# SD Specifications
# Part 1
# UHS-II Protocol Test Guideline

## Version 1.00

## July 14, 2014

**Test Guideline for:**

**Part 1 UHS-II Addendum**
**Version 1.02 May 28, 2014**

## Technical Committee
## SD Card Association

CONFIDENTIAL

# Revision History

| Date | Version | Changes compared to previous issue |
|---|---|---|
| July 14, 2014 | 1.00 | The first release of UHS-II Protocol Test Guideline |

# Conditions for publication

### Publisher and Copyright Holder:

SD Card Association
2400 Camino Ramon, Suite 375
San Ramon, CA 94583 USA
Telephone: +1 (925) 275-6615,
Fax: +1 (925) 886-4870
E-mail: office@sdcard.org

### Confidentiality:

The contents of this document are deemed confidential information of the SD-3C LLC and/or the SD Card Association (the "Disclosers"). As such, the contents and your right to use the contents are subject to the confidentiality obligations stated in the written agreement you entered into with the Disclosers which entitled you to receive this document, such as a Non-Disclosure Agreement, the License Agreement for SDA Memory Card Specifications (also known as "LAMS"), the SD Host/Ancillary Product License Agreement (also known as "HALA") or the IP Policy.

### Disclaimers:

The information contained herein is presented only as a standard specification for SD Card and SD Host/Ancillary products. No responsibility is assumed by SD Card Association for any damages, any infringements of patents or other right of the third parties, which may result from its use. No license is granted by implication or otherwise under any patent or rights of SD Card Association or others.

# Conventions Used in This Document

### Naming Conventions

- Some terms are capitalized to distinguish their definition from their common English meaning.
- Words not capitalized retain their common English meaning.

### Numbers and Number Bases

- Hexadecimal numbers are written with a lower case "h" suffix, e.g., FFFFh and 80h.
- Binary numbers are written with a lower case "b" suffix (e.g., 10b).
- Binary numbers larger than four digits are written with a space dividing each group of four digits, as in 1000 0101 0010b.
- All other numbers are decimal.

### Key Words

- May: Indicates flexibility of choice with no implied recommendation or requirement.
- Shall: Indicates a mandatory requirement. Designers shall implement such mandatory requirements to ensure interchangeability and to claim conformance with the specification.
- Should: Indicates a strong recommendation but not a mandatory requirement. Designers should give strong consideration to such recommendations, but there is still a choice in implementation.

# Table of Contents

# Table of Figures



# Table of Tables

# 1. General

## 1.1 Scope

The primary objective of this Part 1 UHS-II Protocol Test Guideline is to provide a list of verification points for SD Cards/SD Host/Ancillary products (which is called a Test List), and to provide Test Forms for helping SD Card manufacturers to make Verification Records.
The secondary objective is to improve interoperability between SD Host/Ancillary products and SD card products by developing Test Tools and Test Equipment. This guideline defines requirements to enhance reliability and Test Repeatability for making Test Tools and Test Equipment.
Note that the target of this Test Guideline is memory products with UHS-II interface (such as UHS-II SD-memory Card), and does not include IO products like UHS-II SDIO Card.

## 1.2 Related Documents

### 1.2.1 Normative Specification

This Test Guideline defines Test Items and requirements of Test Tools and Test Equipment based on the following Normative Specification:

Part 1 UHS-II Addendum Version 1.02

### 1.2.2 Test Tool Information

A Test Tool Information document provides a summary of a specific Test Tool/Test Equipment. If its test scenarios follow the Test Guideline, the Test Tool provider creates a Test Coverage Table using Form 4. The Test Tool provider needs to provide the Test Tool Information, which includes Test Coverage Table, at an announcement of Test Tools and Test Equipment.

### 1.2.3 Documents for Drafting Test Guideline

Refer to "Release Procedure of Test Guideline" provided by Test Guideline WG about concept of create and update of a Test Guideline.
Refer to Appendix A.1 about documents to be referred.
Refer to Appendix B.1 about Special Terms (Words of first character is upper case).

## 1.3 Concept of Product Verification

### 1.3.1 Self-Verification

Licensed manufacturers of SD Cards/SD Host/Ancillary products are required to self-verify their products conform to the Normative Specification (Refer to Schedule C of the SDA License Agreement). This document provides guidelines for such self-verification.

### 1.3.2 Test Tools and Test Equipment

The development of Test Tools and Test Equipment is not limited by the Test Guideline. The Test Guideline defines test scenarios and its requirements that increase reliability and repeatability; they do not document a full specification of Test Tools or Test Equipment. A Test Tool provider may implement additional tests that are not defined by the Test Guideline.
The Test Guideline specifies followings for Test Tools and Test Equipment:

a) defines Test Conditions;
b) defines the Test Criteria for Pass; and
c) describes a Test Method if required,

Use of the Test Method in the Test Guideline is not mandated. A Test Tool provider may use another Test Method as long as Test Repeatability is available.

If Test Tool providers announce development of Test Tools and Test Equipment that conform to Test Guideline, Test Guideline WG starts Evaluation Procedure to evaluate the Test Tools and Test Equipment by volunteer companies.
"Approved" means the Compliance Committee has endorsed the Test Tool, based on the results of an Evaluation Procedure (Refer to the document "Release Procedure of Test Guideline").

The use of Test Equipment is helpful, but insufficient to ensure Product Conformity to the Normative Specification. It is the responsibility of SD Product manufacturers to ensure through self-verification that SD Products conform to the Normative Specifications.

## 1.4 Framework of Test Guideline

Followings are framework of the Test Guideline

(1) Chapter 1: General
(2) Chapter 2: Test Forms Overview
(3) Chapter 3: Prescription for Test Tools and Test Equipment
(4) Appendix:
Appendix A: Reference
Appendix B: Special Terms
(5) Test Forms:
Form 1: Product Information
Form 2: Acronym Definition of Used Test Tools
Form 3: Test List
Form 4: Test Coverage Table

### 1.4.1 Areas of Interest for SD Product Vendors

The following list provides chapters and forms apply to SD Product Vendors:

- Chapter 2: Framework of Test Forms
- Test Forms (Form 1 to Form 4): for making Verification Records

### 1.4.2 Areas of Interest for Test Tool Providers

The following list provides chapters and forms apply to Test Tool Providers:

- Chapter 3: Requirements for Making Test Tools and Test Equipment
- Form 4: Test Coverage Table for indicating Test Tools Coverage in the Test Tool Information

## 1.5 Notation in This Document

### 1.5.1 Reference of Section, Figure and Table Number

The following rules are applied to this document.

(1) A reference to a section, figure, or table in this document contains the phrase, "of this document".
(2) If nothing is indicated after a section, figure or table number, it implies reference to the Normative Specification.
(3) A reference to a section, figure, or table to another document (except the Normative Specification) is specified by indicating the document name after the reference.

## 1.6 Condition and Criteria

### 1.6.1 Consolidation of Non-Dominant and PVT Conditions

There are multiple test conditions, each with it's own range, covered by the Normative Specification. Such conditions include Process, Voltage, and Temperature (PVT). It is impossible for a practical-

length test to evaluate every possible combination of conditions. Non-dominant conditions and well-known conditions as PVT can be consolidated to simplify Test Guideline.

If the measurement of any value in a condition range does not result in a difference to the Test Results, then that test condition is a non-dominant condition. If a condition is not described in the Test Guideline, Test Tool provider needs to determine the non-dominant test conditions by referring the Normative Specification.

For PVT (Process, Voltage, and Temperature) condition ranges, verification can take place at the worst-case conditions are verified in design level (process variation, all voltage range, and all temperature range). Process variation cannot be tested by actual SD Products and tests are usually performed at room temperature for easiness of test. As Voltage is easy to control by test setup, either worst case (min. or max. voltage) is often used. Typical voltage may be used if voltage is a non-dominant condition.

Test Tool providers should consider both the test condition coverage and the practical test execution time in determining the consolidation of the possible combination of conditions.

### 1.6.2 Condition Range

Figure 1-1 shows the typical relationship between a normative condition range and a test condition range. In order for the Test Equipment to create the condition range (X-Y) to the DUT, the Test Equipment may use the test condition range (A-C). Whether test condition margin is required or not is dependent on of the specific conditions. Any implementation of test condition margins is the responsibility of the Test Equipment.

Conditions can be classified as linear or non-linear conditions. In most cases, conditions have linear characteristics. Test Equipment should use the worst-case conditions on measurement.

In case of a linear condition, a corner condition X or Y can be used as the worst-case condition.
In the case of a non-linear condition, the worst-case condition exists between X and Y. If the worst-case condition exists in more restricted range, such as between A and C, the Test Guideline should define the test condition within the restricted range (A-C). At least three test points should be defined for non-linear conditions.

The Test Guideline uses the following specific phrases to delineate test point requirements for test conditions:

- Expression "**at conditions X and Y**".
  This expression designates both corners of a condition range as two test points.
- Expression "**at conditions A, B and C**".
  This expression designates three test points in a condition range.
- Expression "**between conditions A and C**".
  This expression indicates that the worst-case exists between A and C of non-linear condition. "between" expression admits Test Tool provider to add more test points.
- Expression "**condition at least A**" ("**condition at most C**")
  This is the case that Normative Specification defines one side condition either X(min) or Y(max.). This expression indicates that Test Equipment can use any condition larger than or equal to A (smaller than or equal to C).

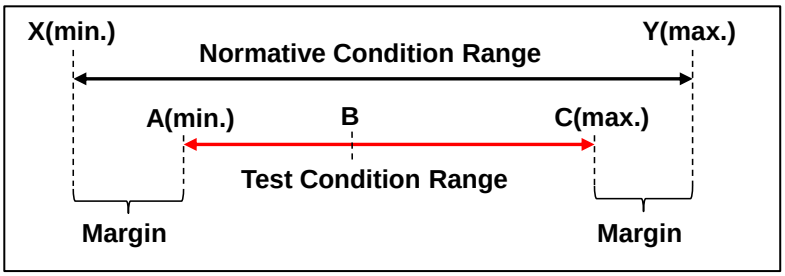


**Figure 1-1 : Range of Condition**

### 1.6.3 Criteria for Pass

For functional tests, the expectations (Criterion) are stated in the Normative Specification. However, when measuring analog characteristics tests (e.g., electrical test and timing tests), test results may be influenced by fluctuating factors (e.g., variations of process and temperature, noise, jitter, influence of test environment, precision of measurement, etc.). In this case, Criteria for Pass should be wider than what is specified by the Normative Specification.

Figure 1-2 shows an example relation between expectation range and Criteria for Pass. Even though an expectation range (X-Y) is specified by the Normative Specification, the Criteria for Pass for the test (CX-CY) should be set by considering the influence of testing fluctuations. The Test Guideline may define some of the fluctuating factors, but the Test Guideline cannot define measurement precision implemented by the Test Equipment. The total margin for Criteria for Pass is determined by the implementation of the Test Equipment.

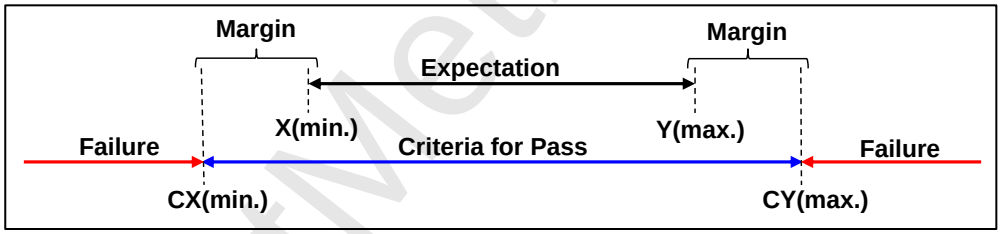


**Figure 1-2 : Criteria for Pass of Test Equipment**

### 1.6.4 De-Embedding and Waiver

The test environment influences the electrical characteristics of measured SD Bus signals. For example, using a Test Fixture that includes a stub to provide a measurement points typically increases the capacitance load, creates timing delay and increases transmission line length.

It is necessary to consider De-Embedding techniques to remove as much as possible of the influence of test environment. Given the electrical impact of test environments, it may difficult to implement the defined conditions in the Normative Specification. In this situation, the Test Equipment may use a Waiver (refer to Appendix B.1 ) that uses another specified condition for measurements (even though such condition is out of the range of the Nominal Specification). In this case, the measured values require converting to the estimated values with normal conditions.

For example, the maximum Capacitance Load of SD Bus changes for different bus speed modes.

Given the requirements of robust test fixturing (e.g., the influence of test environment), the Capacitance Load may be larger than maximum capacitance defined in the Normative Specifications. However, the measurement has to be performed under this over load condition. In this situation, the Test Equipment needs to convert the test results to what would be measured with normal Capacitance Load.

### 1.6.5 Margins Test of DUT

To verify the condition margin of a DUT, the Test Equipment may apply over range conditions to the DUT (e.g., voltage applied in a range less than absolute voltage limit). By sweeping a test condition range larger than normative condition range, the margins of a DUT can be estimated by the border of passing or failing a test. This kind of tests is performed in Level-2 Mode.

For example, input threshold voltages exist between $V_{IL}$ and $V_{IH}$. The margin of threshold can be estimated by sweeping input voltage between $V_{IL}$ and $V_{IH}$. (Usually, voltage is applied smaller than $V_{IL}$ or higher than $V_{IH}$.)

# 2. Test Forms Overview

## 2.1 Form 1: Product Information Under Test

Form 1 is used to record product information about a SD Card/SD Host/Ancillary product under test. The Product Manufacturer fills out optional functions in Form 1 that are supported the product.

## 2.2 Form 2: Acronym Definition of Test Method

Form 2 is used to define acronyms for test methods taken to verify Test Items to use in the "Test Method" field of Form 3. SD Product manufacturers may create any acronyms: for example, if specific test methods and specific test environments are used. DR (Design Review) and SIM (simulation) are defined as reserved acronyms.

## 2.3 Form 3: Test List

Form 3 contains the Test List. The Test List consists of defined Test Items, which is pre-filled with a list of verification points from the Normative Specification.
The Test List may include tests that are difficult (or impractical) to be verified by actual SD Products. Such tests need to be verified at the design level. After the entire test has been completed and the results documented, Form 3 becomes the Verification Records. In addition to the pre-filled list of Test Items, the SD Card licensee may add additional tests.

### 2.3.1 Test List Fields

The test list contains of the following fields:

- **Test Item Number:**
  Each Test Item is distinguished by a unique test number. The Test Number field of pre-filled test items is specified by this document. The following is the defined form for each test number:
  Test Group Number - Sub Group Number - Sequential Number

  The Test Number field value for Test Items added by the SD Card licensee is the responsibility of the SD Card licensee.

