UAS Integration in the NAS Project

INTEGRATED TEST AND EVALUATION (IT&E)

FLIGHT TEST SERIES 4

Flight Test Plan

IT&E FT4 FTP-01

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1 Introduction

The desire and ability to fly Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) is of increasing urgency. The application of unmanned aircraft to perform national security, defense, scientific, and emergency management are driving the critical need for less restrictive access by UAS to the NAS. UAS represent a new capability that will provide a variety of services in the government (public) and commercial (civil) aviation sectors. The growth of this potential industry has not yet been realized due to the lack of a common understanding of what is required to safely operate UAS in the NAS.

NASA’s UAS Integration into the NAS Project is conducting research in the areas of Separation Assurance/Sense and Avoid Interoperability, Human Systems Integration (HSI), and Communication to support reducing the barriers of UAS access to the NAS. This research is broken into two research themes namely, UAS Integration and Test Infrastructure. UAS Integration focuses on airspace integration procedures and performance standards to enable UAS integration in the air transportation system, covering Detect and Avoid (DAA) performance standards, command and control performance standards, and human systems integration. The focus of Test Infrastructure is to enable development and validation of airspace integration procedures and performance standards, including the integrated test and evaluation. In support of the integrated test and evaluation efforts, the Project will develop an adaptable, scalable, and schedulable relevant test environment capable of evaluating concepts and technologies for unmanned aircraft systems to safely operate in the NAS.

To accomplish this task, the Project will conduct a series of Human-in-the-Loop and Flight Test activities that integrate key concepts, technologies and/or procedures in a relevant air traffic environment. Each of the integrated events will build on the technical achievements, fidelity and complexity of the previous tests and technical simulations, resulting in research findings that support the development of regulations governing the access of UAS into the NAS.

1.1 Purpose

The integrated Flight Test 4 (FT4) will gather data for the UAS researchers Sense and Avoid systems (referred to as Detect and Avoid in the RTCA SC 228 ToR) algorithms and pilot displays for candidate UAS systems in a relevant environment. Each of the integrated events will build on the technical achievements, fidelity and complexity of the previous tests and technical simulations, resulting in research findings that support the development of regulations governing the access of UAS into the NAS.

The FT4 objectives and test infrastructure builds from previous UAS project simulations and flight tests. NASA Ames (ARC), NASA Armstrong (AFRC), and NASA Langley (LaRC) Research Centers will share responsibility for conducting the tests, each providing a test lab and critical functionality. UAS-NAS project support and participation on the 2014 flight test of ACAS Xu and DAA Self Separation (SS) significantly contributed to building up infrastructure and procedures for FT3 as well.

The DAA Scripted flight test (FT4) will be conducted out of NASA Armstrong over an eight-week period beginning in April 2016.
Test facilities are Government owned, managed, leased, or under agreement and fall into two categories:

Development Facilities:
- Distributed System Research Laboratory (DSRL) at NASA Ames
- Flight Deck Display Research Laboratory (FDDRL) at NASA Ames
- Research Aircraft Integration Facility (RAIF) at NASA Armstrong
- UAS Sense and Avoid Research Lab at NASA Langley
- GA-ASI Grey Butte Flight Test Facility
- GA-ASI System Integration Lab

Test Facilities:
- Crew Vehicle Simulation Research Facility (CVSRF) at NASA Ames
- Distributed System Research Laboratory (DSRL) at NASA Ames
- Air Traffic Operations Laboratory (ATOL) at NASA Langley
- Research Aircraft Integration Facility (RAIF) at NASA Armstrong
- Dryden Aeronautical Test Range (DATR) at NASA Armstrong
- Stand Alone Facility (SAF) at NASA Armstrong
- The Radio Frequency (RF) Communications facility at NASA Armstrong
- Edwards R-2508 Complex

1.2 Stakeholders, Participants, and Responsibilities

NASA Integrated Aviation Systems Program (IASP) provides direction for the UAS in the NAS project. The project office has overall responsibility for FT4 flight test. NASA Ames, NASA Armstrong, NASA Glenn, NASA Langley, GA-ASI and Honeywell support the project and with the exception of NASA Glenn are participants in the FT4 activity. The following is a brief description of responsibilities:

- **NASA Ames Research Center (ARC):** NASA Ames is responsible for providing one of the DAA systems (Java Architecture for DAA Extensibility and Modeling (JADEM)) to be used during DAA scripted flight test. Further, ARC is responsible for the development and testing of the LVC infrastructure, as well as the integration of the DAA software with the various hardware and software systems used during flight test. The LVC Gateway enables data distribution among all of the other NASA centers involved in the project, as well as to remote users (through RUMS).

- **NASA Armstrong Flight Research Center (AFRC):** NASA Armstrong is the responsible test organization for all test missions flown from AFRC. Further AFRC is responsible for hosting and supporting the Live Virtual Constructive (LVC) infrastructure for hosting data distribution between NASA Ames, and Langley. AFRC is also responsible for providing the live unmanned aircraft (ownership) to be used during DAA scripted encounters within R-2515 airspace. In addition to
providing the UAS ownship aircraft, AFRC will also provide intruder aircraft (T-34, King Air and G-III) as required.

- **NASA Langley Research Center (LaRC):** NASA Langley is responsible for providing a DAA system (Detect & AvoID Alerting Logic for Unmanned Systems (DAIDALUS)) that will be displayed and evaluated by subject pilots during flight encounters.

- **General Atomics Aeronautical Systems Inc. (GA-ASI):** Is responsible for providing hardware, software and integration support on the NASA Ikhana UAS. GA-ASI will provide DAA scripted encounter requirements (CPDS) for autonomous aircraft response maneuvers.

- **Honeywell (HW):** Honeywell is providing the software for the Surveillance Tracking Module (STM) prototype that contains the Honeywell Fusion Tracker. Honeywell will also provide the primary Traffic Alert and Collision Avoidance System (TCAS) II equipped intruder aircraft to support DAA scripted flight test encounters. The Honeywell intruder aircraft is capable of onboard TCAS data recording.

- **RTCA Special Committee (SC) -228:** Is responsible for providing inputs on planned scripted encounters and will provide encounters with unique configurations, geometries and setups that are not covered by the other stakeholders. Their encounters will complement the data set being collected by the other stakeholders and will better inform the overall MOPS development efforts.

### 1.3 Requirements Flow & Documentation

Requirements flow and documentation for FT4 are identified in Figure 1. Project documents are archived in the UAS NAS folder located on NSC Knowledge Now information management tool.
Figure 1. UAS-NAS IT&E Document Tree.
The concept for FT4 is to create an experimental flight environment that simulates Class E airspace and fly Cooperative and Non-Cooperative intruder aircraft at speeds representative of commercial passenger and general aviation aircraft to support data collection for Researchers involved in the SC-228 DAA System MOPS development.

The CONOPS for FT4 leverages from the IHITL, ACAS-Xu and FT3 efforts. The FT3 Configuration 1 (“Pairwise Encounters”) test scenarios where low-speed and high-speed flight testing was conducted with intruder aircraft in a relevant flight environment will be enhanced and implemented for FT4 (Figure 2). FT4 will meet this intent by integrating new DAA Systems technology, where the availability of documentation is limited, with existing systems (e.g., TCAS, ADS-B) to demonstrate engineering feasibility in actual system application.

In FT4, the test scenarios will be referred to as “DAA Scripted Encounters”. Similar to FT3, FT4 will fly the DAA systems under test (SUT) to provide the data needed by researchers for V&V of their models and algorithms so that they in turn can inform the RTCA SC-228 of their results towards supporting development of the MOPS for a DAA system.
FT4 will be configured to continue the evaluation of advisories generated by the SS and CA Algorithms fed by data from live aircraft during flight. DAA Scripted Encounters will involve flight encounters using an unmanned (UAS) ownership aircraft against both low and high-speed manned intruder aircraft. In these tests, a UAS ownership aircraft will be flown against either one or multiple manned intruder aircraft, under carefully designed flight path trajectories to induce DAA alerting. And, based on specific test cases, vertical and horizontal maneuvering will also be performed for data collection.

Three DAA algorithms will be evaluated:

1) Detect & Avoid Alerting Logic for Unmanned Systems (DAIDALUS) – originally developed by NASA Langley as “Stratway+” to support tactical resolution advisories for manned aircraft. Based on TCAS logic, DAIDALUS determines traffic alert levels and the range of maneuver options that will produce a Loss of Well Clear (LoWC) within a configurable look ahead time. When LoWC occurs, it provides Well Clear Recovery (WCR) guidance bands showing the non-conflicted airspace for WCR to minimize collision risk.

2) JAVA Architecture for DAA Extensibility and Modeling (JADEM) – first developed by NASA Ames as “AutoResolver” to support air traffic controllers with advisories to maneuver aircraft in the Enroute and Terminal airspace based on predicted Loss of Separation (LoS). This algorithm has been modified to work with pilots to receive and evaluate intruder TCAS messages, support Resolution Alerts (RAs) and CA maneuvers in response to LoWC. With the incorporation of the banding module, this has been modified to the OmniBands configuration that applies logic to support DAA/TCAS interoperability as well as WCR guidance.

3) Conflict Prediction and Display System (CPDS) – developed by General Atomics – Aeronautical Systems, Inc. (GA-ASI) and the Technische Universiteit Delft (TUD, Delft University of Technology located in the Netherlands) for Human Factors and user display research. This study seeks to exercise the SS concepts alerting guidance and examine the timing and utility of the alerts under actual flight conditions.

2.2 Differences between FT3 and FT4

2.2.1 FT3

FT3 represented the first instance that a prototype DAA technology, designed for UAS pilots, was flight-tested against other live aircraft in addition to simulated traffic provided through the LVC environment.

FT3 accomplished the gathering of key data for the researchers to help validate their simulation models by flying over 200 carefully scripted and executed flights of the NASA870 Ikhana UAS ownership against single and multiple intruder aircraft. It was
during this flight test series that history was made when, for the 1st time, an actual live UAS (Ikhana) was successfully flown against two intruder aircraft and was able to execute the DAA alerts to maintain well clear.

FT3 was executed in two main configurations. The first configuration was “Pairwise Encounters” where the encounters were all one-on-one (or one-on-two) with one ownership and one (or two) intruder(s). The second configuration was designed for “Full Mission Encounters” where the Ikhana UAS ownership, or a Surrogate UAS ownership, was flown against two live intruders and up to five simulated intruders using the LVC simulation environment to “fold” in Oakland airspace (ZOA) with the live flights occurring in Special Use Airspace (SUA) within the restricted airspace range complex of R2508 that covers Edwards Air Force Base (EAFB) and China Lake Naval Weapons Station in southern California near Los Angeles.

Full Mission encounters were unable to be completed due to aircraft integration issues. FT3 intruder aircraft consisted of cooperative and non-cooperative aircraft. Cooperative aircraft carried systems that actively broadcasted their identity, positions and other pertinent data for proximate aircraft that are similarly equipped to receive. Non-cooperative aircraft used did not possess the equipage to actively broadcast their identity, position, etc. to other aircraft and had to be detected by other means for deconfliction. An Air-to-Air Radar was used in FT3 as the active sensor to detect non-cooperative aircraft.

2.2.2 FT4

FT4 represents the latest distributed test activity supporting the UAS-NAS project conducted using the LVC distributed test environment.

The FT4 activities build upon the algorithm development and human factors research conducted in FT3 from June thru August of 2015. FT4 will heavily leverage the LVC environment, aircraft assets, and flight test infrastructure and procedures developed for FT3 (and ACAS Xu prior to FT3) to fast track the FT4 activities. The FT3 efforts originally intended to integrate the DAA technologies into ownership operation, using CNPC for sensor data downlink and to control ownership but this was unable to be accomplished due to technical issues that arose. The FT3 flights probed and verified aspects of the robustness of the DAA algorithm as well as exercising the alerting symbology presented to the UAS pilot. FT4 will also incorporate the lessons learned and system improvements identified during the FT3 testing.

FT4 will be flying the Ikhana as the UAS ownership against multiple intruder aircraft in carefully scripted encounters with the goal to assess for TCAS Interoperability and to collect more data towards validation of the improved DAA and Collision Avoidance (CA) algorithms. These DAA and CA algorithms consist of JAVA Architecture for DAA Extensibility and Modeling (JADEM – formerly AutoResolver), Detect & Avoid Alerting Logic for Unmanned Systems (DAIDALUS – formerly Stratway+) and Conflict Prediction and Display System (CPDS – a General Atomics developed SS algorithm).
Two hardware stakeholders (GA and HON) will be using FT4 to optimize their systems. GA will be working to validate and improve their CPDS system integration with TCAS and radar and HON will be doing the same for their SAAP flight hardware.

Finally, FT4 will also be supporting the SC-228 V&V Subcommittee with their desired test objectives.

2.2.3 Scripted Encounters

FT4 will fly the DAA systems under test (SUT) to provide the data needed by researchers for V&V of their models and algorithms so that they in turn can inform the RTCA SC-228 of their results towards supporting development of the MOPS for a DAA system.

FT4 will be comprised of scripted encounters similar to those of the FT3 Configuration 1. Furthermore, the core stakeholders have increased when compared to FT3. The following core stakeholders have a unique set of scripted encounters designed to capture data that supports the primary objectives.

- SSI, both Langley and Ames Research Centers
- General Atomics including CPDS, Radar development team and TCAS development team
- Honeywell
- SC-228

FT4 includes Honeywell and SC-228 encounters where from FT3 perspective, they did not request to include unique scripted encounters. Additionally, draft MOPS documentation have been released by SC-228. Since the documentation is more mature, SC-228 was able to provide specific use-cases and encounters verify the MOPS as applicable and correct.

The following includes some of the key differences between FT3 and FT4

- TCAS interoperability is being evaluated. This translates to the inclusion of TCAS alerting on both SSI-Ames and SSI-Langley displays as well as the GCS HUD.
- High speed encounters above 10,000 ft MSL are designed around the GIII performance envelope.
- All aircraft will be equipped with DGPS recording equipment for post flight data review.

2.2.4 TCAS II Hybrid Surveillance Description

For Flight Test 4 (FT4), Ikhana will be equipped with a TPA-100B TCAS II Processor with enhanced hybrid surveillance mode enabled. In this mode, the TCAS sensor uses passive surveillance instead of active surveillance to track intruders that meet certain TCAS II Hybrid quality criteria and are not projected to be near-term collision threats as shown in the state transition diagram in Figure 3 (ref. DO-300A).
For an intruder to qualify as a hybrid surveillance target, the Mode S transponder data must pass the following validation test:

|slant range difference| ≤ 290 meters; and
|bearing difference| ≤ 45 degrees; and
|altitude difference| ≤ 100 feet.

For an intruder to qualify as an extended hybrid surveillance target, the Mode S intruder needs to meet the following conditions:

a) ADS-B Version Number ≥ 2  
b) Reported NIC ≥ 6 (<0.6 NM)  
c) Reported NACp ≥ 7 (<0.01 NM)  
d) Reported SIL = 3  
e) Reported SDA = 2 or 3  
f) Barometric altitude is valid

Ownship position source must meet the following data quality standards:
a) Ownship horizontal position uncertainty (95%) is < 0.1 NM
b) Ownship horizontal integrity bounds is < 0.6 NM with integrity of 1e^(-7)

An extended track will be established with the following conditions are met:

a) Two valid airborne position messages have been received within 5 surveillance update intervals.

b) The altitude in the two airborne position messages are within 500 ft of each other or are within a window large enough to accommodate a 10,000 fpm altitude rate – whichever is greater.

c) The Q-bit values in the two airborne position messages are identical.

d) The ICAO aircraft address is the same in both airborne position messages and the address is valid (not all zeroes or all ones).

A hybrid target enters the active surveillance region if both the range and altitude threat criteria are met or if it fails the validation test. In this region, the target is interrogated every second. An intruder track will transition to active surveillance if the following conditions are all true:

\[
\begin{align*}
1) \quad & -\left( z - 4500 \right) / \text{min}(-10/\text{sec}, i) \leq 60 \text{ sec} \\
2) \quad & -(r - 3\text{NM}) / \text{min}(-6\text{kt}/3600, \dot{r}) \leq 60 \text{ sec} \\
3) \quad & \text{Own aircraft is taking off or airborne per section 2.2.8}
\end{align*}
\]

where:

\[\begin{align*}
z &= \text{own altitude} - \text{track altitude}, \text{ in ft} \\
i &= (\text{own altitude rate} - \text{track altitude rate}) \times \text{sign(own altitude - track altitude)} \\
\dot{s} &= \text{rate of change of } s, \text{ in } \text{f/s}, \text{ with negative values indicating decreasing separation} \\
r &= \text{track slant range, in NM} \\
\dot{r} &= \text{rate of change of } r \text{ in } \text{NM/s}, \text{ with negative values indicating decreasing range} \\
\text{sign}(x) &= 1 \text{ if } x \geq 0; -1 \text{ if } x < 0
\end{align*}\]

Conditions 1) and 2) are referred to as the hybrid threat criteria.

As shown in Figure 4, the TCAS interrogation on the intruder track varies as a function of the collision potential.

**Active Surveillance:** TCAS active interrogation every 1s.

**Hybrid Surveillance:** TCAS active interrogation every 10-60s.

**Extended Hybrid Surveillance:** No TCAS interrogation.
2.2.5 Items not in Scope for FT4

- FT4 will not include Human System Integration (HSI) test points and will therefore not include any full mission flight profiles.
- No lighter than Air or rotor wing aircraft will participate in FT4.

2.3 Goals and Objectives

2.3.1 Flight Test 4 Objectives

The UAS-NAS Project worked with researchers, project engineers, and industry partners in conjunction with the RTCA SC-228 Working Group to capture and develop high-level overarching goals and objectives for FT4. Figure 5 provides the general top-level goals and objectives.
These top-level goals and objectives were transformed into high-level requirements and are covered by the Objectives and Requirements Document (ORD). Lower-level requirements resulting from decomposition of the ORD requirements are captured in the FT4 Flight Test Requirements Document (FTRD), System Requirements Documents (SRDs), and Interface Control Documents (ICDs).

Data collected from the FT4 flight tests will be analyzed and evaluated with the results applied toward supporting SC-228 in the MOPS development for civil UAS DAA Systems to pave the way for UAS integration into the NAS.

3 Flight Test Systems and Architecture

3.1 Flight Test Management

3.1.1 Success Criteria

The key to success is to ensure that the test aircraft are able to meet their spatial, temporal, and separation goals in order to provide the researchers with the data required for their evaluation of the DAA SUTs. Put another way, it is very important for the test aircraft to meet the timing and positioning objectives of the initial starting waypoints (i.e., IPs) and encounter points at the CPAs, achieving the desired angles of convergence, latitudes, longitudes, speeds, heading trajectories, turn and/or climb rates, and maintaining safe separation distances to induce the alerting and maneuver data sought.

To that end, the UAS DAA System alerts are expected to be provided to the PIC in a timely manner once an intruder aircraft breaches the CPA SS thresholds. If the DAA SUTs operate as anticipated, then the alerting is expected to allow for sufficient pilot response time to promptly evaluate options and perform the necessary maneuvers until WC is established and the DAA alerts are removed.

The following criteria is anticipated to be met for FT4 to be declared successful:
• Demonstrate the capabilities of the IT&E flight test infrastructure to conduct complex multi-intruder UAS DAA flight testing safely and efficiently
• Perform scripted encounters that trigger DAA alerting and maneuver guidance and interoperate with TCAS
• Collect accurate data to inform V&V of the Minimum Operational Performance Standards (MOPS) for Detect and Avoid systems

In summary, if FT4 is able to properly test the specific DAA functions of the SUTs in all of the various encounter scenarios and situations, then FT4 can be declared successful.

3.1.2 Vehicle Configurations

3.1.2.1 Ikhana Predator B (Ownship)
  • Honeywell Tracking Software
  • Non-Cooperative Sensor System (GA-ASI Air-To-Air Radar)
  • Ground Control Stations (GCS) and Support Crew
  • GCS Displays and Architectures
  • GCS Software to accommodate TCAS II
  • Conflict Prediction and Display System (CPDS)
  • SSI JADEM (Incorporated into VSCS Display)
  • SSI DAIDLUS Display
  • Vigilant Spirit Control Station (VSCS)
  • Avionics Packages for TCAS II, ADS-B, Mode C and Mode S Transponder
  • Data Recording Equipment
  • DGPS Recording System

3.1.2.2 Intruder Aircraft
  • Avionics Packages for TCAS II (as required), ADS-B, and Mode C or S Transponders
  • Honeywell N3GC is equipped with a TCAS II data recording capability. No other intruder is TCAS II recording capable.
  • Navigation system that use Global Positioning System (GPS) derived position.
  • Differential GPS (DGPS) or WAAS position truth source
3.1.3 Flight Test Systems Roles and Responsibilities

This section describes the roles and responsibilities for test systems provided by the various participating organizations participating in Flight Test 4. Flight systems include: aircraft, aircraft support systems (i.e. GCS), communication, IT, simulation, networking, and other systems and subject matters experts to support these systems that contribute directly to executing flight operations.

3.1.3.1 NASA Armstrong Flight Research Center (AFRC)

NASA AFRC is the responsible test organization for all test missions flown from AFRC. AFRC is responsible for hosting and supporting the LVC infrastructure for hosting data distribution between NASA Ames and Langley. AFRC is also responsible for providing the live unmanned aircraft to be used during the flight test encounters. The Predator B Ikhana UAS (NASA870) will provide the unmanned aircraft ownship platform to support flight test encounters within special use airspace. In addition to providing the UAS ownship aircraft, AFRC will also provide intruder aircraft (e.g., T-34, King Air).

3.1.3.2 NASA Ames Research Center (ARC)

NASA ARC is responsible for providing the one of the DAA systems (JADEM) to be used during DAA Scripted Encounters flight test. ARC is responsible for the development and testing of the LVC infrastructure, as well as the integration of the DAA software with the various hardware and software systems used during flight test. The LVC Gateway enables data distribution among all of the other NASA centers involved in the project, as well as to remote users through the Remote User Monitoring System (RUMS). Furthermore a researcher from SSI-ARC will help provide real-time encounter acceptability decision making during JADEM test runs.

3.1.3.3 NASA Langley Research Center (LaRC)

NASA LaRC is responsible for providing a DAA system (DAIDALUS) that will be displayed and evaluated during FT4 flight test encounters. Furthermore a researcher from SSI-LaRC will help provide real-time encounter acceptability decision making during DAIDALUS test runs.

3.1.3.4 General Atomics Aeronautical Systems Inc. (GA-ASI)

GA-ASI is responsible for providing hardware, software and integration support on the NASA Predator B Ikhana UAS. GA-ASI will provide flight test encounter requirements for autonomous aircraft response maneuvers. GA-ASI’s CPDS will be used to gather data for FT4 flight tests.

3.1.3.5 Honeywell (HW)

HW is providing the software for the Surveillance Tracking Module (STM) prototype that contains the Honeywell Fusion Tracker. Honeywell will also provide a Traffic Alert and Collision Avoidance System (TCAS) II equipped aircraft to support scripted flight test encounters by performing as the primary intruder. The HW aircraft is a C-90, King Air, capable of onboard TCAS data recording.
3.1.3.6 SC-228
The requirements subcommittee is a unique stakeholder because they are not providing hardware or software to FT4. Rather, they are providing overarching guidance and other inputs that will help IT&E create flight test program that better helps them evaluate the MOPS. Their test inputs will complement the other systems and collect information that other stakeholders did not plan to acquire but is of cross organizational interest.

3.1.4 Flight Test Planning
AFRC IT&E Subproject is responsible for developing the flight test plan for FT4. Support from ARC, LaRC, HW and GA-ASI is required in order to develop a comprehensive test plan. The baseline for the plan is DAA Scripted encounters conducted within the R-2508/2515 airspace complex located at Edwards AFB, CA.

3.2 Flight Test Resources

3.2.1 Live Resources
The flight test will require various mixtures of manned and unmanned aircraft types with different subsystem requirements (Table 1). The following aircraft are planned to be available for use in the flight test:

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Provider</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predator B “Ikhana”</td>
<td>NASA AFRC</td>
<td>UAS/Ownship</td>
</tr>
<tr>
<td>King Air (N3GC)</td>
<td>Honeywell</td>
<td>Primary TCAS II Threat/Intruder</td>
</tr>
<tr>
<td>T-34C (NASA865)</td>
<td>NASA AFRC</td>
<td>Second/Backup Low/Medium Speed Intruder</td>
</tr>
<tr>
<td>King Air (NASA801)</td>
<td>NASA AFRC</td>
<td>Second/Backup Medium Speed Intruder</td>
</tr>
<tr>
<td>GIII (NASA808)</td>
<td>NASA AFRC</td>
<td>Primary High Speed Intruder</td>
</tr>
<tr>
<td>TG-14 (NASA856)</td>
<td>NASA AFRC</td>
<td>Primary Low Speed Intruder</td>
</tr>
<tr>
<td>King Air C-12</td>
<td>USAF</td>
<td>Mode C Only Intruder (Medium Speed)</td>
</tr>
</tbody>
</table>
### Table 1. FT4 Aircraft Equipment Requirements.

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Role</th>
<th>EDM DRR</th>
<th>ADS-B</th>
<th>DGPS</th>
<th>TCAS-II</th>
<th>TCAS-I</th>
<th>Mode S</th>
<th>Mode C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownship</td>
<td>NASA AFRC T-38C IPA 106A UAS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Primary Intruder</td>
<td>Honeywell Beechcraft King Air C90</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Secondary Intruder</td>
<td>NASA AFRC T-34</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Secondary Intruder</td>
<td>NASA AFRC T-34</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>High Speed / Secondary Intruder</td>
<td>NASA AFRC GIII 511</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Low Speed / Secondary Intruder</td>
<td>NASA AFRC TG-14</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Secondary Intruder</td>
<td>USAF C-12 (Mode C Only)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

#### 3.2.1.1 Unmanned Aircraft (Ownship)

An ‘ownship’ is the unmanned aircraft that hosts the systems (hardware and software) under test for FT4. Reference Flight Test Requirements Document (UAS-NAS.ITE.FT4.FTRD.REQ.20160127.R1) for detailed information.
3.2.1.1.1 Ikhana Predator B (NASA 870)

The NASA AFRC Predator B (Ikhana) is a turbo-prop single engine unmanned aircraft built by GA-ASI (Figure 6). Ikhana has been configured with the GA-ASI prototype Sense and Avoid (SAA) system that includes integrated hardware and software components enabling the aircraft to perform pilot enabled and autonomous response to collision conflict resolution. The system is dependent upon SAA sensors. The SAA cooperative sensors in the aircraft include an Automatic Dependent Surveillance-Broadcast (ADS-B) In/Out compatible Identification Friend-or-Foe (IFF), and a Traffic Alert and Collision Avoidance System (TCAS II). An Active Electronically Scanned Array (AESA) Air-To-Air Radar (ATAR) is installed to detect all airborne targets.

General Performance Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>10,500 lb</td>
</tr>
<tr>
<td>Speed</td>
<td>200 kt</td>
</tr>
<tr>
<td>Ceiling</td>
<td>40,000 ft</td>
</tr>
<tr>
<td>Endurance</td>
<td>24 hr</td>
</tr>
</tbody>
</table>

Figure 6. FT3 NASA AFRC, Ikhana, T/N NASA 870, Ownship Aircraft.
3.2.1.2 Manned Aircraft (Intruder)

An ‘intruder’ is an aircraft that supports the flight test to permit the live data collection requirements to be met. Intruder aircraft must be properly equipped to support the flight test. Reference Flight Test Requirements Document (UAS-NAS.ITE.FT4.FTRD.REQ.20160127.R1) for detailed information.

3.2.1.1.2 Beechcraft C90 (N3GC)

The Honeywell Beechcraft C90 (Figure 7) is a twin engine turbo-prop, eight seat aircraft modified with an onboard TCAS system recording. The C90 will support the test mission as the primary ADS-B and TCAS II equipped intruder aircraft.

General Performance Characteristics

- Weight: 9,650 lb
- Speed: 247 kt
- Ceiling: 30,000 ft
- Endurance: 4.5 hr

Figure 7. Honeywell, Beechcraft C90, T/N N3GC, Intruder Aircraft.
3.2.1.1.3 T-34C Mentor (NASA865)

The NASA AFRC T-34C Mentor (Figure 8) is a turbo-prop single engine aircraft that seats two pilots in tandem. The T-34C will support the test mission as an ADS-B and TCAS I equipped intruder aircraft. NASA865 is also equipped with an Ashtech Z-12 DGPS system.

General Performance Characteristics

Weight: 4,300 lb
Speed: 214 kt
Ceiling: 25,000 ft
Endurance: 4 hr
3.2.1.1.4 Beechcraft B200 (NASA801)

The NASA AFRC Beechcraft B200 (Figure 9) is a twin engine turbo-prop aircraft. NASA801 will support the test mission as an ADS-B and TCAS I equipped intruder aircraft. NASA801 is also equipped with a Novatel ProPak6 DGPS system.

General Performance Characteristics

Weight: 12,500 lb
Speed: 292 kt
Ceiling: 35,000 ft
Endurance: 4.5 hr

Figure 9. NASA AFRC, Beechcraft B200, T/N NASA801, Intruder Aircraft.
3.2.1.1.5 Gulfstream GIII (NASA808)

The NASA AFRC Gulfstream III (GIII) (Figure 10) is a twin engine turbojet aircraft. NASA808 will support the test mission as the primary high speed, ADS-B and TCAS II equipped intruder aircraft. NASA808 is also equipped with a Novatel ProPak6 DGPS system.

General Performance Characteristics

Weight: 69,700 lb
Speed: 340 kt
Ceiling: 45,000 ft
Endurance: 5.5 hr

Figure 10. NASA AFRC, Gulfstream III, T/N NASA808, Intruder Aircraft.
3.2.1.1.6. Ximango TG-14 (NASA856)

The NASA AFRC Ximango AMT 200S (TG-14) (Figure 11) is a single engine motorglider aircraft. NASA856 will support the test mission as the primary low speed, ADS-B equipped intruder aircraft. NASA856 is also equipped with an Ashtech Z-Extreme DGPS system.

General Performance Characteristics

Weight: 1,874 lb
Speed: 132 kt
Ceiling: 10,000 ft
Endurance: 3.5 hr

Figure 11. NASA AFRC, Ximango TG-14, T/N NASA856, Intruder Aircraft.
3.2.1.1.7. Beechcraft C-12

The USAF Beechcraft C-12 (Figure 12) is a twin-engine turboprop aircraft. The C-12 will support the test mission as the Mode C only equipped intruder aircraft. The C-12 will be equipped with a Stratus 2S DGPS system.

General Performance Characteristics

- Weight: 12,500 lb
- Speed: 290 kt
- Ceiling: 35,000 ft
- Endurance: 4.5 hr

Figure 12. USAF, Beechcraft C-12 Huron, T/N TBD, Intruder Aircraft.
3.2.2 Virtual Resources

Although there are many core stakeholders contributing to the encounters, there are only three primary displays that the DAA alerting and situational awareness is displayed. JADEM uses VSCS. DAIDALUS uses an internally developed SA product and GA uses CPDS. TCAS alerts appear on both VSCS as well as the GCS HUD.

3.2.2.1 Vigilant Spirit Control Station (VSCS)

The Vigilant Spirit Control Station was originally developed by the Air Force Research Laboratory (AFRL) as an integrated ground control station for command and control of single or multiple UAS. VSCS Tactical Situation Display (TSD) was augmented by AFRL with self-separation display elements based on inputs from the NASA Human Systems Integration (HSI) group. The VS traffic display and Java Architecture for DAA Extensibility and Modeling (JADEM) algorithm provide the pilot with three general categories of information intended to support: 1) situation awareness, 2) DAA alerts for potential losses of well clear, and 3) DAA maneuver guidance (OmniBands, well clear recovery, and TCAS-II interoperability). Figure 13 shows an example of the evolution of an encounter as it progresses from a preventive intruder through a collision threat. This progression of alerts highlights important features, including DAA icon symbology, heading bands with various levels of alerting, well clear recovery guidance, and TCAS RA. The full set of alerts symbology can be found in Appendix E.

![VSCS with JADEM](image)

Figure 13. Vigilant Spirit Control System (VSCS) with JADEM.
3.2.2.2 Detect & Avoid Alerting Logic for Unmanned Systems (DAIDALUS)

DAIDALUS is a stand-alone display developed internally at LaRC. Their display (Figure 14) is similar to the VSCS display that SSI-Ames uses. DAIDALUS subscribes to LVC flight state messages to receive ownship and surveillance data.

![Figure 14. SSI-Langley DAIDALUS Screen Capture.](image)

3.2.2.3 Conflict Prediction and Display System (CPDS)

Figure 15 shows a screen shot of the Conflict Prediction and Display System (CPDS) developed by General Atomics, which provides GCS-TD functionality. It shows the ownship aircraft with proximal surrounding traffic. During the FT3 the CPDS will provide the UAS pilot with situation awareness and SS advisories.

A key feature of the CPDS is to keep the pilot involved in conflict resolution before collision avoidance is necessary. The CPDS is a display that helps the pilot obtain sufficient situational awareness to anticipate and resolve potential conflicts before they become time-critical through the implementation of Conflict Probes [6].
3.2.3 Communications Resources

DAA Scripted encounter communications are virtually identical to the plan used during the ACAS Xu and FT3 flight test missions (Figure 16). All participating test aircraft will communicate on mission net in order to execute the flight test encounters. SPORT will also participate on this net and provide real-time aircraft deconfliction advisories and airspace boundary calls, as required. The TC will control the flight test on mission frequency and negotiate with SPORT for airspace boundary requirements, such as requesting Buckhorn MOA and other airspace requirements.
3.2.4 Test Support Resources

The test is planned to be performed within the R-2508 range complex which provides for the use of several organic test support resources to include:

3.2.4.1 Test Facilities

Table 2 presents a list of the test facilities to be used for FT4 and their purpose. Testing will be conducted at three primary facilities: the DSRL and CVSRF labs at NASA Ames and the RAIF lab at NASA Armstrong. The DSRL lab at NASA Ames will be the virtual control center as well as contain the core LVC interface components, including HLA, HLA Toolboxes and the LVC Gateways. CVSRF is also located at NASA Ames and will run the instances of MACS ERAM and MACS SimMgr. The RAIF at NASA Armstrong contains two work areas, the RGCS/UAV Simulation Development Lab and the LVC Distributed Environment Lab. The first contains the RGCS, which connects to the HLA via an LVC Gateway. The second contains the LVC Gateway and simulation monitoring displays. The LVC lab also serves as a viewing area for project VIPs. For FT4 test execution, the RGCS will not be used. The SAF provides the test execution location for test conductor, test director, and other required personnel. The situational awareness displays: Zeus and QuickLook 2 are located in the SAF and provide the ability to create and test geometry templates used to track test aircraft during actual flight test missions.
Table 2. List of FT4 Facilities.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew Vehicle Simulation Research Facility (CVSRF)</td>
<td>NASA Ames</td>
<td>MACS ERAM, MACS SimMgr</td>
</tr>
<tr>
<td>Distributed System Research Laboratory (DSRL)</td>
<td>NASA Ames</td>
<td>HLA</td>
</tr>
<tr>
<td>Research Aircraft Integration Facility (RAIF) UAV SIM</td>
<td>NASA Armstrong</td>
<td>RGCS, LVC Test Support</td>
</tr>
<tr>
<td>Development Lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stand Alone Facility (SAF)</td>
<td>NASA Armstrong</td>
<td>SAF, Zeus, QuickLook 2</td>
</tr>
</tbody>
</table>

3.2.4.2 Dryden Aeronautical Test Range

The Dryden Aeronautical Test Range (DATR) supports the actual flight test environment with telemetry, communication and data processing systems.

- DATR telemetry tracking systems consist of multiple fixed antennas at Armstrong and a fleet of mobile systems for deployment to specified locations. The antennas are capable of supporting down-linked telemetry and video signals in C-, L-, and S-bands while sending up-linked commands in either L- or S-bands. The antennas track targets from horizon to horizon and are certified as having full on-orbit capability for low earth orbiting spacecraft. Down-linked telemetry may be received in either analog or digital format. Mobile operations can provide telemetry tracking for test missions operating outside local airspace boundaries.

- The Radio Frequency (RF) Communications facility provides more than 40 ultra-high frequency (UHF), very high frequency (VHF), and high frequency (HF) transmitter receivers, and a UHF flight termination system (FTS). An extensive range intercommunication system consists of trunk lines, communication panels, public address systems, commercial telephone systems, and military ground communication networks. An integrated network of communication, fiber optic, and satellite systems is also used to relay telemetry, radar, audio, and video data between Armstrong facilities, NASA centers, other government agencies, and industry partners.

