ADVISORY CIRCULAR

Subject	Date	AC Number	Version
Protection of Radio Altimeter Systems from undesirable Impact of 5G Telecommunication Networks deployed around the aerodromes and heliports	**1 June 2025**	**AC091-02**	**1.0**

1. Introduction

The increasing deployment of 5G telecommunication networks—particularly those operating in frequency bands adjacent to the 4.2–4.4 GHz band used by Radio Altimeters—has raised safety concerns within the international aviation community. In response to this issue, ICAO issued State Letter SP 74/1-21/22, alerting States to the potential for harmful interference.

In alignment with this global concern, the Kingdom of Saudi Arabia, through the General Authority of Civil Aviation (GACA) and in coordination with the Communications, Space, and Technology Commission (CST), conducted a detailed technical and regulatory assessment. The findings led to the development of national safeguarding measures, coordination mechanisms, and reporting procedures aimed at ensuring the continued safe operation of aircraft in the presence of 5G networks.

Purpose

This Advisory Circular aims to inform all Airspace users, Air Navigation Service Providers, and Aerodrome Operators of the measures that will be applied to ensure the protection of Radio Altimeter Systems from the undesired impact of 5G telecommunications networks and provides information on:

a) the requirements adopted by the Communications, Space, and Technology Commission for the siting and setting of 5G base stations around aerodromes and heliports to protect Radio Altimeters from Potential Interference that these stations could cause;
b) reporting processes and procedures that were jointly adopted by GACA and CST to provide information on any interference or abnormal indication on Radio Altimeters observed in-flight by aircraft and helicopters operators

Radio Altimeters are critical in supporting the conduct of safe operations, particularly during approaches in low-visibility conditions. Therefore, there is a need to set sustainable arrangements to mitigate the risk of interference, ensuring the continued safety of aircraft operations.

Applicability

This Advisory Circular applies to all airspace users, certified Air Navigation Service Providers, and aerodrome operators within the Kingdom of Saudi Arabia.

Cancellation

This is the first official version of this Advisory Circular, and it cancels no Advisory Circular on the subject matter.

Related Regulatory References

a) GACA Part-4 Occurrence Reporting and Safety Information System § 4.15, Appendix D
b) GACAR Part-91 General Operating and Flight Rules § 91.71
c) GACAR Part-5 Safety Management Systems § 5.71

Related Reading Materials

a) GACA Advisory Circular No: AC 091-01 Undesired Impact Of 5G Networks On Airborne Radio Altimeters.
b) ICAO State Letter (ref: SP 74/1-21/22 dated 25 March 2021)
c) ICAO MID DOC 015: Guidance on Safeguarding Measures to Protect Radio Altimeters from Potential Harmful Interference.
d) Study of Coexistence Between Radio Altimeter Systems And 5G Networks by CST and GACA. (A copy can be provided on request).

Definitions of Terms and Abbreviations Used in this Advisory Circular

a) 5G networks - Digital cellular networks operating in 3.7 – 4.2 GHz a C-Band.
b) Radio Altimeters - operate in the frequency band 4.2-4.4 GHz to provide accurate altitude measurements critical for safe flight operations, especially during precision approaches and landings.
c) CST - Communications, Space, and Technology Commission.
d) SAG - Spectrum Advisory Group.

Approval

This Advisory Circular has been approved for publication by the Executive Vice President of the Environmental and Sustainability Sector of the General Authority of Civil Aviation.

2. Background

In the ICAO State Letter (Ref: SP 74/1-21/22 dated 25 March 2021), ICAO informed all Contracting States that it had received studies from several States and organizations regarding the potential risk of interference caused by 5G telecommunication networks on radio altimeters. These studies generally conclude that some radio altimeters will be impacted if high-power cellular systems are deployed near the frequency band used by radio altimeters. Several States have already taken temporary technical, regulatory, and operational mitigations on the deployment of new 5G systems to protect radio altimeter operations while more permanent solutions are being devised.