- **Test Item:**
  The first line of the Test Item field is the test title, with its **text colored blue and the font made bold**. Line 2 of the Test Item field contains a text description of the test with its text colored black. The Test Item field for pre-filled Test Items is specified by this document.

  The Test Item field value for Test Items added by the SD Card licensee is the responsibility of the SD Card licensee.

- **Mode:**
  The Mode field contains entries that indicate whether the Test Item is applicable to SD mode and/or SPI mode. The Mode field entries for pre-filled Test Items are specified by this document.

  The Mode field entries for Test Items added by the SD Card licensee are the responsibility of the SD Card licensee.

  In this document, this item is not applicable.

- **Target:**
  The Target field indicates each test item is for Host or Device. Check "X" if the test item is

applicable to Host or Device.

- **Section Number:**
  The Section Number field indicates the section number of the Normative Specification, which defines the function of the Test Item. The Section Number field values for pre-filled Test Items are specified by this document.
  The Section Number field values for Test Items added by the SD Card licensee are the responsibility of the SD Card licensee.

- **Omission Condition:**
  The Omission Condition field indicates that a condition to exempt execution of test which verifies a feature/capability. The Omission Condition field for pre-filled Test Items is specified by this document. If the SD Product does not contain a feature/capability being tested (The condition of this field is matched), execution of the Test Item may be omitted.

  The Omission Condition field entries for Test Items added by the SD Card licensee are the responsibility of the SD Card licensee.

- **Test Method:**
  The Test Method field entries contain the acronym from Form 2 that specifies how the verification is to be performed. The Test Method field for all Test Items is to be filled out in the test process (e.g., by an SD Card manufacturer performing self-verification).

  If the test is not a functional test or Prescribed Test Item, then it may be difficult to perform the test on actual products. In this case, the test case should be verified by design review or by simulation.

- **Result:**
  The Result field entry is used to capture the result of the test. The entry shall be either Pass, Fail, or Omit. The Result field for all Test Items is to be filled out in the test process (e.g., by an SD Card manufacturer performing self-verification).

- **Remarks:**
  The Remarks field entry is used to capture any comments about the test result. The Remarks field for all Test Items is be filled out in the test process (e.g., by an SD Card manufacturer performing self-verification).

## 2.4 Form 4: Test Coverage Table

### 2.4.1 Form 4 Overview

Form 4 is used to document Test Tools Coverage. It is to be filled out by the Test Tool provider.

### 2.4.2 The Construction of Coverage Table (Form 4)

Form 4 consists of a table that contains a matrix of Test Groups (columns) and Test Numbers (lines) that correspond to Form 3. The intersection of a column and a line specifies one Test Item.
Each Test Item is color-coded:

a) Blank boxes indicate that the referenced Test Item does not exist;
b) Gray boxes indicate that the referenced Test Item had been defined in an earlier version of Test Guideline; and
c) Purple boxes indicate that the referenced Test Item had been added in the latest version.

The first version does not use purple, and purple boxes will be changed to gray boxes on version up of the Test Guideline.

There are three possible entries to be filled in by the Test Tool provider:

a) No letter
In case of Function Tests that are applicable to actual products, how to test is conceivable and expectation is obvious by the Normative Specification. The result of Function Test shall be stable for defined condition ranges. Then, test method and test conditions may not be described in the Test Guideline. Test Tool provider should consider reducing combination of test conditions to simplify test. It is intended that Function Test is executed in Level-1 Mode and how to implement test is entrusted to Test Tool provider.
The other tests that are not applicable to actual products may not be supported by Test Tools and Test Equipment. Such Test Items should be checked by self-verification.
b) "L1"
This test is intended to be executed in Level-1 Mode (may be executed in Level-2 Mode). This test is called as "Prescribed Test Item for Level-1" and its test requirements are described in Chapter 0.
c) "L2"
This test is intended to be executed in Level-2 Mode. This test is called as "Prescribed Test Item for Level-2" and its test requirements are described in Chapter 0.

Examples of Cell Colors and Letters

| | |
|---|---|
| | Blank box means Test Item does not exist |
| | Gray box means Test Item defined in the first version or previous versions |
| | Purple box means Test Item added from this version up |
| L1 | "L1" indicates the Prescribed Test Item for Level-1 |
| L2 | "L2" indicates the Prescribed Test Item for Level-2 |

### 2.4.3 How to Modify Form 4 in the Test Tool Information

Test Tools and Test Equipment provider copies Form 4 to indicate Test Tools Coverage and add it in the Test Tool Information. Test Tool provider modifies colors and letters in boxes as follows:

a) No Letter
If Test Equipment can support the Test Item in Level-1 Mode, the box is changed to green. Otherwise, keeps gray box to indicate the Test Item is not supported.
b) "L1"
If Test Equipment can support the Test Item in Level-1 Mode, the box is changed to green and

"L1" is indicated in the box. If Test Equipment can support the Test Item in Level-2 Mode instead of Level-1 Mode, the box is changed to green and "L2" is indicated in the box. If "waiver" is taken to implement the test, yellow is indicated instead of green (Refer to 1.6.4).

c) "L2"
If Test Equipment can support the Test Item in Level-2 Mode, the box is changed to green and "L2" is indicated. If "waiver" is taken to implement the test, yellow is indicated instead of green (Refer to 1.6.4).

Test Tool provider can add a note to a Test Item. A note number with parentheses (n) in a box indicates existence of a note. Note(n): Descriptions are to be provided below the table.

Examples of Cell Colors and Letters

| | |
|---|---|
| | Blank box means Test Item does not exist |
| | Gray box means Test Item exists and is not supported |
| | Green box means Test Item covered by this Test Tools or Test Equipment |
| | Yellow box means Test Item supported under specific conditions (waiver) |
| L1, (n) | Example of letters indicated in a box. "n" is a number. |

Note(n): Descriptions of note(n).

# 3. Prescription for Test Tools and Test Equipment

## 3.1 Overview of Chapter 3

This chapter describes requirements of Prescribed Test Items for developing Test Tools and Test Equipment in Leve-1 Mode or Level-2 Mode. Prescribed Test Items are selected from the Test List, which are more significant and can be performed without particular modification of DUT (SD Products). Test Item Number of Prescribed Test Item is correspondent to that of the Test List. Test Methods, Test Conditions and Criteria for Pass may be specified in this chapter so that reliability and Test Repeatability are available in the test result. For getting approval of CC, Test Tools and Test Equipment need to be developed according to this chapter.

## 3.2 Test Configuration

Figure 3-1 shows an example configuration for Card Test.
The Test Fixture is inserted between Test Equipment and DUT. Measuring instrument (oscilloscope) is connected to the Test Fixture to measure waveform and eye patterns on SD Bus. Without Test Fixture, DUT (SD Card) may be directory inserted to SD card slot of Test Equipment if it is not necessary to monitor bus signals.

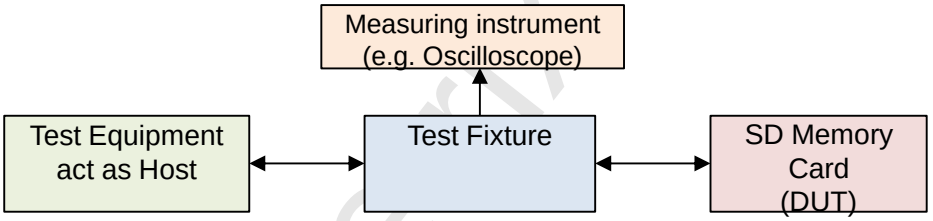


**Figure 3-1 : An Example Configuration of Card Test**

Figure 3-2 shows an example configuration for Host Test. A Test Fixture is inserted to the SD Slot of DUT and a SD Memory Card or Card Emulator is connected through the Test Fixture. Measuring instrument (oscilloscope) is connected to the Test Fixture and used to measure wave forms and eye patterns at SD Bus. An electric load is used to measure host power supply capability.

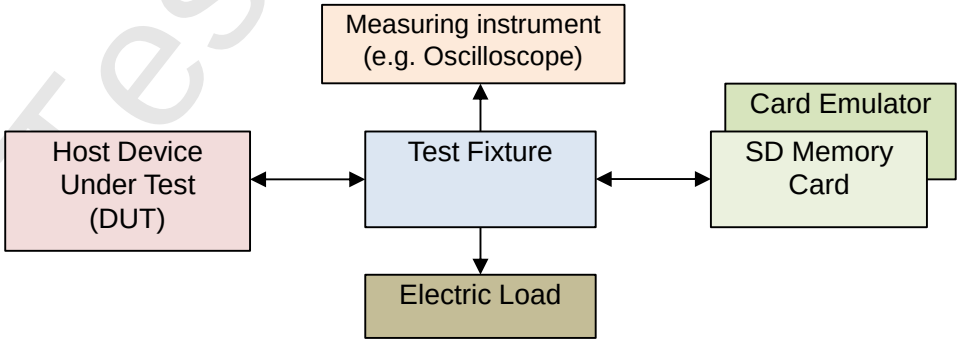


**Figure 3-2 : An Example Configuration of Host Test**

Prescribed Test Items are performed in the ambient temperature ranges. While executing a test, the card surface temperature shall be less than the Card Case Temperature (Tc), which is defined by the Thermal Specification in the Mechanical Addenda.

# 3.3 Details of Prescribed Test Items for Card

## 3.3.1 Definition of Standard Test Procedure

### 3.3.1.1 Basic Concept

Standard Test Procedure is introduced in order to define criteria for detecting Verification Test. Figure 3-3 shows the basic flow for handling UHS-II interface.

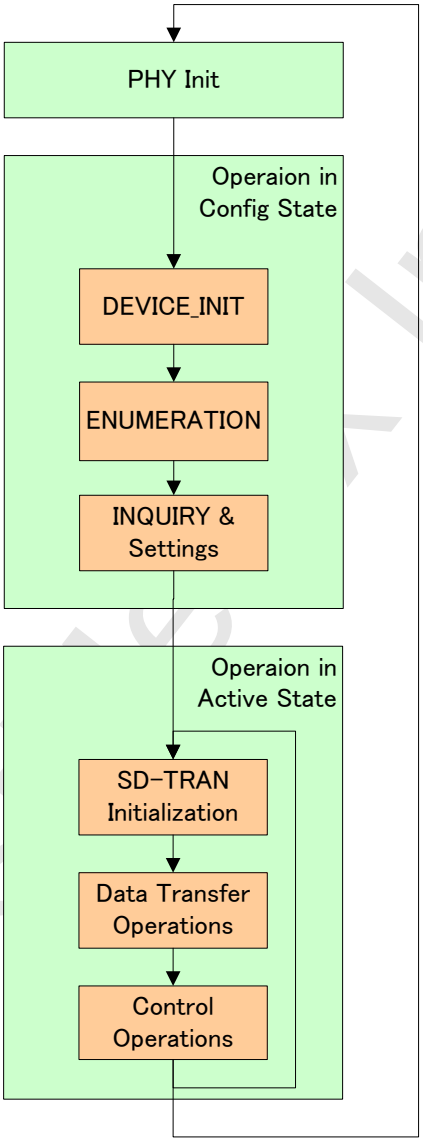


**Figure 3-3 : Basic Flow for Handling UHS-II I/F**

Standard Test Procedure is defined in order to realize the basic flow of UHS-II, and include the following operations.

- PHY Initialization
- Operations in Config State

- ✧ DEVICE_INIT
- ✧ ENUMERATION
- ✧ INQUIRY and Settings

- Operations in Active State
  - ✧ SD-TRAN Initialization
  - ✧ Data Transfer Operations such as read, write and erase.
  - ✧ Control Operations (e.g. FULL_RESET, GO_DORMANT_STATE, CMD0)

#### 3.3.1.2 Parameters

Table 3-1, Table 3-2 and Table 3-3 show sets of parameters to execute Standard Test Procedure.

| Item | Parameter | Value |
|---|---|---|
| RCLK | Frequency | 26MHz |
| Device Initialization | GD | 0h |
| | GAP | 1h |
| | DAP | 0h |
| | CF | 1b |
| Enumeration | ID_F | 1h |
| | ID_L | 0h |
| Settings Registers | Number of Lanes and Functionality | 0000b |
| | Power Control Mode in Active State | 0b |
| | N_LSS_DIR | 0000b |
| | N_LSS_SYN | 0000b (Don't Care) |
| | Selected Transmission Speed Range | 00b |
| | Selected PHY Major Revision | 00b |
| | N_DATA_GAP | FFh (Don't Care) |
| | MAX_BLKLEN | 200h |
| | MAX_RETRY_NUM | 00b |
| | N_FCU | 01h |
| Block Data Transfer | Address | 0h |
| | Size | 64Blocks (32KB) |

**Table 3-1 : Parameter Set A**

| Item | Parameter | Value |
|---|---|---|
| RCLK | Frequency | 26MHz |
| Device Initialization | GD | 0h |
| | GAP | 1h |
| | DAP | 0h |
| | CF | 1b |
| Enumeration | ID_F | 1h |
| | ID_L | 0h |
| Settings Registers | Number of Lanes and Functionality | 0000b |
| | Power Control Mode in Active State | 1b |
| | N_LSS_DIR | 0000b |
| | N_LSS_SYN | 0000b |
| | Selected Transmission Speed Range | 01b |
| | Selected PHY Major Revision | 00b |
| | N_DATA_GAP | FFh |
| | MAX_BLKLEN | 200h |
| | MAX_RETRY_NUM | 01b |
| | N_FCU | If Device-specific N_FCU is more than or equal to 02h, set to 02h, otherwise set to 01h |
| Block Data Transfer | Address | End of User Data Area Address / 2 (Middle of User Data Area) |
| | Size | 64Blocks (32KB) |

**Table 3-2 : Parameter Set B**

| Item | Parameter | Value |
|---|---|---|
| RCLK | Frequency | 52MHz |
| Device Initialization | GD | 0h |
| | GAP | 1h |
| | DAP | 0h |
| | CF | 1b |
| Enumeration | ID_F | Fh |
| | ID_L | 0h |
| Settings Registers | Number of Lanes and Functionality | 0000b |
| | Power Control Mode in Active State | 1b |
| | N_LSS_DIR | Same as Device-specific N_LSS_DIR |
| | N_LSS_SYN | Same as Device-specific N_LSS_SYN |
| | Selected Transmission Speed Range | 01b |
| | Selected PHY Major Revision | 00b |
| | N_DATA_GAP | Same as Device-specific N_DATA_GAP |
| | MAX_BLKLEN | 200h |
| | MAX_RETRY_NUM | 11b |
| | N_FCU | Same as Device-specific N_FCU |
| Block Data Transfer | Address | (End of User Data Area Address) – 40h |
| | Size | 64Blocks (32KB) |

