Airworthiness Bulletin

AWB 34-020 Issue 9 – 24 July 2024

Potential 5G Interference of Radio Altimeter Systems

An Airworthiness Bulletin is an advisory document that alerts, educates and makes recommendations about airworthiness matters. Recommendations in this bulletin are not mandatory.

1. Effectivity

Aircraft that utilise airborne Low Range Radio Altimeters (LRRA). Also known as Radio or Radar Altimeter (RA), RADALT and RALT.

2. Purpose

Raise awareness of the potential for newly deployed 5th Generation (5G) telecommunications infrastructure to interfere with aircraft RA systems. Also, to highlight and encourage reporting of RA or RA integrated system faults.

CASA in conjunction with other services and authorities will use reported data to help determine if airborne RA systems have been affected by 5G telecommunications infrastructure and whether telecommunications restrictions and mitigations are effective.

At this time, the airworthiness concern described in this Airworthiness Bulletin is not considered an unsafe condition that would warrant an Airworthiness Directive to be issued under Part 39 of the *Civil Aviation Safety Regulations 1998*.

3. Background

Use of radio altimeters

RAs are used to determine height above terrain and may be operated as a stand-alone instrument or as an input to numerous aircraft systems. Many RAs form part of and support critical safety-of-life aircraft functions throughout multiple phases of flight.

Band of operation

RAs operate between 4.2 and 4.4 GHz, which is currently allocated to the Aeronautical Radionavigation Service (ARNS) and is reserved for radio altimeters installed on aircraft. The ARNS sits within the ‘C-band’ of 4 GHz to 8 GHz of the radio frequency spectrum.

This band is internationally recognised and protected by the International Telecommunications Union (ITU).

Standards for radio altimeters

TSO-C87a and ETSO-87a are the current technical standards for RAs. Although the E/TSO was updated in 2012 and 2013 respectively the TSO reference material, *RTCA/DO-155 - Minimum Performance Requirements for Airborne Low-Range Radio Altimeters* and *EUROCAE/ED-30 - Minimum Performance Requirements for Low-range Radio (Radar) Altimeters* were released in 1974 and 1980 respectively and have not been updated since.

Wireless broadband infrastructure

5G wireless broadband technology is rapidly expanding worldwide. It is designed to increase speed, reduce latency, and improve flexibility of wireless telecommunication services. To effectively exploit the advances in this technology more spectrum and infrastructure will be required.

The frequency spectrum 3.7 - 4.0 GHz directly adjacent to and below the RA band has been identified as highly desirable for use with both existing and emerging 5G technology.

4. Potential issues with radio altimeters

The radio altimeter offers greater accuracy than an aircraft's barometric altimeter and is essential for operations requiring precise height measurements above a surface, such as low altitude and low visibility scenarios. It calculates exact heights by detecting its own transmitted signals reflected off surfaces below the aircraft. However, if the radio altimeter system cannot adequately filter out unwanted signals, its performance and accuracy may be compromised.

TSO-C87a does not provide criteria for compatibility or rejection of unwanted signals in adjacent bands. Potential issues may arise where newly deployed 5G wireless communications above 3.7 GHz operate in close proximity to aircraft and RA systems in critical phases of flight.

Anomalous, missing, or erroneous radio altimeter inputs can cause various aircraft systems to operate unexpectedly or undesirably during critical phases of flight, such as take-off, approach, and landing. These issues may not be immediately apparent to the crew, potentially compromising the ability to maintain safe operations.

In 2019, Special Committee 239 (SC-239) was formed by the Radio Technical Commission for Aeronautics (RTCA), with the responsibility for updating the RTCA *DO-155 - Minimum Performance Requirements for Airborne Low-Range Radio Altimeters*. As part of SC-239s work, the white paper, *Assessment of the C-band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations* was written to provide a quantitative evaluation of RA performance regarding RF interference from newly planned US Federal Communications Commission (FCC) 5G wireless broadband emissions in the 3.7–3.98 GHz band.

The evaluation concluded there was a major risk of harmful interference to radar altimeters on all types of aircraft from 5G systems in the 3.7 to 3.98 GHz band.

Coupled with outdated minimum design, certification and protection criteria, many approved RA systems may be unable to filter or block unwanted signals from existing and new 5G deployments.

