FeliCa Reader/Writer RF Performance Certification Specification

Version 1.52
August 1, 2022

Japan Electronic-money Promotion Association

Revision History

Version No.	Date issued	Description of Revisions
1.0	April 16, 2013	First edition
1.1	May 21, 2013	The basic performance card was changed to RC-S888.
1.2	November 1, 2013	Termination of Registration of Products for the Interoperability Test
1.3	November 1, 2014	・Changes were made to Section 3.3, *Application Classes*, and Section 3.5, *Addition of Product Models*. ・A measurement method when measurement is impossible at the specified center point was added to Section 6.3, *Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Card/Mobile Phone Used for the Test*. ・A measurement method and pass criteria when measurement is impossible with the specified offset and height were added to Section 6.5, *M-Class Pass Criteria* and Section 6.6, *S-Class Pass Criteria*. ・Product samples used for the basic performance test and for the interoperability test are described specifically.
1.4	March 1, 2015	・Change was made to Section 6.6.1 *Basic Performance Test* of 6.6, *S-Class Pass Criteria*. The maximum communication distance was changed.
1.41	March 1, 2016	・According to the change of Application
1.42	November 1, 2016	・Change of the Ownership of the Certification body. ・Change of the Cards Used for the Basic Performance Test ・Manuals were added to the Materials to be submitted
1.43	June 1, 2017	・Change was made to Section 3.4,3.5 and 3.6. ・Section 3.7 was added.
1.44	Dec.15, 2017	Section 4 Add Digital protocol requirements check sheet
1.45	July 1, 2019	According to the Change of Application
1.46	September 1, 2019	According to the Change of Application
1.47	September 1, 2020	According to the Change of Application
1.5	April 1,2021	・Add the contents of "4 Application" ・Add the contents of "6.4 Communication Performance Measurement Software"
1.51	August 1,2021	・Add measurement center point for mobile products in "5.3 Definitions of Terms Related to the Testing Method" ・Add the time required for 100 times Polling commands and mobile-device to "6.4.3 Requirements: Polling Command Execution"
1.52	August 1,2022	・Add the explanation in Section 6.4.2 Requirements: Software Formats ・Clarify the contents of Section 6.5.1 Basic Performance Test ・Clarify the contents of Section 6.5.2 Interoperability Test ・Clarify the contents of Section 6.6.1 Basic Performance Test ・Clarify the contents of Section 6.6.2 Interoperability Test

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Preface

This document outlines the FeliCa reader/writer RF performance certification test (abbreviated to *certification test* hereafter) that is conducted for FeliCa-capable reader/writers.

The certification test verifies only the RF performance of the reader/writer products, and excludes protocols and other performance factors from testing.

The following chapters specify the contents, methodology, and evaluation criteria, as well as the test environment and test procedures, of the reader/writer RF performance certification test.

The details of this test are specified based on the results of the discussions in Japan Electronic-money Promotion Association.

1. Purpose of the Certification Test

The purpose of the certification test is to create an environment in which service providers and end users feel secure and have a positive experience with services that use FeliCa technology. To that end, we will use the certification process to establish shared RF communication performance standards for equipment and systems to achieve better interconnectivity between FeliCa devices.

2. Positioning of the Certification Test

The standards defined for the certification test do not certify the interoperability of marketed FeliCa equipment.

The certification test verifies product samples submitted by manufacturers in a testing environment specified for the certification test to determine whether the samples meet the communication performance standards defined for the certification test.

Therefore, achieving passing results in the certification test does not mean that all of the products in the same product series have been tested and have passed the certification test.

Warranties on the products tested shall conform to the warranty conditions originally established by the individual manufacturers.

3. Products to Be Tested

3.1. Products Subject to Testing

This test is intended for reader/writers or a reader/writer function that support FeliCa technology.

3.2. Product Models to Be Tested

Applicants for product testing must submit each model of a product for the certification test.

3.3.   Application Classes

The certification test assesses pass criteria based on classifications of maximum communication distance between the reader/writer under test and the standard card.