3.2.4.3 Edwards Air Force Base

Edwards Air Force Base (EAFB) provides a host of test support resources for the flight test environment including main base runways (Rwy 04L/22R & 04R/22L), Class D control tower services, weather briefings, airspace/airfield management offices, restricted airspace scheduling, and other airport support services (Figure 17).
3.2.4.4 Flight Test Environment

The test environment for performing DAA Scripted encounters requires sterile airspace to perform the encounters with 1,000 ft vertical buffers below the lowest participating aircraft and 1,000 ft above the highest participating aircraft. These encounters will be flown within the R-2515 in scheduled airspace that omits other users during the period scheduled. Due to limitations to the size of the scheduled airspace, at times intruder aircraft may maneuver outside of the assigned airspace with concurrence by the dedicated SPORT controller.

3.2.4.5 Operating Area

The operating area for FT4 is identical to FT3 and planned for the Restricted Airspace, R-2515 along with the Buckhorn Military Operating Area (MOA), with operations scheduled and coordinated through the Air Force Test Center (AFTC). Specific airspace scheduled each day during these flight tests included the Four Corners Area, Mercury Spin Area, overflight of the Precision Impact Range Area (PIRA) East/West, and the Buckhorn MOA. These areas within R-2515 are depicted within the yellow shaded area shown in Figure 18. Flight Test Area. These areas may be extended within R-2515 if available and authorized by SPORT.

In some encounter circumstances extensions north and west of the yellow shaded area may be required. The extensions are necessary to either start or complete these encounters and accommodate for geometry or aircraft performance limitations, e.g. NASA808. Approval from the controlling agency (SPORT) will be required. The Buckhorn MOA will be used by the manned intruder aircraft only.
3.2.5 Instrumentation and Data Collection Resources

3.2.5.1 High Level Architecture (HLA) and LVC Gateway

The framework for the simulation environment will be supplied by the LVC via the High Level Architecture (HLA) messaging infrastructure. The LVC uses a version of the IEEE 1516 standard Pitch portable Real Time Infrastructure HLA and Federation Object Model (FOM) middleware, modified at NASA Ames, to exchange information about the air traffic environment (aircraft state, flight plans, digital messaging) among the participants operating from distributed facilities. The HLA utilizes Toolboxes to convert data from simulation components (e.g. flight simulator, or air traffic control display) into its expected format. The LVC Gateway (Figure 19) was developed to enable passing of messages within a facility (without the need to distribute them to HLA), for those messages that are then required to be sent to a distributed facility, the gateway connects to HLA via a toolbox.
3.2.5.2 Remote User Monitoring System (RUMS)

In order to facilitate the monitoring of the data collection, the Remote User Monitoring System (RUMS) software processes connects to the LVC Gateway process and provides an ability to access and display data being collected via a web browser. The RUMS server connects to the LVC Gateway and handles the web browser data requests.

3.2.5.3 ADS-B Receiver Data Source

A Thales AX680 dual-channel (Mode S 1030 MHz and 1090 MHz) receiver is located in NASA AFRC Building 4800 to provide near real time ADS-B data. The received signals are digitized by the Thales receiver, then securely disseminated live and unfiltered via Ethernet. The Thales receiver also tracks aircraft represented in the Mode S 1090 MHz Extended Squitter (1090ES, or ADS-B) messages and forwards the Thales tracker updates for those aircraft as well.

The 1030MHz and 1090MHz data are sent out as binary data. The Thales tracker data are disseminated as ASTERIX messages, with tracker surveillance updates sent as Category 21 messages and system configuration / status data sent as Category 23 messages. All three data streams (digitized 1030MHz, digitized 1090MHz, and ASTERIX tracker/status data) are securely disseminated live and unfiltered via Ethernet by the Dryden Aeronautical Test Range support office located at NASA AFRC.

The Thales data will be used to assess the validity of position data broadcast by ADS-B equipped aircraft in flight and determine whether the broadcast position data are of a
quality to support of Flight Test 4. The data will also be used to drive a scenario development display and Zeus display that will provide situational awareness information to the Test Director (Figure 20. UAS-NAS Project Stand Alone Facility Work Station.).

All of the data types published by the Thales system are transmitted via Ethernet to a single multicast address, with each message type (1030MHz, 1090MHz, ASTERIX Category 21, and ASTERIX Category 23) identified by a separate port number. Data are time-tagged with UTC time and recorded on a daily basis with file rollover at midnight UTC. The aggregate size of the daily message files depend on traffic conditions, generally in the range of 150 MB to 200 MB per day, with most of the message traffic corresponding to periods of high levels of air traffic.

3.3 Flight Test Equipment

Aircraft Required Systems

All participating aircraft require the following minimum required equipment:

- ADS-B Out
- Mode 3/C or S Transponder
- GPS
- DGPS with recording
- VHF Voice Comm Radio (2)

One exception to the aforementioned requirements is the USAF 419th Test Wing C-12 aircraft that will support specific Mode C only flight test encounters required by the researchers. The C-12 will not be equipped with ADS-B in support of FT4.

In addition to the minimum required equipment, certain participating aircraft require specific equipment for flight test as described in 3.3.1.1-3.3.1.4:

3.3.1.1 Navigation Systems

Aircraft supporting this flight test are required to be equipped with navigation systems that use Global Positioning System (GPS) derived position. Due to strict timing and position requirements, aircraft shall not use any mode of navigation that does not use GPS as the primary source for navigation.

All aircraft will use as installed, certified altimeters with a standard QHN barometric pressure setting window. All tests will be performed using 29.92 hg altimeter setting once cleared into the test area by Edwards Tower or the SPORT controller.

3.3.1.2 Certified Systems

A manned intruder aircraft equipped with TCAS II change 7.1, for the purpose of demonstrating legacy TCAS interoperability, the reception of and compliance with 1030 MHz. Honeywell C90 (N3GC) is planned to support this requirement.
A TCAS traffic display or a similar type display installed on participating manned intruder aircraft, in addition to visual, will be the means by which those aircrew will maintain situational awareness for safety during the DAA Scripted flight test. The NASA AFRC intruder aircraft (T-34C or B-200) are equipped with TCAS I only. NASA808 (GIII) is equipped with TCAS II change 7.1 and serves as a TCAS II backup aircraft to N3GC. NASA856 (TG-14) is not equipped with TCAS. The USAF C-12 will be provided with a Stratus 2S system for SA purposes and TSPI data recording.

For the purpose of situational awareness on the ground, interoperability demonstration, and data collection, all aircraft will be equipped with ADS-B, except as noted.

For some encounters a Mode C only equipped intruder aircraft is required. This requirement can be supported with NASA856, but for higher airspeed encounters this requirement will be supported by an Air Force C-12 aircraft.

3.3.1.3 Prototype Systems

● Engineering Development Model (EDM) Due Regard Radar (Air-to-Air Radar):
EDM is a radar system which supports an airborne SAA architecture for the Predator B UAS. The EDM ATAR is an advanced prototype developmental radar system that has increased surveillance volume and is intended to be installed in the NASA AFRC Ikhana as part of a SAA system that senses both cooperative and non-cooperative aircraft, fuses the sensor data, generates alarms.

● Honeywell Tracker:
The Honeywell Tracker fuses all sensor data that is available for a given target. For cooperative targets, ADS-B, TCAS, and EDM measurements (when available) may be fused. For non-cooperative targets, only EDM measurements are available.

3.3.1.4 Truth Data Source System

All aircraft supporting FT4 testing shall have a Time Space Position Information (TISP) or dGPS-based truth data source. Moreover the TISP data source must have recording capability that can be collected post flight for archiving and distribution amongst the test team.

3.3.2 Software Systems

Table 3 describes the applications required to support FT4.

<table>
<thead>
<tr>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFRC Data Processor</td>
<td>Post-test processor for Data Collector data</td>
</tr>
<tr>
<td>AFRC ADRS</td>
<td>Server that allows external simulation interfaces to MACS</td>
</tr>
<tr>
<td>Application</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>AFRC MACS</td>
<td>Multi Aircraft Control System Ground Control Station Alerting Display</td>
</tr>
<tr>
<td>ADRS (DAIDALUS)</td>
<td>Server that allows external simulation interfaces to MACS DAIDALUS</td>
</tr>
<tr>
<td>MACS (DAIDALUS)</td>
<td>Multi Aircraft Control System Ground Control Station Alerting Display</td>
</tr>
<tr>
<td>MACS (Stratway Moving Maps)</td>
<td>Multi Aircraft Control System Moving map display for DAIDALUS</td>
</tr>
<tr>
<td>Saa_Proc</td>
<td>Sense and avoid Process</td>
</tr>
<tr>
<td>VSCS Control Station</td>
<td>Vigilant Spirit Control Station</td>
</tr>
<tr>
<td>LVC Gateway</td>
<td>Server that allows external connections to the HLA</td>
</tr>
<tr>
<td>Gateway Data Logger &amp; Data Player</td>
<td>Records flight state and flight plan messages received by the LVC Gateway – Plays back recorded data</td>
</tr>
<tr>
<td>Gateway Data Collector</td>
<td>Records ownship views, Aircraft and Intruder flight states, and archive LVC subject data, Data collector/recorder software</td>
</tr>
<tr>
<td>CPDS</td>
<td>General Atomics ASI Traffic Display, SS algorithm, UAS-GCS interface.</td>
</tr>
<tr>
<td>IOServer</td>
<td>Interface between CPDS and LVC Environment</td>
</tr>
</tbody>
</table>

3.3.3 Control Room Systems

Stand Alone Facility (SAF) – The SAF, located at NASA AFRC in building 4800, will be used by the test conductor and test director to coordinate, manage, and execute the flight test. The room has three workstations dedicated to UAS-NAS operations (Figure 20). Each work station is configured with DICAS VOIP voice comm systems and several display monitors (e.g. ZEUS, Quick Look 2, Ikhana video camera sources, and DAA algorithm traffic displays) providing situational awareness and two-way voice capability to the control room team for test execution.
3.4 Security Requirements

Security policies and agreements will be established and followed as required by NASA and partner organizations.

3.4.1 General Security

The tests will involve and be conducted by NASA civil servants and contractors; specific partner agreements for external partners for these tests are in place and on file.
3.4.2 Operations Security
There is no sensitivity to the data collected during the tests, except for the radar data which is considered ITAR.

3.4.3 Communications Security
Voice communications will be conducted via actual RF radios transmitting in free space or with comm links over an encrypted VPN. All participants are diligent to potential comm radio spoofing/interference that sometimes occur on VHF nets.

3.4.4 IT Security
All transmissions between distributed facilities are encrypted. The specific IT security plans are on file and under access control.

3.4.5 Data Security
The Data Management Plan (IT&E DMP-01) contains the details regarding handling and storage of the data.

3.5 Flight Test Limitations
The following limitations apply to Flight Test 4:

- Some test encounters (unmitigated) will use actual offsets to test algorithm performance, however, a minimum horizontal offset of 0.4 nmi and a minimum vertical offset of 200 ft will be used in order to maintain safety of flight for all encounters with less than 500 ft vertical offset.

- The Engineering Development Model (EDM) Due Regard Radar has a field of regard limited to ±110° in the horizontal direction and ±15° in the vertical direction.

- As during FT3, some FT4 scenarios will require TCAS active coordination, the ownship or intruder aircraft may be expected to maneuver when an alert occurs during these encounters. At other times, the intruder will disregard TCAS alerts which will ensure that the ownship aircraft receives an alert and has an opportunity to act on it. This, however, does not preclude the TCAS equipped intruder aircraft from responding to TCAS alerts for non-participatory aircraft since these alerts would be unplanned and are to be considered a real-world safety of flight threats.

- TCAS Alerting will occur in two locations within the GCS: the HUD and the SUT display. When using JADEM or DAIDALUS’s displays the TCAS alerts will appear on left side mounted SUT monitor. Additionally for CPDS, alerting will also be passed through the GCS system to the HUD. Although both JADEM and DAIDALUS are capable of Aural Alerts, only JADEM will use this feature. DAIDALUS stakeholders elected not to use this feature since it is not one of their objectives. Training will need to clearly articulate which system is “under test” at any given time and should be used to make test decisions. Safety decisions shall not be made using the SUT.

- The fastest aircraft available and compliant for FT4 is NASA808 but it cannot meet the speed of 600 KTAS desired by some of the researchers. However, the 600 KTAS is
4 Flight Test Execution

NASA Armstrong is the responsible test organization for FT4. The NASA Armstrong airworthiness and flight safety review process will apply to all encounters flown out of AFRC. This section identifies general and specific operational processes and procedures that will be used to execute the flight test.

Flight safety is essential to all test encounters and aircrew are expected to use good judgment at all times. Flight test encounters will be performed using a safety buildup approach which means that test cards with encounters that have the greatest vertical separation will normally occur first followed by encounters where the vertical separation is decreased. Once a particular test encounter geometry has been cleared at a specific vertical separation, like encounters performed on subsequent test days do not require a repeat of the test buildup task. This is also the case for multi-ship test encounters and complex geometries that include blunder (vertical or horizontal) maneuvers.

Visual identification (VID) with ownship aircraft is required by all intruder aircraft operating with a vertical separation of <500 ft and ≤1 nmi horizontal separation (2 nmi for high speed encounters) to ownship based off the onboard situational awareness display. Once VID is established with ownship aircraft, the intruder pilot will callout ‘visual’ on the TC/SPORT (Mission Discrete) net. Visual is required to be maintained while operating within the aforementioned criteria or an abort will be performed by all aircraft to increase separation. For multiship encounters, the VID applies to all manned aircraft operating within the minimum separation volume.

ATC (Joshua / SPORT) expects all participating aircraft to remain within the scheduled/assigned airspace boundaries at all times unless prior coordination/permission is provided by ATC deviate from the assigned airspace. Ikhana is prohibited from operating within a MOA or the NAS unless a specific COA exists permitting that operation.

Sections 4.1 through 4.5 describe procedures and tasks required for every test day unless otherwise noted. Sections 4.5 describe specific requirements, procedures, and tasks for DAA scripted encounters.

4.1 Mission Briefings

Flight test operations will typically be preceded by two briefings using the NASA Armstrong standard operating procedures.

4.1.1 Preflight Brief

The first prebrief is called a T-1 briefing which is normally performed the day prior to a mission. All flight test participants are required to participate in the T-1 briefing. The T-1
briefing covers numerous topics that include the following: Roll Call, Mission Summary (Overview & Objectives), Mission Timeline, Weather & NOTAMS, Aircraft/GCS/Airfield Status, Comm Data, Mission Information (Mission Rules, Go/No-Go, and Flight Safety), Test Overview & Procedures, Test Card Review.

Day of Flight brief (T-0) typically occurs a few hours prior to the flight and is a short 15-20 minute tag up briefing used to complete a time hack, discuss current weather, cover changes (if any), and generally to focus the team on the test.

4.1.2 Post-Flight Brief

The post flight debrief is used to review the mission in terms of timeline (i.e. what occurred), test results, aircraft squawks, lessons learned, issues, and future planning.

4.1.3 SUT Training

Prior to executing test a crew training brief will provide necessary information to the aircrew executing the test. The following as a minimum will be part of the training:

- Specific goals and objectives for the respective SUT
- Specific user interfaces; VSCS, DAIDALUS, CPDS and HUD symbologies.
- How the research team would like the aircrew to interpret and use the symbology. This includes the desired maneuver profile.

4.2 Standard Flight Test Procedures

Pilots will comply with all standard flight rules as described within applicable FARs (14 CFR) and local guidelines as appropriate. The standard requirement to 'see and avoid' other aircraft (14 CFR Part 91.113) applies. The exception is Ikhana when operating within special use airspace where other mitigations (i.e. mission rules, SOPs, etc.) apply in order to help ensure safe flight operations. Aircrew are expected to complete an R-2508 range briefing and a local area briefing prior to flying in the test range.

4.2.1 Air Traffic Control

All airborne participants shall comply with local ATC rules as they apply in the execution of the flight test encounters. Within the Edwards Complex (R-2515), Space Positioning Optical Radar Tracking (SPORT) MRU has ATC authority except during periods of time when operational control is assumed by FAA TRACON Joshua Approach Control.

4.2.2 Visual Flight Rules

All flight test encounters shall be performed using visual flight rules (VFR) as described in 14 CFR Part 91.151, 153, 155 and 159 as they apply to operations within Class E airspace, except where organizational guidelines (NPR, company FOM, for example) take precedence (if more restrictive). Operations within the R-2508 Complex must comply with guidance provided by the R-2508 Complex Users Handbook, EAFBI 13-100, and the aforementioned sections of 14 CFR Part 91. This does not preclude the use of Ikhana, which has procedural means for fulfilling these rules in Restricted Airspace.
4.2.3 Weather

Weather considerations are based on operating in Visual Meteorological Conditions (VMC) at all times during flight test encounters. VMC, or clear of clouds, requires aircrew to operate with outside of visible moisture. For FT4, the minimum weather conditions are defined as cloud ceilings at least 1,000 feet above or below the designated altitude block (as described on the test card) and visibility exceeding 3 statute miles are required. Any other potentially prohibiting flight conditions such as wind, turbulence, and/or precipitation that exceed established criteria for launch or recovery cancels or delays tests until conditions are within tolerance. Any other conditions that interfere with successful flight test outcomes are taken under consideration by the team. Before each scheduled flight, the test team confers via Telecon (during the day of flight brief) to make a final “go/no-go" decision based upon the current and forecast weather or any other last minute changes in operational restrictions.

4.2.4 Aircraft Calibration Procedures

All participating aircraft are expected to have a current altimeter calibration in accordance with airworthiness certification requirements for the type of FAA aircraft certificate held. Pilots are expected to perform a ground altimeter check prior to flight operations to determine whether the altimeter is within normal limits (±75 ft). All encounters flown in the Edward Complex shall use 29.92 altimeter setting as a standard. For flight test operations that are planned to be ≥500 ft vertical separation, no airborne altimeter calibration check is required; however, it is likely that during every flight test day an altimeter calibration will be performed prior to accomplishing any flight test encounters. An altimeter calibration check test card will be developed and provide to aircrew prior to performing altimeter calibration checks.

It is standard for the intruder aircraft to rendezvous with ownship (Ikhana) initiating the rejoin with 1,000 ft vertical separation and upon obtaining a visual with ownship rejoin to a wing position. The standard altimeter setting is 29.92. Once rejoined, the ownship will report altimeter setting and current altitude. Intruder aircraft will then report their altimeter setting and altitude. If the intruder reports a different altitude than ownship, the intruder will correct (adjust) their altimeter setting to match the altitude reported by ownship. Once the procedure is complete, each aircraft will again report altitude to verify a match. For multi-ship intruder missions, each intruder, in sequence, will perform an altimeter calibration with the ownship. Once the procedure is complete, intruder aircraft are expected to clear off the formation by descending at least 500 ft below Ikhana’s current altitude and remaining well clear. For test expediency and/or due to intruder aircraft performance limitations, altitude calibrations may be performed off another intruder aircraft that has calibrated their altimeter off of Ikhana.

Low altitude radar flight test encounters (<10,000 ft MSL) will use 29.92 altimeter settings since those encounters have 1,000 ft vertical separation and the floor for all test encounters is 1,000 ft AGL above the highest terrestrial feature along the planned route of flight for those encounters. For test days where low pressure prevails, the team may redline the minimum test altitude to accommodate the 1,000 ft AGL floor minimum.
All participating aircraft shall monitor GPS navigation error reporting and inform the test conductor if the navigation system reports lateral errors greater than 0.1 nmi (608 ft). Aircrew will monitor the reported GPS position quality (figure of merit) prior to each test run to ensure that the reported error does not exceed test limits. No airborne navigation calibration checks are planned.

All participating aircrew will manage encounter timing using GPS time. A time hack based off the SAF IRIG clock will be performed prior to conducting flight test. Tolerances (timing/distance/performance) for a given encounter will be identified on the respective encounter test card and can be found on the specific flight test objective templates (see Appendix F).

4.2.5 Standard Test Procedures

All participating aircraft are expected to follow applicable test card instructions. Test cards are designed to have a common format with unique components according to the role (ownship or intruder), specific tasks (display under test, encounter maneuvering, multi-ship, etc.), and other guidance.

- **Ownship**
  
  Will use normal piloting techniques and GCS tools to arrive at the test encounter IP on course and on time within the prescribed tolerances.

- **Intruder**
  
  Aircraft will use normal piloting techniques and onboard tools to arrive at the test encounter IP on course and on time within the prescribed tolerances. It is standard for each intruder aircrew to record actual wind data (heading and velocity) at the IP for every test encounter performed. The pilot will be prepared to report the wind value on mission frequency, if requested. Intruder pilots will provide their recorded wind data to the TCO post flight.

- **Encounters**
  
  Are planned to occur approximately every 10 minutes. As the encounter complexity increases or as either ownship or intruder crews require, time between encounters can be increased. Participating crews should request a ‘rolex’ if they are unable to meet the COMEX time.

- **Researcher and Engineering**
  
  Involvement will be increased from FT3 through the use of RUMS or other real time analysis tool. The engineering teams will coordinate through the Test Director as required to modify planned encounters as required.

- **All lateral blunder maneuvers**
  
  Are planned for aircraft to perform standard rate turns except for high speed intruder aircraft where ½ standard rate turns are planned.

4.3 Flight Test Coordination

Successful flight test requires a team effort executing a flight test plan that meets test objectives in a safe and efficient manner.
4.3.1 Flight Test Roles and Responsibilities

The test team has several members who support the test and this section will describe the key roles and responsibilities for conducting the test.

Test Conductor (TC) – The Test Conductor has overall responsibility for test execution and mission success. The TC coordinates flight test scenarios with the aircrew to ensure that flight test objectives are met. The TC is collocated with and interfaces with the Test Director to maintain an overall picture of the test activity. The TC communicates directly via two-way radio with the participating aircrew and local ATC on a mission discrete channel. The TC workstation is located in the SAF.

Test Director (TD) – The Test Director has the overall responsibility for mission safety. The TD is collocated with and interfaces directly with the TC and coordinates with other test team members on back channel nets as required in order to feed the TC with information to help maintain an overall test picture. The TD interfaces with the NASA Senior Ops Representative (SOR) to ensure their understanding of flight test activities. The TD workstation is located in the SAF.

Test Coordinator (TCO) – The Test Coordinator has primary responsibility for recording operational test data information obtained from data received within the SAF. The TCO assists the TC in setting up follow-on test encounters and for configuring the SAF displays prior to the flight test.

Mission Director/Flight Test Engineer(s) – A Mission Director is assigned to each aircraft to help aircrew in the coordination and execution of the test scenarios and to ensure that mission rules are followed. For the unmanned aircraft, the Mission Director is located within the Ground Control Station and communicates with the aircrew to help in coordination and execution of test scenarios. A Flight Test Engineer (if available) flies in the jump-seat for manned aircraft and performs the role of Mission Director in assisting the aircrew in coordination and execution of test scenarios.

Aircrew – The aircrew consists of a pilot and a copilot. The aircrew flies test procedures outlined in this document adhering to navigation/timing constraints and abort procedures given for each flight test card. Aircrew also ensures that the aircraft stays within the vertical and lateral boundaries of the airspace that they have been cleared into. The aircrew coordinates test activities directly with the TC and local ATC to execute the test activity. Some intruder will also operate with a flight test engineer who will support in achieving successful test encounters.

4.4 Flight Test Safety

Flight safety is foremost to all flight test planning and essential to executing responsible flight operations. NASA Armstrong has flight safety responsibility for flight test operations performed at AFRC. Effective hazard analysis is the responsibility of all team members and are a required element to enabling the airworthiness and flight safety review board to make flight release decisions. Encounters that are separated vertically by 500 ft or greater are considered inherently safe based on the premise that standard acceptable
NAS operations allow for IFR and VFR traffic to operate within the same airspace with 500 ft vertical separation. See and avoid requirements always remain in effect regardless of what flight rules a given pilot is operating under.

4.4.1 Flight Safety Process

AFRC will lead the development of the hazard analysis and follow processes described in DCP-S-001 and DCP-S-002. All participants of FT4 are expected to support and contribute to the flight safety process for the flight test activities.

4.4.2 Planning Safety

Test encounters with a vertical separation of >500 ft do not require a lateral offset as this is considered “standard separation” for operations within the NAS (minimum vertical separation between IFR and VFR traffic in Class E airspace). Some mitigated encounters are planned for a 200 ft vertical and 0.4 nmi horizontal minimum separation which is the minimum separation allowed for FT4. These minima meet both the required levels of safety as well as technical requirements for the test.

4.4.3 Mission Rules

Mission rules are mandatory operational procedures specific to the planned flight test and are designed to support safe flight operations. These rules apply to every flight unless specific exceptions are identified within a given rule. Mission rules typically cover standard weather limitations, mission specific constraints to ensure flight safety, and other pertinent operational procedures not covered by the flight manual or other established guidance. FT4 final mission rules will be briefed and approved during the Tech Brief.

4.4.4 Go / No-Go

A Go /No-Go list is a mandatory set of decision guidelines used to determine whether a mission can be accomplished if required equipment, systems, or personnel are functional, operational and/or available and ready for the intended flight activity. FT4 final Go / No-Go will be briefed and approved during the Tech Brief.

4.4.5 Abort Procedures

Abort procedures are specific to each scenario flown and are annotated on the flight test cards. An abort is announced over the radio and all test participants must acknowledge including the TC.

Specific conditions which require an abort are outlined in the mission rules, but general guidance is that an abort is mandatory for the following circumstances:

- Unmanned aircraft goes Lost Link, or loses LOS Link (reverts to SATCOM)
- Timing constraints cannot be met within an acceptable tolerance as identified on flight test card
- “No Visual” after a specified distance between ownship and intruder aircraft (For FT4 this horizontal distance is 1 nmi when separated vertically by <500 ft)
An aircraft begins a maneuver in unplanned vertical direction during an encounter
When test participant observes an aircraft is in the wrong position or profile (executing the wrong test card)
Judgment determines that the run cannot be continued safely

The general procedures for an abort are as follows:

1. Ownship Abort Procedure:
   Shall comply with procedures specified on the flight test card.

2. Intruder Abort Procedure:
   If the intruder aircrew has a visual on the ownship aircraft then the intruder aircraft can maneuver to remain well clear; otherwise, the intruder shall initiate a turn away from ownship and begin a vertical maneuver to increase separation as specified on the flight test card.
   If the intruder pilot has a corrective TCAS RA advisory before or during an abort, the pilot will follow the abort procedure unless the pilot determines that the RA is caused by participating test aircraft and visual with that aircraft is established.

4.4.6 Lost Link Procedures
It is standard for lost link procedures to be planned for every Ikhana flight operation. Ikhana flight crew are expected to load the appropriate lost link mission prior to each flight test encounter (IAW the test card). In the unlikely event that Ikhana experiences a lost link condition, an abort call will be made on mission frequency. In most cases, ownship will remain on heading and altitude while navigating to a point beyond the CPA. All intruder aircraft will be expected to follow their abort procedures identified on their test card. It is standard to increase vertical separation from other participating aircraft and maneuver laterally thereby increasing separation with ownship (IAW the test card procedure).

4.4.7 Post Encounter Procedures
Once test objectives are completed for a given test encounter, the Test Conductor will call “Terminate” and announce the next expected test card to be flown. All participating aircraft will fly the deconfliction altitude identified on the test card just flown and start own navigation to the next IP for the next card announced. The Test Conductor will monitor the post encounter situation using Zeus and provide real-time instructions to help facilitate separation and setup for the next test encounter.

4.5 DAA Scripted Test Encounters
4.5.1 Ownship Requirements
The NASA AFRC Predator B Ikhana aircraft is planned to be the Flight Test 4 ownship for all encounters. Ikhana will be equipped with the GA-ASI EDM radar, ADS-B, TCAS II, DAA Avionics, and DGPS. Ownship aircraft must be available to support the planned flight schedule.
4.5.2 Intruder Requirements

All Intruder aircraft require ADS-B and DGPS, except for a specific requirement for Mode C only data collection. TCAS II with onboard data recording is required for some encounters.

The Honeywell C90 is the primary intruder aircraft and it meets the TCAS II data recording requirement. A small number of planned encounters require a high speed intruder aircraft which will be met using the NASA AFRC Gulfstream GIII aircraft. Further, another small number of planned encounters require a low speed aircraft which will be met using the NASA AFRC TG-14. Some scripted encounters require two or more intruder aircraft which will be provided primarily by the NASA AFRC support aircraft fleet.

4.5.3 Minimum Separation

The minimum geospatial offsets planned are 200 ft vertical and 0 ft horizontal (although not simultaneously during any test run). Test encounters with a minimum vertical separation of <500 ft will include a lateral offset of 2430 ft (0.4 nmi) which allows for some built-in safety margin that still meets well clear volume requirements and test data collection objectives. Test encounters ≥500 ft vertical offset may have a 0 ft horizontal offset.

All participating aircraft will ensure that the aircraft altimeter system meets manufacturer calibration specifications and requirements for normal operation in the NAS.

A maximum of 608 ft (0.1 nmi) navigation error (GPS derived position) is allowed for each aircraft based on the system’s built-in navigation accuracy readout.

4.5.4 DAA Scripted Encounter Test Flow

Figures 23-57 depict the DAA scripted encounters required by NASA ARC, LaRC, GA-ASI, Honeywell, and SC-228 (respectively) researchers. The DAA Scripted encounters are further divided into the following flight test groupings:

- DAA Scripted, low speed intruder—encounters that requires Ikhana ownship versus a low speed intruder aircraft (TG-14);
- DAA Scripted, medium speed intruder—encounters that requires Ikhana ownship versus a medium speed intruder aircraft (Honeywell C90/King Air/T-34C);
- DAA Scripted, high speed intruder—encounters that requires Ikhana ownship versus a high speed intruder aircraft (GIII);

Additionally, encounters are divided into groups of single intruder or multiple (multiship) intruders.

Priority for test sequence will be driven by UAS-NAS PE requirements, test aircraft availability, weather conditions, airspace constraints, and test execution considerations (i.e. encounter repeat runs such as aborts, resets, system performance issues, etc.). A flight test schedule will be published that describes the planned test series based on the number of encounters, encounter priority, flight date, and other factors.
The test conductor will design a flight test order of cards prior to each flight test day that outlines the test card flow for that flight test period (Figure 21). Typically 25 test cards will make up the card order based on data collection priority for the display (or algorithm) under test.

Figure 21. DAA Flight Test 4 Encounter Priorities Worksheet and Intruder Aircraft Scheduling.

4.5.5 Flight Test Matrix

Appendix H depicts the master Flight Test 4 DAA Scripted Test Encounters Matrix, which is a detailed, multi-tabbed compilation of the DAA flight test encounter geometries. This spreadsheet informs and populates the flight test cards automatically via numerous associated tabs in the matrix spreadsheet. Each scenario is planned with unique waypoints for a geometry and timing that places both aircraft 2,430 ft horizontally from each other at the closest point of approach, if the vertical separation is <500 ft. The matrix also includes aircraft groundspeeds, test point altitudes, abort altitudes and headings, tolerances, and Ikhana Lost Link waypoints. Table 4 shows a summarized FTM.

Each aircraft will fly a straight-line or maneuvering trajectory from a known Initial Point (IP) to a known Closest Point of Approach (CPA), with some scenarios using a Maneuver Point (MP) and/or a Descent Point (DP) in between the two aforementioned points. Collectively these are the control points for each encounter. Latitude and Longitude for these points are given in the following two formats with depicted decimal precisions to support the flight management systems and navigation capabilities of participating aircraft:
### Table 4. Summarized Flight Test 4 Matrix.

<table>
<thead>
<tr>
<th>Item</th>
<th>Encounters/SUT</th>
<th>Stakeholder</th>
<th>Scenario Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>JADEM</td>
<td>SSI-West (ARC)</td>
<td>#1-72</td>
</tr>
<tr>
<td>2</td>
<td>DAIDALUS</td>
<td>SSI-East (LaRC)</td>
<td>#73-164</td>
</tr>
<tr>
<td>3</td>
<td>CPDS</td>
<td>GA</td>
<td>#165-175</td>
</tr>
<tr>
<td>4</td>
<td>Radar</td>
<td>GA</td>
<td>#176-211</td>
</tr>
<tr>
<td>5</td>
<td>TCAS</td>
<td>GA</td>
<td>#212-222</td>
</tr>
<tr>
<td>6</td>
<td>Tracker</td>
<td>Honeywell</td>
<td>#223-241</td>
</tr>
<tr>
<td>7</td>
<td>SC-228 (various)</td>
<td>SC-228 V&amp;V WG</td>
<td>#242-292</td>
</tr>
</tbody>
</table>
Manned AC Lat/Long: DD MM.MM/DDD MM.MM
UAS Lat/Long: DD MM SS.S/DDD MM SS.S

This decimal precision will allow navigation to be within +/-10 feet of programmed waypoints.

One of the primary sources of trajectory/CPA prediction uncertainty is winds aloft. The FT4 scenarios were designed to be flown with a constant groundspeed and track. Constant groundspeed facilitates more accurate flying with respect to the target CPA. However, real aircraft typically fly constant airspeed while maintaining constant ground track (i.e., flight plan). By flying constant groundspeed, the pilot minimizes the effect of wind on trajectory prediction error. Moreover, the self-separation algorithms were being tested against unrealistic flight conditions.

The constant groundspeed-constant airspeed flight procedure is designed to address both CPA precision and realistic flight condition. In this procedure, the aircraft will fly to the Initial Point (IP) at the target groundspeed and timing.
4.5.6 Flight Test Geometries

DAA flight test encounters are divided into seven (stakeholder) series types based on whether the encounter requires a low/medium/high speed intruder or is a multi-ship test encounter. Figure 22 describes the nomenclature that was designed to describe the nearly 300 flight encounters that make up the Flight Test 4 encounter series. The primary form of encounter identification for FT4 is the Scenario Number (S/N), unique to each encounter.

FT4 Nomenclature

![Table]

- **Encounter Number**: Unique to each encounter.

  - **Stakeholder**
    - Am = Ames
    - La = Langley
    - Gc = GA CPDS
    - Gr = GA Radar
    - Gt = GA TCAS
    - Hn = Honeywell
    - Sj = SC-228 JADEM
    - Sd = SC-228 DAIDALUS
    - Sc = SC-228 CPDS

- **Intruders**
  - S = Single
  - M = Multiple

- **Minimum Altitude Offset**
  - 1 = 1000 ft
  - 2 = 200 ft
  - 3 = 300 ft
  - 4 = 400 ft
  - 5 = 500 ft

- **Speed**
  - L = Low
  - M = Medium
  - H = High

- **Example 1:**
  - 001 – Am – S1M
  - Encounter 1, Ames, Single Intruder, 1000 ft vertical separation, medium speed intruder

- **Example 2:**
  - 145 – La – M3H
  - Encounter 145, Langley, Multiple Intruders, 300 ft vertical separation, high speed intruder

- **Speed**
  - Low: 100 KGS
  - Medium: 150 – 210 KGS
  - High: >250 KGS

Version: 2016-03-24

Figure 22. DAA Scripted Test Encounter Nomenclature.

4.5.6.1 SSI-West Encounter Geometry

NASA Ames designed encounters to test their DAA system in various flight test encounters to meet their objectives for data collection. SSI-West objectives are broken up as follows:

1. Validate DAA requirements in stressing cases that drive MOPS requirements, including: High-speed cooperative intruder, Low-speed non-cooperative intruder, high vertical closure rate encounter, and Mode C only intruder (i.e. without ADS-B).
2. Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors and in multiple-intruder encounters against both cooperative and non-cooperative intruders.

3. Validate ‘Well Clear Recovery’ guidance in the presence of realistic sensor, tracking and navigational errors.

4. Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors.

5. Collect data to support development and validation of trajectories specified in the DAA MOPS for DAA system acceptance testing.

6. Collect data to supplement simulation analyses as needed due to highly variable, preliminary or inconclusive simulation results, leveraging data from other test cases when possible (e.g., ‘well clear recover’ validation to supplement mini-HitL results if necessary).

Objectives 5 & 6 are ‘targets of opportunity’ and will rely on data collected in the other encounters to meet the stated SSI FT4 objectives. No new FT4 requirements will be levied from these objectives, but encounters may be refined to more closely match those detailed in the SC-228 verification test trajectories where practical.

Test encounters include unmitigated maneuvering and mitigated (or display) maneuvering, as well as, collecting TCAS/DAA interoperability and Well Clear Recovery (WCR) data.

