TERMS OF REFERENCE
Special Committee (SC) 239
Low Range Radar Altimeter

Revision 2

ORIGINAL REQUESTOR(S):

Organization	Person
AIRBUS DESIGN OFFICE	▪ Jean-Luc Robin (Radio Navigation) ▪ Laurent Azoulai (Senior Expert)

SC LEADERSHIP:

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BACKGROUND:

The Low Range Radar Altimeter (LRRA, also referred to as a radar altimeter, radio altimeter, Rad Alt, RADALT, RALT, or RA) provides height measurement above the surface with a high degree of accuracy and integrity during the approach, landing and climb phases of flight (airplane and rotorcraft). Such information is used for aircraft guidance (e.g., Auto Pilot, Flight Controls) and surveillance functions (e.g., Terrain Awareness Warning System (TAWS) and Traffic Collision Avoidance System (TCAS)). LRRA operates in its allocated Aeronautical Radio Navigation Service band 4200–4400 MHz and its implementation relies on the Minimum Performance Specification (MPS) DO-155 and ED-30 that have been applicable since 1974 and 1980, respectively.

Over the last few years there have been and continue to be proposals by several countries/administrations to permit cellular systems to operate in frequency bands very close to the radio frequency (RF) band utilized by LRRA. The primary candidates are 5G telecommunication services that are expected to emit broadband signals in bands near to 4200–4400 MHz. Such new RF transmitters did not exist at the time the DO-155 and ED-30 MPS were defined. As of 2022, some global 5G C-band telecommunication operations have begun.

Technical characteristics and spectrum requirements in those near bands (e.g., maximum signal strength, modulation, and bandwidth) are continually being defined under the umbrella of cellular standards organizations (e.g., 3GPP) and being shared internationally within organizations such as the International Telecommunications Union (ITU) and countries in which changes to the radio regulations are being proposed. The ITU has developed Recommendation ITU-R M.2059-0 providing radar altimeter protection requirements, which countries should comply with in order to protect existing LRRAs in operational service.

An International Civil Aviation Organization (ICAO) Frequency Spectrum Management Panel (FSMP) task (Job Card FSMP.006.01) has also been set up to identify RF and Interference rejection characteristics for LRRA to ensure compatibility with aeronautical and non-aeronautical systems operating in the same frequency band (4200–4000 MHz) as well as in near bands. This job card was considered a priority issue due to efforts to introduce terrestrial communications systems in frequency bands near to that used by LRRAs. For example, in the United States rules have been issued to allow cellular systems to operate up to 3980 MHz while in Japan licenses have been issued allowing 5G up to 4100 MHz below the radar altimeter band and beginning at 4500 MHz above the radar altimeter band.

However, it is important to underline that some of those technical characteristics and spectrum requirements are being defined based on current legacy LRRA transceivers already deployed, with some LRRA design assumptions as well as some operational usage assumptions. Hence, the need to assess the potential for interference to radar altimeter operations, an activity completed with the publication of Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations (RTCA Paper No. 274-20/PMC-2073).

There is also an aeronautical system called Wireless Avionics Intra-Communications (WAIC) which has been granted to share the LRRA band (4200–4400 MHz). The 2015 World Radiocommunication Conference (footnote 5.436 of the ITU-R Radio Regulations) established this new aeronautical mobile route service allocation in the frequency band 4200–4400 MHz. Technical characteristics and spectrum requirements of future WAIC systems are also currently being developed at ICAO in the FSMP.

The long-term task of the committee, the RTCA/DO-155 revision, is intended to enable the efficient use of near-band spectrum by setting a standard for new radar altimeters that provide state-of-the-art[1] near-band rejection while maintaining the current intended functions of the radar altimeters.

[1] For the purposes of this document, "state-of-the-art" RF interference rejection refers to the greatest level of rejection outside of the 4200–4400 MHz band which can be achieved and practicably implemented without compromising the ability of designs to meet the minimum performance requirements necessary for the applicable intended function(s).

DELIVERABLES:

Product	Description	FRAC Completion Due Date*	Change
DO-XXX	**Guidance Document on Radar Altimeter Radio Frequency (RF) Interference Rejection and Tolerance**	**November 2022**	**New**
DO-155A	**MOPS for Low Range Radar Altimeters**	**December 2023**	**September 2022**

*Note: Due Date refers to the date that the committee plenary approves the document after completing the Final Review and Comment Process. Publication will take place at the PMC meeting no earlier than 30 days after the editing process by RTCA is complete.

SCOPE and COORDINATION:

RTCA SC-239 will update equipment MPS DO-155 for Low Range Radar Altimeters to guarantee the robustness of future Radar Altimeter designs against existing and planned IN BAND and OUT OF BAND interferences (WAIC, 5G, European Aeronautical Network (EAN), etc.), producing the Minimum Operational Performance Standard (MOPS) DO-155A.

The scope for DO-XXX will be to provide guidance to radar altimeter designers and manufacturers, aircraft manufacturers and system integrators, and others involved in the modification and development of radar altimeters for RF interference robustness on the current state-of-the-art Aircraft-Level[2] RF Interference Rejection and Tolerance for radar altimeters operating in the 4200–4400 MHz band. This guidance will include data and analysis in support of the defined state-of-the-art performance, as well as explanations of the associated design tradeoffs and performance limitations unique to radar altimeters which contribute to this definition. Additional guidance will be provided detailing the methods by which the RF interference rejection and tolerance can be evaluated and applied, including one or more worked examples of potential compatibility scenarios.

