Voyantic

Application Note

Grading an RFID Tag Based on SAE AS5678B Standard

01/2021

1 Introduction

SAE AS5678 rev. B is a standard describing performance grading for flyable RFID tags used in airborne equipment in the aerospace industry.

The standard is available at *https://www.sae.org/standards/content/as5678b.*

2 Tag Grading

Grading is a method where (sometimes complex) technical criteria are packaged into a simpler code system. The grades create a common language for end-users, technology providers, and parts suppliers, making a purchase of components easier.

A common example of grading is AA, AAA, AAAA, etc. grades used in batteries. The user does not have to worry about various dimensions, voltage levels, or other details in the background. For getting a spare battery it is enough to know which type (which grade) battery is needed for the device.

With grades

AA cell measures 49.2–50.5 mm (1.94–1.99 in) in length, including the button terminal—and 13.5–14.5 mm (0.53–0.57 in) in diameter.

The positive terminal button should be a minimum 1 mm high and a maximum 5.5 mm in diameter, the flat negative terminal should be a minimum diameter of 7mm.

Without grades

Figure 1. Some batteries and their grades, and description of AA battery dimensions

Similarly, the SAE AS5678B standard describes

- performance grades and requirements of passive UHF RFID tags used on airborne equipment
- test requirements for the tags. The requirements are complemented with EUROCAE ED-14 / RTCA DO-160 compliance requirements.

In RAIN RFID, also GS1 Tagged Item Grading (GS1 TIPP) is a commonly used grading system.

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3 Test Method

3.1 Test Summary

The test includes three (3) pass/fail tests and a grading test. 30 tag samples are to be tested.

Pass/fail tests are:

- Quality variation should be within acceptable limits
- The tag must pass the write test
- The tag must pass the data retention test

In grading test, the tag sensitivity and backscatter signal strengths are compared to grade limits across wide (global) UHF RFID frequency band.

3.2 Test Process

3.2.1 Preparations

Test **30 samples** of the tag model to be graded.

Place the tag on the test material (polymeric or metallic), and into the Voyantic anechoic chamber, facing the antenna.

