Rockwell Collins produces a full suite of equipment designed to meet mandated ADS-B Out requirements around the world. The Rockwell Collins TPR-901 transponder can be upgraded for full compliance to ADS-B and is certified on both Boeing and Airbus platforms. Additionally, Rockwell Collins is the only supplier currently producing a SA-Aware Multi-Mode Receiver (MMR), the GLU-925. This functionality is needed to comply with the FAA’s GNSS requirements on January 1, 2020, without the use of a pre-flight prediction tool.

Rockwell Collins is also pleased to announce the introduction of ADS-B In Traffic Applications on the Boeing 787. The following traffic applications are available to improve safety and reduce operating costs on the Boeing 787:

- Cockpit Display of Traffic Information (CDTI)
- In-Trail Procedures (ITP)

The following is an overview of ADS-B and information to help air transport operators make the necessary upgrades to their fleets.

**ADS-B Evolution**

Airlines and operators that are planning aircraft equipment upgrades to take advantage of evolving ADS-B capabilities can do so by selecting cost effective solutions from Rockwell Collins that meet the ADS-B Out mandate requirements and enable access to ADS-B In benefits. Currently available solutions include:

- Mode S Transponders that meet ADS-B Out Mandate criteria
- Industry leading GPS technology for enabling both ADS-B Out and RNP/RNAV capability with growth path to Multi-Frequency/Multi-Constellation (MF/MC) and advanced Ground-Based Augmentation Systems (GBAS)
- 787 ADS-B In Traffic Applications
- Federated Next Generation TCAS II with path to ADS-B In capability
- Plug and Play upgrades for efficient compliance and growth and minimized aircraft downtime through use of existing TCAS control panels, wiring and antennas.
ADS-B Out considerations

Many regions around the world have implemented ADS-B Out and have mandated equipage accordingly as follows:

- **Europe** - IR 1207/12011, amended with IR 1028/2014
  - FF by June 8, 2016 and RF by June 7, 2020
  - DO-260B transponder and TSO-C129a GNSS or better required
- **US** - FAR 91.225/91.227 and AC 20-165B
  - FF and RF by January 1, 2020
  - DO-260B transponder and TSO-C146a GNSS required
  - Exemption approved for GNSS performance requirement until January 1, 2025, pre-dispatch tool required depending on equipment
- **Canada – Hudson Bay** - AIC 21-09/31-11 and AMC 20-24
  - User preferred trajectories available after October 20, 2011 if equipped
  - DO-260B transponder and TSO-C129a GNSS or better required
- **Australia** - CASA CAO 20.18
  - FF by December 12, 2013
  - DO-260B transponder and TSO-C129a GNSS or better required
- **Hong Kong** - Airworthiness Notice 102F and AMC 20-24 or CASA CAO 20.18
  - FF by December 31, 2013
  - DO-260B transponder and TSO-C129a GNSS or better required
- **Singapore** - CAAS AIC 14 and AMC 20-24 or CASA CAO 20.18
  - FF by December 31, 2013
  - DO-260B transponder and TSO-C129a GNSS or better required
- **Taipei** - AIC 02/2012 and AMC 20-24 or CASA CAO 20.18
  - FF by December 31, 2014
  - DO-260B transponder and TSO-C129a GNSS or better required
- **Mexico – DGAC**
  - Expected to match US mandate requirements
- **Other regions likely to follow US and EU such as Central and South America, Middle East, etc.**

Rockwell Collins has the following certified equipment available to support:

<table>
<thead>
<tr>
<th>A/C</th>
<th>Required Equipment</th>
</tr>
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</table>
| B717 | 2 GLU-925 (822-1821-002) SA-Aware  
|     | 2 TPR-901 (822-1338-205) |
| B737 Classic | 1 GPS-4000S (822-2189-011 or -100) SBAS  
|     | 2 TPR-901 (822-1338-205) |
| B737 NG | 2 GLU-920 (822-1152-002/003) SA-On or  
|     | 2 GLU-920 (822-1152-004/-005) SA-Aware or  
|     | 2 GLU-925 (822-1821-002) SA-Aware  
|     | 2 TPR-901 (822-1338-205) |
| B747 | 1 GPS-4000S (822-2189-011 or -100) SBAS or  
|     | 2 GLU-920 (822-1152-002/003) SA-On or  
|     | 2 GLU-920 (822-1152-004/-005) SA-Aware or  
|     | 2 GLU-925 (822-1821-002) SA-Aware  
|     | 2 TPR-901 (822-1338-205) |
| B757 and B767 | 1 GPS-4000S (822-2189-011 or -100) SBAS or  
|     | 2 GLU-920 (822-1152-002/003) SA-On or  
|     | 2 GLU-920 (822-1152-004/-005) SA-Aware or  
|     | 2 GLU-925 (822-1821-002) SA-Aware  
|     | 2 TPR-901 (822-1338-205) |
| B777 | 1 GPS-4000S (822-2189-011 or -100) SBAS or  
|     | 2 GLU-920 (822-1152-002/003) SA-On or  
|     | 2 GLU-920 (822-1152-004/-005) SA-Aware or  
|     | 2 GLU-925 (822-1821-002) SA-Aware  
|     | 2 TPR-901 (822-1338-205) |
| B787 | 2 ISS-2100 (822-2120-102) |
| A319/A320/A321/A330/A340 | 2 GLU-920 (822-1152-XXX) SA-On or  
|     | 2 GLU-925 (822-1821-430) SA-Aware  
|     | 2 TPR-901 (822-1338-225) |
| MD-80/88/90 | 1 GPS-4000S (822-2189-011 or -100) SBAS or  
|     | 2 TPR-901 (822-1338-205) |

