



Reader Module

RC-S660/S

Product Specifications

Version X.X
No. XXXXX-XXX-XX

Introduction

This document describes the major features and specifications of the Sony Reader/Writer module, RC-S660/S.

For the purpose of this document, the following terms and definitions apply to denote the products or equipment described here:

Card	A contactless IC card.
Reader/Writer	A device used to read and write contactless IC cards, tags and devices.
Controller	An external computer or an equivalent device that is directly connected to a Reader/Writer via a specific cable.

User applications use libraries (including FelCa libraries) to access RC-S660/S. API specifications for these libraries can vary depending on the products used, as well as the intended usage of the system, making it necessary to see the appropriate document for each, as follows:

Applicable model	Description	Usage	Reference document
RC-S660/S	UART for controller interfacing	For embedded device	"SDK for NFC (Reference Implementation, Basic Suite API Specifications"

- NOTE 1 You must develop your own driver for embedded devices, as well as your own FelCa libraries. For this purpose, the "SDK for NFC (Reference Implementation) Basic Suite" is optionally available.
- NOTE 2 Before offering services that use specific card brands, you must obtain permission from the companies that hold the rights.
- NOTE 3 Please note that Business Opportunity Loss caused by failure or other causes cannot be compensated, irrespective of the warranty period. Therefore, prior verification of correct system operation is strongly recommended.

- FelCa is a contactless IC card technology developed by Sony Corporation.
- FelCa is a registered trademark or a trademark of Sony Group Corporation or its affiliates.
- All names of companies and products contained herein are registered trademarks or trademarks of the respective companies.
- No part of this document may be copied, or reproduced in any form, without the prior consent of Sony.
- Information in this document is subject to change without notice.
- Sony assumes no liability for damages arising from, or in connection with, the use of this document.

Safety Information and Caution

WARNING

To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture. To avoid electrical shock, do not open the cabinet. Refer servicing to qualified personnel only.

Stable power supply is required from the host device.

Une alimentation électrique stable est requise de la part du périphérique hôte.

The following information must be indicated on the host device of this module.

[For FCC]

Contains FCC ID: AKBRC5660S

or

Contains Transmitter Module FCC ID: AKBRC5660S

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: If it is difficult to describe this statement on the host product due to the size, please describe in the User's manual.

[For IC]

Contains/Contient IC: 4098-RC5660S

or

Contains Transmitter Module / Contient module émetteur IC: 4098-RC5660S

The following statements must be described on the user manual of the host device of this module;

[For FCC]

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

[For IC]

This device contains license - exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- 1) L'appareil ne doit pas produire de brouillage;
- 2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.



Contents of spec indication label

For the customers in the USA**WARNING**

You are cautioned that any changes or modifications not expressly approved in this manual could void your authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.

The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

For the customers in Canada

This Class B apparatus complies with Canadian ICES 003.

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment and meets RSS 102 of the IC radio frequency (RF) exposure rules. This equipment has very low levels of RF energy that is deemed to comply without testing of specific absorption rate (SAR).

The modular transmitter is only IC authorized for the specific rule (i.e., IC transmitter rules) listed on the certificate, and the host product manufacturer is responsible for compliance to any other IC rules that apply to the host not covered by the modular transmitter certification.

The final host product still requires ICES 003 compliance testing with the modular transmitter installed.

Pour les clients au Canada

Cet appareil de la classe B est conforme à la norme NMB 003 au Canada.

Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles d'exposition aux fréquences radioélectriques (RF) CNR 102 de l'IC. Cet équipement émet une énergie RF très faible qui est considérée comme conforme sans évaluation du débit d'absorption spécifique (DAS).

L'émetteur modulaire est uniquement IC autorisé pour la règle spécifique (c'est à dire les règles d'émetteur IC) répertoriée sur le certificat, et le fabricant du produit hôte est responsable de la conformité à toutes les autres règles IC qui s'appliquent à l'hôte non couvertes par la certification de l'émetteur modulaire.

Le produit hôte final nécessite toujours des tests de conformité NMB 003 avec le transmetteur modulaire installé.

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1 Key functions and features

RC-S660/S (hereinafter referred to as “the module”) is a Reader/Writer module that can communicate using Sony FeliCa technology, other broadly adopted technologies that support the ISO/IEC 14443 Type A/B contactless smart card standard including the I-CL transmission protocol and ISO/IEC 15693 used in logistics, and so on.