**Table 3-3 : Parameter Set C**

#### 3.3.1.3 Details of Each Operation

##### 3.3.1.3.1 PHY Initialization

- COM + SYN activation
- COM + BSYN activation (Boot Code Loading Sequence)
  - ✧ Boot Code Loading takes place with the following parameters: MAX_BLKLEN = 200h (512bytes), N_FCU = 1, MAX_RETRY_NUM = 3
  - ✧ DATA Burst bypassing during Boot Code Loading
  - ✧ SET_COMMON_CONFIG to set "Config Completion" to 0

##### 3.3.1.3.2 Operations in Config State

- DEVICE_INIT CCMD
- ENUMERATION CCMD
- Checking Capabilities Registers (IOADR = 000h -- 007h)
  - ✧ INQUIRY_CONFIG
  - ✧ P2P Read CCMD
- Writing Settings Registers (IOADR = 008h -- 00Dh)
  - ✧ SET_COMMON_CONFIG
  - ✧ P2P Write CCMD

##### 3.3.1.3.3 Operations in Active State

- Update Settings Registers
- Data Transaction
  - ✧ DATA Burst Retry also should be checked
  - ✧ Block Read Transfer (e.g. CMD17, CMD18 with LM = 0, 1)
  - ✧ Block Write Transfer (e.g. CMD24, CMD25 with LM = 0, 1)
  - ✧ Byte Read Transfer (e.g. ACMD13)
  - ✧ Byte Write Transfer (e.g. CMD42)
  - ✧ Erase Operation
- FULL_RESET_CCMD (P2P and Broadcast)
- GO_DORMANT_STATE CCMD (P2P and Broadcast)

##### 3.3.1.3.4 Operations for Optional Functions

- Hibernate Mode
  - ✧ If Device supports Hibernate Mode, the sequences of Hibernate Mode are tested.
  - ✧ If Device does not support Hibernate Mode, error response of GO_DORMANT_STATE CCMD is checked.
- 2L-HD Mode
  - ✧ If Device supports 2L-HD Mode, the sequences of 2L-HD Mode are tested (Block Read and Block Write).
  - ✧ If Device does not support 2L-HD Mode, error response of DCMD with DM = 1 is tested.

#### 3.3.1.4 Another Requirements for the Test Tool

The Test Tool shall be implemented the following functions.

- Transmitting packets with wrong CRC.
- Transmitting illegally scrambled data.

# Appendix A (Normative) : Reference

## A.1 Reference

This guideline refers the following documents.

- SD Specifications Part 1 UHS-II Addendum Version 1.02 or later
- SD Specifications Part 1 Physical Layer Specification Version 4.20 or later

# Appendix B (Normative) : Special Terms

## B.1 Terminology

| | |
|---|---|
| Approved Test Tools | Test Tools endorsed by CC according to the result of Evaluation Procedure. Refer to "Release Procedure of Test Guideline" about Evaluation Procedure. |
| Approved Test Equipment | Test Equipment endorsed by CC according to the result of Evaluation Procedure. Refer to "Release Procedure of Test Guideline" about Evaluation Procedure. |
| Capacitance Load | Total capacitance of input capacitance and the transmission line between host and card. |
| Product Conformity | SD Product is developed properly according to the Normative Specifications. Development includes design, implementation, manufacturing, verification and evaluation. |
| Criteria for Pass | Evaluation index of Test Results for judging pass. Margin is considered to employ Criteria for Pass including uncertainty region. |
| De-Embedding | A technique to remove influence of measurement environment from measured result. |
| Evaluation Procedure | Test Tools and Test Equipment are evaluated and improved by volunteers for a specific period. CC uses the result of this procedure to approve them. |
| Test Fixture | A test board or accessory for holding DUT and connecting measuring instrument for verification. |
| Fluctuating Factors | Variations of process and temperature, noise, jitter, influence of test environment, precision of measurement, etc. |
| Function Test | Expectation is logically determined over defined condition ranges and how to check the function is conceivable by the Normative Specification. |
| Interoperability | In combination with Host and Card, they can communicate and operate properly as defined in the Normative Specifications. |
| Level-1 Mode | A test mode of Test Equipment to execute Prescribed Test Items for Level-1 and to report pass/fail according to Criteria for Pass including margins for Fluctuating Factors. Test Equipment shall employ Criteria for Pass including uncertainty region. It is recommended that Test Conditions are pre-set and tests can be executed automatically in order to prevent human error in test procedure and also to improve reliability and Test Repeatability. |
| Level-2 Mode | A test mode of Test Equipment to execute Prescribed Test Items (both for Level-1 and Level-2) by changing test conditions. Test results of Test Equipment are treated as informative and further technical consideration is required to judge pass or fail. |
| Normative Specification | Specification or Addendum of a Part of SD Specifications to which Test Guideline refers. |
| Prescribed Test Item | Prescribed Test Items are other than Function Tests, for verifying SD Products and no alteration of SD Products is required. Test Method (if required), Test Conditions and Criteria for Pass are defined in Chapter 0 of this document for Test Repeatability. Not all Test Conditions may be set to worst case (e.g., process and temperature). |

| | |
|---|---|
| Prescribed Test Item for Level-1 | A Prescribed Test Item that has obvious Criteria for Pass with the well-defined Test Conditions. |
| Prescribed Test Item for Level-2 | A Prescribed Test Item that does not have obvious Criteria for Pass. Test Conditions may be defined with flexibility. Further technical consideration is required to judge pass or fail. |
| Test Conditions | Conditions on measurement of SD Products that is determined by conditions defined by the Normative Specification. Some of conditions have corner condition (min./max.). |
| Test Coverage | There are two types of Test Coverage: one is Test Item Coverage and the other is Test Tools Coverage. |
| Test Equipment | Test Equipment is a subset of Test Tools that is capable of reporting test results. |
| Test Forms | A set of document formats for helping SD Product manufacturers to make a Verification Records by filling out test results in Forms.<br>There are 4 Forms:<br>Form 1: Product Information Under Test<br>Form 2: Acronym Definition of Test Method<br>Form 3: Test List<br>Form 4: Test Coverage Table |
| Test Items | Test points picked up from the Normative Specification and summarized in Test List. It can be distinguished by Group Number and Sequential Number. Test Items may be added to avoid occurrence of interoperability issue that are difficult to think of from the Normative Specification. |
| Test Item Coverage | Test Guideline WG evaluates whether there are sufficient Test Items in the Test List for conformity checkpoints to the Normative Specification. |
| Test List | Test List is one of Test Forms (Form 3) which describes verification points picked up from the Normative Specification. Test List may include Test Items that are difficult to apply to actual SD Products but rather checked by design level. |
| Test Repeatability | To get the same Test Results, even on different Test Equipment or tests executed repeatedly, common essential Test Conditions and Criteria for Pass are specified as information to develop Test Equipment. |
| Test Result | A report of Test Equipment. If a waiver is used, correction is applied to the Test Result. Test Results are treated as informative in Level-2 Mode. |
| Test Tools | Test Tools are general term of any measuring instrument for helping SD products verification. |
| Test Tools Coverage | Test Guideline WG gathers Test Coverage Tables from Test Tool Information and evaluates whether all Prescribed Test Items can be tested by announced Test Tools and Test Equipment. |
| Test Tool Information | A document provided by a Test Tool provider to introduce a Test Tool / Equipment including Test Coverage information. |
| Verification Records | SD Product manufacturers need to create the result of self-verification for each SD Product as evidence. The Verification Records may be created by filling out Test Forms. |
| waiver | If it is difficult to achieve a test condition for a Test Fixture, taking another method as an exemption to measure characteristics of a device under test. |

# B.2 Abbreviations

| | |
|---|---|
| CC | Compliance Committee |
| DUT | Device Under Test |
| SDSC | Standard Capacity SD Memory Card |
| SDHC | High Capacity SD Memory Card |
| SDXC | Extended Capacity SD Memory Card |
| UHS-I | Ultra High Speed Mode Phase I. 1.8V signaling bus mode. There are five modes: SDR12, SDR25, SDR50, SDR104 and DDR50. SDR modes use only rising clock edge. DDR50 uses both rising and falling clock edges. |
| SDR12 | One of UHS-I modes up to 25MHz |
| SDR25 | One of UHS-I modes up to 50MHz |
| SDR50 | One of UHS-I modes up to 100MHz |
| SDR104 | One of UHS-I modes up to 208MHz |
| DDR50 | One of UHS-I modes up to 50MHz |
| UHS-II | Ultra High Speed Mode Phase II using LVDS (Low Voltage Differential Signaling) technology |
| FD156 | UHS-II Full Duplex mode with data transfer rate up to 156MB/s |
| HD312 | UHS-II Half Duplex with 2 Lanes mode with data transfer rate up to 312MB/s |
| U1 | One of UHS Speed Grades more than 10MB/sec |
| U3 | One of UHS Speed Grades more than 30MB/sec |

# Form 1: Product Information Under Test

## Product Name Under Test

Model Name of Product: _____

Name of Inspector: _____

Date of Test Completed: _____

## Information of Manufacturer

Company Name: _____

Company Address: _____

Phone (Fax) Number: _____

## Supported Physical Layer Specification Version

SD_SPEC: ☐ Ver.1.01 ☐ Ver.1.10 ☐ Ver.2.00 ☐ Ver.3.00 ☐ Ver.4.xx

## Card Types

From Factor: ☐ Standard Size ☐ miniSD ☐ microSD

Extra Function: ☐ McEX ☐ Combo

## Optional Functions Details

Check the supported functions

| | | | | | |
|---|---|---|---|---|---|
| Read/Write: | ☐ Read only | ☐ Write only | ☐ Read and Write | | |
| Bus Width: | ☐ 1 bit | ☐ 4 bits | ☐ 1 bit and 4 bits | | |
| Bus Mode: | ☐ SD mode | ☐ SPI mode | ☐ SD and SPI mode | | |
| Card Types: | ☐ Standard | ☐ SDHC | ☐ SDXC | | |
| Bus Speed Modes: | ☐ Default | ☐ High Speed | ☐ | | |
| | ☐ SDR50 | ☐ SDR104 | ☐ DDR50 | | |
| UHS-II Mode: | ☐ Full Duplex | ☐ Half Duplex | ☐ | | |
| Number of Lanes: | ☐ Two lanes | ☐ Three lanes | ☐ Four lanes | ☐ more | |
| Speed Class: | ☐ Class 2 | ☐ Class 4 | ☐ Class 6 | ☐ Class 10 | |
| UHS Speed Grade: | ☐ U1 | ☐ U3 | ☐ | ☐ | |
| Maximum Power (card): | ☐ 0.36W | ☐ 0.72W | ☐ 1.44W | | |
| Power Supply Capability (Host) | ☐ 2.16W | ☐ 2.88W | | | |
| Lock/Unlock: | ☐ Supported | ☐ | | | |

## Comments

# Form 2: Symbol Definition of Used Test Tools

Symbols are defined here to be used within the Test Tools fields in Form 3.

**Symbol Table for Test Tools**

| Symbol | Test Method or Test Tools Name | Comment or Model Number |
|---|---|---|
| DR | Design Review | - |
| SIM | Simulation | - |
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 3-4 : Symbol Table of Used Test Tools**

**Comments:**

| |
|---|
| |

# Form 3: Test List

Note for all Test Items:

- "SD-memory" in this document has UHS-II interface, and includes both SD memory card and embedded SD memory. SD-memory basically supports Link Layer specifications and CM-TRAN specifications if not otherwise specified.
- If "SD-Memory" is described in the Omission Condition column, such test items are for the memory device without SD-TRAN (which is accessed only by UHS-II native protocol).
- Numbers for Section, Figure and Table in this Test List indicate those in the UHS-II Addendum.

## TG1. UHS-II System Features

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 1-1 | **Interface Speed (FD mode):**<br>Device shall fully support Interface speed from 39MB/sec to 156 MB/sec in FD mode. | | X | Ch 2, 3.1 | | | | |
| 1-2 | **Interface Speed (FD mode):**<br>Host shall support at least one Interface speed from 39MB/sec to 78 MB/sec in FD mode. | X | | Ch 2, 3.1 | | | | |
| 1-3 | **Interface Speed (2L-HD mode):**<br>Device shall fully support Interface speed from 78MB/sec to 312 MB/sec in 2L-HD mode. | | X | Ch 2, 3.1, Ch 8 | 2L-HD mode is not supported | | | |
| 1-4 | **Supporting Legacy SD I/F:**<br>Host shall initialize Legacy SD I/F if UHS-II I/F is not detected. | X | | Ch 2 | Embedded Devices | | | |
| 1-5 | **Direction of D0 and D1:**<br>As default, direction of D0 and D1 Lanes are downstream and upstream respectively. | X | X | 3.2.1 | | | | |
| 1-6 | **Direction of D0 and D1 on 2L-HD mode write:**<br>Direction of D0 and D1 Lanes are both downstream when Host sends data to Device. | X | X | 3.2.1 | 2L-HD mode is not supported | | | |
| 1-7 | **Direction of D0 and D1 on 2L-HD mode read:**<br>Direction of D0 and D1 Lanes are both upstream when Host receives data from Device. | X | X | 3.2.1 | 2L-HD mode is not supported | | | |
| 1-8 | **RCLK:**<br>RCLK shall be distributed individually to removable Devices.<br>In case of Ring connection, RCLK is distributed by either point to point method (like Figure 3-6 (a)) or multi-drop method (like Figure 3-6 (b)). | X | | 3.2.2<br>3.2.2.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 1-9 | **Block Mode and Byte Mode:**<br>Length Unit Mode has the following two modes, one is a Block Mode and the other is a Byte Mode. | X | X | 3.3 | | | | |
| 1-10 | **Initialization without Boot Code Loading:**<br>Host shall execute UHS-II Initialization flow as described in Section 3.5.1 (in case of without Boot Code Loading). | X | | 3.5<br>3.5.1 | | | | |
| 1-11 | **Device operation before completing Device Initialization without Boot Code Loading:**<br>During Initialization without Boot Code Loading, Device shall not operate and not transmit RES or broadcast CCMD when it receives CMD other than DEVICE_INIT CCMD. | | X | 3.5.1 | | | | |
| 1-12 | **Initialization with Boot Code Loading:**<br>Host shall execute UHS-II Initialization flow as described in Section 3.5.2 (in case of with Boot Code Loading). | X | | 3.5<br>3.5.2 | Host not supporting Boot Code Loading | | | |
| 1-13 | **Device operation after completing Boot Code Loading:**<br>After finishing Boot Code Loading, Device accepts the broadcast CCMD to set "Config Completion" to 0. | | X | 3.5<br>3.5.2<br>5.9.1 | | | | |

**Table 3-5 : Test List of UHS-II System Features**

Test Item: Describe a test item to test a function as described in a specification. Proper test titles should be utilized that can easily distinguish the test item from others.
Target: Check "X" if the test item is applicable to SD mode or SPI mode.
Section Number: Describe the specification section number to be tested. Function to be tested can be indicated.
Omission Condition: Describe conditions for exemption to execute the test item.
Test Tools: Describe test method and tools information.
Test Result: Check the test result.
Remark: Describe a comment about test result if required.

