

International Civil Aviation Organization



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AIRCRAFT PARAMETERS WORKING GROUP
(MODE S AND DAPS WG/6)**

Bangkok, Thailand, 28 – 30 March 2023

Agenda Item 4: Mode S monitoring and analysis

**TWO CASES OF FALSE ALARM IN A-SMGCS SYSTEM CAUSED BY THE INCORRECT
AIR/GROUND STATUS OF AIRCRAFT**

(Presented by China)

SUMMARY

DAPS data from the aircraft transponder can be used to identify the Air/Ground status of the aircraft in the A-SMGCS system. Incorrect messages would lead to nuisance warnings related to the flight level issuing by the A-SMGCS system.

1. INTRODUCTION

1.1 A-SMGCS system relies on the air/ground status messages which is contained in DAPs data received from S-mode radar and MLAT, to determine whether an aircraft is on the ground or in the air.

1.2 The error air/ground status from Aircraft avionics system causes the ASMGCS system to process DAPs message data and generate false alarms, which affects the accuracy of A-SMGCS system alarms.

1.3 This paper shares two instances of erroneous warnings in the A-SMGCS system brought on by an aircraft's wrong Air/Ground status.

2. DISCUSSION

Air/ground status in DAPs and how A-SMGCS system use it

2.1 Fields relate to Air/ground status in DAPs is shown as following:

Table 1 Fields relate to Air/ground status in DAPs

Downlink format	Filed	Length of bits	On-the -ground	Airborne	
DF4, DF20	FS	3	FS=1, 3	FS=0,2	Altitude Reply
DF5, DF21	FS	3	FS=1, 3	FS=0,2	Identity Reply
DF11	CA	3	CA=4, CA=7 (determined by FS)	CA=5, CA=7 (determined by FS)	All Call Interrogation

D0, F16	VS	3	VS=1	VS=0	Air-Air Surveillance
D17	CA	3	CA=4, CA=7 (determined by FS)	CA=5, CA=7 (determined by FS)	ADS-B
DF17, DF18	ME	First five bits of total 56 bits	Subtype=5-8	Subtype=9-22	

As the table shows, in DF4,DF20 (Altitude Reply) and DF5,DF21 (Identity Reply), value 1 or 3 in the Flight Status field corresponds to on-ground status. In DF11(All Call Interrogation) and DF17 (ADS-B), value 4 in the capacity field reflects on-ground status, while value 7 is judged to be an air/ground status based on the value of the FS field. In DF0,DF16 (Air-Air Surveillance), value 1 in the Vertical Status field represents on-ground state. In DF17,DF18 (ADS-B), values 5-8 in the first five bits of the Message Extended Squitter field denotes on-ground status.

2.2 MLAT may receive and analyze air/ground status messages in the following formats: DF0, DF16, DF4, DF5, DF11, DF17, DF18, DF20, DF21, and output data in ASTERIX CAT020 format. In ASTERIX CAT020 format, the fifth bit of data item 020/020 Target Report Descriptor (one-octet extents sent as necessary) is Ground bit set (GBS).

Structure of First Extent:

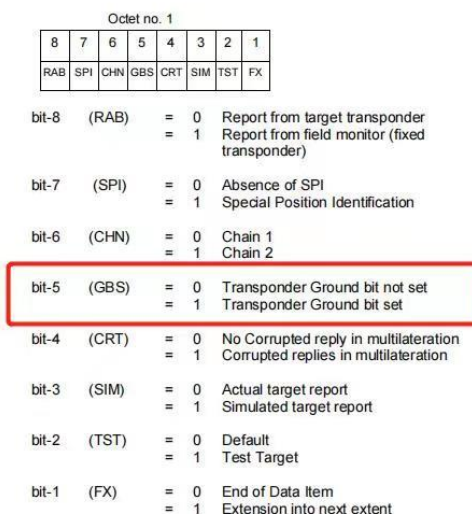


Figure 1 GBS in ASTERIX CAT020 format

2.3 A-SMGCS system receives DAPs data from the MLAT (originally from the aircraft transponder). When GBS is set to 1, the system judges the aircraft as a ground target and sets its system altitude to 0. Otherwise, the system uses the aircraft's barometric altitude and treats it as an airborne target. Air/Ground status in DAPs may prevent level jumps of the system track from MLAT system causing by erroneous altitude from MLAT system.

Cases analysis of False alarms in A-SMGCS system caused by the incorrect Air/Ground status

2.4 Case 1: During the approach, the aircraft's transponder sent ground mode messages, and the GBS value in system is set to 1. By default, the system determined it as a ground target and set its height as 0. An APM alarm raised in the system .

The Approach Path Monitoring (APM) function monitors the aircraft's final approach profile for any vertical and lateral deviation from the optimal one, and alert controllers of a predicted or actual unsafe descending final approach profile.

In this case, the system mistakenly interpreted the flight as a ground target as a ground target in accordance with GBS value, and the system track enters the APM monitoring area as shown in the picture below. The system judged the flight was descending unsafely, and raised the APM alarm.

