

SONY®

Felica

Reader/Writer

RC-S493B

Product Specifications (Preliminary)

Note : This document is preliminary and subject to change without notice.

Version 0.91
No.M440-E0.9-10

Introduction

This document describes the major features and specifications of Sony's RC-S493B Reader/Writer. The following terms used in this document refer to the products or equipment as per the descriptions to the right.

Card	:	An IC card designed in conformity with Sony's FeliCa contactless IC card system.
Reader/writer	:	A device used to read and write cards in Sony's FeliCa contactless IC card system.
Controller	:	An external computer, gate controller or equivalent that is directly connected to a Reader/Writer using a specific cable.

This document does not provide information about pre-operation setup for the Reader/Writer, nor does it contain details of individual commands. Please refer to the "Reader/Writer Command Reference Manual".

To ensure optimal implementation into your system, refer also to the "RC-S460/490 Series Reader/Writers Installation Requirements and Evaluation Methods".

Safety Information and Caution

For customers in USA and Canada

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 FCC Rules and RSS-Gen of IC 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.

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 interface cable with ferrite core must be used with the equipment in order to comply with the limits for a digital device pursuant to Subpart B of Part 15 of FCC Rules.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

For customers in Europe

Sony hereby declares that this equipment is in compliance with the essential requirements and other relevant provisions of European Directive 1999/5/EC.

To obtain a copy of the declaration of conformity (DoC) with the R&TTE Directive, please access the following URL address.

<http://www.compliance.sony.de/>

This product complies with EN 55022 Class B and EN 55024, for use in following areas: residential, commercial and light industrial.

This product has been tested and found compliant with the limits set out in the EMC Directive for using connection cables not longer than 3 meters (9.8 feet).

Emissions from this inductive device could cause interference to nearby receivers of other radio services.



- FeliCa is a contactless IC card technology developed by Sony Corporation.
- FeliCa is a trademark of Sony Corporation.
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- No part of this manual may be copied, or reproduced in any form, without the prior consent of Sony Corporation.
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1. Major Functions and Features

The RC-S493B Reader/Writer read and write data to and from FeliCa-enabled contactless IC cards. Because operation is contactless, they exhibit no wear due to dirt or friction and maintenance is reduced to a minimum.

Major features

- Environmentally friendly, with lead-free soldering used for the board. The board also contains no halogen.
- Equipped with a high-security LSI conforming to ISO/IEC 15693 EAL4.

2. Basic Specifications

The RC-S493B Reader/Writer is composed of an antenna, an RF/control board and an antenna cable for connecting them to each other.

2.1 Communication Specifications

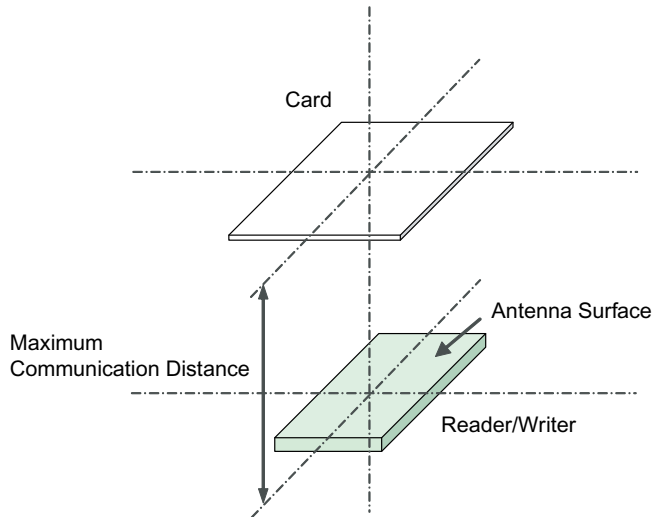
2.1.1 Reader/Writer to Card Wireless Communication Specifications

Wireless communication between the Reader/Writer and the card is based on the following specifications.

Maximum communication distance :	30 mm (when using a card in the RC-S860 Series/RC-S880 Series/RC-S833) 20 mm (when using RC-S890) * The communication distance varies depending on the peripheral environment. The figures shown above are the results of measurements performed in an ideal environment unaffected by electromagnetic waves and metallic substances.
Wireless communication system :	Load modulation system ^{*1}
Data transfer rate :	211.875 kbps or 423.75 kbps ^{*2}
Carrier frequency :	13.56 MHz
Modulation system :	Transmission - ASK (modulation ratio 11±3%) Reception - ASK
Bit coding system :	Transmission - Manchester coding Reception - Manchester coding
Modulation bandwidth :	±300 kHz (at -30 dB carrier level)
Electric field strength (Emissive electric field strength of fundamental wave, 13.56MHz) :	Less than 300 μV/m (at 10m distance) (Complies with the regulations in Clause 46-2 Section 1-1 of the Enforcement Ordinance of the Radio Law of Japan.)
Communication system :	Half-duplex communication, CRC-CCITT
Compatible cards/tokens	
FeliCa cards :	RC-S860 Series (RC-S860, RC-S862, RC-S863, RC-S864) RC-S880 Series (RC-S880) RC-S833 * One card can be used at a time.
Tokens :	RC-S890 Series (RC-S890)

*1 Complies with ISO/IEC 18092 (212 kbps Passive Mode) standards.

