

Tagged-Item Performance Protocol (TIPP) Tagged-Item Grading

GRADE DEFINITIONS

R2.0 — NOV 17 2015



THE GLOBAL LANGUAGE
OF BUSINESS

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1 DOCUMENT INFORMATION

1.1 DOCUMENT SUMMARY

| DOCUMENT ITEM | CURRENT VALUE |
|------------------------|--|
| DOCUMENT TITLE | Tagged-Item Performance Protocol (TIPP) Tagged-Item Grading: Grade Definitions |
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| STATUS | Final |
| DOCUMENT DESCRIPTION | Provides the specific definitions for RFID performance grades |

1.2 TIPP DOCUMENT SERIES

This document is part of a series of documents laying out the tagged-item grading system for specifying tagged-item performance between retailers and suppliers. The series include the following four documents:

- The document entitled [TIPP Tagged-Item Grading: Overview](#) provides an overview of the tagged-item grading guideline.
- The document entitled [TIPP Tagged-Item Grading: Grade Definitions](#) defines the grade specifications. *(This is the current document.)*
- The document entitled [TIPP Tagged-Item Grading: Testing Methodology](#) presents the test procedure and measurement methods to qualify or establish the grade for a tagged item.
- The document entitled [TIPP Tagged-Item Grading Testing Configurations](#) defines the orientation for various types of tagged items (which is critical for repeatable testing using the TIPP procedure).

1.3 SCOPE

This document introduces the TIPP grades, explains the TIPP grade naming system, and defines the specifications for tagged-item sensitivity and backscatter for each grade. It is intended for parties learning about the TIPP grading guidelines and methodology including retailers, suppliers and solution providers.

NOTE: As with all GS1 Standards and solutions, the Tagged-Item Grading System is voluntary, not mandatory. It should be noted that use of the words “must” and “require” throughout this document relate exclusively to technical recommendations for the proper application of the testing protocol to support the integrity of your application.

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2 INTRODUCTION

The Tagged-Item Performance Protocol (TIPP) Workgroup developed a tagged-item grading system to facilitate the specification of tagged-item performance between retailers and suppliers. This system defines a set of “grades” constructed by coalescing several tagged-item performance specifications that are based on a proven set of grade factors defined by Arkansas Radio Compliance (ARC) at Auburn University’s RFID Lab. These factors include sensitivity, backscatter power, orientation, and frequency. Each grade is represented by a name that comprises three indicators: configuration, performance level, and orientation. As such, TIPP grades are simply tagged-item performance specifications given a shorthand names.

3 GRADE IDENTIFIERS

TIPP provides a shorthand naming system for its grades. The naming system provides a convenient way to reference the large set of performance factors contained within each grade definition. (See the [TIPP Tagged-Item Grading: Overview](#) for more description on grade naming.)

TIPP grades are named with a multi-dimensional naming system. A TIPP grade has three components:

- **A single letter S or M denoting the test configuration for the tagged item.**
 - **S** stands for single item. When a grade specifies **S**, the test procedure is performed on a single item and must meet the item factors specified by the grade definition.
 - **M** stands for multiple items. When a grade specifies **M**, the test procedure is performed on a stack of 2 items and a stack of 11 items, and must meet the item factors specified by the grade definition.
- **A number (e.g. 5, 10, 20, etc.) that specifies item factor performance levels.**
 - The initial TIPP numbers are multiples of five to allow space in between existing grades if needed in the future. *(However, it is not anticipated that any intermediate performance levels would be needed.)*
 - Larger numbers correspond to higher performing tagged items.
- **A letter (e.g. B or D) specifying the family to which the grade belongs.** Within a family, tagged items automatically pass lower numbered grades if they pass higher numbered grades. For example, a tagged-item that passes M15B also passes M10B because they are both in the B family. However the same tagged-item might not pass M15D because it is in the D family, or S15B because it is an S (single item) grade instead of an M (stacked) grade. As tag and reader technologies and use-cases progress, new grades within families and new families of grades with different characteristics will be needed.

4 GRADE DEFINITIONS

Each grade is defined by a set of tables that specify the tagged-item sensitivity and backscatter at various orientations. The entries in the table specify the power at the tag in Decibel-milliwatts (dBm) according to the test procedures defined in the [TIPP Tagged-Item Grading: Testing Methodology](#). If an entry in a table is blank, then there is no specification for that orientation. To determine if a tagged item meets a given grade, the test must be performed according to the test procedures defined in the [TIPP Tagged-Item Grading: Testing Methodology](#) using tag placement and configurations specified in the [TIPP Tagged-Item Grading Testing Configurations](#).