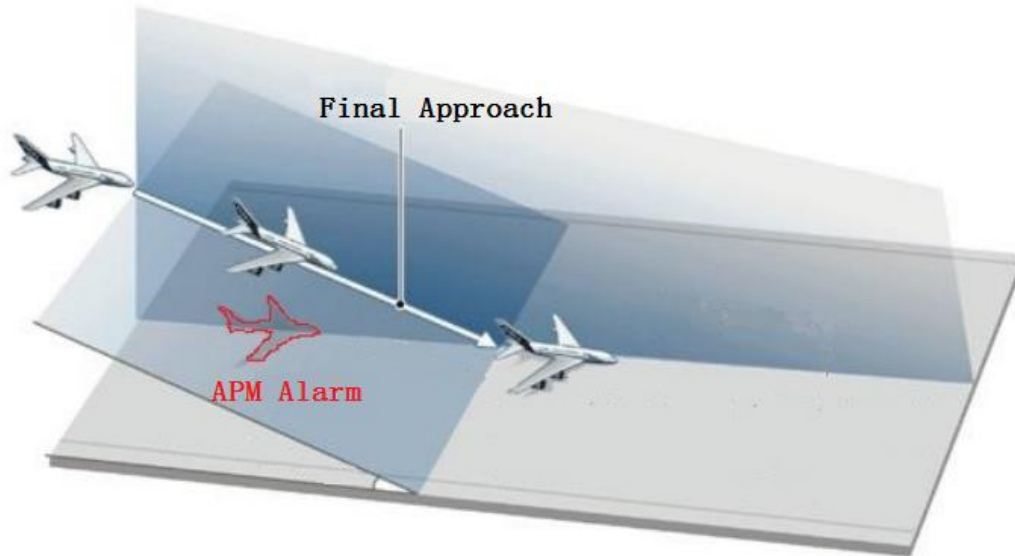


Figure 2 The system track entered the APM alarm area

2.5 Case2: Runway Inursion Warning (RIW) triggered in the A-SMGCS system since the aircraft's transponder sent ground mode messages after departure.

Runway Inursion Warning (RIW) function will alert the controller, when a vehicle enters the runway warning area without permission. In this case, the flight had actually taken off. Once more, the system incorrectly determined that it was a ground target based on the ground state and set its height to 0. Consequently, due to the system track entering the runway alarm region, the Runway Inursion Warning was activated, as shown in the figure below:

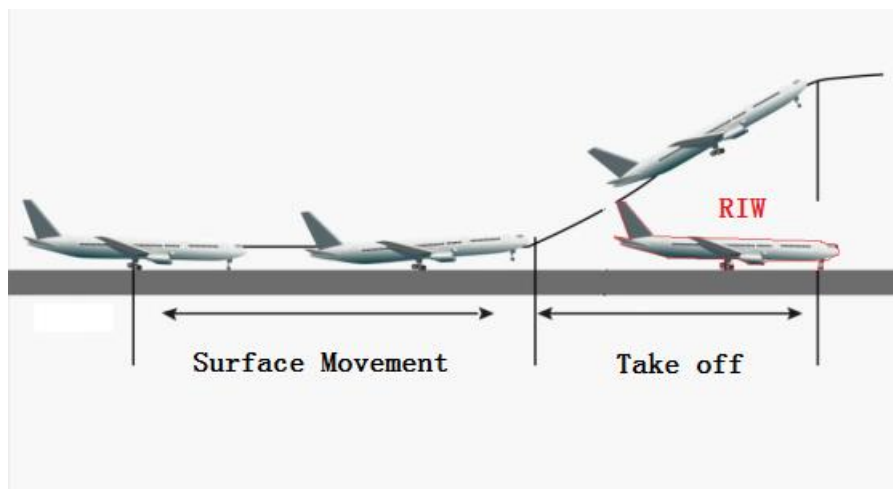


Figure 3 The system track entered the RIW area

Suggestions

2.6 The Air/Ground status of the majority of modern aircraft is set automatically. And the status is recommended to use without additional validation.

In DAPs IGD

It is recommended that aircraft provide means to determine the on-the-ground state automatically and provide that information to the transponder.

In DO-260

When the conditions for “CA” Code 7 are not satisfied, Level 2 or above transponders in installations that do not have automatic means to set on-the-ground condition shall use “CA” Code 6. Aircraft with automatic on-the-ground determination shall use “CA” Code 4 when on the ground, and “CA” Code 5 when airborne.

Note: Modern aircraft with integrated avionics suites commonly contain sophisticated algorithms for determining the air/ground status based on multiple aircraft sensors. These algorithms are customized to the airframe and designed to overcome individual sensor failures. These algorithms are an acceptable means to determine the air/ground status and do not require additional validation.

2.7 When the users finds that there is an error in the ground/air status information of an aircraft, the users should inform the airline company in time to avoid safety impact.

2.8 When the A-SMGCS system generates an incorrect alert related to the air/ground status of the aircraft, the controller needs to pay close attention to it and make final judgment referring to the flight's actual situation and the alarm status in the ATM automation system or relevant systems.

3. ACTION BY THE MEETING

- a) note the information contained in this paper; and
- b) discuss any relevant matter as appropriate.