Radio Altimeters operate in the frequency band 4.2-4.4 GHz to provide accurate altitude measurements critical for safe flight operations, especially during precision approaches and landings.

2.1 The global deployment of 5G telecommunications networks, particularly those operating in the frequency band 3.7-4.0 GHz and 4.0-4.2 GHz (C-band) spectrum, have raised concerns about potential interference with radio altimeter systems. Moreover, the potential risks can be summarized as follows:

a) Erroneous altimeter readings that may result in false altitude data during approach phases;
b) Potential Loss of altimeter functionality which results in complete or intermittent signal loss, affecting critical systems such as autopilot, ground proximity warning systems (GPWS), and enhanced vision systems (EVS);
c) Increased risks of go-arounds, delays, or cancellations due to degraded safety margins in affected airspace.

These risks are higher in proximity to 5G base stations operating near aerodromes, heliports or located along critical low-level flight routes.

3. 5G C-band Network Deployment in the Kingdom

3.1 GACA and CST Coordination

To address the potential risks of 5G telecommunications networks interfering with Radio Altimeter systems, GACA initiated a collaborative effort with the Communications, Space, and Technology Commission (CST). Both parties agreed that there was a need to develop a comprehensive study to assess and mitigate these risks. The study would:

a) Define criteria for safe 5G deployment near aerodromes, ensuring compliance with aviation safety standards;
b) Propose exclusion and protection zones around airports and heliports;
c) Establish reporting and resolution mechanisms for interference incidents;
d) Implement an escalation process to ensure timely resolution of any detected interference events.

3.2 Spectrum Advisory Group (SAG)

To assess the above risks and define measures to protect Radio Altimeter systems from the potential harmful interference from 5G telecommunications networks", CST in consultation with GACA established the Spectrum Advisory Group (SAG) composed of experts and specialists from CST and GACA. This group was tasked to develop a detailed technical study providing recommendations on suitable protection criteria to avoid any interference on Radio Altimeters that may be caused by the 5G telecommunication networks. The study covered:

a) experiments, field measurements, and a follow-up on regional and global developments on 5G telecommunications networks to gather sufficient data and information supporting the definition of protection criteria;
b) the approach used for the analysis of potential interferences, conclusions, and recommendations to adopt specific protection criteria. This approach comprises two main parts covering out-band 3.7 - 4.0 GHz and in-band 4.0 – 4.2 GHz frequencies. **(Refer to Attachment B for further details)**

Moreover, the study included Radio Altimeters installed in fixed-wing aircraft, and rotary aircraft to ensure that it covered all types of aircraft operating in the Kingdom.

3.3 The wireless 5G broadband infrastructure is designed to enhance speed, reduce latency, and improve the adaptability of wireless telecommunications. CST has authorized the use of the 3.8 -4.0 GHz frequency band for International Mobile Telecommunications (IMT) to facilitate 5G broadband services within the Kingdom.

Additionally, CST has authorized the use of the 4.0-4.2 GHz frequency band to support private 5G networks, which are designed for specific organizational needs with limited licensing framework. This model allows multiple users to enhance security, reliability, and low latency with specific technical conditions.

Given its proximity to the Radio Altimeter band, this spectrum allocation presents a significant risk of potential interference that requires clear procedures and recommendations to maintain safe operation.

4. Recommendations

4.1 Airspace users

Airspace users should:

a) Ensure that any Radio altimeter interference event is promptly reported to the Saudi Air Navigation Service (SANS) through the ATS Unit managing the affected flight(s).
b) Adopt procedures to ensure safe landing of an aircraft observing Radio Altimeter interference.

4.2 Air Navigation Service Providers

Certified ANS providers should:

a) Monitor the reporting of Radio Altimeter interference and share any confirmed interference with the aerodrome operator.
b) Issue NOTAMs to inform airspace users on the reported Radio Altimeter interference event with details of the area(s) affected;
c) Coordinate with the CST to eliminate the source of interference. All coordination and reporting shall follow the procedures outlined in Attachment A.