Key functions and features of the module are detailed here:

- Compatible with ISO/IEC 18092 contactless smart card of Sony such as FeliCa Standard, FeliCa Plug, FeliCa Link, FeliCa Lite S, and mobile phones incorporating a Mobile NFC IC chip.
- Compatible with a wide variety of ISO/IEC 14443 Type A/B contactless smart card including the I-CL transmission protocol.
- Compatible with ISO/IEC 15693 contactless smart card and tags used in logistics, and so on.
- Based on an inductive read/write system type certified by the Radio Law of Japan. It is also compliant with the relevant standards in the United States, Canada, and European Union.

For more information, please contact our distributors or sales representative.

2 Hardware specifications

This chapter describes the major hardware specifications of the module.

2.1 Major specifications

This section describes the module's major specifications:

2.1.1 FeliCa communication

- Carrier frequency (fc) : 13.56 MHz
- Data transfer rate¹⁾ : fc / 54 (272 kbps, approximately)
fc / 32 (424 kbps, approximately)
- Modulation system : Transmission: ASK
Reception: ASK
- Bit coding : Transmission: Manchester coding
Reception: Manchester coding

¹⁾ Available only when the card or the device to be used is also compatible with fc / 32.

2.1.2 ISO/IEC 14443 communication

- Carrier frequency (fc) : 13.56 MHz
- Data transfer rate¹⁾ : fc / 128 (106 kbps, approximately)
fc / 64 (212 kbps, approximately)
fc / 32 (424 kbps, approximately)
fc / 16 (848 kbps, approximately)
- Modulation system
 - Type A (fc / 128) : Transmission: ASK
Reception: ASK
 - Type A (fc / 64, fc / 32, fc / 16) : Transmission: ASK
Reception: DPSK
 - Type B : Transmission: ASK
Reception: DPSK
- Bit coding
 - Type A (fc / 128) : Transmission: Modified Miller
Reception: Manchester coding with subcarrier
 - Type A (fc / 64, fc / 32, fc / 16) : Transmission: Modified Miller
Reception: NRZ with subcarrier
 - Type B : Transmission: NRZ
Reception: NRZ with subcarrier

¹⁾Available only when the card or the device to be used is also compatible with fc / 64, fc / 32 or fc / 16.

2.1.3 ISO/IEC 15693 communication

- Carrier frequency (fc) : 13.56 MHz
- Data transfer rate : fc / 512 (26.78 kbps, approximately)
- Modulation system : Transmission: ASK
Reception: ASK
- Bit coding : Transmission: PPM
Reception: Manchester

2.1.4 Compatible cards, tags and devices^{1),2)}

The module is compatible with cards, tags and devices¹⁾ that are based on the following:

- FeliCa
- ISO/IEC 14443 - Type A / Type B
- ISO/IEC 15693

¹⁾ Usable number of cards: One at a time.

²⁾ Correct operation is not necessarily guaranteed.

NOTE Please consult us in advance of using any cards or devices.

2.1.5 RF communication performance

- Communication distance: 25 mm
(No dead zones of at least 1 mm wide within the above range.)

<Measurement conditions>

- Temperature: 25 °C, Humidity: 50 % RH
- The module and antenna are located where they are potentially unaffected by nearby radio waves and magnetic sources.
- A single RC-S100 card (operating at its center frequency) is polled by a standard module.
- The data transfer rate is 16 / 51 (212kops, approximately).
- Antenna is placed in a free space.
- The position of the antenna and the card is as follows.
 - Align the antenna and card longitudinally.
 - Place the card so that its center aligns with the center of the module's antenna, along a vertical axis perpendicular to the antenna surface.

NOTE: Communication performance can differ depending on the type of card, the orientation of the card, and data transfer rate, so please verify the performance required.

2.2 Interface

The connector described in this section provides the interface between the module and the controller.

2.2.1 Connector

- Model number: 95925-06B-04V1, made by IRISO ELECTRONICS CO., LTD.
Low profile, 0.5 mm pitch -FC / FPC connector
(Auto plated / Double sided terminal / SMT / Right angle / Non ZIF / 6 poles)

NOTE1 Please make sure the cable is connected correctly (i.e., the right way round), because the connector has a double sided terminal.

NOTE2 For details of applicable cables, see section B.1 "Terminal requirements of FPC / FPC".