*2 Available only when the card or mobile device to be used also accommodates the 423.75 kbps transfer mode.



* The antenna of the card or mobile phone is placed in parallel with the antenna of the Reader/Writer, with their centers aligned along the same vertical axis.

Fig.2-1 : Maximum Communication Distance to the Card

2.1.2 Reader/Writer to Controller Communication Specifications

The Reader/Writer communicates with the controller in accordance with the following specifications.

Signal level	:	CMOS 5V
Communication speed	:	7.2 kbps ~ 1228.8 kbps (7.2, 8.192, 9.6, 14.4, 19.2, 28.8, 38.4, 57.6, 115.2, 230.4, 460.8, 921.6 and 1228.8 kbps selectable by software, default setting: 115.2 kbps)
Start bit	:	1 bit
Data bits	:	8 bits
Parity bit	:	none
Stop bit	:	1 bit
Flow control	:	None
Communication system	:	Half-duplex communication
Physical connection	:	3-wire connection (Rx, Tx, GND)

2.2 Electrical Specifications

Table 2-1: Electrical Specifications

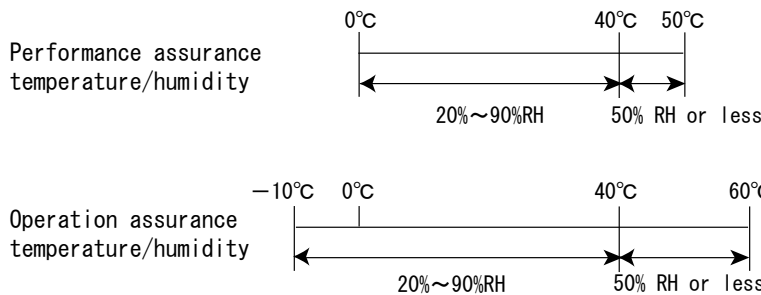
	MIN	TYP	MAX	Unit	Connector
Power supply voltage - 12V system -	11.5	12.0	16.0	V	DC12V
Current consumption (during normal operation) - 12V system -		80		mA	
Allowable power supply ripple		100 ^{*1}		mV	
Power supply voltage - 5V system -	4.75	5.0	5.25	V	DC5V
Current consumption (during normal operation) - 5V system -		100		mA	
Current consumption (when rewriting firmware) - 5V system - ^{*2}			70	mA	
Allowable power supply ripple		100 ^{*1}		mV	

*1 Peak to peak

*2 Communication with the card is interrupted.

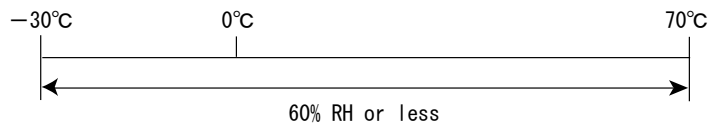
2.3 General Specifications

Usage environment (No condensation or icing)



* Performance assurance: The guaranteed communication distance to the card is maintained.
 Operation assurance: Communication with the card remains possible.

Storage environment (No condensation or icing)



- MTBF : More than 100,000 hours
 Condition: Usage environment, GF (ground level, fixed)
 (Measured in conformity with MIL-HDBK-217 NOTICE2 for evaluating the reliability of electronic components.)
- Mass : Approx. 110g

3. External Dimensions

Dimensions

Control board

Board size : 71.8 (± 0.4)* mm x 63.6 (± 0.4) mm x 12 (± 0.5) mm

* These figures contain the hole part for the product installation.

Antenna assembly

Board size : 50 (± 0.5) mm x 25 (± 0.5) mm x 1 (± 0.2) mm

Thickness : Less than 5 mm
(including ferrite and metal plates but not the connector)

