Voyantic

GS1 Tagged-Item Grading with Tagfomance

Sensitivity and backscatter limits and results explained

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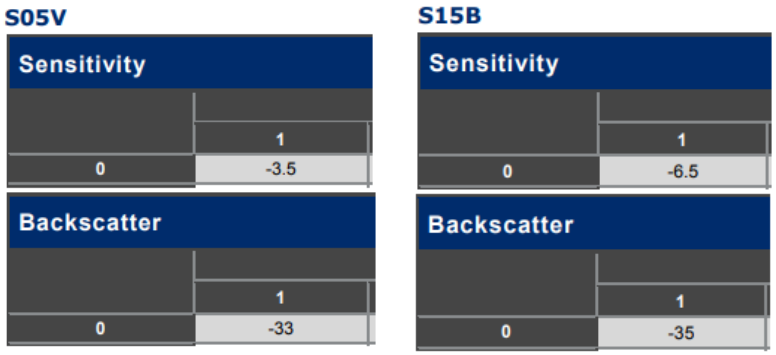
1 Introduction

This document describes how the sensitivity and backscatter are measured in Tagformance GS1 Tagged-Item Grading Suite.

2 Example

As an example, let's use 2 grades – S05V and S15B, at antenna 1 with a 0-degree rotation table angle.



Test process

The following process principle is executed in the background of the Tagged-Item Grading Suite software in the Tagformance system (the actual implementation is optimized for speed).

1. Threshold sweep at the relevant frequency range
    a. The threshold sweep result (Power on Tag Forward) is compared to the limits at each relevant frequency – 902 MHz, 903 MHz, …, 927 Mhz, and 928 MHz when the test is made for the FCC band.
    b. The test result is the smallest of the Power on tag Forward values on the relevant frequencies.
    c. If the result is
        i. smaller than the limit, the sensitivity test passes, and the test moves to the second step
        ii. higher than the limit, the sensitivity test is failed and the backscatter result is shown to be the lowest threshold Power on tag Reverse across the relevant frequency range.

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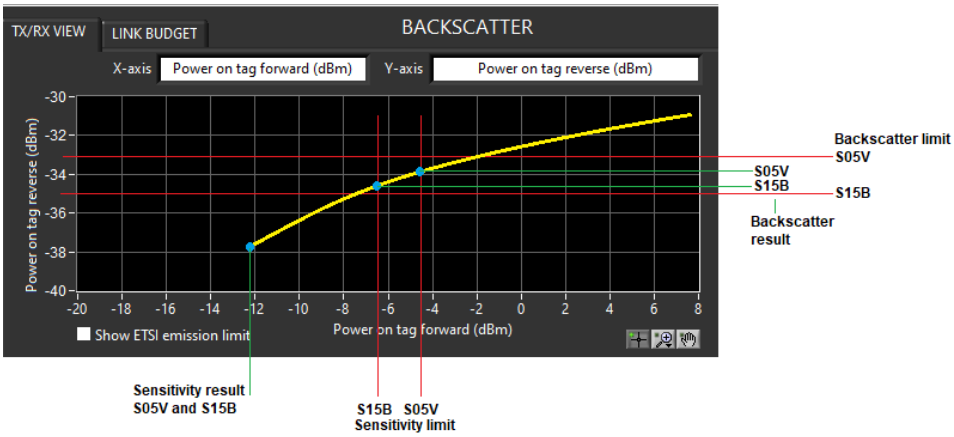
2. A backscatter sweep is made at the first relevant frequency
    a. From the backscatter sweep, it is recorded the Power on tag Reverse (PoTR) value corresponding to the Power on tag Forward value of the sensitivity limit (see picture below)



    b. The PoTR value is modified to match with Backscatter definition* used by GS1. The result to be used in TIPP test result is [PoTR - log(0.4) dB], in practice PoTR –4dB.
    c. The test is repeated at each relevant frequency, the final result is the lowest of the Power on Tag reverse values.
    d. If the result is higher than the limit, the test passes.

In the above example and graph results based on a single frequency would be:

S05V:

- Sensitivity limit -3.5 dBm, result -12.2 dBm → PASS
- Backscatter limit -33 dBm, result: PoTR -33.9 dBm –4 dB = -37.9 dBm → FAIL

S15B:

- Sensitivity limit -6.5 dBm, result -12.2 dBm → PASS
- Backscatter limit -35 dBm, result: PoTR -34.8 dBm – 4dB = -38.8 → FAIL

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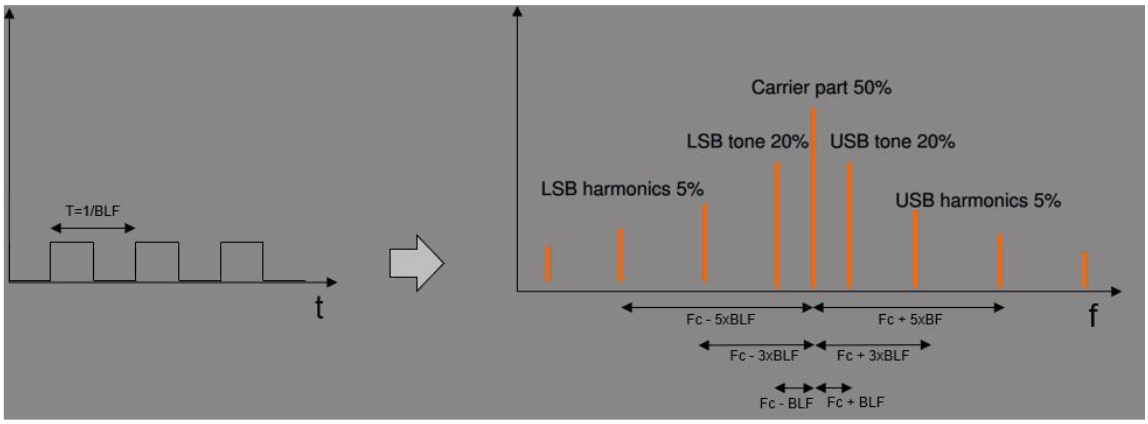
***Backscatter Signal Power Spectrum and Definitions**

Assuming the tag reply is an ideal square wave, its distribution into spectral components may be extrapolated from the carrier frequency and backlink frequency. From this distribution the different backscatter definitions may be calculated.



The Voyantic backscatter definition sums the whole spectrum power, i.e. contains 100% of the power.

The GS1 definition for Backscatter considers only both side tones as the backscatter strength, i.e. 40% of the total power. According to the July 2017 release of the Tagged-Item Performance Protocol (TIPP) Tagged Item Grading: Testing Methodology Guideline the backscatter power may be calculated as follows:

$$P_{BS\,GS1}[dB] = P_{total}[dB] - 10\log 0.4\,[dB] \sim P_{total}[dB] - 4[dB]$$

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