- M class: 25 mm or more of maximum communication distance

- S class: 10 mm or more of maximum communication distance

To use a reader/writer for electronic money payment processing, it must pass the M class certification test.

There are several requirements for each electronic money service provider to use a product that passes the S class certification test for electronic money payment processing. It is strongly recommended to confirm this with your electronic money service provider before taking a test.

Choose either class when you apply for a certification test. The class cannot be changed after a test starts.

3.4.   Updated Products

A manufacturer must resubmit a product that has already passed the certification test if any hardware or software modifications that might affect FeliCa RF communication performance have been made to the product.

3.5.   Addition of Product Models

When a manufacturer adds a new product model to a product series whose models have already passed the certification test, the manufacturer need not submit the new model for certification testing if the manufacturer can guarantee that the new model has the same communication performance as the product that has already passed the certification test. Instead, the manufacturer is only required to submit a *Notice of Added Product Model* form for the new model. Note that product models cannot be added if any hardware or software modifications, including measurement center point and housing changes, that might affect FeliCa RF communication performance have been made to the product.

3.6.   Certified-Product Listing on "FeliCa Interoperability Technology Information Site"

After passing the certification test, your product can be added to a list of certified reader/writer products on "FeliCa Interoperability Technology Information Site".

3.7. The term of validity of the Pass Certificate

The Pass Certificate shall be valid for ten (10) years from the date of issuance (the "Term"). The Term will be indicated on the Pass Certificate. Provided that the Term of the Pass Certificate for a new Product model which has been added in as set forth the Section 3.5 (Addition of Product Models) shall be the same period with the Term of the model of Products which has actually passed the Test.

4. Application

Materials to be submitted

- Test samples:

    ➤ Three units of the product to be tested (one maximum-frequency sample, one standard-frequency sample, and one minimum-frequency sample)

    ➤ The manual for the product (including the cable connection method)

    ➤ Accessories, if any, for each unit

    Note:
    Of all the manufactured units of the product being tested, the maximum-frequency sample must be the sample of the product that has minimally the highest resonance frequency value, the minimum-frequency sample must be the sample of the product that has the lowest resonance frequency value, and the standard-frequency sample must be the sample of the product that has a resonance frequency value between the highest resonance frequency value and the lowest resonance frequency value.

- Communication performance measurement software (including its manual): Refer to 6.4 Communication Performance Measurement Software"

- Digital protocol requirements check sheet:

    Note:
    All the samples to be submitted shall meet all the criteria stipulated in FeliCa Reader/Writer Digital Protocol Requirements Specification, which is a prerequisite for the certification test.

You can apply to the following companies for this test.
- JR East Mechatronics Co., Ltd.
- Sony Corporation

For details about the application procedure, contact each company.

5. Test Method

5.1. Test Environment

This test will be conducted in the following test environment:

Temperature: 20°C to 30°C

Relative humidity: 25% to 70%

5.2. Equipment Used in the Test

The following figure shows the configuration of the equipment used in the certification test.
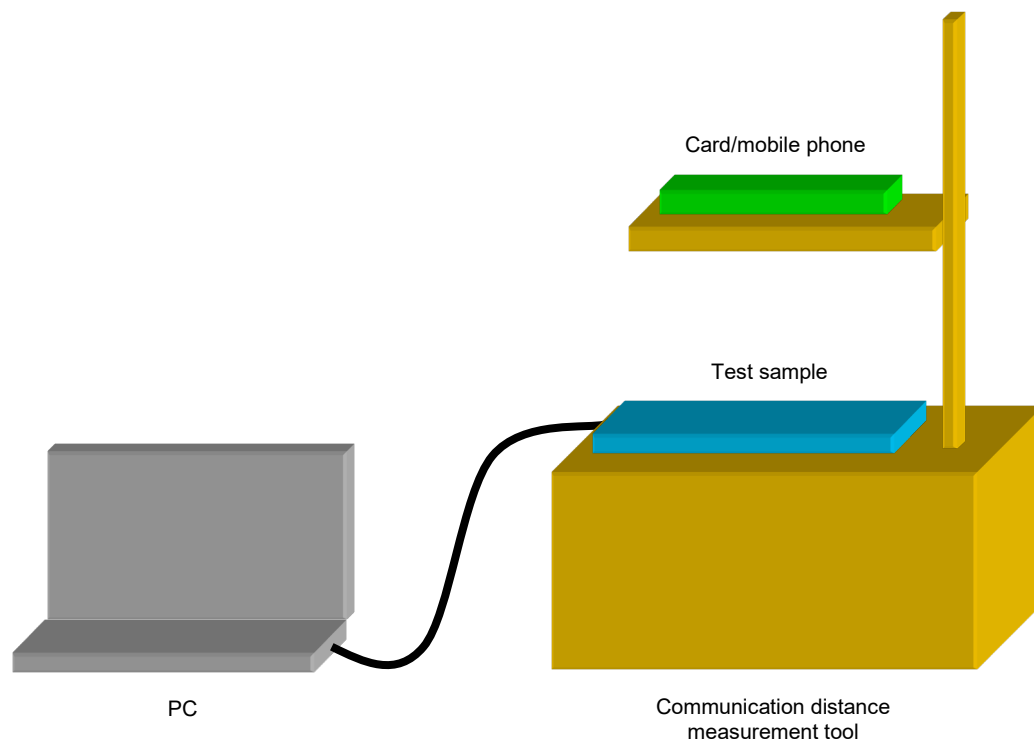
Figure 5-1:   Equipment Configuration for the Test

5.3. Definitions of Terms Related to the Testing Method

The following table defines the terms related to this test.

Measurement center point	The measurement center point of the test sample is either of the following: ⓐ is a trademark of FeliCa Networks, Inc. Figure 5-2: Measurement Center Point of the Test Sample (1) Intersection of the diagonals of a square imposed on the Mobile Contactless IC Communication Mark on the product (Figure 5-2) Note, however, limited to mobile phone products in which FeliCa IC certified by FeliCa Networks is embedded, the measurement center point may be within a radius of 10mm from the center of the Mobile Contactless IC Communication Mark on the product. (2) Center point in the area illustrated to show the location to touch with the card Of the two points above, whichever is judged to be rational is used. The measurement center point of the card or mobile phone used for the test is described in 6.3. Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Card/Mobile Phone Used for the Test.
Angle	The 0-degree direction of the test sample is the longitudinal direction specified by the applicant (product manufacturer). The 90-degree direction is moved clockwise from the 0-degree position.
X axis, Y axis, Z axis	The X axis is the axis that passes through the measurement center point and is parallel to the lines in the 0-degree direction. The positive direction of the X axis is the 0-degree direction. The Y axis is the axis that passes through the measurement center point and is perpendicular to the lines in the 0-degree direction. The Z axis is the axis that is perpendicular to the plane created by the X axis and the Y axis. The positive directions of the X and Y axes of the card or mobile phone used for the test is described in 6.3. Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Card/Mobile Phone Used for the Test.
Center	In centering, the communication distance measuring tool is used to align on the Z axis the measurement center point of the test sample with that of the card or mobile phone used for the test.
Offset	Offset refers to moving the test sample in the X-axis direction (or Y-axis direction) parallel to the X axis (or Y axis).
Maximum communication distance	When the test sample and the testing card or mobile phone are moved closer together during measurement, the maximum communication distance is the distance at which the specified success rate is first obtained.
Communication holes	A communication hole is an area whose success rate is less than the specified level at a distance (height) from 0 mm to the maximum communication distance. Communication holes do not include areas with a width of less than 1 mm. Note, however, that even an area with a width of less than 1 mm is regarded as a communication hole if the measured success rate of the area is below the specified level when the card or mobile phone is positioned at a distance of 0 mm from the end-product reader/writer.
Success rate	The success rate is the ratio of successful communications to the number of Polling command executions. The success rate requirement specified for the certification test is at least 95% (communication must be successful at least 95 times while the Polling command is executed 100 times).

5.4.   Communication Performance Measurement Procedure

■ Measurement conditions

To ensure stable measurement results, the test will begin 30 minutes after the reader/writer under test is turned on.

