

# SONY®

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Reader Module

## RC-S660/U

# Product Specifications

Version 1.0

No. M1147-E01-00

## Introduction

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

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.

- FeliCa is a contactless IC card technology developed by Sony Corporation.
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## 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.

Since this module is not sold to general end users directly, there is no user manual of module. For the details about this module, please refer to the specification sheet of module. This module should be installed in the host device according to the interface specification (installation procedure).

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: AK8RCS660U**

or

**Contains Transmitter Module FCC ID: AK8RCS660U**

**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.**

\* 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: 409B-RCS660U**

or

**Contains Transmitter Module / Contient module émetteur IC: 409B-RCS660U**

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 du 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/U (hereinafter called the module) is a Reader/Writer module which can communicate with FeliCa technology of Sony, other broadly adopted technologies supporting ISO/IEC 14443 Type A/B contactless smart card standard including the T=CL transmission protocol and ISO/IEC 15693 used in logistics and so on.

Key functions and features of the module are detailed below. For more information, please contact our distributors or sales representative.

- Compatible with ISO/IEC 18092 Type F contactless smart card of Sony such as FeliCa Standard, FeliCa Plug, 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 T=CL transmission protocol.
- Compatible with ISO/IEC 15693 contactless smart card and tags used in logistics and so on.
- Support the development of versatile applications for smart card which is certified by Microsoft's Windows HLK (Windows Hardware Lab Kit).
- Reduce PC idle power consumption by having supported remote wakeup with Card / RF detection in USB Selective Suspend for Windows.
- 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, and Europe.

NOTE Average current consumption (ISUS) should exceed the limit (2.5 mA) in the USB specifications.



## 2 Hardware specifications

This chapter focuses on major hardware specifications.

### 2.1 Major specifications

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The following describes the module's major specifications:

#### 2.1.1 FeliCa communication

- Carrier frequency (fc) : 13.56 MHz
- Data transfer rate\*<sup>1</sup> : fc / 64 (212 kbps, approximately)  
fc / 32 (424 kbps, approximately)
- Modulation system : Transmission: ASK, Reception: ASK
- Bit coding : Transmission: Manchester coding  
Reception: Manchester coding

\*<sup>1</sup> 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 rate\*<sup>2</sup> : 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: BPSK
  - Type B : Transmission: ASK, Reception: BPSK
- 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

\*<sup>2</sup> 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) : 13.56MHz
- Data transfer rate :  $fc / 512$  (26.48 kbps, approximately)
- Modulation system : Transmission: ASK, Reception: ASK
- Bit coding : Transmission: PPM, Reception: Manchester

### 2.1.4 Compatible cards, tags and devices<sup>\*1,\*2</sup>

- Card and tags based on ISO/IEC 18092 Type F (FeliCa)
- Card and tags based on ISO/IEC 14443 Type A / Type B
- Card and tags based on ISO/IEC 15693

NOTE Please consult us in advance of using any card or device.

<sup>\*1</sup> Usable number of cards: One at a time.

<sup>\*2</sup> Correct operation is not necessarily guaranteed.

### 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
- 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.
- Data transfer rate is  $fc / 64$  (212kbps, approximately).
- Antenna is placed in a free space.
- The position of antenna and card is as follows.
  - Align the antenna and card in a longitudinal direction.
  - Card is placed so that its center aligns with the center of the module's antenna along a vertical axis perpendicular to the antenna surface.

NOTE Since the communication performance may be different with the kind of the card, direction of the card and data transfer rate, please verify the performance required.

## 2.2 Interface

Interfacing between the module and the controller utilizes the connector described here:

### 2.2.1 Connector

- Model number: 9690S-06B-GFN1, made by IRISO ELECTRONICS CO., LTD.  
Low-profile, 0.5 mm pitch FFC / FPC connector  
(Au plated / Double-sided terminal / SMT / Right angle / NON-ZIF / 6 poles)

NOTE1 Please make sure the cable is connected in the right way, because the connector has a double-sided terminal.