2.2.2 Pin assignment

The following table identifies and describes the connector pins:

Table 2-1: Pin assignment

No.	Designation	Function	Remarks
1	VDD	Power supply	DC 5.3 V input
2	TXD	TXD signal	
3	RXD	RXD signal	
4	GND	Ground	For grounding
5	Reserve	None	Requires OPEN processing by the controller
6	Reserve	None	Requires OPEN processing by the controller

NOTE Please confirm the position of connector 1 pin in the external dimensions (See Figure 2-1).

2.3 UART communication specifications

The following tables list the UART communication specifications:

Table 2-2: UART transfer rate

Transfer rate (bps)
9,600
19,200
38,400
57,600
115,200 (default)
230,400
460,800

Table 2-3: UART communication specifications

Item	Description
Start bit	1
Data bit	8
Parity	None
Stop bit	1
Flow control	None

2.4 Electrical specifications

2.4.1 Absolute maximum rating

To avoid inoperable damage to the module, observe the following ranges of operation:

Table 2-2: Absolute maximum rating

Item	Rating	Unit
Power supply voltage	0 to 3.5	V
Input voltage	0 to 3.5	V

2.4.2 Electrical characteristics

(Conditions: Temperature = 25 °C; Humidity = 50% RH)

Table 2-3: Electrical characteristics

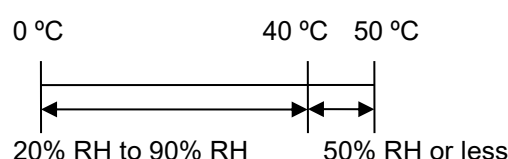
Item	Min	Max	Unit	Remarks
Power supply voltage (VDD) ¹	3.135	3.465	V	DC input, GND = 0 V Ripple voltage: 30 mVpp or less Current capacity: 200 mA or more
Current consumption (I _{DD}) ²		110	mA	VDD = 3.3 V RF ON: Approx. 30 mA RF OFF: Approx. 20 mA
H-level input voltage	2.0	3.465	V	
L-level input voltage	0	0.6	V	
H-level output voltage	2.6	3.465	V	
L-level output voltage	0	0.3	V	

¹ Fully verify the noise from the power supply, other modules, and cables, because noise adversely affects communication performance and Card / RF detection.

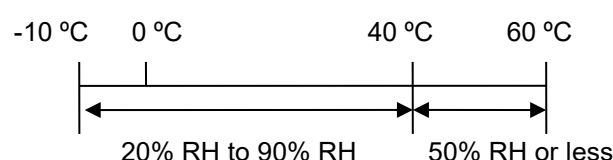
² Current consumption can vary depending on the power supply voltage, the existence of cards, and the installation.

2.4.3 Others

- Operating environment (no condensation or frost)
 - Communication performance assurance temperature and humidity¹



- Function assurance temperature and humidity^{*)}

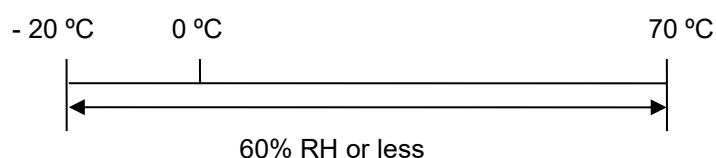


^{*)} More than 80 % of the value shown in section 2.1.5 "RF communication performance" is guaranteed.

^{**)} This guarantees normal operation of the RF communication processor, even though the communication performance described in this section cannot be assured under extremes of temperature.

NOTE The board temperature inevitably rises if the module continually transmits card access commands (such as when polling a card). Therefore, make sure the enclosure is designed so that the internal temperature and humidity can be maintained within the specified ranges.

- Storage environment (no condensation or frost)



- Mass : Approx. 4 g

2.5 Reliability specifications

- Shock : IEC 60068-2-27 Test Ea
- Vibration : IEC 60068-2-64 Test Fh

2.6 External dimensions

The following figure shows the module's external dimensions:

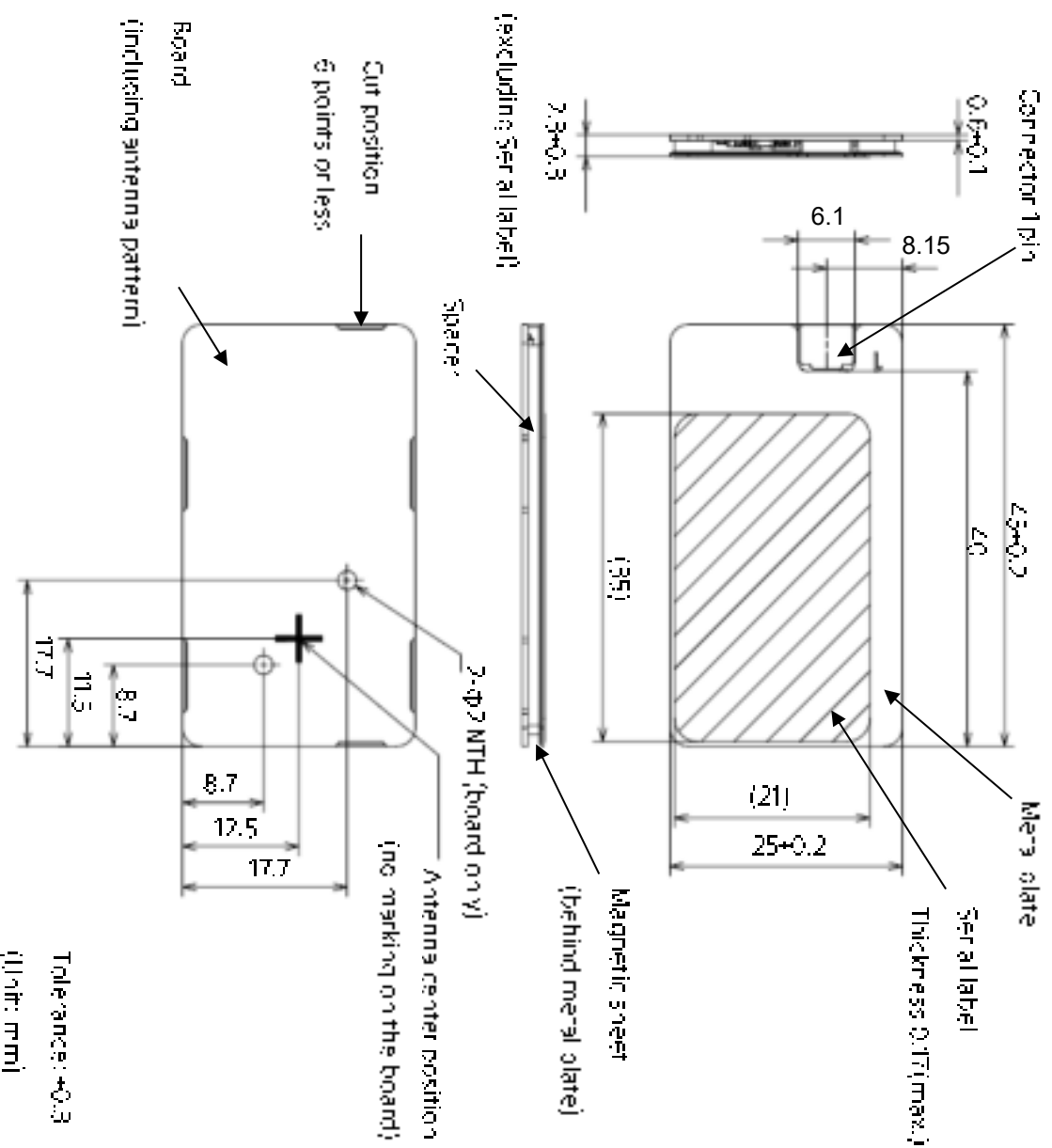


Figure 2-1: External dimensions

- NOI-1 Please turn the board side towards the cords.
- NOI-2 The NTH does not penetrate through to the metal plate. Do not insert anything into the NTHs.
- NOI-3 The perforations (board cut area) are not included in the external dimensions.
- NOI-4 Do not use the perforations (board cut area) of the module for installation alignment.

2.7 Contents of label

The following figure shows the contents of the module's label:

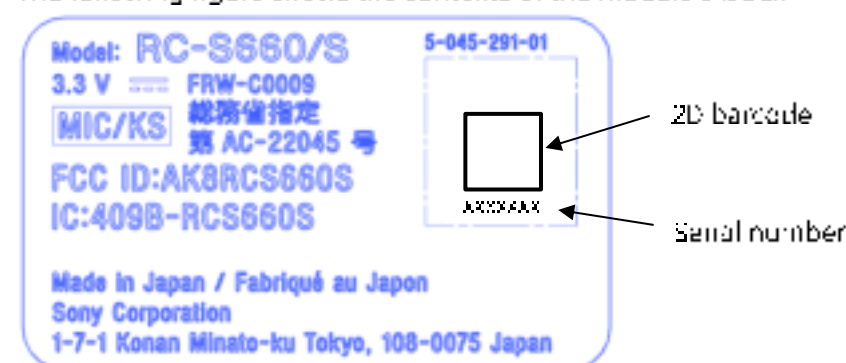


Figure 2-2: Contents of the module's label

2.8 RF performance and the use of a magnetic sheet

- RF (communication) performance is closely related to the effectiveness of the magnetic and metal sheets used below and around the antenna of the module.
- RF performance varies considerably, depending on the magnetic permeability (μ' , μ''), the dimensions and thickness of the magnetic sheet, and the dimensions and material of the metal sheet used. It can also be affected by metal in the installation environment.
- The module is designed to be used with the specified magnetic and metal sheets attached in advance to control the magnetic field generated by the antenna, as well as to minimize the possible effects from the installation environment.
This contributes a great deal to the reduction of the time required for measuring the effects of the installation environment and evaluating the module's RF performance.

2.9 Instruction of RF detection

RF detection is the function that detects the existence of an electromagnetic field around the module. It should react to the carrier frequency (fc) and static electricity, as well as noise from the motor, cooling fan, and so on.

3 Software development kit

This chapter describes the efficient software development kit (SDK) for applications in your system. For more information, please contact our exclusive distributor or sales representative.

3.1 For embedded systems

Product name

- ICS-D101 : SDK for NFC <Reference Implementation> Basic Suite

Overview

- This SDK enables you efficiently to develop applications that access a supported card.
- This SDK provides reference implementations of device driver and libraries, test programs, sample programs, and documentation.
- Those reference implementations are provided as platform-independent C source code and are intended to be modified, adjusted and optimized as necessary according to the CPU or operating system (OS) used.
- This SDK contains sample programs for updating firmware.
- The following operating systems have been tested for operation.
Windows, Ubuntu, Android

4 Firmware update

4.1 Firmware update function

The module supports firmware updates.

Programs to update firmware can be efficiently developed based on the sample programs included in the SDK.

5 Packing specifications

5.1 Packing details

The following shows how modules are packed in each master carton:

- Number of packed modules : 200 pcs (pieces)
- Master carton external dimensions : 415 mm x 108 mm x 430 mm (W x H x D)