The TPR-720s and TPR-900s, as well as some transponders from other suppliers, are not upgradable to be DO-260B compliant. Operators can replace their existing transponders with TPR-901s. Existing antenna and wiring does not have to be changed.

Currently fielded TPR-901s can be upgraded to be DO-260B compliant via existing service bulletin(s).

GLU-920s can be upgraded to SA-AWARE for Boeing aircraft via service bulletin. An Airbus version of this service bulletin is not yet available, but is expected to be available in late 2017.
Aircraft implementation of ADS-B Out

In addition to compliant transponders and GNSS receivers, additional aircraft wiring, flight deck annunciation and documentation must be developed and provided. There are a number of methods for implementing ADS-B Out:

- **In-Production Aircraft**
  - Boeing and Airbus have indicated that they will develop service bulletins to retrofit platforms that are still in production
  - STCs are available, contact Rockwell Collins to discuss

- **Out-of-Production Aircraft**
  - Boeing and Airbus service bulletin development can be negotiated
  - STCs are available, contact Rockwell Collins to discuss

**ADS-B In considerations**

Currently, no known mandates are planned for ADS-B In implementation therefore near term acceptance of ADS-B In will be driven by economic and non-mandated safety factors.

ADS-B In: Interface with TCAS II ADS-B In requires a receiving platform that is able to receive 1090Mhz Extended Squitters from other aircraft (ADS-B Out), decode those signals, merge the ADS-B targets with TCAS targets, host various ADS-B In Applications, and provide the necessary ADS-B targets on an on-board display system. This architecture has evolved over several years of development and today the "Traffic Computer" resides as a function within the aircraft’s TCAS II System. The standard for this platform is ARINC 735B.

Examples of ADS-B In Applications are:

- Cockpit Display of Traffic Information (CDTI)
  - Enhanced Situational Awareness during flight operations and on ground
  - Improved operational efficiency

- Visual Separation on Approach (VSA)
  - Enhanced situational awareness
  - Increased efficiency in terminal area

- In-Trail Procedure (ITP)
  - Improved fuel savings by obtaining optimal cruise altitude sooner
  - Enhanced Situational Awareness

- Flight Deck Interval Management (FIM)

- Advanced Surface Operations
  - Improved indications and alerting
  - Improved efficiency

**ADS-B In: Key Technologies:**

- GPS Source with FDE and SA Aware/SA=Off capable: TSO C-129a, C-145a, or C-146 *
- Mode S Transponder with Extended Squitter: DO-260B *
- TCAS II or Integrated Surveillance System (ISS) with Traffic Computer
- ARINC 735B (TCAS II) or ARINC 768 (Integrated Surveillance System)

* Common with ADS-B Out

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**Recommended ADS-B equipage (high level)**

<table>
<thead>
<tr>
<th>ADS-B Out</th>
<th>ADS-B In</th>
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<tbody>
<tr>
<td>Appropriate GNSS Source (Minimum 1)</td>
<td>Traffic Computer (TCAS/ISS)</td>
</tr>
<tr>
<td>Mode S Transponders (2 Required)</td>
<td>ADS-B In Applications</td>
</tr>
<tr>
<td>Flightdeck Annunciation for ADS-B Out fail</td>
<td>CDTI Display and Control Capability (aircraft)</td>
</tr>
</tbody>
</table>

**Applicable Rockwell Collins GPS products**

- GPS-4000S, CPN 822-2189-XXX
- GLU-920, CPN 822-1152-XXX
- GLU-925, CPN 822-1821-XXX
- GLU-2100, CPN 822-2532-XXX (future availability)

Rockwell Collins continues to lead the aerospace industry in GPS technology and products. The GLU-920 / 925 family of Multi-Mode Receivers (MMR) have provided flexible growth with industry leading implementations of GPS Landing System (GLS) and Satellite Based Augmentation System (SBAS) Rockwell Collins is consistently assessing future airspace requirements to requirements for GNSS growth. Rockwell Collins’ Next Generation MMR, the GLU-2100 is in development now. The two key features of this equipment are:

- Provide a Plug and Play replacement to the GLU-920 and GLU-925, or to other vendor MMRs, to efficiently support retrofit of existing fleets to meet future GNSS needs, such as SBAS or Multi-Frequency/Multi-Constellation
- Provide a mature baseline for forward fit aircraft with hardware capable of supporting global navigation needs in all regions of the world with a software upgradable path to all foreseeable navigation capabilities