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

### 2.2.2 Pin assignment

**Table 2-1: Pin assignment**

No.	Designation	Function	Remarks
1	VDD	Power supply	DC 3.3V input
2	D-	D- signal	USB 2.0, full speed
3	D+	D+ signal	USB 2.0, full speed
4	GND	Ground	For grounding
5	Reserve	Non	Requires OPEN processing by the controller
6	Reserve	Non	Requires OPEN processing by the controller

NOTE Please confirm the position of 1 pin in external dimensions.

## 2.3 USB communication specifications

A suspend signal from the controller is received through the USB interface to enable reduced power consumption.

The following tables in this section detail the USB communication specifications:

**Table 2-2: Communication specifications**

Item	Description
Device Type	Composite Device
Number of interfaces	2
Class	Interface 0 : 0Bh (CCID) Interface 1 : FFh (Vendor Specific)
Supported protocol	USB 2.0, full speed
Endpoint	Interface 0 : 3 (Bulk IN/OUT, interrupt) Interface 1 : 2 (Bulk IN/OUT)

### 2.3.1 Device descriptor

**Table 2-3: Device descriptor**

Field name	Value
bLength	12h
bDescriptorType	01h
bcdUSB	0200h
bDeviceClass	00h
bDeviceSubClass	00h
bDeviceProtocol	00h
bMaxPacketSize0	40h
idVendor	054Ch
idProduct	0D8Fh
bcdDevice	0100h
iManufacturer	01h
iProduct	02h
iSerialNumber	03h
bNumConfigurations	01h

## 2.3.2 Configuration descriptor

**Table 2-4: Configuration descriptor**

Field name	Value
bLength	09h
bDescriptorType	02h
wTotalLength	0074h
bNumInterfaces	02h
bConfigurationValue	01h
iConfiguration	00h
bmAttributes	A0h
bMaxPower	46h

## 2.3.3 Interface descriptor

Interface 0 is for CCID and Interface 1 is for vendor specific.

**Table 2-5: Interface descriptor 0**

Field name	Value
bLength	09h
bDescriptorType	04h
bInterfaceNumber	00h
bAlternateSetting	00h
bNumEndpoints	03h
bInterfaceClass	0Bh
bInterfaceSubClass	00h
bInterfaceProtocol	00h
iInterface	00h

**Table 2-6: Interface descriptor 1**

Field name	Value
bLength	09h
bDescriptorType	04h
bInterfaceNumber	00h
bAlternateSetting	00h
bNumEndpoints	02h

Field name	Value
bInterfaceClass	FFh
bInterfaceSubClass	00h
bInterfaceProtocol	00h
iInterface	00h

## 2.3.4 Smart card device class descriptor

Table 2-7: Smart card device class descriptor

Field name	Value
bLength	36h
bDescriptorType	21h
bcdCCID	0110h
bMaxSlotIndex	00h
bVoltageSupport	07h
dwProtocols	00000003h
dwDefaultClock	0000FA0h
dwMaximumClock	0000FA0h
bNumClockSupported	00h
dwDataRate	0001C200h
dwMaxDataRate	000E1000h
bNumDataRatesSupported	00h
dwMaxIFSD	00000FEh
dwSynchProtocols	00000000h
dwMechanical	00000000h
dwFeatures	00040040h
dwMaxCCIDMessageLength	0000020Ah
bClassGetResponse	00h
bClassEnvelope	00h
wLcdLayout	0000h

Field name	Value
bPINSupport	00h
bMaxCCIDBusySlots	01h

## 2.3.5 Endpoint descriptor

Endpoint 0 to 2 are for CCID and Endpoint 3 to 4 are for Vendor specific.

