



NAT OPS BULLETIN

Serial Number: **2019_003 Rev 4**

Subject: **Data Link Performance Improvement Options**

Originator: **NAT SPG**

Issued: **17 July 2023**

Effective: **17 July 2023**

The purpose of this North Atlantic Operations Bulletin (NAT OPS) is to provide guidance to North Atlantic (NAT) operators regarding options that are available to improve data link performance.

Any queries about the content of the attached document should be addressed to:

ICAO EUR/NAT Office: icaoournat@icao.int

NOTICE

NAT Ops Bulletins are used to distribute information on behalf of the North Atlantic Systems Planning Group (NAT SPG). The material contained therein may be developed within the working structure of the NAT SPG or be third party documents posted at the request of a NAT SPG Member State. A printed or electronic copy of this Bulletin, plus any associated documentation, is provided to the recipient as is and without any warranties as to its description, condition, quality, fitness for purpose or functionality and for use by the recipient solely for guidance only. The information published by ICAO in this document is made available without warranty of any kind; the Organization accepts no responsibility or liability whether direct or indirect, as to the currency, accuracy or quality of the information, nor for any consequence of its use. The designations and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of ICAO concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

The NAT OPS Bulletin Checklist is available at www.icao.int/EURNAT/EUR/NAT Documents, NAT Documents, then NAT Ops Bulletins.

There is no objection to the reproduction of extracts of information contained in this Bulletin if the source is acknowledged.

NAT OPERATIONS BULLETIN – DATA LINK PERFORMANCE IMPROVEMENT OPTIONS

1. Purpose of Bulletin. The purpose of this bulletin is to provide guidance to North Atlantic (NAT) operators regarding options that are available to improve data link performance.

2. Background. Application of the reduced lateral and longitudinal separation minima in the NAT Region is dependent on a smooth functioning FANS 1/A data link system. Various known data link related deficiencies in aircraft systems and poor data link performance have a detrimental effect on the air traffic control system and impede aircraft operator's efforts to obtain performance-based communication and surveillance (PBCS) authorizations. Many of these known deficiencies have already been fixed by aircraft manufacturers and software upgrades are available. To ensure the best possible functioning of the NAT air traffic control system, it is of utmost importance that aircraft operators always operate the latest available FANS 1/A related software version in aircraft that fly in the NAT high level airspace (HLA) and that the aircraft systems are configured in an optimal manner. Meanwhile, implementation of improvements and corrections is also a priority undertaking for the ground and network segments of the overall FANS 1/A system.

3. The list of recommended data link performance improvement options provided in the **Attachment** to this OPS Bulletin describes the problems and solutions identified to improve data link performance. However, it should be noted that not all aircraft operators experience all these problems and therefore not all solutions apply to all aircraft operators. Additionally, while acknowledging there is confidence that the recommended improvement options would improve the data link performance, it should be noted that these updates might not be necessarily seen as sufficient to ensure a PBCS authorization. Aircraft operators are advised to consult with aircraft manufacturers for guidance regarding implementation of the improvement options.

4. The certification status versus EUROCAE ED-122 / RTCA DO-306 standards and PBCS authorization requirements should be clarified by aircraft operators in coordination with the manufacturers concerned, recognizing the aircraft operators need to consider the economic and operational aspects and priorities.

5. Websites

5.1 The ICAO EUR/NAT Office Website is at: **www.icao.int/eurnat**. Click on **EUR & NAT Documents >> NAT Documents** to obtain NAT Operations and NAT Region Update Bulletins and related project planning documents.

6. Contacts

6.1 Any queries about the content of this bulletin should be addressed to ICAO EUR/NAT Office:

icaoeurnat@icao.int.