Revision to radio altimeter standards

Since the release of the SC-239 white paper in 2020, a significant amount of theoretical and empirical testing has taken place around the world.

RTCA SC-239 and EUROCAE Working Group WG-119 are currently developing new standards - *DO-155 - Minimum Performance Requirements for Airborne Low-Range Radio Altimeters* and *EUROCAE/ED-30 - Minimum Performance Requirements for Low-range Radio (Radar).*

The update will '*enable the efficient use of near-band spectrum by setting a standard for new radar altimeters that provide state-of-the-art near-band rejection while maintaining the current intended functions of the radar altimeters.*'

Australian Communications and Media Authority spectrum re-allocation

The Australian Communications and Media Authority (ACMA) is Australia's spectrum regulator, responsible for managing the radiofrequency spectrum.

In 2020, ACMA began consultation with CASA, the aviation and telecommunications industries regarding the planned expansion of 5G wireless broadband services and potential interference issues relating to RA systems and aircraft operations.

Australia has already deployed 5G systems, however, telecommunications companies were only licensed to use frequencies up to 3.7 GHz ana power level of 48dBm EIRP (Effective Isotropic Radiated Power) or 63 Watts.

ACMA have begun re-allocation of the C-band spectrum (3.4 – 4.0 GHz) to facilitate growing wireless broadband telecommunications needs. ACMA are using a staged approach, beginning with the allocation of area-wide licences (AWLs) in remote areas. This will be followed by spectrum allocation within metropolitan and regional areas. Detailed information on the spectrum planning, determinations and allocation of spectrum can be accessed from the Allocating the 3.4-4.0 GHz band ACMA landing page.

5. Coexistence

CASA recommends operators contact both RA OEMs and aircraft type certificate holders to determine their specific RA and aircraft system susceptibility to wireless broadband 5G systems operating above 3.7 GHz.

RA systems currently in use may need to be upgraded or replaced to coexist with new wireless broadband infrastructure. Many RA OEMs and aircraft type certificate holders are designing or currently have upgraded systems available to better filter or enhance RF interference, rejection and tolerance.

Some older RA systems will no longer be supported by equipment manufacturers, and some will not be upgradeable.

Until the release and adoption of new RA standards, ACMA in conjunction with CASA have identified a precautionary approach to new deployments of wireless broadband (WBB) 5G services above 3.7 GHz. This will allow RA OEMs and type certificate holders further time to develop new or upgraded RA systems.

Restrictions, limitations and detailed information can be sourced from the following ACMA sources Allocating the 3.4-4.0 GHz band, *Wireless broadband and radio altimeter coexistence Outcomes paper – June 2023* and RALI MS47: Licensing and coordination procedures for Area-Wide Licences (AWL) in the 3400–4000 MHz band | ACMA.

ACMA has produced Radiocommunications Assignment and Licensing Instruction (RALI) RALI MS47. The purpose of this RALI is to provide information about, and describe necessary steps for, the frequency coordination and licensing of Area-Wide Licences (AWL) and area-wide receive licences (AWL rx) in the 3400– 4000 MHz band.

RALI 47 encompasses interim mitigations and restrictions imposed by ACMA on telecommunications equipment and operators to safeguard RA systems. The temporary mitigations and restrictions are scheduled to remain in place until 1 April 2026.

6. International assessments and requirements

The FAA has issued Policy Statement PS–AIR–600–39–01: Demonstration of Radio Altimeter Tolerant Aircraft. This statement offers guidance for operators and manufacturers to help demonstrate that an aircraft meets the 'radio altimeter tolerant' criteria outlined in FAA Airworthiness Directives (ADs) AD 2023-10-02, AD 2023-11-07, and by default, Transport Canada’s (TC) 5G C-Band wireless broadband interference ADs. Additionally, it serves as an acceptable means of compliance with ANAC AD 2024-04-01 issued by Brazil's Agência Nacional de Aviação Civil (ANAC).

National Aviation Authorities (NAAs) in various countries impose restrictions and limitations based on their airspace requirements and national telecommunications infrastructure. NAA ADs specifying restrictions or limitations within a specific country’s airspace, issued to address RA interference from wireless broadband infrastructure, are only relevant to Australian-registered aircraft when operated within that airspace.