4.1 PERFORMANCE GRADE SO5B

ORIENTATION

| SENSITIVITY | | | | |
|-------------|---------|------|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -3.5 | -3.5 | -2.5 | -2.5 |
| 30 | 1 | 2 | 4 | 2 |
| 60 | | | | |
| 120 | | | | |
| 150 | 1 | 2 | 4 | 2 |
| 180 | -3.5 | -3.5 | -2.5 | -2.5 |
| 210 | 1 | 2 | 4 | 2 |
| 240 | | | | |
| 300 | | | | |
| 330 | 1 | 2 | 4 | 2 |

ORIENTATION

| BACKSCATTER | | | | |
|-------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -29 | -30 | -30 | -29 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -29 | -30 | -30 | -29 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.2 PERFORMANCE GRADE S15B

ORIENTATION

| SENSITIVITY | | | | |
|-------------|---------|------|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -6.5 | -6.5 | -5.5 | -5.5 |
| 30 | -2 | -1 | 1 | -1 |
| 60 | | | | |
| 120 | | | | |
| 150 | -2 | -1 | 1 | -1 |
| 180 | -6.5 | -6.5 | -5.5 | -5.5 |
| 210 | -2 | -1 | 1 | -1 |
| 240 | | | | |
| 300 | | | | |
| 330 | -2 | -1 | 1 | -1 |

ORIENTATION

| BACKSCATTER | | | | |
|-------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -31 | -32 | -32 | -31 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -31 | -32 | -32 | -31 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.3 PERFORMANCE GRADE S15D

ORIENTATION

| SENSITIVITY | | | | |
|-------------|---------|------|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -6.5 | -6.5 | -5.5 | -5.5 |
| 30 | -5 | -5 | -4 | -4 |
| 60 | | | | |
| 120 | | | | |
| 150 | -5 | -5 | -4 | -4 |
| 180 | -6.5 | -6.5 | -5.5 | -5.5 |
| 210 | -5 | -5 | -4 | -4 |
| 240 | | | | |
| 300 | | | | |
| 330 | -5 | -5 | -4 | -4 |

ORIENTATION

| BACKSCATTER | | | | |
|-------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -33 | -32 | -33 | -33 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -33 | -32 | -33 | -33 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.4 PERFORMANCE GRADE S20B

ORIENTATION

| SENSITIVITY | | | | |
|-------------|---------|------|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -9.5 | -9.5 | -8.5 | -8.5 |
| 30 | -5 | -4 | -2 | -4 |
| 60 | | | | |
| 120 | | | | |
| 150 | -5 | -4 | -2 | -4 |
| 180 | -9.5 | -9.5 | -8.5 | -8.5 |
| 210 | -5 | -4 | -2 | -4 |
| 240 | | | | |
| 300 | | | | |
| 330 | -5 | -4 | -2 | -4 |

ORIENTATION

| BACKSCATTER | | | | |
|-------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -32 | -33 | -33 | -32 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -32 | -33 | -33 | -32 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.5 PERFORMANCE GRADE M05B

ORIENTATION

| 2 STACK SENSITIVITY | | | | |
|---------------------|---------|---|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -0.5 | 1 | 1.5 | 1.5 |
| 30 | 2 | 4 | 4 | 3 |
| 60 | | | | |
| 120 | | | | |
| 150 | 2 | 4 | 4 | 3 |
| 180 | -0.5 | 1 | 1.5 | 1.5 |
| 210 | 2 | 4 | 4 | 3 |
| 240 | | | | |
| 300 | | | | |
| 330 | 2 | 4 | 4 | 3 |

| 11 STACK SENSITIVITY | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | 5 | 5 | 6 | 6 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | 5 | 5 | 6 | 6 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

ORIENTATION

| 2 STACK BACKSCATTER | | | | |
|---------------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -33 | -34 | -37 | -36 |
| 30 | -35 | -35 | | |
| 60 | | | | |
| 120 | | | | |
| 150 | -35 | -35 | | |
| 180 | -33 | -34 | -37 | -36 |
| 210 | -35 | -35 | | |
| 240 | | | | |
| 300 | | | | |
| 330 | -35 | -35 | | |

| 11 STACK BACKSCATTER | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | | | | |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | | | | |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.6 PERFORMANCE GRADE M10B