4.3 Aerodrome Operators

Certified aerodrome operators should:

a) At uncontrolled aerodromes, coordinate with the CST to share information on reported Radio Altimeter interference, with notification to GACA.
b) Coordinate with the CST to eliminate the source of interference. The coordination and reporting arrangements should use the attached escalation procedures (Refer to Attachment A of this AC).
c) Engage in close coordination with the ANS provider to monitor the status of the Radio Altimeter interference.
d) Facilitate the activities of the CST monitoring team at the airport.
e) Monitor the level of compliance of telecom providers with the dimensions of the exclusive zones for the base stations installed around the airport. These zones aim to protect the Radio Altimeter from harmful 5G network interference.
f) Monitor the level of compliance with the protection criteria for the deployment and operation of base stations located around the airport considering the technical requirements provided in (Attachment B to this AC).

5. Contact

Questions or comments regarding this Advisory Circular, or requests for further guidance on 5G interference mitigations, should be directed to:

General Authority of Civil Aviation (GACA)	sd@gaca.gov.sa
Saudi Air Navigation Services (SANS)	Atm@sans.com.sa

Attachment A

Coordination Procedure jointly adopted by CST and GACA to protect the Radio Altimeter from Potential Harmful Wireless Interference from 5G Telecommunication Networks Operating in the band 3.7-4.2 GHz (C- Band)

1. Reporting Process

Initial Reporting:

a) The Air Traffic Control Tower (ATC) should share information on any confirmed interference affecting the Radio Altimeters with the airport's operations team.
b) The airport operations team should notify the Communication, Space, and Technology Commission (CST) via email at (spectrum_FOC@cst.gov.sa) and GACA following the contact table provided below.

2. Uncontrolled aerodromes

For uncontrolled aerodromes, the airport operations team should directly escalate the reported interference to CST and notify GACA.

3. Verification and Response

a) Major aerodromes:

CST will investigate and confirm the source of interference within 12 hours for King Abdulaziz, King Khalid, King Fahd, Prince Mohammed Bin Abdulaziz, Abha, and Taif International Airports.

b) Other Airports:

For other international, regional, and domestic aerodromes, CST will investigate and confirm the source of interference within 24 hours.

c) Resolution Measures:

If the interference is identified as originating from 5G Telecommunication networks, CST will immediately coordinate with the concerned telecommunication provider(s) to eliminate the interference to the Radio Altimeter within a maximum of 36 hours.

However, if the interference persists, the telecommunication provider will be instructed to suspend the operation of the base station(s) identified as the source of the interference.

d) Post-Resolution Verification:

The aerodrome operations will coordinate with TWR to monitor airspace operations and ensure that no further radio altimeter interference is reported.

Additionally, a confirmation report on the elimination of the interference should be sent to GACA and CST within 12 hours.

4. Escalation Process

If the interference persists, the following steps should be applied:

a) Escalate to the CST Executive Vice President (EVP) of the spectrum sector via GACA's EVP of Aviation Safety and Environment Sustainability sector, to ensure that the issue is resolved within 24 hours.

b) Further escalation to the CST Governor by GACA's President is necessary if the reported interference is not eliminated.

5. Reporting and Notification

a) The certified Air Navigation Service providers and the aerodrome operators should submit detailed reports regarding the radio altimeter interferences to GACA.
b) For each reported radio altimeter interference, GACA and CST should be notified to ensure the elimination of the interference in a timely manner.