ATTACHMENT - LIST OF DATA LINK PERFORMANCE IMPROVEMENT OPTIONS

PROBLEM / ISSUE	SOLUTIONS / ACTIONS
<p>1. HF datalink – next-on-busy</p> <p>1.1 Airbus ATSU and Rockwell Collins CMU-900 avionics may contain a feature called “next-on-busy” by which those avionics send a new downlink message via HF datalink when outside of VHF coverage and SATCOM is busy sending a previous downlink, instead of waiting for SATCOM to finish sending the previous downlink and then sending the new downlink via SATCOM. This feature reduces datalink performance because the avionics can actually deliver the new downlink more quickly if they wait for SATCOM to finish sending the previous downlink and then send the new downlink via SATCOM. On airframes equipped with Rockwell Collins CMU-900, this problem is compounded by subsequent downlink messages being queued while the avionics wait for acknowledgement of the HF datalink downlink message.</p>	<p><i>Solution a): For CMU-900 installations with Iridium SATCOM where PBCS is showing poor performance, place the HF in “voice-only”. This option removes HF DL as an available media so the “next-on-busy” function will not occur.</i></p> <p>At the recent FAA PARC CWG40, an Iridium SATCOM equipped operator demonstrated the PBCS performance impact of HF DL “next-on-busy”. Some other operators have also taken this action to place HF into “voice-only” mode. Iridium SATCOM operators, equipped with CMU-900, could take this action on interim basis prior to an available CMU software. See item 4 below on HF DL for similar recommendation.</p> <p><i>Solution b): Work with Airbus and Rockwell Collins to install software versions that disable the next-on-busy feature. (For the Rockwell Collins CMU-900 with recent software, this can be done with a database update).</i></p>
<p>2. VHF to SATCOM Transitions</p> <p>2.1 Transitions from using VHF to using SATCOM, especially when they occur repeatedly in a short period of time, reduce datalink performance because the ACARS protocols are generally not designed to maximize performance but rather to minimize cost by persistently attempting to use less costly VHF.</p>	<p><i>Solution a): Disable VHF datalink just prior to entering oceanic airspace</i></p> <p>Implement flight crew procedures to disable VHF datalink (usually by placing the VHF radio used for VHF datalink into voice mode) just prior to entering oceanic airspace or prior to leaving contiguous VHF coverage in order to proactively force SATCOM use. Conversely, enable VHF datalink when exiting oceanic airspace or entering contiguous VHF coverage.</p> <p><i>Caution: In the event of an oceanic diversion, when SATCOM and HF data link (if installed) are lost or otherwise unavailable, flight crews will need to re-enable VHF data link to provide ACARS AOC communication with company.</i></p> <p><i>Solution b): Implement more precise VHF region definitions</i></p> <p>In avionics that offer the capability to prefer specified subnetworks in defined geographic regions (including 777 DCMF and 787 CMF), implement more precise VHF region definitions that exclude areas of the world with only intermittent VHF subnetwork coverage in order to force SATCOM use in those areas. Such areas, in which the DLMA has observed consistent performance problems, include the North Pacific near the Aleutian Islands and the Kamchatka Peninsula, the South Pacific near New</p>

PROBLEM / ISSUE	SOLUTIONS / ACTIONS
	<p>Caledonia and Vanuatu, and the North Atlantic near Bermuda and the Azores.</p> <p><i>Caution: In the event of an oceanic diversion, when SATCOM and HF data link (if installed) are lost or otherwise unavailable flight crews will not have ACARS AOC communication with company.</i></p> <p><i>Solution c): Implement the ARINC 618 RAT1 timer</i></p> <p>Upgrade ACARS router avionics (CMU or equivalent) software to include the new ARINC 618 RAT1 timer when it becomes available. This timer is intended to improve performance for FANS downlink messages during VHF-to-SATCOM transitions by additionally attempting to send a message via SATCOM when attempts to send it via VHF have not been successful for 60 seconds (such as when exiting land-based VHF coverage). This feature is available on some new aircraft types and will gradually become available for retrofit via software updates on existing aircraft.</p>
<p>3. “Ack-and-toss”</p> <p>3.1 ACARS router (CMU or equivalent) avionics may for various reasons acknowledge receipt of a FANS uplink message but then fail to deliver the message to the avionics that host the FANS applications. This is commonly known as “ack-and toss” behaviour.</p>	<p><i>Solution a) Rockwell Collins CMU-900 software problem</i></p> <p>For the 737, 747-400, 757, 767, and MD-11, Rockwell Collins certified core software -014 that fixes this problem. For the 747-8, Boeing certified core software -202 that fixes this problem.</p> <p><i>Solution b) Boeing 777 AIMS-2 software problem</i></p> <p>Boeing developed AIMS-2 BPV17.1 software that fixed this problem.</p> <p><i>Solution c) Airbus A320/A330/A340 software problem</i></p> <p>This problem occurs only in the ATSU CSB/CLR7.1 to 7.4 software versions. CSB/CLR7.5 and CSB/CLR9 that fix this problem are now certified and available.</p> <p><i>Solution d) ARINC 618 false-positive duplicate uplink block identifier (UBI) determination</i></p> <p>ARINC 618-8, which was published in August 2016, contains a recommended avionics enhancement that reduces the likelihood of this problem occurring. For the 777, Boeing developed AIMS-2 BPV17B software that implements the avionics enhancement. For the 787, Boeing developed CMF BPV4 software that implements the avionics enhancement. For the Honeywell CMU Mark II, Honeywell developed -522 software that implements the avionics enhancement. Similar software upgrades are or will</p>

