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ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

ANTI JAMMING ANTENNA MODIFICATION

(Presented by Türkiye)

EXECUTIVE SUMMARY	
The aviation industry's primary goal is to continue its operations safely and sustainably. In this context, GPS signal disruptions, spoofing attacks, and jamming, which have recently occurred, have become the primary threat to flight safety due to military conflicts. Our goal is to ensure that GPS signals are received and analysed accurately by aircraft, enabling them to continue their operations safely, ensuring safe operations with anti-jamming method to prevent serious problems caused by lost GPS signals, spoofing and jamming during aircraft operations.	
Strategic Goals:	This working paper relates to Strategic Goals *Every Flight is Safe and Secure*; and *Aviation Delivers Seamless, Accessible and Reliable Mobility for all*.
Financial implications:	
References:	EASA Part-21 SUPPLEMENTAL TYPE CERTIFICATE 10085589 Airplane Flight Manual Supplement Installation of AD-AFIS-1320 in C680A

1. INTRODUCTION

1.1 Technological design is the driving force behind all innovations and developments in the global world. Power and stability in the international arena are shaped by this context. Aviation is undoubtedly one of humanity's greatest technological achievements. The top priorities for aviation are ensuring safety, sustainability and a commitment to continuous improvement. To ensure the safe operation of aeroplanes and helicopters, manufacturers equip our aircraft with numerous reliable modifications and technologies that minimise human error and enable safe travel. However, emerging technologies used in the military, particularly in civil aviation, are reaching levels that threaten the reliability of civil aviation. The most significant and dangerous threat is the loss of GPS, particularly during aircraft operations.

2. THE IMPORTANCE OF GPS FOR AIRCRAFT

2.1 Navigation (Navigation): With Global Positioning System (GPS), aircraft continuously calculate their precise location (latitude, longitude, altitude). This information allows pilots and auto flight systems to keep the aircraft on course. Navigation becomes difficult without GPS, especially during IFR flights and in areas without ground stations, such as oceans and deserts.

2.2 Precision Approach and Landing: GPS helps aircraft achieve the correct approach angle during take-off and landing. Safe landings can be achieved at more airports with GPS-based systems (e.g., LPV, RNP approaches) than with traditional ILS (Instrument Landing System). This allows safe landings, especially at smaller airports, without the need for expensive ground stations.

2.3 Flight Safety: GPS helps aircraft reduce the risk of collisions. The ability of other aircraft to share their location with automatic dependent surveillance — broadcast (ADS-B) outgoing systems relies on GPS. Air traffic control also tracks aircraft positions more precisely with GPS.

2.4 Fuel Savings and Efficiency: Shorter and more accurate routes can be charted with GPS. Direct routing prevents unnecessary detours. This reduces fuel consumption and carbon emissions.

2.5 Advantages over Alternative Systems: Navigation systems such as VHF omnidirectional radio range (VOR), distance measuring equipment (DME), or instrument landing system (ILS) rely on fixed ground stations. GPS, on the other hand, can be used worldwide and has a much broader coverage area. With global coverage, aircraft can navigate everywhere with the same accuracy.

2.6 Emergencies: With GPS, pilots can instantly see, the nearest airport, the aircraft's precise location, the direction in which it should turn. This is vital in emergencies.

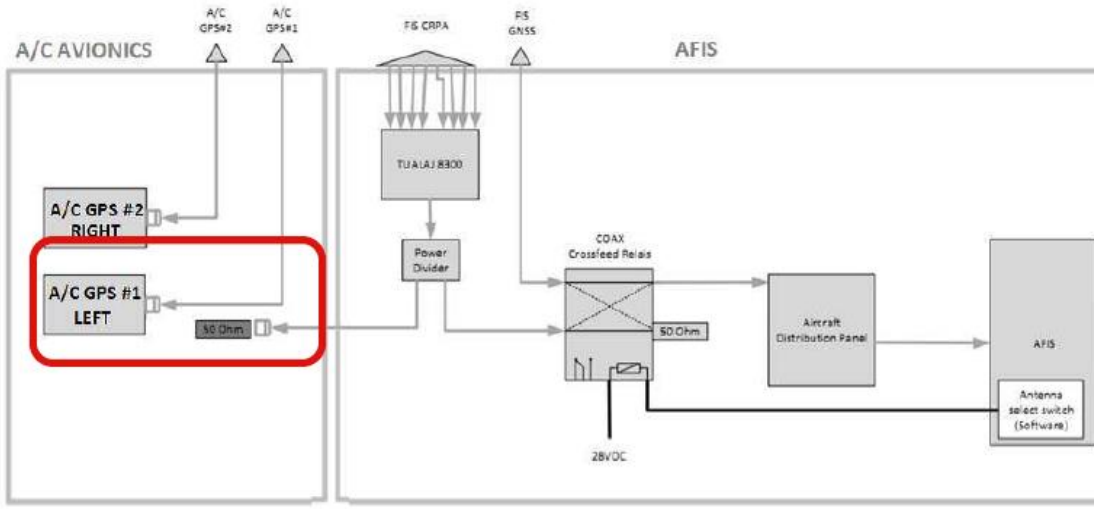
2.7 In short, GPS acts as an "eye" and "compass" for aircraft. While flight without it is possible, both safety and efficiency are significantly reduced.

