

TERMS OF REFERENCE
RTCA Special Committee 228
Minimum Performance Standards for Uncrewed Aircraft Systems
(Rev 19)

SPECIAL COMMITTEE LEADERSHIP:

Position	Name	Affiliation	Telephone	email	Change
Co-Chair	Jim Williams	Aura Network Systems	703 439-9648	jwilliams@auranetworksystems.com	
Co-Chair	Brandon Suarez	Reliable Robotics	858-444-7021	bsuarez@reliable.co	
Government Authorized Representative	Steve Van Trees	FAA/AIR-6B2	202-267-8546	stephen.vantrees@faa.gov	
Secretary	Greg Moran	The Boeing Company	425-234-5012	greg.moran@boeing.com	

BACKGROUND:

Uncrewed Aircraft Systems (UAS) have the potential to allow civil, public, commercial, and government agencies to increase efficiency, save money, enhance safety, and even save lives. A broad range of applications and services seek to integrate these platforms into non-segregated airspace.

In order to safely and seamlessly integrate these platforms into non-segregated airspace, both a robust Detect and Avoid (DAA) and robust and secure Command and Control (C2) Data Link capability need to be established. The Federal Aviation Administration (FAA) established the Unmanned Aircraft Systems Integration Office to integrate Uncrewed Aircraft Systems (UAS) safely and efficiently into the National Airspace System (NAS).

To achieve this objective, the UAS Integration Office and major UAS Stakeholders are working closely with the UAS community to develop the Minimum Operational Performance Standards (MOPS) for DAA equipment.

- Phase One of standards development focused on civil UAS equipped to operate into Class A airspace under IFR flight rules. The Operational Environment for the MOPS in Phase One is the transitioning of a UAS to and from Class A or special use airspace, traversing Class D, E, and G airspace.
- Phase Two extended the Operational Environment to 1) extended UAS operations in Class D, E, and G, airspace, 2) take-off and landing operations in Class C, D, E, and G airspace,

and 3) transit through Class B airspace. Ground operations remain out of scope.

- Phase Three will expand the supported operations of DAA equipment to address use cases that are applicable to smaller UAS as well as more specialized UAS as well as continuing to expand the operational environments. This includes use cases for 1) High Altitude Pseudo-Satellite launch and recovery operations, 2) smaller UAS platforms with more limited performance and operations closer to terrain/obstacles, 3) Advanced Air Mobility (AAM), 4) Part 135 cargo operations, and 5) operations on the surface.

Moreover, the UAS Integration Office is working closely with the UAS community to develop the performance standards for the C2 Data Link.

- Phase One of standards development provided standards for the C2 Data Link using L-Band Terrestrial and C-Band Terrestrial data links.
- Phase Two provides 1) material regarding appropriate content for service level agreements between UAS operators and satellite operators, 2) UAS design and operational considerations for use of SATCOM, and 3) a unified methodology and example of a link budget to support applicants through certification and/or operational approval.
- Phase Three will include:
 - Updates to DO-362A. The document will 1) be harmonized with C-Band satcom usage internationally if required, 2) adjust requirements in response to lessons learned from initial implementations of DO-362A and FCC rulemaking.
 - Update to DO-377A to incorporate new use cases including air taxi, surface operation at public use airports, and low altitude small package delivery.
 - Consider new licensed bands that are made available for use for C2 Links. This includes but is not limited to Cellular Networks. This work will require a new MOPS modeled on the approach taken by SC-222 for SATCOM systems.

PRODUCT DELIVERABLES:

The following documents are currently under development in phase three:

Product	Description	FRAC Completion Due Date*	Projected Publication Date**	Change
C2 Link MOPS for Cellular Networks (DO-YYY)	Create a joint standard with EUROCAE WG-105 for use of Cellular commercial networks for C2 Links used for type certificated UAS.	January 2025	March 2025	
DAA Radar MOPS Update (DO-366B)	Update DAA radar requirements for ACAS Xr and Xu, as well as additional clarity improvements	April 2025	June 2025	