Color marking on the Target Column indicates

- Beige: Defined as Standard Test Procedure and fully covered by the defined operations
- Yellow: Defined as Standard Test Procedure but partially covered by the defined operations
- White: Self-compliance Test items

# TG2. LINK Layer Specification

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-1 | **Number of SYN LSS:**<br>Tx shall issue at least the predetermined number (N_LSS_SYN * 4) of SYN LSSes with keeping running disparity continuity. | X | X | 5.2.2.2<br>5.2.8.2 | | | | |
| 2-2 | **SID field in Header for Host:**<br>Host initiates packets whose SID is 0. | X | | 5.2.3 | | | | |
| 2-3 | **Initial value for Node ID of Device:**<br>For Devices, number 15 is set as the initial value for Node ID after I/F power cycle or FULL_RESET. | | X | 5.2.3<br>5.9.2 | | | | |
| 2-4 | **SID and DID fields in Header for Boot Device before Enumeration:**<br>Boot Device initiates packets whose SID = X (temporal Node ID of Boot Device and 1 ≤ X ≤ 14) and DID = 0 for Boot Code Loading. | | X | 5.2.3<br>5.9.2 | Non Boot Device | | | |
| 2-5 | **SID and fields in Header for Device after Enumeration:**<br>Device initiates packets whose SID is same as its Node ID assigned through Enumeration process. | | X | 5.2.3<br>6.2.7 | | | | |
| 2-6 | **TYP field in Header:**<br>TYP field is as follows.<br>000b: CCMD<br>001b: DCMD<br>010b: RES<br>011b: DATA<br>111b: MSG | X | X | 5.2.3 | | | | |
| 2-7 | **NP field in Header for MSG packet:**<br>NP is always 1 for MSG packet. | X | X | 5.2.3 | | | | |
| 2-8 | **Header for broadcast packet:**<br>Following header indicates Broadcast (CCMD) packet<br>SID = DID = 0<br>TYP = 000b<br>NP = 1. | X | | 5.2.3<br>6.2.2.3 | | | | |
| 2-9 | **In case of Device ID = DID:**<br>If Device whose Node ID is equal to X (1 ≤ X ≤ 15) receives packet with DID = X, it processes. | | X | 5.2.3<br>5.8 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-10 | **In case of Host ID = DID (0):**<br>If Host receives packet with DID = 0, it processes. | X | | 5.2.3<br>5.8 | | | | |
| 2-11 | **In case of Device ID ≠ DID:**<br>If Device whose Node ID is equal to X (1 ≤ X ≤ 15) receives packet with DID ≠ X and DID ≠ SID, it bypasses to the next Node without any modification as far as it does not satisfy the condition of packet discard described in Section 5.8. | | X | 5.2.3<br>5.6.2<br>5.8 | | | | |
| 2-12 | **In case of SID = DID = 0 for Host:**<br>If Host receives packet with SID = DID = 0, Host shall terminate its transaction. | X | | 5.2.3<br>6.2.2.3 | | | | |
| 2-13 | **In case of SID = DID = 0 for Device:**<br>If Device receives packet with SID = DID = 0 and without including any errors, it processes as a Broadcast CCMD, and transmit to the next Node. | | X | 5.2.3 | | | | |
| 2-14 | **Packet Format MSG:**<br>Host and Device shall follow the format of MSG which is described in Figure 5-3, Table 5-4, Table 5-5 and Table 5-6. | X | X | 5.2.4.1<br>5.2.4.2 | | | | |
| 2-15 | **Host receiving MSG with error:**<br>If Host receives an FCREQ, FCRDY or STAT MSG with UNRECOVERABLE_ERROR = 1, it needs to abort the data transaction by issuing TRANS_ABORT CCMD or encapsulated CMD12. | X | | 5.2.4.2 | | | | |
| 2-16 | **Receiving RECOVERABLE_ERROR:**<br>If LINK of DATA initiator side receives a STAT MSG with RECOVERABLE_ERROR = 1 and UNRECOVERABLE_ERROR = 0 just after a DATA Burst transmission, it needs to start performing DATA Burst Retry. | X | X | 5.2.4.2<br>5.5.4 | | | | |
| 2-17 | **Error Indication during Data Transaction**<br>If Host detects UNRECOVERABLE_ERROR from receiving DATA Burst, Host shall issue STAT MSG with UNRECOVERABLE_ERROR = 1. | X | | 5.2.4.2<br>6.2.15.2 | | | | |
| 2-18 | **MSG duplication and Packet Framing Rule of MSG in transmitter:**<br>MSG initiator shall send the same MSG packets twice for one message transmission. | X | X | 5.2.4.3<br>5.2.6.1 | In case of bypassing by intermediate Device | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-19 | **MSG duplication in receiver:**<br>Receiver shall recognize the MSG reception successful if at least one of MSG packets is recognized as a valid MSG. | X | X | 5.2.4.3 | | | | |
| 2-20 | **Packet Framing Rule of TLP:**<br>TLP shall be constructed as described in Figure 5-4. | X | X | 5.2.6.1 | | | | |
| 2-21 | **DATA Burst Framing in Block Mode:**<br>DATA Burst in Block Mode shall be constructed as described in Figure 5-6. | X | X | 5.2.6.2.1 | | | | |
| 2-22 | **Fractional DATA Burst:**<br>Fractional DATA Burst shall be transmitted only as a final part of data transaction when the data transfer length is determined. | X | X | 5.2.6.2.1 | Device specific N_FCU=1 | | | |
| 2-23 | **Payload length of DATA Packets:**<br>The payload length for all DATA Packets shall be equal to Block Length in Block Mode. | X | X | 5.2.6.2.1 | | | | |
| 2-24 | **In case of Block Length is odd in Block Mode:**<br>If Block Length is odd, the DATA initiator shall insert one PAD (K23.7) at the end of each DATA Packet as described in Figure 5-8. | X | X | 5.2.6.2.1 | SD-memory | | | |
| 2-25 | **DATA Burst Framing in Byte Mode:**<br>DATA Burst in Byte Mode shall be constructed as described in Figure 5-9. | X | X | 5.2.6.2.2 | | | | |
| 2-26 | **In case of TLEN is odd in Byte Mode:**<br>If TLEN is odd, the DATA initiator shall insert one PAD (K23.7) at the end of DATA Packet as described in Figure 5-10. | X | X | 5.2.6.2.2 | | | | |
| 2-27 | **LSS sub-state:**<br>The following symbol shall be prefixed by COM symbol;<br>SOP, EOP, BSYN1, BSYN0, SYN1, SYN0, DIR, LIDL1, LIDL0, DIDL1, DIDL0, SDB, EDB. | X | X | 5.2.2.2<br>5.2.8.2 | | | | |
| 2-28 | **Setting Config Completion Flag to 1:**<br>In case of Ring Connection, Host shall use broadcast write CCMD to set "Config Completion" flag to 1. | X | | 5.2.9.4 | P2P connection | | | |
| 2-29 | **Transition to Dormant:**<br>Transition to Dormant takes place as described in Figure 5-23 (in case of Fast Mode), and in Figure 5-24 (in case of Low Power Mode). | X | X | 5.2.9.4<br>5.4.3 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-30 | **PHY initialization (P2P):**<br>PHY initialization takes place as described in Figure 5-19. | X | X | 5.2.9.3<br>5.3.2<br>6.3.1 | | | | |
| 2-31 | **PHY initialization (Ring):**<br>PHY initialization takes place as described in Figure 5-21. | X | X | 5.2.9.3<br>5.3.3<br>6.3.1 | Removable Device | | | |
| 2-32 | **Valid Transmission Gap in Config:**<br>Valid Transmission Gap is filled with LIDL in Config state. | X | X | 5.4.1 | | | | |
| 2-33 | **Valid Transmission Gap in Active.Control (FM):**<br>Valid Transmission Gap is filled with LIDL in Active.Control state if "Power Control Mode in Active.Control State" is Fast Mode. | X | X | 5.4.1<br>5.2.9.5 | | | | |
| 2-34 | **Valid Transmission Gap in Active.Control (LPM):**<br>Valid Transmission Gap is filled with a series of STB.H, EIDL, STB.L and SYN LSS in Active.Control state if "Power Control Mode in Active.Control State" is Low Power Mode. Also refer to Figure 5-26. | X | X | 5.4.1<br>5.4.4<br>5.2.9.5 | | | | |
| 2-35 | **Valid Transmission Gap in Active.Trans:**<br>Valid Transmission Gap is filled with DIDL in Active.Trans. | X | X | 5.4.1<br>5.2.9.5 | | | | |
| 2-36 | **Transition from / to EIDL (Tx):**<br>For transition from / to EIDL, operations of Tx are as described in Figure 5-26. | X | X | 5.4.2<br>5.4.4 | | | | |
| 2-37 | **Transition from / to EIDL (Rx):**<br>For transition from / to EIDL, operations of Rx are as described in Figure 5-26. | X | X | 5.4.2<br>5.4.4 | | | | |
| 2-38 | **CFG_REG values:**<br>CFG_REG values including PHY and LINK parameters (e.g. N_LSS_SYN, N_DATA_GAP, and N_FCU) shall be preserved during Dormant state. | X | X | 5.4.3 | | | | |
| 2-39 | **Flow Control for read transaction in FM:**<br>In Fast Mode, Flow control for read transaction takes place as described in Figure 5-29. | X | X | 5.5.3.1 | | | | |
| 2-40 | **Flow Control for read transaction in LPM:**<br>In Low Power Mode, Flow control for read transaction takes place as described in Figure 5-31. | X | X | 5.5.3.2 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-41 | **Flow Control for write transaction in FM:**<br>In Fast Mode, Flow control for write transaction takes place as described in Figure 5-33. | X | X | 5.5.3.3 | | | | |
| 2-42 | **Flow Control for write transaction in LPM:**<br>In Low Power Mode, Flow control for write transaction takes place as described in Figure 5-35. | X | X | 5.5.3.4 | | | | |
| 2-43 | **Notification of RECOVERABLE_ERROR:**<br>If DATA Receiver side detects CRC_ERROR or FRAME_ERROR during DATA Burst reception, it notifies the Initiator side of the error via STAT with RECOVERABLE_ERROR = 1. | X | X | 5.5.4<br>5.2.4 | | | | |
| 2-44 | **Receiving RECOVERABLE_ERROR and retry counter is smaller than MAX_RETRY_NUM:**<br>If DATA Initiator side receives STAT with RECOVERABLE_ERROR = 1 and UNRECOVERABLE_ERROR = 0, and retry counter is smaller than "MAX_RETRY_NUM", it increments retry counter by 1 and starts from a flow control handshake to retransmit the whole DATA Burst again. | X | X | 5.5.4<br>5.2.4 | | | | |
| 2-45 | **Receiving RECOVERABLE_ERROR and retry counter is equal to MAX_RETRY_NUM:**<br>If DATA Initiator side receives STAT with RECOVERABLE_ERROR = 1 and UNRECOVERABLE_ERROR = 0, and retry counter is equal to "MAX_RETRY_NUM", it handles as RETRY_EXPIRE_ERROR and shall stop flow control sequence. | X | X | 5.5.4<br>5.2.4 | | | | |
| 2-46 | **Receiving UNRECOVERABLE_ERROR:**<br>If DATA Initiator side receives STAT MSG or FCRDY MSG with UNRECOVERABLE_ERROR = 1 during DATA transaction, flow control sequences shall be given up. | X | X | 5.5.4<br>5.2.4 | | | | |
| 2-47 | **Setting RETRY_EXPIRE_ERROR to 1 in ST_REG:**<br>When Device detects that retry counter reaches to "MAX_RETRY_NUM", it sets RETRY_EXPIRE_ERROR to 1 in ST_REG. | | X | 5.5.4<br>6.2.10.2.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-48 | **Receiving no error MSG:**<br>If DATA Initiator side receives STAT with UNRECOVERABLE_ERROR = RECOVERABLE_ERROR = 0, it transmits next DATA Burst and sets retry counter to 0. | X | X | 5.5.4<br>5.2.4 | | | | |
| 2-49 | **Control Packet Bypassing in LPM:**<br>If the state of Tx in Device is EIDL before bypassing, Device transmits STB.L and SYN LSS as described in Section 5.4.4. | | X | 5.6.2<br>5.4.4 | | | | |
| 2-50 | **Enabling Loopback path:**<br>If Device receives FCREQ whose DID is not equal to its Node ID, it switches Loopback path enabled and preserves disparity and LSS boundary in the vicinity of switching Loopback mode. | | X | 5.6.3<br>5.2.9.5 | | | | |
| 2-51 | **Disabling Loopback path by EDB:**<br>If Device receives EDB symbol during DATA Burst Streaming, it switches Loopback path disabled and preserves disparity and LSS boundary in the vicinity of switching Loopback mode. | | X | 5.6.3 | | | | |
| 2-52 | **Bypassed symbol:**<br>Device bypasses VLD symbols, STB.H and EIDL when Loopback path is enabled. | | X | 5.6.3 | | | | |
| 2-53 | **CRC calculation:**<br>All packets are included 16bits CRC generated by the method described in Section 5.7.3.1. | X | X | 5.7.3.1 | | | | |
| 2-54 | **CRC calculation when PAD is included:**<br>If packet has PAD data (K23.7), its CRC is calculated including the PAD data. | X | X | 5.7.3.1 | | | | |
| 2-55 | **CRC transmission:**<br>The result of CRC16 shall be transmitted MSB first and then LSB. | X | X | 5.7.3.1 | | | | |
| 2-56 | **Scrambling of framed packets:**<br>Tx side scrambles framed packets as described in Section 5.7.4.1 and 5.7.4.2. | X | X | 5.7.4.1<br>5.7.4.2 | | | | |
| 2-57 | **Descrambling of framed packets:**<br>Rx side descrambles framed packets as described in Section 5.7.4.1 and 5.7.4.2. | X | X | 5.7.4.1<br>5.7.4.2 | | | | |
| 2-58 | **Descrambling of LSS:**<br>Rx side descrambles LSS as described in Section 5.7.4.1 and 5.7.4.4. | X | X | 5.7.4.1<br>5.7.4.4 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 2-59 | **Header Check during Control Packet Reception**<br>During Control Packet Reception, if errors detected during Header Check, Host and Device handle as ILLEGAL_HEADER_ERROR. | X | X | 5.8.3 | | | | |
| 2-60 | **Header Check during DATA Burst**<br>During receiving DATA Burst, if errors detected during Header Check, including the case when destination is other Device, Host and Device handle as ILLEGAL_HEADER_ERROR. | X | X | 5.8.4 | | | | |
| 2-61 | **PHY initialization for Boot Code Loading:**<br>If Host transmits BSYN instead of SYN in PHY initialization, Boot Code Loading takes place as described in Figure 5-47. | X | X | 5.2.9.3<br>5.9.1<br>6.3.1 | Host not supporting Boot Code Loading | | | |
| 2-62 | **Node ID of Host during Boot Code Loading:**<br>Node ID for Host is 0 during Boot Code Loading. | X | | 5.9.2 | Host not supporting Boot Code Loading | | | |
| 2-63 | **NP and TID for MSG and DATA during Boot Code Loading:**<br>NP is 1 and TID is 0 for all MSG and DATA packets during Boot Code Loading | X | X | 5.9.2 | Non-Boot Device<br>Host not supporting Boot Code Loading | | | |
| 2-64 | **Valid Transmission Gap in Active.Stream:**<br>Valid Transmission Gap is filled with DIDL in Active.Stream. | | X | 5.4.1<br>5.2.9.5 | | | | |

