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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 radars operating in the aeronautical radionavigation service in the frequency band 24.45-24.65 GHz | |
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| **Purpose/Objective:** The purpose of this contribution is to develop a new recommendation for aeronautical radionavigation systems, including 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 systems that operate in the 24.45-24.65 GHz Aeronautical Radionavigation Service allocation including UAS DAA systems. | |

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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] | |
| **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**

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\* This Recommendation should be brought to the attention of the International Civil Aviation Organization (ICAO).

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  (Up to 20 km from sea level fixed ground) |
| Radar type |  | Air-to-air aeronautical radionavigation DAA radar | Ground-to-air aeronautical radionavigation DAA radar |
| Operating range | km | [TBD] | [TBD] |
| Maximum number of drones within the same operating area |  | [TBD] | [TBD] |
| Ground speed | km/h | Upto 400 | 0 |
| Frequency tuning range | GHz | 24.45-24.65 | 24.45-24.65 |
| Channel selection method between radars |  | [TBD] | [TBD] |
| Emission type |  | FXN | FXN |
| Radar Modulation |  | FMCW – ***Up*** Chirp 45MHz each of three channels | FMCW – ***Down*** Chirp 45MHz each of three channels |
| Pulse width | μs | 200 (ON) 10 (OFF) | 200 (ON) 10 (OFF) |
| Pulse rise and fall times | μs | <1 | <1 |
| RF emission bandwidth at  -3 dB  -20 dB  -40 dB | MHz  (45MHz Chirp measured in 1MHz BW) | <48  <54  <60 | <48  <54  <60 |
| Pulse repetition frequency | pps | 4760  CPI <7.5 milliseconds | 4760 pps  CPI <7.5 milliseconds |
| Average transmitter power | W | 1.9  (2W peak power) | 3  (3.2W peak power) |
| Out-of-band emission characteristics | [TBD] | [TBD] | [TBD] |
| Spurious emission characteristics | [TBD] | [TBD] | [TBD] |
| Receiver IF bandwidth  -3 dB  -20 dB  -60 dB | MHz | <10MHz  [TBD]  [TBD] | <10MHz  [TBD]  [TBD] |
| **Parameter** | **Units** | **Radar 1** | **Radar 2** |
| Sensitivity | dBm | [TBD] | [TBD] |
| Receiver noise figure | dB | <6 | <6 |
| Calculated Rx noise power | dBW | [TBD] | [TBD] |
| Saturation level | [TBD] | [TBD] | [TBD] |
| Antenna type |  | Electronically Scanning Array | Electronically Scanning Array |
| Antenna placement |  | Internally Mounted – non-removable separate TX and RX antenna | Internally Mounted – non-removable separate TX and RX antenna |
| Antenna gain | dBi | 21 | 21 |
| First antenna sidelobe | dBi | <-16 | <-16 |
| Horizontal beamwidth | degrees | 2  (2-way at boresight) | 2  (2-way at boresight ) |
| Vertical beamwidth | degrees | 6  (2-way at boresight) | 6  (2-way at boresight) |
| Polarization |  | Horizontal | Horizontal |
| Horizontal antenna scan | degrees | 60 | 60 |
| Vertical antenna scan | degrees | 40 | 40 |
| Protection criteria  [*I/N* or false detection ratio] | dB | [TBD] | [TBD] |

# 3 Protection criteria

***Editor’s note:*** *Further discussion will be needed.*