Antenna cable

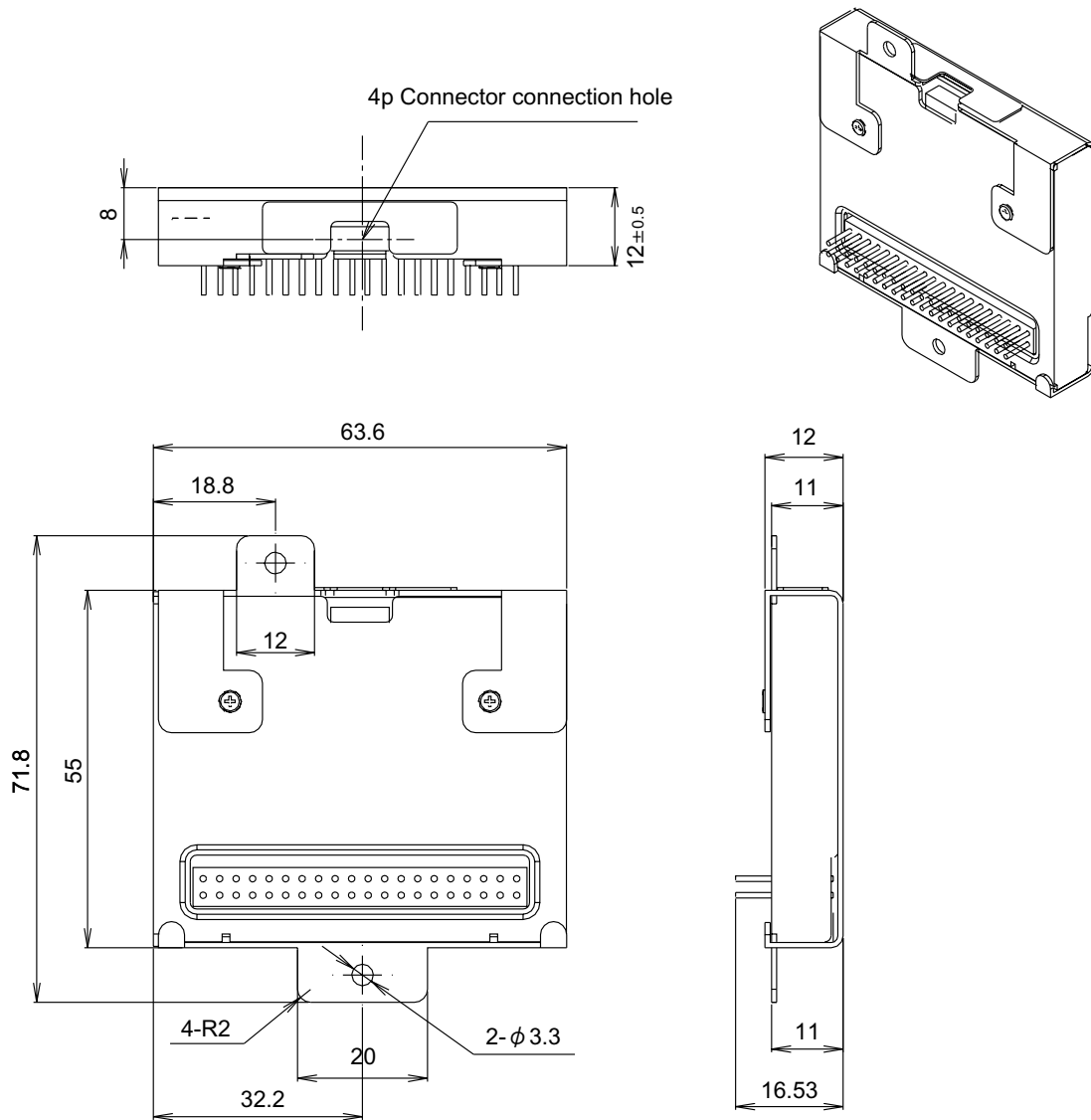
Length : 125 mm ± 3 mm (including the connector housing)

Width : 12.8 mm ± 1 mm (Size in ferrite core)

Mounting hole

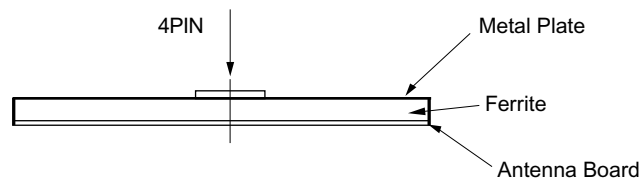
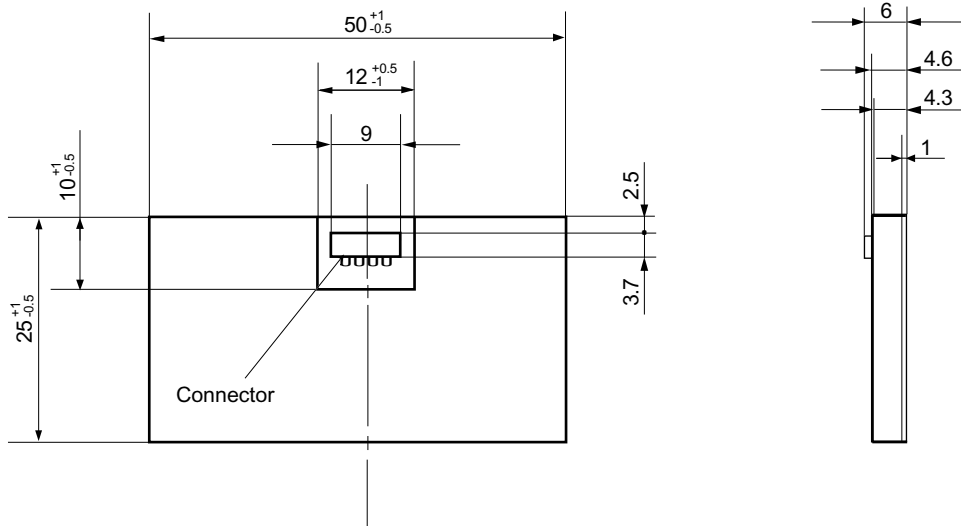
RF/control board : $\text{Ø}3.3$ mm x 2 (M3 compatible, see Fig. 3-1.)

