# GNSS loss and GNSS Interferences on Airbus A/C

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|---|---|---|---|---|---|---|
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| A/C Type: | **A318**<br>**A319**<br>**A320**<br>**A321**<br>**A330**<br>**A340**<br>**A350**<br>**A380** | A/C Serie: | | Topic: | First Issue Date: | **22-FEB-2019** |
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**Background**

On most of Airbus aircraft, Global Navigation Satellite System (GNSS[1]) signals are one of the main inputs used for aircraft positioning and time reference for on-board Communication, Navigation and Surveillance functions. The Airbus aircraft installations are compliant with applicable regulations and recommended practices on aeronautical usage of GNSS for Communication, Navigation and Surveillance applications.

Performance (accuracy, integrity, availability and continuity) of the aircraft positioning highly relies on the external GNSS signals. A degradation of the external GNSS signals due to external or internal interferences (also known as "GNSS RFI" or "jamming"[2]) can lead to a performance degradation of the computed aircraft position.

To ensure the robustness of the Airbus aircraft architecture, the systems also take into account inertial references and/or Navaids (i.e. VOR, DME) to augment and complement the aircraft position's accuracy, integrity, availability and continuity.

Therefore, when GNSS signals from satellite constellation are lost or degraded by interferences, depending on the duration, aircraft capabilities can be maintained, limited or lost during the flight. These effects on aircraft capabilities shall be considered in flight crew decisions: for example, assessment of the capability to fly PBN routes, procedures and approaches.

The objective of this article is to clarify the impact of GNSS signal loss and GNSS RFI on aircraft operations, and to provide recommendations on how to handle these events in the daily aircraft operations.

This document is divided into three parts:

1. Cockpit effects that can be observed by the flight crew during total loss of GNSS signal.
2. Operational considerations to be considered during flight preparation/flight/post-flight phases.

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[1] Global Navigation Satellite System (GNSS) refers to a worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support required navigation performance for the intended operation. It includes the United States Global Positioning System (GPS) currently used by commercial aircraft, and augmentation systems such Satellite Based Augmentation System (SBAS).

[2] GNSS Radio Frequency Interferences (GNSS RFI): The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in GNSS frequency band (1559 – 1610 MHz). GNSS RFI may induce a degradation of position performance (such as lower accuracy and integrity) or loss of information, but not leading to misleading or wrong information.

3. Maintenance recommendations to be considered during post-flight analysis after GNSS loss event.

# Engineering Support

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## 1. COCKPIT EFFECTS

This chapter covers A320, A330, A340, A380 and A350 aircraft in hybrid configuration (i.e. GPS output sent to the IRS which sends a "hybridized" position to the FMS).

These aircraft are fitted with two MMRs, three ADIRUs and two (A320/A330/A340/A380) or three (A350) FMS to compute the aircraft position. The A/C position used by FMS for navigation purpose.

In case GPS data is lost due to GNSS RFI affecting both MMRs, the aircraft position source will switch to pure IRS and will enter into the so called coasting mode. If the integrity of GPIRS data is degraded enough then the position source will switch to other radio navigation based solution (from FMS) according to the availability of DME and VOR. If Navaids are not available, the aircraft position solution will switch to IRS only.

Besides, MMRs elaborate deviations relative to a flight path and distance to a runway datum point in xLS modes such as FLS, GLS and SLS. In case GPS data is lost due to GNSS RFI affecting both the MMRs, the xLS modes: GLS, SLS, FLS using GPS data will not be available.

- Cockpit effects are covered in section 1.1
- Description of the effects on system and functions are covered in section 1.2

## 1.1 DESCRIPTION OF COCKPIT EFFECTS

Important note: The below described effects may be observed if an A/C is operating in an area where RFI are present. Depending on the interference features (and A/C functions), the GPS receivers may be affected differently leading to the potential appearance of one or several of the effects described below.

**A320 / A330 / A340**

| Field | Function | ND/PFD | ECAM ALERT / STATUS | ECAM INOPERATIVE SYSTEMS |
|---|---|---|---|---|
| **Navigation** | GPS | **GPS PRIMARY LOST** | **NAV GPS x FAULT** | **GPS x** |
| | GLS (*) | If GLS selected:<br>- **GLS** Red flag<br>- With NDs in the ROSE mode:<br>○ **LOC** & **G/S** Red flags<br>○ LOC & G/S deviation bar out of view<br>*Same behaviour in PFD* | **NAV GLS x FAULT** | **GLS x**<br>**GPWS INOP SYS** *if GLS 1 fault occurs*<br>**GLS AUTOLAND** *inhibited if*<br>*NAV GLS 1 FAULT + NAV GLS 2 FAULT* |
| | FLS (*) | | **FLS LIMITED TO F-APP + RAW** *if GPS PRIMARY LOST* | |
| | OANS (*) | **ARPT NAV POS LOST** | | |
| **Surveillance** | GPWS TERR (*) | | **NAV GPWS TERR DET FAULT** | **GPWS TERR** |
| | ADS-B std DO-260B (*) | | **NAV ADS-B RPTG x FAULT**<br>*inhibited if NAV GPS 1 FAULT + NAV GPS 2 FAULT* | **ADS-B RPTG** |
| | ADS-B In (*) (also called ATSAW) | **ADS-B** | [1] **NAV ADS-B TRAF FAULT**<br>[2] **NAV ADS-B FAULT**<br>*inhibited if NAV GPS 1 FAULT + NAV GPS 2 FAULT* | [1] **ADS-B TRAF**<br>[2] **ADS-B** |
| | | | *[1] Post / [2] Pre FWC std: A320 H2-F7; A330 T5; A340 L13* | |
| | ROW/ROP (*) | | **SURV ROW/ROP LOST**<br>*inhibited if NAV GPWS TERR DET FAULT* | **ROW/ROP** |