Tolerance: ± 5 mm

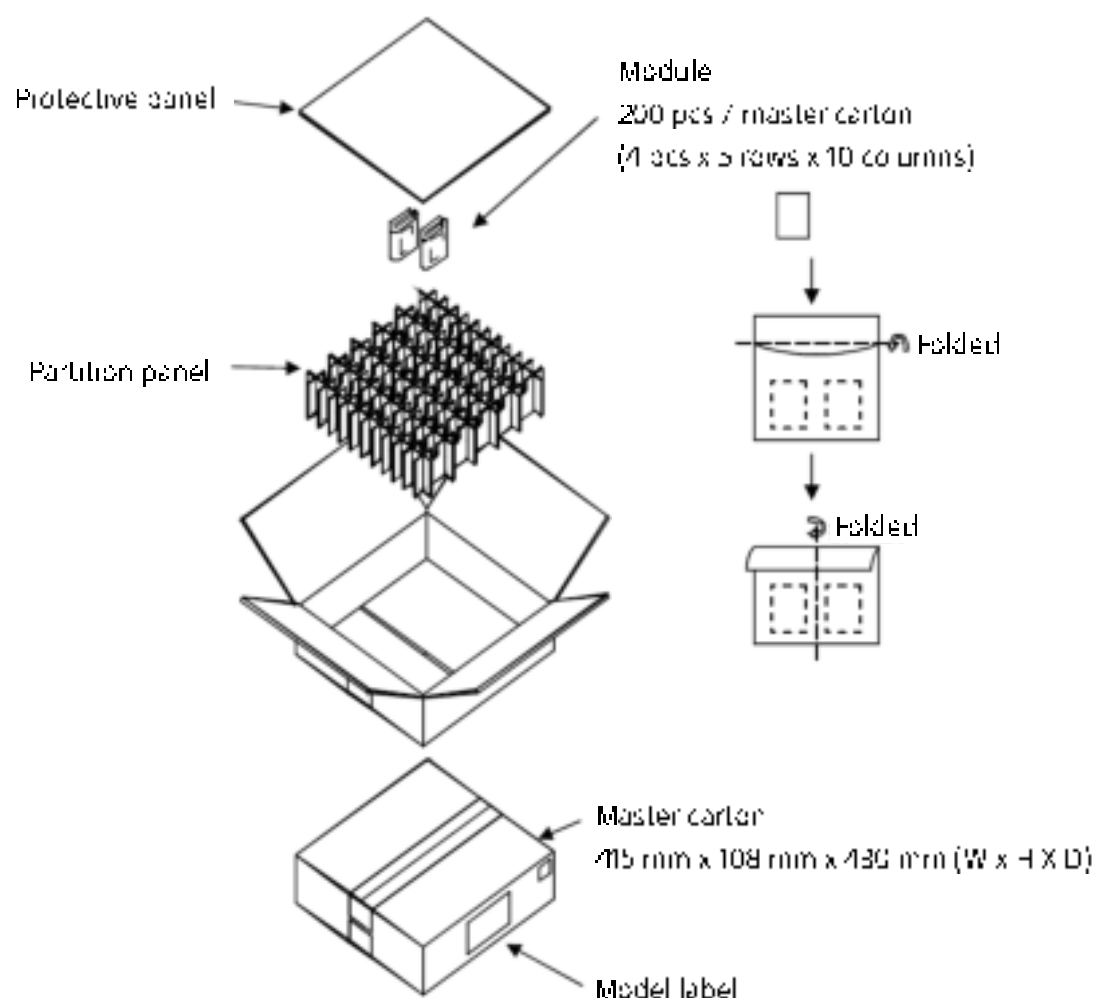


Figure 5-1: Packing details

6 Precautions

6.1 Handling precautions

The module must be handled with special care, keeping the following precautions in mind:

- The module is an inductive type read/write communication device that is type certified in compliance with the Radio Law of Japan. The module uses the 13.56 MHz frequency band. Disassembling or modifying the module or removing the type number or other specification codes from the module is punishable by law.
- When shipping equipment incorporating the module, please note in the instruction manual of the final product that the equipment incorporates a high frequency utilization facility that has acquired type certification in compliance.
- Be sure to use a stable power supply, to protect the module from the effects of noise and excessive voltage peaks, such as lightning, transmitted through the power supply connector.
- Do not cause any chemical or physical damage to the module.
- Do not subject the module surface to contaminated air or materials.
- After installation, lightly ground the module — as well as a table, machines, workbenches, and workers' bodies to prevent static electricity from affecting the module.
- For safety's sake, be sure to wear gloves when handling the module, even though its surfaces are carefully finished.
- Protect the module from interference caused by other wireless devices.
- Do not install the module in an environment where a strong electromagnetic field may adversely affect communication performance. Take special note of the installation location so that interference between the module and other equipment can adequately be controlled.
- Communication performance may be affected by the harmonics of the 13.56 MHz carrier frequency generated on the signal line.
- You must design and incorporate your own measures against static noise and power line noise.
- The interface cable (FFC / FPC) is not supplied, making it necessary to prepare one to suit your system. When attaching the cable, make sure the cable is connected correctly (i.e., the right way round) because the connector has a double-sided terminal.

6.2 Notes on external appearance

The module is designed for embedded applications, so please realize that superficial flaws such as the following can occur:

- Scratches or stains on the product surface, which have no effect on performance.
- The color of boards and parts can vary.

Appendix A Installation

This appendix contains important information about installing the module.

A.1 Installation requirements for RC-S660/S

When installing the module, observe the following instructions:

- Do not use any metal or carbon compound as the material for the cabinet.
- The cabinet surface must be at least 1.5 mm distant from the board surface.
- Do not place any metal in the metal forbidden zone (represented by the dot meshed area in Figure A-1) secured around the module. Specifically, communication performance undoubtedly deteriorates if any plate-like metal is placed near the module.
- To prevent the induction of an eddy current, make a cut in the metal plate surrounding the metal forbidden zone.
- If no performance improvement is achieved by the previous instructions, attempt to add at least one magnetic sheet (70 mm x 60 mm or larger) to the metal surface that faces the card, as shown in Figure A-2, and keep the module at least 3 mm (0.12 in.) away from any metal plate.