**Table 2-8: Endpoint descriptor 0 – Interface0(CCID) Bulk transfer (IN)**

Field name	Value
bLength	07h
bDescriptorType	05h
bEndpointAddress	81h
bmAttributes	02h
wMaxPacketSize:	0040h
bInterval	04h

**Table 2-9: Endpoint description 1 – Interface0(CCID) Bulk transfer (OUT)**

Field name	Value
bLength	07h
bDescriptorType	05h
bEndpointAddress	01h
bmAttributes	02h
wMaxPacketSize	0040h
bInterval	04h

**Table 2-10: Endpoint description 2 – Interface0(CCID) Interrupt transfer (IN)**

Field name	Value
bLength	07h
bDescriptorType	05h
bEndpointAddress	83h
bmAttributes	03h
wMaxPacketSize	0040h
bInterval	FFh

**Table 2-11: Endpoint description 3 – Interface1(Vendor specific) Bulk transfer (IN)**

Field name	Value
bLength	07h
bDescriptorType	05h
bEndpointAddress	82h
bmAttributes	02h
wMaxPacketSize	0040h
bInterval	04h

**Table 2-12: Endpoint description 4 – Interface1(Vendor specific) Bulk transfer (OUT)**

Field name	Value
bLength	07h
bDescriptorType	05h
bEndpointAddress	01h
bmAttributes	02h
wMaxPacketSize	0040h
bInterval	04h

## 2.3.6 String descriptor

**Table 2-13: String descriptor 0**

Field name	Value
bLength	04h
bDescriptorType	03h
wLANGID	0409h

**Table 2-14: String descriptor 1**

Field name	Value
bLength	0Ah
bDescriptorType	03h
bString	"SONY" (Unicode)

**Table 2-15: String descriptor 2**

Field name	Value
bLength	0Ah
bDescriptorType	2Eh



Field name	Value
bString	"FeliCa Port/PaSoRi 4.0" (Unicode)

Table 2-16: String descriptor 3

Field name	Value
bLength	0Ah
bDescriptorType	2Eh
bString	"Serial number" (e.g., 1000001) (Unicode)

## 2.3.7 OS string descriptor

Table 2-17: OS sting descriptor

Field name	Value
bLength	12h
bDescriptorType	03h
qwSignature	"MSFT100" (Unicode)
bMS_VendorCode	00h
bPad	00h

## 2.3.8 OS feature descriptor

Table 2-18: OS feature descriptor

Field name	Value
dwLength	40h
bcdVersion	0001h
wIndex	0004h
bCount	02h
RESERVED	All0
bFirstInterfaceNumber	00h
RESERVED	01h
compatibleID	"WUDF" (ASCII character)
subCompatibleID	All0
RESERVED	All0
bFirstInterfaceNumber	01h
RESERVED	01h

Field name	Value
compatibleID	"WINUSB" (ASCII character)
subCompatibleID	All0
RESERVED	All0

## 2.4 Electrical specifications

### 2.4.1 Absolute maximum rating

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

**Table 2-19: 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 2-20: Electric characteristics**

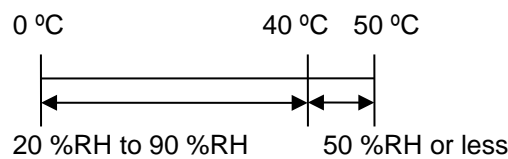
Item	Min	Max	Unit	Remarks
Power supply voltage <sup>*1</sup>	3.135	3.465	V	DC input, GND = 0V Ripple voltage: 30 mVpp or less Current capacity: 200mA or more
Current consumption <sup>*2</sup>		140	mA	VDD = 3.3V RF ON: Approx. 90mA RF OFF: Approx. 30mA
Current consumption <sup>*3</sup>		140	mA	During USB suspend RF ON: Approx. 90mA RF OFF: Approx. 0.4mA Average of a cycle: Approx. 8mA
H-level input voltage	2.0	3.465	V	
L-level input voltage	0	0.8	V	
H-level output voltage	2.8	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 during USB Selective Suspend.

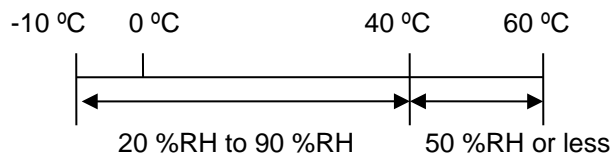
\*2,\*3 The module's maximum current consumption is the same as the value set to MaxPower of the USB descriptor. Current consumption can vary depending on the power supply voltage, the existence of cards, and the installation.