Unmitigated scenarios are designed to collect data to validate CPA predictions. Self-separation advisories are also recorded, but not acted upon, during the entire duration of the scenario. The term unmitigated refers to an encounter with no self-separation (i.e., mitigating) maneuver and has been cited in previous UAS research. Aircraft in the unmitigated scenarios fly towards a target CPA. Neither aircraft maneuvers until after the CPA has been reached. Actual CPA is not critical since any CPA can be compared to the CPA predictions. It is desirable, however, to fly close enough to trigger a self-separation alert (+/- 1.2 nmi for VSCS).

The Display Maneuver scenarios are where the pilot maneuvers the aircraft as directed by the specific self-separation display. In addition to recorded data, the pilot may be asked to provide answers to post-encounter questionnaire.

DAA alerting and guidance and TCAS-II alerting and guidance both intend to mitigate mid-air collisions, but are not currently designed to interoperate. The TCAS interoperability scenarios are designed to evaluate interoperability features between TCAS and DAA systems. DAA systems are expected to keep the ownship well clear of an intruder. Although well clear is not specifically defined to avoid alerting the intruder’s TCAS, alerting TCAS can generally be considered not well clear. Ideally, the DAA alert would trigger long before the TCAS alert. The TCAS interoperability maneuvers are to be flown unmitigated until the intruder’s TCAS is alerted. Because CPA precision is critical, these encounters should be flown at constant groundspeed. Ideally the flights would not
maneuver before the CPA, but this is not a requirement in lieu of safety. The TCAS scenarios require TCAS alerts to be recorded from the intruder aircraft.

Well Clear Recovery scenarios are designed to test the DAA display mode when guidance is provided to the pilot to regain well clear. The encounters are flown as mitigated encounters, but the pilot will be instructed to ignore corrective and warning DAA alerts and instead respond to the DAA WCR once the aircraft can no longer stay well clear. TCAS RAs are ignored in this scenario, unless there is concern for safety of flight.

JADEM will require the use of a high speed, medium speed, and low speed intruders, speeds as defined in the previously discussed Figure 22.

Figure 23 depicts NASA ARC JADEM high speed intruder encounters required to collect data to validate CPA predictions for encounters where the intruder aircraft has jet aircraft representative airspeeds. Encounters of this type will be flown unmitigated and mitigated, and additionally at altitudes both above 10k ft MSL (425 KGS intruder) and below 10k ft MSL (300 KGS intruder). In addition, this set of encounters will be flown with Well Clear Recovery guidance.

Figure 23. JADEM High Speed Intruder Encounters.
Figures 24 shows JADEM encounters that will require a medium speed intruder, with TCAS recording for TCAS interoperability encounters.

Figure 24 shows the two types of single intruder TCAS interoperability JADEM encounters. The first type is with intruder descending at a high descent rate, in this case 2500 fpm. These encounters will be flown above and below 10k ft MSL, due to the change in TCAS alerting threshold at those altitudes. The second encounter type requires the intruder to fly at various angles at the ownship and at the two specified altitudes. Since the threshold is different under 10k ft MSL, the vertical separation is also required to be as low as 200 ft to ensure proper alerting is achieved.

**Medium Speed Intruder (1)**

![Figure 24. JADEM Medium Speed Intruder Encounters (1).]
Figure 25 shows DAA medium speed intruder mitigated/unmitigated and maneuvering encounters, which will essentially be a repeat of select encounters flown during FT3.

**Medium Speed Intruder (2)**

![Diagram of DAA and Maneuvering Intruder encounters](image)

Similar to the high speed intruder encounters, SSI-West requires mitigated, unmitigated, and WCR encounters flown with a low speed intruder. These encounters are shown in Figure 26 and will all be flown below 10k ft MSL.
Multiship encounters are also required for the SSI-West JADEM algorithm. The multiple intruder series of scenarios are designed to constrain the solution space presented to the pilot and to evaluate the JADEM solution. These scenarios increase the complexity of the solution and increase the complexity of data presented to the pilot as there may be solutions which are constrained to either side of the aircraft’s course. For an SAA system to operate effectively in the NAS it must be able to solve a multiple intruder scenario even though this may be a very low probability scenario. Figure 27 shows encounters which JADEM requires for FT4, that are also essentially a repeat of FT3 for additional data acquisition.
Figure 27. JADEM Multiship Intruder Encounters (1).

Figure 28 depicts the second stage of complexity for multiship encounters, new for FT4. This TCAS interoperability multiship encounter requires ownship to fly the line until a corrective TCAS RA is received from maneuvering intruder 1 (red). The ownship will comply with the TCAS guidance and descend. A minute after, the pilot will receive DAA guidance for intruder 2 (blue) and maneuver based on that following guidance. Additionally, intruder 2 is a radar-only target – transponder off. These types of encounters will be coordinated with SPORT beforehand.
4.5.6.2 SSI-East Encounter Geometry

NASA Langley designed self-separation encounters to test and collect data on their self-separation algorithm DAIDALUS (Detect & AvoID Alerting Logic for Unmanned Systems) using mitigated (pilot follows displayed guidance), unmitigated, and WCR flight test encounters. This series of scenarios is designed to collect data to validate CPA predictions and validate the DAIDALUS solution well clear band data during live flight test conditions. The encounters will also operate on the edge of the TCAS RA envelope and ensure DAIDALUS guidance provides maneuver bands to operate outside the RA envelope of TCAS II. Researchers plan to analyze the TCAS II data of ownship and intruder, where available, to ascertain where a Self-Separation maneuver would have conflicted with the RA envelope. DAIDALUS requires a high speed, medium speed, and low speed intruder.

The high speed intruder scenarios are designed to evaluate the effectiveness of the DAIDALUS algorithm when engaging intruders operating at speeds typically encountered with commercial jet transport aircraft transiting below Class A airspace. The increased intruder speed will shorten the available pilot reaction time and provide faster closure while the UA starts to execute the maneuver to remain well clear. It is also of interest to
evaluate if alerting times effective at lower closure rates with slower intruders will remain sufficient with higher closure speeds. This testing will enable researchers to analyze the TCAS II data of ownship and intruder, where available, to ascertain where a Self-Separation maneuver would have conflicted with the TCAS II RA envelope.

Figure 29 shows the required high speed encounters for the DAIDALUS algorithm. In addition to high speed, the intruder will maneuver into the flight path of the ownship at 45 and 90 degree relative angles, turning both from the front of ownship and from behind. This increases complexity and will gather data on a high speed intruder transitioning to a threat. The encounters are expected to be mitigated.

### High Speed Intruder

- 400 KGS intruder
  - Maneuvering
  - Mitigated

**Figure 29.** DAIDALUS High Speed Intruder Encounters.

Figures 30-32 depict the set of medium speed intruder encounters for DAIDALUS.

Figure 30 demonstrates the first set of encounters, where geometry angles will include 0, 45, 90, 135, and 180 degree geometries. The 135 degree geometry is of particular interest to evaluate the effectiveness of DAIDALUS in a late intruder discovery scenario where radar is operating at the edge of its azimuth. The 180 degree relative is also of interest, as ownship overtakes intruder. These encounters will be flown mitigated, with WCR, and with a select few chosen for fly-through (unmitigated) data collection. The other set of
encounters in Figure 30 will have ownship following vertical guidance from DAIDALUS, a change from FT3, where all guidance was lateral.

**Medium Speed Intruder (1)**

![Diagram of medium speed intruder encounters](image)

**Figure 30.** DAIDALUS Medium Speed Intruder Encounters (1).

Figure 31 shows the next set of medium speed intruder encounters, with the intruder maneuvering into the ownship flight path 45 and 90 degrees relative. These intruder paths will maneuver from in front of and behind ownship. The purpose of this set of encounters is to watch for TCAS RAs above and below 10k ft MSL and terminate the encounter when the RA is received. A DAIDALUS maneuver will be secondary. TCAS recording will be required for this set of encounters.
Medium Speed Intruder (2)

- Maneuvering (>10K MSL/<10K MSL)
  - Mitigated

Figure 32 describes a new set of DAIDALUS encounters for FT4: intruder acceleration and intruder high descent rate. For intruder acceleration encounters, the intruder will be expected to accelerate 50 to 80 KGS so as to place its CPA inside the well clear volume of ownship. The ownship pilot will then follow DAIDALUS guidance. The high intruder descent rate encounters will be flown at 1000 fpm and 3000 fpm, with the encounter being mitigated. These stressing intruder vertical maneuvers will represent additional evaluation of the DAIDALUS algorithm performance and also potentially engage the TCAS II RA envelope.

In addition to high and medium speed intruder encounters, a set of low speed intruder encounters are planned for DAIDALUS. Depicted in Figure 33, these encounters will all be flown mitigated and below 10k ft MSL.
Medium Speed Intruder (3)

Figure 32. DAIDALUS Medium Speed Intruder Encounters (3).

Low Speed Intruder

Figure 33. DAIDALUS Low Speed Intruder Encounters.
SSI-East will require its own set of multiship intruder encounters in order to constrain the solution space for the DAIDALUS algorithm. The multiship encounters for DAIDALUS are shown in Figures 34 and 35.

Figure 34 shows a new type of multiship encounter for DAIDALUS, with second intruder at a specified lateral separation from ownship blocking the DAA maneuver either horizontally or vertically. The second intruder will constrain the solution space for the alerting that ownship will receive from intruder 1. These encounters will be flown mitigated, with the pilot following DAIDALUS guidance in lateral or vertical space for ownship.

Multiship (1)

![Multiship Intruder Encounters Diagram](image)

The third type of multiship encounter is a combination of horizontal blocking and maneuvering intruder. Figure 35 shows this type of encounter. Intruder 1 will begin a maneuver 45 or 90 degree relative into from in front of or behind the ownship, with the second intruder holding a set lateral distance from ownship. These encounters will be mitigated with a DAIDALUS display maneuver from ownship.
Multiship (2)

- Maneuvering/Blocking
  - Medium speed
  - Mitigated

Figure 35. DAIDALUS Multiship Intruder Encounters (2).

4.5.6.3 GA-ASI Encounter Geometry - CPDS

For FT4, CPDS encounters are separated into two sections: first, encounters where a previously undetected intruder comes into the radar FOV, and second, an RA maneuver from a primary intruder causes a DAA alert from a second intruder.

The first is a particularly challenging encounter in which during the ownship traffic avoidance maneuver, a previously undetected intruder appears at a location where it threatens to cause a near-future loss of well clear. Figures 36 and 37 depict this situation. Ownship flies with the intruder either at 120 or 130 degrees bearing, at a specified range (1.5, 2, or 2.5 nmi). The ownship and intruder fly at the same groundspeed. Once the ownship and intruder are stabilized, ownship begins a 30 degree change of heading towards intruder at standard rate of turn for 1 minute, at which moment it detects the previously undetected intruder 1. Based on what kind of, and when it receives alerting, the next encounter is flown, for a maximum of 4 CPDS encounters of this type for FT4. The flow down logic for the order of encounters flown is shown in Figure 38.
Figure 36. CPDS Medium Speed Intruder Encounters (1).

Figure 37. CPDS Medium Speed Intruder Encounters (2).
The second type of encounter in FT4 for CPDS are multiship RA and DAA alerts encounters. The major goal of the second type of encounter is to gather data that can be used to analyze timeliness, correctness, and stability of DAA alerts and guidance that are suddenly triggered by an ownship collision avoidance maneuver. ‘Suddenly’ in this context implies that the time to predicted loss of well clear is at least within the CSSA threshold. These encounters have ownship receive alerting from a first intruder, then a second, essentially a ‘sequential’ multiship encounter.

In the first intruder encounter of the sequential encounter, a TCAS RA should serve as the trigger of the ownship collision avoidance maneuver (which leads to another DAA alert). In a geometry that is already stable before the collision avoidance alert threshold is reached, a DAA system will provide information about an upcoming loss of well clear. Hence, in such a situation the pilot would have to ignore the DAA alerts and guidance. To prevent confusion with the pilots (and be as close to a worst-case scenario as possible), it is not desired to have to brief pilots to ignore DAA alerts (that may persist for over a minute) of intruder 1 and ‘wait’ for a TCAS RA, while also having to explain that the DAA alerts and guidance for the second intruder are not to be ignored. To achieve this, conflict geometries are required in which the RA is not preceded by a significant time of DAA...
alerts. Hence, the primary intruder needs to maneuver such that the collision hazard geometry occurs at a time to CPA not much above 40 seconds.

This can be achieved by setting up a geometry in which either one or both of the conditions for the loss of well clear are not met until the time to CPA is so small that a maneuver is possible which reduces the predicted distance at CPA to within the alert boundary, without significantly reducing the time to CPA. To test the DAA algorithms both for level and climbing/descending intruders (important for the vertical velocity filters) two trigger geometries are needed for the first type of CPDS encounters:

1. The intruder first performs a blunder turn similar to the one performed in FT3 (with the result of DCPA decreasing to 0.5 nmi), followed by a descent (or climb) of the intruder which brings the predicted vertical separation at the horizontal CPA point to 200 ft.
2. The intruder is already at a conflicting altitude (i.e. within 300 ft) but the predicted horizontal miss distance is above the alerting threshold (i.e. > 1nmi).

The first trigger geometry is shown in Figure 39. Before the intruder 1 descent, the predicted horizontal separation has been reduced (due to the intruder turn) to within the TCAS RA limits. The descent will be the actual trigger for both DAA and TCAS. To minimize the duration of the DAA alert preceding the TCAS RA, the start of the descent will not be much sooner than about the TCAS tau for RA. The intruder will have the possibility to actually transition to a stable descent. The Descent Point (DP) is about 40 seconds before the horizontal CPA point. The descent will take place after ownship has completed the 45 degree change in heading.

Once the ownship has had the RA encounter with the first intruder, the second intruder will be in a position that the descent of ownship due to the RA will trigger a DAA alert. Two different situations are to be created, one in which the DAA alert is a CSSA (7.9 nmi initial lateral) and one in which the DAA alert is a SSWA (6.2 nmi initial lateral). Since SSWA is suppressed for TCAS-equipped intruders (in TARA mode), the second intruder should not have TCAS or at least not active in TA/RA mode.

With the second trigger geometry (Figure 40), the vertical speed of the intruder is zero at the moment the RA is triggered, i.e. the intruder is already at a conflicting altitude. Before the turn, the predicted horizontal miss distance is above the alerting threshold. To limit the time a DAA system will provide alerts and guidance before the TCAS RA occurs, the turn needs to be moved closer to the CPA point. The ownship descends, and then gets into a CSSA or SSWA alerting situation with intruder 2, just like in trigger geometry 1.
Multiship (1)

- Medium speed
  - Mitigated

  - Initial Point (IP)
  - Maneuver Point (MP)
  - Closest Point of Approach (CPA)
  - Lateral Offset ±0.6 NM
  - SS Alerting Boundary ±0.75 NM
  - Minimum Altitude Offset ±300 ft

3. CPDS - #172, #173

Figure 39. CPDS Multiship Intruder Encounters (1).

Multiship (2)

- Medium speed
  - Mitigated

  - Initial Point (IP)
  - Maneuver Point (MP)
  - Closest Point of Approach (CPA)
  - Lateral Offset ±0.6 NM
  - SS Alerting Boundary ±0.75 NM
  - Minimum Altitude Offset ±300 ft

3. CPDS - #172, #174

Figure 40. CPDS Multiship Intruder Encounters (2).
If for a certain target only TCAS data is available, and no estimates of velocity (groundspeed) and direction (track) are computed (tracker function), no DAA guidance can be provided. This will increase the likelihood that ownship pilot maneuvers in a direction that will cause an imminent loss of well clear, potentially followed by a TCAS RA. This type of encounter is most likely to occur if the TCAS-only target is in a low-closure rate geometry in which an ownship turn will cause an acceleration in time to CPA combined with a reduction in distance at CPA.

The final multiship CPDS geometry in Figure 41 is designed to get data on this type of encounter. To limit variability in the moment that ownship pilot responds to the DAA alert, the alert should not exist for the full CSSA warning time. This can be achieved by having intruder 1 turn within the CSSA alert time. In Figure 41 it is indicated that when intruder 1 comes out of the turn, time to CPA is 70 seconds. Intruder 1 is flying 300 ft higher than ownship.

Intruder 2 flies at a constant range and 120 degree bearing to ownship at an altitude of 500 ft below ownship.

**Figure 41. CPDS Multiship Intruder Encounters (3).**

- **Medium speed**
  - Mitigated
4.5.6.4 GA-ASI Encounter Geometry - Radar

Test encounter geometries provided by GA-ASI will collect data on the performance of the company provided EDM radar system and to help inform the SC-228 radar working group MOPS. To continue the research in operating at low altitudes from FT4, test encounters are planned at low altitude with ground clutter affecting target resolution. Figure 42 depicts the planned low altitude radar flight test geometries. The minimum test altitude will be 1,000 ft AGL based off the highest ground feature located along the flight path of the encounter. Both the ownship and the intruder will perform 1,000 ft AGL runs but at no time will an encounter participant operate below 1,000 ft. Ten low altitude radar runs are planned.

Low Altitude Encounters

- Medium speed
  - Unmitigated

![Diagram of Low Altitude Encounters](Image)

*Lowest altitude 1000 ft AGL from highest point on ground
*Incremented from 1000 ft to 5000 ft AGL

Figure 42. Radar Low Altitude Encounters.

Further, GA-ASI requires system performance with ownship overtaking (Figure 43), a small RCS, glider-type intruder (Figure 43), performance at various angles and initial distances, climbs, and descents (Figures 44-46), system performance of the radar during intruder ownship/intruder maneuvering (Figures 46-48), performance testing of the EDM radar to determine targeting capabilities at the azimuth limits of the radar (Figure 49) and performance with aircraft of various Radar Cross Sections (RCS) – small (TG-14), medium (T-34C), and large (Honeywell C90/King Air/GIII). A radar saturation encounter is also required for FT4 with 4 intruders. All intruders will be flying straight and level with 1000 ft vertical separation between each (Figure 50).
Medium Speed/Low Speed Intruder

- **Ownship Overtaking**
  - Unmitigated
  - Medium Speed

- **65 KGS Intruder**
  - Unmitigated

**Figure 43. Radar Medium/Low Speed Intruder Encounters.**

**Multiship (1)**

- **Statistical**
  - Medium Speed
    - Unmitigated

**Figure 44. Radar Multiship Intruder Encounters (1).**
Multiship (2)

- **Statistical**
  - Medium Speed
  - Unmitigated

![Diagram of Multiship (2)](image)

Figure 45. Radar Multiship Intruder Encounters (2).

Multiship (3)

- **Statistical**
  - Medium Speed
  - Unmitigated

![Diagram of Multiship (3)](image)

Figure 46. Radar Multiship Intruder Encounters (3).
Multiship (4)

- Statistical
  - Medium Speed
  - Unmitigated

Figure 47. Radar Multiship Intruder Encounters (4).

Multiship (5)

- Statistical
  - Medium Speed
  - Unmitigated

Figure 48. Radar Multiship Intruder Encounters (5).
Multiship (6)

- Statistical
  - Medium Speed
  - Unmitigated

Figure 49. Radar Multiship Intruder Encounters (6).

Multiship (7) Four Intruders

- Mixed speeds
  - Unmitigated

Figure 50. Radar Multiship Intruder Encounters (7) Four Intruders.
4.5.6.5 GA-ASI Encounter Geometry - TCAS

The CA performance encounters have been designed to test the full range of TCAS Resolution Advisories (i.e., preventive and corrective) and when executed automatically, to test the performance of the vehicle response in a real world environment. Climbing/descending ownship and intruders have been included to capture realistic encounter dynamics of the Phase I DAA MOPS definition of "transition". These encounters will also serve to capture Radar performance data all the way through a CA maneuver. Since the CPDS SS display will be running in the background during these CA encounters, researchers will have an opportunity to gather data on when TCAS RA affect SS algorithms and in what manner.

An encounter will test the RF shadow region of the TCAS directional antenna. This encounter is a simple fly-through data collection, and is shown in Figure 51.

Medium Speed Intruder (1)

- Medium speed
  - Unmitigated

![Diagram of Medium Speed Intruder (1)]

- Initial Point (IP)
- Maneuver Point (MP)
- Closest Point of Approach (CPA)

Figure 51. TCAS Medium Speed Intruder Encounters (1).
Additional encounters test the increased climb of TCAS version 1107.4 software. Figure 52 shows this encounter. The ownship pilot will experience a climb RA, followed by an increased climb RA, which will then be flown in advisory mode.

**Medium Speed Intruder (2)**

- **Medium speed**
  - Advisory – Increased Climb RA*
    - 1.2 NM Increased Climb RA ("INCREASEDCLIMB 2500 FPM")
    - 3 NM Climb RA ("CLIMB 1500 FPM")

- 3 NM distance between ownship/intruder: Climb RA Triggered (ignore)
- 1.2 NM distance between ownship/intruder: Increased Climb RA triggered
- End of Encounter as soon as Increased Climb RA triggered, break away

*Success depends on altimeter check at day of flight

**Figure 52. TCAS Medium Speed Intruder Encounters (2).**

In addition, two encounters will be flown that trigger a “Do not descend >-500 fpm” RA and a “Do not descend >-1500 fpm”. These encounters are depicted in Figure 53. Intruder will climb at a specific rate from a specified vertical distance and timing from ownship. This will cause the desired warning.
Medium Speed Intruder (3)

- Medium speed
  - Advisory – Do not descend -500 fpm/-1500 fpm

Figure 53. TCAS Medium Speed Intruder Encounters (3).

Similar to FT3, the stakeholder will require a TCAS sequential warning encounters that involve two intruders. These encounters are depicted in Figures 54 and 55. The first encounter will trigger a “Climb” RA from first intruder and a “Do Not Climb” RA from the second intruder. The second encounter is reversed, and will trigger a “Descend” RA from the first intruder and a “Do Not Descend” RA from the second intruder. These encounters will be flown in advisory and then AUTO mode.
Multiship (1)

- Medium speed
  - Advisory/AUTO: multi-threat CLIMB

- From intruder 1: CLIMB
- From intruder 2: DO NOT CLIMB
  ~35 seconds to second alert

Multiship (2)

- Medium speed
  - Advisory/AUTO: multi-threat DESCEND

- From intruder 1: DESCEND
- From intruder 2: DO NOT DESCEND
  ~35 seconds to second alert

Figure 54. TCAS Multiship Intruder Encounters (1).

Figure 55. TCAS Multiship Intruder Encounters (2).
4.5.6.6 Honeywell Encounter Geometry

To test the full capabilities of the Honeywell Fusion Tracker, Honeywell has provided various geometries in stressing the tracker using the full sensor selection suite.

The first set, shown in Figure 56, has ownship overtaking intruder and intruder performing pitch steps at various climb/descent rates: +/- 500 ft/min, +/- 1000 ft/min, +/- 1500 ft/min, +/- 2000 ft/min. The purpose for these encounters is to test the vertical rate estimation for various vertical rates of the tracker.

The second set, also in Figure 56, has ownship and intruder both performing accelerating “zig-zag” standard turn rate maneuvers toward one another at various altitudes. Both ownship and intruder turn in the same direction. These encounters will test the tracking of an accelerating intruder.

Medium Speed Intruder (1)

Figure 56. Honeywell Medium Speed Intruder Encounters (1).

Figure 57 is a new for FT4 and requires the intruder to climb and maneuver or descend and maneuver, towards the straight and level ownship, at the same time. The tracking of an intruder in multiple dimensions will be tested. These encounters are set to have CPA
at 5 nmi, at which point the intruder begins to maneuver away and climb or descend at 2000 fpm.

Figure 58 has the ownship and intruder reverse roles, with the ownship performing the maneuver and climb or descent at 1000 fpm. The purpose is to test the tracking of an intruder while ownship is performing maneuvers in multiple dimensions.

The final set of encounters in Figure 59 requires ownship to maneuver and intruder to climb (2000 fpm), or intruder to maneuver and ownship to climb (1000 fpm). As in the previous set, the CPA will be at 5 nmi. This is another case of testing tracking in multiple dimensions.

All Honeywell encounters will be tested at various altitudes to assess the tracker performance at the change of altitude.

Medium Speed Intruder (2)

- Maneuver and Climb/Descend Intruder
  - 2000 FPM

Figure 57. Honeywell Medium Speed Intruder Encounters (2).
Medium Speed Intruder (3)

- Maneuver and Climb/Descend Ownship
  - 1000 FPM

Figure 58. Honeywell Medium Speed Intruder Encounters (3).

Medium Speed Intruder (4)

- Maneuver Ownship/Climb Intruder
  - 1000 FPM

- Maneuver Intruder/Climb Ownship
  - 1000 FPM

Figure 59. Honeywell Medium Speed Intruder Encounters (4).
4.5.6.7 SC-228 Encounter Geometry

A new stakeholder for FT4, SC-228 V&V Subcommittee are interested in: collecting overall DAA system and subsystem performance and interface data to validate DAA MOPS requirements, collecting radar system performance and interface data to validate Radar MOPS requirements, and collecting data to validate simulation models used for MOPS validation.

For this reason, the SC-228 V&V Subcommittee will not only collect data from the previous described encounters, but they will require encounters not performed by the previous researchers’ objectives using the three DAA algorithms for their test encounters.

Many of these encounter types, although not complex, have not been flown before for UAS in the NAS. The SC-228 encounters will include a large variety of sensor combinations, flight altitudes, maneuvers, speeds, and a unique mode C only intruder mentioned previously. For a few of their encounters, the intruder will even need to turn off its transponder to represent a radar-only target. Additional details on the test objectives for each encounter can be found in Appendix F.

As the other researchers, SC-228 will require a high-speed intruder for some encounters, shown in Figure 60. The high speed encounters are a simple geometry and 1v1.

High Speed Intruder

- 425 KGS intruder
  - Mitigated

Figure 60. SC-228 High Speed Intruder Encounters.
A low speed intruder will also be utilized, depicted in Figure 61. The two types of encounters shown in the figure have not been flown before. First, a maneuvering low speed intruder encounter will be flown, with the intruder turning 90° to a final CPA in front of the ownship. A second type of low speed intruder encounter will simulate a loitering maneuver by intruder.

**Low Speed Intruder**

**Intruder Maneuver**
- 100 KGS intruder
  - Mitigated

**Holding Pattern/Intruder Ascent**
- 100 KGS intruder
  - Mitigated

---

Figure 61. SC-228 Low Speed Intruder Encounters.

Figure 62 depicts the first set of medium speed intruder encounters. The group on the left will be flown with the mode C only intruder, as a TCAS RA target for interoperability, and for WCR. On the right is a similar maneuver performed during FT3, with ownship only climbing to intruder.

Figure 63 shows an ownship overtaking encounter whilst descending simultaneously. On the right is a double blunder encounter, similar to what was flown during FT3.
Medium Speed Intruder (1)

Mode C Only Intruder/Non-Cooperative/TCAS/WCR
- Mitigated

Ascending Abeam
- Mitigated

Figure 62. SC-228 Medium Speed Intruder Encounters (1).

Medium Speed Intruder (2)

Overtake Descend
- Mitigated

Double Blunder
- Mitigated

Figure 63. SC-228 Medium Speed Intruder Encounters (2).
Figure 64 shows an intruder maneuvering encounter on the left, with a slight difference than what was flown for other stakeholders: the intruder’s predicted CPA is expected to be on the side of ownship CPA. This encounter is designed to test the limits of the DAA algorithms’ predictive capability. The encounter on the right is also a double blunder, but again, with a difference: the expected predicted CPA is set to alert at 1000 ft separation, at which point the intruder will level off. This tests the outer limits of the DAA alerting boundaries.

Medium Speed Intruder (3)

Figure 64. SC-228 Medium Speed Intruder Encounters (3).

Figure 65 left is an ownship turn and climb. Although Honeywell has a similar encounter, this is the first time an ownship hybrid maneuver will be performed to test the DAA algorithm. The blunder on the left is similar to the double blunder shown in Figure 64, expect with ownship flying level for this type of encounter.
Medium Speed Intruder (4)

Figure 65. SC-228 Medium Speed Intruder Encounters (4).

SC-228 also has a set of multiship encounters. The first set, shown in Figure 66, is divided into Blocking Type 1 and Blocking Type 2. Blocking Type 1 has the two intruders flying co-altitude but staggered towards ownship. Blocking Type 2 has the two intruder flying the same latitude line, but again, staggered and separated by a large altitude block. Some of these encounters include a radar-only target (no transponder).

Figure 67 shows the second set of multiship encounters, Blocking Type 3 with a low and medium speed intruder. Intruder 1 (red), either a low-speed or medium-speed intruder, blocks ownship in the horizontal direction and is being overtaken by ownship. The second intruder flies on the other side of the alerting volume with a large altitude offset. Again, a selection of these encounters have a radar-only target.
Multiship (1)

**Blocking Type 1**
- Medium Speed
- Mitigated

**Blocking Type 2**
- Medium Speed
- Mitigated

Figure 66. SC-228 Multiship Intruder Encounters (1).

Multiship (2) + Low Speed

**Blocking Type 3 (with Low Speed)**
- Medium/Low Speed
- Mitigated

**Blocking Type 3**
- Medium Speed
- Mitigated

Figure 67. SC-228 Multiship Intruder Encounters (2).
4.5.7 Minimum Success Criteria

Success criteria for specific test encounters are captured in the test objective templates located in Appendix F.

5 Test Reporting

Several reports shall be developed by specific members of the test team and distributed as described in this section.

5.1 Deficiency Report

During testing any deficiencies that are found in the system or any component of the system will be reported to the Test Conductor. The circumstance of the testing during the deficiency will be noted. At the discretion of the Test Conductor the test may continue, or be terminated. During the Post-test Brief, any deficiency reports will be reviewed. The Test Conductor and Project Engineers will determine whether any steps need to be taken to mitigate the deficiency before continuing with the next set of tests.

5.2 Progress Report

The IT&E sub-project will deliver preliminary test results to the UAS-NAS Project Office during testing on a per request basis. After each debrief, the AFRC IT&E PE will compile and submit a daily test run sheet to the Project Office including runs/events planned versus successfully accomplished on that day, a summary of deficiencies identified during the day, and a brief statement of the next test period/day’s planned runs.

5.3 Flight Test Report

After completion of Flight Test 4, the IT&E Ops team will develop a report that details the flight test execution, results and lessons learned to be submitted to the UAS-NAS Project Office. The final report will be processed through the NASA AFRC Export Control office and become a public releasable document.

6 Data Collection

The Flight Test 4 Data Management Plan, IT&E DMP-001, is the reference source for the following data management activities required for FT4:

- Purpose of data collection;
- Sources and types of data to be collected by each flight test participant;
- Quick-Look at data on day-of-flight;
- Reception and archival in a central data repository; and
- Providing data from the central data repository to test participants.

Each participating organization captures data relevant to the FT4 flights received by its aircraft or generated by that aircraft, including surveillance and tracking data (both
ownership and other aircraft), inter-aircraft data communications, air-ground data communications, as well as data provided to and actions produced by the on-board TCAS.

A “quick-look” on each day of FT4 test flights will be performed to assess the prospects of successful flight tests both during the flights and immediately post-flight. Refer to IT&E DMP-001 for a description of roles and responsibilities related data analysis pertaining to “quick-look” activities and post-flight data analysis.

6.1 Summary of Data Sources from Flight Test Aircraft

Figure 19 depicts the data collection sources for DAA Scripted encounters. For a more detailed description of the data collection source information, reference the Flight Test 4 Data Management Plan, IT&E DMP-001.

7 Appendices
## Appendix A  Reference Documents

<table>
<thead>
<tr>
<th>Document Number</th>
<th>Document Title</th>
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### Appendix B  Acronyms

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<td>ADRS</td>
<td>Aeronautical Data Link and Radar Simulator</td>
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<td>Automatic Dependent Surveillance-Broadcast</td>
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<td>Active Electronically Scanned Array</td>
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<td>Airworthiness and Flight Safety Review</td>
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<td>Applied Physics Laboratory</td>
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<td>ASTERIX</td>
<td>All Purpose STuctured Eurocontrol SuRveillance Information EXchange</td>
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<td>DAIDALUS</td>
<td>Detect &amp; AvoID Alerting Logic for Unmanned Systems</td>
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<td>Stand Alone Facility</td>
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<td>SOR</td>
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<td>TBD</td>
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<td>Time to Closest Point of Approach</td>
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<td>Time Space Position Information</td>
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<td>WAAS</td>
<td>Wide Area Augmentation System</td>
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<td>WCT</td>
<td>Well Clear Threshold</td>
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### Appendix C  Definition of Terms

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<tr>
<td>Blunder</td>
<td>A planned vertical or horizontal maneuver performed by the intruder, ownship or both aircraft that occurs at some point during the flight test encounter to intentionally stimulate conflict alerting. The blunder maneuver is a technique by which the researcher uses to obtain data required to refine algorithm parametric logic.</td>
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<td>Intruder</td>
<td>Intruder aircraft (when properly equipped) provide a target solution for the self-separation algorithm under test. Both low speed, high speed, multi-ship encounters are planned using intruder aircraft. All participating intruder aircraft will be equipped with ADS-B as a minimum.</td>
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<tr>
<td>Ownship</td>
<td>Ownship aircraft provide the self-separation algorithm host solution for testing airborne geospatial encounters with target (intruder) aircraft. The ownship may be a UAS or UAS surrogate aircraft. Self-separation alerting solutions are presented to the ground control station pilot who determines the best course of action based on display alerting evaluation.</td>
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<td>Mitigated</td>
<td>Flight test encounters that are designed for the controlling UAS pilot to either manually respond to a self-separation or resolution advisory alert or monitor the aircraft response during an automatic resolution advisory alert. Mitigated test encounters are typically planned with vertical, lateral, and timing flight safety margins designed into the flight test encounters to help minimize the potential for an inflight collision.</td>
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<td>STANAG</td>
<td>In NATO a Standardization Agreement (STANAG) defines processes, procedures, terms, and conditions for common military or technical procedures or equipment between the member countries of the alliance. Each NATO state ratifies a STANAG and implements it within their own military.</td>
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<tr>
<td>Unmitigated</td>
<td>The term unmitigated refers to an encounter with no self-separation (i.e., mitigating) maneuver Flight test encounters that due to adequate vertical offsets do not require an associated lateral offset for flight safety. Unmitigated encounters typically are non-maneuvering.</td>
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## Appendix D  Flight Test 4 Intruder Summary Matrix

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<th>Multi-Ship Need</th>
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<td>Medium (Intruder 1)</td>
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<td>• NASA 865/NASA 801/N3GC</td>
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<td>• ADS-B/TCAS II (recording)</td>
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### Appendix E  VSCS/DAA MOPS Alerting Symbology

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Pilot Action</th>
<th>Aural Alert Verbiage</th>
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</thead>
</table>
| ![Symbol] | TCAS RA *(Cooperative Only)*        | • *Immediate action required*  
• No researcher coordination required | “Climb/Descend”  |
| ![Symbol] | DAA Warning Alert                   | • *Immediate action required*  
• No researcher coordination required | “Traffic, Maneuver Now”  |
| ![Symbol] | Corrective DAA Alert                | • On current course, *corrective action required*  
• Coordinate maneuver with researcher prior to maneuvering | “Traffic, Avoid”  |
| ![Symbol] | Preventive DAA Alert                | • *No action required*  
• No coordination required | “Traffic, Monitor”  |
| ![Symbol] | None (Target)                       | • *No action required*  
• No coordination required | N/A  |
Appendix F  Flight Test Objective Templates

1. JADEM
2. DAIDALUS
3. CPDS
4. Radar
5. TCAS
6. Tracker
7. SC-228
UAS in the NAS FT4 Test Objectives (SSI-ARC)
SSI-ARC FT4 Objectives

1. Validate DAA requirements in stressing cases that drive MOPS requirements, including: High-speed cooperative intruder, Low-speed non-cooperative intruder, high vertical closure rate encounter, and Mode C only intruder (i.e. without ADS-B).

2. Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors and in multiple-intruder encounters against both cooperative and non-cooperative intruders.

3. Validate ‘Well Clear Recovery’ guidance in the presence of realistic sensor, tracking and navigational errors.

4. Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors.

5. Collect data to support development and validation of trajectories specified in the DAA MOPS for DAA system acceptance testing.

6. Collect data to supplement simulation analyses as needed due to highly variable, preliminary or inconclusive simulation results, leveraging data from other test cases when possible (e.g., ‘well clear recover’ validation to supplement mini-HitL results if necessary).
Objectives 5 & 6 are ‘targets of opportunity’ and will rely on data collected in the other encounters to meet the stated SSI FT4 objectives. No new FT4 requirements will be levied from these objectives, but encounters may be refined to more closely match those detailed in the SC-228 verification test trajectories where practical.

