3 Software specifications

3.1 Communication packet

The host packet format defines three types of frames – normal, extended and ACK.

Transactions between the host controller and the module are based on packet communication using host packets. The module processes the received host command packet and returns a host response packet. Needless to say, the module cannot autonomously transmit host response packets.

3.1.1 Normal frame

Between the host controller and the module, the normal frame allows transmission and reception of host command/host response packets whose LEN value is equal to or smaller than 255 bytes. This frame also provides a subordinate error frame used by the module to notify the host controller of syntax error detection.

Table 3-1: Normal frame

Designation	Size (bytes)	Remarks
Preamble	1	00h fixed
Start Of Packet	2	00h FFh fixed
LEN	1	Specify the data length (max. 255 bytes)
LCS	1	Specify the checksum of LEN data (a value that sets 00h to the lower 1 byte of the sum of LEN and LCS bytes).
Packet data	Max. 255	
DCS	1	Specify the checksum of data in a packet (a value that sets 00h to the lower 1 byte of the sum of data and DCS bytes).
Postamble	1	00h fixed

3.1.2 Extended frame

The extended frame is used to send and receive host command/host response packets whose LEN value is equal to or greater than 256 bytes and equal to or smaller than 265 bytes.

Table 3-2: Extended frame

Designation	Size (bytes)	Remarks
Preamble	1	00h fixed
Start Of Packet	2	00h FFh fixed
2-byte frame identification code	2	FFh FFh fixed
LENEx	2	Specify the data length (max. 265 bytes) in the big endian format. All data equal to or greater than 266 bytes is interpreted as 265 bytes.
LCSEx	1	Specify the checksum of LENEx data (a value that sets 00h to the lower 1 byte of the sum of 2-byte LENEx and 1-byte LCSEx).
Packet data	Max. 265	
DCS	1	Specify the checksum of data in a packet (a value that sets 00h to the lower 1 byte of the sum of data and DCS bytes).
Postamble	1	00h fixed

Which type of frame is to be used for the host response packet is automatically determined – the normal frame if the LEN value is equal to or smaller than 255 bytes and the extended frame if it is equal to or greater than 256 bytes.

3.1.3 ACK frame

The ACK frame is intended for use in the following situations.

- Module to Host Controller Transmission
  - Informing the host controller that no data link level error is detected in the received host command packet.

NOTE This is the one and only instance the module transmits the ACK frame.

- Host Controller to Module Transmission
  - Interrupting host command execution.
  - Determining the results on command execution (prerequisite with the Reset command or SetSerialBaudrate command).

    For more information, see the "RC-S956 Series Command Reference Manual".

NOTE In the cases other than those above, the module ignores the ACK frame received from the host controller.

Table 3-3: ACK frame

Designation	Size (bytes)	Remarks
Preamble	1	00h fixed
Start Of Packet	2	00h FFh fixed
LEN	1	00h fixed
LCS	1	FFh fixed
Postamble	1	00h fixed

3.2 Communication protocol

The communication protocol consists of a data link level and an application level.

3.2.1 Data link level

The module uses this level to make sure that the host packet is transmitted or received in accordance with the communication protocol, i.e., without any error. For this purpose, the module verifies the following information contained in each host packet.

- Host Packet Format
  - LEN, LCS (In case of normal frame)
  - LENEx, LCSEx (In case of extended frame)
  - DCS
  - Postamble

If no error is detected in the received host packet, the module returns an ACK packet to the host controller.

A) Figure 3-1 shows a typical communication sequence on the data link level.