### 2.4.3 Others

- Operating environment (no condensation or frost)
  - Communication performance assurance temperature and humidity\*1



- Function assurance temperature and humidity\*2

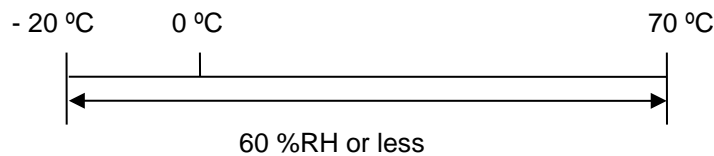


\*1 This guarantees the Max. communication distance defined in section 2.1.5 "RF communication performance".

\*2 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. 4g

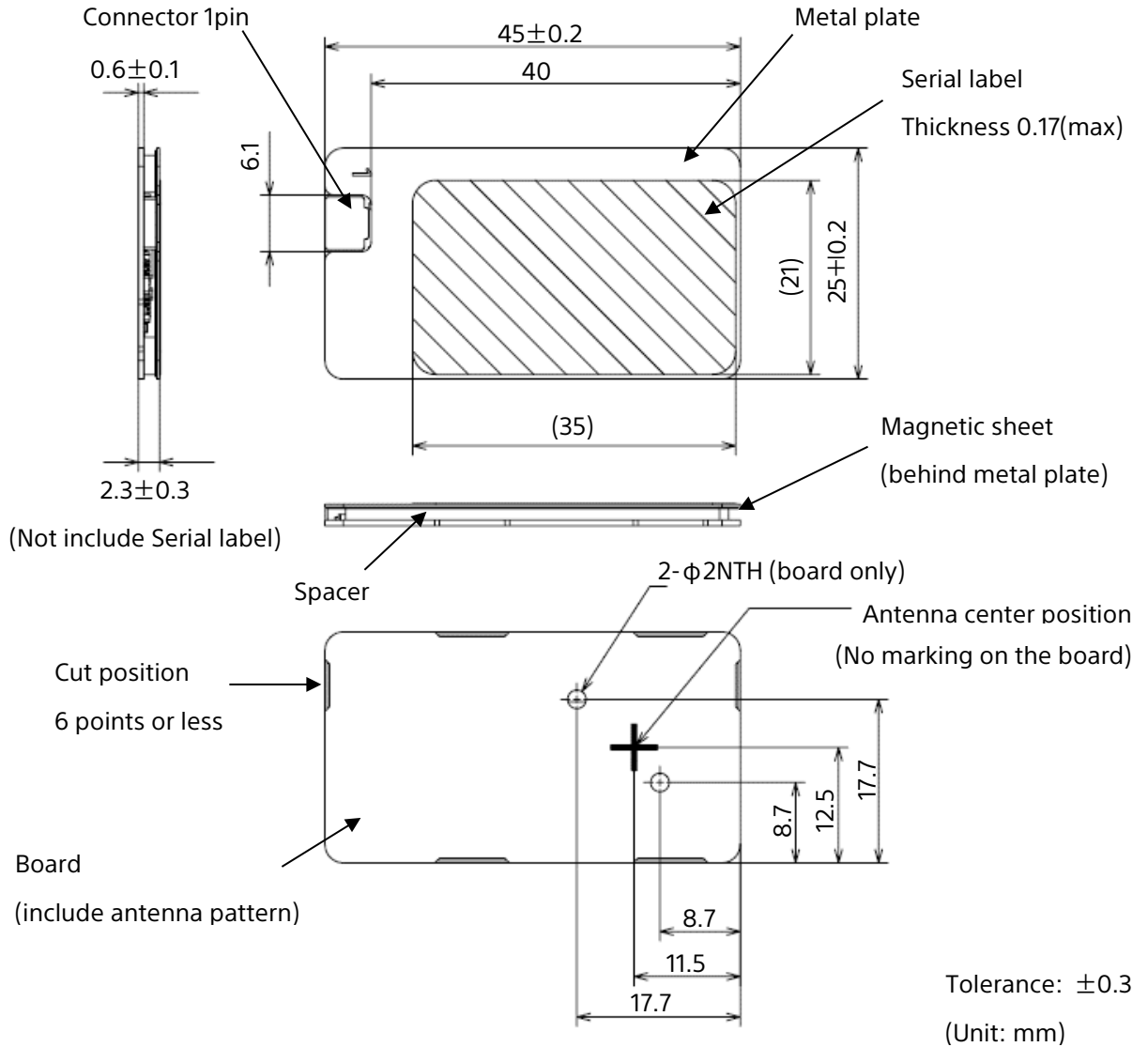
## 2.5 Reliability specifications

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

## 2.6 External dimensions

The following figures in this section show the module's external dimensions:



**Figure 2-1: External dimensions**

- NOTE1 Please turn the board side towards the cards.
- NOTE2 The NTH does not penetrate through to the metal plate. Do not insert anything into the NTHs.
- NOTE3 The perforations (board cut area) are not included in the external dimensions.
- NOTE4 Do not use 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:

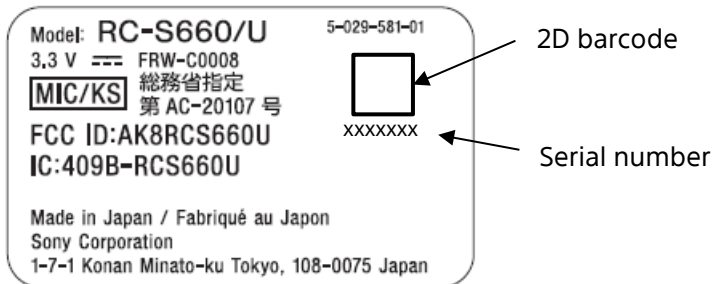


Figure 2-2: Contents of the module's label

## 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 ( $\mu'$ ,  $\mu''$ ), 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 ( $f_c$ ) and static electricity, as well as noise from the motor, cooling fan, and so on.

Therefore, prior inspection of the following operations in your system is strongly recommended:

- The module transitions properly to USB Selective Suspend.
- The module does not wake up frequently.

## 3 Software development kit

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

### 3.1 For embedded systems

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- Product name