The FAA, TC, and ANAC have all issued ADs regarding RAs and aircraft operations within their specific administered airspace. Under Part 39 of the *Civil Aviation Safety Regulations 1998*, these ADs are automatically accepted as Australian ADs. However, those foreign NAA ADs are expressed so that when applied as an Australian AD the operational restrictions only apply to Australian-registered aircraft when operating within the airspace of the relevant foreign country.

EASA Position

EASA determined that both the FAA and TC ADs are not eligible for adoption and is currently not planning to issue similar EASA ADs for products for which it acts as State of Design Authority.

EASA have released SIB 2021-16R1 - Operations to aerodromes located in United States with potential risk of interference from 5G ground stations, that recommends various awareness and risk assessments operators may wish to consider.

7. Potential or suspected radio altimeter 5G interference

Reported Australian suspected RA interference and discrepancies

Following the initial release of this AWB, CASA received multiple reports from operators which included,

- errors
- failures
- malfunctions
- erratic values
- autopilot disengagement
- terrain warning systems and
- flight director failures.

To date, none of the reports received can or have been confirmed as interference from current 5G wireless broadband infrastructure.

CASA recognises that spurious interference and its effects can be challenging to identify, as the interference may not be noticeable to operating crews and often occurs intermittently. These malfunctions are difficult to replicate through ground testing due to the dynamic nature of wireless broadband base stations and their intermittent transmissions.

CASA encourages operators to continue reporting potential or suspected 5G interference occurrences.

CASA suggests operators, where possible, review data outputs from radio altimeter systems via any appropriate methods. Information to support reporting may be derived from

- Flight crew reporting
- Maintenance reporting
- ADS-B Heights by Australian Airspace Monitoring Agency (AAMA)
- Aircraft Health Monitoring/Management systems
- Flight Operations Quality Assurance (FOQA) downloads
- Quick Access Recorder (QAR) downloads
- Flight Data Recorder (FDR) download reports
- Aircraft Communication Addressing and Reporting System (ACARS)
- Airservices (air traffic control) reports.

The graph below shows downloaded discrepancies in RA computed data.

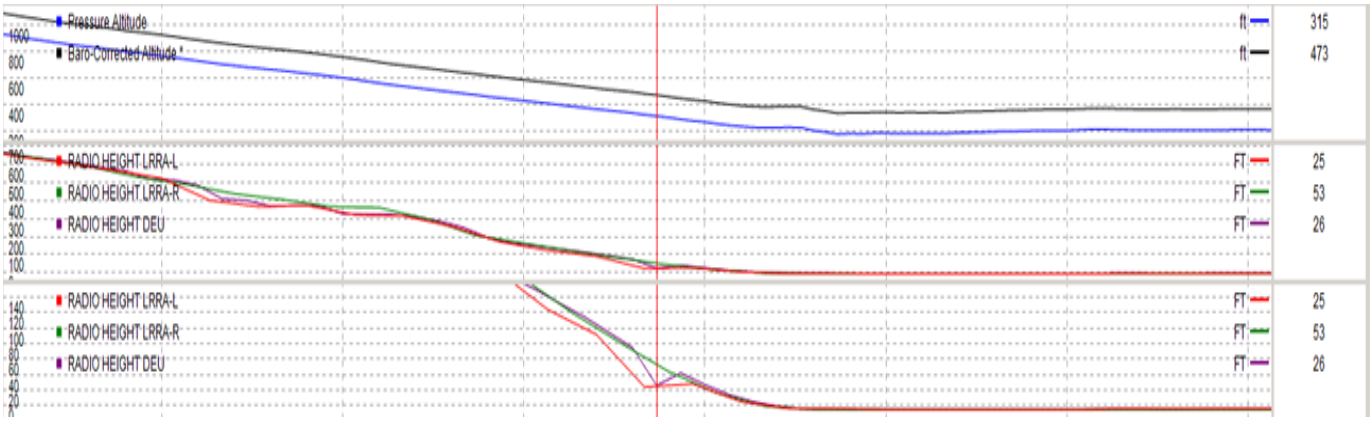

Figure 1 - Radio altimeter values compared to barometric altimeter.