DO-XXX will contain:

1. The current state-of-the-art RF Interference (RFI) Rejection and Tolerance, provided as a signal-in-space (i.e. power-flux density, or PFD) throughout the

[2] In this context, "Aircraft-Level" refers to characterizing radar altimeter RF interference rejection at a point external to the aircraft, e.g. using a signal-in-space definition, rather than solely defining the rejection characteristics referenced at the input of the radar altimeter receiver.

operational volume relevant to civil and commercial aircraft. PFD levels will be defined as a function of aircraft height above ground and frequency throughout the range of 3 to 5 GHz.

2. Supporting data and analysis for the current state-of-the-art performance definition, including details of specific design tradeoffs and performance limitations associated with this definition.

3. Recommended methods for evaluating and applying the RFI rejection and tolerance levels, including one or more illustrative examples of potential compatibility scenarios.

The scope for DO-155A will remain to complete all sections of the MOPS to support use in obtaining a TSO Approval for new radar altimeter designs, including RFI rejection and tolerance requirements.

ENVISIONED USE OF DELIVERABLE(S)

The DO-155A MOPS developed by this special committee is envisioned to be referenced by the Federal Aviation Administration (FAA) and other civil aviation authorities (CAAs) as appropriate in certification guidance material including Technical Standard Orders (TSOs) or other national documents. The DO-155A MOPS will be developed jointly with EUROCAE WG-119, which will produce a technically equivalent ED-30A document.

DO-XXX developed by this special committee will provide guidance characterizing the Radar Altimeter RFI Rejection and Tolerance which is expected to be achievable for state-of-the-art radar altimeter equipment while performing the same intended function. This guidance will benefit radar altimeter designers and manufacturers, aircraft manufacturers and system integrators, and others involved in the modification and development of radar altimeters for RFI robustness. The guidance may also be beneficial to other stakeholders seeking to better understand radar altimeter operation, performance, capabilities, and limitations. The publication of DO-XXX will help to enhance global knowledge of radar altimeters and provide transparency into the process of developing performance standards for future radar altimeter designs.

It is expected that the state-of-the-art performance defined in DO-XXX will be the primary basis for the MOPS RFI Tolerance requirements in DO-155A. However, the special committee may consider additional technical inputs and developments, as applicable, for DO-155A.

SPECIFIC GUIDANCE:

The following coordination is envisaged:

- *ICC Coordination* – inform the Integration and Coordination Committee (ICC) of the committee's needs for coordination with joint RTCA WAIC Special Committee 236 (SC-236) and EUROCAE WAIC Working Group 96 (WG-96).

- *EUROCAE Coordination* – joint committee with EUROCAE WG-119 for ED-30A (LRRA MOPS) and new document (Radio Frequency Interference Rejection and Tolerance for Radar Altimeters).
- *Support for the Activity* – support from Aerospace Vehicle Systems Institute (AVSI) is expected. AVSI has already been deeply involved with the identification of in-band WAIC interferences on RA band and identification of out-of-band 5G interferences on RA band.
- *Additional Coordination* – ITU, ICAO FSMP

- *Initial Documentation* – Following documentation are elements of the document baseline:

Documents	**Intended Use**
WAIC-Altimeter Interference Study Report, Issue 2, AVSI AFE 76s1, 12 August 2019	DO-XXX DO-155A
Preliminary Report: Behavior of Radio Altimeters Subject to OOB Interference, Issue 1, AVSI AFE 76s2, 22 October 2019	DO-XXX DO-155A
Effect of Out-of-Band Interference Signals on Radio Altimeters, Issue 1, AVSI AFE 76s2, 4 February 2020	DO-XXX DO-155A
Minimum Performance Standards Airborne Low-Range Radar Altimeters, Industry Standard DO-155, Radio Technical Commission for Aeronautics, Washington, D.C., Nov. 1974	DO-XXX DO-155A
Minimum Performance Specification for Airborne Low Range Radio (Radar) Altimeter Equipment, ED-30, EUROCAE, 1980	DO-XXX DO-155A
ARINC Characteristic 707-7 Radio Altimeter, Industry Standard 707-7, Aeronautical Radio, Inc., Annapolis, Maryland, Apr. 2009	DO-155A
Operational and Technical Characteristics and Protection Criteria of Radio Altimeters Utilizing the Band 4 200-4 400 MHz, Recommendation ITU-R M.2059, Feb. 2014	DO-XXX DO-155A

Compatibility Analysis between Wireless Avionics Intra-Communication Systems and Systems in the Existing Services in the Frequency Band 4 200-4 400 MHz, Report ITU-R M.2319, approved Nov. 2014	DO-XXX DO-155A
Technical Conditions for the Use of the Aeronautical Mobile (R) Service in the Frequency Band 4 200- 4 400 MHz to Support Wireless Avionics Intra-Communication Systems, Report ITU-R M.2283, Jul. 2015	DO-XXX DO-155A
Technical conditions for the use of wireless avionics intra-communication systems operating in the aeronautical mobile (R) service in the frequency band 4 200-4 400 MHz, Recommendation ITU-R M.2085-0, ITU 2015	DO-XXX DO-155A
Expanding Flexible Use of the 3.7 to 4.2 GHz Band, GN Docket No. 18-122, Final Report and Order, March 3, 2020	DO-XXX DO-155A
RTCA Paper No. 274-20/PMC-2073 (October 2020) *Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations*	DO-XXX DO-155A
AVSI AFE 76s2 Report *Derivation of Radar Altimeter Interference Tolerance Masks, Volumes I - III*	DO-XXX DO-155A
FCC Release: *Promoting Efficient Use of Spectrum through Improved Receiver Interference Immunity Performance*, April 21, 2022	DO-XXX DO-155A

TERMINATION:

When the scope of this Terms of Reference is complete, the committee will recommend to the PMC that the committee Sunset, go into Active Monitoring Mode, or spend a period of time in Hiatus. Any change/extension in the committee's work program requires prior PMC approval.