SDK for NFC <Reference Implementation> Basic Suite

- Overview

This SDK enables you efficiently to develop applications that access unsecure services.

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 codes and are intended to be modified, adjusted and optimized as necessary according to the CPU or operating system (OS) used.

Reference implementations of drivers and libraries, test programs and sample programs provided from this

- OS CPU Development environment

Ubuntu 18.04 LTS (self-compile)

Android Studio

### 3.2 For Windows

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- Product name

SDK for NFC Lite, SDK for NFC Starter Kit

- Overview

Any SDK enables you efficiently to develop applications that access unsecure services.

Any SDK provides device driver, libraries, documents, and sample source code.

SDK for NFC Lite and Starter Kit enable you to control access to all cards with PC/SC.

### 3.2.1 Development environment

Microsoft Visual Studio 2019

### 3.2.2 API

Device driver supports the following APIs:

- o FeliCa Library (Sony proprietary)
- o PC/SC Ver.2.0

### 3.2.3 System requirements for platform

Operating system

- o Windows 10 32-bit (x86), 64-bit (x64)
- o Windows 8.1 32-bit (x86), 64-bit (x64)

Language

English and Japanese (the device driver is not dependent on the language)

## 3.3 For Web Applications

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- Product name
  - SDK for NFC Web Client

- Overview

Any SDK enables you efficiently to develop web applications that access unsecure services.  
It enables you to control access to all cards by web contents with Java Script on Chrome browser