PROBLEM / ISSUE	SOLUTIONS / ACTIONS
	be available for other affected ACARS router (CMU or equivalent) avionics, although it should be noted that the Rockwell Collins CMU-900 was never subject to this problem; the way it detects duplicate uplink blocks was standardized in ARINC 618-8 as the recommended avionics enhancement. A complete solution, however, requires the Communication Service Providers (CSPs) to ensure that two sequential non-general response uplinks do not contain the same UBI value.
4. HF data link - general 4.1 HF datalink performance has not been demonstrated to meet the RCP240 and RSP180 specifications, although for various reasons the avionics may send FANS downlink messages via HF datalink. This behaviour has a detrimental effect on data link performance.	<i>Solution Manually prevent HF datalink use</i> Prevent HF datalink use manually by implementing flight crew procedures to disable HF datalink (usually by placing the HF radio used for HF datalink into voice mode).
5. Internetworking 5.1 The DLMA has observed that some performance problems are caused by the challenges of effective CSP internetworking when an aircraft operator chooses to use one of the two global CSPs (ARINC or SITA) for VHF and the other global CSP for SATCOM. (The DLMA also realizes that some aircraft operators configure their avionics to first prefer regional DSPs, such as Avicom in Japan, which has not been shown to affect performance).	<i>Solution: For aircraft operators that do not configure their avionics to first prefer a regional CSP, use the same global CSP for both VHF and SATCOM</i> It is likely that the data link performance will be improved if the same global CSP is used for both VHF and SATCOM.
6. Large Pilot Operational Response Time (PORT) values 6.1 PORT is one component of the Actual Communications Performance (ACP), the other being the Actual Communications Technical Performance (ACTP). For an uplink-downlink CPDLC transaction, PORT captures the human portion of the transaction time and ACTP captures the technical (mainly network) portion of the transaction time. Accordingly, large PORT values reduce performance.	<i>Solution: Implement flight crew procedures to respond to CPDLC messages with STANDBY when appropriate.</i> In accordance with ICAO Doc 9869, Performance-Based Communication and Surveillance (PBCS) Manual, ATS providers should exclude CPDLC transactions with STANDBY responses from performance monitoring. ICAO Doc 10037, Global Operational Data Link (GOLD) Manual explains in paragraph 4.3.2.4 when STANDBY responses are appropriate under certain circumstances: <i>4.3.2.4 The flight crew should respond to CPDLC messages as soon as practical after they are received. For most messages, the flight crew will have adequate time to read and respond within one minute. However, the flight crew should not be pressured to respond without taking adequate time to fully understand the CPDLC message and to satisfy other higher priority operational demands. If</i>