Also, the test will be conducted in an environment that eliminates effects caused by metallic objects, electrical interference, and other factors on FeliCa RF communication performance.

■ Measuring the communication distance and communication holes

(1)   The card or mobile phone will be placed stably on the measuring surface of the reader/writer under test in close contact with the surface while its measurement center point is aligned with that of the reader/writer. The distance of the card or mobile phone in this position will be treated as 0 mm. If the card or mobile phone cannot be placed in close contact with the measuring surface of the reader/writer under test, it will be positioned on a plane that extends from the measuring surface of the reader/writer, creating the effect of close contact with the measuring surface.

(2)   The position of the card or mobile phone will be adjusted for centering and offset.

(3)   The communication distance measurement tool will be used to move the card or mobile phone to a position where it exceeds the maximum communication distance.

(4)   The communication performance measurement software will be used to execute the Polling command from the test sample.

(5)   The communication distance measurement tool will be used to move the card or mobile phone downward in order to determine the maximum communication distance.

(6)   The card or mobile phone will be moved from the maximum communication distance to a distance of 0 mm in 1 mm steps to locate any communication holes.
If it is impossible to measure up to 0 mm for some physical limitations on the measuring surface of the test sample, measurement is done as close to the measuring surface of the test sample as possible.

(7)   Steps (2) to (6) will be repeated until measurement at all measurement points has been completed.

6. Test Items

6.1. Test Configuration

This certification test consists of a basic performance test and an interoperability test.

The basic performance test is to verify that the product under test achieves a certain level of communication performance.

The interoperability test is to check for fatal communication problems of the product under test in an ordinary use environment.

The test sample passes the test when it satisfies the performance standards for all the test items.

All tests are conducted in communication speed of 212 kbps.

6.2. Cards and Mobile Phones Used for the Test

6.2.1. Cards Used for the Basic Performance Test

No.	Manufacturer and model	Description
1	Sony RC-S100	One card for each of the maximum, standard, and minimum resonance frequency values
2	Sony RC-S888	One card for each of the maximum, standard, and minimum resonance frequency values
3	JR EAST MECHATORONICS 4K transportation card(S)	One card for each of the maximum, standard, and minimum resonance frequency values
4	JR EAST MECHATORONICS 8K transportation card(S)	One card for each of the maximum, standard, and minimum resonance frequency values
5	JR EAST MECHATORONICS 10K transportation card (P)	One card for each of the maximum, standard, and minimum resonance frequency values

Notes:

For more information about the cards used for the test, contact an exclusive Sony distributor of FeliCa products.

The cards used for the test in the above table are products designed for use in Japan. Anyone who intends to use any of these products outside Japan must assume responsibility for compliance with the laws of the country where the product will be used.

6.2.2. Cards Used for the Interoperability Test

The card used in the interoperability test is a card that is designated by the testing organization for the interoperability test and that is a registered product that has already been certified for performance.

A card having the standard resonance frequency is used.

The card used for the interoperability test is changed as required. Please check the latest information when you plan to take the certification test.

6.2.3. Mobile Phones Used for the Interoperability Test

A standard mobile phone model designated by the testing organization is used.

A mobile phone having the standard resonance frequency is used.

A standard mobile phone model, chosen from mobile phones that have already been certified for performance, is designated every six months.

Please refer to the latest information when applying for the test.

6.3. Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Card/Mobile Phone Used for the Test

This section describes the measurement center point, X-axis direction, and Y-axis direction of the card or mobile phone used for the test.

6.3.1. Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Card Used for the Test

Measurement center point: The intersection of two diagonal lines traversing the card.

X-axis and Y-axis directions: Shown in Figure 6-1.

Figure 6-1:   X-Axis and Y-Axis Directions of the Card Used for the Test

If measurement cannot be made with the measurement center point shown above, measurement is made at the point closest to the measurement center point above on the X and Y axes of the test sample in the 0- or 90-degree direction of the card for the test.

6.3.2. Measurement Center Point, X-Axis Direction, and Y-Axis Direction of the Mobile Phone Used for the Test

Measurement center point: Shown in Figure 6-2.