Future navigation capabilities include:

- Multi-Frequency/Multi-Constellation
- GLS CAT II/Ill
- LPV Database Hosting
- Policy Database Hosting
- On-Wing Dataload
- Blended Constellation PVT Outputs
- Advanced RAIM

Certain fleets have older GPS sensors installed which do not output the required ARINC 743 labels to meet the ADS-B Out requirements or do not have GPS sensors at all. For these aircraft Rockwell Collins offers the GPS-4000S as a standalone GPS sensor which interfaces to the transponders. Certification of the GPS interface to navigation systems is not required. At the heart of the GPS-4000S is a GPS engine/processor shared with the MMR. This design takes advantage of experience gained by Rockwell Collins during the past 20 years in the invention, development and production of both military and commercial GPS Sensor applications.

Rockwell Collins is, and will continue to be, the leader in air transport global navigation.
Applicable Rockwell Collins
transponder products

- TPR-901, CPN 822-1338-XXX
- ISS-2100, CPN 822-2120-XXX

Rockwell Collins is a leader in implementing surveillance solutions and is the first avionics manufacturer (March 2009) to certify a DO-260A Change 2 (TSO C166a) transponder. Following that success, Rockwell Collins has recently certified the TPR-901 -205 and -225 in accordance with DO-260B. Rockwell Collins continues to participate in ADS-B standards bodies (RTCA, ICAO, Eurocae) and support implementation of the DO-260B compliant TPR-901 to help operators meet all global mandates. Equally capable for supporting ADS-B Out is the recently updated and certified ISS-2100, an integrated surveillance cabinet that provides transponder and traffic computer functionality on the 787 and 777X.

Applicable Rockwell Collins traffic
computer products

- TTR-2100, CPN 822-2911-XXX
- ISS-2100, CPN 822-2120-XXX

The Rockwell Collins' TTR-2100 Traffic Computer has been recently certified at both Boeing and Airbus and is fully capable of providing a future path to ADS-B In. The TTR-2100 is a direct plug and play replacement (AC input power applications) for the, TTR-920 and TTR-921 TCAS computers. With its plug and play capability the TTR-2100 requires no aircraft changes, or the need to replace the existing TRE-920 antennas. The TTR-2100 will meet the TCAS Change 7.1 requirements in Europe and will provide a Traffic Computer architecture needed to support ADS-B In & CDTI applications.

In summary, Rockwell Collins has the surveillance and navigation products, and support, needed to help operators satisfy the airspace requirements that continue to emerge around the world. Rockwell Collins is committed to helping define efficient paths to compliance and working with the operator implement those solutions. As NextGen and SESAR continue to evolve, ADS-B will be a significant part of the overall plan in both cases.
Background

Automatic Dependent Surveillance-Broadcast (ADS-B) is a key enabling technology that continues to advance as a major component of future airspace such as NextGen and SESAR. ADS-B standards have been completed and a variety of airspace regions are beginning to take advantage of its benefits. Further mandates are being considered. ADS-B capability is defined by two categories of use: “ADS-B Out” and “ADS-B In”.

ADS-B Out refers to the broadcast of ADS-B information from the aircraft Mode S Transponder on 1090MHz to any receiving ground or aircraft system. The main benefit of ADS-B Out is to provide a more accurate source of an aircraft’s position to air traffic controllers who manage the safe separation of aircraft. The goal is to achieve reduced safe separation standards and increased airway capacity. ADS-B Out is an important component of Next Generation Airspace design. Systems are already operational and providing separation benefits in Australia, Southeast Asia, Indonesia, Europe, Canada, and the United States. Other regional deployments are planned. ADS-B Out derived separation benefits include:

- Air Traffic Control surveillance capability in areas where Secondary Surveillance Radar (SSR) coverage in not possible or not adequate
- Reduced separation and User Preferred Trajectories in areas where SSR coverage is not available – such as Hudson Bay and the Gulf of Mexico

ADS-B Out is also a key prerequisite for implementation of ADS-B In. Air Transport industry estimates link widespread implementation of ADS-B In to a “critical mass” ADS-B Out adoption rate of 90% of aircraft. Therefore, ADS-B In will likely become more important after ADS-B Out Mandate deadlines in 2020.

ADS-B In refers to an aircraft receiving system with ADS-B In applications hosted on an onboard Traffic Computer.

The output from the Traffic Computer is provided to the flight crew via Cockpit Display of Traffic Information (CDTI) on either forward field of view displays or EFBs. CDTI will provide cockpit crews added situational awareness which form the basis for the following operational and safety benefits:

- Capacity and safety enhancements in terminal areas of congested, complex, or multiple airports
- In route fuel savings resulting from optimal In Trail Procedure (ITP) enabled climbs
- Growth to Increased airport surface operations safety
Building trust every day.

Rockwell Collins delivers innovative aviation and high-integrity solutions to commercial and government customers worldwide. Backed by a global network of service and support, we stand committed to putting technology and practical innovation to work for you whenever and wherever you need us. In this way, working together, we build trust. Every day.

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