Antenna : None



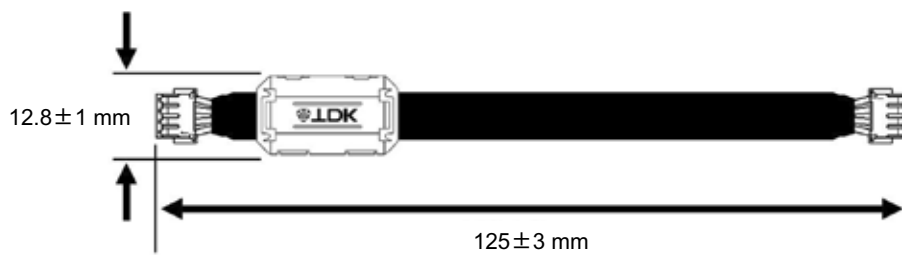
(unit: mm)

Fig.3-1 : RF/Control Board



(unit: mm)

Fig.3-2 : Antenna



(unit: mm)

Fig.3-3 : Antenna cable

4. Internal Structure

The RC-S493B Reader/Writers is configured as in Fig. 4-1.

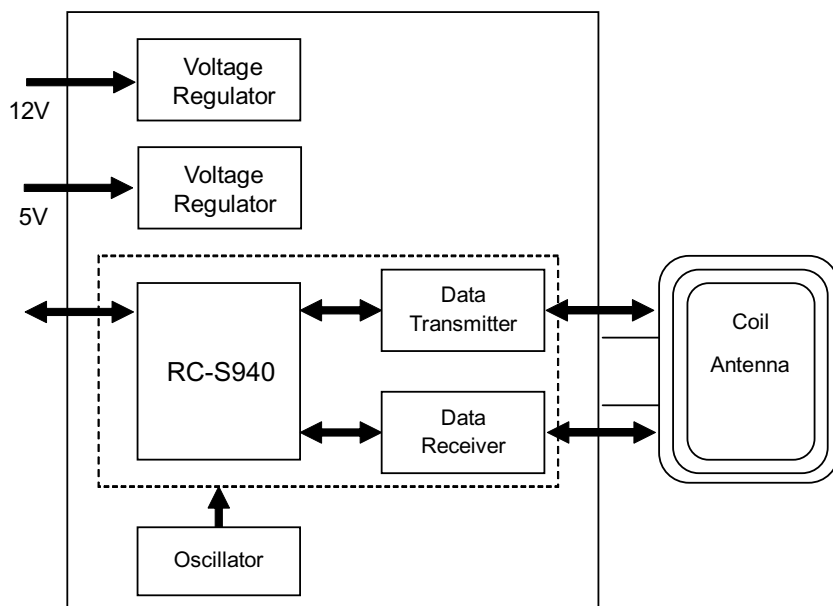


Fig.4-1 : Reader/Writer Schematic Diagram

5. Connection Specifications

This chapter provides details of interfacing with the controller. (Refer to Table 5-1 on the next page.)

The RC-S493B Reader/Writer employs the HKP-40M1 40-pin interface connector manufactured by HONDA TSUSHIN KOGYO CO., LTD.

As shown in Fig. 3-1, the connector is located on the bottom edge of the RF/control board. Connector pins are 2.54 mm in pitch and gold-plated. Also, they are arranged in double rows and numbered from the lower row's leftmost pin (pin No. 1). During installation, particular attention must be paid to their polarities.

Table 5-1: CN2 Connector Pin Assignment

Pin No.	Designation	Function	Remarks
1	DC12V	DC power supply terminal	For RF amplifier
2	NC	No Connection	
3	DC12V	DC power supply terminal	For RF amplifier
4	NC	No Connection	
5	NC	No Connection	
6	GND	Ground terminal	
7	NC	No Connection	
8	GND	Ground terminal	
9	-	(Reserved)	Do not connect the signal line.
10	SI	Serial data I/O (CMOS 5V)	
11	-	(Reserved)	Do not connect the signal line.
12	SO	Serial data I/O (CMOS 5V)	
13	-	(Reserved)	Do not connect the signal line.
14	NC	No Connection	
15	-	(Reserved)	Do not connect the signal line.
16	MODE	No need to connect for normal operation.	When loading a program, be sure to apply a high level voltage (5V) to this pin prior to powering up the RF/control board.
17	-	(Reserved)	Do not connect the signal line.
18	-	(Reserved)	Do not connect the signal line.
19	-	(Reserved)	Do not connect the signal line.
20	-	(Reserved)	Do not connect the signal line.
21	-	(Reserved)	Do not connect the signal line.
22	-	(Reserved)	Do not connect the signal line.
23	-	(Reserved)	Do not connect the signal line.
24	-	(Reserved)	Do not connect the signal line.
25	-	(Reserved)	Do not connect the signal line.
26	-	(Reserved)	Do not connect the signal line.
27	-	(Reserved)	Do not connect the signal line.
28	-	(Reserved)	Do not connect the signal line.
29	-	(Reserved)	Do not connect the signal line.
30	-	(Reserved)	Do not connect the signal line.
31	-	(Reserved)	Do not connect the signal line.
32	-	(Reserved)	Do not connect the signal line.
33	NC	No Connection	
34	DC5V	DC power supply terminal	
35	NC	No Connection	
36	DC5V	DC power supply terminal	
37	GND	Ground terminal	
38	NC	No Connection	
39	GND	Ground terminal	
40	NC	No Connection	

6. Basic Reader/Writer Operation/Data Flow

6.1 Transaction Overview

6.1.1 Communication Protocol

The Reader/Writer returns ACK upon successful reception of a command packet. It remains unresponsive if reception fails.