PROBLEM / ISSUE	SOLUTIONS / ACTIONS
	<i>additional time is needed, the flight crew should send a RSPD-3 STANDBY response.</i>
7. Unknown causes 7.1 If a data link performance problem has an unknown cause, then the DLMA recommends submitting a problem report at http://www.fans-cra.com/ so that the DLMA and other involved stakeholders can attempt to determine the cause.	<i>Submit problem reports at http://www.fans-cra.com/</i>
8. Maximising access to the Classic Aero Ground Earth Station (GES) services: 8.1 In the Inmarsat SATCOM system, there are a multitude of transmission paths available via the different ground stations and satellites. If one path fails, the aircraft may be able to switch to an alternate path provided the Operator Requirement Table (ORT) in the SATCOM terminal is correctly configured. 8.2 Proper configuration of the ORT table is therefore vital for maximizing availability of SATCOM services in the NAT.	<i>Operators are requested to ensure that they review all Service Information Letters (SILs) and Software Bulletins (SBs) released from their Satcom avionics manufacturers, taking particular care to ensure that their advice on Operator Requirement Table (ORT) set-up for optimising accessibility to Inmarsat's GES resources is taken. In doing this, it will be ensured that all available satellite/GES combinations are included in the ORT, optimising access to the communications resource. This will maximise the aircraft capability to switch to an alternate communication path in case of a failure in the SATCOM communication chain.</i> <i>Below are some links to the SATCOM manufacturers' information portals:</i> <i>Cobham: https://sync.cobham.com/satcom/</i> <i>Honeywell: https://myaerospace.com/</i> <i>Thales: https://www.thalesgroup.com/en/customer-online</i> <i>Rockwell Collins: https://www.shopcollins.com]</i>
9. Software updates 9.1 Aircraft and avionics manufacturers work persistently on fixing problems that have been identified in data link operations. Periodically new software releases are issued that solve some of the problems that have been identified. Some of those fixes may improve data link performance and most of them fix issues that cause problems for pilots and air traffic controllers in the use of data link. 9.2 To ensure the best possible functioning of the NAT air traffic control system it is of utmost importance that aircraft operators take care to always operate the latest available FANS 1/A related software version in aircraft that fly in the NAT high level airspace and to ensure that the aircraft systems are configured in an optimal manner. A list of recommended aircraft avionics software versions is provided in the table below.	<i>Update FANS 1/A related software using the list of recommended aircraft avionics software versions provided in the table below.</i>