X-axis and Y-axis directions: Shown in Figure 6-3.

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Figure 6-2:   Measurement Center Point of the Mobile Phone Used for the Test
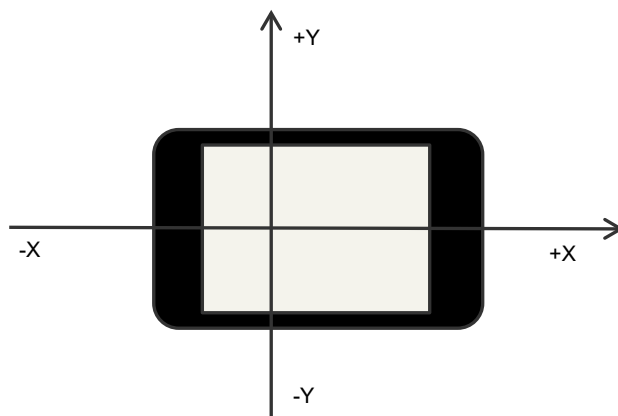
As viewed from the opposite side of the Mobile Contactless IC Communication Mark.
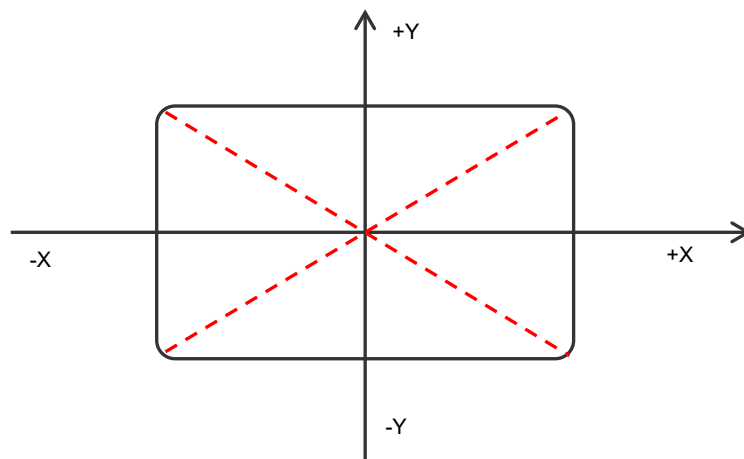
Figure 6-3:   X-Axis and Y-Axis Directions of the Mobile Phone Used for the Test

If measurement cannot be made with the measurement center point shown above, measurement is made at the point closest to the measurement center point above on the X and Y axes of the test sample in the 0-, 90-, 180- or 270-degree direction of the mobile phone for the test.

6.4. Communication Performance Measurement Software

The applicant manufacturer shall prepare communication performance measurement software.

This section describes the requirements for communication performance measurement software.

6.4.1. Equipment Configuration

The software assumes the equipment configuration shown in Figure 5-1.

On PCs, we assume that Microsoft's Windows OS is running.

6.4.2. Requirements: Software Formats

- A software format that allows changing the operating settings by arguments at the command prompt. And it shall be possible to be called and executed from a batch file, etc.
  However, it is also acceptable to execute the terminal software with macros on the command line.

- If the serial port is used to communicate with the test sample, the COM port number shall be specified by the argument.

  EXAMPLE (if COM5 is specified): polling.exe c COM5

- The following information shall be returned as a software return value.

Return value (decimal display)	Content
0-100	Polling command success rate (%)
-1	Abnormal termination of software

  However, instead of the software return value, it is also acceptable to specify a log file as an argument of the communication performance measurement software and output the measurement result in CSV, text format, or the like.

  EXAMPLE (When specifying a log file as an argument and returning the value): polling.exe f "C:/ temp/Result.csv"]

6.4.3. Requirements: Polling Command Execution

● In response to operations from the PC shown in Figure 5-1, the communication performance measurement software shall be able to send the Polling FeliCa card command to the card or mobile phone from the reader/writer under test. The software shall also receive a response from the card and be able to determine whether the operation yielded a normal response (succeeded) or failed.

The Polling command is executed with the following parameters:

Parameter	Setting value
System Code	ffffh
Timeout period	200 [ms]
Time slot	00h

The criteria for determining success/failure of the Polling command response shall be as follows.