ORIENTATION

| 2 STACK SENSITIVITY | | | | |
|---------------------|---------|----|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -3.5 | -2 | -1.5 | -1.5 |
| 30 | -1 | 1 | 1 | 0 |
| 60 | | | | |
| 120 | | | | |
| 150 | -1 | 1 | 1 | 0 |
| 180 | -3.5 | -2 | -1.5 | -1.5 |
| 210 | -1 | 1 | 1 | 0 |
| 240 | | | | |
| 300 | | | | |
| 330 | -1 | 1 | 1 | 0 |

| 11 STACK SENSITIVITY | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | 2 | 2 | 3 | 3 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | 2 | 2 | 3 | 3 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

ORIENTATION

| 2 STACK BACKSCATTER | | | | |
|---------------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -32 | -33 | -36 | -35 |
| 30 | -34 | -34 | | |
| 60 | | | | |
| 120 | | | | |
| 150 | -34 | -34 | | |
| 180 | -32 | -33 | -36 | -35 |
| 210 | -34 | -34 | | |
| 240 | | | | |
| 300 | | | | |
| 330 | -34 | -34 | | |

| 11 STACK BACKSCATTER | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | | | | |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | | | | |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.7 PERFORMANCE GRADE M15B

ORIENTATION

| 2 STACK SENSITIVITY | | | | |
|---------------------|---------|------|-------|----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -7 | -6 | -3 | -4 |
| 30 | -3.5 | -2.5 | -2.25 | -2 |
| 60 | | | | |
| 120 | | | | |
| 150 | -3.5 | -2.5 | -2.25 | -2 |
| 180 | -7 | -6 | -3 | -4 |
| 210 | -3.5 | -2.5 | -2.25 | -2 |
| 240 | | | | |
| 300 | | | | |
| 330 | -3.5 | -2.5 | -2.25 | -2 |

| 11 STACK SENSITIVITY | | | | |
|----------------------|---------|----|----|----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -1 | -2 | -3 | -2 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -1 | -2 | -3 | -2 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

ORIENTATION

| 2 STACK BACKSCATTER | | | | |
|---------------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -31 | -30 | -30 | -25 |
| 30 | -32 | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | -32 | | | |
| 180 | -31 | -30 | -30 | -25 |
| 210 | -32 | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | -32 | | | |

| 11 STACK BACKSCATTER | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | | | | |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | | | | |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

4.8 PERFORMANCE GRADE M20D

ORIENTATION

| 2 STACK SENSITIVITY | | | | |
|---------------------|---------|------|------|------|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -8 | -6.5 | -7 | -7 |
| 30 | -5.5 | -6.5 | -5.5 | -2.5 |
| 60 | | | | |
| 120 | | | | |
| 150 | -5.5 | -6.5 | -5.5 | -2.5 |
| 180 | -8 | -6.5 | -7 | -7 |
| 210 | -5.5 | -6.5 | -5.5 | -2.5 |
| 240 | | | | |
| 300 | | | | |
| 330 | -5.5 | -6.5 | -5.5 | -2.5 |

| 11 STACK SENSITIVITY | | | | |
|----------------------|---------|----|----|----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -1 | -4 | -5 | -1 |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | -1 | -4 | -5 | -1 |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

ORIENTATION

| 2 STACK BACKSCATTER | | | | |
|---------------------|---------|-----|-----|-----|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | -21 | -26 | -26 | -24 |
| 30 | -24 | -25 | -26 | -27 |
| 60 | | | | |
| 120 | | | | |
| 150 | -24 | -25 | -26 | -27 |
| 180 | -21 | -26 | -26 | -24 |
| 210 | -24 | -25 | -26 | -27 |
| 240 | | | | |
| 300 | | | | |
| 330 | -24 | -25 | -26 | -27 |

| 11 STACK BACKSCATTER | | | | |
|----------------------|---------|---|---|---|
| | ANTENNA | | | |
| | 1 | 2 | 3 | 4 |
| 0 | | | | |
| 30 | | | | |
| 60 | | | | |
| 120 | | | | |
| 150 | | | | |
| 180 | | | | |
| 210 | | | | |
| 240 | | | | |
| 300 | | | | |
| 330 | | | | |

5 THE GS1 US GRADE SUBMISSION PROCEDURE

GS1 US defined a [Tagged Item Performance Protocol \(TIPP\)](#) to establish a set of performance grades for RFID tagged-items and a test procedure to validate the grade of a tagged item.

Grades themselves are not directly related to item category or use case, but it is expected that as use cases expand and new technology becomes available, new grades will need to be developed to span the range of performance required. The [GS1 US Grade Submission Procedure](#) defines a draft process for establishing new grades.



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