beamwidth | degrees | [TBD] | [TBD] |
| Vertical beamwidth | degrees | [TBD] | [TBD] |
| Polarization |  | [TBD] | [TBD] |
| Antenna scan | degrees | [TBD] | [TBD] |
| Protection criteria | dB | [TBD] | [TBD] |

# 3 Protection criteria

The desensitizing effect on radars from other services of a continuous-wave or noise-like type modulation is predictably related to its intensity. In any azimuth sectors in which such interference arrives, its power spectral density (PSD) can, to within a reasonable approximation, simply be added to the PSD of the radar receiver thermal noise. If PSD of radar‑receiver noise in the absence of interference is denoted by *N*0 and that of noise-like interference by *I*0, the resultant effective noise PSD becomes simply *I*0 + *N*0.

***Editor’s note:*** *more information on the appropriate protection criteria will be provided once the technical and operational characteristics of radars in section 2 have been finalized.*

• For typical radars an increase of about 1 dB would constitute significant degradation, equivalent to a detection-range reduction of about 6%. Such an increase corresponds to an *I/N* ratio of 1.26, or an I/N ratio of about −6 dB.

• For the radionavigation service considering the safety-of-life function, an increase of about 0.5 dB would constitute significant degradation. Such an increase corresponds to an (*I/N*) ratio of −10 dB.

These protection criteria represent the aggregate effects of multiple interferers, when present; the allowable *I*/*N* ratio for an individual interferer depends on the number of interferers and their geometry, and needs to be assessed in the course of analysis of a given scenario. The aggregation factor can be very substantial in the case of certain communication systems in which a great number of stations can be deployed.

1. \* This Recommendation should be brought to the attention of the International Civil Aviation Organization (ICAO). [↑](#footnote-ref-1)