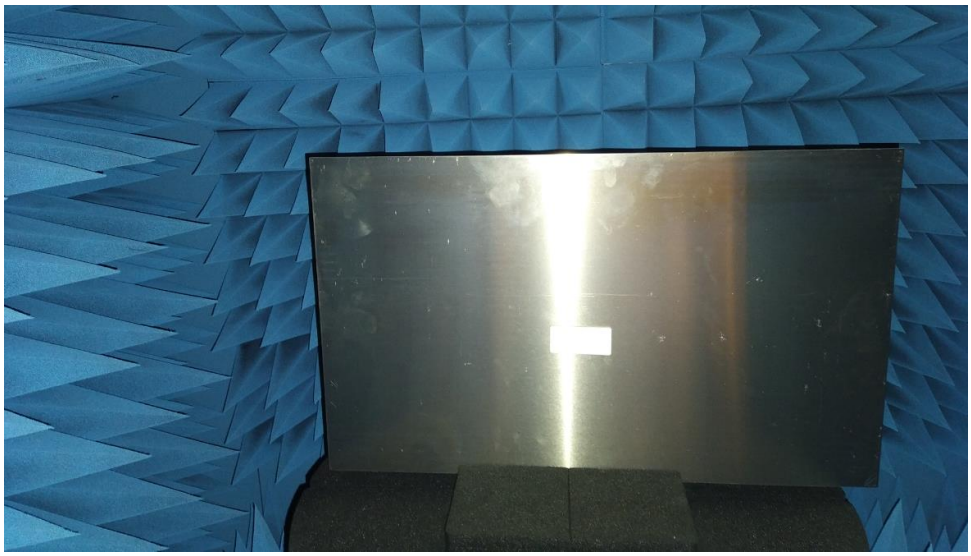

Figure 2. Tag on 30 cm x 50 cm aluminum sheet, in the test chamber

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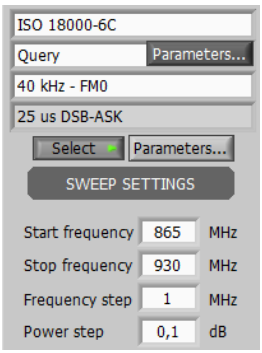
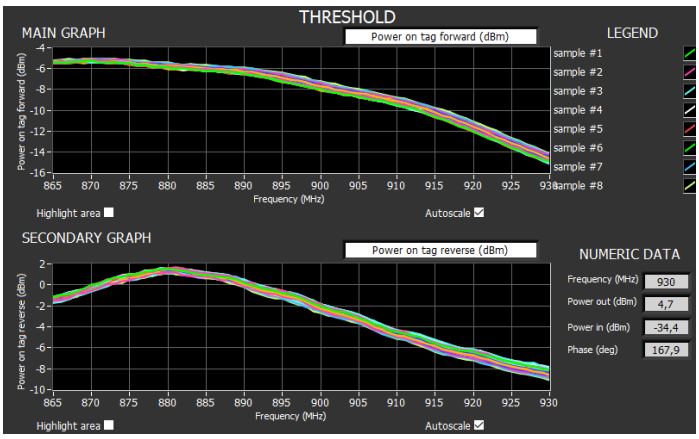
Measure the Threshold sweep

- from 865 MHz to 930 MHz with 1 MHz frequency step
- use select and query with 40 kHz BLF



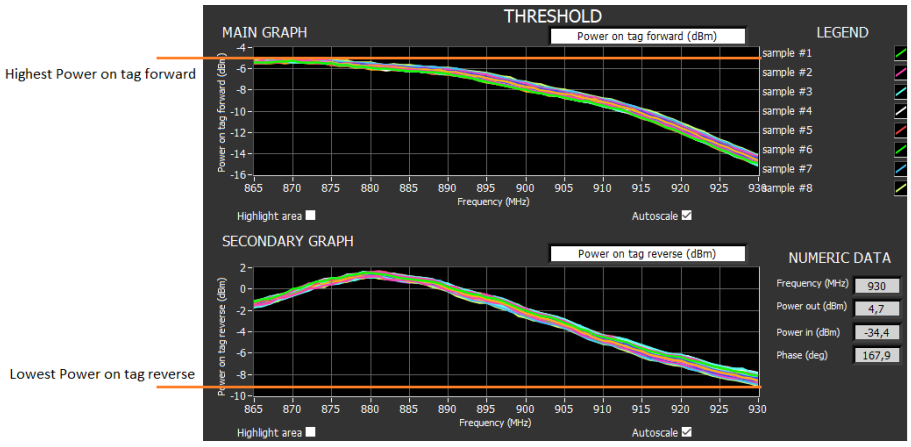
3.2.2 Confirm Quality Variation

Test results of the 30 samples should be within +/- 2 dB.



3.2.3 Define the Grade

- Compare the highest Power on Tag Forward value of the 30 samples, at all tested frequencies to the standard's Minimum Read Sensitivity (dBm) values
- Compare the lowest Power on Tag Reverse values of the 30 samples, at all tested frequencies to the standard's Minimum Backscatter (dBm) values
- The grade is the highest grade in which the requirements are met.



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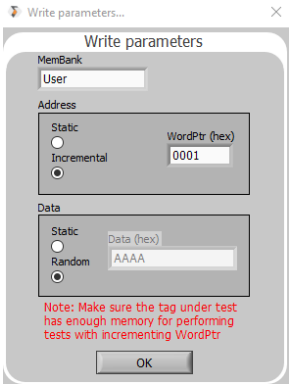
3.2.4 Test Write Capability

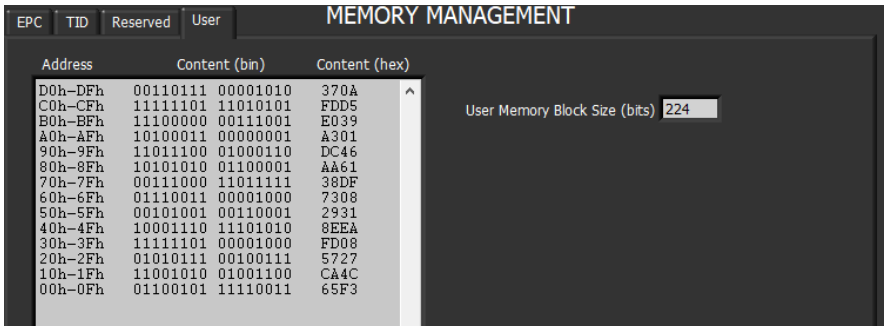
- Threshold sweep
- From 865 MHz to 930 MHz with 1 MHz frequency step
- Use select and write with 40 kHz BLF