# of Encounters:
- Objective 1: 18
- Objective 2: 29
- Objective 3: 9
- Objective 4: 16
- Total: 72
- Lower priority encounters: 9
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements: (a) high speed intruder (mitigated, >10kft MSL)

MOPS Appendix D, Section 2.3 – Aircraft Speed Limitations

### Configuration

#### System Under Test:
- **Omnibands**

#### Display: VSCS

#### Contributing Sensors:

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<th>Mode C</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
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### Scenario(s):
- #001-003

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

### Test Objectives (TO)
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

### Success Criteria (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

### Test Method
- **MANUEVER:** Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder >500 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

### Additional Information

- Omnibands
- 500 ft
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
- TCA S
- Mode C
- ADS-B
- Radar
- Tracker
- YES
- NO
- YES
- YES
- YES

- YES
- YES
- NO
- YES
- YES

- 0° Relative
- 45° Relative
- 90° Relative

- Ownship

- 500 ft
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements: (b) high speed intruder (unmitigated, >10kft MSL)

### Configuration

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**Display:** VSCS

**Contributing Sensors:**

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### Scenario(s):

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

### Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

### Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

### Test Method

- **MANEUVER:** none.
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder >500 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

### Additional Information

- **Omnibands**
  - Lateral Offset = 0 NM
  - SS Alerting Boundary = 0.75 NM
  - Minimum Altitude Offset ≥ 500 ft
- **Scenario(s):** #004-006
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements: (c) high speed intruder (mitigated, <10kft MSL)

**Configuration**

**System Under Test:** Omnibands

**Display:** VSCS

**Contributing Sensors:**

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**Scenario(s):** #007-009

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria (retest if criteria not met)**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method**

- **MANUEVER:** Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder 250 KIAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**

- Omnibands
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

- TCA S
- Mode C
- ADS-B
- Radar
- Tracker

- 90° Relative
- 45° Relative
- 0° Relative
- 500 ft
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements:
(d) high speed intruder (unmitigated, <10kft MSL)

MOPS Appendix D, Section 2.3 – Aircraft Speed Limitations

Configuration

**System Under Test:** Omnibands

**Display:** VSCS

**Contributing Sensors:**

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Scenario(s): #010-012

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

Test Method

- **MANEUVER:** none.
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder 250 KIAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

Additional Information

- **Omnibands**
  - Lateral Offset = 0 NM
  - SS Alerting Boundary = 0.75 NM
  - Minimum Altitude Offset ≥ 500 ft
### Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements:
(e) low speed intruder (mitigated, <10kft MSL)

**Configuration**

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**Scenario(s):**

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

**Test Objectives (TO):**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria (retest if criteria not met):**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method:**

- MANUEVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 120 KGS, Intruder 100 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ±8 sec, ±5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**

1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**

- Omnibands
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements:
(f) low speed intruder (unmitigated, <10kft MSL)

Success Criteria (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

Test Method
- MANUEVER: none.
- Aircraft speeds (non-accelerating): Ownship 120 KGS, Intruder 100 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria
1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

Additional Information
- Minimum Altitude Offset ≥ 500 ft
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Ownship Scenario(s): #016-018

Test Objectives (TO)
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (a) high vertical closure rate encounter (mitigated TCAS RA maneuver, >10kft).

**Configuration**

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**Scenario(s):** #019

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.80 NM
- Minimum Altitude Offset: 200 ft

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

**Success Criteria** (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder and the UAS pilot complies with TCAS RA guidance.

**Test Method**

- MANEUVER: Pilot disregards DAA guidance and follows TCAS guidance if consistent with test constraints.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts, ± 100 fpm at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. UAS pilot promptly evaluates (and complies with) TCAS RA guidance and avoids NMAC.
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (b) high vertical closure rate encounter (unmitigated TCAS RA, >10kft).

### System Under Test
Omnibands

### Display
VSCS

### Contributing Sensors
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### Configuration

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<th>#020</th>
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- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.80 NM
- Minimum Altitude Offset: 200 ft

### Test Objectives (TO)
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

### Success Criteria (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder.

### Test Method
- **MANUEVER:** none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts, ± 100 fpm at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (c) high vertical closure rate encounter (mitigated TCAS RA maneuver, <10kft).

MOPS Sections 2.2.4.2.4 Alerting 2.2.4.3 Determine Processing, 2.2.4.4 Collision Avoidance Interoperability

Configuration

System Under Test: Omnibands

Display: VSCS

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Scenario(s): #021

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.55 NM
- Minimum Altitude Offset: 200 ft

Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot's ability to assess and follow TCAS RA guidance.

Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder and the UAS pilot complies with TCAS RA guidance.

Test Method

- MANUEVER: Pilot disregards DAA guidance and follows TCAS guidance if consistent with test constraints.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts, ± 100 fpm at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. UAS pilot promptly evaluates (and complies with) TCAS RA guidance and avoids NMAC.
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (d) high vertical closure rate encounter (unmitigated TCAS RA, <10kft).

**Test Objectives (TO)**
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

**Success Criteria (retest if criteria not met)**
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder.

**Test Method**
- MANEUVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ±8 sec, ±5 kts, ±100 fpm at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**
1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (e) level-level TCAS RA encounters (mitigated, >10kft).

**Configuration**

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**Scenario(s):** #023-031

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.80 NM
- Minimum Altitude Offset: 200 ft

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot's ability to assess and follow TCAS RA guidance.

**Success Criteria**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder and the UAS pilot complies with TCAS RA guidance.

**Test Method**

- MANEUVER: Pilot disregards DAA guidance and follows TCAS guidance if consistent with test constraints.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 150/180/210 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.

**MOPS Sections**

2.2.4.2.4 Alerting
2.2.4.3 Determine Processing, 2.2.4.4 Collision Avoidance Interoperability
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (f) level-level TCAS RA encounters (unmitigated, >10kft).

MOPS Sections 2.2.4.2.4 Alerting 2.2.4.3 Determine Processing, 2.2.4.4 Collision Avoidance Interoperability

**Configuration**

**System Under Test:** Omnibands

**Display:** VSCS

**Contributing Sensors:**

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**Scenario(s):** #032-040

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.80 NM
- Minimum Altitude Offset: 200 ft

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

**Success Criteria (retest if criteria not met)**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder.

**Test Method**

- MANUEVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 150/180/210 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
FT4 TEST OBJECTIVES – SSIWest.2.g

Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (g) level-level TCAS RA encounters (mitigated, <10kft).

MOPS Sections 2.2.4.2.4 Alerting 2.2.4.3 Determine Processing, 2.2.4.4 Collision Avoidance Interoperability

Configuration

System Under Test: Omnibands

Display: VSCS

Contributing Sensors:

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Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder and the UAS pilot complies with TCAS RA guidance.

Test Method

- MANEUVER: Pilot disregards DAA guidance and follows TCAS guidance if consistent with test constraints.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.

Scenario(s): #041-043

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.55 NM
- Minimum Altitude Offset: 200 ft
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (h) level-level TCAS RA encounters (unmitigated, <10kft).

### Configuration

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### Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

### Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A corrective TCAS RA is generated for the primary intruder.

### Test Method

- **MANUEVER:** none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500 FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. DAA alerting and guidance is generated once RA expires (if appropriate).
5. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 2: Validate TCAS/DAA alerting and guidance interoperability concept in the presence of realistic sensor, tracking and navigational errors: (i) multi-intruder encounter (mitigated TCAS RA maneuver, >10kft).

**Configuration**

**System Under Test:** Display: VSCS

**Contributing Sensors**

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**Scenario(s):** #047

- Lateral Offset = 0.5 NM
- TCAS Alerting Boundary = 0.8 NM
- Minimum Altitude Offset: ≥ 300 ft (primary), 500 ft (secondary)
- Initial Intruder Course Lateral Offset: 1nmi (primary), 0 nmi (secondary)

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate DAA alerting and guidance do not interfere with UAS pilot’s ability to assess and follow TCAS RA guidance.

**Success Criteria**

1. A corrective TCAS RA is generated for the primary intruder and the UAS pilot complies with TCAS RA guidance.
2. A timely DAA alert for secondary intruder is provided to the UAS pilot (timely relative to TCAS maneuver initiation).

**Test Method**

- **MANEUVER:** Pilot complies with TCAS RA for primary intruder and follows DAA guidance for secondary intruder (after RA initiation).
- **Aircraft speeds (non-accelerating):** Ownship 180 KGS, Primary Intruder 200 KGS, Secondary Intruder (NO ADS-B) 150 KGS.
- **Encounter Length:** 2 min (IP to CPA)
- **Stable Conditions:** stable at the IP (2 minutes prior to CPA)
- **Test Termination Criteria:** targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- **Climb/Roll/Pitch Rates:** Ownship & Secondary 0/0/0, Primary Intruder: TBD climb/descent to generate RA.
- **Tolerance:** ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

(Post-test analysis to determine if test objectives are met)

1. UAS pilot receives and complies with TCAS corrective RA for primary intruder.
2. Vertical DAA guidance indicates no viable vertical maneuvers in temporal proximity to TCAS RA and while RA persists.
3. DAA alerting and guidance for the primary intruder are removed while a TCAS RA is present for the primary intruder.
4. UAS pilot receives DAA Warning Alert for secondary intruder with associated guidance.
5. UAS pilot maneuvers according to DAA guidance and remains well clear of secondary intruder.
Objective 3: Validate Well Clear Recovery (WCR) guidance in the presence of realistic sensor, tracking and navigation errors: (a) high speed intruder (mitigated, >10kft MSL)

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Scenario(s): #048-050
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Test Objectives (TO)
1. Validate DAA Well Clear Recovery guidance to UAS pilot is appropriate (reasonable, timely & responsive).
2. Validate WCR guidance results in pilot maneuvering to avoid collision and regain Well Clear.

Success Criteria (retest if criteria not met)
1. DAA Well Clear Recovery guidance is provided to the UAS pilot.

Test Method
- MANEUVER: UAS pilot to ignore corrective and warning DAA alerts and respond promptly to DAA WCR guidance.
- Ignore TCAS RA guidance
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder >500 KTAS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA Well Clear Recovery guidance
2. UAS pilot maneuvers in response to DAA Well Clear Recovery guidance and regains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.
Objective 3: Validate Well Clear Recovery (WCR) guidance in the presence of realistic sensor, tracking and navigation errors: (b) high speed intruder (mitigated, <10kft MSL)

System Under Test: Omnibands

Display: VSCS
Contributing Sensors:

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Scenario(s): #051-053

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Test Objectives (TO)
1. Validate DAA Well Clear Recovery guidance to UAS pilot is appropriate (reasonable, timely & responsive).
2. Validate WCR guidance results in pilot maneuvering to avoid collision and regain Well Clear.

Success Criteria (retest if criteria not met)
1. DAA Well Clear Recovery guidance is provided to the UAS pilot.

Test Method
- MANUEVER: UAS pilot to ignore corrective and warning DAA alerts and respond promptly to DAA WCR guidance.
- Ignore TCAS RA guidance
- Aircraft speeds (non-accelerating): Ownship 200 KTAS, Intruder 250 KIAS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA Well Clear Recovery guidance
2. UAS pilot maneuvers in response to DAA Well Clear Recovery guidance and regains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

Additional Information
Objective 3: Validate Well Clear Recovery (WCR) guidance in the presence of realistic sensor, tracking and navigation errors: (c) low speed intruder (mitigated, <10kft MSL)

Under Test:
- System Under Test: Omnibands
- Display: VSCS
- Contributing Sensors:
  - TCA: NO
  - Mode C: NO
  - ADS-B: NO
  - Radar: YES
  - Tracker: YES

Scenario(s): #054-056
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Test Objectives (TO):
1. Validate DAA Well Clear Recovery guidance to UAS pilot is appropriate (reasonable, timely & responsive).
2. Validate WCR guidance results in pilot maneuvering to avoid collision and regain Well Clear.

Success Criteria (retest if criteria not met):
1. DAA Well Clear Recovery guidance is provided to the UAS pilot.

Test Method:
- MANEUVER: UAS pilot to ignore corrective and warning DAA alerts and respond promptly to DAA WCR guidance.
- Ignore TCAS RA guidance
- Aircraft speeds (non-accelerating): Ownship 120 KGS, Intruder 100 KGS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met):
1. UAS pilot receives DAA Well Clear Recovery guidance
2. UAS pilot maneuvers in response to DAA Well Clear Recovery guidance and regains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

Additional Information:
- Omnibands
- 500 ft
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
- TCA S Mode C ADS-B Radar Tracker
  - NO NO NO YES YES

Scenario(s):
- #054-056
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: a) nominal speed encounter (mitigated, >10kft)

MOPS Sections 2.2.4.2.4 Alerting 2.2.4.3 Determine Processing

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria (retest if criteria not met)**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method**

- MANEUVER: Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

**Scenario(s): #057-059**
Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: b) nominal speed encounter (unmitigated, >10kft)

Configuration
Display: VSCS
Contributing Sensors:

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Scenario(s): #060-062
- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Test Objectives (TO)
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

Success Criteria (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

Test Method
- MANUEVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

Additional Information
**Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: c) maneuvering intruder (mitigated, >10kft)**

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**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method**

- MANUEVER: Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
- Initial Intruder Course Lateral Offset: TBD ft.
- Scenario(s): #063-064
- TCA S Mode C ADS-B Radar Tracker
  - YES
  - YES
  - YES
  - YES
  - YES
- 90° Relative 3 nmi
- 45° Relative 2 nmi
- 500 ft
Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: d) maneuvering intruder (unmitigated, >10kft)

**Configuration**

- **System Under Test:**
  - Display: VSCS
  - Contributing Sensors:
- **TCA S** | **Mode C** | **ADS-B** | **Radar** | **Tracker**
  - NO | YES | YES | YES | YES

**Scenario(s):** #065-066

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
- Initial Intruder Course Lateral Offset: TBD ft.

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

**Success Criteria (retest if criteria not met)**

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

**Test Method**

- MANEUVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Intruder 180 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

- Omnibands 500 ft
- TCA S Mode C ADS-B Radar Tracker
- NO YES YES YES YES
- 90° Relative 3 nmi
- 45° Relative 2 nmi
- 500 ft
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
- Initial Intruder Course Lateral Offset: TBD ft.
Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: e) multiple intruder (mitigated, >10kft)

**Configuration**

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**Scenario(s):**

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

**Test Objectives (TO)**

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria** (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method**

- MANUEVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Primary Intruder 180 KGS, Secondary Intruder 150 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**

- Omnibands
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft
Objective 4: Validate DAA alerting and guidance requirements in the presence of realistic sensor, tracking and navigational errors: e) multiple intruder (unmitigated, >10kft)

Success Criteria (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.

Additional Information
- OMNIBANDS
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

Scenario(s): #070-072

Test Method
- MANEUVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KGS, Primary Intruder 180 KGS, Secondary Intruder 150 KGS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.
Additional (lower priority) encounters
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements: (h) high vertical closure rate encounter (unmitigated, >10kft MSL)

Configuration

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Omnibands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display: VSCS</td>
<td></td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. A timely DAA warning alert is provided to the UAS pilot prior to CPA.

Test Method

- MANEUVER: none.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 180 KTAS
- Encounter Length: 1 min (IP to CPA)
- Stable Conditions: stable at the IP (1 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: Ownship 0/0/0, Intruder -2500FPM/0/0
- Tolerance: ± 8 sec, ± 5 kts, ±100 FPM at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

Additional Information SSI-INTERNAL: This is very similar to the single intruder TCAS interoperability encounter with high vertical closure rate. This should be assessed as...
Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements:
(i) Mode C only intruder (mitigated, <10kft MSL)

**Configuration**
- **System Under Test**: AOA
- **Display**: VSCS
- **Contributing Sensors**:
  - TCA
  - Mode C
  - ADS-B
  - Radar
  - Tracker

<table>
<thead>
<tr>
<th>TCA</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Test Objectives (TO)**
1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate selected DAA maneuver results in remaining well clear, and removal of the alert once clear of threat.

**Success Criteria** (retest if criteria not met)
1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. UAS pilot maneuvers in response to DAA alert.

**Test Method**
- MANUEVER: Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 150/180/210 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)
1. UAS pilot receives DAA corrective alert with associated guidance
2. UAS pilot maneuvers in response to DAA alert and remains well clear of intruder.
3. DAA alert(s) and guidance are removed once ownship is clear of threat.

**Additional Information**
SSI-INTERNAL: Unclear if this geometry is of any utility in flight test... radar tracks are provided to the fusion tracker usually far beyond RDR... as
FT4 TEST OBJECTIVES – SSIWest.1.j

Objective 1: Validate DAA requirements in stressing cases that drive MOPS requirements:
(j) Mode C only intruder (unmitigated, <10kft MSL)

### Configuration

**System Under Test:** Omnibands

**Display:** VSCS

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>TCA S</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Test Objectives (TO)

1. Validate DAA alert timing allows pilot sufficient time to assess options and maneuver to remain well clear.
2. Validate DAA guidance to UAS pilot is appropriate (reasonable, timely & responsive).
3. Validate removal of DAA alert(s) once clear of threat.

### Success Criteria (retest if criteria not met)

1. A timely (corrective initially) DAA alert is provided to the UAS pilot.
2. Well Clear Recovery guidance is provided to the UAS pilot prior to CPA.

### Test Method

- **MANEUVER:** none.
- **Aircraft speeds (non-accelerating):** Ownship 150 KTAS, Intruder 150/180/210 KTAS
- **Encounter Length:** 2 min (IP to CPA)
- **Stable Conditions:** stable at the IP (2 minutes prior to CPA)
- **Test Termination Criteria:** targets diverging, range > 0.75 nmi., no DAA alerts displayed.
- **Climb/Roll/Pitch Rates:** 0/0/0
- **Tolerance:** ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. UAS pilot receives DAA corrective alert with associated guidance
2. DAA alert(s) and guidance are removed once ownship is clear of threat.
3. CPA prediction accuracy sufficient for DAA function.

### Additional Information

- Lateral Offset = 0 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

---

**Notes:**

- TCA S
- Mode C
- ADS-B
- Radar
- Tracker

**Diagram:**

- Ownship
- Intruder
- 0° Relative
- 500 ft

---

**MOPS reference**
UAS in the NAS
FT4 Test Objectives
(DAIDALUS)
DAIDALUS MOPS Traceback

The sections in the MOPS we will be validating for FT4 are as follows:

- 2.2.4.2.1 DAA Well Clear Definition
- 2.2.4.3 Determine Processing
- 2.2.4.4 Collision Avoidance Interoperability
- Appendix D. UAS Maneuver Requirements
- Appendix G. DAA Alerting Logic Reference Implementation

Although we are not validating the sensors themselves, we are characterizing how the sensors impact state estimation, include 2.2.3 DAA Surveillance Subsystem
Fly Through
## TEST OBJECTIVES

Demonstrate performance in a Head-on scenario.

### Configuration

<table>
<thead>
<tr>
<th>System Under Test</th>
<th>DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
</tbody>
</table>

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.
2. SAA fusion processor correctly correlates tracks.
3. Establish baseline for DAIDALUS.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- MANEUVER – NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate: 0
- Roll Rate: 0
- Pitch Rate: 0
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

### Success Criteria

- Data collected from MACS display (see data requirements)

### Expected Results

- Ownship alerting
  - Progress through each DAA alerting condition

### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM.
**Test Objectives**

Demonstrate performance in Front-Quartering scenario.

**Configuration**
- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**
  - Native Display
  - VSCS
  - TCAS

**Test Objective (TO)**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.
2. SAA fusion processor correctly correlates tracks.
3. Establish baseline for DAIDALUS.

**Evaluation Criteria**
- The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
  - TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
  - TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

**Test Method**
- MANEUVER – NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

**Success Criteria**
- Data collected from MACS display (see data requirements)

**Expected Results**
- Ownship alerting
  - Progress through each alerting condition

**Additional Information**
- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM.
## TEST OBJECTIVES

**Demonstrate performance in Crossing scenario.**

**Configuration**

| Display: Native Display (as opposed to VSCS, TCAS on HUD) |

**Contributing Sensors:**

- **Test Objective (TO)**
  1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a crossing scenario.
  2. SAA fusion processor correctly correlates tracks.

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the crossing intruding aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

**Test Method**

- MANEUVER –NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

**Success Criteria**

- Data collected from MACS display (see data requirements)

**Expected Results**

- Ownership alerting
  - Progress through each alerting condition

**Additional Information**

- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM.
**TEST OBJECTIVES**

**Demonstrate performance in Rear-Quartering scenario.**

**Configuration**
- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

**Scenario(s):** #076

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

**Test Objective (TO)**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.

**Evaluation Criteria**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method**
- MANEUVER - NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

**Success Criteria**
- Data collected from MACS display (see data requirements)

**Expected Results**
- Ownship alerting
  - Progress through each alerting condition

**Additional Information**
- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM

**Altitude**
- UAS: 10000ft-20000ft
- INT: 10000ft-20000ft
### TEST OBJECTIVES

Demonstrate performance in an Overtaking scenario.

#### Configuration

<table>
<thead>
<tr>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
</table>

#### Contributing Sensors:

- TCAS
- ADS-B
- Radar
- Fusion

#### Scenario(s):

- #077

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in an overtaking scenario
2. SAA fusion processor correctly correlates tracks

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the overtaken intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

#### Test Method

- MANEUVER -NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

#### Success Criteria

- Data collected from MACS display (see data requirements)

#### Expected Results

- Ownship alerting
  - Progress through each alerting condition

#### Additional Information

Do not follow guidance. Follow pre-described path, hold constant altitude and speed.

The closest point of approach (CPA) is 0.5NM

---

**Lateral Offset = 0.5 NM**

**SS Alerting Boundary = 0.75 NM**

**Minimum Altitude Offset ≥ 300 ft**

**Altitude**

- UAS 10000ft-20000ft
- 10000ft-20000ft

**Relative Altitude**

- Ownship 180°
- Intruder 10000ft-20000ft

**Scenario(s): #077**
**TEST OBJECTIVES**

Demonstrate performance in a Head-on scenario.

**Configuration**

<table>
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<tr>
<th>Display</th>
<th>Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Under Test:</strong></td>
<td><strong>DAIDALUS</strong></td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

**TCAS** | **ADS-B** | **Radar** | **Fusion** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
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<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
</tr>
</tbody>
</table>

**Scenario(s):**

- **#078**

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario
2. SAA fusion processor correctly correlates tracks

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method**

- MANEUVER –NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

**Success Criteria**

- Data collected from MACS display (see data requirements)

**Expected Results**

- Ownership alerting
  - Progress through each alerting condition

**Additional Information**

Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM
### TEST OBJECTIVES

**Demonstrate performance in Front-Quartering scenario.**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Display:</strong></td>
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<tr>
<td><strong>Contributing Sensors:</strong></td>
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</table>

**Scenario(s):** #079

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a front quartering scenario.
2. SAA fusion processor correctly correlates tracks.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- **TO-2** TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- **MANEUVER** - NO
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Ownship: 150-180kgs
- Intruder: 150-180kgs

### Success Criteria

- Data collected from MACS display (see data requirements)

### Expected Results

- Ownership alerting
  - Progress through each alerting condition

### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed.

The closest point of approach (CPA) is 0.5 NM.
### Test Objectives

**Scenario(s):** #080

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test</th>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
<th>Contributing Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>DAIDALUS</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a crossing scenario.
2. SAA fusion processor correctly correlates tracks.

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:
- **TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...**
- **TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.**

#### Test Method

- **MANEUVER:** NO
- **Encounter Length:** 3 min
- **Stable Conditions:** 2.5 min before CPA
- **Climb Rate:**
- **Roll Rate:**
- **Pitch Rate:**
- **Tolerance:** ± 10 sec
- **Ownship:** 150-180kgs
- **Intruder:** 150-180kgs

#### Success Criteria

- Data collected from MACS display (see data requirements)

#### Expected Results

- **Ownship alerting**
  - Progress through each alerting condition

#### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed.

The closest point of approach (CPA) is 0.5NM.
Ownship Vertical Maneuvers
TEST OBJECTIVES

Demonstrate performance in a Head-on scenario.

Configuration

System Under Test: DAIDALUS

Display: Native Display (as opposed to VSCS, TCAS on HUD)

Contributing Sensors:

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Lateral Offset = 0.5 NM

SS Alerting Boundary = 0.75 NM

Minimum Altitude Offset ≥ 300 ft

Test Objective (TO)
1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance
2. SAA fusion processor correctly correlates tracks
3. Determine suitability of sensor for vertical guidance

Evaluation Criteria
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- ALT and VS bands provide vertical separation solution

Test Method
- MANEUVER – Follow ALT or VS bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

Success Criteria
- UAS Maneuvers away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

Expected Results
- Ownship alerting
- Progress through each alerting condition
- Ownship maneuvers away from encounter then maneuvers back to course

Additional Information
Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) is 0.5NM
**TEST OBJECTIVES**

**Demonstrate DAIDALUS vertical guidance during a Front-Quartering scenario.**

### Configuration

| Display: Native Display (as opposed to VSCS, TCAS on HUD) |

**Contributing Sensors:**

- TCAS
- ADS-B
- Radar
- Fusion

### Lateral Offset = 0.5 NM

- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Scenario(s):

- #084

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance
2. SA fusion processor correctly correlates tracks
3. Determine suitability of sensor for vertical guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- ALT and VS bands provide vertical separation solution

### Test Method

- MANEUVER – Follow ALT or VS bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- UAS Maneuvers away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownership alerting
- Progress through each alerting condition
- Ownership maneuvers away from encounter then maneuvers back to course

### Additional Information

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM
**Test Objectives**

Demonstrate DAIDALUS vertical guidance during a Crossing scenario.

### Configuration

- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

  - **Test Objective (TO)**
    1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance
    2. SAA fusion processor correctly correlates tracks
    3. Determine suitability of sensor for vertical guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- ALT and VS bands provide vertical separation solution

### Test Method

- MANEUVER – *Follow ALT or VS bands*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- UAS Maneuvers away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownership alerting
  - Progress through each alerting condition
  - Ownership maneuvers away from encounter then maneuvers back to course

### Additional Information

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM.
**TEST OBJECTIVES**

Demonstrate DAIDALUS vertical guidance during a Rear-Quartering scenario.

### Configuration

<table>
<thead>
<tr>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributing Sensors:</td>
</tr>
</tbody>
</table>

### System Under Test

- **DAIDALUS**

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance
2. SAA fusion processor correctly correlates tracks
3. Determine suitability of sensor for vertical guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- ALT and VS bands provide vertical separation solution

### Test Method

- **MANEUVER – Follow ALT or VS bands**
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- UAS Maneuvers away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter then maneuvers back to course

### Additional Information

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM

### S20

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
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<td>YES</td>
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### Configuration Table

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<th>#086</th>
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</table>

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<thead>
<tr>
<th>Lateral Offset</th>
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</tr>
</thead>
<tbody>
<tr>
<td>SS Alerting Boundary</td>
<td>0.75 NM</td>
</tr>
<tr>
<td>Minimum Altitude Offset</td>
<td>≥ 300 ft</td>
</tr>
<tr>
<td>Altitude</td>
<td>UAS 10000ft-20000ft INT 10000ft-20000ft</td>
</tr>
<tr>
<td>TCAS</td>
<td>YES</td>
</tr>
<tr>
<td>ADS-B</td>
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</tr>
<tr>
<td>Radar</td>
<td>YES</td>
</tr>
<tr>
<td>Fusion</td>
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</tr>
</tbody>
</table>
## TEST OBJECTIVES

**Demonstrate DAIDALUS vertical guidance during a Head-on scenario.**

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s):

- **#087**

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance.
2. SAA fusion processor correctly correlates tracks.
3. Determine suitability of sensor for vertical guidance.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, SS, CA,...
- **TO-2** TCAS and ADS-B tracks are correctly fused into 1 single track.
- **ALT and VS bands** provide vertical separation solution.

### Test Method

- **MANEUVER** – Follow **ALT or VS bands**
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- UAS Maneuvers away from intruder to remain well clear.
- Alerting progress from each alerting level.
- Data collected at the LVC (Time Synced).

### Expected Results

- **Ownship alerting**
  - Progress through each alerting condition.
  - Ownship maneuvers away from encounter then maneuvers back to course.

### Additional Information

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM.
**TEST OBJECTIVES**

**Demonstrate DAIDALUS vertical guidance during a Front-Quartering scenario.**

**Configuration**

<table>
<thead>
<tr>
<th>System Under Test:</th>
<th>DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display:</strong></td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td><strong>Contributing Sensors:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Section A.5.1 DAA MOPS / Version:** July 28, 2015

**System Configuration**

<table>
<thead>
<tr>
<th>Display</th>
<th>Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contributing Sensors:</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance.
2. SAA fusion processor correctly correlates tracks.
3. Determine suitability of sensor for vertical guidance.

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- **TO-2** TCAS and ADS-B tracks are correctly fused into 1 single track
- **ALT** and **VS** bands provide vertical separation solution

**Test Method**

- **MANEUVER** – Follow ALT or VS bands
- Encounter Length: 3 min
- **Stable Conditions:** 2.5 min before CPA
- **Roll Rate:**
- **Pitch Rate:**
- **Tolerance:** ± 10 sec
- **Speed:** Own-150-180kgs, Intruder-150-180kgs
- **Vertical Speed:** 500-1000fpm

**Success Criteria**

- **UAS Maneuvers** away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

**Expected Results**

- **Ownship alerting**
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter then maneuvers back to course

**Additional Information**

Follow Alt or VS bands to avoid intruder.

The closest point of approach (CPA) is 0.5NM

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Altitude**

- **UAS:** 10000ft-20000ft
- **INT:** 10000ft-20000ft

**Lateral Offset:** 0.5 NM

**SS Alerting Boundary:** 0.75 NM

**Minimum Altitude Offset:** ≥ 400 ft

**Scenario(s):** #088
**TEST OBJECTIVES**

**System Under Test: DAIDALUS**

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance.
2. SAA fusion processor correctly correlates tracks.
3. Determine suitability of sensor for vertical guidance.

**Evaluation Criteria:**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- ALT and VS bands provide vertical separation solution

**Test Method:**

- MANEUVER – Follow ALT or VS bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- Speed: Own-150-180kgs, Intruder-150-180kgs
- Vertical Speed: 500-1000fpm

**Success Criteria:**

- UAS Maneuvers away from intruder to remain well clear
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

**Expected Results:**

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter then maneuvers back to course

**Additional Information:**

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM.
Horizontal Blocking Intruder
**TEST OBJECTIVES**

**Section A.5.1 DAA MOPS / Version: July 28, 2015**

**Configuration**

<table>
<thead>
<tr>
<th>System Under Test</th>
<th>DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display:</strong> Native Display (as opposed to VSCS, TCAS on HUD)</td>
<td></td>
</tr>
<tr>
<td><strong>Contributing Sensors:</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Evaluation Criteria

- The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:
  - TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
  - TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
  - DAIDALUS does not guide the operator into a secondary encounter

### Test Method

- MANEUVER – Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownship alerting
  - Progress through each alerting condition

### Additional Information

- Follow heading bands to avoid intruder
- The closest point of approach (CPA) for intruder 1 is 0.5NM.
- Intruder 2 should be on parallel path at a range of .7nm-1nm at same GS
**TEST OBJECTIVES**

Demonstrate that DAIDALUS will not guide UAS horizontally into path of another known intruder.

**Configuration**

<table>
<thead>
<tr>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributing Sensors:</td>
</tr>
</tbody>
</table>

**Scenario(s):** #092

- **Lateral Offset = 0.5 NM**
- **SS Alerting Boundary = 0.75 NM**
- **Minimum Altitude Offset ≥ 400 ft**

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders
2. SAA fusion processor correctly correlates tracks

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

**Test Method**

- MANEUVER –Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

**Success Criteria**

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course

  *Show images of expected alerting*

**Additional Information**

Follow heading bands to avoid intruder

The closest point of approach (CPA) is 0.5NM
### Test Objectives

**Demonstrate that DAIDALUS will not guide UAS horizontally into path of another known intruder.**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

#### Scenario(s):
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

| Test Objective (TO) | 1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2. SAA fusion processor correctly correlates tracks</td>
<td></td>
</tr>
</tbody>
</table>

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

#### Test Method

- **MANEUVER** – Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

#### Success Criteria

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

#### Expected Results

- Ownership alerting
- Progress through each alerting condition
- Ownership maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course

**Show images of expected alerting**

#### Additional Information

Follow heading bands to avoid intruder
- The closest point of approach (CPA) is 0.5NM

---

**Table: Configuration**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: DAIDALUS</th>
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</thead>
<tbody>
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<tr>
<td>Contributing Sensors:</td>
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<table>
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<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
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</thead>
<tbody>
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**Altitude**

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<tr>
<th>UAS</th>
<th>INT 1</th>
<th>INT 2</th>
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</thead>
<tbody>
<tr>
<td>10000ft-20000ft</td>
<td>10000ft-20000ft</td>
<td>10000ft-20000ft</td>
</tr>
</tbody>
</table>

---

**Lateral Offset** = 0.5 NM

**SS Alerting Boundary** = 0.75 NM

**Minimum Altitude Offset** ≥ 400 ft

---

**Scenario(s):**

- #093
**TEST OBJECTIVES**

**Demonstrate that DAIDALUS will not guide UAS horizontally into path of another known intruder.**

### Configuration

**System Under Test:** DAIDALUS  
**Display:** Native Display (as opposed to VSCS, TCAS on HUD)  
**Contributing Sensors:**

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders
2. SAA fusion processor correctly correlates tracks

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

### Test Method

- MANEUVER – Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownership alerting
  - Progress through each alerting condition
  - Ownership maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  
*Show images of expected alerting*

### Additional Information

- Follow heading bands to avoid intruder
- The closest point of approach (CPA) is 0.5NM

### Altitude

- UAS  
  - INT 1: 10000ft-20000ft
  - INT 2: 10000ft-20000ft

### TCAS / ADS-B / Radar / Fusion

- TCAS: YES
- ADS-B: YES
- Radar: YES
- Fusion: YES

### Scenario(s):

#094
TEST OBJECTIVES

The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders.

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders.
2. SAA fusion processor correctly correlates tracks.

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

**Test Method**

- MANEUVER - Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

**Success Criteria**

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course

*Show images of expected alerting*

**Additional Information**

- Follow heading bands to avoid intruder
- The closest point of approach (CPA) is 0.5NM
**Test Objectives**

Demonstrate that DAIDALUS will not guide UAS horizontally into path of another known intruder.

### Configuration

- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders
2. SAA fusion processor correctly correlates tracks

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

### Test Method

- MANEUVER – Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

### Success Criteria

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  - *Show images of expected alerting*

### Additional Information

- Follow heading bands to avoid intruder
- The closest point of approach (CPA) is 0.5NM
TEST OBJECTIVES

Demonstrate that DAIDALUS will not guide UAS horizontally into path of another known intruder.

**Configuration**

System Under Test: **DAIDALUS**

Display: Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- TCAS
- ADS-B
- Radar
- Fusion

**Configuration**

- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**
  - TCAS
  - ADS-B
  - Radar
  - Fusion

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct guidance to the UAS - provides solution away from primary and secondary intruders
2. SAA fusion processor correctly correlates tracks

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS does not guide the operator into a secondary encounter

**Test Method**

- MANEUVER – Follow ALT/VS/Heading bands
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- Speed: 150-180kgs
- Vertical Speed: 500-1000fpm

**Success Criteria**

- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)

**Expected Results**

- Ownership alerting
  - Progress through each alerting condition
  - Ownership maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course

*Show images of expected alerting*

**Additional Information**

- Follow heading bands to avoid intruder
- The closest point of approach (CPA) is 0.5NM
Vertical Blocking
### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- TCAS
- ADS-B
- Radar
- Fusion

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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</tbody>
</table>

**Scenario(s):** #099

- **Lateral Offset:** 0.5 NM
- **SS Alerting Boundary:** 0.75 NM
- **Minimum Altitude Offset:** ≥ 300 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear
4. Fly an encounter which blocks a descent maneuver

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

### Test Method

- **MANEUVER** – Follow ALT/VS
- **Encounter Length:** 3 min
- **Stable Conditions:** 2.5 min before CPA
- **Descent Rate:** 1000fpm
- **Tolerance:** ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

### Expected Results

- Ownship alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.

