Rotary Wing Aircraft: Configure Mode S / ADS-B Out Properly

(Passages highlighted in yellow are particularly important)

BLUF: During maintenance on the APX-123/APX-123A Mode 5 transponder, the aircraft-assigned default Mode S can be zeroized or "set to factory default." Units are subsequently not ensuring that the default Mode S address is reloaded into the APX-123/APX-123A. As a result, the FAA detects an invalid address, which is flagged and reported to the Army as non-compliance. In some instances, the FAA could restrict access to airspace for non-compliant aircraft.

_____

Background to the Problem: The Army rotary wing fleet was upgraded to the APX-123/APX-123A Mode 5 transponder with Mode S and ADS-B Out (civil modes) to meet the 2020 Mode 5 and ADS-B Out operational mandates. The Army fleet has achieved full operational capability (FOC) for Mode 5. The Army fleet has also completed ADS-B Out AIMS certification testing and requested a frequency authorization and airworthiness release (AWR) to operate ADS-B Out. Multiple Army platforms (AH-64E, CH-47F, and UH-60M) have initiated the implementation of the ADS-B Out modification work order (MWO). Each platform is at various stages of ADS-B Out integration/ operation.

ADS-B Out functionality is a subset of Mode S; therefore, ADS-B Out cannot be enabled without Mode S being enabled. There has been a misunderstanding as to when the Mode S capability was available in the Army rotary wing fleet. Mode S has been available and AIMS certified since the Army upgraded to the APX-118 transponder. When the APX-118 was installed, the AIMS Program Office assigned each platform a Mode S address. The Mode S address did not affect when the APX-123/APX-123A transponder upgrade was completed.

_____

Mode S Operations:

It is critical that the correct Mode S address is used. The APX-123/APX-123A has two Mode S address functions; "default Mode S" and "operational Mode S":

The **default Mode S address** is where the aircraft-assigned Mode S address is loaded/stored. The only exception is the UH-60L, where the default Mode S address is hardwired on the aircraft. <mark>For all other Army aircraft, the default Mode S address must be loaded any time the aircraft system processors are replaced or a new aircraft OFP software is loaded. It is critical to ensure the aircraft-assigned default Mode S address is loaded after aircraft maintenance</mark>. (**Note**: there is a difference between the aircraft-assigned default Mode S address and the factory default address.)

The **operational Mode S address** is used for missions where a **temporary** address is provided/entered for a specific mission; it does not change the default Mode S address. The flight crew should confirm the correct operational Mode S address is loaded during transponder set-up, prior to aircraft taxi. After mission completion, the operator can enter the aircraft-assigned address or the default Mode S will be uploaded into the operational Mode S address when aircraft power is removed on the ground.

If the Mode S address cannot be confirmed as the assigned-aircraft address, Mode S / ADS-B Out should not be enabled.

The **Mode S Flight ID** is used for aircraft identification for Mode S and ADS-B Out. It is recommended the flight ID be entered with an "R" for Army or "G" for National Guard, followed by the last five digits of the aircraft serial number. Flight ID can display up to 8 alpha-numeric characters for the aircraft ID. Flight ID data is included in the Mode S and ADS-B Out replies/squitters. Units may enter a unit call-sign or crew ID such as "Eval11", if approved by the unit standard operating procedure (SOP).

_____

Mode S Address and Mode S Flight ID Field:

During the writing of this article, another ADS-B Out issue was identified. The issue is related to where the Mode S address is entered. In the past few weeks, multiple Army aircraft have entered their Mode S address in their transponder **Mode S Flight ID** field; with an invalid Mode S address in their operational Mode S address. The FAA ADS-B Out ground stations do not have the capability to accept as a "valid" Mode S address, those Mode S addresses entered in the Mode S Flight ID field.

To reiterate, the Mode S address is separate from the Mode S Flight ID, and each must be inputted into their correct field.

_____

ADS-B Out Status/Issues: With fielding/use of ADS-B Out in the Army rotary wing fleet, there has been a significant increase of Army aircraft operating with "invalid" or "duplicate" Mode S addresses.

The FAA has identified multiple Army aircraft operating throughout the United States squittering an invalid Mode S address as part of ADS-B Out data. It has been determined that this issue is related to maintenance personnel not reentering the "Default Mode S Address" after aircraft system processor replacement or reloading of aircraft OFP software. The APX-123/APX-123A factory default Mode S address is "00000001," as set by the platform OFP. This factory default Mode S is flagged by the FAA ADS-B Out ground stations as an invalid Mode S address. The APX-123/APX-123A does not retain the aircraft-assigned and loaded default Mode S address in the transponder; it is retained in the aircraft system processors.

Another issue (although fewer occurrences) is when the same Mode S address is entered on multiple aircraft and the aircraft are flying at the same time and with Mode S / ADS-B Out enabled. FAA ADS-B Out ground stations flag these instances of duplicate addresses and issue an alert message to the DoD AIMS Program Office (PO). The AIMS PO contacts the Service representatives to identify the unit, aircraft type, and when the issue has been resolved.

Aircraft operations with an invalid or duplicate Mode S address in the national airspace (NAS) is a distractor for air traffic control (ATC) operations and could a create flight hazard. ==Each aircraft must have its own assigned Mode S address loaded prior to operating Mode S / ADS-B Out. Mode S addresses cannot be shared.==

Production-line Aircraft: Platform PM's should request a Mode S address from the AIMS PO for new (production line) aircraft at least 30 days prior to the aircraft coming off the production line.

Mode S Address Storage: It is highly recommended that each unit codify the loading, verifying, and storage of the aircrafts' assigned Mode S addresses within the unit's standard operating procedures (SOPs). As per AIMS specification, each aircraft must maintain the Mode 5 PIN and National Origin (NO) codes on the aircraft for manual entry. Most units maintain these codes in the aircraft logbook; this process could also be used for the Mode S addresses.

———————————

Conclusion: It will be difficult to eliminate all Mode S address issues, but with a focused approach at the maintainer and operator levels, the Army aviation community can minimize these occurrences.

Fact Sheet prepared by:

Michael E. Trigger, PdM A3S Test Lead

Lee A. Ritenour, PdM A3S Test Engineer

If you have questions about this fact sheet, contact Mr. Trigger or Mr. Ritenour through the global address book in Outlook.