➢ **Conditions for success:**
For the execution of the Polling command to be considered successful, the reader/writer under test receives a normal Polling response packet including the response code, IDm, and PMm within the timeout period in response to a single Polling command sent.

➢ **Conditions for failure:**
A failure occurs if the reader/writer under test does not receive a response within the timeout period or if it does not receive a normal response packet in response to a single Polling command sent.

● Even if the test sample is a mobile phone product, the PC must be able to execute the Polling command and confirm whether the test sample successfully received the Polling response packet or failed by connecting the PC and test sample with a USB cable and so on.

● To execute Polling command 100 times consecutively within 25 seconds with the parameter specified in the previous section.

6.4.4. Requirements: Display function

● **Graphical Representation of Success or Failure of Command Execution**
The communication performance measurement software shall be able to graphically represent the success or failure of each execution of 100 consecutive executions of the Polling command described in the previous section The results (success or failure) can be displayed simply with symbols such as ○ and ×.

● **Calculation and Display of the Total Number of Successes and Executions of the Polling Command**
The communication performance measurement software shall be able to count the number of executions and the number of successful executions for 100 consecutive executions of the Polling command described in previous section and display that information on the computer screen. This information does not need to be displayed the number of times of the Polling command executions, but must be displayed upon the completion of 100 Polling command executions consecutively.

● **Calculation and Display of the Success Rate**
The communication performance measurement software must be able to calculate and display the success rate of the results of 100 consecutive execution of the Polling command described in the previous section. The success rate is the number of successful Polling command executions divided by the total number of Polling command executions.

6.4.5. Example

Figure 6-4 shows an example of a screenshot of the communication performance measurement software.

Polling command success rate displayed for groups of 100 executions (Number of successes/total number of executions)

A circle (○) indicates a successful execution and a dot (.) indicates a failed execution.

Polling command success rate displayed for groups of 50 executions (Number of successes/total number of executions)

Figure 6-4: Communication Performance Measurement Software Screenshot

6.5.　M-Class Pass Criteria

The table below shows the M-class pass criteria of this test.

The product samples to be tested shall be one maximum-frequency sample, one standard-frequency sample, and one minimum-frequency sample.

6.5.1. Basic Performance Test

The reader/writer shall satisfy the following criteria in the measurement performed according to Section 5.4 using the card for the basic performance test.

No.	Test item	Pass criteria
1	Communication distance (Center at 0 degree)	The maximum communication distance shall be 25 mm or more.
2	Communication holes (Center at 0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to 15 mm of the reader/writer. There must be no communication holes which are 3 mm or wider in the range from 15 mm to 25 mm of the reader/writer. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.
3	Communication distance (XY±10 mm at 0 degree)	The maximum communication distance shall be 15 mm or more.
4	Communication holes (XY±10 mm at 0 degree)	There must be no communication holes which are 3 mm or wider in the range from 0 mm to 15 mm of the reader/writer. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.

Notes:
1. If there is a limit on the offset value and measurement cannot be made at the specified offset, measurement is performed at the offset limit point. Note that, if the offset width is less than 1 mm, no measurement is performed at this offset point.

2. When measuring the center and offset, if there is a limit on the height and the maximum communication distance cannot be measured as specified, measurement is performed up to the height limit.

If all XY±10 mm measurements cannot be made due to an offset limit and there is a limit on the height, the product must satisfy the following criteria by using the card for the basic performance test.

No.	Test item	Pass criteria
1	Communication holes (Center, XY ± up to the offset limit in 1-mm increments /0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to the height limit. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.

6.5.2. Interoperability Test

The reader/writer shall satisfy the following criteria in the measurement performed according to Section 5.4 using the card or mobile phone for the interoperability test.

The product samples to be tested shall be one maximum-frequency sample, one standard-frequency sample, and one minimum-frequency sample.