### Additional Information

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) for intruder 1 is 0.5NM
- Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
<th>Contributing Sensors:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Scenario(s): | 
|--------------|--------------------------------|
| #100         | Lateral Offset = 0.5 NM<br>SS Alerting Boundary = 0.75 NM<br>Minimum Altitude Offset ≥ 400 ft |

<table>
<thead>
<tr>
<th>Test Objective (TO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.</td>
</tr>
<tr>
<td>2. SAA fusion processor correctly correlates tracks</td>
</tr>
<tr>
<td>3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear</td>
</tr>
<tr>
<td>4. Fly an encounter which blocks a descent maneuver</td>
</tr>
</tbody>
</table>

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

<table>
<thead>
<tr>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANEUVER – Follow ALT/VS</td>
</tr>
<tr>
<td>Encounter Length: 3 min</td>
</tr>
<tr>
<td>Stable Conditions: 2.5 min before CPA</td>
</tr>
<tr>
<td>Descent Rate: 1000fpm</td>
</tr>
<tr>
<td>Tolerance: ± 10 sec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collected from MACS display (see data requirements)</td>
</tr>
<tr>
<td>Encounter causes DAIDALUS to provide preventive/corrective guidance</td>
</tr>
<tr>
<td>UAS operator follows DAIDALUS guidance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownship alerting</td>
</tr>
<tr>
<td>Progress from no factor to corrective guidance</td>
</tr>
<tr>
<td>Guidance will indicate a vertical solution to remain well clear.</td>
</tr>
</tbody>
</table>

**Additional Information**

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) for intruder 1 is 0.5NM. Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship.
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test:** DAIDALUS  
**Display:** Native Display (as opposed to VSCS, TCAS on HUD)  
**Contributing Sensors:**

### Display Diagram

- Lateral Offset = 0.5 NM  
- SS Alerting Boundary = 0.75 NM  
- Minimum Altitude Offset ≥ 400 ft

### Scenario(s): #101

- Lateral Offset = 0.5 NM  
- SS Alerting Boundary = 0.75 NM  
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.  
2. SAA fusion processor correctly correlates tracks  
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear  
4. Fly an encounter which blocks a descent maneuver

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:  
- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts  
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

### Test Method

- MANEUVER – Follow ALT/VS  
- Encounter Length: 3 min  
- Stable Conditions: 2.5 min before CPA  
- Descent Rate: 1000fpm  
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)  
- Encounter causes DAIDALUS to provide preventive/corrective guidance  
- UAS operator follows DAIDALUS guidance

### Expected Results

- Ownership alerting  
  - Progress from no factor to corrective guidance  
  - Guidance will indicate a vertical solution to remain well clear.

### Additional Information

Follow Alt or VS bands to avoid intruder.  
The closest point of approach (CPA) for intruder 1 is 0.5NM  
Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship
### TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

**Configuration**

- **System Under Test**: DAIDALUS
- **Display**: Native Display *(as opposed to VSCS, TCAS on HUD)*
- **Contributing Sensors**:

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<tr>
<th>Sensor</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADS-B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusion</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Altitude</th>
<th>10000ft-20000ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>UAS</td>
<td>INT 1</td>
</tr>
<tr>
<td></td>
<td>10000ft-20000ft</td>
</tr>
<tr>
<td></td>
<td>INT 2</td>
</tr>
<tr>
<td></td>
<td>10000ft-20000ft</td>
</tr>
</tbody>
</table>

**Scenario(s):**

- **#102**

<table>
<thead>
<tr>
<th>Lateral Offset</th>
<th>0.5 NM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS Alerting Boundary</td>
<td>0.75 NM</td>
</tr>
<tr>
<td>Minimum Altitude Offset</td>
<td>≥ 300 ft</td>
</tr>
</tbody>
</table>

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear
4. Fly an encounter which blocks a descent maneuver

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

**Test Method**

- MANEUVER – Follow ALT/VS
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Descent Rate: 1000fpm
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display *(see data requirements)*
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

**Expected Results**

Ownship alerting
- Progress from no factor to corrective guidance
- Guidance will indicate a vertical solution to remain well clear.

**Additional Information**

Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) for intruder 1 is 0.5NM
Intruder 2 should be on parallel path at a range of .7nm-.1nm at same speed 3500ft below ownship.
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

### Configuration

- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

#### Configuration Table

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

#### Display Diagram

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

#### Scenario(s):

- #103

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear
4. Fly an encounter which blocks a descent maneuver

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

#### Test Method

- MANEUVER – Follow ALT/VS
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Descent Rate: 1000fpm
- Tolerance: ± 10 sec

#### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

#### Expected Results

- Ownership alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.

#### Additional Information

Follow Alt or VS bands to avoid intruder.

The closest point of approach (CPA) for intruder 1 is 0.5NM
Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

Configuration

System Under Test: DAIDALUS

Display: Native Display (as opposed to VSCS, TCAS on HUD)

Contributing Sensors:

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Scenario(s): #104

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear
4. Fly an encounter which blocks a descent maneuver

Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

Test Method

- MANEUVER – Follow ALT/VS
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Descent Rate: 1000fpm
- Tolerance: ± 10 sec

Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

Expected Results

- Ownship alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.

Additional Information

Follow Alt or VS bands to avoid intruder.

The closest point of approach (CPA) for intruder 1 is 0.5NM

Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship
# Test Objectives

**Objectives:**
- Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

## Configuration

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test:</th>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Contributing Sensors:**

- [Image]

## Scenario(s): #105

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

## Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which causes DAIDALUS to indicate a vertical maneuver to stay well clear
4. Fly an encounter which blocks a descent maneuver

## Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

## Test Method

- MANEUVER – Follow ALT/VS
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Descent Rate: 1000fpm
- Tolerance: ± 10 sec

## Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

## Expected Results

- Ownership alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.

## Additional Information

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) for intruder 1 is 0.5NM
- Intruder 2 should be on parallel path at a range of .7nm-1nm at same speed 3500ft below ownship
High/Low Altitude Maneuvering
**Test Objectives**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario(s):</th>
<th>#107</th>
</tr>
</thead>
</table>

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

<table>
<thead>
<tr>
<th>Test Objective (TO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario</td>
</tr>
<tr>
<td>2. SAA fusion processor correctly correlates tracks</td>
</tr>
<tr>
<td>3. Demonstrate TCAS RA boundary in relation to well clear boundary at TCAS SL5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:</td>
</tr>
<tr>
<td>- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…</td>
</tr>
<tr>
<td>- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>- MANEUVER –Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed</td>
</tr>
<tr>
<td>- Encounter Length: 3 min</td>
</tr>
<tr>
<td>- Stable Conditions: 2.5 min before CPA</td>
</tr>
<tr>
<td>- Tolerance: ± 10 sec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Success Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Data collected from MACS display (see data requirements)</td>
</tr>
<tr>
<td>- Achieve TCAS RA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership alerting</td>
</tr>
<tr>
<td>- Progress through each alerting condition</td>
</tr>
<tr>
<td>- Receive RA before the well clear boundary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow Heading, Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM</td>
</tr>
</tbody>
</table>
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

Section A.5.1 DAA MOPS / Version: July 28, 2015

Configuration

System Under Test: DAIDALUS

Display: Native Display (as opposed to VSCS, TCAS on HUD)

Contributing Sensors:

Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

1. TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
2. TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate TCAS RA boundary in relation to well clear boundary at TCAS SL6

Test Method

• MANEUVER –Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed
• Encounter Length: 3 min
• Stable Conditions: 2.5 min before CPA
• Tolerance: ± 10 sec

Success Criteria

• Data collected from MACS display (see data requirements)
• Achieve TCAS RA

Expected Results

Ownship alerting
• Progress through each alerting condition
• Receive RA before the well clear boundary

Additional Information

Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) is 0.5NM
## Test Objectives

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test**: DAIDALUS

- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

1. TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
2. TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Method

- **MANEUVER** – Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

### Expected Results

- Ownship alerting
- Progress through each alerting condition
- Receive RA before the well clear boundary

### Additional Information

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM.
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

Configuration
- System Under Test: **DAIDALUS**
- Display: Native Display (as opposed to VSCS, TCAS on HUD)
- Contributing Sensors:

<table>
<thead>
<tr>
<th>System</th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Scenario(s):** #110

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

**Test Objective (TO):**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate TCAS RA boundary in relation to well clear boundary at TCAS SL6

**Evaluation Criteria:**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method:**
- MANEUVER – *Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria:**
- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

**Expected Results:**
- Ownship alerting
  - Progress through each alerting condition
  - Receive RA before the well clear boundary

**Additional Information:**
- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM

Altitude
- UAS
  - 10000ft-20000ft
- INT 1
  - 10000ft-20000ft
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

Configuration

System Under Test: DAIDALUS

Display: Native Display (as opposed to VSCS, TCAS on HUD)

Contributing Sensors:

Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate TCAS RA boundary in relation to well clear boundary at SL5

Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

Test Method

- MANEUVER – Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

Success Criteria

- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Receive RA before the well clear boundary

Additional Information

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test**: DAIDALUS

**Display**: Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors**:

- Test Objective (TO)
  1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
  2. SAA fusion processor correctly correlates tracks
  3. Demonstrate TCAS RA boundary in relation to well clear boundary at SL6

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Method

- MANEUVER – Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Receive RA before the well clear boundary

### Additional Information

Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) is 0.5NM

### Scenario(s):

- **#112**

### Configuration Table

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Altitude

- UAS: 10000ft-20000ft
- INT 1: 10000ft-20000ft
TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

**Configuration**
- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>Scenario(s): #113</th>
</tr>
</thead>
</table>

<table>
<thead>
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<th>Lateral Offset = 0.5 NM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS Alerting Boundary = 0.75 NM</td>
</tr>
<tr>
<td>Minimum Altitude Offset ≥ 300 ft</td>
</tr>
</tbody>
</table>

**Test Objective (TO)**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate TCAS RA boundary in relation to well clear boundary SL5

**Evaluation Criteria**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method**
- MANEUVER – *Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed*
  - Encounter Length: 3 min
  - Stable Conditions: 2.5 min before CPA
  - Tolerance: ± 10 sec

**Success Criteria**
- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

**Expected Results**
- Ownship alerting
  - Progress through each alerting condition
  - Receive RA before the well clear boundary

**Additional Information**
- Follow Alt or VS bands to avoid intruder.
  - The closest point of approach (CPA) is 0.5NM
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate TCAS RA boundary in relation to well clear boundary SL6

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Method

- MANEUVER – *Follow heading/alt/VS bands to stay well clear once TCAS RA is displayed*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Achieve TCAS RA

### Expected Results

**Ownship alerting**

- Progress through each alerting condition
- Receive RA before the well clear boundary

### Additional Information

Follow Alt or VS bands to avoid intruder. The closest point of approach (CPA) is 0.5NM
High Speed Maneuvering
**Test Objectives**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test:** DAIDALUS  
**Display:** Native Display (as opposed to VSCS, TCAS on HUD)  
**Contributing Sensors:**

### Configuration Table

<table>
<thead>
<tr>
<th>System Under Test</th>
<th>Display</th>
<th>Contributing Sensors</th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
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<td>Native Display</td>
<td>(as opposed to VSCS, TCAS on HUD)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s):

- #115  
  - Lateral Offset = 0.5 NM  
  - SS Alerting Boundary = 0.75 NM  
  - Minimum Altitude Offset ≥ 300 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.  
2. SAA fusion processor correctly correlates tracks.  
3. Demonstrate DAIDALUS performance with maneuvering high speed intruder.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Method

- **MANEUVER** - *Follow heading, alt or VS bands to remain well clear*
- **Speed:** 400KGS  
- **Encounter Length:** 3 min  
- **Stable Conditions:** 2.5 min before CPA  
- **Climb Rate:**  
- **Roll Rate:**  
- **Pitch Rate:**  
- **Tolerance:** ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)

### Expected Results

- Ownership alerting  
  - Progress through each alerting condition

### Additional Information

Follow Heading, Alt or VS bands to avoid intruder.  
The closest point of approach (CPA) is 0.5NM
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

---

**Configuration**

**System Under Test**: DAIDALUS

**Display**: Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors**:

---

**Scenario(s):** #116

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

---

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Demonstrate DAIDALUS performance with maneuvering high speed intruder.

---

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

---

**Test Method**

- **MANEUVER** - *Follow heading/alt/V/S bands to stay well clear*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec

---

**Success Criteria**

- UAS Maneuvers away from intruder before TCAS-RA
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)
  - Data type 1
  - Data type 2...

---

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  
  *Show images of expected alerting*

---

**Additional Information**

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
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<tbody>
<tr>
<td>Display</td>
<td>Native Display <em>(as opposed to VSCS, TCAS on HUD)</em></td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
</tbody>
</table>

**Scenario(s):**  
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

**Test Objective (TO):**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Demonstrate DAIDALUS performance with maneuvering high speed intruder.

**Evaluation Criteria:**  
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

**Test Method:**
- MANEUVER – *Follow heading/alt/VS bands to stay well clear*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec

**Success Criteria:**
- UAS Maneuvers away from intruder before TCAS-RA
- Alerting progress from each alerting level
- Data collected at the LVC (Time Synced)
  - Data type 1
  - Data type 2...

**Expected Results:**
- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  - *Show images of expected alerting*

**Additional Information:**
- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM.
## TEST OBJECTIVES

**Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.**

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: DAIDALUS</th>
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</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
</tbody>
</table>

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario
2. SAA fusion processor correctly correlates tracks
3. Demonstrate DAIDALUS performance with maneuvering high speed intruder

### Test Method

- **MANEUVER** – *Follow heading/alt/VS bands to stay well clear*
- **Encounter Length:** 3 min
- **Stable Conditions:** 2.5 min before CPA
- **Climb Rate:**
- **Roll Rate:**
- **Pitch Rate:**
- **Tolerance:** ± 10 sec

### Success Criteria

- **UAS Maneuvers away from intruder before TCAS-RA**
- **Alerting progress from each alerting level**
- **Data collected at the LVC (Time Synced)**
  - Data type 1
  - Data type 2...

### Expected Results

- **Ownship alerting**
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  - *Show images of expected alerting*

### Additional Information

Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) is 0.5NM
Maneuvering/Blocking
## System Under Test

**DAIDALUS**
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**
  - TCAS
  - ADS-B
  - Radar
  - Fusion

### Configuration

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

#### Contributing Sensors:
- TCAS
- ADS-B
- Radar
- Fusion

### Scenario(s):
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objectives (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks.
3. Fly an encounter which blocks a descent maneuver.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts.
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear.

### Test Method

- **MANEUVER** – Follow HDG/ALT/VS bands to stay well clear.
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance.
- UAS operator follows DAIDALUS guidance.

### Expected Results

- **Ownership alerting**
  - Progress from no factor to corrective guidance.
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder.

### Additional Information

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1.
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship.

### Altitude

- **UAS**
  - INT 1: 10000ft-20000ft
  - INT 2: 10000ft-20000ft

### Scenario(s):

- #123
## Test Objectives

**Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.**

### Configuration
- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

### Test Objective (TO)
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which blocks a descent maneuver

### Evaluation Criteria
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

### Test Method
- **MANEUVER** – *Follow HDG/ALT/VS bands to stay well clear*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria
- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

### Expected Results
- **Ownship alerting**
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder

### Additional Information
- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1.
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship.
**TEST OBJECTIVES**

**Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.**

**Configuration**

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- Ownship
- 0.7 NM

- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

**Scenario(s):** #125

**Test Objective (TO):**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which blocks a descent maneuver

**Evaluation Criteria:**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

**Test Method:**

- MANEUVER – *Follow HDG/ALT/VSS bands to stay well clear*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria:**

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDAULUS guidance

**Expected Results:**

- Ownship alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder

**Additional Information:**

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1.
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownership.
## TEST OBJECTIVES

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration
- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

### Scenario(s):
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks.
3. Fly an encounter which blocks a descent maneuver.

### Evaluation Criteria
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- **TO-1 Alerts:**
  - Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts.
  - DAIDALUS does not guide the operator into a secondary encounter/loss of well clear.

### Test Method
- **MANEUVER**
  - Follow HDG/ALT/VS bands to stay well clear
  - Encounter Length: 3 min
  - Stable Conditions: 2.5 min before CPA
  - Tolerance: ± 10 sec

### Success Criteria
- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

### Expected Results
- **Ownship alerting**
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder.

### Additional Information
- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship.
**TEST OBJECTIVES**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
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</thead>
<tbody>
<tr>
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<td></td>
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<tr>
<td>Contributing Sensors:</td>
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<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Scenario(s):** #127

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

<table>
<thead>
<tr>
<th>Test Objective (TO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.</td>
</tr>
<tr>
<td>2. SAA fusion processor correctly correlates tracks</td>
</tr>
<tr>
<td>3. Fly an encounter which blocks a descent maneuver</td>
</tr>
</tbody>
</table>

**Evaluation Criteria**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

**Test Method**

- MANEUVER – *Follow HDG/ALT/VS bands to stay well clear*
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDAULUS guidance

**Expected Results**

- Ownership alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder

**Additional Information**

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1
- Intruder 2 should be on parallel path 0.7nm-1nm at same velocity as ownship

---

Altitude

<table>
<thead>
<tr>
<th>UAS</th>
<th>INT 1</th>
<th>INT 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>10000ft-20000ft</td>
<td>10000ft-20000ft</td>
<td>10000ft-20000ft</td>
</tr>
</tbody>
</table>
Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

**Configuration**

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which blocks a descent maneuver

**Evaluation Criteria:**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

**Test Method:**

- MANEUVER – Follow HDG/ALT/VX bands to stay well clear
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria:**

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

**Expected Results:**

- Ownship alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder

**Additional Information:**

- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship

**Scenario(s):**

- #128

**Altitude**

<table>
<thead>
<tr>
<th>UAS</th>
<th>10000ft-20000ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT 1</td>
<td>UAS 10000ft-20000ft</td>
</tr>
<tr>
<td>INT 2</td>
<td>10000ft-20000ft</td>
</tr>
</tbody>
</table>

**Lateral Offset = 0.5 NM**

- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft
Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

**Test Objective (TO):**
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which blocks a descent maneuver

**Evaluation Criteria:**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

**Test Method:**
- MANEUVER – Follow HDG/ALT/VS bands to stay well clear
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria:**
- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

**Expected Results:**
- Ownship alerting
  - Progress from no factor to corrective guidance
  - Guidance will indicate a vertical solution to remain well clear.
  - Guidance will not indicate a turn towards the secondary intruder

**Additional Information:**
- Follow Alt or VS bands to avoid intruder.
- The closest point of approach (CPA) is 0.5NM for intruder 1
- Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship
**Test Objectives**

Demonstrate DAIDALUS will not guide UAS vertically into path of another known intruder.

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting and guidance to the UAS operator.
2. SAA fusion processor correctly correlates tracks
3. Fly an encounter which blocks a descent maneuver

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, preventive, corrective alerts
- DAIDALUS does not guide the operator into a secondary encounter/loss of well clear

### Test Method

- MANEUVER – Follow HDG/ALT/VS bands to stay well clear
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter causes DAIDALUS to provide preventive/corrective guidance
- UAS operator follows DAIDALUS guidance

### Expected Results

- Ownship alerting
- Progress from no factor to corrective guidance
- Guidance will indicate a vertical solution to remain well clear.
- Guidance will not indicate a turn towards the secondary intruder

### Additional Information

Follow Alt or VS bands to avoid intruder.
The closest point of approach (CPA) is 0.5NM for intruder 1
Intruder 2 should be on parallel path .7nm-1nm at same velocity as ownship
Well Clear Recovery
### Test Objectives

**Demonstrate performance in a Head-on scenario.**

#### Configuration

- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

#### Scenario(s):

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

#### Test Method

- MANEUVER – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

#### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

#### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

#### Additional Information

Fly into the encounter until recovery bands are displayed (typically just outside of well clear volume) or until prescribed distance.
## Test Objectives

### Demonstrate performance in Front-Quartering scenario.

### Configuration

<table>
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<tr>
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<tbody>
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<td>Contributing Sensors</td>
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### System Under Test

**DAIDALUS**

### TCAS | ADS-B | Radar | Fusion |
<table>
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<th></th>
<th></th>
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<tbody>
<tr>
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<td>YES</td>
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</tbody>
</table>

### Scenario(s):

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

### Test Method

- **MANEUVER** – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

### Additional Information

- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM
### TEST OBJECTIVES

Demonstrate performance in Crossing scenario.

#### Configuration

<table>
<thead>
<tr>
<th>Display</th>
<th>Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
</tbody>
</table>

#### System Under Test

**DAIDALUS**

#### TCAS | ADS-B | Radar | Fusion
---|---|---|---
YES | NO | YES | YES

#### Scenario(s):

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

#### Test Method

- **MANEUVER** – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

#### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

#### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

#### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM
Demonstrate performance in a Head-on scenario.

**Configuration**
- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

**Scenario(s):**
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

**Test Objective (TO)**
1. The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

**Evaluation Criteria**
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

**Test Method**
- MANEUVER –Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

**Success Criteria**
- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

**Expected Results**
- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

**Additional Information**
- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM
## Test Objectives

### System Under Test
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

#### Configuration

<table>
<thead>
<tr>
<th>Scenario(s):</th>
<th>#137</th>
</tr>
</thead>
</table>

**Lateral Offset:** 0.5 NM  
**SS Alerting Boundary:** 0.75 NM  
**Minimum Altitude Offset:** ≥ 400 ft

### System Under Test Details

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
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<td>YES</td>
</tr>
</tbody>
</table>

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- **TO-2** TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

### Test Method

- **MANEUVER** – Maneuver once well clear recovery guidance is displayed or at .7nm
  - Encounter Length: 3 min
  - Stable Conditions: 2.5 min before CPA
  - Tolerance: ± 10 sec
  - DTHR: .7nm – 1nm

### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

### Additional Information

- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM
### Test Objectives

**TEST OBJECTIVES**

Demonstrate performance in Crossing scenario.

### Configuration

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors</td>
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</table>

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<table>
<thead>
<tr>
<th>TCAS</th>
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<th>Radar</th>
<th>Fusion</th>
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</thead>
<tbody>
<tr>
<td>NO</td>
<td>YES</td>
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<td>YES</td>
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</tbody>
</table>

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA, etc.
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

### Test Method

- MANEUVER – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
The closest point of approach (CPA) is 0.5NM.
**Test Objectives**

**Display**: Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors**:

1. **The DAIDALUS algorithm as displayed on the native display will show the correct well clear recovery guidance**
2. **SAA fusion processor correctly correlates tracks**
3. **Evaluate performance of well clear recovery guidance**

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

**Test Method**

- **MANEUVER** – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

**Expected Results**

- **Ownship alerting**
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

**Additional Information**

Do not follow guidance. Follow predescribed path, hold constant altitude and speed.

The closest point of approach (CPA) is 0.5NM
## TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

### Configuration

**System Under Test**: DAIADALUS

**Display**: Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors**:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

### Test Objective (TO)

1. The DAIADALUS algorithm as displayed on the native display will show the correct well clear recovery guidance
2. SAA fusion processor correctly correlates tracks
3. Evaluate performance of well clear recovery guidance

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIADALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- Recovery guidance will show quickest time to recovery of well clear

### Test Method

- MANEUVER – Maneuver once well clear recovery guidance is displayed or at .7nm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- DTHR: .7nm – 1nm

### Success Criteria

- Data collected from MACS display (see data requirements)
- Well clear recovery guidance is displayed
- Operator follows well clear guidance

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Well clear recovery guidance provides options for shortest time to recover well clear from intruder

### Additional Information

- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM

### Scenario(s): #140

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Altitude

- **UAS**: 10000ft-20000ft
- **INT**: 10000ft-20000ft

### TCAS

- NO

### ADS-B

- YES

### Radar

- YES

### Fusion

- YES
Low Speed Intruders
### TEST OBJECTIVES

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
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</table>

**Configuration**

<table>
<thead>
<tr>
<th>Scenario(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>#141</td>
</tr>
</tbody>
</table>

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.
2. SAA fusion processor correctly correlates tracks.
3. DAIDALUS will account for low GS of intruder.

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method**

- MANEUVER – *Follow heading, Alt or VS bands*
- Speed: ~100kgs
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Corrective Self-separation guidance provides guidance away from intruder

**Additional Information**

- Follow heading, Alt, or VS bands to remain well clear

---

**Diagram**

- Ownship alerting diagram with lateral offset and altitude boundaries.

**Altitude**

- UAS 5000ft-20000ft
- 300 ft distance to intruder
**TEST OBJECTIVES**

**Demonstrate performance in Front-Quartering scenario.**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test</th>
<th>Display: Native Display (as opposed to VSCS, TCAS on HUD)</th>
<th>Contributing Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DAIDALUS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Scenario(s):** #142
- **Lateral Offset = 0.5 NM**
- **SS Alerting Boundary = 0.75 NM**
- **Minimum Altitude Offset ≥ 400 ft**

| Test Objective (TO) | 1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario  
2. SAA fusion processor correctly correlates tracks  
3. DAIDALUS will account for low GS of intruder |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|

| Evaluation Criteria | The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:  
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...  
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|

| Test Method | • MANEUVER –Follow heading, Alt or VS bands  
• Speed: ~100kgs  
• Encounter Length: 3 min  
• Stable Conditions: 2.5 min before CPA  
• Tolerance: ± 10 sec |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------|

| Success Criteria | • Data collected from MACS display (see data requirements)  
• Encounter generates corrective self-separation alerts and guidance  
• Operator maneuvers in accordance with DAIDALUS guidance |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------|

| Expected Results | Ownship alerting  
• Progress through each alerting condition  
• Corrective Self-separation guidance provides guidance away from intruder |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------|

<table>
<thead>
<tr>
<th>Additional Information</th>
<th>Follow heading, Alt, or VS bands to remain well clear</th>
</tr>
</thead>
</table>
**Test Objectives**

DAA algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.
2. SAA fusion processor correctly correlates tracks.
3. DAIDALUS will account for low GS of intruder.

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

**Test Method**

- MANEUVER – Follow heading, Alt or VS bands
- Speed: ~100kgs
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Corrective Self-separation guidance provides guidance away from intruder

**Additional Information**

Follow heading, Alt, or VS bands to remain well clear.
TEST OBJECTIVES

Demonstrate performance in a Head-on scenario.

**Configuration**

- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

**Evaluation Criteria**

- The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:
  1. TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
  2. TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario
2. SAA fusion processor correctly correlates tracks
3. DAIDALUS will account for low GS of intruder

**Test Method**

- MANEUVER – *Follow heading, Alt or VS bands*
- Speed: ~100kgs
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

**Expected Results**

- Ownship alerting
  1. Progress through each alerting condition
  2. Corrective Self-separation guidance provides guidance away from intruder

**Additional Information**

Follow heading, Alt, or VS bands to remain well clear
### TEST OBJECTIVES

**Demonstrate performance in Front-Quartering scenario.**

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario
2. SAA fusion processor correctly correlates tracks
3. DAIDALUS will account for low GS of intruder

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

### Test Method

- MANEUVER – *Follow heading, Alt or VS bands*
- Speed: ~100kgs
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

### Expected Results

**Ownship alerting**

- Progress through each alerting condition
- Corrective Self-separation guidance provides guidance away from intruder

### Additional Information

Follow heading, Alt, or VS bands to remain well clear
**Test Objectives**

Demonstrate performance in Crossing scenario.

**Configuration**

- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

  - [Image of sensor contributions]

  - Lateral Offset = 0.5 NM
  - SS Alerting Boundary = 0.75 NM
  - Minimum Altitude Offset ≥ 400 ft

**Scenario(s):** #146

**Test Objective (TO)**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario
2. SAA fusion processor correctly correlates tracks
3. DAIDALUS will account for low GS of intruder

**Evaluation Criteria**

- The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:
  - TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
  - TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track

**Test Method**

- MANEUVER – *Follow heading, Alt or VS bands*
- Speed: ~100kgs
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Corrective Self-separation guidance provides guidance away from intruder

**Additional Information**

- Follow heading, Alt, or VS bands to remain well clear
## TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

### Configuration

- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

### Scenario(s):

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a head-on scenario.
2. SAA fusion processor correctly correlates tracks.
3. DAIDALUS will account for low GS of intruder.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the head-on intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- **MANEUVER** – Follow heading, Alt or VS bands
- **Speed**: ~100kgs
- **Encounter Length**: 3 min
- **Stable Conditions**: 2.5 min before CPA
- **Tolerance**: ± 10 sec

### Success Criteria

- Data collected from MACS display (see data requirements)
- Encounter generates corrective self-separation alerts and guidance
- Operator maneuvers in accordance with DAIDALUS guidance

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Corrective Self-separation guidance provides guidance away from intruder

### Additional Information

Follow heading, Alt, or VS bands to remain well clear.

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Altitude

- UAS
  - 5000ft-20000ft
- INT
  - 5000ft-20000ft

### Lateral Offset = 0.5 NM

### SS Alerting Boundary = 0.75 NM

### Minimum Altitude Offset ≥ 400 ft

### Scenario(s): #147
Intruder Acceleration
**Test Objectives**

Demonstrate performance in Front-Quartering scenario.

**Configuration**

- **System Under Test:** DAIDALUS
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**
  - TCAS
  - ADS-B
  - Radar
  - Fusion

**Evaluation Criteria**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

1. **TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...**
2. **TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track**
3. **DAIDALUS adjusts corrective guidance to account for updated intruder state information**

**Test Method**

- **MANEUVER** – *Follow heading bands to remain well clear.*
- **Intruder speed:** Increase ground speed 50-80 kts ground speed to place CPA inside the well clear volume
- **Encounter Length:** 3 min
- **Stable Conditions:** 2.5 min before CPA
- **Tolerance:** ± 10 sec

**Success Criteria**

- Data collected from MACS display (see data requirements)
- Intruder’s CPA moves from outside the well clear volume to inside the well clear volume
- Appropriate corrective guidance is provided
- Operator maneuvers to remain well clear

**Expected Results**

- Ownship alerting
  - Progress through each alerting condition
  - Guidance changes from proximate to corrective after intruder acceleration

**Additional Information**

- Follow heading, alt or vs bands to remain well clear
- The closest point of approach (CPA) before the increase in speed should be .7nm-1nm, CPA after speed increase should be .5nm

**Scenario(s):** #148
## Test Objectives

**Demonstrate performance in Crossing scenario.**

### Configuration

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: <strong>DAIDALUS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

### Contribution to Scenario:
- **Lateral Offset = 0.5 NM**
- **SS Alerting Boundary = 0.75 NM**
- **Minimum Altitude Offset ≥ 400 ft**

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a front quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. DAIDALUS correctly accounts for increase in speed of intruder.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- **TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…**
- **TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track**
- **DAIDALUS adjusts corrective guidance to account for updated intruder state information**

### Test Method

- MANEUVER—Follow heading bands to remain well clear.
- Intruder speed: Increase ground speed 50-80 kts ground speed to place CPA inside the well clear volume.
- Encounter Length: 3 min.
- Stable Conditions: 2.5 min before CPA.
- Tolerance: ±10 sec.

### Success Criteria

- Data collected from MACS display (see data requirements).
- Intruder’s CPA moves from outside the well clear volume to inside the well clear volume.
- Appropriate corrective guidance is provided.
- Operator maneuvers to remain well clear.

### Expected Results

- Ownship alerting:
  - Progress through each alerting condition.
  - Guidance changes from proximate to corrective after intruder acceleration.

### Additional Information

Follow heading, alt or vs bands to remain well clear.
The closest point of approach (CPA) before the increase in speed should be .7nm-1nm, CPA after speed increase should be .5nm.
## TEST OBJECTIVES

Demonstrate performance in Front-Quartering scenario.

### Configuration

<table>
<thead>
<tr>
<th>Display</th>
<th>Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributing Sensors:</td>
<td></td>
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</table>

### System Under Test: **DAIDALUS**

### TCAS | ADS-B | Radar | Fusion |
<table>
<thead>
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<th></th>
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<tbody>
<tr>
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</tbody>
</table>

### Scenario(s):

- **#150**

### Lateral Offset = 0.5 NM

### SS Alerting Boundary = 0.75 NM

### Minimum Altitude Offset ≥ 400 ft

### Altitude

- **UAS**
  - 10000ft-20000ft
  - 10000ft-20000ft

### Increase speed 50-80kgs

### Success Criteria

- Data collected from MACS display (see data requirements)
- Intruder's CPA moves from outside the well clear volume to inside the well clear volume
- Appropriate corrective guidance is provided
- Operator maneuvers to remain well clear

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Guidance changes from proximate to corrective after intruder acceleration

### Additional Information

Follow heading, alt or vs bands to remain well clear
The closest point of approach (CPA) before the increase in speed should be .7nm-1nm, CPA after speed increase should be .5nm
### Test Objectives

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a front quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. DAIDALUS correctly accounts for increase in speed of intruder.

**Evaluation Criteria:**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS adjusts corrective guidance to account for updated intruder state information

**Test Method:**

- MANEUVER – Follow heading bands to remain well clear.
- Intruder speed: Increase ground speed 50-80 kts ground speed to place CPA inside the well clear volume.
- Encounter Length: 3 min.
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

**Success Criteria:**

- Data collected from MACS display (see data requirements)
- Intruder’s CPA moves from outside the well clear volume to inside the well clear volume.
- Appropriate corrective guidance is provided.
- Operator maneuvers to remain well clear.

**Expected Results:**

- Ownship alerting
  - Progress through each alerting condition
  - Guidance changes from proximate to corrective after intruder acceleration

**Additional Information:**

Follow heading, alt or vs bands to remain well clear.

The closest point of approach (CPA) before the increase in speed should be .7nm-1nm, CPA after speed increase should be .5nm.
TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

Configuration

System Under Test: DAIDALUS
Display: Native Display (as opposed to VSCS, TCAS on HUD)
Contributing Sensors:

Scenario(s): #152

1. Lateral Offset = 0.5 NM
2. SS Alerting Boundary = 0.75 NM
3. Minimum Altitude Offset ≥ 400 ft

Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a front quartering scenario
2. SAA fusion processor correctly correlates tracks
3. DAIDALUS correctly accounts for increase in speed of intruder

Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track
- DAIDALUS adjusts corrective guidance to account for updated intruder state information

Test Method

- MANEUVER – Follow heading bands to remain well clear.
- Intruder speed: Increase ground speed 50-80 kts ground speed to place CPA inside the well clear volume
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec

Success Criteria

- Data collected from MACS display (see data requirements)
- Intruder’s CPA moves from outside the well clear volume to inside the well clear volume
- Appropriate corrective guidance is provided
- Operator maneuvers to remain well clear

Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Guidance changes from proximate to corrective after intruder acceleration

Additional Information

Follow heading, alt or vs bands to remain well clear
The closest point of approach (CPA) before the increase in speed should be .7nm-1nm, CPA after speed increase should be .5nm
High Descent Rate
TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- TCAS
- ADS-B
- Radar
- Fusion: YES

- UAS: 10000ft-20000ft
- INT: 10000ft-20000ft

#### Scenario(s):

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Evaluate effectiveness of Time to Co-Altitude variable on alerting.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- MANEUVER – *Follow heading, VS, or Alt bands*
- Intruder VS: 3000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 0

### Success Criteria

- Data collected from MACS display (see data requirements)
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Alerting and guidance shown earlier when TCOA is 20

### Additional Information

Follow heading or vertical bands.
## TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

### Configuration
- **System Under Test**: DAIDALUS
- **Display**: Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors**:

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s):
- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

### Test Objective (TO)
1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Evaluate effectiveness of Time to Co-Altitude variable on alerting.

### Evaluation Criteria
The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method
- MANEUVER – *Follow heading, VS, or Alt bands*
- Intruder VS: 1000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 0

### Success Criteria
- Data collected from MACS display (see data requirements)
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

### Expected Results
- Ownship alerting
  - Progress through each alerting condition
  - Alerting and guidance shown earlier when TCOA is 20

### Additional Information
Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM.
**TEST OBJECTIVES**

Demonstrate performance in Rear-Quartering scenario.

### Configuration

<table>
<thead>
<tr>
<th><strong>System Under Test</strong></th>
<th>DAIDALUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display</strong></td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td><strong>Contributing Sensors</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Evaluate effectiveness of Time to Co-Altitude variable on alerting.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA…
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- MANEUVER –*Follow heading, VS, or Alt bands*
- Intruder VS: 3000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 0

### Success Criteria

- Data collected from MACS display (see data requirements)
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Alerting and guidance shown earlier when TCOA is 20

### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM.
### Test Objectives

**System Under Test:** DAIDALUS

**Display:** Native Display *(as opposed to VSCS, TCAS on HUD)*

**Contributing Sensors:**

1. **Test Objective (TO):**
   - The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
   - SAA fusion processor correctly correlates tracks.
   - Evaluate effectiveness of Time to Co-Altitude variable on alerting.