PROBLEM / ISSUE	SOLUTIONS / ACTIONS
9.3 It should be noted that new software versions that fix several known data link problems will become available for many aircraft types within the next year. Operators are advised to seek information from aircraft manufacturers (OEM) about the status of those new software releases.	

~~~~~

**RECOMMENDED AVIONICS DATA LINK SOFTWARE VERSIONS**

| Recommended software versions for NAT data link operations |                                                          |                                                                                                                                                             |                                                                                                                                                                                             |
|------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Aircraft type                                              | FANS software                                            | ACARS software                                                                                                                                              | Notes                                                                                                                                                                                       |
| A318/A319/A320/A321                                        | CSB7.5 or CSB9.4                                         | CSB7.5 or CSB9.4                                                                                                                                            | FMS Release 2 recommended (S8 and subsequent for Thales/GE FMS; H3 and subsequent for Honeywell FMS)                                                                                        |
| A330/A340                                                  | CLR7.5 or CLR9.4                                         | CLR7.5 or CLR9.4                                                                                                                                            | MS Release 2 recommended (T6 and subsequent for Thales/GE FMS; P6 and subsequent for Honeywell FMS)                                                                                         |
| A350                                                       | CLV1.4                                                   | S4                                                                                                                                                          |                                                                                                                                                                                             |
| A380                                                       | CLA4.2                                                   | S3                                                                                                                                                          |                                                                                                                                                                                             |
| A220                                                       | DLCA-6500 with Avionics Buil 8A (Collins Proline Fusion) | Collins CMU-4000 within RIU-4010                                                                                                                            |                                                                                                                                                                                             |
| MD11                                                       | FMC Pegasus -924                                         | Honeywell CMU Mark II+:<br>B73x or B3xM: Core -524<br>All other: Core -523<br>Collins CMU-900:<br>Non-ATN : Core -016<br>ATN: Core -505<br>747-8: Core -203 |                                                                                                                                                                                             |
| B736/B737/B738/B739<br>B37M/B38M/B39M/B3XM                 | A4 hardware: FMC U12<br>C1 hardware: FMC U13* or U14.1   |                                                                                                                                                             | * There are planned ADs against the currently listed software. Updated software with AD related fixes are currently in the certification process or are already available for installation. |
| B744                                                       | Original FMC: Load 16 (not PBCS compliant)               |                                                                                                                                                             |                                                                                                                                                                                             |
|                                                            | NG FMC: NG FMC BP4                                       |                                                                                                                                                             |                                                                                                                                                                                             |
| B748                                                       | NG FMC BP4                                               |                                                                                                                                                             |                                                                                                                                                                                             |
| B752/B753                                                  | Pegasus I FMC: Peg '09*                                  |                                                                                                                                                             | * There are planned ADs against the currently listed software. Updated                                                                                                                      |



| Recommended software versions for NAT data link operations              |                                    |                                            |                                                                            |
|-------------------------------------------------------------------------|------------------------------------|--------------------------------------------|----------------------------------------------------------------------------|
| Aircraft type                                                           | FANS software                      | ACARS software                             | Notes                                                                      |
|                                                                         | Pegasus II FMC: BP1A               |                                            | software with AD related fixes are currently in the certification process. |
| B762/B763/B764                                                          |                                    |                                            |                                                                            |
| B772/B773/B77L/B77W                                                     | AIMS-1: BPV16 (not PBCS compliant) |                                            |                                                                            |
|                                                                         | AIMS-2: BPV17C                     |                                            |                                                                            |
| B779                                                                    | CMF and FMF entry into service     |                                            |                                                                            |
| B788/B789/B78X                                                          | CMF BPV6 and FMF BPV4              |                                            |                                                                            |
| Beechcraft 4000                                                         | Universal Avionics UNS-1           | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs                                                             |
| Bombardier Learjet<br>35, 36, 35A, 36A, 40, 40XR,<br>45, 45XR, 60, 60XR | Universal Avionics FMS SCN 1002.1  | Universal Avionics UniLink UL-80X SCN 31.3 |                                                                            |
| Bombardier Challenger 300, 350                                          | Collins Proline 21 Advanced        | Collins RIU-4000                           |                                                                            |