No.	Test item	Pass criteria
1	Communication distance (Center at 0 degree)	The maximum communication distance shall be 15 mm or more.
2	Communication holes (Center at 0 degree)	There must be no communication holes which are 3 mm or wider in the range from 0 mm to 15 mm of the reader/writer.
3	Communication holes (XY±10 mm from center at 0 degree)	At 0 mm, communication shall be possible at least three points out of five points at ±10 mm of the X-axis and Y-axis offset from the measurement center point.

Notes:

1. If there is a limit on the offset value and measurement cannot be made at the specified offset, measurement is performed at the offset limit point. Note that, if the offset width is less than 1 mm, no measurement is performed at this offset point.

2. When measuring the center and offset, if there is a limit on the height and the maximum communication distance cannot be measured as specified, measurement is performed up to the height limit.

3. If no mobile phone for the interoperability test cannot be physically mounted in the test setup, no interoperability test is performed with the mobile phone for the interoperability test.

4. The table below shows the pass criteria when the number of measurement points is less than 5.

Number of measurement points	4	3	2	1
Number of communication holes	2 or less	1 or less	0	0

If all XY±10 mm measurements cannot be made due to an offset limit, there is a limit on the height, and no mobile phone for the interoperability test cannot be mounted, the product must satisfy the following criteria by using the card for the interoperability test.

No.	Test item	Pass criteria
1	Communication holes (Center, XY ± up to the offset limit in 1-mm increments /0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to the height limit. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.

6.6. S-Class Pass Criteria

6.6.1. Basic Performance Test

The reader/writer shall satisfy the following criteria in the measurement performed according to Section 5.4 using the card for the basic performance test.

The product samples to be tested shall be one maximum-frequency sample, one standard-frequency sample, and one minimum-frequency sample.

No.	Test item	Pass criteria
1	Communication distance (center at 0 degree)	The maximum communication distance shall be 10 mm or more.
2	Communication distance (XY±10 mm at 0 degree)	The maximum communication distance shall be 3 mm or more.
3	Communication holes (XY±10 mm from center at 0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to 3 mm of the reader/writer. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.

Notes:
1. If there is a limit on the offset value and measurement cannot be made at the specified offset, measurement is performed at the offset limit point. Note that, if the offset width is less than 1 mm, no measurement is performed at this offset point.

2. When measuring the center and offset, if there is a limit on the height and the maximum communication distance cannot be measured as specified, measurement is performed up to the height limit.

If all XY±10 mm measurements cannot be made due to an offset limit and there is a limit on the height, the product must satisfy the following criteria by using the card for the basic performance test.

No.	Test item	Pass criteria
1	Communication holes (Center, XY ± up to the offset limit in 1-mm increments /0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to the height limit. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.

6.6.2. Interoperability test

The reader/writer shall satisfy the following criteria in the measurement performed according to Section 5.4 using the card or mobile phone for the interoperability test.

The product samples to be tested shall be one maximum-frequency sample, one standard-frequency sample, and one minimum-frequency sample.

No.	Test item	Pass criteria
1	Communication holes (XY±10 mm from center at 0 degree)	At 0 mm, communication shall be possible at least three points out of five points at ±10 mm of the X-axis and Y-axis offset from the measurement center point.

Notes:
1. If there is a limit on the offset value and measurement cannot be made at the specified offset, measurement is performed at the offset limit point. Note that, if the offset width is less than 1 mm, no measurement is performed at this offset point.

2. If no mobile phone for the interoperability test cannot be physically mounted in the test setup, no interoperability test is performed with the mobile phone for the interoperability test.

3. The table below shows the pass criteria when the number of measurement points is less than 5.

Number of measurement points	4	3	2	1
Number of communication holes	2 or less	1 or less	0	0

If all XY±10 mm measurements cannot be made due to an offset limit, there is a limit on the height, and no mobile phone for the interoperability test cannot be mounted, the product must satisfy the following criteria by using the card for the interoperability test.

No.	Test item	Pass criteria
1	Communication holes (Center, XY ± up to the offset limit in 1-mm increments /0 degree)	There must be no communication holes which are 1 mm or wider in the range from 0 mm to the height limit. Note that, at a height of 0 mm, not even one communication hole with a width of less than 1 mm is allowed.