Depicted in Figure 2, below, is an international example of an erroneous RA indication/output where a licensed communications network is suspected as the cause. Depending on the aircraft and the degree of integration of radio altimeter system, a variety of different system malfunctions could occur.

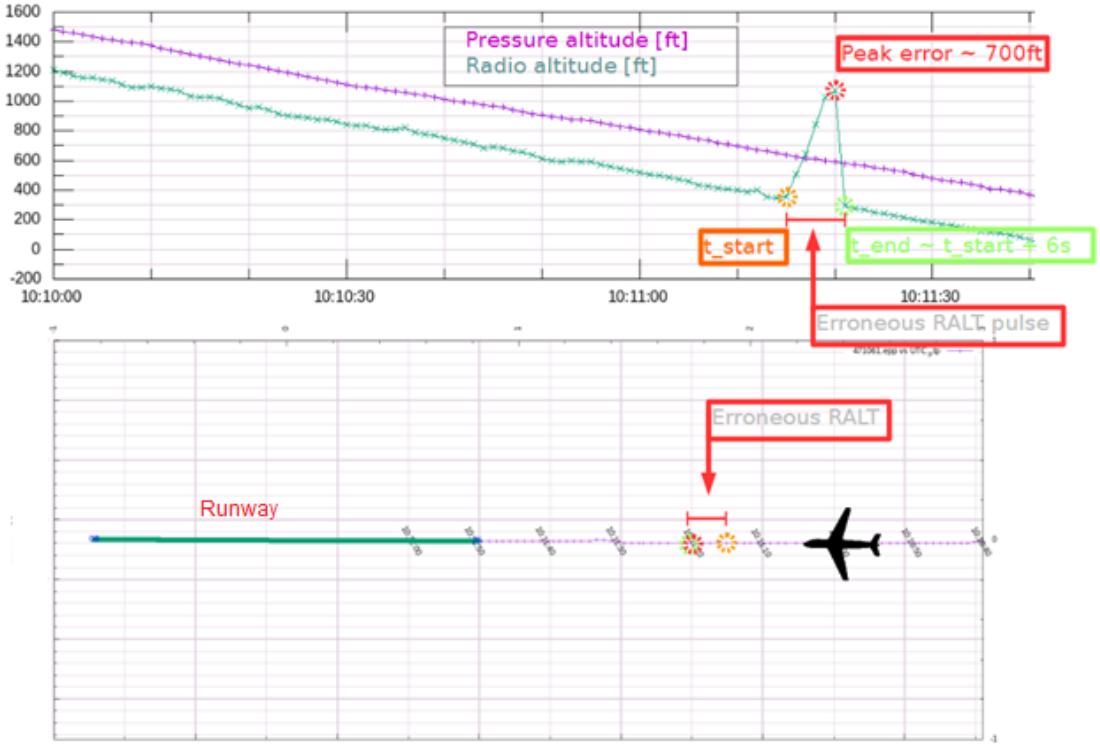

Figure 2 - Radio altimeter over-read.

5G wireless broadband infrastructure locations

It is possible to review where 5G infrastructure is located around airfields or approach and departure paths. Both ACMA and RFNSA provide interactive location maps to allow the public to determine where and what telecommunication systems are positioned in a specific location.

Reporting 5G infrastructure interference

ACMA is responsible for managing any interference issues caused by 5G wireless broadband infrastructure, further information and consultation regarding 5G infrastructure should be directed to ACMA. Suspected or actual aircraft defects related to 5G should be addressed directly to CASA.

8. Recommendations

Aircraft operators

Operators are encouraged to contact both the RA OEMs and aircraft TC holders to seek the most up to date information concerning their systems in relation to 5G tolerance and capabilities.

Operators with a Safety Management System (SMS) should use its tools to assess the risk to each type of radio altimeter configuration and how it impacts typical flight operations.

Operators without an SMS should assess their operational risks, using publicly available risk assessment tools, in relation to each type of radio altimeter configuration and how it impacts typical flight operations.

Operations

Standard Operating Procedures (SOP) should identify alternate procedures especially flying operations that require or utilise RA information.

Of greatest concern within Australia are low altitude and low visibility operations. Such as low-visibility take-offs (LVTO), precision approaches — Category II and III (CAT II and CAT III) and Special Authorisation Category I and II (SA CAT I and SA CAT II). Autoland along with RNP AR operations may be affected by radio altimeter interference.