**Table 3-6 : Test List of LINK Layer Specification**

# TG3. CM-TRAN Layer Specification

For test items described in Table 3-7, NP is set to 1 for all packets. In other words, command transactions are based on UHS-II native protocol.

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-1 | **Packet Format of CCMD**<br>Host and Device shall follow the format of CCMD which is described in Figure 6-5, Figure 6-6, Figure 6-7 and Table 6-2. | X | X | 6.2.2.2 | | | | |
| 3-2 | **Packet Format of DCMD**<br>Host and Device shall follow the format of DCMD which is described in Figure 6-8, Figure 6-9 and Table 6-3. | X | X | 6.2.2.4 | | | | |
| 3-3 | **Packet Format of RES**<br>Host and Device shall follow the format of RES which is described in Figure 6-10, Figure 6-11, Figure 6-12, Figure 6-13 and Table 6-4. | X | X | 6.2.2.5<br>6.2.2.6 | | | | |
| 3-4 | **Packet Format of DATA)**<br>Host and Device shall follow the format of DATA which is described in Figure 6-14. | X | X | 6.2.2.7 | | | | |
| 3-5 | **PLEN of CCMD**<br>Host shall set PLEN in CCMD to specify the length of payload filed in CCMD or RES. The definition of PLEN is described in Table 6-2. | X | | 6.2.2.2<br>6.2.14.1 | | | | |
| 3-6 | **Response of P2P Read CCMD**<br>When Device accepts the read CCMD, the Device shall issue RES with NACK=0, CMD_ECHO_BACK and Payload to the Host. The sequence is illustrated in Figure 6-44. | | X | 6.1.1<br>6.2.2.5<br>6.2.14.1 | | | | |
| 3-7 | **Response of P2P Write CCMD**<br>When Device accepts the write CCMD, the Device shall issue RES with NACK=0 and CMD_ECHO_BACK to the Host. The sequence is illustrated in Figure 6-45. | | X | 6.1.1<br>6.2.2.5<br>6.2.14.1 | | | | |
| 3-8 | **Error Response(COND_ERR) of P2P CCMD**<br>When Device receives CCMD in any improper states defined in all layers, the Device shall issue RES with NACK=1 and ECODE=001b to the Host. The sequence is illustrated in Figure 6-52. | | X | 6.2.2.6<br>6.2.15.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-9 | **Error Response(ARG_ERR) of P2P CCMD**<br>When Device receives CCMD and at least one of parameters in any of Argument field, Extended Argument field, or Payload field is improper in it, the Device shall issue RES with NACK=1 and ECODE=010b to the Host. The sequence is illustrated in Figure 6-52. | | X | 6.2.2.6<br>6.2.15.1 | | | | |
| 3-10 | **Error Response(GEN_ERR) of P2P CCMD**<br>When Device receives CCMD and detects other errors not belonging to COND_ERR or ARG_ERR, the Device shall issue RES with NACK=1 and ECODE=011b to the Host. The sequence is illustrated in Figure 6-52. | | X | 6.2.2.6<br>6.2.15.1 | | | | |
| 3-11 | **Response of Broadcast CCMD**<br>Device shall process the broadcast CCMD though DID is not equal to its own Node ID, and transmit broadcast CCMD to the next node. Note that SID=DID=0 for UHS-II Addendum Ver1.02. | | X | 6.2.2.3 | | | | |
| 3-12 | **Error Response of Broadcast CCMD**<br>When Device detects some error from broadcast CCMD, the Device shall not transmit to the next node. The sequence is illustrated in Figure 6-56. | | X | 6.2.2.3<br>6.2.15.3 | | | | |
| 3-13 | **Function of DCMD**<br>When Host issues DCMD, DATA packets are transferred described in Figure 6-46, Figure 6-47, Figure 6-48 and Figure 6-49. | X | | 6.1.1<br>6.2.2.4<br>6.2.14.2 | SD-memory | | | |
| 3-14 | **Response of DCMD**<br>When Device accepts DCMD, the Device shall issue RES with NACK=0 and CMD_ECHO_BACK to the Host. The sequences are illustrated in Figure 6-46, Figure 6-47, Figure 6-48 and Figure 6-49. | | X | 6.1.1<br>6.2.2.5<br>6.2.14.2 | SD-memory | | | |
| 3-15 | **Error Response(COND_ERR) of DCMD**<br>When Device receives DCMD in any improper states defined in all layers, the Device shall issue RES with NACK=1 and ECODE=001b to the Host. The sequence is illustrated in Figure 6-53. | | X | 6.2.2.5<br>6.2.15.2 | SD-memory | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-16 | **Error Response(ARG_ERR) of DCMD**<br>When Device receives DCMD and at least one of parameters in any of Argument field, Extended Argument field, or Payload field is improper in it, the Device shall issue RES with NACK=1 and ECODE=010b to the Host. The sequence is illustrated in Figure 6-53. | | X | 6.2.2.6<br>6.2.15.2 | SD-memory | | | |
| 3-17 | **Error Response(GEN_ERR) of DCMD**<br>When Device receives DCMD and detects other errors not belonging to COND_ERR or ARG_ERR, the Device shall issue RES with NACK=1 and ECODE=011b to the Host. The sequence is illustrated in Figure 6-53. | | X | 6.2.2.6<br>6.2.15.2 | SD-memory | | | |
| 3-18 | **TMODE of DCMD for Device**<br>When the TMODE value in the DCMD packet is not available which is defined in Table 6-3, Device shall issue RES with NACK=1 and ECODE=010b (ARG_ERR). | | X | 6.2.2.4<br>6.2.2.6 | SD-memory | | | |
| 3-19 | **DM=1 of DCMD for Device**<br>When Device receives DCMD with DM=1 and does not support 2L-HD mode, the Device shall issue RES with NACK=1 and ECODE=010b (ARG_ERR). | | X | 6.2.2.4<br>6.2.2.6 | SD-memory or Device support 2L-HD mode | | | |
| 3-20 | **LM and TLEN of DCMD**<br>When Host sets LM to 1 in DCMD, the Host shall include TLEN field in the DCMD. | X | | 6.2.2.4 | SD-memory | | | |
| 3-21 | **Payload Length of DATA packet**<br>The length of payload in a DATA packet is equal to Block Length in Block Mode and TLEN in Byte Mode. | X | X | 6.1.1<br>6.2.2.7<br>6.2.8.2<br>6.2.9.2.6 | SD-memory | | | |
| 3-22 | **Data Transaction**<br>Host and Device shall follow Data Transactions which are illustrated in Figure 6-46, Figure 6-47, Figure 6-48, Figure 6-49, Figure 6-50 and Figure 6-51. | X | X | 6.1.1<br>6.2.14.2<br>6.2.14.3 | SD-memory | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-23 | **Fractional DATA Burst in LM=0**<br>If Device detects Fractional DATA Burst during Data Transfer in LM=0 and the data transfer length is not determined by another means, the Device regards it as FRAME_ERROR and transmit MSG (STAT) packet with RECOVERABLE_ERROR=error. The sequence is illustrated in Figure 6-57. | | X | 5.2.6.2<br>6.2.15.4 | SD-memory | | | |
| 3-24 | **Terminate Transaction by TRANS_ABORT CCMD**<br>When Device receives TRANS_ABORT CCMD, the Device shall terminate all transactions and updates "Status in TRANS_ABORT Register". | | X | 3.4.5<br>6.2.12<br>6.2.14<br>6.2.15 | | | | |
| 3-25 | **Recovery from Dormant State**<br>At the recovery sequence from Dormant State, if "Config Completion" is equal to 1, the Device shall transit to Active State without Configuration process. | | X | 6.2.3 | | | | |
| 3-26 | **Packet Format of GO_DORMANT_STATE CCMD**<br>Host and Device shall follow the format of GO_DORMANT_STATE CCMD which is described in Figure 6-17. | X | X | 6.2.4.1 | | | | |
| 3-27 | **Availability of Hibernate Mode**<br>If Device supports Hibernate Mode, "Supporting Hibernate Mode" shall be set to 1b, otherwise the fields shall be set to 0b. | | X | 6.2.4.1<br>6.2.9.2.2 | | | | |
| 3-28 | **Activation of Hibernate Mode**<br>Before Host uses Hibernate Mode, the Host shall inquire whether the Devices support Hibernate Mode. | X | | 6.2.4.2.1<br>6.2.4.2.2 | Host not supporting Hibernate Mode | | | |
| 3-29 | **Error Response of GO_DORMANT_STATE CCMD**<br>If Device is not supporting Hibernate mode (setting "Supporting Hibernate Mode" field in PHY Capabilities Register to 0) receives GO_DORMANT_STATE CCMD with HBR = 1, Device shall handle it as an illegal CMD. | | X | 6.2.4.1 | Device supporting Hibernate Mode | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-30 | **GO_DORMANT_STATE CCMD and FULL_RESET CCMD in Ring Connection**<br>In Ring connection, Host shall not use P2P GO_DORMANT_STATE CCMD and P2P FULL_RESET CCMD. | X | | 6.2.12 | Not Ring Connection | | | |
| 3-31 | **VDD1 On/Off Specification**<br>When Host turns off VDD1 during Hibernate Mode, the Host shall comply with the specification of VDD1 turning on/off process described in Figure 6-18, Figure 6-19, Figure 6-20, and the "power up" specification to ramp up VDD1. | X | | 6.2.4.2.1<br>6.2.4.2.2<br>6.2.4.2.3 | Host not supporting Hibernate Mode | | | |
| 3-32 | **Signal Output During Hibernate Mode**<br>During Hibernate Mode, D0, D1 and RCLK signals shall comply with DORMANT state specifications to avoid a situation in which the operating current is drawn through Lines. | X | X | 6.2.4.2.1 | Host and Device not supporting Hibernate Mode | | | |
| 3-33 | **Exit from Hibernate Mode**<br>Device which supports Hibernate Mode, shall recover from Hibernate Mode without Device Initialization, Enumeration and Configuration, even if VDD1 is turned off during Hibernate Mode.<br>At the recovery sequence from Dormant State, if "Config Completion" is equal to 1, Device shall transit to Active State without Configuration process. | | X | 6.2.3<br>6.2.4.2.3 | Device not supporting Hibernate Mode | | | |
| 3-34 | **Sequence of FULL_RESET CCMD**<br>After Device transmits the FULL_RESET CCMD or its RES to the next node, all state machines defined in this specification get back to the initial state, and in addition, all registers in all layers defined in this specification are reset to the initial value. | | X | 6.2.5 | | | | |
| 3-35 | **Packet Format of DEVICE_INIT CCMD**<br>Host and Device shall follow the format of DEVICE_INIT CCMD which is described in Figure 6-21. | X | X | 6.2.6.1 | | | | |
| 3-36 | **Acceptance of DEVICE_INIT CCMD**<br>When Device receives DEVICE_INIT CCMD in other than Config state, the Device shall regard it as an illegal CMD and shall not transmit to the next node. | | X | 6.2.6.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-37 | **Power limit during DEVICE_INIT**<br>Device shall support DCP=1. | | X | 6.2.6.2 | | | | |
| 3-38 | **Parameters related to DEVICE_INIT CCMD**<br>Device shall have the following two parameters in the Preset Registers, CDCP and GN. | | X | 6.2.6.2 | | | | |
| 3-39 | **Value of CDCP and GN**<br>If the Device is removable Device, CDCP and GN shall be set to 0h. | | X | 6.2.6.2<br>6.2.9.2.7 | Not Removable Device | | | |
| 3-40 | **Sequence of DEVICE_INIT CCMD for Device**<br>When Device receives DEVICE_INIT CCMD in Config state, the Device shall issue DEVICE_INIT CCMD to the next node according to the operation flow described in Figure 6-23. | | X | 6.2.6.2 | | | | |
| 3-41 | **Forward DEVICE_INIT CCMD at Starting Device Initialization**<br>When Device starts initialization by the command, it shall transmit the command to the next Node without waiting initialization completion of the Device. | | X | 6.2.6.2 | | | | |
| 3-42 | **Sequence of DEVICE_INIT CCMD for Host**<br>Host shall follow the sequence of DEVICE_INIT CCMD which is described in Figure 6-24 and Figure 6-25. | X | | 6.2.6.3 | | | | |
| 3-43 | **Packet Format of ENUMERATE CCMD**<br>Host and Device shall follow the format of ENUMERATE CCMD defined in Figure 6-28. | X | X | 6.2.7.1 | | | | |
| 3-44 | **Sequence of ENUMERATE CCMD for Device**<br>Device shall handle ENUMERATE CCMD and decide own Node ID with the sequence which described in Figure 6-29. | | X | 6.2.7.1 | | | | |
| 3-45 | **Acceptance of ENUMERATE CCMD**<br>When Device receives ENUMERATE CCMD in other than Config state, the Device shall regard it as an illegal CMD and shall not transmit to the next node. | | X | 6.2.7.1 | | | | |
| 3-46 | **Argument of ENUMERATE CCMD**<br>When Host issues ENUMERATE CCMD, ID_L shall be set to 0. | X | | 6.2.7.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-47 | **Packet Format of INQUIRY_CONFIG CCMD**<br>Host and Device shall regard broadcast CCMD read which targets Capabilities Registers as INQUIRY_CONFIG CCMD. The format of INQUIRY_CONFIG is described in Figure 6-35. | X | X | 6.2.8.3 | | | | |
| 3-48 | **Target of INQUIRY_CONFIG CCMD**<br>Device shall accept INQUIRY_CONFIG CCMD whose target is entirely within Capabilities registers (IOADDR=000h – 007h). Otherwise Device shall discard INQUIRY_CONFIG CCMD. | | X | 6.2.8.3 | | | | |
| 3-49 | **Parameter Selection of INQUIRY_CONFIG CCMD**<br>When Device receives INQUIRY_CONFIG CCMD, the Device shall select parameters with comparison conditions which defined in this Specification, and transmit INQUIRY_CONFIG CCMD to the next node. | | X | 6.2.8.3<br>6.2.9.2.1<br>6.2.9.2.2<br>6.2.9.2.3 | | | | |
| 3-50 | **Reserved Field Access of INQUIRY_CONFIG CCMD**<br>When Device receives INQUIRY_CONFIG CCMD, the Device shall select parameters from the payload of INQUIRY_CONFIG CCMD for Reserved field, and transmit INQUIRY_CONFIG CCMD to the next node. No operations take place for Reserved field. | | X | 6.2.8.3<br>6.2.9.2 | | | | |