Contacts

For the initial reporting of the radio altimeter interferences, the following contacts should be used:

Authority		Name	Contact Information
General Authority of Civil Aviation (GACA)	Level 1 Escalation	Eng. Faris Alzahrani	Email: Faalzahrani@gaca.gov.sa Mobile: 0541877717
Communications, Space, and Technology Commission (CST)		Eng. Sultan Al-Balawi	Email : Ssbalawi@cst.gov.sa Mobile : 0502027600

ATTACHMENT B
Section 1

Safeguarding Measures adopted by CST to Protect Radio Altimeters from Potential Harmful Interference at Aerodromes and Heliports for Base Stations Operating in the Band 3.7-4.0 GHz.

This section summarizes the protection criteria that must be applied to protect the Radio Altimeter from 5G telecommunication networks operating in the band 3.7-4.0 GHz. These criteria are based on the aircraft's altitude during the approach phase and landing, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and within their vicinity.

1. Fixed-wing and rotary-wing aircraft measures are necessary to protect aerodromes and heliports from 5G harmful interference

The 5G base stations deployment at an aerodrome or heliport or within their vicinity should comply with the following conditions:

1.1 The maximum Equivalent Isotropic Radiated Power (EIRP) must be -45 dBm/MHz with an antenna height not exceeding 40 m above ground level. The antenna radiation pattern modes that point away from the runway with emitted energy below the horizon can greatly reduce the probability of interference power exceeding receiver blocking specification for worst-case Radio Altimeter specification.

1.2 The installation must consider the following zoning:

a) **Precautionary protection criteria for fixed-wing aircraft:** Exclusion and protection zones are proposed to mitigate interference at an aerodrome (as shown in Figure 1). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape with a radius of 2000 meters from the runway end; and

Protection Zones: recommended for all 5G base stations with a circular shape with a radius between 2000 meters and 6000 meters from the runway end, and a specific technical configuration to limit the maximum radiated power and antenna tilt angle below the horizon.

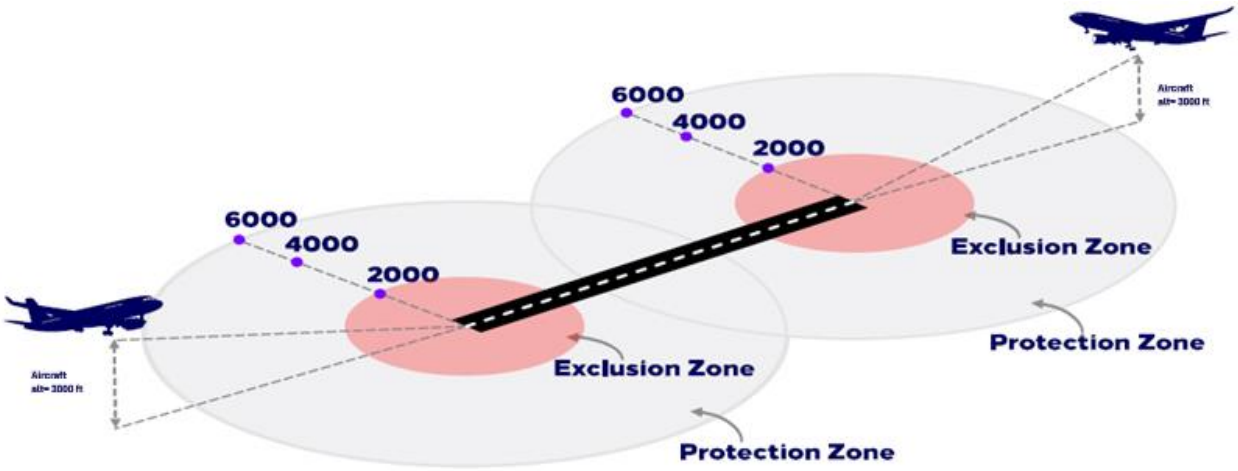

Figure1: Exclusions zones have a circular shape centered on the Runway end with a radius of 2000m and the protection areas are circular with a radius between 2000m to 6000m

EIRP	Antenna Height
Pmax -45 dBm/MHz	40 m (AGL)

Table1

b) **Precautionary protection criteria for rotary wing aircraft:** The exclusion and protection zones aim to mitigate interference at a heliport (as shown in Figure 2). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape centered the heliport with 2000 meters; and

Protection Zones: recommended for all 5G base stations with a circular shape with a radius of 2000 meters up to 6000 meters from the runway end, and a specific technical configuration to limit the maximum radiated power and antenna tilt angle below the horizon.

