# Special Airworthiness Bulletin

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ANAC
NATIONAL CIVIL AVIATION AGENCY - BRAZIL

# Operations in environments with GNSS signal degradation.

This Special Airworthiness Bulletin (BEA) is intended to alert the civil aviation community (mainly aircraft operators and flight crew) regarding the identification and mitigation of GNSS degradation, mainly GPS, which is the most widely used.

This bulletin is informative, and the recommendations herein are not mandatory. Up to this time, there is no airworthiness concern that would warrant an Airworthiness Directive (AD) according to Regulamento Brasileiro de Aviação Civil (RBAC) nº 39.

## Applicability:

Aircraft Operators and flight crew.

## Description:

The Global Navigation Satellite System (GNSS) is essential for the safe operation of aircraft. Interference with this system's signals can significantly impact essential means of communication, navigation and surveillance. In addition, GNSS time signals are often used as a reference for aircraft systems.

There has been an increase in the frequency of jamming and spoofing of GNSS signals, a general increase in intensity and an increase in the severity of their impact, especially in areas of conflict, areas with military operations and areas of protection against remotely piloted aircraft or drones.

Jamming is an intentional radio frequency interference (RFI) with GNSS signals. This interference prevents receivers from locking onto satellites signals and has the main effect of rendering the GNSS system ineffective or degraded for users in the jammed area.

Spoofing involves broadcasting counterfeit satellite signals to deceive GNSS receivers, causing them to compute incorrect position, navigation, and timing data.

The effects of jamming and spoofing of GNSS signals have been observed by crews at various flight phases. In some cases, these effects have led to route changes or deviations due to the

inability to carry out instrument procedures safely. The magnitude of the problems generated by these disruptions depends on the area, duration of the event, type of aircraft, type of avionics and flight phase of the affected aircraft.

Aircraft operators should be aware of the impacts on the specific aircraft systems operated, as identified by the aircraft manufacturers. A non-exhaustive list of effects that can be caused by jamming or spoofing GNSS signals is presented below:

- Inability to use GNSS for navigation.

- Inability to use GNSS hybrid inertial systems for navigation.

- Loss of ability to conduct or maintain GNSS based area navigation (RNAV) and/or required Navigation Performance (RNP) operations.

- Loss of or erroneous Automatic Dependent Surveillance - Broadcast (ADS-B).

- Unreliable triggering of Terrain Avoidance and Warning systems (TAWS) e.g. false PULL UP alert triggered by TAWS during cruise phase.

- Inconsistent, potentially misleading aircraft operation.

- Inconsistent flight guidance possibly resulting in route deviations.

- Loss of or misleading time dependent systems (e.g. clock, fuel computation system, flight management system).

- Unanticipated position-dependent flight management system effects (e.g. insufficient fuel indication).

## Recommendation(s):

*To address the problems identified, ANAC recommends implementing the following mitigation measures.*

*NOTE: These measures should be considered for any area where jamming or spoofing of GNSS signals has been identified. Check any NOTAM (Notice to Air Mission) for operations in the USA, the regions indicated in EASA SIB No.: 2022-02R2 for operations in Europe; or any alerts issued by the authorities regarding jamming or spoofing of GNSS signals, including in Brazil.*

*During flight, ANAC recommends that operators:*

1. Be vigilant for any indication of GNSS signal disruption, reviewing information provided by the aircraft manufacturer when available. Verify the aircraft's position by conventional aids to navigation, when available. Indications of interference may include:
   - Changes in actual navigation performance.
   - Aircraft clock changes.
   - Incorrect FMS (Flight Management System) position.

- Large shift in displayed GNSS position.
- Primary flight display (PFD)/navigation display (ND) warnings about position error.
- Other aircraft reporting clock problems, position errors or requesting vectors.

2. Assess operational risks and limitations related to the loss of GNSS capability, including any aircraft systems that require information from GNSS signals.
3. Ensure that operational limitations introduced by the dispatch of aircraft with inoperative radio navigation systems, in accordance with the MEL (Minimum Equipment List), are considered before operating the aircraft in the affected areas (availability of conventional navigation aids).
4. Plan the flight so as to be prepared to revert to conventional instrument flight procedures.
5. Report any anomalies in GNSS signals to ANAC via the Single Notification Portal and by e-mail to pac@anac.gov.br , providing the following information:
   - Date.
   - Aircraft model.
   - Flight phase.
   - Location of the anomaly.
   - Transient or permanent anomaly.

## References:


1. FAA SAFO 24002: "Recognizing and Mitigating Global Positioning System (GPS) / Global Navigation Satellite System (GNSS) Disruptions."– acesse o link: https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/SAFO24002.pdf
2. EASA SIB 2022-02R2: "Global Navigation Satellite System Outage and Alterations Leading to Navigation / Surveillance Degradation" – acesse o link: https://ad.easa.europa.eu/ad/2022-02R2

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