**Table 1.1: A320/A330/A340 Cockpit Effects description**

(*) Optional function, the effects can be shown only if the option has been selected for a given A/C

Other effects:

- GPS Data dashed on GPS MONITOR pages of MCDUs
- Total GPS loss leads to a red flag (“ALT”) on grey background and red scale displayed on PFD, in case no air data are available.

**A380**

| Field | Function | ND / PFD | ECAM ALERT / STATUS | ECAM INOPERATIVE SYSTEMS |
|---|---|---|---|---|
| **Navigation** | GPS | **GPS PRIMARY LOST** | **NAV GPS x FAULT** | **GPS x** |
| | GLS (*) | If GLS selected:<br>- **GLS** Red flag on ND<br>- With NDs in the ROSE mode:<br>○ **LOC** & **G/S** Red flags<br>○ LOC & G/S deviation bar out of view<br>*Same behaviour on PFD* | **NAV GLS x FAULT**<br>**SURV GPWS 1+2 FAULT** *(only shown on ground for maintenance purposes, only when both GLS are lost)* | **GLS x**<br>**GLS AUTOLAND**<br>*inhibited in case of NAV GLS 1 FAULT + NAV GLS 2 FAULT*<br>**GPWS 1+2** |
| | FLS (*) | | **FLS LIMITED TO F-APP+RAW** *if GPS PRIMARY LOST* | |
| | OANS (*) | **ARPT NAV POS LOST** | | |
| **Surveillance** | GPWS TERR | **WX GND CLUT** (anti clutter function not avail) | **SURV TERR SYS x FAULT** | **TERR SYS x** |
| | ADS-B Out | | **ADS-B POS RPTG LOST** | **ADS-B RPTG** |
| | ROW/ROP (*) | PFD: **RUNWAY TOO SHORT** could be spuriously raised on OANS Std pre 6.3 (refer to TFU 34.38.00.002) | **SURV ROW/ROP LOST**<br>*inhibited in case of NAV GPS 1 FAULT + NAV GPS 2 FAULT* | **ROW/ROP**<br>**BTV** (*) |

**Table 1.2: A380 Cockpit Effects description**

(*) Optional function, the effects can be shown only if the option has been selected for a given A/C

Other effects:

- Data dashed on POSITION/GPS Page of both MFD
- Total GPS loss leads to a red flag (“ALT”) on grey background and red scale displayed on PFD, in case no air data are available.

**A350**

| Field | Function | ND/PFD | ECAM ALERT / STATUS | ECAM INOPERATIVE SYSTEMS |
|---|---|---|---|---|
| **Navigation** | GPS | **NAV PRIMARY LOST** | **NAV GNSS x FAULT** | **GNSS x** |
| | GLS (*) | If GLS selected:<br>- **GLS** Red flag<br>- With NDs in the ROSE mode:<br>○ **LOC** & **G/S** Red flags<br>○ LOC & G/S deviation bar out of view<br>*Same behaviour in PFD* | **NAV GLS x FAULT**<br>**GLS limited to APPR1** *if only one side lost* | **GLS x**<br>**GLS AUTOLAND**<br>*inhibited in case of NAV GLS 1 FAULT + NAV GLS 2 FAULT* |
| | SLS (*) | If SLS selected:<br>- **SLS** Red flag<br>- With NDs in the ROSE mode:<br>○ **LOC** & **G/S** Red flags<br>○ LOC & G/S deviation bar out of view<br>*Same behaviour in PFD* | **NAV SLS x FAULT** | **SLS x** |
| | FLS (*) | | **FLS LIMITED TO F-APP+RAW** *if GNSS 1+2 FAULT* | |