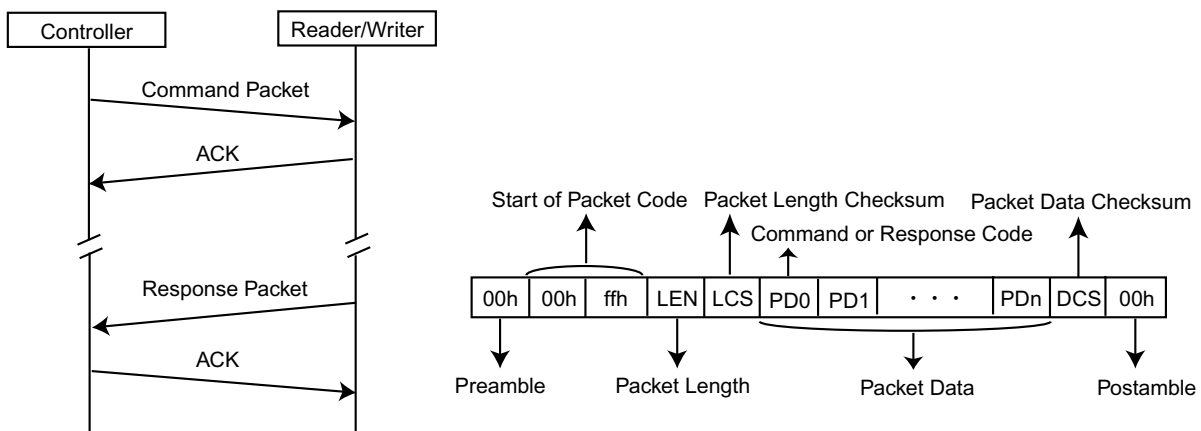
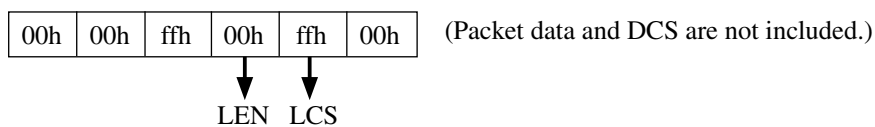


Fig.6-1 : Communication Protocol and Packet Structure

6.1.2 ACK Packet

The ACK packet is formatted as follows.



6.1.3 Mutual Authentication

Mutual authentication* is the process of two units authenticating each other. Between a controller and Reader/Writer, this is performed by using the following elements in order to provide protection against fraudulent access, tampering, spoofing and other illicit data manipulation.

1. Two 56-bit keys
2. ISO9798-2 compliant authentication model comprising three paths
3. Encryption algorithm

* For more information about mutual authentication and encryption, refer to the “Reader/Writer Command Reference Manual”.

7. Security

Illicit data access and tampering that may occur during communication are serious security risks to any IC card system. To safeguard against such risks, the Reader/Writer encrypts and decrypts data transmitted to and received from the card, whereas the same is performed by the controller for security protection of data communication between the controller and the Reader/Writer. More specifically, the following must be observed to ensure secure system operation.

- 1) Communication between the controller and the Reader/Writer must always be performed in the encryption mode. Data flows through the communication path when the Reader/Writer communicates with the card in accordance with the command received from the controller. The path must therefore be protected by turning on the encryption mode and performing mutual authentication between the controller and the Reader/Writer.
- 2) Access keys used for mutual authentication between the controller and the Reader/Writer must be updated periodically. Leakage of key information can result in surreptitious use or divulgence of eavesdropped data, and in the worst case, may seriously affect the operation of the entire system. Do not continue to use factory-preset access keys (Kar, Kbr) without changing their values, especially for mutual authentication in actual applications. The access keys can be changed by using the Change Reader/Writer Access Key command. For more details, refer to the “Reader/Writer Command Reference Manual”.

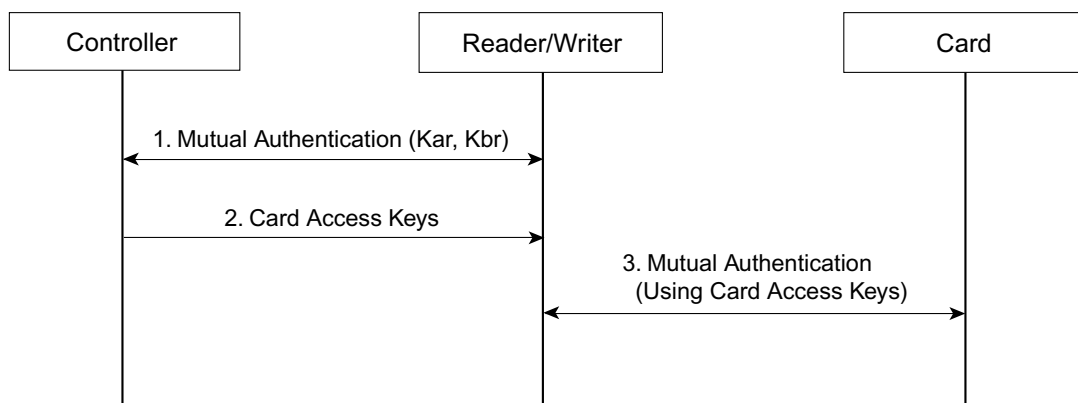


Fig.7-1 : Schematic Diagram of Security Protection

8. Packing Specifications

Each master carton used to ship the RC-S493B contains 20 unitary packages.