Product	Description	FRAC Completion Due Date*	Projected Publication Date**	Change
C2 Link MOPS (Terrestrial) (DO-362B)	Incorporate changes required to harmonize SATCOM compatibility with EUROCAE Standard. Updates required as a result on initial implementation of A revision.	October 2024	December 2024	
DAA MOPS (DO-365C Change 1)	Incorporate only DO-366B Class B2 into DO-365C Change 1 Class 3 and for use in later revisions.	January 2025	March 2025	New
RTCA Report (RR) for Users of DO- 377B for Deriving C2 Link System Requirements	Address the concerns about the definition of availability and continuity raised in DO-377B FRAC and describe methods that can be used by UAS OEM, UAS operators and C2CSPs (Command and Control Link Communication Service Providers) when deriving C2 Link System Quality of Service Requirements from DO-377B	April 2025****	June 2025	
MASPS for DAA Supporting Taxi Operations (DO-WWW)	This document will capture guidance and requirements for DAA equipment to facilitate operations of UAS on the surface.	July 2025	September 2025	
MASPS: Navigation for Automatic Taxi (DO-VVV)	Define navigation performance requirements to support automatic taxi operations.	July 2025	September 2025	
DAA MOPS (DO-365D)	Future revision of the DAA MOPS to add a class of equipment for ACAS Xr.	January 2026	March 2026	April 2025

*Note: Final Review and Comment (FRAC) Completion Due Date refers to the date that the committee plenary approves the document after completing the FRAC Process. SCs should submit the final document at least 45 days before the Program Management Committee (PMC) meeting where it will be considered for approval.

**Note: Projected Publication Date refers to the date that the item will be approved by the PMC and officially published by RTCA.

***Note: This document will undergo a public Final Review and Comment.

SCOPE AND COORDINATION:

Detect and Avoid MOPS & MASPS – Phase Three

Phase Three activities are focused on developing DAA capabilities that address more specialized UAS operations that require more tailored performance or constrained guidance. These operations are expected to take place in all classes of airspace with the exception of Class E above A which remain out of scope. These operations are expected to address the following use cases but will be prioritized according to community needs and support.

- Smaller UAS operations that occur at slower speeds and closer to terrain and obstacles. The expectation is that the guidance may need to be constrained by airspace restrictions and terrain and obstacle concerns.
- High Altitude Pseudo-Satellite launch and recovery operations. This functionality will be limited to the transition to/from Class E above A. It is expected that there will be a separate layer of separation automation employed in Class E above A that will be developed outside of the scope of SC-228.
- AAM use case. These aircraft are capable of different maneuvers and make approaches to different environments than addressed by the Phase 2 activity. It is expected that guidance may need to be tailored for the approach and departure phase of these vehicles.
- Part 135 cargo operations. It is expected that the existing functionality will support this use case, however, detailed operations were not investigated during Phase 2 OSED development. Phase 3 OSED development will further develop the concept and capture any changes needed.

DO-365B was revised to incorporate any modifications necessary to accommodate minor changes to Phase I and II functionalities in support of these new use cases.

DAA MOPS (DO-365C Change 1) will address incorporating only DO-366B Class B2 into DO-365 Class 3 requires “Change 1” to DO-365C. This is motivated by FAA’s planned revision to TSO-C211a. The change will incorporate of DO-366B Class B2 radars which provides significant near-term value to industry. This will align with the schedule for TSO-C211a.

Major functions (e.g., ACAS sXu) will be captured in new documents. DO-365C will be revised to Rev D to add a class of equipment for ACAS Xr.

DO-366A will be revised to Rev B to include new radar requirements for ACAS Xr and to introduce material related to how a manufacturer can reduce the required radar performance for more capable aircraft. This will also align with the new scope in DO-398A and the new requirements in DO-365D that support ACAS Xr.

SC-228 will continue to work in close collaboration with SC-147 in the design, development, and standardization of the Airborne Collision Avoidance System X (ACAS X) variants that are relevant to remotely piloted aircraft (ACAS Xu and sXu). During Phase 3 this collaboration will center around ACAS Xr in support of the AAM use case.

Additionally, new concepts will be pursued to address object detection, alerting, and guidance on and near the surface environment. The initial scope will be to draft a new MASPS DO-WWW to capture the use cases, functions, and performance analysis supporting DAA functionality on and near the surface environment. This MASPS will identify standards for detecting other aircraft, airport vehicles, runway and taxiway construction barriers, and other obstacles which present a safety risk to surface operations.