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|---|---|---|---|---|
| | RNP AR<br>only displayed during RNP AR operations | **RNP AR CAPABILITY LOST** | **NAV RNP AR CAPABILITY DOWNGRADED**<br>*if NAV GNSS x FAULT x=1 or 2*<br>**ECAM status/INFO:**<br>"**FOR RNP AR : MINIMUM LIMITED TO RNP 0.3**"<br>*Note: post FWS S5.2 and post PRIM P8 occurrence rate is reduced (ref TFU 22.00.00.201)*<br><br>**NAV RNP AR CAPABILITY LOST**<br>*If NAV GNSS 1+2 FAULT* | **RNP AR** (in case of RNP AR CAPABILITY LOST) |
| | ANF (*) | **ARPT NAV POS LOST** | | |
| **Surveillance** | GPWS TERR | **MAP NOT AVAIL**<br>**WX GND CLUT** (anticlutter function not avail)) | **SURV TERR SYS FAULT x** | **TERR SYS x** |
| | ADS-B Out | | **ADS-B POS RPTG LOST** | **ADS-B RPTG 1 + 2** |
| | ADS-B In (*)<br>(also called ATSAW) | | **SURV ADS-B TRAFFIC x FAULT** | **ADS-B TRAFFIC x** |
| | ROW/ROP (*) | | **SURV ROW/ROP LOST**<br>*inhibited in case of NAV GPS 1 FAULT + NAV GPS 2 FAULT* | **ROW/ROP**<br>**BTV** |

**Table 1.3: A350 Cockpit Effects description**

(*) Optional function, the effects can be shown only if the option has been selected for a given A/C

Other effects:

- Data dashed on POSITION/GNSS Page of both MFD
- Total GPS loss leads to a red flag ("ALT") on grey background and red scale displayed on PFD, in case no air data are available.

## 1.2 SUMARY OF FUNCTIONAL AND SYSTEM EFFECTS

### 1.2.1 Navigation

In case of GPS total loss, the cockpit effects listed in section 1.1 could be observed. The table below contains the functional and system effects corresponding to cockpit effects on the ND, ECAM alerts/status/ INOP sys.

| SYSTEMS | A320<br>A330/A340 | A380 | A350 |
|---|---|---|---|
| **MMR** | All Phases: Loss of GPS Navigation functions. | | All Phases: Loss of GPS and SBAS Navigation functions for the duration of the loss. |
| | Approach & Landing: Loss of GLS deviations. | | Approach & Landing: Loss of GLS deviations and SLS deviations. |
| **ADIRU** | All Phases: The hybridization between GPS measurements and IRS data is lost and GPIRS position enters into coasting mode. GPIRS position drifts and stay valid when the A/C is in flight.<br><br>During alignment, flight crew needs to enter position manually to align IRS. | | All Phases: The hybridization between GPS measurements and IRS data is lost and GPIRS position enters into coasting mode. GPIRS position drifts and stays valid.<br>In flight: the A/C position switches to an alternate navigation mode that offers the best position solution accuracy and integrity among: radio navaids and IRS position.<br>On ground: the A/C position switches on IRS position.<br>Time data are maintained according to ADIRS internal clock<br>During alignment, flight crew needs to enter position manually to align IRS. |
| **Clock** | All Phases: Clock will not be synchronized with UTC time provided by GPS; Clock is maintained based on its internal reference. At aircraft power up the UTC displays zero's in case of unavailability of GPS signal. | | All Phases: Clock will not be synchronized with UTC time provided by GPS; Clock is maintained based on ADIRS clock function. |

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|---|---|---|---|
| **ISIS** | Approach & Landing: GLS deviations are not available. | Approach & Landing: GLS parameters (deviations, course, and channel) are not available. Aircraft position and velocity coming from MMR is invalid. | Approach & Landing: GLS and SLS parameters (deviations, course, and channel) are not available during approach and landing. Aircraft position and velocity coming from MMR is invalid. |
| **Flight Guidance**<br>**FMGC** (A320)<br>**FMGEC** (A330/A340)<br>**FCGU**/**PRIM** (A380&A350) | Approach functions requiring GPS are not available: GLS, FLS (in case of RNAV (GNSS)) and RNP AR. | Approach functions requiring GPS are not available: GLS, FLS (in case of RNAV (GNSS)) and RNP AR.<br>The functions BTV, ROW/ROPS are not available. | Approach functions requiring GPS are not available: SLS, GLS, FLS (in case of RNAV (GNSS)) and RNP AR.<br>The functions BTV, ROW/ROPS are not available |
| **Flight Management**<br>**FMGC** (A320)<br>**FMGEC** (A330/A340)<br>**FMS** (A380&A350) | All Phases: The aircraft position solution will switch from GPIRS to radio navaids and inertial position.<br>GPS data are dashed in the GPS monitor page. | | All Phases: The aircraft position provided by the ADIRU is used irrespective of GPS loss.<br>GPS data are dashed in the GNSS monitor page. |
| **Airport Navigation**<br>**OANS** (A320/A330/A340/A380)<br>**ANF** (A350) | Approach & Landing: The aircraft position cannot be computed and displayed on the airport moving map.<br>Loss of support to Airport Navigation, Runway Approaching Advisory and BTV/ROPS (on A380 only) functions from OANS. | | Approach & Landing: The aircraft position used by ANF is provided by ADIRU.<br>Loss of support to Airport Navigation, Runway Approaching Advisory, BTV/ROPS and TOS2 functions from ANF. |

**Table 1.4: Functional and System Effect for Navigation System**

Note: The above described functional or system effects may not always be observed due to GPS total loss, but these are the alerts/warning that could arise in case of potential RFI or due to GPS data loss.