3.2.5 Test Data Retention



1. Write random data to all available memory locations.
   - Use Threshold sweep and set Write parameters to incremental memory location and write random data.
   - Note that memory banks (EPC memory and user memory) must be written separately.

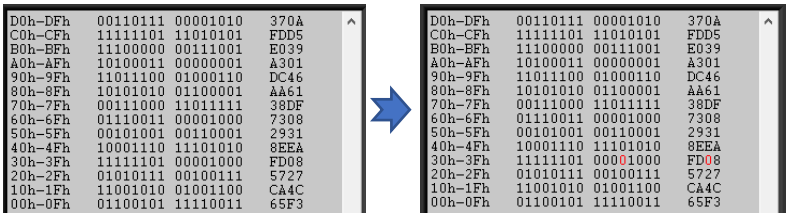
2. Read the data with Memory Management, and save data to list



3. Subject the tags to environmental conditions as specified

4. Analyze the tag data again

Read the tag again with Memory Management and check that there are no changes in the data. After analyzing the tag again, when you select the previous Memory Management test, any differences between the contents are shown with red color. (This would indicate that the tag is not suitable for aerospace use.)



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4 Test Results

If the tag passes pass/fail tests

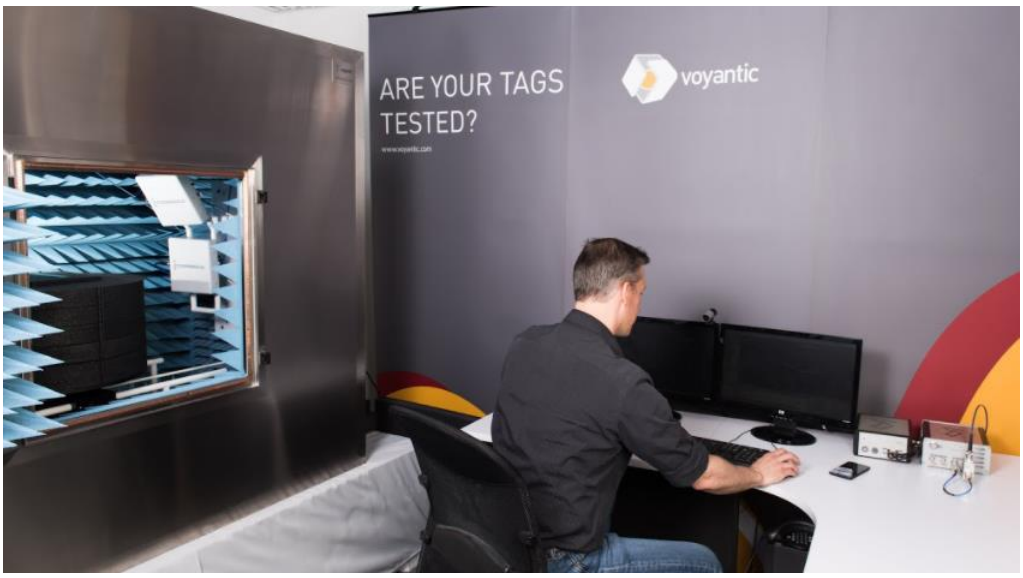
- Quality variation is within acceptable limits
- Tag is write-capable
- Tag maintains data under environmental stress

The tag grade is as defined by the sensitivity and backscatter signal strengths.

5 Equipment Used

The tests were made in an RFID lab with the following equipment and software:

- Voyantic Tagformance Pro with 800 – 1000 MHz range
- Tag Designer Suite
- Protocol Testing Suite
- C50 RFID measurement chamber (with a multiplexer, 4 antenna assembly, and tag rotation table).



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