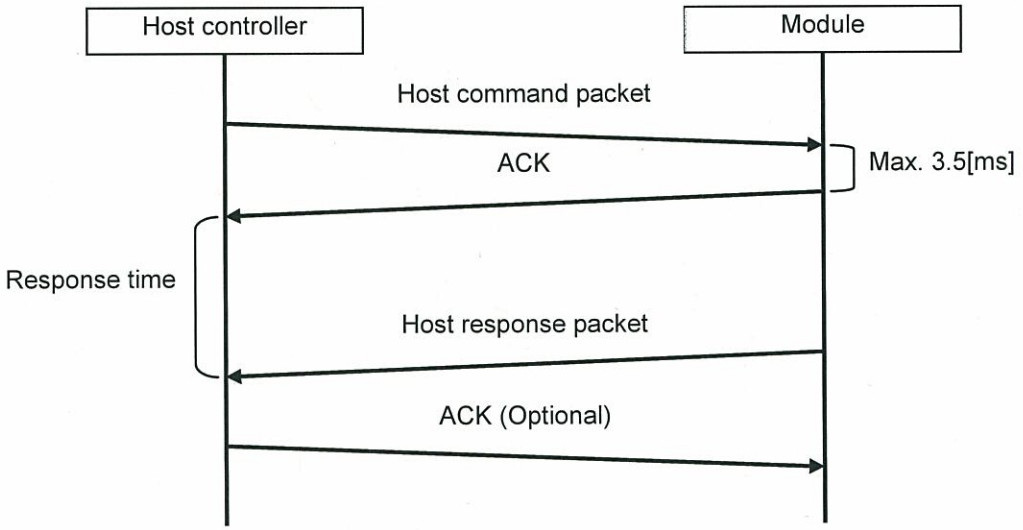

Figure 3-1: Communication protocol between host controller and module

If the host command packet is verified, the module prepares an ACK frame within 3.5 ms. Stated the other way round, the module requires a maximum of 3.5 ms in order to be ready to transmit an ACK packet after receiving an IN packet.

Acknowledging packet reception, the module proceeds to host command processing, returns a host response packet, and waits for the reception of the next host command packet. Accordingly, it is not necessary for the host controller to be concerned with the time interval between the reception of a host response packet and the transmission of the next host command packet. Upon detection of a host response packet from the module, the controller optionally transmits an ACK frame to the module.

B) If a data link level error is detected, the module remains non-responsive to the host controller. Seeing that no ACK frame is returned, the host controller retransmits a host command packet to recover communication.

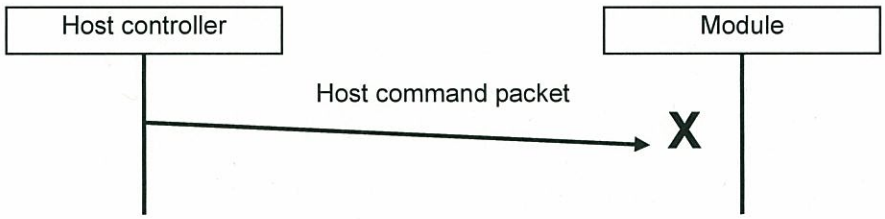

Figure 3-2: Data link level error in host command packet

Major errors encountered during data link level communication are listed below.

- LCS Error
  In the case of Normal Frame, the lower 1 byte of the sum (2 bytes) of LEN and LCS is not 00h.
  In the case of Extended Frame, the lower 1 byte of the sum of the upper 1 byte of LENEx, the lower 1 byte of LENEx, and LCSEx (totally 3 bytes) is not 00h.
- DCS Error
  The lower 1 byte of the sum obtained by adding up all data bytes and DCS is not 00h.
- Postamble Error
  The postamble byte is not included.
- Data Link Level Timeout Error
  This error refers to a condition that occurs when the time limit predetermined for data detection has been exceeded.
  With the module, a timeout occurs if all the packets, between the 3-byte data headed by the Start Of Packet bytes and the Postamble byte at the end of the frame, are not received within the timeout interval specified in Table 3-4.
  In the event of a timeout error, the module discards all the packets received up to that point. The timeout interval varies depending on the transfer rate, although the same setting and detection method are used for both the normal frame and the extended frame.

Table 3-4: UART host command reception timeout interval

Transfer rate (bps)	Timeout (ms)
9,600	1067
19,200	533
38,400	267
57,600	178
115,200 (default)	89
230,400	44
460,800	22

3.2.2 Application level

This is the level where the module executes the host command specified in the host command packet.

A) When command processing is complete, the module returns a host response packet to the controller.