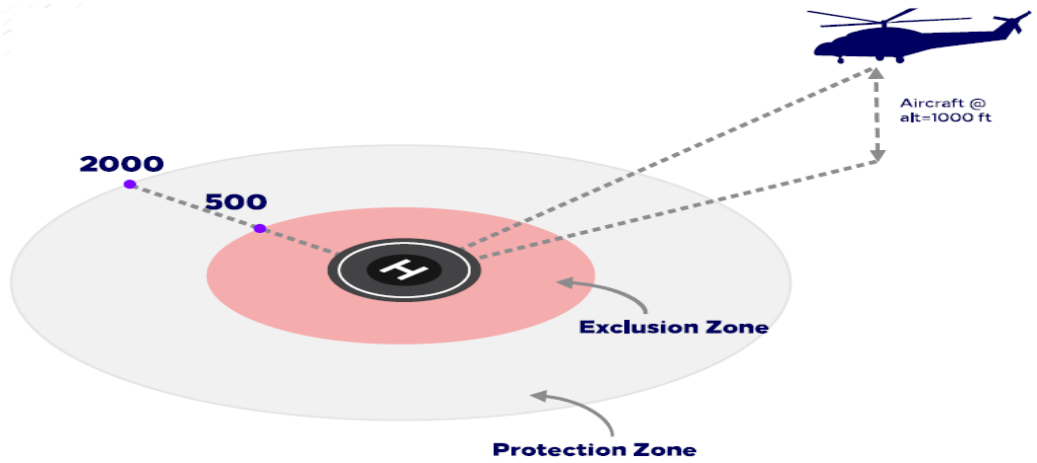

Figure2: Exclusive zones have a circular shape with a radius of 500m and the protection area is circular with a radius between 500 m and 6000m

EIRP	Antenna Height
Pmax -45 dBm/MHz	40 m (AGL)

Table 2

Section 2

Safeguarding Measures adopted by CST to Protect Radio Altimeters from Potential Harmful Interference at Aerodromes and Heliports for Base Stations Operating in the Band 4.0-4.2 GHz.

This section summarizes the protection criteria that should be applied to protect the Radio Altimeter from 5G telecommunication networks operating in the band 4.0-4.2 GHz. These criteria are based on the aircraft's altitude during the approach phase and landing, to reduce the probability of interference during the deployment of 5G base stations at aerodromes and within its vicinity.

1. Fixed-wing and rotary-wing aircraft measures are necessary to protect aerodromes and heliports from 5G harmful interference:

The 5G base stations deployment at an aerodrome and a heliport or within their vicinity should comply with the following conditions:

1.1 The Maximum Equivalent Isotropic Radiated Power (EIRP) must be -29 dBm/MHz with an antenna height not exceeding (40 m) above ground level. The antenna radiation pattern modes that point away from the runway with emitted energy below the horizon can greatly reduce the probability of interference power exceeding receiver blocking specification for worst-case Radio Altimeter specification.

1.2 The installation must consider the following zoning:

a) **Precautionary protection criteria for fixed-wing aircraft:** Exclusion zones are proposed to mitigate interference at an aerodrome (as shown in figure1). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape with a radius of 1500 meters from the runway end.