### 1.2.2 Surveillance

In case of GPS total loss, the cockpit effects discussed in section 1.1 could be observed. The table below contains the functional and system effects corresponding to cockpit effects on the ND, ECAM alerts/status/ INOP sys.

| SYSTEMS | A320<br>A330/A340 | | A380 | A350 |
|---|---|---|---|---|
| **TCAS** | All Phases: Loss of ATSAW function* | | Part of AESS<br>ATSAW function not available on A380 | Part of AESS<br>All Phases: Loss of ATSAW function |
| **XPDR** | All Phases: GPS parameters are invalid within ADS-B out messages (position integrity tagged as degraded). | | Part of AESS<br>All Phases: GPS parameters are invalid within ADS-B out messages (position integrity tagged as degraded).<br>Note: A380 and A350 ADS-B function is more robust with respect to A320/A330/A340 as it is based on GPIRS position. GPIRS position enters in coasting mode and can remain available longer than GPS position. | |
| **TAWS**<br>**(EGPWC/ GPWC, T3CAS)** | Take-off, en-route & approach: In case of invalid GPS position, the TAWS use the alternate position computed by the FM or the IRS.<br><br>Approach , Landing & on Ground : Loss of ROW/ROP ,RAAS functions**<br><br>Loss of terrain function when GPS FOMs exceed the current RNP according to flight phases | | Part of AESS.<br><br>All Phases: No immediate loss thanks to back-up positioning (FMS, IRS) but some degradations may be expected after certain time :<br><br>– Potential loss of envelope modulation (when position too degraded)<br>– Potential loss of predictive terrain alerts and display on ND (when position too degraded | |
| **WXR** | N/A | N/A | Part of AESS<br><br>All Phases: WXR – Potential loss of ground declutter function (when position too degraded) | |
| **Conditions** | ONLY IF ATSAW FUNCTION CONFIGURED*<br>ONLY IF GPS configuration and RAAS FUNCTION ACTIVATED** | | | |

**Table 1.5: Functional and System Effect Description for Surveillance Systems**

Note: The above described functional or system effects may not always be observed due to GPS total loss, but these are the alerts/warning that could arise in case of potential RFI or due to GPS data loss.

### 1.2.3 OTHERS

The table below contains the functional and system effects of the communication systems ATSU, SATCOM and other systems such as BUSS or BOW ROTOR:

| SYSTEMS | IMPACT |
|---|---|
| **SATCOM** | Some impact anticipated due to the SATCOM frequency band (1626.5 MHz) being close to the GPS L1 frequency band (1575.42 MHz). |
| **ATSU** | No impact. AFN messages timestamp will not be synchronized with UTC time provided by GPS. The source of the timestamp switches to either: ADIRU (A350 only), CLOCK, CMC/CFDIU. |
| **BUSS** | In case of total loss of GPS, GPS altitude will not be available. |
| **BOW ROTOR** | Computed time to cool the engine will be augmented by 3 minutes |

**Table 1.6: Functional and System Effect Description for other Systems**

Note: The above described functional or system effects may not always be observed due to GPS total loss, but these are the alerts/warnings that could arise in case of potential RFI or due to GPS data loss.

## 2. OPERATIONAL CONSIDERATIONS

The effects of GNSS loss detailed in section 1 should be considered in airline's operations in order to ensure the safe operation of the aircraft.

**During the flight preparation:**
The operators should consider the NOTAMs related to known or expected GNSS RFI. If a NOTAM is applicable to the flight, the availability of non GNSS-Based routes, procedures and approaches (such as ILS, VOR and DME) shall be checked for the affected area.

**During the flight phase:**
The loss of GNSS data is detected by the systems which indicate associated loss of capability and messages on cockpit displays. All additional impacts on aircraft capabilities are detected by the systems and indicated on ECAM displays and ND as defined in section 1.

Note1: Aircraft functions apply different confirmation times before declaring the loss of GNSS data or to declare the loss of a capability. Not all ECAM messages will therefore appear at the same time.

Note 2: The GPS/GNSS position may be displayed in with dashes ('-') and the number of tracked satellites ("NBR OF SAT") maybe abnormally low or null.

- ⇨ When flying in an area affected by GNSS RFI, if the flight crew observes the cockpit effects described in section 1, the existing FCOM normal and abnormal/emergency procedures apply and shall be followed.
- ⇨ Airbus does not specifically require to deselect GPS: the GNSS RFI can be transitory and normal navigation mode based on GNSS data (A320/A330/A340/A380 "GPS PRIMARY" or A350 "NAV PRIMARY" displayed on ND), as well as communication and surveillance functions can be recovered.
- ⇨ When ADS-B OUT is required in the flight area or on the current route, the flight crew should notify ATC of the loss of ADS-B OUT reporting due to the loss of the GNSS signal.