B) The host controller transmits an ACK frame when it is necessary to interrupt command execution by the module. The next host command cannot be sent until more than 1 ms elapses from the interruption of host command execution (or the completion of ACK frame transmission),but never interrupt the host command execution by the following way.

- When a host command packet, comprised of equal to or greater than 3 bytes appended to the Preamble byte and the Start Of Packet bytes, is received from the host controller, the module discontinues the on-going processing and executes the newly received host command if no error is detected through the verification at the data link level.

C) If a syntax error is detected in the received packet, the module notifies the controller by returning an error frame.

Table 3-5: Error frame

Designation	Size (bytes)	Remarks
Preamble	1	00h fixed
Start Of Packet	2	00h ffh fixed
LEN	1	01h fixed
LCS	1	ffh fixed
Packet data	1	7fh fixed
DCS	1	81h fixed
Postamble	1	00h fixed

3.3 Mode transition

3.3.1 Concept of operating mode

The module operates in seven modes - Mode 0, Mode 1, Mode 2, Mode 3, Mode 4, Mode 5 and Mode 6. Available commands vary according to the mode, while the mode changes as the result of host command execution or RF command reception. For more details, see the "RC-S956 Series Command Reference Manual".

3.3.2 Overview of individual modes

- Mode 0

[Initial Mode]

Used to perform the following functions.

  - Self diagnosis
  - Transfer speed setting for host communication
  - RF waveform test
  - Various settings for RF communication
  - Starting up as an initiator or a target

In Mode 0, the module exists neither as an initiator nor a target. Switching between the initiator and target states cannot be performed without traversing this mode.

- Mode 1

[Target Initial State]

Enables the module to operate as a target to wait for RF command packets (see Condition R-1, R-2 and R-3 of 5.1 "Concept of Operation Modes" mentioned in the "RC-S956 Series Command Reference Manual").

In other words, this is the mode where the TgInitTarget command is executed. As soon as the command execution is normally completed the operation mode shifts to Mode 2, Mode 3 or Mode 5. Reception of a new host command packet terminates and disables the ongoing TgInitTarget command processing and causes transition to Mode 0 for processing of the newly received host command packet.

- Mode 2

[Target Initial ATR Incomplete State]

Enables the module to operate as DEPTarget to receive the first ATR_REQ. This is the mode to set Gt of ATR_RES by the host controller, and to reply ATR_RES.

It is the state immediately after receiving ATR_REQ when fAutomaticATR_RES flag is (0)b.

- Mode 3

[Target Initial ATR Complete State]

Enables the module to operate as DEPTarget to receive the first DEP_REQ. In this mode, the module can not reply DEP_RES.

It is the state immediately after receiving ATR_REQ and replying ATR_RES when fAutomaticATR_RES flag is (1)b.

- Mode4

[DEPTarget State]

Enables the module to operate as DEPTarget to perform the following function.

  - Replying DEP_RES
  - Receiving second or later DEP_REQ

- Mode 5

[FeliCa Target State]

The module operates and RF communicates as a FeliCa target.

- Mode 6

[Initiator Operation]

The module operates and RF communicates as an initiator.

3.4 Command list

Table 3-6 provides a list of available commands. Command/response code size is 2 bytes. Command code is comprised of d4h (fixed) and sub-command code (1 byte), response code is also comprised of d5h (fixed) and sub-response code (1 byte). The module returns a syntax error message if a value other than the one specified in the sub-command code column is used. Functional details of individual commands are provided in the "RC-S956 Series Command Reference Manual".