- Master carton : Contains 20 unitary packages.
- Unitary package dimensions : 128.5 mm x 43 mm x 262 mm (W x H x D)
- Master carton Dimensions : 318 mm x 292 mm x 527 mm (W x H x D)

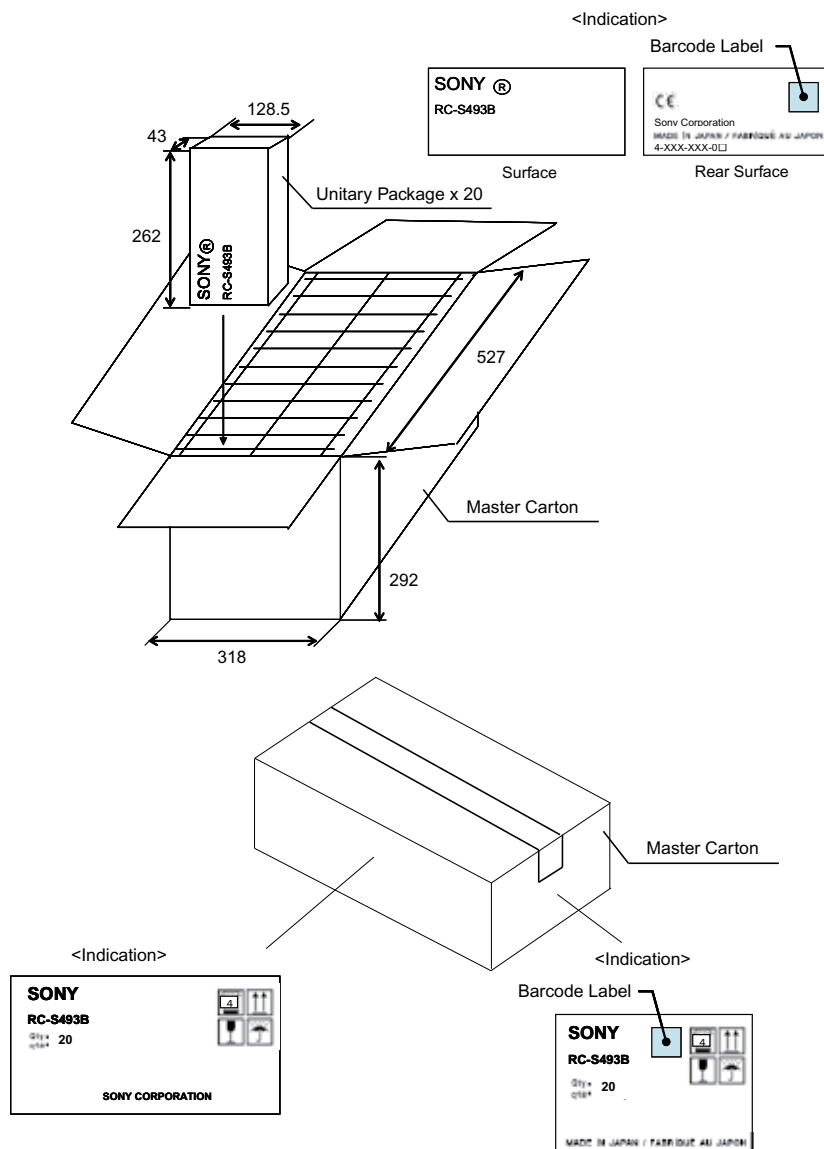


Fig.8-1 : Packing Specifications

(unit: mm)

9. Precautions

9.1 Precautions for Installation

The RC-S493B Reader/Writer must be installed with special care as described below. For optimal installation, also refer to the “RC-S460/490 Series Reader/Writers Installation Requirements and Evaluation Methods”.

9.1.1 Reader/Writer

- Maximum communication distance can be ensured only when an RF/control board is used in combination with an antenna bearing the same serial number. With other combinations, there is no guarantee of the communication distance.
- Remove any source of electromagnetic noise from the antenna coverage area. The same can be said of any object that may reflect or interfere with electromagnetic waves. In a system accommodating multiple Reader/Writers, antennas must be separated from each other for a distance of more than 30 cm in order to ensure the max. communication distance of 30 mm (when used with the RC-S860 Series/RC-S880 Series/RC-S833) or 20 mm (when used with the RC-S890). Note, however, data communication remains possible even when the distance between two antennas is less than 30 cm, although the communication distance is shortened.
- Connecting the Reader/Writer’s GND terminal to the ground line of its enclosure is not recommended.
- Communication performance may be affected by power line noise and the harmonics of the 13.56 MHz carrier signal.
- Communication performance may also be affected by the high-frequency noise (800 MHz or higher) generated by mobile phones.
- Transmission/reception performance of communication devices such as mobile phones may be affected when they are brought very close to the Reader/Writer.