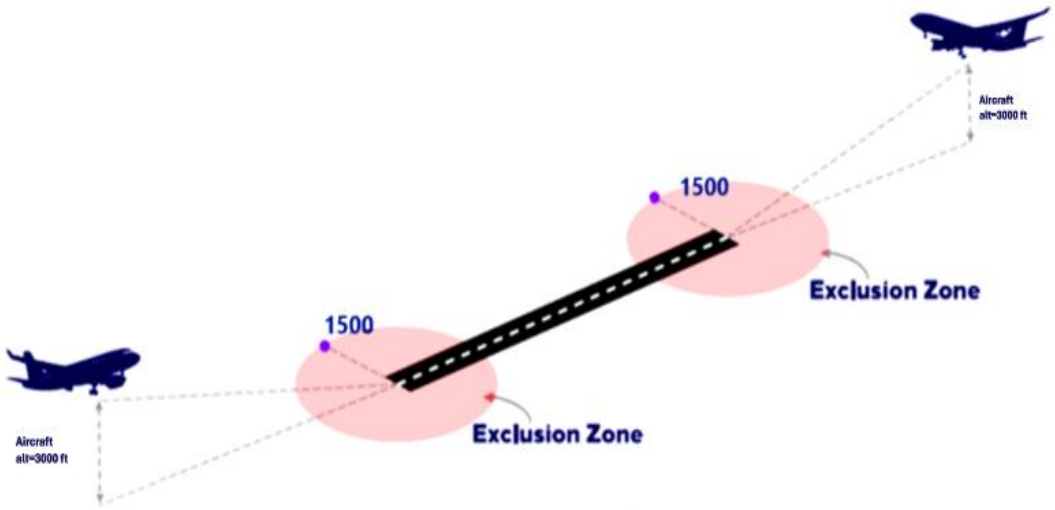

Figure 3: Exclusive zones have a circular shape with a radius of 1500m

Table 3

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -29 dBm/MHz	40 m (AGL)

b) **Precautionary protection criteria for rotary-wing aircraft:** The exclusion zones aim to mitigate interference at a heliport (as shown in Figure 2). The 5G base stations must not be permitted to operate inside the exclusion zones defined as a circular shape centered on the heliport with 1500 meters.

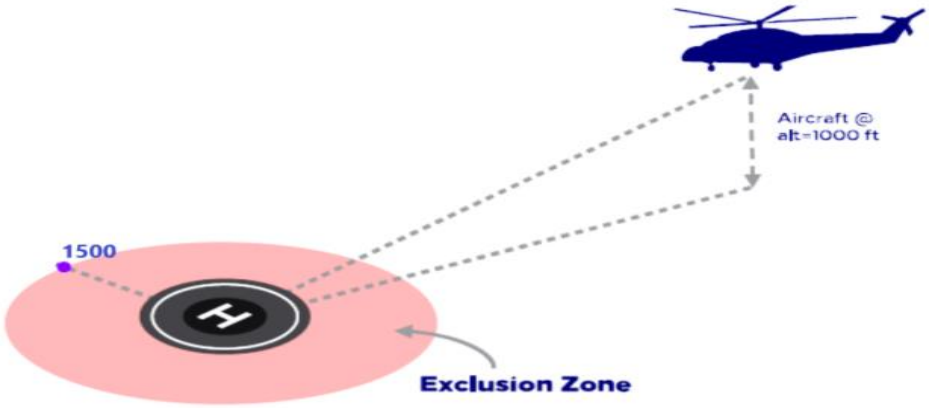

Figure 4: Exclusive zones have a circular shape with a radius of 1500m

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -29 dBm/MHz	40 m (AGL)

Table2

c) **Protection zones for low-power licensing:** There is no need to impose exclusive zones or protection zones for low-power licensing, provided that transmitting stations are operated with Maximum Equivalent Isotropic Radiated Power (EIRP) of -11 dBm/MHz with an antenna height not exceeding (40 m) above ground level with antenna radiation pattern modes that point away from the runway with emitted energy below the horizon.

Maximum Emitted Power (EIRP)	Antenna Height
Pmax -11 dBm/MHz	40 m (AGL)

Table 3

-END-