Table 3-6: Command list

Command	Sub-command code	Sub-response code	Command overview
Normal command			
Diagnose	00h	01h	Used to perform self-diagnosis of RC-S956
GetFirmwareVersion	02h	03h	Used to obtain RC-S956 firmware version information.
GetGeneralStatus	04h	05h	Used to obtain information about RC-S956 internal state.
ReadRegister	06h	07h	Used to access data in the RAM or I2C EEPROM.
WriteRegister	08h	09h	Used to write data in the RAM or I2C EEPROM.
ReadGPIO	0ch	0dh	Used to obtain the value of the input port (P34).
RFU*1	0eh	0fh	
SetSerialBaudrate	10h	11h	Used to change the transfer rate between RC-S956 and the host controller.
SetParameters	12h	13h	Used to change the internal parameters RC-S956 retains in the RAM.
RFU*2	14h	15h	
PowerDown	16h	17h	Used to set RC-S956 in the power-down state.
RFConfiguration	32h	33h	Used to change the RF setting information RC-S956 retains in the RAM.
RFRegulationTest	58h	59h	Used to test RC-S956 RF waveform.
Reset	18h	19h	Used to cause transition to Mode 0.
RFU*3	1ch	1dh	
Command for initiator			
InJumpForDEP	56h	57h	Used to capture DEPTarget for DEP communication.
InJumpForPSL	46h	47h	Used to test the command. The function of this command is same as InJumpForDEP.
InListPassiveTarget	4ah	4bh	Used to capture a target to obtain its target ID.
InATR	50h	51h	Used to transmit ATR_REQ and receive ATR_RES.
InPSL	4eh	4fh	Used to change RF communication rate.
InDataExchange	40h	41h	Used to transmit and receive RF packets when the classification of Target card is FeliCa card but not ISO/IEC 14443 Type B card.
InCommunicateThru	42h	43h	Used to transmit and receive RF packets when the classification of Target card is FeliCa card or ISO/IEC 14443 Type B card.

Command	Sub-command code	Sub-response code	Command overview
InDeselect	44h	45h	Used to set the Target in Deselected state.
InRelease	52h	53h	Used to set the Target in Released state.
InSelect	54h	55h	Used to change state of the Target in Selected from Deselected.
Command for target			
TgInitTarget	8ch	8dh	Used to start up RC-S956 in the target mode.
TgSetGeneralBytes	92h	93h	Used to set Gt parameter and reply ATR_RES.
TgGetDEPData	86h	87h	Used to obtain payload data of DEP_REQ(INF)
TgSetDEPData	8eh	8fh	Used to reply payload data of DEP_REQ(INF)
TgSetMetaDEPData	94h	95h	Used to reply chaining payload data of DEP_REQ(INF).
TgGetInitiatorCommand	88h	89h	Used to obtain an RF packet when RC-S956 is started in the target mode.
TgResponseToInitiator	90h	91h	Used to transmit an RF packet when RC-S956 is started in the target mode.
TgGetTargetStatus	8ah	8bh	Used to obtain information about the currently set transfer speed when RC-S956 is started in the target mode.
CommunicateThruEX	a0h	a1h	Used to transmit and receive RF packets in Ad-hoc communication. This command can be used regardless of whether RC-S956 is started in the initiator mode or the target mode.

*1,*2,*3 Command to be implemented in the future.

4 Packing specifications

4.1 Packing details

The following shows how modules are packed in a master carton.

- Number of packed modules : 100
- Master carton external dimensions : 415 mm × 108 mm × 430 mm (W × H × D)