| 3-51 | **Access to Reserved Area**<br>P2P CCMD Read: Device shall issue RES with NACK=0 and its Payload field corresponding to the reserved bit is set to 0.<br>P2P CCMD Write: Device shall issue RES with NACK=0 and value of reserved bit is not changed.<br>Broadcast CCMD Write: Device shall forward broadcast CCMD to the next node, and value of reserved bit is not changed. | | X | 6.2.1<br>D.1.1 | | | | |
| 3-52 | **Write Access to RO and HwInit Registers**<br>P2P CCMD Write: Device shall issue RES with NACK=0 and bit value of such register is not changed.<br>Broadcast CCMD Write: Device shall forward broadcast CCMD to the next node, and bit value such register is not changed. | | X | 6.2.9.2<br>D.1.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-53 | **Default values of RW Registers**<br>Registers whose attribute are RW except MAX_BLKLEN, N_FCU and MAX_RETRY_NUM shall be set to 0 when Power On or FULL_RESET is executed. MAX_BLKLEN, N_FCU and MAX_RETRY_NUM are set to 200h, 1h and 3h respectively. | | X | 5.9.2<br>6.2.5<br>6.2.9.2.6<br>D.1.2 | | | | |
| 3-54 | **Value of Device-specific Number of Lanes and Functionality**<br>If Device supports 2L-HD mode, bit 08 shall be '1'.<br>If Device supports 2D1U-FD mode, bit 09 shall be '1'.<br>If Device supports 1D2U-FD mode, bit 10 shall be '1'.<br>If Device supports 2D2U-FD mode, bit 11 shall be '1'. | | X | 6.2.9.2.1 | | | | |
| 3-55 | **Larger Value of PHY Major Revision**<br>Host shall accept Device with any PHY Major Revision. And Host shall use PHY functions which defined by minimum capability of PHY Major Revision. | X | | 6.2.9.2.2 | | | | |
| 3-56 | **Larger Value of LINK/TRAN Major Revision**<br>Host shall accept Device with any LINK/TRAN Major Revision. And Host shall use LINK/TRAN functions which defined by minimum capability of LINK/TRAN Major Revision. | X | | 6.2.9.2.3 | | | | |
| 3-57 | **Value of Device-specific MAX_BLKLEN**<br>In SD-memory, this field shall be set to 200h (512Bytes). | | X | 6.2.8.2<br>6.2.9.2.3 | Not SD-memory | | | |
| 3-58 | **Value of Device-specific N_FCU**<br>In SD-memory, this field shall be set to one of the following values: 01h, 02h, 04h, 08h, 10h, 20h, 40h or 80h. | | X | 6.2.9.2.3 | Not SD-memory | | | |
| 3-59 | **Acceptance of CCMD Write to Settings Registers**<br>When Device receives CCMD packet to write to IOADR=008h or 00Bh in Config State, the Device shall accept it.<br>When Device receives CCMD packet to write to IOADR=009h, 00Ah, 00Ch or 00Dh in Config or Active State, the Device shall accept it. | | X | 6.2.9.2.4<br>6.2.9.2.5<br>6.2.9.2.6 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-60 | **Error Response of CCMD Write to Settings Registers**<br>When Device receives CCMD packet to write to IOADR=008h or 00Bh in Active State, the Device shall response RES with NACK=1 and ECODE=001b (COND_ERR) or discard broadcast CCMD. These Settings Registers can be written in Config State only. | | X | 6.2.9.2.4<br>6.2.9.2.5 | | | | |
| 3-61 | **Write Settings Registers in Ring Connection**<br>In Ring connection, Host shall use broadcast CCMD to write Settings Registers (IOADR=009h, 00Ah or 00Bh). | X | | 5.2.9.4<br>6.2.8.1<br>6.2.9.2.4 | Not Ring Connection | | | |
| 3-62 | **Effective after exiting Dormant State**<br>When the following field is updated, they are effective after exiting Dormant State.<br>* Number of Lanes and Functionality (Generic Settings, IOADR=008h)<br>* Selected Transmission Speed Range (PHY Settings, IOADR=00Ah). | | X | 6.2.9.2.4<br>6.2.9.2.5 | | | | |
| 3-63 | **Effective in Active State**<br>When the following fields of Settings Registers are updated in Config State, they are effective in transiting to Active state.<br>* "Power Control Mode in Active.Control State" (Generic Settings, IOADR=008h)<br>* N_LSS_DIR (PHY Settings, IOADR=00Bh)<br>* N_LSS_SYN (PHY Settings, IOADR=00Bh) | | X | 6.2.9.2.4<br>6.2.9.2.5 | | | | |
| 3-64 | **Immediately Effective**<br>When the following fields of Setting Registers are updated, they are immediately effective.<br>* N_DATA_GAP (LINK/TRAN Settings, IOADR= 00Dh)<br>* MAX_RETRY_NUM (LINK/TRAN Settings, IOADR= 00Ch)<br>* N_FCU (LINK/TRAN Settings, IOADR= 00Ch) | | X | 6.2.9.2.6 | | | | |
| 3-65 | **Immediately Effective with No Application Specific Layers**<br>When the following field is updated, it is immediately effective in Active State if there are no application specific layers.<br>* MAX_BLKLEN (LINK/TRAN Settings, IOADR=00Bh) | | X | 6.2.8.2<br>6.2.9.2.6 | Supporting Application Specific Layer | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-66 | **Immediately Effective with Application Specific Layers**<br>With any application specific layers, the following field is not reflected immediately if it is written (updated) in Active State.<br>* MAX_BLKLEN (LINK/TRAN Settings, IOADR=00Bh) | | X | 6.2.8.2<br>6.2.9.2.6 | SD-memory or Not Supporting Application Specific Layer | | | |
| 3-67 | **Effective Period of Low Power Mode**<br>When "Power Control Mode in Active.Control State" field is 1b and "Config Completion" field is written by 1b in Config State, Device shall transmit EIDL after receiving EIDL.<br>When "Power Control Mode in Active.Control State" field is 1b and "Config Completion" field is written by 0b in Active State, Device shall keep Low Power Mode until entering Dormant State.<br>Because DLSM does not transit Active State to Config State immediately when Config Completion field is written by 0b excepting after Boot Code Loading. | | X | 5.4.1<br>6.2.8.1<br>6.2.9.2.4 | | | | |
| 3-68 | **Reset Power Control Mode**<br>When PHY Initialization is done by BSYN LSS, Device shall set "Power Control Mode in Active.Control State" to 0b. | | X | 6.2.9.2.4 | | | | |
| 3-69 | **Unsupported Value for Number of the Lanes and Functionality**<br>When Device receives CCMD to write with value which specifies to use no-support lanes settings, the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.4 | | | | |
| 3-70 | **Unsupported Value for N_LSS_DIR**<br>When Device receives CCMD to write with value which is smaller than "Device-specific Number of N_LSS_DIR", the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.5 | Device-specific N_LSS_DIR=1 | | | |
| 3-71 | **Unsupported Value for N_LSS_SYN**<br>When Device receives CCMD to write with value which is smaller than "Device-specific Number of N_LSS_SYN", the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.5 | Device-specific N_LSS_SYN=1 | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-72 | **Unsupported Value for Selected Transmission Range**<br>When Device receives CCMD to write with value which is neither 00b nor 01b, the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.5 | | | | |
| 3-73 | **Unsupported Value for N_DATA_GAP**<br>When Device receives CCMD to write with value which is smaller than "Device-specific Number of N_DATA_GAP", the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.6 | Device-specific N_DATA_GAP= 0 | | | |
| 3-74 | **Unsupported Value for MAX_BLKLEN in SD-Memory**<br>When Device receives CCMD to write with value which is not 200h, the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.8.2<br>6.2.9.2.6 | Not SD-memory | | | |
| 3-75 | **Unsupported Value for MAX_BLKLEN in not SD-Memory**<br>When Device receives CCMD to write with value which is larger than "Device-specific MAX_BLKLEN", the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.8.2<br>6.2.9.2.6 | SD-memory | | | |
| 3-76 | **Unsupported Value for N_FCU in SD-Memory**<br>When Device receives CCMD to write with value which is larger than "Device-specific N_FCU", or neither 01h, 02h, 04h, 08h, 10h, 20h, 40h nor 80h, the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD. | | X | 6.2.9.2.6 | Not SD-memory | | | |
| 3-77 | **Unsupported Value for N_FCU in not SD-Memory**<br>When Device receives CCMD to write with value which is larger than "Device-specific N_FCU" or makes the length of a DATA Burst larger than 64K bytes, the Device shall not update the field, and shall issue RES with NACK=1 or discard broadcast CCMD.<br>The length of a DATA Burst obtained by Block Length and N_FCU shall be smaller than or equal to 64K (65,536) bytes. | | X | 6.2.9.2.6 | SD-memory | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-78 | **Update Timing of Status in TRANS_ABORT Register (1)**<br>Field of TBSM, TPSM and TSSM are updated only when Device accepts TRANS_ABORT CCMD and reflected the last status of each state machine before accepting TRANS_ABORT CCMD. TBSM, TPSM and TSSM are defined in Section 6.2.13.1, Section 6.2.13.2 and Section 6.2.13.3 respectively. And after I/F power cycle or FULL_RESET, all bits in these fields are set to 0. | | X | 6.2.10<br>6.2.13.1<br>6.2.13.2<br>6.2.13.3 | | | | |
| 3-79 | **Update Timing of Status in TRANS_ABORT Register (2)**<br>Filed of RECOVERABLE_ERROR, RETRY_EXPIRE_ERROR, DEVICE_SPECIFIC_ERROR and ILLEGAL_HEADER_ERROR are updated when each error is detected and cleared after Device issues RES of the corresponding any P2P commands for the Device other than TRANS_ABORT. And after I/F power cycle or FULL_RESET, all bits in these fields are set to 0. | | X | 6.2.10 | | | | |
| 3-80 | **INT_REG Registers Support**<br>Device shall have the following registers: INT Enable and INT Status. | | X | 6.2.1<br>6.2.11 | SD-memory | | | |
| 3-81 | **Command Handling during Command Time Slot**<br>Device shall accept FULL_RESET, TRANS_ABORT and arbitrary read CCMD during Command Time Slot.<br>Command Time Slot is defined as follows<br>In case of read transaction:<br>Between RES transmission and FCRDY reception<br>Between STAT reception and FCRDY reception<br>In case of write transaction:<br>Between RES transmission and FCREQ reception<br>Between STAT transmission and FCREQ reception | | X | 5.5.2<br>6.2.13.4 | | | | |
| 3-82 | **Command Issuing during Command Time Slot**<br>Host shall not issue any commands to other Devices during Command Time Slot. | X | | 6.2.13.4 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-83 | **Waiting for Command Response during Command Time Slot**<br>After issuing read CCMD during CTS, the Host shall not transmit MSG(FCRDY) in read transaction nor transmit MSG(FCREQ) in write transaction before receiving RES accompanied with read CCMD. | X | | 6.2.13.4 | | | | |
| 3-84 | **Timing Rules during PHY Initialization**<br>In PHY Initialization, Device shall satisfy Teidl_stb, Tactivate and Tlidl_lidl as in Figure 6-58. The Values are defined in Table 6-25. | | X | 6.3.1 | | | | |
| 3-85 | **Timing Rules during Boot Code Loading**<br>After transmitting the first LIDL, Boot Device shall satisfy Tlidl_fcreq_boot as in Figure 6-58. The Value is defined in Table 6-25. | | X | 6.3.1 | Not Boot Device | | | |
| 3-86 | **Timing Rules during DEVICE_INIT**<br>In Device initialization process, Device shall satisfy Tfwd_init_cmd from DEVICE_INIT CCMD EOP reception on Device Rx to its SOP transmission on Device Tx. The Value is defined in Table 6-25. | | X | 6.3.1 | | | | |
| 3-87 | **Timing Rules for Command and Response**<br>On receiving P2P CCMD or DCMD, Device shall satisfy Tcmd_res as in Figure 6-59. The Value is defined in Table 6-25. | | X | 6.3.1 | | | | |
| 3-88 | **Timing Rules for Broadcast CCMD**<br>On receiving broadcast CCMD (except DEVICE_INIT), Device shall satisfy Tfwd_bcmd as in Figure 6-58. The Value is defined in Table 6-25. | | X | 6.3.1 | | | | |
| 3-89 | **Timing Rules for Data Transaction**<br>In Data Burst, Device shall satisfy Tfcrdy_edb and Tedb_stat as in Figure 6-59. The Value is defined in Table 6-25. | | X | 6.3.1 | | | | |
| 3-90 | **Timing Rules for Data Transaction related to Application Layer**<br>In Data Burst, Device shall satisfy Tres_fcreq(r), Tstat_fcreq(r) and Tfcreq_fcrdy(w) as in Figure 6-59. The Value is defined in application specific layer. | | X | 6.3.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 3-91 | **Initiator Operation of Reserved Bits in the Packet**<br>Initiator shall be set to '0' for Reserved bits other than in CMD_ECHO_BACK field. | X | X | 6.2.2.8 | | | | |
| 3-92 | **Device Operation of Reserved Bits in the Packet When Bypassing Control Packet**<br>When Device bypasses a control packet, Device shall ignore Reserved bits upon reception, and shall not set or clear them upon transmission. | | X | 6.2.2.8 | | | | |
| 3-93 | **Device Operation of Reserved Bits in the Packet When Handling Broadcast Packet**<br>When Device handles a broadcast packet, Device shall ignore Reserved bits upon reception, and shall not set or clear them upon transmission. | | X | 6.2.2.8 | | | | |

**Table 3-7 : Test List of CM-TRAN Specification**

# TG4. SD-TRAN Specification

For test items described in Table 3-8, NP in the packet of SD CMDs and their associated RES and DATA is set to 0. In other words, command transactions are based on SD-TRAN specification.