**Evaluation Criteria:**

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

**Test Method:**

- MANEUVER – *Follow heading, VS, or Alt bands*
- Intruder VS: 1000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 0

**Success Criteria:**

- Data collected from MACS display *(see data requirements)*
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

**Expected Results:**

- Ownship alerting
  - Progress through each alerting condition
  - Alerting and guidance shown earlier when TCOA is 20

**Additional Information:**

Do not follow guidance. Follow predescribed path, hold constant altitude and speed. The closest point of approach (CPA) is 0.5NM.
### Test Objectives

Demonstrate performance in Rear-Quartering scenario.

#### Configuration

**System Under Test:** DAIDALUS

- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- Ownship
- Radar

#### System Under Test

- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)

#### Contributing Sensors

- Ownship
- Radar

#### Test Objective (TO)

1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
2. SAA fusion processor correctly correlates tracks.
3. Evaluate effectiveness of Time to Co-Altitude variable on alerting.

#### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- **TO-1** Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- **TO-2** TCAS and ADS-B tracks are correctly fused into 1 single track.

#### Test Method

- MANEUVER – *Follow heading, VS, or Alt bands*
- Intruder VS: 3000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 20

#### Success Criteria

- Data collected from MACS display (see data requirements)
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

#### Expected Results

Ownership alerting

- Progress through each alerting condition
- Ownership maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course

*Show images of expected alerting*

#### Additional Information

- Do not follow guidance. Follow predescribed path, hold constant altitude and speed.
- The closest point of approach (CPA) is 0.5NM.
TEST OBJECTIVES

Demonstrate performance in Rear-Quartering scenario.

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

- **Test Objective (TO)**
  1. The DAIDALUS algorithm as displayed on the native display will show the correct alerting to the UAS in a rear-quartering scenario.
  2. SAA fusion processor correctly correlates tracks.
  3. Evaluate effectiveness of Time to Co-Altitude variable on alerting.

### Evaluation Criteria

The alerting displayed to the UAS will provide adequate SA to the UAS Pilot Operator as to the status of the intruder aircraft. DAIDALUS Display provides the following:

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA...
- TO-2 TCAS and ADS-B tracks are correctly fused into 1 single track.

### Test Method

- MANEUVER – *Follow heading, VS, or Alt bands*
- Intruder VS: 1000fpm
- Encounter Length: 3 min
- Stable Conditions: 2.5 min before CPA
- Tolerance: ± 10 sec
- TCOA: 20

### Success Criteria

- Data collected from MACS display (see data requirements)
- Corrective self separation guidance is provided
- Intruder reaches 3000fpm
- Operator maneuvers to stay well clear

### Expected Results

- Ownship alerting
  - Progress through each alerting condition
  - Ownship maneuvers away from encounter prior to TCAS-RA and then maneuvers back to course
  - *Show images of expected alerting*

### Additional Information

Do not follow guidance. Follow predescribed path, hold constant altitude and speed.

The closest point of approach (CPA) is 0.5NM.
UAS in the NAS
FT4 Test Objectives
CPDS
Version 3, Feb. 1, 2016
**TEST OBJECTIVES**

**S/N 165 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver**

**Section 2.2.4. DAA MOPS / Version: July 28, 2015**

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<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: CPDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display: CPDS CDTI and VPD</td>
<td></td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td>YES</td>
</tr>
</tbody>
</table>

**Configuration**

- **System Under Test:** CPDS
- **Display:** CPDS CDTI and VPD
- **Contributing Sensors:**
  - **Ownship:** TCAS in TARA mode
  - **Intruder 2:** ADS-B and TCAS
  - Selected traffic on Winconverter must be the ADS-B of the non-cooperative intruder
  - Synthetic ownship altitude offset of -500 ft

**Scenario(s):**

- #165

<table>
<thead>
<tr>
<th>Test Objective (TO)</th>
<th>1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.</th>
</tr>
</thead>
</table>
| Evaluation Criteria | • Relative location of intruder at the moment of detection  
• Progression of DAA alert status  
• Progression of detection during and after ownship turn |
| Test Method | • Ownership and intruder are in a stable relative formation described by range, bearing and altitude (1.5 nmi, 120 deg, -500 ft)  
• Ownership changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV  
• Ownership continues on new heading until non-cooperative intruder is either  
  • no longer detected or  
  • DAA alert state has reverted to NORMAL or  
  • UAS pilot deems maneuver required for safety  
• Encounter Length: TBD  
• Stable Conditions: stable relative formation described by range, bearing and altitude  
• Tolerance: 0.1 nmi range and 2 degrees bearing |
| Success Criteria | • No detection of the non-cooperative intruder before ownship turn  
• Detection of non-cooperative occurs during ownship turn  
• Predicted DA Alert states occur  
• A735B data recorded |
| Expected Results | Ownership alerting  
• SSWA |
| Additional Information | Anything not covered above. |
TEST OBJECTIVES

S/N 166 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver

Section 2.2.4. DAA MOPS / Version: July 28, 2015

Configuration

System Under Test: CPDS

Display: CPDS CDTI and VPD

Contributing Sensors:

<table>
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<tr>
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<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
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<td>Ownship: TCAS in TARA mode</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intruder 2: ADS-B and TCAS</td>
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<td></td>
</tr>
</tbody>
</table>

Selected traffic on Winconverter must be the ADS-B of the non-cooperative intruder

Synthetic ownship altitude offset of -500 ft

Scenario(s):

#166

Test Objective (TO)

1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.

Evaluation Criteria

- Relative location of intruder at the moment of detection
- Progression of DAA alert status
- Progression of detection during and after ownship turn

Test Method

- Ownership and intruder are in a stable relative formation described by range, bearing and altitude (2.0 nmi, 120 deg, -500 ft)
- Ownship changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV
- Ownship continues on new heading until non-cooperative intruder is either
  - no longer detected or
  - DAA alert state has reverted to NORMAL or
  - UAS pilot deems maneuver required for safety
- Encounter Length: TBD
- Stable Conditions: stable relative formation described by range, bearing and altitude
- Tolerance: 0.1 nmi range and 2 degrees bearing

Success Criteria

- No detection of the non-cooperative intruder before ownship turn
- Detection of non-cooperative occurs during ownship turn
- Predicted DA Alert states occur
- A735B data recorded

Expected Results

Ownership alerting
- SSWA

Additional Information

Anything not covered above.
S/N 167 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver

Configuration

System Under Test: CPDS

Display: CPDS CDTI and VPD

Contributing Sensors:

<table>
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<tr>
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<th>Radar</th>
<th>Fusion</th>
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<td>NO</td>
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<tr>
<td>Intruder 2:</td>
<td>ADS-B and TCAS</td>
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</tbody>
</table>

Ownship: TCAS in TARA mode
Intruder 2: ADS-B and TCAS
Selected traffic on Winconverter must be the ADS-B of the non-cooperative intruder
Synthetic ownship altitude offset of -500 ft

Scenario(s): #167

Test Objective (TO):
1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.

Evaluation Criteria
- Relative location of intruder at the moment of detection
- Progression of DAA alert status
- Progression of detection during and after ownship turn

Test Method
- Ownership and intruder are in a stable relative formation described by range, bearing and altitude (2.5 nmi, 120 deg, -500 ft)
- Ownership changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV
- Ownership continues on new heading until non-cooperative intruder is either
  - no longer detected or
  - DAA alert state has reverted to NORMAL or
  - UAS pilot deems maneuver required for safety
- Encounter Length: TBD
- Stable Conditions: stable relative formation described by range, bearing and altitude
- Tolerance: 0.1 nmi range and 2 degrees bearing

Success Criteria
- No detection of the non-cooperative intruder before ownship turn
- Detection of non-cooperative occurs during ownship turn
- Predicted DA Alert states occur
- A735B data recorded

Expected Results
Ownership alerting
- SSWA

Additional Information
Anything not covered above.
S/N 168 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver

Test Objective (TO)

1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.

Evaluation Criteria

- Relative location of intruder at the moment of detection
- Progression of DAA alert status
- Progression of detection during and after ownship turn

Test Method

- Ownship and intruder are in a stable relative formation described by range, bearing and altitude (1.5 nmi, 130 deg, -500 ft)
- Ownship changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV
- Ownship continues on new heading until non-cooperative intruder is either
  - no longer detected or
  - DAA alert state has reverted to NORMAL or
  - UAS pilot deems maneuver required for safety
- Encounter Length: TBD
- Stable Conditions: stable relative formation described by range, bearing and altitude
- Tolerance: 0.1 nmi range and 2 degrees bearing

Success Criteria

- No detection of the non-cooperative intruder before ownship turn
- Detection of non-cooperative occurs during ownship turn
- Predicted DA Alert states occur
- A735B data recorded

Expected Results

- Ownship alerting
  - SSWA

Additional Information

Anything not covered above.
TEST OBJECTIVES

S/N 169 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver

Section 2.2.4. DAA MOPS / Version: July 28, 2015

Configuration

System Under Test: CPDS

Display: CPDS CDTI and VPD

Contributing Sensors:

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

Ownership: TCAS in TARA mode
Intruder 2: ADS-B and TCAS

Selected traffic on Winconverter must be the ADS-B of the non-cooperative intruder

Synthetic ownship altitude offset of -500 ft

Scenario(s):

#169

Test Objective (TO)

1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.

Evaluation Criteria

- Relative location of intruder at the moment of detection
- Progression of DAA alert status
- Progression of detection during and after ownship turn

Test Method

- Ownership and intruder are in a stable relative formation described by range, bearing and altitude (2.0 nmi, 130 deg, -500 ft)
- Ownership changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV
- Ownership continues on new heading until non-cooperative intruder is either
  - no longer detected or
  - DAA alert state has reverted to NORMAL or
  - UAS pilot deems maneuver required for safety
- Encounter Length: TBD
- Stable Conditions: stable relative formation described by range, bearing and altitude
- Tolerance: 0.1 nmi range and 2 degrees bearing

Success Criteria

- No detection of the non-cooperative intruder before ownship turn
- Detection of non-cooperative occurs during ownship turn
- Predicted DA Alert states occur
- A735B data recorded

Expected Results

Ownership alerting
- SSWA

Additional Information

Anything not covered above.
S/N 170 DAA guidance against non-cooperative intruder being detected during ownship DAA maneuver

**Scenario(s):**

#170

**Test Objective (TO):**

1. Obtain data that can be used to define the real boundaries (due to processing latencies etc.) of the space where a non-cooperative intruder will become detectable during an ownship turn.

**Evaluation Criteria:**

- Relative location of intruder at the moment of detection
- Progression of DAA alert status
- Progression of detection during and after ownship turn

**Test Method:**

- Ownership and intruder are in a stable relative formation described by range, bearing and altitude (2.5 nmi, 130 deg, -500 ft)
- Ownership changes heading 30 degrees using rate 1 turn in the direction which will get intruder into radar FOV
- Ownership continues on new heading until non-cooperative intruder is either
  - no longer detected or
  - DAA alert state has reverted to NORMAL or
  - UAS pilot deems maneuver required for safety
- Encounter Length: TBD
- Stable Conditions: stable relative formation described by range, bearing and altitude
- Tolerance: 0.1 nmi range and 2 degrees bearing

**Success Criteria:**

- No detection of the non-cooperative intruder before ownship turn
- Detection of non-cooperative occurs during ownship turn
- Predicted DA Alert states occur
- A735B data recorded

**Expected Results:**

- Ownership alerting
- SSWA

**Additional Information:**

Anything not covered above.
### Configuration

**System Under Test:** CPDS

**Display:** CPDS CDTI and VPD

**Contributing Sensors:**

<table>
<thead>
<tr>
<th></th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownship: TCAS in TARA mode</td>
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<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Intruder 1: ADS-B and TCAS</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intruder 2: ADS-B and TCAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Selected traffic must be ADS-B of intruder 2

### Scenario(s): #171

### Test Objective (TO)

1. Obtain data on multi-intruder encounter in which ownship DAA maneuver results in a TCAS RA with another target.

### Evaluation Criteria

- Timeliness, correctness, stability and persistence of the DAA alert states (2.2.4.2)
- Timeliness, correctness, stability and persistence of the depicted conflict space (coasting)
- Timeliness, correctness, stability and persistence of the depicted heading bands
- Occurrence of (unexpected) overlapping alerts (2.2.4.4)

### Test Method

- Encounter Length: 180 seconds
- Intruder 1 trajectory triggers CSSA
- Ownship turns to avoid loss of well clear and consequently triggers RA
- Ownship follows RA
- Tolerance: TBD

### Success Criteria

- CSSA occurs with intruder 1
- Ownship maneuver prevents TCAS RA with intruder 1
- No loss of well clear occurs with intruder 1
- TCAS RA occurs with intruder 2
- A735B data recorded

### Expected Results

Ownship alerting

- CSSA with intruder 1
- TCAS RA with intruder 2

### Additional Information

The ownship DAA maneuver does not result in a predictable endstate, i.e. an exact heading change. The geometry must be set up in such a way that the RA with intruder 2 will occur for a larger heading range beyond the minimum heading required to prevent a loss of well clear with intruder 1.
### Configuration

**System Under Test:** CPDS

**Display:** CPDS CDTI and VPD

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>Sensor</th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownship</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Intruder 1: ADS-B and TCAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intruder 2: ADS-B and TCAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Ownship:** TCAS in TARA mode

**Intruder 1:** ADS-B and TCAS

**Intruder 2:** ADS-B and TCAS

On Winconverter, intruder 1 must be selected until RA. After RA, intruder 2 must be selected.

### Scenario(s):

**#172**

### Test Objective (TO)

1. Obtain data on multi-intruder encounter in which ownship TCAS RA maneuver against intruder triggers DAA CSSA for another target.

### Evaluation Criteria

- Timeliness, correctness, stability and persistence of the DAA alert states (2.2.4.2)
- Timeliness, correctness, stability and persistence of the depicted conflict space
- Timeliness, correctness, stability and persistence of the depicted heading bands
- Occurrence of (unexpected) overlapping alerts (2.2.4.4)

### Test Method

- **Encounter Length:** 180 seconds
- **Intruder 1** horizontal maneuvers to trigger RA
- **Ownship** does not maneuver based on CSSA which may precede RA
- **Ownship** follows RA
- After clear of conflict from TCAS, ownship uses DAA information to prevent loss of well clear
- **Tolerance:** TBD

### Success Criteria

- No ownship maneuver before RA
- **RA** occurs as predicted
- Following RA triggers CSSA
- Ownship maneuver resolves CSSA and both targets become PSSA
- No SSWA occurs for intruder 2
- **A735B** data recorded

### Expected Results

- Ownship alerting
  - TCAS descend RA with intruder 1
  - CSSA with intruder 2
  - No loss of well clear is expected to occur with intruder 2
  - Ownship altitude change to around 9600 ft will make both intruders PSSA

### Additional Information

Anything not covered above.
**Scenario(s): #173**

**Configuration**
- Display: CPDS CDTI and VPD
- Contributing Sensors: CPDS / ADS-B / Radar / Fusion
  
  - Ownship: TCAS in TARA mode
  - Intruder 1: ADS-B and TCAS
  - Intruder 2: ADS-B and TCAS

**Test Objective (TO)**
1. Obtain data on multi-intruder encounter in which ownship TCAS RA maneuver against intruder triggers DAA CSSA for another target.

**Evaluation Criteria**
- Timeliness, correctness, stability and persistence of the DAA alert states (2.2.4.2)
- Timeliness, correctness, stability and persistence of the depicted conflict space
- Timeliness, correctness, stability and persistence of the depicted heading bands
- Occurrence of (unexpected) overlapping alerts (2.2.4.4)

**Test Method**
- Encounter Length: 180 seconds
- Intruder 1 vertical maneuver to trigger RA
- Ownship does not maneuver based on CSSA which may precede RA
- Ownship follows RA
- After clear of conflict from TCAS ownship uses DAA information to prevent loss of well clear
- Tolerance: TBD

**Success Criteria**
- No ownship maneuver before RA
- RA occurs as predicted
- Following RA triggers CSSA
- Ownship maneuver resolves CSSA and both targets become PSSA
- No SSWA occurs for intruder 2
- A735B data recorded

**Expected Results**
- Ownship alerting
- TCAS descend RA with intruder 1
- CSSA with intruder 2
- No loss of well clear is expected to occur with intruder 2
- Ownship altitude change to around 9600 ft will make both intruders PSSA

**Additional Information**
Anything not covered above.
S/N 174 Get data on Collision Avoidance Interoperability

TEST OBJECTIVES

Scenario(s): #174

Test Objective (TO)
1. Obtain data on multi-intruder encounter in which ownship TCAS RA maneuver against intruder triggers DAA SSWA for another target.

Evaluation Criteria
- Timeliness, correctness, stability and persistence of the DAA alert states (2.2.4.2)
- Timeliness, correctness, stability and persistence of the depicted conflict space
- Timeliness, correctness, stability and persistence of the depicted heading bands
- Occurrence of (unexpected) overlapping alerts (2.2.4.4)

Test Method
- Encounter Length: 180 seconds
- Intruder 1 horizontal maneuvers to trigger RA
- Ownship does not maneuver based on CSSA which may precede RA
- Ownship follows RA
- After clear of conflict from TCAS ownship uses DAA information to prevent loss of well clear or restore well clear
- Tolerance: TBD

Success Criteria
- No ownship maneuver before RA
- RA occurs as predicted
- Following RA triggers SSWA
- Ownship maneuver resolves SSWA
- A735B data recorded

Expected Results
- Ownship alerting
  - TCAS descend RA with intruder 1
  - SSWA with intruder 2
  - Loss of well clear likely to occur
  - Ownship returning to its altitude resolves SSWA

Additional Information
Anything not covered above.
TEST OBJECTIVES

 Configuration

 System Under Test: CPDS
 Display: CPDS CDTI and VPD
 Contributing Sensors:

<table>
<thead>
<tr>
<th></th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

 Ownership: TCAS in TARA mode
 Intruder 1: ADS-B and TCAS
 Intruder 2: ADS-B and TCAS

 On Winconverter, intruder 2 must be selected

 Scenario(s): #175

 Test Objective (TO)

 1. Obtain data on multi-intruder encounter in which ownership TCAS RA maneuver against intruder triggers DAA SSWA for another target.

 Evaluation Criteria

 • Timeliness, correctness, stability and persistence of the DAA alert states (2.2.4.2)
 • Timeliness, correctness, stability and persistence of the depicted conflict space
 • Timeliness, correctness, stability and persistence of the depicted heading bands
 • Occurrence of (unexpected) overlapping alerts (2.2.4.4)

 Test Method

 • Encounter Length: 180 seconds
 • Intruder 1 vertical maneuver to trigger RA
 • Ownership does not maneuver based on CSSA which may precede RA
 • Ownership follows RA
 • After clear of conflict from TCAS ownership uses DAA information to prevent loss of well clear or restore well clear
 • Tolerance: TBD

 Success Criteria

 • No ownship maneuver before RA
 • RA occurs as predicted
 • Following RA triggers SSWA
 • Ownership maneuver resolves SSWA
 • A735B data recorded

 Expected Results

 Ownership alerting
 • TCAS descend RA with intruder 1
 • SSWA with intruder 2
 • Loss of well clear likely to occur
 • Ownership returning to its altitude resolves SSWA

 Additional Information

 Anything not covered above.
UAS in the NAS FT4 Test Objectives (Radar)
TEST OBJECTIVES

GA Radar Statistical Run #1

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

**Scenario(s): #176**

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 500ft

**Test Objective (TO)**

Track Radar Range and Accuracy against two intruders

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- **MANEUVER:** Ownship and Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 0<IBA<30 , Intruder 2 = 0<IBA<30
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- **Altitude:** >10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Climb Rate:** 0 ft/min
- **Tolerance:** TBD

**Success Criteria**

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results**

Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

**Additional Information**

Requirement: 16 scenarios 0<IBA<30
### TEST OBJECTIVES

**GA Radar Statistical Run #2**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
</tbody>
</table>

#### Scenario(s):

**#177**

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

### Test Objective (TO)

1. Track Radar Range and Accuracy against two intruders

### Evaluation Criteria

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

### Test Method

- **MANEUVER**: Ownship and Intruders fly without maneuver
- **Rel. Bearing**: Intruder 1 = 0<IBA<30°, Intruder 2 = 0<IBA<30°
- **Progressive Closure**: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- **Altitude**: >10k MSL
- **Encounter Length**: TBD min
- **Stable Conditions**: TBD min before CPA
- **Climb Rate**: 0 ft/min
- **Tolerance**: TBD

### Success Criteria

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

### Expected Results

Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

### Additional Information

Requirement: 16 scenarios 0<IBA<30°
TEST OBJECTIVES

GA Radar Statistical Run #3

<table>
<thead>
<tr>
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<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Contributing Sensors:</td>
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</tr>
<tr>
<td>TCAS</td>
<td>ADS-B</td>
</tr>
<tr>
<td>No</td>
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</tr>
</tbody>
</table>

Scenario(s): #178

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 500 ft

Test Objective (TO)

1. Track Radar Range and Accuracy against two intruders

Evaluation Criteria

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

Test Method

- MANEUVER: Ownship and Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 0° < IBA < 30°, Intruder 2 = 0° < IBA < 30°
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- Altitude: > 10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Climb Rate: 0 ft/min
- Tolerance: TBD

Success Criteria

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ± 5 degrees of the required heading.

Expected Results

- Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

Additional Information

- Requirement: 16 scenarios 0° < IBA < 30°
- Intruder 1 Equipage: DGPS
- Intruder 2 Equipage: DGPS
Test Objectives

**Scenario(s): #179**

**Configuration**
- **System Under Test:** Radar
- **Display:** CPDS
- **Contributing Sensors:**
  - TCAS
  - ADS-B
  - Radar
  - Fusion
  - Lateral Offset = N/A
  - SS Alerting Boundary = N/A
  - Minimum Altitude Offset = 500 ft

**Test Objective (TO):**
1. Track Radar Range and Accuracy against two Intruders

**Evaluation Criteria:**
Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method:**
- **MANEUVER:** Ownship and Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 0°I<BA<30°, Intruder 2 = 0°I<BA<30°
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- **Altitude:** >10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Climb Rate:** 0 ft/min
- **Tolerance:** TBD

**Success Criteria:**
- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results:**
Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

**Additional Information:**
Requirement: 16 scenarios 0°I<BA<30°
**TEST OBJECTIVES**

**GA Radar Statistical Run #5**

**Configuration**

**System Under Test:** Radar

<table>
<thead>
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<th>Display</th>
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<th>Contributing Sensors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS</td>
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</tr>
<tr>
<td>ADS-B</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Radar</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Fusion</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

**Scenario(s): #180**

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

**Test Objective (TO):**

1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria:**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method:**

- MANEUVER: Ownship and Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 0<IBA<30, Intruder 2 = 0<IBA<30
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Climb Rate: 0 ft/min
- Tolerance: TBD

**Success Criteria:**

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results:**

Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

**Additional Information:**

R4, R7, R9, R11, R13-16, R22-25, R28, R29, R30, R33, R34, R35
TEST OBJECTIVES

GA Radar Statistical Run #6

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display:</strong></td>
<td>CPDS</td>
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<tr>
<td><strong>Contributing Sensors:</strong></td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

**Scenario(s): #181**
- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset ≥ 1000 ft.

**Test Objective (TO):**
1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria:**
Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**
- **MANEUVER:** Ownship climb, Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 0<IBA<30, Intruder 2 = 0<IBA<30
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- **Altitude:** ≥10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Climb Rate:** TBD ft/min
- **Tolerance:** TBD

**Success Criteria**
- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results**
Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B. Target below the own ship will leave Radar’s FOV earlier than target above ownship

**Additional Information**
Requirement: 16 scenarios 0<IBA<30
<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
<tr>
<td>TCAS</td>
<td>ADS-B</td>
</tr>
<tr>
<td>No</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s): #182
- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset ≥ 1000 ft

### Test Objective (TO)
1. Track Radar Range and Accuracy against two intruders

### Evaluation Criteria
Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

### Test Method
- **MANEUVER:** Ownship descent, Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 0°<IBA<30°, Intruder 2 = 0°<IBA<30°
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- **Altitude:** >10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Climb Rate:** TBD ft/min
- **Tolerance:** TBD

### Success Criteria
- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

### Expected Results
Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B. Target below the own ship will leave Radar’s FOV earlier than target above ownship

### Additional Information
Requirement: 16 scenarios 0°<IBA<30°
**TEST OBJECTIVES**

**GA Radar Statistical Run #8**

<table>
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<th>Configuration</th>
<th>System Under Test: Radar</th>
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</thead>
<tbody>
<tr>
<td>Display: CPDS</td>
<td></td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

**Scenario(s): #183**

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset ≥ 1000 ft

**Test Objective (TO)**

1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- MANEUVER: Ownship flies without maneuver, Intruder 1 climbs, Intruder 2 descends fly without maneuver
- Rel. Bearing: Intruder 1 = 0<IBA<30, Intruder 2 = 0<IBA<30
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Climb Rate: TBD ft/min
- Descent Rate: TBD ft/min
- Tolerance: TBD

**Success Criteria**

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm. Intruder aircrafts should maintain heading within ± 5 degrees of the required heading.

**Expected Results**

Intruders are acquired at greater than 12 nm and tracked until 0.5nm, results should be comparable to ADS-B

**Additional Information**

For climb/descend start 3000 ft below/above and then climb / descend by 2000 feet so final separation is 1000 feet. Descend at 1500 ft/mi, ascend at aircraft capability 1500 or less.

Requirement: 16 scenarios 0<IBA<30
**Test Objectives**

### GA Radar Statistical Run #9

<table>
<thead>
<tr>
<th>Section DAA MOPS / Version: R4, R7, R9, R11, R13-16, R22-25, R28, R29, R30, R33, R34, R35</th>
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</table>

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Display</th>
<th>CPDS</th>
<th>Contributing Sensors:</th>
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<tr>
<td>TCAS</td>
<td>Yes</td>
<td>YES</td>
</tr>
<tr>
<td>ADS-B</td>
<td>Yes</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s): #184
- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft
- Intruder 1 Equipage: DGPS
- Intruder 2 Equipage: DGPS

<table>
<thead>
<tr>
<th>Test Objective (TO)</th>
<th>1. Track Radar Range and Accuracy against two intruders</th>
</tr>
</thead>
</table>

### Evaluation Criteria
- Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

### Test Method
- MANEUVER: Ownship flies horizontal maneuver, Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 0<IBA<30, Intruder 2 = 0<IBA<30
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

### Success Criteria
- Intruders are acquired at least at 8nm and from own ship and tracked until they are outside of Radar FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

### Expected Results
- Intruders are acquired at greater than 12 nm and tracked until the own ship turns and targets leave Radar's FOV.
- Intruder 2 will remain in radar FOV longer than Intruder 1

### Additional Information
- 90 degree turn
- Requirement: 2 with ownship horizontal maneuver
TEST OBJECTIVES

GA Radar Statistical Run #10

System Under Test: Radar
Configuration

Display: CPDS
Contributing Sensors:

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
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</thead>
<tbody>
<tr>
<td>No</td>
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<td>YES</td>
<td>No</td>
</tr>
</tbody>
</table>

Scenario(s): #185

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

Test Objective (TO)

1. Track Radar Range and Accuracy against two intruders

Evaluation Criteria

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

Test Method

- MANEUVER: Ownship flies horizontal maneuver, Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 0<IBA<30, Intruder 2 = 0<IBA<30
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

Success Criteria

- Intruders are acquired at least at 8nm and from own ship and tracked until they are outside of Radar FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading

Expected Results

Intruders are acquired at greater than 12 nm and tracked until the own ship turns and targets leave Radar's FOV. Intruder 1 will remain in radar FOV longer than Intruder 2

Additional Information

90 degree turn
Requirement: 2 with ownership horizontal maneuver,
### Configuration
- **System Under Test:** Radar
- **Display:** CPDS
- **Contributing Sensors:**
  - TCAS: Yes
  - ADS-B: Yes
  - Radar: No
  - Fusion: N/A

### Scenario(s): #186-187
- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

### Test Objective (TO)
1. Track Radar Range and Accuracy against two intruders

### Evaluation Criteria
Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

### Test Method
- MANEUVER: Ownship flies without maneuver, Intruders fly horizontal maneuver
- Rel. Bearing: Intruder 1 = 0°<IBA<30°, Intruder 2 = 0°<IBA<30°
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS (Ownship and intruder speeds should be adjusted to fit profile)
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

### Success Criteria
- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm or within Radar's FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

### Expected Results
Intruders are acquired at greater than 8 nm and tracked until the own ship turns and targets leave Radar's FOV.

### Additional Information
Start head-on, then 45 degree turn at 7-8 NM. SV: I'm still a little confused on what the difference is between these two. Different relative bearing? Perhaps one can be performed at 0 and the other at 30? Requirement: 2 with intruder horizontal maneuver
**Test Objectives**

**GA Radar Statistical Run #13-17**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test:</th>
<th>Display:</th>
<th>Contributing Sensors:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radar</td>
<td>CPDS</td>
<td></td>
</tr>
</tbody>
</table>

- **Scenario(s): #188-192**

**Test Objective (TO)**

1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- **MANEUVER:** Ownship and Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 30°-IBA<60°, Intruder 2 = -30°-IBA<60°
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS *(Ownship and intruder speeds should be adjusted to fit profile)*
- **Altitude:** >10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Tolerance:** TBD

**Success Criteria**

- Intruders are acquired at least at 6.5 nm and from own ship and tracked until 1nm or within Radar's FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results**

Intruders are acquired at greater than 8nm and tracked until the own ship turns and targets leave Radar's FOV.

**Additional Information**

Requirement: 10 scenarios 30°-IBA<60°
**TEST OBJECTIVES**

**GA Radar Statistical Run #18-19**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Display: CPDS</th>
<th>Contributing Sensors:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Under Test:</th>
<th>Radar</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>8 NM</th>
<th>60°-90°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Section DAA MOPS / Version:** R4, R7, R9, R11, R13-16, R22-25, R28, R29, R30, R33, R34, R35

**Test Objective (TO):**

1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria:**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method:**

- **MANEUVER:** Ownship and Intruders fly without maneuver
- **Rel. Bearing:** Intruder 1 = 60°<IBA<90°, Intruder 2 = -60°<IBA<90°
- **Progressive Closure:** Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS (Ownship and intruder speeds should be adjusted to fit profile)
- **Altitude:** >10k MSL
- **Encounter Length:** TBD min
- **Stable Conditions:** TBD min before CPA
- **Tolerance:** TBD

**Scenario(s):**

#193-194

**Intruder 1 Equipage:** DGPS

**Intruder 2 Equipage:** DGPS

**Success Criteria:**

- Intruders are acquired at least at 6nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results:**

Intruders are acquired at least at 7nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Additional Information:**

Maintain bearing angle of 75 deg to intruder, intruder speed should be (1/sin 75°=1.035) that of ownship to maintain Requirement: 4 scenarios 60°<IBA<90°
**Test Objectives**

**GA Radar Statistical Run #20**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td>TCAS  YES  Radar  YES  Fusion  No</td>
</tr>
</tbody>
</table>

**Test Objective (TO)**

1. Track Radar Range and Accuracy against two intruders

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- MANEUVER: Ownship and Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 90°<IBA<110°, Intruder 2 = 90°<IBA<110°
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS, Intruder 2 = 160 KGS **(Ownship and intruder speeds should be adjusted to fit profile)**
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

**Scenario(s):**

#195

**Success Criteria**

- Intruders are acquired at least at 4nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

**Expected Results**

Intruders are acquired at greater than 5 nm and tracked until the own ship turns and targets leave Radar’s FOV.

**Additional Information**

Repeat of FT3 flight but starting at longer range, intruder speed should be ( 1/sin 80°=1.015 ) that of intruder to maintain Requirement: 2 scenarios 90°<IBA<110°
### Test Objectives

**GA Radar Non Statistical Run #21**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test:</th>
<th>Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
<td></td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td>TCAS</td>
<td>ADS-B</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>YES</td>
</tr>
</tbody>
</table>

#### Scenario(s): 
#196
- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

#### Test Objective (TO)
1. Track Radar Range and Accuracy against two intruders

#### Evaluation Criteria
Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

#### Test Method
- MANEUVER: Ownship and Intruder fly without maneuver
- Rel. Bearing: Intruder 1 = 180 degrees
- Progressive Closure: Ownship = 160 KGS, Intruder 1 = 160 KGS **(OWNSHIP to be faster at least by 50KGS)**
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

#### Success Criteria
- Intruders are acquired at least at 4nm and from own ship and tracked until Own ship overtakes the intruder. Intruder aircrafts should maintain heading within ±5 degrees of the required heading.

#### Expected Results
Intruders are acquired at greater than 5 nm and tracked until the own ship turns and targets leave Radar's FOV

#### Additional Information
Requirement: 1 with ownship overtake intruder (above)
**TEST OBJECTIVES**

**GA Radar Non Statistical Run #23-32**

**Configuration**

- Display: CPDS
- Contributing Sensors:
  - TCAS: No
  - ADS-B: Yes
  - Radar: Yes
  - Fusion: No

**Scenario(s): #198-207**

- Lateral Offset = 0.5 nmi
- SS Alerting Boundary = 0.75 nmi
- Minimum Altitude Offset = 1000 ft

**Test Objective (TO)**

1. #23 – 1k AGL
2. #24 – 2k AGL
3. #25 – 3k AGL
4. #26 – 4k AGL
5. #27 – 5k AGL
6. #28 – 1k AGL
7. #29 – 2k AGL
8. #30 – 3k AGL
9. #31 – 4k AGL
10. #32 – 5k AGL

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- MANEUVER: Ownship and Intruder fly without maneuver
- Rel. Bearing: Intruder 1 = 0 degrees
- Progressive Closure: Ownship = 150 KGS, Intruder 1 = 180 KGS
- Altitude: 1,000 – 5,000 AGL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

**Success Criteria**

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm or within Radar’s FOV.
- Some fast ground Moving Targets, could be acquired. Intruder aircrafts should maintain heading within $\pm 5$ degrees of the required heading.

**Expected Results**

- Intruders are acquired at least at 8nm and from own ship and tracked until 1nm or within Radar’s FOV.
- Some fast ground Moving Targets, could be acquired. Intruder aircrafts should maintain heading within $\pm 5$ degrees of the required heading.

**Additional Information**

- Requirement: Low altitude
### Test Objectives

#### Configuration

<table>
<thead>
<tr>
<th>Scenario(s): #208-209</th>
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</thead>
<tbody>
<tr>
<td>Lateral Offset = N/A</td>
</tr>
<tr>
<td>SS Alerting Boundary = N/A</td>
</tr>
<tr>
<td>Minimum Altitude Offset = 1000 ft</td>
</tr>
</tbody>
</table>

#### System Under Test

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>YES</td>
<td>YES</td>
<td>No</td>
</tr>
</tbody>
</table>

#### Test Objective (TO)

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- MANEUVER: Ownship and Intruders fly without maneuver
- Rel. Bearing: 0 degrees
- Progressive Closure: Ownship = Various, Intruder 1 (High Speed), Intruder 2 = Various, (Medium Speed) Intruder 3 = Various, (medium Speed) = Various, Intruder 4 = Low Speed
- Altitude: >10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

**Success Criteria**

- All four Intruders are acquired at least at 8nm (depending on RCS) and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ± 5 degrees of the required heading. System should track all the four intruders simultaneously.

**Expected Results**

- All four Intruders are acquired at least at 10 nm (depending on RCS) and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within ± 5 degrees of the required heading. System should track all the four intruders simultaneously.

**Additional Information**

All head on, +1k vertical, -1k vertical, +5k lateral, -5k lateral

Requirement: Multiple Intruders
**TEST OBJECTIVES**

**GA Radar Non Statistical Run #35-36**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Radar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>CPDS</td>
</tr>
<tr>
<td>Contributing Sensors</td>
<td></td>
</tr>
<tr>
<td>TCAS</td>
<td>ADS-B</td>
</tr>
<tr>
<td>No</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Scenario(s): #210-211**

- Lateral Offset = N/A
- SS Alerting Boundary = N/A
- Minimum Altitude Offset = 1000 ft

**Test Objective (TO)**

**Evaluation Criteria**

Range and angular accuracy are within the limits defined in SC228. No track losses, track splits or false targets during the test.