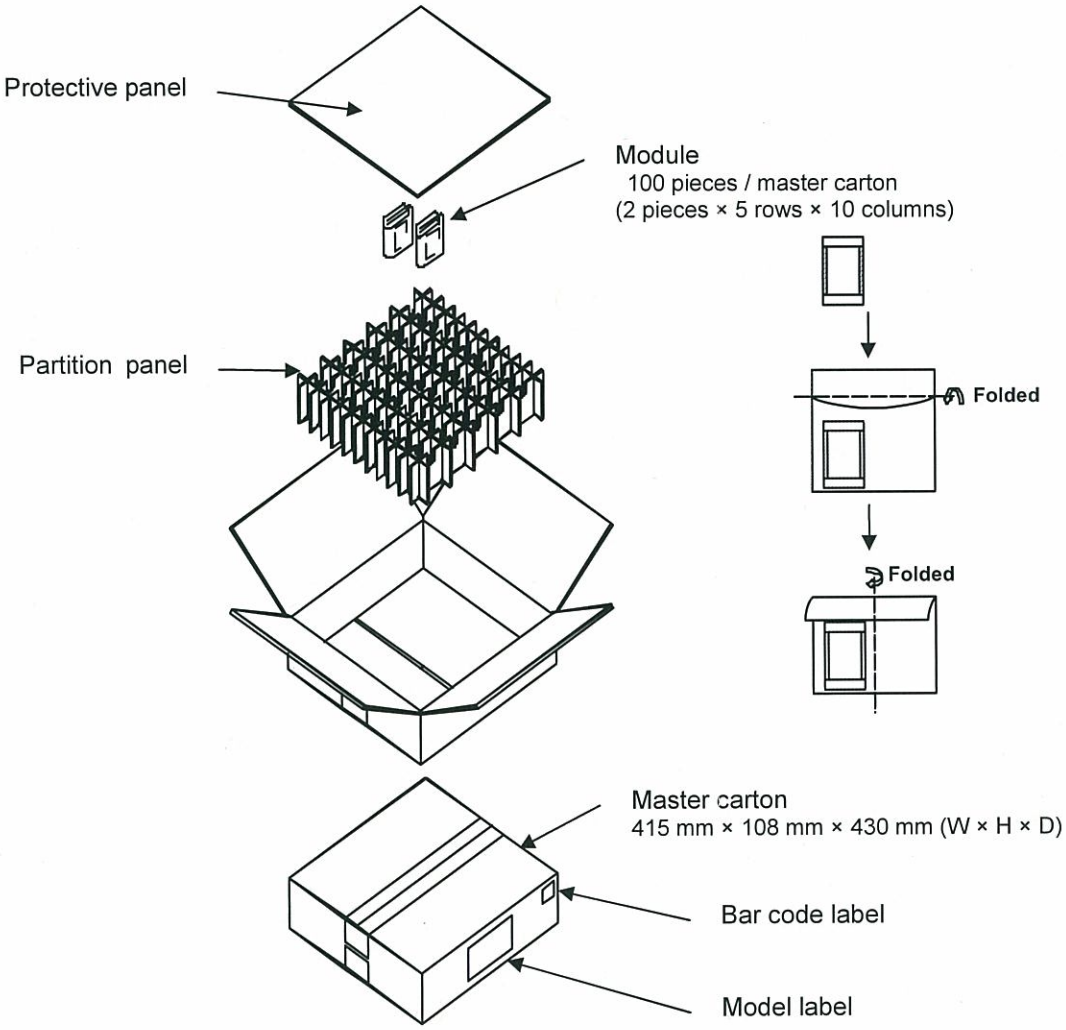

Figure 4-1: Packing details

4.2 Contents of bar code label

Model name

Sony product number (fixed number)

Sony internal use code (not fixed)