9.1.2 Ferrite core

Please install the ferrite core in the power supply, and the communications cable for the electromagnetic radiation from Reader/Writer not to influence a peripheral electric equipment. Please refer to Figure 9-1 for how to install the ferrite core.

(1) Opening and shutting of cover

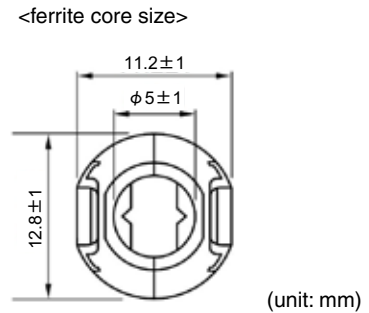
The cover opens when the lock of two places is removed. Please multiply the lock firmly when shutting.



(2) The cable is wrapped.

Please bundle the cable, pass the ferrite core twice, and wrap it.

Note: The effect decreases if it is not double. Please use the cable that can be done by the double rolling.



(3) The final shape

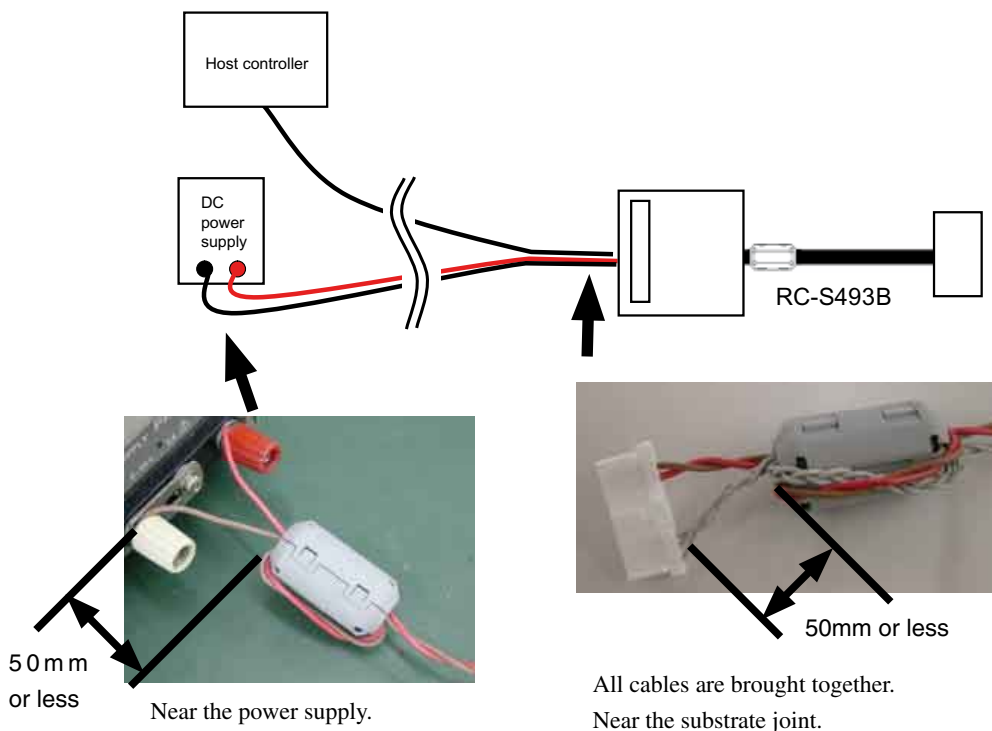


Fig.9-1 : How to install the ferrite core

9.2 Handling Precautions

The RC-S493B is module products designed for built-in use. It must be handled carefully, keeping the following precautions in mind.

- Be careful when handling the board edge and case edge and lead connector so that you do not hurt your hands.
- Do not throw the module to a person.
- In order to prevent short-circuiting, do not soil the exposed part of the terminal with metallic substances such as solder residue.
- When plugging and unplugging the connector cable, make sure that it is inserted correctly without any wire disconnection. If connected inversely, the Reader/Writer may ignite or emit smoke.
- Handle the module with care as it contains delicate electronic circuits.
- Do not shut down or reset the Reader/Writer while data is being written into the internal non-volatile memory (EEPROM). In this case, the Reader/Writer cannot be re-started.

10. Command List

Table 10-1 provides a list of commands supported by the RC-S493B Reader/Writer, together with brief descriptions of their functions.