2.8 As the GPS signal is very weak and susceptible to external influences, various technical measures are taken to ensure reliable use in aircraft. The most effective methods for ensuring reliable GPS operation on aircraft are jamming and spoofing measures to reduce the risk of jamming and spoofing and advanced GPS receivers and directional antennas can be used on aircraft.

3. APPLICATION OF GNSS ANTI-JAMMING ANTENNA

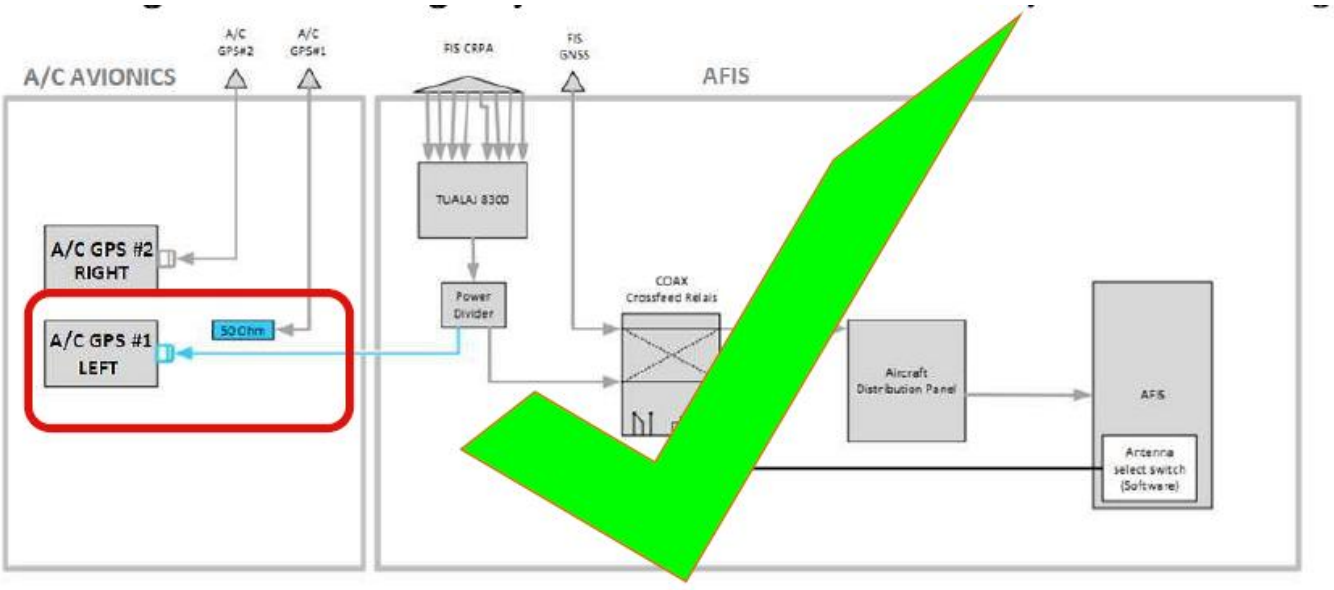
3.1 General Directorate of State Airports Administration of Türkiye (DHMİ - Turkish ANSP and Airport Management) continues flight control activities with the aircraft in its fleet. Operations using AFIS (Aircraft Flight Inspection System) equipment have experienced problems due to GPS loss and spoofing jammers. Therefore, Anti-jamming (GNCC) antenna modifications were carried out for the aircraft used in flight control activities.

3.2 Integration/certification process of Controlled Reception Pattern Antenna (CRPA) integrated into the AFIS system in aircraft into the GARMIN avionics system.