Figure 4-2: Contents of bar code label

4.3 Contents of model label

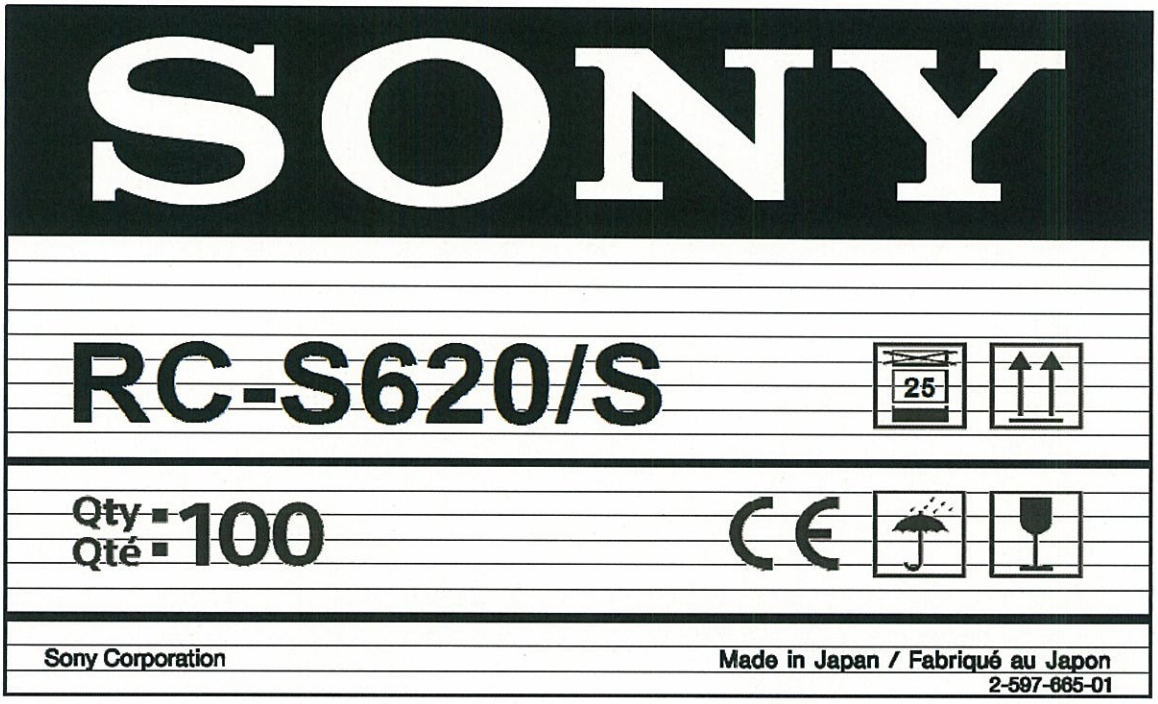

Figure 4-3: Contents of model label

5 Precautions

5.1 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 operating frequency is 13.56 MHz. Disassembly or modification of the module, removal of the type number or similar acts are subject to penalties according to applicable laws.
- Be sure to use a stable power supply so that the module can be protected from the effect 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 not only module after installation but 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, although its surfaces are carefully finished.
- Protect the module from interference from other wireless machines.
- Do not install the module in an environment where a strong electromagnetic field may exert deleterious effects on communication performance. Take special note of the installation location so that interference between the module and other equipment can be adequately controlled.
- Communication performance may be affected by the harmonics of the 13.56 MHz carrier frequency generated on the signal line.
- Check in advance the compatibility between the module and your system. The module cannot handle part of the processing sequences[*1] provided by mobile phones and other portable devices incorporating mobile FeliCa IC chips.
- 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 to connect a cable in the right direction because the connector has a double terminal.
- Measures for static noise and power line noise must be designed and incorporated on your own.

[*1] Among the processing sequences unique to mobile FeliCa compatible portable devices, the module cannot handle the sequence which allows wireless communication from the Reader/Writer after the mobile FeliCa IC chip was activated by the portable device via a wired interface. For more information, see the "Mobile FeliCa Technical Information" (Japanese only) that explains Reader/Writer operation in mobile applications.

5.2 Notes on external appearance

Since the module is designed for embedded applications, please realize that flaws on the order described below may occur.

- Scratch or stain on the product surface, which has no effect on performance.
- Change in the board color.

Appendix A About installation

A.1 Installation requirements for RC-S620/S

The following describes the points to remember when installing the modules.

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 apart from the board surface.
2. Do not place any metal in the forbidden area (dot-meshed area in Figure A-1) secured around the module. Particularly, communication performance undoubtedly deteriorates if a plate-like metal is put near the module.
3. In order not to induce eddy current, make a cut in the metal plate surrounding the above forbidden zone.
4. If no performance improvement is achieved through the steps described above, attempt to add magnetic sheets, as shown in Figure A-2, to the metal surface that faces the card and keep away the module from a metal plate at least 0.5 mm (d > 0.5).