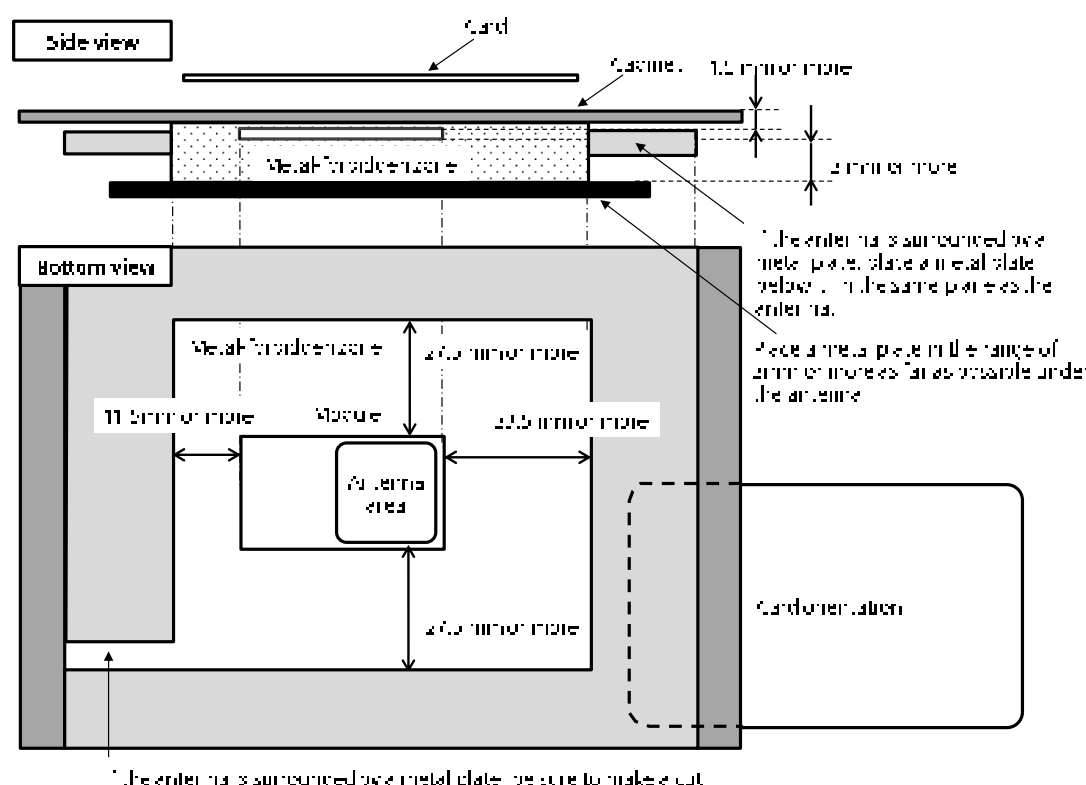


Figure A-1: Installation requirements

A.2 Reducing the effects of metal

Deviation from the resonance point caused by bringing the card closer to the metal plate may result in a change to the card's original characteristics. The effect of the metal plate can be reduced by adding at least one magnetic sheet between the module and the plate, as shown in the following figure:

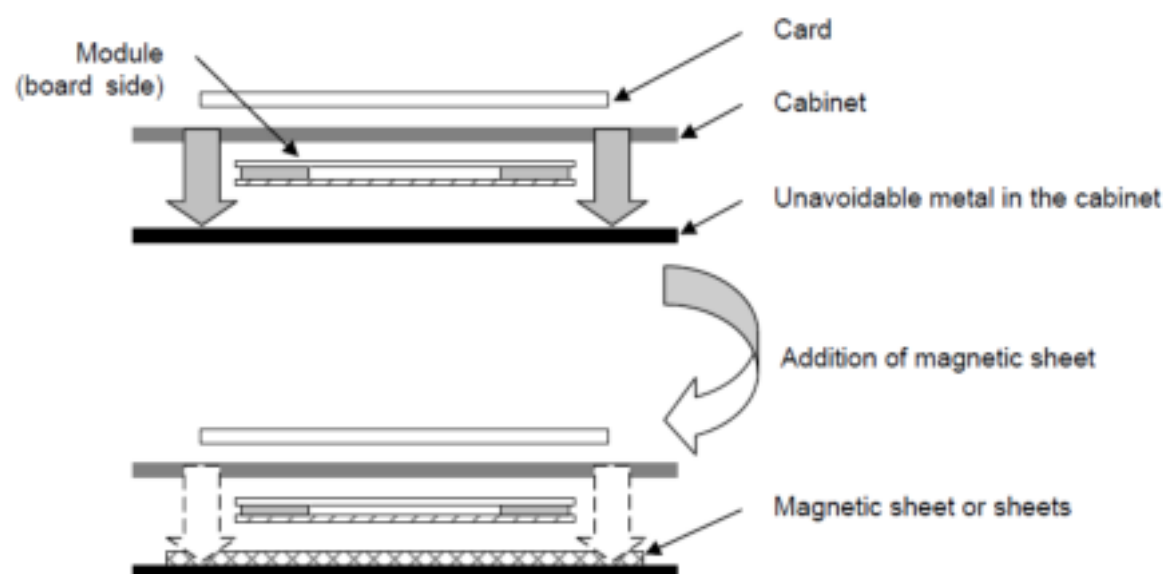


Figure A-2: Reducing the effects of metal

Appendix B Interface cable

B.1 Terminal requirements of FFC / FPC

The following figure shows the recommended FFC / FPC (for host controller communication) dimensions:

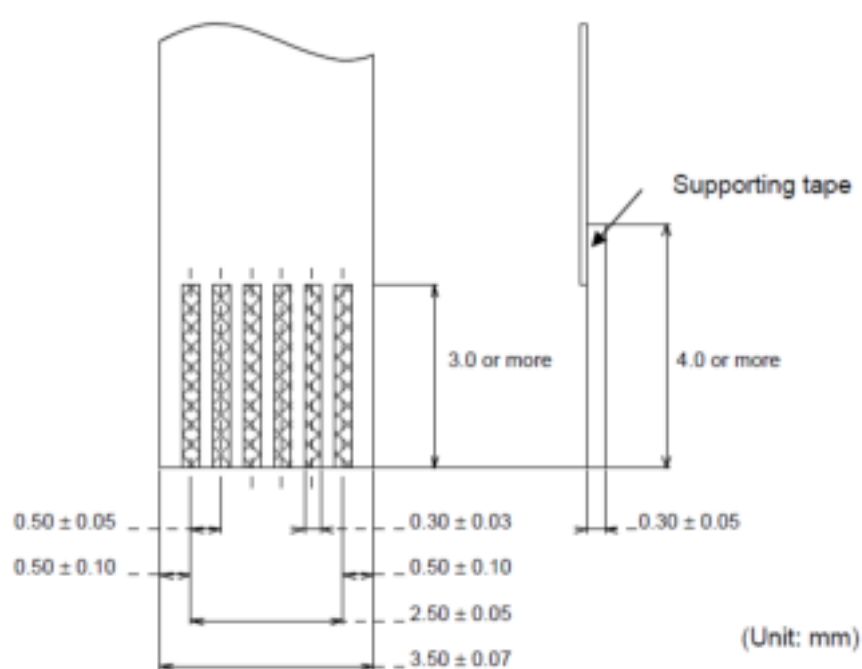


Figure B-1: Recommended FFC / FPC dimensions

Appendix C Temperature rise

C.1 Verifying and measuring temperature rise

The temperature of the module rises, when emitting a magnetic field. Therefore, monitor the internal temperature and humidity at the location of the module installed in your system continuously, because the temperature of the module is affected by power supply voltage, the existence of cards, and so on. An example of the temperature rise is shown in Figure C-1.

The temperature rise of the module can be suppressed by implementing the following measures:

- Generate the magnetic field only when it is needed.
- Generate the magnetic field intermittently until it detects a card, even while it is being used.

NOTE If the internal temperature and humidity at the location of the module installed in your system is always within the range of the operating environment, you do not necessarily need to take these measures.

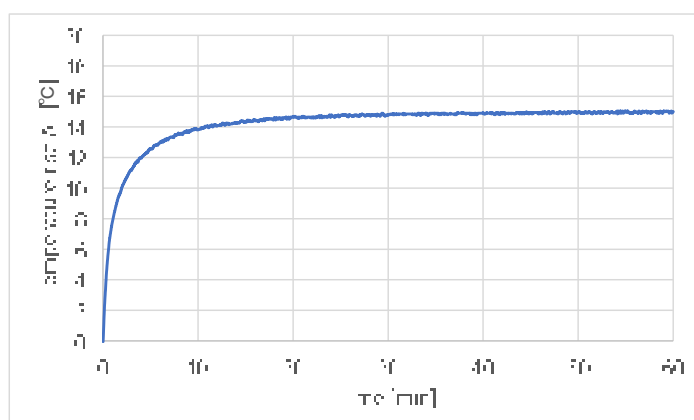


Figure C-1: Temperature rise (in the free space)

<Measurement condition>

- Temperature: 25 °C, Humidity: 50 % RH
- VDD: 3.3V
- Continuous RF output
- A single RC-S860 card is placed on the antenna surface:
 - Align the module and the card in a longitudinal orientation.
 - The Card is in the position where the module consumes the maximum current.

Reader Module

RC-S660/S Product Specifications Version X.X

Sony Corporation

No.

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Printed in Japan