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-1 | **CCMD Format:**<br>Verify that the CCMD structure for the following command is as defined in Figure 7-4. List of CCMD in SD-TRAN: CMD0, CMD2, CMD3, CMD7, CMD8, CMD9, CMD10, CMD12, CMD13, CMD16, CMD20, CMD32, CMD33, CMD38, ACMD23, ACMD41 and ACMD38. | X | X | 7.2.1.1 | CMD20 is optional | | | |
| 4-2 | **DCMD Format:**<br>Verify that the DCMD structure for the following command is as defined in Figure 7-5. List of DCMD in SD-TRAN: CMD17, CMD18, CMD24, CMD25, CMD27, CMD42, CMD56, CMD6, ACMD13, ACMD22, ACMD51, ACMD45, ACMD46, ACMD47, ACMD48, ACMD18, ACMD25, ACMD43, ACMD44 and ACMD26<br>Host may set DM to 1 for DCMD which supports multi-block read / write regardless of data transfer length (e.g. CMD25, CMD18, ACMD25 and ACMD18). Otherwise, it shall not set DM to 1. These rules are also applied to other multi-block read / write commands defined in other Part of SD specifications. LM is alternative only for CMD18 and 25, and it shall be set to 0 for other DCMDs. | X | X | 7.2.1.2 | | | | |
| 4-3 | **RES Format:**<br>Verify that RES Format structure for CCMD and DCMD is as defined Figure 7-6, Figure 7-7 and Figure 7-8. | X | X | 7.2.1.3 | | | | |
| 4-4 | **RES With NACK=1 Format:**<br>Verify that RES with NACK=1 and ECODE shall be set to 001b in SD-TRAN Format structure is as defined Figure 7-9. | X | X | 7.2.1.4 | | | | |
| 4-5 | **DATA Payload Format:**<br>Verify that DATA Payload Format structure is as defined Figure 7-10. | X | X | 7.2.1.5 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-6 | **Application commands:**<br>Application commands shall be realized in one command by setting APP field to 1b in CCMD or DCMD. Check that the card distinguishes app command from regular commands. | | X | 7.2.1.6 | | | | |
| 4-7 | **Unsupported SD Commands in UHS-II mode:**<br>The UHS-II Card shall treat following commands as illegal command: CMD4, CMD11, CMD15, CMD19, CMD28, CMD29, CMD30, ACMD6, ACMD42 and ACMD55. | | X | 7.2.1.6<br>7.2.1.7<br>(Part 1<br>4.7.5) | | | | |
| 4-8 | **Ignored commands:**<br>The UHS-II Card is not affected by the following commands: CMD23 and CMD55. These commands are not executed in any card state, and response is returned (response type is up to implementation). | | X | 7.2.1.7<br>(Part 1<br>4.7.5) | | | | |
| 4-9 | **Multi-block Read/Write Command**<br>DATA Bursts accompanied by CMD18 and CMD25 shall follow the DATA Burst framing rule in Block Mode described in Section 5.2.6.2.1. The Block Length shall be 512 bytes. | X | X | 7.2.2.1<br>5.2.6.2.1 | | | | |
| 4-10 | **CMD42:**<br>DATA Burst accompanied by CMD42 shall follow the DATA Burst framing rule in Byte Mode in Section 5.2.6.2.2. The payload length of DATA shall be equal to the block length set by CMD16 (regulated in Legacy SD specification). If block length set by CMD16 is odd, Host shall insert one PAD (K23.7) at the end of DATA Packet in order to make the length of Framed DATA Packet even bytes. | X | X | 7.2.2.2<br>5.2.6.2.2 | | | | |
| 4-11 | **Other DCMD on SD-TRAN**<br>DATA Bursts shall follow the DATA Burst framing rule in Byte Mode described in Section 5.2.6.2.2. The payload length of DATA depends on the Legacy SD specification. The relevant DCMDs are CMD6, ACMD22, CMD27, ACMD13 and ACMD51. | X | X | 7.2.2.3<br>5.2.6.2.2 | | | | |
| 4-12 | **UHS-II Card initialization after Power up:**<br>After power up, the UHS-II Card shall be initialized according to Figure 7-11. | X | X | 7.2.3.2 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-13 | **UHS-II Card initialization after FULL_RESET or GO_DORMANT_STATE:**<br>After FULL_RESET or GO_DORMANT_STATE, the UHS-II Card shall be initialized according to Figure 7-12. | X | X | 7.2.3.3 | | | | |
| 4-14 | **UHS-II Card initialization after FULL_RESET or GO_DORMANT_STATE:**<br>Host shall not select Legacy SD interface after issuing FULL_RESET or GO_DORMANT_STATE. | X | | 7.2.3.3 | | | | |
| 4-15 | **Card Identification Mode:**<br>The UHS-II Card shall be identified using legacy encapsulated SD commands according to Figure 7-14.<br>The RCA returned in response of encapsulated CMD3 shall be the same as Device ID. | X | X | 7.2.4.1 | | | | |
| 4-16 | **IDLE state commands:**<br>The Card shall accept the following commands according to its state in SD-TRAN Mode:<br>FULL_RESET, GO_DORMANT_STATE, CMD0, ACMD41, CMD8, TRANS_ABORT, Native Write CCMD and Native Read CCMD. | | X | 7.2.4.1 | | | | |
| 4-17 | **READY state commands:**<br>The Card shall accept the following commands according to its state in SD-TRAN Mode:<br>FULL_RESET, GO_DORMANT_STATE, CMD0, CMD2, TRANS_ABORT, Native Write CCMD and Native Read CCMD. | | X | 7.2.4.1 | | | | |
| 4-18 | **IDENT state commands:**<br>The Card shall accept the following commands according to its state in SD-TRAN Mode:<br>FULL_RESET, GO_DORMANT_STATE, CMD0, CMD3, TRANS_ABORT, Native Write CCMD and Native Read CCMD. | | X | 7.2.4.1 | | | | |
| 4-19 | **Illegal command in any state:**<br>If Device receives illegal command, Device shall return RES with NACK = 1. | | X | 7.2.4.2 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-20 | **STBY state commands:**<br>The Card shall accept the following commands according to its state in SD-TRAN Mode:<br>FULL_RESET, GO_DORMANT_STATE, CMD0, CMD3, CMD7, CMD9, CMD10, CMD13, TRANS_ABORT, Native Write CCMD, Native Read CCMD. | | X | 7.2.4.2 | | | | |
| 4-21 | **TRAN state commands:**<br>The Card shall accept the following commands according to its state in SD-TRAN Mode:<br>CMD0, CMD6, CMD7, CMD13, CMD16, CMD17, CMD18, CMD20, CMD24, CMD25, CMD27, CMD32, CMD33, CMD38, CMD42, CMD56(r), CMD56(w), ACMD13, ACMD22, ACMD23, ACMD51, FULL_RESET, GO_DORMANT_STATE, TRANS_ABORT, Native Write CCMD and Native Read CCMD. | | X | 7.2.4.2 | | | | |
| 4-22 | **CCMD Sequence**<br>The CCMD headers ([CCMD], [RES]) values shall be according to the definition in section 7.2.5.1.<br>Device shall notice the end of busy period to Host by issuing MSG packets as described in Figure 7-23 when RES type is R1b. | X | X | 7.2.5.1 | | | | |
| 4-23 | **Read DCMD (Fixed Transfer Length)**<br>When read DCMD with fixed transfer length is issued with a valid address and length, all data payloads are read. Host is not required to issue CMD12 to terminate the data transmission as shown in Figure 7-17. Device shall notice the end of busy period to Host by issuing MSG packets as described in Figure 7-26. | X | X | 7.2.5.2<br>7.2.6.3 | | | | |
| 4-24 | **Read DCMD (Infinite Transfer Length):**<br>When Read DCMD (Infinite Transfer Length) is issued with a valid address, data payloads are read until the transfer shall be interrupted by a STOP_TRANSMISSION (CMD12). Device shall notice the end of busy period to Host by issuing MSG packets as described in Figure 7-27. | X | X | 7.2.5.3<br>7.2.6.3 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-25 | **Write DCMD (Fixed Transfer Length)**<br>When write DCMD with fixed transfer length is issued with a valid address and length, all data payloads are sent. Host is not required to issue CMD12 to terminate the data transmission as shown in Figure 7-19. Device shall notice the end of busy period to Host by issuing MSG packets as described in Figure 7-24. | X | X | 7.2.5.4<br>7.2.6.3 | | | | |
| 4-26 | **Write DCMD (Infinite Transfer Length):**<br>When Write DCMD (Infinite Transfer Length) is issued with a valid address, data payloads are written until the transfer shall be interrupted by a STOP_TRANSMISSION (CMD12). Device shall notice the end of busy period to Host by issuing MSG packets as described in Figure 7-25. | X | X | 7.2.5.5<br>7.2.6.3 | | | | |
| 4-27 | **Application Specific MSG**<br>Host and Device shall follow the format of application specific MSG which is described in Table 7-3 and Table 7-4. | X | X | 7.2.6.1 | | | | |
| 4-28 | **CMD0:**<br>After CMD0 is issued, the Card shall move to idle state. Device shall transmit RES without payload to Host before CMD0 operation.<br>Also in case of read transaction, if Device receives CMD0 during the time period from transmitting FCREQ to receiving FCRDY, TPSM shall transit from TP_C_WAIT to TP_IDLE and DLSM shall transit from Active. Trans.WaitRDY to Active. Control at the transmission of RES of CMD0. | | X | 7.2.6.2 | | | | |
| 4-29 | **CMD7:**<br>When CMD7 for de-selection is received, device shall transmit RES without payload to Host. | | X | 7.2.6.2 | | | | |
| 4-30 | **CMD18 or CMD25 termination:**<br>During the transaction of CMD18 or CMD25, Device shall terminate the transaction when it receives CMD12 with any TID. | | X | 7.2.6.4 | | | | |
| 4-31 | **End of User Data Area Error in write operation:**<br>In case that the host accidently sends DATA packets beyond the user data area the DATA packets after the end of User Data Area are not written. | | X | 7.2.8.4 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-32 | **Read busy timeout:**<br>Tres_fcreq(r) and Tstat_fcreq(r) timeout values for SD-memory Card shall be applied the value defined in Section 4.6.2.1 of "SD Specifications Part 1 Physical Layer Specification Version 4.10". | | X | 7.3.1 | | | | |
| 4-33 | **Write busy timeout:**<br>During Device write operation, Device shall satisfy Tfcreq_fcrdy(w) from FCREQ EOP reception to FCRDY SOP issuing in write transaction. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-34 | **Read busy timing:**<br>During Device read operation, Device shall satisfy Tr_stat_ebsy from MSG (STAT) EOP transmission to MSG (EBSY) SOP issuing in case of read operation. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-35 | **Write busy timing:**<br>During device write operation, Device shall satisfy Tw_stat_ebsy from MSG (STAT) EOP reception to MSG (EBSY) SOP issuing in case of write operation. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-36 | **Read response busy timing:**<br>After read busy response, Device shall satisfy Tr_res_ebsy from RES (R1b) EOP reception to MSG (EBSY) SOP issuing in case of read operation. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-37 | **Write response busy timing:**<br>After write busy response, Device shall satisfy Tw_res_ebsy from RES (R1b) EOP reception to MSG (EBSY) SOP issuing in case of write operation. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-38 | **Erase response busy timing:**<br>After erase busy response, Device shall satisfy Te_res_ebsy from RES (R1b) EOP reception to MSG (EBSY) SOP issuing in case of erase operation. The Value is defined in Table 7-5. | | X | 7.3.1 | | | | |
| 4-39 | **TMODE of DCMD for Device**<br>When the TMODE value in the DCMD packet is not available which is defined in Table 6-3 and Section 7.2.1.2, Device shall issue RES with NACK=1 and ECODE=001b. | | X | 6.2.2.4<br>7.2.1.2<br>7.2.1.4 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 4-40 | **DM=1 of DCMD for Device**<br>When Device receives DCMD with DM=1 and does not support 2L-HD mode, the Device shall issue RES with NACK=1 and ECODE=001b. | | X | 7.2.1.2 | Device support 2L-HD mode | | | |
| 4-41 | **LM and TLEN of DCMD (CMD18 or CMD25)**<br>When Host sets LM to 1 and NP to 0 in DCMD (CMD18 or CMD25), the Host shall include TLEN field in the DCMD. | X | | 6.2.2.4<br>7.2.1.2 | | | | |
| 4-42 | **Payload Length of DATA packet**<br>The length of payload in a DATA packet is equal to Block Length in Block Mode for NP=0. Only 512bytes Block Length is available in case of SD-memory. | X | X | 6.1.1<br>6.2.2.7<br>6.2.8.2<br>6.2.9.2.6<br>7.2.2.1 | | | | |
| 4-43 | **Fractional DATA Burst in LM=0 in SD-TRAN**<br>If Device detects Fractional DATA Burst during Data Transfer in LM=0 and NP=0 and the data transfer length is not determined by another means, the Device regards it as FRAME_ERROR and transmit MSG (STAT) packet with RECOVERABLE_ERROR=error. | | X | 5.2.6.2<br>6.2.15.4<br>7.2.2.1 | | | | |

**Table 3-8 : Test List of SD-TRAN Specification**

# TG5. 2L-HD Mode (Optional)

All test items may not be done if Host or Device does not support 2L-HD mode. Thus there are no descriptions for such Host or Device in "Omission Condition" of Table 3-9.
Variable 'n' denotes a non-negative integer.