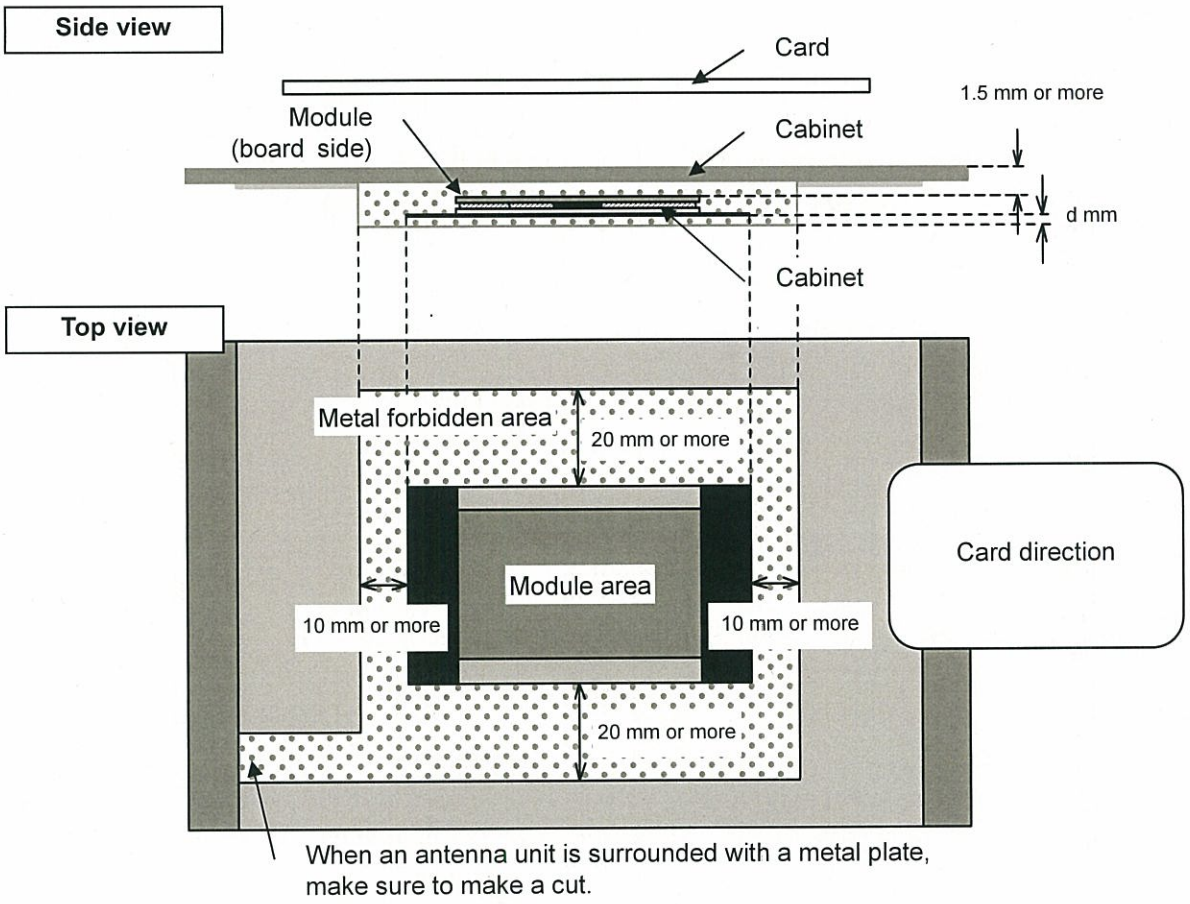

Figure A-1: Installation requirements

A.2 Reduction of the impact of metal

Deviation from the resonance point caused by bringing the card closer to the metal plate may result in a change in the card's original characteristics. The effect of metal plate could be reduced by adding magnetic sheets to the positions illustrated above.