### 3.3.1 System requirements for platform

Operating system

- macOS
- Windows



# 4 Packing specifications

## 4.1 Packing details

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

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

Tolerance: ±5mm

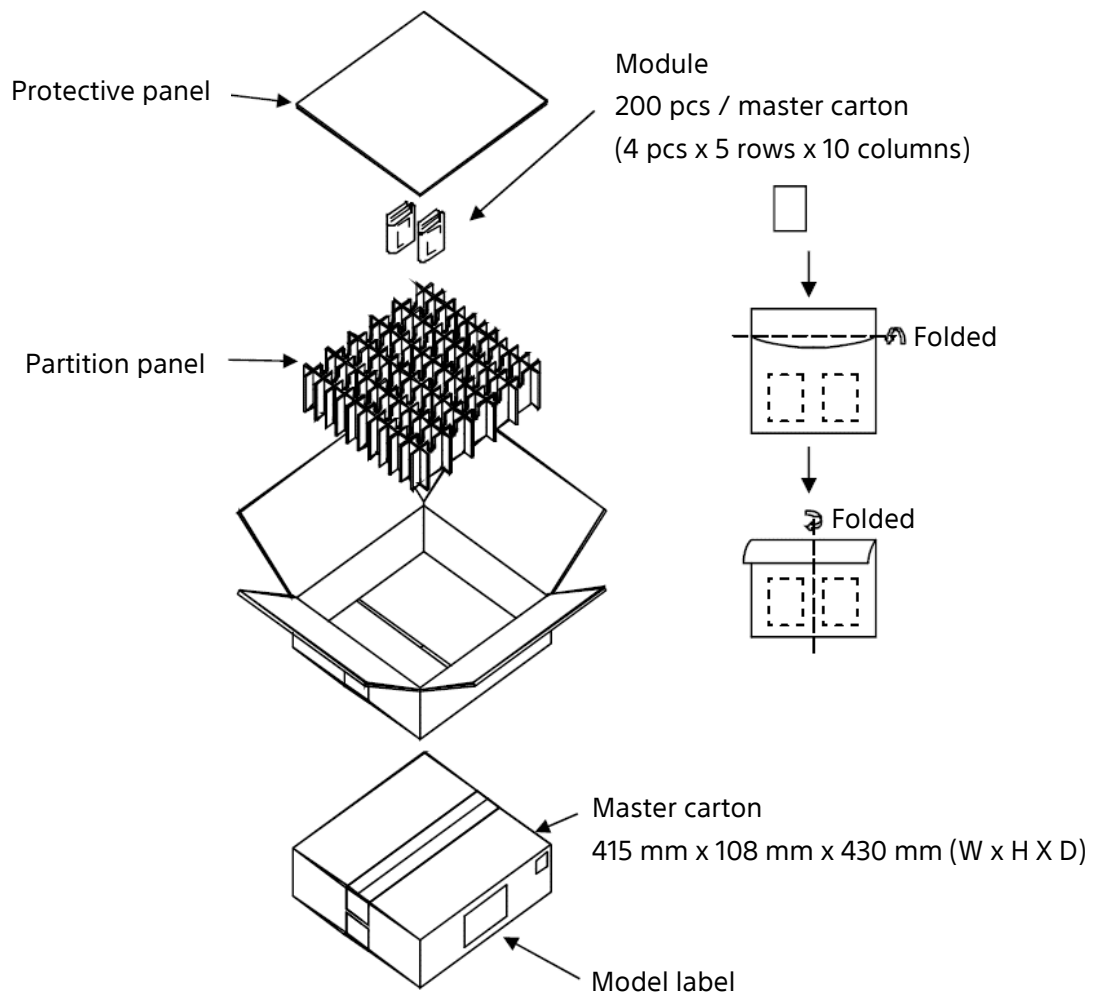


Figure 4-1: Packing details

## 5 Precautions

### 5.1 Handling precautions

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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.
- Be sure to use a stable power supply so that the module can be protected 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.
- Tightly ground the module after installation, as well as all jigs, 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 the one appropriate for your system. When selecting the cable, make sure the cable is connected in the right way, because the connector has a double-sided terminal.