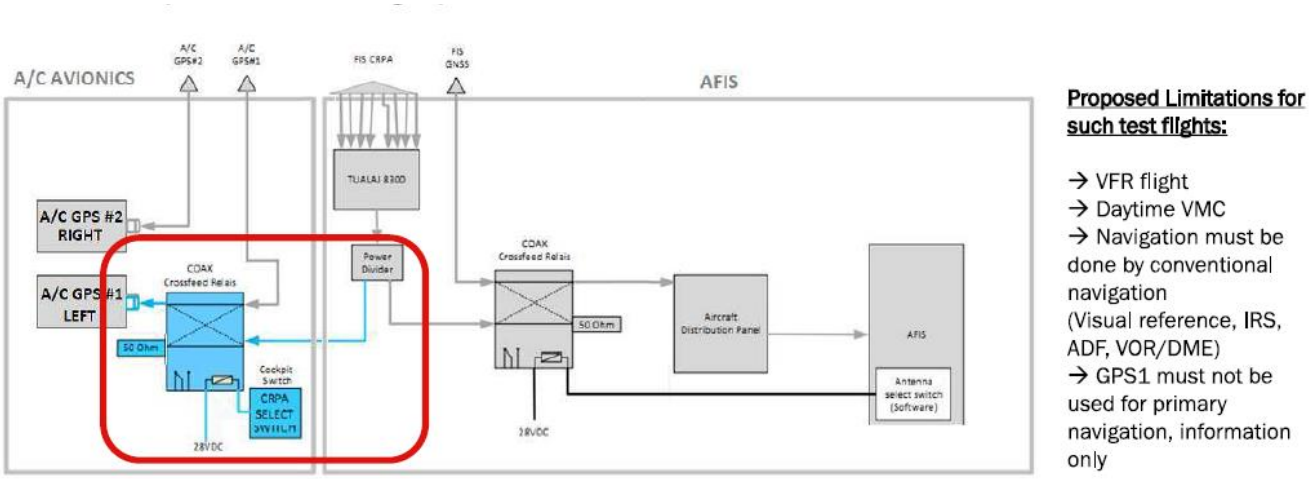
First state of the CRPA antenna, not connected to the GARMIN avionics system

3.3 Connection only to GPS Receiver#1 to keep the existing approved system selectable and for modification with minimal impact to the existing system.



Ground Correction Test Configuration: CRPA antenna connected to the GARMIN avionics system

3.4 In order to reduce the reliability of the system and ensure that the system can operate in its original state in a non-jamming environment, the final Flight Test Configuration has been submitted to EASA.



Flight/STC Test Configuration: Integration of CRPA antenna and Aircraft GPS antenna into GARMIN avionics system via "new switching unit".

4. TECHNICAL SOLUTION DETAILS

4.1 The proposed solution management system ensures that the reliability of the existing/original avionics system is not compromised. The new configuration will only be activated when necessary. Once the GPS jamming condition is resolved, the system connection can be restored to its original state.

4.2 The reliability level of the entire system has been measured, as it allows for "use on an as-needed basis" under the conditions specified by EASA. In the event of a combined loss of GPS1 and GPS2 signals, signals can continue to be received from the CRPA antenna connected to Receiver #1 via a qualified coaxial switch. When the GARMIN 5000 system receives a valid signal from only one side, both consoles can share this data.

5. GARMIN 5000 OPERATING PRINCIPLE

5.1 When a partial GPS loss occurs in the Garmin 5000 avionics suite, the system automatically uses the current signal on both consoles. The Garmin 5000 generates a "BOTH ON GPSX" alert on both touchscreens to alert pilots of the partial signal loss. When the partial signal loss disappears, the "BOTH ON GPSX" alert disappears from the screens.

5.2 Thanks to this Garmin feature, pilots can tell when the civilian GPS signal is restored by the disappearance of the alert.

6. REFLECTION ON THE TECHNICAL SOLUTION

6.1 When GPS signal jamming begins, a partial GPS failure warning will be generated when one of the consoles initially loses signal. This indicates that a jamming environment has been entered. When both consoles lose GPS signal, a GPS loss warning will be displayed on the screens. In this case, pilots will connect GPS Receiver #1 (left console) to the CRPA antenna using a switch integrated into the system as part of the STC, ensuring that navigation functions can operate in the partial GPS loss mode in the jamming environment.

6.2 In partial GPS loss mode, there will be no functional loss in the system because the GARMIN system provides a healthy GPS signal to both consoles. Although the CRPA antenna is not connected to either console via independent connections, GARMIN effectively feeds the CRPA antenna signal to both consoles.

6.3 If both consoles were fed with separate CRPA signals, the civilian would not have a chance to understand that the GPS signal was returning, and the security level of the system would not be maintained with the changes made.

7. ADVANTAGES

a) operation of aircraft in GPS jamming environments;

b) achieving EASA STC approval without compromising safety with minimal changes to the existing avionics system;

c) restoring operational capability to aircraft experiencing such problems and unable to continue operations as quickly as possible;

d) no disruption to the aircraft's original/current configuration, preventing the implementation of OEM software updates and future service bulletins;

e) a single physical connection allows both consoles to be powered by the CRPA GPS signal; and

f) the pilot can still decide with which GPS receiver to feed the Flight Director.

8. CONCLUSION

8.1 According to EASA SUPPLEMENTAL TYPE CERTIFICATE 10085589, the anti-jamming system has been activated. This modification, which is recommended be integrated into other civil aircraft in the future, implemented for the first time on DHMİ civil aircraft and has prevented problems affecting flight safety such as GPS loss, jamming and spoofing.

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