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 5-1 | **Framed DATA Packet in Block Mode:** When Payload length is 4 * n (n ≠ 0), Framed DATA packet in Block Mode shall be constructed as described in Figure 8-2. | X | X | 8.3.1.1 | | | | |
| 5-2 | **Framed DATA Packet in Block Mode:** When Payload length is 4 * n + 1, Framed DATA packet in Block Mode shall be constructed as described in Figure 8-3 [a]. | X | X | 8.3.1.1 | SD-memory | | | |
| 5-3 | **Framed DATA Packet in Block Mode:** When Payload length is 4 * n + 2, Framed DATA packet in Block Mode shall be constructed as described in Figure 8-3 [b]. | X | X | 8.3.1.1 | SD-memory | | | |
| 5-4 | **Framed DATA Packet in Block Mode:** When Payload length is 4 * n + 3, Framed DATA packet in Block Mode shall be constructed as described in Figure 8-3 [c]. | X | X | 8.3.1.1 | SD-memory | | | |
| 5-5 | **Even Framed DATA packet:** Even Framed DATA packet is transmitted through the Direction Fixed Lane (DFL) within a transaction of 2L-HD mode. | X | X | 8.3.1.1 | | | | |
| 5-6 | **Odd Framed DATA packet:** Odd Framed DATA packet is transmitted through the Direction Switched Lane (DSL) within a transaction of 2L-HD mode. | X | X | 8.3.1.1 | | | | |
| 5-7 | **DATA Burst Framing in Block Mode:** DATA Burst in Block Mode shall be constructed as described in Figure 8-4. | X | X | 8.3.1.1 | | | | |
| 5-8 | **Byte Mode in 2L-HD mode:** Device returns RES with NACK = 1 if DCMD with DM = 1 and TLUM = 1. | | X | 8.3.1.2 | | | | |
| 5-9 | **Duplex mode switching:** Duplex mode switching from FD mode to 2L-HD mode in read transaction takes place as described in Figure 8-5 and Figure 8-8. | X | X | 8.3.2<br>8.3.4.1<br>8.6 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 5-10 | **Duplex mode switching:**<br>Duplex mode switching from 2L-HD mode to FD mode in read transaction takes place as described in Figure 8-5 and Figure 8-9. | X | X | 8.3.2<br>8.3.4.1<br>8.6 | | | | |
| 5-11 | **Duplex mode switching:**<br>Duplex mode switching from FD mode to 2L-HD mode in write transaction takes place as described in Figure 8-6 and Figure 8-10. | X | X | 8.3.2<br>8.3.4.2<br>8.6 | | | | |
| 5-12 | **Duplex mode switching:**<br>Duplex mode switching from 2L-HD mode to FD mode in write transaction takes place as described in Figure 8-6 and Figure 8-11. | X | X | 8.3.2<br>8.3.4.2<br>8.6 | | | | |

**Table 3-9 : Test List of 2L-HD Mode**

# TG6. Additional Lanes Support (Optional)

These test items are for Hosts or Devices that support at least one of the following optional modes:

a. 2D1U-FD Full Duplex with 2 Downstream and 1 Upstream Lanes
b. 1D2U-FD Full Duplex with 1 Downstream and 2 Upstream Lanes
c. 2D2U-FD Full Duplex with 2 Downstream and 2 Upstream Lanes

Thus there are no descriptions for Host or Device not supporting all of a. b. and c. above in "Omission Condition" of Table 3-10.

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 6-1 | **Configuring Number of Lanes and Functionality**<br>Using SET_COMMON_CONFIG CCMD to configure each one of the supported additional lanes modes (bits 11-08 in Generic Settings Register). | X | X | 6.2.9.2.4 | | | | |
| 6-2 | **Activating Additional Lanes through GO_DORMANT_STATE command**<br>Additional lanes are activated only after exiting from DORMANT state as shown in Figure 9-14. The host sends STB.L on D0 (1D2U-FD) or on D0 and D2 (2D2U-FD) and the device responds with STB.L on D1 (2D1U-FD) or D1 and D3 (2D2U-FD). | X | X | 9.4.1 | | | | |
| 6-3 | **Framing Rule in 2D1U-FD and 2D2U-FD write command:**<br>Write operation as shown in Figure 9-7 shall comply with framing rules as in 2L-HD as explained in 8.3.1.1. Note that even bytes are carried on D0 and odd bytes are carried on D2<br><br>Payload Length / Construction Model<br>4 * n (n ≠ 0) / Figure 8-2<br>4 * n + 1 / Figure 8-3 [a]<br>4 * n + 2 / Figure 8-3 [b]<br>4 * n + 3 / Figure 8-3 [c] | X | X | 9.3.1<br>8.3.1.1 | | | | |

| No. | Test Item | Target | | Section Number | Omission Condition | Test Tools | Result | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Host | Device | | | | | |
| 6-4 | **Framing Rule in 1D2U-FD and 2D2U-FD read command:**<br>Read operation as shown in Figure 9-6 shall comply with framing rules as in 2L-HD as explained in 8.3.1.1. Note that even bytes are carried on D1 and odd bytes are carried on D3.<br><br>Payload Length / Construction Model<br>4 * n (n ≠ 0) / Figure 8-2<br>4 * n + 1 / Figure 8-3 [a]<br>4 * n + 2 / Figure 8-3 [b]<br>4 * n + 3 / Figure 8-3 [c] | X | X | 9.3.1<br>8.3.1.1 | | | | |
| 6-5 | **Read transaction for 1D2U-FD or 2D2U-FD – Fast Mode**<br>Read transaction is performed as described in Figure 9-9. | X | X | 9.3.3 | | | | |
| 6-6 | **Read transaction for 1D2U-FD or 2D2U-FD – Low Power Mode**<br>Read transaction is performed as described in Figure 9-10. | X | X | 9.3.4 | | | | |
| 6-7 | **Write transaction for 2D1U-FD or 2D2U-FD – Fast Mode**<br>Write transaction is performed as described in Figure 9-11. | X | X | 9.3.5 | | | | |
| 6-8 | **Write transaction for 2D1U-FD or 2D2U-FD – Low Power Mode**<br>Write transaction is performed as described in Figure 9-12. | X | X | 9.3.6 | | | | |

**Table 3-10 : Test List of Additional Lanes Support**

# Form 4: Test Coverage Table

**Name of the Test Guideline:** UHS-II Protocol Test Guideline Version 1.00

| | TG1 | TG2 | TG3 | TG4 | TG5 | TG6 |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| 21 | | | | | | |
| 22 | | | | | | |
| 23 | | | | | | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |
| 31 | | | | | | |
| 32 | | | | | | |
| 33 | | | | | | |
| 34 | | | | | | |
| 35 | | | | | | |
| 36 | | | | | | |
| 37 | | | | | | |
| 38 | | | | | | |
| 39 | | | | | | |
| 40 | | | | | | |
| 41 | | | | | | |
| 42 | | | | | | |
| 43 | | | | | | |
| 44 | | | | | | |
| 45 | | | | | | |

| | TG1 | TG2 | TG3 | TG4 | TG5 | TG6 |
|---|---|---|---|---|---|---|
| 46 | | | | | | |
| 47 | | | | | | |
| 48 | | | | | | |
| 49 | | | | | | |
| 50 | | | | | | |
| 51 | | | | | | |
| 52 | | | | | | |
| 53 | | | | | | |
| 54 | | | | | | |
| 55 | | | | | | |
| 56 | | | | | | |
| 57 | | | | | | |
| 58 | | | | | | |
| 59 | | | | | | |
| 60 | | | | | | |
| 61 | | | | | | |
| 62 | | | | | | |
| 63 | | | | | | |
| 64 | | | | | | |
| 65 | | | | | | |
| 66 | | | | | | |
| 67 | | | | | | |
| 68 | | | | | | |
| 69 | | | | | | |
| 70 | | | | | | |
| 71 | | | | | | |
| 72 | | | | | | |
| 73 | | | | | | |
| 74 | | | | | | |
| 75 | | | | | | |
| 76 | | | | | | |
| 77 | | | | | | |
| 78 | | | | | | |
| 79 | | | | | | |
| 80 | | | | | | |
| 81 | | | | | | |
| 82 | | | | | | |
| 83 | | | | | | |
| 84 | | | | | | |
| 85 | | | | | | |
| 86 | | | | | | |
| 87 | | | | | | |
| 88 | | | | | | |
| 89 | | | | | | |
| 90 | | | | | | |
| 91 | | | | | | |
| 92 | | | | | | |
| 93 | | | | | | |

**Table 3-11 : Test Coverage Table for Device**

| | TG1 | TG2 | TG3 | TG4 | TG5 | TG6 |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | | | | | | |
| 19 | | | | | | |
| 20 | | | | | | |
| 21 | | | | | | |
| 22 | | | | | | |
| 23 | | | | | | |
| 24 | | | | | | |
| 25 | | | | | | |
| 26 | | | | | | |
| 27 | | | | | | |
| 28 | | | | | | |
| 29 | | | | | | |
| 30 | | | | | | |
| 31 | | | | | | |
| 32 | | | | | | |
| 33 | | | | | | |
| 34 | | | | | | |
| 35 | | | | | | |
| 36 | | | | | | |
| 37 | | | | | | |
| 38 | | | | | | |
| 39 | | | | | | |
| 40 | | | | | | |
| 41 | | | | | | |
| 42 | | | | | | |
| 43 | | | | | | |
| 44 | | | | | | |
| 45 | | | | | | |
| 46 | | | | | | |
| 47 | | | | | | |
| 48 | | | | | | |
| 49 | | | | | | |

| | TG1 | TG2 | TG3 | TG4 | TG5 | TG6 |
|---|---|---|---|---|---|---|
| 50 | | | | | | |
| 51 | | | | | | |
| 52 | | | | | | |
| 53 | | | | | | |
| 54 | | | | | | |
| 55 | | | | | | |
| 56 | | | | | | |
| 57 | | | | | | |
| 58 | | | | | | |
| 59 | | | | | | |
| 60 | | | | | | |
| 61 | | | | | | |
| 62 | | | | | | |
| 63 | | | | | | |
| 64 | | | | | | |
| 65 | | | | | | |
| 66 | | | | | | |
| 67 | | | | | | |
| 68 | | | | | | |
| 69 | | | | | | |
| 70 | | | | | | |
| 71 | | | | | | |
| 72 | | | | | | |
| 73 | | | | | | |
| 74 | | | | | | |
| 75 | | | | | | |
| 76 | | | | | | |
| 77 | | | | | | |
| 78 | | | | | | |
| 79 | | | | | | |
| 80 | | | | | | |
| 81 | | | | | | |
| 82 | | | | | | |
| 83 | | | | | | |
| 84 | | | | | | |
| 85 | | | | | | |
| 86 | | | | | | |
| 87 | | | | | | |
| 88 | | | | | | |
| 89 | | | | | | |
| 90 | | | | | | |
| 91 | | | | | | |
| 92 | | | | | | |
| 93 | | | | | | |
| ..... | | | | | | |

**Table 3-12 : Test Coverage Table for Host**

# The Construction of Coverage Table (Form 4)

Form 4 consists of a table that contains a matrix of Test Groups (columns) and Test Numbers (lines) that correspond to Form 3. The intersection of a column and a line specifies one Test Item.
Each Test Item is color-coded:

a) Blank boxes indicate that the referenced Test Item does not exist;
b) Gray boxes indicate that the referenced Test Item had been defined in an earlier version of Test Guideline; and
c) Purple boxes indicate that the referenced Test Item had been added in the latest version.

The first version does not use purple, and purple boxes will be changed to gray boxes on version up of the Test Guideline.

There are three possible entries to be filled in by the Test Tool provider:

a) No letter
   In case of Function Tests that are applicable to actual products, how to test is conceivable and expectation is obvious by the Normative Specification. The result of Function Test shall be stable for defined condition ranges. Then, test method and test conditions may not be described in the Test Guideline. Test Tool provider should consider reducing combination of test conditions to simplify test. It is intended that Function Test is executed in Level-1 Mode and how to implement test is entrusted to Test Tool provider.
   The other tests that are not applicable to actual products may not be supported by Test Tools and Test Equipment. Such Test Items should be checked by self-verification.
b) "L1"
   This test is intended to be executed in Level-1 Mode (may be executed in Level-2 Mode). This test is called as "Prescribed Test Item for Level-1" and its test requirements are described in Chapter 3.
c) "L2"
   This test is intended to be executed in Level-2 Mode. This test is called as "Prescribed Test Item for Level-2" and its test requirements are described in Chapter 3.

Examples of Cell Colors and Letters

| | |
|---|---|
| | Blank box means Test Item does not exist |
| | Gray box means Test Item defined in the first version or previous versions |
| | Purple box means Test Item added from this version up |
| L1 | "L1" indicates the Prescribed Test Item for Level-1 |
| L2 | "L2" indicates the Prescribed Test Item for Level-2 |

# Modification of Coverage Table for Test Tool Information

Test Tools and Test Equipment provider copies Form 4 to indicate Test Tools Coverage and add it in the Test Tool Information. Test Tool provider modifies colors and letters in boxes as follows:

a) No Letter
   If Test Equipment can support the Test Item in Level-1 Mode, the box is changed to green. Otherwise, keeps gray box to indicate the Test Item is not supported.

b) "L1"
   If Test Equipment can support the Test Item in Level-1 Mode, the box is changed to green and "L1" is indicated in the box. If Test Equipment can support the Test Item in Level-2 Mode instead of Level-1 Mode, the box is changed to green and "L2" is indicated in the box. If "waiver" is taken to implement the test, yellow is indicated instead of green (Refer to 1.6.4).

c) "L2"
   If Test Equipment can support the Test Item in Level-2 Mode, the box is changed to green and "L2" is indicated. If "waiver" is taken to implement the test, yellow is indicated instead of green (Refer to 1.6.4).

Test Tool provider can add a note to a Test Item. A note number with parentheses (n) in a box indicates existence of a note. Note(n): Descriptions are to be provided below the table.

Examples of Cell Colors and Letters

| | |
|---|---|
| | Blank box means Test Item does not exist |
| | Gray box means Test Item exists and is not supported |
| | Green box means Test Item covered by this Test Tools or Test Equipment |
| | Yellow box means Test Item supported under specific conditions (waiver) |
| L1, (n) | Example of letters indicated in a box. "n" is a number. |

Note(n): Descriptions of note(n).