**During the post-flight phase:**
Airbus recommends to perform the following actions after a flight with possible GNSS RFI:

- Flight crew should report possible GPS interferences and associated cockpit effects to the maintenance team,
- Maintenance team should apply recommended action detailed in section 3 (system tests, data collection, reporting to Airbus engineering or flight operations support),
- Operator should report any identified suspected GNSS RFI events to regional (e.g. ANSPs) and international organizations (e.g. EUROCONTROL's Voluntary ATM Incident Reporting (EVAIR)) in order to facilitate and accelerate GNSS RFI event confirmation/resolution, and generate NOTAM to operators' community.

## 3. MAINTENANCE RECOMMENDATIONS

The alerts described in section1 may point to a real defect of a system. In order to confirm that the events were not due to equipment failure, maintenance actions need to be carried out.

The required maintenance actions depend on the context under which the faults have been observed. In this article, we consider three different use cases:

1. Case 1: Transient symptoms observed when A/C overflies a known GNSS RFI area
2. Case 2: Transient symptoms observed in an area not known for GNSS RFI
3. Case 3: Symptoms observed during GPS interferences exposure not covered in section 1

### 3.1 CASE1 – TRANSIENT SYMPTOMS OBSERVED WHEN A/C OVERFLIES A KNOWN GNSS RFI AREA

In this case, symptoms described in section 1 of this article are confirmed to be transient and observed when the A/C was overflying a known GPS interference area (e.g. NOTAM available or analysis/experience confirmed GNSS disturbances affecting this area). Effects disappear during flight after leaving the affected area.

Once on ground AIRBUS recommends performing the following actions:

*Note: The list of associated maintenance tasks references can be found in Table 3.1*

1. Reset both MMR 1 and MMR 2 (power off >10 sec)
2. Perform MMR 1 and MMR 2 system test
3. Perform IR system test
4. If ADS-B Out function was affected, perform ATC1 and ATC2 system test
5. If OANS function was affected, perform OANS system test
6. If TAWS function was affected, perform TAWS system test
7. If ADS-B In (ATSAW) function was affected, perform TCAS system test
8. If ROW/ROP function was affected, perform
    - A320/A330/A340/A350 family: GPWS system test
    - A380: OANS system test

If all the tests are OK neither further troubleshooting nor LRU removal is required. Please, note that new LRUs will exhibit same behavior when exposed to the same interferences.

If a fault is confirmed, perform troubleshooting as per the applicable TSM task.

Special cases:

- If the GPS interference is still present on ground the tests might not pass. In case of known interference on ground, the operator can either move the A/C to a non-affected location or apply MEL for affected equipment. Systems nominal behavior should be retrieved soon after leaving the interference area.
- Please report the event to AIRBUS if normal system behavior was not recovered after exiting the RFI area.

| TASK | A/C TYPE | AMM / MP(A350) REFERENCE |
|---|---|---|
| **MMR reset** | **A320/A330/ A340/A380** | AMM Task 34-34-00-860-801-A – Reset of the Multi-Mode Receiver |
| **IR System test** | **A320FAM** | AMM TASK 34-14-00-740-004-A SYSTEM TEST of the Inertial Reference (IR) |
| | **A330/A340** | AMM TASK 34-14-00-740-803-A SYSTEM TEST of the Inertial Reference (IR) |
| | **A380** | AMM TASK 34-10-00-740-802-A BITE Test of the IR (System Test) |
| | **A350** | AMM TASK A350-A-34-1X-XX-00001-343A-A BITE Test of the Inertial Reference (IR) (System Test) |
| **MMR BITE test** | **A320/A330/ A340** | AMM Task 34-36-00-740-003-A – BITE test of the MMR |
| | **A380** | AMM Task BITE Test of the MMR (System Test |
| | **A350** | MP TASK A350-A-34-36-XX-00001-343A-A – BITE Test of the Multi-Mode Receiver (MMR) (System Test) |
| **ATC BITE test** | **A320** | **ATC standalone**: AMM Task 34-52-00-74-004-A – BITE Test of the ATC<br>**T3CAS**: AMM Task 34-72-00-740-001-A – BITE Test of the T/TISS → SUBTASK 34-72-00-740-053-A C. BITE Test of the T/TISS (ATC2 part) |
| | **A330/A340** | AMM Task 34-52-00-740-801-A – BITE test of the Air Traffic Control (ATC) |
| | **A380** | AMM Task 34-71-00-740-803-A – BITE Test of the AESS (Master AESU XPDR/TCAS Test) |