| Bombardier Challenger 600, 601,<br>601-1A, 601-3A, 601-3R, 604          | Universal Avionics FMS SCN 1002.1  | Universal Avionics UniLink UL-80X SCN 31.3 |                                                                            |
| Bombardier Challenger 600, 601,<br>601-1A, 601-3A, 601-3R               | Honeywell NZ6.1.1                  | Honeywell CMU MK II+                       |                                                                            |
| Bombardier Challenger 605, 650                                          | Collins Proline 21 Advanced        | Collins CMU-4000                           |                                                                            |
| Bombardier Global Express,<br>Global Express XRS, Global 5000           | Honeywell NZ6.1.1                  | Refer to applicable Service Bulletins/STCs |                                                                            |
| Bombardier Global 5000 GVFD                                             | Collins Proline Fusion             | Collins DLCA-6000                          |                                                                            |
| Bombardier Global 5500                                                  | Collins Proline Fusion             | Collins DLCA-6000                          |                                                                            |
| Bombardier Global 6000                                                  | Collins Proline Fusion             | Collins DLCA-6000                          |                                                                            |
| Bombardier Global 6500                                                  | Collins Proline Fusion             | Collins DLCA-6000                          |                                                                            |
| Bombardier Global 7500                                                  | Collins Proline Fusion             | Collins DLCA-6500                          |                                                                            |
| Bombardier Global 8000                                                  | Collins Proline Fusion             | Collins DLCA-6500                          |                                                                            |
| Cessna Citation Longitude C700                                          | Garmin G5000 SW5.1                 | Garmin G5000 SW5.1                         | Updates planned, contact OEM                                               |

| Recommended software versions for NAT data link operations   |                                |                                            |                           |
|--------------------------------------------------------------|--------------------------------|--------------------------------------------|---------------------------|
| Aircraft type                                                | FANS software                  | ACARS software                             | Notes                     |
| Dassault F50, F50EX                                          | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs            |
| Dassault F50, F50EX                                          | Honeywell NZ6.1.1              | Honeywell CMU MK II+                       | 3rd party STCs            |
| Dassault F2000                                               | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs            |
| Dassault F2000 DX/EX/LX/S                                    | Honeywell EPIC NZ7.1.2         | Honeywell EPIC CMF 2.51                    | EASy II 4th Cert          |
| Dassault F900, F900B, F900C, F900EX                          | Honeywell NZ6.1.1              | Honeywell CMU MK II+                       |                           |
| Dassault F900 DX/EX/LX                                       | Honeywell EPIC NZ7.1.2         | Honeywell EPIC CMF 2.51                    | EASy II 4th Cert          |
| Dassault F900B                                               | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs            |
| Dassault F7X                                                 | Honeywell EPIC NZ7.1.2         | Honeywell EPIC CMF 2.51                    | EASy II 4th Cert          |
|                                                              | Honeywell NGFMS                | Honeywell EPIC CMF 3.1+                    | Contact OEM for update    |
| Dassault F8X                                                 | Honeywell NGFMS                | Honeywell EPIC CMF 3.0                     | EASy III 2nd Cert         |
|                                                              | Honeywell NGFMS                | Honeywell EPIC CMF 3.1+                    | Contact OEM for update    |
| Dassault F10X                                                | Honeywell NGFMS                | Honeywell EPIC CMF 3.4                     | Contact OEM for update    |
| Embraer E135/145<br>"Legacy 600/650" business jet<br>version | Honeywell NZ6.1.1              | Honeywell CMU MK III Bld 1.29              |                           |
| Embraer E170/190<br>"Lineage 1000" business jet version      | Honeywell NGFMS                | Honeywell EPIC CMF 3.0                     |                           |
| Embraer E170/175/190/195                                     | Honeywell NGFMS                | Honeywell EPIC CMF 3.0                     |                           |
|                                                              | Honeywell NGFMS                | Honeywell EPIC CMF 3.4                     | Update ready, contact OEM |
| Embraer E2-190/195                                           | Honeywell NGFMS                | Honeywell EPIC CMF 3.3                     |                           |
|                                                              | Honeywell NGFMS                | Honeywell EPIC CMF 3.4                     | Update ready, contact OEM |
| Gulfstream G100                                              | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs            |
| Gulfstream G150                                              | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | Gulfstream STC            |
| Gulfstream G200                                              | Collins Proline 4 (FMC SW 4.0) | Collins CMU-1000                           | Gulfstream STC            |
| Gulfstream G200                                              | Universal Avionics UNS-1       | Universal Avionics UniLink UL-80X SCN 30.4 | Gulfstream STC            |

| Recommended software versions for NAT data link operations |                          |                                            |                         |
|------------------------------------------------------------|--------------------------|--------------------------------------------|-------------------------|
| Aircraft type                                              | FANS software            | ACARS software                             | Notes                   |
| Gulfstream G200                                            | Universal Avionics UNS-1 | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs          |
| Gulfstream G280                                            | Collins Proline Fusion   | DLCA-6000                                  | Production Standard     |
| Gulfstream GII, GIIB, GIII                                 | Honeywell NZ6.1.1        | Honeywell CMU MK III Bld 1.29              | 3rd party STCs          |
| Gulfstream GII, GIIB, GIII                                 | Universal Avionics UNS-1 | Universal Avionics UniLink UL-80X SCN 30.4 | 3rd party STCs          |
| Gulfstream G450                                            | Honeywell EPIC NZ7.1.2   | Honeywell EPIC CMF 2.6                     | (ASC 912C)              |
| Gulfstream G550                                            | Honeywell EPIC NZ7.1.2   | Honeywell EPIC CMF 2.6                     | (ASC 912C)              |
| Gulfstream GIV, GIV-SP                                     | Honeywell NZ6.1.1        | Honeywell CMU MK III Bld 1.29              |                         |
| Gulfstream GV, GV-SP                                       | Honeywell NZ6.1.1        | Honeywell CMU MK III Bld 1.29              |                         |
| Gulfstream G500                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.1                     | (Type Cert)             |
| Gulfstream G600                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.1                     | (Type Cert)             |
| Gulfstream G650                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.0                     | (ASC 902B)              |
|                                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.1                     | New Block 3 late 2023   |
| Gulfstream G700                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.5                     | New Type Cert late 2023 |
| Gulfstream G800                                            | Honeywell NGFMS          | Honeywell EPIC CMF 3.5                     | New Type Cert late 2024 |

- END -