Table 10-1 : Command List

Command Name	Command/ Sub Command Code	Response/ Sub Response Code	Function Overview
Reader/Writer Operation Commands			
Attention	00h / -	01h / -	Used either to confirm the operation of the Reader/Writer or to terminate the ongoing command execution.
Authentication1	02h / -	03h / -	Enables the controller to authenticate the Reader/Writer.
Authentication2	04h / -	05h / -	Enables the Reader/Writer to authenticate the controller.
Disconnect	06h / -	07h / -	Causes the Reader/Writer to return to Mode 0 from Mode 2.
Reader/Writer Management Commands			
Change Reader/Writer Access Key * ¹	20h / -	21h / -	Used to change the access keys necessary for mutual authentication.
Self Diagnosis	40h / -	41h / -	Makes the Reader/Writer perform self-diagnosis and return the results.
Firmware Maintenance * ¹	42h / -	43h / -	Used to update the Reader/Writer firmware.
Check Firmware Version	44h / -	45h / -	Used to check the version of the Reader/Writer firmware.
Change Communication Mode * ¹	46h / -	47h / -	Used to change the settings (speed, encryption, etc.) for communication.
Reset	4ch / -	4dh / -	Places the Reader/Writer in the power-on state.
Change Parameter * ^{1,2}	26h / -	27h / -	Used to change the internal settings of the Reader/Writer.
Get Last Error * ²	28h / -	29h / -	Used to obtain the error code of the error detected in the last executed command.
Get Attribute * ²	2ah / -	2bh / -	Used to obtain the Reader/Writer's internal parameters.

Command Name	Command/ Sub Command Code	Response/ Sub Response Code	Function Overview
General Card Commands			
Polling	80h / -	81h / -	Used to poll the card from the Reader/Writer. The captured card returns a response that contains the card's IDm.
Request Service	82h / -	83h / -	Used to check if the card has the specified area/service. The card returns the key version data for the specified area/service.
Request Response	84h / -	85h / -	Used to obtain information on the card mode.
Mutual Authentication	86h / -	87h / -	Executes mutual authentication between the Reader/Writer and the card, resultantly causing mode transition in the card.
Read Block	88h / -	89h / -	Used to read data in block units from the authenticated service.
Write Block	8ah / -	8bh / -	Used to write data in block units to the authenticated service.
Read Block Without Encryption	98h / -	99h / -	Used to read data in block units from a service that need not be authenticated.
Write Block Without Encryption	9ah / -	9bh / -	Used to write data in block units to a service that need not be authenticated.
Communicate Thru	8ch / -	8dh / -	Used to transmit the specified packet data, in the form of wireless packet data, to the card.
Release	8eh / -	8fh / -	Makes it possible to delete the card table's IDt data specified by the command.
RF Switch *2	48h / -	49h / -	Turns on and off the radio frequency.
Request System Code	a0h / -	a1h / -	Used to obtain the system code list registered in the card.
Search Service Code	a2h / -	a3h / -	Causes the card to return the area/service code of the specified area/service.
Request Block Information	a4h / -	a5h / -	Causes the card to return the block number information for the specified area/service.
Request Block Information Ex *2	a6h / -	a7h / -	Causes the card to return 4-byte data containing information about the number of blocks and the number of available empty blocks.
Card Issuance Commands			
Register Issue ID	c0h / -	c1h / -	Registers the Issue ID Block, Area 0000 Definition Block and system code in the card and performs data initialization.
Register Area	c2h / -	c3h / -	Registers a new area and area key in the card.
Register Service	c4h / -	c5h / -	Allows service and service key registration, as well as allocation of data blocks.
Register Issue ID Ex	c6h / -	c7h / -	Registers the Issue ID Block, System Definition Block and Area 0000 Definition Block and performs data initialization.
Set Relational Service *2	b4h / -	b5h / -	Allows collaborative authentication.

*1 These commands are used to write data in the Reader/Writer's internal non-volatile memory (EEPROM). Note that the Reader/Writer cannot resume operation if it is shut down or reset during execution of one of these commands, as described in Section 9.2: Handling Precautions.

*2 The firmware version must be 5.32 or higher.

Glossary

<A>

Access Key

The key used for mutual authentication.

ACK

Abbreviation for the ACKnowledgement message used to confirm that the previous message was received correctly.

Area

Allows hierarchical management of services and other areas.

Area Key

The key used to authenticate the use of a specific area.

ASK Modulation

ASK stands for Amplitude Shift Keying. The amplitude of the carrier frequency is modulated according to the logic of the data to be transmitted.

The degree of modulation (normally indicated in percent) is expressed by $(a - b)/(a + b)$, where a and b respectively represent the maximum and minimum amplitudes of the modulated signal waveform.

Block

A minimum unit of information used for writing, reading and erasing.

<D>

DCS

Abbreviation for packet Data CheckSum representing the checksum for packet data.

<I>

Issue ID (IDi)

Identification data written when the card is issued.

<L>

LCS

Abbreviation for packet Length CheckSum representing the checksum for the number of data bytes indicated by the LEN byte.

LEN

Abbreviation for packet LENgth indicating the number of data bytes contained in the packet.

<M>

Manchester Encoding

A method of coding bit data. The bit duration time is divided at the transition point in the center and translated into two logical values.

Mutual Authentication

A process of checking that the card and Reader/Writer have the same access key.

<S>

Service

Defines the method of accessing user blocks stored in the card.

Service Key

The key used to authenticates the use of a service.

<U>

User Block

The block allocated in the memory using a specific service.

Reader/Writer
RC-S493B Product Specifications

Version 0.91

May, 2008

Sony Corporation
FeliCa Business Division

No.M440-E0.9-10

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