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|---|---|---|
| | **A350** | MP Task A350-A-34-71-XX-02001-343A-A – BITE Test of the Aircraft Environment Surveillance System (AESS) (Master-AESU XPDR/TCAS Module-Test) |
| **OANS BITE Test** | **A320/A330/ A340/A380** | AMM Task 34-38-00-740-801-A – BITE Test of the Onboard Aircraft Navigation System (OANS) (System Test) |
| **GWPS BITE Test** | **A320** | **GPWS:** AMM Task 34-48-00-740-002-A BITE Test of the GPWS<br>**EGPWS:** AMM Task 34-48-00-740-002-B BITE Test of the GPWS<br>**T2CAS:** AMM TASK 34-43-00-740-004-A Bite Test of the T2CAS → SUBTASK 34-43-00-740-054-A B.BITE Test of the T2CAS (TAWS part)<br>**T3CAS:** AMM Task 34-72-00-740-001-A – BITE Test of the T/TISS → SUBTASK 34-72-00-740-052-F B.BITE Test of the T/TISS (TAWS part) |
| | **A330/A340** | **EGPWS:** AMM TASK 34-48-00-740-801-B Operational Test of the Enhanced Ground Proximity Warning (GPW) Computer by BITE<br>**T2CAS:** AMM Task 34-43-00-740-802-A BITE Test of the Traffic and Terrain Collision Avoidance System (T2CAS) → SUBTASK 34-43-00-740-054-A B.BITE Test of the T2CAS (TAWS part)<br>**T3CAS:** AMM TASK 34-72-00-740-801-A BITE Test of the T/TISS → SUBTASK 34-72-00-740-051-D B.BITE Test of the T/TISS (TAWS part) |
| | **A380** | AMM TASK 34-71-00-740-802-A – BITE Test of the AESS (Master AESU TAWS Test) |
| | **A350** | MP TASK A350-A-34-71-XX-01001-343A-A BITE Test of the Aircraft Environment Surveillance System (AESS) (Master AESU TAWS Module Test |
| **TCAS BITE Test** | **A320** | **TCAS:** TASK 34-43-00-740-001-A BITE Test of the TCAS<br>**T2CAS:** AMM TASK 34-43-00-740-004-A Bite Test of the T2CAS → SUBTASK 34-43-00-740-053-A A.BITE Test of the T2CAS (TCAS part)<br>**T3CAS:** AMM Task 34-72-00-740-001-A – BITE Test of the T/TISS → SUBTASK 34-72-00-740-051-A A.BITE Test of the T/TISS (TCAS part) |
| | **A330/A340** | **TCAS:** TASK 34-43-00-740-801-A – BITE test of the Traffic Collision Avoidance System (TCAS)<br>**T2CAS:** AMM Task 34-43-00-740-802-A BITE Test of the Traffic and Terrain Collision Avoidance System (T2CAS) → SUBTASK 34-43-00-740-053-A A.BITE Test of the T2CAS (TCAS part)<br>**T3CAS:** AMM TASK 34-72-00-740-801-A BITE Test of the T/TISS → SUBTASK 34-72-00-740-050-A A. BITE Test of the T/TISS (TCAS part |
| | **A380** | AMM Task 34-71-00-740-803-A – BITE Test of the AESS (Master AESU XPDR/TCAS Test) |
| | **A350** | MP Task A350-A-34-71-XX-02001-343A-A – BITE Test of the Aircraft Environment Surveillance System (AESS) (Master-AESU XPDR/TCAS Module-Test) |

**Table 3.1: Maintenance tasks references**

## 3.2 CASE2 – TRANSIENT SYMPTOMS OBSERVED IN AN AREA NOT KNOWN FOR GPS INTERFERENCES

In case a GNSS RFI is suspected and the area is not known to be affected via a NOTAM entry or previous experience, an analysis needs to be performed in order to confirm the root cause.

The analysis consists in the study of all potential sources of GNSS perturbation: aircraft and/or receiver failure, GNSS constellation anomaly, environment masking, multipath or space weather. In case all of those potential sources are discarded, then it is likely that a GNSS RFI occurred.

Please report such a case to AIRBUS together with further information in order to allow an assessment of the event and to confirm to if it can be linked to RFI or if regular troubleshooting is required on A/C.

Information to be provided for analysis:

| A320 / A330 / A340 | A380 | A350 |
|---|---|---|

| Post Flight Report | Post Flight Report<br>CMS dump | Post Flight Report<br>CMS dump |
|---|---|---|
| Flight data:<br>- DFDR/QAR<br>- DAR if customization available including additional GPS/ADIRU parameters | Flight data:<br>- DFDR/QAR<br>- SAR 58 (this report contains useful GPS information) | Flight data:<br>- DFDR/QAR<br>- SAR 99 (this report contains useful GPS information) |
| Pilot Report:<br>- Detailed event report<br>- Picture of FMS pages in MCDU:<br>- GPS MONITOR<br>- POSITION MONITOR<br>- IRS MONITOR | Pilot Report:<br>- Detailed event report<br>- POSITION/GPS Page status during events ( MFD) | Pilot Report:<br>- Detailed event report<br>- POSITION/GNSS Page status during events ( MFD) |
| MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT for MMR Rockwell Collins GLU-925 or Honeywell RMA 55B (*)<br>*Accessible via MDCU → SYSTEM REPORT TEST → MMR → SPECIFIC DATA* | MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → MMR → SPECIFIC DATA* | MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → MMR → SPECIFIC DATA* |
| IR data:<br>- TSD of IR1, IR2 and IR3<br>- GPIRS IN-AIR REPORT (Northrop Grumman ADIRU and Honeywell Block III(**)<br>*Accessible via MDCU → SYSTEM REPORT TEST → IR → SPECIFIC DATA* | IR data:<br>- GPIRS IN-AIR REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → IR → SPECIFIC DATA* | IR data:<br>- GPIRS IN-AIR REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → IR → SPECIFIC FUNCTIONS* |

**Table 3.2: Information to be provided to evaluate presence of GPS interferences**

(*) MMR with "GPS REPORT" menu:
- Collins GLU-925 P/N 822-1821-430 (A320/A330/A340/A380)
- Honeywell RMA-55B P/N 066-50029-1161 (A320/A330/A340)

(**) ADIRUs with "GPIRS REPORT" menu:
- Honeywell Block III P/N HG2030BE0x
- Northrop Grumman P/N 465020-0303-0318, 465020-0304-0318, P/N 465020-0303-0316, P/N 465020-0304-0316

<u>If the event is confirmed to be related to GNSS RFI</u>:

Recommendations given in chapter 3.1 apply.
We recommend the A/L to report any identified suspected GNSS RFI events to regional (e.g. ANSPs) and international organizations (e.g. EUROCONTROL's Voluntary ATM Incident Reporting (EVAIR)) in order to facilitate and accelerate GNSS RFI event confirmation/resolution, and generate NOTAM to operators' community

<u>If the event is not confirmed to be related to GNSS interference</u>

Regular troubleshooting to be applied as per TSM.

## 3.3 <u>CASE3</u> – EFECTS DURING GPS INTERFERENCES EXPOSURE NOT COVERED IN CHAPTER 1

If an A/L suspects GNSS RFI and observes effects not covered in chapter 1, we recommend contacting AIRBUS for further event analysis.

For instance, AIRBUS has received reports about different kind of events potentially linked to GNSS RFI exposure such as:

- GPS losses not recovered during flight with Collins GLU-925 P/N 822-1821-430 (already understood and documented. See TFU 34.36.00.030)
- Spurious GPWS (TAWS) alerts
- ADS-B Out erroneous position

These represent unexpected behaviour and require investigation.

We recommend A/Ls to provide AIRBUS with the following information along with the event report to help events analysis:

| | **A320 / A330 / A340** | **A380** | **A350** |
|---|---|---|---|
| General GPS analysis information (Equivalent to Table 3.2) | Post Flight Report | Post Flight Report<br>CMS dump | Post Flight Report<br>CMS dump |
| | Flight data:<br>- DFDR/QAR<br>- DAR if customization available including additional GPS/ADIRU parameters | Flight data:<br>- DFDR/QAR<br>- SAR 58 (this report contains useful GPS information) | Flight data:<br>- DFDR/QAR<br>- SAR 99 (this report contains useful GPS information) |
| | Pilot Report:<br>- Detailed event report<br>- Picture of FMS pages in MCDU:<br>- GPS MONITOR<br>- POSITION MONITOR<br>- IRS MONITOR | Pilot Report:<br>- Detailed event report<br>- POSITION/GPS Page status during events ( MFD) | Pilot Report:<br>- Detailed event report<br>- POSITION/GNSS Page status during events ( MFD) |
| | MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT for MMR Rockwell Collins GLU-925 or Honeywell RMA 55B (*)<br>*Accessible via MDCU → SYSTEM REPORT TEST → MMR → SPECIFIC DATA* | MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → MMR → SPECIFIC DATA* | MMR data:<br>- Troubleshooting Data (TSD)<br>- GPS REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → MMR → SPECIFIC DATA* |
| | IR data:<br>- TSD of IR1, IR2 and IR3<br>- GPIRS IN-AIR REPORT (Northrop Grumman ADIRU and Honeywell Block III(**)<br>*Accessible via MDCU → SYSTEM REPORT TEST → IR → SPECIFIC DATA* | IR data:<br>- GPIRS IN-AIR REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → IR → SPECIFIC DATA* | IR data:<br>- GPIRS IN-AIR REPORT<br>*Accessible via OMT → SYSTEM REPORT TEST → ATA 34 → IR → SPECIFIC FUNCTIONS* |
| In case of a spurious TAWS warning | Depending on A/C GPWS computer configuration :<br>- T2CAS dump or<br>- T3CAS dump or<br>- EGPWS dump | Not possible to dump AESU on wing | Not possible to dump AESU on wing |
| In case of an ADS-B Out issue | - Air Traffic Control report together with ADS-B raw data containing position + integrity information (data to be requested by A/L to authorities, not usually available at A/L level) | | |

| | |
|---|---|
| | - ATC transponder side in use during events<br>- Was the pilot requested to switch transponder? Did the situation change if done? |