**Test Method**

- MANEUVER: Ownship and Intruders fly without maneuver
- Rel. Bearing: Intruder 1 = 0 degrees
- Progressive Closure: Ownship = 150 KGS, Intruder 1 = 100 KGS
- Altitude: <10k MSL
- Encounter Length: TBD min
- Stable Conditions: TBD min before CPA
- Tolerance: TBD

**Success Criteria**

- Intruders are acquired at least at 5nm and from own ship and tracked until 1nm or within Radar’s FOV. Intruder aircrafts should maintain heading within $\pm 5$ degrees of the required heading.

**Expected Results**

Intruders are acquired at greater than 5 nm and tracked until the own ship turns and targets leave Radar’s FOV.

**Additional Information**

Basic head on scenarios

Requirement: Other intruders (Glider)
UAS in the NAS
FT4 Test Objectives
TCAS
TCAS Encounters traceback

- TCAS Encounters based on AC 20-151B, Chapter 3
- MOPS traced back to
  - RTCA DO-185B MOPS for TCAS II
  - RTCA DO-300B MOPS for TCAS II
  - RTCA DO-317B MOPS for ASA System
  - TSO-119d
**CORRECTIVE RESOLUTION ADVISORY**

1. CLIMB 1500 FPM
2. DESCEND -1500 FPM
3. CROSSING CLIMB 1500 FPM
4. CROSSING DESCEND -1500 FPM
5. LEVEL OFF (REDUCED CLIMB)
6. LEVEL OFF (REDUCED DESCEND)
7. REVERSE CLIMB 1500 FPM
8. REVERSE DESCENT -1500 FPM
9. INCREASED CLIMB 2500 FPM
10. INCREASED DESCENT -2500 FPM*
11. MAINTAIN VERTICAL SPEED (CLIMBING)
12. MAINTAIN VERTICAL SPEED (DESCENDING)
13. MULTI-THREAT (CLIMBING)
14. MULTI-THREAT (DESCENDING)
15. LEVEL OFF (WEAKENING RA)
16. CLEAR OF CONFLICT

**PREVENTIVE RESOLUTION ADVISORY**

1. MONITOR VERTICAL SPEED (DO NOT CLIMB)
2. MONITOR VERTICAL SPEED (DO NOT CLIMB >500 FPM)
3. MONITOR VERTICAL SPEED (DO NOT CLIMB >1000 FPM)
4. MONITOR VERTICAL SPEED (DO NOT CLIMB >2000 FPM)
5. MONITOR VERTICAL SPEED (DO NOT DESCEND)
6. MONITOR VERTICAL SPEED (DO NOT DESCEND >500 FPM)
7. MONITOR VERTICAL SPEED (DO NOT DESCEND >1000 FPM)
8. MONITOR VERTICAL SPEED (DO NOT DESCEND >2000 FPM)
9. MONITOR VERTICAL SPEED (DO NOT DESCEND AND DO NOT CLIMB)
## TEST OBJECTIVES – TCAS Shadow

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test:</th>
<th>TBD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display: TCAS on HUD</td>
<td>Any</td>
<td>-</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCAS</td>
<td>ADS-B</td>
<td>Radar</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
<td>No</td>
</tr>
</tbody>
</table>

### Scenario(s): #212

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = N/A NM
- Minimum Altitude Offset ≥ 200 ft

### Test Objective (TO)

1. Identify RF shadow region of TCAS directional antenna (from V-tail, fuselage)

### Evaluation Criteria

N/A

### Test Method

- MANEUVER – NO
- MANEUVER – Fly commanded heading
- Start at 120 knots TAS for ownship and 220 TAS for intruder
- Encounter Length: 5.5 min
- Stable Conditions: Maintain 130 ± 10 degree bearing
- Climb Rate:
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 5 sec, adjust speed to maintain bearing range

### Success Criteria

- Identify TCAS RF shadow range when V-tail is blocking line of sight with intruder aircraft

### Expected Results

Intruder TCAS signal to appear as range closes between intruder and ownship

### Additional Information

Prefer to repeat with altitude offset 0 ft, -200 ft and -400 ft
<table>
<thead>
<tr>
<th><strong>Configuration</strong></th>
<th><strong>System Under Test:</strong> Any</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display:</strong> TCAS on HUD</td>
<td><strong>Contributing Sensors:</strong></td>
</tr>
<tr>
<td></td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td>YES</td>
</tr>
</tbody>
</table>

**Scenario(s):** #215/216

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = N/A NM
- Minimum Altitude Offset ≥ 150 ft

**Test Objective (TO):**
1. Demonstrate strengthening climb RA from TCAS

**Evaluation Criteria:**
- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA1, CA2
- TO-2 TCAS issues a strengthening climb RA

**Test Method:**
- MANEUVER – Advisory only
- MANEUVER – Fly commanded heading
- 130 IAS for ownship, 150 TAS for intruder
- Encounter Length: 2 min
- Stable Conditions: stable heading at IP
- Climb Rate: N/A
- Roll Rate: 0
- Pitch Rate: 0
- Tolerance: speed is not a large factor, importance in vertical and horizontal CPA distance

**Success Criteria:**
- Same as Evaluation Criteria

**Expected Results:**
- [3 nmi distance between ownship/intruder]: Climb RA Triggered
- [1.2 nmi distance between ownship/intruder]: Increased Climb RA triggered
- End of Scenario as soon as Increased Climb RA triggered, break away

**Additional Information:**
- Need acceptance whether 150 ft vertical separation / 1 nmi horizontal separation is acceptable
**TEST OBJECTIVES – TCAS Head on Multi-threat Climbing**

**Demonstrate TCAS Corrective RA# 13 (MULTI-THREAT: Climb)**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>TCAS on HUD</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td>TCAS</td>
</tr>
<tr>
<td></td>
<td>YES</td>
</tr>
</tbody>
</table>

**Test Objective (TO)**

1. Demonstrate multi-threat RA during descend

**Evaluation Criteria**

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA1, CA2
- TO-2 TCAS issues a climb RA
- TO-3 TCAS issues a Multi-threat RA during descend to level-off

**Test Method**

- MANEUVER – Advisory then Auto
- MANEUVER – Fly commanded heading
- Ownship: 130 IAS, Intruders: 130 TAS
- Encounter Length: 5 min
- Stable Conditions: steady level flight and velocity at entry point
- Climb Rate: Ownship (+1500 FPM)
- Tolerance: distance is flexible, but intruder should be 3 nmi horizontally away from each other

**Success Criteria**

- Same as Evaluation Criteria

**Expected Results**

1. TCAS issues a climb RA
2. TCAS issues a level-off RA
3. TCAS issues a level-off RA (multiship)

**Additional Information**

Validated in SIL

**Scenario(s): #217/218**

- Lateral Offset = 0.4 NM
- SS Alerting Boundary = N/A NM
- Minimum Altitude Offset ≥ 300 ft

![Diagram showing the scenario withOwnship, 6 nmi, 9 nmi, 450 ft, 350 ft, 300 ft, and the TCAS alerts.](image-url)
TEST OBJECTIVES – TCAS Head on Multi-threat descending

Demonstrate TCAS Corrective RA# 13 (MULTI-THREAT: Descend)  

**Configuration**

- **Display:** TCAS on HUD
- **Contributing Sensors:**
  - TCAS: YES
  - ADS-B: YES
  - Radar: No
  - Fusion: No

**Scenario(s):** #219/220

- Lateral Offset = 0.4 NM
- SS Alerting Boundary = N/A NM
- Minimum Altitude Offset ≥ 300 ft

**Test Objective (TO)**

1. Demonstrate multi-threat RA during descend

**Evaluation Criteria**

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA1, CA2
- TO-2 TCAS issues a descent RA
- TO-3 TCAS issues a Multi-threat RA during descend to level-off

**Test Method**

- MANEUVER – Advisory then Auto
- MANEUVER – Fly commanded heading
- Ownship: 130 IAS, Intruders: 130 TAS
- Encounter Length: 5 min
- Stable Conditions: steady level flight and velocity at entry point
- Climb Rate: Ownship (~1500 FPM)
- Tolerance: distance is flexible, but intruder should be 3 nmi horizontally away from each other

**Success Criteria**

- Same as Evaluation Criteria

**Expected Results**

1. TCAS issues a descent RA
2. TCAS issues a level-off RA
3. TCAS issues a level-off RA (multiship)

**Additional Information**

- Validated in SIL
### Configuration

**System Under Test:** Any

**Display:** TCAS on HUD

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>Sensor</th>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>YES</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### Scenario(s): #221/222

- Lateral Offset = 0.4 NM
- SS Alerting Boundary = N/A NM
- Minimum Altitude Offset ≥ 300 ft

### Test Objective (TO)

1. Demonstrate multi-threat RA during descend

### Evaluation Criteria

- TO-1 Alerting shall progress from NO FACTOR, Proximate, SS, CA1, CA2
- TO-2 TCAS issues a descent RA
- TO-3 TCAS issues a Multi-threat RA during descend to level-off

### Test Method

- MANEUVER – Advisory only
- Ownship: 120 IAS, Intruders: 130 TAS
- Encounter Length: 5 min
- Stable Conditions: steady level flight and velocity at entry point
- Climb Rate: None

### Success Criteria

- Same as Evaluation Criteria

### Expected Results

1. TCAS issues a Do not descend >-500 FPM RA

+ Additional encounter >-1500 FPM RA

### Additional Information

Validated in SIL, need to extract SAAP data for horizontal and vertical CPA
UAS in the NAS
FT4 Test Objectives
(HON Tracker Scenarios)
TEST OBJECTIVES – Vertical Rate Estimation

Demonstrate performance in an overtaking scenario.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: GA-CPDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native Display (as opposed to VSCS, TCAS on HUD)</td>
</tr>
<tr>
<td>Contributing Sensors:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TCAS</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Fusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
<td>Yes</td>
<td>YES</td>
</tr>
</tbody>
</table>

Scenario(s): #223-226

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 400 ft

Test Objective (TO)

1. Test Vertical Rate Estimation for various vertical rates
2. SAA fusion processor correctly correlates TCAS and ADS-B & Radar tracks

Evaluation Criteria

Does the state estimate for vertical rate match the planned vertical rates of {+/- 500 ft/min, +/- 1000 ft/min; +/- 1500 ft/min; +/- 2000 ft/min}

Test Method

- 160 KIAS
- Vertical Rate Doublet -> climb rate for 30 sec; descend for 60 sec; climb for 30 sec.
- Encounter Length: as space allows. If can only fit one doublet in, then 3 min, else 3 min * number of vertical rate doublets
- Stable Conditions: 3 min before CPA
- Climb Rate: {+/- 500 ft/min, +/- 1000 ft/min; +/- 1500 ft/min; +/- 2000 ft/min}
- Roll Rate: 0
- Pitch Rate: 0
- Tolerance: ± 10 sec
- 4 doublets at the different altitude rates

Success Criteria

- Doublets completed with expected rates
- Data (sensor & track) collected in SAAP onboard Ikhana
- Data collected at the LVC (Time Synced)

Expected Results

Vertical Rates match

Additional Information
**TEST OBJECTIVES** – Horizontal maneuvers by both intruder and ownship aircraft simultaneously

Demonstrate performance in an overtaking scenario.

### Configuration

- **System Under Test:** [GA-CPDS]
- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)
- **Contributing Sensors:**

<table>
<thead>
<tr>
<th>Sensor Type</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS</td>
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<tr>
<td>ADS-B</td>
<td>YES</td>
</tr>
<tr>
<td>Radar</td>
<td>Yes</td>
</tr>
<tr>
<td>Fusion</td>
<td>YES</td>
</tr>
</tbody>
</table>

### Scenario(s): №227-229

- Ownship

### Test Objective (TO)

1. Tracking of an accelerating intruder
2. SAA fusion processor correctly correlates TCAS and ADS-B & Radar tracks

### Evaluation Criteria

Successful data collection with successful maneuvers

### Test Method

- 160 KIAS
- (pull from FT3 test cards)
- Standard turn rates (3 deg/sec)
- Roll Rate: 0
- Pitch Rate: 0
- Tolerance: ± 10 sec
- 3 scenarios

### Success Criteria

- Data (sensor & track) collected in SAAP onboard Ikhana
- Data collected at the LVC (Time Synced)

### Expected Results

Tracking during an accelerating encounter

### Additional Information
## TEST OBJECTIVES – Multi-Dimensional Intruder Maneuver

**Demonstrate performance in an overtaking scenario.**

### Configuration

**System Under Test:**

<table>
<thead>
<tr>
<th>Display</th>
<th>Native Display (as opposed to VSCS, TCAS on HUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributing Sensors:</td>
<td>TCAS</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
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</table>

### Scenario(s):

| #230-233 |

### Test Objective (TO)

1. Tracking of an intruder that is performing maneuvers in multiple dimensions
2. SAA fusion processor correctly correlates TCAS and ADS-B & Radar tracks

### Evaluation Criteria

Successful data collection with successful maneuvers

### Test Method

- 160 KIAS
- Standard turn rates (3 deg/sec)
- Climb rate of +/- 2000 ft/min
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- 2 scenarios minimally, 4 ideally

### Success Criteria

- Data (sensor & track) collected in SAAP onboard Ikhana
- Data collected at the LVC (Time Synced)

### Expected Results

Tracking during an accelerating encounter

### Additional Information

- **GA-CPDS**
- **TCAS**
- **ADS-B**
- **Radar**
  - **Fusion**
  - **YES**
  - **YES**
  - **Yes**
  - **YES**

45 deg right turn, 3 deg/sec

200 ft

2000 ft/min

200 ft

-2000 ft/min

5 nmi
## Test Objectives – Multi-Dimensional Ownship Maneuver

**Demonstrate performance in an overtaking scenario.**

### Configuration

**System Under Test:**

- **Display:** Native Display (as opposed to VSCS, TCAS on HUD)

**Contributing Sensors:**

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Status</th>
</tr>
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<tbody>
<tr>
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<tr>
<td>ADS-B</td>
<td>YES</td>
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<tr>
<td>Radar</td>
<td>Yes</td>
</tr>
<tr>
<td>Fusion</td>
<td>YES</td>
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</table>

### Scenario(s):

- #234-237

### Test Objective (TO)

1. Tracking of an intruder while ownship is performing maneuvers in multiple dimensions
2. SAA fusion processor correctly correlates TCAS and ADS-B & Radar tracks

### Evaluation Criteria

Successful data collection with successful maneuvers

### Test Method

- 160 KIAS
- Standard turn rates (3 deg/sec)
- Climb rate of +/- 1000 ft/min
- Roll Rate:
- Pitch Rate:
- Tolerance: ± 10 sec
- 2 scenarios minimally, 4 ideally

### Success Criteria

- Data (sensor & track) collected in SAAP onboard Ikhana
- Data collected at the LVC (Time Synced)

### Expected Results

Tracking during an accelerating encounter

### Additional Information

- **GA-CPDS**
- **TCAS**
- **ADS-B**
- **Radar**
- **Fusion**

---

**Figure:** Diagram showing an overtaking scenario with Ownship maneuvering. The diagram illustrates the tracking of an intruder while Ownship performs 45 deg right turn with 3 deg/sec at +/- 1000 ft/min. The Ownship is at 200 ft, and the intruder is 5 nmi away with a 45 deg right turn at -1000 ft/min.
**TEST OBJECTIVES** – Vertical maneuver by one aircraft while the other aircraft is performing an horizontal maneuver

**Demonstrate performance in an overtaking scenario.**

<table>
<thead>
<tr>
<th>Scenario(s):</th>
<th>#238-241</th>
</tr>
</thead>
</table>

| Configuration | System Under Test: **GA-CPDS**
Display: Native Display (as opposed to VSCS, TCAS on HUD) |
Contributing Sensors: |
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<th></th>
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<tr>
<td>TCAS</td>
<td>ADS-B</td>
</tr>
<tr>
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</tr>
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</table>

| Test Objective (TO) | 1. Tracking of an intruder that is performing maneuvers in multiple dimensions
2. SAA fusion processor correctly correlates TCAS and ADS-B & Radar tracks |

| Evaluation Criteria | Successful data collection with successful maneuvers |

| Test Method | • 160 KIAS
• Standard turn rates (3 deg/sec)
• Climb rate of +/- 1000 ft/min
• Rerun with intruder and ownship changing roles.
• Roll Rate:
• Pitch Rate:
• Tolerance: ± 10 sec
• 2 scenarios minimally, 4 ideally |

| Success Criteria | • Data (sensor & track) collected in SAAP onboard Ikhana
• Data collected at the LVC (Time Synced) |

| Expected Results | Tracking during an accelerating encounter |

| Additional Information | |

1000 ft/min
1000 ft/min
200 ft
45 deg right turn, 3 deg/sec
5 nmi
Ownship
UAS in the NAS
FT4 Test Objectives
(SC-228 RevC)

Won-Zon Chen, Ethan Pratt, Anthony Long
SC-228 V&V Group
14 March 2016
SC228 FT4 Test Objectives

1. Collect overall DAA system and subsystems performance and interface data to validate DAA MOPS requirements.
   a) Sec 2.2.2 DAA architecture and interface requirements
   b) Sec 2.2.3 DAA surveillance equipment, data processing, and tracking requirements
   c) Sec 2.2.4 DAA guidance requirements
   d) Sec 2.2.5 and 2.2.6 DAA display and pilot entry subsystem requirements
   e) Assumptions described in Appendices

2. Collect radar system performance and interface data to validate Radar MOPS requirements.

3. Collect data to validate simulation models used for MOPS validation.
FT4 Test Scenario Selection Process
Development Approach and Status

- 24 test configurations were identified based on test objectives in consideration of available DAA sensors and algorithms and operational constraints.
- A comprehensive set of 35 encounter geometries were identified including some described in OSED.
- Draft test scenarios have been coordinated with NASA OWG to better align with available test assets.
- Draft test scenarios have been compared with scenarios requested by other FT4 participants to remove duplicates.
- Draft test scenarios have been prioritized and reduced to a final set of 51 scenarios which meets the constraint of available flight time.

We will continue participating in NASA FT4 planning process to refine the final set of scenarios for flight test card preparation.
Summary of Test Configurations

<table>
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<th>TCAS II</th>
<th>Tracker</th>
<th>Guidance</th>
<th>Display</th>
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<th>ATC</th>
<th>Intruder</th>
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- Total of 24 different test configurations.
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<th>Airspeed (KIAS)</th>
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<td>1000</td>
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<td>150</td>
<td>7,700</td>
<td>0</td>
<td>100</td>
<td>8,000</td>
<td>0</td>
<td>-3.0</td>
<td>0.0</td>
<td>2,400</td>
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<td>VMC</td>
<td>N/A</td>
<td>Level Overtake of a turning intruder.</td>
</tr>
<tr>
<td>21</td>
<td>150</td>
<td>varying</td>
<td>1000</td>
<td>100</td>
<td>8,000</td>
<td>0</td>
<td>-3.0</td>
<td>0.0</td>
<td>2,400</td>
<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Ascending Overtake of a turning intruder</td>
</tr>
<tr>
<td>22</td>
<td>150</td>
<td>7,700</td>
<td>0</td>
<td>173</td>
<td>8,000</td>
<td>0</td>
<td>varying</td>
<td>225.0</td>
<td>2,400</td>
<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
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<td>Level encounter with an intruder turns 45 deg and straight in from left.</td>
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<tr>
<td>23</td>
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<td>173</td>
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<td>varying</td>
<td>270.0</td>
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<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
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<td>Level encounter with an intruder turns 90 deg and straight in from left.</td>
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<tr>
<td>24</td>
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<td>1000</td>
<td>100</td>
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<td>0</td>
<td>3.0</td>
<td>varying</td>
<td>3,200</td>
<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Climbing into a circling intruder (OSED N-2).</td>
</tr>
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</table>
Summary of Encounter Geometries (cont’d)

### Total of 35 different encounter geometries:
- 14 straight single intruder scenarios
- 16 maneuvering single intruder scenarios
- 5 multiple intruder scenarios

<table>
<thead>
<tr>
<th>Scenario #</th>
<th>Ownership Airspeed (KIAS)</th>
<th>Alt (ft)</th>
<th>V Rate (ft/min)</th>
<th>Intruder Airspeed (KIAS)</th>
<th>Alt (ft)</th>
<th>V Rate (ft/min)</th>
<th>T Rate (deg/sec)</th>
<th>IA (deg)</th>
<th>HMD (ft)</th>
<th>VMD (ft)</th>
<th>ATC</th>
<th>Weather</th>
<th>Airspace* Class</th>
<th>Notes</th>
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<tbody>
<tr>
<td>25</td>
<td>150</td>
<td>varying</td>
<td>1000</td>
<td>173</td>
<td>8,000</td>
<td>0</td>
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<td>2,400</td>
<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Climb and turn into a level intruder (OSED N-12)</td>
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</tr>
<tr>
<td>26</td>
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<td>varying</td>
<td>0.0</td>
<td>180.0</td>
<td>2,400</td>
<td>300</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Level Head-on with an intruder initially level but descending at 1500fpm toward the ownship.</td>
</tr>
<tr>
<td>27</td>
<td>150</td>
<td>8,000</td>
<td>0</td>
<td>173</td>
<td>varying</td>
<td>-1500</td>
<td>0.0</td>
<td>180.0</td>
<td>2,400</td>
<td>1000</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Head-on with an intruder initially descending but leveling off</td>
</tr>
<tr>
<td>28</td>
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<td>0</td>
<td>173</td>
<td>varying</td>
<td>-1500</td>
<td>0.0</td>
<td>90.0</td>
<td>2,400</td>
<td>1000</td>
<td>Selected Cases</td>
<td>VMC</td>
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<td>Abeam with an intruder initially descending but leveling off</td>
</tr>
<tr>
<td>29</td>
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<td>173</td>
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<td>1500</td>
<td>0.0</td>
<td>180.0</td>
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<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Head-on with an intruder initially ascending but leveling off</td>
</tr>
<tr>
<td>30</td>
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<td>-1000</td>
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<td>VMC</td>
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<tr>
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<td></td>
<td></td>
<td>Multiple Intruder Geometry</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Sandwiched by two head-on intruders horizontally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
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<td>10,000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Multiple Intruder Geometry</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Sandwiched by two head-on intruders vertically</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>150</td>
<td>10,000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Multiple Intruder Geometry</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Encounter with one parallel intruder and one turning intruder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>150</td>
<td>10,000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Multiple Intruder Geometry</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Encounter with two intruders above and one descends to avoid collision.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>150</td>
<td>10,000</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>Multiple Intruder Geometry</td>
<td>Selected Cases</td>
<td>VMC</td>
<td>N/A</td>
<td>Overtake an intruder above with a second intruder below in opposite direction (OSED N-7)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Airspace Class is handled inherently (i.e., speeds/altitudes are consistent with airspace classification).
## Summary of Selected Flight Test Scenarios

| Scenario # | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Notes | # of Scenarios |
| 1          |   | x | x |   |   |   |   |   |   | x | x | x | x | x | x | x |   |   |   |   |   |   |   |   | Level Head-on - low altitude/speed. | 6 |
| 2          |   |   |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Level Head-on - high altitude/speed. | 2 |
| 3          |   |   |   |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Ascending Head-on - low altitude/speed. | 0 |
| 4          |   |   |   |   |   | x | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Ascending Head-on - high altitude/speed. | 0 |
| 5          |   |   |   |   |   |   |   | x |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   | Descending Head-on. | 0 |
| 6          |   | x | x |   |   |   |   |   |   | x | x | x | x |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with intruder from right side - low altitude/speed. | 3 |
| 7          |   |   | x |   |   |   |   |   |   | x | x | x | x |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with intruder from right side - high altitude/speed. | 2 |
| 8          |   |   |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with intruder from left side. | 0 |
| 9          |   |   |   |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Ascending Abeam with intruder from left side (OSED N-4). | 0 |
| 10         |   |   | x |   |   |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a descending intruder that levels off 1000ft above. CPA at 6000ft. | 0 |
| 11         |   |   |   |   | x |   | x |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from right. | 0 |
| 12         |   |   | x |   |   |   |   |   |   |   |   | x | x |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from right. | 0 |
| 13         |   |   |   | x |   |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from right. | 0 |
| 14         | x | x | x |   |   |   |   |   |   | x | x | x | x |   |   |   |   |   |   |   |   |   |   |   | Ascending Head-on with a descending intruder. CPA at 6000ft. | 0 |
| 15         | x | x |   |   |   |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Ascending Head-on with a descending intruder that levels off 1000ft above. CPA at 6000ft. | 0 |
| 16         | x | x | x | x |   |   |   |   |   | x | x | x | x |   |   |   |   |   |   |   |   |   |   |   | Level Head-on with a turning intruder converging from right. | 0 |
| 17         | x | x | x | x | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from right. | 0 |
| 18         | x | x | x | x | x |   |   |   |   |   |   |   | x | x |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from left. | 0 |
| 19         | x | x | x | x | x |   |   |   |   | x | x | x | x | x |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from left. | 0 |
| 20         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with an intruder converging from left and turning right after SS maneuver (OSED N-12) | 0 |
| 21         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from left. | 0 |
| 22         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from left. | 0 |
| 23         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with an intruder initially descending but leveling off | 0 |
| 24         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with an intruder initially descending but leveling off | 0 |
| 25         | x | x |   |   | x |   |   |   |   | x | x | x |   |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with an intruder initially descending but leveling off | 0 |
| 26         | x | x |   |   | x |   |   |   |   | x | x | x | x |   |   |   |   |   |   |   |   |   |   |   | Level Abeam with a turning intruder converging from right. | 0 |

- **Total # of Scenarios:** 51

- **Covered by other FT4 participants**: 
- **Selected by SC-228**: 

**Total of 51 flight test scenarios**
Single Non-accelerating Intruder
FT4 TEST OBJECTIVES – SC228 Scenario #1 (Conf. 1-C)

Evaluate DAA system and subsystem performance for a level head-on encounter with a medium Mode C intruder (mitigated, medium closure rate, <10kft MSL)

**Configuration**

- **System Under Test:** Omnibands

- **Display:** VSCS

- **RCS Mode C ADS-B TCAS II**
  - TA/RA: YES
  - ADS-B: YES
  - Radar: NO
  - Tracker: NO

- **USAF C-12 @ 173 KTAS preferred; if not, then TG-14 @100 KTAS**

**Scenario(s):** #242

**Test Objectives (TO)**
1. Collect Mode-C and radar data and fusion tracker data
2. Collect pilot/system performance data with Omnibands guidance and potential TCAS RAs
3. Intruder equipage (i.e., Mode-C only) has priority over its speed and RCS.

**Success Criteria (retest if criteria not met)**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANUEVER: Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 to 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
- Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #2 (Conf. 1-D)

Evaluate DAA system and subsystem performance for a level head-on encounter with a medium Mode C intruder (mitigated, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS

Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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Intruder Equipage:

<table>
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<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

USAF C-12 @ 173 KTAS preferred; if not then TG-14 @ 100 KTAS.

Scenario(s): #243

Test Objectives (TO)

1. Same as the previous scenario (scenario #1) except TCAS II is placed in TA-only mode for this scenario and hence, no RA is expected. This will allow SS guidance provided by Omnibands to play out without interplays caused by TCAS RAs.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 to 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
## FT4 TEST OBJECTIVES – SC228 Scenario #3 (Conf. 1-J)

Evaluate DAA system and subsystem performance for a level head-on encounter with a medium non-cooperative intruder (mitigated, medium closure rate, <10kft MSL)

### MOPS Sections
- 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

<table>
<thead>
<tr>
<th>Display: Native display</th>
<th>Intruder Equipage:</th>
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#### Configuration Table

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<tr>
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<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

<table>
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<tr>
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<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
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</table>

### System Under Test:
- **DAIDALUS**

### Display
- **Ownship @ 150 KTAS**
- **Intruder @ 173 KTAS**
- **0° Relative**

### Scenario(s):
- **#244**

### Test Objectives (TO)
1. Collect radar data and fusion tracker data (operating with single sensor only)
2. Collect pilot/system performance data with DAIDALUS guidance
3. Intruder equipage is not a factor. Intruder speed has priority over RCS (medium is preferred but large is acceptable).

### Success Criteria
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

### Test Method
- **MANEUVER:** Follow guidance to remain well clear.
- **Aircraft speeds (non-accelerating):** Ownship 150 KTAS, Intruder 173 KTAS
- **Encounter Length:** 2 min (IP to CPA)
- **Stable Conditions:** stable at the IP (2 minutes prior to CPA)
- **Test Termination Criteria:** targets diverging, range > 0.75 nm, no DAA alerts displayed.
- **Expected guidance:** TBD
- **Tolerance:** ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

### Additional Information
- **Priority:** High.
**FT4 TEST OBJECTIVES – SC228 Scenario #4 (Conf. 1-K)**

**Evaluate DAA system and subsystem performance for a level head-on encounter with a large TCAS/ADS-B intruder (mitigated, medium closure rate, <10kft MSL)**

**MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.**

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<th>CPDS</th>
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<tr>
<td><strong>Contributing Sensors (Ownship):</strong></td>
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<td></td>
</tr>
<tr>
<td>TCAS II</td>
<td>ADS-B</td>
<td>Radar</td>
</tr>
<tr>
<td>TA/RA</td>
<td>YES</td>
<td>YES</td>
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<td><strong>RCS</strong></td>
<td><strong>Mode C</strong></td>
<td><strong>ADS-B</strong></td>
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<tr>
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<td>YES</td>
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<tr>
<td>Intruder Equipage:</td>
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<td></td>
</tr>
<tr>
<td>(N3GC or GIII)</td>
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<td></td>
</tr>
</tbody>
</table>

**Scenario(s):**  
#245

**Ownship @ 150 KTAS**  
0° Relative  
**Intruder @ 173 KTAS**  
300 ft

**Test Objectives (TO)**
1. Collect Mode-S, ADS-B, and radar data and fusion tracker data
2. Collect pilot/system performance data with CPDS guidance and potential TCAS RAs

**Success Criteria**
(retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- **MANEUVER:** Follow guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

**Evaluation Criteria**  
(Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
- Priority: Medium.
Evaluate DAA system and subsystem performance for a level head-on encounter with a large TCAS/ADS-B intruder (mitigated - WCR only, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

Display: CDTI/VPD
Contributing Sensors (Ownship):
<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
<td>YES</td>
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<td>YES</td>
</tr>
</tbody>
</table>

Intruder Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

(N3GC or GIII)

Scenario(s):

#246

Test Objectives (TO)

1. Same as the previous scenario (scenario #4) except this scenario focuses on testing well clear recover (WCR) guidance.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Ignore SS guidance until WCR guidance is issued and then follow WCR guidance to regain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
Evaluate DAA system and subsystem performance for a level head-on encounter with a medium non-cooperative intruder (mitigated, medium closure rate, <10kft MSL)

**Configuration**
- System Under Test: CPDS
- Display: CDTI/VPD
- Contributing Sensors (Ownship):
  - TCAS II
  - ADS-B
  - Radar
  - Tracker
- Intruder Equipage:
  - RCS
  - Mode C
  - ADS-B
  - TCAS II

**Scenario(s):**
- #247

**Test Objectives (TO)**
1. Collect radar data and fusion tracker data (single sensor only)
2. Collect pilot/system performance data with CPDS guidance
3. Intruder equipage is not a factor. Intruder speed has priority over RCS (medium is preferred but large is acceptable).

**Success Criteria (retest if criteria not met)**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANUEVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
- Priority: High.
**Evaluate DAA system and subsystem performance for a level head-on encounter with a large TCAS/ADS-B intruder (mitigated, high closure rate, >10kft MSL)**

**Configuration**
- **System Under Test:** DAIDALUS
- **Display:** Native display
- **Contributing Sensors (Ownship):**
  - TCAS II: YES
  - ADS-B: YES
  - Radar: YES
  - Tracker: YES
- **Intruder Equipage:**
  - TCAS II: NO
  - ADS-B: YES
  - Radar Tracker: YES
  - RCS: Mode C

**Scenario(s):** #248

**Test Objectives (TO):**
1. Main focus on high-speed, high-altitude operation
2. Collect Mode-S, ADS-B, and radar data and fusion tracker data
3. Collect pilot/system performance data with DAIDALUS guidance and potential TCAS RAs

**Success Criteria (retest if criteria not met):**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 180 KTAS, Intruder 425 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
- Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #8 (Conf. 2-K)**

**Evaluate DAA system and subsystem performance for a level head-on encounter with a large TCAS/ADS-B intruder (mitigated, high closure rate, >10kft MSL)**

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

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<thead>
<tr>
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<tr>
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<tr>
<td>Contributing Sensors (Ownship):</td>
<td></td>
</tr>
<tr>
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<td>ADS-B</td>
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<td>TA/RA</td>
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</tr>
<tr>
<td>Intruder Equipage:</td>
<td></td>
</tr>
<tr>
<td>RCS</td>
<td>Mode C</td>
</tr>
<tr>
<td>L</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Scenario(s):** #249

**Test Objectives (TO)**

1. Same as the previous scenario (scenario #7) except SS guidance is provided by CPDS.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 180 KTAS, Intruder 425 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #9 (Conf. 6-C)

Evaluate DAA system and subsystem performance for a level abeam encounter with medium Mode C intruder from right side (mitigated, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
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</table>

Intruder Equipage:

<table>
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<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
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<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

USAF C-12 @ 173 KTAS preferred; if not, then TG-14 @ 100 KTAS.

Lateral Offset = 0.4 NM
SS Alerting Boundary = 0.75 NM
Minimum Altitude Offset ≥ 300 ft

Scenario(s): #250

Test Objectives (TO)
1. Collect Mode-C and radar data and fusion tracker data
2. Collect pilot/system performance data with Omnibands guidance and potential TCAS RAs
3. Intruder equipage (i.e., Mode-C only) has priority over its speed and RCS.

Success Criteria (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method
- MANUEVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 to 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information
Priority: High.
Evaluate DAA system and subsystem performance for a level Abeam encounter with a medium Mode C intruder (mitigated, medium closure rate, <10kft MSL)

Configuration

System Under Test: Omnipands

Display: VSCS
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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Intruder Equipage:

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<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

USAF C-12 @ 173 KTAS preferred, if not, then TG-14 @ 100 KTAS.

Scenario(s):

#251

Test Objectives (TO)

1. Same as the previous scenario (scenario #9) except TCAS II is placed in TA-only mode for this scenario and hence, no RA is expected. This will allow SS guidance provided by Omnipands to play out without interplays caused by TCAS RAs.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 to 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
Evaluate DAA system and subsystem performance for a level abeam encounter with medium non-cooperative intruder from right side (mitigated, medium closure rate, <10kft MSL)

### Test Objectives (TO)
1. Collect radar data and fusion tracker data (operating with single sensor only)
2. Collect pilot/system performance data with DAIDALUS guidance
3. Intruder equipage is not a factor. Intruder speed has priority over RCS (medium is preferred but large is acceptable).

### Success Criteria (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

### Test Method
- MANUEVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

### Additional Information
Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #12 (Conf. 9-A)**

Evaluate DAA system and subsystem performance for an ascending abeam encounter with a large cooperative intruder from left side (mitigated, medium closure rate, <10kt MSL)

**MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.**

<table>
<thead>
<tr>
<th>Configuration</th>
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</thead>
<tbody>
<tr>
<td>Display</td>
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</tr>
<tr>
<td>Contributing Sensors (Ownship):</td>
<td>Intruder Equipage:</td>
</tr>
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</tr>
<tr>
<td>L</td>
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</tr>
</tbody>
</table>

**Scenario(s): #253**

**Test Objectives (TO)**
1. Collect Mode-S, ADS-B, and radar data and fusion tracker data
2. Collect pilot/system performance data with Ominbands guidance and potential TCAS RAs
3. Collect right of way data

**Success Criteria (retest if criteria not met)**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if triggered.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
Priority: High.

