



**U.S. Department  
of Transportation  
Federal Aviation  
Administration**

# SAFO

Safety Alert for Operators

SAFO 24002

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Flight Standards Service  
Washington, DC

**[http://www.faa.gov/other\\_visit/aviation\\_industry/airline\\_operators/airline\\_safety/safo/all\\_safos](http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos)**

*A SAFO contains important safety information and may include recommended action. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.*

**Subject:** Recognizing and Mitigating Global Positioning System (GPS) / Global Navigation Satellite System (GNSS) Disruptions.

**Purpose:** This SAFO provides information and guidance to operators and manufacturers regarding operations in a GPS/GNSS disrupted environment.

**Background:** Recent GPS/GNSS jamming and spoofing activities reported by civil air operators operating globally pose a potential safety of flight risk to civil aviation. GPS/GNSS disruptions often occur in and around conflict zones, military operations areas, and areas of counter unmanned aircraft systems (UAS) protection. The term GNSS includes satellite augmentation systems.

The recent jamming and spoofing incidents may pose increased safety of flight risks due to possible loss of situational awareness and increased pilot and regional Air Traffic Control (ATC) workload issues. Due to the increasing frequency of GPS/GNSS disruptions, the Federal Aviation Administration (FAA) recommends flightcrews put additional emphasis on closely monitoring aircraft equipment performance for any discrepancies or anomalies, promptly informing ATC of any apparent GPS/GNSS degradation, and being prepared to operate without GPS/GNSS navigation systems.

**Discussion:** The effects of GPS/GNSS jamming and/or spoofing have been observed by crews in various phases of flight. In some cases, these effects led to re-routing or diversions, due to the inability to perform safe instrument procedures. The magnitude of the issues generated by these disruptions would depend upon the impacted area, the duration of the event, type of aircraft, type of avionics, and the phase of flight of the affected aircraft. To improve analysis and dissemination of these issues, the FAA stresses the need for “real time” pilot reporting to ATC and the use of the Pilot Reporting site, [Report a GPS Anomaly | Federal Aviation Administration](https://www.faa.gov/air_traffic/nas/gps_reports), ([https://www.faa.gov/air\\_traffic/nas/gps\\_reports](https://www.faa.gov/air_traffic/nas/gps_reports)) for reporting of GPS/GNSS anomalies, to enable tracking and mitigation. Safety impacts should be reported through normal safety channels.

Aircraft operators should be aware of impacts to their specific aircraft systems identified by Original Equipment Manufacturers (OEMs). Manufacturers, operators, and ATC should be aware of the general impacts of GPS/GNSS interference, jamming, and spoofing. such as:

- Inability to use GPS/GNSS for navigation;
- Inability to use hybrid GPS/GNSS inertial systems for navigation;
- Loss of area navigation (RNAV) capability, to include required navigation performance (RNP);
- Unreliable triggering of Terrain Avoidance and Warning systems (TAWS);
- Inaccurate aircraft position on navigation display (e.g. moving map and electronic flight bag);
- Loss of or erroneous Automatic Dependent Surveillance-Broadcast (ADS-B) outputs;
- Unanticipated effects to use of conventional navigation aids (e.g. inability to autotune);
- Unanticipated position-dependent flight management system effects (e.g. insufficient fuel indication)
- Failure or degradation of Air Traffic Management (ATM) infrastructure and its associated systems reliant on GPS/GNSS, resulting in potential airspace infringements and/or route deviations.

**Recommended Action:** Prior to departure, operators should be aware of potential risk locations, check for any relevant Notices to Air Missions (NOTAMs), plan fuel contingencies, and research alternative conventional arrival/approach procedures at the destination and all alternate airports. When available, operators should plan to use conventional Navigational Aids (NAVAIDs) in these locations. The FAA recommends that each operator follow the detailed guidance from their respective OEM.

During flight, the FAA recommends operators:

1. Be vigilant for any indication that the aircraft's GPS/GNSS is being disrupted by reviewing the manufacturer's guidance for that specific aircraft type and avionics equipment. Verify the aircraft position by means of conventional NAVAIDs, when available. Indications of disruption may include:
  - Changes in actual navigation performance
  - Aircraft clock changes (e.g., incorrect time)
  - Incorrect Flight Management System (FMS) position
  - Large shift in displayed GPS/GNSS position
  - Primary flight display (PFD)/navigation display (ND) warnings about position error
  - Other aircraft reporting clock issues, position errors, or requesting vectors
2. Assess operational risks and limitations linked to the loss of GPS/GNSS capability, including any on-board systems requiring inputs from a GPS/GNSS signal.
3. Ensure NAVAIDs critical to the operation for the intended route/approach are available.
4. Remain prepared to revert to conventional instrument flight procedures.
5. Promptly report disruption to ATC, followed by a detailed written report post flight at: [Report a GPS Anomaly | Federal Aviation Administration](#) and through normal safety channels when safety effects are encountered.

**Contact:** Direct questions or comments regarding this SAFO to the Flight Technologies and Procedures Division, Flight Operations Group at (202) 267-8790 or e-mail: [9-AWA-AVS-AFS410@faa.gov](mailto:9-AWA-AVS-AFS410@faa.gov).