**Table 3.3: Information to be provided in case of different symptoms**

## 4. GLOSSARY

| | |
|---|---|
| **A/C** | Aircraft |
| **ACMS** | Aircraft Condition Monitoring System |
| **ADIRS** | Air Data and Inertial Reference System |
| **ADIRU** | Air Data and Inertial Reference Unit |
| **AESS** | Aircraft Environment Surveillance System |
| **AFN** | ATC Facilities Notification |
| **ANF** | Airport Navigation Function |
| **ATSAW** | Airborne Traffic Situation Awareness |
| **ATSU** | Air Traffic Service Unit |
| **BTV** | Brake To Vacate |
| **BUSS** | Back Up Speed Scale |
| **CFDIU** | Central Fault Display Interference Unit |
| **CFDS** | Central Fault Display System |
| **CMC** | Central Maintenance Computer |
| **CMS** | Central Maintenance System |
| **DAR** | Digital AIDS Recorder (A320) |
| **DAR** | Digital ACMS Recorder (A330/A340/A380) |
| **DFDR** | Digital Flight Data Recorder |
| **DLCS** | Data Loading Configuration System |
| **DMC** | Display Management Computer |
| **DME** | Distance Measuring Equipment |
| **ECAM** | Electronic Centralized Aircraft Monitoring |
| **EFB** | Electronic Flight Bag |
| **EGPWC** | Enhanced Ground Proximity Warning Computer |
| **EGPWS** | Enhanced Ground Proximity Warning System |
| **EICU** | EFB interface Control Unit |
| **EIS** | Electronic Instrument System |
| **EIU** | Electronic Instrument Unit |
| **EPE** | Estimated Position Error |
| **EPU** | Estimated Position Uncertainty |
| **FANS** | Future Air Navigation System |
| **FDIF** | Flight Data Interface Function |
| **FLS** | FMS Landing System |
| **FMC** | Flight Management Computer |
| **FMG (E)C** | Flight Management Guidance and (Envelope) Computer |
| **FMS** | Flight Management System |
| **FOM** | Figure Of Merit |
| **FOMAX** | Flight Operation and MAintenance eXchanger |
| **FWC** | Flight Warning Computer |
| **FWS** | Flight Warning System |
| **GBAS** | Ground Based Augmentation System |
| **GLS** | GBAS Landing System |
| **GNSS** | Global Navigation Satellite System |
| **GPIRS** | GPS and IRS mixed data |
| **GPS** | Global Positioning System |
| **GPWC** | Ground Proximity Warning System |
| **HDOP** | Horizontal Dilution Of Precision |
| **HFOM** | Horizontal Figure Of Merit |
| **HIL** | Horizontal Integrity Limit |
| **HIPL** | Horizontal Integrity Protection Level |
| **HUD** | Head Up Display |
| **HUDC** | Head Up Display Computer |
| **IFE** | In Flight Entertainment |
| **IRS** | Inertial Reference System |
| **ISIS** | Integrated Standby Instrument System |
| **LOC** | Localizer |
| **ELT** | Emergency Locator Transmitter |
| **MCDU** | Multipurpose Control Display Unit |

| | |
|---|---|
| **MFD** | Multi Functions Display |
| **MMR** | Multi-Mode Receiver |
| **ND** | Navigation Display |
| **NSE** | Navigation System Error |
| **OANS** | Onboard Airport Navigation System |
| **PFD** | Primary Flight Display |
| **PRAIM** | Predictive Receiver Autonomous Integrity Monitoring |
| **PRIM** | PRIMary System |
| **PVT** | Position, Velocity, Time |
| **RAAS** | Runway Awareness and Advisory System |
| **RFI** | Radio Frequency Interference |
| **RNP** | Required Navigation Performance |
| **RNP AR** | Required Navigation Performance Authorization Required |
| **ROPS** | Runway Overrun Prevention System |
| **ROW** | Runway Overrun Warning |
| **RVSM** | Reduced Vertical Separation Minima |
| **SATCOM** | SATellite COMmunication |
| **SBAS** | Satellite Based Augmentation System |
| **SCI** | Secure Communication Interface |
| **SLS** | SBAS Landing System |
| **TAWS** | Terrain Avoidance and Warning System |
| **TCAS** | Traffic Alert and Collision Avoidance System |
| **TOS** | Take Off Securing |
| **UTC** | Universal Time Coordinated |
| **VDOP** | Vertical Dilution Of Precision |
| **VHF** | Very High Frequency |
| **VIL** | Vertical Integrity Limit |
| **VOR** | VHF Omnidirectional Range |
| **WXR** | Weather Radar |
| **XPDR** | Transponder |