An initial list of identified runways that requires protection against potential 5G interference and subject to ACMA interim restrictions can be found within the ACMA *Frequency coordination and licensing procedures for Area-Wide Licences (AWL) in the 3400–4000 MHz band, Radiocommunications Assignment and Licensing Instruction, RALI MS 47*.

Helicopter operations

Assess the impact of radio altimeter system inaccuracy or failure on helicopter operations that may include:

- Night Vision Goggles (NVG) or Night Vision Imaging Systems (NVIS) operations without external lighting should consider the impact of potential 5G interference for operations that rely on radio altimeter inputs.
- offshore helicopter operations (oil/gas platforms etc.) within the presence of known 5G infrastructure should not be conducted under IFR unless there is an alternate means to identify obstacles and terrain because the radio altimeter may not be reliable.

- low level operations should not be conducted without alternative altitude reference (known barometric height for example) because the radio altimeter may not be reliable.
- helicopter auto hover – consideration should be given to an alternate means of height and drift references.
- for essential communications, limit the use of 5G devices used for external crew communications during medical service operations (EMS) to 3G or 4G systems.

Operations into other countries

All operators flying outside of Australian airspace should familiarise themselves with, consider, and comply with relevant airspace considerations and directives.

9. Reporting

Reporting suspected or actual interference is crucial, as it enables CASA to monitor and document the effects on radio altimeters and integrated systems as new infrastructure is deployed.

It also helps assess the effectiveness of any implemented mitigations and restrictions.

CASA requests a defect report submitted via the DRS for any occurrences at or below 2500ft AGL of:

a. all spurious RA displays or indications during take-off and landing
b. any aircraft system faults/failures caused by RA inputs/data such as
    i. Class A Terrain Awareness Warning Systems (TAWS-A)
    ii. Enhanced Ground Proximity Warning Systems (EGPWS)
    iii. Traffic Alert and Collision Avoidance Systems (TCAS II)
    iv. Take-off guidance systems
    v. Flight Control (control surface)
    vi. Tail strike prevention systems
    vii. Windshear detection systems
    viii. Envelope Protection Systems
    ix. Altitude safety call outs/alerts
    x. Autothrottle
    xi. Thrust reverser
    xii. Flight Director
    xiii. Primary Flight Display of height above ground
    xiv. Alert/warning or alert/warning inhibit systems
    xv. Stick pusher/stick shaker
    xvi. Engine and wing anti-ice systems
    xvii. Automatic Flight Guidance and Control Systems (AFGCS)

When submitting a defect report please include the following information that will assist in conducting a trend analysis and identification of possible interference sites.

a. Airport/aerodrome/heliport, including the specific approach/departure
b. Runway
c. Phase of flight
d. Approximate altitude
e. Systems affected, including particulars on the manufacturer and/or model numbers.
f. Weather (rain, snow, fog etc)

Other information from National Airworthiness Authorities

CASA is collecting and collaborating information from radio altimeter anomalies with the FAA, EASA, TC, ANAC and CAA NZ. CASA will update this reference list as more information becomes available.

Several other airworthiness authorities have produced safety information and awareness documents highlighting the potential risks.

IATA

FAA AD 2023-10-02 – Fixed wing

FAA AD 2023-11-07 – Rotorcraft

TC AD CF-2024-14 - Fixed wing

TC AD CF-2024-15 - Rotorcraft

Transport Canada CASA 2024-05

FAA SAIB AIR-21-18R3

EASA SIB 2021-16R1

UK CAA SN-2021/017

Brazil (ANAC) ASO : 0003-0/2022

Brazil (ANAC) AD 2024-04-01

PORTARIA Nº 14.318, DE 10 DE ABRIL DE 2024. – Brazilian RA tolerance limits (read in conjunction with ANAC AD 2024-04-01

French Civil Aviation Authority (DGAC)

Allocating the 3.4-4.0 GHz band

Wireless broadband and radio altimeter coexistence Outcomes paper – June 2023

RALI MS47: Licensing and coordination procedures for Area-Wide Licences (AWL) in the 3400–4000 MHz band | ACMA.

10. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link email address:

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or in writing, to:

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