### 5.2 Notes on external appearance

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

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

# Appendix A Installation

## A.1 Installation requirements for RC-S660/U

When installing the module, observe the following instructions:

- 1) 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.
- 2) Do not place any metal in the 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 put near the module.
- 3) To prevent the induction of an eddy current, make a cut in the metal plate surrounding the forbidden zone.
- 4) 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 ( $d > 3$ ) away from any metal plate.

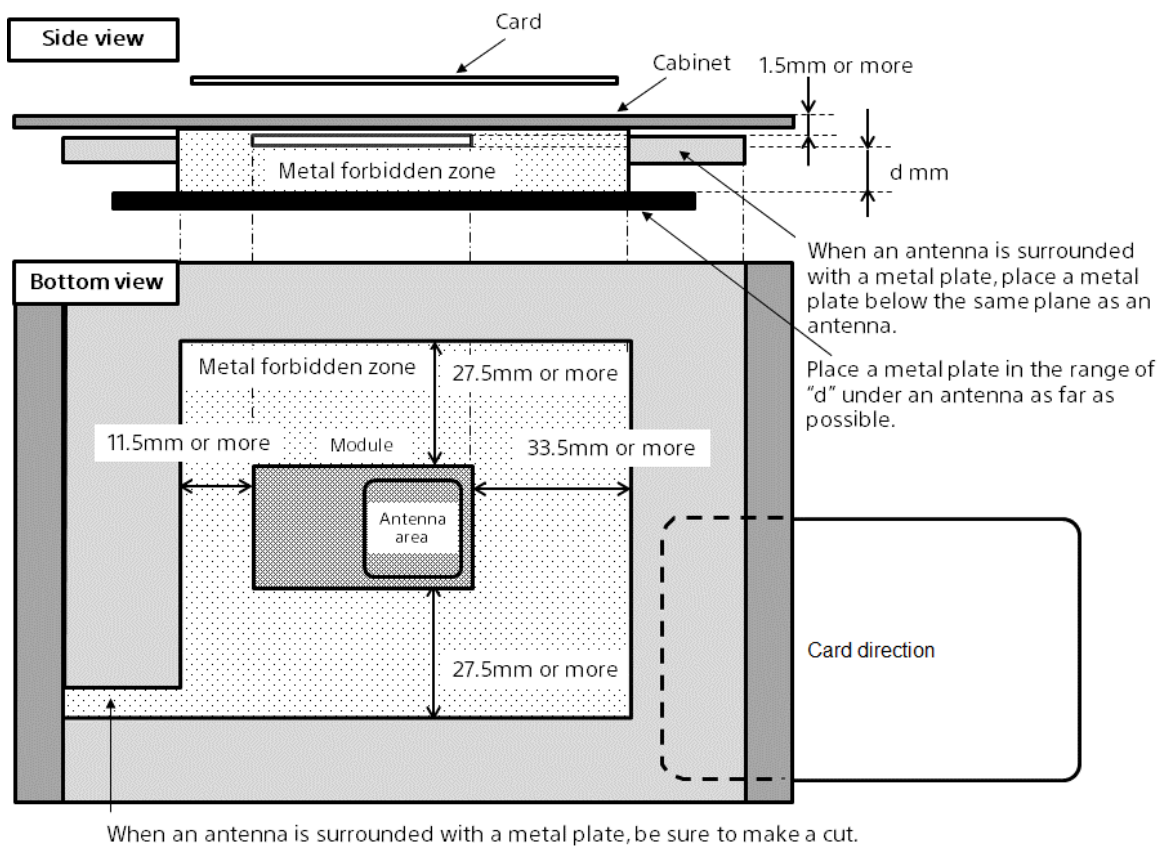


Figure A-1: Installation requirements

## 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:

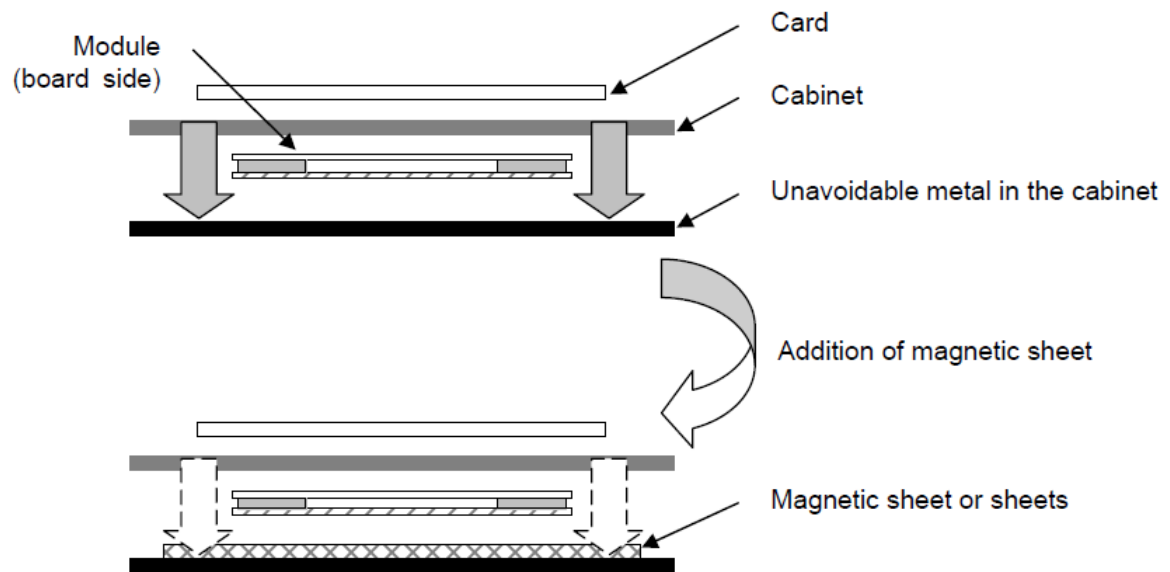
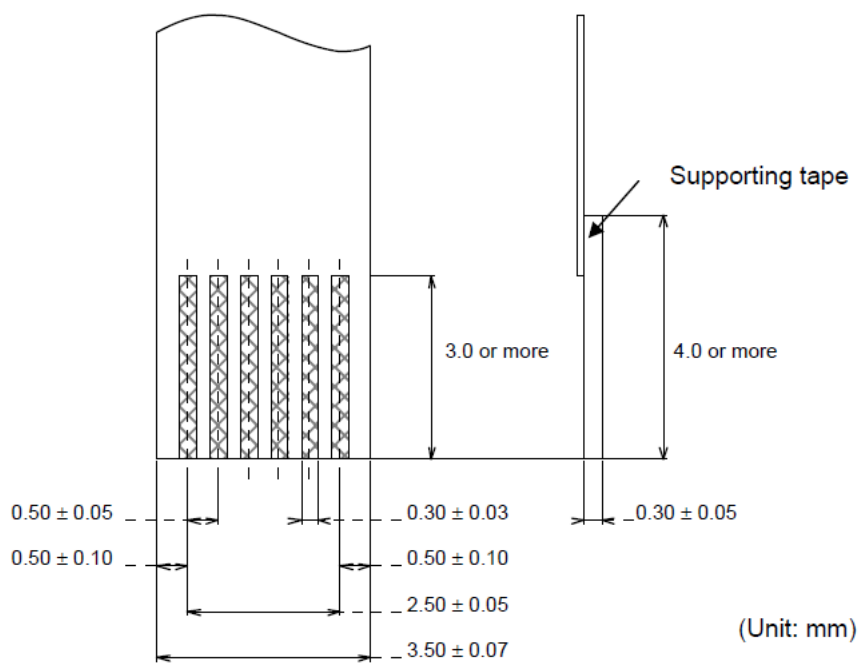


Figure A-2: Reducing the effects of metal

# 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**

Reader Module

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