- Lateral Offset = 0.4 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

**Scenario Details**
- Intruder @ 173 KTAS
- Ownship @ 150 KTAS
- Slant range between IPs ~ 7.6nm
- Altitude above ground = 1000 ft
- Vertical rate = 2000 ft/min
- Minimum vertical offset = 500 ft
FT4 TEST OBJECTIVES – SC228 Scenario #13 (Conf. 11-A)

Evaluate DAA system and subsystem performance for a fast level overtake encounter with a cooperative intruder (mitigated, low closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS

Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
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</tbody>
</table>

Intruder Equipage:

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<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

(T-34 or TG-14)

Intruder @ 100 KTAS

Ownship @ 150 KTAS

(Virtual offset can be used if 500ft physical separation is required for safety reason)

Scenario(s): #254

(Key requirement is to maintain closure rate to 40 – 50 KTAS)

Test Objectives (TO)

1. Collect TCAS, ADS-B, and radar data and fusion tracker data.
2. Collect pilot/system performance data with Omnibands guidance and its interplays with TCAS RAs.
3. Key requirement for this scenario is to maintain closure rate to 40 – 50 KTAS. The absolute speeds are less important. For example, 180 vs 130 KTAS would work too.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if triggered.
- Aircraft speeds (non-accelerating): Ownship/Intruder speeds: 150/100 KTAS or 180/130 KTAS
- Encounter Length: 3 min (IP to CPA)
- Stable Conditions: stable at the IP (3 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #14 (Conf. 11-E)

Evaluate DAA system and subsystem performance for a fast level overtake encounter with a non-cooperative intruder (mitigated, low closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS
Contributing Sensors (Ownship):

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<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Intruder Equipage:

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<td>ON if equipped</td>
<td>ON if equipped</td>
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</table>

(T-34 or TG-14)

Omnibands

Intruder @ 100 KTAS

Ownship @ 150 KTAS

(Key requirement is to maintain closure rate to 40 – 50 KTAS)

Scenario(s): #255

Test Objectives (TO)

1. Same as the previous scenario (scenario #13) except the intruder is non-cooperative (i.e., radar data only for DAA processing) for this scenario. No TCAS RAs is expected.
2. Like the previous case, key requirement is to maintain closure rate to 40 – 50 KTAS. The absolute speeds are less important. For example, 180 vs 130 KTAS would work too. Intruder RCS is also less important (medium is preferred but large is acceptable).

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANUEVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship/intruder speeds: 150 /100 KTAS or 180/130 KTAS
- Encounter Length: 3 min (IP to CPA)
- Stable Conditions: stable at the IP (3 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #15 (Conf. 13-A)**

Evaluate DAA system and subsystem performance for a descending fast overtake encounter with a cooperative intruder (mitigated, low closure rate, <10kft MSL)

**Configuration**

**System Under Test:** Omnibands

**Display:** VSCS

**Contributing Sensors (Ownship):**

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<th>TCAS II</th>
<th>ADS-B</th>
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<th>Tracker</th>
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<tbody>
<tr>
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</table>

**Intruder Equipage:**

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<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
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<tbody>
<tr>
<td>M/L</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

(T-34 or TG-14)

**Scenarios:**

- #256

**Test Objectives (TO)**

1. Collect TCAS, ADS-B, and radar data and fusion tracker data.
2. Collect pilot/system performance data with Omnibands guidance and its interplays with TCAS RAs.
3. Key requirement for this scenario is to maintain closure rate to 40 – 50 KTAS. The absolute speeds are less important. For example, 180 vs 130 KTAS would work too.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if triggered.
- Aircraft speeds (non-accelerating): Ownship/intruder speeds: 150/100 KTAS or 180/130 KTAS.
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluate DAA system and subsystem performance for a descending fast overtake encounter with a cooperative intruder (mitigated, low closure rate, <10kft MSL)

**Configuration**

- **System Under Test:** CPDS

**Display:** CDTI/VPD

**Contributing Sensors (Ownship):**

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<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
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</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
<td>YES</td>
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</tbody>
</table>

**Intruder Equipage:**

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<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

- **Intruder @ 100 KTAS**
- **Ownship @ 150 KTAS**

(Key requirement is to maintain closure rate to 40 – 50 KTAS)

**Scenario(s):** #257

**Test Objectives (TO)**

1. Same as previous scenario (scenario #15) except CPDS is used to provide SS guidance for this scenario.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if triggered.
- Aircraft speeds (non-accelerating): Ownship/intruder speeds: 150/100 KTAS or 180/130 KTAS.
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Priority:** High.
Evaluate DAA system and subsystem performance for ascending head-on with a descending non-cooperative intruder (mitigated, high vertical closure rate, <10kft MSL) MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Intruder Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
</tr>
</tbody>
</table>

Scenario(s): 

#258

Ownship @ 150 KTAS
Intruder @ 173 KTAS

Test Objectives (TO)

1. Collect radar data and fusion tracker data (operating with single sensor only)
2. Collect pilot/system performance data with Omnibands guidance
3. Intruder equipage is not a factor. Intruder speed has priority over RCS (medium is preferred but large is acceptable).

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #18 (Conf. 14-J)**

**Evaluate DAA system and subsystem performance for ascending head-on with a descending non-cooperative intruder (mitigated, high vertical closure rate, <10kft MSL)**

**Configuration**
- **System Under Test:** DAIDALUS

**Display:** Native display

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
</tr>
</tbody>
</table>

**Scenario(s):** #259

**Ownship @ 150 KTAS**

**Intruder @ 173 KTAS**

- **RCS:** M/L
- **Lateral Offset:** 0.4 NM
- **SS Alerting Boundary:** 0.75 NM
- **Minimum Altitude Offset:** ≥ 500 ft
- **Slant range between two IPs:** ~ 10.8nm

**Test Objectives (TO):**
1. Same as previous scenario (scenario #17) except that DAIDALUS is used to provide SS guidance for this scenario.

**Success Criteria** (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- **MANEUVER:** Follow SS guidance to remain well clear.
- **Aircraft speeds (non-accelerating):** Ownship 150 KTAS, Intruder 173 KTAS
- **Encounter Length:** 2 min (IP to CPA)
- **Stable Conditions:** stable at the IP (2 minutes prior to CPA)
- **Test Termination Criteria:** targets diverging, range > 0.75 nm, no DAA alerts displayed.
- **Expected guidance:** TBD
- **Tolerance:** ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Priority:** High.
FT4 TEST OBJECTIVES – SC228 Scenario #19 (Conf. 14-K)

Evaluate DAA system and subsystem performance for ascending head-on with a descending large cooperative intruder (mitigated, high vertical closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

<table>
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<tr>
<th>Display: CDTI/VPD</th>
<th>Contributing Sensors (Ownship):</th>
<th>Intruder Equipage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS II</td>
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<td>Radar</td>
</tr>
<tr>
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<tr>
<td>RCS</td>
<td>Mode C</td>
<td>ADS-B</td>
</tr>
<tr>
<td>L</td>
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<td>YES</td>
</tr>
</tbody>
</table>

(N3GC)

Scenario(s): #260

Scenario execued as specified.

Test Objectives (TO)

1. Collect TCAS, ADS-B, and radar data and fusion tracker data.
2. Collect pilot/system performance data with CPDS guidance and its interplays with TCAS RAs.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Follow SS guidance to remain well clear. Follow TCAS RAs if triggered.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #20 (Conf. 14-O)

Evaluate DAA system and subsystem performance for ascending head-on with a descending non-cooperative intruder (mitigated, high vertical closure rate, <10kft MSL) MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration
System Under Test: CPDS
Display: CDTI/VPD
Contributing Sensors (Ownship):

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<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
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<tbody>
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Intruder Equipage:

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<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
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<td>M/L</td>
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<td>ON if equipped</td>
<td>ON if equipped</td>
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Configuration System Under Test: CPDS
Display: CDTI/VPD
Contributing Sensors (Ownship):

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<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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Intruder Equipage:

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<th>ADS-B</th>
<th>TCAS II</th>
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</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
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<td>ON if equipped</td>
</tr>
</tbody>
</table>

Scenario(s): #261

Test Objectives (TO) 1. Same as previous scenarios (scenarios #17 & 18) except CPDS is used to provide SS guidance for this scenario.

Success Criteria (retest if criteria not met) 1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method
- MANUEVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Expected guidance: TBD
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met) 1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information Priority: High.
Single Maneuvering Intruder
FT4 TEST OBJECTIVES – SC228 Scenario #21 (Conf. 15-A)

Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, high vertical closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration (System Under Test): Omnibands

Display: VSCS
Contributing Sensors (Ownership):

<table>
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<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
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</tr>
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</table>

Intruder Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
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</table>

(N3GC)

Scenario(s): #262

Test Objectives (TO)

1. This scenario is designed to test the chance of false alert under high vertical closure rate condition given the MOPS alerting threshold.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

Test Method

- MANEUVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 1000 fpm, Intruder -1500 fpm
- Expected guidance: Intermittent corrected alerts but no warning alert. No TCAS RA is expected.
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, high vertical closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

**Configuration**

**System Under Test:** DAIDALUS

**Display:** Native display

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
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</tr>
</tbody>
</table>

**Scenario(s):** #263

**Test Objectives (TO):**

1. Same as previous scenario (scenario #21) except DAIDALUS is used to provide SS guidance for this scenario.

**Success Criteria (retest if criteria not met):**

1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

**Test Method:**

- MANEUVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 1000 fpm, Intruder -1500 fpm
- Expected guidance: Intermittent corrected alerts but no warning alert. No TCAS RA is expected.
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #23 (Conf. 15-K)

Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, high vertical closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: CPDS

Display: CDTI/VPD
Contributing Sensors (Ownship):

<table>
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<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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<td>YES</td>
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Intruder Equipage:

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<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
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</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Scenario(s): #264

Test Objectives (TO)

1. Same as previous scenarios (scenarios #21 ad #22) except CPDS is used to provide SS guidance for this scenario.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

Test Method

- MANEUVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 1000 fpm, Intruder -1500 fpm
- Expected guidance: Intermittent corrected alerts but no warning alert. No TCAS RA is expected.
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
**Scenario(s): #265**

**Test Objectives (TO)**
1. This scenario is designed to test system’s ability to deal with turning intruder (initially well clear until it turns) with relatively accurate sensor data. (i.e., ADS-B available for fusion tracker)

**Success Criteria (retest if criteria not met)**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANEUVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship $0 \text{ deg/s}$, Intruder $1.5 \text{ deg/s}$
- Tolerance: $\pm 8 \text{ sec}$, $\pm 5 \text{kts}$ at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Configuration**
- System Under Test: Omnibands
- Display: VSCS
- Contributing Sensors (Ownship):
  - TCAS II: YES
  - ADS-B: YES
  - Radar: YES
  - Tracker: YES
- Intruder Equipage:
  - TCAS II: NO
  - Mode C: YES
  - ADS-B: NO

**Additional Information**
Priority: High.

**Notes**
- Lateral Offset = 0.4 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset $\geq 300$ ft
- (Virtual offset can be used if 500ft physical separation is required for safety reason)
- (T-34 for best visibility)
- Ownship at 150 KTAS
- Intruder at 173 KTAS
- slang range at maneuvering point ~ 4.6nm
- $1.5 \text{/sec}$
- $1.4 \text{ nm}$
Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, medium closure rate, <10kft MSL) 

**Configuration**
- **System Under Test:** Omnibands
- **Display:** VSCS
- **Contributing Sensors (Ownship):**
  - TCAS II: NO
  - ADS-B: NO
  - Radar: YES
  - Tracker: YES
- **Intruder Equipage:**
  - RCS: M/L
  - Mode C: ON if equipped
  - ADS-B: ON if equipped
  - TCAS II: ON if equipped

**Scenario(s):** #266

**Test Objectives (TO):**
1. Same as previous scenario (scenario #24) except that only radar data is available for DAA processing.

**Success Criteria (retest if criteria not met):**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method:**
- **MANEUVER:** Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder 1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information:**
- Priority: High.
Evaluate DAA system and subsystem performance for a turning intruder encounter with a cooperative intruder (mitigated, medium closure rate, <10kft MSL) 

**Configuration**

System Under Test: **DAIDALUS**

**Display:** Native display

**Contributing Sensors (Ownship):**

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<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
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**Intruder Equipage:**

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<th>ADS-B</th>
<th>TCAS II</th>
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<tr>
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**Configuration System Under Test:**

**Display:** Native display

**Contributing Sensors (Ownship):**

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**Intruder Equipage:**

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<tbody>
<tr>
<td>L</td>
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</table>

**Scenario(s):** #267

- Ownship @ 150 KTAS
- Intruder @ 173 KTAS

(slang range @ maneuvering point ~ 4.6nm)

**Test Objectives (TO):**

1. Same as previous scenario (scenario #24) except that DAIDALUS is used to provide SS guidance.

**Success Criteria**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANUEVER: Follow SS guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder 1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

- Priority: High.

**MOPS Sections:** 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.
Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, medium closure rate, <10kft MSL)

**Configuration**
- System Under Test: DAIDALUS
- Display: Native display
- Contributing Sensors (Ownship):
  - TCAS II: NO
  - ADS-B: NO
  - Radar: YES
  - Tracker: YES
- Intruder Equipage:
  - RCS: M/L
  - Mode C: ON if equipped
  - ADS-B: ON if equipped
  - TCAS II: ON if equipped

**Scenario(s):** #268

**Test Objectives (TO)**
1. Same as previous scenario (scenario #25) except DAIDALUS is used to provide SS guidance.

**Success Criteria**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**
- MANEUVER: Follow guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder 1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**
- Priority: High.
Evaluate DAA system and subsystem performance for a turning intruder encounter with a cooperative intruder (mitigated, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

<table>
<thead>
<tr>
<th>Display: CDTI/VPD</th>
<th>Intruder Equipage:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCAS II</td>
<td>ADS-B</td>
</tr>
<tr>
<td>TA/RA</td>
<td>YES</td>
</tr>
</tbody>
</table>

(T-34 for best visibility)

---

### Test Objectives (TO)

1. Same as previous scenarios (scenarios #24 and #26) except that CPDS is used to provide SS guidance.

---

### Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

---

### Test Method

- MANEUVER: Follow guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder 1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

---

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

---

### Additional Information

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #29 (Conf. 16-O)

Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

**System Under Test:** CPDS

**Display:** CDTI/VPD

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
</tr>
</tbody>
</table>

(T-34 for best visibility)

### Scenario(s):

#270

(slang range @ maneuvering point ~ 4.6nm)

### Test Objectives (TO)

1. Same as previous scenarios (scenarios #25 and #27) except that CPDS is used to provide SS guidance.

### Success Criteria

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

### Test Method

- MANEUVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder 1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

### Additional Information

Priority: High.

- Lateral Offset = 0.4 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 300 ft

(Virtual offset can be used if 500ft physical separation is required for safety reason)

- TCAS II
- ADS-B
- Radar
- Tracker
Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, low closure rate, <10kft MSL)

**Configuration**

<table>
<thead>
<tr>
<th>System Under Test:</th>
<th>Omnibands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display: VSCS</td>
<td></td>
</tr>
<tr>
<td>Intruder Equipage:</td>
<td></td>
</tr>
</tbody>
</table>

**MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.**

**Scenario(s):**

#271

**Test Objectives (TO)**

1. This scenario is designed to test system’s ability to deal with turning intruder with radar data only.
2. Key requirement for this scenario is to have closure rate in the range of 40 – 50 KTAS. The absolute speeds are less important. For example, 180 vs 130 KTAS would work too.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANUEVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level).
- Aircraft speeds (non-accelerating): Ownship/intruder speeds: 150 /100 KTAS or 180/130 KTAS.
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder -1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #31 (Conf. 20-J)

Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, low closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

**System Under Test:** DAIDALUS

**Display:** Native display

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
</tr>
</tbody>
</table>

(T-34 or TG-14)

---

### Scenario(s): 

#272

---

### Test Objectives (TO)

1. Same as previous scenario (scenario #30) except that DAIDALUS is used to provide SS guidance.

---

### Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

---

### Test Method

- **MANEUVER:** Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder -1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

---

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

---

### Additional Information

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #32 (Conf. 20-0)

Evaluate DAA system and subsystem performance for a turning intruder encounter with a medium non-cooperative intruder (mitigated, low closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: CPDS

Display: CDTI/VPD

Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Intruder Equipage:

<table>
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<tr>
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<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M/L</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
<td>ON if equipped</td>
</tr>
</tbody>
</table>

(T-34 or TG-14)

Scenario(s):

#273

Test Objectives (TO)

1. Same as previous scenarios (scenarios #30 and #31) except that CPDS is used to provide SS guidance.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Follow SS guidance to remain well clear.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Turn Rate: Ownship 0 deg/s, Intruder -1.5 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #33 (Conf. 24-A)

Evaluate DAA system and subsystem performance for a climb into circling intruder encounter with a cooperative intruder (mitigated, medium closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands

Display: VSCS
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
<td>YES</td>
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</tbody>
</table>

Intruder Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/M</td>
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<td>NO</td>
</tr>
</tbody>
</table>

(TG-14 preferred due to low speed capability and hence tighter turn)

Success Criteria

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Pilot to manually select and execute 'minimum' maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 KTAS or any to meet the turn radius requirement
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 1000 fpm, Intruder 0 fpm
- Turn Rate: Ownship 0 deg/s, Intruder 3 deg/s or any to meet the turn radius requirement
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #34 (Conf. 24-F)**

Evaluate DAA system and subsystem performance for a climb into circling intruder encounter with a cooperative intruder (mitigated, medium closure rate, <10kft MSL)

**System Under Test:** DAIDALUS

**Display:** Native display

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

(TG-14 preferred due to low speed capability and hence tighter turn)

Configuration System Under Test: DAIDALUS

**Scenario(s):** #275

Ownship @ 150 KTAS

Intruder @ 100 KTAS

(Key requirement is to keep loiter radius ~ 3200ft)

**Test Objectives (TO)**

1. Same as previous scenario (scenario #33) except DAIDALUS is used to provide SS guidance.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 100 KTAS or any to meet the turn radius requirement
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 1000 fpm, Intruder 0 fpm
- Turn Rate: Ownship 0 deg/s, Intruder 3 deg/s or any to meet the turn radius requirement
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
### FT4 TEST OBJECTIVES – SC228 Scenario #35 (Conf. 24-K)

**Evaluate DAA system and subsystem performance for a climb into circling intruder encounter with a cooperative intruder (mitigated, medium closure rate, <10kft MSL)**

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

<table>
<thead>
<tr>
<th>Scenario(s):</th>
<th>#276</th>
</tr>
</thead>
</table>

#### Configuration

**System Under Test:** CPDS

**Display:** CDTI/VPD

**Contributing Sensors (Ownship):**

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
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<td>YES</td>
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</tbody>
</table>

**Intruder Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

(TG-14 preferred due to low speed capability and hence tighter turn)

- **Ownship @ 150 KTAS**
- **Intruder @ 100 KTAS**

(Key requirement is to keep loiter radius ~ 3200ft)

- Lateral Offset = 0.5 NM
- SS Alerting Boundary = 0.75 NM
- Minimum Altitude Offset ≥ 500 ft

#### Test Objectives (TO)

1. Same as previous scenarios (scenarios #33 and #34) except that CPDS is used to provide SS guidance.

#### Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

#### Test Method

- **MANEUVER:** Pilot to manually select and execute ‘minimum’ maneuver at edge of band (or quantized altitude level). Pilot to follow TCAS RAs if generated.
- **Aircraft speeds (non-accelerating):** Ownship 150 KTAS, Intruder 100 KTAS or any to meet the turn radius requirement
- **Encounter Length:** 2 min (IP to CPA)
- **Stable Conditions:** stable at the IP (2 minutes prior to CPA)
- **Test Termination Criteria:** targets diverging, range > 0.75 nm, no DAA alerts displayed.
- **Climb Rate:** Ownship 1000 fpm, Intruder 0 fpm
- **Turn Rate:** Ownship 0 deg/s, Intruder 3 deg/s or any to meet the turn radius requirement
- **Tolerance:** ± 8 sec, ± 5 kts at IP crossing.

#### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

#### Additional Information

**Priority:** High.
FT4 TEST OBJECTIVES – SC228 Scenario #36 (Conf. 25-A)

Evaluate DAA system and subsystem performance for climb & turn into a level large TCAS/ADS-B intruder (mitigated, medium closure rate, <10kft MSL)

Configuration

<p>| Display: VSCS | Contributing Sensors (Ownship): |</p>
<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

<p>| Intruder Equipage: |</p>
<table>
<thead>
<tr>
<th>TCAS II</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Scenario(s): #277

Ownship @ 150 KTAS

Intruder @ 173 KTAS

1.5°/sec

(Slant range at maneuvering point ~ 4.9nm)

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
**FT4 TEST OBJECTIVES – SC228 Scenario #37 (Conf. 25-F)**

Evaluate DAA system and subsystem performance for climb & turn into a level large TCAS/ADS-B intruder (mitigated, medium closure rate, <10kft MSL)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>System Under Test: [DAIDALUS]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Native display</td>
</tr>
<tr>
<td>Contributing Sensors (Ownship):</td>
<td></td>
</tr>
<tr>
<td>TCAS II</td>
<td>ADS-B</td>
</tr>
<tr>
<td>TA/RA</td>
<td>YES</td>
</tr>
<tr>
<td>Intruder Equipage:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RCS</td>
</tr>
<tr>
<td></td>
<td>L</td>
</tr>
</tbody>
</table>

**Configuration System Under Test:**

**Display:** Native display

**Contributing Sensors (Ownship):**

- TCAS II: YES
- ADS-B: YES
- Radar: YES
- Tracker: YES

**Intruder Equipage:**

- RCS: NO
- Mode C: YES
- ADS-B: YES
- TCAS II: YES

**Scenario(s):** 

#278

**Test Objectives (TO):**

1. Same as previous scenario (scenario #36) except that DAIDALUS is used to provide SS guidance.

**Success Criteria (retest if criteria not met):**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method:**

- MANUEVER: Follow SS guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb and turn Rates: Ownship 1000 fpm and 1.5 deg/s, Intruder 0 fpm and 0 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluate DAA system and subsystem performance for climb & turn into a level large TCAS/ADS-B intruder (mitigated, medium closure rate, <10kft MSL)

**Configuration**

- **System Under Test:** CPDS
- **Display:** CDTI/VPD
- **Intruder Equipage:**
  - TCAS II: YES
  - ADS-B: YES
  - Radar: YES
  - Tracker: YES

**Configuration**

- **System Under Test:** CPDS
- **Display:** CDTI/VPD
- **Intruder Equipage:**
  - TCAS II: YES
  - ADS-B: YES
  - Radar: YES
  - Tracker: YES

**Test Objectives (TO)**

1. Same as previous scenarios (scenarios #36 and #37) except that CPDS is used to provide SS guidance.

**Success Criteria**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Follow guidance to remain well clear. Follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb and turn Rates: Ownship 1000 fpm and 1.5 deg/s, Intruder 0 fpm and 0 deg/s
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Priority:** High.
Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, moderate vertical closure rate, <10kft MSL) - MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: Omnibands
Display: VSCS
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
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Intruder Equipage:

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<tbody>
<tr>
<td>L</td>
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</table>

Scenario(s): #280

Test Objectives (TO)
1. This scenario is designed to test the chance of false alert under moderate vertical closure rate condition given the MOPS alerting threshold.

Success Criteria (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

Test Method
- MANUEVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 0 fpm, Intruder -1500 fpm
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information
Priority: Medium.
Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, moderate vertical closure rate, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

**Configuration**

System Under Test: **DAIDALUS**

**Display**: Native display

**Contributing Sensors (Ownship)**: TCAS II, ADS-B, Radar, Tracker

**Intruder Equipage**: TCAS II, ADS-B, Radar, Tracker

**Scenario(s): #281**

**Success Criteria**

1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

**Test Method**

- MANEUVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 0 fpm, Intruder: -1500 fpm
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Priority**: Medium.
Evaluate DAA system and subsystem performance for a vertical closure encounter with a large TCAS/ADS-B intruder (mitigated, moderate vertical closure rate, <10kft MSL) according to MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

- **System Under Test:** CPDS
- **Display:** CDTI/VPD
- **Contribution Sensors (Ownship):**
  - TCAS II: TA/RA
  - ADS-B: YES
  - Radar: YES
  - Tracker: YES
- **Intruder Equipage:**
  - TCAS II: L
  - Mode C: NO
  - ADS-B: YES
  - Radar: YES

### Scenario(s): #282

- **Ownship @ 150 KTAS**
- **Intruder @ 173 KTAS**
- **Lateral Offset = 0.4 NM**
- **SS Alerting Boundary = 0.75 NM**
- **Minimum Altitude Offset ≥ 1500 ft**
- **Relative Ownship @ 150 KTAS**
- **Intruder @ 173 KTAS**

### Test Objectives (TO)

1. Same as previous scenarios (scenarios #39 and #40) except that CPDS is used to provide SS guidance for this scenario.

### Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts: TBD
3. Data collected: TBD

### Test Method

- MANEUVER: No pilot maneuver is expected.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Intruder 173 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb Rate: Ownship 0 fpm, Intruder -1500 fpm
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

### Additional Information

- Priority: Medium.
Multiple Intruders
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally by two intruders (mitigated, <10kft MSL)

**Configuration**
- System Under Test: Omnibands
- Display: VSCS
- Contributing Sensors (Ownship):
  - TCAS II
  - ADS-B
  - Radar
  - Tracker

**Intruder 1 Equipage:**
- RCS: L/M
- Mode C: NO
- ADS-B: YES
- TCAS II: YES

**Intruder 2 Equipage:**
- RCS: L/M
- Mode C: NO
- ADS-B: YES
- TCAS II: YES

(Note: TCAS I is OK if two TCAS II intruders are not available)

**Scenario(s): #283**

**Test Objectives (TO):**
1. This scenario is designed to test if the DAA system can deal with multi-threats with relatively accurate sensor data (i.e., ADS-B data is available to fusion tracker) – one threat (intruder 1) requires SS maneuver while the other (intruder 2) is near-by such that action space for SS maneuver is constrained.

**Success Criteria (retest if criteria not met):**
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method:**
- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met):**
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information:**
- Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally by two intruders (mitigated, <10kft MSL) 

**Scenario #43 (Conf. 31-Q)**

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

**Configuration**

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</tr>
<tr>
<td><strong>Contributing Sensors (Ownship):</strong></td>
<td></td>
</tr>
<tr>
<td>TCAS II</td>
<td>ADS-B</td>
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<tr>
<td>---</td>
<td>---</td>
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**Intruder 1 Equipage:**

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<tr>
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<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
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**Intruder 2 Equipage:**

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<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/M</td>
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</tr>
</tbody>
</table>

**Scenario(s): #284**

**Test Objectives (TO)**

1. Same as previous scenario (scenario #42) except intruder 1 is non-cooperative (i.e., only radar data is available for DAA processing), thus making it more challenging.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #44 (Conf. 31-T)

Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally by two intruders (mitigated, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

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</thead>
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<tr>
<td>Contributing Sensors (Ownship):</td>
<td>Intruder 2 Equipage:</td>
</tr>
<tr>
<td>TCAS II</td>
<td>ADS-B</td>
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<td>RCS</td>
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</tr>
<tr>
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</tbody>
</table>

Scenario(s): #285

Test Objectives (TO)
1. Same as previous scenario (scenario #43) except that DAIDALUS is used to provide SS guidance for this scenario.

Success Criteria (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method
- MANUEVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information
Priority: High.
FT4 TEST OBJECTIVES – SC228 Scenario #45 (Conf. 32-T)

Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched vertically by two intruders (mitigated, <10kft MSL)

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<td>Contributing Sensors (Ownship):</td>
<td>Intruder 2 Equipage:</td>
</tr>
<tr>
<td>TCAS II</td>
<td>RCS</td>
</tr>
<tr>
<td>TA/RA</td>
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</tr>
<tr>
<td>Intruder 1 Equipage:</td>
<td>Intruder 2 Equipage:</td>
</tr>
<tr>
<td>RCS</td>
<td>Mode C</td>
</tr>
<tr>
<td>L/M</td>
<td>NO</td>
</tr>
</tbody>
</table>

Scenario(s): #286

Test Objectives (TO)
1. This scenario is designed to test if the DAA system can deal with multi-threats – one threat (intruder 1) requires SS maneuver while the other (intruder 2) is near-by such that action space for SS maneuver is constrained.

Success Criteria (retest if criteria not met)
1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method
- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)
1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information
Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched vertically by two intruders (mitigated, <10kft MSL)

**Configuration**

**System Under Test:** CPDS

**Display:** CDTI/VPD

**Contributing Sensors (Ownship):**

- TCAS II: YES
- ADS-B: YES
- Radar: YES
- Tracker: YES

**Contributing Sensors (Intruder 1):**

- Intruder 1 Equipage:
  - RCS: L/M
  - Mode C: NO
  - ADS-B: YES
  - TCAS II: YES

**Contributing Sensors (Intruder 2):**

- Intruder 2 Equipage:
  - RCS: L/M
  - Mode C: NO
  - ADS-B: YES
  - TCAS II: YES

**Scenario(s):** #287

**Test Objectives (TO):**

1. Same as previous scenario (scenario #45) except that: 1) both intruders are cooperative with ADS-B and TCAS II and 2) CPDS is used to provide SS guidance.

**Success Criteria** (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANUEVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria** (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched vertically by two intruders (mitigated, <10kft MSL)

**Configurations**

- **System Under Test**: CPDS

**Display: CDTI/VPD**

**Contributing Sensors (Ownship):**

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<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
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<td>YES</td>
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**Intruder 1 Equipage:**

<table>
<thead>
<tr>
<th>RCS</th>
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<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
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**Intruder 2 Equipage:**

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<tbody>
<tr>
<td>L/M</td>
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</table>

**Scenario(s): #288**

**Test Objectives (TO)**

1. Same as previous scenario (scenario #45) except that CPDS is used to provide SS guidance for this scenario.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANUEVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship 150 KTAS, Both intruders 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm, no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally & vertically by two intruders (mitigated, <10kft MSL)

### FT4 TEST OBJECTIVES – SC228 Scenario #48 (Conf. 35-Q)

**Overview:**
- Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally & vertically by two intruders (mitigated, <10kft MSL)
- MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

### Configuration

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**Contributing Sensors (Ownship):**

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<th>Tracker</th>
</tr>
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<tbody>
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<td>YES</td>
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**Intruder 1 Equipage:**

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<th>TCAS II</th>
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</thead>
<tbody>
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<td>NO</td>
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**Intruder 2 Equipage:**

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<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/M</td>
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</tbody>
</table>

### Scenario(s):

- #289

### Test Objectives (TO)

1. This scenario is designed to test if the DAA system can deal with multi-threats – one threat (intruder 1) requires SS maneuver while the other (intruder 2) is near-by such that action space for SS maneuver is constrained.
2. Key requirement for the set-up with respect to intruder 1 is to have closure rate in the range of 40 – 50 KTAS. The absolute speeds are less important (e.g., 180 vs. 130 KTAS would work as well).

### Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

### Test Method

- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship/intruder1 150/100 KTAS or 180/130 KTAS, Intruder2 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

### Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

### Additional Information

- Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally & vertically by two intruders (mitigated, <10kft MSL)

**Configuration**

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<tr>
<th>System Under Test:</th>
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<tr>
<td>Contributing Sensors (Ownship):</td>
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<td>Intruder 2 Equipage:</td>
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<tr>
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</tbody>
</table>

**Intruder 1 @ 100 KTAS**

**Intruder 2 @ 150 KTAS**

**Scenario(s): #290**

**Test Objectives (TO)**

1. Same as previous scenario (scenario #48) except that DAIDULUS is used to provide SS guidance for this scenario.

**Success Criteria**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship/intruder1 150/100 KTAS or 180/130 KTAS, Intruder2 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluate DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally & vertically by two intruders (mitigated, <10kft MSL)

**Scenario(s): #291**

**Test Objectives (TO)**

1. Same as previous scenario (scenario #49) except that: 1) CPDS is used to provide SS guidance for this scenario and 2) both intruders are cooperative with ADS-B and TCAS II.

**Success Criteria (retest if criteria not met)**

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

**Test Method**

- MANUEVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship/intruder1 150/100 KTAS or 180/130 KTAS, Intruder2 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ± 8 sec, ± 5 kts at IP crossing.

**Evaluation Criteria (Post-test analysis to determine if test objectives are met)**

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

**Additional Information**

Priority: High.
Evaluating DAA system and subsystem performance for a multiple intruder encounter: sandwiched horizontally & vertically by two intruders (mitigated, <10kft MSL)

MOPS Sections 2.2.2, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and applicable appendices.

Configuration

System Under Test: CPDS
Display: CDTI/VPD
Contributing Sensors (Ownship):

<table>
<thead>
<tr>
<th>TCAS II</th>
<th>ADS-B</th>
<th>Radar</th>
<th>Tracker</th>
</tr>
</thead>
<tbody>
<tr>
<td>TA/RA</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Intruder 1 Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

Intruder 2 Equipage:

<table>
<thead>
<tr>
<th>RCS</th>
<th>Mode C</th>
<th>ADS-B</th>
<th>TCAS II</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/M</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Scenario(s):

#292

Test Objectives (TO)

1. Same as previous scenario (scenario #50) except that intruder 1 is non-cooperative (i.e., radar data only), thus making it more challenging.

Success Criteria (retest if criteria not met)

1. Scenario executed as specified.
2. DAA alerts generated and pilot followed the guidance correctly.
3. Data collected: TBD

Test Method

- MANEUVER: Pilot to follow DAA guidance. Pilot to follow TCAS RAs if generated.
- Aircraft speeds (non-accelerating): Ownship/intruder1 150/100 KTAS or 180/130 KTAS, Intruder2 150 KTAS
- Encounter Length: 2 min (IP to CPA)
- Stable Conditions: stable at the IP (2 minutes prior to CPA)
- Test Termination Criteria: targets diverging, range > 0.75 nm., no DAA alerts displayed.
- Climb/Roll/Pitch Rates: 0/0/0
- Tolerance: ±8 sec, ±5 kts at IP crossing.

Evaluation Criteria (Post-test analysis to determine if test objectives are met)

1. Sensor provides data with expected performance.
2. Sensor data processing and tracking provides integrated track with expected performance.
3. UAS pilot receives DAA corrective alert with associated guidance.
4. DAA alert(s) and guidance are removed once ownship is clear of threat.
5. CPA prediction accuracy sufficient for DAA function.

Additional Information

Priority: High.
### FT4 Test Aircraft Equipage & Parametric Worksheet

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Owner Aircraft</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| NASA870 (Pred II)             | BAe/ALF/DLR-7 ADS-B/Mode S
HW TPA-1008 TCAS II (ver 7.2)
CA-ACS IEDM DME
AVAD DGNSS SIGMA-2 GT DGPS | <10 min/4500 ft + ADS-B <60 sec/4500 ft + TCAS | NACp - 11
NAC - 6
NAC - 6
SIL - 3
SDA - 3 | 100 ft | 140, 150, 160, 180, 200 | 1,000 ft AGL to 18,000 ft MSL
60-190 | ±1,000 | N/A | GPS/L1/L2/L2C/L5; Hybrid surveillance rate once per minute increased to once every 10 sec (>60 sec), then once per second (>60 sec) in near threat. Airspeed window at 15' KIAS is 85-190 KIAS.

**Intruder Aircraft**

| N30C (C90)                    | HW TPA-300B ADS-B/Mode S
HW TPA-1008 TCAS II (ver 7.2)
HW CMA-3012 OGS/1406
Novatel ProPak6 DGPS | N/A | N/A | NACp - 10
NAC - 2
SIL - 3
SDA - 2 | 100 ft | 140, 150, 160, 180 | 1,000 ft AGL to 18,000 ft MSL
60-175 | ±1,000 | 3,000 | Middle-Speed Medium RSC

| NASA865 (T-34C)               | Garmin GNS-430W ADS-B/Mode S
Skywatch TCAS I
Garmin GNS-430W GPS
Atech Tech 2.1.2 DGPS | N/A | Out (1000 MHz) | NACp - 12
NAC - 2
SIL - 3
SDA - 2 | 100 ft | 140, 150, 160, 180 | 1,000 ft AGL to 18,000 ft MSL
140-250 | ±1,500 | 3,000 | Middle-Speed Large RSC

| NASA7 (B200)                  | Garmin GNS-430W ADS-B/Mode S
Skywatch TCAS I
Garmin GNS-430W GPS | N/A | Out (1000 MHz) | NACp - 2
NAC - 1
SIL - 3
SDA - 3 | 100 ft | 140, 150, 160, 180, 210, 250 | 1,000 ft AGL to 18,000 ft MSL
140-250 | ±1,500 | 3,000 | Middle-Speed Large RSC

**NOT AVAILABLE FOR FT4**

### Notes

- *ADS-B Out Ground Test Predicted Performance Requirements (14 CFR 91.227 & AC 20-165A)*
  - NACp ≥ 8
  - SDA ≥ 8
  - NAC ≥ 7
  - SIL ≥ 3
  - NAC ≥ 1
  - SDA ≥ 2
  - ≥10 m/s
  - ≥10° per hr

- All aircraft performance figures are based on clean, level flight, mid-weight, standard day conditions at 15,000 ft MSL (except TG-14 which are at 9,000 MSL).

- Note: Data marked in red represents notional, planned or missing.
Appendix H  FT4 Flight Test Matrix