C2 Data Link — Phase Three Activities

Phase Three activities are focused on creating a standard for use of cellular commercial networks for C2 Links used for type certificated UAS as part of a new standalone MOPS. This MOPS (DO-YYY) would be modeled on the SC-228 SATCOM documents that consider the installed base of an existing communications system and address the safety requirements for its use as a C2 Link System. Additional frequency bands proposed for use could be added to the new MOPS structure if support from avionics companies and the network provider obtain approval from the PMC to increase the scope beyond generic cellular services. This document will be developed jointly with EUROCAE WG-105 to enable a common standard for avionics using standardized cellular services offered worldwide.

Updates to DO-362A

- Incorporate changes required to harmonize SATCOM compatibility with EUROCAE Standard, if applicable.
- Add additional C-band waveforms as presented by proponents who bring resources to validate those proposed waveforms.
- Updates required as a result on initial implementation of A revision.

Development of this revision is dependent on FCC action subsequent to their notice of proposed rulemaking for the 5030-5091 MHz band and may be delayed if no FCC action is taken.

New C2 Scope

- Create a joint standard with EUROCAE WG-105 for use of Cellular commercial networks for C2 Links used for type certificated UAS.
- Create standard for use of the UHF spectrum band used for C2 Links used in type certificated UAS.

RTCA Report for Users of DO-377B for Deriving C2 Link System Requirements

- Address the concerns about the definition of availability and continuity (performance parameters) within DO-377B that were raised during DO-377B FRAC.
- Describe methods that can be used by UAS OEM, UAS operators and C2CSPs when deriving C2 Link System Quality of Service Requirements from DO-377B.

DO-VVV: Minimum Aviation Systems Performance Standards (MASPS): Navigation for Automatic Taxi

- The WGs initial document, DO-397, identified a lack of navigation standards to support automatic taxi operations. This document is being developed to fill the identified gap.

- The scope of this document is to define navigation system performance requirements to support automatic taxi operations (traditionally crewed or remotely piloted).

Note: Similar to DO-236(): RNP for Area Navigation, certain requirements defined in this document may go beyond what is typically regarded as a navigation requirement.

Operational Use Case / Scenario Baseline Ad Hoc

To initiate the Phase Three activities SC-228 will stand up an ad hoc working group of stakeholders with a focus on the operational framework for setting the foundation for the two new working groups. Some key characteristics of this group:

- Will be chaired by the SC-228 Plenary Co-Chairs.
- Will include representatives from FAA Air Traffic Organization, air traffic controllers, airspace user community, and related operational organizations.
- Will include some members across the current standing working groups to seed the initial Phase Three activity.

ENVISIONED USE OF DELIVERABLES

While SC-228 deliverables can be used by the UAS industry, the primary intent of these deliverables is for FAA (and potentially other civil aviation authorities) use in integrating UAS safely and efficiently into the NAS (or other civil airspace), with operational deployment of UAS with certified equipment as soon as is practical. It is the FAA's intent to invoke the MOPS through Technical Standard Orders (TSOs) and Advisory material. The work efforts leading to these products are being informally coordinated with EUROCAE and the ICAORPAS Panel, among other bodies, to facilitate harmonization.

SPECIFIC GUIDANCE:

The following provides specific guidance that should guide all work within SC-228:

- SC-228 recommendations and standards will be based on the premise that UAS will safely and seamlessly integrate into the NAS.
- The Working Group products will be developed using the RTCA MOPS Development Guidelines and considering as appropriate the methodology described in the RTCA MASPS/SPR development guidelines and the accelerated standards development methodology used by RTCA SC-186. The committee will conduct studies and analyses of current and planned capabilities of the NAS to evaluate and present various alternatives for use in development of future products.
- Without distracting from the Phase Two and Three guidance above or delaying the schedule, SC-228 will coordinate with other RTCA special committees and stakeholder groups tasked with the development of enabling systems and technologies such as:
 - RTCA SC-147, SC-159, SC-186, and SC-227
 - EUROCAE WG-75 and WG-105
 - ICAO RPAS Panel
 - ASTM F-38

- ISO TC-20
- NATO Flight in Non-Segregated Airspace (FINAS) Working Group

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 of the committee's work program requires prior PMC approval.