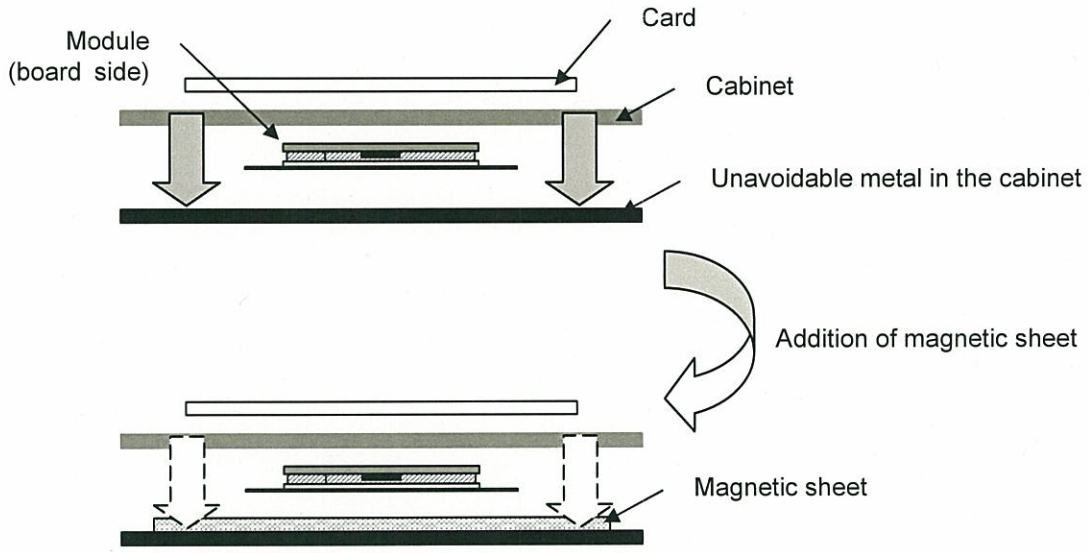

Figure A-2: Reduction of the impact of metal

Appendix B About temperature rise

B.1 The verification method and measure

The temperature of the module rises, when emitting a magnetic field. Therefore, check that the internal temperature in the situation that the module is installed in your system. And verify on any conditions, since the temperature of the module changes by power supply voltage, the existence of cards. Note that the module temperature rises considerably when power supply is 5.0V.

The temperature rise of the module could be suppressed by implementing the following measures.

- Cut a magnetic field except when using.
- Emit a magnetic field intermittently until it catches a card even when using.
- Shorten the processing time and set up timeout.

NOTE If satisfactory in your system, it is not this limitation.

Appendix C About interface cable

C.1 Terminal requirements of FFC/FPC

Recommended FFC/FPC (for host controller communication) dimensions are illustrated below.

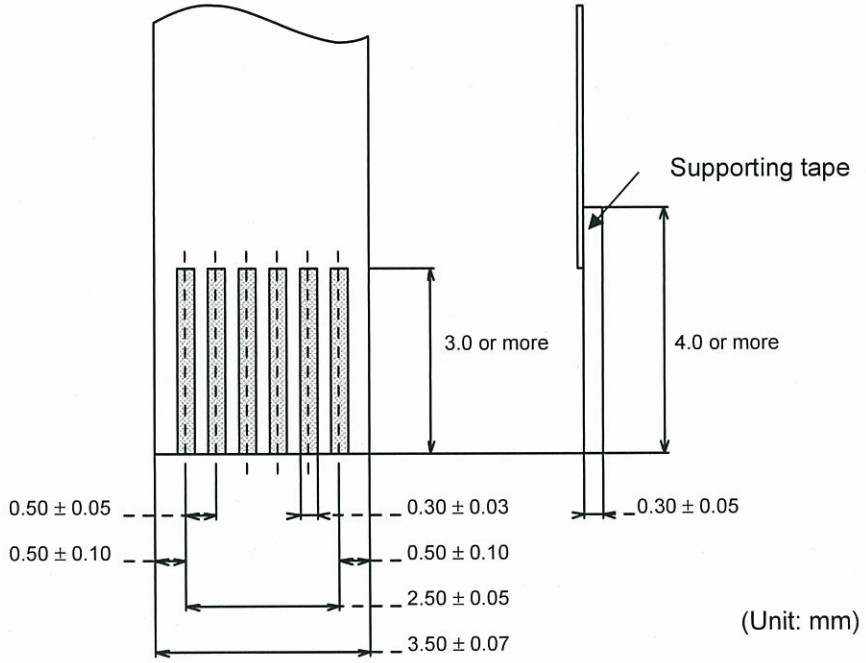

Figure C-1: Recommended FFC/FPC dimensions

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Reader/Writer Module

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